Science and Language Instructional Shifts with English Learners

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• Topic 1: Science instructional shifts
• Topic 2: Language instructional shifts
• Classroom example 1: Case study on ELs
• Classroom example 2: Classroom video
3-Dimensional Learning

- Practices
- Core Ideas
- Crosscutting Concepts
- Crosscutting Ideas
- Practices
Dimension 1: 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
Dimension 2: Crosscutting Concepts

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
Dimension 3: Disciplinary Core Ideas

- Physical sciences
- Life sciences
- Earth and space sciences
- Engineering, technology and applications of science
Topic 1: Science Instructional Shifts

1) Focus on phenomena or designing solutions

2) 3-dimensional learning

3) Coherence (or learning progression)
1) Explaining a phenomenon or designing solutions to a problem: A phenomenon or problem in a local context of students’ home and community capitalizes on everyday language and experience.

The University of Delaware built a turbine at their Lewes Campus. How might this affect local wildlife?

There has been much wonder about how the lead got into the water in Flint, MI. Can it happen in our community?
1) Community-based Phenomenon

Diversity
- create relevance (respect for diversity)
- utilize funds of knowledge (cultural resources)
- provide context for language (linguistic resources)
- promote participation of all students (inclusion)

Science
- integrate science disciplines
- link engineering to local context
- Reflect current concerns using science
2) Three-dimensional learning: The NGSS science and engineering practices are language intensive.
2) **Three-dimensional learning:** The NGSS practices afford rich language use.

### NGSS Practice 7: Engage in argument from evidence

<table>
<thead>
<tr>
<th><strong>Analytical Science Tasks</strong></th>
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</thead>
<tbody>
<tr>
<td>• Distinguish between a claim and supporting evidence or explanation</td>
</tr>
<tr>
<td>• Analyze whether evidence supports or contradicts a claim</td>
</tr>
<tr>
<td>• Analyze how well a model and evidence are aligned</td>
</tr>
<tr>
<td>• Construct an argument</td>
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<table>
<thead>
<tr>
<th><strong>Receptive Language Functions</strong></th>
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</thead>
<tbody>
<tr>
<td>• Comprehend arguments made by others orally</td>
</tr>
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<td>• Comprehend arguments made by others in writing</td>
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<table>
<thead>
<tr>
<th><strong>Productive Language Functions</strong></th>
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</thead>
<tbody>
<tr>
<td>Communicates (orally and in writing) ideas, concepts, and information related to the formation, defense, and critique of arguments</td>
</tr>
<tr>
<td>• Structure and order written or verbal arguments for a position</td>
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<tr>
<td>• Select and present key evidence to support or refute claims</td>
</tr>
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<td>• Question or critique arguments of others</td>
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</table>
3) Coherence (or learning progression): Three-dimensional learning becomes sophisticated over time.

Lessons often raise questions that motivate what we want to figure out in subsequent lessons

(Figure by Brian Reiser)
3) Coherence (i.e., learning progressions): As 3-dimensional learning becomes sophisticated over time, language use becomes precise, explicit, and complex.

**Precision**
- Does the discourse use discipline-specific terms appropriately?
- Is the discourse exact enough to communicate nuanced meaning?

**Explicitness**
- Would the audience understand the discourse without context?
- Could someone who is not in the classroom understand the discourse?
- Does the student appropriately use logical connectors (e.g., because, since, therefore, so) to be explicit about relationships between ideas?

**Complexity**
- Does the student communicate about relationships between concepts?
- Does the student explain why (cause and effect)?
- Does the student provide evidence to support a claim?
Topic 2: Language Instructional Shifts

- Language use for purposeful communication
- Engagement in disciplinary practices (e.g., science) using less than perfect English
- Strategic use of multiple modalities appropriate to the discipline (e.g., science)
- Precise and explicit use of registers appropriate to the discipline (e.g., science)
<table>
<thead>
<tr>
<th></th>
<th>Over K-12</th>
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<tbody>
<tr>
<td><strong>Modalities</strong></td>
<td>Increasingly strategic use of multiple modalities appropriate to the discipline (e.g., science)</td>
</tr>
<tr>
<td><strong>Registers</strong></td>
<td>Increasingly precise and explicit use of registers appropriate to the discipline (e.g., science)</td>
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Classroom Example #1: Case Study on ELs

English Language Learners:
Grade 2 Earth Science

Developing and Using Models to Represent Earth’s Surface Systems

Emily Miller, NGSS Diversity and Equity Team Member
1) The investigation is carried out by a class of 2nd grade students with 80% English learners.

While observing the soil in the school yard, they ask if all soil is the same. Some students think that sand is an example of different soil. They discuss how they would be able to find out.
2) The students ask their families the driving question in an interview for a homework assignment. They share the answers with their peers. They discuss the soil in different parts of the country and home countries where students come from.

A grandmother from Laos visits the class and, through a school translator, describes the rich soil in the rice field in Laos and wonders how corn grows in the sandy soil in Wisconsin.
Lus Nug txog Av:

Nug Koj li Niamtxiv

Tag nrho av puas zoo ib yam (Is all soil the same)?

They are different.
Some are rocky, some are dry,
some are sandy.

Koj yuav paub tau li cas (How do you know)?

We want to dig and
see different types.

Peb yuav nriav tau li cas (How can we find out)?

You can go look at five different farms,
you can even go and dig and feel them.
3) Based on the evidence that soil is different around the world, the students wonder if it is different in the neighborhood.

After choosing three different locations using an aerial map and a topographic map, they investigate whether soil within walking distance of the school is the same.
Using an Aerial Map and a Topographical Map in the Community
<table>
<thead>
<tr>
<th>PLACE</th>
<th>School Yard</th>
<th>Coniferous Hill</th>
<th>Urban Marsh</th>
</tr>
</thead>
<tbody>
<tr>
<td>Worms</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>How many</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How far down</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Tools</td>
<td>Thick 11</td>
<td>Thin 11</td>
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<tr>
<td>How far down</td>
<td>12 in</td>
<td></td>
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<tr>
<td>Trash</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>How far down</td>
<td>17 in</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fungi</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>How many</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colors</td>
<td>Brown</td>
<td>White</td>
<td>Light Brown</td>
</tr>
<tr>
<td>Do you see?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>What colors?</td>
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</table>
4) The students develop “expert groups,” and each group works on a soil profile model of one area in the neighborhood.

Each group investigates (a) what makes up the soil (sand, silt, clay, and organic materials) in the area and (b) how quickly the soil filters water.

The groups present their models to the whole class. They talk about patterns they observe across maps.
Modeling Soil Profiles to Explain Patterns

Urban Marsh

Coniferous Hill

School Yard
5) The students are given three unidentified soil samples that came from sites within walking distance of the school.

They use the models to develop claims, based on evidence, as to where the soil came from.
Reasoning to Identify Soil Types
Using Evidence to Support Claims

Do you think the soil came from the urban marsh, the coniferous hill, or the school yard field?

Use evidence to support your claim:

Claim:
I think the soil is from the Coniferous Hill

Why do you think that?
Evidence:

I think it is because it was prior dumped and it has a dark color and slight brown smell color and a dark brown smell too. And I look at the bottom of the Coniferous Hill and that helps me know.
Writing Claims and Evidence on the Whiteboard

- soil A is from Urban marsh
- It is wet and has earthworms
- B is from School
- My evidence
6) One of the locations the students investigate is the mucky and smelly soil under a highway (urban marsh). It has a lot of trash and sand in it. They argue that the trash ends up in the soil because of the wind blowing the trash there and the sand is washed into the soil from the highways.

The students care about this soil because it is right next to the apartments where many students live.

This finding leads the students to consider solutions to this problem, which is engineering.
Engineering Solutions to Trash Problem

How can wind and rain change the soil?

When the wind come
it reach the trash

When the rain come
it reach the urban marsh and

What can we do to STOP wind and rain from changing the soil?

We can make a house

The soil
How does the EL case study illustrate:

1. **Science instructional shifts?**
   - Focus on phenomena or designing solutions
   - 3-dimensional learning
   - Coherence (or learning progressions)

2. **Language instructional shifts?**
   - Language use for purposeful communication
   - Engagement in disciplinary practices (e.g., science) using less than perfect English
   - Strategic use of multiple modalities appropriate to the discipline (e.g., science)
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The video shows a fourth grade science classroom at a Title I school with 64% economically disadvantaged and 34% ELs. The teacher has been teaching NGSS-based instruction for the past couple of years.

https://vimeo.com/166410948\
Science Instructional Shift #1: Explaining a phenomenon or designing solutions to a problem
A phenomenon or problem in a local context of students’ home and community capitalizes on everyday language and experience.
Science Instructional Shift #2: 3-D Learning
NGSS science and engineering practices are language intensive.
Science Instructional Shift #3: Coherence (Learning Progression)
How does the classroom video illustrate:

1. Science instructional shifts?
   - Focus on phenomena or designing solutions
   - 3-dimensional learning with a focus on practices
   - Coherence (or learning progressions)

2. Language instructional shifts?
   - Language use for purposeful communication
   - Engagement in disciplinary practices (e.g., science) using less than perfect English
   - Strategic use of multiple modalities appropriate to the discipline (e.g., science)
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Thank You!