

# Next Generation Science Standards and English Language Learners

Project CORE

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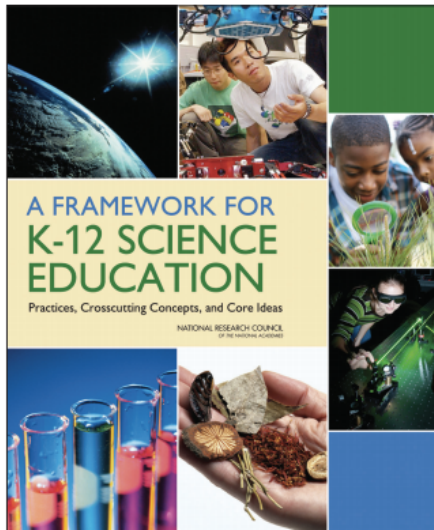
## Agenda

1. Brief background on the development of Next Generation Science Standards (NGSS)
2. Relationships and convergences across the content area standards
3. Promoting integrated content and language learning for ELLs



# **Next Generation Science Standards (NGSS)**

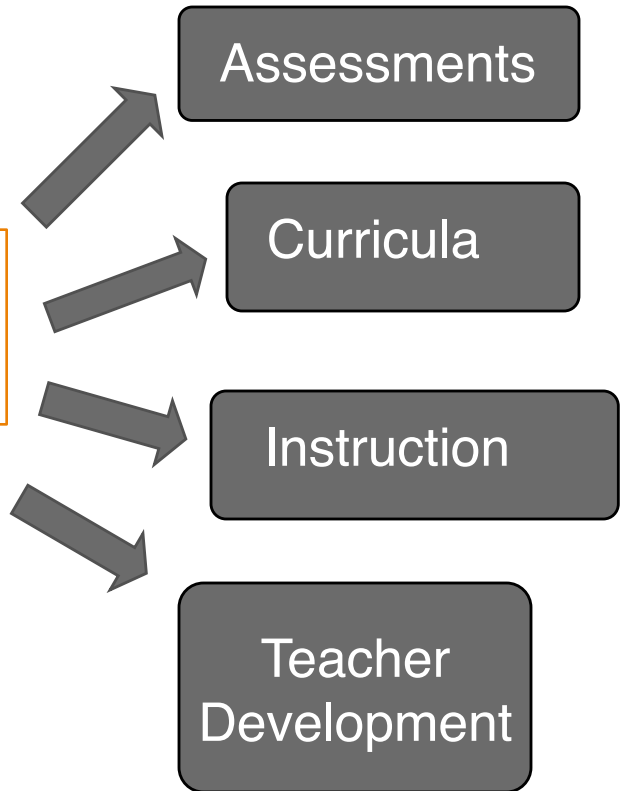
## Lots of Work Completed, Underway, and Left To Do



NRC Science Framework  
(July 2011)



Achieve



## Next Generation Science Standards (NGSS)

- *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas* (National Research Council, 2011) is guiding development of NGSS
- Achieve, Inc. is overseeing the development
- The design team consists of classroom teachers, state and district supervisors, faculty from higher education institutions, and representatives from the private sector
- Currently, 26 states have signed with state teams to provide feedback to the NGSS design team
- There was a public release of drafts for feedback (May 2012)
- The first draft of NGSS is expected in early 2013

## Important to note:

### COMMON CORE STATE STANDARDS FOR

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English Language Arts  
&

Literacy in History/Social Studies,  
Science, and Technical Subjects



## Reading Standards for Literacy in Science and Technical Subjects 6-12

Grades 6-8 students:	Grades 9-10 students:	Grades 11-12 students:
<b>Key Ideas and Details</b>		
1. Cite specific textual evidence to support analysis of science and technical texts.	1. Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions.	1. Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account.
2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.	2. Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.	2. Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.	3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks, attending to special cases or exceptions defined in the text.	3. Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.
<b>Craft and Structure</b>		
4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 6-8 texts and topics</i> .	4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 9-10 texts and topics</i> .	4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to <i>grades 11-12 texts and topics</i> .
5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.	5. Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., <i>force</i> , <i>friction</i> , <i>reaction force</i> , <i>energy</i> ).	5. Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding of the information or ideas.
6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.	6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, defining the question the author seeks to address.	6. Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, identifying important issues that remain unresolved.
<b>Integration of Knowledge and Ideas</b>		
7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).	7. Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.	7. Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
8. Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.	8. Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a scientific or technical problem.	8. Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text, verifying the data when possible and corroborating or challenging conclusions with other sources of information.
9. Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.	9. Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts.	9. Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
<b>Range of Reading and Level of Text Complexity</b>		
10. By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.	10. By the end of grade 10, read and comprehend science/technical texts in the grades 9-10 text complexity band independently and proficiently.	10. By the end of grade 12, read and comprehend science/technical texts in the grades 11-CCR text complexity band independently and proficiently.

## Reading Standards for Literacy in Science and Technical Subjects 6–12 (CCSS)

- Cite specific textual evidence to support analysis of science and technical texts...
- ...summarize complex concepts, processes, or information... paraphrasing them in simpler but still accurate terms.
- Follow precisely a complex multistep procedure...; analyze the specific results based on explanations...
- Analyze how the text structures information or ideas into categories or hierarchies, demonstrating understanding...
- Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text, ...
- Integrate and evaluate multiple sources of information ...
- Evaluate the hypotheses, data, analysis, and conclusions in a science or technical text ...
- Synthesize information from a range of sources ...



# Writing Standards for Literacy in Science and Technical Subjects 6–12 (CCSS)

- Write arguments focused on *discipline-specific content*.
- Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject ...
- Gather relevant information from multiple authoritative print and digital sources ...
- Draw evidence from informational texts to support analysis, reflection, and research.

# Shifts in the NGSS

1. K–12 science education should reflect the real world ***interconnections*** in science
2. ***Science and engineering practices and crosscutting concepts*** should not be taught in a vacuum; they should always ***be integrated with multiple core concepts*** throughout the year
3. Science concepts build ***coherently*** across K–12
4. The NGSS focus on ***deeper understanding and application of content***
5. Science and engineering are ***integrated*** in science education from K–12
6. Science standards ***coordinate with English language arts and mathematics Common Core State Standards\****

## 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

## Performance Expectations Foundation Boxes Connection Boxes

### MS.PS-E Energy

#### MS.PS-E.1 Energy

**Analyzing and interpreting data to explain that the kinetic energy of an object is proportional to the mass of a moving object and grows with the square of its speed.** [Assessment Boundary: Qualitative, not quantitative]

#### Science and Engineering Practices

##### Analyzing and Interpreting Data

- Use standard techniques for displaying, analyzing, and interpreting data including appropriate statistical techniques.

#### Disciplinary Core Ideas

##### PS3.A: Definitions of Energy

- Motion energy is properly called kinetic energy; it is proportional to the mass of the moving object and grows with the square of its speed.

#### Crosscutting Concepts

##### Scale, Proportion, and Quantity

- Proportional relationships (e.g., speed as the ratio of distance traveled to time taken) among different types of quantities provide information about the magnitude of properties and processes.

*Connections to other DCIs in this grade-level:* **MS.ESS-SS, MS.LS-MEOE**

*Articulation to DCIs across grade-levels:* **4.E, HS.PS-E, HS.PS-FE, HS.PS-ECT**

*Common Core State Standards Connections:*

*ELA—*

**W.6.1** Write arguments to support claims with clear reasons and relevant evidence

**W.7.1** Write arguments to support claims with clear reasons and relevant evidence

**W.8.1** Write arguments to support claims with clear reasons and relevant evidence

**WHST.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.

*Mathematics—*

**MP.2** Reason abstractly and quantitatively.

**MP.4** Model with mathematics.

**6.RP** Understand ratio concepts and use ratio reasoning to solve problems.

**6.EE** Represent and analyze quantitative relationships between dependent and independent variables.

**7.RP** Analyze proportional relationship and use them to solve real-world and mathematical problems.

**7.EE** Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

**8.EE** Understand the connections between proportional relationships, lines, and linear equations.

**8.F** Use functions to model relationships between quantities

Relationships and convergences  
across the content area standards

## Dimensions of ELA Standards

### Student Portraits

1. Demonstrate independence in **reading complex texts**, and **writing** and **speaking** about them
2. Build strong content knowledge
3. **Obtain, synthesize**, and **report** findings clearly and effectively
4. **Construct viable arguments** & **critique** the reasoning of others
5. **Read, write, and speak** grounded in evidence
6. **Use technology and digital media** strategically and capably
7. Understand other perspectives and cultures

(p. 7 of CCSS-ELA Standards)

### Key Features

Reading: Text complexity and the growth of comprehension

Writing: Text types, responding to reading, and research

Speaking & Listening: Flexible communication & collaboration

Language: Conventions, effective use, and vocabulary



## Dimensions of Math Standards

### Mathematical Practices

1. **Make sense of problems** and persevere in solving them
2. **Reason abstractly and quantitatively**
3. **Construct viable arguments** and **critique** the reasoning of others
4. **Model** with mathematics
5. **Use appropriate tools** strategically
6. Attend to precision
7. Look for and make use of structure
8. **Look for and express regularity in repeated reasoning**

### Core Ideas

#### K-5

Counting & Cardinality (K)  
Operations & Algebraic Thinking  
Number & Operations  
Fractions (3)  
Measurement & Data  
Geometry

#### 6-8

Ratios & Proportional Relationships  
Number System  
Expressions & Equations  
Functions (8)  
Geometry  
Statistics & Probability

#### 9-12

Number & Quantity  
Algebra  
Functions  
Modeling  
Geometry  
Statistics & Probability

## Three Dimensions of Science Framework

### Scientific & 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

### Crosscutting Concepts

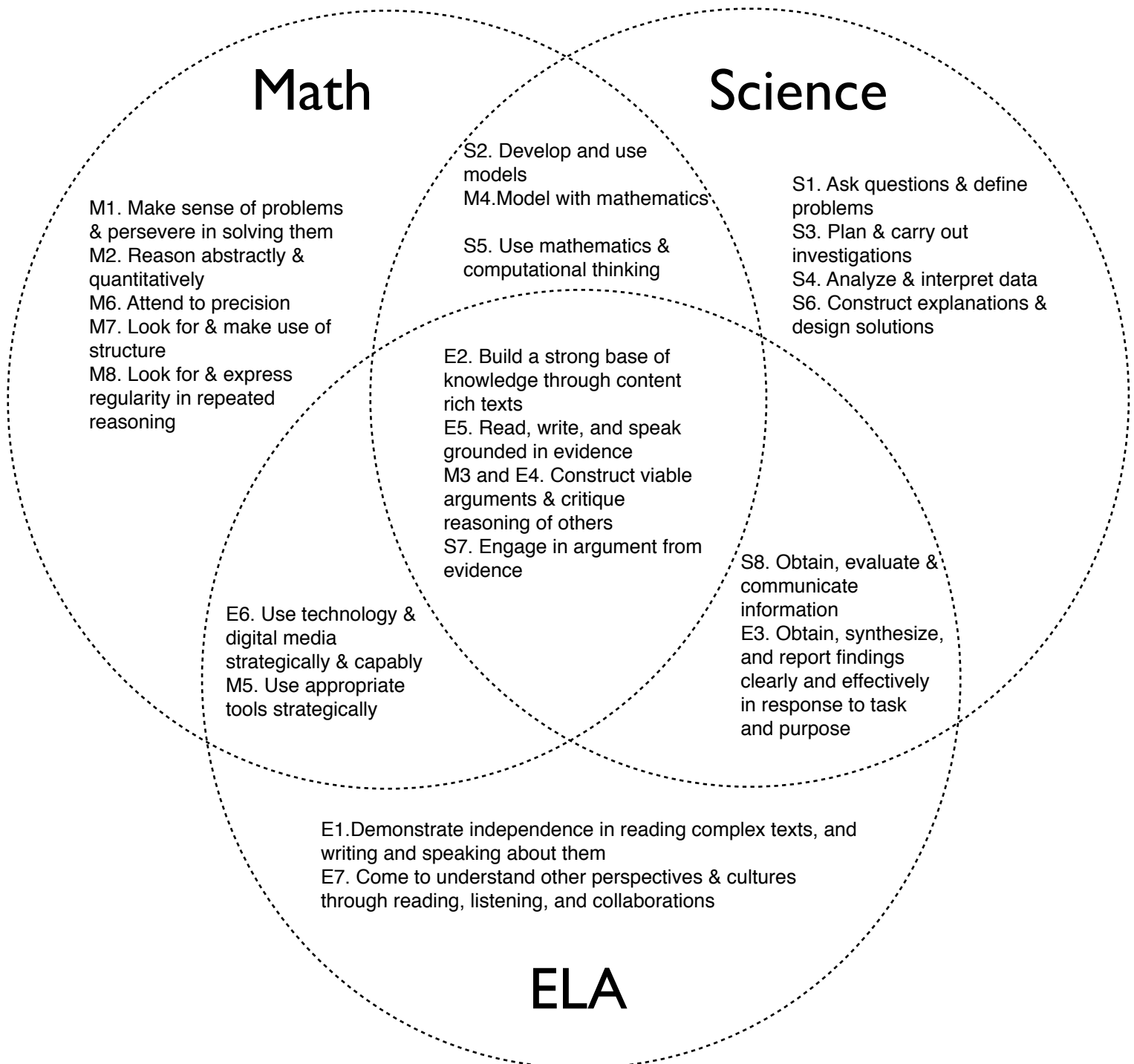
1. Patterns
2. Cause and effect
3. Scale, proportion and quantity
4. Systems and system models
5. Energy and matter
6. Structure and function
7. Stability and change

### Core Ideas

Physical Sciences  
Life Sciences  
Earth and Space Sciences  
Engineering, Technology and Applications of Science

# Relationships and Convergences Found in the Common Core State Standards in Mathematics (practices), Common Core State Standards in ELA/Literacy\*(student portraits), and A Framework for K-12 Science Education (science & engineering practices)

These student practices and portraits are grouped in a Venn diagram. The letter and number set preceding each phrase denotes the discipline and number designated by the content standards or framework. The Science Framework will be used to guide the production of the Next Generation Science Standards.



## Sources:

Common Core State Standards for English Language Arts & Literacy\* in History/Social Studies, Science, and Technical Subjects, p7.

Common Core State Standards for Mathematical Practice p6-8.

A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas, ES-3 and chapter 3: I-32.

## Promoting integrated content and language learning for ELLs

## Table 6: Key NGSS Science and Engineering Practices with Embedded Analytical Tasks and Receptive and Productive Language Functions (ELPD Framework)

*Table 6 defines in detail these practices by outlining the language functions that ELLs need to engage with science and engineering content.*

Key NGSS Practice 7: Engage in argument from evidence	
Analytical Tasks	<ul style="list-style-type: none"><li>• Distinguish between a claim and supporting evidence or explanation</li><li>• Analyze whether evidence supports or contradicts a claim</li><li>• Analyze how well a model and evidence are aligned</li><li>• Construct an argument</li></ul>
Receptive Language Functions	<ul style="list-style-type: none"><li>• Comprehend arguments made by others orally</li><li>• Comprehend arguments made by others in writing</li></ul>
Productive Language Functions	<p>Communicate (orally and in writing) ideas, concepts, and information related to the formation, defense, and critique of arguments:</p> <ul style="list-style-type: none"><li>• Structure and order written or verbal arguments for a position</li><li>• Select and present key evidence to support or refute claims</li><li>• Question or critique arguments of others</li></ul>

Level	Modality		Argue from Evidence (ELA, Math, Science)
Level 1	Oral	Receptive	<ul style="list-style-type: none"> <li>Can begin to guess intelligently at the main argument provided by teacher if given guided listening instruction in monitoring and improving comprehension and with the support of gestures, illustrations, advanced organizers, and background knowledge including the L1.</li> <li>Can draw on resources to respond to comprehension check questions or activities.</li> </ul>
		Productive	<ul style="list-style-type: none"> <li>Can make statements to fill interactional turns in which an argument is expected by using basic structures, single words, gestures, and L1.</li> <li>Can request information or clarification using memorized chunks or expressions.</li> <li>Can use models, gestures, pictures, and memorized language chunks, as well as some L1, to explain own or other's argument.</li> </ul>
	Written	Receptive	<ul style="list-style-type: none"> <li>With support and text at reading level, can identify statements or segments of the text that make an argument.</li> <li>Can read and comprehend texts that explain known concepts, such as texts jointly constructed by the class and/or read repeatedly.</li> <li>Can display information obtained from texts writing in his/her L1 if receiving instruction in this language.</li> </ul>
		Productive	<ul style="list-style-type: none"> <li>Can explain an argument by drawing and labeling.</li> <li>Can follow a simple example to write an argument, using developing English structures. With support, can copy and then produce original simple statements using developing English structures and L1.</li> </ul>
Level 2	Oral	Receptive	<ul style="list-style-type: none"> <li>Can understand most main arguments presented by teacher if supported by gestures, illustrations, and other scaffolds.</li> <li>Can differentiate between some claims and reasons/supporting evidence, but may miss details related to the latter.</li> <li>Can respond appropriately to comprehension check questions or activities to communicate basic understanding of claims and evidence supporting an argument.</li> </ul>
		Productive	<ul style="list-style-type: none"> <li>Can use models, gestures, pictures, memorized language chunks, and basic language structures (I think xxx) as well as some L1 to make an argument related to subject matter, including claims and reasons/supporting evidence.</li> </ul>
	Written	Receptive	<ul style="list-style-type: none"> <li>Can comprehend written arguments he/she reads when he/she has relevant background knowledge and can draw from accompanying images to support comprehension. May miss details related to reasons/evidence.</li> <li>Can ask clarification questions that demonstrate comprehension of some aspects of the written argument.</li> </ul>
		Productive	<ul style="list-style-type: none"> <li>Guided by an example, can write a basic argument with claims and reasoning/evidence, using developing English structures.</li> <li>Can write argumentative texts what student can produce orally.</li> <li>Can create graphic representations to record comprehension of written arguments and their component parts.</li> </ul>

Table 2: Argue from Evidence (ELA, Math, Science).

p. 60-61 of ELPD Framework



# Understanding Language

Language, Literacy, and Learning  
in the Content Areas

Level 3		
Oral	Receptive	<ul style="list-style-type: none"> <li>• Can understand teacher and some peer arguments about subject matter if supported by gestures, illustrations, background knowledge, and other supports.</li> <li>• Can differentiate between most claims, reasons/supporting evidence, and counterclaims, but may not comprehend all of them.</li> <li>• Can elicit clarification or further evidence/reasoning by posing questions with developing English structures. Questions provide evidence of some comprehension.</li> </ul>
	Productive	<ul style="list-style-type: none"> <li>• Can express arguments on themes known (through experience and texts) including claims, reasons/evidence, and counterclaims and using developing English structures. Argument can be understood by an interlocutor familiar with the student's classroom context.</li> <li>• Can incorporate or approximate discipline-specific language that has been modeled in instruction (for example, typical transitions in argumentation)</li> <li>• Can use formulaic and repetitive phrases to connect sections of text and conclude it.</li> <li>• Can include evidence drawn from written and oral sources appropriate to proficiency level.</li> <li>• Can ask questions about arguments offered by others.</li> </ul>
Written	Receptive	<ul style="list-style-type: none"> <li>• Can comprehend written arguments, claims reasons/evidence, and counterclaims he/she reads when he/she has relevant background knowledge and can draw from accompanying images to support comprehension.</li> <li>• Can elicit clarification or further explanation about aspects of text he/she does not understand or is interested in. Questions demonstrate comprehension of aspects of argumentation.</li> <li>• Can make relevant connections between multiple related arguments.</li> </ul>
	Productive	<ul style="list-style-type: none"> <li>• Using a model text, can create an original argument about a related topic including claims, reasons/evidence, and counterclaims and using developing English. Given appropriate opportunities for modeling, discussion, interaction with peer and teacher, and analysis of sample texts:               <ul style="list-style-type: none"> <li>» Can include some discipline-specific language or approximations of that language which has been modeled.</li> <li>» Can draw from background experiences, personal opinions, and some resources at reading level to describe evidence in support of a claim.</li> <li>» Can respond to counterclaims.</li> <li>» Can use formulaic and repetitive phrases to connect sections of the text and draw it to a conclusion.</li> <li>» Can anticipate audiences' knowledge and concerns to a limited degree, depending on background knowledge.</li> <li>» Can use evidence drawn from written and oral sources appropriate to proficiency level.</li> </ul> </li> </ul>

Table 2: Argue from Evidence (ELA, Math, Science) (Level 3)

p. 60-61 of ELPD Framework



## How Language Develops

- Multiple opportunities to hear and use (language)
  - Rich contexts – desire and opportunity to engage and contribute
  - Appropriate supports
  - Acceptance of “flawed” language
-

## How Science Understanding Develops

- Multiple opportunities to hear and use (science ideas)
  - Rich contexts – desire and opportunity to engage and contribute
  - Appropriate supports
  - Acceptance of “flawed” language; for example non-scientific language
-

## Promoting Both Science and Language Learning for ELLs

- ELLs can participate in classroom discourse focused on rich and exciting academic content
  - ELLs learn language best when they engage with academic content
  - Focusing on both text and discourse gives ELLs opportunities for extended engagement with complex ideas
-

## Example: Argument from Evidence

(science & engineering practice #7)

### Language tasks

- Listen or read to understand arguments
- Speak or write to express own arguments
- Analyze arguments

### Science tasks

- Analyze, support, and refute claims & rebuttals of others
- Present and support own claims & rebuttals (counterclaims) with reasoning and evidence (that includes simple and complex data).

## Teacher Role

- Set culture of respectful argumentation
- Ensure all voices can contribute
- Elicit contributions or expansion of contributions
- Accept and support incomplete thoughts and “flawed” language (help student to clarify)
- Ensure that students are understanding contributions of others (rephrase, question)
- Support student questioning of others (whether for clarification or argumentation)

## Teacher Role

- Clarify rather than correct (language or concept)
  - Provide language support as needed (offer or elicit from other students a needed word, or the rephrasing of a poorly expressed idea)
  - Reward engagement (sense-making effort)
  - Value logic of argument, not correctness of claim or language
  - ***Trust and support both language and science learning by the group process***
-

## Literacy Strategies for All Students

### **Incorporate reading and writing strategies**

- Activate prior knowledge
- Promote comprehension of expository science texts
- Promote scientific genres of writing
- Connect science process skills (e.g., describe, explain, predict, conclude, report) to language functions (e.g., explain, compare, contrast, justify)
- Encourage use of graphic organizers to organize thoughts (e.g., concept map, word wall, Venn diagram, KWL)

## ESOL Strategies for ELLs

**Use language support strategies (*make diversity visible*)**

- Use realia (real objects or events)
- Encourage multiple modes of representations (gestural, oral, pictorial, graphic, textual)
- Use graphic devices (graphs, charts, tables, drawings, pictures)
- Use a small number of key terms in multiple contexts



## Making connections

The multiple representations of an idea through sequential transformations of inquiry and sensory experiences into group discussions, data tables, graphs, pictures, diagrams, and written descriptions, arguments, or explanations have demonstrated positive influences on elementary and secondary school students' achievement.

(Hand et al., 2001).

## Home Language Support

- Present science terms in context in multiple languages in the beginning of each lesson
- Use cognates (and highlight false cognates) in home language
- Allow code-switching
- **Encourage ELLs to use home language to read, discuss or write about science**
- Relating youth discourse to scientific discourses
- Encourage bilingual students to assist less English proficient students in their home language (**group, not one to one**)

## Home Culture Connections

- Build on students' lived experiences at home and in the community (i.e., funds of knowledge)
- Explore culturally-based ways students communicate and interact in their home and community (i.e., cultural congruence)
- Use students' cultural artifacts, culturally relevant examples, and community resources
- Approach science learning as a cultural accomplishment

## Resources

1. Language Demands and Opportunities in Relation to the Next Generation Science Standards, by Helen Quinn, Okhee Lee, and Guadalupe Valdés.  
<http://ell.stanford.edu/publication/3-language-demands-and-opportunities-relation-next-generation-science-standards-ells>
2. A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas.  
[http://www.nap.edu/catalog.php?record\\_id=13165](http://www.nap.edu/catalog.php?record_id=13165)
3. Diversity and Equity in the NGSS: All Standards, All Students  
<http://www.nextgenscience.org/next-generation-science-standards>
4. NSTA series of free webinars focused on the 8 practices. (9/11-12/18).  
[http://learningcenter.nsta.org/products/symposia\\_seminars/Ngss/webseminar.aspx](http://learningcenter.nsta.org/products/symposia_seminars/Ngss/webseminar.aspx)

## Discussion Questions

- 1. What are the implications of the Next Generation Science Standards for your roles?**
  - dean & faculty at colleges of education
  - district leaders planning professional learning opportunities
  - content & language specialists/coaches working with teachers
  - PD support providers, curriculum developers, etc.
- 2. What supports do you anticipate you and your team will need as schools & districts begin implementing the new standards for ELLs?**

Thank you!

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