Translating the NGSS into the Classroom

Analyzing and Interpreting Data: What makes things sink or float?

NSTA

Jody Bintz
Science Educator

Connie Hvidsten
Science Educator
Our work today

Goals
• Deepen understanding of NGSS science practice 4: analyzing and interpreting data
• Increase understanding of the vision for science teaching and learning forth by the NGSS

Agenda
• Opening
• What makes things sink or float?
• How can we better support students in analyzing and interpreting data?
• Closing
Science Teaching and Learning

• Introduce yourselves in your small group as you respond to the following question:

What are students and teachers doing in NGSS-focused classrooms?
What makes things sink or float?

• The story so far...
  – Two lessons at the middle school level
  – Heavy things sink and light things float

• Lesson 3 of 6
  – Pick up with one piece of Lesson 2 to become familiar with the cube sets
  – Continue with Lesson 3
What makes things sink or float?
Learning Goals

• I can make predictions about whether something will sink or float and give reasons for my predictions.
• I can analyze data that I collect to identify patterns in what combinations of blocks sink in water and what combinations of blocks float in water.
• I can interpret data that I collect to describe the factors that influence whether something will sink or float in water.

• INSERT PERSONAL LEARNING GOAL (at any point in the lesson)

• Extension. I can use data that I collect and patterns in sinking and floating to predict whether combinations of blocks will sink or float in liquids other than water.
• I can use the idea of forces to explain how an object will sink or float in various fluids.
• I can design a solution that solves a practical problem by using characteristic chemical and physical properties of pure substances.
Traffic Light

• Read each of the “I can” statements and traffic light your current understanding in the PRE column.
  – **Red** means stop!
    • I don’t understand!
  – **Yellow** means slow down!
    • I need more practice but I am getting there.
  – **Green** means go!
    • I’ve got it!

• Remember that we are just starting the unit. It is okay to not know!
### 2.1 Becoming Familiar with the Cubes

<table>
<thead>
<tr>
<th>Cube</th>
<th>Mass</th>
<th>Does it sink or float?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Predict</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sink (S) or Float (F)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sink (S) or Float (F)</td>
</tr>
</tbody>
</table>
Becoming Familiar with the Cubes

1. Record your ideas: What will you think about to make your predictions?

2. Predict whether each of the cubes will sink or float. Mark your prediction the table. Be sure to share your reasoning with your partner(s).

3. For our purposes...sinking blocks are completely submerged and touch the bottom of the container and floating blocks do not.

4. Place each of the cubes in the water and note on Student Page 2.1 which ones sink and which ones float.
## Recording Results

<table>
<thead>
<tr>
<th>Cube Combination</th>
<th>Prediction (Share reasoning)</th>
<th>Quantitative Observations (e.g., mass of block combination)</th>
<th>Qualitative Observations (e.g., sinking or floating behavior)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(create two, three, four, and five block combinations)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Recording Results

<table>
<thead>
<tr>
<th>Cube Combination (create two, three, four, and five block combinations)</th>
<th>Prediction (Share reasoning)</th>
<th>Quantitative Observations (e.g., mass of block combination)</th>
<th>Qualitative Observations (e.g., sinking or floating behavior)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 blocks (oak and PVC)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Recording Results

<table>
<thead>
<tr>
<th>Cube Combination (create two, three, four, and five block combinations)</th>
<th>Prediction (Share reasoning)</th>
<th>Quantitative Observations (e.g., mass of block combination)</th>
<th>Qualitative Observations (e.g., sinking or floating behavior)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 blocks (oak and nylon)</td>
<td>Sink (because oak is the heaviest wood and nylon sank)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Recording Results

<table>
<thead>
<tr>
<th>Cube Combination</th>
<th>Prediction (Share reasoning)</th>
<th>Quantitative Observations (e.g., mass of block combination)</th>
<th>Qualitative Observations (e.g., sinking or floating behavior)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 blocks (oak and nylon)</td>
<td>Sink (because oak is the heaviest wood and nylon sank)</td>
<td>37.2 g</td>
<td>.....</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Representing Your Data

*PLOT* your results on an overhead transparency

Blue  =  floaters

Red   =  sinkers
Compile Class Results

• Use a blue and red pen to transfer data from the class results to your scatter plot.
Identify Floaters and Sinkers

- On your scatter plot, write the phrase: “What I see:” near the right side of your sketch.

- Record what you see and draw an arrow pointing to what you are describing.
  - Think about trends, patterns, and changes in THIS data set.
  - Draw arrows to what you are describing.
  - No “because” statements!
Interpret Floaters and Sinkers

• Write the phrase: “What it means” underneath the first phrase

• Record what it means and draw arrows pointing to what you are describing
  – You should have one WIM statement for each WIS statement
A Caption for Floaters and Sinkers

- Think of the caption as an executive summary
- Begin with a topic sentence describing the graphic
- Join WIS with WIM to form a short paragraph
**CCCR**

**Consider-Contribute-Consult-Revise**

- **Consider** and think individually. Write down your best ideas.
- **Contribute** your ideas with a partner.
  - Just listen!
- **Consult** your partner.
- **Revise** your ideas.
  - Make revisions in a different colored pen or pencil.
  - Carefully consider the advice from your peers
Overarching Question

• What can we now say about our overarching question?

What makes things sink or float?
Traffic Light

• Traffic light your **I Can** statements on the Learning Goals handout.
  – Use the “mid” column to record your understanding of each statement using the red, yellow, and green dots.
  – Remember that you have not completed this unit yet so you may not have green dots for all the statements!
What could one learn through this experience?
NGSS Connections for the Unit

• Science and engineering practices:
  – Analyzing and interpreting data
  – Constructing explanations
  – Engaging in argument from evidence

• Disciplinary core idea: MS-PS1 Matter and its interactions
  – Framework PS1.A: Structure and properties of matter
    • Framework grade 8 end point: Measurements of a variety of properties can be used to identify particular materials.
  – NGSS PS1.A: Structure and properties of matter
    • Each pure substance has characteristics physical and chemical properties that can be used to identify it.
  – NGSS ETS1.B
    • There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem.

• Cross-cutting concepts:
  – Scale, proportion, and quantity

• Performance expectation:
  – MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of a problem.
How can we support students in developing science practice 4: analyzing and interpreting data?
Ways to use the Identify and Interpret (I²) Strategy

- Graphs
- Data tables
- Complex figures in textbooks
- Before and after sketches to see changes
Teaching the $I^2$ Strategy

- Model, model, model
- Work through one or part of one together
- Examples and non examples of appropriate responses.
- Don’t require the caption initially
- Work toward the goal of just requiring a caption
  - Students make the $I^2$ comments a habit of mind.
Describe: There was one food coloring added to each, food coloring spreaded fast because the particles moved faster because they collide with the food coloring which gave more energy. Food coloring mixed slower because the particles move slower because they collide which gave less energy.

Caption: What I see:
- Food coloring spreaded fast
- Food coloring mixed slower
- What does it mean:
  - The particles moved faster because they collide with the food coloring which gave more energy.
  - The particles move slower because they collide which gave less energy.
How will this strategy help students make sense of what they are learning?

And...

How will this strategy help the teacher know if the student is making sense of what they are learning?
CCCR
Consider-Contribute-Consult-Revise

• **Consider** and think individually. Write down your best ideas.

• **Contribute** your ideas with a partner.
  – Just listen!

• **Consult** your partner.

• **Revise** your ideas.
  – Make revisions in a different colored pen or pencil.
  – Carefully consider the advice from your peers
Questions I Asked Myself

• Which strategies am I going to use and where?
  – Does the I² strategy (or other strategy) match the learning and “activity”?

• How fast am I going to go through the lessons?
  – Where do I want to invest time for sense-making using the I² strategy (or other strategy)?

• How will I know students have learned?
  – How well does the teaching match the learning goal?
  – Have I thought of the ideal student response?
NGSS Science and Engineering Practices

1. Asking questions
2. Developing and using models
3. Designing and carrying out investigations
4. Analyzing and interpreting data
5. Using mathematics and computational thinking
6. Constructing explanations
7. Engaging in argument from evidence
8. Obtaining, evaluating, and communicating information
NGSS Science and Engineering Practice 4: Analyzing and Interpreting Data

• Read the summary of SEP 4
  – What is the nature of this practice?
  – Which elements of this practice (MS unit) were part of your experience?
Variations in Practices

<table>
<thead>
<tr>
<th>NGSS Scientific Practice</th>
<th>A. Learners are provided an example of or instructions for engaging in the scientific practice.</th>
<th>B. Learners are guided in how to engage in the scientific practice.</th>
<th>More…………………………………………………………….……………….Learner takes a stronger lead</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Asking questions (for science)</td>
<td>A. Students are provided with scientific questions related to a natural phenomenon.</td>
<td>B. Students are guided in using frameworks, or strategies to help them identify evidence, arguments and explanations about a natural phenomenon.</td>
<td>Learner takes a stronger lead</td>
</tr>
<tr>
<td>2. Developing and using models</td>
<td>A. Students are provided with models and given their limitations, approximations, and assumptions. They are shown how models can illuminate aspects of a system, and lead to questions, predictions, and explanations about a natural phenomenon.</td>
<td>B. Students are guided in using frameworks, or strategies to help them develop and use models to generate questions, make predictions, and develop a causal explanation of a phenomenon.</td>
<td>Learner takes a stronger lead</td>
</tr>
<tr>
<td>3. Planning and carrying out investigations</td>
<td>A. Students are provided with a plan for collecting the data needed to address a scientific question (including the controls, dependent and independent variables, and protocols to follow). Students collect the appropriate data.</td>
<td>B. Students are guided in using frameworks, or strategies to help them identify the data needed to be collected and provided with a structure for collecting the data (including identifying control variables, and protocols to follow). They are supported in some aspect of the collection of data related to a natural phenomenon.</td>
<td>Learner takes a stronger lead</td>
</tr>
<tr>
<td>4. Analyzing and interpreting data</td>
<td>A. Students are shown how to represent and analyze data to identify patterns, trends, or relationships that reveal the meaning or relevance of the results of an investigation so they may be used as evidence. They are shown how to interpret the data in light of relevant models and theories.</td>
<td>B. Students are guided in using frameworks, or strategies to help them represent and analyze data related to a natural phenomenon. They are guided in interpreting the data in the light of the evidence quality, strengths and limitations of the reasoning, and alternative explanations. They are shown how to critically evaluate the argument and identify how it links scientific ideas with observations and data in order to make sense of some aspect of the natural world.</td>
<td>Learner takes a stronger lead</td>
</tr>
<tr>
<td>5. Using mathematics and computational thinking</td>
<td>A. Students are given appropriate mathematical routines and tools for computational thinking, as well as step-by-step instructions for applying them to qualitative or quantitative data sets to represent their ideas, solve problems, describe relationships, and make predictions about natural phenomena.</td>
<td>B. Students are guided in using frameworks, or strategies to help them represent and analyze data related to a natural phenomenon. They are guided in interpreting the data in the light of the evidence quality, strengths and limitations of the reasoning, and alternative explanations. They are shown how to critically evaluate the argument and identify how it links scientific ideas with observations and data in order to make sense of some aspect of the natural world.</td>
<td>Learner takes a stronger lead</td>
</tr>
<tr>
<td>6. Constructing explanations (for science)</td>
<td>A. Students are provided a causal explanation of a phenomenon and identify how it links scientific ideas with observations and data in order to make sense of some aspect of the natural world.</td>
<td>B. Students are guided in using frameworks, or strategies to help them represent and analyze data related to a natural phenomenon. They are guided in interpreting the data in the light of the evidence quality, strengths and limitations of the reasoning, and alternative explanations. They are shown how to critically evaluate the argument and identify how it links scientific ideas with observations and data in order to make sense of some aspect of the natural world.</td>
<td>Learner takes a stronger lead</td>
</tr>
<tr>
<td>7. Engaging in argument from evidence</td>
<td>A. Students are given a scientific argument and provided with instructions on how to critically evaluate it in light of the evidence quality, strengths and limitations of the reasoning, and alternative explanations. They are shown a revised argument based on the results of its evaluation.</td>
<td>B. Students are guided in using frameworks, or strategies to help them engage in scientific argument that is guided in the light of evidence quality, strengths and limitations of the reasoning, and alternative explanations. They are shown a revised argument based on the results of its evaluation.</td>
<td>Learner takes a stronger lead</td>
</tr>
<tr>
<td>8. Obtaining, evaluating, and communicating information</td>
<td>A. Students are given examples of how information from scientific texts can be integrated with current understanding and examples of salient ideas, sources of error, mythological flaws, and distinctions between observations and inferences, arguments and explanations, and claims from evidence. They are provided with step-by-step instructions for presenting results of inquiry to peers.</td>
<td>B. Students are guided in using frameworks, or strategies to help them engage in scientific argument that is guided in the light of evidence quality, strengths and limitations of the reasoning, and alternative explanations. They are shown a revised argument based on the results of its evaluation.</td>
<td>Learner takes a stronger lead</td>
</tr>
</tbody>
</table>

- What are the key components of the chart?
- Which variation was most consistent with your experience?
- Why is thinking about these variations important?
Revisit chart

- What would you emphasize on our chart?
- What would you add?