Teaching Today's Student Scientists in Three Dimensions Note Catcher

Session Objectives

- Close read a "performance expectation" to understand grade-level science expectations.
- Observe a lesson to understand what 3D science instruction looks like.

Understanding 3D Instruction

Activity 1: Science and Engineering Practices

Directions

1. Scan the progressions for "Constructing Explanations and Designing Solutions."
2. Look for grade-level expectations.
    a. What do you notice?
    b. What do you wonder?

Notice	Wonder

Constructing Explanations and Designing Solutions (Next Generation Science Standards (NGSS) Science and Engineering Practices)

Grades 3–5 Practices	Grades 6–8 Practices	Grades 9–12 Practices
Construct an explanation of observed relationships (e.g., the distribution of plants in the backyard).	Construct an explanation that includes qualitative or quantitative relationships between variables that predict(s) or describe(s) phenomena. Construct an explanation using models or representations.	Make a quantitative or qualitative claim regarding the relationship between dependent and independent variables.
Use evidence (e.g., measurements, observations, patterns) to construct or support an explanation or design a solution to a problem.	Construct a scientific explanation based on valid and reliable evidence obtained from sources. Apply scientific ideas, principles, or evidence to construct, revise, or use an explanation for real-world phenomena, examples, or events.	Construct and revise an explanation based on valid and reliable evidence obtained from various sources. Apply scientific ideas, principles, or evidence to explain phenomena and solve design problems, considering possible unanticipated effects.
Identify the evidence that supports particular points in an explanation.	Apply scientific reasoning to show why the data or evidence is adequate for the explanation or conclusion.	Apply scientific reasoning, theory, or models to link evidence to the claims to assess the extent to which the reasoning and data support the explanation or conclusion.
Apply scientific ideas to solve design problems. Generate and compare multiple solutions to a problem based on how well they meet the criteria and constraints of the design solution.	Apply scientific ideas or principles to design, construct, or test a design of an object, tool, process, or system. Undertake a design project to construct or implement a solution that meets design criteria and constraints. Optimize the performance of a design by prioritizing criteria, making tradeoffs, testing, revising, and retesting.	Design, evaluate, or refine a solution to a complex real-world problem based on scientific knowledge, student-generated sources of evidence, prioritized criteria, and tradeoff considerations.

NGSS Lead States. (2013). *Next Generation Science Standards: For States, By States: Appendix F Science and Engineering Practices.* Retrieved from https://www.nextgenscience.org/

Activity 2: Crosscutting Concepts

Directions:

1. Scan the progressions for "Scale, Proportion, and Quantity."
2. Look for grade-level expectations.
    a. What do you notice?
    b. What do you wonder?

Notice	Wonder

NGSS Crosscutting Concepts: Scale, Proportion, and Quantity

Grades 3–5 Crosscutting Concepts	Grades 6–8 Crosscutting Concepts	Grades 9–12 Crosscutting Concepts
Natural objects and observable phenomena exist from the very small to the immensely large or from very short to long periods. Standard units measure and describe physical quantities such as weight, time, temperature, and volume.	Time, space, and energy phenomena can be observed at various scales using models to study too large or small systems. The observed function of natural and designed systems may change with scale. 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. Algebraic expressions and equations can represent scientific relationships. Phenomena that can be observed at one scale may not be observable at another scale.	The significance of a phenomenon is dependent on the scale, proportion, and quantity at which it occurs. Some systems can only be studied indirectly, as they are too small, too large, too fast, or too slow to observe directly. Patterns that can be observed at one scale may not be observable or exist at other scales. Using the concept of orders of magnitude allows one to understand how a model at one scale relates to a model at another scale. Algebraic thinking is used to examine scientific data and predict the effect of a change in one variable on another (e.g., linear growth vs. exponential growth).

NGSS Lead States. (2013). *Next Generation Science Standards: For States, By States: Appendix G Cross Cutting Concepts.* Retrieved from https://www.nextgenscience.org/

Observing Grade-Level 3D Instruction

Directions:

1. Watch the video.
2. Record quotes focused on:
    a. SEP: Constructing Explanations
    b. DCI: Earth's Materials and Systems
    c. CCC: Scale, Proportion, and Quantity

MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying times and spatial scales.

What are students doing to meet grade-level expectations? (Appendix F)	**What are students learning to meet grade-level expectations? (Appendix E)**	**How are students making connections to meet grade-level expectations? (Appendix G)**
Construct a scientific explanation based on valid and reliable evidence obtained from sources. Apply scientific ideas, principles, or evidence to construct, revise, or use an explanation for real-world phenomena, examples, or events.	Energy flows and matter cycles within and among Earth's systems, including the sun and Earth's interior as primary energy sources. Plate tectonics is one result of these processes.	Time, space, and energy phenomena can be observed at various scales using models to study too large or small systems.
Video Quotes:	Video Quotes:	Video Quotes:

Close Reading a Science Standard

Performance Expectation

Science and Engineering Practice:	Crosscutting Concept:
☐ Ask Questions ☐ Develop and Use Models ☐ Plan and Carry out Investigations ☐ Analyze and Interpret Data ☐ Use Mathematics and Computational Thinking ☐ Construct Explanations ☐ Engage in Argument from Evidence ☐ Obtain, Evaluate, and Communicate Information	☐ Patterns ☐ Cause and effect: Mechanism and explanation ☐ Scale, proportion, and quantity ☐ Systems and system models ☐ Energy and matter: Flows, cycles, and conservation ☐ Structure and function ☐ Stability and change

What are students doing to meet grade-level expectations? (Appendix F)	What are students learning to meet grade-level expectations? (Appendix E)	How are students making connections to meet grade-level expectations? (Appendix G)