



# Discussion Guide for

## HEAT: MOLECULES IN MOTION 2ND EDITION

### OBJECTIVES

- To identify heat as a form of mechanical energy, into which all forms of energy can be converted.
- To show that applying or removing heat can cause matter to change its state, between solid, liquid, or gas.
- To teach the difference between heat and temperature.
- To teach how heat and temperature are each measured.
- To show how heat is transferred by conduction, convection, and radiation.
- To demonstrate how heat is used in daily life.

### SYNOPSIS

Heat is an essential element of daily life, whether it's used for cooking dinner, heating homes, or drying hair. This film examines the ways we use heat by looking in on a typical family. Mike and Marie's restaurant kitchen is used to show the relationship between heat and matter. Animated sequences show that matter consists of molecules-tiny particles that are in constant motion-and that motion creates heat. The swimming pool demonstrates the difference between heat and temperature.

A visit to the food lab where Mike and Marie's son David works teaches how calories really measure heat, not just how fattening food is. Back at home, Grandpa is getting the furnace ready for the coming winter. The heating system of the house is used to launch a lesson on the three methods of transferring heat: convection, conduction, and radiation. The furnace is used as an example of convection: a fry-pan on the stove as an example of conduction: and the sun and fireplace as examples of radiation.

### QUESTIONS TO ASK BEFORE SHOWING THE FILM

- What are some ways you use heat?
- Give some examples of energy. What do they all have in common?
- How do we measure heat?
- Do you think there is a difference between heat and temperature? What is it?
- Which would you think has more heat: a cup of water at 70 degrees, or a swimming pool at 70 degrees? Why?

### QUESTIONS TO ASK AFTER SHOWING THE FILM

1. How does the film define energy? (The ability to do work-to produce motion or change.)
2. What are the two states of energy? (Kinetic, the energy of motion; potential, energy at rest or stored energy.)
3. Name some different forms of energy and an example of each. (Mechanical, car engine; electrical, current produced by electric companies: chemical, dry cell battery: nuclear, nuclear power plant: solar, solar cells heating water and homes.)
4. All forms of energy can be converted into what kind of mechanical energy? (Heat.)
5. What is the name of the tiny particles that make up all matter? (Molecules.)
6. Name the three states or phases of matter. (Solid, liquid, gas.) Give examples of matter in each state.
7. How does matter change from one state to another? (When heat is applied or taken away.)
8. What is the "melting point" of matter? (The temperature at which the solid state changes into liquid.) What is the "boiling point" of matter? (The temperature at which the liquid state changes into gas.)
9. What is the difference between temperature and heat? (Temperature is a measurement of the movement of molecules in matter: heat is the total amount of energy that a given quantity of matter has.) Which would have more heat: a concrete block setting in the sun with a temperature measuring 80 degrees Fahrenheit, or a ten-foot high concrete block wall in the shade with a temperature measuring 80 degrees Fahrenheit? (The block wall has more heat. Matter with more mass has more heat than matter with less mass even though the temperatures are the same.)
10. Temperature is measured in degrees. How is heat measured? (In calories or joules.) What is a calorie? (The amount of heat required to raise the temperature of one gram of water one degree Celsius.) What instrument is used to measure heat? (Calorimeter.)

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11. How many calories would be needed to heat 200 grams of water ten degrees Celsius? (2000.)

12. What are the three methods by which heat is transferred? (Conduction, convection, radiation.) How does each method work? (Conduction transfers heat by direct contact: convection transfers heat by the movement of a heated gas or liquid; radiation transfers heat through space by infrared rays.)

13. Give examples that demonstrate each of the three methods of heat transfer. (Conduction: food cooked in a frying pan: convection: a furnace heating a home: radiation: the sun or a fire.)

14. Identify the method of heat transfer working in the following: Blowing on your hands to warm them. (Convection.) Warming lamp in a restaurant. (Radiation.) Burning a finger on a hot stove. (Conduction.)

15. What example did the film give of a common event that used all three methods of heat transfer? (Grilling hamburgers.) Describe how each method worked to cook the hamburgers. (The hot coals radiated heat; the air between the coals and the grill moved heat; the hot grill transferred heat to the burgers.)

### ADDITIONAL ACTIVITIES

- Have students bring in as many different types of thermometers as they can find. Have the class examine them all to determine how each measures temperature.
- Bring a list of foods with their caloric contents into class. Give the students a list of foods to place in order according to the caloric content they believe each contains. Then have them compare their lists with the actual correct caloric levels.
- If practical, take the students on a short tour of (the school's furnace and/or air conditioning system. Ask them to determine how heat is transferred in the school.

### PROGRAMS DETAILS

#### LENGTH:

16 minutes

#### SUBJECT AREAS:

Science

#### AUDIENCE LEVELS:

Junior/Senior High

#### ORDER NUMBER:

1-9811SG

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