

Topic: Day 1 The Day/Night Cycle and Apparent Motion of the Sun

Grade Level: Third Grade

Subject: Science

Prepared by: Julia Plummer & Cyndie Slagle

Materials:

- Signs around the room that say North, South, East and West
- Lamp for the sun
- Small earth globes – one for each pair
- A flashlight
- Stickers
- Paper and pencils

Standards:

3.4.4 D Describe the composition and structure of the universe and the earth's place in it.

- Recognize earth's place in the solar system.
- Describe the solar system motions and use them to explain time (e.g. days, seasons), major lunar phases and eclipses.

Student Learning Outcomes

- SWBAT *infer* that the sun appears to move across the sky from east to west.
- SWBAT *determine* that the sun appears to move across the sky each day because of the earth's rotation.

Vocabulary:

- Axis
- Rotate and rotation

Common Alternative ideas: While most of your students will know that the sun rises and sets, many will not know that the earth's rotation *explains* this motion. Instead, they will say that the sun goes up and down or that the sun goes around the earth. Even students who know that the earth spins may not use that concept to explain the sun's apparent motion. Another alternative idea that students may express is to use the earth's rotation in combination with the sun moving around the earth to explain the sun's rising and setting.

The word *rotation* is commonly misused (by children and adults). Rotation only refers to spinning on one's own axis (the earth's 24 hour rotation for example). However, many people use rotation when they mean *revolution* (synonymous with orbit in this situation). The earth revolves around the sun, making a large circle. It rotates on its axis.

Finally, many students believe that while the sun somehow causes day that it is the moon (rather than the absence of the sun) that causes night.

LESSON PLANS

Learning Activities

Introduce students to the topics of these lessons:

“We are going to be working on understanding the earth, the sun, the moon and the stars. We’re going to start by having you all share your ideas about what we can see in the sky and why the sun appears to move the way that it does.”

Another way to introduce this lesson is to play the song (and let the students sing along) “Where does the sun go at night?” from http://acme.com/jef/singing_science/ (scroll to the bottom for the Experiment songs).

(10 minutes)

Point out signs up in the classroom that say NORTH, SOUTH, EAST and WEST. Have the students stand and imagine they are standing outside.

“Does anyone know where we would see the sun when we first get up in the morning? Is it low in the sky or high in the sky? What direction would we look to see the sun?”

Have the students point low in the EAST. *You may want to darken the room and use a flashlight for this demonstration.*

“Where will the sun be in the middle of the day, around lunchtime?”

Have the students point high and towards the south.

“Where will we see the sun at the end of the day when it sets?”

After students have made their guesses, have them point to the WEST as if the sun is setting.

Have the students repeat the motion for the whole day again, drawing out arcs with their arms.

(5 minutes) Think-Pair-Share

Ask the students to talk to their partner and explain why they think the sun rises and sets. Ask a few students to share some of their ideas.

(10 minutes)

The purpose of this sections is the help students kinesthetically experience **rotation** and to help students understand why the sun rises in the east and sets in the west.

Bring out a lamp for the sun. Ask the students to stand up where they can freely move. Tell them that we are going to act out what happens to make day and night and the rising and setting of the sun.

“We are all going to pretend that we are each the earth!”

“Watch what I am going to do – Scientists call this **rotating** but you might also calling it spinning or turning. It is important that we all **rotate** in the same direction: **counter-clockwise** because this is the direction that the earth rotates.”

“Everyone raise their left hand” (Make sure students are raising their left hand.)

“Point to your left. Now **rotate** towards your left until you are facing away from the sun. If you can’t see the sun, is it day or night?”

The students will respond that it is night.

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“Now keep rotating in the same direction until you are facing the sun. What time of day is it now?” Noon.

“Rotate again, slowly and keep looking at the sun. Stop just before you can’t see the sun anymore. It’s now **sunset**. Tap the shoulder that you see the sun over. That is the west where the sun is setting! Keep rotating slowly – now it is night. Keep rotating slowly and stop as you can just see the sun again. Now tap on the shoulder that you see the sun over. Is that the same shoulder as you looked over when the sun set? No! It’s the other shoulder – now you are looking east. So what time is it? Yes, it’s the morning.”

Repeat this process to emphasize the different times of day and where we (The Earth) are facing compared to the stationary sun. Use the word “rotating” to emphasize its use.

“Now, think back to the path of the sun that we traced out with our arms. The sun rises in the east and sets in the west because the earth is always spinning counter-clockwise. We see the sun going that way (**trace the path yourself**) because the earth is spinning the other direction.”

Also ask the students:

“How long does it take for the earth to rotate once – to face the sun, turn around and face back towards the sun?” **Twenty-four hours or one day.**

(10 minutes)

Now give each pair of students an **earth globe**. Ask the students to do the following WITH A PARTNER:

“Find Philadelphia on the globe and put a sticker on it. Now use the globe to explain why the sun rises and sets just like we did as a group when we rotated like the earth. Use the globe to show when it is noon, sunset, midnight, and sunrise happen for where we live near Philadelphia.” Students should spin the globes counter-clockwise to show the scientific direction of the earth’s rotation. Make sure that each child has a chance to demonstrate this motion.

Explain to the students that the line the globes spin around is called the **axis**.

You can substitute any locations here that you know your students might be familiar with.

“Position the globe so that it is about noon for us in Philadelphia. Now find China on the globe. Put a sticker as a person in China. Is it day or night for people in China?”

“What about Australia? Put a sticker for a person living in Australia.”

“Position the globe so that it is midnight for us. What time is it now in China? Australia?”

“Does the sun rise and set in China? In Australia?” Yes, the sun rises and sets as it does here because of the earth’s rotation.

“What direction does the sun rise in for people in China? What direction does the sun set in for people in Australia?” The sun rises in the east and sets in the west just as it does here.

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Closing (10 minutes)

The purpose of this closing activity is for students to reinforce what they learned in the kinesthetic modeling not necessarily to produce an accurate representation on paper, which may be challenging.

Each person in the group should now get out a piece of paper.

“Draw a picture of why the sun rises and sets so that we have day and night.” In their groups, have the students compare their drawings.

Assessment

At the end of the lesson, the students will draw a picture showing why they think we have day and night. Hopefully, they will demonstrate in drawings, arrows, and/or words that it is the rotation of our earth that causes us to face towards and away from the stationary sun.

Topic: Day 2 The Motion of the Moon

Grade Level: Third Grade

Subject: Science

Prepared by: Julia Plummer & Cyndie Slagle

Materials:

- Papers and pencils
- Sun-lamp
- Dylite moon balls on sticks (pens or pencils will work)

Standards:

3.4.4 D Describe the composition and structure of the universe and the earth's place in it.

- Recognize earth's place in the solar system.
- Describe the solar system motions and use them to explain time (e.g. days, seasons), major lunar phases and eclipses.

Student Learning Outcomes

- SWBAT *deduce* the moon appears to move across the sky from east to west like the sun.
- SWBAT *conclude* that the moon appears to move across the sky each day because of the earth's rotation, not the moon's actual motion.
- SWBAT *infer* that the moon can be seen in the day and the night using the earth's rotation and the moon's slow 28 day orbit (revolution).

Vocabulary:

- Rotate and rotation
- Revolution
- Orbit

LESSON PLANS

Common Alternative ideas:

While many students know that the moon rises and sets, some think that it sits at the top of the sky during the night and then sets when the sun comes up. They often explain the moon's apparent motion by saying that it is the moon actually moving around the earth once a day. Other may think that the moon never moves, but instead is always on the opposite side of the earth from the sun.

A few students may not have seen the moon during the sky during the day. If possible, keep an eye open for the moon to show them before this unit starts or during the unit.

Learning Activities

Before class:

Set up the sun-lamp so that you can have day and night as well.

(5 minutes)

Review the earth-sun connection by first asking the students to show you with their arms what the sun looks like as it rises and sets and then asking to show you why the sun looks like it is rising and setting. The students should all rotate counter-clockwise (the opposite direction that they traced the sun's path).

(5 minutes) Seeing the moon in the sky

It is important to get the students thinking about their prior experiences seeing the moon so that this lesson connects to their current thinking about the moon.

Have students share their answers to these questions.

“Now let's talk about the Moon.

Has anyone seen the moon in the sky?

Has anyone seen the moon during the day? When did you see it?

Who has seen the moon low in the sky?

Who has seen the moon high in the sky?

Is the moon always in the same place when we see it in the sky or does it change where it is in the sky like the sun?”

Describe to the students that, like the sun, the moon also rises and sets in the sky and that we can see it sometimes in the day and sometimes at night. Have the students stand up and do the same demonstration of the moon's apparent motion (tracing the path of the moon across the sky) as they did with the sun – from east to west.

(10 minutes) Drawing pictures

“Draw a picture that shows your idea of what is really happening when the moon rises and sets, as if you were looking at it from space (like we did with the globes to talk about why the sun rises and sets). You can use words and sentences if it helps too.” Give students paper and pencils to draw their ideas. It's okay if they talk to each other and look at each other's pictures.

“Let's see if we can figure out why the moon seems to move like the sun does!”

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(10 minutes) Public sharing

Having the students publically share their drawings and explain why they think the moon rises and sets gives you a chance to learn more about what your students think about these ideas. This will also allow the students to have their own working personal model to compare the scientific model to.

Ask for a volunteer to explain why he or she thinks that the moon rises and sets. Ask the student to be the earth and to pretend that you are the moon. Have them explain to the class their idea. Ask if anyone had a different idea and have them share their idea.

(10 minutes)

After this discussion about the students' ideas suggest to the students that we should all see if just having the earth rotating is enough to explain the moon rising and setting. Remind them that they used the earth's rotation to explain the apparent motion of the sun each day.

"Now I want you to get with a partner. One of you will be the Moon and the other will be the Earth." If you want, give the Moon-partner a moon-ball on a stick.

Pick a volunteer to be the earth while you are the moon to demonstrate how this works. All of the other students will be in pairs. Remind the students that the Earth rotates once every 24 hours.

Using students' own kinesthetic experience helps them solidify these ideas in their minds. The combination of rotating, observing, and tapping their shoulders helps them remember that as the earth turns we see the moon appearing to rise on one side of the sky and set on the other.

"I am the moon and my partner is the Earth. Partner, please start rotating slowly towards your left hand like you did to show why the sun rises and sets. All of the other earths can do this too. Everyone face the moon. This is when you would see the moon high in the sky. Now as you turn slowly to your left, tap on the shoulder that you are looking towards the moon. As you rotate the moon disappears. Now as you keep rotating, the moon is on the other side of the earth so you can't see it. Keep rotating now and notice that you see the moon rising over your other shoulder. Tap this shoulder. This is why the moon appears to move across the sky."

Have the students switch so that both children get to be the earth and watch the moon rise and set.

(10 minutes)

Some of the students already knew that the earth's rotation causes the moon to rise and set (though not all). However, these students believed that the moon never moves. Conversely, those who believe that the moon moves or orbits thought that the moon moved around the earth every day. You can use this idea but help them understand that it is actually a very slow process.

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“Some of you suggested earlier that moon does actually move around the earth. You were right! But it does so very slowly. We’re going to try to act that out now.”

Turn on the sun lamp. You are the moon and your partner is the earth. Stand so that you have enough room to walk around the earth. Do this very slowly and tell the students that it takes about 28 days or almost a month for the moon to **orbit** around the earth once. Point out that the moon **orbits** in a **counter-clockwise** direction – the same direction as the earth’s rotation.

“That’s 28 days so the earth **rotates** 28 times each time the moon **orbits** the earth one time. So that means that the moon doesn’t move very far every time that the earth **rotates** on its **axis**.”

You can have the earth-students spin while their partner orbits. Have them switch so that each experiences the orbit.

We have found that some students find it useful to connect the appearance of the moon during the day & night with the moon’s slow orbit.

Ask the pairs to stand so that the moon-partner is closer to the sun than the earth is.

Start with the earth-partner facing both the moon-partner and the sun lamp.

“Is it day or night?” It is day.

“Can you see the moon?” Yes!

“Now earth-partner, slowly rotate so that you experience day and night. Notice that the sun is rising and setting and at the same time the moon is rising and setting. Notice that you see the moon and the sun in the sky together.”

Have the student who is the moon now orbit around the earth so that he/she is half way around the earth. Keep reminding the students how long this motion takes (half way is about 2 weeks). Have the earth-students rotate again so that they see the sun and moon still rise and set but now they see the moon at night and not during the day.

Switch the earth and moon pairs so that all of the students get to be earth.

A common misconception among the students is that they think the moon is always opposite the sun in space.

Bring out the earth globe and the moon on a stick.

Ask the students: “Is the moon always on the opposite side of earth from the sun?”

No, and you can demonstrate that with moon-on-a-stick.

“During how much of the month is the moon opposite from the sun?”

Only for a few days.

(5 minutes) Conclusion

Conclude by playing the song, *The Earth Goes Around the Sun*:

http://acme.com/jef/singing_science/

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This is a nice way to help students review some of the main topics from this lesson and to introduce some new ideas, such as the earth's orbit and the stationary stars, that will be discussed in later lessons.

You may also wish to remind them that as the earth is going around the sun, it is also rotating on its axis.

Assessment

Students will demonstrate their predictions through drawings and discussions with each other.

Topic: Day 3 The Motion of the Stars

Grade Level: Third Grade

Subject: Science

Prepared by: Julia Plummer & Cyndie Slagle

Materials:

- Size of the stars power point
- Star cut-outs
- Tape

Standards:

3.4.4 D Describe the composition and structure of the universe and the earth's place in it.

- Recognize earth's place in the solar system.
- Describe the solar system motions and use them to explain time (e.g. days, seasons), major lunar phases and eclipses.

3.4.7 D Describe essential ideas about the composition and structure of the universe and the earth's place in it.

- Illustrate how the positions of stars and constellations change in relation to the Earth during an evening and from month to month.

Student Learning Outcomes

- SWBAT *infer* the stars' appearing to move across the sky at night and that we see different stars throughout the night.
- SWBAT *determine* that the stars appear to move because of the earth's rotation.
- SWBAT *estimate* that stars appear small because, even though they are the size of the sun they are very far away.

LESSON PLANS

Vocabulary:

- Rotate and rotation
- orbit

Common Alternative ideas:

Few students understand that the stars are huge, as large as our sun, and very far away. Instead, most students believe they are small and as close as or closer than the moon (some think that they are part of the atmosphere). This limits their ability to understand that the stars also appear to rise and set because of the earth's rotation. Many do not think that the stars appear to move. This can be helpful step towards knowing that stars do not actually move but appear to because of the earth's rotation.

Learning Activities

(5 minutes)

Review:

- Earth's rotation causes the sun to rise and set and the moon to rise and set
- Moon has a slow 28 day orbit and this does not cause the moon to rise and set but it does mean that sometimes we see the moon during the day and sometimes during the night.

(10 minutes)

"Now let's talk about the stars. You might already know that the sun is a star. In fact, while there are many stars out there in space that are smaller than the sun, many of the stars you can see in the sky at night are much, much bigger than the sun. If most of the stars are really bigger and brighter than our sun, why does the sun look so bright and the stars at night so faint?"
Because the stars are so far away.

Misconception alert: Many students believe that stars are very small. We found that even after showing students images of stars larger than the sun, they retained a belief that there are tiny stars close to the earth. Even the smallest stars are still much larger than the moon or any planet.

Project the power point showing the size of the stars sizes compared to the sun. Point out how large some of the stars are. Remember to emphasize that even the smallest stars are bigger than the earth and the moon.

(10 minutes)

"The stars are all far away and outside of our solar system. The sun is the only star in our solar system. They are much farther away than both the sun and the moon! We have been pretending that we are the earth and moon and that little lamp is the sun. If we were to really add stars to this model then the nearest one might be as far away as the other side of the country! But since we can't do that, we're just going to put some stars around the walls of the classroom and pretend that they are much farther away."

Each student will take a star with tape on the back and put them around the room.

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(10 minutes)

Have students once again pretend to be the earth. They will rotate **counter-clockwise** and observe the stars appear to move because they are rotating. They should pick one star and determine if it rises and sets like the sun and moon did.

“Do we see the same stars all night long?” No, because some are setting while others are rising.

“The stars appear to rise and set at night just like the sun and moon because the earth is rotating. They rise and set in the same direction, from east to west, as the earth”

Also point out that the stars are still moving across the sky during the day but the sun is too bright for you to see them. Many of the students already realize this but it is important to connect this information to new understanding of the stars’ apparent motion.

(5 minutes)

Conclusions:

“Now draw a new picture that explains why the moon rises and sets and why the stars rise and set! Then compare this to the picture that you drew yesterday.”

(10 minutes) *Optional activity: the Earth’s Orbit around the Sun*

If possible, arrange to have the sun lamp in the center of the room. Arrange the students in a circle around the sun lamp. If this is not possible, have one student do the kinesthetic activity described below:

“The earth doesn’t just spin in place. The earth also slowly **orbits** around the sun. Another word for this motion is **revolving**.” Have the students slowly orbit around the sun once.

Tell the students that this orbital motion takes 365 days – a whole year! This concept will return again in the lesson for the seasons.

Additional optional activities:

1. While students are in a circle around the sun, discuss how we can see different stars at night (facing away from the sun) on one side of the sun in our orbit compared to the opposite side. This is why we see different stars each season.
2. If there is time, point out that there is one star that does not appear to move – the North Star. Ask them where that star would be (and help them if they can’t figure out that it would be over their heads). Bring a stick with a star on the end out with the globe. Put the post-it note on Philly. Have the kids be the stars and rotate the globe so that the students can see that the place we live sees most stars rising and setting but not the North Star.

Assessment

Students draw a new picture at the end of the lesson to show why they think the moon and stars appear to move.

Topic: The Phases of the Moon

Grade Level: Third Grade

Subject: Science

Prepared by: Julia Plummer & Cyndie Slagle

Illustrations, figures, and some questions for students originally appeared in *Moonstruck* (a curriculum guide written by Colonial School District, 2005)

Materials:

- Papers and pencils
- Sun lamp
- Moon balls (Styrofoam) on sticks (one for each student)
- Moon phase pictures (cut out prior to the lesson) – one set per small group of students

Standards:

3.4.4 D Describe the composition and structure of the universe and the earth's place in it.

- Recognize earth's place in the solar system.
- Describe the solar system motions and use them to explain time (e.g. days, seasons), major lunar phases and eclipses.

3.1.4 B Know models as useful simplifications of objects or processes.

- Identify and apply models as tools for prediction and insight.

3.1.4 C Illustrate patterns that regularly occur and reoccur in nature.

- Use knowledge of natural patterns to predict next occurrences (e.g., seasons, leaf patterns, lunar phases).

Student Learning Outcomes

- SWBAT *predict* the phase of the moon that we will see on the earth based on alignment of the sun, earth and moon.
- SWBAT *arrange* the phases of the moon in the proper order and state that it takes about 28 days to see all of the phases.
- SWBAT *infer* that half of the moon is always lit by the sun but only part of that side is usually facing towards the earth.

Vocabulary:

- Phases
- Orbit
- Waxing
- Waning

LESSON PLANS

Common Alternative ideas:

Without instruction, students in third grade will have non-scientific explanations for the changing appearance of the moon. Many students will think that the phases are caused by clouds moving in front of the moon. Other students will think that it is a shadow falling on the moon. Some students think that the moon is physically changing its shape during the month. It will be important for students to see that the phases can be produced without shadows or anything blocking the moon (another common misconception).

Pre-lesson engagement

Students should begin their Moon Calendar activity during the month before this lesson. This is a blank calendar page that can be used by students to make actual observations of the Moon at night. The month and observation dates will need to be filled in and additional direction for these observations should be provided by you. By completing their moon calendar, they will have developed an observational knowledge of the sequence of moon phases and the approximate length of time it takes for the appearance of the moon to change. Finally, this activity may help excite them about learning to explain the phases of the moon.

If students miss observations, the following websites can be used to help them add to their calendar:

Moon connections – Full month (you can update to do any month and any year):

<http://www.moonconnection.com/moon-november-2009.phtml>

Just the current day's phase:

http://www.calculatorcat.com/moon_phases/phasesnow.php



The Moon photographed over 4 days.

LESSON PLANS

Name _____

Student Activity Sheet



Moon Phase Observation Calendar

(Month)

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday

LESSON PLANS

Learning Activities

Day 1

The purpose of this activity is for students to organize their understanding of the sequence of the phases of the moon and to continue learning the names for these phases.

(10 minutes)

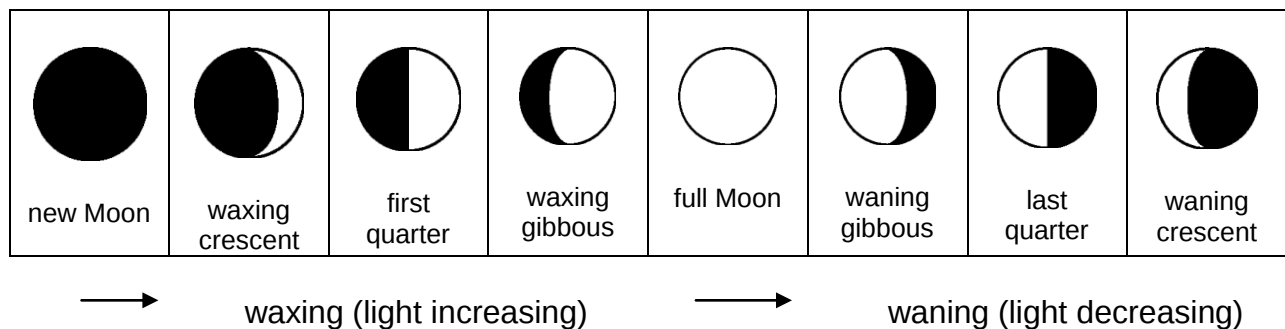
Begin by asking the students to get out their moon calendars. In small groups, students should compare their moon calendars and help each other fill in missing data (drawings of the moon on days that they missed seeing the moon). This will help them activate their prior knowledge by thinking about the phases as a pattern.

(5 minutes)

Next, hand each group a set of the moon phase pictures (on the next page) and ask them to put them in order using what they already know and their moon calendars. If students have not completed a moon calendar, they can still put the phases in order as they see fit.

(5 minutes)

Once students are done with their sequencing, arrange the phases on the overhead or white board, with input from the students, to show the accurate sequence. Ask the groups to correct theirs if needed:



(10 minutes)

Have each group tape down their sequence and write the names of each phase of the moon under each picture.

(15 minutes)

The next set of questions will help the students relate their observations of the moon to the length of time that the pattern of phases occurs. If students have not completed the moon phase calendar, use an online moon phase calendar (<http://www.moonconnection.com/moon-november-2009.phtml>) or print calendar that shows the major moon phases.

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“Can anyone use their moon phase calendar to tell me how long it is between the 1st Quarter phase and the full moon?”

1 week

“How long between the full moon and a 3rd quarter moon?”

1 week

Continue asking questions to help students see the relationship between time and the phases.

It is important that students are able to use their understanding of the time and sequence of the moon phases to make predictions. Look up the current phase of the moon and let the students know the current phase (You could show the phase website: http://www.calculatorcat.com/moon_phases/phasesnow.php). Use this to have the students make predictions. For example,

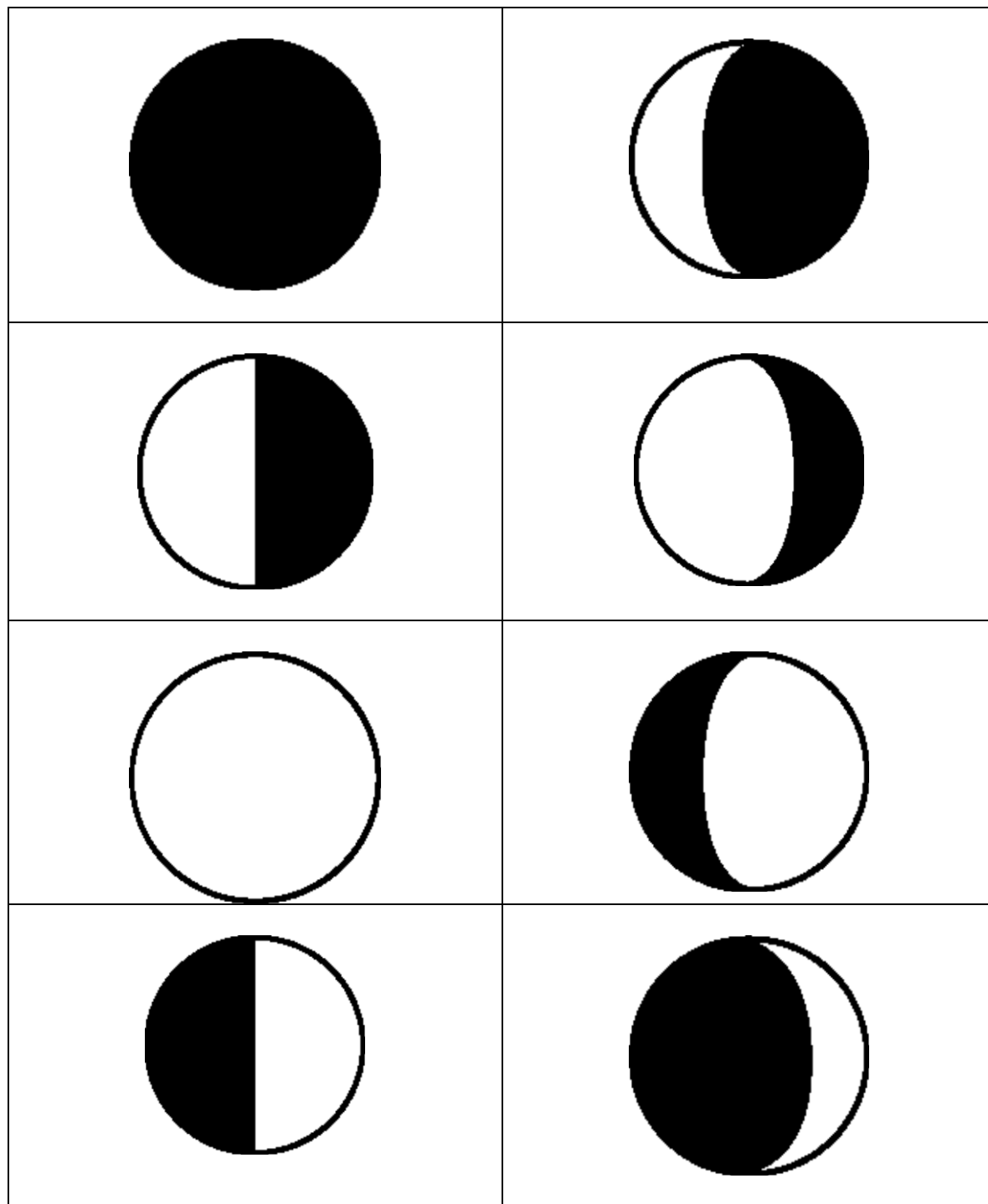
“If today the moon is New, what phase will it be in 2-3 days?”

Waxing Crescent

“What phases will it be in two weeks?”

Full moon

Moon Pictures



LESSON PLANS

Day 2

Before class:

Set up the sun-lamp, preferably somewhere that all the students can stand around. Try to darken the room as much as possible. Place a lamp (without a shade) on a table and tape the cord to the floor.

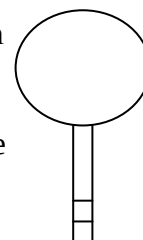
(10 minutes)

Arrange the class in a large enough circle that all students can see the sun-lamp and have room to spin around with their arm held out holding the moon.

Make sure each student has their own moon-ball on a stick. It is important that each student model the phases of the moon on their own to learn to explain the phases accurately.

Darken the room and turn on the lamp. Tell the students:

“The next activity will help you understand why you see different shapes of the Moon at different times during a month. You will be using models to represent the Sun and the Moon. A lamp will be a model of the Sun. Each group will need a styrofoam ball and a pencil. Push the point of the pencil into the foam ball so it looks like the picture to the right. This will be a model of the Moon. Your head will represent the Earth.”



Begin by reviewing some concepts that students learned in Activity 2. Ask the students demonstrate the moon's **orbit** around them in a counter-clockwise direction. Remind them that it takes about 28 days. Ask the students, how many times does the earth **rotate** during that orbit? 28 times – once per day.

Review the concept that we see the moon by reflected light. Have the students observe that half of the moon is always facing the sun and that side is lit up by the sun.

(10 minutes)

Direct students to find a way to position the ball (Moon) so that the side facing them is not lit and appears dark. This position models a new Moon where the side of the Moon facing the Earth reflects no sunlight. To see the new Moon, students will need to hold the ball directly between them and the lamp.

In their student booklets:

Describe how you were standing and the positions of the Sun, the Earth (yourself) and the Moon when the Moon was not illuminated (a new Moon.)

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(15 minutes)

Now, demonstrate how to model the phases of the moon, as follows. You do not need to spend a lot of time on this as the students will all be following along next.

Stand facing the light source (as shown in position one) and hold the Moon between you and the light source to show the new Moon again. Each time you rotate to a new position (two through eight) you will be rotating **45 degrees** in a **counterclockwise** direction. To rotate you will be standing in one place and rotating your **feet only** to move your body. Think of it as spinning in place. The ball should be held slightly above your head at every position, except number one, to make sure that some of the light is not being blocked.

From position one, rotate to position two to observe the waxing crescent (a small part of the right side is lit, the rest of the ball is in shadow.)

Rotate to position three to observe the first quarter (the right half of the ball is lit, the left half in shadow.)

Rotate to position four to see the waxing gibbous (large lighted side on right and small shadow on left side.)

Rotate to position five half way around in a circle to see the full Moon (the entire ball is illuminated.) Make sure to hold the ball above your head.

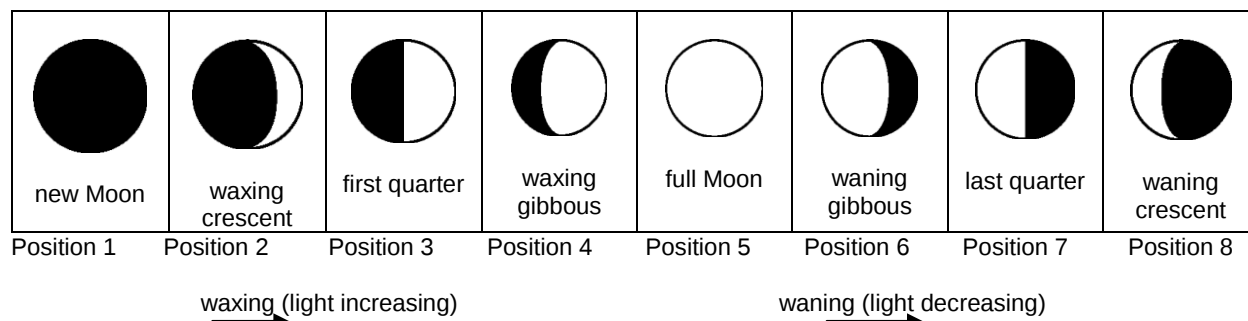
Rotate to position six to see a waning gibbous (right side is now in shadow and the large part on the left is lit.)

Rotate to position seven to see the last quarter (the right half of the ball is dark and the left half is lit.)

Rotate to position eight to see the waning crescent (most of the ball on the right is dark and a small part on the left is lit.) One more rotation will bring you back to position one to observe the new Moon again.

The diagram below illustrates what should be seen as students rotate through the eight positions.

PHASES OF THE MOON



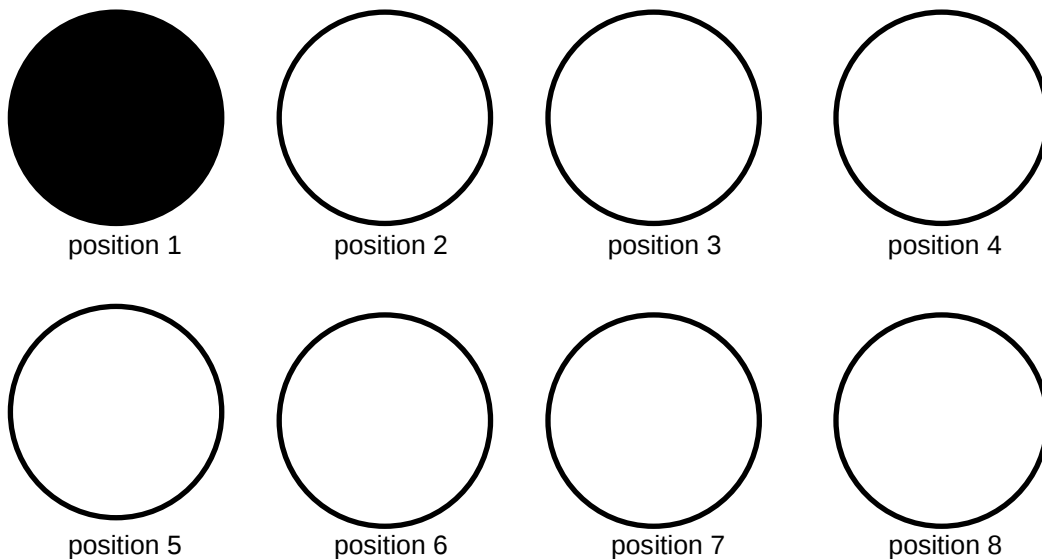
LESSON PLANS

After observing you model Activity 4C, instruct the students to slowly work through each phase together. Have all of the students turn 45 degrees to their left (counter-clockwise). Ask them, “What phase do you see?” Waxing crescent. “Turn a little bit more, so that the sun is over your right shoulder. What phase is the moon in now?” First quarter. Keep going as students observe the changing appearance.

Students can also record their observations of the moon in their Student Booklet. You will need to model for students how to record their observations in 4C by shading in the dark part with their pencil and leaving the lit part white. The first position (new Moon) is already done for students in their Student Booklet (see below).

Student guide:

Record your observations at each position by drawing a picture that shows how much of the ball (Moon) appears lit. Shade the dark part with your pencil and leave the lit part white. The first position, new Moon, is already colored in for you.



LESSON PLANS

Day 3

Set up the lamp again and have the students stand in a circle with their moon balls.

(10 minutes)

Many students believe that the phases are caused by the earth's shadow falling on the moon. These students may need to be specifically shown that this is not the cause of the phases.

Remind the students that they are pretending that their head represents the earth and that while they modeled the phases they needed to keep the moon just over their head as it orbited through Full Moon phase.

Have a student hold an Earth globe at the front of the class so that it is illuminated by the sun-lamp. Demonstrate the moon's orbit around the earth to show that the moon usually goes above or below the earth's shadow rather than through the shadow.

(10 minutes)

Now help students connect the timing to the phases. Ask them to start at New Moon again.

Remind them that it takes the moon about a month to go around the earth in its orbit. Ask them, how far around do you think the moon will go in 1 week? One quarter of the way around. What phases is the moon? A first quarter. Continue having the students turn one week around in the orbit to point out each major phase.

(20 minutes)

Have students return to their desks to complete Activity 4E and 4F and the final assessment. On December 9 the missing phase would be last quarter and on December 31 the missing phase would be a full Moon. In Activity 4F, students should determine that a blue Moon did occur during the month of December because the first full Moon was on December 2 and the second full Moon was on December 31.

LESSON PLANS

Student Guide Book

Now that you have investigated and read about the phases of the Moon, analyze the following data and complete the data table by filling in the missing phases of the Moon (noted by the gray shaded areas).

Moon Phases for December 2009 and January 2010

DATE	MOON PHASE
December 2	Full Moon
December 6	Waning gibbous
December 9	
December 12	Waning crescent
December 16	New Moon
December 21	Waxing crescent
December 24	First quarter
December 27	Waxing gibbous
December 31	
January 4	Waning gibbous
January 7	Last quarter

When there are two full Moons in the same month, the second full Moon is called a “blue Moon.” Did a blue Moon occur during the month of December 2009? Explain your thinking.

Final assessment items:

Describe how you were standing and the positions of the Sun, the Earth (yourself) and the Moon when the Moon was fully illuminated (a Full Moon.)

Imagine that you are looking down on the sun, earth, and moon from above. Draw a picture of the positions of the Sun, the Earth and the Moon when the Moon is a first quarter phase.

Assessment

Day 1: Students will create a display of the ordering of the phases of the moon to demonstrate their understanding of the sequence of lunar phases.

Day 2: Students will draw pictures showing what the moon looks like at different positions in its orbit around the earth. Students will also describe the position of the sun, earth and moon when the moon is new.

Day 3: Students respond to a set of written prompts to describe the blue moon and explain the positioning of the Sun-Earth-Moon for the full and first quarter moons.