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UNIT 4

Unit 4 Summary

BLM 4-1

Goal • Use this summary to review the concepts in Unit 4, Space Exploration.

Chapter 10 What we know about the universe has taken us thousands of years to learn.

- Patterns of stars in the sky are called constellations, from the Latin phrase meaning "with stars." (10.1)
- A star's brightness is described as its magnitude, which depends on how close the star is to Earth. (10.1)
- The observations and recordings by early astronomers significantly contributed to our current understanding of Earth and space. (10.2)
- By the 16th century, once it was understood that the Sun was at the centre of the solar system and the planets revolved around it, astronomers began to explain the motions of the planets. (10.3)

Chapter 11 We continue to learn a lot about our solar system by using space exploration.

- Life is made possible from the Sun's heat and light. By studying the Sun, scientists have learned a lot about average-sized stars. (11.1)
- Planets, moons, asteroids, and comets—all in motion around the Sun—are part of our solar system. The eight planets in our solar system are separated by great distances. (11.2)
- Technology has enabled us to see farther into space and expand our understanding of the universe. One of the largest successes in NASA's space program has been the Canadian-designed and -built robotic arms. (11.3)
- The International Space Station (ISS) is in orbit around Earth, so it is falling around Earth. The gravitational pull of Earth is keeping the ISS in orbit. (11.3)

Chapter 12 We can use space exploration to learn about stars, nebulae, and galaxies outside our solar system.

- About 13.7 billion years ago, the universe is believed to have begun during a rapid expansion of a tiny volume of space, which we now call the "Big Bang." (12.1)
- In order to talk about the enormous distances outside our solar system, astronomers have devised a measurement unit called a light-year. A light-year is the distance that light, which moves at 100 000 km/s, travels in a year. It is equal to about 9.5 trillion km. (12.1)
- A star is an object in space made up of hot gases, with a core that is like a thermonuclear reactor. Astronomers estimate that 9000 billion billion stars have formed in the observable universe over its 13.7 billion year history. Our Sun is one of the estimated 100 billion stars in the Milky Way galaxy. (12.2)
- A range of tools and technologies are constantly improved to help astronomers continue to make new discoveries, both from Earth and by going into space. (12.3)
- Small pieces of debris orbiting Earth, regardless of their size, can damage anything they hit. NASA estimates that there are more than a million pieces of debris orbiting Earth at any one time. The paths of the larger pieces of debris are closely monitored to ensure spacecraft avoid the objects during takeoff and landing. (12.3)

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UNIT 4

Retrograde Motion

BLM 4-10

Goal • Use this page to complete an activity about retrograde motion.

Safety

- When using any electrical equipment, make sure the electrical cords are not frayed.

Materials

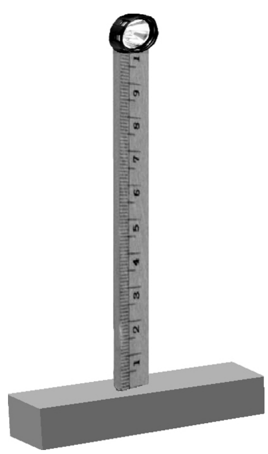
- decorative lights (or star field drawn on chalkboard)
- small LED flashlight
- two metre sticks
- modelling clay or two wooden blocks with a slot to hold metre sticks
- masking tape

Question

Why do Mars, Jupiter, and Saturn appear to reverse direction briefly in their westward motion across the sky?

Procedure

1. Make your planet (call it "Mars"). Attach the LED flashlight to the top of a metre stick using masking tape. Point the flashlight horizontally. Insert the bottom of the metre stick into the clay or block so that the metre stick stands upright, as shown in Figure A.

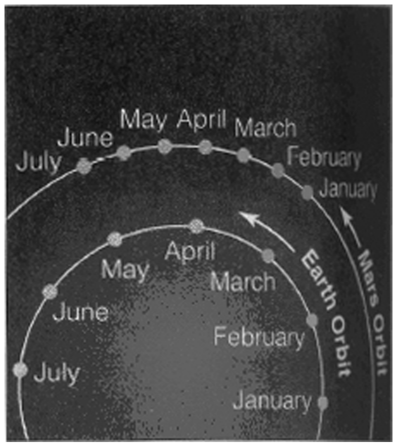


2. Make "Earth." Stand the second metre stick upright in its clay or block.

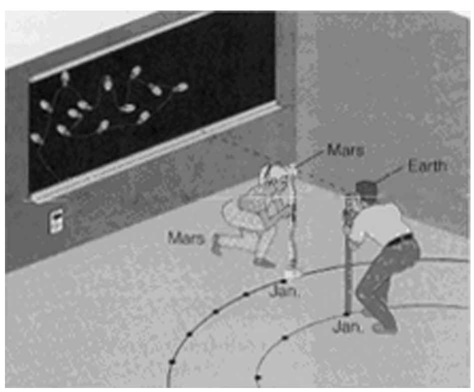
3. Make the distant stars. Tape the decorative lights onto a far wall, as shown in Figure C.

Draw the star field pattern in your notebook. (If you do not have lights, the "stars" can be drawn on a chalkboard.)

4. Label positions on the floor that match those in Figure B. The larger circle represents Mars' orbit and the smaller circle represents Earth's orbit. The dots show the position of each planet at one-month intervals. Note that the dotted positions in Mars' orbit are closer together than those in Earth's orbit.



5. Organize into pairs. While your partner holds Mars at its January position, place Earth at its January position, as in Figure C. Looking in a straight line from Earth to Mars, note where Mars appears in relation to the pattern of the background stars. Place a dot, labelled "January," at this location on your star field diagram.



6. Repeat Step 5, moving Mars and Earth to their February positions, then their March positions, and so on. Each time, take a sighting of Mars from Earth. Record the month and the position of Mars for your sighting, on the star field diagram in your notebook.

7. When you have moved both planets through all their marked positions and recorded your sightings, connect all the points for Mars in month order. This indicates the motion of Mars through the stars over a six-month period.

Analyze

1. Which planet, Earth or Mars, moves faster in its orbit? _______________
2. Study your diagram. Explain the pattern of Mars' movements over the six-month period.

3. Where are the relative positions of Earth and Mars when Mars appears to be moving backward through the stars?

Conclude and Apply

1. In a paragraph, explain why Mars sometimes appears to be reversing direction in the sky.

2. Why would Mars, Jupiter, and Saturn show this type of retrograde motion, but not Venus and Mercury

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UNIT 4

Find Out Activity 10-3A, The Length of the School Year on Different Planets

BLM 4-11

Goal • Use this page to help you complete Find Out Activity 10-3A, The Length of the School Year on Different Planets.

1. On the table below, calculate the school year on each planet relative to a school year on Earth.
   Example:
   Earth school year = 9 months
   Mercury year (relative to Earth's) = 0.24 Earth years
   Mercury school year = 0.24×9 months
   = 2.16 months

Planet	Period of Revolution (relative to 1 Earth year)	School Year (Earth months)
Mercury	0.24	2.16
Venus	0.61	
Mars	1.70	
Jupiter	11.90	
Saturn	29.50	
Uranus	84.00	
Neptune	165.00	

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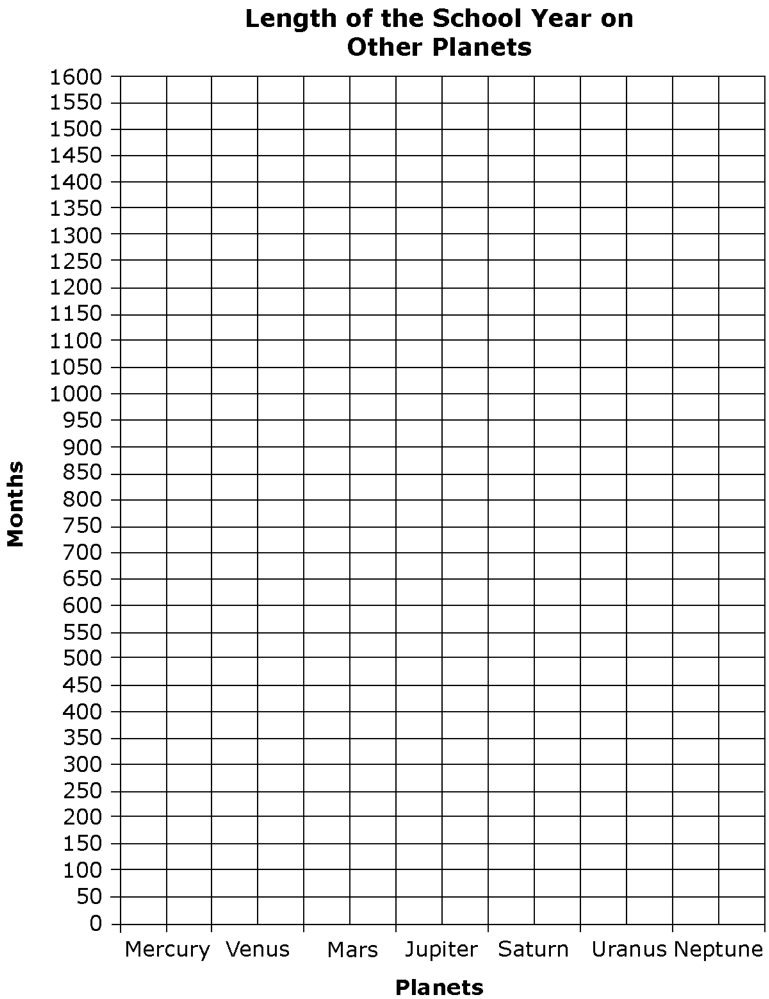
BLM 4-11 continued

2. Draw a graph of your data.



4. Connect the points on your graph with a best-fit straight line.

What Did You Find Out?

1. What did you notice about the length of the school year as you moved farther from the Sun?

____

____

____

2. What does the slope of the line tell you about change in the length of the school year as you move from one planet to another?

____

____

____

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UNIT 4

Core Lab Conduct an Investigation 10-3B, Strolling Through the Solar System

BLM 4-12

Goal • Use this page to help you complete Core Lab Conduct an Investigation 10-3B, Strolling Through the Solar System.

Question

What are the relative distances between planets in the solar system?

Procedure

Part 2 How Do the Distances to the Planets Compare?

4. Using the measuring tape and the table below, determine the scale distance of the objects in the solar system. Please each model in the correct position relative to the Sun.

Solar System Object	Actual Distance from Sun (km)	Scale Distance from Sun (m)	Distance from Previous Planet (m)
Sun			
Mercury	58 million		
Venus	108 million		
Earth	150 million		
Mars	228 million		
Asteroid belt	~ 400 million		
Jupiter	778 million		
Saturn	1 430 million		
Uranus	2 870 million		
Neptune	4 500 million		

Analyze

1. The planets are typically described as inner (Mercury, Venus, Earth, and Mars) and outer (Jupiter, Saturn, Uranus, and Neptune). Based on your scale models, describe what you notice about the following:

   (a) the size of the inner planets compared with the outer planets

   ____

   ____

   ____

(b) the distances to the outer planets compared with the inner planets

2. How do the distances between the inner planets compare with the distances between the outer planets?

Conclude and Apply

1. Use a scale of 1 m = 50 million km to calculate the scale distance (in metres) to Proxima Centauri (the nearest star to the Sun). The real distance from the Sun to Proxima Centauri is 30 000 000 000 million km.

Solar System Object	Actual Distance from Sun (km)	Scale Distance from Sun (m)	Distance from Previous Planet (m)
Proxima Centauri	30 000 000 000 million		

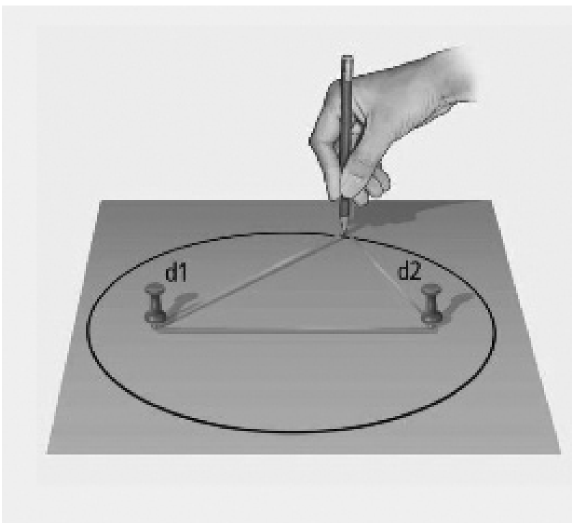
2. Based on your scale model, explain why it seems unlikely that humans will ever journey outside the orbit of Neptune.

Find Out Activity 10-3C, Easy Ellipses

Goal • Use this page to help you complete Find out Activity 10-3C, Easy Ellipses.

What to Do

Follow instructions 1 through 4 on page 384 of the student textbook to create an ellipse like this one.



5. Put three dots at different points of your ellipse. Label the dots A, B, and C.

6. Measure the distance from each dot to one focus (d1) and then to the other focus (d2). Record the measurements on the table below.

	d1	d2	Sum of Distances (d1 + d2)
A			
B			
C			

7. Add up the two distances from each point and record the sums in the table.

What Did You Find Out?

1. What do you notice about the sum of the distances for each point on your ellipse?

____

____

____

2. State what happens to the shape of the ellipse if you move the pushpins (foci):

(a) farther apart?

____

____

(b) closer together?

____

____

3. Calculate the sum of distances for another ellipse.

	d1	d2	Sum of Distances (d1 + d2)
A			
B			
C			

4. Describe the shape that results when you put the two pushpins together.

____

____

____

5. Write a general rule for the sum of distances from any point on an ellipse.

____

____

____

Chapter 10 Review

Goal • Check your understanding of Chapter 10.

Circle the letter of the best answer.

1. An astrophysicist is which of the following?
   A. an astronomer
   B. a physicist
   C. a scientist who studies astronomy and physics
   D. a scientist who studies biology and chemistry

2. As a planet gets closer to the Sun in its elliptical orbit, its speed does which of the following?
   A. decreases
   B. increases
   C. increases, then decreases
   D. stays the same

3. Which statement does not describe Kepler's laws?
   A. Planets move in ellipses.
   B. Planets sweep out equal areas of their elliptical orbit in equal times.
   C. The force of gravity extends beyond the surface of Earth.
   D. The time a planet takes to revolve around the Sun is directly related to how far away it is from the Sun.

4. Which effect does gravity have on celestial bodies?
   A. Gravity causes celestial bodies to remain in orbit around larger bodies.
   B. Gravity causes celestial bodies to remain in orbit around smaller bodies.
   C. Gravity causes celestial bodies to stop orbiting around larger bodies.
   D. Gravity does not affect celestial bodies.

5. Which of the following planets is not visible in the sky without the use of a telescope?
   A. Mars
   B. Mercury
   C. Neptune
   D. Saturn

6. Which of the following statements does not describe inner planets?
   A. They are relatively small.
   B. They have gaseous atmospheres.
   C. They have rocky crusts.
   D. They have solid cores.

7. Planets orbit the Sun in which of the following paths?
   A. circular
   B. elliptical
   C. linear
   D. triangular

8. Which of the following statements best describes the Newtonian telescope?
   A. a reflecting telescope that uses a curved mirror to focus the light
   B. a refracting telescope that uses a lens to focus the light
   C. a space telescope
   D. smaller than other telescopes

9. Which planet did astronomers discover by observing the orbit of Uranus?
   A. Earth
   B. Jupiter
   C. Mars
   D. Neptune

Match the Term on the left with the best Descriptor on the right.
Each Descriptor may be used only once.

Term	Descriptor
_____10. asterism	A. the brightness of a celestial body
_____11. circumpolar constellation	B. a constellation that never goes below the horizon
_____12. ecliptic	C. Earth-centred
_____13. geocentric	D. an object in space with a spherical shape
_____14. magnitude	E. the path that the Sun follows every day
_____15. star	F. a smaller group of stars forming a pattern with a constellation

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UNIT 4

Conduct an Investigation 11-1A, Observing Sunspots

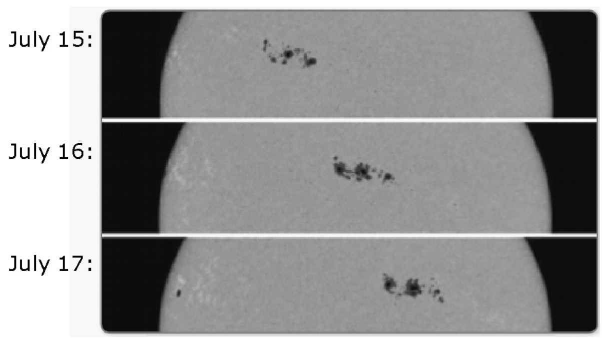
BLM 4-15

Goal • Use this page to help you complete Conduct an Investigation 11-1A, Observing Sunspots, if you are not able to observe sunspots on the Sun.

Question

What patterns can you observe in the locations of sunspots?

The SOHO satellite took these image of the Sun.



Conclude and Apply

1. Did the sunspots change in appearance or location from day to day? If so, how?

____

____

____

2. Predict how many days it will take for the same sunspot or group of sunspots to return to the same position in which the sunspot or group of sunspots appeared on day 1. Show your work and explain how you made your prediction.

____

____

____

3. Conduct research to learn more about SOHO. What were its goals? What has it helped us to learn? What kind of observation technology were built into the space observatory? Summarize what you learn on the back of this page.

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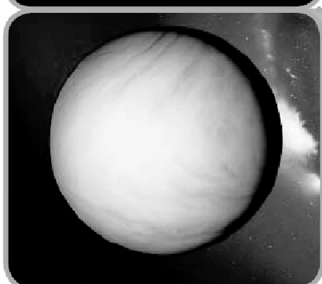
The Planets

Goal • Review the features of the planets.

Mercury

The closest planet to the Sun is also the smallest. Mercury is a rocky ball covered in meteor craters. It is slightly larger than our Moon and is about one third the size of Earth. It does not have any significant atmosphere. Mercury experiences extraordinary differences between night and day temperatures on its surface (ranging from 400°C to −183°C). This constant cycle of extreme heating and freezing causes the rock of Mercury to expand and contract, forming immense cracks in the surface.

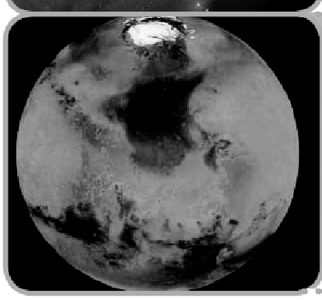


Venus

Venus is often called Earth's sister planet because of its similar size and composition to Earth. A notable difference, however, is the atmosphere. The atmosphere of Earth provides oxygen and nitrogen. Venus's atmosphere is almost completely carbon dioxide. Surface features of Venus cannot be seen through optical telescopes because the planet is shrouded in thick clouds. Sulphur mixes with moisture in the atmosphere to rain down as sulphuric acid. In 1990, the *Magellan* spacecraft began scanning the surface of Venus using a radar probe. It revealed that large portions of the planet are very flat, while other areas have volcanoes, lava flows, and cracks called rifts.

Earth

Our little blue planet, third from the Sun, is home to the only life yet discovered in the universe. Besides having a suitable atmosphere and temperature, Earth is the only place known to have water in three phases: liquid, solid, and gas. Water covers nearly three quarters of Earth's surface. Earth's atmosphere is composed mostly of nitrogen and oxygen, components essential to life. Running water, atmospheric effects, and plate tectonics together constantly shape the surface of Earth.



Mars

Mars is often called the red planet because the iron in its surface rocks gives it that colour. Despite being half the size of Earth, Mars has about the same amount of surface area. Several extraordinary features mark its surface, such as a volcano that is three times higher than Mount Everest and an 8 km deep canyon that would stretch from Vancouver to Toronto. Mars has a very thin atmosphere of carbon dioxide and can experience winds of more than 900 km/h. Dust storms can cover the whole planet and last for weeks. Mars has two polar ice caps made of frozen carbon dioxide and water. In 2008, the space probe *Phoenix* landed near one of these polar caps and discovered water ice on the planet's surface.

Planet	Average Distance from Sun (AU)	Radius (km)	Mass (relative to Earth)	Average Surface Temperature (°C)	Period of Rotation (relative to 1 Earth day)	Period of Revolution (relative to 1 Earth year)
Mercury	0.39	2 440	0.06	179	58.90	0.24
Venus	0.72	6 052	0.82	467	244.00	0.61
Earth	1.00	6 378	1.00	17	1.00	1.00
Mars	1.52	3 397	0.11	−63	1.03	1.70

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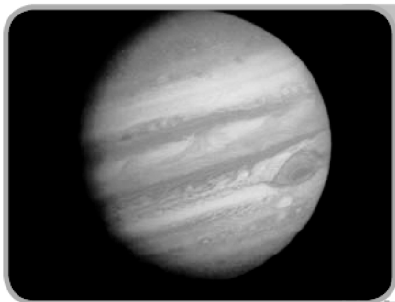
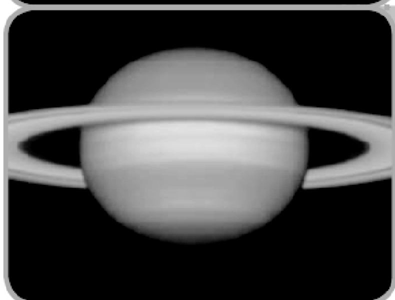
BLM 4-16 continued



Jupiter

The largest planet in the solar system is Jupiter. It has a mass 2.5 times greater than that of all the other planets combined. Its "Great Red Spot" has been visible from Earth for more than 300 years. This spot, as large as three Earths, is a storm raging in the clouds of hydrogen and helium that form the planet's outer layers. Despite its immense size, Jupiter has the shortest day of any of the planets, turning once on its axis every 10 hours. If it were only 100 times more massive, Jupiter might have formed into a small, faint star.

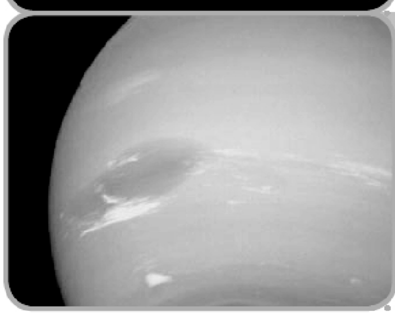


Saturn

Saturn, another gas giant, is easily identified by its elaborate system of rings. Its rings are formed from ice particles rather than rocky chunks. Those particles range in size from specks of dust to the size of houses. The rings are 250 000 km wide but can be as thin as 10 m. A sheet of paper the size of a city would have the same thickness-to-width ratio as Saturn's rings. The planet itself is composed mainly of hydrogen and some helium.

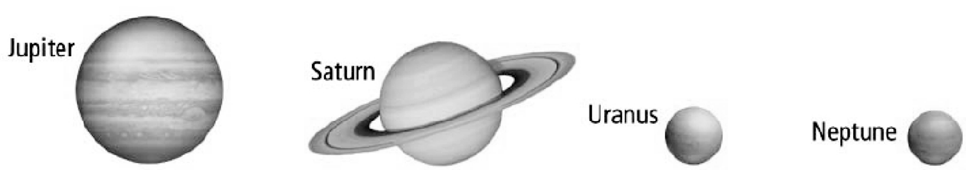
Uranus

Uranus is the fourth most massive planet in the solar system. A gas giant, it has a similar composition to Jupiter and Saturn, including a ring system composed of ice and dust. The planet gets its distinctive blue colour from the methane gas in its atmosphere (methane absorbs red light). Uranus has an unusual rotation in that it is flipped on its side. As a result, it appears to be rolling through its orbit around the Sun.



Neptune

Neptune is the outermost planet and the third most massive. Its composition is similar to that of Uranus, and it has the same dark blue colour. Like the other three gas giants, Neptune has a ring system, but it is very faint. When the *Voyager 2* spacecraft flew by Neptune in 1989, it discovered a large, blue, Earth-size patch on Neptune's surface. The patch, similar to Jupiter's Great Red Spot, was likely a storm in the clouds of Neptune's atmosphere. When the planet was viewed again in 1994 through the Hubble Space Telescope, the spot was gone. A new dark spot has since appeared in the northern hemisphere.



Planet	Average Distance from Sun (AU)	Radius (km)	Mass (relative to Earth)	Average Surface Temperature (°C)	Period of Rotation (relative to 1 Earth day)	Period of Revolution (relative to 1 Earth year)
Jupiter	5.27	71 492	317.8	–150	0.41	11.9
Saturn	9.54	60 268	95.2	–170	0.45	29.5
Uranus	19.19	25 559	14.5	–215	0.72	84.0
Neptune	30.06	24 764	17.1	–215	0.67	165.0

Chapter 11 Review

Goal • Check your understanding of Chapter 11.

Circle the letter of the best answer.

1. Which of the following statements about the Sun is false?
   A. In the photosphere, hot gas rises to the surface, cools, and then sinks back into deeper layers.
   B. Solar prominences are large loops of super-hot gas that extend out from the Sun's surface.
   C. The corona is the innermost part of the Sun.
   D. The dark patches on the Sun's surface are called sunspots.

2. What is the temperature of sunspots?
   A. about 10°C
   B. about 3500°C
   C. about 25 000°C
   D. about 100 000°C

3. Which of the following could be damaged by space weather?
   A. buildings
   B. Earth's orbit
   C. satellites
   D. wetlands

4. Which of the following statements does not describe an astronomical unit?
   A. about 150 million km
   B. equal to one light-year
   C. the average distance between the Sun and Earth
   D. used to measure distances in the solar system

5. Which of the following are sometimes called shooting stars?
   A. asteroids
   B. comets
   C. meteors
   D. planets

6. Which of the following statements about optical telescopes is false?
   A. can be affected by cloudy weather, air and light pollution, and distortion caused by heat and the atmosphere
   B. collect wavelengths that are longer than those of light
   C. use lenses to gather and focus light
   D. use mirrors to collect light and project the image to an eyepiece lens

7. Which of the following planets has the least mass in our solar system?
   A. Jupiter
   B. Neptune
   C. Saturn
   D. Venus

8. Which of the following parts is not a component of a rocket?
   A. frame
   B. guidance
   C. payload
   D. rover

Match the Term on the left with the best Descriptor on the right.
Each Descriptor may be used only once.

Term	Descriptor
_____ 9. asteroid _____ 10. comet _____ 11. dwarf planet _____ 12. meteorite _____ 13. Oort Cloud _____ 14. rover _____ 15. solar wind _____ 16. thermonuclear reaction	A. a celestial body orbiting the Sun that is smaller than a planet but massive enough for its own gravity to give it a round shape B. a process where two or more atoms fuse to create a different, larger atom, as well as a tremendous amount of energy C. a robotic space explorer D. a source of comets E. high-energy particles from the Sun's corona that rush past Earth F. meteoroids that land on Earth's surface G. rocky material composed of ice, rock, and gas H. small body that is believed to be leftover remains of the formation of the solar system

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UNIT 4

Find Out Activity 12-1B, Investigating the Relative Motion of Galaxies in the Expanding Universe

BLM 4-18

Goal • Use this page to help you complete Find Out Activity 12-1B, Investigating the Relative Motion of Galaxies in the Expanding Universe.

What to Do

3. Write a title for this table.

Title: ____

Galaxy	Distance to M (mm)		
	Trial 1	Trial 2	Trial 3
A			
B			
C			
D			
E			

Trial 1

4. Measure the distance between M and the other dots using the string and ruler. Record the measurement in the table above.

Trial 2

5. Loosen the twist-tie and inflate the balloon a little bit more. Measure the new distances between the dots and record the numbers in the table.

Trial 3

6. Repeat step 5, and record the numbers in the table.

What Did You Find Out?

1. When measured from M, what galaxy distances increased the most?

2. Which distances did not increase as much?

3. (a) How is this activity similar to what you would expect from an expanding universe?

   (b) How is this model different from what you would expect?

4. Write a brief statement relating how each point increases its distance from the Milky Way galaxy (dot M).

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UNIT 4

Find Out Activity, Spying Spectra

BLM 4-19

Goal • Record your observations for Activity 12-2B, Spying Spectra.

Part 1 Analyzing Light Spectra

1. Label the rectangles below with the names of the light sources you are using.

Light Source ____________	Light Source ____________
Light Source ____________	Light Source ____________

2. Carefully look at each light source, one at a time, through the spectroscope. With the pencil crayons, colour the spectrum you observe for each light source in the appropriate rectangle.

3. Experiment with viewing the light sources through the spectroscope at different angles. Record what you observe.

____

____

____

Part 2 Analyzing Gas Spectra

4. Label the rectangles below with the names of the specific gas discharge tubes you are using.

Gas Discharge Tube ____________________

Gas Discharge Tube ____________________

Gas Discharge Tube ____________________

Gas Discharge Tube ____________________

5. With your teacher's assistance, observe each of the elements in the gas discharge tubes. Use the pencil crayons to colour the spectrum for each gas.

What Did You Find Out?

Part 1 Analyzing Light Spectra

1. Where do you see the spectra in the spectroscope?

____

____

2. In which order do the colours appear?

____

____

3. How did changing the angle of the spectroscope affect the appearance of the spectra?

____

____

____

Part 2 Analyzing Gas Spectra

4. How were the spectra from the gas discharge tubes different from the spectra of the light sources in Part 1?

5. How would knowing the spectra for specific elements help astronomers determine the composition of stars?

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UNIT 4

Unit 4 Key Terms

BLM 4-2

Goal • Use this page to review the Unit 4 Key Terms.

Chapter 10 Key Terms	Chapter 11 Key Terms	Chapter 12 Key Terms
asterism	asteroid	adaptive optics
astrolabe	astronomical unit	astronomical unit
celestial body	comet	axis
circumpolar constellation	corona	Big Bang theory
constellation	chromosphere	black hole
ecliptic	dwarf planet	cosmological red shift
ellipse	geosynchronous orbit	electromagnetic radiation
geocentric	Kuiper Belt	elliptical galaxy
heliocentric	meteor	fusion
magnitude	meteorite	galaxy
orbit	meteoroid	Hubble Space Telescope
planet	moon	interstellar matter
retrograde motion	Oort Cloud	irregular galaxy
star	optical telescope	light-year
telescope	planet	nebula
zodiacal constellations	photosphere	parallax
	probe	planetesimal
	radio telescope	Oscillating theory
	rover	quasar
	satellite	red shift
	solar prominences	reflecting telescopes
	solar radiation	revolution
	solar wind	rotation
	space weather	spectroscope
	sunspots	spectral lines
	thermonuclear reaction	spiral galaxy
	transit	star
		supernova
		triangulation

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UNIT 4

Chapter 12 Review

BLM 4-20

Goal • Check your understanding of Chapter 12.

Circle the letter of the best answer.

1. Which of the following statements about the Thirty Meter project is false?
   A. It is composed of 36 hexagonal segments.
   B. It is expected to be completed in 2015.
   C. It should be able to help us see objects more than 150 times fainter than can be seen by the Hubble Space Telescope.
   D. It will have a 30 m diameter.

2. What types of electromagnetic radiation can pass through Earth's atmosphere and be used by telescopes on the surface of Earth?
   A. gamma rays
   B. radio waves
   C. ultraviolet rays
   D. X rays

3. Which of the following is not one of the challenges of humans travelling in space?
   A. Humans need to be protected from the extreme heat of space.
   B. Humans in space are exposed to solar wind.
   C. It is dangerous and costly to send humans to space.
   D. The spacecraft must not break down and leave humans stranded in space.

4. Which of the following is a space spinoff?
   A. bicycle helmets
   B. freeze-dried foods
   C. optical telescopes
   D. zippers

5. Which of the following is an Earth-based telescope?
   A. Canada-France-Hawaii Telescope
   B. Chandra X-ray Observatory
   C. Fermi Gamma-ray Space Telescope
   D. Hubble Space Telescope

6. Which of the following statements about the Hubble Space Telescope is false?
   A. It determined that the universe is between 13 and 14 billion years old.
   B. It is positioned on Earth.
   C. It was launched into orbit on the space shuttle *Discovery* in 1990.
   D. It was named after Edwin Hubble.

7. What is "space junk"?
   A. debris found on other planets
   B. debris in orbit around Earth
   C. irrelevant information about space
   D. old planets

Match the Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
_______ 8. adaptive optics _______ 9. Big Bang theory _______ 10. cosmological red shift _______ 11. fusion _______ 12. light-year _______ 13. parallax _______ 14. quasar _______ 15. spectral lines	A. a design using mirrors that change shape slightly to compensate for the distortion caused by the atmosphere B. a phenomenon where wavelengths of radiated light are being constantly stretched as the light crosses an expanding universe C. a process where hydrogen atoms combine to form helium, creating an enormous amount of energy D. a region of powerful electromagnetic energy that develops around a supermassive black hole E. a theory stating that a tiny volume of space suddenly and rapidly expanded to an immense size about 13.7 billion years ago F. lines standing out across the bands of colour in a star's spectrum G. the change in position of observation H. the distance that light, which moves at 300 000 km/s, travels in a year—equal to about 9.5 trillion km

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UNIT 4

Unit 4 Test

BLM 4-21

Goal • Test your understanding of Unit 4, Space Exploration.

What to Do

Circle the letter of the best answer.

1. What part of the Sun's atmosphere is visible only during a total solar eclipse?
   A. corona
   B. solar flare
   C. solar prominence
   D. sunspot

2. What are the two most common elements found in the Sun?
   A. hydrogen and helium
   B. neon and magnesium
   C. oxygen and iron
   D. silicon and chlorine

3. Which of the following planets has only one moon?
   A. Earth
   B. Jupiter
   C. Mercury
   D. Venus

4. Which are characteristics of outer planets?
   A. large radius, made mostly of gas
   B. large radius, rocky
   C. small radius, made mostly of gas
   D. small radius, rocky

5. How long ago do astronomers believe the Big Bang occurred?
   A. 13.7 billion years
   B. 13.7 million years
   C. 13.7 thousand years
   D. 13.7 trillion years

6. How do most stars form?
   A. from the collapsing of dust and gas in a nebula
   B. from the collision of two galaxies
   C. from the core of a dead star
   D. from the nuclear explosion of the Big Bang

7. Astronomers observe light from a distant galaxy to be "red-shifted." What does this red shift mean?
   A. The galaxy is approaching Earth.
   B. The galaxy is moving at the same speed as Earth.
   C. The galaxy is moving away from Earth.
   D. The galaxy is not moving at all relative to Earth.

8. Why does a comet's tail always point away from the Sun?
   A. Small particles break off the comet, leaving a trail.
   B. The comet material is melting as it approaches the Sun.
   C. The solar wind blows the tails away from the Sun.
   D. The tails are magnetically attracted to Earth.

9. Which unit is commonly used to measure distances between stars?
   A. astronomical unit
   B. kilometers
   C. light years
   D. light kilometers

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.

Term	Descriptor
_______ 10. supernova	A. Milky Way is an example
_______ 11. nebula	B. created by a high mass star collapsing
_______ 12. spiral galaxy	C. mostly hydrogen and dust
_______ 13. elliptical galaxy	D. area of extremely powerful electromagnetic radiation
_______ 14. irregular galaxy	E. mix of newly forming stars and old stars
_______ 15. asteroid	F. contains the oldest stars in the universe
_______ 16. meteorite	G. remains of the formation of the solar system
_______ 17. meteoroid	H. pieces of rock floating through space
_______ 18. quasar	I. pieces of rock that have entered Earth's atmosphere

Short Answer Questions

19. How did people in early civilizations use their knowledge of the positions of the Sun, planets, and stars?

20. Sir Isaac Newton made this statement about his work in astronomy. “If I have seen further it is by standing on the shoulders of giants”. What do you think it means?

21. What explanation did American astronomer Edwin Hubble give for the reason the spectra of all galaxies he observed were shifted to the red part of the spectrum?

22. Explain the statement: “Stars have a life cycle.”

23. Imagine a new planet has been discovered between Jupiter and Saturn. Describe three characteristics you would expect the planet to have.

24. Explain how comets and asteroids are different.

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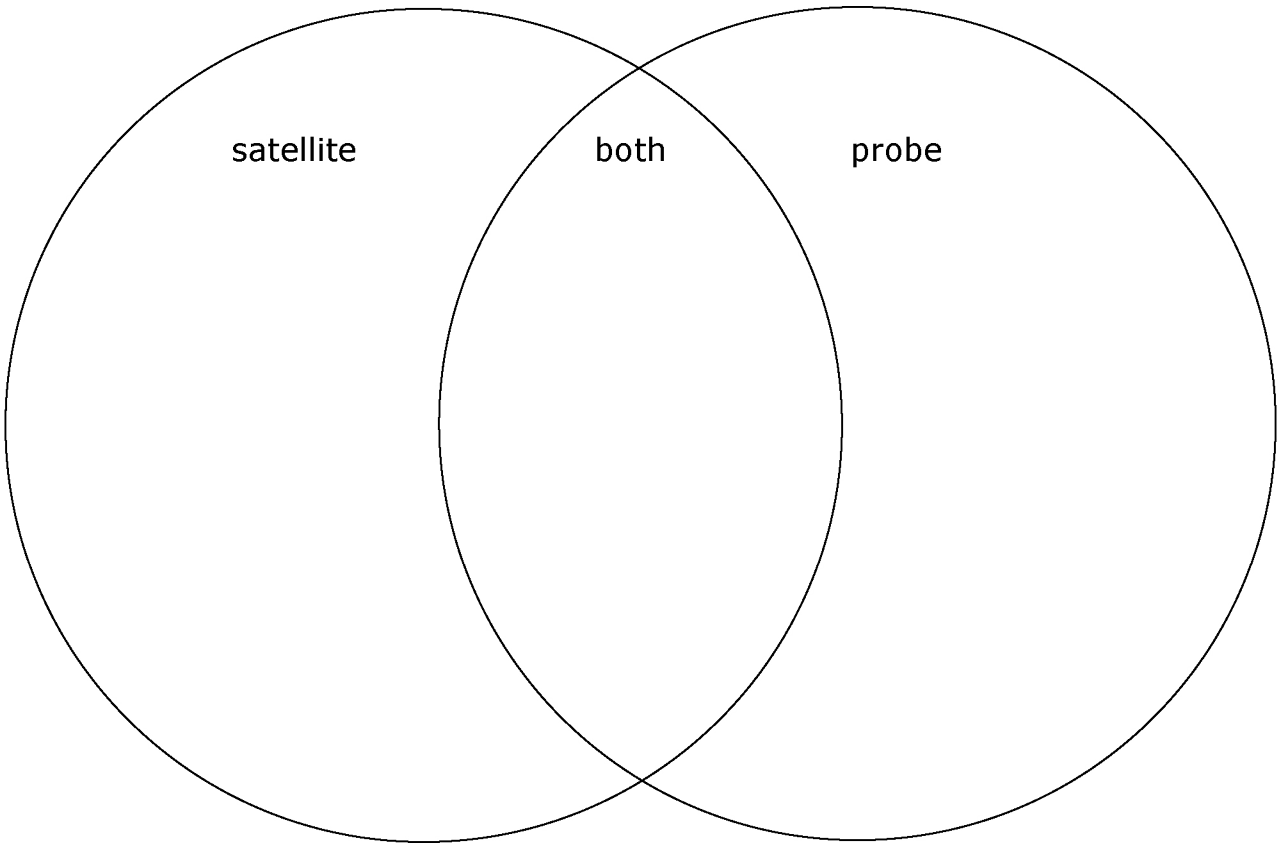
BLM 4-21 continued

25. Use the Venn diagram below to compare and contrast a satellite and a space probe.



26. Name one risk and one reward of space exploration.

____

____

27. Describe three problems that need to be considered in order to colonize the Moon.

____

____

____

28. Explain what is meant by the term "space junk."

____

____

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UNIT 4

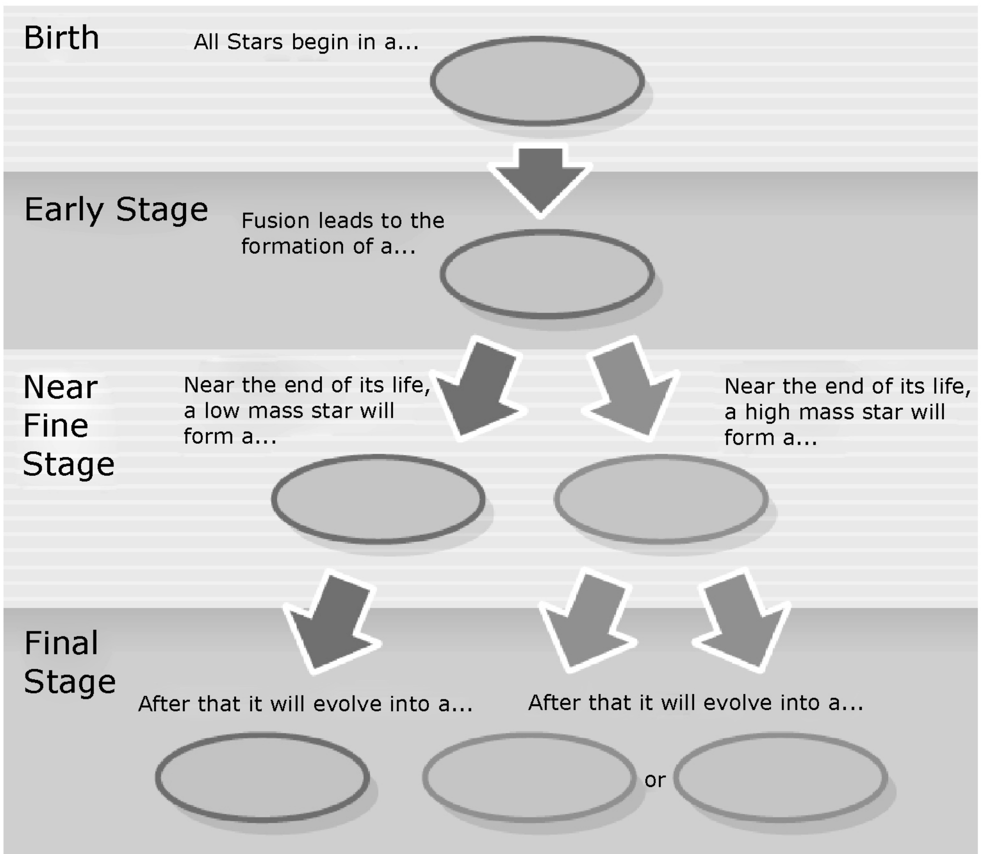
Unit 4 Review Concept Map

BLM 4-22

Goal • Show your understanding of the life of a star.

What to Do

Use this concept map to answer question 1 of the Unit 4 Review.



Unit 4 BLM Answers

BLM 4-3, Chapter 10 Key Terms

1. e
2. j
3. o
4. l
5. h
6. b
7. a
8. p
9. m
10. f
11. k
12. g
13. i
14. d
15. c
16. n

BLM 4-4, Chapter 11 Key Terms

1. chromosphere
2. meteoroid
3. solar wind
4. dwarf planet
5. optical telescope
6. transit
7. geosynchronous orbit
8. asteroid
9. probe
10. rover

BLM 4-5, Chapter 12 Key Terms

Riddles will vary.
adaptive optics: a design using mirrors that change shape slightly to compensate for the distortion caused by the atmosphere
astronomical unit: a large measure equal to the distance from Earth to the Sun, or approximately 150 million km
axis: an invisible line through a planet, from one pole to the other
Big Bang theory: the theory that the universe formed in a single, dramatic moment of expansion
black hole: a super-dense object that has an extremely strong gravitational pull
cosmological red shift: the phenomenon where the wavelengths of radiated light are being constantly stretched (lengthened) as the light crosses an expanding universe
electromagnetic radiation: energy that is carried, or radiated, in the form of waves. Electromagnetic radiation includes visible light, microwaves, radio waves, and X rays.
elliptical galaxy: a galaxy that ranges in shape from a perfect sphere to a stretched-out ellipse
fusion: a process in which hydrogen atoms combine to form helium. Releases enormous amounts of energy.
galaxy: a collection of stars, planets, gas, and dust held together by gravity
Hubble Space Telescope: an optical telescope, launched in 1990, that has provided clear images of distant celestial objects that have led to many discoveries about space
interstellar matter: the gas (mostly hydrogen) and dust that fills outer space
irregular galaxy: a galaxy that does not have any regular shape such as spiral arms or an obvious central bulge

light-year: the distance that light, which moves at 300 000 km/s, travels in a year. It is equal to about 9.5 trillion km.
nebula: a cloud of hydrogen gas and dust
parallax: the change in position of observation that causes an object to appear to move relative to an unmoving background
planetesimal: a big rocky lump spinning around a star, which might become a planet
Oscillating theory: a theory the universe will stop expanding and will collapse in the Big Crunch
quasar: a region of powerful electromagnetic energy that develops around a supermassive black hole
red shift: a sign that a star or galaxy is moving away from us. The object shows a spectral absorption pattern in the red spectrum.
reflecting telescopes: telescopes that use a series of mirrors to collect light and focus the image to an eyepiece
revolution: the path of a planet around a sun
rotation: the path of a planet turning around its axis
spectroscope: an optical instrument that acts like a prism to separate light into its basic component colours
spectral lines: lines on a star's spectral pattern that tell us about the types of atoms giving off the star's light
spiral galaxy: a galaxy that looks like a pinwheel from above and like a paper plate with an orange inserted into its centre when views along its edge
supernova: a dramatic, massive explosion caused by a supergiant collapsing in on itself
triangulation: the process of using a triangle to find the distance to an object. By measuring two angles and the length of a baseline, the distance to any object that is visible can be determined.

BLM 4-10, Retrograde Motion

What Did You Find Out?

1. Earth
2. Mars moves west to east, then changes direction and moves east to west, then goes back to moving west to east.
3. Mars is behind Earth, so it is moving slower than Earth.

Conclude and Apply

1. In some parts of Earth's orbit, Mars appears to be moving more quickly than we are. In other parts, Mars seems to be moving more slowly than we are. These observations cause Mars to seem to change directions—sometimes appearing to move from east to west and sometimes from west to east.
2. Mars, Jupiter, and Saturn move slower in their orbits that Earth, so they appear to be moving backwards at times. Venus and Mercury move faster in their orbits than Earth, so they never appear to fall behind Earth.

BLM 4-14, Chapter 10 Review

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

BLM 4-17, Chapter 11 Review

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

BLM 4-20, Chapter 12 Review

1. A
2. B
3. A
4. D
5. A
6. B
7. B
8. D
9. E
10. B
11. C
12. H
13. G
14. A
15. F

BLM 4-21, Unit 4 Test

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

15. G
16. H
17. I
18. D
19. Early civilizations used their knowledge of the positions of the Sun, planets, and stars to predict seasonal changes, predict animal migrations, and to navigate.
20. Our understanding of the solar system and the universe has been cumulative. Early astronomers used the best technology they had, and learned many things. Later astronomers used the information these early astronomers had gathered together with new observations, and built on the knowledge. We continue to build on the knowledge of early astronomers and to learn new things about the universe today.
21. Red shift implies all the galaxies were moving away from Earth and from one another. This suggests the universe is expanding.
22. Stars go through a life cycle: they are born in nebulae, they live for long periods of time, and then they die in a large explosion and finally collapse into smaller objects (black holes, dwarfs).
23. The new planet would likely be large and gaseous, have many moons, have a ring system, and have a cold surface temperature.
24. Asteroids are rocky bodies orbiting between Mars and Jupiter. They range from softball-sized chunks to the 1000 km wide Ceres. Most stay within the confines of that orbit, but occasionally some are pulled by the Sun's gravity toward the inner solar system. Comets are relatively small, ranging in sizes from a few hundred metres to 20 km. They are mostly dust with a thin covering of ice. As they approach the Sun in a parabolic path, the Sun's warmth heats the comet, causing effervescence. The result is a long tail, which trails away from the Sun. Asteroids have no tails.
25. Satellite: orbits planet, collects data from high altitude, does not land on planet (or moon). Probes: land on the surface of the planet, collect data from the surface. Both: collect data and send it back to Earth, replace the need for humans to physically explore the planet (or moon).
26. Risks: explosion of fuel, collision with space junk, high costs, may be hit by micrometeoroids in space, system failure could jeopardize safety of crew or success of mission. Rewards: improvement of scientific knowledge, exploitation of unknown resources, development of materials unattainable in Earth's gravity, possible colonization, etc.
27. Answers will vary but may include:
    - the need for food, water, and oxygen
    - The Moon has less gravity than Earth. How will that affect colonists?
    - Where will the colony by located?
    - Daytime on the Moon is different than on Earth.
    - How will the colony be protected from meteoroids? The Moon has no atmosphere like Earth to deflect or burn up space debris.
    - How will colonists be taken care of psychologically given long periods of isolation, little communication with people at home on Earth, etc?
28. The term space junk describes debris orbiting Earth. This includes pieces of old satellites, and things accidentally dropped by astronauts. Space junk can be as small as a flake of paint, or as large as a complete satellite.

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UNIT 4

Chapter 10 Key Terms

BLM 4-3

Goal • Use this page to review the Key Terms in Chapter 10.

Match each Key Term in the left column with its definition in the right column.

Key Term	Definition
(a) asterism	1. a pattern of stars
(b) astrolabe	2. how bright a star appears to us
(c) celestial body	3. an optical device that uses lenses to gather and focus light to provide a magnified view
(d) circumpolar constellation	4. an object that orbits the Sun in its own orbital path
(e) constellation	5. Earth-centred
(f) ecliptic	6. an instrument used to help astronomers locate and predict the positions of the Sun, Moon, and stars
(g) ellipse	7. a smaller group of stars that forms a pattern within a constellation
(h) geocentric	8. constellations known as the signs of the zodiac, which lie on the ecliptic
(i) heliocentric	9. a change of direction so that a planet appears to orbit in a loop or S shape in the sky
(j) magnitude	10. the path that the Sun follows through the sky
(k) orbit	11. the path of a celestial object in space
(l) planet	12. a shape with two focal points. The distance from one focal point to the edge, then to the other focal point is always the same
(m) retrograde motion	13. Sun-centred
(n) star	14. a constellation that never goes below the horizon
(o) telescope	15. a natural object in space such as a planet, a moon, an asteroid, a comet, or a star
(p) zodiacal constellations	16. a spherical object in space that creates its own thermal energy

DATE: NAME: CLASS:

UNIT 4

Chapter 11 Key Terms

BLM 4-4

Goal • Use this page to help you review the Key Terms in Chapter 11.

Create a list of 10 Key Terms or phrases from the descriptions below. Then find the words and phrases in the puzzle.

1. the Sun's 3000 km thick layer of hot (6000–20 000°C), low-density gas (12 letters)	
2. meteors that enter Earth's atmosphere and reach Earth's surface (9 letters)	
3. the hot and energetic gases in the Sun's corona that are ejected in a sudden burst and rush past Earth (5 letters, 4 letters)	
4. a celestial body orbiting the Sun that is generally smaller than a planet but massive enough for its own gravity to give it a round shape (5 letters, 6 letters)	
5. a telescope that gathers and focusses light to provide a magnified view (7 letters, 9 letters)	
6. takes place when a planet passes in between Earth and the Sun (7 letters)	
7. an orbit that appears to sit above the same place on Earth (14 letters, 5 letters)	
8. a small body believed to be leftover remains of the formation of the solar system (8 letters)	
9. a space vehicle sent to other celestial bodies (5 letters)	
10. a robotic space explorer that can be programmed to carry out tests that humans would otherwise make (5 letters)	

C	H	R	O	M	O	S	P	H	E	R	E	A	V	X	K	Q	O	U
Y	D	E	P	E	R	H	K	R	G	S	J	R	D	B	D	I	R	T
J	W	I	X	T	J	M	S	D	O	F	C	E	O	L	G	J	D	X
B	A	Q	T	E	F	J	T	I	H	B	M	B	W	V	F	L	S	R
A	R	W	H	O	G	C	W	R	V	N	E	P	A	J	E	K	Q	L
P	F	A	B	R	I	U	N	B	A	O	K	C	O	Z	P	R	E	U
K	P	S	S	O	L	A	R	W	I	N	D	B	V	S	H	W	A	E
O	L	T	K	I	U	G	Y	T	X	Q	S	W	R	I	F	L	Z	Y
Z	A	E	I	D	F	V	M	R	R	M	U	I	G	H	E	H	G	V
C	N	R	N	H	L	A	D	E	X	Y	W	T	T	Y	M	Z	T	F
G	E	O	S	Y	N	C	H	R	O	N	O	U	S	O	R	B	I	T
L	T	I	C	O	E	L	Z	N	B	X	I	V	C	D	P	K	Y	U
N	F	D	M	Q	P	X	A	C	U	B	O	C	F	P	X	Z	M	A
E	V	S	D	G	D	Q	N	D	T	R	J	S	Q	N	F	S	W	T
O	P	T	I	C	A	L	T	E	L	E	S	C	O	P	E	A	O	Z

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UNIT 4

Chapter 12 Key Terms

BLM 4-5

Goal • Use this page to help you learn and review the Key Terms in Chapter 12.

Work in a small group. Choose three Key Terms and write a riddle about each one. Other group members should write riddles about different Key Terms. Ask other group members to guess the answers to your riddles while you guess the answers to theirs. Together, check the answers, and revise the riddles if you need to.

adaptive optics
astronomical unit
axis
Big Bang theory
black hole
cosmological red shift
electromagnetic radiation
elliptical galaxy
fusion
galaxy
Hubble Space Telescope
interstellar matter
irregular galaxy
light-year
nebula
parallax
planetesimal
Oscillating theory
quasar
red shift
reflecting telescopes
revolution
rotation
spectroscope
spectral lines
spiral galaxy
star
supernova
triangulation

For example:

I am the the process in which hydrogen atoms combine to form helium. I create an enormous amount of energy.

What am I? ______________________________

Riddle 1:

What am I? ______________________________

Riddle 2:

What am I? ______________________________

Riddle 3:

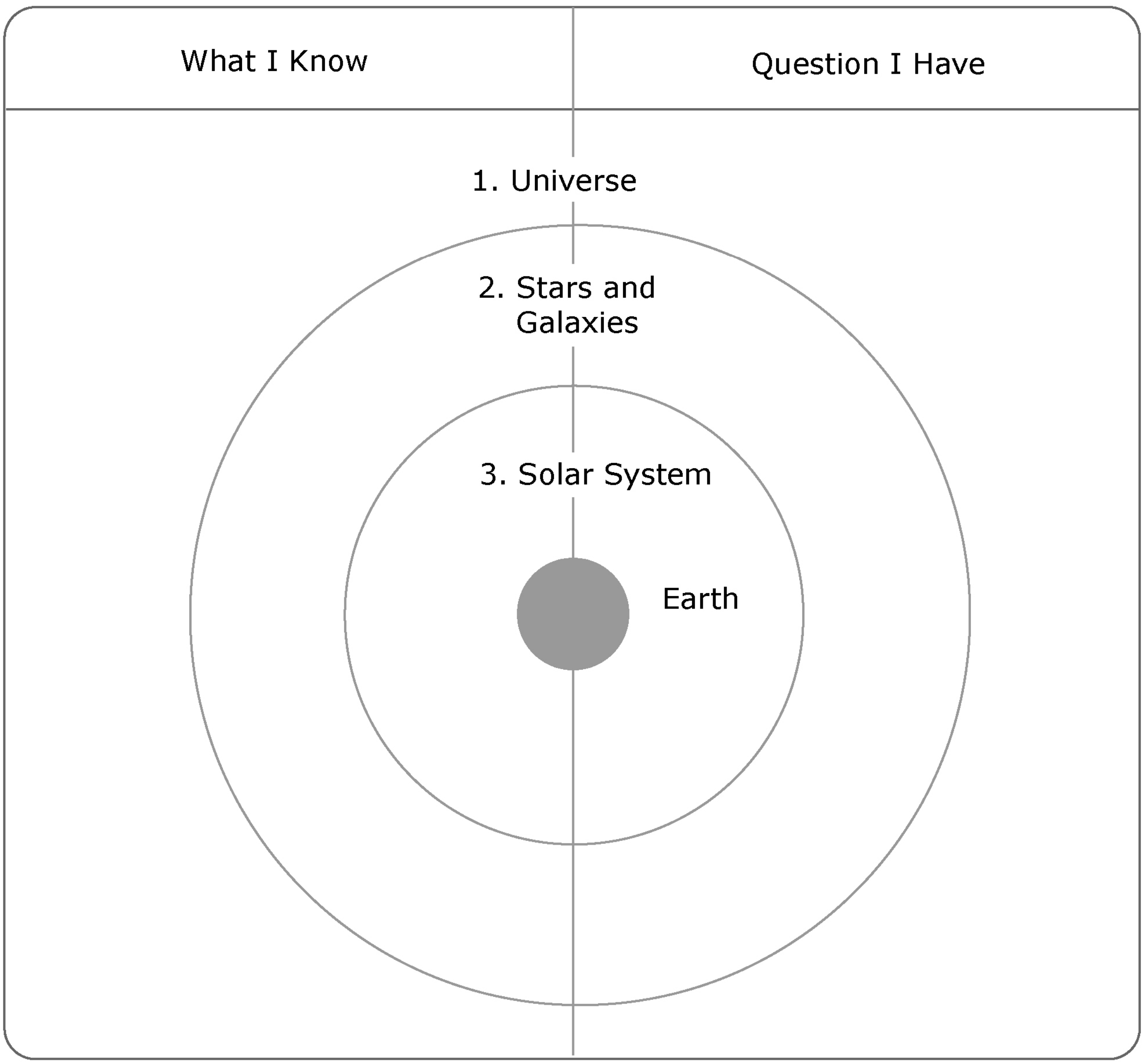
What am I? ______________________________

Find Out Activity, What Do You Know about the Universe?

Goal • Use this page to help you complete Find Out Activity, What Do You Know about the Universe?

What to Do

1. Under "What I Know" on the graphic organizer below, list the objects that you think are found in space. Make sure you write the object under the appropriate category: universe, stars and galaxies, or solar system.



2. Write at least one question per category under "Questions I Have."

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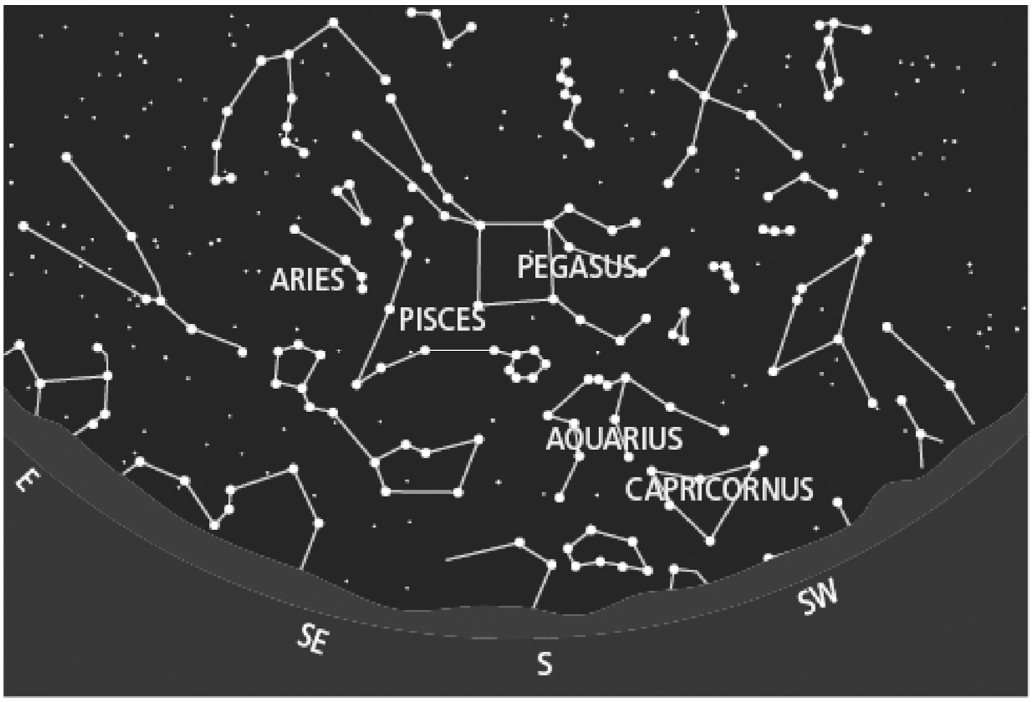
UNIT 4

Star Charts for Fall, Winter, and Spring

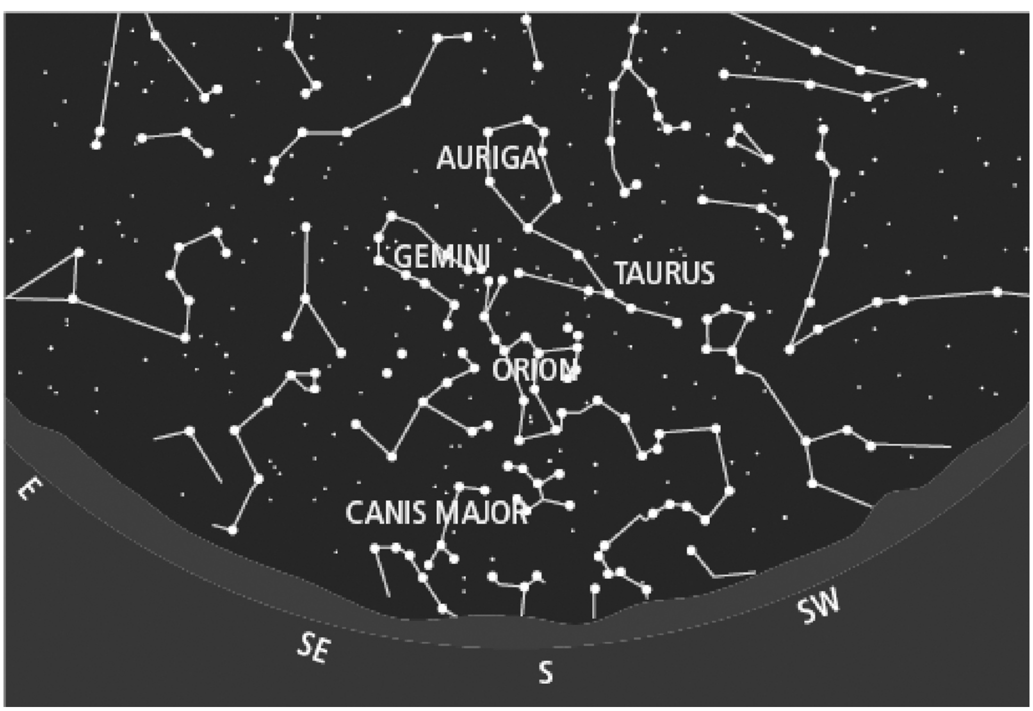
BLM 4-7

Goal • Use this page to review the positions of stars in the fall, winter, and spring.

Fall



Winter



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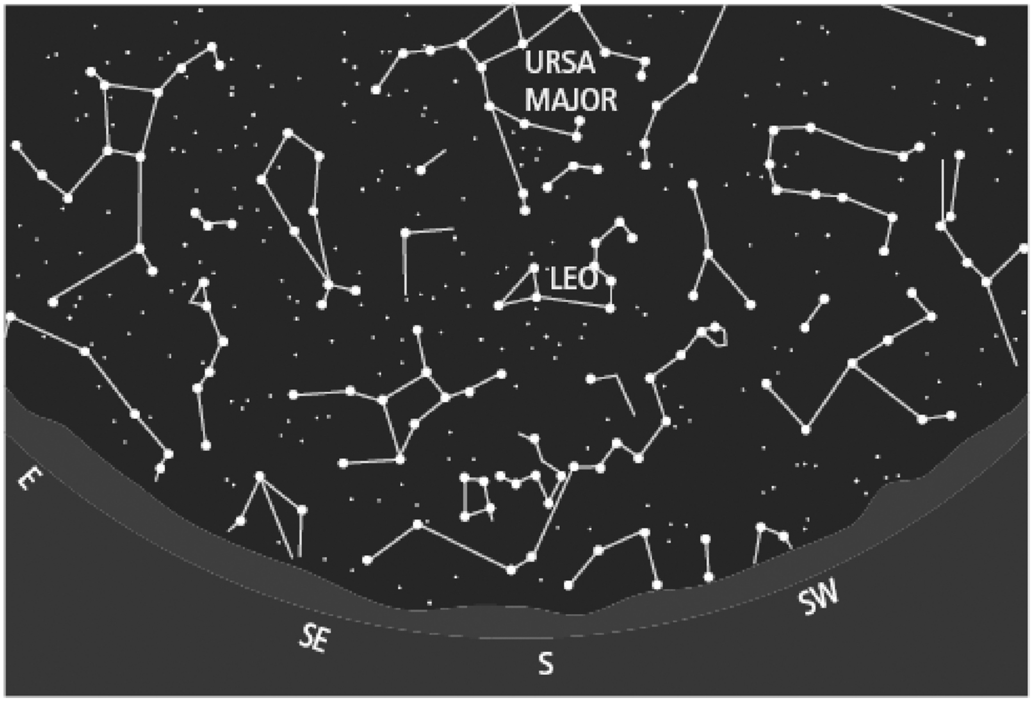
BLM 4-7 continued

Spring



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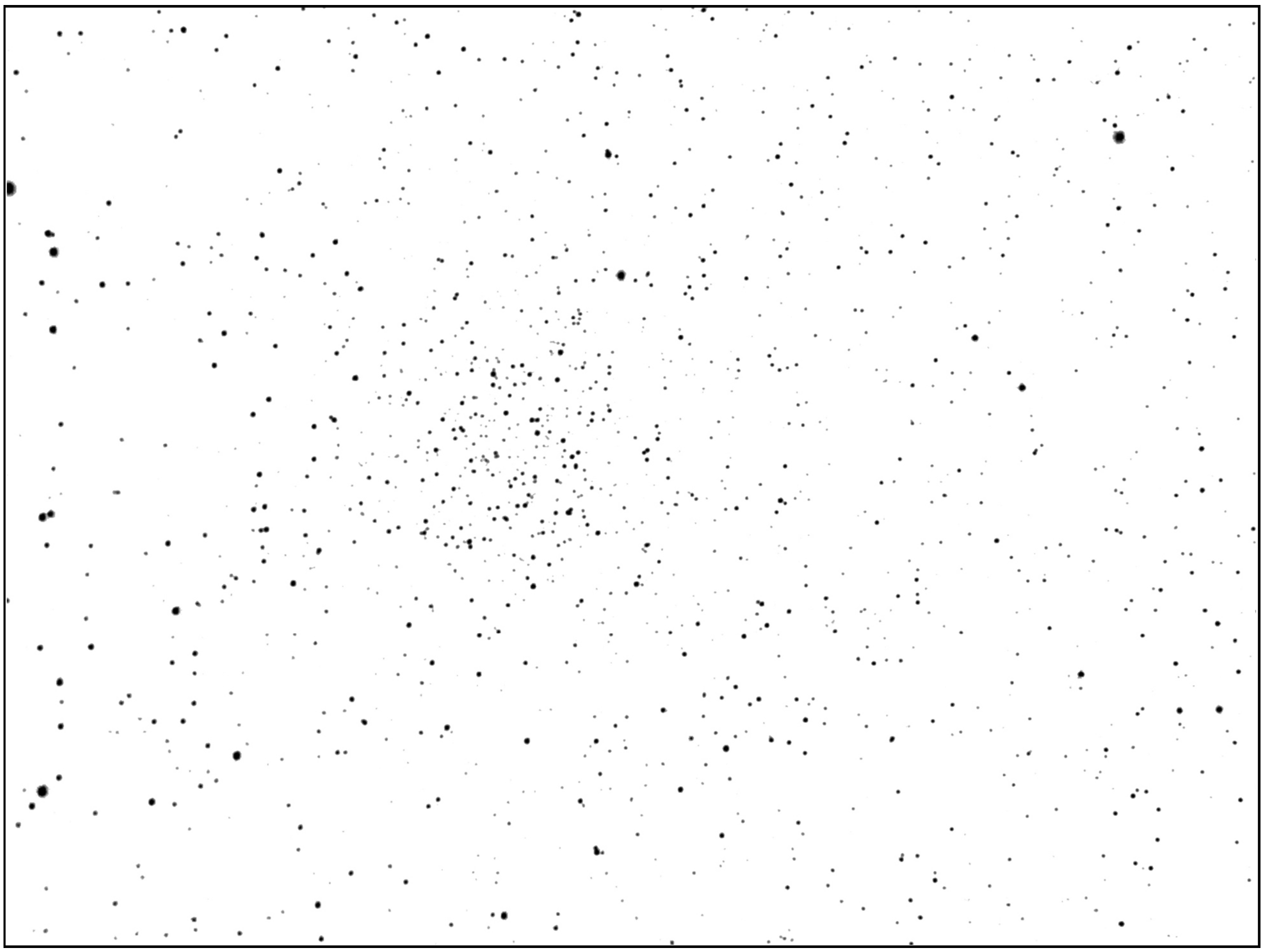
UNIT 4

Think About It Activity 10-1A, Constructing Constellations

BLM 4-8

Goal • Use this page to answer the questions in Think About It Activity 10-1A, Constructing Constellations.

1. Study this star chart to create an idea for a constellation. To help you get some ideas, rotate the sheet to view the stars from different perspectives.



2. Once you have an idea, use your pencil to connect the most visible stars so that they form a very simple outline of the figure you see in the star pattern. this diagram will be the basic structure of your constellation.

3. Use coloured pencils to draw and colour the rest of the details of the figure.

4. Give your constellation a name.

DATE: NAME: CLASS:

BLM 4-8 continued

What Did You Find Out?

1. Compare your constellation with some constellations your classmates drew. How did your classmates' constellations compare with your constellation? Did anyone interpret the star patterns in the same way?

____

____

____

2. How does your answer to question 1 explain why different cultures see different shapes and figures in the same set of stars?

____

____

____

3. Would using a telescope that can help you see many more stars make creating a constellation easier? Explain.

____

____

____

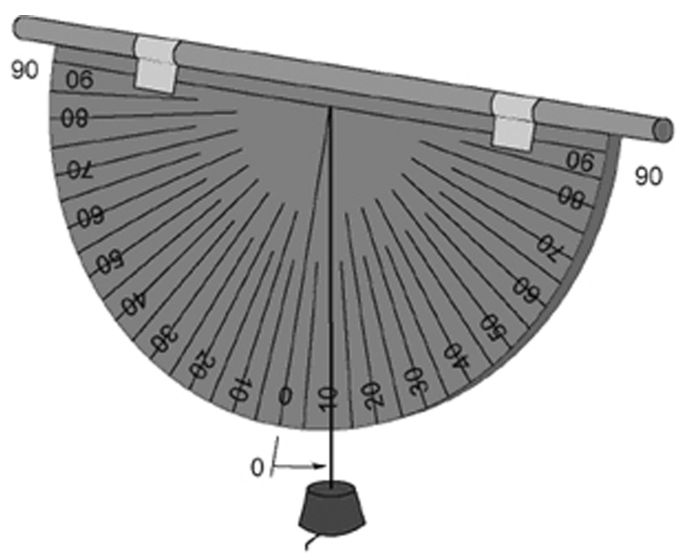
Find Out Activity 10-2B, Pointing in the Right Direction

Goal • Use this page to help you complete Find Out Activity 10-2B, Pointing in the Right Direction.

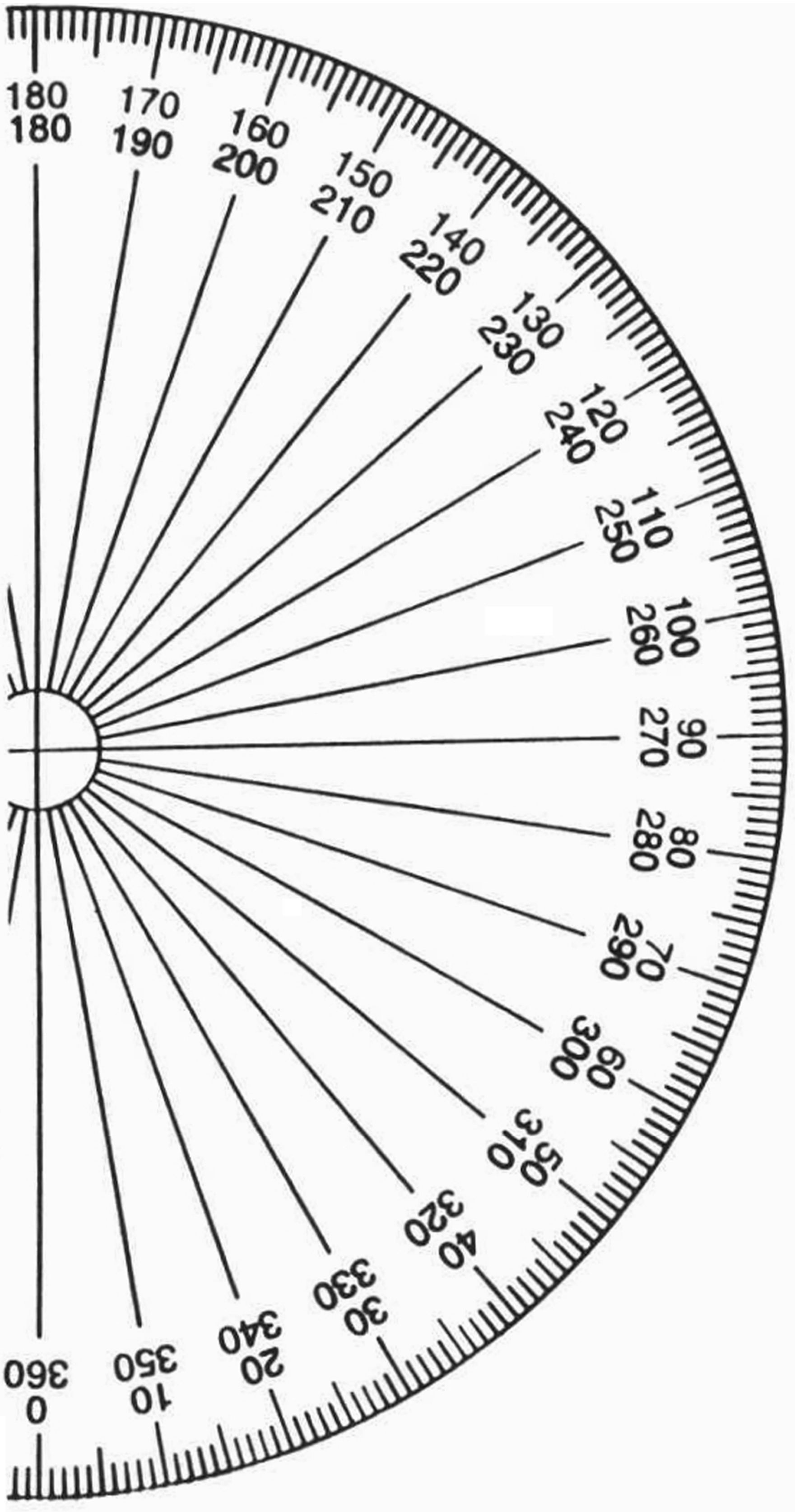
Use this diagram to construct an astrolabe.

You will need:
a straight stick or dowel
string
tape
a cork or heavy bead
cardboard
the calibrated figure on the next page

1. Assemble the materials as shown in the diagram below. Glue or tape the calibrated figure to a piece of cardboard and cut it out. Feed the string through a small hole at exactly 0° and tie a knot to hold it in place.



2. To use the astrolabe, hold one end at your eye and point the other end at something in the room. Have a classmate observe which line the string falls closest to, and read the number of degrees in the angle. This angle is the same size as the angle between horizontal and the object you are looking at.



DATE: NAME: CLASS:

BLM 4-9 continued

What to Do

1. List the target objects that your teacher gives you in the "Object" column of the table below.

Object	Angle	Height
1.		
2.		
3.		
4.		

2. Use the compass to find out which part of your classroom faces due north. Then use the compass to determine the angle of the first object in relation to due north. Record this angle in the "Angle" column of the table. Remember that an angle farther from north will measure a greater number of degrees.

3. Use the astrolabe to determine the height of the object. Make your measurement from a sitting position at your desk. Record this value in the "Height" column of the table.

4. Repeat steps 2 and 3 for three more objects assigned by your teacher.

What Did You Find Out?

1. Describe the difficulties of locating objects using this technique.

2. What could be done to improve this way of measuring?

3. Compare your coordinates (angle and height measurements) with those of a classmate. Why are they different?

DATE: NAME: CLASS:

BLM 4-9 continued

4. How does the time of day you take a measurement of an object in the sky using an astrolabe affect the ability of someone else to find the same location?

5. Write a general rule about the accuracy of using an astrolabe to share the location of objects in the sky.