UNIT LEARNING PACKS

FOCUS IN ACTION

Grade 8 Science in Action

Unit 1 - Mix and Flow of Matter

EDQUEST
MIDDLE SCHOOL SCIENCE RESOURCES

http://www.edquest.ca

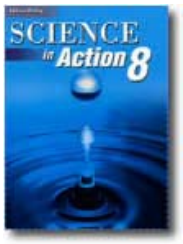
'Focus in Action' UNIT LEARNING PACKS

These booklets are designed to provide Grade 8 students with all the resources needed to review or reinforce concepts, covered in the Alberta Science Curriculum, and included in the Grade 8 Science Final Exam in June. There are circumstances in which **an entire unit** may be missed and covering the concepts from that unit (for the final exam) can be difficult. This can happen for a number of reasons:

- Students – new to the school – register throughout the year (from other provinces, school jurisdictions or countries)
- Students may be ill or have surgery and often can miss one or more units
- Students have extended holidays throughout the year
- Transfers from another school, who have completed the units in a different order

For additional support, students are directed to the **Edquest Middle School Science Website** or, Scienceman Resource (www.scienceman.com/scienceinaction/pgs/hot_8u1.html)

Unit 1 – Mix and Flow of Matter



- **Section 1 Notes**
- **Section 1 Quiz**
- **Section 2 Notes**
- **Section 2 Quiz**
- **Section 3 Notes**
- **Section 3 Quiz**
- **Section 4 Notes**
- **Section 4 Quiz**
- **Unit Summary**
- **Review Booklet**
  (Covered in class, prior to the Final Achievement Exam)
- **Unit 1 Test**
- **Answer Key for Section Quizzes and Unit Test**

Freshwater Website:
http://www.ec.gc.ca/water/e_main.html

Additional support will be provided, in the form of practice Achievement Test Questions, during the course review in June. Multiple Choice Questions and Numerical Response Questions will be reviewed, as these are the types that will make up the Science 8 Final Exam

Handouts and other activities, to reinforce the concepts covered in this Unit, will be made available based on need. If you require further information or resources, email Edquest directly: edquest@gmail.com.

Finding Solutions to Problems, instead of Making Excuses

Student Instructions for use of this Learning Pack

The purpose of this Learning Unit Pack is to provide you with the resources that will help you cover the material from the curriculum that will be tested on the Final Exam in June.
Follow these steps to successfully complete this Unit Learning Pack:

Step 1 – Read the **Topic Notes**

Step 2 – Use a **highlighter** to identify the key words or phrases in the Topic Notes and reread the material again paying close attention to those words that you highlighted. If necessary, modify your highlights to make sure you understand the material in the notes.

Step 3 – Complete the **Topic Quiz**

Step 4 – Correct the Topic Quiz by **checking the answers** in the back of this Learning Pack.

Step 5 – Using your **textbook** and the **completed quiz**, find the page where the question and correct answer can be found and write it next to the question number in your Learning Pack.

Step 6 – **Repeat Steps 1-5** for each of the other Topics in this Unit.

Step 7 – Look over the **Unit Outline** to review the **Key Concepts** once you have completed all of the Topics.

Step 8 – Complete the **Unit Review**, using your **Learning Pack** and **Textbook**.

Step 9 – **Highlight** those sections of the Review that you had difficulty with and review those sections with your teacher prior to taking the Unit Test.

Step 10 – Take the **Unit Test** and correct it using the answer key provided in the back of the Learning Pack.

Step 11 – You should now be ready to answer any questions on the **Final Exam** related to this Unit.

Anything you still do not understand should be discussed with your teacher. Congratulations on your **Independent Study**, and Good Luck on the Final Exam. I hope you have made good use of this resource. Please provide feedback to your teacher, so that this resource can be improved.

Additional support is available in the form of practice Achievement Test Questions. **Multiple Choice Questions** and **Numerical Response Questions** will be made available on request, as these are the types that will make up the **Alberta Science 9 Achievement Exam**.

Handouts and other activities, to reinforce the concepts covered in this Unit may be acquired by visiting the Edquest Middle School Science Resource Website

http://www.edquest.ca

Section 1.0 – Fluids are used in technological devices and everyday materials

1.1 – WHMIS Symbols and Safety Procedures

Use the Safety Notes and the Practice Test

- **Safety Notes -** http://www.edquest.ca/content/view/109/
- **Practice Safety Test -** http://www.edquest.ca/content/view/110/

1.2 – The Many Uses of Fluids

A **fluid** is anything that has no fixed shape and can flow. Usually it is a **liquid**, or a **gas**.

> Info**BIT**: **Agrifoam** is a fluid – a shaving-cream-like material that can be sprayed onto plants to protect them from freezing.

Fluids Make It Easier To Use Materials

Fluids move materials, even if they are solids.

Slurries
A mixture of water and a solid (like dirt and water) is called a **slurry**. Slurry technology – the transport of solids in water – has many important applications. One of these is mining in the Oil Sands. Syncrude originally used conveyor belts to move the oil sand from the mine to the processing plant, but found it was too expensive. It is now pumped to the plant by way of a slurry pipeline.

Fluids Become Solids
Fluids take the shape of their containers.
Many solid materials are originally prepared as fluids. Glass, Steel and concrete are examples where the solids are processed as liquids to shape them easier, so then they cool or dry as a solid they are in the form they should be.

Fluids Can Hold Other Materials

The ability of fluids to **flow** and **carry other materials** makes them useful in many different applications. Toothpaste has a ***'binder'*** (which is made from wood pulp) that keeps all of the ingredients together.

Useful Properties of Fluids

Fluid properties enable a wide variety of uses to be possible. By understanding these properties, such as: density, buoyancy, viscosity and compressibility; technological devices can be designed which make use of these properties.

A common method of processing mineral ore is called **froth flotation**.
Find out more: http://www.engr.pitt.edu/chemical/undergrad/lab_manuals/flotation.pdf

Section 1.0 - Practice Quiz

Fluids are used in technological devices and everyday materials.

1.2 The Many Uses of Fluids

1. Frost damage is a big risk for farmers who grow fruit. To help farmers protect their crops, a shaving-cream-like foam, to spray on the fruit, was invented to protect it. It is called ...

A. Foam aid
B. Agrifoam
C. Fruit foam
D. Agriprotect

2. Anything that has no fixed shape and can flow and usually is a liquid or a gas is called a ...

A. fluid
B. hydraulic
C. pneumatic
D. compressed gas

3. To move a solid, like dirt, more easily, it is mixed with water making this - a ...

A. suspension
B. sludge
C. colloid
D. slurry

4. Syncrude originally used conveyor belts to move the oil sand from the mine to the processing plant, but it proved to be very expensive to continue operating in this way. They now use ...

A. a slurry pipeline
B. transport trucks
C. very large bulldozers
D. monster dump trucks

5. Toothpaste contains bauxite to polish your teeth. It also contains a detergent to clean your teeth and fluoride to strengthen them. All these substances are kept together with a substance made from wood pulp. It is called ...

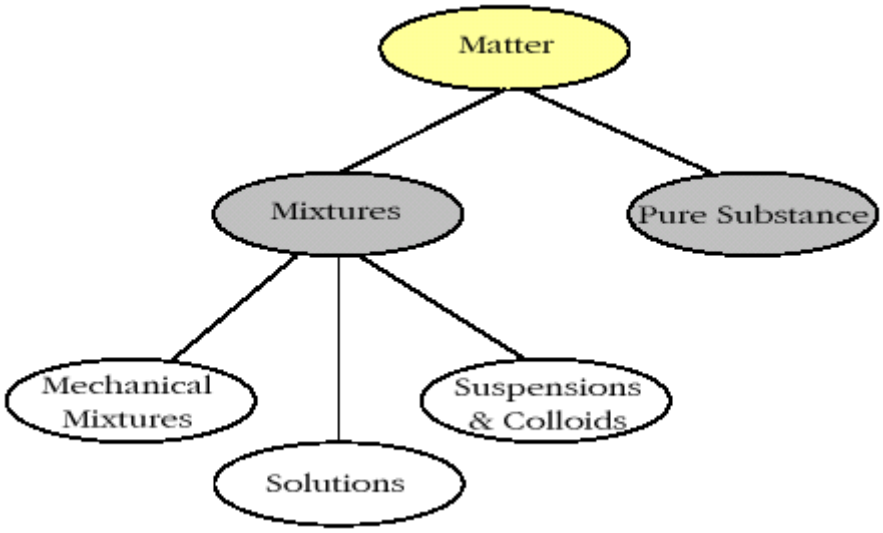
A. pulp mix
B. glue
C. paste
D. binder

2.0 The properties of mixtures and fluids can be explained by the particle model of matter

2.1 Pure Substances and Mixtures

- All pure substances have their own unique set of properties, or characteristics
  All mixtures contain two or more pure substances, which have their own distinct properties (some of which may be hidden)

  Classification of Matter Chart (p.20)



Homogenous Mixtures

- are mixtures which look as though they have only one set of properties.
- the blended mixture has equal amounts of both substances (all parts of the mixture are the same)
- if the homogenous mixture does not have any settling of any of the substances it is made of, then it is called a solution
- solutions occur because each particle slips between each other particle and is evenly distributed throughout the entire mixture

Heterogenous Mixtures

- the properties of the pure substances, in a heterogeneous mixture, are not hidden
- if there are two or more materials that are visible within a mixture, then it is called a heterogeneous mixture

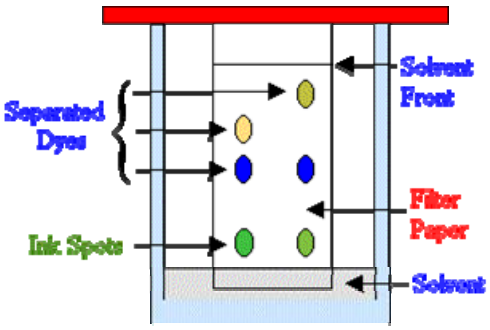
In-Between Mixtures

- a heterogeneous mixture, in which the particles settle slowly after mixing, is called a **suspension** (eg. orange juice)
- a heterogeneous mixture, in which the particles do not settle at all, is called a **colloid** (eg. fog)
- to disperse the particles for a longer period of time, an **emulsifying agent** (like a protein) is used to form an emulsion (eg. mayonnaise)
- mixtures that are obviously two or more substances are called **mechanical mixtures**
  the separate parts of the mechanical mixture are called ***phases***.

Paper Chromatography

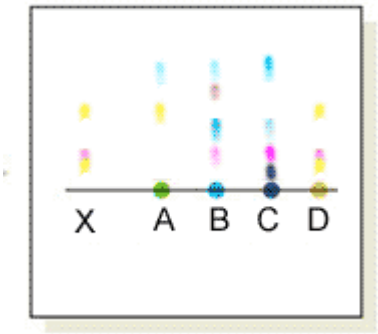
A paper chromatography test can be used to determine if a substance is pure or a solution.

A filter paper is placed partially in a solution – if the fluid moves up to only one level it is a pure substance – if it moves up to multiple levels showing each substance, then it is a solution.



Reading Chromatograms

The filter paper used in the paper chromatography test is called a **chromatogram**.
The distance a substance move up the chromatogram depends on its attraction to the paper. Those with a stronger attraction to the paper don't move up as far as those with a weaker attraction.



Applications

Separation systems are used in a wide variety of industrial and scientific applications. These systems isolate and analyze products that come from mixtures formed during chemical synthesis. Chromatography applications are used in many scientific analyses, including:

- Medical/biomedical research, quality control of pharmaceuticals, routine clinical determination, and drug screening
- Space-related and geo-chemical research and development
- Forensic sciences
- Food and cosmetic chemical measurement
- Process control in the petroleum industry
- Environmental monitoring and pollution control
- Investigation of the chemistry and metabolism of biological systems

2.2 Concentration and Solubility

Forming a solution by mixing two or more materials together is called **dissolving**.
- dissolving occurs because of the attracting between the particles (there may be a stronger attraction to the particles of another substance, than to the particles of the same substance)

Solutes and Solvents

The **solute** is the substance that dissolves in a solvent. The **solvent** is the substance that dissolves the solute to form a solution.

Soluble means to be able to be dissolved in a particular solvent. Solutes and solvents can be gases or liquids. **Measuring Concentration**

The **concentration** of a solution is the actual amount of solute in a specific amount of solvent. example: 50 grams of solute dissolved in 100 ml of water has a concentration of 50g/100ml (Another common way to express concentration is how much solute is dissolved in a 100 ml of a solvent) Concentration can also be stated as a percentage - ie. 5% (means, 5g/100ml). Extremely low concentrations are stated in ppm (parts per million).

Comparing Concentrations

To compare concentrations of two solutions, you need to know the amount of solute in the **same volume** of solvent for each solution.

Solution 1	**10g of salt in 50ml of water (10g/50ml)**	**= 20g/100ml**
Solution 2	**25g of salt in 100ml of water (25g/100ml)**	**= 25g/100ml**

Solution 2 has a higher concentration

Saturated and Unsaturated Solutions

The limit to concentration is called **solubility**. (The maximum amount of solute that can be dissolved in a fixed volume of solvent at a given temperature.)

- a **saturated solution** is one in which no more solute will dissolve in a specific amount of solvent at a specific temperature (Using the particle theory, the attractive forces between the particles becomes balanced and no more particles of the solute can be attracted by the particles of the solvent)
- an **unsaturated solution** is one in which more solute can be dissolved in a specific solvent at the same specific temperature

Supersaturated Solutions (**Solubility** is a unique property **- *Solubility Chart*** (**sia** p. 28)

- a solution that contains more solute than would normally dissolve at a certain temperature is called a super-saturated solution.

2.3 Factors Affecting Solubility

Water - is called the '**universal solvent**', because it can dissolve so many materials. The term ' ***aqueous*** ' means water. 97% of the water on Earth is Ocean water, 2% is frozen and only about 0.5% is 'usable' (and even this has materials already dissolved in it that can be harmful), Solutions are not only made up of liquids. The chart on p. 29 illustrates other mixtures that can make solutions.

Solubility Changes With Temperature

Solubility increases as the temperature of the solvent increases, because more space is provided between the particles for the solute particles to fit (dissolve) into. The reverse is true for a gas though - as the temperature increases, the solubility of a gas, in a liquid solvent decreases.

Thermal Pollution

This decrease in the solubility of gases can have a serious effect on the environment. If the temperature of water increases (warm industrial waste water poured directly into lakes and rivers) then there is less oxygen that can be dissolved in the water – thus, affecting the living organisms in the water. This is called thermal pollution.

2.4 The Particle Model of Matter and The Behaviour of Mixtures

- All matter is made up of tiny particles. Different substances have different particles.
- The particles are always moving and vibrating
- The particles in matter may be attracted to each other or bonded together
- The particles have spaces between them

The particles flow in a fluid by moving freely past one another and at rest have a flat surface. For this reason, solids do not flow, because at rest, they form a cone-shaped *heap*.

How the Particle Model Explains Mixing Substances

Particles are different sizes and when two substances are mixed, the smaller particles fill the spaces between the larger particles. The particle model also states that particles are attracted to each other. However, in some substances particles can be attracted more to particles in other substances than to its own particles.

Factors Affecting the Rate of Dissolving

The speed at which the solute dissolves in a solvent is called the rate of dissolving and can be affected by:

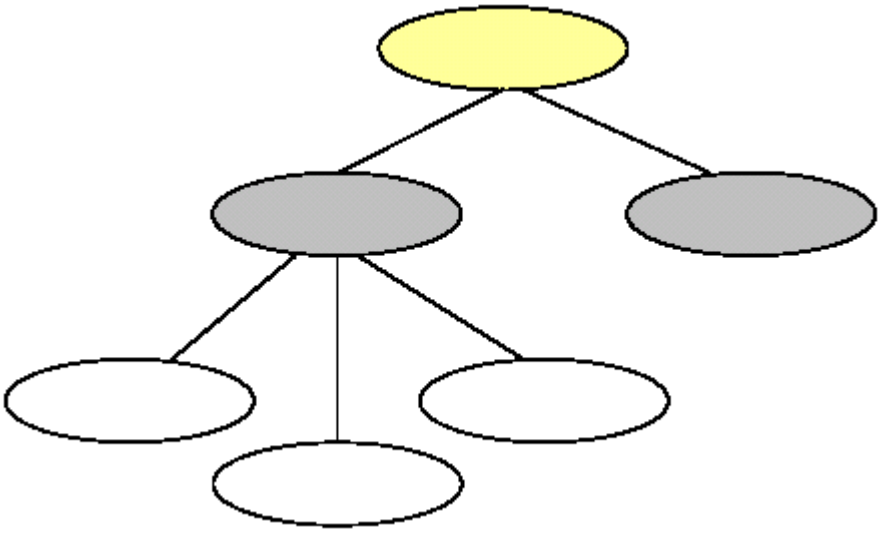
- Temperature
- Agitation (*stirring or shaking*)
- Size of pieces (*surface area exposed*)

Section 2.0 - Practice Quiz

The properties of mixtures and fluids can be explained by the particle model of matter.

2.1 Pure substances and Mixtures

1. Use the following words to complete a visual organizer, showing the relationships between and among the words provided. **Use each word only once.**
Pure Substances, Matter, Solutions, Mixtures,
Mechanical Mixtures, Suspensions and Colloids



2. Mixtures can be made with solids, liquids or gases. The kind of mixture or solution that is referred to as heterogeneous is a mixture or solution which …

A. is clear
B. is cloudy
C. appears as a single substance
D. all the parts are visible

3. For some fluids, paper chromatography is a test that determines whether a substance is a ...

A. mixture or a colloid
B. pure substance or a mixture
C. colloid or suspension
D. mixture or suspension

4. Insulating foam is sprayed into cracks to seal them. The gas and liquid together make a ...

A. colloid
B. suspension
C. mechanical mixture
D. solution

5. At school we use coffee filter paper to investigate the process of paper chromatography. The filter paper is called a ...

A. chromatogram
B. chromatograph
C. filtrate
D. pH indicator

2.2 Concentration and Solubility

6. When a substance, such as sugar, dissolves in water, the particles intermingle. This is possible because the particles of sugar ...

A. are pure
B. have strong attractions to each other
C. have spaces between them
D. are vaporized

7. In concentrated solutions, there are large amounts of ...

A. empty spaces
B. diluted particles
C. solvent in the solute
D. solute in the solvent

8. Concentration amounts can be stated in many different ways. 50g per 100ml is one common way. Another way is to express it as a percent, like they do in juice containers. If an apple juice Tetra Pak had 20 grams of apple juice per 100ml, the concentration would be …

A. 2%
B. 8%
C. 20%
D. 80%

9. When comparing concentrations of different solutions, it is necessary to compare the concentrations in the same volume. Which of the following solutions would have the highest concentration?

A. 5.6g per 10ml
B. 12g per 25ml
C. 25g per 50ml
D. 50%

10. The difference between a saturated and unsaturated solution is that an unsaturated solution can dissolve more …

A. solvent
B. solute
C. particles
D. spaces

11. Solubility is the maximum amount of solute that you can add to a fixed volume of solvent at a given …

A. depth
B. time
C. temperature
D. place

2.3 Factors Affecting Solubility

12. Solubility is affected by a number of factors including all of the following, EXCEPT ...

A. temperature
B. agitation
C. type of solute
D. type of solvent

13. Water is referred to as the universal solvent, because it can dissolve so many different substances. To identify a solution that contains water as the solvent, chemists use the term ...

A. aqueous
B. agitated
C. watery
D. evaporated

14. A common solution in which the solute is solid and the solvent is liquid is …

A. antifreeze
B. air
C. rubber cement
D. saltwater

15. For most common solid or liquid substances, solubility increases as temperature increases. This is NOT the case with ...

A. alcohol
B. gases
C. ethanol
D. water

2.4 The Particle Model and the Behavior of Mixtures

16. Diffusion occurs when the particles of a solute ...

A. are heated and cooled very quickly
B. fill the spaces between the particles of the solvent
C. are dissolved by a change of state
D. attach to particles of the solvent

17. Dissolving occurs when a solute and a solvent are added together. The factors that affect the rate of dissolving are ...

A. type of solute, type of solvent, temperature
B. agitated, temperature, size of pieces
C. temperature, concentration, solubility
D. type of agitation, temperature, type of solvent

3.0 The *Particle Model of Matter* can explain the properties of gases and liquids.

3.1 Viscosity and the Effects of Temperature

Fluids can flow. How quickly they can flow is called **flow rate**. A substance's resistance to flow (*how thick or thin it is*), or **viscosity**, affects flow rate. The internal resistance or friction between the particles of the substance determines the viscosity of that substance. The more friction - the more viscous (thicker) a substance is. The higher the viscosity of a substance, the slower it flows.

More Viscous

Less Viscous

The Effect of Temperature on Viscosity

Temperature has an effect on the viscosity of a substance.

When thick syrup is poured over hot pancakes, the syrup becomes thinner and runs over the sides of the pancakes.

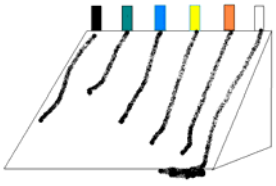
When thick oil is added to the engine of a car, the oil thins out when the engine heats up.

Olive oil is very thin (almost watery). To make it a little thicker it can be placed in the fridge, where it's viscosity can be increased.

Asphalt (road paving) materials are heated up (making them less viscous) so they can be poured easily before it hardens.

Viscosity can be easily measured using the *ramp method*.

Pour different liquids down a ramp and time how long it takes for each of them to get to the bottom. The one that is the slowest will be the most viscous.



Reminder: Increasing temperature lowers viscosity (makes it thinner)
Decreasing temperature increases viscosity (making it thicker)

3.2 Density of Fluids

Density is the amount of matter in a given volume. Every substance has a different density, because each substance is made up of different particles. The density of a substance depends on the particles it is made up of. When we talk about density, it's usually mass density we're referring to. The mass density of an object is simply it's mass divided by it's volume.
Density depends on whether the object is solid, filled with air pockets, or something in between.

Substances that have a ***higher density*** than the density of the substance it is placed in will **sink**, substances that have a ***lower density*** than the density of the substance it is placed in will **float**.

Calculating Density

Density is the mass of a substance divided by its volume, which changes as temperature changes.

This is shown in the following equation form:

Density (d) = mass (m) / volume (V)

solids: d = grams/cubic centimeters (cm^3)
liquids: d = grams/milliliters (*mL*)

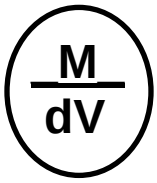
(**Figure 3-4** Densities of some common substances at 20^o - **SIA p. 43**)

One way to determine the volume of an irregular object is to measure its mass in air and then in water, subtract the second measurement from the first, and divide by the density of water.

Another way to determine the volume of an irregularly shaped object is to submerge the object in a full container of water. The volume of the object equals the volume of water that overflows.

Density Calculations (Memory Method)

This simple equation will help you figure out how to solve density problems:

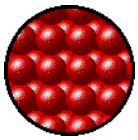
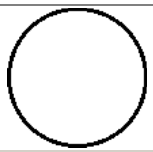


Simply cover up whichever value you need to calculate and the other two are shown in their proper placement, either multiply or divide.

Ships can float because they contain large volume of air. The overall density of the ship is less dense than water, so it floats.

3.3 Density, Temperature and Buoyancy

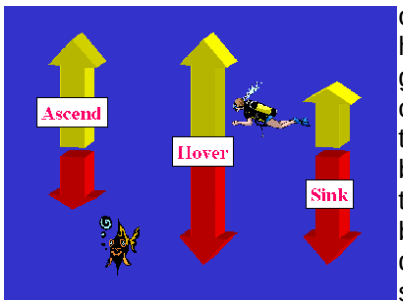
Viscosity changes with temperature. Density does not change as long as the temperature remains the same. The particle model of matter states that for every substance, the number of particles in a given volume, remain constant, if the temperature is kept constant. As energy is added, the particles move more quickly and further apart, thus increasing the substance's volume. When this happens, the density of the substance (which is the mass to volume ratio) decreases because the mass remains constant, but the volume increases. One substance can have different densities, depending on the state it is in.

Solid	Liquid	Gas
		
Particles are closely packed together	Particles can slip past each other	Particles have lots of space between them

Changing Density by Changing Concentration

Objects that are less dense than 1g/ml float in water. The Dead Sea is one of the saltiest bodies of water on the Earth. When salt is added to water, there are more particles in a given volume, which increases the density of the water, allowing denser objects to float in the saltwater.

Buoyancy is the tendancy of a substance to float. Buoyant objects take up space in a fluid. pushing some of the fluid away or displacing it, causing them to float, because the fluid pushes back against the force of gravity.



When an object is in a liquid, the force of gravity pulls it down. The liquid itself has a force that acts against the force of gravity. This buoyant force pushes objects upward. Objects that are denser than water will ***sink*** (negative buoyancy); objects that are less dense than water will ***float*** (positive buoyancy); objects with the same density as water, will ***hover*** (or, be suspended - ***(neutral buoyancy)***, neither sinking nor floating.)

Measurement of Buoyancy

Force is a push or a pull on an object, and is measured in **Newtons** (N).
The upward force of a fluid on an object is called its buoyant force, which is also measured in Newtons.

Calculation of Buoyant Force

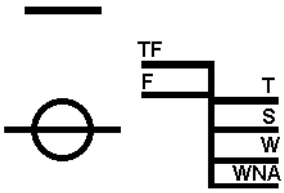
Buoyant Force = Weight in Air - Weight in Liquid

Applications of Buoyancy

This principle has important applications in transportation.

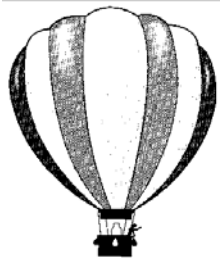
Figure 3.11 (**sia** p.51)

Ships are designed to float in all types of water,
regardless of the density of the water.
This is possible because of the **Plimsoll Line**
- which shows how heavily a ship can be loaded
in different water conditions.



The marks on the **left** indicate **fresh water** - while the marks on the **right** are for **saltwater**.

Hot Air Balloons - As the air inside the balloon is heated, it becomes less dense than the surrounding air. The buoyant force of the air will push the hot air balloon upwards, until the buoyant force equals the force of gravity.



See re**SEARCH**

about *zeppelins* - and especially the ***HINDENBERG***

(**sia** p.51)

Section 3.0 - Practice Quiz

The properties of gases and liquids can be explained by the particle model of matter.

3.1 Viscosity & Flow Rate

1. The viscosity of liquids can be compared by observing their ...

A. clarity
B. volume
C. resistance to flow
D. resistance to acceleration

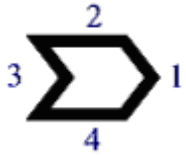
2. In order to increase the speed of flow of oil in a pipeline, the oil should be ...

A. heated
B. cooled
C. expanded
D. compressed

3. Using the ramp method to determine viscosity, a student found out that Fluid A has a flow rate of 10. 5 ml, per second. Fluid B has a flow rate of 11. 3 ml, per second. Compared to fluid A, fluid B is ...

A. more viscous
B. less viscous
C. more dense
D. less dense

4. Use this diagram to answer the next question.



This shape travels through a fluid.

It would experience the LEAST drag if it were moving in direction ...

A. 1
B. 2
C. 3
D. 4

5. When your dad or mom start the cold car in the morning, they may mention that the viscosity of the motor oil would be decreased by ...

A. running the engine
B. charging the battery
C. changing the antifreeze
D. replacing the thermostat

6. To explain viscosity using the particle model, the following statement would be correct ...

A. the particles can slide and roll over each other
B. the particles move randomly
C. the particles bump into each othe
D. the particles rearrange themselves

3.2 Density

7. An everyday situation, like a 'crowded' elevator, can represent the particle model, which helps us to visualize empty spaces between the particles. In this example a 'spacing box' is used in an elevator. Each person has his or her own individual 'spacing box'. This idea of spaces between the particles, helps us to understand the concept of density, if we consider the ...

A. placement of the spacing boxes in the elevator
B. type of spacing box used
C. size of the spacing box
D. number of spacing boxes

8. The particles in a liquid cannot support the particles of a solid, unless the ...

A. liquid is less dense
B. liquid particles have less attractive force between them
C. solid particles have more attractive force between them
D. solid is less dense

9. Which of the following statements best describes the correct difference, in terms of density

A. liquids are less dense than gases
B. gases are less dense than liquids
C. gases are more dense than solids
D. liquids are more dense than solids

10. A Grade 8 student made the following statement, “All liquids are less dense than all solids and more dense than all gases”. Which of the following substances proves this student's statement to be INCORRECT?

A. mercury
B. wood
C. iron
D. helium

11. The formula for density is Density = Mass / Volume. If a substance has a volume of 100cm3 and has a mass of 1932 grams, what is the density of the substance?

A. 193.20 g/cm^3
B. 19.32 g/cm^3
C. 1.932 g/cm^3
D. 0.1932 g/cm^3

3.3 Buoyancy

12. Buoyancy is the tendency of an object to float. A diver demonstrates neutral buoyancy when the…

A. force of gravity equals force of buoyancy
B. force of buoyancy is greater than force of gravity
C. force of buoyancy is less than force of gravity
D. force of gravity does not affect force of buoyancy

13. Large ocean liners, and cargo ships, can float on the water because ...

A. its average density is lower than saltwater
B. the metal it was made of is less dense than water
C. the metal is more dense and therefore can float
D. saltwater is more dense and can hold up steel

14. Archimedes principle states that 'the buoyant force acting on an object equals the ...

A. mass of the fluid displaced by the object
B. force that holds the object afloat
C. weight of the object displaced by the fluid
D. weight of the fluid displaced by the object

15. Fresh and saltwater systems have different densities. All cargo ships have a special line that shows how much the ship should be safely loaded so it won't sink as it goes from freshwater to saltwater. This line is called the …

A. Sinking Line
B. Buoyancy Line
C. Plimsoll Line
D. Density Line

16. Density and buoyant force are related. As the ...

A. density of a fluid increases, the buoyant force decreases
B. density of a fluid decreases, the buoyant force increases
C. density of a fluid increases, the buoyant force remains the same
D. density of a fluid decreases, the buoyant force decreases

3.4 Compression

17. A gas can be compressed more than a liquid because the gas particles ...

A. can increase their energy level more than the liquid particles
B. need extra energy to take up more space
C. have more space between them than the liquid particles do
D. need less energy to take up more space

18. When a force is applied to a substance and the particles cannot be forced closer together the substance is said to be incompressible. What happens to the force? A. B. C. D.

A. It changes the volume
B. It is absorbed by the substance
C. It is applied throughout the substance
D. It changes direction

3.5 Pressure

19. Pressure is the amount of force applied to a given area. This is measured in …

A. Newtons
B. Meters squared
C. Pascals
D. Compressions

20. When we suck on a straw in a Tetra Pak juice container, the sides of the container collapse. This happens because ...

A. we are increasing the pressure inside the container
B. the atmospheric pressure is collapsing the walls of the container
C. the pressure inside the container is increased and collapses from the added pressure
D. we are lowering the strength of the container when we suck on the straw

21. Pascal's Law states that an enclosed fluid transmits pressure in …

A. an upward direction
B. a downward direction
C. a sideways direction
D. all directions equally

22. In a model hydraulic press model built by an apprentice, a pedal is used to push down the large piston, while the small piston lifts up a load. The apprentice's model didn't work. What is wrong with it?

A. The pistons should have the same diameter.
B. The load should be on the larger piston.
C. Both pistons should be smaller
D. Both pistons should be larger

23. Two identical syringes are used to build a model of a hydraulic press. The press does not lift the loads you expect. To remedy the situation, you should use ...

A. larger syringes
B. longer syringes
C. smaller syringes
D. syringes with different diameters

24. In terms of design, a pneumatic device (such as a compressor) resembles a hydraulic press. The distinguishing difference is that this pneumatic device uses ...

A. compressed alcohol
B. incompressible fluids
C. compressed air
D. an electrical current to operate it

25. Hydraulic and pneumatic devices are able to function properly only if this occurs. These systems are ...

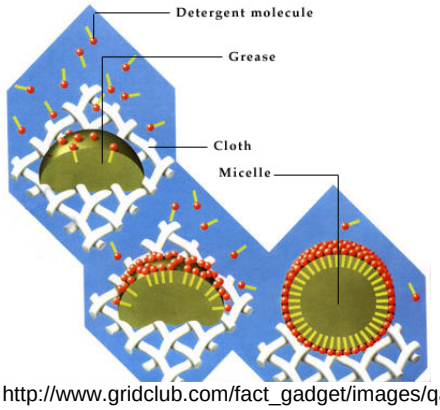
A. completely sealed
B. full of water
C. full of air
D. completely compressed

Section 4.0 – Many technologies are based on properties of fluids.

4.1 Technologies Based on Solubility

Fat & dirt are most times "**hydrophobic**" (meaning "*afraid of water*"). Hydrophobic materials do not solve in water. A detergent is a substance that can remove dirt from fabrics.

Most detergents are liquids or powders that are soluble in water. They contain a cleaning agent called a **surfactant**. Soap (the surfactant) encapsulates the fat & dirt molecules in the water, removing them from the fabric. In this way the dirt and water forms an ***emulsion***, which can then be drained away.



http://www.gridclub.com/fact_gadget/images/qa2c06f3.jpg

See also Textbook Illustration **(Figure 4.1** p. 63**)**

Phosphates were once used in detergents, but the environmental side effects were bad. Because phosphates encourage plant growth, the phosphates would cause weeds to overgrow in water systems and choke out the sunlight.

Typical Laundry Detergent Ingredients

Ingredient	Function	Ingredient	Function
surfactant	cleans fabric	*builder*	softens water
filler	prevents clumping	*corrosion inhibitor*	prevents rusting
suspension agent	prevents reattachment	*enzyme*	removes protein stains
bleach	removes stains	*optical whitener*	adds brightness
fragrance	adds scent	*colouring agent*	gives detergent colour

Diving and Decompression

Going below the surface of the water is now possible because of the (*Self-Contained Underwater Breathing Apparatus*) **S.C.U.B.A.** gear (air tanks and regulators) that was invented to help a diver breath underwater. When going deeper, nitrogen can dissolve in the divers body cells and tissues in a higher concentration than normal. As the diver rises slowly back to the surface, the nitrogen will leave the body gradually. If the diver ascends too quickly the nitrogen gas bubbles out of the blood and tissue, or collects in different parts of the body causing extreme pain. ***"The bends"*** can be treated in a **hyperbaric chamber**, which forces the nitrogen to re-dissolve back into the blood and tissue.

How Does DRY CLEANING work?
– Find out at - http://science.howstuffworks.com/dry-cleaning.htm

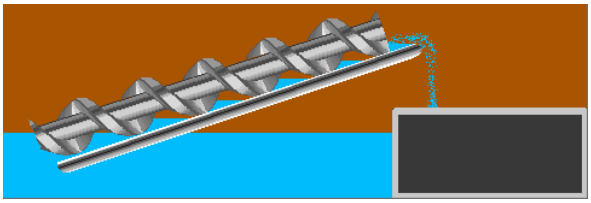
4.2 Technologies Based on Flow Rates and Moving Fluids

Pumps

Visit: **Glossary of Pumps** ... it's fantastic as a resource for this Topic.
http://www.animatedsoftware.com/pumpglos/pumpglos.htm

To obtain water from below the surface (the groundwater) and to move a fluid through a fluid system, you need to use something that will work against the pull of gravity, a **pump**.

One of the first pumps invented was **Archimedes Screw** (***invented to remove water from the hold of a ship***).



Other Applications include:

... Pumps in a city to move water to an elevated reservoir (so the force of gravity can allow the water to flow into all the homes - you see this in a small town as well - a water tower is usually the tallest structure in this town).
... Pumps are also use to move oil, natural gas and other fluids through pipelines.
... Pumps are located in automobiles to get the gasoline from the fuel tank to the engine.
... Pumps are also use to force air into tires.
... Your mouth is also a pump that can be used to draw a fluid up a straw and into your mouth.

See if you can find more information about the operation of a **sphygmomanometer**
http://www.sahaj.com/sphygmostetho.html

Valves

Valves are devices that ***regulate the flow of a fluid***.

Today's **valves** can **control** not only **the flow**, but **the rate**, **the volume**, **the pressure** or **the direction** of liquids, gases, slurries or dry materials through a pipeline, chute or similar passageway.

Valves can:

... turn on and turn off, regulate, modulate or isolate.
... control flow of all types, from the thinnest gas to highly corrosive chemicals, superheated steam, abrasive slurries, toxic gases and radio active materials.
... handle temperatures from cryogenic region to molten metal, and pressures from high vacuum to thousands of pounds per square inch.
... range in size from a fraction of an inch to as large as 30 feet in diameter
... vary in complexity from a simple brass valve available at the local hardware store to a precision-designed, highly sophisticated coolant system control valve, made of an exotic metal alloy, in a nuclear reactor.

Practical Applications: (for Valves)

A Valve is a product rarely noticed by the average person, yet it plays an important role in the quality of our lives.

… It is essential to virtually all manufacturing processes and every energy production and supply system. Yet it is one of the oldest products known to man, with a history of thousands of years. … Each time you turn on a water faucet, use your dishwasher, turn on a gas range, or step on the accelerator of your car, you operate a valve. Without modern valve systems, there would be no fresh pure water or automatic heat in your home. There would be no public utilities, and beyond wood and coal, almost no energy of any kind. Plastics would be unheard of, as would many inexpensive consumer products.

4.3 Designing a Working model of a Fluid-Using Device

A deep-diving submarine used to explore the ocean is called a **submersible.** Submersibles are usually smaller than submarines. They are often equipped with external cameras, manipulating arms, and special lights. **Submersibles** are built to do specific jobs, not for long-distance travel. We use them to help us recover "black box" flight recorders from wrecked airplanes, bury cables in the sea floor, investigate ancient shipwrecks, map the ocean floor, look for signs of undersea earthquakes, study marine life, repair damaged offshore oil wells, take rock samples of the ocean floor, and study ocean currents.

LINKS	*Explorer Submarine Specs*	*How Subs work*

SUBMARINES

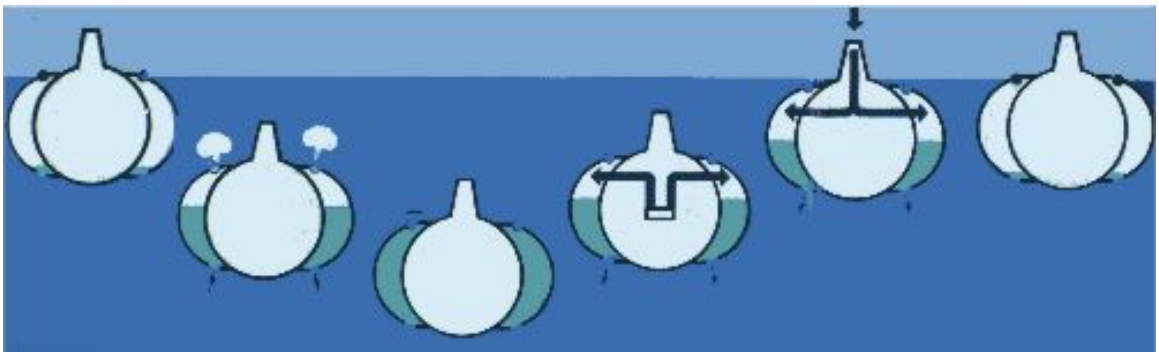
Inside a submarine there are containers called ballast tanks. If these are full of air, the submarine will float. Even though it is made of steel, the average density of the submarine is less than that of water. By pumping water into the ballast tanks, the submarine can sink. This is because when its ballast tanks fill with water, the submarine has a greater density than water.

History of Submarines

Submarines are ships that can operate both under and on top of the water. One of the first submersible vessels was built around 1620 by a Dutchman named Cornelius van Drebbel. We don't know that much about Drebbel's vessel, but diaries and books written at the time tell us his sub was really just a rowboat covered with a waterproof leather skin. Apparently 12 people with oars moved the vessel through the water. It could submerge to about 4.5 metres and go up to 8 kilometres before it needed to surface. It must have had some type of portholes to let in the light because one passenger wrote that people could see well enough underwater to read.

How Submarines Work

Submarines are designed for use at great depths. Their rigid, double-walled hulls allow the crew to live and work normally underwater for as long as air and power supplies last. Submarines are steered by turning a rudder left and right. A propeller moves the sub through the water--pushing against the water and creating a forward force.

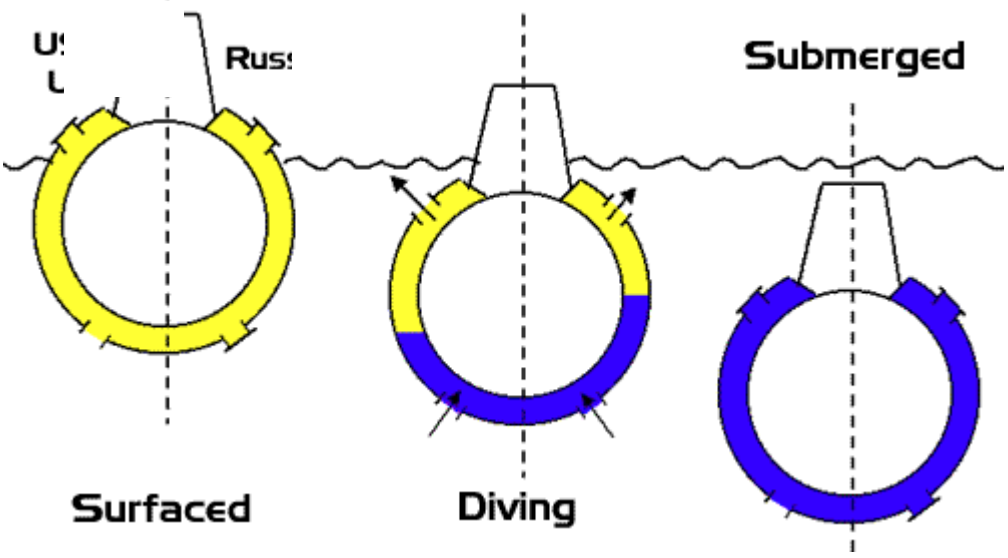


Buoyancy is the upward force of water pushing against the submarine.
When an object is underwater, it pushes aside (or "displaces") an amount of water equal to its volume.

An object floats if it displaces enough water to support its weight. Subs don't sink because their metal shell (or "hull") surrounds a volume weighing less than an equal amount of water.

Subs can sink, rise, and float underwater (maintain "neutral buoyancy"). Subs do all this by adjusting the amount of water and air in their **ballast tanks**. When the tanks are full of air, the sub weighs less than the volume of water it displaces and it floats. When the ballast tanks are flooded with water, the sub weighs more than the water it displaces, and it sinks.

To rise again, the sub reduces its weight by pushing compressed air into the ballast tanks. The air forces the sea water out, and the sub goes up toward the surface. To move beneath the surface and to hover, the amount of water in a submarine's ballast tanks is made equal to the weight of the water it is displacing.



Submarine Facts

Trieste is a **bathyscaph**, which went 11km beneath the surface to the bottom of the ocean in 1960. A submersible, called Alvin, was used to recover a hydrogen bomb accidentally dropped from an air force bomber back in 1966.
Japan also has a bathyscaph called Kaiko that can dive over 11 kilometres. In 1994, Kaiko went down to the Mariana Trench, the deepest spot in the ocean! While the largest submarines stretch up to almost 200 metres, the smallest working submarine, the Water Beetle, is only 2.7 metres long! It can go down to 30 metres and stay underwater for four hours.

Section 4.0 - Practice Quiz

Many technologies are based on the properties of fluids.

4.1 Technologies Based on Solubility

1. A detergent is a substance that can remove dirt from different kinds of fabric. The cleaning agent in the detergent attaches itself to the dirt particles. It is called ...

A. detergent
B. suspension
C. surfactant
D. enzyme

2. Phosphates pollute the environment when they are present in large amounts. The reason they pollute is because they ...

A. make the water dirty
B. increase plant growth
C. kill fish and shrimp
D. remove the oxygen

3. There are many ingredients in detergents that have a very important role. This ingredient removes protein stains. It is called ...

A. a filler
B. a surfactant
C. a fragrance
D. an enzyme

4. ‘ S C U B A ’ stands for ...

A. Special Cell Used By Aquanauts
B. Submerging Cubicle Used Below Air
C. Self Contained Underwater Breathing Apparatus
D. Submerged Container Using Breathable Air

5. When a diver has risen too quickly, the nitrogen in the body bubbles out of the blood and tissues, which can collect in different parts of the body causing extreme pain and eventually death. This condition, known as ‘the bends’ is treated in a special pressure chamber. The chamber enables the nitrogen ‘bubbles’ to re-dissolve back into the blood and tissues. It is called a ...

A. bends chamber
B. pressure chamber
C. nitrogen chamber
D. hyperbaric chamber

6. Dry cleaning involves using a chemical that attaches itself to the dirt and then is removed. This modern day chemical is then reused over and over again (recycled). It is called …

A. MONOTRI
B. TRICH
C. PERC
D. KEROSENE

4.2 Technologies Based on Flow Rates and Moving Fluids

7. A device that moves a fluid into or through something is called a pump. A pump operating in your body is your ...

A. kidney
B. liver
C. spleen
D. heart

8. A pump that uses an upward stroke to suck the liquid in and then a downward stroke to force the liquid out is called a ...

A. piston pump
B. diaphragm pump
C. Archimedes screw
D. pressure pump

9. A computerized device that cleans a natural gas pipeline with brushes, as it moves through it, is called a pipeline …

A. dog
B. pig
C. cow
D. rat

10. Valves are important devices used in any system for moving fluids. The purpose of a valve is to …

A. control the flow of a fluid
B. provide pressure for the fluid to flow
C. enable fluids to flow unrestricted
D. maintain fluid consistency

11. When you flush your toilet, a valve is used to make sure the tank doesn't overflow. This valve, that opens allowing water to enter and closes allowing water to leave the tank, is connected to the …

A. handle
B. toilet seat
C. brass ring
D. float

4.3 Designing a Working Model of a Fluid-Using Device

1. The ***'Trieste'*** is an underwater ship that is designed to go extremely deep in the ocean. This type of submersible is called a …

A. submarine
B. SCUBA
C. bathyscaph
D. trencher

2. Fish can change their buoyancy naturally. This is done with a ***special gas-filled sac*** called a ...

A. ballast
B. bender
C. buoy
D. bladder

3. When air is released in a submarine it is able to dive. This process enable the submarine to ...

A. increase its buoyancy
B. decrease its viscosity
C. increase its density
D. decrease its pressure

4. Tanks, which fill up and empty with compressed air, enable a submarine to move up and down in the water. These ***tanks*** are called …

A. bulged
B. ballast
C. balloon
D. breakwater

Unit 1 – Mix and Flow of Matter

1.0 Fluids in Technological Devices

- WHMIS symbols and safety procedures in the lab
- Transporting (slurry), processing (glass and steel) and using materials (toothpaste) using fluids
- Properties of fluids include: viscosity, density, buoyancy and compressibility

2.0 Properties of Mixtures and Fluids using the Particle Model

- Matter can be classified as pure substances and mixtures
- Solutions are made with a solute and a solvent
- Concentration describes how much solute is in a particular solvent
- Solubility depends on the temperature of the solution, the type of solute and the type of solvent

3.0 Properties of Gases and Liquids using the Particle Model

- Viscosity is a fluid's resistance to flow
- Density is the amount of mass in a given volume
- An increase in temperature decreases viscosity and increases density
- The particle model describes the spaces between the particles
- Less dense objects float on more dense substances because of buoyant force
- Gases are compressible, but liquids are nearly incompressible
- Pressure is calculated by dividing force over area
- Pascal's Law states that force applied to a fluid is transmitted equally throughout the fluid

4.0 Fluid Technologies

- Fluid technologies include: solvents, pumps, valves, hydraulics and pneumatics

Mix and Flow of Matter Unit Test

/40

Student Name **Class**

Section 1.1 WHMIS

For each of the following hazardous products match the correct **WHMIS** symbol

1 Flammable **A.**

2 Corrosive **B.**

3 Dangerously Reactive **C.**

Section 1.2 The Many Uses of Fluids

4. Anything that has no fixed shape and can flow and usually is a liquid or a gas is called a ...

A. hydraulic
B. pneumatic
C. compressed gas
D. fluid

5. To move a solid, like dirt, more easily, it is mixed with water making this - a ...

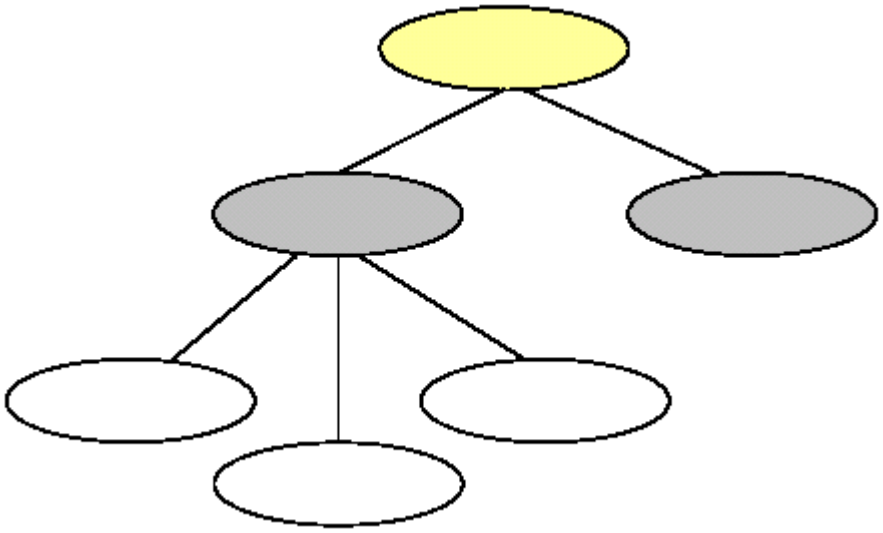
A. mess
B. sludge
C. slurry
D. colloid

6. Syncrude originally used conveyor belts to move the oil sand from the mine to the processing plant, but it proved to be very expensive to continue operating in this way. They now use ...

A. a slurry pipeline
B. transport trucks
C. very large bulldozers
D. monster dump trucks

Section 2.1 Pure Substances and Mixtures

7. Use the following words to complete a visual organizer, showing the relationships between and among the words provided. **Use each word only once.**
Pure Substances, Matter, Solutions, Mixtures,
Mechanical Mixtures, Suspensions and Colloids



8. Mixtures can be made with solids, liquids or gases. The kind of mixture or solution that is referred to as heterogeneous is a mixture or solution which …

A. is clear
B. is cloudy
C. appears as a single substance
D. all the parts are visible

9. For some fluids, paper chromatography is a test that determines whether a substance is a ...

A. mixture or a colloid
B. pure substance or a mixture
C. colloid or suspension
D. mixture or suspension

10. An insulating foam is sprayed into cracks to seal them. The gas and liquid together make a ...

A. colloid
B. suspension
C. mechanical mixture
D. solution

Section 2.2 Concentration and Solubility

11. Concentration amounts can be stated in many different ways. 50g per 100ml is one common way. Another way is to express it as a percent, like they do in juice containers. If an apple juice Tetra Pak had 20 grams of apple juice per 100ml, the concentration would be …

A. 2%
B. 8%
C. 20%
D. 80%

12. When comparing concentrations of different solutions, it is necessary to compare the concentrations in the same volume. Which of the following solutions would have the highest concentration?

A. 5.6g per 10ml
B. 12g per 25ml
C. 25g per 50ml
D. 50%

13. The difference between a saturated and unsaturated solution is that an unsaturated solution can dissolve more …

A. solvent
B. solute
C. particles
D. spaces

Section 2.3 The Particle Model and the Behavior of Mixtures

14. A common solution in which the solute is solid and the solvent is liquid is …

A. antifreeze
B. air
C. rubber cement
D. saltwater

15. For most common solid or liquid substances, solubility increases as temperature increases. This is NOT the case with ...

A. alcohol
B. gases
C. ethanol
D. water

16. The decrease in the solubility of gases can have a serious effect in the environment. When warm water is poured directly into a lake or river, the temperature of the water goes up. This type of thermal pollution occurs because **less of this gas** can dissolve in the water.

A. hydrogen
B. carbon dioxide
C. oxygen
D. chlorine

Section 2.4 The Particle Model and the Behavior of Mixtures

17. Diffusion occurs when the particles of a solute ...

A. are heated and cooled very quickly
B. fill the spaces between the particles of the solvent
C. are dissolved by a change of state
D. attach to particles of the solvent

18. The particle model can explain how some substances dissolve. The attraction between particles of potassium permanganate and water is ...

A. opposite
B. weak
C. strong
D. missing

Section 3.1 Viscosity & Flow Rate

19. The viscosity of liquids can be compared by observing their ...

A. clarity
B. volume
C. resistance to flow
D. resistance to acceleration

20. Using the ramp method to determine viscosity, a student found out that Fluid A has a flow rate of 10. 5 ml, per second. Fluid B has a flow rate of 11. 3 ml, per second. Compared to fluid A, fluid B is ...

A. more viscous
B. less viscous
C. more dense
D. less dense

21. After your dad or mom has started the cold car in the morning, they may mention that the viscosity of the motor oil would be increased by ...

A. letting the car idle
B. charging the battery
C. shutting off the engine
D. parking in the shade

Section 3.2 Density

22. The particles in a liquid cannot support the particles of a solid, unless the ...

A. **liquid is less dense**
B. **liquid particles have less attractive force between them**
C. **solid particles have more attractive force between them**
D. **solid is less dense**

23. Which of the following statements best describes the correct difference, in terms of density

A. **liquids are less dense than gases**
B. **gases are less dense than liquids**
C. **gases are more dense than solids**
D. **liquids are more dense than solids**

Section 3.3 Buoyancy

24. Large ocean liners, and cargo ships, can float on the water because ...

A. **its average density is lower than saltwater**
B. **the metal it was made of is less dense than water**
C. **the metal is more dense and therefore can float**
D. **saltwater is more dense and can hold up steel**

25. Fresh and saltwater systems have different densities. All cargo ships have a special line that shows how much the ship should be safely loaded so it won't sink as it goes from freshwater to saltwater. This line is called the …

A. **Sinking Line**
B. **Buoyancy Line**
C. **Plimsoll Line**
D. **Density Line**

26. Density and buoyant force are related. As the ...

A. **density of a fluid increases, the buoyant force decreases**
B. **density of a fluid decreases, the buoyant force increases**
C. **density of a fluid increases, the buoyant force remains the same**
D. **density of a fluid decreases, the buoyant force decreases**

Section 3.4 Compression

27. A gas can be compressed more than a liquid because the gas particles ...

A. **can increase their energy level more than the liquid particles**
B. **need extra energy to take up more space**
C. **have more space between them than the liquid particles do**
D. **need less energy to take up more space**

28. When a force is applied to a substance and the particles cannot be forced closer together the substance is said to be incompressible. What happens to the force?

A. **It changes the volume**
B. **It is absorbed by the substance**
C. **It is applied throughout the substance**
D. **It changes direction**

29. The incompressibility of a fluid enables it to be useful when the fluid is used in a ...

A. **bicycle air pump**
B. **closed system**
C. **garden hose**
D. **open system**

Section 3.5 Pressure

30. Pressure is the amount of force applied to a given area. This is measured in …

A. **Newtons**
B. **Meters squared**
C. **Pascals**
D. **Compressions**

31. When we suck on a straw in a Tetra Pak juice container, the sides of the container collapse. This happens because ...

A. **we are increasing the pressure inside the container**
B. **the atmospheric pressure is collapsing the walls of the container**
C. **the pressure inside the container is increased and collapses from the added pressure**
D. **we are lowering the strength of the container when we suck on the straw**

32. Pascal's Law states that an enclosed fluid transmits pressure in …

A. **an upward direction**
B. **a downward direction**
C. **a sideways direction**
D. **all directions equally**

Section 4.1 Technologies Based on Solubility

33. There are many ingredients in detergents that have a very important role. This ingredient removes protein stains. It is called ...

A. **a filler**
B. **a surfactant**
C. **a fragrance**
D. **an enzyme**

34. **‘ S C U B A ’** stands for ...

A. **Special Cell Used By Aquanauts**

B. **Submerging Cubicle Used Below Air**

C. **Self Contained Underwater Breathing Apparatus**

D. **Submerged Container Using Breathable Air**

35. When a diver rises too quickly, the nitrogen in the body bubbles out of the blood and tissues, which can collect in different parts of the body causing extreme pain and eventually death. This condition, known as ‘the bends’ is treated in a special pressure chamber. The chamber enables the nitrogen ‘bubbles’ to re-dissolve back into the blood and tissues. It is called a ...

A. **bends chamber**

B. **pressure chamber**

C. **nitrogen chamber**

D. **hyperbaric chamber**

Section 4.2 Technologies Based on Flow Rates and Moving Fluids

36. A pump that uses an upward stroke to suck the liquid in and then a downward stroke to force the liquid out is called a ...

A. **piston pump**

B. **diaphragm pump**

C. **Archimedes screw**

D. **pressure pump**

37. A computerized device that cleans a natural gas pipeline with brushes, as it moves through it, is called a pipeline …

A. **dog**

B. **pig**

C. **cow**

D. **rat**

38. When you flush your toilet, a valve is used to make sure the tank doesn’t overflow. This valve, that opens allowing water to enter and closes allowing water to leave the tank, is connected to the …

A. **handle**

B. **toilet seat**

C. **brass ring**

D. **float**

Section 4.3 Designing A Working model of a Fluid-Using Device

39. When air is released in a submarine it is able to dive. This process enable the submarine to ...

A. **increase its buoyancy**
B. **decrease its viscosity**
C. **increase its density**
D. **decrease its pressure**

40. Tanks, which fill up and empty with compressed air, enable a submarine to move up and down in the water. These ***tanks*** are called …

A. **bulged**
B. **ballast**
C. **balloon**
D. **breakwater**

Complete the following 2 **Numerical Response** Questions in this booklet

NR1 -To test the success of a protective egg carton (which has a mass of 200g), Jacobs (who has a mass of 60kg), carried it up to the roof. It was dropped from a height of 4m.

How much work was done by Jacobs to test the egg protection device?
(**Show your work**)

	.	.	
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

NR2 - The work done by a lever is 5225J. The work done by the effort force is 8650J.

What is the efficiency of the lever?
(**Show your work**)

	.	.	
0	0	0	0
1	1	1	1
2	2	2	2
3	3	3	3
4	4	4	4
5	5	5	5
6	6	6	6
7	7	7	7
8	8	8	8
9	9	9	9

Mix and Flow of Matter Section Quiz Answer Keys

Section 1 Quiz		Section 2 Quiz		Section 3 Quiz				Section 4 Quiz	
1	B	1	Page 20	1	C	16	B	1	C
2	D	2	D	2	A	17	C	2	B
3	C	3	B	3	B	18	C	3	D
4	A	4	A	4	A	19	C	4	C
5	B	5	A	5	A	20	B	5	D
		4	C	6	A	21	D	6	C
		8	D	7	A	22	B	7	D
		9	C	8	D	23	D	8	B
		10	A	9	B	24	C	9	B
		11	B	10	A	25	A	10	A
		12	C	11	B			11	D
		13	B	12	A			12	C
		14	A	13	A			13	D
		15	D	14	D			14	C
		16	B	15	C			15	B
		17	B						
		18	C						

Mix and Flow of Matter Unit Test (v_2) Answer Key

1	C	9	B	17	B	25	C	33	B
2	A	10	A	18	C	26	D	34	C
3	B	11	C	19	C	27	C	35	D
4	D	12	A	20	B	28	C	36	B
5	C	13	B	21	A	29	B	37	A
6	A	14	D	22	D	30	B	38	B
7	Page 20	15	B	23	B	31	B	39	C
8	C	16	C	24	A	32	D	40	A

Numerical Response	NR1	NR2
	2408	60.4