Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hour\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**WS: Minerals, Weathering, and Soil**

**Chapter 3: Minerals-** Section 1: Properties of Minerals

**What is a Mineral (pp. 66-74)**

1. What are the 5 characteristics a substance must have to be classified as a mineral?
2. Give an example of an item that is naturally occurring.
3. Give a short definition for the term inorganic that contains 3 words or less.
4. What is the difference between a solid and a liquid?
5. Create a metaphor to describe the term crystal structure.
	* 1. (Metaphor: one thing used or considered to represent another)
6. Give a definition for the term definite chemical composition.
7. Create an anagram or acronym for the 5 mineral properties. (Acronym/Anagram defined at bottom of page)

**Identifying Minerals (pp.68-74)**

1. How does a geologist (i.e., scientist) identify a mineral? (Note: don’t forget to mention the 9 identifiers)
2. Explain why color is not a reliable way to identify a mineral.
3. Give a short definition for the term streak that contains 3 words or less.
4. Give an example for the term luster.
5. Explain why density always stays the same, even when the size of the mineral changes.

e.g., Gold’s density is 19 g/cm3. A piece of gold the size of your thumb has the same density as a piece of gold the size of the Earth… 19 g/cm3.

1. Complete “Math Skills- Calculating Density” on page 70.
	* + 1. A sample of calcite has a mass of 324 g and a volume of 120 cm3. What is its density?
2. Complete the” Math: Analyzing Data- Mineral Density” Activity on page 71.
	* + 1. Reading Graphs:
			2. Calculating:
			3. Reading Graphs:
			4. Calculating:
			5. Comparing & Contrasting:
			6. Predicting:
			7. Drawing Conclusions:
3. Give a metaphor for the identifying property hardness.
4. What is the Mohs hardness scale?
5. Give a short definition for the term crystal systems that contains 8 words or less.
6. Is a mineral sample that does not have a smooth faces still a crystal?
7. Compare and contrast the terms (i.e., mineral identifiers) cleavage and fracture.
8. How would a geologist test if a mineral had cleavage or fracture?
9. List the different “special properties” that are used to identify some minerals.
10. Create an anagram or acronym for the 9 identifying factors of a mineral.

\*Acronym: word formed from initials

\*Anagram: rearranging the letters of a word or phrase to produce a new word or phrase

**How Mineral Crystals Form (pp. 76-79)**

23. What is crystallization?

24. Give an example of a solution.

25. How do minerals form from magma and lava?

26. What are the mineral crystals like when the mineral cools slowly in magma (i.e., inside Earth/intrusive)

27. What are the mineral crystals like when the mineral cools rapidly in lava (i.e., outside Earth/extrusive)

28. How do minerals form from solutions?

29. Explain the process in which minerals form from evaporite solutions (i.e., evaporation).

30. How do minerals form from hot water solutions?

**Chapter 8: Weathering and Soil Formation**

Section 1: Rocks and Weathering (pp. 238-243)

31. Define weathering in 4 words or less.

32. Define erosion in 4 words or less.

33. Compare and contrast weathering and erosion. List as many answers as possible.

|  |  |
| --- | --- |
| Similarities of Weather/Erosion | Differences |
|  | Weathering | Erosion |
|  |  |  |
|  |  |  |
|  |  |  |

34. Create a metaphor for uniformitarianism.

35. Define mechanical weathering in 4 words or less.

36. Define chemical weathering in 4 words or less.

37. List the different types of mechanical and chemical weathering. List as many answers as possible.

|  |  |
| --- | --- |
| Mechanical | Chemical |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

38. What are the most important factors that determine the rate at which rock weathers?

**Chapter 9:** Soils (pp. 248-254)

39. What is soil?

40. What is the composition of soil?

41. What is the process of soil formation?

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hour\_\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**WS: Identifying Rocks**

**(pp. 94-97)**

1. Rocks:

2. What are rock forming minerals?

3. Which rock-forming minerals make up granite?

3 Ways to Identify Rocks

4. Explain how geologists identify rocks.

5. Composition:

6. Color:

7. Texture:

* 1. The 3 Grain Size types:
	2. The 2 Grain Shape types:
	3. The 2 Grain Pattern types:

8. Draw the 7 types of grains and label the 7 different grains, found on page 96

9. How do rocks form?

10. What are the 3 types of rocks?

11. How does igneous form?

12. How does sedimentary form?

13. How does metamorphic form?

**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hour\_\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_**

**WS: Igneous Rocks**

**(Section 2: pp. 98-101)**

1. Define Igneous Rock:
2. Define Extrusive (plate boundary handout & 98-99):
3. Define Intrusive (plate boundary handout & 98-99):
4. What determines the size of a crystal, in a rock? (pp. 98-99 & 77)
5. How are igneous rocks identified (i.e., classified)?
6. Where do igneous rocks form; their origin?
7. What is the texture of an igneous rock?

**Explain Basalt Rock (circle correct answer)**

1. Classification: Igneous, Metamorphic, or Sedimentary
2. Primary Location: Oceanic or Continental Crust
3. Formation: Extrusive or Intrusive
4. Plate Tectonic Origin (pp. 152-153): Divergent, Convergent, or Transform Plate Boundary
5. Composition (i.e., Silica Level): High, or Low Amounts of Silica
6. Color: Dark (e.g., black) or Light (e.g., gray)

**Explain Granite Rock (circle correct answer)**

1. Classification: Igneous, Metamorphic, or Sedimentary
2. Primary Location: Oceanic or Continental Crust
3. Formation: Extrusive or Intrusive
4. Plate Tectonic Origin (pp. 152-153): Divergent, Convergent, or Transform Plate Boundary
5. Composition (i.e., Silica Level): High, or Low Amounts of Silica
6. Color: Dark (e.g., black) or Light (e.g., gray)

**Explain the Different Textures (circle correct answer)**

**Slowly Cooled Crystals**

1. Crystal Size: Coarse, Fine, Non-visible, or Mixture (i.e., coarse & fine)
2. Origin of Formation: Intrusive, Extrusive, Both

**Rapidly (i.e., fast) Cooled Crystals**

1. Crystal Size: Coarse, Fine, Non-visible, or Mixture (i.e., coarse & fine)
2. Origin of Formation: Intrusive, Extrusive, Both

**Very Rapidly Cooled Crystals**

1. Crystal Size: Coarse, Fine, Non-visible, or Mixture (i.e., coarse & fine)
2. Origin of Formation: Intrusive, Extrusive, Both

**Slowly and Rapidly Cooled Crystals**

1. Crystal Size: Coarse, Fine, Non-visible, or Mixture (i.e., coarse & fine)
2. Origin of Formation: Intrusive, Extrusive, Both
3. At which plate boundaries/locations do igneous rocks form? (pp. 152-153 & plate boundary handout)
4. How does intrusive and extrusive igneous rock form at an oceanic to continental convergent plate boundary (i.e., subduction zone)? Complete the Diagram below to answer the question. (p. 99, 146, 152-153, & plate boundary handout)

**How Igneous Rock Forms Diagram:** Label the parts of the diagram. (p. 99, 146, 152, & plate handout)



**Study the Obsidian Sample (p. 98)**

1. What is its crystal structure?
2. What is its origin or formation: Intrusive or Extrusive
3. At what plate boundary is it formed? Divergent/Oceanic, Convergent/Subduction Zone, or Transform Boundary

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hour\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Metamorphic (Section 5: pp. 110-112 and handout)**

1. Metamorphic Rock Definition:
2. How do geologists classify/identify metamorphic rocks?
3. At which types of plate boundaries do metamorphic rocks form?
4. Give a definition for “Foliated”(i.e., banded) rock and draw a picture:

Foliated

1. Give a definition for “Nonfoliated” (i.e., nonbanded) rock and draw a picture:

Nonfoliated

1. Explain the difference between regional and contact metamorphism. (i.e., handout)
2. **How Metamorphic Rock Forms at a Plate: Draw** and **label** a picture that demonstrates how metamorphic rock forms at an oceanic to continental convergent plate boundary (i.e., subduction zone).

**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hour\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Sedimentary (Section 3: pp. 102-106)**

1. Sedimentary Rock Definition:
2. Define Sediment:

**How Sedimentary Rocks Form**

1. **Step 1**- Weathering:
	1. Physical weathering:
	2. Chemical weathering:
2. **Step 2**- Erosion:
3. **Step 3**- Deposition:
4. **Step 4**- Compaction:

 7. **Step 5**- Cementation:

**8. How Sedimentary Rock Forms Pictures:** Draw a picture for each box, to represent each step in the formation of sedimentary rock.

 1. Weathering 2. Erosion 3. Deposition 4. Compaction 5. Cementation

**Types of Sedimentary Rocks (pp. 104-105)**

9. How do geologists identify/classify sedimentary rock?

10. Explain the difference between clastic, chemical, and organic sedimentary rock.

1. **Coal (pgs. 356-357):** is an organic rock. It forms from what?
2. Explain Hydrocarbons:

**Plate Tectonic Formation (use the handout)**

13. Explain how sedimentary rock forms at a subduction zone.

14.Explain the difference between anActive Continental Plate Margin and a Passive Continental Plate Margin. (handout)

15. Which picture (i.e., 1 or 2) best represents the East Coast of the United Sates? Explain why. (handout)

****

Picture 1

Picture 1

****

Picture 2

Picture 2

Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_Hour\_\_\_\_\_\_\_\_\_\_\_Date\_\_\_\_\_\_\_\_\_\_\_\_\_

**The Rock Cycle (pp. 114-116)**

1. What is the “Rock Cycle?”
2. Which product, of the rock cycle, creates igneous rock?
	1. Sediment b. Magma (including lava) c. Other Rock
3. Which product, of the rock cycle, creates sedimentary rock?
	1. Sediment b. Magma (including lava) c. Other Rock
4. Which product, of the rock cycle, creates metamorphic rock?
	1. Sediment b. Magma (including lava) c. Other Rock
5. Which process creates igneous rock?
	1. Melting & cooling b. Heat & pressure c. Weathering, erosion, deposition, compaction, & cementation
6. Which process creates sedimentary rock?
	1. Melting & cooling b. Heat & pressure c. Weathering, erosion, deposition, compaction, & cementation
7. Which process creates metamorphic rock?
	1. Melting & cooling b. Heat & pressure c. Weathering, erosion, deposition, compaction, & cementation
8. Explain how igneous rock is created.
9. Explain how sedimentary rock is created.
10. Explain how metamorphic rock is created.
11. Which one property, when identifying a rock, is most important for determining if the rock is igneous?
12. Grain size b. Grain shape/type c. Grain pattern
13. Explain how geologists may use this factor to identify a rock as igneous.
14. Which one texture property, when identifying a rock, is most important for determining if the rock is sedimentary?
	1. Grain size b. Grain shape/type c. Grain pattern
15. Explain how geologists may use this factor to identify a rock as sedimentary.
16. Which one property, for identifying a rock, is most important when determining if the rock is metamorphic?
	1. Grain size b. Grain shape/type c. Grain pattern
17. Explain how geologists may use this factor to identify a rock as metamorphic.
18. Explain why the rock cycle does not have a beginning or an end.
19. **Label** the picture of the rock cycle. You can find an example on page 115.

****

**Which Rock Came First (p. 104, 111, & 114):** The following questions will use rock samples of **sandstone**, **quartzite**, and **granite**. Observe the color and texture of each rock. Look for similarities and differences. Also, use the rock packet to find more information on each rock. However, remember to return the packet.

1. To which major group does each individual rock belong? (igneous, metamorphic, or sedimentary)

**Sandstone:**

**Quartzite:**

**Granite:**

1. How are quartzite, granite, and sandstone similar? (look at the rocks and use rock packet)
2. Put the **name** of each rock in the correct corresponding box, on the rock cycle picture.
3. In what order did these three rocks form? (e.g., sandstone, granite, quartzite)

1st to form\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 2nd to form\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 3rd to form\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. With enough time, what may happen to the quartzite? (think about question 22)
2. Explain how the sandstone rock could become part of a granite rock.
3. Explain how the granite rock could become part of a sedimentary rock.
4. Explain how sandstone becomes quartzite.

**ANSWER KEY**

**WS: Minerals, Weathering, and Soil**

**Chapter 3: Minerals-** Section 1: Properties of Minerals

**What is a Mineral (p. 66-74)**

1. What are the 5 characteristics a substance must have to be classified as a mineral?

Naturally Occurring, Inorganic, Solid, Crystal Structure, & Definite Chemical Composition

1. Give an example of an item that is naturally occurring.

Sun (Answers will vary; just cannot be made by humans)

1. Give a short definition for the term inorganic that contains 3 words or less.

Never alive (i.e., abiotic)

1. What is the difference between a solid and a liquid?

Has definite volume and shape. Also, particles are packed together more tightly.

1. Create a metaphor to describe the term crystal structure.

Checker/chess board (i.e., repeating pattern of squares)

1. Give a definition for the term definite chemical composition.

Minerals contain defined elements in certain amounts

1. Create an anagram or acronym for the 5 mineral properties. (Answers will vary)

**5 Properties of Minerals**

**Never  Naturally Occurring or Solid**

**Interrupt  Inorganic Crystal Structure**

**Science  Solid Inorganic SCIND**

**Class  Crystal Structure Naturally Occurring**

**Children  Chemical Composition Definite Chemical Composition**

**Identifying Minerals (p.68-74)**

1. How does a geologist (i.e., scientist) identify a mineral?

Geologists study the 9 characteristic properties of the mineral; color, streak, luster, density, hardness, crystal systems, cleavage, fracture, & special properties.

1. What are the 9 identifying properties of a mineral?

color, streak, luster, density, hardness, crystal systems, cleavage, fracture, & special properties

1. Explain why color is not a reliable way to identify a mineral.

Color is based on a qualitative observation and often a mineral can come in many different colors. For example, hematite can be red, brown, black, and silver/metallic. Unfortunately, few minerals are a single color. Continually, many different minerals have a similar color.

1. Give a short definition for the term streak that contains 3 words or less.

Color of powder

1. Give an example for the term luster.

Glassy reflection off of a pond or lake (answers will vary; just need to explain reflection off surface)

Metallic reflection off chrome chair (answers will vary; just need to explain reflection off surface)

1. Explain why density always stays the same, even when the size of the mineral changes.

e.g., Gold’s density is 19 g/cm3. A piece of gold the size of your thumb has the same density as a piece of gold the size of the Earth… 19 g/cm3.

Density is a physical property based on the amount of atoms packed into a space. These atoms/particles have a specific size and amount/arrangement for the substance (e.g., mineral). The size & arrangement of the atoms (i.e., how they’re packed) does not change when mass & volume change. Therefore, mass & volume will always change in equal proportions, and these two items divided will always equal out to the same density.

Example:

Mass 2/ Volume 1 = 2 Density

Mass 10/Volume 5 = 2 Density

1. Complete “Math Skills- Calculating Density” on page 70.
	* + 1. A sample of calcite has a mass of 324 g and a volume of 120 cm3. What is its density?

2.7 g/cm3

1. Complete the” Math: Analyzing Data- Mineral Density” Activity on page 71.

1. Reading Graphs: 50 g, 10 cm3

* + - 1. Calculating: 5 g/cm3
			2. Reading Graphs: 100 g, 20 g
			3. Calculating: 5 g/cm3
			4. Comparing & Contrasting: The density of samples B and C are the same.
			5. Predicting: 200 g
			6. Drawing Conclusions: No; density does not depend on the size. Larger samples have more mass, but the ratio between mass and volume is constant.
1. Give a metaphor for the identifying property hardness.

Different types of wood; oak to pine (Answers will vary)

1. What is the Mohs hardness scale?

Ranks 10 minerals from softest to hardest (talc to diamond)

1. Give a short definition for the term crystal systems that contains 8 words or less.

Six crystal faces based on angel/number sides

1. Is a mineral sample that does not have a smooth faces still a crystal?

Yes, it still has the same atomic structure.

1. Compare and contrast the terms (i.e., mineral identifiers) cleavage and fracture.

Cleavage:

|  |  |  |
| --- | --- | --- |
|  | Contrast | Compare |
| Cleavage | Mineral splits easily/smoothly along flat surfaces/planes. (e.g., 900) | Both are a form of breaking a mineral |
| Fracture | Irregular breaking of mineral (e.g., jagged) |

1. How would a geologist test if a mineral had cleavage or fracture?

Break apart the mineral.

1. List the different “special properties” that are used to identify some minerals.

Fluorescence, magnetism, optical properties, reactivity with chemicals, electrical properties, radioactivity

1. Create an anagram or acronym for the 9 identifying factors of a mineral. (Answers will vary)

Special Properties Some Parents

Streak Love

Luster School

Density Days

Hardness However

Crystal Systems Crabby Students

Cleavage Clearly

Fracture Fear

Color Class

How Mineral Crystals Form (p. 76-79)

24. Crystallization:

Arrangement of atoms to form crystal structure

25. Solutions:

It is a mixture of dissolved substances (i.e., solute) in liquid (i.e., solvent). Or also stated as, a mixture in which one substance is dissolved in another.

26. How do minerals form from magma and lava?

Minerals form from magma when they cool/crystalize inside the Earth.

Minerals form from lava when they cool/crystalize outside the Earth.

27. How do minerals form from solutions?

Minerals dissolved in water (i.e., solution) can crystalize on the surface of Earth by way of evaporation (e.g., lakes) or underground by cooling (i.e., veins).

28. How do minerals form from evaporite solutions (i.e., evaporation)?

Evaporites form when solutions evaporate and leave behind dissolved mineral crystals.

e.g., Halite, also known as salt, will form on the edge of a dried seabed.

 29. How do minerals form from hot water solutions?

Magma can heat water underground and cause minerals to dissolve into a solution. This solution runs through cracks in the rock (i.e., veins), when the solution cools the minerals crystalize in these veins.

e.g., The mineral gold is dissolved in water (i.e., solution) deep in the Earth. Magma (often around volcanoes) heats the solution and this solution travels through veins. When the solution cools it crystalizes leaving behind the gold in tiny streaks/lines/veins.

**Chapter 8: Weathering and Soil Formation**

Section 1: Rocks and Weathering (238-243)

30. Define weathering in 4 words or less.

Breaking down rocks/substances

31. Define erosion in 4 words or less.

Removal/moving rock particles

32. Compare and contrast weathering and erosion. List as many answers as possible.

|  |  |
| --- | --- |
| Similarities of Weather/Erosion | Differences |
| Deal with particles of rock or other substances | Weathering | Erosion |
| Both impacted by water/ice | Break down of rocks/substances into particles  | Removal of particles to new place; **not** break down |
| Both impacted by atmosphere  Weathering: gases; oxygen, carbon dioxide  Erosion: wind | Break down in place, on Earth’s surface | Particles (i.e., sediment) can be transferred under Earth’s surface |
| Both impacted by gravity  | Impacted by plants, & chemicals |  |

33. Create a metaphor for uniformitarianism. (Answers will vary)

 The basic rules of school today, are the basic rules my parents followed.

(i.e., what happens to me, is what happened to them)

34. Define mechanical weathering in 4 words or less.

 Rock physically broken down

 Movement/Action

35. Define chemical weathering in 4 words or less.

 Chemicals make rocks smaller

 Rock chemically broken down

 Water, air, plants destroy

 Chemistry/Reaction

36. List the different types of mechanical and chemical weathering. List as many answers as possible.

|  |  |
| --- | --- |
| Mechanical | Chemical |
| **Plants**: growth splitting rock | **Water**: dissolves rock |
| **Animals**: digging | **Oxygen**: oxidation causes iron in rocks to rust & break down |
| **Wind**: abrasion  | **Carbon Dioxide**: carbonic acid (carbon dioxide & water solution- i.e., acid rain) seeps into ground & eats away at rocks  |
| **Ice Wedging**: splitting by freezing/thawing | **Living Organisms**: living organisms release weak acids (e.g., lichens) |
| **Release of Pressure**: water moves material away (i.e., erosion) allowing rocks to flake off | **Acid Rain**: sulfur, carbon dioxide, & nitrogen mix with water (i.e., solution) in the atmosphere and create a weak acid that breaks down rocks |
| **Gravity**: material falls on rocks breaking |  |

37. What are the most important factors that determine the rate at which rock weathers?

 1. **Type of Rock:**

a. Mineral Composition: some minerals weather easily

b. Permeability: more porous (i.e., holes), the more weathering

 2. **Climate:** more hot & wet, the more weathering

**Chapter 9:** Soils (p. 248-254)

38. What is soil? Soil is the loose, weathered material on Earth’s surface in which plants can grow.

39. What is the composition of soil? Soil is a mixture of rock particles, minerals, decayed organic material (i.e., rotting plant/animal matter), water, & air.

40. What is the process of soil formation? Soil forms as rock is broken down by weathering and mixes with other materials on the surface. Soil is constantly being formed wherever bedrock is exposed.

**Answer Sheet**

**WS: Identifying Rocks**

**(p. 94-97)**

1. Rocks: rocks are made of minerals and other materials; like organic material. – ex. coal

2. What are rock forming minerals? 20 common minerals that make up the majority of rocks in Earth’s crust

3. Which rock-forming minerals make up granite? Quarts, feldspar, hornblende, & mica (i.e., biotite/muscovite)

**3 Ways to Identify Rocks**

4. Explain how geologists identify rocks. Study color, composition, & texture

5. Composition:the materials (e.g., organic) or minerals that make up the rock

6. Color: visual observation of minerals inside rock

7. Texture: look & feel of surface

* 1. The 3 Grain Size types:fine, coarse, non-visible
	2. The 2 Grain Shape types:rounded and jagged
	3. The 2 Grain Pattern types:banded and non-banded

8. Draw the 7 types of grains and label the 7 different grains, found on page 96

9. How do rocks form? From cooling magma/lava (i.e., igneous), cementing rock particle & plants/animals (i.e., sedimentary), & heat/pressure/chemical change (i.e., metamorphic)

10. What are the 3 types of rocks? Igneous, Metamorphic, & Sedimentary

11. How does igneous form? Cooling/crystalizing intrusively (i.e., lava) or extrusively (i.e., magma)

12. How does sedimentary form? Compacting & cementing particles of rocks and plants/animal remains

13. How does metamorphic form? Heat, pressure, and chemical change of existing rocks

**Answer Sheet**

**WS: Igneous Rocks**

**(Section 2: 98-101)**

1. Define Igneous Rock: formed from the cooling of magma or lava
2. Define Extrusive (pp. 98-99): formed from lava, outside of Earth
3. Define Intrusive (pp. 98-99): formed from magma, inside Earth
4. In a rock, what determines the size of a crystal? (pp. 98-99 & 77)

Rate of cooling (i.e., intrusive, slow cooling, big crystals or extrusive, fast, small crystals)

1. How are igneous rocks identified (i.e., classified)?

Origin, texture, & mineral composition; the size of the grains tells the origin of the igneous rock- (e.g., Coarse grains are extrusive in origin), and mineral composition will tell how much silica is present (e.g., granite has lots of quarts and quarts is made of silica; granite is therefore light in color)

1. Where do igneous rocks form; their origin?

Wherever there is lava or magma (e.g., volcanoes)

1. What is the texture of an igneous rock?

Depends on size and shape of mineral crystals; which is dependent on rate of cooling

**Explain Basalt Rock (circle correct answer)**

1. Classification: **Igneous,** Metamorphic, or Sedimentary
2. Primary Location: **Oceanic** or Continental Crust
3. Formation: **Extrusive** or **Intrusive**
4. Plate Tectonic Origin (pp. 152-153): **Divergent, Convergent**, or Transform Plate Boundary
5. Composition (i.e., Silica Level): High, or **Low Amounts of Silica**
6. Color: **Dark (e.g., black)** or Light (e.g., gray)

**Explain Granite Rock (circle correct answer)**

1. Classification**: Igneous**, Metamorphic, or Sedimentary
2. Primary Location: Oceanic or **Continental Crust**
3. Formation: **Extrusive** or **Intrusive**
4. Plate Tectonic Origin (pp. 152-153): **Divergent, Convergent,** or Transform Plate Boundary
5. Composition (i.e., Silica Level): **High,** or Low Amounts of Silica
6. Color: Dark (e.g., black) or **Light (e.g., gray)**

**Explain the Different Textures (circle correct answer)**

**Slowly Cooled Crystals**

1. Crystal Size: **Coarse**, Fine, Non-visible, or Mixture (i.e., coarse & fine)
2. Origin of Formation: **Intrusive**, Extrusive, Both

**Rapidly (i.e., fast) Cooled Crystals**

1. Crystal Size: Coarse, **Fine,** Non-visible, or Mixture (i.e., coarse & fine)
2. Origin of Formation: Intrusive, **Extrusive**, Both

**Very Rapidly Cooled Crystals**

1. Crystal Size: Coarse, Fine, **Non-visible,** or Mixture (i.e., coarse & fine)
2. Origin of Formation: Intrusive, **Extrusive**, Both

**Slowly and Rapidly Cooled Crystals**

1. Crystal Size: Coarse, Fine, Non-visible, or **Mixture** (i.e., coarse & fine)
2. Origin of Formation: Intrusive, Extrusive, **Both**
3. At which plate boundaries/locations do igneous rocks form? (p. 152-153 & plate boundary handout)

Convergent, divergent, and hot spots (Note: hot spot is not a plate boundary)

1. How does intrusive and extrusive igneous rock form at an oceanic to continental convergent plate boundary (i.e., subduction zone)? Complete the Diagram below to answer the question. (pp. 99, 146, 152-153, & plate boundary handout)

**How Igneous Rock Forms Diagram:** Label the parts of the diagram. (pp. 99, 146, 152, & plate handout)



Continental Crust

Extrusive igneous rock has small crystals/grains because it cools quickly

Subduction Zone

Oceanic Crust

Intrusive igneous rock has large crystals/grains because it cools slowly

**Study the Obsidian Sample (p. 98)**

34. What is its crystal structure?

Non-visible

1. What is its origin or formation: Intrusive or **Extrusive**
2. At what plate boundary is it formed? Divergent/Oceanic, **Convergent/Subduction Zone**, or Transform Boundary

**Answer Key**

**Metamorphic (Section 5: pp. 110-112 and handout)**

1. Metamorphic Rock Definition: A type of rock that forms from existing rock that is changed by heat, pressure, and/or chemical change.
2. How do geologists classify/identify metamorphic rocks? They classify according to the arrangement of the grains that make up the rocks.
3. At which types of plate boundaries do metamorphic rocks form?

Convergent (subduction and crushing), transform, and divergent

1. Give a definition for “Foliated”(i.e., banded) rock and draw a picture:

Grains arranged into parallel layers; banded or lined appearance



1. Give a definition for “Nonfoliated” (i.e., nonbanded) rock and draw a picture:

Random arraignment of grains; no bands or layers

1. Explain the difference between regional and contact metamorphism. (i.e., handout)

Regional is crushing pressure over large areas (e.g., burial of rock at a subduction zone)

Contact is localized heating of rock; rock must be near the surface (e.g., heated in the core of a mountain)

1. **How Metamorphic Rock Forms at a Plate: Draw** and **label** a picture that demonstrates how metamorphic rock forms at an oceanic to continental convergent plate boundary (i.e., subduction zone).

**Answer Key**

**Sedimentary (Section 3: pp. 102-106)**

1. Sedimentary Rock Definition: A type of rock that forms when particles from other rocks or the remains of plants and animals are pressed and cemented together.
2. Define Sediment: Small, solid pieces of material that comes from rocks or organisms; earth materials deposited by erosion.

**How Sedimentary Rocks Form**

1. **Step 1**- Weathering: breaking rock down by physical or chemical means, in place.
	1. Physical/mechanical weathering: breaking down of rocks by gravity, wind, ice, animal, or plants
	2. Chemical weathering: breaking down of rock by acids, solvents (i.e., water), or gases
2. **Step 2**- Erosion: **removing** sediments (i.e. weathered particles) away, by wind or water
3. **Step 3**- Deposition: when particles settle out of wind or water carrying them - deposit in layers
4. **Step 4**- Compaction: the process of pressing layers of sediment together – increasing layers of sediment cause more pressure on original/lower layers

7. **Step 5**- Cementation: minerals in a solution, seep into spaces between the particles of sediment and get glued

**8. How Sedimentary Rock Forms Pictures:** Draw a picture for each box, to represent each step in the formation of sedimentary rock.

 1. Weathering 2. Erosion 3. Deposition 4. Compaction 5. Cementation

Answers Vary

****

**Types of Sedimentary Rocks (pp. 104-105)**

9. How do geologists classify sedimentary rock? Based on the type of sediment that makes of the rock

10. Explain the difference between clastic, chemical, and organic sedimentary rock.

**Clastic:** sedimentary rock made from pieces of other rocks cemented together

**Chemical:** rocks formed from minerals dissolved in a solution. When these mineral crystals get large enough they are considered a rock. For example, when halite crystals get large enough, it is called Rock Salt.

**Organic:** These are sedimentary rocks that form from once living materials.

1. **Coal (pp. 356-357):** is an organic rock. It forms from what? Trees and other plant remains that grew in a swamp
2. Explain Hydrocarbons: are chemical compounds that contain carbon and hydrogen atoms; highly flammable

**Plate Tectonic Formation (use the handout)**

13. Explain how sedimentary rock forms at a subduction zone.

Sedimentary rocks that are comprised of volcanic rock fragments indicate a volcanic source region, and if sub-rounded to angular a short travel history, such as that of an ocean trench next to a volcanic arc. Well rounded, quartz rich sandstones may represent a beach environment at a passive continental margin.

14.Explain the difference between anActive Continental Plate Margin and a Passive Continental Plate Margin. (handout)

**Active: plates are still moving (i.e., subduction)**

**Passive: plate movement has stopped; extensive weathering and erosion.**

15. Which picture (i.e., 1 or 2) best represents the East Coast of the United Sates? Explain why. (handout)

**Picture 1;** the east coast is a passive plate boundary. The east coast has heavy wreathing of the Appalachians, wider beaches, gradual continental shelve, flatter land, etc.

****

Picture 1

Picture 1

****

Picture 2

**Sedimentary Rock Formation:** break, move, drop, squish, and glue

1. **Weathering:** rocks, minerals, and organic materials get broke down.
	1. *Physical weathering:* wind, water, heat, ice, and plants
	2. *Chemical weathering:* chemical reactions (e.g. acid rain, oxidation)
		1. ***Soil:*** created from weathered rocks and organic material (i.e. dead plants and animals)
2. **Erosion:** the removal of sediments by way of wind, water or ice (i.e. mainly glaciers).
3. **Deposition:** sediments drop out of the wind or water carrying them away.
4. **Compaction:** the squashing together of sediments, caused by layer after layer of heavy sediment stacking up.
5. **Cementation:** the gluing together of sediments by way of minerals seeping into the cracks and hardening.

The composition and sorting of sedimentary grains provides clues to the sediment source region, transport history and environment of deposition.

Sedimentary rocks that are comprised of volcanic rock fragments indicate a volcanic source region, and if sub-rounded to angular a short travel history, such as that of an ocean trench next to a volcanic arc. Well rounded, quartz rich sandstones may represent a beach environment at a passive continental margin.

Chemically precipitated rocks that have formed due to evaporation (e.g., rock salt, rock gypsum) are possibly remnants of shallow seas in warm arid climates.

Biochemical sedimentary rocks (e.g., chert, fossiliferous limestone) originate in ocean environments when the hard remains of marine organisms collect as sediment. Great ocean depth can be inferred from chert because calcium carbonate has high solubility in colder high pressure environments, typical of the deep oceans.

Picture 2

**ANSWERS KEY**

**The Rock Cycle (114-116)**

1. What is the “Rock Cycle?”

**This is a series of processes on the Earth's surface and in the crust and mantle that builds, destroys, and changes rocks from one type to another.**

1. Which product, of the rock cycle, creates igneous rock?
	1. Sediment  **b. Magma (including lava)** c. Other Rock
2. Which product, of the rock cycle, creates sedimentary rock?
	1. **Sediment** b. Magma (including lava) c. Other Rock
3. Which product, of the rock cycle, creates metamorphic rock?
	1. Sediment b. Magma (including lava) c. Other Rock
4. Which process creates igneous rock?
	1. **Melting & cooling** b. Heat & pressure c. Weathering, erosion, deposition, compaction, & cementation
5. Which process creates sedimentary rock?
	1. Melting & cooling b. Heat & pressure c. Weathering, erosion, deposition, compaction, & cementation
6. Which process creates metamorphic rock?
	1. Melting & cooling **b. Heat & pressure** c. Weathering, erosion, deposition, compaction, & cementation
7. Explain how igneous rock is created.

**Igneous rock is created when minerals melt inside of the Earth (magma) and then cool and crystalize. These crystals will cool intrusively (magma) or extrusively (lava).**

1. Explain how sedimentary rock is created.

**Sedimentary rock is created when organic material (plants, shells, animals), chemicals, or rocks are weathered (broken) into sediment. The sediment is then transported (eroded) by wind, water, or ice to a location where it will settle and deposited. Often the place where it is deposited is a lake or ocean bed. The sediment then gets compacted over many years as ne, erode sediment settles on top. Finally, a solution (water with dissolved minerals) will seep into the cracks around the sediment and crystalize. This cements (freezes) the sediment together, into a sedimentary rock.**

1. Explain how metamorphic rock is created.

**Metamorphic rock is created from other rocks (igneous and sedimentary). Metamorphism occurs in two ways; contact and regional. In regional metamorphism, the Earth’s plates rub, collide, or sink causing huge crushing pressures. This pressure, along with heat, changes the rock. In contact metamorphism, large amounts of heat and less pressure, changes the rock chemically.**

1. Which one property, when identifying a rock, is most important for determining if the rock is igneous?
2. Grain size b. Grain shape/type c. Grain pattern
3. Explain how geologists may use this factor to identify a rock as igneous.

**Large grains/crystals = slow cooling = intrusive –Pegmatite rock**

**Small grains/crystals = fast cooling = extrusive –Obsidian rock**

1. Which one texture property, when identifying a rock, is most important for determining if the rock is sedimentary?
	1. Grain size b. Grain shape/type c. Grain pattern
2. Explain how geologists may use this factor to identify a rock as sedimentary.

Type of material tells a geologist what the rock is made of and therefore, where it formed (i.e., environment).

**Organic= plants, animals, shells**

**Clastic= pieces of rock**

**Chemical= minerals in solution (i.e., water)**

Shape of grain tells the geologist age, weathering, and environment where it formed.

**Rounded grains = lots of weathering = running water or wind = weathered over long period of time**

**Jagged grains = minimal weathering = still water = probably younger, traveled short distance, or sheltered**

1. Which one property, for identifying a rock, is most important when determining if the rock is metamorphic?
	1. Grain size b. Grain shape/type c. Grain pattern
2. Explain how geologists may use this factor to identify a rock as metamorphic.

**Foliated grains = banded = more likely regional metamorphism = deep burial/crushing pressure**

**Non-foliated = non-banded = more likely contact metamorphism = high heat & lower pressure**

1. Explain why the rock cycle does not have a beginning or an end.

**It does not have a beginning or end, because one rock can change into another. For example, igneous rock can change into sedimentary rock by way of erosion and cementation and igneous can also turn into metamorphic rock by way of heat and pressure.**

1. **Draw** and **label** a picture of the rock cycle. You can find an example on page 115.

****



1. To which major group does each individual rock belong? (igneous, metamorphic, or sedimentary)

**Sandstone: sedimentary**

**Quartzite: metamorphic**

**Granite: igneous**

1. How are quartzite, granite, and sandstone similar? (look at the rocks and use rock packet)

**They all contain high levels of silica. The silica primarily comes from the quarts minerals in the rock.**

1. Put the **name** of each rock in the correct corresponding box, on the rock cycle picture.
2. In what order did these three rocks form? (e.g., sandstone, granite, quartzite)

1st to form: **Granite**  2nd to form:  **Sandstone** 3rd to form: **Quartzite**

1. With enough time, what may happen to the quartzite? (think about question 22)

**It could weather and become sedimentary rock, or it could melt and crystalize into igneous rock.**

1. Explain how the sandstone rock could become part of a granite rock.

**The sandstone (sedimentary) would have to melt and then crystalize into igneous rock. This is common at a subduction zones.**

1. Explain how the granite rock could become part of a sedimentary rock.

**The granite (igneous) rock would have to weather, erode, deposit, compact and cement into sedimentary.**

1. Explain how sandstone becomes quartzite.

**Sandstone will become quartzite when great heat and pressure is added. This often occurs at subduction zones.**