A Closer Look at NGSS Grades 6-8

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Session Objectives

- Develop an Understanding of NGSS Performance Expectations
- Share the Story of our Thinking Process as we developed one example as a model for learning
- Have fun thinking and acting like teachers of preparing to teach middle school students to think and act like scientists

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Science for the next generation!

Begin with the end in mind!

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Locate 6-8 Standards (NGSS Topics)

Physical Science

- **MS.SPM** Structure and Properties of Matter
- **MS.CR** Chemical Reactions
- **MS.FI** Forces and Interactions
- **MS.EN** Energy
- **MS.WER** Waves and Electromagnetic Radiation

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Locate 6-8 Standards (NGSS Topics)

Earth and Space Science
- **MS.SS** Space Systems
- **MS.HE** History of Earth
- **MS.ES** Earth’s Systems
- **MS.WC** Weather and Climate
- **MS.HI** Human Impacts

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Locate 6-8 Standards (NGSS Topics)

Life Science

- **MS.SFIP** Structure, Function and Information Processing
- **MS.MEOE** Matter and Energy in Organisms and Ecosystems
- **MS.IRE** Interdependent Relationships in Ecosystems
- **MS.NSA** Natural Selection and Adaptations
- **MS.GDRO** Growth, Development, and Reproduction of Organisms

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Structure of NGSS

- Expressed as *Performance Expectations* (PEs)
- *Integrate* practices, core ideas, and crosscutting concepts
- Statements of what is to be *assessed*
- Require demonstration of *knowledge-in-use*
- NOT instructional strategies
- NOT lesson objectives
- State what students should be able to do at the *end of instruction*
- Organized by Topic and by DCI (See chart)
How to Read a PE

“NGSS Structure” Supporting document on NGSS page


Inside the NGSS Box – Content Description (NSTA)

http://nstahosted.org/pdfs/ngss/InsideTheNGSSBox.pdf

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How to Read a PE
How to Read a PE

• Select one PE. **MS-LS2-1** (In MS.Matter and Energy in Organisms and Ecosystems )

• Read the PE, the clarification statement, and the assessment boundary.

• Read the applicable DCI in the foundation box.

• Check *Appendix E* (**p.5**) for DCI progression.
How to Read a PE

- Read the associated practice in the foundation box.
- Check *Appendix F* for Practice progression.
- Read the associated crosscutting concept (CCC) in the foundation box.
- Check *Appendix G* for CCC progression.
Strategies for Planning Instruction

• Scaffold the development of understanding expressed in the PE(s).

• Develop a series of learning tasks that blend together various practices, core ideas, and CCC.

• Integrate.

• Consider prior knowledge.
  • Preconception and misconceptions

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Developing a Lesson: Step 1

MS. Matter and Energy in Organisms and Ecosystems

Question 1: What performance expectations are related and can be included in instruction within the lessons/unit? (Cluster PEs)
Developing a Lesson: Step 1

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
Developing a Lesson: Step 2

MS. Matter and Energy in Organisms and Ecosystems

Question 2: What are the performance expectations, clarification statements, and assessment boundaries and how are they related in terms of instructional practices?
Developing a Lesson: Step 2

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem. [Clarification Statement: Emphasis is on cause and effect relationships between resources and growth of individual organisms and the numbers of organisms in ecosystems during periods of abundant and scarce resources.]

- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations. [Clarification Statement: Emphasis is on recognizing patterns in data and making warranted inferences about changes in populations, and on evaluating empirical evidence supporting arguments about changes to ecosystems.]
Developing a Lesson: Step 3

MS. Matter and Energy in Organisms and Ecosystems

Question 3: What are the disciplinary core idea(s), practices, and crosscutting concepts coded to the performance expectations and how will they drive instruction?

http://www.nextgenscience.org/msls-meoe-matter-energy-organisms-ecosystems

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Developing a Lesson: Step 3

Practices:
- Analyzing and Interpreting Data
- Engaging in Argument from Evidence
- Nature of Science Connection
  - Scientific Knowledge is Based on Empirical Evidence

Disciplinary Core Ideas:
- Interdependent Relationships in Ecosystems
- Ecosystem Dynamics, Functioning, and Resilience

Crosscutting Ideas:
- Cause and Effect
- Stability and Change

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Developing a Lesson: Step 4

MS. Matter and Energy in Organisms and Ecosystems

Question 4: What understandings need to be developed for students to be successful in the performance expectation(s)?

What content ideas will they need to know and what skills will they need to learn?
Developing a Lesson: Step 4

Students will need to know....

- Organisms, and populations of organisms, are dependent on their environmental interactions both with other living things and their nonliving factors.

- In any ecosystem, organisms and populations with similar requirements for food, water, oxygen, or other resources may compete with each other for limited resources, access to which consequently constrains their growth and reproduction.

- Growth of organisms and population increases are limited by access to resources.

- Ecosystems are dynamic in nature; their characteristics can vary over time. Disruptions to any physical or biological component of an ecosystem can lead to shifts in all its populations.
Developing a Lesson: Step 4

Students will be able to...

- Analyze and interpret data to provide evidence for phenomena.
- Construct an oral and written argument supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution.
Developing a Lesson: Step 4

• Common Misconceptions
  • Competition between animals does not always involve direct confrontation (fighting). (63%)
  • Plants do not compete for resources (AAAS Project 2061, n.d.). (31%)
  • If a population in a food web is disturbed, there will be little or no effect on populations that are not within the linear sequence in the food web (Webb & Boltt, 1990). (31%)
  • Varying the size of a population of organisms will affect only those populations of organisms that are directly connected to it in a feeding relationship, not organisms that are one or more steps removed/away from it (Griffiths & Grant, 1985; Webb & Boltt, 1990). (20%)

Developing a Lesson: Step 5

MS. Matter and Energy in Organisms and Ecosystems

**Question 5**: What Science and Engineering Practices are appropriate with the instruction of the disciplinary core ideas?

(See Appendix F for description of Practices for 6-8.)
Developing a Lesson: Step 5

- Analyzing and Interpreting Data
- Engaging in Argument from Evidence
- Asking questions
- Planning and carrying out investigations
- Constructing Explanations
- Obtaining, evaluating, and communicating information

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Developing a Lesson: Step 6

MS. Matter and Energy in Organisms and Ecosystems

Question 6: What are the lesson level expectations (learning performances) and how will they build to meet the performance expectations?
Developing a Lesson: Step 6: Lesson Level Performances

- Ask questions about how a change in an ecosystem can affect an entire ecosystem. (Asking Questions)

- Design and conduct an investigation to find relationships among abiotic and biotic factors of an ecosystem. (Planning and Carrying Out Investigations)

- Look for patterns and cause & effect relationships in ecosystem data sets. (Analyzing and Interpreting Data)

- Analyze other students’ claims regarding resource availability and population changes. (Engaging in argument from evidence)

- Argue that physical and biological components of ecosystems effect populations. (Engaging in argumentation from evidence)

- Cite specific textual evidence from science text to support their claims. (Obtaining, evaluating, and communicating information, and engaging in argument from evidence)
Developing a Lesson: Step 7

MS. Matter and Energy in Organisms and Ecosystems

**Question 7**: What assessment (formative and summative) will provide evidence of the understanding and/or ability to perform lesson level expectations (learning performances)?
Developing a Lesson: Step 7

Performance Tasks/Projects

- A written scientific explanation supporting the claim that resource availability affects organism population in ecosystems. [Constructing explanation (for science) and designing solutions (for engineering) *Use rubric*]

- A written scientific explanation that supports the claim that physical and biological components of ecosystems affect populations. [Constructing explanation (for science) and designing solutions (for engineering) *Use rubric*]

- A journal recording their plant investigation and their findings. [Planning and carrying out investigations *Use rubric*]
Developing a Lesson: Step 7

Other Evidence

- Observations during discourse (rubric)
- Self-reflection after discourse (either video or written)
- Data analysis activities

Student Self-Assessment

- Classroom discussions
- Critical Friends
- CER Rubric

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Developing a Lesson: Step 8

MS. Matter and Energy in Organisms and Ecosystems

Question 8:

What is the storyline that helps learners apply what they know, build new, sophisticated ideas from observation and evidence, and use information to answer a scientific question or solve an engineering problem?
During these lessons students wonder explore and ask questions about how a biotic or abiotic change in an ecosystem can affect an entire ecosystem. The effects of these changes may directly or indirectly affect the populations of the species of organisms within an ecosystem. The abundance or scarcity of a resource may affect populations in complex ways. These changes may include increased predation, starvation, migration, changes in predator/prey relationships etc.

Students have a grade-appropriate understanding and use of the practices of investigations, constructing arguments based on evidence, and oral and written communication.
Developing a Lesson: Step 9

MS. Matter and Energy in Organisms and Ecosystems

Question 9: How do the lessons and tasks help students move towards an understanding of the performance expectation(s)?
Title/Question for the series of learning performances:

How do changes to physical or biological components of an ecosystem affect populations of organisms (plants and animals) of the ecosystem?
Developing a Lesson: Step 9

- Regarding the concepts of how a small change in an ecosystem can affect the entire ecosystem, the teacher designs a question then keeps a question board of student questions that arise from the activities, readings, lecture bursts, demonstrations and investigations. These student-generated questions are used as a basis for student investigations.

- While considering how matter cycles in organisms and the interactions of organisms to obtain the matter and energy from the ecosystem to survive and grow, students can design and conduct investigations to find relationships between abiotic and biotic conditions of the ecosystems. These student-conducted investigations need to begin with a student-designed question that is doable and testable.

- Based upon the student-generated question, students design and conduct an investigation to find relationships among a-biotic and biotic factors of an ecosystem.

- After gathering qualitative and quantitative observations over time, students look for patterns as well as cause and effect relationships in ecosystem data sets.

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This process of data analysis enables students to develop an explanation answering their own questions. This process of explaining involves three steps. First, making a claim (the answer to the original student’s question.) Next, selecting and providing evidence from their data to support their own claim that answers their investigation question. Finally revealing their scientific thinking that offers their rationale as to why their selected evidence matters and indeed counts as evidence.

It is one thing to write down or express thoughts in written answers. However, to engage in discourse with peers regarding impact of abiotic changes of the ecosystem on biotic components of the ecosystems involves a more sophisticated set of thinking skills.

Students justify their reasoning to others in support of their claim that changes in ecosystems affect populations.

Argue that physical (abiotic) and biological (biotic) components of ecosystems affect populations of organisms.
For More Information

All NGSS official documents are available at

http://www.nextgenscience.org/

NGSS at NSTA
 Standards and Supporting Materials Tab

http://www.nsta.org/about/standardsupdate/standards.aspx

All of today’s session materials will be available at the meeting site

http://www.create4stem.msu.edu/ngss

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