**GEOLOGY (GEOL)**

**GEOL 11040 HOW THE EARTH WORKS (KBS) 3 Credit Hours**
Explores processes that shape Earth's landscapes (e.g., volcanism, flooding, landslides, sea-level rise, mountain building) and that are of vital interest to humans (e.g., earthquakes, groundwater, energy and mineral resources, climate change).
- **Prerequisite:** None.
- **Schedule Type:** Lecture
- **Contact Hours:** 3 lecture
- **Grade Mode:** Standard Letter
- **Attributes:** Kent Core Basic Sciences, TAG Science, Transfer Module Natural Sciences

**GEOL 11041 HOW THE EARTH WORKS LABORATORY (KBS) (KLAB) 1 Credit Hour**
Students study earth materials (e.g., mineral crystals, common and unusual rock specimens) and Google Earth images. Students conduct experiments demonstrating processes at earth's surface such as groundwater pollution, flooding and earthquakes.
- **Pre/corequisite:** GEOL 11040.
- **Schedule Type:** Laboratory
- **Contact Hours:** 3 lab
- **Grade Mode:** Standard Letter
- **Attributes:** Kent Core Basic Sciences, TAG Science, Transfer Module Natural Sciences

**GEOL 11042 EARTH AND LIFE THROUGH TIME (KBS) 3 Credit Hours**
Explores major events in the history of Earth, including mass extinctions, Snowball Earth hypothesis, birth and death of oceans, growth of continents, explosion of life, dinosaurs and the inter-relatedness of earth and life processes.
- **Prerequisite:** None.
- **Schedule Type:** Lecture
- **Contact Hours:** 3 lecture
- **Grade Mode:** Standard Letter
- **Attributes:** Kent Core Basic Sciences, TAG Science, Transfer Module Natural Sciences

**GEOL 11043 EARTH AND LIFE THROUGH TIME LABORATORY (KBS) (KLAB) 1 Credit Hour**
Student conduct lab experiments with fossils, rocks and sedimentary features, a river process simulator and the concept of deep time.
- **Pre/corequisite:** GEOL 11042.
- **Schedule Type:** Laboratory
- **Contact Hours:** 3 lab
- **Grade Mode:** Standard Letter
- **Attributes:** Kent Core Basic Sciences, TAG Science, Transfer Module Natural Sciences

**GEOL 21062 ENVIRONMENTAL EARTH SCIENCE (KBS) 3 Credit Hours**
Application of Earth science to environmental problems, including natural resource extraction, water supply, pollution, waste disposal, landslides, floods and land use planning. Students take local field trips.
- **Prerequisite:** None.
- **Schedule Type:** Lecture
- **Contact Hours:** 3 lecture
- **Grade Mode:** Standard Letter
- **Attributes:** Kent Core Basic Sciences, Transfer Module Natural Sciences

**GEOL 21080 ALL ABOUT THE OCEANS (KBS) 3 Credit Hours**
Explores the many fascinating (and some still little known) features and processes of the Earth's oceans, including mid-ocean ridges, hydrothermal vents, tsunamis, tides, rogue waves, marine life and the role of the ocean in climate change.
- **Prerequisite:** None.
- **Schedule Type:** Lecture
- **Contact Hours:** 3 lecture
- **Grade Mode:** Standard Letter
- **Attributes:** Kent Core Basic Sciences, Transfer Module Natural Sciences

**GEOL 22000 DEGREE AND CAREER PATHS IN GEOLOGY (ELR) 1 Credit Hour**
Provides students with an overview of career paths and opportunities in the Geology and Earth Science majors. Components of the course include a journal club; informational presentations by geoscientists in industry, government and academia; and skills training needed for the majors. Required overnight field trip.
- **Prerequisite:** None.
- **Schedule Type:** Lecture
- **Contact Hours:** 1 lecture
- **Grade Mode:** Standard Letter
- **Attributes:** Experiential Learning Requirement

**GEOL 23063 EARTH MATERIALS I 4 Credit Hours**
Occurrence, associations, characteristics, crystallography and crystal chemistry of common minerals. Laboratory identification emphasizing physical properties. Required field trip.
- **Prerequisite:** GEOL 11040 and GEOL 11041.
- **Pre/corequisite:** CHEM 10060.
- **Schedule Type:** Combined Lecture and Lab
- **Contact Hours:** 5 other
- **Grade Mode:** Standard Letter
- **Attributes:** TAG Science

**GEOL 31070 EARTH MATERIALS II (WIC) 4 Credit Hours**
Occurrence and origin of igneous, sedimentary and metamorphic rocks. Laboratory identification, description and classification of hand specimens. Required field trip.
- **Prerequisite:** GEOL 23063.
- **Schedule Type:** Laboratory, Lecture
- **Contact Hours:** 3 lecture, 2 lab
- **Grade Mode:** Standard Letter
- **Attributes:** Writing Intensive Course

**GEOL 31080 STRUCTURAL GEOLOGY 4 Credit Hours**
Mechanical principles of rock deformation. Structures in sedimentary igneous and metamorphic rocks. Lecture three hours lab two hours weekly. Required field trip.
- **Prerequisite:** None.
- **Schedule Type:** Combined Lecture and Lab
- **Contact Hours:** 5 other
- **Grade Mode:** Standard Letter

**GEOL 32066 GEOMORPHOLOGY 4 Credit Hours**
Earth's surface features as functions of geological structures, processes and time. Landform analysis using topographic maps and some stereographic aerial photos. Trigonometry recommended.
- **Prerequisite:** GEOL 11040 and GEOL 11041.
- **Schedule Type:** Combined Lecture and Lab
- **Contact Hours:** 4 other
- **Grade Mode:** Standard Letter
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Grade Mode</th>
<th>Contact Hours</th>
<th>Schedule Type</th>
<th>Prerequisite</th>
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</thead>
<tbody>
<tr>
<td>GEOL 33025</td>
<td>WATER AND THE ENVIRONMENT</td>
<td>3</td>
<td>Standard</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>BSCI 10002 or BSCI 10110.</td>
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<tr>
<td>GEOL 34061</td>
<td>INVERTEBRATE PALEONTOLOGY</td>
<td>4</td>
<td>Standard</td>
<td>5 other</td>
<td>Lecture and Lab</td>
<td>GEOL 11042 and GEOL 11043.</td>
</tr>
<tr>
<td>GEOL 40093</td>
<td>VARIABLE TITLE WORKSHOP IN GEOLOGY</td>
<td>1-8</td>
<td>Standard</td>
<td>1-8 other</td>
<td>Workshop</td>
<td>Special approval</td>
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<tr>
<td>GEOL 40095</td>
<td>SELECTED TOPICS IN GEOLOGY</td>
<td>1-3</td>
<td>Standard</td>
<td>1-3 lecture</td>
<td>Lecture</td>
<td>20 credit hours of GEOL courses.</td>
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<tr>
<td>GEOL 40096</td>
<td>INDIVIDUAL INVESTIGATION IN GEOLOGY</td>
<td>1-3</td>
<td>Standard</td>
<td>1-3 other</td>
<td>Individual Investigation</td>
<td>Special approval</td>
</tr>
<tr>
<td>GEOL 41025</td>
<td>GENERAL GEOPHYSICS</td>
<td>3</td>
<td>Standard</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>GEOL 31070 and GEOL 31080 and MATH 12002; and PHY 13001 or PHY 23101.</td>
</tr>
<tr>
<td>GEOL 41073</td>
<td>GEOLOGY OF OHIO</td>
<td>3</td>
<td>Standard</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>None.</td>
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<tr>
<td>GEOL 41077</td>
<td>GEOLOGY OF THE NATIONAL PARKS</td>
<td>3</td>
<td>Standard</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>None.</td>
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<tr>
<td>GEOL 41079</td>
<td>ALL ABOUT DINOSAURS</td>
<td>3</td>
<td>Standard</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>None.</td>
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<td>GEOL 41080</td>
<td>TECTONICS AND OROGENY</td>
<td>3</td>
<td>Standard</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>None.</td>
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<tr>
<td>GEOL 41082</td>
<td>ADVANCED STRUCTURAL GEOLOGY</td>
<td>3</td>
<td>Standard</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>None.</td>
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<td>GEOL 41092</td>
<td>SUMMER FIELD CAMP (ELR)</td>
<td>6</td>
<td>Standard</td>
<td>42 other</td>
<td>Practicum or Internship</td>
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<td>GEOL 42030</td>
<td>REMOTE SENSING</td>
<td>3</td>
<td>Standard</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>None.</td>
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**Prerequisites:**
- GEOL 31070 and GEOL 31080.
- Junior standing.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.

**Corequisites:**
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.
- None.

**Attributes:**
- Experiential Learning Requirement
GEOL 42035 SCIENTIFIC METHODS IN GEOLOGY  3 Credit Hours
(Slashed with GEOL 52035) Applying scientific methods to geologic data in the field and laboratory; models and sampling procedures. Collecting and analyzing data. Formulating and testing hypotheses. Provides background necessary for upper-division geology courses.
Prerequisite: None.
Schedule Type: Combined Lecture and Lab
Contact Hours: 2 lecture, 2 lab
Grade Mode: Standard Letter

GEOL 42036 PHYSICAL HYDROGEOLOGY LABORATORY  1 Credit Hour
(Slashed with GEOL 52036) Laboratory course offering fundamental training for professional hydrogeologists. Required weekend field trip.
Prerequisite: Junior standing.
Corequisite: GEOL 42066.
Schedule Type: Laboratory
Contact Hours: 2 lab
Grade Mode: Standard Letter

GEOL 42065 WATERSHED HYDROLOGY  3 Credit Hours
(Slashed with GEOL 52065) Study of water movement, storage and transformation across landscapes.
Prerequisite: Junior standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 42066 PHYSICAL HYDROGEOLOGY  3 Credit Hours
(Slashed with GEOL 52066) Principles of water flow in hydrologic cycle, soil and aquifer hydraulic properties, groundwater flow, surface water–groundwater interactions and geochemical evolution of groundwater. Application of principles for evaluation of water resources; emphasizing utilization, conservation and management of groundwater resources in a changing environment.
Prerequisite: MATH 12002 or higher MATH course; and junior standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 42067 INTRODUCTORY HYDROGEOLOGY  3 Credit Hours
(Slashed with GEOL 52067) Occurrence of ground water in geologic materials; emphasizing utilization, conservation and management of ground water resources.
Prerequisite: Junior standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 42068 CONTAMINANT HYDROLOGY AND HYDROGEOLOGY  3 Credit Hours
(Slashed with GEOL 52068) An introduction to the basic principles of chemical and physical behavior of contaminants introduced by humans into the environment. Students are expected to understand concepts and work practical quantitative problems.
Prerequisite: CHEM 10060 and CHEM 10061 and CHEM 10062 and CHEM 10063 and GEOL 42067.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 42069 HYDROGEOCHEMISTRY  3 Credit Hours
(Slashed with GEOL 52069 and GEOL 72069) Processes and evolution of the chemical composition of water in the natural hydrologic cycle. Methods of hydrochemical interpretation applied to ground water and pollution problems.
Prerequisite: 10 credit hours of CHEM courses.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 42074 ENVIRONMENTAL CORE AND WELL LOGGING  3 Credit Hours
(Slashed with GEOL 52074) Examination of subsurface processes and the distribution of stratigraphic layers using core and well-logging techniques and based on analysis of physical properties of sediment, rock and pore fluids. Applications to paleoclimate, hydrogeology, engineering geology, oil and gas exploration and environmental remediation.
Prerequisite: GEOL 31070.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 42078 ENGINEERING GEOLOGY  4 Credit Hours
(Slashed with GEOL 52078) Engineering properties of soils and rocks. Site evaluation for building foundations, dams, tunnels and highways. Slope stability.
Prerequisite: Geology or Earth Science major; and junior standing.
Schedule Type: Combined Lecture and Lab
Contact Hours: 4 other
Grade Mode: Standard Letter

GEOL 43040 PRINCIPLES OF GEOCHEMISTRY  3 Credit Hours
(Slashed with GEOL 53040) Introduction to chemical thermodynamics and its applications in solving geochemical problems. Distributions of elements and isotopes in the Earth and laws governing these distributions.
Prerequisite: CHEM 10060 and CHEM 10061 and GEOL 31070 and MATH 12002.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 43042 ENVIRONMENTAL GEOCHEMISTRY  3 Credit Hours
(Slashed with GEOL 53042 and GEOL 73042) Explores chemical processes that influence the natural environment, including anthropogenic impacts. Topics include atmospheric chemistry and air pollution, energy and climate change, toxic organic compounds, water chemistry and water pollution, metals, soils, sediments and waste disposal. Environmental problem-solving using steady state and non-steady state box models, thermodynamics and energy transfer and chemical reactions and equilibria. Required half-day field trip.
Prerequisite: CHEM 10060 and CHEM 10061.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
GEOL 43043  ENVIRONMENTAL MINERALOGY  3 Credit Hours  
(Slashed with GEOL 53043) Explores reactions between minerals and 
aqueous solutions, focusing on their role in chemical weathering, 
contaminant mobility, microbe-mineral interactions and an understanding 
of mineral-water interface processes and mechanisms at the molecular 
level. Through a series of case studies, the course explores the societal 
impacts of environmental contaminants and the potential role of remediation.  
Prerequisite: GEOL 23063; and junior standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 43044  ENVIRONMENTAL ISOTOPES  3 Credit Hours  
(Slashed with GEOL 53044 and GEOL 73044) Deals with the fundamentals 
of isotope geochemistry and the application of primarily light 
stable isotopes (H, O, C, N) to Earth system processes (involving the 
hydrosphere, biosphere and upper geosphere).  
Prerequisite: CHEM 10060 and CHEM 10061.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 44025  GEOLOGIC HAZARDS AND DISASTERS  3 Credit Hours  
(Slashed with GEOL 44025) Explores the geological processes that 
drive a broad range of different natural hazards (including earthquakes, 
volcanoes, landslides and floods), and how they interact with human 
behavior to produce geological risks and disasters. Through discussion 
of historical and topical events, students focus on the dual challenges of 
combining uncertain and incomplete information from various geological 
and historical sources into realistic assessments of future risks; and the 
communication of accurate, relevant, actionable information about these 
risks to the public and authorities.  
Prerequisite: Junior standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 44052  GLACIERS AND GLACIATION  3 Credit Hours  
(Cross-listed with GEOG 41052)(Slashed with GEOL 54052, GEOL 74052, 
GEOG 51052, GEOG 71052) Examination of how glacial ice masses 
change the shape of the earth's surface, how they are integral to climate 
and sea level change, and how they pose high risk hazards.  
Prerequisite: GEOG 21062 or GEOL 11040.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 44070  SEDIMENTOLOGY AND STRATIGRAPHY  4 Credit Hours  
(Slashed with GEOL 54070) Students are introduced to the principles 
regarding the systematics of sedimentary rocks and the relationships 
between geologic formations at various spatial and temporal scales. 
Lectures are integrated with readings from the open literature and 
required labs and field trips.  
Prerequisite: GEOL 31070.  
Schedule Type: Combined Lecture and Lab  
Contact Hours: 3 lecture, 2 lab  
Grade Mode: Standard Letter  

GEOL 44074  PALEOECEANOGRAPHY  3 Credit Hours  
(Slashed with GEOL 54074) A broad spectrum of geological approaches. 
Paleontology, geochemistry and stratigraphy are employed to interpret 
the history of earth's oceans.  
Prerequisite: None.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 50093  VARIABLE TITLE WORKSHOP IN GEOLOGY  1-8 Credit Hours  
(Repeatable for credit)(Slashed with GEOL 40093 and GEOL 70093) 
Workshop or training program focused on a specific professional or 
disciplinary topic within geology.  
Prerequisite: Graduate standing; and special approval.  
Schedule Type: Workshop  
Contact Hours: 1-8 other  
Grade Mode: Satisfactory/Unsatisfactory  

GEOL 50095  SELECTED TOPICS IN GEOLOGY  1-3 Credit Hours  
(Slashed with GEOL 50095)(Repeatable for credit) Selected topics 
presented by visiting professors or one-time offerings presented by 
regular faculty.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 1-3 lecture  
Grade Mode: Standard Letter  

GEOL 51025  GENERAL GEOPHYSICS  3 Credit Hours  
(Slashed with GEOL 51025) Physics of Earth, seismology, geomagnetism, 
heat flow, radioactivity, geochronology, geotectonic models. Required field 
trip.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 51073  GEOLOGY OF OHIO  3 Credit Hours  
(Slashed with GEOL 41073) Minerals, rocks, fossils, structural geology, 
physiography, environmental geology and geologic resources. Required 
field trips. Does not count toward the Geology major.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 51077  GEOLOGY OF THE NATIONAL PARKS  3 Credit Hours  
(Slashed with GEOL 41077) Introduction to the geology of selected 
major national parks, emphasizing basic geological principles and the 
processes that have produced the spectacular scenery, rocks and fossils 
in each park. Does not count toward the Geology major.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 51079  ALL ABOUT DINOSAURS  3 Credit Hours  
(Slashed with GEOL 41079) Dinosaurs (and some relatives) and their 
world, emphasizing how to interpret evidence concerning their history, 
biology and evolutionary relationships. Does not count toward the Geology major.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 51074  PALEOECEANOGRAPHY  3 Credit Hours  
(Slashed with GEOL 54074) A broad spectrum of geological approaches. 
Paleontology, geochemistry and stratigraphy are employed to interpret 
the history of earth's oceans.  
Prerequisite: None.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 50093  VARIABLE TITLE WORKSHOP IN GEOLOGY  1-8 Credit Hours  
(Repeatable for credit)(Slashed with GEOL 40093 and GEOL 70093) 
Workshop or training program focused on a specific professional or 
disciplinary topic within geology.  
Prerequisite: Graduate standing; and special approval.  
Schedule Type: Workshop  
Contact Hours: 1-8 other  
Grade Mode: Satisfactory/Unsatisfactory  

GEOL 50095  SELECTED TOPICS IN GEOLOGY  1-3 Credit Hours  
(Slashed with GEOL 50095)(Repeatable for credit) Selected topics 
presented by visiting professors or one-time offerings presented by 
regular faculty.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 1-3 lecture  
Grade Mode: Standard Letter  

GEOL 51025  GENERAL GEOPHYSICS  3 Credit Hours  
(Slashed with GEOL 51025) Physics of Earth, seismology, geomagnetism, 
heat flow, radioactivity, geochronology, geotectonic models. Required field 
trip.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 51073  GEOLOGY OF OHIO  3 Credit Hours  
(Slashed with GEOL 41073) Minerals, rocks, fossils, structural geology, 
physiography, environmental geology and geologic resources. Required 
field trips. Does not count toward the Geology major.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 51077  GEOLOGY OF THE NATIONAL PARKS  3 Credit Hours  
(Slashed with GEOL 41077) Introduction to the geology of selected 
major national parks, emphasizing basic geological principles and the 
processes that have produced the spectacular scenery, rocks and fossils 
in each park. Does not count toward the Geology major.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter  

GEOL 51079  ALL ABOUT DINOSAURS  3 Credit Hours  
(Slashed with GEOL 41079) Dinosaurs (and some relatives) and their 
world, emphasizing how to interpret evidence concerning their history, 
biology and evolutionary relationships. Does not count toward the Geology major.  
Prerequisite: Graduate standing.  
Schedule Type: Lecture  
Contact Hours: 3 lecture  
Grade Mode: Standard Letter
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credit Hours</th>
<th>Grade Mode</th>
<th>Prerequisite Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>GEOL 51080</td>
<td>TECTONICS AND OROGENY</td>
<td>3</td>
<td>Graduate standing</td>
<td>Required field trip to New England.</td>
</tr>
<tr>
<td>GEOL 51082</td>
<td>ADVANCED STRUCTURAL GEOLOGY</td>
<td>3</td>
<td>Graduate standing</td>
<td>Required field trip.</td>
</tr>
<tr>
<td>GEOL 51092</td>
<td>SUMMER FIELD CAMP</td>
<td>6</td>
<td>Standard Letter-IP</td>
<td>Five weeks devoted to geologic mapping and solving structural and stratigraphic problems in the Black Hills of South Dakota.</td>
</tr>
<tr>
<td>GEOL 52030</td>
<td>REMOTE SENSING</td>
<td>3</td>
<td>Standard Letter</td>
<td>Computer analysis of multispectral satellite datasets. Applications in terrestrial Earth science are emphasized.</td>
</tr>
<tr>
<td>GEOL 52035</td>
<td>SCIENTIFIC METHODS IN GEOLOGY</td>
<td>3</td>
<td>Graduate standing</td>
<td>Applying scientific methods to geologic data in the field and laboratory; models and sampling procedures. Collecting and analyzing data. Formulating and testing hypotheses.</td>
</tr>
<tr>
<td>GEOL 52036</td>
<td>PHYSICAL HYDROGEOLOGY LAB</td>
<td>1</td>
<td>Graduate standing</td>
<td>Laboratory course offering fundamental training for professional hydrogeologists. Required weekend field trip.</td>
</tr>
<tr>
<td>GEOL 52065</td>
<td>WATERSHED HYDROLOGY</td>
<td>3</td>
<td>Graduate standing</td>
<td>Study of water movement, storage and transformation across landscapes.</td>
</tr>
<tr>
<td>GEOL 52066</td>
<td>PHYSICAL HYDROGEOLOGY</td>
<td>3</td>
<td>Graduate standing</td>
<td>Principles of water flow in hydrologic cycle, soil and aquifer hydraulic properties, groundwater flow, surface water—groundwater interactions and geochemical evolution of groundwater. Application of principles for evaluation of water resources; emphasizing utilization, conservation and management of groundwater resources in a changing environment.</td>
</tr>
<tr>
<td>GEOL 52067</td>
<td>Introductory Hydrogeology</td>
<td>3</td>
<td>Graduate standing</td>
<td>Occurrence of ground water in geologic materials; emphasizing utilization, conservation and management of ground water resources.</td>
</tr>
<tr>
<td>GEOL 52068</td>
<td>Contaminant Hydrology and Hydrogeology</td>
<td>3</td>
<td>Graduate standing</td>
<td>An introduction to the basic principles of chemical and physical behavior of contaminants introduced by humans into the environment. Students are expected to understand concepts and work practical quantitative problems.</td>
</tr>
<tr>
<td>GEOL 52069</td>
<td>Hydrogeochemistry</td>
<td>3</td>
<td>Graduate standing</td>
<td>Processes and evolution of the chemical composition of water in the natural hydrologic cycle. Methods of hydrochemical interpretation applied to ground water and pollution problems.</td>
</tr>
<tr>
<td>GEOL 52074</td>
<td>Environmental Core and Well Logging</td>
<td>3</td>
<td>Graduate standing</td>
<td>Examination of subsurface processes and the distribution of stratigraphic layers using core and well-logging techniques and based on analysis of physical properties of sediment, rock and pore fluids. Applications to paleoclimate, hydrogeology, engineering geology, oil and gas exploration and environmental remediation.</td>
</tr>
<tr>
<td>GEOL 52078</td>
<td>Engineering Geology</td>
<td>4</td>
<td>Graduate standing</td>
<td>Engineering properties of soils and rocks. Site evaluation for building foundations, dams, tunnels and highways. Slope stability.</td>
</tr>
</tbody>
</table>

**Geology (GEOL)**
<table>
<thead>
<tr>
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<th>Course Title</th>
<th>Credit Hours</th>
<th>Grade Mode</th>
<th>Contact Hours</th>
<th>Schedule Type</th>
<th>Prerequisite</th>
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<tbody>
<tr>
<td>GEOL 53040</td>
<td>PRINCIPLES OF GEOCHEMISTRY</td>
<td>3</td>
<td>Standard Letter</td>
<td>3 lecture</td>
<td>Lecture</td>
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<tr>
<td>GEOL 53042</td>
<td>ENVIRONMENTAL GEOCHEMISTRY</td>
<td>3</td>
<td>Standard Letter</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>Graduate standing.</td>
</tr>
<tr>
<td>GEOL 53043</td>
<td>ENVIRONMENTAL MINERALOGY</td>
<td>3</td>
<td>Standard Letter</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>Graduate standing.</td>
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<tr>
<td>GEOL 53044</td>
<td>ENVIRONMENTAL ISOTOPES</td>
<td>3</td>
<td>Standard Letter</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>Graduate standing.</td>
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<tr>
<td>GEOL 54025</td>
<td>GEOLOGIC HAZARDS AND DISASTERS</td>
<td>3</td>
<td>Standard Letter</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>Graduate standing.</td>
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<tr>
<td>GEOL 54074</td>
<td>PALEOCEANOGRAPHY</td>
<td>3</td>
<td>Standard Letter</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>Graduate standing.</td>
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<tr>
<td>GEOL 54070</td>
<td>SEDIMENTOLOGY AND STRATIGRAPHY</td>
<td>4</td>
<td>Standard Letter</td>
<td>4 lecture</td>
<td>Lecture</td>
<td>Graduate standing.</td>
</tr>
<tr>
<td>GEOL 54052</td>
<td>GLACIERS AND GLACIATION</td>
<td>3</td>
<td>Standard Letter</td>
<td>3 lecture</td>
<td>Lecture</td>
<td>Graduate standing.</td>
</tr>
<tr>
<td>GEOL 60080</td>
<td>RESEARCH ORIENTATION</td>
<td>1</td>
<td>Satisfactory/Unsatisfactory</td>
<td>1 lecture</td>
<td>Lecture</td>
<td>Graduate standing.</td>
</tr>
<tr>
<td>GEOL 60084</td>
<td>GEOLOGY GRADUATE STUDENT ORIENTATION</td>
<td>1</td>
<td>Satisfactory/Unsatisfactory</td>
<td>1 lecture</td>
<td>Lecture</td>
<td>Conduct research at a graduate level. Training and experience in presentation of data and college teaching of applied geology, as well as a discussion forum on professional ethics and responsibilities.</td>
</tr>
<tr>
<td>GEOL 60091</td>
<td>SEMINAR</td>
<td>1-2</td>
<td>Standard Letter</td>
<td>1-2 other</td>
<td>Seminar</td>
<td>Graduate standing.</td>
</tr>
</tbody>
</table>

**Grade Mode:** Satisfactory/Unsatisfactory

**Schedule Type:** Lecture

**Contact Hours:** 3 lecture

**Prerequisite:** Graduate standing.
GEOL 60095  SELECTED TOPICS IN GEOLOGY  1-3 Credit Hours
(Repeatable for credit) Selected topics presented by visiting professors or one-time offerings presented by regular faculty.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

GEOL 60098  RESEARCH  1-15 Credit Hours
(Repeatable for credit) Research for master's level students. Credits earned may be applied toward degree if department approves.
Prerequisite: Graduate standing.
Schedule Type: Research
Contact Hours: 1-15 other
Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 60199  THESIS I  2-6 Credit Hours
Thesis students must register for a total of 6 hours, 2 to 6 hours in a single semester distributed over several semesters if desired.
Prerequisite: Graduate standing.
Schedule Type: Masters Thesis
Contact Hours: 2-6 other
Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 60299  THESIS II  2 Credit Hours
Thesis students must continue registration each semester until all degree requirements are met.
Prerequisite: GEOL 60199; and graduate standing.
Schedule Type: Masters Thesis
Contact Hours: 2 other
Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 61093  WORKSHOP IN COLLEGE TEACHING  1-2 Credit Hours
(Repeatable for credit) Workshop in college teaching.
Prerequisite: Graduate standing.
Schedule Type: Workshop
Contact Hours: 1-2 other
Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 62011  HYDROLOGY  3 Credit Hours
(Slashed with GEOL 72011) Introduction to hydrologic measurements, properties of water precipitation, evapotranspiration runoff computations, streamflow and flood routing.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 62068  ADVANCED HYDROGEOLOGY  3 Credit Hours
(Slashed with GEOL 72068) Quantitative approach to occurrence of ground water; methods of investigation, evaluation and development of ground water resources emphasizing optimization and maximal exploitation without environmental changes.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 62079  ADVANCED ENGINEERING GEOLOGY  3 Credit Hours
(Slashed with GEOL 72079) Role of geology in site selection, design and construction relative to dams, tunnels, highways, slope stability and nuclear power plants. Selected case histories. Field trip and term paper required.
Prerequisite: GEOL 52078; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 62082  INTRODUCTION TO SOIL MECHANICS  4 Credit Hours
(Slashed with GEOL 72082) Engineering properties and engineering behavior of soils, including classification properties, compaction permeability strength and compressibility.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 5 other
Grade Mode: Standard Letter

GEOL 62083  ROCK SLOPE STABILITY  3 Credit Hours
(Slashed with GEOL 72083) Provide information used to recognize, avoid, design for, control and correct slope movements in rocks; determination of shear strength along rock discontinuities; stability analysis of rock slopes.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 62084  FOUNDATION ENGINEERING  3 Credit Hours
Prerequisite: GEOL 52078 or GEOL 72082; and graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 63063  SEDIMENTARY PETROLOGY  3 Credit Hours
(Slashed with GEOL 73063) Classification, texture, composition, provenance and diagenesis of sandstones and carbonates, following review of optical mineralogy. Petrographic microscopy and other laboratory techniques are emphasized.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 64028  PALEOECOLOGY  3 Credit Hours
(Slashed with GEOL 74028) Relationships between ancient organisms and their environments, as interpreted from fossils, enclosing rock strata and recent analogs. Field and laboratory studies. Saturday field trips.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
GEOL 64030  SYSTEMATIC INVERTEBRATE PALEONTOLOGY I 3 Credit Hours
(Slashed with GEOL 74030) Detailed investigation and examination of important literature concerning taxonomic characters of invertebrate phyla: Protista, Porifera, Cnidaria and Bryozoa. Numerous oral reports, specimen examination.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 64032  SYSTEMATIC INVERTEBRATE PALEONTOLOGY II 3 Credit Hours
(Slashed with GEOL 74032) Detailed investigation and examination of important literature concerning taxonomic characters of invertebrate phyla: Brachiopoda, Mollusca, Arthropoda and Echinodermata. Numerous oral reports, specimen examination.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 64036  CENOZOIC CLIMATE CHANGE 3 Credit Hours
(Slashed with GEOL 74036) An overview of the concepts and principles involved in interpreting global and hemispheric Cenozoic climate change (past 65 million years). Emphasis on particular temporal and spatial scales and cycles. Extensive reading in scientific journals.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 64038  PALEOLIMNOLOGY 3 Credit Hours
(Slashed with GEOL 74038) An overview of significant topics and applications in paleolimnology of Holocene (last 10,000 years) and Pleistocene (last two million years) records, including current issues in environmental and climatic reconstruction. Extensive reading expected.
Prerequisite: Graduate standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 70080  RESEARCH ORIENTATION 1 Credit Hour
(Slashed with GEOL 60080) Faculty research presentations; thesis/dissertation proposal preparation; discussion of professional organizations, preparation of manuscripts and oral presentation of papers.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 1 lecture
Grade Mode: Satisfactory/Unsatisfactory

GEOL 70084  GEOLOGY GRADUATE STUDENT ORIENTATION 1 Credit Hour
(Slashed with GEOL 60084) Introduction to departmental resources, procedures and expectations, as well as approaches to successfully conduct research at a graduate level. Training and experience in presentation of data and college teaching of applied geology, as well as discussion forum on professional ethics and responsibilities.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 1 lecture
Grade Mode: Satisfactory/Unsatisfactory

GEOL 70091  SEMINAR 1-2 Credit Hours
(Repeatable for credit)(Slashed with GEOL 60091) Topics in geology varies per course offering.
Prerequisite: Doctoral standing.
Schedule Type: Seminar
Contact Hours: 1-2 other
Grade Mode: Standard Letter

GEOL 70093  VARIABLE TITLE WORKSHOP IN GEOLOGY 1-8 Credit Hours
(Repeatable for credit)(Slashed with GEOL 40093 and GEOL 50093) Workshop and/or training program, of varying duration focused on a specific professional or disciplinary topic.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Workshop
Contact Hours: 1-8 other
Grade Mode: Satisfactory/Unsatisfactory

GEOL 71093  WORKSHOP IN COLLEGE TEACHING 1-2 Credit Hours
(Slashed with GEOL 61093) Workshop in college teaching.
Prerequisite: Doctoral standing.
Schedule Type: Workshop
Contact Hours: 1-2 other
Grade Mode: Satisfactory/Unsatisfactory

GEOL 72011  HYDROLOGY 3 Credit Hours
(Slashed with GEOL 62011) Introduction to hydrologic measurements, properties of water precipitation, evapotranspiration, runoff computations, streamflow and flood routing.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 72030  REMOTE SENSING 3 Credit Hours
(Cross-listed with GEOG 71052)(Slashed with GEOL 42030, GEOL 52030, GEOG 41052, GEOG 51052) Computer analysis of multispectral satellite datasets. Applications in terrestrial Earth science are emphasized.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 72068  ADVANCED HYDROGEOLOGY 3 Credit Hours
(Slashed with GEOL 62068) Quantitative approach to occurrence of ground water; methods of investigation evaluation and development of ground water resources emphasizing optimization and maximal exploitation without environmental changes.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 72069  HYDROGEOCHEMISTRY 3 Credit Hours
(Slashed with GEOL 42069 and GEOL 52069) Processes and evolution of the chemical composition of water in the natural hydrologic cycle. Methods of hydrochemical interpretation applied to ground water and pollution problems.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
GEOL 72079 ADVANCED ENGINEERING GEOLOGY  3 Credit Hours
(Slashed with GEOL 62079) Role of geology in site selection, design and construction relative to dams, tunnels, highways, slope stability and nuclear power plants. Selected case histories. Field trip and term paper required.
Prerequisite: GEOL 52078; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 72082 INTRODUCTION TO SOIL MECHANICS  3 Credit Hours
(Slashed with GEOL 62082) Engineering properties and engineering behavior of soils, including classification properties, compaction permeability strength and compressibility.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 72083 ROCK SLOPE STABILITY  3 Credit Hours
(Slashed with GEOL 62083) Provide information used to recognize, avoid, design for control and correct slope movements in rocks; determination of shear strength along rock discontinuities; stability analysis of rock slopes.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 72084 FOUNDATION ENGINEERING  3 Credit Hours
Prerequisite: GEOL 52078 or GEOL 72082; and doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 73042 ENVIRONMENTAL GEOCHEMISTRY  3 Credit Hours
(Slashed with GEOL 43042 and GEOL 53042) Explores chemical processes that influence the natural environment, including anthropogenic impacts. Topics include atmospheric chemistry and air pollution, energy and climate change, toxic organic compounds, water chemistry and water pollution, metals, soils, sediments and waste disposal. Environmental problem-solving using steady state and non-steady state box models, thermodynamics and energy transfer and chemical reactions and equilibria. Required half-day field trip.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 73044 ENVIRONMENTAL ISOTOPES  3 Credit Hours
(Slashed with GEOL 43044 and GEOL 53044) Deals with the fundamentals of isotope geochemistry and the application of primarily light stable isotopes (H, O, C, N) to Earth system processes (involving the hydrosphere, biosphere and upper geosphere).
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 73063 SEDIMENTARY PETROLOGY  3 Credit Hours
(Slashed with GEOL 63063) Classification, texture, composition, provenance and diagenesis of sandstones and carbonates, following review of optical mineralogy. Petrographic microscopy and other laboratory techniques are emphasized.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 74028 PALEOEKOLOGY  3 Credit Hours
(Slashed with GEOL 64028) Relationships between ancient organisms and their environments, as interpreted from fossils, enclosing rock strata and recent analogs. Field and laboratory studies. Saturday field trips.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 74030 SYSTEMATIC INVERTEBRATE PALEONTOLOGY I  3 Credit Hours
(Slashed with GEOL 64030) Detailed investigation and examination of important literature concerning taxonomic characters of invertebrate phyla: Protista, Porifera, Cnidaria and Bryozoa. Numerous oral reports, specimen examination.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 74032 SYSTEMATIC INVERTEBRATE PALEONTOLOGY II  3 Credit Hours
(Slashed with GEOL 64032) Detailed investigation and examination of important literature concerning taxonomic characters of invertebrate phyla: Brachiopoda, Mollusca, Arthropoda and Echinodermata. Numerous oral reports, specimen examination.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 74036 CENOZOIC CLIMATE CHANGE  3 Credit Hours
(Slashed with GEOL 64036) An overview of the concepts and principles involved in interpreting global and hemispheric Cenozoic climate change (past 65 million years). Emphasis on particular temporal and spatial scales and cycles. Extensive reading in scientific journals.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 74038 PALEOLIMNOLOGY  3 Credit Hours
(Slashed with GEOL 64038) An overview of significant topics and applications in paleolimnology of Holocene (last 10,000 years) and Pleistocene (last two million years) records, including current issues in environmental and climatic reconstruction. Extensive reading expected.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter
GEOL 74052    GLACIERS AND GLACIATION    3 Credit Hours
(Cross-listed with GEOG 71052) (Slashed with GEOG 41052, GEOG 51052, GEOG 44052, GEOG 55052) Examination of how glacial ice masses change the shape of the earth's surface, how they are integral to climate and sea level change and how they pose high risk hazards.
Prerequisite: Doctoral standing.
Schedule Type: Lecture
Contact Hours: 3 lecture
Grade Mode: Standard Letter

GEOL 80095    ADVANCED TOPICS IN GEOLOGY    1-3 Credit Hours
(Repeatable for credit) Advanced topics presented by visiting professors or one-time offerings presented by regular faculty.
Prerequisite: Doctoral standing; and special approval.
Schedule Type: Lecture
Contact Hours: 1-3 lecture
Grade Mode: Standard Letter

GEOL 80098    RESEARCH    1-15 Credit Hours
(Repeatable for credit) Research for doctoral students. Credits earned may be applied toward degree with departmental approval.
Prerequisite: Doctoral standing.
Schedule Type: Research
Contact Hours: 1-15 other
Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 80199    DISSERTATION I    15 Credit Hours
(Repeatable for credit) Doctoral dissertation, for which registration in at least two semesters is required first of which will be semester in which dissertation work is begun and continuing until the completion of 30 hours. prerequisite: Admission to candidacy for doctoral degree; and doctoral standing.
Schedule Type: Dissertation
Contact Hours: 15 other
Grade Mode: Satisfactory/Unsatisfactory-IP

GEOL 80299    DISSERTATION II    15 Credit Hours
(Repeatable for credit) Continuing registration required of doctoral students who have completed the initial 30 hours of dissertation, continuing until all degree requirements are met.
Prerequisite: GEOL 80199; and doctoral standing.
Schedule Type: Dissertation
Contact Hours: 15 other
Grade Mode: Satisfactory/Unsatisfactory-IP