Earth in Space
Guided Reading and Study

Use Target Reading Skills This is one possible way to complete the graphic organizer. Accept all logical answers.

What You Know

1. The sun's rays heat Earth.
2. Earth has seasons.
3. In the Northern Hemisphere, fall begins in September and spring begins in March.

What You Learned

1. Areas where the sun hits at a more direct angle are generally warmer than areas where the sun's rays are more spread out.
2. The tilt of Earth's axis as it moves around the sun causes seasons.
3. Around March 21 and September 22, day and night are each about 12 hours long.

1. astronomy
2. b
3. d
4. a
5. c
6. Earth's rotation on its axis causes day and night.
7. day
8. Earth's orbit around the sun takes about 365 1/4 days. Four years of about 365 1/4 days each can be approximated by taking three years of 365 days and a fourth year of 366 days.
9. It is warmer near the equator because sunlight hits Earth's surface more directly and is less spread out at the equator.
10. Earth has seasons because its axis is tilted as it revolves around the sun.
11. c, d
12. solstice
13. equinox
14. **a.** June 21 **b.** Northern Hemisphere **c.** September 22 **d.** Daytime equals nighttime **e.** Shortest daytime **f.** Southern Hemisphere **g.** March 21 **h.** Neither
15. a, d

Earth in Space
Review and Reinforce

1. winter
2. At point A the sun would be directly overhead, at point B it would be on the horizon, and at point C it would not be visible because it is night.
3. sunset; Earth rotates from west to east.
4. d
5. c
6. g
7. f
8. a
9. h
10. e

Earth in Space
Enrich

1. Answers will vary. Students will probably find that telling time within 15 minutes is difficult with a sundial.
2. Answers will vary. Possible answer: A "moondial" couldn't be made because the moon's position in the sky from day to day varies much more than the position of the sun.
3. Accept any two: Sundials can't easily be moved. They don't work at night, indoors, or in cloudy weather. They are not as accurate as clocks.

Gravity and Motion
Guided Reading and Study

Use Target Reading Skills This is one possible way to complete the graphic organizer. Accept all logical answers.

a. Gravity is the force that attracts all objects toward each other.
b. Why is gravity different on the moon?
c. The force of gravity is an object's weight, and weight can change with location.
d. How does inertia affect the orbit of Earth?
e. Inertia keeps Earth moving ahead instead of being pulled into the sun.

1. false
2. This law states that every object in the universe attracts every other object.
3. **a.** The masses of the objects **b.** The distance between the objects

4. **a.** increases **b.** decreases **c.** increases **d.** decreases **e.** Possible answer: If distance stays the same, the force of gravity increases as mass increases and decreases as mass decreases. If mass stays the same, the force of gravity increases when distance decreases and decreases when distance increases.

5. Inertia is the tendency of a moving object to continue in a straight line or a stationary object to remain in place.

6. **a.** Gravity **b.** Inertia

7. a, d

Gravity and Motion Review and Reinforce

1. The force of gravity on an object is its weight. The greater the pull of gravity on an object, the greater the weight of that object.

2. Newton's law of universal gravitation states that every object in the universe attracts every other object. The Earth exerts a gravitational force on the moon, pulling the moon toward it. Similarly, the moon exerts a gravitational force on Earth.

3. An object in motion will stay in motion with a constant speed and direction unless acted on by a force. A basketball will roll across the court until friction pulls it to a stop, it runs into another object, or a person stops it.

4. The force of gravity between two objects decreases rapidly as the distance between them increases. Conversely, the force of gravity increases rapidly as this distance decreases.

5. a push or pull

6. attraction of all objects toward each other

7. Every object in the universe attracts every other object.

8. the amount of matter in an object

9. the force of gravity on an object

10. the tendency of an object to resist a change in motion

11. An object at rest will stay at rest and an object in motion will stay in motion with a constant speed and direction unless acted on by a force.

Gravity and Motion Enrich

1. The sun; it is much more massive than Earth is.

2. Pluto; it has the lowest mass.

3. On Mars; a person weighs less on Mars than on Venus.

4. They were able to drive the ball much farther than they otherwise could.

5. The gravitational force on its surface would increase because the distance between the surface and all of the sun's mass would be reduced.

Phases, Eclipses, and Tides Guided Reading and Study

Use Target Reading Skills This is one possible way to complete the graphic organizer. Accept all logical responses.

Q. Why does the moon have phases?
A. The changing relative positions of the moon, Earth, and sun cause the phases of the moon.
Q. Do we see different sides of the moon as the phases of the moon appear?
A. No, the same side always faces Earth.

1. b, c, d

2. These are all caused by the changing relative positions of the moon, Earth, and sun.

3. phases

4. It goes through a whole set of phases about once every 29.5 days.

5. It depends on how much of the sunlit side of the moon faces Earth.

6. **a.** Half of the side of the moon facing Earth is lighted. **b.** All of the side of the moon facing Earth is lighted. **c.** Half of the side of the moon facing Earth is lighted. **d.** The near side is not always the dark side. The near side is the dark side during a new moon. The far side is the dark side during a full moon. **e.** You see about half.

7. An eclipse occurs.

8. **a.** Solar
b. Lunar

9. umbra

10. The moon passes directly between Earth and the sun, blocking sunlight from reaching Earth.

11. penumbra

12. b, c

13. Earth is directly between the moon and the sun.

14. b, c, d

15. tides

16. gravity

17. Tides occur mainly because of differences in how much the moon's gravity pulls on different parts of Earth.

18. a, d

19. A spring tide is a tide with the greatest difference between consecutive low tides and high tides.

20. A neap tide is a tide with the least difference between consecutive low tides and high tides.

21. In the left illustration, the moon should be

drawn in at the 9:00 or 3:00 position on the orbit around Earth; in the right illustration, at the 6:00 or 12:00 position.

22. a, c

Phases, Eclipses, and Tides
Review and Reinforce

1. New moon, waxing crescent, first quarter, full moon, waning gibbous, third quarter
2. spring, neap, spring, neap
3. neap
4. eclipse
5. penumbra
6. tides
7. umbra
8. phase
9. spring
10. lunar
11. solar
12. gravity

Phases, Eclipses, and Tides
Enrich

1. A lunar year is 12 × 29.5 = 354 days.
A solar year = 365 days.
2. 19 × 365 = 6,935 days
19 × 354 + (7 × 29.5) = 6,932.5 days
It's off by 2.5 days.
3. The planting and growth of crops and the movements of animals are seasonal, so it is important for hunters and farmers to be able to accurately predict the seasons.

A "Moonth" of Phases
Skills Lab

For answers, see the Teacher's Edition.

Earth's Moon
Guided Reading and Study

Use Target Reading Skills This is one possible way to complete the graphic organizer. Accept all logical answers.

a. Dark, flat areas called maria, which formed from huge lava flows
b. Large, round pits called craters, which were caused by the impact of meteoroids
c. Highlands, or mountains, which cover much of the moon's surface

1. Italian astronomer Galileo Galilei
2. **a.** Maria **b.** Craters **c.** Highlands
3. craters
4. They are caused by the impacts of meteoroids, chunks of rocks or dust from space.
5. b
6. He saw the dark shadows cast by the peaks of the lunar highlands and the rims of the craters.
7. d
8. false
9. The moon has no atmosphere, so it is very hot in direct sunlight and very cold at night. The moon's surface gravity is so weak that gases can easily escape into space.
10. There may be large patches of ice near the moon's poles. The ice is thought to be located in areas that are shielded from sunlight by crater walls. Temperatures in these regions are always low, so any ice there would remain frozen.
11. **a.** Earth **b.** outer **c.** orbit **d.** moon
e. Possible answer: Material from Earth was ejected into space after a collision with a large object, formed a ring that orbited Earth, and was shaped into the moon by gravity.

Earth's Moon
Review and Reinforce

1. The moon's diameter is about one-fourth that of Earth. Its mass is much less than that of Earth, about one-eightieth.
2. When Earth was very young, a planet-sized object collided with it. Material from this collision was thrown into orbit around Earth. Eventually, the materials combined to form the moon.
3. Galileo. He saw craters, highlands, and maria.
4. Compared to Earth, the moon has large variations in its surface temperature.
5. Highlands; Galileo saw the dark shadows cast by their peaks.
6. He put two lenses in a wooden tube.
7. Craters are pits on the moon's surface that were caused by the impact of meteoroids.
8. Maria are flat, dark parts of the moon's surface formed by lava flows billions of years ago.
9. Meteoroids are chunks of rock or dust from space.

Earth's Moon
Enrich

1. Region D is probably the oldest, and region A is probably the youngest.
2. Crater 2 is older.
3. Crater 3 is probably older, because many more meteoroids have struck it than have struck crater 2.
4. Crater 4 must be older than region A because the material of region A could not have filled its floor if it hadn't already been there.

5. It must be younger. Had the rill been older, it would have been filled with molten rock when region A formed. From oldest to youngest they are crater 4, the floor of region A, the labeled rill, crater 1.

Traveling Into Space Guided Reading and Study

1. e
2. c
3. d
4. f
5. a
6. g
7. b
8. a
9. In the early 1900s.
10. Gases expelled from the rear of the rocket push it in the opposite direction.
11. reaction
12. c, d
13. Once it uses up its fuel, it separates from the rest of the rocket and falls to Earth.
14. It ignites and continues with the third stage.
15. **a.** falls to Earth **b.** Second **c.** separates **d.** ignites
16. Sending spacecraft to the moon and to the solar system beyond
17. c
18. A satellite is any natural or artificial object that revolves around an object in space.
19. By speeding up its own space program and establishing a government agency in charge of its space program, the National Aeronautics and Space Administration (NASA)
20. *Explorer 1*
21. False
22. **a.** *Sputnik 1 b.* 1958 **c.** U.S. **d.** Soviet Union **e.** 1961 **f.** Alan Shepard **g.** Possible answer: A race is a competition. The better one performs, the harder the other tries. When the Soviets put a satellite into orbit, this motivated the U.S. to do better. The Soviets and Americans competed in sending astronauts into orbit and spacecraft to explore the moon.
23. The Apollo program was the U.S. effort to land astronauts on the moon. It was started by President John F. Kennedy.
24. d
25. *Apollo 11* astronaut Neil Armstrong
26. Neil Armstrong said, "That's one small step for man, one giant leap for mankind."
27. b, d
28. space shuttle
29. space probe
30. space station
31. rover
32. They can go back and forth, or shuttle, between Earth and space.
33. **a.** Take satellites into orbit **b.** Repair damaged satellites **c.** Carry astronauts and equipment to and from space stations.
34. space station
35. A space shuttle is a reusable vehicle that carries humans and equipment back and forth between Earth and space. A space station, in contrast, remains in orbit around Earth and provides an environment in which humans can live and work for long periods.
36. Space probes are not designed to carry humans, so they can go to places where humans cannot live, or to places in the solar system that would take a very long time to get to.

Traveling Into Space Review and Reinforce

1. reaction
2. action
3. rocket
4. forward
5. opposite
6. space probe
7. space station
8. rovers
9. space shuttle

Traveling Into Space Enrich

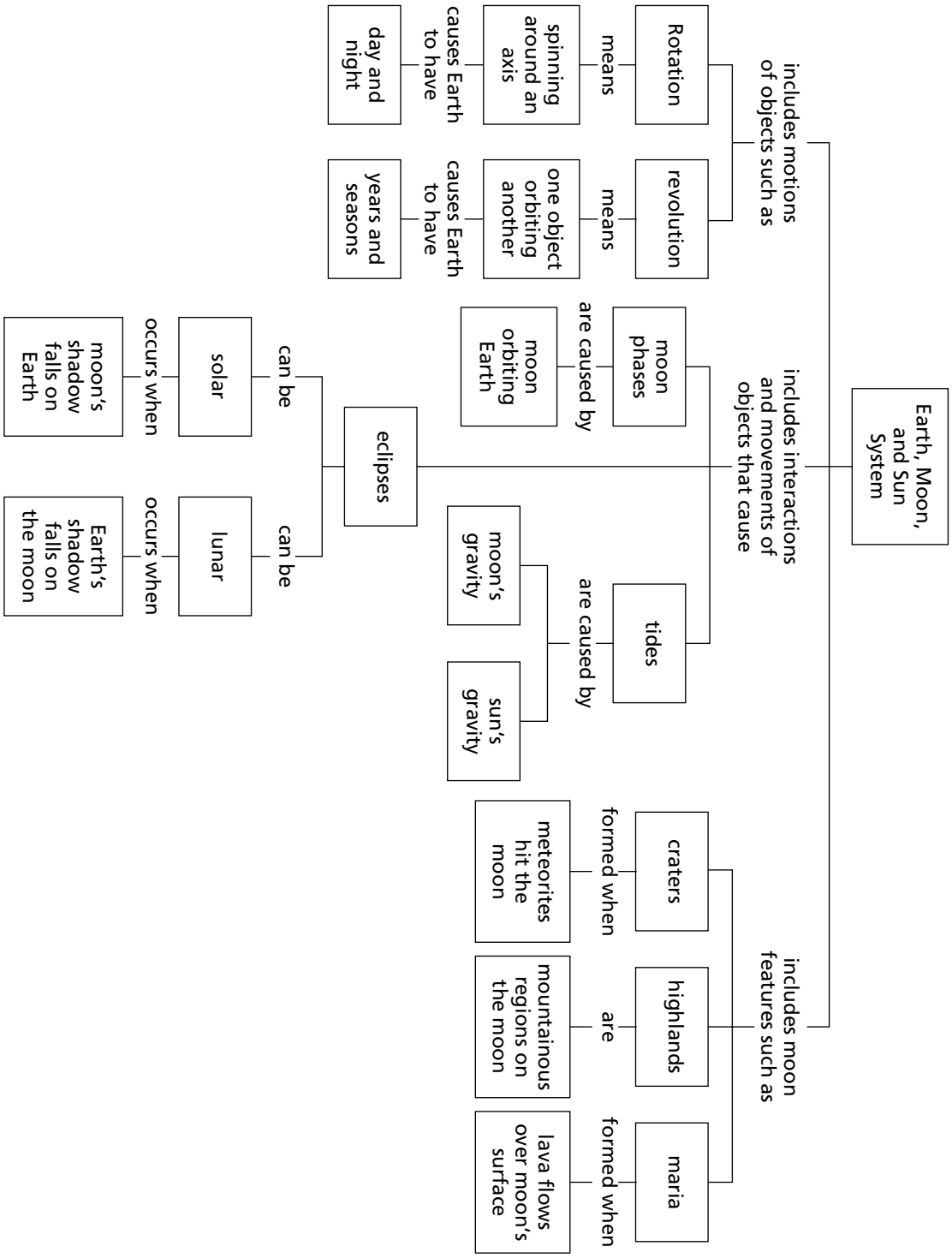
1. Yes. Earth's gravity pulls almost as strongly as it does on Earth's surface.
2. It would fall directly to Earth's surface.
3. It would escape Earth's gravity and fly off into space.
4. In both cases, people are falling and may feel weightless or nearly weightless.
5. The astronauts and the space station are both falling around Earth at the same rate.

Design and Build a Water Rocket Technology Lab

For answers, see the Teacher's Edition.

Connecting Concepts

This concept map is only one way to represent the main ideas and relationships in this chapter. Accept other logical answers from students.



Use Key Terms

1. rotation
2. astronomy
3. phases
4. axis
5. solstice
6. orbit
7. revolution
8. tide
9. crater
10. umbra
11. maria
12. penumbra

x	c	r	a	t	e	r	r	u	q	r
p	a	s	t	r	o	n	o	m	y	e
e	x	o	m	o	n	t	t	b	w	v
n	i	l	m	a	r	i	a	r	l	o
u	s	s	d	e	n	b	t	a	t	l
m	w	t	d	c	m	s	i	m	i	u
b	s	i	k	p	m	b	o	t	a	t
r	t	c	m	l	s	s	n	p	t	i
a	a	e	u	i	l	k	a	i	d	o
y	p	h	a	s	e	s	h	n	u	n

Lab Investigation

Constructing A Foucault Pendulum

Pre-Lab Discussion

1. Rotation and revolution are both motions of Earth. Rotation is spinning on an axis, and revolution is one object moving around another object.
2. Rotation, because day and night are caused by Earth's spinning on its axis.

Procedure

3. Students will likely predict that the swing will again match the direction of arrow A, given that arrow B was perpendicular to arrow A.

Observations

1. Arrow A is perpendicular to arrow B.
2. The pendulum changed direction 90° in relation to the lines on the sheet of paper.

Analyze and Conclude

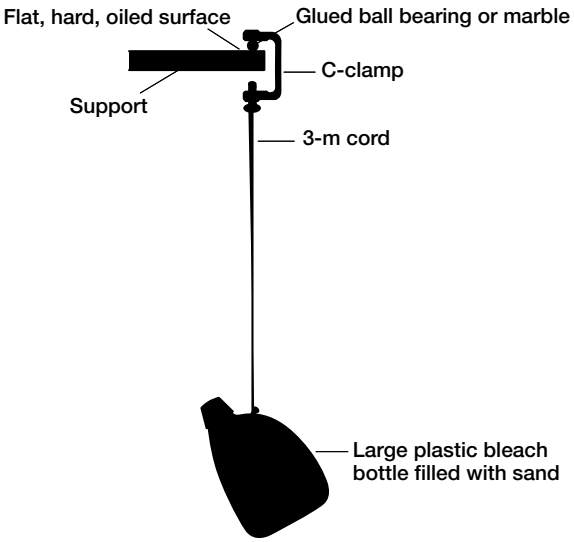
1. The pendulum would appear to slowly change direction opposite to the direction of Earth's rotation.
2. The direction of the pendulum would appear to stay the same.
3. More weight keeps the pendulum swinging longer and in a more consistent direction.

Critical Thinking and Applications

1. The pendulum would slowly turn until it appeared to swing east–west. Then it would be back to north–south. Then it would gradually return to east–west. Eventually it would be back to north–south.
2. The swing, or arc, gets smaller and smaller. Eventually the pendulum stops swinging.
3. Air resistance and friction of the thread on the dowel slow the pendulum, eventually stopping it.

More to Explore

See the following figure for a sample setup. Suggest where students could find a flat surface at the necessary height. Students can set up blocks around the pendulum to see the actual effects of Earth's rotation. A surface clamped on top of a 10-foot stepladder works well. As Earth rotates, the orientation of the arc of the pendulum will change. This model can be used to observe Earth's actual rotation because the cord is long enough and the weight has enough mass to make air resistance less important than it is with the smaller pendulum.



Performance Assessment

1. Students should show two positions of Earth, the sun, and the moon in a line, with the sun farthest from Earth and the moon. In one position, Earth is between the sun and the moon. In the other position, the moon is between Earth and the sun. In both positions, a high tide is on the side of Earth facing the moon, and on the side facing away from the moon.

2. When the moon is on the opposite side of Earth from the sun, it is full. When the moon is on the side toward the sun, it is new.

3. If connected by a line, the positions of Earth, the sun, and the moon should form a right triangle, with the sun at the vertex of the two longest sides. The moon will be at either side of Earth in the two positions. In both positions, a high tide is on the side of Earth facing the moon, and on the side facing away from the moon.

4. In both positions, the moon will be half illuminated by the sun. The two positions are called first quarter and third quarter.

Earth, Moon, and Sun Chapter Test

1. c
2. d
3. b
4. d
5. c
6. a
7. d
8. c
9. a
10. c
11. solstices
12. neap tide
13. weight
14. rovers
15. equinox
16. rotations
17. vernal equinox
18. lunar eclipse
19. escape
20. true
21. **A.** overhead
B. on the horizon
C. on the horizon
D. not visible
22. **E.** last quarter
F. new moon
G. first quarter
H. full moon

23. At most points by the seashore there are two high tides separated by two low tides during 25 hours. The length of time between a high and low tide is a little more than 6 hours.

24. The seasons are caused by the tilt of Earth's axis in relation to the plane of the orbit and the revolution of Earth around the sun. When the Northern Hemisphere is pointed toward the sun, it is warm because the sun hits the Northern Hemisphere most directly. We call that summer. Six months later, sunlight hits the Northern Hemisphere less directly, and so is more spread out and provides less heat. This is winter. During spring and fall, sunlight hits at an angle between the maximum and minimum.

25. About 4.5 billion years ago, a planet-sized object collided with Earth. Material from Earth's outer layers was ejected into orbit around Earth, where it formed a ring. Gravity caused this material to combine to form the moon.

26. Neap tides—positions B and D because the gravity of the moon and sun are pulling at right angles. Spring tides—positions C and E, because the gravity of the sun and moon are pulling along the same line.

27. During spring tides, the moon would be either new or full. A person standing at position A would observe a low tide.

28. The back side of the moon is not visible from Earth because it always faces away. Space probes could observe the back side of the moon, or astronauts could go there.

29. Each month, as the moon revolves around Earth, it crosses between Earth and the sun. Occasionally, it crosses directly between Earth and the sun. Then the moon's shadow hits Earth's surface. Anyone in this shadow sees a solar eclipse. Occasionally, the moon passes directly behind Earth, so that the moon enters Earth's shadow. People on Earth then observe a lunar eclipse.

30. The first stage of the multistage rocket provides the thrust needed to launch the rocket off the ground. When its fuel has been used up, the first stage separates from the rocket and falls back to Earth. The second and third stages perform in the same way, each boosting the rocket higher and then falling away. This leaves the satellite in orbit at orbital velocity.