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# Geology

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## **Professors**

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### **Professors**

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## **Assistant**

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[Print Version of Catalog](#) ■

Department of Geology and Environmental Science

# Mission Statement

Our mission is to serve two vital needs of the JMU students. First, the majors in geology present high-quality programs of specialized study focusing on Earth materials, internal and external Earth processes, analysis of Earth history and application of geology to environmental and engineering issues. In support of this mission is a commitment to foster the ability to think analytically and to communicate both within the discipline and with non-scientists. Course work and research experiences prepare the student for postgraduate study or professional careers that are subject to rapidly changing societal needs. Second, our department strives to enhance the university's general education program by offering timely and challenging courses that provide insight into Earth processes and human-environment interactions. These courses promote life-long liberal learning by fostering critical thinking and an awareness of natural science.

## Goals

Provide a stimulating, intellectual environment for students in geology and environmental science that will generate interest and enthusiasm for learning and will provide a solid foundation for graduate work and careers in geology and environmental science.

Teach science as science is practiced. Since the advancement of scientific knowledge often occurs within a social context – collaboration among scientists, conferences, seminars – the goal is to develop a similar mode of operation for the geology program.

Provide high-quality, relevant general studies courses within the discipline that focus on the fundamental science in the societal context (e.g., environmental change, climate change, hazards). These courses will incorporate critical thinking and an appreciation of human-environment interactions.

## **Career Opportunities**

- Earth Science Teacher
- Engineering Geologist
- Environmental Geologist
- Environmental Scientist/Specialist
- Geochemist
- Government or Industry Geologist
- Geological Oceanographer
- Geomorphologist
- Geophysicist
- Hydrogeologist
- Meteorologist
- Science Museum Curator
- Paleoclimatologist/paleoceanographer
- Paleontologist
- Petroleum Geologist
- Soil Scientist

## **Co-curricular Activities and Organization**

The department encourages majors and minors to participate in the student Geology Club, which sponsors field trips, camping excursions, and hosts educational activities for elementary school students. Geology majors are encouraged to apply to be laboratory teaching assistants and research assistants for faculty in the department. Majors and minors are also strongly encouraged to become members of one or more of the following geoscience organizations and to present their research at the affiliated regional or national meetings:

- Geological Society of America (GSA)
- American Association of Petroleum Geologists (AAPG)
- American Geophysical Union (AGU)
- National Association of Geoscience Teachers (NAGT)

## **Degree and Major Requirements**

There are two bachelor degrees offered in the Department of Geology and Environmental Science, a B.S. in geology and a B.A. in Earth science. Both degree options have a research requirement that includes a formal presentation. The B.S.

degree has two concentrations: a general geology concentration designed for students who want to take a wider range of geology elective courses and an environmental and engineering geology concentration designed for students who want to focus their geology electives toward applied environmental science.

The B.A. in Earth science prepares individuals to work in a wide range of professional public sector service careers where preparation in Earth science and communication of science to nonscientific audiences is a requirement or an asset. This includes the preparation of Earth science teachers.

## Bachelor of Science in Geology

### Degree Requirements

#### Required Courses

	Credit Hours
General Education <sup>1</sup>	41
Quantitative requirement (in addition to General Education) <sup>2</sup>	3
Scientific Literacy requirement (in addition to General Education) <sup>2</sup>	3-4
Major requirements (listed below)	68-76
General Electives	2-11
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	120

1 The [General Education program](#) contains a set of requirements each student must fulfill. The number of credit hours necessary to fulfill these requirements may vary.

2 The quantitative and scientific literacy requirements are met by courses required by the major.

### Major Requirements

#### Core Requirements

	Credit Hours
Choose one of the following:	3
<a href="#">GEOL 110</a> . Physical Geology	
<a href="#">GEOL 102</a> . Environmental Earth	
<a href="#">GEOL 115</a> . Earth Systems and Climate Change	
<a href="#">GEOL 110L</a> . Physical Geology Lab	1
<a href="#">GEOL 230</a> . Evolution of Earth	4
<a href="#">GEOL 280</a> . Mineralogy	4
<a href="#">GEOL 291</a> . Geowriting and Communication	1
<a href="#">GEOL 300</a> . Introduction to Petrology	4
<a href="#">GEOL 387</a> . Stratigraphy, Structure, and Tectonics	4
<a href="#">GEOL 388</a> . Advanced Structure, Stratigraphy, Tectonics	4
<a href="#">GEOL 399</a> . Field Geology	6
Research Requirements	2-6
In addition to <a href="#">GEOL 291</a> , choose from the following to complete the research requirement. All majors must complete a minimum of two credits. Students conducting research with faculty should select <a href="#">GEOL 497</a> ; Honors students doing research with faculty must complete a minimum of six credits in <a href="#">GEOL 499</a> . All students must give a formal presentation to fulfill this requirement.	
<a href="#">GEOL 491</a> . Geological Literature Research	

[GEOL 494](#). Internship  
[GEOL 497](#). Problems in Geology  
[GEOL 499](#). Honors in Geology

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33-37

The B.S. degree in geology is designed for students who plan to obtain professional employment in geology or enter graduate school upon graduation. It is recommended that incoming B.S. degree students complete the following courses prior to enrolling in required geology courses numbered 300 and higher.

**Courses**

**Credit Hours**

<a href="#">CHEM 131-131L</a> ; <a href="#">132-132L</a> . General Chemistry I-II	8
<a href="#">MATH 235</a> . Calculus I	4-6
or <a href="#">MATH 231-232</a> . Calculus with Functions I-II	
<a href="#">MATH 220</a> . Elementary Statistics	3-4
or <a href="#">MATH 236</a> . Calculus-II	
Choose one of the following two sequences:	8
<a href="#">PHYS 140-140L</a> ; <a href="#">PHYS 150-150L</a> . College Physics I-II with Labs	
<a href="#">PHYS 240-140L</a> ; <a href="#">PHYS 250-150L</a> . University Physics I-II with Labs	

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23-26

Students planning graduate study in some areas of the geosciences should consider courses in mathematics, physics or chemistry beyond those required for the B.S. major.

## Concentrations

The B.S. degree option requires that each student complete at least 12 credit hours chosen from one of the two concentrations.

**General Geology Concentration**

[GEOL 302](#). Sedimentary Petrology  
[GEOL 380](#). Genetic Mineralogy  
[GEOL 340](#). Environmental Soil Science  
[GEOL 350](#). Paleobiology  
[GEOL 355](#). Geochemistry of Natural Waters  
[GEOL 377](#). Earth Surface Processes  
[GEOL 390](#). Laboratory Techniques in Geology  
[GEOL 395](#). Geological Perspectives in Materials Science and Engineering  
[GEOL 398](#). Topics in Field Geology (must be approved by adviser)  
[GEOL 400](#). Geology and Ecology of the Bahamas  
[GEOL 405](#). Vertebrate Paleontology  
[GEOL 406](#). Paleoclimatology and Paleoceanography  
[GEOL 410](#). Engineering Geology  
[GEOL 415](#). Geological Evolution of North America  
[GEOL 440](#). Geophysics  
[GEOL 442](#). Field Geophysics  
[GEOL 460](#). Hydrogeology  
[GEOL 489](#). Quantitative Methods in Geology

**Environmental and Engineering Geology Concentration**

- [GEOL 340](#). Environmental Soil Science
- [GEOL 355](#). Geochemistry of Natural Waters
- [GEOL 377](#). Earth Surface Processes
- [GEOL 390](#). Laboratory Techniques in Geology
- [GEOL 395](#). Geological Perspectives in Materials Science and Engineering
- [GEOL 398](#). Topics in Field Geology (must be approved by adviser)
- [GEOL 410](#). Engineering Geology
- [GEOL 440](#). Geophysics
- [GEOL 442](#). Field Geophysics
- [GEOL 460](#). Hydrogeology
- [GEOL 489](#). Quantitative Methods in Geology

## Recommended Schedule for B.S. Degree in Geology

### First Year

	<b>Credit Hours</b>
<a href="#">CHEM 131-131L</a> ; <a href="#">132-132L</a> . General Chemistry I-II	8
<a href="#">GEOL 110</a> . Physical Geology and <a href="#">GEOL 110L</a> . Physical Geology Lab	4
<a href="#">GEOL 230</a> . Evolution of Earth	4
Choose one of the following:	6-8
<a href="#">MATH 231-232</a> . Calculus with Functions I-II (six credits)	
<a href="#">MATH 235-236</a> . Calculus I-II (eight credits)	
General Education Courses	12
	34-36

### Second Year

	<b>Credit Hours</b>
<a href="#">GEOL 280</a> . Mineralogy	4
<a href="#">GEOL 291</a> . Geowriting and Communication	1
<a href="#">GEOL 387</a> . Stratigraphy, Structure, and Tectonics	4
Geology elective	3
Choose one of the following:	8
<a href="#">PHYS 140-140L</a> ; <a href="#">PHYS 150-150L</a> . College Physics I-II with Lab	
<a href="#">PHYS 240-240L</a> ; <a href="#">PHYS 250-250L</a> . University Physics I-II with Lab	
General Education courses	11
	31

### Third Year

	<b>Credit Hours</b>
<a href="#">GEOL 300</a> . Introduction to Petrology	4
<a href="#">GEOL 388</a> . Advanced Stratigraphy, Structure, Tectonics	4
<a href="#">GEOL 399</a> . Field Geology (summer session)	6
Geology electives	8
General Education courses	9
General Electives	3
	34

### Fourth Year

**Credit Hours**

Choose from the following:

[GEOL 491](#). Geological Literature Research (2 credits)

[GEOL 494](#). Internship (2 credits)

[GEOL 497](#). Problems in Geology (2 credits)

[GEOL 499](#). Honors in Geology (6 credits)

Electives

2-6

9-20

11-26

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## Bachelor of Arts in Earth Science

The B.A. in Earth science degree is designed to integrate all the Earth sciences in a systems approach to understanding the Earth. This includes incorporating and integrating subjects such as oceanography, meteorology and astronomy. The emphasis is on the preparation of individuals to work in a wide range of professional public sector service careers where preparation in Earth science and communication of science to non-scientific audiences is a requirement or an asset.

### Degree Requirements

#### Required Courses

General Education<sup>1</sup>

Foreign Language classes (intermediate level required)<sup>2</sup>

Philosophy course(s) (in addition to General Education courses)<sup>3</sup>

Major requirements (listed below including cognate sciences and math)

General Electives

#### Credit Hours

41

0-14

3

59-63

0-17

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120

1 The [General Education program](#) contains a set of requirements each student must fulfill. The number of credit hours necessary to fulfill these requirements may vary.

2 The foreign language requirement may be satisfied by successful completion of the second semester of the intermediate level of the student's chosen language (typically 232), or by placing out of that language through the [Department of Foreign Languages, Literatures and Cultures' placement exam](#).

3 100, 200, 300 or 400-level course acceptable or consult the list of courses satisfying B.A. degree requirements at <http://www/jmu.edu/registrar>.

### Major Requirements

B.A. degree students are expected to complete [CHEM 131-131L](#) before enrolling in geology courses numbered 300 and higher.

#### Core Requirements

Choose one of the following:

[GEOL 110](#). Physical Geology

[GEOL 102](#). Environmental Earth

[GEOL 115](#). Earth Systems and Climate Change

[GEOL 110L](#). Physical Geology Lab

[GEOL 167](#). History and Philosophy of the Geosciences

[GEOL 211](#). Introduction to Oceanography or

#### Credit Hours

3

1

3

3

<a href="#">GEOL 401</a> . Oceanography for Teachers	4
<a href="#">GEOL 230</a> . Evolution of Earth	1
<a href="#">GEOL 291</a> . Geowriting and Communication	3
<a href="#">GEOL 320</a> . Meteorology	4
<a href="#">GEOL 367</a> . Genesis of Solid Earth Materials	3
<a href="#">GEOL 377</a> . Earth Surface Processes	4
<a href="#">GEOL 387</a> . Stratigraphy, Structure, and Tectonics	3
<a href="#">GEOL 477</a> . Contemporary Issues in the Geosciences	3
Choose one of the following:	2-6
<a href="#">ASTR 200</a> . General Astronomy I	
<a href="#">GEOL 272</a> . Planetary Geology	
Research Requirements	
In addition to <a href="#">GEOL 291</a> , choose from the following to complete the research requirement. All majors must complete a minimum of two credits. Students conducting research with faculty should select <a href="#">GEOL 497</a> ; Honors students doing research with faculty must complete a minimum of six credits in <a href="#">GEOL 499</a> . All students must give a formal presentation to fulfill this requirement.	
<a href="#">GEOL 491</a> . Geological Literature Research	
<a href="#">GEOL 494</a> . Internship	
<a href="#">GEOL 497</a> . Problems in Geology	
<a href="#">GEOL 499</a> . Honors in Geology	

37-41

The B.A. degree option requires that each student complete at least 16 hours of cognate science credit hours with at least one course from biology, physics and chemistry chosen from:

**Cognate Science and Mathematics Area**

**Credit Hours**

**Biology**

4

[BIO 140](#). Foundations of Biology I

[BIO 350](#). Paleobiology

**Chemistry**

4

[CHEM 131-131L](#). General Chemistry I

[CHEM 132-132L](#). General Chemistry II

**Physics**

3-4

[PHYS 140-140L](#). College Physics I

[PHYS 150-150L](#). College Physics II or [GEOL 440](#). Geophysics

**Math**

3-4

The B.A. option requires that each student complete at least six credit hours of mathematics, including one of the following:

[MATH 205](#). Introductory Calculus I

[MATH 232](#). Calculus with Functions II

[MATH 235](#). Calculus I

20-22

**Recommended Minors for the Bachelor of Arts in Earth Science**

The B.A. Earth science degree recommends (but does not require) that students complete a minor in a complementary program, suitable toward the career goals of the student. Approved minors include:

<b>Minor</b>	<b>Credit Hours</b>
<a href="#">Astronomy</a>	121
<a href="#">Biology</a>	12-16
<a href="#">Business Analytics</a>	18-19
<a href="#">Chemistry</a>	201
<a href="#">Economics</a>	18
<a href="#">Environmental Information Systems</a>	24
<a href="#">Environmental Management</a>	191
<a href="#">Environmental Science</a>	151
<a href="#">Environmental Studies</a>	181
<a href="#">Humanitarian Affairs</a>	18
<a href="#">Geographic Science</a>	19
<a href="#">Mathematics</a>	14-18
<a href="#">Nonprofit Studies</a>	19-21
<a href="#">Physics</a>	14-22
<a href="#">Political Science</a>	19
<a href="#">Public Policy and Administration</a>	19
<a href="#">Science, Technology and Society</a>	18
<a href="#">Secondary Education</a>	22-24
<a href="#">Sociology</a>	18
<a href="#">Statistics</a>	15-16
<a href="#">Urban and Regional Studies</a>	24
Writing, Rhetoric and Technical Communication	18

1 Credit hours for courses in the minor that are already required courses for the B.A. in Earth Science major have been subtracted from the total hours listed here.

Students may also propose a minor that is not listed above to their adviser for approval.

## Recommended Schedule for B.A. Degree in Earth Science

<b>First Year</b>	<b>Credit Hours</b>
Cluster One: Skills for the 21st Century	9-12
<a href="#">GEOL 110</a> . Physical Geology and <a href="#">GEOL 110L</a> . Physical Geology Lab	4
<a href="#">GEOL 167</a> . History and Philosophy of the Geosciences	3
<a href="#">GEOL 230</a> . Evolution of Earth	4
<a href="#">MATH 205</a> . Introductory Calculus I	3
<a href="#">CHEM 131-131L</a> . General Chemistry I	4
<hr/>	
	27-30

<b>Second Year</b>	<b>Credit Hours</b>
<a href="#">GEOL 211</a> . Introduction to Oceanography	3
<a href="#">GEOL 291</a> . Geowriting and Communication	1
<a href="#">GEOL 320</a> . Meteorology	3
<a href="#">GEOL 367</a> . Genesis of Solid Earth Materials	4
<a href="#">GEOL 377</a> . Earth Surface Processes	3
Foreign language courses <sup>1</sup>	1-8
General Education courses	12
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**Third Year**[GEOL 387](#). Stratigraphy, Structure and Tectonics

Choose one of the following:

[ASTR 220](#). Astronomy[GEOL 272](#). Planetary Geology

Cognate science and mathematics

General Education courses

**Credit Hours**

4

3

9-12

9

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25-28**Fourth Year**[GEOL 477](#). Contemporary Issues in the Geosciences

Cognate science

Choose one from the following:

[GEOL 491](#). Geological Research Literature[GEOL 494](#). Internship[GEOL 497](#). Problems in Geology[GEOL 499](#). Honors in Geology

Geology electives

Electives

**Credit Hours**

3

3-4

2-6

4-6

12-20

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24-39

1 Foreign language at the intermediate level.

## Teaching Licensure

Students interested in becoming teachers must meet specific curriculum requirements in their major as part of the undergraduate academic degree. The B.A. in Earth science includes state course requirements in astronomy, meteorology and oceanography, to total no less than 32 hours in the Earth sciences (including geology) and a minimum of 16 hours total in physics, chemistry and biology.

In addition to the general education and academic major requirements, Earth science majors desiring secondary teacher licensure must be admitted to the pre-professional program in secondary education at the undergraduate level and complete the graduate level Master of Arts in Teaching degree.

It is critical that students seeking teaching licensure consult regularly with both their education adviser and their major adviser to support their progression through the programs.

For a full description of the program in secondary teaching, refer to the [Department of Middle, Secondary and Mathematics Education](#), in addition to the [College of Education](#).

# Minor Requirements

## Geology Minor

The requirement for a minor in geology is a minimum of 18 credit hours of geology approved by the student's geology adviser.

## Geophysics Minor

The minor in geophysics is designed to provide adequate training for professional work or graduate school in geophysics in the broad sense. No more than 10 credits from the geophysics minor may be used to double count with a major. The requirements for the geophysics minor are a minimum of 21 credits, including at least one semester each of geology, mathematics and physics, distributed as follows:

### Required Courses

Choose one of the following:

- [GEOL 110](#) and [GEOL 110L](#). Physical Geology and Lab
- [GEOL 210](#). and [GEOL 110L](#). Applied Physical Geology and Lab
- [PHYS 140](#). and [140L](#). College Physics I and Lab
- [PHYS 240](#). and [140L](#). University Physics I and Lab

Complete all of the following:

- [GEOL 440](#). Geophysics
- [GEOL 442](#). Field Geophysics
- [MATH 238](#). Linear Algebra with Differential Equations
- [MATH 248](#). Computers & Numerical Algorithms

Choose one of the following elective courses:<sup>1</sup>

- [ASTR 220](#). General Astronomy I
- [CHEM 331](#). Physical Chemistry I
- [GEOL 410](#). Engineering Geology
- [GEOL 460](#). Hydrogeology
- [MATH 237](#). Calculus III
- [PHYS 260](#). University Physics III

**Credit Hours**

4

4

3

4

4

3-4

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22-23

1 Additional elective courses permitted upon approval from minor adviser.

Note for geology majors: The geology major requires a sequence of math and physics courses (see major program for details). The following sequence of courses will satisfy the major requirements and is strongly recommended for students interested in geophysics. In particular, [MATH 236](#) is a prerequisite for several courses included in the geophysics minor.

- [MATH 235-236](#). Calculus I & II
- [PHYS 240-250](#). Physics I & II (and Lab)