

NATIONAL ACADEMY OF SCIENTIST EDUCATION

YEARBOOK 2022/23



NEMZETI TUDÓSKÉPZŐ AKADÉMIA
NATIONAL ACADEMY OF SCIENTIST EDUCATION



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**A new, multigenerational education system
for the 21st century
2013 – 2033**

MOTTO:

“He who organizes public education, abundantly sows the seeds of culture in the loam of wide layers of people, like the Hungarian seed sower. He who cares about scientist education should be like an orchid gardener, dealing with each pot individually.”

(Kuno Klebelsberg)

TABLE OF CONTENTS

SALUTATORY	3
THE PROGRAM OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION	4
The National Academy of Scientist Education	5
The transformation of the Szeged Scientists Academy into the National Academy of Scientist Education	5
General introduction of the National Academy of Scientist Education	6
The Students of the Academy	7
The Teachers of the Academy	10
The Mentors of the Academy	12
THE EDUCATION PROGRAM OF THE NEW SCHOOL SYSTEM	14
Secondary School Education Program (SSEP)	15
Current opportunities for talented secondary school pupils	16
The goals of the Secondary School Education Program	16
Training sites in the Secondary School Education Program	18
The activities of the Secondary School Education Program	23
University Education Program (UEP)	27
The University Education Program's partner institutions	27
Oversight of the Academy's University Education	33
Admission to the University Education Program	33
Scientific laboratory work	34
Career model at the National Academy of Scientist Education	34
The National Academy of Scientist Education's requirements for BSc, MSc and MD students	34
Social life	37
Awards given by the Academy	38
STATISTICS OF THE EDUCATION PROGRAM	43
NATIONAL ACADEMY OF SCIENTIST EDUCATION YEARBOOK 2022/23	48
The members of the National Biomedical Foundation's Board of Trustees	49
Members of the Oversight Committee	50
Chief scientific leaders	51
Professional and Operational implementers	52
Secondary School Education Program	54
Szent-Györgyi Senior Teachers	56
University Education Program	70
Budapest	72
Debrecen	114
Pécs	128
Szeged	148
Szeged	202
International Mentors	204
MEETINGS, TRAININGS, PROFESSIONAL PROGRAMS	208

SALUTATORY

In supporting young talents, there is always the opportunity to change our future, as the science of today is the medicine of tomorrow. What we invest in talents today will create value tomorrow.

The National Academy of Scientist Education program was developed with the aim of finding the young people with whom we can research the future!



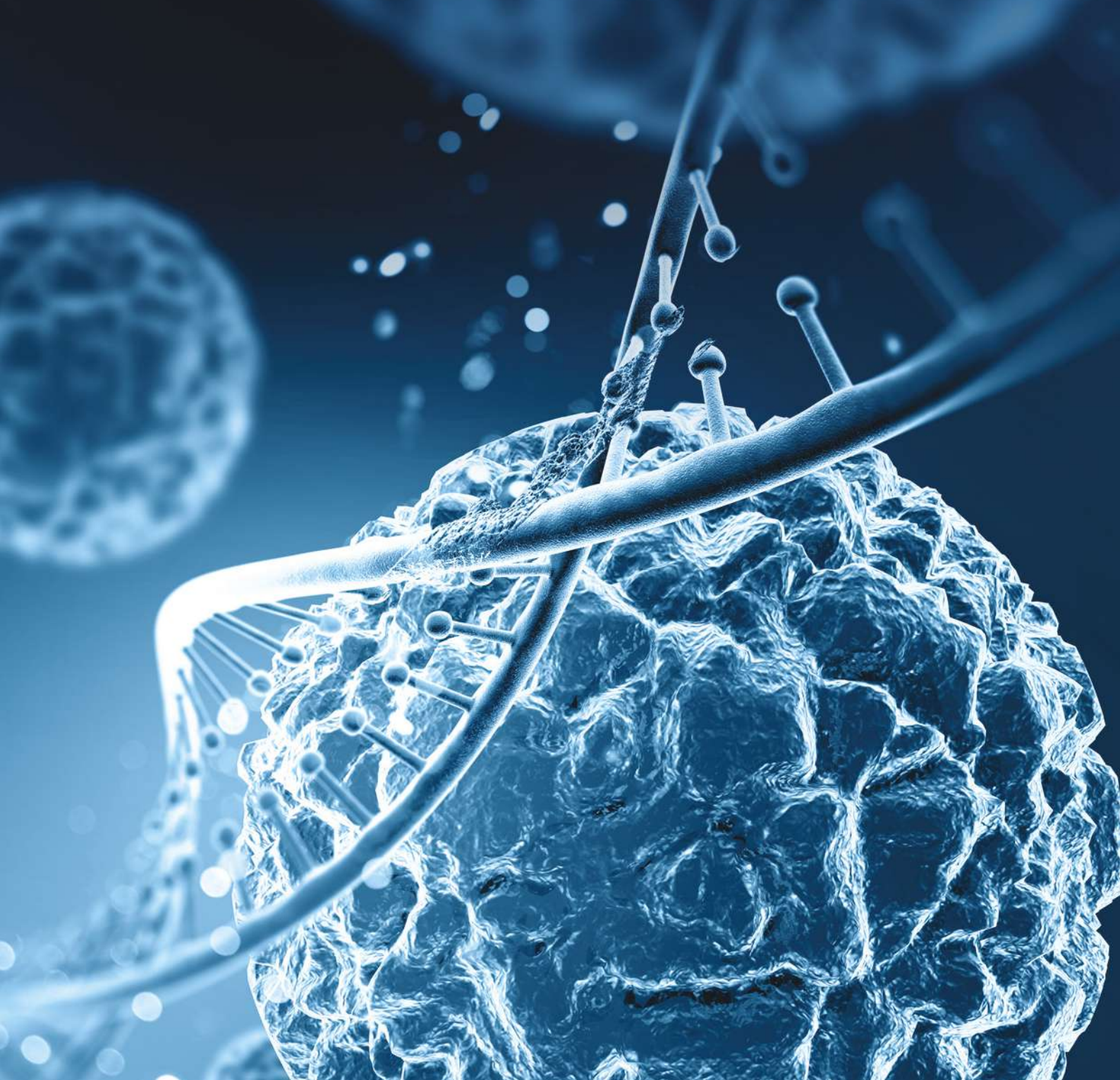
PÉTER HEGYI
Program director



ANDRÁS VARRÓ
Strategic director



THE PROGRAM OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION



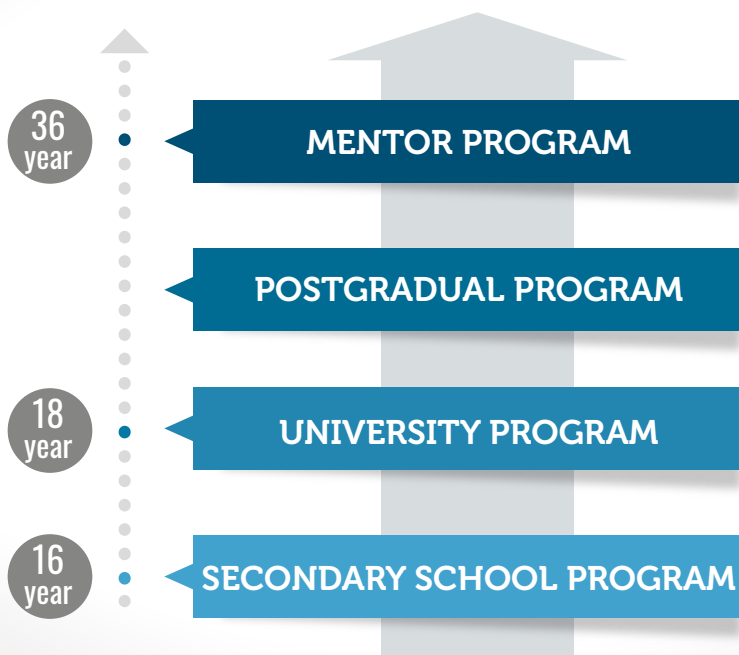
THE NATIONAL ACADEMY OF SCIENTIST EDUCATION

THE TRANSFORMATION OF THE SZEGED SCIENTISTS ACADEMY INTO THE NATIONAL ACADEMY OF SCIENTIST EDUCATION

In 2013, the Foundation for the Future of Biomedical Sciences in Szeged established the Szeged Scientists Academy. Based on the results listed over the years, it came to the point in 2021 where - with the support of the Hungarian government - the name of the Foundation was changed to **National Biomedical Foundation** and the program expanded to **National Academy of Scientist Education (NASE)** program, to include all cities with institutes of higher education in human life sciences (Budapest, Debrecen, Pécs, Szeged).

The short-term goal of the program remained to embrace talented young people interested in biomedical research, to support their scientific work, to make the career model of scientists more attractive, as well as to keep young researchers in Hungary in the long-term.

National Academy of Scientist Education



GENERAL INTRODUCTION OF THE NATIONAL ACADEMY OF SCIENTIST EDUCATION

One of the essential innovations of the educational processes of the Szeged Scientists Academy, and then of the National Academy of Scientist Education is that it guides students who are talented in research through the steps of becoming a scientist from their secondary school years.

The principal education of the secondary school pupils takes place in seven National Education Centres (in Debrecen, Gödöllő, Hódmezővásárhely, Pécs, Szeged and Szombathely) and 20 Regional Education Centres. The Regional Education Centres are led by the Szent-Györgyi Senior Teachers whose primary task is to find and mentor the pupils within their region who are particularly interested in natural sciences and are later planning to choose a research career.

The professional background to the regular theoretical and practical trainings organized by the Senior Teachers is constantly provided by the Academy.

The university **students are trained in** four cities (**Budapest, Debrecen, Pécs, Szeged**), **in six Scientific Laboratories**, at the best-equipped laboratories in the country, under the professional supervision of the **best mentors** (the so-called Szent-Györgyi Mentors). In each laboratory, a group of mentors awaits the students, who will also start research work along with their university studies. On the educational side, some university students are helped with an individual curriculum, so students can independently plan being in the laboratory when necessary for their research work. Of course, high-quality research activity cannot come at the expense of educational obligations.

The work of the Szent-Györgyi Mentors is supported by an **International Mentor Team** of nearly 60 members including outstanding researchers, even several Nobel Laureates.

The first dormitory of the Academy was opened in Szeged and has been available for the university students since September 2022.



The dormitory of the Academy in Szeged



Laboratory experiments



Eric F. Wieschaus (Nobel Laureate in Medicine, 1995) at the University of Szeged Teacher Training Secondary and Primary School

THE STUDENTS OF THE ACADEMY

Szent-Györgyi Pupils

A Szent-Györgyi Pupil can be a secondary school pupil who is already enrolled in secondary school and has an intense interest in the life sciences and related subjects (biology, chemistry). The National Academy of Scientist Education invites young people based on the recommendation of their teacher to join the Secondary School Education Program so that they might acquire the basic practical and theoretical knowledge necessary for their later research work.

A great majority of the Szent-Györgyi Pupils become Szent-Györgyi Students, and thus they take part in a 20-year training system.

Benefits:

- Laboratory training in the National and Regional Education Centres
- The opportunity to meet outstanding researchers



Project assignment under the supervision of a Szent-Györgyi Senior Teacher



Szent-Györgyi Students at the Meeting of Nobel Laureates and Talented Students



Laboratory practice under the supervision of a Szent-Györgyi Senior Teacher



Ole Petersen International Mentor and the professional leaders of the Academy with the Szent-Györgyi Students

Szent-Györgyi Students

Getting accepted and dropping out:

Students are admitted on the basis of an application and admission process in all four university cities. A prerequisite is that the young person applying to the program must be a first- or second-year student with active student status at Semmelweis University, the University of Debrecen, the University of Pécs, or the University of Szeged. Szent-Györgyi Students are primarily comprised of Szent-Györgyi Pupils. This opportunity is also announced to OKTV's (National Secondary School Academic Competition) podium finishers, thus ensuring geographical openness to the program.

Fluency in English (at least on an intermediate level) is also a prerequisite for successful admission, as well as a serious dedication to biomedical research which is to be expressed in a motivational letter.

At the end of a given academic year, students must report on their scientific progress. After the English-language "Audit" before the scientific committee, a decision is made as to whether the student will remain part of the scholarship program in the following academic year. The place of those who drop out can be taken if another student meets the entry requirements.

Students who have been admitted to the program but do not meet the expectations, or who may, in the meantime, develop in a different direction, will be dropped from the program, but later, e.g. at the beginning of each academic year, it is possible to admit older talents who reapply as academic students.

Benefits:

- Monthly scholarship
- Research opportunities in the laboratories of the best mentors in the country
- Listening to lectures by outstanding international and domestic instructors
- Dormitory accommodation in Szeged
- English language lessons
- Training in presentation techniques
- Communication training



Szent-Györgyi Students and scientific leaders at the Meeting of Nobel Laureates and talented students

THE TEACHERS OF THE ACADEMY

Szent-Györgyi Teaching Staff

The mentoring of secondary school pupils in the national and cross-border secondary school program is carried out by secondary school teachers with the titles of **Szent-Györgyi Senior Teacher** and **Szent-Györgyi Teacher**.

A **Szent-Györgyi Senior Teacher** can be a recognized authority in his region in the field of biology or chemistry education and who has decades of experience in talent development in these subjects. The National Academy of Scientist Education establishes a contractual relationship with the leading teachers who receive the title, thus helping them to devote as much of their time as possible to the organizational tasks of the talent development program. Currently, talent selection is carried out by 24 Senior Teachers covering the 19 national districts.

Their main tasks:

- Visiting partner schools in their region and maintaining continuous contact with the Szent-Györgyi Teachers there.
- Recruitment of the most talented pupils (in natural sciences) of the given region
- Mentoring pupils within their region
- Organization and conduct of laboratory practices and scientific programs for the Szent-Györgyi Pupils belonging to their area
- Participation in spring and autumn Meetings of Nobel Laureates and Talented Students
- Participation in further trainings organized by the NASE
- Recommending pupils to the National Academy of Scientist Education program, organizing, and assisting their participation

Benefits:

- They receive compensation for carrying out their duties

A **Szent-Györgyi Teacher** can be someone who effectively recognizes talents and provides them with additional knowledge in the secondary school where they teach biology or chemistry. Their pupils are regular participants in the National Secondary School Academic Competitions (OKTV), as well as in other international and national competitions, mainly in natural sciences. The faculty of the National Academy of Scientist Education is constantly growing. The Szent-Györgyi Teachers select the young people who get the opportunity to get to know the Academy's program.

Getting accepted and dropping out:

Teachers are selected on the basis of their previous talent management work. Teachers who have been admitted to the program but do not meet the requirements will lose their title and may be replaced by new teachers.

Benefits:

- Participation in further scientific trainings



Szent-Györgyi Senior Teachers with Botond Roska and the professional leaders of the Academy



Laboratory work at the Németh László Secondary and Primary School in Hódmezővásárhely under the direction of a Szent-Györgyi Teacher



Project assignment under the direction of a Szent-Györgyi Senior Teacher

THE MENTORS OF THE ACADEMY

Szent-Györgyi Mentors

The **National Academy of Scientist Education Szent-Györgyi Mentors** are researchers at one of NASE's Scientific Laboratories, who carry out internationally recognized scientific research, lead their own research group, and their publications appear in highly prestigious scientific journals.

Their main tasks:

- Academic mentoring, teaching, and topic management of students admitted to the program
- Giving students the opportunity to get involved in the activities of the research group they lead, providing them with the conditions for high-level research activity
- Holding lectures for secondary school pupils and university students
- Active participation in the seminar series to be organized for NASE students by inviting their renowned foreign collaboration partners (International Mentor)
- Participation and presentations at spring and autumn Meetings of Nobel Laureates and Talented Students
- Promoting the NASE's University Education Program

Getting accepted and dropping out:

Mentors are selected on the basis of their previous scientific or recruitment activities (in a scientific student association). Mentors who have been admitted to the program but do not meet the expectations will be dropped from the program, and new mentors may join the program in their place. The directors of the University Education Program and the Foundation decide on the invitation of mentors.

Benefits:

- They receive compensation for carrying out their duties

A certain amount of the cost of their international partner's (International Mentor) visit to Hungary will be covered in the event that, during their stay in Hungary, the International Mentor gives at least one lecture to Szent-Györgyi Students



Ole Petersen International Mentor (on the left) with the Foundation's scientific supervisors, the title "Excellent Student of the Year 2019" recipient, and the Student's Mentors

Szent-Györgyi Junior Mentors

Szent-Györgyi Mentors have the opportunity to nominate a talented, young researcher working in their laboratory, to become a Junior Mentor of a Szent-Györgyi Student, who will take an active, daily role in their education.

Their main tasks:

- They contribute to the Szent-Györgyi Student's education
- Participation at the spring and autumn Meetings of *Nobel Laureates and Talented Students*

Getting accepted and dropping out:

A Szent-Györgyi Junior Mentor must hold a PhD and be nominated by a Szent-Györgyi Mentor. The nomination is examined and approved by the relevant scientific supervisor. Junior Mentors who have been admitted to the program but do not meet the expectations will be dropped from the program.

Benefits:

- They receive compensation for carrying out their duties

Szent-Györgyi International Mentors

A **Szent-Györgyi International Mentor** can be researcher working in a research laboratory abroad, who carries out scientific work of considerable international reputation, leads their own research group, engages in original experimental work, the results of which are published in highly prestigious scientific journals, as well as having a scientific and research relationship (or is planning on developing one) with a Szent-Györgyi Mentor of the NASE.

Their main tasks:

- They get involved in the NASE's talent management activities, which they provide free of charge
- During their stay in Hungary, they give a lecture(s) in one or more NASE Scientific Laboratories and hold discussions with NASE Students
- They undertake the hosting of NASE Students in their own laboratories and research facilities, thus developing the young person's international contact network

Being accepted:

International mentors are selected based on their previous academic work. The decision to ask for their participation is decided on jointly by the directors of the University Education Program and the Foundation.

Benefits:

- A certain amount of their expenses when visiting their Hungarian partner (Szent-Györgyi Mentor) will be covered in the event that, during their stay in Hungary, the International Mentor gives at least one lecture to Szent-Györgyi Students
- They can recruit talented young people for their laboratories

Summary

The future benefits of the new school system are invaluable. It can start a new type of school and communication channels that have not been seen, in the history of Hungarian education, since Kunó Klebelsberg. As the name of the National Biomedical Foundation reflects, the Foundation initially intends to continue its activities in the field of medical biology. In the future, the Foundation also plans to invite leading researchers from other scientific fields (e.g. chemistry, physics, mathematics, social sciences) to the Program in order to introduce them to the secondary school pupils, university students, and teachers of the Academy.



András Varró, chairman of the Board of Trustees of the National Biomedical Foundation, and program director Péter Hegyi in front of the picture boards documenting the visits of the Nobel Laureates at the Radnóti Miklós Experimental Grammar School in Szeged

THE EDUCATION PROGRAM OF THE NEW SCHOOL SYSTEM



The program is built into the current school system and provides continuous scientific education for secondary school pupils (Szent-Györgyi Pupils) and university students (Szent-Györgyi Students).

The scientific program of the National Academy of Scientist Education is based on two main elements:

- Secondary School Education Program
- University Education Program

SECONDARY SCHOOL EDUCATION PROGRAM (SSEP)

The first element of the NASE's education program focuses on secondary school aged pupils. The professional background of the Secondary School Education Program is given on the one hand, by the talent nurturing traditions of biology and chemistry education in Hungary, and on the other hand, represented by successful foreign examples.

The novelty of this initiative, which is unique in domestic talent management, is that it combines the development experience of professionals working in secondary schools with the expertise of university teaching staff. This makes it possible to introduce a new form of education, in which modern scientific content, with the help of the best didactic methods, ensures that hundreds of young, interested pupils can gain insight into the process of cutting-edge biomedical research and those that show some interest can join in as well.

The education plan of the program includes both, independent knowledge processing, group presentations, related discussions, conference participation, and laboratory experiments which can be carried out in several locations.

The process also includes important evaluation steps, as continuous reflections are necessary for the sake of sustainability. The teachers therefore collect the opinions and experiences of the participants after each event. Based on the accumulated information, the education program is reviewed every academic year to ensure its effectiveness by incorporating any modifications deemed necessary.



Round table discussions with the participation of Szent-Györgyi Students and Pupils at a Meeting of Nobel Laureates and Talented Students

CURRENT OPPORTUNITES FOR TALENTED SECONDARY SCHOOL PUPILS

Hungary's education system has a rich history of particularly effective talent management traditions in the fields of mathematics and natural sciences. In addition to the, now commonplace, achievements of Nobel Laureates, this is supported by the fact that talented Hungarian secondary school pupils regularly achieve resounding success in these subjects. The medals won at the International Student Olympiad and the successes in Natural Science and Technical Innovation Competitions all support the effectiveness of these traditions. In the last 8-10 years, it has also become clear that our most successful students are welcomed with open arms by the world's leading institutions of higher education. At the same time, it is also an unfortunate experience that only a small percentage of students who go abroad at this age return to their homeland, so, practically speaking, other countries benefit from the secondary school education of these pupils.

It is also important to note, that the current practices do not effectively ensure that pupils identified as talented in secondary school will have all the opportunities to become successful at university. Students entering higher education – including those who achieve success in secondary school – usually have to start all over again on the path to success. With few exceptions, the number of domestic higher education programs that allow first- and second-year students to get close to research quickly is extremely small. Excellent research ability is usually difficult to measure and recognize, even though some students with such abilities can already be identified in secondary school. The first few years of university represent a kind of loss for these students, as well as for the research groups, who could start collaborating even sooner with students if they had the appropriate preparation and capacity.

THE GOALS OF THE SECONDARY SCHOOL EDUCATION PROGRAM

When defining the goals of the program, in addition to the facts stated above, it is essential to consider the opinions of the leaders of the secondary schools and research groups. The following well-articulated goal system was compiled based on the expressed needs:

To provide an effective alternative to further education abroad

The experience gained in the analysis of the situation led the Foundation's leaders to create a special talent management program for pupils talented in the natural sciences a real viable alternative compared to the opportunities offered by foreign universities, which leads to early emigration. However, this alternative only works if the pupils learn about this option in the early stages of secondary school, before they finally decide which country they will continue their studies in.

The purpose of the program is to offer pupils involved in the system, the university program as a realistic alternative to going abroad, having special educational benefits, as well as financial and intellectual support for committed pupils.



Laboratory demonstration led by a Szent-Györgyi Student at the Biological Research Centre, Szeged



Laboratory visit at the Biological Research Centre, Szeged

Effective aid in biology education at secondary schools

The traditions of secondary school biology education in Hungary can be traced back to the exceptionally thorough work of great forerunners. At the same time, in the last few decades, with the rapid development of the sub-disciplines of biology, Hungarian biology education seems to be lagging behind top international standards. This is primarily due to the fact that the higher education system did not adequately convey the novelties of this dynamically developing science to teaching colleagues who have graduated several years ago. This lag is particularly noticeable in the case of the quantitative analysis methods of biological phenomena and certain topics, such as, molecular biology, neurobiology, cell science, the immune system, etc.

The aim of the educational program is to offer support to secondary school teachers and their pupils.

Community building and social sensitivity

An essential element of the SSEP is to identify talented pupils in places where they have not had the opportunity to join a program of this kind until now. Social equality requires, at least in the field of talent management in biology, that we somehow counterbalance the well-known effects of inequality among Hungarian secondary schools. An important educational goal of the program is also to demonstrate a socially just aspect of research success: the results one can achieve in scientific research are irrespective of gender and ethnic origin. Talented pupils in a given field usually know each other well and form a cooperative community. This confirms to them that what they are delving into is a valuable activity, thus making it possible for them to build a community based on shared values.

The aim of the program is to enforce a socially just worldview and to build a pupil community that shares these values.

Bringing together teachers working in the field of talent management

Based on the information above, perhaps it is obvious that secondary school teachers participating in talent management have a key role to play in ensuring that such a program can have a real impact. Therefore, it is the secondary school teachers that are considered to be the most important strategic partners in the SSEP. They are the ones who arouse interest in young pupils, and they are the ones whose work the program wants to help the most. It is important to emphasize that an essential aspect of the program is that each pupil can develop most effectively in their own school, with the help of their own teacher.

The goal of the program is to build a community of secondary school teachers in order to facilitate their dedicated work.

TRAINING SITES IN THE SECONDARY SCHOOL EDUCATION PROGRAM

The basic training of secondary school pupils takes place in the well-equipped, modern laboratories of the seven National Education Centres and in the twenty Regional Education Centres.



The 7 National and the 20 Regional Education Centres

National Education Centres

National Education Centres operate in Debrecen, Gödöllő, Hódmezővásárhely, Pécs, Szombathely and two in Szeged. Their scientific work is coordinated by the head of the NEC. Their most important tasks include the management of talented pupils, introduction of new laboratory methods and tests and also the regular education of Szent-Györgyi Senior Teachers.

Schools housing central laboratories

The Specialized Laboratory for Scientific Education (TERMOSZ Laboratory) located at the **Radnóti Miklós Experimental Grammar School in Szeged**, the (SzeReTeD) Laboratory at the **University of Szeged Teacher Training Secondary and Primary School**, the laboratory of the **Nagy Lajos Grammar School of the Cistercian Order** in Pécs, the laboratory of the **ELTE Bolyai János Practice Primary and Secondary Grammar School** in Szombathely, the laboratory of the **Tóth Árpád Secondary School** in Debrecen, the laboratory of the **Premonstratensian St. Norbert Secondary School** in Gödöllő and the József Gyulai Laboratory at the **Németh László Secondary and Primary School** in Hódmezővásárhely all play an important role in the Academy's Secondary School Education concept. The support of the Hungarian government made it possible for the NASE to equip and renovate the laboratories above which are serving also the goals of the Academy. In addition to their core activities, all these secondary school laboratories serve as national centres where pupils from all over the country can conduct complex biological experiments. Furthermore, the teachers actively participating in the program also receive professional trainings in the centres, where they learn the methodology of the modern molecular biology exercises that they later perform with the Szent-Györgyi Pupils. Accordingly, NASE provides the necessary background for carrying out research and teaching tasks. During the school year, the laboratories welcome pupils and teachers who visit for several days.

National Education Centres:



RADNÓTI MIKLÓS EXPERIMENTAL GRAMMAR SCHOOL IN SZEGED
 Headmaster: Anett Nagy
 Szent-Györgyi Senior Teacher: Andrea Borbola



UNIVERSITY OF SZEGED TEACHER TRAINING SECONDARY AND PRIMARY SCHOOL
 Headmaster: János Dobi
 Szent-Györgyi Senior Teacher: István Csigér



NAGY LAJOS GRAMMAR SCHOOL OF THE CISTERCIAN ORDER IN PÉCS
 Headmaster: Márta Bodáné Gálósi
 Szent-Györgyi Senior Teachers: Zsolt Nyisztor, Eszter Dénes



ELTE BOLYAI JÁNOS PRACTICE PRIMARY AND SECONDARY GRAMMAR SCHOOL IN SZOMBATHELY
 Headmaster: Zoltán Csapodi
 Szent-Györgyi Senior Teachers: József Baranyai, Bence Farkas Szabó



TÓTH ÁRPÁD SECONDARY SCHOOL IN DEBRECEN
 Headmaster: Amália Fenyősné Kircsi
 Szent-Györgyi Senior Teacher: József Gőz



PREMONSTRATENSIAN ST. NORBERT SECONDARY SCHOOL IN GÖDÖLLŐ
 Headmaster: Borbála Takácsné Elek
 Szent-Györgyi Senior Teacher: Zoltán Kerényi



NÉMETH LÁSZLÓ SECONDARY AND PRIMARY SCHOOL IN HÓDMEZŐVÁSÁRHELY
 Headmaster: László Árva
 Szent-Györgyi Senior Teacher: Edit Csaláné Böngyik

Regional Education Centres:



BOLYAI FARKAS HIGHSCHOOL TARGU MURES

Headmaster: Zoltán Hajdú
Szent-Györgyi Senior Teacher: Éva József



CALVINIST GRAMMAR SCHOOL OF KECSKEMÉT

Headmaster: Anna Durucz
Szent-Györgyi Senior Teachers: Adrien Lengyel, Anna Nagy



DEÁK TÉRI LUTHERAN GYMNASIUM – BUDAPEST

Headmaster: Edit Gadóné Kézdy
Szent-Györgyi Senior Teacher: Andrea Fazakas



DOBÓ ISTVÁN HIGH SCHOOL IN EGER

Headmaster: Krisztián Berkes
Szent-Györgyi Senior Teacher: Krisztina Veresné Kis



ELTE BOLYAI JÁNOS PRACTICE PRIMARY AND SECONDARY GRAMMAR SCHOOL IN SZOMBATHELY

Headmaster: Zoltán Csapodi; Szent-Györgyi Senior Teachers:
József Baranyai, Bence Farkas Szabó



ELTE TREFORT ÁGOSTON SECONDARY GRAMMAR SCHOOL – BUDAPEST

Headmaster: Zoltán Csapodi; Szent-Györgyi Senior Teachers:
Norbert Faragó, László Kutrovácz



FAZEKAS MIHÁLY PRIMARY AND SECONDARY GRAMMAR SCHOOL – BUDAPEST

Headmaster: Zsolt Erős-Honti; Szent-Györgyi Senior Teachers:
Zsolt Erős-Honti, Julianna Erős-Honti



FÖLDES FERENC HIGH SCHOOL – MISKOLC

Headmaster: Róbert Fazekas
Szent-Györgyi Senior Teacher: Csilla Szentesi



GÖDÖLLŐ REFORMED SECONDARY SCHOOL

Headmaster: Árpádné Bajusz
Szent-Györgyi Senior Teacher: Zsolt Horváth



LOVASSY LÁSZLÓ GRAMMAR SCHOOL – VESZPRÉM

Headmaster: Zoltán Schultz
Szent-Györgyi Senior Teacher: Tünde Szalainé Tóth



NAGY LAJOS GRAMMAR SCHOOL OF THE CISTERCIAN ORDER IN PÉCS
 Headmaster: Márta Bodáné Gálosi
 Szent-Györgyi Senior Teachers: Zsolt Nyisztor, Eszter Dénes



NÉMETH LÁSZLÓ SECONDARY AND PRIMARY SCHOOL IN HÓDMEZŐVÁSÁRHELY
 Headmaster: László Árva
 Szent-Györgyi Senior Teacher: Edit Csaláné Böngyik



PREMONSTRATENSIAN ST. NORBERT SECONDARY SCHOOL IN GÖDÖLLŐ
 Headmaster: Borbála Takácsné Elek
 Szent-Györgyi Senior Teacher: Zoltán Kerényi



RADNÓTI MIKLÓS EXPERIMENTAL GRAMMAR SCHOOL IN SZEGED
 Headmaster: Anett Nagy
 Szent-Györgyi Senior Teacher: Andrea Borbola



SZÉKESFEHÉRVÁR TELEKI BLANKA HIGH SCHOOL AND PRIMARY SCHOOL
 Headmaster: Anikó Ráczné Kálmán; Szent-Györgyi Senior Teacher: Ildikó Kiss



TÁNCSICS MIHÁLY SECONDARY GRAMMAR SCHOOL OF KAPOSVÁR
 Headmaster: László Vámosi
 Szent-Györgyi Senior Teachers: Beatrix Bagi Kertész, Róbert Kertész



TÓTH ÁRPÁD SECONDARY SCHOOL IN DEBRECEN
 Headmaster: Amália Fenyősné Kircsi
 Szent-Györgyi Senior Teacher: József Gőz



UNIVERSITY OF NYÍREGYHÁZA EÖTVÖS JÓZSEF PRACTICE PRIMARY SCHOOL AND HIGH SCHOOL
 Headmaster: István Komáromi; Szent-Györgyi Senior Teacher: Erika Szuhi



UNIVERSITY OF SZEGED TEACHER TRAINING SECONDARY AND PRIMARY SCHOOL
 Headmaster: János Dobi; Szent-Györgyi Senior Teacher: István Csigér



VARGA KATALIN SECONDARY SCHOOL, SZOLNOK
 Headmaster: László Molnár
 Szent-Györgyi Senior Teacher: Marianna Jeneiné Fekete

Regional Education Centres (Base Schools)

Within the NASE's Secondary School Education Program, the country is divided into 18 areas, fully covering the country. In addition, there is also a centre in Târgu Mureş, Romania. Each region belongs to a Regional Education Centre, which is under the direction of a Szent-Györgyi Senior Teacher, who, in addition to their daily work, deals with the promotion of the SSEP and the organization of local programs. The Senior Teachers maintain direct contact with the pupils belonging to the areas.

The Senior Teachers, who carry out regional coordination, regularly participate in specialized trainings, where they discuss current organizational issues and share good practices with each other, with the help of which, they can carry out development activities in their own regional centres. During the trainings, they also learn the methodology of the modern molecular biology experiments that they will have their pupils perform.

Partner schools

The priority of the Foundation is to support the talent development process in its natural environment, in secondary schools. To this end, it is essential to establish a partnership with the teachers of talented pupils, which includes recognition of their achievements and respect for the significant amount of extra work devoted to their talent management. An important part of the partnership is the fact that, along with the pupils, their teachers are also invited to every event, because the shared learning experience enables the creation of a mutually motivating situation. Being awarded the title of Szent-Györgyi Teacher in and of itself is serious incentive for secondary school teachers, as is participation in Nobel Laureate conferences, as well as access to the teaching materials and methodological guidance of the SSEP, the express purpose of which are to support the methodological development of biology education in Hungary within its own framework.

Through regular secondary school activities, pupils can get to know the outstanding scientific results of the higher education institutions participating in the national program (Budapest, Debrecen, Pécs, Szeged), all in the hopes that interested pupils will eventually choose one of these institutions as a destination for their further education and thus their development will be continuous.



Szent-Györgyi Pupils in the laboratory of a Szent-Györgyi Mentor

THE ACTIVITIES OF THE SECONDARY SCHOOL EDUCATION PROGRAM

The activities of the Program were designed in such a way as to, as much as possible, achieve the set goals. The activities include theoretical education based on pupils' independent learning and group work, but great emphasis is placed on the development of practical skills. Some of the activities can be done from home, while other forms of education take place in the regional or national centres. The common goal of all activities is to impart, with the help of the most modern pedagogical methods possible, valuable knowledge that is difficult or not able to be obtained within the framework of normal public education. The content of this imparted knowledge will contribute to successful research in the future.

Processing of online course material

It's impossible to imagine modern education without online elements. eLearning gives pupils the opportunity to progress through a topic at their own pace. In order to help facilitate this, a series of teaching materials has been developed to supplement school studies, which ensure the uniformity of requirements, but at the same time also supports individual learning styles. Each topic elaborated on begins with a short theoretical summary in Hungarian, using technical terms, which is supplemented by diagrams that facilitate understanding. In addition to this, for every topic, we offer free access to English language animations and videos to process the material. Pupils also have access to multiple English language scientific publications related to each topic. Comprehension is measured by an evaluating method developed by the Szent-Györgyi Senior Teachers, on the basis of which pupils can proceed.

The range of topics is constantly expanding, so far, the following eight topics have been elaborated on:

- Basic neurological phenomena (with particular regard to processes at the cellular level)
- Membrane transport processes and channel types
- The structure and functioning of the immune system, immunological methods in biological research
- Spectroscopic methods in biomedical research
- Cellular biology (cell membranes, vesicular transport, cytoskeleton)
- Cardiology (especially in regard to the examination of heart function)
- Biomathematics and bioinformatics
- Signal transmission processes



Laboratory work at the TERMOSZ Laboratory (Radnóti Miklós Experimental Grammar School in Szeged)

Laboratory experiments

Biomedical research is largely experimental work. Pupils who are, at the very least, familiar with the basic methods of modern laboratories will be able to effectively participate in the experimental work. That is why practical preparation also plays a prominent role among the goals of the SSEP. The program's activities include two types of experiments: experiments that develop basic laboratory skills and multi-day projects.

The experiments that develop basic laboratory skills are organized and overseen by the Senior Teachers in the laboratories of the Regional Education Centres. The Senior Teachers acquire the scientific background and teaching methodology of these practices as part of specialized training courses. Acquiring the equipment needed to carry out these experiments - which is lacking most Hungarian secondary schools - results in a drastic improvement in Hungarian biology education as a whole. As a result of continuous investments, basic molecular biology experiments can be carried out at base schools for groups of up to 30 pupils at a time. Basic practical knowledge of current research includes the use of automatic pipettes, gel electrophoresis equipment, spectrophotometer upon which the correct interpretation of the information can be obtained. The transfer of this practical knowledge is practically absent from Hungarian secondary school education due to a lack of knowledge and financial resources. That is why the development of the basic molecular biology equipment of Regional Education Centres is considered an essential development in the national public education system. Not only does the NASE provide the equipment and material required for these experiments, but also the methodological knowledge necessary for their completion (in the form of workbooks and teacher's workbooks).

The content developed for the second academic year is a curriculum system which includes a theoretical introduction, tests to check their mastery, every step of the way, from preparation to execution.

Topics of experimentation to be introduced in the Regional Education Centres:

- Basics of restriction analysis; Analysis of λ -phage genetic material
- DNA investigation via PCR reaction
- Expression of GFP fluorescent protein in model organisms
- Human genetic analysis by examining the PV92 DNA segment
- Spectrophotometric protein content determination using the Bradford method



Aaron Ciechanover (in the middle) Noble Laureate scientist and Michael Brecht (on the left) German neurobiologist visiting the laboratory practice at Radnóti Miklós Experimental Grammar School in Szeged

After getting familiar with the simple methods, the pupils' knowledge becomes suitable for carrying out complex, multi-step experiments which model research processes. The short-term goal is that these experiments will be carried out, over the course of several days, by groups of pupils in the laboratories of the National Education Centres. During the development of these exercises, the emphasis was not on teaching technical execution - as the pupils who came here had already mastered it in the Regional Education Centres - but on modeling the real research process. The goal is for the pupils to be able to carry out every step of a research sub-process on site, so that they can get to know the complex process of biological research.

The complex exercises are organized around the following topics:

- The diverse application possibilities of chromatography in biological research
- Protein detection in biological research
- Complex examination of bacterial protein production
- The possibilities of using the PCR method in biological research
- Dissection and histological experiments on vertebrae organs
- Enzyme kinetic examinations

Group development programs performed in Regional Education Centres

As previously stated, Szent-Györgyi Senior Teachers working in the Regional Education Centres, play a key role in the operation of the SSEP. These occasions provide an opportunity to gather pupils from each region and have an invited Szent-Györgyi Mentor or a Szent-Györgyi Student tell them about their own research. The processing of the research report can be supplemented by a group discussion. The Senior Teachers also have the opportunity to lead other types of group sessions based on their own experience, where they present calculations or the method of essay writing to the pupils. These occasions also offer the opportunity for pupils from the same region to get to know each other and form their own communities and friendships.



Erwin Neher (who, along with Bert Sakmann, won the Nobel Prize in Medicine in 1991) and Eva-Maria Neher at TERMOSZ Laboratory (Radnóti Miklós Experimental Grammar School, Szeged)

Participation in the “Meeting of Nobel Laureates and Talented Students” conferences

In the spring and autumn of each academic year, the National Biomedical Foundation, which implements the NASE Program, organizes a conference, to which, primarily, secondary school pupils are invited.

At the spring conference, the organizers give priority to the applications of those 10th grade pupils that want to take part in the conference. At these events pupils, through the interpretation of Szent-Györgyi Students, can learn about ongoing research and their results, which, at the same time create an opportunity for secondary school pupils to get a firsthand view of the university program. The spring events also provide an opportunity to get to know the cultural diversity of the host cities, while at the same time, the secondary school central laboratories are open to guests.

The autumn conference is mainly attended by upper-year pupils (primarily 11th and 12th year) who are close to choosing a career. Accordingly, as part of the official conference program, in small groups, pupils will also have the opportunity to visit the laboratories of the Szent-Györgyi Mentors of the University Education Program accompanied by Szent-Györgyi Students, so they can see, up close, the research being carried out there. In these encounters, the pupils’ questions can be answered directly by the Szent-Györgyi Mentors and Szent-Györgyi Students present.

Summary

During the development of the Secondary School Education Program, the aim has always been to provide secondary school pupils and their teachers with a diverse range of modules. The offered forms of education make it possible for pupils to add valuable information to the knowledge and skills they have learned in secondary school with the help of state-of-the-art equipment and modern teaching methods.



Bert Sakmann Director General of Education (pictured second from right) at the Meeting of Nobel Laureates and Talented Students

University Education Program (UEP)

The primary task of the National Academy of Scientist Education is to provide world-class training for future researchers in Hungary. The NASE actively helps university students, from Budapest, Debrecen, Pécs, and Szeged, who are committed to science, to develop, starting in their first year, their scientific interests and enable them to get involved in scientific projects at the highest level. The NASE considers the front line of science as its reference point and sets the goal of reaching and surpassing it for its students and mentors.

At the same time, the aim of the Academy is, emphatically, not to support the cultivation of science at an average level, nor to assist studies that are part of university education. The education in the program actively complements university studies and the goal is that time spent in the laboratories of Szent-Györgyi Mentors be recognized by the universities in the form of credit points.

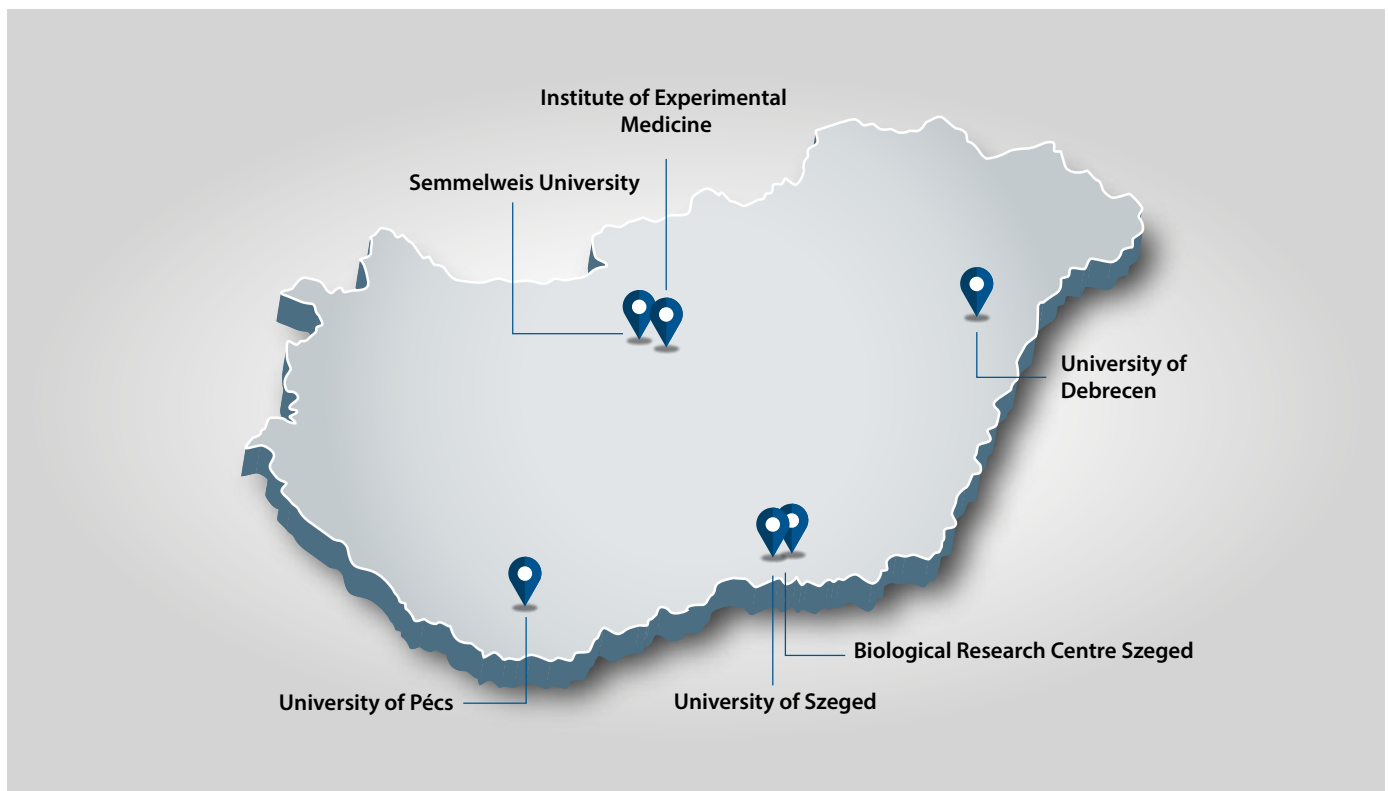
The education within the NASE is based on the concept of providing its students with medium and long-term scientific development starting in their university years and, optimally, getting students to the point where they are independent, research group leaders who are resource independent which, as reference, is imagined at the level of MTA Lendület and ERC Starting Grant winners. To encourage this, the long-term goal of the NASE is to provide competitive scholarships at all stages of a scientist's career (BSc, MSc, MD, or PhD student, Postdoctoral and Senior Researcher) that are superior to any alternative supported by the public sector in Hungary.



Zoltán Rakonczy,
Director of University Education

THE UNIVERSITY EDUCATION PROGRAM'S PARTNER INSTITUTIONS

The education of university students takes place in four Hungarian cities, in a total of six partner institutions, which are the following:



The NASE's Scientific Partner Institutions

University of Debrecen

With its uninterrupted history of more than four and a half centuries, the University of Debrecen is today the country's oldest continuously operating institution of higher education in the same city, and having one of the largest domestic educational complexes, it is a prominent player in the Hungarian higher education system. It also has outstanding education, research, innovation capacities and scientific results at the international level, based on which, it plays a significant role in the implementation of national strategic goals, and is also one of the 500 best universities in the world. The student community of nearly 30,000 students can increase their knowledge in 14 faculties at an institution that exhibits serious professional values. As a university of science, it has become known as an intellectual centre with the widest vertical training in Hungary, which takes part in the private sector, business life, and the socio-economic life of the local government.



University of Debrecen

The Institute of Experimental Medicine (Budapest)

The Institute of Experimental Medicine (KOKI) was founded in 1952 with the aim of carrying out high-quality research work in the field of medical sciences. By the early 2000s, the Institute had developed into one of the leading neuroscience centres in Central Europe. The focus of KOKI's activities is basic and translational research in neuroscience. The primary goal of the Institute is to contribute to the general understanding of the functioning of the nervous system, the protection of human health, more effective treatment of nervous system diseases and the development of modern technologies in all areas of neuroscience. In recent years, KOKI has been extremely successful in obtaining prestigious foreign financial resources such as the European Research Council (ERC), Howard Hughes Medical Institute or the Wellcome Trust grants. All of which have greatly contributed to the creation of new technologies and many central research units. In many cases, the discoveries made by the Institute's research groups have been published in leading scientific journals, such as *Science*, *Nature*, *Nature Neuroscience* or *Neuron*. The Institute is also dedicated to education and the training of up-and-coming researchers, which is why the Institute jointly operates a neuroscience doctoral school together with Semmelweis University.



Institute of Experimental Medicine

Semmelweis University (Budapest)

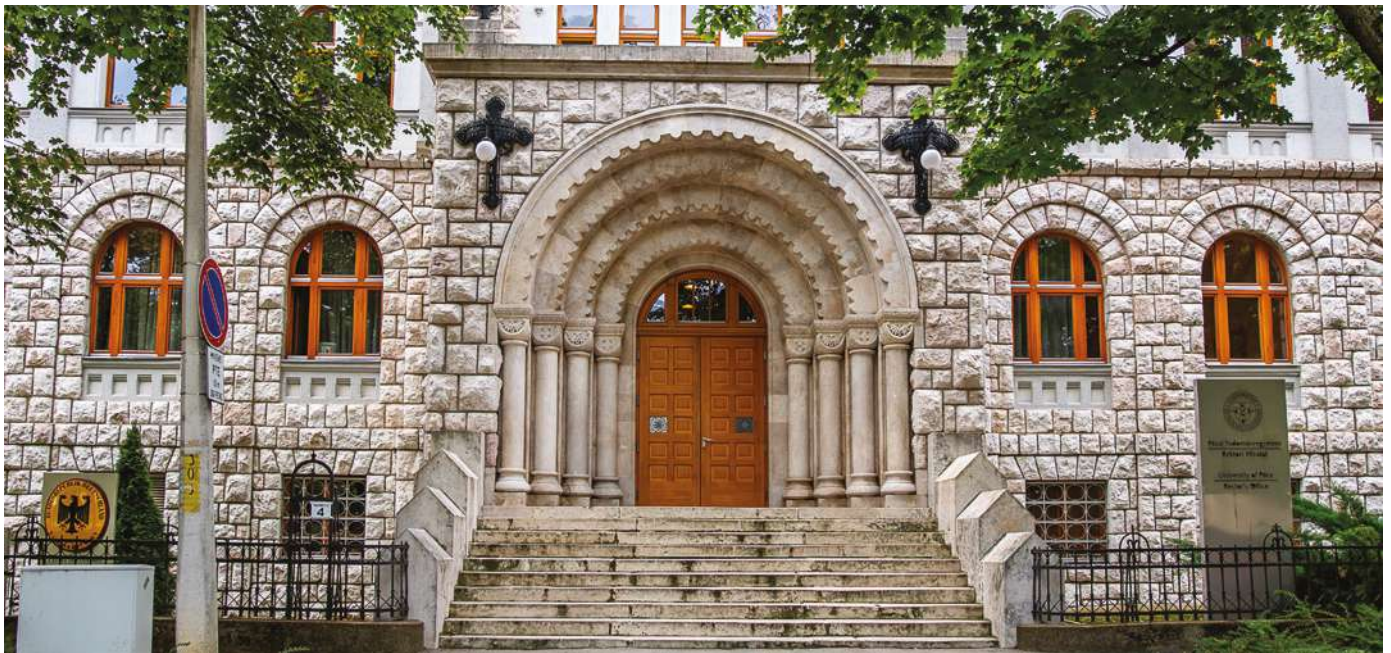
The more that 250-year-old Semmelweis University, which is unique in the country as a specialized university, is the leading institution of medicine and health higher education, not only in Hungary but also in the Central European region. Its three main activities are education, research-innovation, and healing; these three things make it an internationally recognized centre of knowledge. Most doctors, dentists, pharmacists, and midwives in Hungary have graduated from Semmelweis University, which is also one of the most internationally diverse universities in the world; a third of the more than 12,000 students are foreigners, coming from 97 countries around the world. Most of the country's academics work here in either the field of medicine or biomedicine, and many pioneering medical procedures were performed here in the country for the first time. The university is one of the most successful Hungarian players in international rankings: in the 2022 overall world ranking of Times Higher Education (THE), it is among the top 300 universities in the world, but it is also among the best in specialized rankings. The university is not only one of the largest healthcare institutions in the country, but it is also home to the largest number of research groups supported by the Hungarian Academy of Sciences and the National Research, Development and Innovation Office: around 300 university research groups operate here, and their research is supported by 46 international and 263 domestic grants. There are 8 doctoral schools operating at the university, and more than a thousand students are members of its Scientific Students Association.



Semmelweis University

University of Pécs

The history of higher education in Pécs dates back to 1367, when our King, Louis the Great, initiated the creation of a university in the episcopal capital, Pécs. As a result of a multi-stage integration process, the University of Pécs was created, which has now become one of the country's most famous universities with a regional leadership role. The university's 10 faculties and research centre provide high-quality education across the entire spectrum of higher education fields, 18 vocational colleges and 21 doctoral schools offer 300 courses for nearly 20,000 students. The university does a lot to ensure that it is not only an optimal choice for its talented researchers as a starting point, but also as a workplace. Its Clinical Centre is one of the largest healthcare providers in Hungary. Its three main activities are healing, education, and scientific research. The presence of a large number of Hungarian and foreign students, along with the Mediterranean atmosphere make Pécs a pleasant, bustling, and lively university city.



University of Pécs

Biological Research Centre Szeged

The defining institution of internationally recognized Hungarian life science research is the Biological Research Centre, Szeged (BRC). The four institutes of the BRC, founded in 1973 – the Institute of Biophysics, Biochemistry, Genetics and Plant Biology – employs around 260 researchers, whose work is characterized by numerous prestigious international scientific publications and patents. The researched topics cover many areas of molecular and cellular biology, which range from the industrial utilization of bacteria to the controlled breeding of cultivated plants as well as to issues of human health and environmental protection. The BRC is mainly a laboratory for basic scientific research, but BRC researchers play a prominent role in initiating the creation and management of biotechnological enterprises, as well as in performing educational tasks. The efficient operation of the BRC and the high quality of research were recognized by the European Molecular Biology Organization (EMBO) and the Centre was awarded the title of Centre of Excellence of the European Union in 2000.



Biological Research Centre Szeged



University of Szeged

University of Szeged

Committed to quality higher education, the University of Szeged (SZTE) is one of Hungary's leading universities. The University of Szeged was established on January 1, 2000, via the integration of the József Attila University of Szeged, the Szent-Györgyi Albert Medical University, the Szeged Food Industry College, the Juhász Gyula Teacher Training College, and the Hódmezővásárhely Agricultural College. SZTE offers hundreds of bachelors, masters, and doctoral programs, higher education vocational training, specialized trainings, and adult education programs for students and those who wish to learn. With nearly 25,000 students and around 7,000 employees (of which 2,400 are lecturers/researchers), SZTE is one of the largest organizations in the Southern Great Plain Region. Education and research are carried out at the university's 12 faculties, and health care is the responsibility of the Szent-Györgyi Albert Clinical Centre. The mission and goal of SZTE is to cultivate internationally competitive science and research and to ensure the spirit of a research university.



Meeting of Nobel Laureates and Talented Students

The common work takes place in the best-equipped laboratories at all six locations under the guidance of the best mentors (Szent-Györgyi Mentors). In each research laboratory, a group of mentors awaits students, who will, along with their university studies, also start research work in the given city.

Mentors play the most important role in the training of **Szent-Györgyi Students**. When entering the program, they all choose a Szent-Györgyi Mentor, whose research laboratory they join and participate in the ongoing work there. **Junior Mentors**, who are researchers with a doctorate degree and also work in the Mentor's laboratory, assist the Szent-Györgyi Students with their daily tasks. The **International Mentors** are internationally recognized scientists who have a close scientific and research relationship with the Szent-Györgyi Mentors.



The Bert Sakmann Dormitory

The Bert Sakmann Dormitory

The aim of the Academy is to ensure that the program's conditions meet high professional expectations, and that those participating in the program are placed in a highly motivating, quality environment.

This idea has already been realized in Szeged when the NASE's first dormitory – the **Bert Sakmann Dormitory** – was opened in the spring of 2022. In addition to several student rooms, there is also an international mentor room, where Nobel Laureates and other internationally renowned mentors can comfortably spend time in the company of young people. In addition to these rooms, a community and educational space has been created, where cultural programs, professional forums and trainings are organized for the students of the Academy. The aim of the Academy is to educate broad-minded intellectuals who, in addition to their excellent professional knowledge, will be useful members of society.

In the summer of 2022, Professor Bert Sakmann donated the original duplicate of his Nobel Prize medal and diploma to the Academy, which are exhibited in the dormitory named after him, to the delight of the visitors and the students living there.



An original duplicate of Bert Sakmann's Nobel Prize medal and diploma

OVERSIGHT OF THE ACADEMY'S UNIVERSITY EDUCATION

The oversight of the Academy's university education is provided by the **Board of Trustees** of the National Biomedical Foundation, the general director of education (**Bert Sakmann**, Nobel Prize-winning German physiologist), **the director of university education**, and the **six scientific supervisors** who oversee the six Scientific Laboratories which operate in the four university cities.

The director of education makes a proposal on the method of education, is in daily contact with the professional leaders, helps in the selection of Mentors, and participates in the Meetings of Nobel Laureates and talented students.

Students and Mentors keep in touch with the scientific supervisor overseeing the work in the given city.

The scientific supervisors coordinate the professional activities of the students and the mentors working in the Scientific Laboratories that they supervise. With their advice, they promote scientific cooperation between laboratories with different instrumentation and methodological preparation that train students.

The scientific supervisors visit the students and their mentors at their research site once per semester. The visits for the second semesters also serve as a meeting to prepare their annual work reports. Based on a comparison of the annual written and oral reports (Audit) and the system of requirements, the directors of the NASE make an annual proposal for every student and mentor as to the further payment of the scholarship and the mentor's honorarium, or its suspension or termination.



Szent-Györgyi Students with Botond Roska and the Academy's scientific supervisors

ADMISSION TO THE UNIVERSITY EDUCATION PROGRAM

Every academic year, the NASE advertises admissions to its Scientific Laboratories. The requirement for applying is that the student have active student status at an institution of higher education included in the program.

Students admitted to the program are selected in three ways:

First- or second-year undergraduate students at the University are admitted to the first year of the NASE program through an entrance exam. During the multi-step process, the examination board assesses the students' mental readiness, creativity, scientific problem-solving ability, and English language skills. The exam is organized and administered by NASE's directors responsible for secondary school and university education. To assess the candidates' English language skills, a professional English language teacher can be called in to help. The best performing students are then invited to participate in the NASE program.

The NASE also welcomes the applications of undergraduate students with scientific interests studying in the upper years of university. 2nd to 6th year undergraduate students must prove their record of excellence in scientific research in comparison with the best of their contemporaries in order to be awarded a NASE scholarship. This presupposes particularly successful participation in local and national Scientific Student Associations (SSA), as well as first and/or co-authorship in scientific publication(s).

SCIENTIFIC LABORATORY WORK

The placement of students admitted to the NASE Scientific Laboratories is coordinated and supervised by the scientific supervisors of the NASE. Students are obligated, within 3 months of admission, to discuss their selected academic topic as well as their chosen Szent-Györgyi Mentor with the scientific supervisors.

The aim of the program is for the Szent-Györgyi Mentors and the Junior Mentors to actively help the students, on a daily basis, acquire necessary laboratory skills. International Mentors (recognized researchers who publish their results in the highest quality journals) also play an important role in the training process. The short-term goal is for the international mentors to regularly take turns participating in the work of the NASE's Scientific Laboratories and dormitories, and to give lectures to the students, after which it is possible to have conversations with them.

THE NATIONAL ACADEMY OF SCIENTIST EDUCATION'S REQUIREMENTS FOR BSC, MSc AND MD STUDENTS

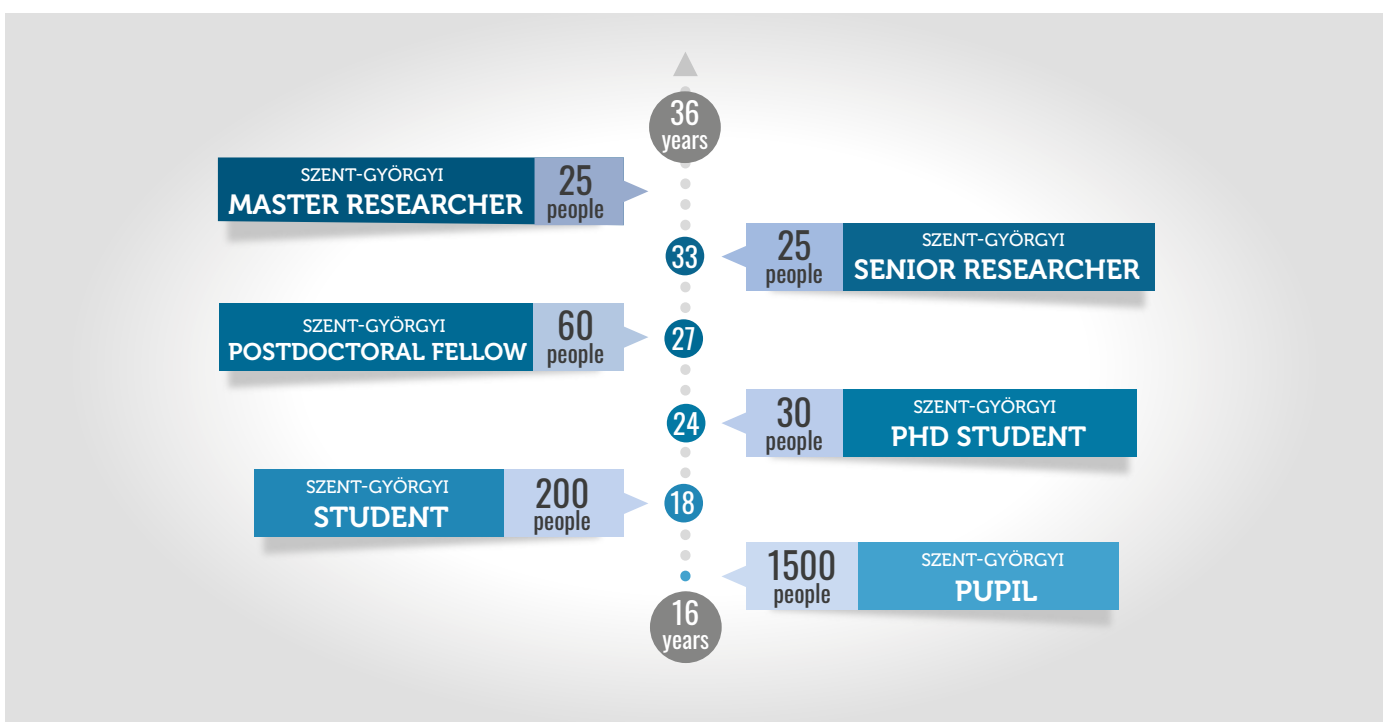
NASE Students focus on their university studies in the mornings, while in the afternoons and evenings they engage in laboratory work and have discussions with International Mentors.

Students receiving a scholarship are required, by end of the third year, to achieve co-authorship in at least one original article which is published in a journal belonging to the top 25% of the given field of study, which they must present at either a domestic or international SSA conference.

By the end of the sixth (MD) or fifth (MSc) year, it is necessary to author an article with first authorship in a journal belonging to the top 25% of the given field of study, which in most of our doctoral schools may already be formally sufficient to submit as a PhD dissertation. Accordingly, the system of requirements helps provide a MD-PhD MSc-PhD equivalent qualification during an MD/MSc education. As an alternative, the students' first author publication can be replaced by a publication with an impact factor of over 10, in which he/she is listed as a co-author and verifies his/her own results/work added to the creation of the publication in a creditable manner.

CAREER MODEL AT THE NATIONAL ACADEMY OF SCIENTIST EDUCATION

The Foundation is currently able to finance the program until the Szent-Györgyi PhD student level is reached (Szent-Györgyi Student graduates). Further stages of the career model can only be achieved with the involvement of new financial resources.





Anna Georgina Kopasz, winning the title of the „Excellent Student of 2022”. In the picture (from left to right): Péter Hegyi, Lajos Mátés, András Varró, Botond Roska, Anna Georgina Kopasz

Szent-Györgyi Student

Students admitted to the National Academy of Scientist Education receive a monthly scholarship. Students who successfully meet the above requirements will receive a certificate upon graduation. Students with a certificate can apply for the next stage or to the university's doctoral school, for PhD student status.

Szent-Györgyi PhD Student

In the first round, Szent-Györgyi Students who have received a certificate are most likely to be admitted to the PhD program of the Academy. In the longer term, the goal of the NASE is for these students to be automatically admitted to the doctoral schools of the universities. The remaining places are advertised by the NASE and filled via an application process. An applicant coming from outside the NASE program may join the scholarship system if they have published at least 2 articles in journals belonging to the top 25% of the given scientific field (in one of which they must be the first author). Students who enter the school at this level are no longer under „publication pressure” since they already meet the PhD conditions upon admission. For this reason, they can join a major, relatively long-term project which may take several years to complete. At this stage, Szent-Györgyi Students can focus on high-quality research that is exceptional, even by international standards, and also particularly beneficial to the laboratory.

The researcher must attend at least one international conference a year, and both Mentor and Student must submit a report at the end of the year. At the end of each year, the scientific supervisors along with the Board of Trustees decide whether the PhD student will retain their scholarship in the following year.

Within the four-year scholarship period, the PhD student must publish at least three articles with an IF of 5 or more, of which in at least one they are the first author. In the event that the PhD student fails to meet this criteria, they may request an extension from the Director of University Education but they must provide a detailed reason. The deadline for completion may be extended for up to 2 years but no scholarship will be given during this time. PhD Students who successfully meet the requirements will receive a certificate at the end of their PhD training.

Szent-Györgyi Postdoctoral Fellow

The postdoctoral program works on a 6-year cycle, of which the researcher spends 3-4 years in a domestic research laboratory and 2-3 years in a foreign one. The Mentor and the Postdoc can decide together which part of the cycle he/she will spend abroad. A foreign facility can only be chosen as a research site if the Board of Trustees has previously included it among the accepted foreign research laboratories (which are typically published in multidisciplinary journals). While doing their research in Hungary, the postdoctoral fellow must win an independent research grant (e.g. NRDIO).

The purpose of this period is for the Postdoctoral fellow to become independent within the 6 years and gain experience abroad that they can later assimilate at home, ideally at the same level (as a Szent-Györgyi Senior Researcher) or at the cutting edge of a particular specialized field (as a Szent-Györgyi Master Researcher).

Getting accepted and dropping out:

Szent-Györgyi PhD Students are admitted into the program in the first round. It is possible to join the program during one's studies if there is a vacancy and the candidate meets the criteria described above. The Postdoc fellow must participate in at least one international conference a year and the end of the year both Mentor and Postdoc fellow must submit a report. It is at this point that the International Mentor gets involved in the training, and thus the report must be written by all three people.

At the end of each year, the scientific supervisors along with the Board of Trustees decide whether the Postdoctoral fellow will retain their scholarship in the following year. A new student may take the place of a Postdoc who drops out of the program, provided they can meet the standards.

In six years, the researcher must publish at least three articles with an IF of above 8, of which he/she is the first author in at least one. If the Postdoc fellow does not satisfy the criteria he/she may request an extension, with detailed reasons, from the Board of Trustees. The deadline can be extended for up to three years but during that time the NASE does not provide a scholarship for that period. Postdoctoral fellows who successfully meet the criteria will get a certificate at the end of their training.

Szent-Györgyi Senior Researcher and Master Researcher

Szent-Györgyi Senior researchers and Szent-Györgyi Master researchers have at least 15 years of experience in high quality research and have received professional training at outstanding domestic and international laboratories.

Goal:

For those with serious research potential to strengthen either Hungarian scientific life or the Hungarian industrial research sector, as well as participate in the education of the next generation.

Getting accepted and dropping out:

The Master researcher or Senior researcher scholarship begins when the candidate meets the given requirements.

The title of Master researcher is conferred on those who have published articles in famous multidisciplinary newspapers (e.g., Science, Nature) as corresponding author based on research conducted in a Hungarian centre.

The title of Senior researcher is conferred on those who have published in leading specialized journals (e.g., Gastroenterology, Circulation) as corresponding author based on research conducted in a Hungarian centre. The scholarship can be awarded for up to 3 years from the publication of the given article, if the researcher in question demonstrates that he/she is conducting research which may potentially be accepted for publication in a journal of similar rank. If, during the three years, the researcher wins a substantial amount of money from an international grant (e.g. European Research Council or the Wellcome Trust), the scholarship can be extended for another 2 years.

The Senior researchers and Master researches are expected to act as Mentors at NASE, while their laboratories function as part of the program. If the researcher fails to present a publication of similar rank or to win a major grant in three years, the scholarship will cease until the candidate satisfies the above requirements.

The NASE seeks, primarily, to continue to support PhD students, Postdoctoral fellows and Senior or Master researchers from those previously supported undergraduate students to validate its educational model, however, it also considers researchers of exceptional talent and results as new recipients of scholarships during their PhD or postdoctoral studies.

Regarding the NASE's career model as a whole, we want to enforce the ever-strengthening principle of quality-based selection, which assumes a decreasing number of NASE scholarship recipients (<15 PhD students, maximum 7 postdoctoral fellows) over time.

SOCIAL LIFE

The NASE provides accommodation in its dormitory for its students in Szeged, which also provides an opportunity for interaction between students and guest lecturers/researchers/international mentors. In order to form a community of students, the NASE organizes regular scientific and other (e.g. cultural, communication) programs in Budapest, Debrecen, Pécs and Szeged.



Gala at the National Theater of Szeged



Performance of Virtuoses at the Meeting of Nobel Laureates and Talents Students Gala

AWARDS GIVEN BY THE ACADEMY

The Szent-Györgyi Talent Award

In 2013, the Foundation for the Future of Biomedical Sciences in Szeged established the Szent-Györgyi Talent Award. According to the original concept, the condition for receiving this award, is that the discovery – like in the case of the great predecessor, Albert Szent-Györgyi – has to be connected to a research carried out in Szeged and – modeled after the Nobel Prize – it has to be connected to a once-in-a-lifetime discovery.

With the establishment of the National Academy of Scientist Education, not only does outstanding research in Szeged receive recognition every year, but also in Budapest, Debrecen and Pécs.

The award winners are jointly selected by the Nobel Laureate researchers visiting the Academy's events, the scientific supervisors of the National Academy of Scientist Education's University Education Program, and the members of the Board of Trustees. The awards are presented every year in the spring on the evening of the „Meeting of Nobel Laureates and Talented Students” gala event.

Researchers awarded so far:

2013: Balázs Papp

A senior scientific associate at the Institute of Biochemistry at the Biological Research Centre, Szeged *won for his work on exploring the general properties of genetic interaction networks.*

2014: Csaba Pál

A senior scientific associate at the Institute of Biochemistry at the Biological Research Centre, Szeged *won for his work on the detailed mapping of bacterial resistance to antibiotics.*

2015: Gábor Tamás

Professor at the University of Szeged Faculty of Natural Sciences and Informatics, Institute of Biology, Department of Physiology, Organization and Neuroscience *won for the discovery of the cells responsible for slow cortical inhibition and the description of their mechanism.*

2016: Péter Hegyi

Professor at the Faculties of General Medicine of the University of Szeged and Pécs *won for his work in understanding the pathomechanism of acute alcoholic pancreatitis.*

In light of the fact that a member of the Board of Trustees received the highest professional prize in 2016, the award was not handed over. The professional achievement was recognized with a certificate.

2017: Antal Berényi

Assistant professor at the Institute of Physiology, Faculty of General Medicine, University of Szeged *won for his work exploring the principles of electrical treatment of epileptic seizures.*



Balázs Papp (in the middle), the first Talent Award winner, 2013



Csaba Pál (on the right), the 2014 award winner



Gábor Tamás (on the left), who won the award in 2015



Péter Hegyi received a certificate in 2016



Antal Berényi, the 2017 award winner



Lajos Haracska, the 2018 award winner

2018: Lajos Haracska

Research fellow at the Institute of Genetics of the Biological Research Centre, Szeged of the Hungarian Academy of Sciences won for his research in the field of carcinogenesis, during which he described how new molecular actors influenced the stability of the genome.

2019: Péter Horváth

Director at the Institute of Biochemistry of the Biological Research Centre, Szeged of the Hungarian Academy of Sciences won for his publication in the January 15, 2018, edition of *Nature Communications* in which he and his colleagues described the technique of intelligent image-based single-cell isolation.

2020: László Nagy

Research fellow at the Institute of Biochemistry of the Biological Research Centre, Szeged won for his outstanding research results in the topic "Exploring the evolutionary origin of hyphae multicellularity using comparative genomic methods".

2021: Tamás Martinek

Professor and department head at the Institute of Medicinal Chemistry of the University of Szeged for his outstanding research results in the field of "Delivery of proteins into the cell with endocytosis-directing sequences".

2022: Ádám Dénes

Senior research fellow at the Institute of Experimental Medicine, won for his outstanding research in the field of "Compartment-specific modulation of neuronal and vascular responses by microglia".

Gábor Juhász

Professor at the Biological Research Centre Szeged, won for his outstanding research in the field of "Canonical and non-canonical roles of autophagy genes".

Norbert Kovács

Professor at the University of Pécs, won for his outstanding research in the field of "Deep brain stimulation to improve the quality of life for patients with movement disorders such as Parkinson's disease and dystonia".

Attila Tóth

Professor at the University of Debrecen, won for his outstanding research in the field of "Gains and losses upon improving cardiac contractility".



The 2022 award winners with András Varró, the strategic director of the Foundation and the Nobel Laureate Erwin Neher (from left to right: András Varró, Ádám Dénes, Attila Tóth, Norbert Kovács, Gábor Juhász, Erwin Neher)

“Excellent Student of the Year” awardees

2018: Bernát Nógrádi

Szeged Scientists Academy 3rd year
University of Szeged, Faculty of Medicine, 3rd year

2019: Gergő Porkoláb

Szeged Scientists Academy 3rd year
University of Szeged, Faculty of Science and Informatics, Biology 3rd year

2020: Valéria Éva Meszlényi

Szeged Scientists Academy 5th year
University of Szeged, Faculty of Medicine, 6th year

2021: Márton Simon Czikkely

National Academy of Scientist Education 5th year
University of Szeged, Albert Szent-Györgyi Medical School, 5th year

2022: Anna Georgina Kopasz

National Academy of Scientist Education 6th year
University of Szeged, Faculty of Science and Informatics, Biology MSc 2nd year



BERNÁT NÓGRÁDI
Excellent Student of 2018



GERGŐ PORKOLÁB
Excellent Student of 2019



VALÉRIA ÉVA MESZLÉNYI
Excellent Student of 2020



MÁRTON SIMON CZIKKELY
Excellent Student of 2021



ANNA GEORGINA KOPASZ
Excellent Student of 2022

“Excellent Pupil of the Year” awardees

2019: Gergő Bitay

Radnóti Miklós Experimental Grammar School Szeged

2020: Dominik Dobos

ELTE Bolyai János Practice Primary and Secondary Grammar School, Szombathely

2021: Botond Szikra

Táncsincs Mihály Secondary Grammar School of Kaposvár

2022: Lucien Lemaître

Németh László Secondary and Grammar School, Hódmezővásárhely



GERGŐ BITAY
Excellent Pupil of 2019



DOMINIK DOBOS
Excellent Pupil of 2020



BOTOND SZIKRA
Excellent Pupil of 2021



LUCIEN LEMAITRE
Excellent Pupil of 2022



STATISTICS OF THE EDUCATION PROGRAM

STATISTICS OF THE SECONDARY SCHOOL EDUCATION PROGRAM

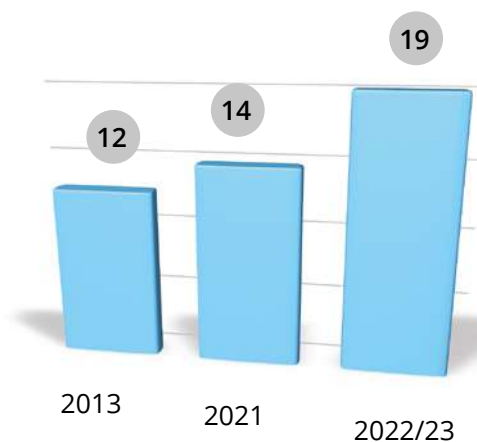
Venues

In 2013, when the *Szeged Scientists Academy* was launched by the *Foundation for the Future of Biomedical Sciences in Szeged*, the 12 regions, the 3 National Training Centres and the 14 Regional Training Centres of the Secondary School Education Program provided a geographical national coverage regarding the talent management of the pupils in the field of natural sciences.

As a result of the transformation of the *Szeged Scientists Academy* to the *National Academy of Scientist Education* in 2021, the number of the regions began to increase within Hungary and in 2022 also a region beyond the border was involved in Târgu Mureş, Romania.



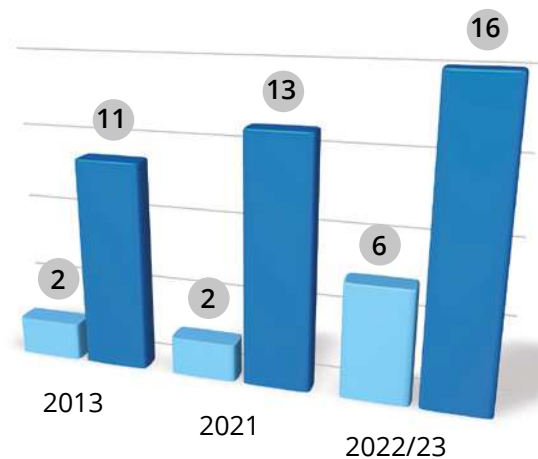
REGIONS



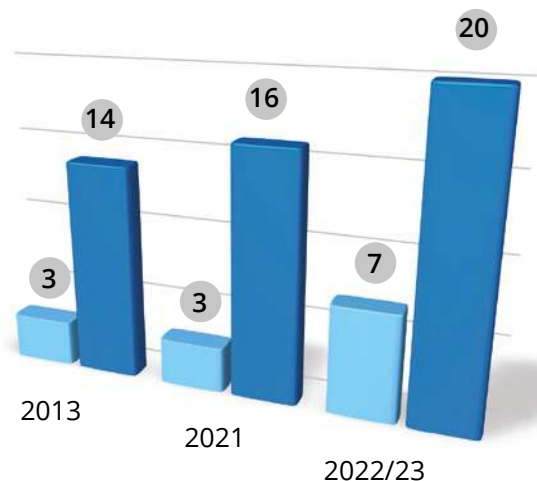
Parallel to the increase in the number of regions, the number of cities and schools involved in the implementation of the program also grew, in order to make the talent management of the pupils even more effective. Consequently, regular teacher trainings and special laboratory practices for advanced pupils can now be carried out in the 7 National Training Centres, while the 20 Regional Training Centres are responsible for the regular theoretical and practical education of the secondary school pupils.



CITIES



INSTITUTIONS



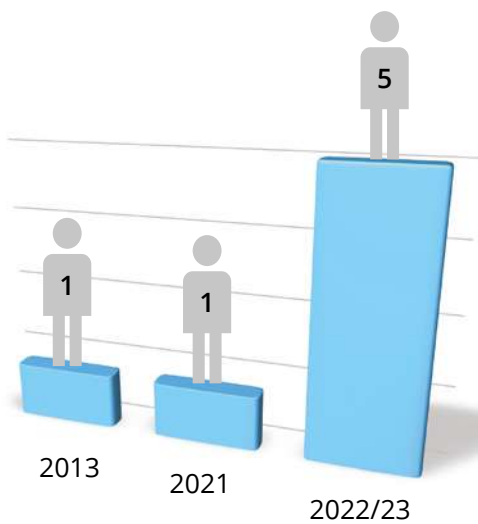
● National Training Centres

● Regional Training Centres

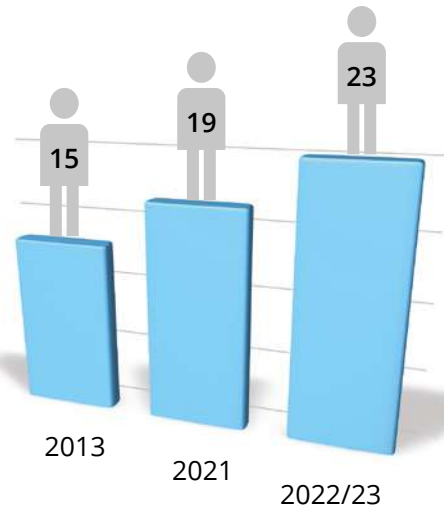
Participants

Szent-Györgyi Senior Teachers, who are recognized experts within their region in the field of biology or chemistry education, must have decades of experience in talent development in these subjects. From the very beginning, the management of the Academy was determined to involve as many experts as possible, with whom the Secondary School Program could be made even more effective and successful. As the professional work of the regions is led by the Szent-Györgyi Senior Teachers, they play a crucial role in the system.

SZENT-GYÖRGYI SENIOR TEACHERS OF THE NATIONAL TRAINING CENTRES

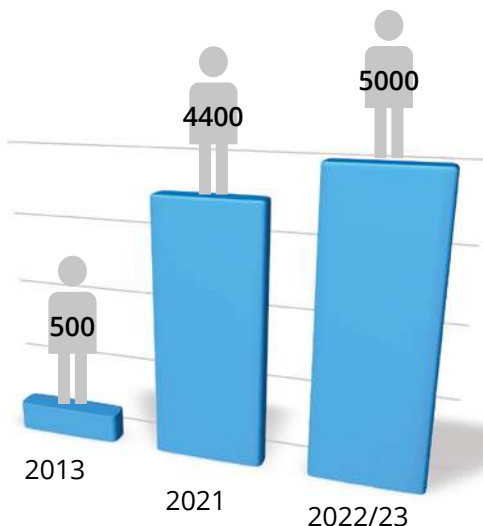


SZENT-GYÖRGYI SENIOR TEACHERS OF THE REGIONAL TRAINING CENTRES

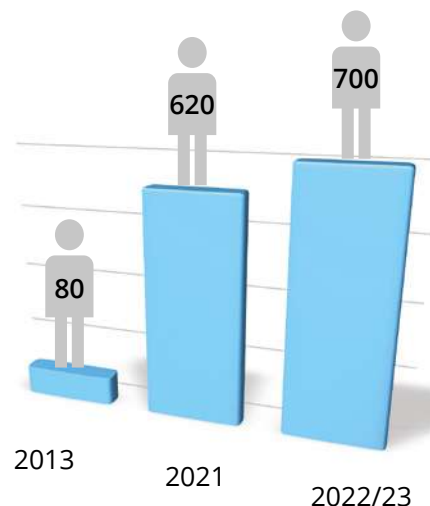


Secondary school pupils and their teachers can regularly participate in various professional programs. Since 2013, the Academy organizes two major conferences (*Meeting of Nobel Laureates and talented students*) every year, where both pupils and teachers are invited. They can also regularly attend trainings in the National and Regional Centres. The diagram below shows the total number of participants throughout the years. The exponential increase in the numbers is an outstanding success for the Academy.

SZENT-GYÖRGYI PUPILS PARTICIPATING IN PROFESSIONAL PROGRAMS



SZENT-GYÖRGYI TEACHERS PARTICIPATING IN PROFESSIONAL PROGRAMS



STATISTICS OF THE UNIVERSITY EDUCATION PROGRAM



VENUES

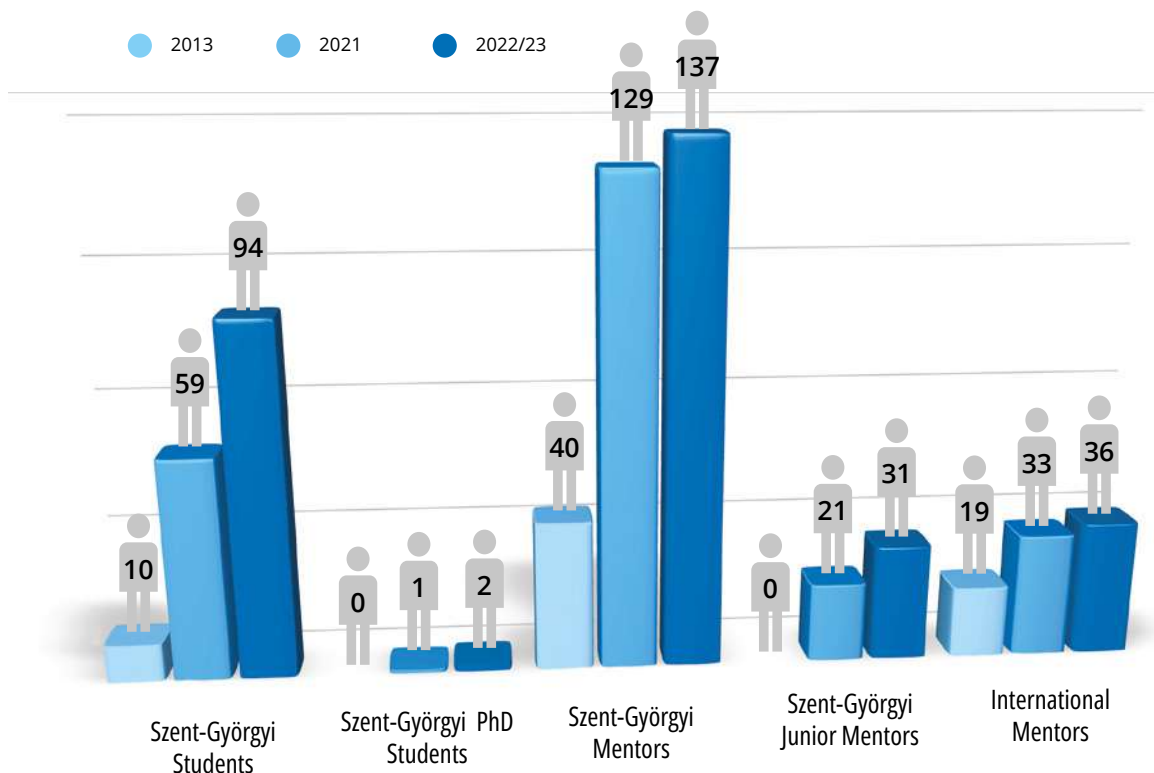


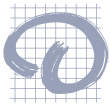
Szeged Scientists Academy was established in 2013. In the beginning, the university program was implemented exclusively in Szeged. Based on the results listed over the years, it came to the point in 2021 where the program expanded to **National Academy of Scientist Education program**, to include all cities in the country with institutes of higher education in human life sciences. Consequently, the number of the partner institutions also increased significantly during the transformation period.

Owing to the expansion of the University Education Program in 2021, parallel to geographical growth, the number of participants in the professional program also increased significantly. The management of the Academy is determined to ensure that this growth continues unabated in the future as well.



PARTICIPANTS





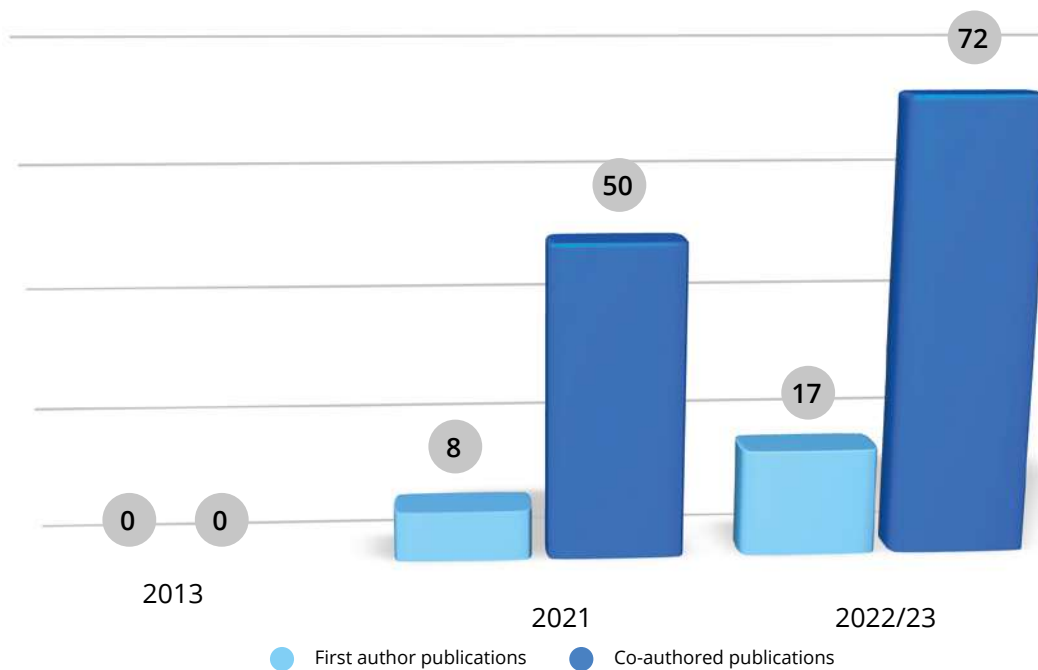
Szent-Györgyi Students performing research within the framework of the Academy need to meet the following publication requirements:

- by the end of the 30th month from the conclusion of the scholarship contract, a co-authored publication must be performed in a SciMago Q1 international journal within the field, and
- by the time they receive their university degree, Students must be the first authors of at least one SciMago Q1 original international publication in an additional field

In accordance with preliminary expectations, as the number of students increased, so did the number of publications. It is important to note, however, that Students entering the Research Institutions joining the Program in 2021, were admitted in a progressive system.



PUBLICATIONS OF THE SZENT-GYÖRGYI STUDENTS





**NATIONAL ACADEMY OF
SCIENTIST EDUCATION
YEARBOOK 2022/23**

The members of the National Biomedical Foundation's Board of Trustees



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Chairman of the Board of Trustees
Professor of the Department of Pharmacology and Pharmacotherapy at the Albert Szent-Györgyi Medical School of the University of Szeged



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BERT SAKMANN

Director general of education
Nobel Laureate cell physiologist,
Max Planck Institute für Neurobiologie,
Munich



ANDRÁS VARRÓ

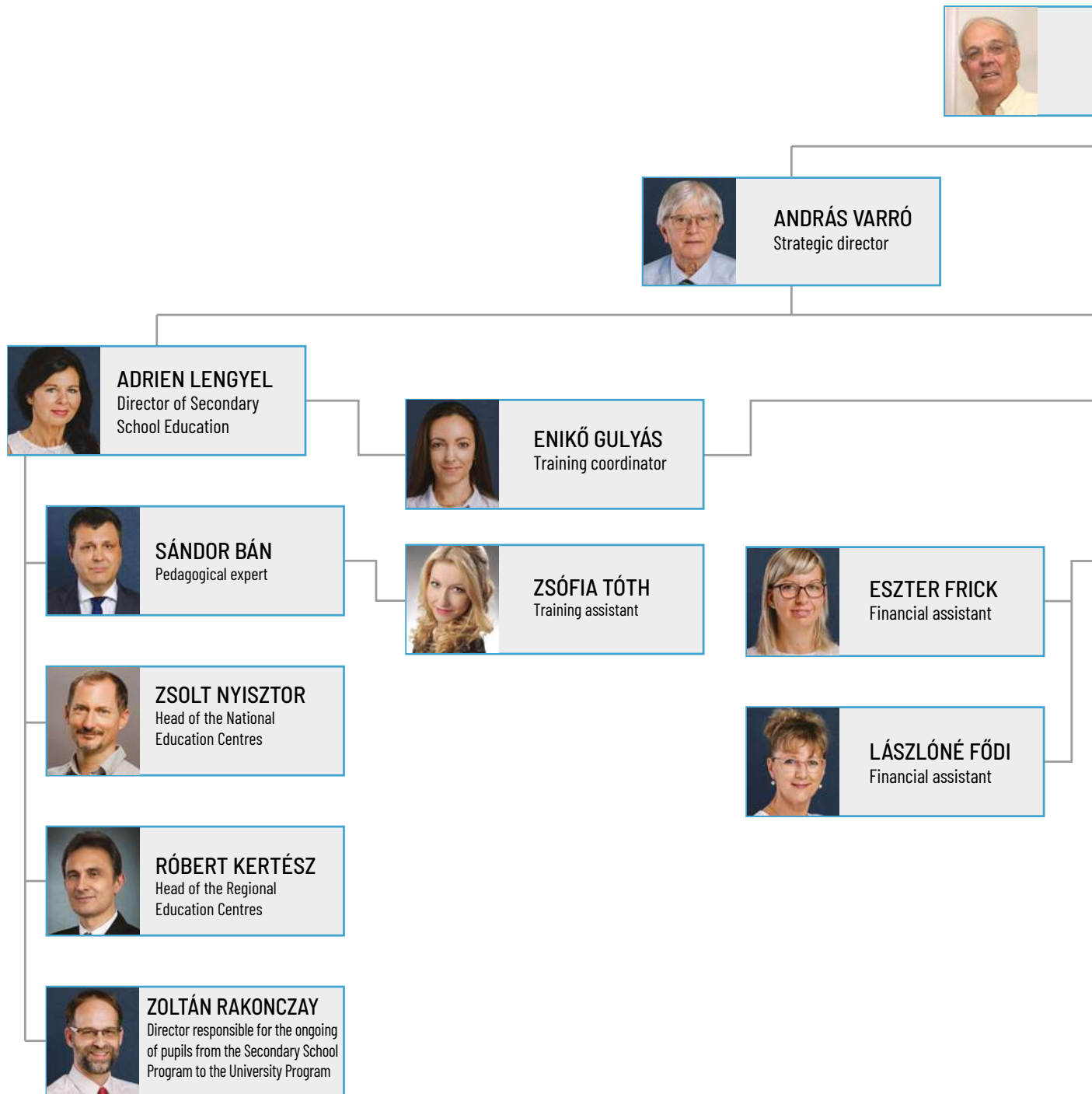
Strategic director
Professor of the Department of
Pharmacology and Pharmacotherapy at
the Albert Szent-György Medical School
of the University of Szeged

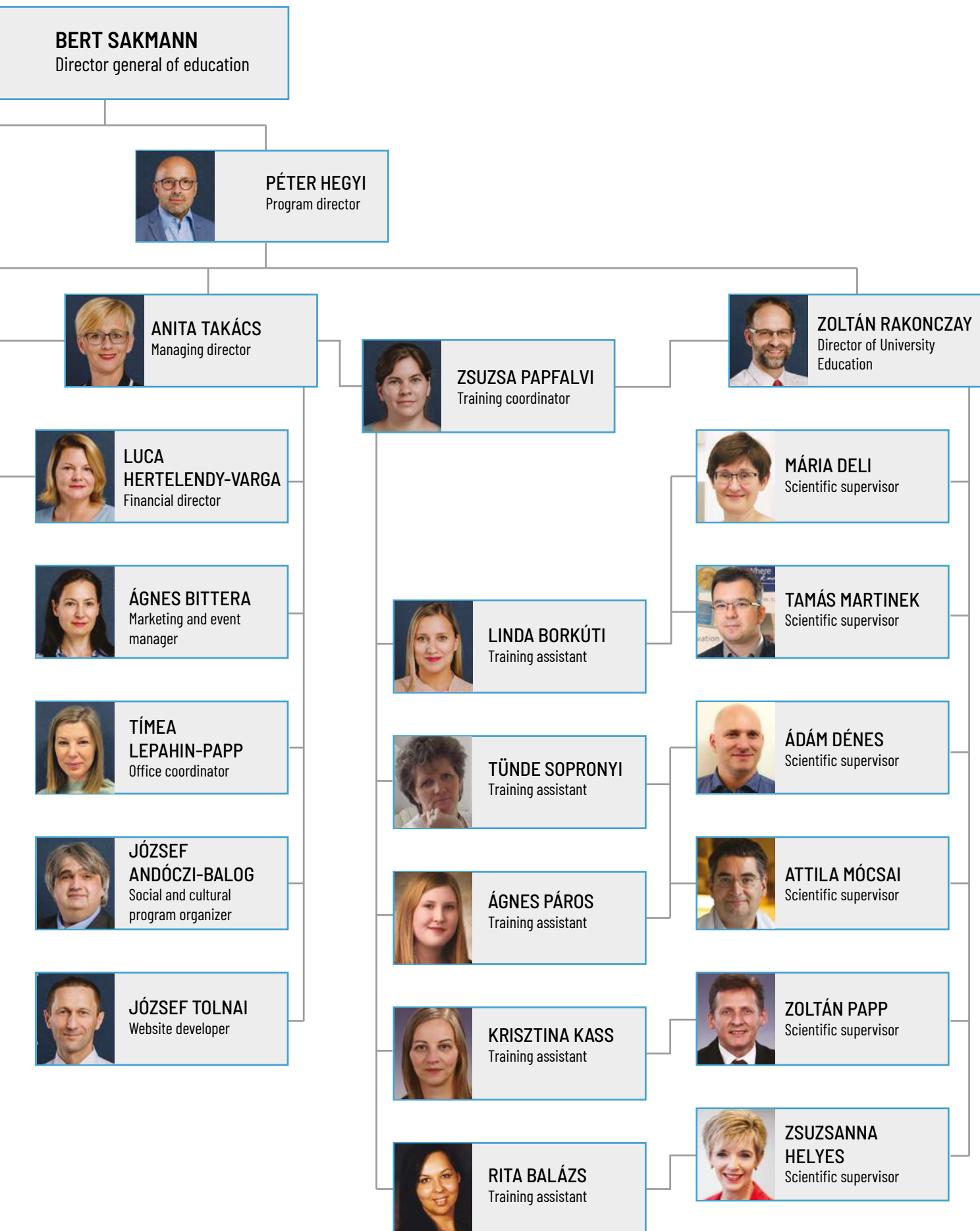


PÉTER HEGYI

Program director
developer of the National Academy of Scientist Education (NASE)
program. Professor at the Faculty of General Medicine of the
Semmelweis University and the University of Pécs, professor at the
Albert Szent-Györgyi Medical School of the University of Szeged

Professional and Operational implementers





SECONDARY SCHOOL EDUCATION PROGRAM



Leaders of the Secondary School Education Program



ADRIÉN LENGYEL

Director of Secondary School Education

Master teacher of biology and chemistry at the Calvinist Secondary School in Kecskemét



SÁNDOR BÁN

Pedagogical expert

Master teacher of biology at the Radnóti Miklós Experimental Grammar School Szeged



ZSOLT NYISZTOR

Head of the National Education Centres

Master teacher of biology and chemistry at the Nagy Lajos Grammar School for the Cistercian Order



RÓBERT KERTÉSZ

Head of the Regional Education Centres

Master teacher of biology and chemistry at the Táncsics Mihály Secondary Grammar School of Kaposvár



ZOLTÁN RAKONCZAY

Director responsible for the ongoing of pupils from the Secondary School Program to the University Program

Professor and head of the Institute of Pathophysiology at the Albert Szent-Györgyi Medical School of the University of Szeged



ENIKŐ GULYÁS

Training coordinator



ZSÓFIA TÓTH

Training assistant



**SZENT-GYÖRGYI
SENIOR TEACHERS**



ADRIÉN LENGYEL

DIRECTOR OF SECONDARY SCHOOL EDUCATION

Calvinist Grammar School of Kecskemét

TEACHING CAREER IN BRIEF

Being a student at the József Attila University of Szeged, I concluded my studies as a Biology and Chemistry teacher. My first employment was at the Katona Secondary School at Kecskemét, then I changed to the Calvinistic Secondary School where I'm working up to this day. Upon launching the six-grade education program, my task was to develop the Chemistry curriculum, later I became the head of the teacher's team. We are frequent participants of the TUDOK (Annual Conference of National Scientific Students' Associations) with remarkable success. The achieved results truly enhanced my personal development. Along with a colleague, I'm organizing the Biology field trips which are quite popular amongst our students. I'm also an evaluating teacher at the advanced level final examinations. Throughout the years my main focus has been to modernize Biology education; especially reaching out for students who show interest in this field - for this achievement I received an award. Other significant professional steps were publishing textbooks and books assisting the preparation for final examinations (MAXIM publishing). These activities demand great devotion, lots of reading, consulting and many working hours, yet offer the best way for self-improvement in the dynamically changing subject of Biology. In addition, I handled full leadership of a laboratory project and held advanced education to my colleagues. I find these activities both challenging and exciting. I have been working

for the foundation since 2015, so our grammar school also became a basic school. The program is very attractive for students of regional high schools, today the active number covers more than a hundred students who are happy to attend our lectures and take part in laboratory classes, only here in the Kecskemét district. My work is to help as many talented students as possible find a place in our excellent universities, to take an active part in research and academic life. (My several former pupils are currently Szent-Györgyi Students.)

PUBLICATIONS

Cselekedeteink tüköre - /A szegedi orvosbiológiai kutatások jövőjéért/ - cikk : **Lengyel Adrién** Print 2000 Nyomda 2020

Juhász K., **Vargáné L.A.** Theme Outlines for Biology Final Examination, Maxim Publishing, Szeged, 2017.

Juhász K., **Vargáné L.A.** 130 themes of Biology, Maxim Publishing, Szeged, 2017.

Juhász K., **Vargáné L.A.** Colourful thesmes of Biology, Maxim Publishing, Szeged, 2017.

Csigér, I., Juhász, K., **Vargáné Lengyel, A.** (2012). *Biológia 12* (Biology 12). Szeged: Maxim Könyvkiadó



SÁNDOR BÁN

PEDAGOGICAL EXPERT

Radnóti Miklós
Experimental Grammar School Szeged

TEACHING CAREER IN BRIEF

I started my career in 1993 at the Dugonics András Piarist Grammar School, Szeged, where I taught chemistry and biology, both as part of the regular curriculum and in advanced elective courses as well as special after-school lessons. In 1998–99, I played a leading role in designing and equipping the science section of the school's new building. I was also the head of the department of biology and chemistry for four years. Since 2002, I have taught in the special biology, chemistry and mathematics programs at the Radnóti Miklós Grammar School in Szeged, mostly in small groups. Between 2005 and 2012, I headed the biology department, which developed into the most successful high school biology workshop in the country during that period, based on advanced Matura examination and competition results. My colleagues and I have also established a state-of-the-art high school molecular biology laboratory. This facility has been made available to biology teachers from other schools for in-service trainings as well as to students for selection tests for international biology competitions. My colleagues and I have attended in-service trainings in molecular biology at the EMBL laboratories in Cambridge, Heidelberg and Monterotondo on a number of occasions. Since 2009, I have been the team leader of the Hungarian

national teams at the International Biology Olympiad (IBO) and mentor to our national teams at the European Union Science Olympiad (EUSO). In 2010, I won the Rátz Lifetime Achievement Award. I am currently head of the EU-funded high school science laboratory.

PUBLICATIONS

Bán S. (1998). Gondolkodás a bizonytalanról: a valószínűségi és korrelatív gondolkodás fejlődése. [Thinking about the uncertain: developing probabilistic and correlative thinking]. In Csapó B. (Ed.): *Az iskolai tudás*. Budapest: Osiris Kiadó.

Bán S. (2010). A tanulás természetes jellemzőinek érvényesülése az iskolai biológiaoktatásban [Implementing natural features of learning in biology instruction]. *Mester és Tanítvány* 28: 48-56.

Bán S et al. (Eds.). (2003). *From Vandal to Voter: Active Citizenship in Europe - Analysis and Methods*. Szeged-Paris: KIFE.



ZSOLT NYISZTOR

HEAD OF THE NATIONAL EDUCATION CENTRES

Nagy Lajos Grammar School of the Cistercian Order, Pécs

TEACHING CAREER IN BRIEF

I received my teaching degree in biology and chemistry at the University of Pécs. During my studies, I was engaged in an ecological study of barn owls, among other topics, as well as a molecular biology project involving the processing of samples collected in the field for taxonomic purposes. During this time, I also spent half a year in Italy as an ERASMUS student at the University of L'Aquila. In 2001, I began teaching at the Nagy Lajos Cistercian Grammar School in Pécs, where I have been a teacher ever since. I graduated from the Doctoral School of Biology and Sportbiology of University of Pécs in 2019. I studied the development of the mammalian retina. I would like to pass on to my students my enthusiasm for the sciences and the ability to wonder at the myriad beauty of the created world. I believe that Hungary should be represented among the scientific elite of the world through diligence and endurance. I consider it important for my students to leave high school not only strengthened in knowledge, but also in moral and spiritual values.

PUBLICATIONS

Nyisztor, Zs. (2015) Biológia munkafüzet 11-12. osztály [Biology workbook grades 11–12]. Pécs: Ciszterci Rend Nagy Lajos Gimnáziuma és Kollégiuma.

Nyisztor, Zs. (2015) Biológia szaktanári segédlet 11. osztály [Biology teacher's guide grade 11]. Pécs: Ciszterci Rend Nagy Lajos Gimnáziuma és Kollégiuma.

Nyisztor, Zs. (2015) Biológia szaktanári segédlet 12. osztály [Biology teacher's guide grade 12]. Pécs: Ciszterci Rend Nagy Lajos Gimnáziuma és Kollégiuma.

Nyisztor, Zs., Dénes, V., Kovács-Valasek, A., Hideg O., Berta G., Gábrriel R. (2018). Pituitary adenylate cyclase activating polypeptide (PACAP1-38) exerts both pro and anti-apoptotic effects on postnatal retinal development in rat. **Neuroscience** 385, 59-66.

Denes, V., Hideg, O., **Nyisztor, Zs.**, Lakk, M., Godri, Z., Berta, G., Geck, P., Gábrriel, R. (2019). The neuroprotective peptide, PACAP1-38 contributes to horizontal cell development in postnatal rat retina. **Investigative Ophthalmology and Visual Science**.



RÓBERT KERTÉSZ

HEAD OF THE REGIONAL EDUCATION CENTRES

Táncsics Mihály Secondary Grammar School of Kaposvár

TEACHING CAREER IN BRIEF

I earned my secondary school teaching degree in biology and chemistry at the József Attila University (University of Szeged) in 1993. I started working at the Department of Botany there and then moved to Kaposvár in 1997. Since then, I have been teaching biology and chemistry in the regular and specialized curricular programs at my alma mater there, Táncsics Mihály Grammar School. Since the Research area of the two-tier Matura examinations, I have participated in the work of the advanced Matura examination boards, I have corrected advanced written Matura examinations and was even requested to oversee examination marking. I passed two specialized examinations (at the University of Szeged and the Budapest University of Technology and Economics) and have incorporated the knowledge I have thus acquired into my everyday practice. In 2014, I received the rank of master teacher, so I am now also called on to provide consultations, through which I endeavour to improve the position of my scientific subjects, which are continually being pushed into the background. During my work in secondary school, I have always laid great stress on nurturing excellence – I have prepared my students for various competitions in both of my subjects. I consider it important to aid my students in strengthening their own innate interest and developing their own high professional standards.



JÓZSEF BARANYAI

ELTE Bolyai János Practice Primary and Secondary Grammar School, Szombathely

TEACHING CAREER IN BRIEF

I completed my biology degree at the József Attila University (University of Szeged) in 1994. During my university years, I was a demonstrator at the Department of Zoology, and I stayed on as an assistant lecturer after receiving my degree. I have much to thank the excellent staff at the department (Drs. Róbert Gábrriel, Éva Fekete and Katalin Halasi) for my professional development. They inspired me to become an outstanding student and assistant lecturer. Soon afterward, I was invited by János Iker to the newly established Bolyai Grammar School in Szombathely and have been teaching there since then for over 20 years. I am an advocate of problem-/inquiry-based learning, but also believe that there is not one single right method: one must always dynamically adjust to the problem at hand and tailor the methods accordingly. I have worked on a number of professional boards (Hungarian National Institute for Educational Research and Development (OKI/OFI) in curriculum development, dealing with the National Curriculum etc.). I am the head of our talent center, and I am proud of all the results of all my students. In 2011, I received the Rátz Lifetime Achievement Award, and in 2013 the Bonis Bona National Talent Award.

PUBLICATIONS

Baranyai J, Veres G. (2022). *Biológia kompetencia fejlesztő feladatgyűjtemény*

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Baranyai J, Szűcsné Kerti A. (2006). *Biológia középszintű érettségi feladatgyűjtemény 12.* [Intermediate biology Matura examination papers 12]. Budapest: Nemzeti Tankönyvkiadó.



ANDREA BORBOLA

Radnóti Miklós
Experimental Grammar School Szeged

TEACHING CAREER IN BRIEF

I've been an associate at the TERMOSZ Laboratory since 2014, I consider it as a prime element in my life. During my high school years I had the opportunity of assisting at the Cell Biology and Evolutional Micropaleontology Laboratory of the University of Szeged, which helped me start my scientific work. Throughout my university studies I was co-authoring several English publications, participated in an Indian-Hungarian joint research and for years I was the technical editor of the Plant Cell Biology and Development (Szeged) issue. In addition I also acquired some successful applications (Pro Renovanda Cultura Hungariae Fund – 'Students for Science' foundation).

My interests shifted towards molecular biology - starting from 2001, I carried out my PhD studies at the Genetic Institute of the Biological Research Center (Hungarian Academy of Sciences); later on I worked there as a science assistant. Next to learning the basic molecular biology techniques and elaborating new methods I also participated in several conferences. At the moment I'm teaching Biology at the Radnóti Miklós Experimental Grammar School and tending to the TERMOSZ Laboratory.

PUBLICATIONS

Kiss E, Olah B, Kalo P, Morales M, Heckmann AB, **Borbola A**, Lozsa A, Kontar K, Middleton P, Downie JA, Oldroyd GED, Endre G: (2009) Lin, a novel type of u-box/wd40 protein, controls early infection by rhizobia in legumes. **PLANT PHYSIOLOGY 151**: 1239-1249.

Borbola A: (2004) Construction of a linkage map for *Medicago truncatula* RIL population and its comparative analysis with other *Medicago* genetic maps. **ACTA BIOLOGICA SZEGEDIENSIS 48**: 51.

Kedves M, Párdutz Á and **Borbola A**: (1998) Transmission electron microscopy of X-ray irradiated teliospores of *Ustilago maydis*. **GRANA 37**: 29-34.



EDIT CSALÁNÉ BÖNGYIK

Németh László Secondary and Primary
School, Hódmezővásárhely

TEACHING CAREER IN BRIEF

I began teaching in the Commercial and hospitality secondary school of Hódmezővásárhely in 1998, parallel with my university studies and I have been working in the Németh László Grammar School since 2015. I have been teaching biology and chemistry and during my years in the vocational secondary school my students performed well at professional competitions. I have always felt fortunate to be a teacher, I am one of the few persons whose job is their hobby. I regularly attend professional trainings and always embrace varied pedagogical methods and educational forms. Recently, I have been committed to digital pedagogy. I was teaching complex nature for a long time, I also prepared a workbook for internal use with one of my colleagues. Thanks to this I became closer to the activities of the Öveges labs and also had the opportunity to participate in the elaboration of complex laboratory workbooks. I was also engaged for two years in a teacher training for renewing STEM thinking. I gladly contribute to project writing, I am proud of my two successful National Talent Projects. I held Visible Natural Science – Digital Teaching Practice course as a trainer of MDOE from 2018. In the spring of 2020, I was invited to develop professional recommendations in line with the new NAT. In December 2020, I won the Digital Educator Award in the Tempus competition. At

present, I am teaching students committed to natural sciences at each grade above 8th and also the ones who wish to perform the advanced level biology final exam.

PUBLICATIONS

- (2001) K. Hernádi, I. Pálkó, **E. Böngyik**, I. Kiricsi, Biomimetic oxygen transfer by Co and Cu complexes immobilized in porous matrices, **Studies in Surface Science and Catalysis** (<https://www.sciencedirect.com/science/article/abs/pii/S0167299101818607?fbclid=IwAR0Bjxq2VFVhqnFrsiEJZDJS3VEmpI6j-lbyL5IuL2zC7RhBZwtu6ooSo8>)
- (2016) Mobileszközök az oktatásban konferencia, Okostelefonokkal a természettudományos oktatásban, Debreceni Egyetemi Kiadó, Veszprém 2016



ISTVÁN CSIGÉR

University of Szeged Teacher Training
Secondary and Primary School, Szeged

TEACHING CAREER IN BRIEF

I earned my degree at the József Attila University (University of Szeged) in 1985, which qualified me to teach biology and chemistry in secondary school. Right after I completed my studies, I started my career at the Vocational School for Forestry and Water Resources Engineering and Management in Barcs, where I spent six years. I taught biology and chemistry to students in the forestry stream and chemistry and lab practice to students in the water resources engineering and management stream. In acknowledgement of my work, I received a Ministerial Commendation in 1989. In 1991, I came to my current workplace, the University of Szeged Grammar School and Primary School (previously the University of Szeged Ságvári Endre Grammar School) as a mentor teacher in biology. My basic job has been to teach biology and to train university students studying to become biology teachers (supervising student teaching and administering examinations to student teachers). I also work as the lead teacher for biology in the Szeged Regional Student Science Laboratory, established by our high school and by the University of Szeged, which supports it financially. Within the limits of reason, I endeavour to develop relationships with my high school and university students based on collegiality and respect, never compromising on quality work standards or the requirements of consistent and rigorous assessment. In acknowledgement of my teaching activities, I received

the Golden Rostrum Commemorative Plaque in 2001. I first became involved in the Szeged Scientists Academy in 2012, which honored me with the title of Szent-Györgyi Teacher and then in 2016 with that of Szent-Györgyi Senior Teacher. I have endeavoured to aid the academy from the beginning to discover and cultivate young talent.

PUBLICATIONS

- Csigér I**, Juhász K, Vargáné Lengyel A. (2011). *Biológia 11* [Biology 11]. Szeged: Maxim Könyvkiadó.
- Csigér I**, Juhász K, Vargáné Lengyel A. (2012). *Biológia 12* [Biology 12]. Szeged: Maxim Könyvkiadó.
- Csigér I**, Németh E. (2005). Néhány szakmai észrevétel Lénárd Gábor *Biológia II. és Biológia III. Tankönyvéről* [Some observations on Gábor Lénárd's Biology II and Biology III coursebooks]. *A biológia tanítása* 2. szám: 7-19



ESZTER DÉNES

Nagy Lajos Grammar School of the Cistercian Order, Pécs

TEACHING CAREER IN BRIEF

In 2002, I started teaching at the first agricultural secondary school in Szentlőrinc, Hungary, in parallel with my university studies. In 2005, I graduated as a biology and environmental science teacher at the University of Pécs. During the first ten years of my teaching career, I focused on the development of pupils and talent management in parallel. Both are a source of getting my students to love biology and develop a scientific approach. I am constantly motivated by the success of my students, which encourages them to continue learning in science and methodology.

I wrote my teacher's exam in 2012, based on the intermediate level written exam and the measurement of everyday science knowledge. I wrote my teacher's exam in 2012, based on the biology intermediate written exam and the measurement of everyday science knowledge.

Between 2005 and 2016, I coordinated the Road to Science project, which created a unique science laboratory in vocational education and training, which provided the basis for professional training. I have been 'Pro Talento' awarded for my work in talent management.

Since 2006, I have been continuously involved in administering the advanced Matura examination. In 2019, I joined to the Nagy Lajos Grammar School of the Cistercian

Order, where I was introduced to a whole new segment of talent management. The professional cooperation within the school and the direct knowledge of the goals of the National Academy of Science and Humanities have given my talent management work a different aspect. I consider it important to help my students achieve their goals, for which continuous professional development and network-based learning are essential.



JULIANNA ERŐS-HONTI

Fazekas Mihály Primary and Secondary Grammar School, Budapest

TEACHING CAREER IN BRIEF

I completed my studies as a research biologist at Eötvös Loránd University, Budapest, with a concentration in evolutionary biology, systematics and ecology. Later, at the same institution, I studied in the Theoretical Ecology Program within the Doctoral School for Biology. In the meanwhile, I also earned a teaching degree. I conducted my research in the field of plant ecology, examining the distribution of grass species in the Dolomites. In my research work, I gained experience in planning research. I can thus assist students in carrying out independent research and writing articles. I taught biology at Fazekas Mihály Primary and Grammar School for 8 years. Here I gained experiences in nurturing excellence, preparing students for competitions, as well as in giving demonstrative lessons. Actually, I work in the ELTE Trefort Ágoston Grammar School, where I also mentor candidate teachers in addition to the above mentioned tasks. A great emphasis is placed on academic competitions at our school, for which we continuously prepare our students. I consider my most significant tasks to be the special after-school lessons for nurturing excellence and the summer biology camps that I organise, in which our students can become acquainted with the mentality of the researcher and the diversity of the academic field. In addition to teaching, I have worked as an educational developer for the Hungarian National

Institute for Educational Research and Development (OFI), and I also contribute to the work of the Matura examination, as assigned by the Office of Education.

PUBLICATIONS

Mihók B, Erős-Honti Zs, Gálhidy L, Bela Gy, Illyés E, Tinya F, **Erős-Honti J**, Molnár Á, Szabó R. (2006). A Borsodi-ártér természeti állapota a helyben élők és az ökológusok szemével - interdiszciplináris kutatás a hagyományos ökológiai tudásról [The natural state of the Borsod flood plain through the eyes of locals and ecologists: interdisciplinary research on traditional ecological knowledge]. TERM. VÉD. KÖZL. 12: 79-103.

Dobolyi K, **Erős-Honti J**, Botta-Dukát Z. (2008). Habitat preference of *Linum dolomiticum* (Linaceae) STUDIA. BOT. HUNG. 39: 135-144.

Dobolyi K, **Erős-Honti J**, Rédei T. (2010). Az Odvas-hegy flórája és vegetációja [The flora and vegetation of the Odvas Mountain]. In Molnár Cs, Molnár Zs, Varga A. (Eds.): „Hol az a táj szab az életnek teret, Mit az Isten csak jókedvében terem.” Válogatás az első tizenhárom MÉTA-túrafüzetből MTA-ÖBKI, Vácrátót, 2003-2009. pp. 191-199.



ZSOLT ERŐS-HONTI

Fazekas Mihály Primary and Secondary Grammar School, Budapest

TEACHING CAREER IN BRIEF

I am a research biologist with a PhD as well as having been trained as a specialized translator and secondary school biology teacher. For several years I had been working as an active researcher at the Faculty of Horticultural Science, Szent István University. Ever since I received my teaching degree, I have been teaching biology to secondary school students (both in Hungarian and English). I participate in the nurturing excellence program at the school, preparing students for both domestic and international competitions, including the International Biology Olympiad. I also organise camps and prepare students for the Matura examination. I have developed teaching materials for public education, edited and published educational methodology coursebooks, and provided professional editing for materials used in public education. I participated in a Social Renewal Operational Program (TÁMOP) project dealing with the implementation of the framework curriculum in the Hungarian National Institute for Educational Research and Development (OFI), and I was also a member of a working group that harmonised the requirements of the Matura examinations with those of the framework curriculum. Since 2012, I have regularly completed assignments for the Office of Education. Currently, I am working as a biology teacher and vice principal at the Fazekas Mihály Primary and Grammar School of Budapest. As someone previously involved in higher education,

it is my conviction that development and nurturing excellence should not be a process tied to particular educational phases. It should be an overarching effort. I am also convinced that success in the education system depends on effective communication between public and higher education.

PUBLICATIONS

Erős-Honti Zs. (2011). A kertészeti növények alakтана [Morphology of horticultural plants]. Egyetemi jegyzet. Budapest: BCE-KeTK.

Erős-Honti Zs. (2015). Az info-kommunikációs technológiák (IKT) alkalmazásának lehetőségei a kertészeti oktatás szakmódszertanában [Options for using Information and Communications Technology (ICT) in teaching horticulture]. In Szakmódszertani jegyzet az agrár-mérnöktanárok és -hallgatók számára (mezőgazdasági gépészet, mezőgazdaság, kertészet és parképítés) (Erős-Honti Zs, Nagy J). Budapest: BCE.

Jakucs E, **Erős-Honti Z**, Seress D, Kovács G M. (2015). Enhancing our understanding of anatomical diversity in *Tomentella ectomycorrhizas*: characterization of six new morphotypes. MYCORRHIZA 25(6): 419-429



NORBERT FARAGÓ

ELTE Trefort Ágoston Secondary Grammar School, Budapest

TEACHING CAREER IN BRIEF

I began my teaching career at the Terézváros Bilingual Primary and Grammar School in Budapest in 2001. I also taught biology and chemistry at a private grammar school concurrently. Since 2005, I have taught at the Trefort Ágoston School in Budapest, mostly biology. I have been a mentor teacher since 2006. In 2010, I received a certificate in mentoring candidate teachers. At school, I teach seventh- to twelfth-grade students as well as preparing the eleventh- and twelfth-grade students in advanced elective courses. Our students have achieved strong results at the Herman and Kitaibel competitions as well as at the National Secondary School Competition (OKTV) and the Árokzállás biology and environmental protection competition. I regularly prepare students in groups for the advanced Matura examination. Since 2013, I have been head of the school's TÁMOP-funded science laboratory.

PUBLICATIONS

Faragó N., Szászné H J. (2013). Biológia lépésről lépésre [Biology step by step]. Budapest: Bölcelet Egyesület.

Czédulás K, **Faragó N**, Solymoss M, Szászné H J. (2013). Még egy lépés a biológia érettségéhez [One more step toward the biology Matura examination]. Budapest: Bölcelet Egyesület.



ANDREA FAZAKAS

Deák Téri Lutheran Gymnasium, Budapest

TEACHING CAREER IN BRIEF

I graduated with a secondary school teaching degree in biology and chemistry at József Attila University (University of Szeged) in 1988. I began teaching at the Deák Tér Lutheran Grammar School in Budapest in 1993. I quickly learned the importance of an encouraging school atmosphere in nurturing talented students. I developed Matura examinations for the Hungarian National Institute for Educational Research and Development (OFI) between 2003 and 2006. In 2004, I attended a Training for Trainers program to implement the two-tier Matura examination, and in 2004–05, I held talks on this new system for my colleagues. I have also participated in administering the advanced Matura examination since 2005. Meanwhile, in 2005, I passed a qualifying examination to become a mentor teacher at the Faculty of Sciences, Eötvös Loránd University, Budapest. I have always been happy to mentor future teachers. I have seen five of my candidates complete their teacher training. I received the BONIS BONA for the Nation's Talent Award in 2013 in acknowledgement of my efforts in preparing students for the National Secondary School Competition (OKTV). In 2015, I applied for the master teacher rank and received it the following year. I consider it important during my work to instil a passion for biology in my students and introduce them to the logic of the natural sciences. Various extracurricular events offer excellent opportunities in that regard. During the

academic year, we usually take hiking trips, mainly in the Danube–Ipoly National Park (DINP). In addition, we also visit laboratories and attend lectures organised for students by the Hungarian Academy of Sciences. During the summer holidays, I take my students to one-week ecocamps. We have already visited the Kis-Balaton, Szatmár, Őrség and Lake Velence regions in and around Hungary as well as the North Hungarian Mountains.

PUBLICATIONS

Kisfaludy A, Dombóvári L, **Fazakas A**, Lóczy D. (2008). Természet-tudományi Enciklopédia [Encyclopaedia of science]. Budapest: Nemzeti Tankönyvkiadó.



JÓZSEF GŐZ

Tóth Árpád Secondary School, Debrecen

TEACHING CAREER IN BRIEF

I have been teaching biology and chemistry at the Tóth Árpád Grammar School in Debrecen since 2000. During my career, I have earned a qualification in specialized Hungarian–English translation as well as passing a mentor teaching examination and receiving the title of master teacher. At my job, in addition to teaching in the specialized biology program, I also joined the Arany János Nurturing Excellence Program, the International Baccalaureate Program and the Öveges Scientific Laboratory Program, as well as being involved in grant projects and in mentoring candidate teachers. In our school we are engaged in a specialized high school program for Biology and Chemistry that enjoys the longest history in the country. An integral part of this is nurturing excellence, developing projects, and preparing students for competitions and the Matura examinations. As a Matura examiner, I operate an online database which aids in the students' preparations for the examination with items on the written part presented in a system. My main area of interest and research is the methodology of teaching biology and, within that, digital innovation. In my work, I do my best to combine the facilities of ICT and the international environment with the traditional values embodied by my workplace and the domestic professional community. In 2018, I was awarded the Szent-

Györgyi Trophy by the University of Szeged, and the MESTER-M award by the MOL Foundation. As a translator I participate in the Hungarian adaptation of science education materials of Khan Academy since 2021.

PUBLICATIONS

Dobroné Tóth M, Futóné Monori E, **Gőz J**, Revákné Markóczi I. (2015). Biológiatechnológia az IKT és IBL világában [Biology teaching in a world of ICT and IBL]. Debrecen: Debreceni Egyetemi Kiadó

Gőz J. (2021): A Khan Academy egy középiskolai tanár szemével. **Magyar Kémikusok Lapja 76(11):** 343-344.



ZSOLT HORVÁTH

Gödöllő Reformed Secondary School

TEACHING CAREER IN BRIEF

I received my teaching degree in biology and chemistry from the Kossuth Lajos University (University of Debrecen) in 1995 and have been working since then at the Reformed Church Grammar School in Gödöllő. During the first years of my career, I learned about the BISEL biological water quality assessment method, and in 2000 I participated in the Bioindication and Internet 2000 EU Leonardo in-service training for teachers in Belgium. Then in summer 2002, I organised the BISEL bioindication water quality assessment method 2 accredited in-service training. Between 2006 and 2008, I was asked to update high school biology coursebooks written by Gábor Lénárd and published by Nemzeti Tankönyvkiadó publishers. My tasks included editing (the Prizma series written by Mrs József Berger), preparing digital teaching materials (a CD-ROM with images, figures and experiments for the Lénárd biology coursebook series) and holding lectures (at the start-of-the-year Nemzeti Tankönyvkiadó conference). I have participated in designing biology competition items since 2008. Between 2011 and 2012, I edited digital teaching materials for chemistry and biology called Yenka and Sunflower, and I prepared a series of histological images for Mozaik Publishers. In 2015, I edited digital teaching materials entitled "The molecular cell biology of autolysis, apoptosis and cell regeneration", created by the Department of Anatomical, Cell and



MARIANNA JENEINÉ FEKETE

Varga Katalin Grammar School, Szolnok

TEACHING CAREER IN BRIEF

I obtained my first degree in biology at the Károly Eszterházy Teacher Training College in Eger in 1992, and then I graduated from the University of Debrecen in 2012 as a certified biology teacher (MSc). In the meantime, thanks to the University of Debrecen, I became a Master of Arts (MA) in English in 2010. Later, in 2018, I became a qualified teacher with a specialization in mentoring. I taught in several types of schools until 2008, when I became a teacher at the Katalin Varga Secondary School in Szolnok, where I teach English and biology in Hungarian and English at intermediate and advanced levels. I participate in graduation committees of middle- and advanced-level exams, both as a member and as chairman, for biology exams in English and Hungarian. As a master teacher, I have been working as a qualifier and supervisor since January 2022. From 2009 to 2019, I was one of the implementers of the student exchange program of BIO CAMP, which was organized twice a year in Szolnok and Brussels. We worked together with the teachers of European School in Brussels. Within the framework of the program, my colleagues and I developed an English-language students' task set for internal use, which was adapted to the theme of the given year: e.g. light, water. I became the deputy head of the laboratory set up thanks to the Öveges program in 2014, where, alongside our students, we hosted

Developmental Biology, Eötvös Loránd University, and took part in a training for trainers on the advanced Matura examination in biology. As of 2016, my school (along with three other Hungarian high schools) has participated in a health protection program based on the TANTUDSZT contemporary teaching project, which won a teaching methodology competition announced by the Hungarian Academy of Sciences. In 2016, I had three articles published in the Eduvital column of Élet és Tudomány (Life and Science), a popular science weekly.

PUBLICATIONS

Horváth Zs. (2008). Képek, ábrák és kísérletgyűjtemény a Lénárd-féle biológia-tankönyvcsaládhoz [Images, figures and experiments for the Lénárd biology coursebook series]. Budapest: Nemzeti Tankönyvkiadó Zrt.

Horváth Zs. (2016). Fehérjebontás a sejtekben [Proteolysis in cells]. ÉLET ÉS TUDOMÁNY 71: 140-142.

Papp T, Szekeres Zs, Huoranszki Cs, **Horváth Zs.** (2016). Mindennapi kenyereünk 1-2 [Our daily bread 1-2]. ÉLET ÉS TUDOMÁNY 71: 468-470.

Horváth Zs. Biology assignments for those preparing for advanced level graduation and OKTV Mozaik Publisher, Szeged, 2019

Horváth Zs. Test maturity task sets 10 task sets with solutions and explanations Mozaik Publisher, Szeged, 2020

practical classes in the four science subjects in a total of 12 primary schools. I became responsible for setting up the biology department in the program. In addition to organizing the in-service training of primary school teachers, my task was to introduce them to the operation of the laboratory's ICT tools and e-lab diary. From 2016, I have been regularly visiting the programs of the Szeged and National Academy of Science with my students. I became a Szent-Györgyi Teacher because I could see that lab practise, lectures in English, and especially meetings with Nobel Prize-winning scientists bring scientific research closer to my students, bring the book-like curriculum to life, and strengthen their commitment to science. As a teacher, the most important thing for me is to help students find and achieve their goals.

PUBLICATIONS

Jeneiné Fekete M: Biology Workbook 12th grade (intermediate level), Szolnok, 2014.

Jeneiné Fekete M: Teacher's Guide 12th grade (biology intermediate level), Szolnok, 2014.

Jeneiné Fekete M: Biology Workbook 11-12. grade (advanced level), Szolnok, 2014.

Jeneiné Fekete M: Teacher's Guide 11-12. grade (biology advanced level), Szolnok, 2014.



ÉVA JÓZSEF

Bolyai Farkas Highschool, Targu Mures

TEACHING CAREER IN BRIEF

I graduated from the University of Bucharest with a biology degree in 1995. I am grateful to the university because during that time, outstanding professionals guided my scientific development, I received a remarkable training in molecular biology and genetics and they provided an insight into science that defined my further development. Thanks to this I have become always open to new things and, having received a strong foundation, I have always been able to keep up with the advancement of science, knowing that my knowledge is at a certain stage and that will always be new things that need to be understood and passed on.

I began to take study trips abroad in 2003. That year I received continuative education at EMBL (European Molecular Biology Laboratory). That same year I participated in teaching workshops in Heidelberg and Jerusalem, where I got a glimpse of the current questions science was asking and the research conducted. Consequently, I went to continue this kind of work in Heidelberg in 2005 and 2007. In 2010 I gained insight into the work of EMBL and EBI (European Bioinformatics Institute) in Hinxton, where I studied bioinformatics. In 2014 I took my first steps in structural biology in Grenoble. Also in 2014 I obtained a master's degree in medicinal biotechnology at the University of Medicine and Pharmacy of Targu Mures. In 2020 and 2021, I also learned about the microbiome and CRISPR/cas9 technology online in the courses organized by EMBL.

These study trips have had a huge impact on my life's work. On one of my first trips I learned that these further trainings serve the purpose of preparing high school teaching how to effectively handle the rapid development of science. There are so many novelties in the various areas of science that if high school teachers cannot explain them adequately to their students, society is going to fall behind on everything that happens on the level of scientific life. This is why I aim to be a bridge between my students and the current scientific level so that my students won't have to feel left out and behind and so they understand that science isn't stagnant and they need to acquire enough knowledge so they can keep up with the pace of development.

PUBLICATIONS

Bioinformatics in public education, Teaching natural science in an up-to-date and engaging way, Lecture notes, Eötvös Lóránd University Center for Science Methodology, 2011

The theory and implementation of evolution in public education, Let's Research Together! Presentations of the conference organized by the Csíkszereda Faculty of the Sapientia Transylvanian Hungarian University, Cluj University Publishing House, 2019

To raise to life. History of the Department of Biology, 65 Years in Bolyai Highschool, Lector Publishing House, Targu Mures, 2021



ZOLTÁN JÁNOS KERÉNYI

Premonstratensian School Center, Gödöllő

TEACHING CAREER IN BRIEF

I graduated from József Attila University (University of Szeged) as both a biology teacher and a biologist with specialization in ecology. I started my teaching career in Dugonics András Piarist Grammar School in Szeged as an external teacher, then in 1998 I joined Premonstratensian St. Norbert Grammar School in Gödöllő. I was teaching in the regular curriculum for years, and I taught biology as an extracurricular activity to students applying to university and to enthusiasts as well. We launched a specialized program in biology and chemistry in 2014-15, and I played an active role in developing its content and structure as the lead of the working group. Since our school boasts a great many outstanding students, my teaching activity has become focused on working with young people with particular talent. In order to carry out this work with a truly professional manner, I attended a course at the University of Debrecen to become a talent development teacher (pedagogical professional examination), and completed 'Génius' in-service training as well ('Nurturing excellence among talented biology students'). One regular, preferred form of working with talented young people is the 'Path to Science' program where research teams of five students are formed to learn and improve their thinking through joint research activities on a particular subject. At the end of these projects the research teams present their results in a scientific presentation each year at 'TUDOK' regional

and national conferences. For my work in nurturing excellence, I have received Kontra György Award (2010), Bonis Bona Award (2013), Ministerial Certificate of Recognition (2016) and Pro Progressio Award (2018) so far.

PUBLICATIONS

Kerényi Z. (2004). Pilisjászfalu madárvilága [The bird world of Pilisjászfalu]. In Pilisjászfalu I. Pilisjászfalu: Pilisjászfaluért Közalapítvány.

Kerényi Z. (2011). A Gödöllői-dombság állatvilága [The animal world of the Gödöllő Hills]. In Szabó L. (Ed.): A Gödöllői-dombság természeti- és gazdaságföldrajzi viszonyai. Budapest: Agroinform Kiadó.

Kerényi Z, Ivók E. (2013). Nestsite characteristics of the European Bee-eater (*Merops apiaster* L.) in the Gödöllő Hills. *ORNIS HUNGARICA* 21(2): 23-32.



BEATRIX CSILLA BAGI KERTÉSZ

Táncsics Mihály Secondary Grammar
School of Kaposvár

schools at a high standard, an effort I strive to support as a consultant with a master teacher qualification. Finally, I think one needs sufficient professional humility and endurance to be successful in one's work, not only talent.

TEACHING CAREER IN BRIEF

I earned my teaching degree in biology and chemistry at the József Attila University (University of Szeged) in 1993. I rounded out my degree with a postgraduate qualification in environmental protection in 1995. I taught at the Corvin Mátyás Vocational School in Hódmezővásárhely for four years, and I have been teaching in my current workplace at the Táncsics Mihály Grammar School in Kaposvár since 2001. Throughout my career, I have placed a major emphasis on nurturing excellence in my professional work. My students have achieved success at various competitions in chemistry, biology and environmental protection, many of them having gone on to study medicine, pharmacy, biology and chemistry. I teach advanced elective courses in both my subject areas, and I was the form teacher for three of the groups in the school specializing in biology and chemistry as well as their teacher in those subjects. I have aided my students with a great deal of useful experience by regularly participating in the advanced Matura examinations in both of my subjects. I have always considered it important to learn about and apply an objective measurement of knowledge. I therefore did a specialized examination in teaching with a specialization in educational assessment at the University of Pécs in 2011. I feel responsible for the future of my academic subjects. My aim is for us to engage in a truly appealing science education in our



ILDIKÓ KISS

Teleki Blanka High School and Primary
School, Székesfehérvár

species and the characteristics of plant communities, and carry out botanical, zoological, anthropological, cell biological and environmental experiments and measurements.

In addition to the above, I also help with the work of the Scientific Students' Association (TDK), which is a highly active scientific research group at our school. I am also involved in the preparation for the school-leaving exams every year as an examiner and a teacher marking and grading exam scripts. After their graduation, several of my students have become successful doctors, pharmacists and biologists. Moreover, from autumn 2022 as a Szent-Györgyi Senior Teacher, I also have the opportunity to guide and support students who are talented and interested. It is a great pleasure for me to shape the future through consistent engagement with bright, young minds

TEACHING CAREER IN BRIEF

I graduated from the József Attila University of Szeged as a Secondary Education Biology and Chemistry major. Since 1994, I have been working at the Teleki Blanka Secondary School in Székesfehérvár where I teach both subjects in ordinary level classes and in groups preparing for the advanced level school-leaving examination. Since 2015, I have held the certificate of Master Teacher, and since 2018 I have been contributing to the operation of the institution as the head of the Biology-Chemistry department. In recent years, I have been involved in applying for and implementing several tenders, which have helped us to successfully upgrade the equipment needed for the practice-based approach of teaching Biology, Chemistry and Physics in our school.

I attach great importance to the use of methods that require the active participation of pupils and provide them with hands-on experience, both during lessons and, in extra-academic activities falling outside the realm of the normal school curriculum. Accordingly, I am an active outdoor educator and facilitator of field trips and summer nature camps organised by our school in natural environments. Learning in out-of-school settings draws the participants' attention to relevant aspects of the natural and social environment: during these events, pupils can learn about plant



LÁSZLÓ KUTROVÁCZ

ELTE Trefort Ágoston Secondary
Grammar School, Budapest

TEACHING CAREER IN BRIEF

I started my teaching career in autumn 2002 at the Eötvös Loránd University Trefort Ágoston School in Budapest, where I have worked ever since. I have trained candidate teachers as a mentor teacher in chemistry there for nine years, and I have been department head since 2011. As a form teacher, I will see my second group of students complete their Matura examinations. In 2010, I received the Trefort Ágoston Certificate of Recognition from the Eötvös Loránd University Senate. In the same year, I was certified as a mentor teacher with a specialization in nurturing excellence. My goal is to shed light on the beauty and importance of scientific connections and their close ties to our everyday lives. I lay a great deal of emphasis on mentoring talented students in special after-school lessons. Two of my students have reached the National Secondary School Competition (OKTV) finals in biology and two have done so in chemistry. One of my students became a member of the national team for the International Mendeleev Chemistry Olympiad. In 2018 I received the Lórrántfy Zsuzsanna Award from the ELTE Senate, and in 2019 I received the Bonis Bona Award from the Ministry of Human Resources.



ANNA NAGY

Calvinist Grammar School of Kecskemét

TEACHING CAREER IN BRIEF

I graduated from Eötvös Loránd University with a degree in Biology-Science and Environment. During my university internship I went back to my former secondary school, the Calvinist Secondary School in Kecskemét, where I have been working ever since. I teach biology in each grades from 7-12 at the intermediate and advanced levels, and from this year onwards I also teach science. Through the teaching of biology I wish to discover with my students how exciting and wonderful the living world around us is. My colleagues and I regularly organise field trips, which are always very enjoyable. I believe it is important to transfer knowledge and values when working with students.



TÜNDE SZALAINÉ TÓTH

Lovassy László Grammar School, Veszprém

TEACHING CAREER IN BRIEF

I have been an educator since 1982 and continue to derive great joy from my work to the present day. In addition to my daily teaching responsibilities, I have endeavoured to use and pass on my knowledge and experience at the school, municipal, county and national levels. I consider it a priority to nurture excellence: so far, 45 of my students have reached the final round of Hungary's highly respected National Secondary School Competition (OKTV) in biology, two of them won first place, two of them won second place, and 13 of them finished in the top ten. My students have achieved great success in numerous other prominent competitions for young scholars. As an acknowledgement of my work in nurturing excellence, I received the Rátz Life Achievement Award in 2014, the „Excellent Competition Preparator” title in 2017 and the MOL-Mester-M Award in 2018, as well as a Ministerial Certificate of Recognition. I have also been awarded the Ranolder Prize from the City of Veszprém and the Pro Talento Prize from the Veszprém County Institute of Education. I take part in organising county and national competitions as well as school events. I am a master teacher, consultant, board chair for the Matura examination and multiplier as well as participating in bringing grant projects to fruition. I was a form teacher for 19 years. I enjoy professional challenges, and I have worked as an educational developer in several projects for the Hungarian National Institute for

Educational Research and Development (OFI). I have often published in *Élet és Tudomány* (Life and Science), a popular science weekly, in which studies by my students are also occasionally published. Since 2014, I have participated in the work of the National Teachers Chamber (NPK) as a national delegate, and I have been the national chair of the Man and Nature section of the Chamber since 2015.

PUBLICATIONS

Feith H, Melicher D, Máthé G, Gradwohl E, Füzi R, Darvay S, Hajdú Zs, Nagyné Horváth E, Soósné Kiss Zs, Bihariné Krekó I, Földvári-Nagy Lászlóné, Molnár E, **Szalainé Tóth T**, Urbán V, Kassay A, Falus A. (2016). Tapasztaltok és motiváltság: magyar középiskolások véleménye az egészségnevelő programokról [Experience and motivation: Hungarian high school students' views on health education programs]. *ORVOSI HETILAP* 2: 65-69.

Szalainé Tóth T. (2015). Megváltoztatható-e, ami génjeinkben meg van írva? [Can we change what is written in our genes?] *ÉLET ÉS TUDOMÁNY* 48: 1526-1528.

Szalainé Tóth T, Szűcsné Kerti A. (2017). Érettségi mintafeladatsorok biológiából (10 írásbeli emelt szintű feladatsor) [Sample Matura examinations in biology (10 advanced written examination papers)]. Szeged: Maxim Kiadó.



CSILLA SZENTESI

Földes Ferenc High School, Miskolc

TEACHING CAREER IN BRIEF

I completed my studies in biology and geography at the Kossuth Lajos University (University of Debrecen) in 1998. To this day, I have taught in my former high school, Földes Ferenc Grammar School in Miskolc. In 1998, I also completed a teaching degree in the field of environmental protection at the Eszterházy Károly College in Eger. In 2005, I passed an examination in public school management and teaching. In 1996, I joined the County Institute of Education, and I was appointed a municipal consultant in biology and environmental protection between 1998 and 2011. Since 2005, I have been a board chair for the advanced Matura examination in my subject areas and am also engaged in coordinating the corrections for the advanced written Matura examination. During my career, I have organised lectures and held practical in-service training for my colleagues in the county. I have participated in testing digital teaching materials, preparing task sheets and editing geography coursebooks as well as serving as a mentor teacher for a number of student teachers from the University of Debrecen.

As of 2015, I have also worked as a master teacher and an educational inspection and teacher certification expert. In 1997, my colleagues and I launched the Árokszállásy Biology and Environmental Protection Competition, of which I am the main organiser. My school has had a great natural sciences tradition. My work in

preparing my students for the advanced Matura examination and in my capacity as a form teacher is a top priority for me. I prepare my students continuously, hold special after-school lessons, and organise fieldwork and lectures. I have received a number of certificates at national competitions through my students as well as a certificate of appreciation from the city. My greatest source of pride is my students' success and the happy smiles on their faces when they achieve their goals.

PUBLICATIONS

Szentesi Cs. (2014). *Biológia munkafüzet és tanári segédlet 7.8.10. évfolyam* [Biology workbook and teacher's guide for grades 7, 8 and 10]. Miskolc: Miskolc Megyei Jogú Város Önkormányzat



ERIKA SZUHI

University of Nyíregyháza
Eötvös József Practice Primary School And
High School

TEACHING CAREER IN BRIEF

I graduated as a teacher of biology and chemistry at the Bessenyei György Tanárképző Főiskola and then during my work I received a diploma as a secondary school teacher in chemistry at ELTE and biology at DE. In the meantime, I graduated as an environmental ecologist. In 1999 I started teaching at the Korányi Frigyes Gimnázium és Kollégium in Nagykálló. As a lecturer, I also worked at the local vocational high school and the vocational school, where I gained a lot of experience in the field of pedagogy. In September 2017, I started the school year at the a Nyíregyházi Egyetem Eötvös József Gyakorló Általános Iskola és Gimnáziumban, where I have been teaching ever since. I had to face new challenges in my workplace - primary school age, elevated biology education. From this year also elevated chemistry education. It's always a big responsibility, but the new challenges are inspiring to me. I have been an active member of both advanced written and oral graduation committees from the beginning. This requires continuous self-education, but this is the only way to become a good preparatory teacher. I consider it important that my students see not only the teacher in me, but the person who is helping them realize their dreams.



KRISZTINA VERESNÉ KIS

Dobó István High School in Eger

TEACHING CAREER IN BRIEF

In 1992, I graduated from the biology-geography department of Kossuth Lajos University in Debrecen. I first started teaching in Miskolc at Ilona High School in Zrín, then in 1997 I moved to Dobó István High School in Eger, where I am still teaching. In 1998, I graduated from Eszterházy Károly College with a degree in environmental protection, in 2010, I obtained a mentor teacher degree, and in 2015, I obtained a talent development teacher qualification. In 2006, I took a professional exam in the field of examination chairman, expert and manager, and then in 2016 in the field of talent development teacher. In my school, I have been the leader of the biology-chemistry-geography work community since 2006. I currently coordinated the area of talent management, internal self-evaluation, eco school, and previously the finance school. In 2013, I received the Bonis Bona award and received several city and school talent management awards. I consider it a matter of my heart to embrace talented students and help them choose a career. To this end, I wrote and implemented quite a few successful applications, which helped to improve the equipment of my subjects, to implement programs and study trips that helped to develop their talents. Since 2008, I have been running the Natural Science Talent Care Workshop, and for years I have been organizing a biology competition for 8th graders with my colleagues. Carrying out the duties of the exam chairperson and the tasks of the high school graduation helps to prepare my students

as well as possible for the graduation. Since 2011, I have helped quite a few students become teachers as a mentor and supervisor. Since 2016, as a master teacher, I have been performing expert tasks in the field of teacher certification and teaching supervision. In 2018-2019, on behalf of the OFI, I proofread digital teaching materials and participated in the preparation of professional materials for the laboratory of the EKE Practical School. I try to educate my students to love my subjects, to be open to learning about the ever-changing world and the latest research areas. Their success is shown by their national and international competition results.

PUBLICATIONS

Competence-based education in Heves County, Pedagogical Institute of Heves County Municipality, 2007.

Field practice for high school students - student workbook, teacher's aids 2009.

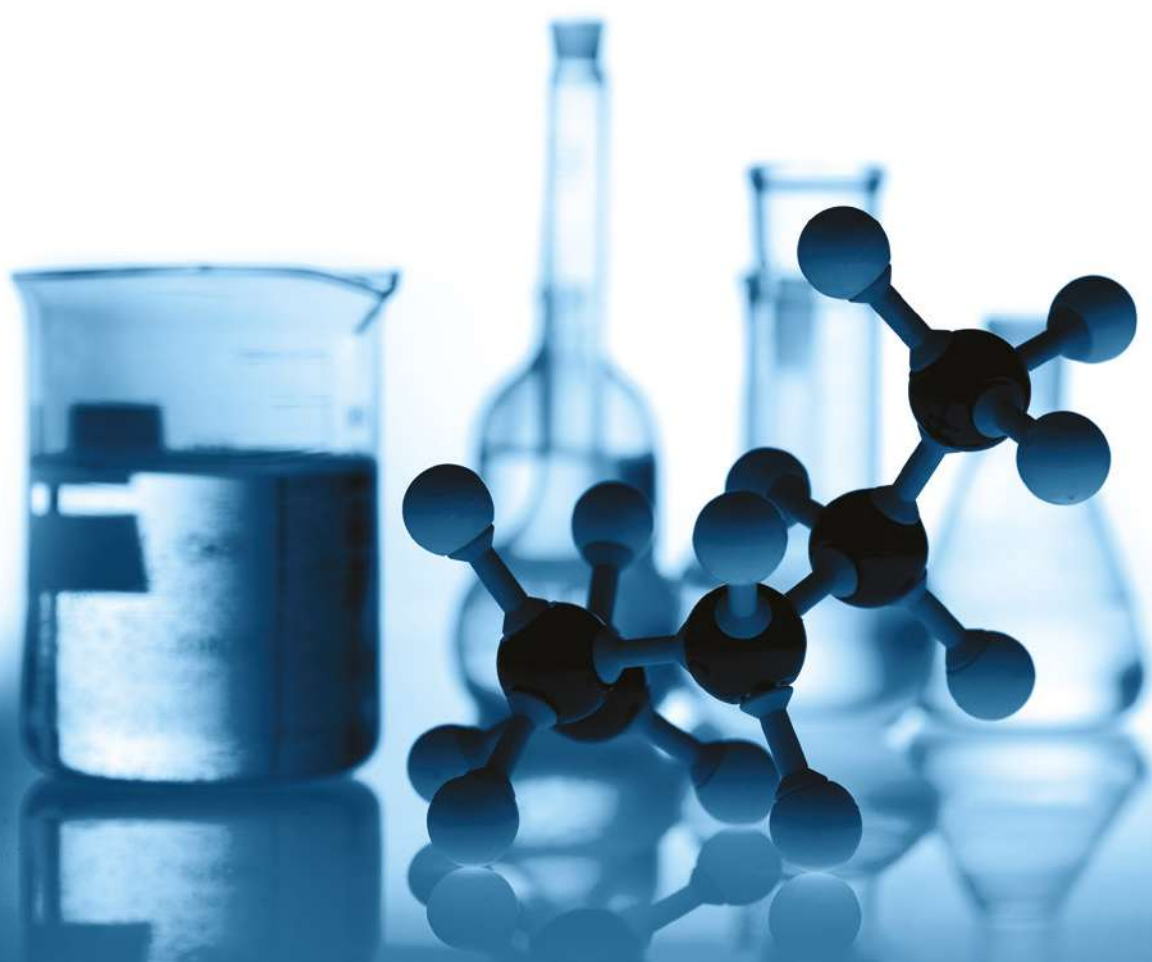
Veresné Kis K. (2011) PRESENTATION OF A SUCCESSFUL PROJECT IS THE TOPIC OF PRESENTATION OF THE WATER SHELLA Modern and attractive science teaching.

"Education of natural science content with modern infrastructure, in network cooperation in the Northern Hungary region", preparation of student workbooks and teacher's aids in biology and geography. 2012

"Education of natural science content with modern infrastructure, in network cooperation in the Northern Hungary region", auxiliary material entitled "Project work water tests" was prepared in 2013.

Edited by: Á. Horváth, M. Dobó: Good practices in talent management in the publication **Veresné Kis K.** - Nemcsikné Pinczés Gy.: The talent management activity of Egri Dobó István Gimnázium. 2014

UNIVERSITY EDUCATION PROGRAM



Leaders of the University Education Program



ZOLTÁN RAKONCZAY

Director of University Education

Professor and head of the Institute of Pathophysiology at the Albert Szent-Györgyi Medical School of the University of Szeged



MÁRIA DELI

Scientific supervisor of the National Academy of Scientist Education (Biological Research Centre Szeged)

Director of the Institute of Biophysics, Biological Barriers Research Group at the Biological Research Centre Szeged



ÁDÁM DÉNES

Scientific supervisor of the National Academy of Scientist Education (Institute of Experimental Medicine)

Senior research fellow at the Institute of Experimental Medicine, Director of the Neuroimmunology Research Group and the Cell Biology Centre



ZSUZSANNA HELYES

Scientific supervisor of the National Academy of Scientist Education (University of Pécs)

Professor of the Department of Pharmacology and Pharmacotherapy at the Faculty of General Medicine of the University of Pécs



TAMÁS MARTINEK

Scientific supervisor of the National Academy of Scientist Education (University of Szeged)

Head of the Institute of Medical Chemistry at the Albert Szent-Györgyi Medical School of the University of Szeged



ATTILA MÓCSAI

Scientific supervisor of the National Academy of Scientist Education (Semmelweis University)

Professor of the Institute of Physiology at the Medical School of the Semmelweis University



ZOLTÁN PAPP

Scientific supervisor of the National Academy of Scientist Education (University of Debrecen)

Professor and head of the Institute of Clinical Physiology at the University of Debrecen, Deputy Dean of Science at the University of Debrecen



ZSUZSA PAPFALVI

Training coordinator



TÜNDE SOPRONYI

Training assistant

(Semmelweis University - Institute of Experimental Medicine)



ÁGNES PÁROS

Training assistant

(Semmelweis University - Institute of Experimental Medicine)



KRISZTINA KASS

Training assistant

(University of Debrecen)



RITA LÍVIA BALÁZS

Training assistant

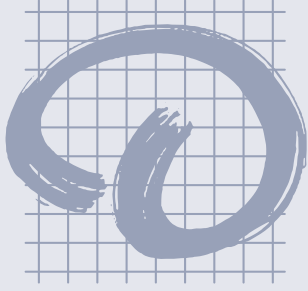
(University of Pécs)



LINDA BORKÚTI

Training assistant

(University of Szeged - Biological Research Centre Szeged)



BUDAPEST SZENT-GYÖRGYI MENTORS



LÁSZLÓ ACSÁDY

Institute of Experimental Medicine
Thalamus Research Group

RESEARCH AREA

The main research focus of the Thalamus Research Group is to decipher the network mechanisms of the thalamocortical circuits that underlies higher order cognition as well as its pathological and alterations. To this end we utilize cell type specific investigations at morphological, physiological and behavioral levels to reveal how nucleus specific synaptic organization of thalamic circuits provides a framework for plastic behavioral and neuronal response to environmental challenges.

SELECTED PUBLICATIONS

Acsády, L. (2018) Heartless beat or beatless heart? *Nat Neurosci* **21**: 649-651.

Acsády, L., Harris, K.D. (2017) Synaptic scaling in sleep. *Science* **355**: 457-457.

Acsády, L. (2017) The thalamic paradox. *Nat Neurosci* **20**: 901-902.

Fiath, R., Beregszaszi, P., Horvath, D., Wittner, L., Aarts, A.A., Ruther, P., Neves, H.P., Bokor, H., Acsady, L., Ulbert, I. (2016) Large-scale recording of thalamocortical circuits: in vivo electrophysiology with the two-dimensional electronic depth control silicon probe. *Journal of Neurophysiology* **116**: 2312-2330.

Halassa, M.M., Acsády, L. (2016) Thalamic Inhibition: Diverse Sources, Diverse Scales. *Trends in Neurosciences* **39**: 680-693.



CSABA BARTA

Semmelweis University
Faculty of Medicine
Department of Molecular Biology

RESEARCH AREA

The main research field of our laboratory is psychogenetics. Within these we study the genetic and epigenetic background of a number of child psychiatric disorders, so called neurodevelopmental conditions (such as Tourette syndrome, attention deficit, hyperactivity disorder /ADHD/, obsessive-compulsive disorder /OCD/) using molecular biological techniques and bioinformatic analyses. The other main research area of our group is the genetic study of different addictions. We study genetic variation associated with both substance use and dependence, as well as behavioral addictions, such as internet use, gambling, gaming, etc.) The functional role of the studied genetic variants is investigated in cell cultures derived from neural tissue, and also in some animal models (*C. elegans* and rodents). Apart from the above we currently have genetic and epigenetic studies on infant behavior (regulational disorder), as well as the link between type 2 diabetes and certain insulin signaling related mental disorders.

SELECTED PUBLICATIONS

Pagliaroli, L., Vereczkei, A., Padmanabhuni, S.S., Tárnok Zs., Farkas, L., Nagy, P., Rizzo, R., Wolanczyk, T., Szymanska, U., Kapisyzi, M., Basha, E., Koumoula, A., Androutsos, C., Tsironi, V., Karagiannidis, I., Paschou P., and Barta, C. (2020) Association of genetic variation in the 3'UTR of LHX6, IMMP2L and AADAC with Tourette Syndrome. *Front Neurol* **11**: 803.

Pagliaroli, L., Fothi, A., Nespoli, E., Liko, I., Veto, B., Devay, P., Szeri, F., Hengerer, B., Barta, C., Aranyi, T. (2021) Riluzole Administration to Rats with Levodopa-Induced Dyskinesia Leads to Loss of DNA Methylation in Neuronal Genes. *Cells* **10**: 1442.

Yang, Z., Wu, H., Lee, P.H., Tsetsos, F., Davis, L.K., Yu, D., Lee, S.H., Dalsgaard, S., Haavik, J., Barta, C., Zayats, T., Eapen, V., Wray, N.R., Devlin, B., Daly, M., Neale, B., Børglum, A.D., Crowley, J.J., Scharf, J., Mathews, C.A., Faraone, S.V., Franke, B., Mattheisen, M., Smoller, J.W., Paschou, P. (2021) Investigating Shared Genetic Basis Across Tourette Syndrome and Comorbid Neurodevelopmental Disorders Along the Impulsivity-Compulsivity Spectrum. *Biol Psychiatry* **90**: 317-327.

Vereczkei, A., Barta, C., Magi, A., Farkas, J., Eisinger, A., Király, O., Belik, A., Griffiths, M.D., Szekely, A., Sasvári-Székely, M., Urbán, R., Potenza, M.N., Badgaiyan, R.D., Blum, K., Demetrovics, Z., Kotyuk, E. (2022) FOXP3 and GDNF Polymorphisms as Common Genetic Factors of Substance Use and Addictive Behaviors. *J Pers Med* **12**: 690.



ZOLTÁN BENYÓ

Semmelweis University
Faculty of Medicine
Department of Translational Medicine

RESEARCH AREA

Physiology and pathophysiology of the cardiovascular system.
Regulation of the cerebral blood flow.
Signaling pathways of the endothelium and smooth muscle.
Physiological and pathophysiological functions of lipid mediators in the cardiovascular system.
Tumor angiogenesis and metastasis formation.
Physiological control and dysfunctions of the urinary bladder.



CSABA BÖDÖR

Semmelweis University
Faculty of Medicine
Department of Pathology and
Experimental Cancer Research

RESEARCH AREA

Our research focuses on better understanding of the genomic background of the malignant diseases of the hematopoietic system, i. e. leukemias and lymphomas with a special focus on identification of biomarkers and development of technologies supporting a more precise diagnosis, risk stratification and application of targeted therapies in this disease group.

SELECTED PUBLICATIONS

Borsodi, K., Balla, H., Molnár, P.J., Lénárt, Á., Kenessey, I., Horváth, A., Keszthelyi, A., Romics, M., Majoros, A., Nyirády, P., Offermanns, S., **Benyó, Z.** (2022) Signaling pathways mediating bradykinin-induced contraction in murine and human detrusor muscle. **Frontiers in Medicine** **8**: 745638.

Thomas, M.J., Major, E., Benedek, A., Horváth, I., Máthé, D., Bergmann, R., Szász, A.M., Krenács, T., **Benyó, Z.** (2020) Suppression of metastatic melanoma growth in lung by modulated electro-hyperthermia monitored by a minimally invasive heat stress testing approach in mice. **Cancers** **12**: 3872.

Dancs, P.T., Ruisanchez, E., Balogh, A., Panta, C.R., Miklós, Z., Nüsing, R.M., Aoki, J., Chun, J., Offermanns, S., Tigyi, G., **Benyó, Z.** (2017) LPA1 receptor-mediated thromboxane A2 release is responsible for lysophosphatidic acid-induced vascular smooth muscle contraction. **FASEB Journal** **31**: 1547-1555.

Benyó, Z., Ruisanchez, E., Leszl-Ishiguro, M., Sándor, P., Pacher, P. (2016) Endocannabinoids in cerebrovascular regulation. **American Journal of Physiology - Heart and Circulatory Physiology**, **310**: H785-H801.

Wirth, A., **Benyó, Z.**, Lukasova, M., Leutgeb, B., Wettschreck, N., Gorbey, S., Órsy, P., Horváth, B., Maser-Gluth, C., Greiner, E., Lemmer, B., Schütz, G., Gutkind, S., Offermanns, S. (2008) G12/G13-LARG-mediated signalling in vascular smooth muscle is required for salt-induced hypertension. **Nature Medicine** **14**: 64-68.

SELECTED PUBLICATIONS

Bödör, C., Kotmayer, L., László, T., Takács, F., Barna, G., Kiss, R., Sebestyén, E., Nagy, T., Hegyi, L.L., Mikala, G., Fekete, S., Farkas, P., Balogh, A., Masszi, T., Demeter, J., Weisinger, J., Alizadeh, H., Kajtár, B., Kohl, Z., Szász, R., Gergely, L., Gurbity Pálfi, T., Sulák, A., Kollár, B., Egyed, M., Plander, M., Rejtő, L., Szerafin, L., Ilonczai, P., Tamáska, P., Pettendi, P., Lévai, D., Schneider, T., Sebestyén, A., Csermely, P., Matolcsy, A., Mátrai, Z., Alpár, D. (2021) Screening and monitoring of the BTKC481S mutation in a real-world cohort of patients with relapsed/refractory chronic lymphocytic leukaemia during ibrutinib therapy. **British Journal of Haematology** **194**: 355-364.

Nagy, Á., Batai, B., Balogh, A., Illés, S., Mikala, G., Nagy, N., Kiss, L., Kotmayer, L., Matolcsy, A., Alpár, D., Masszi, T., Masszi, A., **Bödör, C.** (2020) Quantitative Analysis and Monitoring of EZH2 Mutations Using Liquid Biopsy in Follicular Lymphoma. **Genes** **11**: 785.

Rendeiro, AF., Krausgruber, T., Fortelny, N., Zhao, F., Penz, T., Farlik, M., Schuster, L.C., Nemc, A., Tasnády, S., Réti, M., Mátrai, Z., Alpár, D., **Bödör, C.**, Schmidl, C., Bock, C. (2020) Chromatin mapping and single-cell immune profiling define the temporal dynamics of ibrutinib response in CLL. **Nature Communications** **11**: 577.

Gángó, A., Alpár, D., Galik, B., Marosvári, D., Kiss, R., Fésüs, V., Aczél, D., Eyüpoglu, E., Nagy, N., Nagy, Á., Krizsán, S., Reiniger, L., Farkas, P., Kozma, A., Ádám, E., Tasnády, S., Réti, M., Matolcsy, A., Gyenesei, A., Mátrai, Z., **Bödör, C.** (2019) Dissection of subclonal evolution by temporal mutation profiling in chronic lymphocytic leukemia patients treated with ibrutinib. **International Journal of Cancer** **146**: 85-93.



CHRISTOS CHINOPOULOS

Semmelweis University
Faculty of Medicine
Department of Biochemistry

RESEARCH AREA

Alterations in oncometabolism are substantiated by changes in protein expression 'rewiring' certain metabolic pathways, providing an excellent opportunity for cancer-specific therapeutic intervention. Identifying those proteins involved in bioenergetic pathways that are up- or downregulated in order to serve the needs of neoplasia, is crucial for beating cancer.

SELECTED PUBLICATIONS

Seyfried, T.N., Arismendi-Morillo, G., Mukherjee, P., **Chinopoulos, C.** (2020) On the Origin of ATP Synthesis in Cancer. *iScience* **23**: 101761.

Chinopoulos, C. (2020) Acute sources of mitochondrial NAD⁺ during respiratory chain dysfunction. *Exp Neurol* **327**: 113218.

Dobolyi, A., Bago, A., Palkovits, M., Nemeria, N.S., Jordan, F., Doczi, J., Ambrus, A., Adam-Vizi, V., **Chinopoulos, C.** (2020) Exclusive neuronal detection of KGDHC-specific subunits in the adult human brain cortex despite pancellular protein lysine succinylation. *Brain Struct Funct* **225**: 639-667.

Chinopoulos, C. (2020) Quantification of mitochondrial DNA from peripheral tissues: Limitations in predicting the severity of neurometabolic disorders and proposal of a novel diagnostic test. *Mol Aspects Med* **71**: 100834.

Chen, E., Kiebish, M.A., McDaniel, J., Niedzwiecka, K., Kucharczyk, R., Ravasz, D., Gao, F., Narain, N.R., Sarangarajan, R., Seyfried, T.N., Adam-Vizi, V., **Chinopoulos, C.** (2018) Perturbation of the yeast mitochondrial lipidome and associated membrane proteins following heterologous expression of Artemia-ANT. *Sci Rep* **18**: 5915.



GÁBOR CZIRJÁK

Semmelweis University
Faculty of Medicine
Department of Physiology

RESEARCH AREA

The main research area of our group is the study of the molecular regulatory mechanisms of potassium channels. The focus is on the background potassium channels (with two pore domains per subunit, K2P), but we also reported results on the function of voltage-gated Kv8.2 and lysosomal, unconventional TMEM175 channels. Significant results have been obtained in the detection of heterodimerization of subunits of the TASK and TREK subfamilies and in the study of the regulation of TASK and TRESK channels by signaling pathways. We are known for the first detection of the TASK-1 / TASK-3 heterodimer and the comprehensive description of the TRESK regulation by calcineurin-dependent dephosphorylation.

SELECTED PUBLICATIONS

Czirják, G., Tóth, Z.E., Enyedi, P. (2004) The two-pore domain K⁺ channel, TRESK, is activated by the cytoplasmic calcium signal through calcineurin. *Journal of Biological Chemistry* **279**:18550-8.

Czirják, G., Enyedi, P. (2006) Targeting of calcineurin to an NFAT-like docking site is required for the calcium-dependent activation of the background K⁺ channel, TRESK. *Journal of Biological Chemistry* **281**:14677-82.

Enyedi, P., **Czirják, G.** (2010) Molecular background of leak K⁺ currents: two-pore domain potassium channels. *Physiological Reviews* **90**: 559-605.

Braun, G., Lengyel, M., Enyedi, P., **Czirják, G.** (2015) Differential sensitivity of TREK-1, TREK-2 and TRAAK background potassium channels to the polycationic dye ruthenium red. *British Journal of Pharmacology* **172**:1728-38.

Pergel, E., Veres, I., Csigi, G.I., **Czirják, G.** (2021) Translocation of TMEM175 Lysosomal Potassium Channel to the Plasma Membrane by Dynasore Compounds. *International Journal of Molecular Sciences* **22**:10515.



LÁSZLÓ CSANÁDY

Semmelweis University
Faculty of Medicine
Department of Biochemistry

RESEARCH AREA

Ion channel structure-function. CFTR chloride ion channel. TRPM2 cation channel.

SELECTED PUBLICATIONS

Mihályi, C., Iordanov, I., Töröcsik, B., **Csanády, L.** (2020) Simple binding of protein kinase A, prior to phosphorylation, allows CFTR anion channels to be opened by nucleotides. *Proc Natl Acad Sci USA* **117**: 21740-21746.

Liu, F., Zhang, Z., **Csanády, L.**, Gadbsy, D.C., Chen, J. (2017) Molecular structure of the human CFTR ion channel. *Cell* **169**: 85-95.

Sorum, B., Czege, D., **Csanády, L.** (2015) Timing of CFTR Pore Opening and Structure of Its Transition State. *Cell* **163**: 724-733.

Tóth, B., Iordanov, I., **Csanády, L.** (2014) Putative chanzyme activity of TRPM2 cation channel is unrelated to pore gating. *Proc Natl Acad Sci USA* **111**: 16949-16954.

Tóth, B., **Csanády, L.** (2012) Pore collapse underlies irreversible inactivation of TRPM2 cation channel currents. *Proc Natl Acad Sci USA* **109**: 13440-13445.



ÁDÁM DÉNES

Institute of Experimental Medicine
Laboratory of Neuroimmunology

RESEARCH AREA

Adam Denes is heading the Laboratory of Neuroimmunology and the Cell Biology Centre in the Institute of Experimental Medicine. His main interest is neuroinflammation and brain-immune interactions in health and disease. Their research explored the mechanisms through which inflammation inside or outside the central nervous system contributes to different forms of brain injury. They have also studied the pathways through which immune processes are controlled by the nervous system. His research group has revealed the role of microglia, the main immune cells of the brain in regulating neuronal activity and injury and the pivotal role of microglia in modulating cerebral blood flow.

SELECTED PUBLICATIONS

Császár, E., Lénárt, N., Cserép, C., Környei, Z., Fekete, R., Pósfai, B., Balázsfi, D., Hangya, B., Schwarcz, A.D., Szabadits, E., Szöllősi, D., Szigeti, K., Máthé, D., West, B.L., Sviatkó, K., Brás, A.R., Mariani, J.C., Kliewer, A., Lenkei, Z., Hricisák, L., Benyó, Z., Baranyi, M., Sperlágh, B., Menyhárt, Á., Farkas, E., **Dénes, Á.** (2022) Microglia modulate blood flow, neurovascular coupling, and hypoperfusion via purinergic actions. *J Exp Med* **219**: e20211071.

Cserép, C., Pósfai, B., **Dénes, Á.** (2021). Shaping neuronal fate: functional heterogeneity of direct microglia-neuron interactions. *Neuron* **109**: 222-240.

Cserép, C., Pósfai, B., Lénárt, N., Fekete, R., László, Z.I., Lele, Z., Orsolits, B., Molnár, G., Heindl, S., Schwarcz, A.D., Ujvári, K., Környei, Z., Tóth, K., Szabadits, E., Sperlágh, B., Baranyi, M., Csiba, L., Hortobágyi, T., Maglóczy, Z., Martinecz, B., Szabó, G., Erdélyi, F., Szipócs, R., Tamkun, M.M., Gesierich, B., Duering, M., Katona, I., Liesz, A., Tamás, G., **Dénes, Á.** (2020) Microglia monitor and protect neuronal function via specialized somatic purinergic junctions. *Science* **367**: 528-537.

Fekete, R., Cserép, C., Lénárt, N., Tóth, K., Orsolits, B., Martinecz, B., Méhes, E., Szabó, B., Németh, V., Gönci, B., Sperlágh, B., Boldogkői, Z., Kittel, Á., Baranyi, M., Ferenczi, S., Kovács, K., Szalay, G., Rózsa, B., Webb, C., Kovacs, G.G., Hortobágyi, T., West, B.L., Környei, Z., **Dénes, Á.** (2018) Microglia control the spread of neurotropic virus infection via P2Y12 signalling and recruit monocytes through P2Y12-independent mechanisms. *Acta Neuropathol* **136**: 461-482.



HENRIETTE FARKAS

Semmelweis University
Faculty of Medicine
Department of Internal Medicine and
Hematology

RESEARCH AREA

The Hungarian Angioedema Centre of Reference and Excellence (the member of the ACARE Network <https://acare-network.com>) at the Department of Internal Medicine and Haematology, Semmelweis University was established in 1998. Our centre is the founder and organizer of The International C1-Inhibitor deficiency and Angioedema Workshop which has taken place on 12 occasions since 1999 in Budapest, established the HAENETWORK project and Central Eastern European Angioedema Centre. Our research focuses on pathomechanism of angioedema, especially bradykinin mediated forms. Complement, molecular genetic and cell laboratories, patient registry, biobank provides the appropriate background for both clinical and basic research. We are investigating the function of plasma enzyme systems, white blood cells and endothelial cells involved in the development of angioedema, mainly in hereditary angioedema due to C1 inhibitor Deficiency. We have very good partnership and collaboration with colleagues from 44 countries.



ANDREA FEKETE

Semmelweis University
Faculty of Medicine
1st Department of Paediatrics

RESEARCH AREA

Open-angle glaucoma, diabetic keratopathy and corneal scarring are severe, non-retinal complications of diabetes. Their therapy is insufficient: POAG is treated by lowering intra-ocular pressure by medication or surgery; however, progression continues in many patients. Treatment of corneal dysfunction is largely symptomatic as well. Therefore preclinical research should aim at identifying disease mechanisms and novel antifibrotic therapies for both diseases. Renal ischemia/reperfusion injury-induced acute kidney injury develops in various clinical conditions and is the main cause of graft loss or delayed graft function following transplantation. Beside the shortage in donors, minimizing ischemia/reperfusion injury and thus improving long-term graft function remains a major and yet unsolved problem. Our aim is to characterize previously unknown molecular signaling mechanisms for the treatment of renal ischemia/reperfusion injury. By developing a new preservation solution containing Sigma-1 receptor agonists we could tackle the problem of donor shortage by optimizing the condition of expanded criteria donor grafts and extending maximum graft storage time. Idiopathic pulmonary fibrosis is the most common form of interstitial pulmonary diseases, with constantly growing incidence. The disease is associated with high mortality, as median survival after diagnosis is only 2-3 years. Main causes include environmental factors, infections and genetic factors. The latest

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studies suggest that fibrosis of the lungs is common among patients who recovered from the acute phase of a COVID-19 infection. Despite obvious clinical significance, the molecular mechanisms leading to fibrosis are largely unknown and currently there is no effective therapeutic agent which could prevent tissue fibrosis. Our aim is to identify the molecular pathways responsible for the protective effect of Sigma-1 receptor agonists, and thus to develop novel, effective therapies.

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CSABA FEKETE

Institute of Experimental Medicine
Integrative Neuroendocrinology Research
Group

RESEARCH AREA

The main research goals of our laboratory are the elucidation of the central regulatory mechanisms controlling the hypothalamic-pituitary-thyroid axis and the examination of the neuronal circuits controlling the energy homeostasis.



BALÁZS GEREBEN

Institute of Experimental Medicine

RESEARCH AREA

Thyroid hormones (TH) are master regulators of cellular metabolism and proliferation and consequently exert a fundamental impact on brain development and function predominantly due to their impact on transcriptomic activity. The Laboratory aims to (i) identify and modulate cell-type specific molecular pathways responsible for the regulation of TH economy in the brain and coupled peripheries; (ii) translate these mechanisms to specific brain functions under physiological and pathophysiological conditions; (iii) develop transgenic approaches to assess and modulate cell-type specific TH action. They combine molecular, cell biological, anatomical and transgenic techniques to study regulation and consequences of TH signalling. (1) They study the molecular regulation of deiodinase enzymes mediating TH metabolism with special respect to the complex and tight regulation of type 2 deiodinase (D2) to identify molecular elements and protein-protein interactions allowing the rapid regulation of D2 activity along the ubiquitin/proteasome pathway and its role in the generation of tissue-specific hypothyroidism. The studies also target the regulation of the D2-encoding *dio2* gene during hypothalamic response to inflammation, a phenomenon they described as a component of the pathogenesis of the nonthyroidal illness syndrome. (2) They investigate the mechanisms and biological consequences of D2 and type 3 deiodinase (D3) mediated neuro-glial coupling of TH metabolism and its

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impact on the hypothalamo-pituitary-thyroid axis and thyroid hormone signaling of the nervous system. (3) The Laboratory is involved in the generation of transgenic mouse models for cell-type specific modulation and assessment of TH signalling and also aims to identify human markers representing tissue TH economy. This resulted in the generation and patenting of the Thyroid Hormone Action Indicator (THAI) Mouse, allowing tissue-specific assessment of TH action in vivo.

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ANIKÓ GÖRBE

Semmelweis University
Faculty of Medicine
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

In experimental cardiology models, several studies have already demonstrated that the reperfusion phase following cardiac oxygen deprivation activates processes that lead to further damage of myocardial tissue. However, there are protective mechanisms that can reduce the extent of damage. However, failures in clinical trials show that these mechanisms are not sufficiently effective in ischemic heart patients. Preclinical data suggest that co-morbidities such as hyperlipidemia, metabolic syndrome, diabetes mellitus-induced tissue changes and drug treatment of these diseases have a strong interfering effect. Furthermore, the presence of ischaemia/reperfusion injury and co-morbidities poses additional risks, as the hidden side effects of many drugs are only seen in such cases. Our research addresses the potential cardioprotective effects of microRNAs. The development of noncoding RNAs (such as microRNAs) as molecules of diagnostic and therapeutic value has in recent years brought them to the forefront of the pharmaceutical industry for the precision diagnosis and treatment of a number of diseases.



BALÁZS HANGYA

Institute of Experimental Medicine

RESEARCH AREA

We are interested in the neural basis of cognitive functions both in the normal and diseased brain. We are investigating how different neuron types of subcortical centres mediate cognitive processes such as attention, learning and memory. Cholinergic neurons have been associated with learning and other cognitive functions; however, their activity during behavior is unknown. Understanding how the activity of basal forebrain cholinergic neurons support learning as well as how their impairment leads to learning deficits can help understanding their role in neurodegenerative dementias. Intermingled with cholinergic neurons, the basal forebrain also contains cortically projecting long-range inhibitory neurons. To understand how the basal forebrain supports cognition, it is important to determine how cognitive functions associated with the basal forebrain are segregated among different cell types.

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TAMÁS HEGEDŰS

Semmelweis University
Faculty of Medicine
Department of Biophysics and Radiation
Biology

RESEARCH AREA

Our research focuses on transmembrane proteins, which are associated with many diseases and are the targets of most available drugs. We are investigating ABC proteins acting as multidrug transporters to protect cells from toxic substances. We use theoretical and computational methods to understand their mechanism of function and substrate recognition. We also investigate how cystic fibrosis causing mutations in the CFTR/ABCC7 chloride channel affect protein unfolding, dynamics and function. CFTR channel opening requires phosphorylation of its disordered regulatory region. In order to understand the associated regulatory processes, we determine the intramolecular interactions of the disordered region and design a protein to counteract these interactions to achieve activation. In a similar manner, we design a small protein that binds to the C-terminus of the SARS Cov-2 Envelope transmembrane protein, inhibiting its binding to the human Pals1 protein, thus the degradation of cell-cell contacts and the development of inflammation.



ESZTER MÁRIA HORVÁTH

Semmelweis University
Faculty of Medicine
Department of Physiology

RESEARCH AREA

Oxidative stress is characterized by the imbalance between the release of oxygen and nitrogen-derived free radicals and oxidants and the body's antioxidant capacity. Accumulating free radicals and oxidants can damage cellular components, which play important role in the development and maintenance of several diseases. Our group examines these processes and their predictive value in physiological and pathophysiological conditions; in pregnancy and its complications, in inflammatory and in cardiovascular diseases

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ERIK HRABOVSKY

Institute of Experimental Medicine
Reproductive Neurobiology Research Group

RESEARCH AREA

Molecular, cellular and system biology research at the Laboratory of Reproductive Neurobiology aims to provide a deeper understanding of the central regulatory mechanisms of human reproduction. Hypothalamic secretion of gonadotropin-releasing hormone (GnRH) builds up during pubertal development. Secretory pulses of GnRH at every 30-90 minutes stimulate luteinizing and follicle stimulating hormone (LH and FSH) production in the anterior pituitary gland. These troph hormones, in turn, initiate and later maintain functions of the gonads (testes and ovaries). This laboratory combines anatomical, electrophysiological and molecular approaches to study i) the neuronal and hormonal control of pulsatile GnRH/LH secretion, ii) the mechanisms of the mid-cycle GnRH/LH surge which triggers ovulation in females, iii) the central effects of gonadal steroid hormones on neuroendocrine systems and on wider aspects of general neuronal functioning and iv) the molecular and cellular processes underlying reproductive senescence.



PÉTER IGAZ

Semmelweis University
Faculty of Medicine
Department of Internal Medicine and
Oncology
Department of Endocrinology

RESEARCH AREA

Studies on endocrine tumors, especially adrenal and neuroendocrine tumors. In the focus, non-coding RNAs (especially microRNAs), their pathogenic roles and utility as biomarkers are examined. Both tissue and biofluid samples are used. As biomarkers, markers of malignancy and prognosis are searched for. The clinical relevance of these studies is underlined by the diagnostic difficulties related to the adrenal and neuroendocrine tumors both in histology and clinical diagnostics.

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ZOLTÁN PÉTER JAKUS

Semmelweis University
Faculty of Medicine
Department of Physiology

RESEARCH AREA

The lymphatic system plays an essential role in regulating fluid balance, controlling immune cell migration and lipid absorption. Recently, other novel and unexpected functions of the system have been revealed. It is therefore critical that we understand the organ-specific functions of the lymphatic system. Our research group aims to study the organ-specific roles of the lymphatic system and lymphatic growth signaling pathways under physiological and pathological conditions using preclinical transgenic mouse models. In our experiments, we have developed a nucleoside-modified mRNA-based system that induces organ-specific lymphatic growth and reverses experimental lymphedema. We revealed that pulmonary lymphatic function and fetal breathing movements play a critical role in the preparation of the fetal lung for inflation at birth. In addition, our data suggest that the mechanical forces induced by lymphatic flow are critical factors in controlling the developmental program of meningeal lymphatics.



KRISZTINA KÁLDI

Semmelweis University
Faculty of Medicine
Department of Physiology

RESEARCH AREA

The circadian time-keeping system enhances the adaptive ability of the organism by preparing it to the periodical changes in the environment, and on the other hand, allows temporal separation of otherwise conflicting biochemical activities. Endogenous time measuring is organized at the cellular level and almost all mammalian cells harbour self-sustained circadian oscillators. In mammals, the suprachiasmatic nucleus is considered as the master pacemaker, that drives and synchronizes peripheral oscillators by neuronal and humoral mechanisms. Circadian rhythm disturbances are associated with an increased risk of severe health problems, including cardiovascular diseases, metabolic syndrome, diabetes mellitus, various malignancies and psychiatric diseases such as mood disorders. In the modern society the risk for circadian misalignment is increasing due to the growing demand of shift work and intense exposure to artificial light during the late evening hours. Our research group is interested in a broad field of chronobiology research including the examination of molecular clock functions, studying circadian control of the immune system and exploring human behavioral rhythms.

SELECTED PUBLICATIONS

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ISTVÁN KATONA

Institute of Experimental Medicine
Molecular Neurobiology Research Group

RESEARCH AREA

Synaptic junctions are major sites of communication in the brain, where chemical messenger molecules transmit information from presynaptic neurons to their postsynaptic partners. The efficacy of synaptic transmission is not constant in time and space. Instead, its plasticity is a fundamental phenomenon underlying information storage and adaptation to environmental stimuli. Although classical neurotransmitters (such as glutamate and GABA) have well characterized principal roles in mediating basal neurotransmission, emerging evidence has revealed that synapses exploit a wide array of additional messenger molecules integrated into sophisticated signaling pathways to accomplish their complex functions. Thus, the major objective of our laboratory is to identify new signaling systems regulating synaptic transmission and its plasticity. We aim to characterize the molecular architecture of these novel pathways and to elucidate their physiological roles. Ultimately, this activity is envisaged to help gain a better understanding of synaptic function and reveal new aspects of impaired synaptic activity in brain disorders.



KRISZTINA KOVÁCS

Institute of Experimental Medicine

RESEARCH AREA

Neurobiology of stress. Regulation of the hypothalamo-pituitary-adrenocortical axis. The role of gut microbiome in the neuroendocrine regulation.

SELECTED PUBLICATIONS

Prokop, S., Ábrányi-Balogh, P., Barti, B., Vámosi, M., Zöldi, M., Barna, L., Urbán, G.M., Tóth, A.D., Dudok, B., Egyed, A., Deng, H., Leggio, G.M., Hunyady, L., van der Stelt, M., Keserű, G.M., **Katona, I.** (2021) PharmacostORM nanoscale pharmacology reveals cariprazine binding on Islands of Calleja granule cells. **Nature Communications** **12**: 6505.

László, Z., Lele, Z., Zöldi, M., Miczán, V., Mógó, F., Simon, G.M., Mackie, K., Kacsokovics, I., Cravatt, B.F. and **Katona, I.** (2020) ABHD4-mediated developmental anoikis safeguards the embryonic brain. **Nature Communications** **11**:1.

Frau, R.*, Miczan, V.*, Traccis, F., Aroni, S., Pongor, C.I., Saba, P., Serra, V., Sgheddu, C., Fanni, S., Congiu, M., Devoto, P., Cheer, J.F., **Katona, I.***, Melis, M.* (2019) Prenatal THC exposure produces a hyperdopaminergic phenotype rescued by pregnenolone. **Nature Neuroscience** **22**: 1975–1985.

Barna, L., Dudok, B., Miczán, V., Horváth, A., László, Z.I., and **Katona, I.** (2016) Correlated confocal and super-resolution imaging by VividSTORM. **Nature Protocols** **11**: 163-183.

Dudok, B., Barna, L., Ledri, M., Szabó, S.I., Szabadits, E., Pintér, B., Woodhams, S.G., Henstridge, C.M., Balla, G.Y., Nyilas, R., Varga, C., Lee, S.H., Matolcsi, M., Cervenak, J., Kacsokovics, I., Watanabe, M., Sgheddu, C., Melis, M., Pistis, M., Soltész, I. and **Katona, I.** (2015) Cell-specific STORM superresolution imaging reveals nanoscale organization of cannabinoid signaling. **Nature Neuroscience** **18**: 75-86.

SELECTED PUBLICATIONS

Xu, L., Füredi, N., Lutter, C., Geenen, B., Pétervári, E., Balaskó, M., Dénes, Á., **Kovács, K.J.**, Gaszner, B., Kozicz, T. (2022) Leptin coordinates efferent sympathetic outflow to the white adipose tissue through the midbrain centrally-projecting Edinger-Westphal nucleus in male rats. **Neuropharmacology** **205**: 108898.

Kuti, D., Winkler, Zs., Horváth, K., Juhász, B., Paholcsek, M., Stágel, A., Gulyás, G., Czeglédi, L., Ferenczi, Sz., **Kovács, K.J.** (2020) Gastrointestinal (Non-systemic) Antibiotic Rifaximin Differentially Affects Chronic Stress-induced Changes in Colon Microbiome and Gut Permeability without Effect on Behavior. **Brain Behav Immun** **80**: 218-228.

Winkler, Zs., Kuti, D., Polyák, Á., Juhász, B., Gulyás, K., Lénárt, N., Dénes, Á., Ferenczi, Sz., Kovács, K.J. (2019) Hypoglycemia-activated Hypothalamic Microglia Impairs Glucose Counterregulatory Responses. **Sci Rep** **9**: 6224.

Winkler, Z., Kuti, D., Ferenczi, S., Gulyás, K., Polyák, A., **Kovács, K.J.** (2017) Impaired microglia fractalkine signaling affects stress reaction and coping style in mice. **Behav Brain Res** **334**: 119-128.

Ferenczi, S., Szegi, K., Winkler, Z., Barna, T., **Kovács, K.J.** (2016) Oligomannan Prebiotic Attenuates Immunological, Clinical and Behavioral Symptoms in Mouse Model of Inflammatory Bowel Disease. **Sci Rep** **6**: 34132.



ZSOLT LELE

Institute of Experimental Medicine
Molecular Neuroendocrinology

RESEARCH AREA

"The Laboratory of Molecular Neurobiology has 3 major projects running currently. 1. Development and novel application of the PharmacostORM superresolution microscopy. 2. The role of endocannabinoid synthesizing enzymes in the development of the central nervous system. 3. The role of cadherin cell adhesion molecules in cortical development. Of these, the second and the third projects are under my supervision. Endocannabinoids are endogenous molecules which bind to the same receptor which Δ^9 -tetrahydrocannabinol, the main psychoactive component of marijuana targets. Currently there are two main endocannabinoids anandamide and 2-AG although there are several more or less uncharacterized lipids which may belong to this category. Synthesis of these signalling molecules can occur via many pathways, at least based on biochemical and in vitro cell culture experiments. Our main targets are the potential alternative synthesizing enzymes of anandamide, and we aim to characterize their role in the development of the CNS. The other project focuses on cadherins (Ca^{2+} -dependent adhesion molecules) and their role in cortical development. Of the more than 100 members of the cadherin superfamily our lab focuses on the classic (ie. β -catenin-binding) cadherin family. One of our main projects is actually at the crossing point of these projects where



ZSOLT LIPOSITS

Institute of Experimental Medicine
Endocrine Neurobiology Research Team

RESEARCH AREA

Neuronal and hormonal regulation of reproduction.

we recently described a novel protecting mechanism in the developing embryonic cortex which we termed developmental anoikis. Our main goal is currently to describe the molecular mechanisms behind this phenomenon."

SELECTED PUBLICATIONS

László, Z.I., **Lele, Z.**, Zöldi, M., Miczán, V., Mógor, F., Simon, G.M., Mackie, K., Kacsokovics, I., Cravatt, B.F., Katona, I. (2020) ABHD4-dependent developmental anoikis safeguards the embryonic brain. **Nat Commun** **11**: 4363.

Cserep, C., Posfai, B., Lenart, N., Fekete, R., Laszlo, Z.I., **Lele, Z.**, Orsolits, B., Molnar, G., Heindl, S., Schwarcz, A.D. et al. (2020) Microglia monitor and protect neuronal function through specialized somatic purinergic junctions. **Science** **367**: 528-537.

László, Z.I., Bercsényi, K., Mayer, M., Lefkovic, K., Szabó, G., Katona, I., **Lele, Z.** (2020) N-cadherin (Cdh2) Maintains Migration and Postmitotic Survival of Cortical Interneuron Precursors in a Cell-Type-Specific Manner. **Cereb Cortex** **30**: 1318-1329.

Klinger-Gratz, P.P., Ralvenius, W.T., Neumann, E., Kato, A., Nyilas, R., **Lele, Z.**, Katona, I., Zeilhofer, H.U. (2018) Acetaminophen Relieves Inflammatory Pain through CB1 Cannabinoid Receptors in the Rostral Ventromedial Medulla. **J Neurosci** **38**: 322-334.

Lefkovic, K., Mayer, M., Bercsenyi, K., Szabo, G., **Lele, Z.** (2012) Comparative analysis of type II classic cadherin mRNA distribution patterns in the developing and adult mouse somatosensory cortex and hippocampus suggests significant functional redundancy. **J Comp Neurol** **520**: 1387-1405.

SELECTED PUBLICATIONS

Balint, F., Csillag, V., Vastagh, C., **Liposits, Z.**, and Farkas, I. (2021) Insulin-like growth factor 1 (IGF-1) increases GABAergic neurotransmission to GnRH neurons via suppressing the retrograde tonic endocannabinoid signaling pathway in mice. **Neuroendocrinology** **111**: 1219–1230.

Vastagh, C., Farkas, I., Scott, M.M., and **Liposits, Z.** (2021) Networking of glucagon-like peptide-1 axons with GnRH neurons in the basal forebrain of male mice revealed by 3DISCO-based immunocytochemistry and optogenetics. **Brain Structure & Function** **226**: 105–120.

Bake, T., Le May, M.V., Edvardsson, C.E., Vogel, H., Bergström, U., Albers, M.N., Skibicka, K.P., Farkas, I., **Liposits, Z.** and Dickson, S.L. (2020) Ghrelin Receptor Stimulation of the Lateral Parabrachial Nucleus in Rats Increases Food Intake but not Food Motivation. **Obesity** **28**: 1503–1511.

Leiszter, K., Galamb, O., Kalmár, A., Zsigrai, S., Valcz, G., Szigeti, K.A., Barták, B.K., Nagy, Z.B., Dank, M., **Liposits, Z.**, Igaz, P., Tulassay, Z. and Molnár, B. (2020) Az ösztrogének lehetséges szerepe a vastagbél-daganatok kialakulásában. **Orvosi Hetilap** **161**: 532–543.

Balla, B., Sárvári, M., Kósa, J.P., Kocsis-Deák, B., Tobiás, B., Árvai, K., Takács, I., Podani, J., **Liposits, Z.** and Lakatos, P. (2019) Long-term selective estrogen receptor-beta agonist treatment modulates gene expression in bone and bone marrow of ovariectomized rats. **Journal of Steroid Biochemistry and Molecular Biology** **188**: 185–194.



JUDIT MAKARA

Institute of Experimental Medicine
Neuronal Signaling Research Group

RESEARCH AREA

The focus of our research is to understand the principles of information processing by neurons. Nerve cells receive thousands of synaptic inputs onto their thin and long processes called dendrites and transform the integrated information to an output signal at the cell body. Processing of inputs takes place primarily in the dendrites that express a variety of voltage dependent ion channels, allowing them to perform diverse forms of nonlinear summation and input-output transformation. Furthermore, the fine regulation of ion channel function makes this processing dynamic. We use cutting edge microscopic and electrophysiological methods in brain slices and awake behaving rodents to elucidate the basic principles and regulation of dendritic function in neurons of the hippocampus (a brain region important for episodic memory) as well as the possible roles of these cellular information processing mechanisms in learning and memory guiding behaviour.



ÉVA MIKICS

Institute of Experimental Medicine
Laboratory of Translational Behavioural
Neuroscience

RESEARCH AREA

Our lab conducts behavioral neuroscience research with a translational approach. We aim to better understand the neurobiological background of mental disorders using animal models in order to identify potential targets for novel treatment strategies. Our work is mainly focused on the long-term effects of early-life stress, i.e. how early adverse factors contribute to vulnerability for the development of specific mental disorders.

SELECTED PUBLICATIONS

Magó, Á., Kis, N., Lükő, B., **Makara, J.K.** (2021) Distinct dendritic Ca²⁺ spike forms produce opposing input-output transformations in rat CA3 pyramidal cells. *eLife* **10**: e74493.

Ujfalussy, B.B., **Makara, J.K.** (2020) Impact of functional synapse clusters on neuronal response selectivity. *Nature Communications* **11**: 1413.

Magó, Á., Weber, J.P., Ujfalussy, B.B., **Makara, J.K.** (2020) Synaptic plasticity depends on the fine-scale input pattern in thin dendrites of CA1 pyramidal neurons. *J. Neuroscience* **40**: 2593-2605.

Raus Balind, S., Magó, Á., Ahmadi, M., Kis, N., Varga-Németh, Z., Lőrincz, A., **Makara, J.K.** (2019) Diverse synaptic and dendritic mechanisms of complex spike burst generation in hippocampal CA3 pyramidal cells. *Nature Communications*, **10**: 1859.

Harnett, M.T.*[†], **Makara, J.K.***, Spruston, N., Kath, W.L., Magee, J.C.† (2012) Synaptic amplification by dendritic spines enhances input cooperativity. *Nature*, **491**: 599-602. *shared first authors.

SELECTED PUBLICATIONS

Bruzsik, B., Biro, L., Zelena, D., Sipos, E., Török, B., Sarosdi, K.R., Szebik, H., **Mikics#**, E., Toth#. M. #equal contribution (2022) Neurochemically distinct populations of the bed nucleus of stria terminalis modulate innate fear response to weak threat evoked by predator odor stimuli. *Neurobiol Stress* **15**: 100415.

Bruzsik, B., Biro, L., Zelena, D., Sipos, E., Szebik, H., Sarosdi, K.R., Horvath, O., Farkas, I., Csillag, V., Finszter, C.K., **Mikics#**, E., and Toth#, M. #equal contribution, (2021) Somatostatin neurons of the bed nucleus of stria terminalis enhance associative fear memory consolidation in mice. *J Neurosci* **41**: 1982–1995.

Miskolczi, C., Halász, J., and **Mikics, É.** (2019) Changes in neuroplasticity following early-life social adversities. *Pediatr Res* **85**: 225–233.

Mikics*↵, E., Guirado*, R., Umemori, J., Toth, M., Biro, L., Miskolczi, C., Balazsfi, D., Zelena, D., Castren, E., Haller, J., and Karpova, N. *equal contribution (2018) Social Learning Requires Plasticity Enhanced by Fluoxetine Through Prefrontal Bdnf-TrkB Signaling to Limit Aggression Induced by Post-Weaning Social Isolation. *Neuropsychopharmacology* **43**: 235–245.

Mikics, É., Kruk, M., and Haller, J. (2004) Genomic and non-genomic effects of glucocorticoids on aggressive behavior in male rats. *Psychoneuroendocrinology* **29**: 618–635.



ATTILA MÓCSAI

Semmelweis University
Faculty of Medicine
Department of Physiology

RESEARCH AREA

The aim of our group is to understand the molecular mechanisms of various human diseases, laying down the foundations for new diagnostic and therapeutic approaches. Our experiments focus on the inflammatory processes that determine the pathomechanism of a large number of major human diseases. We investigate their molecular mechanisms using transgenic animal models, healthy and patient-derived human cells and tissues, state-of-the-art molecular biology and gene editing, as well as functional and imaging methods. We have close collaboration with several prominent international research groups. Our group is supported by several programmes of excellence, including the Frontline and Topical Excellence programmes, as well as the European Union's largest international rheumatology consortium.



NÁNDOR NAGY

Semmelweis University
Faculty of Medicine
Department of Anatomy, Histology and Embryology
Stem Cells and Experimental Embryology Laboratory

RESEARCH AREA

Our research is focusing on two broad areas. Firstly, our laboratory is interested in developmental mechanisms of enteric nervous system (ENS) formation. This work is aimed at understanding the development of the ENS in normal, abnormal, and evolutionary contexts. We do this by examining the role of the extracellular environment in the embryonic gut that regulate the mechanisms of neural crest derived stem cell differentiation during intestinal morphogenesis. Secondly, our laboratory focuses on mechanisms that underlie lymphoid organ formation. This work also uses the avian embryo as the model system, and addresses cellular (stem cell migration, differentiation), molecular (Foxn1, CXCR4, Shh, BMP4 expression), immunological (IBDV and bronchitis infection) and morphological (confocal, immune electron-microscopy) aspects of the primary and secondary lymphoid organ formation. Our aim is to discover how the avian lymphoid organs are built, and how immunosuppressive diseases affect its organization.

<https://semmelweis.hu/stemcell/en/about-us>

SELECTED PUBLICATIONS

Szilveszter, K.P., Vikár, S., Horváth, Á.I., Helyes, Z., Sárdy, M. and **Mócsai, A.** (2022) Phospholipase C γ 2 is essential for experimental models of epidermolysis bullosa acquisita. **J Invest Dermatol** **142**: 1114-1125.

Futosi, K., Kása, O., Szilveszter, K.P. and **Mócsai, A.** (2021) Neutrophil phospholipase C γ 2 drives autoantibody-induced arthritis through the generation of the inflammatory microenvironment. **Arthritis Rheumatol** **73**: 1614-1625.

Orosz, A., Walzog, B. and **Mócsai, A.** (2021) In vivo functions of mouse neutrophils derived from HoxB8-transduced conditionally immortalized myeloid progenitors. **J Immunol** **206**: 432-445.

Németh, T., Sperandio, M. and **Mócsai, A.** (2020) Neutrophils as emerging therapeutic targets. **Nat Rev Drug Discov** **19**: 253-275.

Csete, D., Simon, E., Alatschan, A., Aradi, P., Dobó-Nagy, C., Jakus, Z., Benkő, S., Győri, D.S. and **Mócsai, A.** (2019) Hematopoietic or osteoclast-specific deletion of Syk leads to increased bone mass in experimental mice. **Front Immunol** **10**: 937.

SELECTED PUBLICATIONS

Nagy, N. (Corresponding author), Kovács, T., Stavely, R., Halasy, V., Soós, A., Szócs, E., Hotta, R., Graham, H., Goldstein, A.M. (2021) Avian ceca are required for hindgut enteric nervous system development by inhibiting neuronal differentiation via non-canonical Wnt signaling and by promoting enteric neural crest cell proliferation. **Development** **148**: dev199825.

Dóra, D., Ferenczi, S., Stavely, R., Tóth, V.E., Varga, Z.V., Kovács, T., Bódi, I., Hotta, R., Kovács, K.J., Goldstein, A.M., and **Nagy, N.** (2021) Evidence of a Myenteric Plexus Barrier and Its Macrophage-Dependent Degradation During Murine Colitis: Implications in Enteric Neuroinflammation. **Cell Mol Gastroenterol Hepatol** **12**: 1617-1641.

Nagy, N. (Corresponding author), Barad, C., Hotta, R., Bhawe, S., Arciero, E., Dora, D., and Goldstein, A.M. (2018) Collagen 18 and agrin are secreted by neural crest cells to remodel their microenvironment and regulate their migration during enteric nervous system development. **Development** **145**: dev160317.

Nagy, N. (Corresponding author), Barad, C., Graham, H.K., Hotta, R., Cheng, L.S., Fejszak, N., and Goldstein, A.M. (2016) Sonic hedgehog controls enteric nervous system development by patterning the extracellular matrix. **Development** **143**: 264-275. IF: 5,843

Dóra, D., Fejszak, N., Goldstein, A.M., Minkó, K., **Nagy, N.** (2017). Ontogeny of ramified CD45 cells in chicken embryo and their contribution to bursal secretory dendritic cells. **Cell Tissue Res** **368**: 353-370.



ZOLTÁN NUSSER

Institute of Experimental Medicine
Cellular Neurophysiology Research Group

RESEARCH AREA

The most fundamental function of nerve cells is the integration of their synaptic inputs to generate their propagating output signal, the action potential. The major aims of Dr Nusser's laboratory are to understand how identified presynaptic nerve cells release neurotransmitters; how the released transmitter molecules activate their postsynaptic receptors; and how the generated postsynaptic potentials are integrated to generate an action potential. The Laboratory of Cellular Neurophysiology focuses on the following major project areas using a variety of molecular, neuroanatomical, in vitro electrophysiological, in vitro and in vivo imaging and in silico modeling approaches: 1. Revealing the molecular, structural and functional heterogeneity of cortical excitatory and inhibitory synapses. Determine the molecular specializations underlying the functional and structural diversity of synapses, such as the probability and short-term plasticity of transmitter release, and the extent of postsynaptic receptor activation. 2. Creating a molecular map of the neuronal surface by determining the location and density of various voltage- and ligand-gated ion channel subunits in defined subcellular compartments of identified nerve cells. 3. Understanding the mechanisms underlying hippocampal network activity during behaviour.



GÁBOR NYIRI

Institute of Experimental Medicine
Cerebral Cortex Research Group

RESEARCH AREA

My research group focuses on the sub-cortical control of learning and memory processes. We study these questions from synaptic-level electron microscopy studies to viral neuronal tracing methods and behavioral-level studies.

SELECTED PUBLICATIONS

Karlocai, M.R., Heredi, J., Benedek, T., Holderith, N., Lorincz, A. and **Nusser, Z.** (2021) Variability in the Munc13-1 content of excitatory release sites. *eLife* **0**:e67468

Holderith, N., Heredi, J., Kis, V., and **Nusser, Z.** (2020) A high-resolution method for quantitative molecular analysis of functionally characterized synapses. *Cell Rep* **32**: 107968.

Rebola, N., Reva, M., Kirizs, T., Szoboszlai, M., Lorincz, A., Moneron, G., **Nusser, Z.** and DiGregorio, D.A. (2019) Distinct nanoscale calcium channel and synaptic vesicle topographies contribute to the diversity of synaptic function. *Neuron* **104**: 693-710.

Éltes, T., Kirizs, T., **Nusser, Z.** & Holderith, N. (2017) Target cell type-dependent differences in Ca²⁺ channel function underlie distinct release probabilities at hippocampal glutamatergic terminals. *J Neurosci* **37**: 1910-1924.

Szoboszlai M., Lorincz, A., Lanore, F., Vervaeke, K., Silver, R. A. & **Nusser, Z.** (2016) Functional properties of dendritic gap junctions in cerebellar Golgi cells. *Neuron* **90**: 1043-1056.

SELECTED PUBLICATIONS

Szőnyi, A., Sos, K.E., Nyilas, R., Schlingloff, D., Domonkos, A., Takács, V.T. Pósfai, B., Hegedüs, P., Priestley, J.B.J.B., Gundlach, A.L.A.L., Gulyás, A.I.A.I., Varga, V., Losonczy, A., Freund, T.F., **Nyiri, G.** (2019) Brainstem nucleus incertus controls contextual memory formation. *Science* **364**.

Szőnyi, A., Zichó, K., Barth, A.M., Gónczi, R.T.R.T., Schlingloff, D., Török, B., Sipos, E., Major, A., Bardóczy, Z., Sos, K.E.K.E., Gulyás, A.I.A.I., Varga, V., Zelena, D., Freund, T.F., **Nyiri, G.** (2019) A., Median raphe controls acquisition of negative experience in the mouse. *Science* **366**.

Takács, V.T., Cserép, C., Schlingloff, D., Pósfai, B., Szőnyi, A., Sos, K.E.K.E., Környei, Z., Dénes, Á., Gulyás, A.I.A.I., Freund, T.F., Freund, T.F., **Nyiri, G.** (2018) Co-transmission of acetylcholine and GABA regulates hippocampal states. *Nat Commun.* **9**: 2848.

Szabadits, E., Cserép, C., Szonyi, A., Fukazawa, Y., Shigemoto, R., Watanabe, M., Itohara, S., Freund, T.F.T.F., **Nyiri, G.** (2011) NMDA receptors in hippocampal GABAergic synapses and their role in nitric oxide signaling. *J Neurosci* **31**: 5893–5904.

Szabadits, E., Cserép, C., Ludányi, A., Katona, I., Gracia-Llanes, J., Freund, T.F., **Nyiri, G.** (2007) Hippocampal GABAergic synapses possess the molecular machinery for retrograde nitric oxide signaling. *J Neurosci* **27**: 8101–8111.



ATTILA PATÓCS

Semmelweis University
Faculty of Medicine
Department of Laboratory Medicine

RESEARCH AREA

Genetics, oncogenetics, genomics, endocrine tumors, hereditary cancer.

SELECTED PUBLICATIONS

Patocs, A., Zhang, L., Xu, Y., Weber, F., Caldes, T., Mutter, G.L., Platzer, P., Eng, C. (2007) Breast-Cancer Stromal Cells with TP53 Mutations and Nodal Metastases. **N Engl J Med** **357**: 2543-2551.

Tretter, L., **Patocs, A.**, Chinopoulos, C. (2016) Succinate, an intermediate in metabolism, signal transduction, ROS, hypoxia, and tumorigenesis. **Biochim Biophys Acta** **1857**: 1086-1101.

Butz, H., Rácz, K., Hunyady, L., **Patócs, A.** (2012) Crosstalk between TGF- β signaling and the microRNA machinery. **Trends Pharmacol Sci** **33**: 382-393.

Ni, Y., Zbuk, K.M., Sadler, T., **Patocs, A.**, Lobo, G., Edelman, E., Platzer, P., Orloff, M.S., Waite, K.A., Eng, C. (2008) Germline mutations and variants in the succinate dehydrogenase genes in Cowden and Cowden-like syndromes. **Am J Hum Genet** **83**: 261-268.

Butz, H., Likó, I., Czirják, S., Igaz, P., Khan, M.M., Zivkovic, V., Bálint, K., Korbonits, M., Rácz, K., **Patócs, A.** (2010) Down-regulation of Wee1 kinase by a specific subset of microRNA in human sporadic pituitary adenomas. **J Clin Endocrinol Metab** **95**: E181-E191.



KAROLINA MILENA PIRACS

Semmelweis University
Faculty of Medicine
Department of Translational Medicine

RESEARCH AREA

I am interested in how alterations in autophagy contribute to healthy ageing and the pathophysiology of age-related, chronic neurodegenerative disorders such as Parkinson's disease, Alzheimer's disease and Huntington's disease.

SELECTED PUBLICATIONS

Piracs, K., Drouin-Ouellet, J., Horváth, V., Gil, J., Rezeli, M., Garza, R., Grassi, D.A., Sharma, Y., St-Amour, I., Harris, K., Jönsson, M.E., Johansson, P.A., Vuono, R., Fazal, S.V., Stoker, T., Hersbach, B.A., Sharma, K., Lagerwall, J., Lagerström, S., Storm, P., Hébert, S.S., Marko-Varga, Gy., Parmar, M., Barker, R.A., Jakobsson, J. (2021) Distinct subcellular autophagy impairments in induced neurons from Huntington's disease patients. **Brain** awab473 (online, ahead of print)

Brattas, P.L., Hersbach, B.A., Madsen, S., Petri, R., Jakobsson, J., **Piracs, K.** (2020) Impact of differential and time-dependent autophagy activation on therapeutic efficacy in a model of Huntington disease. **Autophagy** **17**: 1316-1329.

Piracs, K., Petri, R., Madsen, S., Brattås, P.L., Vuono, R., Ottosson, R.D., St-Amour, I., Hersbach, A.B., Matusiak-Brückner, M., Hult, Lundh, S., Petersén, A., Déglon, N., Hébert, S.S., Parmar, M., Barker, A.R., Jakobsson, J. (2018) Huntingtin aggregation impairs autophagy leading to Argonaute-2 accumulation and global microRNA dysregulation. **Cell Rep** **24**: 1397-1406.

Drouin-Ouellet, J., Lau, S., Brattas, P.L., Rylander, Ottosson, D., **Piracs, K.**, Grassi, D., Collins, M.L., Vuono, R., Sjöland, A.A., Westergren-Thorsson, G., Graff, C., Minthon, L., Toresson, H., Barker, A.R., Jakobsson, J., Parmar, M. (2017) REST suppression mediates neural conversion of adult human fibroblasts via microRNA dependent and independent pathways. **EMBO Mol Med** **9**: 1117-1131.



FRIGYES SÁMUEL RÁCZ

Semmelweis University
Faculty of Medicine
Department of Physiology

RESEARCH AREA

In our study we investigate the effects of aging on neurodynamics and various aspects of cognitive functioning. Our research focuses on the identification of neurophysiological biomarkers that can potentially predict age-related changes in cognition and help better understand their biological origin. Our project has two fundamental aspects. First, we develop new analytical and computational methods that can effectively capture nontrivial features of neural dynamics. These include, but are not limited to methods for assessing the fractal properties of dynamic functional connectivity among distinct brain regions, a subfield that only recently became the focus of interest in the field of neuroscience. Second, we collect and analyze data from our population of interest, specifically healthy (i.e., no history of any neuropsychiatric disorder or any severe general medical condition), elderly individuals. Results from the elderly group are contrasted with those obtained from healthy, young (age < 40 years) adults. We record cortical activity using electroencephalography (EEG). Measurements are first performed in resting-state (i.e., not engaging in any specific mental activity), then EEG is recorded while subjects perform three different cognitive tasks. These all put different mental skills to test, such as pattern recognition, working memory or spatial orientation and learning. Following the EEG recordings, participants are further evaluated using the standardized and validated



ANNA SEBESTYÉN

Semmelweis University
Faculty of Medicine
Department of Pathology and Experimental
Cancer Research

RESEARCH AREA

The signalling network failures of solid tumours, and their tissue heterogeneity are in the focus of our Tumour Metabolism Research Group. Our main questions are related to the regulatory role of mTOR signalling in cellular metabolism, metabolic heterogeneity and plasticity. We are characterising human cancer tissues and additionally, we can use traditional 2D cell culturing and xenograft models in our experimental research work regarding to tumour progression, therapy resistance and metastasis. Furthermore, in our new research direction we are developing and applying new in vitro 3D bioprinted cancer models.

Cambridge Neuropsychological Test Automated Battery (CANTAB). This session includes seven further tasks, each testing various aspects of cognition that are most commonly affected in conditions related to age and pathologies eventually leading to dementia. Our research therefore not only focuses on how resting-state neural activity might predict performance related to different aspects of cognition, it is also equivalently important, how the brain adapts to increased mental challenge/workload, and how this adaptation might be affected at a later age.

SELECTED PUBLICATIONS

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Racz, F.S., Mukli, P., Nagy, Z. and Eke, A., (2018) Multifractal dynamics of resting-state functional connectivity in the prefrontal cortex. **Physiological measurement 39**: p.024003.

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Nemes, K., Csóka, M., Nagy, N., Márk, Á., Várad, Z., Dankó, T., Kovács, G., Kopper, L., **Sebestyén, A.** Expression of certain leukemia/lymphoma related microRNAs and its correlation with prognosis in childhood acute lymphoblastic leukemia. **Pathol Oncol Res. 2015 Jul**;21(3):597-604.



BEÁTA SPERLÁGH

Institute of Experimental Medicine
Molecular Pharmacology Research Group

RESEARCH AREA

ATP is one of the most versatile molecule in the living cells: it is well known as the universal “energy currency”, and as a building block of DNA, but it is also an important signalling substance of intercellular communication. This latter function of ATP is mediated by ionotropic P2X and metabotropic P2Y receptors. The general scientific mission of my research is to understand the ATP mediated signalling in the normal and pathological nervous system; and thereby to identify new therapeutic targets for the treatment of CNS diseases. We employ multidisciplinary approaches to study purinergic mechanisms, including studies on the release and action of ATP, mapping and identification of purinergic receptors under physiological conditions and in animal models of various neurological and psychiatric disorders and clinical studies. The main focus of our current interest is to identify the role of P2X7 receptors and the coupled signalling pathways (NLRP3-IL-1beta) in animal models of autism, schizophrenia and mood disorders as well as that of the metabotropic P2Y12 receptors in the pathophysiology of pain and Parkinson’s disease.



JÁNOS SZABADICS

Institute of Experimental Medicine
Cellular Neuropharmacology Group

RESEARCH AREA

The current theories of the broader hippocampal network explain its memory functions based on the firing of individual neurons. However, the cellular mechanisms that underlie these functions are elusive. We are interested in the functions that determine the activity of dentate gyrus granule cells (DG GC). DG GCs translate diverse inputs into highly different specific codes, which underlies the so-called pattern separation that allows us to distinguish similar events, objects. We focus on the principles that govern how single GCs extract information from the activity of single upstream neurons from the four major input pathways using direct patch clamp recordings and voltage-sensitive dye/protein imaging of single small axon terminals together with anatomical and computational approaches. The two perforant paths (PPs) that originate from the medial and lateral entorhinal cortices convey spatial context (such as the famous grid cell activity) or specific information content (for example certain objects). Inputs from hilar mossy cells distinguishes subtle differences and inputs from the hypothalamic supramammillary nucleus synchronizing GC activities during attention.

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- Bekó, K., Koványi, B., Gölöncsér, F., Horváth, G., Dénes, Á., Környei, Z., Botz, B., Helyes, Z., Müller, C.E., **Sperlách, B.** (2017) Contribution of platelet P2Y12 receptors to chronic Complete Freund’s adjuvant-induced inflammatory pain. **J Thromb Haemost** **15**: 1223-1235.

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NÁNDOR SZEGEDI

Semmelweis University
Faculty of Medicine
The Hearth and Vascular Center of
Semmelweis University

RESEARCH AREA

My main research area is cardiac electrophysiology, with a highlight on catheter ablation treatment of atrial fibrillation (AF). AF is the most common sustained rhythm disorder, the invasive therapy of which is much more effective than drug treatment, but its effectiveness falls short of that of other arrhythmias. Accordingly, further developments and the evaluation of new techniques' effectiveness and safety are essential. Currently, I am mainly interested in high-energy radiofrequency ablation and electroporation.

SELECTED PUBLICATIONS

Orbán G., Salló Z., Perge P., Ábrahám P., Piros K., Nagy KV., Osztheimer I., Merkely B., Gellér L., **Szegedi N.** (2022) Characteristics of Very High-Power, Short-Duration Radiofrequency Applications. **Front Cardiovasc Med.** **9:** 941434.

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KÁLMÁN TORY

Semmelweis University
Faculty of Medicine
1st Department of Paediatrics

RESEARCH AREA

The research group formerly identified the first variant with a trans-associated mutation-dependent pathogenicity in an autosomal recessive disorder (NPHS2 R229Q) [Tory et al, Nat Genet, 2014] and a novel gene of steroid-resistant nephrotic syndrome (DKC1). They demonstrated the role of rRNA-pseudouridylation in DKC1-associated nephrotic syndrome [Balogh et al, PNAS, 2020]. The group created a novel population-genetic algorithm to identify novel incompletely penetrant variants and interallelic interactions in autosomal recessive disorders [Mikó et al, Hum Mutat, 2021]. Function and interallelic interactions of the most frequently implicated protein in steroid-resistant nephrotic syndrome, podocin, as well as the function of novel genes are studied in cell culture experiments and on a *Caenorhabditis elegans* model.

SELECTED PUBLICATIONS

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BALÁZS UJFALUSSY

Institute of Experimental Medicine
Biological Computation Research Group

RESEARCH AREA

We are using mathematical models and computational analysis to study the neuronal basis of memory and navigation. Our goal is to understand how basic biophysical mechanisms in a specific neuronal system (the hippocampus) give rise to higher order cognitive processes. What is the effect of nonlinear dendritic processing of inputs on the dynamics of the network and thus how they influence the learning and recall of memories and ultimately the behavior of the animal? We answer similar questions using computational models in close collaborate with experimental colleagues. During the research, models are also used in a different way: during learning the neuronal network of the brain develops a model of the environment that the animal can use to interpret the incoming sensory information or to predict possible future consequences of its actions. Describing or analysing both of these models requires computational tools. We are looking for students passionate for understanding the nervous system but also interested in mathematics and programming.



SZABOLCS VÁRBÍRÓ

Semmelweis University
Faculty of Medicine
Department of Obstetrics and Gynaecology

RESEARCH AREA

Our work group studied cardiovascular effects of female sexualsteroids in different animal models: its protective role in gender studies and in gender related cardiovascular sport adaptation studies. In pathophysiological models: cardiovascular adaptation in hypertension, menopause and polycystic ovary syndrome. In clinical studies we examine the connections of cardiovascular diseases with previous deliveries, spontaneous abortions - and its potential genetic and psychological background. During our experiments we use in vivo and in vitro observation methods: eg. treatment of vigil and anaesthetized animals - different surgical methods of experimental animals - isolation of vessels from different regions and vascular beds, the biomechanical and pharmacological reactivity of isolated vessels and also LAD network analysis with vascular physiology methods and immunohistochemical analysis of histological sections.

SELECTED PUBLICATIONS

Ujfalussy, B.B., Orbán, G. (2021) Sampling motion trajectories during hippocampal theta sequences. *BioRxiv* 2021.12.14.472575.

Ujfalussy, B.B., Makara, J.K., (2020) Impact of functional synapse clusters on neuronal response selectivity. *Nature Comm* 11: 1-14.

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VIKOR VARGA

Institute of Experimental Medicine
Subcortical Modulation Research Group

RESEARCH AREA

We live in an ever-changing world. Our survival and well-being depend on how we can adapt to it by momentarily readjusting our actions. In order to do so, we have to filter out unimportant inputs and store only relevant information. Then, based on the combination of freshly acquired information and our memories, we select an action plan matching the actual situation. Subcortical modulation, by influencing all stages of cortical information processing, is indispensable for the selection, storage and recall of information and for carrying out the optimal action. Disruption of subcortical modulation leads to severe psychiatric illnesses. Our lab aims to unravel the operational principles of subcortical modulation. We aim to decipher the modulatory signal (or code) and how it influences information processing in target cortical circuits. We are also interested in the feedback from the cortex to subcortical regions whereby we would be able to uncover how cortical circuits control their modulation.



ZOLTÁN VARGA

Semmelweis University
Faculty of Medicine
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

We are aiming to explore key inflammatory mechanisms of cardiovascular (heart failure and myocardial infarction) and oncological diseases by using translational animal models, cell cultures, and human samples. We place special emphasis on studying the interconnection of cancer and cardiovascular comorbidities, and investigating the potential pharmacological treatment of these conditions.

SELECTED PUBLICATIONS

Varga, V. (2021) Activity and coupling to hippocampal oscillations of median raphe GABAergic cells in awake mice. *Front Neural Circuits* **15**: 784034.

Barth, A.M., Domonkos, A., Fernandez-Ruiz, A., Freund, T.F., **Varga, V.** (2018) Hippocampal network dynamics during rearing episodes. *Cell Reports* **23**: 1706-1715.

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Vandecasteele, M., **Varga, V.**, Berényi, A., Papp, E., Bartho, P., Venance, L., Freund, T.F., Buzsáki, G. (2014) Optogenetic activation of septal cholinergic neurons suppresses sharp wave ripples and enhances theta oscillations in the hippocampus. *Proc Natl Acad Sci USA* **111**: 13535-13540.

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Onódi, Z., Ruppert, M., Kucsera, D., Sayour, A.A., Tóth, V.E., Koncsos, G., Novák, J., Brenner, G.B., Makkos, A., Baranyai, T., Giricz, Z., Görbe, A., Leszek, P., Gyöngyösi, M., Horváth, I.G., Schulz, R., Merkely, B., Ferdinandy, P., Radovits, T., **Varga, Z.V.** (2021) AIM2-driven inflammasome activation in heart failure. *Cardiovasc Res* **117**: 2639-2651.

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ZOLTÁN ZÁDORI

Semmelweis University
Faculty of Medicine
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

The gastrointestinal (GI) mucosa is constantly exposed to a wide variety of luminal aggressors, including gastric acid, pepsin, bile acids and bacterial components. In order to withstand these damaging factors and maintain the integrity of mucosal barrier, several physical and chemical defense mechanisms interact in a complex manner. Numerous conditions can lead to GI ulcers by directly damaging the epithelial cells and/or by disrupting the delicate balance between aggressive and defensive factors. Our previous studies focused mainly on the pathogenesis of gastric ulcers, whereas our recent projects aim to characterize the pathogenesis of small intestinal injury (enteropathy) caused by nonsteroidal anti-inflammatory drugs (NSAIDs) or by ischemia/reperfusion. One of our main interests is to analyze the NSAID-induced changes in intestinal bacteria and bile acids, and to identify the factors contributing to alterations of the microbiota. We also aim to identify novel therapeutic options for the treatment of enteropathy.

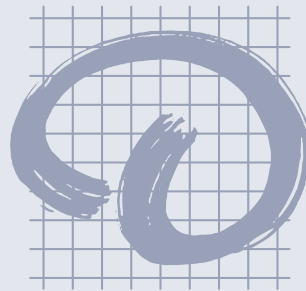
SELECTED PUBLICATIONS

Hutka, B., Lázár, B., Tóth, A.S., Ágg, B., László, S.B., Makra, N., Ligeti, B., Scheich, B., Király, K., Al-Khrasani, M., Szabo, D., Ferdinandy, P., Gyires, K., **Zádori, Z.S.** (2021) The nonsteroidal anti-inflammatory drug ketorolac alters the small intestinal microbiota and bile acids without inducing intestinal damage or delaying peristalsis in the rat. **Frontiers In Pharmacology 12:** 664177.

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László, S.B., Lázár, B., Brenner, G.B., Makkos, A., Balogh, M., Al-Khrasani, M., Hutka, B., Mohammadzadeh, A., Kemény, Á., László, T., Scheich, B., Szabados, T., Kenyeres, É., Giricz, Z., Bencsik, P., Varga, Z.V., Novák, J., Helyes, Z., Ferdinandy, P., Gyires, K., **Zádori, Z.S.** (2020) Chronic treatment with rofecoxib but not ischemic preconditioning of the myocardium ameliorates early intestinal damage following cardiac ischemia/reperfusion injury in rats. **Biochemical Pharmacology 178:** 114099.

Lázár, B., Brenner, G.B., Makkos, A., Balogh, M., László, S.B., Al-Khrasani, M., Hutka, B., Bató, E., Ostorházi, E., Juhász, J., Kemény, Á., László, T., Tiszlavicz, L., Bihari, Z., Giricz, Z., Szabó, D., Helyes, Z., Ferdinandy, P., Gyires, K., **Zádori, Z.S.** (2019) Lack of small intestinal dysbiosis following long-term selective inhibition of cyclooxygenase-2 by rofecoxib in the rat. **Cells 8:** (3) 251.



BUDAPEST SZENT-GYÖRGYI JUNIOR MENTORS



LÁSZLÓ BIRO

Institute of Experimental Medicine

RESEARCH AREA

Exposure to acute stress can lead to the emergence of behavioral disturbances that place a heavy burden on both the individual and society. Previous research indicated that the paraventricular thalamic nucleus (PVT) is a brain area that plays a key role in the modulation of fear, anxiety, and increased arousal. Calretinin-expressing neurons in the paraventricular thalamus (PVT/CR+) exhibit significant activation under acute stress. In addition, PVT/CR+ cells send selective innervation to key stress-sensitive brain regions in the forebrain, suggesting a large-scale influence on brain function and behavior. In our research, we study the neurochemical identity, topography and the functional contribution of the ascending subcortical projections targeting the PVT/CR+ neurons in stress-induced behavioral disturbances.



HENRIETT BUTZ

Semmelweis University
Faculty of Medicine
Department of Laboratory Medicine

RESEARCH AREA

Our research interest focuses on the clinical and molecular genetics of hereditary cancer and tumor syndromes and the pathogenesis of rare cancers and tumors of the neuroendocrine system. Clinical genetic research supports the complex genetic care of cancer patients including genetic susceptibility, prevention, targeted therapy, family screening, and the implementation of novel genetic methods into the daily routine. Modern molecular genetic methods and translational research support the precise understanding of tumor pathogenesis and the identification of diagnostic, prognostic, and predictive biomarkers.

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CSABA CSERÉP

Institute of Experimental Medicine

RESEARCH AREA

Microglia, the resident immune cell of the brain, plays an important role during the development of the nervous system, contributes to the maintenance of the brain microenvironment's stability, and participates in many physiological and pathophysiological processes. Over the past few years, we have managed to discover a previously unknown functional-anatomical relationship between microglia and neurons, which seems to be crucial in the regulation of neuronal activity. In the future – going down on this new path – we would like to systematically explore the communication sites microglia establish with neurons, other glial cells or the vasculature, and explore the molecular and ultrastructural characteristics of these intercellular communication hot-spots. We plan to pay special attention to the mitochondria, since these cell organelles - based on our preliminary results - play a prominent role in the communication between microglia and other cells. During the research, we use the most modern microscopic imaging procedures, such as STED super-resolution microscopy, scanning electron microscopic array tomography or transmission electron tomography and reconstruction.



KRISZTINA ELLA

Semmelweis University
Faculty of Medicine
Department of Physiology

RESEARCH AREA

The circadian time-keeping system enables the organism to anticipate the daily environmental changes and therefore is a crucial factor of adaptation. The endogenous rhythm is generated at the cellular level by a mechanism based on the action of interconnected transcription/translation feedback loops. The circadian system has a central pacemaker in the suprachiasmatic nucleus (SCN), which may coordinate and synchronize the peripheral oscillators present in other tissues through neuronal and humoral pathways. The main regulator of the SCN is light, but the peripheral clocks can also be modified by metabolic effects (e.g. food intake and its timing). Cellular clock function influences a wide range of physiological and pathological processes, e.g. both activity of the immune system and leukocyte migration have a characteristic circadian rhythm. Our investigations focus on the following questions: 1.) Which neural, humoral, hormonal and metabolic factors influence the circadian rhythm of immune functions? 2.) Which clock proteins control the effector functions of immune cells? 3.) What kind of individual differences can be detected in the clock function of the immune system? 4.) How does the circadian rhythm of the immune system change in different inflammatory and metabolic diseases and in sepsis? 5.) Is a cell's own molecular clock necessary for the control of rhythmic processes or is the operation of the central clock in the SCN sufficient? Understanding the regulation of the rhythmic

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immune system activity may help to identify therapeutic targets or design complementary therapeutic tools. For example, development of chronotherapeutic (time-dependent drug administration) strategies and design of individualised therapy for various inflammatory or other immune-related diseases could be possible.

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ANNA ZSUZSANNA FÖLDES

Semmelweis University
Faculty of Dentistry
Department of Oral Biology

RESEARCH AREA

Present research field: Characterisation of stem cells of dental origin, studies on tissue regeneration-, differentiation capacity and immunomodulatory effects in vitro; studies on the structural and functional differentiation of the salivary gland and its secretion and transport processes. Development of a 3D cellular model of the ameloblast, studies on its structural and functional differentiation, secretion and transport processes. Covid research. previous research field: Functional neuroanatomy of the neuroendocrine hypothalamus, mapping of stress-related CNS networks; neurobiological effects of drug withdrawal, role and effects of histamine in the regulation of feeding (nutrition).



KRISZTINA NÉMETHNÉ FUTOSI

Semmelweis University
Faculty of Medicine
Department of Physiology

RESEARCH AREA

Autoimmune and autoinflammatory diseases are characterized by the pathological overactivation of the immune system. In addition to acute flares, these inflammations in most cases show a chronic, progressive course and are associated with significant tissue damage, resulting in a significant deterioration in the quality of life of the affected patients. Our research group investigates the cellular and molecular mechanisms underlying the above inflammatory processes, which may contribute to a better understanding of the pathomechanism of these diseases and to identify new therapeutic targets. In our recent studies, we investigate the role of tyrosine kinase signaling pathways in the development of autoimmune arthritis, and in the urate crystal-mediated non-autoimmune gout by using genetic and pharmacological approaches. In recent years, we have identified a number of signaling molecules involved in the development of these inflammatory processes.

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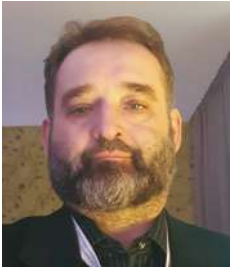
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GÁBOR NYIRŐ

Semmelweis University
Faculty of Medicine
Department of Laboratory Medicine
Department of Internal Medicine and
Oncology

RESEARCH AREA

Tumors originating from the human adrenal cortex can be divided in two groups, adrenocortical adenomas (ACA) which are more frequent but benign and adrenocortical carcinomas (ACC) with bad prognosis but luckily also less frequent. Differentiating these two tumor types is difficult even for an experienced pathologist from postoperative tissue samples. Our research group is looking for specific molecular markers, so called microRNAs, that could help in these differentiations. The expression of microRNAs is tissue specific (thus tumor specific). They also have a role in the regulation of gene expression so their role can be regarded either tumor driver or tumor suppressor. MicroRNAs are stable, they are present in (tumor) tissues, in the blood, and in other body fluids. This gives us a possibility to exploit them as minimal invasive biomarkers in diagnostics. MicroRNAs are present in neuroendocrine tumors of the gastrointestinal tract. We plan to investigate the diagnostic possibilities of microRNA expression in pancreas neuroendocrine tumors (pNET) in this project.



BALÁZS PÓSFAI

Institute of Experimental Medicine

RESEARCH AREA

Microglia are the main immune-competent cells of the brain that form transient contacts with other cellular elements of the central nervous system using their evermoving processes. We set out to examine the role of microglia in basic physiological and pathological processes of the nervous system. We combine cutting-edge anatomical techniques with in vivo, ex vivo and in vitro approaches to investigate microglial contactomics, especially somatic junctions established with the cell bodies of neurons and contacts with elements of the neurovascular unit. Our experiments provide opportunity for observations ranging from population level to the subcellular, nanoscale level.

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DÓRA RAVASZ

Semmelweis University
Faculty of Medicine
Department of Biochemistry

RESEARCH AREA

Energy is provided in the form of ATP by the mitochondrial respiratory chain in many cell types, as the oxidation of nutrients takes place partially in mitochondria, with the help of oxygen from the air. In case of oxygen deprivation or inhibition of the respiratory chain, the energy supply of the cell is disrupted, and instead of producing, mitochondria start to consume energy. An enzymatic reaction in the mitochondrial matrix can prevent this by generating ATP independently of the respiratory chain. Our research group has described several biochemical pathways which modulate the efficiency of this reaction. We also investigate metabolic pathways that can still fuel the respiratory chain when it is inhibited, by providing alternative entry points into the system, thus they are able to maintain ATP production to a certain level. Our aim is to characterize such ATP generating processes and the pathways required for their operation. These can not only help the survival of cells exposed to decreased oxygen supply, but they can also provide energy for tumor cells, often found in a hypoxic environment. Thus the enzymes involved are potential therapeutic targets in these tumors.



ANDREA SZABÓ-VERECZKEI

Semmelweis University
Institute of Biochemistry and Molecular
Biology
Department of Molecular Biology

RESEARCH AREA

The main topic of my research interest is the genetic analysis of various psychiatric diseases and their possible predisposing genetic factors. My research career began with the investigation of genetic risk factors for heroin addiction at the Institute of Medical Chemistry, Molecular Biology and Pathobiochemistry at Semmelweis University (currently Department of Molecular Biology). During my work, I mainly investigated the genetic risk factors of the dopaminergic and serotonergic systems in the background of the development of heroin addiction and the success of replacement therapies. Over the years, I have participated in the genetic research of depression, obsessive-compulsive disorder (OCD), attention deficit hyperactivity disorder (ADHD) and Tourette's syndrome as part of collaborations. In recent years, I have primarily been involved in examining the genetic risk factors of potentially addictive substances (alcohol, tobacco, cannabis and other drugs) and behaviors (internet use, online gaming, social media use, gambling, exercise, hair pulling, eating).

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SZABOLCS TAKÁCS

Institute of Experimental Medicine
Reproductive Neurobiology

RESEARCH AREA

Molecular, cellular and system biology research at the Laboratory of Reproductive Neurobiology aims to provide a deeper understanding of the central regulatory mechanisms of human reproduction. Hypothalamic secretion of gonadotropin-releasing hormone (GnRH) builds up during pubertal development. Secretory pulses of GnRH at every 30-90 minutes stimulate luteinizing and follicle stimulating hormone (LH and FSH) production in the anterior pituitary gland. These troph hormones, in turn, initiate and later maintain functions of the gonads (testes and ovaries). This laboratory combines anatomical, electrophysiological and molecular approaches to study i) the neuronal and hormonal control of pulsatile GnRH/LH secretion, ii) the mechanisms of the mid-cycle GnRH/LH surge which triggers ovulation in females, iii) the central effects of gonadal steroid hormones on neuroendocrine systems and on wider aspects of general neuronal functioning and iv) the molecular and cellular processes underlying reproductive senescence. Techniques applied for single-cell research include traditional neuroanatomical approaches, slice electrophysiology and high-throughput and high-resolution molecular biology methods. In recent years, the laboratory preferentially uses human hypothalamic tissue samples in anatomical and molecular research. In view of the limited translational value of rodent models in reproductive biology, the Human Hypothalamus Research Unit

became the most dynamically developing research unit with a broad focus on the role of the hypothalamus in neuroendocrine, metabolic and autonomic regulation. Studies of the Laboratory of Reproductive Neurobiology may lead to a better understanding of various human pathologies, such as different forms of central infertility, polycystic ovary syndrome (PCOS), ovarian cycle disturbances due to insufficient caloric intake (e.g. anorexia nervosa) or stress, abnormal pubertal development (e.g. precocious puberty, hypogonadotropic hypogonadism), and central nervous system dysfunctions caused by postmenopausal estrogen deficiency.

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MÁTÉ TÓTH

Institute of Experimental Medicine
Laboratory of Translation Behavioural
Neuroscience

RESEARCH AREA

Our behavioral neuroscience research focuses on translational research questions, i.e. to explore the neurobiological mechanisms of mental disorders (mainly anxiety-affective and posttraumatic stress disorders). We use and develop clinically valid animal models of these disorders in order to explore the etiological background on multiple levels: what molecular and neural network alterations mediate pathological changes and vulnerabilities for these conditions. We apply mostly 'top-down' approach by using relevant behavioral paradigms to catch an important aspect of the disorder (e.g. fear generalization or passive coping) and then we investigate the underlying molecular and network characteristics/mechanisms by means of qPCR, immunohistochemistry, and microscopic techniques. Subsequently, we test the casual importance of these mechanisms (e.g. by chemogenetics).

SELECTED PUBLICATIONS

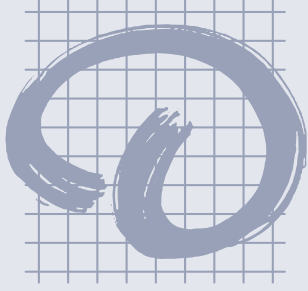
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BUDAPEST SZENT-GYÖRGYI STUDENTS



BÁLINT ANTAL

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 1st year

1ST YEAR STUDENTS

Szent-Györgyi Mentor: Attila Patócs

Junior mentor: Henriett Butz

Theme of research: Modelling of mechanisms associated
with hereditary genetic alteration

Language: English/intermediate



ANDRÁS BUZÁS-KAIZLER

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Éva Mikics

Junior mentor: Máté Tóth

Theme of research: Mechanisms of neuroplasticity in
stress-related mental disorders

Language: English/intermediate



MÁTÉ CSEPI

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Csaba Hegedűs

Theme of research: In silico characterization of membrane
proteins' complexes and disordered regions

Language: English/intermediate



REBEKA ÉRSEK

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: László Köhidai

Junior mentor: Orsolya Láng

Theme of research: Antitumor effects of novel
aminophosphonate derivatives on pancreatic tumor cells

Language: English/advanced



ZSANNA GECSE

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Nándor Nagy

Theme of research: Isolation and transplantation of
embryonic and postnatal enteric nervous system derived
stem cells

Language: English/advanced



REBEKA GELENCSÉR

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 1st year

Szent-Györgyi Mentor: Anna Sebestyén

Theme of research: Metabolic heterogeneity studies
applying newly developed 3D bioprinted cancer models
stem cells

Language: English/intermediate, German/intermediate



MIRJAM HEGEDÜS

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 1st year

Szent-Györgyi Mentor: Zsolt Lele

Theme of research: Investigation of the neuronal
distribution of potentially novel endocannabinoid
synthesizing enzymes, receptors, and ligands with super-
resolution (STORM) microscopy.

Language: German/advanced



CSENGE LILI JURENKA

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Eszter Horváth

Theme of research: Oxidative-nitrative stress in endocrine
and cardiovascular diseases of females

Language: English/intermediate



VIOLA NAGY

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Csaba Barta

Junior mentor: Andrea Szabó-Vereczkei

Theme of research: Genetic and epigenetic associations of
addictions and other psychiatric disorders

Language: English/advanced



ÁGNES PAKUTS

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Eszter Horváth

Theme of research: Role of oxidative-nitrative stress in
polycystic ovary syndrome related periodontal disease

Language: English/advanced, German/advanced



VIVIEN SIMON

National Academy of Scientist Education,
1st year

Semmelweis University
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Tamás Német
Theme of research: Identification of the cellular and
molecular components of autoimmune inflammation
Language: English/advanced



CSONGOR GYÖRGY SZÁNTÓ

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 1st year

Szent-Györgyi Mentor: Krisztina Káldi
Junior mentor: Krisztina Ella
Theme of research: Investigation of the interactions of the
circadian clock with metabolism and the immune system in
mouse models
Language: English/advanced



SÁRA VIDA

National Academy of Scientist Education,
1st year

Semmelweis University,
Faculty of Medicine, 1st year

Szent-Györgyi Mentor: Ádám Dénes
Junior mentor: Balázs Pósfai
Theme of research: Molecular mechanisms of microglia-
neuron interactions
Language: English/advanced, French/intermediate,
German/intermediate



BENCE CZUMBEL

National Academy of Scientist Education,
2nd year

Semmelweis University
Faculty of Medicine, 3rd year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Hydrogen sulfide (H₂S) was once considered to have only toxic properties, until it was discovered to be an endogenous signaling molecule. Mitochondria play an important role in its catabolism, in the reaction catalysed by sulfide-quinon-oxidoreductase, H₂S is oxidized, coenzyme Q is reduced, thus it has a metabolic connection to the respiratory chain. Our research focuses on the effect of H₂S on oxidative phosphorylation, especially if the respiratory chain works dysfunctionally (which we model by blocking different complexes of the respiratory chain and/or creating anoxic conditions).

2ND YEAR STUDENTS

Szent-Györgyi Mentor: Christos Chinopoulos

Junior mentor: Dóra Ravasz

Specialization: oncometabolism, mitochondriology

Language: English/intermediate

AMBITIONS AND CAREER GOALS

My goal is to be a useful member of my research group and to gain scientific experience. As a second year medical student I have not made any definite plans regarding my future, I can see myself both as a researcher and a practicing physician, therefore, the most appealing option for me would be if my future work could somehow combine these two activities.



DORINA DEBRECZENI

National Academy of Scientist Education,
2nd year

Semmelweis University
Faculty of Medicine, 2nd year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

In my research, I investigate human TMEM175 lysosomal and TRESK two-pore potassium channels and their various mutations for their electrophysiological properties and regulatory mechanisms. The TMEM175 potassium channel plays an important role in regulating the K⁺ permeability of the lysosomal and endosomal membranes. This transmembrane protein has a special structure: it does not contain the P domain, which is the selectivity filter in all other known potassium channels. It is therefore questionable what is the reason for the high selectivity of TMEM175 for K⁺ over Na⁺. We also investigate the regulation of PKB, ion selectivity, and the effect of additional inhibitors (e.g., 4-aminopyridine) on TMEM175. One variant of TMEM175 (M393T) may be associated with an early onset of a neurodegenerative disease, Parkinson's disease, according to recent research. To understand this mechanism, it is particularly important to investigate the properties of the TMEM175 channel, as it may later be the target of drug treatments. K₂P channels are common determinants of the regulated K⁺ conductance of the plasma membrane, found in most animal and plant species, but are extremely structurally and functionally diverse. The TRESK K₂P channel I examined is found in significant amounts in the sensory neuron subpopulations responsible for pain perception, affecting their excitability and the intensity of the response to painful stimuli. Some mutations in TRESK cause a rare

Szent-Györgyi Mentor: Gábor Czirják

Specialization: molecular biology and electrophysiology

Language: English/advanced, German/intermediate

form of hereditary migraine headache. In our research, we study general and direct regulatory mechanisms of the TRESK channel in heterologous systems that are likely to be independent of the cell-expressing cell type. Thus, a significant part of the mechanisms we describe provide a good basis for further studies to elucidate the role of the TRESK channel in pain perception.

AMBITIONS AND CAREER GOALS

I have been very curious and busy getting to know the complex living systems, the microscopic material world around us, and I can create something scientifically lasting. I believe that research provides an opportunity to develop a new way of thinking in addition to the material knowledge that can be acquired. One of my goals is to do research in addition to my medical work after completing my studies, as this way I may help more.



KATA KÓTA

National Academy of Scientist Education,
2nd year

Semmelweis University
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: László Acsády

Junior mentor: László Biró

Specialization: thalamic research

Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

The thalamus is an especially important area in the brain, as it is the major source of inputs of the cerebral cortex, which is the top level information processor. Without the thalamus, the cortex has very little access to information from other areas of the brain. The cortex and the thalamus form a functional unit, and the disfunction of this thalamocortical system plays role in numerous neurological and psychiatric diseases. In spite of this, until recently thalamic research has been focused on a very narrow area, the relay of sensory inputs to the cortex, however all cortical areas are in connection with thalamic nuclei. Because of the lack of research, very little is known about the exact function of many thalamic nuclei so far. Our group aims to understand better this complex thalamocortical system.

A part of the group focuses on the inputs of one of the thalamic nuclei, the paraventricular nucleus (PVT). Via injecting viruses into definite areas of the brain of transgenic mice, we can visualize the axons ending in the PVT using a fluorescent or confocal microscope. This helps us determine the source of PVT inputs. Besides, we are also interested in exactly which areas of the PVT the axons from different sources

end, and whether they are segregated or not. Based on this information, we can reveal the degree of integration of inputs from different sources in the PVT, which could help in understanding its exact function.

AMBITIONS AND CAREER GOALS

During my university years, I would like to acquire both theoretical and practical knowledge in order to become a good physician. It is equally important for me to join a scientific research group to learn about research work because of scientific techniques, because, I am convinced, this experience will be valuable later during my work.



HUNOR SEBŐK

National Academy of Scientist Education,
2nd year

University of Veterinary Medicine,
Budapest, 3rd year

Szent-Györgyi Mentor: Gábor Nyiri

Specialization: functional neuroanatomy

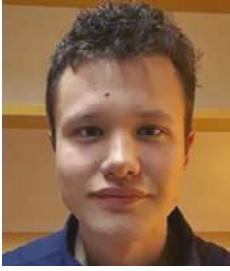
Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Different parts of the cerebral cortex, like the memory encoding hippocampus, are highly dependent on the excitatory and inhibitory pathways from deeper brain regions. Understanding how they work is essential to understanding their role in pathological conditions so that we can later treat these diseases by stimulating or inhibiting them. Both pharmacological and gene therapy would be possible for cell-specific treatment in the future. Our group has recently discovered a novel neural pathway provided by a basal forebrain cholinergic cell population that targets the hippocampus. Cholinergic cells have been implicated many times in a variety of neurodegenerative diseases, therefore examining this pathway may provide a promising opportunity to treat certain attention-related or anxiety-related diseases.

AMBITIONS AND CAREER GOALS

The complexity of nature and the underlying mechanisms of biological systems has always amazed me. The brain is one of the most complex systems in the world, thereby understanding it is exciting from many aspects. In addition to getting to know the brain, my goal is to learn and master as many modern techniques as possible. After the bachelor's and master's degrees, I would like to use these in my PhD studies as well.



BENDEGÚZ GÁBOR SRAMKÓ

National Academy of Scientist Education,
2nd year

Semmelweis University
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Karolina Piracs
Junior mentor: Anna Zsuzsanna Földes
Specialization: neurobiology
Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

His research will focus on the isolation and reprogramming of dental pulp stem cells (DPSCs). These neural crest derived mesenchymal stem cells shows an excellent potential for neuronal fate determination. Therefore they may provide a new source of functionally active, direct reprogrammed neurons in vitro. Bendegúz will collaborate with the Semmelweis University Department of Oral Biology in order of the isolation and characterisation of DPSCs.

their physiological job and it can lead to diseases. I think these reasons are enough for a following medical doctor to want to know the world of cells always better and better. The human species interested me always better than everything else in biology, but maybe it is not my only one reason to study medicine. I can't imagine more beautiful cognitive behaviour, than medicine, because it is not just a type of science, it is an altruist behaviour, that helps me to be a useful member of society. I want to be an experienced doctor in science and in humane.

AMBITIONS AND CAREER GOALS

I think I have a subjective relationship with biology. To observe and describe a part of life makes me a special joy, a type of enthusiasm. To deal with biology means for me to deal with living systems, which are well describable, and between them, the scientist can observe a logical system, which is the evolution. Most of these proceedings, which are making organisms be able to change their morphological structure and therefore be able to adapt to the varying environment, are manifested firstly in the level of the genes of cells. That's why my interest takes a special look at cells, they are dynamic systems, which can change their metabolism in the order of adaptation. If they aren't able to do that, their function will change inadequately for



MÁTÉ MÁRK SZEKÉR

National Academy of Scientist Education,
2nd year

Semmelweis University
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Krisztina Káldi
Junior mentor: Krisztina Ella
Specialization: circadian rhythm and metabolism
Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

The circadian rhythm is a biological regulatory mechanism, that helps our body adapt to the changing environmental conditions throughout the day. The creation of this rhythm requires a working endogenous clock, the so-called circadian clock. One of the more important regulators of the clock is the timing of food intake. Observation of epidemiologic, as well as animal experiments showed, that limiting food intake to a short time period of the day (time-restricted eating, TRE) has beneficial effects on the rhythm of metabolic activities, and it can be an effective tool in preventing and treating obesity and type II diabetes. Our research group has found that in animal models TRE has a fundamental effect in the responsive capabilities of our immune system, and, overall has an anti-inflammatory effect. Our current experiments are aimed at finding out what is the connection between TRE, leukocyte function, which is determined by bone marrow activity, and the rhythm of adipose tissue function, which represents metabolic activity.

AMBITIONS AND CAREER GOALS

During my time in university, I would like to continue my scientific research within the NTA program, and I would also like to present said work in TDK conferences. While scientific work is important, I don't want to neglect my actual studies. When I'll be working as a doctor, I would still want to take part in scientific research, if I choose to not make research the main focus of my career.



SOMA SZENTKIRÁLYI-TÓTH

National Academy of Scientist Education,
2nd year

University of Veterinary Medicine,
Budapest, 3rd year

Szent-Györgyi Mentor: Erik Hrabovszky

Junior mentor: Szabolcs Takács

Specialization: reproductive neurobiology

Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Activity of hypothalamic gonadotropin-releasing hormone (GnRH) neurons, that comprise the highest level of the reproductive axis, is controlled by estradiol through the kisspeptin neuropeptide system. Kisspeptin neurons have been shown to be abundant in extrahypothalamic regions such as the putamen or the basal forebrain, where they control unknown functions. The goal of our research program is to shine light on the anatomical and molecular biological characteristics of these neuron populations. Based on prior evidence our research will pay special attention to studying the lateral part of the septum pellucidum.

AMBITIONS AND CAREER GOALS

Following my graduation from my current BSc. course I aim to continue my studies. I plan to acquire an MSc. and consequently a doctorate, during and following which working as a research fellow to gain experience. In my career, it is my goal to use the opportunity this scholarship offers to its maximum and contribute to a brighter future.



BÁLINT KENDE SZEREDÁS

National Academy of Scientist Education,
2nd year

Semmelweis University
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: Péter Igaz

Junior mentor: Gábor Nyirő

Specialization: (pancreatic) neuroendocrine tumors

Language: English/advanced, Italian/intermediate,
German/basic

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

A) 2 micro-RNA. We select two of the micro-RNAs used in the literature (hsa-mir-130b-3p and hsa-mir-96-5p), which have been shown to be differentially expressed in different stages of PAN-NETS. The expression of these two miRNAs is rising in a trend between the stages and they show significant expression change. The expression of the hsa-mir-96-5p is rising according to grade, while its target, the FoxO1 shows decreasing staining in the tumors. Expected scientific results: We can validate that the expression of these two miRNAs follows well the development of the tumor, and their expression is clearly equivalent to the grade rank. And does it have diagnostic value? B) We have the opportunity to examine and probably narrow (by type and grade) a panel of 8 miRNAs, which express in every GEP-NET grade based on previous studies. This has diagnostic value. We could examine the FoxO1 expression with qRT-PCR to confirm the microscopic image. Also, we could confirm the connection of miRNA-mRNA with a functional luciferase assay.

AMBITIONS AND CAREER GOALS

Ever since I was committed to biology and medicine, research has always seemed interesting to me. I loved to find out things and understand the background of processes. However, medicine has another part, which is at least as important, where we heal people. I would like to find a combination of these, where I can do both fairly and usefully. This program gives me the opportunity to get a taste of the world of research, even this early in my studies at the university. Due to this, till my graduation I will know, which area I would like to research, and I will have a knowledge base for my PhD work. In addition, probably I will see what proportion should I share my energy and time between medical practice and research.



SIMON TUSNÁDY

National Academy of Scientist Education,
2nd year

Semmelweis University
Faculty of Medicine, 3rd year

Szent-Györgyi Mentor: Attila Mócsai
Junior mentor: Krisztina Némethné Futosi
Specialization: immunology
Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Gout is a common arthritis characterized by recurrent severe inflammatory attacks of the joints, caused by monosodium urate (MSU) crystals deposition. Myeloid cells (neutrophils and macrophages) play an important role in the development of the disease, however, the molecular pathomechanism is not fully understood. In recent years, our research group has investigated the role of tyrosine kinase signaling pathways in autoantibody-induced inflammatory processes and has identified a number of essential signaling molecules. However, the role of tyrosine kinase pathways and PLC γ 2 in the pathogenesis of gout, which is thought to be mediated by a different mechanism from the previously studied diseases, is unknown. Our aim is to investigate the role of PLC γ 2 in MSU crystal-induced neutrophil activation and in an experimental model of gout. Better understanding the pathomechanism of gouty arthritis may contribute to the identification of novel therapeutic targets.

AMBITIONS AND CAREER GOALS

Both in my studies and research project, my main purpose is to gain as much knowledge as possible, to learn many practical techniques, and to obtain a complex and multidisciplinary perspective of science. In my opinion, these skills and experiences will have a great impact on my later scientific career.



KORNÉL MOLNÁR

National Academy of Scientist Education,
4th year

Semmelweis University
Faculty of Medicine, 4th year

4TH YEAR STUDENTS

Szent-Györgyi Mentor: Jakus Zoltán Péter
Specialization: vascular biology
Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Vaccines using messenger RNA (mRNA-LNP) technology packaged in lipid nanoparticles have recently attracted considerable scientific interest, as two vaccines against SARS-CoV-2 approved for emergency use are also based on this technology. However, processes in the immune response elicited by mRNA-LNP-based vaccines are still not fully understood. The aim of our research was to investigate the role of immune cells involved in the immune response induced by mRNA-LNP-based vaccines as well as the role of the lymphatic system in transgenic mouse models. To facilitate the success of our studies, a more detailed understanding of the processes elicited by mRNA-LNP-based vaccines may be offered in the future to increase the efficacy of these vaccines and to alleviate possible side effects.

AMBITIONS AND CAREER GOALS

My goal is to help people at the best of my ability during my future medical and research careers. To do this, it is essential to be up to date with the latest research findings in my field. The National Academy of Scientist Education Training program is a great opportunity for me to start developing both my theoretical and practical knowledge to the highest possible level during my university years.



RÉKA ZSÓFIA SEBESTÉNY

National Academy of Scientist Education,
4th year
Semmelweis University
Faculty of Medicine, 4th year

Szent-Györgyi Mentor: Gábor Nyiri
Specialization: neuroscience
Language: English/advanced, German/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

As a student researcher I am investigating the cortical pathways and their role in memory formation. In the brain, spatial and episodic memory cues are encoded by different small subpopulations of principal hippocampal neurons called engram cells. My goal is to gain a deeper understanding of the formation of these cell assemblies and thus understand the precise function of memory formation and recall itself. Our results are expected to contribute to a better understanding of memory processes and could help the development of treatment for memory problems.

AMBITIONS AND CAREER GOALS

My primary goal in my research career is my own professional development. I would like to become as independent of a researcher as possible and be able to realise my own ideas to the fullest. I would like to further develop my skills in stereotaxic and optical fibre surgery as well as further my knowledge in the design of behavioural experiments. My long term goal would be to write and publish my own research results.



ANNA KELLERMAYER

National Academy of Scientist Education,
5th year
Semmelweis University
Faculty of Medicine, 5th year

5TH YEAR STUDENT

Szent-Györgyi Mentor: Ádám Dénes
Junior mentor: Csaba Cserép
Specialization: Neuroimmunology
Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Neurological diseases are a huge burden on society. Unfortunately, therapeutic attempts aimed at curing diseases by targeting neurons are extremely expensive and most of them fail. An important element of most diseases is neuroinflammation, the main coordinator of which is the brain's resident immune cell, microglia. Until now, research aimed at microglia-neuron interactions has been almost exclusively limited to the relationships between microglial processes and neuronal synapses. Our group recently discovered a special connection between microglial projections and neuronal cell bodies, the somatic junction, through which microglia monitor and modulate neuronal function, and when necessary, microglia can exert a neuroprotective effect through it. The relationship is evolutionarily conserved, as we have also confirmed its presence in human samples. We assume that the studying of the functioning of this relationship in a neuropathological context can contribute to a better understanding of diseases and the discovery of possible therapeutic targets. In our research, we will therefore examine possible changes in microglia-neuron interactions in human epileptic and control samples.

AMBITIONS AND CAREER GOALS

I would like to continue my medical career in the field of neurology and neuroradiology after completing my undergraduate studies and obtaining my PhD. In addition, I would like to continue my research work and my main goal is to strengthen the link between clinical medicine and neuroscience research, and to practice the application of the research approach in bedside medicine.



GÁBOR ORBÁN

National Academy of Scientist Education,
6th year
Semmelweis University
Faculty of Medicine, 6th year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

The importance of my research stems from the prevalence and severe, life-threatening potential complications of the heart rhythm disorder we are investigating, atrial fibrillation. Atrial fibrillation is adults' most common sustained arrhythmia, and its prevalence increases gradually with age. Its serious complications include arterial embolization, mainly in the form of stroke and heart failure. Our work aims to improve the invasive treatment of atrial fibrillation. This method is radiofrequency catheter ablation, but its therapeutic success rate can vary widely. We aim to increase ablation's efficiency by developing novel real and virtual imaging methods used before or during ablation. From the development and application of these new techniques, we hope that the ablation of patients can become more personalized and, therefore, more successful.

6TH YEAR STUDENTS

Szent-Györgyi Mentor: Nándor Szegedi
Specialization: Cardiology, cardiac electrophysiology
Language: English/advanced

AMBITIONS AND CAREER GOALS

I have been fascinated by science and scientific thinking since childhood. I chose the wonderful field of cardiac arrhythmias. I aim to use the tools of science to increase humanity's knowledge of cardiac arrhythmias. I also aim to present my discoveries at conferences and build international relationships and collaborations to broaden the knowledge spectrum. Finally, my main goal is to use science to help patients suffering from atrial fibrillation to recover and improve their quality of life.



SIMON VIKÁR

National Academy of Scientist Education,
6th year
Semmelweis University
Faculty of Medicine, 6th year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

My research encompasses the examination of the pathomechanism of bullous pemphigoid (BP), a rare autoimmune blistering. In this disease, the patients have severe pain and itching due to the developing tight blisters, but currently, for these symptoms, there is no specific therapy available. The investigation of BP pathology was made possible by a fully human ex vivo skin separation model that we previously set up, which replicated BP pathophysiology in our lab. Currently, I am using this model to assess the efficacy of various inhibitors and prospective medicinal treatments that can be further investigated in clinical investigations. With this research, I'm hoping to discover medicines that can effectively cure the severe symptoms of these individuals.

Szent-Györgyi Mentor: Attila Mócsai
Specialization: Physiology, Immunology, Autoimmune and inflammatory diseases
Language: English/intermediate, German/intermediate

AMBITIONS AND CAREER GOALS

During my career, I want to work on the unanswered problems in rheumatology and immunology, two of the medical specialties that I find most fascinating. I'm hoping to get the chance to study and treat these critical, fascinating diseases from both a clinical and a scientific perspective. I also hope that I will be able to contribute to the body of knowledge about these diseases that is already known to humanity.

PUBLICATIONS

Szilveszter KP, **Vikár S**, Horváth IÁ, Helyes Zs, Sárdy M, Mócsai A: Phospholipase C γ 2 Is Essential for Experimental Models of Epidermolysis Bullosa Acquisita



**DEBRECEN
SZENT-GYÖRGYI
MENTORS**



BÁLINT LÁSZLÓ BÁLINT

University of Debrecen
Faculty of Medicine
Department of Biochemistry and Molecular
Biology

RESEARCH AREA

Over the past decade, an extremely large amount of omics data has become publicly available. Data processing is ongoing, with suboptimal biomedical use. Our research group aims to find answers to unsolved clinical problems using the available data. Our main area of interest is the regulation of gene expression. Over the last few years, several oncologically relevant translocations have been shown to induce tumour cell proliferation by fusion of a cell-specific, highly active super-enhancer with an oncogene. Superenhancers can be identified by bioinformatic methods using chromatin-level markers. The key proteins involved in the function of superenhancers are now being mapped, and small molecules that inhibit their function are available. One such key protein is BRD4, a bromodomain protein with a role in the recognition of acetylated histone and thus the linking of enhancer and promoter regions. Several clinical trials are currently underway to test the efficacy of BRD4 inhibitors in malignancies. Our research aims to understand further details of how superenhancers work. We focus on breast cancer because a significant amount of multi-omics data is available. Significant basic research has already mapped several breast cancer cellular models at the molecular level and these data are freely available for further research. Complemented by the significant number of clinical



PÉTER BAI

University of Debrecen
Faculty of Medicine
Department of Medical Chemistry

RESEARCH AREA

The laboratory carries out exploratory and applied research in three main areas. We carry out investigations to understand the metabolic and non-oncological roles of PARP enzymes that were originally described as DNA repair proteins. The primary aim of these investigations is to facilitate the repurposing of clinically available, registered PARP inhibitors and to understand the role of these enzymes in cells. Oncological diseases are accompanied by changes to the composition of the bacterial communities (the microbiome) of the human body that is termed oncobiosis. The connections between tumors and the microbiome are bidirectional. Our aim is to understand the mechanisms through which neoplasias induce oncobiosis and those through which oncobiosis supports the growth and metastasis formation of tumors. We are developing diagnostic procedures in that field. Finally, in collaboration with the Department of Organic Chemistry at the University of Debrecen we are developing organic metal ion complexes with selective cytostatic property against tumors.

genomics projects, there is a good chance to better understand the role of super-enhancers in tumorigenesis, stratification and identification of new treatment approaches.

SELECTED PUBLICATIONS

Bojcsuk, D., Nagy, G., **Balint, B.L.** (2017) Inducible super-enhancers are organized based on canonical signal-specific transcription factor binding elements. **Nucleic Acids Research** **45**: 3693-3706 Oxford University Press

Ozgyin, L., Horvath, A., Hevessy, Z., **Balint, B.L.** (2019) Extensive epigenetic and transcriptomic variability between genetically identical human B-lymphoblastoid cells with implications in pharmacogenomics research. **Scientific Reports** **9**: 4889 Nature Publishing Group

Bojcsuk, D., Nagy, G., **Balint, B.L.** (2020) Alternatively constructed estrogen receptor alpha-driven super-enhancers result in similar gene expression in breast and endometrial cell lines. **Int J Mol Sci** **21**: 1630 Multidisciplinary Digital Publishing Institute

Erdős, E., **Balint, B.L.** (2020) NR2F2 orphan nuclear receptor is involved in estrogen receptor alpha-mediated transcriptional regulation in luminal a breast cancer cells. **Int J Mol Sci** **21**: 1910, Multidisciplinary Digital Publishing Institute

Gargya, P., **Balint, B.L.** (2021) Histological Grade of Endometrioid Endometrial Cancer and Relapse Risk Can Be Predicted with Machine Learning from Gene Expression Data. **Cancers** **13**: 4348 Multidisciplinary Digital Publishing Institute

SELECTED PUBLICATIONS

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SZILVIA BENKŐ

University of Debrecen
Faculty of Medicine
Department of Physiology

RESEARCH AREA

Nod-like receptors are intracellular pattern recognition receptors that recognize pathogen- or danger-associated molecules and initiate cellular responses in order to protect the cell. Either directly (via inflammasome formation) or indirectly (via signal pathway), they regulate various cellular functions including pro-inflammatory cytokine secretion (like IL-1beta), cell division or cell death. NLRs function as potential therapeutic and diagnostic target since most of the already-characterized members of the family have been associated to some form of autoimmune-, autoinflammatory-, allergic- or cancer diseases. This is proven by the fact that many pharmaceutical company focuses on the molecular manipulation of NLRs by drug development. Despite of the intensive studies many questions are still open, including the cell specific function of NLRs and the molecular mechanisms that modify the functions. Our research team aims to study (1) the expression and the molecular mechanisms of the action in various macrophage subpopulations; (2) the role of skeletal muscle NLRs in the cytokine (myokine) production and insulin resistance.



ANIKÓ BORBÁS

University of Debrecen
Faculty of Pharmacy
Department of Pharmaceutical Chemistry

RESEARCH AREA

Our group is engaged in the field of synthetic carbohydrate, nucleoside and antibiotic chemistry. We focus on the production of oligosaccharides of potential antithrombotic, antiviral and antitumor effects, the synthesis of thioglycoside mimetics of biorelevant carbohydrates, the development of new types of nucleic acid analogues and the chemical modification of glycopeptide antibiotics. In the last decade, we have designed and prepared heparin-like pentasaccharides with high anticoagulant activity, and important structure-activity relationships have been revealed in the field of heparinoid anticoagulants. We applied a biocompatible conjugation reaction, the photocatalytic thiol-ene coupling reaction on unsaturated carbohydrates, and prepared a number of biologically active (antiviral, enzyme-inhibiting) glycoconjugates. Significant progress has been made in the synthesis of glycopeptide-based semisynthetic antibacterial and antiviral compounds, as well as in the design and synthesis of new nucleoside analogs with antitumor activity. Our research has recently been extended to the study of NO- and H₂S-donor nonsteroidal anti-inflammatory drugs. The biological activity of our compounds is evaluated in extensive domestic and international cooperation.

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ENDRE KÁROLY KRISTÓF

University of Debrecen
Faculty of Medicine
Department of Biochemistry and Molecular
Biology

RESEARCH AREA

Primarily, we aim to identify the unique molecular regulators of browning in human adipose-derived stromal cells and differentiated adipocytes obtained from adipose tissues of distinct anatomical origins by analyzing the global gene expression pattern of these cells. To prove that the identified molecular elements directly regulate brown/beige differentiation or activation, the specific genes will be deleted or overexpressed. Based on the obtained gene expression data, we wish to determine the secreted cytokine and metabolite profiles of distinct human thermogenic adipose tissues and adipocytes by system biology approaches. We also intend to systematically investigate how human browning adipocytes switch off their thermogenic capacity and become dormant in response to the withdrawal of browning-inducers. Our research might open up better strategies for specific stimulation of beneficial fat browning or preventing entry into dormancy in humans, which aid weight reduction and decrease insulin resistance in obese individuals.



CSABA MATTA

University of Debrecen
Faculty of Medicine
Department of Anatomy, Histology and
Embryology

RESEARCH AREA

Traditional therapies for the treatment of osteoarthritis, which affects a large proportion of the population worldwide, have limited effectiveness, owing to limited regeneration of articular cartilage. Therefore, cartilage regeneration remains a major challenge, due in part to the lack of detailed knowledge of the molecular processes that regulate cartilage formation. For this reason, a number of biological therapies are currently being developed for which a more complete understanding of cartilage differentiation is essential. Our research group is interested in the biology of cartilage tissue, with particular emphasis on its formation (chondrogenesis). We aim to understand the cell surface proteome (surfaceome) of developing cartilage cells with the hope of identifying new biomarkers. We also aim to gain a better understanding of the biological clock in differentiating chondrocytes and to synchronise these clocks with mechanical stimuli. A more precise mapping of chondrogenic pathways could contribute to the development of more efficient cartilage regeneration procedures.

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NORBERT NÉMETH

University of Debrecen
Faculty of Medicine
Department of Operative Techniques and
Surgical Research

RESEARCH AREA

Hemorheological, microcirculatory and histomorphological investigations of tissue/organ ischemia-reperfusion related to surgical interventions, with comparative analysis of the detectable injuries and their preventive/therapeutic possibilities. Complex investigation of the pathomechanism of sepsis with special regard to the hemodynamic and microcirculatory changes. Examination of regeneration of microvascular anastomoses, setting the optimal geometry of anastomoses and shunts with the usage of agents having a positive effect on the maturation processes.



ATTILA OLÁH

University of Debrecen
Faculty of Medicine
Department of Physiology

RESEARCH AREA

Complex cannabinoid signaling contributes to the regulation of a number of (patho)physiological processes in human skin. These include, but are not limited to, local inflammatory processes, sebum production, pigmentation, hair growth, or differentiation of epidermal keratinocytes. Dysregulation of these processes play an important role in the pathogenesis of highly prevalent diseases (e.g., acne, hair growth disorders, atopic dermatitis, etc.). Thus, together with national and international collaborators, and industrial partners, our team aims to explore the putative therapeutic potential of the cannabinoid signaling in the above diseases. We mostly use molecular and cellular physiology approaches. In addition to the “endogenous” cannabinoids produced in our body, we also study the effects of plant-derived cannabinoids and “cannabinoid-like” compounds, as well as signaling systems that are related to the cannabinoid signaling (e.g., purinergic signaling, TRP channels, etc.). Moreover, we plan to pay special attention to the interactions between the cannabinoid signaling and the extracellular vesicle-mediated intercellular communication.

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ZOLTÁN PAPP

University of Debrecen
Faculty of Medicine
Department of Cardiology Division of
Clinical Physiology

RESEARCH AREA

The cellular myocardial physiology laboratory, established in 2001 and unique in Hungary, provides the opportunity to study the mechanical properties of single myocardial cells obtained from human or experimental animal models of cardiovascular diseases. With the help of our sensitive mechanical measuring system, we can determine the contractile parameters of individual myocardial cells isolated from deep-frozen or even biopsy-derived myocardial tissues. Thus, the Ca²⁺-dependent isometric force generation of contractile proteins can be measured directly at the cellular level, and direct conclusions can be drawn about the kinetic characteristics of the actin-myosin cycle. In addition to cellular studies, the small size of the preparation (single isolated myocardial cell) allows the characterization of the composition of contractile proteins under control conditions and following enzymatic modifications (e.g., phosphorylation, degradation) or the induction of different model conditions. Thus, our experimental system is suitable for mapping cellular and subcellular changes during altered myocardial contractility in various human and experimental disease states.



VALTER PÉTER PFLIEGLER

University of Debrecen
Faculty of Science and Technology
Institute of Biotechnology

RESEARCH AREA

The domestication of *Saccharomyces* yeasts, their macro- and microevolution, especially in the case of clades infecting and colonizing humans, with the use of genomics and experimental evolution.

SELECTED PUBLICATIONS

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ATTILA TÓTH

University of Debrecen
Faculty of Medicine
Department of Cardiology Division of
Clinical Physiology

RESEARCH AREA

We deal with three areas of research in our laboratory. (1) High blood pressure affects one in three adults, but the cause is unknown in 90% of cases. The diameter of the blood vessels determines the tissue blood supply and blood pressure. We investigate the mechanisms of regulation of the vascular diameter, with particular reference to mechanisms that depend on temperature-dependent receptors and angiotensin peptides. (2) Heart failure is a high-mortality disease that is unfortunately common in Hungary. In our research, we investigate the mechanisms leading to heart failure and the mechanisms of action of new experimental drugs. (3) Cardiovascular disease is the leading cause of death. With proper medication, survival can be significantly improved. Nevertheless, less than half of patients are taking their medications properly. In addition, setting the right dose of drug is difficult and time consuming. In our research, we develop methods that are suitable for measuring the biochemical efficacy of drugs. This may make it possible to determine the optimal dose for a given patient after a simple blood draw.



DÁNIEL TÖRŐCSIK

University of Debrecen
Faculty of Medicine
Department of Dermatology

RESEARCH AREA

The Group is a great opportunity for all who are interested in everyday skin problems such as acne and want to have a knowledge that can be translated into the real world. Our aim is to provide a knowledge that the participant could benefit from not only throughout the university years but also in post-doctoral fellowships. Moreover, we offer an exciting field of research for anyone who is interested in dermatology or in the cosmetic industry. In the nearly 10 years that we spent with research on how sebocytes moisturize the skin and how their altered lipid production leads to the development of acne. We also revealed that the changing sebaceous gland density at different parts of the body could be behind the site-specific appearance of some inflammatory skin diseases. Based on these findings we are currently investigating how sebocyte derived lipids could be therapeutically applied not only to treat dry skin but also inflammatory diseases.

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Fagyas, M., Bánhegyi, V., Úri, K., Enyedi, A., Lizanecz, E., Mányiné Siket, I., Mártha, L., Fülöp, G., Radovits, T., Pólos, M., Merkely, B., Kovács, Á., Szilvássy, Z., Ungvári, Z., Édes, I., Csanádi, Z., Boczán, J., Takács, I., Szabó, G., Balla, J., Balla, G., Seferović, P., Papp, Z., **Tóth, A.** (2021) Changes in the SARS-CoV-2 cellular receptor ACE2 levels in cardiovascular patients: a potential biomarker for the stratification of COVID-19 patients. *GeroScience* [Epub ahead of print]

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Szentkereszty-Kovács, Z., Gáspár, K., Szegedi, A., Kemény, L., Kovács, D., **Törőcsik, D.** (2021) Alcohol in Psoriasis-From Bench to Bedside. *Int J Mol Sci* **22**: 4987.

Dull, K., Fazekas, F., **Törőcsik, D.** (2021) Factor XIII-A in Diseases: Role Beyond Blood Coagulation. *Int J Mol Sci* **22**: 1459.



GYÖRGY VEREB

University of Debrecen
Faculty of Medicine
Department of Biophysics and Cell Biology

RESEARCH AREA

Developing and optimizing novel therapies against solid tumors and autoimmune diseases based on genetically reprogrammed immune cells, particularly using chimeric antigen receptors (CAR) and chimeric autoantigen receptors (CAAR) in T and NK cells. As a mechanistic background, the molecular assembly and function of immune synapses recruited by various CARs that contain versatile costimulatory domains and/or drive additional signaling pathways through other ectopic genes or RNA interference is also being explored.

Exploitation for diagnosis, prognosis, or therapeutic targeting of the interactions of receptor tyrosine kinases and integrins. Developing microscopic and other spectroscopic/cytometric methods for the quantitative analysis of molecular interactions and signaling processes in situ in cells and tissues with a view to migrate these methods to histopathology diagnostics.

Understanding the molecular dynamics of the corneal limbal stem cell niche, defining non-invasive in vivo imaging modalities that correlate with age or disease-related limbal stem cell deficiency (LSCD) and creating improved methodologies for regenerating corneas with LSCD (in cooperation with the Department of Ophthalmology, University of Debrecen).



LÁSZLÓ VIRÁG

University of Debrecen
Faculty of Medicine
Department of Medical Chemistry

RESEARCH AREA

The main profile of our research group is to investigate the relationship between oxidative stress and poly-ADP-ribosylation of proteins in different cellular systems and animal models. A common feature of living organisms is the generation of various free radicals and other reactive intermediates from the oxygen consumed during cellular respiration. These oxygen derivatives may have an important cellular regulatory role, but in pathological conditions, such as inflammation, ischemia-reperfusion injury (e.g. in myocardial infarction or stroke), their overproduction cannot be counteracted by the antioxidant system and they cause tissue damage. In addition to the peroxidation of lipids and the oxidation of proteins, oxidative damage also leads to DNA breaks, which are mainly recognized by the enzyme poly(ADP-ribose) polymerase-1 (PARP1), which marks DNA breaks with NAD-derived ADP-ribose polymers to initiate DNA repair. Through its role in DNA damage sensing, the enzyme is a survival factor, but when DNA damage is irreparably severe, PARP1 overactivation triggers a poly(ADP-ribose)-dependent cell death pathway termed parthanatos. In addition to this dual role in cell death, PARP1 also has several functions independent of DNA breakage e.g. in transcriptional regulation. ADP-ribosylation by the 17-members of the PARP enzyme family regulates almost all cellular functions. Our research group is working on diverse and multifaceted

SELECTED PUBLICATIONS

Csaplár, M., Szöllősi, J., Gottschalk, S., Vereb, G*, Szöőr, Á*. (2021) Cytolytic Activity of CAR T Cells and Maintenance of Their CD4+ Subset Is Critical for Optimal Antitumor Activity in Preclinical Solid Tumor Models. **Cancers** 13: 1-19.

Szöőr, Á., Tóth, G., Zsebik, B., Szabó, V., Eshhar, Z., Abken, H., Vereb, G. (2020) Trastuzumab Derived HER2-specific CARs for the Treatment of Trastuzumab-Resistant Breast Cancer: CAR T Cells Penetrate and Eradicate Tumors That Are Not Accessible to Antibodies. **Cancer Lett** 484: 1-8.

Tóth, G., Szöőr, Á., Simon, L., Yarden, Y., Szöllősi, J., Vereb, G. (2016) The combination of trastuzumab and pertuzumab administered at approved doses may delay development of trastuzumab resistance by additively enhancing antibody-dependent cell-mediated cytotoxicity. **mAbs** 8: 1361-1370.

Petrás, M., Lajtos, T., Friedländer, E., Klekner, Á., Pintye, É., Feuerstein, B., Szöllősi, J., Vereb, G. (2013) Molecular interactions of ErbB1 (EGFR) and integrin-β1 in astrocytoma frozen sections predict clinical outcome and correlate with Akt-mediated in vitro radioresistance. **Neuro-Oncology** 15: 1027-1040.

Takács, L., Tóth, E., Losonczy, G., Szántó, A., Bahr-Ivacevic, T., Benes, V., Berta, A., Vereb, G. (2011) Differentially Expressed Genes Associated with Human Limbal Epithelial Phenotypes: New Molecules That Potentially Facilitate Selection of Stem Cell-Enriched Populations. **Invest. Ophthalmol Vis Sci** 52: 1252-1260.

research projects, including the study of redox balance and the role of PARP enzymes in tissue macrophages, therapeutic resistance of tumor cells, cell death models, inflammatory processes and tumor-host interactions. An integral part of our research program is the identification of molecules with high-throughput screening that interfere with the above processes.

SELECTED PUBLICATIONS

Erdélyi K., Bai, P., Kovács, I., Szabó, E., Mocsár, G., Kakuk, A., Szabó, C., Gergely, P., Virág, L. (2009) Dual role of poly(ADP-ribose) glycohydrolase in the regulation of cell death in oxidatively stressed A549 cells. **FASEB J** 23: 3553-63.

Géhl, Z., Bakondi, E., Resch, M.D., Hegedűs, C., Kovács, K., Lakatos, P., Szabó, A., Nagy, Z., Virág, L. (2016) Diabetes-induced oxidative stress in the vitreous humor. **Redox Biol** 9: 100-103.

Kiss, A., Ráduly, A.P., Regdon, Z., Polgár, Z., Tarapcsák, S., Sturniolo, I., El-Hamoly, T., Virág, L*, Hegedűs, C*. (2020) Targeting Nuclear NAD+ Synthesis Inhibits DNA Repair, Impairs Metabolic Adaptation and Increases Chemosensitivity of U-2OS Osteosarcoma Cells. **Cancers** 12: 1180. (*shared corresponding authors)

Regdon, Z., Demény, M.A., Kovács, K., Hajnád, Z., Nagy-Pérez, M., Bakondi, E., Kiss, A., Hegedűs, C., Virág, L. (2021) High-content screening identifies inhibitors of oxidative stress-induced parthanatos: cytoprotective and anti-inflammatory effects of ciclopirox. **Br J Pharmacol** 178: 1095-1113.



**DEBRECEN
SZENT-GYÖRGYI JUNIOR
MENTORS**



MÁTÉ ÁGOSTON DEMÉNY

University of Debrecen
Faculty of Medicine
Department of Medical Chemistry

RESEARCH AREA

Regulation of signaling pathways is largely achieved by dynamic chemical modification of proteins. The focus of our research lies on protein modifications through ADP-ribosylation during interaction between tumors and the immune system. As of present, one in six deaths worldwide is still due to malignant tumors. Today's medicine is pinning its best hopes on targeted molecular therapy and immunotherapy to fight cancer. An effective immune response can, indeed, eradicate malignant cells and curb metastasis. However, tumors have a number of processes that inhibit immune cell function. One of the most abundant cells in the tumor stroma are macrophages (Mφ), phagocytes that are part of the innate immune system and also play an important role in directing the adaptive immune response. Paradoxically, their presence in the tumor is usually associated with a poor prognosis, as their interaction with tumor cells results in the acquisition of a phenotype that enhances tumor vascularisation, cancer cell proliferation and resistance to chemotherapy. Both others' and our own preliminary results suggest that protein ADP-ribosylation events are involved in this reprogramming of Mφs. In the laboratory, we are using proteomic methods to identify ADP-ribosylome changes in Mφs as they switch phenotype in association with tumor cells. We are using 2D and 3D tumor cell-Mφ co-culture models to study this. We aim to identify the signaling

proteins, transcription factors, metabolic enzymes that undergo modification and the ADP-ribosyltransferase enzymes responsible for their modification. We envision that targeted interference with the identified signaling pathways by manipulating ADP-ribosylation will alter the behavior of tumor Mφs in a favorable direction, which may provide the basis for new cancer therapies.

SELECTED PUBLICATIONS

Guti, E., Regdon, Z., Sturniolo, I., Kiss, A., Kovács, K., **Demény, M.**, Szőőr, Á., Vereb, G., Szöllősi, J., Hegedűs, C., Polgár, Z., Virág, L. (2022) The multitargeted receptor tyrosine kinase inhibitor sunitinib induces resistance of HER2 positive breast cancer cells to trastuzumab-mediated ADCC. *Cancer Immunol Immunother* doi: 10.1007/s00262-022-03146-z. Online ahead of print.

Demény, M.,A., Virág, L. (2021) The PARP Enzyme Family and the Hallmarks of Cancer Part 1. Cell Intrinsic Hallmarks. *Cancers* **13**: 2042.

Demény, M.,A., Virág, L. (2021)The PARP Enzyme Family and the Hallmarks of Cancer Part 2: Hallmarks Related to Cancer Host Interactions. *Cancers* **13**: 2057.

Regdon, Z., **Demény, M.,A.**, Kovács, K., Hajnády, Z., Nagy-Pénzes, M., Bakondi, E., Kiss, A., Hegedűs, C., Virág, L. (2021) High-content screening identifies inhibitors of oxidative stress-induced parthanatos: cytoprotective and anti-inflammatory effects of ciclopirox. *Br J Pharmacol* **178**: 1095-1113.

Sharma, R.* **Demény, M.***, Ambrus, V., Király,, S.B., Kurtán, T., Gatti-Lafranconi, P., Fuxreiter, M. (2019) Specific and Fuzzy Interactions Cooperate in Modulating Protein Half-Life. *J Mol Biol* **431**: 1700-1707.



KATALIN KOVÁCS

University of Debrecen
Faculty of Medicine
Department of Medical Chemistry

RESEARCH AREA

Development of high throughput screening methods and molecular library screening to identify compounds that influence autophagy and other biological processes. Molecule library screening allows the investigation of existing drugs for new therapeutic purposes (drug repurposing). Our goal is to detect compounds that boost cancer cell elimination. The student will perform Antibody-Dependent Cell-Mediated Cytotoxicity (ADCC) assays. ADCC involves bridging target cells (e.g. virus-infected or cancer cells) and effector cells [e.g. natural killer (NK) cells or macrophages] with an antibody. The latter binds specifically to a cell surface antigen on the target cell while the constant region (Fc fragment) binds to the Fc receptor on the effector cells. We plan to set up assays for the quantification of cancer cell killing by NK cells and to perform high-content screening to identify ADCC enhancing drug candidates from drug libraries.

SELECTED PUBLICATIONS

Guti, E., Regdon, Z., Sturniolo, I., Kiss, A., **Kovács, K.**, Demény, M., Szőőr, Á., Vereb, G., Szöllősi, J., Hegedűs, C., Polgár, Z., Virág, L. (2022) The multitargeted receptor tyrosine kinase inhibitor sunitinib induces resistance of HER2 positive breast cancer cells to trastuzumab-mediated ADCC. *Cancer Immunol Immunother*

Regdon, Z., Robaszekiewicz, A., **Kovács, K.**, Rygielska, Ż., Hegedűs, C., Bodoor, K., Szabó, É., Virág, L. (2019) LPS protects macrophages from AIF-independent parthanatos by downregulation of PARP1 expression, induction of SOD2 expression, and a metabolic shift to aerobic glycolysis. *Free Radic Biol Med* **131**: 184-196.

Kovács, K., Erdélyi, K., Hegedus, Cs., Lakatos, P., Regdon, Zs., Bai, P., Haskó, Gy., Szabó, É., Virág, L. (2012) Poly(ADP-ribosylation) is a survival mechanism in cigarette smoke-induced and hydrogen peroxide-mediated cell death. *Free Radic Biol Med* **53**: 1680-8.



**DEBRECEN
SZENT-GYÖRGYI
STUDENTS**



INGRID TÍMEA BÍRÓ

National Academy of Scientist Education,
1st year
University of Debrecen
Faculty of Science and Technology,
1st year

1ST YEAR STUDENTS

Szent-Györgyi Mentor: Péter Bay
Theme of research: Role of bacterial metabolites
in breast tumours
Language: English/proficiency, German/intermediate,
Romanian/proficiency



BOGLÁRKA HARSÁNYI

National Academy of Scientist Education,
1st year
University of Debrecen,
Faculty of Medicine,
1st year

Szent-Györgyi Mentor: Csaba Matta
Theme of research: Chondrogenesis and its biology
Language: English/intermediate



ZSÓFIA ANNA KÁDÁR

National Academy of Scientist Education,
1st year
University of Debrecen,
Faculty of Medicine,
1st year

Szent-Györgyi Mentor: Zsuzsanna Bagoly
Language: English/advanced



KOTHALAWALA ROSEMARY CHANDRAKANTHI

National Academy of Scientist Education,
1st year
University of Debrecen,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: Tamás Kovács
Theme of research: Investigation of the role of membrane
organization and lipids in the functional modulation of
transmembrane proteins
Language: English/advanced



OTTÓ TATAI

National Academy of Scientist Education,
1st year
University of Debrecen,
Albert Szent-Györgyi Medical School,
1st year

Szent-Györgyi Mentor: Attila Tóth
Theme of research: Investigation of the pathomechanism
of cardiovascular diseases on clinical samples
Language: English/intermediate



CSONGOR ATTILA VÁRÓCZY

National Academy of Scientist Education,
1st year
University of Debrecen,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: Attila Bácsi
Junior mentor: Endre Kókai
Theme of research: The role of PARP enzymes in the
interactions of malignant tumor cells and macrophages
Language: English/advanced, German/advanced



ÁKOS MÁTÉ BEDE

National Academy of Scientist Education,
2nd year

University of Debrecen,
Faculty of Medicine, 2nd year

2ND YEAR STUDENTS

Szent-Györgyi Mentor: László Virág

Junior mentor: Katalin Kovács

Specialization: Immunopharmacology

Language: English/advanced, Romanian/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Antibody-Dependent Cell-Mediated Cytotoxicity (ADCC) involves bridging target cells (e.g. virus-infected or cancer cells) and effector cells [e.g. natural killer (NK) cells or macrophages] with an antibody. The latter binds specifically to a cell surface antigen on the target cell while the constant region (Fc fragment) binds to the Fc receptor on the effector cells. ADCC is one of the key mechanisms by which cell-based cancer therapies fight the tumor. However, these mechanisms easily burn out and boosting ADCC activity would provide therapeutic benefit in oncology. We plan to set up assays for the quantification of cancer cell killing by NK cells and to perform high-content screening to identify ADCC enhancing drug candidates from drug libraries.

AMBITIONS AND CAREER GOALS

Throughout my university education I strive to acquire deep theoretical and practical medical knowledge. My goal after graduating medical school is getting a Phd degree. I wish to become a scientist-physician, working to improve people's lives in a clinical setting as well as by conducting biomedical research.



MIKLÓS LOVAS

National Academy of Scientist Education,
2nd year

University of Debrecen,
Faculty of Pharmacy, 2nd year

Szent-Györgyi Mentor: Anikó Borbás

Specialization: pharmaceutical chemistry

Language: English/advanced, Spanish/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Hydrogen sulfide is widely regarded as a toxic, foul-smelling chemical, but studies have identified it as the third gasotransmitter molecule. It has been found that it plays roles in various physiological processes, and has cardioprotective, pro-apoptotic and anti-inflammatory properties. In my research project I aim to synthesize compounds that can release hydrogen-sulfide upon enzymatic hydrolysis, and study the cardioprotective properties of these compounds in ischemic rat hearts.

AMBITIONS AND CAREER GOALS

After graduating, I intend to take part in PhD education, participate in research, and also get to know different areas of pharmacy. I would like to do all this at least partly abroad, building international relations that help me grow professionally, and help building my career.



BEÁTA VÁRKONYI

National Academy of Scientist Education,
2nd year

University of Debrecen,
Faculty of Medicine, 2nd year

Szent-Györgyi Mentor: László Virág

Junior mentor: Máté Demény

Specialization: Cell biology

Language: English, German, French

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

My research focuses on the interaction between tumour cells and macrophages. Using a co-culture system of breast cancer cells and macrophages, I investigate the role of PARP enzyme family members in the process by which the tumour reprograms tumour-associated macrophages into a tumour cell growth promoting phenotype. I plan to study the role of the post-translational protein modification process called ADP-ribosylation catalyzed by PARP enzymes, in the tumour cell-induced metabolic, transcriptional and signalling processes of macrophages. The aim and expected outcome of the research is to identify ADP-ribosylation-regulated proteins in macrophages that may be targets for reprogramming efforts towards a tumour-killing immune cell phenotype.

AMBITIONS AND CAREER GOALS

I intend to learn the research approach during my university years and then apply it in the clinic. I would like to gain experience abroad as well, which I plan to apply to my work here in Hungary. My aim is to learn as much as possible about the literature, to keep up to date with it and thus to gain a more complete picture of the challenges and achievements of the medical profession. I plan to obtain a PhD after graduating from medical school and to continue the research work I have already started.



CSABA CSIKOS

National Academy of Scientist Education,
6th year

University of Debrecen,
Faculty of Medicine, 6th year

6TH YEAR STUDENT

Szent-Györgyi Mentor: Péter Bay

Junior mentor: Csaba Hegedűs

Specialization: Biochemistry

Language: English

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

NMNAT1 is an enzyme localized in the nucleus and it plays an important role in several biochemical processes. We are investigating the effect of NMNAT1 on the migration of tumor cells. We set up an in vitro wound healing assay with which we can examine the proliferation and migration of the cells at the same time. With this method, we may be able to find new therapeutic approaches that can improve the survival rate of malignant diseases.

AMBITIONS AND CAREER GOALS

I would like to become a physician who fulfills both their professional duties and their humanitarian requirements. For this, I find it important to acquire lots of knowledge and many skills while being a medical student. Joining a research project also contributes to achieving my future goals in many ways.



**PÉCS
SZENT-GYÖRGYI
MENTORS**



TAMÁS ATLASZ

University of Pécs
Faculty of Sciences
Institute of Biology

RESEARCH AREA

Retinal diseases are among the leading causes of blindness. Therefore, any experimental approach that leads to a better understanding of the molecular background of these diseases, as well as the testing of groups of molecules that can reduce or potentially prevent damage, is a priority research activity. Our research focuses on the study of two posterior segment diseases of the eye (glaucoma and diabetic retinopathy) which are leading causes in the development of blindness. Our goal is to develop a new effective treatment strategy for the previously mentioned ophthalmic diseases by using different neuroprotective pharmaceuticals, with each having distinct target points that reduce the development of the disease.

SELECTED PUBLICATIONS

- Patko, E., Szabo, E., Toth, D., Tornoczky, T., Bosnyak, I., Vaczy, A., **Atlasz, T.**, Reglodi, D. (2022) Distribution of PACAP and PAC1 Receptor in the Human Eye, *J Mol Neurosci*
- Kvarik, T., Reglodi, D., Werling, D., Vaczy, A., Kovari, P., Szabo, E., Kovacs, K., Hashimoto, H., Ertl, T., Gyarmati, J., **Atlasz, T.** (2021) The Protective Effects of Endogenous PACAP in Oxygen-Induced Retinopathy, *J Mol Neurosci* **71**: 2546–2557.
- Szabó, E., Patkó, E., Váczy, A., Molitor, D., Csutak, A., Tóth, G., Reglődi, D., **Atlasz, T.** (2021) Retinoprotective Effects of PACAP Eye Drops in Microbead-Induced Glaucoma Model in Rats, *Int J Mol Sci* **22**: 16.
- Kovacs, K., Vaczy, A., Fekete, K., Kovari, P., **Atlasz, T.**, Reglodi, D., Gabriel, R., Gallyas, F., Sumegi, B. (2019) PARP Inhibitor Protects Against Chronic Hypoxia/Reoxygenation-Induced Retinal Injury by Regulation of MAPKs, HIF1 α , Nrf2, and NF κ B. *IOVS* **60**: 1478–1490.
- Atlasz, T.**, Werling, D., Song, S., Szabo, E., Vaczy, A., Kovari, P., Tamas, A., Reglodi, D., Yu, R. (2019) Retinoprotective Effects of TAT-Bound Vasoactive Intestinal Peptide and Pituitary Adenylate Cyclase Activating Polypeptide. *J Mol Neurosci* **68**: 397–407.



BOLDIZSÁR CZÉH

University of Pécs
Szentágotthai Research Centre
Structural Neurobiology Research Group

RESEARCH AREA

The physiological stress response is essential for our everyday survival, but traumatic or chronic stress represents a strong risk factor for the development of various mental and somatic disorders. The aim of our research is to investigate the functional and structural changes in the brain caused by stress. Such studies help us to understand the pathophysiology of mental disorders such as depression.

We perform clinical studies and we work also with animal models of neuropsychiatric disorders. We employ different imaging methods to examine the cellular alterations that develop under stress. Structural and functional changes in the brain are examined by magnetic resonance imaging (MRI). This method is suitable for determining the volume of different brain structures and for providing information on the microstructure of white matter structures. Functional MRI investigations are suitable for examining brain areas which are specifically activated during cognitive and emotional tasks. The in vivo imaging experiments are complemented by postmortem histological studies, in which we study morphological changes of the cells and neural networks using different microscopic methods.

SELECTED PUBLICATIONS

- Nagy, S. A., Kürtös, Z., Németh, N., Perlaki, G., Csernela, E., Lakner, F. E., Dóczy, T., **Czéh, B.**, Simon, M. (2021) Childhood maltreatment results in altered deactivation of reward processing circuits in depressed patients: A functional magnetic resonance imaging study of a facial emotion recognition task. *Neurobiol Stress* **15**: 100399.
- Nagy, S. A., Vranesics, A., Varga, Z., Csabai, D., Bruszt, N., Bali, Z. K., Perlaki, G., Hernádi, I., Berente, Z., Miseta, A., Dóczy, T., **Czéh, B.** (2020) Stress-Induced Microstructural Alterations Correlate With the Cognitive Performance of Rats: A Longitudinal in vivo Diffusion Tensor Imaging Study. *Front Neurosci* **14**: 474.
- Simon, M., Németh, N., Gálber, M., Lakner, E., Csernela, E., Tényi, T., **Czéh, B.** (2019) Childhood Adversity Impairs Theory of Mind Abilities in Adult Patients With Major Depressive Disorder. *Front Psychiatry* **10**: 867.
- Czéh, B.**, Müller-Keuer, J. I., Rygula, R., Abumaria, N., Hiemke, C., Domenici, E., Fuchs, E. (2007) Chronic social stress inhibits cell proliferation in the adult medial prefrontal cortex: hemispheric asymmetry and reversal by fluoxetine treatment. *Neuropsychopharmacology* **32**: 1490–1503.
- Coe, C. L., Kramer, M., **Czéh, B.**, Gould, E., Reeves, A. J., Kirschbaum, C., Fuchs, E. (2003) Prenatal stress diminishes neurogenesis in the dentate gyrus of juvenile rhesus monkeys. *Biol Psychiatry* **54**: 1025–1034.
- Czéh, B.**, Michaelis, T., Watanabe, T., Frahm, J., de Biurrun, G., van Kampen, M., Bartolomucci, A., Fuchs, E. (2001) Stress-induced changes in cerebral metabolites, hippocampal volume, and cell proliferation are prevented by antidepressant treatment with tianeptine. *Proc Natl Acad Sci USA* **98**: 12796–12801.



ANDRÁS GARAMI

University of Pécs
Medical School
Institute for Translational Medicine

RESEARCH AREA

Normal body temperature – which is essential for life – is maintained by various thermoregulatory mechanisms. Thermoregulatory disorders are present in many pathological conditions, e.g., febrile diseases, systemic inflammation (sepsis), organ dysfunctions (e.g., pancreatitis), heat stroke, and hypothermia. It is of utmost importance to discover the pathophysiological processes in the thermoregulatory disorders. More and more influencing factors are identified, such as the pH status and transient receptor potential channels. In our research, we aim at identifying the neural substrates and molecular mediators involved in the thermoregulatory processes mainly in different animal models, but to some extent also in human studies. Our findings can further advance the knowledge of bodily homeostasis, moreover, they can open new directions in clinical practice, most of all intensive therapy, and other sciences. Successful development of drugs designed specifically to target body temperature, could pave the road to pharmacologically controlled temperature management, thereby advancing the therapeutic approaches in clinical conditions with thermoregulatory disorders.



ZSUZSANNA HELYES

University of Pécs
Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

Mapping the complex mechanisms underlying chronic arthritic pain. A significant proportion of people with rheumatoid arthritis are ‘difficult to treat’ patients, falling into the categories of non-inflammatory and persistent inflammation. Chronic pain is the main symptom in both cases, with autoimmune, neuroinflammatory and neuropathic processes underlying central and peripheral mechanisms. As conventional analgesics are often ineffective, our aim is to understand the mechanisms of sensitisations responsible for chronic pain and to identify the key mediators and pathways involved. In mouse models of arthritis, we perform complex functional and analytical as well as morphological studies of the central nervous system (glial cell-neuron interactions, neuroinflammation). RNA isolated from peripheral blood mononuclear cells and dorsal root ganglia will be subjected to transcriptomic measurements and from plasma to metabolomic measurements, which will be evaluated using bioinformatic methods. Pain levels will be correlated with other inflammatory and immunological parameters, as well as anxiety and mood changes. Brain functional imaging studies will be performed to map changes in the activation pattern of the “pain matrix”.

SELECTED PUBLICATIONS

Toldi, J., Kelava, L., Marton, S., Muhl, D., Kustan, P., Feher, Z., Maar, K., Garai, J., Pakai, E., **Garami, A.** (2023). Distinct patterns of serum and urine macrophage migration inhibitory factor kinetics predict death in sepsis: A prospective, observational clinical study. *Sci Rep* **13**: 588.

Keringer, P., Furedi N., Gaszner, B., Miko, A., Pakai, E., Fekete, K., Olah, E., Kelava, L., Romanovsky, A. A., Rumbus, Z., **Garami, A.** (2022). The hyperthermic effect of central cholecystokinin is mediated by the cyclooxygenase-2 pathway. *Am J Physiol Endocrinol Metab* **322**: E10–E23.

Olah, E., Rumbus, Z., Kormos, V., Tekus, V., Pakai, E., Wilson, H. V., Fekete, K., Solymar, M., Kelava, L., Keringer, P., Gaszner, B., Whiteman, M., Keeble, J., Pinter, E., **Garami, A.** (2021). The hypothermic effect of hydrogen sulfide is mediated by the transient receptor potential ankyrin-1 channel in mice. *Pharmaceuticals (Basel, Switzerland)* **14**: 992.

Garami, A., Shimansky, Y. P., Rumbus, Z., Vizin, R., Farkas, N., Hegyi, J., Szakacs, Z., Solymar, M., Csenkey, A., Chiche, D. A., Kapil, R., Kyle, D. J., Van, Horn W. D., Hegyi, P., Romanovsky, A. A. (2020). Hyperthermia induced by transient receptor potential vanilloid-1 (TRPV1) antagonists in human clinical trials: Insights from mathematical modeling and meta-analysis. *Pharmacol Ther* **208**: 107474.

Pakai, E., Tekus, V., Zsiboras, Cs., Rumbus, Z., Olah, E., Keringer, P., Khidhir, N., Matics, R., Deres, L., Ordog, K., Szentés, N., Pohoczky, K., Kemeny, A., Hegyi, P., Pinter, E., **Garami, A.** (2018) The neurokinin-1 receptor contributes to the early phase of lipopolysaccharide-induced fever via stimulation of peripheral cyclooxygenase-2 protein expression in mice. *Front Immunol* **9**: 166.

SELECTED PUBLICATIONS

Pohóczk, K., Kun, J., Szentés, N., Aczél, T., Urbán, P., Gyenesei, A., Bölskei, K., Szőke, É., Sensi, S., Dénes, Á., Goebel, A., Tékus, V., **Helyes, Z.** (2022) Discovery of novel targets in a complex regional pain syndrome mouse model by transcriptomics: TNF and JAK-STAT pathways. *Pharmacol Res.* **182**:106347.

Botz, B., Kriszta, G., Bölskei, K., Horváth, Á., Mócsai, A., **Helyes, Z.** (2021) Capsaicin-Sensitive Peptidergic Sensory Nerves Are Anti-Inflammatory Gatekeepers in the Hyperacute Phase of a Mouse Rheumatoid Arthritis Model. *Int J Mol Sci.* **22**: 1682.

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ISTVÁN HERNÁDI

University of Pécs
Faculty of Sciences
Institute of Biology

RESEARCH AREA

Investigating the neurocognitive underpinnings of ageing and neurocognitive impairment in rodents: identification of preclinical drug development strategies and development of combined cognitive enhancer therapies. The main objective of the project is to understand and model the processes underlying brain ageing and neurocognitive disorders (dementias) in rodents and to study cellular and behavioural processes in a coordinated manner in the same model. The research is carried out in two locations: our cellular biology (electrophysiology) laboratory is located at the Faculty Sciences and our small animal behavioural pharmacology laboratory is located at the Szentágotthai Research Centre (SzRC). Our preclinical animal models include e.g. pharmacologically induced amnesia, natural ageing, repetitive mild traumatic brain injury and genetic (DREADD) models. Behavioural changes are investigated in state-of-the-art test packages. Our results are further utilized in both basic and applied drug discovery research. Our main long-term goal is to unravel the yet unknown mechanisms underlying neurocognitive diseases and to identify biomarkers that may later play a crucial role in the diagnosis and treatment of cognitive disorders and in the development of new drug candidates.



CSABA HETÉNYI

University of Pécs
Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

Development and application of computer-aided drug design A key step in the early stages of drug design is the design of potent drug molecules. This process is now mostly carried out using computer (pharmaco-informatics) methods, which are capable of handling both large amounts of structural data and complex energy calculations. The pharmacoinformatics toolbox will be used in both target-based and ligand-based design and will be extended with new procedures in the course of the PhD work. The methods will be tested and applied in curricular areas of pharmacology such as pain management, regulation of signalling, antiviral and epigenetic-based therapies. Computational analysis of target-drug interactions: Computational docking is an indispensable tool in drug design and is widely used by pharmaceutical companies. This project focuses on the prediction of the structure and energy of drug-target interactions by computer docking. The capabilities and limitations of the method will be investigated.

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Nagy, L.V., Bali, Z. K., Kapus, G., Pelsőczy, P., Farkas, B., Lendvai, B., Lévy, G., **Hernádi, I.** (2021) Converging Evidence on D-Amino Acid Oxidase-Dependent Enhancement of Hippocampal Firing Activity and Passive Avoidance Learning in Rats. **Int J Neuropsychopharmacol 24**: 434.

Bali, Z. K., Nagy, L.V., **Hernádi, I.** (2017) Alpha7 nicotinic acetylcholine receptors play a predominant role in the cholinergic potentiation of N-methyl-D-aspartate evoked firing responses of hippocampal CA1 pyramidal cells. **Front Cell Neurosci 11**: 271.

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FERENC JAKAB

University of Pécs
Szentágotthai Research Centre

RESEARCH AREA

Description and molecular characterisation of new viral pathogens. Emerging infectious diseases pose an extremely serious and complex challenge to humanity, but especially to the globalised world order and economy. Over the past decades, several epidemics have emerged in human populations, many of them mediated by wild animals. Two thirds of the pathogens thus emerged originate from wild animals. A striking example is the current pandemic SARS-2 coronavirus, which originates from an as yet unknown animal, but evolutionarily from bats. If we know of naturally occurring viruses with similar potential, we can use their detailed natural history to take clear and effective preventive action to avert, or at least reduce, the likelihood of their emergence in human populations. We aim at the identification of such pathogens and the development of innovative capacities for their rapid, modern and efficient testing. New viruses detected or discovered from the animal populations studied, in addition to further investigation of natural processes, transmission properties and innovative detection capacity development, may also be directly useful in other basic research lines (e.g. drug development). The National Laboratory of Virology has decades of experience in the sampling and complex virological analysis of naturally occurring zoonotic viruses.



MIKLÓS KECSKÉS

University of Pécs
Faculty of Sciences
Institute of Biology

RESEARCH AREA

The main goal of the research group is to study the expression and function of transient receptor potential (TRP) ion channels in the brain. The TRP ion channel family includes 28 members in mammals. The understanding of TRP ion channels was made possible by research on TRPV1, TRPA1 and TRPM8 channels located on peripheral nerve endings. These classic receptors play a role in cold and hot sensation, inflammatory pain sensation, but also, for example, in sensing the pungency of chili peppers. However, the expression and function of TRP ion channels in the brain is still a debate, especially with regard to the expression pattern at the cellular level. Our research focuses on neurons expressing TRP ion channels from different brain areas, including the hippocampus, the amygdala and the piriform cortex.

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GÁBOR KEMENESI

University of Pécs
Faculty of Sciences
Institute of Biology

RESEARCH AREA

Research on emerging and re-emerging infectious diseases with high biosafety level (BSL3 and BSL4) as part of the OneHealth concept. Discovery, characterization and complex understanding of new viruses, assessment of their zoonotic ability (ability to jump from animal to human).



SÁNDOR KUNSÁGI-MÁTÉ

University of Pécs
Faculty of Pharmacy
Department of Organic and
Pharmacological Chemistry

RESEARCH AREA

The determinant role of the weak molecular interactions in the transport of bioactive molecules is associated either to their moderated adsorption onto the macromolecule's surface or also to the solubility of bioactive molecules moderated by the formation of inclusion complexes. The latter process offers too the selective and sensitive detection of bioactive molecules. Further the stereo-chemical and structural facts, the weak molecular interactions and the resulted chemical equilibria are also affected by the temperature and the molecular environment. During the last few years we described the effect of the bulk properties of the molecular environment onto the stabilities of the above mentioned inclusion complexes and also the effect of the solvent water structures have been investigated accordingly in our lab. Some cases the antioxidant, scavenging effect has been investigated regarding to the target-specific therapeutic applications. Our overall goal is to perform investigations to determine the effect of the molecular packing in the stability of drugs, to clarify the role of micro-solvation and to describe the related overall mechanisms.

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Kemenesi, G., Tóth, E G., Bajusz, D., Keserű, M Gy., Terhes, G., Burián, K., Zeghib, S., Somogyi B A., Jakab, F. (2021) Effect of An 84-bp Deletion of the Receptor-Binding Domain on the ACE2 Binding Affinity of the SARS-CoV-2 Spike Protein: An In Silico Analysis **Genes** **12**: 194.

Kemenesi, G., Zeghib, S., Somogyi A B., Tóth, G E., Bányai, K., Solymosi, N., Szabó, M P., Szabó, I., Bálint, Á., Urbán, P., Herczeg, R., Gyenesei, A., Nagy, Á., Pereszlényi, Cs I., Babinszky, Cs G., Dudás, G., Terhes, G., Zöldi, V., Lovas, R., Tenczer, Sz., Kornya, L., Jakab, F. (2020) Multiple SARS-CoV-2 Introductions Shaped the Early Outbreak in Central Eastern Europe: Comparing Hungarian Data to a Worldwide Sequence Data-Matrix. **Viruses** **12**: 1401.

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KRISZTIÁN KVELL

University of Pécs
Faculty of Pharmacy
Department of Pharmaceutical
Biotechnology

RESEARCH AREA

Anti-tumour effect of exercise-derived microRNAs: Regular exercise is known to protect against the development of many chronic diseases, including cancer. Our research has mapped the health protective effects of microRNAs at the molecular level. Levels of several micro-RNAs that protect against the development of tumours, including lung tumours, are elevated, based on our own data and literature. These micro-RNAs have a long-term preventive effect, but in the short term they may have an adjuvant oncotherapeutic, i.e. additional anti-tumour effect. Investigation of the toxic effects of the SARS2 viral spike protein: COVID-19 disease, caused by SARS-CoV-2, affects many tissues and organs. Although it has become known as a respiratory disease, it actually attacks the kidneys, heart/circulatory system, digestive system and central nervous system as well. Some articles have raised the toxicity of Spike protein and its degradation products in aqueous solution on cells. Our working hypothesis is that Spike protein and its degradation products released from SARS-CoV-2 viruses during infection of epithelial cells exert toxic effects. We test this working hypothesis in a conventional 2D, conventional 3D cell culture system.



EDINA LEMPEL

University of Pécs
Medical School
Department of Dentistry
Oral and Maxillofacial Surgery

RESEARCH AREA

Physical and biocompatibility investigations of rapid polymerized and pre-heated resin composites. According to the manufacturer's recommendation, the adequate curing of the rapid polymerized resin composites can be achieved in 3 seconds with a suitable curing unit up to 4 mm in layer thickness. However, both the layer thickness and the short exposure time could be a barrier to the proper monomer-polymer conversion. Additionally, internal stress can develop due to shrinkage of the polymerizing material, which can cause gaps at the filling/tooth interface. Insufficient polymerization may result in unreacted monomer release in the oral cavity or may diffuse to the pulp through the tubular dentin. The monomers' toxic effects are well known, although details are still being researched to this day. However, this chemical effect might be supplemented by a thermal effect, arises from both the energy, delivered by the curing unit and from the heat generated during the exothermic polymerization of the resin composite. It may cause further cell damage to pulpal cells if it exceeds the 5.5 °C threshold in the pulp. This thermal effect is even more significant in the cases of pre-heated resin composites, which are preferred because of their good adaptation ability and mechanical properties. During our investigations, we would test the gap formation caused by the polymerization shrinkage using

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Garai, K., Adam, Z., Herczeg, R., Banfai, K., Gyebrovski, A., Gyenesei, A., Pongracz, J.E., Wilhelm, M., **Kvell, K.** (2021) Physical Activity as a Preventive Lifestyle Intervention Acts Through Specific Exosomal miRNA Species-Evidence From Human Short- and Long-Term Pilot Studies. **Front Physiol 12**: 658218.

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Banfai, K., Ernszt, D., Pap, A., Bai, P., Garai, K., Belharazem, D., Pongracz, J.E., **Kvell, K.** (2019) „Beige“ Cross Talk Between the Immune System and Metabolism. **Front Endocrinol (Lausanne) 10**: 369

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Ernszt, D., Banfai, K., Kellermayer, Z., Pap, A., Lord, J.M., Pongracz, J.E., **Kvell, K.** (2017) PPARgamma Deficiency Counteracts Thymic Senescence. **Front Immunol 8**: 1515.

micro-CT; we would measure the intrapulpal manifestation of the heat generated during the polymerization; and we would examine the effects of physical and chemical stimuli on cells histomorphometric and immunohistochemical changes) on 3D pulpal tissue model.

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ERIKA PINTÉR

University of Pécs
Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

Scientific interests: neuro-immuno-pharmacology, inflammation The role of capsaicin-sensitive sensory nerve endings in the regulation of microcirculation and neurogenic inflammation. Immunomodulatory effects of neurogenic inflammation. Anti-inflammatory effects of somatostatin and its analogues. Biological effects of hydrogen sulphide.



MIKLÓS POÓR

University of Pécs
Faculty of Pharmacy
Department of Pharmacology

RESEARCH AREA

I. Interaction of mycotoxins with biomolecules and with potential mycotoxin binders: Toxicokinetic studies, investigation of combinative effects, and experiments with potential mycotoxin binders (for toxin extraction, decontamination, and/or detoxification purposes). II. Interaction of natural polyphenols and their metabolites with drugs: Certain dietary supplements contain extremely high doses of polyphenols; in this project, the interaction of these polyphenols and their metabolites are examined with important proteins from the pharmacokinetic point of view (e.g., serum albumin, biotransformation enzymes, drug transporters).

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Mohos, V., Pánovics, A., Fliszár-Nyúl, E., Schilli, G., Hetényi, C., Mladěňka, P., Needs, P.W., Kroon, P.A., Pethő, G., Poór, M. (2019) Inhibitory effects of quercetin and its human and microbial metabolites on xanthine oxidase enzyme. *Int J Mol Sci* **20**: 2681.

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Saghy, E., Sipos, E., Acs, P., Bolcskei, K., Pohoczky, K., Kemeny, A., Sandor, Z., Szoke, E., Setalo Jr. G., Komoly, S., **Pinter, E.** (2016) TRPA1 deficiency is protective in cuprizone-induced demyelination-A new target against oligodendrocyte apoptosis. *Glia* **64**: 2166-2180.
Kemény, A., Kodji, X., Horváth, Sz., Komlódi, R., Szőke, E., Sándor, Z., Perkecz, A., Gyömörei, Cs., Sétáló, Gy., Kelemen, B., Biro, T., Toth, B., **Pinter, E.**, Gyulai, R. (2018) TRPA1 acts in a protective manner in imiquimod-induced psoriasisiform dermatitis in mice. *J Invest Dermatol* **138**: 1774-1784.
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Kriszta, G., Nemes, B., Sándor, Z., Ács, P., Komoly, S., Berente, Z., Bölskei, K., **Pintér, E.** (2020) Investigation of Cuprizone-Induced Demyelination in mGFAP-Driven Conditional Transient Receptor Potential Ankyrin 1 (TRPA1) Receptor Knockout Mice. *Cells* **9**: 81
Kántás, B., Szőke, É., Börzsei, R., Bánhegyi, P., Asghar, J., Hudhud, L., Steib, A., Hunyady, Á., Horváth, Á., Kecskés, A., Borbély, É., Hetényi, Cs., Pető, G., **Pintér, E.** (2021) In Silico, In Vitro and In Vivo Pharmacodynamic Characterization of Novel Analgesic Drug Candidate Somatostatin SST4 Receptor Agonists *Front Pharmacol* **11**: 601887.
Faisal, Z., Garai, E., Csepregi, R., Bakos, K., Fliszár-Nyúl, E., Sente, L., Balázs, A., Cserháti, M., Kőszegi, T., Urbányi, B., Csenki, Z., **Poór, M.** (2020) Protective effects of beta-cyclodextrins vs. zearalenone-induced toxicity in HeLa cells and Tg(vtg1:mCherry) zebrafish embryos. *Chemosphere* **240**: 124948.
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DÓRA REGLÓDI

University of Pécs
Medical School
Department of Anatomy

RESEARCH AREA

Investigating the effects of PACAP. Pituitary adenylate cyclase activating polypeptide (PACAP) is an anti-apoptotic, anti-inflammatory and antioxidant neuropeptide with neuroprotective and general cytoprotective effects that have been demonstrated in a number of experiments. Our group has been working for more than 15 years on mapping the physiological effects of PACAP and its protective role in in vitro and in vivo models of various pathological conditions. In the absence of endogenous PACAP, knockout (KO) mice are highly susceptible to adverse effects. Early signs of ageing are also observed due to increased oxidative stress, inflammation and apoptosis associated with the deficiency state. Our preliminary observations show increased neuronal degeneration in the brains of KO mice. In the absence of PACAP, we have described systemic tissue amyloidosis associated with aging, in addition to retinal degeneration. Our results so far suggest that the absence of PACAP accelerates several degenerative processes and leads to premature ageing. Our human, translational studies investigate PACAP expression/levels in different human tissues and biological fluids and we investigate correlations between pathological conditions and alterations in PACAP levels. These may be important for the future biomarker use of PACAP as a diagnostic and/or prognostic tool. Results can also shed light on biological functions of PACAP in the human body.



ÉVA SZŐKE

University of Pécs
Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

Pain sensation is mediated by the nociceptor Transient Receptor Potential ion channels such as the Vanilloid 1 (TRPV1) and the TRP ankyrin 1 (TRPA1). Previous discoveries on TRP channels described important structural and functional properties of these proteins, but very little is known about the function, importance and modulation opportunities of the lipid rafts surrounding them in the plasma membrane. We recently discovered that lipid raft disruption by depletion of various constituents, by methyl β -cyclodextrin (MCD), sphingomyelinase (SMase), myriocin and our carboxi-steroid compound reduced TRP activation on sensory neurons and transfected cells. We examine the potential analgesic effect of MCD, SMase, myriocin or our carboxi-steroid compound in topical dermatological formulation in in vivo mouse models. The lipid raft disruptor myriocin had an antitumor activity in a murine melanoma model. We examine the potential dual effect (antitumor and analgesic activity) of myriocin in our mouse osteosarcoma model.

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DÓRA TÍMEA ZELENA

University of Pécs
Medical School
Institute of Physiology

RESEARCH AREA

Effect of the lipid component of mRNA vaccines on the menstrual cycle. Observations from women and clinicians alike suggest that during the COVID-19 pandemic, the incidence of menstrual cycle problems increased, especially after vaccination with the new mRNA vaccines. However, it remains to be seen whether there is indeed a link between COVID-19 mRNA vaccination and menstrual disorders and, if so, whether the effect of the vaccine on the menstrual cycle is short- or long-term. We plan to investigate this question using three approaches. Our human questionnaire study, which is collecting data on menstrual problems following mRNA vaccination among women aged 18 to 65 years at the time of the pandemic, is already underway. In our *in vivo* experiments, we would like to observe whether the estrus cycle or fertility of female mice is altered by mRNA vaccination or treatment with lipid droplets. Finally, we want to test *in vitro* whether lipid droplets modify the function of normal human endometrial cells.

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**PÉCS
SZENT-GYÖRGYI
JUNIOR MENTORS**



ZSOLT KRISTÓF BALI

University of Pécs
Translational Neuroscience Research Group

RESEARCH AREA

Investigating the neurocognitive underpinnings of ageing and neurocognitive impairment in rodents: identification of preclinical drug development strategies and development of combined cognitive enhancer therapies. The main objective of the project is to understand and model the processes underlying brain ageing and neurocognitive disorders (dementias) in rodents and to study cellular and behavioural processes in a coordinated manner in the same model. The research is carried out in two locations: our cellular biology (electrophysiology) laboratory is located at the Faculty of Natural Sciences (Faculty of Science) and our small animal behavioural pharmacology laboratory is located at the Szentágotthai Research Centre (SZKK). Our preclinical animal models include e.g. pharmacologically induced amnesia, natural ageing, repetitive mild traumatic brain injury and genetic (DREADD) models. Behavioural changes are investigated in state-of-the-art test packages. Our results are further utilized in both basic and applied drug discovery research. Our main long-term goal is to unravel the as yet unknown mechanisms underlying neurocognitive diseases and to identify biomarkers that may later play a crucial role in the diagnosis and treatment of cognitive disorders and in the development of new drug candidates.



KLAUDIA BARABÁS

University of Pécs
Medical School
Institute of Physiology

RESEARCH AREA

The female reproductive period begins at sexual maturation and continues to last around 45-50 years of age. During this time, several factors can influence normal female sexual function, via the hypothalamic-pituitary-gonadal (HPG) axis. Malfunctioning of the HPG axis causes a number of problems such as endometrial hyperplasia, irregular menstruation, endometrial cancer or difficulties in fertilisation. In our experiments, we would like to investigate the factors influencing fertility and endometrial receptivity.

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ÉVA BORBÉLY

University of Pécs
Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

Neuropeptides are important regulatory molecules of the central and peripheral nervous systems. Tachykinins represent one of the biggest family of neuropeptides, known for their wide expression throughout the brain and diverse actions in the whole body. They can influence among others pain sensation, inflammation, mood regulation and memory consolidation. HK-1, discovered in 2000, is also a member of the tachykinin family originally demonstrated in B cells. The structure of HK-1 is very similar to SP which makes the protein identification difficult and it has very similar binding properties on the NK1 receptor. We proved that HK-1 plays an important role in acute stress, acute and chronic pain conditions as well as in inflammation. The main goal of research is to unravel the expression patterns of HK-1 in the brain and stress-related organs (thymus, adrenal gland), to investigate the role of HK-1 in behavioural and structural changes characteristic for depression and its comorbidities (pain, memory disorders) and to further understand the mechanism of action of HK-1 in neuro-immune interactions.



KITTI GARAI

University of Pécs
Faculty of Pharmacy
Department of Pharmaceutical
Biotechnology

RESEARCH AREA

It has long been evident that physical exercise reduces the risk of cancer and improves treatment efficacy in tumor patients. Recent studies have shown that miRNAs are actively released into the circulation during exercise, and are deeply involved in cancer pathology. During our previous research, we detected several microRNAs that protect against the development of lung tumors. In the future, by studying the biological functions of the identified microRNAs, we will be able to better understand the regulatory network of the molecular mechanisms through which regular exercise can prevent lung carcinoma.

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ISTVÁN ÁDÁM HORVÁTH

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Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

Chronic joint pain affects a large patient population worldwide, placing a heavy burden on society, healthcare systems and individuals, and significantly reducing quality of life. Its treatment is a huge unresolved problem, therefore clarification of the pathomechanism and discovery of new therapeutic targets, as well as development of more effective and safer analgesics with new mechanisms of actions are crucial. One such new target could be CX3CL1 (fractalkine) chemokine receptor 1 (CX3CR1), which is expressed on microglia playing a key role in the sensitisation of the pain-related central nervous system areas, as well as on peripheral monocytes, T cells, synoviocytes, endothelial cells and osteoclasts. We plan to investigate the role of the receptor in mouse models of chronic joint pain.



ESZTER PÁKAI

University of Pécs
Medical School
Institute for Translational Medicine

RESEARCH AREA

Normal body temperature – which is essential for life – is maintained by various thermoregulatory mechanisms. Thermoregulatory disorders are present in many pathological conditions, e.g., febrile diseases, systemic inflammation (sepsis), organ dysfunctions (e.g., pancreatitis), heat stroke, and hypothermia. It is of utmost importance to discover the pathophysiological processes in the thermoregulatory disorders. More and more influencing factors are identified, such as the pH status and transient receptor potential channels. In our research, we aim at identifying the neural substrates and molecular mediators involved in the thermoregulatory processes mainly in different animal models, but to some extent also in human studies. Our findings can further advance the knowledge of bodily homeostasis, moreover, they can open new directions in clinical practice, most of all intensive therapy, and other sciences. Successful development of drugs designed specifically to target body temperature, could pave the road to pharmacologically controlled temperature management, thereby advancing the therapeutic approaches in clinical conditions with thermoregulatory disorders.

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ANDREA TAMÁS

University of Pécs
Medical School
Department of Anatomy

RESEARCH AREA

Examination of the effects of PACAP. Pituitary adenylate cyclase activating polypeptide (PACAP) is an anti-apoptotic, anti-inflammatory and antioxidant neuropeptide with neuroprotective and general cytoprotective effects demonstrated in numerous experiments. Our group has been working for more than 20 years on mapping the physiological effects of PACAP and its protective role using in vitro and in vivo models of various pathological conditions. In the absence of endogenous PACAP, PACAP-deficient (KO) mice are highly susceptible to harmful effects. Early signs of ageing are also observed in KO mice due to increased oxidative stress, inflammation and apoptosis. Our preliminary observations show increased neuronal degeneration in the brains of KO mice. In the absence of PACAP, we have described systemic tissue amyloidosis associated with aging, in addition to retinal degeneration. Our results so far suggest that the absence of PACAP accelerates several degenerative processes and leads to premature ageing. Our human, translational studies examine the changes of PACAP expression in different human tissues and biological fluids and we investigate correlations between pathological conditions and alterations in PACAP levels. These may be important for the future biomarker use of PACAP as a diagnostic and/or prognostic tool. Results can also shed light on biological functions of PACAP in the human body.



ALEXANDRA VÁCZY

University of Pécs
Medical School
Department of Anatomy

RESEARCH AREA

Investigating the effects of PACAP. Pituitary adenylate cyclase activating polypeptide (PACAP) is an anti-apoptotic, anti-inflammatory and antioxidant neuropeptide with neuroprotective and general cytoprotective effects that have been demonstrated in a number of experiments. Our group has been working for more than 15 years on mapping the physiological effects of PACAP and its protective role in in vitro and in vivo models of various pathological conditions. In the absence of endogenous PACAP, knockout (KO) mice are highly susceptible to adverse effects. Early signs of ageing are also observed due to increased oxidative stress, inflammation and apoptosis associated with the deficiency state. Our preliminary observations show increased neuronal degeneration in the brains of KO mice. In the absence of PACAP, we have described systemic tissue amyloidosis associated with aging, in addition to retinal degeneration. Our results so far suggest that the absence of PACAP accelerates several degenerative processes and leads to premature ageing. Our human, translational studies investigate PACAP expression/levels in different human tissues and biological fluids and we investigate correlations between pathological conditions and alterations in PACAP levels. These may be important for the future biomarker use of PACAP as a diagnostic and/or prognostic tool. Results can also shed light on biological functions of PACAP in the human body.

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Vaczy, A., Reglodi, D., Somoskeoy, T., Kovacs, K., Lokos, E., Szabo, E., Tamas, A., Atlasz, T. (2016) The Protective Role of PAC1-Receptor Agonist Maxadilan in BCCAO-Induced Retinal Degeneration. *J Mol Neurosci* **60**: 186–194.



BALÁZS ZSIDÓ

University of Pécs
Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

A key step in the early stages of drug design is the design of potent drug molecules. This process is now mostly carried out using computer (pharmaco-informatics) methods, which are capable of handling both large amounts of structural data and complex energy calculations. The pharmacoinformatics toolbox will be used in both target-based and ligand-based design and will be extended with new procedures in the course of the PhD work. The methods will be tested and applied in curricular areas of pharmacology such as pain management, regulation of signalling, antiviral and epigenetic-based therapies.

SELECTED PUBLICATIONS

Zsidó, B. Z., Börzsei, R., Pintér, E., Hetényi, C. (2021) Prerequisite Binding Modes Determine the Dynamics of Action of Covalent Agonists of Ion Channel TRPA1. **Pharmaceuticals** **14**: 988

Zsidó, B. Z., Hetényi, C. (2021) The role of water in ligand binding. **Curr Opin Struct Biol** **67**: 1-8

Zsidó, B. Z., Börzsei, R., Szél, V., Hetényi, C. (2021) Determination of Ligand Binding Modes in Hydrated Viral Ion Channels to Foster Drug Design and Repositioning. **J Chem Inf Model** **61**: 4011-4022

Zsidó, B. Z., Hetényi, C. (2020) Molecular Structure, Binding Affinity, and Biological Activity in the Epigenome. **Int J Mol Sci** **21**: 4134



**PÉCS
SZENT-GYÖRGYI
STUDENTS**



BÁLINT KISJÓS

National Academy of Scientist Education,
1st year
University of Pécs,
Medical School,
2nd year

1ST YEAR STUDENTS

Szent-Györgyi Mentor: Krisztián Kvell
Junior mentor: Kitti Garai
Theme of research: The anti-tumour effect of microRNAs induced by regular physical activity
Language: English/advanced



KRISZTIÁN KLONFÁR

National Academy of Scientist Education,
1st year
University of Pécs,
Medical School,
1st year

Szent-Györgyi Mentor: András Garami
Junior mentor: Eszter Pákai
Theme of research: Investigation of the thermoregulation system in health and disease
Language: English/intermediate, German/intermediate



LAURA MUNDRUCZ

National Academy of Scientist Education,
1st year
University of Pécs,
Medical School,
1st year

Szent-Györgyi Mentor: Miklós Kecskés
Theme of research: The role of TRPM4 in temporal lobe epilepsy
Language: English/advanced, Russian/basic, French/basic



POLETT OROSZ

National Academy of Scientist Education,
1st year
University of Pécs,
Medical School,
1st year

Szent-Györgyi Mentor: Zsuzsanna Helyes
Junior mentor: Ádám István Horváth
Theme of research: Investigation of the role of fractalkine receptor in mouse models of chronic joint pain
Language: English/advanced



DÁVID VINCE SIMON

National Academy of Scientist Education,
1st year
University of Pécs,
Medical School,
2nd year

Szent-Györgyi Mentor: Zsuzsanna Helyes
Junior mentor: Éva Borbély
Theme of research: Investigation of hemokinin-1 functions in physiological and pathophysiological processes of the central nervous system in mice
Language: English/advanced



INEZ BOSNYÁK

National Academy of Scientist Education,
1st year
University of Pécs,
Medical School,
5th year

Szent-Györgyi Mentor: Dóra Reglódi
Junior mentor: Alexandra Váczy
Theme of research: Ischemic retinopathy and the role of endogenous PACAP
Language: English/intermediate, German/intermediate



ANGELIKA BODÓ

National Academy of Scientist Education,
2nd year

University of Pécs,
Medical School, 3rd year

2ND YEAR STUDENTS

Szent-Györgyi Mentor: István Hernádi

Junior mentor: Zsolt Kristóf Bali

Specialization: neurobiology

Language: English/intermediate, German/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Examination of ageing and neurocognitive disorders in rodents: identification of preclinical drug development strategies and development of combined performance-enhancing therapies. In neuroscience recently, pharmacological studies are increasingly being replaced by so-called chemogenetic methods, which have the advantage of allowing selective, spatially and temporally defined manipulation of the brain area of interest. In our experiments, we aim to develop such a translational model in rodents and non-human primates using DREADD (Drug Receptors Exclusively Activated by Designer Drugs) technology that reliably represents cognitive impairment related to certain human pathologies, thus providing a significant role both in basic research and in the preclinical investigation of new drug candidates that enhance cognitive performance.

AMBITIONS AND CAREER GOALS

My goal is to develop, through continuous learning and experience, the knowledge base that I will later use to help advance medicine. This is why I would like to pursue a career in research after my medical degree, as I am driven by curiosity and a desire to learn, and I believe that future doctors will need to use innovative diagnostic and therapeutic methods to help their patients. I am particularly keen to promote efforts to treat the now incurable but increasingly problematic neurodegenerative diseases of the soul, such as Alzheimer's, which are a growing problem in our ageing society, and I hope that one day I will find a way to restore the hope of a long, happy and quality life for those affected.



LAJOS KARAKAI

National Academy of Scientist Education,
2nd year

University of Pécs,
Medical School, 2nd year

Szent-Györgyi Mentor: Éva Szóke

Specialization: neuropharmacology

Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Investigation of modification of lipid rafts for analgesic and antitumor effects. We investigate the functional relationship between Transient Receptor Potential (TRP) ion channels and lipid rafts in different mouse models of acute pain and in a complex mouse osteosarcoma tumor model. Lipid rafts are specific microdomain of the cell membrane that can be disrupted through their cholesterol or sphingolipid content, thereby affecting the function of different receptors. In the acute pain model we investigate the effect of lipid raft disruption on the TRP Melastatin 3 (TRPM3) and TRP Melastatin 8 (TRPM8) ion channel, and in the chronic tumor pain model on the TRP Vanilloid 1 (TRPV1) and TRP Ankyrin 1 (TRPA1) ion channel activity, respectively.

AMBITIONS AND CAREER GOALS

Self-development in many areas of life is a close goal of mine. Of these, with a particular focus on science, where I can delve deeper into the background and learn new and exciting methods. My long-term goals are still vague, but I can see that whatever I do, I will dive into it with great enthusiasm.



ENIKŐ TARI

National Academy of Scientist Education,
2nd year

University of Pécs,
Faculty of Sciences, Biology, 3rd year

Szent-Györgyi Mentor: Csaba Hetényi
Junior mentor: Balázs Zoltán Zsidó
Specialization: structural biochemistry, bioinformatics,
pharmacoinformatics, bioorganic chemistry
Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

It is generally recognized that carrying out drug research and the development of new pharmaceuticals is highly time and resource-consuming nowadays. This process can take up approximately 10-15 years. As a result various virtual screening techniques are now widely applied by both pharmaceutical companies and academic research groups. In this way the research is more cost-effective, and it greatly reduces the time required for the discovery of potent drugs. Throughout the research our main goal is not only to continuously expand the toolbox for drug design, but also we would like to develop and test new methods. We aim to present and publish these results in the future at conferences and scientific papers.

AMBITIONS AND CAREER GOALS

My aim is to gain as much experience and skills as possible during my university years because I believe that this is essential to become a successful researcher in the future. During these years it is important for me to continuously improve myself. In addition, I would like to work in a community where I have the opportunity to discuss my ideas and get feedback on my work.



KATA VÁRADI

National Academy of Scientist Education,
2nd year

University of Pécs,
Medical School, 2nd year

Szent-Györgyi Mentor: Dóra Tímea Zelena
Junior mentor: Klaudia Barabás
Specialization: endocrinology, neuroendocrinology,
molecular signalling
Language: English/advanced, French/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

The female reproductive period begins at sexual maturation and continues to last around 45-50 years of age. During this time, several factors can influence normal female sexual function, via the hypothalamic-pituitary-gonadal (HPG) axis. Malfunctioning of the HPG axis causes a number of problems such as endometrial hyperplasia, irregular menstruation, endometrial cancer or difficulties in fertilisation. In our experiments, we would like to investigate the factors influencing fertility and endometrial receptivity.

AMBITIONS AND CAREER GOALS

The science of today derives from the magic of yesterday, and the magic of today can be the science of tomorrow. With the right skills, knowledge and tools, the idea of yesterday can become tomorrow's discovery. My goal as a researcher is to get as close as possible to a picture of how the human body works as an extremely complex - and incredibly precise - biological system. I believe that by unraveling the precise molecular mechanisms of the 'human machine', I can contribute to the advancement of medicine and to a better understanding of our fellow human beings. I would like to make discoveries that can be passed on to future generations in the form of general knowledge, and from which they can generate insights themselves.

PUBLICATIONS

Barabás K, Makkai B, Farkas N, Horváth H, Nagy ZS, Váradi K, Zelena D. Influence of COVID-19 pandemic and vaccination on the menstrual cycle: a retrospective study in Hungary. **Frontiers in Endocrinology**; 2022; 13: 9747882022.



**SZEGED
SZENT-GYÖRGYI
MENTORS**



RITA AMBRUS

University of Szeged
Faculty of Pharmacy
Institute of Pharmaceutical Technology
and Regulatory Affairs

RESEARCH AREA

Modern pharmaceutical technology is focused on formulations that are targeted to the exact site at the appropriate time, with maximum efficiency and with reduced side-effects. Nanoparticle engineering has been developed and reported for pharmaceutical applications. In this approach, poorly water-soluble compounds are formulated as nanometer-sized (< 1000 nm) drug particles. Nanoparticulate technology offers increased bioavailability, improved absorption, and the potential for drug targeting. The main question of our work how we can use and apply the prepared nanosized systems (as predispersions) in drug formulation (to reach local or systemic effect) to get effective therapies in different diseases. Therefore we should find cost-effective production by new technological processes containing the most important technological and material parameters. The aim is to reach a local and systemic effect with alternative, mainly pulmonary / nasal drug administration. There is a great need for the development of pulmonary and nasal generic formulations, as the protection of currently marketed formulations is about to expire. From a therapeutic point of view, the treatment of local asthma and Chronic Obstructive Pulmonary Disease (COPD) / remains the main indications for inhalation therapy. However, inhalation formulations for the treatment of e.g. diabetes or schizophrenia



ISTVÁN BACZKÓ

University of Szeged
Albert Szent-Györgyi Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

Cardiovascular diseases lead mortality statistics worldwide. Congestive heart failure and atrial fibrillation are major contributors to cardiovascular mortality and morbidity, in addition, their prevalence is constantly increasing. The two conditions often co-exist, further increasing mortality in these patients. Despite significant improvements in their treatment in the last two decades, congestive heart failure and atrial fibrillation remain significant health care problems. Our laboratory aims at the identification of common and separate elements of electrical remodeling (changes in the expression of transmembrane ion channels and transporters in response to these conditions) in heart failure and atrial fibrillation that can serve as novel therapeutic targets with the help of different animal models of atrial fibrillation established in our laboratory with continuous clinical collaboration. Furthermore, new compounds acting on identified molecular targets are also tested in our atrial fibrillation models. Another important goal of our work is to study the mechanisms responsible for increased arrhythmia susceptibility in models of congestive heart failure, with special attention to elements of electrical remodeling. In addition, our laboratory also focuses on the unmet need for improved preclinical models for better prediction and prevention of proarrhythmic adverse effects of drugs in development

are already available as to have systemic treatment. Many new types of nasal products were developed for systemic drug delivery are already on the market. However, the development of nasal delivery systems for the treatment of central nervous system diseases that provide rapid and effective brain pharmac concentrations for drugs that utilize the nasal route could be a new area of research.

SELECTED PUBLICATIONS

- Party, P., Bartos, Cs., Farkas, Á., Szabó-Révész, P., **Ambrus, R.** (2021) Formulation and In Vitro and In Silico Characterization of "Nano-in-Micro" Dry Powder Inhalers Containing Meloxicam. **Pharmaceutics 13**: 2 Paper: 211.
- Gieszinger, P., Stefania, Csaba, N., Garcia-Fuentes, M., Prasanna, M., Gáspár, R., Sztajkov-Ivanov, A., Ducza, E., Márki, Á., Janáky, T., Kecskeméti, G., Katona, G., Szabó-Révész, P., **Ambrus, R.** (2020) Preparation and characterization of lamotrigine containing nanocapsules for nasal administration. **Eur J Pharm Biopharm 153**: pp. 177-186.
- Alshweiat, A., Csóka, I., Tömösi, F., Janáky, T., Kovács, A., Gáspár, R., Sztajkov-Ivanov, A., Ducza, E., Márki, Á., Szabó-Révész, P., **Ambrus, R.** (2020) Nasal delivery of nanosuspension-based mucoadhesive formulation with improved bioavailability of loratadine: preparation, characterization, and in vivo evaluation **Int J Pharm 579**: Paper: 119166.
- Ambrus R.**, Alshweiat A., Csóka I. Ovari G., Esmail A., Radacsi N. (2019) 3D-printed electrospinning setup for the preparation of loratadine nanofibers with enhanced physicochemical properties **Int J Pharm 567**: Paper: 118455.

in order to improve cardiovascular safety of novel compounds entering the market. In this regard, in the last 5 years, for the first time in the world, we have participated in the creation of several transgenic rabbit models of long QT syndromes.

SELECTED PUBLICATIONS

- Castiglione, A., Hornyik, T., Wülfers, E.M., Giammarino, L., Eder, I., Jowais, J.J., Rieder, M., Perez-Feliz, S., Koren, G., Bősze, Z., Varró, A., Zehender, M., Brunner, M., Bode, C., Liin, S.I., Larsson, H.P., **Baczkó, I.**, Odening, K.E. (2021) Docosaheptaenoic acid normalizes QT interval in LQT2 transgenic rabbit models in a genotype-specific fashion. **Europace 24**: 511-522.
- Varró, A., Tomek, J., Nagy, N., Virág, L., Passini, E., Rodriguez, B., **Baczkó, I.** (2021) Cardiac transmembrane ion channels and action potentials: cellular physiology and arrhythmogenic behavior. **Physiol Rev 101**: 1083-1176.
- Hornyik, T., Castiglione, A., Franke, G., Perez-Feliz, S., Major, P., Hiripi, L., Koren, G., Bősze, Z., Varró, A., Zehender, M., Brunner, M., Bode, C., **Baczkó I.***, Odening K.E.* (2020) Transgenic LQT2, LQT5 and LQT2-5 rabbit models with decreased repolarisation reserve for prediction of drug-induced ventricular arrhythmias. **Br J Pharmacol 177**: 3744-3759. *shared senior authorship
- Ferdinandy, P., **Baczkó, I.**, Bencsik, P., Giricz, Z., Görbe, A., Pacher, P., Varga, Z.V., Varró, A., Schulz, R. (2019) Definition of hidden drug cardiotoxicity: paradigm change in cardiac safety testing and its clinical implications. **Eur Heart J 40**: 1771-1777.



FERENC BARI

University of Szeged
Albert Szent-Györgyi Medical School
Faculty of Science and Informatics
Department of Medical Physics and Informatics

RESEARCH AREA

Adequate and continuous blood supply of the brain requires a very precise regulatory mechanism. Investigating the properties of the cerebral microcirculation opens a unique way for understanding the details (components, dynamics) of blood flow regulation in both the healthy and the injured brain. We have been studying the major characteristics of the neurovascular coupling (enhanced neuronal activity is followed by changes in the local blood perfusion) for more than 20 years. We have obtained considerable knowledge on the nature of excitatory amino acid release and the concomitant changes in local microcirculation. We have intensively studied the vascular consequences of hypoxic-ischemic injuries and tested various, potentially neuroprotective strategies. We study cerebral microcirculation in various animal models. Our major approach is using optical methods (intravital microscopy, laser Doppler flowmetry, laser speckle contrast analysis [LASCA]). In addition, we perform *ex vivo* studies in order to characterize morphological alterations and changes in protein expression in the injured brain. Recently, we have been working on new neuroprotective approaches.

During the last years our research interest involves the question how medical informatics could help in stroke prevention and treatment of stroke victims.



ZSUZSANNA BATA-CSÖRGŐ

University of Szeged
Albert Szent-Györgyi Medical School
Department of Dermatology and Allergology

RESEARCH AREA

Psoriasis is the most common inflammatory skin disease among Caucasians. Our research focus is on the pathomechanism of this disease. The disease is polygenic with complex pathology therefore our work has different aspects: immunology, epidermal and dermal biology, regulation of cell proliferation and differentiation and extracellular matrix biology. We are engaged in classical theory driven research, but also use large scale studies. The research group is closely related to the clinic that makes it possible to use human tissues and cells for some of our work, which enhances the clinical relevance of our results. Some of our work is more basic research, we investigate normal and pathological functions of keratinocytes, fibroblasts and melanocytes.

SELECTED PUBLICATIONS

Clark, D., Tuor, U.I., Thompson, R., Institoris, A., Kulynych, A., Zhang, X., Kinniburgh, D.W., **Bari, F.**, Busija, D.W., Barber, P.A. (2012) Protection against recurrent stroke with resveratrol: endothelial protection. **PLOS One 7**: e47792.

Domoki, F., Zölei, D., Oláh, O., Tóth-Szűki, V., Hopp, B., **Bari, F.**, Smausz, T. (2012) Evaluation of Laser-speckle contrast image analysis techniques in the cortical microcirculation of piglets. **Microvasc Res 83**: 311-7.

Hugyecz, M., Mracskó, E., Hertelendy, P., Farkas, E., Domoki, F., **Bari, F.** (2011) Hydrogen supplemented air inhalation reduces changes of prooxidant enzyme and gap junction protein levels after transient global cerebral ischemia in the rat hippocampus. **Brain Res 1404**: 31-8.

Mracsko, E., Hugyecz, M., Institoris, A., Farkas, E., **Bari, F.** (2010) Changes in prooxidant and antioxidant enzyme levels during cerebral hypoperfusion in rats. **Brain Res 1321**: 13-9.

Lenti, L., Domoki, F., Gáspár, T., Snipes, J.A., **Bari, F.**, Busija, D.W. (2009) N-methyl-D-aspartate induces cortical hyperemia through cortical spreading depression-dependent and independent mechanisms in rats. **Microcirculation 16**: 629-39.

SELECTED PUBLICATIONS

Gál, B., Dulic, S., Kiss, M., Groma, G., Kovács, L., Kemény, L., **Bata-Csörgő, Z.** (2017) Increased circulating anti- $\alpha 6$ -integrin autoantibodies in psoriasis and psoriatic arthritis but not in rheumatoid arthritis. **J Dermatol 44**: 370-374

Göblös, A., Danis, J., Vas, K., **Bata-Csörgő, Z.**, Kemény, L., Széll, M. (2016) Keratinocytes express functional CARD18, a negative regulator of inflammasome activation, and its altered expression in psoriasis may contribute to disease pathogenesis. **Mol Immunol 73**: 10-18.

Gubán, B., Vas, K., Balog, Z., Manczinger, M., Bebes, A., Groma, G., Széll, M., Kemény, L., **Bata-Csörgő, Z.** (2016) Abnormal regulation of fibronectin production by fibroblasts in psoriasis. **Br J Dermatol 174**: 533-41.

Belső, N., Széll, M., Pivarcsi, A., Kis, K., Kormos, B., Kenderessy, A.S., Dobozy, A., Kemény, L., **Bata-Csörgő, Z.** (2008) Differential expression of D-type cyclins in HaCaT keratinocytes and in psoriasis. **J Invest Dermatol 128**: 634-42.

Bata-Csorgo, Z., Hammerberg, C., Voorhees, J.J., Cooper, K.D. (1995) Kinetics and regulation of human keratinocyte stem cell growth in short-term primary *ex vivo* culture. Cooperative growth factors from psoriatic lesional T lymphocytes stimulate proliferation among psoriatic uninvolved, but not normal, stem keratinocytes. **J Clin Invest 95**: 317-27.

Bata-Csorgo, Z., Hammerberg, C., Voorhees, J.J., Cooper, K.D. (1993) Flow cytometric identification of proliferative subpopulations within normal human epidermis and the localization of the primary hyperproliferative population in psoriasis. **J Exp Med 178**: 1271-81.



PÉTER BENCSIK

University of Szeged
Albert Szent-Györgyi Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

Our research group, which has been operating for more than 25 years, investigates the tissue and cellular biochemical basis of myocardial stress adaptation and attempts to identify new drug targets for the development of cardioprotective drugs together with national and foreign pharmaceutical industrial partners. We focus primarily on matrix metalloproteinase-2 (MMP-2) and its possible substrate molecules, which enzyme is also found in the intra- and extracellular compartments of the heart. In the preclinical phases of drug development, we investigate the inhibitory effect of potential drug candidate molecules on MMP-2. In addition, in close collaboration with the Institute of Pharmacology at Semmelweis University, we investigate the role and expression changes of microRNAs during acute myocardial infarction. We synthesized microRNAs, which showed significant change during myocardial ischemia/reperfusion injury and test their potential cardioprotective effect by administration of these so called protectomiRs in a mouse model of acute myocardial infarction. With both of the above-mentioned therapeutic options, our aim is to develop cardioprotective drugs or therapeutic formulations that can have a positive effect on cardiac muscle even in the presence of cardiovascular risk factors, comorbidities, and already authorized and widely used other pharmacological treatments.



ANTAL BERÉNYI

University of Szeged
Albert Szent-Györgyi Medical School
Department of Physiology
MTA-SZTE 'Lendület' Oscillatory Neuronal
Networks Research Group

RESEARCH AREA

Recent technical development gave a new momentum to experiments studying the brain, although the extremely complex structure of the nervous system still supplies the researchers with an endless inventory of open questions. In our research we investigate the possible therapeutic effects of Transcranial Electrical Stimulation (TES) on epileptic seizures. Particularly, we plan to develop a focused stimulation protocol both in time and space to interact only with the desired brain areas within an appropriate time-frame. To determine the appropriate focal points of stimulation, we investigate the internal dynamics of neural networks involved in seizure generation. We do this by performing a throughout analysis of networks on microscopic and mesoscopic scale with extremely high spatial and temporal resolution. The same approach is used to focus on the role of hippocampus and related circuitries in memory formation and spatial navigation. We pay special interest to the role of sensory information in this field.

Our long-term vision is to develop a closed-loop, implantable seizure suppressor device that continuously monitors the patterns of brain activity, and delivers electrical pulses in order to terminate any occurring seizures. We are hoping to translate our laboratory-stage experimental results into clinical trials within a few years.

SELECTED PUBLICATIONS

Gömöri, K., Szabados, T., Kenyeres, É., Pipis, J., Földesi, I., Siska, A., Dormán, G., Ferdinandy, P., **Bencsik, P.** (2020) Cardioprotective effect of novel matrix metalloproteinase inhibitors. *Int J Mol Sci*. **21**: 6990.

Bencsik, P., Gömöri, K., Szabados, T., Sántha, P., Helyes, Z., Jancsó, G., Ferdinandy, P., Görbe, A. (2020) Myocardial ischemia reperfusion injury and cardioprotection in the presence of sensory neuropathy: therapeutic options. *Br J Pharmacol* **177**: 5336-5356.

Bencsik, P., Kiss, K., Ágg, B., Baán, J.A., Ágoston, G., Varga, A., Gömöri, K., Mendler, L., Faragó, N., Zvara, Á., Sántha, P., Puskás, L.G., Jancsó, G., Ferdinandy, P. (2019) Sensory Neuropathy Affects Cardiac miRNA Expression Network Targeting IGF-1, SLC2a-12, EIF-4e, and ULK-2 mRNAs. *Int J Mol Sci* **25**: 20.

Bencsik, P., Kupai, K., Gorbe, A., Kenyeres, E., Varga, Z.V., Paloczi, J., Gaspar, R., Kovacs, L., Weber, L., Takacs, F., Hajdu, I., Fabo, G., Cseh, S., Barna, L., Csont, T., Csonka, C., Dorman, G., Ferdinandy, P. (2018) Development of Matrix Metalloproteinase-2 Inhibitors for Cardioprotection. *Front Pharmacol* **9**: 296.

Kiss, K., Csonka, C., Pálóczi, J., Pipis, J., Görbe, A., Kocsis, G.F., Murlasits, Z., Sárközy, M., Szűcs, G., Holmes, C.P., Pan, Y., Bhandari, A., Csont, T., Shamloo, M., Woodburn, K.W., Ferdinandy, P.*, **Bencsik, P.** (2016) Novel, selective EPO receptor ligands lacking erythropoietic activity reduce infarct size in acute myocardial infarction in rats. *Pharmacol Res* **113**: 62-70.

SELECTED PUBLICATIONS

Oliva, A., Fernández-Ruiz, A, Buzsáki, G., **Berényi, A.** (2016) Role of Hippocampal CA2 Region in Triggering Sharp-Wave Ripples. *Neuron* **91**: 1342-55.

Agarwal, G., Stevenson, I.H., **Berényi, A.**, Mizuseki, K., Buzsáki, G., Sommer FT. (2014) Spatially distributed local fields in the hippocampus encode rat position. *Science* **344**: 626-30.

Berényi, A., Somogyvári, Z., Nagy, A.J., Roux, L., Long, J.D., Fujisawa, S., Stark, E., Leonardo, A., Harris, T.D., Buzsáki, G. (2014) Large-scale, high-density (upto 512 channels) recording of local circuits in behaving animals. *J Neurophysiol* **111**: 1132-49.

Berényi, A., Belluscio, M., Mao, D., Buzsaki, G. (2012) Closed-loop control of epilepsy by transcranial electrical stimulation. *Science* **337**: 735-737.

Madisen, L., Mao, T., Koch, H., Zhuo, J.M., **Berényi, A.**, Fujisawa, S., Hsu, Y.W., Garcia, A.J. 3rd., Gu, X., Zanella, S., Kidney, J., Gu, H., Mao, Y., Hooks, B.M., Boyden, E.S., Buzsáki, G., Ramirez, J.M., Jones, A.R., Svoboda, K., Han, X., Turner, E.E., Zeng, H.A. (2012) Toolbox of Cre-dependent optogenetic transgenic mice for light-induced activation and silencing. *Nat Neurosci* **15**: 793-802.



ZSOLT ENDRE BOLDOGKŐI

University of Szeged
Albert Szent-Györgyi Medical School
Department of Medical Biology

RESEARCH AREA

The main projects of our research group: 1. Genetic regulation in various viral families: We have been assembling the transcriptome atlases of various viruses using short- and long-read sequencing technologies. We have currently been investigating the following viruses: herpes simplex virus, pseudorabies virus, varicella-zoster virus, human cytomegalovirus, Epstein-Barr virus, vaccinia virus, influenza virus, a baculovirus, an endogenous retrovirus, a circovirus, various RNA viruses, etc. Additionally, we have been examining how the transcriptions as well as the transcription and the DNA replication are interrelated with each other. We have put forward two hypotheses for assuming a genome-wide interplay among the transcription and replication machineries, which are the Transcription Interference Network (TIN) hypothesis and the Transcription and replication Network (TRIN) hypothesis, respectively. 2. Generation of intelligent viral vectors for brain research: Application of genetically modified pseudorabies virus for transneuronal tract-tracing, as well as analysis of neural activity using optical methods. 3. Examination of the genetic basis of major depression and suicide: high-coverage whole-exome analysis of depression. 4. Various microbiome research projects since 2019 have been launched.



IMRE MIKLÓS BOROS

Biological Research Centre Szeged
Institute of Biochemistry
University of Szeged
Faculty of Science and Informatics
Department of Biochemistry and Molecular
Biology

RESEARCH AREA

Transcription of eukaryotic genes is a multistep process that involves a large number of functionally different proteins and requires the ordered assembly of giant multiprotein complexes. In recent years the important role of chromatin structure in transcription regulation has been recognized and new directions in transcription research have been initiated. It is hoped that a better understanding of the roles of functionally distinct classes of transcription regulatory proteins and chromatin modifiers will provide keys to decipher why and how can these drive development and can be de-regulated in diseases like cancer. In joint laboratories located at the BRC and at the Biochemistry and Molecular Biology Department of SzU we use combined approaches to characterize proteins which modify chromatin structure. In one area of research we focus our studies on histone proteins used only under specific conditions for example at the very early stage of embryonic development. For these studies we use *Drosophila* model, as this permits us to combine genetic and cell- and molecular biology methods. Another research approaches we study gene expression changes in cancer cells. For this we use clinical samples and are primarily interested in identifying the genetic alterations that contribute tumor formation.

SELECTED PUBLICATIONS

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MIHÁLY BOROS

University of Szeged
Albert Szent-Györgyi Medical School
Institute of Surgical Research

RESEARCH AREA

Surgical research can bring together many clinical disciplines and interests, ranging from cardiovascular biology to gastroenterology. The ischemia-reperfusion (I/R)-induced cellular hypoxia - reoxygenation, and subcellular oxidoreductive stress are major determinants of mortality and morbidity in many areas of clinical practice, such as sepsis or shock situations, and investigations targeting the I/R-caused microcirculatory dysfunction are essential for development of treatment strategies for several clinical pathologies. From a general perspective, it is worth pointing out that any intervention protecting microcirculation is likely to result in protection of tissue function and structure. In this scheme we have characterized the anti-inflammatory potential of membrane-forming phospholipids in I/R-induced antigen-independent inflammation, and the observation that methane formation from phosphatidylcholine metabolites occurs in ischemic systems opened up new avenues for future research. Currently we examine the possible biological roles of endogenous methane formation and whether methane - or potentially methane-releasing agents influence IR-induced microcirculatory dysfunctions and modulate the outcome of inflammation.



PÉTER BURKOVICS

Biological Research Centre Szeged
Institute of Genetics

RESEARCH AREA

Duplication of the genetic material is essential for every living organism. In our laboratory, located at the Institute of Genetics in the Biological Research Centre Szeged, we examine the replication of eukaryotic cells. The replicative protein complex works with high speed and high fidelity, but several circumstances can interfere with this process. These could be different damage or structural barriers formed on the template DNA strand. The focus of our research interest is the replication of stable secondary structures, which formation is induced by the endogenous nucleotide sequence of the DNA. There are several types of the stable secondary structures, but our laboratory examines the replication of G-quadruplex (G4) structures. Computational analysis identified that there are more than 700,000 G4 motifs in our genome. Thus, the replication of the G4 in cells is challenging. G4 is a tetramer structure formed by stacking of guanine quartets on single-stranded nucleic acid (DNA or RNA) via Hoogsteen's base pairing. The most well examined form of G4 structures are the telomeres, which ensure the stability of the chromosome ends. Our work focuses on the replication of intrachromosomal G4 structures. Since G4 structures are very stable in physiological conditions, they can block the movement of the replicative machinery, which could lead to genome instability. On this basis, it is expected that the amount of G4-forming sequences is reduced during evolution,

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but the opposite is true. In *E. coli* and *C. elegans* the amount of G4-forming sequences in the genome is 0.42% and 0.89%, respectively, but in human cells 4.17% of the genome can form G4 structures that highlights the important function of G4s in the nuclear processes. Recently it has been described, that G4 structures can regulate the gene expression, the initiation of replication, the recombination and the epigenetic code. Therefore, fast and precise replication of G4 structures is essential, otherwise important nuclear functions might be damaged. For the efficient replication special DNA helicases and regulatory proteins are needed, which can synchronize the action of G4 unwinding DNA helicases and the replication apparatus. In our laboratory we examine the function of these regulatory proteins.

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TAMÁS CSONT

University of Szeged
Albert Szent-Györgyi Medical School
Department of Biochemistry

RESEARCH AREA

Cardiovascular diseases and especially acute myocardial infarction are among the leading causes of death worldwide. Although prevention and the therapy of myocardial infarction have been significantly improved in the last decades, mortality is still unacceptably high. Therefore, development of new therapies aiming to attenuate infarct size is very relevant. Thus, our research group investigates the molecular mechanisms of infarction as well as the adaptive responses of the myocardium to ischemic stress (pre- and postconditioning) to develop novel potential therapies for the treatment of myocardial infarction. Since the risk of myocardial infarction is increased by the presence of several co-morbidities and risk factors including high cholesterol level, diabetes, obesity, hypertension, smoking, lack of exercise, kidney failure, etc., we also look at the effects of certain risk factors on the myocardium as well as on adaptive mechanisms of the heart.



MÁRIA DELI

Biological Research Centre Szeged
Institute of Biophysics
Biological Barriers Research Group

RESEARCH AREA

Organisms are protected by biological barriers from harmful effects. These barriers also impede drug penetration. Our lab investigates methods to increase drug delivery on culture models of the blood-brain, nasal, corneal, respiratory and intestinal barriers. The pathways examined are (i) reversible opening of tight intercellular junctions by peptides or small molecules; (ii) targeting solute carriers at barriers for drug delivery by nanoparticles. Cellular toxicity of active ingredients and pharmaceutical excipients are measured by a real-time impedance-based method. Double and triple co-culture models are used for experiments, and a microfluidic integrated chip has been developed in a collaborative project. Our other major research interest is the examination of blood-brain barrier injury and dysfunctions in different diseases, like Alzheimer's disease, acute pancreatitis and diabetes. The goal of these experiments is to reveal the effect of disease pathogenic factors on blood-brain barrier functions and to identify protective molecules. The protection of brain endothelial cells and the improvement of BBB functions in pathological conditions, the exploration of new approaches for drug transport/targeting to brain may have therapeutic potential in the treatment of central nervous system diseases.

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ANDRÁS DÉR

Biological Research Centre Szeged
Institute of Biophysics
Work Group of Bioelectronics

RESEARCH AREA

Bioelectronics has a double meaning in scientific literature. On the one hand, as a branch of basic biophysical sciences, it deals with electric phenomena appearing on any organization level of living systems. On the other hand, as a recently developed discipline of information technological science, it explores the potential of biological materials for application in molecular electronics. These two areas of research are in close interaction not only with each other, but also with other disciplines of basic applied sciences. Our main goal is to develop novel methods on integrated micro- and nanotechnological platforms for the investigation of light-induced processes in biological membranes, and utilize them in both branches of bioelectronic science. The most important scientific problems to be solved are, on the one hand, concerned with the investigation of electric properties of single cells and cellular interfaces, while on the other hand with the application of photochromic proteins in optoelectronics and photonics. Besides its impact on basic biophysical science, our research is expected to have utilizations in various branches of applied bioelectronics.



ATTILA GÁCSE

University of Szeged
Faculty of Science and Informatics
Department of Microbiology

RESEARCH AREA

Infectious diseases are one of the leading causes of mortality worldwide, killing millions of people every year. While bacteria and viruses cause the majority of deadly infections, notably the number of fungal diseases is increasing at an alarming rate. In fact, it is estimated that nearly as many people die annually from invasive fungal infections as from the greatly feared tuberculosis (1.4 million) or malaria (1.2 million). Our research program focuses on the most common human fungal pathogens, the opportunistic *Candida* species with special focus on *C. parapsilosis*. We investigate the basic mechanisms of fungal pathogenesis and host immunity, and we aim to improve diagnosis and identify novel biomarkers of infection. Recently, we also investigate the role of the human "mycobiome" in health and disease development and progression.

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ANIKÓ GÖRBE

University of Szeged
Albert Szent-Györgyi Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

In experimental cardiology models, several studies have already demonstrated that the reperfusion phase following cardiac oxygen deprivation activates processes that lead to further damage of myocardial tissue. However, there are endogenous protective mechanisms that can reduce the extent of damage. The beneficial effects of ischemic pre-, post- and remote conditioning as well as pharmacological pre- and post-conditioning have been demonstrated in vivo and ex vivo in animal models. However, failures in clinical trials show that these mechanisms are not sufficiently effective in ischemic heart patients. Preclinical data suggest that co-morbidities such as hyperlipidemia, metabolic syndrome, diabetes mellitus-induced tissue changes and drug treatment of these diseases have a strong interfering effect. The most cost-effective way to study intracellular mechanisms is to use in vitro cardiomyocyte models. Furthermore, the presence of ischaemia/reperfusion injury and co-morbidities poses additional risks, as the hidden side effects of many drugs are only seen in such cases. Our research addresses the potential cardioprotective effects of microRNAs. The development of noncoding RNAs (such as microRNAs) as molecules of diagnostic and therapeutic value has in recent years brought them to the forefront of the pharmaceutical industry for the precision diagnosis and treatment of a number of diseases. In particular, to further investigate the role of



LAJOS HARACSKA

Biological Research Centre Szeged
Institute of Genetics
Mutagenesis and Carcinogenesis
Laboratory

RESEARCH AREA

Stalling of the DNA replication machinery, which occurs as a consequence of encountering unrepaired DNA damage, is a challenge for cells. To rescue the stalled replication fork, different DNA damage bypass mechanisms have evolved that promote replication through DNA lesions. In humans, increased error-prone bypass of DNA lesions causes increased mutagenesis and, as a consequence, a rise in the incidence of cancers. Error-free bypass processes, by contrast, keep mutagenesis low and reduce the frequency of cancers. Our research laboratory is interested in the driving forces and molecular mechanisms of mutagenesis and carcinogenesis. In particular, we investigate the following questions: What are the common roots of evolution and carcinogenesis? What are the molecular mechanisms of chromosomal rearrangements and the formation of point mutations? Why do we observe increased genome instability during carcinogenesis? What is the role of the recently described DNA repair genes in cancer suppression? Why do mutations in certain genes predispose to cancer? Which genes are commonly mutated in cancer, and how do these mutations contribute to tumour development and drug resistance? We investigate these challenging problems using human tissue culture-based reporter systems, next-generation DNA sequencing and purified proteins in

mammalian metalloproteinase (MMP) enzymes in cardiac remodelling, the research group is developing MMP inhibitor molecules, which are being tested at several levels: in silico molecular design in collaboration with a chemistry group, in vitro pretesting, screening, ex vivo and in vivo testing.

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reconstituted reaction pathways. Our research provides more insight into the molecular events of genome instability, carcinogenesis and has the potential to identify new tumour markers and drug targets as well as to improve personal cancer treatment.

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PETRA HARTMANN

University of Szeged
Albert Szent-Györgyi Medical School
Department of Traumatology

RESEARCH AREA

Antibiotics and non-steroidal anti-inflammatory drugs (NSAIDs) have a potential influence on eukaryotic cells through affecting mitochondrial functions, the oxidative phosphorylation and mitochondrial reactive oxygen free radicals formation. Both drug classes are commonly used in acute and chronic inflammatory and non-inflammatory diseases of the gastrointestinal (GI) tract, where mitochondrial dysfunction can also occur. Our research group investigates the potential role of mitochondrial dysfunction in the inflamed and non-inflamed states of the digestive tract in experimental and clinical settings. We also aim at investigating the effect of drugs being commonly administered in these diseases. We perform a comprehensive analysis of in vitro doseresponse effect of antibiotics and NSAIDs using highresolution respirometry (HRR) in clinical and experimental tissue samples. In parallel, simultaneous manifestations of intramitochondrial and microcirculatory dysfunctions are monitored in a colitis model with particular interest in mucosal barrier functions and composition of the microbiome; these are examined in the presence and absence of various treatment combinations (antibiotics, antibiotics and NSAIDs, respectively).



JUDIT HOHMANN

University of Szeged
Faculty of Pharmacy
Department of Pharmacognosy

RESEARCH AREA

Natural products play an important role in drug discovery because of their unmatched structural diversity, amazing, and often complex structures. The aim of our group is to perform purposeful research by rational selection of plant extracts and compounds to be isolated, in order to obtain efficiently new secondary plant metabolites, which are perspective for drug discovery. Literature data, ethnomedicinal knowledge, results of screen investigations and metabolomic approaches are considered for selection of plant species. Compounds are isolated from the very complex multi-component extracts exhibiting efficacy in the used tests, with the aid of different chromatographic methods by guidance of bioassay. The structures of the purified compounds are determined by means of spectroscopic methods (NMR and MS). The biological activity is usually investigated in collaborations.

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PÉTER HORVÁTH

Biological Research Centre Szeged
Institute of Biochemistry

RESEARCH AREA

Recent advances in light microscopy have changed the way biological research is conducted. The ability to acquire massive amounts of image data has given rise to new fields such as high content screening (HCS) or 3D imaging, which promise to open new doors both for basic research and drug discovery. However, with such massive amounts of data comes a need for automatic analysis tools. Our research concentrates on how human knowledge can be best integrated into intelligent computer algorithms for automated microscopy. To reach this goal, we have interest in image processing that is concerned with extracting biologically relevant quantitative information in 3-4-5D imaging and multi-parametric machine learning analysis that is necessary to make sense of this information. Recently, machine learning algorithms have become a popular solution for analyzing large single cell-based imaging scenarios. We concentrate on improving the state-of-the-art by detecting unusual patterns corresponding to unknown phenotypes.



ATTILA HUNYADI

University of Szeged
Faculty of Pharmacy
Institute of Pharmacognosy

RESEARCH AREA

Cancer is a leading cause of morbidity and mortality worldwide, and it is expected that annual cancer cases will rise from 14 million in 2012 to around 22 million within the next two decades. Resistance is a major factor promoting failure of chemotherapy and there is an urgent need for new therapeutic strategies. By following a natural product inspired drug discovery strategy, our group focuses on novel chemical approaches to fight cancer and particularly multi-drug resistant cancer. In this endeavor, we aim at the preparation of nature-inspired chemical scaffolds that can act as chemo-sensitizers on resistant tumor cells, hence can be used as non-toxic adjuvants in combination with chemotherapeutics. A broad scale of interesting natural products is utilized as starting materials, e.g. well-known antioxidants, insect hormones utilized as anabolic food supplements, etc. Thanks to this and to our intensive international collaboration, an inspiring multidisciplinary working environment awaits the candidates to join our team.

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GÁBOR JUHÁSZ

Biological Research Centre Szeged
Institute of Genetics

RESEARCH AREA

Autophagy is a fundamental catabolic pathway in eukaryotic cells. During the main route, portions of cytosol and organelles are captured into double-membrane autophagosomes, which then fuse with lysosomes to deliver their cargo for degradation and reuse. Our group is studying the role and mechanisms of autophagy mainly using the popular animal model *Drosophila*. We are also working on related trafficking pathways including endocytosis and crinophagy (secretory granule degradation). In recent years, we have started experiments to understand the regulation of lysosomal function.

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JÓZSEF KASZAKI

University of Szeged
Albert Szent-Györgyi Medical School
Institute of Surgical Research

RESEARCH AREA

Sepsis remains one of the leading causes of death in the intensive care units which necessitates the development of new diagnostic tools and novel, more efficient therapeutic possibilities. The basic problem in sepsis is the discrepancy between oxygen delivery and oxygen consumption which can lead to irreversible oxygen extraction deficit and energy shortage. The cornerstone of acute care should be to prevent, assess and treat oxygen debt globally. We propose that causative factors and signs of oxygen deficit have to be examined together on microcirculatory, cellular (endothelial) and subcellular (mitochondrial) levels in different shock-affected organs (e.g. the intestine and lung) by employing sufficiently long-term, clinically relevant experimental models. With this theoretical background, the major goal of our study is to find optimal, clinically applicable manoeuvres for microcirculatory recruitment and mitochondrial resuscitation to minimize the energy deficit of organs during the septic response.

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ANIKÓ KELLER-PINTÉR

University of Szeged
Albert Szent-Györgyi Medical School
Department of Biochemistry

RESEARCH AREA

Skeletal muscle is a highly dynamic tissue that can undergo successful regeneration upon injury, and change in size in response to exercise, aging or due to diseases (e.g. cancer cachexia, immobilization, or denervation). The muscle stem cells, satellite cells are stimulated by local damage to proliferate extensively and form myoblasts that will subsequently migrate, differentiate and fuse to form muscle fibers. Our research aims are to study (i) the signaling pathways and mechanisms in myoblast migration, differentiation, and fusion (ii) the role of exosomes in cell migration, (iii) the biology of satellite cells. Moreover, we investigate the molecular mechanisms regulating skeletal muscle mass, and we aimed to find new nanotechnological approaches for the local treatment of muscle atrophy. Skeletal muscle has an important role in whole-body metabolism, it accounts for 40% of adult human body weight, and about 90% of insulin-stimulated glucose uptake occurs in skeletal muscle. The vesicular transport of GLUT4 glucose transporters is impaired in cases of insulin resistance and type-2 diabetes mellitus leading to decreased glucose uptake of skeletal muscle and increased blood glucose level. Our further aim is to study this mechanism and to find new signaling pathways regulating glucose uptake of skeletal muscle. Our work is mainly basic research and we have strong scientific collaborations with clinicians.



LAJOS KEMÉNY

University of Szeged
Albert Szent-Györgyi Medical School
Department of Dermatology and Allergology

RESEARCH AREA

Trillions of bacteria, fungi and viruses colonize the skin surface, collectively comprising the skin microbiome. There is a continuous interaction in between the microbes and the different cells in the skin. Recent data suggest, that the skin commensal bacteria play an important role in providing a protection against more harmful bacteria, and in the regulation of skin immune system. Commensal bacteria can activate the different cells in the skin to produce inflammatory mediators. However, it is not known, how the skin cells can differentiate in between commensal and pathogenic bacteria? How do we tolerate the great number of bacteria without inducing inflammation in the skin? In special circumstances, the commensal flora has been suggested to play a role in the induction or in the maintenance of chronic inflammatory skin diseases, such as acne, rosacea or psoriasis. Important member of the skin's commensal flora is the bacterium called *Propionibacterium acnes* (*P. acnes*). Even though it resides in the pilosebaceous unit of the skin, under certain circumstances it may also play an important role in the pathogenesis of acne, the most common inflammatory skin disease. We investigate how and when this commensal microbe turns pathogenic and how this bacterium influences the skin immune system.

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BÁLINT KINTSES

Biological Research Centre Szeged
Institute of Biochemistry
Synthetic and Systems Biology Unit

RESEARCH AREA

The human body is a complex ecosystems consisting of the host and its associated microbiota made up of hundreds of beneficial commensal and disease causing pathogenic and opportunistic pathogenic bacterial species. As modern human lifestyles keep changing the ecological environment of the human microbiota at an unprecedented pace, these bacteria respond to these changes with continuous adaptation. A well known consequence of this process is the global antibiotic resistance crisis which is responsible for over 700,000 deaths annually, primarily driven by the emergence of multi-drug resistant opportunistic pathogenic bacteria. In our laboratory, we develop novel technologies in the field of synthetic biology, genomics and genome engineering for two complementary goals. First, to understand the evolutionary dynamics of antibiotic resistance development, and second, to develop novel therapeutic approaches designed to selectively target multi-drug resistant pathogenic bacteria. Beyond asking fundamental scientific questions, we are interested in the utilisation and commercialisation of our inventions.



MÓNIKA KIRICSI

University of Szeged
Faculty of Science and Informatics
Department of Biochemistry and Molecular
Biology

RESEARCH AREA

The general strategy to treat cancer relies largely on traditional chemotherapy using small molecular drugs. Although conventional chemotherapy has a decent success rate it frequently causes severe side effects and can even result in the evolution of multidrug resistant cancer phenotypes. Nanoparticle based treatment of solid tumors is regarded as a novel, attractive strategy to improve cancer therapy, since approximately 10-200 nm sized materials are selectively accumulated in tumor tissues due to the passive targeting effect, where many of them, especially metallic particles can exert direct anti-cancer activity. Owing to their large surface area nanomaterials can also serve as controllable delivery platforms of various cytotoxic drugs for active tumor targeting. Our research group investigates the cellular and molecular events behind the anti-cancer activity of different types of metal nanoparticles in *in vitro* and *in vivo* animal model systems.

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ISTVÁN KRIZBAI

Biological Research Centre Szeged
Institute of Biophysics

RESEARCH AREA

The central nervous system is one of the most complex and meantime the most sensitive part of our organism. For its proper function the central nervous system needs a steady state environment which is largely provided by the neurovascular unit. In this respect changes in functions of the neurovascular unit have important consequences in causing or aggravating a large number of neurological diseases. The main goal of our research is to understand the molecular mechanisms underlying the function of the neurovascular unit under physiological and pathological conditions. For this purpose, we use different in vitro models and in vivo two-photon microscopy. On the one side, we investigate the role of neurovascular unit in the formation of brain metastases and the mechanisms of migration of tumour cells into the brain. On the other hand, we investigate how cellular components of the neurovascular unit (brain endothelial cells, pericytes, astrocytes) communicate with each other in neurological disorders associated with aging and with inflammatory processes.



JÓZSEF MALÉTH

University of Szeged
Albert Szent-Györgyi Medical School
First Department of Medicine

RESEARCH AREA

Epithelial cells are essential orchestrators of organ physiology by determining fluid and volume homeostasis and secreting many biologically active compounds (including enzymes and mucins). Furthermore impaired epithelial function is associated with a plethora of severe and potentially lethal diseases, such as cystic fibrosis, or acute pancreatitis, whereas malignant epithelial transformation leads to different forms of cancer. Thus, epithelial functions are extensively regulated, but the details of these regulatory pathways are not well understood. I believe that the detailed understanding of complex epithelial functions will lead to better treatment of lethal diseases therefore in my research projects I focus on the physiological and pathophysiological roles of pancreatic epithelial cells.

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MÁTÉ MANCZINGER

Biological Research Centre Szeged
Institute of Biochemistry

RESEARCH AREA

How does our immune system distinguish between billions of molecules? What are the main determinants of immune recognition? What factors explain that certain people are more likely to get infections or cancer, while others are protected from these diseases? My research group aims to answer these questions. We focus on the adaptive immune system, which recognizes specific molecular motifs of pathogens, cancer and our self-cells. While this system is extremely complex, it is controlled by some less complicated laws, which we intend to characterize in detail. For example, while one would expect that the immune system is more likely to recognize molecular motifs that are highly dissimilar to our self-molecules, we showed that overly high dissimilarity hinders immune recognition. Moreover, adaptive immune recognition is largely influenced by diverse genetic factors resulting in variable susceptibility to infections, cancer and autoimmune diseases. If you would like to take part in untangling the complexity of adaptive immune recognition, don't hesitate to join us!



TAMÁS MARTINEK

University of Szeged
Albert Szent-Györgyi Medical School
Department of Medical Chemistry

RESEARCH AREA

The aim of our research group is to create new macromolecules from unnatural building blocks (foldamers), of which 3D structure can be predicted and programmed. Manipulating protein-protein, protein-membrane and protein-carbohydrate interactions by these chemically well defined substances is a great challenge and holds promise. While small molecule drugs can not effectively decouple macromolecule interactions in general because of their geometry, the right sized and often used antibodies have many disadvantages. We utilize foldamers as artificial self-organizing protein mimetics to modulate protein interactions, to develop diagnostic tools and novel antibacterial materials.

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LAJOS MÁTÉS

Biological Research Centre Szeged
Institute of Genetics

RESEARCH AREA

Cancer is the leading cause of death in the developed world. According to estimates from the International Agency for Research on Cancer, there were 8.2 million cancer deaths in 2012 worldwide. Cancer research began as early as at the end of the 19th century, indicating the social efforts to control this devastating disease. In recent years, the tremendous advances reached in molecular biology and genomics has given further impetus to the development of this field. Among other things, the recently developed high-throughput sequencing technology platforms have generated massive amounts of genetic variation data from a huge number of cancer samples. The collected data support the concept that cancer is a disease of our genome, because in the majority of tumors tens or even hundreds of thousands of mutations have been detected. These data also show that the spontaneous mutation rate observed in normal cells is not sufficient to account for the high number of mutations found in cancers. The key feature of cancer cells, allowing them to rapidly evolve more and more new mutations, is the instability of their genetic material. The long-term objective of our laboratory is to explore genetic alterations fuelling malignant transformation by undermining the stability of the genome.



JÓZSEF MIHÁLY

Biological Research Centre Szeged
Institute of Genetics
Developmental Genetics Unit

RESEARCH AREA

Coordinated regulation of the actin and microtubule cytoskeleton is known to play a pivotal role in the growth and proper navigation of neuronal axons and dendrites that are necessary to the formation of a functional nervous system. One of our major scientific interests is to gain a better understanding of the molecular mechanisms of axonal growth and guidance by uncovering the role of the growth cone cytoskeleton regulatory proteins. In addition, we are interested in the mechanisms of myofibrillogenesis. Myofibrils are composed of repeated sarcomeres that are extremely highly ordered macromolecular assemblies where structural organization is intimately linked to their functionality as contractile units. Recently, we developed a powerful nanoscopic approach that allowed us to determine the position of 27 muscle proteins with a quasi-molecular localization precision, and by means of template based protein structure modelling, we assembled a refined I-band and H-zone model with an unparalleled scope and resolution. We aim to combine this method with genetic approaches to investigate the molecular mechanisms of sarcomere assembly during muscle development. Our studies are of potential biomedical relevance as they may help to develop more efficient neuronal regeneration methods, and to understand sarcomere assembly and function in healthy and disease conditions.

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LÁSZLÓ NAGY

Biological Research Centre Szeged
Institute of Biochemistry

RESEARCH AREA

We are interested in the general principles of genomes evolution, that of the evolution of organismal complexity, fungal development and their biotechnological applications. Fungi are the most ubiquitous microbes in modern biotechnology which, despite centuries of research, offer huge unharnessed potentials. Our research focuses on gene regulatory networks underlying fungal morphogenesis and the degradation of complex plant polysaccharides (e.g. lignocellulose). Complex plant polysaccharides, such as lignin and cellulose, are the most abundant repositories of sequestered carbon on Earth. Fungi can most efficiently reintroduce this sequestered carbon into the carbon cycle, contributing a key step to ecosystem functioning worldwide. However, the genes and gene regulatory networks that underlie the fungal decomposition of complex plant biomass are unknown. Gene regulatory networks are finely tuned circuits that regulate precise spatial and temporal expression of genes. We use modern -omics, genetic, phylogenetic and bioinformatic approaches to uncover the evolutionary origins and genetic bases of fungal morphogenesis, multicellularity and to translate basic research results into biotechnological applications.



NORBERT NAGY

University of Szeged
Albert Szent-Györgyi Medical School,
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

The cardiac electrophysiology investigates the electrical changes of the heart, including both the physiological and pathological functions as well as novel pharmacological interventions. The cardiovascular diseases, and especially the arrhythmias are leading cause of mortality. The arrhythmias have a complex underlying mechanism where the intracellular Ca^{2+} handling plays a critical role. Therefore, the main aim of our laboratory is the investigation of the physiological function of the cardiac Ca^{2+} handling, its role in different arrhythmias, and development of new pharmacological interventions. A novel antiarrhythmic strategy could be the selective inhibition of the cardiac Na^+/Ca^{2+} exchanger that may decrease the excessive Ca^{2+} load of the cell, additionally may have positive inotropic effect. The sinus-node as a primary rhythm generator of the heart has an extremely complex electrophysiological mechanism, at the same time, it could be involved in several types of arrhythmias. Our further aim is the investigation of the Ca^{2+} handling in sinus-node cells under normal as well as during pathological condition (e.g.: metabolic syndrome). It is well-known that physical activity is healthy and significantly contributes to the normal physiology of the cardiovascular system. Still, several times sudden cardiac death of competitive athletes was observed where organic disease of the heart was not found. The underlying mechanism of sudden death could be the abrupt disturbance of the

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normal electrophysiological function of heart, however the arrhythmia mechanism is unknown. Therefore, further aim of our Institute is to develop a reliable "athlete's heart" animal model that provides data regarding the electrophysiological changes during physical activity. Our group investigates the alterations of the Ca^{2+} handling in the athlete's heart.

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CSABA PÁL

Biological Research Centre Szeged
Institute of Biochemistry
Synthetic and Systems Biology Unit

RESEARCH AREA

We focus on bacterial pathogens and the problem of antibiotic resistance. We found that multidrug resistance mutations in bacteria simultaneously enhance sensitivity to other unrelated antibiotics (collateral sensitivity). This finding has led to the design of new antibiotic cocktails. Using bacterial genome engineering, we aim to develop novel resistance-free antibiotics. Finally, we study the evolution of adaptive immune system in response to pathogens and cancer.

More details: <http://www.brc.hu/sysbiol>



TIBOR PANKOTAI

University of Szeged
Albert Szent-Györgyi Medical School
Institute of Pathology

RESEARCH AREA

Faithful repair of DNA double-strand breaks (DSBs) is indispensable since improper repair can lead to genome instability and subsequently to tumorigenesis. DSBs can be repaired through different pathways, and the balance between the choice of them must be tightly regulated to preserve genome integrity. DNA damage can be considered as a harmful stressor in which various biochemical pathways are activated, ensuring the proper DNA repair and cell survival. The main focus of the project is to map the signalling circuit induced by DNA damage and to understand how the malfunctional DNA repair can initiate tumorigenesis. In our experimental setup, we will use state-of-the-art biochemical technologies and genomic mapping in a human cell culture model system, and we combine these with single-cell data using super-resolution STORM microscopy. Additionally, with our experimental data, we can verify the existence and the means of DNA damage-induced cell signalization circuits and reveal the potential mechanisms of cellular communication. Although as a primary goal, the project aimed to unveil a basic research clue, identifying key steps in the repair process can help us to recognize new anti-cancer therapeutic targets, thereby also contributing to the development of novel drugs in tumor therapy.

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BALÁZS PAPP

Biological Research Centre Szeged
Institute of Biochemistry
Synthetic and Systems Biology Unit

RESEARCH AREA

Metabolism is central to life as it provides the building blocks and energy for all biological processes. While its fundamental tasks are highly conserved across all life forms, there are substantial differences in the details of how metabolism works across species and individuals. Humans are no exception. Any two of us show large metabolic differences and many diseases are known to involve changes in metabolism. However, not all metabolic differences are harmful and identifying those that impact human health is of paramount importance for medicine. Our laboratory uses computational approaches to study the variation of metabolism both within human populations and between different species. Our goal is to uncover the signatures of natural selection acting on human metabolism and thereby increase our understanding of healthy and diseased states.

For more details, see www.brc.hu/sysbiol/.



FERENC PETÁK

University of Szeged
Albert Szent-Györgyi Medical School
Faculty of Science and Informatics
Department of Medical Physics and Informatics

RESEARCH AREA

The cardiopulmonary research laboratory performs scientific activities in various fields of cardiopulmonary physiology and pathophysiology by using translational animal models of lung diseases and performing assessments in clinical environment. A research area is focusing on the involvement of the pulmonary hemodynamics and lung vasculature in various respiratory diseases. We clarify the mechanisms responsible for the lung function deteriorations with a particular focus on the cardiopulmonary interactions. Further research focuses on the characterization of the pulmonary consequences of general anesthesia in various animal models and in clinical environment. Improvement of patient monitoring is essential for the optimization of patient management in anesthesia and intensive care settings. Analyses of the expired gases has great importance in respiratory patient monitoring. Thus we analyze the within-breath dynamics of CO₂ exhalation by using capnography to gain insights into the ventilation-perfusion matching. Further research focuses on the pulmonary manifestations of type-2 diabetes mellitus (T2DM) that presents major public health concerns. We characterize the changes in airway function and clarify the deteriorations in the viscoelastic properties of the pulmonary parenchyma, which may be a consequence of lung volume loss, interstitial edema, proliferation, and the effect of advanced glycation endproducts and their interaction with receptors.

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ZOLTÁN RAKONCZAY

University of Szeged
Albert Szent-Györgyi Medical School
Department of Pathophysiology

RESEARCH AREA

Acute pancreatitis is a sudden inflammation of the pancreas which can have mild or severe course. Unfortunately, the latter form still has an unacceptably high mortality. The reason for this is, at least in part, due to the facts that the pathomechanism of acute pancreatitis is unclear and we have no specific treatment of the disease. The main aims of our group are to investigate the roles of various inflammatory factors, mitochondria and the recently identified pancreatic ductal cells in the development of acute pancreatitis. Our hope is to eventually open up new therapeutic possibilities in acute pancreatitis.



MÁRTA JULIANNA SÁRKÖZY

University of Szeged
Albert Szent-Györgyi Medical School
Department of Biochemistry

RESEARCH AREA

Diastolic dysfunction and left ventricular hypertrophy are characteristic features of chronic heart failure in the early phases. With the progression of cardiac fibrosis, systolic dysfunction also develops leading to the late phases of chronic heart failure. Common causes of chronic heart failure are arterial hypertension, chronic kidney disease (CKD), metabolic syndrome, oncologic treatments such as chemotherapy and/or radiotherapy-induced cardiotoxicity forms. Our aim is to investigate and compare the molecular mechanisms of heart failure forms developed as a consequence of different underlying diseases. The identification of the early predictors and prevention of hypertrophy and fibrosis by the administration of protective agents are relevant research perspectives both experimentally and clinically. In our experiments, we investigate the heart function and morphology, the molecular changes in the cardiac microRNA/mRNA profiles and downstream targets as well as the circulating marker molecules, and we test new agents for the prevention of heart failure. Moreover, the hypertrophic heart is more prone to ischemia. In industrialized countries, acute myocardial infarction is the leading cause of mortality. Therefore, the ischemic adaptation of the hypertrophic and fibrotic heart is also the focus in our disease models.

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ÁRON SZABÓ

Biological Research Centre Szeged
Institute of Genetics

RESEARCH AREA

Key to the long-term survival of the nervous system is its resilience towards unwanted environmental effects coupled to plasticity and regeneration following adverse events. Nerve injuries, traumatic spinal cord and brain injury, neurodegenerative diseases, viral infections, and certain chemotherapeutic agents all compromise the integrity of the nervous system. Injury, for example, results in short-term cell death and degeneration of neurites in the vicinity of the injury, which in turn may lead to inflammation and neurodegeneration that can last for years, damaging other cells. Debris and dead cells that form after injury are cleared by glial cells, which make up half of the nervous system. Without removal of debris by microglia, which represent the major phagocyte population in the brain, secondary damage may be much more sustained and severe than with normal phagocytic activity. Therefore, it is important to understand the regulation of glial phagocytosis after nerve injuries. Our working group studies glial phagocytic processes and membrane-limited degradation pathways involved in lysosomal degradation of extracellular cargoes such as axonal debris and internal cell constituents such as regulatory proteins, in the nervous system of *Drosophila melanogaster* or fruit fly. The ensheathing and wrapping glia of *Drosophila* have similar phagocytic function to microglia and use a similar

phagocytic receptor as mammalian glia. The genetic toolkit and neural complexity of *Drosophila* allows us to obtain results that are relevant in vivo, more rapidly in contrast to those obtained in cell cultures and that are potentially translatable to mammals.

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MÁRTA SZÉLL

University of Szeged
Albert Szent-Györgyi Medical School
Institute of Medical Genetics and the
Dermatological Research Group

RESEARCH AREA

The genome programs of the past decades have provided an enormous amount of information about the human genome and how this information is translated to the "language of life". This knowledge is essential for understanding the pathogenesis of human diseases at the molecular level and, in fact, is currently being used to develop novel diagnostics and therapeutic modalities. Our workgroup identifies novel pathogenic mutations that result in rare monogenic human diseases. By performing functional analyses of these mutations, we attempt to understand how their mode of action leads to human disease. In another project, we investigate the genetics and molecular susceptibility factors of multifactorial human skin diseases, with a primary focus on psoriasis. We are also engaged in the investigation of non-coding RNAs. In particular, we analyze the role of the PRINS mRNA-like non-coding RNA, which was previously identified by our workgroup, in cellular stress responses and in various human diseases. In the last few years our research group has joined the Hungarian Brain Research Program (NAP Project) and as the member of the clinical branch we are engaged in the identification of genetic factors in neurodegenerative human diseases. This work has already yielded several new results for the field.

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GÁBOR TAMÁS

University of Szeged
Albert Szent-Györgyi Medical School
Department of Physiology, Anatomy and Neuroscience
MTA-SZTE Research Group for Cortical Microcircuits

RESEARCH AREA

Our research is characterized by a combination of technically challenging electrophysiology, molecular biology, imaging and anatomy in pursuit of the function of cell types and their synapses in the human and rodent cerebral cortex. We discovered the cellular source (neurogliaform cells) of slow, GABAB receptor mediated inhibition in the cerebral cortex. Subsequently, we discovered the mechanism of this slow inhibition as single neuron driven nonsynaptic or volume transmission of the neurotransmitter GABA. In addition, our experiments assigned a new, excitatory role to axo-axonic cells, which were considered as the most specific inhibitory neurons of the cortex. Our commitment to cutting edge methodology recently resulted in recordings from identified interneurons in completely anaesthetized, freely behaving rodents and identified the first ripple-like oscillatory events in the neocortex and their cellular structure. We initiated a research program in 2004 for multiple patch clamp recordings in slices taken from the human cerebral cortex leading to the first recordings of human synaptic interactions and showing the existence of Hebbian networks in the human cerebral cortex.



GYULA TIMINSZKY

Biological Research Centre Szeged
Department of Genetics

RESEARCH AREA

Genome integrity is crucial for all living organisms. If damaged DNA is not promptly repaired, the mutations ultimately lead to the development of cancer. Defective repair can also cause immunodeficiency, neurodegenerative disorders and premature ageing. The range of DNA lesions require diverse signaling and repair pathways to shape the DNA damage response. This involves changes in nuclear dynamics including alterations in chromatin structure, nucleocytoplasmic transport and protein activities. ADP-ribosylation is one of the earliest post-translational modifications appearing upon DNA damage. Its effects are numerous. One of its functions is to relax chromatin at the sites of DNA damage, facilitating the access of DNA repair processes to the lesions. Our findings indicate that nuclear dynamics, mRNA metabolism and chromosome organization strongly depend on nuclear ADP-ribosylation reactions and their crosstalk with other signaling pathways. Its deregulation impairs DNA repair and is implicated in cancer. At the bedside, the inhibition of ADP-ribosylation by drugs is used to treat cancer with certain gene mutations. Our research goal is to characterize novel molecular mechanisms that regulate the DNA damage response, including nucleocytoplasmic transport, mRNA metabolism and chromatin architecture. We study novel cancer relevant mutations

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that are sensitive to ADP-ribosylation inhibitors, which could be potentially used to treat tumors carrying such mutations. Furthermore, we investigate the molecular basis of a novel DNA damage-induced nuclear export mechanism that regulates ADP-ribose metabolism.

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ANDRÁS VARRÓ

University of Szeged
Albert Szent-Györgyi Medical School
Department of Pharmacology and
Pharmacotherapy

RESEARCH AREA

Sudden cardiac death is among the leading causes of mortality worldwide. Therefore to better understand the mechanisms of sudden cardiac death and consequently to introduce effective preventive measures represent extremely important issues in the field of public health care. Sudden cardiac death may occur due to cardiac ischaemia, adverse reaction following drug treatment is associated with diseases like heart failure, congenital diseases or can develop in top athletes due to excessive exercise and/or doping. These cases can manifest due to electrophysiological malfunctions of the heart as a consequence of disturbances in cardiac transmembrane ion channel function including various types of potassium channels. Our research team focuses on investigations on the physiology and pathophysiology of these ion channels including pharmacological modulation and possible prevention of cardiac arrhythmias in general, achieving international attention worldwide.

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SZILVIA VESZELKA

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Institute of Biophysics

RESEARCH AREA

Pharmaceutical treatment of most disorders of the central nervous system, including neurodegenerative diseases and brain tumors, is restricted due to the poor penetration of drugs across the blood-brain barrier, the major entry route for therapeutic compounds to the central nervous system. The great majority of neuropharmaceutical candidates, hydrophilic molecules, biopharmaceuticals, and efflux transporter ligands have a low permeability across the blood-brain barrier. Biocompatible and biodegradable drug targeting systems, so-called nanocarriers hold a great promise. Nanovesicles which can incorporate drug cargos and present on their surfaces ligands for blood-brain barrier endogenous nutrient transporters achieve increased specificity and efficacy for drug delivery across the blood-brain barrier. Combination of such ligands is a novel and innovative idea which could contribute to develop systems for better treatment of central nervous system diseases.

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LÁSZLÓ VÉCSEI

University of Szeged
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Department of Neurology

RESEARCH AREA

Our main research interest is the experimental and clinical investigation of the pathomechanism and possible therapeutic targets of neurological diseases. With the aid of MR imaging and electrophysiological recordings we search for the characteristic features of multiple sclerosis, Alzheimer's disease, Parkinson's disease and given headache disorders. From cerebrospinal fluid and from blood samples we determine biomarkers, which could help the diagnosis confirmation and provide details about the course of the diseases. In genetic studies, we investigate the genetic background of multiple sclerosis and Parkinson's' disease. The foundation of these experiments is our Biobank of human tissue samples, which we collect continuously. In our animal models we examine the molecular background of neurological disorders, particularly the protective effects of kynurenic acid derivatives. The kynurenine system is our main research target, which is involved in the pathomechanism of numerous neurological disorders due to the modulatory effects on glutamatergic neurotransmission. In previous experiments, these molecules were effective in the experimental models of headache, Huntington's disease, epilepsy and stroke. Our aim is to further elucidate the mechanisms of effect and potential therapeutic value of this molecules.



VIKTÓRIA VENGLÓVECZ

University of Szeged
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Department of Pharmacology and
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RESEARCH AREA

Disruption of epithelial ion transport plays a central role in the development of many diseases, such as cystic fibrosis or diarrhea. Research in recent years has shown that altered ion transport processes are also involved in the pathomechanism of inflammatory or cancerous diseases of the esophagus (eg Barrett's esophagus or esophageal adenocarcinoma), although their role is not fully clarified. The incidence of esophageal diseases is increasing worldwide, placing a huge and costly burden on health-care systems. However, the pathomechanism of these diseases is largely unknown, which makes it difficult to develop effective therapies. The goal of our working group is to investigate the role of ion transport processes in the development and progression of esophageal diseases and to identify novel therapeutic targets that can be a promising starting point in the treatment of these diseases.

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LÁSZLÓ VÍGH

Biological Research Centre Szeged
Institute of Biochemistry

RESEARCH AREA

As a “central dogma” earlier it was suggested that stress-induced protein denaturation serves as a major stress-sensing machinery, which triggers the expression of the molecular chaperone heat shock proteins (HSPs). We have introduced a new but not exclusive cellular “membrane thermosensor” model, which predicts the existence of membrane-associated stress sensing and signaling mechanisms. It proposes that changes in the physical state and composition of lipid molecular species with the concomitant destabilization/reorganization of membrane microdomains (“rafts”) can serve also as “molecular switches” to operate “cellular thermometers”. Using mammalian cells and the fission yeast (*S.pombe*) as models we intend to elucidate the mechanism of membrane-associated stress sensors, signaling pathways and the interplay and networking of potential cellular stress survival strategies. Since HSPs play a fundamental role in the pathology of several human diseases, understanding the mechanism whereby mammalian cells can elicit a stress response may also be of paramount importance for the design of novel drug molecules.



IMOLA WILHELM

Biological Research Centre Szeged
Institute of Biophysics
Neurovascular Unit Research Group

RESEARCH AREA

Homeostasis and proper functioning of the central nervous system are largely determined by the coordinated action of cells of the neurovascular unit. Formed by microvascular endothelial cells, pericytes, glial cells and neurons, the neurovascular unit controls the traffic of solutes and cells between the circulation and the brain (blood-brain barrier function) and regulates cerebral blood flow in response to local neural activity (neurovascular coupling). The neurovascular unit is involved in several pathologies of the brain, including cerebral metastases and small vessel ischemic disease. Recently, we have shown that a poorly characterized cell type, namely cerebral pericytes possess significant pro-metastatic features, especially in triple negative breast cancer. In addition, we observed constriction of capillaries in the vicinity of metastatic cells and also cerebral microinfarcts, which seems to be mediated by pericytes. Therefore, on the one hand, we aim to evaluate the role of capillary pericytes in the regulation of blood supply, which is a highly debated scientific question. On the other hand, we focus on the effects of cancer cells on pericytes and other cells of the brain, to understand the mechanisms of tumour cell-induced shaping of the metastatic niche.

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ISTVÁN ZUPKÓ

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Faculty of Pharmacy
Department of Pharmacodynamics and
Biopharmacy

RESEARCH AREA

In spite of the impressive achievements in the treatment possibilities of malignant disorders, cancers still have leading roles in mortality statistics worldwide indicating the need for novel anticancer agents. Natural products and their analogs are inexhaustible source of drugs candidates. The main aims of our group are to identify potential lead molecules by screening isolated and synthetic compounds for their anticancer properties. In vitro cell culture based studies are performed in order to characterize the cancer selectivity and the mechanism of the action of the most promising hits.

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**SZEGED
SZENT-GYÖRGYI
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RENÁTA BOZÓ

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Department of Dermatology and Allergology

RESEARCH AREA

Psoriasis is a common, chronic inflammatory, immune-mediated skin disease characterized by red, scaly patches. The psoriatic involved skin is mainly characterized by hyperproliferation of epidermal keratinocytes and infiltration of immune cells. Although nowadays the number of therapeutic options is increasing, however, there is currently no solution to prevent the recurrence of symptoms after the suspension of the therapy.

The disease is characterized by the fact that the involved skin areas are well separated from the clinically uninvolved, healthy-looking skin areas. Furthermore, even a number of cellular and extracellular abnormalities are present in the uninvolved skin areas. However, the main characteristic mechanisms of involved skin such as hyperproliferation of epidermal keratinocytes and infiltration of immune cells, are not observed in uninvolved skin. Our previous studies suggest that abnormalities of the uninvolved skin on one hand can predispose to the development of symptoms, on the one hand, alterations of the uninvolved skin can be protective factors and mechanisms as well. These alterations can contribute to the special balanced, so-called pre-psoriatic condition. Studying these protective mechanisms is a novel approach in psoriasis research. Recurrence of the psoriatic lesions may potentially be prevented by a better understanding of the changes that can maintain the uninvolved state.



ÁRPÁD CSERNETICS

Biological Research Centre Szeged
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RESEARCH AREA

Transition from simple to complex multicellularity was a giant evolutionary innovation in the history of life. Mushroom-forming fungi are ideal model organisms of complex multicellularity: they start their lifecycle as unicellular spores thus developing multicellular filaments followed by formation of a complex fruiting body structures with various fungal tissues in the sexual cycle. Complex multicellularity appeared multiple times independently (convergent origins) in the fungal kingdom via unique mechanisms. In contrast, yeasts are secondarily simplified organisms with multicellular ancestors. They spend most of their life cycle as unicellular organisms but retain the genes for multicellular complexity. The potential for yeast-like growth (i.e. genetic toolkit) evolved early in fungal evolution but the transitions to yeast-like lifestyle happened much later multiple times and yeast-like growth became dominant independently in distantly related clades. To gain deeper insight into such evolutionary innovations we examine genome-evolution, differences in gene expression and reconstruct gene regulatory networks with comparative genomics and -transcriptomics and lab experiments. Investigating the genetic and molecular background of fungal plant cell wall degradation is also among our research interests. Lignocellulose decomposition is one of the most industrially exploited fungal traits (e.g. in bioethanol production). Our goal is to reconstruct gene regulatory networks that underlie plant biomass degrading fungal extracellular enzyme biosynthesis.

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ILONA GRÓF

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RESEARCH AREA

Investigation of peptide carriers on culture models of biological barriers
Targeted delivery of protein drugs into cells and through biological barriers to achieve a more effective therapeutic effect is an area of intensive research. Several strategies exist already for delivery to the intracellular space, however the drugs that enter by endocytosis are unable to be effective due to entrapment in vesicles or degradation by lysosomes. We are investigating carriers that can be conjugated to a peptide or protein drug to enter cells and avoid lysosomal degradation. The aim of the research is to investigate these peptide carriers in culture models of different biological barriers for the delivery of large biomolecules. In this work, comparative study of several peptide carriers are performed on the culture model of endothelial and epithelial barriers, such as the blood-brain barrier, cornea-, lung-, and intestinal epithelium. In our experiments, we characterize the viability, integrity, and morphological changes of intercellular junctions of the cell layers. We study the intracellular localization of peptide carriers as well as their penetration through cell layers. Furthermore, passage of fluorescent proteins loaded into peptidetargeted nanoparticles through barrier models is tested. The expected results may contribute to the development of new types of carrier systems for the delivery of drugs or biopharmaceuticals across biological barriers, which may contribute to a better cure for diseases.



NÓRA IGAZ

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RESEARCH AREA

Metal nanoparticles have a great potential in cancer treatment due to a broad spectrum of anti-cancer activities. Nano-sized materials are able to accumulate in the tumor tissue owing to the fenestrated endothel of the tumor blood vessels. Moreover, the large specific surface of nanoparticles can be functionalized with tumor-specific ligands to achieve active tumor targeting. Among metal nanomaterials, silver and gold nanoparticles are the most promising entities for oncotherapeutic applications. Silver nanoparticles induce apoptosis in tumor cells by triggering the production of reactive oxygen species, whereas gold nanoparticles potentiate the efficacy of ionizing radiation, thus possess radiosensitizing activity on tumor cells. Metal nanoparticles are also excellent combinational partners of chemotherapeutic agents and of different treatment modalities. Besides the tumor-targeting activity of nanoparticles, nano-sized materials can be used to modulate the cancer promoting activity of other cell types such as cancer-associated fibroblasts and tumor-associated macrophages in the tumor microenvironment, thus we examine how metal nanoparticles affect the paracrine cross-talk between cells in the tumor tissue in order to attenuate tumor progression, invasion and dissemination.

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LÁSZLÓ JUHÁSZ

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Albert Szent-Györgyi Medical School
Institute of Surgical Research

RESEARCH AREA

Functional and morphological changes within mitochondria and their altered interaction with other organelles are suggested to play a critical role in the pathogenesis of various diseases associated with life-threatening organ dysfunction. Some of them, such as sepsis and ischaemia/ reperfusion-induced injury (I/R) have more recently become an intensively developing field of basic research. Our main purpose is to investigate the underlying mitochondrial and cellular mechanisms involved in the corresponding animal model of diseases.



TAMÁS MARUZS

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Institute of Genetics

RESEARCH AREA

Organelles of eukaryotic cells represent an intricate network the members of which are connected with each other either via vesicular transport processes or permanent physical contacts. Significance of the latter type of organellar communication (the so-called membrane contact sites) has only been recognized in the last decade. The complex, dynamic endomembrane system plays a pivotal role in normal cell physiology and its proper function requires the concerted action of several proteins. Main research focus of our group is the investigation of genes and proteins involved in vesicular trafficking routes channelling to the lysosomes, the central degradative organelles of cells. Members of the Sorting nexin (Snx) protein family play important roles in numerous points of the endolysosomal system. All Snx proteins contain the lipid-binding PX-domain that enables them to associate with organellar membranes where they utilize other protein domains to take part in versatile molecular events. However, exact cellular functions of many Snx proteins are currently unknown, and importantly, some of these proteins are involved in the pathogenesis of human diseases. Most of the Sorting nexins are evolutionarily conserved, offering the possibility to investigate their functions in model organisms. We use various fruitfly tissues to study the molecular functions of the less well-characterized Snx proteins in the endolysosomal system. Our current focus is on the investigation of the function

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of Snx25, a known membrane contact site protein, which is involved in a human hereditary neurodegenerative disease. Our results show that the mutation of the fruitfly counterpart of this gene leads to severe defects in the endosomal maturation process of the highly endocytic larval nephrocytes. However, the exact mechanism of this phenomenon is currently not known.

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MÁRIA MÉSZÁROS

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RESEARCH AREA

The pharmaceutical treatment of central nervous system disorders is far from satisfactory due to the poor penetration of drugs to the brain tissue. The blood-brain barrier is the major obstacle to prevent potential neuropharmaceuticals to reach their targets. Nanosized drug carriers, or nanoparticles are in the focus of research efforts to develop successful drug delivery systems for the central nervous system. Drug loading to nanoparticles alone is not enough for successful delivery of drugs to the brain. In order to elevate the permeability of nanocarriers across the blood-brain barrier a specific targeting is needed. Influx transport systems are highly expressed on the cerebral endothelium in contrast to blood vessel endothelial cells of other organs. Nanoparticles targeted by the ligands of these transporters may better dock to the luminal surface of brain microvascular endothelial cells resulting in better cellular uptake into the cells and penetration of the cargo across the blood-brain barrier. Blood-brain barrier dysfunction and inflammation play central role in the pathomechanism of many central nervous system disorders. Protection of the blood-brain barrier, the inhibition of causal factors of the brain microvascular breakdown offers an innovative therapeutic target of brain diseases. Several studies confirm that long-term treatment with non-steroidal anti-inflammatory drugs such as ibuprofen reduces the risk of Alzheimer's disease by the inhibition of inflammatory cascades.



GÁBOR MOLNÁR

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Microcircuits

RESEARCH AREA

Since the beginning of modern neuroscience it is a primary desire to understand the human cerebral cortex. How neurons build up networks and how they are able to serve higher brain functions such as cognition, complex perception, decision-making or language is still a mystery yet to be solved. The research of human brain mainly approached with noninvasive low resolution brain-imaging technologies or scalp electrode based techniques. We still are missing the information on the intricate organization of human neuronal networks. To date substantial data have been acquired from animal models investigating the physiological mechanisms. However, research on human neural circuits are more challenging due to lack of suitable tissue. Human neurons are not "scaled-up" versions of rodent or primate neurons, but have unique structural and functional properties. Our results, apart from deepening our understanding of basic features and mechanisms neuronal circuits and connections, can also provide a basis for development of proper therapies for neurodegenerations.

The serious peripheral side effects of long-term administration of ibuprofen limits its clinical applicability. Formulation of ibuprofen with targeted nanocarriers increases the brain specific penetration of the drug and at the same time reduces treatment doses and peripheral side-effects. The expected new results contribute to the development of new targeted nanocarrier systems for better brain delivery of drugs and to prevent and treat the diseases of central nervous system.

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Cserep, C., Posfai, B., Lenart, N., Fekete, R., Laszlo, Z.I., Lele, Z., Orsolits, B., **Molnar, G.**, Heindl, S., Schwarcz, A.D., Ujvari, K., Kornyei, Z., Toth, K., Szabadits, E., Sperlagh, B., Baranyi, M., Csiba, L., Hortobagyi, T., Magloczky, Z., Martinecz, B., Szabo, G., Erdelyi, F., Szipocs, R., Tamkun, M.M., Gesierich, B., Duering, M., Katona, I., Liesz, A., Tamas, G., Denes, A. (2020) Microglia monitor and protect neuronal function through specialized somatic purinergic junctions. *Science* **367**: 528-537.

Molnar, G., Rozsa, M., Baka, J., Holderith, N., Barzo, P., Nusser, Z., Tamas, G. (2016) Human pyramidal to interneuron synapses are mediated by multi-vesicular release and multiple docked vesicles. *eLife*: e18167.

Molnar, G., Farago, N., Kocsis, A.K., Rozsa, M., Lovas, S., Boldog, E., Baldi, R., Csajbok, E., Gardi, J., Puskas, L.G., Tamas, G. (2014) GABAergic neurogliaform cells represent local sources of insulin in the cerebral cortex. *J Neurosci* **34**: 1133-1137.

Molnar, G., Olah, S., Komlosi, G., Fule, M., Szabadics, J., Varga, C., Barzo, P., Tamas, G. (2008) Complex events initiated by individual spikes in the human cerebral cortex. *PLoS Biol* **6**: e222.

Szabadics, J., Varga, C., **Molnar, G.**, Olah, S., Barzo, P., Tamas, G. (2006) Excitatory effect of GABAergic axo-axonic cells in cortical microcircuits. *Science* **311**: 233-5.



MÁRTON PIPICZ

University of Szeged
Albert Szent-Györgyi Medical School
Department of Biochemistry

RESEARCH AREA

Despite improving therapeutic options, cardiovascular diseases including myocardial infarction remain the leading cause of death. Research aiming to reduce heart damage is therefore of great importance. The heart has its own adaptive response to the cardiac injury. Various procedures can enhance this response and result in cardioprotection by reducing the injury. In addition to classical pre- and postconditioning techniques, our research group investigates pharmacological and non-pharmacological cardioprotective approaches and molecular mechanisms to alleviate cardiac injury. Certain metabolic diseases (e.g. hypercholesterolemia, diabetes) increase the risk of myocardial infarction, directly impair cardiac function and interfere with the heart's adaptive response to myocardial infarction. Our research focuses on the adverse effects of metabolic diseases as cardiovascular risk factors on cardiac function and adaptive response. We comprehensively analyse molecular changes with genomic and proteomic approaches, then we elucidate them in detail by focused studies. We also conduct experiments regarding pharmacological and non-pharmacological interventions to affect these undesirable molecular changes and to mitigate adverse cardiac effects.



ATTILA RUTAI

University of Szeged
Albert Szent-Györgyi Medical School
Institute of Surgical Research

RESEARCH AREA

Sepsis is one of the most challenging diseases in intensive care, with a high mortality rate despite modern, costly therapies. The septic disease process is an uncontrolled inflammatory response to infection, leading to the development of life-threatening multi-organ failure. The main difficulty in the therapy of sepsis is the heterogeneity of organ damage and the dynamic variability of the septic response, which significantly complicate the diagnosis and the use of effective OTC therapies. Nowadays, the main goal of clinical care is to eliminate the infection and, if necessary, to use organ-supportive therapies, which are not sufficient in themselves. The focus of our experiments is on new therapeutic strategies that may be able to correct the global oxygen and energy deficits that are most responsible for the development of multi-organ failure and to restore oxygen dynamic balance. In addition to reducing the inflammatory response, our therapeutic goal is to improve the function of the main elements of oxygen transport: macro- and microcirculation; and mitochondrial oxygen consumption, the key to energy production.

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Pipicz, M., Kocsis, G.F., Sarvary-Arantes, L., Bencsik, P., Varga, Z.V., Ferdinandy, P., Csont, T. (2017) Low-dose endotoxin induces late preconditioning, increases peroxynitrite formation, and activates STAT3 in the rat heart. **Molecules** **22**: 433.

Varga, Z.V., **Pipicz, M.**, Baán, J.A., Baranyai, T., Koncsos, G., Leszek, P., Kuśmierczyk, M., Sánchez-Cabo, F., García-Pavía, P., Brenner, G.J., Giricz, Z., Csont, T., Mendler, L., Lara-Pezzi, E., Pacher, P., Ferdinandy, P. (2017) Alternative splicing of nox4 in the failing human heart. **Front Physiol** **8**: 935.

Pipicz, M., Demján, V., Sárközy, M., Csont, T. (2018) Effects of cardiovascular risk factors on cardiac STAT3. **Int J Mol Sci** **19**: 3572.

Szabó, M.R., Gáspár, R., **Pipicz, M.**, Zsindely, N., Diószegi, P., Sárközy, M., Bodai, L., Csont, T. (2020) Hypercholesterolemia Interferes with Induction of miR-125b-1-3p in Preconditioned Hearts. **Int J Mol Sci** **21**: 3744

Demján, V., Sója, A., Kiss, T., Fejes, A., Gausz, F. D., Szűcs, G., Siska, A., Földesi, I., Tengölics, R., Darula, Z., Csupor, D., **Pipicz, M.**, & Csont, T. (2021) *Stellaria media* tea protects against diabetes-induced cardiac dysfunction in rats without affecting glucose tolerance. **J Tradit Complement Med** **12**: 250-259.

SELECTED PUBLICATIONS

Rutai, A., Zsikai, B., Tallósy, S. P., Érces, D., Bizánc, L., Juhász, L., Poles, M. Z., Sóki, J., Baaity, Z., Fejes, R., Varga, G., Földesi, I., Burián, K., Szabó, A., Boros, M., Kaszaki, J. A. (2022) Porcine Sepsis Model With Numerical Scoring for Early Prediction of Severity. **Front Med (Lausanne)** **9**: 867796

Rutai, A., Fejes, R., Juhász, L., Tallósy, S. P., Poles, M. Z., Földesi, I., Mészáros, A. T., Szabó, A., Boros, M., Kaszaki, J. (2020) Endothelin A and B Receptors: Potential Targets for Microcirculatory-Mitochondrial Therapy in Experimental Sepsis. **Shock** **54**: 87-95

Juhász, L., **Rutai, A.**, Fejes, R., Tallósy, S. P., Poles, M. Z., Szabó, A., Szatmári, I., Fülöp, F., Vécsei, L., Boros, M., Kaszaki, J. (2020) Divergent Effects of the N-Methyl-D-Aspartate Receptor Antagonist Kynurenic Acid and the Synthetic Analog SZR-72 on Microcirculatory and Mitochondrial Dysfunction in Experimental Sepsis. **Front Med (Lausanne)** **7**: 566582

Tallósy, S. P., Poles, M. Z., **Rutai, A.**, Fejes, R., Juhász, L., Burián, K., Sóki, J., Szabó, A., Boros, M., Kaszaki, J. (2021) The microbial composition of the initial insult can predict the prognosis of experimental sepsis. **Sci Rep.** **11**: 22772

Poles, M. Z., Nászai, A., Gulácsi, L., Czákó, B. L., Gál, K. G., Glenz, R. J., Dookhun, D., **Rutai, A.**, Tallósy, S. P., Szabó, A., Lőrinczi, B., Szatmári, I., Fülöp, F., Vécsei, L., Boros, M., Juhász, L., Kaszaki, J. (2021) Kynurenic Acid and Its Synthetic Derivatives Protect Against Sepsis-Associated Neutrophil Activation and Brain Mitochondrial Dysfunction in Rats. **Front Immunol.** **12**: 717157



BALÁZS SZAPPANOS

Biological Research Centre Szeged
Institute of Biochemistry
Synthetic and Systems Biology Unit

RESEARCH AREA

The recent emergence of the field of systems biology brought a new era in the research of evolution. The novel methods and largescale datasets enable the systematic exploration of the elements of biological systems and the interactions between them. Our group is particularly interested in studying the evolution of metabolism. By measuring the intracellular metabolite levels, that is, the metabolome in different yeasts we can assess how fast metabolism evolves and what are the driving forces behind its evolution. We are also studying the evolution of the metabolic network, that is, how can organisms gain novel enzymes and biochemical pathways to better adapt to the environmental conditions. We utilize this knowledge for strain design by discovering genetic modifications that can boost the microbial production of chemicals with industrial importance.



DÓRA TOMBÁ CZ

University of Szeged
Albert Szent-Györgyi Medical School
Department of Medical Biology

RESEARCH AREA

Genomics is the study of the structure and function of genome. The genome sequences of many organisms have now been determined. It has also been described that the mammalian genomes contain approximately 22,000 protein-coding genes, however, they only represent about 1% of the genomes. It has also been demonstrated, that almost the entire genome is transcriptionally active at both DNA strands. More and more results show that the non-protein coding RNAs have a very important role on the regulation of gene expression, on various post-transcriptional processes and on the translation. Our research projects focus on the analysis of various viruses (e. g., Herpes simplex virus, Varicella Zoster virus, Vaccinia virus, etc.). We examine the gene expression profiles and transcriptional complexity of these viruses, and also use them as model organisms for the study of our Transcriptional Interference Network (TIN) hypothesis, which propose a novel layer of genetic regulation, and is based on the interactions between the gene activities via the mechanisms of transcriptional read-through between convergent, divergent and parallel gene pairs. For these, we apply state-of-the-art sequencing and bioinformatics techniques, as well as other cutting edge technologies such as the CrispR-Cas9/dCas9 techniques, with which we generate genetically modified viruses

SELECTED PUBLICATIONS

Zampieri, M., **Szappanos, B.**, Buchieri, M.V., Trauner, A., Piazza, I., Picotti, P., Gagneux, S., Borrell, S., Gicquel, B., Lelievre, J., Papp, B., Sauer, U. (2018) High-throughput metabolomic analysis predicts mode of action of uncharacterized antimicrobial compounds. *Sci Transl Med* 10: eaal3973.

Szappanos, B., Fritzeimer, J., Csörgő, B., Lázár, V., Lu, X., Fekete, G., Bálint, B., Herczeg, R., Nagy, I., Notebaart, R.A., et al. (2016) Adaptive evolution of complex innovations through stepwise metabolic niche expansion. *Nat Commun* 7: 11607.

Notebaart, R.A., **Szappanos, B.**, Kintses, B., Pál, F., Györkei, A., Bogos, B., Lázár, V., Spohn, R., Csörgő, B., Wagner, A., Rupp, E., Pál, C., Papp, B. (2014) Network-level architecture and the evolutionary potential of underground metabolism. *Proc Natl Acad Sci USA* 111: 11762-11767.

Szappanos, B., Kovács, K., Szamecz, B., Honti, F., Costanzo, F., Baryshnikova, A., Gelius-Dietrich, G., Lercher, M.J., Jelasity, M., Myers, C.L., Andrews, B.J., Boone, C., Oliver, S.G., Pál, C., Papp, B. (2011) An integrated approach to characterize genetic interaction networks in yeast metabolism. *Nat Genet* 43: 656-62.

or inducible gene expression. Our group also has bacterial- fungal- and human genomics projects (analysis of the genetic background of major depression, Alzheimer's Disease) by applying exome-, transcriptome-, methyl- and ChIP-seq techniques.

SELECTED PUBLICATIONS

Boldogkői, Z., Moldován, N., Balázs, Z., Snyder, M., **Tombácz, D.** (2019) Long-Read Sequencing - A Powerful Tool in Viral Transcriptome Research. *Trends Microbiol* 27: 578-592.

Tombácz, D., Prázsák, I., Szűcs, A., Dénes, B., Snyder, M., Boldogkői, Z. (2018) Dynamic transcriptome profiling dataset of vaccinia virus obtained from long-read sequencing techniques. *Gigascience* 7: gjy139.

Tombácz, D., Sharon, D., Szűcs, A., Moldován, N., Snyder, M., Boldogkői, Z. (2018) Transcriptome-wide survey of pseudorabies virus using next- and third-generation sequencing platforms. *Sci Data* 5: 180119.

Tombácz, D., Maróti, Z., Kalmár, T., Csabai, Z., Balázs, Z., Takahashi, S., Palkovits, M., Snyder, M., Boldogkői, Z. (2017) High-Coverage Whole-Exome Sequencing Identifies Candidate Genes for Suicide in Victims with Major Depressive Disorder. *Sci Rep* 7: 7106.

Boldogkői, Z., Balint, K., Awatramani, G.B., Balya, D., Busskamp, V., Viney, T.J., Lagali, P.S., Duebel, J., Pásti, E., **Tombácz, D.**, Tóth, J.S., Takács, I.F., Scherf, B.G., Roska, B. (2009) Genetically timed, activity-sensor and rainbow transsynaptic viral tools. *Nat Methods* 6(2): 127-30.



RENÁTA TÓTH

University of Szeged
Faculty of Science and Informatics
Department of Microbiology

RESEARCH AREA

Besides the bacterial flora, several fungal species are also long-term occupants of the oral microbiota. Among these, *Candida* are the most abundant species. Although the role of the human bacteriome and virome is well characterized, less is known about the composition of the mycobiome, let alone its role in the host. Therefore, one purpose of our project is to examine how do normal oral epithelial cells respond to the presence of commensal *Candida* species. We aim to explore their recognition, the corresponding signal transduction mechanisms and potential effector functions in the presence of various fungal stimuli. Since the last decade, numerous studies report alterations in the diversity of the oral microflora of immunocompromised and cancer patients (e.g. with oral squamous cell carcinoma), allowing the overgrowth of opportunistic pathogenic species (such as *C. albicans* and *C. parapsilosis*). Besides the increased probability of oral candidiasis in these patients, the abnormally altered microbiota might also influence the underlying diseases' progression. In addition to investigating the immune response regulatory effect of normal oral epithelial cells, we further aim to examine the potentially altered immunomodulatory effects of oral squamous cell carcinoma cells and to explore signaling routes that might be associated with tumor progression following fungal stimuli.



MÁTÉ VÁGVÖLGYI

University of Szeged
Faculty of Pharmacy
Institute of Pharmacognosy

RESEARCH AREA

Bioactive natural compounds and their semi-synthetic derivatives represent a highly promising treasury of potential new drugs. Two particularly interesting naturally occurring, pharmacologically active compound groups are ecdysteroids and protoflavonoids. Ecdysteroids are present both in flora and fauna. In mammals, they are non-toxic compounds that can exert numerous beneficial non-hormonal bioactivities, such as anabolic and adaptogenic effects. Besides, our research group has discovered the particular property of notably less polar ecdysteroid derivatives to sensitize the drug resistance of both multi-drug resistant (MDR) and non-MDR cancer cells towards various chemotherapeutics. The pharmacological potential of protoflavonoids is also wide-ranging. They are intensively studied for their antitumor effects, which stem from their representatives' cytotoxic nature and their inhibitory effect on specific DNA damage response mechanisms (ATR-dependent signaling), through which they can enhance, e.g., the activity of cisplatin. Besides, considerable evidence has been revealed in recent years (e.g., inhibition of xanthine oxidase enzyme, antiviral activities) suggesting that the pharmacology of protoflavonoids might exceed their antitumor potential. The focus of our research efforts is on the structural optimization of compounds of the outlined groups with therapeutic

SELECTED PUBLICATIONS

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- Toth, R.,** Cabral, V., Thuer, E., Bohner, F., Nemeth, T., Papp, Cs., Nimrichter, L., Molnar, G., Vagvolgyi, Cs., Gabaldon, T., Nosanchuk, J.D., Gacser, A. (2018) Investigation of *Candida parapsilosis* virulence regulatory factors during hostpathogen interaction. **Sci Rep** 8: 1346.
- Toth, R.,** Toth, A., Vagvolgyi, Cs., Gacser, A. (2017) *Candida parapsilosis* secreted lipase as an important virulence factor. **Curr Protein Pept Sci** 18: 1043-1049.
- Nagy, L.G., **Toth, R.,** Kiss, E., Slot, J., Gacser, A., Kovacs, G.M. (2017) Six Key Traits of Fungi: Their evolutionary origins and genetic bases. **Microbiol Spectr** 5.
- Toth, R.,** Toth, A., Papp, Cs., Jankovics, F., Vagvolgyi, Cs., Alonso, M.F., Bain, J.M., Erwig, L.P., Gacser, A. (2014) Kinetic studies of *Candida parapsilosis* phagocytosis by macrophages and detection of intracellular survival mechanisms. **Front Microbiol** 5: 633.

potential, according to which semi-synthetic modifications are made on the molecules, which may result in the improvement of their chemical-physical parameters, the enhancement of their biological effects and/or the reduction of their potential disadvantageous side effects.

SELECTED PUBLICATIONS

- Vágvolgyi, M.,** Béteky, P., Bogdán, D., Nové, M., Spengler, G., Latif, A.D., Zupkó, I., Gáti, T., Tóth, G., Kónya, Z., Hunyadi, A. (2020) Squalenoylated Nanoparticle Pro-Drugs of Adjuvant Antitumor 11 α -Hydroxycyclosteroid 2,3-Acetonides Act as Cytoprotective Agents Against Doxorubicin and Paclitaxel. **Front Pharmacol** 11: 552088.
- Vágvolgyi, M.,** Girst, G., Kúsz, N., Ötvös, S.B., Fülöp, F., Hohmann, J., Servais, J.-Y., Seguin-Devaux, C., Chang, F.-R., Chen, M.S., Chang, L.-K., Hunyadi, A. (2019) Less Cytotoxic Protoflavones as Antiviral Agents: Protoapigenone 1'-O-isopropyl ether Shows Improved Selectivity Against the Epstein–Barr Virus Lytic Cycle. **Int J Mol Sci** 20: 6269.
- Fumagalli, G., Giorgi, G., **Vágvolgyi, M.,** Colombo, E., Christodoulou, M.S., Collico, V., Prosperi, D., Dosio, F., Hunyadi, A., Montopoli, M., Hyeraci, M., Silvani, A., Lesma, G., Dalla Via, L., Passarella, D. (2018) Heteronanoparticles by Self-Assembly of Ecdysteroid and Doxorubicin Conjugates To Overcome Cancer Resistance. **ACS Med Chem Lett** 9: 468-471.
- Vágvolgyi, M.,** Martins, A., Kulmány, A., Zupkó, I., Gáti, T., Simon, A., Tóth, G., Hunyadi, A. (2018) Nitrogen-containing ecdysteroid derivatives vs. multi-drug resistance in cancer: Preparation and antitumor activity of oximes, oxime ethers and a lactam. **Eur J Med Chem** 144: 730-739.



GABRIELLA VARGA

University of Szeged
Albert Szent-Györgyi Medical School
Institute of Surgical Research

RESEARCH AREA

The extracorporeal circulation (ECC) can be lifesaving in conditions, accompanied by severe acute respiratory or circulatory failure, but the ECC related complications limit the application of the technique, and this reduces the group of patients who can benefit from the ECC treatment. Moreover, the complications frequently affect vital organs (kidney, brain, heart) and as a result long lasting aftercare can be necessary or in case of the most severe cases, it might even cause the death of the patient. Our main purpose is to develop and establish animal models, which will be suitable to the examination of inflammatory processes that play critical role in the pathomechanism of the ECC related complications. The other aim is to develop an innovative treatment method, the trans-oxygenator methane administration to moderate ECC associated complications.



EDIT WÉBER

University of Szeged
Albert Szent-Györgyi Medical School
Department of Medical Chemistry

RESEARCH AREA

Protein-protein interactions play an important role in a number of therapeutically relevant pathophysiological processes. These interactions include large protein surfaces; hence their modulation is challenging. While small-molecule drugs cannot effectively decouple macromolecule interactions in general because of their small size, the right sized and often used antibodies have many disadvantages. Thus, proteomimetic compounds and innovative drug development strategies are required. The aim of our research group is to create new proteomimetic macromolecules from unnatural building blocks (foldamers), of which 3D structure can be predicted and programmed. Manipulating protein functions by these chemically well-defined substances is a great challenge and holds promise. We utilize foldamers as artificial self-organizing proteomimetics to modulate protein-protein interactions or to develop diagnostic tools. Our targets are proteins that have a key role in tumour development and progression. We aim to design foldamers that can bind to our target proteins and are able to inhibit their interactions, thereby modulating their function. Our goal is to construct new foldamers which can inhibit tumour growth in cells.

SELECTED PUBLICATIONS

- Szűcs, S., Bari, G., Ugocsai, M., Lashkarivand, R.A., Lajkó, N., Mohácsi, A., Szabó, A., Kaszaki, J., Boros, M., Érces, D., **Varga, G.** (2019) Detection of Intestinal Tissue Perfusion by RealTime Breath Methane Analysis in Rat and Pig Models of Mesenteric Circulatory Distress. *Crit Care Med* **47**: e403-e411.
- Bari, G., Érces, D., **Varga, G.**, Szűcs, Sz., Varga, Z., Bogáts, G., Boros, M. (2019) Methane inhalation reduces the systemic inflammatory response in a large animal model of extracorporeal circulation. *Eur J Cardiothorac Surg* **56**: 135-142.
- Poles, M.Z., Bódi, N., Bagyánszki, M., Fekete, É., Mészáros, A.T., **Varga, G.**, Szűcs, Sz., Nászai, A., Kiss, L., Kozlov, A.V., Boros, M., Kaszaki, J. (2018) Reduction of nitrosative stress by methane: Neuroprotection through xanthine oxidoreductase inhibition in a rat model of mesenteric ischemia-reperfusion. *Free Radic Biol Med* **120**: 160-169.
- Mészáros, A.T., Büki, T., Fazekas, B., Tuboly, E., Horváth, K., Poles, M.Z., Szucs, S., **Varga, G.**, Kaszaki, J., Boros, M. (2017) Inhalation of methane preserves the epithelial barrier during ischemia and reperfusion in the rat small intestine. *Surgery* **161**: 1696-1709.
- Boros, M., Ghyczy, M., Érces, D., **Varga, G.**, Tokes, T., Kupai, K., Torday, C., Kaszaki, J. (2012) The anti-inflammatory effects of methane. *Crit Care Med* **40**: 1269-1278.

SELECTED PUBLICATIONS

- Tököli, A., Mag, B., Bartus, É., **Wéber, E.**, Szakonyi, G., Simon, M. A; Czibula, Á., Monostori, É., Nyitray, L., Martinek, T.A. (2020) Proteomimetic surface fragments distinguish targets by function. *Chem Sci* **11**: 10390.
- Fenteany, G., Gaur, P., Hegedűs, L., Dudás, K., Kiss, E., **Wéber, E.**, Hackler, L., Martinek, T.A., Puskás, L., Haracska, L. (2019) Multilevel structure–activity pro ling reveals multiple green tea compound families that each modulate ubiquitin-activating enzyme and ubiquitination by a distinct mechanism. *Sci Rep* **9**: 12801.
- Fenteany, G., Gaur, P., Hegedűs, L., Dudás, K., Kiss, E., **Wéber, E.**, Hackler, L., Martinek, T.A., Puskás, L., Haracska, L. (2019) Multilevel structure–activity pro ling reveals multiple green tea compound families that each modulate ubiquitin-activating enzyme and ubiquitination by a distinct mechanism. *Sci Rep* **9**: 12801.
- Bartus, É., Hegedűs, Z., **Wéber, E.**, Csipak, B., Szakonyi, G., Martinek, T.A. (2017) De Novo Modular Development of a Foldameric Protein-Protein Interaction Inhibitor for Separate Hot Spots: A Dynamic Covalent Assembly Approach. *Chemistryopen* **6**: 236-241.
- Hetényi, A., Németh, L., **Wéber, E.**, Szakonyi, G., Winter, Z., Jósavay, K., Bartus, É., Oláh, Z., Martinek, T.A. (2016) Competitive inhibition of TRPV1 – calmodulin interaction by vanilloids. *FEBS Lett* **590**: 2768.



**SZEGED
SZENT-GYÖRGYI
STUDENTS**



FANNI DZSUBÁK

National Academy of Scientist Education,
1st year

University of Szeged,
Albert Szent-Györgyi Medical School,
1st year

1ST YEAR STUDENTS

Szent-Györgyi Mentor: Tibor Pankotai
Theme of research: Next generation sequencing based analysis of the Hungarian tumour related diseases for increasing the therapeutic efficiency.
Language: English/intermediate, German /advanced



ANDRÁS ZSOMBOR GRESCHIK

National Academy of Scientist Education,
1st year

University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: Márta Julianna Sárközy
Theme of research: Investigation of therapeutic targets and molecular mechanisms of heart failure developed as a complication of oncological treatments in rodent models
Language: English/intermediate



ANDRÁS GULYÁS

National Academy of Scientist Education,
1st year

University of Szeged,
Albert Szent-Györgyi Medical School,
1st year

Szent-Györgyi Mentor: Márta Julianna Sárközy
Theme of research: Investigation of therapeutic targets and molecular mechanisms in uremic cardiomyopathy models
Language: English/advanced



ALEXANDRA DÓRA GYÉMÁNT

National Academy of Scientist Education,
1st year

University of Szeged,
Albert Szent-Györgyi Medical School,
1st year

Szent-Györgyi Mentor: Máté Manczinger
Theme of research: Systems biology analysis of the immune recognition of pathogens and cancer
Language: English/advanced



LUCIEN LEMAITRE

National Academy of Scientist Education,
1st year

University of Szeged,
Albert Szent-Györgyi Medical School,
1st year

Szent-Györgyi Mentor: Mária Deli
Junior mentor: Ilona Gróf
Theme of research: Examination of the maturation of the blood-brain barrier properties on a human stem cell based model.
Language: English/advanced, German/intermediate



CSONGOR BENCE LUDÁNYI

National Academy of Scientist Education,
1st year

University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: Gábor Tamás
Theme of research: Network roles for identified neocortical
Language: English/intermediate



BENJÁMIN PASKUJ

National Academy of Scientist Education,
1st year

University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: István Baczkó
Theme of research: Investigation of the cardiac electrophysiological effects of SGLT1 and SGLT2 inhibitors
Language: English/intermediate



ZSÓFIA ILONA PISZMAN

National Academy of Scientist Education,
1st year

University of Szeged,
Faculty of Pharmacy,
2nd year

Szent-Györgyi Mentor: Rita Ambrus
Theme of research: Development of pulmonary pharmaceutical preparations for the treatment of chronic lung diseases using technological procedures to form micro- and nanoparticles
Language: English/advanced



DOROTTYA ANNA SZAFIÁN

National Academy of Scientist Education,
1st year

University of Szeged,
Faculty of Science and Informatics, Biology,
1st year

Szent-Györgyi Mentor: László Nagy
Theme of research: Investigating the role of conserved transcription factors in the regulation of complex multicellular structure formation in mushroom-forming fungi
Language: English/intermediate, German/intermediate



ZORKA SZOLLÁR

National Academy of Scientist Education,
1st year

University of Szeged,
Albert Szent-Györgyi Medical School,
1st year

Szent-Györgyi Mentor: Tibor Pankotai
Theme of research: Identify potential biomarkers by next-generation sequencing and bioinformatics based data analysis
Language: English/advanced



MÁRK VIKTOR TRESZTIÁN

National Academy of Scientist Education,
1st year

University of Szeged,
Faculty of Science and Informatics, Biology,
1st year

Szent-Györgyi Mentor: Tamás Martinek
Junior mentor: Zsófia Hegedűs
Theme of research: Development and Application of Biomimetic Systems targeting pharmacologically relevant proteins
Language: English/intermediate



BOTOND DÁVID VINCZE

National Academy of Scientist Education,
1st year

University of Szeged,
Albert Szent-Györgyi Medical School,
1st year

Szent-Györgyi Mentor: Csaba Pál
Theme of research: The future antibiotics induce multidrug resistance: hypothesis
Language: English/intermediate, German/advanced



BARBARA AMBRUS

National Academy of Scientist Education,
2nd year
University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Psoriasis vulgaris is an immune-mediated, multifactorial, chronic skin disease, which is primarily caused by the hyperproliferation of keratinocytes and the infiltration of immune cells. There are several therapies with a short-term effect but there is no available treatment strategy which could entirely prevent the recurrence/spread of the disease. Psoriasis is characterized by well-demarcated, scaly plaques and uninvolved, healthy-looking skin, referred to as non-lesional (NL) skin. There is now strong evidence that non-lesional (NL) psoriatic skin, despite its normal appearance, represents an intermediate state between healthy and lesional skin. Extracellular matrix could play an important role in maintaining skin in NL condition, and the molecular changes in NL skin is a completely new approach. Thereby the aim of my research is to examine the changes of extracellular matrix and its regulating mechanisms in NL skin, which could be responsible for maintaining the NL phenotype. Proteases and protease inhibitors are known to play a role in the regulation of extracellular matrix components, therefore our aim is to compare the expression of proteases and protease inhibitors in lesional, non-lesional and healthy skin.



GERGŐ ZALÁN BIRÓ

National Academy of Scientist Education,
2nd year
University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Cardiovascular diseases are still the leading causes of death today. Obesity and its associated, or isolated metabolic disorders (eg. hypercholesterolemia, diabetes) have a negative effect on heart function and increase the risk of myocardial infarction and reduce the heart's ability to adapt to heart attack. Some findings indicate that the environmental effects on the mother can also cause alterations in the offspring, such as abnormal heart function, which may be due to epigenetic changes. However, the effects of maternal high blood cholesterol on the hearts of adult offspring have not been studied to date. One of the aims of our research group is to investigate the cardiac function of the offspring of such mothers and the adaptation of the heart to infarction in animal experiments. Furthermore, we investigate whether hypercholesterolemia causes epigenetic changes in the heart that may be associated with adverse cardiac effects, whether these are inheritable, and if so, whether they can be reversed by medication or lifestyle interventions. We hope that our research will contribute to a detailed understanding of the cardiac effects of maternal metabolic abnormalities in the offspring and to the development of treatment possibilities.

2ND YEAR STUDENTS

Szent-Györgyi Mentor: Zsuzsanna Bata-Csörgő
Junior mentor: Renáta Bozó
Specialization: dermatology, psoriasis
Language: English/advanced, Italian/advanced

AMBITIONS AND CAREER GOALS

As a member of the National Academy of Scientist Education I have the opportunity to experience all the aspects of laboratory work, along with its laborious and pleasurable side, and provides a strong background for my future career as a doctor or a researcher, both academically and socially. My long-term goal is not just to participate in a clinical research, but to come up with own ideas, which humankind could directly benefit from.

Szent-Györgyi Mentor: Tamás Csont
Junior mentor: Márton Pípicz
Specialization: Biochemistry, myocardial function
Language: English/intermediate, German/basic

AMBITIONS AND CAREER GOALS

I would like to serve society as a specialist worthy of the title of Doctor of Medicine, both in terms of expertise and humanity. In addition to research, I am also attracted to clinical medicine, so I wish to combine the two fields during my career.



ZSOMBOR ESKÜDT

National Academy of Scientist Education,
2nd year

University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: Áron Szabó

Specialization: Drosophila genetics, glial degradation

Language: English/intermediate, German/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

One of greatest medical challenge today is the effective cure of people suffering from a neurodegenerative disease. For most of these diseases there is no therapy yet. In order to develop therapies it is important to understand which enzymes play a role in autophagic processes after nerve injury. These enzymes are evolutionary conserved, so this processes can be excellently examined in fruit flies (*Drosophila melanogaster*). In our model animal we can see which factors are important in STAT mediated autophagy. Our long time goal is the understanding of glial activation and to have a better view on the early transcriptional response after injury.

AMBITIONS AND CAREER GOALS

As a medical student my goal is to do research that can be well translated into human medicine. I hope that the experience gathered in the lab will make me able to work as a researcher even after graduation. Currently my most important goal is to make the best and most comprehensive article possible, out of my research topic.



BÁLINT ENDRE FEKETE

National Academy of Scientist Education,
2nd year

University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: Bálint Kintses

Specialization: synthetic biology, genome engineering

Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

The emergence of antibiotic resistant pathogens is a growing threat in the global healthcare. The conventional treatments based on antibiotics are losing their efficacy. An alternative solution could be the use of bacteriophages (also phages). The host range (which bacteria can a phage infect) is determined by the proteins located on the tail end of the phage. The goal of the research is designing phages with specific tail proteins by the means of synthetic biology, so that the phage will only recognize the disease causing bacteria exclusively. To prevent the prevalence of resistance against the bacteriophage we can change these proteins while keeping the desirable properties.

AMBITIONS AND CAREER GOALS

During the Szent-Györgyi Program I got my chance to start my scientific work during my university studies. I find this instance of encounter of synthetic and microbiology rather fascinating. My goal is to be able to continue my scientific work after finishing my studies, even alongside of practising medicine.



ADÉL LÜVI

National Academy of Scientist Education,
2nd year

University of Szeged,
Faculty of Science and Informatics, Biology,
2nd year

Szent-Györgyi Mentor: Imola Wilhelm

Specialization: tumour biology

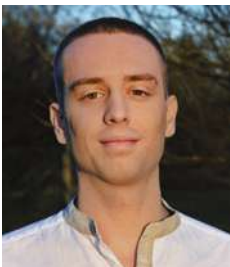
Language: English/intermediate, German/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

One of the most important roles of the neurovascular unit – which is built up by cerebral endothelial cells, pericytes, glial cells, and neurons – is to form the blood-brain barrier. In order to form brain metastases, tumour cells – originating principally from malignant melanoma, breast carcinoma and lung cancer – have to migrate through the blood-brain barrier, the main function of which is to prevent the penetration of toxic substances to the brain. Therefore, metastatic cells which are able to extravasate into the brain are protected from therapeutic drugs by the blood-brain barrier itself. This is the main reason why brain metastases have an extremely poor prognosis. According to our group's results, not only brain endothelial cells, but pericytes can also increase survival of the tumour cells. Currently, we are investigating whether pericytes protect tumour cells against chemotherapeutic drugs. However, not only pericytes influence the tumour cells, but this is a mutual interaction. In our experiments, we want to test how brain metastatic breast cancer cells communicate with pericytes and what changes are induced by tumour cells in pericytes to contribute to the formation of the metastatic niche. Understanding of these mechanisms may contribute to the development of novel therapeutic methods.

AMBITIONS AND CAREER GOALS

During my research work, my ambition is to contribute to the understanding of brain metastases and therefore, to help people suffering from this tumour disease. In the following years, I want to learn new methods, to improve my scientific skills, and to be a useful member of our research group with the final goal of being able to use this acquired knowledge later in my own projects.



ISTVÁN GELLÉRT MAGYARY

National Academy of Scientist Education,
2nd year

University of Szeged,
Faculty of Science and Informatics, Biology,
2nd year

Szent-Györgyi Mentor: Balázs Papp

Junior mentor: Balázs Szappanos

Specialization: systems biology, metabolomics,
bioinformatics

Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Recent advances in technology made metabolomics an integral part of systems biology research. Despite the surge in popularity in metabolomics, the processes governing the evolution of metabolite levels are still largely unknown. One of our lab's focuses has been the emerging field of evolutionary metabolomics, i.e. the evolution of metabolite concentrations. These previous analyses have focused on the between-species differences of metabolite concentrations with the help of data from multiple mammalian and yeast species. Among the findings were the discovery of simple molecular traits that govern the extent of evolutionary conservation. One such principle is that metabolites involved in human diseases have highly conserved concentrations between species, indicating that evolution permits less changes in metabolites that have a high health impact. Building on these findings, I will study the principles driving metabolome variation within human populations. Specifically, I will test whether the same factors govern the evolution of metabolite concentrations across species as within human populations. For my research I use a dataset of hundreds of serum metabolites from a healthy human population. Ultimately, the results will give new insights into why some metabolites are more variable between individuals than others and may inform the discovery of new biomarkers.

AMBITIONS AND CAREER GOALS

My career goal is to conduct research in the research field of personalised omics as a bioinformatician, a subfield of systems biology where the long-term goal is to help improve people's quality of life with the help of new discoveries and contribute to the early diagnoses of pathological processes. Throughout my studies I also plan on acquiring knowledge in statistics and data science and participating in relevant networking events.



GERGŐ DÁVID SVORENJ

National Academy of Scientist Education,
2nd year
University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: Attila Gácsér
Junior mentor: Renáta Tóth
Specialization: microbiology, immunology
Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

My research topic is based on recent observations, that inform us about the fact that besides the growing number of fungal infections, caused by *Candida* species, they also contribute to the progression of certain diseases. One such disease is oral squamous cell carcinoma. It has been shown that the presence of certain *Candida* species, such as *C. albicans*, the migration and potentially invasive properties of tumor cells increase following the tumor-microbe contact. The current aim of the research group, and my project as well, is to further investigate this phenomenon and to examine what molecular processes could be responsible for this effect. Identification of such processes will lead to better understanding of the complexity of microbe-tumor interactions, and may contribute to health care advancements. Understanding of these mechanisms may contribute to the development of novel therapeutic methods.

AMBITIONS AND CAREER GOALS

My ultimate aim is to achieve proper fundamentals regarding my research field, as well as to gain in-depth insights and deep knowledge into the research field of immunology and microbiology. My long-term plans enhance after every single goal achieved, the sky is the only limit. My current aim is to join the scientific community, acquire all of the basic skills needed for fundamental research, participate in a project, learn how to interpret the results and how to insert them in the current standing of the research topic.



DÓRA JULIANNA SZABÓ

National Academy of Scientist Education,
2nd year
University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: Anikó Keller-Pintér
Specialization: Skeletal muscle
Language: English/advanced, German/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Skeletal muscle demonstrates a high degree of regenerative capacity repeating the embryonic myogenic program. The impairment of this program is the cause of numerous illnesses. One of them, is the rhabdomyosarcoma, which is the most common sarcoma in childhood. Our research team works on understanding the physiological and pathological molecular background of this regeneration program. At present, syndecan-4 is observed the most, which is a transmembrane protein, that contributes to several mechanisms, like cell adhesion and migration, cell proliferation or cytokinesis, therefore tumorigenesis. By unfolding the role of syndecan-4, we could get closer to understanding the illnesses regarding the skeletal muscle, and also to their successful treatment.

AMBITIONS AND CAREER GOALS

As a Szent-Györgyi student, I have the opportunity to get an insight into the world of researches, improve in a motivating environment and broaden my knowledge, as well as challenge myself day by day. After finishing medical school, I would like to do my PhD, then work as a biomedical researcher.



NORMAN NOEL TANNER

National Academy of Scientist Education,
2nd year

University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: Anikó Keller-Pintér

Specialization: Biochemistry

Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Cell migration is absolutely necessary in the formation of the tissues, in differentiation and in regeneration. Besides that the cell migration is also an important factor in the metastasis of tumour cells. Syndecan-4 is a transmembrane protein which has a crucial role in the process that lead to efficient cell migration. The syndecan-4 is able to bind growth factors as a receptor to begin important signal transduction processes that are necessary to the cell migration. The main purpose of our research is to get a deeper understanding of the cell migration and the role of the syndecan-4 protein in this process in muscle regeneration and in rhabdomyosarcoma.

AMBITIONS AND CAREER GOALS

My greatest objective is to become a good doctor with a wide knowledge in medicine and science. To achieve that, during my university years I would like to get scientific knowledge alongside the clinical knowledge. I hope that I can use these experiences in my clinical carrier and also in research.



ISTVÁN TÓTH

National Academy of Scientist Education,
2nd year

University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

Szent-Györgyi Mentor: István Krizbai

Specialization: neuroscience

Language: English/intermediate, German/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Research in recent years supported the idea that both aging and a significant part of age-related diseases of the central nervous system are due to the inadequate functionality of the neurovascular unit that coordinates the interaction between the cerebral circulation and the functioning of the central nervous system. The physiological functioning of the nervous system requires a precisely regulated microenvironment, which is maintained by the aforementioned neurovascular unit through its two main functions (formation of the brain-blood barrier and neurovascular coupling). The main purpose of our research is to understand the functioning of the neurovascular unit more precisely in aging and age-related diseases of the brain. We plan to focus on pericytes and cerebral endothelial cells. In addition, using endothelial precursor cells we are looking for regenerative mechanisms that could provide an opportunity to maintain the functionality of neurovascular unity, thus contributing to the prevention of cognitive disabilities in elderly people.

AMBITIONS AND CAREER GOALS

During my undergraduate studies, I want to become a useful member of the research team. After completing my medical studies, I would like to get a PhD and gain experience abroad to gain as much knowledge as possible, which I can later use in my own research to become an internationally recognized researcher and help the development of science.



CSENGE BOCZ

National Academy of Scientist Education,
3rd year

University of Szeged,
Faculty of Pharmacy, 3rd year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Nowadays many people are affected by some kind of cancerous disease. Tumor cells are able to change their microenvironment, thereby creating the ideal conditions to multiply, migrate and become malignant. In this process stromal cells have a major role. These are altered functioned, cancer associated fibroblasts and immune cells. Targeting these cells is a potential therapeutic method. Nanoparticles can be used in the treatment of tumors, and they have several beneficial impacts, in contrast with the traditional cytotoxic molecules. In our research group we examine the anti-tumor effects of metal nanoparticles on stromal cells. Our goal is to get a better understanding of the communication between the cancer cells and their microenvironment, and recon the cellular and molecular events behind this process. This could provide relevant information in the fields of cancer research, and give the opportunity to develop new diagnostic techniques and treatments



BÁLINT LÁSZLÓ CZAKÓ

National Academy of Scientist Education,
3rd year

University of Szeged,
Albert Szent-Györgyi Medical School,
3rd year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Sepsis is a potentially life-threatening multiorgan failure, an uncontrolled, self-harming response of the body to inflammation. This disease is one of the biggest challenges in intensive clinical care, so it is extremely important to develop new organ-protective therapies. In our study, we examined the damage of vital organs, and its underlying mitochondrial function impairment in untreated and methane-inhaled rats with peritonitis induced sepsis. Methane is a biologically active, anti-inflammatory gas that, due to its apolar nature, can pass through membrane systems without hindrance, thus it can offer a promising targeted therapy in sepsis. In our sepsis model, we examine the extent of circulatory and inflammatory parameters, mitochondrial function, and organ damage, which features are expected to improve with methane treatment.

3RD YEAR STUDENTS

Szent-Györgyi Mentor: Mónika Kiricsi

Junior mentor: Nóra Igaz

Specialization: nanoparticles, tumor stroma

Language: English/advanced, German/basic

AMBITIONS AND CAREER GOALS

During my studies I would like to acquire the skills that will be really useful in my future work. I find it important to deepen my knowledge, and get a first-hand experience about what it is like to work in a laboratory and be part of a research group. My primary goal is to become a researcher and take part in the development of novel therapeutic strategies.

Szent-Györgyi Mentor: József Kaszaki

Junior mentor: László Juhász

Specialization: circulatory physiology and pathophysiology

Language: English/intermediate

AMBITIONS AND CAREER GOALS

My ambition is to master techniques and gain knowledge while working in the laboratory and to be able to exploit those skills when becoming a doctor. The program and the organised events provide an excellent opportunity to acquire insight into the life of a researcher and to lay down the foundations for my future research career.

PUBLICATIONS

Poles, M., Z., Nászai, A., Gulácsi, L., **Czakó, B.**, L., Gál, G., K., Glenz, J. R., Dookhun, D., Rutai, A., Tallósy, Sz., P., Szabó, A., Lőrinczi, B., Szatmári, I., Fülöp, F., Vécsei, L., Boros, M., Juhász, L. and Kaszaki, J. (2021) Kynurenic Acid and Its Synthetic Derivatives Protect Against Sepsis-Associated Neutrophil Activation and Brain Mitochondrial Dysfunction in Rats. *Front Immunol* **12**: 717157.



ANNA HEGYI

National Academy of Scientist Education,
3rd year

University of Szeged,
Albert Szent-Györgyi Medical School,
3rd year

Szent-Györgyi Mentor: Mária Deli
Junior mentor: Ilona Gróf
Specialization: cell biology, pharmacology
Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

In several diseases the targeted delivery of large protein cargo at therapeutically relevant concentrations is difficult due to their poor penetration across biological barriers. These barriers protect organisms from damaging agents and create homeostasis for physiological functions. The Biological Barriers Research group has an expertise in modelling and studying the epithelium of the intestinal or respiratory systems and the endothelium of blood vessels. The goal of our team is to investigate different peptide constructs to enhance the penetration of high molecular weight drugs across different biological barriers using co-culture models. In these experiments, we study the viability of the cells, the integrity and the barrier functions of the cell layers, the morphological changes of tight junction proteins and the penetration of fluorescently labeled peptide constructs. In our latest studies, we got promising results with a pentapeptide sequence which can deliver large proteins into different cell types via endocytosis. Our aim is to achieve specific targeting of biological barriers with a short, easily applied and nontoxic peptide tag which can not only facilitate the endocytosis of the protein cargo in a carrier/receptor triggered manner but also act as a shuttle for biopharmaceutics.

AMBITIONS AND CAREER GOALS

In my research, I would investigate methods by which I can broaden my knowledge about drug delivery through barriers, thereby contributing to more effective treatment of various diseases. I consider it important to be able to align scientific research with clinical practice throughout my career because I believe both are essential areas for my future results.



DORINA KOVÁCS

National Academy of Scientist Education,
3rd year

University of Szeged,
Faculty of Dentistry, 3rd year

Szent-Györgyi Mentor: Bálint Kintsés
Specialization: antibiotic resistance
Language: German/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Testing resistance evolution with predictive screens is an imperative step of antibiotic development. These screens help to choose the lead molecules for further drug development which are less prone to resistance evolution, and thus may remain effective for years. In the laboratory of my mentor, Bálint Kintsés, I'm able to join the development of a platform that accurately predicts which resistance genes will be acquired by disease-causing bacteria via horizontal gene transfer to eradicate the efficacy of a future antibiotic. We would achieve this strategic aim by testing resistance evolution in an experimental system resembling the real-life clinical environment, unlike the current technologies that use oversimplified experimental conditions. The goal is to provide a unique toolset that supports the development of promising antibiotic candidates which may remain effective for years once on the market.

AMBITIONS AND CAREER GOALS

I want to develop my theoretical and practical knowledge by taking advantage of the opportunities offered by the Szent-Györgyi program, and by learning the most possible from my Mentor. My goal is to arrange this acquired competence in the scientific research, thereby being able to cooperate in solving major scientific questions.



BENCE NAGYMIHÁLY

National Academy of Scientist Education,
3rd year

University of Szeged,
Albert Szent-Györgyi Medical School,
3rd year

Szent-Györgyi Mentor: Tamás Martinek

Junior mentor: Edit Wéber

Specialization: Molecular biology, protein analysis
techniques

Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Protein-protein interactions play a role in a number of pathophysiological processes, the manipulation of which can be therapeutically beneficial. Targeting extensive protein surfaces, however, is difficult with small molecules. For this purpose, artificial agents with higher interaction surface area, e.g. protein mimetics are required. Artificial self-assembling polymers (foldamers) can inhibit protein-protein interactions. The advantages of foldamers are that they have a designable and stable secondary structure, have a larger surface area than small molecule drugs, are resistant to proteases and are less immunogenic than antibodies. We are focusing on PCNA and on Rad6 proteins. PCNA is essential for DNA replication, however, its ubiquitination promotes error-prone DNA replication and allows cancer cells to survive. Rad6 plays a role in the ubiquitination of PCNA. Our goal is to inhibit PCNA ubiquitination with foldamers by blocking the key protein-protein interactions of PCNA and Rad6. We construct the foldamers by linking small-sized, protein surface mimetic building blocks, and innovative optimisation methods, such as dissipative systems are applied. Our compounds could serve as novel anti-tumour agents.

AMBITIONS AND CAREER GOALS

During my work and studies, my aim is to acquire as much theoretical and practical knowledge as possible, so that I can later become an active participant not only in the clinical field, but also in the scientific field. The opportunities provided by the National Academy of Scientist Education will enable me to acquire scientific knowledge on which I can build and guarantee my development in the future. I would like to adopt the concepts and perspectives I have learned here, so that I can later, in my individual work, come up with my own unique ideas to influence the development of the field and use my knowledge to help people beyond the sickbed.



EMESE KINCŐ PÁLI

National Academy of Scientist Education,
3rd year

University of Szeged,
Albert Szent-Györgyi Medical School,
4th year

Szent-Györgyi Mentor: Szilvia Veszélka

Junior mentor: Mária Mészáros

Specialization: cell biology, pharmacology

Language: English/intermediate, German/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Cyclodextrins are versatile sugar molecules that can act both as medicines and as nanocarriers of other active ingredients. Cyclodextrins interact with lipid membranes and can selectively remove lipids from cell membranes. Some cyclodextrins are used as therapeutic drugs, while others are currently tested in clinical studies to treat human neurological diseases, including Alzheimer's disease. It is still a question whether cyclodextrins are able to cross the blood-brain barrier, the gatekeeper and protector of the central nervous system, which blocks the entry of the majority of drug molecules. The Biological Barriers Research group has an expertise in modelling and studying the blood-brain barrier. Our goal is to test different unmodified and modified cyclodextrin molecules on human cell based models of blood-brain barrier. With the help of fluorescent tags we will measure the interaction of cyclodextrins with the cells of the blood-brain barrier, namely, brain endothelial cells, pericytes and astrocytes. We will determine cellular toxicity, the entry of the cyclodextrins to the cells and using a complex model with three cell types the crossing of cyclodextrin across the barrier. These studies will help to determine if cyclodextrins need to cross the blood-brain barrier to act directly on the neuronal cells, or they can exert therapeutic effects without entering the central nervous system. Our results will help in the future therapeutic application of modified cyclodextrins in diseases.

AMBITIONS AND CAREER GOALS

In the course of my work, it is especially essential for me to accomplish activities that are useful and beneficial for society, and I have the opportunity to do so in the Biological Barriers Research Group. Drug delivery research not only has a great future ahead, but its success also promises to make human lives easier. My personal intentions include actively participating in Hungarian scientific life both as a doctor and a researcher. The possibilities provided by the Szeged Scientist Academy open unique gates to reach my goals.



DOMONKOS JÁNOS PERÉNYI

National Academy of Scientist Education,
3rd year

University of Szeged,
Albert Szent-Györgyi Medical School,
4th year

Szent-Györgyi Mentor: Petra Hartmann
Specialization: mitochondrial respirational activity
Language: German/intermediate, English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

The main goal of the usage of profilactic antibiotics is to prevent infections that could occur in connection with surgical interventions. Several studies have proved, that properly applied antibiotal profilaxis plays an important role in the prevention of wound-infections. However, the effect of antibiotics is not confined only to the bacterias. Depending on the concentration of the agent and the duration of the treatment, it can cause different deformities in the tissues and cells, leading to various side-effects. Effects causing mitochondrial disfunction have been proved in cases of several antibiotics, that were followed with increased reactive oxigen species (ROS) production, after which tissue-damage can emerge. To find a proper solution for these problems, we started to experience with some antibiotics that not have been used before. During our research we use the third generational ceftriaxone and the poorly absorbed rifaximine. The goal of our research is to examine the effects of these antibiotics on the mitochondrial respirational activity, and on the coupling of electron transport chain.

AMBITIONS AND CAREER GOALS

Practicing medicine always walked hand in hand with research. That is why I think it is utterly important, to take part in it during my years at the university, and get a broader perspective in disciplines. I see the scholarship of SZTA a one of a kind opportunity to develop myself, from which I hope I can make the most out of.

PUBLICATIONS

Baráth, B., Jász, D., K., Horváth, T., Baráth, B., Maróti, G., Stifler, G., Varga, G., Sándor, L., **Perényi, D.**, Tallósy, S., Donka, T., Jávör, P., Boros, M., Hartmann, P. (2022) Mitochondrial Side Effects of Surgical Prophylactic Antibiotics Ceftriaxone and Rifaximin Lead to Bowel Mucosal Damage. *Int J Mol Sci* **23**: 5064



BENEDEK SZATHMÁRI

National Academy of Scientist Education,
3rd year

University of Szeged,
Faculty of Science and Informatics, Biology,
3rd year

Szent-Györgyi Mentor: László Nagy
Junior mentor: Árpád Csernetics
Specialization: fungal genomics
Language: English/advanced, Latin/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Fungal evolution, the investigation of which is challenging but also interesting due to great amount of convergence, is still burdened by countless unanswered questions. Our research group investigates the evolutionary biology and developmental genetics of fungi, focusing on the origin of complex multicellularity that, in contrast with other branches of the tree of life, appeared eight times independently in this clade. One of my projects is connected to the mentioned topic: I knock out genes responsible for basidium and fruiting body formation. Our aim here is to understand the origin of other fruiting body cells present around basidia better. There were also lots of simplifications in the course of fungal evolution. The group of unicellular yeasts with a reduced morphology provided some 'workstocks' for the industry, however, we know unworthily little about their evolution. I hope that with my other project, during which I investigate the density-dependent behaviour (quorum sensing) of spores of a mould species, I can also contribute to the creation of a gap-filling evolutionary concept regarding yeasts.

AMBITIONS AND CAREER GOALS

'*Nothing in biology makes sense except in the light of evolution*' I cannot agree more with this statement of Theodosius Dobzhansky, and my aim is to understand this overall concept. I think achieving this goal does not only require studying, but also the investigation of important problems and interesting phenomena, as well, during which one can pose, and even answer questions no one has before. Creating a complex scientific world-view built upon scepticism is crucial for me. I would like to become a broad-minded researcher with creative thoughts.

PUBLICATIONS

Nagy, L., G., Vonk, R., J., Künzler, M., Földi, Cs., Virágh, M., Ohm, R., A., Hennicke, F., Bálint, B., Csernetics, Á., Hegedüs, B., Hou, Z., Liu, X., Nan, S., Pareek, M., Sahu, N., **Szathmári, B.**, Varga, T., Wu, H., Yang, X., Merényi, Z. (2022) Lessons on fruiting body morphogenesis from genomes and transcriptomes of Agaricomycetes. doi: <https://doi.org/10.1101/2021.12.09.471732> *Studies in Mycology* (in press)



GERGŐ BITAY

National Academy of Scientist Education,
4th year
University of Szeged,
Albert Szent-Györgyi Medical School,
2nd year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Our research group specialises in researching the electrophysiological and pharmacological properties of the heart. We mainly focus on the spontaneous activity of the heart, Ca^{2+} - homeostasis; sudden cardiac arrest related research on athletic heart syndrome models. In our laboratory we conduct research on rabbit and dog models, both on tissue samples (conventional microelectrode technique) and on individual cells (patch-clamp). My main research involves the spontaneous activity of the sinus node: Ca^{2+} - homeostasis, sodium-calcium exchanger, small-conductance calcium-activated potassium (SK) channels. SK channels have a significant role in neurons, and due to the fact that they create a direct connection between the intracellular calcium handling and the repolarisation of the cell membrane, their role in the cardiac tissue could also be important. However, there is no consensus in the literature on the extent of their contribution to cardiac repolarisation. Because both the Ca^{2+} - homeostasis and the repolarisation are related to arrhythmias, SK channels could potentially have a major role pathophysiologically and pharmacologically.

4TH YEAR STUDENTS

Szent-Györgyi Mentor: Norbert Nagy
Specialization: electrophysiology, pharmacology
Language: English/advanced

AMBITIONS AND CAREER GOALS

My ambition is to become a successful doctor and to continue with research. Furthermore, my goals are to earn a PhD and other degrees. The amount of knowledge given to us by the programme, the publications and the scientific conferences all contribute to achieve these goals.

PUBLICATIONS

Tóth, N., Szlovák, J., Kohajda, Zs., **Bitay, G.**, Veress, R., Horváth, B., Papp, J. Gy., Varró, A., Nagy, N. (2021) The development of L-type Ca^{2+} current mediated alternans does not depend on the restitution slope in canine ventricular myocardium. **Sci Rep 11**: 16652.

Bitay, G., Tóth, N., Déri, Sz., Szlovák, J., Kohajda, Zs., Varró, A., Nagy, N. (2022) The Inhibition of the Small-Conductance Ca^{2+} -Activated Potassium Channels Decreases the Sinus Node Pacemaking during Beta-Adrenergic Activation. **Pharmaceuticals 15**: 313.



ANNA TÁCIA FÜLÖP

National Academy of Scientist Education,
4th year
University of Szeged,
Faculty of Science and Informatics,
Molecular Bionics Engineer Program,
1st MSc year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

HLA molecules are essential in immune recognition, because they present short peptides to T cells. HLA-encoding genes are the most variable ones in the human genome. Using bioinformatics, we investigate the possible relationships between the peptide binding properties of different HLA variants and certain diseases (e.g. different tumours). We also aim to explain the molecular background of these associations.

Szent-Györgyi Mentor: Máté Manczinger
Specialization: immunology, bioinformatics, bionics
Language: English/advanced, French/basic

AMBITIONS AND CAREER GOALS

After the current Bachelor's degree, I would like to continue my Master's degree and then to obtain a PhD degree. After graduating, I would like to join an international research team at a Hungarian university or research institute.



ZSÓFIA RITA HERNÁDI

National Academy of Scientist Education,
4th year
University of Szeged,
Faculty of Pharmacy, 4th year

Szent-Györgyi Mentor: István Krizbai
Specialization: neuroscience
Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

For the physiological functioning of the central nervous system it is inevitable to maintain a constant internal environment in which the so-called neurovascular unit plays a pivotal role. Damage to this defence system can lead to the development of or can aggravate various serious diseases affecting the central nervous system. Pericytes have been attributed a prominent role in the pathophysiology of age-related brain pathologies including ischemic stroke, particularly in the production of abnormal vasoconstriction, which may impede the maintenance of normal cerebral circulation.

As there is currently no clear evidence that pericytes are responsible for pathological vasoconstriction, in the research group we set out to investigate the structural changes and molecular mechanisms that may be involved in this process using in vivo two-photon microscopy imaging and ex vivo techniques. Our expected results may shed new light on the active role of blood-brain barrier elements, particularly the pericytes, in the pathomechanism of age related brain diseases, and may lead to the discovery of new therapeutic targets in the future.

AMBITIONS AND CAREER GOALS

As a Pharmacy student, I feel that the Szent-Györgyi program offers a unique opportunity to master both research and pharmacy skills. After graduating from the University, I would like to join a doctoral school and obtain a PhD while also working as a scholarship holder at famous foreign laboratories. Finally, I would like to use my experience in independent research projects as a neuroscientist.

PUBLICATIONS

Mészáros, Á., Molnár, K., Nógrádi, B, **Hernádi, Z.**, Nyúl-Tóth, Á., Wilhelm, I., Krizbai, I. A. (2020) Neurovascular Inflammaging in Health and Disease. **Cells** **9**: 1614.

Kozma, M., Mészáros, Á., Nyúl-Tóth, Á., Molnár, K., Costea, L., **Hernádi, Z.**, Fazakas, Cs., E Farkas, A., Wilhelm, I., Krizbai, I., A. (2021) Cerebral Pericytes and Endothelial Cells Communicate through Inflammasome-Dependent Signals. **Int J Mol Sci** **22**: 6122.



GÁBOR JUHÁSZ

National Academy of Scientist Education,
4th year
University of Szeged,
Albert Szent-Györgyi Medical School,
4th year

Szent-Györgyi Mentor: Gábor Juhász
Junior mentor: Tamás Maruzs
Specialization: endosomal system, membrane contact sites, drosophila genetics
Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

The existence of membrane contact sites, i.e. permanent physical contacts between organelles of eukaryotic cells has been known for a long time, however, understanding their functions has just begun during the last decade. The most well-characterized function of these contacts is enabling lipid transport between the contacting organelles. Interestingly, recent studies shed light on the direct role of such contacts in the endosomal system as well. During our work, we aim to investigate the function of Snx25, a known membrane contact site protein, which is involved in a human hereditary neurodegenerative disease, a distinctive type of spinocerebellar ataxia. Our results show that the mutation of the fruit fly (*Drosophila melanogaster*) counterpart of this gene leads to severe defects in the endosomal maturation process of the highly endocytic larval nephrocytes. As the exact mechanism of this phenomenon is currently not known, we aim to decipher the role of the *Drosophila* Snx25 protein in endosomal maturation using genetics and light-microscopy and our self-maintained fruit fly stocks' nephrocytes as an experimental model system.

AMBITIONS AND CAREER GOALS

My primary aim is to match the medical and scientific work. In my opinion through knowledge in all natural sciences, especially in regards to modern biology is essential to understand and discover the most effective therapies. In the near future I would like to work in the fields of genetics and cell biology. Later I intend to continue this work during my PhD study, and my task in inland and foreign laboratories in addition to my medical studies.



GÁBOR MOHÁCSI

National Academy of Scientist Education,
4th year

University of Szeged,
Albert Szent-Györgyi Medical School,
3rd year

Szent-Györgyi Mentor: András Varró

Specialization: neurophysiology

Language: English/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Our aim is to understand of the mechanisms underlying cortical information processing. The two distinct type of processes are excitation and inhibition. The efferent and afferent connections of inhibitory neurons are precise and diverse. We conduct experiments in order to determine the physiological significance of the distinct cells. We are recording from identified interneurons in completely unaesthetized freely behaving rodents. The neurogliaform cells play an important role in neuronal inhibition.

AMBITIONS AND CAREER GOALS

After obtaining my degree I would like to earn a PhD, as well. As a researcher I hope that I can find answers to some important questions. My dream is to develop new methods, which can be applied in clinical environments.



BENCE PÓSA

National Academy of Scientist Education,
4th year

University of Szeged,
Albert Szent-Györgyi Medical School,
3rd year

Szent-Györgyi Mentor: Péter Bencsik

Specialization: Pharmacology of the Cardiovascular system

Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Cardiovascular diseases are the leading cause of death in industrialised societies. The function of the heart is diverse, but the most prominent is the pump function, which is circulating blood through the vascular system. To perform this pumping function, the heart also requires oxygenated blood, which it receives from its own private „coronary“ circulation. Impairment of this coronary circulation results in ischaemia and death of the heart muscle, and thus impairment of pump function. MicroRNAs are RNA sequences that account for only 1% of the genome, but significantly affect the expression of other genes. In our study, we investigate the effects of myocardial ischemia, abnormal enlargement (hypertrophy) and other diseases affecting other organs (e.g. colitis) on the microRNA profile of the heart. Our aim is to identify pharmacological compounds that mimic (miRNA mimic) or inhibit (antagomiR) microRNAs, which influence the expression of microRNAs that mitigate myocardial damage and the genes/proteins they regulate, and thus have cardioprotective potential by influencing a number of processes.

AMBITIONS AND CAREER GOALS

After graduating from medical school, I would like to continue my work primarily as a clinician, but also do research. My goals are to obtain a PhD and to be actively involved in teaching and educational organisation. I believe that even as a student, we should not only treat our present patients, but also help and support our fellow doctors and students, so that we can move closer to a viable and humane professional future.



JOANNA GRACE SANDLE

National Academy of Scientist Education,
4th year

University of Szeged,
Faculty of Science and Informatics, Biology,
1st MSc year

Szent-Györgyi Mentor: Gábor Tamás
Junior mentor: Gábor Molnár
Specialization: neurobiology, electrophysiology
Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

The way we perceive and process information and inputs from our environment is unique to us, humans and still most of the mechanisms which enable us to perform complex and abstract thinking are yet to be discovered. In Tamás Gábor's Research Group for Cortical Microcircuits we seek to unveil the underlying elementary mechanisms of this process on the level of synapses and neural microcircuits and the functions of different cell types in rodent and human cortical cortex. We have the excellent opportunity to compare the functions of the commonly used model animals' brain with ours by performing in vitro patch clamp in non-pathological human brain slices among other electrophysiological techniques. Our primary focus is on the role of inhibitory interneurons in such networks.

AMBITIONS AND CAREER GOALS

I endeavour to exploit the opportunities offered by Szent-Györgyi programme, broaden my understanding and learn new methods. It is of great importance to me to keep up with the developments and findings of neuroscience, and to acquire up-to-date, applicable knowledge not only in the fields of neurobiology and electrophysiology but also in borderline sciences. I want to become a useful member of a research group and be able to contribute to the development of my field of expertise.

PUBLICATIONS

Iacone, Y., Morais, T. P., David, F., Delicata, F., **Sandle, J.**, Raffai, T., Parri, H. R., Weisser, J. J., Bundgaard, C., Klewe, I. V., Tamás, G., Thomsen, M. S., Crunelli, V., Lőrincz, M. L. (2021) Systemic administration of ivabradine, a hyperpolarization-activated cyclic nucleotide-gated channel inhibitor, blocks spontaneous absence seizures. **Epilepsia** **62**: 1729-1743.



NOÉMI VIDA

National Academy of Scientist Education,
4th year

University of Szeged,
Albert Szent-Györgyi Medical School,
4th year

Szent-Györgyi Mentor: Mihály Boros
Junior mentor: Gabriella Varga
Specialization: diseases of systemic circulation
Language: English/advanced

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Extra corporal circulation (ECC) is commonly used during several type of heart surgeries and intensive care. During extracorporeal membrane oxygenation (ECMO) or cardiopulmonary bypass (CPB) the lungs are excluded from the circulation and the blood is introduced to a considerable amount of heparin. Furthermore the blood contact with the foreign surface of the CPB circuit causes an immediate inflammatory response similar to the septic systemic inflammatory response (SIRS) in which humoral and cellular factors play an essential role. The contact activation leads to intrinsic activation of the coagulation cascade and further activation of pro-inflammatory cascades, triggering a wide variety of cellular systems. If these cascade activations are dysregulated due to prolonged ECC time and further metabolic changes, significant tissue and organ damage can occur in sensitive organs such as the kidneys and intestines. In vivo animal models are used to explore the mechanisms behind these reactions, therefore in the Institute for Surgical Research, University of Szeged, a clinically relevant large animal model is used to monitor inflammatory responses during ECC. Our aim is to investigate the exact mechanism behind the ECC-induced inflammatory reactions along with the development of novel therapeutic strategies to reduce post-ECC inflammatory damage.

AMBITIONS AND CAREER GOALS

As a medical student clinical knowledge and skills are exceptionally important, however I find keeping up with scientific research and integrating them into practice is just as crucial. By working in this laboratory, I would like to deepen my knowledge in the pathophysiology of post-surgical inflammatory response and obtain surgical skills, which I will benefit from later as a practitioner.

PUBLICATIONS

Bársony, A., **Vida, N.**, Gajda, Á., Rutai, A., Mohácsi, Á., Szabó, A., Boros, M., Varga, G., Érces, D. (2020) Methane Exhalation Can Monitor the Microcirculatory Changes of the Intestinal Mucosa in a Large Animal Model of Hemorrhage and Fluid Resuscitation. **Front Med (Lausanne)** **7**: 567260.
Varga, P., **Vida, N.**, Hartmann, P., Szabó, A., Mohácsi, Á., Szabó, G., Boros, M., Tuboly, E. (2019) Methanogenic potential of consumable organosulfur administration: in vitro and in vivo evidences. **PLOS One** **15**: e0236578.



ÁKOS HARANGOZÓ

National Academy of Scientist Education,
5th year

University of Szeged,
Albert Szent-Györgyi Medical School,
5th year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

With modern sequencing technologies we are able to make structural and functional examination of living organisms and viruses, thus we can understand better the role of the present genes and non-coding sequences and their effect on each other. The main focus of our research group includes the genomic analysis of various human and non-human pathogenic viruses by using state of the art genome- and transcriptome sequencing methods (long- and short-read sequencing approaches). The gained genomic data is processed with the help of bioinformatical programs. Also we generate genetically modified viruses by using the CrispR-cas9/dCas9 - which is a state of the art genome editing technology capable of making very precise changes - methods for the evaluation of the effect of the gene modification on the global transcriptome.

Our major goal is to describe the static and dynamic transcriptome profiles of these viruses, and to apply them as model organisms for the study of the Transcriptional Interference Network (TIN) hypothesis proposed by our group



ENDRE KOCSIS

National Academy of Scientist Education,
5th year

University of Szeged
Albert Szent-Györgyi Medical School,
5th year

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

According to WHO, one in every 6 people's death (a total of 9,6 million deaths in 2018) is due to cancer, making it the second leading cause of death globally. In most cases, the cause of failure in pharmacotherapy is originated in the tumor's space development of resistance against cytotoxic agents, which is also called as multidrug resistance (MDR). This issue is unsolved to the present day, which calls for an urgent need for a radically new approach in enhancing our strategies. Ecdysteroids are analogs of ecdysone, a moulting hormone of arthropods, that are non-toxic and bioactive in mammals. Some of their less polar derivatives combined with a certain chemotherapeutic agent have a strong chemo-sensitizing effect on both drug susceptible and MDR cancer cell lines. The main goals of our research are the identification and semisynthetic chemical modification of new and promising lead molecules (e.g. production of fluorine substituted derivatives and their self-assembling nanostructures), as well as defining their pharmacological potential.

5TH YEAR STUDENTS

Szent-Györgyi Mentor: Zsolt Endre Boldogkői

Junior mentor: Dóra Tombác

Specialization: genomics and gene technology

Language: English/advanced

AMBITIONS AND CAREER GOALS

As a medical doctor I want perform medical practice and research side by side, for which this program gives the best bases. My goal with my research is to gain theoretical knowledge and practical experience which will help me in my career which hopefully will lead me to be able to help others. During my career besides finishing medical university, I also want to reach academic degree in which the Szent-Györgyi program provides help.

PUBLICATIONS

Tombác, D., Dörmő, Á., Gulyás, G., Csabai, Z., Prazsák, I., Kakuk, B., Harangozó, Á., Jankovics, I., Dénes, B., Boldogkői Z. (2022) High temporal resolution Nanopore sequencing dataset of SARS-CoV-2 and host cell RNAs. *Gigascience* 11: 094

Szent-Györgyi Mentor: Attila Hunyadi

Junior mentor: Máté Vágvolgyi

Specialization: pharmacognosy

Language: English/advanced

AMBITIONS AND CAREER GOALS

As a medical student I would like to represent the level of quality this profession requires both in my academic studies, and in my research. Apart from improving my cooperating and problem solving ability, research also provides me with an important support in leading me in the scientific literature, which sufficiently supplements my academic knowledge with comprehensive and up-to-date information. I also hope that our work can lead to results that can emerge as useful help in therapy.

PUBLICATIONS

Vágvolgyi, M., Kocsis, E., Nové M., Szemerédi, N., Spengler, G., Kele, Z., Berkecz, R., Gáti, T., Tóth, G., Hunyadi, A. (2022) Diversity-Oriented Synthesis Catalyzed by Diethylaminosulfur-Trifluoride-Preparation of New Antitumor Ecdysteroid Derivatives. *Int J Mol Sci* 23: 3447



ÁKOS KOVÁCS

National Academy of Scientist Education,
5th year

University of Szeged,
Albert Szent-Györgyi Medical School,
5th year

Szent-Györgyi Mentor: Mónika Kiricsi
Specialization: molecularbiology, genetics
Language: English/intermediate, German/intermediate

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Early recognition is one of the most important factors in successful treatment of cancer, which ideally can be achieved through non-invasive or minimally invasive way. In case of bladder cancer, tumour cells appear in the urine, from which DNA could be purified and analysed to detect mutations specific to cancer. Mutation hotspots are in oncogenes and among them in the promoter of the telomerase reverse transcriptase, which is responsible for DNA elongation at the ends of chromosomes. The telomerase is active in embryonic cells but inactive in somatic cells, therefore the telomeres of the latter are progressively shortening, with each cell division, until they are critically shortened, that results senescence. In tumours, however the telomerase is often re-activated, therefore these cells become immortalised, so they can endlessly divide. In most cases telomerase reactivation is due to mutations at hotspots in its promoter. Our aim is to study telomerase promoter mutations in order to get answers for the following questions: Under what circumstances do the mutations appear? At which stage of carcinogenesis / tumour progression do telomerase promoter mutations appear? Is there any correlation with mutation types, appearance and bladder cancer subtypes? How do the mutations affect the course of the disease? Our long-term goal is to develop a PCR-based, simple and

cost-efficient rapid test to detect the presence of potentially cancerous cells from urine targeting telomerase promoter mutation and other tumour markers.

AMBITIONS AND CAREER GOALS

I would like to improve my knowledge continuously in order to become as good researcher and physician as I can. With my work I hope to contribute to the advance of society that I consider the most important goal one can aim at.

PUBLICATIONS

Vedelek, B., **Kovács, Á.**, Boros, I. M. (2021) Evolutionary mode for the functional preservation of fast-evolving *Drosophila* telomere capping proteins. **Open Biol** 11: 210261.



MÁRTON SIMON CZIKKELY

National Academy of Scientist Education,
6th year

University of Szeged,
Albert Szent-Györgyi Medical School,
6th year

6TH YEAR STUDENT

Szent-Györgyi Mentor: Csaba Pál
Specialization: genetic engineering, experimental evolutionary biology, antibiotic resistance
Language: English/advanced, Spanish/advanced, German/intermediate, Latin/intermediate, Persian/basic

IMPORTANCE, AIMS, POSSIBLE OUTCOME OF RESEARCH

Pathogens seem invariably to attempt to survive the immune system of the invaded host or the pressures of applied therapies. During this accommodation process, DNA-level changes and mutations occur in the cells. These invisible, but important evolutionary processes lead to one of our biggest clinical challenges: antimicrobial resistance. Thanks to scientific advances of recent decades, it has become possible to manipulate the DNA in a precise manner, which enables a rapid and targeted examination of these very mutations. This approach offers a breakthrough in the investigation of antimicrobial resistance. A technique developed in the laboratory of my mentor, Csaba Pál, makes the rapid examination and manipulation of evolution possible with unprecedented accuracy. In our current work, we use this technique also to predict the most important resistance processes against antibiotics under development.

AMBITIONS AND CAREER GOALS

My aim is to help the fight against antibiotic resistance – a major crisis in medicine – through the examination of its evolution in clinically important pathogens.

PUBLICATIONS

Wannier, T. M., Nyerges, A., Kuchwara, H. M., **Czikkely, M.**, Pál, C., Church G. M., et. al. (2020) Improved bacterial recombineering by parallelized protein discovery. **Proc Natl Acad Sci U S A** 117: 13689-13698.

Szili, P.Š, Draskovits, G., Révész, T.Š, **Czikkely, M.**, Pál*, Á. Nyerges, Á.,* et al. (2019) Rapid evolution of reduced susceptibility against a balanced dual-targeting antibiotic through stepping-stone mutations. **Antimicrob Agents Chemother** 63: 00207-19.



**SZEGED
SZENT-GYÖRGYI
PHD STUDENTS**



ANNA GEORGINA KOPASZ

National Academy of Scientist Education,
PhD 1st year

University of Szeged,
Doctoral School of Multidisciplinary Medical
Sciences, PhD 1st year

Szent-Györgyi Mentor: Gyula Timinszky
Former Szent-Györgyi mentor: Lajos Mátés
Research interests: ADP-ribosylation, DNA repair
Language: English/advanced

BACKGROUND, AIMS, POSSIBLE OUTCOME OF RESEARCH

Nowadays cancer is the leading cause of death in economically developed countries. The contraction of cancer can be considered as an evolutionary process within our bodies. The tumor genome sequence data collected so far show that there are tens or even hundreds of thousands of mutations in each tumor sample, and the spontaneous mutation rate observed in normal cells is not sufficient to account for the high number of mutations found in cancers. However, it is this very instability of their genetic material that may allow cancer cells to generate an enormous number of mutations. The long-term objective of our laboratory is to explore genetic alterations fueling malignant transformation by undermining the stability of the genome.

AMBITIONS AND CAREER GOALS

By earning my PhD degree, I would like to master a broad range of molecular biological techniques and their biological bases. As a postdoctoral researcher, I hope I will have the chance to spend some years abroad before I can establish my own research group.

PUBLICATIONS

Kopasz, A. G. (2021), Optimization of RNA interference-based gene silencing using a well-balanced bidirectional promoter in a somatic transgenic mouse model, Young Investigators RNA Forum, presentation and abstract.

Kopasz, A. G. (2020), Establishment of an RNA interference based gene silencing system in a somatically transgenic mouse model, IV National Conference of Young Biotechnologists, presentation and abstract.

Kopasz, A. G., Pusztai, D. Z., Karkas, R., Hudoba, L., Abdullah, K., Imre, G., Pankotai-Bodó, G., Migh, E., Nagy, A., Kriston, A., Germán, P., Drubi, A. B., Molnár, A., Fekete, I., Dani, V. É., Ocsovszki, I., Puskás, L. G., Horváth, P., Sükösd, F., Mátés, L. (2022) A versatile transposonbased technology to generate loss- and gain-of-function phenotypes in the mouse liver. **BMC Biology** 20: 74.



GERGŐ PORKOLÁB

National Academy of Scientist Education,
PhD 3rd year

University of Szeged,
Doctoral School of Biology, PhD 3rd year

Szent-Györgyi Mentor: Mária Deli
Former Szent-Györgyi mentors: Mária Deli, Szilvia Veszelka
Research interests: cell biology, blood-brain barrier
Language: English/advanced

BACKGROUND, AIMS, POSSIBLE OUTCOME OF RESEARCH

The main goal of our research is to develop a novel drug delivery system that is capable of transporting therapeutics across the blood-brain barrier (BBB). We load the drugs into nanoparticles, which are targeted to the BBB by special molecules on their surfaces. These targeting molecules are recognised by the BBB and the drug-loaded nanoparticles – like „molecular Trojan horses – are able to enter the brain. We are also interested in developing novel, human cell-based models that enable us to investigate the interactions of nanoparticles with the BBB, as well as the healthy and diseased brain.

AMBITIONS AND CAREER GOALS

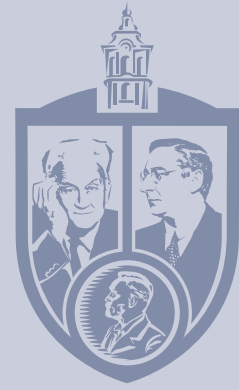
As a researcher, I would like to focus on and find solutions to relevant basic scientific problems that can potentially improve people's lives in the future.

PUBLICATIONS

Topal, G.R, Mészáros, M., **Porkoláb, G.**, Szecskó, A., Polgár, T.F, Siklós, L., Deli, M.A, Veszelka, S., Bozkir, A. (2020) ApoE-Targeting Increases the Transfer of Solid Lipid Nanoparticles with Donepezil Cargo across a Culture Model of the Blood-Brain Barrier. **Pharmaceutics** 13: 38.

Porkoláb, G., Mészáros, M., Tóth, A., Szecskó, A., Harazin, A., Szegletes, Z., Ferenc, G., Blastyák, A., Mátés, L., Rákhely, G., Deli, M.A., Veszelka, S. (2020) Combination of Alanine and Glutathione as Targeting Ligands of Nanoparticles Enhances Cargo Delivery into the Cells of the Neurovascular Unit. **Pharmaceutics** 12: 635.

Mészáros, M., **Porkoláb, G.**, Kiss, L., Pilbat, A.M., Kóta, Z., Kupihár, Z., Kéri, A., Galbács, G., Siklós, L., Tóth, A., Fülöp, L., Csete, M., Sipos, Á., Hülpér, P., Sipos, P., Páli, T., Rákhely, G., Szabó-Révész, P., Deli, M.A., Veszelka, S. (2018) Niosomes decorated with dual ligands targeting brain endothelial transporters increase cargo penetration across the blood-brain barrier. **Eur J Pharm Sci** 123: 228-240.



INTERNATIONAL MENTORS



IVAN AHEL

United Kingdom

Sir William Dunn School of Pathology,
University of Oxford

Contact mentor: Gyula Timinszky



DAN ANDERSSON

Sweden

Department of Medical Biochemistry
and Microbiology,
Uppsala University

Contact mentor: Csaba Pál



MATTHEW CAMPBELL

Ireland

Smurfit Institute of Genetics,
Trinity College Dublin

Contact mentor: Mária Deli



FANG-RONG CHANG

China

Graduate Institute of Natural
Products,
Kaohsiung Medical University

Contact mentor: Attila Hunyadi



CHRISTIAAN DE KOCK

The Netherlands

Vrije University Amsterdam

Contact mentor: Gábor Tamás



DOBROMIR DOBREV

Germany

Institute of Pharmacology,
University Duisburg-Essen

Contact mentor: András Varró



ZSUZSANNA FABRY

United States of America

Department of Pathology and
Laboratory Medicine,
University of Wisconsin-Madison

Contact mentor: Mária Deli



TONI GABALDÓN

Spain

Bioinformatics and Genomics
Program (CRG),
ICREA Research Professor

Contact mentor: Attila Gácsér



CSILLA GERGELY

France

Laboratoire Charles Coulomb
UMR 5221 CNRS – Université
Montpellier 2

Contact mentor: László Zimányi



THOMAS H. GILLINGWATER

United Kingdom

Edinburgh Medical School
Biomedical Sciences

Contact mentor: László Siklós



ANNA GUKOVSKAYA

United States of America

Department of Medicine
David Geffen School of Medicine
University of California at Los Angeles

Contact mentors:
Péter Hegyi, Zoltán Rakonczay



GYÖRGY HAJNÓCZKY

United States of America

MitoCare Center for Mitochondrial
Imaging Research and Diagnostics,
Thomas Jefferson University,
Philadelphia

Contact mentor: Péter Hegyi



JOACHIM HEBERLE

Germany

FreieUniversität Berlin,
Department of Physics Experimental
Molecular Biophysics

Contact mentor: László Zimányi



MARKUS HEIMESAAT

Germany

Department of Microbiology
Gastrointestinal Microbiology
Research Group, Charité,
University Medicine Berlin

Contact mentor: Mária Deli



LAURENCE D. HURST

United Kingdom

Department of Biology and
Biochemistry,
The University of Bath

Contact mentor: Balázs Papp



ZOLTÁN IVICS

Germany

Division of Medical Biotechnology
Paul Ehrlich Institute,
Langen, Germany

Contact mentor: Lajos Mátés



HARM H. KAMPINGA

Netherlands

Department of Cell Biology,
University of Groningen

Contact mentor: László Vigh



ENDRE KISS-TOTH

United Kingdom

The University of Sheffield,
Department of Infection,
Immunity and Cardiovascular Disease

Contact mentor: Lajos Haracska



ANDREAS LADURNER

Germany

Butenandt Institute of Physiological
Chemistry LMU, Biomedical Center
Faculty of Medicine, Ludwig-
Maximilians-University of Munich

Contact mentor: Imre Boros



GERGELY L. LUKÁCS

Canada

Departments of Physiology and
Biochemistry
McGill University, Montreal

Contact mentor: Péter Hegyi



ELEK MOLNÁR

United Kingdom

School of Physiology, Pharmacology
and Neuroscience
University of Bristol

Contact mentor: László Dux



SHMUEL MUALLEM

United States of America

Epithelial Signaling and Transport
Section, Molecular Physiology and
Therapeutics Branch, NIH NIDCR

Contact mentors:
Péter Hegyi, Zoltán Rakonczay



GEORG NAGEL

Germany

University of Würzburg

Contact mentor: András Dér



LÁSZLÓ NAGY

United States of America

Departments of Medicine and
Biological Chemistry, Johns Hopkins
University School of Medicine, Johns
Hopkins All Children's Hospital

Contact mentor: Zsolt Boldogkői



JOSHUA D. NOSANCHUK

United States of America

Albert Einstein College of Medicine
Contact mentor: Attila Gácsér



STEPHEN G. OLIVER

United Kingdom

Department of Biochemistry
University of Cambridge
Contact mentor: Balázs Papp



GÁBOR PÁPAI

France

Integrated Structural Biology,
Institute of Genetics and Molecular
and Cellular Biology (IGBMC)
Contact mentor: Imre Boros



ANANT P. PAREKH

United Kingdom

Department of Physiology
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MEETINGS, TRAININGS, PROFESSIONAL PROGRAMS





CONFERENCES IN 2022



XVIII. MEETING OF NOBEL LAUREATES AND TALENTED STUDENTS

4-7 April
2022
SZEGED

NOBEL LAUREATE GUESTS OF HONOR:



BERT SAKMANN
German physiologist
Nobel Prize in Physiology or
Medicine, 1991



ERWIN NEHER
German biophysicist
Nobel Prize in Physiology or
Medicine, 1991



AARON CIECHANOVER
Israeli biologist
Nobel Prize in Physiology or
Medicine, 2004



KURT WÜTHRICH
Swiss chemist/biophysicist
Nobel Prize in Physiology or
Medicine, 2002



PETER DOHERTY
Australian veterinarian, immunologist
Nobel Prize in Physiology or
Medicine, 1996

INTERNATIONAL GUESTS OF HONOR:



ARTHUR KONNERTH
German Brain-Prize laureate
neuroscientist



MICHAEL BRECHT
German neurobiologist



CHRISTIAAN DE KOCK
Dutch neuroscientist

4 days
9 venues
600 participants

46 secondary schools
410 Szent-Györgyi Pupils
60 Szent-Györgyi Teachers

100 Szent-Györgyi Students
40 Szent-Györgyi Mentors
and Junior Mentors

XIX. MEETING OF NOBEL LAUREATES AND TALENTED STUDENTS

10-12 November
2022
SZEDED

GUEST OF HONOR:



BOTOND ROSKA
Hungarian Neurobiologist



2 days
4 venues
470 participants

41 secondary schools
250 Szent-Györgyi Pupils
50 Szent-Györgyi Teachers

150 Szent-Györgyi Students
20 Szent-Györgyi Mentors
and Junior Mentors

TRAININGS FOR SZENT-GYÖRGYI SENIOR TEACHERS

13-14 May 2022, Villány

7-8 October 2022, Debrecen

23 participants



TRAININGS FOR SZENT-GYÖRGYI TEACHERS

18 November 2022, Szombathely

25 November 2022, Pécs

2 December 2022, Pécs

21 participants



COMMUNICATION TECHNIQUES TRAINING

In Budapest, Debrecen, Pécs and Szeged for the 1st and 2nd year Szent-Györgyi Students
28 occasions



PRESENTATION TECHNIQUES TRAINING

In Budapest, Debrecen, Pécs and Szeged for Szent-Györgyi Students

63 occasions



ENGLISH LANGUAGE TRAINING

In Budapest, Debrecen, Pécs and Szeged for Szent-Györgyi Students

252 occasions

VISITS OF INTERNATIONAL MENTORS

26 April 2022, Szeged



NORBERT RADÁCSI

Senior researcher of the Institute for Materials and Processes at The University of Edinburgh

10 November 2022, Szeged



JOSHUA D. NOSANCHUK

Senior associate dean for medical education and professor of medicine and of microbiology & immunology at Albert Einstein College of Medicine



UPCOMING CONFERENCES IN 2023

XX. MEETING OF NOBEL LAUREATES AND TALENTED STUDENTS



26-28 March
2023
SZEGED

Keynote speaker:

BRUCE ALAN BEUTLER
American immunologist
and geneticist
Nobel Prize in Physiology or
Medicine, 2011



XXI. MEETING OF NOBEL LAUREATES AND TALENTED STUDENTS



13-15 December
2023
SZEGED

Keynote speakers:



RANDY WAYNE SCHEKMAN
Nobel Prize in Physiology or
Medicine, 2013



TOM C. SÜDHOF
Nobel Prize in Physiology or
Medicine, 2013

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