Answer Key

Directed Reading A

SECTION: WHAT IS A MINERAL?

1. A mineral is a naturally formed, inorganic solid that has a definite crystalline structure.
2. D
3. B
4. C
5. D
6. A
7. E
8. silicate; nonsilicate
9. silicate minerals
10. feldspar
11. mica
12. quartz
13. E
14. A
15. F
16. B
17. D
18. C

SECTION: IDENTIFYING MINERALS

1. Impurities inside a mineral can change its color.
2. luster
3. metallic; submetallic; nonmetallic
4. streak
5. Because the streak is not affected by air or water, it is more reliable than using color.
6. mica; halite
7. fracture
8. D
9. the Mohs hardness scale
10. talc
11. density
12. water
13. specific gravity
14. fluorescence
15. radioactivity
16. magnet

SECTION: THE FORMATION, MINING, AND USE OF MINERALS

1. metamorphism
2. gypsum; halite
3. pegmatites
4. Answers may include gold, copper, sulfur, pyrite, and galena.
5. pluton
6. Answers may vary. Sample answer: calcite and dolomite
7. ore
8. surface mining; subsurface mining
9. surface
10. subsurface
11. Mining can destroy plant and animal habitats. The waste from a mine can pollute water.
12. reclamation
13. We can reduce our need for minerals by recycling.
14. heat; electricity
15. metals
16. nonmetallic
17. gemstones
18. Two important characteristics of gemstones are attractive color and durability.

Directed Reading B

SECTION: WHAT IS A MINERAL?

1. D
2. A
3. C
4. C
5. C
6. silicate minerals
7. feldspar
8. mica
9. quartz
10. C
11. A
12. B
13. D

SECTION: IDENTIFYING MINERALS

1. B
2. A
3. D
4. B
5. C
6. A
7. density
8. water
9. specific gravity

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10. fluorescence
11. radioactivity
12. magnet

SECTION: THE FORMATION, MINING, AND USE OF MINERALS

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

Vocabulary and Section Summary

SECTION: WHAT IS A MINERAL?

1. mineral: a naturally formed, inorganic solid that has a definite crystalline structure
2. element: a substance that cannot be separated or broken down into simpler substances by chemical means
3. compound: a substance made up of atoms of two or more different elements joined by chemical bonds
4. crystal: a solid whose atoms, ions, or molecules are arranged in a definite pattern
5. silicate mineral: a mineral that contains a combination of silicon, oxygen, and one or more metals
6. nonsilicate mineral: a mineral that does not contain compounds of silicon and oxygen

SECTION: IDENTIFYING MINERALS

1. luster: the way in which a mineral reflects light
2. streak: the color of the powder of a mineral
3. cleavage: the splitting of a mineral along smooth, flat surfaces
4. fracture: the manner in which a mineral breaks along either curved or irregular surfaces
5. hardness: a measure of the ability of a mineral to resist scratching
6. density: the ratio of the mass of a substance to the volume of the substance

SECTION THE FORMATION, MINING, AND USE OF MINERALS

1. ore: a natural material whose concentration of economically valuable minerals is high enough for the material to be mined profitably
2. reclamation: the process of returning land to its original condition after mining is completed

Section Review

SECTION: WHAT IS A MINERAL?

1. Sample answer: Pure substances that cannot be broken down into simpler substances are called elements. Compounds are two or more elements bonded together. A mineral is a naturally formed, inorganic solid with a crystalline structure.
2. C
3. A crystal is a solid, geometric form of mineral produced by a repeating pattern of atoms that is present throughout the mineral. The shape of a crystal is determined by the arrangement of atoms within the crystal.
4. The two major groups of minerals are silicate and nonsilicate minerals. Silicate minerals contain a combination of silicon and oxygen. Nonsilicate minerals do not contain a combination of silicon and oxygen.
5. $20 \div 3{,}600 \times 100 = .55\%$
6. Water is not a mineral because it does not have a crystalline structure and it is a liquid, not a solid. Oxygen is not a mineral because oxygen atoms by themselves do not have a crystalline structure. Teeth are not minerals because they are living parts of your body. Honey is not a mineral because it is made of organic substances.
7. Ice is considered a mineral because it is a solid, it is a nonliving material, it is formed in nature, and it has a definite crystalline structure.

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8. Sulfate minerals are similar to sulfide minerals because both contain the element sulfur. Sulfate minerals and sulfide minerals are different because sulfide minerals contain one or more elements combined with sulfur, whereas sulfate minerals contain one or more elements combined with sulfur and oxygen.

SECTION: IDENTIFYING MINERALS

1. Sample answer: Luster is the way the surface of a mineral reflects light. Streak is the thin layer of powder that a mineral leaves when rubbed against a streak plate. If a mineral has cleavage, it breaks along flat surfaces.
2. C
3. The streak of a mineral is determined by rubbing the mineral against a streak plate. The thin layer of powder left on the streak plate is the mineral's streak.
4. The special properties of minerals include fluorescence (glowing under ultraviolet light), chemical reaction, optical properties (such as producing a double image), magnetism, taste, and radioactivity.
5. There is 5.5 times more matter in 1 cm^3 of this mineral than in 1 cm^3 of water.
6. Properties that would be useful to determine whether two mineral samples are different include color, luster, streak, cleavage and fracture, hardness, density, or any of the special properties listed in the text.
7. The hardness would be 4 on the Mohs hardness scale.
8. The easiest way to identify calcite would be to place a drop of weak acid on the sample to see if the acid produces bubbles.

SECTION: THE FORMATION, MINING, AND USE OF MINERALS

1. Reclamation
2. Ore
3. D
4. The two types of mining are surface mining and subsurface mining. Surface mining methods are used when mineral deposits are located at or near the Earth's surface. Subsurface. methods are used when mineral deposits are located too deep within the Earth to be surface mined. Surface mining usually requires some form of open-pit mining. Subsurface mines feature shafts and passageways that are excavated to reach ore.
5. Sample answer: Metallic minerals are used in aircraft, automobiles, computers, communications and electronic equipment, and spacecraft.
6. Sample answer: Nonmetallic minerals are used to make concrete, glass, and computer chips.
7. The raw diamond weighed 3,900 mg (19.5 carats × 200 mg = 3,900 mg). Each cut diamond will weigh 1,000 mg (5 carats × 200 mg = 1,000 mg).
8. Sample answer: Reclamation reduces the harmful effects of mining by returning the land to its original state.
9. Sample answer: The crystal could have formed in a slow-cooling magma body surrounded by rock.

Chapter Review

1. Sample answer: An element is a pure substance that cannot be broken into simpler substances by normal chemical means. A compound is a substance made of two or more bonded elements. A mineral is an inorganic solid that is naturally formed and has a crystalline structure.
2. Sample answer: Streak is the color of a mineral in powdered form. The color of a mineral may change due to air or water, but the mineral's streak is always the same.
3. Sample answer: A mineral is a naturally formed, inorganic solid with a crystalline structure. An ore is a deposit of minerals that is large enough and pure enough to be mined for a profit.
4. Sample answer: Silicate minerals contain compounds of silicon and oxygen; nonsilicate minerals do not contain compounds of silicon and oxygen.
5. B
6. B
7. C
8. D

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9. C
10. B
11. Surface mining is used to mine mineral deposits that are near the Earth's surface. Subsurface mining is used to mine mineral deposits that are too deep in the Earth to be surface mined.
12. A mineral is inorganic, meaning its origin is not living things. A mineral is a solid, not a liquid or gas. A mineral is formed in nature and is not made by people. A mineral has a crystalline structure and has the same chemical structure throughout.
13. Sample answer: Two environments in which minerals form are plutons, in which a magma body solidifies before it reaches the Earth's surface, and hot-water solutions, from which dissolved metals and other elements crystallize out of a hot fluid to form minerals.
14. Sample answer: Metallic minerals such as gold are used in the manufacture of computers and spacecraft. Nonmetallic minerals such as quartz are used to manufacture computer chips and glass.
15. Two ways to reduce the effects of mining are the reclamation of mined land and the recycling of mineral products.
16. Sample answer: chemical reaction: some minerals, such as calcite, bubble when a drop of weak acid is placed on them; fluorescence: some minerals glow under ultraviolet light; radioactivity: minerals that contain radium or uranium can be detected by a Geiger counter.
17. An answer to this exercise can be found at the end of the Teacher Edition.
18. No, the test was successful. I learned that the unknown mineral has no streak and that the material is harder than the streak plate. This clue will help me identify the mineral.
19. Sample answer: Gem cutters can cut along cleavage surfaces to shape gemstones. Gem cutters also want to avoid cutting across cleavage surfaces.
20. Students should suggest performing several tests to see whether the mineral is gold. Gold is very dense and soft, so one would start with density and hardness tests.
21. Sample answer: Since halite is salt (sodium chloride), the crusts of halite crystals formed when a body of salt water evaporated and left the halite behind.
22. The difference between the highest and lowest melting points is 2,539°C, the difference between the melting points of mercury and zircon. (2,500°C - - 39°C = 2,500°C + 39°C = 2,539°C)
23. Mercury would be a liquid at room temperature because its melting point is -39°C.
24. Pyrite has a higher melting point than gold does (1,171°C > 1,062°C).
25. mercury, -38°F; sulfur, 235°F; halite, 1,474°F; silver, 1,762°F; gold, 1,944°F; copper, 1,981°F; pyrite, 2,140°F; fluorite, 2,480°F; quartz, 3,110°F; zircon, 4,532°F (Answers are rounded.)

Reinforcement

THE MINERAL QUIZ SHOW

Announcer Don Fargo: It's time to play your favorite quiz game—The Mineral Quiz! Now, here's your host, Harry Halite! Take it away, Harry...(Applause)

Harry: Thank you very much, everyone. Let's begin! Our first category is "Luster."

For 100 points, *luster* is the way the surface of a mineral reflects *light*. For a bonus of 50 points, fill in the blank: A vitreous luster is *nonmetallic*. (metallic or nonmetallic)

Don: Now it's time for a word from our sponsors, Inorganic Crystals. Remember, minerals have a repeating inner structure!

Harry: Hey, we're back! Our new category is "Cleavage." For 100 points, *cleavage* is the tendency of some minerals to break along *flat* surfaces. For a 50-point bonus, describe the cleavage of halite. *Halite breaks at* 90 *degree angles in three directions.*I think we have one more category—

"Hardness"! For 100 points, *talc* is the softest reference mineral on the Mohs hardness scale. For a 50-point bonus, what is the hardest reference mineral on the Mohs scale? *diamond* (Buzzer sounds):

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Don You know what that means! It's time to play the Bonus Round! Each question is worth 75 points.
Harry: Fill in the blanks below for bonus points! The measure of how much matter is in a given space is *density*.
Conchoidal describes a type of *fracture*.
Streak is more reliable than color as an indicator of a mineral's identity.
A mineral with a nonmetallic, silky luster has *fibrous luster*.
Harry: Well, that's all the time we have for today. Thanks so much for playing The Mineral Quiz! (Applause)

MYSTERY MINERAL

1. calcite
2. feldspar
3. quartz or feldspar
4. mica
5. halite
6. gold

Critical Thinking

1. Hanksite is an evaporite mineral. Evaporites are mineral deposits left behind by evaporated salt water. A dry lake bed would be a likely place to find evaporate minerals.
2. Hanksite could be placed in either the carbonate group or the sulfate group because it contains both carbonate and sulfate.
3. Scratch test—try to scratch a penny with the crystal; hanksite won't scratch it. Streak test—rub the crystal on a white, unglazed tile; hanksite will leave a white streak. Specific gravity—measure the specific gravity of the crystal; hanksite is 2.6 times denser than water.
4. Pictures may vary. Materials could include toy logs, toothpicks, and marshmallows. The model must have a repeating structure in order to be considered crystalline.

Section Quizzes

SECTION: WHAT IS A MINERAL?

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

SECTION: IDENTIFYING MINERALS

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

SECTION: THE FORMATION, MINING, AND USE OF MINERALS

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

Chapter Test A

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

Chapter Test B

1. mineral
2. cleavage
3. element
4. ore
5. density
6. C
7. A
8. D
9. A
10. C

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11. The color of a mineral can be affected by exposure to air or water. The streak is not affected by this exposure and therefore provides a more reliable identifier.
12. Two methods of mining minerals are surface and subsurface. Surface mining is used when minerals are located at or near the Earth's surface. Examples of this type of mining are open pits, surface coal mines and quarries. Subsurface mining is used when minerals are located deep within Earth's surface. Passageways or vertical shafts often have to be dug in this type of mining.
13. Mining can harm the environment because it can destroy or disturb plant and animal habitats. In addition, waste products from mines can seep into water sources, polluting both surface and groundwater.
14. Answers may vary. Sample answer: She could try to scratch a piece of quartz with her crystal. If her crystal scratches the quartz, it might be a diamond. Rebecca could measure the mass and volume of her sample, then compare her crystal's specific gravity with that of the quartz.
15. Helium is not a mineral because it is not a solid and does not have a crystalline form. Gold is a mineral because it is a solid, inorganic, crystalline structure formed in nature. Water is not a mineral because it is not a solid. Ice is considered a mineral when it is formed in nature because it is a solid, inorganic material with a crystalline structure.
16. Answers may vary. Sample answer: Nonmetallic minerals other than gemstones are more valuable than gemstones because they are widely used in industry. Without them, we would have to create materials in a lab to replace those minerals such as gypsum and silica that are so important in providing the products that we use every day.
17. a.chemical composition
    b. cooling
    c. hot water solutions
    d. evaporates
    e. lakes and seas

Chapter Test C

1. D
2. C
3. B
4. D
5. C
6. A
7. C
8. D
9. B
10. B
11. A
12. D
13. C
14. A
15. D
16. B
17. C
18. fluorescence
19. silicate minerals
20. reclamation
21. density
22. metallic minerals
23. surface mines

Standardized Test Preparation

READING

Passage 1

1. D
2. H
3. A

Passage 2

1. B
2. H
3. A

INTERPRETING GRAPHICS

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

MATH

1. D
2. I
3. B

Vocabulary Activity

1. miner**A**l
2. meta**L**lic
3. **L**uster
4. frac**T**ure
5. **H**ardness
6. **A**tom
7. elemen**T**s
8. cleava**G**e

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9. si**L**icate
10. dens**I**ty
11. crys**T**als
12. s**T**reak
13. r**E**clamation
14. o**R**e
15. non**S**ilicate
16. metamorph**I**sm
17. **S**treak plate
18. **N**ative
19. comp**O**und
20. pegmati**T**es
21. **G**ravity
22. gemst**O**ne
23. p**L**uton
24. Mohs har**D**ness scale
25. All that glitters is not gold.

SciLinks Activity

1. galena; halite
2. conchoidal; fibrous and splintery; hackly; uneven and irregular
3. tenacity
4. Answers may vary, but should include three gemstones from each of the following color groups: Red: ruby, garnet, tourmaline, spinel, alexandrite; Green: emerald, tourmaline, tsavorite garnet, demantoid garnet, peridot, jade, sapphire, chrome diopside, chrysoprase, alexandrite; Blue: sapphire, aquamarine, topaz, tourmaline, paraiba tourmaline, tanzanite, spinel, zircon, lapis lazuli, iolite, turquoise.
5. Answers may vary according to which of the three following minerals students choose.
   Halite: Mineral class—halide; Specific gravity—2.1-2.6; Hardness—2–2.5; Color—colorless or white; sometimes pink, blue, purple, yellow, orange, or gray; Luster—vitreous; Streak—white
   Hematite: Mineral class—oxide; Specific gravity—5.0–5.3; Hardness—5–6.5; Color—red, brown or black, silver-gray or steel-gray to dark gray; Luster—metallic when well-crystallized; dull if poorly crystallized; Streak—brownish-red
   Quartz: Mineral class—silicate; Specific gravity—2.6–2.7; Hardness—7 (the mineral quartz defines the level on Mohs hardness scale); Color—highly variable; commonly white or colorless, but also many other colors such as gray, brown, or purple; flint; may be red, brown, green, gray or black if impurities are present; Luster—mostly vitreous; may be greasy or waxy; Streak—white

Performance-Based Assessment

FORM A HYPOTHESIS

1. Answers may vary. Sample answer: I think the pyrite will be the hardest.

TEST THE HYPOTHESIS

2.

	Did the mineral scratch the...			
	fingernail?	**penny?**	**glass?**	**Hardness**
Calcite	**yes**	**yes**	**no**	3 - 5.5
Galena	**yes**	**no**	**no**	2.5-3
Graphite	**no**	**no**	**no**	<2.5
Pyrite	**yes**	**yes**	**yes**	>5.5
Quartz	**yes**	**yes**	**yes**	>5.5

7.

Mineral Properties				
Mineral	Color(s)	Luster	Streak	Cleavage
Calcite	colorless, white	nonmetallic	white	yes
Galena	gray, silver	metallic	gray	yes
Graphite	black to gray	metalic	black	no
Pyrite	brass, yellow	metallic	green, black	no
Quartz	colorless	nonmetallic	none	no

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DRAW CONCLUSIONS

9. Quartz is the hardest of the mineral samples. The quartz left a scratch when it was rubbed against the pyrite.
10. Answers may vary. Sample answer: I used Chris Doe's flowchart. It was easy to follow, and I could accurately identify each mineral.

Is It Fool's Gold? A Dense Situation

DRAW CONCLUSIONS

3. Because the density of the sample is not 19.0 g/cm3, it is not gold.
4. Because the density of the sample is not 10.5 g/cm3, it is not pure silver. (The sample could contain silver mixed with other minerals.)
5. Sample answer: You could find the density and specific gravity of the goldcolored nugget. If it was pure gold, the density would be 19.0 g/cm^3 and the specific gravity would be 19.0, but you would have to perform more tests. If the sample had a density of 5.0 g/cm^3 and a specific gravity of 5.0, then it would likely be pyrite (fool's gold).

Scratch Test

PROCEDURES

4. The mineral graphite is the softest material of the three, followed by the fingernail and then the penny.

Mysterious Minerals

ANALYZE THE RESULTS

1. Students will find that some minerals required fewer steps to identify than others. For example, pyrite and galena are identified in two steps. Students may also find that they recognize some of the minerals and that the identification key is there merely to verify the identity.
2. For a mineral to leave a streak on the streak plate, the plate must be harder than the mineral. Therefore, extremely hard minerals do not leave a streak. Also, some minerals that are softer than a streak plate leave behind a colorless streak.
3. Answers may vary.

APPLYING YOUR DATA

Scientists test minerals for their density, crystal form, reaction to acids, optical properties, fluorescence, and radioactivity. Students should create an identification key that is very similar to the one provided in the lab, but their key should include different characteristics.

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