MIDDLE SCHOOL PHYSICAL SCIENCE: ATOMIC MODELS

Standards Bundle

Standards are listed within the bundle. Bundles are created with potential instructional use in mind, based upon potential for related phenomena that can be used throughout a unit.

MS-PS1-1 Develop models to describe the atomic composition of simple molecules and extended structures. (SEP:2 ; DCI: PS1.A; CCC: Scale/Prop.) [Clarification Statement: Emphasis is on developing models of molecules that vary in complexity. Examples of simple molecules could include ammonia and methanol. Examples of extended structures could include sodium chloride or diamonds. Examples of molecular-level models could include drawings, 3D ball and stick structures, or computer representations showing different molecules with different types of atoms.] *[Assessment Boundary: Assessment does not include valence electrons and bonding energy, discussing the ionic nature of subunits of complex structures, or a complete description of all individual atoms in a complex molecule or extended structure is not required.]*

MS-PS1-3 Obtain and evaluate information to describe that synthetic materials come from natural resources and impact society. (SEP: 8; DCI: PS1.A, PS1.B; CCC: Structure/Function, Technology.) [Clarification Statement: Emphasis is on natural resources that undergo a chemical process to form the synthetic material. Examples of new materials could include new medicine, foods, and alternative fuels.] *[Assessment Boundary: Assessment is limited to qualitative information.]*

Content Overview

This section provides a generic overview of the expectations of the standards above.

All substances are made up of atoms, which combine with one another in various ways. Atoms form molecules that range in size from two to thousands of atoms. Each form of molecules has its own chemical and physical characteristics. Pure substances are made from a single type of atom or molecule; each pure substance has characteristic physical and chemical properties that can be used to identify it.

Substances made of atoms can be broken down and cycled into other uses both by nature (natural resources) and by man (synthetic materials). All of the elements found on Earth and throughout the universe (other than hydrogen and most of helium) were formed in the stars or supernovas by fusion processes. How these atoms are used, both as natural resources or as synthetic materials, can have a direct impact on many biological and geophysical phenomena.

Phenomena

Phenomena can be used at varying levels of instruction. One could be used to anchor an entire unit, while another might be more supplemental for anchoring just a unit. Please remember that phenomena should allow students to engage in the SEP and use the CCC/DCI to understand and explain the phenomenon.

- This cookie package said it expired three weeks ago, but the cookies looks the same as when I bought it.

- When I measure the volume of water and the volume of my kool-aid, the total volume of the two separate is not equal to the total volume when they are mixed.
- When I make slime, when I vary the quantity or the order of the ingredients, the substance behaves differently.
- When I measure with a graduated cylinder, the water clings to the side of the glass.
- When I make salad dressing, the oil and the vinegar separate.
- My polar fleece jacket is made from petroleum.

Storyline

This section aims to decode not only the DCI connections, but also the SEP and CCC in a detailed account of how they possibly fit together in a progression for student learning, including both rationale and context for the bundle.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Developing and Using Models ● Develop a model to predict and/or describe phenomena. **Obtaining, Evaluating, and Communicating Information** ● Gather, read, and synthesize information from multiple appropriate sources and assess the credibility, accuracy, and possible bias of each publication and methods used, and describe how they are supported or now supported by evidence.	**PS1.A: Structure and Properties of Matter** ● 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. ● Solids may be formed from molecules, or they may be extended structures with repeating subunits (e.g., crystals). ● Each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. **PS1.B: Chemical Reactions** ● Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants.	**Scale, Proportion, and Quantity** ● Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. **Structure and Function** ● Structures can be designed to serve particular functions by taking into account properties of different materials, and how materials can be shaped and used.

Students will develop models to identify individual atoms, molecules, extended structures, repeating subunits, and solids, liquids and gases. Models, such as ball and stick structures, drawings, and computer-based models, are helpful scientific tools used to study atoms, molecules, and their properties. Models can describe the relationships between individual atoms, and how they combine to form molecules. Students will also recognize that some molecules can connect to each other while others can not, and that within some molecules, some elements arrange themselves in repeating patterns (crystals), while others do not.

Students will use models to describe the characteristics of a pure substance, such as how atoms form extended structures, and that some atoms are attracted to each other, while others are not. Students will also use their model to describe how the behavior of substances is dependent on their structure.

Students will obtain information from two credible sources about the need for synthetic material, the process through which synthetic material is made, and which natural resources synthetic materials come from. Using these sources, students should determine and explain the process of synthetic materials being created from natural resources, and the effects their production and use have on society. The process of creating synthetic materials changes the physical and chemical properties of the natural resource making it better suited for certain needs. Students will present this information in modes (graphs, diagrams, photographs, text, mathematical formulas, verbal) and determine the bias, accuracy and credibility of each source used.

Formative Assessment

Formative assessment is crucial because all learners benefit from timely and focused feedback from others. It promotes self-reflection, self-explanation, and social learning. It can also make learning more relevant. Each of the questions below might be used throughout the formative assessment process. Specific prompts may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given bundle, standard or lesson-level performance expectation.

SEP Developing and Using Models

- Develop several models of salt (NaCl) and put them together to create a larger molecule, noticing the repeating pattern of the crystalline structure.

SEP Obtaining, Evaluating, and Communicating Information

- Select a synthetic item in your life. Using credible and accurate sources, trace your item back to its natural origins. Describe how sources are credible and supported by evidence.

CCC Scale, Proportion, and Quantity

- Using a model of an atom or a molecule, explain the accuracy and the limitations of the model.
- What scale of a model would allow you to gain insight into atomic or molecular structure?

CCC Structure and Function

- Imagine a day in your life without plastic. How would it be the same? How would it be different?

Performance Outcomes

These are statements of how students use knowledge and are similar to the standards in how they blend DCI, SEP, and CCC, but at a smaller grain-size. These are potential outcomes for instruction as it plays out in lessons and activities in the classroom. It is important to also think of these as smaller outcomes that build toward the larger goal of mastering the standards.

- **Develop models *to scale*** of individual atoms, molecules, extended structures with repeating subunits, and substances as solids, liquids, and gases.
- **Use models to describe** the relationships between atoms, molecules, and to ***recognize patterns in the structure*** of molecules.
- **Use models to demonstrate** the ***structure*** of of pure substances and how that ***structure*** influences the behavior of the substance.
- **Obtain information t**o identify differences in the ***structure and function*** of synthetic materials and natural resources.
- **Evaluate information** from different sources to determine the ***effect*** of the use of synthetic materials on natural resources and society.