Designing Science Lessons Aligned to the New Standards to Promote English Learners’ Science and Language Learning

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The NGSS & the NYS P-12 Science Learning Standards

- The NGSS have been adopted by 18 states and adapted by 16 states including NY
- NYS P-12 Science Learning Standards
How familiar are you with NGSS/NYS P-12 Science Standards?

1. I am not.

2. I’ve heard of the new science standards, but don’t really know how they impact students or my teaching.

3. I am familiar with the new science standards, but I have questions and would like more specifics.

4. I am very familiar with new science standards. I could help others understand what they are and how they impact students and our teaching.
Goals for the Workshop

• Experience NGSS-aligned instruction and how it differs from prior approaches

• Experience how NGSS-aligned instruction can create opportunities for rich language use and development for all students.
Activity 1
The Phenomenon: Falling Stars
Driving Question Board

What are stars made of?

- How are they formed?
- Are stars made of ice?
- Why are they made of ice?
- How many stars are in the sky?
- What are the shapes of stars?
- Why are there stars in the sky?

Where/Where do we see falling stars?

- Why do stars fall from the sky?
- Why do we see stars falling?
- Why do they fall?
Driving Question Board

- How do stars fall?
- "Startling Questions"

Sticky notes with various questions and thoughts, such as:
- Why is there a hole in the sky?
- Why do they shine at night?
- Why do they fall and why?
- Why do they shine so brightly?
- Why do they fall at the same time?
Driving Question: Why do falling stars fall?

- What are falling stars made of?
- When do we see falling stars?
- How do falling stars fall?
Driving Question:
Why do falling stars fall?

What are falling stars made of?

Lesson 1-1: What do you see in the sky?
Lesson 1-2: What are the properties of falling stars?
Lesson 2-1: Is a falling star a star?
Lesson 2-2: Why is the sun brighter than other stars?
The Phenomenon: Garbage
How does anchoring science learning in phenomena support English learners’ language development?
How does anchoring science learning in phenomena support English learners’ language development?
Science learning anchored in phenomena provides English learners with a purpose to communicate and a compelling context in which to express their ideas.
Affordances of a Local Phenomenon

- **Creates relevance**
  Makes science real by grounding experiences in students’ everyday lives.

- Utilizes funds of knowledge

- Provides context for language use

- Promotes participation of all students
Affordances of a Local Phenomenon

- Creates relevance
- Utilizes funds of knowledge
  - Allows students to use their funds of knowledge from their homes and communities.
- Provides context for language use
- Promotes participation of all students

<table>
<thead>
<tr>
<th>Category from School Garbage</th>
<th>Home Garbage Materials That Fit This Category</th>
<th>Properties</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic (non-food)</td>
<td>1. Empty Toothpaste Tube</td>
<td>Smooth, Dull, No smell, White or clear</td>
</tr>
<tr>
<td></td>
<td>2.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.</td>
<td></td>
</tr>
<tr>
<td>Cardboard</td>
<td>Cardboard boxes</td>
<td>Bristable, Bendable</td>
</tr>
<tr>
<td>Metal</td>
<td>Soda cans</td>
<td>Crushable, Hard, Shiny</td>
</tr>
<tr>
<td>Fruit</td>
<td>Rotten fruit</td>
<td>Squeaky, Turns black, Tastes bad</td>
</tr>
</tbody>
</table>
Affordances of a Local Phenomenon

- Creates relevance
- Utilizes funds of knowledge
- Provides context for language use
  - Generates language and facilitates communication as students talk about science in everyday language, including home language.
- Promotes participation of all students
Affordances of a Local Phenomenon

- Creates relevance
- Utilizes funds of knowledge
- Provides context for language use
- Promotes participation of all students
  Creates an inclusive learning environment by acknowledging diversity.
NGSS Instructional Shifts

Shift 1: Explaining phenomena or designing solutions to problems

Shift 2: Three-dimensional learning

Shift 3: Learning progressions (or coherence): build and apply ideas across time
Three-dimensional Learning

Blending of Three Dimensions

- Science and engineering practices
- Disciplinary core ideas
- Crosscutting concepts
Science and Engineering Practices (SEPs)

Describe what scientists do to investigate the natural world and what engineers do to design and build systems.
Science and Engineering Practices

1. Ask questions (for science) and define problems (for engineering)
2. Develop and use models
3. Plan and carry out investigations
4. Analyze and interpret data
5. Use mathematics and computational thinking
6. Construct explanations (for science) and design solutions (for engineering)
7. Engage in argument from evidence
8. Obtain, evaluate, and communicate information
Disciplinary Core Ideas (DCIs)

Key ideas in science in four domains:

- Physical Science
- Life Science
- Earth and Space Science
- Engineering Design
Disciplinary Core Ideas (DCIs)

Physical Sciences
- PS 1: Matter and its interactions
- PS 2: Motion and stability: Forces and interactions
- PS 3: Energy
- PS 4: Waves and their applications in technologies for information transfer

Life Sciences
- LS 1: From molecules to organisms: Structures and processes
- LS 2: Ecosystems: Interactions, energy, and dynamics
- LS 3: Heredity: Inheritance and variation of traits
- LS 4: Biological Evolution: unity and diversity

Earth and Space Sciences
- ESS 1: Earth’s place in the universe
- ESS 2: Earth’s systems
- ESS 3: Earth and human activity

Engineering, Technology, and the Applications of Science
- ETS 1: Engineering design
- ETS 2: Links among engineering, technology, science, and society
Crosscutting Concepts (CCC)

Connections across the four domains of science.

They provide organizational schema for interrelating knowledge from various science field into a coherent and scientifically-based view of the world.
Crosscutting Concepts (CCC)

1. Patterns
2. Cause and effect
3. Scale, proportion, and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change
3-Dimensional Learning Analogy

Kitchen Tools & Techniques
(Practices)

Basic Ingredients
(Core Ideas)

Preparing a Meal
(Three-dimensional Learning)

Herbs, Spices, & Seasonings
(Crosscutting Concepts)

Source: NSTA

SAIL

NEW YORK UNIVERSITY
5. Structure and Properties of Matter

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Students who demonstrate understanding can:

5-PS1-1. Develop a model to describe that matter is made of particles too small to be seen. [Clarification Statement: Examples of evidence supporting a model could include adding air to expand a basketball, compressing air in a syringe, dissolving sugar in water, and evaporating salt water.] [Assessment Boundary: Assessment does not include the atomic-scale mechanism of evaporation and condensation or defining the unseen particles.]

5-PS1-2. Measure and graph quantities to provide evidence that regardless of the type of change that occurs when heating, cooling, or mixing substances, the total weight of matter is conserved. [Clarification Statement: Examples of changes could include phase changes, dissolving, and mixing that form new substances] [Assessment Boundary: Assessment does not include distinguishing mass and weight.]

5-PS1-3. Make observations and measurements to identify materials based on their properties. [Clarification Statement: Examples of materials to be identified could include baking soda and other powders, metals, minerals, and liquids. Examples of properties could include color, hardness, reflectivity, electrical conductivity, thermal conductivity, response to magnetic forces, and solubility. Density is not intended as an identifiable property.] [Assessment Boundary: Assessment does not include density or distinguishing mass and weight.]

5-PS1-4. Conduct an investigation to determine whether the mixing of two or more substances results in new substances.
Space Systems Unit: Falling Stars
Performance Expectations Addressed in Falling Stars Unit

5-ESS1-1. Support an argument that the apparent brightness of the sun and stars is due to their relative distances from the Earth.

5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

5-PS2-1. Support an argument that the gravitational force exerted by earth on objects is directed down.
Activity 2
Activity 2

How are you going to investigate which are the falling stars?

1 MINUTE
Activity 2: Tools / Herramientas

- Magnet / Imán
- Magnifying glass / Lupa
- Streak plate / Placa de raya
Lesson 1-2: What are the properties of falling stars?

Science and engineering practices (SEN):

Disciplinary core idea (DCI):

Cross-cutting concept (CCC):
Lesson 1-2: What are the properties of falling stars?

Science and engineering practices (SEN):
3. Plan and carry out investigations
4. Analyze and interpret data

Disciplinary core idea (DCI):
PS1-A Structure and Properties of Matter

Cross-cutting concept (CCC): 1. Patterns
How does 3-dimensional learning support English learners’ language use and development?
How does 3-dimensional learning support English learners’ language use and development?

2 MINUTES
Engaging in 3-dimensional learning provides ELs opportunities to use and develop language across various registers, modalities, and types of interactions.

<table>
<thead>
<tr>
<th>Modalities</th>
<th>Registers</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Linguistic</strong></td>
<td>Everyday talk and text</td>
</tr>
<tr>
<td>• Talk</td>
<td>Specialized talk and text</td>
</tr>
<tr>
<td>• Text</td>
<td></td>
</tr>
<tr>
<td><strong>Visual</strong></td>
<td>Precision: Do ELs communicate disciplinary</td>
</tr>
<tr>
<td>• Drawing</td>
<td>meaning with exactness?</td>
</tr>
<tr>
<td>• Table</td>
<td></td>
</tr>
<tr>
<td>• Graph</td>
<td></td>
</tr>
<tr>
<td>• Chart</td>
<td></td>
</tr>
</tbody>
</table>

**Interactions**

- One-to-one
- One-to-small group
- Small group-to-many
- One-to-many

Explicitness: Do ELs communicate disciplinary meaning beyond the “here and now”? 
<table>
<thead>
<tr>
<th>More of this…</th>
<th>Less of this…</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students learn science as an iterative, dynamic, creative, and collaborative process similar to how real scientists and engineers do their work.</td>
<td>Students learn science as a collection of facts. They memorize definitions and rote procedures.</td>
</tr>
<tr>
<td>Student reasoning and argumentation play a central role in understanding labs and text.</td>
<td>Student thinking is limited by a “cook book” approach to lab experiences and problems or end-of-the chapter questions and test experiences.</td>
</tr>
<tr>
<td>Engaging in science and engineering practices allows students to revise their thinking and understanding.</td>
<td>The science process is just things to learn/apply and “be done.”</td>
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</tbody>
</table>
Roger collected four rock samples and wrote a description of how each was formed. Which of the following rocks that Roger collected is a metamorphic rock?

A. Formed from magma that cooled slowly
B. Formed by pressure and heat over time
C. Formed from lava that cooled quickly
D. Formed by pieces of rock cemented together
8. Dr. Flores carries out an investigation to find out what happens when three substances are mixed:

- Dish soap
- Yeast
- Hydrogen peroxide

Based on the pictures, record the properties of each substance in the table below.

<table>
<thead>
<tr>
<th>Substance</th>
<th>Properties</th>
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<tr>
<td></td>
<td>Color</td>
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<td>Dish soap</td>
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Next, your class will watch a video of Dr. Flores carrying out her investigation. After watching the video, record the properties of the mixed substance in the table below.

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<tr>
<td></td>
<td>Form of matter (State)</td>
</tr>
<tr>
<td>Mixed substance</td>
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When Dr. Flores mixed dish soap, yeast, and hydrogen peroxide, **was a new substance formed?**

Write an argument to answer this question using evidence from both tables.

a. Claim

   ___________________________________________________________

   ___________________________________________________________

b. Evidence and Reasoning

   ___________________________________________________________

   ___________________________________________________________

   ___________________________________________________________

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**a. Claim**

**Science Practice 7:** Engage in argument from evidence

**b. Evidence and Reasoning**

**Disciplinary Core Idea:** When two or more different substances are mixed, a new substance with different properties may be formed.
To summarize . . .

Simply by engaging English learners in NGSS-aligned instruction we are providing them with a rich context for language use and development.

The next step is to provide appropriate supports based on students’ individual characteristics.
### Science Vocabulary

Put these words in alphabetical order.

- hatch
- peeps
- heart
- egg
- beak
- yolk
- white
- shell
- chicken
- egg tooth
- rooster
- hen
- chick
- embryo
- sac
- wings
- temperature
- membrane
- blood vessels
- incubator
- fertilized
- development
- thermometer
- feathers

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24. 

Choose 12 vocabulary words. Use each word in a complete sentence.

This worksheet is a part of the Incubation and Embryology Project (http://www.extension.illinois.edu/UI). University of Illinois Extension, 1999.
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THANK YOU!

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