GENERATIONGENIUS
ALWAYS QUESTION. ALWAYS WONDER.

# TEACHER GUIDE

## PROPERTIES OF ELEMENTS
## GRADES 6-8

## COMMON MISCONCEPTIONS

- **The elements are listed in order of importance or order of discovery on the periodic table.**
  The periodic table is a model that illustrates the properties of elements and also how they interact with each other. Many students believe the table is a random assortment of naturally occurring substances either in the order of which they were scientifically discovered or order of importance.

- **All of the same types of elements are in the same rows.**
  Elements are arranged in two patterns—periods (horizontally) and columns (vertically). There are seven periods numbered 1 through 7. The number of periods indicates how many electron orbitals, or energy levels, an atom has. Some elements can lose and gain electrons easily. Other types of elements, like noble gases, are arranged vertically in the same column because their electrons remain relatively stable.

- **All elements have been discovered.**
  Science is an ongoing quest for more information. New elements are being discovered and are added to the periodic table based upon their properties. As new elements continue to be discovered, they will be observed compared to other elements to determine their most appropriate position in the periodic table.

## ELEMENTS AND ATOMS

All elements are made of atoms that each have subatomic particles—protons, neutrons, and electrons. Protons have a positive charge, neutrons have no charge, and electrons are negatively charged. Protons and neutrons exist in the nucleus of an atom, while the electrons are arranged in what are called *energy levels*, or *orbitals*, around the perimeter of the nucleus. Each energy level can hold a maximum amount of electrons. When an energy level is fully saturated with as many electrons as it can hold, electrons will form another energy level on its perimeter.

## PROPERTIES OF ELEMENTS

All elements have properties and those properties are used to identify elements. Elements exist naturally in many different forms. Elements can exist naturally in all three states—solid, liquid, and gas. Elements can also exist naturally as being made of more than one atom. For example, oxygen is considered a diatomic element because it exists naturally as O2. Properties of elements such as color, conductivity, magnetism, melting point, and others can be tested. Elements are categorized based on their properties and arranged in the periodic table based upon them.

## THE PERIODIC TABLE

The periodic table of elements is a model used to predict the relative properties of elements and their reactivity with each other. The periodic table is arranged in such a way that elements with similar properties are grouped together. Each period (row) of the periodic table is associated with the number of energy levels that orbit a nucleus. Row 1 has one energy level; Row 2 has two energy levels; Row 3 has three energy levels, and so on, up to 7. The number of electrons orbiting the nucleus of an atom will determine how that element interacts with other elements. For example, when you combine a metal and a nonmetal, you get a substance that is only somewhat conductive. When you combine two metals, you get highly conductive compounds. Other elements can combine in chemical reactions to form new substances, change colors, and also change states of matter.

## TEACHER TIPS

As much as possible, encourage students to ask questions and engage in dialogue with one another. The phenomenon of sugar water not, or barely, completing a circuit versus salt water raises many interesting questions for students. Encourage productive academic talk and have students share and record observations and questions as they move through the investigations. Their curiosity will breed investment in the lesson.

## ABOUT THIS LESSON

**This lesson was created by the National Science Teaching Association (NSTA) to pair with the Generation Genius video and support *NGSS*.**

**They have requested we provide the following background with this lesson:**

*The Next Generation Science Standards (NGSS)* are the national standards on how students learn science, and they are based on contemporary research presented in *A Framework for K–12 Science Education (the Framework).* The shift in science teaching and learning required by the Framework is summarized in this infographic: A New Vision for Science Education.

At the start of each Generation Genius lesson, students are presented with a phenomenon, then they try to explain it. Students will notice they have gaps in their knowledge and ask questions, which motivates them to build ownership of science ideas they need in order to explain how or why the phenomenon occurred. The way students build ownership of science and engineering ideas is through active engagement in the science and engineering practices (SEPs). This process of sensemaking, or doing science to figure out how the world works, is one of the major shifts the *Framework* encourages.

To engage in the SEPs, students should be part of a learning community that allows them to share their ideas, evaluate competing ideas, give and receive critiques, and reach consensus. Students can start by sharing ideas with a partner, then with a small group, and finally, with the whole class. This strategy creates opportunities for all students to be heard, build confidence, and have something to contribute to whole-class discussions. Each Generation Genius lesson provides conversational supports to facilitate such productive student discussions to contribute to sensemaking.

Excited to continue your shift toward the new vision for science education? Check out the Generation Genius Teacher Guide page on the NSTA website for resources and strategies to engage every student in your classroom in **doing** science.