

Teacher Package

Science and Technology Exemplar Task Grade 4

Teacher Package

Title: The Mood Machine

Time Requirements: 400–440 minutes (over several class periods)

Introductory activities

- Pre-task 1: 50 minutes

Exemplar task

- Part 1: 90 minutes
- Part 2: 180–200 minutes
- Part 3: 80–100 minutes

Description of the Task

Students are challenged to use their knowledge of the properties of light and of how materials affect light to design and construct a device to provide a “mood light” for the classroom.

Students will complete the worksheets provided in this package and submit selected worksheets for assessment.

Scenario and Instructions for Students

Students should be presented with the scenario and instructions outlined in Appendix 2.

Curriculum Expectations Addressed in the Task

Note that the codes that follow the expectations relate to the Ministry of Education’s *Curriculum Unit Planner* (CD-ROM).

Students will:

1. demonstrate understanding that certain materials can transmit, reflect, or absorb light or sound (4s20);
2. investigate materials that transmit, reflect, or absorb light or sound and use their findings in designing objects and choosing materials from which to construct them (4s21);
3. explain why materials that transmit, reflect, or absorb light and/or sound are used in a variety of consumer products (4s22);
4. demonstrate an understanding of the characteristics and properties of light and sound (4s45);
5. investigate different ways in which light and sound are produced and transmitted, and design and make devices that use these forms of energy (4s46);
6. identify technological innovations related to light and sound energy and how they are used and controlled at home and in the community, and determine how the quality of life has been affected by these innovations (4s47);
7. formulate questions about and identify problems related to the ways in which materials transmit, reflect, or absorb sound or light, and explore possible answers or solutions (e.g., predict and verify the size, shape, and location of shadows from a given light source, or the types of materials that will make ringing sounds when struck) (4s30);
8. plan investigations for some of these answers and solutions, identifying variables that need to be held constant to ensure a fair test and identifying criteria for assessing solutions (4s31/4s61);
9. compile data gathered through investigation in order to record and present results, using tally charts, tables, and labelled graphs produced by hand or with a computer (e.g., create a table to show the types of sounds made by hollow objects, such as a coffee can full of air, and by solid objects, such as a coffee can filled with sand) (4s33/4s63);
10. communicate the procedures and results of investigations for specific purposes and to specific audiences, using oral presentations, written notes and descriptions, drawings, and charts (4s34/4s64).

“Big Ideas”

Based on the expectations being assessed, the following “big ideas” have been identified for this task:

- Light is a form of energy that has specific properties.
- Materials affect and are affected by light.

Teacher Instructions**Prior Knowledge and Skills Required**

Before attempting the task, students should have had experience with the following:

- the design process
- construction techniques (e.g., cutting cardboard boxes)
- the topics that pertain to light from the strands Energy and Control, and Matter and Materials

The Rubric

The rubric* provided with this exemplar task is to be used to assess students' work. The rubric is based on the achievement levels outlined on page 13 of *The Ontario Curriculum, Grades 1-8: Science and Technology, 1998*.

Introduce the task-specific rubric to students at least one day before administering the task. Copy the rubric for students or create a transparency to use with the class. You may find it useful to rephrase the rubric for students to help them in their work.

Review the elements of the rubric with students to ensure that they understand the criteria and the descriptions for achievement at each level. Allow ample class time for a thorough reading and discussion of the assessment criteria outlined in the rubric.

Accommodations

Accommodations that are normally provided in the regular classroom for students with special needs should be provided in the administration of the exemplar task.

Classroom Set-up

- Each student will need a large work surface such as a section of the floor or a large table.
- Centres may be set up for cutting and gluing materials.
- A dark test area should be made available so students can test the effectiveness of their devices.

Materials Needed

Students will need some of the following materials:

- | | |
|---------------------------------------|--|
| - wire | - small mirrors |
| - broad-tipped markers | - low-temperature glue gun |
| - construction paper | - low-temperature glue sticks |
| - coloured tissue paper | - junior hacksaw |
| - flashlights (optional) | - coloured acetate |
| - boxes (e.g., small boxes from home) | - simple bulb holders |
| - margarine containers | - bulbs |
| - tinfoil | - battery holders |
| - tape | - batteries |
| - jinx wood | - scissors |
| - wood glue | - “found” materials (e.g., cloth pieces, plastic lids) |

Safety Considerations

- Students should be equipped with safety glasses.
- The bulbs and holders or flashlights are the only recommended light sources for this activity, as lamps above twenty watts are likely to give off enough heat to burn a student or damage materials such as plastics. Halogen sources should definitely not be used, no matter what the wattage, as they are extremely hot.
- Remind students to follow established safety procedures when working with batteries.

Definitions of Key Terms

absorb. To “soak up” or take in. Depending on their colour pigments, opaque materials absorb all or some light energy and reflect the non-absorbed light energy that we see as the colour of the materials.

artificial light sources. Sources of light that are created by humans (e.g., candles, flashlights, fireworks, televisions).

natural light sources. Light sources that are not created by humans (e.g., sun, fire, fireflies, lightning).

opaque materials. Materials that do not allow any light to pass through. Opaque materials either reflect or absorb light energy. Most materials are opaque.

reflect. To cast light back or bend it back in another direction. Smooth, shiny surfaces usually reflect light.

shadow. If you place an opaque material in front of a light source, the light beam cannot bend around the object and an area of darkness – a shadow – is created.

translucent materials. Materials that allow some light to pass through. Clear images cannot be seen through the materials.

transmit. To allow light to pass through space or a medium (e.g., light passing through a coloured filter. The filter is said to “transmit” light.).

transparent materials. Materials that allow most light to pass through easily. Clear images can be seen through the materials.

*The rubric is reproduced on pages 68–69 of this document.

Task Instructions

Introductory Activities

The pre-tasks are designed to ensure that students have the prior knowledge required to complete the exemplar task. These activities review and reinforce the skills and concepts that students will be using in the exemplar task. The student work is to be completed in its entirety at school. Materials may be brought from home, but they may *not* be pre-constructed at home.

Pre-task 1: Introducing the Exemplar Task

1. Turn off the lights in the classroom and close the curtains. Choose a short story or picture book to read in which the illustrator has used light effectively to evoke a mood or feeling (e.g., soft colours for calmness).
2. Begin to read the story. Emphasize the fact that you are having difficulty reading because of the lighting. Ask students what could be done to help you read more easily. (Students will probably suggest turning on the lights, opening the curtains, or using alternative light sources. Help students think of many possibilities.)
3. Discuss reasons why you might have turned out the lights. (For example, students might suggest to create a calm effect or to save energy.) Focus the discussion on the idea of creating an appropriate mood for listening to a story. Have students brainstorm different moods. How and why do moods change? How is the mood created in books? In movies? How is light used to create mood?
4. Introduce a small-group discussion with: "I wanted to create a different mood for our reading time today. I made it darker to create a mood, but then I found that I could not see to read the story. What device could we make to create a different mood, but still give me enough light to read by?"
5. Have students work in small groups to brainstorm possible solutions to your problem, recording their brainstorming ideas on chart paper. Have each group share two ideas with the class. Post the charts in the classroom for future reference.
6. Distribute a Student Package to each student. Read the task and criteria with students (see Appendix 2). Emphasize that they will be working independently to complete the task.

Exemplar Task

The completed student worksheets "Identify the Problem/Need", "Planning", "Test/Revise/Retest", "Final Drawing", and "Reflection" (see Appendices 3 to 7) are to be submitted for marking.

Part 1: Planning

1. Review the design process (see Appendix 1) with students.
2. Ask students to work independently, using their worksheets, to rephrase the challenge they have been given and plan their solutions to the challenge (see Appendices 3 and 4). Remind students to include references both to the problem to be solved and to the design criteria.
3. Have students hand in these pages at the end of the session for your review. This will allow both you and your students an opportunity to identify the materials to be obtained (from class or home).

Part 2: Construction and Testing

1. Prepare the classroom so that each student has a large enough workspace.
2. Ensure that cutting and materials stations are established as well as a darkened test area.
3. Remind students of the criteria to be met when doing this task: their alternative light sources must have an interesting lighting effect and must provide sufficient light for you to read.
4. Have students complete the construction of their devices and then test them in the dark area, making modifications to their devices as required.

Part 3: Communicating

1. Have students analyse their work using the worksheets in their student packages (see Appendices 5, 6, and 7).
2. Have students demonstrate their models for other class members.

Part 4: Relating

Have students record specialized light sources found in their community and explain how this lighting is used for a specific purpose (e.g., a traffic light uses different colours to control the movement of the traffic) (see Appendix 7, examples section).

Appendix 1

The Design Process

Identifying the Problem/Need

- Provide a description of the problem/need (see Appendix 3, under “The Challenge”).
- Brainstorm solutions to the problem (see Appendix 3, boxes “A” and “B”).

Making the Plan

- Select a solution from the alternatives and outline the steps to be followed using the appropriate vocabulary (i.e., make a labelled sketch) (see Appendix 4, “Planning”).
- Select and record the appropriate materials and tools (see Appendix 4, “Planning”).

Executing and Evaluating the Plan

- Construct the solution that represents the plan and meets the design criteria (see Appendix 6, “Final Drawing”).
- Test the solution and make necessary modifications to meet the design criteria (see Appendix 5, “Test/Revise/Retest”).
- Reflect (see Appendix 7).

Communicating

- Communicate the solution concisely and accurately (see Appendix 6, “This is how it works ...”) using the appropriate science and technology vocabulary.

Appendix 2

The Challenge: A Mood Machine

Your teacher is planning a special story time and wants to change the mood in the classroom by changing the lighting. Your task is to design and construct a device that will provide an alternative light source for the room with an interesting lighting effect and enough light for the teacher to read.

You will have to convince your class and your teacher that your device meets the challenge and includes the required criteria. This challenge tests your understanding of the properties of light and how materials affect or control light.

Criteria

Your project should:

- use an artificial light source;
- provide sufficient light for your teacher to read with;
- use transparent, translucent, and opaque materials;
- demonstrate transmission, reflection, and absorption of light.

Before you build your device, you will need to hand in the following:

- a description/restatement of the problem in your own words and a list (or sketches) of possible solutions
- a labelled sketch of your proposed project that shows the transparent, translucent, and opaque materials you plan to use
- a list of the materials you will need to build your device
- an outline of how your device will work and what mood (what effect) it will create (Use appropriate science and technology vocabulary.)

After you have constructed your device, you must hand in the following:

- a drawing of your final project that points out the changes between your final project and your original proposal (Include labels using appropriate science and technology vocabulary.)
- an analysis of your work using the prompts in the student booklet
- examples of specialized lighting in your community with a description of their purpose

Appendix 3

Identify the Problem/Need

The Challenge (Describe in your own words.)

My challenge is to design ...

In the space below draw two labelled sketches of what your mood machine could look like. Then choose the design that you think will work best for Appendix 4.

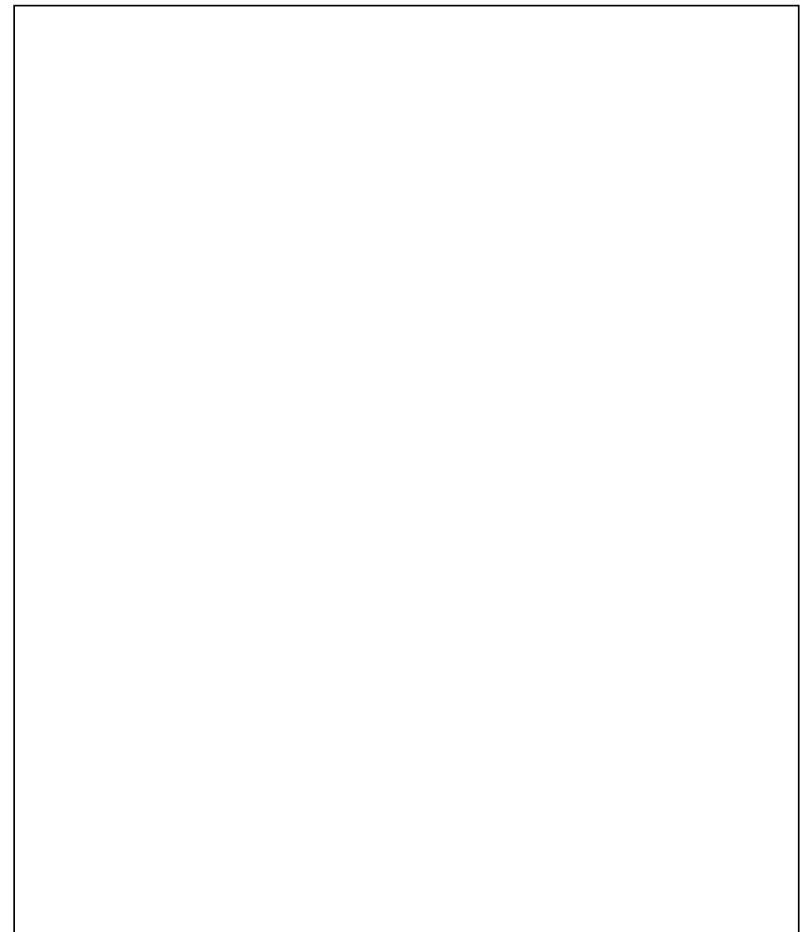
| | |
|----------|----------|
| A | B |
|----------|----------|

9

Appendix 4

Planning

This is a picture of the design I will try. Draw a more detailed, labelled sketch in the space.



10

This is a list of materials I will need...

| Material | Effect on Light |
|-----------------|----------------------------|
| (e.g., mirror) | (e.g., reflects the light) |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

Appendix 5

Test/Revise/Retest

I made the following changes to my plan.

| Change | How It Improved My Design |
|---------------|----------------------------------|
| | |
| | |

