

# The Next Generation Science Standards (NGSS)

## CHAPTER 1, LESSON 2 – MOLECULES IN MOTION

**MS-PS1-4. Develop a model that predicts and describes changes in particle motion, temperature, and state of a pure substance when thermal energy is added or removed.**

### DISCIPLINARY CORE IDEAS

#### *PS1.A: Structure and Properties of Matter*

- Gases and liquids are made of molecules or inert atoms that are moving about relative to each other. (MS-PS1-4)
- 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)

*Students add food coloring to hot and cold water. Students further develop their understanding of the motion, attraction, and arrangement of the molecules of a liquid by observing the relative amount of mixing in the hot and cold water. The motion, attraction, and arrangement of the molecules in solids and gasses are addressed in later lessons in Chapter 1.*

### 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*

#### *Engaging in Argument from Evidence*

*Students investigate the question: Is the speed of water molecules different in hot and cold water? Students help design an experiment to see if heating and cooling water affects the motion of the water molecules. Students see an enhanced molecular model animation in which the molecules move faster and slightly further apart when heated, and slower and closer together when cooled. 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)

*Students see and apply the cause and effect relationship between heating and cooling and the motion and arrangement of molecules. Students use molecular models to explain how heating and cooling on the molecular level affects how water behaves on the macroscopic level.*