Particle Theory	Grade 7: Matter and Energy

Lesson Plan

Safety Notes

Be careful when using very cold or hot water.

Description

In this lesson, students will learn about the particle theory of matter and how it explains the behaviour of particles at different temperatures.

Materials

- Balloons
- 2 Empty pop bottles
- String
- Coin (loonie)
- Tupperware containers
- Freezer
- Kettle (Hot Water)

Science Background

Particle Theory of Matter

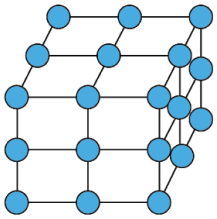
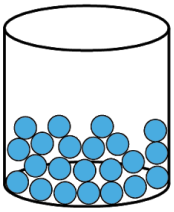
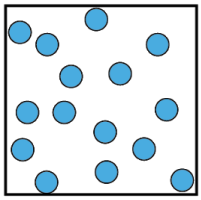
Matter is anything that has mass and takes up space. All matter is made up of many small particles called atoms, and they are in a continual state of motion. How much these particles move is determined by the amount of energy they have and their relationship to other particles. Particle Theory helps us understand the behaviour of all particles of matter:

1. All matter is made of tiny particles
2. Particles are in constant random motion, they have kinetic energy (movement energy)
3. All particles of one substance are identical
4. Particles move faster when heated
5. Particles have empty space between them, but are attracted to each other

States of Matter

Matter exists in various states or phases, the most common of which include solids, liquids, and gases. Other states of matter can exist under highly specialized conditions, such as plasma

and Bose-Einstein condensate. The Particle Theory of Matter can help us understand the three main states:

Solids	Liquids	Gases
• Fixed Shape and volume • Difficult to compress • Often dense - particles close together • Atoms held together by strong intermolecular forces (strongly attracted to each other) • Atoms in a fixed position but still vibrate	• No fixed shape or volume, flow to fill container shape from bottom up • Difficult to compress, less dense than solids • Weaker intermolecular forces than solids (can move in more directions) • Is a fluid (flows)	• No fixed shape or volume, flow to fill entire container • Easily compressed and often have a low density • Particles are widely separated from each other and have weaker intermolecular forces than liquids or solids • More energy, moving and vibrating at high speeds • Is a fluid (flows)
		

Activity Procedure

Dancing Coin

1. Place a pop bottle in the sink
2. Run a wet finger around the mouth of the bottle and place a coin on the mouth to create a seal.
3. Run hot water over the sides of the bottle
4. What happens to the coin? Why is it moving?
5. To try this experiment again, take the coin off and run cold water over the sides of the bottle, place the coin back on the mouth, and run hot water over the sides again.

Chilly Balloon

1. Inflate a balloon and tie a string around the middle of the balloon. This will help us measure the size of our balloon.
2. Place the balloon in the freezer for 10-15 minutes. While you wait, try the next activity.

3. Remove your balloon from the freezer. What happened to it? Is the string still around the middle? Why? What will happen if you leave the balloon at room temperature now?

Hot and Cold Balloons

1. Place a balloon over the mouth of a 2L pop bottle. Repeat with a second bottle and balloon.
2. Submerge one bottle in ice water, and the second in hot water. Be careful! Wear gloves as needed.
3. Swap the balloons. Place the first bottle from the cold water into the hot water, and the bottle from the hot water into the cold water.
4. What happens to the balloons? Do they shrink or inflate? Why? Think of the particles in the bottle and how they react to temperature.

Debrief

Dancing Coin

When you place the coin on the mouth of the bottle, you create a seal so that no air can escape. Once you start heating the sides of the bottle, the air particles inside also start heating up. Particles have more energy, move quickly and spread further apart as they are heated. This causes the air particles to push up on the coin as they escape from the bottle. The "dancing" of the coin demonstrates the energy of the newly heated particles!

Chilly Balloon

The balloon is sealed, meaning it always has the same amount of gas particles inside, so how did it shrink after being put in the freezer? Once in the freezer, the air particles inside the balloon start cooling down and start losing energy. As they slow down, they will be closer together and the balloon will shrink. The string on the outside of the balloon shows you the size of the balloon before going into the freezer and how much it has shrunk. If you leave the frozen balloon at room temperature, it will warm up, increase the energy it has (kinetic), and inflate to its original size!

Hot and Cold Balloon

When you place the cold bottle inside the hot water, you'll notice that the balloon will start to expand because the gas particles inside the bottle will start heating up and gaining more kinetic energy. The particles will start moving more quickly and more further apart, which in turn will start to inflate the balloon. When you place the bottle into the cold water, the particles start to slow down from the temperature decrease, causing the balloon to shrink.

Particle Theory	Grade 7: Matter and Energy

Handout

Fill in the blank using the word bank:

increase cold particles less temperature
moving energy water faster more

1. Everything is made of _____.
2. Particles are always_____.
3. An increase in _____ makes particles move _____.
4. An increase in_____ is the same thing as an _____ in energy.
5. The particles in hot water have _____ energy than _____water.
6. The particles in ice move _____ than particles in _____.

7. Draw what happens to two balloons that start out as the same size:
   a) One is put into liquid Nitrogen
   b) One is put in a hot car.
   c) Draw 6 particles into each balloon.

Balloon in liquid Nitrogen	Balloon in a hot car

8. Circle the answer to the following questions about the balloons.
   a) Which balloon is the biggest? Cold Balloon Hot Balloon Same
   b) Which particles have less energy? Cold Balloon Hot Balloon Same
   c) Which balloon is heaviest? Cold Balloon Hot Balloon Same

Particle Theory — Grade 7: Matter and Energy

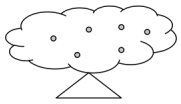
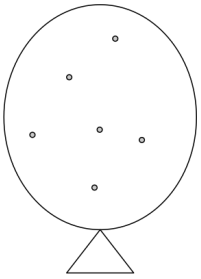
Handout Answers

Fill in the blank using the word bank:.

increase cold particles less temperature
moving energy water faster more

1. Everything is made of particles.
2. Particles are always moving.
3. An increase in energy makes particles move faster.
4. An increase in temperature is the same thing as an increase in energy.
5. The particles in hot water have more energy than cold water.
6. The particles in ice move less than particles in water.

7. Draw what happens to two balloons that start out as the same size:
   a) One is put into liquid Nitrogen
   b) One is put in a hot car.
   c) Draw 6 particles into each balloon.

Balloon in liquid Nitrogen	Balloon in a hot car
	

8. Circle the answer to the following questions about the balloons.

a) Which balloon is the biggest? Cold Balloon **Hot Balloon** Same

b) Which particles have less energy? **Cold Balloon** Hot Balloon Same

c) Which balloon is heaviest? Cold Balloon Hot Balloon **Same**