Building Essential Test Readiness Skills in Science for the TASC Part 2:

INQUIRY AND THE NATURE OF SCIENCE

Central/Southern Tier RAEN
June 9, 2014
9:00 am – 4:00 pm

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Director of Program Support for OACE

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Learning Objectives

- To explore the nature of scientific inquiry
- To use strategies and resources to engage students in science content, specifically Earth/Space Science and Life Science
- To better understand the TASC Science assessment, and the content and process skills students need to master

Agenda

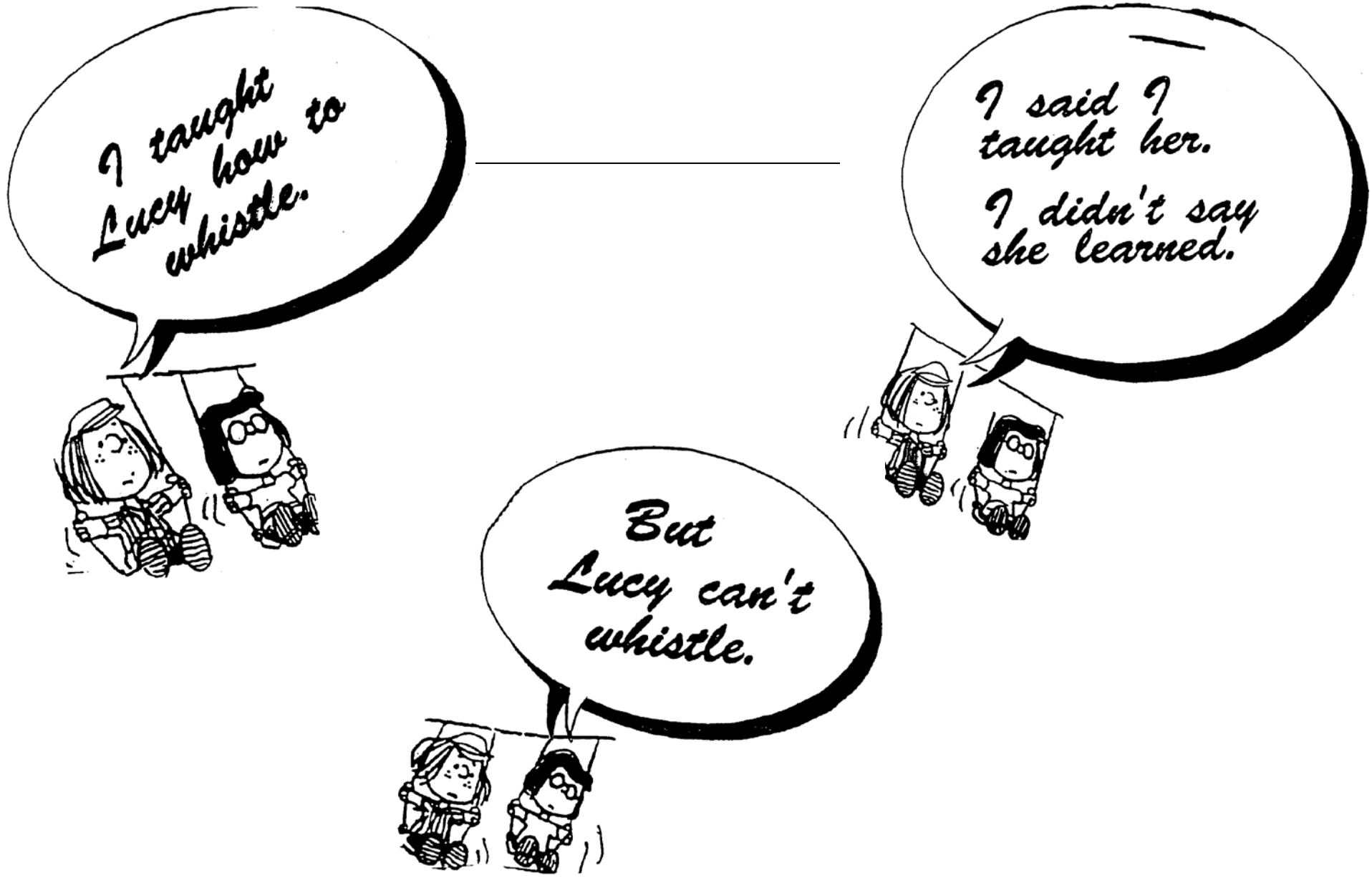
Introductions/ Objectives / Instructional Updates

The 5E's Instructional Model
Inquiry and the Nature of Science
The Structure of the TASC

Lunch

Earth and Space Science
Life Science

Final Reflections / Evaluations


I taught Lucy how to whistle.
I said I taught her.
I didn't say she learned.
But Lucy can't whistle.

The 5Es Instructional Model

Engage

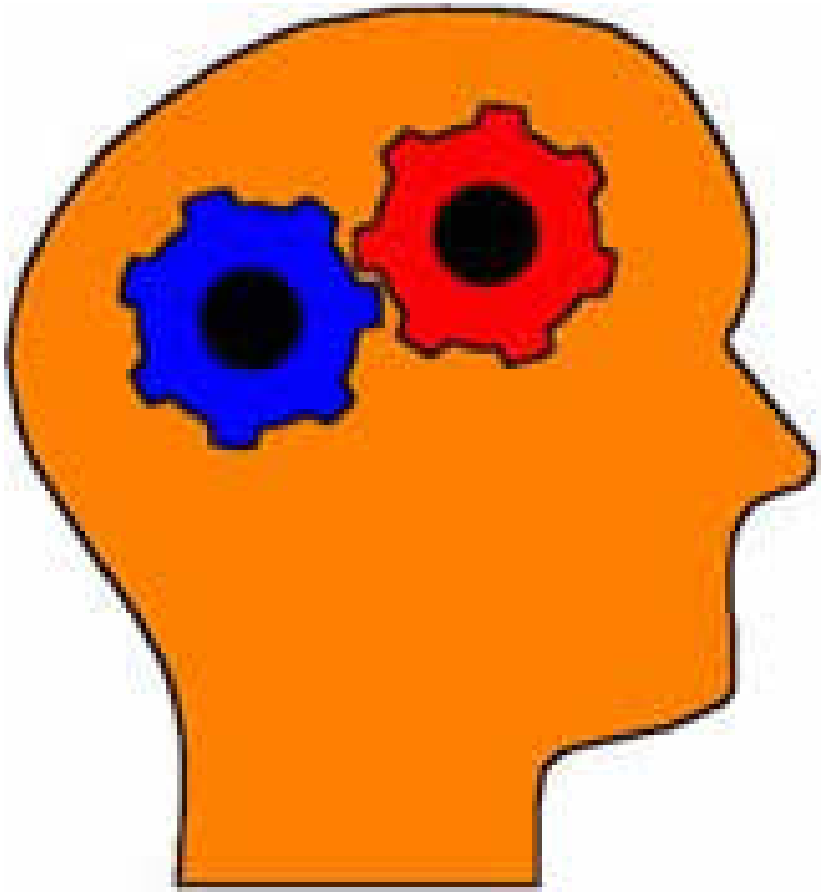
Explore

Explain

Elaborate

Evaluate

Inquiry and the Nature of Science



TAPPS: Thinking Aloud Paired Problem Solving

Speaker:

- Say aloud everything you are thinking as you solve the problem

Listener:

- Take notes on what your speaker is saying
- Remind the speaker to talk if there is silence
- You may ask clarifying questions, but do not help solve the problem
- Be prepared to share what you heard

How does your image resonate with the concept of scientific inquiry?

Science and Engineering Practices (from NGSS, Appendix F)

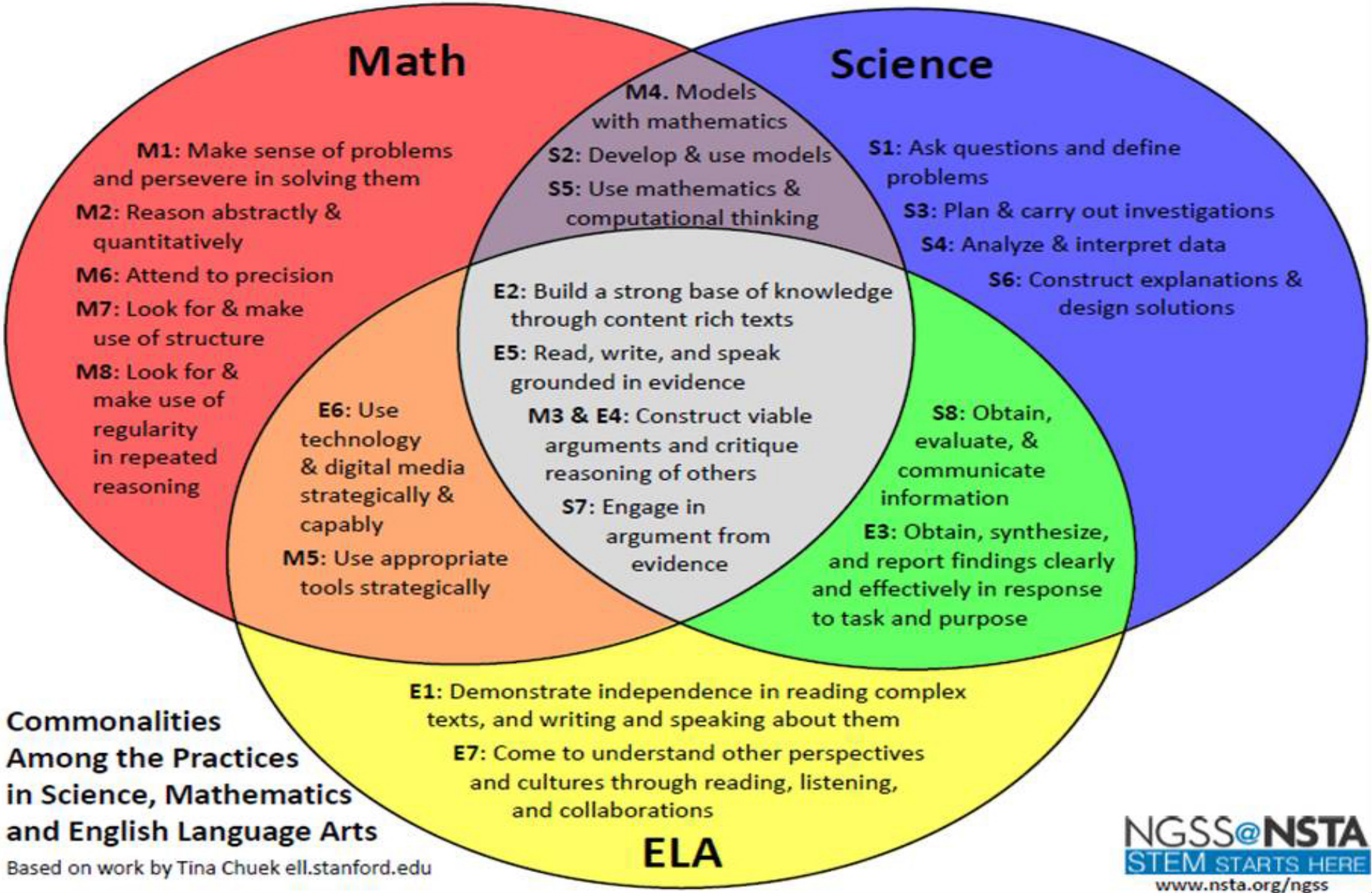
- Asking questions (for science) and defining problems (for engineering)
- Developing and using models
- Planning and carrying out investigations
- Analyzing and interpreting data
- Using mathematics and computational thinking
- Constructing explanations (for science) and designing solutions (for engineering)
- Engaging in argument from evidence
- Obtaining, evaluating, and communicating information

Practices in Mathematics, Science, and English Language Arts*

Math	Science	English Language Arts
M1. Make sense of problems and persevere in solving them.	**S1.** Asking questions (for science) and defining problems (for engineering).	**E1.** They demonstrate independence.
M2. Reason abstractly and quantitatively.	**S2.** Developing and using models.	**E2.** They build strong content knowledge.
M3. Construct viable arguments and critique the reasoning of others.	**S3.** Planning and carrying out investigations.	**E3.** They respond to the varying demands of audience, task, purpose, and discipline.
M4. Model with mathematics.	**S4.** Analyzing and interpreting data.	**E4.** They comprehend as well as critique.
M5. Use appropriate tools strategically.	**S5.** Using mathematics, information and computer technology, and computational thinking.	**E5.** They value evidence.
M6. Attend to precision.	**S6.** Constructing explanations (for science) and designing solutions (for engineering).	**E6.** They use technology and digital media strategically and capably.
M7. Look for and make use of structure.	**S7.** Engaging in argument from evidence.	**E7.** They come to understanding other perspectives and cultures.
M8. Look for and express regularity in repeated reasoning.	**S8.** Obtaining, evaluating, and communicating information.	

* The Common Core English Language Arts uses the term "student capacities" rather than the term "practices" used in Common Core Mathematics and the Next Generation Science Standards.

NGSS@NSTA STEM STARTS HERE



Commonalities Among the Practices in Science, Mathematics and English Language Arts

Based on work by Tina Chuek ell.stanford.edu

NGSS@NSTA STEM STARTS HERE
www.nsta.org/ngss

Text Rendering

Take a few moments to review the document and mark the sentence, the phrase, and the word that you think is particularly important for our work.

1. First Round: Each person shares a *sentence* from the document that he/she thinks/feels is particularly significant.
2. Second Round: Each person shares a *phrase* that he/she thinks/feels is particularly significant.
3. Third Round: Each person shares the *word* that he/she thinks/feels is particularly significant.
4. The group discusses what they heard and what it says about the document.
5. The group shares the words that emerged and any new insights about the document.
6. The group debriefs the text rendering process.

TASC Test Science

- Includes items for the disciplines of Physical Sciences, Life Sciences, and Earth and Space Sciences.
- Each discipline is subdivided into several Core Ideas, which each contain multiple performance expectations.
- Each test item assesses one performance expectation. Items may require recalling knowledge, applying knowledge and skills, or reasoning.
- The number of test items per Core Idea is proportional to the number of performance expectations within the Core Idea. As a result, each Core Idea will have about 2-5 items on a given test.

TASC and GED Science Sections Compared

	TASC	GED
Content Area		
• **Physical Sciences**	33%	35%
• **Earth and Space Sciences**	33%	20%
• **Life Sciences**	34%	45%
• **Scientific and Engineering Practices**	Integrated	
• **Cross-Cutting Concepts**	Integrated	

TASC Expected Science Test Design

	TASC Expected %
Prior Knowledge Required	70%
Cross-Cutting Concepts (cause-and-effect, proportion)	78%
Computation	35%

7 High Emphasis Core Ideas

Life Sciences

- LS1 From Molecules to Organisms: Structures and Processes
- LS2 Ecosystems: Interactions, Energy, and Dynamics
- LS3 Heredity: Inheritance and Variation of Traits
- LS4 Biological Evolution: Unity and Diversity

Earth and Space Sciences

- ESS1 Earth's Place in the Universe
- ESS1 Earth's Systems
- ESS1 Earth and Human Activity

4 Medium Emphasis Core Ideas

Physical Sciences

- PS1 Matter and Its Interactions
- PS2 Motion and Stability: Forces and Interactions
- PS3 Energy
- PS4 Waves and Their Applications in Technologies for Information Transfer

GED Sample Question

	W	w
W	WW	Ww
w	Ww	ww

*A certain plant species varies in the shape of its leaf edges. The wavy-edged (**W**) is dominant to the straight-edged (**w**). According to the Punnett Square, what is the probability of an offspring having wavy-edged leaves?*

1. 25%
2. 0%
3. 50%
4. 75%
5. 100%

TASC Sample Question

A certain plant species varies in the shape of its leaf edges. Some of the plants have wavy-edged leaves, and some of the plants have straight-edged leaves. In this plant species, the trait for leaf-edge shape is controlled by a single gene. The dominant allele is represented by W, and the recessive allele is represented by w.

Two plants with wavy-edged leaves are crossed with each other, producing 421 offspring plants. Of these, 298 offspring plants have wavy-edged leaves, and 123 offspring plants have straight-edged leaves.

What are the genotypes of the parent plants in this cross?

A. Ww and ww
B. Ww and Ww
C. WW and ww
D. WW and Ww

MS-LS3 Heredity: Inheritance and Variation of Traits

MS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

MS-LS3-1. **Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.** [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

MS-LS3-2. **Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.** [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices

Developing and Using Models

Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.

- Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)

Disciplinary Core Ideas

LS1.B: Growth and Development of Organisms

- Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)*

LS3.A: Inheritance of Traits

- Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1)
- Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2)

LS3.B: Variation of Traits

- In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2)
- In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)

Crosscutting Concepts

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2)

Structure and Function

- Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Connections to other DCIs in this grade-band: **MS.LS1.A** (MS-LS3-1); **MS.LS4.A** (MS-LS3-1)

Articulation across grade-bands: **3.LS3.A** (MS-LS3-1),(MS-LS3-2); **3.LS3.B** (MS-LS3-1),(MS-LS3-2); **HS.LS1.A** (MS-LS3-1); **HS.LS1.B** (MS-LS3-1),(MS-LS3-2); **HS.LS3.A** (MS-LS3-1),(MS-LS3-2); **HS.LS3-B** (MS-LS3-1),(MS-LS3-2)

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1	Cite specific textual evidence to support analysis of science and technical texts. *(MS-LS3-1),(MS-LS3-2)*
RST.6-8.4	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 grades 6-8 texts and topics. *(MS-LS3-1),(MS-LS3-2)*
RST.6-8.7	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). (MS-LS3-1),(MS-LS3-2)
SL.8.5	Include multimedia components and visual displays in presentations to clarify claims and findings and emphasize salient points. *(MS-LS3-1),(MS-LS3-2)*

Mathematics –

MP.4	Model with mathematics. *(MS-LS3-2)*
6.SP.B.5	Summarize numerical data sets in relation to their context. *(MS-LS3-2)*

Next Generation Science Standards Organization

Title and Code: ***MS*** identifies this as Middle School, ***LS*** as Life Science

MS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

MS-LS3-1. **Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.** [Clarification Statement: Emphasis is on conceptual understanding that changes in genetic material may result in making different proteins.] [Assessment Boundary: Assessment does not include specific changes at the molecular level, mechanisms for protein synthesis, or specific types of mutations.]

MS-LS3-2. **Develop and use a model to describe why asexual reproduction results in offspring with identical genetic information and sexual reproduction results in offspring with genetic variation.** [Clarification Statement: Emphasis is on using models such as Punnett squares, diagrams, and simulations to describe the cause and effect relationship of gene transmission from parent(s) to offspring and resulting genetic variation.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Performance Expectations: what students should be able to do to show mastery

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. ▪ Develop and use a model to describe phenomena. (MS-LS3-1),(MS-LS3-2)	**LS1.B: Growth and Development of Organisms** ▪ Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. *(secondary to MS-LS3-2)* **LS3.A: Inheritance of Traits** ▪ Genes are located in the chromosomes of cells, with each chromosome pair containing two variants of each of many distinct genes. Each distinct gene chiefly controls the production of specific proteins, which in turn affects the traits of the individual. Changes (mutations) to genes can result in changes to proteins, which can affect the structures and functions of the organism and thereby change traits. (MS-LS3-1) ▪ Variations of inherited traits between parent and offspring arise from genetic differences that result from the subset of chromosomes (and therefore genes) inherited. (MS-LS3-2) **LS3.B: Variation of Traits** ▪ In sexually reproducing organisms, each parent contributes half of the genes acquired (at random) by the offspring. Individuals have two of each chromosome and hence two alleles of each gene, one acquired from each parent. These versions may be identical or may differ from each other. (MS-LS3-2) ▪ In addition to variations that arise from sexual reproduction, genetic information can be altered because of mutations. Though rare, mutations may result in changes to the structure and function of proteins. Some changes are beneficial, others harmful, and some neutral to the organism. (MS-LS3-1)	**Cause and Effect** ▪ Cause and effect relationships may be used to predict phenomena in natural systems. (MS-LS3-2) **Structure and Function** ▪ Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the shapes, composition, and relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. (MS-LS3-1)

Foundation Box: the Science and Engineering Practices, Disciplinary Core Ideas, and Cross-Cutting Concepts from the Framework for K-12 Science Education used to define the Performance Expectations above

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Connections Box: Connections to other science standards within this grade band, articulations across grade bands, and connections to Common Core Standards in Mathematics and English Language Arts/Literacy

Next Generation Science Standards Organization

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Next Generation Science Standards Organization

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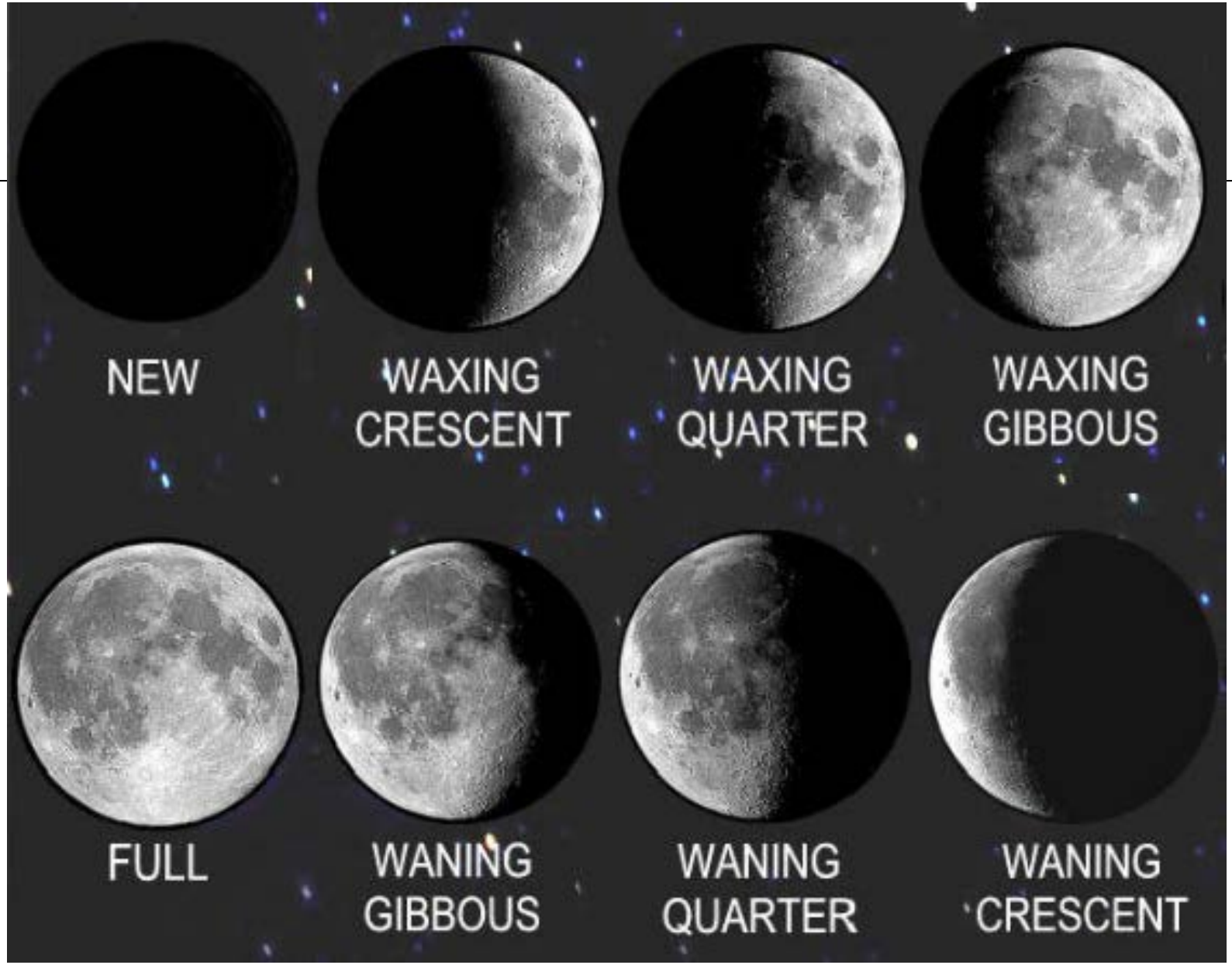
Note the Clarification Statements above, which supply examples or additional clarification to the performance expectations.

Also note the Assessment Boundary statements, which specify the limits to large scale assessment

Next Generation Science Standards

http://www.nextgenscience.org/

Earth and Space Science



Earth’s Rotation

Explore a model of Earth's yearly revolution around the sun.

The Vastness of Space

Earth & Moon System as seen by passing Juno Spacecraft.

Moon Phases

Bill Nye Explains the Moon Phases

Phases of the Moon

Viewed From Above

First Quarter

Waxing Gibbous

Waxing Crescent

Full Moon

Earth

New Moon

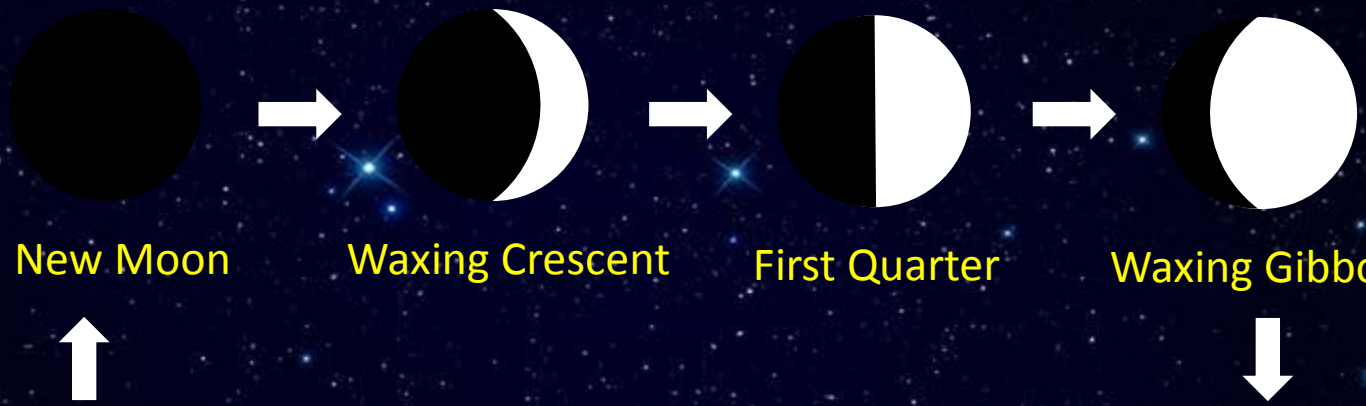
Waning Gibbous

Last Quarter

Waning Crescent

Phases of the Moon

Viewed From the Earth



New Moon

Waxing Crescent

First Quarter

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Full Moon

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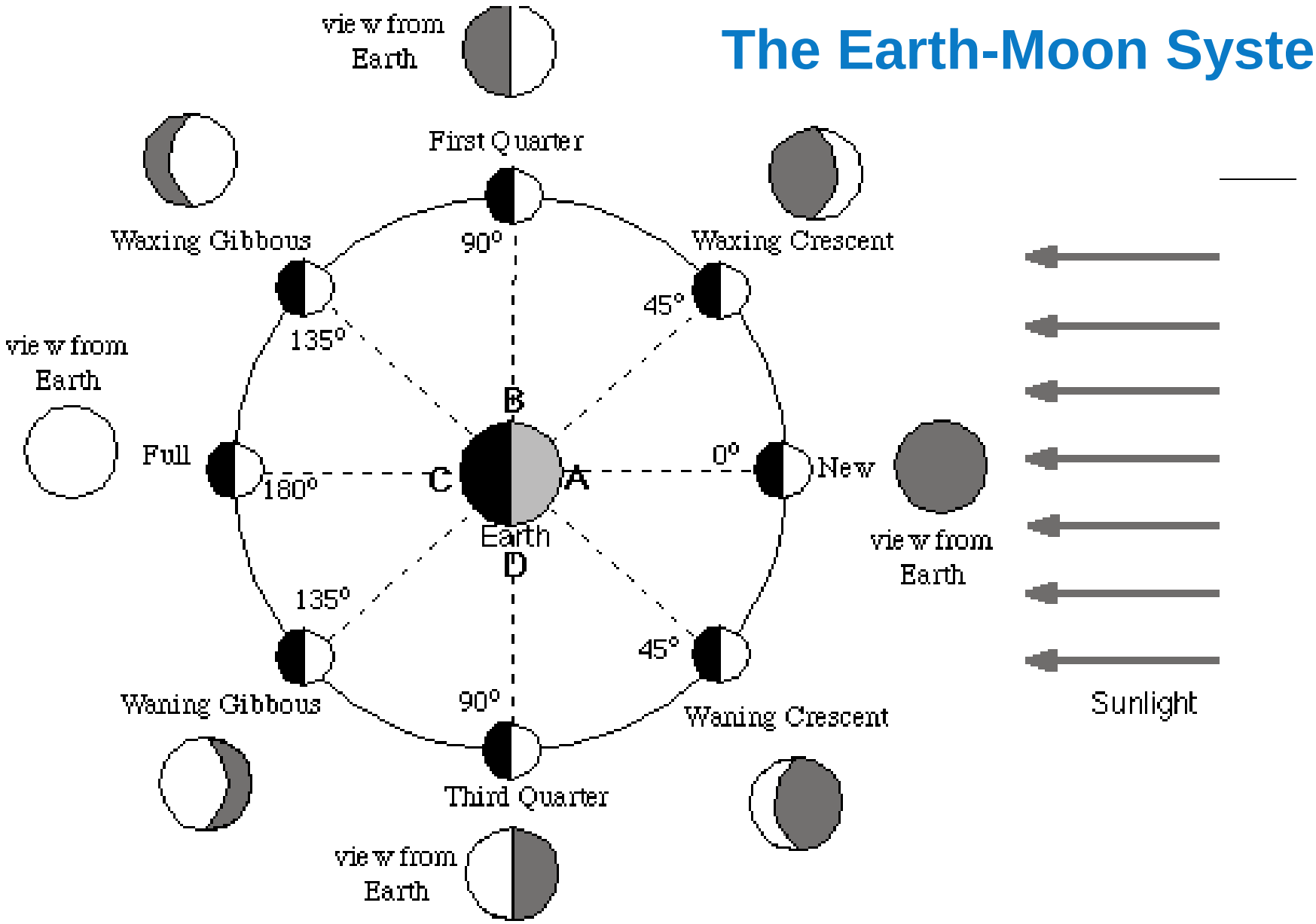
Last Quarter

Waning Crescent

The Earth-Moon System



Moon Links

Moon Phases:
http://www.sems.und.edu/index_MoonPhases.php

The Sun-Earth-Moon System:
http://quizlet.com/15003882/the-sun-earth-moon-system-flash-cards/

A model of Earth's yearly revolution around the sun:
http://www.classzone.com/books/earth_science/terc/content/visualizations/es0408/es0408page01.cfm?chapter_no=visualization

Earth-Moon System Seen By Passing Juno Spacecraft:
http://www.youtube.com/watch?v=RKo80qU0Whk

Bill Nye Explains the Moon's Phases:
http://www.youtube.com/watch?v=LaqrQyTm9B4

A Private Universe

Eliciting student ideas is vital to successful understanding. Until you confront your private universe, you cannot develop true understanding of science principles. Students must be given time to prove or disprove what they believe in the real world.

Detroit Science Center

Review of Strategies

- Jigsaw Read
- The 5E's Instructional Model
- TAPPS: Thinking Aloud Paired Problem Solving
- Text Rendering

Final Reflection

What are your biggest take-aways from today?

What are your unanswered questions?

- Think (quiet reflection for 2 minutes)
- Pair (pick partners)
- Share (with each other for 1 minute each)
- Square (share what you heard with your group of 4)
- Report (report out what your group said and heard)

Online Resources

- Next Generation Science Standards:

  http://www.nextgenscience.org/

- The OACE TASC webpage:

  http://www.oacenyc.org/home/t-a-s-c

- CTB McGraw-Hill's TASC webpage:

  http://www.tasctest.com/