DCI, CCC, and SEPs Oh My!
Sweet and Salty Investigations
a 3-D Twist!

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What is the **5E** Model of Instruction?

1. Engage
2. Explore
3. Explain
4. Extend
5. Evaluate
**HS-PS1-3**

Students who demonstrate understanding can:

**HS-PS1-3.** Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles. [Clarification Statement: Emphasis is on understanding the strengths of forces between particles, not on naming specific intermolecular forces (such as dipole-dipole). Examples of particles could include ions, atoms, molecules, and networked materials (such as graphite). Examples of bulk properties of substances could include the melting point and boiling point, vapor pressure, and surface tension.] [Assessment Boundary: Assessment does not include Raoult’s law calculations of vapor pressure.]

The performance expectation above was developed using the following elements from *A Framework for K-12 Science Education*:

**Science and Engineering Practices**

Planning and Carrying Out Investigations

Planning and carrying out investigations in 9-12 builds on K-8 experiences and progresses to include investigations that provide evidence for and test conceptual, mathematical, physical, and empirical models.

- Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence, and in the design: decide on types, how much, and accuracy of data needed to produce reliable measurements and consider limitations on the precision of the data (e.g., number of trials, cost, risk, time), and refine the design accordingly.

**Disciplinary Core Ideas**


- The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms.

**Crosscutting Concepts**

Patterns

- Different patterns may be observed at each of the scales at which a system is studied and can provide evidence for causality in explanations of phenomena.
YOUR TASK

- Investigate why salt is added to ice when making homemade ice cream

AND

- why salt is added to icy roads.
YOUR MATERIALS

Thermometer or TI Nspire CX handheld/Vernier Temperature Sensor

Cups
Ice
Water
Salt
Sugar
Spoons
Sample Data
<table>
<thead>
<tr>
<th><strong>Gathering</strong></th>
<th><strong>Reasoning</strong></th>
<th><strong>Communicating</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Obtain Information</td>
<td>Evaluate Information</td>
<td>Communicate Information</td>
</tr>
<tr>
<td>Ask Questions/Define Problems</td>
<td>Analyze Data</td>
<td>Argue from Evidence (written &amp; oral)</td>
</tr>
<tr>
<td>Plan &amp; Carry Out Investigations</td>
<td>Use Mathematics/Computational Thinking</td>
<td>Use Models to Communicate</td>
</tr>
<tr>
<td>Use Models to Gather Data and Information</td>
<td>Use Mathematics/Computational Thinking</td>
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<tr>
<td>Use Mathematics/Computational Thinking</td>
<td>Use Models to Predict &amp; Develop Evidence</td>
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<tr>
<td></td>
<td>Construct Explanations/Solve Problems</td>
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<tr>
<td></td>
<td>Developing Arguments from Evidence</td>
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<tr>
<td></td>
<td>Use Models to Predict &amp; Develop Evidence</td>
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</tbody>
</table>
Molecular Level/Particle Pictures
“what students do”

“what students know”

“how students think”

Quoted text from Peter A’Hearn
SEP – Science and Engineering Practices - what the students will do to meet the standard.

DCI – Disciplinary Core Ideas - what concepts must be covered in order for the student to meet the standard.

CCC – Crossing Cutting Concepts - what concepts or themes are covered in this standard that are common in other content areas.
SCIENCE AND ENGINEERING PRACTICES

1. ASKING QUESTIONS – ASKING QUESTIONS AND DEFINING PROBLEMS IN 9–12 BUILDS ON K–8 EXPERIENCES AND PROGRESSES TO FORMULATING, REFINING, AND EVALUATING EMPIRICALLY TESTABLE QUESTIONS AND DESIGN PROBLEMS USING MODELS AND SIMULATIONS.

2. DEVELOPING AND USING MODELS – MODELING IN 9–12 BUILDS ON K–8 EXPERIENCES AND PROGRESSES TO USING, SYNTHESIZING, AND DEVELOPING MODELS TO PREDICT AND SHOW RELATIONSHIPS AMONG VARIABLES BETWEEN SYSTEMS AND THEIR COMPONENTS IN THE NATURAL AND DESIGNED WORLDS.

3. PLANNING AND CARRYING OUT INVESTIGATIONS – PLANNING AND CARRYING OUT INVESTIGATIONS IN 9-12 BUILDS ON K-8 EXPERIENCES AND PROGRESSES TO INCLUDE INVESTIGATIONS THAT PROVIDE EVIDENCE FOR AND TEST CONCEPTUAL, MATHEMATICAL, PHYSICAL, AND EMPIRICAL MODELS.
4. **ANALYZING AND INTERPRETING DATA** – ANALYZING DATA IN 9–12 BUILDS ON K–8 EXPERIENCES AND PROGRESSES TO INTRODUCING MORE DETAILED STATISTICAL ANALYSIS, THE COMPARISON OF DATA SETS FOR CONSISTENCY, AND THE USE OF MODELS TO GENERATE AND ANALYZE DATA.

5. **USING MATHEMATICAL AND COMPUTATIONAL THINKING** – MATHEMATICAL AND COMPUTATIONAL THINKING IN 9–12 BUILDS ON K–8 EXPERIENCES AND PROGRESSES TO USING ALGEBRAIC THINKING AND ANALYSIS, A RANGE OF LINEAR AND NONLINEAR FUNCTIONS INCLUDING TRIGONOMETRIC FUNCTIONS, EXPONENTS AND LOGARITHMS, AND COMPUTATIONAL TOOLS FOR STATISTICAL ANALYSIS TO ANALYZE, REPRESENT, AND MODEL DATA. SIMPLE COMPUTATIONAL SIMULATIONS ARE CREATED AND USED BASED ON MATHEMATICAL MODELS OF BASIC ASSUMPTIONS.
6. CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS – CONSTRUCTING EXPLANATIONS AND DESIGNING SOLUTIONS IN 9–12 BUILDS ON K–8 EXPERIENCES AND PROGRESSES TO EXPLANATIONS AND DESIGNS THAT ARE SUPPORTED BY MULTIPLE AND INDEPENDENT STUDENT-GENERATED SOURCES OF EVIDENCE CONSISTENT WITH SCIENTIFIC IDEAS, PRINCIPLES, AND THEORIES.

7. ENGAGING IN ARGUMENT FROM EVIDENCE – ENGAGING IN ARGUMENT FROM EVIDENCE IN 9–12 BUILDS ON K–8 EXPERIENCES AND PROGRESSES TO USING APPROPRIATE AND SUFFICIENT EVIDENCE AND SCIENTIFIC REASONING TO DEFEND AND CRITIQUE CLAIMS AND EXPLANATIONS ABOUT THE NATURAL AND DESIGNED WORLD(S). ARGUMENTS MAY ALSO COME FROM CURRENT SCIENTIFIC OR HISTORICAL EPISODES IN SCIENCE.

8. OBTAINING, EVALUATING, AND COMMUNICATING INFORMATION – OBTAINING, EVALUATING, AND COMMUNICATING INFORMATION IN 9–12 BUILDS ON K–8 EXPERIENCES AND PROGRESSES TO EVALUATING THE VALIDITY AND RELIABILITY OF THE CLAIMS, METHODS, AND DESIGNS.
<table>
<thead>
<tr>
<th>Life Science</th>
<th>Earth &amp; Space Science</th>
<th>Physical Science</th>
<th>Engineering &amp; Technology</th>
</tr>
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<tbody>
<tr>
<td>LS1: From Molecules to Organisms: Structures and Processes</td>
<td>ESS1: Earth’s Place in the Universe</td>
<td>PS1: Matter and Its Interactions</td>
<td>ETS1: Engineering Design</td>
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*Note: In NGSS, the core ideas for Engineering, Technology, and the Application of Science are integrated with the Life Science, Earth & Space Science, and Physical Science core ideas.*
CROSS CUTTING CONCEPTS

1. **PATTERNS** – Observed patterns in nature guide organization and classification and prompt questions about relationships and causes underlying them.

2. **CAUSE AND EFFECT** – Events have causes, sometimes simple, sometimes multifaceted. Deciphering causal relationships, and the mechanisms by which they are mediated, is a major activity of science and engineering.

3. **SCALE, PROPORTION AND QUANTITY** – In considering phenomena, it is critical to recognize what is relevant at different size, time, and energy scales, and to recognize proportional relationships between different quantities as scales change.
4. SYSTEMS AND SYSTEM MODELS – A system is an organized group of related objects or components; models can be used for understanding and predicting the behavior of systems.

5. ENERGY AND MATTER – Tracking energy and matter flows, into, out of, and within systems helps one understand their system’s behavior.

6. STRUCTURE AND FUNCTION – GRADES 9-12: The way an object is shaped or structured determines many of its properties and functions.
Resources

https://nextgenscience.org/
https://nsta.org/AccessStandardsByTopic.aspx

BOOKS:
https://www.nap.edu/catalog/13145/a-framework-for-k-12-science-education-practices-crosscutting-concepts

ARTICLES:
http://digital.nsta.org/publication/?i=2760155/article_id=2282803&view=articleBrowser&ver=html5#