
IMHOTEP'S

LEGACY ACADEMY

6.6 Relative positions of the earth, moon and sun

Grade 6 Lesson Plan

Reviews and Updates

6.6 Relative Positions and Motion of the Earth, Moon and Sun

Objectives:

1. To show the approximate relative size of the planets and sun and the approximate relative orbits of the planets around the sun.
2. To show how the Earth's rotation causes the day and night cycle and how Earth's revolution causes the yearly cycle of seasons.
3. To show how the relative positions of Earth, the moon and the sun are responsible for moon phases.
4. To show how the relative positions of Earth, the moon and the sun are responsible for eclipses.

Keywords/concepts: Moon, sun, earth, solar system, planets, orbit, phases, cycles, relative positions, predictions, solar eclipse, lunar eclipse

Segment	Details
African Proverb and Cultural Relevance (5 min.)	"You can't use your hand to force the sun to set." Nigeria
Background (10 min.)	What is the solar system? Where are we in relation to the solar system? What is the sun's role in the solar system and how does it affect us? What is an orbit and how does gravity relate to it? What is the moon and how does it affect us?
Demo 1 (15 min.)	Use everyday objects to demonstrate the relative sizes and orbits of the sun and planets in the solar system.
Activity 1 (a) (20 min.)	Use a Styrofoam ball and a flashlight to learn about the effect of Earth's rotation and orbit on light and seasons.
Activity 1 (b) (10 min.)	Use a Styrofoam ball, a flashlight and a Ping-Pong ball to learn about eclipses.
Activity 2 (a) (20min.)	Use Oreos to show moon phases.
Activity 2 (b) (10 min.)	Make predictions about the lunar cycle.
Post-test (10 min.)	Earth, moon and sun quiz.

Suggested interpretation of the proverb

You cannot change some things in life with force, you have to accept them and go with the natural flow of things sometimes. In today's activity we learn about the natural events that occur due to the motions and positions of the earth, moon and sun we cannot change these events so we have to accept them and adapt to them.

Background Information

Solar system

The words *solar system* refer to the sun and all of the objects that travel around it: planets, natural satellites such as the moon, the asteroid belt, comets and meteoroids. Our solar system is part of a spiral galaxy known as the Milky Way. The sun, the center of our solar system, holds eight planets and countless smaller objects in its orbit.

Orbit

An orbit is the curved path of a celestial object or spacecraft around a star, planet, or moon, especially a periodic elliptical revolution.

Sun

The sun is a star, a hot ball of glowing gases at the heart of our solar system. Its influence extends far beyond the orbits of distant Neptune and Pluto. Without the sun's intense energy and heat, there would be no life on Earth. And though it is special to us, there are billions of stars like our sun scattered across the Milky Way galaxy.

Earth

Earth, our home planet, is the only planet in our solar system known to harbour life - life that is incredibly diverse. All the things we need to survive exist under a thin layer of atmosphere that separates us from the cold, airless void of space.

Moon

Our moon makes Earth a more liveable planet by moderating our home planet's wobble on its axis, leading to a relatively stable climate, and creating a tidal rhythm that has guided humans for thousands of years. The moon was likely formed after a Mars-sized body collided with Earth and the debris formed into the most prominent feature in our night sky.

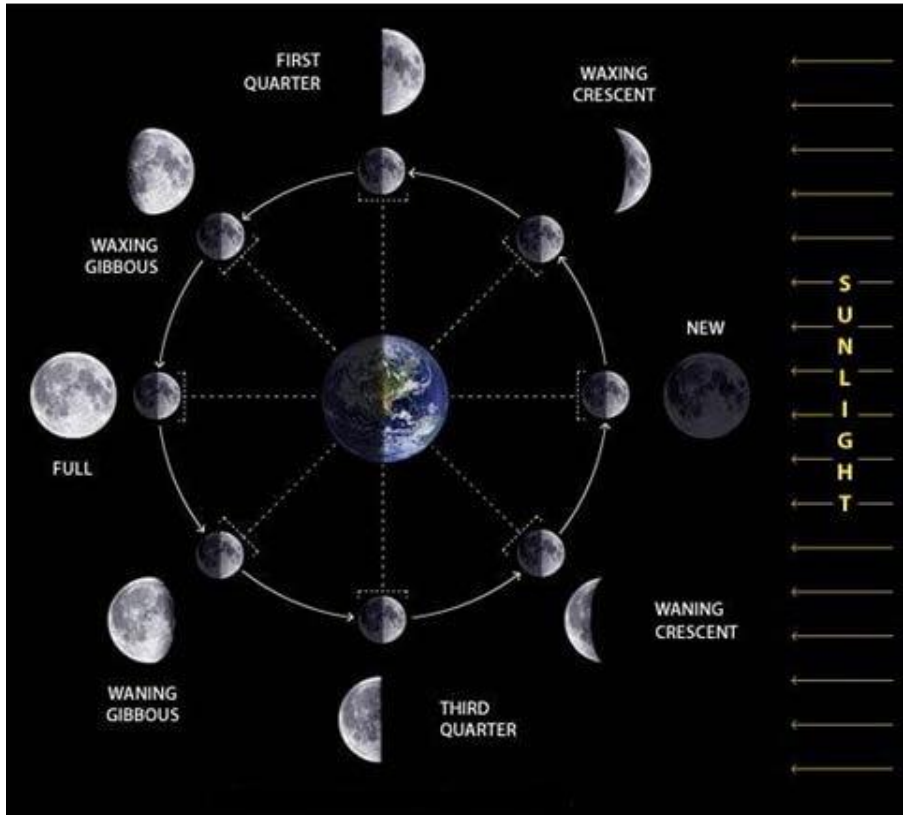
The gravity of the Moon, the pull which it exerts on the Earth, causes two high tides on the Earth every day – one every 12 hours and 25 minutes.

The Moon is much smaller than the Earth, with a diameter of 2159 miles, or 3476 kilometres. It is airless, waterless and lifeless.

If the moon didn't spin at all, then eventually it would show its far side to the earth while moving around our planet in orbit. However, since the rotational period is exactly the same as the orbital period, the same portion of the moon's sphere is always facing the earth.

Moon phases

All parts of the Moon are lit in turn by the Sun. As it rotates round the Earth we see different fractions of the sunlit half, or hemisphere, of the Moon. These are known as the phases of the Moon, or lunar phases. The Moon changes from a thin crescent to a full moon and back again to a crescent in one month (actually 29 days, which is a lunar month).



This diagram shows the phases of the moon, from a new moon, which you can hardly see at all, round to a full moon and back again in just over four weeks. Follow the phases in an anticlockwise direction (the opposite way from how the hands of a clock move).

- The waxing Moon. "Waxing" means growing. After the new moon appears in the sky as a tiny sliver of light the moon waxes. It grows into a crescent, curving to your left as you look at it and then into a half moon. This takes a week and so the period is described as the Moon's first quarter.
- The waxing gibbous Moon. Gibbous means humped and describes the shape of the Moon as it grows from a half moon to a full moon. Another week has passed and this is the Moon's second quarter.
- The waning Moon. "Waning" means shrinking. Now the Moon begins to get smaller again – it "waned". The third quarter takes us from a full moon to a half moon again, but this time it is the right hand side of the moon that shines
- The waning crescent Moon. The last quarter takes us from a half moon back to a crescent moon, facing right, and to a point where the moon disappears.

Eclipses

Anytime there are three bodies (the sun, the moon, or planet) lined up so that one blocks the light from another, we call that an eclipse. During a solar eclipse, our moon moves between us (on Earth) and the sun and blocks the sunlight. During a lunar eclipse, Earth blocks the sun's light that normally lights up the moon. Since we are standing on Earth, what we see is that the moon gets dark.

Other kinds of eclipses happen too. For instance if you were standing on the surface of Jupiter (kind of hard, but we can imagine) you might see one of its moons eclipse the sun!

Reference:

<https://solarsystem.nasa.gov/kids/index.cfm?Filename=weight>

<http://www.planetsforkids.org/moon-moon.html>

Demo 1: Scale Down the Solar System

Purpose: To use everyday objects to show the approximate relative size of the planets and sun, and the approximate relative orbits of the planets around the sun

Suggested format: Do this activity in a large open space

Item	Quantity (10 students)
Ball about 27 inches in diameter (such as a beach ball or exercise ball)	1
Pea sized beads	4
Softball	1
Tangerine	1
Large Walnut sized Marble	2
Tape measurer	1

Procedure:

- 1) Play this video of a true scale model of the solar system:
<https://www.youtube.com/watch?v=BdAqg-wEQV0>
- 2) Explain to students that the size scale and the distance scale are not the same but we are modeling it like this to get a better view (the sizes of the planets and sun are too large for the distances, they have this size so that we can get a better grasp of the relative sizes and distances in the same activity)
- 3) Put your ball at one end of the large space; this will represent the sun.
- 4) Place the other objects as shown in the chart below (remember to measure each planet from the sun):

Planet	Object	Distance from the Sun
Mercury	Pea	1-3/4 inches
Venus	Pea	1-3/4 inches
Earth	Pea	4-1/2 inches
Mars	Pea	4-1/2 inches
Jupiter	Orange	4-1/2 inches
Saturn	Tangerine	3 feet, 7 inches
Uranus	Walnut	7 feet, 3 inches
Neptune	Walnut	11 feet, 4 inches

Reference:

<http://lifestyle.howstuffworks.com/crafts/other-arts-crafts/science-projects-for-kids-the-incredible-universe5.htm>

Activity 1: Effect of Earth's Rotation and Orbit on Light and Seasons

Purpose: To demonstrate how Earth's rotation causes the day and night cycle and how Earth's revolution causes the yearly cycle of seasons.

Suggested format: Students work in pairs

Item	Quantity (10 students)
Styrofoam ball (slightly larger than an orange)	5
Skewer	5
Toothpicks	10
Flashlight	5
Markers	5
Protractor	5

Procedure:

- 1) Make a globe:
 - a. Place the toothpicks in the ball to represent the north and south poles.
 - b. Draw a rough outline of North America (or the entire world map if time permits) in relation to the poles and draw a dot on Halifax.
 - c. Tilt the ball approximately 23° and insert the skewer from top to bottom through the ball to that the ball is permanently tilted at 23° . This represents the earth.
- 2) Dim or turn off the lights.
- 3) Day and night:
 - a. Have student 1 turn on the flashlight and adjust its position or beam size so it shines over the entire width of the globe.
 - b. Have student 2 hold the ball and vertically rotate it in place using the skewers. This demonstrates how the rotation of the Earth causes day and night. Even though the sun is always shining, it is dark on the side of the Earth that is not facing the sun.
- 4) Seasons:
 - a. Have student 1 turn on the flashlight and adjust its position or beam size so it shines over the entire width of the globe.
 - b. Have student 2 rotate the globe so that Canada is facing the sun.
 - c. Have student 2 keep the globe facing in a particular direction (for example keep one side directed at a poster) and rotate around student 1.

- d. Student 1 should keep the flashlight aimed at the globe.
- e. Rotate the globe vertically so the same country as before is facing the flashlight. This shows how the tilted rotation of the Earth causes half of Earth to face the sun more directly as our planet moves in its orbit. The seasons gradually change as different parts of the Earth move to face the sun more directly or more indirectly.

<http://www.enchantedlearning.com/subjects/astronomy/planets/earth/Seasons.shtml>

References:

http://www.lpi.usra.edu/education/skytellers/day_night/activities/cycle_of_light.shtml

http://www.ehow.com/how_7297371_design-earth_s-rotation-effect-weather.html

Activity 1 (b): Eclipses

Purpose: To show how the relative positions of the earth, moon and sun are responsible for eclipses.

Suggested format: Students work in pairs

Item	Quantity (10 students)
Globe from part (a)	5
Flashlight	5
Ping-Pong ball or Styrofoam ball the size of a ping pong ball	5
Pipe cleaner or wire	5
Flashlight	5

Procedure:

- 1) Make the moon by inserting the pipe cleaner into the top of the Ping-Pong ball.
- 2) Have student 1 point the flashlight directly on the earth's equator.
- 3) Have student 2 hold the globe in one hand and the moon in the other by the pipe cleaner.
- 4) Have student 2 stand facing the flashlight.
- 5) Student 2 should then line the moon's equator up with the earth's equator and hold the moon about a finger's length away from the earth.
- 6) Dim or turn off the lights.
- 7) Solar eclipse:
 - a. Have student 2 hold the moon directly in-between the earth and the flashlight; the moon will cast a shadow on the earth.
 - b. Since the moon is now between earth and the sun and it is blocking the sunshine for some people on Earth. Point out that only people directly in the shadow see a complete eclipse of the sun.
- 8) Lunar eclipse:
 - a. Have the student 2 hold the moon directly behind the earth, no light should be hitting the moon.
 - b. Since the earth is between the sun and the moon, it is casting a shadow over the entire moon. Explain that unlike during the solar eclipse, the entire 'night side' of Earth can see the lunar eclipse.

Reference:

<http://www.scienceinschool.org/2012/issue23/eclipses>

Activity 2 (a): Moon Phases

Purpose: To show how the relative positions of the earth, moon and sun are responsible for moon phases. To learn the terms for the phases of the moon.

Item	Quantity (10 students)
6 Regular Oreos	60 (two standard sized packs)
Plastic spoons or knives	10
Paper towels	10 sheets
Handout	10

Procedure:

- 1) **TO BE DONE BY MENTOR PRIOR TO ACTIVITY:** Print off the "Lunar Cycle" worksheet from the next page or the following website:
[http://sciencewear.net/assets/lcstudent-plan-\(revised-2015\)2.pdf](http://sciencewear.net/assets/lcstudent-plan-(revised-2015)2.pdf)
- 2) **TO BE DONE BY MENTOR:** Draw and label the moon phases on the board in the orientation of the handout. Explain why we see the different phases and where they got their names.
- 3) Demonstrate how to twist open an Oreo so that all of the frosting is on one side
- 4) Pass out 6 cookies, a paper towel, a plastic spoon or knife, and a copy of the hand out (attached below) to each student
- 5) Each cookie should be able to make two Moon phases
- 6) Twist open and scrape the cookies to illustrate the moon phases
- 7) Arrange the cookies on the handout in order

References:

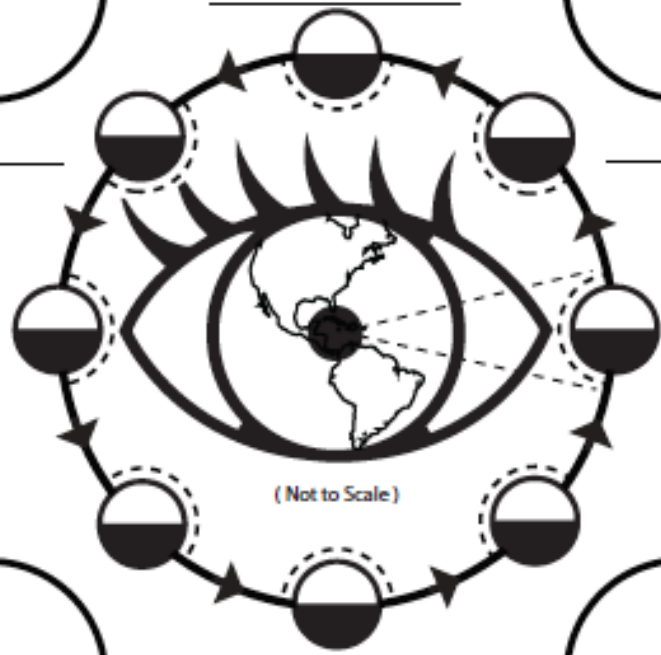
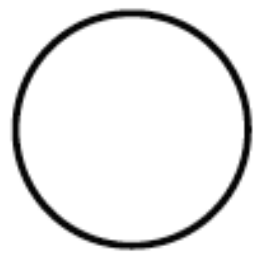
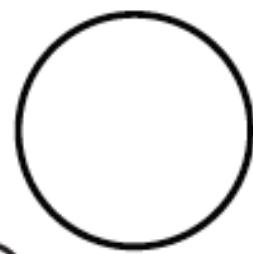
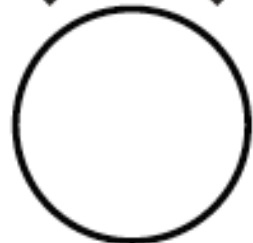
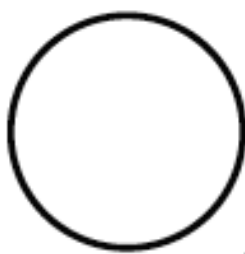
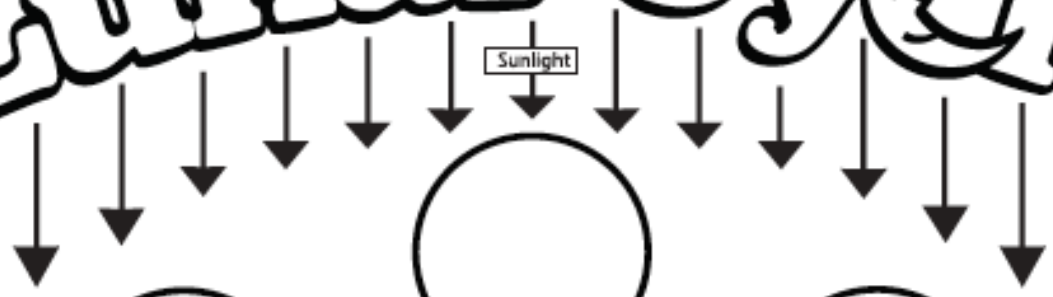
<http://thesciencepenguin.com/2014/09/7-ideas-to-teach-students-about-moon-phases.html>

<http://www.lpi.usra.edu/education/workshops/phasesSeasons/OreoPhases.pdf>

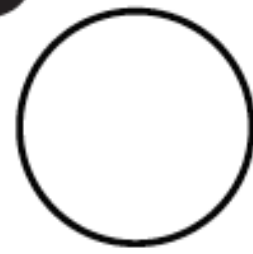
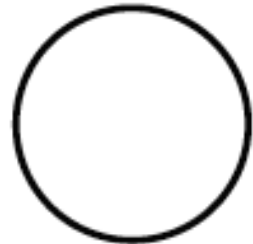
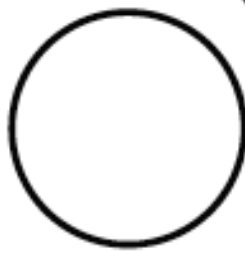
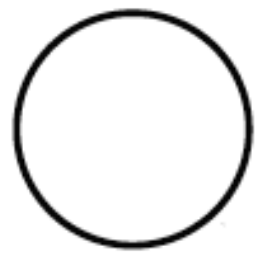
[http://sciencewear.net/assets/lcstudent-plan-\(revised-2015\)2.pdf](http://sciencewear.net/assets/lcstudent-plan-(revised-2015)2.pdf) (worksheet)

Lunar Cycle

Sunlight



(Not to Scale)



Activity 2 (b): Lunar Cycle Predictions

Purpose: To learn how to make simple predictions in the lunar cycle.

Item	Quantity (10 students)
Handout	10

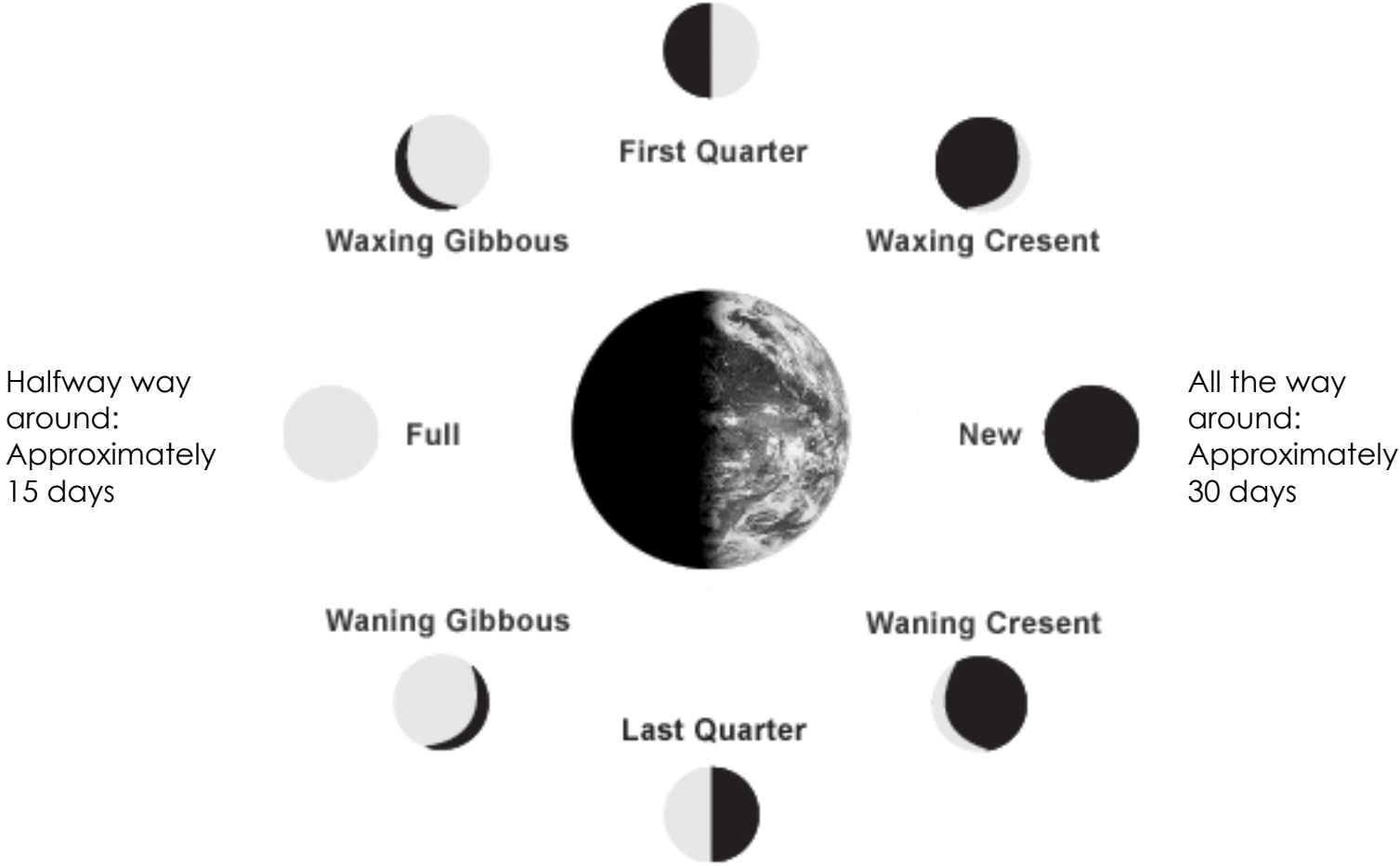
Procedure:

- 1) **TO BE DONE BY MENTOR PRIOR TO ACTIVITY:** Print out "Lunar Cycle Predictions" worksheet.
- 2) Play the NASA video taken by the Deep Space Climate Observatory (DSCOVR) satellite of the dark side of the moon:
<https://www.youtube.com/watch?v=DMdhQsHbWTs>
- 3) Pass out the worksheet and explain the activity

References:

<http://thesciencepenguin.com/2014/09/7-ideas-to-teach-students-about-moon-phases.html>
<https://origin.ih.constantcontact.com/fs012/1101373623497/img/155.gif> (Image)
<http://www.nasa.gov/feature/goddard/from-a-million-miles-away-nasa-camera-shows-moon-crossing-face-of-earth>

Lunar Cycle Predictions



Predictions

Phase	First Appearance	Second Appearance	Third Appearance
New Moon	Day 8		
Full Moon			
Last Quarter			

Post Test

Print off the "So what do you know about the earth, moon and sun?" worksheet.

Answers:

- 1) One year
- 2) b.
- 3) a.
- 4) a.
- 5) b
- 6) Solar system
- 7) c.
- 8) a.
- 9) b.
- 10) b.

Reference:

https://www.middletownschools.org/uploaded/Curriculum/Curriculum_Office/Files/Gr_5-EMS.pdf

What do you Know About the Earth, Moon and Sun?

- 1) How long does it take the earth to revolve around the sun?
- 2) The seasons on earth are caused by
 - a. The fact that the earth's distance from the sun varies.
 - b. The tilt of the earth's axis.
- 3) Do we always see the same side of the moon from the earth?
 - a. Yes
 - b. No
- 4) The moon has phases that change on a monthly basis.
 - a. True
 - b. False
- 5) The earth rotates on its axis every 24 hours. This produces
 - a. The seasons
 - b. High tides
 - c. Night and day
- 6) The earth is a part of the _____.
- 7) The phases of the moon are caused by
 - a. The earth rotating on its axis
 - b. The moon rotating on its axis
 - c. The moon revolving around the earth
 - d. The earth revolving around the moon
- 8) The time it takes for the moon to orbit the earth from start to finish is approximately one
 - a. Month
 - b. Year
 - c. Day
- 9) We can see the moon at night because
 - a. It is a star
 - b. It reflects the light of the sun
 - c. It gives off its own light
- 10) A solar eclipse is when
 - a. The earth's shadow blocks the sun's light from hitting the moon
 - b. The moon moves between the earth and the sun and blocks sunlight, casting a shadow on the earth

Materials list

Materials	Source	Cost
Ball about 27 inches in diameter (such as a beach ball)	Amazon https://www.amazon.ca/Incline-EBab-55hp-10-Burst-Exercise-Stability/dp/B01198W92S/ref=sr_1_1?ie=UTF8&qid=1496085412&sr=8-1&keywords=Fitness+Ball	\$12.99 (1ball, 65cm)
Beads	Activity bin 7.1	Varies
Softball	Walmart	Varies
Tangerine	Grocery store	Varies
Walnut sized Marble	Walmart	Varies
Tape measure	Walmart https://www.walmart.ca/en/ip/30-x-1-stanley-tape-rule-30-464cp/6000108188903	\$9.98 (1 tape measure 30')
Styrofoam ball (slightly larger than an orange)	Michaels https://www.amazon.ca/FloraCraft-Packaged-Styrofoam-Snowballs-Package/dp/B003V5XW9M/ref=sr_1_1?ie=UTF8&qid=1496085978&sr=8-1&keywords=styrofoam+balls+4+inch	\$6.99 (2 balls, 4")
Skewer	Walmart https://www.walmart.ca/en/ip/mainstays-12-100-piece-bamboo-skewers/6000195939303	\$2.50 (100 skewers)
Toothpicks	Activity bins: 7.1, 7.9, 8.1 and 9.6	-
Flashlight	Activity bins: 8.3 and 8.9	-
Markers	Activity bins: 8.1, 8.6 and 8.9	-
Ping-Pong ball or Styrofoam ball the size of a ping pong ball	Amazon https://www.amazon.ca/BREWSKI-BROTHERS-Beer-Balls-White/dp/B00J39OM2Q	\$15.99 (144 Pong Ball 1-1/2")
Pipe cleaner or wire	Activity bins: 7.2, 7.4 and 8.6	-

Oreos	Walmart https://www.walmart.ca/en/ip/christie-oreo-less-fat-cookies/6000197073697	\$2.97 (≈26 Oreos, 300g)
Plastic spoons or knives	Walmart http://www.walmart.ca/en/ip/great-value-clear-plastic-spoons/6000191349719 Activity bin: 8.8	\$1.00 (48 spoons)
Paper towels	Activity bin 7.9 (or on site)	-