

Unit 3: Structure of Matter Determines Function

Standard(s):

8.1.1 Develop a model to describe the scale and proportion of atoms and molecules. Emphasize developing atomic models of elements and their numbers of protons, neutrons, and electrons, as well as models of simple molecules. Topics like valence electrons, bond energy, ionic complexes, ions, and isotopes will be introduced at the high school level. (PS1.A)

8.1.2 Obtain information about various properties of matter, evaluate how different materials' properties allow them to be used for particular functions in society, and communicate your findings. Emphasize general properties of matter. Examples could include color, density, flammability, hardness, malleability, odor, ability to rust, solubility, state, or the ability to react with water. (PS1.A)

8.1.4 Obtain and evaluate information to describe how synthetic materials come from natural resources, what their functions are, and how society uses these new materials. Examples of synthetic materials could include medicine, foods, building materials, plastics, or alternative fuels. (PS1.A, PS1.B, ESS3.A)

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Obtaining, Evaluating, and Communicating Information Students obtain, evaluate, and derive meaning from scientific information or presented evidence using appropriate scientific language. They communicate their findings clearly and persuasively in a variety of ways including written text, graphs, diagrams, charts, tables, or orally.	PS1.A Structure and Properties of Matter PS1.B Chemical Reactions ESS3.A Natural Resources	Structure and Function Students relate the shape and structure of an object or living thing to its properties and functions.
Overarching Concepts from Framework: - While too small to be seen with visible light, atoms have substructures of their own. They have a small central region or nucleus—containing protons and neutrons—surrounded by a larger region containing electrons. - Each element has characteristic chemical properties. - The varied properties (e.g., hardness, conductivity) of the materials one encounters, both natural and manufactured, can be understood in terms of the atomic and molecular constituents present and the forces within and between them. - Materials can be characterized by their intensive measurable properties. Different materials with different properties are suited to different uses. - Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources, including air, water, soil, minerals, metals, energy, plants, and animals.		
Preceding Grade Bands:	Target Grade Bands:	Following Grade Bands:

● Matter can be described and classified by its observable properties (e.g., visual, aural, textural), by its uses, and by whether it occurs naturally or is manufactured. Different properties are suited to different purposes. ● Measurements of a variety of properties (e.g., hardness, reflectivity) can be used to identify particular materials. ● All materials, energy, and fuels that humans use are derived from natural sources, and their use affects the environment in multiple ways. Some resources are renewable over time, and others are not.	● Pure substances are made from a single type of atom or molecule; each pure substance has characteristic physical and chemical properties (for any bulk quantity under given conditions) that can be used to identify it. ● Atoms form molecules that range in size from two to thousands of atoms. ● Humans depend on Earth's land, ocean, atmosphere, and biosphere for many different resources. Minerals, fresh water, and biosphere resources are limited, and many are not renewable or replaceable over human lifetimes.	● Each atom has a charged substructure consisting of a nucleus, which is made of protons and neutrons, surrounded by electrons. ● The structure and interactions of matter at the bulk scale are determined by electrical forces within and between atoms. ● Resource availability has guided the development of human society. All forms of energy production and other resource extraction have associated economic, social, environmental, and geopolitical costs and risks, as well as benefits. New technologies and regulations can change the balance of these factors.
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Proficiency Scale:

4 Advanced	3 Proficient	2 Approaching Proficiency	1 Beginning Proficiency
I can: Obtain information from a variety of reliable scientific sources about the types of natural resources humans use, their properties, how the <u>structure</u> of these atoms and/or molecules determine their properties (<u>function</u>), how they are used to make synthetic materials, and what the natural and/or synthetic materials are used for. AND Describe how harvesting and using natural resources impacts society and/or the environment.	I can: Obtain information from a variety of reliable scientific sources about the types of natural resources humans use, their properties, how the <u>structure</u> of these atoms and/or molecules determine their properties (<u>function</u>), how they are used to make synthetic materials, and what the natural and/or synthetic materials are used for.	I can: Obtain information about the types of natural resources humans use, their properties, how the <u>structure</u> of these atoms and/or molecules determine their properties (<u>function</u>), how they are used to make synthetic materials, and what the natural and/or synthetic materials are used for.	I can: Obtain information about the types of substances (atoms and molecules) humans use.

Anchoring Phenomenon:

[Making Casein](#)

Essential Question:

How do humans depend on Earth's resources?

Learning Goals:

Students will be able to. . .

- 3A: Develop a model that describes the structure of atoms and molecules by comparing the scale and proportion of their parts.
- 3B: Obtain and evaluate information to explain how the properties of a substance make it valuable to us as humans.
- 3C: Obtain and evaluate information to describe how synthetic materials come from natural resources, and how society uses these materials.

	Learning Opportunities	Formative Assessments
Engage	Making Casein Casein is a synthetic plastic made from the natural substance milk. Casein was widely used in the early 20th century to make items such as buttons, knife handles and fountain pens. The students will follow a recipe to make casein. They will make observations about what they observed, create an explanation for why the casein formed and ask questions about what happened.	Unit 3 Notebook - This document contains all of the activities described below for this unit.
Learning Goal 3A: Develop a model that describes the structure of atoms and molecules by comparing the scale and proportion of their parts.		
Engage	Activity 1 - What's in the Balloon? The students compare two balloons, one that floats to the ceiling when released and one that sinks to the floor.	Students record observations, explanations and questions in their digital notebook.
Explore	Activity 2 - How small can you go? Students generate a definition of what an atom is by attempting to cut a piece of paper into the smallest piece possible, asking how small it can be cut before it is no longer paper. Students also begin creating a drawn model of an atom and learn about the parts of an atom. Activity 3 - Scotch Tape Experiment	Learning Ticket 3A.1 - Parts of an atom Learning Ticket 3A.2 - Scale of atoms Develop a model of an atom

	Students participate in an experiment in which they use clear tape to discover charges of atomic particles. Activity 4 - Scale and Size of Atoms Students make predictions about how big an atom really is and about the size of the atomic particles compared to the size of the whole atom. They watch a TedEd Atoms video to establish if their predictions are correct.	
Explain	Activity 5 - Atoms in a Dish After learning about elements and the Periodic Table, students use items such as beads to create a physical model of a specific element. Once their model has been checked off by the teacher they return to their model drawing and revise it, this time including the 3 atomic particles, their position in the atom, their relative sizes and their correct numbers based on the element they are modeling.	• Students create a physical model of an atom. • Students revise their drawn model of an atom.
Explore	Activity 6 - Atoms vs. Molecules Students generate a definition of a molecule. They use the Atoms/Elements/Molecules cards to practice determining the difference between atoms, elemental molecules and compound molecules and the different ways they might be represented. Activity 7 - Molecular Equations Students explore how to create a molecular formula based on the types and numbers of elements in a molecule. They use model kits to practice building molecules and writing their molecular formula.	Learning Ticket 3A.3 - Molecules Learning Ticket 3A.4 - Molecular Formulas

Explain	Activity 8 - Molecular Models Students demonstrate their knowledge of molecular formulas by using model kits to build a molecule when given its molecular formula. Balloon Phenomenon: Students generate an explanation for the What's in the Balloon Phenomenon based on what they have learned about Atoms and Molecules. Casein Phenomenon: Students return to the Casein Phenomenon and reflect on how their knowledge of atoms and molecules adds to their understanding of the phenomenon.	• Learning Goal 3A Levels 1 and 2 Atoms and Molecules - Google Doc • Learning Goal 3A Level 3 Atoms and Molecules - Google Doc • Learning Goal 3A Level 4 Atoms and Molecules - Google Doc
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	Learning Opportunities	Formative Assessments
Learning Goal 3B: Obtain and evaluate information to explain how the properties of a substance make it valuable to us as humans.		
Engage	Activity 1: Money to Burn Students experience a phenomenon in which a dollar bill is lit on fire but does not burn. They make observations about what occurred, come up with a possible explanation and record questions they still have about what is going on.	Unit 3 Notebook - This document contains all of the activities described below for this unit.
Explore	Activity 2 - Is it Water? In this lab students are given 4 clear liquids. The class defines what is meant by 'properties of matter' and they perform tests on the four liquids	Learning Ticket 3B.1 - Review of Chemical Formulas

	to identify some of their properties. They make a conclusion about what the four liquids may be based on the properties they have. <u>Activity 3</u> - The Dangers of Dihydrogen Monoxide The students obtain information about the properties and uses of the chemical Dihydrogen Monoxide. The class discusses the properties, uses and dangers of the chemical and then each student makes a decision about whether the substance should be banned. After the students learn that dihydrogen monoxide is actually water the class discusses what bias is and that they should be aware of the bias of information found on the internet and other sources. <u>Activity 4</u> - Properties of Molecules This activity is a follow up to the previous activity about dihydrogen monoxide. Students use the internet to obtain information about the properties of elemental oxygen, hydrogen, and the compounds water and hydrogen peroxide. Students observe that creating bonds between the different elements changes the properties of the substance.	Learning Ticket 3B.2 - Properties and Uses
Explain	<u>Activity 5</u> - Mystery Liquid Research The students research the properties of one of the liquids from Activity 2 to determine if their conclusion about the identity of the substance is correct. The students learn from the teacher if their conclusion was correct. <u>Explaining the Money to Burn Phenomenon</u> - Students revisit the Money to Burn phenomenon and use what they have learned in the learning goal this far to explain the phenomenon.	• Learning Goal 3B Levels 1 and 2 Properties of Matter - Google Doc • Learning Goal 3B Level 3 Properties of Matter - Google Doc • Learning Goal 3B Level 4 Properties of Matter - Google Doc

	<u>Activity 6</u> - Properties and Uses Students explore the properties of simple objects made from one material (rubber bands, wood popsicle sticks, silverware) and make connections between the properties of the substance and the uses we make of the substance based on the properties it has. The students identify the uses of one of the liquids from Activity 2 and discuss why we use the substance for that purpose, based on the properties of the substance. <u>Revisiting the Casein Phenomenon</u> - Students use what they have learned in the learning goal to revisit the Casein phenomenon, identifying what questions we have answered and what questions we still have.	
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Learning Goal 3C: Obtain and evaluate information to describe how synthetic materials come from natural resources, and how society uses these materials.

Explore	Activity 1 - Natural or Synthetic? The student groups are provided with a box containing 10 different simple items made from one material. They sort them into categories based on properties they have in common. After defining Natural and Synthetic materials students recategorize their items according to the definitions. Activity 2 - Where do Synthetic Materials Come From? In this activity the students explore the idea that synthetic materials are made using natural materials. They are given a list of items that we use everyday and are asked to identify which items were created using petroleum. They watch a video clip about where plastic comes from and identify that it is a synthetic material made from the natural material oil.	Unit 3 Notebook - This document contains all of the activities described below for this unit.
Explain	Revisit the Casein Phenomenon - Students use what they have learned in the learning goal to revisit the Casein phenomenon, identifying what questions we have answered and what questions we still have.	In their notebooks students explain that synthetic materials are made from natural materials. • Learning Goal 3C Levels 1 and 2 Natural and Synthetic - Google Doc • Learning Goal 3C Level 3 Natural and Synthetic - Google Doc • Learning Goal 3C Level 3 Natural and Synthetic (simplified text) - Google Doc

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Elaborate	Activity 3 (Learning Goal 3C Notebook) - Researching Synthetic Materials The students choose an object that is made from three or four substances. They obtain information about what the object is made from and create a mind map illustrating the substances used to make the object, whether they are natural or synthetic, and what natural materials are used to make the synthetic materials. They explain why the properties of the substances make them appropriate to use for the object.	
Evaluate	possible start https://docs.google.com/document/d/1lqw2knVcsYL3Lr4NO7WTAZ2I5QXrPGw0QQINeaKDCE0/template/preview	