NGSS IN THE CLASSROOM

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INTRODUCTORY QUESTIONS

- What questions do you have related to:
  - 3 – dimensional learning?
  - the NGSS?
  - Implementing instruction?

FUNDAMENTAL SHIFTS

- Scaffolding
  - Building on prior knowledge and experience
- Integration
  - Less isolated facts and information
- Problem Solving and Perseverance
  - Explaining phenomena or designing solutions

3-DIMENSIONAL LEARNING

- **Disciplinary Core Ideas**
  - Life Science
  - Physical Science
  - Earth and Space Science
  - Engineering
- **Crosscutting Concepts**
  - Patterns
  - Cause and effect
  - Scale, proportion, and quantity
  - Systems and system models
  - Energy and matter
  - Structure and function
  - Stability and change
- **Science & Engineering Practices**
  - Asking questions and defining problems
  - Developing and using models
  - Planning and carrying out investigations
  - Analyzing and interpreting data
  - Using mathematics and computational thinking
  - Constructing explanations and designing solutions
  - Engaging in argument from evidence
  - Obtaining, evaluating, and communication information

DISCIPLINARY CORE IDEAS

Life Science	Physical Science
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	PS1: Matter and Its Interactions PS2: Motion and Stability: Forces and Interactions PS3: Energy PS4: Waves and Their Applications in Technologies for Information Transfer
Earth & Space Science	**Engineering & Technology**
ESS1: Earth's Place in the Universe ESS2: Earth's Systems ESS3: Earth and Human Activity	ETS1: Engineering Design ETS2: Links Among Engineering, Technology, Science, and Society

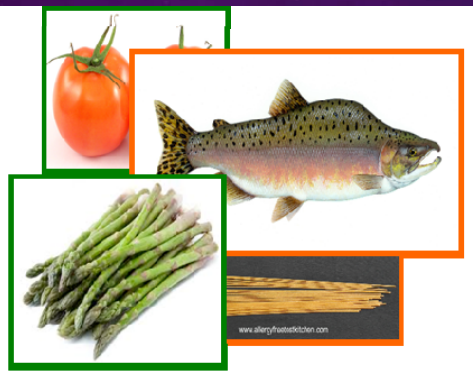
BUILDING KNOWLEDGE AND SKILL

- **Key features of the disciplinary core ideas**:
  - Content significance
  - Explanatory power
  - Generative
  - Relevant
  - Usable from K – 12

- **Practices vs Inquiry**:
  - Practices build on and extend earlier efforts of students engaging in inquiry to a focus on students investigating, developing, evaluating, and refining ideas to explain phenomena and solve problems.
  - Practices shift the focus from science classrooms as an environment where students learn about science ideas to places where students explore, examine and use science ideas to explain how and why phenomena occur.
  - Science instruction should focus on figuring out how phenomena work!

AN ANALOGY BETWEEN 3-DIMENSIONAL LEARNING AND COOKING

Kitchen Tools & Techniques (Practices)



Basic Ingredients (Core Ideas)

Herbs, Spices, & Seasonings (Crosscutting Concepts)

Preparing a Meal

(Three dimensional Learning)

NGSS PERFORMANCE EXPECTATION STRUCTURE

Practice	Core Idea	Crosscutting Concept
• Developing and Using Models - Use a model based on evidence to illustrate the relationships between systems or between components of a system. (HS-LS1-4),(HS-LS1-5),(HS-LS1-7)	• LS1.C: Organization for Matter and Energy Flow in Organisms - The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (HS-LS1-5)	• Energy and Matter - Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system. (HS-LS1-5), (HS-LS1-6)

HS-LS1-5. Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.

[Clarification Statement: Emphasis is on illustrating inputs and outputs of matter and the transfer and transformation of energy in photosynthesis by plants and other photosynthesizing organisms. Examples of models could include diagrams, chemical equations, and conceptual models.]

[Assessment Boundary: Assessment does not include specific biochemical steps.]

CONNECTION BOXES

Common Core State Standards Connections:
ELA/Literacy –
SL.11-12.5 Make strategic use of digital media (e.g., textual, graphical, audio, visual, and interactive elements) in presentations to enhance understanding of findings, reasoning, and evidence and to add interest. (HS-LS1-2),(HS-LS1-4),(HS-LS1-5),(HS-LS1-7)
AND…

Mathematics –
???

NGSS PERFORMANCE EXPECTATION STRUCTURE

Practice	Core Idea	Crosscutting Concept
• Asking Questions and Defining Problems - Ask questions that can be investigated within the scope of the classroom, outdoor environment, and museums and other public facilities with available resources and, when appropriate, frame a hypothesis based on observations and scientific principles. (MS-PS2-3)	• PS2.B: Types of Interactions - Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3)	• Cause and Effect - Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS2-3),(MS-PS2-5)

MS-PS2-3. Ask questions about data to determine the factors that affect the strength of electric and magnetic forces.

[Clarification Statement: Examples of devices that use electric and magnetic forces could include electromagnets, electric motors, or generators. Examples of data could include the effect of the number of turns of wire on the strength of an electromagnet, or the effect of increasing the number or strength of magnets on the speed of an electric motor.]

[Assessment Boundary: Assessment about questions that require quantitative answers is limited to proportional reasoning and algebraic thinking.]

CONNECTION BOXES

Common Core State Standards Connections:

ELA/Literacy –

RST.6-8.1 Cite specific textual evidence to support analysis of science and technical texts, attending to the precise details of explanations or descriptions. (MS-PS2-1),(MS-PS2-3)

AND…

Mathematics –

MP.2 Reason abstractly and quantitatively. (MS-PS2-1),(MS-PS2-2),(MS-PS2-3)

AND…

LESSON SAMPLES

- 5e Model and Behaviors –

https://s-media-cache-ak0.pinimg.com/736x/84/89/db/8489db4e8a24610a9c2f82061f99dc93.jpg

- Life Science (LS) – http://www.biologycorner.com/worksheets/estimating_population_size.html
- Physical Science (PS) – http://sbsciencematters.com/5th/physical/5.15MysteryPowders.pdf
- Earth and Space Science (ESS) – http://cse.ssl.berkeley.edu/lessons/indiv/coe/details.html

THE NGSS ARE **NOT**…

- Curriculum – standards are not a description of the curriculum
- Lessons – standards are not to be used as objectives for a lesson
- Instructional Strategies – standards do not dictate instruction

THE NGSS **ARE**…

- A combination of practices, core ideas, and crosscutting concepts into a single statement of what is to be assessed at the end of instruction (a unit, grading period, grade level, and/or grade span: K – 5, 6 – 8, and 9 – 12).

CONCLUSION

- Questions
- Main Resources –
  - www.nextgenscience.org
  - http://create4stem.msu.edu/people/joseph-krajcik
- Contact –
  - Dr. Natacia Campbell
    - ncampbell@d230.org
    - ncampbell@sxu.edu
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The 5E Model of Instruction

5E Definition	Teacher Behavior	Student Behavior
Engage		
• Generate interest • Access prior knowledge • Connect to past knowledge • Set parameters of the focus • Frame the idea	• Motivates • Creates interest • Taps into what students know or think about the topic • Raises questions and encourages responses	• Attentive in listening • Ask questions • Demonstrates interest in the lesson • Responds to questions demonstrating their own entry point of understanding
Explore		
• Experience key concepts • Discover new skills • Probe, inquire, and question experiences • Examine their thinking • Establish relationships and understanding	• Acts as a facilitator • Observes and listens to students as they interact • Asks good inquiry-oriented questions • Provides time for students to think and to reflect • Encourages cooperative learning	• Conducts activities, predicts, and forms hypotheses or makes generalizations • Becomes a good listener • Shares ideas and suspends judgment • Records observations and/or generalizations • Discusses tentative alternatives
Explain		
• Connect prior knowledge and background to new discoveries • Communicate new understandings • Connect informal language to formal language	• Encourages students to explain their observations and findings in their own words • Provides definitions, new words, and explanations • Listens and builds upon discussion form students • Asks for clarification and justification • Accepts all reasonable responses	• Explains, listens, defines, and questions • Uses previous observations and findings • Provides reasonable responses to questions • Interacts in a positive, supportive manner
Extend/Elaborate		
• Apply new learning to a new or similar situation • Extend and explain concept being explored • Communicate new understanding with formal language	• Uses previously learned information as a vehicle to enhance additional learning • Encourages students to apply or extend the new concepts and skills • Encourages students to use terms and definitions previously acquired	• Applies new terms and definitions • Uses previous information to probe, ask questions, and make reasonable judgments • Provides reasonable conclusions and solutions • Records observations, explanations, and solutions
Evaluate		
• Assess understanding (Self, peer and teacher evaluation) • Demonstrate understanding of new concept by observation or open-ended response • Apply within problem situation • Show evidence of accomplishment	• Observes student behaviors as they explore and apply new concepts and skills • Assesses students' knowledge and skills • Encourages students to assess their own learning • Asks open-ended questions	• Demonstrates an understanding or knowledge of concepts and skills • Evaluates his/her own progress • Answers open-ended questions • Provides reasonable responses and explanations to events or phenomena

Based on the 5E Instructional Model presented by Dr. Jim Barufaldi at the Eisenhower Science Collaborative Conference in Austin, Texas, July 2002.

INSTRUCTIONAL ACTIVITY/LESSON REVIEW

	GRADE LEVEL: 5TH GRADE		
Core Ideas:	Life Science: 5-LS1 From Molecules to Organisms: Structures and Processes & 5-LS2 Ecosystems: Interactions, Energy, and Dynamics Physical Science: 5-PS1 Matter and Its Interactions, 5-PS2 Motion and Stability: Forces and Interactions, & 5-PS3 Energy Earth & Space Science: 5-ESS1 Earth's Place in the Universe, 5-ESS2 Earth's Systems, & 5-ESS3 Earth and Human Activity Engineering Design: 3-5-ETS1 Engineering Design		
Cross Cutting Concepts:	Patterns: Cause & Effect: Scale, Proportion, & Quantity: Systems & System Models: Energy & Matter: Structure & Function: Stability & Change:	Science & Engineering Practices:	Asking Questions & Defining Problems: Developing & Using Models: Planning & Carrying Out Investigations: Analyzing & Interpreting Data: Using Mathematics & Computational Thinking: Constructing Explanations & Designing Solutions: Engaging In Argument From Evidence: Obtaining, Evaluating, & Communicating Information:

	GRADE LEVEL: 5TH GRADE
NGSS Performance Expectations:	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-PS2-1. Support an argument that the gravitational force exerted by Earth on objects is directed down. 5-PS3-1. Use models to describe that energy in animals' food (used for body repair, growth, motion, and to maintain body warmth) was once energy from the sun. 5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water. 5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment. 5-ESS1-1. Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth. 5-ESS1-2. Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky. 5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere interact. 5-ESS2-2. Describe and graph the amounts and percentages of water and fresh water in various reservoirs to provide evidence about the distribution of water on Earth. 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

NGSS Performance Expectations (Cont'd):	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. 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem. 3-5-ETS1-3. Plan and carry out fair tests in which variables are controlled and failure points are considered to identify aspects of a model or prototype that can be improved.
	Grade levels: K-5
CCSS ELA Standards:	Reading Standards for Literature K–5, Reading Standards for Informational Text K–5, Reading Standards: Foundational Skills K–5 Writing Standards K–5 Speaking and Listening Standards K–5 Language Standards K–5
CCSS Mathematics 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. 5th Grade Standards: Operations and Algebraic Thinking, Number and Operations in Base Ten, Number and Operations—Fractions, Measurement and Data, & Geometry
Other Possible Standards:	Social Studies/Geography: Health: Other:

3-DIMENSIONAL LEARNING

INSTRUCTIONAL ACTIVITY/LESSON TITLE:

IDENTIFY THE CORE IDEA(S) & EVIDENCE FROM THE ACTIVITY/LESSON:	IDENTIFY THE CROSS CUTTING CONCEPT(S) & EVIDENCE FROM THE ACTIVITY/LESSON:	IDENTIFY THE SCIENCE & ENGINEERING PRACTICE(S) & EVIDENCE FROM THE ACTIVITY/LESSON:
Do you do have any similar activities/lessons?...Please identify/describe.		
What ideas do you have to improve upon this lesson and/or better demonstrate 3 Dimensional Learning?		

STANDARDS IDENTIFICATION

INSTRUCTIONAL ACTIVITY/LESSON TITLE:

IDENTIFY THE NGSS PERFORMANCE EXPECTATION(S) & EVIDENCE FROM THE ACTIVITY/LESSON:	IDENTIFY THE CCSS ELA STANDARD(S) & EVIDENCE FROM THE ACTIVITY/LESSON:	IDENTIFY THE CCSS MATHEMATICS STANDARD(S) & EVIDENCE FROM THE ACTIVITY/LESSON:	IDENTIFY ANY OTHER STANDARD(S) & EVIDENCE FROM THE ACTIVITY/LESSON: