Leopoldina
Nationale Akademie
der Wissenschaften

Programme

Gregor Mendel – a Pioneer of Modern Genetics

Celebratory symposium on the occasion of his 200th birthday with talks by Mendel Medal laureates

Wednesday, 20 July 2022

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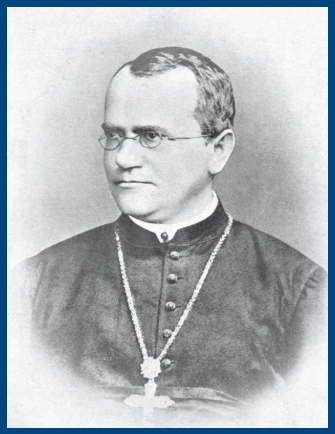
Titelbild:



Gregor Mendel
(1822-1884)

Picture taken from William Bateson (1909):
Mendel's principles of heredity, Cambridge University Press.
Photograph originally provided by St. Thomas' Abbey in Brno.

Gregor Mendel

Gregor Johann Mendel was born on July 20, 1822 in Hynčice (Austrian Silesia) into a family of farmers. He attended the Philosophical Institute in Olomouc (Moravia) from 1840 to 1843, where he studied different disciplines including physics and philosophy. In 1843, he entered the Augustinian Abbey of St. Thomas in Brno and was ordained as priest in 1847. Mendel was then sent to study at the University of Vienna in 1851. He returned to the abbey as teacher of physics. In 1867, he became Abbot of the monastery in Brno. Gregor Mendel died on January 6, 1884.

Mendel is widely regarded as the founder of modern genetics. He studied the inheritance of traits in pea plants by breeding and cultivating them in the abbey garden and discovered the well-known rules of heredity named after him. Based on his results, Mendel proposed pairs of "heritable elements" that specify different plant traits such as flower colour and leaf and seed morphology. More specifically, he developed three principles of inheritance that describe the transmission of these genetic traits, before the existence of genes themselves was even known.

In 1865, Mendel delivered two lectures on his findings to the Natural Science Society in Brno, who published his results in their journal the following year under the title "Experiments on Plant Hybrids". It was not until the early 20th century, however, that the importance of Mendel's research and ideas was recognised. His rules of inheritance were rediscovered and proven correct by Hugo de Vries, Carl Correns and Erich von Tschermak. Therefore, Mendel is considered the first scientist who statistically analysed the inheritance of genes and thus figured out how hereditary traits are passed from one generation to the next. Since the beginning of the 20th century, multiple scientific societies and institutions have been named after Gregor Mendel.

Mendel Medal

The Leopoldina awards this medal for pioneering achievements in the fields of general biology. The Academy Senate decided to institute the medal on 20 October 1965 to honor Gregor Mendel. The medal shall be awarded regardless of membership status and without national restrictions.

List of Laureates

Year	Laureate	City	Discipline
1967	Max Delbrück (1906 - 1981)	Pasadena	General biology
1970	Sydney Brenner (1927 - 2019)	Cambridge (GB)	General biology
1970	Nikolaj V. Timofeev-Resovskij (1900 - 1981)	Obninsk	General biology
1973	Erwin Chargaff (1905 - 2002)	New York	Biochemistry/Biophysics
1975	Curt Stern (1902 - 1981)	Berkeley	General biology
1977	H. Günter Wittmann (1927 - 1990)	Berlin	Biochemistry/Biophysics
1980	Ernst Mayr (1904 - 2005)	Cambridge (USA)	Zoology
1983	Dietrich Starck (1908 - 2001)	Frankfurt (M.)	Anatomy
1985	Jozef Schell (1935 - 2003)	Cologne	Agricultural science/ Molecular biology
1987	Jane Goodall (born 1934)	Dar es Salaam	General biology
1989	Andrei D. Mirzabekov (1937 - 2003)	Moscow	Molecular biology
1991	Masahiro Sugiura (born 1936)	Nagoya	Molecular genetics
1993	Dieter Oesterhelt (born 1940)	Martinsried	Biochemistry/Biophysics
1995	Diter H. von Wettstein (1929 - 2017)	Copenhagen	Molecular biology
1997	Walter J. Gehring (1939 - 2014)	Basel	Molecular biology/Genetics
1999	Herbert Jäckle (born 1949)	Göttingen	Genetics
2001	Konrad Sandhoff (born 1939)	Bonn	Human genetics/ Molecular medicine
2003	Peter Propping (1942 - 2016)	Bonn	Human genetics/ Molecular medicine
2005	Rolf Knippers (1936 - 2017)	Konstanz	Genetics
2007	August Böck (born 1937)	Munich	Biochemistry/ Molecular biology
2009	Heinz Saedler (born 1941)	Cologne	Molecular plant biology
2011	Regine Kahmann (born 1948)	Marburg	Genetics/Molecular biology
2013	Nicholas H. Barton (born 1955)	Klosterneuburg	Genetics
2015	Detlef Weigel (born 1961)	Tübingen	Molecular biology
2017	Peter Hegemann (born 1954)	Berlin	Optogenetics
2019	Magdalena Götz (born 1962)	Munich	Molecular biology
2021	Stefan Mundlos (born 1958)	Berlin	Human genetics

Moderators

Prof. Dr. Ulla Bonas (born 1955 in Cologne, Germany), professor for Plant Genetics at the Martin-Luther-University Halle-Wittenberg and current vice president of Leopoldina. She is a member of Leopoldina since 2008.

Photo: © Christof Rieken for Leopoldina

Prof. Dr. Andreas Graner (born 1957), Managing Director, Leibniz Institute of Plant Genetics and Crop Plant Research (IPK), Gatersleben, Germany since 2007 and member of Leopoldina since 2001.

Photo: © IPK / Andreas Bähring

Programme

(all talks 20 minutes plus 10 minutes for discussion)

Opening

13:00—13:05	Gerald Haug	**Welcome**
13:05—13:10	Regine Kahmann	**Introductory remarks**
13:10—13:40	Widmar Tanner	**A Moravian monk characterized quantitatively the behavior of inheritable "elements", later called genes**

Session I

13:40—14:10	Herbert Jäckle	**Lack of histone synthesis causes cell cycle arrest during early embryonic development**
14:10—14:40	Nicholas Barton	**Using hybrid zones to analyse divergence and adaptation in nature**
14:40—15:10	**Coffee Break**	

Session II

15:10—15:15	Andreas Graner	**Introductory remarks**
15:15—15:45	Magdalena Götz	**From mechanisms of neurogenesis to neural repair**
15:45—16:15	Konrad Sandhoff	**Regulation of neuronal ganglioside degradation by genetic and posttranslational modifiers**
16:15—16:45	Regine Kahmann	**The road from self-nonself recognition to a critical structure for disease development in smut fungi**
16:45—17:15	**Coffee Break**	

Session III

17:15—17:20	Ulla Bonas	**Introductory remarks**
17:20—17:50	Stefan Mundlos	**From Mendel's laws to 3D genomics - how sequence determines function and phenotype**
17:50—18:20	Peter Hegemann	**Photoreceptor mendeling (via Zoom)**
18:20—18:30	Jane Goodall	**Hope through action (pre-recorded video)**

Conclusion

18:30—18:45	Ulla Bonas, Gerald Haug	**Concluding remarks**
19:00 Dinner	**(special invitation)**	

Nicholas Barton (Mendel Medal awarded in 2013)

Using hybrid zones to analyse divergence and adaptation in nature

Hybrid zones separate populations that remain distinct, despite gene flow. For example, in the snapdragon Antirrhinum majus, yellow and magenta flowers are separated by ~1 Km. Comparison of DNA sequence reveals that divergence is concentrated at just a few loci involved with flower colour, and allows us to estimate rates of selection and gene flow. Nevertheless, additional divergence may be spread over much of the genome, without leaving much trace in sequence data. Such polygenic divergence is in principle the most efficient source of adaptation, and yet also, the most difficult to analyse.

Photo: © private

Prof. Dr. Nicholas H. Barton (born 30 August 1955 in London, United Kingdom) is an evolutionary biologist and geneticist who has worked on multiple fundamental questions of evolutionary theory which he characterized by the application of sophisticated mathematical analysis. Since 2008, he is professor for Evolutionary Genetics at the Institute of Science and Technology Austria (ISTA). He was awarded the Mendel Medal in 2013 for his work on narrow hybrid zones that separate different species, and his contributions to our knowledge of how species adapt and how they split into new species.

Magdalena Götz (Mendel Medal awarded in 2019)

From mechanisms of neurogenesis to neural repair

We study the mechanisms of neurogenesis in order to implement them for neuronal repair. This lead us to the discovery of organellar diversity even between subset of neural stem cells. I will describe our most recent data unravelling centrosome heterogeneity with more than half of all centrosome proteins in neural stem cells as novel centrosome interactors. These are relevant for development and disease as I will illustrate. I will then move to illustrate that also other organelles, such as the nucleolus or the mitochondria differ profoundly in their composition between cell types. This is also critical for repair. I will outline the novel approach of direct neuronal reprogramming turning glial cells into neurons and how mitochondria conversion is a crucial hurdle that can be overcome by novel CRISPR technology. If time permits, I will end by summarizing the state of in vivo direct neuronal reprogramming for repair and replacement of neurons.

Photo: © private

Prof. Dr. Magdalena Götz (born 17 January 1962 in Heidelberg, Germany) performs research in the fields of cell generation, neurogenesis and treatment after brain injuries, with a particular focus on glial cells. Since 2004, she is Director of the Institute for Stem Cell Research at Helmholtz Center Munich as well as Head of Department of Physiological Genomics at Ludwig-Maximilians-University in Munich. Since 2008, she is a member of Leopoldina and was awarded the Mendel Medal in 2019 for her discovery of glial cells' capacity to function as stem cells and for identifying the transcription factor Pax6 which enables this process.

Jane Goodall (Mendel Medal awarded in 1987)

Hope through action

Dr. Jane Goodall, DBE, Founder of the Jane Goodall Institute (JGI) and UN Messenger of Peace, is a world-renowned ethologist and activist inspiring greater understanding and action on behalf of the natural world.

Dr. Goodall is known for groundbreaking studies of wild chimpanzees in Gombe Stream National Park, Tanzania, which forever changed our understanding of our relationship to the rest of the animal kingdom. This transformative research continues today as the longest running wild chimpanzee study in the world. Jane's work builds on scientific innovations, growing a lifetime of advocacy including trailblazing efforts through her international organization the Jane Goodall Institute which advances community-led conservation, animal welfare, science, and youth empowerment through JGI's Roots & Shoots program.

Today, Jane continues to connect with worldwide audiences, despite the challenges of the pandemic, through 'Virtual Jane' including remote lectures, recordings, and her podcast, the "Jane Goodall Hopecast." In 2021, Jane was the recipient of the Templeton Prize, and her newest book, "The Book of Hope: A Survival Guide for Trying Times," was published.

Jane is a global icon spreading hope and turning it into meaningful positive impact to create a better world for people, other animals, and the planet we share.

Photo: © Andrew Zuckerman

Peter Hegemann (Mendel Medal awarded in 2017)

Photoreceptor Mendeling

The fame of the Silesian Augustini Friar, astronomer, and gardener Gregor Johann Mendel is based on the breeding experiments with peas, where he carefully analyzed the flowers of one generation after the other. The changes he observed are based on the shuffling of genes and regulatory elements that determine color, structure, and patterning of the flowers. This DNA shuffling may be considered as "Long Range Mendeling" of parts of chromosomes, groups of genes or other larger homologous DNA-fragments. In our experiments with sensory photoreceptors we swap individual helices, chromophore binding pockets, N- and C-termini or exchange single amino acid residues to modify color, kinetics, ion conductance and selectivity of channelrhodopsins or substrate specificities of enzyme rhodopsins or catalytically active Flavin-based blue-light photoreceptors. Additionally, we combine like nature photoreceptors as tandems to generate new properties and multidirectional control systems. This kind of "Short Range Mendeling" generates new hybrids that might or might not exist in nature but could be useful for Optogenetic application in host systems, whereas it would not be advantageous for the source organism that developed the photoreceptors during the 4 billions of years organismal evolution.

Photo: © private

Prof. Dr. Peter Hegemann (born 11 December 1954 in Münster, Germany) is a biophysicist, whose main areas of research include neuronal networks and the photobiology of green algae. He is one of the discoverers of channelrhodopsins, light-sensitive ion channels in unicellular algae, which provide the foundations for the novel technique of optogenetics. He is professor for experimental biophysics at Humboldt-University Berlin since 2005 and a member of Leopoldina since 2012. In 2017, Prof. Hegemann was awarded the Mendel Medal for proving that cells – and specifically neurons – can be controlled using light.

Herbert Jäckle (Mendel Medal awarded in 1999)

Lack of histone synthesis causes cell cycle arrest during early embryonic development

Epigenetic inheritance during DNA replication requires an orchestrated assembly of nucleosomes from modified parental and newly synthesized histones. We generated and analyzed Drosophila HisC mutant embryos lacking the canonical histone genes, i.e. their nucleosome assembly relies only on parental histones from embryonic cell cycle 14 onwards, resulting in a cell cycle arrest in the G2 phase of cycle 15. Parental histone recycling in the mutants leads to more accessible chromatin and upregulated spurious transcription. Recycled histones possessing activating marks are more dispersed along the gene bodies, while those with repressive marks keep their position after DNA replication. This suggests that recycled parental histones harbour a “positional memory”. We also found that the cell cycle arrest is associated with the lack of cdc25/string activity. string is transcribed in HisC mutants, but transcripts are rapidly degraded in response to the RNA-binding factor How. Transgene-dependent string mRNA, which lacks the How binding site in the 3´UTR, rescues the cell cycle arrest.

Photo: © Irene Böttcher-Gajewski / Max Planck Institute for Biophysical Chemistry

Prof. Dr. Herbert Jäckle (born 6 July 1949 in Konstanz, Germany) is a developmental biologist with a particular focus on processes of organ development. After being director of Max Planck Institute for Biophysical Chemistry from 2015–2016, today, he is head of the emeritus group Molecular Developmental Biology at the Max Planck Institute for Multidisciplinary Sciences, Göttingen. He is a member of Leopoldina since 2000, after he received the Mendel Medal in 1999 for his discoveries concerning the induction of segmentation processes during the embryogenesis of Drosophila melanogaster.

Regine Kahmann (Mendel Medal awarded in 2011)

The road from self-nonself recognition to a critical structure for disease development in smut fungi

In the smut fungus Ustilago maydis pathogenic and sexual development are intimately linked, fostering the belief that understanding the mating system would allow to understand disease development. We characterized the tetrapolar mating system and showed that it is based on a pheromone-receptor system as well as combinatorial control via two homeodomain-transcription factors. However, we did not anticipate the strong contribution of the plant to disease development. This became apparent only when the genome sequence was available and secreted effectors were discovered whose expression occurred in discrete waves during plant colonization. These effectors suppress plant defense responses and manipulate the physiology of the host. Unexpectedly, we detected a group of effectors with an essential virulence function. These effectors exist in a protein complex together with two transmembrane proteins. The complex resides in a surface-exposed structure likely involved in effector delivery to the host. The essential nature of this complex for disease and its conservation in smut fungi allowed to develop this complex into an attractive fungicide target.

Photo: © private

Prof. Dr. Regine Kahmann (born 20 October 1948 in Staßfurt, Germany) is a microbiologist working predominantly in the field of molecular phytopathology. From 2000–2019, she was director and head of the Department of Organismic Interactions at the Max Planck Institute in Marburg. She is a member of Leopoldina since 2008 and was awarded the Mendel Medal in 2011 for her accomplishments regarding the sequence specific recombination and regulation of DNA modification in Mu-phages, as well as the sexual development of the phytopathogenic fungus Ustilago maydis.

Stefan Mundlos [Mendel Medal awarded in 2021)

From Mendel's Laws to 3D Genomics – How Sequence determines Function and Phenotype

The rediscovery of Mendel's laws and its application to human disease at the beginning of the last century was the "Big Bang" of Human Genetics and Genomics. Eventually, the concept of heritability and its laws led to the identification of gene loci and finally gene mutations. The Human Genome Project with the first human genome sequence made public in 2000 paved the way to explore the function of our genome in all details. Thousands of disease mutations have been identified since and sequencing the human genome or at least parts of it has become diagnostic routine. Despite all this progress, our understanding of the non-coding genome and its role in gene regulation is limited. Recent discoveries have added multiple additional layers of information to the sequence itself. Epigenetic mechanisms control the activitiy of certain regions of the genome thereby functioning as a major regulators of gene expression. Chromosomes in the cell's nucleus fold in a genetically determined manner resulting in an intricate three-dimensional structure that has a direct influence on gene regulation. How these different layers of information work together and how they influence health and disease and the evolution of species will be discussed.

Photo: © David Ausserhofer

Prof. Dr. Stefan Mundlos (born 9 June 1958 in Marburg/Lahn, Germany) works on genetic mechanisms of normal and abnormal development, particularly of the skeleton, as well as on mechanisms of gene regulation and how they are influenced by genomic variation. Since 2009, he is head of the Institute of Medical Genetics and Human Genetics at the University Clinic Charité in Berlin. He is a member of Leopoldina since 2004 and was awarded the Mendel Medal in 2021 for his accomplishments in the field of gene regulation and the genetic causes of abnormal skeletal development.

Konrad Sandhoff (Mendel Medal awarded in 2001)

Regulation of neuronal ganglioside degradation by genetic and posttranslational modifiers

Amaurotic Idiocy was the clinical description of an inherited neurodegenerative disease. My lipid analysis of postmortem brain tissue yielded three glycolipid storage compounds identified as ganglioside GM2, its sialic acid free residue GA2 and globoside. The enzymatic and genetic analysis of 3 patients yielded controversial results in 1966 & 1967. Brain tissue of one had increased Hex A & B activities, another one had loss of both & the third one was deficient of Hex A only. Studies on the structure of catabolic enzymes, their genes and patient mutations in many laboratories confirmed 3 genetic diseases, now known as Tay-Sachs disease with HexA deficiency, Sandhoff disease with loss of both, HexA and HexB activity, and AB-variant of GM2-gangliosidoses with a loss of GM2AP, an essential lipid binding protein for catabolism of GM2.

The lipid-cleaving activity of these hydrolases is furthermore regulated by post-translational modifiers and primary storage inducing cascades of secondary storage as in Niemann-Pick-disease type A & B.

Photo: © private

Prof. Dr. Konrad Sandhoff (born 11 August 1939 in Berlin, Germany) is a biochemist who works primarily in the field of cellular metabolism. Since 2007, he is head of the research group Lipid Biochemistry at the Life & Medical Sciences (LIMES) Institute at the University of Bonn. He is a member of Leopoldina since 1999 and was awarded the Mendel Medal in 2001 primarily for his substantive contributions regarding the synthesis and effects of sphingolipids as well as our understanding of sphingolipidoses.

Widmar Tanner

A Moravian monk characterized quantitatively the behavior of inheritable “Elements”, later called genes

Gregor Johann Mendel, the father of Genetics, is a scientist known also to a general public. This is due to his very unusual CV. Born 1822 to a poor farm family in a Moravian-Austrian village; his father had still to carry out unpaid feudal work 3 days per week. Being a brilliant pupil, Mendel entered a gymnasium in Opava. However, he had to study and care for his living by tutoring at the same time. Eventually, after 6 years and 2 years in Olomouc, he had to give up and join the Augustinian monastery in Brno. There he taught as supplementary teacher in classes with more than 100 students. Trying to climb up in career, he studied for two years at the University of Vienna. Among others, he got interested in sexual plant reproduction. Back in the monastery, he crossed pea plants for 8 years, which clearly differed in traits. Based on statistics he was the first to establish quantitative rules, how differing traits are handed on from generation to generation. In 1866 he published his data in a 43-page booklet. This however was little read, not to speak of being understood. His work was rediscovered in 1900, sixteen years after his death. From then, on and on Mendel’s rules of inheritance appeared in all biology textbooks around the world.

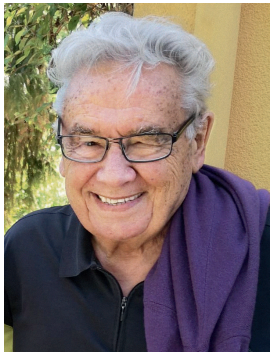


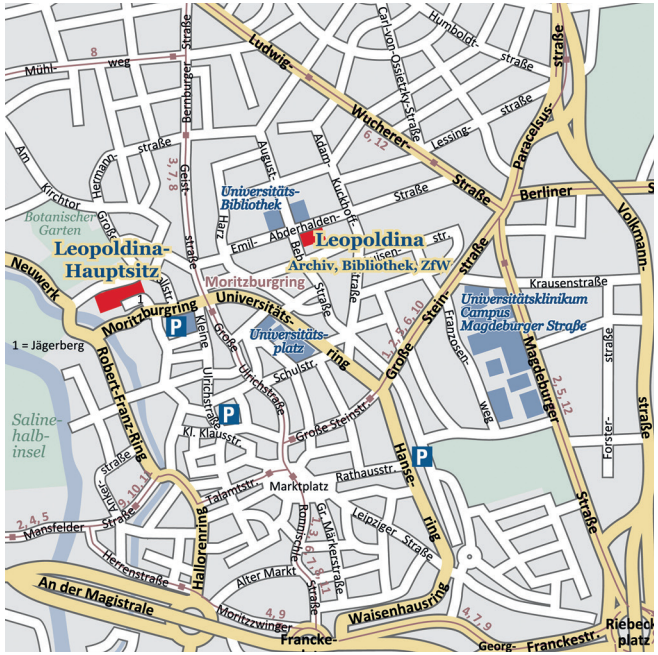
Photo: © private

Prof. Dr. Widmar Tanner (born 3 May 1938 in Bílovec/Wagstadt, Czechoslovakia, today Czech Republic) is professor for Cell Biology & Plant Physiology at the University of Regensburg. He is a member of Leopoldina since 1991.

Venue

Deutsche Akademie der Naturforscher Leopoldina e. V.
– Nationale Akademie der Wissenschaften –
Jägerberg 1
06108 Halle (Saale)

Detailed travel information:
https://www.leopoldina.org/en/service/contact/



Registration

Please register until 18.07.2022 via:

https://www.leopoldina.org/form/anmeldungen-gregor-mendel-symposium/

Deutsche Akademie der Naturforscher Leopoldina e. V.
– Nationale Akademie der Wissenschaften –

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The Leopoldina originated in 1652 as a classical scholarly society and now has 1,600 members from almost all branches of science. In 2008, the Leopoldina was appointed as the German National Academy of Sciences and, in this capacity, was invested with two major objectives: representing the German scientific community internationally, and providing policymakers and the public with science-based advice.

The Leopoldina champions the freedom and appreciation of science on both the national and the international level. It is her role to identify and analyse scientific issues of social importance. The Leopoldina presents its policy recommendations in a scientifically qualified, independent, transparent and prospective manner, ever mindful of the standards and consequences of science.

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