CS8.1 Analyze the characteristics of cells, and compare structural and functional characteristics of plant and animal cells.

- ❑ Explain that the cell is a living system that exhibits all the characteristics of life including growth, movement, respiration, reaction to stimulus, nutrition, removal of wastes and reproduction.
- ❑ Categorize organisms as single-celled and multi-cellular.
- ❑ Observe and describe how single-celled organisms take in food and move.
- ❑ Explain how growth & reproduction of living organisms depends on cell division (mitosis).
- ❑ Define selectively permeable membranes in cells.
- ❑ Explain the processes of diffusion and osmosis focusing on how gases and water move into and out of plant and animal cells.
- ❑ Observe and identify cell structures (e.g., cell wall, cell membrane, vacuole, nucleus, cytoplasm, mitochondria, and chloroplast) and identify which are found in plant cells and which are found in animal cells.
- ❑ Explain the function of cell structures (e.g., cell wall, cell membrane, vacuole, nucleus, cytoplasm, mitochondria, and chloroplast), including how each structure contributes to the health of plant and animal cells.

CS8.2 Demonstrate proficiency in the use of a compound light microscope to observe plant and animal cells.

- ❑ Identify the parts of a compound light microscope, describe their functions, and describe how to use a compound light microscope correctly and safely.
- ❑ Calculate the magnification of a microscope, and estimate and determine the size of objects viewed through a microscope.
- ❑ Use a microscope effectively and accurately to observe differences in structure between plant and animal cells and draw labelled diagrams of what is seen.
- ❑ Show concern for self and others by safely planning and carrying out activities involving microscopes, slides, and biological material.

CS8.3 Distinguish structural and functional relationships among cells, tissues, organs, and organ systems in humans and how this knowledge is important to various careers.

- ❑ Discuss various ideas and theories, past and present, used to explain the composition of the human body (e.g., living organisms were made of air, fire, and water; and body is animated by spirit).
- ❑ Discuss why cells and tissues are specialized in multi-cellular organisms.

CS8.3 Distinguish structural and functional relationships among cells, tissues, organs, and organ systems in humans and how this knowledge is important to various careers (CONT'D)

- ❑ Describe the function and provide examples of the four major types of tissue found in humans (i.e., muscle, nerve, epithelial, and connective tissue).
- ❑ Construct a representation of the relationships among cells, tissues, organs, and organ systems in humans using examples from the respiratory, circulatory, digestive, excretory, and nervous systems.
- ❑ Relate the needs and functions of various cells and organs (delivery of oxygen, nutrients and waste removal) to the needs and functions of the human organism as a whole.
- ❑ Summarize the main points of modern cell theory and identify the contributions of men and women, past and present, to the development of the theory.
- ❑ Describe examples of science- and technology-based careers in Saskatchewan that require an understanding of cells and human body systems (e.g., lab and X-ray technicians, doctors, physiotherapists, nutritionists, and public health nurses).

CS8.4 Analyze how the interdependence of organ systems contributes to the healthy functioning of the human body.

- ❑ Examine First Nations and Métis perspectives on the interdependence and connectedness of human body systems and the sacredness of life.
- ❑ Show interest in science-related questions and issues by posing questions and defining practical problems related to the healthy functioning of the human body.
- ❑ Describe how various body systems work together to accomplish tasks such as eating, running, and sleeping.
- ❑ Provide examples of how the body reacts to internal and external stimuli such as viruses, bacteria, alcohol, drugs, dust, and temperature changes.
- ❑ Discuss how organ systems work together to obtain and transport nutrients and oxygen, and to remove wastes from the body.
- ❑ Explain the impact of personal lifestyle choices (e.g., nutrition, exercise, smoking, drugs, and alcohol) on the functions and efficiency of the human respiratory, circulatory, digestive, excretory, and nervous systems.
- ❑ Predict the impact of the failure or removal of one or more organs on the healthy functioning of the human body.
- ❑ Discuss personal and societal ethical issues related to the use of various technologies (e.g., pacemaker, artificial hip, prosthetic limbs, and artificial heart) that support or replace ailing body systems.

Science =

systematic knowledge of the universe gained through predictions, observation and experimentation

BIG IDEAS Summary:
Cells, Tissues, Organs & Systems

1. The cell is the basic scientific unit of all living things.

Key Concepts

- Living things surround us
- Worldviews affect our actions
- Microscopes extend our sight
- Cells contain a variety of structures that are different

Summary

- Scientists believe that all living things share certain characteristics. Living things are made up of cells, breathe, require energy to live, respond to their environment, grow and develop, reproduce, and get rid of waste.
- First Nations and Metis peoples believe that everything on Earth is alive with Spirit. The First Nations and Metis worldviews emphasize the connectedness of everything in Mother Earth and that all humanity has a responsibility to future generations to maintain and care for everything that is part of Mother Earth.
- Many life forms are too small to be seen with the naked eye.
- A microscope is a scientific tool that allows us to see objects smaller than 0.1mm
- Inside every cell are structures called organelles. Different organelles perform different functions.
- Scientists have developed the Cell Theory to help explain the relationship between cells and living things. The Cell Theory states that all living things are composed of cells, cells are the basic units of structure and function of all living things, and all cells are produced from other cells.

2. Cells must interact with their external environment to meet their basic needs.

Key Concepts

- Cells can be observed
- Unicellular organisms have specific needs
- Substances can move into and out of cells
- Cell specialization

Summary

- Living cells interact with their environment and respond to changes in conditions.
- Living organisms can be unicellular or multicellular. Multicellular organisms have specialized cells that perform different jobs.
- The cell membrane is selectively permeable – some substances can pass through the membrane, others cannot.
- Substances can move into and out of cells by diffusion and osmosis.
- Cont'd next page!

2. **Cells must interact with their external environment to meet their basic needs. (cont'd)**

Summary

- Diffusion is the movement of particles from an area of high concentration to an area of lower concentration.
- Osmosis is the diffusion of water particles through a selectively permeable membrane. Water is the only substance that moves by osmosis.
- Cells reproduce when a cell divides to form two fully functioning cells.
- In humans, similar cells group together to form four types of tissues: connective, epithelial, nervous, and muscle tissues.

3. Your health depends on the effective functioning of your interdependent organ systems.

Key Concepts

- Organ systems, organs, tissues and cells
- Organ systems are interdependent

Summary

- Cell structures suit their role in the body. Similar cells combine to form tissues, tissues combine to form organs, and organs make up your body's organ systems.
- Although your organ systems are separate, they are interdependent and work together as a whole. Organ systems are responsible for blood circulation, breathing, digestion, responding to stimuli, and eliminating wastes.
- Your body responds to stimuli with physical and behavioral changes.

4. Good health can be viewed as a balance among a person's physical, mental, and spiritual wellness.

Key Concepts

- Basic needs to keep your body's cells healthy
- Substances are transported to and from cells
- Traditional medicine
- Developing a theory for disease

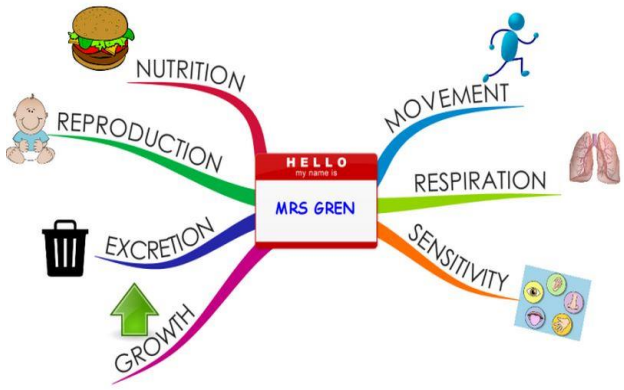
Summary

- Your body requires water, oxygen, exercise, nutritious food, and an adequate amount of sleep in order to keep its cells and body systems healthy.
- Negative lifestyle choices can affect the health of your cells.
- Vital substances are transported throughout the body in blood vessels.
- The respiratory system brings in oxygen-rich air and releases carbon dioxide.
- Traditional healers believe that our mind, body, spirit, and emotions are interconnected and must be in balance.
- Medicinal plants and healing ceremonies are sometimes used in traditional medicine to help encourage healing.
- Research into disease has led to better understanding of how to prevent and treat health problems.

Organisms = any living thing

Although there is great diversity, living things are alike in many ways and share common **characteristics of living things,** otherwise known as organisms. All living things:

- ❒ Are made up of one or more cells - **MOVEMENT**
- ❒ Respire (breathe) - **RESPIRATION**
- ❒ Respond to stimuli in their environment - **SENSITIVITY**
- ❒ Grow and develop – **GROW**
- ❒ Reproduce - **REPRODUCE**
- ❒ Excrete (get rid of wastes) – **EXCRETION**
- ❒ Require energy to live - **NUTRITION**



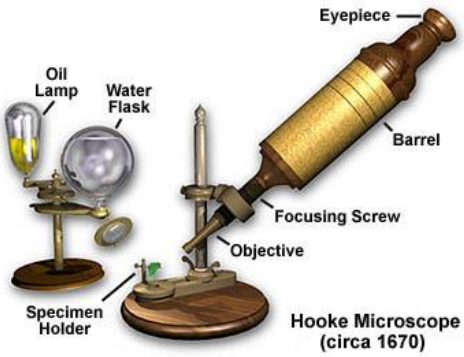
Characteristics of living things

MRS GREN

Movement
Respiration
Sensitivity

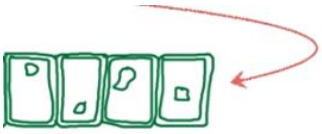
Growth
Reproduction
Excretion
Nutrition

Cell = basic unit of structure & function of all living things



Before we can learn about cells we need to be able to see them! A **microscope** is a device that was invented in the **1600's** by **Robert Hooke** to help us see cells. He looked at a piece of cork using the microscope he built himself and made an amazing discovery, noticing row after row of empty, box like spaces.

Hooke thought that the spaces looked similar to the tiny rectangular rooms (a.k.a. cells) that monks slept in at monasteries - so he called them **cells**!



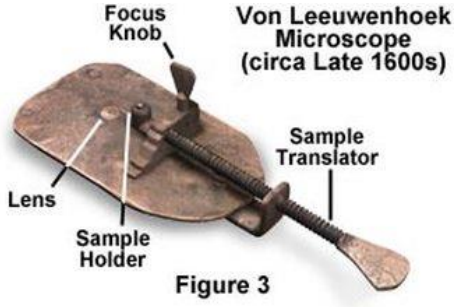
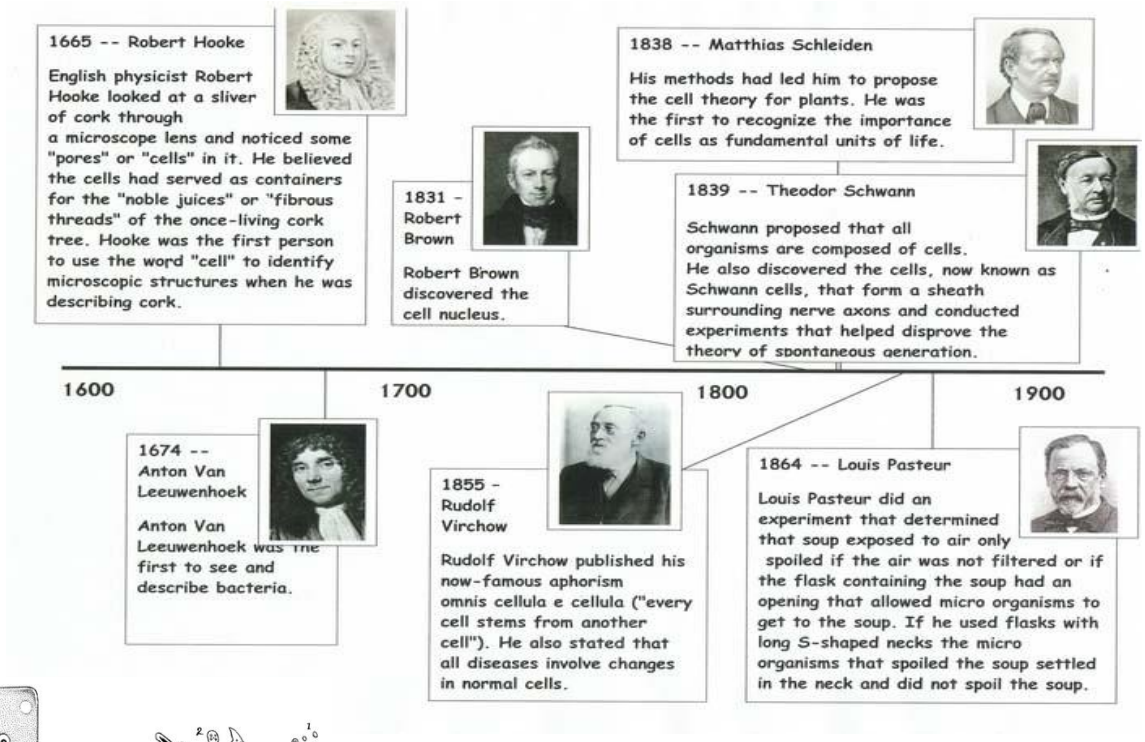
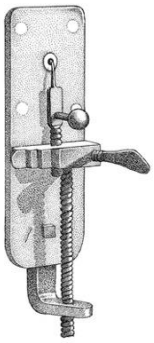


Figure 3

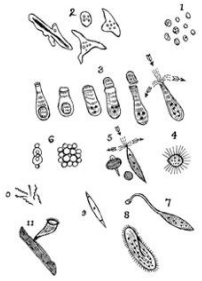
Around the same time as Hooke, another man named **Anton Van Leeuwenhoek** made his own microscope as well. Instead of looking at cork took samples of water from lakes, ponds, gutter, as well as samples of blood, and scrapings from teeth and gums. What he saw under the microscope was a little different. He saw organisms that hopped, whirled and swam, which he in turn called **animalcules** – a term that means "little animals".

History of the Cell Theory





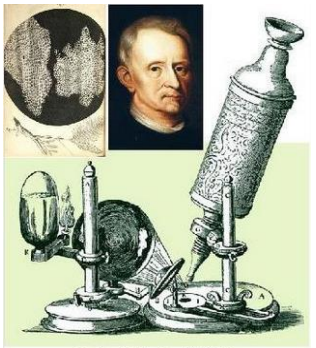
LEEUWENHOEK'S MICROSCOPE



LEEUWENHOEK'S ANIMALCULES

Much of the scientific process that occurred in the 16th century depended on the development of glass lenses. By 1650, the art of grinding and polishing pieces of glass into lenses had so developed that it became possible to build good microscopes. **Anton van Leeuwenhoek** (1632-1723), a Dutch civil servant, was a master lens maker. Leeuwenhoek placed his lenses into simple microscopes. Using these microscopes, he discovered an amazing, invisible world of "cavorting beasties" known today as protists and bacteria. For 50 years, he described and made careful drawings of bacteria, detailed structures in small insects, and even sperm cells from humans, dogs, frogs and insects.

In the late 1600's, an Englishman named **Robert Hooke** made compound microscopes and used them to examine small objects. When Hooke examined the cork layer of bark from an oak tree, he observed rows of compartments. The compartments reminded him of the small cells in which monks lived in medieval monasteries. For that reason, he called the compartments **cells**.



Robert Hooke (1665)

Scientists gradually began to realize that cells are the fundamental units of living organisms. Two German biologists, **Matthias Schleiden** (botanist) and **Theodor Schwann** (zoologist) proposed the cell theory in 1838.

M.J. Schleiden Theodor Schwann

According to the cell theory, all organisms consist of cells and cell products, and one can understand how living creatures are built and how they function if cells can be understood. Until the development of the cell theory, the emphasis had been on the cell walls. Schwann had been unable to find the box-like cells seen in plants while looking at animal cells. Schwann interpreted his observations in a new way, emphasizing what was *inside* the box rather than the box itself. Further studies showed that certain structures are common to plant and animal cells as well as those of microorganisms. Once the contents of cells began to be studied, ideas about the origins of organisms began to change.

For hundreds of years, people thought that organisms could come from non-living matter - an idea known as **abiogenesis** or **spontaneous generation** - life coming from non-living. Several different studies started to disprove the idea, including **Fransesco Redi's** meat and maggot experiment in 1668.

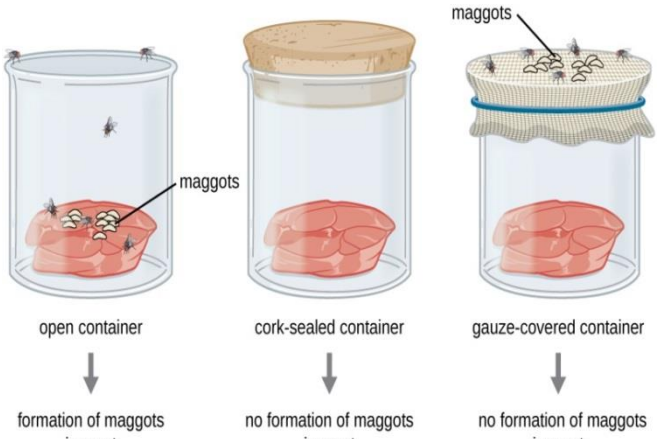
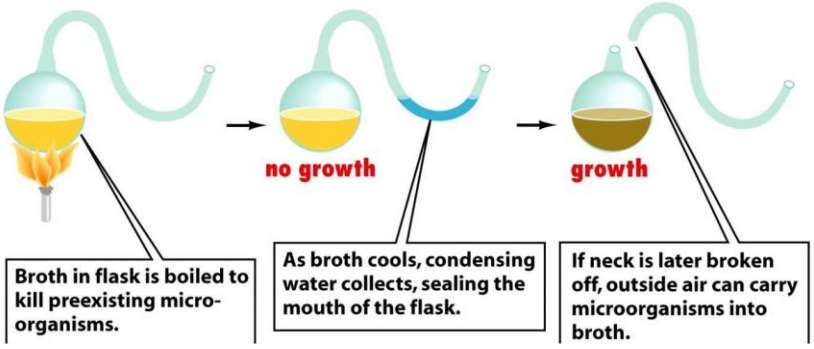


Figure 1: Francesco Redi's Experiment

In 1855, **Rudolph Virchow**, a physician and biologist, proposed that all cells produce more cells through time, but his idea was not accepted by everyone. This idea was known as **biogenesis** - life coming from life.

In 1864, **Louis Pasteur**, a French scientist working with yeast cells, demonstrated that microorganisms cannot arise from completely non-living matter, finally disproving abiogenesis or spontaneous generation. This process of pasteurization is still used today to kill pathogenic (disease-causing) microorganisms making food safer to eat.



By the 1880s, the work of French and German scientists showed how cells divide and produce more cells. Organisms, therefore, come from existing organisms and their cells arise from existing cells.

Today, the cell theory is summarized in two main ideas:

1. **Cells are the units of structure and function of all living organisms.**
2. **All new cells come from pre-existing cells.**

Microscopes

Unicellular = made up of only ONE cell

Multicellular = made up of TWO or MORE cells

Simple Microscope = magnifies using ONE lens

Compound Microscope = magnifies using TWO lenses

Care & Handling of Microscopes

Microscopes are **valuable** precision instruments and must be **handled carefully**! Here are a few rules that must be followed while working with a microscope:

1. The work area must be clean and clear of any hazards.
2. When carrying the microscope have one hand gripping the arm and the other supporting it under the base.
3. The microscope is to be kept upright at ALL times, especially when using wet mount slides.
4. Ensure the eyepiece, objective lenses, and stage are all clean before viewing. Only use lens paper to clean lenses!
5. When viewing slides through the microscope make sure not to let the objective lenses touch them.
6. When working with scientific instruments always conduct yourself in an appropriate professional manner. No fooling around or horse play in the lab!
7. When storing the microscope back in its cupboard ensure that all slides have been removed, the low power objective returned to its starting position, lenses have been cleaned, and the cover has been replaced.

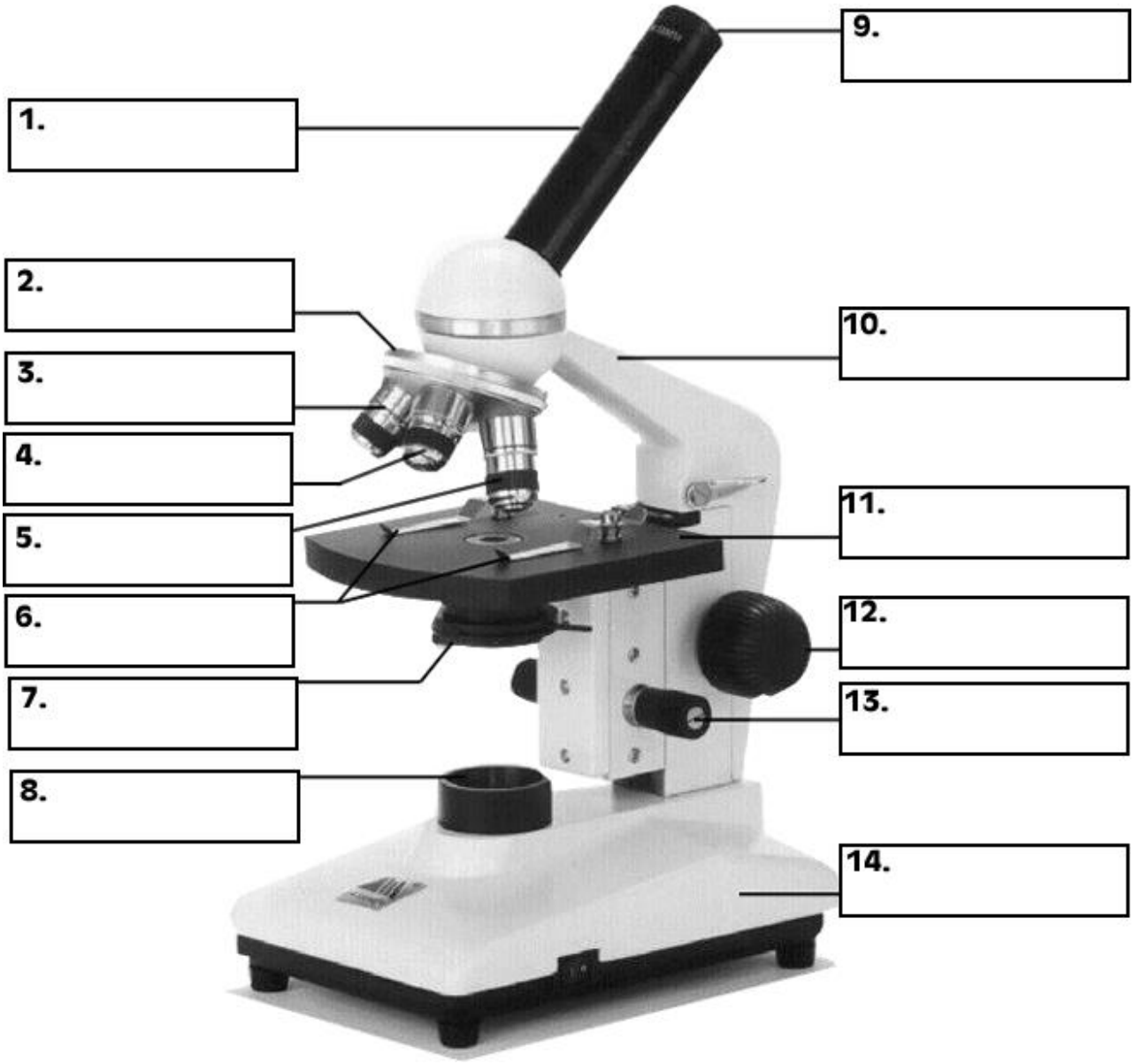
Magnification

FINISH!!!!!!

Estimating Size in Field of View

FINISH!!!!!

Parts of A Compound Light Microscope



How to Use a Microscope:

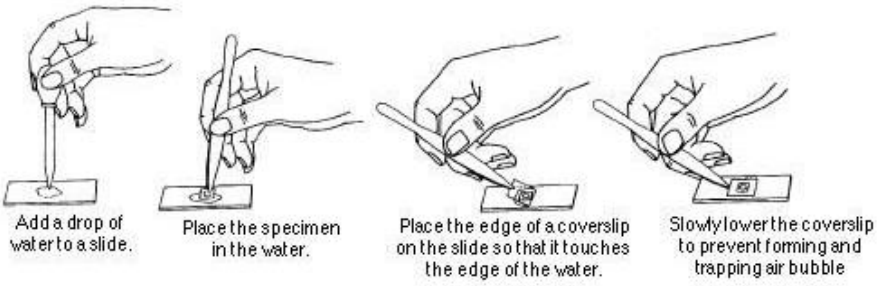
Read through **Toolkit 10** on **p. 401** found in the Pearson SK Science 8 Textbook

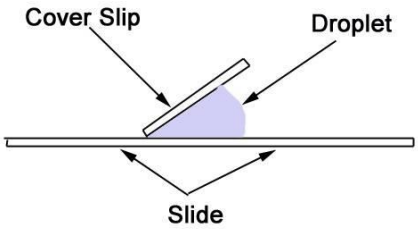
Drawing the Field of View:

Read through **Toolkit 10** on **p. 403** found in the Pearson SK Science 8 Textbook

Preparing Wet Mount Slides

1. Gather slide, cover slip, specimen, dropper, and tweezers/toothpick.
2. Using a dropper, place one drop of water in center of slide. Place specimen right-side-up on the drop of water. Place another drop of water on top of specimen, if needed.
3. Pick up cover slip by the edges. Lower one edge onto the slide, carefully holding it at a 45 degree angle. Use the tweezers/toothpick to SLOWLY lower the cover slip onto the slide. Air bubbles can form if the cover slip is lowered to quickly.

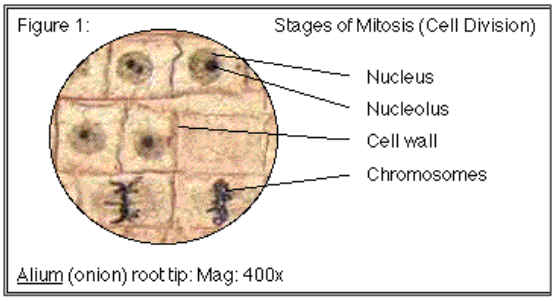




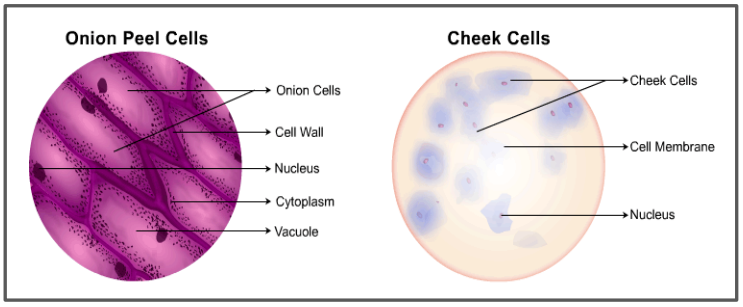
Drawing the Field of View

1. Start with a sharp pencil and a piece of paper.
2. Using a mathematical compass, draw a circle – this will represent what you see through the eyepiece – known as the **field of view**.
3. Draw only what you see. Keep your details simple and straightforward. You don't need to add color, but you can shade areas, if necessary.
4. Add labels that identify features by name or with brief notes. Always draw your label line with a ruler. Arrange your labels and label lines clearly and neatly on the page.
5. Record which objective lens/magnification you used to observe the image.
6. Give your drawing a title at the top of your drawing. The title should include information about the object shown.

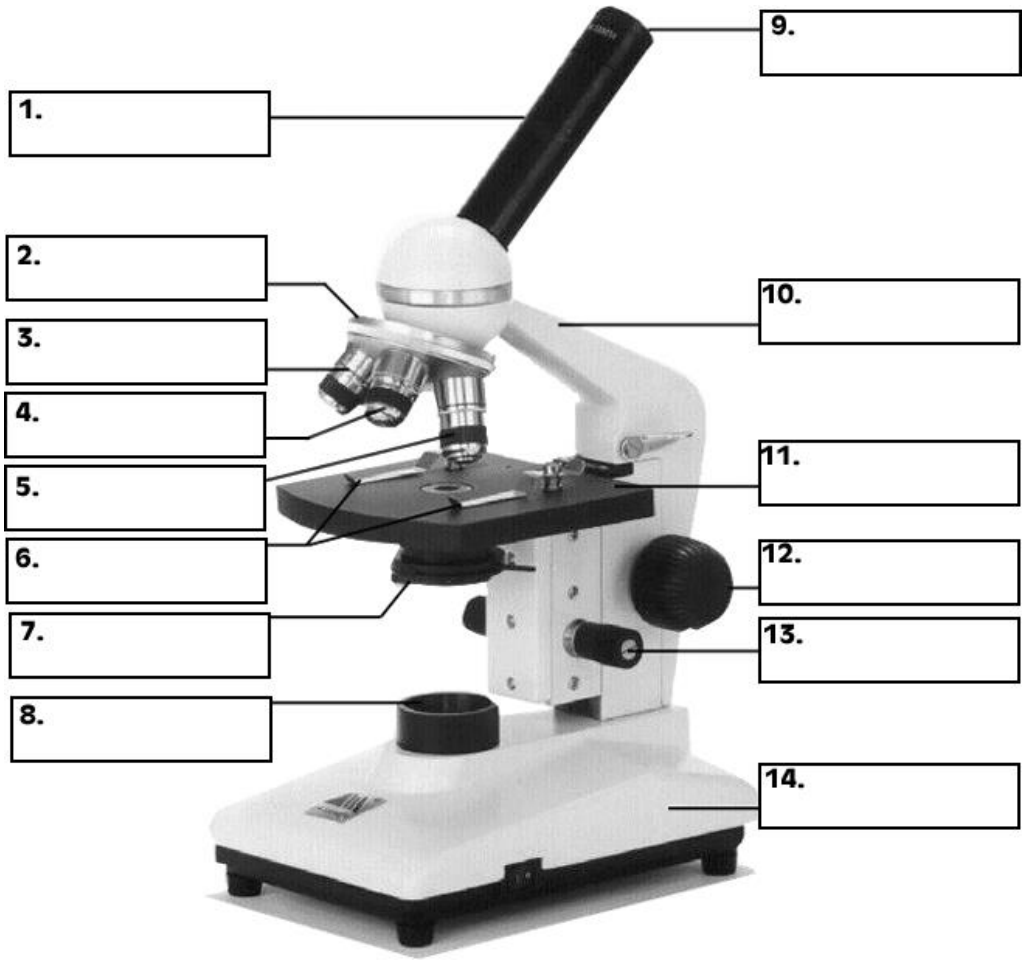
Proper Slide Drawing



What Are These Slide Drawings Missing?



Quiz Yourself: Microscope Parts



What are each of the parts used for?

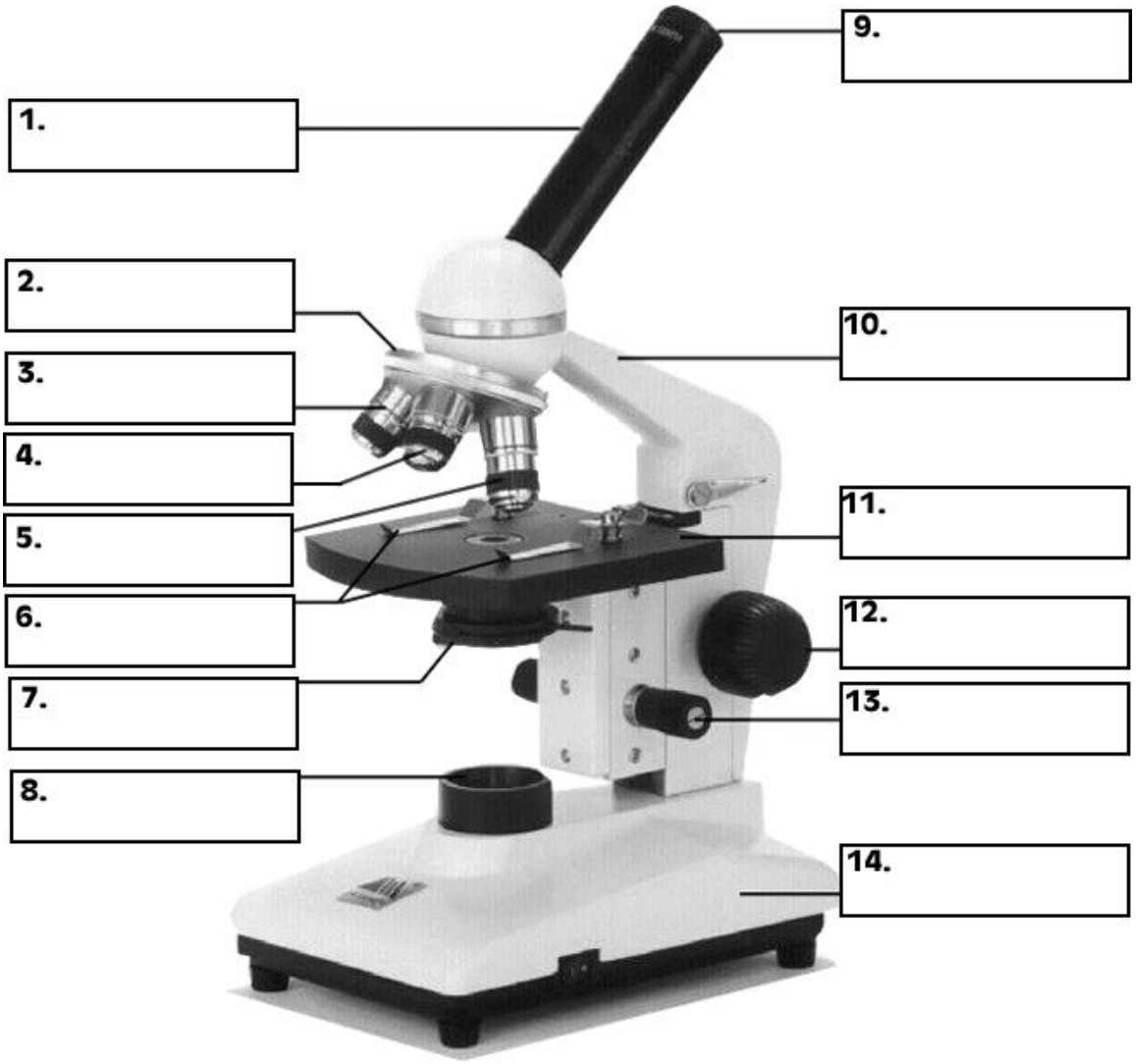
1.
2.
3.
4.
5.
6.
7.
8.
9.
10.
11.
12.
13.
14.

Microscopes

Name: _____ Date: _____ Class: _____

Sci8: CS2 Cell, Tissues, Organs & Systems **Microscope Lab**

Station 1: Label the microscope <u>without</u> using your textbook or binder notes.



Explain the proper steps to using/focusing the microscope:

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____

Name: _____ Date: _____ Class: _____

Sci8: CS2 Cell, Tissues, Organs & Systems **Microscope Lab**

Station 2: Label the microscope <u>without</u> using your textbook or binder notes.

FINISH LAB!!!!!!!!!!!!!!!!!!!

Cell – basic structural & functional unit of life

Prokaryote Cell
(Pro carry oat)

Only Example: Bacteria

- Has DNA strands for genetic information therefore ***lacks*** a nucleus and other membrane-enclosed organelles.
- Simplest & smallest cell

Eukaryote Cell
(You carry oat)

Examples: Fungi, Protista, Plants, Animals

- Has membrane-enclosed organelles therefore has a nucleus for genetic information.
- Most complex & larger cell

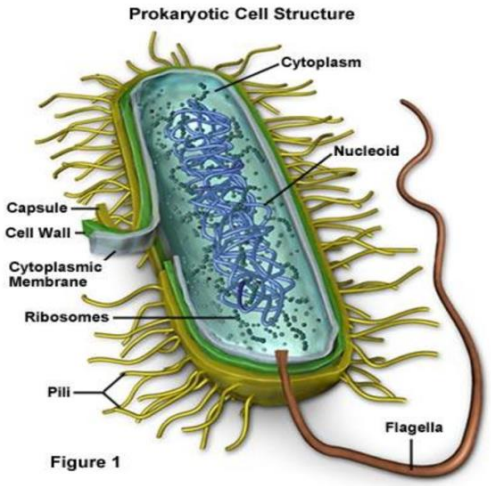
Cell Theory:

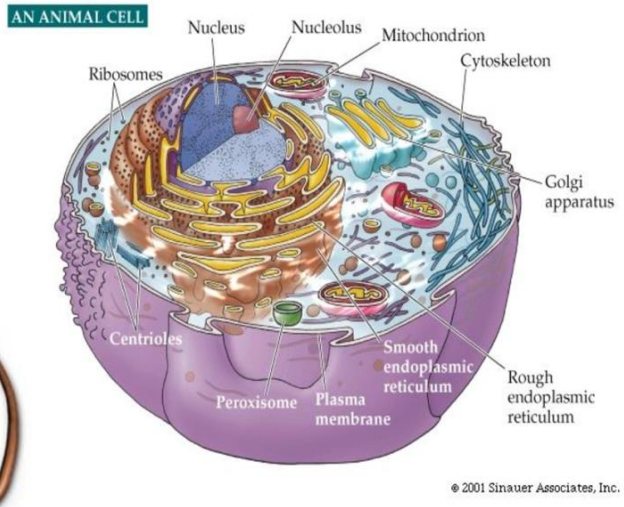
1. **Cells are units of <u>structure</u> & <u>function</u> of all living things.**
2. **All cells come from pre-existing cells.**

Organelle – a tiny organ with a specific job/function within a cell surrounded by a membrane.

DNA – Deoxyribonucleic Acid; contains genetic information for cells…the "blueprint for life".

Prokaryotic vs Eukaryotic Cells





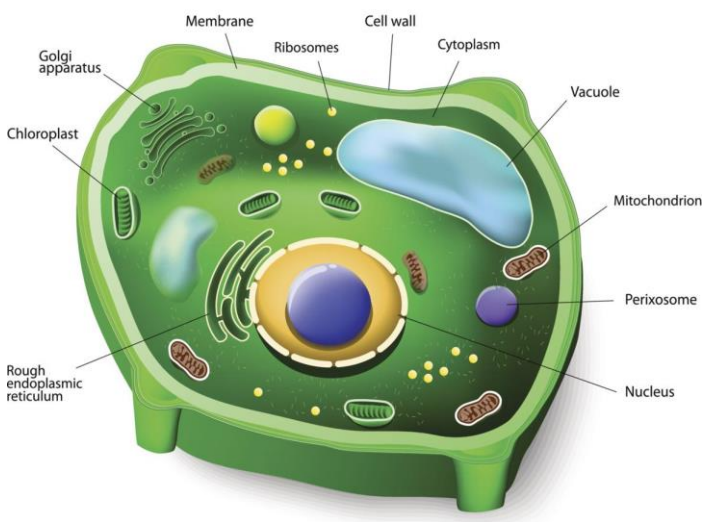
Cell Parts & Function

Sketch	Cell Part	Function
	Vacuole	
	Chloroplast	
	Centrioles	
	Cytoplasm	
	Golgi Apparatus	
	Lysosome	
	Cytoskeleton	
	Endoplasmic Reticulum	
	Nucleus	
	Mitochondria	
	Plasma Membrane	
	Ribosomes	
	Cell Wall	

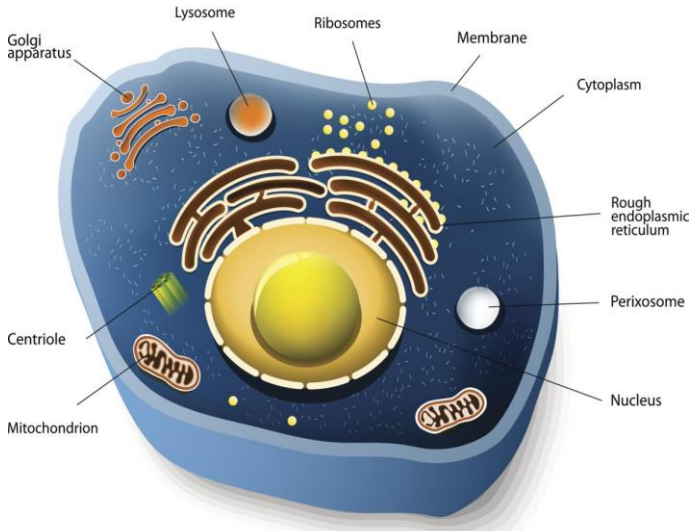
Prokaryote Only – DNA in Strand Form, Capsule
Animal Only – Lysosomes, Centrioles, Vacuole (movement)
Plant Only – Chloroplast, Cell Wall, Vacuole (storage)

Two Types of Eukaryote Cells

PLANT CELL

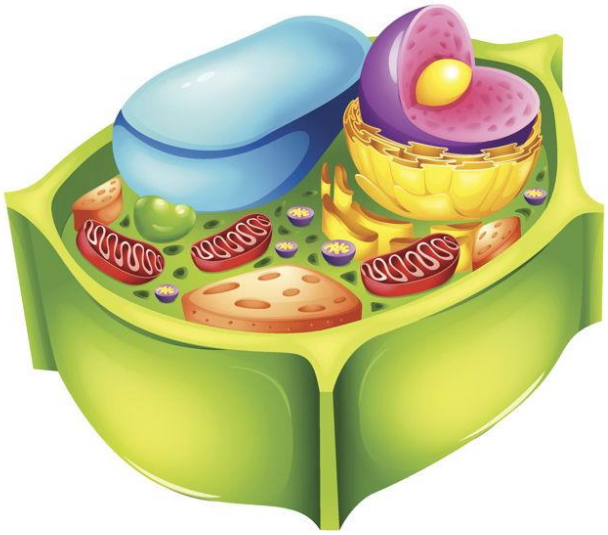


ANIMAL CELL



Cover Above & Quiz Yourself Below: Label Plant vs Animal Cell

animal cell



plant cell

Quiz Yourself: Cell Parts & Function

Sketch	Cell Part	Function

Prokaryote Only Has: _____

Animal Only Cells Have: _____

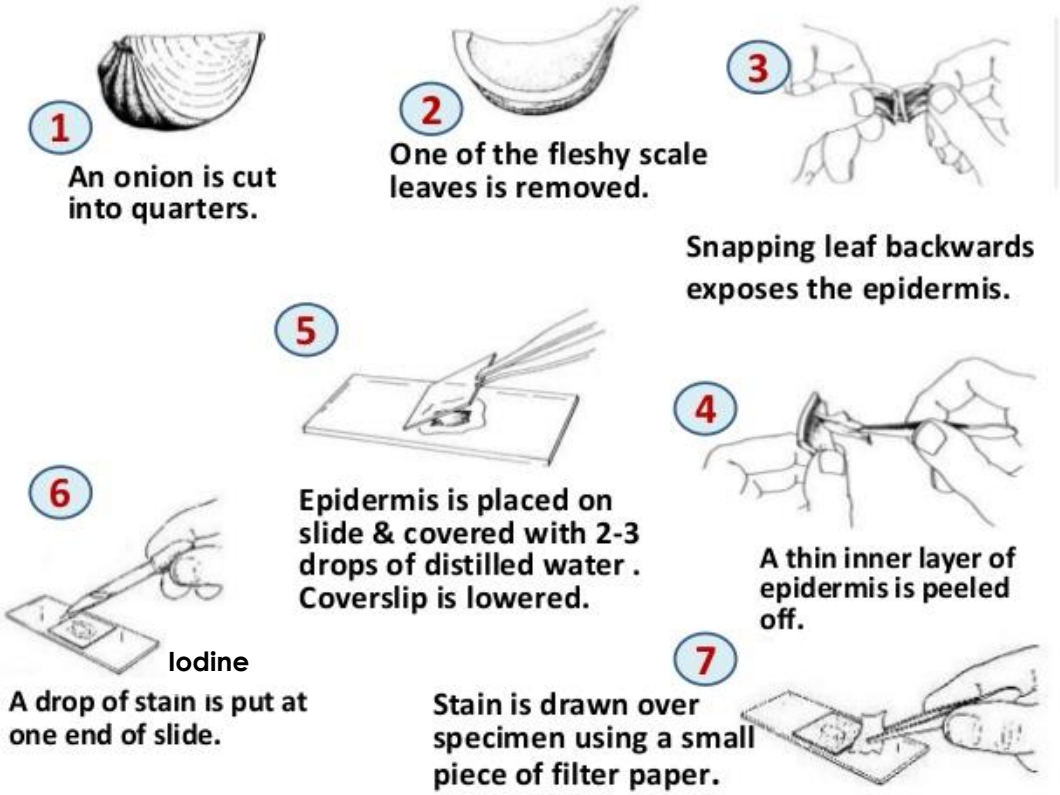
Plant Only Cells Have: _____

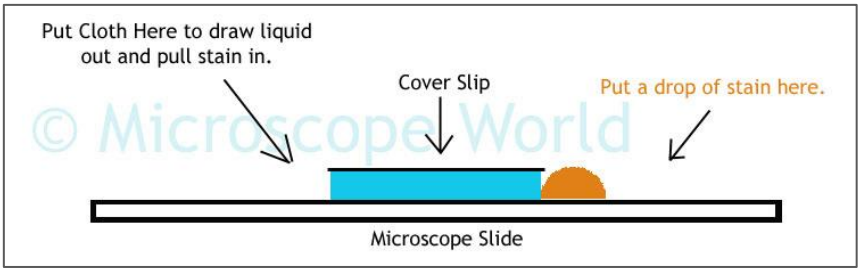
Name: _____ Date: _____ Class: _____

Sci8: CS2 Cell, Tissues, Organs & Systems p.401 **Microscope Lab 2**

Preparing & Viewing Slides: PLANT Cells

Part A: Preparing Wet Mount Slide of Onion Cells





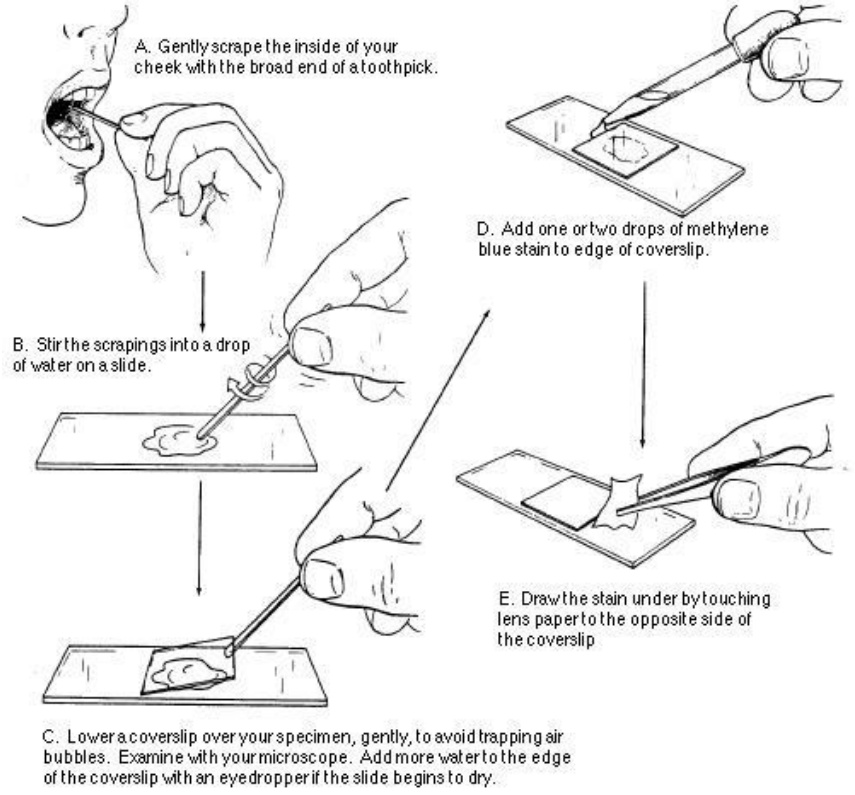
Part B: Slide Drawing (Field of View, Slide Title, Labeled Diagram, Magnification)

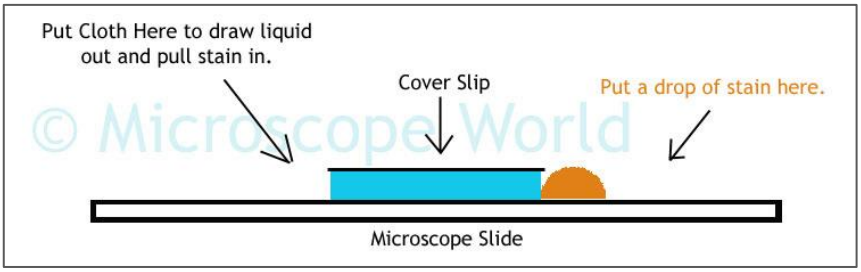
Name: _____ Date: _____ Class: _____

Sci8: CS2 Cell, Tissues, Organs & Systems p.401 **Microscope Lab 2**

Preparing & Viewing Slides: ANIMAL Cells

Part A: Preparing Wet Mount Slide of Cheek Cells





Part B: Slide Drawing (Field of View, Slide Title, Labeled Diagram, Magnification)

Cell Research & Model

This is your opportunity to research any type of cell you would like. It can be one of the specialized cells within the human body shown in the textbook or any type of plant cell. **Your research of the cell of your choice you must include:**

- Purpose / function of the cell (what it's for and what it does)
- Structures that make it unique
- Function of the unique structures
- Interesting facts

After your one page report has been completed you need to create a model out of household materials. **Your model you must include:**

- Labels
- Specific cell organelles
- Cell structure and shape

Criteria (50 marks total)	Planning Notes
Content (20 marks): Student reported on a cell, including appropriate information. Information was in their words and found from credible sources. All the requested areas were included and expanded on.	
Presentation (10 marks): Students used appropriate tone, speed and volume during presentation. It was easy to follow, organized and student was able to answer any questions that arose.	
Material (20 marks): Students handed in a completed report along with an accurate model. The model had all of the required parts and was labelled correct. The model was an accurate representation of what they studied. Student was able to explain different organelles and their function.	

Model Owner Name: _____ Date: _____ Class: _____

Sci8: CS1 Cell, Tissues, Organs & Systems **Cells Visualized**

Cell Research & Models: Student Analysis

Critique Name:	Strengths of Model	Weaknesses of Model

Model Owner Name: _____ Date: _____ Class: _____

Sci8: CS1 Cell, Tissues, Organs & Systems **Cells Visualized**

Cell Research & Models: Student Analysis

Critique Name:	Strengths of Model	Weaknesses of Model

Selectively Permeable =

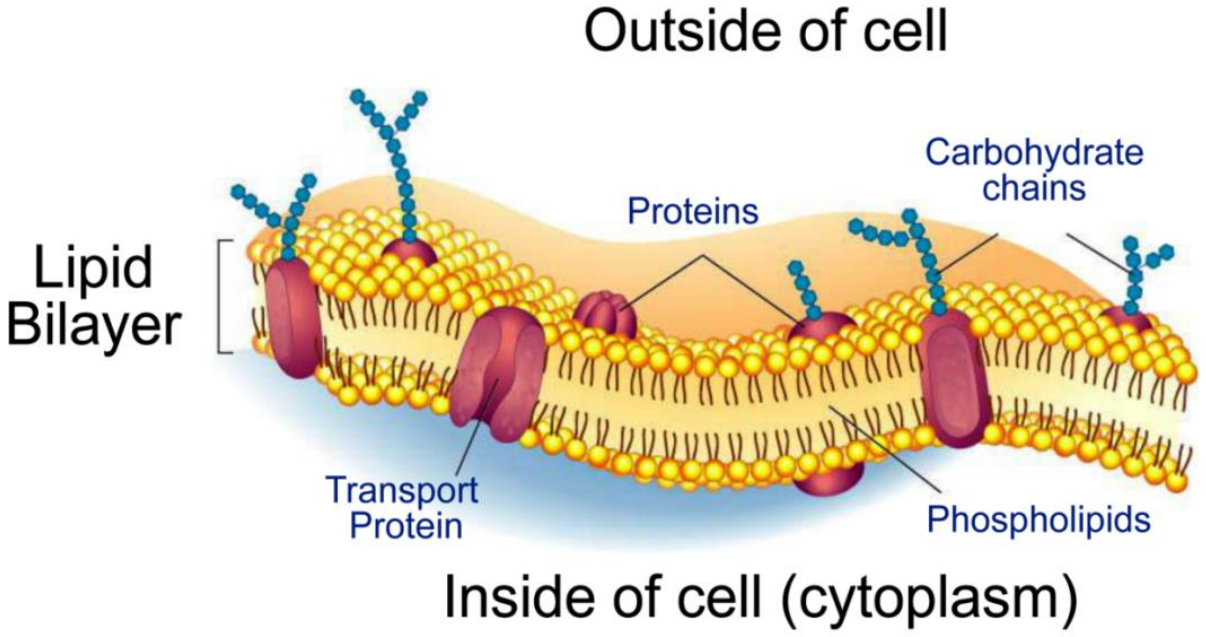
only allows certain molecules to pass through

Differentially Permeable =

allows easy diffusion passage of small molecules but <u>NOT</u> easy diffusion passage of larger molecules

The plasma membrane that surrounds cells has a **bilayer** (two layers) of **phospholipids** (a.k.a. fats with phosphorous attached). These bilayers at body temperature are like vegetable oil (fluid). And the structure of the plasma membrane supports the old saying, "Oil and water don't mix." Plasma membranes are both **differentially permeable** and **selectively permeable**. Smaller molecules like oxygen, carbon dioxide, and hydrogen gas can easily diffuse through the membrane while larger molecules like water and sugars must cross the membrane by going through specific protein channels in the membrane.

Each phospholipid molecule has a **hydrophilic head** (attracted to water) and a **hydrophobic tail** (repels water). Both layers of the plasma membrane have the hydrophilic heads pointing toward the outside; the hydrophobic tails form the inside of the bilayers. The hydrophobic tails create the "outer cell boundary" aspect of the cell.



Miss Foley

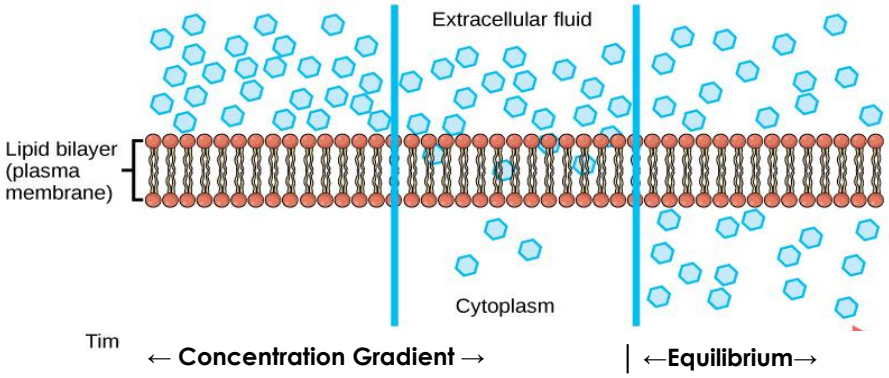
Sci8: CS1 Cell, Tissues, Organs & Systems p.31-34,37 **Cell Transport**

Concentration Gradient (c.g.) =

a gradual change in the concentration between two different areas

Equilibrium =

when concentrations are equal on both sides of the membrane



Passive Transport =

moving substances from an area of high concentration to an area of low concentration

(a.k.a. moving DOWN the concentration gradient – does <u>NOT</u> require energy)

While active transport requires energy and work, **passive transport** does not. There are several different types of this easy movement of molecules. It could be as simple as molecules moving freely such as **osmosis** or **diffusion**. You may also see proteins in the cell membrane that act as channels to help the movement along. And of course there is an in-between transport process where very small molecules are able to cross a **semi-permeable membrane**.

<u>Types of Solutions</u> **Always in reference to environment outside of cell*

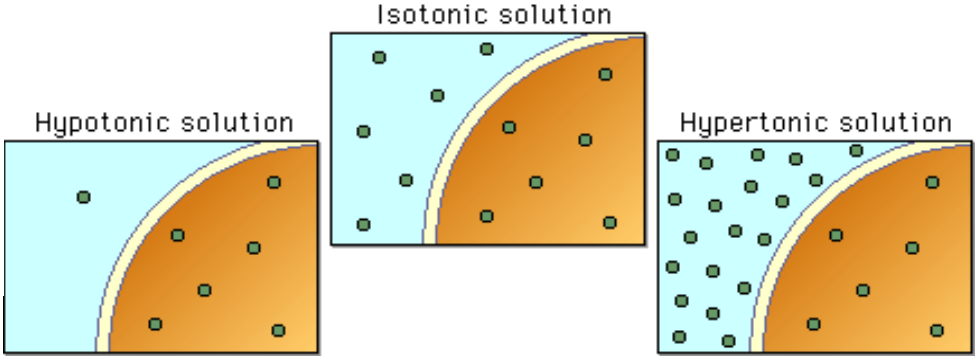
Hypotonic - concentration of solutes are higher inside than outside = water moves in & solutes move out = cell swells Animal cells – burst Plant cells – increase turgor pressure

Isotonic – solute concentrations are equal inside & outside of cell = no movement of anything

Hypertonic – Concentration of solutes lower inside than outside = water moving out & solutes moving in = cell shrinks Ex. Too Much Fertilizer

<u>Legend</u>

Green = solute
Brown = inside cell
Blue = outside cell
White = cell membrane

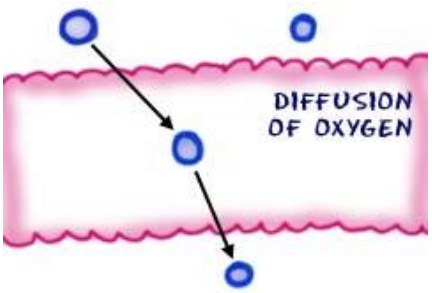


Types of Passive Transport

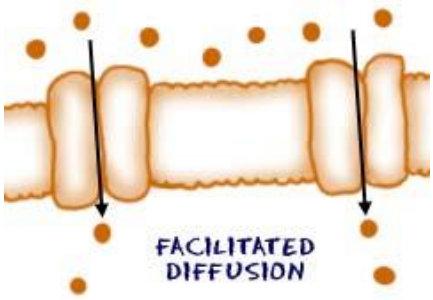
Diffusion =

substances moving from areas of high to low concentrations

Sometimes cells are in an area where there is a large **concentration difference**. For example, oxygen, carbon dioxide and other gas concentrations could be very high outside of the cell and very low inside. Those gas molecules are so small that they are able to cross the **lipid bilayer** and enter the cell. There is no energy needed for this process. In this case, it's good for the cell because cells need oxygen to survive. It can also happen with other molecules that can kill a cell.



Sometimes, proteins are used to help move molecules more quickly. It is a process called **facilitated diffusion**. It could be as simple as bringing in a glucose molecule. Since the cell membrane will not allow glucose to cross by diffusion, helpers are needed. The cell might notice outside fluids rushing by with free glucose molecules. The membrane proteins then grab one molecule and shift their position to bring the molecule into the cell. That's an easy situation of passive transport because the glucose is moving from higher to lower concentration. It's moving down a **concentration gradient**. If you needed to remove glucose, that would be active transport and the cell would require energy to do that work.

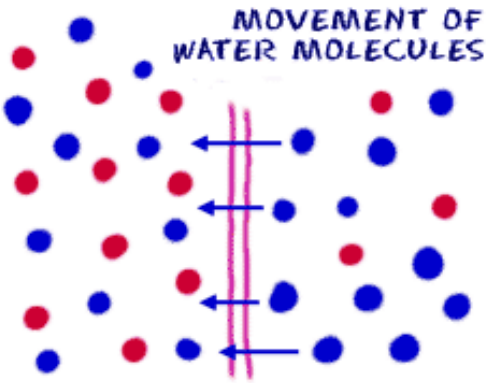


Osmosis =

diffusion of water across a selectively permeable membrane

Cells are usually in an environment where there is one concentration of substances outside and one inside. Because concentrations like to be the same on each side of the cell membrane or in **equilibrium**, the cell can pump substances in an out to stay alive.

For a cell to survive, certain concentrations need to be the same on both sides of the cell membrane. If the cell does not pump out all of its extra substances to even out the concentrations, the water is going to move in. This can be very bad. The cell can swell up and explode. The classic example of this type of swelling happens when red blood cells are placed in water or human animal cells in hot/bath tubs. The water rushes in to the cells, they expand and eventually rupture…POP!



Diffusion Demo: Food Coloring In Water

Observe food coloring drops diffuse in a beaker of water.

Osmosis Demo: Colored Flowers/Celery

Notice: *Start this lab when you know you will be able to check on it every couple hours or overnight.*

Problem: Do Celery Stalks Take In Water?

Hypothesis: If cut celery stalks are placed into water, then water will go into the celery by the process of osmosis.

To easily see whether or not water goes into the celery, this experiment uses colored water. If the color is visible in the celery then water has entered the plant's cells.

Materials:

- 1 clear container (plastic water bottle works)
- Food coloring, red or blue
- 4 freshly cut stalks of celery (as close to the same size as possible)
- 1 kitchen knife
- Optional: Small magnifying lens if available
- Timer of clock
- Ruler or meter stick

CAUTION: *You'll be using a sharp instrument in this lab experiment. Although you're most likely responsible and safe, you may wish to have an adult assist you with the cuts.*

Procedure:

1. Fill the container about 3/4th full.
2. Add about ½ tsp of food coloring to the water.
3. **Carefully** cut about one inch off of the bottom end of each stalk.
4. Quickly place celery stalks into the colored water.
5. Set the container in a place where it will receive indirect sunlight.
6. Check the stalks every 30 minutes and record observations.
7. Remove one stalk of celery after two hours.
8. Cut about one inch off the bottom of the stalk.
9. Look carefully at the freshly cut sides of the stalk. Use a magnifying lens if possible.

Data Collection:

10. Create a table in which to record your observations.

Questions:

1. What is osmosis?
2. Celery is composed of millions of plant cells. Do these cells contain any water?
3. Did the cut celery in step 8 & 9 show any color change that would indicate that the water did enter the celery cells?
4. If you placed the celery into a bottle of colored water that was 35% sugar, would the colored water be seen in the celery? Why or why not?

Name: _____ Date: _____ Class: _____

Sci8: CS1 Cell, Tissues, Organs & Systems **Osmosis Lab #1**

Potato Osmosis Lab

In this experiment the solvent particles are water particles, the selectively permeable membrane are the cell membranes of the cells in the potato tissue. The concentration gradient is the result of the difference in the concentration of solute in the cytoplasm of the potato cells and the solutions.

Apparatus & Materials:

- 3 Potato strips (5 x 1 x 1) cm (or potato cylinders/cores of equal length e.g. 5 cm diameter, made with a cork borer)
- 2 Petri dishes with equal volumes of solutions A and B ; A = sucrose or salt solution (hypertonic solution); B = distilled water (hypotonic solution)
- 1 empty petri dish (control)
- paper towels
- Stop watch or timing device
- top pan balance
- ruler

Procedure:

1. Observe each strip by feeling it, noting whether it is turgid or flaccid. Record this.
2. Weigh and measure each potato strip, recording the initial mass and length
3. Place a strip in each petri dish, taking care not to mix the strips. Start the timer.
4. Remove the strips after 15 minutes and dab on tissue.
5. Weigh each strip and measure each potato strip, recording the final mass and length.
6. Observe each strip by feeling it, noting whether it is turgid or flaccid. Record this.
7. Perform % difference calculations for the mass and length using the formula:
   (final - initial) x 100% / initial

Record your results in the table below:

Solution		Initial	Final	% Difference
Tap Water	**Description** (turgid, flaccid, normal)			
	Mass (g)			
	Length (cm)			
Salt Solution	**Description** (turgid, flaccid, normal)			
	Mass (g)			
	Length (cm)			
Air	**Description** (turgid, flaccid, normal)			
	Mass (g)			
	Length (cm)			

Name: _____ Date: _____ Class: _____

Sci8: CS1 Cell, Tissues, Organs & Systems **Osmosis Lab #1**

Discussion Questions

1. Define osmosis and identify the semi-permeable membrane in the experiment.

2. Account for the changes - if any - in the mass and length of the strips in water, salt solution and air.

Strips in Water

- Description -

- Mass -

- Length -

Strips in Salt Solution

- Description -

- Mass -

- Length -

Strips in Air

- Description -

- Mass –

- Length -

Name: _____ Date: _____ Class: _____

Sci8: CS1 Cell, Tissues, Organs & Systems **Osmosis Lab #2**

Gummy Bear Osmosis Lab ____ /50 = ____ %

PURPOSE:

To observe the effects of osmosis on a gummy bear.

HYPOTHESIS: **Circle one for each statement (3 Marks)**

The gummy bear left in plain water will	shrink	swell	stay the same.
The gummy bear left in salt water will	shrink	swell	stay the same.
The gummy bear left in no water will	shrink	swell	stay the same.

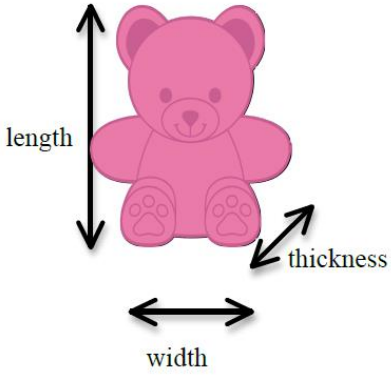
MATERIALS:

- 3 beakers
- 100 mL water
- Labels
- Salt dissolved in 100 mL water
- 3 gummy bears
- Scale & ruler

PROCEDURES: ***Fill in the blanks below using the materials listed above.**

DAY 1:

1. Label the beakers: "Plain Water", "Salt Water", and " Control Group (No Water)"
2. Next, fill the "Plain Water" and "Salt Water" beakers with 100 mL of water each.
3. Next, add salt to the water in the beaker labeled "Salt." Stir. Add until no more will dissolve.
4. Measure and describe the 3 gummy bears "before" using a scale and ruler.
5. Place a gummy bear in each beaker.



DAY 2:

1. CAREFULLY remove the gummy bears from the beakers.
2. Measure and describe the gummy bears "after".

Name: _____ Date: _____ Class: _____

Sci8: CS1 Cell, Tissues, Organs & Systems **Osmosis Lab #2**

DATA COLLECTION: **Record your data in the chart below. (30 marks)**

Observations and Measurements of Gummy Bear in _____

	Color	Length	Width	Thickness	Mass
Before					
After					

Observations and Measurements of Gummy Bear in _____

	Color	Length	Width	Thickness	Mass
Before					
After					

Observations and Measurements of Gummy Bear in _____

	Color	Length	Width	Thickness	Mass
Before					
After					

ANALYSIS: **(3 marks)**

In your own words, describe the difference between the three gummy bears AFTER the experiment:

_____

_____

_____

_____

_____

_____

_____

_____

Name: _____ Date: _____ Class: _____

Sci8: CS1 Cell, Tissues, Organs & Systems **Osmosis Lab #2**

CONCLUSION: (14 marks)

water	membrane	cell	selectively permeable	osmosis

Why did that happen? It has to do with a process called _____. Imagine the gummy bear is a real living thing. It would be made up of tiny, living units called _____. Each cell is surrounded by a _____ that protects the cell by keeping the cells parts inside and keeping other things outside. While it stops most things, _____ can pass through it. We call the membrane _____ , because it decides what comes in and out.

inside	outside	higher	lower

Osmosis is a kind of diffusion. When diffusion occurs, molecules move from a _____ concentration of water towards a _____ concentration of water. If the water outside the cell has LESS water than inside, water will move from the _____ of the cell to the _____. That is what happened to the Gummy Bear in the salt. The water had to move out of the Gummy Bear to "even out" the concentration of water. The Gummy Bear became smaller with less water to fill it up.

inside	outside	losing	increased	osmosis

The opposite happened to the Gummy Bear in the **plain water.** Water moved from the _____ of the Gummy Bear to the _____ to "even out" the concentration of water. As more and more cells gained water, the Gummy Bear became larger as more water filled it up.

So why didn't the Gummy Bear in **salt water** get as big as the Gummy Bear in plain water? Since there was salt in the water AND in the Gummy Bear, the water didn't have to move as much to "even out" the concentration.

What does that have to do with me? Osmosis works the same way for your cells as it does in the Gummy Bear. When you sweat a lot, you are _____ water. Osmosis takes over and starts to pull water out of your cells, which is not a good thing. Now that water left your cells, the concentration of salt in your cell has _____. It is very important to drink LOTS of water if you are sweating a lot. _____ would occur again and balance out the water to keep you healthy.

Quiz Yourself: Membranes & Types of Transport

Finish!!!!!

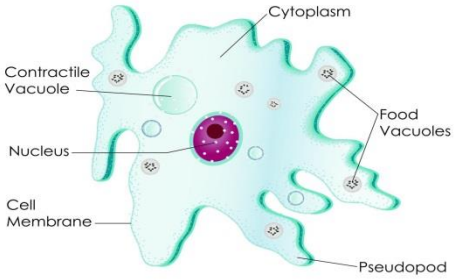
Unicellular Organisms = single celled living things

ALL organisms share the same **basic needs**. These basic needs are:

1. Suitable temperatures and living conditions = **SHELTER**
2. Food or the building blocks and energy to make food = **ENERGY**
3. A way to eliminate or recycle waste products = **DETOX**
4. To divide, grow and develop = **GROW**
5. To respond to changes in their environment = **ADAPT**
6. To reproduce making more of their kind = **REPRODUCE**

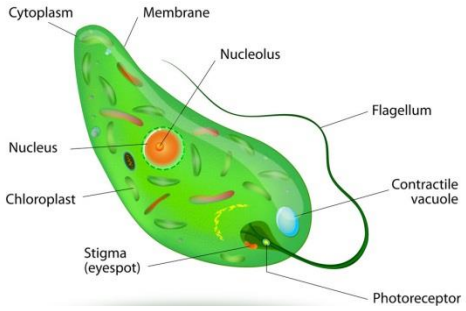
Amoeba

An amoeba is a type of cell or organism that is capable of changing its shape, mainly by extending and retracting **pseudopods**. They are normally found in the soil and in aquatic habitats. They move by using pseudopods. They typically ingest their food by extending their pseudopods to engulf a prey. They do not possess a mouth.



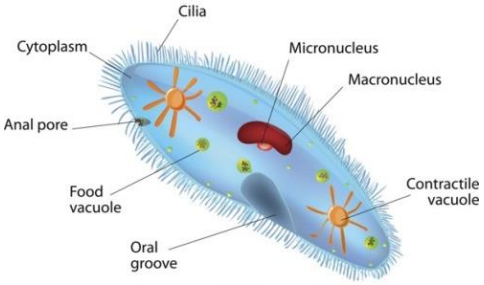
Euglena

Euglenas are major examples of flagellates. Flagellates are organisms which have one or more whip-like organelles called **flagella** used to move and get food to eat. They may be solitary, colonial, free-living or parasitic. Parasitic forms live in the intestine or bloodstream of the host. Many other flagellates like dinoflagellates live as plankton in the oceans and freshwater. Some flagellates are **autotrophic** (make their own food with photosynthesis) while others are **heterotrophs** (can't make their own food).



Paramecium

Paramecium are examples of free-living ciliates. Ciliates are a group of protozoans which possesses hair-like organelles called **cilia.** Cilia are used in swimming, crawling, attachment, feeding, and sensation. Most ciliates are heterotrophs. They eat organisms such as bacteria and algae. They sweep the food by their modified oral cilia into their oral groove (mouth). The food is moved with the help of cilia through the mouth pore into the gullet, which forms food vacuoles.

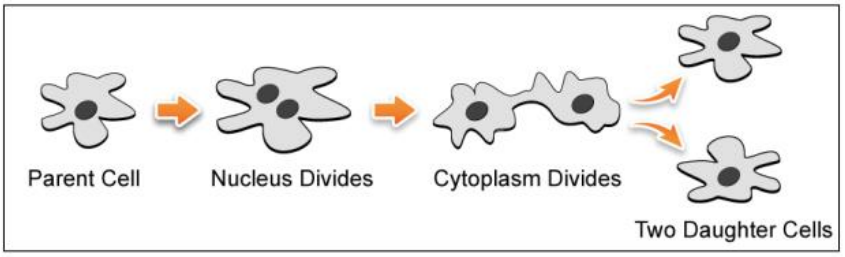


The standard measurement unit for length is meters, centimeters, and millimeters. Because most unicellular organisms are much smaller than 1 mm, scientists use another measuring unit to describe them: the micrometer. The **micrometer symbol is µm - µ is the Greek letter "m"**. One micrometer is one-millionth of a meter or one micrometer is 1000 mm.

1 micrometer (µm) = 0.000 0001 m <u>OR</u> 1000 micrometers (µm) = 1 mm

Growth & Reproduction = Cell Division = MITOSIS

Unicellular organisms are tiny because there are limits to how large they can grow. One of the reasons involves **diffusion and osmosis** - these vital processes work well only over very short distances. For example, it takes an oxygen particle a fraction of a second to diffuse over a distance of 10 μm. To diffuse over a distance of 1 mm takes several minutes!



Like all living things, unicellular organisms grow and develop. When they reach the limits of their size, such as the amoeba shown below, they reproduce by a process of cell division called **mitosis**. Amoebas do this by dividing into two – this **division results in two smaller, identical copies of each organism**.

Cell Specialization

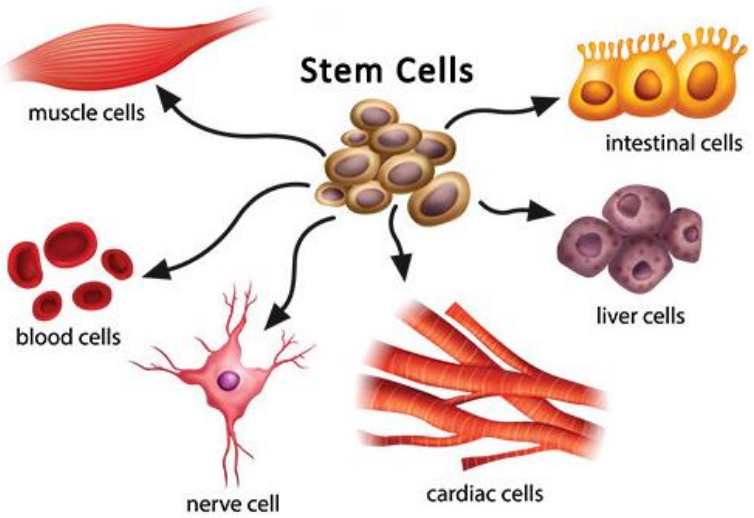
Your human cells also reproduce by mitosis. During cell division, one cell divides to become two fully functioning cells. Each of them then divide into two more cells, and so on creating a multicellular human being. Every day, old cells die and new cells are created. This is how your body replaces the 50 million or so skin cells lost each day! Your body's cells also reproduce to repair any damaged tissues. For example, if you scrape your elbow, your skin cells reproduce to form new skin tissue.

Most multicellular organisms have **specialized cells** – meaning there are **various kinds of cells** and **each kind of cell serves a specific function** needed to support life. For example, the function of red blood cells is to carry oxygen to all cells of your body. To do this, they must travel through extremely small blood vessels. Their thin, flexible disk shape enables them to do this. Red blood cells do not reproduce to replace themselves the way skin cells do. When red blood cells mature into their mature shape, they lose their nucleus. Since the nucleus controls cell division, red blood cells cannot reproduce by mitosis – dividing to make more of them. Most bones of the skeletal system contain a tissue called bone marrow that contains specialized cells that make red blood cells.

Similar specialized cells group together to form tissues:

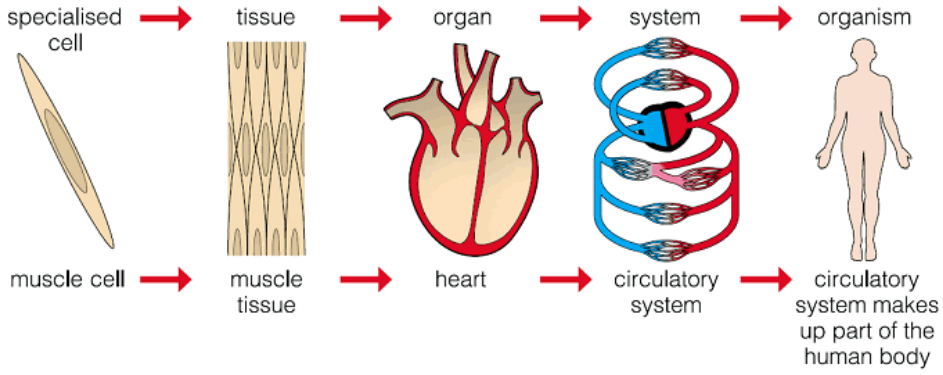
1. **Connective Tissue** – supports other tissues and connects different parts of the body. Blood is a connective tissue, along with fat, bones, fascia, cartilage, and tendons.
2. **Epithelial Tissue** – covers the surface of your body and the outside of your organs. The skin and the linings of various passages inside your body are made of epithelial tissue.
3. **Nervous Tissue** – carries messages to and from various parts of your body. Your brain, spinal cord, and nerves are all made up of nervous tissue.
4. **Muscle Tissue** – allows your body to move and is specialized for contraction. Different muscle tissues pump blood through your body, push food through your intestines, and allow you to move various structures in your body.

Cell Specialization = originates with stem cells that then follow genetic instructions from DNA



Levels of Organization

Just like a cell is made up of different parts called organelles that work together for the health of the cell, our body is also made up of systems that work together that we call organs.



An **organ** is a particular arrangement of tissues that has a special function. A group of organs together forms a body system called an **organ system**. They all work together to perform certain tasks or functions.

All of the organ systems must work together as a single unit for a common purpose, to **support and maintain life**. This idea of everything working together goes deeper than just the organs within the human body. Each of these organs are made up of a group of tissues found within the human body. For example your heart is made of connective tissue, muscle tissue, and nerve tissue. Depending on the type of organ, they will be made up of different kinds and amounts of tissues.

Cell - an individual unit of life.

Tissue - a group of specialized cells.

Organ - a group of tissues that perform a special function.

Body System - group of organs working together to perform certain functions.

Name: _____ Date: _____ Class: _____

Sci8: CS4 Cell, Tissues, Organs & Systems p.45-48 **Body Systems**

The Human Body: Study Jams!

Past belief was that living organisms were made of **air, fire**, and **water**. We then believed that bodies were animated by **active spirits**. Investigate these Study Jam Activities before completing chart to find out what beliefs are NOW about what makes up the human body:

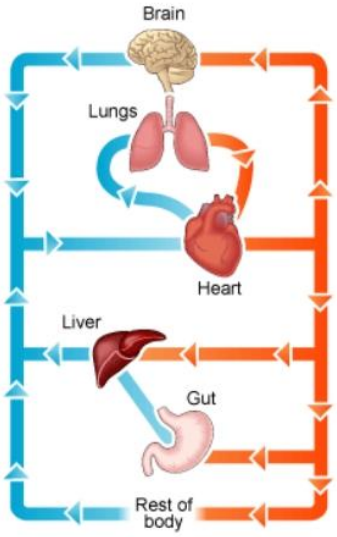
Body System	Things I Learned…	Questions I Still Have…
Skeletal		
Muscular		
Circulatory		
Respiratory		

Name: _____ Date: _____ Class: _____

Sci8: CS4 Cell, Tissues, Organs & Systems p.45-48 **Body Systems**

Body System	Things I Learned…	Questions I Still Have…
Nervous		
Immune		
Digestive		
Senses **(Seeing, Smelling, Touching, Hearing Tasting)**		

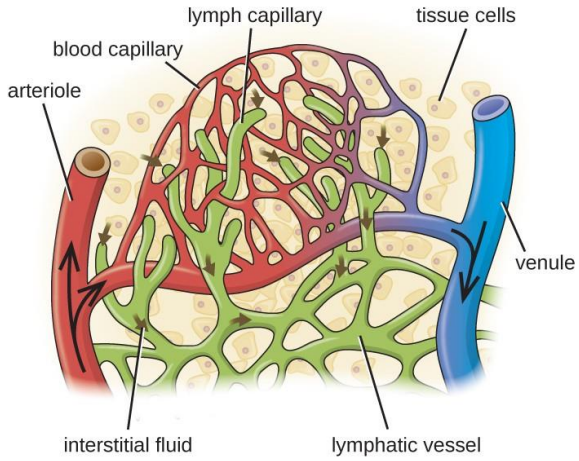
Circulatory System

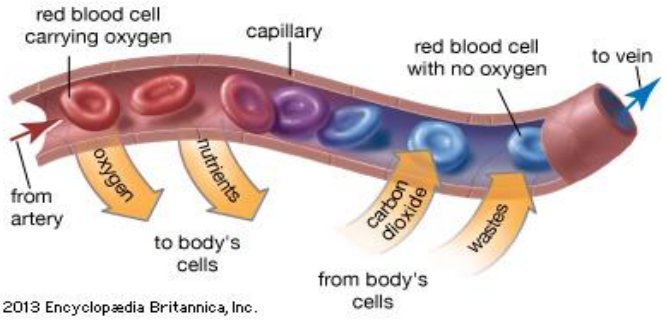


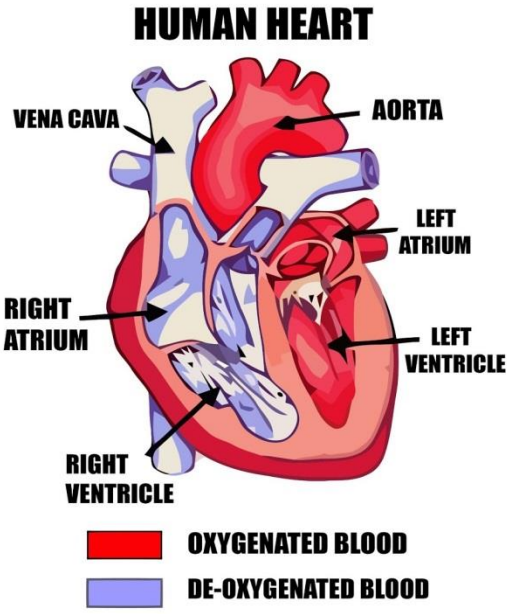
Below are five (5) early ideas about the circulatory system and its main organ, the heart. Today after ~350 years of investigation, we know that only one of these early ideas is accurate. One is partially accurate. The rest have been shown to be incorrect. Can you figure out which is which?

1. The heart is the source of the emotion happiness.
2. The heart pumps blood which is carried once throughout the body in arteries and veins.
3. Arteries and veins get thinner and thinner in various parts of the body.
4. The heart is the source of human intelligence.
5. Blood is made in the liver. It flows into the heart and gets used up, so the liver must constantly make more.

The circulatory system is the main transportation network in your body for delivering nutrients, clearing wastes, regulating body temperature, and delivering your immune system as it works to maintain **homeostasis** – maintaining stability despite changes. There are a number of different aspects or organs working together to create this system. The main parts are the heart along with the different veins, arteries, and capillaries located all throughout the body. **Veins** carry blood <u>TOWARDS</u> the heart and turn into **venules** as they get smaller in size. **Arteries** carry blood <u>AWAY</u> from the heart and turn into **arterioles** as they get smaller in size. **Capillaries** are hair-like vessels that connect arterioles and venules where nutrients and wastes are exchanged.





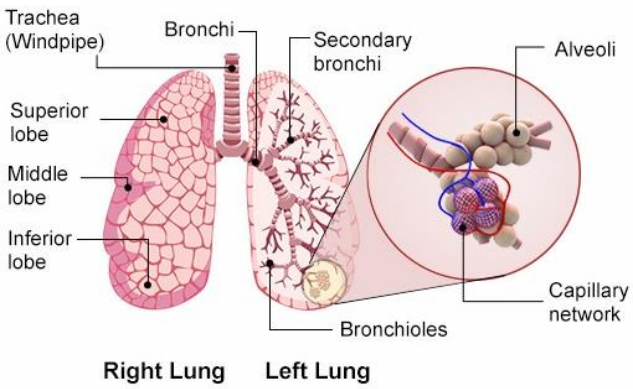


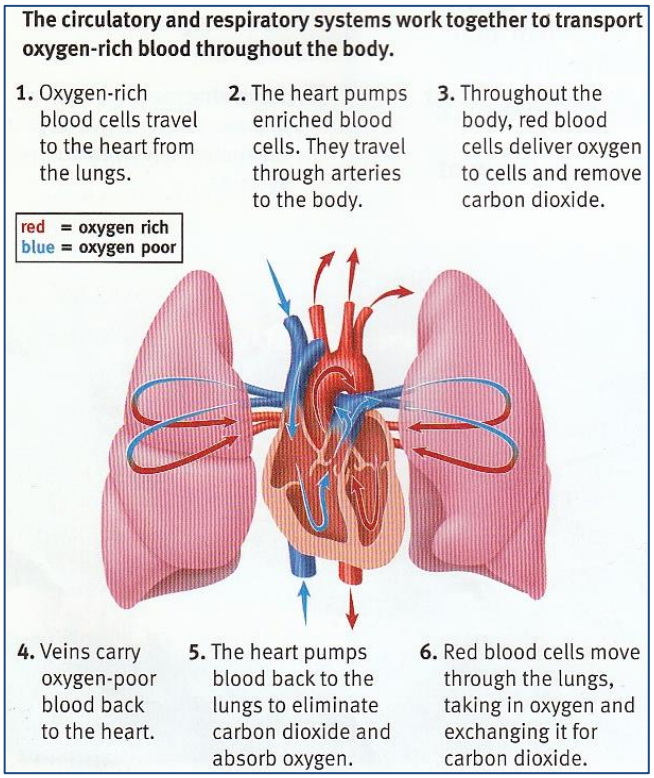
The center of this system, where everything flows to and from, or the "engine" is called the heart. Your heart is about the size of your fist and weighs about 300g. The heart must pump of an average of 70 times per minute for your entire life. Your heart must be able to exert enough pressure to be able to pump blood all the way through your body continually. When new blood enters an artery and it bulges, we call this a **pulse**.

Miss Foley

Sci8: CS4 Cell, Tissues, Organs & Systems p.53, 60-62 **Body Systems**

Respiratory System

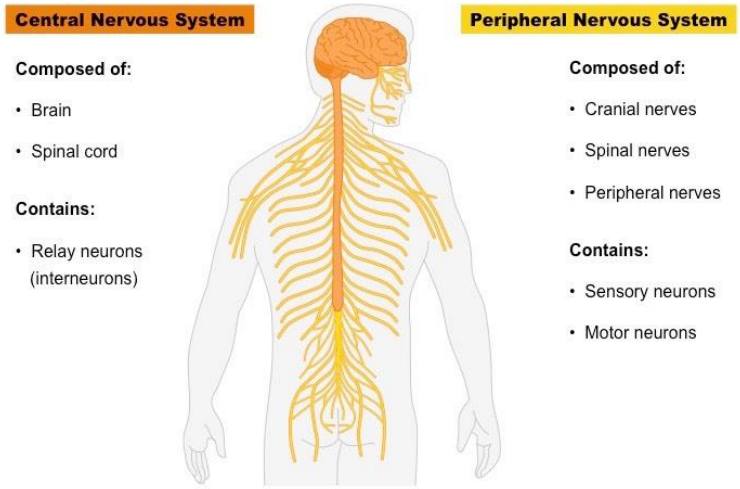




Your cells need **oxygen** to release energy through cellular respiration as well as get rid of the **carbon dioxide** they produce. Two body systems work together to ensure this happens. The respiratory system is the system in your body that allows you to breath (respire). It draws oxygen-rich air into your lungs through tube like passageways called **bronchi** that continue to get smaller as **bronchioles** and even smaller until there are about 600 000 000 tiny air-filled sacs called **alveoli**. The tissue that makes up these sacs are so thin that they are only one cell thick and are surrounded by capillaries. **Capillaries** are extremely thin blood vessels that are also made of tissue that is only one cell thick. Oxygen and carbon dioxide are exchanged between two structures via **diffusion**.

Nervous System

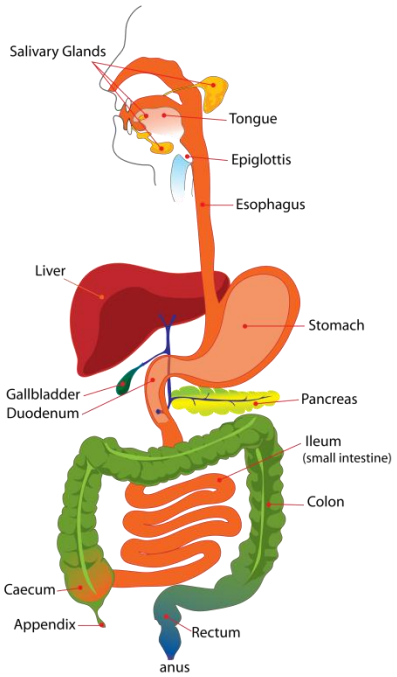
The nervous system is the **complete control center of your entire body**. It coordinates and controls the actions of all organs and organ systems. Within the human body we can split the nervous system up into two different parts. The **central nervous system (CNS)** and the **peripheral nervous system (PNS)**. The central nervous system contain your brain and spinal cord while the peripheral nervous system consists mainly of all the nerves in your body. These **nerves** all send and receive messages that travel from the **brain**, through the **spinal cord**, and then out to its **destination** (or vice versa). The nervous system is all the way down to the cellular level where messages can be sent across single nerve cells to the desired destination. When you feel pain or any other sensation, these are nerve cells sending a message back to your brain that interprets what it has received and lets you feel that specific feeling.



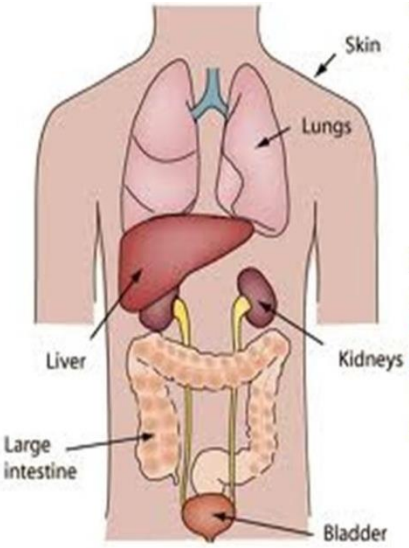
Miss Foley

Sci8: CS3 Cell, Tissues, Organs & Systems p.53, 60-62 **Relationships**

Digestive System



Excretory System



This system represents the excretory system.

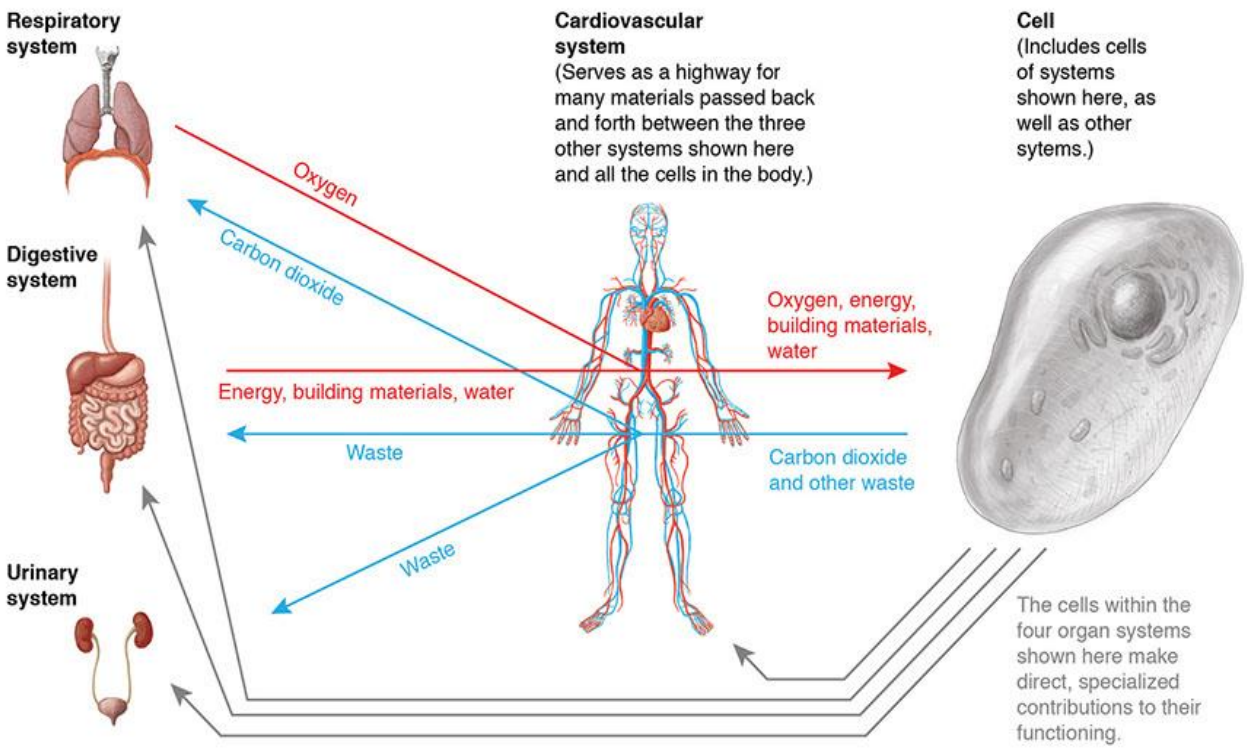
1. Describe excretion.
Removal of metabolic wastes.
2. Identify some metabolic wastes.
CO2, water, urea, salts
Identify an excretory organ in the diagram.
Skin
Lungs
Liver
Kidneys

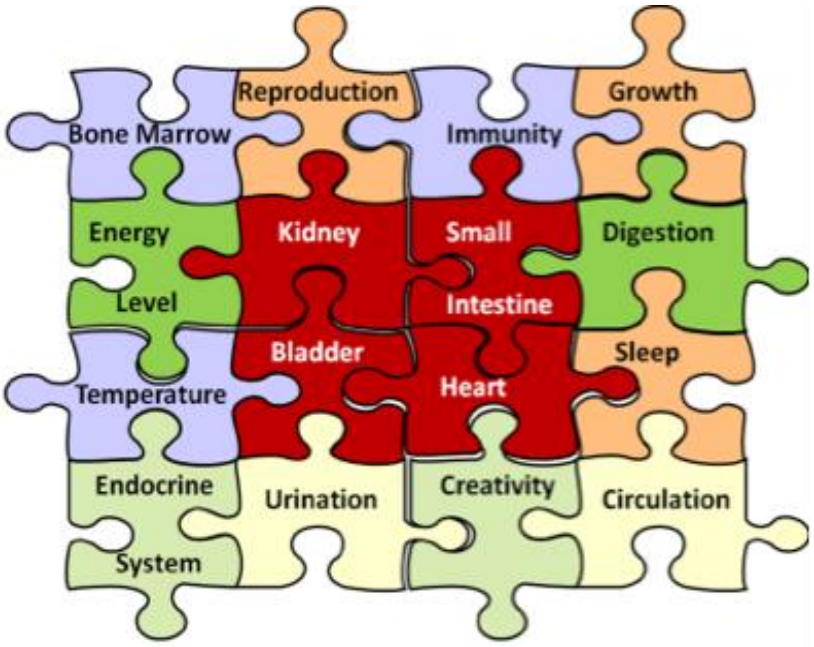
Human Body Systems:
Levels of Organization Relationships

Cell Examples	Tissues	Organs	Organ Systems
			Circulatory System
			Respiratory System
			Nervous System
			Digestive System
			Excretory System

Interdependence:
Body Systems Working Together To Deliver Oxygen, Deliver Nutrients & Remove Wastes for Individual Cells and Organs

Exchange of services between several organ systems and the cells of the body





Human Body-Related Careers

Examples of science & technology-based careers in Saskatchewan that require an understanding of cells and human body systems are:

_____ - measure, count, mix, and dispense drugs and medicines prescribed by physicians, physician assistants, and dentists, among others. Pharmacists must understand the use, composition, and effects of drugs, and how they are tested for purity and strength.

_____ - evaluate, treat, and care for patients with breathing disorders. They treat many types of patients from premature infants whose lungs are not fully developed to elderly people whose lungs are diseased. Therapists run ventilators and can check on them for mechanical problems.

_____ - help elderly, disabled, or ill persons to live in their own homes instead of a health facility. They assist these patients with their daily routines, check their vital signs, oversee their exercise needs, and assist with medication routines.

_____ - are formally trained to perform many of the routine but time-consuming tasks physicians usually do. They take medical histories, perform physical examinations, order laboratory tests and X rays, make preliminary diagnoses, and give inoculations. They also treat minor injuries by suturing, splinting, and casting.

_____ - provide preventive dental care and teach patients how to practice good oral hygiene. They remove calculus, stain, and plaque from above and below the gum line; apply caries-preventive agents such as fluorides and pit and fissure sealants; and expose and develop dental X-rays.

_____ - care for the sick and injured and help people stay well. They observe, assess, and record symptoms, reactions, and progress; assist physicians during treatments and examinations; and administer medications. Licensed practical nurses (L.P.N.s) provide basic bedside care.

_____ - plan nutrition programs and supervise the preparation and serving of meals in institutions such as hospitals and schools. Working in such places as public health clinics, home health agencies, and health maintenance organizations, dietitians and nutritionists determine individual need, establish nutritional care plans, instructing both individuals and families.

_____ - treat patients whose health problems are associated with the body's muscular, nervous, and skeletal systems, especially the spine. Chiropractors use natural, nondrug, nonsurgical health treatments and rely on the body's inherent recuperative abilities.

_____ - work to improve the mobility, relieve the pain, and prevent or limit the permanent physical disabilities of patients suffering from injuries or disease. Treatment often includes exercise for patients who have been immobilized and lack flexibility.

_____ - meet with clients who are having difficulty coping with relationships and everyday problems. Psychologists allow patients to discuss their feelings in a friendly and secure atmosphere. The goal is to resolve inner conflicts, leading to a more productive and well-adjusted life-style.

_____ - examine the eyes and related structures to determine the presence of vision problems and/or other abnormalities. They prescribe glasses or lenses when needed and routinely test for glaucoma and diseases of the retina. They may use visual training to preserve or restore vision to a maximum level of efficiency.

Careers

_____ - operate laser equipment in a proficient and safe manner and assist in the training of operating room personnel. Technicians keep abreast of the current laser research technologies and participate in basic research and data collection. They also order and are responsible for laser supplies and auxiliary equipment needed to perform the laser procedure.

_____ - work with people who cannot speak clearly or who cannot understand language. They test patients to determine the nature and extent of impairment and to analyze speech irregularities. For people who cannot speak, they select an alternative communication system, such as sign language and teach patients how to use the system.

_____ - record brain waves using an EEG machine, and also perform related types of tests to diagnose brain disorders such as tumors, strokes, epilepsy, or the presence of Alzheimer disease. Some are specialists in speech disorders. Other technologists may choose to manage an EEG laboratory and/or become an instructor in EEG techniques.

_____ - provide college instruction to prepare individuals for careers in dentistry, medicine and other healthcare fields. Their basic duties involve preparing lessons, instructing students and marking their work. Those who are instructing students in these fields typically need to have a doctoral degree, although some may be able to find work with a master's degree in a health specialty. They need strong knowledge of human biology and human anatomy to teach these subjects to their students.

_____ - capture images of the internal body with x-rays, while MRI techs use magnetic resonance imaging to obtain anatomical images. They need a thorough understanding of anatomy and human biology to effectively and safely position patients so that they capture images of the necessary body parts. Technicians also must be to effectively answer patient questions about these procedures. Radiologic and MRI technicians can prepare for their career by earning an associate's degree in their respective fields. Most radiologic techs need a state license, and some states also require licensure for MRI technicians.

_____ - must have a doctoral degree in physical therapy and a state license. Their studies include biology and anatomy because they need extensive knowledge of how the human body is structured and how it works in order to effectively diagnose and treat their patients. They are responsible for identifying the physical effects of an illness or injury on their patients and determining the best way to help them regain physical functions and minimize their pain.

_____ - produce things like manuals and other written documents that usually explain how something works or how to perform a specific task. Technical writers typically need a bachelor's degree in English or a similar subject, as well as specialized knowledge of a particular field. In some cases, they produce scientific materials related to scientific inventions or prepare applications for research funding. Those who perform these tasks or write medical documents may need to have knowledge of anatomy and human biology in order to effectively explain the processes they're covering, which could include medical treatments or medical products.

_____ - typically earn a bachelor's degree in biomedical engineering, which requires studying engineering principles along with scientific fields such as biology and physiology. They create healthcare products as varied as computer software and artificial organs. They need to understand human biology and anatomy so that they can produce artificial body parts that can function in place of the original part or organ. Biomedical engineers also work on designing, evaluating and repairing diagnostic equipment or medical devices.

_____ - focus on improving healthcare treatments for people and preventing disease. They must have a doctoral degree in a life science subject, such as biology, or a medical degree. Expertise in human biology and anatomy is necessary for medical scientists in order to identify abnormalities in how a person's body is developing or functioning as a result of illness or injury. This knowledge is also valuable when determining whether treatments are effective at combating the cause of the medical issue.

Human Body-Related Careers

Examples of science & technology-based careers in Saskatchewan that require an understanding of cells and human body systems are:

Pharmacists measure, count, mix, and dispense drugs and medicines prescribed by physicians, physician assistants, and dentists, among others. Pharmacists must understand the use, composition, and effects of drugs, and how they are tested for purity and strength.

Respiratory Therapists evaluate, treat, and care for patients with breathing disorders. They treat many types of patients from premature infants whose lungs are not fully developed to elderly people whose lungs are diseased. Therapists run ventilators and can check on them for mechanical problems.

Home Health Aides help elderly, disabled, or ill persons to live in their own homes instead of a health facility. They assist these patients with their daily routines, check their vital signs, oversee their exercise needs, and assist with medication routines.

Physician Assistants are formally trained to perform many of the routine but time-consuming tasks physicians usually do. They take medical histories, perform physical examinations, order laboratory tests and X-rays, make preliminary diagnoses, and give inoculations. They also treat minor injuries by suturing, splinting, and casting.

Dental Hygienists provide preventive dental care and teach patients how to practice good oral hygiene. They remove calculus, stain, and plaque from above and below the gum line; apply caries-preventive agents such as fluorides and pit and fissure sealants; and expose and develop dental X-rays.

Registered Nurses care for the sick and injured and help people stay well. They observe, assess, and record symptoms, reactions, and progress; assist physicians during treatments and examinations; and administer medications. Licensed practical nurses (L.P.N.s) provide basic bedside care.

Dietitians and Nutritionists plan nutrition programs and supervise the preparation and serving of meals in institutions such as hospitals and schools. Working in such places as public health clinics, home health agencies, and health maintenance organizations, dietitians and nutritionists determine individual need, establish nutritional care plans, instructing both individuals and families.

Chiropractors treat patients whose health problems are associated with the body's muscular, nervous, and skeletal systems, especially the spine. Chiropractors use natural, nondrug, nonsurgical health treatments and rely on the body's inherent recuperative abilities.

Physical Therapists work to improve the mobility, relieve the pain, and prevent or limit the permanent physical disabilities of patients suffering from injuries or disease. Treatment often includes exercise for patients who have been immobilized and lack flexibility.

Psychologists meet with clients who are having difficulty coping with relationships and everyday problems. Psychologists allow patients to discuss their feelings in a friendly and secure atmosphere. The goal is to resolve inner conflicts, leading to a more productive and well-adjusted life-style.

Optometrists examine the eyes and related structures to determine the presence of vision problems and/or other abnormalities. They prescribe glasses or lenses when needed and routinely test for glaucoma and diseases of the retina. They may use visual training to preserve or restore vision to a maximum level of efficiency.

Careers

Biomedical Laser Technicians operate laser equipment in a proficient and safe manner and assist in the training of operating room personnel. Technicians keep abreast of the current laser research technologies and participate in basic research and data collection. They also order and are responsible for laser supplies and auxiliary equipment needed to perform the laser procedure.

Speech-Language Pathologists work with people who cannot speak clearly or who cannot understand language. They test patients to determine the nature and extent of impairment and to analyze speech irregularities. For people who cannot speak, they select an alternative communication system, such as sign language and teach patients how to use the system.

Neurophysiological Technologists record brain waves using an EEG machine, and also perform related types of tests to diagnose brain disorders such as tumors, strokes, epilepsy, or the presence of Alzheimer disease. Some are specialists in speech disorders. Other technologists may choose to manage an EEG laboratory and/or become an instructor in EEG techniques.

Postsecondary Health Specialties Teachers provide college instruction to prepare individuals for careers in dentistry, medicine and other healthcare fields. Their basic duties involve preparing lessons, instructing students and marking their work. Those who are instructing students in these fields typically need to have a doctoral degree, although some may be able to find work with a master's degree in a health specialty. They need strong knowledge of human biology and human anatomy to teach these subjects to their students.

Radiologic and MRI Technicians capture images of the internal body with x-rays, while MRI techs use magnetic resonance imaging to obtain anatomical images. They need a thorough understanding of anatomy and human biology to effectively and safely position patients so that they capture images of the necessary body parts. Technicians also must be to effectively answer patient questions about these procedures. Radiologic and MRI technicians can prepare for their career by earning an associate's degree in their respective fields. Most radiologic techs need a state license, and some states also require licensure for MRI technicians.

Physical Therapists must have a doctoral degree in physical therapy and a state license. Their studies include biology and anatomy because they need extensive knowledge of how the human body is structured and how it works in order to effectively diagnose and treat their patients. They are responsible for identifying the physical effects of an illness or injury on their patients and determining the best way to help them regain physical functions and minimize their pain.

Technical Writers produce things like manuals and other written documents that usually explain how something works or how to perform a specific task. Technical writers typically need a bachelor's degree in English or a similar subject, as well as specialized knowledge of a particular field. In some cases, they produce scientific materials related to scientific inventions or prepare applications for research funding. Those who perform these tasks or write medical documents may need to have knowledge of anatomy and human biology in order to effectively explain the processes they're covering, which could include medical treatments or medical products.

Biomedical Engineers typically earn a bachelor's degree in biomedical engineering, which requires studying engineering principles along with scientific fields such as biology and physiology. They create healthcare products as varied as computer software and artificial organs. They need to understand human biology and anatomy so that they can produce artificial body parts that can function in place of the original part or organ. Biomedical engineers also work on designing, evaluating and repairing diagnostic equipment or medical devices.

Medical Scientists focus on improving healthcare treatments for people and preventing disease. They must have a doctoral degree in a life science subject, such as biology, or a medical degree. Expertise in human biology and anatomy is necessary for medical scientists in order to identify abnormalities in how a person's body is developing or functioning as a result of illness or injury. This knowledge is also valuable when determining whether treatments are effective at combating the cause of the medical issue.

Name: _____ Date: _____ Class: _____

Sci8: CS4 Cell, Tissues, Organs & Systems **Body Systems**

Osmosis Jones Video Questions _____/34 = _____%

These questions follow the movie in order; use the bold headings to keep your place in the movie.

Part I. Frank Eats an Egg (0:00:00)

1. What type of cell is Osmosis (Ozzie) Jones?

2. A cop and his girlfriend are going to the kidneys to see whom? Why do they need to go see them soon?

3. After germs enter the bloodstream, whose problem do they become?

4. What does Ozzie's bullet hit causing Frank to get a leg cramp?

5. When the saliva boat patrol is cleaning up the remnants of the dirty egg what do they say they are going to send a letter to the mayor about?

6. What statue has the title, "Our Founder" outside the mayor's office?

7. There is a fat cell housing shortage. What does the mayor say that they are working on to solve this problem?

8. Hair cells are being laid off on the scalp (Frank is balding); where can these hair cells find plenty of jobs?

Tom Colonic's Campaign Ad (0:12:00)

9. Tom Colonic is running for mayor on a campaign of cleaning up the rot and stagnation in the bowels. He wants to "get things moving" by adding what to Frank's diet?

10. The mayor says that he has a plan that will "Flush Colonic_____."

11. What is the location of Ozzie's police station?

Name: _____ Date: _____ Class: _____

Sci8: CS4 Cell, Tissues, Organs & Systems **Body Systems**

Cold Pill (Drixenol) Enters Frank (0:15:25)

12. When Drix (the cold pill) arrives in Frank's stomach the cells are amazed by his size. What is Ozzie's comment about the pill?

13. When Thrax (the virus) confronts the "Godfather" in the sauna, what part of the body and what type of gland is the sauna in?

14. The "Godfather" tells his underlings to take Thrax and "bury him in a_____."

15. According to the sign at the doughnut shop, what two requirements are there in order service?

16. What is the nasal dam made out of?

17. What hall is Mayor Phlemming's office located in?

18. What community (inside Frank) cheers when the Mayor announces the trip to the Buffalo Wing Festival?

Frank Eats a Toxic Oyster (0:41:15)

19. What button does Jones push to get rid of the bacteria on the oyster?

20. Now that some of the "Godfather's" underlings have joined Thrax, where do they meet to plan out their attack of Frank?

21. What types of viruses are fighting on the street as cells place bets?

22. The "guy" running the fight used to be a virus. How did he enter the body?

23. What is the name of the club where Thrax holds a meeting with other bacteria and viruses?

24. What is the name of the rock band playing at the club?

25. What part of Frank's body controls the temperature?

Name: _____ Date: _____ Class: _____

Sci8: CS4 Cell, Tissues, Organs & Systems **Body Systems**

The Zit Explodes (0:59:00)

26. What do Ozzie and Drix decide to call for in order to clean up the mess after the zit explodes?

27. When Thrax is going to leave the ingrown toenail with his two remaining henchmen, one of them suggests that they do what for a while first?

28. What did Osmosis' Great Great Grandpappy fight?

29. What did Ozzie's ancestors come over on?

30. When Drix decides to leave the body, what effect does he not want to have on Frank?

31. Drix gets on a bus whose sign indicates that its destination is what?

32. What is the "little dangly thing" in the back of the throat?

33. What substance kills Thrax (and most other pathogens)?

34. In order for Drix to stay in Frank's body, he'll need a lawyer. Where does Ozzie suggest he go to get one?

Lifestyle Factors Impacting Human Body Systems

Lifestyle

1. **Nutrition** –

2. **Physical Activity** –

3. **Sleep** –

4. **Energy Drinks** –

5. **Substance Use (Alcohol, Smoking, Drugs)** –

Environmental

1. **Viruses & Bacteria** –

2. **Supplements** –

3. **Pesticides** –

4. **Immunizations/Vaccinations** –

5. **Temperature** –

6. **Dust/Air Quality** –

Ethical

1. **Pacemakers** –

2. **Prosthetic Limbs** –

3. **Removing Limbs/Organs** –

4. **Artificial Body Parts** –

Lifestyle Factors Impacting Human Body Systems

Lifestyle

1. **Nutrition** – (+) affects digestive system which delivers energy to other systems; (-) affects storage of excess energy and increases workload of immune system and excretory system.
2. **Physical Activity** – (+)affects nervous system increasing learning; (+) affects circulatory system delivering oxygen, nutrients and picking up waste; (+) affects muscular system increasing muscle mass = strength; (-) affect when overtraining and not recovering; (+) affects the strength of your skeletal system.
3. **Sleep** – (+) affects nervous system by removing toxic waste; (+) affects excretory system by removing wastes; (+) affects all systems allowing time to rebuild and recover; (-) affects nervous, immune and digestive system when you don't get any sleep.
4. **Energy Drinks** – (-) affects all systems when not sleeping; (-) affects circulatory system by speeding up heart rate; (-) affects fight or flight stress response and nervous system.
5. **Substance Use (Alcohol, Smoking, Drugs)** – (-) affects nervous, circulatory, and respiratory system functioning; (+) and (-) affects most body systems when using prescription drugs; (+) affect when using alcohols for disinfecting.

Environmental

7. **Viruses & Bacteria** – (-) affect immune system, digestive system, respiratory system when causing disease; (+) affects digestive, nervous and immune system with gut bacteria.
8. **Supplements** – (+) affect chemical processes for all body systems when present in the correct amounts; (-) affect all body systems if over/under dosing.
9. **Pesticides** – (-) affects digestive, nervous, respiratory, and endocrine, and excretory systems with increased exposure.
10. **Immunizations/Vaccinations** –(+) affects immune systems giving it a memory of how to fight it; (-) affect when people have reactions to them.
11. **Temperature** – (+) affects all body systems when temperature is within correct ranges; (+) affects immune system when fevers are needed to kill bacteria; (-) affects all body systems when temperature drops too low.
12. **Dust/Air Quality** – (-) affects if irritating to respiratory; (-) affects immune system if allergic response engages; (+) affects respiratory and circulatory system with higher air quality.

Ethical

5. **Pacemakers** – (+) affects controlling circulatory system via nervous system when properly working; (-) affects circulatory system when dysfunctional.
6. **Prosthetic Limbs** – (+) affect circulatory and excretory systems by increasing mobility; (-) affects muscular and skeletal systems if not fitted properly.
7. **Removing Limbs/Organs** – (-) affects nervous system when phantom pains exist (brain still thinks body part is there to communicate with); (+) affects if diseased organs causing death are removed; (-) affects if body rejects organs.
8. **Artificial Body Parts** – (+) affects function of body system placed in; (-) affects body's immune system if body rejects it as its own; possible (-) affects with materials exposure.
9. **Stem Cells** – (+) affects rebuilding/repairing various body systems as stem cells can grow into any type of cell when exposed to the right factors and environments.

Miss Foley

Sci8: CTOS Cells, Tissues, Organs & Systems **Review**

REMINDER: This is a guideline, not a copy of the questions on the test. It is to be used to help guide studying. All of the material from the unit is fair game for the test, even if it is not included on this study guide. It is your responsibility to study ALL of the material provided in your notes.

Key Terms:

Knowing and being able to explain / describe the following terms and concepts will be beneficial for the test. Many of these terms (but not limited to these) will be on the test.

cell	diffusion	multicellular	organ
organelle	osmosis	selectively permeable	system
tissue	unicellular	cytoplasm	specialized cells
red blood cells	connective tissue	epithelial tissue	nervous tissue
muscle tissue	interdependent	respiratory system	digestive system
nervous system	excretory system	circulatory system	heart
arteries	veins	pulse	alveoli
capillaries	stimuli	holistic	reductionist

Foundational Questions to Consider When Studying:

1. List the requirements for determining if something is a living organism.
2. Who invented the microscope?
3. Who was the first person to view "cells"?
4. Who discovered single celled organisms? What did he call them?
5. There are two main world views, what are they? Describe them.
6. What is a compound light microscope? What does it do?
7. What are the different parts of a compound light microscope?
8. What are the different functions of each of these parts?
9. What does the Cell Theory state?
10. Cells are made up of many different parts. List and describe each of the different structures.
11. What is the difference between a plant and animal cell?
12. Draw a diagram comparing a plant and animal cell.
13. How does a cell interact with its external environment?

14. What are the main processes for transporting things in and out of a cell? Describe them.

15. What is a selectively permeable membrane?

16. What are specialized cells?

17. When a bunch of the same type of specialized cells are grouped together what do they form?

18. What is a tissue?

19. What are the main types of tissues that humans are made up of?

20. What does the term interdependent mean?

21. How are things within our body interdependent? Explain while relating back to cells, tissues, organs, and systems.

22. What is an organ system?

23. What are the different organ systems within the human body?

24. What does the circulatory system do? What are the different components that work together to create this system?

25. What is the purpose of blood in our body?

26. What is the transport cell within blood?

27. What is the difference between arteries and veins?

28. What does the respiratory system do? What are the different components that work together to create this system?

29. What are the small air sacs at the end of the tubes in the lungs called?

30. How does the respiratory system get oxygen throughout out body and remove waste?

31. What processes are used to move oxygen and waste between the blood and alveoli in the lungs? Explain them.

32. What does the digestive system do? What are the different components that work together to create this system?

33. What does the excretory system do? What are the different components that work together to create this system?

34. What does the nervous system do? What are the different components that work together to create this system?

35. What is the difference between the peripheral nervous system and the central nervous system?

FD 8.1 Investigate and represent the density of solids, liquids, and gases based on the particle theory of matter.

- ❑ Explain the relationship between mass, volume, and density of solids, liquids, and gases using the particle theory of matter.
- ❑ Know how to use instruments safely, effectively, and accurately for collecting data about the density of solids, liquids, and gases.
- ❑ Discuss how the water displacement method is used to determine the density of various regularly shaped and irregularly shaped materials.
- ❑ Know how to measure the mass and volume of a variety of objects, record the data in tabular form, and display the data graphically.
- ❑ Demonstrate the importance of accuracy, precision, and honesty when gathering data about the density of objects.
- ❑ Determine the mass or volume of a substance from density graphs.
- ❑ Calculate the density of various regularly shaped materials using the formula d=m/v and using units of g/mL or g/cm^3.
- ❑ Compare the densities of common substances to the density of water and discuss practical applications that are based on differing densities.
- ❑ Discuss the effects of changes in temperature on the density of solids, liquids, and gases and explain the results using the particle theory of matter.
- ❑ Describe situations in daily life where we see evidence that the density of substances changes naturally (e.g., molten lava as it cools, water 'turning over' at 4°C in the fall, air when mirages form) or is intentionally altered (e.g., air in a hot-air balloon, cream when it is churned and cooled).

FD 8.2 Examine the effects of forces in and on objects in fluids, including the buoyant force.

- ❑ Identify questions involving floating, sinking, and buoyancy (e.g., "What factors affect the amount of cargo a barge can hold?", "Why do some objects float and some objects sink?", and "How can a ship made of steel float in the ocean?").
- ❑ Discuss contributions of people from various cultures to understanding the principles of buoyancy, including Archimedes Principle, and the development of watercraft such as canoes and kayaks.
- ❑ Explain the concept of force and provide examples of different types of contact and non-contact forces.
- ❑ Illustrate, using force diagrams, the movement of objects in fluids in terms of balanced and unbalanced forces acting on the objects.
- ❑ Know how to use a spring scale to determine the relationship between mass and weight for various substances.
- ❑ Explain the relationship between pressure, force, and area in fluids.

FD 8.2 Examine the effects of forces in and on objects in fluids, including the buoyant force. (cont'd)

- ❑ Identify which factors determine whether a given object will float or sink, and discuss reasons why scientists control some variables when conducting a fair test.
- ❑ Discuss your prototype that floats and can carry the greatest amount of cargo.
- ❑ Explain how buoyancy is controlled in nature (e.g., fish, humans, and sharks) and in constructed devices (e.g., submarines, airplanes, airships, scuba gear, and hot air balloons).
- ❑ Using examples compare different fluids to determine how they alter the buoyant force on a given object.
- ❑ Explain the operation of technologies whose development is based on scientific understanding of the properties of fluids (e.g., personal flotation devices, float planes, surfboards, gliders, anti-freeze tester, and heart pumps).
- ❑ Discuss designs of traditional and contemporary watercraft (e.g., canoe, kayak, lake boat, catamaran, and jet-ski) with respect to the principles of buoyancy.

FD8.3 Investigate and describe physical properties of fluids (liquids and gases), including viscosity and compressibility.

- ❑ Design and conduct an experiment to compare the viscosity of various fluids (e.g., water, syrup, oil, shampoo, glycerin, honey, ketchup, hand cream, and detergent) and identify variables relevant to the investigation.
- ❑ Use appropriate vocabulary related to the study of fluids, including fluid, viscosity, buoyancy, pressure, compressibility, hydraulic, pneumatic, and density.
- ❑ Demonstrate knowledge of Workplace Hazardous Materials Information System (WHMIS) standards by using proper techniques for handling and disposing of lab materials and by explaining the WHMIS labelling system.
- ❑ Investigate the relationship between the temperature and viscosity of a liquid, controlling the major variables.
- ❑ Use a temperature measuring technology, such as a temperature probe, effectively and accurately for collecting data to investigate the relationship between temperature and viscosity of a liquid.
- ❑ Identify products in which viscosity is an important property (e.g., paint, hand lotion, motor oil, salad dressing, and condiments) and evaluate different brands of those products using student-developed criteria.
- ❑ Predict and investigate the effect of applying external pressure to the behaviour of liquids and gases (e.g., squeezing a balloon, depressing a plunger in a syringe).

FD8.3 Investigate and describe physical properties of fluids (liquids and gases), including viscosity and compressibility. (cont'd)

- ❑ Describe situations in which pressure can be increased or decreased by altering surface area (e.g., snowshoes vs. boots, flat-heeled vs. high-heeled shoes, adaptive hoof shape of the woodland caribou, dual or triple tires on a tractor, and placing a thumb over the end of a garden hose).
- ❑ Use the particle theory of matter to explain the differences in compressibility between liquids and gases.
- ❑ Explain the relationship between pressure, volume, and temperature when liquids and gases are compressed or heated.
- ❑ Demonstrate concern for safety of self and others when planning, carrying out, and reviewing procedures involving heating and compressing liquids and gases.

FD8.4 Identify and interpret the scientific principles underlying the functioning of natural and constructed fluid systems.

- ❑ Describe how hydraulic or pneumatic pressure can be used to create a mechanical advantage in a simple mechanical device (e.g., hydraulic jack, air powered tools, hairstylist's chair, and water spraying toy)
- ❑ Compare natural (e.g., circulatory and respiratory system) and constructed (e.g., hydraulic and air brakes, oil and gas pipelines, swimming pool circulation system, bicycle and other pumps, Archimedes screw, and automobile lifts) hydraulic and pneumatic fluid systems and identify advantages and disadvantages of each, using criteria such as cost and impact on society and the environment.
- ❑ Discuss your prototype of a device that models the operation of a natural or constructed fluid system. Identify, discuss and correct any problems with how the prototype functions.
- ❑ Apply given criteria for evaluating evidence and sources of information by testing a prototype of a natural or constructed fluid system in a variety of situations to ensure that the results were not due to chance.
- ❑ Describe and explain the role of collecting evidence, finding relationships, proposing explanations, and imagination in the development of scientific knowledge related to fluids and fluid systems (e.g., finding relationships between density or pressure and change in temperature provides insights into practical uses for fluids).
- ❑ Provide examples of Canadian contributions to the science and technology of fluids (e.g., submersibles, oil rigs and platforms, diving equipment, pumps, tires, and vacuum cleaners).

BIG IDEAS Summary:
Forces, Fluids and Density

1. All fluids demonstrate the property of viscosity, or the internal friction that causes a fluid to resist flowing.

Key Concepts

a. Particle Theory
b. Fluid
c. viscosity

Summary

- The Particle Theory explains differences among states of matter, why fluids flow, and how temperature affects different materials.
- A fluid is a gas or liquid that flows and takes on the shape of its container.
- The viscosity of a fluid is measured by how fast the fluid flows. Viscosity increases as temperature decreases.

2. Density is another important property of fluids.

Key Concepts

- weight and mass
- volume
- density

Summary

- Weight is the measure of the force of gravity on an object, while mass is the amount of matter in the object. The unit for weight is the newton (N) and the unit for mass is the kilogram (kg).

a. The volume of an object is how much space it takes up, and can either be measured directly using measuring tools, or measured by displacement of water. The units for volume are cm^3 or mL.

b. Density can be calculated using the formula $D = m/V$ and measures the mass per unit volume. The units for density are g/cm^3 or g/mL.

- • Water's density at 4°C is defined as 1 g/mL. Water is a special fluid and acts as the universal solvent. Water is the only pure substance that is more dense in liquid form than it is in solid form.

3. Fluids exert a buoyant force on objects that causes objects to float.

Key Concepts

- forces

a. buoyant force
b. First Nations designs

- canoe and kayak technology

Summary

- The buoyant force is exerted by a liquid, pushing an object up against the force of gravity. The buoyant force is affected by the type of liquid, and can be calculated by subtracting the weight of the object in the liquid from the weight of the object in air.
- Living and non-living things are able to control their depth in water by altering their weight.
- From observations over many generations, First Nations, Inuit, and Métis boat designers built up place-based knowledge that enabled them to create a variety of boat designs to suit different purposes.
- Modern canoe and kayak technologies depend on designs unchanged from those of traditional craft.

4. Understanding the properties of fluids helps in the design and construction of useful devices.

Key Concepts

- pressure

a. area
b. compression
c. hydraulic

- pneumatic

Summary

- Pressure is the amount of force applied on a surface. Snowshoes reduce the force per unit area, allowing people to walk in the surface layers of the snow.

d. As a fluid is heated, it will exert greater pressure on the walls of its container.
e. Pascal's law states that when pressure is applied to a contained liquid, that pressure and force are transmitted without losing any force, and in all directions throughout the liquid.
f. Gases are compressible, while liquids are incompressible. This allows liquids to transfer forces efficiently.
g. Hydraulic systems use liquids within a closed system to transfer forces from one part of a device to another. When two pistons of a hydraulic system have different areas, a larger force is created by the larger piston.

- Pneumatic systems use gases within an open system to transfer forces from one part of a device to another. A compressor works to compress gases in the system to cause them to transfer forces from one area to another.

International System of Units (SI) = Metric System

1. The metric system is based on **base units** such as **meters**, **liters**, and **grams**.

2. All of the other units are derived from this base unit in powers of 10.

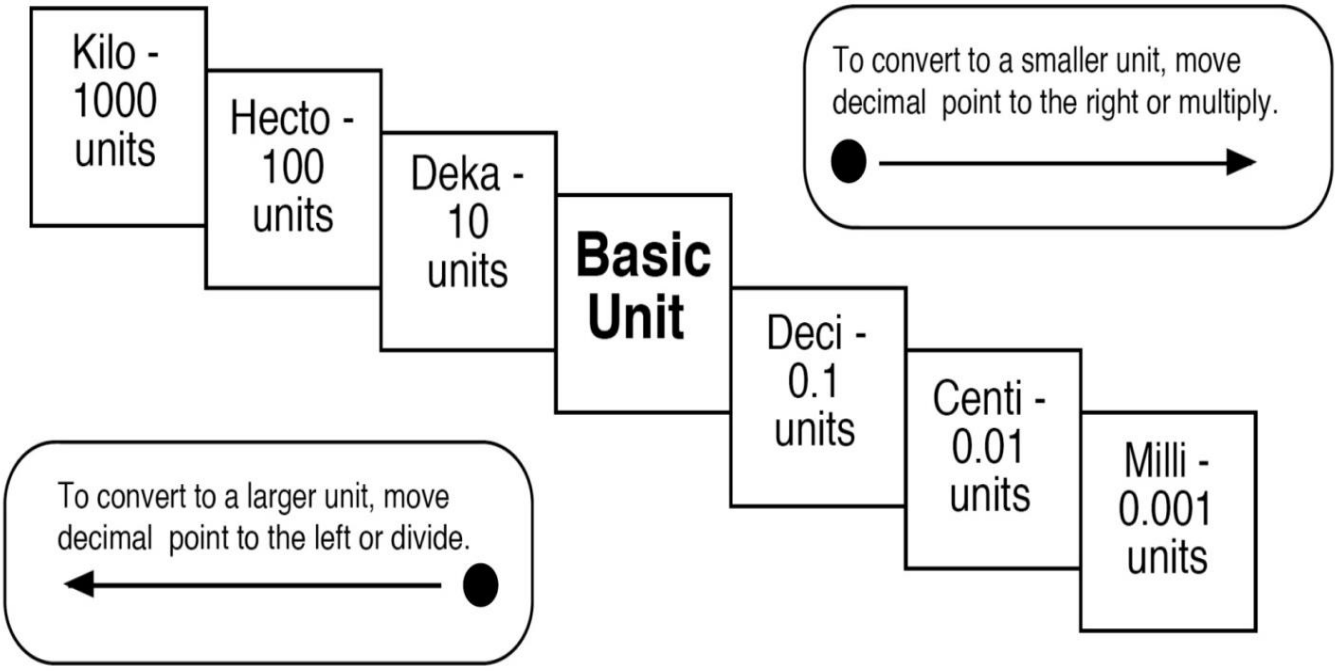
3. **International System of Units (SI):** a.k.a. the official name for the metric system includes:

   Length – meter (m) Volume – liter (L)

   Mass – kilogram (kg) Time – seconds (s)

   Temperature – Kelvin (K)

Metric Conversion Chart



Common Measurements and Units

Mass: grams

Force/Weight: push/pull = Newtons (N)

Area: length x width = m^2

Pressure: N/m^2 = Pascal (Pa)

Density: *liquids* = g/mL OR *solids* = g/cm^3

Volume of Irregular Shapes: water displacement method = mL

Volume of Regular Shapes: *solids* = length x width x height = cm^3 OR *liquids* = mL

Data Collection Tools

Balance Scale

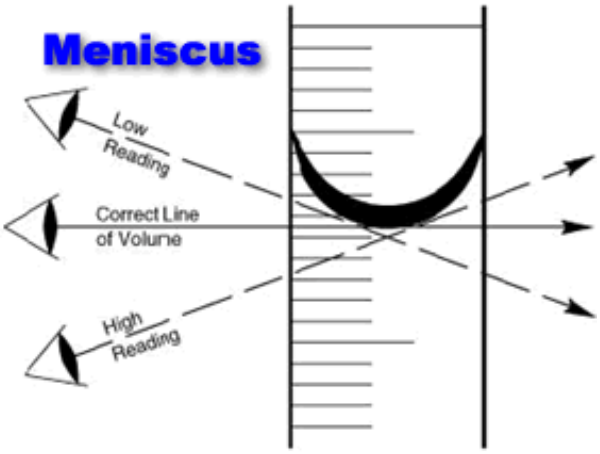
Spring Scale

Graduated Cylinder

Digital Scale

Erlenmeyer Flask

Beaker

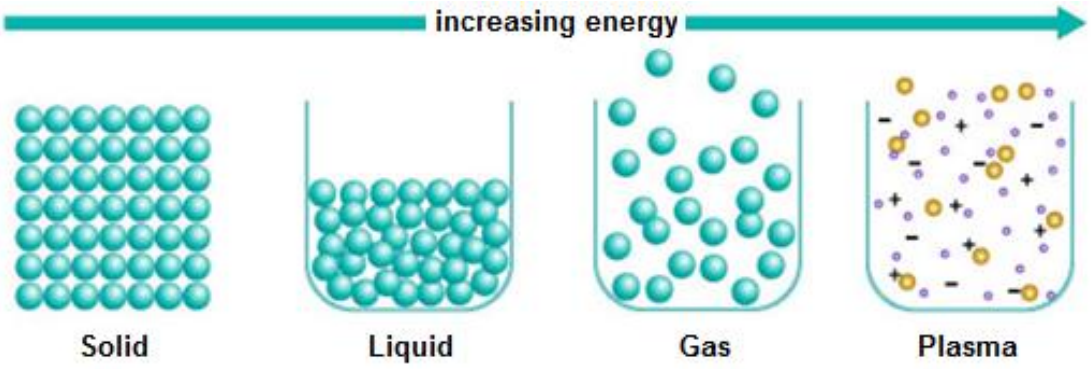


Particle Theory =

a model of matter describing different states of matter along with what happens when matter changes from one state to another

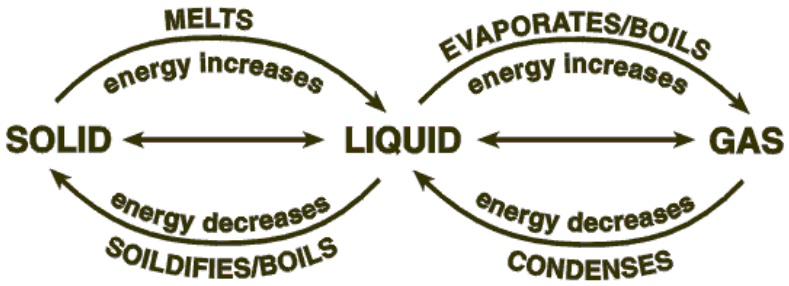
The Particle Theory states:

1. All matter is made of tiny particles.
2. Different substances are made of different particles.
3. Particles of matter are always moving and vibrating.
4. Particles move differently in solids, liquids, and gases.
5. Adding heat makes particles move more vibrating faster decreasing density resulting in a state of matter change.



Common States of Matter:

1. **Solid** - particles are close together and fixed in place; denser than liquids
2. **Liquid** – particles are close together but can slide around and over each other; denser than gases
3. **Gas** – particles are farther apart and move around rapidly



Matter = anything that takes up space and has mass

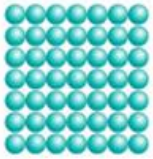
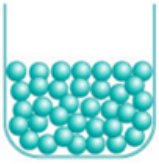
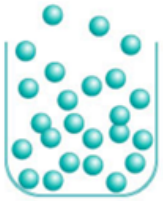
Mass = amount of matter (#of atoms) in an object

Volume = measure of how much space an object takes up

Weight = measure of the force of gravity on an object

Density = m/v =
mass of an object compared to a given volume

Denser has more particles that are more tightly compact.

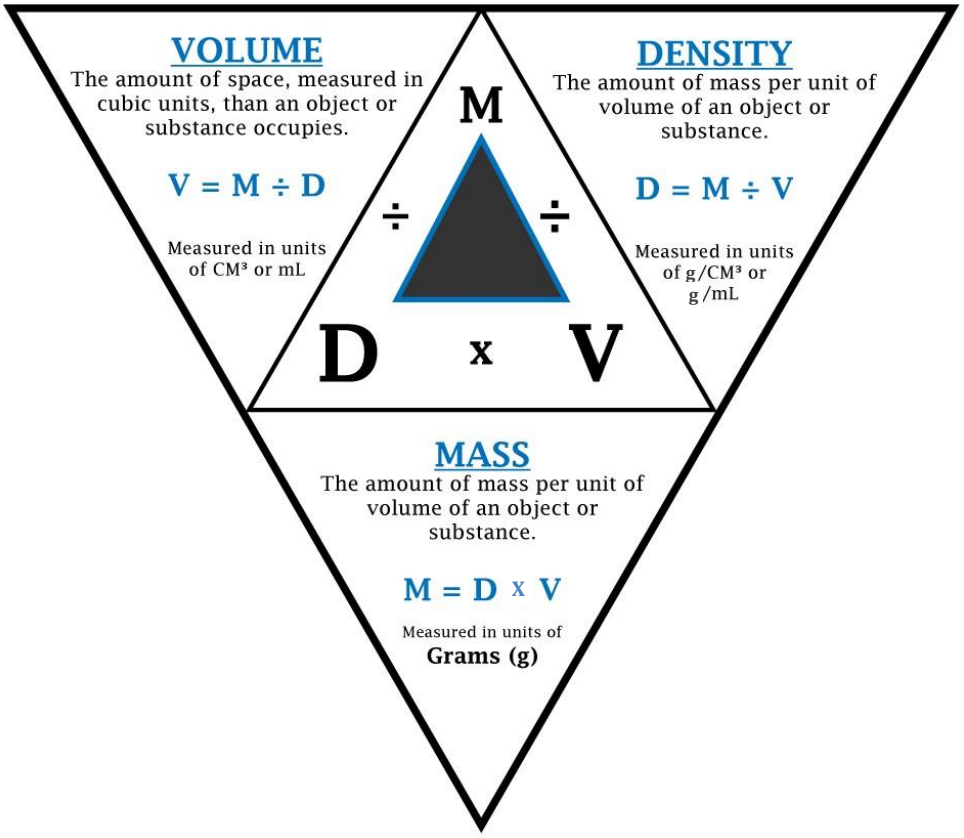
	 **Solid**	 **Liquid**	 **Gas**
Particle Distribution	Very close together	Farther apart than solids but closer than gases	Quite spread out
Strength of Particle Bonds	Very strong	Weaker than solids but stronger than gases	Quite weak
Particle Movement	Very little motion; vibration only	Very little motion; yet more than vibration only	A lot of fast, quick motion bouncing into one another
Mass	Usually greater than liquids and gases	Usually in between solids and gases	Usually lower than solids and gases
Volume	Keep their shape when put into a container; take up smallest volume	Take on shape of container; doesn't fill whole container	Take on shape of container taking-up entire space of container
Density	Usually have greater density than liquids and gases	Usually between solids and gases	Usually have lower density than liquids and gases
Effect of Temperature on Density	Density decreases with heat & vice versa	Density decreases with heat & vice versa	Density decreases with heat & vice versa

Determining Density, Volume and Mass

The density (d) of a substance is the ratio of its mass (m) to its volume (v). If we know two different variables then we are able to find the missing one. The **density formula** can be written as:

D = M/V

Examples:



1. If 242 mL of a substance has a mass of 424g, what is the density of the substance?

2. If you have a 375mL glass of orange juice with a density of 1.15g/mL, what is the weight of it?

3. Which is more dense 500 mL of Substance A weighing 674g OR 227 mL of Substance B that weighs 840g?

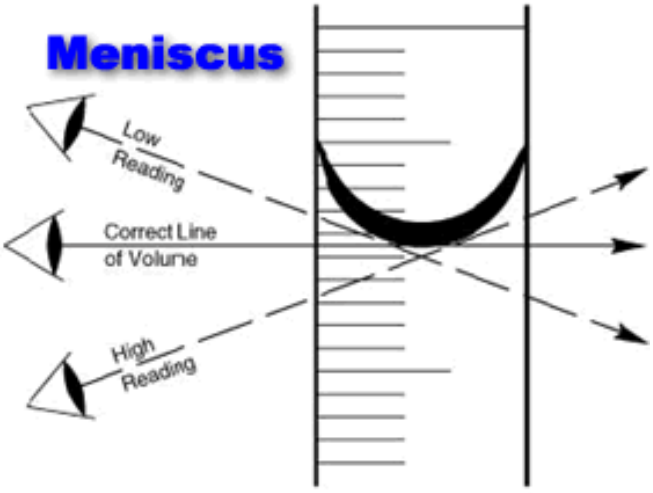
4. How dense is 1.5L of Kool-Aid with a mass of 873g?

5. What is the density of a 17kg, 13L tank of gas?

Liquid Layers Lab Day

1. Join a group of 2-3.
2. Get a Sci 8 textbook.
3. Read **Problem Solver: Dense and Denser p. 196** for detail and understanding.
4. Read **Investigator: Liquid Layers p.197** for detail and understanding.
5. Complete Problem Solver: Dense and Denser p. 196
6. Complete Investigator: Liquid Layers

Can you correctly identify the following?



Work To Learn: Density Problems

1. A block of aluminum occupies a volume of 15.0 mL and weighs 40.5 g. What is its density?

2. Mercury metal is poured into a graduated cylinder that holds exactly 22.5 mL. The mercury used to fill the cylinder weighs 306.0 g. From this information, calculate the density of mercury.

3. What is the weight of the ethanol that exactly fills a 200.0 mL container? The density of ethanol is 0.789 g/mL.

4. A rectangular block of copper metal weighs 1896 g. The dimensions of the block are 8.4 cm by 5.5 cm by 4.6 cm. From this data, what is the density of copper? (Hint: find the volume of a block first)

5. What volume of silver metal will weigh exactly 2500.0 g. The density of silver is 10.5 g/cm3.

6. Find the mass of 250.0 mL of benzene. The density of benzene is 0.8765 g/mL.

7. A block of lead has dimensions of 4.50 cm by 5.20 cm by 6.00 cm. The block weighs 1587 g. From this information, calculate the density of lead.

8. 28 g of iron shot is added to a graduated cylinder containing 45.50 mL of water. The water level rises to the 49.10 mL mark, From this information, calculate the density of iron.

Name: _____ Date: _____ Class: _____

Sci8: FD1 Forces, Fluids & Density **Density**

Progress Check: Density _____ /15 = _____%

When answering calculation questions be sure to follow all the appropriate steps:

1. Write down the variables that you know.
2. Check that everything is in the proper units (g, mL, cm^3).
3. Write the formula to be used. Re-arrange the formula as needed.
4. Solve for the missing variable.
5. Write out the answer using proper units.

1. What is the density of an object if it has a mass of 632g and a volume of $240cm^3$?

2. A 1014g brick of gold takes up $200cm^3$, what is its density?

3. Your water bottle holds 375mL of water that weighs 514g. What is the density?

4. If 600mL of water has a density of 1.8 g/mL, what does it weigh?

5. A chunk of copper has a density of 5.0 g/cm^3 and weights 892g. How big is it?

Name: _____ Date: _____ Class: _____

Sci8: FD1 Forces, Fluids & Density **Density**

6. A bathtub filled with 17 L of Jello weighs 25000 g. How dense is it?

7. Al Capone used to smuggle barrels of alcohol across the border during prohibition. He made sure that all his barrels were of a standard size and used math and science to make sure. All of his alcohol was made with the same density of 2.29g/mL and was stored in barrels. After they were filled they weighed 75.8 kg. How many litres did each barrel hold?

8. Oil had a density of 8.3 g/mL, an oil tanker off the coast of Newfoundland spilled 100 75kg barrels when it hit an iceberg. All of the contents from the barrels leaked into the ocean. As a scientist you need to figure out how much oil has leaked so you can clean it up as soon as possible.

9. What is the density of a 1000cm^3 brick that weighs 10kg?

10. A 1 L bottle of Coke weighs 2.5 kg. How dense is it?

Mass vs Weight

Mass =

amount of matter (#of atoms) in an object

MASS is measured using balance scales or digital scales.
Measured in units of grams (g).

Volume =

measure of how much space an object takes up

VOLUME is measured using the container holding the fluid.
Measured in units of mL or cm^3.

Weight =

measure of the force of gravity on the mass of an object

WEIGHT is measured using spring scales.
Measured in units of newton (N) 100g = 1 N on Planet Earth

Eureka! The Mind of Archimedes = Water Displacement Method

Legend has it that 2300 years ago, the king of Syracuse summoned **Archimedes** (287–212 BCE) - a famous **Greek scientist and mathematician**. The king suspected that his new crown was not made of pure gold as promised but had some silver in it. He wanted Archimedes to find out - but without damaging the crown. While thinking hard about his problem, Archimedes decided to have a hot, relaxing bath. As he lowered himself into the tub, he noticed water overflowing its sides. At that instant, he realized he had solved the king's problem! The legend continues that, in his absent-mindedness, Archimedes jumped out of the tub and ran naked down the street, shouting, "*Eureka! Eureka!*" (Greek for "I've got it! I've got it!").

When Archimedes saw the water overflowing from the bathtub, he realized that **his body was displacing the water**. **The volume of water he displaced was equal to the volume of his body**. He could now test the king's crown in the same way to determine its volume. It is said that Archimedes fashioned a piece of pure gold and a piece of pure silver with the same mass as the King's new crown. He filled a large vessel to the brim with water, and dropped the piece of silver in. The volume of water that flowed over the rim was equal to the volume of the piece of silver. He repeated this with the piece of gold, and again with the King's crown, resulting in three volumes of water. What did Archimedes discover? The volume of water displaced by the crown was more than the volume of water displaced by the pure gold, and less than the volume of water displaced by the pure silver. Not only did Archimedes discover that the King's crown was not made of pure gold, he also discovered the idea of density.

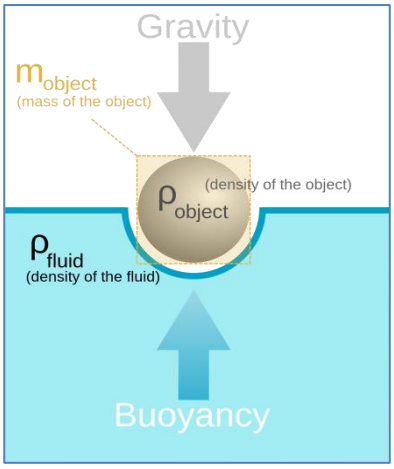
Demonstrations: Buoyancy

FINISH!!!!!!!!!!!!!!!

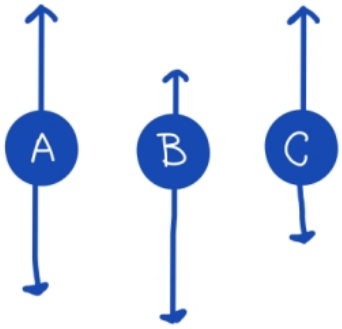
Buoyancy

(a.k.a. buoyant force) =

an upward force exerted by a fluid that opposes the weight of an immersed object



In order for buoyancy to occur we need to understand that there are forces all around us acting on different objects. A **force** is a push or a pull that tends to cause an object to move or change its motion. When there are greater amounts of force in one direction compared to another different things happen. For instance **floating** occurs when an upwards force on an object is equal to or greater than the force of gravity pulling the object down .There is a force pushing an object up while there is also gravitational force pulling the object down. Objects in fluids may rise or sink if these two forces are not balanced forces.



Label forces as balanced or unbalanced & explain:

Object A - Balanced forces

Object B - Unbalanced forces. The down- wards force is greater; the object moves down

Object C- Unbalanced forces. The upwards force is greater; the object moves up

When an object is in a liquid, the **force of gravity** (Earth = 9.8 m/s^2) or the gravitational force pulls down on the object. The force of gravity always pulls an object toward the Earth. The liquid also provides an opposing force. This force opposes the force of gravity, and if strong enough can cause objects to **float**. This force is called the **buoyant force**. If the mass of an object is greater than the mass of water the object displaces, then the gravitational force is greater than the buoyant force and the object will **sink/dive**.

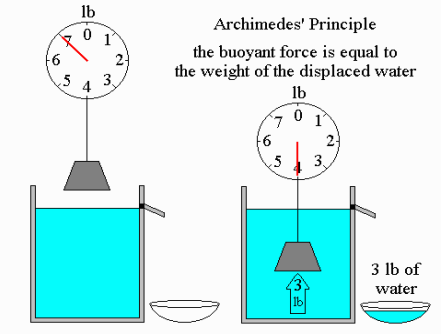
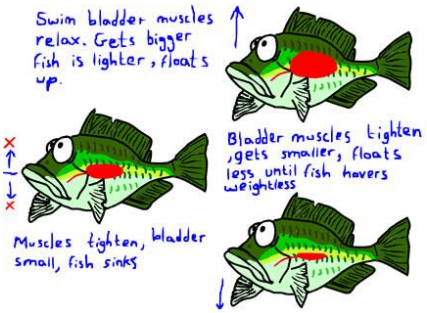
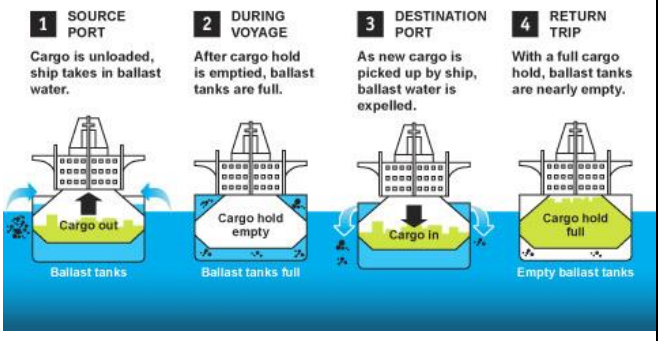
Using this logic about forces, an object floats when:

If the mass of an object is less than the mass of the water it displaces, then the gravitational force is less than the buoyant force and the object will float!

Using this logic about forces, the buoyant force is calculated by:

The buoyant force is calculated by subtracting the weight of an object in the air from the weight of the object in the liquid. The difference in the weight between the two is the buoyant force expressed in **Newton units (N)**. With Earth's gravity, **100g = 1 N**

Review & Applications of Buoyancy

Archimedes' Principle	• States that the buoyant force acting on an object equals the weight or gravitational force of the fluid being displaced by the object. 
Gravitational Force	• the force trying to pull an object into a fluid (towards the Earth) = **9.8 m/s²**
Buoyant Force	• the force that acts against gravity • the greater the mass displaced by an object, the greater the buoyant force
Personal Flotation Device	• A PFD and a "life" jacket are different things • A **PFD** keeps you afloat in the water • less bulky • more comfortable • A **life jacket** can turn an unconscious victim upright • Both must be the right size to work properly 
Swim Bladder	• A physical structure that allows a fish to control its depth • An increase in air = an increase in displacement therefore the gravitational force is less than the buoyant force (the fish rises toward the surface) • A decrease in air = a decrease in displacement therefore the gravitational force is greater than the buoyant force (the fish sinks toward to bottom) 
Ballast Tanks	• Are man-made example of the natural swim bladder that can be used in **submarines** and other **underwater vehicles** • They use the same concept of displacement and buoyant/gravitational forces. 

Name: _____ Date: _____ Class: _____

Sci8: FD2 Forces, Fluids & Density **Buoyancy**

Progress Check: Mass & Weight ____ /5 =____%

1. How might you measure the mass of a boat on the moon? Why does this method work? (2 marks)

2. How might you measure the weight of a boat on the moon? Why does this method work? (2 marks)

3. Using the relationship between mass and weight on Earth that you discovered in your Investigator lab, estimate the weight of an object that has a mass of 1 kg. (1 mark)

Progress Check: Buoyancy ____ /20 = ____%

1. A rectangular block measures 3 cm x 4 cm x 3 cm. How much water would it displace? (1 mark)

2. A 100 g mass is placed on a spring scale and the force of gravity, or weight, on the mass is measured as 1 N. The mass is then lowered into a liquid and found to weight 0.6 N. What is the buoyant force? (1 mark)

3. The same mass is lowered into a second liquid. What is the weight on the mass of this liquid to produce a buoyant force of 0.6 N? (1 mark)

4. Why does an object appear to weigh less in liquids than in air? (1 mark)

5. Why do some objects remain suspended in the one position in water while others sink? (1 mark)

Progress Check: Buoyancy (cont'd)

6. What is neutral buoyancy? Sketch an example showing the forces acting on the object. (3 marks)

7. When an object is suspended in water, how does the volume of water displaced impact the:
   a. Size of the buoyant force acting on the object? (2 marks)

   b. Size of the gravitational force acting on the object? (1 mark)

8. What is the buoyant force acting on a 20 N steel ball if it weighs 15 N in water? (1 mark)

9. Why do some objects (such as boats) float even though they are often made of materials that are denser than water? (1 mark)

10. Sketch two force diagrams showing the movement in water of a can of regular pop and a can of diet pop. (3 marks)

11. How might you control a hot-air balloons height above the ground? Give ideas for how to make the balloon rise and fall explaining why these ideas may work. (3 marks)

12. How does a PFD allow you to float in water? (1 mark)

Magic School Bus: Ups & Downs Questions

____ /23 =____%

Fill-in-the-Blank:

Fill in the blanks with the correct answers from the video. For the questions that do not have a blank, circle the correct answer.

1. Bananas _____ in water.
2. To prove something is real you need _____.
3. Adding _____ will cause objects to sink.
4. An object will continue to _____ until it hits the bottom of the water.
5. Water pushes up / down on an object as it floats up to the surface.
6. If you push water it will _____ back.
7. A piece of bread floats, but a bread _____ sinks.
8. Removing weight from a sunken object will cause it to float back up

   to the _____.
9. Water is heavy / light.
10. The evidence proved that the monster in the lake was a _____.
11. Air is lighter / heavier than water.
12. The air pushed the _____ out of the way allowing the bus to float.
13. The force of the water is greater / less than the weight pushing down.
14. The _____ of water in a lake or an ocean is called the surface.
15. A bigger object pushes more water under it than a _____ object.

Short Answer:

1. How did the students sink the bus to the bottom of the lake off the start?

2. What happened when the weights were removed?

3. Why did the piece of bread not sink?

4. How did the students make the bread sink? Why did it work?

5. How did they apply this knowledge to the bus? What happened?

6. What happened to the boat when Wanda jumped out?

7. How did they stop themselves from going back to the surface?

8. What forces were the students discovering when they were rising and sinking?

Name: _____ Date: _____ Class: _____

Sci8: FD2 Forces, Fluids & Density p. 216, 221-226 **Fluid Technologies**

Research: Fluid-based Technologies

Step 1: Choose ONE (1) of the following fluid-based technologies.

Canoes	Kayaks	Lake boats	Catamarans
Float planes	Surfboards	Gliders	SCUBA gear
Airplanes	Jet-skis	Hot air balloons	Life Jacket
Anti-freeze tester	Heart pumps	Submarines	Other?

Step 2: Research and answer the following:

1. Analyze the design and explain how this fluid-based technology works.
2. Explain how the scientific principles of mass, weight, volume, water displacement, gravitational force and buoyancy are applied in the design of this fluid –based technology.

Step 3: Create a digital poster to share your findings.

Step 4: Electronically submit your poster.

Hand in your poster using the submit button found at www.liveitup4life.com – Sciences – Science 8 – Physical Science: Forces, Fluids & Density section.

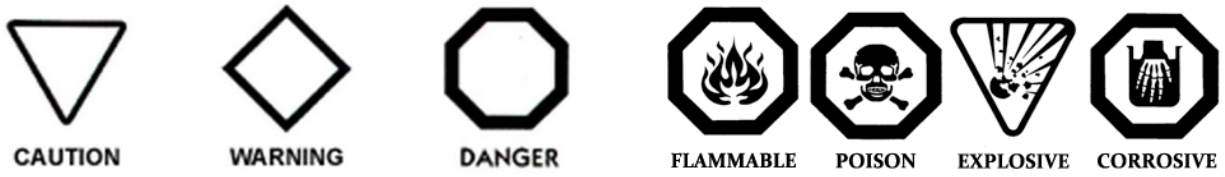
*** Be sure to use the correct link for YOUR class!**

Fluid =

any matter that has no fixed shape
but takes the shape of its container (incl. liquids & gases)

Safe Handling of Fluids

Some fluids are safe to handle while others can be very harmful. There two different labelling systems used in Canada that help us know which fluids are safe and which need to be handled cautiously. At home you may have seen some symbols on containers around the house. These symbols are called **Hazardous Household Products Symbols (HHPS)**.

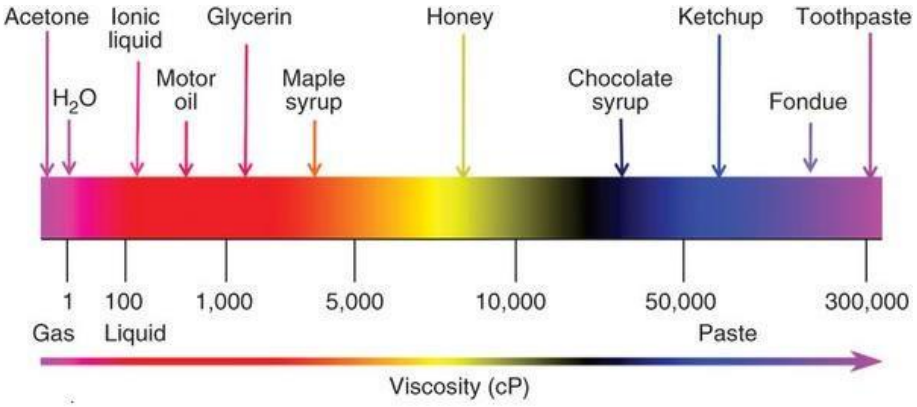


There is another type of symbols that can be seen in workplaces, including schools, all over Canada. These are called the **Workplace Hazardous Materials Information System (WHMIS)**. Some of the materials we use this unit may have some of these symbols on them.

	**Exploding bomb** (for explosion or reactivity hazards)		**Flame** (for fire hazards)		**Flame over circle** (for oxidizing hazards)
	**Gas cylinder** (for gases under pressure)		**Corrosion** (for corrosive damage to metals, as well as skin, eyes)		**Skull and Crossbones** (can cause death or toxicity with short exposure to small amounts)
	**Health hazard** (may cause or suspected of causing serious health effects)		**Exclamation mark** (may cause less serious health effects or damage the ozone layer*)		**Environment*** (may cause damage to the aquatic environment)
	**Biohazardous Infectious Materials** (for organisms or toxins that can cause diseases in people or animals)				

* The GHS system also defines an Environmental hazards group. This group (and its classes) was not adopted in WHMIS 2015. However, you may see the environmental classes listed on labels and Safety Data Sheets (SDSs). Including information about environmental hazards is allowed by WHMIS 2015.

Viscosity = a liquid's internal resistance
or friction keeping it from flowing



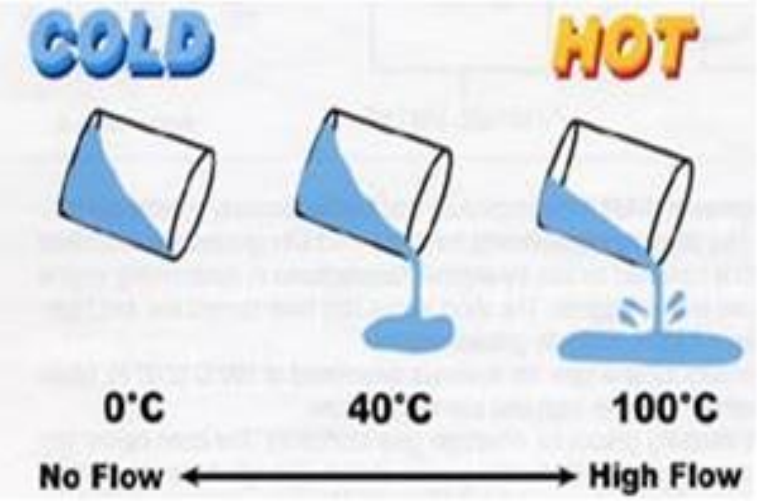
One property of fluids is how they flow or move. Looking at the property of viscosity we can observe how fluids move. Looking back at the particle theory we know that particles in a liquid slide around and roll over each other. The **greater the amount of friction, or rubbing between the particles** in the liquid, the **higher the viscosity**. Fluids with a high viscosity do not flow as easily as fluids with a low viscosity.

There are several ways to determine viscosity in fluids, however two common ways are:

1. **The Bubble Test:** How long it takes an air bubble to rise through a tube of fluid. The longer it takes for the bubble to travel through a fluid, the higher the viscosity.

2. **The Ramp Method:** How long it takes a fluid to flow down a ramp. The longer it takes for a fluid to flow down a ramp, the higher the viscosity

Viscosity and Temperature



As **temperature increases** the **viscosity of a liquid decreases**. Particles at higher temperatures move with more energy therefore are able to move out of the way and make more room for other particles to pass, allowing liquid to flow more easily. As the **temperature decreases** the **viscosity of a liquid increases.** Particles at lower temperatures move with less energy therefore the spaces between the particles get smaller, making less room for other particles to pass. This causes the liquid to flow less easily.

Name: _____ Date: _____ Class: _____

Progress Check: Fluids & Viscosity

_____ /15 = _____%

1. What is a fluid? Make a list of all the words related to fluids. (1 marks)

2. Use the Particle Theory of Matter to explain what viscosity is and why temperature affects viscosity. (2 marks)

3. Describe two methods used to test viscosity. (4 marks)

4. When you pour cereal into a bowl for breakfast, the cereal takes the shape of the bowl. Is cereal fluid? Explain your answer. (2 marks)

5. Give <u>at least one</u> example of how an understanding of viscosity benefits people. (1 mark)

Name: _____ Date: _____ Class: _____

6. a) How are the Hazardous Household Product Symbols and WHMIS symbols the same and different? Complete the table below. (4 marks)

	Hazardous Household Product Symbols	**WHMIS Symbols**
Ways the two symbol systems are different		
Ways the two symbol systems are similar		

b) What is the importance of having both systems? (1 mark)

Investigator: Feel the Pressure

Textbook p. 237

Complete and hand in lab report by the end of THIS period.

Teacher Demonstration Lab

Read Textbook p. 236, 238-39

Investigator: Looking for a Relationship

Textbook p. 240

Complete as teacher demonstrates and hand in
your completed lab report by the end of the second period.

Teacher Demonstration

Investigator: A Compressing Situation

Textbook p. 243

Pressure =
an amount of force applied to a particular area

a.k.a. force (N) per unit area (m^2)

Wherever we are on Earth, pressure is something we feel with our bodies all the time. Scientists define the term pressure in a way that tells you how it is measured. The amount of pressure depends on two things:

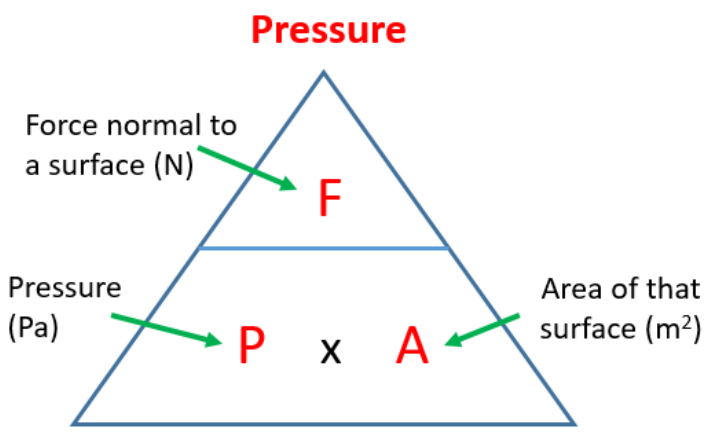
- the amount of force being applied, measured in newtons (N), and
- the size of an area the force pushes or pulls on, measured in square meters (m^2)

The more force you can apply to a given area, the greater the pressure. The pressure on a given area can also be changed by making the area smaller (for greater pressure) or larger (for less pressure).

Units of Pressure

Pressure is measured in **pascals (Pa)** and a pascal equals the force of one newton over an area of one square metre. **Pa = N/m²**

Air pressure is measured in kilopascals (kPa). The average air pressure at **sea level is 101.3 kPa**.



$$\text{Pressure (Pa)} = \frac{\text{Force normal to a surface (N)}}{\text{Area of surface (m}^2\text{)}}$$

The **weight** of an object or animal is a **force caused by gravity**. Where two objects have similar weight, the amount of pressure each object exerts on a surface depends on the size of the area where the object contacts the surface. Think about the animals whose feet are adapted to walking in the surface layers of the snow rather than sinking deeply into it. Compare the force exerted by two animals of the same weight. Which of the animals on the left would have an easier time walking if it had to move through deep snow?

A caribou's feet are large and wide. Force applied over a large area creates a small amount of pressure on the surface. Caribou are well adapted to walking in snow.

A pronghorn's feet are small and narrow. Force applied over a small area creates a large amount of pressure on the surface. The pronghorn would not be efficient walking in deep snow.

Snowshoes

First Nations peoples observed animals walking on snow easily. They created snowshoes that reflected the characteristics of the feet of animals such as the snowshoe hare, prairie chicken, bear, and lynx. The invention of large, wide snowshoes allowed First Nations people to transport themselves and goods in winter, keeping them in the surface layers of the snow.

Miss Foley

Sci8: FD3 Forces, Fluids & Density p. 236-38 **Fluids under Pressure**

Traditional knowledge about snowshoes has been passed down from generation to generation through the ages by Knowledge Keepers, in the language of their particular First Nation.

The Ojibwe called this type of snowshoe a "bear paw."

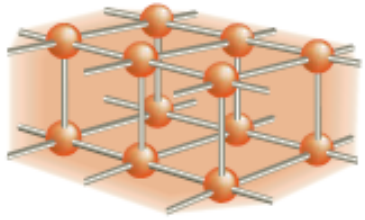
Scientists describe the operation of snowshoes as the distribution of the weight of the hunter across a larger surface area, causing *less* pressure on the snow. This explains how snowshoes prevent someone from sinking into the snow. The observations of Elders and scientists both contribute to our understanding of natural phenomena.

Traditional snowshoes were made of two basic parts, the frame made of hardwood, and the netting made of sinew or hide. The rounded type of snowshoe was called the "bear paw" by the Ojibwe, while other groups referred to them as "catfish." Without snowshoes, First Nations peoples and early traders would have found it almost impossible to travel, trade, or hunt in winter seasons.

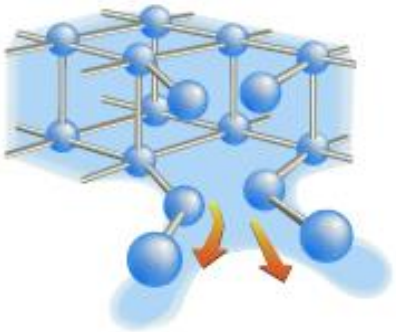
Modern snowshoes are designed using the same principles that traditional snowshoes used. The materials have changed to provide a more lightweight and durable product.

Review: Particle Theory of Matter

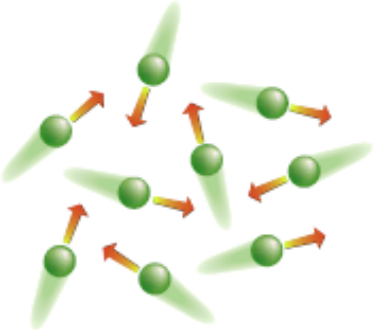
Recall that the Particle Theory of Matter provides a way of describing the structure of matter in its three states: solid, liquid, and gas. Below is a magnified view of the particles in each state. The Particle Theory does more than help to explain the structure of matter. It can also be used to **explain the way fluids behave when they are under pressure** and **when there is a temperature change**.



A Particles in a solid state are vibrating in one place.

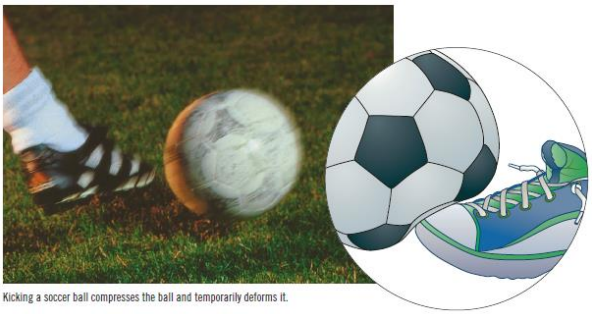


B Particles in a liquid state are sliding around and over each other.

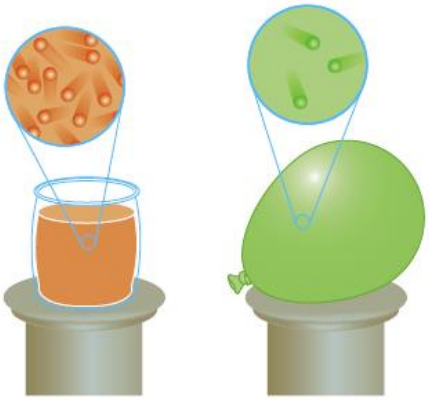


C Particles in a gaseous state are moving as far apart as they can within the space.

Compressibility = the ability to become more compact when squeezed

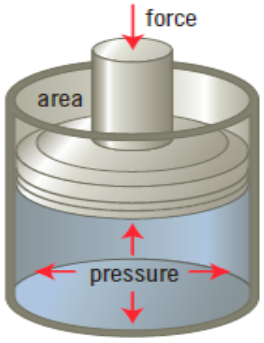

Kicking a soccer ball compresses the ball and temporarily deforms it.

When a force pushes on an object, the object is said to be under compression. Objects under compression tend to deform in shape. For example, when you kick a soccer ball, the force of your foot compresses the ball and temporarily deforms it.



One of the properties of fluids is **that gases can be compressed and liquids cannot**. The Particle Theory can explain these observations. The illustration on the right shows that there is much more space between particles in the gas than in the liquid. As a result, when a force is applied to the particles, **there is more room for compression in the gas than in the liquid**. In fact, very little compression occurs in liquids. Materials in a liquid state are said to be **incompressible**; that is, they cannot be compressed easily. This property of liquids is very useful.

This pressure - and force - is exerted equally everywhere in the liquid. A scientist named **Blaise Pascal** first made this observation. The pressure exerted by a liquid at the bottom of a container does not depend on the shape of the container. Regardless of shape, the pressures are identical as long as the levels of liquid are equal. However the **mass of fluid in the upper part of the container acts as a force pressing down on the fluid in the lower part of the container**. The more fluid there is above a hole in the container, the greater the pressure, and the farther the fluid will flow out of the container.



Pressure is in all directions in a fluid. Increasing the force will increase the pressure inside the container.

Pascal's Law =

when pressure is applied to a contained liquid, that pressure and force are transmitted in <u>all</u> directions <u>without</u> losing any force

Name: _____ Date: _____ Class: _____

Sci8: FD4 Forces, Fluids & Density **Compressibility**

Progress Check: Compressibility & Pascal's Law

____ /10 =____%

1. Compare the compressibility of liquids and gases. (2 marks)

2. How does the Particle Theory explain why solids cannot be compressed. (2 marks)

3. How does the Particle Theory explain why gases compress more than liquids do? (2 marks)

4. Using the Particle Theory, explain which material in each of the following pairs would compress more than the other. (3 marks)
   a) helium balloon or a water balloon

   b) full plastic bottle of juice or the empty plastic bottle

   c) plastic bubble wrap or a liquid-filled baby teething ring

5. What does Pascal's Law state? (1 mark)

Name: _____ Date: _____ Class: _____

Sci8: FD4 Forces, Fluids & Density **Pressure**

Progress Check: Be sure to show your work☺ _____ /20 =____%

Pressure, Compressibility & Pascal's Law

1. _____ One of the most common unit of pressure is:
   a. Joule
   b. Kilojoule
   c. Pascal
   d. Kilogram

2. _____ The heel of a stiletto shoe can exert a lot of pressure. If the area of the heel is $0.5cm^2$ and a force of 200N is exerted using the heel, what is the pressure exerted by the heel?
   a. 10 Pa
   b. 200 Pa
   c. 400 Pa
   d. 1000 Pa

3. _____ Crash test dummies are used to test safety in vehicles. The main reason for this is because they are:
   a. inexpensive to use
   b. realistic
   c. easily repaired
   d. non-living

4. _____ Pascal's law states that:
   a. pressure exerted on a contained fluid is transmitted equally in all directions
   b. pneumatics exerted on a contained fluid is transmitted equally in all directions
   c. force exerted on a contained fluid is transmitted equally in all directions
   d. hydraulics exerted on a contained fluid is transmitted equally in all directions

5. _____ A window washer notices that the spray hoses he uses are spraying water at too high a pressure and damaging the trim on the windows. The rate of flow of water coming out of the nozzle could be reduced by:
   a. shortening the hoses
   b. lengthening the hoses
   c. increasing the nozzle opening
   d. decreasing the nozzle opening

6. _____ A gas can be compressed if three conditions are met. They include all of the following EXCEPT:
   a. the gas must be at room temperature
   b. the gas must be in a sealed container
   c. it will remain a gas even after it has been compressed
   d. a force is applied to push the particles closer together

7. _____ 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

8. _____ There are advantages to compression because they can exert a counterforce. This counterforce can be useful in the following application - of a bicycle:
   a. sprockets
   b. gears
   c. handlebars
   d. shocks

Progress Check: Pressure, Compressibility & Pascal's Law

9. _____ The atmosphere around the Earth is approximately 160 km thick. It is the force of gravity which keeps it in place. What effect does this layer of air have on us when we hike up a mountain?
   a. it weighs us down a lot less as we climb
   b. it weighs us down a lot more as we climb
   c. it has no effect, because our body is use to it
   d. it has no effect, because our body can adjust to it

10. _____ When we suck on a straw in a tetrapak 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

11. _____ In physics, pressure is defined as the _____ over a given area:
   a. Work
   b. Velocity
   c. Force
   d. Mass
   e. Energy

12. _____ Finish the formula: Pressure = Force divided by _____:
   a. Time
   b. Area
   c. Speed
   d. Distance
   e. Mass

13. _____ Will air pressure be higher on top of a mountain or on the beach?
   a. Beach
   b. Mountain
   c. It's always the same

14. _____ What pressure will be exerted by a 10 N box that has equal sides of 1 meter?
   a. 1 Pa
   b. 2 Pa
   c. 5 Pa
   d. 10 Pa
   e. 20 Pa

15. _____ A 40 N block exerts 20 Pa of pressure on a table. What is the area of the block that is touching the table?
   a. 0.5 m^2
   b. 1 m^2
   c. 2 m^2
   d. 4 m^2
   e. 40 m^2

16. _____ A red cube with sides of 3 meters and a blue cube with sides of 2 meters are on a table. They both weigh the same. Which cube exerts more pressure on the table?
   a. Red cube
   b. Blue cube
   c. Both are the same

Progress Check: Pressure, Compressibility & Pascal's Law

17. _____ Does water pressure increase or decrease the deeper you are?
    a. Increase
    b. Decrease
    c. Stays the same

18. _____ What type of tool is used to measure air pressure?
    a. Pascalometer
    b. Atmospherometer
    c. Aerometer
    d. Anemometer
    e. Barometer

19. Compare the compressibility of liquids and gases.

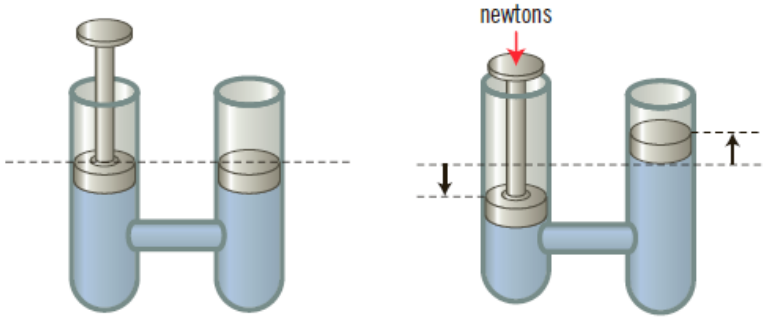
20. How does the Particle Theory explain why solids cannot be compressed.

Name: _____ Date: _____ Class: _____

Sci8: FD4 Forces, Fluids & Density **Pressure**

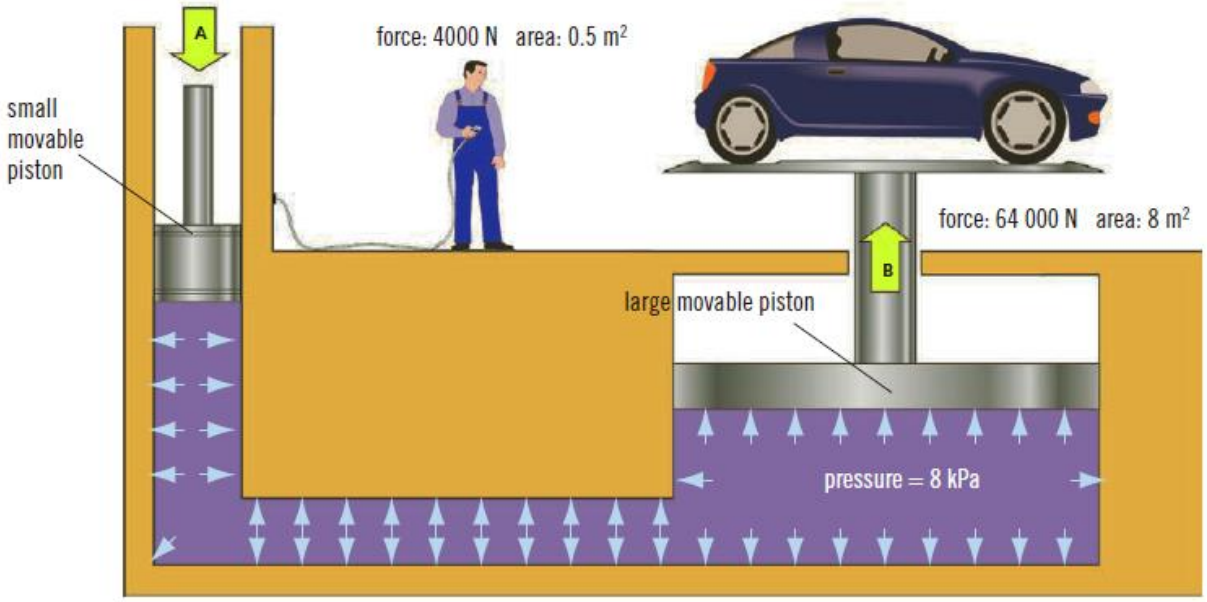
Hydraulic System =
a system that uses liquids in a confined space to transfer forces

Hydraulic systems operate according to Pascal's law. The liquid put into a hydraulic system is called **hydraulic fluid.** It is moved through the system by a pump. In a hydraulic system, pressure results from a force applied to one surface of the liquid by a piston, or cylinder. This pressure is then transmitted equally throughout the entire hydraulic system.



Force applied to one part of a system results in the same pressure throughout the system.

The power of a hydraulic system, however, exists when there is a difference in area between two parts of a system. **A small input force can be increased by designing an output device that has a larger area than the input device.** For example, look at the diagram of the car lift or hoist on this page. In the diagram, you can see that the **input device** is a piston with a small area. A piston is similar to the syringes you used in your activities. The **output device** is another piston, but it has an area 16 times larger than that of the input device.



A car hoist is used in a repair garage so that mechanics can work more easily and safely. Each arrow in the picture represents the same amount of force. What conclusion can you make about the forces acting on the two pistons?

A hydraulic system can create a **mechanical advantage**. This means that the **output force is larger than the input force**. In the hydraulic system on the previous page, a fluid exerts the same amount of pressure throughout the system, so there is 16 times as much force being exerted by the fluid on the larger piston. Notice that the small piston has to move a larger distance than the large piston to move the car.

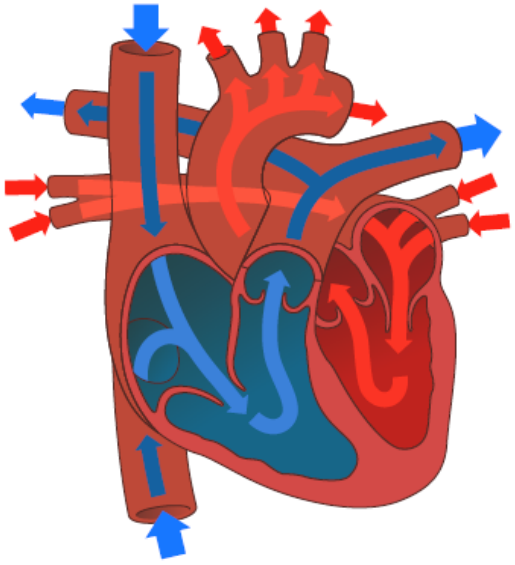
The hydraulic fluid in a system is not used up. It continues to circulate throughout the system. A **pump**, a machine or device that displaces a fluid by physical or mechanical action, is used to force the fluid to flow, allowing it to move against gravity. Valves control the flow of fluid and keep the fluid flowing in the desired direction.

There are many technologies that use hydraulic systems to move large, heavy objects easily. These include backhoes and excavators, and different systems in a vehicle including brakes and steering.

A Biological Hydraulic System: The Heart

Your circulatory system is a hydraulic system. The **hydraulic fluid** is **blood**, and there are **valves** that **control the direction of fluid flow**. Imagine a pump no bigger than a clenched fist that pumps 7200 L of fluid through more than 95 000 km of tubing every day for 80 years. This extraordinary pump, your heart, beats over 100 000 times a day, moving blood through your arteries and veins, supplying all living cells with nutrients while carrying away waste products.

Blood pressure is a measure of the force being exerted on a given surface within your circulatory system. **Hypertension** is a common heart disease related to the hydraulic nature of the blood system. In hypertension, an increase in pressure inside the blood vessels causes the heart to work harder just to keep the blood circulating.



Your heart is a pump with valves that pushes hydraulic fluid (blood) through your circulatory system.

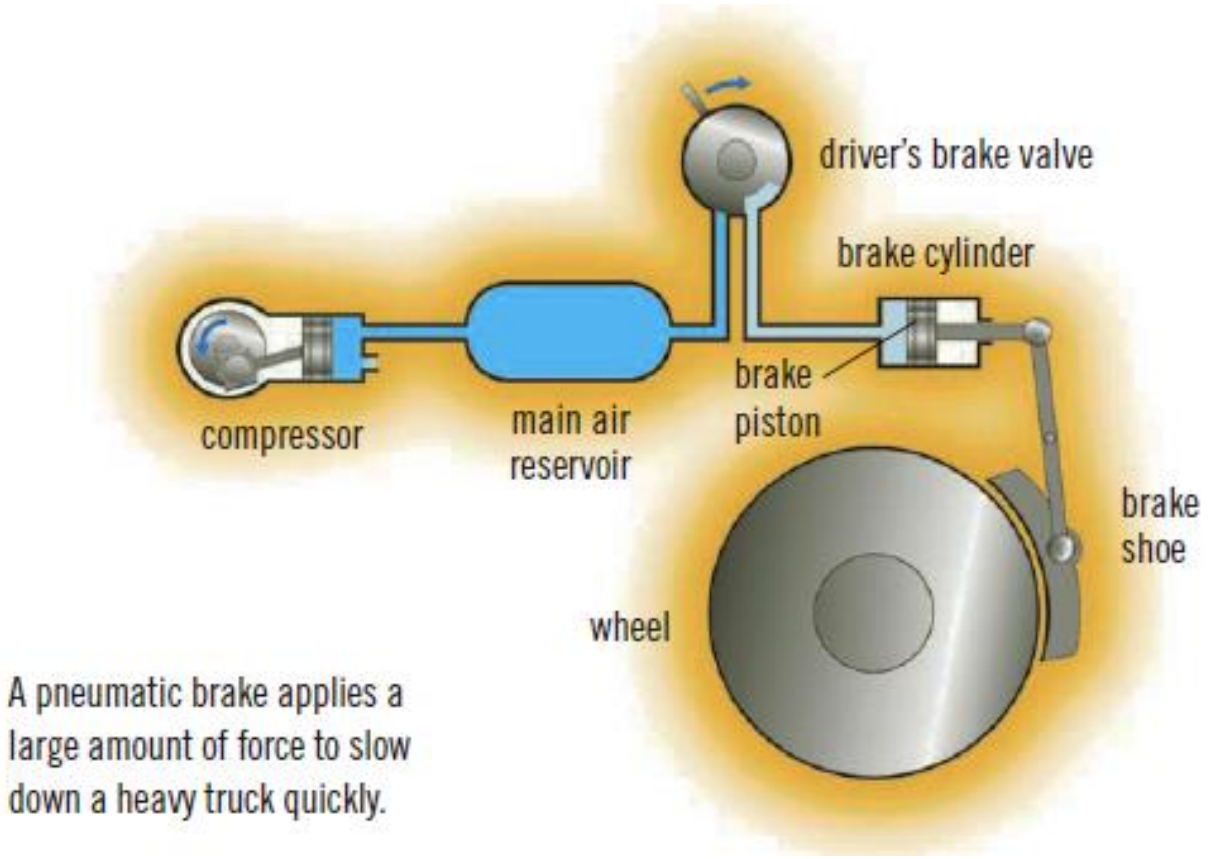
Hydraulics as Transport Systems

So far, you have examined **closed hydraulic systems**, where the liquid cannot leave the system. In an **open hydraulic system**, the liquid can leave the system. Open hydraulic systems can be used to transport liquids. The hand pumps used to bring fresh ground water to the surface through pipes in African countries such as Malawi are examples of open hydraulic systems. In Canada, there are many fluids transported through pipes, including water, sewage, oil, and gas. These fluids must be under pressure in order for them to move through the pipes.

Pneumatic System =
a confined, pressurized system that uses air or other gases to transfer forces

Like hydraulic systems, pneumatic systems also store fluids under pressure to provide a force to move objects. Gases can be compressed while liquids cannot. In a pneumatic system, a gas is compressed by a device called a **compressor**. Like a pump in a hydraulic system, the compressor forces a fluid to move through the system. The more the air has been compressed, the more force is created. If this force is exerted over a large area, it creates a mechanical advantage, producing a sudden, large force that can move objects and perform tasks. Unlike hydraulic systems that pump the fluid back through a system, **a pneumatic system releases air when the work is performed**. If you listen carefully, you can actually hear the air being exhausted from the system.

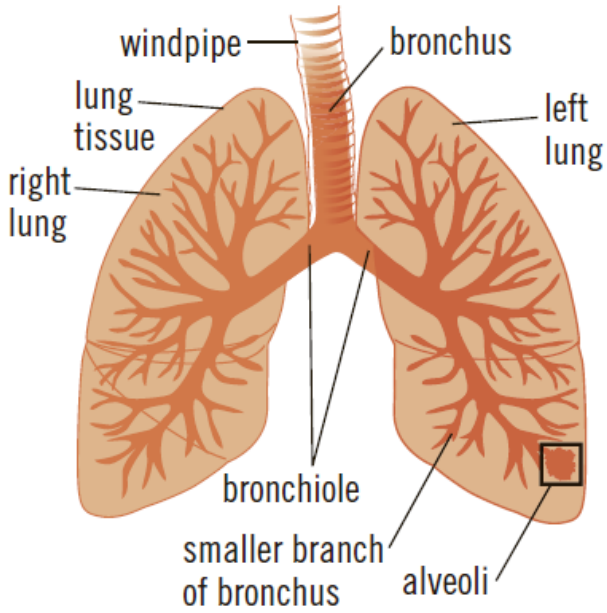
Pneumatic systems are used in machinery such as jackhammers, wrenches, drills, and air-powered nail guns. You may have seen, or heard, air brakes on large trucks. This is an example of a pneumatic system. The diagram below explains how air brakes work.



A pneumatic brake applies a large amount of force to slow down a heavy truck quickly.

A Biological Pneumatic System: The Lungs

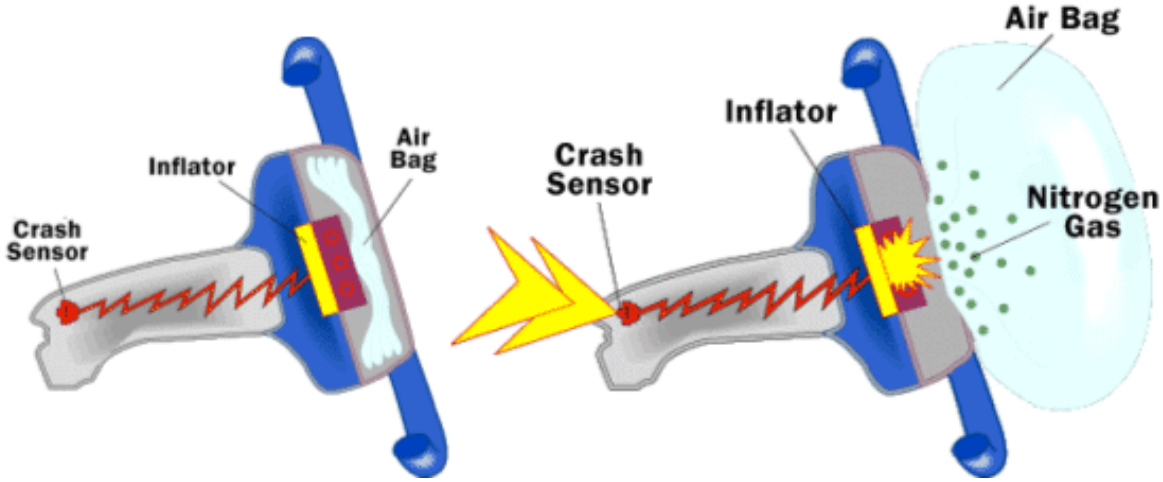
Your respiratory system is a pneumatic system. The gas is air, and the compressor is your lungs. Your diaphragm acts like a plunger in a syringe. When it moves upward, it decreases the volume of your lungs, increasing the pressure and forcing you to breathe out. When the diaphragm moves downward, it increases the volume of your lungs, decreasing the pressure and causing air to rush in. The average pair of adult lungs has a capacity of approximately 6 L, with 1 L of air remaining in your lungs at all times to prevent them from collapsing.



The human lungs are a natural pneumatic system.

Air-Bag Systems as Protection

Because gases exert a force when they expand, they are often used to protect people and objects from injury. Since the 1980s, **airbags** have been installed in vehicles to help save lives. Vehicle air-bag systems are pneumatic systems that include a crash sensor, igniter, gas generator, and inflatable bag. The sensor is able to detect a collision equal to running into a wall at 16–24 km/h. From there, chemicals mix to form a reaction similar to a rocket booster, which creates a large volume of nitrogen gas. This pressurized gas inflates a nylon bag in less than a tenth of a second, causing it to burst out of the steering wheel or dashboard. Gases do not remain in the bag for long, allowing it to deflate after a few seconds.



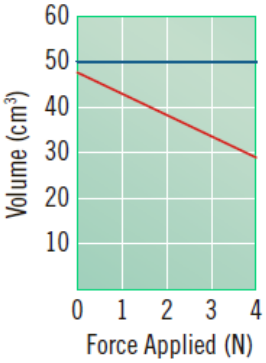
Name: _____ Date: _____ Class: _____

Sci8: FD4 Forces, Fluids & Density **Hydraulics & Pneumatics**

Progress Check: Hydraulic Systems

____ /10 =____%

1. A gas and a liquid were compressed in two different syringes. The results were graphed, as shown to the right. Which line on the graph was for the gas? Which one was for the liquid? Explain your answer. (2 marks)



Which line on the graph represents a gas? which line a liquid?

2. How might you identify a hydraulic system? (2 marks)

3. What are two industries that use hydraulic systems? (2 marks)

4. What makes the fluid flow in a hydraulic system? What controls its direction? (2 marks)

5. Explain how your understanding of hydraulic systems has helped you understand the human vascular system. (2 marks)

Name: _____ Date: _____ Class: _____

Sci8: FD4 Forces, Fluids & Density **Hydraulics & Pneumatics**

Progress Check: Pneumatic Systems

____ /5 =____%

1. How does the Particle Theory explain the fact that gases are compressible and liquids are not? (2 marks)

2. What is the difference between a pneumatic system and a hydraulic system? (1 marks)

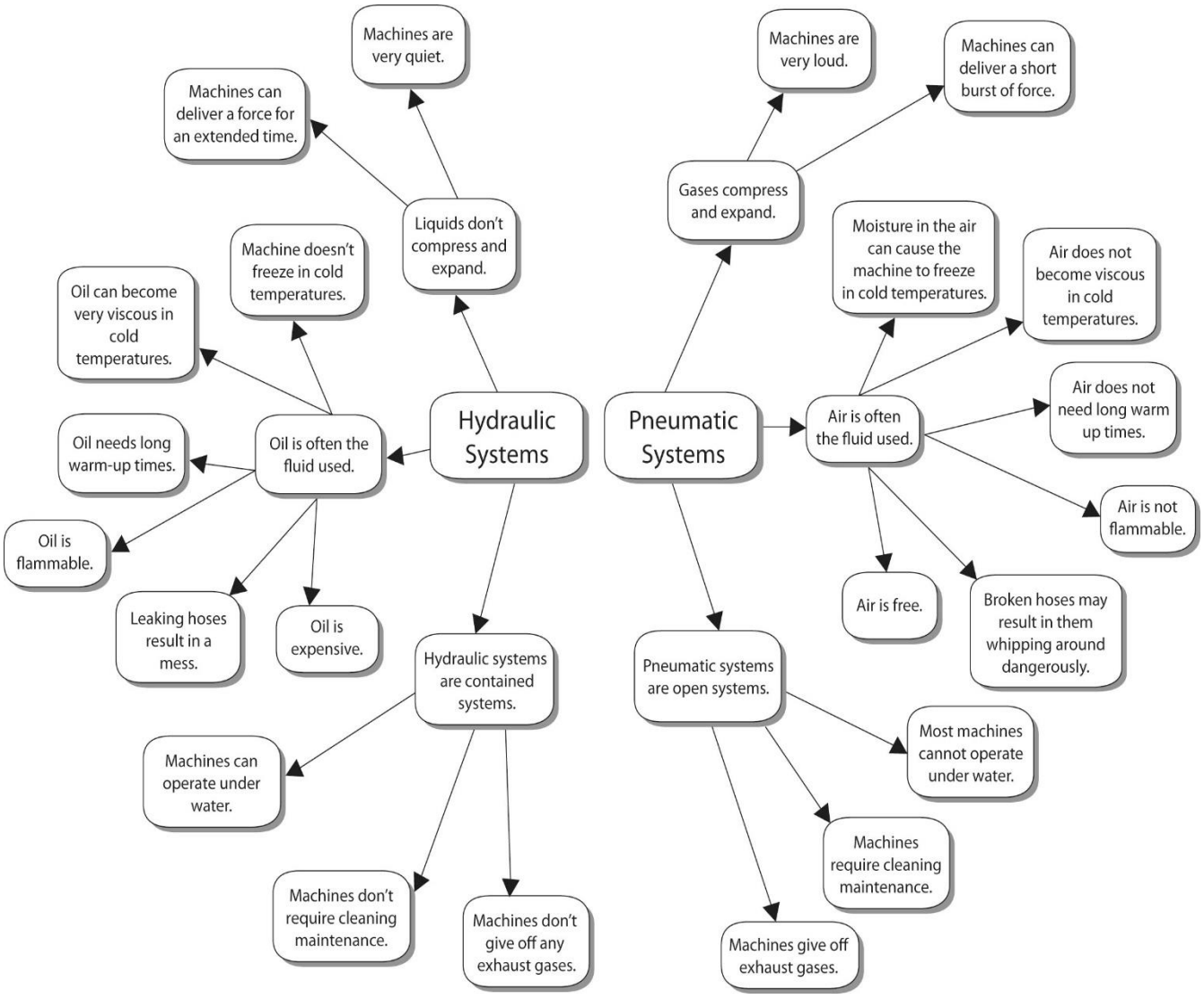
3. What uses exist for pneumatic devices? (2 marks)

Hydraulic vs Pneumatic Systems

We know the following about fluid systems:

1. As the pressure exerted by a fluid increases, it will create a larger force.
2. Liquids do not compress and are used in hydraulic systems.
3. Gases compress and are used in pneumatic systems.

Although both pneumatic and hydraulic systems can transfer forces from one part of a system to another, the **compressibility of gases and incompressibility of liquids** give the two types of systems different characteristics. Technologists use these characteristics to decide which system they should use as a basis for their new tools.

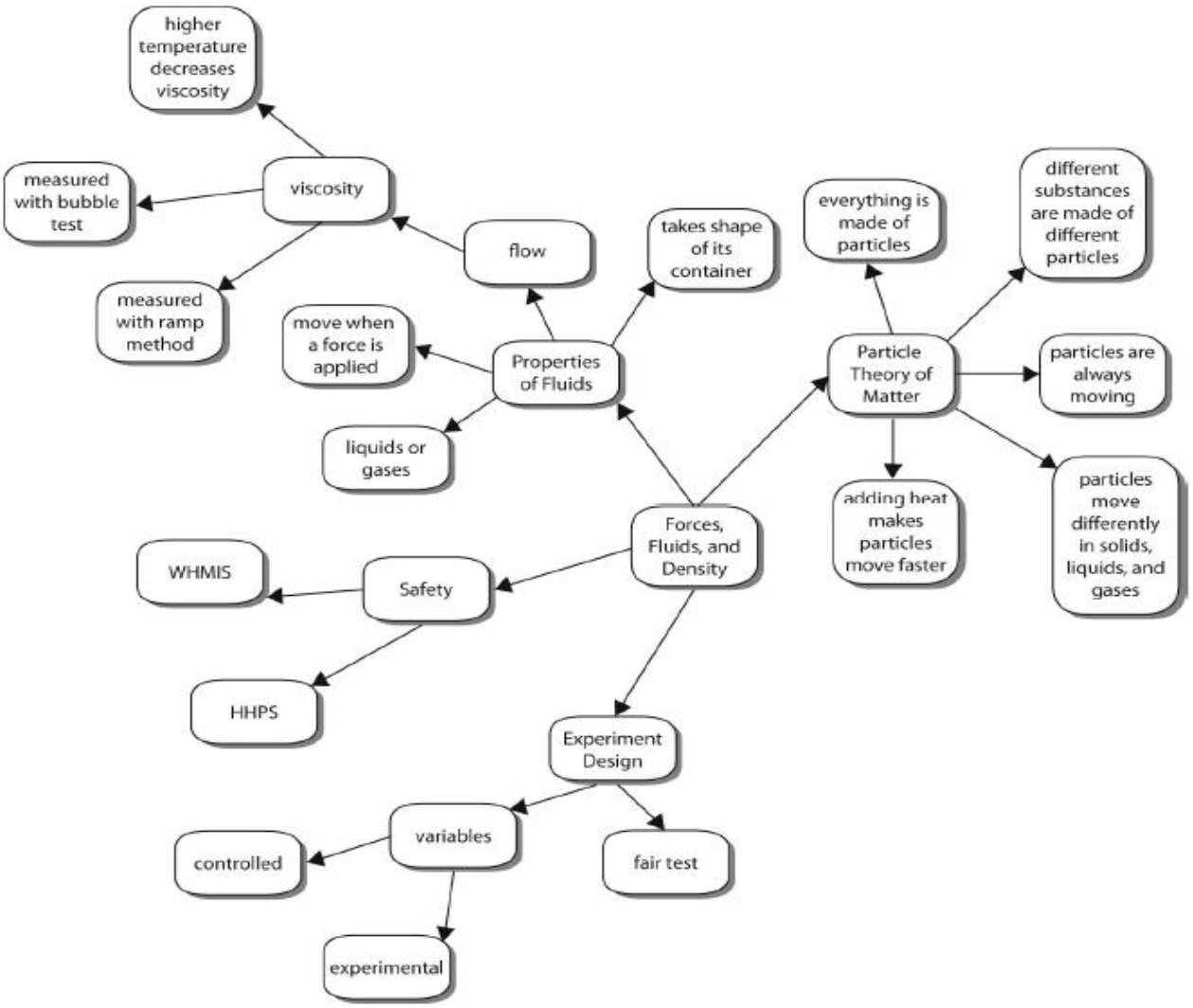


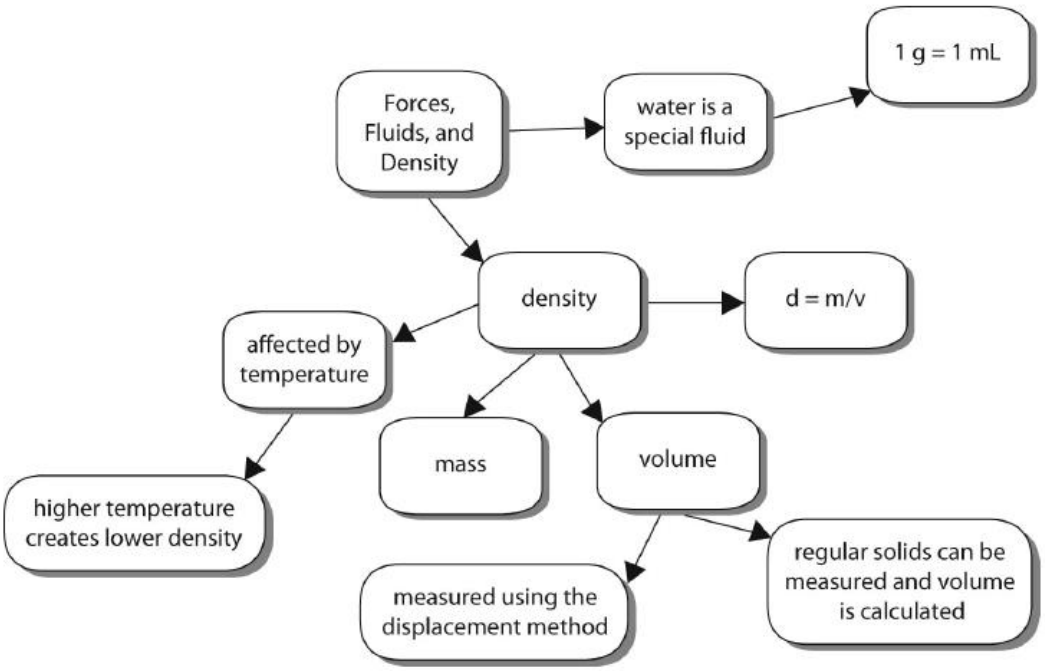
Quiz Yourself: Hydraulic vs Pneumatic Systems

Characteristics of Hydraulic Systems	Characteristics of Pneumatic Systems
Liquids do not compress and expand so they are: • •	**Gases compress and expand, so they are:** • •
Oils are used as hydraulic fluids. • • • • • •	**Air is used in pneumatic systems.** • • • • • •
Hydraulics are contained systems. • • •	**Pneumatics exhaust air into the environment.** • • •

Miss Foley

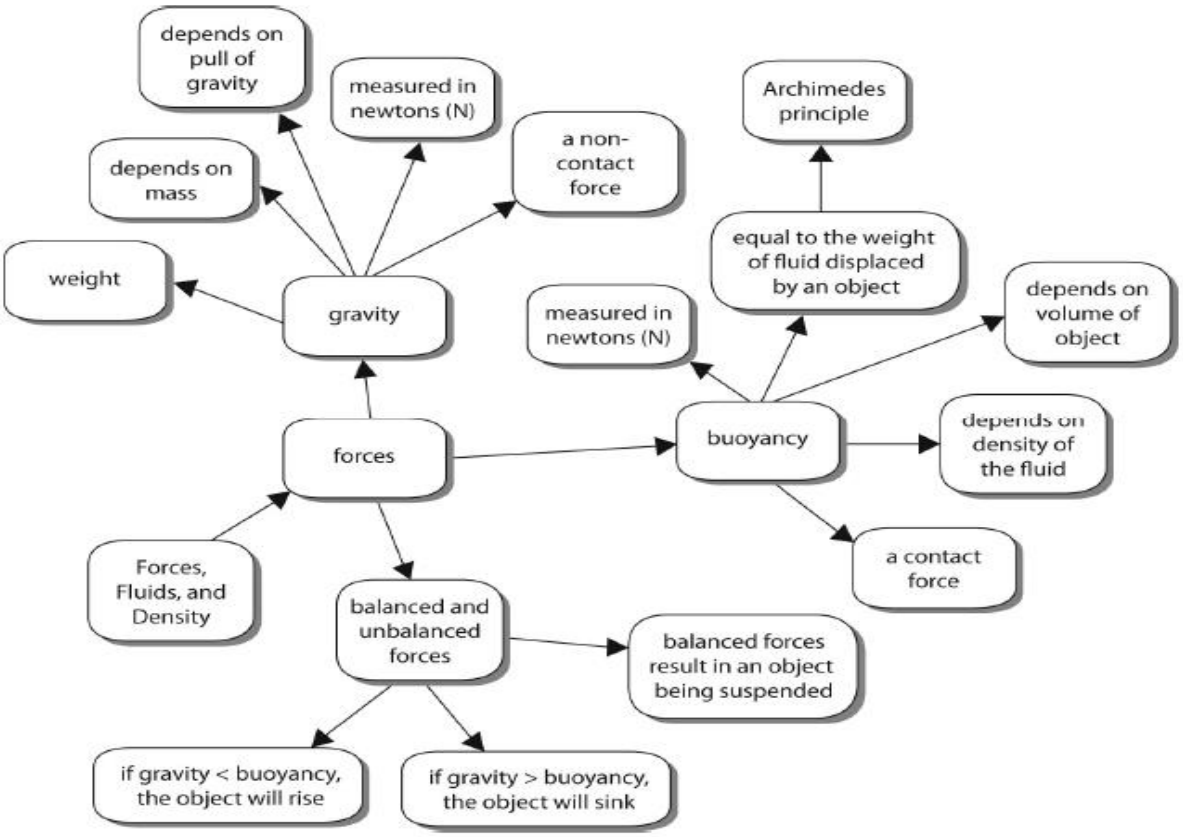
Sci8: FD4 Forces, Fluids & Density **Review**

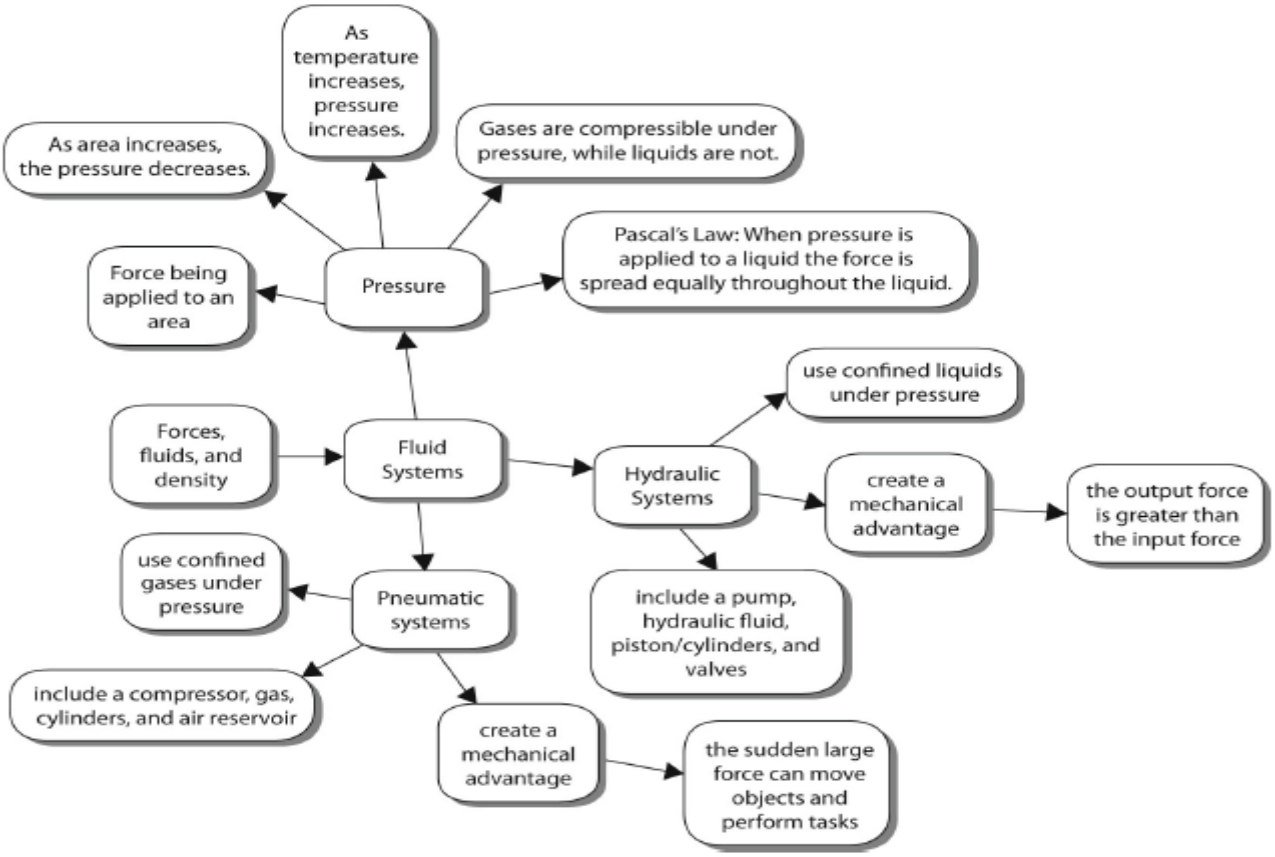




Miss Foley

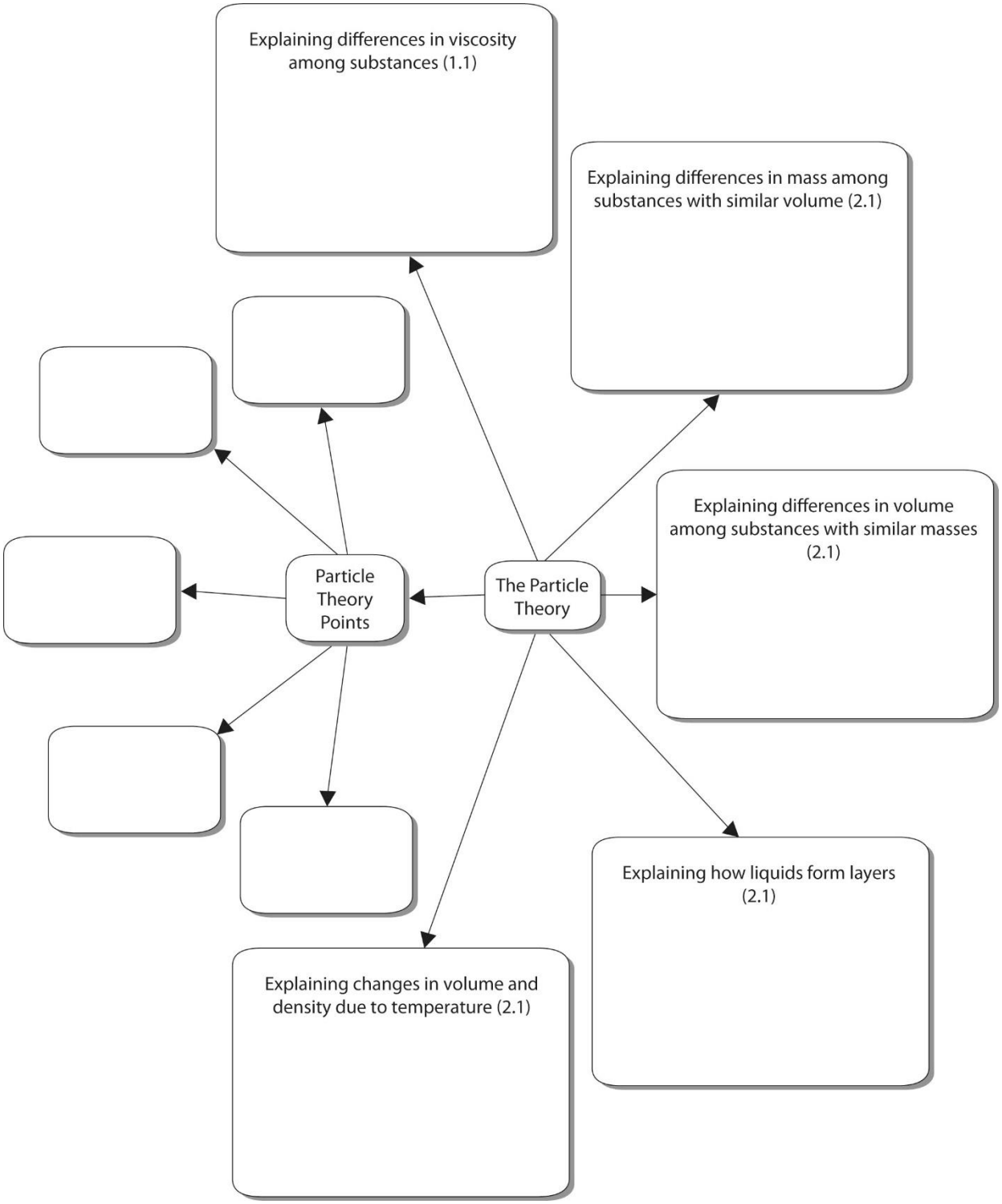
Sci8: FD4 Forces, Fluids & Density **Review**





Connections with the Particle Theory

Summarize the connections you made between the Particle Theory of Matter and your observations of fluids in the concept map below. Be sure to include viscosity, volume, temperature, and density in your summary.



So Many Relationships!

Temperature & Viscosity

If…	Then…
Temperature ↑	Viscosity ↓

If…	Then…
Temperature ↓	Viscosity ↑

Buoyant Forces & Gravitational Forces

If…	Then…
Buoyant force is greater than or equal to gravitational force	Object will float

If…	Then…
Gravitational force (a.k.a. weight) on object is greater than buoyant force	Object will sink

Density, Mass & Volume

If…	Then…
Mass ↑	Density ↑
Volume ↑	Density ↓

If…	Then…
Mass ↓	Density ↓
Volume ↓	Density ↑

Temperature, Volume & Pressure

If…	Then…
Temperature ↑	Volume ↑
Temperature ↑	Pressure ↑

If…	Then…
Temperature ↓	Volume ↓
Temperature ↓	Pressure↓

Pressure, Force & Area

If…	Then…
Force ↑	Pressure ↑
Area ↑	Pressure ↓

If…	Then…
Force ↓	Pressure ↓
Area ↓	Pressure ↑

Miss Foley

Sci8: FFD Forces, Fluids & Density **Review**

REMINDER: This is a guideline, not a copy of the questions on the test. It is to be used to help guide studying. All of the material from the unit is fair game for the test, even if it is not included on this study guide. It is your responsibility to study ALL of the material provided in your notes.

Key Terms:

Knowing and being able to explain / describe the following terms and concepts will be beneficial for the test. Many of these terms (but not limited to these) will be on the test.

Particle Theory	solid	liquid	gas
plasma	fluid	viscosity	weight
mass	density	volume	force
buoyant force	gravitational force	pressure	area
compression	hydraulic	pneumatic	WHMIS
HHPS	variables	fair test	balanced forces
Newton	PFD	Archimedes Principle	swim bladder
ballast tank	displacement	contact force	non-contact force
Pascal's Law	incompressible	input device	output device
mechanical advantage	pump	closed hydraulic system	open hydraulic system

Foundational Questions to Consider When Studying:

1. What does WHMIS stand for?
2. What does HHPS stand for?
3. Be able to describe, recognize, and draw the different symbols.
4. Describe the Particle Theory of Matter
5. What are different states of matter?
6. What is viscosity?
7. What are two different tests to check viscosity?
8. What is density?
9. How can the particle theory help explain density?

10. Know how to do density calculations.

11. What is the difference between mass and weight?

12. What is volume?

13. How are mass, volume, and density related?

14. How would you describe force?

15. What is buoyancy?

16. How does a personal flotation device differ from a life jacket? How do they work?

17. What is floating?

18. How do the gravitational force and buoyant force interact with each other?

19. What is Archimedes Principle?

20. How are swim bladders and ballast tanks similar and different?

21. How would you describe pressure?

22. What things does pressure depend on?

23. How does pressure, temperature, and volume related to each other?

24. What are hydraulic and pneumatic systems?

25. How does a hydraulic system work?

26. What is Pascal's Law?

27. How does depth affect pressure?

28. How does a pneumatic system work?

29. How can the hydraulic system be related to different human body systems?

30. How can the pneumatic system be related to different human body systems?

31. Compare and contrast hydraulic and pneumatic systems.

OP8.1 Identify and describe, through experimentation, sources and properties of visible light including: rectilinear propagation, reflection, refraction.

- ❑ Classify natural and artificial sources of light as incandescence or fluorescence (including phosphorescent, chemiluminescent, and bioluminescent).
- ❑ Demonstrate that light is a form of energy, that light can be separated into a visible spectrum, and that light travels in straight lines in a uniform transparent medium.
- ❑ Investigate the properties of shadows, including umbra and penumbra formation, and demonstrate how the existence of shadows provides evidence that light travels in straight lines.
- ❑ Select appropriate methods and tools and use them safely when collecting data and information to investigate properties of visible light.
- ❑ Estimate and measure angles of incidence and angles of reflection of visible light and determine the quantitative relationship between the angle of incidence and the angle of reflection.
- ❑ Investigate characteristics and applications of specular and diffuse reflection, including the absorption of light by surfaces of different colour and made of different materials (e.g., coloured paper, white paper, aluminum foil, mirror, and water).
- ❑ Describe applications of the laws of reflection in everyday life (e.g., sun dogs, rear view mirror, magician's tricks, and the ability to see the Moon and other non-luminous bodies).
- ❑ Describe qualitatively how visible light is refracted when passing from one substance to a substance of a different refractive index.
- ❑ Predict how light will refract when passing into transparent media with different refractive indices (e.g., water, salt water, plastic, glass, and oil) and conduct an experiment to confirm or refute that prediction.
- ❑ State a conclusion that explains how evidence gathered supports or refutes a prediction related to the refraction of light through media with different refractive indices.

OP8.2 Explore properties and applications of optics-related technologies, including concave and convex mirrors and lenses.

- ❑ Investigate to determine how light interacts with transparent, translucent, and opaque materials.
- ❑ Investigate to determine how light interacts with concave and convex mirrors and lenses, including the formation of real and virtual images.
- ❑ Predict and verify the effects of changes in lens position on the size and location of images produced by a convex lens and/or mirror.
- ❑ Receive, understand, and act on the ideas of others when trying other lenses or mirror combinations to obtain various light patterns.
- ❑ Draw geometric ray diagrams to illustrate how light travels within optical devices such as pin-hole cameras, single lens reflex cameras, telescopes, microscopes, and periscopes.
- ❑ Use a technological problem-solving process to design and construct a prototype of an optical device to address a student-defined problem based on findings related to an understanding of geometric optics.

- ❑ Work collaboratively and safely with others to identify and correct practical problems in the way a prototype of an optical device functions.
- ❑ Provide examples of optics-related technologies that have enabled scientific research (e.g., lasers have enabled research in the fields of medicine and electronics; microscopes have enabled research in medicine, forensics, and microbiology; and fibre optics and the endoscope has facilitated medical research).

OP8.3 Compare the nature and properties of human vision with optical devices and vision in other living organisms.

- ❑ Identify questions to investigate arising from practical problems and issues related to human vision (e.g., "How are contact lenses crafted?", "Do humans see colour the same way?", and "What are some problems associated with human vision?").
- ❑ Illustrate, using a geometrical ray diagram, how the human eye sees objects.
- ❑ Compare the functional operation of the human eye to that of a camera or other optical instruments in focusing an image.
- ❑ Compare human vision with that of other vertebrates and invertebrates, including the function and design of the eye.
- ❑ Explain how the human eye detects colour, and demonstrate that the ability to perceive colour may vary from person to person.
- ❑ Explain how colours are produced, using both the additive and subtractive models of colour, and identify applications of the additive and subtractive models of colour in daily life, including the use of traditional dyes.
- ❑ Describe the operation of optical technologies that enhance human vision (e.g., contact lenses, glasses, night vision scopes, and snow goggles).

OP8.4 Evaluate the impact of electromagnetic radiation-based technologies on self and community.

- ❑ Describe the characteristics (i.e., wavelength, frequency, energy transferred, and typical sources) of different types of electromagnetic radiation, including infrared, visible light, ultraviolet, X-rays, microwaves, and radio waves.
- ❑ Compare properties of visible light (e.g., relative energy, frequency, wavelength, and human perception) to the properties of other types of electromagnetic radiation, including infrared, ultraviolet, X-rays, microwaves, and radio waves.
- ❑ Provide examples of uses of instruments that emit or detect different types of electromagnetic radiation (e.g., cordless phone, cell phone, GPS, wireless computer network, black light, X-ray photographic film, radio, and thermal imaging camera).
- ❑ Analyze the design and function of a technology that incorporates electromagnetic radiation (e.g., microwave oven, solar cooker, sun tanning lamp, infrared heat lamp, radio, medical imaging X-ray, black light, UV fire detector, night vision goggles, infrared thermography, and radar) on the basis of student-identified criteria such as cost, usefulness, and impact on self, society, and the environment.
- ❑ Defend a position on an issue or problem, identified through personal research, related to the impact of electromagnetic radiation-based technologies on self and community.
- ❑ Identify new questions and problems that arise from what was learned about electromagnetic radiation (e.g., identify issues such as how and why to protect oneself against various forms of electromagnetic radiation).

Optics =

scientific study of the properties of light & the way technology uses these properties

BIG IDEAS Summary:
Optics & Vision

1. Light travels in straight lines and illuminance decreases with distance from its source.

Key Concepts

- Light
- Shadow
- Illuminance

Summary

- Light moves in straight lines.
- A shadow is created whenever light hits an opaque material.
- As light moves away from its source, the illuminance is less intense.

2. The law of reflection describes how light reflects from a plane mirror.

Key Concepts

- The law of reflection
- Concave mirrors
- Convex mirrors

Summary

- The angle of incidence is equal to the angle of reflection.
- Concave mirrors are curved inward and show different types of images depending on the distance between the object and the mirror. Concave mirrors can form both real and virtual images.
- Convex mirrors are curved outward and form virtual images.
- A ray diagram is used to represent how light travels.

3. Light is refracted by transparent materials, and this is what makes lenses so useful.

Key Concepts

- Refraction
- Lenses

Summary

- Light changes direction and speed as it passes through different materials.
- A convex lens is used to focus light by converging light rays.
- A concave lens is used to disperse light by diverging light rays.

(Cont'd Next Page)

4. The properties of light explain how the eye and the camera capture images.

Key Concepts

- Human eye
- Camera
- Optical instruments

Summary

- Human eyes and cameras have many similarities, such as controlling the amount of light entering the eye or the device, as well as the ability to focus the image.
- Light enters the eye through the pupil and the lens focusses light onto the retina.
- Lenses can correct problems with vision, such as near- and far-sightedness.
- Lenses and mirrors can be used in combination to create optical instruments.

5. The visible light spectrum is made up of different colours. Colours hold special meaning for First Nations and Métis peoples.

Key Concepts

- Visible light spectrum
- Meaning of colours
- Addition model of colour
- Subtraction model of colour

Summary

- Light can be refracted into the visible light spectrum.
- For First Nations and Métis peoples, colours have many deep, symbolic meanings. These are often connected to the medicine wheel.
- The primary colours of light when mixed together form white light.
- The colour of an object is due to colour subtraction. Objects absorb and reflect colours of light. The colours of light that are reflected are the colours we see.

6. Visible light is only one part of the electromagnetic spectrum.

Key Concepts

- Wave model of light
- Properties of a wave
- Invisible spectrum
- Electromagnetic radiation
- Radiation technologies
- Natural or artificial light sources

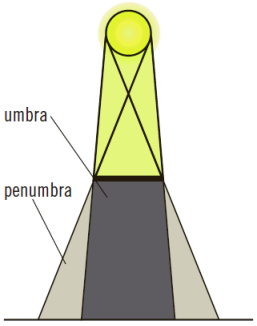
Summary

- The wave model of light explains all electromagnetic radiation.
- When wave motion is analyzed, the distance between the top of one wave and the top of the next wave is called the wavelength.
- The electromagnetic radiation spectrum includes the spectrum of light you can see, as well as other waves you cannot see.
- The term used to refer to all forms of radiant energy is "electromagnetic radiation."
- The primary natural light source is the Sun.
- Artificial light sources include phosphorescent and chemiluminescent sources; bioluminescent sources are a form of natural light source.

Visible Light = a form of energy that is electromagnetic radiation visible to the human eye

Light travels in straight lines from its source. Light cannot bend around objects.

Visible light is responsible for our sense of sight. When you placed your hand between the light source and this page, it prevented the light from reaching the page and made a shadow. Your hand is an opaque material. Opaque materials, such as bricks, books, and people, **reflect** (throw back) or **absorb** (take in) all the light that reaches them.

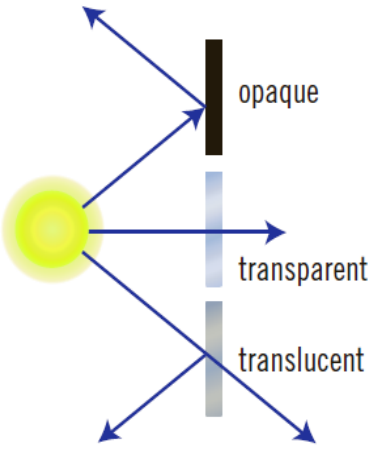


Shadows have two regions.

A **shadow** is created whenever light hits an opaque material. A shadow is composed of two regions, a partially shaded region and a fully shaded region. The fully shaded region is known as the **umbra** (from the Latin word meaning *shade*). The partially shaded region is known as the **penumbra** (from the Latin word meaning *partial shade*); the penumbra forms due to some of the light being blocked and some passing by the opaque object.

Term	Definition	Examples
luminous	objects that produce light	Sun, light bulb, fire
non-luminous	objects that do not produce light but reflect it	Moon, most objects on Earth
transparent	materials that allow light to pass through	glass, air, your family's old photographic slide film
opaque	materials that do not allow light to pass through	wood, metal, thick plastic
translucent	materials that allow some light to pass through	some types of cloth, stained glass

You can see how light travels in a straight line when you use a flashlight or see a beam of sunlight coming down through a cloudy sky. You might wonder why, when you turn on the light in a room, the light seems to reach almost everywhere. How is that possible, if light travels in straight lines? One reason is that the **light from the light source in your room travels outward in all directions**. Another reason is that **light reflects in straight lines from the ceiling and walls**. The lighting in a room is usually designed to allow light to reach all directions. A flashlight is designed to allow light to go in one direction. In either case, light travels in straight lines from its source.



A ray diagram illustrates the direction of the path of light in different media.

A directed straight line that represents the path followed by the light is called a **ray**. A **ray diagram** illustrates the direction of the path of light. Straight lines and an arrowhead indicate the direction the light travels.

Illuminance =

the amount of light arriving at one place per unit area

Luminance intensity, also known as brightness, refers to the light that is emitted from the surface of an object such as a light or candle. A person sitting far away from a light source will notice that the light is dimmer, or the illuminance is less intense, than when she sits closer.

Telescopes can receive light that has travelled from incredibly distant galaxies because that light has moved through the vacuum of space. There is very little matter in space to block or interfere with the movement of light. On the surface of Earth, however, light is constantly being reflected or absorbed by matter.

Light Pollution

Have you ever been on the outskirts of a city at night? If so, you probably noticed an unusual glow in the sky. Light rays from streetlamps and buildings travel up into the sky. There, they bounce off clouds and dust particles to form this glow. Ordinarily, this light "pollution" would not be a problem, but many large telescopes are located near big cities. Astronomers working with telescopes need a very dark sky in order to observe distant stars and galaxies. This light pollution also greatly affects human health as it disrupts human sleep cycles.

Dark-Sky Preserve =

area in which NO artificial lighting is visible and active measures are in place to educate promoting the reduction of light pollution to the public & nearby RM's

Sky glow from beyond the borders of the Preserve will be of comparable intensity, or less, to that of natural sky glow. In 2004, **Cypress Hills Interprovincial Park** was designated as a dark sky preserve, a sanctuary from artificial light. This means it is a great place to view the night sky and a great home for nocturnal animals! The Cypress Hills Dark-Sky Preserve is the **largest dark-sky preserve in Canada**, with 39 600 ha protected—that is the same as 97 850 football fields!

In 2009, **Grasslands National Park** was designated as a dark sky preserve. Grasslands National Park is the **darkest Dark-Sky Preserve in Canada**! With all the environmental concerns going on these days, we don't often think of the "Dark Sky' as a threatened space. The opportunity to see the constellations or even our very own galaxy is being threatened by light pollution. Light pollution is caused by unnecessary glare in urban and rural areas. Preserving the dark sky is becoming more important than ever before!

A Nocturnal Preserve =

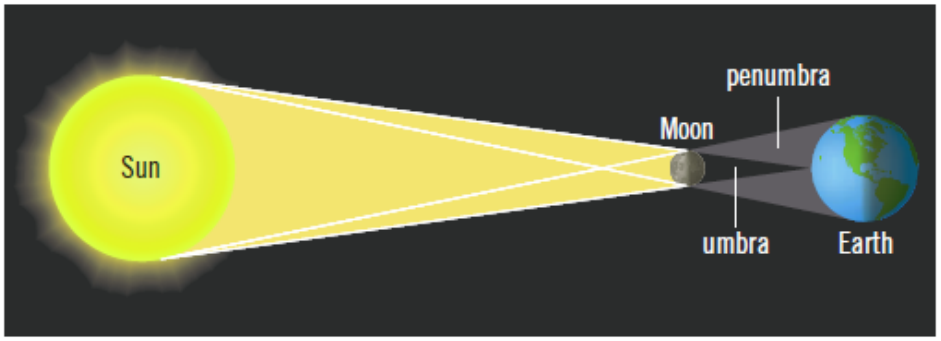
area in which artificial lighting is strictly controlled and active measures are in place to educate promoting the reduction of light pollution to the public & RM's

Old Man on His Back Prairie and Heritage Conservation Area, near Eastend SK, is a working ranch stretching across 13,095 acres of historic grasslands. The ranch isn't home to just bison and beautiful skies, it is home to at-risk species such as ferruginous hawk and the once-extirpated swift fox. Light pollution interrupts processes such as sleep, feeding, migration and reproductive habits for many animal species. Astronomy enthusiasts now realize that conserving areas like OMB not only protects the flora and fauna on the ground, but the evening skies above. In turn, new research is finding that dark skies themselves play a role in ensuring the well-being of species at night.

Progress Check: Visible Light

____ /10 =____%

1. During a solar eclipse, if you are standing in the umbra portion of the shadow and look up, the Sun will be blocked, and it will be very dark. If you are standing in the penumbra, the Sun will be partially blocked, and you will see a crescent shape like a crescent moon. The diagram shows the relative positions of the Sun, Moon, and Earth during a solar eclipse. Explain how a solar eclipse occurs with reference to light travelling in straight lines.



Sun, Moon, and Earth forming a solar eclipse

2. Explain why you agree or disagree with this statement: "Once light leaves its source, it will persist and keep going forever." If you disagreed, under what conditions might this statement be true?

3. Explain, using ray diagrams, how light travels. (2 marks)

4. How far does the light from a flashlight travel during the day? Is this different from the distance the light from a flashlight travels during the night? Explain.

5. What happens to light when it hits an opaque object?

6. What happens to illuminance as you move farther from a light source? Why?

7. Is Earth a luminous or non-luminous object? Use evidence from these photographs to support your answer.

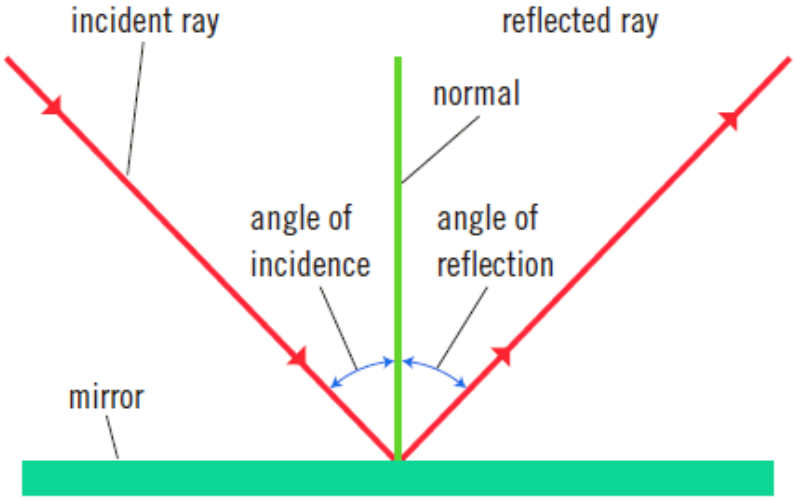
8. Gardeners and farmers know that some kinds of plants need full sunlight (high level of illuminance) while others grow best in the shade (lower level of illuminance).

   a) What is the light source for a plant growing in the shade?

   b) If you want to put a flowering plant that normally grows best in direct sunlight in a shady location, what could you do?

Law of Reflection

The Law of Reflection = angle of incidence equals angle of reflection

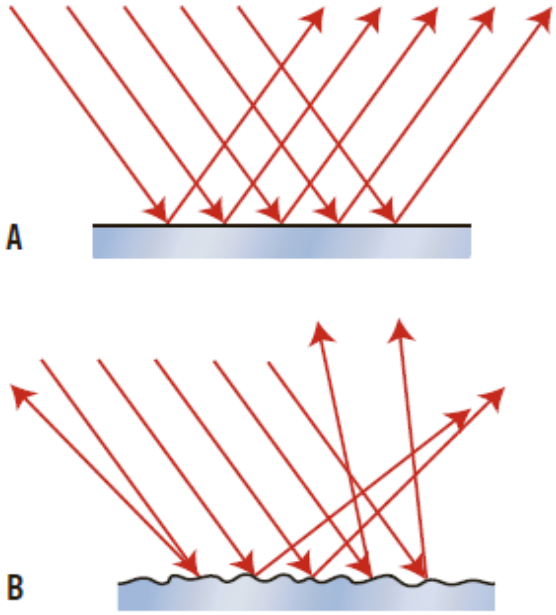


Illustrating the law of reflection

When a ray of light hits a mirror straight on, that is, at right angles, it bounces straight back. When a light ray hits the mirror at an angle to the mirror, it bounces back at an angle. If you use straight lines to represent the mirror and rays in a drawing, a line perpendicular to the mirror is called a **normal**. The angle between the incoming ray, the **incident ray**, and the normal is the **angle of incidence**. The angle between the reflected ray and the normal is the **angle of reflection**. How are these angles related? The relationship between these angles is the basis of the **law of reflection**.

Specular & Diffuse Reflections

When bouncing a ball on a flat surface, such as your driveway, you can predict where the ball will bounce. However, if you bounce the ball on a rough surface, such as grass or a rocky path, do you know where it will bounce? Light behaves in the same way as the ball when reflecting off smooth and rough surfaces. Reflection off smooth surfaces results in a type of reflection known as **specular** (or **regular**) **reflection**. Mirrors, smooth metal surfaces, or calm water will create specular reflection. If light reflects off an uneven surface such as the ocean surface, **diffuse reflection** occurs. A rough surface causes reflected light to scatter in many directions.



A) Specular and B) diffuse reflection

Use of Mirrors

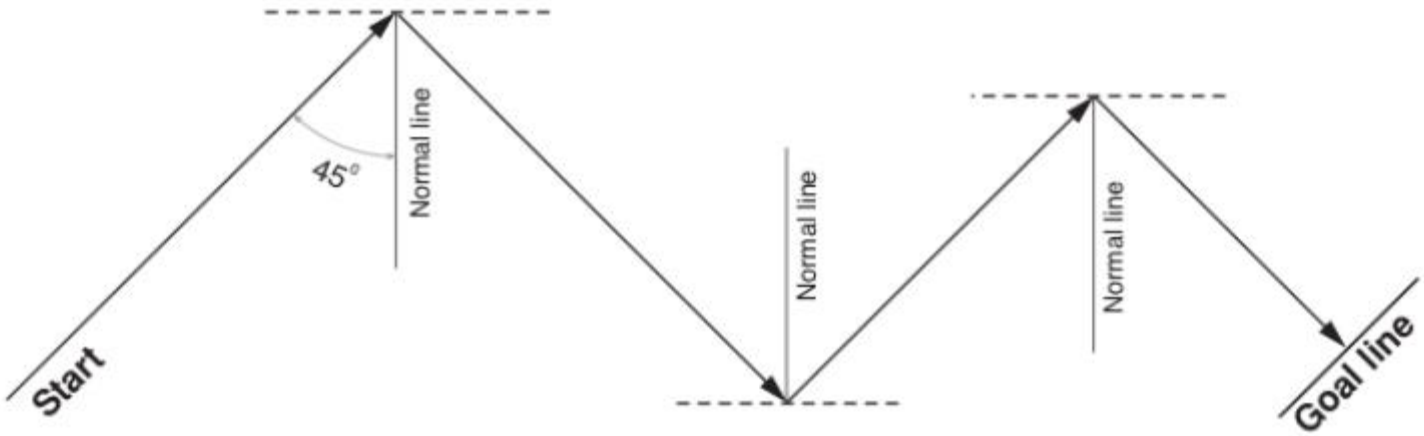
There are two basic ways in which people use plane mirrors:

1. You can look into them and observe the reflection.
2. The second use is to take light from one source and send it in a different direction.

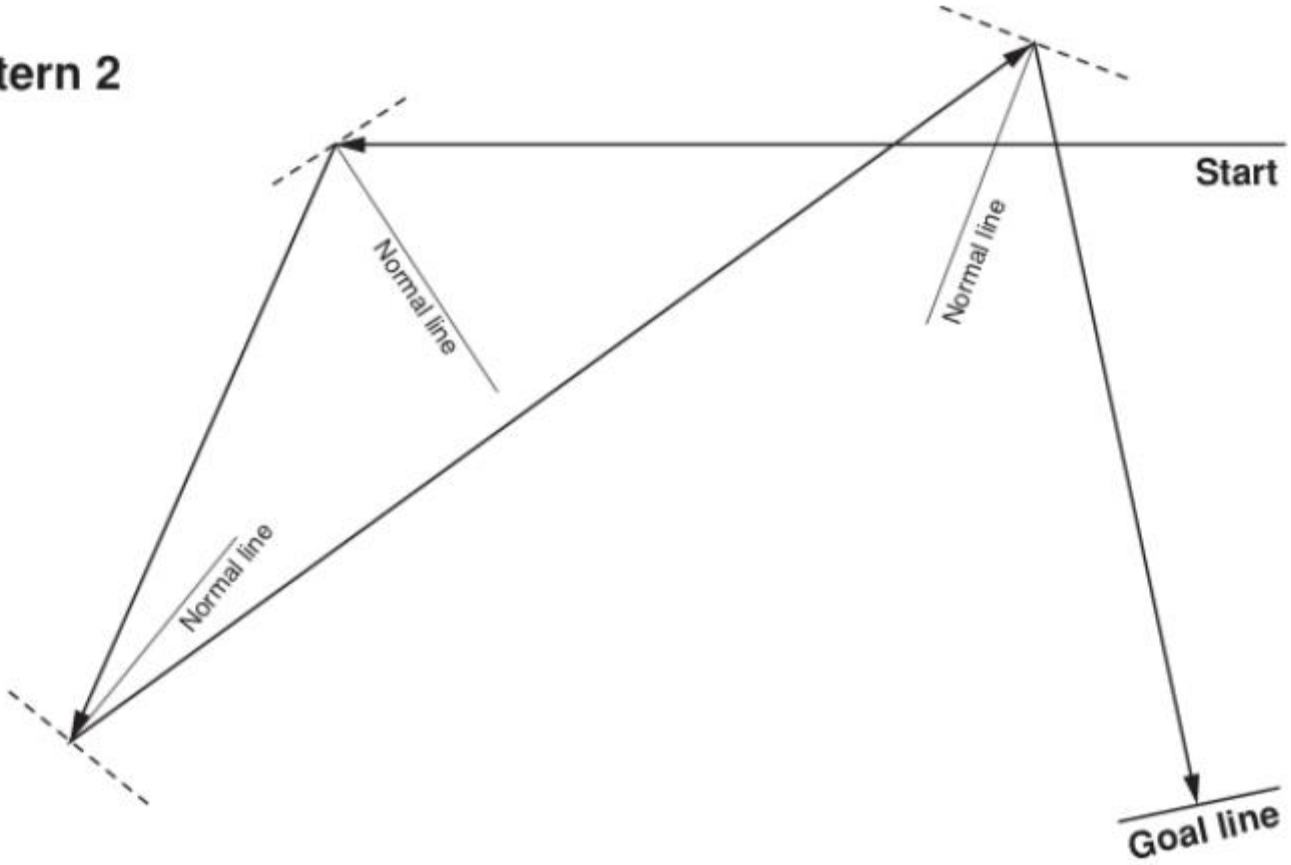
Light and Reflection: Law of Reflection Laser Patterns

Place the mirrors carefully on the dashed lines. Be sure that they are placed right on the dashed lines or your pattern will not work!
Place the goal block on the goal line.
Place the laser along the first incident ray.
Notice the path of the laser.
Can you hit the goal?
Can you tell how the Law of Reflection was used to set up these patterns?

Pattern 1



Pattern 2



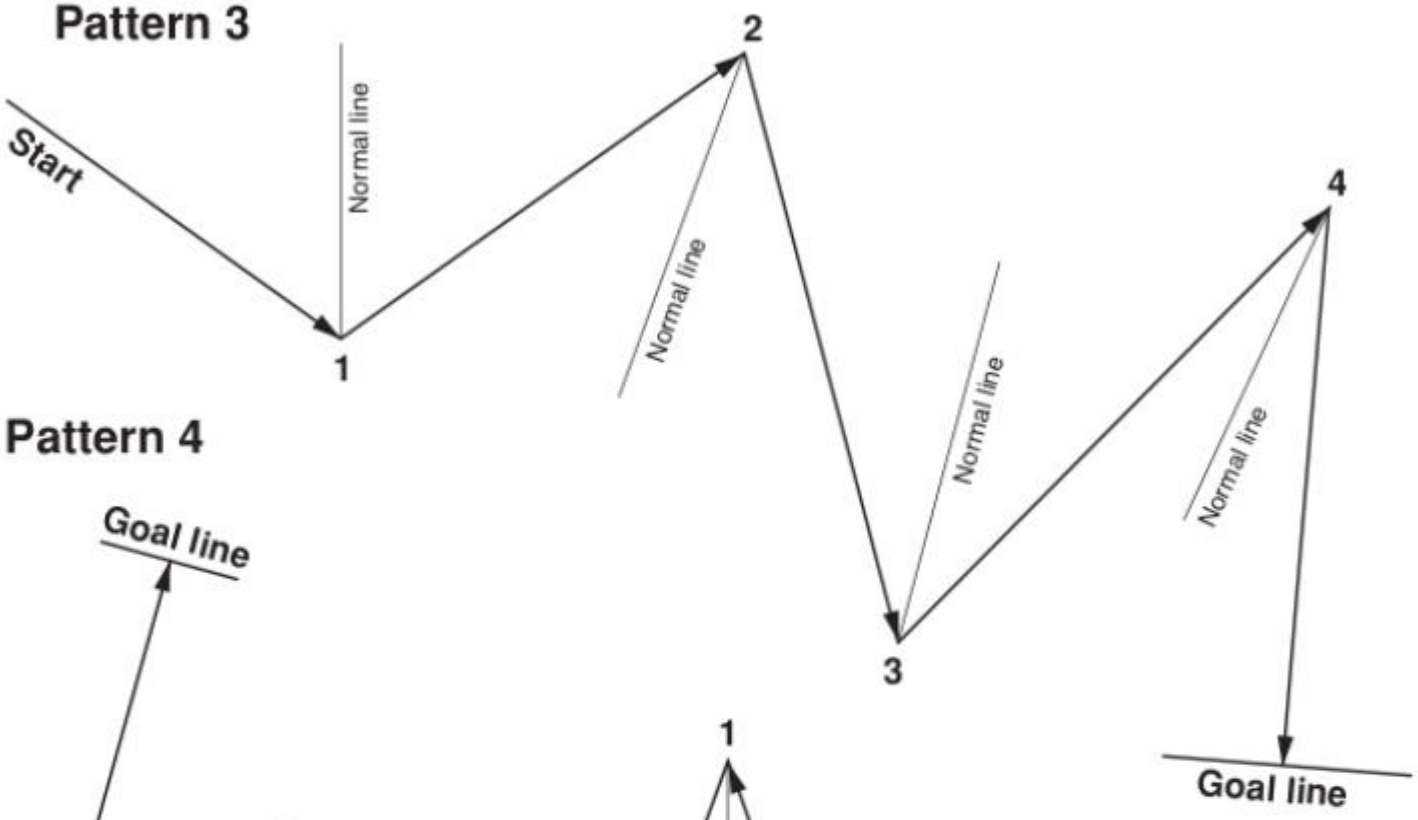
Miss Foley

Sci8: OP1.2 Visible Light p.99-105

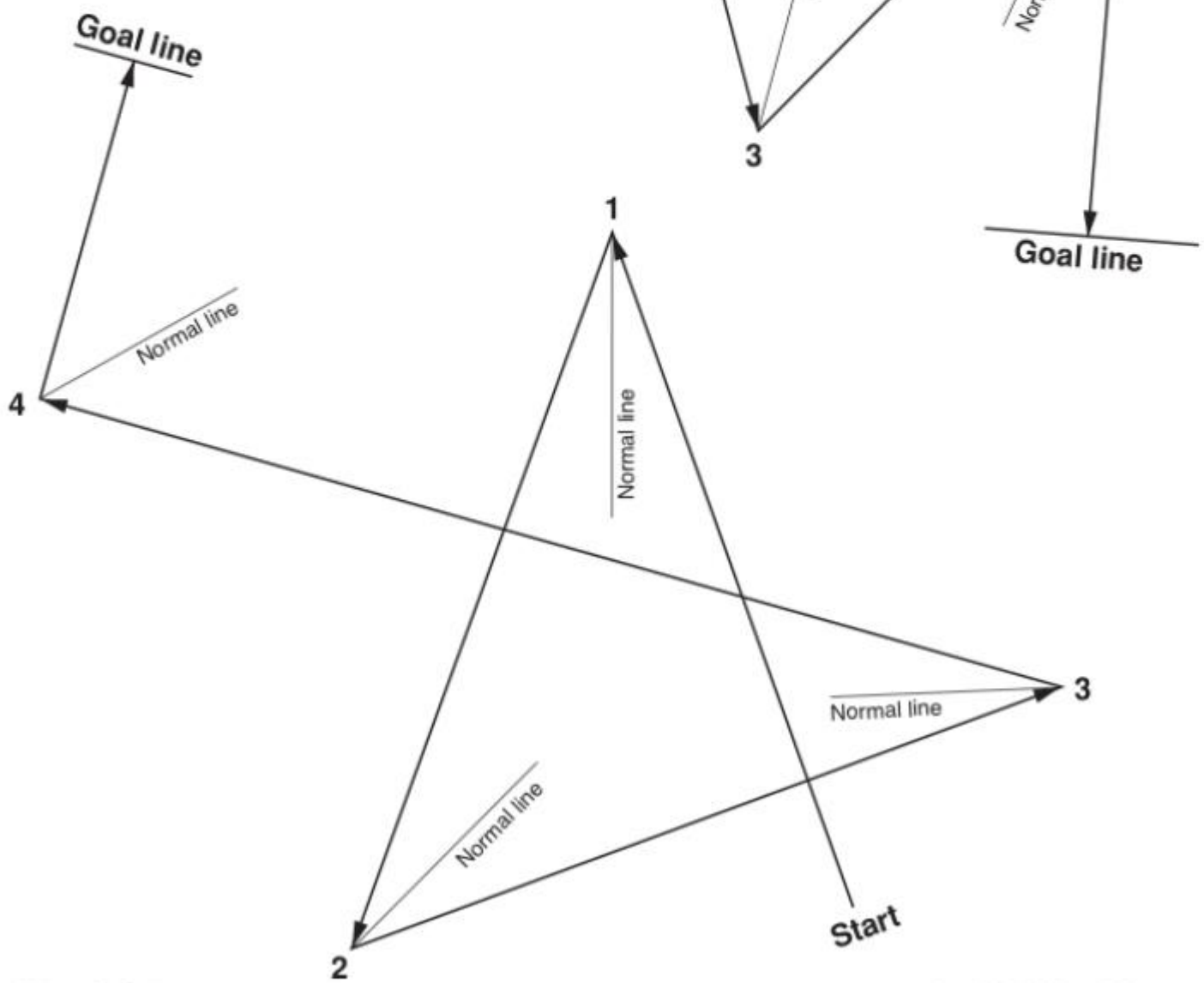
Law of Reflection

These 2 patterns do not have the mirror lines drawn on them!! Using the normal lines to help you, can you set up the mirrors at the numbered spots so that the pattern works? Remember, the normal line should be perpendicular to the mirror. (The mirror and the normal line form a 90… angle.)

Pattern 3



Pattern 4

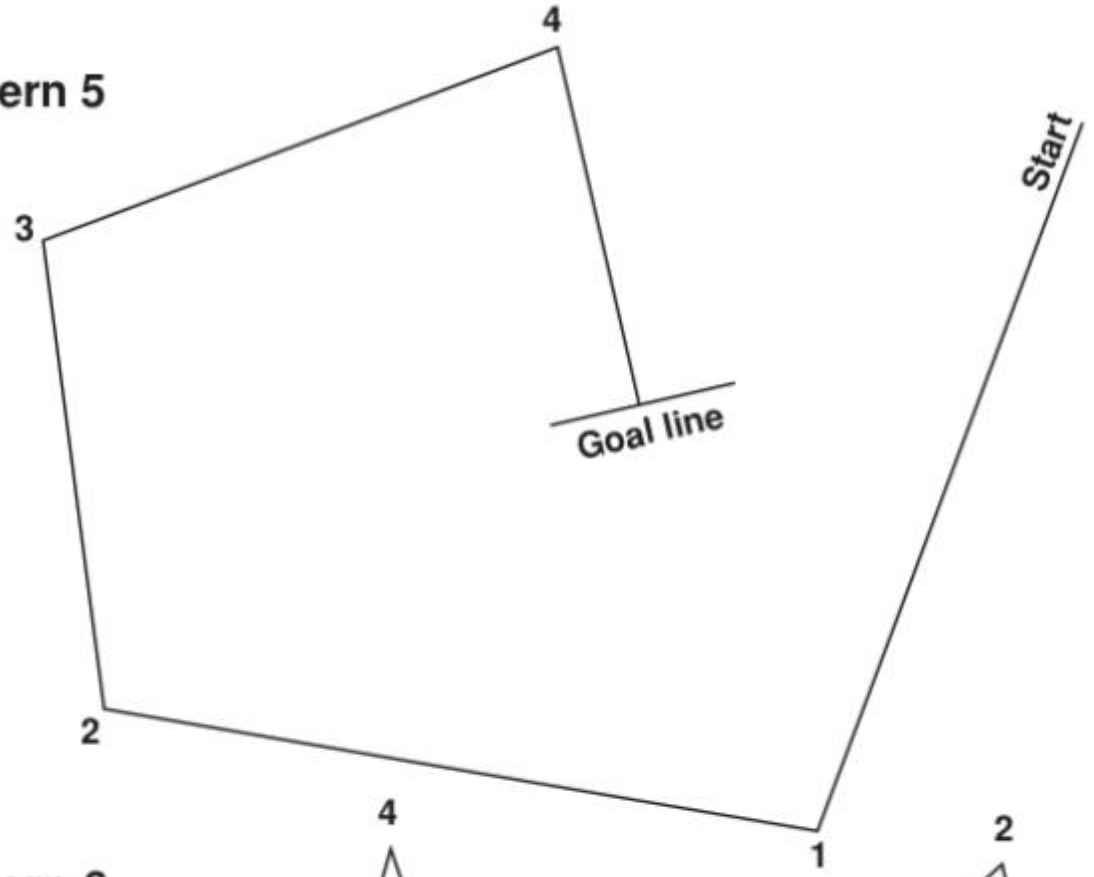


Miss Foley

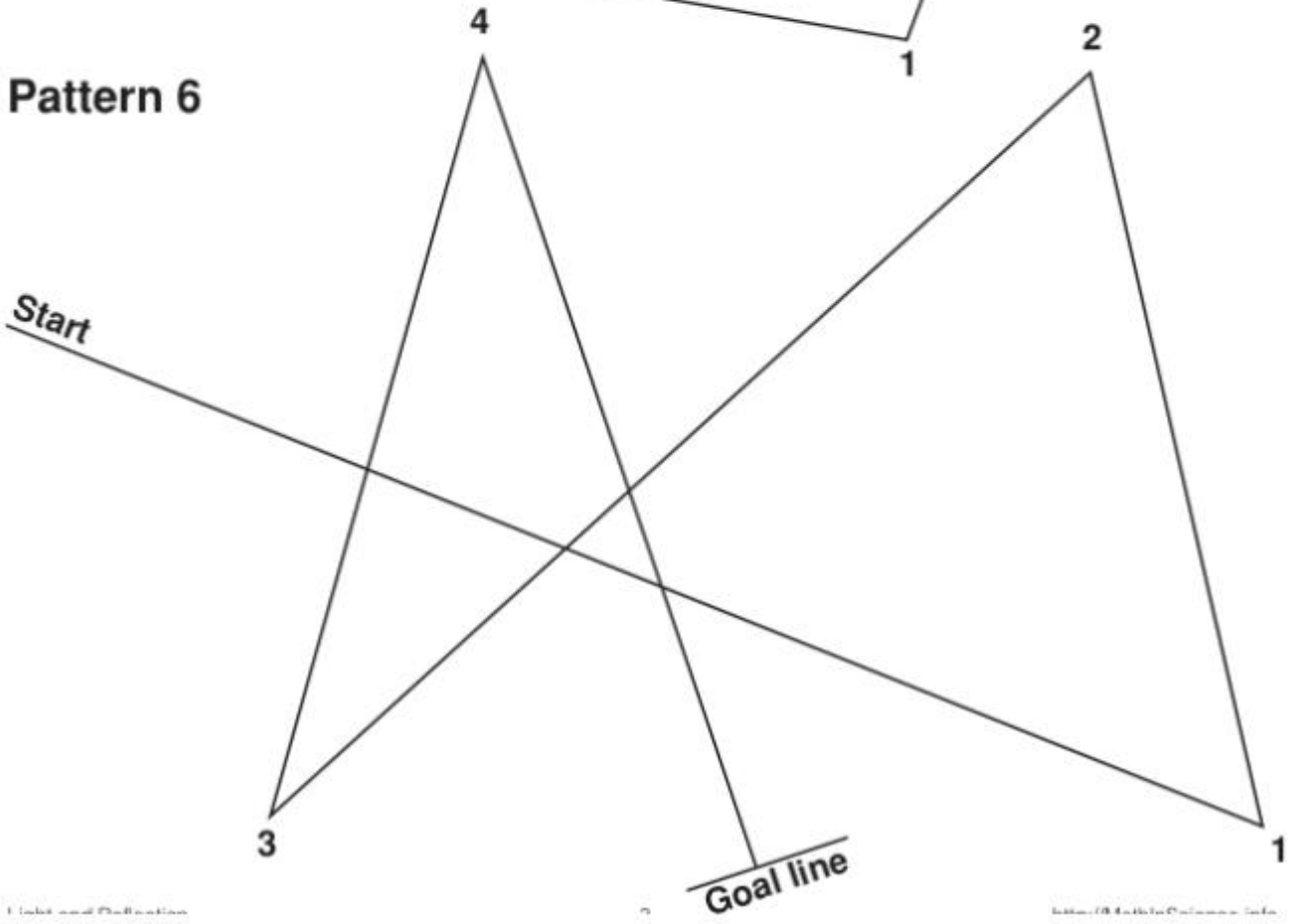
Sci8: OP1.2 Visible Light p.99-105 **Law of Reflection**

These patterns do not have the mirror lines or the normal lines drawn on them! Can you place the mirrors so that the pattern will work?

Pattern 5



Pattern 6



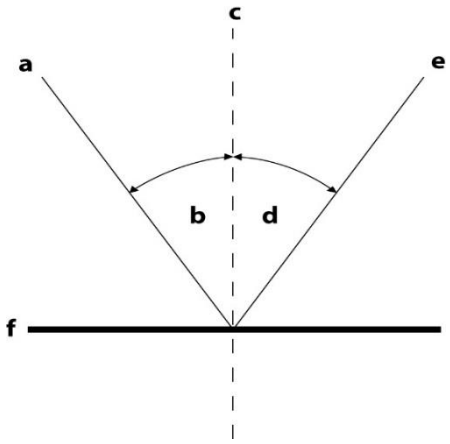
Name: _____ Date: _____ Class: _____

Sci8: OP1.2 Visible Light **Law of Reflection**

Progress Check: Measuring & Labelling Angles

_____ /26 =____%

1. Label the following:



a) _____

b) _____

c) _____

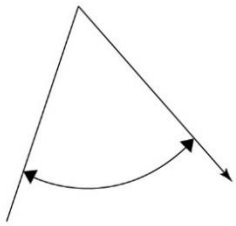
d) _____

e) _____

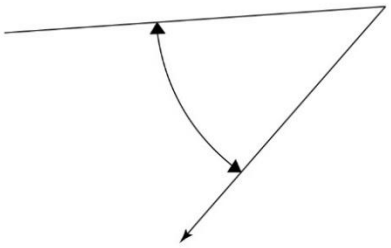
f) _____

2. Complete the following for each angle shown below. (5 marks each)
   a. Draw the normal and mirror. (2 marks)
   b. Measure the angle. (1 mark)
   c. Label the angle of incidence and reflection. (2 marks)

A

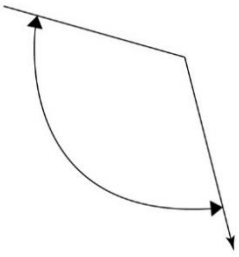


E



B

F



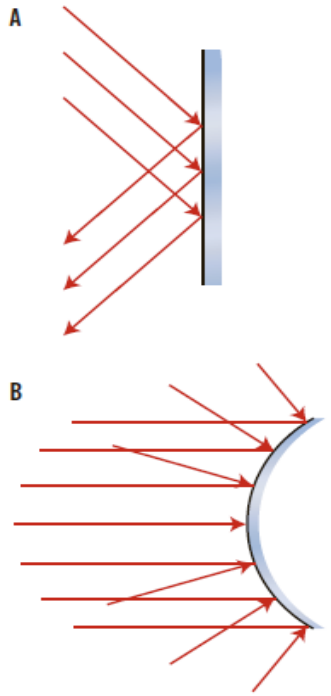
Plane vs Convex vs Concave Mirrors

When you look into a **Plane** (a.k.a. flat) mirror:

1. **Image Size** - As you step back from the mirror, your image stays the same size. It appears smaller only because it is farther away.
2. **Image Orientation (a.k.a. Position)** – the image in a plane mirror is upright. However, your image is reversed – the left & right sides appear as the right and left sides of the image.

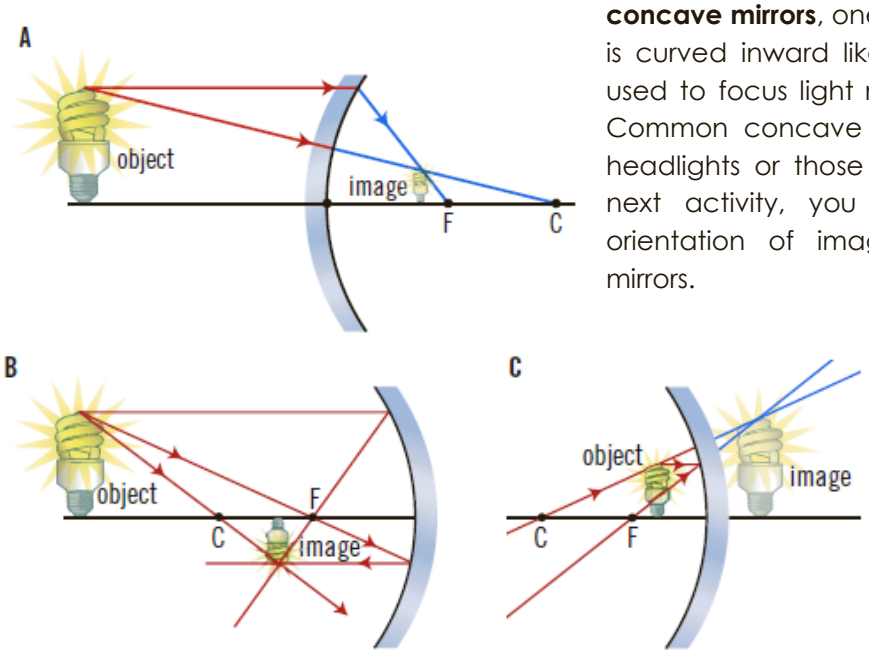
Convex vs Concave

When you look into a curved mirror, you see something quite different from the image produced by a plane mirror. There is a difference in the field of view of the mirrors. The geometric centre of the mirror is called the **vertex** and a line perpendicular to the mirror surface at the vertex is the **principal axis**. There are two important reference points for curved mirrors. The **centre of curvature C** is the point in space that would represent the centre of the sphere from which the mirror was cut. The **principal focus F** is a point on the principal axis at which rays parallel to the principal axis converge or appear to diverge from. The **focal point** is located halfway between C and the mirror.



There is a difference in the field of view of the A) plane and B) convex mirrors.

Convex surveillance mirrors are used to monitor a large area. The outwardly-curved surface of a **convex mirror** reflects light from several parts of the room to the person's eye so that a single mirror reflects a large area. Images in convex mirrors appear smaller than the object's true size. Convex mirrors are also used in parking garages so drivers can see if an oncoming car is coming around the corner. School buses use convex mirrors, which allow the driver to see children in front of and beside the bus. In addition to convex mirrors, there are **concave mirrors**, ones in which the reflecting surface is curved inward like a bowl. Concave mirrors are used to focus light rays or to create larger images. Common concave mirrors are those found in car headlights or those used to apply makeup. In the next activity, you will investigate the size and orientation of images in convex and concave mirrors.

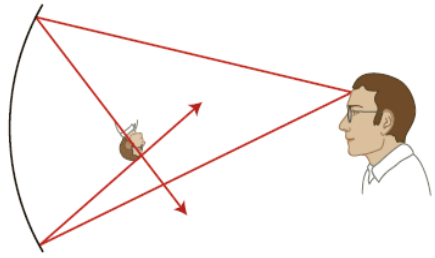


A) Convex mirror ray diagram. An image formed in a convex mirror is upright and smaller than the object. B) and C) concave mirror ray diagrams. The position, size, and type of the image depends on how close the object is to the mirror.

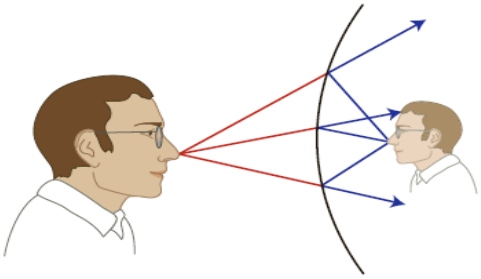
Curved Mirror Images

Curved mirrors produce images different from those that a plane mirror produces. When you are looking at a plane mirror, your image appears behind the mirror. This image is known as a **virtual image**. Light does not pass through the mirror, it only appears that light is travelling from this location.

Real image formed by looking at a concave mirror from far away.



Curved mirrors can produce both virtual and real images. **Real images** are created on the same side of a concave mirror as the object; light passes through the image location and the image formed can be caught on a screen. When the object is far away from a concave mirror, the image is upside down and smaller, but is a real image. When the object is very near, the image is upright and larger than the object. The enlarged images formed from concave mirrors when the object is very close are virtual images.



Virtual image formed by a convex mirror

When the object is far away from a convex mirror, the image is upright and very small. As the object comes closer to a convex mirror, the image remains upright and becomes larger, but is still smaller than the object. Convex mirrors produce only virtual images.

Use of Concave & Convex Mirrors

Concave Mirrors	
Device	**Use of Concave Mirror**
Flashlight 	• to produce a parallel beam of light leaving the flashlight
Telescope 	• to collect a large amount of light from a star or other distant source and focus it for viewing
Cosmetic or shaving mirror 	• to produce an enlarged image of the face
Headlights of a car 	• to produce a parallel beam of light leaving the car that can be pointed down (low beam) or straight ahead (high beam)

Convex Mirrors	
Device	**Use of Convex Mirror**
Security mirror 	• to increase the field of view allowing all parts of a room to be monitored
Side vehicle mirror 	• to view a large area beside and behind the vehicle, reducing blind spots
Safety mirror 	• to reflect every angle you need to see, thus decreasing dangerous collisions and accidents
Mouth mirrors or "dental mirrors" 	• to allow indirect vision and lighting in confined spaces; used by dentists and engineers

Test Yourself:
Images in Concave and Convex Mirrors

	Convex		**Concave**	
	Size as compared to real object (bigger, smaller, or the same)	Orientation compared to real object (upright or upside down)	Size as compared to real object (bigger, smaller, or the same)	Orientation compared to real object (upright or upside down)
Object FAR From Mirror				
Object CLOSE to Mirror				

Reflections

Progress Check: Reflections

____ /15 =____%

1. If you see someone in a mirror, can they see you? Explain why or why not.

2. Use a labeled ray diagram to illustrate the law of reflection in a plane mirror.

3. If light is reflecting at an angle of 27°, what is the angle of incidence? Would the angle of incidence change if the type of reflection were specular or diffuse?

4. Two rules you have learned about light are:
   • Light travels in straight lines.
   • Light reflects from a plane mirror according to the law of reflection.
   Using these rules, explain why, when you look in a mirror, everything appears reversed. (Your left hand is in the place of your right hand.)

5. How does the reflection of light help explain why you can see non-luminous objects?

Name: _____ Date: _____ Class: _____

Sci8: OP2.1 Visible Light **Reflections**

6. What types of materials reflect light best?

7. Draw a capital "B" about 2 cm tall at the top of a piece of paper. Below it, use ray diagrams to draw your predictions of how this letter's image would appear in:
   a) a plane mirror

   b) a second plane mirror placed at an angle to the first plane mirror (that is, the image of the image of the letter)

   c) a concave mirror, with the letter near the mirror

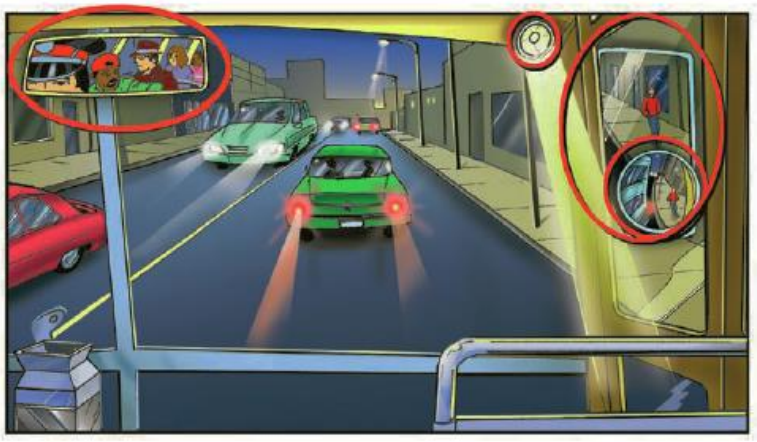
   d) a concave mirror, with the letter very far away from the mirror

   e) a convex mirror

8. Why do car side mirrors that have a convex mirror attached to them carry a warning to drivers that says, "Objects seen in the mirror are closer than they appear"?

9. The circled objects in the picture are, or contain, mirrors.

   a) What type of mirror is being shown in each case?



   b) How are the reflections in each mirror of use to the bus driver?

   c) Could a different type of mirror be used in each case? Explain.

Name: _____ Date: _____ Class: _____

Sci8: OP2.2 Visible Light p.114 **Refraction Lab**

Investigator: Refraction in Water and Other Liquids

The Question

What happens to the path of light rays when they pass from air into water or other liquids?

Hypothesis

_____

_____

Materials

See p.114 of Science 8 Nelson Textbook.

Procedure

See p.114 of Science 8 Nelson Textbook for details.

4. Use the table below to record your data.

Liquid	Observations	Distance to Focal Point of Refracted Ray	Thickness of liquid	Opacity (cloud-ness of liquid)	Particles Present?

Name: _____ Date: _____ Class: _____

Sci8: OP2.2 Visible Light p.114 **Refraction Lab**

Keeping Records

See p.114 of Science 8 Nelson Textbook for details.

9. Graph Title:

_____

Analyzing & Interpreting

10. How did the water affect the path taken by the rays of light? How did you know this change was due to the water and not to the glass of the beaker or jar?

11. When you tested different liquids, which factors made the most difference in how much the light was refracted?

12. Compare your predicted path and the tested path. Was your predicted angle of refraction greater than or less than the tested angle of refraction?

13. Write your own definition of refraction.

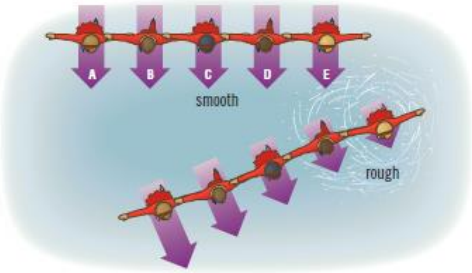
14. What factors affect refraction the most? Why do you think this is so?

Forming Conclusions

15. Write a conclusion about what happens to the path of light rays when they pass from air into other liquids. How does your evidence support or refute the predictions you made about the refraction of light through the different liquids?

Refraction =
light passing through one substance into another changes speeds causing a change of direction

The change in direction of light, called refraction, occurs because light travels at different speeds through different materials. As light passes from air to water, it slows down and changes direction. Light travels forward much like the line of skaters shown here. If some of the skaters at the end of the line slow down on rough ice, but the rest continue at the original speed, the line of skaters will change direction. When part of a beam of light slows down, and the rest keeps going, the result is a change in direction of the light.

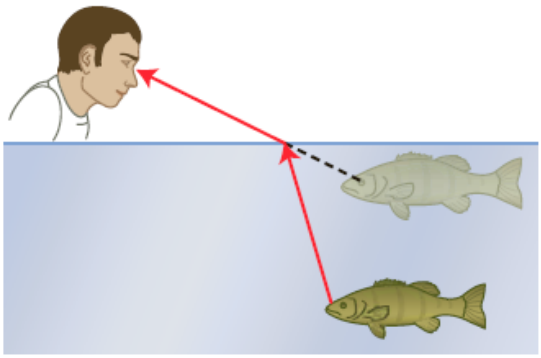


Skater E slows down, making the entire row of skaters turn. Compare this situation with the pencil in the glass of water on the previous page.

Skillful Spearfishing

In North America, Indigenous groups who have traditionally hunted fish with spears have developed skills to solve the problem of underwater objects looking nearer than they really are. In Alaska, Indigenous people fish with spears as did the Inuit and the First Nations peoples of northern Saskatchewan. The native people of Alaska spear fish in the fall when the river begins to ice up. They hunt from a boat on the river or from shore when the ice is thick enough to support a hunter's weight. Fishing is done at night using a lantern, which is shielded on one side so that only a fraction of the light is emitted. The men spear fish from the bow of the boat as ice rushes across the surface of the water. In the darkness no shadows are cast and so the fish are not alerted to the presence of the hunter.

On the shore ice, the hunters cut a wide hole. Young spruce trees are peeled and lashed together. This framework of spruce trunks is sunken with rocks below the hole cut in the ice. The peeled spruce appears white against the sand and silt of the riverbed. When fish swim over the framework or bump into it, their presence is obvious and they can be speared.


Because of refraction the fish appears closer to the surface than it really is.

Spearfishing is made more difficult because of refraction. **Refraction occurs at the surface point when light passes through one substance into another.** As light passes from the water into the air, the light changes direction. This change in the direction that the light travels causes the fish to appear where we think we see it, but in fact the fish is really lower in the water. Refraction causes the optical illusion so that the fish appears larger and closer to the surface than it really is. When a hunter attempts to spear the fish from directly above, refraction does not affect the image of the fish. It appears to the hunter where it actually is. Hunters must understand how to deal with optical illusions. Sea hawks and fish eagles must learn this lesson too. They must compensate for the refraction of light. If they do not, they will miss many meals.

Miss Foley

Sci8: OP2.2 Visible Light p.112-119

Refraction

Glass is transparent and easy to shape. Mirrors are made by applying a reflective coating to glass. Refraction depends on factors such as the angle of incidence and the type of material.

When light travels through an interface between two regions at an angle other than 90°, it will most likely change direction depending on the properties of each region. For example, when light travels **from air to water/glass, it will change direction toward the normal**. When light **travels from water/glass to air it will change direction away from the normal**. This change in direction happens if light travels at different speeds on either side of the interface. For example, light travels at different speeds through glass and water.

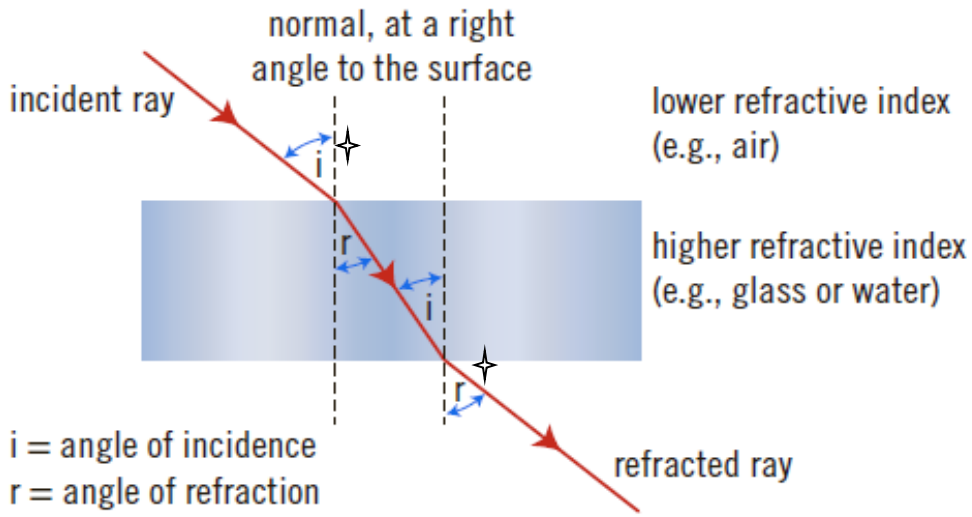
Whenever there are parallel surfaces:

In The Air

$i = r$

In The Water/Glass

$i = r$



Refractive indexes of some common substances	
Substance	**Refractive index**
air	1.003
ice	1.31
water	1.33
crown glass	1.42
glycerin	1.47
ruby	1.54
diamond	2.42

*Want to learn more? Check out the **Law of Refraction** online…also known*

Refractive Index (a.k.a. index of refraction) =

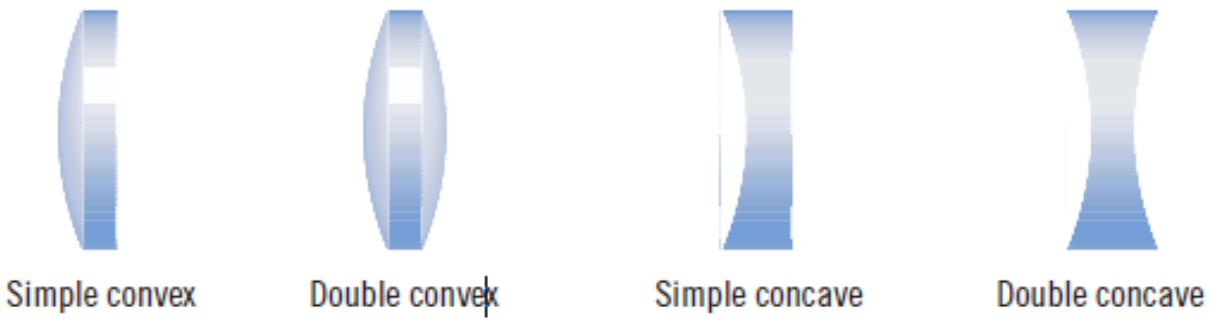
the measure of how much the speed of light is reduced in the region

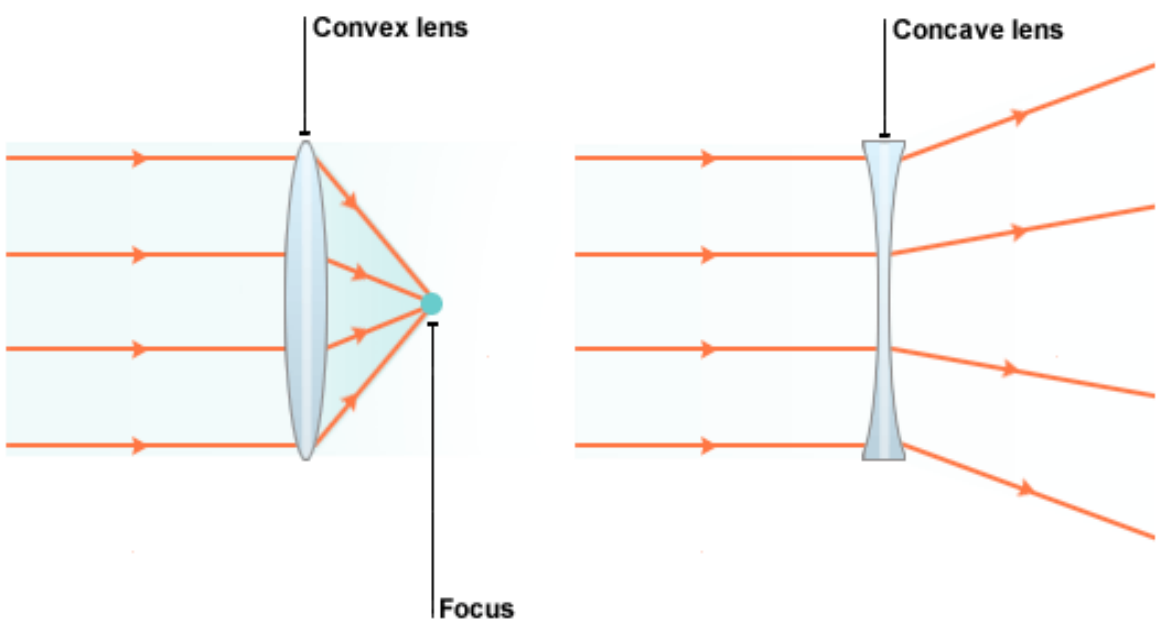
Using Refraction to Focus Light

When you experimented with mirrors, you found that the shape of the mirror had an effect on the image. For example, the image reflected by a concave mirror was smaller and upside down when the object was far away. The image reflected by a convex mirror was larger and right side up. These characteristics of curved mirrors make them very useful. In the same way, the shape of a block of glass through which light passes has an effect on the refracted image. A lens is a piece of transparent material (glass, plastic) with at least one curved surface.

Types of Lenses

A convex lens curves outward. You can quickly spot a convex lens by noticing it is thicker in the middle than at the edges. A concave lens curves inward. You can tell because concave lenses are thicker at the edges than in the middle.





Refraction

Progress Check: Refraction

____ /14 =____%

1. When would it be easier for a bear to catch a fish: as the fish jumps into the air, or as it swims? Explain your reasoning in terms of how light travels through air and through water. (2 marks)

2. Why do objects at the bottom of an aquarium filled with water look closer than they really are? (1 mark)

3. Imagine that you have a waterproof flashlight, underwater in a swimming pool. You point the flashlight perpendicular (at 90°) to the surface of the water. Predict how the path of light would change direction as it came out of the water into the air. What would happen to the light if the flashlight was pointed at 45°? (2 marks)

4. What factors affect how light is refracted through a material? (2 marks)

5. A "magic" trick involves putting a coin in the bottom of a cup, then having the person step back until he or she can no longer see the coin from the top. The magician then makes the coin "reappear" by pouring in water. How does this trick work? (2 marks)

Name: _____ Date: _____ Class: _____

Sci8: OP2.2 Visible Light **Refraction**

6. Some light fixtures contain a lens through which the light passes before it is used. In each of the following situations, decide whether this lens should be convex or concave. Use a diagram to explain. (3 marks)

   a) You are designing an outdoor light that will spread a soft light over a large area.

   b) You are designing a reading light that someone could use without the light bothering others in the room.

   c) You are designing a store light that will keep the floor well lit, but which will also shine most of its light on the display case directly below.

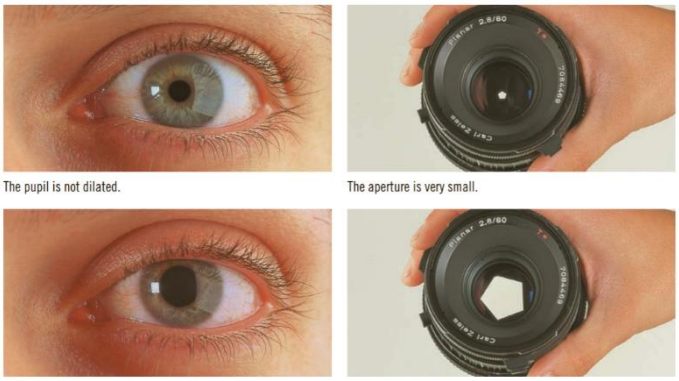
7. Explain why the newsprint in the drops of water is magnified in the photograph. (2 marks)

Human Vision vs Cameras

You have learned that light either travels from a source to your eyes or reflects off an object to your eyes. But how exactly does light enter your eye?

Both the eye and the camera have a hole that lets in light. In the eye, this hole is called the **pupil**. In the camera, it is called the **aperture**.

The pupil of your eye is surrounded by a band of muscle, called the **iris**. This band controls the size of the pupil, and so controls the amount of light that can enter your eye. In dim light, the iris opens, and the pupil dilates, or becomes wider, so you can gather more light. In bright light, such as outside, your iris closes down, so the eye receives just the right amount of light. This happens automatically, without your conscious control.

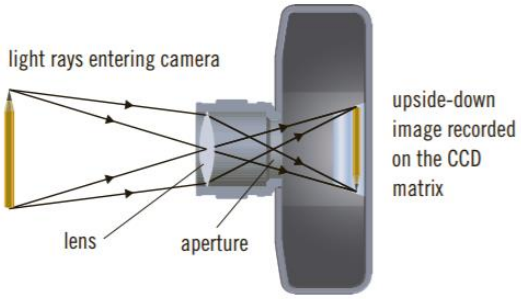

The pupil is not dilated.
The aperture is very small.
The pupil is dilated.
The aperture is wide open.

In the same way, the **diaphragm** changes the size of the aperture of a camera lens to allow in the proper amount of light. The **shutter** of a camera acts like a door. If the shutter is open for a long time, more light enters the camera. Which part of your eye is like a camera's shutter?

What Happens Inside

For you to see, something must react to the light entering your eye. The part that accomplishes this for you is the **retina**, a special lining on the back of your eye. When light hits the retina, receptor cells send messages to the brain, which are translated into an image.

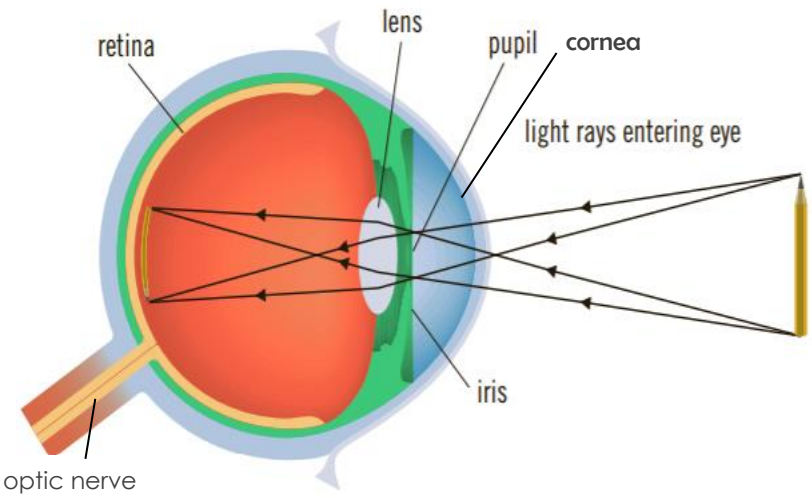
In a similar way, the light entering a digital camera hits the **charged coupled device (CCD)** cell. Several cells are combined to form the **CCD matrix**, which has a similar function to the retina, because it contains photosensitive elements. When light reaches the photosensitive elements in the CCD matrix, pixels are illuminated. Each pixel represents one portion or location in the image. Red, blue, and green colour filters over the individual pixels let the appropriate light through. The illumination of the pixel creates an electronic pulse and the built-in computer software in the camera creates digital data to produce the image. **This essentially means that light is turned into electricity**. Digital cameras with a higher pixel rating (a larger number of sample locations in each area) produce larger and more refined pictures.



The image formed on the CCD matrix is also upside down. However, the camera software displays the photo correctly on the camera's screen.

When working with mirrors and lenses, you discovered that an image is only clear and distinct when it is focused. Another way of saying this is that the **light rays forming the image converge, or come together, at one point, called the focal point**. Your eye has a transparent lens, too, just behind the pupil. This **lens** focuses light on the retina so you can see a clear image. The lens of your eye automatically **changes its shape to focus on near or distant objects**. In the same way, a camera has one or more lenses to focus incoming light on the CCD matrix. Some cameras focus automatically while others require the user to manually focus the lens.

Human Eye



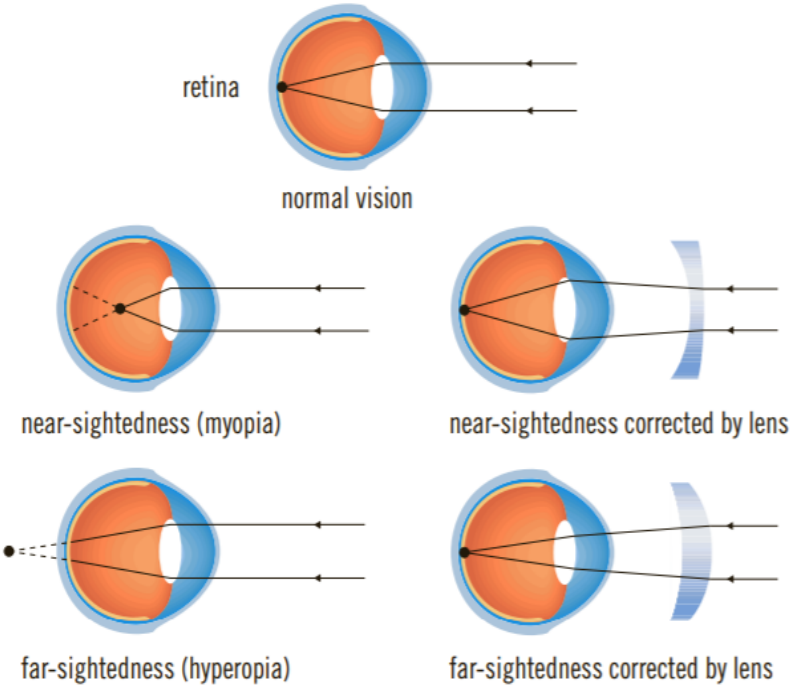
The image formed on the retina is upside down. You do not see things that way because your brain interprets the information sent by the retina and flips it around.

Improving Human Vision

What happens when you look through a lens? Light is refracted by that lens, then is refracted by your eye. The combination lets you see a magnified image. There are many ways lenses are used in combinations. Perhaps the most important in everyday life is to help correct vision problems. If you examine a pair of eyeglasses, you will notice that they are made up of two lenses. Which type are they: concave or convex?

Many people wear glasses or contact lenses because their eyes do not focus images on their retinas properly. The additional lenses refract the light entering the eye so that the lens in the eye will produce a good, clear image. The two most common problems, **myopia (near-sightedness)** and **hyperopia (far-sightedness)**, are shown below.

In a near-sighted person, the eyeball may be too long or the lens too thick. In this case, light entering the eye is focussed too soon, short of the retina. When a near-sighted person tries to see things at a distance, the image is blurred. In a far-sighted person, the eyeball may be too short or the lens too thin. In this case, the refracted light focusses behind the retina. Objects close to a far-sighted person will be blurred. Lenses can be used to correct both of these problems.



Many Eyes

Not all animals see the world in the same way that humans do. Snakes see adequately. However, they are able to see motion better than still objects and have been known to leave motionless prey unharmed during the day. Some snakes such as rattlesnakes have sensitive receptors in grooves between their nose and eyes, allowing them to pick up heat signals from warm objects. Horses and similar animals, such as zebras, have excellent peripheral vision due to the placement of their eyes. Having eyes on the side of the head allows these animals to see advancing predators from many directions; however, they have a blind spot directly in front of their noses. Deer also have excellent peripheral vision due to the size of their eyes, providing a large field of view. Deer can see only the colours blue and green. Since they cannot perceive any difference between red and green, they are essentially red-green colour-blind, as some humans are. Dogs and cats are also colour blind. However, dogs and cats have better peripheral and night vision that humans do. Human eyes have a filter that blocks almost all ultraviolet (UV) light. Deer eyes do not filter UV so they are sensitive to the UV spectrum.

Most insects have compound eyes. **Compound eyes** may have hundreds to thousands of sections, depending on the insect. Dragonflies have the largest number of sections in their compound eyes. They are very efficient hunters, catching their prey in flight. Grasshoppers have three simple eyes and two large compound eyes. They have fewer sections in their compound eyes and see grainy images compared to those that dragonflies see. Honeybees' compound eyes cannot see the colour red; however, they can see regions of the electromagnetic spectrum that humans cannot see.

The Eagle — Significant Sight

In First Nations cultures, the Eagle is very important. Some believe that the Eagle can see far into the past and far into the future; that it flies highest in the North American sky; and that it carries prayers to the spirit world. The Eagle represents compassion, respect, detachment, and humility. These qualities are also the qualities of an Elder.

A dragonfly eye displays the large number of sections in the compound eye

- Many First Nations give an Eagle feather as a great honour to any worthy member of their nation who has contributed in an outstanding way as a warrior, a teacher, or a person who is revered as a leader or Elder. The individual receiving the feather must understand that as there are two sides to the structure of the feather, so there are two ways of using the feather. On the one side there is authority; on the other, compassion.
- Eagle feathers are used at powwows by many First Nations peoples. They make up the Eagle staff, which is analogous to the Canadian flag at these gatherings.
- Eagle feathers are harvested for ceremonial purposes only. Those people who have earned the right to collect Eagle feathers must have permission from their Elders and communities, live in the traditional way, have direction and visions from the spirit world, and undergo ceremonies such as fasts before they undertake the harvest of these feathers. Modern people sometimes try to buy Eagle head-dresses, but this is not appropriate. Feathers must be freely given for outstanding contributions to the community.

The Eagle flies to great heights and can see many things below.

Name: _____ Date: _____ Class: _____

Sci8: OP3.1 Human Vision **Human Eye**

Progress Check: Human Vision

____ /25 =____%

1. Complete the following chart. (10 marks)

This part of the human eye is like…	…this part of a camera	Function of Both Eye & Camera Parts
Eyelid		
Pupil & Iris		
Lens		
Retina		
Optic Nerve		

2. Explain the following observations about a camera, based on what you know of its function and how light travels. (3 marks)

   a) The inside of a camera is usually black.

   b) To take a picture in dim light, you must open the aperture wider.

   c) To take a picture in very dim light, you can leave the shutter open for a period of time.

Name: _____ Date: _____ Class: _____

Sci8: OP3.1 Human Vision **Human Eye**

3. Looking directly into a very bright light can damage the retina. Even a brief exposure can cause discomfort and leave bright after-images that make it hard to see. When there is a solar eclipse, most of the Sun's light is blocked for a few seconds. Knowing that the iris opens to dilate the pupil in dim light, why do you think it is so dangerous to stare up at an eclipse? (2 marks)

4. Explain two (2) causes of near-sightedness. What effect does this have on a person's vision? (2 marks)

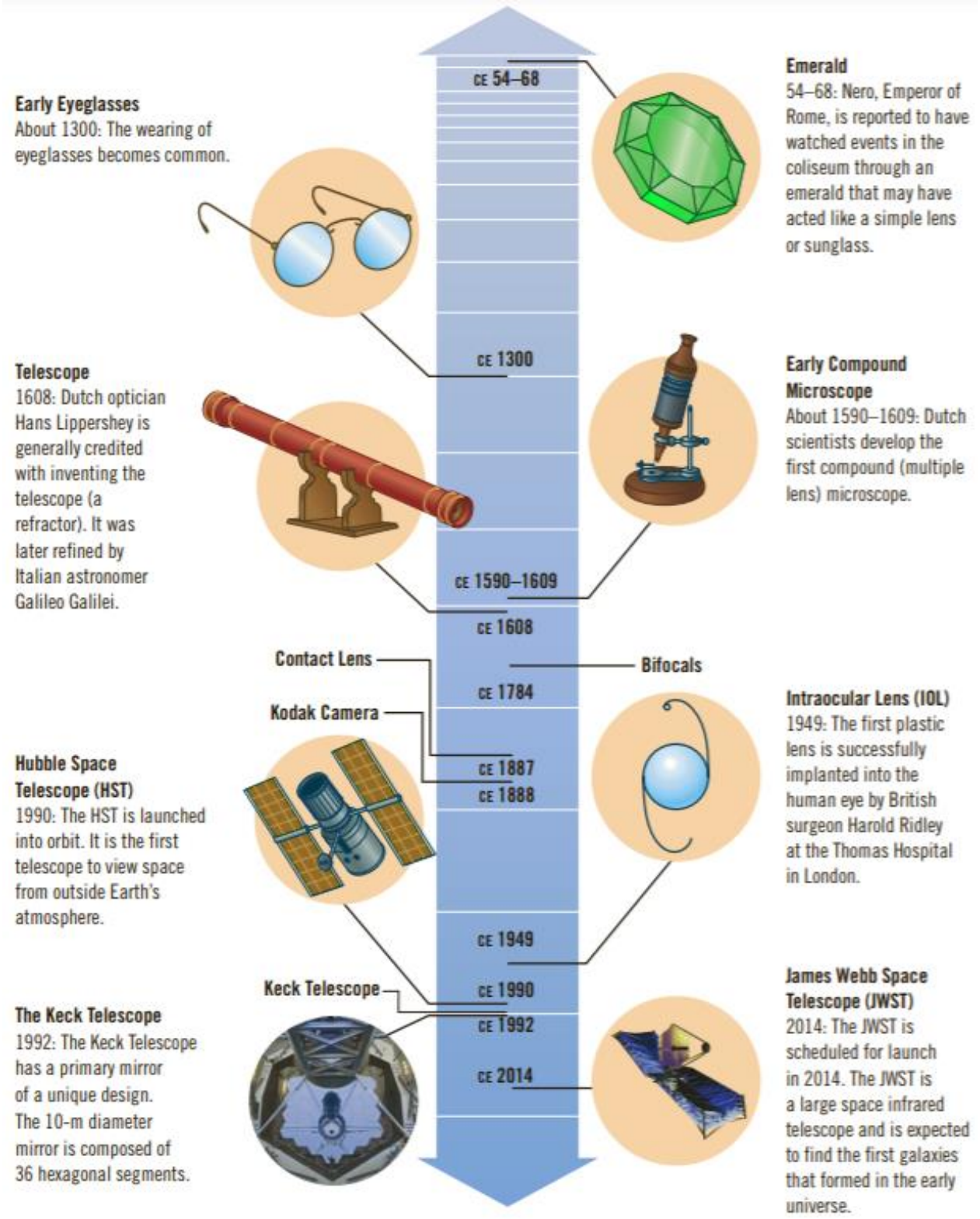
5. Explain two (2) causes of far-sightedness. What effect does this have on a person's vision? (2 marks)

6. Complete the following table comparing and contrasting dragonfly, deer, and human vision. (6 marks)

	Human	Deer	Dragonfly
# of Eyes			
Peripheral Vision			
Colors			
UV Light			

Common Optic Devices

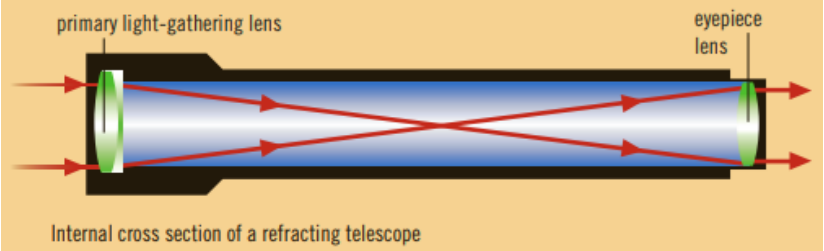
You now have an understanding of how light can be reflected using mirrors and refracted using lenses. However, lenses and mirrors can be used in combination to create optical instruments. Below is a time line of the development of optical instruments from the days of the Romans up to today.



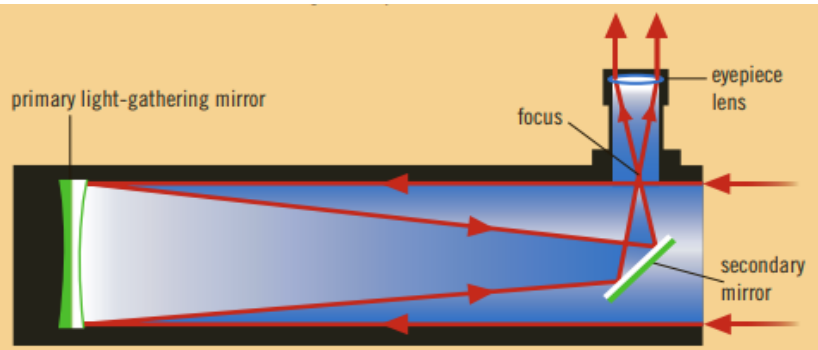
Telescopes

Telescopes also use lenses and mirrors. There are three types of telescopes: refracting telescopes, which use convex lenses to change the direction of light; reflecting telescopes, which use mirrors to collect light and reflect it to form an image; and telescopes that include parts of both reflecting and refracting telescopes. The world's largest telescopes are reflecting telescopes.

REFRACTING Telescope



Internal cross section of a refracting telescope



Internal cross section of a reflecting telescope

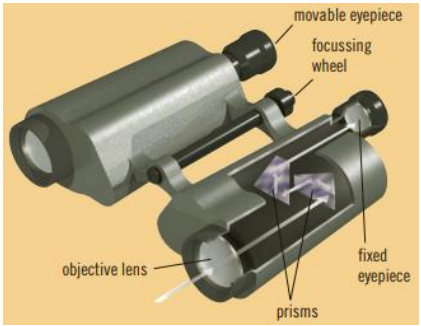
REFLECTING Telescope

The **objective lens** or **mirror** of a telescope gathers the light. The greater its diameter, the more light it can collect. More light means more information from a planet or star. The light forms an image, which can be magnified further by the **eyepiece** lens. In some telescopes, the image formed by the objective lens can be used to expose film or to activate a CCD matrix. As mentioned before in the discussion of a digital camera, this matrix contains a computer chip that turns the light into a digital signal.

Several factors can make it difficult to achieve a sharp image with a telescope, including the steadiness of the object and the alignment of the object and the telescope.

The stability of the optical system depends on:

- the clarity of the sky
- the balance of the telescope (must be able to stay in position)
- the ease with which the telescope can be adjusted



Although telescopes are useful for looking at the stars, they are not very easy to carry around. People who wish to look at other less distant objects often use binoculars. **Binoculars** are really two short refracting telescopes fixed together.

The Microscope

You see the greatest detail when you look at an object about 25 cm from your eye. If you need to see more detail, you use a microscope. **Microscopes** have at least two lenses—the objective lens and the eyepiece lens—as well as a light source. The light passing through the specimen is focused by the objective lens to form a magnified image. The eyepiece lens magnifies this image so that you see an even larger image. The most powerful light microscope can magnify up to 2000 times.

Progress Check: Common Optic Devices

____ /15 =____%

1. a) Which property of light do mirrors demonstrate? (1 mark)

   b) Which property of light do lenses demonstrate? (1 mark)

   c) How are mirrors and lenses useful in creating optical instruments? (2 marks)

2. You are a member of a group deciding where to build a new telescope. You have considered several locations listed below, each with at least one advantage. Which location will you recommend? Why? (2 marks)
   a) in the city center, close to the university and other schools
   b) near the local airport, convenient for visiting astronomers
   c) on the top of a tall mountain, where the atmosphere is thinner
   d) on an ocean-going vessel, so the telescope can be moved to different locations to view different parts of the sky

3. Brainstorm as many optical instruments as you can that use lenses and mirrors to control light. Choose one. Based on your experiences and observations, use a diagram to describe how the lenses and mirrors may be arranged in the instrument.
   Show how light is refracted or reflected and indicate the point of incidence, incident ray(s), and refracted or reflected rays. Show the direction of travel of light using arrows. (4 marks)

Name: _____ Date: _____ Class: _____

Sci8: OP3.2 Human Vision **Optic Devices**

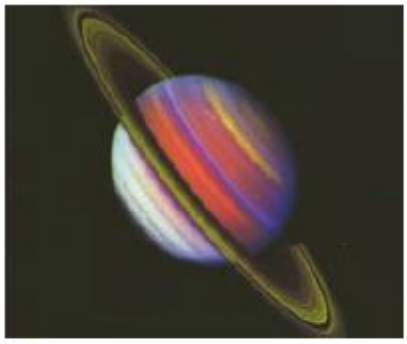
4. Matching: Which instrument was used to view each of the objects shown here? (5 marks)
   a) magnifying glass _____

   b) microscope _____

   c) telescope _____

   d) binoculars _____

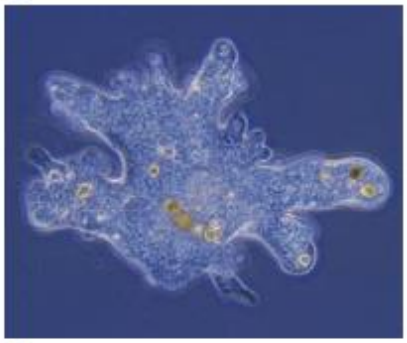
   e) unaided eye _____



A

B

C



D

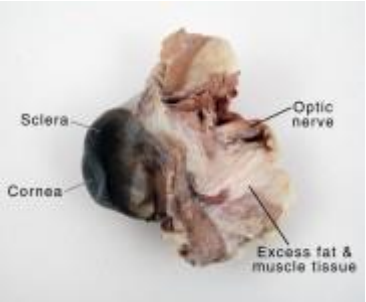
E

Cow Eye Dissection [(See Exploratorium's PDF for Full Guide)]

The human eye is one of the most complex and sophisticated organs in the body. Despite being small and extremely delicate, the eye allows us to see our world without any conscious effort on our part. The eye automatically adjusts its light sensitivity, allowing us to see both in starlight and the brightest sunlight. Its unique automatic focusing system outstrips that of any camera. While a camera lens must be moved back and forth to adjust for distance, the lens of the human eye simply changes shape. Each fragile part of the eye works together to provide information to the brain, and the brain interprets it instantaneously giving you a perfect image. It is an amazing process.

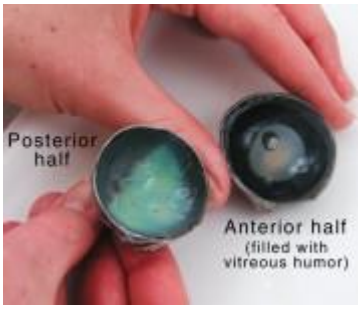
A cow eye is very similar to the eye of a human. By dissecting and examining the anatomy of a preserved cow eye, you can learn how your own eye forms images of the world and sends these images to your brain. This cow eye dissection guide is complete enough for a high school lab, or the pictures can be used to just get an idea of what the eye looks like inside.

Observation: External Anatomy



Look carefully at the preserved cow eye. The most noticeable part of the eye is the large mass of gray tissue that surrounds the posterior (back) of the eye and is attached to the sclera. The second most noticeable part of the eye is the cornea, located in the anterior (front) part of the eye. Due to the fact that the eye has been preserved, the cornea is cloudy and bluish-gray in color. It may also be wrinkly and seem a bit 'deflated'. On the posterior side of the eye, nestled in the fat and muscle tissue, there is a noticeably round protuberance that feels stiffer than the surrounding tissue. This is the optic nerve, and it sends the images collected in the eye to the brain.

Dissection: Internal Anatomy



1. Place the cow eye on a dissecting tray. The eye most likely has a thick covering of fat and muscle tissue. Carefully cut away the fat and the muscle. As you get closer to the actual eyeball, you may notice muscles that are attached directly to the sclera and along the optic nerve. These are the extrinsic muscles that allow a cow to move its eye up and down and from side to side. Keep cutting close to the sclera, separating the membrane that attaches the muscle to it. After removing the excess tissue, the sclera and optic nerve should be exposed but still intact.

2. Using a sharp scalpel, cut through the sclera around the middle of the eye so that one half will have the anterior features of the eye (the cornea, lens, iris, and ciliary body) and the other half will contain the posterior features (most noticeably where the optic nerve is attached to the eye). The inside of the eye cavity is filled with liquid. This is the vitreous humor. Depending on how the specimen was preserved, it will be either a dark liquid that will flow out easily, or a slightly gelatinous material that you can pour out to remove. (In a living eye, the vitreous humor is clear and gel-like.)

3. Flip the anterior half of the eye over so that the front of it is facing upward. Using a pair of sharp scissors, cut the cornea from the eye along the boundary where the cornea meets the sclera.

4. When the scissors have cut in far enough, a clear fluid will start to seep out – this is the aqueous humor. While cutting out the cornea, be careful to not accidentally cut the iris or the lens. After removing the cornea, pick it up and look through it. Although it is cloudy due to the degrading of the tissue, it is still fairly transparent. Notice the toughness and strength of the cornea. It is designed this way to protect the more delicate features found inside the eye.

5. With the front of the anterior half of the eye facing up, locate the iris. Notice how the iris is positioned so that it surrounds and overlaps the lens. This position allows the iris to open and close around the lens to allow different amounts of light into the eye. In bright light, the iris contracts to let in less light. In dim light, such as at night, the iris expands to let in more light.

6. Flip the anterior half over and examine the back half. Locate the lens and ciliary body. The ciliary body surrounds the lens, allowing it to change the shape of the lens to help the eye focus on the object it is viewing.

7. After examining both sides of the anterior half of the eye, pull the lens out. While the cow was alive, the lens was clear and very flexible. In a preserved cow eye, the lens will most likely have yellowed and become very hard. However, it may still be possible to look through the lens and see its ability to magnify objects. Try this by placing the lens on a piece of paper with writing on it.

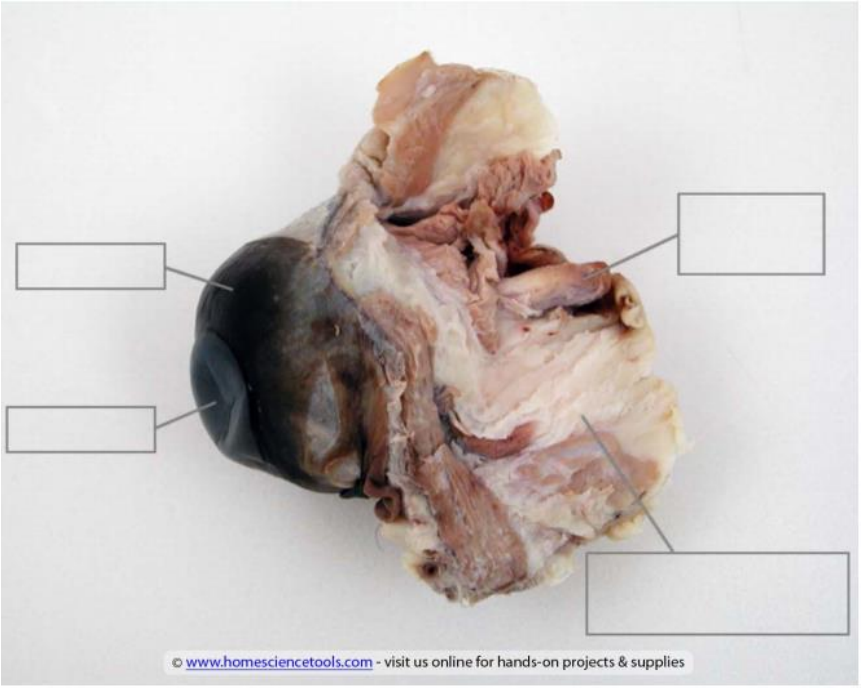
8. On the posterior half of the eye, there is a thin, tissue-like material that slides easily inside the sclera. This is the retina. The retina contains photoreceptor cells that collect the light entering the eye through the lens from the outside world. These images are sent to the optic disc, the spot where the optic nerve attaches to the eye. At this point, there are no photoreceptor cells; there are only nerves sending images to the brain. Because of this, this place in the eye is often referred to as the blind spot since no images can be formed here. To compensate for this blind spot, the other eye often sees the images that the first eye cannot see and vice versa. In the rare occasions where neither eye can see a particular spot, the brain 'fills in' the spot using the surrounding background information it receives from the eye. However, the 'filling in' of the blind spot is not always accurate. To see this in action, try some blind spot experiments.

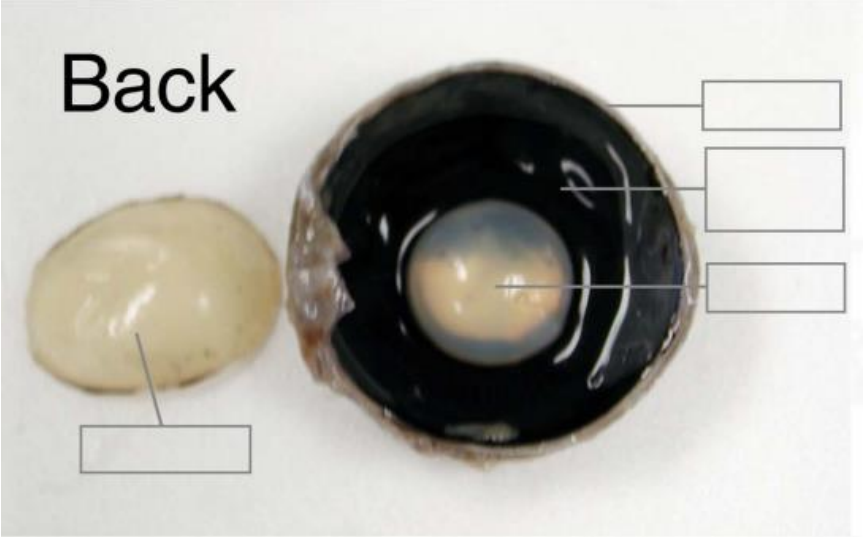
9. Most of the retina is not attached to the eye. Instead, it is held in place by fluids in the eye. The tissue of the retina gathers at the back of the eye where it forms into the optic nerve. This is the only place where the retina is attached to the eye. Use a pair of tweezers to gently lift the retina off the inside wall of the eye. The retina may tear because it is very delicate. Underneath the retina you will find a very shiny and colorful tissue. This is the choroid coat. The choroid coat is also known as the vascular tunic because it supplies the eye with blood and nutrients. In a human eye, the choroid coat is very darkly colored to minimize the reflection of light which would cause distorted images.

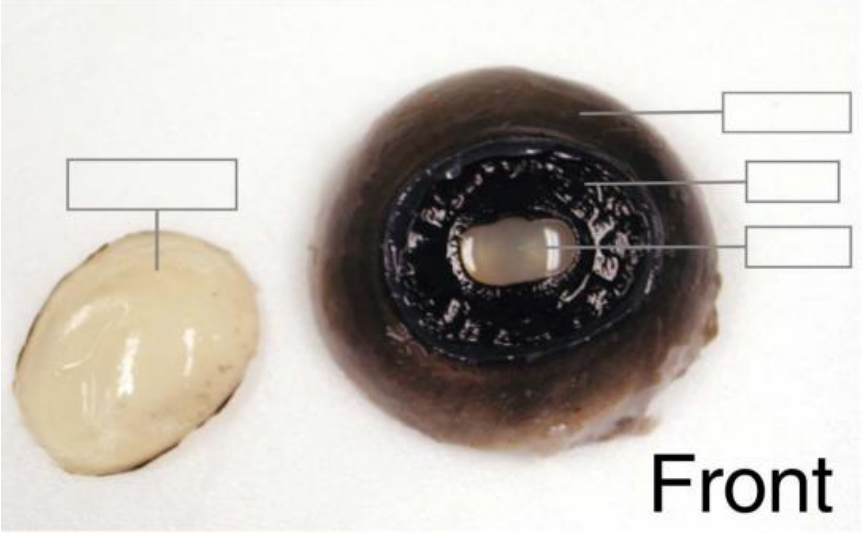
10. Notice that the choroid coat in the cow's eye is very colorful and shiny. This reflective material is the tapetum lucidum, and its reflective properties allow a cow to see at night by reflecting the light that is absorbed through the retina back into the retina. (While this does allow the cow to see better at night than humans can, it distorts the clarity of what the cow sees because the light is reflected so much.) The tapetum lucidum is also responsible for the 'glowing' eyes of animals, such as cats, when a small amount of light reflects off the tapetum lucidum in an otherwise dark room.

Miss Foley

Sci8: OP3.3 Human Vision **Eye Dissection**





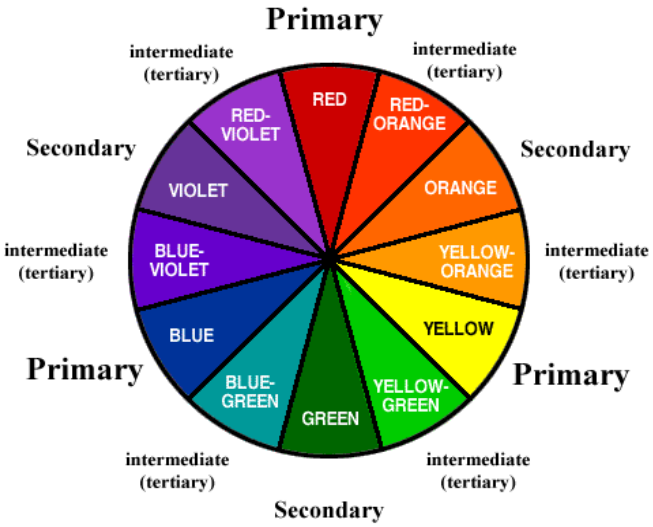


The Colour Spectrum

White light is the **<u>presence</u> of all visible light** wave lengths…ROYGBV

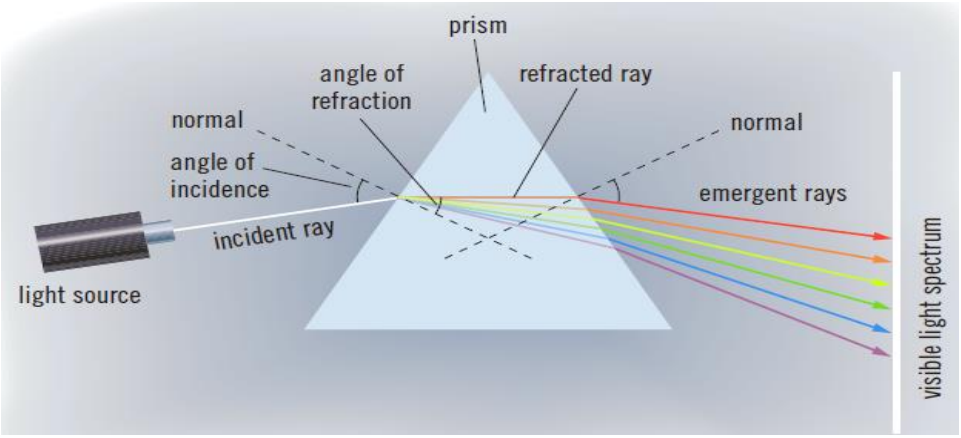
Black is the **<u>absence</u> of all visible light** wave lengths.

The human eye can see millions of colors. A color wheel is used to represent these possibilities. Colour wheels have infinite number of sections should you keep combining colors on the wheel.



When you use a **prism to refract a light ray, you are able to split light into its colours**. A rainbow is created in the same way. A **rainbow** is formed as sunlight changes direction as it enters single raindrops. Inside the raindrop, the coloured rays are bounced off the inside wall, which acts like a mirror and reflects the rays back out again. As the rays leave the raindrop and return to the air, they change direction again. The result is a band of colours across the sky.

The colours of light together form the **visible light spectrum** red, orange, yellow, green, blue, violet (**ROYGBV**). Every colour you see is a mixture of these colours.

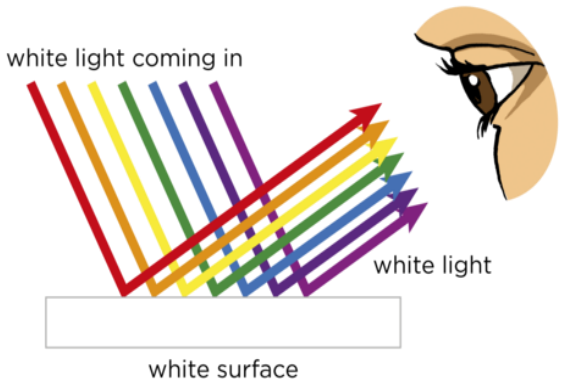


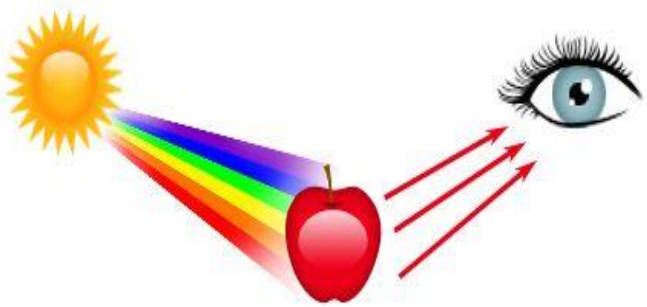
Colour

Seeing Colour in Our World

Did You Know? The technological breakthrough that led to colour television involved making a screen that contained tiny dots of colour. When these dots glow in different combinations, different colours appear on the screen.

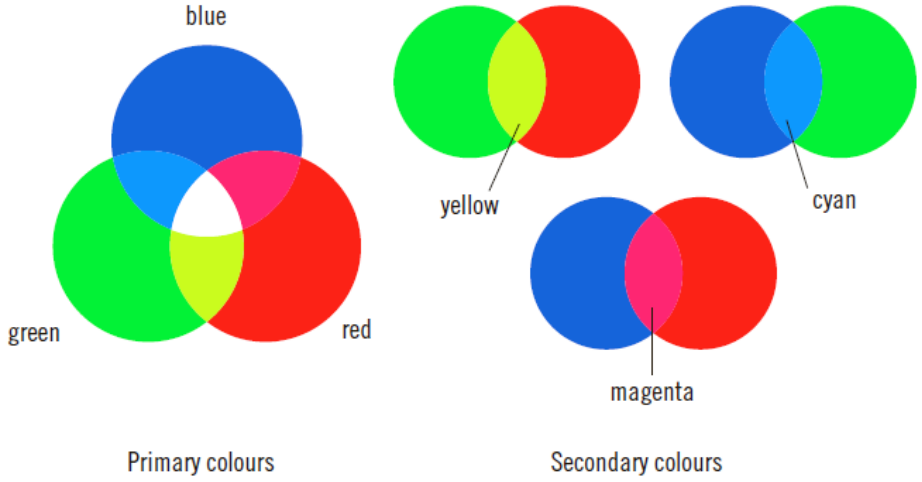
When we look at different objects we see different colours. For instance, an apple is red. If an object appears to be red then its surface is reflecting red light waves to your eye, and absorbing (subtracting) the other colours of visible light. White surfaces reflect ALL of the visible light waves (a.k.a. colours) into your eye.





The Addition Model of Colour =

when red, green, and blue lights are put together in various combinations, your eyes add these colours together and see an average, or secondary, colour



The **primary colours of light** are red, green, and blue. When you put all the primary colours of light together, you produce white light. **Secondary colours of light** are produced when you mix pairs of primary colours of light together. The secondary colours of light are yellow, cyan, and magenta. Yellow is produced by mixing green and red light.

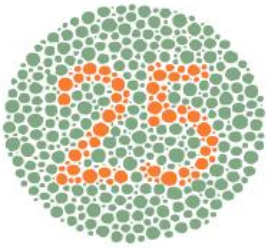
Miss Foley

Sci8: OP3.4 Human Vision p.143-149

Colour

Recall that the retina is the lining at the back of your eye that reacts to light. The retina itself is made up of specialized cells. Some of these cells are called **cones**. There are three types of cones, each sensitive to different ranges of colour**: red, green, and blue**. When light hits the cones they get excited, these excited cones send messages to your brain. The colour that you see depends on the type and number of cones responding to the light entering your eye.

Some people do not see all colours. The cone cells within the eye may be defective causing a condition known as **colour blindness.**



People who are green and yellow colour-blind will not see the number "25."

People who are red and green colour-blind will not see the number "5."

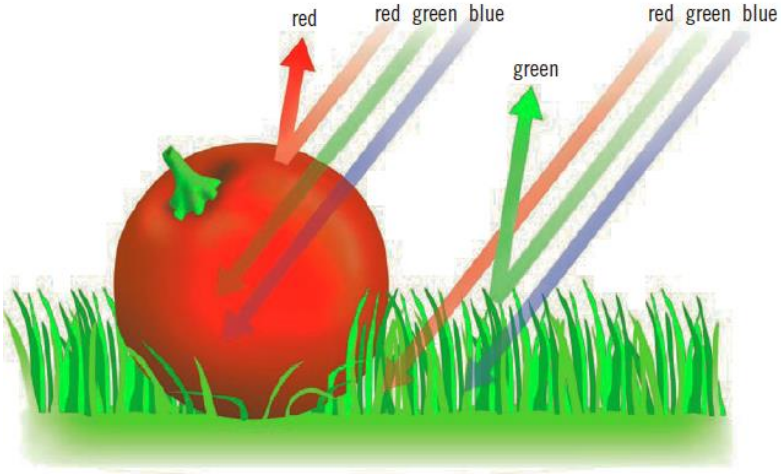
The Subtraction Model of Colour =

each primary colour of pigment absorbs (subtracts) one of the primary colours of light and while reflecting the others

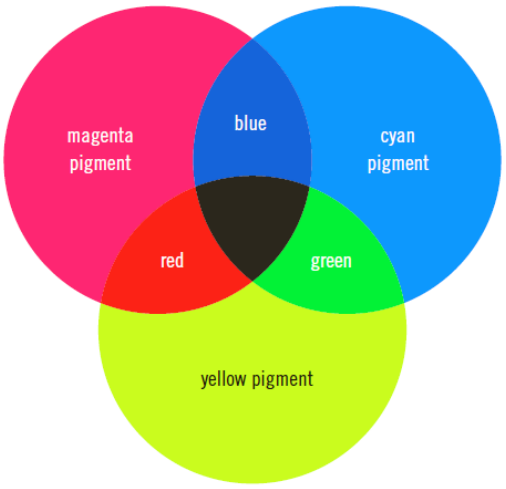
A filter lets some parts through and keeps other parts out. A coffee filter lets water and the flavor of coffee pass into a pot, while keeping out the coffee grains. Coloured sunglasses are like filters that act to take out, or subtract, some part of light.

Recall that the primary colours of light are red, blue, and green. If an object appears red, then its surface is reflecting red to your eye, while absorbing (subtracting) the other two primary colours, blue and green.

The primary colours in pigments (substances used as colouring) are different than those found in the natural world. They use the colours of magenta, cyan, and yellow. When light shines on these colours the pigments act the same way as a coloured filter works by filtering out one or more of the primary colors.



The subtraction model of colour helps explain why objects are coloured. Pigments in objects absorb (subtract) certain colours and reflect others. You see a tomato as red because the chemicals in the tomato's skin absorb all the colours except for red. Only the red light is reflected to your eyes. Green grass absorbs all light except green, which is reflected. Special lights for growing plants look reddish. Why wouldn't they be coloured green?



Notice what is happening when the secondary colours are mixed together. Magenta pigments absorb green light and reflect a mix of red and blue light; cyan pigments absorb red light and reflect a mix of green and blue light; yellow pigments absorb blue light and reflect a mix of red and green light.

Chinook

Progress Check: Colour

____ /15 =____%

1. What colours are produced when white light is shone through a prism? (1 mark)

2. What do you think would happen if light of one colour, such as red, was shone through a prism? Explain your answer. (1 mark)

3. Imagine you have a choice of using any combination of red, green, or blue spotlights to decorate the front of your home for the holidays. Predict what would happen if you shone each of these combinations against a white wall. (2 marks)

   a) red and green

   b) red and blue

   c) green and blue

   d) all three colours combined

4. Explain why you can see a rainbow. Do you think it is possible to reach the end of a rainbow? Why or why not? (2 marks)

5. What are the primary colours of light? (1 mark)

6. What are the secondary colours of light? (1 mark)

Name: _____ Date: _____ Class: _____

Sci8: OP3.4 Human Vision **Colour**

7. a) How does the eye detect colour? Explain, using the addition model of colour. (2 marks)

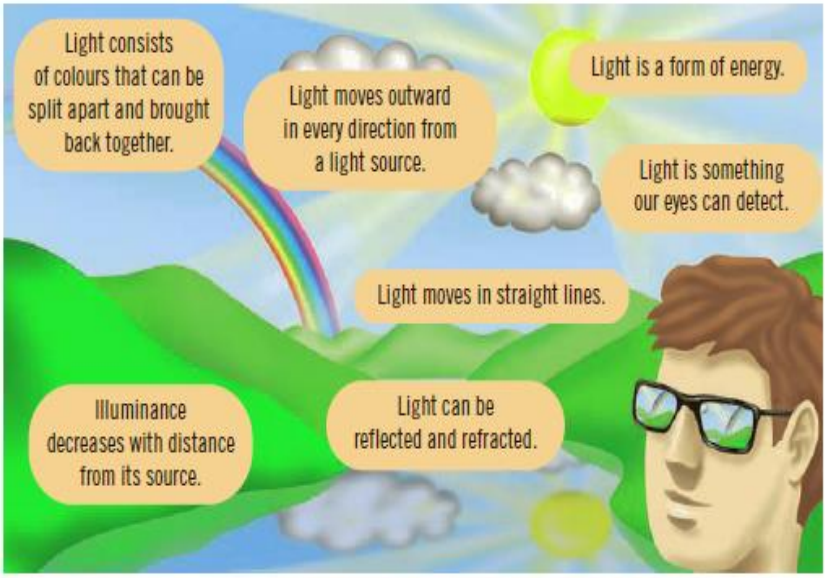
   b) How does a painting show a colour image? Explain, using the subtraction model of colour. (2 marks)

8. Imagine you are an actor in a horror film. Your costume calls for scary, red contact lenses to change the colour of your eyes. When you examine the lenses, you see that they are clear in the center, with only a ring of red colour. Why do you think this is so? What would you see if the contacts were completely red? Completely yellow? Explain, using the subtraction model of colour. (3 marks)

The Wave Model of Light

The term used to refer to all forms of radiant energy is **electromagnetic radiation**. The **electromagnetic spectrum** includes visible light, as well as other waves, such as infrared radiation, ultraviolet radiation, radio waves, and X-rays. Like any scientific model, the wave light model provides explanations for many aspects of observed phenomena. This model assumes that light shows the properties of waves.

Properties of Light Reviewed



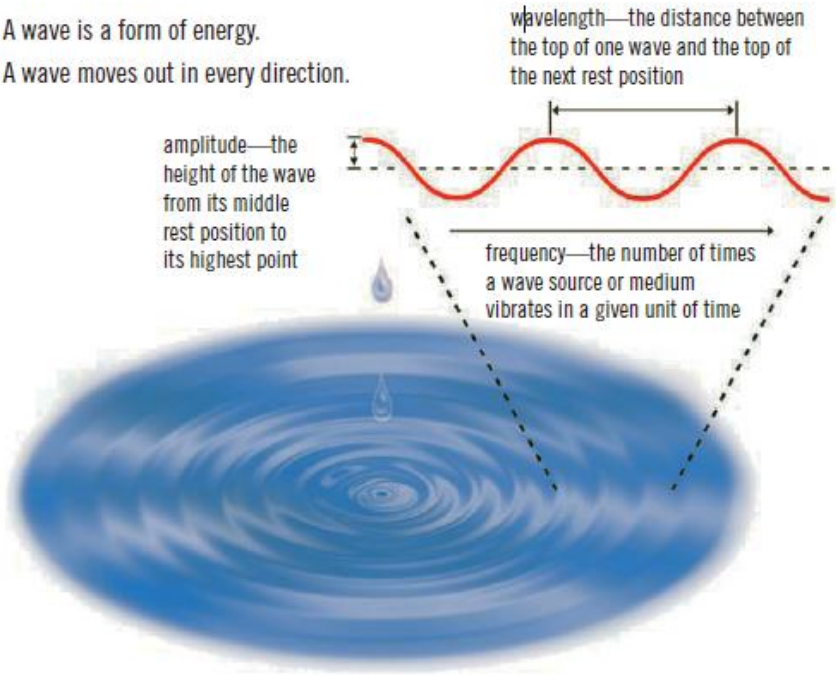
The properties of light

Laser Light…Did You Know?

Lasers produce a fine beam of light that travels long distances without spreading out. Laser light is made of waves that have exactly the same wavelength, and each wave is in step with the next. The beam concentrates light energy into a small spot so that lasers can be used to cut metals and perform delicate eye surgery, as well as provide an input module for many electronic devices. (The term "laser" is an acronym for Light Amplification by the Stimulated Emission of Radiation.) Arthur Schawlow (1921–99), who was educated in Toronto, received the Nobel Prize in Physics as its co-inventor.

The Properties of a Wave

- A wave is a form of energy.
- A wave moves out in every direction.



Wave Length =

distance between the top of one wave to the top of the next rest position

Amplitude =

height of the wave from its middle rest position to its highest point

Frequency =

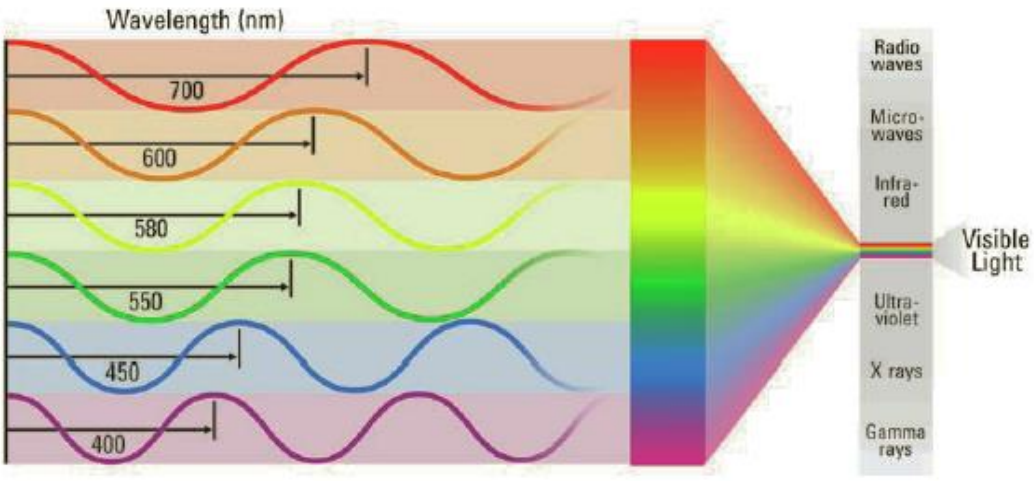
number of times a wave cycles/ vibrates in a given time

Miss Foley

Sci8: OP4.1 Electromagnetic p.150-159 **The Spectrum**

Electromagnetic Radiation: The VISIBLE Spectrum

The visible spectrum extends from red light at one end to violet light at the other. The wavelength is not the same for different colours of the spectrum. It ranges from 700 nm (nanometre, 1 nm = 0.000 000 001 m) for red light to 400 nm for violet light. You can see that some of the light waves are short and some are longer.

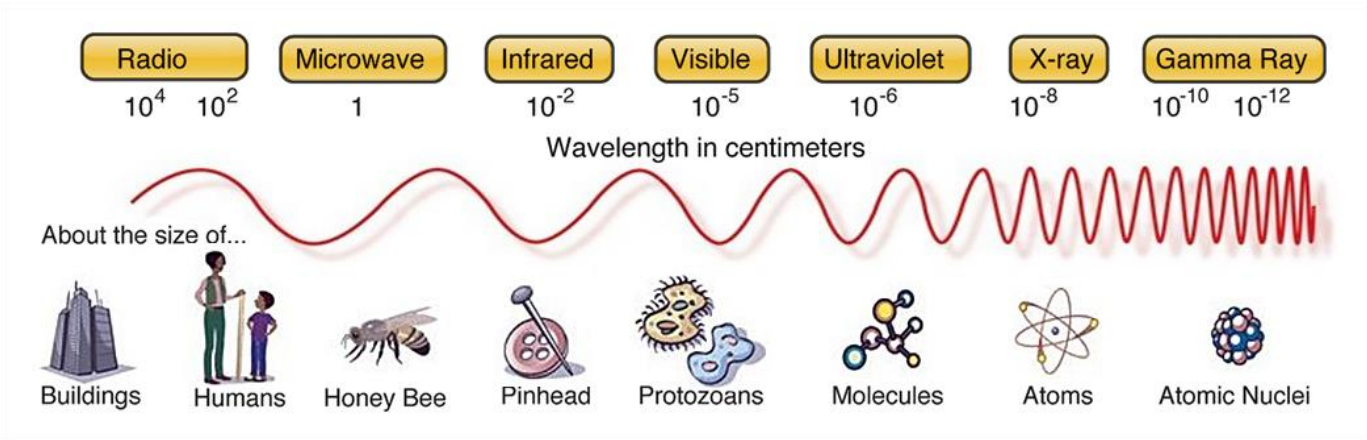


The visible spectrum is a part of the electromagnetic spectrum.

Electromagnetic Radiation: The INVISIBLE Spectrum

The electromagnetic radiation spectrum includes visible light, as well as other waves, such as infrared radiation, ultraviolet radiation, radio waves, and X rays. The wave model of light is used to explain all electromagnetic radiation. The movement of waves in straight lines is called **rectilinear propagation**. Just as each colour has its own wavelength, so does each of the invisible components of the electromagnetic spectrum. However, you see only visible light. Your eyes are sensitive to the wavelengths from red to violet. You cannot see the other waves because your eyes are not sensitive to their wavelengths. Although the human eye cannot detect the invisible parts of the electromagnetic spectrum, we have found ways to use the energy they contain. As you examine the uses of the various parts of the spectrum, note which parts have more energy.

shorter wavelengths = higher wave frequency = carry more energy



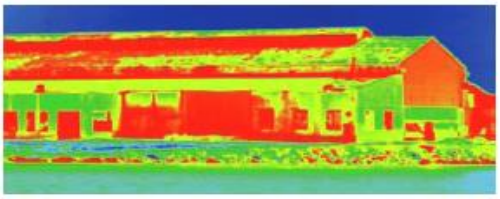
Electromagnetic Technologies

The technological breakthrough that led to colour television involved making a screen that contained tiny dots of colour. When these dots glow in different combinations, different colours

Radio waves are used in communications around the world. International agreements assign certain frequencies to different uses, including AM/FM radio, television, cellular phones, short-wave radio, and radar. With AM radio waves, the amplitude of the signal is varied. With FM radio waves, the frequency of the signal is varied.

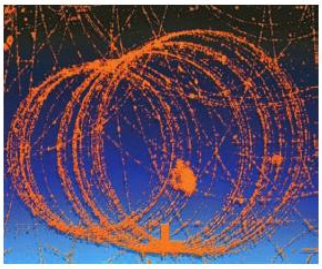
Microwaves have a shorter wavelength than radio waves. They also carry more energy. When focused on food, they cause the particles inside the food to vibrate. This vibration produces heat, so the food cooks from the inside out.

Infrared waves are longer than visible light and so have less energy. You can detect infrared waves as heat on your skin. South-facing windows and skylights allow infrared radiation to help heat homes. Devices that detect infrared radiation are used to locate sources of heat.



Ultraviolet (UV) waves have short wavelengths with more energy than visible light. Most ultraviolet radiation is absorbed by Earth's ozone layer. Ultraviolet waves can penetrate and harm the skin, causing tanning and burning, and increasing the risk of skin cancer. Sunblock creams are opaque and block ultraviolet rays. Sunglasses with UV filtering protect the eyes from damage. There is evidence that daily exposure to UV radiation increases the risk of developing cataracts.

X rays and **Gamma rays** have very short wavelengths and carry a large amount of energy. Even low-energy X rays can penetrate soft tissues, although they cannot pass easily through bone. High energy X rays and gamma rays can pass easily through soft tissues and bones, but cannot penetrate lead 5 cm thick. X rays can be used to make images of the interior of the body, because they will be slowed down by very dense tissues such as bone. Gamma rays and high-energy X rays are used to destroy cancer cells.



Gamma ray trails in a cloud chamber.

Fractures and other medical conditions can be shown by X-ray technology.

Electromagnetic Fields (EMF)

Absolute Safe Levels Have Not Been Established…
However, current research as of 2020 states
no problems associated with staying BELOW:

Radio/Microwave Frequencies: Cell Phones, WiFi Routers, Microwave Ovens, Radio/TV)

RF Field Measurement – **0.200 mW/m²**
RF Peak Measurement – **1.000mW/m²**

Magnetic Fields: Power Lines, Appliances, Wiring in Walls, Motors

Standard Magnetic – **3 mG**
Weighted Magnetic – **5 mG**

Electric Fields: Fluorescent Lights, Wall Outlets & Wiring, Electrical Switches

Standard OR Weighted Electric – 50 V/m

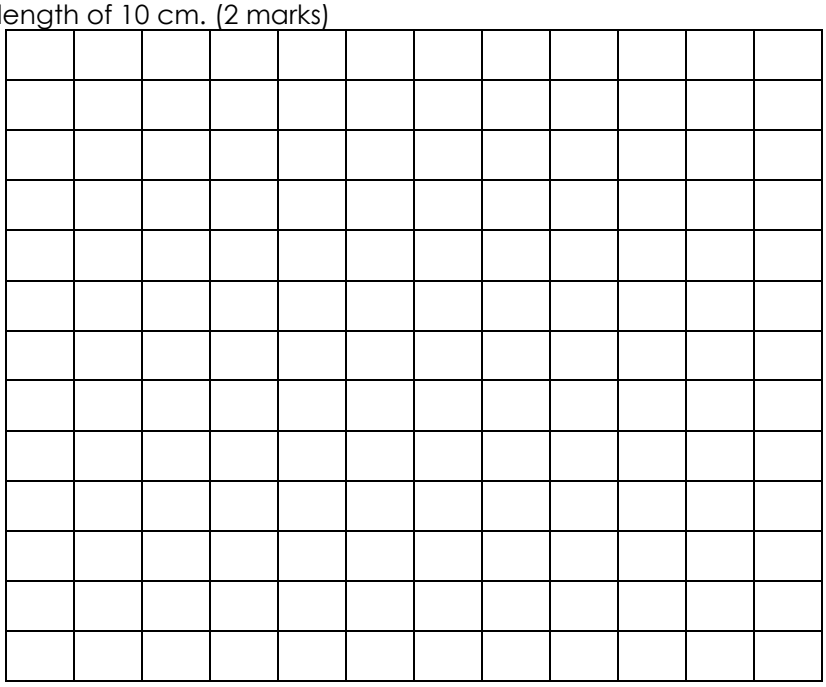
Name: _____ Date: _____ Class: _____

Sci8: OP4.1 Electromagnetic **Electromagnetic Spectrum**

Progress Check: Electromagnetic Spectrum

____ /20 =____%

1. Draw a diagram of a wave on the grid below. Your wave should have amplitude of 4 cm and a wavelength of 10 cm. (2 marks)



2. Compare X rays to radio waves and visible light waves to radio waves. How are they different? (2 marks)

3. How do sunscreen lotions protect your skin from the Sun's rays? Which part of the electromagnetic spectrum can cause skin damage? (2 marks)

4. Why do you think X rays and gamma rays are used to treat cancer? (1 mark)

Name: _____ Date: _____ Class: _____

Sci8: OP4.1 Electromagnetic **Electromagnetic Spectrum**

5. Briefly describe three positive effects and three negative effects of wireless technologies. (3 marks)

6. Explain similarities between the wave model and actual observations of light-related phenomena. (1 mark)

7. The electromagnetic spectrum ranges from low-energy to high-energy waves. Which of the following would you expect in a high-energy wave? Which would indicate a lower-energy wave? Provide examples to support your answers. (2 marks)
   a) a long wavelength

   b) a short wavelength

8. a) Where does infrared radiation appear on the electromagnetic spectrum? (1 mark)

   b) Can you detect infrared radiation with your body? If so, how? (1 mark)

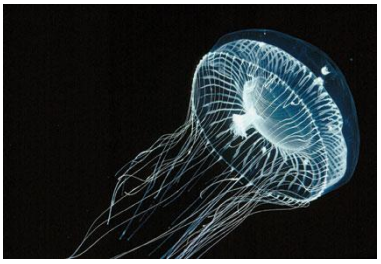
   c) What is the importance of infrared radiation to you? (1 mark)

   d) Provide answers to parts a)–c) for ultraviolet radiation. (4 marks)

Natural Sources of Light

During the day, our primary natural source of light is from the Sun. Most forms of electromagnetic radiation are produced in space by the Sun and other stars, also giving us starlight, moonlight and bioluminescence.

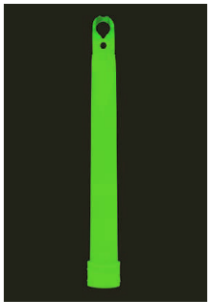
Bioluminescence = producing light due to a <u>naturally</u> occurring chemical reaction



The phenomenon of **bioluminescence** happens when a naturally occurring chemical reaction (see chemiluminescence below) takes place within a living organism and results in the emission of light. Fireflies and glow-worms (their larvae) use a complex reaction to make their tails glow. Other organisms such as shrimp, squid, and starfish use bioluminescence for communication. Some forms of fungi that cause wood decay glow at night. This creates the eerie nighttime phenomenon known as *foxfire*. Bioluminescence is a naturally occurring source of light.

Artificial Sources of Light

All types of electromagnetic radiation can be artificially produced. You are most familiar with devices used to produce visible light. Imagine the moment when your ancestors first used firelight to push away the darkness. Think about all that you do at night or indoors that you could not do without light.



The mixture of two liquids inside the stick causes a reaction that produces light.

Chemiluminescence = producing light due to a chemical reaction

Items that glow in the dark (produce light) due to a chemical reaction are described as **chemiluminescent**. When a **glow stick** is bent, the two liquids inside the stick mix, resulting in a chemical reaction. This chemical reaction causes the stick to glow for several hours until the chemical energy is depleted. In crime scene investigations, blood is detected from a **luminol test**. Luminol glows blue when it chemically reacts with iron in the blood.

Phosphorescence = absorbing & storing light energy released later as a form of light

Have you ever wondered why some stickers or plastic shapes glow in the dark? These items when exposed to light absorb it and then glow. **Phosphorescent** materials absorb light energy, store it for long periods of time, and then release it as a form of light. Other items that use phosphorescence are photographic-darkroom timers and wristwatch dials. Fluorescent sources and phosphorescent sources are similar; they absorb light, store it, and release it. The difference between the two is that fluorescent sources immediately release their light energy while phosphorescent sources take longer to emit the light.

Electroluminescence – light emitted by passing electricity through a semiconductor material

Light-emitting diodes (LEDs) and **organic light-emitting diodes (OLEDs)** are technologies that are applications of electroluminescence. Many wristwatches use electroluminescence to turn on a backlight. This produces a blue or green glow, allowing the numbers to be seen in the night.

OLED vs. LCD?

Liquid crystal displays (LCDs) are used every day to display information electronically on computer monitors, television screens, and instrument panels. However, the OLED may become the next trend for consumer TVs. An **OLED** is a source of electroluminescence in which the light **emitting layer is an organic compound**. Many other applications of the OLED technology exist: mobile telephones, laptop and stereo displays, car navigation systems, and billboards. Some of the advantages of this technology over traditional LCD screens are:

- simpler and cheaper manufacturing process
- thinner screens (less than 1 mm thick)
- high contrast and brightness (can see the screen with direct sunlight on it)
- high response speeds and wide viewing angles

Common Lighting Devices

What types of devices are used today to make light? If you look around classrooms, you will probably see either incandescent or fluorescent lights. An **incandescent light bulb** uses electrical energy to heat a thin wire thread, called a *filament*. Because the filament is too thin to carry the electricity easily, it overheats and glows white-hot. You see this glow of the white-hot filament as light. **Compact fluorescent lamps** contain an opaque tube that is coated on the inside with a fluorescent material. The tube is filled with argon gas and a small amount of mercury vapour. When you turn on the electricity, UV light is produced in the tube. When the UV light hits the fluorescent material, the UV waves are absorbed. The material then releases the absorbed energy as visible light.

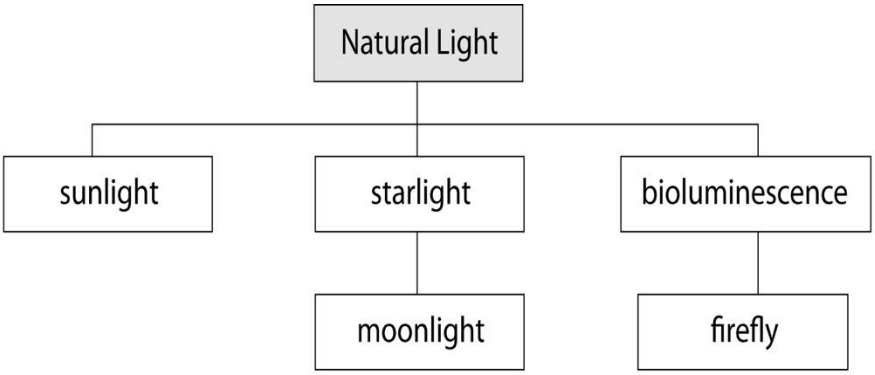

LED lights in a cluster

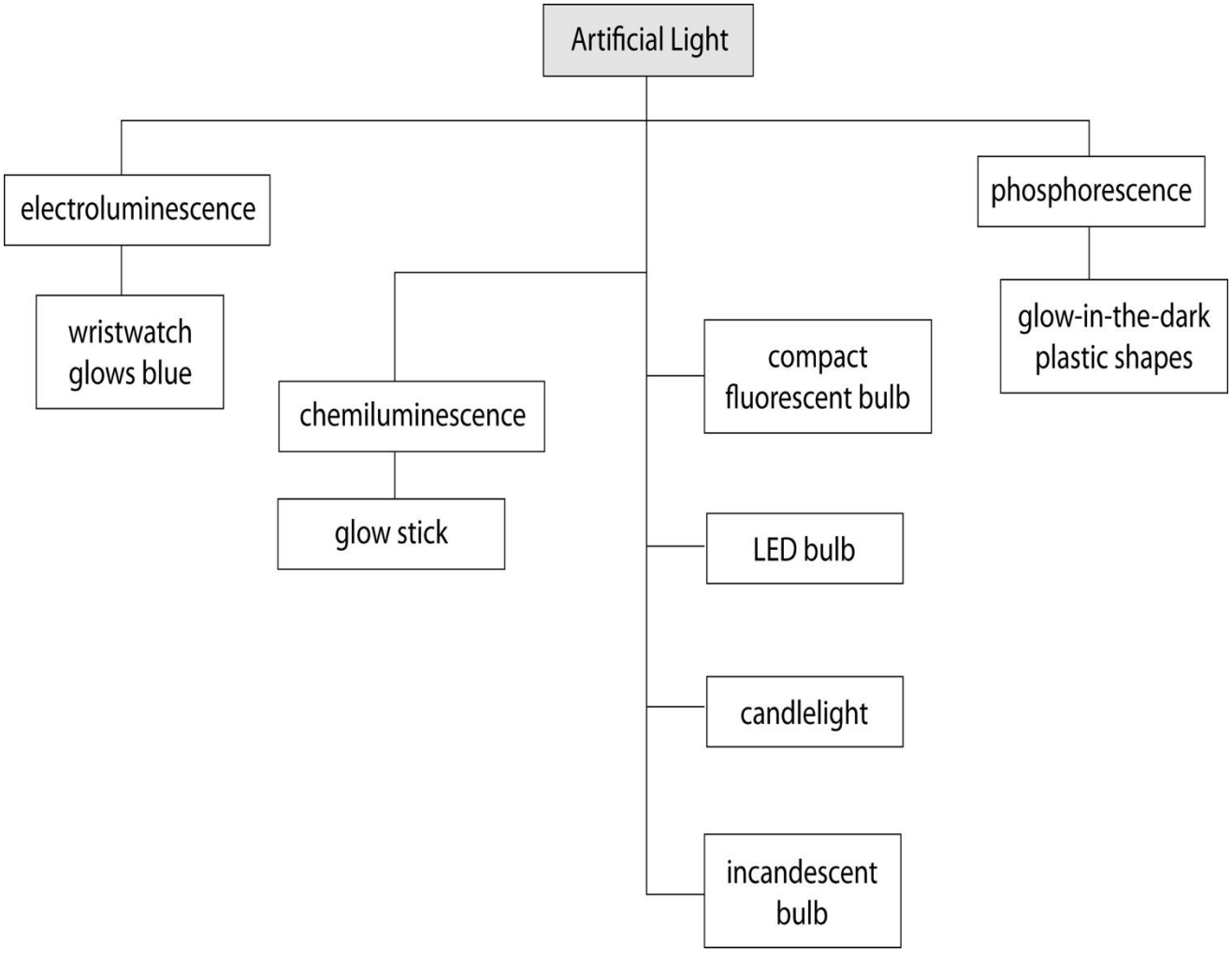

A compact fluorescent lamp


An incandescent light bulb

Another important new form of lighting is the **light-emitting diode (LED)**. LEDs do not have a filament the way an incandescent bulb does. Electrons which are tiny negatively-charged particles, move through a semiconductor material and emit light. LEDs are commonly found in electronic devices. The LED is now being made into clusters of up to 180 individual LEDs to make a light bulb. The clusters of LEDs are encased in a diffuser lens, which disperses the light in wider beams.

Overview: Sources of Light





Light Sources

Name: _____ Date: _____ Class: _____

Sci8: OP4.2 Electromagnetic **Light Sources**

Progress Check: Light Sources

____ /10 =____%

1. List four light sources and identify whether they are natural or artificial. Describe briefly how each source produces light. (2 marks)

2. Here are two approaches used by the makers of detergents. Explain how each approach uses light to make a white T-shirt look whiter. (2 marks)
   a) Some detergents contain fluorescent materials.

   b) Some detergents contain blue pigment (think back to the subtraction model of colour).

3. Think about where you like to sit and read. What light source are you using? What, if anything, would you change about this light if you could? (2 marks)

4. How is light being used in this doctor's office? Name as many ways as you can. Add to your list any other ways you can think of in which light plays a role in medicine. (2 marks)

5. Which source would give the greatest amount of light: a 100-W incandescent bulb or a 23-W compact fluorescent bulb? Explain your answer. (2 marks)

Light Sources

Miss Foley

Sci8: OP Optics & Vision **Review**

REMINDER: This is a guideline, not a copy of the questions on the test. It is to be used to help guide studying. All of the material from the unit is fair game for the test, even if it is not included on this study guide. It is your responsibility to study ALL of the material provided in your notes.

Key Terms:

Knowing and being able to explain / describe the following terms and concepts will be beneficial for the test. Many of these terms (but not limited to these) will be on the test.

transparent	opaque	reflection	umbra
penumbra	specular reflection	diffuse reflection	real image
virtual image	incidence	refraction	concave
convex	visible light spectrum	electromagnetic radiation	wavelength
ray	properties light	illuminance	lenses
retina	aperture	diaphragm	pupil
CCD matrix	iris	myopia	hyperopia
addition model of colour	subtraction model of colour	amplitude	frequency
bioluminescence	chemiluminescence	phosphorescence	OLED
electroluminescence	CFL	LCD	ray diagram
shadow	law of reflection	law of refraction	focal point
primary colours of light	secondary colours of light	cones	rods

Foundational Questions to Consider When Studying:

1. How is a shadow created?
2. What are the different parts of a shadow? Describe them.
3. What are the three types of materials light can hit?
4. What is illuminance?
5. How is illuminance affected by distance?
6. What is light pollution?
7. What are some ways to combat light pollution?
8. What is the law of reflection?

9. Draw a diagram showing the different aspects of the law of reflection including the incident ray, reflected ray, angle of incidence, angle of reflection, and mirror.

10. What is the difference between specular and diffuse reflection?

11. What is refraction?

12. Add on to your law of reflection diagram adding in a refracted ray, angle of refraction.

13. What is the difference between a concave and convex lens?

14. How does light pass through a concave lens?

15. How does light pass through a convex lens?

16. List and describe all the different parts of the eye? What is the function of each part of the eye?

17. What are the different parts of the camera?

18. Compare the different parts of the camera with the different parts of the eye.

19. What are the different colours of the visible light spectrum?

20. What are the three primary colours of light?

21. What are the secondary colours of light?

22. What is the addition model of colour?

23. How is a rainbow created?

24. Describe the subtraction model of colour?

25. What are the seven properties of light we have learnt about?

26. What are the three main parts of a wave? Describe them.

27. List the visible colour spectrum from shortest wavelength to longest wavelength.

28. What type of light has a wavelength just longer than red light?

29. What type of light has a wavelength just shorter than violet light?

30. What is bioluminescence?

31. What are the three types of artificial light sources? Describe each one.