Grade 9 Science Performance Task – Teacher Resource
UNIT C: Environmental Chemistry

A. Task Overview

Students have been hired by BurnAway, an up and coming company that sells antacid tablets. The company wants to determine how strong they should make their tablets in order to compete with other companies. As an environmentally conscious company, they also want to know what impact excess tablets, or by-products of antacid production, might have on consumers, local plant populations, or other living things.

Students' task is to design and construct a scientific experiment that determines and compares the strengths of 2 different kinds of antacid tablets already on the market. Then, using their knowledge of acids and bases and their effects on the environment, students are to assess the potential influence that excess antacid tablets, or by-products of the antacid production process, might have on consumers, local plant populations, or other living things. With their data, students will make recommendations to BurnAway regarding the strength of the tablets as well as relay information that should be included on the product's warning label.

Students may complete the task individually or with a partner. Students may communicate their data in an appropriate format of their choosing.

B. Outcomes from Alberta Science Program of Studies: Science 9 Unit C Environmental Chemistry

General Learning Outcomes:	
Knowledge Outcomes	
STS-K 2	Identify processes for measuring the quantity of different substances in the environment and for monitoring air and water quality
Skills Outcomes	
S-IP	Ask questions about the relationships between and among observable variables, and plan investigations to address those questions
S-PR	Conduct investigations into the relationships between and among observations, and gather and record qualitative and quantitative data

Specific Learning Outcomes:		**Criteria**
Knowledge Outcomes		
STS-K 2.3	identify chemical factors in an environment that might affect the health and distribution of living things in that environment	identify by-products of antacid production that might affect living things in the environment
STS-K 2.5	identify acids, bases and neutral substances, based on measures of their pH *(e.g., use indicator solutions or pH meters to measure the pH of water samples)*	determine pHs of antacid samples
STS-K 2.6	investigate, safely, and describe the effects of acids and bases on each other and on other substances *(e.g., investigate and describe the reaction that results when baking powder is dissolved; describe the role of acids and bases in neutralizing each other*	design and carry out an experiment that measures and compares the capacity of 2 brands of antacids to neutralize an acid
STS-K 2.7	describe effects of acids and bases on living things *(e.g., acid rain in lakes, antacids for upset stomachs, pH in shampoos and conditioners)*	research the effects of excess antacids on living things and create a warning label that describes these effects
Skills Outcomes		
S-IP 4	select appropriate methods and tools for collecting data and information and for solving problems *(e.g., design an investigation to compare the chemical characteristics of two soils)*	experiment uses appropriate materials and methods
S-PR 4	organize data, using a format that is appropriate to the task or experiment	create a graph or chart to display data collected

C. Assessment Strategies

1. **Assessment *for* and *as* Learning**. Consider providing the task at the beginning of the unit so students' learning is guided and focused. In this way, the assessment process can be used for both assessment *for* learning (formative) and assessment *as* learning (summative).
2. **Rubric Language**. Consider introducing the rubric at the beginning of the unit. Discuss with students the meaning of qualitative descriptors used. In addition, this will give students a chance to process the language used and mentally prepare themselves for the kind of effort that is expected of them.
3. **Rubric Exposure.** Consider using mini rubrics for other assignments so students begin to feel comfortable with that mode of assessment. In this way, students will become comfortable with rubric language and they'll also learn what a "4" looks like in terms of the effort they put in.
4. **Peer Feedback**. Consider providing time for students to reflect upon their work before summative assessment. This may be in conjunction with peer feedback. In allowing students to view their peers' work, they can be encouraged to identify strengths and weaknesses of their individual work.
5. **Student Checklist**. Consider providing a checklist for students that breaks down the performance task into smaller chunks. This will help guide and focus students; especially those with ADHD, or some of the learning disabilities that cause students to struggle with organization, focus, etc.

6. **Reflection**. Consider adding a Learning Goals Reflection page for students to fill in after completing the task. Here, students will take time to identify a couple of things they feel they did well, a couple things they feel they could improve on, and a couple things they would do differently next time. This reflection page should be filled out before students receive their marks back.
7. **Self-Evaluation**. Consider asking students to evaluate their own work by filling in a copy of the same rubric the teacher will use. This will force students to analyze and be accountable for their own work. (Interestingly, students are generally harder on themselves than the teacher would be).

D. Teaching Strategies

1. **Lab Experience**. Students should have prior extensive experience with the scientific method, lab procedures, lab equipment, designing experiments, recording data, displaying data, etc.
2. **Student Creativity**. Students can be given the option to display their findings in a variety of formats. The experiment they design could be shown digitally in a video, on a poster, in lab report format, as a poem or song, etc (they would still need to find an appropriate method of displaying the scientific data they collect). Their recommendations to the company could also be in any of the above formats, or designed as a warning label to be displayed on the bottle of antacids. In this way, students are provided opportunity for creativity while still demonstrating their understanding.
3. **Expected Behavior**. A class discussion should take place prior the start of the task to reinforce expected behaviors for working collaboratively and sharing the workload.
4. **Key Terms**. Students should have adequate exposure to key terms; steps should be taken to ensure student understanding of key terms before the task start date.
5. **Timing**. The task is split into two major parts: 1) designing and carrying out an experiment 2) determining environmental effects and informing the company of them. Teachers should plan the unit such that students have enough information mid-unit to begin one of the two parts. This will facilitate the process and hopefully prevent students from feeling overwhelmed. The second part of the task can be completed closer to the end of the unit. Designing and carrying out the experiment will span at least 3 days; determining environmental effects will span 2 days. Although this may seem rushed, students should be expected to begin planning earlier since they were given the task at the beginning of the unit. Each lesson before the task should be explicitly linked to the task in some way; students should be encouraged to budget their time since they will experience time crunches in the world outside of school. Of course, if the majority of students are struggling to complete the task on time, the time allotted may need to be re-evaluated.
6. **Teacher Approval**. Students should be required to receive teacher approval at appropriate intervals during the course of the performance task. Teacher approval could be required for: sound experiment design, appropriate method of display for data, sound research conducted to determine environmental/consumer effects of antacids. Teacher approval can be used as a form of formative assessment.
7. **Student Resources**. Students should be provided with a list of resources that will assist and guide them in their research and experiment design. Students are not limited to these resources but should be encouraged to explore them prior to performing other searches. These resources will provide a foundation for students, as well as give them an idea of the extent of research that is expected.

8. **Alternative Task**. This task is designed to focus mainly on bases (antacid tablets), but could be expanded to include acids (carbonated beverage companies, etc.). Students could work as researchers for various companies that sell various products.

E. List of Student Resources

1. Lab equipment from the school: beakers, flasks, acid/base indicator solution, litmus paper, etc.
2. Alberta Native Plant Council website
   http://www.anpc.ab.ca/content/index.php
3. Antacids information from Health Canada website
   http://www.hc-sc.gc.ca/dhp-mps/prodpharma/applic-demande/guide-ld/label-etiquet-pharm/antacid_antiacid-eng.php
4. Sample Antacid Neutralizing Lab from the University of Lethbridge http://classes.uleth.ca/200703/chem1000d/Lab%20Manual/17_Antacid_v07.pdf
5. Sample Antacid Neutralizing Lab from the University of Michigan http://www.reachoutmichigan.org/funexperiments/quick/csustan/antacid.htm
6. Sample Antacid Neutralizing Lab from Wooddale High School, Tennessee http://www.slideshare.net/patfrett/chemistry-antacid-lab
7. Effect of acids and bases on freshwater
   http://www.lenntech.com/aquatic/acids-alkalis.htm
8. The Scientific Method
   http://www.sciencebuddies.org/science-fair-projects/project_scientific_method.shtml#overviewofthescientificmethod
9. More Information about Antacids http://www.nlm.nih.gov/medlineplus/ency/patientinstructions/000198.htm
10. Displaying Scientific Data
    http://www.ipl.org/div/projectguide/displayingyourproject.html

F. Rubric

Level / Criteria	Excellent 4 marks	Proficient 3 marks	Adequate 2 marks	Limited* 1 mark	Insufficient/ Blank*
Identify chemical factors in an environment that might affect living things in that environment	Industrial antacid production is **extensively** researched and identification of by-products that might influence the environment is **comprehensive**	Industrial antacid production is **thoroughly** researched and identification of by-products that might influence the environment is **thorough**	Industrial antacid production is **sufficiently** researched and identification of by-products that might influence the environment is **sufficient**	Industrial antacid production is **narrow** and identification of by-products that might influence the environment is **narrow**	No score is awarded because there is insufficient evidence of student performance based on requirements of the assessment task
identify acids, bases and neutral substances, based on measures of their pH	**Skillful** methods are used to measure pH; any acids, bases, and neutral substances are **correctly** identified by their pH	**Appropriate** methods are used to measure pH; any acids, bases, and neutral substances are **correctly** identified by their pH	**Adequate** methods are used to measure pH; any acids, bases, and neutral substances are **mostly correctly** identified by their pH	**Superficial** methods are used to measure pH; any acids, bases, and neutral substances are **mostly incorrectly** identified by their pH	
investigate, safely, and describe the effects of acids and bases on each other and on other substances	Experiment is **skillfully** designed and **accurately** describes the comparison of the antacids' capacity to neutralize an acid	Experiment is **systematically** designed and **accurately** describes the comparison of the antacids' capacity to neutralize an acid	Experiment is **simplistically** designed and **somewhat erroneously** describes the comparison of the antacids' capacity to neutralize an antacid	Experiment is **superficially** designed and **erroneously** describes the comparison of the antacids' capacity to neutralize an acid	
describe effects of acids and bases on living things	**Comprehensive** description of how antacids might affect living things in the environment using **appropriate** scientific vocabulary	**Thorough** description of how antacids might affect living things in the environment using **appropriate** scientific vocabulary	**Partial** description of how antacids might affect living things in the environment using **simplistic** scientific vocabulary	**Superficial** description of how antacids might affect living things in the environment using **incorrect** scientific vocabulary	
select appropriate methods and tools for collecting data and information and for solving problems	Methods and tools are **skillfully** selected and data collected is **comprehensive**	Methods and tools are **appropriately** selected and data collected is **thorough**	Methods and tools are **adequately** selected and data collected is **sufficient**	Methods and tools are **somewhat erroneously** selected and data collected is **incomplete**	
organize data, using a format that is appropriate to the task or experiment	Scientific data collected is represented in a **skillful** and **creative** format	Scientific data collected is represented in an **appropriate** format	Scientific data collected is represented in an **adequate** format	Scientific data collected is represented in an **unsuitable** format	

TOTAL OUT OF 24 MARKS

**When work is judged to be limited or insufficient, the teacher makes decisions about appropriate interventions to help the student improve*

Grade 9 Science Performance Task – Student Task
UNIT C: Environmental Chemistry

A. Task Overview

You have been hired by BurnAway, an up and coming company that sells antacid tablets. The company wants to determine how strong they should make their tablets in order to compete with other companies. As an environmentally conscious company, they also want to know what impact excess tablets, or by-products of antacid production, might have on consumers, local plant populations, or other living things.

Your task is to **design and construct a scientific experiment** that determines and compares the strengths of 2 different kinds of antacid tablets already on the market. Then, using your knowledge of acids and bases and their effects on the environment, **assess the potential influence** that excess antacid tablets, or by-products of the antacid production process, might have on consumers, local plant populations, or other living things. With your data, you will make recommendations to BurnAway regarding the strength of the tablets as well as relay information that should be included on the product's warning label.

You may complete the task individually or with a partner. You may communicate your data in an appropriate format of your choosing.

B. Target Outcomes

1. identify chemical factors in an environment that might affect the health of living things in that environment
2. identify acids, bases and neutral substances, based on measures of their pH
3. investigate, safely, and describe the effects of acids and bases on each other and on other substances
4. describe effects of acids and bases on living things
5. choose appropriate materials and methods for collecting data from your experiment
6. organize data in an appropriate format

C. Detailed Task Description

This task is separated into two parts, as shown in the table below.

Beginning mid-way through the unit, you will plan and carry out Task 1 over a span of 3 in-class days. It will be up to you to manage your time, but it is suggested that day one is spent planning and gathering materials, day two is performing the experiment and collecting data, and day three is analyzing and writing the discussion, as well as finalizing the report. Some portions of the task, for example finalizing of the lab report, can be completed at home outside of class time. On the fourth day, there will be peer assessment session. **Task 1 will be due two days after peer assessment day**, but there will be no further class time to work on it.

Task 2 will begin after Task 1 is complete. You will have 2 days of class time to research and present your findings in an appropriate format. There will be a peer assessment session on the third day and **Task 2 will be due two days after peer assessment day**. No further class time will be provided.

Tasks will be showcased in class at the end of the unit, which will be shortly after Task 2 is due.

Task	Requirements	Target Outcome(s)	Resources
1. Design and construct an experiment that compares the acid neutralizing capacity of 2 different antacid tablet brands.	Your report should be clearly organized and include the following elements: introduction (stating background information), materials, methods (procedure), results (including a visual representation of data, discussion, references. **You will require a teacher check for your materials and methods before performing your experiment.** Your report can be in digital, print, or other appropriate format, but should resemble a traditional lab report in its organization. **You will require a teacher check for your format choice.**	3, 5, 6	You will have access to all of the classroom lab equipment Displaying Scientific Data http://www.ipl.org/div/projectguide/displayingyourproject.html The Scientific Method http://www.sciencebuddies.org/science-fair projects/project_scientific_method.shtml#overviewofthescientific method Sample Antacid Neutralizing Lab from the University of Lethbridge http://classes.uleth.ca/200703/chem1000d/Lab%20Manual/17_Antacid_v07.pdf Sample Antacid Neutralizing Lab from the University of Michigan http://www.reachoutmichigan.org/funexperiments/quick/csustan/antacid.htm Sample Antacid Neutralizing Lab from Wooddale High School, Tennessee http://www.slideshare.net/patfrett/chemistry-antacid-lab
2. Research and describe antacids, and how they, their by-products, or other bases may affect consumers, local plant populations, water systems, or animal populations. Use an appropriate format to present your findings to BurnAway	You only need to **choose one** element/sector of the environment (e.g. water systems) to research and describe how it might be affected by antacids or their by-products. Reference list Your findings may be presented in a variety of formats: design a warning label for the bottle of antacids, film a mock video conference with the company, create a video or radio ad for the product, etc. **You will require a teacher check for your format choice.** Be sure to include specific information about antacids such as their pH.	1, 2, 4	Information about Antacids http://www.nlm.nih.gov/medlineplus/ency/patientinstructions/000198.htm Effect of acids and bases on freshwater http://www.lenntech.com/aquatic/acids-alkalis.htm Alberta Native Plant Council website http://www.anpc.ab.ca/content/index.php Antacids information from Health Canada website http://www.hc-sc.gc.ca/dhp-mps/prodpharma/applic-demande/guide-ld/label-etiquet-pharm/antacid_antiacid-eng.php

D. Assessment

- Formative peer feedback will be provided twice throughout the task (once after each task is drafted)

Grade 9 Science Performance Task – Student Task (cont'd)

- Summative assessment will be based on the rubric shown below

Level / Criteria	Excellent 4 marks	Proficient 3 marks	Adequate 2 marks	Limited* 1 mark	Insufficient/ Blank*
Identify chemical factors in an environment that might affect living things in that environment	Industrial antacid production is **extensively** researched and identification of by-products that might influence the environment is **comprehensive**	Industrial antacid production is **thoroughly** researched and identification of by-products that might influence the environment is **thorough**	Industrial antacid production is **sufficiently** researched and identification of by-products that might influence the environment is **sufficient**	Industrial antacid production is **narrow** and identification of by-products that might influence the environment is **narrow**	No score is awarded because there is insufficient evidence of student performance based on requirements of the assessment task
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organize data, using a format that is appropriate to the task or experiment	Scientific data collected is represented in a **skillful** and **creative** format	Scientific data collected is represented in an **appropriate** format	Scientific data collected is represented in an **adequate** format	Scientific data collected is represented in an **unsuitable** format	

TOTAL OUT OF 24 MARKS

**When work is judged to be limited or insufficient, the teacher makes decisions about appropriate interventions to help the student improve.*

E. Reflection & Goal Setting

After submitting both Task 1 and Task 2, you will write a reflection that communicates not only what you feel were your areas of strength, but also areas you feel require improvement. Identify and describe a minimum of two areas of strength and two areas that need improve on. Then, describe what you might do differently next time, or for future work in general. Finally, set a goal that targets one of your areas of improvement and list two or three strategies to help you reach your goal.

Grade 9 Science Performance Task – Descriptive Rationale

This assessment task takes a student-centered approach:

- This task provides an opportunity for students make creative choices: they design their own experiment and choose how to communicate their data, and they also choose how to communicate their research. Students can self-differentiate: a learner who struggles with handwriting may choose to type on a computer; a learner who struggles with writing composition may choose to make a video recording, etc.
- This task lets students whether to work collaboratively or independently.
- This task allows students to make choices about time management.
- This task encourages students to pursue their research interests: students can choose a sector or sectors of the environment that may be impacted by a chemical.

This assessment task emphasizes student learner competencies:

- This task requires students to perform research which encourages literacy.
- This task requires students to collect and analyze quantitative data which encourages numeracy.
- This task encourages students to be engaged thinkers and to think critically: they must design an experiment, analyze and apply experimental data, make recommendations based on experimental data, synthesize research data, analyze how consumer antacids might affect living systems or consumers themselves.
- This task encourages students to demonstrate good communication skills: students must communicate scientific data and research in an appropriate and meaningful way for their audience.
- This task encourages students to become ethical citizens through analyzing chemical effects on the environment.