

# ORIGINS SCIENCES PROGRAM

217 Rockefeller, Institute for the Science of Origins

<http://origins.case.edu/major/>

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The Origins Sciences Program offers the Bachelor of Arts degree. The major provides a rigorous course of study with great flexibility in the choice of specific topics and courses. Students play a creative role in designing their own individual educational plans within the major. As a result, they are free to explore nontraditional, multidisciplinary and transdisciplinary subjects.

The Origins Sciences major is designed to connect students with professors breaking through barriers to ask big questions in ways that matter, both at the highest theoretical levels and also with immediate practical applications in areas such as medicine and technology. Its concerns range from the nanoscale to ecological relationships to galaxies to dark matter, dark energy and the nature of the universe itself. The major's sponsor, the Institute for the Science of Origins (<http://origins.case.edu>) (ISO), brings together scientists from Case Western Reserve University, (<http://www.case.edu>) the Cleveland Museum of Natural History (<https://www.cmnh.org>) and other partner institutions to answer questions about the origin and evolution of simple and complex systems, from the big bang to the human mind.

The curriculum emphasizes a broad grounding in the origins sciences, including fundamentals of physics, biology, chemistry and mathematics, and encompassing aspects of anthropology, cognitive science, astronomy and earth, environmental and planetary sciences, making it reasonable for students to consider a double or secondary major or a dual degree. A faculty actively engaged in research in these fields and beyond provides first-rate instruction and opportunities for undergraduate involvement in cutting-edge research, including laboratory and museum experience and fieldwork across the globe.

An undergraduate degree in Origins Sciences can be tailored to meet the needs of pre-med or other pre-health students, or to prepare students for graduate programs in any of the allied disciplines, including anthropology, astronomy, biology, chemistry, cognitive science, geosciences, applied mathematics, paleontology and physics.

Majoring in Origins Sciences gives students added value in applying to medical school, graduate school or the increasingly technical science-related MBA and JD programs. The major also provides a strong background for students interested in pursuing careers in science writing; internships are available at ideastream, ISO's public TV and radio partner institution.

## Program Faculty

Patricia Princehouse, PhD

*Senior Research Associate, Department of History; Director, Origins Sciences Program; Director, Program in Evolutionary Biology; Outreach Director, Institute for the Science of Origins*

Glenn Starkman, PhD

*Distinguished University Professor, Department of Physics; Director, Institute for the Science of Origins; Director, Center for Education and Research in Cosmology and Astrophysics (CERCA)*

Cynthia Beall, PhD

*Distinguished University Professor and Sarah Idell Pyle Professor of Anthropology; Co-Director, Center for Research on Tibet*

Daniela Calvetti, PhD

*James Wood Williamson Professor, Department of Mathematics, Applied Mathematics, and Statistics*

Darin Croft, PhD

*Associate Professor, Department of Anatomy, School of Medicine*

Christopher A. Cullis, PhD

*Francis Hobart Herrick Professor of Biology*

Michael Decker, PhD

*Associate Professor, Frances Payne Bolton School of Nursing*

Neil S. Greenspan, MD PhD

*Professor, Department of Pathology, School of Medicine*

Mark Griswold, PhD

*Professor, School of Medicine*

Yohannes Haile-Selassie, PhD

*Curator and Head of Physical Anthropology, Cleveland Museum of Natural History*

Ralph Harvey, PhD

*Professor, Department of Earth, Environmental, and Planetary Sciences*

Joseph LaManna, PhD

*Jeanne M. and Joseph S. Silber Professor, Department of Physiology and Biophysics, School of Medicine*

Harsh Mathur, PhD

*Professor, Department of Physics*

J. Christopher Mihos, PhD

*Professor, Department of Astronomy*

John E. Ruhl, PhD

*Connecticut Professor, Department of Physics*

Scott W. Simpson, PhD

*Professor, Department of Anatomy, School of Medicine*

Erkki Somersalo, PhD

*Professor, Department of Mathematics, Applied Mathematics, and Statistics*

Giuseppe Strangi, PhD

*Professor and Ohio Research Scholar in Surfaces of Advanced Materials, Department of Physics*

Kingman P. Strohl, MD

*Professor, School of Medicine*

Wanda Strychalski, PhD

*Assistant Professor, Department of Mathematics, Applied Mathematics, and Statistics*

James Van Orman, PhD

*Professor and Chair, Department of Earth, Environmental, and Planetary Sciences*

Mark A. Willis, PhD

*Professor and Chair, Department of Biology*

## Major

Origins Sciences is a primary major, but may also be pursued in conjunction with a more traditional disciplinary major. Up to 12 credits in required and elective courses taken by students for their other major may be applied to their Origins Sciences major.

The 30-credit interdisciplinary major in Origins Sciences consists of:

1. Science Core
2. Origins Core
3. Origins Foci

Within the Origins foci, each student will design a curriculum that includes concentrations in at least two Origins Sciences fields, such as:

- Cosmology and astrophysics
- Integrative evolutionary biology (e.g., biochemistry, physical anthropology, paleontology, and evolutionary cognitive science)
- Planetary science and astrobiology

In consultation with a major advisor, students create their individual plans of study to suit their own particular interests within the major. A typical student will develop a proposal as a sophomore and submit that plan for approval by the Origins Sciences Major Advisory Committee. Each concentration must include at least two 300 or higher level classes and their prerequisites. Subsequent revisions to the plan are encouraged when appropriate, but must be submitted for approval by the committee at least two weeks before the beginning of the semester preceding the one in which the revisions take effect. Students are strongly encouraged to include an Origins Sciences research experience in their educational plans.

### Science Core:

BIOL 214	Genes, Evolution and Ecology	3
BIOL 214L	Genes, Evolution and Ecology Lab	1
BIOL 225	Evolution	3
CHEM 105	Principles of Chemistry I	3
CHEM 106	Principles of Chemistry II	3
MATH 121	Calculus for Science and Engineering I	4
or MATH 125	Math and Calculus Applications for Life, Managerial, and Social Sci I	
MATH 122	Calculus for Science and Engineering II	4
or MATH 126	Math and Calculus Applications for Life, Managerial, and Social Sci II	
PHYS 121	General Physics I - Mechanics	4
or PHYS 123	Physics and Frontiers I - Mechanics	
PHYS 122	General Physics II - Electricity and Magnetism	4
or PHYS 124	Physics and Frontiers II - Electricity and Magnetism	

### Origins Core:

ORIG 101	Origins Prologue: Life, the Universe, and Everything (Optional)	1
ORIG 201	Origins I: From the Beginning	3
ORIG 202	Origins II: Life in all its diversity	3

ORIG 301	Mathematical Modeling Across the Sciences	3
ORIG 351	Topics in Origins (Must be taken twice)	3

## Sample First Year Schedule

	Units	
	Fall	Spring
<b>Freshman</b>		
Origins Prologue: Life, the Universe, and Everything (ORIG 101) (or ORIG 202)	1	
Calculus for Science and Engineering I (MATH 121) (or MATH 125)	4	
General Physics I - Mechanics (PHYS 121) (or PHYS 123 or BIOL 214 or CHEM 105)	4	
Humanities Elective	3	
SAGES First Seminar	3	
PHED Elective	0	
Origins I: From the Beginning (ORIG 201) or The Earth and Planets (EEPS 101)		3
Calculus for Science and Engineering II (MATH 122) or Math and Calculus Applications for Life, Managerial, and Social Sci II (MATH 126)		4
Genes, Evolution and Ecology (BIOL 214) or General Physics I - Mechanics (PHYS 121) or Physics and Frontiers I - Mechanics (PHYS 123) or Evolution (BIOL 225)		3-4
Humanities or Global/Cultural Elective		3
SAGES University Seminar		4
PHED Elective		0
Year Total:	15	17-18
Total Units in Sequence:		32-33

## Courses

### ORIG 101. Origins Prologue: Life, the Universe, and Everything. 1 Unit.

This one-credit course introduces students to the research interests of Origins faculty, and thereby to some of the possibilities for student research or focused study. Topics range across cosmology, astronomy, planetary sciences, astrobiology, evolutionary biology, evolutionary cognitive science, anthropology, and evolutionary medicine.

### ORIG 201. Origins I: From the Beginning. 3 Units.

A three credit quantitative introduction to cosmology, astrophysics, planetary science and geology in which they are connected through the narrative of origins setting the stage for the development of life on Earth. Prereq: PHYS 121 or PHYS 123.

### ORIG 202. Origins II: Life in all its diversity. 3 Units.

An integrated introduction to the origins sciences including aspects of evolutionary biology, ecology, paleontology, physical anthropology and cognitive science. The course will generally meet at the Cleveland Museum of Natural History. Prereq: BIOL 214.

**ORIG 301. Mathematical Modeling Across the Sciences. 3 Units.**

A three credit course on mathematical modeling as it applies to the origins sciences. Students gain practical experience in a wide range of techniques for modeling research questions in cosmology and astrophysics, integrative evolutionary biology (including physical anthropology, ecology, paleontology, and evolutionary cognitive science), and planetary science and astrobiology. Offered as ORIG 301, ORIG 401 and MATH 357. Prereq: ORIG 201, ORIG 202, BIOL 225, MATH 122, CHEM 106 and (PHYS 122 or PHYS 124).

**ORIG 351. Topics in Origins. 3 Units.**

A three-credit special topics course in any Origins discipline or interdisciplinary combination. Instruction may take place on campus or at partner institutions such as the Cleveland Museum of Natural History, and may at times include fieldwork. Offered as ORIG 351 and ORIG 451. Prereq: ORIG 201, ORIG 202, ORIG 301.

**ORIG 360. Independent Study in Origins. 1 - 3 Units.**

A 1-3 credit offering available on an ad hoc basis to students wishing to pursue in depth study in an appropriate origins topic under the supervision of a willing faculty member. Prereq: ORIG 201, ORIG 202.

**ORIG 370. Research in Origins. 1 - 6 Units.**

A 1-6 credit offering available on an ad hoc basis to students wishing to pursue independent research in an origins topic under the supervision of a willing faculty member. Offered as ORIG 370 and ORIG 470. Prereq: ORIG 201, ORIG 202, ORIG 301.

**ORIG 401. Mathematical Modeling Across the Sciences. 3 Units.**

A three credit course on mathematical modeling as it applies to the origins sciences. Students gain practical experience in a wide range of techniques for modeling research questions in cosmology and astrophysics, integrative evolutionary biology (including physical anthropology, ecology, paleontology, and evolutionary cognitive science), and planetary science and astrobiology. Offered as ORIG 301, ORIG 401 and MATH 357. Prereq: ORIG 201, ORIG 202, BIOL 225, MATH 122, CHEM 106 and (PHYS 122 or PHYS 124).

**ORIG 451. Topics in Origins. 3 Units.**

A three-credit special topics course in any Origins discipline or interdisciplinary combination. Instruction may take place on campus or at partner institutions such as the Cleveland Museum of Natural History, and may at times include fieldwork. Offered as ORIG 351 and ORIG 451. Prereq: ORIG 201, ORIG 202, ORIG 301.

**ORIG 470. Research in Origins. 1 - 6 Units.**

A 1-6 credit offering available on an ad hoc basis to students wishing to pursue independent research in an origins topic under the supervision of a willing faculty member. Offered as ORIG 370 and ORIG 470. Prereq: ORIG 201, ORIG 202, ORIG 301.

**ORIG 485. Comparative & Evolutionary Physiology. 4 Units.**

This course presents physiological concepts from the comparative and evolutionary perspective. Aspects of vertebrate and mammalian evolution will be considered with respect to the generation of adaptive advantages for organisms to changing environmental challenges since the Cambrian. Comparative physiological concepts include scaling, variations in nutrition, energy metabolism and work efficiency. The important influences of time, temperature, water and energy on mammalian biology will be presented. The course is a lecture based course that can be taken in person or on-line. Evaluations will be by regular quizzes, a mid-term and a final exam, all MCQ. Offered as PHOL 485 and ORIG 485.