Understanding Language
Language, Literacy, and Learning in the Content Areas

NEXT GENERATION SCIENCE STANDARDS
For States, By States

SAIL

Science and Integrated Language:
Development of Language-Focused Three-Dimensional Science Instructional Materials to Support English Learners in Fifth Grade

NGSS Instructional Shifts and Language Instructional Shifts Support Each Other with English Learners

Science Kickstart
Honolulu, Hawaii
July 17, 2017

Okhee Lee
New York University

Changing Student Demographics

ESSA four demographic groups for accountability measures:

1. Economically disadvantaged students

- 51% of students were eligible for free and reduced price lunch in 2013 (Southern Education Foundation, 2015)

2. Students from major racial and ethnic groups

- Racial and ethnic minority students made up 50% of students in fall 2013 (National Center for Education Statistics [NCES], 2016)

3. Children with disabilities

- 13% of students received special education services in 2013–2014 (NCES, 2016)

4. English learners

- 21% of children spoke a language other than English at home (U.S. Census Bureau, 2012)
- English learners constituted 9.3% of public school students in 2013-2014, or an estimated 4.5 million students (NCES, 2016)

NGSS Diversity & Equity Team: All Standards, All Students

Bias Reviews

- Inclusive language
- Consistency of language
- Clarity of language

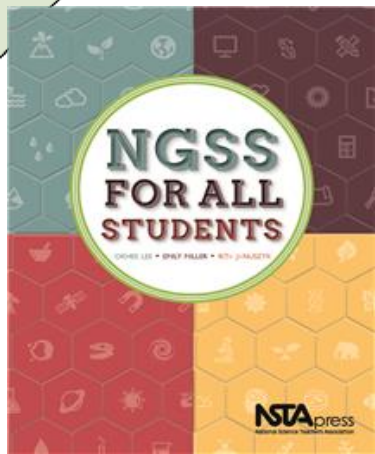
Appendix D

- NGSS learning opportunities and demands
- Effective strategies
- Context

Diversity and Equity Topic in Appendices

7 Case Studies

- Economically disadvantaged
- Racial and ethnic groups
- Students with disabilities
- English learners
- Girls
- Alternative ed
- Gifted and talented



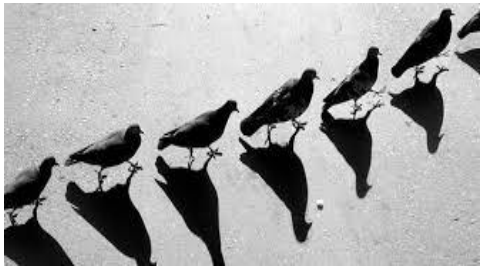
Topics

NGSS Instructional Shifts and Language Instructional Shifts Support Each Other with All Students, Including English Learners (ELs)

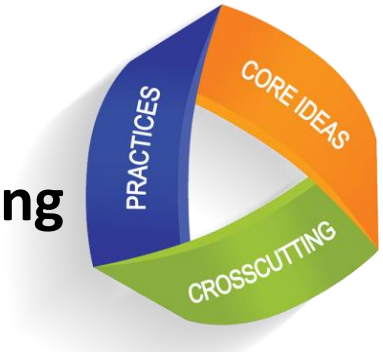
1. Conceptual Framework
2. Classroom Video
3. Instructional Materials

NGSS Instructional Shifts and Language Instructional Shifts Support Each Other with ELs

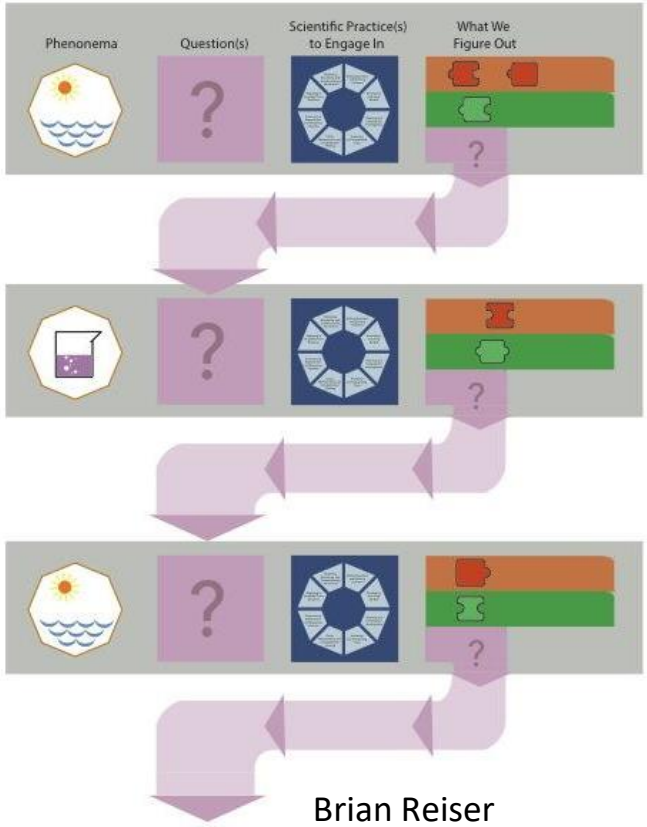
Shift 1: Explaining phenomena or designing solutions to problems



Shift 2: Three-dimensional learning



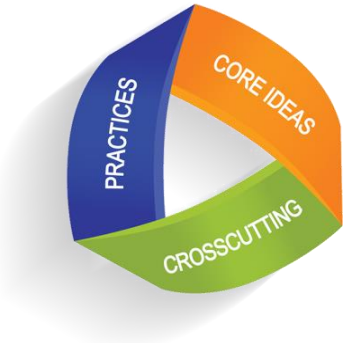
Shift 3: Coherence (or Learning progression)



Brian Reiser

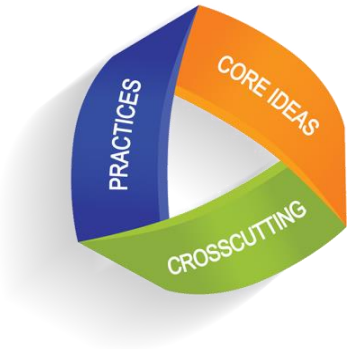
NGSS Science and Engineering Practices

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



NGSS 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



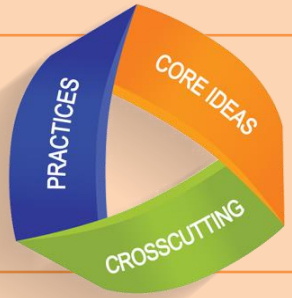
NGSS Disciplinary Core Ideas

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

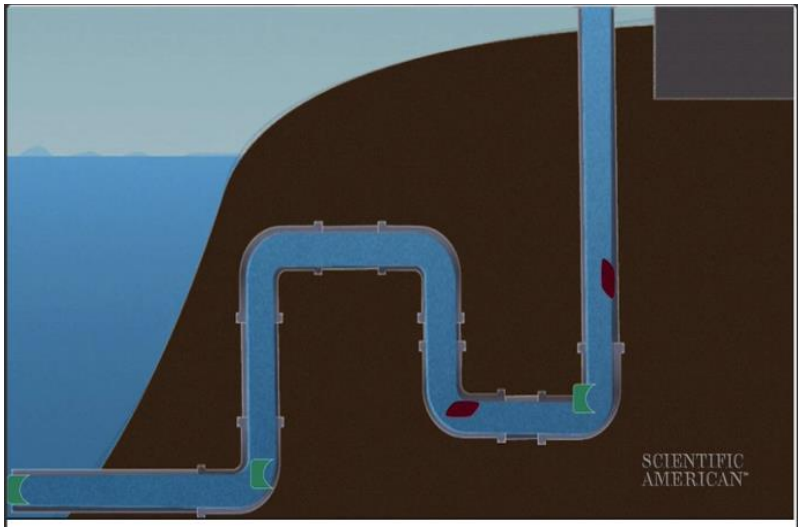
Shift 1: Explaining a phenomenon or designing solutions to a problem. A phenomenon or problem in a local context of ELs' home and community capitalizes on everyday language and experience

Our school makes large amounts of garbage every day.

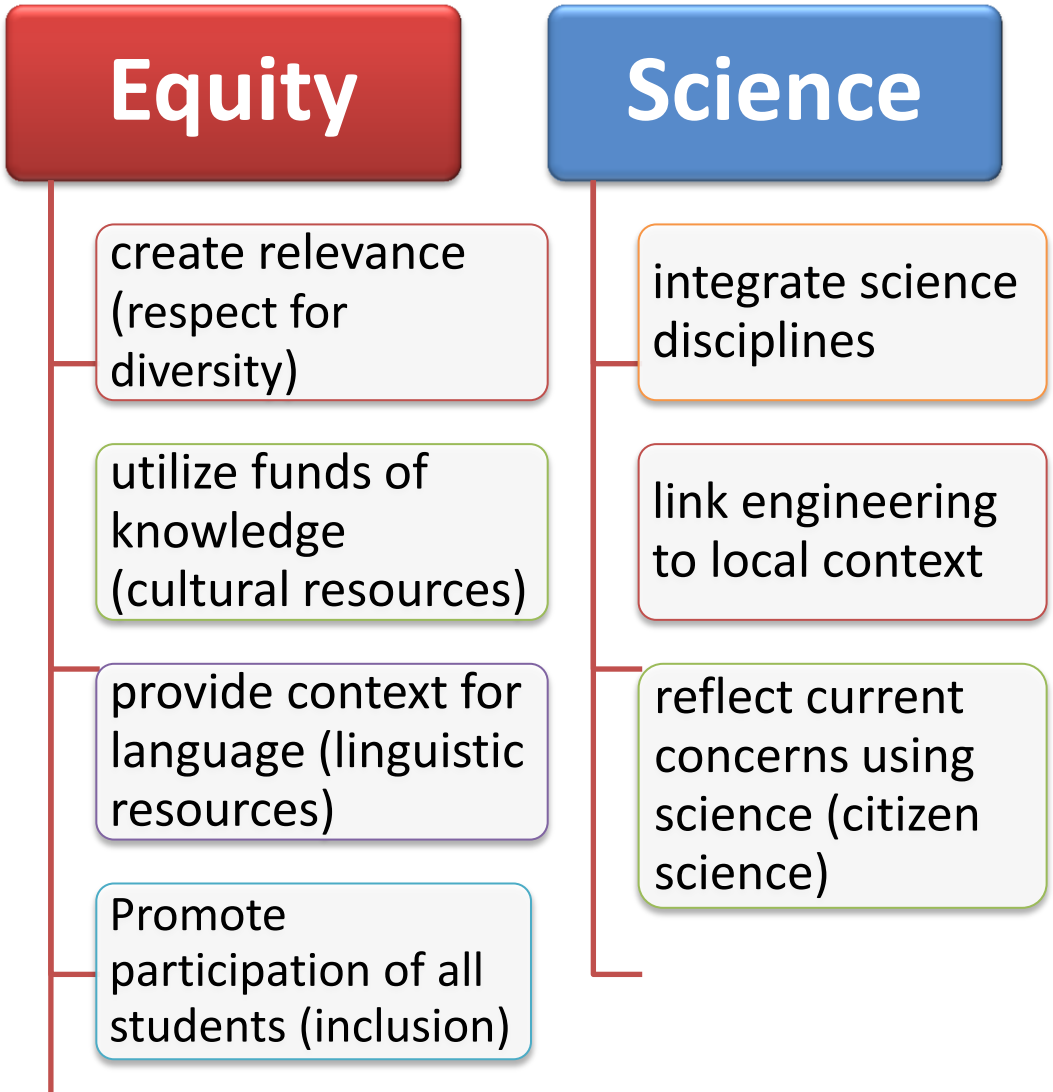
What happens to our garbage?

There is much concern over lead in the water in Flint, Michigan.

Can this problem happen in our community?



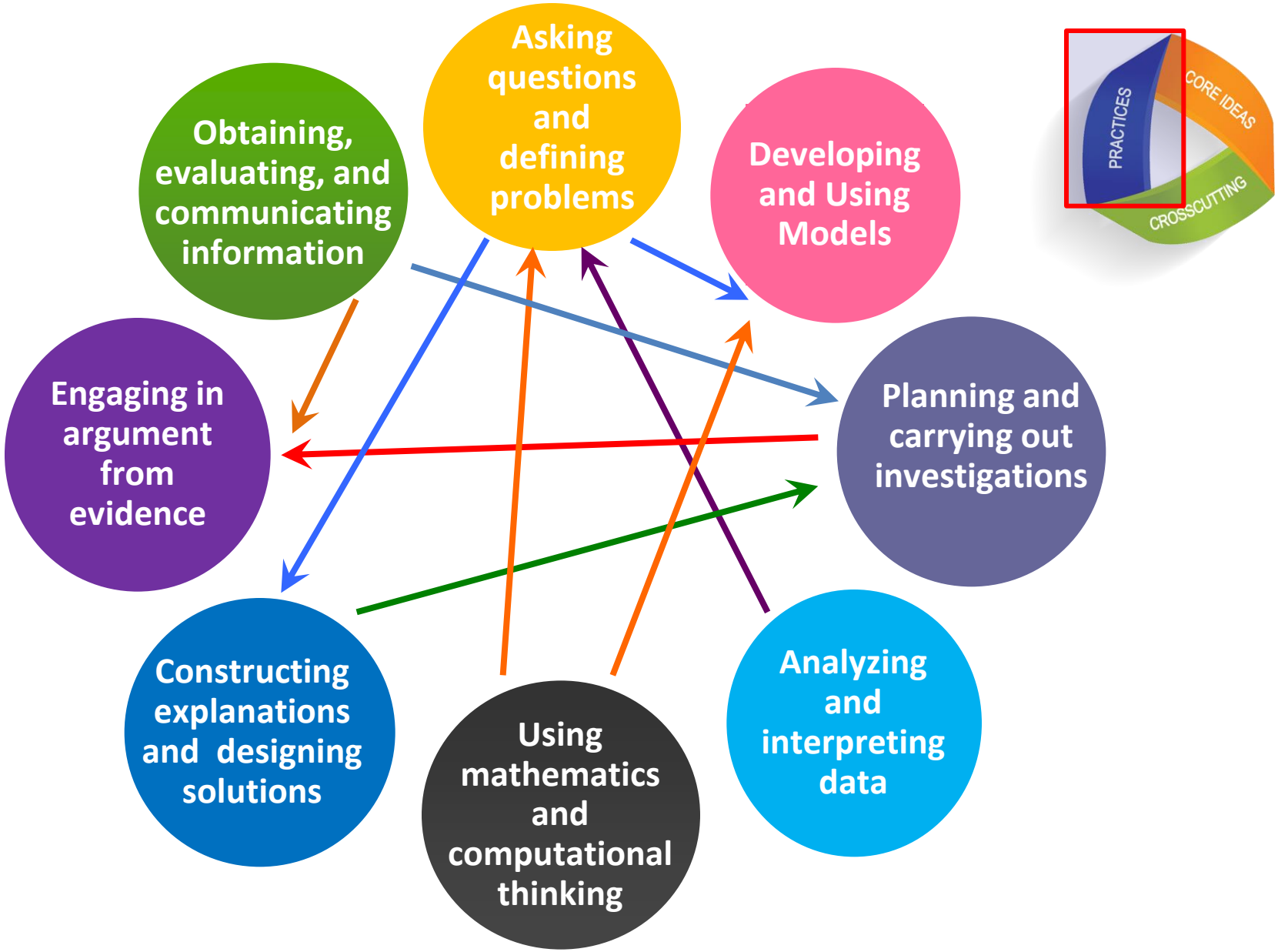
Shift 1: A phenomenon or problem in in a local context integrates equity through place-based learning with science through project-based learning



Shift 1: Local phenomena or problems

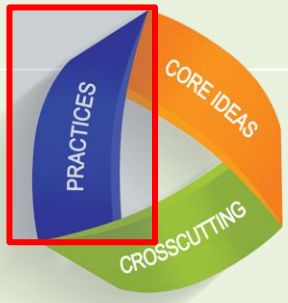
in Hawaii

Shift 2: Three-dimensional learning. The NGSS science and engineering practices are language intensive



Shift 2: Three-Dimensional Learning. NGSS practices afford rich language use

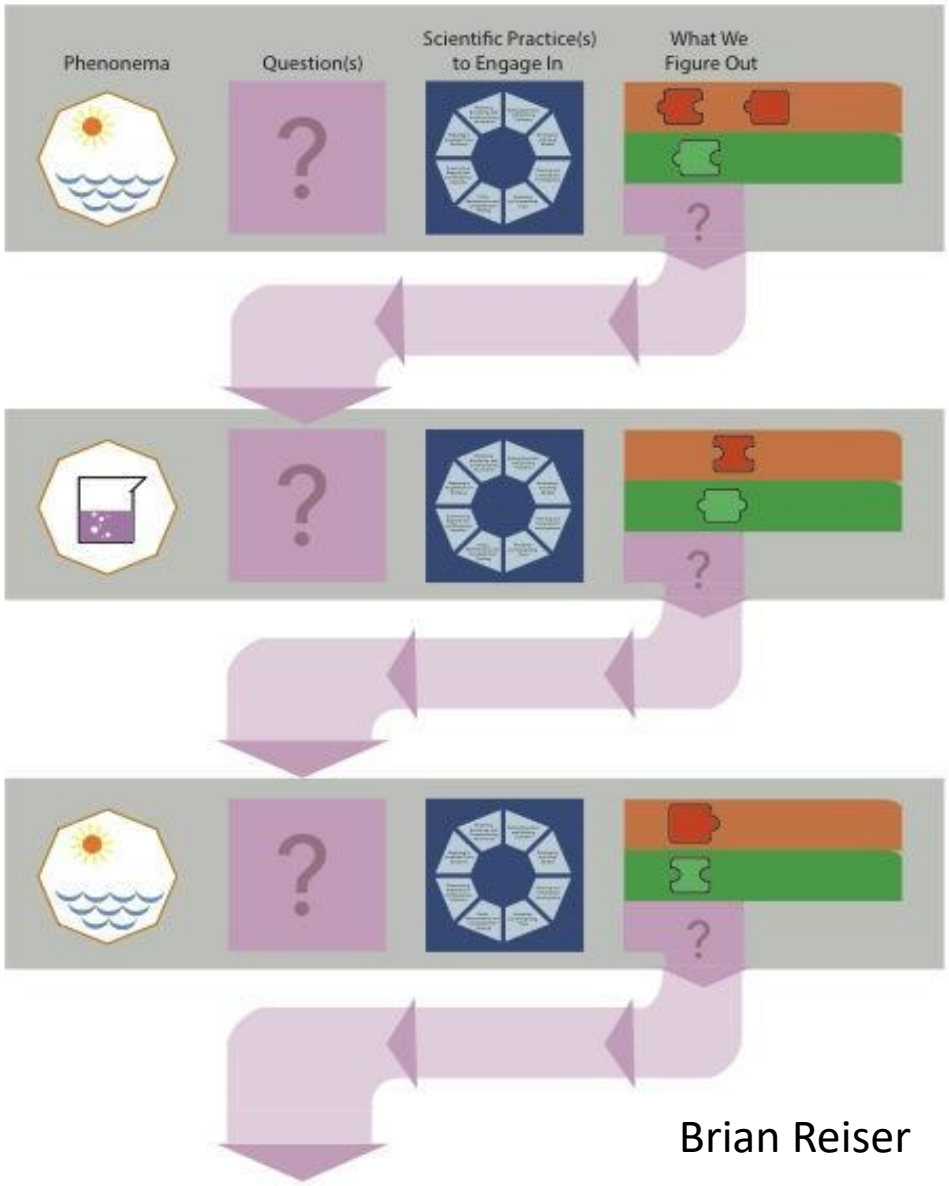
NGSS Practice 7: Engage in argument from evidence	
Analytical Science Tasks	• Distinguish between a claim and supporting evidence or explanation • Analyze whether evidence supports or contradicts a claim • Analyze how well a model and evidence are aligned • Construct an argument
Receptive Language Functions	• Comprehend arguments made by others orally • Comprehend arguments made by others in writing
Productive Language Functions	Communicates (orally and in writing) ideas, concepts, and information related to the formation, defense, and critique of arguments • Structure and order written or verbal arguments for a position • Select and present key evidence to support or refute claims • Question or critique arguments of others



Lee, O., Quinn, H., & Valdés, G. (2013)

Shift 3: Learning Progression. Three-dimensional learning becomes more sophisticated over time

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



Brian Reiser

Shift 3: Learning Progression. Language use becomes more sophisticated over time

Modalities	Registers	Interactions
• **Talk** • **Text** • **Diagram** ➢ Drawing ➢ Table ➢ Graph ➢ Chart	**Colloquial/ everyday talk and text** ⟷ **Specialized/ disciplinary talk and text** • **Precision:** Is the language exact enough to communicate discipline-specific ideas (e.g., using discipline-specific terms)? • **Explicitness:** Can someone who is not in the classroom understand?	• **One-to-one** • **One-to-small group** • **One-to-many** • **Small group-to-many**

Lee, O., Quinn, H., & Valdés, G. (2013)

NGSS Instructional Shifts with Student Diversity: Classroom Video

The video shows a 4th 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. It takes time to implement NGSS-aligned science instruction.

https://vimeo.com/166410948\

Classroom Video

1. As you watch a video of science instruction, identify:
   1) NGSS science and engineering practices
   2) NGSS crosscutting concepts
   3) how the teacher demonstrates NGSS and language instructional shifts
2. Discuss with your partner
3. Share your ideas with the whole group

Question 1:

Science and Engineering Practices

1. Ask questions (for science) and define problems (for engineering)
2. Develop and use models
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6. Construct explanations (for science) and design solutions (for engineering)
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8. Obtain, evaluate, and communicate information

Question 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

Question 3:

NGSS Instructional Shifts

1. Explaining phenomena
2. Three-dimensional learning
3. Coherence (or learning progression) across time

Discussion

1. Identify:
   1) NGSS science & engineering practices
   2) NGSS crosscutting concepts

2. Discuss with your partner

3. Share your ideas with the whole group

Shift 1:

How does a phenomenon or problem in a local context support language development?

Shift 2:

How does three-dimensional learning support language use and development?

Shift 3:

How does science understanding support language development over time (i.e., learning progression)?

Discussion

Shift 1:

How does a phenomenon or problem in a local context support language development?

Shift 1:

Phenomenon-based science instruction provides students with a purpose to communicate and a compelling context in which to express their ideas

Discussion

Shift 2:

How does three-dimensional learning support language use and development?

Shift 2:
As students "do" science, they use language

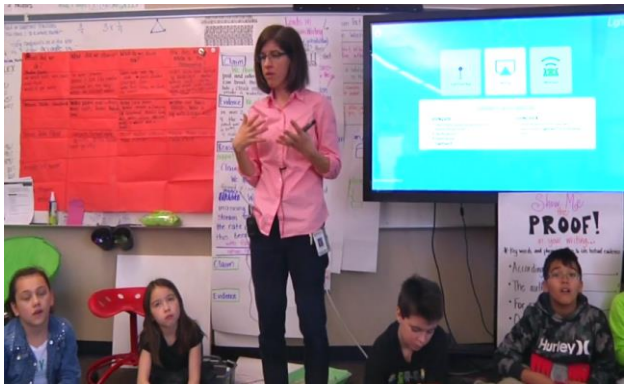
Discussion

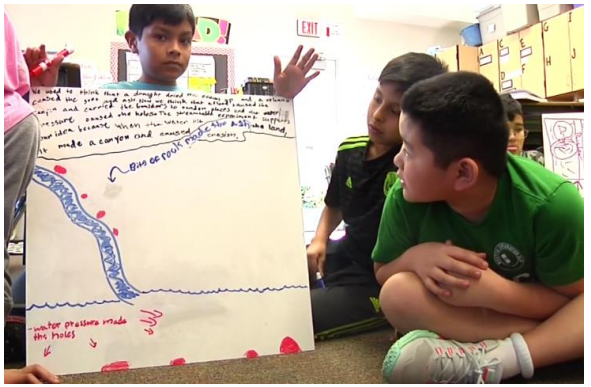
Shift 3:

How does science understanding support language development over time (i.e., learning progression)?

Shift 3:

As three-dimensional learning becomes more sophisticated over time, language use becomes more sophisticated





Shift 3:

As three-dimensional learning becomes more sophisticated over time, language use becomes more sophisticated

Modalities	Registers	Interactions
• Talk • Text • Diagram ➢ Drawing ➢ Table ➢ Graph ➢ Chart	Colloquial/ everyday talk and text ⟷ Specialized/ disciplinary talk and text • Precision • Explicitness	• One-to-one • One-to-small group • One-to-many • Small group-to-many

Lee, O., Quinn, H., & Valdés, G. (2013)

Science and Integrated Language

Development of Language-Focused Three-Dimensional Science Instructional Materials to Support English Learners in Fifth Grade

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This work is supported by the National Science Foundation (NSF Grant DRL-1503330). Any opinions, findings, conclusions, or recommendations expressed in this publication are those of the authors and do not necessarily reflect the position, policy, or endorsement of the funding agency.

Perspective on Science and Language Integration with English Learners

- ELs participate in a classroom community of practice that offers continuous opportunities to "do" science
- ELs use language for purposeful communication, as they "do" science
- All ELs participate meaningfully in rigorous science learning, regardless of their English proficiency levels

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Design Principles for Science (NGSS) and Language Integration with ELs

Science (NGSS) and Language Design Principles Support Each Other with ELs:

- **Science Design Principles**
  - ELs explain phenomena and design solutions to problems
  - ELs engage in three-dimensional learning
  - ELs build understanding over time (learning progressions)
- **Language Design Principles**
  - ELs use multiple modalities strategically
  - ELs use increasingly specialized/disciplinary register of talk and text
  - ELs use multiple modalities and registers to meet communicative demands of different types of interactions

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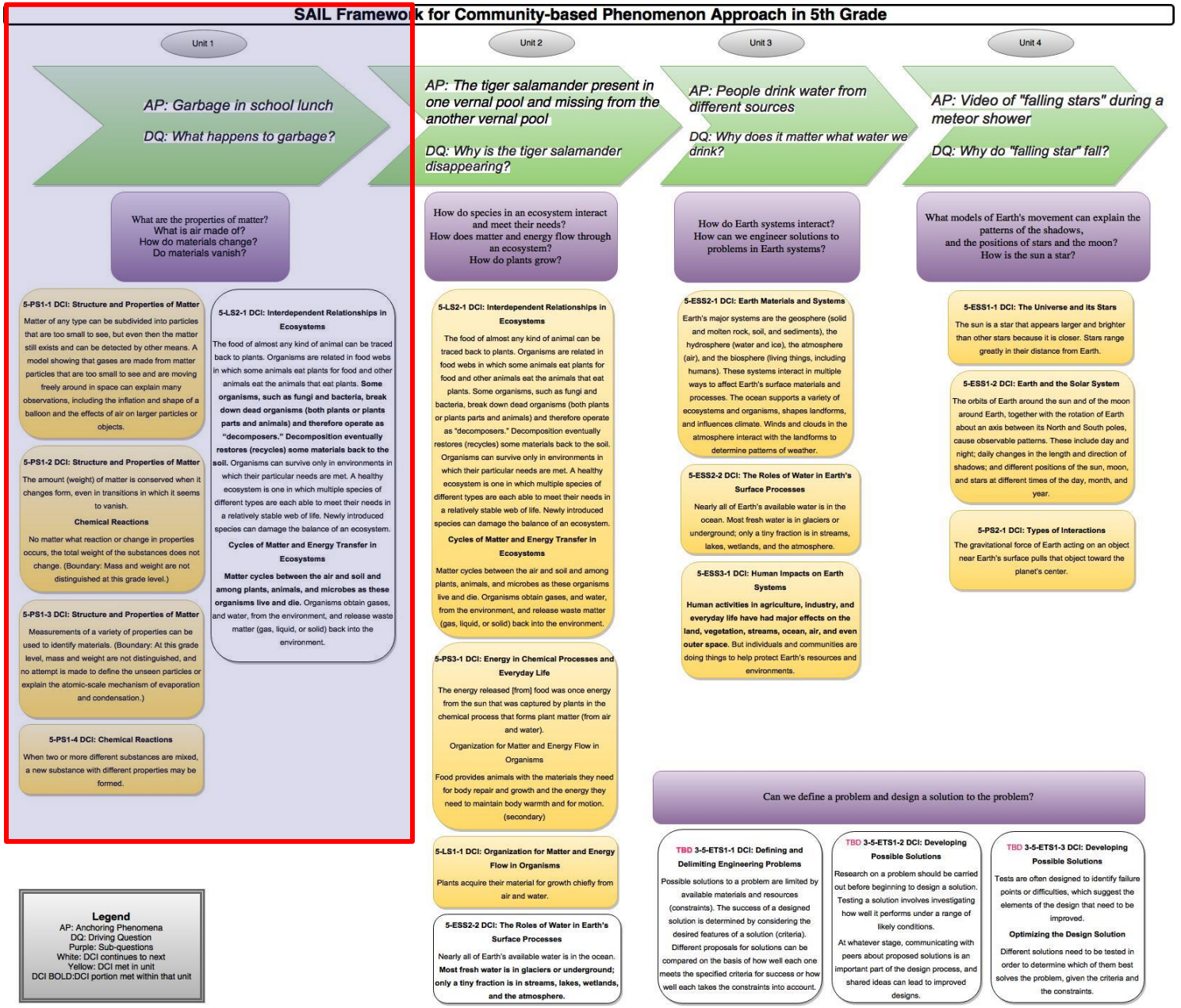
Content Framework for 5th Grade – 4 Units



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Unit 1: What Happens to Our Garbage? – Performance Expectations (PEs)

Grade 5 PEs Topical Arrangements

5. **Structure and Properties of Matter**

   5-PS1-1 5-PS1-2 5-PS1-3 5-PS1-4

5. **Matter and Energy in Organisms and Ecosystems**

   5-PS3-1 5-LS1-1 5-LS2-1 (introduced)

5. **Earth's Systems**

   5-ESS2-1 5-ESS2-2 5-ESS3-1 (introduced)

5. **Space Systems: Stars and the Solar System**

   5-PS2-1 5-ESS1-1 5-ESS1-2

3-5. Engineering Design

3-5-ETS1-1 3-5-ETS1-2 3-5-ETS1-3

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Unit 1: What Happens to Our Garbage? – Performance Expectations (PEs)

5-PS1-1: Develop a model to describe that matter is made of particles too small to be seen

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

5-PS1-3: Make observations and measurements to identify materials based on their properties

5-PS1-4: Conduct an investigation to determine whether the mixing of two or more substances results in new substances

5-LS2-1: Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment

5-ESS3-1: Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment

3-5-ETS1-1: Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost

Shift 1: A phenomenon or problem in a local context of ELs' home and community capitalizes on everyday language and experience

Phenomenon: Our school makes large amounts of garbage every day.

Driving question: What happens to our garbage?

Shift 1: Phenomenon and Driving Question

Write down your questions about the garbage on sticky notes, one question per note. See how I wrote on my sticky note: "Why does the trash stink?"

Why does the trash stink?

Shift 2: The NGSS science and engineering practices are language-intensive

What happens to our garbage (in the real world)?

What happens to our garbage (in the classroom)?

Shift 3: Three-dimensional learning becomes more sophisticated over time

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
• **What do we want to know about our garbage?** (phenomenon and driving question of the unit)	• **What happens to materials of garbage?** (properties of matter)	• **How do we smell garbage?** (particle nature of matter)	• **What causes changes in the garbage?** (chemical reactions, conservation of matter)	• **How can we help the environment with engineering solutions to problems caused by garbage?** (human impacts and solutions)

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Shift 3: Language use becomes more sophisticated over time

	Over the Course of the Unit
Modalities	Increasingly strategic use of multiple modalities
Registers	Increasingly specialized / disciplinary registers
Interactions	Increasingly strategic use of multiple modalities and registers in different interactions

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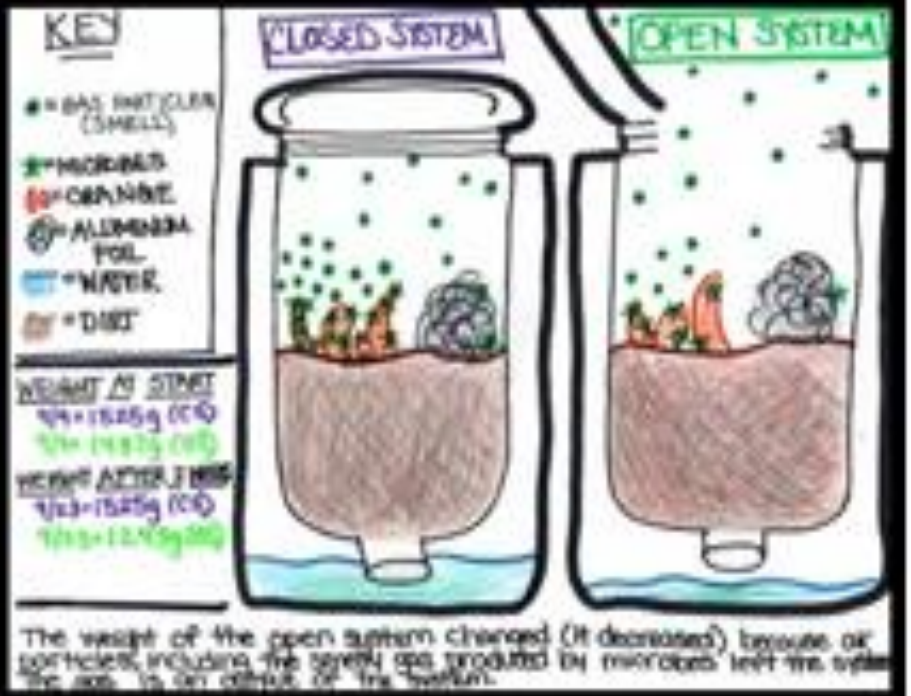
Shift 1:
Phenomenon

Shift 2:
3-D Learning

Shift 3:
Coherence



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Thank You!