ACTIVITY 1

HOW CAN LIGHT'S INTENSITY BE VARIED?

EXPERIMENT OBJECTIVES AND CONTENT

In this activity, which covers the concepts of transparency and opacity, students gain a better understanding of how light's intensity can be varied. They will also discover the two major types of light: natural light and artificial light.

STUDENTS OFTEN FORGET THAT IT IS POSSIBLE TO GRADUALLY INCREASE OR DECREASE LIGHT'S INTENSITY.

ESSENTIAL KNOWLEDGE

MATERIAL WORLD
- Transparence (e.g., translucence, opaqueness)

EARTH AND SPACE
- Light and shadow

SUGGESTED MATERIALS

Scientific equipment:
- Magnifying glasses or binocular magnifiers

Perishable non-scientific materials:
- Aluminum foil

Household materials:
- Table lamps
- Flashlights
- Lamp shade
- Various fabrics
- Elastic bands
- Night light
- Electric alarm clock

School supplies:
- Adhesive tape
- Pencils

School equipment:
- Sunny windows and curtains (optional)

CONTEXT: SITUATIONAL PROBLEM OR RESEARCH QUESTION

At recess, you are playing outside with your friends when a big cloud hides the sun. You notice that everything becomes darker. The cloud has reduced the light's intensity. Back in class, you wonder if you can act like a cloud too, and change light's intensity. How will you go about it?

SUGGESTED PREPARATORY ACTIVITIES (INTRODUCTION)

The teacher begins the activity by asking the students to name sources of light. To enrich the discussion, we suggest presenting certain objects or photographs. The students then classify the sources of light identified into two groups: natural and artificial sources. Which can be used to produce light?

Note: Certain bodies, such as the Moon and mirrors, only reflect light.

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 I can increase the intensity of light in the class by turning on a number of table lamps. I predict this because when it rains, my parents turn on lights in the house to make it brighter.

Example 2
I predict that I can reduce the intensity of a lamp's light by placing fabric over its lamp shade. I predict this because in my bedroom, if the light is on, it's darker when I hide under the bed sheets.

Example 3
I predict that I can reduce the intensity of light emitted by a flashlight by placing a piece of cardboard with a small hole in front of it. I predict this because a small flashlight makes less light than a big flashlight.

Example 4
I predict that I can increase the light in the class by changing the light bulbs of the lamps. I predict this because at the store, there are all sorts of light bulbs with different strengths.

WORK PLAN AND EXPERIMENTATION

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

Example A
In addition to the sunlight coming through the windows, the students turn on several lamps with lamp shades. Using magnifying glasses or binocular magnifiers, they examine how these materials are made. Are the threads thick or not? Each time they turn on a lamp, they should take note of whether they can see better by looking at a reference object and whether a lamp shade changes the intensity of the light illuminating the reference object.

RECORD ALL YOUR IDEAS AND OBSERVATIONS IN YOUR EXPERIMENT WORKBOOK.

Example B

The students place fabric on the lamp shade of a lit lamp and note any changes in luminosity. They can do the same test with a different lamp shade to see if there is any difference. They can use a piece of colored cardboard to verify the degree of luminosity. If the color is lighter, it means the light is more intense.

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WARNING: SUPERVISE THE EXPERIMENTS AND ENSURE THAT THE FABRIC IS NOT LEFT ON THE LAMPS FOR TOO LONG TO PREVENT OVERHEATING.

Example C

The students use an elastic band to attach a piece of aluminum foil with a hole in it to a flashlight. An interesting variation would be to use a piece of cardboard with a hole in it. The students then observe if the reference object is more or less illuminated.

Note: Light travels in a straight line. Thus, when a flashlight beam is blocked by a piece of cardboard or aluminum foil with a hole in it, the eye sees only those rays of light that travel through the hole. All the other light rays are blocked. The eye therefore sees fewer rays of light, which makes it seem as though the flashlight's intensity is much less than it really is.

WARNING: LIGHT BULBS ARE FRAGILE AND MAY BECOME VERY HOT. REMEMBER TO VERIFY THE MAXIMUM WATTAGE ALLOWED FOR EACH LAMP.

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Example D

The students have at hand several identical lamps with different light bulbs in them. They note the intensity of the light produced by each lamp and verify if the reference object is more or less illuminated.

EXPERIMENTAL FACTORS

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

- Level of opacity of lamp shade
- Type of fabric (tightly woven or not)
- Intensity of ambient light
- Size and power of flashlights
- Strength of light bulbs (number of watts)

DISCUSSION: SUGGESTED INTEGRATION ACTIVITIES (CONSOLIDATION)

The teacher asks each team to present their experiment to the rest of the class. He or she may also take this opportunity to lead a discussion on the difficulties encountered and to clarify the concepts covered.

SUGGESTED ACTIVITIES FOR APPLYING KNOWLEDGE (APPLICATION)

The teacher invites the students to determine whether plants need light to live or not. An experiment on plant growth could then be done.

SCIENTIFIC CONCEPTUAL CONTENT

Light

Light is a form of radiation that the eye can detect. Visible light represents only a tiny portion of the electromagnetic spectrum, which is made up of wavelengths that are mostly invisible to the naked eye, such as gamma rays, x-rays, ultraviolet rays, and infrared rays. (For an image of the light spectrum, consult the supplementary links on the *Éclairs de sciences* website.) Visible light is white because it comes from adding together all the colors of the rainbow. Light is made up of photons, which are particles of energy that move as electromagnetic waves, i.e., in a straight line.

Light intensity

This is the level of brightness that we perceive. The farther away a light source, the weaker its intensity, since its rays disperse into the environment. This is why our sun, which is a star, seems brighter than the other stars in the galaxy. This impression is caused by the fact that the Sun is near the Earth, unlike the other stars.

Natural sources of light

The sun, fire, stars, fireflies, and certain chemical reactions produce light naturally.

Artificial sources of light

All sources of light developed by humans; for example, light bulbs, flashlights, traffic lights, televisions.

Transparence

Materials allow light to pass through them in different degrees. Transparent materials such as glass allow light to pass through them. Translucent materials such as tinted glass only let some light through, while opaque materials block all light.

CULTURAL REFERENCES

History

The sun, a source of light and heat, has always been a very powerful symbol. Many countries have a representation of the sun on their flags. The sun on the Argentinean flag honors the Inca people, while the sun on the Japanese flag symbolizes the word "Japan," which means "Empire of the Rising Sun."

Culture

To explain why the sun's light varies throughout the day, the Maya people had the myth of the sun god Kinich Ahau, or "Lord Eye Solar," who personified the sun. At dawn, Kinich Ahau is a young god, but he ages and weakens throughout the day. When he has no strength left, he goes to bed and closes his eyes, which causes night to fall. When he has recovered, he wakes up and a new day begins.

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

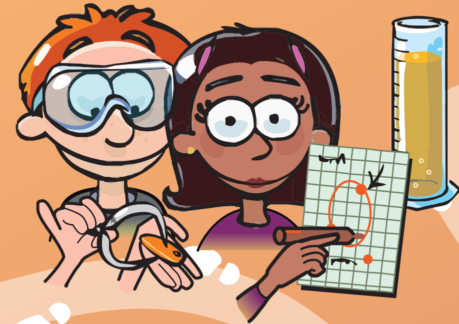
- **Situation problem** or
- **Discovery question** or
- **Need to be fulfilled**
- **Question related to the operation of an object** (how does it work?)

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



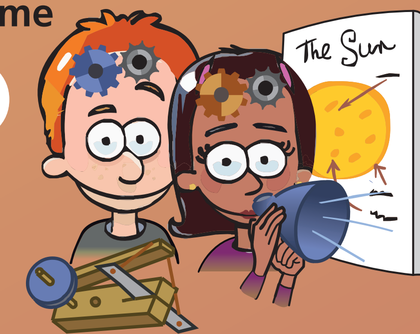
My equipment:
- I observe and handle the equipment.
- How could this equipment be useful to me?
- I choose my equipment and my materials.

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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