

## *Careers that make a world of difference*



**We invite you to explore the  
Department of Earth & Planetary Sciences.**

**For more information:  
[EPS.rutgers.edu](http://EPS.rutgers.edu)**

# Thinking of becoming a major in **Earth & Planetary Sciences?**

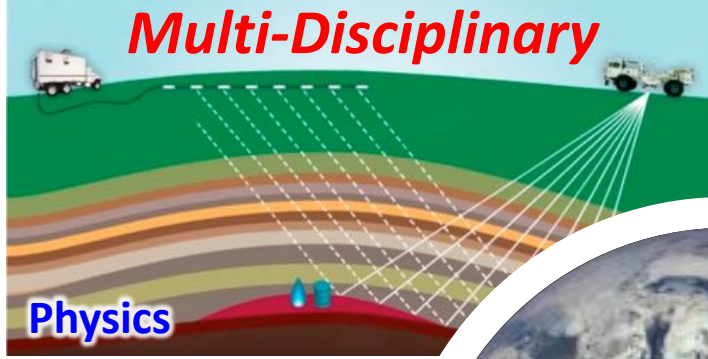
*You can...*

1. Be a physicist, chemist, biologist, mathematician, computer scientist, and historian all at once
2. Help save lives by understanding how the Earth works
3. Help reduce the impact of humans on the environment
4. Help find the resources that society needs
5. Understand how the Solar System, Earth, and life formed
6. Secure a meaningful and well-paid job
7. Choose from 4 programs / career paths
8. Join a tight-knit community

In this short presentation, we invite you to consider becoming a major or minor in Earth and Planetary Sciences. This slides lists some of the reasons why EPS could be a good fit for you.



# Multi-Disciplinary



$$\begin{bmatrix} D_{11} & D_{12} \\ D_{21} & D_{22} \end{bmatrix} \begin{bmatrix} x \\ y \end{bmatrix} = \begin{bmatrix} D_{11}x + D_{12}y \\ D_{21}x + D_{22}y \end{bmatrix}$$

Matrix-matrix multiplication:

$$\begin{bmatrix} D_{11} & D_{12} \\ D_{21} & D_{22} \end{bmatrix} \begin{bmatrix} d_{11} & d_{12} \\ d_{21} & d_{22} \end{bmatrix} = \begin{bmatrix} D_{11}d_{11} + D_{12}d_{21} & D_{11}d_{12} + D_{12}d_{22} \\ D_{21}d_{11} + D_{22}d_{21} & D_{21}d_{12} + D_{22}d_{22} \end{bmatrix}$$

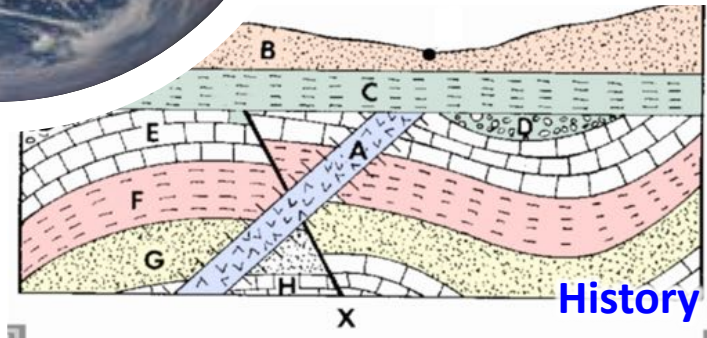
Transposition, meaning shifting of columns and rows:

$$\begin{bmatrix} D_{11} & D_{12} \\ D_{21} & D_{22} \end{bmatrix}^T = \begin{bmatrix} D_{11} & D_{21} \\ D_{12} & D_{22} \end{bmatrix}$$

The inverse of a matrix  $\mathbf{D}$  is denoted  $\mathbf{D}^{-1}$  and is the matrix multiplied by  $\mathbf{D}$ :

$$\begin{bmatrix} D_{11} & D_{12} \\ D_{21} & D_{22} \end{bmatrix}^{-1} \begin{bmatrix} D_{11} & D_{12} \\ D_{21} & D_{22} \end{bmatrix} = \begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \mathbf{I}$$

**Mathematics**



You can be a physicist, chemist, biologist, mathematician, computer scientist, and historian all at once and, thereby, practice one of the few truly inter-disciplinary sciences. Not only do you learn how to understand questions and answers from a multidisciplinary perspective, but you also have the opportunity for an impactful career.

*Clockwise from top left:* Seismic-reflection profiling helps us see inside the Earth; conducting geochemical analyses to learn the composition of rocks; computer modeling allows us to understand how certain parameters influence physical processes; reading a geologic cross sections allows us to determine the geologic history represented by the rocks and structures; paleobiologists use fossils to unravel the tree of life; linear algebra used to study deformation and strain.

# ***Geo-hazards***

***You can help save lives***

***Earthquakes***



***Floods***



***Volcanic eruptions***



***Landslides***



Geo-hazards kill people and destroy communities – and understanding how they happen can help reduce the damage. Earth science builds the intellectual structure to predict and avoid damage, suffering and loss of lives and livelihoods. A more earth-science literate public and legislature can make wiser decisions on where to live and invest.

<https://www.sciencemag.org/news/2015/04/smart-phones-could-be-used-to-detect-earthquakes>

<https://www.nytimes.com/2015/01/06/science/predicting-what-a-volcano-may-or-may-not-do-is-as-tricky-as-it-is-crucial-as-iceland-well-knows.html>

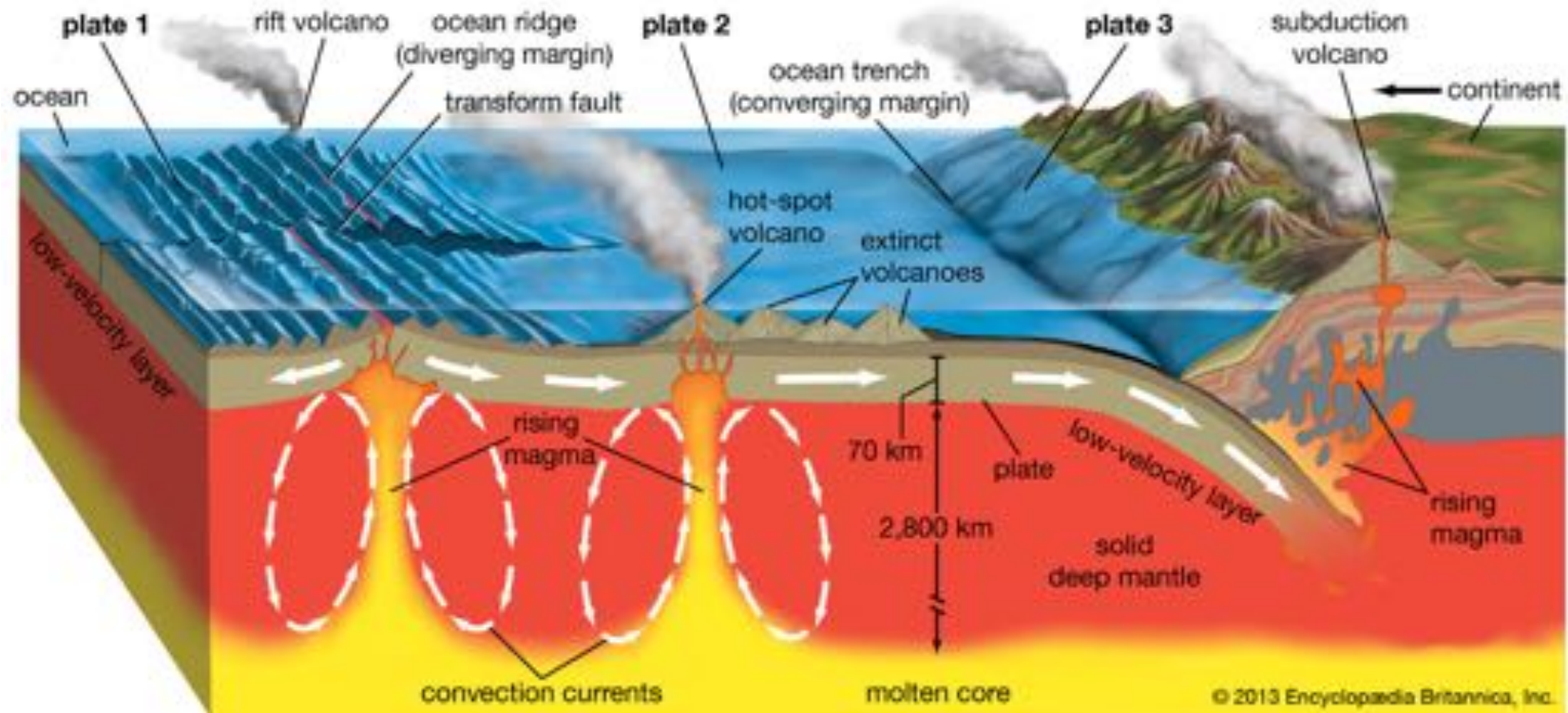


# Geo-hazards

*You can help save lives...*

*...by understanding how the Earth works*

Plate tectonics helps us understand why earthquakes occur where they do and why some volcanoes are more dangerous than others.



# ***Balancing nature & humanity***

***You can help reduce the impact of humans on the environment***



Earth's population is increasing, and humanity is consuming more resources. But the Earth has limited carrying capacity. What can humanity do? By knowing where our planet came from – how it evolved to the conditions we see today, we will have a better idea where it is heading, and how we can steer its future. We need dedicated people to transform the way we work with nature.

# Geo-resources

*You can help find the raw materials that society needs*



You cannot go one day without using a resource derived from the Earth.

Upper right image: Clockwise from upper left: gold, coal, copper, diamonds.



Lower row, from left: Studying cores to determine the extent of an ore body; oil-well grasshopper pump; elements needed in the manufacture of a smart phone.



# *Understand how the solar system, Earth, and life formed*



Our discipline explores how our solar system, Earth and life, and other planets and moons formed, pushing the boundary of our knowledge of the cosmos.

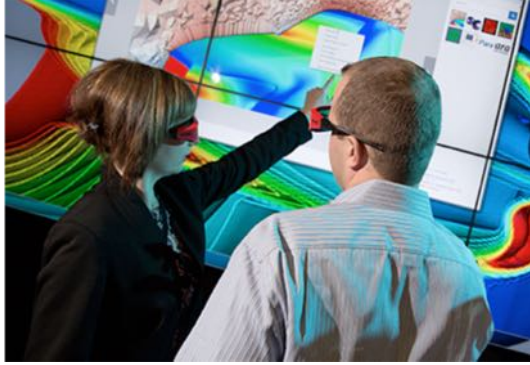
Note: 3 planet cluster is Earth, Moon and Mars. Two surface images are of Moon (Chang'e 4 mission) and Mars (rover) This shows that we can go to other bodies in the Solar System and explore!

Image credits are:  
<https://www.nasaspacesflight.com/2019/01/china-returning-moon-change-4-mission/> ;  
<https://serc.carleton.edu/details/images/928.html> ; NASA; ALMA



# *The world needs Earth scientists*

## *You can secure meaningful employment*

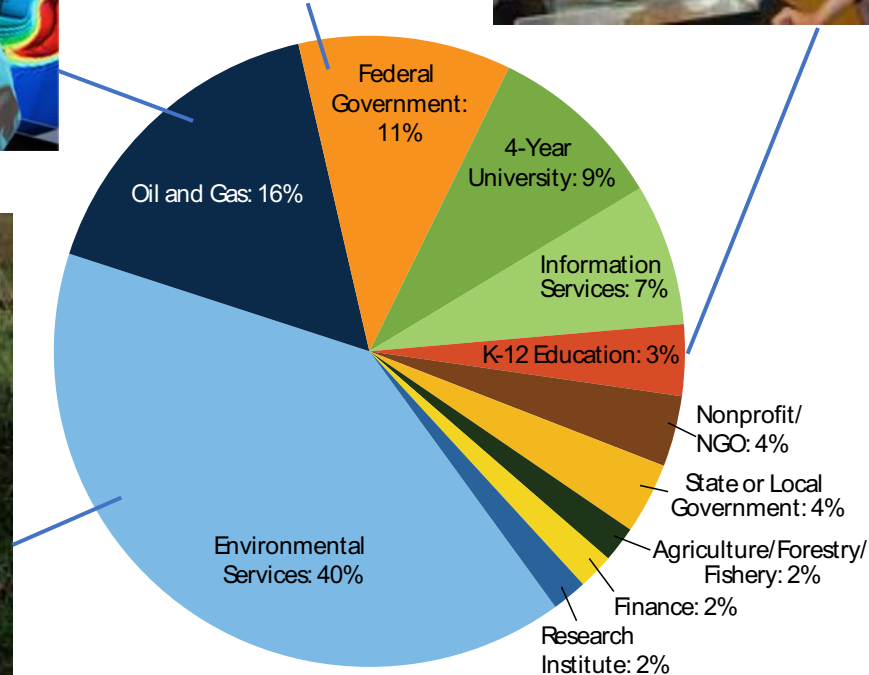


United States Geological Survey



Our graduates are sought after and have good jobs – here is a recent national breakdown. Most Earth scientists work in the environmental service, followed by oil & gas, followed by the federal government.

Source: American Geological Institute



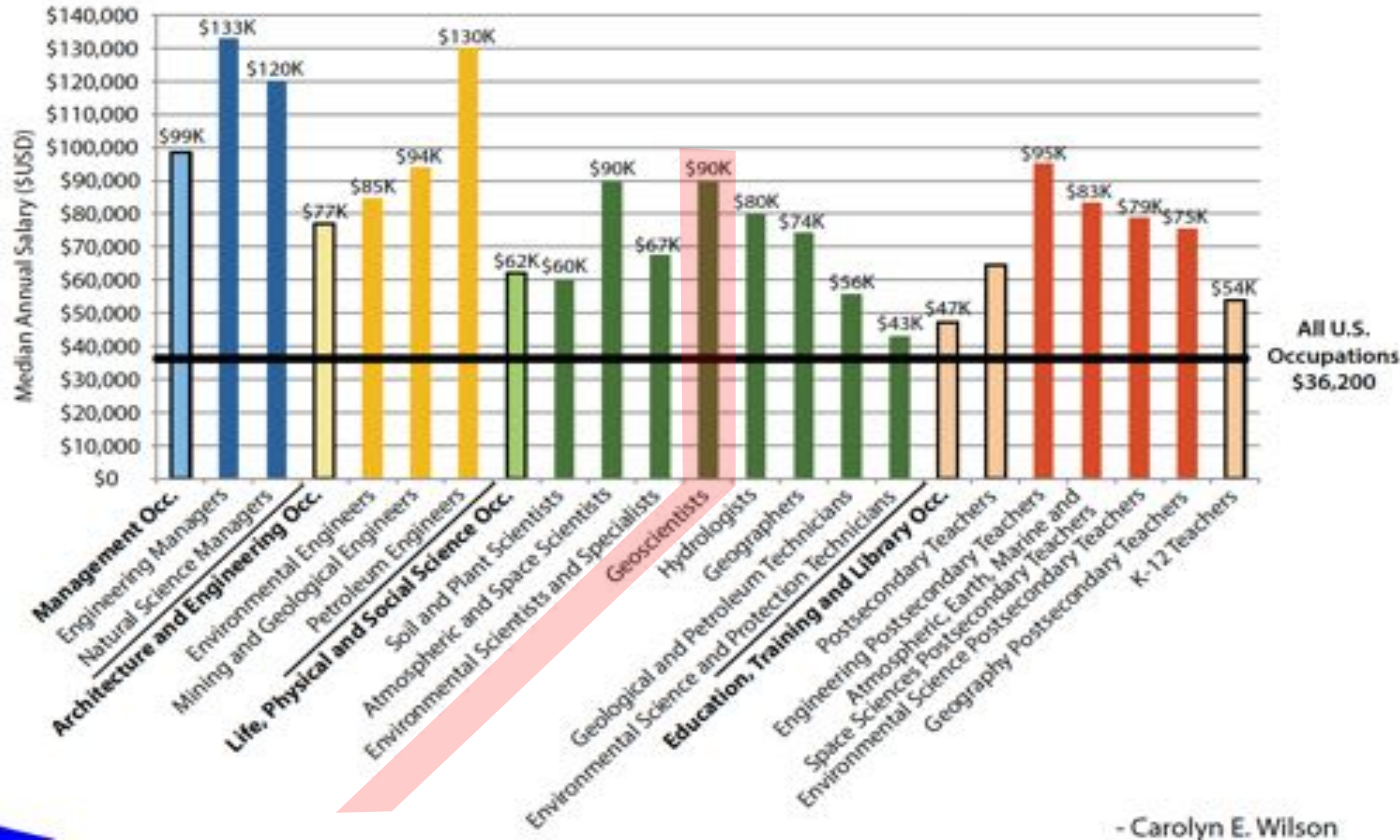
# ***The world needs Earth scientists***

***You can secure meaningful, well-paid employment***

Median salaries for geoscientists is \$90k (\$90,000). Starting salaries are around \$50,000.

Source: American Geological Institute

**2015 Median Annual Salaries for Geoscience-Related Occupations**





# ***You can choose from 4 programs / career paths***

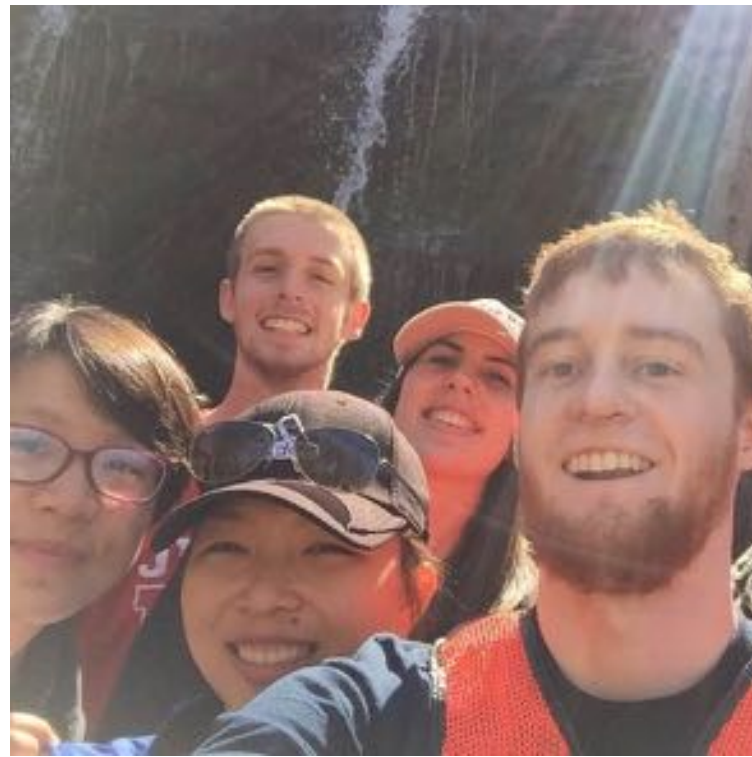
**Geological Sciences:** For students who expect to make geology an important component of their career, e.g. in engineering / environmental consulting, oil & gas & mineral exploration and mining, and federal and state government; grad school.

**Environmental Geology:** For students who plan to work in environmental sector (largest employer of geoscientists in the U.S.), with focus on characterizing modern shallow subsurface environment; grad school.

## **Planetary Science:**

For students who wish to pursue a research career in planetary science, e.g. in universities, research institutions and museums; for math, physics, chemistry, biology transfer students.

**Liberal Arts / General:** For students with interests in Earth and planetary sciences but who plan for careers in science education/communication and journalism, medicine, environmental law and policy, and business, etc.



We have a diversity of students and a diversity of programs. You can choose one that best matches your interests and career objectives. Many options share the same course requirements, so you can transfer from one option to another.

# You can choose from 4 major programs / career paths

We tailor our programs to your interests and strengths, and offer 4 options:

**Geological Sciences Option**  
B.S., 62 credits

**Environmental Geology Option**  
B.S., 63 credits

**Planetary Science Option**  
B.S., 63 credits

**Liberal Arts / General Option**  
B.A., 40 credits

Course requirements for the major options are at right. The table is arranged to emphasize common elements. Students can move relatively easily from one option to another.

	Geological Sciences Option		Environmental Geology Option		Planetary Science Option		General Option	
Cognate Courses	Calc 1 & (Calc 2 or Stats)	8	Calculus 1 & 2	8	Calc 1&2 & (Calc 3 or Stats)	12	Calculus 1	4
	General Chemistry 1	4	General Chemistry 1	4	General Chemistry 1 & 2	8	General Chem. 1	4
	General Physics 1	3	General Physics 1	3	General Physics 1, 2	6	---	---
	Subtotal: 15		Subtotal: 15		Subtotal: 26		Subtotal: 8	
EPS Core Courses	Intro Geology or equiv.	4	Intro Geology or equiv.	4	Intro Geology or equiv.	4	Intro Geology or equiv.	4
	Mineralogy	4	Mineralogy	4	Mineralogy	4	Mineralogy	4
	Petrology	4	Petrology	4	Petrology	4	Petrology	4
	Geochemistry	4	Environ. Geochem.	3	Geochemistry	4	---	---
	Major Events in Earth History	3	---	---	Major Events in Earth History	3	---	---
	Sedimentary Geology	4	Sedimentary Geology	4	---	---	Sedimentary Geology	4
	Paleontology	4	---	---	---	---	Paleontology	4
	Structural Geology	4	Structural Geology	4	---	---	Structural Geology	4
	Geophysics	4	Geophysics	4	---	---	---	---
	Field Geology	3	Field Geology	3	---	---	Field Methods	2
	---	Environmental Geology		3	---	---	---	
	---	Hydrogeology		3	---	---	---	
	---	---	---	Planet Mars / Moons & Planets	3	---	---	
	---	---	---	Structure & Formation of Terrestrial Planets	3	---	---	
	Subtotal: 38		Subtotal: 36		Subtotal: 25		Subtotal: 26	
Elective Courses	Elective	3	Elective	3	Elective	3	Elective (100 & above)	3
	Elective	3	Elective	3	Elective	3	Elective (300 & above)	3
	Elective	3	Elective	3	Elective	3	---	---
			Elective	3	Elective	3	---	---
	Subtotal 9		Subtotal 12		Subtotal 12		Subtotal 6	
TOTAL CREDITS: 62		TOTAL CREDITS: 63		TOTAL CREDITS: 63		TOTAL CREDITS: 40		



## ***You can choose from 2 minors:***

**Minor in Earth & Planetary Sciences** requires 460:101 Introductory Geology plus five additional EPS courses of 3 credits or more, of which at least 2 must be at the 300 level or higher.

**Minor in Astrobiology** requires Astrobiology plus 9 credits from select courses in Earth & Planetary Sciences and 6 credits from courses in Astrophysics, Microbiology, and Evolutionary Biology.

**Astrobiology** is an interdisciplinary scientific field of study that examines the origin of life, the past history of life on Earth, and the possible existence of life on other planets and moons.



For more details:

<https://eps.rutgers.edu/academics/undergraduate-program/minor>

Students who have completed Planet Earth (460:100) prior to declaring a minor in EPS can use 460:100 plus 460:103 instead of 460:101.

Graphic courtesy of NASA

## ***We are a small, tight-knit department***

- 22 professors + ~8 PhD researchers teach >35 courses
- 30 majors + 20 minors result in low student/faculty ratio
- Class size for major courses:  $\leq 20$  students
- Geology Club organizes field trips and career nights



In a huge public school like Rutgers, you can find a small and supportive community in Earth & Planetary Sciences. Our undergraduates have their own study lounge in Wright Labs, where nearly all of our major and elective courses take place.

We often find ourselves in the wilderness, but we work as a team.

Our Geology Club is the cement to build a coherent undergrad community. You can find them in the Undergraduate Study Lounge in Wright Labs.





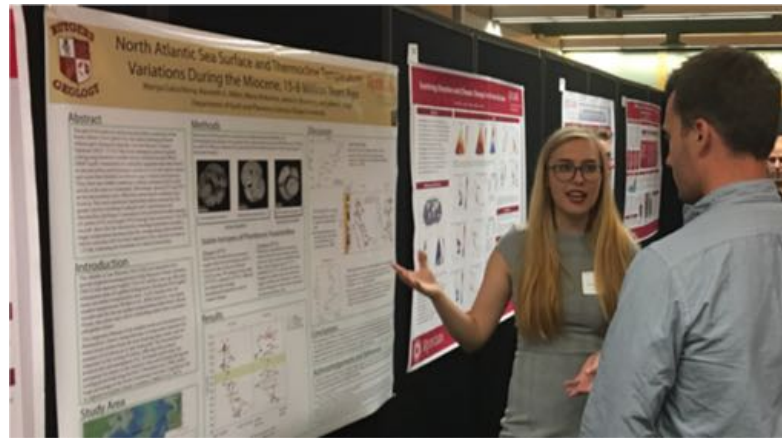
## ***We are a small, tight-knit department***

- Students may apply for funds (donated by alumni) to support research projects
- Some students receive prestigious internships
- Students receive scholarships for geology field camps



We work in small groups in our physical (upper right) and computer labs (lower left).

Our students have received prestigious NASA internships (e.g., Sophie Benaroya, upper left, was involved in a study of Martian soils). Mariya Galochkina, lower right, presents research on what she learned about past climate change from fossils in ocean-bottom muds.



# ***Courses to get you started***

To view course offerings, go to:  
<https://sis.rutgers.edu/soc/#home>

## *Introductory courses:*

- 460:100 Planet Earth (3 cr) for non-majors
- 460:101 Introductory Geology (4 cr): for majors & minors

Select semester; then click on New Brunswick  
& Undergraduate

## *Signature Course:*

- 460:110 Sea Change - Rise & Fall of Sea Level & Jersey Shore

Then select 460: Geological Sciences

## *Survey Courses:*

- 460:201 Earthquake & Volcanoes
- 460:202 Environmental Geology
- 460:203 Building & Maintaining a Habitable Planet
- 460:204 Water Planet
- 460:206 Dinosaurs
- 460:207 Oil & Gold: the Good, the Bad, the Ugly
- 460:212 Earth & Life Through Time
- 460:213 Walk Thru Time: Evolution of Mammals
- 460:222 Planet Mars
- 460:224 Geology of Moons & Planets
- 460:225 Astrobiology



All courses  
listed here  
satisfy the SAS  
Natural Science  
core  
requirement,  
and some also  
satisfy the  
Contemporary  
Challenges  
requirement.

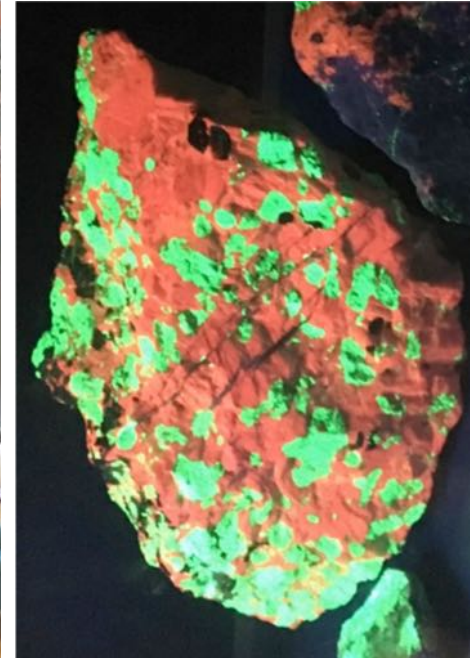
## *How you can find out more*

- *Attend SAS Academic Planning/Advising (APA) Days*
- *Attend SAS Major/Minor Fair*
- *Visit Rutgers Geology Museum*
- *Speak with any faculty member*
- *Attend geology field trip open to students in survey courses*



Our museum is the oldest geology museum in North America!

Right image shows fluorescent minerals from Franklin, NJ, on exhibit at the geology museum.



Left Image shows mastadon skeleton and other exhibits at the Rutgers Geology Museum.



## Why Earth and Planetary Sciences?



The Department of Earth & Planetary Sciences (EPS) explores the past, present and future of the Earth and other planets and moons in our solar system and beyond. Through education and research, we examine Earth and planetary interiors, surface environments, and life through time. The Earth and planetary sciences are interdisciplinary fields that draw on fundamental knowledge in physics, chemistry, biology, and mathematics. Our studies have scientific and societal relevance: global change to the solid Earth and its environment, oceans, climate, and life; natural hazards (earthquakes, volcanic eruptions, tsunamis, floods, and landslides); natural resource exploration and management (hydrocarbons, ore minerals, groundwater); and planetary geology and the search for extraterrestrial life. Several faculty

### Contacts

Departmental Chair  
**Prof. Gregory Mountain**

Undergraduate Director  
**Prof. Roy Schliche**

### Undergraduate

> Why Earth and Planetary Sciences?

**Prospective Students**

Introductory and Survey Courses

Learning Goals

Major

Minor

Courses

Course Schedules

Advising

Honors

### Undergraduate Quicklinks

You can find more information from our undergraduate home page:

<https://eps.rutgers.edu/academics/undergraduate-program/why-earth-and-planetary-sciences>

We also have a page for Prospective students along with detailed descriptions of majors, minors, courses, etc.

## Prospective Students

Meet our EPS Majors and Alumni



Sophie Benaroya



Mariya Galochkina



Peter Graham

Majoring in EPS can take you where you want to go!

Our Department offers both challenging and comprehensive instruction, and students are encouraged to become vital members of this research community. Click on the photographs above to read profiles of current students and alumni.

To find out if a career in the Earth & Planetary Sciences is right for you, download this [brochure](#).



**Ria Sarkar**

“I connected right away with geology,” Sarkar said. “It was that sense of being aware of our natural surroundings and all the issues that are related to that.”  
“It became obvious to me that this would be my major.”

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### Undergraduate Quicklinks

- Academic Calendar
- SAS Academic Services
- SAS Core Curriculum
- University Schedule Of Classes
- Web Registration System

Read about current students and alumni. [Reload](#) the page to see more profiles.

Questions? Send an email to contacts listed in box.

## Earth And Planetary Sciences

Explore the relationships among the solid Earth, hydrosphere, cryosphere, atmosphere, and biosphere

Acquire knowledge about the long history of the Earth and solar system using principles of geology, biology, chemistry, and physics

Participate with faculty in conducting research in the field and/or laboratory

Secure gainful employment with environmental and engineering consulting firms, energy and resource companies, federal and state surveys, and educational institutions and museums.