

The Next Generation Science Standards (NGSS)

CHAPTER 6, LESSON 2: CONTROLLING THE AMOUNT OF PRODUCTS IN A CHEMICAL REACTION

MS-PS1-2. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred.

MS-PS1-5. Develop and use a model to describe how the total number of atoms does not change in a chemical reaction and thus mass is conserved.

DISCIPLINARY CORE IDEAS

PS1.A: Structure and Properties of Matter

- Substances react chemically in characteristic ways. In a chemical process, the atoms that make up the original substances are regrouped into different molecules, and these new substances have different properties from those of the reactants. (MS-PS1-2), (MS-PS1-5)
- The total number of each type of atom is conserved and thus the mass does not change. (MS-PS1-5)

Students combine vinegar and baking soda and see the production of a gas. They look at the chemical equation for the reaction and realize that the gas is carbon dioxide. Students count the type and number of atoms in the reactants and products and see that they are the same.

SCIENCE AND ENGINEERING PRACTICES

Developing and Using Models

- Develop a model to describe unobservable mechanisms. (MS-PS3-2)

Planning and carrying out investigations

Analyzing and interpreting data

Engaging in argument from evidence

Students investigate the question: How can you make just the right amount of foam that rises to the top of the graduated cylinder without overflowing? Students plan and conduct an investigation using vinegar and baking soda to see how accurately they can adjust the amount of reactants to form a certain amount of gas. Students see that changing the

amount of either or both reactants can affect the amount of products produced. Students discuss the idea that adding a large excess of one reactant will have a limited effect on increasing the amount of products. Students look at an illustrated version of the chemical equation for the reaction along with an equation using the chemical formulas to get a better idea of what the formulas actually represent. Students use and further develop this molecular model and apply it to evidence they have observed to explain their observations on the molecular level and to answer the question to investigate.

CROSCUTTING CONCEPTS

Cause and Effect

- Cause and effect relationships may be used to predict phenomena in natural or designed systems. (MS-PS1-4)

Scale, Proportion, and Quantity

- Time, space, and energy phenomena can be observed at various scales using models to study systems that are too large or too small. (MS-PS1-1)

Energy and Matter

- Matter is conserved because atoms are conserved in physical and chemical processes. (MS-PS1-5)

Students use illustrations of molecules along with their formulas to explain how the interaction and rearrangement of atoms in the baking soda-and-vinegar reaction results in the macroscopic observation of the production of more gas or less gas depending on the amount of reactants used.