

# The Next Generation Science Standards (NGSS)

## CHAPTER 1, LESSON 5 – AIR, IT’S REALLY THERE

**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*

- 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)

*Students observe a bubble expanding and contracting on top of a bottle when the bottle is placed in hot and then in cold water. Students use this observation and what they have learned about the atoms and molecules in liquids and solids to begin to develop their understanding of the attraction, motion, and arrangement of the molecules in a gas.*

### SCIENCE AND ENGINEERING PRACTICES

#### *Developing and Using Models*

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

#### *Engaging in Argument from Evidence*

*Students investigate the question: How does heating and cooling affect a gas? In addition to observing the bubble growing and shrinking as the gas is heated and cooled, students see a molecular model animation of the heating and cooling of the gas inside the bottle. 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 bubble expanding and contracting when it is heated and cooled. Students also see that the expanding and contracting of a solid is a problem in road construction on bridges. Students see that scientists and engineers have developing flexible materials and movable joints to solve this problem.*