Module 5.3

The Solar System
How does the position of Earth in the solar system affect conditions on our planet ?

CT Science Framework Topics

Science Content Standard 5.3	*CMT Expected Performances*
5.3 Most objects in the solar system are in a regular and predictable motion. ♦ The Sun, Earth, and its moon are spherical objects that move in two ways: they spin (rotate) and they change position relative to each other (revolve). ♦ The Sun is a star that produces light that travels in straight lines away from the sun in all directions. Light from the Sun illuminates objects that reflect light, including Earth and its moon. The side of the earth that is facing the sun experiences daylight; the side of the Earth facing away from the sun experiences night. All parts of the earth experience a cycle that includes both day and night, providing evidence that the earth is rotating on its axis. ♦ The amount of time it takes for the earth to rotate once on its axis is regular and predictable (24 hours) and is called a "day". Earth's rotation makes it appear as if the sun is moving across the sky from east to west. ♦ The moon is a rocky object that revolves around the earth in a circular path called an orbit. The amount of time it takes for the moon to revolve once around s the earth about 29 days and is called a "lunar month". ♦ Half of the moon is always illuminated by the sun. Phases of the moon occur because a different portion of the lit half of the moon is visible from Earth each day as the moon revolves around the earth. ♦ The changes in the moon's phases occur in a regular and predictable sequence. At predictable periods during the lunar cycle, the moon is visible in either the daytime or the nighttime sky. ♦ At the beginning of a lunar month, no lit part of the moon is visible from Earth (new moon). As the moon progresses through the first two quarters of its complete trip around the earth, larger portions of the right side of the moon are illuminated each day. When the moon has completed half its trip around the earth, the full moon is illuminated. During the third and fourth quarters of the moon's trip around the earth, the illuminated portion gradually decreases so only the left side is illuminated and finally no lit portion of the moon is visible from Earth again. ♦ Like the sun, the moon appears to rise at the eastern horizon and set at the western horizon due to the earth's rotation. From one day to the next, when observed at the same time from the same location, the moon's position in the sky varies in predictable ways.	**B 22. Explain the cause of day and night based on the rotation of Earth on its axis.** ♦ Exercise 5.3.1 **B 23. Describe the monthly changes in the appearance of the moon, based on the moon's orbit around the Earth**. ♦ Exercise 5.3.2

NH-Greater New Haven Science Collaborative in Earth & Physical Science

Module 5.3:The Solar System

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Glossary

Full Moon Phase – the entire face of the moon appears illuminated to an observer on Earth

Month -

Moon – the Earth's rocky satellite

Natural Satellite – any natural object that revolves around another object

New Moon – first phase of the Moon – the moon does not appear illuminated to an observer on Earth.

Orbit – the scientific name given to the elliptical path an object follows around another object

Phases of the Moon – the names scientists use to describe how brightly lit the Moon appears to an observer on Earth

Planetary Day – the length of time it takes for a planet to complete one full rotation on its axis. It varies among the planets.

Planetary Year – the length of time it takes for a planet to complete one full orbit around the Sun.

Reflect –

Revolve (Revolution) – to follow a path (circular or elliptical) around another object, usually at a fixed distance from the object

Rotate (Rotation) – to spin around a central axis

Solar System – a star (e.g. the Sun) and everything that is within its gravitational field. Our solar system consists of the Sun, the planets, their moons, and all space debris held within the gravitational pull of the Sun.

Waning Half-Moon Phase – the left half of the face of the moon appears illuminated to an observer on Earth - occurs about 1 week following a full moon

Waning Moon – follows full moon phase – refers to the phase in between full moon and new moon

Waxing Half-Moon Phase – the right half of the face of the moon appears illuminated to an observer on Earth – also known as Growing Moon - occurs about 1 week following the new moon

Waxing Moon – follows new moon phase – refers to the phase in between new moon and full moon phase

Inquiry Lesson 5.3.1 **Night and Day**

Content Standard	Expected Performance
5.3 Most objects in the solar system are in a regular and predictable motion ♦ The positions of the Earth and moon relative to the Sun explain the cycles of day and night and the monthly moon phases.	**B 22. Explain the cause of day and night based on the rotation of the Earth on its axis.**

Science Materials:

1 large lamp with shade removed so that light bulb is exposed
Darkened room
Paper, pencils, copies of data sheets

Student Handout 5.3.1 – Night and Day classroom exercise

Vocabulary: Day-Night Cycle, Axis, Revolve (Revolution), Rotate (Rotation), Horizon, Illuminate, Sphere, Orbit, Year

Inquiry: In this exercise, students will investigate how the Earth's rotation causes day and night on the Earth. Students will take turns being the Earth and observing how much of their face is in shadow and light as they turn in one spot relative to an illuminated light bulb.

Procedures and Directions: Review the concepts covered in the literacy handouts. Ask students if the know what causes day and night. Ask students what they know about the Earth in space – does it move? Where is it in relation to the Sun?

Science Concepts: The Earth is not a stationary body – it both rotates and revolves – it rotates on its axis, it wobbles on its axis, and it revolves around the Sun. Each of these movements affects us in some way. The rotation of the Earth is responsible for our days and nights. The Earth completely rotates 365.25 times during one complete revolution around the Sun – this is why we have 365 days in a year and every four years we have 356 days.

Student Exercise 5.3.1: Night & Day

Purpose: This experiment will examine how the movement of the Earth relative to the Sun produces periods of light (day) and darkness (night).

Materials: Lamp with exposed light bulb

Methods:

1. Find your teacher-assigned partner for this exercise. Decide who will be the observer / data recorder. The student demonstrator needs to stand with their face turned towards the turned off light bulb and their eyes closed. The light bulb represents the Sun and the student demonstrator's head represents the Earth. The student's nose represents the state of Connecticut.
2. When the teacher turns on the light bulb, the student observer / data recorder needs to observe the face of the student demonstrator. How much of their face is in the light? Record your observation on the data sheet in the spot marked "NOON".
3. The student demonstrator should turn very slowly to her/his left (counter-clockwise) until she/he is standing with her/his back to the light. The student observer needs to observe the face of the student demonstrator. How much of their face is in the light? Record your observation on the data sheet in the spot marked "MIDNIGHT".
4. The student demonstrator should continue to turn to the left and stop anywhere but directly facing the light or directly facing away from the light. The student observer records how much of the student demonstrator's face is in the light in Box 3 on the Data Chart. In particular, the student observer should pay careful attention to how much of the student demonstrator's nose is in the light.
5. The student demonstrator should continue to turn to the left and, again, stop anywhere but directly facing the light or directly facing away from the light. The student observer records how much of the student demonstrator's face is in the light in Box 4 on the Data Chart.

Discussion:

1.If the light bulb represents the Sun and the student demonstrator's head represents the Earth, describe how day and night on the Earth are caused primarily by the rotation of the Earth on its axis.

2. When it is Noontime in Connecticut what is the position of Connecticut relative to the Sun ? How do you know this from the classroom demonstration ?

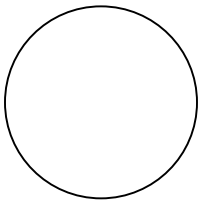
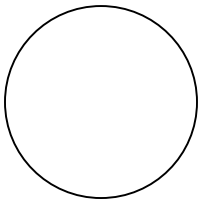
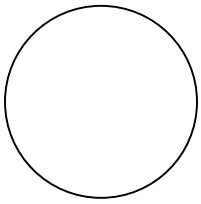
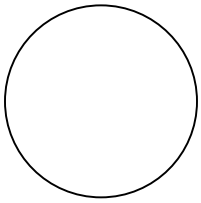
3. When it is Midnight in Connecticut what is the position of Connecticut relative to the Sun ? How do you know this from the classroom demonstration ?

4. Look at the two other observations made during the classroom demonstration. What times of the day might they represent? Explain how you figured this out?

5. What would happen to daytime and nighttime in Connecticut if the Earth did not revolve on its axis but instead stayed in the Noon position ?

Conclusion: (Make a statement about how this experiment demonstrated that the movement of the Earth relative to the Sun causes day and night.)

Data Chart:

Position of Demonstrator	Amount of Light Observed on Face
Facing Towards Sun (NOON)	
Facing Away From Sun (MIDNIGHT)	
Box 3	
Box 4	

Application Problems

Lesson 5.3.1

These items are intended to provide closure for each lesson and assist teachers in determining how well the students grasped the scientific concepts presented in the lesson. The assessments are also intended to provide students with additional opportunities to apply the lesson's concepts. Teachers should use the assessment items as they deem appropriate. For example, teachers may wish to assign them as homework problems, as additional class activities, as a quiz at the end of a lesson or as exit passes. Teachers may also use these problems as a closing group activity for the entire class.

1. The planet Mercury takes 59 Earth days to rotate on its axis. If you were living on Mercury, how long would your day be? Explain how you arrived at your answer.

2. Is it day-time or night-time in India when it is Noon in Connecticut? Explain how you arrived at your answer.

For additional application problems, see *Reading Assignments,* "Fun Thinking Activities."

Inquiry Lesson 5.3.2 Lunar Cycles

Content Standard	Expected Performance
5.3 Most objects in the solar system are in a regular and predictable motion ♦ The positions of the Earth and moon relative to the Sun explain the cycles of day and night and the monthly moon phases.	**B 23. Describe the monthly changes in the appearance of the moon based on the moon's orbit around the Earth.**

Science Materials:

1 large lamp (with shade removed so that light bulb is exposed) placed in center of room
Darkened room
2" Styrofoam balls with a popsicle stick inserted into each one
Paper, pencils, copies of data sheets

Student Handout 5.3.2 – Lunar Cycles classroom exercise

Student Vocabulary: Month (One Lunar Cycle), Moon Phase, New Moon, Reflect

Inquiry: In this exercise, students will investigate how the Moon's orbit around the Earth and its position relative to the Sun during its orbit results in the phased appearance of the moon. Students will take turns being the Earth – Moon system and observing how much of the lunar surface is in shadow and light as the moon orbits around the Earth.

Procedures and Directions: Review the concepts covered in the literacy handouts. Ask students if the know what causes the moon to shine. Ask students what is meant by the "phases" of the moon. Ask students if they know how long it takes for the moon to go through all of its phases?

Science Concepts: The Moon, like the Earth, is not a stationary body – it both rotates and revolves – it rotates on its axis around the Earth and it revolves around the Earth. The moon is held in its place relative to the Earth by the pull of the Earth's gravity on it. Together the Earth-Moon system revolves around the Sun. While it takes the Earth only 24 hours to make one complete rotation on its axis, it takes the Moon nearly 28 Earth days to complete one rotation on its axis. It also takes the Moon about 28 Earth days to complete one revolution around the Earth. This is why only one side of the Moon is ever seen from the Earth and scientists refer to the other side of the moon – the side that we never see from Earth – as the "dark side of the Moon".

Student Exercise 5.3.2: Lunar Phases

Purpose: This experiment will examine why the Moon appears to change shape as it orbits the Earth.

Materials: Lamp with exposed light bulb
2" Styrofoam ball with wooden skewer inserted halfway into it as a handle
Data Recording Sheet
Pencil

Methods:

1. Find your teacher-assigned partner for this exercise. Decide who will be the observer / data recorder. The student demonstrator needs to stand with his face turned towards the turned off light bulb, with the styrofoam ball on the skewer held up in front of him and slightly above his head. The light bulb represents the Sun, the student demonstrator's head represents the Earth, and the Styrofoam ball represents the Moon. The student's nose represents the state of Connecticut.
2. The student observer/data recorder needs to stand so that she can clearly see the side of the styrofoam ball that faces the student demonstrator.
3. When the teacher turns on the light bulb, the student observer / data recorder needs to observe the side of the styrofoam ball facing her partner. How much of the surface of the ball that you can see appears to be lit by the lamp. Draw a picture of this in the data chart provided..
4. The student demonstrator should turn very slowly to her/his left (counter-clockwise) until she/he is standing perfectly sideways to the lamp – with the styrofoam ball still held out in front of him and slightly above his head. The student observer needs to observe how much of the surface of the ball that she can see appears lit by the lamp. Draw a picture of this in the chart provided.
5. The student demonstrator should continue to turn to the left and stop when his back is facing the lamp. The styrofoam ball must still be held out in front of the demonstrator and slightly above his head. How much of the surface of the ball that the observer can see appears lit by the lamp? Draw a picture of this in the chart provided.
6. The student demonstrator should continue to turn to their left until they are sideways to the light. Observe the styrofoam ball's surface. How much of it appears lit by the lamp? Draw a picture of this in the chart provided.

Discussion:

1.If the light bulb represents the Sun, the student demonstrator's head represents the Earth, and the styrofoam ball represents the Moon, describe how the amount of the Moon's surface lit by the light changes as the student demonstrator moves.

2. Compare and contrast your drawings to the pictures of the real Moon shown in your reading handout. Are they similar? How? Are they different? How?

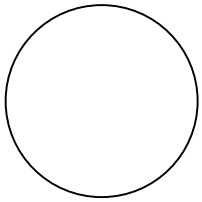
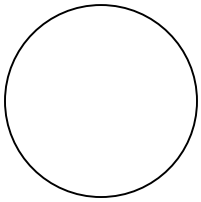
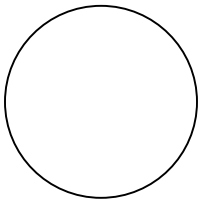
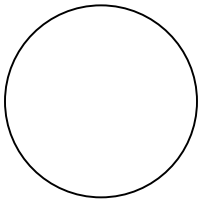
3. Explain why the shape of the Moon appears to change and how this is related to the positions of the Moon, the Earth, and the Sun. How do you know this from the classroom demonstration ?

4. What position corresponds to a "Full Moon". How do you know this from the classroom demonstration?

5. What position corresponds to a "New Moon". How do you know this from the classroom demonstration?

Conclusion: (Make a statement about how this experiment demonstrated that the Moon's appearance changes as the Moon orbits the Earth. What causes the change in the Moon's appearance?)

Data Chart:

Position of Student Demonstrator	Amount of Light Observed on the Surface of the Lunar Popsicle Facing Towards the Earth
Directly Facing the Sun	
Facing Sideways to the Sun - Left	
Facing Away from the Sun	
Facing Sideways to the Sun - Right	

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1. Why do you think the words "Month" and "Moon" are related? How many days are there in a month?

2. Can you ever see the "dark side" of the moon from the Earth? Why or why not?

3. We often hear the term "moonlight." Actually, the moon does not have its own light. Where does the moon get its light from? (What makes the moon shine?)

4. The following are different "shapes" of the moon, which we see in the sky. Actually, the moon never changes its shape. Explain why it appears that the moon changes shapes.

5. When you see a full moon in the sky, about how much time will go by before you see another full moon?
a) one year b) two weeks c) one week
d) one month

For additional application problems, see *Reading Assignments,* "Fun Thinking Activities."