GENERATIONGENIUS
ALWAYS QUESTION. ALWAYS WONDER.

TEACHER GUIDE

CHEMICAL REACTIONS
GRADES 6-8

COMMON MISCONCEPTIONS

- **A change of state, or phase change, is a chemical reaction.**
  Middle school students often have difficulty distinguishing between physical and chemical changes. It is important to emphasize to students that chemical changes result in new substances being formed that are likely to have different properties from the substances that existed before the reaction took place.

- **The mass of substances changes in a chemical reaction.**
  The same amount of matter exists before and after a chemical reaction. This is because of the Law of Conservation of Matter, which says that matter cannot be created or destroyed; matter can only change forms. For that reason, the same number of atoms exist in the reactants in a chemical reaction as the products.

- **"Dissolving" is a phase change.**
  What students often describe as "dissolving," as seen in the bath bomb investigation, is actually a chemical change that results in new substances being formed. As in the case of the bath bomb investigation, baking soda and citric acid combine with water to react and form carbon dioxide gas, liquid water, and trisodium citrate.

LAW OF CONSERVATION OF MATTER

The total amount of matter in a system is conserved because matter cannot be created or destroyed. Atoms will rearrange themselves in the presence of a catalyst and/or the proper conditions. Sometimes adding energy to a chemical reaction can be a catalyst. This occurs in the instance of thermal energy and would be observed if the bath bomb were placed into hot water versus ice cold water. The rate of the chemical reaction has an optimal temperature at which it works the fastest. However, regardless of how much energy is applied to a system, the same number of atoms exist before and after the reaction. That is evidence that the total amount of matter is conserved within a system.

NEW SUBSTANCES

One substance formed in the bath bomb investigation is carbon dioxide. Carbon dioxide was not initially present in the reactants as sodium bicarbonate and citric acid were mixed with water. Carbon dioxide is not flammable. In fact, it extinguishes a flame because it replaces the oxygen around the flame with carbon dioxide. Because fire needs oxygen to burn (a combustion reaction), carbon dioxide will put the flame out. Examining the properties of substances, especially after a chemical reaction, can help you determine what those substances are.

CHEMISTRY CAREERS

Many careers require a great deal of chemistry, one of which is a pharmacist. Pharmacists work with chemists and medical doctors to develop new treatments for bacterial infections, called antibiotics, as well as viral infections, called vaccines. Chemical engineers also work for biomedical engineering companies to conduct chemical reactions that result in new substances that can be used to treat common illnesses and prevent people from getting sick.

TEACHER TIPS

- Encourage student questions to motivate the bath bomb investigation. The investigation is most authentic if it is generated by student questions.
- Facilitate student discourse among partners and with 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 when conducting chemical reactions and using an open flame (matches).

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.