Using NGSS Practices to Explore Chemistry Concepts: Phenomenon, Modeling, and Arguing from Evidence

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SHIFTING TOWARDS NGSS

- Making Science Contextual
- Making it Real, Relatable, & Relevant

PURPOSE

ENGAGEMENT

WITHOUT STARTING OVER
CHARACTERISTICS OF AN NGSS CLASSROOM

• Phenomenon or story-lined based lessons
• Students are "practicing scientists" as they solve problems
• Students build on their own understanding based on evidence
• Questioning strategies are used to foster student-to-student discourse
• Tolerance of ambiguity
CREATIVE PLANNING
Consider Units or Lessons You Already Do—many are phenomenon-ready!

- **SPORTS**
  - AMUSEMENT PARK RIDES
    - Newton’s Laws

- **OCEAN**
  - ACIDIFICATION
    - Chemistry of Acids & Bases

- **LAVA**
  - LAMPS
    - Thermodynamics

- **CRIME**
  - SCENE INVESTIGATION
    - Evidence & Argumentation

- **WATER**
  - POLLUTION & BIOACCUMULATION
    - Solutions & Solubility

- **OCEAN**
  - CURRENTS & CLIMATE CHANGE
    - Density
DESIGNING PHENOMENON

ENGAGING HOOK

MODEL INITIAL IDEAS

INVESTIGATE QUESTIONS

MODEL FINAL IDEAS
ENGAGING HOOK

• Introducing an Unforgettable Lesson with Music, Visuals, Costumes

  • A Foundational Common Experience to Return to
  • Builds Excitement and Interest
  • Memorable and Meaningful
  • Applicable to Life Beyond School
A GROOVY PHENOMENON

Already Teaching Density & Thermodynamics?
INITIAL MODELING

Demonstrate Your Understanding with a Model- “Show What You Know”

• **Diagram & Explain** How Something Works
• **Collect New Evidence, Ask Questions** and Challenge Other Scientist’s Ideas
• **Create the “Phenomenal Door”**- Questions to Drive Class Investigations
INITIAL LAVA LAMP MODELS

FACETS OF UNDERSTANDING
Using Student Questions to Gather Publicly Verifiable Evidence
INVESTIGATIVE QUESTIONS

The Guide on the Side – Providing Independent Learning Opportunities

• Preexisting Activities
• Encourage Movement
• Intentional Grouping
• Challenges that offer evidence to phenomenal door questions
• Developing Model Rules
STATION INVESTIGATIONS

• Content knowledge and hands on activities from Middleschoolchemistry.com
ASSESSMENT CONNECTIONS

• Assessment connections with sub phenomenon—Foggy Mirror to practice modeling

Check for understanding & modeling techniques
SENSE MAKING WITH MODEL RULES

SCIENCE CONCEPTS

- Rule – Cohesion
- Rule – Molecular Motion
- Rule – Effect of Heat Energy on Molecular Motion/Spacing
- Rule- Expansion
- Rule- Energy transfer(s) identified
  - Identify source/sink/loss (where energy comes from and where it goes)
  - Identify type of transfer (RAD, COND, CONV)
TALK MOVES

How do we move from “experiences and concepts” to developing “rules”?

- **Guided Discussion** placing students at the center
- **Selected questions & models** from activities highlighting central ideas
- Asking and training students to **ask as a coach**
- **Summarizing main understandings as "rules"**

### ACTIVE LISTENING
learning from listening
Coaching and Explaining

- I heard you say _________________. What makes you think that?
- I heard you say _________________. What if ________________?
- Can you repeat the part about ______?
- Would you explain a bit more about ______?
- What do you mean when you say ___?
- I’m not sure I understood ____. Would you tell me more?

### AFTER LISTENING
making meaning
Collaboration

- Your idea about ____ makes me think about ...
- Our ideas seem different. I think we disagree about...
- Our ideas are similar because...
- Our ideas differ when....
- I agree with your idea about ____________ and now I’m wondering....
- To support ideas with evidence we need to....
3. In each of your pictures above add arrows, air particles (air bubbles), and motion lines, to show movement of the air particles both INSIDE & OUTSIDE of the bottle.

4. Explain how/why the soap bubbles behave differently in hot and cold situations. HINT: STEP is a fast way to understanding why the soap bubbles are changing!

In the hot water, particles expanded in the bubble and pushed it out. However, in cold water the particles contracted and sucked the bubble in.

5. Imagine that your work at a party store during the summer. You are going to ride home with the owner of the store whose car has been sitting in the hot sun all day long. The owner tells you that you can take home a big bunch of balloons, but advises you to not blow the balloons up all of the way before putting them in the car. Knowing what you do about heating the molecules of a gas, explain why the owner's advice is wise:

The prudent advice is wise because if you blow the balloons up all the way, the increase in temperature of them would get bigger and cause the balloons to pop. If you don't blow the balloons up all the way, the balloons wouldn't pop.

**RULE:**

Heat causes particles to move faster with more kinetic energy and expand.
COMPARING PRE- & POST MODELS

LAVA LAMP: A GROOVY PHENOMENON

Observe a lava lamp in action then DRAW and LABEL a picture of the lava lamp to explain how it works. Be sure to include color, arrows to show motion, label any energy transfer or transformation, and terms to annotate or explain your picture. Please think back to old labs and personal experiences for ideas. Try to add a CUT-AWAY view or a ZOOM IN view to help your explanation of how the lava lamp works.

1. Power lights up the light
2. Light heats up the colored liquid causing it to float up (increasing volume, decreasing density)
3. Colored liquid floats to the top of the lava lamp
4. Colored liquid waits at the top until cool enough and floats back down (decreasing volume, increasing density when cooled)
5. The process repeats

Complete & Final Lava Lamp Model

- Static electricity
- Molecules expand and absorb energy
- The heater coil
- Heat energy
- The lamp is composed of:
  1. Source of heat (light bulb)
  2. Glass container
  3. Wax
  4. Water

- Convection
- Rising
- Cooling
- Falling
- Molecules

- Radiation
- Glass
- Heat
- Electrical Source

- Heat energy
- The heated wax increases and the density decreases below the density of the clear liquid
- The warehouse rises within the clear liquid
- Then, the wax continues to rise & falls due to the air current
- Convection

- The warm thick endless dense liquid becomes more dense.
REFRAMING EXISTING UNITS

- Look for engaging, complex opportunities & storylines
- Provide memorable experiences
- Require application
Resources

Middleschoolchemistry.com
Chemistry in the Community
Stemteachingtools.org
Thank you

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Survey, Certificate, and Downloads

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