Evidence in the era of the NGSS

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The Learning Design Group
A curriculum development and research team

The Lawrence Hall of Science
University of California, Berkeley
A deep collaboration

The Lawrence Hall of Science + Amplify = AmplifyScience

Evidence in the era of NGSS

- Framing
- Amplify Science unit example
- Reflection
- Q & A

Use Chat to share ideas and ask questions!
Why do we teach science?

Think and write

You can reflect on your personal motivation to teach science, or your ideas about why students should learn science in school.

Why teach science?

From the Learning Design Group

To create the next generation of scientific innovators as well as citizens who are curious, skeptical, evidence-based thinkers capable of making decisions that improve their and their communities’ lives.
Scientific Phenomena: observable events that occur in the universe and that we can use our science knowledge to explain or predict.

Next Generation Science Standards
A paradigm shift
Phenomenon-based approach
### Considering topics and phenomena

**How might teaching and learning be different?**

<table>
<thead>
<tr>
<th>Topic</th>
<th>Phenomenon</th>
</tr>
</thead>
<tbody>
<tr>
<td>The water cycle</td>
<td>Storms in this area have become more severe</td>
</tr>
<tr>
<td>Sea turtles</td>
<td>Sea turtles are able to survive in a habitat where sharks live</td>
</tr>
<tr>
<td>Light energy and matter</td>
<td>Australia has an elevated skin cancer rate</td>
</tr>
<tr>
<td>Erosion</td>
<td>A cliff's edge is closer to a building than it was 100 years ago</td>
</tr>
</tbody>
</table>

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from learning about (like a student)  

→  

to figuring out (like a scientist)
Amplify Science unit example

The role of evidence in phenomenon-based instruction

Instructional Approach

Introduce a **phenomenon** and a related problem

Gather **evidence** from multiple sources

Construct increasingly complex **explanations**

**Apply** knowledge to solve a different problem

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Unit example: *Chemical Reactions*

Anchor phenomenon

The residents of Westfield found a reddish-brown substance coming out of their water pipes.

Dr. Yung took a sample of water from Westfield’s well. She did not find the reddish-brown substance in the sample. However, she did find some fertilizer.
Anchor phenomenon

The town of Westfield found a reddish-brown substance coming out of their water pipes.

Anchor phenomena:
- Rich and complex
- Includes many ideas to explain
- Specific and observable

Phenomenon (Chapter Question)  Phenomenon (Chapter Question)  Phenomenon (Chapter Question)
Chemical Reactions Chapter 1 summary

What is the reddish-brown substance in the water?

- Substances have different properties at the observable scale because they are different at the atomic scale.
- The reddish-brown substance, the pipes, and the fertilizer all have different properties and different atomic structures.
- The reddish-brown substance is rust.

Chapter 2 Question:

How did the rust form?

- Claim 1: The iron pipes changed into rust.
- Claim 2: The fertilizer changed into rust.
- Claim 3: The iron pipes and the fertilizer changed into rust.
Can substances change into different substances?

Investigating substance changes

- Observe the properties of each substance before they are combined.
- Observe the properties of the substance or substances after they are combined.
- Did the substances change into different substances?

Reflecting on the activity

Add to chat

After working on this activity, what can we explain about the phenomenon?
Coherence flowchart

**Chemical Reactions: Chapter 2**

Phenomenon: How did the rust form?

Investigation Question: Can substances change into different substances?

Multiple sources of evidence

Discuss how the evidence supports your claim about whether substances can change into different substances.
Investigation Question: Can substances change into different substances?

Key concept: During a chemical reaction, one or more starting substances (reactants) change into one or more different substances (products).
Coherence flowchart

**Chemical Reactions: Chapter 2**

Investigation Question: Can substances change into different substances?

Phenomenon: How did the rust form?

Investigation Question: How do substances change into different substances during chemical reactions?

Evidence: Sim Investigation.

Evidence: Physical model

Key concept: During a chemical reaction, one or more starting substances (reactants) change into one or more different substances (products).

Key concept: During a chemical reaction, atoms do not change from one type to another.

Key Concept: During a chemical reaction, atoms rearrange themselves to form different groups of atoms.

How did the rust form?

**Testing the claims**

1. The iron pipes changed into rust.
2. The fertilizer changed into rust.
3. The iron pipes and the fertilizer changed into rust.

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Chapter 2 explanation
How did the rust form?

I believe the rust formed from a chemical reaction between the iron pipes and the fertilizer. I know that atoms in substances can rearrange during a chemical reaction, so the iron atoms from the pipe must have combined with the oxygen atoms from the fertilizer to make the rust (which is made up of iron and oxygen atoms.)

Reflection

The role of evidence in phenomenon-based instruction
Next Generation Science Standards

A paradigm shift

Phenomenon-based approach

Chapter structure

Phenomenon

Investigation Question

Multiple sources of evidence

Key concepts

Explanation of the phenomenon

Investigation Question

Multiple sources of evidence

Key concepts
Activities

Hands on
Macro level evidence that substances can change into other substances

Sim
Atomic level evidence that substances change into other substances because their atoms rearrange

Token model
Applying ideas to evaluate claims and generate evidence that atoms in the iron pipe and in the fertilizer rearranged to form rust

Evidence

Hands on
Macro level evidence that substances can change into other substances

Sim
Atomic level evidence that substances change into other substances because their atoms rearrange

Token model
Applying ideas to evaluate claims and generate evidence that atoms in the iron pipe and in the fertilizer rearranged to form rust
Engaging with evidence in Chemical Reactions

- **Observing** and **investigating** with physical substances
- **Investigating** substances and chemical reactions in the Simulation
- **Observing** video modeling the atomic scale
- Closely **reading** scientific articles
- Student-to-student **discourse** about investigations and texts
- **Developing physical and digital models** to investigate and reflect on ideas about chemical reactions
- **Evaluating** claims about Westfield

Science and Engineering Practices

1. Asking questions and defining problems
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 and designing solutions
7. Engaging in arguments from evidence
8. Obtaining, evaluating, and communicating information
Today’s world requires shifts in learning

“Understanding science ... now more than ever, is essential for every American citizen.

Science permeate[s] every aspect of modern life... Some knowledge of science ... is required to engage with the major public policy issues of today as well as to make informed everyday decisions, such as selecting ... medical treatments or determining how to invest public funds...

... In these contexts, learning science is important for everyone, even those who eventually choose careers in fields other than science or engineering.”


The role of evidence

Using multiple sources of evidence, students figure out phenomena like a scientist.
@Home resources
Preserving the phenomenon-based approach in a remote setting

- Reduced instructional time
- Digital slides/videos, or print version

Amplify Science@Home Units

- Full instructional time
- Video-based

Amplify Science@Home Videos

@Home Units
Adaptations for remote settings

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The Learning Design Group at UC Berkeley’s Lawrence Hall of Science
The role of evidence in remote settings

When making adaptations, keep in mind how you use multiple sources of evidence in a phenomenon-based approach.

Q & A
Thank you for your participation!