Argument-based Inquiry

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Argument-based inquiry

• Testable Questions
• Design appropriate investigations
• Data collection and analysis
• Make a claim
• Evidence

Construction and Critique (practices of science)
Using simple equipment and a common candy, students practice:

- observational skills
- forming testable questions
- designing experiments
- data collecting
- analyzing data to provide evidence for a claim that can be defended
• Decide on a beginning question to test
• Conduct the appropriate experiment(s) to answer your question(s)
• Write a claim, and support it with evidence
• Present your claim to your peers
• Negotiate meaning
Generated Questions

• Do all the colors act similarly?
• Does the temperature of the water affect the rate of dissolving?
• If I use more than one M&M in the same bowl, will the colors mix?
• If I do the experiment using oil instead of water, will the results be the same?
• What will happen if I stack M&M’s in a test tube instead of a bowl?
• When I stack them, is the order of the color important?
• Is there a difference in the results if I pour the water over them as opposed to dropping them in water?
• Do different types of M&M’s (peanut, pretzel) act similarly?
• Do other types of hard-shelled candy (Skittles, Reese’s pieces) act in a similar manner?
• Is the color that dissolves in a sphere completely surrounding the candy?
• Would a colored sugar solution dropped in water act similarly?
Authentic HS Research
Authentic Research Within the Grasp of High School Students

Annis Hapkiewicz
Okemos High School
Okemos, MI

Journal of Chemistry Education
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Research Question:

Will an ice cube melt faster in salt water or tap water?
Equipment:

2 Styrofoam cups
Salt water  (160 g NaCl / 1 L)
Thermometers
Room temperature tap water
20 mL ice cubes  (made in plastic soufflé cups)
RESULTS

Tap Water
Ice cube floats higher in salt water which causes the difference.

Hold ice cubes under the surface of the water

Results: No difference from the initial experiment
Salt water does not transfer heat as well as tap water.

Measure temperature vs time for ice in salt water and ice in tap water
New School

Results:
Temperature changed more slowly in salt water
Ions in Salt causes the ice cube to melt slower

Compare ice cube in a sugar solution vs tap water

Results: ice cube melted slower in sugar solution
Difference in density of melted ice in salt water vs room temperature tap water
Stirring the tap water and the salt water during the experiment

Results: ice cubes melted at the same rate
The density difference between the salt water and the water from the melted ice keeps the cold water around the ice cube. This cold water causes the ice cube to not lose heat to the surroundings as quickly and the ice cube melts slower.
INVESTIGATING RATES OF REACTION USING AN IODINE CLOCK REACTION
Solution A  Potassium iodate (KIO₃) solution
1) Dissolve 1.0 g of potassium iodate in a small amount of water. Dilute with water until the volume of the solution is 250 mL

Solution B
1) Dissolve 10 mL of liquid laundry starch in 250 mL of water. Add 2.0 g of sodium bisulfite (NaHSO₄) to the solution right before doing the experiment.
What could affect the time it takes for the reaction to occur?
Micro-rocket challenge

Equipment used:

• Oxygen generator
  • 3% $\text{H}_2\text{O}_2$ with $\text{MnO}_2$ catalyst
• Hydrogen generator
  • 3M HCl with mossy zinc
• Pipet bulb with calibration
• Container of water
• Piezo electric igniter
Micro-rocket challenge

Use water displacement to collect gases into the calibrated pipet bulb.
Place the water-filled bulb over the nozzle of appropriate generator.

Fill with the amount of gas you want to try.

\[
2H_2O_2(l) \xrightarrow{\text{MnO}_2} 2H_2O(l) + O_2(g)
\]
Once the bulb is over second generator fill it completely with second gas

\[2\text{HCl}(aq) + \text{Zn}(s) \rightarrow \text{H}_2(g) + \text{ZnCl}_2(aq)\]
• Place bulb over the ignition wires of the Piezo popper
• Hold bulb and press the trigger
• Rate the sound of pop on scale of 0 to 10 (10 loudest)
• Change the variable and repeat as necessary to collect sufficient data
The winner is

\[ 4 \text{ H}_2 : 2 \text{ O}_2 \]
$2H_2(g) + O_2(g) \rightarrow 2H_2O(g)$

2 : 1 ratio gives

Loudest Pop
THANK YOU

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