



THE PONTIFICAL
ACADEMY
OF SCIENCES

WORKSHOP ON

EVOLUTION *and* **DEVELOPMENT**



22-23 September
Casina Pio IV, Vatican City



““In that era, science was increasingly being presented as a rival source of truth to religion so that the Church felt an urgent need to counter the growing perception that faith and science were enemies.

Yet today, both science and religion face a different and perhaps more insidious threat: those who deny the very existence of objective truth. Too many in our world refuse to acknowledge what both science and the Church plainly teach – that we bear a solemn responsibility for the stewardship of our planet and for the welfare of those who dwell upon it, especially the most vulnerable, whose lives are imperilled by the reckless exploitation of both people and the natural world. This is precisely why the Church’s embrace of rigorous, honest science remains not merely valuable, but essential.”

Address of Pope Leo XIV
to Members of the Board of the Vatican Observatory Foundation
Consistory Hall, Monday, 11 May 2026

Concept and rationale

The absence of conflict between the biological sciences and religion was explained in an admirable way by Werner Arber, President Emeritus of the Pontifical Academy of Sciences, in an address to the 2012 Synod of Bishops: “For a long time curious human beings have acquired scientific knowledge primarily by observing with their senses and aided by mental reflections including logical reasoning. The chapter of the Genesis in the Old Testament is for me a testimony of an early scientific worldview already existing several thousand years ago. This chapter also reflects a wide consistency between religious faith and available scientific knowledge. It proposes a logical sequence of events in which the creation of our planet Earth may have been followed by the establishment of the conditions for life. Plants were then introduced and subsequently provided food for animal before human beings were finally introduced.”

The Evolution and Development Workshop will consider not only how the interpretation of the visible world through human reason led to powerful intellectual insights by Geoffroy Saint-Hilaire and Charles Darwin, but also how molecular biology uncovered an invisible historical book of animal evolution recorded in DNA. Variation and conservation, as recorded in genomic DNA, will be the leitmotif of this study

group, with the purpose of advancing the still-young discipline of molecular Evo-Devo.

In recent decades molecular genetics has revealed that animals share a conserved set of developmental genes that, under the pressure of natural selection of the fittest, has given rise to immense morphological diversity. At the same time, the reliance on ancient positional information systems to construct body plans has likely constrained the range of possible animal forms.

Before animals arose, microbial life developed photosynthesis and oxygenated the atmosphere, enabling the later evolution of multicellular life in the oceans. The origin of life, Oxygen, multicellularity, germ layers, Hox genes, positional information in the antero-posterior, dorsal-ventral and left-right axes, organogenesis, ecological change, and human speciation are among the topics to be examined. The common primeval ancestor of all extant bilateral animals possessed a complex developmental toolkit and a planktonic larval stage for dispersal before settling for life on the seafloor as an adult. Life on earth appears to have followed a very narrow evolutionary path before blossoming into the beautiful diversity of animal forms that surround us today.

Agenda

FIRST DAY, TUESDAY, SEPTEMBER 22, 2026

Opening Session

Chair: Joachim von Braun

- 09:00-09:10 Words of Welcome
Joachim von Braun PAS President and **Chancellor Peter Card. Turkson**
- 09:10-09:30 Objectives of the Workshop
Eddy De Robertis (PAS/USA)
Variation and constraints using an ancestral animal tool-kit
- 09:30-09:35 Discussion

Session 1: Origin of Life

Chair: Eddy De Robertis

- 09:35-10:00 Keynote address:
Detlev Arendt (Germany)
Human Genesis: an Evo-Devo Perspective
- 10:00-10:10 Discussion
- 10:10-10:30 **Karin Öberg**
From the Big Bang to habitable Planets
- 10:30-10:35 Discussion
- 10:35-11:00 Coffee Break

Session 2: Early Evolutionary Events

Chair: Michael Rosbash

- 11:00-11:20 **Siavash Kurdistan, (USA)**
How Oxygen changed the World: Metals, Histones and the making of Eukaryotes
- 11:20-11:25 Discussion
- 11:25-11:45 **Rafael Vicuña, (PAS/Chile)**
The origin of life on Earth: a persistent enigma
- 11:45-11:50 Discussion
- 11:50-12:10 **Luis F. Larrondo Castro (PAS/Chile)**
Fungal Genomes and their Contribution to Ecological Change
- 12:10-12:15 Discussion
- 12:15-12:35 **Nicole King (USA)**
The unicellular ancestry of animals
- 12:35-12:40 Discussion
- 12:40-13:00 **Brigitte Galliot (Switzerland)**
Morphogen gradients in Hydra
- 13:00-13:05 Discussion
- 13:05-14:10 Lunch at the Casina Pio IV

Session 3: Invertebrate Larvae and Dispersal in the Oceans

Chair: Detlev Arendt

- 14:10-14:30 **Ulrich Technau (Austria)**
Sea anemone embryos and the Chordin/Dpp Pathway
- 14:30-14:35 Discussion
- 14:35-14:55 **Maria Ina Arnone (Italy)**
Dispersal of Primary Larvae
- 14:55-15:00 Discussion
- 15:00-15:20 **Gaspar Jékely (Germany)**
Zooplankton and the Origin of Nervous Systems
- 15:20-15:25 Discussion

Session 4: Evolution of Morphogenesis

Chair: Nicole King

- 15:25-15:45 **Aoife McLysaght (Ireland)**
Genome Duplication in Vertebrate Evolution
- 15:45-15:50 Discussion
- 15:50-16:10 **Alexander Schier (Switzerland)**
Evolution of gastrulation
- 16:10-16:15 Discussion
- 16:15-16:35 **Christof Niehrs (Germany)**
FGF in Urbilateria Left-Right patterning
- 16:35-16:40 Discussion
- 16:40-17:00 Coffee Break

Session 5: Conservation of Hox Gene Complexes and Segmentation

Chair: Cliff Tabin

- 17:00-17:20 **Olivier Pourquié (PAS/USA/France)**
Evolution of the segmentation clock in the animal kingdom
- 17:20-17:25 Discussion
- 17:25-17:45 **Peter W. H. Holland (UK)**
Conservation with variation: Homeobox genes and the evolution of animal biology
- 17:45-17:50 Discussion
- 17:50-18:10 **Denis Duboule (College de France/Switzerland)**
The Hoxmunculus
- 18:10-18:15 Discussion
- 18:15-19:00 **Whole-group Discussion**
Evolvability, Constraints, Larvae, and Diversity
Moderators: Alejandro Sanchez Alvarado, Denis Duboule and Detlev Arendt
- 19:00-21:00 Dinner at Casina Pio IV

SECOND DAY, WEDNESDAY SEPTEMBER 23, 2016

Session 6: Regeneration and Molecular Mechanisms

Chair: Denis Duboule

- 9:00-9:20 **Alejandro Sanchez Alvarado (USA/Venezuela)**
Regeneration in Evolution
- 9:20-9:25 Discussion
- 9:25-9:45 **Michael Rosbash (USA)**
Evolution of circadian rhythms

9:45-9:50	Discussion
9:50-10:10	Lawrence Zipursky (USA) <i>Convergent Mechanisms of Self-non-Self Discrimination in Neurons</i>
10:10-10:15	Discussion
10:15-10:45	Coffee Break
10:45-11:05	Clifford Tabin (USA) <i>Evolution of Organogenesis</i>
11:05-11:10	Discussion
11:10-11:30	Neil Shubin (USA/NAS President) <i>Palaeontology and Evo-Devo</i>
11:30-11:35	Discussion
11:35-12:00	Whole-group discussion on <i>evolutionary conservation and variability, how conserved molecular systems enabled and constrained animal diversity</i>
12:00-13:45	Group photo and Lunch at the Casina Pio IV patio

Session 7: The DNA Record of Life

Chair: Alejandro Sanchez Alvarado

13:45-14:05	Eske Willerslev (Denmark) <i>Environmental DNA and Ecological Change</i>
14:05-14:10	Discussion
14:10-14:40	Svante Pääbo (Germany/Sweden) <i>Recent Evolution of the Human genome</i>
14:40-14:50	Discussion
14:50-15:20	General discussion by all participants Conclusions and Perspectives. Conserved toolkits, endless forms. The future of Evo-Devo. Generating the final statement to be published in the Vatican PAS website and preparation of manuscripts for publication of a PAS <i>Scripta Varia</i> book by Vatican Press. Moderators Alejandro Sanchez Alvarado and Eddy De Robertis
15:20-15:30	Closing reflections: Peter Cardinal Turkson <i>The Book of Scripture and the Book of Nature</i>
15:30-16:00	Coffee and preparation for departure for Vatican excursions
19:00	Closing Dinner at Romolo restaurant (Via di Porta Castello, 17)

List of Participants

Prof. Dr. Joachim von Braun

President of the Pontifical Academy of Sciences
Distinguished Professor, Economic and
Technological Change,
University of Bonn
Germany

Cardinal Peter Turkson

Chancellor
The Pontifical Academy of Sciences
The Vatican City

Msgr. Dario E. Viganò

Vice Chancellor
The Pontifical Academy of Sciences
The Vatican City

Prof. Edward De Robertis

Council member, Pontifical Academy of Sciences
President of Academia de Ciencias de America
Latina (ACAL)
Distinguished Professor at the
University of California, Los Angeles
United States of America

Prof. Dr. Detlev Arendt

Group Leader and Senior Scientist
ERC Investigator
European Molecular Biology Laboratory
Heidelberg
Germany

Dr. Maria Ina Arnone

Head of Department
Stazione Zoologica Anton Dohrn
Naples
Italy

Prof. Chien-Jen Chen

Council Member Pontifical Academy of Sciences
Distinguished Professor
President, Academia Sinica
Background in Epidemiology, Human Genetics,
Public Health, and Preventive Medicine
Taiwan

Prof. Denis Duboule

Professor of Developmental Genetics and
Genomics at the École Polytechnique Fédérale de
Lausanne (EPFL) and at the Department of
Genetics and Evolution of the University of
Geneva. Director of the Swiss National Research
Center “Frontiers in Genetics” and Professor at the
Collège de France, Paris
Switzerland

Prof. Brigitte Galliot

Professor Emeritus
Department of Genetics & Evolution
University of Geneva
Switzerland

Dr. Fabiola Gianotti

Council Member, Pontifical Academy of Sciences
Research physicist, former Director-General
CERN
Switzerland

Prof. Mohamed Hag Ali Hassan

Council Member, Pontifical Academy of Sciences
President of Sudanese National Academy of Sciences
United Arab Emirates

Prof. Peter W H Holland

Linacre Professor of Zoology
Department of Biology & Fellow of Merton College
University of Oxford
Oxford
United Kingdom

Prof. Gaspar Jekely

Professor, Head of Department, Managing
Director Centre for Organismal Studies,
Heidelberg University
Germany

Prof. Nicole King

Professor of Molecular and Cell Biology, University
of California, Berkeley
Investigator, Howard Hughes Medical Institute
United States of America

Prof. Siavash Kurdistan

Professor, Biological Chemistry
University of California Los Angeles
United States of America

Prof. Luis Larrondo

Member of the Pontifical Academy of Sciences
Full Professor
Department of Molecular Genetics & Microbiology
Faculty of Biological Sciences, Pontifical Catholic
University of Chile, Santiago Pontificia Universidad
Católica de Chile
Chile

Prof Aoife McLysaght, PhD

Chair of Evolutionary Genetics
Department of Genetics
Trinity College Dublin
Ireland

Prof. Dr. Christof Niehrs

Molecular Embryology
German Cancer Research Center (DKFZ),
Heidelberg and Institute of Molecular Biology, Mainz
DKFZ Heidelberg & IMB Mainz
Germany

Prof. Karin Öberg Marini

Professor of Astronomy
Harvard University
United States of America

Prof. Olivier Pourquie

Frank Burr Mallory Professor of Pathology at the
Brigham and Women's Hospital and Professor in
the Department of Genetics at Harvard
United States of America

Prof. Veerabhadran Ramanathan

Council Member, Pontifical Academy of Sciences
Distinguished Professor Emeritus
Scripps Institution of Oceanography
University of California at San Diego
USA; Climate Solutions Scholar, Cornell
University, Ithaca
United States of America

Prof. Michael Rosbash

Biology faculty member, Brandeis University.
Peter Gruber Endowed Chair in Neuroscience,
Professor of Biology and Investigator, Howard Hughes
United States of America

Prof. Alexander Schier

Professor of Cell Biology
and the Director of the Biozentrum University of Basel
Switzerland

Prof. Neil Shubin

Paleontologist, evolutionary biologist, and popular
science communicator.
President of the National Academy of Sciences
(NAS) University of Chicago
United States of America

Prof. Svante Pääbo

Professor of molecular evolutionary biology
Founding director of the Department of Genetics
at the Max Planck Institute for Evolutionary
Anthropology, Director of Max Planck
Institute for Evolutionary Genetics
Leipzig
Germany

Prof. Alejandro Sánchez Alvarado

Priscilla Wood Neaves Chair in the Biomedical Sciences
President & Chief Scientific Officer,
Stowers Institute for Medical Research
Investigator Emeritus
Howard Hughes Medical Institute
Member, National Academy of Sciences
United States of America

Prof. Clifford J. Tabin

George Jacob and Jacqueline Hazel Leder
Professor
Chair of the Department of Genetics
Harvard Medical School
United States of America

Prof. Dr. Ulrich Technau

Vice Dean of Faculty of Life Sciences
Head of Department of Neurosciences and
Developmental Biology
Professor for Developmental Biology
University of Vienna
Austria

Prof. Ewine van Dishoeck

Council Member Pontifical Academy of Sciences
Professor
Leiden University
The Netherlands

Prof. Rafael Vicuña

Member, Pontifical Academy of Sciences
Professor Emeritus
Pontifical Catholic University of Chile
University of Chile, Santiago. Departamento de
Genética Molecular y Microbiología
Chile

Prof. Eske Willerslev

Professor
University of Copenhagen
Denmark

Prof. S. Lawrence (Larry) Zipursky

Jerome J. Belzer Chair in Medical Research
Distinguished Professor Emeritus of Biological
Chemistry
Investigator Emeritus, Howard Hughes Medical Institute
David Geffen School of Medicine
University of California, Los Angeles
United States of America

Memorandum

General information

- › Dress code is business attire.
- › Please remember to bring a valid ID.
- › Please refer to www.pas.va for further information on the Academy, the Academicians, and current and past events.

Access instructions to the Vatican and the Casina Pio IV

- › Your name is already communicated to the Vatican Security. They will check your Identity and let you in. If you are bringing a guest, kindly let us know, and we shall add their name on the list.
- › You can come through the closest entrance called Perugino (Via della Stazione Vaticana, no number, it's a very short street). Instructions to the Casina Pio IV, headquarters of the Pontifical Academy of Sciences, can be found in the following link:
<http://www.casinapioiv.va/content/accademia/en/about/contacts.html>
- › For all eventualities the telephone numbers of the Academy are the following:
+39 06 69883195 or +39 06 69883451. A Mobile number is also available +39 3420026216
On travel days, the mobile phone number +393420026216 will be available.



IMPORTANT:

Please check your PPT presentation
with the conference technicians before your talk.



Wi-Fi network: Academy-Guest
Password: will be available in the Casina Pio IV



CONTACTS
AND MAPS







THE PONTIFICAL ACADEMY OF SCIENCES
CASINA PIO IV | V-00120 VATICAN CITY
Tel: +39 0669883451 | Fax: +39 0669885218 | Email: pas@pas.va
For further information please visit: www.pas.va

<https://www.youtube.com/@CasinaPioIV>