**NACA UbD Unit Template**

[**Rob Unit 1 Feedback Form**](https://docs.google.com/forms/d/17qqCLnpNN-N1QI7VOwaw2CFAFyY2u0K9zk4Ju-isGWc/viewform?usp=send_form)

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| Designer: Rob Salazar | Unit #: 1 | Calendar Window: Weeks 3-9: 8/29-10/13 (33 days) |

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| Stage 1 - Desired Results | |
| Unit Big Idea: | |
| Meaning (EQs and EUs) | |
| Unit EQs:   * What can we learn about the unseen properties of materials by studying the properties we can observe? | Unit EUs:   * The properties of natural and designed objects and systems can be inferred from the molecular substructures of its various materials. |
| Outcomes (Knowledge and Skills) | |
| Unity Knowledge Outcomes:  Lesson 1   * Attraction and repulsion between electric charges at the molecular scale explain the structure, properties, and transformations of matter   Lesson 2   * The structure and interactions of matter at the bulk scale are determined by electrical forces within and between molecules..   Lesson 3   * Water’s ability to dissolve and transport materials, and lower the viscosities and melting points of rocks | Unit Skills Outcomes:  Lesson 1  Lesson 2  Lesson 3  Plan and conduct an investigation individually and collaboratively to produce data to serve as the basis for evidence  In the design of investigations:   * decide on types, how much, and accuracy of data needed to produce reliable measurements * consider limitations on the precision of the data (e.g., number of trials, cost, risk, time) * refine the design accordingly |

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| Stage 2 - Assessment Evidence | |
| **Transfer Statement**: I want my students to learn \_\_\_\_\_\_\_\_\_\_ so that in the long-run, on their own, they will be able to \_\_\_\_\_\_\_\_\_\_\_. (A transfer statement is the foundation of your unit summative assessment, described below.)   * I want my students to learn to plan and conduct investigations so that in the long-run, on their own, they will be able to describe a phenomenon, or to test a theory or model for how the world works. | |
| **Summative Assessment Rubric**   |  | | --- | | **Rubric Criteria** | | 1 Identifying the phenomenon to be investigated   * a Students describe\* the phenomenon under investigation, which includes the following ideas:   + the relationship between the measurable properties (solubility) of a substance and the strength of the electrical forces between the particles of the substance.   + a connection between the properties of water and its effects on Earth materials and surface processes. | | 2 Identifying the evidence to answer this question   * a Students develop an investigation plan and describe\* the data that will be collected and the evidence to be derived from the data, including   + bulk properties of a substance (solubility)) that would allow inferences to be made about the strength of electrical forces between particles.   + Properties of water, including:     - c) The polar nature of the water molecule due to its molecular structure.   + iv. Chemical effects of water on Earth materials that can be used to infer the effect of water on Earth’s surface processes. Examples can include:     - a) The solubility of different materials in water, which can be used to infer chemical weathering and recrystallization; * b Students describe\* why the data about bulk properties would provide information about strength of the electrical forces between the particles of the chosen substances, including the following descriptions\*:   + i. The spacing of the particles of the chosen substances can change as a result of the experimental procedure even if the identity of the particles does not change (e.g., when water is boiled the molecules are still present but further apart).   + ii. Thermal (kinetic) energy has an effect on the ability of the electrical attraction between particles to keep the particles close together. Thus, as more energy is added to the system, the forces of attraction between the particles can no longer keep the particles close together.   + iii. The patterns of interactions between particles at the molecular scale are reflected in the patterns of behavior at the macroscopic scale.   + iv. Together, patterns observed at multiple scales can provide evidence of the causal relationships between the strength of the electrical forces between particles and the structure of substances at the bulk scale. * b In their investigation plan, students describe\* how the data collected will be relevant to determining the effect of water on Earth materials and surface processes. | | 3 Planning for the investigation   * a In the investigation plan, students include:   + i. A rationale for the choice of substances to compare and a description\* of the composition of those substances at the atomic molecular scale.   + ii. A description\* of how the data will be collected, the number of trials, and the experimental set up and equipment required. * a In their investigation plan, students include a means to indicate or measure the predicted effect of water on Earth’s materials or surface processes. Examples include:   + v. The role of the polarity of water in facilitating the dissolution of Earth materials; * b Students describe\* how the data will be collected, the number of trials, the experimental set up, and the equipment required. * b In the plan, students state whether the investigation will be conducted individually or collaboratively. | | 4 Collecting the data   * a Students collect and record data — quantitative and/or qualitative — on the bulk properties of substances. * a Students collect and record measurements or indications of the predicted effect of a property of water on Earth’s materials or surface. | | 5 Refining the design   * a Students evaluate their investigation, including evaluation of:   + i. Assessing the accuracy and precision of the data collected, as well as the limitations of the investigation; and   + ii. The ability of the data to provide the evidence required. * b Students evaluate whether the data can be used to infer the effect of water on processes in the natural world. * b If necessary, students refine the plan to produce more accurate, precise, and useful data. | | **Summative Assessment** |
| Unit Assessment Title and Description  Investigation: Mineral Properties: Solubility in Water  Goal: Plan and conduct an investigation  Role: Soil Scientist  Audience: Community farmers  Situation: Local farmers are considering adding mineral supplements to the soil because they are considered that over-watering is washing away the indigenous minerals.  Product, Performance, and Purpose: Mineral solubility report and recommendations on whether mineral supplementation is recommended. |
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| Stage 3 - Plan for Learning | | | |

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|  | ***Lesson Big Idea/Title and Topical EQ*** | Activities to Support the Lesson (feel free to link in electronic resources) | Unit Modifications (aligned to IEPs) | Formative Assessment of the Lesson |
| Lesson 1 | Big Idea/Title: Exploring Materials  EQ: | * Material sort and classification * Presenting the Issue: Mineral Depletion in the Soil OR Soil Contamination | Scaffolded learning of investigation planning skills  Graphic organizer for [investigation pre-plan](https://docs.google.com/a/nacaschool.org/document/d/1wzCssJuhzJparBr7PnGybsuqs3v-_569NoAaQrzdvpM/edit?usp=sharing) and investigation plan | Descriptions of how properties used for classification |
| Lesson 2 | Big Idea/Title: Review  EQ: | * Review: Solids, Liquids, & Gases * Review: Changes in State * Review: Atoms & Molecules * Review: Electrostatic Forces * Review: Water Cycle |  |
| Lesson 3 | Big Idea/Title: Solid Structures  EQ: How to particles interact to form solid structures? | * Crystal Formation Explorations * Crystal Structure Building * Modeling: Crystal Structures * Investigation: Testing Crystal Structure Theories |  |
| Lesson 4 | Big Idea/Title: Water’s Unique Structure  EQ: | * Water Crystal Formation * Water Molecular Structure |  |
| Lesson 5 | Big Idea/Title:  EQ: |  |  |
| Lesson 6 | Big Idea/Title: Mineral Density Investigation  EQ: | * Material Density Exploration * Training: Measuring Volume (lxwxh method) * Training: Measuring Volume (displacement method) * Training: Measuring Mass (digital scale) * Training: Calculating Density |  |
| Lesson 7  10/3-10/7 | Big Idea/Title: Salt Solubility vs. Temperature Investigation  EQ: How does the solubility of salt in water change with temperature? | * Investigation Overview * Training: Solubility Testing (1 day) * Team Pre-Planning (given ) (1 class) * Team Planning (1 class) * Team Experiment (1 class) * Team Analysis Writing (1 class) |  |
| Lesson 8  10/10-10/13  4 days | Big Idea/Title: Mineral Solubility Investigation  EQ: How are mineral solubility in water and molecular structure related? | * Team Pre-Planning (1 class) * Team Planning (1 class) * Team Experiment (1 class) * Team Analysis Writing (1 class) | [Investigation Pre-Plan](https://docs.google.com/a/nacaschool.org/document/d/1wzCssJuhzJparBr7PnGybsuqs3v-_569NoAaQrzdvpM/edit?usp=sharing)  Investigation Plan  Investigation Conduct Notes  Investigation Report |
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| Sorts natural and manufactured materials by weight | Classifies objects as liquids |
| Explains that the amount of water in an open container will decrease because it goes into the air, but the amount of water in a closed container will remain the same  Classifies materials according to their magnetism  Recognizes that physical properties can be measured using tools  Identifies tools used to measure length  Recognizes that temperature is measured in degrees | Gives examples of gases  Classifies objects as liquids  Classifies objects as gases |
| Explains that all matter is made of tiny particles called atoms  Describes the shape of crystals  Generalizes that all physical objects are made of matter  Infers that the more matter in an object, the greater the mass of that object  Classifies materials according to their magnetism  Determines the volume of an object using the displacement method  Recognizes that adding an object to a container of water will raise the water level within the container  Relates density to the ability to sink or float  Infers the mass of objects with identical volume, based on their buoyancy  Describes ways to separate mixtures | Gives examples of solids  Names the three different states of matter  Describes basic properties of solids, liquids, and gases  Classifies objects as solids, liquids, or gases  Describes the process of evaporation  Describes the process of melting  Gives examples of forms of matter which have undergone a change from liquid to solid form |
| Describes applications of differential expansion of metals  Explains that all matter is made of tiny particles called atoms  Defines matter as anything that takes up space and has mass  Recognizes that a magnifier allows one to see details that are not otherwise visible  Compares objects in terms of mass  Determines the volume of an object using the displacement method  Estimates length of common objects using metric units  Compares objects in terms of density  Predicts how changes in temperature will affect the density of an object  Defines density  Recognizes that when one divides mass by volume, one is calculating density  Infers that an object is more dense than an object with the same volume, based on differences in mass (as measured by a double-pan balance)  Defines mixture | Names the three different states of matter  Describes the process of evaporation  Recognizes that evaporation changes a liquid to a gas  Gives examples of evaporation  Relates surface area to evaporation  Describes the process of evaporation in terms of the changes to the molecules involved  Describes the process of freezing  Explains that heating or cooling materials can cause their state to change  Explains that matter can change from one physical state to another  Explains that as heat is applied to a substance, the particles making up the substance increase their motion |
| Explains that all matter is made of tiny particles called atoms  Identifies the tools and units used to measure weight  Recognizes that volume is measured in milliliters or liters  Measures the volume of liquid in a graduated cylinder  Understands that in the SI system, length is measured in meters, kilometers, centimeters  Estimates length of common objects using metric units  Recognizes that base unit for length in the SI system is the meter  Predicts how changes in temperature will affect the density of an object  Predicts how objects of differing density will behave when combined  Explains that objects of differing density will layer when combined  Describes characteristics of physical change  Describes properties of solutions  Describes properties of mixtures  Gives examples of mixtures  Understands that evaporation can be used to separate solutions | Describes properties of gases  Classifies unknown substances as liquids, based on their properties  Recognizes properties of gases  Describes the process of condensation  Describes the process of freezing in terms of phase changes  Explains that removing heat will cause a substance to change from gas to liquid or from liquid to solid form  Gives examples of substances which have undergone a change of state  Describes the relative freedom of motion of particles in solids, liquids, and gases  Explains that as heat is applied to a substance, the particles making up the substance move farther apart  Recognizes that as heat is applied to a solid, its molecules move farther and farther apart  Interprets diagrams showing the relative spacing and movement of matter in different phases  Defines melting point  Defines boiling point |
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| **Standards** | |
| **NGSS - Performance Expectations** | |
| * 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.] * HS-ESS2-5. Plan and conduct an investigation of the properties of water and its effects on Earth materials and surface processes. [Clarification Statement: Emphasis is on mechanical and chemical investigations with water and a variety of solid materials to provide the evidence for connections between the hydrologic cycle and system interactions commonly known as the rock cycle. Examples of mechanical investigations include stream transportation and deposition using a stream table, erosion using variations in soil moisture content, or frost wedging by the expansion of water as it freezes. Examples of chemical investigations include chemical weathering and recrystallization (by testing the solubility of different materials) or melt generation (by examining how water lowers the melting temperature of most solids).] * MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth’s materials.] [Assessment Boundary: Assessment does not include the identification and naming of minerals.] * MS-ESS2-2. Construct an explanation based on evidence for how geoscience processes have changed Earth's surface at varying time and spatial scales. [Clarification Statement: Emphasis is on how processes change Earth’s surface at time and spatial scales that can be large (such as slow plate motions or the uplift of large mountain ranges) or small (such as rapid landslides or microscopic geochemical reactions), and how many geoscience processes (such as earthquakes, volcanoes, and meteor impacts) usually behave gradually but are punctuated by catastrophic events. Examples of geoscience processes include surface weathering and deposition by the movements of water, ice, and wind. Emphasis is on geoscience processes that shape local geographic features, where appropriate.] | |
| **NGSS - 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. (HS-PS1-3), (HS-ESS2-5) | |
| **NGSS - Disciplinary Core Ideas** | |
| **PS1.A: Structure and Properties of Matter**   * The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. (HS-PS1-3),(secondary to HS-PS2-6)   **PS2.B: Types of Interactions**   * Attraction and repulsion between electric charges at the atomic scale explain the structure, properties, and transformations of matter, as well as the contact forces between material objects. (HS-PS2-6),(secondary to HS-PS1-1),(secondary to HS-PS1-3)   **ESS2.C: The Roles of Water in Earth's Surface Processes**   * The abundance of liquid water on Earth’s surface and its unique combination of physical and chemical properties are central to the planet’s dynamics. These properties include water’s exceptional capacity to absorb, store, and release large amounts of energy, transmit sunlight, expand upon freezing, dissolve and transport materials, and lower the viscosities and melting points of rocks. (HS-ESS2-5)   **FOUNDATIONAL**  **PS1.A: Structure and Properties of Matter (HS-PS1-1),(HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-7),(HS-PS2-6),(HS-ESS2-5)**   * Substances are made from different types of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. (MS-PS1-1) * Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-2),(MS-PS1-3) * Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4) * In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4) * Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). (MS-PS1-1) * The changes of state that occur with variations in temperature or pressure can be described and predicted using these models of matter. (MS-PS1-4)   **PS2.B: Types of Interactions (HS-PS1-3),(HS-PS1-4),(HS-PS2-6)**   * Electric and magnetic (electromagnetic) forces can be attractive or repulsive, and their sizes depend on the magnitudes of the charges, currents, or magnetic strengths involved and on the distances between the interacting objects. (MS-PS2-3) * Forces that act at a distance (electric, magnetic, and gravitational) can be explained by fields that extend through space and can be mapped by their effect on a test object (a charged object, or a ball, respectively). (MS-PS2-5)   **ESS2.C: The Roles of Water in Earth's Surface Processes (HS-PS1-2),(HS-PS1-3)**   * Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4) * Water’s movements—both on the land and underground—cause weathering and erosion, which change the land’s surface features and create underground formations. (MS-ESS2-2) | |
| **NGSS - 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. (HS-PS1-1),(HS-PS1-2),(HS-PS1-3)   **Structure and Function**   * The functions and properties of natural and designed objects and systems can be inferred from their overall structure, the way their components are shaped and used, and the molecular substructures of its various materials. (HS-ESS2-5) | |
| **CCSS - ELA/Literacy** | |
| * RST.11-12.1 Cite specific textual evidence to support analysis of science and technical texts, attending to important distinctions the author makes and to any gaps or inconsistencies in the account. (HS-PS1-3),(HS-PS2-1),(HS-PS2-6),(HS-ESS3-2),(HS-ESS3-4), * WHST.9-12.7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation. (HS-PS1-3), (HS-ESS2-5) * WHST.11-12.8 Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation. (HS-PS1-3) * WHST.9-12.9 Draw evidence from informational texts to support analysis, reflection, and research. (HS-PS1-3) | |
| **CCSS - Mathematics** | |
| * HSN-Q.A.1 Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays. (HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-7),(HS-PS2-6),(HS-ESS3-4) * HSN-Q.A.3 Choose a level of accuracy appropriate to limitations on measurement when reporting quantities. (HS-PS1-2),(HS-PS1-3),(HS-PS1-4),(HS-PS1-7),(HS-PS2-6),(HS-ESS2-5),(HS-ESS3-4) | |
| **Indigenous Standards** | |
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