**Are All Antacids the Same?**

In this lesson, students will collaborate with their peers to conduct an experiment that will help them answer the question, “Are all antacids the same, or do some work better than others?” Students will use their writing skills to provide evidence and reasoning to defend their answer to this question. This real-world scenario will not only engage students, but will also help them understand how science can be used to improve their quality of life.

**Standards:**

**Next Generation Science Standards:**

* **5th Grade**
  + **5-PS1-3** – Make observations and measurements to identify materials based on their properties.
* **Middle School**
  + **MS-PS1-2** – Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

**Common Core State Standards:**

* **5th Grade**
  + **CCSS.ELA-Literacy.W.5.2** – Write informative/explanatory texts to examine a topic and convey ideas and information clearly.
  + **CCSS.ELA-Literacy.W.5.4** – Produce clear and coherent writing in which the development and organization are appropriate to task, purpose, and audience.
  + **CCSS.ELA-Literacy.W.5.10** – Write routinely over extended time frames (time for research, reflection, and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
* **Middle School**
  + **CCSS.ELA-Literacy.WHST.6-8.2** – Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiences, or technical processes.
  + **CCSS.ELA-Literacy.WHST.6-8.4** – Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
  + **CCSS.ELA-Literacy.WHST.6-8.10** – Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.
  + **CCSS.MATH-Content.6.SP.A.3** – Recognize that a measure of center for a numerical data set summarizes all of its values with a single number, while a measure of variation describes how its values vary with a single number.
  + **CCSS.MATH-Content.6.SP.B.5** – Summarize numerical data sets in relation to their context, such as by:
    - **CCSS.MATH-Content.6.SP.B.5.A** – Reporting the number of observations.
    - **CCSS.MATH-Content.6.SP.B.5.B** – Describing the nature of the attribute under investigation, including how it was measured and its units of measurement.
    - **CCSS.MATH-Content.6.SP.B.5.C** – Giving quantitative measures of center (median and/or mean) and variability (interquartile range and/or mean absolute deviation), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered.
    - **CCSS.MATH-Content.6.SP.B.5.D** – Relating the choice of measures of center and variability to the shape of the data distribution and the context in which the data were gathered.

**Objectives:**

* Students will be able to conduct an experiment to explore the chemical reactions that occur between acids and bases.
* Students will be able to summarize the findings of their experiment to make a claim supported by evidence and reasoning about the best antacid they tested.

**Lesson Duration:** approximately 50-75 minutes

**Materials:**

* The Building Blocks of Chemistry series, specifically Acids, Bases, and Salts
* Several test tubes or small containers (enough for 1 per type of antacid tested per group)
* Eye droppers (1 per group)
* Grape juice – no sugar added (enough for each group to use as a pH indicator)
* Lemon juice (enough for each group to use as their acid in each test)
* Several different types of liquid antacids, we suggest 4-5
* Pencils
* Data Tracking and Guiding Questions sheet (1 per student)
* Summary Response worksheet (1 per student)

**Requisite Prior Knowledge:**

* Prior to engaging in this lesson, students should read the Building Blocks of Chemistry: Acids, Bases, and Salts text. Students should understand that substances are classified as acids or bases based on their pH levels. Students should also understand the basics of pH indicators and that they change colors when exposed to a basic or acidic solution.
* In addition, it would be helpful for students to have prior experience writing summaries and making claims based on scientific experiments and data. Consider reviewing major components students should include prior to having them independently write their summary.

**Assessments:**

* Students’ written summary including their claim, evidence, and reasoning

**Vocabulary:**

* Acid – a chemical compound with a pH value of less than 7; acids typically have a sour or bitter taste
* Base – a chemical compound with a pH value of more than 7; bases are typically bitter to the taste and have a soapy feel
* Indicator – a substance used to indicate chemical properties, usually by a change in color
* Median – the middle number of a series of data when arranged from smallest to largest value
* Mean – average; found by adding the values of the data in a set and dividing it by the total number of data points in that set
* Mode – the value of the variable with the highest frequency in a set of data
* Neutral – a substance that is neither an acid nor a base
* pH scale – a scale that measures the strength of acids and bases; an increase of 1 on the scale represents a tenfold drop in acidity

**Differentiation Considerations:**

* Determine students’ teams prior to starting this lesson. Consider making groups of about 3-4 students. Be strategic with your grouping. It can be helpful to ensure each group contains a range of learning abilities as well as a student who can be a strong leader.
* Consider pulling a small group of students during the Independent Application portion of this lesson to provide writing support. Depending on your students’ needs, you could create a small group summary during this time, rather than individual student summaries.

**Lesson and Instruction:**

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| **Lesson Components and Time Guidelines** | **Teacher Actions** |
| **Introduction/Hook**  Approximately 5 minutes | Pique students’ interest by asking them a question about their own experience:  *Have you or someone you know ever experienced heartburn? Heartburn is a burning pain or discomfort you feel in your upper and mid chest and is caused by a backward flow of stomach acid in your esophagus. Ouch! This is commonly caused by people eating foods that are high in acid or fat. When people eat too much of these foods, like citrus fruits, spicy foods, or even cheese, they can experience heartburn.*  *One common way of treating heartburn is with antacids. These are medicines that work to neutralize acidic substances. But there are SO many kinds of antacids out there, how do you know which one to purchase to help treat heartburn? Which antacid, if any, is the best and why?* |
| **Direct Instruction and Modeling**  Approximately 10-15 minutes | Begin by modeling the first few steps of the experiment procedure for students:   1. Set up your experiment: You should have the same number of test tubes as types of antacid to test. Make sure to label these so you know which experiment is which. 2. Begin by modeling how to add ten drops of grape juice to each test tube. Explain to students that grape juice is a natural acid-base indicator. Ask them to use what they learned in the Acids, Bases, and Salts text to explain how indicators typically work. Students should note that indicators change color when exposed to an acid or a base. 3. Rinse the dropper carefully. 4. Next model how to add ten drops of lemon juice to each test tube. Ask students why they believe we are using lemon juice in this experiment. Explain that lemon juice is an acid, kind of like the acid found in our stomachs that causes heartburn. 5. Explain that we are now all set up and can begin collecting our data. We will carefully use the eye dropper to add one drop of antacid to the solution at a time. (Depending on your students’ level of independence and needs, consider modeling this step.) Ask students to make an inference about *why* we are adding only one drop at a time or how we know when to stop adding drops of antacid. Students should discuss that we are looking for the liquid in each test tube to change color. They should explain that this indicates that the acid has been neutralized. 6. Explain that students will repeat this process for all the types of liquid antacid, record their data, and summarize their findings to make a claim supported by evidence and reasoning about the best antacid they tested. |
| **Application Activity**  Approximately 20-30 minutes | Provide time for pre-determined groups of students to conduct the experiment you just modeled. Students should work as a team to gather and set up their materials, test each type of antacid, and record their data. In addition, groups should discuss their findings and respond to the guiding questions included with their data recording table.  Each student should have their own completed copy of data, notes, and guiding question answers. They will use these to summarize their findings and make a claim about the best type of antacid. |
| **Independent Application**  Approximately 10-15 minutes | Transition to the independent work setting and pass out copies of the Summary Response worksheet. Provide time for students to respond to the summary prompt: Explain how the experiment you conducted helped you determine the best antacid of the ones you tested. Use clear language, specific examples, and plenty of details to help your reader understand *why* this experiment’s results are valid and useful to people who experience heartburn.  Students will also respond to a prompt asking them to make a claim supported by evidence from their experiment and reasoning about the best type of antacid. |
| **Closure**  Approximately 5-10 minutes | Bring students back to the whole group setting to reflect and close the lesson. Ask students to self-reflect in their minds about a positive experience they had collaborating with their peers today as well as one area for growth (what could they do differently in the future to improve their collaborate, teamwork, and learning?). Consider having 2-3 students shar out, focusing on supporting students’ growth mindset and self-concept.  Review the objectives: *today you collaborated to explore the chemical reactions that occur within acids. You applied the information you gathered to help you evaluate and make claims about solutions to real world problems, like which medicine is best for treating the symptoms of heartburn.* |

**Next Steps and Reflection:**

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| What went well? |  |
| What changes might be beneficial? |  |
| Reteaching needs |  |
| Extension needs |  |