Answer Key

Directed Reading A

SECTION: THE ROCK CYCLE

1. B
2. C
3. building materials
4. weathering
5. sediment
6. erosion
7. deposition
8. minerals
9. uplift
10. surface
11. C
12. E
13. A
14. B
15. D
16. C
17. A
18. A
19. D
20. C
21. A
22. D
23. A

SECTION: IGNEOUS ROCK

1. B
2. A
3. the composition of the magma and the amount of time the magma takes to cool
4. magma
5. when rock is heated, when pressure is released, or when rock changes composition
6. temperature, pressure, and composition
7. Rather than solidifying at one exact temperature, magma cools at various temperatures, depending on its composition, because different minerals melt at different temperatures. Magma can be made up of various minerals in different mixtures. Some minerals within the magma will only solidify at low temperatures while other minerals will begin to solidify earlier when the temperature is still quite high.
8. dense
9. felsic
10. mafic
11. mineral crystals, coarse
12. finer
13. A
14. C
15. D
16. B
17. intrudes
18. coarsegrained
19. extrusive igneous rock
20. fissures
21. ocean floor
22. lava plateau

SECTION: SEDIMENTARY ROCK

1. sandstone
2. sedimentary rock
3. cement
4. surface
5. strata
6. clasts
7. clastic
8. texture
9. chemical
10. organic
11. coral, reefs
12. fossiliferous
13. coal
14. C
15. A
16. D

SECTION: METAMORPHIC ROCK

1. A
2. C
3. B
4. solid
5. mineral grains
6. contact metamorphosis
7. distance, temperature
8. regional metamorphosis
9. crust
10. B
11. C
12. D
13. C
14. A
15. D
16. F
17. C
18. A
19. E
20. B
21. D
22. A

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Directed Reading B

SECTION: THE ROCK CYCLE

1. C
2. B
3. A
4. D
5. C
6. A
7. D
8. A
9. sedimentary
10. metamorphic
11. igneous
12. magma
13. A
14. B
15. A
16. B
17. D
18. A
19. D
20. B
21. A
22. B

SECTION: IGNEOUS ROCK

1. A
2. D
3. C
4. B
5. D
6. A
7. crystals
8. felsic rocks
9. mafic rocks
10. cooled
11. fine
12. A
13. A
14. D
15. B
16. C
17. D
18. A
19. B

SECTION: SEDIMENTARY ROCK

1. weather
2. sediment
3. erosion
4. surface
5. dissolved minerals
6. strata
7. C
8. D
9. B
10. A
11. C
12. C
13. A
14. D
15. fossils
16. coral
17. reefs
18. fossiliferous limestone
19. coal
20. B
21. D
22. B

SECTION: METAMORPHIC ROCK

1. C
2. A
3. D
4. B
5. C
6. A
7. pressure
8. stable
9. index minerals
10. C
11. A
12. D
13. B
14. C
15. B
16. D
17. D
18. B

Vocabulary and Section Summary

SECTION: THE ROCK CYCLE

1. rock cycle: continual process by which new rock forms from old rock
2. rock: naturally occurring solid mixture of one or more minerals and organic matter
3. erosion: the process by which sediment is removed from its source
4. deposition: the process by which material is laid down
5. composition: the minerals a rock contains
6. texture: the quality of a rock that is based on the sizes, shapes, and positions of the rock's grains

SECTION: IGNEOUS ROCK

1. intrusive igneous rock: rock that is formed when magma pushes into surrounding rock beneath the Earth's surface
2. extrusive igneous rock: rock that forms when magma erupts onto the Earth's surface

SECTION: SEDIMENTARY ROCK

1. strata: layers found in sedimentary rock
2. stratification: the process in which sedimentary rocks are arranged in layers

SECTION: METAMORPHIC ROCK

1. foliated: the texture of metamorphic rock in which the minerals are arranged in planes or bands
2. nonfoliated: the texture of metamorphic rock in which the mineral grains are not arranged in planes or bands

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Section Review

SECTION: THE ROCK CYCLE

1. composition
2. Rock
3. B
4. Rock has been used by humans to make tools and weapons and to construct buildings.
5. Four processes that change rock inside the Earth are compaction and cementation, metamorphism, melting, and cooling.
6. Weathering is the process by which water, wind, ice, and heat break down rock. Erosion is the process by which sediment is removed from its source. Deposition is the process by which sediment moved by erosion is laid down. Uplift is the process by which rock within the Earth moves to Earth's surface.
7. Answers may vary. Sample answer: Fine grains in an igneous rock indicate that the rock cooled quickly, which means it was likely to have formed at Earth's surface.
8. Composition is the percent of elements that make up a rock. Texture is a quality of a rock that is based on the size, shape, and position of its grains.
9. Answers may vary. Sample answer: Rock is continually recycled by different processes in the rock cycle. Melting of sedimentary, metamorphic, or igneous rock creates new igneous rock. The weathering, erosion, deposition, burial, compression, and cementation of igneous, metamorphic, or sedimentary rock creates new sedimentary rock. Igneous, sedimentary, or metamorphic rock that is subjected to increased heat and pressure can be metamorphosed.
10. a mediumgrained texture

SECTION: IGNEOUS ROCK

1. Sample answer: Intrusive igneous rock forms from magma that solidifies underground. Extrusive igneous rock forms from magma that solidifies after it has reached the surface.
2. C
3. Temperature, pressure, and a change in the composition of a rock can cause magma to form. A rise in temperature can cause minerals in a rock to melt, forming magma. When pressure in a rock that is hot is released, the minerals in that rock can melt, forming magma. When fluids such as water combine with rock, the composition of the rock changes. This change in composition lowers the melting point of the rock enough to melt it, forming magma.
4. When magma cools slowly, crystals have a long time to grow, so the igneous rock that forms is coarse grained. When magma cools quickly, crystals have a short time to grow, so the igneous rock that forms is fine grained.
5. 1,825 ft ÷ 3.28 ft/m = 556.4 ft/m
6. A sill intrudes rock parallel to the surrounding rock layers. A dike cuts across the surrounding rock layers.
7. Because the rock formed from slowly cooling magma deep inside the Earth, the crystals had more time to grow. Therefore, the texture of the rock would most likely be coarse grained.

SECTION: SEDIMENTARY ROCK

1. Sample answer: Strata are layers in sedimentary rock. Stratification is the process in which layers are arranged into sedimentary rock.
2. C
3. Clastic sedimentary rock is formed by the processes of weathering, erosion, deposition, compaction, and cementation. Rocks are physically weathered into fragments called sediment. Sediment is transported by erosion and is deposited in layers. Older layers of sediments are compacted by younger layers of sediments. Sediments in layers that have been compacted are cemented together by minerals that are dissolved in water, such as calcite and quartz, forming clastic sedimentary rock.

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4. Clastic sedimentary rock forms when sediments are compacted and cemented together. Chemical sedimentary rock forms when dissolved minerals separate out of solution and crystallize. Organic sedimentary rock is made from the remains of animals that once lived in the ocean.
5. 2 m = 2,000 mm; 2,000 mm ÷ 4 mm/year = 500 years
6. Texture is more useful in classifying clastic sedimentary rock because the size of the grain can provide clues to where and how the rock was formed.
7. Answers will vary. Sample answer: The finer the grains of sediment are, the more likely delicate structures such as raindrop impressions will be preserved in them.

SECTION: METAMORPHIC ROCK

1. Sample answer: Foliated metamorphic rock consists of minerals that are arranged in planes or bands. The minerals in nonfoliated metamorphic rock do not appear to be arranged in a pattern.
2. C
3. Contact metamorphism is a type of metamorphism that occurs near igneous intrusions, where magma comes into direct contact with surrounding rock. Regional metamorphism is a type of metamorphism that occurs when large pieces of Earth's crust collide, causing rock to become deformed and chemically changed over large areas.
4. Because index minerals form only at certain temperatures and pressures, index minerals indicate the temperature, pressure, and depth at which a rock metamorphosed.
5. 16 km ÷ 3.3 km = 4.84 km × 0.1 gigapascal = 0.484 gigapascal + .101 gigapascal (atmospheric pressure) = .585 gigapascal
6. The rock with garnet crystals would probably have formed deeper in the Earth because the mineral garnet forms at a higher temperature and at a higher pressure than the mineral chlorite.
7. Because the grains in a foliated metamorphic rock are arranged in parallel bands, foliated metamorphic rock would be easier to break than a nonfoliated metamorphic rock.
8. Rock becomes deformed and chemically changed over large areas of Earth's crust by increases in temperature and pressure that occur when tectonic plates collide. Therefore, most of the rock in the mountain range would be the product of regional metamorphism.

Chapter Review

1. Sample answer: The rock cycle is the process in which one rock type changes into another rock type. In this process, rock is continuously recycled.
2. texture
3. Foliated
4. stratification
5. Extrusive igneous rock
6. C
7. D
8. C
9. B
10. B
11. D
12. Scientists use differences in composition, or the minerals a rock is made up of, to classify rock. Scientists use differences in texture—the sizes, shapes, and positions of the grains a rock is made up of—to further classify rocks.
13. Two ways in which a rock can undergo metamorphism is by contact metamorphism and regional metamorphism. Contact metamorphism occurs near igneous intrusions, where magma comes in direct contact with the surrounding rock. Regional metamorphism occurs when pressure builds up in deep rock or when large pieces of Earth's crust collide, deforming and chemically changing rock over large areas.
14. Some minerals can form only at specific pressures and temperatures present during metamorphism

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.15. Sample answer: When rocks are buried, they are heated and squeezed to create metamorphic rock. Sometimes, the heat is enough to melt the rock and create magma,which cools to form igneous rock. Buried rocks are uplifted, and when rocks at the Earth's surface are eroded, sediments are created. These sediments later harden into sedimentary rock.
16. Two ways rocks were used by early humans and ancient civilizations were as tools and as building materials.
17. An answer to this exercise can be found at the end of the Teacher Edition.
18. You would not find many—or any—fossils where you live because fossils are usually found in sedimentary rock, not metamorphic rock. (Occasionally, fossils are preserved in metamorphic rock that was once sedimentary rock.)
19. The property with the batholith would be a better buy because batholiths are much bigger than sills.
20. The seashells that make up coquina are made up of the remains of onceliving organisms, so coquina is an organic sedimentary rock. (The shells are technically clasts, because they are particles that have been deposited.)
21. A rock buried deep beneath the surface cannot be changed by weathering and erosion, which are geological processes that change Earth's surface features.
22. orthoclase = 30%, plagioclase = 20%, biotite = 10%, quartz = 40%
23. plagioclase + orthoclase = 30% + 20% = 50% 100% - 50% + 50% Fifty percent of the minerals in the granite are not feldspars.
24. 10 g × 0.40 = 4 g
25. Accept all reasonable responses. Charts should show the correct percentages of the minerals.

Reinforcement

WHAT IS IT?

1. a sedimentary rock
2. organic sedimentary, clastic sedimentary, and chemical sedimentary
3. a metamorphic rock
4. foliated, nonfoliated
5. Accept any reasonable answer. Sample answer: It is the result of the cooling of magma. It can be intrusive or extrusive. Its origin is magma. What is it? an igneous rock
6. intrusive igneous rocks, extrusive igneous rocks

Critical Thinking

BETWEEN A ROCK AND A HARD PLACE

1. Large amounts of heat and pressure would be necessary to form synthetic gemstones in a laboratory.
2. As the depth of the Earth increases, so does the amount of pressure. The composition of the surrounding rocks also changes as depth increases. Both composition and pressure determine the type of metamorphic rock that forms.
3. At temperatures greater than 1,000°C, rock usually melts into magma.
4. The carbon from a prehistoric animal could be preserved in sedimentary rock. As the Earth's crust moves, that rock is forced downward into the Earth. There the great temperature and pressure could transform elements of a sedimentary rock into a metamorphic mineral, such as a diamond.

Section Quizzes

SECTION: THE ROCK CYCLE

1. B
2. E
3. C
4. F
5. A
6. D
7. B
8. D
9. D
10. A

SECTION: IGNEOUS ROCK

1. C
2. A
3. D
4. C
5. D

SECTION: SEDIMENTARY ROCK

1. A
2. C
3. D
4. B
5. A
6. D

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SECTION: METAMORPHIC ROCK

1. B
2. C
3. E
4. D
5. A
6. F

Chapter Test A

1. D
2. A
3. A
4. B
5. A
6. D
7. B
8. D
9. A
10. B
11. C
12. B
13. D
14. A
15. C
16. A
17. E
18. D
19. B
20. F
21. B
22. D
23. C
24. A
25. E

Chapter Test B

1. stratification
2. nonfoliated rock
3. erosion
4. composition
5. rock cycle
6. A
7. C
8. D
9. D
10. Answers may vary. Sample answer: Clastic sedimentary rock is formed from rock fragments that are cemented together by a mineral. Chemical sedimentary rock is made of crystallized minerals that were previously dissolved.
11. Answers may vary. Sample answer: Contact metamorphism occurs when magma comes into direct contact with rock. Regional metamorphism occurs when large pieces of the Earth's crust collide with each other.
12. Answers may vary. Sample answer: Nonfoliated rock has mineral grains that are not aligned.
13. Answers may vary. Sample answer: Limestone is formed from the remains, or fossils, of animals that once lived in the ocean.
14. Answers may vary. Sample answer: Rocks recrystallize when the crystals of the minerals change in size or the mineral changes in composition.
15. Rocks like granite and marble are good building materials because they can withstand weathering for long periods of time.
16. Answers may vary. Sample answer: An extrusive rock formation reveals that there is a lot of activity, perhaps volcanic, going on below the Earth's surface.
17. All three rock types weather when they are uplifted to the Earth's surface, forming sediments that cover the Earth's surface.
18. **a**. igneous rock; **b**. composition; **c**. texture; **d.** dikes; **e**. erode; **f**. conglomerate; **g**. sedimentary rock

Chapter Test C

1. D
2. A
3. C
4. B
5. A
6. D
7. A
8. B
9. B
10. D
11. B
12. A
13. C
14. uplift
15. stratification
16. index minerals
17. erosion
18. intrusive igneous rock

Standardized Test Preparation

READING

Passage 1

1. D
2. G
3. B

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Passage 2

1. B
2. G
3. D

INTERPRETING GRAPHICS

1. B
2. G
3. C
4. H

MATH

1. B
2. G

Vocabulary Activity

1. J
2. B
3. G
4. O
5. A
6. D
7. K
8. I
9. E
10. L
11. M
12. F
13. C
14. N
15. H
16. P

SciLinks Activity

Answers may vary, but should trace the cycle in a progression beginning with igneous rock to sedimentary rock to metamorphic rock to finally igneous rock.

Performance-Based Assessment

ANALYSIS

6. The granules in a sugar cube have been compacted so that they stick together. If sugar granules represent sediment eroded from other rock, a sugar cube would represent sedimentary rock. Sedimentary rock forms when sediments are compacted and stick together.
7. If sugar represents sedimentary rock and heat was applied to melt the sugar, the melting sugar represented molten magma. When sedimentary rock is heated so that it melts, it becomes magma.
8. After the sugar melted and cooled, its cooled, solidified form represented igneous rock. Sedimentary rock that is heated until it melts and then cools becomes igneous rock.
9. After the sugar was pulled and cooled, it represented metamorphic rock. Metamorphic rock forms when pressure is applied to igneous rock.

Let's Get Sedimental

ANALYZE THE RESULTS

1. Answers may vary. Students should understand that the finest sediments should be at the top. This sequence can indicate the top of a layer in a sedimentary outcrop. If the layers are not in this order, the rock may have been disturbed.

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2. Students should indicate that in the sorting process, gravel settled out first, followed by sand, and then soil.
3. If features that geologists expect to find only in the top layer are found elsewhere, this finding indicates that the column has been disturbed. Geologists carefully study the layers for these features so that they can determine the original order of the layers.
4. Each layer should show finer particles at the top. This pattern can be seen only from the side.
5. Students should see the same grading effect at the boundaries. The changes within each layer will be gradual, but the changes between layers may be more dramatic.

DRAW CONCLUSIONS

6. If sediment having the same particle sizes as the mixture in steps 1–5 is deposited on top of the sediment in the bottle, the new layer should have the same composition as the layer in the bottle.

Stretching Out

PROCEDURE

3. The "crystals" become stretched and deformed. The "granite" changed its shape because of the force applied to it.

Crystal Growth

ANALYZE THE RESULTS

1. Answers will vary. A correct prediction would state that a cool solution will produce crystals more quickly than a warm solution. A correct prediction would also state that the crystals produced in a warm solution will be much larger than those produced in a cool solution.
2. Because the original crystals were small, students may conclude that they formed quickly.
4. Accept all reasonable sketches.
5.

	Granite	Basalt	Pumice
How did the rock sample form?	when magma cools slowly beneath the Earth's surface	when lava cools quickly on the Earth's surface	when magma is ejected from a volcano during a violent eruption
Rate Of Cooling	cools slowly; large crystals	cools quickly small crystals	cools very quickly; very small or no crystals

COMMUNICATING YOUR DATA

Volcanic rocks that form in the air as the result of a violent volcanic eruption would cool quickly and have small crystals. Volcanic rocks that form from lava oozing out of a volcano would cool more slowly and have larger crystals.

Metamorphic Mash

PROCEDURE

3. The sequins should be lying in a random pattern. Any layering is the result of rolling the ball.
5. The sequins are all horizontal.

ANALYZE THE RESULTS

1. It represents the pressure that creates metamorphic rock.
2. Before the ball was flattened, the sequins were in a random pattern. Once the ball was flattened, they lined up perpendicular to the pressure.

DRAW CONCLUSIONS

3. The sequins are aligned perpendicular to the force.
4. Because the grains line up at right angles to the pressure, they are perpendicular to the strongest stress.

APPLYING YOUR DATA

Answers will vary. Two pressures acting on the rock at different times must have pushed on the rock in different directions.

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