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| **Target Grade***: 9-11* | **Lesson Title:** *Making Ice Cream*  *Adapted from Freezing & Melting of Water from Sciencenspired.com at https://bit.ly/2MLhIZO*  **Developed by: Stacy Thibodeaux** |
| **Topic**:  *States of matter, freezing/melting point of water, colligative properties of matter* |
| **Three Dimensions Color Coding Key**   * Disciplinary Core Ideas – Red Text * Crosscutting Concepts – Green Text * Science & Engineering Practices – Blue Text | |
| **NGSS Performance Expectation**  *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.]*  *Note to Teacher – Students do not need to know about vapor pressure, Raoult’s Law, or molality and molarity. This is a conceptual approach from which students will build upon in their understanding.* | |
| **Lesson Objectives**   * Ss will collect temperature data during the freezing and melting of water. * Ss will analyze graphs to determine the freezing and melting temperatures of water. * Ss will determine the relationship between adding a solute to a solvent and its effect on the freezing point of the solution | |
| **Lesson Body:**  *This lesson is a lab investigation into the freezing and melting points of water/ice and what happens to the freezing point of water when a solute (salt) is added to a solvent (water). See the Ss handout for materials needed.* | |
| **Phenomena**  Adding salt to ice will make it cold enough to make ice cream. *https://www.youtube.com/watch?v=\_Zt1EuIEhvw* | |
| **What Is the Teacher Doing?**  **Gathering:**   * *NOTE: Ts may elect to have Ss actually make ice cream.* * Ts will look for the following evidence when students are asking questions: 1.a; 1.e.; planning and conducting an investigation: 3.a. analyzing data: 4a, 4d, 4e;   **Suggested Questions to Initiate Class Discussion:**  Q: What caused (2c) the ice to change (5c) in temperature so they the ice cream mixture would freeze?  Q: What are the key parts of the system (4b) that you observed in the video?  Q: How do the different components of the system (4b) interact?  Q: What effect would another solute, besides salt, have if it were added to the ice water bath?  **Reasoning:**  Ts will look for the following evidence when students are developing and using models: 2d; constructing an explanation: 6c; argue from evidence: 7c  **Suggested Questions to Initiate Class Discussion:**  Q: What patterns (1a) in the graph are observed as the test tube is in the water bath?  Q: What patterns (1a) are observed in the relationship between the mean (average) temperature and the freezing point?  Q: What patterns (1a) are observed when salt is added to the water bath?  Q: What is going on at the molecular level in the test tube? In the salt-ice bath?  **Communicating:**  Ts will look for the following evidence when students are developing and using models: 2d; constructing an explanation: 6c;  *See the Teacher Questions above* | **What Is the Student Doing?**  **Gathering:**   * *Ss watch video “Homemade Ice Cream in 5 Minutes”* * *Ss ask questions to investigate how salt makes ice “colder”.* * *Ss in groups of 2 or 3 , will conduct an investigation into the freezing and melting point of water and analyze the data from their investigation to observe any patterns (1a) within the data (using DataQuest 18)*   **Reasoning:**   * Ss will collaborate to use data from investigation to develop a model to explain what is happening at the molecular level when salt is added to the ice bath. * Ss, as a class, will argue from evidence derived from their own investigation to critique and question the various student models. * Ss, As a class, will collaborate to construct an explanation from evidence for how salt causes ice to lower its freezing point as a class consensus.   **Communicating:**   * Ss individually develop an explanation from evidence for why the freezing point of water is lowered when salt is added. * Ss use a model to explain the phenomena of freezing point depression. |
| **Assessment of Student Learning**  Students should provide a clear argument for the evidence they have gathered that the freezing point of water is affected by adding salt. Water molecules, without adding salt, will slow in motion due to decrease in temperature allowing intramolecular forces to form hydrogen bonds between the molecules. The Na+ and the Cl- ions of the slat attract the water molecules and prevent the hydrogen bonds from forming at the normal freezing point of water. This concept is essential to explain how road salt works to prevent ice formation or how ocean water does not freeze unless it is substantially colder than pure water’s normal freezing point. | |