ACTIVITY 6

WHERE DOES THE SUN GO WHEN IT SETS?

EXPERIMENT OBJECTIVES AND CONTENT

The goal of the activity is for students to understand the alternation of day and night and the apparent movement of the sun.

KNOWLEDGE GAINED FROM PROGRESSION OF LEARNING

EARTH AND SPACE

C. Forces and motion:

1. Rotation of the Earth
   (a) Associate the day/night cycle with the Earth's rotation

D. Systems and interaction:

2. System involving the sun, the Earth and the moon
   (b) Describe the motions of rotation and revolution of the Earth and the moon

F. Appropriate Language:

1. Terminology related to an understanding of the Earth and the universe
   (a) Use terminology related to the Earth and space in a suitable manner

SUGGESTED MATERIALS

Scientific equipment:

- Internet-connected computer
- Poster of the solar system
- Model of the solar system (orrery)
- Globe

Household materials:

- Source of light (flashlight or lamp)
- Various sized polystyrene balls
- Balls of different sizes
- Wooden skewers
- Various balls borrowed from the gym (optional)

School supplies:

- Coloured pencils
- Pencils and erasers
- White paper
- Compass
- Thumbtacks
- Stickers

EXAMPLE OF CONTEXT RELATED TO EVERYDAY LIFE

When you looked outside last night, you saw a magnificent sunset. When the sun finally set beneath the horizon, you asked yourself: "Where does the sun go when it sets? Does it rest, like we do?" What can you do to find an answer?

SUGGESTED PREPARATORY ACTIVITIES

You could discuss the sun's location in the sky throughout the day, from sunrise to sunset. Then have students focus on three specific times during the day: morning, noon, and evening. The important thing is to make students realize that we see the sun move through the sky throughout the day. This discussion could go along with a drawing activity in which students are to draw the sun-Earth-moon system as they imagine it.

NOTE

During the activity "Where does the sun go when it sets?" students build a model. In science, a model must be able to predict observed phenomena. Certain models might explain certain aspects of the phenomena but neglect others. The models we use today were developed by trial and error, a process that your students will use. While it is vital to allow room for their naïve conceptions, it is just as important, during the discussion afterward, to guide them toward a functional model of the sun-Earth-moon system.

INITIAL IDEAS AND HYPOTHESES

Here are a few examples of hypotheses the students might formulate based on their initial ideas:

Example 1

I predict that the sun sets because it can only light one side of the Earth at a time. I think this because the Earth rotates on its axis, so when it rotates, there is light on one side and shadow on the other.

Example 2

I predict that the sun goes below the ground at night. I think this because in the evening, at sunset, I can see it go down and disappear. And early in the morning, I can see it rise up into the sky.

Example 3

I think that the sun disappears at night because the Earth is round and revolves around the sun. I think this because I have seen photos of Earth taken in space, and I have been told that the Earth revolves around the sun.

Example 4

I believe that the sun disappears at night because the Earth rotates on its axis and also revolves around the sun. I think this because I saw it in a book and a TV show.

Example 5

I believe that the sun disappears at night because it revolves around the Earth to light up the other countries. I think this because I know that when it's day here, it's night in Australia.

RECORD ALL YOUR IDEAS AND OBSERVATIONS IN YOUR EXPERIMENT WORKBOOK.

PLANNING AND CARRYING OUT

Here are a few examples of experiments the students can carry out to verify their hypotheses:

Example A

The students use a ball to represent the Earth and a flashlight to represent the sun. After marking their position on the ball with a sticker, they illuminate the ball and rotate it on an axis. They note that one side is illuminated and the other side is in shadow. By turning the ball, the students can observe the alternation of the illuminated and shadowed areas.

Note: This model explains the alternation of day and night, but if students do not mark their position on the ball, they may not comprehend the apparent movement of the sun through the sky. If so, it is important to bring up this question during the discussion.

Example B

The students use a ball to represent the Earth and a flashlight to represent the sun. After marking their position on the ball with a sticker, they move the flashlight, which they hold parallel to the ground and move vertically (up and down), while maintaining the "Earth" in a fixed position and always illuminating the same hemisphere of the ball with the "sun."

Note: With this model, the students observe that the sun seems to rise and set over the horizon, but they cannot explain why it rises in the east and sets in the west. The model also suggest that half of the Earth is in permanent darkness and that the sun moves relative to the Earth. Nor do the students account for the Earth's rotation in this experiment.

Example C

The students hold a ball representing the Earth, on which they have marked their position with a sticker, and they revolve it around a lamp (without a lamp shade), which represents the sun. They observe the alternation of illuminated and shadowed areas on the ball.

Note: This model appears to explain the alternation of day and night, as well as the apparent movement of the sun through the sky, but it is false because it does not account for the rotation of the Earth on its axis or for the fact that the Earth takes a year to revolve around the sun.

Example D

The students use a polystyrene ball fixed on an axis (wooden skewer) to represent the Earth. They mark their position with a sticker or a thumbtack. They illuminate the ball with a lamp in order to imitate the effect of the sun on the Earth. The students turn the "Earth" on its axis using the skewer, while moving it around the lamp.

Note: With this model, the students can explain not only the alternation of day and night by the Earth's rotation on its axis, but if they incline their model Earth, they can also explain the seasons by the Earth's revolution around the sun. In the discussion, ensure that the students distinguish the two phenomena.

Example E

The students place a sticker on a ball to mark their position. The ball represents the Earth. They then revolve a flashlight around the ball, keeping it parallel with the ground.

Note: With this model, students can explain the apparent movement of the sun and the alternation of day and night. However, the model is false because it suggests that the sun revolves around the Earth.

EXPERIMENTAL FACTORS

To ensure scientific rigor, the students should evaluate the experimental factors that might influence the experimental results.

- Variable ambient lighting
- Placement of the position sticker (i.e., its distance from the equator)
- Distance between the models representing Earth and sun
- Size relationship between the models representing Earth and sun

DISCUSSION: SUGGESTED INTEGRATION ACTIVITIES

Have the students present the conclusion of their experiments to the rest of the class. Ask questions to fuel the discussion depending on the models used: Earth rotating on its axis, inclined or not, sun rotating around the Earth or not, etc. Then summarize what has been learned by representing the Earth's rotation around its axis and its revolution around the sun using an orrery (i.e., a model of the solar system) or using internet videos or animations. It is important to distinguish the phenomena of rotation, revolution, and inclination, and indicate the effect of each.

SUGGESTED ACTIVITIES FOR APPLYING KNOWLEDGE

Suggest that students make a complete solar system, including planets, sun, and moon. This could be done by way of a model, a poster, or a PowerPoint presentation. To go even further, students could try and explain the phenomenon of the eclipse.

SCIENTIFIC CONCEPTUAL CONTENT

The sun

Located 150 million kilometres from Earth, the sun is our nearest star. It is an average sized yellow dwarf. It is made up of high-temperature gasses, which emit radiation made up of particles, light, and heat. Without its presence, life would not exist on Earth.

The Earth

The Earth is the only planet in the solar system with abundant water and oxygen. These conditions contributed to the appearance of life. It is nicknamed the blue planet because of its many oceans and rivers, which are visible from space. In fact, 70 percent of our planet's surface is covered with water.
The Earth is a sphere that is slightly flattened at the poles. It rotates on its axis in slightly under 24 hours, which creates the alternation of day and night. This axis of rotation is tilted, or inclined, in relation to the plane of its revolution around the sun, which it completes in just over 365 days. This inclination is what produces the seasons.

The solar system

Formed out of a cloud of gas and dust about 4.6 billion years ago, our solar system includes the sun and all the other celestial bodies that orbit it. These include the eight planets and their moons, the five dwarf planets, and billions of other small bodies (asteroids, comets, dust, etc.).

Revolution

The motion of a planet around its star is called "revolution." The Earth revolves around (or orbits) the sun following a stretched circle (or ellipse) in 365 days, 6 hours and 29 minutes. Combined with the inclination of its axis of rotation, the Earth's revolution is what causes the seasons.

Rotation

In addition to revolving around (or orbiting) the sun, the planets also rotate around an axis. The Earth rotates once every 23 hours and 56 minutes. This rotation is what causes the alternation of day and night.

Inclination

The Earth's axis of rotation is not perpendicular to its orbital trajectory but is inclined about 23 degrees. In the Northern hemisphere, the North Pole's axis is tilted toward the sun in summer. In winter, the North Pole's axis is tilted away from the sun. This inclination, combined with the Earth's revolution around the sun, is what causes the seasons. So the seasons are not caused by the distance between the Earth and sun.

The moon

Earth's only natural satellite. The moon's gravitational attraction is what causes the tides. We can see different phases of the moon from Earth that change from full moon to new moon and back to full moon over a cycle of 29.5 days.

CULTURAL REFERENCES

Antiquity

In antiquity, the Earth was thought to be a circular disc floating in the ocean. It was also thought to be the centre of the universe, with everything revolving around it. It was only in the Renaissance that Copernicus came up with the idea of heliocentrism, the theory that the sun is at the centre of the universe and that all the other planets revolve around it. History would prove him partially right: the planets of the solar system do revolve around the sun, but the sun also moves through the universe.

Myths and legends

Many cultures have myths and legends that involve heavenly bodies. Among the Aztecs, the Legend of the Five Suns tells the story of how the sun and moon appeared in the sky. The Native American legend How the Stars were Created tells the story of a turtle that was named guardian of the sky after finding a way to bring light into the sky.

FOR MORE CULTURAL REFERENCES, VISIT THE ÉCLAIRS DE SCIENCES WEBSITE:

www.eclairsdesciences.qc.ca

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PROCESS OF ACTIVE DISCOVERY

GENERAL LEARNING PROCESS IN SCIENCE AND TECHNOLOGY (IN ELEMENTARY SCHOOL)

Context related to everyday life

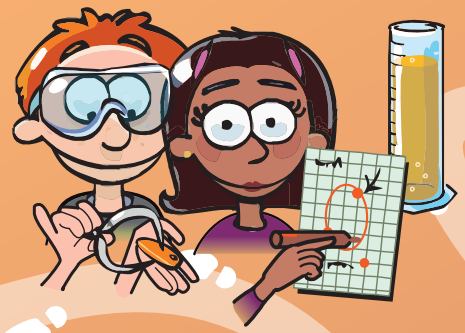
- **Situation problem** or
- **Discovery question** or
- **Need to be fulfilled**
- **Question related to the operation of an object** (how does it work?)

Initial ideas and hypothesis

My initial ideas:
- I share my own ideas.

My hypothesis:
- I predict that... I think that because…
- I imagine my prototype.
- I think it works like this…

Planning and carrying out



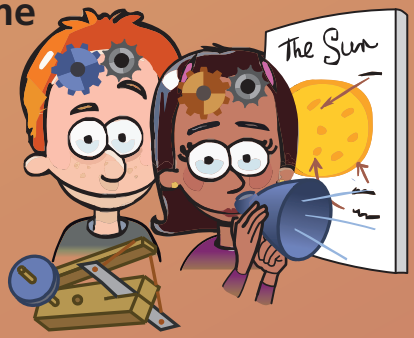
My equipment:
- I observe and handle the equipment.
- How could this equipment be useful to me?
- I choose my equipment and my materials.

Carrying out my process:
- What will the steps be?
- What precautions should I take?

My actions:
- I carry out the steps of my protocol.
- I note or draw what I observe, what I do and what I discover.

My results:
- What is my answer to the problem, question or need?

Outcome



My outcome:
- Do my results confirm my hypothesis or not?
- Are my results similar to those of the other teams?
- Can the other teams' results help me to find answers to my problem, my question or my initial need?
- What could I communicate concerning my discoveries?

New question?

What I learned:
- What do I retain from this activity?
- What could I communicate concerning my results or my discoveries?

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