

# The Next Generation Science Standards (NGSS)

## CHAPTER 2, LESSON 1 – HEAT, TEMPERATURE, AND CONDUCTION

**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

#### *PS3.A: Definitions of Energy*

- Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present. (MS-PS3-3), (MS-PS3-4)
- The term “heat” as used in everyday language refers to both thermal energy (the motion of atoms or molecules within a substance) and the transfer of that thermal energy. In science, heat is used only for this second meaning; it refers to the energy transferred due to the temperature difference between two objects. (MS-PS1-4)

*Students place heated metal washers in room-temperature water and measure the temperature change of the water and the washers. Students begin to develop the understanding that temperature is related to the motion of atoms and molecules and that heat is transferred from a substance at a higher temperature to a substance at a lower temperature.*

### SCIENCE AND ENGINEERING PRACTICES

#### *Developing and Using Models*

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

#### *Engaging in Argument from Evidence*

*Students investigate the question: Does the temperature of an object change when it is placed in hot water? Along with heating and taking temperature readings of metal washers and water, students see a molecular model animation depicting conduction on the molecular level. 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 a molecular-level explanation to explain the macroscopic effect of the observed change in temperature.*