The Next Generation Science Standards (NGSS)

CHAPTER 5, LESSON 8: CAN GASES DISSOLVE IN WATER?

MS-PS1-1. Develop models to describe the atomic composition of simple molecules and extended structures.

DISCIPLINARY CORE IDEAS

PS1.A: Structure and Properties of Matter

- In a liquid, the molecules are constantly in contact with others; in a gas, they are widely spaced except when they happen to collide. In a solid, atoms are closely spaced and may vibrate in position but do not change relative locations. (MS-PS1-4)
- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)
- Each pure substance has characteristic physical properties (for any bulk quantity under given conditions) that can be used to identify it. (MS-PS1-3)

Students experiment with club soda and see that it is composed of water with carbon dioxide (CO_2) gas dissolved in it. Students see that the process of dissolving involves the attraction and interaction of the molecules of the solute with the solvent whether they are solid and liquid or gas and liquid. Students use what they know about the polarity of water molecules and the structure of carbon dioxide to understand why carbon dioxide dissolves in water. Students also see that as the temperature rises, less carbon dioxide stays dissolved in the water.

SCIENCE AND ENGINEERING PRACTICES

Developing and Using Models

- Develop a model to predict and/or describe phenomena. (MS-PS1-1), (MS-PS1-4)

Planning and carrying out investigations

Analyzing and interpreting data

Engaging in argument from evidence

Students investigate the question: Does carbon dioxide stay dissolved better in water that is warmed or water that is cooled? Students plan and conduct an investigation to see if temperature affects the amount of carbon dioxide that stays dissolved in water. Students use molecular models of water and carbon dioxide and what they know about the motion of molecules when they are heated and cooled to model the attraction and interaction of water and carbon dioxide. 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.

CROSSCUTTING 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)

Students use molecular-level models of water and carbon dioxide to explain how these sub-microscopic characteristics affect the macroscopic observable characteristic of carbon dioxide being less soluble as the temperature of water increases.

