

Our Solar System Unit

Teacher Masters: Table of Contents

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Teacher Masters

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Dear Families,

Our class is beginning a Science Companion® unit about the solar system.

Learning about the solar system is challenging for children this age. The children will be asked to think about familiar things—the sun, moon, and stars, as well as shadows—in new ways. During a series of activities over the school year, they will identify how the length of a day changes over the year, how the position of the sun in the sky changes slowly from day to day, and how the shape of the moon cycles through a pattern. After they recognize these patterns, they will explore and address questions about why these things happen, such as: Why are there seasons? Why does the moon change shape? These are questions that scientists have asked for thousands of years.

From time to time, your child will bring home handouts called **Family Links**. These handouts will give you information about what your child is learning and offer suggestions about how you can help. They will be your link to the classroom. There are three kinds of Family Link handouts:

- **Homework** assignments your child will be expected to complete and return to class.
- **Fact Sheets** containing information you and your child can read and refer back to about the topics your child is learning. These fact sheets provide enough information to give you confidence about your own knowledge of the topic, so you can help your child learn.
- **Home Activities** for you and your child to do together if you have the time and are interested in learning more. They are not required homework.

If you have a computer at home with access to the Internet, there are wonderful sites for children where they can look at pictures from space and delve as deeply into the topic as their interest takes them. Visit <http://www.sciencecompanion.com/links> to find descriptions of recommended web sites.

Your child's study of the solar system may inspire questions. Whether you know a great deal about the solar system already or will be learning right along with your child, your interest and assistance will enhance your child's learning experience.

This is going to be fun for the class. We hope you enjoy it too. The following pages outline the unit and describe some common misconceptions that people have about the solar system.

Sincerely,

A Brief Outline of the Our Solar System Unit

Note: Due to time available or local science standards, your child's class may cover all or some of these topics.

Learning about the Sun's Daily Pattern and the Sun's Annual Pattern

We begin our study of the sun by observing it as it moves across the sky. By recording the shapes of the shadows cast by the sun throughout the course of a day, we can tell how high the sun is in the sky (as seen from our location on Earth). We will discover the patterns of how the sun appears to move in a day.

As a class, we will track sunrise and sunset data to see how the length of daylight changes over the course of the year.

We will repeat our observations of the sun and its shadows in the fall, around the winter solstice, and in the spring. The children will observe how the height of the sun (as viewed from Earth) changes over the course of the seasons and the year. We will use hands-on models to show how Earth moves in relationship to the sun, and how these movements explain our observations of the sun and its shadows.

Big Ideas:

- The sun appears to travel through the sky in a predictable daily pattern.
- The sun's daily pattern can be explained by the rotation of Earth.
- The apparent path of the sun across the sky changes slowly over a year.
- The length of daylight slowly changes over the year.
- The sun's annual pattern is the result of Earth orbiting the sun once a year.

Learning about the Moon's Cycle

The children will observe the moon for a month, recording observations in the daytime and nighttime. They'll learn the patterns of how the moon moves across the sky, and how the shape we can see from Earth changes over the month. The children will have a chance to model how the moon is lit by sunlight as it moves around the Earth.

Big Ideas:

- Like the sun, the moon appears to move across the sky daily. Sometimes you can see the moon during the day.
- The observable shape of the moon changes from day to day in a predictable pattern. The moon's cycle takes about a month.
- The moon's shape seems to change from day to day because we see different views of the moon's sun-lit portion as the moon orbits around Earth. The moon's cycle takes about a month, the time it takes for the moon to orbit Earth.

Learning about Stars and Planets

We will learn about stars outside our solar system and planets in our solar system.

Big Ideas:

- The sun is the center of our solar system, and Earth is one of eight planets that orbit it.
- The stars lie outside our solar system.
- The sun is a star like all other stars. Like the sun appears to move across a daytime sky, the stars appear to move across the nighttime sky because Earth rotates on its axis.
- Each planet has unique characteristics that distinguish it from other planets.
- Vast distances exist between the planets that orbit around our sun.

Misconceptions About the Solar System

Children are curious about our solar system, and many have formed their own explanations for the things they have observed or heard about. Researchers who interviewed children about the solar system found that some children had ideas like these:¹

- The Earth we live on is flat and not round like a ball.
- Nighttime is caused because the sun hides, goes to sleep, turns off, goes out, is on the ground, hides behind trees, or goes behind hills.
- The shape of the moon changes because the shadow of Earth falls on the moon.
- The difference in temperature over the seasons is caused by Earth being a different distance from the sun during parts of its orbit.

Children are not the only ones with misconceptions about how Earth, the sun, and the moon interact. In one study interviewers asked Harvard professors and students at graduation what caused the seasons.² Many of the adults interviewed had the mistaken idea that winter is caused because Earth is farther from the sun during that part of its yearly journey around the sun. Even though some of these adults had taken courses in physics and relativity, they had developed and retained incorrect views formed by misleading pictures in textbooks—pictures that seemed to represent the orbit of Earth around the sun as an exaggerated oval instead of the almost circular shape it actually is.

Correcting Misconceptions

Studying the solar system poses the challenge that objects like the sun, moon, and stars cannot be touched or viewed up close. However, this unit includes several ways for your child to experience the solar system and discover how it is put together.

Your child's class has the opportunity to correct misconceptions. By studying our solar system, the children can learn that:

- Earth is a sphere. It rotates around its axis once a day and orbits the sun once a year.
- Nighttime is caused by the daily rotation of Earth. The part of Earth where we are turns away from the sun at night.
- The lit portion of the moon that we see is reflected sunlight. The shape that we see depends on where the moon is in its orbit of Earth. The shadow of Earth only falls on the moon during lunar eclipses.
- The difference in temperature over the seasons is caused by the tilt of Earth on its axis, and by its yearly orbit of the sun. During winter in the northern hemisphere, the North Pole is tipped away from the sun. During summer in the northern hemisphere, Earth is a half-orbit away from its "winter" position, and the North Pole is tipped toward the sun.

¹ Driver, R., Squires, A., Guesne, E., Tiberghien, A. *Children's Ideas in Science*. Philadelphia: Open University Press, 1985. Driver, R., Squires, A., Rushworth, P., and Wood-Robinson, V. *Making Sense of Secondary Science*. New York: Routledge, 1994.

² Private Universe Project. *A Private Universe* [Videotape]. Cambridge, MA: Harvard-Smithsonian Center for Astrophysics, 1989.

Feeling Sunlight

Please work with your partner to answer the following questions. Make sure you remain focused, because you will be responsible for sharing your results with the group.

1. What direction do you need to face to feel the sun on your face?
2. How does the sun feel when it shines on your back?
3. Find an object that is in the sun. How does it feel?
Now find an object that is located in the shade. How does it feel?
4. When you stand in the shade, does it feel different than when you stand in the sun? How?
5. Where is the sun?
6. What caused the shade?

Shadow Challenge Cards

Directions: Duplicate the challenges below and attach them to index cards. Place the cards in the Science Center after Lesson 2, “A Sense of Sun” or 3, “Watching the Sun for a Day.” Place blank index cards in the Science Center for the children to write their own challenges on. Make sidewalk chalk available, and invite the children to take the cards and chalk outdoors on sunny days during recess.

<p>Shake hands with your hands touching. Make your shadows shake hands without letting your hands touch. How far apart can you get your hands, and still get your shadows to shake hands?</p>	<p>Shadow Acrobats: Trace an outline of a friend’s shadow on the ground. Have another friend make a shadow that stands on the first shadow’s hand or head (or whatever you choose). Trace that. Keep going!</p>
<p>Shadow Puzzles: Choose an interesting object to take outside. Have one friend close her eyes. Make a shadow with your object, and have another friend draw its outline. Then ask your first friend to make the same kind of shadow.</p>	<p>Mark an X on the ground with chalk. Touch the X with your finger’s shadow. How far away can you place your finger? Can you guess where your finger will need to be?</p>
<p>Make or find some shadows that are crisp and dark. Then make or find some shadows that are pale and fuzzy.</p>	<p>Make up your own shadow challenge for yourself or your friends. Write it down on an index card, and add it to the stack.</p>

Shadows and Bodies

Please work with your partner to answer the following questions. Make sure you remain focused, because you will be responsible for sharing your results with the group.

1. Face your shadow. Where is the sun located?
2. Put your shadow to the right side of you. Where is the sun now?
3. Can both the sun and shadow be on the same side of you?
4. Could we face the sun and face our shadows at the same time?
Why or why not?

Once you have completed this, return to the pole. GOOD WORK!

Making Models

Your group will work together and create one model to share after the activity.

The following children are in your group:

Challenge

Your challenge today is to create a model that explains these questions:

1. Why is there daytime and nighttime?
2. Why does the sun seem to move across the sky during the daytime?

Sharing

Each group will share the model they've created with the class. The other groups need to think about whether or not the model they are seeing explains the two challenge questions.

Remember, all models are valuable, and all ideas are valid.

Follow up

Be prepared to discuss:

- What you liked
- What your group found challenging
- Questions your group has about the models

Think about this:

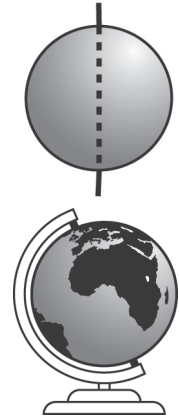
- Was there one model that you thought best explained the observations?
If so, which model was it?

Useful Words for Solar System Models

axis

If you took a ball (or **sphere**) and stuck a stick through the middle of it, the stick would be an axis of the ball. You could spin the ball around the axis.

The axis of Earth is slightly tilted in relationship to its orbit around the sun. So when you see a mounted globe of Earth, and it's tilted, that represents the tilt of Earth on its axis.

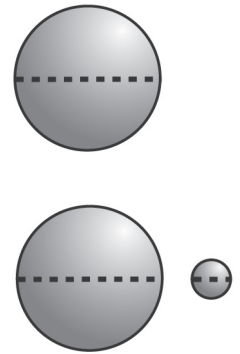


diameter

The diameter of a sphere is the measurement across the sphere at its widest point. The diameter always goes through the center of the sphere.

Comparing the diameters of spheres is not the same as comparing their volume. For example, the diameter of a racquetball is about one quarter the diameter of a basketball. But if you put them side by side, the racquetball looks much smaller than one quarter of a basketball.

The same idea applies to the moon, which has a diameter about one quarter of Earth's.



orbit

The path a planet travels around the sun is the planet's orbit. The path the moon travels around Earth is the moon's orbit.

The shape of Earth's orbit is an ellipse that is almost a circle. Pictures in books that show Earth orbiting the sun in a long, flat ellipse are misleading.

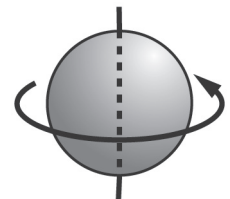
It takes one year for Earth to orbit the sun. It takes a little less than a month for the moon to orbit Earth.

rotation

A rotation is one spin of a sphere around its axis.

It takes one day for Earth to make one rotation. Earth rotates between 365 and 366 times during one orbit around the sun.

The moon rotates more slowly. It takes the same time for the moon to make one rotation as it takes the moon to orbit the Earth (a little less than a month). That is why we only see one side of the moon from Earth.



Teacher Master: Weekly Sunrise and Sunset Data (Lesson 8)

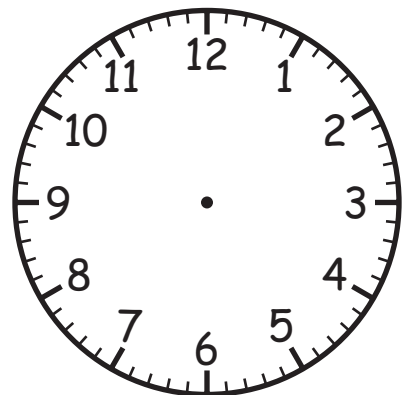
Our Solar System Teacher Master 5

Daily Sunrise and Sunset Data

Date	Time of Sunrise	Time of Sunset	Length of Daylight
/ /	am	pm	hr min
/ /	am	pm	hr min
/ /	am	pm	hr min
/ /	am	pm	hr min
/ /	am	pm	hr min

Daily Sunrise and Sunset Data

Use the space provided below to calculate the length of daylight.



Science Center

Time Passing Challenge Cards

Directions: Copy the challenges below and attach them to index cards. Write the answers on the back of the cards. Place the cards in the Science Center after Lesson 8, along with blank index cards for the children to write their own challenges on. Put a clock and calculator in the Science Center to help the children solve the problems.

<p>Bobby found that the sun rose at 6:38 A.M. and set at 5:15 P.M. How many hours of daytime were there?</p>	<p>Megan leaves to go swimming at 4:05 P.M. and returns at 5:25 P.M. How long has she been gone?</p>
<p>Jamal rides his bike 37 miles. He rides from 10:15 A.M. until 3:50 P.M. How long does it take him to ride 37 miles?</p>	<p>Caroline went to sleep at 9:00 P.M. The garbage truck woke her up at 6:00 A.M. She went back to sleep at 6:15 A.M., and woke at 7:00 A.M. How long did she sleep all together?</p>
<p>Marina got on a train on Saturday morning at 8:00 A.M. She got off the train in another city on Sunday at 11:00 A.M. How many hours was she on the train?</p>	<p>Make up some problems for a friend to solve. Write them down on index cards.</p>

Answers: 10 hours, 37 minutes
5 hours, 35 minutes
27 hours

1 hour, 20 minutes
9 hours, 45 minutes

Lunar Phase Dates, 2011

New Moon	First Quarter	Full Moon	Third Quarter
Jan 4	Jan 12	Jan 19	Jan 26
Feb 2	Feb 11*	Feb 18	Feb 24
Mar 4	Mar 12	Mar 19	Mar 26
Apr 3	Apr 11	Apr 17	Apr 24
May 3*	May 10	May 17	May 24
Jun 1	Jun 8	Jun 15	Jun 23
Jul 1	Jul 8*	Jul 15*	Jul 23**
Jul 30	Aug 6	Aug 13	Aug 21
Aug 28	Sep 4	Sep 12	Sep 20
Sep 27	Oct 3	Oct 11	Oct 19
Oct 26	Nov 2	Nov 10	Nov 18
Nov 25**	Dec 2	Dec 10	Dec 17
Dec 24			

Dates apply to Central Standard Time and Central Daylight Time. If the exact phase occurs within a couple of hours of midnight, the date may be one date earlier or later in other time zones.

* One date earlier in Pacific Time.

** One date earlier in Pacific Time and Mountain Time.

Lunar Phase Dates, 2012

New Moon	First Quarter	Full Moon	Third Quarter
	Jan 1**	Jan 9*	Jan 16
Jan 23*	Jan 30	Feb 7	Feb 14
Feb 21	Feb 29	Mar 8	Mar 14
Mar 22	Mar 30	Apr 6	Apr 13
Apr 21	Apr 29	May 5	May 12
May 20	May 28	Jun 4	Jun 11
Jun 19	Jun 26	Jul 3	Jul 10
Jul 18***	Jul 26	Aug 1	Aug 9
Aug 17	Aug 24	Aug 31	Sep 8
Sep 15	Sep 22	Sep 29	Oct 8
Oct 15	Oct 21	Oct 29	Nov 6
Nov 13	Nov 20	Nov 28	Dec 6
Dec 13	Dec 19***	Dec 28	

Dates apply to Central Standard Time and Central Daylight Time. If the exact phase occurs within a couple of hours of midnight, the date may be one date earlier or later in other time zones.

* One date earlier in Pacific Time.

** One date earlier in Pacific Time and Mountain Time.

*** One date later in Eastern Time.

Lunar Phase Dates, 2013

New Moon	First Quarter	Full Moon	Third Quarter
			Jan 4
Jan 11	Jan 18	Jan 26	Feb 3
Feb 10*	Feb 17	Feb 25	Mar 4
Mar 11	Mar 19	Mar 27	Apr 2
Apr 10	Apr 18	Apr 25	May 2
May 9	May 17***	May 24***	May 31
Jun 8	Jun 16	Jun 23	Jun 29***
Jul 8	Jul 15	Jul 22	Jul 29
Aug 6	Aug 14	Aug 20	Aug 28
Sep 5	Sep 12	Sep 19	Sep 26
Oct 4	Oct 11	Oct 18	Oct 26
Nov 3	Nov 9	Nov 17	Nov 25
Dec 2	Dec 9	Dec 17	Dec 25

Dates apply to Central Standard Time and Central Daylight Time. If the exact phase occurs within a couple of hours of midnight, the date may be one date earlier or later in other time zones.

* One date earlier in Pacific Time.

*** One date later in Eastern Time.

Lunar Phase Dates, 2014

New Moon	First Quarter	Full Moon	Third Quarter
Jan 1	Jan 7	Jan 15	Jan 23***
Jan 30	Feb 6	Feb 14	Feb 22
Mar 1	Mar 8	Mar 16	Mar 23
Mar 30	Apr 7	Apr 15*	Apr 22*
Apr 29**	May 6	May 14	May 21
May 28	Jun 5	Jun 12	Jun 19
Jun 27	Jul 5	Jul 12	Jul 18
Jul 26	Aug 3	Aug 10	Aug 17
Aug 25	Sep 2	Sep 8	Sep 15
Sep 24**	Oct 1	Oct 8	Oct 15
Oct 23	Oct 30	Nov 6	Nov 14
Nov 22	Nov 29	Dec 6	Dec 14
Dec 21	Dec 28		

Dates apply to Central Standard Time and Central Daylight Time. If the exact phase occurs within a couple of hours of midnight, the date may be one date earlier or later in other time zones.

* One date earlier in Pacific Time.

**One date earlier in Pacific Time and Mountain Time.

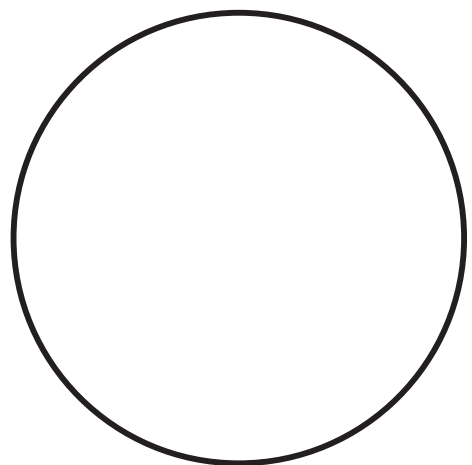
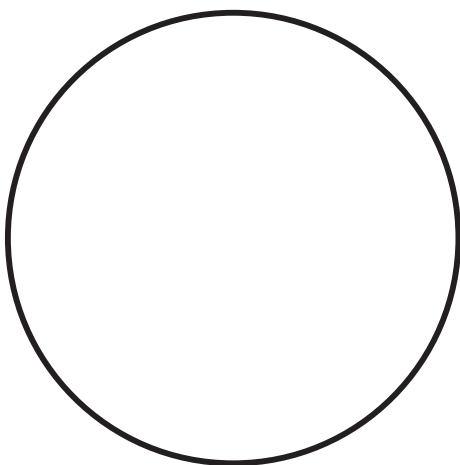
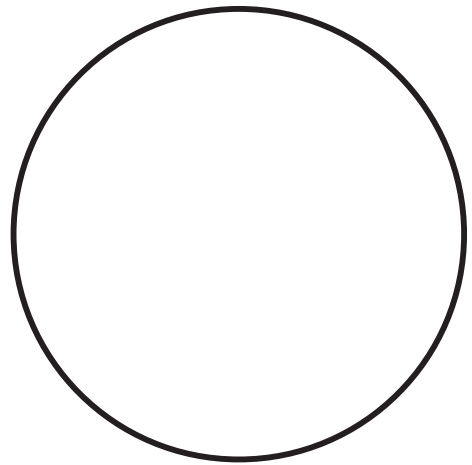
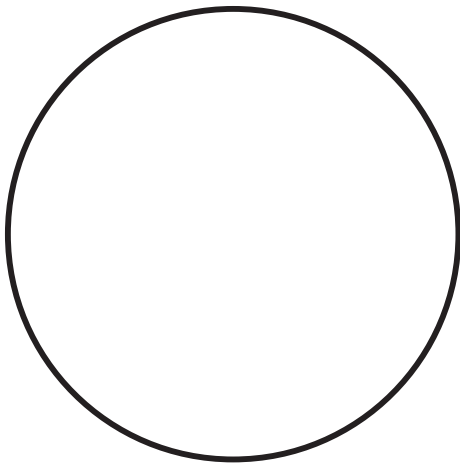
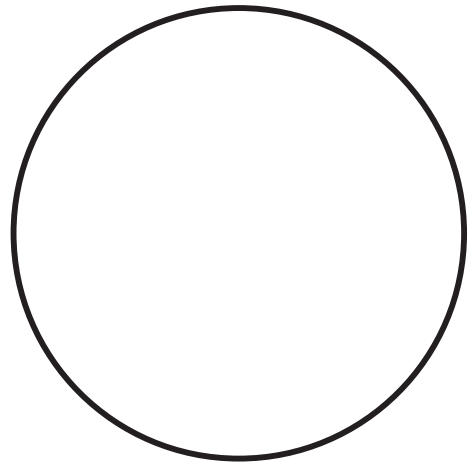
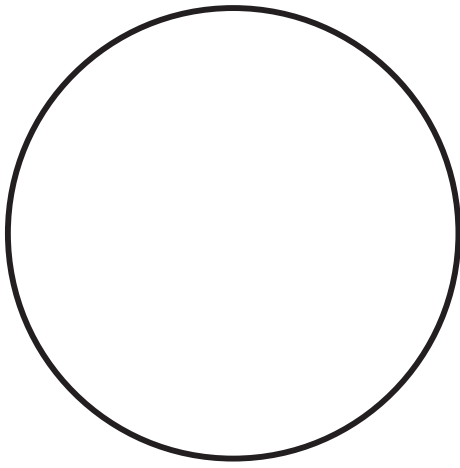
*** One date later in Eastern Time.

Moonrise and Moonset Times for the Week

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Date							
Moonrise Time							
Moonset Time							

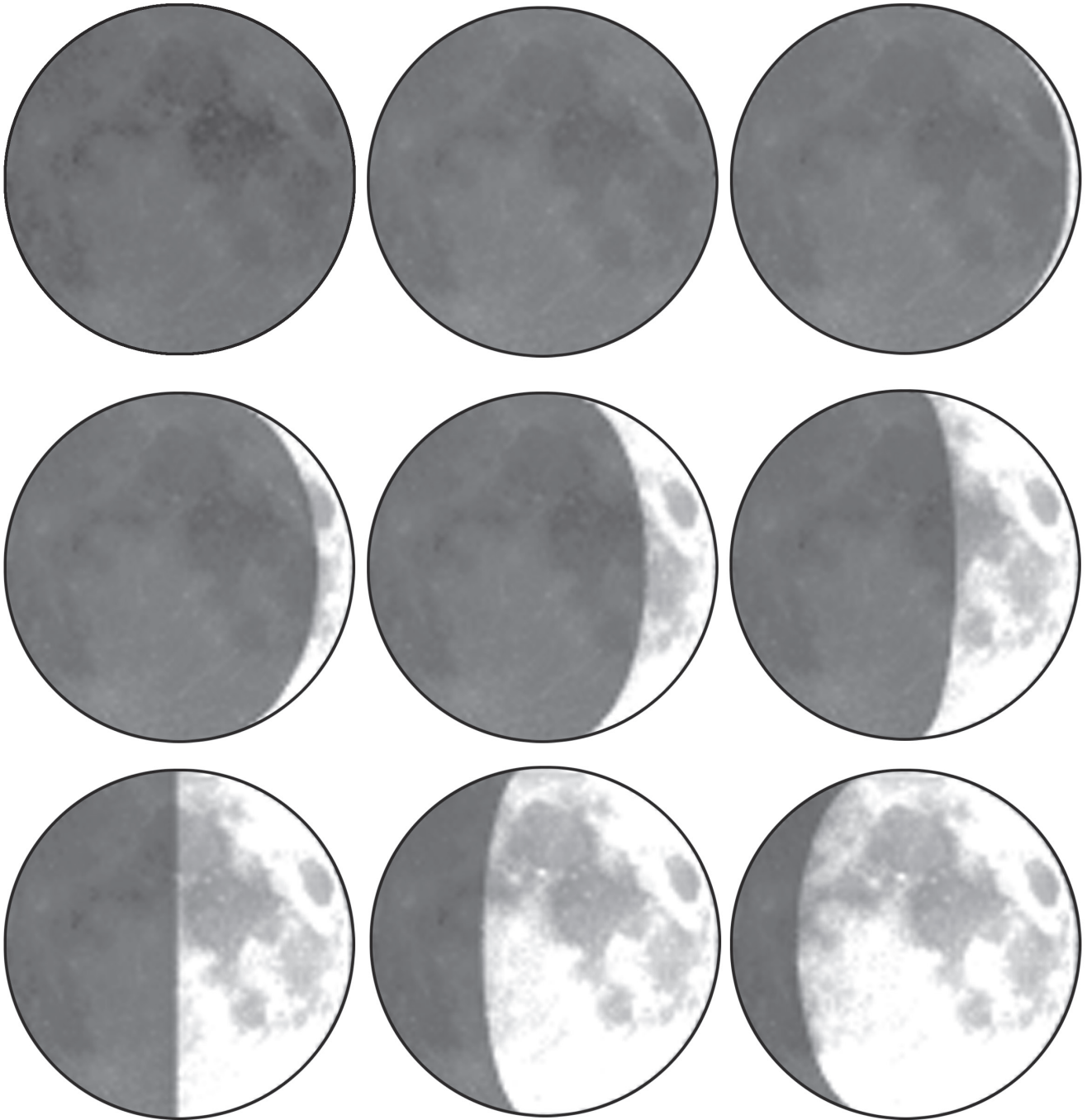
Moon Circles

Directions: Each day the class astronomer should draw the daily moon observation in a circle and then cut it out and attach it to the "Moon Observations" poster.



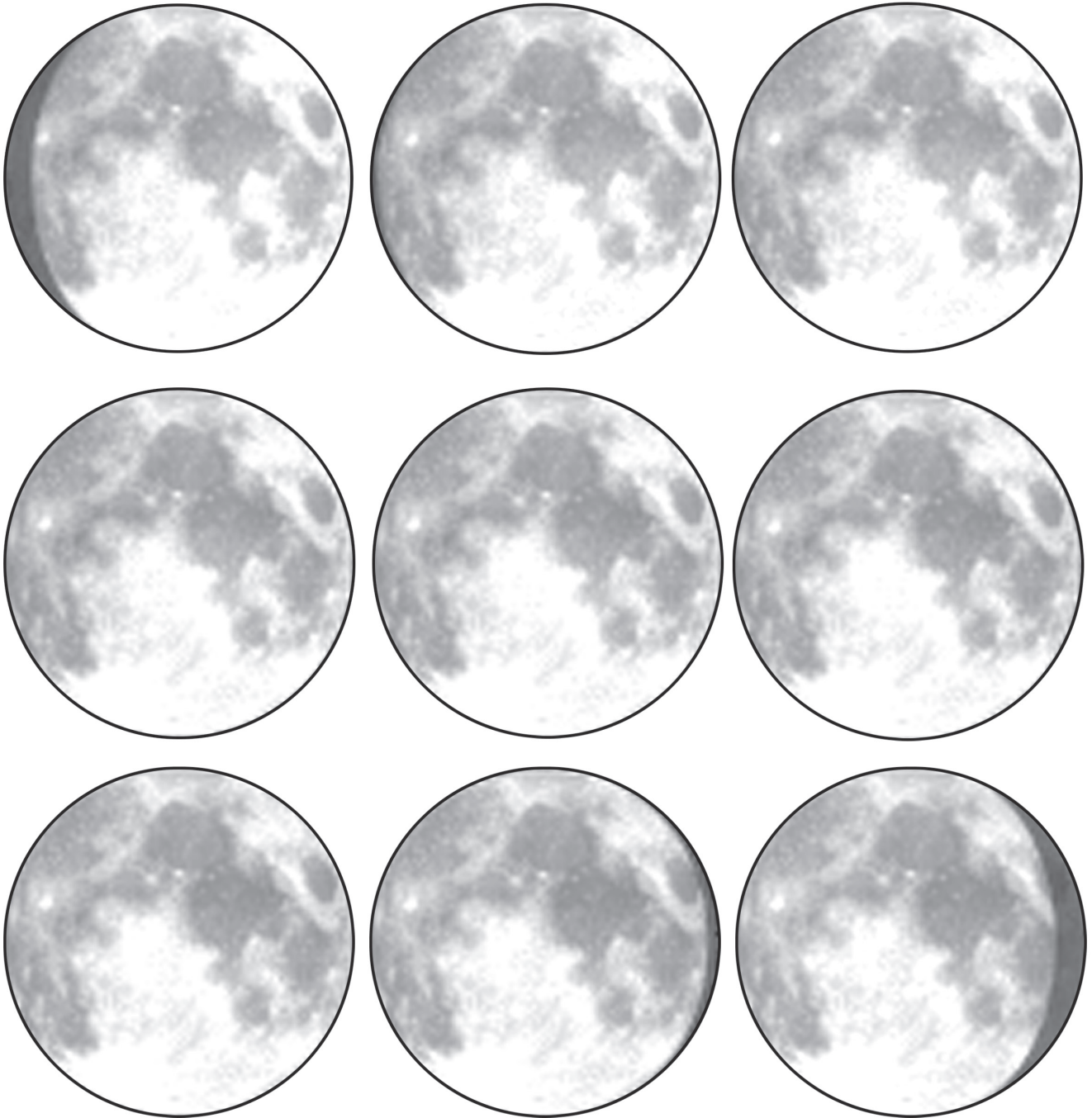
A Cycle of Moons (page 1 of 4)

Directions: For the days your class is unable to observe the moon due to weather or other factors, you can cut out the pictures of the moon that have the appropriate shape for the missing observation, and have the class astronomer attach them to the "Moon Observations" poster.



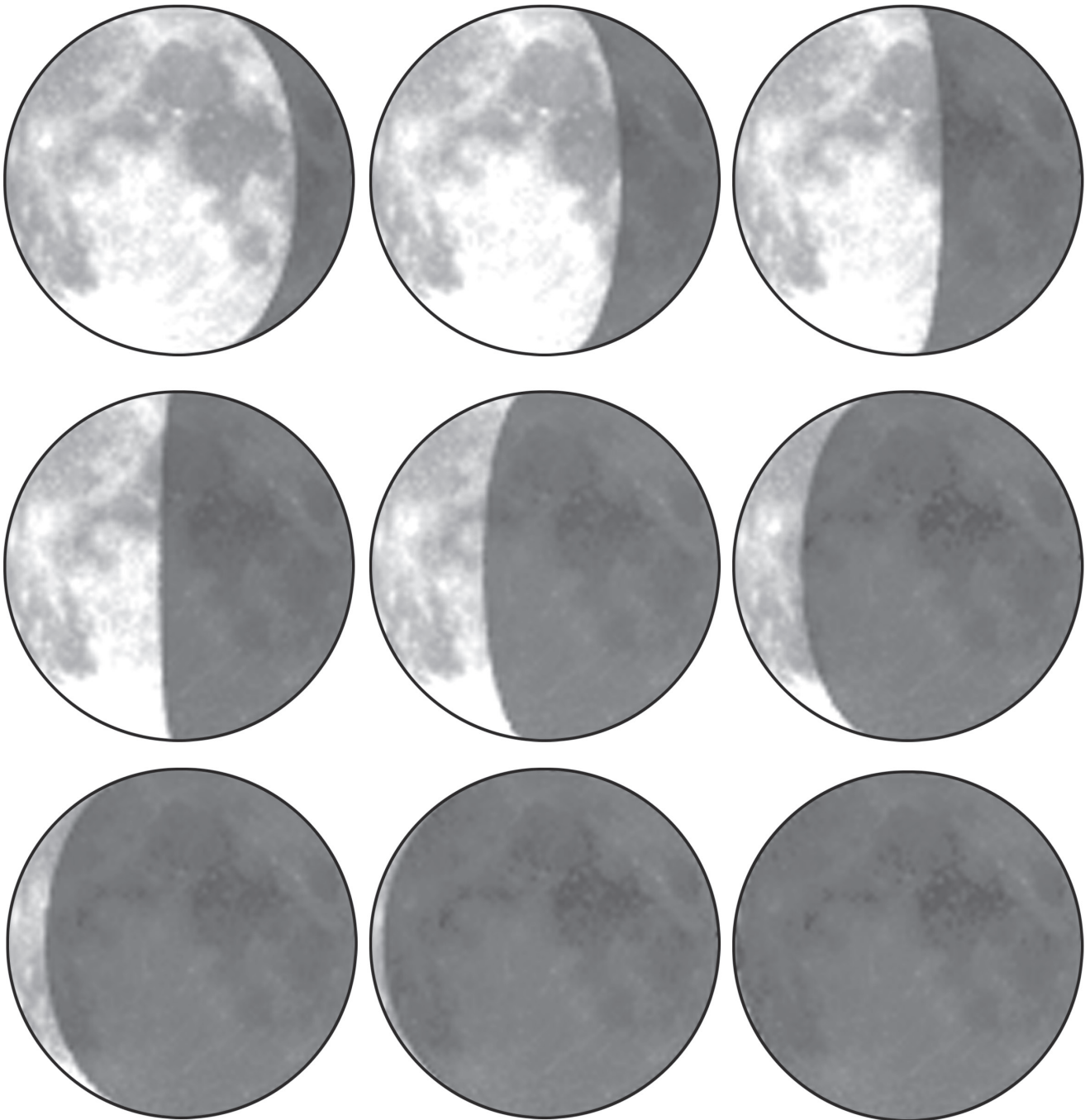
Source: <http://tycho.usno.navy.mil/vphase.html>

A Cycle of Moons (page 2 of 4)



Source: <http://tycho.usno.navy.mil/vphase.html>

A Cycle of Moons (page 3 of 4)



Source: <http://tycho.usno.navy.mil/vphase.html>

A Cycle of Moons (page 4 of 4)



Source: <http://tycho.usno.navy.mil/vphase.html>

Children's Ideas about the Moon

Record the children's initial ideas about the moon that are revealed during the course of the discussion. *Remember, this is a recording tool, not an outline for the discussion.* As the children express their ideas and challenge each other's ideas, you might probe gently or ask leading questions, but do not attempt to uncover and correct all erroneous ideas at this time.

The moon and nighttime:

(Do some children believe that the moon causes nighttime?)

The moon's shape:

(Do some children believe that the moon is a sphere? A disk? A changing crescent?)

Why the moon shines (source of moon's light):

(Do some children believe that the moon emits its own light?)

Why the moon changes shape (cause of moon's phases):

(Do some children believe that moon's phases are caused by the shadow of the Earth?)

Other ideas:

Know What You Learn

Know	Want	Predict	Learned
What we already know	What we want to know	What do we think will happen?	What did we learn?

Read About Early Space Exploration

Use the books in the Science Center, or go to the library, and read about early space exploration. Choose one of these topics:

- The space program of the USSR (now Russia)
- The USA's Apollo space program

Make challenge cards for your classmates by writing questions on one side of index cards and writing answers on the back. Leave the cards in the Science Center. Or, write in the "Moon Journal" section of your science notebook.

Here's an example of how you might do it.

MY NAME, DATE

I read Spacebusters: The Race to the Moon by Philip Wilkinson.

Q: What did Neil Armstrong say as he took the first human step onto the moon's surface? (see page 24)

A: "That's one small step for man, one giant leap for mankind."

Q: What did it feel like to run on the moon? (see page 29)

A: Buzz Aldrin "made huge strides and bounded like a kangaroo. But he felt as though he was running in slow motion."

Q: What did Michael Collins do while Armstrong and Aldrin were on the moon? (see pages 36-39)

A: He orbited the moon in the command module. His job was to meet the landing craft when Armstrong and Aldrin left the moon.

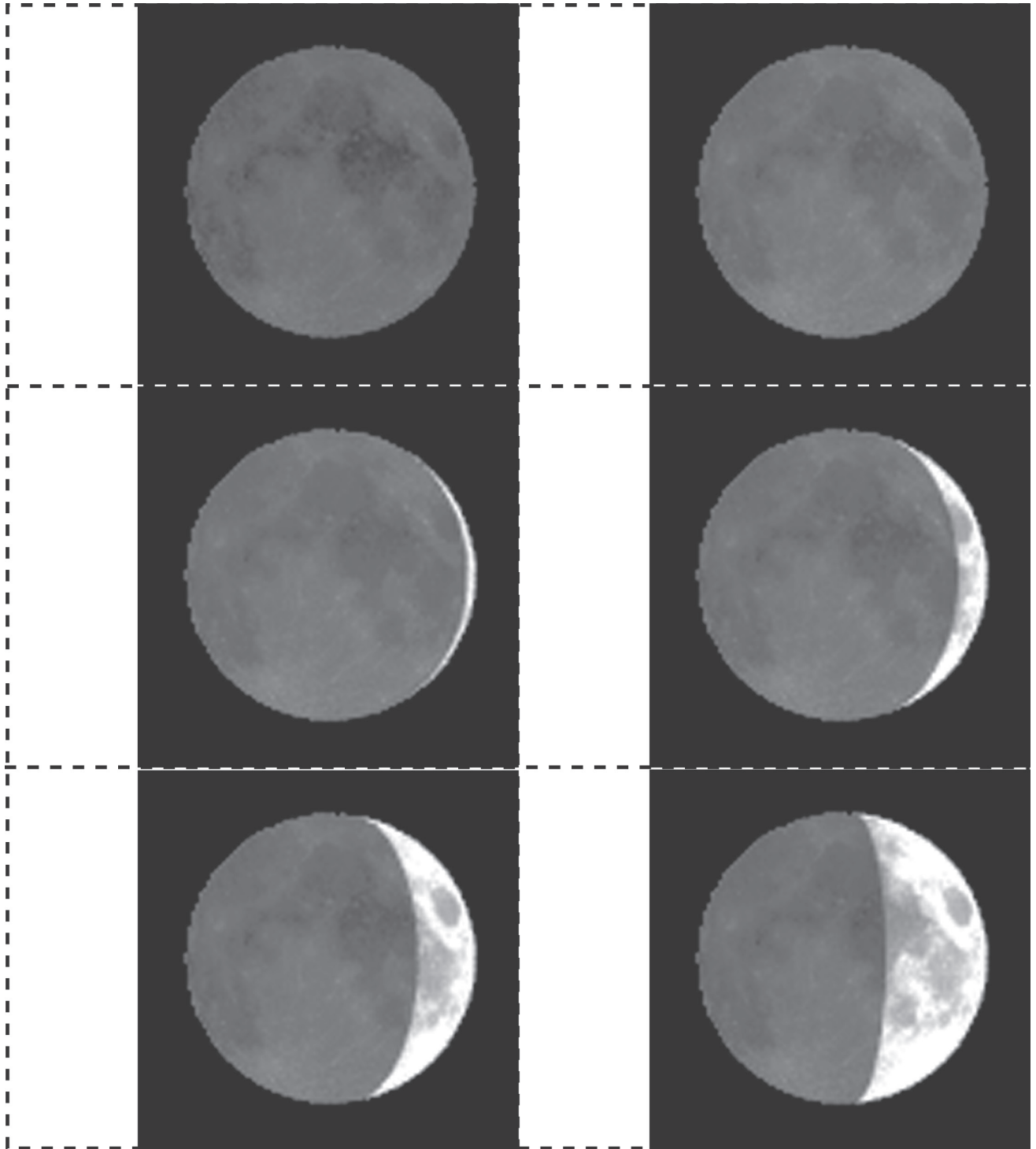
Q: Are the astronaut's footprints still on the moon? (see page 28)

A: Yes. There is no wind or rain on the moon, so the footprints from 1969 are still there.

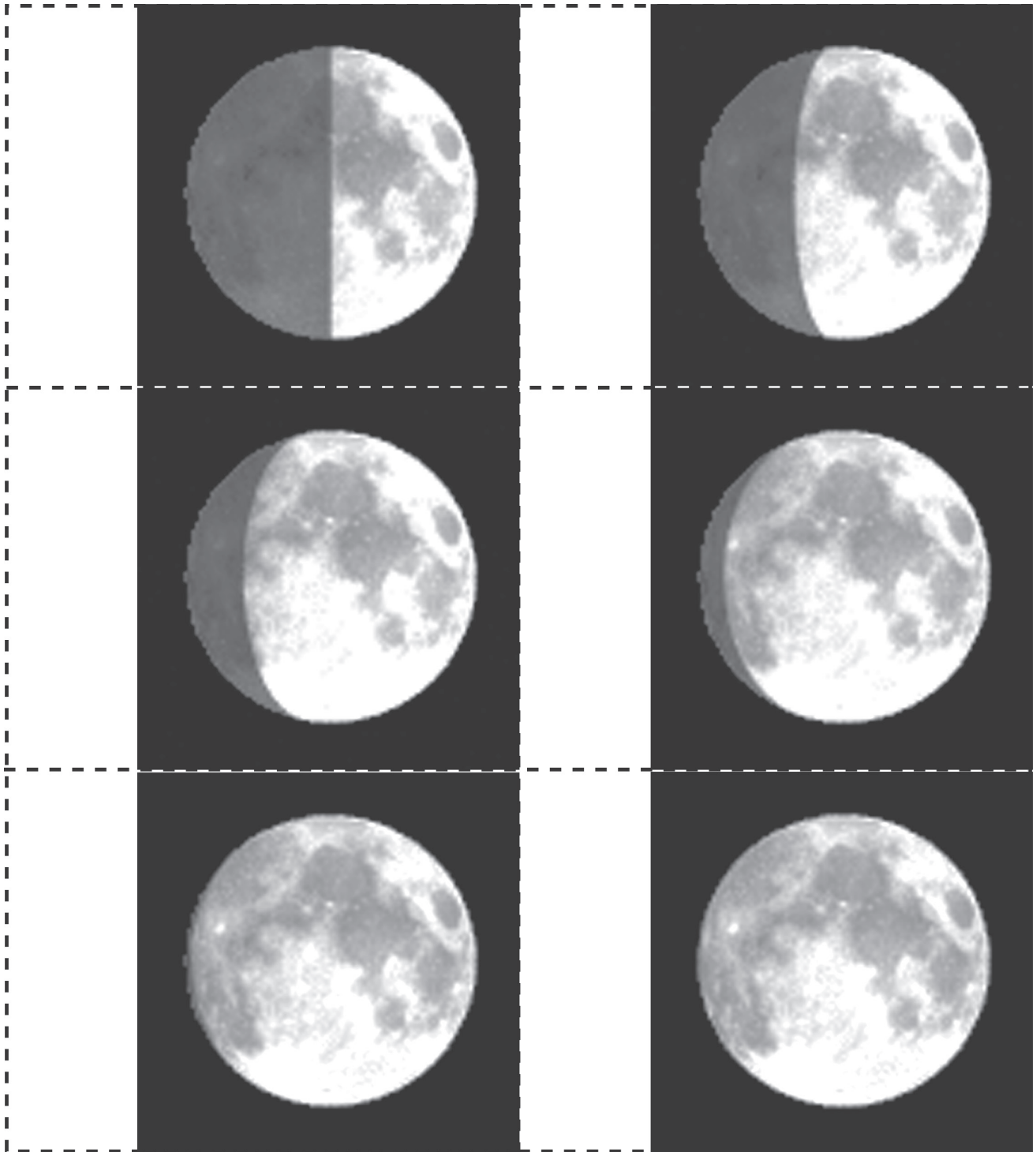
Q: What did Neil Armstrong do after he retired? (see page 46)

A: He ran a farm in Ohio.

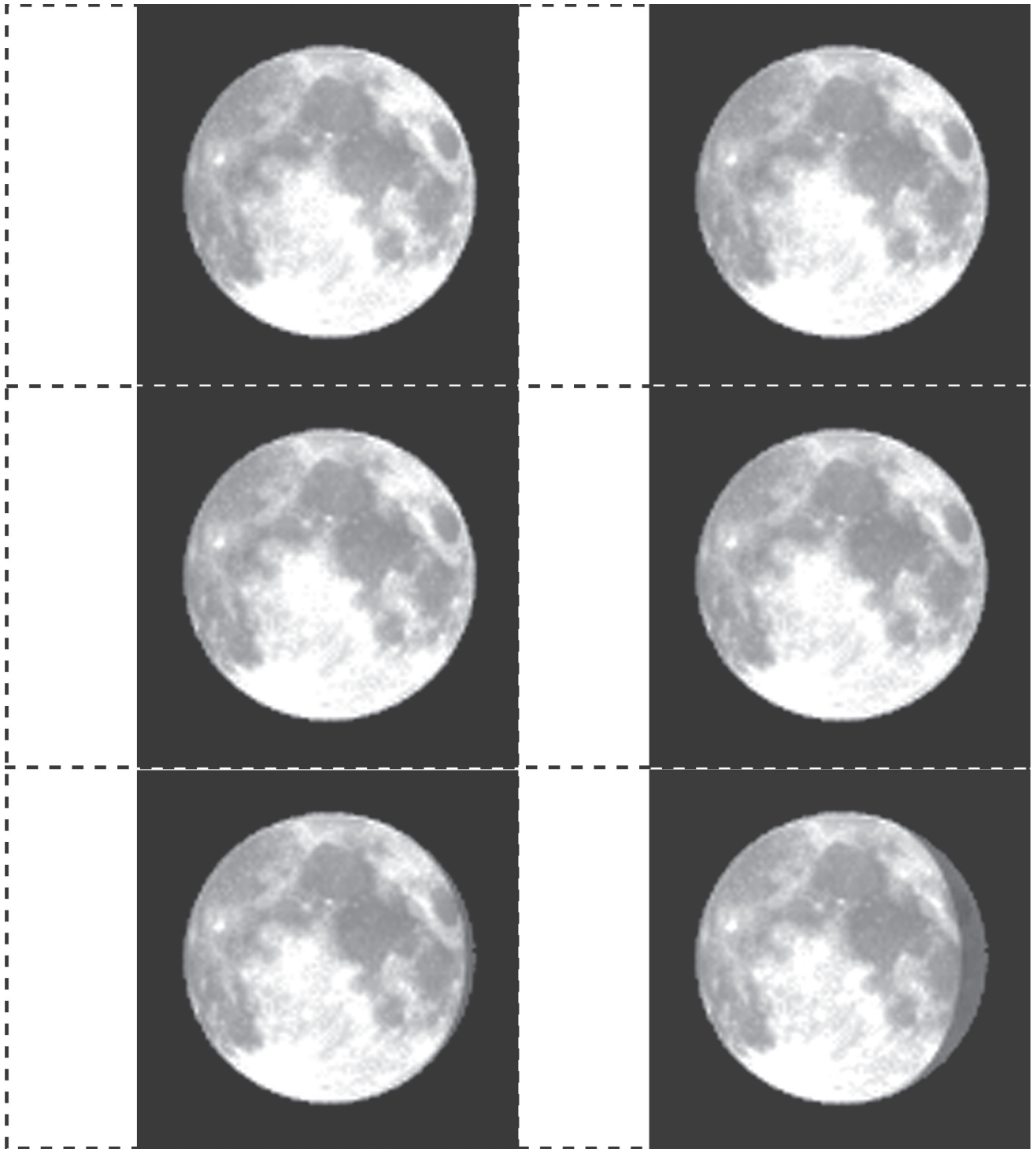
Moon Flipbook (page 1 of 6)



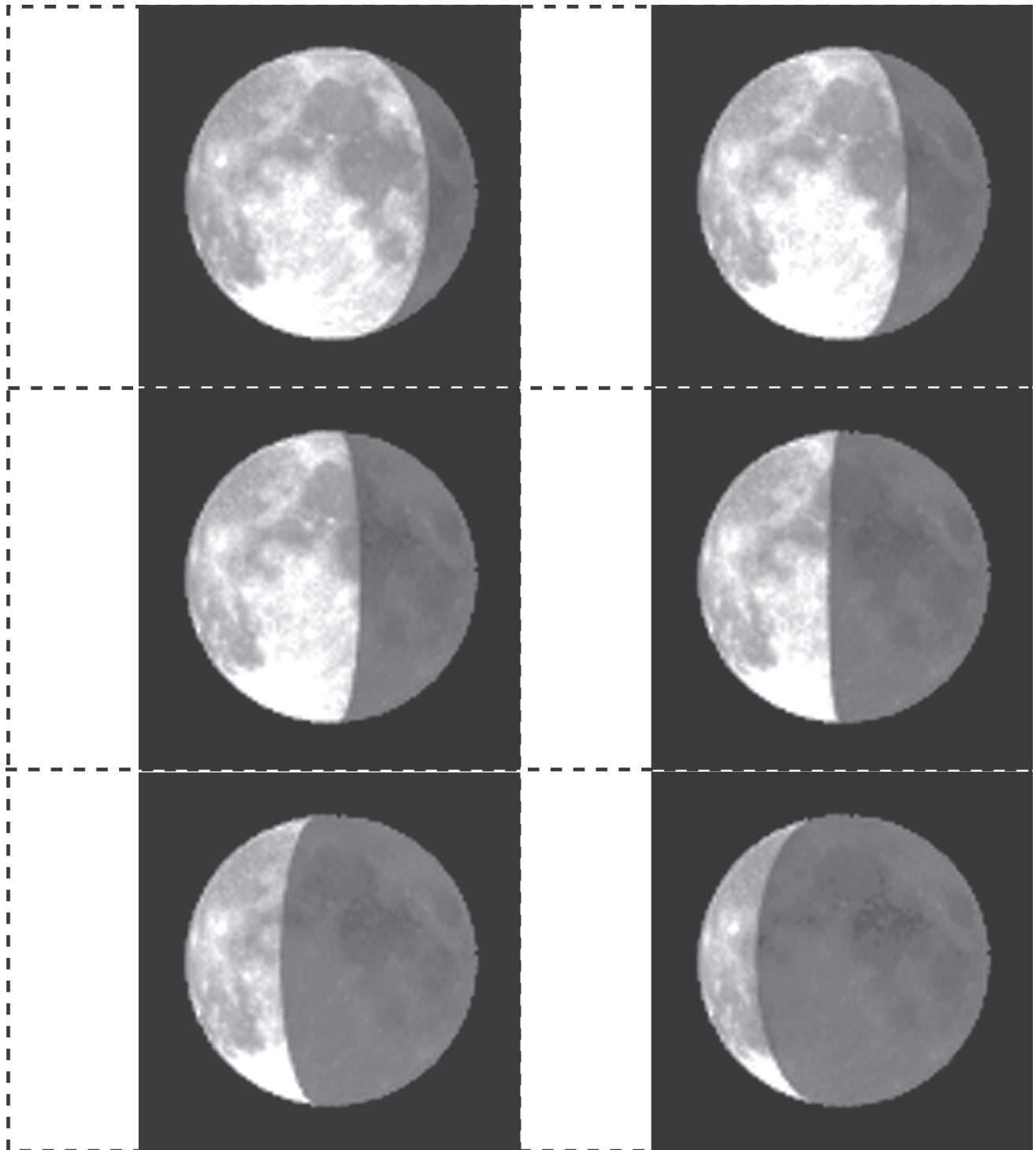
Moon Flipbook (page 2 of 6)



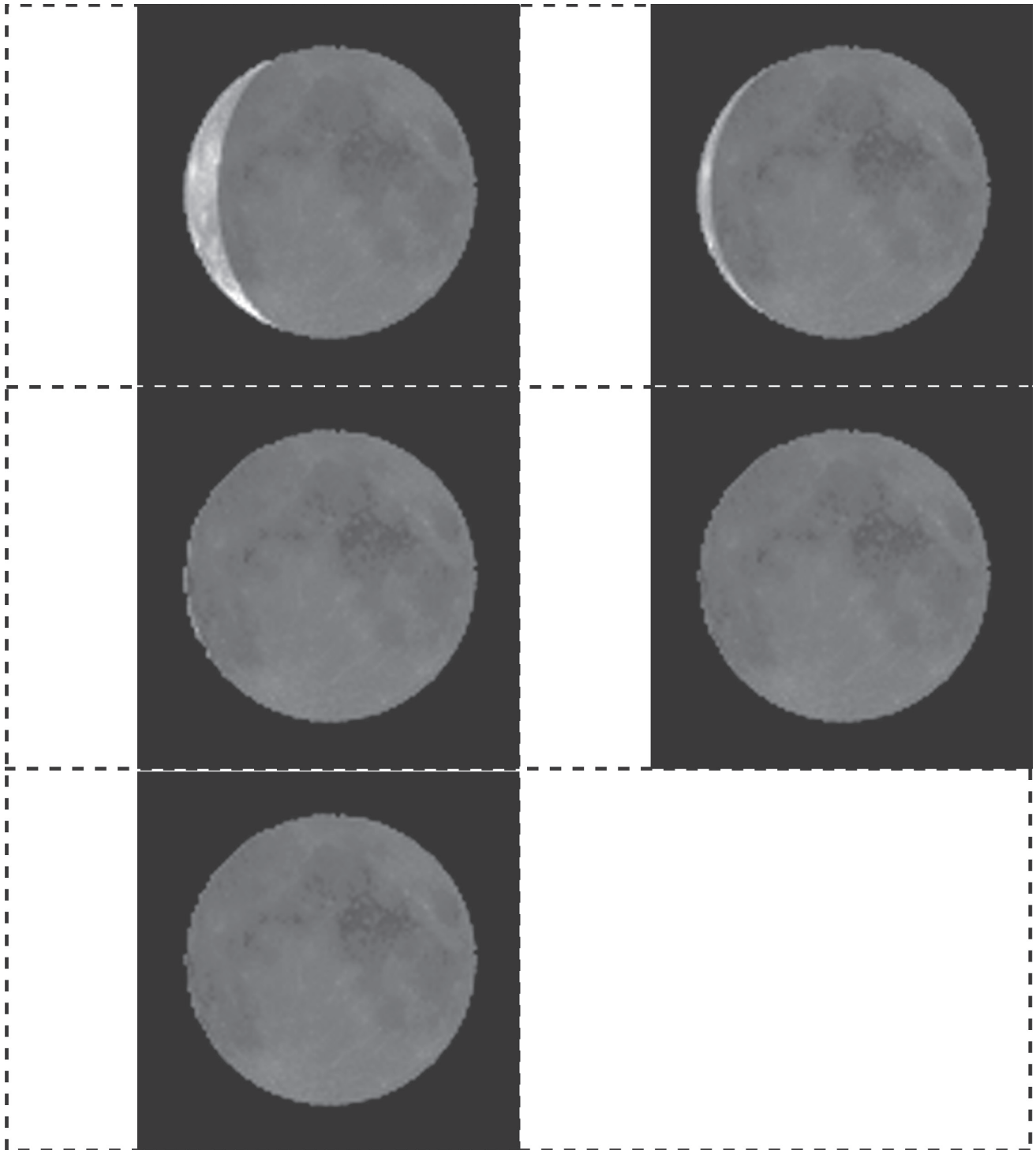
Moon Flipbook (page 3 of 6)



Moon Flipbook (page 4 of 6)



Moon Flipbook (page 5 of 6)



Moon Flipbook (page 6 of 6)

Modeling a Year Challenge Cards

Directions: Duplicate the challenges below and attach them to index cards. Place the cards in the Science Center after Lesson 19. Place blank index cards in the Science Center for the children to write their own challenges on. Put a world globe and a light or ball in the Science Center for the children to use to model the sun.

Place the globe in the correct position in its orbit for your birthday.	Place the globe in the correct position in its orbit for today.
Place the globe in the correct position for mid-winter. Why is winter colder than summer in the northern hemisphere?	When it is mid-winter in the northern hemisphere, what season is it in South America?
What season is it right now in Europe?	Make up your own challenge for a friend. Write it down on an index card and add it to the stack.

Modeling a Year

1. Place the light or ball that you're using to model the sun on a table.

2. Hold the globe of the world on its mounted base. Locate the North Pole. If you hold the globe so that the base is flat, the North Pole should be pointing slightly away from the ceiling.



3. Holding the globe so the North Pole is always pointing in the same direction, walk around your sun counter-clockwise in a circle.



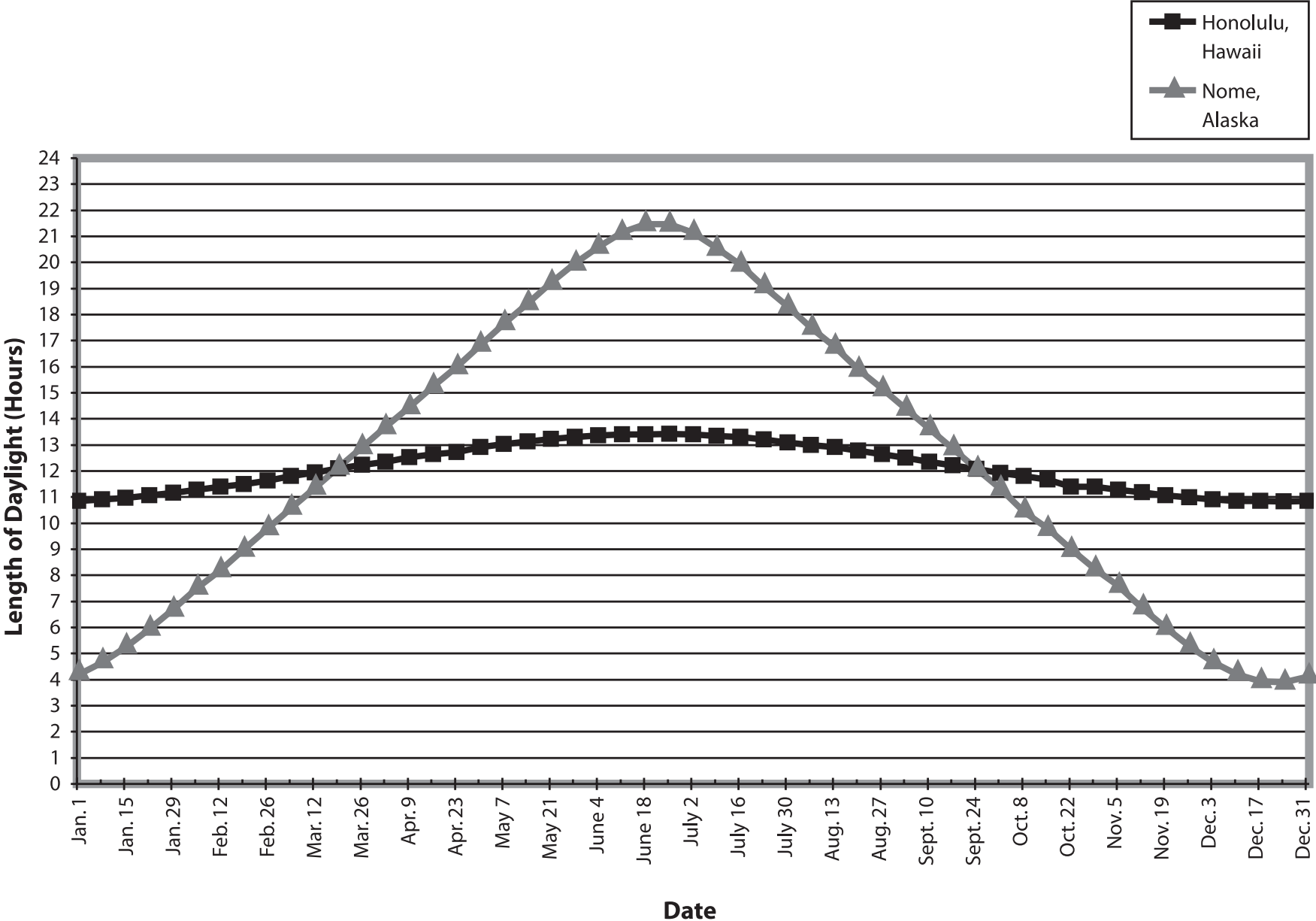
4. Stop when the North Pole is pointed as far from the sun as it can (while you're still holding the base of the world globe flat). That is mid-winter (December) in the northern hemisphere.



5. Walking counter-clockwise, go halfway around the sun, so that the North Pole is pointed as close to the sun as it can (while you're still holding the base of the world globe flat). That is mid-summer (June) in the northern hemisphere.



Comparing Length of Daylight



Name: _____ Date: _____

Science Center

Make Your Own Scale Model

Using the information on the Family Link Fact Sheet, "Notes about Size and Distance," make your own scale model of Earth, the moon, and the sun.

Earth

For Earth I would use _____.

The diameter of this object is about _____.

(Remember to include units of measurement.)

Moon

The diameter of the moon is about one-fourth of the diameter of Earth.

$$\frac{\text{Earth's diameter in model}}{\text{moon's diameter in model}} \div 4 = \text{_____}$$

For the moon I would use _____.

The distance from Earth to the moon is about 30 Earth-lengths.

$$\frac{\text{Earth's diameter in model}}{\text{distance between Earth and moon in model}} \times 30 = \text{_____}$$

Sun

The diameter of the sun is about 109 times of the diameter of Earth.

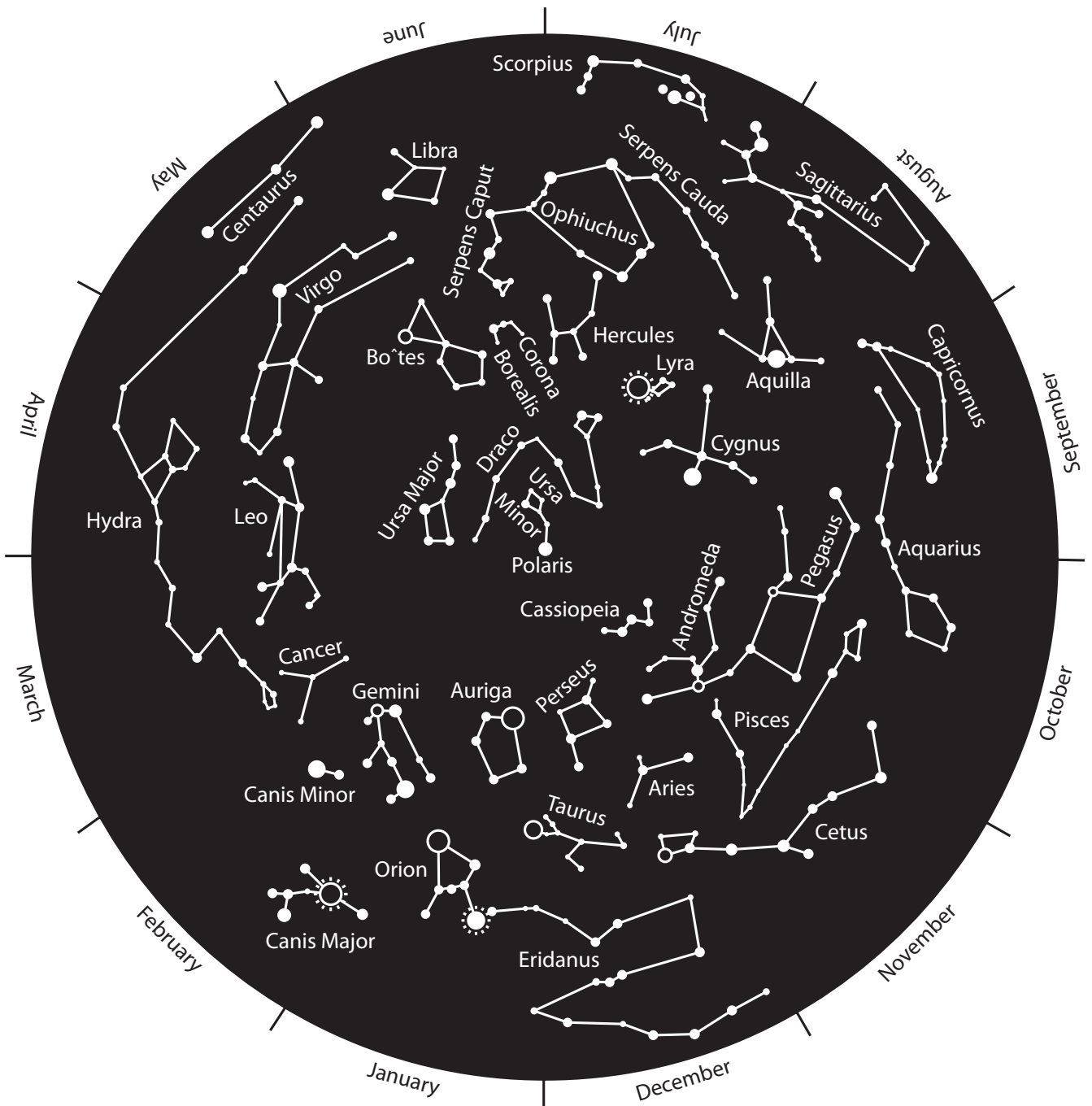
$$\frac{\text{Earth's diameter in model}}{\text{sun's diameter in model}} \times 109 = \text{_____}$$

For the sun I would use _____.

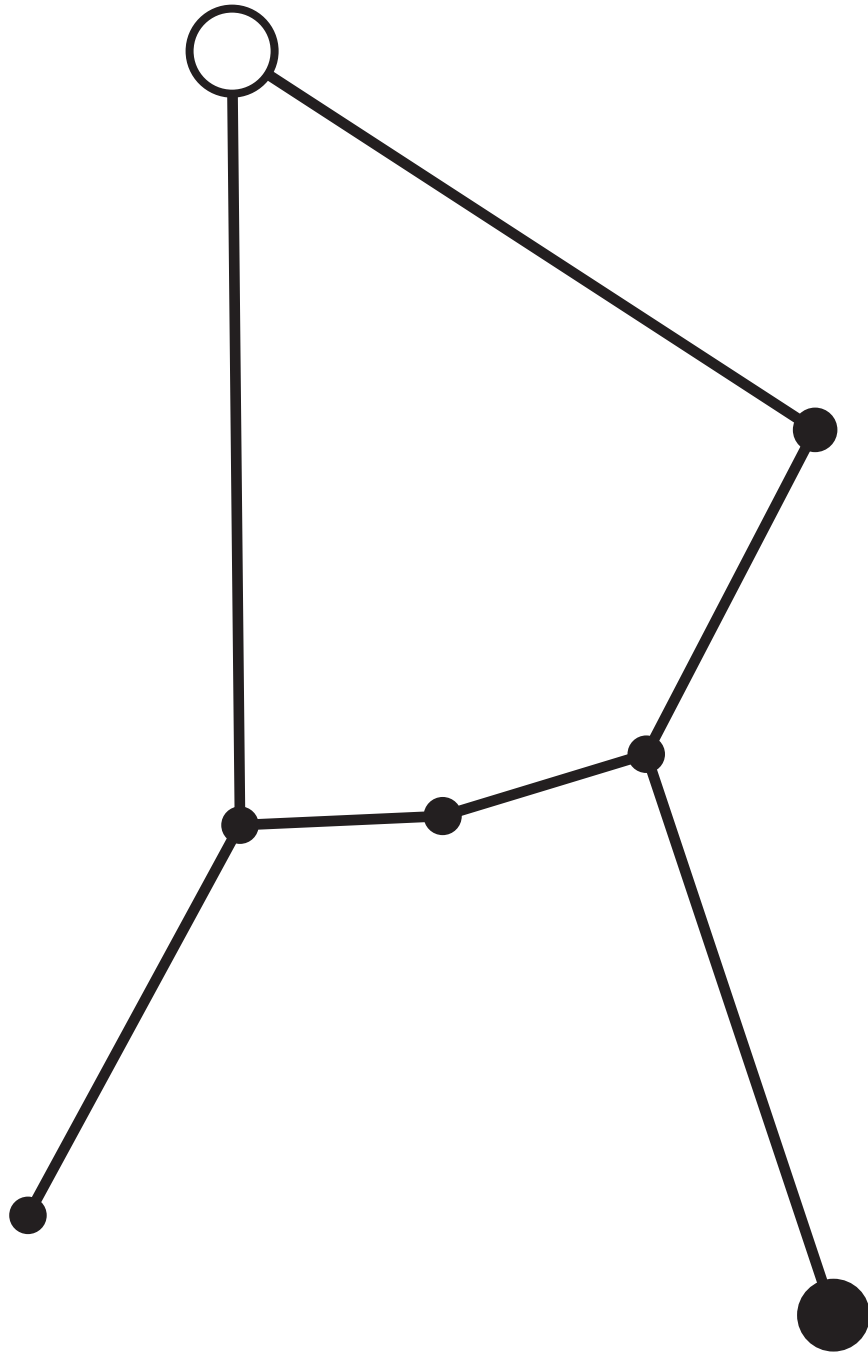
The distance from Earth to the sun is about 108 sun-lengths.

$$\frac{\text{Sun's diameter in model}}{\text{distance between Earth and sun in model}} \times 108 = \text{_____}$$

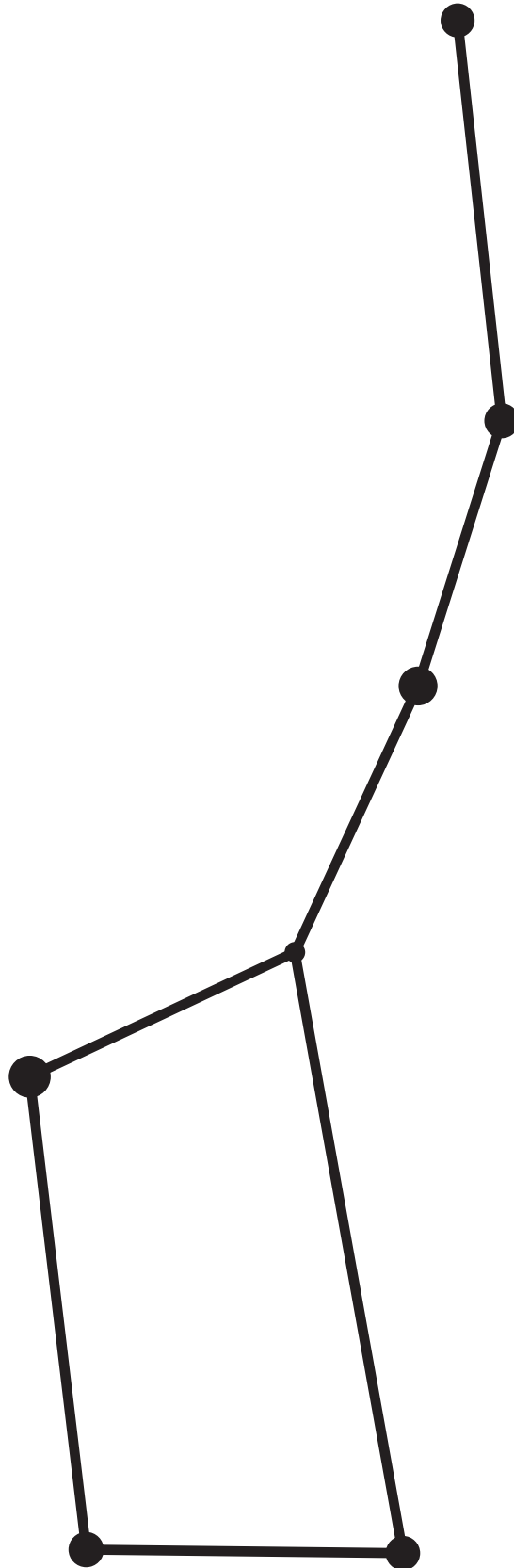
Star Chart for the Northern Hemisphere



Orion



Ursa Major (Big Dipper)



Making a Constellation Viewer

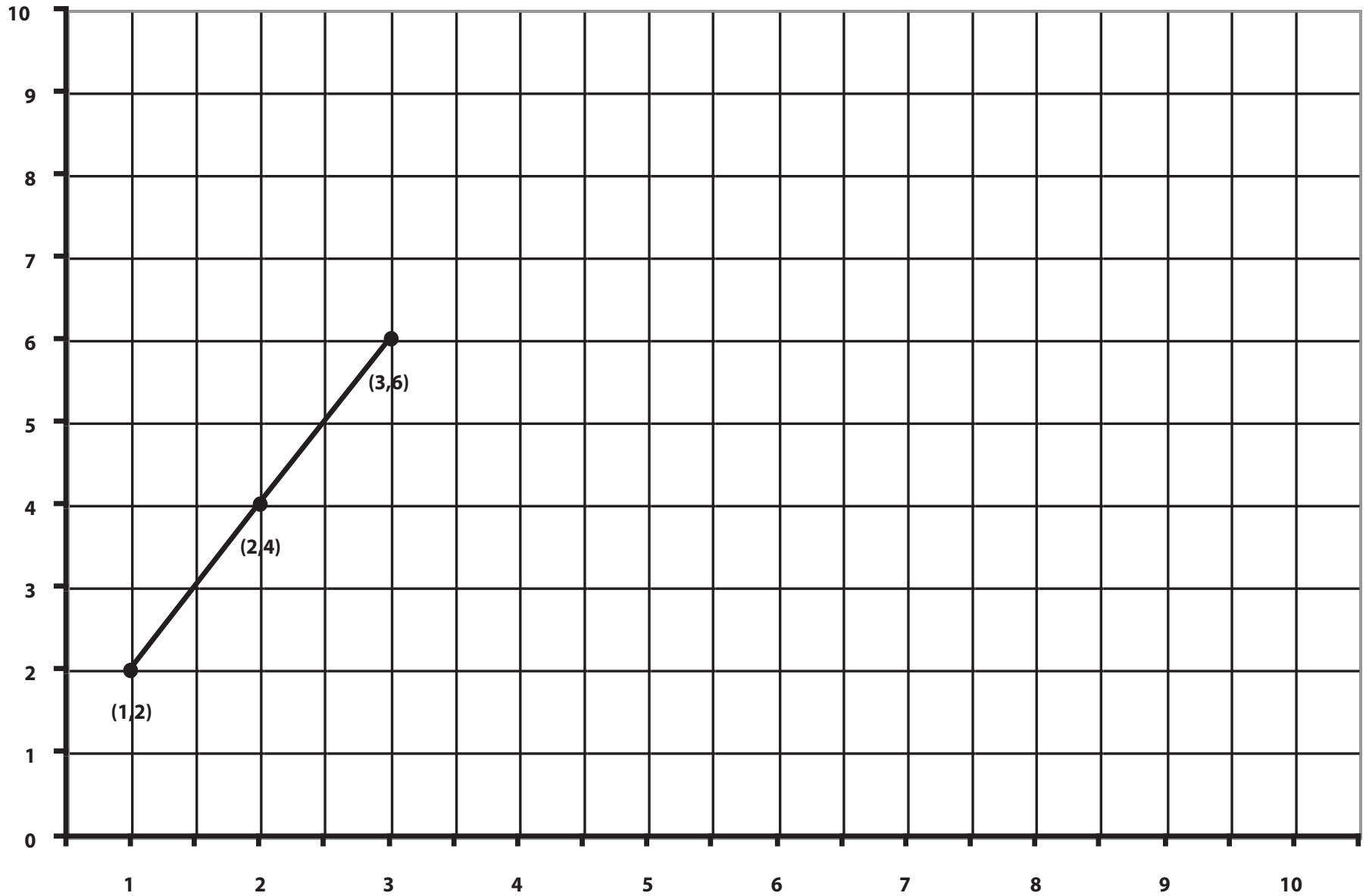
Directions:

1. Place the black construction paper on top of the cardboard or foam board.
2. Place the paper showing Orion or the Big Dipper on top of the black construction paper.
3. Use a nail, pin, or sharp pencil to poke through all of the dots that are supposed to be stars. Poke holes through the top paper and through the black construction paper below.
4. Remove the white paper showing the constellation. Make sure the holes are round and go all the way through the black construction paper.
5. Tape the black paper over one end of an open can, so that the area with holes representing the constellation covers the opening.
6. Put a flashlight into the other, open end of the can, and turn it on in a dark room.

Scale of Our Solar System

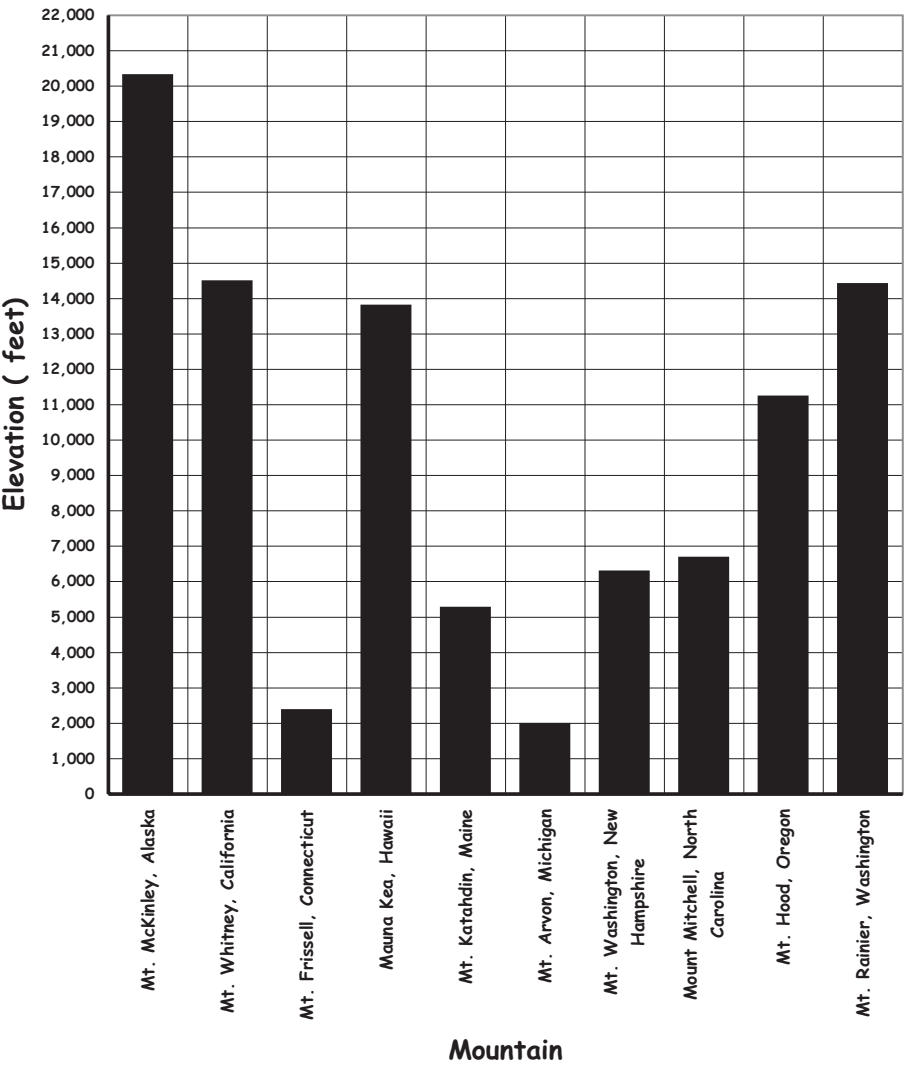
Scale: 1 in = 300,000 miles	Model Distance	Paces Between Orbits of Planets (If your pace is not 3 ft/step)		Paces Between Orbits of Planets		Actual Distance	Actual Distance
	(feet)	1 pace = ____ ft/step		1 pace = 3 ft/step		(miles)	(kilometers)
		Cumulative Paces	Paces Between	Cumulative Paces	Paces Between		
Sun	0	0		0		0	0
					4		
Mercury	12			4		36,000,000	58,000,000
					3.5		
Venus	22.5			7.5		67,000,000	108,000,000
					3		
Earth	31			10.5		93,000,000	149,000,000
					5.5		
Mars	47.5			16		142,000,000	227,000,000
					38		
Jupiter	161.5			54		484,000,000	777,000,000
					44.5		
Saturn	295.5			98.5		887,000,000	1,426,000,000
					99.5		
Uranus	594.5			198		1,783,000,000	2,869,000,000
					112.5		
Neptune	932			310.5		2,794,000,000	4,496,000,000

Plotting the Path of the Sun

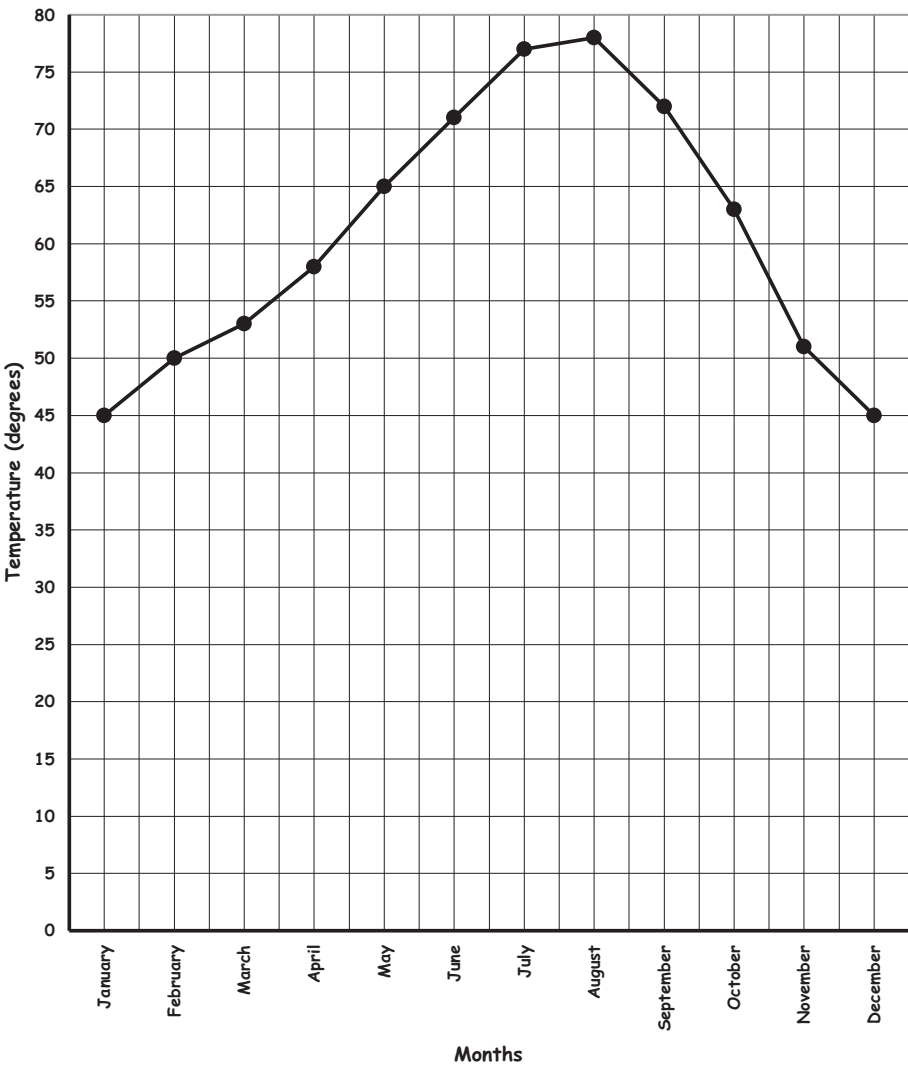


Comparing Graphs

Highest Elevations by State



Average High Temperatures, Mt. Rainier



Graphing the Height of a Fern

The chart below lists a fern's height, in centimeters, at the end of each month from January 2012 to June 2013.

5	7	10	15	20	30	45	53	59	65	68	70	70	72	75	80	86	95
Jan 2012	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan 2013	Feb	Mar	Apr	May	Jun

This image shows a full page of blank graph paper. It features a consistent grid of small squares formed by thin black lines. The grid covers the entire area of the page, providing a structured space for drawing or writing. There are no margins, text, or other markings present.

Science Center

Elapsed Time Challenge Cards

Directions: Duplicate the challenges below and attach them to index cards. Write the answers on the back of the cards. Place the cards in the Science Center after Skill Building Activity "Elapsed Time." Place blank index cards in the Science Center for the children to write their own challenges on. Put a clock and calculator in the Science Center to help the children solve the problems.

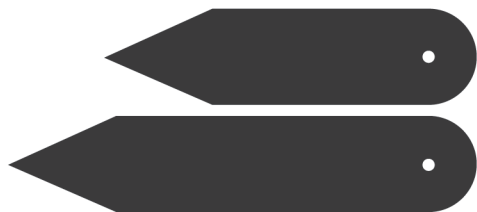
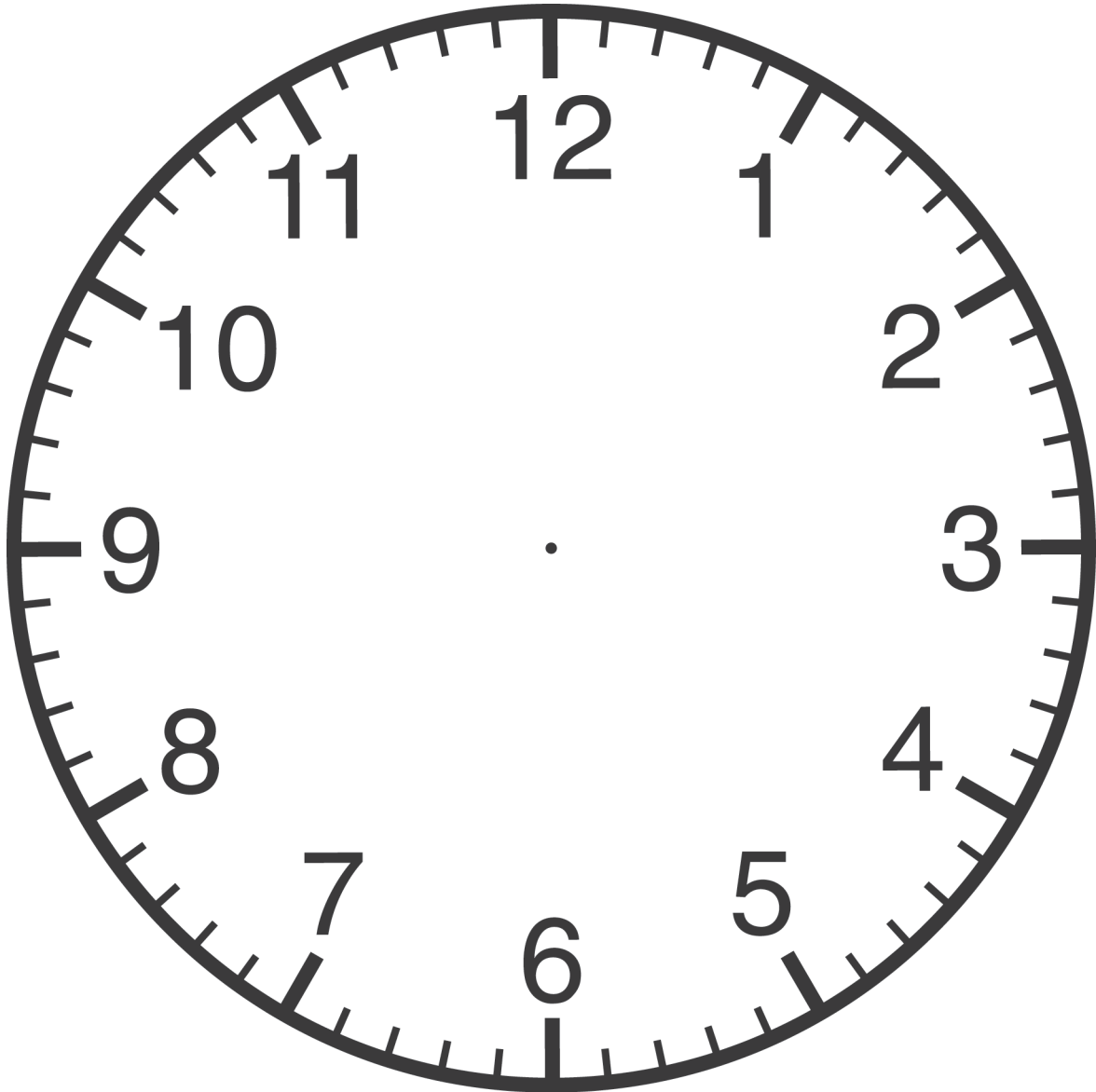
Jimmy practiced football from 8:00 A.M. until 10:15 A.M. How many hours did he practice?	Kelly leaves her house at 10:05 A.M. and returns at 5:25 P.M. How long has she been gone?
Andy sailed his boat to an island off the coast. He began sailing at 9:15 A.M. and arrived at 4:50 P.M. How long did it take him to get to the island?	Jamie arrived at work at 8:10 A.M. She left at 5:25 P.M. How long was she at work?
Samantha got on a bus at 9:20 A.M. She got off the bus at 11:00 A.M. How long was she on the bus?	Make up some problems for a friend to solve. Write them down on index cards or on one of the blank pages in your science notebook so that others can try them out.

Answers:
2 hours, 15 minutes
7 hours, 35 minutes
1 hour, 40 minutes

7 hours, 20 minutes
9 hours, 15 minutes

Paper Clock

Directions: Cut out the clock face, the minute hand, and the hour hand. Punch a hole through the center of the clock face and through the circles on the hands. Fasten the hands to the clock face with a brad.

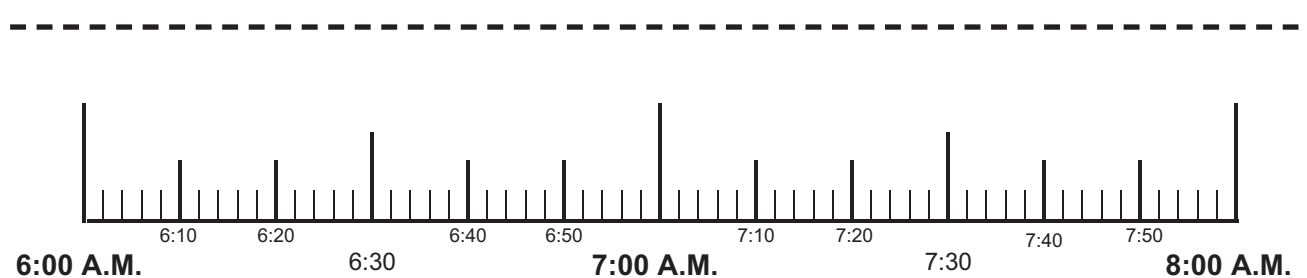
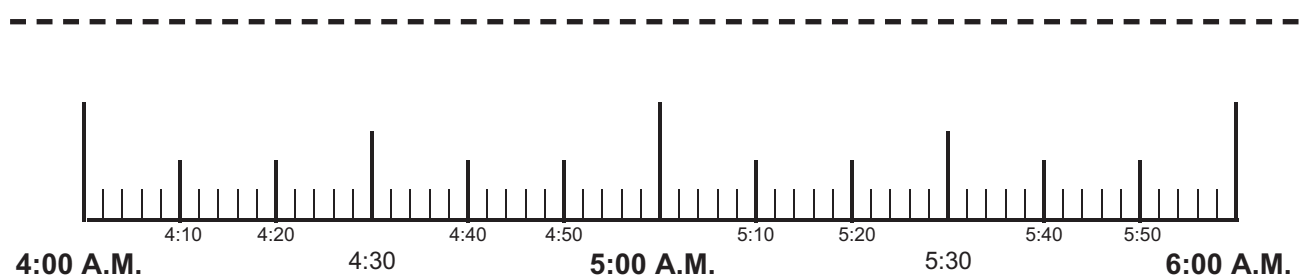
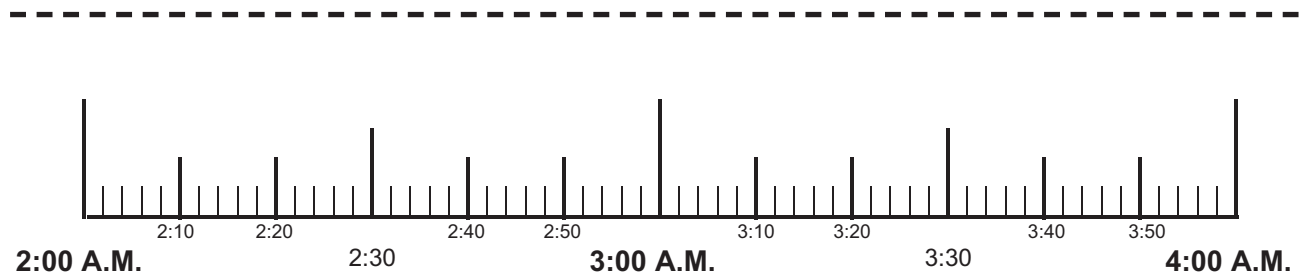
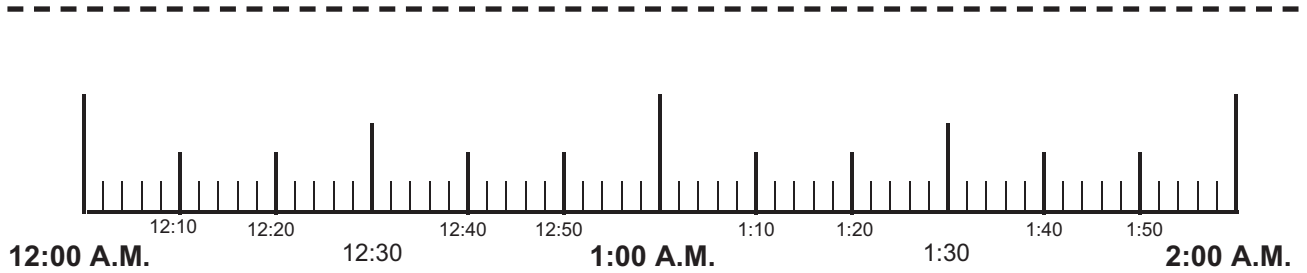


a brad

Time Line

(Page 1 of 3)

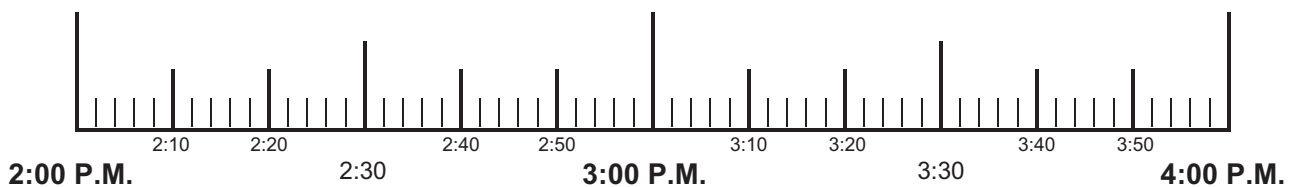
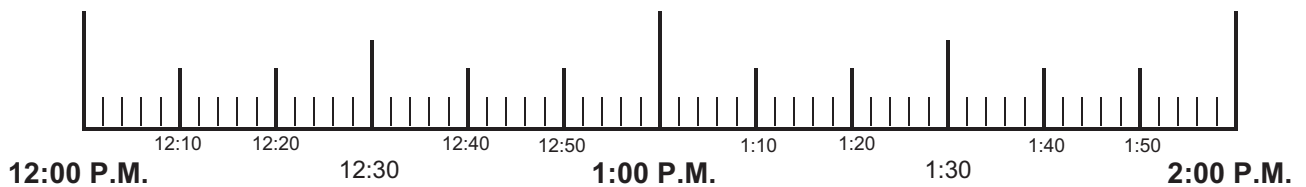
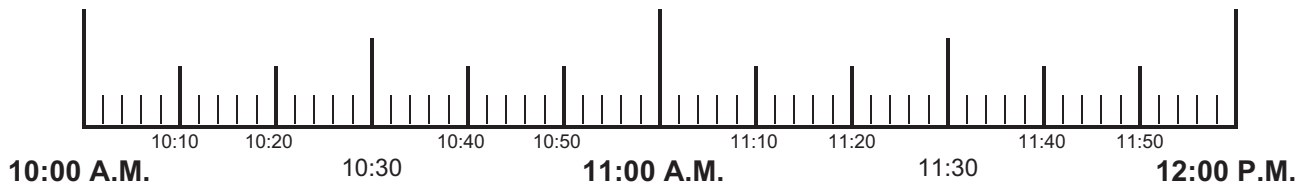
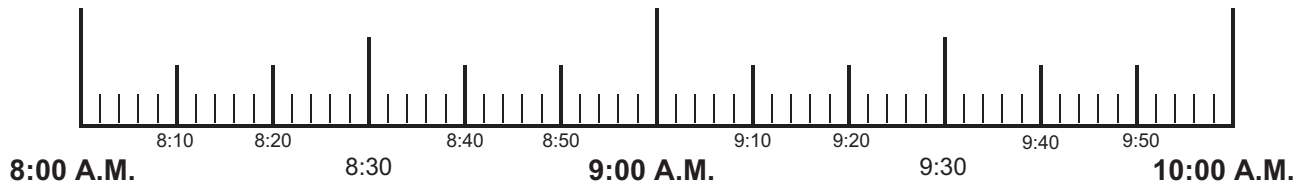
Directions: Cut out each strip and tape them together to form a continuous, 24-hour time line.



Time Line

(Page 2 of 3)

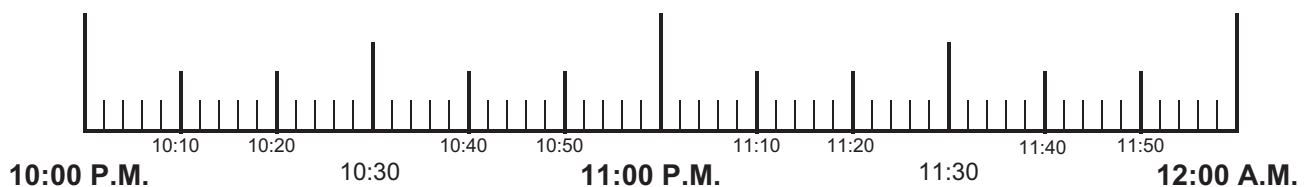
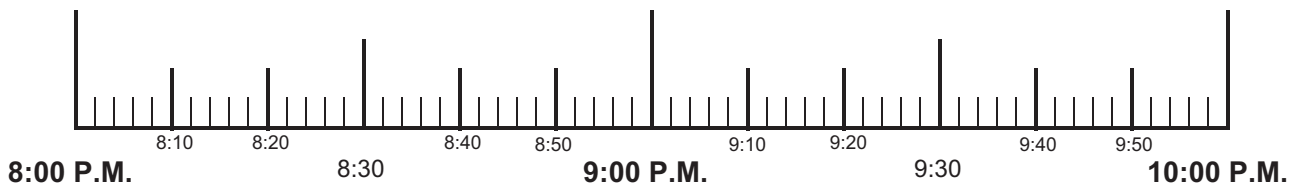
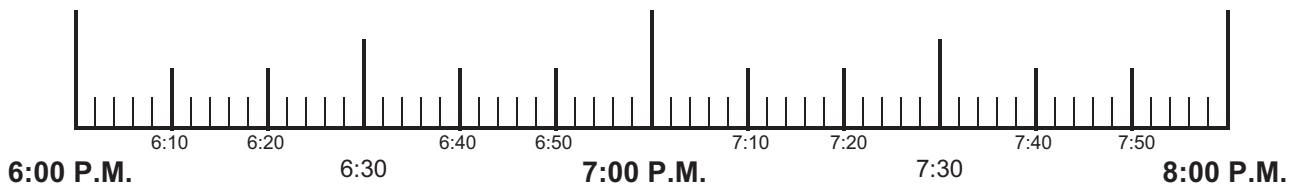
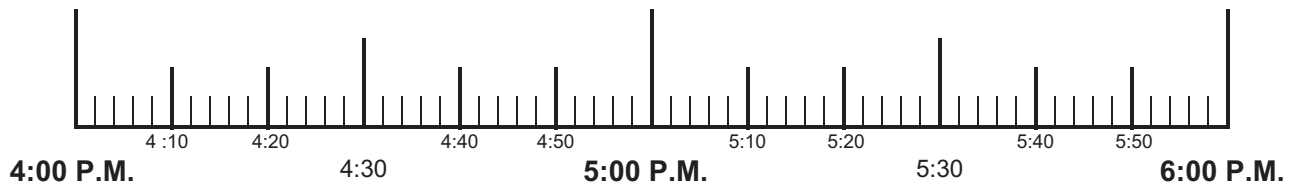
Directions: Cut out each strip and tape them together to form a continuous, 24-hour time line.



Time Line

(Page 3 of 3)

Directions: Cut out each strip and tape them together to form a continuous, 24-hour time line.



Which Battery Lasts the Longest?

A scientist wanted to determine which brand of batteries lasted the longest. She tested 10 different brands of batteries by placing them in identical flashlights, turning on each flashlight and leaving it on until the flashlight stopped working. Listed below are the times the flashlights were turned on and when they stopped working. For each sample, calculate how much time elapsed before the batteries no longer worked.

Battery Sample Number	Time Flashlight Turned On	Time Flashlight Stopped	Elapsed Time:
Sample 1	7:00 A.M.	11:00 A.M.	
Sample 2	7:05 A.M.	11:35 A.M.	
Sample 3	7:10 A.M.	11:45 A.M.	
Sample 4	7:10 A.M.	12:50 P.M.	
Sample 5	7:10 A.M.	2:10 P.M.	
Sample 6	7:15 A.M.	2:05 P.M.	
Sample 7	7:15 A.M.	11:45 A.M.	
Sample 8	7:20 A.M.	4:30 P.M.	
Sample 9	7:20 A.M.	3:25 P.M.	
Sample 10	7:20 A.M.	6: 55 P.M.	

Name: _____ Date: _____

Family Link with Science—Homework

Looking at the Nighttime Sky

*Your child is beginning to study our **solar system** in science.*

With a family member, observe the nighttime sky on a clear night.

1. What interesting things do you observe in the sky?
2. An hour later than your first observation, do you think the sky would look the same or different? Why?
3. If you get a chance, make a second observation an hour later on the same night. Does the sky look the same or different? Why?

Please complete this assignment for science class.

Name: _____ Date: _____

Family Link with Science—Homework

Reflecting on Models of Daytime and Nighttime

Your child is studying models of the sun's daily pattern in the sky. Today the class created models of what makes daytime and nighttime. In the next lesson, they're going to think about the models that scientists use to explain the same phenomenon.

Describe to a family member the model that your group designed in class.

1. How did your group's model explain day and night?
2. Did seeing other group's models change your ideas about what makes day and night? How?

Please complete this assignment for science class.

Family Link with Science—Fact Sheet

Useful Words for Solar System Models

axis If you took a ball (or **sphere**) and stuck a stick through the middle of it, the stick would be an axis of the ball. You could spin the ball around the axis.

The axis of Earth is slightly tilted in relationship to its orbit around the sun. So when you see a mounted globe of Earth, and it's tilted, that represents the tilt of Earth on its axis.

diameter The diameter of a sphere is the measurement across the sphere at its widest point. The diameter always goes through the center of the sphere.

Comparing the diameters of spheres is not the same as comparing their volume. For example, the diameter of a racquetball is about one quarter the diameter of a basketball. But if you put them side by side, the racquetball looks much smaller than one quarter of a basketball. The same idea applies to the moon, which has a diameter about one quarter of Earth's.

orbit The path a planet travels around the sun is the planet's orbit. The path the moon travels around Earth is the moon's orbit.

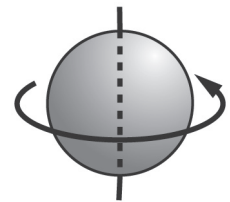
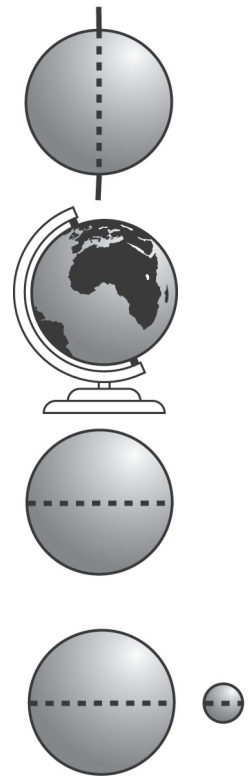
The shape of Earth's orbit is an ellipse that is almost a circle. Pictures in books that show Earth orbiting the sun in a long, flat ellipse are misleading.

It takes one year for Earth to orbit the sun. It takes a little less than a month for the moon to orbit Earth.

rotation A rotation is one spin of a sphere around its axis.

It takes one day for Earth to make one rotation. Earth rotates between 365 and 366 times during one orbit around the sun.

The moon rotates more slowly. It takes the same time for the moon to make one rotation as it takes the moon to orbit the Earth (a little less than a month). That is why we only see one side of the moon from Earth.



Name: _____ Date: _____

Family Link with Science—Homework

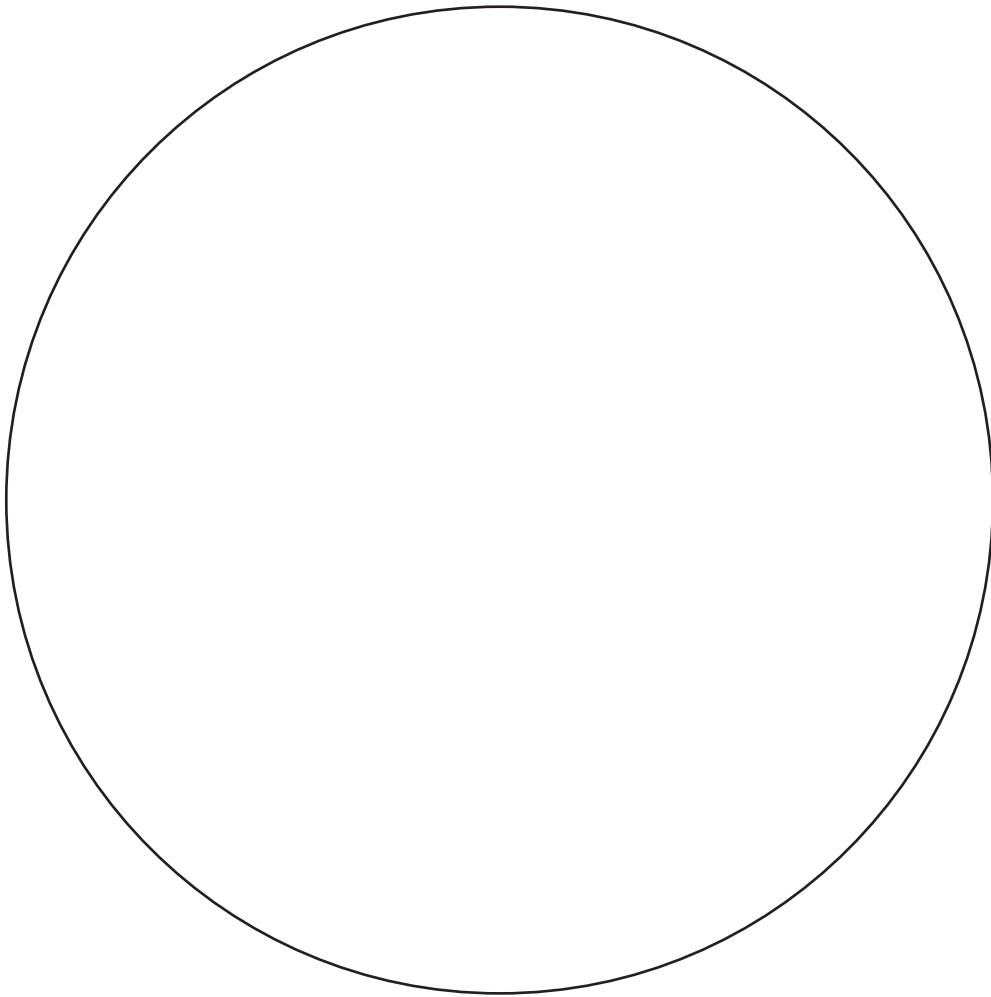
Drawing the Moon's Shape

Your child is learning about the moon in science class.

Look for the moon on this date: _____

It will be visible between _____ and _____.

When you see the moon, record its shape below. Color the light side of the moon yellow. Color the dark side black.



Please complete this assignment for science class.

Name: _____ Date: _____

Family Link with Science—Homework

The Moon's Position in the Sky

Your child is learning about the moon in science class. Observing the moon from home is an important part of learning about this topic.

1. Face the moon, and take note of where you are standing or sitting.
2. Draw a few landmarks on the next page to help you track the moon's position in the sky.
3. Neatly draw the moon's position in the sky and write the time of your observation next to the moon.
4. Return to exactly the same observation post an hour or so later. Draw the moon's position again. Write your observation time again.
5. Repeat as many times as you are able to in one day or evening.

Please complete this assignment for science class.

Family Link with Science—Homework

The Moon's Position in the Sky

Family Link: The Moon's Position in the Sky (Lesson 9)

Our Solar System Teacher Master 55

Name: _____ Date: _____

Family Link with Science—Homework

Watching the Moon

Your child's class is observing the moon for one month. The children are divided into groups and each group is assigned to observe the moon and gather data about it for one week, until the class collects one month's data. Your child has been assigned to collect data on these dates: _____ . The moon will be visible from _____ to _____ on those dates.

Encourage your child to look for the moon and draw its shape on the days when it is visible, even if he or she is not assigned to collect data for the class on those days.

Sometimes you can see the moon in the daytime, and sometimes you can see it at night. Make a special effort to look for the moon on the dates when you are assigned to collect data for the whole class.

When you see the moon, record its shape on the "Home Moon Observations" table.

- Find the square for the right date.
- Color the light side of the moon yellow.
- Color the dark side black.

If the moon is not visible, write "not visible" or "NV" for that date.

Please complete this assignment for science class.

Name: _____

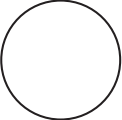
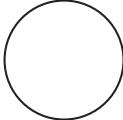
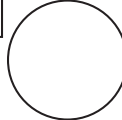

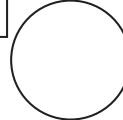
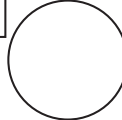

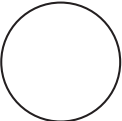
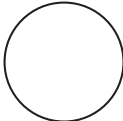
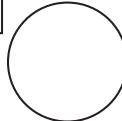

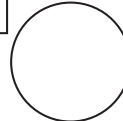


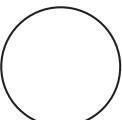
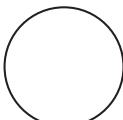





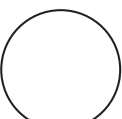
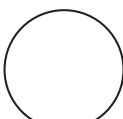





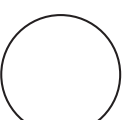
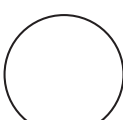





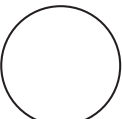
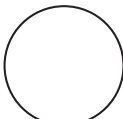
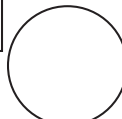
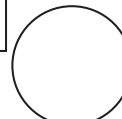
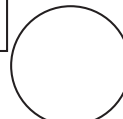
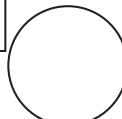

Date: _____

Home Moon Observations

Month(s) _____

Year _____

Draw the shape of the moon as you see it each day.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
						
						
						
						
						
						

Name: _____ Date: _____

Family Link with Science—Home Activity

Magnifying the Moon

Your child's study of the moon in science class continues. This activity can teach a lot about the nature of the moon, but make sure it happens after the sun goes down. (Looking at the sun with binoculars can cause permanent and serious eye damage.)

If you have a set of binoculars, go outside after the sun goes down and look at the moon with the binoculars. What do you see?

Write some notes and draw some pictures.

This activity is optional.

Family Link with Science—Fact Sheet

Waxing Moon, Waning Moon

After a month of observing the moon, your child's science class has detected some patterns in the moon's cycle.

A *waxing* moon:

- In this context, waxing means “to grow.” During this time the moon is between the new and full phases. More of the moon is visible every day. The curve of illuminated moon is on the right.

A *waning* moon:

- In this context, waning means “to become smaller, weaker, dimmer, or fainter.” During this time the moon is between the full and the new phases. Less of the moon is visible every day. The curve of illuminated moon is on the left.

Three ways to tell a waxing moon from a waning moon:


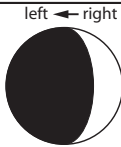

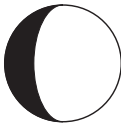
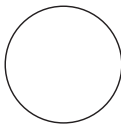


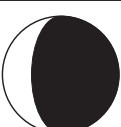

1. If the moon is *waxing*, the illuminated part is on the *right*. (“The moon is filling *right* up.”)
If the moon is *waning*, the illuminated part is on the *left*. (“Nothing’s *left*.”)
2. Make the letters “b” and “d” with your hands in the air.
 - “b” is for baby moon (the *waxing* moon loops to the *right*)
 - “d” is for dying moon (the *waning* moon loops to the *left*)
3. Remember this rhyme:
Right side bright, baby moon tonight.
Right side dark, dying moon’s mark.

Name: _____ Date: _____

Family Link with Science—Fact Sheet

The Moon's Cycle

After a month of observing the moon, your child's science class has detected some patterns in the moon's phases. This is a reference sheet for the moon's monthly cycle.

	New Moon: Not visible, unless with Earthshine. (Earthshine is sunlight that reflects off of Earth and shines on the moon.) In its orbit around Earth, the moon comes between the sun and Earth, so that the side of the moon facing the sun is lit, but the side facing Earth is dark. The new moon usually rises and sets with the sun and is directly overhead at noon.
	Waxing Crescent Moon
	First Quarter Moon: Named because the moon has completed the first quarter of its trip around Earth. The first quarter moon occurs six to eight days after the new moon, and is directly overhead at sunset.
	Waxing Gibbous Moon
	Full Moon: The full circle of the moon is visible, lit by reflected sunlight on the moon's side facing Earth. It appears about two weeks following the new moon, and is directly overhead at midnight.
	Waning Gibbous Moon
	Third Quarter Moon: Named because the moon has completed the third quarter of its trip around Earth. The third quarter moon occurs about three weeks after the new moon and one week after the full moon. It rises around midnight, is directly overhead at sunrise, and sets around noon the following day.
	Waning Crescent Moon
	New Moon: Appears four weeks (or, more precisely, 29.5 days) after the previous new moon. The reappearance of the new moon marks one lunar cycle.

Name: _____ Date: _____

Family Link with Science—Homework

Reflecting on Models of the Moon's Cycle

Your child is learning about the moon's cycle. Today the class used a model that demonstrates scientists' explanation of the cause of the moon's cycle.

Think about what you learned in class about the cause of the moon's cycle. Create a model at home that explains the moon's cycle and share your model with a family member.

Describe the model you designed at home.

Please complete this assignment for science class.

Family Link with Science—Home Activity

Sun Catcher

Your child has been observing how the sun's apparent position changes during the day. Help your child demonstrate how the sun appears to travel across the sky by making a simple "sun catcher." Tell your child that after recording the sun's position on the piece of white paper throughout the day, they will see an arc. Remind them never to look directly at the sun.

1. In this envelope you will find the following:
 - One 4" x 4" card with a hole in the center
 - One 8.5" x 11" sheet of plain white paper
 - One piece of chalk
2. Find a flat, paved area that will receive sunlight throughout the day.
3. Put the sheet of paper on the ground, and outline it with the chalk. You will need to use this same spot each time you make an observation.
4. Place the file card in the center of the white paper and trace its outline. You will need to put the file card in this spot each time you make an observation.
5. Lift the file card about 6 inches straight up from the white piece of paper.
6. You will see a spot from the sun on the white piece of paper. Have another person mark that spot with a pencil and record the time of day next to the spot.
7. Repeat this procedure at least three more times during the day. Make sure your observations are at least 90 minutes apart.

This activity is optional.

Name: _____ Date: _____

Family Link with Science—Home Activity

Predicting Solstices

Your child has been studying sunrise and sunset times, and the length of daylight during the day. After graphing the information collected throughout the year, we have predicted what will happen during the summer solstice and the winter solstice. As a family, check the accuracy of these predictions by either looking at one of the web sites listed in the *Family Link Notebook*, or referring to the newspaper on the actual days the summer and winter solstices occur.

Predicted Times

SUMMER SOLSTICE	WINTER SOLSTICE
Date_____	Date_____
I predict the sun will rise at _____a.m.	I predict the sun will rise at _____a.m.
I predict the sun will set at _____p.m.	I predict the sun will set at _____p.m.
I predict daylight will be _____hours _____minutes.	I predict daylight will be _____hours _____minutes.

Actual Times

SUMMER SOLSTICE	WINTER SOLSTICE
The sun rose (or will rise) at _____a.m.	The sun rose (or will rise) at _____a.m.
The sun set (or will set) at _____p.m.	The sun set (or will set) at _____p.m.
Daylight is (or will be) _____hours _____minutes.	Daylight is (or will be) _____hours _____minutes.

How accurate were your predictions?

This activity is optional.

Name: _____ Date: _____

Family Link with Science—Homework

Reflecting on the Length of Daylight

Your child is studying the solar system in science class. Today in class they modeled Earth's orbit around the sun and discussed how the amount of daylight we receive and the position of the sun, as seen from Earth, changes throughout the year.

Share with a family member your first idea about why there is more daylight in summer and less daylight in winter.

Are your ideas the same or different after today's lesson?

If they are different, what are your ideas now?

If they are the same, why have they not changed?

Please complete this assignment for science class.

Family Link with Science—Home Activity

Photograph an Illusion of Scale

Your child is studying the scale of the solar system in science class. Today in class, your child learned that because the sun is much farther away than the moon is from Earth, the sun and moon appear to be the same size in the sky.

Photographers and filmmakers sometimes use the same sort of illusion (called “forced perspective”) to make people or things look larger or smaller than they really are. For example, in the movie “The Lord of the Rings,” the actor playing the wizard, Gandalf, sits several feet closer to the camera than the actor playing the hobbit, Frodo. To a movie viewer’s eyes, it looks as if they are sitting opposite each other at a table or next to each other on a cart, and as if Frodo is much smaller than Gandalf.

Try taking photographs that make this illusion. You will need a no-flash camera and an outside location with a plain, uncluttered background (such as a grassy field or an empty parking lot). The photographs work best when the models are positioned below the horizon line. The photographer will look through the camera’s viewfinder, and use hand signals until the illusion looks right.

Here are some ideas:

- Make a doll look like a child’s same-sized friend. Stand the doll close to the photographer, and have the child stand far behind it until he or she appears to be the same height as the doll.
- Make a child look like a “tiny person” being chased by a giant insect or other animal. Put the toy insect or other animal close to the photographer, and have the child pose “in alarm” far behind it.
- Make a child look like a “tiny person” standing on top of the earth. Put a globe close to the photographer, and have the tiny person stand far behind it.
- Make a child look like a “tiny person” standing inside a high-top shoe, toy dump truck, flowerpot, or other container. Put the container close to the photographer, and have the tiny person stand far behind it. The photographer needs to be at eye-level with the container, so that the camera doesn’t show the container’s inside.

Name: _____ Date: _____

Family Link with Science—Fact Sheet

Notes about Size and Distance

Your child is studying scale models of Earth, the sun, and the moon. Today in class, they used familiar objects to compare the sizes of the sun, the moon, and Earth, and to try to comprehend the huge distances between them.

Comparing Earth and the Moon

Say you had a globe of the world that was one foot across. The moon has a diameter of about one-quarter of Earth's diameter. So if Earth were a foot across, the moon would be about 3 inches across, or the size of an apple.

The moon is about 30 Earth-lengths away from Earth. So if one person held the globe and the second held the apple, you'd need to stand 30 feet apart to model the correct distance. That's about the height of a two- or three-story building, or about 10 steps along the ground.

Comparing Earth and the Sun

More than 109 Earths could fit across the sun. So if you were making a scale model with your 1-foot globe, you would need a sphere that was 109 feet across to represent the sun. That's a sun that's wider than the length of a basketball court!

Your 1-foot globe and 109-foot sun-sphere would have to be about two miles apart, or about 108 sun-lengths, to model the distance between Earth and the sun.

Trying a Smaller Model

If Earth were a mustard seed, the moon would be a grain of sand. They would be 2.4 inches apart. If Earth were a mustard seed, the sun would be a basketball with a diameter of about 8.7 inches. The mustard seed-Earth and basketball-sun would need to be nearly 78 feet apart. That's the length of a tennis court!

Name: _____ Date: _____

Family Link with Science—Homework

Star Watching

Your child is studying the stars in science class. To look for stars at night, your child needs to go outside two times with a flashlight and the constellation illustration on the following page.

With a family member, observe the nighttime sky on a clear night, once just after sunset and once just before bedtime.

1. What is the name of a constellation you see?
2. Describe where the constellation is in the sky, relative to some landmarks on the ground.
3. If you get a chance, make a second observation just before bed. Is the constellation in the same place?

Please complete this assignment for science class.

Star Watching

Look for this constellation in the nighttime sky:

Name: _____ Date: _____

Family Link with Science—Homework

Take-Home Star Counter

Your child is studying the stars in science class. This activity helps your child practice estimation, a valuable skill in both science and mathematics.

1. Make sure your envelope holds:
 - One Star Square counter
 - One piece of red plastic wrap
 - One rubber band
 - One homework sheet, “Estimating the Number of Stars”
2. Place the red plastic wrap across a flashlight’s front end, and secure it with a rubber band. This will give you a red-tinted light with which you can read at night.
3. Go outside on a clear night with a family member. Remember to bring a jacket or sweater, your flashlight, this envelope, and a pencil.
4. Take the Star Square counter out of the envelope and hold it up about 30 cm (1 foot) in front of one eye.
5. Count all the stars you can see through the Star Square counter.
6. Record the count on the homework sheet, “Estimating the Number of Stars.”
7. Repeat the count for a total of ten times and complete the homework sheet.

Please complete the enclosed assignment for science class.

Name: _____ Date: _____

Family Link with Science—Homework

Estimating the Number of Stars

Your child is studying the stars in science class. This activity helps your child practice estimation, a valuable skill in both science and mathematics.

With a family member, observe the nighttime sky on a clear night.

1. How many stars do you guess you can see? _____
2. Count the number of stars you can see through the Star Square counter in ten sections of the sky:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

3. Add up the star counts for a total. _____
4. Divide by 10 to get the average. $\div 10$ _____
5. Multiply by 50 to get your estimate. $\times 50$ _____

My Estimate

Each count samples about 1/50th of the sky area. By multiplying your average count by 50, you get an estimate of the number of stars you can see.

Please complete this assignment for science class.

Name: _____ Date: _____

Family Link with Science—Home Activity

Planet Search

Your child is beginning to study the planets in our solar system. Some planets are visible to the naked eye.

If the skies are clear, you can find _____

Did you find it?

Describe what you saw:

This activity is optional.

Name: _____ Date: _____

Family Link with Science—Homework

My Weight on Other Planets

Your child is studying the solar system in science class. Today they began researching information about the planets.

First, choose a row that begins with your weight on Earth in pounds (to nearest 10 pounds).

My Weight on Earth

My Weight on Earth	Mercury	Venus	Mars	Jupiter	Saturn	Uranus	Neptune
100	38	91	38	250	107	93	120
90	34	82	34	225	96	84	108
80	30	73	30	200	86	74	96
70	27	64	27	175	75	65	84
60	23	55	23	150	64	56	72
50	19	46	19	125	54	47	60

Now, make a bar graph that shows your weight on the other planets (to nearest 25 pounds).

My Weight on Other Planets

My Weight	Mercury	Venus	Mars	Jupiter	Saturn	Uranus	Neptune
250							
225							
200							
175							
150							
125							
100							
75							
50							
25							
0							

Please complete this assignment for science class.

Name: _____ Date: _____

Family Link with Science—Homework

Realistic Toys

Your child is going to study scale models at school. Please have your child bring in a toy that represents a real object. They can also bring any of the toy's accessories, if they want. But, please, don't let your child bring any toy that is valuable or irreplaceable.

Bring a realistic toy to school. For example:

- Dolls
- Dollhouse furniture
- Trains
- Train tracks and tunnels
- Cars
- Airplanes
- Plastic horses
- Other animals

Please bring the toy to school on _____.

(Day and date)

Please complete this assignment for science class.