Chemical and Physical Change

The Task

In the first part of the task, students worked in pairs to:

- observe the physical and chemical changes that produce carbon dioxide gas, and record their observations;
- examine the properties of the gas.

In the second part of the task, students were to work individually to design a container (on paper) to hold two chemical compounds that make carbon dioxide gas, and explain the process involved in designing the container, on the basis of their understanding of physical and chemical change. The container was to be such that:

- the chemical compounds would not come in contact with each other when the carbon dioxide product was not required for any application;
- when required, a fairly simple manipulation of the container would result in the two chemical compounds' coming into contact to produce the necessary carbon dioxide to extinguish a flame.

Each student was required to complete questions 1–7 in the student booklet.

Expectations

This task gave students the opportunity to demonstrate achievement of the following selected expectations from the strand Chemistry: Exploring Matter.

Students will:

1. describe, using their observations, the evidence for chemical changes;
2. demonstrate knowledge of laboratory, safety, and disposal procedures while conducting investigations;
3. determine how the properties of substances influence their use;
4. demonstrate the skills required to plan and conduct an inquiry into the properties of substances, using apparatus and materials safely, accurately, and effectively;
5. communicate scientific ideas, procedures, results, and conclusions using appropriate language and formats;
6. investigate the properties of changes in substances, and classify them as physical or chemical based on experiments;
7. explain how a knowledge of the physical and chemical properties of elements enables people to determine the potential uses of the elements and assess the associated risks.

Prior Knowledge and Skills

To complete this task, students were expected to have some knowledge or skills relating to the following:

- distinguishing between chemical and physical properties (elements and compounds)
- recording observations (including creating appropriate headings for the task) in a table, chart, or other suitable organizer, by hand or using spreadsheet software
- accurately drawing and labelling a diagram using a pencil and ruler, and writing a clear, concise explanation of what the diagram represents
- writing, using appropriate vocabulary, observations concerning colour, texture, density, and combustibility

For information on the process used to prepare students for the task and on the materials and equipment required, see the Student Task Description on pages 58–59 and the Teacher Package reproduced on pages 92–95.

Task Rubric – Chemical and Physical Change

Expectations*	Criteria	Level 1	Level 2	Level 3	Level 4
Knowledge/Understanding					
	The student:				
1, 3, 6	– demonstrates an understanding of the concepts of physical and chemical change and physical and chemical property	– demonstrates limited understanding of the concepts	– demonstrates some understanding of the concepts	– demonstrates considerable understanding of the concepts	– demonstrates a thorough understanding of the concepts
Inquiry					
	The student:				
3, 4, 6	– draws valid inferences from data	– draws inferences that have limited validity	– draws inferences that have some validity	– draws inferences that have considerable validity	– draws inferences that have a high degree of validity
	– follows the identified procedures	– follows a few of the identified procedures	– follows some of the identified procedures	– follows most of the identified procedures	– follows all/almost all of the identified procedures
Communication					
	The student:				
1, 5	– provides details that are consistent with data	– provides details often not consistent with data	– provides details sometimes consistent with data	– provides details mostly consistent with data	– provides details entirely consistent with data
	– communicates required information clearly and in an organized manner	– communicates information with limited clarity and organization	– communicates information with some clarity and organization	– communicates information with considerable clarity and organization	– communicates information with a high degree of clarity and organization
	– prepares diagram with neatness and appropriate detail	– prepares diagram with limited neatness and detail	– prepares diagram with some neatness and detail	– prepares diagram with considerable neatness and detail	– prepares diagram with a high degree of neatness and detail
	– displays data in complete and well-organized chart	– makes incomplete chart with limited organization	– makes partially complete, partially organized chart	– makes mostly complete, well-organized chart	– makes very complete, very well organized chart
	– uses scientific terminology accurately	– uses scientific terminology with limited accuracy	– uses scientific terminology with some accuracy	– uses scientific terminology with considerable accuracy	– uses scientific terminology with a high degree of accuracy

Expectations*	Criteria	Level 1	Level 2	Level 3	Level 4
Making Connections					
	The student:				
7	– proposes a course of practical action (container design) in response to a problem involving physical/chemical change	– proposes a course of action with limited effectiveness	– proposes a course of action with some effectiveness	– proposes a course of action with considerable effectiveness	– proposes a course of action with a high degree of effectiveness

* The expectations that correspond to the numbers given in this chart are listed on page 54. Although all of the expectations were addressed through instruction relating to the task, student achievement of expectation 2 was not assessed in the final product.

Note: A student whose overall achievement at the end of a course is below level 1 (that is, below 50%) will not obtain a credit for the course.

Student Task Description

Chemical and Physical Change

The Task

Congratulations on your new position as a summer student working with Chemwide Industries. You will work with a fellow student on the following two-part project:

- Observe a variety of physical and chemical changes that produce carbon dioxide gas. At the end of each of the required procedures, you will pour the carbon dioxide over a lit candle to establish an important physical property of the gas that makes it useful for extinguishing fires.
- Design a container that will:
  - keep two chemical substances that produce carbon dioxide apart for as long as required;
  - allow for the substances to mix when carbon dioxide is needed to extinguish a flame.

Each summer student will be required to submit to the supervisor a chart of observations and a work plan that includes the design for the container (questions 1 to 7 in the student booklet).

Materials

Make certain that the following materials are available at your work station:

- safety goggles – one pair for each student
- small amount of Bromoseltzer crystals or crushed Alka-Seltzer tablets
- small amount of sodium bicarbonate
- 1 bottle of soda pop – 600 mL (cola works best)
- 3 balloons, round, about 30 cm in diameter
- 3 test tubes, large
- 50 mL of water
- 50 mL of vinegar
- 1 candle
- tin can with lid removed
- matches
- can containing sand in which to extinguish matches

Instructions for Question 1

1. You and your partner will be asked to follow each of the procedures listed below to produce carbon dioxide gas. In each case, record all observations in an appropriate table or chart that you have made.

a)

- Place the candle in the tin can and light it carefully.
- Add 25 mL of water to a test tube
- Prepare the balloons by stretching their necks and inflating them several times so they will expand when they should. Open the neck of one balloon and place a pinch of Bromoseltzer inside.
- Attach the balloon to the lip of the test tube and hold it in place. Then hold the balloon upright so that the Bromoseltzer falls into the water.
- When effervescence ceases, tightly pinch the neck of the balloon closed and remove it from the test tube. Place the neck of the balloon just inside the rim of the can containing the burning candle and slowly push the contents out of the balloon so that they pour onto the flame.

b) Add 25 mL of vinegar to the second test tube and a pinch of sodium bicarbonate to a second balloon. Repeat the steps above.

c) Attach a third balloon to the neck of a recently opened bottle of pop and use your fingers to hold the balloon in place while you shake the bottle. Pour the contents of the balloon over a burning candle.

d) Sprinkle a pinch of sodium bicarbonate directly onto the flame of a burning candle.

Instructions for questions 2–7 are contained in the pages of the student booklet reproduced in the samples that follow.