Teacher Package

Science and Technology Exemplar Task
Grade 5

Teacher Package

Title: Slippery Shapes

Time Requirements: 265 minutes (over several class periods)

Introductory activities
- Pre-task 1: 15 minutes
- Pre-task 2: 20 minutes
- Pre-task 3: 30 minutes
- Pre-task 4: 20 minutes

Exemplar task
- Part 1: 30 minutes
- Part 2: 60 minutes
- Part 3: 90 minutes

Description of the Task

Using the inquiry process, students will choose an appropriate lining material for gelatin moulds. They will identify the properties of the materials they select, conduct a fair test to determine the best lining, and communicate their findings. Students will also explain the states of matter and changes in the states of matter observed through the process of making gelatin cookies.

Students will complete the worksheets provided in this package and submit selected worksheets for assessment. They will also be asked to respond orally to questions posed by the teacher, and these interviews will be videotaped. The videotapes will also be used for assessment purposes.

Scenario and Instructions for Students

Students should be presented with the following scenario and set of instructions:

A Grade 2 teacher is planning to make "Slippery Shapes" cookies for his class. He is using a mould that must be lined to contain the "slippery solution". He is not sure which lining material will be best to:

- *contain the shape until it sets;*
- *allow him to remove the shape easily and with a minimum of damage from both the mould and the lining material;*
- *ensure that the finished product has the shape of the mould.*

He has asked your class to recommend a lining material for his moulds. To do so you will have to develop and record the results of a fair test that will allow you to determine a material that will meet his criteria. You will be asked to explain your findings to the teacher.

The Grade 2 teacher is also wondering if he will be able to teach his class about matter as he makes the shapes. You will need to convince him that he can do so. To be prepared, you will identify the states of matter and the changes in the states of matter that you observed as the shapes were made.

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 an understanding of the three states of matter and of changes in state (5s27);
2. investigate common changes of state (e.g., melting, freezing, condensing, evaporating) and make informed choices about materials when finding solutions to problems in designing and constructing objects (5s28);
3. identify the three different states of matter – solid, liquid, and gas – and give examples of each state (e.g., solid: sugar, rock; liquid: water, oil, gasoline; gas: water vapour, air, oxygen) (5s33);
4. identify the characteristic properties of each of the three states of matter and group materials on the basis of these properties (e.g., solids have definite volume and hold their shape; liquids have definite volume but take the shape of their container; gases have no definite volume and take the volume and shape of their container) (5s34);
5. conduct a fair test to determine the effectiveness of a variety of commercial products designed for the same purpose (e.g., compare the adhesive qualities of different types of glue) (5s41);
6. formulate questions about and identify needs and problems related to the properties and changes in state of familiar materials, and explore possible answers and solutions (5s42);
7. 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 (5s43);
8. use appropriate vocabulary, including correct science and technology terminology, in describing their investigations and observations (e.g., use terms such as *texture, hardness, strength, buoyancy, solubility,* and *flexibility* to describe properties of materials) (5s44);

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., record the reactions of different materials when vinegar is dropped on them, and use a data table to present their findings) (5s45);
10. communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, oral presentations, written notes and descriptions, drawings, and charts (e.g., make accurate and detailed drawings of sugar crystals, as seen both with the unaided eye and through a magnifying glass or microscope) (5s46).

"Big Ideas"

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

- There are three states of matter and matter can go through changes of state.
- The properties of materials will determine the specific purpose(s) for which they will be used.

Teacher Instructions

Prior Knowledge and Skills Required

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

- activities and content related to the strand Matter and Materials: Grade 5 – Properties of and Changes in Matter
- conducting an inquiry, including a fair test

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 T*he 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

Water must be available at a test centre (e.g., water table, counter, tile floor).

Materials Needed

- copies of the Student Package
- writing instruments
- unflavoured gelatine, flavoured gelatine, small paper cups for moulds
- a clear container big enough to hold 30 mL
- water
- a kettle
- lining material for paper-cup moulds, such as plastic wrap, foil wrap, waxed paper, parchment paper, swatches of nylon material, plastic bag, or butcher paper
- stir sticks
- measuring devices
- chart paper
- (use of) a refrigerator
- a tray for carrying the paper-cup moulds to a refrigerator
- at least three types of erasers

Note: As the lining materials for the moulds must not produce any chemical change, do not use any linings made from foodstuffs such as cooking spray or vegetable oil.

Safety Considerations

When adding boiling water to the powders, ensure that students are far enough away from the steam of the boiling water in the kettle and the hot liquid that they will not be scalded.

Task Instructions

Introductory Activities

The pre-tasks are intended to ensure that students have the prior knowledge required to complete the exemplar task. The purpose of Pre-task 1 is to introduce the exemplar task, review the elements of the rubric, and allow time for students to ask questions for clarification. Pre-tasks 2, 3, and 4 are designed to review and reinforce the skills and concepts that students will be using in the exemplar task.

*The rubric is reproduced on pages 14–15 of this document.

Pre-task 1: Introducing the Task

1. Explain to students that a Grade 2 teacher has a problem to solve and that the class might be able to help.
2. Introduce the student scenario.
3. Share and discuss the assessment rubric with students.
4. Allow time for questions and clarification.

Pre-task 2: Properties of Materials

1. Discuss with students the uses of a pencil.
2. Divide the class into two groups. Have one group brainstorm a list of characteristic properties of the graphite used in pencils. Have the other group brainstorm a list of characteristic properties of the wood used in pencils. Record the lists on chart paper and display them in the classroom.
3. Present the group lists to the class and discuss the characteristic properties of the two materials that determine their appropriate use for pencils (e.g., both wood and graphite can be shaved to a point; graphite leaves a mark on paper that can be removed with an eraser).
4. Discuss the environmental impact of the use of graphite and wood. (Ask students why graphite pencils are commonly called lead pencils and why pencils were once made with lead but now use graphite instead.)

Pre-task 3: Conducting an Inquiry

1. Tell your students that they have been asked to determine which of three erasers works best to remove graphite pencil marks from paper.
2. Have students complete the first two columns of the "Erasers Observation Chart" (see Appendix 2) and then outline on the "Erasers Inquiry Recording Sheet" (Appendix 3) the steps they would follow to determine which of the erasers will best remove pencil marks.
3. Allow students to conduct the experiment, record and interpret their observations in column 3 of the "Erasers Observation Chart" (see Appendix 2), draw conclusions, and make any necessary revisions to their "Erasers Inquiry Recording Sheet".
4. Lead the class through a reflection about the importance of fair testing and about its related aspects: constants, variables, making detailed observations, recording data systematically, drawing valid conclusions, communicating clearly, and using appropriate vocabulary (see Appendices 1 and 7).

Pre-task 4: Discussion

1. Through class discussion, have students recall the work they have done on the states of matter and changes in these states.
2. Record students' replies and post them for reference.

Exemplar Task

The completed student worksheets "Slippery Shapes Inquiry Recording Sheet", "Slippery Shapes Observation Chart", and "What Did I Learn?" (see Appendices 4, 5, and 6) are to be submitted for marking.

Part 1: Class Demonstration by Teacher

Note: Before the class demonstration, prepare a Slippery Shape in a yogurt container and leave it in the refrigerator.

For the class demonstration, have ready the materials needed to prepare Slippery Shape solution for the whole class to use and a container to mix it in. Ensure that students see the actual boiling of the water, the mixing of the powders and liquids, and the filling of the container. Use the Slippery Shape you prepared before class to demonstrate how difficult it is to remove from the container.

1. Distribute the Student Packages.
2. Display the various lining materials available for student selection.
3. Provide opportunities for students to make and share observations about the characteristic properties of the various lining materials.
4. Have students independently select three materials and complete sections 1 and 2 of the "Slippery Shapes Inquiry Recording Sheet" (see Appendix 4).
5. Have students make further observations of their selected materials and record the data in the first two columns of the "Slippery Shapes Observation Chart" (see Appendix 5).
6. Have students outline the steps they will follow to determine the best lining material, recording these in parts 3 to 6 of the "Slippery Shapes Inquiry Recording Sheet".

Slippery Shape Solution

This recipe makes Slippery Shape solution for five students with approximately 30 mL used for each mould.

20 mL	unflavoured gelatin (two envelopes) (for thickening)
250 mL	flavoured gelatin (two 85 g boxes) (for colour)
250 mL	boiling water
250 mL	cold water

Mix the first three ingredients until the gelatin is dissolved, then add the cold water. The solution is ready to put into the moulds.

Part 2: The Experiment

Have students carry out the experiment. Each student is to:
- gather the three lining materials he or she has selected;
- line three moulds with these materials;
- fill the moulds with the Slippery Shape solution that was prepared earlier;
- put the moulds on a tray and carry them to a refrigerator;
- make any necessary additions or revisions to the "Slippery Shapes Observation Chart" and the "Slippery Shapes Inquiry Recording Sheet".

Part 3: Drawing Conclusions

1. Have each student remove the Slippery Shapes from his or her three lined moulds after the moulds have been in the refrigerator for at least one hour and record his or her observations in the third column of the "Slippery Shapes Observation Chart".
2. Ask students to analyse and interpret the results of the experiment, recording their conclusions in part 7 of the "Slippery Shapes Inquiry Recording Sheet".
3. Have students complete the "What Did I Learn?" worksheet (see Appendix 6).

About the Videotaping

For this video exemplar, teachers were asked to set the stage for students to be videotaped individually by TVOntario. Teachers were present for the videotaping and provided the questions/prompts listed below to help students articulate their understanding/learning.

Prompts Used in Videotaping Students

1. What problem were you trying to solve in this inquiry?
2. Which three materials did you choose for your liners and why?
3. When you were asked to make a prediction/hypothesis, which material did you select as the best liner and why?
4. What liner would you recommend to the Grade 2 teacher as the most effective material to:
   - contain the shape until it sets?
   - allow him to remove the shape easily from the mould and the liner?
   - ensure that the finished product has the shape of the mould?
5. Tell me why you made this recommendation?
6. What states of matter did you observe as the Slippery Shapes were being made?
7. Give examples of each of the states that you observed.

8. (*Teacher: Choose one of the following questions, based on the student response to question 6.*)
   - How did you know that there was a gas? *or*
   - How did you know that there was a solid? *or*
   - How did you know that there was a liquid?
9. What changes did you observe as the Slippery Shapes were being made?
10. Tell me of other times, outside the classroom, when you have seen examples of changes in the state of matter.
11. Choose one of your examples and, in scientific terminology, explain how you know there was a change in state.

Appendix 1

A Fair Test

- One variable* at a time is selected for testing.
- Only the chosen variable is altered.
- As many variables as possible are kept constant in the testing.
- All tests are measured in the same way.
- Tests are repeated to determine the validity of the test results.

*A *variable* is something that can be changed and that may affect results.

Appendix 2

Erasers Observation Chart

Type of Eraser	Description of Material (Properties)	Observations (How effectively did the eraser remove the pencil mark?)

Appendix 3

Erasers Inquiry Recording Sheet

Describe the experiment you will use to determine which eraser will best remove graphite pencil marks from a piece of paper. You may use pictures and/or words to complete the recording sheet. Write on the back if more space is required.

1. **My question:**

2. **My prediction/hypothesis:**

3. **The variable I am going to change:**

4. **The variables I am going to keep the same:**

5. **Materials/equipment I need:**

6. **My plan:**

7. **My conclusion:**

Appendix 4

Slippery Shapes Inquiry Recording Sheet

Describe the experiment you will use to determine which lining material you are going to recommend to the Grade 2 teacher. You may use pictures and/or words to complete the recording sheet. Write on the back if more space is required.

1. **My question is:**

2. **My prediction/hypothesis is:**

3. **The variable I am going to change is:**

4. **The variables I am going to keep the same are:**

5. **Materials/equipment I need:**

6. **My plan is:**

7. **My conclusion:** In the space below, indicate the material you would recommend to the Grade 2 teacher as the liner for his moulds. Explain your thinking.

Appendix 5

Slippery Shapes Observation Chart

Material	Description of Material (Properties)	Observations (How effective was this liner for the mould and why?)

Appendix 6

What Did I Learn?

1. **What states of matter did you observe through the process of making the slippery shapes? Give evidence by naming examples and identifying the properties of each state that support your thinking.**

2. **At what point did you observe changes in the states of matter? Explain and give examples.**

3. **Identify and compare changes of state in matter in the outside world to the changes of state you observed in your procedure.**

4. Briefly summarize the information you want to communicate to the Grade 2 teacher.

What material are you recommending?	What characteristics and properties of the material made it a good liner?
Making Slippery Shapes is a good demonstration of the states of matter and changes in these states because:	

Appendix 7

Glossary for Teachers

changes of state. When matter changes from one state to another.

chemical change. Usually a non-reversible change in which a material is changed into a new material.

evaporation. When a liquid changes into a gas as a result of the addition of heat.

fair test. An experiment carried out with all but one variable being controlled.

freezing. When a liquid changes into a solid as a result of the removal of heat.

gas. A state of matter that does not have a definite shape or occupy a definite volume.

liquid. A state of matter that has a definite volume but not a definite shape.

matter. Any material with mass and volume.

melting. When a solid changes into a liquid as a result of the addition of heat.

physical change. Usually a reversible change in which the original material is not altered chemically.

property. A property of matter is what it looks, feels, tastes, smells, or sounds like, or how it behaves.

Slippery Shape. A jelly that is both a solid and a liquid; it contains liquid particles that are suspended in the solid. For this task, the Slippery Shapes are considered a solid as they have a definite volume and a definite shape.

solid. A state of matter that has a definite volume and a definite shape.

solidification. When a liquid changes into a solid as a result of the removal of heat.

states of matter. The physical form of matter: solid, liquid, or gas.

variable. Something that can be changed that may affect results.