Answer Key

Directed Reading A

SECTION: BRANCHES OF EARTH SCIENCE

1. geology
2. C
3. B
4. A
5. Some formations develop from minerals in water that drip from air-filled caves. When Robert Fronk finds these formations under water, he knows the caves used to be above sea level.
6. oceanography
7. B
8. D
9. A
10. C
11. Answers may vary. Sample answer: Oceanographers today use miniature research submarines to study the ocean floor.
12. black smokers
13. Thermal vents supply minerals and hot water to the biological community around them.
14. meteorology
15. Fewer people died during Hurricane Andrew because people were warned by hurricane tracking and weather forecasting and left the area before the hurricane struck.
16. Some meteorologists chase tornadoes to gather data about them. These scientists hope to learn more about tornadoes and predict how they behave.
17. C
18. B
19. C
20. A
21. C
22. environmental science
23. One task of an environmental scientist is to determine whether humans are damaging the environment.
24. Answers may vary. Sample answer: Environmental science relies on geology, life science, chemistry, and physics.
25. ecologist
26. An ecologist might work in wildlife management, agriculture, forestry, or conservation.
27. Geochemistry combines the studies of geology and chemistry.
28. geochemists
29. Geochemists study the chemistry of rocks, minerals, and soil to determine their economic value. They determine what the environment was like when rocks first formed. They study how chemicals affect the environment.
30. physical geographers
31. cartographers
32. Answers may vary. Sample answer: aerial photos, satellite photos, computer mapping systems

SECTION: SCIENTIFIC METHODS IN EARTH SCIENCE

1. a Seismosaurus hallorum
2. Scientists ask questions to begin to learn about the natural world.
3. Scientific methods are a series of steps that scientists use to answer questions and solve problems.
4. The goal of scientific methods is to come up with reliable answers and solutions.
5. A
6. A
7. C
8. A hypothesis is a possible explanation or answer to a question that can be tested.
9. David Gillette thought that the bones came from a dinosaur not yet known to science.
10. Scientists test hypotheses by gathering data.
11. controlled experiment
12. By changing only one variable in an experiment, scientists can see the results of just that one change.
13. Gillette took hundreds of measurements of the dinosaur bones. He compared his measurements with those of bones from known dinosaurs.

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14. Scientists may repeat experiments to verify their findings.
15. Scientists often make tables and graphs to organize and summarize their data.
16. When Gillette analyzed his results, he found that the bones of the mystery dinosaur did not match those of any known dinosaur.
17. D
18. A
19. Gillette concluded that the bones found were from a very large, yet unknown dinosaur.
20. Gillette shared his results at a press conference and in a scientific journal.
21. Evaluate the evidence.
22. An investigation may continue if there is new evidence or if a scientist forms more questions.
23. D
24. E
25. C
26. A
27. F
28. B

SECTION: SCIENTIFIC MODELS

1. model
2. Models are used to help us understand the natural world. Scientists use models to explain or analyze objects, systems, or concepts in more detail. Models can also be used to represent things that are too large or small to see completely. They can be used to explain the past and present and to predict the future.
3. B
4. A
5. C
6. B
7. C
8. A
9. D
10. D
11. B
12. A
13. Scientists can use the information they gather from using a model to help support a theory or show it to be wrong.
14. A scientist may change or replace a model when new observations are made that lead scientists to change their theories.
15. Some of the variables of a climate model are: the level of carbon dioxide in the atmosphere; land and ocean-water temperatures; and information about clouds, cloud cover, snow, ice cover, and ocean currents.
16. Scientists can process the data of a mathematical climate model with the help of computers.
17. Mathematical climate models may someday help scientists prevent serious climate problems, such as global warming or another ice age.

SECTION: MEASUREMENT AND SAFETY

1. B
2. C
3. Answers may vary. Sample answer: One advantage of using SI measurements is that scientists all over the world can share and compare their observations and results. Another advantage is that all units are based on the number 10.
4. meter
5. B
6. C
7. A
8. volume
9. liters
10. one cubic meter, or cm^3
11. To calculate the volume of a box-shaped object, multiply its length by its width and then by its height.
12. To calculate the volume of an irregularly shaped object, measure the volume of the liquid that the object displaces.
13. mass
14. B
15. A
16. C
17. temperature
18. B
19. C
20. A
21. area
22. the surface area of an object
23. To calculate the area of a square or rectangle, measure the length and width. Then use the equation, $area = length \times width$.
24. density

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25. The units g/ml and g/cm^3 are often used to describe density.
26. To calculate density, you can use the equation: density = mass ÷ volume

27.you start any science investigation, you should get your teacher's permission, carefully read the lab procedures, and pay attention to safety information.

28. G
29. F
30. A
31. E
32. B
33. D
34. I
35. H
36. C

Directed Reading B

SECTION: BRANCHES OF EARTH SCIENCE

1. geology
2. paleontologist
3. seismologist
4. volcanologist
5. A
6. C
7. A
8. A
9. B
10. A
11. C
12. C
13. A
14. B
15. C
16. C
17. B
18. ecologist
19. geochemist
20. physical geographer
21. cartographer

SECTION: SCIENTIFIC METHODS IN EARTH SCIENCE

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

SECTION: SCIENTIFIC MODELS

1. A
2. B
3. physical model
4. mathematical model
5. conceptual model
6. D
7. B
8. A
9. C
10. C
11. D

SECTION: MEASUREMENT AND SAFETY

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

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29. A
30. C
31. B

Vocabulary and Section Summary

SECTION: BRANCHES OF EARTH SCIENCE

1. geology: the study of the origin, history, and structure of the Earth and the processes that shape the Earth
2. oceanography: the scientific study of the sea
3. meteorology: the scientific study of the Earth's atmosphere, especially in relation to weather and climate
4. astronomy: the study of the universe section: scientific methods in earth science

SECTION: SCIENTIFIC METHODS IN EARTH SCIENCE

1. scientific methods: a series of steps followed to solve problems
2. hypothesis: an explanation that is based on prior scientific research or observations and that can be tested

SECTION: SCIENTIFIC MODELS

1. model: a pattern, plan, representation, or description designed to show the structure or workings of an object, system, or concept
2. theory: an explanation that ties together many hypotheses and observations

SECTION: MEASUREMENT AND SAFETY

1. meter: the basic unit of length in the SI (symbol, m)
2. volume: a measure of the size of a body or region in three-dimensional space
3. mass: a measure of the amount of matter in an object
4. temperature: a measure of how hot (or cold) something is
5. area: a measure of the size of a surface or a region
6. density: the ratio of the mass of a substance to the volume of the substance

Section Review

SECTION: BRANCHES OF EARTH SCIENCE

1. Sample answer: Geology is the study of the structure of Earth and the processes that shape Earth. Oceanography is the study of the oceans. Astronomy is the study of the universe.
2. C
3. A
4. The major branches of Earth science are geology, oceanography, meteorology, and astronomy.
5. oceanography
6. Answers may vary. Branches listed in the text include environmental science, ecology, geochemistry, geography, and cartography. Other branches not mentioned in the text are acceptable at the teacher's discretion. If branches are chosen from the text, explanations of how the branches rely on other areas should reflect the information given in the text.
7. Answers may vary. Any of the careers listed in the text are acceptable. Descriptions should match the text. Other careers may be accepted.
8. 80 pages per week $3 \times$ weeks = 320 pages.
9. A hydrogeologist is a geologist who studies water. (The prefix *hydro-* refers to water.)
10. Answers may vary. An ecologist studies the relationships between organisms and their environment. Part of an organism's environment is its physical environment, which includes geologic structures such as landforms.
11. Answers may vary. An airline pilot must understand the characteristics of the atmosphere and weather patterns. The study of the atmosphere is a branch of Earth science called *meteorology*.

SECTION: SCIENTIFIC METHODS IN EARTH SCIENCE

1. Sample answer: Forming a hypothesis is an important part of using scientific methods.
2. D

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3. B
4. Answers may vary. Scientists perform controlled experiments and make observations to study the natural world.
5. Scientists communicate the results of their investigations because scientific progress depends on the exchange of information.
6. Answers may vary. Ascientist could change his or her hypothesis because subsequent observations or experiments provide new data.
7. 20 m ÷ 4 2 m per scientist = 10 scientists
8. Answers may vary. A hypothesis is a possible explanation for observations that have been made. It is possible that two scientists have different explanations of the same data.
9. Sample answer: Gillette's hypothesis was testable because he could compare the discovered bones with the bones of known dinosaurs.

SECTION: SCIENTIFIC MODELS

1. Sample answer: A model is a representation of an object, system, or process. A theory is an explanation that ties together many observations and hypotheses.
2. C
3. Answers may vary. Scientists use models to study objects, systems, and concepts. They also use models to communicate results.
4. Answers may vary. Physical models are models that you can touch. Mathematical models are made of data and equations. Conceptual models consist of ideas and hypotheses supported by observation and data.
5. Answers may vary. All three types of models could be used to study objects that are too small to be seen.
6. Answers may vary. A climate model is a mathematical model that contains a vast amount of data. Equations help predict the consequences of changes in the data.
7. 1 m ÷ 0.025 = 40 m
8. Answers may vary. One advantage of physical models is that they often look like the object or system that they are intended to model.
9. Answers may vary. Students may choose any of the models described in the section.

SECTION: MEASUREMENT AND SAFETY

1. area
2. mass
3. A
4. Answers may vary. Students should mention that the SI is used by scientists throughout the world. Students may also note the advantages of using a system of units that is based on 10.
5. 0ºC
6. Answers may vary. Sample answer: Safety rules are created to minimize risks associated with some experiments.
7. 34 g ÷ 14 mL = 2.43 g/mL
8. Answers will vary. Students should recognize that both materials weigh 1 lb.

Chapter Review

1. geology
2. hypothesis
3. Scientific methods
4. B
5. B
6. B
7. B
8. A
9. Students should recognize that observations and data gathered during a scientific investigation can lead to new questions, which lead to new investigations.
10. Answers may vary. Scientists use models to represent things that are too small or too large to see, to test designs and hypotheses, to explain the past, and to predict the future.
11. Sample answer: physical: A globe is a physical model of the Earth; conceptual: A theory is a conceptual model that explains a broad range of observations and hypotheses; mathematical: An equation can be a mathematical model of a chemical reaction.

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12. Answers may vary. Students may suggest that if the results of an investigation are not communicated, scientists could not build on each other's knowledge and science could not advance as quickly.
13. Answers may vary. Students should note that it would be difficult for scientists to share data.
14. eye protection, chemical safety, clothing protection, and hand safety
15. An answer to this exercise can be found at the end of the Teacher's Edition.
16. Answers may vary. Students should note that each step of scientific methods can lead to other steps. For example, observations might lead a researcher to develop a new hypothesis.
17. Answers may vary. Sample answer: The scientists may make different observations, form different hypotheses, test the same hypothesis differently, or analyze the results of their tests differently.
18. Answers may vary. Observation can limit what scientists can study because some objects and phenomena cannot be observed easily.
19. Sample answer: geology and paleontology; A geologist might be interested in studying how the rock formed and how it relates to other rock formations in the area. A paleontologist might study the rock because it contains fossils of ancient life.
20. The amount of CO_2 has increased.
21. The rate at which the amount of CO_2 in the atmosphere increased has also increased over time.
22. higher; The line in the graph curves more steeply between 1940 and 1960 than it does between 1880 and 1900.
23. Answers may vary. Sample answer: The rate at which CO_2 has been added to the atmosphere has increased over time.

Reinforcement

SCENES FROM THE EARTH

1. Scene 1: astronomer; Scene 2: physical oceanographer; Scene 3: meteorologist; Scene 4: volcanologist
2. Answers may vary. Sample answer: I think the astronomer has the most interesting job. I am interested in astronomy because I love to look at the stars and to learn about the different bodies in space. An astronomer's job seems full of adventure because the universe has so many things that we have yet to discover!

Critical Thinking

1. Jack and Diego want to know if the rock they have found is from another planet.
2. The rock is from outer space.
3. Jack and Diego test their hypothesis by comparing the properties of their "Kryptonite" to the properties of different rocks on Earth.
4. Diego notes that the density, hardness, and streaks of the rock they found match those of an emerald, not Kryptonite.
5. Yes; even though their hypothesis was proven to be wrong, the scientific methods help them answer their original question. They found out that the rock was not from another planet.
6. Answers may vary. Sample answer: They could have confused and misled the public by making them think that they had found Kryptonite.

Section Quiz

SECTION: BRANCHES OF EARTH SCIENCE

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

SECTION: SCIENTIFIC METHODS IN EARTH SCIENCE

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

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SECTION: SCIENTIFIC MODELS

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

SECTION: MEASUREMENT AND SAFETY

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

Chapter Test A

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

Chapter Test B

1. mass
2. physical geographer
3. mathematical model
4. hypothesis
5. meters
6. C
7. D
8. A
9. B
10. Geology is the study of the origin, history, and structure of the Earth and the processes that shape it. Oceanography is the study of the sea. Meteorology is the study of the Earth's atmosphere, especially in relation to weather and climate. Astronomy is the study of the universe.
11. Scientists usually begin by asking questions. To explain or answer the questions, they form hypotheses. They gather data to test the hypotheses. After the tests are finished, they analyze the results. They draw conclusions about whether the results supported their hypotheses. Then they communicate the results.
12. Physical models are models that you can touch; they look and act like the real thing. Mathematical models are made up of mathematical equations and data. Conceptual models are systems of ideas that are composed of many hypotheses.
13. Answers may vary. Accept all reasonable answers that follow the scientific method and demonstrate sound critical thinking. Sample answer: First I would predict that if it is wood, then it will likely float in water. Then I would conduct an experiment by placing it in water. If it floats, then I can conclude that it is more likely wood than stone.
14. A hypothesis is an educated guess based on previous observations or knowledge. In the case of guessing a randomly drawn number, the correct answer depends entirely on chance—there is no evidence on which to base a guess.
15. Answers may vary. Sample answer: Physical models may resemble real things, but they do not necessarily behave or function like real things. Complex mathematical models with many variables usually do not make exact predictions about future events. Conceptual models are based on ideas and not facts. Their theories still must be proven.
16. Answers may vary. Sample answer: No, you shouldn't be worried. Your French friend described his temperature in degrees Celsius, in which 37ºC is normal body temperature.
17. a. Earth scientists; b. volume; c. grams; d. astronomers; e.meteorologists; f. paleontologists

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Chapter Test C

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

Standardized Test Preparation

READING

Passage 1

1. A
2. G
3. C

Passage 2

1. B
2. F
3. D

INTERPRETING GRAPHICS

1. C
2. I
3. B
4. I

MATH

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

Vocabulary Activity

ACROSS

1. meteorology
4. geographer
6. oceanography
7. astronomy
8. area
13. geochemistry
16. volume
18. theory
19. cartographer
20. liter
21. temperature

DOWN

2. geology
3. kilogram
5. hypothesis
9. density
10. model
11. physical
12. ecologist
14. meter
15. scientific
17. mass

SciLinks Activity

Answers may vary. The journal entry should include a date and the topic of students' scientific investigation. Students may write the journal entry in first person. They should include details that explain how they used a model to investigate something in the natural world. Their drawing should support one or more important ideas from their journal entries.

Performance-Based Assessment

FORM A HYPOTHESIS

1. Sample answer: I think the regular sugar cubes will erode the fastest because I've seen my parents put them in their coffee each morning.

ANALYZE RESULTS

6. The granulated sugar eroded the fastest.
7. Sample answer: All three were made of sugar granules.

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8. What made the sugar shapes different was how the sugar granules were attached. For example, the regular and rounded shapes had granules that were pressed together into a form.

DRAW CONCLUSIONS

9. Sugar erodes faster when there are more sugar granules exposed to the water.
10. My prediction was not correct because I based my prediction on what I observed my parents do. If my parents want sugar to dissolve in their coffee faster, they should try a spoonful of granulated sugar instead of a cube!

Using Scientific Methods

ANALYZE THE RESULTS

1. Diagrams may vary.
2. Diagrams may vary.
4. Sample answer: The rock-layer diagram provides a general overview of the layers. It may not be as specific as the model or provide all the details from the model.
5. Answers may vary. Sample answer: My model would not allow me to see all of the details of the rock.
6. Answers may vary depending on students' hypotheses.

APPLYING YOUR DATA

Answers may vary. Sample answers: More core samples could be taken, or the core samples could be taken at standard increments. The core samples could be larger or closer together, or smaller areas could be combined for an overall picture of the layers.

How Hot Is 300ºC?

PROCEDURE

3. Answers may vary, but students should recognize that the temperature of the water around a black smoker is much hotter than the temperatures that they measured. Encourage students to speculate how the water temperature around a black smoker can be 200°C above the boiling point of water at sea level. Students might conclude that the tremendous pressure at that depth raises the boiling point of water.

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