Unit 2 : All About Matter

Overview

Welcome to Unit 2: All About Matter!

In this unit, students will learn to represent matter via particles. They will be introduced to elements and compounds and explore pure substances and mixtures. Additionally, they will learn about substances' physical properties and how to use these properties to separate them from one another. And, finally, they will learn about chemical properties and chemical changes as the foundation of chemical reactions. The All About Matter unit consists of the following lessons:

- Lesson 2.1 - What is Matter?
- Lesson 2.2a - Pure Substances
- Lesson 2.2b - Mixtures vs. Pure Substances
- Lesson 2.3 - Physical and Chemical Properties
- Lesson 2.4 - Separating Mixtures
- Lesson 2.5 - Physical and Chemical Changes

This teacher's guide will provide an overview of each lesson and additional resources that can be used to enhance the lessons.

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How to use Viziscience

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*Teachers can use the lessons **in class or as homework.***

- *For lessons and reflective questions, students work individually on the platform*
- *For assignments, teachers can choose to have students work on the activities in class individually or as teams, but students must submit their answers online and teachers will grade the answers manually on the platform*
- *We are not looking for correct answers, but rather to train students how to think and articulate and present their information with clarity*
- *A rubric will be provided as a guide on how to grade the assignments*

*Teachers can also use the lessons to **flip their classroom.***

- *The unit can be assigned as homework prior to teaching the topics*
- *Students will engage with all the activities and must complete all the concept check questions*
- *In class, teachers can hold discussions with their students and go through problems that they struggle with*
- *Teaches can also maximize class time with more example problems to challenge students further*

For students who are not self-starters, the flip classroom model may prove to be challenging so teachers will have to exercise discretion how often to flip their classroom.

The advantage of using the lessons in class:

- *Teachers can give individual attention to students who are struggling while the other students who are more capable can work on their own.*

Students should not have to look elsewhere for answers, as all the answers are either found on the page or they are considered prior knowledge.

- *It does not matter if students do not get answers correct, the idea is to get them actively working and learning from mistakes. This is the best way to learn science.*
- *The activities can be reattempted any number of times.*
- *The activities can also be used for credit recovery.*

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Pacing Guide

Students learn best when they have multiple days to process and apply new concepts, and we recommend spending a minimum of two days per topic. This will allow time for deeper discussions, extending activities and additional practice as you desire. Refer to the lessons in this guide for additional considerations for each lesson.

Approximately: 21 days

Unit	Lesson & Activity	Approx. #days
2.1	**What is Matter** ➢ Lesson Reflection Assignment | Extending States of Matter	3
2.2	**Pure Substances** ➢ Lesson (Part a & b) Reflection Assignment | Classifying Matter Quiz #1	5 - 6
2.3	**Physical & Chemical Properties** ➢ Lesson Reflection Assignment | Identifying Properties	3
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2.5	**Physical & Chemical Changes** Reflection Assignment | Identifying Changes	3
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Standards Alignment

NGSS[1] & Common Core State Standards Connections

ELA/ Literacy

- ***RST.9-10.7*** *Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.*
- ***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.*
- ***WHST.9-12.2*** *Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.*

Mathematics

- ***MP.2*** *Reason abstractly and quantitatively.*

Science and Engineering Practices

- ***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.*
- ***Apply scientific principles and evidence*** *to provide an explanation of phenomena and solve design problems, taking into account possible unanticipated effects.*
- ***Construct and revise an explanation*** *based on valid and reliable evidence obtained from a variety of sources (including students' own investigations, models, theories, simulations, peer review) and the assumption that theories and laws that describe the natural world operate today as they did in the past and will continue to do so in the future.*

[1]The Next Generation Science Standards (NGSS) is a registered trademark of WestEd. Neither WestEd nor the lead states and partners that developed the Next Generation Science Standards were involved in the production of this product, and do not endorse it.

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Crosscutting Concepts

- *The total amount of energy and matter in closed systems is conserved.*
- *Changes of energy and matter in a system can be described in terms of energy and matter flows into, out of, and within that system.*
- *Stability and Change: Much of science deals with constructing explanations of how things change and how they remain stable.*

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Lesson Plans

➢ Lesson 2.1 | What is Matter?

Overview:

The lesson “What is Matter?” gets students thinking about what constitutes matter. The lesson begins with them distinguishing between matter and non-matter, and gets students to represent matter via particle diagrams. Additionally, students learn key properties and diagram representations of the three primary phases of matter.

Learning Objectives	Vocabulary
I can define matter and give examples of matter versus non-matter I can describe the three primary phases of matter and provide particle diagrams for each I can describe the key characteristics of each primary phase of matter	• Matter Particle • Particle Diagram • Phase of Matter
Lesson 2.1 | What is Matter?	

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Discussion

(Lesson 2.1 | What is Matter)

The approach

- *Instead of the traditional approach - to start off with lecturing students on supposed facts that matter is anything that takes up space and has mass*
- *Alternative approach is to direct students to take an inquiry process to finding out for themselves what constitutes matter*
- *Students use their intuition to classify a list of common entities into matter and non-matter*
- *Lead students to construct the definition of what matter is*

We discuss weight and mass and the differences between the two concepts. We also explore if air has mass.

- *Air is invisible and so light, does it have mass?*
- *Benefit - a hands-on class experiment to prove or validate that air has mass. Students can design the experiment!*
- *Do a presentation and record it - include the scientific method*
- *Post on Viziscience's blog to share!!*

Extra hands-on lab suggestions for exploring state of matter

- *Not sure if this fits into the spectrum of phases but this is an interesting concept to explore - Newtonian fluid - what state of matter is this fluid? https://www.youtube.com/watch?v=biAOOJgvRYI*
- *Watch a walk on water video https://www.youtube.com/watch?v=biAOOJgvRYI*
- *Dry ice, plasma, jelly*

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➢ Lesson 2.2a | Pure Substances

Overview:

Students begin the quintessential classification matter chart with pure substances. Since this part of the unit involves a lot of concepts, we suggest separating it from lesson 2.2b by at least one day so that students have time to digest the concepts. In Lesson 2.2a, students learn that pure substances can either be elements or compounds and are exposed to particle diagrams for each.

Learning Objectives	Vocabulary
I can explain what a pure substance is I can explain the difference between a pure substance, a compound and an element I can illustrate particle diagrams for pure substances, compounds and elements	• Pure Substance • Element • Compound
Lesson 2.2a | Pure Substances	

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➢ Lesson 2.2b | Mixtures

Overview:

This lesson is a follow-up to Lesson 2.2a. In Lesson 2.2b, students build on their understanding of pure substances by examining mixtures – both homogeneous and heterogeneous. Again, students represent these using particle diagrams. At the end of the lesson, students will comprehensively classify matter as a pure substance, homogeneous mixture or heterogeneous mixture.

Learning Objectives	Vocabulary
I can explain what a mixture is I can explain the difference between a homogeneous and heterogeneous mixture I can illustrate particle diagrams for homogeneous mixtures and heterogeneous mixtures I can classify examples of matter as pure substances, homogeneous mixtures or heterogeneous mixtures	• Pure Substance • Mixture • Homogeneous • Heterogeneous
Lesson 2.2b | Mixtures	

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➢ Lesson 2.3 | Physical and Chemical Properties

Overview:

Lesson 2.3 focuses primarily on physical properties. Students learn the importance of physical properties when identifying substances. Additionally, students learn that some properties are intrinsic to the substance while others are intrinsic–this is built upon in lesson 2.5 to build definitions and understanding of physical and chemical changes.

The lesson ends by having students hypothesize what a chemical property is. Since the lesson provides many examples of physical properties it is ideal for students not to be given the definition of chemical property until they've had exposure to varieties of chemical changes in Lesson 2.5.

Learning Objectives	Vocabulary
I can define a physical property and provide examples of it for various substances I can explain the difference between intrinsic and extrinsic properties I can infer what a chemical property is, and differentiate it from a physical property.	• Physical Property • Intrinsic • Extrinsic • *Chemical Property * Will not be covered explicitly in this lesson (covered in detail in Lesson 2.5)
Lesson 2.3 | Physical & Chemical Properties	

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➢ Lesson 2.4 | Separating Mixtures

Overview:

Lesson 2.4 further exposes students to physical properties and how they can be used for separation purposes. The lesson takes students through several common laboratory practices including dissolution, filtration and distillation.

Learning Objectives	Vocabulary
I can describe a variety of separation techniques and discuss their relevance, including: • Dissolving solids • Filtering liquids • Evaporating liquids • Distilling liquids	• Extraction • Dissolution (dissolving) • Filtration • Evaporation • Distillation
Lesson 2.4 | Separating Mixtures	

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➢ Lesson 2.5 | Physical and Chemical Changes

Overview:

This lesson builds upon Lesson 2.3 by establishing definitions of physical and chemical changes. Chemical properties are then formally introduced following exposing students to chemical changes. Students then use these definitions to think analytically about if changes are physical or chemical.

Learning Objectives	Vocabulary
I can describe a physical change and provide examples I can describe a chemical change and provide examples I can explain a chemical property and differentiate it from a physical property I can identify a change as being physical or chemical and justify with reasoning	• Physical Change • Chemical Change
Lesson 2.5 | Physical and Chemical Changes	

Extensions

All the extensions provided here can be utilized either in class or as homework, with the teacher having the opportunity to review them during in-class sessions.

Category	Description
2.1 | Assignment | Extending States of Matter	**This section aims to deepen students' understanding of the behavior of particles in different states of matter and how particle diagrams are used as models to represent these behaviors.** It promotes critical thinking by encouraging students to make connections between particle-level interactions and macroscopic observations.
2.2 | Assignment | Classifying Matter	**Students classify everyday substances/mixtures and create particle diagrams.** Students receive a list of everyday object pictures or can use their own examples. Students categorize substances as mixtures, pure substances, elements, compounds, and states of matter. They justify classifications based on particle diagrams. Findings are organized into classification tables for pure substances and mixtures. Students create particle diagrams to represent particle arrangements and movements. This exercise applies knowledge, reinforces chemistry concepts, encourages critical thinking, and enhances classification skills through practical engagement.

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2.3 | Assignment | Identifying Properties	**Mastering Scientific Literacy.** The focus on this exercise is to craft procedures that are clear, specific, efficient, and easily reproducible to facilitate successful experiments and consistent outcomes. There are five unlabeled substances. Students will write a procedure of tests to help identify these substances based on their properties.
2.4 | Assignment | Separation Challenge	**Students apply their knowledge of substance properties and separation techniques from Lesson 2.4 to develop procedures for separating three mixtures.** They exercise autonomy in choosing equipment from the provided list and crafting techniques they've learned. This empowers them to plan experiments, communicate effectively, and ensure replicability. **Peer review** enriches the learning process through collaboration and constructive feedback.
2.5 | Assignment | Identifying Changes	Students will be shown five reactions: some physical, some chemical. Students will use observations for each reaction to justify each change as being physical or chemical. **Clear and specific writing is emphasized, enhancing scientific literacy through precise communication.**
2 | Lab | Conservation of Mass	**Students will uncover the conservation of mass through a series of chemical reactions.** In this lab, students further reinforce important scientific skills like hypothesizing, data collection, data analysis, and drawing conclusions.
Quiz #1	Lesson 2.1 Lesson 2.2(a) Lesson 2.2(b)
Quiz #2	Lesson 2.3

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	Lesson 2.4
Unit Assessment	Covers the entire unit 20 multiple choice questions

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