*Please note that this syllabus should be regarded only as a general guide to the course and is subject to change at the instructor’s discretion.

EESC114001 Our Mobile Earth, 3 credits
Boston College Summer Session 2018
Summer 1, May 15, 2018 – June 21, 2018
Tues/Thurs 9:30 AM – 12:45 PM

Instructor Name: Suzanne R. O’Brien
BC E-mail: Suzanne.obrien.4@bc.edu
Office Hours: before and after class, or by appointment

Boston College Mission Statement
Strengthened by more than a century and a half of dedication to academic excellence, Boston College commits itself to the highest standards of teaching and research in undergraduate, graduate and professional programs and to the pursuit of a just society through its own accomplishments, the work of its faculty and staff, and the achievements of its graduates. It seeks both to advance its place among the nation's finest universities and to bring to the company of its distinguished peers and to contemporary society the richness of the Catholic intellectual ideal of a mutually illuminating relationship between religious faith and free intellectual inquiry.

Boston College draws inspiration for its academic societal mission from its distinctive religious tradition. As a Catholic and Jesuit university, it is rooted in a world view that encounters God in all creation and through all human activity, especially in the search for truth in every discipline, in the desire to learn, and in the call to live justly together. In this spirit, the University regards the contribution of different religious traditions and value systems as essential to the fullness of its intellectual life and to the continuous development of its distinctive intellectual heritage.

Course Description
This course will provide you with an introduction to the structure of the Earth and the dynamic processes that continuously shape and remodel its surface. During class, we will discuss the formation and evolution of the oceans and continents within the framework of the modern theory of plate tectonics. The locations, causes and effects of earthquakes and volcanoes are presented. The dynamics within Earth which drive the tectonic plates are outlined.

Textbooks & Readings (Required)
Essentials of Geology (Third Edition or more recent) by: Stephen Marshak

Course Goal
After taking this course you should be able to identify and interpret some of the geological features and events you encounter in your daily life, and relate these features to plate tectonic processes. In addition, you will gain a better understanding of geologic hazards, geologic resources and geologic time.
Course Learning Objectives
1. to gain factual knowledge (geologic terminology, classifications, scientific methods);
2. to learn fundamental geologic principles, generalizations and theories;
3. to improve your ability to associate geologic features and events with plate tectonics;
4. to develop your understanding of geologic hazards and resources; and,
5. to apply course material to recognize and identify basic earth materials and earth processes.

Class Outcomes

Class 1 May 15
Introduction
1. You will learn about this course: its structure, learning objectives, grading policy, and your course instructor.
2. You will consider how geology relates to your life.

Physical and Chemical Layers of the Earth/Lithospheric Plate Boundaries
1. You will examine the chemical and physical layers of the Earth.
2. You will compare granite, basalt, peridotite (rocks).
3. You will identify the main types of plate boundaries associated with tectonic plate motion.
4. You will identify geologic features at each type of plate boundary.

Class 2 May 17
The Way the Earth Works
1. You will contemplate the hypothesis of Continental Drift (Wegner) and the concept of Sea Floor Spreading (Hess and Dietz).
2. You will identify the basic principles of the Theory of Plate Tectonics.
3. You will contemplate intra plate volcanism and hot spots.
4. You will locate “real life” (geographic) examples of different plate boundaries and hotspots.
5. You will prepare for Quiz 1 (Chapters 1, 2 and associated homework).

Class 3 May 22
Magma and Igneous Environments/Igneous Rocks
1. You will take Quiz I (Chapters 1, 2 and associated homework).
2. You will identify why rocks melt.
3. You will review P/T Phase Diagrams as they relate to molten rock/magma.
4. You will compare the different chemical compositions of magma and associate magmatic chemistry to tectonic plate boundaries.
5. You will examine and identify the most common types of igneous rocks and igneous features.

Class 4 May 24
Volcanoes and Volcanic Hazards
1. You will review Quiz I.
2. You will relate different volcano eruption styles to magmatic chemistry and plate boundaries.
3. You will identify the different types of volcanoes.
4. You will research the various hazards to life and environment that can result from volcanic eruptions (Mt. St. Helens case study Box 5.1)
5. You will examine and identify the most common types of igneous volcanic rocks and volcanic debris.

Class 5 May 29
Sedimentary Environments and Sedimentary Rocks
1. You will learn how sediment is produced and compare different types of sedimentary
environments.
2. You will examine and identify the most common types of sedimentary rocks.
3. You will contemplate transgression and regression in a sedimentary sequence.
4. You will investigate caves, sinkholes, hydrofracking.
5. You will prepare for Quiz II (Chapters 4, 5, 6 and associated homework).

**Class 6 May 31**

**Metamorphic Settings and Metamorphic Rocks**
1. You will take Quiz II (Chapters 4, 5, 6 and associated homework).
2. You will examine how a rock changes/metamorphoses under stress.
3. You will examine and identify the most common types of metamorphic rocks and their protoliths.
4. You will consider all three rock types in the Rock Cycle Summary Cross Section (Interlude C).

**Class 7 June 5**

**Earthquakes/ Faults**
1. You will review Quiz II.
2. You will observe how the Earth’s crust responds to and moves under stress.
3. You will identify the major types of faults and relate these to different types of stress and tectonic boundaries.
4. You will evaluate the main types of seismic waves.
5. You will determine the geographic location of an earthquake by triangulating its epicenter in Triangulating the Epicenter of an Earthquake assignment.

**Class 8 June 7**

**Structural Geology**
1. You will examine how the Earth’s crust can deform under stress.
2. You will compare brittle and ductile deformation.
3. You will measure structural deformation through strikes and dips of rock units, folds and faults.
4. You will identify various geologic features in structural geology homework and relate these structures to geologic stress, plate tectonics, and our course concept map.
5. You will prepare for Quiz III (Chapters 7, 8, 9 and associates homework).

**Class 9 June 12**

**Relative Dating**
1. You will take Quiz III (Chapters 7, 8, 9 and associates homework).
2. You will review the principles of relative dating.
3. You will identify the main types of unconformities and what they represent.
4. You will use the principles of relative dating to evaluate the sequence of geologic events in a block diagram.
5. You will interpret the geologic history of an area using what you know about rock formation and the principles of relative dating.

**Class 10 June 14**

**Correlation**
1. You will review Quiz III.
2. You will consider index fossils and correlation of stratigraphic sequences.
3. You will interpret a geologic cross section using the principles of relative dating (lab).
4. You will correlate data from well logs to construct a geologic cross section (in class).
Class 11 June 19
Geologic Time/Intro to groundwater
1. You will examine the geologic time scale.
2. You will research major events (including extinction events) in Earth’s history.
3. You will construct a comprehensive geologic cross section using well logs and interpret the
geologic history of an area.
4. You will prepare for Quiz IV (cumulative, plus Chapter 10, parts of Chapter 16 and associated
homework).

Class 12 June 21
Putting it all together!
1. You will review your geologic cross section and interpretation.
2. You will take Quiz IV.

Grading Procedures
4 quizzes* – each worth 15% (includes all material covered in lectures, readings and homework) = 60%
Final homework – Constructing and Interpreting a Geologic Cross Section = 15%

Proposed Assessment dates:
dates are approximate only and subject to change

Quiz I: May 22, 2018 – 15%
Quiz II: May 31, 2018 – 15%
Quiz III: June 12, 2018 – 15%
Quiz IV: June 21, 2018 – 15%

Constructing and Interpreting a Geologic Cross Section: due June 19, 2018 – 15%

Equal weight all homework assignments: 25%

<table>
<thead>
<tr>
<th>Assessment</th>
<th>Course Learning Objective (as numbered above)</th>
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<tbody>
<tr>
<td>In-class Assessments (proposed dates listed above)</td>
<td>1, 2, 3</td>
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<tr>
<td>Textbook reading</td>
<td>1, 2, 4</td>
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<tr>
<td>Homework assignments/Lecture Tutorials</td>
<td>1, 3, 4, 5</td>
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</table>

*Quizzes:* Students are expected to take quizzes at the scheduled time. Only very unusual circumstances
(e.g. family emergency, serious illness) are acceptable reasons for missing an assessment. You must
notify me prior to the assessment date if you will miss an assessment, in any event. Failure to notify me
prior to a missed assessment will result in a zero for that assessment grade.

Grading
A    >93                        C    73-76.9
A-   90-92.9                     C-   70-72.9
B+   87-89.9                     D+   67-69.9
B    83-86.9                     D   63-66.9
B-   80-82.9                     D-   60-62.9
C+   77-79.9                        F below 59.9
All students can access final grades through Agora after the grading deadline each semester. Transcripts are available through the [Office of Student Services](#).

**Course Expectations/Students' Responsibilities**
You are expected to attend every class, submit all homework assignments and take all in-class assessments. Attendance is taken every class; I do not post lecture notes on line. All assignments must be submitted on time and according to instructions. They will not be accepted at other times. Students are responsible for completing all course requirements and for keeping up with all that goes on in the course, whether or not the student is present.

### Proposed Lecture Topics
**Our Mobile Earth**  
*(subject to change)*

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Proposed Lecture Topic/Objective</th>
<th>Homework*</th>
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<tbody>
<tr>
<td>Class 1</td>
<td><strong>Introduction</strong></td>
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</table>
  - Introduction  
  - Review of syllabus |  
  **Physical and Chemical Layers of the Earth**  
  - granite, basalt, peridotite (rocks)  
  - Lithosphere  
  - Asthenosphere  
  - Crust  
  - Mantle  
  - Inner Core  
  - Outer core | **Read: Ch. 1: Welcome to the Neighborhood or Introducing the Earth System**  
pg. 20-31  
**Read Ch. 2: The Way the Earth Works**  
pg: 33-67  
**Complete:**  
1. Pacific Ocean Lithospheric Plate Motion Assignment  
2. Plate Tectonic Boundaries Assignment |
| Class 2 | **Plate Boundaries** |  
  - Main types of plate boundaries: divergent, convergent, transform  
  - Geologic features at plate boundaries | **Continental Drift/ Sea Floor Spreading**  
  - Hypothesis of Continental Drift  
  - Concept of Sea Floor Spreading  
  - Theory of Plate Tectonics  
  - Real life examples | **Complete:**  
3. Plate Tectonics and Hotspots Assignment  
**Hot Spots**  
  - Intra plate volcanism  
  - Yellowstone hotspot case study |
<table>
<thead>
<tr>
<th>Week</th>
<th>Class</th>
<th>Date</th>
<th>Notes</th>
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<tbody>
<tr>
<td>2</td>
<td>3</td>
<td>May 22</td>
<td>QUIZ I (Chapters 1, 2 and associated homework)</td>
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<tr>
<td></td>
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<td></td>
<td><strong>Magma and Igneous Environments</strong></td>
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<td></td>
<td></td>
<td></td>
<td>• Why rocks melt</td>
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<td>• Phase diagrams for igneous environments; decompressional melt, heat transfer, and flux/wet melting</td>
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<td>• Different chemical compositions of magma and resulting igneous rocks/rock names</td>
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<td>• Phaneritic/aphanitic textures</td>
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<td><strong>Bowen’s Reaction Series/Igneous Rocks</strong></td>
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<td>• Bowen’s Reaction Series, common types of igneous rocks, igneous features</td>
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<td></td>
<td><strong>Volcanoes</strong></td>
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<td>• Different eruption styles</td>
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<td>• Different magmatic chemistry</td>
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<td>• Main types of volcanoes: Shield, Cinder, Stratovolcano/Composite</td>
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<td>• Mt. St. Helens case study</td>
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<td>• Most common types of volcanic rocks/debris</td>
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<td>2</td>
<td>4</td>
<td>May 24</td>
<td>Read Ch. 4: Magma and Igneous Rocks</td>
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<td>Complete:</td>
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<td>4. P/T Phase Diagram and the Origin of Magma Assignment</td>
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<td>5. Bowens Reaction Series Assignment</td>
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<td>3</td>
<td>5</td>
<td>May 29</td>
<td>Read Ch. 5: Wrath of Vulcan, Volcanic Eruptions</td>
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<td>Complete:</td>
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<td>6. Volcanoes and Igneous Features Worksheet</td>
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<td><strong>Sedimentary Environments/ Sedimentary Rocks</strong></td>
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<td>• Introduction to common sedimentary rocks: clastic, biochemical, chemical, organic</td>
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<td>• Sedimentary environments</td>
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<td>• Transgression/Regression</td>
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<td><strong>Sedimentary Environments</strong></td>
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<td></td>
<td>• Caves, sinkholes</td>
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<td>• Marcellus shale, hydro fracking</td>
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<td>• Oil and Gas formation (see Recent Class Notes)</td>
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<td>Class 6</td>
<td>May 31</td>
<td>Chapter 12: Energy and Mineral</td>
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<td>• Hydro fracking</td>
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<td>• Oil and Gas formation</td>
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<td>• Sed, review for midterm</td>
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**Quiz II**  
(Chapters 4, 5, 6) & associated homework  

<table>
<thead>
<tr>
<th>Metamorphic Settings/Metamorphic Rocks</th>
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<tbody>
<tr>
<td>• Agents of metamorphism—T, P fluids</td>
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<tr>
<td>• Response of a rock (growth of new minerals)</td>
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<tr>
<td>• Metamorphic setting: contact, burial, reginal</td>
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| Complete: |
| 7. Rock and Tectonic Summary Worksheet |

<table>
<thead>
<tr>
<th>Class 7</th>
<th>June 5</th>
<th>Week 4</th>
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<td>Earthquakes/Faults</td>
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<td>• Brittle deformation vs. ductile deformation</td>
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<td>• Block diagrams</td>
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<td>• Normal, reverse, strike-slip faults</td>
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<td>• Hanging wall/footwall</td>
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<td>• Intro to seismic waves P and S waves (time permitting)</td>
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<td>• Epicenter/hypocenter</td>
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<td>• Elastic rebound</td>
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| Read Ch 8: Earthquakes |
| Complete: |
| 8. Triangulating the Epicenter of an Earthquake Lab |

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<thead>
<tr>
<th>Class 8</th>
<th>June 7</th>
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<tr>
<td></td>
<td></td>
<td>Structural Geology</td>
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<tr>
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<td></td>
<td>• Anticline/syncline/surficial rock layers…</td>
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<td>• Plunging/nonplunging</td>
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<td>• Strikes and dips</td>
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</table>

| Read Ch 9: Structural Geology |
| Complete: |
| 9. Structural Deformation Worksheet |
| Week 5 | Class 9  
June 12 | Rock deformation and the Earth's crust  
- Deformation relationship to stress, and plate tectonics | Prepare for Quiz III (Ch. 7, 8, 9 and associated homework) |
| --- | --- | --- | --- |
| | Quiz III  
(Ch. 7, 8, 9) and associated homework | **Relative Dating**  
- Introduce 5 Principles of Relative Dating:  
  - Original horizontality  
  - Superposition  
  - Cross cutting relationships, inclusions, faunal succession  
  - Unconformities  
  - Basic geologic sequences | **Read Ch.10: Relative Dating and Geologic Time**  
**Complete:**  
- 10. Principles of Relative Dating Worksheet |
| | Class 10  
June 14 | **Correlation**  
- In class – 11. Relative Dating Lab | **Read Ch.10: Relative Dating and Geologic Time**  
**Complete:**  
- 12. Correlating Well Logs |
| Week 6 | Class 11  
June 19 | **Groundwater**  
- Permeability  
- Porosity  
- Correlating Well Logs  
- Geologic time | **Complete:**  
- Final Correlation Assignment |
| | | **Geologic time**  
- Major events in Earth’s history  
- Structure of geologic time  
- Start Final Correlation |  
**Prepare for Quiz IV (cumulative, Chapter 10, pt. of 16)** |
| | Class 12  
June 21 | **Putting it all together!**  
- Construct a geologic cross section and interpret its geologic history  
- Quiz IV |  |

*All homework is due at the beginning of the following class.*
Written Assignments
Summer Session students are expected to prepare professional, polished written work. Written materials must be typed and submitted in the format required by your instructor. Strive for a thorough yet concise style. Cite literature appropriately, using APA, MLA or CLA style per your instructor’s requirements. Develop your thoughts fully, clearly, logically and specifically. Proofread all materials to ensure the use of proper grammar, punctuation and spelling. For writing support, please contact the Connors Family Learning Center.

Accommodation and Accessibility
Boston College is committed to providing accommodations to students, faculty, staff and visitors with disabilities. Specific documentation from the appropriate office is required for students seeking accommodation in Summer Session courses. Advanced notice and formal registration with the appropriate office is required to facilitate this process. There are two separate offices at BC that coordinate services for students with disabilities:

The Connors Family Learning Center (CFLC) coordinates services for students with LD and ADHD. The Disabilities Services Office (DSO) coordinates services for all other disabilities.

Scholarship and Academic Integrity
Students in Summer Session courses must produce original work and cite references appropriately. Failure to cite references is plagiarism. Academic dishonesty includes, but is not necessarily limited to, plagiarism, fabrication, facilitating academic dishonesty, cheating on exams or assignments, or submitting the same material or substantially similar material to meet the requirements of more than one course without seeking permission of all instructors concerned. Scholastic misconduct may also involve, but is not necessarily limited to, acts that violate the rights of other students, such as depriving another student of course materials or interfering with another student’s work. Please see the Boston College policy on academic integrity for more information.