CoursePack
Geology I: Physical Geology Lab
Newton Campus, Perimeter College, GSU
Polly A. Bouker

In this course pack, you will find a schedule of lab exercises, instructions, assignment coversheets, and other necessary items for Physical Geology Lab.

Each lab has a cover page that should be attached to the papers you turn in to your professor.

NOTE: Several labs require basic unit conversions and other calculations. If you are in this course, you have already demonstrated that you have the necessary math skills for these labs, even if the type of problem is different from other problems you have solved.

GSU offers tutoring in the tutoring center and the Science Department offers assistance with various scientific questions in the “SCIENCE GROTTO.” The Grotto is staffed by scientists from various disciplines (biology, chemistry, physics), but anyone would be able to assist with calculations you may encounter.

Each lab includes a pre-lab video, that can be accessed by scanning the QR code at the beginning of the lab in your manual. You will be required to view these, and will need a barcode scanner on your cell phone or tablet to read this code. Note that there are many FREE barcode scanners in the Apple App Store, and the Google Play Store. If you do not have the ability to view these with the type of cell phone or tablet you have, please let me know asap.

Schedule on next page
# Course Outline:

Keep a copy of this schedule available at all times so that you stay aware of important dates. There may not be in-class reminders.

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<td>Plate Tectonics</td>
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<td>FINAL EXAM</td>
<td></td>
</tr>
<tr>
<td>4/20</td>
<td>TBA - Keep available in case needed</td>
<td></td>
</tr>
</tbody>
</table>

*Dates and assignments are subject to change at the discretion of the instructor*
Thinking like a Geologist

Pre-Lab Assignment

• View the pre-lab video by scanning the QR code on the first page of the lab reading in your lab manual before coming to class.
• Read through the ENTIRE lab before coming to class.

In-Class Assignment

• 1.1 ALL
• 1.4 ALL

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with this coversheet attached.
Topographic Maps

Pre-Lab Assignment

- View the pre-lab video by scanning the QR code on the first page of the lab reading in your lab manual before coming to class.
- Read through the ENTIRE lab before coming to class in both lab manuals.
- Complete Pre-Lab assignment that follows here in the course pack. TURN IN AT BEGINNING OF CLASS

In-Class Assignment

USE A PENCIL
- Complete the assignment found following the Pre-Lab here in the course pack.

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with this coversheet attached.

The following pages are an excerpt from http://ung.edu/university-press/books/laboratory-manual-for-introductory-geology.php by Deline, Harris, and Tefend, University System of Georgia, licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.
1. A 15 minute quadrangle map of a region within the United States with a longitude of $76^\circ 00'00''$ in the right corner of the map, will read what longitude in the left corner?

2. A 15 minute quadrangle map of a region within the United States with a latitude of $43^\circ 15'00''$ in the top corner of the map, will read what latitude in the bottom corner?

3. A fractional scale of 1:24,000 means that 1 inch = ________ feet.

4. A fractional scale of 1:24,000 means that 1 foot = ________ kilometers.

For Questions 5 through 9, refer to Figure 3.4 below, which shows a hill, an intermittent stream, and two index contours (darkened contour lines). Assume the contour interval for this map is 5ft, and the index contour that is crossing the stream has an elevation of 70ft.

5. Which way is the stream flowing, to the North to the South?

6. What is the elevation of the highest contour on this portion of the map?

7. Calculate the relief of this map (Hint: Review the “Contour Lines” section in this chapter for assistance calculating relief).

8. Calculate the gradient of the stream between the highest and lowest contour lines that you can see cross the stream. These two contour lines are 2 miles apart.

9. The hill in the above diagram has a slightly steeper side on which side of the hill, the west or east side?
Maps will need to be viewed online using lab laptops or your own computer at home if you need to finish. There are found at the end of the document found at the following link.

https://ung.edu/university-press/books/laboratory-manual-for-introductory-geology.php

(CHAPTER 3)

3.8 TOPOGRAPHIC MAPS LAB ASSIGNMENT

Note: This lab is in color. Therefore, if you print it out in black and white please refer back to the electronic copy to avoid confusion.

This Lab Assignment is to be mailed to your Instructor at the contact address recorded in the Syllabus. Make sure that you use additional postage if needed. There is no online assessment for the Topographic Maps Lab.

Complete the entire assignment and mail to your instructor postmarked by the assignment deadline. You should make an extra copy to practice on and mail in a clean and neat version for grading. Make sure to include your name on every page and staple all of the pages together.

Please take advantage of all the resources available to you. Be sure to read the corresponding lecture which contains directions to work out the solutions to the problems below. You should also review the instructional videos located in the unit content area within the course for additional assistance. Finally, check the Topographic Map Unit Discussion forum and the tutor talk area for additional resources and hints.

3.8.1 Topographic Maps Lab

NOTE: For all of the following figures, assume North is up.

1. (10 pts) The following topographic map (Map 3.1) is from a coastal area and features an interesting geological hazard in addition to the Ocean. Using a contour interval of 40 meters, label the elevation of every contour line on the map below. (Note: elevation is meters above sea level, which makes sea level = ____m).

Map 3.1
Author: Brad Deline
Source: Original Work
License: CC BY-SA 3.0
2. (10 pts) Imagine you are a geologist for the United States Geological Survey. You are tasked with creating your own coastal Topographic map, so you hike around the area with a GPS receiver (Global Positioning System) and every so often you record your position along with the elevation in meters at that point, which results in the following map (Map 3.2). Complete Map 3.2 by adding in the contour lines using a contour interval of 100 meters. Draw the contour lines so that they are continuous (do not die off), and either continue off the map or form an enclosed circle (look at the topographic map in the problem 1 for an example). More often than not, your contour lines will fall between the GPS points on your map, so do your best to determine the contour line positions.

![Map 3.2](image1)

Map 3.2
Author: Brad Deline
Source: Original Work
License: CC BY-SA 3.0

For questions 3-7 refer to the Map 3.3. The following topographic map shows an interesting and informative geological feature called a drumlin, which is a pile of sediment left behind by a retreating glacier.

![Map 3.3](image2)

Map 3.3
Author: Brad Deline
Source: Original Work
License: CC BY-SA 3.0
3. (2 pts) What is the contour interval on Map 3.3?

4. (2 pts) What is the regional relief on Map 3.3?

5. (5 pts) Using the contour lines on Map 3.3, which area along the red line is steeper A to B or B to C? Explain how you came to this conclusion.

6. (5 pts) What is the gradient from A to B and B to C on Map 3.3? Show your work.

7. (2 pts) Drumlins can be used to determine the direction of movement in the glacier with the glacier moving toward the shallower side of the structure. Using your previous answers for Map 3.3, what direction was the glacier traveling? Note: unless indicated otherwise, assume that North is up (towards the top of the map).
8. (20 pts) Construct a topographic profile from A to A' on the graph paper below.

9. (5 pts) Based on the scale you choose for the topography (vertical axis) in question 8, calculate the amount of vertical exaggeration on the topographic profile you constructed above. Show your work.
For this part of the lab you will need to use Maps 3.5 and 3.6 (appearing at the end of this chapter). Following Maps 3.5 and 3.6 is a Map Key that you can use to identify the various symbols found on topographic maps. Also, note that the maps are in color and the colors have significance in terms of the symbols.

**Questions 10-18: Rome North Quadrangle (27 pts)**

10. (2 pts) What is the ratio scale of this map?

11. (2 pts) Explain in a sentence how this type of scale works.

12. (2 pts) What is the latitude on the north edge of the map?

13. (2 pts) What is the longitude on the east edge of the map?

14. (6 pts) Find Big Dry Creek, which is north of Rome. What direction does that river flow? Explain two reasons why you came to this conclusion.

15. (2 pts) Examine the large Ridge in the Northwestern portion of the map. What is the tallest point in this ridge? How tall is it?

16. (2 pts) How much higher is that point from Lake Conasauga?

17. (5 pts) What is the gradient between Lake Conasauga and the tallest point in the ridge? Show your work (Hint: zooming out will let you see both features on the map at the same time and may make it easier to measure).
18. (4 pts) How would the gradient change if you measured from Swan Lake to the tallest point in the ridge rather than Lake Conasauga? Explain why.

Questions 19-22: Grand Tetons (12 pts)
19. (3 pts) Explain why this map is referred to as a 7.5 minute map?

20. (3 pts) What is the relief on this map?

21. (2 pts) Does Taggert Creek flow into Taggert Lake or Lake Taminah? What direction does the creek flow?

22. (4 pts) Garnet Canyon (a little to the west of the word Garnet) is a common camping location for hikers and mountain climbers at the Grand Teton's National Park. Examine the topography surrounding Garnet Canyon and the Middle Teton. What would be the easiest and safest route from Garnet Canyon to the top of the Middle Teton? Explain why. (Drawing a simple map will help).

Maps 3.5, 3.6, and Map Key (appearing on following pages)
Author: USGS
Source: USGS
License: Public Domain
Minerals

Pre-Lab Assignment

• View the pre-lab video by scanning the QR code on the first page of the lab reading in your lab manual before coming to class.
• Read through the ENTIRE lab before coming to class.
• Complete 3.2 - TURN IN AT BEGINNING OF CLASS

In-Class Assignment

USE A PENCIL
• 3.4 (Sample numbers assigned in class)
• 3.5

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with this coversheet attached.
Igneous Rocks

Pre-Lab Assignment

- View the pre-lab video by scanning the QR code on the first page of the lab reading in your lab manual before coming to class.
- Read through the ENTIRE lab before coming to class.
- Complete 5.1, 5.2 - TURN IN AT BEGINNING OF CLASS

In-Class Assignment

USE A PENCIL
- 5.4 B, C, D (Additional instructions will be given in class)
- 5.5 A, B, C
- 5.8 (Sample numbers assigned in class)

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with this coversheet attached.
Part A.
1. Below is an “Ash Thickness Map”, where each numbered locations gives the thickness of the ash in centimeters.

Draw contour lines showing locations on the surface of the ground where the thickness is constant at 50 cm, 40, 30, 25, 20, 15, 10, 5, and 1 cm. The contour lines of equal “thickness” are called isopach contours. Keep in mind that the source of the ash is the caldera of Mt. Pinatubo and that the winds have blown some of the ash out to sea. Once you have established the contour pattern for the thicker deposits on the land you are to extend the pattern over the water to show the approximate thickness of ash that would have been deposited on the deck of any boat anchored at any location in the South China Sea and the Manila Bay.
2. Write on the Ash Thickness Map to show the location of the following three cities; note that the locations are already marked with a circled star on the isopach map:

<table>
<thead>
<tr>
<th>City</th>
<th>Latitude:</th>
<th>Longitude:</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Fernando</td>
<td>15° 02’ N</td>
<td>120° 41’ E</td>
</tr>
<tr>
<td>Lubao</td>
<td>14° 55’ N</td>
<td>120° 37’ E</td>
</tr>
<tr>
<td>Manila</td>
<td>14° 37’ N</td>
<td>120° 58’ E</td>
</tr>
</tbody>
</table>

3. Using the scale in the lower left corner of the map, determine how far it is from the central caldera to...

San Fernando = _____ km.  Lubao = _____ km.  Manila = ________ km.

4. Using your completed contour map estimate the thickness of the ash that fell on each city?

San Fernando = _____ cm  Lubao = _____ cm  Manila = ________ cm

5. The pattern of the isopach contours indicates the wind was blowing during the pyroclastic eruption. The wind was blowing toward what compass direction?

6. Use the isopach contour pattern to determine the expected amount of ash that would have fallen on the city of Manila if the wind had been blowing directly toward the City?

7. Again use the scale and measure perpendicular to the wind direction and determine the approximate width of the area that was covered by more than 1 cm of ash.... ___ km wide

8. The maximum amount of ash that can be plowed back into a soil and have it maintain its ability to grow crops is about 5 cm. Again using the scale and measuring perpendicular to the wind direction determine the surface area of the land that will no longer support farming... hint, recall that the area of a circle is equal to $\pi r^2$ (show your calculation)

9. Examine the Explanation (often called a “Key”) and note the special symbol used to show a lahar deposit, which is a volcanic mud-flow made from ash mixing with melted glacier waters. Examine the map and explain why the lahar deposits display such a unique pattern ... (hint...likes spokes of a wheel).
Part B:
1. Using a microscope examine each of the ash samples sampled from each of the three cities and record your observations in the Data Table below. Note the grain size and make a general description of the texture (a comparison of the three samples, i.e. which one is coarsest, which one is finest.) Remember that ash fragments are generally under 1 mm in size, and material up to 1 mm should be termed “fine”. Lapilli are grains larger than 2 mm. The composition should be reported as to percent of black minerals, percent of white minerals, and percent of clear mineral grains.

<table>
<thead>
<tr>
<th>City sampled:</th>
<th>Texture 1: Visual (Rank 1 = most coarse)</th>
<th>Texture 2: Using microscope. Estimate % using tool at back of lab manual</th>
<th>Color / Composition Estimate % using tool at back of lab manual</th>
</tr>
</thead>
<tbody>
<tr>
<td>San Fernando</td>
<td>Rank (1st to 3rd) for coarseness:</td>
<td>% of ash greater than 1 mm:</td>
<td>% White (feldspars) =</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% of ash less than 1 mm:</td>
<td>% Black (ferromag.) =</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>% Colorless (quartz &amp; glass) =</td>
</tr>
<tr>
<td>Lubao</td>
<td>Rank (1st to 3rd) for coarseness:</td>
<td>% of ash greater than 1 mm:</td>
<td>% White (feldspars) =</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% of ash less than 1 mm:</td>
<td>% Black (ferromag.) =</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>% Colorless (quartz &amp; glass) =</td>
</tr>
<tr>
<td>Manila</td>
<td>Rank (1st to 3rd) for coarseness:</td>
<td>% of ash greater than 1 mm:</td>
<td>% White (feldspars) =</td>
</tr>
<tr>
<td></td>
<td></td>
<td>% of ash less than 1 mm:</td>
<td>% Black (ferromag.) =</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>% Colorless (quartz &amp; glass) =</td>
</tr>
</tbody>
</table>

2. Why is there a size differences between the ash samples? (Hint if you cannot recall the location of each sample on the map, the instructor will let you see a copy of the key)

3. In the ash samples you should have found some larger crystals of single minerals. If the Mt. Pinatubo lava erupted quickly enough to form glass, explain the origin of these larger crystals. In other words, how is it possible to have both GLASS and MINERALS (crystalline) in the same ash.
Since it is so difficult to see felsic vs. mafic... etc. as you can tell from the microscope analysis you performed, it is often easier to determine the chemical composition of an ash, and then plot two of the chemical components on a graph to determine the name of the rock that has been pulverized to ash sized particles. Below are four chemical compositions for four different volcanic centers.

**Chemical Table for the Composition of Various Pyroclastic Eruptions**

<table>
<thead>
<tr>
<th>Weight %</th>
<th>Mt. Pinatubo</th>
<th>Mt. St. Helen’s</th>
<th>Kilauea, HI</th>
<th>Toana Range, NV</th>
</tr>
</thead>
<tbody>
<tr>
<td>SiO₂</td>
<td>63.8</td>
<td>63.5</td>
<td>49.2</td>
<td>77</td>
</tr>
<tr>
<td>Al₂O₃</td>
<td>16.3</td>
<td>17.8</td>
<td>13.3</td>
<td>12.1</td>
</tr>
<tr>
<td>Fe₂O₃</td>
<td>4.2</td>
<td>4.8</td>
<td>10.9</td>
<td>1.1</td>
</tr>
<tr>
<td>MgO</td>
<td>2.3</td>
<td>2.1</td>
<td>10.4</td>
<td>0.1</td>
</tr>
<tr>
<td>CaO</td>
<td>5.2</td>
<td>5.1</td>
<td>10.9</td>
<td>0.6</td>
</tr>
<tr>
<td>Na₂O</td>
<td>4.4</td>
<td>4.5</td>
<td>2.2</td>
<td>3.1</td>
</tr>
<tr>
<td>K₂O</td>
<td>1.5</td>
<td>1.3</td>
<td>0.5</td>
<td>5.6</td>
</tr>
<tr>
<td>Eruption Temp. °C</td>
<td>925</td>
<td>900</td>
<td>1200</td>
<td>740</td>
</tr>
</tbody>
</table>

4. Determine a rock name for the lava erupted at each volcanic center by taking the SiO₂ and K₂O values from the top table and plotting them into the various fields of the Lava Composition Diagram above. (Show and label your plotted poi)

Mt. Pinatubo ___________________________  Kilauea ___________________________

Mt. St. Helen’s ___________________________  Tonana Range ___________________________
13. In general, the chemical composition of magma will dictate how explosive the eruption of lava will be. Magmas of higher SiO$_2$ content are more viscous, possess a cooler temperature at time of eruption, and are most often associated with more explosive volcanic eruptions. Based on the lava compositional data (note SiO$_2$ content), rank each of the four volcanic events in order of expected explosiveness (Lowest to Highest)

<table>
<thead>
<tr>
<th>Lowest</th>
<th></th>
<th></th>
<th>Highest</th>
</tr>
</thead>
</table>

14. Given the same volume of magma, what would the eruption of Mt. Pinatubo have been like if it had a chemistry like the lavas of the Toana Range, Nevada. Comment on the explosivity and the amount of ash produced.
Sedimentary Rocks

Pre-Lab Assignment

- View the pre-lab video by scanning the QR code on the first page of the lab reading in your lab manual before coming to class.
- Read through the ENTIRE lab before coming to class.
- Complete 6.1, 6.2 A (1, 2, 3), 6.2 B - TURN IN AT BEGINNING OF CLASS

In-Class Assignment

USE A PENCIL
Question numbers will be assigned in class.
- 6.3
- 6.4
- 6.5
- 6.6 (Sample numbers assigned in class)
- 6.7

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with this coversheet attached.
Metamorphic Rocks

Pre-Lab Assignment

- View the pre-lab video by scanning the QR code on the first page of the lab reading in your lab manual before coming to class.
- Read through the ENTIRE lab before coming to class.
- Complete 7.1 - TURN IN AT BEGINNING OF CLASS

In-Class Assignment

USE A PENCIL

- 7.2
- TBA

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with this coversheet attached.
Geologic Structures

Pre-Lab Assignment

- View the pre-lab video by scanning the QR code on the first page of the lab reading in your lab manual before coming to class.
- Read through the ENTIRE lab before coming to class.
- Complete 10.1, 10.2 - TURN IN AT BEGINNING OF CLASS

In-Class Assignment

USE A PENCIL
Questions assigned during class.
- 10.4
- 10.5
- 10.6
- 10.8

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with this coversheet attached.
Georgia Geology

The colors on the Geological Highway Map of the Southeastern Region can be correlated to the type of rock, the formation name, and its age using the key “Generalized Chart of Surface Time and Rock Units”, located on the bottom center of the map. The key is subdivided into regions based upon the ROCK TYPE (Igneous, Sedimentary, or Metamorphic) and the STATES where they occur. When you see a rock unit on the map (such as the red mPzg in the Piedmont region), find the column labeled "Georgia", and carefully look for the color and symbol (mPzg). Also note that along the left side of the chart there is a geologic time scale, which will help you make sense of the symbols. In this case, mPzg means, "middle Paleozoic granite". (See if you can find it in the column under igneous rocks.)

1. From the colors on the map and the key for the colors, determine the DOMINANT Rock Type(s) and Ages of the rock units in each province, and put them in the chart below. In addition two rocks from each province are located on the table in the front of the room. Identify each rock by name... such as basalt, or chert, or marble...

<table>
<thead>
<tr>
<th>Province</th>
<th>Dominate Rock - (Ign., Sed., or Meta.) Name of two rocks provided... A &amp; B</th>
<th>Ages (Era names only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coastal Plain</td>
<td>Dominant Rock Type is __________</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rock A = ___________________________</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rock B = ___________________________</td>
<td></td>
</tr>
<tr>
<td>Piedmont</td>
<td>Dominant Rock Types are __________ &amp; __________</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rock A = ___________________________</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rock B = ___________________________</td>
<td></td>
</tr>
<tr>
<td>Blue Ridge</td>
<td>Dominant Rock Type is __________</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rock A = ___________________________</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rock B = ___________________________</td>
<td></td>
</tr>
<tr>
<td>Valley and Ridge</td>
<td>Dominant Rock Type is __________</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rock A = ___________________________</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Rock B = ___________________________</td>
<td></td>
</tr>
</tbody>
</table>
2. For the sedimentary rocks, the legend shows a generalized **stratigraphic column** with **lithologic symbols**. Each pattern indicates a particular rock type (these are shown in black and white in the Legend in the lower left part of the chart. (Dots indicate sandstone, bricks indicate limestone, etc.) If you plan to take Historical Geology (GEOL 1122), you will want to become familiar with these symbols.

<table>
<thead>
<tr>
<th>Province</th>
<th>Dominate Rock - (Ign., Sed., or Meta.)</th>
<th>Ages (Era names only)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian Plateau</td>
<td><strong>Dominant Rock Type is _____________</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Rock A = ________________</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td><strong>Rock B = ________________</strong></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Province</th>
<th>Name of two rocks provided... A &amp; B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Appalachian Plateau</td>
<td></td>
</tr>
</tbody>
</table>

- Appalachian Plateau
- Blue Ridge
- Valley and Ridge
- Piedmont
- Coastal Plain

**Cartersville Fault**
Draw the lithologic symbols of the following rock types in the spaces provided:

<table>
<thead>
<tr>
<th>Sandstone</th>
<th>Siltstone</th>
<th>Shale</th>
<th>Limestone</th>
<th>Dolomite</th>
<th>Conglomerate</th>
</tr>
</thead>
</table>

3. Look at the geologic cross-section and green tectonic map with the lines of the cross-sections indicated, on the back of the Southeastern Region map, and answer the following questions about geologic structures.

   a. Which physiographic province is characterized by plutons and faults?

   b. Note that the rocks of the Coastal Plain dip (see chapter on crustal deformation in your text if you need a review of this term). In which compass direction do they dip?

   c. Which province is characterized by folded rocks and thrust faults?

   d. Locate the buried Triassic Red Beds in the cross section. Which province are they buried beneath?

   What type of fault (normal or reverse) bounds the edges of this buried basin?

4. a. Find the Chattahoochee River on the geologic map. It runs along a relatively straight line across the state. This line is a fault zone. What is its name? (It is labeled on the map.)

   b. On your satellite image, carefully draw this fault, and label it with its name.

5. a. The Piedmont and Valley and Ridge provinces are separated by a fault in northwestern Georgia. What is its name? (It is labeled on the map.)

   b. On the satellite image located on the next page, carefully draw this fault, and label it with its name.

6. There are two major mountainous regions in Georgia, the Blue Ridge Mountains and the Valley and Ridge. Describe (compare and contrast) the appearance of these two provinces on the satellite image.
7. The coast of Georgia is marked by a series of barrier islands, often called "Sea Islands".
   a. Looking at the geological map, list the names of these 9 islands in order from north to south.
b. Using the map colors and symbols, what is the “Period” name of the sediment that makes up these islands?

8. Inland, within 50 miles of the coast, is a series of sandy ridges that parallel the coastline. They are colored dark orange, and each ridge has its own map symbol. (Example: Qwi = Quaternary Wicomico. Find it on the map and in the chart at the bottom before proceeding further. They will be near the top of the Georgia Sedimentary Rock column because they are young.) Each of these sandy ridges represents an old barrier island or beach ridges from a time when sea level was higher in this area. Using the chart on the map, list the names of each of these old shoreline sand ridges. One of them is Wicomico. Now list the names of the other 5 ridges.

9. Find Stone Mountain on the map. It is EAST of Atlanta, and is a small red body elongated in an east-west direction. Just to the left of it is its symbol (Pzg).
   a. What is its age (Era not date)?
   b. Give the name of the rock that makes up Stone Mountain?
   c. How large is the surface area (in square miles, length x width) of the Stone Mountain Formation? (Look for the map scale.) Show your work.
   d. Is Stone Mountain a stock or a batholith?
   e. From an examination of the geologic map and cross-sections, would you agree with the statement that we sometimes hear, that the rock unit at Stone Mountain extends under much of Georgia, and into other neighboring states? (This is a common belief among residents of the area.) Is it true or false? Why?
   f. Find the largest granite body in the state. It is the Elberton granite. (East of Athens.) How many square miles does it cover? Show your work.
   e. Is the Elberton granite a stock or a batholith?

10. Marble is mined in Georgia.
   a. Marble is the metamorphosed equivalent of what sedimentary rock?
   b. Which geologic province in Georgia contains the marble deposits? (Check the legend under Metamorphic Rocks to find the marble, then look for that color and symbol on the map.)
   c. On the Southeastern region map, marble is the purple unit labeled "Lpzm", Lower Paleozoic marble. It belongs to a particular named formation. Check the chart and give its name.
11. Locate the Tallulah Falls Dome on the Southeastern Region map. It is in the far northeastern corner of Georgia.

   a. Study the diagrams of domes in your textbook and/or lab manual. Then decide whether the rocks exposed in the center of a dome are older or younger than the rocks around the edge of a dome.

   b. In the center of the Tallulah Falls Dome is a rock unit shown in dark yellow or light orange and labeled "q". It is metamorphic. Find it in the chart at the bottom of the map. From the list of names given beside this symbol, what is the formation name of this rock unit?

12. Locate the Towaliga Fault on the Southeastern Region map. (It is between Atlanta and Columbus, GA). Notice the dark yellow units of quartzite near it (Hollis Quartzite of the Pine Mountain Group). The Hollis Quartzite underlies Pine Mountain near Callaway Gardens.

   a. Draw and Label the Towaliga Fault on your satellite image.

   b. Label the Hollis Quartzite on your satellite image by coloring the area Yellow.

13. Water seeping down along the Towaliga fault is heated at great depth, and then moves upward through the quartzite deposits. The naturally warm water in this area produces a particular geologic feature, which was the reason that one of our former presidents moved to this area. The feature is also the name of a town in this area. There is a hint on the back of the map (#20).

   c. What is the geologic feature produced by the water? __________________________

   d. Who was the President? _________________________________

   e. Why did he want to be near this particular geologic feature?

14. Kaolinite (kaolin) is mined in Georgia. It is used in glossy coatings on paper, tire manufacturing, ceramics, etc. The kaolin deposits are of Cretaceous and Tertiary age. Find them on the map. They are shown in green with map symbol "Tku" (Tertiary and Cretaceous undifferentiated). In which physiographic province is the kaolin located?

15. The dome of the State Capitol in Atlanta is covered by 43 ounces (2.7 lbs.) of gold that was mined in Georgia, and donated by citizens in 1956. Fresh gold was reapplied in 1981 and 1996. In what Georgia counties was gold mined? If you cannot find it on the map, try Google!

Turn in all pages from GEOLOGY OF GEORGIA LAB (in page order to avoid points reduction).
WATER

Pre-Lab Assignment

• View the pre-lab video by scanning the QR code on the first page of the lab reading in your
  lab manual before coming to class.
• Read through the ENTIRE lab before coming to class in BOTH lab manuals

In-Class Assignment:
To complete this lab, you will need to follow along online using in lab laptops or your own
computer at home if you need to finish. You will also need to use GOOGLE EARTH to complete
all of the questions.

https://ung.edu/university-press/books/laboratory-manual-for-introductory-geology.php
(CHAPTER 5)

USE A PENCIL
• Complete the assignment found on the following pages here in the course pack.

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with
this coversheet attached.

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manual-for-introductory-geology.php by Deline, Harris, and Tefend, University System of
Georgia, licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.
1. What type of stream drainage pattern is present on this map? This may be easier to determine by examining the tributaries to the main stream.
   a. dendritic b. trellis c. radial d. rectangular

2. Based on the drainage pattern type, does the bedrock underlying this area consist of rocks uniformly resistant to erosion or rocks alternating between resistant and non-resistant layers?
   a. uniformly resistant bedrock b. alternately resistant and non-resistant bedrock

3. Are the rocks likely tilted and folded or horizontal?
   a. tilted and folded b. horizontal

4. Are streams in this area downcutting or laterally eroding?
   a. downcutting b. laterally eroding

5. In which stage of the cycle of stream erosion is this area?
   a. old age b. mature c. youthful

6. Calculate the stream gradient of Grape Creek in ft/mile. Use the index contour just above the “m” in Temple Canyon for your initial spot. Measure the gradient to the index contour past the word Creek (the last contour before it reaches Arkansas River). The distance between these areas is ~1.6 miles (measured along the curving distance of the non-magnified stream). What is the gradient?
   a. 15’/mile b. 100’/mile c. 125’/mile d. 200’/mile

7. Observe the stream on the Omaha N, Nebraska-Iowa quadrangle. In which stage of the cycle of stream erosion is this area?
   a. old age b. mature c. youthful

8. Compare the contour intervals from the Royal Gorge, Colorado map (map 5.1) to the Omaha N, Nebraska-Iowa map. Would you expect the gradient of the Missouri River in Nebraska to be greater or less than the gradient that you calculated for the Grape River in Colorado?
   a. less than the Grape River gradient b. greater than the Grape River gradient
9. Locate the state boundary between Nebraska and Iowa along the Missouri River. Why does the boundary depart from the river channel?
   a. when the boundary was created, Iowans wanted the Carter Lake area in their state
   b. the boundary follows the course of the river at the time that it was drawn; the river has since moved
   c. none of the above

10. What is the term for the geologic feature called Carter Lake?
    a. entrenched meander
    b. oxbow lake
    c. cutbank
    d. point bar

11. Was Carter Lake cut off before or after the state boundary between Nebraska and Iowa was drawn?
    a. before
    b. after

For Questions 12-17, you will need to complete the chart and graph on the next page.
Part B – Recurrence Intervals

Data from the chart below was collected at the USGS site, and includes the 20 largest discharge events for Sweetwater Creek at station 02337000 from January 1, 2008 – May 1, 2015, excluding the dramatic 2009 flood (we will learn more about it later). In order to create a flood frequency graph, first the recurrence interval must be calculated (one is calculated below for an example). A recurrence interval refers to the average time period within which a given flood event will be equaled or exceeded once. To calculate it, first determine the rank of the flood, with a 1 going to the highest discharge event and a 20 going to the lowest discharge event. Calculate the recurrence interval using the following equation:

$$RI = \frac{n+1}{m}$$

where $RI$ = Recurrence Interval (yrs)
$n$ = number of years of record (in this case, 8)
$m$ = rank of flood

<table>
<thead>
<tr>
<th>Peak Discharge Date</th>
<th>Discharge (cfs – cubic ft/sec)</th>
<th>Rank</th>
<th>Recurrence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/27/2008</td>
<td>5,140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/2/2009</td>
<td>2,360</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10/13/2009</td>
<td>3,290</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11/12/2009</td>
<td>6,120</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>12/3/2009</td>
<td>2,860</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/10/2009</td>
<td>2,170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/19/2009</td>
<td>3,830</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Peak Discharge Date</th>
<th>Discharge (cfs – cubic ft/sec)</th>
<th>Rank</th>
<th>Recurrence Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>12/26/2009</td>
<td>2,650</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/25/2010</td>
<td>2,500</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/6/2010</td>
<td>3,680</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/12/2010</td>
<td>3,600</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3/10/2011</td>
<td>2,350</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/17/2011</td>
<td>3,100</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/24/2013</td>
<td>2,060</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2/27/2013</td>
<td>2,190</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5/6/2013</td>
<td>3,610</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12/23/2013</td>
<td>3,790</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/8/2014</td>
<td>4,170</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1/5/2015</td>
<td>3,970</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4/20/2015</td>
<td>2,940</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Now that you have completed the chart, plot the discharge against the recurrence interval on the following graph. Please note that the x-axis (for recurrence interval) is in logarithmic scale and you may need to estimate where the data points fall. A logarithmic scale is non-linear, based on orders of magnitude. Each mark on the x-axis is the previous mark multiplied by a value. Use a straight edge to draw a best fit line (a straight line along the graph that shows the general direction that the group of points seem to be heading – it doesn’t have to hit every point on the graph) through the graph when you are done, and then answer the following questions. Make sure your best fit line continues to the end of the graph.

12. On which date did a flood event have a recurrence interval of 0.5?
   a. 2/27/2013        b. 10/13/2009        c. 3/10/2011        d. 4/20/2015

13. Of the following dated flood events, which one would you expect to happen more often?

14. Observe your best fit line. What approximate discharge would be associated with a 50 year recurrence interval?
   a. 2,000 cfs        b. 4,750 cfs        c. 8,500 cfs        d. 14,000 cfs

15. Flood stage, or bankfull stage, on Sweetwater Creek occurs at a discharge of ~4,500 cfs. According to your best fit line, what is the recurrence interval of such a discharge?
   a. 0.5 years        b. 3 years        c. 25 years        d. 50 years
16. During the flood event of 9/23/2009, the discharge measured at this gaging station was 21,200 cfs. Note where this would plot on your graph. Would the recurrence interval for this flood plot at:
   a. 100 years    b. 300 years    c. 700 years    d. longer than 1,000 years

17. Is it possible that a flood with a similar discharge to that of the event from 9/23/2009 could happen again in the next 20 years?
   a. Yes    b. No

18. Which gas station is the most likely source of the gasoline leak?
   a. Station A    b. Station B    c. Station C

19. Is the school likely to be at risk of contamination from this same leak?
   a. Yes    b. No

20. Is the church likely to be at risk of contamination from this same leak?
   a. Yes    b. No

21. Locate Little Sinking Creek in the southern portion of the map, north of Hwy. 68 and south of the Edmonson County Line. In which direction does it flow?
   a. south    b. north    c. southeast    d. northwest

22. Follow the creek along its path. Where does it wind up?
   a. Along Hwy. 68    b. It disappears underground

23. Find Sloans Crossing. It is south of Mammoth Cave. What is the benchmark elevation at Sloans Crossing?
   a. 600’    b. 630’    c. 800’    d. 834’

24. Now look farther south of Sloans Crossing at Hwy. 31W. Look closely at the topography south of highway, and it changes abruptly. What feature(s) can you observe south of Hwy. 31?
   a. sinkholes    b. disappearing streams
   c. generally lower land surface elevations    d. all of the above
25. Keeping the abrupt topography change in mind, which of the following is true?
   a. In the northern portion of the map, the area is underlain by limestone
   b. In the southern portion of the map, the area is underlain by limestone

26. Locate the Louisville and Nashville Railroad line just south of Hwy. 31. Would this be an easy location to maintain a railroad?
   a. Yes   b. No

27. How would one describe this river?
   a. Straight   b. Meandering   c. Low sinuosity   d. Braided

28. In this stream, erosion is occurring on the _______________ because _______________, while deposition is occurring on the _______________ because _______________.
   a. point bars; the fastest velocity water flows to this point; cut banks; the slowest velocity water flows to this point
   b. point bars; the slowest velocity water flows to this point; cut banks; the fastest velocity water flows to this point
   c. cut banks; the fastest velocity water flows to this point; point bars; the slowest velocity water flows to this point
   d. cut banks; the slowest velocity water flows to this point; point bars; the fastest velocity water flows to this point

29. How would one describe this river?
   a. Straight   b. Meandering   c. Low sinuosity   d. Braided

30. What factors control the course of this river?
   a. Steep gradient and high discharge
   b. Low gradient and low discharge
   c. Low gradient and abundant sediment supply
   d. Steep gradient and low sediment supply
31. The river in this area has a rather particular pattern, what geologic process caused this?
   a. a meander eroded through its bank and created an oxbow lake
   b. the river is in a karst terrain and disappeared into the ground
   c. the river is following patterns, likely faults, in the underlying bedrock
   d. during a flood the river breached the natural levee flowing into the floodplain

32. Zoom out and examine the surrounding area, what geological hazards are likely in the area?
   a. sinkholes
   b. flooding of urban areas
   c. erosion and subsidence
   d. none of the above

33. What type of drainage pattern is present in this area?
   a. Trellis   b. Dendritic   c. Rectangular   d. Radial   e. Deranged

34. What does this type of drainage pattern indicate about the area?
   a. rocks in the area are homogeneous and/or flat lying
   b. rocks in the area are alternating resistant and non-resistant, forming parallel ridges and valleys
   c. stream channels radiate outward like wheel spokes from a high point
   d. stream channels flow randomly with no relation to underlying rocks or structure

35. What type of drainage pattern was present in this area?
   a. Trellis   b. Dendritic   c. Rectangular   d. Radial   e. Deranged
36. What does this type of drainage pattern indicate about the area?
   a. rocks in the area are homogeneous and/or flat lying
   b. rocks in the area are alternating resistant and non-resistant, forming parallel ridges and valleys
   c. stream channels radiate outward like wheel spokes from a high point
   d. stream channels flow randomly with no relation to underlying rocks or structure

37. In what direction was the main river flowing?
   a. west  b. east  c. north  d. south

38. How were these lakes formed?
   a. they were man-made – all are dammed
   b. they are formed by large rivers in the area
   c. as sinkholes, as underlying soluble rock was dissolved and areas collapsed
   d. they are impact structures that filled with water

39. What type of bedrock is present in this area?
   a. limestone  b. sandstone  c. gneiss  d. granite  e. chert

40. These features you are seeing are linear valleys. Assume that water flowed through these valleys at some time. What type of drainage pattern would this area represent?
   a. Trellis  b. Dendritic  c. Rectangular  d. Radial  e. Deranged

41. Think about the drainage pattern you selected in the previous answer – what does this tell you about the underlying rocks?
   a. the rocks are probably fractured
   b. the rocks are uniformly resistant
   c. the rocks are part of a topographic high, like a mountain
   d. the rocks are alternately resistant and non-resistant

42. Notice the general shape of this feature. It is thought to have formed by the runoff of either precipitation or groundwater. What type of drainage does this appear to be?
   a. Trellis  b. Dendritic  c. Rectangular  d. Radial  e. Deranged
Earthquakes

Pre-Lab Assignment

• View the pre-lab video by scanning the QR code on the first page of the lab reading in your lab manual before coming to class.
• Read through the ENTIRE lab before coming to class.

In-Class Assignment

USE A PENCIL

• 16.1
• 16.2
• 16.3

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with this coversheet attached.
Plate Tectonics

Pre-Lab Assignment

- View the pre-lab video by scanning the QR code on the first page of the lab reading in your lab manual before coming to class.
- Read through the ENTIRE lab in both lab manuals before coming to class.

In-Class Assignment:
To complete this lab, you will need to follow along online using in lab laptops or your own computer at home if you need to finish. You will also need to use GOOGLE EARTH to complete all of the questions.

**This lab is intended to include and summarize most of the plate tectonic concepts you have learned in your lecture this course this semester. It is long but it is very good material for solidifying your understanding of this important topic.**

https://ung.edu/university-press/books/laboratory-manual-for-introductory-geology.php
(CHAPTER 4)

USE A PENCIL
- Complete the assignment found on the following pages here in the course pack.

Notes:

Turn in all necessary pages from your lab manual (in page order to avoid points reduction) with this coversheet attached.

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The following is a summary of the questions in this lab for ease in submitting answers online.

1. Brazil (Latitude and Longitude)

2. Angola (Latitude and Longitude)

3. Measure in centimeters the distance (Map Length) between the two points you recorded in the previous question. Given that this portion of Pangaea broke apart 200,000,000 years ago, calculate how fast South America and Africa are separating in cm/year? (Hint: Speed = Distance/Time)

4. When will the next supercontinent form? Examine the Western Coast of South America, the Eastern Coast of Asia, and the Pacific Ocean. If South America and Africa are separating and the Atlantic Ocean is growing, then the opposite must be occurring on the other side of the earth (the Americas are getting closer to Asia and the Pacific Ocean is shrinking). How far apart are North America and Mainland Asia in cm? (measure the distance across the Pacific at 40 degrees north latitude—basically measure between Northern California and North Korea)? Take that distance and divide it by the speed you calculated in question 3 to estimate when the next supercontinent will form. Show your work!

5. How far have the snake fossils moved apart since they were originally deposited?
   a. 1250 miles        b. 1700 miles        c. 2150 miles        d. 2700 miles
6. Given that this portion of the Australian plate moves at a speed of 2.2 inches per year, how old are the snake fossils?
   a. 310 million years old  
   b. 217 million years old
   c. 98 million years old  
   d. 62 million years old
   e. 34 million years old

7. There are fossils such as *Glossopteris* and *Lystrosaurus* that are found in rocks in South America and Africa that indicate they were part of Pangaea approximately 200 million years ago. These same fossils can be found in Australia, which indicates it, along with Antarctica, was also part of Pangaea at that time. Based on your answer to question 6 which of the following statements about the break-up of Pangaea is TRUE?
   a. Australia and Antarctica separated before the break-up of Pangaea.
   b. Australia and Antarctica separated during the break-up of Pangaea.
   c. Australia and Antarctica separated after the break-up of Pangaea.

8. Consider the ages and positions of the islands listed above along with what you know about plate tectonics and hotspots. In what general direction is the Pacific Plate moving?
   a. Northwest  
   b. Southeast  
   c. Northeast  
   d. Southwest

9. How fast was the Pacific plate moving during the last 1.1 million years between the formation of the Big Island and Maui in cm/year? To calculate this divide the distance (in centimeters) between the two islands by the difference in their ages.

10. How fast was the Pacific plate moving from 7.2 million years ago to 4.7 million years ago between the formation of Kauai and Nihoa in cm/year? To calculate this divide the distance (in centimeters) between the two islands by the difference in their ages.
11. Examine the headings of the measurements that you took for the previous two questions. The headings indicate the direction the Pacific Plate is moving over the hot spot. How does the direction of motion of the Pacific Plate during the last 1.1 million years differ from direction of movement between 4.7 and 7.2 million years ago? The direction of plate movement in the last 1.1 million years__________.

a. shows no change  b. has become more southerly  c. has become more northerly

12. Zoom out and examine the dozens of sunken volcanoes out past Nihoa, named the Emperor Seamounts. As one of these volcanic islands on the Pacific Plate moves off the hotspot it becomes inactive, or extinct, and the island begins to sink as it and the surrounding tectonic plate cool down. The speed the islands are sinking can be estimated by measuring the difference in elevation between two islands and dividing by the difference in their ages (this method assumes the islands were a similar size when they were active). Calculate how fast the Hawaiian Islands are sinking, by using the ages and elevations of Maui and Nihoa.

13. Using the speed you calculated in the previous question (and ignoring possible changes in sea level), when will the Big Island of Hawaii sink below the surface of the ocean? Divide the current maximum elevation of the Big Island by the rate you calculated in the previous question.

14. Now zoom out to ~4000 miles eye altitude and look at the chain of Hawaiian Islands again. Notice the chain continues for thousands of miles up to Aleutian Islands (between Alaska and Siberia). Examine the northernmost sunken volcano (50 49 16.99N 167 16 36.12E) in this chain. Where was that volcano located when it was still active, erupting, and above the surface of the ocean?

a. 50 49 16.99N 167 16 36.12E  b. 52 31 48.72N 166 25 43.14W

c. 27 45 49.27N 177 10 08.75W  d. 19 28 15.23N 155 19 14.43W

15. The rock that most closely resembles the composition of continental crust based on the description in the previous section is:

16. Based on the choice you made for question 15, what is the density of the rocks that make up continental crust? Please give your answer in grams/milliliter.

17. The rock that most closely resembles the composition of oceanic crust based on the description in the previous section is:

18. Based on the choice you made for question 17, what is the density of the rocks that make up oceanic crust? Please give your answer in grams/milliliter.

19. Remember, because of isostasy the denser plate will be lower than the less dense plate. If oceanic and continental crust collided, based on their densities the ________ crust would sink below the ________ crust.
   a. continental; oceanic    b. oceanic; continental

20. According to the geothermal gradient, rocks buried 75 km beneath the surface would normally be at what temperature?
   At 75 km depth, rocks will be heated to about ________ degrees Celsius.
   a. 1500    b. 1250    c. 1000    d. 750

21. According to the geothermal gradient, rocks at 500 degrees Celsius will be buried how deep?
   At 500 degrees Celsius, rocks will be buried to about ________ km depth.
   a. 8    b. 12.5    c. 20    d. 27

22. What is the physical state of a dry mantle rock at point X?
   a. Completely melted    b. Starting to melt    c. Completely solid

23. What happens when the lithosphere at point X is heated to 1500 °C?
   a. No change    b. Starts to crystallize    c. Starts to melt
24. At what depth will the dry mantle rock at point X begin to melt if it is uplifted closer to Earth’s surface and its temperature remains the same?
   a. 35 km  b. 25 km  c. 18 km  d. 12 km

25. What would happen to the mantle rock at point X if water is added to it?
   a. No change  b. Starts to crystallize  c. Starts to melt

26. Which of the following places represent a Wadati-Benioff zone?
   a. 10°S, 110°W  b. 0°, 0°  c. 15°S, 180°  d. 30°N, 75°E

27. The Wadati-Benioff zone is associated with which type of plate boundary?
   a. Divergent  b. Convergent (Continent-Continent)
   c. Convergent (Continent-Ocean or Ocean-Ocean)  d. Transform

28. Examine the path of the river that feeds into and flows out of Quail Lake. What direction is the North American plate moving in comparison to the Pacific Plate at this location?
   a. East  b. West

29. Given that San Francisco is located on the North American Plate and Los Angeles is located on the Pacific Plate, are these two cities getting closer together or farther apart over time?
   a. Closer  b. Farther

30. Type “15 19 48.78 S 75 12 03.41 W” into the Google Earth Search bar. What type of tectonic plates are present?
   a. Ocean- Ocean  b. Ocean- Continent  c. Continent- Continent

31. What type of plate tectonic boundary is present?
   a. Transform  b. Convergent  c. Divergent

32. Type “6 21 49.68 S 29 35 37.87 E” into the Google Earth Search bar. What type of process is going on at this location?
   a. Seafloor spreading  b. Continental rifting  c. Subduction
33. What features would you expect to occur at this type of boundary?
   a. Earthquakes and a trench  b. Volcanoes and a valley  c. Mountains and landslides  d. Earthquakes and offset rivers

34. Type “28 04 27.044N 86 55 26.84E” into the Google Earth Search bar. What type of tectonic plates are present?
   a. Ocean- Ocean  b. Ocean- Continent  c. Continent- Continent

35. What type of plate tectonic boundary is present?
   a. Transform  b. Convergent  c. Divergent

36. Type “46 55 25.66 N 152 01 25.17 E” into the Google Earth Search bar. What type of tectonic plates are present? Make sure to zoom out to get a good view of the relevant features.
   a. Ocean- Ocean  b. Ocean- Continent  c. Continent- Continent

37. What features would you expect to occur at this type of boundary?
   a. Volcanos, earthquakes and a trench  b. Volcanoes and a linear valley  c. Mountains and landslides  d. Earthquakes and offset rivers

38. Type “43 41 07.81 N 128 16 56.29 W” into the Google Earth Search bar. What type of tectonic plates are present? Hint- make sure to re-read the section on plate boundaries before answering!
   a. Ocean- Ocean  b. Ocean- Continent  c. Continent- Continent

39. What type of plate tectonic boundary is at this exact location?
   a. Transform  b. Convergent  c. Divergent

40. This plate boundary isn’t as simple as the previous examples, meaning another nearby plate boundary directly influences it. Zoom out and examine the area, what other type of boundary is nearby?
   a. Transform  b. Convergent  c. Divergent

41. Go back to the location in Google Earth that you examined for question 36 (46 55 25.66 N 152 01 25.17 E). Which of the three proposed plate tectonic mechanisms would NOT occur at this location?
   a. Slab pull  b. Ridge push  c. Slab suction