Teacher Package

Science Exemplar Task
Grade 9 Science – Applied

Teacher Package

Title: Chemical and Physical Change

Time Requirement: Two classroom periods of 70 minutes each

Description of the Task*
Students will assume the role of summer students working for a chemical company. Initially, they will be part of a team, working in pairs. In the first part of this task, the team of students will observe a variety of physical and chemical changes that produce carbon dioxide gas. In each case, the carbon dioxide gas or solid baking soda will be "poured" over a lit candle to establish an important physical property and an important chemical property of the gas.

In the second part of the task, students will individually 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 should be such that:

- the chemical compounds cannot come in contact with one another when the carbon dioxide product is not required for any application;
- when required, a fairly simple manipulation of the container will result in the two chemical compounds coming into contact to produce the necessary carbon dioxide to extinguish a flame.

Final Product
Each student will submit his or her table or chart, the design, and a work plan for the container consisting of the answers to questions 1–7 in the booklet.

Assessment and Evaluation Components
The criteria on which the written work will be assessed are outlined in the task-specific rubric.**

Teachers can choose to use the task rubric to assess the students' laboratory skills as they work.

*This task has been adapted from Activity 3: "Chemical and Physical Changes" (Unit 1-8-10) in the course profile for Science, Grade 9, Applied (Catholic).

Expectations Addressed in the Exemplar Task

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.

Teacher Instructions

Prior Knowledge and Skills Required
Students should have some experience in:

- distinguishing between chemical and physical properties;
- 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.

Students in the initial years of this project will not have had the background in Grades 5 and 7 that will be in place once the new Ontario curriculum has been fully implemented from Kindergarten to Grade 12.

If the chemistry unit has not been covered yet, it will be necessary to carry out diagnostic activities to determine what the students know and are able to do. Review or supplement as necessary.

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

You may wish to review the relevant course profile for specific suggestions for accommodations appropriate for students in special education programs.

**The rubric is reproduced on page 56 of this document.

Materials Required (per Student Pair)

- small amount of fresh Bromoseltzer crystals (or crushed Alka-Seltzer tablets)
- small amount of fresh sodium bicarbonate
- 1 bottle of soda pop – 600 mL (cola works best)
- 3 balloons, round, approximately 30 cm in diameter
- 3 test tubes, large
- 50 mL of water
- 50 mL of vinegar
- 1 candle
- 1 soup can with the lid removed (or a 250 mL beaker)
- matches
- can containing sand in which to extinguish matches
- safety goggles – one pair per student

Preparation

- Perform the task before the day it is administered to the students so that you will be familiar with the observations.
- Students should be required to wear safety goggles while at the work stations.
- Experiment with the amounts of water and fresh Bromoseltzer, and vinegar and fresh sodium bicarbonate, to give the desired results.
- If available, tea candles (very short candles in metal containers) are ideal. Place the candle at the bottom of an empty soup can or 250 mL beaker so that the gas will not dissipate too quickly. Candles can be ignited with fireplace matches.

Rubric

Introduce the task-specific rubric to the students at least one day prior to the administration of the task. Review the rubric with the students and ensure that each student understands 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.

Some students may perform below level 1. It will be important to note the characteristics of their work in relation to the criteria in the assessment rubric and to provide feedback to help them improve.

Task Instructions

Students will be given the following context for their 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 using one of the above procedures 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 and a work plan that includes the design for the container (questions 1 to 7 in the student booklet).

DAY 1

Students work in pairs to investigate ways in which carbon dioxide gas can be produced:

- They will need to prepare the balloons by stretching their necks and inflating them several times to ensure they will expand as required.
- Place a pinch of Bromoseltzer crystals inside a balloon.
- Attach the balloon to the lip of a test tube containing 25 mL of water.
- Tip the crystals into the water.
- When effervescence ceases, “pour” the gaseous contents of the balloon over a burning candle.
- Place a pinch of sodium bicarbonate inside a second balloon.
- Attach the balloon to the lip of a test tube containing 25 mL of vinegar.
- Tip the powder into the vinegar.
- When effervescence ceases, “pour” the contents of the balloon over a burning candle.
- Place a balloon over the top of a recently opened bottle of pop with its contents shaken.
- Pour the contents of the balloon over a burning candle.
- Sprinkle a pinch of sodium bicarbonate over an open candle flame.
- Students, working in pairs, observe and record the appearances of each substance before, during, and after the activity described above.

- Observations are recorded by *each* student in his or her *own* student booklet, using a suitable organizer of the student's own design.
- Students will write a conclusion for the observed data, listing those properties associated with physical changes, and those properties associated with chemical changes.

DAY 2

- Students individually design a single container to hold two chemicals that, when mixed together, produce carbon dioxide gas. The challenge is to keep the chemicals separate until the carbon dioxide is needed. At this point, a simple manipulation of the container would cause the two chemicals to mix and produce carbon dioxide, which then can be used to extinguish a flame, as already observed. While it is intended that the container resemble a fire extinguisher, the instructions are purposely general so as not to be limiting.

- Although the task concludes at this point, it is strongly recommended that students construct a working model of their design and then be given a period of time to evaluate its performance. They should then make design changes that will allow them to make a better product.

Potential Responses

Question 1:

Reactants	Initial Appearance	During Mixing	Product Appearance	Effect on Combustion
Bromoseltzer + water	Bromo: *small white crystals* Water: *clear, colourless liquid*	*Effervescence*	*Fine white residue Balloon inflates with gas*	*Extinguishes flame*
Sodium bicarbonate + vinegar	Sodium bicarbonate: *white powder* Vinegar: *clear, colourless liquid*	*Effervescence*	*Fine white residue Balloon inflates with gas*	*Extinguishes flame*
Soda pop	*Some fizzing when cap opened*	*Balloon expanded*	*No fizzing in soda pop*	*Extinguishes flame*
Sodium bicarbonate	*Coarse white powder*			*Extinguishes flame*

Question 2:

a) Chemical – A gas is produced when Bromoseltzer and water are mixed.
b) Chemical – A gas is produced when sodium bicarbonate and vinegar are mixed.
c) Physical – The gas is released from the soda pop. It was already there.
d) Chemical – A gas is released when the sodium bicarbonate is heated.
   or
   Physical – The solid smothers the flame, and oxygen cannot reach the candle wick.

Question 3:

a) clear, colourless, heavier than air, etc.
b) will not support combustion

Question 4:

The diagram should be neat and labelled appropriately.

Question 5:
The answer should clearly indicate how the chemicals are kept apart and how they are mixed when needed.

Question 6:
The carbon dioxide is denser than air and falls onto the flame, cutting off the oxygen supply and smothering it.

Question 7:
- The answer should discuss some of the thinking skills used in answering questions 5 and 6, as well as those areas that needed to be planned carefully in light of the results observed in the experiments in Part 1.
- An attempt should be made to explain the difficulties anticipated, and how the choice of design would solve these problems.
- A brief plan for future changes to the container design should be included.