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FLUIDS IN TECHNOLOGY AND DEVICES

Learning Intention:

Students will investigate and describe fluids used in technological devices and everyday materials.

Success Criteria:

- investigate and identify examples of fluids in household materials, technological devices, living things and natural environments
- explain the Workplace Hazardous Materials Information System (WHMIS) symbols for labelling substances; and describe the safety precautions to follow when handling, storing and disposing of substances at home and in the laboratory
- describe examples in which materials are prepared as fluids in order to facilitate transport, processing or use
- identify properties of fluids that are important in their selection and use

Materials Needed:

- a copy of ***Fluids*** Worksheets 1 and 2 for each student
- a copy of ***WHMIS Symbols and Safety Procedures*** Worksheets 3 and 4 for each student
- a copy of ***Preparing Fluids for Transport, Processing and Use*** Worksheets 5 and 6 for each student
- pens, pencils, pencil crayons, notebooks, clipboards, binders, rulers, scissors
- internet access, video equipment, chart paper

Procedure:

***This lesson can be done as one long lesson or divided into shorter lessons.**

1. Introduce the concept of fluids to students with a brainstorming activity. Have students list the fluids in the classroom or in their homes. Be sure to highlight how both gases and liquids can be fluids. Gives students Worksheets 1 and 2. Read as a class or assign as independent reading. Check for understanding. Gather together as a group again to add to the list of fluids and highlight the vocabulary for fluid properties.
2. Using chart paper or a front-of-room display, highlight the different pictograms used for WHMIS. Ask students what they might think if they saw these pictograms on a package or product. How would they act different handling the product? Would they be more careful? Discuss why the WHMIS pictograms and labels are used. Give students Worksheets 3 and 4. Read as a class and check for understanding. Draw attention to classroom rules and procedures during experiments.
3. Give students worksheets 5 and 6. Read as a class or assign as independent reading. Check for understanding. Assign questions as needed and monitor progress. Review material when work is complete.

Differentiation:

Slower learners may benefit from a reading partner or verbal presentation of all the content on the worksheets. Pair up students with a study-buddy or work-partner for the assignments and activities.

Faster Learners can :

create a WHMIS pictogram trivia card game using the pictograms and descriptions.

design a Lab Safety Poster

go on a “Safety Inspection” at home and report on ways fluids are used at home, how certain fluids are kept in safe places and how certain products have safety warnings or directions for use.

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Answer Key

Most questions in the worksheets may be answered in sentences or paragraphs. For brevity, the answer key may be reduced to point-form notes.

Worksheet 6

1. According to the Particle Model of Matter, all matter is made up of particles constantly in motion. These particles vibrate or move depending on the levels of thermal energy and kinetic energy. At higher temperatures, the particles move faster. The particles arrange themselves into solids, liquids or gases.
2. Compressibility is the ability of a fluid to be pushed into a smaller volume. Gases tend to be more compressible than liquids and solids. This is because there is more space between particles in gases, and molecules are not bound to each other like they are in liquids or solids.
3. a) density = mass / volume d = 1 kg/L

   b) 25.0 g / 15 mL = 1.67 g/mL

   c) 450 / 20 = 22.5 g/cm3

   d) 1.225 kg / 1 m3 = 1.225 kg/m3
4. a) Oxidizing means chemically combining or causing a combination with oxygen. Oxidizing can sometimes release a lot of energy in the form of heat, flame and light.

   b) Corrosive means that an object or substance can cause burning or harmful reactions.

   c) Toxins can be organic poisons or substances made from plant or animal origin. Toxins can wear down bodily systems or cause disease when in the body.
5. a) gas cylinder, exclamation mark, possibly explosive depending on make of extinguisher

   b) biohazard

   c) skull and crossbones, corrosive material, exclamation mark

   d) environment, health hazard

   e) exploding bomb
6. Answers may vary.
7. A slurry is a mixture of water and solid substances.

   Answers may vary. Suggestions: The company could boil out the water, or drain the water away, to separate the mixture.
8. Answers may vary. Suggestions: A liquid can be poured. A liquid has no set shape where solids have shape.

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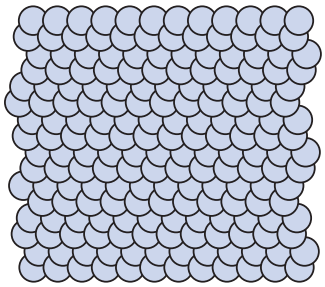
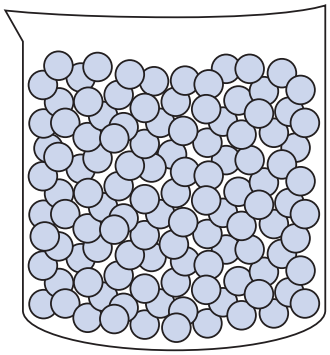
Fluids

According to the **Particle Model of Matter**, all matter is made up of particles constantly in motion. These particles vibrate or move depending on the levels of thermal energy and kinetic energy. Forces of attraction exist between the particles. These particles are called atoms or molecules. Molecules are several atoms clumped together. At higher temperatures, the particles move faster. The particles arrange themselves into solids, liquids or gases.

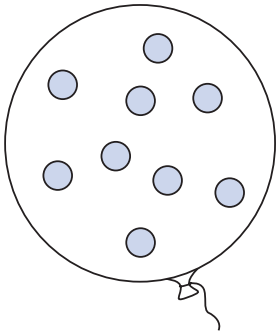
Solid



Liquid



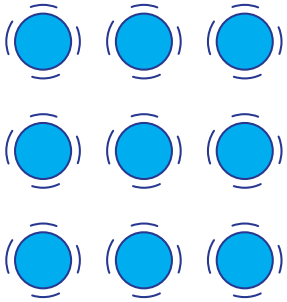
Gas



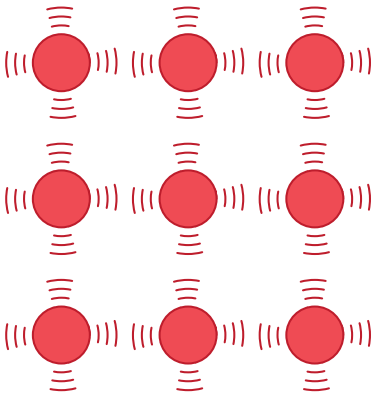
Solid	Liquid	Gas
• fixed volume and shape • particles vibrate in place • little space between particles • form a pile when poured or collected	• takes the shape of part of the container it occupies • particles can slide past one another and can be poured • little free space between particles • not easily compressed	• takes shape and volume of container • particles can move past one another and move in all directions • lots of free space between particles • compressible

The particle theory also explains why substances expand when they are heated and contract when they are cooled. At high temperatures, particles have more energy, move more quickly, and have more collisions. As a result, they take up more space, and the substance expands. At lower temperatures, particles have less energy, move more slowly, and have fewer collisions. They take up less space, and the substance contracts.

Contraction



Expansion



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A fluid is anything with no fixed shape and can flow. Liquids and gases are sometimes called fluids. They share some useful properties. When you study fluids, you may need to think about the following properties:

Mass is the amount of matter in the fluid object. It is often measured in grams (g) or kilograms (kg).

Volume is the amount of space taken up by the matter. Volume can be measured in litres (L) and millilitres (mL) or in cubic centimetres (cm^3) and cubic metres (m^3).

Density refers to how tightly packed the particles are in the fluid, or the mass of a substance per the unit volume. Density is often measured using a rate, such as grams per millilitre, or g/mL.

Compressibility is the ability of a fluid to be pushed into a smaller volume. When you apply pressure to some fluids, they will compress. We use compressed gas in wheels for vehicles. Other fluids, like water for example, do not change volume much under pressure.

Viscosity is a special property of fluids which measures the resistance of a fluid to flowing or moving. Thick ketchup does not flow or move at the same rate as water. Therefore ketchup is considered more **viscous** than water.

Flow Rate is similar to viscosity in that it measures how quickly a fluid flows in a given amount of time. It is often measured in volume per second.

Fluids make it easier to use materials and help machines run.

- **Household Materials -** Toothpaste and liquid soap are examples of how fluids are used around the home. Liquid soap gives surfaces a slippery feel and also loosens dirt. This makes it easier to wash things off your hands or your dishes.
- **Technological Devices -** A car's engine uses oil as a lubricant. It reduces friction and heat between moving parts. Liquid crystal display (LCD) devices use some of the properties of fluids to create visual images.
- **Living Things -** Blood carries oxygen to parts of the body. Tears, saliva and sweat are other body fluids that help the body work properly.
- **Natural Environments -** Water over a smooth surface is called sheet flow while water through rapids is considered turbulent flow. River systems, ocean currents and wind patterns develop from the properties of fluids. Even lava flows from volcanoes demonstrate measurable fluid properties like viscosity and flow rate.

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WHMIS Symbols and Safety Procedures

Some workplaces and work equipment use sensitive material. This material can be natural or chemical, like acids and bases, but create hazards if not handled safely. For example, something as important as oxygen can be hazardous because it is flammable.

WHMIS was created to help reduce injuries, illnesses, deaths, medical costs and fires caused by hazardous materials. WHMIS stands for the **Workplace Hazardous Materials Information System**. The containers or packaging of many work products and resources are now labelled with WHMIS stickers or come with WHMIS data sheets. This is to prepare people for the safe handling of the materials.

WHMIS uses pictograms, or images, as well as descriptions. Two signal words are used as well - "DANGER" for more severe hazards and "WARNING" for less severe hazards.

 **Flame** – for fire hazards. Gasoline, hydrogen, propane, kerosene, diesel fuel	 **Flame Over Circle** – for oxidizing hazards. Hydrogen peroxide, solid calcium hypochlorite used to clean pools	 **Gas Cylinder** – for gases under pressure. Propane tanks, acetylene tanks for welding, carbon dioxide in fire extinguishers
 **Corrosive Material** – for corrosive damage to metals as well as skin and eyes. Sulphuric acid, sodium hydroxide base, chlorine bleach	 **Skull and Crossbones** – can cause death or toxicity with short exposure to small amounts. Chlorine bleach, ammonia, carbon monoxide	 **Health Hazard** – may cause or is suspected of causing serious health effects Asbestos, acetone to the eye, latex to skin, Aspergillus flavus fungus growing on stored crops
 **Exclamation Mark** – may cause less serious health effects or damage to the ozone layer Formaldehyde, tartrazine, chlorofluorocarbons, hydrofluorocarbons	 **Environment** – may cause damage to wilderness or aquatic environments Mercury, arsenic, cyanide	 **Biohazardous Infectious Materials** – for organisms or toxins that can cause diseases in people or animals. E. coli bacteria, blood samples
 **Exploding Bomb** – for explosion or reactivity hazards. Benzoyl peroxide, acetyl peroxide		

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Lab Safety

Good Safety Rules

- Report accidents immediately and help to contain the problem, or clean up the materials quickly.
- Tie back long hair.
- Wear appropriate clothing and safety equipment.
- Keep aisles and work spaces clean and clear.

Preparation

- Clear your work space.
- Know what is expected and know where safety and clean-up materials can be found.
- Wait for permission to begin.

Heat Sources

- Remove flammable sources away from heat sources.
- Use tongs or gloves to pick up hot objects.
- Place electrical cords away from water sources, where no one will trip or slip on them.
- Let everyone know what you are doing so they can avoid burns.
- Extinguish burners or turn off heat sources when not being used.

Procedures

Know your classroom procedures for starting an experiment, handling materials safely and cleaning up after all work is completed.

What are some of the most important procedures for experiments in your classroom? Use the space provided to make notes and diagrams for yourself and your groups.

1. _____

2. _____

3. _____

4. _____

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Preparing Fluids for Transport, Processing and Use

Fluids have no fixed shape. Fluids also have the ability to flow. These properties make fluids incredibly useful for moving things, taking the shape of things and holding other materials in mixtures.

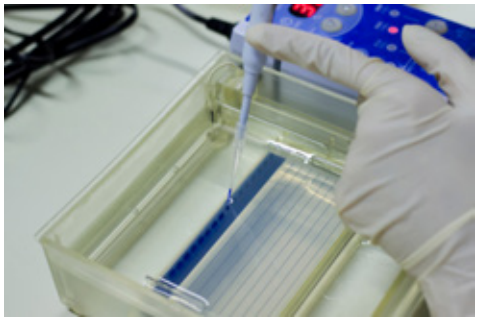
Transporting

When fluids run down a slope, they can take solid objects in the path right along for the ride. People have used this combination of fluids and the right slope in indoor plumbing, industrial mining and in pipeline projects. A mixture of a fluid, like water, and solid material is called a **slurry**. Slurry technology uses the transportation of solids in fluids like water.

In medicine, **saline** is a solution of salt in water. It is used to flush harmful material away from wounds or skin abrasions. It helps with the healing process.

Casting and Moulding

Glass, concrete and steel are all examples of solids that are first processed in liquid form. In liquid form, they are easier to shape and control. Die casting or metal casting is a process of injecting molten metal into a mould. The molten metal takes the shape of the mould. When it cools, it keeps the new shape. A lot of our machines and tools come from casting and moulding.



Holding or Binding

Fluids can hold materials and mixtures. Many laboratories use a gel-like substance for trial experiments. Bacteria or samples of organic material might be held in place within small containers of the gel. The researcher can then measure and record reactions or growths. At home, we use hair products and toothpaste which bind mixtures of ingredients together by fluids.

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Answer the following questions on a separate piece of paper. Use information from the worksheets and other sources for your answers.

1. What is the Particle Model of Matter? How does the Particle Model of Matter explain how things change when the temperature changes?

2. What is meant by compressibility? What tends to compress more – a solid, liquid or gas, and why?

3. Find the density of the following items:
   a) water in a container, with a mass of 1 kg and a volume of 1 L (in kg/L)
   b) a piece of wood with a mass of 25.0 grams and a volume of 15 mL (in g/mL)
   b) a bracelet of gold beads having a mass of 450 g and a volume of 20 cm3 (in g/cm^3)
   d) a box of air, where the box has a volume of 1 m^3 and a volume of 1.225 kg (in kg/m^3)

4. Look up the following terms and give their definitions in your own words:
   a) oxidizing
   b) corrosive
   c) toxins

5. What WHMIS pictograms or labels would appear on the following items (may be more than one):
   a) a fire extinguisher tank of carbon dioxide
   b) an aerosol spray with contents that would burn
   c) a container on a hospital wall where nurses put needles and used gloves
   d) chlorine bleach
   e) arsenic
   f) acetyl peroxide

6. Each WHMIS symbol has example products or materials on Worksheet 3. Pick 4 of the example products and create a profile for each one. What are some common uses for it, how is it packaged (is it a gas, liquid or solid?) and what safety precautions would you recommend if you had to handle it?

7. What is meant by the word **slurry**? Imagine if a company used a slurry of water to transport material from one place to another. The company has to separate the water out afterwards. What do you think they could do to separate the water from the solid material?

8. Casting and moulding turn a liquid material into a solid final product. Why do you think a liquid is easier to use rather than starting with a solid?

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Alberta Science Curriculum Map

The lessons and experiments in this book fall under 5 main topics that relate to the Alberta curriculum for Grade 8 Science.

Unit A: Mix and Flow of Water
Unit B: Cells and Systems
Unit C: Light and Optical Systems
Unit D: Mechanical Systems and
Unit E: Freshwater and Saltwater Systems.

In each lesson, you will find teacher notes designed to provide guidance with the learning intentions, the success criteria, materials needed and a lesson outline. As well, the notes will provide some insights on what results to expect when the experiments are conducted.

Suggestions for differentiation or accommodation are also included so that all students can be successful in the learning environment.

The lessons are designed to involve tactile participation and knowledge application while providing opportunities to connect ideas between topics and school subjects.

Lesson Topics:

Unit A: Mix and Flow of Matter

Key Concepts
Lesson 1 - Fluids in Technology and Devices
Lesson 2 - Pure Substances, Mixtures and Solutions
Lesson 3 - Properties of Fluids – Density and Buoyancy
Lesson 4 - Properties of Fluids – Viscosity and Pressure
Lesson 5 - Technologies That Use Fluid Properties

Unit B: Cells and Systems

Key Concepts

Lesson 1 - The Science of Living Things
Lesson 2 - The Role of Cells in Living Things
Lesson 3 - Healthy Functions and Body Reactions to Stimuli
Lesson 4 - Innovations in Understanding the Body and Medicine

Unit C: Light and Optical Systems

Key Concepts

Lesson 1 - The Nature of Light and Vision
Lesson 2 - The Transmission of Light and the Geometric Ray Model
Lesson 3 - Using Science to Form Images

Unit D: Mechanical Systems

Key Concepts

Lesson 1 - Improvements Over Time – Simple Machines and Mechanical Devices
Lesson 2 - Structures and Functions of Machines
Lesson 3 - How Mechanical Systems Transmit Force and Energy
Lesson 4 - Mechanical Systems – Fluids and Hydraulics
Lesson 5 - Science, Society and the Environment: Living with Mechanical Devices

Unit E: Freshwater and Saltwater Systems

Key Concepts

Lesson 1 - Characteristics and Significance of Water in Environments
Lesson 2 - Linking Landforms, Water and Climate
Lesson 3 - Waves, Ocean Currents, Glaciers and Regional Climates
Lesson 4 - Marine and Freshwater Environments
Lesson 5 - Aquatic Systems – The Human Impact
Lesson 6 - Aquatic Systems – The Role of Science and Technology