GENERATIONGENIUS
ALWAYS QUESTION. ALWAYS WONDER.

TEACHER GUIDE

SYNTHETIC MATERIALS
GRADES 6–8

COMMON MISCONCEPTIONS

- **Chemical changes occur when you mix two substances together.**
  A chemical change is the interaction of two substances to form new substances. Sometimes combining substances can cause a chemical reaction and bonding, which creates an entirely new substance called a *compound*. However, sometimes there is no chemical reaction or bonding. Instead, a mixture is formed from the combined substances.

- **Physical changes are reversible but chemical changes are not.**
  This idea is usually true, but there are exceptions such as the physical change of cracking an egg or breaking a large rock into smaller pieces and the chemical change of ultraviolet beads or heat-sensitive baby spoons.

- **Matter is lost during physical and chemical changes. For example, if you melt a solid, it becomes lighter; if you have a phase change where liquid water changes to a gas and is invisible, parts of it have disappeared.**
  Matter is not lost during physical and chemical changes. During a chemical reaction, atoms are rearranged to form different substances—the total number of atoms and the kinds of atoms are the same before and after the reaction.

PHYSICAL CHANGES

A physical change, otherwise known as a *physical reaction*, affects the physical properties of a substance. The size or shape of the substance may change, but its molecular composition has not been altered. Although physical changes are generally reversible, it is important to remember that some physical changes (e.g., grinding, tearing, cutting, shattering) would be difficult or impossible to reverse. Examples of physical changes include phase changes. Students often have the misconception that melting and boiling are chemical changes. It is important to remember that although the position or arrangement of the molecules may have changed, the actual molecule itself (e.g., H_2O) remains intact.

CHEMICAL CHANGES

Chemical changes are also known as *chemical reactions*. They are usually irreversible, but not always, and involve the rearrangement of the atoms of at least one of the original substances to create a new substance with a new atomic arrangement and properties. The original number of atoms and the original type of atoms does not change as the result of a chemical reaction.

SYNTHETIC MATERIAL

Synthetic materials are created as a result of one or more chemical reactions for the express purpose of creating something entirely new that can be used for various purposes. Sometimes, synthetic materials are referred to as "human-made" because of the deliberate use of chemical reactions to form them. However, synthetic materials originate from materials that can be found on Earth. Synthetic materials can be extremely useful to society, such as medicines, building materials, or types of clothing that can help keep you warm or cool. However, the misuse of synthetic materials can have negative consequences, such as the Great Trash Island that can be found in the Pacific Ocean. This "island" is composed of small pieces of plastics (a synthetic material) that don't decompose like natural resources do.

TEACHER TIPS

- Encourage student questions from the chemical reaction investigation to motivate their gathering of evidence for arguments. This lesson is most authentic if it is generated by student questions.
- Facilitate student discourse among partners, small groups, and the whole class to support consensus-building. It is important for the class to take stock in competing ideas and then use evidence to figure out science ideas.
- Be sure to remind students of important lab safety considerations when engaging in the lab investigations.

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.