**What is Light? Lesson 2**

<table>
<thead>
<tr>
<th>Critical Learning</th>
<th>Guiding Questions</th>
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<tbody>
<tr>
<td>• Light is a form of energy, produced from a variety of sources, and can be</td>
<td>• What is light and how is it produced?</td>
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<td>transformed into other useful forms of energy.</td>
<td>• How is light used in technology?</td>
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<td>• Energy comes in many forms, and can change forms.</td>
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**Curriculum Expectations**

**Scientific Investigation Skills and Career Exploration**

**A1.** demonstrate scientific investigation skills related to both inquiry and research in the four areas of skills: initiating and planning, performing and recording, analysing and interpreting, and communicating

**A1.11** communicate ideas, plans, procedures, results, and conclusions orally, in writing, and/or in electronic presentations, using appropriate language and a variety of formats

**Physics: Light and Applications of Optics**

**E2** Investigate, through inquiry, properties of light, and predict its behaviour and predict its behaviour in mirrors and as it passes through different media

**E2.1** use appropriate terminology related to light and optics, including, but not limited to: angle of incidence, angle of reflection, angle of refraction, centre of curvature, focal length, luminescence, magnification, principal axis, radius of curvature, and vertex [C]

**E3** demonstrate an understanding of characteristics and properties of light, particularly with respect to reflection and refraction and the addition and subtraction of colour

**E3.1** describe various types of light emissions and how they produce light

**Learning Goals**

Students will be able to:

• identify light as a form of energy
• identify types of light transmission using appropriate terminology
• demonstrate inquiry skills of performing and recording, analyzing and interpreting, and communicating

**Instructional Components and Context**

**Readiness**

• Group work norms and skills, e.g., taking roles, taking turns, disagreeing agreeably, coming to consensus
• Students will use learning from Grade 9 electricity and chemistry units.

**Terminology**

• Emit
• Reflect
• Luminous/non-luminous
• Combustion
• Electric discharge
• Incandescence
• Fluorescence
• Phosphorescence
• Luminescence
• Electroluminescence
• Bioluminescence
• Chemiluminescence

**Materials**

• Chart paper/board/markers/chalk
• Objects or images of objects that are luminous and non-luminous (see vocabulary list) for stations
• Vocabulary cards
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Minds On (Elicit, Engage)

Whole Class ➔ Connecting Prior Knowledge and Sharing learning goals
Using think-pair-share, students discuss what is meant by the word energy. Create a mind map based on student responses. Extend the discussion by focusing on light as a form of energy.

Referring to the anchor chart from the previous class, discuss if any of the optical devices involve energy.

Introduce the learning goals and the guiding questions for this lesson. Review any safety procedures pertinent to this lesson.

Pause and Ponder

Quick Tip
See Strategy Implementation Continuum.

AOLT Use the learning goals and guiding questions as prompts to introduce the Action! and for opportunities to reflect on learning throughout the lesson. See Metacognition Guide.

Action! (Explore, Explain)

Pairs/Small Groups ➔ Investigating Energy Transformation
Set up stations around the room with objects or images of objects, e.g., candle, glow stick, flashlight, mirror, image of the moon that emit or reflect light. Review the terms emit and reflect.

Using a bell-ringer format, pairs visit stations, record the name of the object and indicate whether it emits or reflects light.

Pairs combine to form small groups, compare their lists, and resolve any discrepancies. Post the following sentence stems: Objects that emit light do...; Objects that reflect light do...

Students to complete the sentence stems to draw conclusions and make a jot note. Debrief by inviting responses and then students add any additional information to their jot note.

Small Groups/Whole Class ➔ Reviewing and Building Vocabulary
Provide each group with three sets of cards - one set with terms related to light production, e.g., combustion, fluorescence, chemiluminescence, another with definitions, and a third with images.

Students match the three sets of cards based on their current understanding.

Point out that these terms can be broken down into parts in order to understand their meanings, for example, by identifying prefixes, e.g., bio (life), chemi (chemical), tribo (friction). Explain that the meaning can be derived by looking at the word origins, for example, fluorescent (fluorspar) and phosphorescence (phosphor). Discuss how knowledge of the words often assists us with understanding the type of energy transformation involved in producing light energy.

In their groups, students revisit their card matching to confirm or revise based on these vocabulary strategies. Circulate and monitor students’ understanding of the terms, and use prompts to guide their matches, where necessary.

Debrief and point out that in science (as in other subject areas), using the correct terminology is important to communicating concepts and ideas.

Consolidation (Elaborate, Evaluate, Extend)

Individual ➔ Drawing Conclusions
Students add their responses to the following question ‘What is light and where does it come from?’ to their jot note.

Whole Class/Individual ➔ Gathering Information for Culminating Task
Review the anchor chart listing the various technologies (from Lesson 2). Add any additional technologies that students may have encountered in the lesson. Pose the questions: Which of these technologies emit light? Which reflect light? Which do both? Which do neither? Invite student responses and code the items on the list to signify these characteristics.

In their project logs, each student jots information about their technology (selected in Lesson 2) related to if and how it emits and/or reflects light.

Quick Tip
Remind students that light is a form of energy.

AOLT Check students understanding as evident in their conclusions. Use question prompts to support and/or challenge student understanding.
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Think-Pair-Share

Bennett and Rolheiser (2001) describe Think-Pair-Share as “one of the simplest of all the tactics” (page 94). As pointed out by Bennett and Rolheiser and Think Literacy (page 152), students require skills to participate effectively in Think-Pair-Share:

- active listening
- taking turns
- asking for clarification
- paraphrasing
- considering other points of view
- suspending judgement
- avoiding put-downs

These skills can be modelled and explicitly taught. During group work, teachers can provide oral feedback and reinforce expectations.

Bennett and Rolheiser (2001) note additional considerations:

- the level of thinking required in a think-pair-share
- accountability and level of risk, e.g., are all students expected to share with the whole group? (page 94).


Strategy Implementation Continuum

It is important that the teacher model each strategy or skill with a think-aloud before engaging students in shared and guided practice. See the Strategy Implementation Continuum (gradual release model). Provide feedback on effective strategy use as students use the strategy.

Safety Procedures

Teachers must model safe practices at all times and communicate safety expectations to students in accordance with school board and Ministry of Education policies and Ministry of Labour regulations. Teachers are responsible for ensuring the safety of students during classroom activities and also for encouraging and motivating students to assume responsibility for their own safety and the safety of others. Teachers must also ensure that students have the knowledge and skills needed for safe participation in science activities.

To carry out their responsibilities with regard to safety, it is important for teachers to have:

- concern for their own safety and that of their students
- the knowledge necessary to use the materials, equipment, and procedures involved in science safely
- knowledge concerning the care of living things – plants and animals – that are brought into the classroom
- the skills needed to perform tasks efficiently and safely

Students demonstrate that they have the knowledge, skills, and habits of mind required for safe participation in science activities when they:

- maintain a well-organized and uncluttered work space
- follow established safety procedures
- identify possible safety concerns
- suggest and implement appropriate safety procedures
- carefully follow the instructions and example of the teacher
- consistently show care and concern for their own safety and that of others

Various kinds of health and safety issues can arise when learning involves field trips. Out of-school field trips can provide an exciting and authentic dimension to students’ learning experiences. They also take the teacher and students out of the predictable classroom environment and into unfamiliar settings. Teachers must preview and plan these activities carefully to protect students’ health and safety.

The Ontario Curriculum, Grades 9 and 10: Science, 2009

Specific Safety Notes for this Lesson

When working with open flames, students should:

- wear goggles
- take care that hair, clothing, and hands are a safe distance from the flame at all times
- never reach over an open flame
- never leave an open flame unattended

When working with a light source, students should:

- never look directly into the light source

When working with glow sticks, students should:

- never puncture or open the sealed container
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Grade 10, Science, Applied SNC2P

Mind Map
Bennett and Rolheiser (2001) identify critical attributes of mind maps:
- a central image representing the subject
- main themes radiating like branches from that central image
- a key image or key word for each branch
- connections between the image and branches
- use of colour


Action! (Explore, Explain)

Jot Notes
Jot Notes is one approach to making notes. Jot notes include:
- a title and date
- information recorded in point form using bullets
- key words or phrases that will help recall important ideas

Vocabulary
Effective vocabulary-building practices include the following:
- Knowing a definition is not synonymous with understanding a word.
- Word knowledge is built incrementally.
- Limit words to those essential to the unit and to those students will use during teaching-learning activities.
- Include proper names.
- Students need to hear words used in context and to practise using words themselves in context about a half-dozen times.
- For multi-syllabic words, pronounce words clearly while cueing students to word parts visually so that students both hear and see words.
- Associate words with visual symbols and with words students already know.
- Use color and clustering, e.g., concept maps and mind maps, to show connections between words.
- Gradually build understanding of the multiple meanings of words.
- Use semantic maps to focus on related words, explanations, what it isn't, word roots, and prefixes and suffixes, word history (how it came to mean what it does).

Resources for vocabulary building:


Consolidation (Elaborate, Evaluate, Extend)

Anchor Charts
An anchor chart is a strategy for capturing students’ voices and thinking. Anchor charts are co-constructed. By making students’ thinking visible and public, they “anchor,” or stabilize and scaffold classroom learning. Anchor charts should be developmentally appropriate and clearly focused, accessible, and organized.