1. What is thermal energy?
   1. **Thermal energy** is the total kinetic energy of all particles in a substance.
   2. Thermal energy is measured in joules (J).
2. What is the difference between thermal energy and temperature?
   1. Temperature is related to the average kinetic energy of particles.
   2. Thermal energy is the total kinetic energy of all the particles.
   3. For example, a glass of water can have the same temperature as a lake, but the lake has much more thermal energy because the lake contains many more water molecules.
3. What is heat?
   1. **Heat** is the energy transferred from an object at a higher temperature to an object at a lower temperature.
   2. Energy in the form of heat always flows from hot to cold.
4. How is heat measured?
   1. Heat is measured in two ways.
   2. One way is the calorie (cal).
   3. One **calorie** is equal to the amount of energy needed to raise the temperature of 1 g of water by 1 °C.
   4. Heat is also measured in joules (J) because heat is a form of energy.
   5. One calorie is equal to 4.18 joules.
   6. In nutrition, 1 Calorie (with a capital C) is actually 1 kilocalorie, or 1,000 calories.
   7. To find out how many calories are in food, a sample of food is burned inside an instrument called a calorimeter.
   8. The change in temperature in the calorimeter is used to calculate how much energy is released from the food sample.
5. How is heat related to thermal energy?
   1. Adding or removing heat from a substance will affect its temperature and thermal energy.
   2. Heat, however, is not the same as thermal energy and temperature.
   3. Thermal energy and temperature are properties of a substance. Heat is the energy involved when these properties change.
   4. Even though two materials might have the same temperature, their thermal energies might be different.
   5. Thermal energy depends on how many particles are present in the object.
6. How can heat affect the state of an object?
   1. The state of a substance depends on the speed of its particles.
   2. Adding energy in the form of heat to a substance can result in a change of state.
   3. Removing energy in the form of heat from a substance can also result in a change of state.
7. What is conduction?
   1. Energy as heat can be transferred in three main ways: conduction, convection, and radiation.
   2. **Conduction** is the transfer of energy as heat from one substance to another through direct contact.
   3. As long as two objects are in contact, conduction continues until the temperatures of the objects are equal.
   4. A **conductor** is a material that transfers heat very well.
   5. Metals are typically good conductors.
   6. An **insulator** is a material that is a poor conductor of heat.
   7. Wood, paper, and plastic foam are examples of good insulators.
8. What is convection?
   1. **Convection** is the transfer of energy as heat by the movement of a liquid or gas.
   2. Convection occurs when a cooler, denser mass of gas or liquid replaces a warmer, less dense mass of gas or liquid by pushing it upward.
   3. When water is boiled, the water moves in roughly circular patterns because of convection.
   4. This motion is due to density differences that result from temperature differences.
   5. The motion is called a *convection current*.
9. What is radiation?
   1. **Radiation** is the transfer of energy by electromagnetic waves.
   2. All objects, including the sun and all living things, emit radiation.
   3. When radiation is emitted from one object and is absorbed by another, the result is often a transfer of heat.
   4. Radiation can travel through empty space.