The 2026 Evolution Conference

Programme

The conference is organized around the following six themes, spanning the three conference days:

Biological Relativity and the Biomedical Sciences
Natural Genetic Engineering, Biogenesis, and Reticulate Evolution
Epigenetics and Directed Evolution of Complex Systems
Paradigms and Narratives of Evolution
Cognition, Teleonomy, Agency, and Consciousness
Learning and Intelligence Across and Beyond Life

Thursday January 8th, 2026

THEME: Natural Genetic Engineering, Biogenesis, and Reticulate Evolution

9h15

James A. Shapiro (Onsite)

How Life Changes Itself in Evolution Organically

Conventional neo-Darwinian theory does not account for the numerous ways in which living cells can alter their genomes. For example, plasmid-based horizontal transfer and integron structures that accumulate coding sequences have enabled the evolution of multiple resistant superbugs in under 20 years. Horizontal transfers occur across virtually all taxonomic boundaries to provide one-step acquisitions of complex adaptive functions. Symbiogenetic cell fusions involving massive endosymbiont-to-nucleus transfers of coding sequences were essential in the evolution of eukaryotes and photosynthetic eukaryotes. Many proteins have evolved novel functions through domain shuffling, facilitated by exon rearrangements. Repetitive transposable elements formatted chromosomes for accurate genome replication (centromeres and telomeres) and organised complex adaptations by mobilizing control sequences to dispersed coordinately regulated loci. One genetic locus can encode multiple adaptive products via alternative splicing and production of bioactive ncRNAs. There is no junk DNA. Genome change is responsive to stress conditions, which activate transposable elements. Of particular importance is interspecific hybridization that often results from the failure to find a conspecific mate. Interspecific hybridization is the most reliable method for generating new taxa, such as the potato. As we learned in 2011, first in cancer cells and then in human and other germlines, chromosome breakage and other traumas can induce episodes of chromosome-wide or genome-wide DNA rearrangements. During the process of repairing chromosome breakage, some repair functions involve DNA polymerases that jump templates to combine sequences from multiple sites in the genome, or even produce completely untemplated DNA. There seems to be no limit on how living cells can rewrite their genomes.

James A. Shapiro is Professor of Microbiology Emeritus in The Department Of Biochemistry And Molecular Biology at the University Of Chicago. He received his Ph.D. in Genetics from Cambridge University in 1968 under Prof. W. Hayes, FRS. At the University of Chicago since 1973, he was the Darwin Prize Visiting Professor at the University of Edinburgh (1993). In 2001, he received an O.B.E. for services to the Marshall Scholarship Program. He is a founder of the Third Way of Evolution, which aims to raise awareness of scientific alternatives to Intelligent Design and Neo-Darwinism. His pioneering books are on mobile genetic elements, natural genetic engineering, and bacterial multicellularity. His complete CV can be found here.

10hr30 break

11h00 - 13h00

Predrag Slijepcevic (Onsite)

Biocivilisations: A New Look at the Science of Life

When evolution is examined through the lenses of agent theory and systems biology, the focus shifts from a mechanical and deterministic view, where organisms are seen as passive automata shaped by selfish genes and inflexible environments, to a dynamic and indeterministic perspective. In this view, organisms are recognized as biological agents whose cognitive activities shape the living systems of our planet. The actions of these biological agents, particularly their ability to learn, drive the ever-changing structure of the biosphere, constantly expanding its phase space. This new perspective challenges the anthropocentrism often found in the life sciences, which tends to interpret cognition as a trait unique to humans. Instead, cognition is seen as a biological universal. The accomplishments of civilisation – ranging from communication and engineering to science and medicine – are typically framed by modern science as products of human culture alone. However, these achievements exist within societies formed by all biological agents, representing a long evolutionary continuum of biocivilisations, from bacteria to humans. Moreover, the anthropocentric view of human culture becomes untenable when we consider the context of biocivilisations. Culture is a phenomenon that spans the entire biosphere, arising from the learning capacities of various agents and their societies. Ultimately, this revised perspective leads to a vision of life as a biocivilising force, wherein culture transcends its anthropocentric meaning and assumes broader significance across the biosphere. It also challenges the standard evolutionary narrative, which suggests that evolutionary changes are mainly driven by genetic mutations or shifts in gene frequencies. Instead, these changes are influenced by the cognitive actions of agents, particularly their capacity to learn.

Predrag Slijepcevic is a Biologist with a keen interest in chromosome structure and organization, the evolution of life, and the philosophy of science. He is an expert in cell biology, molecular cytogenetics, and the emerging field of cell-based cognition. Throughout his career, Predrag has worked at Cambridge, St. Andrews, and Leiden Universities. He is currently a lecturer and Researcher at Brunel University of London. His book, Biocivilisations: A New Look at the Science of Life , has won the prestigious Nautilus Book Award for 2024 with a gold medal in the Restorative Earth Practices category. The German edition of the book will be published in 2026. Predrag is currently involved in a project titled Cognition-Based Biology: Sentience, Communication, and Symbiosis, collaborating with William B. Miller Jr., František Baluška, and Arthur S. Reber.

Marilyn J. Roossinck (Onsite)

Viruses, Fungi, and Plants: Intimate Relationships

Since plants made the transition from sea to land some 470 million years ago, they have relied on fungi for survival. Plant-fungal symbioses have strongly impacted the evolution of both individuals in the holobiont. Evolutionary studies of land plants often overlook the role of fungi in plant adaptation to their terrestrial environment. The role of viruses in these relationships, where viruses have been essential yet unknown actors, has been largely overlooked. With the extreme plasticity of their genomes, viruses can serve as a means for rapid adaptation to changing environments, providing essential traits for survival. Viruses are also involved in fungal-animal relationships, where they can impact a fungus's ability to colonize an animal. I will present data from field and laboratory studies that demonstrate the critical role of fungal viruses in plant adaptations to extreme environments and in the colonization and invasion of animals.

Marilyn Roossinck is an Emeritus Professor of Virus Ecology from Penn State University. She spent four decades studying the relationships and evolution of plant and fungal viruses at Cornell University, The Noble Foundation, and Penn State's Centre for Infectious Disease Dynamics. She is currently an Associate Editor for the journal Virus Evolution, and is a writer of accessible science books such as Virus, An illustrated Guide to 101 Incredible Microbes; and Viruses, A Natural History. Recent scholarly publications include papers on virus-free and wild-type isolates of Pseudogymnoascus destructans; The role of Pseudogymnoascus destructans partitivirus-pa in the spread of white-nose syndrome; The Impact of cultivated hosts on the recombination of Cucumber mosaic virus; and the Manipulation of aphid behaviour by a persistent plant virus.

Joana C. Xavier (Onsite)

Causality at the Root: Metabolism, Cooperation, and the Making of Life

Dominant narratives in biology raised the gene to become the privileged agent of causality not only in evolution, but in life itself. Yet, no living system known to maintain itself or replicate does so without a membrane, proteins, and cofactors supporting its genome. Here I argue that contemporary origins of life research exposes deep fractures in Modern Synthesis, a stark position in Philosophy of Biology passing as science wearing reductionist garments. I will show that data-based, engineering-informed origins science reveals the essential cooperation of multiple cellular components. If simplistic paradigms remain appealing and easier to communicate widely, modern Biology demands Noble's relativity, Kauffman's complexity, and Fox Keller's attention to the power of metaphor. My work backs up the preceding arguments through (1) The reconstruction of ancient autocatalytic cores of metabolism, which can exhibit cooperation and adaptation in particular geochemical contexts independently of genetic replication; and (2) Exposing the vital role of cofactors in establishing and coordinating those networks, all the way to modern prokaryotes and us. Metabolic networks, old and new, challenge reductionist assumptions about individuality, inheritance, and selection. They suggest instead a relational view where structure and function co-emerge from environmental constraints. Their origin and evolution depended not only on mutational variation but primarily on collective dynamics and deep environmental coupling. Processes such as constraint-based emergence and energy transfer are not background conditions, but co-constitutive with the evolution and unfolding of biological function. These findings extend current evolutionary paradigms by foregrounding systemic and multilevel causation, offering an empirically grounded and computationally formalizable path beyond the gene-to-trait paradigm. They also call for a revision of intra- and interdisciplinary boundaries, as well as a reestablishment of the boundaries between science and philosophy. Origins research emerges as the ultimate foundation for the Biology of the 21st century: understanding how life's components persist in intricate connections begins at the root.

Joana C. Xavier is a Bioengineer, Computational Biologist, Philosopher of Science, and Entrepreneur whose research explores the origins of life, agency and feelings, with a focus on metabolism, autocatalysis, and the relational dynamics of evolution. Her work bridges prebiotic chemistry, computational biology, and advanced bioengineering with philosophical approaches to causation in living systems. Xavier has held research positions at Imperial College London, University College London, EMBL, and the University of Düsseldorf. She has received research support from the Portuguese Foundation for Science and Technology (FCT), Argonne National Laboratory, and EMBL, and was awarded a prestigious UKRI Future Leaders Fellowship, which she declined. She is a co-founder and former executive board member of the Origins of Life Early-career Network (OoLEN), where she helped shape interdisciplinary collaboration across the field. Her recent publications include papers on autocatalytic networks and reaction networks; Wilhelm Ostwald; and the origin of life. She is currently pursuing independent research and entrepreneurship, integrating computational modelling with modern bioengineering and philosophical analysis — from prokaryotes, to dogs, to us.

13hr00 lunch

THEME: Paradigms and Narratives of Evolution

14hr30

Nathalie Gontier (Onsite)

From the Flower of Evolution to the 7E Cognition Approach for Understanding Symbolic Evolution

The biological sciences evolved along seven leading research schools, each studying different aspects of the evolution process. The school of Darwinism introduced natural selection theory; the Modern Synthesis combined selection theory with drift and population genetics; Microevolution examines molecular structures; Mesoevolution takes an organism-centred approach; Macroevolution studies how species and higher groups evolve over deep time; Ecology researches organism-environmental relationships; and Reticulate evolution investigates community interactions. I depict these schools as a large hexagonal structure that I call the Flower of Evolution. The Flower of Evolution is as valuable an educational tool for what it incorporates into these evolutionary epistemological frameworks as for what it leaves out. The symbolic sciences are one such example. The symbolic sciences study behaviour, cognition, communication, sociocultural, economic and political lifeways, and technological innovations. While attempts have been made to integrate such research within the various evolution schools, research on symbolism has often remained confined to traditional cognitive and behavioural fields that primarily focus on how humans and, to some extent, other animals manipulate signs, symbols, and information. The cognitive study of these phenomena gave way to the 4E cognition approach, which recognizes cognition as embodied in the organism, embedded in sociocultural lifeways, enacted by agential individuals, and extended into material artifacts. I will demonstrate that this approach finally allows for an evolutionary perspective on symbolism. 4E cognition theory can be extended to what I call a 7E cognition framework, which additionally recognizes cognition as Evolved, mostly Extra-genetically, by Ensembles of individuals. A 7E approach to symbolic evolution requires an eco-evo-devo and reticulate, as well as a hierarchically interactive understanding of how not just individuals but entire communities bring forth symbolic lifeways that in turn shape biorealities; the life-based and lived actualities that define a community's past, current, and future worlds.

Nathalie Gontier is a Philosopher, Anthropologist, Science Educator, and Academic Editor. Her expertise lies in the philosophy of the evolutionary sciences, where she investigates how evolutionary theories impact worldview formation; how evolutionary theories develop in biology; how they are applied to study symbolic evolution; and how biological and symbolic evolution are depicted in diagrams and cosmographies such as cycles, chains, scales, timelines, trees, and networks. She has organized numerous conferences and symposia on these topics for, among others, the American Association for the Advancement of Science, the American Anthropological Association, the International Symbiosis Society, the Portuguese Calouste Gulbenkian Foundation, and the Society for the History, Philosophy, and Social Studies of Biology. Her work has been presented at the Linnaean Society, the UNESCO-patronaged Ontology conference, Euraxess, and various Natural History Museums, amongst others. Gontier is Editor-in-Chief of the Springer Nature Book Series Interdisciplinary Evolution Research; Editor of the Elsevier Journal BioSystems; Associate Editor of the Springer Nature Journal Evolutionary Biology; and Advisory Board Member of the Intellect Books Journal Empedocles. Recent publications include the Oxford Handbook of Human Symbolic Evolution, special issues on topics such as Evolutionary Epistemology and Combinatoriality and Compositionality in Apes, Hominins, Humans, and Birds, as well as encyclopedia entries on 7E Cognition, Language Research, and the history of Symbiosis and Symbiogenesis research.

15hr45 break
16hr15- 18hr15

Johann Peter Gogarten (Online)

Reticulate Evolution and the Units and Levels of Selection and Evolution

Organisms do not live in isolation, rather they closely interact with other organisms, including symbionts (parasites, mutualists and commensals). Selection can act on multiple levels: genes, individuals, groups of organisms, and holobionts (i.e. a eukaryotic host and all its microbial symbionts). Selection at the gene level occurs in two flavours: (1) Selfish genetic elements or molecular parasites, which can be parts of genes as in the case of introns and inteins, that propagate in genomes of infected organisms. At least initially these molecular parasites do not increase the fitness of the infected organism or virus. (2) Genes that are adapted to a particular ecological niche, and through gene sharing can help newcomers to survive in the new environment. Selection at the group level includes Pyotr Kropotkin's Mutual Aid, but also biofilms and microbials communities. Members of microbial communities formed by members of the same species or by different species often engage in a division of labour that results in mutual interdependence as described in the different versions of the Black Queen hypothesis. In addition to natural selection favouring units that create more offspring or are more persistent, evolution also occurs through constructive neutral evolution (CNE). Due to the transfer of genetic information, the phylogeny of genomes is embedded in a web formed by transfers of genes and parts of genes. Some hold out hope that the main strands in the genes' histories reflect the tree of cells. However, highways of gene sharing, bias in gene transfer, frequent within-gene recombination events, and transfers from now extinct or unsampled lineages make inferring the tree of cells a problematic enterprise. Phylogenetic reconstruction is further complicated by artifacts due to high substitution rates and compositional bias. Nevertheless, the study of molecules' evolutionary histories provides insights into early evolution, dating back to the time before the Last Universal Common Ancestor, the origin of molecular innovations, and the contributions of molecular parasites to shaping the web of life.

Johann Peter Gogarten is a Geneticist who studies molecular evolution, with expertise in the early evolution of life, ancient gene duplications, horizontal gene transfer, and molecular parasites. He is Distinguished Professor of Molecular and Cell Biology and a member of the Institute for Systems Genomics at the University of Connecticut, USA. The National Science Foundation has funded his research, as well as NASA's Exobiology/Astrobiology Program and the US-Israel Binational Science Foundation. Gogarten was one of the pioneers recognizing the importance of horizontal gene transfer in microbial evolution. Dubbed one of the four horsemen of the gene transfer apocalypse, his ideas on exchange groups and pan-genomes as a shared genetic resource full have dramatically changed the understanding of microbial evolution and of approaches to reconstruct evolutionary history. He is best known for rooting the tree of life using an ancient gene duplication in ATPases/ATPsynthases that predated the divergence of the three cellular domains. Using this information, he inferred properties of the last universal common ancestor, and suggested correlations between molecular phylogenies and Earth's early history. His recent work focusses on inteins, aka self-splicing protein introns. These are selfish genetic elements that often harbour a homing endonuclease domain, which allows for the invasion of previously uninvaded homologs. These molecular parasites provide a means to trace gene flow, and they illustrate that the apparent result of group selection (increased recombination rate) may often be better explained using a gene-centred view of evolution. The Gogarten lab recently discovered an intein-based gene drive in phages, which leads to rapid invasion of local phage populations. More of his works are available here.

Laura Nuño de la Rosa (Onsite)

Reproduction and Evolvability

Although heredity has long been central to evolutionary theory, reproduction itself—understood as the material process by which new organisms are generated from organisms of the same kind—has often been reduced to genetic transmission and framed as a strategy for maximizing fitness. This gene-centred, adaptationist view overlooks the complex relational and material dimensions of reproduction, a limitation also present in much of evolutionary development studies or evo-devo, which has historically focused on internal embryological processes generating morphological characters. In contrast, recent work in evo-devo enables us to theorize reproductive characters—such as gametes, gonads, courtship, incubation, and nourishment—as well as reproductive modes (e.g., oviparity, internal fertilization, matrotrophy) — in relational and developmental terms that account for diversity across lineages. In this conference, I explore how considering inter-organismal reproductive relations—between parents and between parents and offspring—offers a new perspective on evolvability. Rather than viewing reproduction merely as a vehicle for heredity or fitness optimization, I argue that it should be seen as the material link between generations, regulating plastic interactions with the environment and shaping the evolutionary potential of different lineages through constraints and affordances embedded in reproductive modes.

Laura Nuño de la Rosa is a Philosopher of Science whose research spans the History and Philosophy of Biology and the general Philosophy of Science. While she has worked on Aristotle's biology and the legacy of morphological thought, her main focus is the recent history of evolutionary biology, particularly evo-devo and evolvability. She combines bibliometric analysis and oral history to reconstruct scientific practice and applies conceptual tools from cultural evolution to interpret its dynamics. Her philosophical work explores dispositions and propensities in evolutionary explanation, the role of imaging in developmental biology, and teleological and agential reasoning in evolution. More recently, her research has turned to reproduction, both as a theoretical contribution to evolutionary understanding and as a feminist critique of scientific representations of female sexuality. Her broader interests include theory integration, interdisciplinarity, values in science, new materialism, and scientific realism. She has been an Assistant Professor at the Complutense University of Madrid and has recently joined the Spanish National Research Council (CSIC) as a Tenured Scientist. She has held a Juan de la Cierva Fellowship, is External Faculty at the KLI Institute, and serves on the editorial board of the Journal of Experimental Zoology Part B. She co-coordinates the Philosophy of Biology group BioKoinos. She leads the project Metaphysics of Biology (2022–2026), funded by the Spanish Ministry of Science and Innovation, and has recently coordinated two thematic clusters within the Evolvability project (2019–2020) and the Templeton-funded Agency, Directionality, and Function project (2021–2024). Recent publications include works on Pere Alberch; The evolution of reproductive characters; Agency in reproduction; The female orgasm; and A mapping of evolvability research.

Athena Aktipis

Cooperation from Cells to Societies

Abstract: Cooperation and conflict have shaped the evolution of life in fundamental ways, from the very cells in our bodies to the ways that humans

work together in large-scale societies. Across these diverse systems, cooperation is underlain by a set of shared principles. In this talk I will give an overview of those principles of cooperation science and how they apply across disciplines. I will explain how large multicellular bodies can maintain cooperation among trillions of cells despite the constant risk of cellular cheating in the form of cancer. In both human and cellular societies, cooperation at higher levels of organization is vulnerable to exploitation by lower levels, whether by cheaters in human societies or cancer cells in multicellular organisms. Stability depends on the strength of selection at the higher level outweighing the pressures at the lower level. For systems like multicellular life and human societies to be viable, the forces driving cooperation must outweigh those promoting exploitation. I will conclude by discussing how these principles can inform our relationships with emerging technologies, including AI, and how understanding cooperation as a cross-cutting evolutionary process can help us build more resilient, adaptive, and equitable systems as we navigate an increasingly uncertain future.

Athena Aktipis is an Associate Professor in the Department of Psychology at Arizona State University. She is a cooperation theorist, evolutionary biologist, and cancer biologist who researches cooperation in humans, particularly in times of need, as well as other systems that are governed by fundamental tensions between cooperation and conflict. She is co-Director of The Human Generosity Project and The Cooperation Science Network. Aktipis is the President and co-Founder of the International Society for Evolution Ecology and Cancer and also the founder and President of Zombified Media. Aktipis is an avid science communicator, hosting the science podcast, Zombified, and producing events across the country and internationally at Universities, community spaces, and music festivals. She is the author of *The Cheating Cell: How evolution helps us understand and treat cancer* (Princeton University Press, 2020), and is currently on tour for her second book, *A Field Guide to the Apocalypse: A mostly serious guide to surviving our wild times* (Workman, 2024). Aktipis also writes for Scientific American, Slate, Aeon, and other magazines. Her forthcoming book, *Hijacked: The New Science of Neural Manipulation and What It Means for Our Health, Happiness and Sense of Self* (Princeton, 2026), leverages the science of cooperation and conflict for understanding the shared mechanisms underlying influence, from parasites to social media.

On Thursday evening, there will be a Recital by Denis Noble and the Oxford Trobadors, starting at 21h.

Download the Programme for January 7th

Download the Programme for January 8th

Download the Programme for January 9th