Name_____

Reading #1: What Is Matter?

Fireworks! The night sky lights up with a shower of colour and the air crackles with explosive sounds. You have probably seen such spectacular displays on holidays such as Canada Day. Fireworks have an ancient tradition. The Chinese invented them more than 2000 years ago. Since then, their use has spread all around the world. Fireworks displays have improved over the years thanks to a branch of chemistry called pyrotechnics. The word "pyrotechnics" refers to controlled explosions used to put on a show. Pyrotechnics are used often in Hollywood movies and sometimes in concerts.

Fireworks are a dramatic display of matter. **Matter** is anything that has mass and volume. Mass is the *amount of matter* in a substance or object. Volume is the *amount of space* that substance or object takes up. Mass is often measured in grams. Volume is often measured in litres. Basically, everything is matter. Everything! If something has mass and takes up space, it is matter. Rain drops are matter, your jeans are matter, the smoke that escapes from fire is matter. But they are all made of very different types of matter.

The study of chemistry begins with understanding matter and how it can change. In the past, you may have learned that matter exists in three major forms.

We call these forms ‘states’. The three states of matter are solid, liquid, and gas.

***Solid** is the state of matter that has a definite shape and volume. For example, the sugar you added to your breakfast cereal was a solid.

***Liquid** is the state of matter that has a definite volume BUT does not have a definite shape. A liquid’s shape will fit into its surroundings. For example, the milk you pour into a glass has a definite volume (measured in litres) but the milk will fit into whatever shape the glass is.

***Gas** is the state of matter that has its shape and volume determined by its surroundings. That means a gas will fit into whatever container or space it occupies. For example, the air you blow into a balloon takes the shape of the balloon. Its volume (how much space a substance or object takes up) is the same volume as the balloon.

Chemistry includes facts and observations about the many different types of matter. It also includes laws that describe the way matter behaves in different situations. You will learn about how matter behaves next.

Name_____

Reading #1: What Is Matter?

True or False: Circle the correct answer

1) Fireworks were invented in the year 2000 by the Chinese. True / False
2) Matter is anything that has space and time. True / False
3) There are many different types of matter. True / False
4) Chemistry is the study of matter and how it changes. True / False

Circle the correct answer

1) The branch of chemistry that deals with controlled explosions is called… (matter / pyrotechnics / fireworks)
2) Mass is usually measured in (grams / volume) and volume is usually measured in… (grams / volume)
3) The major forms of matter are called… (surroundings / shapes / states)
4) When matter has a definite volume but not a definite shape it is called a… (solid / liquid / gas)

Think about the question and give your best answer

1) How is mass different from volume? (there are 2 ways – tell me both)

2) Give an example of something measured in grams.

3) Give an example of something measured in litres.

4) Are your answers to questions 2 and 3 both examples of matter?

5) What are the three most common states of matter on Earth?

6) Why does a liquid take the shape of whatever container it is in BUT does not grow or expand to fill that container completely?

Name_____

Reading #2: A Model of Matter

Matter and the states of matter (remember, these are solid, liquid, and gas) are all part of chemistry. In this reading, we will take a look at how matter behaves. You will learn about a **model** of matter and a **theory** of matter. Don't get confused! These are not the same thing. In science, a model is a way to think about how something really is. Scientific models help us to visualize objects or actions that we cannot see with our eyes. A theory is different from a model. A theory is a scientific explanation that comes from years of testing and experiments. So, a scientific model tells us HOW something might look or work. A theory tells us WHY it does what it does. Got it? Let's look at a model of matter first. In the next reading, we'll look at a theory of matter.

A Particle Model of Matter

Remember, a model is a way to think about objects or actions we can't see with our eyes. The particle model of matter allows us to imagine what's going on with these particles (extremely tiny parts) that make up 'matter'. The Particle Model offers us four important points to help understand matter. Here they are:

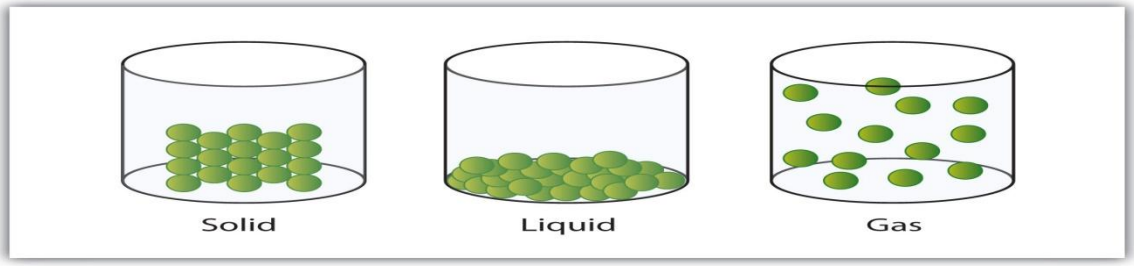
* All matter is made of very small particles. These particles are too tiny to see, even with a good microscope. So don't expect to see them if you stare!

*There are spaces between the particles that make up matter (remember, matter is anything that has mass and takes up space). The amount of space between the particles depends on the state of the matter. Spaces between particles in a solid are very small as the particles are crammed together. In a liquid there is more room between the particles and a gas will have a lot of space between particles.

*The particles that make up matter are always moving – no matter how close or far apart they are from each other.

*The particles are attracted to one another. How attracted? Well, that depends on the type of particle that makes up the matter.

This picture shows us what the Particle Model of matter looks like.



Particles in solid matter are packed tightly together, giving the object a definite shape	Particles in liquid matter are close but can slip and slide around each other so there is no definite shape	Gas particles have very large spaces between them. Gases are mostly empty space between particles!

Name _____

Reading #2: A Model of Matter

True or False: Circle the correct answer

1) A model and a theory are two ways to explain the same thing.

   True / False

2) Scientific theories come from years of testing and experiments.

   True / False

3) The Particle Model tells us that matter is basically one big particle.

   True / False

4) Gases are full of empty space between particles of matter.

   True / False

Circle the correct answer

1) The particles that make up matter are always moving in …

   (the liquid state only / the gas state only / all states of matter)

2) Particles are close but can slip and slide around each other in…

   (solid matter / liquid matter / gas matter)

3) In science, _____ (a model / a theory / matter) helps us imagine how objects or actions we can't see actually work.

4) The Particle Model tells us that all matter is made of …

   (one big chunk / many extremely tiny parts / empty space)

Think about the question and give your best answer

1) How is a model different from a theory?

2) What are the three points of the Particle Model of Matter?

   Tell me in your own words.

3) What are the particles like in solid matter?

4) What are the particles like in liquid matter?

5) What are the particles like in gas matter?

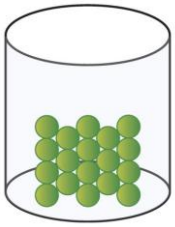
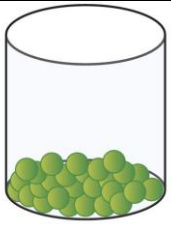
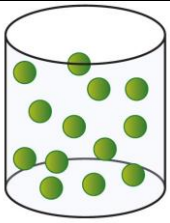
Name_____

Reading #3: Particles and Kinetic Energy

Let's think about what we've learned so far. *Everything* is made up of matter. That matter will be in either a solid, liquid, or gas state. Scientists have come up with a model to help us visualize what all this 'matter' might look like up close. This model, called the Particle Model, tells us a few things: 1) all matter is made of tiny pieces called particles; 2) there is space between the particles (the amount of space depends on if it's a solid, liquid, or gas we're talking about), and 3) the particles are always moving, in all states of matter. Particles in solids move, particles in liquids move, and particles in gases move. Got it? If you're not sure, read this over once more.

Kinetic Energy

Anything that is moving has **kinetic energy**. Kinetic energy simply means 'energy of motion'. If you are moving, you have kinetic energy. Think of a soccer ball that's just been kicked. It's got kinetic energy because it is moving. Something that does not move has no kinetic energy. You know that the particles that made up solids, liquids, and gases are always moving. This means that ALL particles have kinetic energy. The more kinetic energy the particles have, the faster they can move and the farther apart they get. Let's look at particles in all three states of matter and compare how much kinetic energy they have.

	Looks like…	Particles are…	Kinetic Energy
Solid matter		Packed so tightly that they cannot move much – only vibrate!	Low kinetic energy
Liquid matter		Close but loose, particles can slide past each other	Some kinetic energy
Gas matter		Particles are spread far apart so they move far and move quickly	Lots of kinetic energy

Changes of state happen when one of these states of matter turns into another. When a solid melts into a liquid, when a liquid evaporates in a gas, or when a liquid freezes into a solid – these are all changes of state. These changes happen because of kinetic energy – the energy of motion that comes from these particles that are always moving!

Kinetic energy helps us understand the differences between solid, liquid, and gas matter. Particles in a solid can't move much so they have low kinetic energy. Particles in a liquid move easily so they have some kinetic energy. Particles in a gas move so much because they are so spread out – they have high kinetic energy.

Name_____

Reading #3: Particles and Kinetic Energy

True or False: Circle the correct answer

1) Except for gases, everything is made of matter

   True / False

2) In science, a model allows us to imagine how something might look or work

   True / False

3) All matter is made of tiny particles that are always moving

   True / False

4) Particles always look the same in solid, liquid, and gas states

   True / False

Circle the correct answer

1) Particles in (gases only / liquids only / all states of matter) move
2) Kinetic energy comes from (motion / gravity / gases)
3) The more kinetic energy that particles have, the (faster / slower / bigger) they move around
4) (Solids / liquids / gases) have the most kinetic energy
5) (Solids / liquids / gases) have the least kinetic energy
6) There is lots of empty space between (solid / liquid / gas) particles

Think about the question and give your best answer

1) What does the Particle Model tell us? (there are 3 things)

2) What is kinetic energy?

3) Why does a solid have low kinetic energy?

4) Why does a gas have high kinetic energy?

5) Give an example of a change of state.

6) Why do changes of state happen?

Name_____

Reading #4: The Kinetic Molecular Theory

Kinetic energy is the energy of motion. All particles in every solid, liquid, and gas are always moving, so they have kinetic energy. You already know that. In this reading, you will learn what happens when the kinetic energy in those particles changes. This is called the **kinetic molecular theory**. Remember, a theory is an explanation why something happens.

Temperature and kinetic energy

Energy makes particles move. The more energy the particles have, the faster they move and the further apart they get. The particles in cold objects, such as ice cubes, have low kinetic energy. This is because the particles do not move fast or move far – they simply vibrate back and forth. When heat is added to matter, its particles gain kinetic energy. This causes the particles to move faster and further apart. If enough heat is added to a solid, it will melt. Melting is the change of state from a solid to a liquid. The temperature that this happens at is called the **melting point**. Different types of matter will have different melting points. For ice (water), the melting point is 0°C. For chocolate, the melting point will be about 30°C.

If we continue to add heat, we continue to increase the kinetic energy. This will cause the state of matter to change again. Boiling is the change of state from a liquid to a gas. The temperature that this happens at is called the **boiling point**. Like with the melting point, the boiling point will be different for different types of matter. For water, it will be near

100°C. For iron, the boiling point (yes, you can boil a metal) is 2,862°C.

When heat is removed from matter, the particles lose kinetic energy. That means the particles move slower and get closer together. If enough heat is removed from a gas, it will change into a liquid (this is **condensation**). If even more heat is removed, a liquid will become a solid (**freezing**). Ice is so cold because its particles have no heat, no kinetic energy, and are stuck close together.

Adding heat…	Taking away heat…
➔ adds kinetic energy ➔ makes particles move faster and further ➔ causes change of state (melt, boil)	➔ removes kinetic energy ➔ makes particles move slower, closer ➔ causes change of state (condensation, freezing)

The Kinetic Molecular Theory

So what exactly does the kinetic molecular theory explain? The kinetic molecular theory explains changes of state. Matter changes state because the amount of kinetic energy between its particles changes. Why do things melt, or boil, or freeze? The kinetic molecular theory has the answer!

Name_____

Reading #4: The Kinetic Molecular Theory

True or False. Circle the correct answer.

1) Matter makes particles move.

   True / False

2) A theory is a scientific explanation of why something happens.

   True / False

3) Chocolate has a higher melting point than water (as ice).

   True / False

4) Different types of matter will always have the same boiling point.

   True / False

Circle the correct answer.

1) When heat is added to matter, its particles (gain / lose / are not affected by) more kinetic energy.
2) The change of state from liquid to gas is called (condensation / melting / boiling).
3) Particles move slower and closer together when (kinetic energy increases / heat increases / heat decreases).
4) If enough heat is removed from a gas that it becomes a liquid, this is called (melting / condensation / evaporation)
5) Matter changes state because the amount of (force / kinetic energy / molecules) between its particles changes.

Think about each question then give your best answer

1) Why is ice so cold?

2) How is a melting point different from a boiling point?

3) How do particles of matter change when the amount of heat is reduced?

4) How does the space between particles change when heat is added?

5) How does the movement of particles change when heat is added?

6) What does the kinetic molecular theory explain?