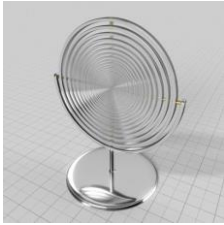


Fostering Inquiry



Brandon Rutherford

• 3rd Grade National Board Certified Teacher •

A little bit about me:



- Interested in project/inquiry based learning
 - Amateur marine biologist
 - Illinois Science Teachers Association Region 4 Co-Director
 - 3rd Grade teacher at Stratton in Champaign (Title One school)
-

Before we begin:

How do you ultimately want to impact your students?

Critical Thinking

Career Ready

Life Long Learner

•

Inquiry Learning is a Process

Science isn't just a body of knowledge, it's a process of organizing and interpreting data.



The NGSS seek to change science instruction and it's **mandatory** in Illinois

•

What the NGSS Thinks:

The National Research Council defines science as “both a body of knowledge (content) and a model and theory-building enterprise, that continually extends, refines, and revises knowledge.” i.e. a **method of interpreting and understanding the world.**



“The principal goal of science education is been to cultivate students’ scientific habits of mind and teach them how to reason in a scientific context.”

“There has always been a tension between the emphasis on developing knowledge of the content of science and the emphasis placed on scientific practices. A narrow focus on content alone has the consequence of leaving students the impression that science is simply a body of isolated facts.”

Practices for K-12 Classrooms

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information



Will it Float or Sink

Activity that helps students inquire about the physical nature of objects

- Can be adjusted in complexity for a variety of grade levels
- Allows for students to apply many NGSS practice standards
- Should always involve students formulating a hypothesis **i.e. inquiry time is not playtime**



Will it Float or Sink

This activity can stump adults:

- The labels of different 12 oz beverages are covered up
- Some float and some sink
- What property of the different drinks are causing it to float or sink?



Will it Float or Sink

Science Practices this

Activity Involves:

What do you think?

1. Asking questions (for science) and defining problems (for engineering)
2. Developing and using models
3. Planning and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations (for science) and designing solutions (for engineering)
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information



Will it Float or Sink

Science Practices this

Activity Involves:

4. Analyzing and interpreting data
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information



Demonstration inquiry can only go so far!



Alka-Seltzer Inquiry

Nature of inquiry: what factors influence the reaction rate of Alka-Seltzer?

- Tablet size?
- Temperature?
- Salinity?



Alka-Seltzer Inquiry

Nature of inquiry: what factors influence the reaction rate of Alka-Seltzer?

- **Tablet size?**



Alka-Seltzer Inquiry

Nature of inquiry: what factors influence the reaction rate of Alka-Seltzer?

NGSS Practice #1. Asking questions and defining problems

NGSS Practice #3. Planning and carrying out investigations

NGSS Practice #4. Analyzing and interpreting data

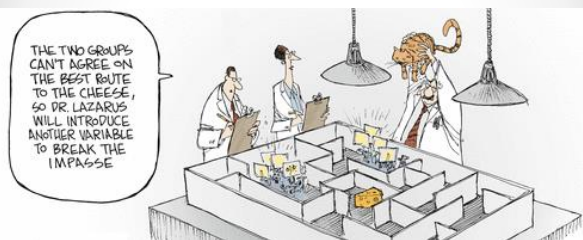
NGSS Practice #6. Constructing explanations

NGSS Practice #8. Obtaining, evaluating, and communicating information



Alka-Seltzer Inquiry

Pick One (*and only one*) Variable To Test:



Alka-Seltzer Inquiry

Pick One (*and only one*) Variable To Test:

- **Tablet grain size:** amount of pieces tablet is broken into
- Whole
- 4 pieces
- Crushed



Alka-Seltzer Inquiry

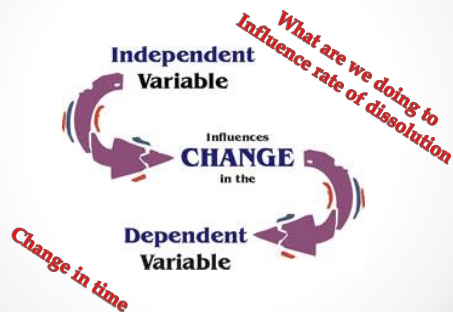
What are we measuring in our experiment?



How long it takes for the tablet to completely dissolve (no pieces)

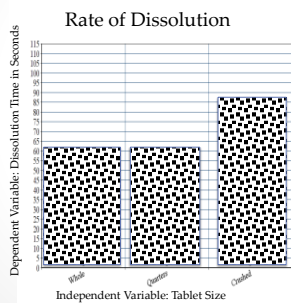
Alka-Seltzer Inquiry

Let's Communicate Our Results:



Alka-Seltzer Inquiry

What are we measuring in our experiment?



**You should make a bar graph*

Alka-Seltzer Inquiry

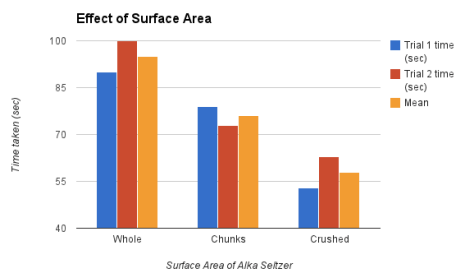
Open Inquiry Time: We are experimenting with the different factors that influence rate of reaction

- perform one reaction at a time
- remember to time each reaction
- record your data
- only experiment with one variable!
- don't make a mess



Alka-Seltzer Inquiry

NGSS Practice #4. Analyzing and interpreting data



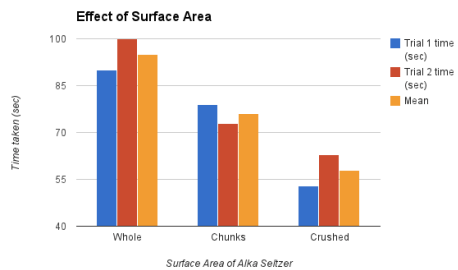
Alka-Seltzer Inquiry

NGSS Practice #6. Constructing explanations



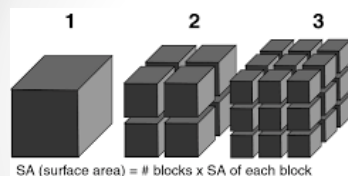
Alka-Seltzer Inquiry

NGSS Practice #6. Constructing explanations



Alka-Seltzer Inquiry

Surface Area to Volume Relationship



SA (surface area) = # blocks x SA of each block

- area of each face = $l \times w = 3'' \times 3'' = 9 \text{ in}^2$
total SA = 6 faces $\times 9 \text{ in}^2 = 54 \text{ in}^2$
- area of each face = $l \times w = 1.5'' \times 1.5'' = 2.25 \text{ in}^2$
total SA = 6 faces $\times 8 \text{ blocks} \times 2.25 \text{ in}^2 = 108 \text{ in}^2$
- area of each face = $l \times w = 1'' \times 1'' = 1 \text{ in}^2$
total SA = 6 faces $\times 27 \text{ blocks} \times 1 \text{ in}^2 = 162 \text{ in}^2$

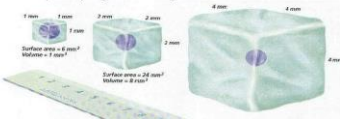
- Dissolution happens at the surface of the solute.
- The greater the surface area per unit mass, the faster the rate of dissolution.

Alka-Seltzer Inquiry

Surface Area to Volume Relationship

Factors Influencing Gas Exchange

- › **Surface to volume ratio**
 - › As animal grows, its surface area increases at a lesser rate than its volume
 - › Makes diffusion of gases into interior a problem
 - › Animals either must have a small flattened body that keeps internal cells close to surface or they must have specialized respiratory organs to move gases inward



What Principles of Inquiry Learning Have We Just Experienced?

Physical Representation of Data Makes Concepts Less Abstract

Analytical Data Helps Students Compare Results

We Practiced Generalized Process Skills and Learned Content Information

We (Hopefully) Had Fun

How You Can Go Further As A Science Teacher!

Join the Illinois Science Teachers
Association: ISTA-IL.ORG

- Get help from other teachers
- Discounts on conferences and teaching supplies
- Ongoing PD opportunities
- Mention my name for \$10 discount on membership



Comments? Questions?

Please feel free to contact me:

Email: rutherbr@champaignschools.org

Website:

MrRutherfordIsAwesome.weebly.com