YORK/SENECA INSTITUTE FOR SCIENCE, TECHNOLOGY AND EDUCATION

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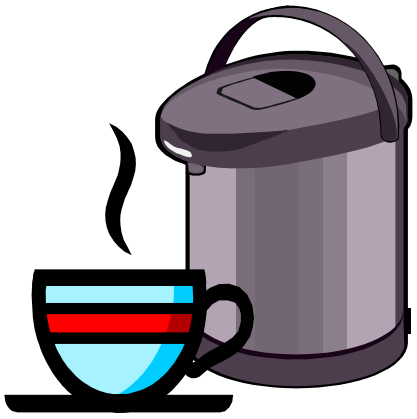
ASSESSMENT OF SCIENCE AND TECHNOLOGY ACHIEVEMENT PROJECT (ASAP)

Science and Technology Exemplars

Grade 7: Energy and Control – Heat

Exemplar Task (7ECPT01/Mar 27, 2001)

Hot Drinks, Please!



Preface

This task is one of a series developed by the Assessment of Science and Technology Achievement Project (ASAP) which is being used for the ASAP Science and Technology Exemplars Project.

This task is organised in three parts:

A. Task Overview
B. Student task sheet – designed to be photocopied for the students
C. Teacher Information – providing essential information relating specifically to this task

For further information, contact the ASAP office at 416-736-5269 or email: asap@edu.yorku.ca

Task Overview

Description of the Task:

> ***This is a culminating activity designed to assess a cluster of expectations for this grade and strand. Students should have been taught the concepts and skills required to perform this task prior to attempting it.***
>
> ***In this activity, students will design and test a drink container to keep a liquid hot for a minimum of 10 minutes.***

Materials and Equipment Required:

selection of styrofoam cups, glass or ceramic mugs
different types of insulation (e.g., fur, foam, cloth, cotton, wool, corrugated cardboard and other available materials)
thermometers
clock or stopwatch
kettle
water
graduated cylinders
funnels
elastics
tape

Suggested Timeline:

3 x 65 minutes

Suggested Grouping:

- The task is to be completed in groups of 2 or 3
- The task report is to be completed individually

Safety Considerations:

Students should be warned about scalding risks of hot water. The teacher may want to handle the kettle. Safety procedures regarding use of thermometers should be reviewed. (e.g., only use alcohol thermometers)

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Student Task Sheets

Hot Drinks, Please!

You and a friend are planning to make some extra pocket money by setting up a hot drink service for your teachers. The teachers have been complaining that their ceramic mugs and Styrofoam cups are not working well. You will need to design and build a better drink container that will keep your teachers' drinks hot during lunch. Using the materials, design and build your container and conduct a fair test it to see if it will keep liquid hotter for 10 minutes.

Describe the fair test you will use to determine a better drink container (include the problem, prediction/hypothesis, materials and steps you would take to conduct your fair test. You may use works and pictures).

Problem

Prediction/Hypothesis

Materials

Steps

Draw a cross-section sketch of your container and indicate how the device minimizes energy transfer through conduction, convection and radiation.

Minimizing Conduction:_____

Minimizing Convection:_____

Minimizing Radiation:_____

Briefly summarize the information you want to communicate to your teacher.

What container design are you recommending?	What characteristics of the design minimize heat loss by conduction, convection and radiation?

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Teacher Information Sheets

A Fair Test

The second goal of Science and Technology Education encourages students to develop the skills, strategies, and habits of mind for scientific inquiry and technological design. As students investigate solutions to problems through an inquiry approach, it is important that they accommodate the conditions of a fair test as follows:

- 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

Note: A variable is something which can be changed and which may affect results.

This task addresses the following cluster of expectations. Expectations assessed by the rubric are highlighted in bold.

Understanding Basic Concepts

- **explain how heat is transmitted by conduction, convection, and radiation in solids, liquids, and gases (e.g., conduction: a pot heating on a stove; convection: a liquid heating in the pot; radiation: the air being warmed by heat from the element)**
- **design and build a device that minimises energy transfer (e.g., an incubator, a Thermos flask)**

Developing Skills of Inquiry, Design and Communication

- **formulate questions about and identify needs and problems related to heat (e.g., interactions involving energy transfers), and explore possible answers and solutions (e.g., identify the steps that could be followed to test the effectiveness of the heating system in a home that uses solar energy)**
- **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**
- **use appropriate vocabulary, including correct science and technology terminology to communicate ideas, procedures, and results (e.g., state the boiling and freezing point of water, room temperature, and body temperature in degrees Celsius; correctly use the terms *heat conductor and heat insulator*)**
- **compile qualitative and quantitative data gathered through investigation in order to record and present results, using diagrams, flow charts, frequency tables, bar graphs, line graphs, and stem-and –leaf plots produce by hand or with a computer (e.g., plot a graph showing he decrease in temperature and various liquids from identical initial temperatures)**
- **communicate the procedures and results of investigations for specific purposes and to specific audiences, using media works, written notes and descriptions, charts, graphs, drawings, and oral presentations (e.g., use a diagram to illustrate convection in a liquid or a gas)**

Relating Science and Technology to the World Outside the School

- explain why heat energy is considered to be the final or end form of energy transformation

Prior Knowledge Required:
Before attempting this task students should have been taught the following:

- how heat energy is transmitted by conduction, convection and radiation
- how energy transfer can be minimized through insulation
- that heat energy is the final form of energy transformation because heat dissipates and cannot be used again

Students should be familiar with the following science and technology terminology:

Conduction, convection, radiation, heat energy, transfer, insulation, heat conductor, heat insulator, temperature, degrees celsius, variables

Prior Skills Required:
Before attempting this task students should have experience of the following:

- use of thermometer
- investigating the affects of variables
- collecting and recording data
- report writing

Suggested Introductory Activities:
The following activities are suggested to introduce this task to the students:

- brainstorm designs and materials that would prevent heat loss from the cup as a class
- review the concepts of conduction, convection, radiation and insulation – list main points on chart paper

Cross-strand Links:

Every strand in the Science and Technology document has a common set of expectations clustered under the title ***Developing Skills of Inquiry, Design and Communication.*** This task is therefore appropriate to assess and evaluate these skills for every Grade 7 strand

Cross-curricular Links:

Links can be made to *The Ontario Curriculum Grades 1-8, Mathematics* Data Management and Probability: Grade 7. The specific expectations that could be addressed are:

- collect and organise data on tally charts
- identify and describe trends in graphs
- use conventional symbols, titles and labels when displaying data
- make inferences and convincing arguments that are based on data analysis
- evaluate arguments that are based on data analysis

Considerations for Split/Grade Classes:

Appropriate strategies are as follows:

- Teach one grade while the other grade completes the task which does not require active teacher guidance
- Create separate learning centers for student investigation specific to each grade topic and strand. The methods of science and technology (inquiry and communication) would provide the whole class focus
- Introduce self-directed student activities connected to specific expectations
- Reorganize students into grade groupings for the purposes of teaching a given topic
- Teach specific grade expectations when part of the class is working with another teacher
- Make connections by clustering the overall expectations around a theme.

RUBRIC FOR GRADE 7: Hot Drinks, Please!

Knowledge/Skills	Level 1	Level 2	Level 3	Level 4
Understanding of Basic Concepts • explains how heat is transmitted by conduction, convection and radiation	**The Student:** • gives simple explanation that shows limited understanding of heat transfer	**The Student:** • gives partial explanation that shows some understanding of heat transfer	**The Student:** • gives nearly complete explanation that shows good understanding of heat transfer	**The Student:** • gives complete and detailed explanation that shows thorough understanding of heat transfer
Inquiry Skills • developing and following a plan • safe use of equipment • control of variables in a fair test	**The Student:** • develops and follows a limited plan • needs frequent reminders about safety • does not identify and control variables when attempting to obtain measurable results	**The Student:** • develops and follows some aspects of an adequate plan • needs some reminders about safety • attempts to identify and control variables to obtain measurable results	**The Student:** • develops and follows an appropriate plan • needs few reminders about safety • identifies and control variables and conducts a test to obtain measurable results	**The Student:** • develops and follows an appropriate, detailed plan • needs no reminders about safety • identifies and controls a number of appropriate variables and conducts repeated tests to obtain measurable results
Communication of Required Knowledge • clarity and precision of the work • use of appropriate science and technology terminology in a correct context • clarity with discussion of experimental results	**The Student:** • presents a limited number of ideas and details with little clarity • contains few appropriate science and technology terms in a correct context • provides limited discussion of experimental results using only qualitative language	**The Student:** • presents ideas and details with some clarity but little detail • contains some appropriate science and technology terminology in a correct context • provides limited discussion of experimental results in quantitative ways but without appropriate tools (e.g., graphs, charts, diagrams)	**The Student:** • presents most of the main ideas and details clearly • contains frequent and appropriate science and technology terminology in a correct context • provides detailed discussion of experimental results in quantitative ways (e.g., graphs, charts, diagrams)	**The Student:** • presents all of the main ideas clearly and precisely within appropriate contexts • contains all appropriate science and technology terminology in a correct context • provides detailed and concise discussion of experimental results in quantitative ways (e.g., graphs, charts, diagrams)

*Written using the **Ontario Curriculum Unit Planner** (March 2001)*