Georgia Performance Standards Framework for Physical Science – GRADE 8

Unit: Food and Cooking
Inquiry Task
In a Pickle

Subject Area: Physical Science
Grade: 8

Standards (Content and Characteristics):

S8P1. Students will examine the scientific view of the nature of matter.
   b. Describe the difference between pure substances (elements and compounds) and mixtures.
   d. Distinguish between physical and chemical properties of matter as physical (i.e. density, melting point, boiling point) or chemical (reactivity, combustibility).

S8CS1. Students will explore the importance of curiosity, honesty, openness, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.
   a. Understand the importance of— and keep—honest, clear, and accurate records in science.
   b. Understand that hypotheses can be valuable even if they turn out not to be completely accurate.

S8CS2. Students will use standard safety practices for all classroom laboratory and field investigations.
   a. Follow correct procedures for use of scientific apparatus.
   b. Demonstrate appropriate techniques in all laboratory situations.
   c. Follow correct protocol for identifying and reporting safety problems and violations.

S8CS3. Students will have the computation and estimation skills necessary for analyzing data and following scientific explanations.
   a. Analyze scientific data by using, interpreting, and comparing numbers in several equivalent forms, such as integers, fractions, decimals, and percents.

   b. Find the mean, median, and mode and use them to analyze a set of scientific data.
   d. Decide what degree of precision is adequate, and round off appropriately.
   e. Address the relationship between accuracy and precision.

   Use ratios and proportions, including constant rates, in appropriate problems.

S8CS8. Students will be familiar with the characteristics of scientific knowledge and how it is achieved.

Students will apply the following to scientific concepts:

a. When similar investigations give different results, the scientific challenge is to judge whether the differences are trivial or significant, which often requires further study. Even with similar results, scientists may wait until an investigation has been repeated many times before accepting the results as meaningful.

b. When new experimental results are inconsistent with an existing, well-established theory, scientists may pursue further experimentation to determine whether the results are flawed or the theory requires modification.

c. As prevailing theories are challenged by new information, scientific knowledge may change.

S8CS9. Students will understand the features of the process of scientific inquiry.

Students will apply the following to inquiry learning practices:

a. Investigations are conducted for different reasons, which include exploring new phenomena, confirming previous results, testing how well a theory predicts, and comparing different theories. Scientific investigations usually involve collecting evidence, reasoning, devising hypotheses, and formulating explanations to make sense of collected evidence.

b. Scientific investigations usually involve collecting evidence, reasoning, devising hypotheses, and formulating explanations to make sense of collected evidence.

c. Scientific experiments investigate the effect of one variable on another. All other variables are kept constant.

d. Students will apply the following to inquiry learning practices:

e. Accurate record keeping, data sharing, and replication of results are essential for maintaining an investigator’s credibility with other scientists and society.

f. Scientists use technology and mathematics to enhance the process of scientific inquiry.

Enduring Understandings:

- Matter can be described by its physical and chemical properties.
- Compounds are made of two or more kinds of atoms held together chemically (bonded).
- Mixtures are formed when elements and/or compounds are combined physically.
- Chemical elements and compounds possess their own characteristic properties (density, boiling point, melting point, solubility, etc.) and these properties distinguish one pure substance from another.

Georgia Performance Standards Framework for Physical Science – GRADE 8

Essential Questions:

- How do rock candy and rock salt illustrate the characteristics of liquids, solids, and solutions?
- Corollary question: How can understanding the properties of pure substances and mixtures be used to address practical problems?

ADMINISTRATION PROCEDURES

Pre-Assessment:

Present this scenario which will serve as the pre-assessment and the hook for this task. Display a jar of pickles (homemade if possible). Explain that when you made pickles you saved the brine (salt water) to use in another batch. You put the brine in a gallon water jug in the refrigerator but forgot to label it. Now you need to know which of your two jugs contains the brine, and which contains the drinking water. Present the two jugs. Pour some of the brine into one beaker and some of the drinking water into another beaker. Use a document camera or the platform of an overhead projector if available to increase the visual impact. (Create the brine by dissolving two grams of sodium chloride, NaCl, per 100 milliliters of water.)

Have students brainstorm in pairs how you might determine the contents of the jugs so they can be properly labeled. Students should record and initial their ideas. Have students submit their lists. Use this information to determine what students already know. Also, use their lists as a guide when you debrief their brainstorming session. Ask students to expand on their thoughts as they discuss their brainstorming ideas.

Teacher Note: Most students will put “taste the liquids” at the top their list. Since they are brainstorming accept all ideas at this point. Testing their ideas will come later. However, point out that although tasting would be a very direct method, we do not taste chemicals for safety reasons.

Possible whole-class preparatory activity: Read http://dbhs.wvusd.k12.ca.us/webdocs/Matter/2.6SeparationOfMixtures.html (Can be printed)

| Outcome/ Performance Expectations | Students will use physical and chemical properties to qualitatively predict which of two liquids contains salt. As an extension they may quantitatively analyze the solutions by evaporating the water and determining the mass of the salt to prove or disprove their hypotheses. Students will understand that a mixture has more than one part that can be separated by physical means. |

One Stop Shop For Educators

Georgia Performance Standards Framework for Physical Science – GRADE 8

Write a concept statement...How would you formulate an expert idea?

1. Use the physical property of density to distinguish between the two solutions. Experimentally determine density, or simply find the mass of equal volumes and compare these masses.
   Or
2. Use the physical property of density indirectly by determining the difference in buoyancy between the two liquids.
   Or
3. Determine density by determining the amount of light that passes through the liquid. (With the concentration provided in this activity, the solutions would have to be reduced by evaporation before the difference would become noticeable.)

Write a concept statement / question...What kind of situation would cause this concept to become apparent in students’ understanding?

Set the stage for this task by setting up the following demonstration. First, put a regular can of cola in an aquarium filled with water. Have students make observations. Then add a can of diet cola to the aquarium. Have students make observations. (The cola will sink and the diet cola will not sink as much.) Why? Have students suggest explanations for their observations. (The main reason is that the amount of sugar in the cola makes it denser than the artificially sweetened cola.) Now for visual impact, show students 39 grams of sugar, the amount in a cola, and 0.100 gram of artificial sweetener, which is the amount found in a diet cola. Next, put each can of cola in a concentrated salt water solution. Have students make observations and offer explanations for the differences they observe. (The cola will not sink completely and the diet cola will float higher.) Why? (The salt water is denser.) Note: A document camera or overhead projector will enhance the visual aspects of this demonstration.
(see http://www.middleschoolscience.com/dietcoke.htm for more information on this demonstration)

- How can you use this idea to distinguish your solutions?
- Are you making your analysis based on a physical property or a chemical property?
- How do you determine mass? (balance)
- How do you determine volume? (graduated cylinder)

How do you calculate density?
(divide mass by volume)

Teacher Note: By dividing mass by volume, the density of each liquid can be determined. However, students may meet the standard by comparing masses of equal volumes of the liquids. It is important for students to build experiential knowledge at this grade level. Calculations are not required for this standard.

Possible misconceptions:
- Students must use only the mass of the solution; the mass of the container must be subtracted before dividing by the volume.
- The entire 100 milliliters doesn’t need to be massed, although it decreases the error if you use the entire sample.

Opportunity for teaching related measurement and math skills:
Ask: If the balance reads 25.54 g, what would you record for your mass?
(Some students may want to round off masses, but this is an opportunity to explain that all digits should be recorded.)
How many digits should be given in your density calculation?
(When the density is calculated, significant figure rules should be obeyed. The number of digits in the density calculation should be the same as the least number of significant digits in either measurement, mass or volume.)

Identify necessary data and observations…What data would demonstrate the mastery of the concept by ALL students in the classroom?

- Mass of liquid (remembering to subtract mass of container)
- Volume of liquids
  And
- Observation of difference in buoyancy
  Or
- Determination of difference in light transmittance or absorption

Now that you know the density (or have compared mass to volume ratios), or have determined the difference in buoyancy, or light transmittance or absorption, how do you know which solution is which?

All students should be able to use the data to explain the properties that distinguish the brine from the water in at least one of the following ways:
- The brine has a higher mass to volume ratio (density).
- The brine is more buoyant than pure water.
- The brine transmits less (absorb more) light than pure water.

<table>
<thead>
<tr>
<th>Write questions or activities to use or apply the concept (represent, model, visualize, or design new experiments).</th>
</tr>
</thead>
<tbody>
<tr>
<td>- What type of property was used to distinguish the solutions above?  (physical)</td>
</tr>
<tr>
<td>- Are there other properties you could use to distinguish the solutions?  (Students could explore the conductivity of the two liquids.) (Guide students to consider chemical properties.)</td>
</tr>
<tr>
<td>- What chemical component is in brine that isn't in distilled water?  (salt )</td>
</tr>
<tr>
<td>- How might you use chemical properties do distinguish these solutions?  (Use chemical properties of salt.)</td>
</tr>
<tr>
<td>- How could you find some chemical properties of salt?  (Use reference materials.)</td>
</tr>
<tr>
<td>- What is the chemical identity of salt? (sodium chloride-If students don't know, they should use reference materials.)</td>
</tr>
<tr>
<td>- What are the chemical properties of sodium chloride that you could use to determine the differences in the two solutions?  (Students should research tests for sodium ions and chloride ions.)</td>
</tr>
</tbody>
</table>

Which tests they ultimately perform depend on your supplies. It is easiest is to test for sodium with a flame test and to test for chloride ion with slightly acidified silver nitrate solution. If students use a chemistry book as a reference you can find these tests. If they use a search engine, enter "tests for sodium ion" and "tests for chloride ion". Here are suggested methods:

1. To test for sodium ion, soak a wooden splint in your brine solution and wave the splint over the fire of a Bunsen burner. You should see the characteristic emission spectrum of sodium, a bright orange-yellow flame. Compare to the distilled water. The splint should be held with tongs. Goggles should be worn and students should be given a demonstration of how to light a Bunsen burner, along with safety considerations.

2. To test for chloride ion, use a 0.5 M solution of silver nitrate. To make this solution, dissolve 7.95 g of silver nitrate in 100 milliliters water. Add one drop of concentrated nitric acid. Ask the chemistry teacher at your local high school to help you with this solution if you do not have the supplies. Special caution must be used when handling concentrated nitric acid and silver nitrate. The acid is corrosive, so you must wear goggles and an apron and gloves when handling this substance. It should be dispensed under a hood. You should always wear goggles, an apron, and gloves when handling silver nitrate. Wash hands after handling the acid and the silver nitrate. Since silver is a heavy metal, you will want to use small quantities. For that reason it is suggested that you use a spot plate so you can mix only three drops of the silver nitrate solution and five drops of your brine or distilled water. A positive test for chloride ion is the appearance of a white precipitate, or insoluble substance, when the silver nitrate is added.

<table>
<thead>
<tr>
<th>Homework/Extension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students can quantitatively assess the differences in the solutions: What happens when you boil a solution? OR ask, Why do they sell distilled water in the store? (Students should identify that when you boil a solution, the solutes are left behind and the solvent evaporates. This should lead to the realization that you could isolate the salt in the solution by boiling off the solvent. This is a good way to introduce the terms, solute and solvent.) Will you boil (evaporate) all your solution? (Students should think about how long it will take to boil 100 milliliters and opt for boiling less, e.g., 25 milliliters) If you get the mass of salt in 25 milliliters solution, how will you know how much was in all 100 milliliters? (Use ratio and proportion.) Necessary data and observation:</td>
</tr>
<tr>
<td>• Mass of beaker or evaporating dish with 25 milliliters salt solution</td>
</tr>
<tr>
<td>• Mass of beaker or evaporating dish after water has been evaporated</td>
</tr>
</tbody>
</table>

To determine the amount of salt, set up a ratio and solve for grams of salt in 100 milliliters solution:

\[
\text{Grams of salt / 25 milliliters solution} = X \text{ grams of salt / 100 milliliters solution}
\]

Put a class data table on the board or screen. Have students enter their data on this class data table. Discuss accuracy and precision. Are the numbers close to each other? If so, we say the data is precise.

(Data will probably not be very precise.)

Why would answers not be precise?

(Measurement error- measuring volume, measuring mass, spilling, popping of salt as it gets close to dry.)

What is the mean value?
What is the median?
What is the mode?

(Note: The statistical program on a graphing calculator can be used to calculate these or to check your answers)

Once again, use significant figure rules.

Which answer is closest to the “right” answer? Scientists call this the accuracy.

(Students should research the concentration of pickling brine to get an idea of which answer is most accurate. Most pickling brine contains 2g of salt/100 milliliters)

Questions for discussion:

- Is pickling brine an element, a compound, or a mixture?
- Is this a mixture of elements or compounds?
- Is density a physical or chemical property?
- Would you require physical or chemical methods to separate brine into its components?
- How is brine like other mixtures?

Students could be given sets of data and asked to analyze the precision and accuracy.

### Instructional Tasks Accommodations for ELL Students

Assign the ELL student a specific task at each stage of the lab. Be sure to visit the team at frequent intervals to assess comprehension and progress.

### Instructional Tasks Accommodations for Students with Disabilities

For the student with attention difficulties, the teacher may want to assess focus and progress at frequent intervals throughout the basic lab.

### Instructional Tasks Accommodations for Gifted Students

What are the components of pickling brine? What properties of brine make it a preservative? Are these chemical or physical properties? What other mixtures or techniques of preserving food are used? How do they work? Would any mixture work in the same manner? Pretend you are a cucumber about to be made into a pickle. Write a story from the perspective of the pickle describing what happens to your cells when placed in the brine. Consider using ReadWriteThink's helpful Story Map tool at [http://readwritethink.org/student_mat/student_material.asp?id=8](http://readwritethink.org/student_mat/student_material.asp?id=8) to help you organize your ideas.