Thank yous...
Ms. Randazzo
@MsRandazzo

Chemistry teacher 🎒 Student-centered learning 🎒 NGSS 🎒 Tech 🎒 My favorite scientists are my students. 🎙

📍 Hillsborough, NJ
PHENOMODELING: [fi-nom-od-el-ing] verb. A process by which students engage in authentic science experiences to explain the natural world.
Instead of TELLING you, let me SHOW you...
Phenomodeling: Chemical Reactions

Constructing a model for a chemical reaction using the Hindenburg Disaster
CHALLENGE:

Gather evidence to identify the unknown gas in this phenomenon.
Safety First!

Hydrochloric acid (HCl) is corrosive. Wear gloves, goggles, and push your sleeves up. Watch the location of sleeves, hair, etc. when working with open flame.
To observe the phenomenon:

1. This reaction will produce a gas. Have your partner ready to capture the gas by holding the gas collecting cap then placing an inverted test tube into the clamp.

2. Add ‘one squirt’ of the acid into the well containing the magnesium turnings. Move quickly to place the gas collecting cap on top of the well, then place the test tube on top for at least 10 seconds.

3. While keeping it inverted, lift the test tube, light the lighter, then bring it toward the mouth of the tube.
CHALLENGE:
CONSTRUCT A MODEL:

Construct an explanatory model to explain what occurred at the mouth of the test tube.
Recall, a good model must include:

- **Labels** that are used to identify all components.
- **Observable**: What do you see?
- **Unobservable**: How/why do you think it happened? *Use things you know; simple representations of why the phenomenon occurs.*
- A **sequence of events** used to explain the phenomenon.
QUESTIONS to consider:

1. Did a chemical reaction occur? What is your evidence?
2. What is the identity of the gas in the test tube?
3. Which elements are diatomic?
4. How can your observations (macroscopic) support the unobservable (microscopic) in your model?
QUESTIONS to consider:

1. Did a chemical reaction occur? What is your evidence?
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CONSTRUCT A MODEL: 

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CONSTRUCT A MODEL:
GALLERY WALK:

Pick one team member to stay behind to serve as an expert on the model you created.

Remaining team members will walk to the other models and ask those students to explain their models.
SNAP A PICTURE:
Take a picture of your model using your device and save it so that you can refer back to it.
CLASS DISCUSSION:

What does the test tube phenomenon have in common with this one?
“Ms. R, we need more hydrogen!”
“Hydrogen isn’t the only thing we need...”
MODEL REVISION:
Using the new information you gathered from the discussion, revise your models.
QUESTIONS to consider:

1. Is there anything besides the particles you can include in your model?
2. What happens to the structures of the reactants in the reaction?
3. What happens when the structures of the products are formed?
4. What doesn't “add up” with the particles in your model?
MODEL REVISION:

Considering your model of the phenomenon, revise your model using your answers to the following questions:

QUESTIONS to consider:

1. Is there anything besides the particles you can include in your model?
2. What happens to the structures of the reactants in the reaction?
3. What happens when the structures of the products are formed?
4. What doesn't “add up” with the particles in your model?
MODEL REVISION:

**Before:**
- **well plate**
- **Mg**
- **O₂**
- **H₂O**

**After:**
- **Whistle sound**
- **Lather**
- **Flame, pop, shrapnel, streams of gas, Mg turning**

We were able to hear the pop when the flame was placed at the mouth of the test tube. We also observed condensation. This supports the microscopic because hydrogen is present and the reaction produces water.

Gas production is evidence of a chemical reaction.
SNAP A PICTURE:

Take a picture of your model using your device and save it so that you can refer back to it.
REFLECTION:

Use the **exit ticket** provided to gather your thoughts and ideas. Please complete this individually.
### NGSS 3-Dimensional Alignment: Phenomodeling – Chemical Reactions

#### Science and Engineering Practices

- Developing and using models
- Analyzing and interpreting data
- Constructing explanations
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

#### Disciplinary Core Ideas

- **HS-PS1 Matter and its Interactions**
  - PS1.B: Chemical Reactions
- **HS-PS3 Energy**
  - PS3.A: Definitions of Energy

#### Crosscutting Concepts

1. Cause and effect
2. Scale, proportion, and quantity
3. Systems and system models
4. Energy and matter

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Suggestions for when to use

• Beginning of a unit
• Anchoring phenomenon
• Pre-assessment of prior knowledge
• Student-paced station activity
• Post-lab activity/reflection
• Reading Comprehension (ChemMatters)
• CERs
Where to start

• Do now: Explanatory Models
• Critique existing models (e.g. DNA, water cycle, mitosis, etc.)
• Teams of 2-4 students
• Materials: Whiteboards, dry erase markers, erasers
• Choose a phenomenon
Construct a model to explain phenomena

Questions to consider
Challenge
Gallery walk
Class discussion
Model revision
Snap a picture
Reflection
Problem Experience Observation Event
Suggestions for when to use each task type

**Challenge** – Something the students must engage in to observe the phenomenon

**Questions to Consider** – Reminders of important chemistry concepts, hints for a more accurate model, etc.

**Gallery walk** – Collaborate and share ideas and trigger prior knowledge
Suggestions for when to use each task type

**Class discussion** – Scaffolding for model revision, introducing more authentic phenomenon, Q/A

**Model Revision** – Revision of ideas after collaboration (gallery walk), improve model accuracy after class discussion

**Snap a Picture** – Once the model is complete or before model revision takes place
Suggestions for when to use each task type

**Reflection** – Have students reflect on the phenomenon, model components, or model revision

**Exit Ticket**

- Identify the components of your model that demonstrate the characteristics of a good explanatory model.
- What revisions did you make to your model? Why was this necessary?
- 3-2-1 List: Identify 3 things you learned, 2 things you found interesting, and 1 question you have.
Other helpful tips:

• Explicitly teach model vs. explanatory model
• Reasoning vs. Model Accuracy
• Reminders about components of a good model
• Always start with the observable
• Unleash the power of the zoom in bubble
• “Hey Ms. R, can we make water?”
• Exit ticket reflection at the end of each period
• Revisit and revise models throughout the unit
• Run, revise, reflect, repeat!
## Examples of phenomena I use

<table>
<thead>
<tr>
<th>Unit: Atomic Structure</th>
<th>Phenomenon: Static Electricity</th>
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<tbody>
<tr>
<td>Unit: Light</td>
<td>Phenomena: Glow sticks, fireworks, sun, x-rays, light bulbs</td>
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<tr>
<td>Unit: Periodic Trends</td>
<td>Phenomenon: Alkali metals in water</td>
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<td>Unit: Bonding</td>
<td>Phenomenon: Conductivity</td>
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<tr>
<td>Unit: Intermolecular Forces</td>
<td>Phenomenon: Evaporation race (water, isopropyl alcohol, acetone)</td>
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<td>Unit: Chemical Reactions</td>
<td>Phenomenon: Hindenburg</td>
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<tr>
<td>Unit: Solutions</td>
<td>Phenomena: Making iced tea, Colorimetric analysis of CuSO₄</td>
</tr>
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</table>
Examples of Phenomena: Student Artifacts

Unit: Atomic Structure
Phenomenon: **Static Electricity**
Examples of Phenomena: Student Artifacts

Unit: Electrons in Atoms
Phenomena: Fireworks, Glow sticks, Light bulbs
Examples of Phenomena: Student Artifacts

Unit: Periodic Trends
Phenomena: Alkali metals + water
Examples of Phenomena: Student Artifacts

Unit: Bonding
Phenomenon: **Conductivity**
Examples of Phenomena: Student Artifacts

Unit: Chemical Reactions
Phenomenon: **Making Water / Hindenburg**
Examples of Phenomena: Student Artifacts

Unit: Solutions
Phenomenon: **Colorimetric Analysis CuSO₄**
How the Phenomodeling process evolves...

• Less-guided
• Students take more ownership: Asking questions, Evaluating evidence, Researching, Designing arguments, etc.
• New ways to incorporate modeling: labs, assessments, station learning, QFT, etc.
• A checklist of good model components are explicit and reviewed prior to activity
Question Formulation Technique (QFT)
5. Construct an explanatory model to illustrate the differences between the original penny, the ‘silver’ penny, and the ‘gold’ penny.

Original penny

- 97.5% zinc on the inside and copper on the outside.

'Silver' penny

- The layers of copper react with NaOH and bring out a layer of zinc ions.

'Gold' penny

- The heat reacts with the zinc and copper on the penny to change the color (appearance) to gold. The zinc and copper combine to make...
Assessment Ideas

- Create a model to describe a phenomenon
- Revise a model with inaccuracies
- Create a comparison of two models
- Revise a model with new evidence
- Use a model to construct an explanation for a phenomenon
- Critique a model
- Make predictions using a model
Periodic Trends Phenomenon

Your goal is to construct an explanation for the phenomenon you observed. At least two team members must be in the video and explaining their models of this phenomenon.

You are expected to include:
1. Bohr models for lithium, sodium, and potassium
2. Observations for each reaction
3. Selected questions about this phenomenon that will help you construct the explanation.
4. An explanatory model that includes both the observable and the unobservable.
Post-lab Quiz: Golden Penny

Please complete the following questions based on what you have learned from our lab.

Your lab report (randazzo@math.un) will be reviewed when you submit this form. Test your!

1. Sketch a particle diagram to represent the reaction of copper(II) chloride and zinc nitrate.

```
\[ \text{Cu}^{2+} + \text{Zn}^{2+} \rightarrow \text{Cu}^{2+} + \text{Zn}^{2+} \]
```

2. Sketch a particle diagram to represent the reaction of lead(II) nitrate and sodium sulfate.

```
\[ \text{Pb}^{2+} + \text{Na}_2\text{SO}_4 \rightarrow \text{PbSO}_4 + 2\text{Na}^+ \]
```

A student draws the following explanatory model for a post-1982 penny. How would the student need to revise her model after she completed all the steps in the lab procedure?

**Chemical Reactions**

**Modeling a Chemical Reaction**
Collaborate on this digital whiteboard in real-time!

No whiteboards??

No problem!!

Share just like a Google doc!
Are you ready to get started?

Enjoy a digital goody bag to help get started! 😊

http://tinyurl.com/AACTPhenomodeling
References

• Make your own whiteboards and stands https://youtu.be/wAg9L4A8LhY

• Question Formulation Technique (QFT) http://rightquestion.org/education/

• Assessment Task Ideas - Models http://stemteachingtools.org/brief/30


• Hindenburg Disaster https://youtu.be/CgWHbpMVQ1U

To complete a brief survey about this webinar, and to generate your certificate of attendance, visit:  http://bit.ly/AACT-PD

To Download Resources:  
http://bit.ly/Phenomodeling

Want to present a webinar this year? Send an email!  AACTconnect@acs.org