Introducing Thermal Energy

All matter is made up of small particles and these particles are always in motion. Particles making up the table (a solid) in motion even though we can't see movement in the table; particles making up a cold soda (a liquid) are in motion and particles inside a helium balloon (a gas) are in motion. Scientists refer to the collective motion of particles in matter as thermal energy. The amount of thermal energy a substance has depends on its temperature and amount. Anything that has a temperature has thermal energy. The higher the temperature the more kinetic energy they have, too.

Temperature is a way of measuring a substance's thermal energy. Heat is thermal energy that is on the move. It is moving from one system to another. Thermal energy is transferred when there are temperature differences and always transfers from warmer substances to cooler ones. The faster atoms move, the greater quantity of heat they transfer.

Materials: Teacher Demo: Clear beaker of hot water, clear beaker of cold water, red food coloring

What To Do:

1. Place a beaker of hot water and a beaker of cold water in a place that all students can see it.
2. Predict what will happen when a drop of food coloring is placed in both beakers?

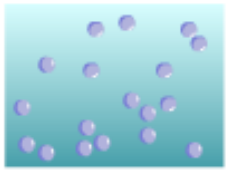
_____

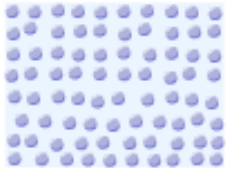
3. When the water is very still place one drop of food coloring in each beaker at the same time.

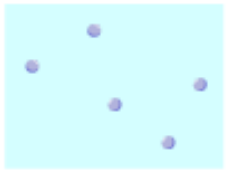
4. Describe what you see happening in the beakers.

_____

5. Watch the Free BrainPop video on States of Matter.
6. Match the object below to the picture of its particles.







Questions:

1. Why did the food coloring spread out through the water? _____

2. Why did the food coloring in the hot water spread out faster? _____

3. Why did the food coloring in the cold water spread out slower? _____

When equal amount of warm water and cold water are mixed together it stands to reason that the resulting temperature will be somewhere in the middle of the two starting temperatures. Let's do some math and then test our predictions.

The equation for this prediction would be:

$$\frac{\text{Cold starting temp.} + \text{Hot starting temp.}}{2} = \text{ending temp.}$$

Cold temp = 4ºC **Hot temp = 56ºC**
What would be the ending temp? _____

Cold temp = 3ºC **Hot temp = 67ºC**
What would be the ending temp? _____

Materials: hot plate, coffee carafe or large coffee maker, ice water, 3 Styrofoam cups, graduated cylinder, thermometer, funnel

What To Do:
1. Get half a cup of each temperature of water.
2. Measure the starting temperature of each cup of water.
3. Record both temperatures in the data table below.
4. Do the math and predict the temperature of the mixed water. Record your prediction below.
5. Use the funnel and measure out 40 mL of hot water into the graduated cylinder and then pour it into the empty cup.
6. Use the funnel and measure out 40 mL of cold water into the graduated cylinder and then pour it into the empty cup to mix them.
7. Measure the temperature of the 3rd cup of water.

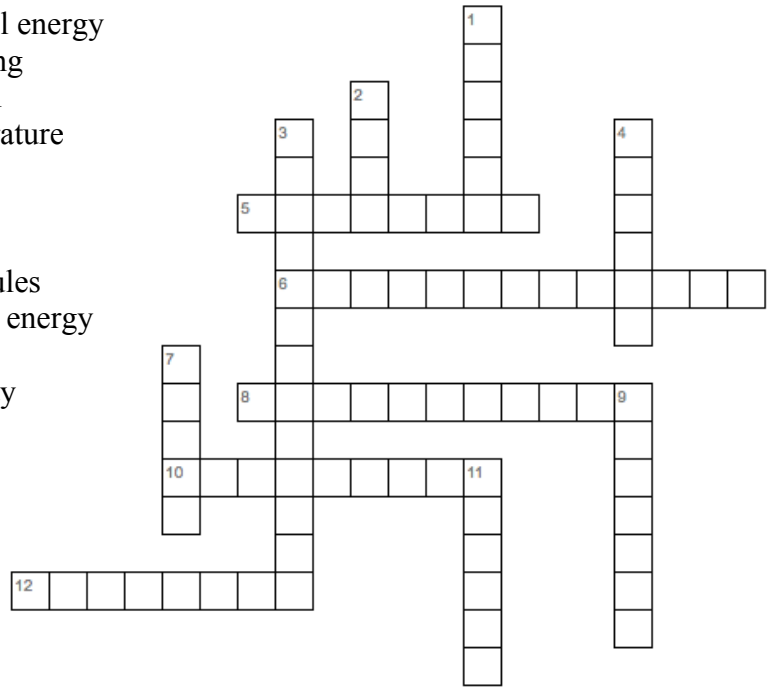
Amount of water mL	Temp. of warm water	Temp. of cold water	Predicted mixed temp.	Temp. of mixed water
40 warm 40 ice				

Questions:
1. How close was your prediction to the real temperature?

_____

THERMAL ENERGY

Word Bank
thermal energy
anything
motion
temperature
effects
slower
atoms
molecules
kinetic energy
colder
quantity
heat



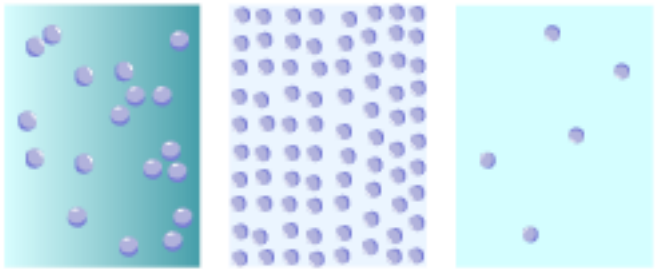
Across
5. _____ that has a temperature has Thermal Energy.
6. The collective motion of particles of matter in _____ _____.
8. _____ is a way of measuring a substances thermal energy.
10. Combination of atoms
12. The faster the molecules move the greater _____ of heat they transfer.

Down
1. Atoms and molecules are always in _____.
2. _____ is thermal energy on the move.
3. The hotter something is, the more _____ _____ the particles have.
4. The slower the molecules move the _____ the temperature is.
7. The basic building blocks of matter are _____.
9. The motion of thermal energy is usually not visible but we can feel or see its _____.
11. The colder something is the _____ its particles move and the less kinetic energy it has.

Name _____ period _____

EXIT TICKET

1. Which of the following pictures show the particles found in a liquid? Circle the correct one.



2. How are the particles in a hot liquid different from the particles in a cold liquid?

A. There would be no difference
B. They would be moving faster
C. They would be moving slower
D. They would be farther apart

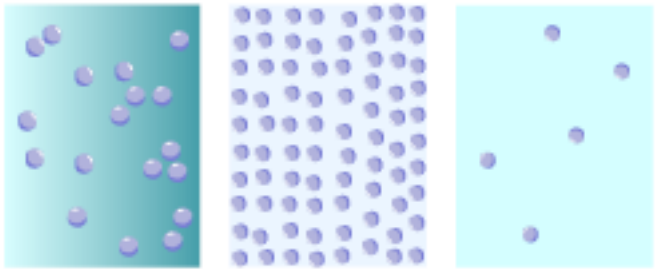
Conclusion: (middle, thermal energy, temperature)

Scientists refer to the motion of particles in matter as _____ _____ . _____ is a way of measuring a substance's thermal energy. When mixing equal amounts of hot and cold water the resulting temperature should be near the _____.

Name _____ period _____

EXIT TICKET

1. Which of the following pictures show the particles found in a liquid? Circle the correct one.



2. How are the particles in a hot liquid different from the particles in a cold liquid?

A. There would be no difference
B. They would be moving faster
C. They would be moving slower
D. They would be farther apart

Conclusion: (middle, thermal energy, temperature)

Scientists refer to the motion of particles in matter as _____ _____ . _____ is a way of measuring a substance's thermal energy. When mixing equal amounts of hot and cold water the resulting temperature should be near the _____.