A Professional Learning Model to Develop Strong Instructional Practices

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AGENDA

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3. Science Instruction under the Science GSE
4. Commonalities of the Science and Engineering Practices
5. The Work
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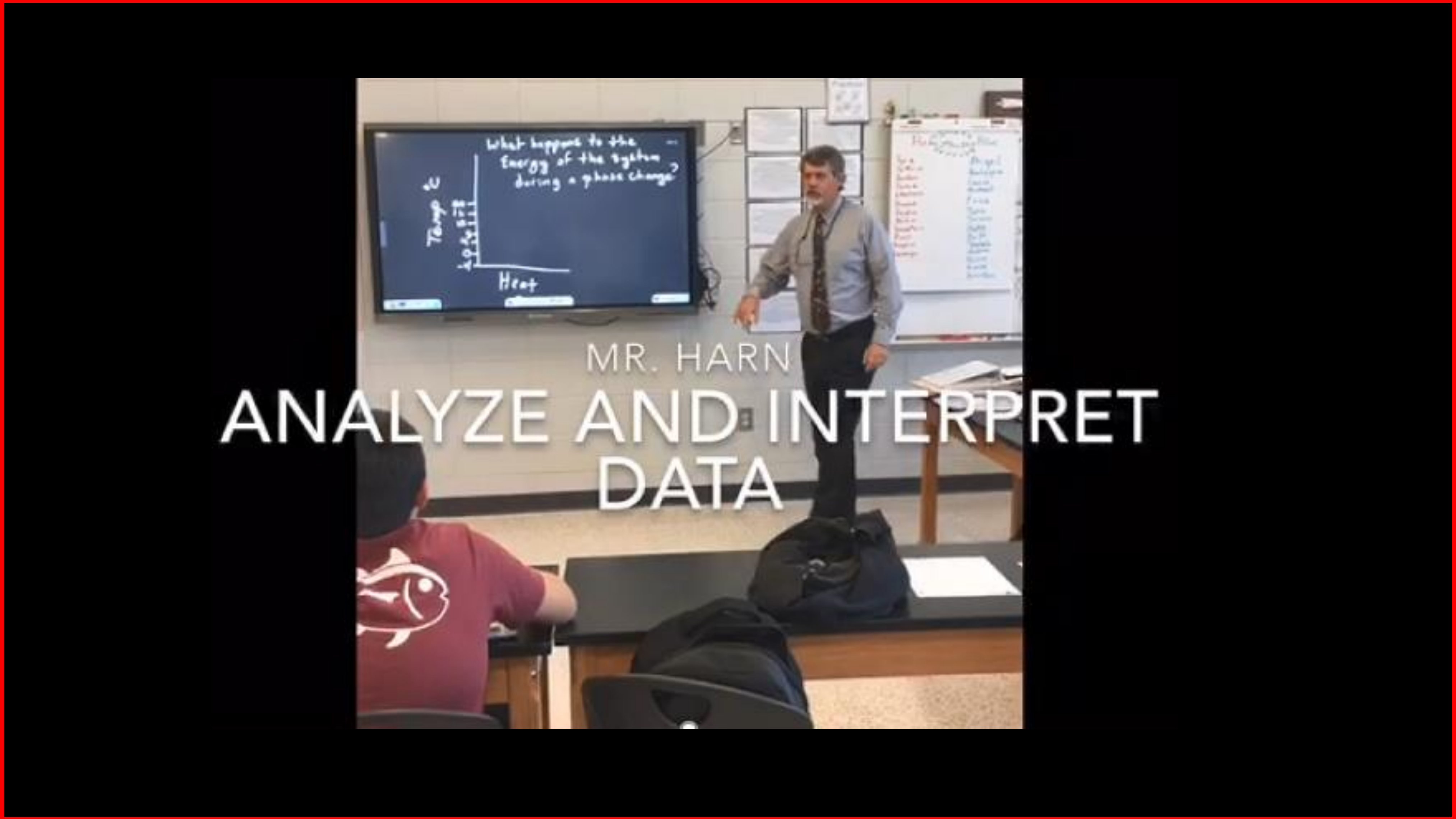
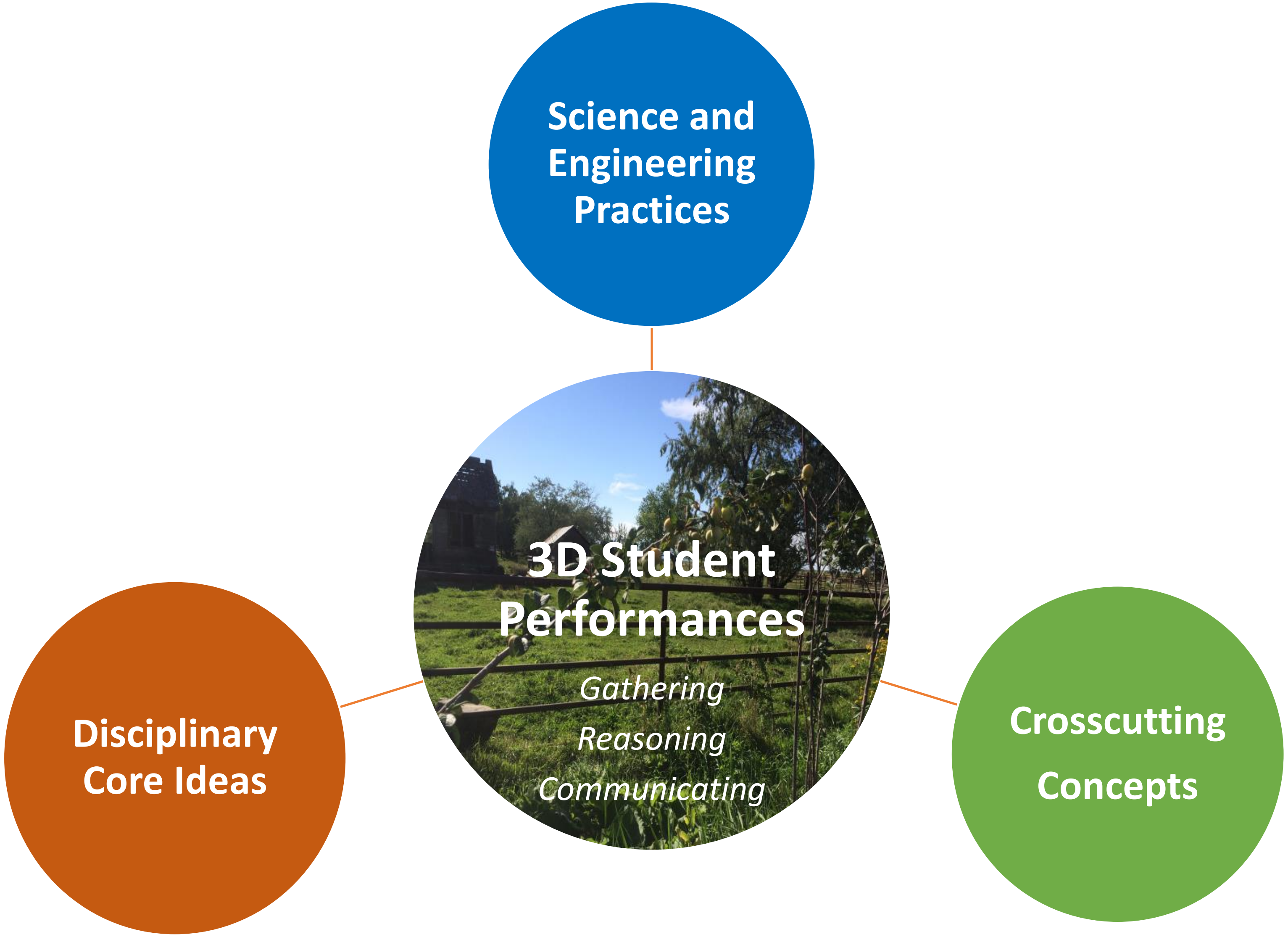
    c. Developing of Sample Assessment Items
    d. Developing of Sample Instructional Units
6. Main Lesson Learning
7. Final Thoughts


MR. HARN
ANALYZE AND INTERPRET
DATA
What happens to the Energy of the system during a phase change?
Temp °C
Heat

Science Performance at the Intersection



Instructional Lessons

Student Science Performances

Student Science Performances

Student science performances are a way to describe how students engage in the practices using crosscutting concepts and core disciplinary ideas to make sense of the causes of phenomena. These performances should be described within lesson plans or assessment prompts. Formative assessment is one way to focus learning by providing descriptions of the attributes of proficient student performances across the practices, crosscutting concepts, and core disciplinary ideas.

What Do We Mean By 3-D Science?

Students Actively Engage in….

Science and Engineering Practices

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

And apply

Crosscutting Concepts

- Patterns
- Cause and effect
- Scale, proportion, and quantity
- Systems and system models
- Energy and matter
- Structure and function
- Stability and change

To deepen understanding

Core Disciplinary Ideas

- Matter and its interactions
- Motion and stability: Forces and interactions
- Energy
- Waves and their applications in technologies for information transfer
- Structure and processes in living organisms
- Ecosystems: Interactions, energy, and dynamics
- Heredity: Inheritance and variation of traits
- Biological evolution: Unity and diversity
- Earth's place in the universe
- Earth's systems
- Earth and humanity
- Engineering design

Gather (Obtain)

- Obtain Information
- Ask Questions/Define Problems
- Plan & Carry Out Investigations
- Use Mathematics & Computational Thinking
- *Use Models to Organize Data and/or Information*

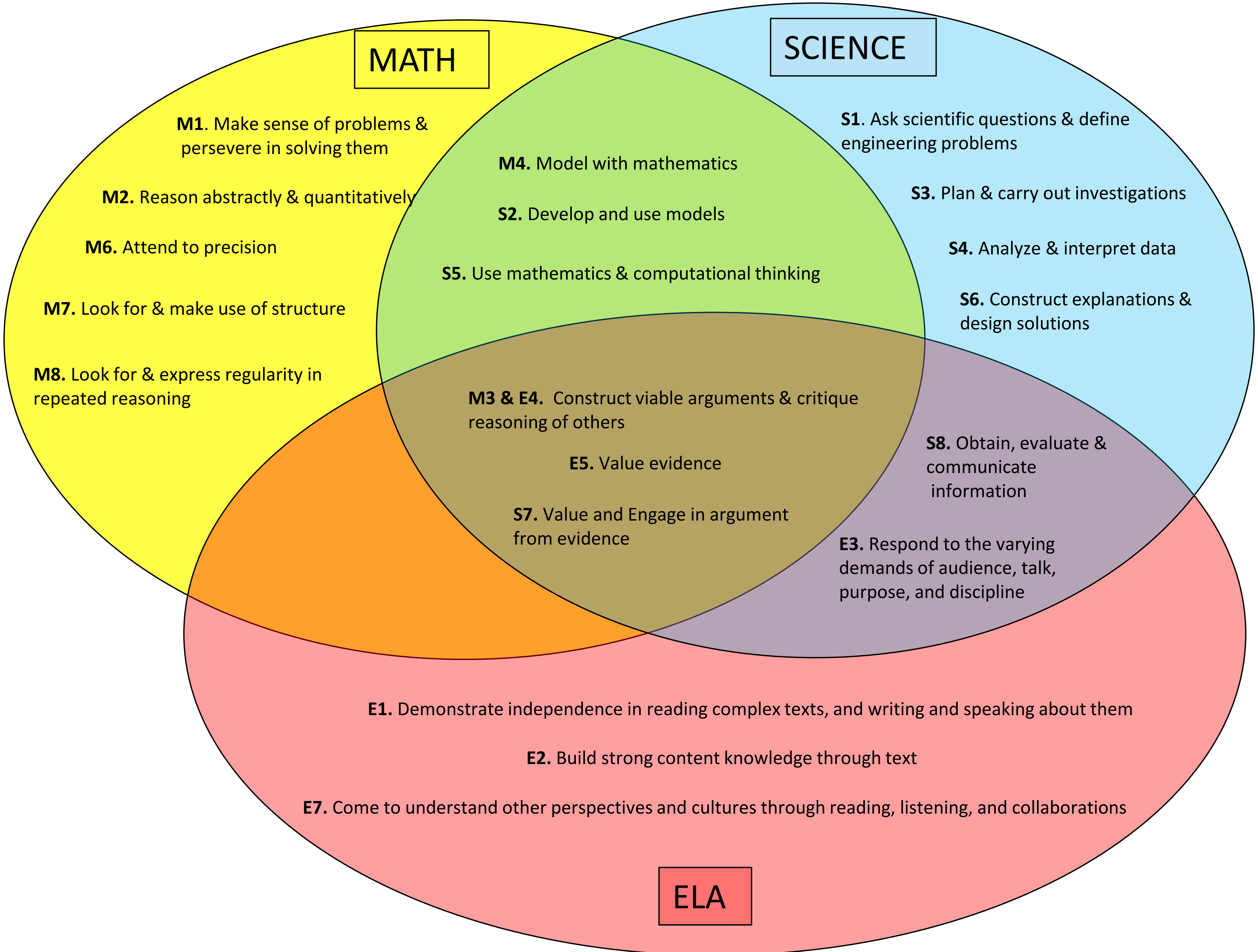
Reason (Evaluate)

- Evaluate Information
- Analyze Data
- Use Mathematics and Computational Thinking
- Construct Explanations/Solve Problems
- Develop Arguments for How or Why the Evidence Supports an Explanation or Claim
- *Use Models to Predict & Develop Evidence*

Communicate

- Communicate Information
- Communicate Arguments for How or Why the Evidence Supports an Explanation
- *Use Models to Communicate Reasoning*

(Moulding, 2012)


MATH
SCIENCE
ELA
M1. Make sense of problems & persevere in solving them
M2. Reason abstractly & quantitatively
M6. Attend to precision
M7. Look for & make use of structure
M8. Look for & express regularity in repeated reasoning
M4. Model with mathematics
S2. Develop and use models
S5. Use mathematics & computational thinking
S1. Ask scientific questions & define engineering problems
S3. Plan & carry out investigations
S4. Analyze & interpret data
S6. Construct explanations & design solutions
M3 & E4. Construct viable arguments & critique reasoning of others
E5. Value evidence
S7. Value and Engage in argument from evidence
S8. Obtain, evaluate & communicate information
E3. Respond to the varying demands of audience, talk, purpose, and discipline
E1. Demonstrate independence in reading complex texts, and writing and speaking about them
E2. Build strong content knowledge through text
E7. Come to understand other perspectives and cultures through reading, listening, and collaborations

Phenomena

Science phenomena are observable events that occur in the universe unusual or not.

Students Science Performances are anchor in phenomena that are meaningful to them.

Anchor Phenomena

- builds upon everyday or family experiences.
- require students to develop understanding of and apply multiple science practices, crosscutting concepts, and core ideas.
- is complex enough for students so solutions or explanations are not possible after only one lesson.
- it is “observable” to students. The observation can be aided by scientific procedures or technological devices to see things at very large and very small scales.
- can be a case, something that is puzzling, or a wonderment.
- has relevant data, images, and text to engage students in the range of ideas students need to understand.
- it has an audience or stakeholder community that cares about the findings or products.

The Work

SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system.

d. Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.

Learning Target	Success Criteria
I can analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.	Students will • Explanation of how temperature changes/ does not change along a heating/cooling curve. • Ability to properly identify phases of matter in a heating curve including phase change points.

The Work

SPS7. Obtain, evaluate, and communicate information to explain transformations and flow of energy within a system.

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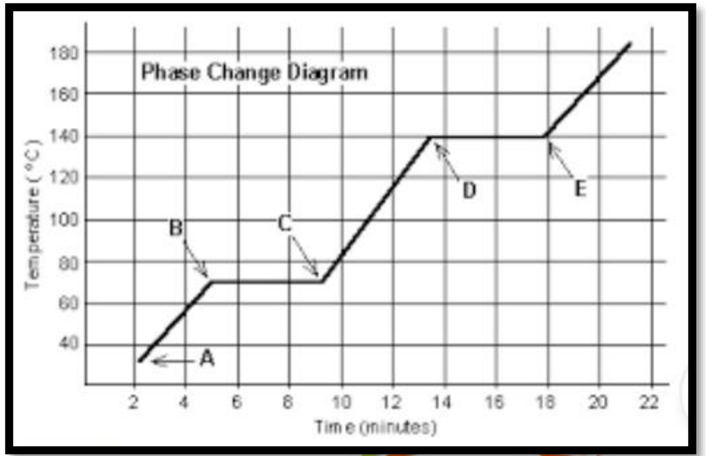
Assessment Sample Items	
Data is plotted on a graph and presented in a student's lab report. According to the data, what happens to the heat energy during a phase change?	
a. As a substance changes phase heat energy leaves the substance at a constant rate. b. As a substance changes phase heat energy remains the same. c. As a substance changes phase heat energy enters the substance at a constant rate. d. As a substance changes phase heat energy enters and leaves the substance at different points.	

The Work

Engage	OBTAIN
	Phenomenon: Show video on Lava melting different items. Discuss Lava in water. ***Lava vs Monster Energy Can*** Lava vs Ocean Water ***Class Discussion on Phenomenon*** *Questions to initiate Discussion:* *Q: What does not melt in Lava?* *Q: What energy is in the system?* *Q: What is the cause and effect creating change in the system?* *Q: What evidence can support the claim that lava melts the can?* *(Teaching suggestion: Show the video from above)*

The Work

Explore	***OBTAIN*** ***Class Discussion for molecular motion.*** *Questions to initiate Discussion:* • *How does energy transfer in a system? (How does Lava melt can?)* • *What patterns are exhibited in the transfer of heat in a variety of systems? (lava, can, water, air?)* 1. Students **use models** to represent molecular motion and its relationship to thermal energy. (Teacher provides supplies and guidelines for models. Use video, animations, or physical actions to model) Students present models to class and teacher. 2. Students **plan and carry out investigations** on conduction, convection, and radiation. (Heat station lab)(This lab provides examples for each type or heat transfer and students collect qualitative data on the rate of heat transfer and temperature change.

The Work

Explain	EVALUATE
Explain	***EVALUATE*** ***Class Discussion for Specific Heat and Energy Phase Change*** • *What types of material melt faster in the lava?* • *What patterns can be found in the specific heat data table?* • *What claim can be made about insulators and conductors specific heats?* • *What relationship can be found between energy and phase change for a system?* • *Where does the energy go during a phase change?* 1. Students **analyze and interpret data** of materials used for insulators and conductors. (data can be provided in table form or graphical form) 2. Students **collect and analyze data** on temperature change for systems of insulators and conductors. (Students are provided a range of insulators and conductors and measure the change in temperature. Then create a table of specific heats and temperature change to support a claim) 3. Students **analyze and interpret data** for the phase change of a substance. (Boil water and record temperature while creating a graphical model of the evidence. Students use the graphical model to make a claim about the energy during a phase change.)

The Work

Evaluate	***EVALUATE*** 1. Students **compare and contrast** the molecular motion related to the thermal energy transfer in conduction, convection, and radiation. 2. Students **compare and contrast** the specific heats of insulators and conductors. ***COMMUNICATE*** 1. Students **construct an investigation** that provides evidence for conduction, convection, and radiation. 2. Students **construct a claim** about molecular motion based on evidence related to heat transfer in a system. 3. Students **construct a claim** based on the **analysis of data** to determine which material would make a good insulator or conductor of heat. 4. Students **explain** the flow of energy during a phase change based on data provided.

The Work

Formative Assessment for Student Learning		
Elicit Evidence of Learning: I can Analyze and interpret data to explain the flow of energy during phase changes using heating/cooling curves.		
Evidence of Student Proficiency The product will include: 1. Explanation of how temperature changes/ does not change along a heating/cooling curve. 2. Ability to properly identify phases of matter in a heating curve including phase change points.	**Range of Typical Student Responses** This has a series of descriptors of the student responses from best typical responses to the poorest student response. **Full understanding -** *"I know that during a phase change the temperature remains the same because the energy being added to the substance is not causing the particles to move faster but to change phase."* *"I know that once the system has changed phase the energy being added to the system is causing the molecules to*	**Acting on Evidence of Learning** This is a brief description of the instructional actions to take based on the students' performance. Student is engaged in a discussion on experimental design.

The Work

Evidence of Student Proficiency	Range of Typical Student Responses	Acting on Evidence of Learning
	Partial understanding – *"I know that during a phase change the temperature remains the same.."* **Limited understanding -** *"I can identify the areas on a phase change graph that represents the phases of matter. "*	**Extensions of learning for student who displays full understanding** *Elaborate with research on phase change graphs of different material and their specific heats. Student can show that specific heats would change how much energy would have to be added to change the phase, but the same pattern for phase change and energy would be true. (Same graph with different slopes)* **Action for student who displays partial or limited understanding** *The student collects data on a substance undergoing a phase change using web video to show how temperature is affected during a phase change.*

End of Course Assessment

2018

% Beginning Learner	% Developing Learner	% Proficient Learner	% Distinguished Learner	% Developing Learner & Above	% Proficient Learner & Above
45.5	30.6	23.9	0.0	54.5	23.9

2019

% Beginning Learner	% Developing Learner	% Proficient Learner	% Distinguished Learner	% Developing Learner & Above	% Proficient Learner & Above
12.7	29.1	54.5	3.6	87.3	58.2
48.7	37.8	12.6	0.8	51.3	13.4
37.4	35.1	25.9	1.7		

End of Course Assessment

2018

Chemistry: Atomic and Nuclear Theory and the Periodic Table			Chemistry: Chemical Reactions and Properties of Matter			Physics: Energy, Force, and Motion			Physics: Waves, Electricity, and Magnetism		
% Remediate Learning	% Monitor Learning	% Accelerate Learning	% Remediate Learning	% Monitor Learning	% Accelerate Learning	% Remediate Learning	% Monitor Learning	% Accelerate Learning	% Remediate Learning	% Monitor Learning	% Accelerate Learning
73.1	22.4	4.5	67.2	29.9	3.0	73.1	20.1	6.7	71.6	20.1	8.2

2019

Chemistry: Atomic and Nuclear Theory and the Periodic Table			Chemistry: Chemical Reactions and Properties of Matter			Physics: Energy, Force, and Motion			Physics: Waves, Electricity, and Magnetism		
% Remediate Learning	% Monitor Learning	% Accelerate Learning	% Remediate Learning	% Monitor Learning	% Accelerate Learning	% Remediate Learning	% Monitor Learning	% Accelerate Learning	% Remediate Learning	% Monitor Learning	% Accelerate Learning
65.5	30.9	3.6	32.7	58.2	9.1	27.3	50.9	21.8	36.4	27.3	36.4
74.8	20.2	5.0	75.6	22.7	1.7	68.1	23.5	8.4	75.6	18.5	5.9
71.8	23.6	4.6	62.1	33.9	4.0	55.2	32.2	12.6	63.2	21.3	15.5

Survey Link

https://www.surveymonkey.com/r/3WVZ6RW