TABLE 1

Teacher units including representations for supporting three-dimensional science learning.

Karen – first grade

Unit Topic: Properties of Matter; Related Disciplinary Core Idea – Matter and Its Interactions

Phenomenon (DCI)	Representational Forms Included	Representation Learning Activity	Teacher Support of Learning Activity	SEPs and CCCs
What are properties shared by all forms of matter and how can matter be changed?	**Individual Students** • Drawings • Tables • Videos/Pictures • Samples/ Materials	• Creating Representations • Using/Gathering Representations • Independently Revising Representations	• Organizing materials in a progression • Options for organizing data. • Framing questions to connect what students are doing to what scientists do • Scaffolding revision process of representation • Reference in whole class discussion back to class chart	• Developing and using models • Planning and carrying out investigations • Analyzing and interpreting data • Obtaining, evaluating, and communicating information • Patterns • Structure & Function
	Whole Class • Chart (class created) • Embodiment (class mimicking molecule movement)	• Feedback on Representations • Revising Representations • Explaining Representations		• Developing and using models • Engaging in argument from evidence • Obtaining, evaluating, and communicating information • Patterns • Structure and function • Cause and effect

TABLE 1 (CONTINUED)

Teacher units including representations for supporting three-dimensional science learning.

Deb – third grade

Unit Topic: Earth's Processes; Related Disciplinary Core Idea – Earth's Systems

Phenomenon (DCI)	Representational Forms Included	Representation Learning Activity	Teacher Support of Learning Activity	SEPs and CCCs
How and why does Earth change over time?	**Individual Students** • Drawings • Tables • Videos/Pictures • Samples/Materials Physical structures	• Creating Representations • Using Representations Independently • Revising Representations	• Organizing materials in a progression • Providing multiple representations of the same phenomenon • Scaffolding conventions when creating representations including color, labels, and arrows • Making scientific processes explicit (e.g., modeling)	• Developing and using models • Analyzing and interpreting data • Constructing explanations • Patterns • Cause and effect • Stability and change Systems and system models
	Whole Class • Whole Class • Videos/pictures • Text • Samples/Materials Physical structures	• Explaining Representations • Using representations • Feedback on representations		• Developing and using models • Analyzing and interpreting data • Constructing explanations • Patterns • Cause and effect • Stability and change • Systems and system models

TABLE 2

Example representational forms connecting the three dimensions of the *Next Generation Science Standards.*

Disciplinary Core Idea and Select Representational Form	Crosscutting Concepts	Science and Engineering Practices
Representations can be used to show general patterns and abstractions of patterns (e.g., water cycle).	Patterns	• Developing and using models • Analyzing and interpreting data
Cause and effect can be shown in diagrammatic representations such as concepts maps, flow charts and story boards.	Cause and effect: Mechanism and explanation	• Constructing explanations • Obtaining, evaluating, and communicating information
Drawings, graphs, and diagrams can explicitly demonstrate this CCC.	Scale, proportion, and quantity	• Developing and using models • Using mathematics and computational thinking
Diagrams of systems, graphs, tables of relationships and dependencies in systems are good targets for representational activity.	Systems and system models	• Developing and using models • Constructing explanations
Diagrams of cycles, charts of energy and matter flow show how energy and matter are conserved.	Energy and matter: Flows, cycles, and conservation	• Constructing Explanations • Obtaining, evaluating, and communicating information
Diagrams and tables can show relationships between structure and function and can include evidence for those relationships.	Structure and function	• Engaging in argument from evidence • Constructing explanations
Graphs and storyboards can show change over time (or lack thereof).	Stability and change	• Analyzing and interpreting data • Engaging in argument from evidence