Chapter 3: Unlocking the Atom

## <H1>Essential Question:

How does our understanding of atomic structure, including atomic number, mass, and isotopes, help predict element properties?

## <H1>Big Idea

Understanding the atom unlocks the fundamental structure of matter.

## <H1>Chapter Phenomenon: Is Salting the Road a Magic Trick?

How does the ice and snow vanish? Does adding salt to the road cause this reaction? To answer these questions, you must look inside the structure of the salt and the water. Let’s start with the very basic structure of all substances, the atom. Salt, water, metals, and all matter are made of atoms. Are all atoms alike? Kind of …. In some ways they are, in some other ways they are not. In this chapter, you will discover what atoms are and how atoms of different elements have different structured. You will learn that water is made of hydrogen and oxygen atoms, and that the atoms of those two elements are different. But then again, are all hydrogen atoms identical? Are all oxygen atoms identical? What are isotopes? When are they stable or radioactive? How does tracking isotopes help scientists keep the roads safe and manage water and land resources?

<H1>Chapter STEM Task:

Investigate the properties of a selected element. Your goal is to analyze how its atomic structure, atomic number, mass, and isotopes contribute to its behavior and applications.

STEM Link Questions:

1. Research the selected element's atomic structure using current atomic models.
2. Identify the element's atomic number and mass. How these values help determine its placement in the Periodic Table and predict its properties?

<H1>Chapter Overview:

Lesson 1: The Evolution of Atomic Models and Structure

Lesson 2: Atomic Number and Mass

Lesson 3: Isotopes and Atomic Variations

# Chapter: Wrap-Up

## <H1> Summary

* According to Dalton’s atomic theory, all matter is made of indivisible atoms
* The studies during the late 19th and early 20th centuries revealed that the atom has a more complex structure and is not indivisible. These studies showed that atoms are made up of smaller particles, such as electrons, protons, and neutrons, which can be separated.
* According to the Plum Pudding model, the atom was a sphere of positive charge (like a pudding), with negatively charged electrons (like plums) scattered throughout it.
* According to Rutherford’s nuclear model, the atom consists of a small, dense, positively charged nucleus at its center, surrounded by mostly empty space where electrons are located.
* According to Bohr’s model, electrons orbit the nucleus in specific paths or energy levels, similar to planets orbiting the sun. Each energy level is associated with a certain amount of energy.
* Schrodinger model is based on quantum mechanics and describes the behavior of electrons in atoms as waves, not particles.
* It is the protons that determines the element’s identity or atomic number. It is designated by Z.
* The sum of the total number of protons and neutrons is known as mass number. It is denoted by ‘A’.
* One amu is defined as one twelfth of the mass of a carbon-12 atom, which has an atomic mass of exactly 12 amu.
* Isotope are the atoms of the same elements having the same atomic number but different mass numbers.
* Relative abundance refers to the amount of each isotope of an element found in nature.

## <H1> Revisiting the Chapter Phenomenon

Why do salt and metal behave so differently with water?

All substances, including salt, water, and metals, are composed of atoms. While atoms may share certain characteristics, they are not alike. Each element has a unique atomic structure that defines its properties and behavior. Not all hydrogen or oxygen atoms are identical. Isotopes are variations of elements that have the same number of protons but different numbers of neutrons, leading to variations in their mass and stability. When salt is added to icy roads, it interacts with the water molecules, lowering the freezing point and promoting the melting process. This physical reaction is not only a practical application of atomic interactions but also illustrates how the atomic structure of substances directly influences their properties and behavior. By tracking isotopes, scientists can enhance road safety, manage water resources efficiently, and make informed decisions regarding land management, ultimately contributing to environmental protection and public safety.

## <H1> Extended STEM Activity

Create a visual representation that includes:

* A brief history of the atomic model relevant to their isotope
* A comparison of atomic number and mass number.
* Real-life applications of the isotope.

## <H1> Bring it together!

In this chapter, you set out to learn about the atoms, the properties of a selected element and analyze how its atomic structure, atomic number, mass, and isotopes contribute to its behavior and applications. To do that, you had to use your prior knowledge of the matter, its classification and properties to learn about atomic structure and models in this Lesson 1 of this chapter. Then, in lesson 2, you identified and described subatomic particles and relationship between electrons, protons and neutrons. In lesson 3, you explained isotopes and its applications. You also learned to calculate the atomic mass of an element based on the abundance of its isotopes.

## <H1> Chapter Reflective journal

# Record the key learning that you take from this chapter on unlocking the atom. You may exchange ideas with a classmate.

**Note: Add 5 Chapter formative questions (Related to all lessons of the chapter)**