Answer Key
Lecture Tutorials for
Introductory Physical Geology
with Quantitative Reasoning

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2019

Context

- The audience for these activities is an introductory physical geology or quantitative reasoning course for non-majors.
- The skills and concepts that students must have mastered involve creating and interpreting graphs (including triangle plots), explaining diagrams, and reading maps.
- These activities are designed to reinforce specific lecture topics and are scattered throughout the course.

Goals

- The content and concept goals for these activities follow those of the lecture topics: earthquakes, plate tectonics, minerals and rocks, volcanoes, geologic time, petroleum, rivers, groundwater, glaciers, and climate change.
- The higher order thinking skills goals for these activities involve making traditional lectures more interactive, holding students' attention throughout a class and deepening their comprehension and retention of lecture topics.
- Other goals for these activities are to increase attendance in a traditional lecture class and to prepare students for laboratory exercises.

Reference

- The concept and the name "lecture tutorial" originate from the following publication: Kortz, K.M., and J.J. Smay, 2012, *Lecture Tutorials for Introductory Geoscience*, W.H. Freeman & Co., New York.

Lecture Tutorial 1   **Name** _____
SCIENTIFIC HYPOTHESES
Date

1. Why does a rubber basketball fall back to the ground after it is thrown into the air?

       a. Aliens are pushing the ball down.

       b. Earth's magnetic field is attracting the ball.

       c. Gravity is pulling the ball to the ground

2. Which statement is not a hypothesis because it is not supported by current data?

         a   /   **b**   /   c

3. Which statement is not a hypothesis because it is not testable?

   a   /   b   /   c

4. Which statement is not a hypothesis because it is more certain than a hypothesis?

   a   /   b   /   **c**

5. The definition of the word "theory" in scientific discussions is different from the usage in casual conversation. Which word in the description of the scientific method is most similar to the informal use of the word "theory"?

       Informal "theory" = scientific hypothesis

6. Number the steps in the scientific method listed below in order of certainty with 1 = most certain.

      __**3**__ Hypothesis   __**1**__ Law   __**2**__ Theory

7. Why do you think feedback is an important process within the scientific method?

       Answers will vary but should include revising and refining hypotheses.

Lecture 2 Tutorial
Using Google Earth   **Name** _____
Date

1. What are the latitude and longitude of the Statue of Liberty?

   40°41′N, 74°03′W

2. What is the elevation of Liberty Island?

   5 m

3. What is the length of the island?

   0.38 km

4. a. In what country is the impact crater occupied by Manicouagan Lake?

   Canada

   b. Is the crater visible from space?

   Yes

   c. What is the eye altitude for the closeup view of Manicouagan Lake?

   105 km

   d. What is the width of the impact crater?

   66 km

Lecture 3 Tutorial
EARTHQUAKES
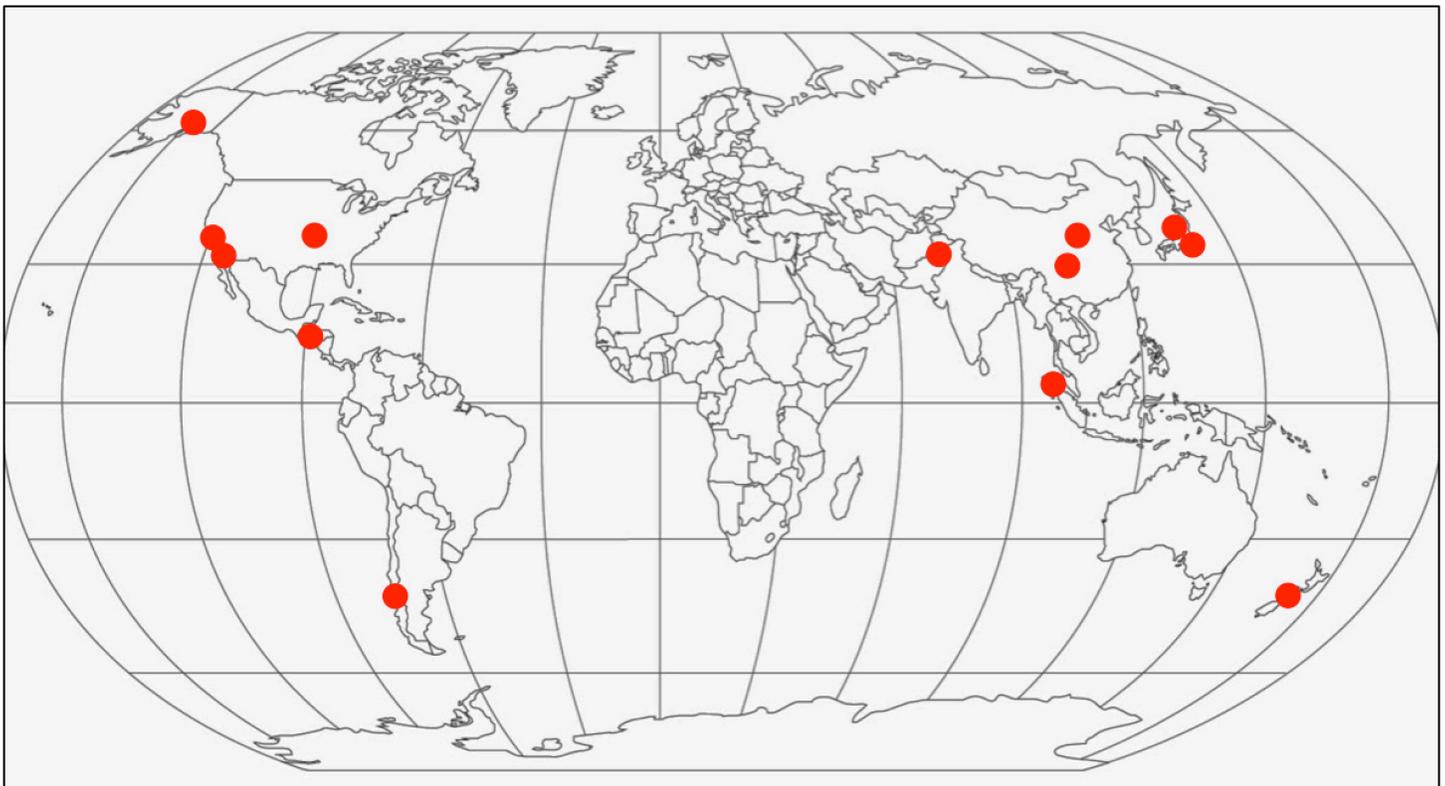Date

1. Plot earthquake epicenters throughout lecture using the map below.

2. Is every place on Earth equally likely to experience an earthquake?

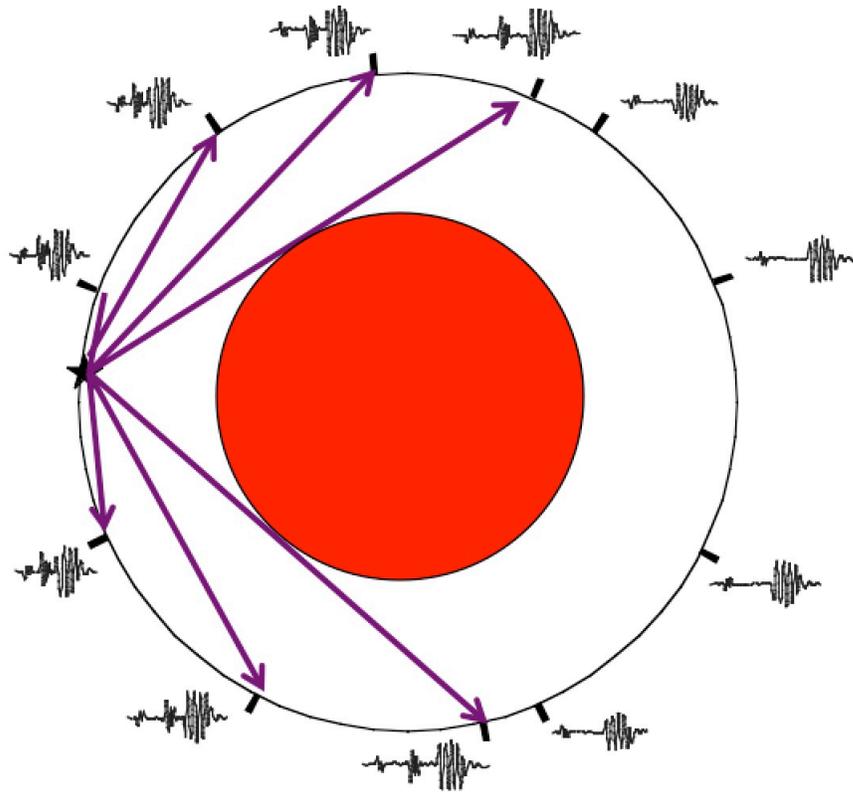   **No, some places are more likely to have earthquakes than others.**

3. Form a hypothesis to explain your observations in #1 and #2.

   Answers will vary but may include references to faults or plate tectonics.

Lecture 4 Tutorial
**EARTH'S CORE**   **Name** _____
Date

1. If we could cut open the Earth with a knife, the interior would look like: **apple, onion, M&M, Twinkie**

2. From which layer(s) can we obtain samples?   **Crust and mantle**

3. Draw arrows on globe (top of page) from the focus to stations with both P *and* S waves. Draw the
   outer core tangent to (just touching) the inner arrows.

4. What does the lack of S waves at some stations imply about the physical state of the core?

       Liquid (outer core only)

5. Label the crust on the
   diagram.

6. Draw a line along the
   Moho on the diagram.

7. Label the asthenosphere
   on the diagram.

crust

(mantle lithosphere)

asthenosphere
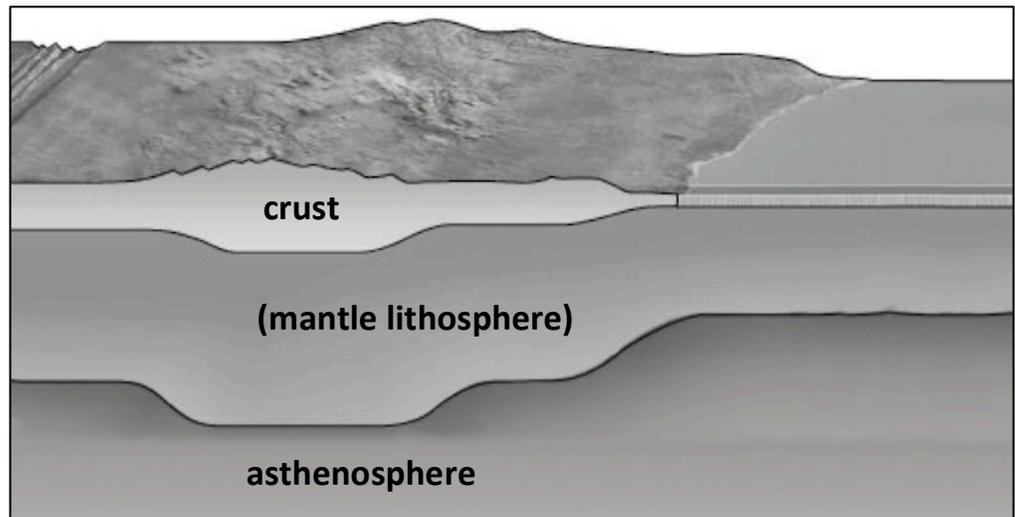
**Lecture 5 Tutorial**   **Name** _____
PALEOCLIMATES
Date

1. Shade in the areas with scratched rocks indicating glaciers and a polar climate. **See map.**

2. Draw horizontal lines in the areas with limestone or coal indicating a tropical climate. **See map.**

3. Put dots in the areas with sandstone or salt indicating subtropical latitudes of 20-30° N or S. **See map.**

4. Do the different areas coincide with today's climate zones?   yes / **no**

5. Draw a line on your map marking the approximate position of the paleoequator, based on the
   paleoclimates recorded by rocks.

        See map.

6. Do you agree with Alfred Wegener that paleoclimates support the idea of continental drift? Why or
   why not?

        Answers will vary but should be supported by at least two reasons.
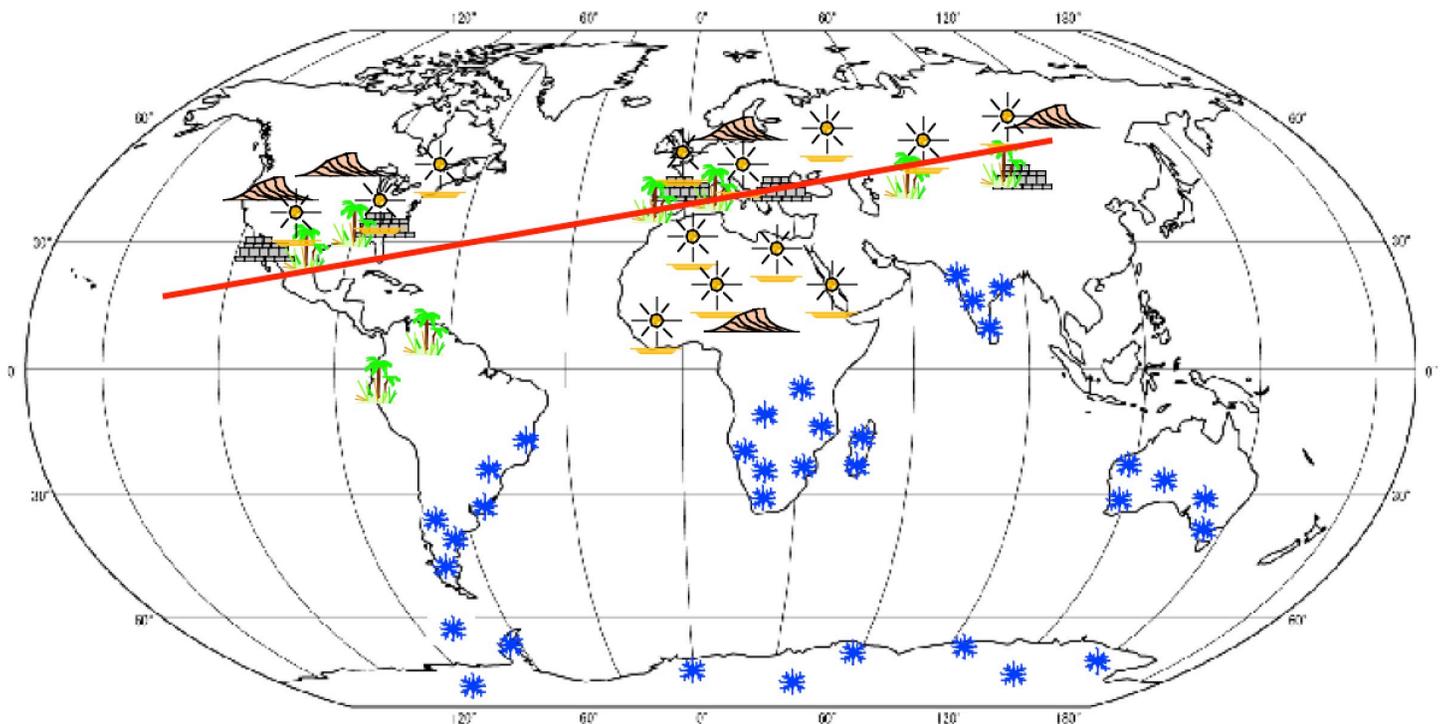
Lecture 6 Tutorial   **Name** _____

SEAFLOOR SPREADING

Date

1. The diagram on the screen shows two plates and a mid-ocean ridge. The double line represents the ridge, and arrows indicate the direction in which the plates are moving. Which location has the oldest rocks?

    A / B / C / I do not know.

2. Which location has the youngest rocks?

    A / **B** / C / I do not know.

3. The diagram on the screen shows marine magnetic anomalies, which are symmetric across a mid-ocean ridge. Which location marks the ridge?

                          A / **B** / C / D / I do not know.

4. Which location marks the ridge?

                          A / B / C / D / I do not know.

5. Which rate is not equivalent to the others?

                 20 km/Ma   /   20 mm/yr   /   2 cm/yr   /   **2 m/yr**   /   I do not know.

6. If a sample of seafloor basalt is collected 160 km from a mid-ocean ridge, and its age is found to be 4 Ma, what is the rate of seafloor spreading? Express your answer in cm/yr. **Show your work.**

    160 km = 16,000,000 cm = 16/4 cm/yr = 4 cm/yr
    4 Ma   4,000,000

7. If a sample of seafloor basalt is collected 480 km from a mid-ocean ridge, and the full spreading rate is 6 cm/yr, how old is the basalt? **Show your work.**

    480 km = 48,000,000 cm = 16,000,000 yr = 16 Ma
    3 cm/yr   3 cm/yr

Lecture 7 Tutorial   **Name** _____
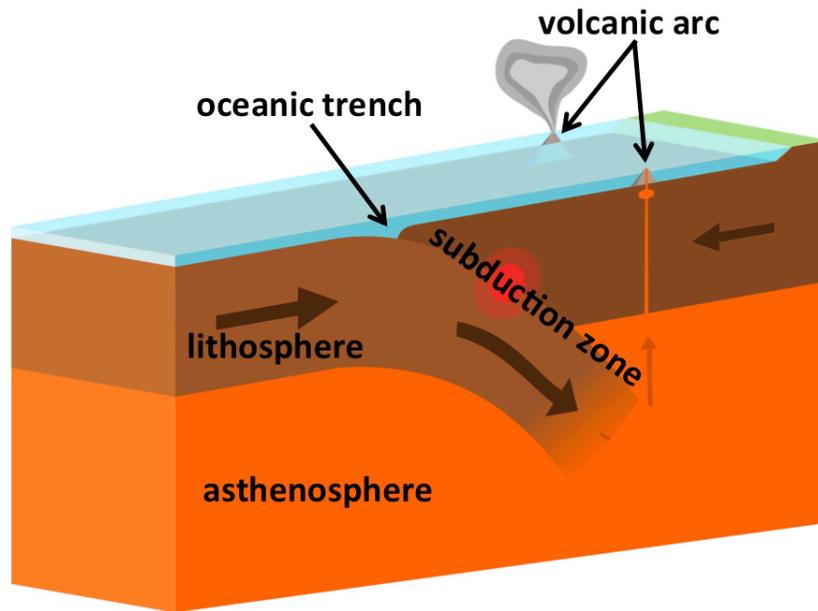**PLATE BOUNDARIES**
Date

1. Compare the two maps on the front screen. Based on the marine magnetic anomalies, which ridge is
   spreading faster?

   The one on the left (East Pacific Rise) is spreading faster because the magnetic anomalies are wider.

2. Sketch a cross-section that shows what happens when the two oceanic plates move toward each other.
   Your sketch should resemble the front of the block diagram on the screen. Label the following on your
   sketch: oceanic trench, volcanic island arc, subduction zone, lithosphere, and asthenosphere.

3. How many plates are shown on the map on the front screen?

   Four

4. Match each number to a type of plate boundary.

   __**B**__ 1   __**B**__ 2   __**D**__ 3   __**D**__ 4   __**A**__ 5   __**C**__ 6

   A. Divergent boundary   B. Ocean-ocean convergent boundary
   C. Transform boundary   D. Ocean-continent convergent boundary

5. Which two points listed on the screen are on the same plate?

   1 and 2

6. Which way does point 5 move relative to point 6?

   Slightly southeast

Lecture 8 Tutorial
PLATE TECTONICS   **Name** _____
Date

1. How many plates are visible on the Google Earth image on the front screen?

   1 / 2 / 3 / 4 / **5** / ?

2. On the Google Earth image on the front screen, how does the distance between Port-au-Prince, Haiti, and Caracas, Venezuela, change over time?

   Increases   /   **Decreases**   /   Stays constant   /   I do not know.

3. On the Google Earth image on the front screen, how does the distance between Miami, USA, and Mexico City, Mexico, change over time?

   Increases   /   Decreases   /   **Stays constant**   /   I do not know.

4. On the Google Earth image on the front screen, how does the distance between Port-au-Prince, Haiti, and Havana, Cuba, change over time?

   Increases   /   Decreases   /   Stays constant   /   I do not know.

5. According to the map on the front screen, toward which direction did the African Plate move to produce the Tristan da Cunha hotspot track?
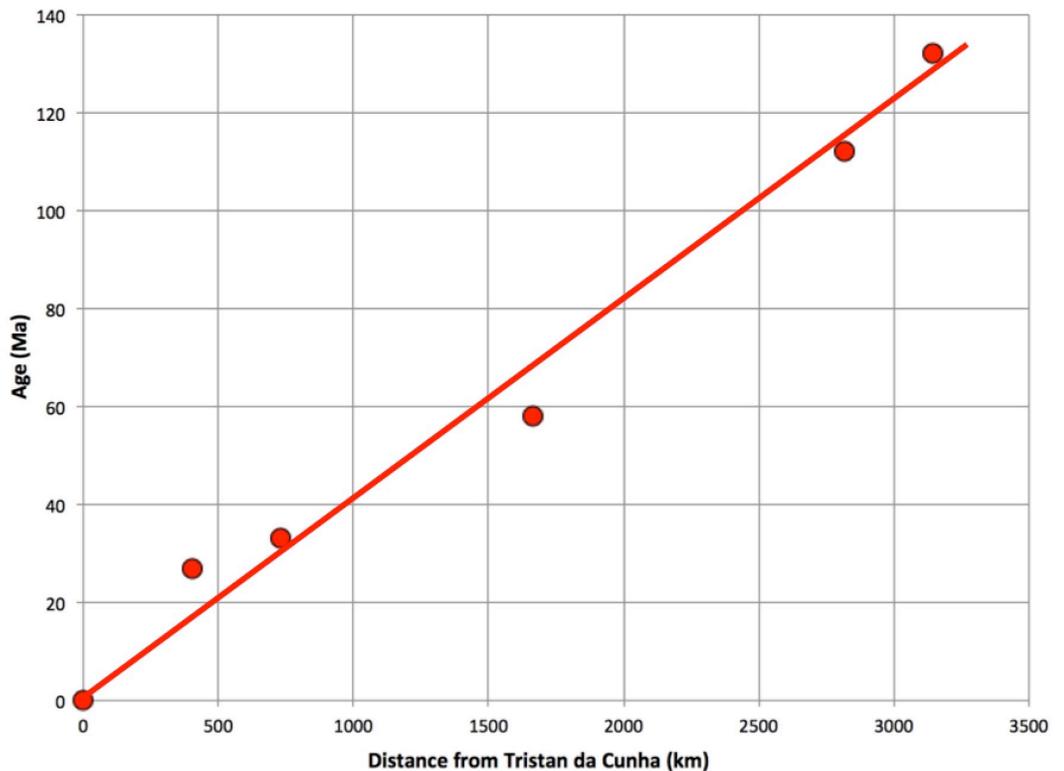
   NE

6. Which location should have the oldest rocks?

   Etendeka

7. Plot the points shown on the front screen.

8. Are the points arranged approximately in a line?

   Yes

Name _____

1. Which colored point has the coordinates (85,5,10)? Plot this point.

   Red / Blue / Purple / Black / ?

2. Which colored point has the coordinates (27, 40, 33)? Plot this point.

   Red / Blue / **Purple** / Black / ?

3. Which colored point has the coordinates (58, 20, 22)? Plot this point.

   Red / **Blue** / Purple / Black / ?

4. Plot the red line shown on the front screen and write its description here.

   A = 50%; B, C = 0-50%

5. Plot the blue line shown on the front screen and write its description here.

   C = 30%; A, C = 0-70%

6. Label the vertices with the feldspar minerals orthoclase (K), albite (Na), and anorthite (Ca) as shown on the front screen. Plot the point that represents pure orthoclase.

   Red

7. Plot the point on the front screen that contains no potassium (K). What are the contents of Na and Ca represented by this point?
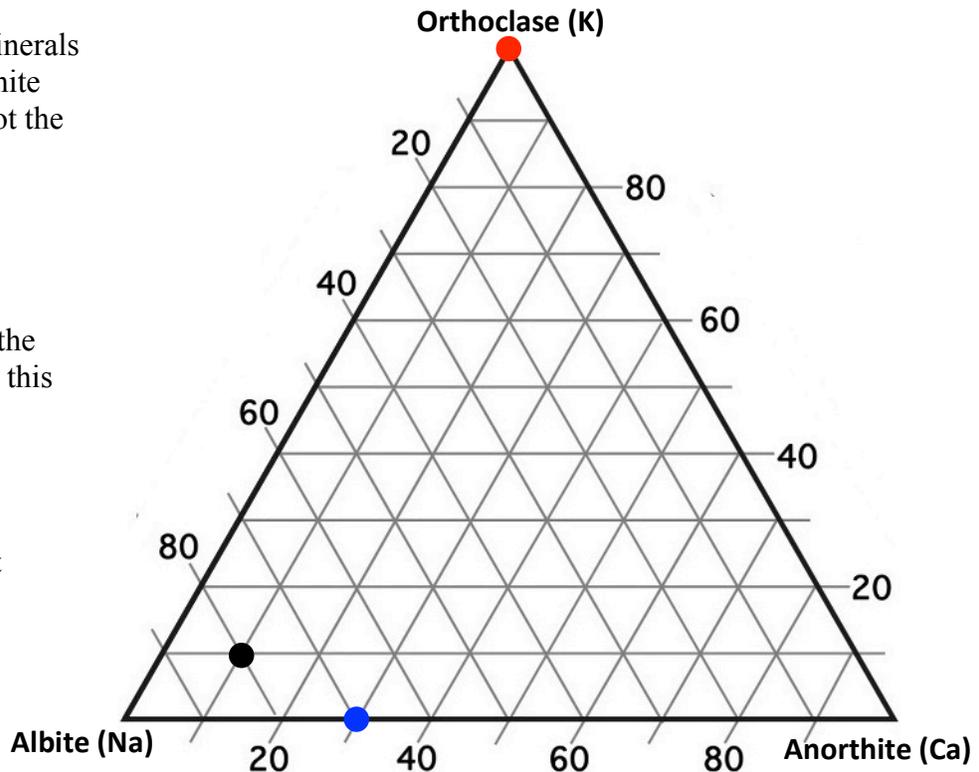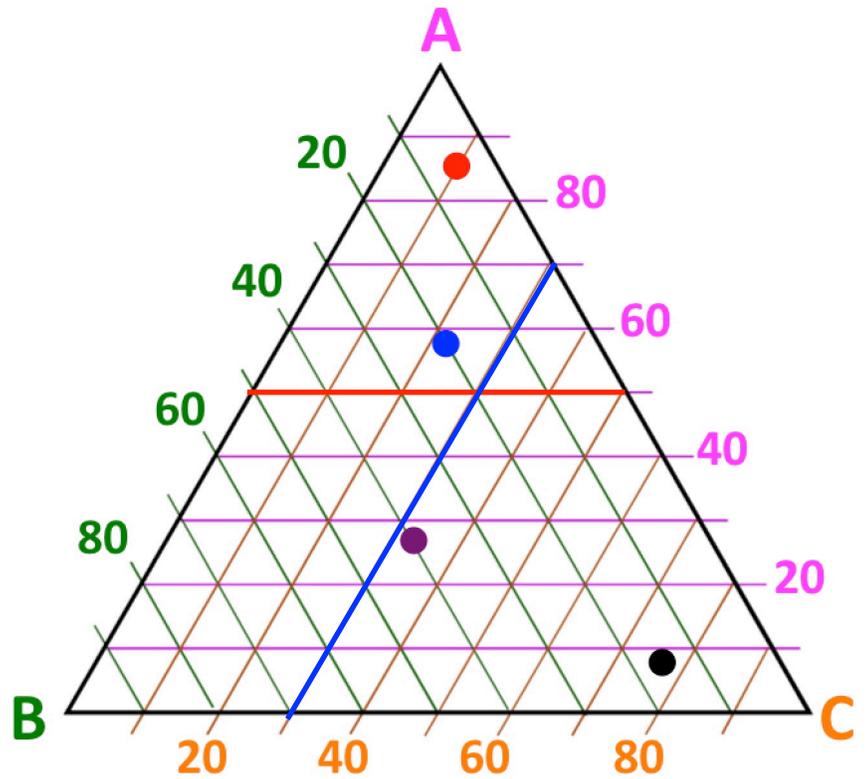
   Blue; Na = 70%, Ca = 30%

8. Plot the black point shown on the front screen. Write its coordinates here.

   Orthoclase = **10%**

   Albite = **80%**

   Anorthite = **10%**

Lecture 10 Tutorial
FELDSPAR TRIANGLES
Date

Name _____

1. Given the compositions on the front screen, eliminate one feldspar and label the vertices on the triangle.

2. Normalize the compositions. **Show your work here!**

    15% + 45% + 35% = 95%
    Ca: 15/95*100 = 16%
    K: 45/95*100 = 47%
    Na: 35/95*100 = 37%

3. Plot the feldspar on the triangle.

Orthoclase (K)
20
80
40
60
60
40
80
20
Albite (Na)   20   40   60   80   Anorthite (Ca)

4. Given the compositions on the front screen, eliminate one feldspar and label the vertices on the triangle.

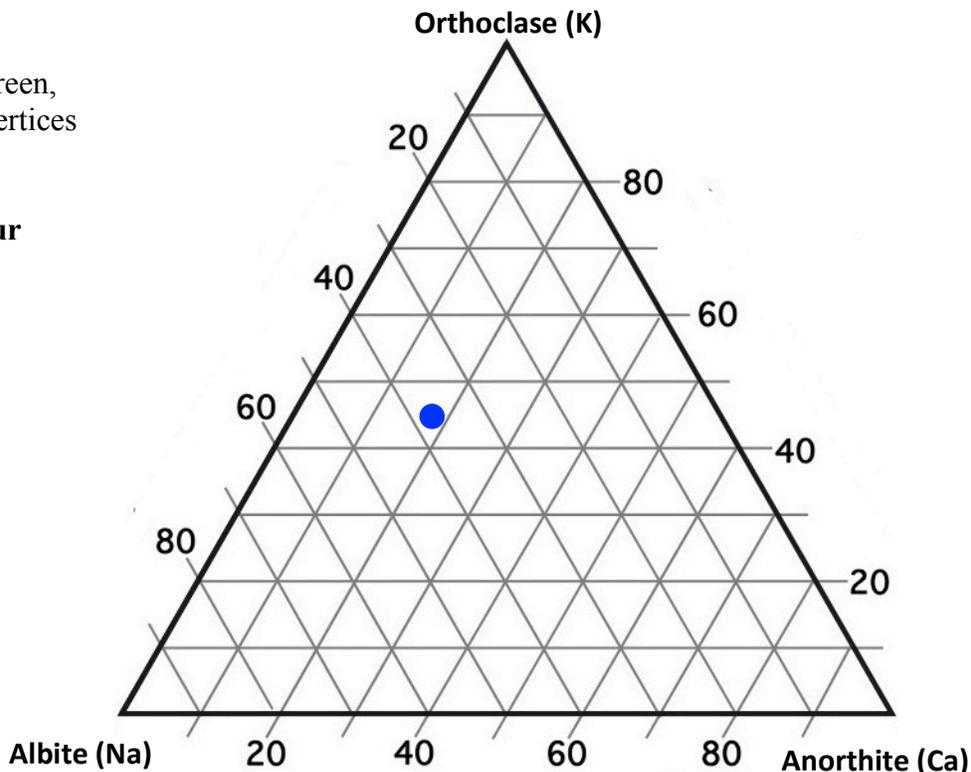5. Normalize the compositions. **Show your work here!**

    72% + 10% + 12% = 94%
    Ba: 72/94*100 = 76%
    K: 10/94*100 = 11%
    Na: 12/94*100 = 13%

6. Plot the feldspar on the triangle.

7. The rock on the front screen contains two different kinds of feldspar. How many types of minerals are visible in total?

    4: pink (orthoclase)
    white (plagioclase)
    gray (quartz)
    black (biotite)

Orthoclase (K)
20
80
40
60
60
40
80
20
Albite (Na)   20   40   60   80   Celsian (Ba)
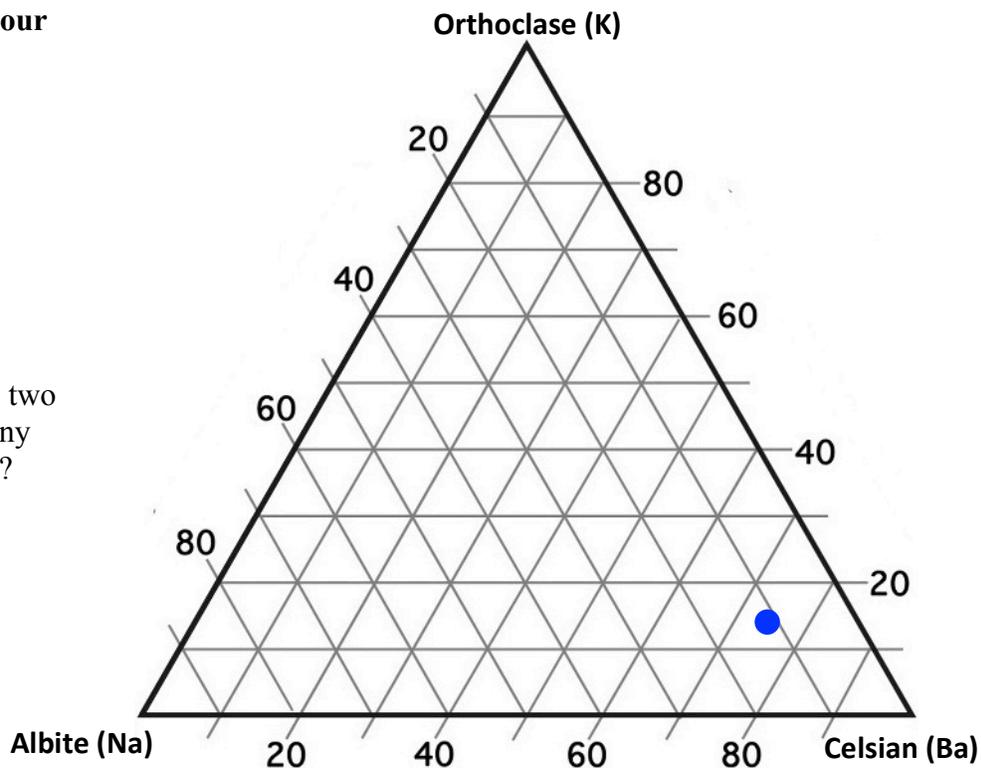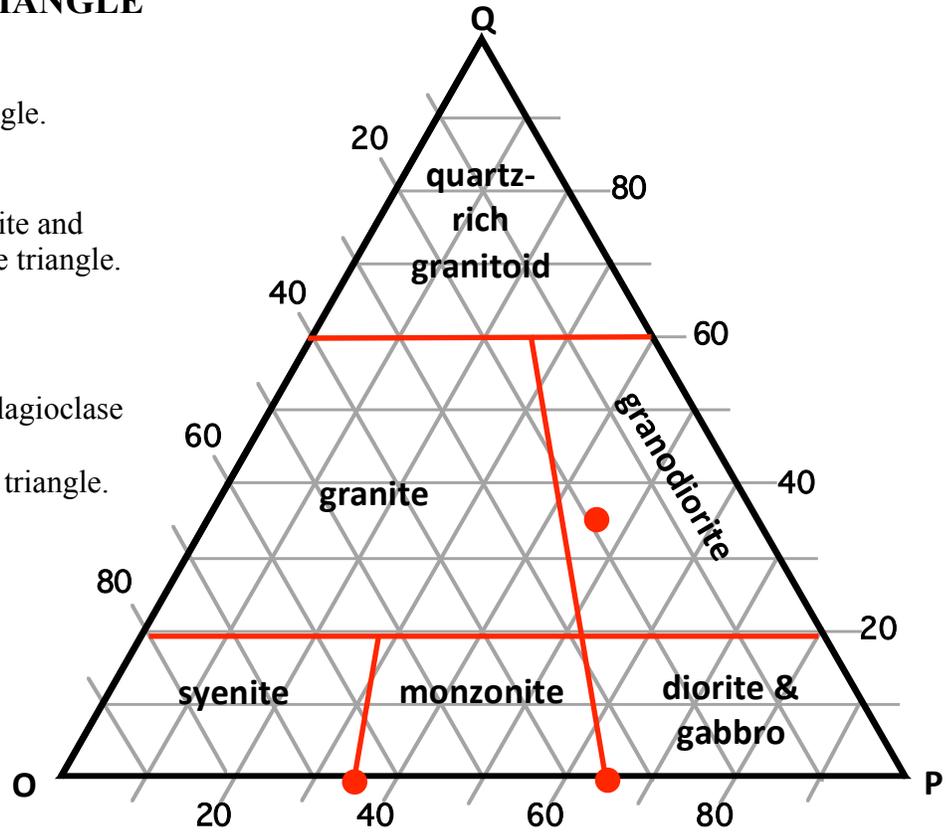
IGNEOUS ROCKS ON A TRIANGLE
Date

Name _____

1. Label the vertices of the QOP triangle.

2. What is the range of quartz in granite and granodiorite? Draw the lines on the triangle.

   Q = 20% - 60%

3. What is the ratio of orthoclase to plagioclase along the line between granite and granodiorite? Draw the line on the triangle.

   O:P = 35:65

Q

20
quartz-
rich
granitoid
40
80
60
granodiorite
60
granite
40
80
20
syenite   monzonite   diorite & gabbro
O   P
20   40   60   80

4. a. What is the composition of quartz-rich granitoid as shown on the triangle? Label the area for this rock.

   Q > 60%

   b. What is the composition of diorite & gabbro as shown on the triangle? Label the area for these rocks.

   Q < 20%, O:P < 35:65

5. What is the ratio of orthoclase to plagioclase along the line separating syenite and monzonite? Label the areas for these rocks.

   O:P = 65:35

6. Normalize the composition of the rock on the front screen. Show your work here. Plot the rock on the triangle. What is its name?

   40% + 16% + 30% = 86%
   P: 40/86*100 = 46%
   O: 16/86*100 = 19%
   Q: 30/86*100 = 35%

Lecture 12 Tutorial   Name _____
VOLCANOES AND PLATE TECTONICS
Date

1. Mark an "X" in the appropriate cells to show which types of tectonic activity occur in each tectonic setting.

Tectonic Setting → Features	Hotspot	Mid-Ocean Ridge	Oceanic Trench	Transform Fault
Asthenosphere rises & melts	X	X		
Earthquakes occur	X	X	X	X
Island arc forms			X	
New lithosphere created		X		
Not a plate boundary	X			
Old lithosphere destroyed			X	
Volcanoes erupt	X	X	X	X

2. Give an example of a volcano along a mid-ocean ridge.

   Juan de Fuca Ridge; Mid-Atlantic Ridge; East Pacific Rise; Gakkel Ridge

3. Give an example of a volcano above an oceanic trench.

   Mt. Etna, Italy; White Island, New Zealand; Mt. Pinatubo, Philippines; Mt. Cleveland, Alaska

4. Give an example of a volcano at a transform fault.

   Siqueiros Fracture Zone, East Pacific Rise; Emerald Fracture Zone, Pacific-Antarctic Ridge; Western Limassol Forest Complex, Cyprus
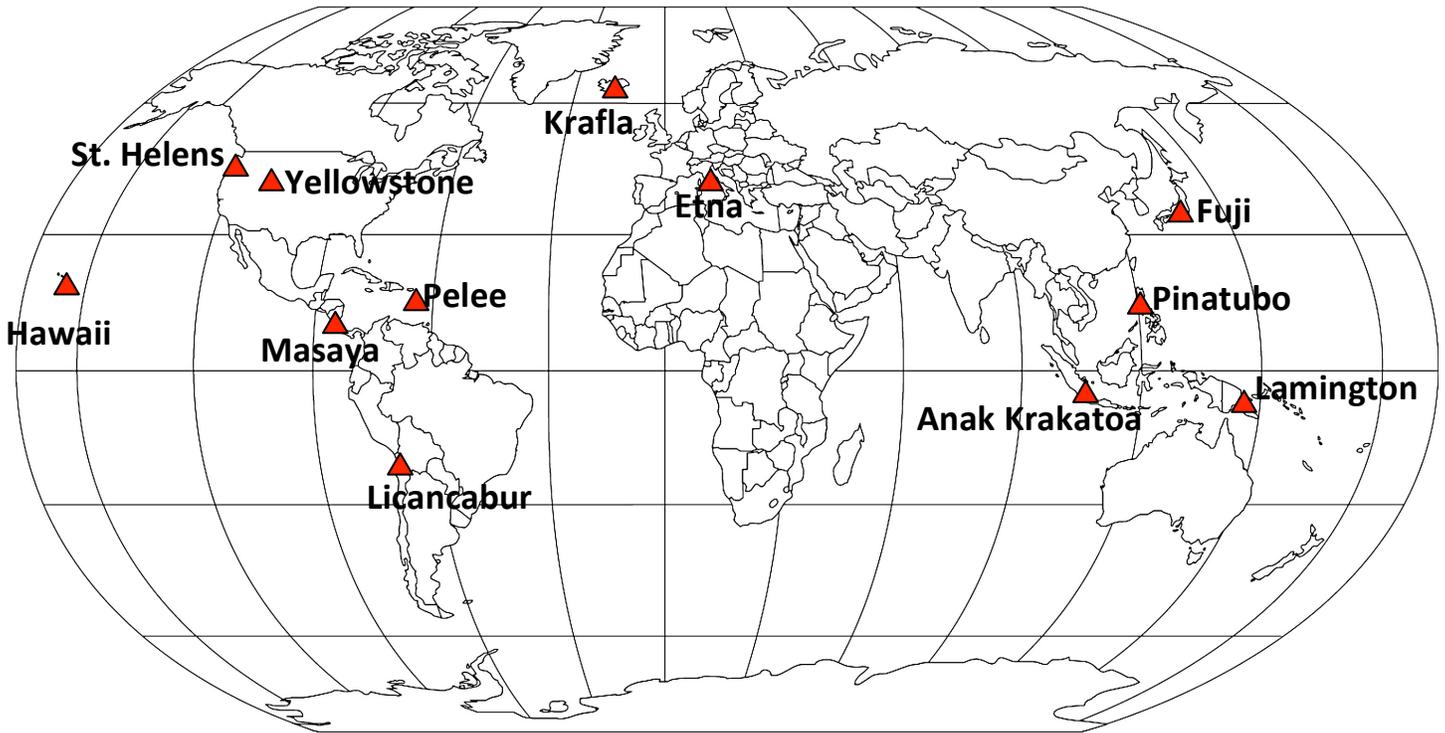
5. Give an example of a volcano at a hotspot.

   Galapagos; Iceland; Reunion; Yellowstone

Lecture 13 Tutorial
ERUPTIONS   Name _____
Date

1. Label volcanoes on the map throughout lecture.

2. Which volcano listed on the front screen is NOT located at a volcanic island arc? Record all four below.
   Vesuvius

3. Which volcano listed on the front screen is NOT located at a continental volcanic arc? Record all four below.
   Pelée

4. Which volcano listed on the front screen is NOT located at a hotspot? Record all four below.
   Lamington

	Hotspot	Volcanic Island Arc	Continental Volcanic Arc	Mid-Ocean Ridge
Anak Krakatoa		X		
Fuji		X		
Hawaii	X			
Krafla	X			X
Lamington		X		
Licancabur			X	
Masaya			X	
Pelée		X		
Pinatubo		X		
St. Helens			X	
Vesuvius			X	
Yellowstone	X			

1. Which pictures on the front screen illustrate
   physical weathering?

   A / B / C / D / I do not know.

2. Does the picture on the front screen illustrate
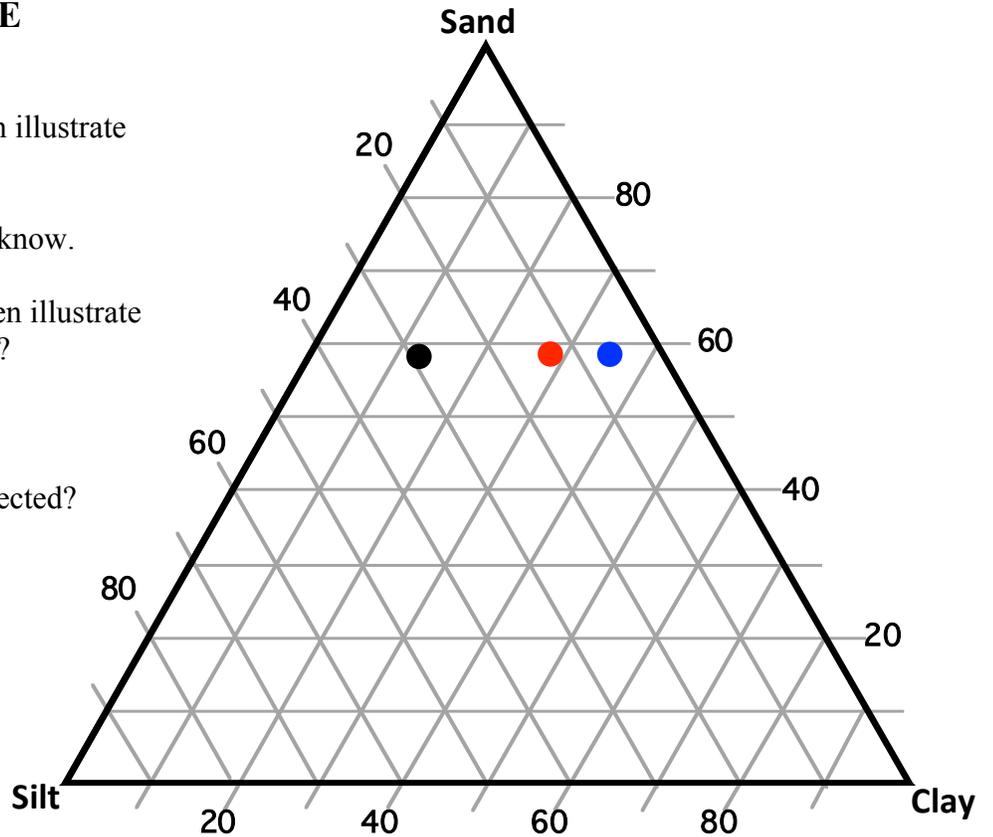   physical or chemical weathering?

   Chemical

3. Which component should be neglected?
   Label the vertices.

   A / B / C / D / I do not
   know.

4. Which point on the front screen
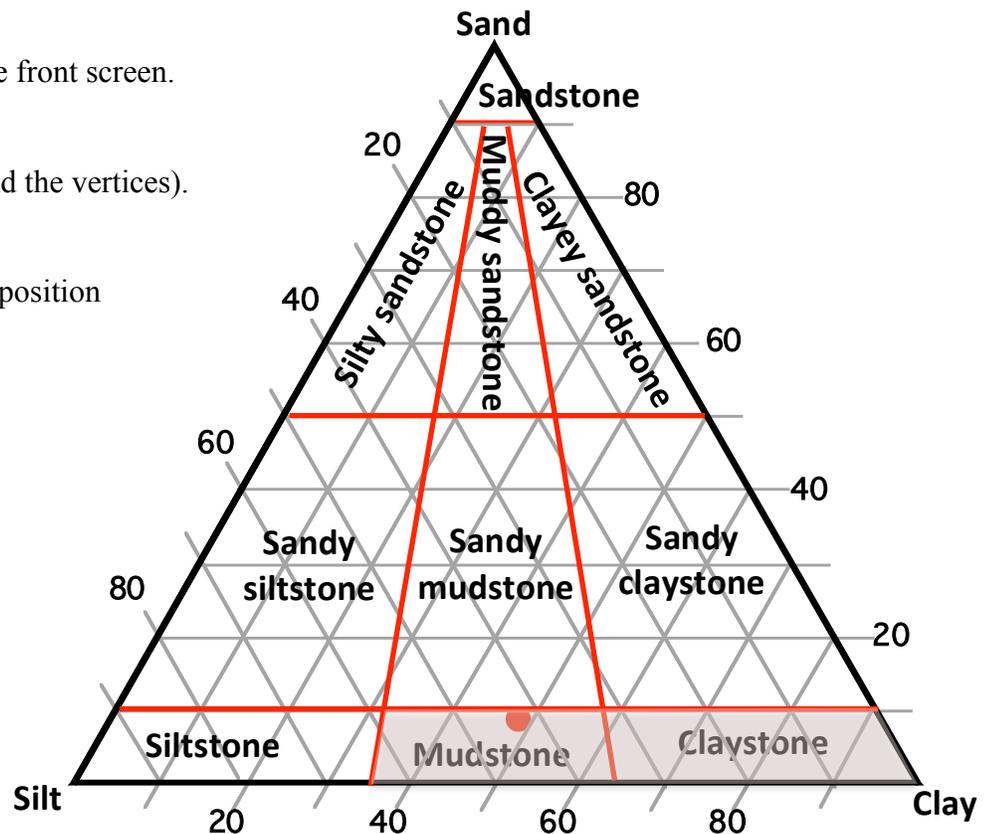   represents the rock?

   A / B / C / I do not
   know.

5. Plot the five lines described on the front screen.

6. Label the areas on the triangle (and the vertices).

7. What is the name of the rock composition
   shown on the front screen?

   Mudstone

8. Shade in the area for shale.

Lecture 15 Tutorial
METAMORPHIC TRIANGLE
Date

Name _____

1. Calculate A, C, and F for a metamorphosed basalt. Show your work.

   A = 16-3-1 = 12 → 30%
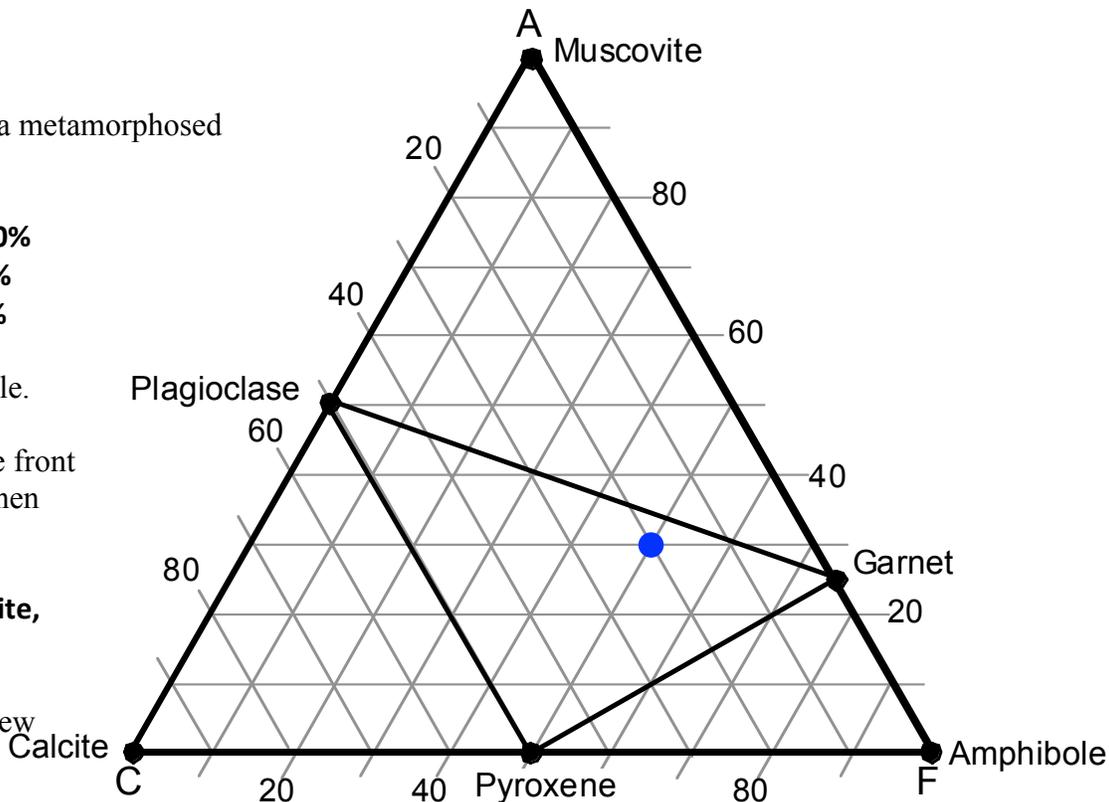   **C = 11-3.3 = 8 → 20%**
   F = 13+7 = 20 → 50%

2. Plot the rock on the triangle.

3. What mineral listed on the front screen does NOT form when basalt is metamorphosed?

   Muscovite (also calcite, amphibole)

4. What minerals does this new rock contain?

   Garnet, pyroxene, plagioclase + quartz, K-feldspar

5. Plot the metamorphosed granite.

   Red

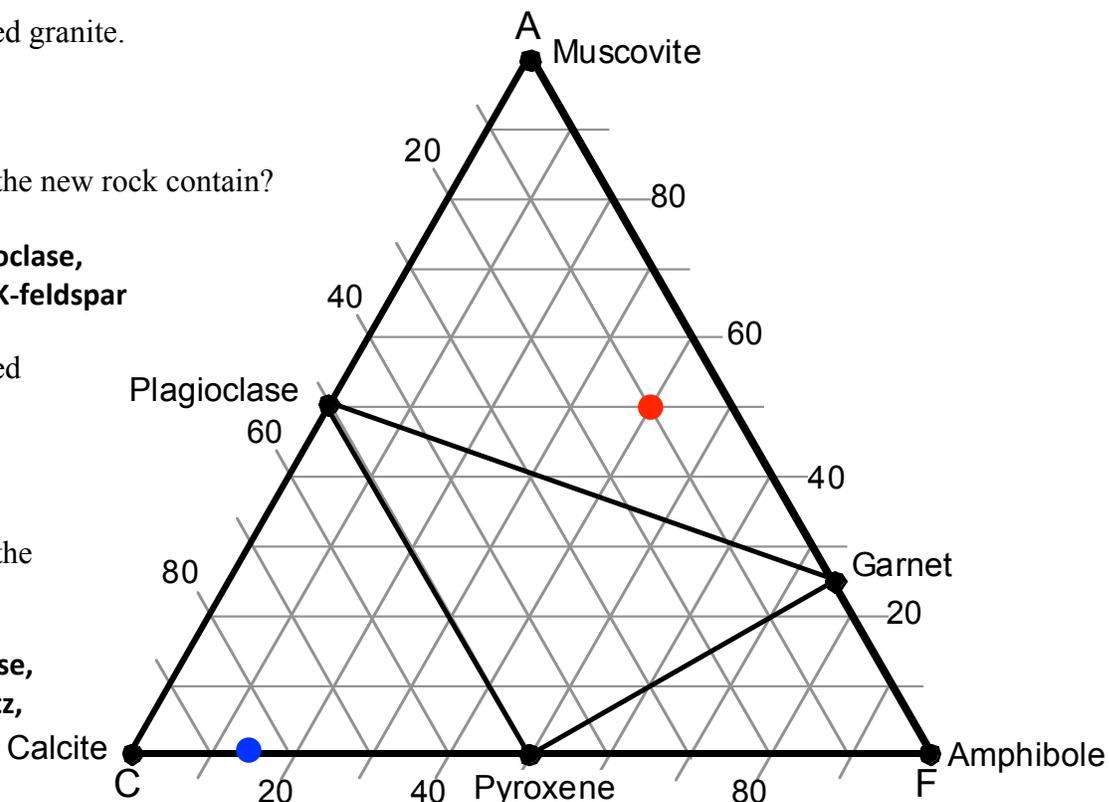6. What minerals would the new rock contain?

   Muscovite, plagioclase, garnet + quartz, K-feldspar

7. Plot the metamorphosed limestone.

   Blue

8. What minerals would the new rock contain?
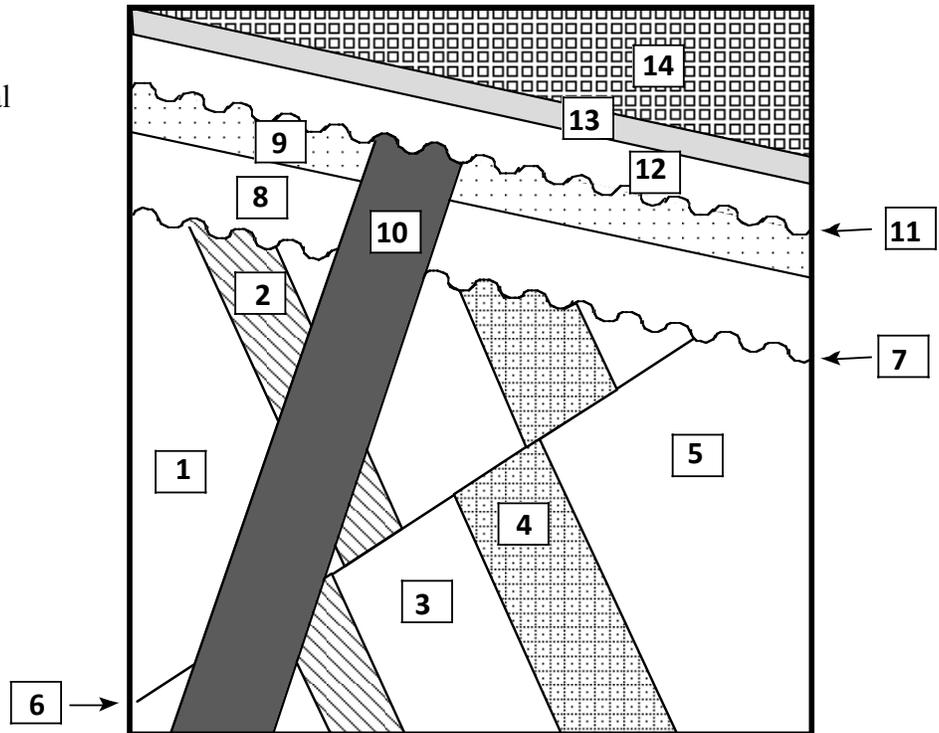
   Calcite, plagioclase, pyroxene + quartz, K-feldspar

Lecture 16 Tutorial
STRATIGRAPHIC PRINCIPLES
Date

Name _____

1. Number the layers, fault, and
   unconformities in chronological
   order (1 = oldest).

2. Which stratigraphic principle did you use to determine that unit 2 is older than unit 5?

   Superposition / Cross-Cutting Relations / Original Horizontality / Fossil Succession / ?

3. Which stratigraphic principle could you use to determine that #11 represents a long gap in time?

   Superposition / Cross-Cutting Relations / Original Horizontality / **Fossil Succession** / ?

4. Which stratigraphic principle would you use to infer that all layers have been tilted?

   Superposition / Cross-Cutting Relations / **Original Horizontality** / Fossil Succession / ?

5. Which stratigraphic principle did you use to determine that the fault is older than the dike?

   Superposition / **Cross-Cutting Relations** / Original Horizontality / Fossil Succession / ?

Lecture 17 Tutorial
ISOTOPIC DATING
Date

Name _____

1. How many parent atoms remain after two half-lives?   1020 / 205 / 512 / **256** / ?

2. How many daughter atoms have formed after four half-lives?   **960** / 896 / 64 / 120 / ?

3. How many million years pass until only 16 parent atoms remain?   960 / 896 / 64 / **120** / ?

4. What percentage of parent remains after three half-lives?   50% / **12.5%** / 30% / 3.25% / ?

5. What fraction of daughter has formed after 120 Ma?   3/4 / 7/8 / **15/16** / 31/32 / ?

6. Graph the decay of the **parent** isotope and the growth of the **daughter** isotope in terms of
    percentages, using the numbers on the front screen and the graph below.

7. a. How many half-lives have
   passed if a crystal in the
   volcanic ash contains equal
   amounts of parent and
   daughter?

   1 half-life

   b. How old is a crystal in the
   volcanic ash if it contains
   equal amounts of parent and
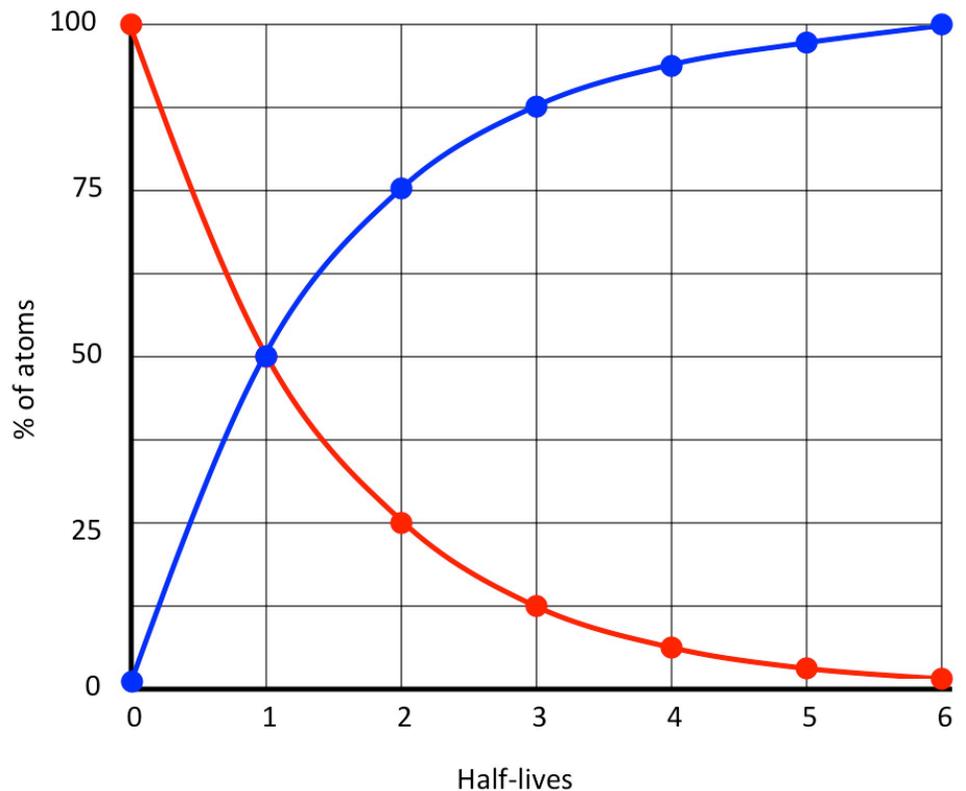   daughter?

   30 Ma

   \c. How many half-lives have
   passed if a crystal in the
   granite contains seven times
   more daughter atoms than
   parent atoms?

   3 half-lives

   d. How old is the sandstone
   between the ash and the granite?

   30-90 Ma

1. Label the rock layers on the diagram on the back of this sheet.

2. Label the fluids in the sandstone layers.

3. Which letter marks the reservoir rock?   A / B / **C** / D / I do not know.

4. Which letter marks the source rock?   A / B / C / **D** / I do not know.

5. Which letter marks the seal rock?   A / **B** / C / D / I do not know.

6. What type of oil trap is illustrated by the diagram?

    Fault trap   /   **Fold trap**   /   Pinchout trap   /   Salt dome trap   /   I do not know.
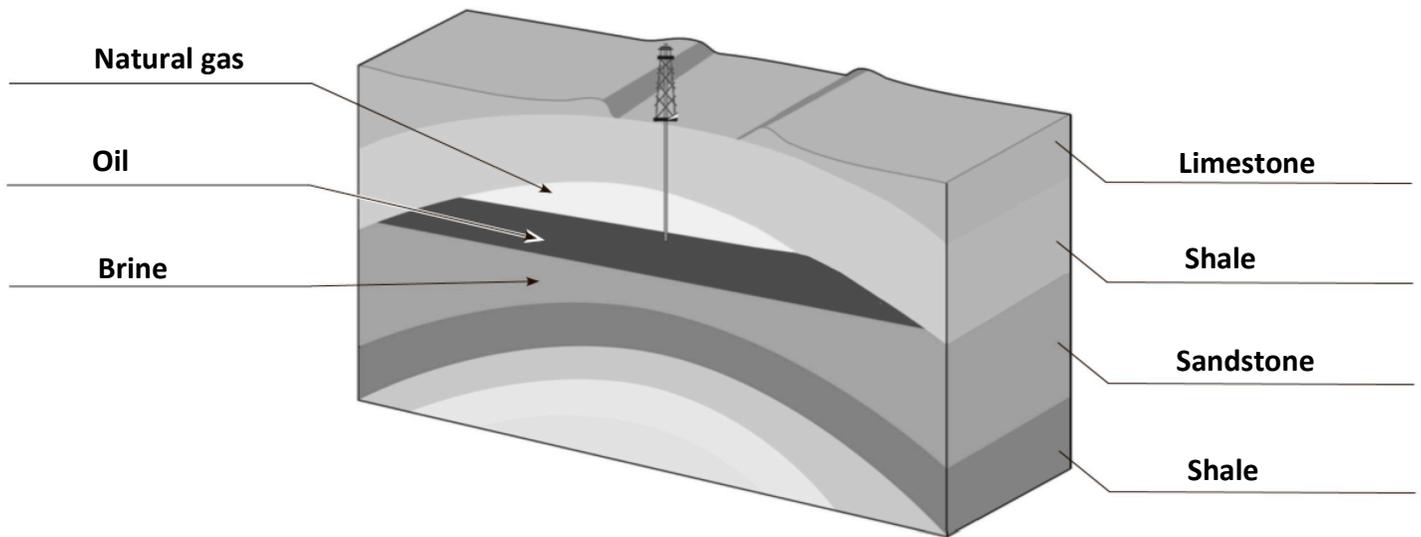
Lecture 19 Tutorial
Energy Return on Energy Invested   **Name** _____
Date

1. Match the percentages of energy returned on investing the energy in one unit of each fuel.

   ___D___ Coal   __B__ Tar sands   ___C___ US oil after 1950   A. 65 B. 80 C. 93 D. 97

2. Why is EROEI lower after 1950?

      Easy oil was extracted first (high-grade, near the surface). Remaining oil is more costly to extract.

3. Plot percent available vs. EROEI for **fossil fuels**, using the data on screen and the graph on the back of this sheet.

      Red dots

4. Plot percent available vs. EROEI for **alternative energy** sources (data on screen).
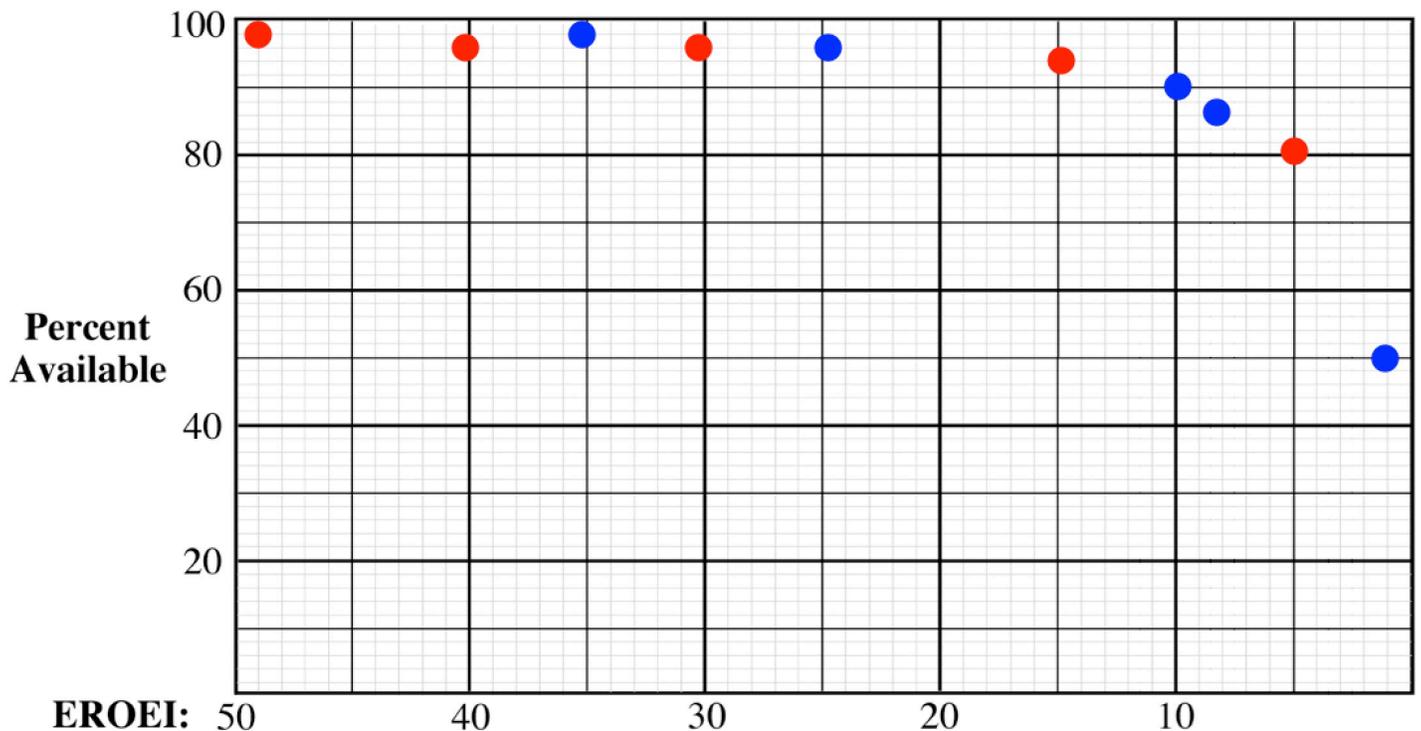
      Blue dots

5. What percent of energy is returned for an EROEI value of 10?

      90%

6. Does the "net energy cliff" imply problems for the way our society operates?

      Answers will vary but should be supported by reasoning.

Rivers   Name _____

Date

1. How many major drainage basins are present in North America?

   5 or 6 (depends on whether the Great Basin is considered "major")

2. How many major divides are present in North America?   **4 or 5**

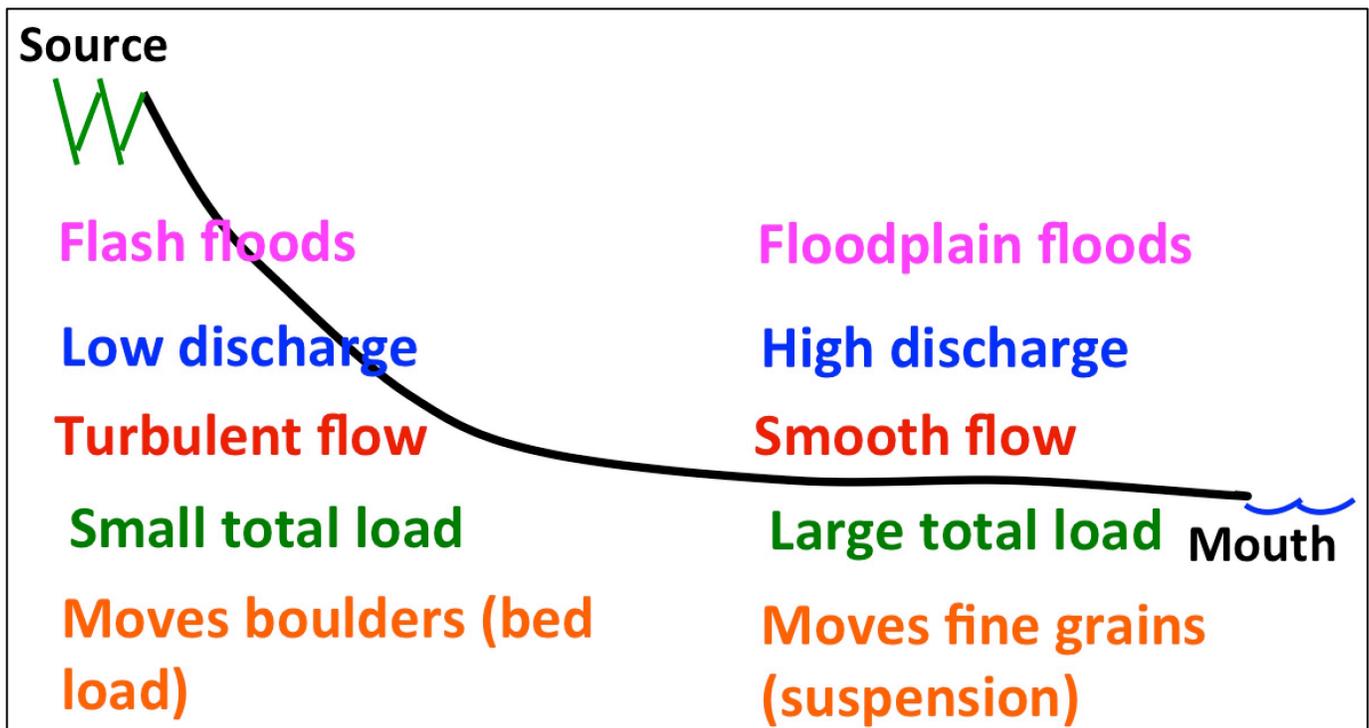3. Label the mouth and source on the lengthwise sketch of a river on the back of this sheet.

4. Label the areas of highest and lowest discharge on the sketch on the back of this sheet.

5. Label the areas of smoothest and most turbulent flow on the sketch on the back of this sheet.

6. Label the areas of highest and lowest total load on the sketch.

7. Label the areas where the largest and smallest grains are carried.

8. Label the areas where flash floods and floodplain floods occur.

Source

Flash floods   **Floodplain floods**

Low discharge   **High discharge**

Turbulent flow   **Smooth flow**

Small total load   **Large total load**   Mouth

Moves boulders (bed load)   **Moves fine grains (suspension)**

Name _____
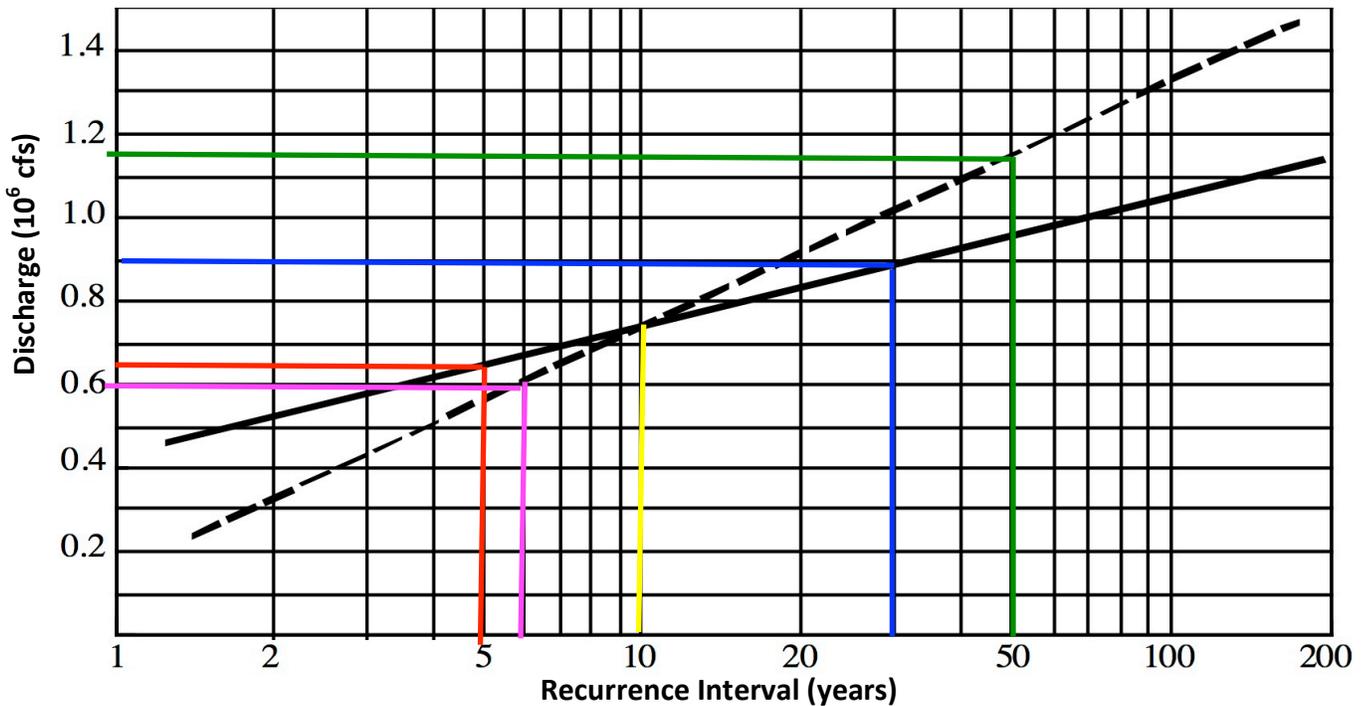
1. Write out the X-axis and Y-axis titles, including units, on the graph above.

2. What is unusual about the X-axis?   **Logarithmic scale**

3. The solid line represents discharge data for Big River. What is the discharge of a 5-year flood on Big River?

    320,000 cfs   /   530,000 cfs   /   **650,000 cfs**   /   1,300,000 cfs

4. What is the recurrence interval of a flood with discharge of 0.9 x 10^6 cfs on Big River?

    30 years   /   90 years   /   100 years   /   200 years

5. The dashed line represents discharge data for Fast River. What is the discharge of a 50-year flood on Fast River?

    980,000 cfs   /   **1,150,000 cfs**   /   1,600,000 cfs   /   9,800,000 cfs

6. What is the recurrence interval of a flood with discharge of 6 x 10^5 cfs on Fast River?

    2 years   /   4 years   /   **6 years**   /   8 years

7. What recurrence interval corresponds to equal-sized floods, in terms of discharge level, on both Big and Fast Rivers?

    10 years   /   20 years   /   50 years   /   100 years

Lecture 22 Tutorial
The Mahomet Aquifer   **Name** _____
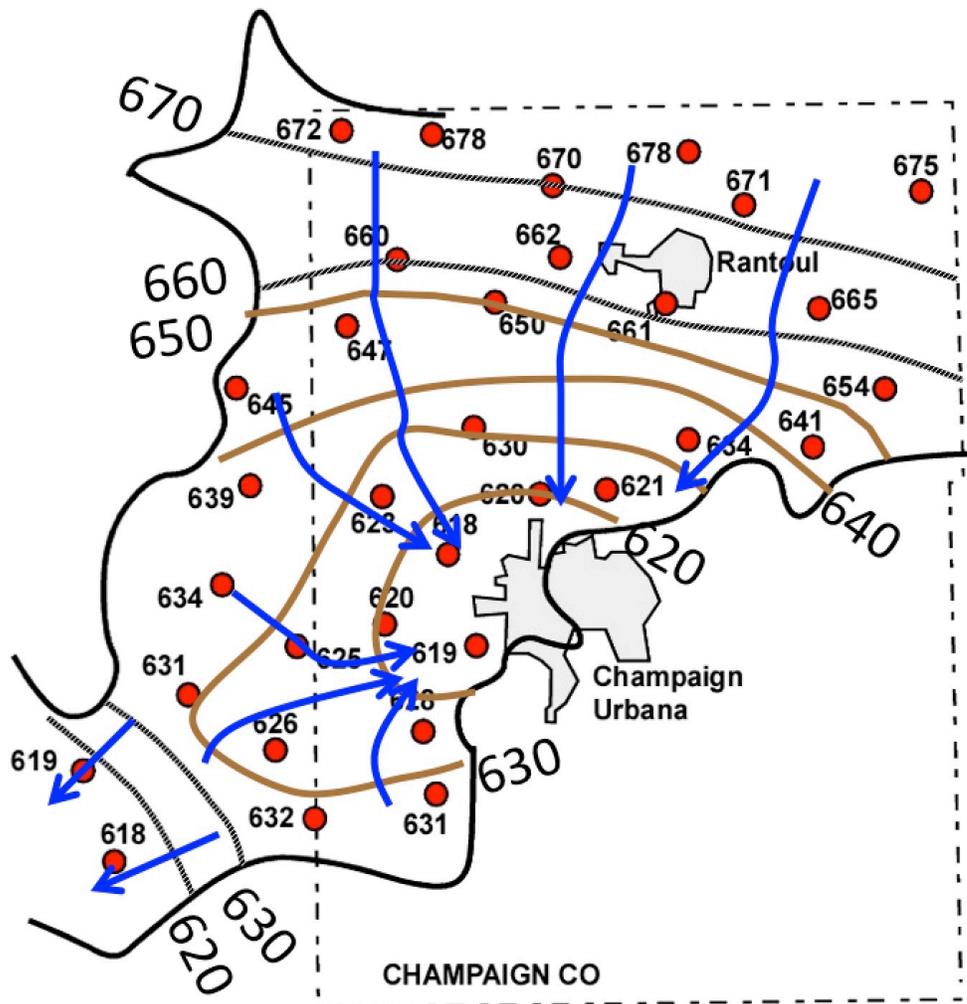**Date**

1. The Mahomet Aquifer is: **a confined aquifer**   /   an unconfined aquifer

2. Draw contour lines on the surface of the Mahomet Aquifer on the back of this page.

3. What is the pattern of contours near Urbana-Champaign?   **Cone of depression**

4. Draw arrows to show the direction of groundwater flow. What direction do they point?

      Toward Champaign

5. Compare your map with the one on the front screen. What effects has the growth of the Urbana-Champaign area had on the aquifer that provides the cities' drinking water?

   change in flow direction   /   **cone of depression**   /   **drawdown of water level**

      ground subsidence   /   **groundwater divide**   /   permeability decrease

Lecture 23 Tutorial
Glaciers   Name _____
Date

1. Which of the following is NOT a name for a narrow, confined glacier?

   Alpine glacier   /   **Continental glacier**   /   Mountain glacier   /   Valley glacier

2. Fill in the table according to the lecture slides.

Description of budget	Gains (G) vs. losses (L) (G >, <, or = L)	Volume change (increases, decreases, or no change)	Movement of ice margin (advances, retreats, or stationary)	Alpine glaciers (move to higher or lower elevation or no change)	Continental glaciers (cover more or less area or no change)
Positive	**G > L**	**Increases**	**Advances**	**Lower elevation**	**More area**
Neutral	**G = L**	**No change**	**Stationary**	**No change**	**No change**
Negative	**G < L**	**Decreases**	**Retreats**	**Higher elevation**	**Less area**

3. If the ice flows at 3 m/yr and the glacial budget is neutral, what is the melting rate?

   Neutral budget → G = L, so melting rate = 3 m/yr

4. If the ice flows at 3 m/yr and the glacial budget is positive, what is the melting rate?

   Positive budget → G > L, so melting rate = <3 m/yr

5. If the ice flows at 3 m/yr and the glacial budget is negative, what is the melting rate?

   Negative budget → G < L, so melting rate = >3 m/yr

6. If the ice flows at 6 m/yr and the ice margin moves upslope at 4 m/yr, is the glacier advancing or retreating?

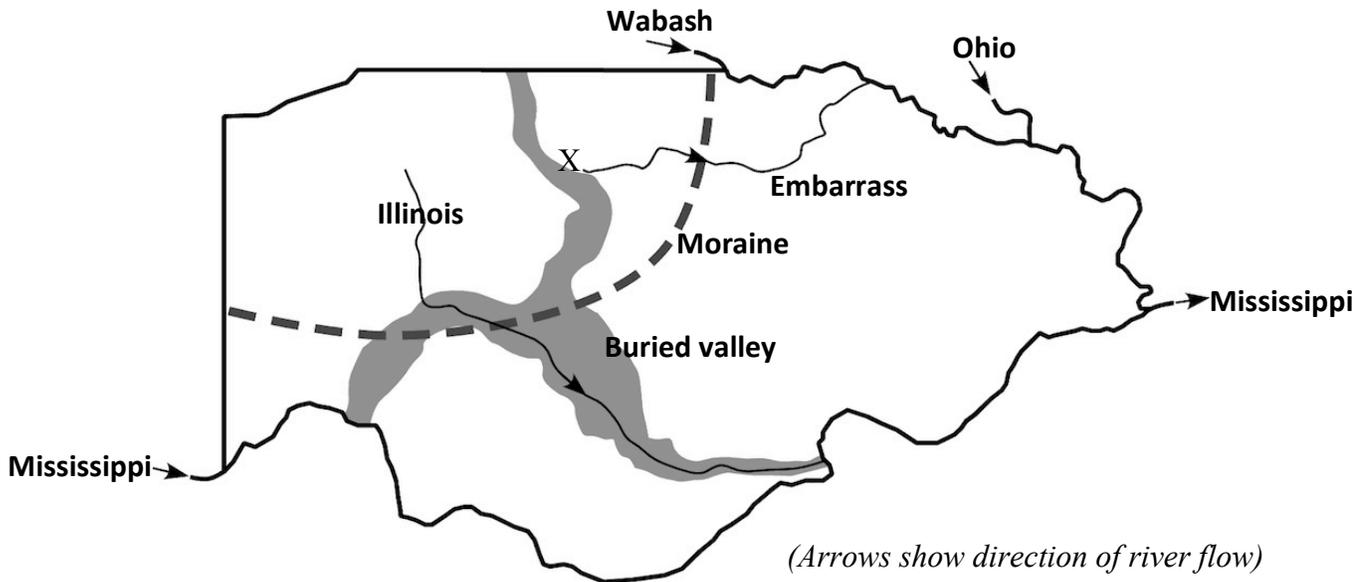   **Retreating, by definition (moving upslope). Melting rate = 10 m/yr**

Lecture 24 Tutorial
Ice Age Illinois   Name _____
Date

1. Label the following: Mississippi River, Illinois River, Wisconsinan end moraine, buried bedrock valleys.

2. Rain that falls at the University of Illinois (X) eventually reaches the Mississippi River. First, however, it enters the Embarrass River, which flows into the Wabash, which flows into the Ohio. Label these rivers.

Wabash   **Ohio**

X

Illinois
              Embarrass

              Moraine

                              →Mississippi

              Buried valley

Mississippi→

(Arrows show direction of river flow)

3. Choose the best match:

   B   Evidence that an ocean used to cover Illinois   A. Buried valley filled with outwash

   D   Evidence that glaciers used to cover Illinois   B. Limestone bedrock

   A   Source of drinking water in Urbana   C. Shifting location of Mississippi River
           Champaign

   C   Evidence that glaciers entered Illinois at different   D. Till is found in most of the state
           times from different directions

4. How did glaciers in Illinois link with each of the other reservoirs of the hydrologic cycle?

   A   Glacial deposits covered the rock that had formed in   A. Ocean
           this reservoir.

   C   Glacial meltwater supplied the water for this reservoir.   B. Groundwater

   D   Glaciers needed water from this reservoir in order   C. Surface water
           to grow.

   B   Glacial outwash holds the water for this reservoir.   D. Water in the atmosphere

Lecture 25 Tutorial　　　　　　　　　　　　　Name _____
Carbon Dioxide
Date

1. What are the units for concentration? Write out your answer in words.

　　　parts per million (ppm)

2. What was the *rate* of change in CO_2 concentration between 1500 and 1900?

　　　　0.0055 ppm per year　　/　**0.0375 ppm per year** /　0.1325 ppm per year

3. What was the *rate* of change in CO_2 concentration between 2000 and 2018?

　　　　1.9 ppm per year　　/　2.0 ppm per year /　**2.1 ppm per year**

4. Plot the data on the front screen using the graph on the back of this page.

5. What does the graph of past variations in CO_2 and temperature imply about future temperatures?

　　　It implies that temperatures will increase.
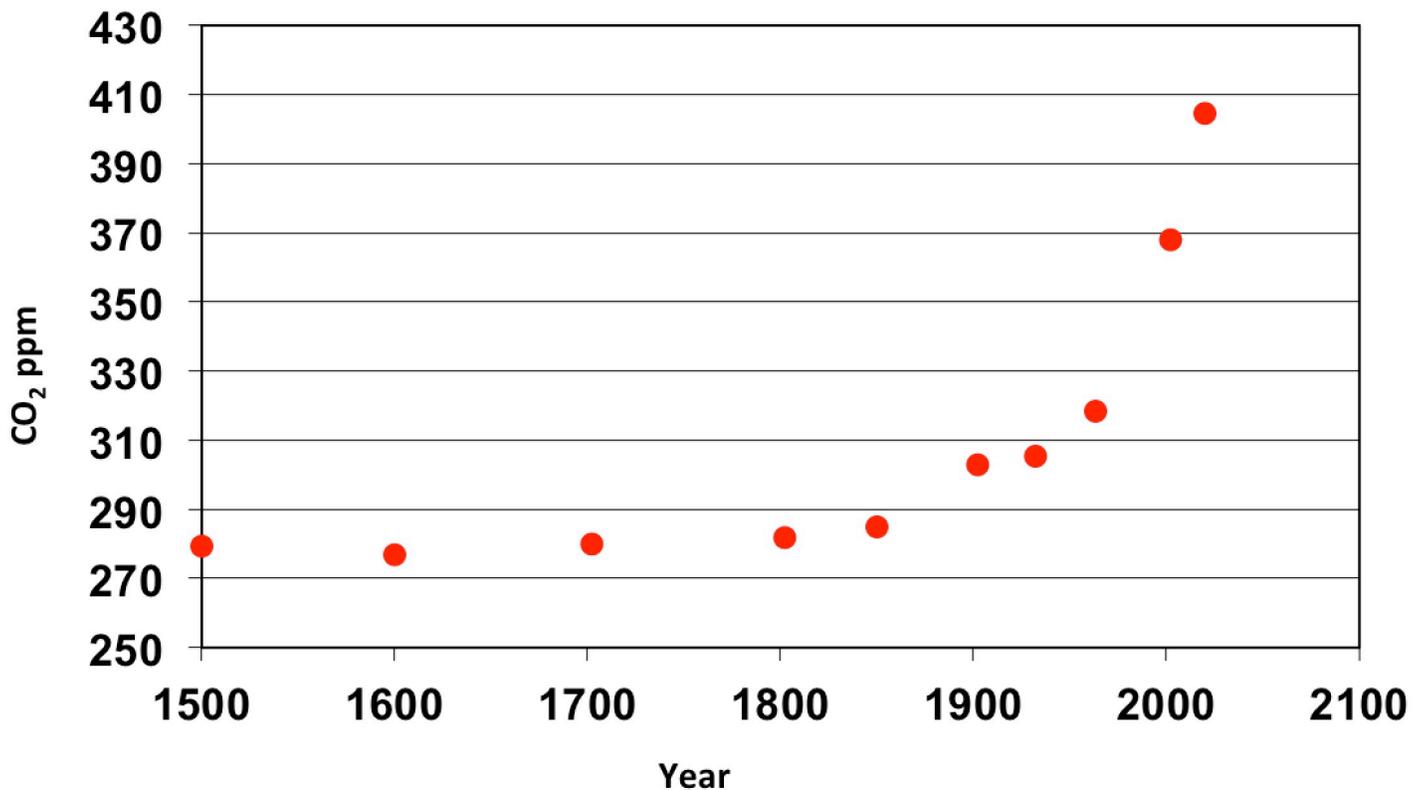
Lecture 26 Tutorial   Name _____
The IPCC
Date

1. What is the IPCC, and when and how was it established? Write out your answer below.

Intergovernmental Panel on Climate Change, established by the United Nations in 1990

2. Match the working groups of the IPCC.

   B   Impacts, Adaptation and Vulnerability   A. WG I

   C   Mitigation of Climate Change   B. WG II

   A   Physical Science Basis   C. WG III

   D   Renewable Resources   D. Not a working group

3. What was the amount of CO_2 relative to CH_4 (methane) in 2018?

407 ppm / 1858 ppb = 407000 ppb / 1858 ppb ≈ 220 times more CO_2 than CH_4

4. What was the amount of heating from CO_2 relative to that from CH_4 in 2018?

220 / 29 times more heating from methane = 7X more heating from CO_2

5. Do the observed data (black lines in the graphs on the front screen) better match with the natural trends (blue shaded areas) or the anthropogenic trends (red shaded areas)?

Black lines follow models that include anthropogenic effects.

6. What does the graph on the front screen imply about the costs of addressing climate change?

Achieving lower CO_2 would be expensive, but the costs of climate change are higher.

7. Which two choices best describe the IPCC assessment reports? Explain your answers.

Aggressive   /   **Conservative**   /   **Optimistic**   /   Pessimistic

Conservative because they issue consensus reports, not extreme warnings.
Optimistic because predictions are usually more positive than reality.