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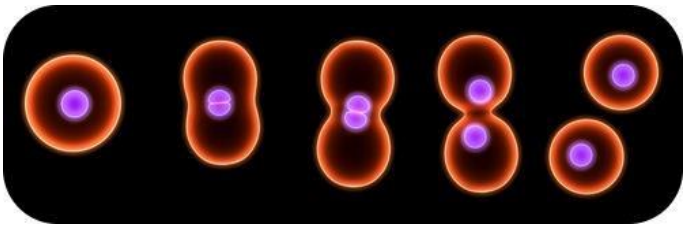
Task 1: Cell Cycles and Hepatitis B



Where do cells come from?

No matter what the cell, all cells come from pre-existing cells through the process of cell division. The cell may be the simplest bacterium or a complex muscle, bone, or blood cell. The cell may comprise the whole organism, or be just one cell of trillions.

Cell Division

Cell division is part of the life cycle of virtually all cells. Cell division is the process in which one cell divides to form two new cells. You consist of a great many cells, but like all other organisms, you started life as a single cell. How did you develop from a single cell into an organism with trillions of cells? The answer is cell division. After cells grow to their maximum size, they divide into two new cells. These new cells are small at first, but they grow quickly and eventually divide and produce more new cells. This process keeps repeating in a continuous cycle.

Cell division is the process in which one cell, called the **parent cell**, divides to form two new cells, referred to as **daughter cells**.

Cells need to duplicate. There are two main methods of replication, mitosis and meiosis. The big idea to remember is that mitosis is the simple duplication of a cell and all of its parts. It duplicates its DNA and the two new cells (daughter cells) have the same pieces and genetic code.

1. The first step is **mitosis**, a multi-phase process in which the nucleus of the cell divides.
   During mitosis, the nuclear membrane breaks down and later reforms. The chromosomes are also sorted and separated to ensure that each daughter cell receives a diploid number (2 sets) of chromosomes. In humans, that number of chromosomes is 46 (23 pairs).During cell division, the DNA is packed very tight into chromosomes so all the chromosomes are able to duplicate when divided into 2 cells.
2. The second major step is cytokinesis. The cytoplasm must divide. Cytokinesis is the division of the cytoplasm in eukaryotic cells, resulting in two genetically identical daughter cells.

[1] adopted from CK12.org

What is a cell's life like?

The eukaryotic cell spends most of its "life" in interphase of the cell cycle, which can be subdivided into the three phases, G1, S and G2. During interphase, the cell does what it is supposed to do
i.e. the cell grows, performs routine life processes, and prepares to divide.

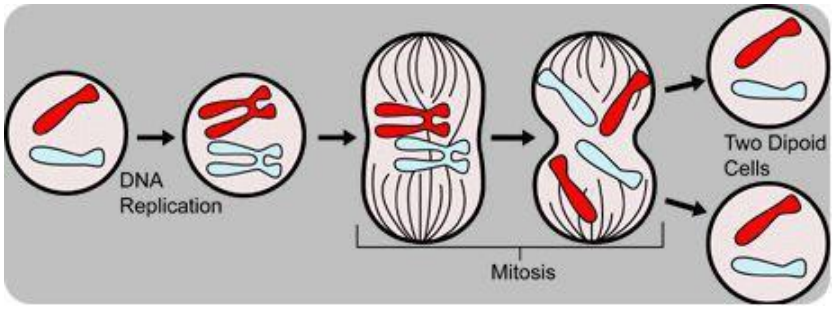
Though cells have many common functions, such as DNA replication, they also have certain specific functions. That is, during the life of a heart cell, the cell would obviously perform certain different activities than a kidney cell or a liver cell. The length of a cell cycle depends on
the function of the cell. The skin cell, for instance, has the shortest life span. It lasts on average for 28 days. Red blood cells live for about four months, while white blood cells live on average more than a year. The brain cell has the longest life span i.e. some of them stay for a lifetime.

The Cell Cycle

Cell division is just one of several stages that a cell goes through during its lifetime. The **cell cycle** is a repeating series of events that include growth, DNA synthesis, and cell division. The cell cycle in prokaryotes is quite simple: the cell grows, its DNA replicates, and the cell divides. In eukaryotes, the cell cycle is more complicated.

Mitosis

Mitosis is the division of the nucleus into two genetically **identical nuclei**. This type of reproduction is called **asexual** reproduction because it is one parent cell that is production 2 daughter cells. The purpose of mitosis is to reproduce new cells, while the purpose of Interphase is for growth. The cell enters mitosis as it approaches its size limitations. Four distinct phases of mitosis have been recognized: *prophase, metaphase, anaphase, and telophase,* with each phase merging into the next one (**Figure** below).



During mitosis, the nucleus divides, paving the way for two cells to be produced after cell division, each with a complete makeup of genetic material. [Figure1]

Prophase is the first and longest phase of mitosis. During prophase, the DNA coils up into visible chromosomes, each made up of two sister chromatids held together by the centromere. The nucleus disappears as the nuclear envelope and nucleolus break apart.

During metaphase the spindle attaches to the centromere of each chromosome. Helped by the spindle, the chromosomes line up at the center, or equator, of the cell, also known as the metaphase plate. Each sister chromatid is attached to a separate spindle fiber, with one fiber extending to one pole, and the other fiber extending to the other pole. This ensures that the sister chromatids separate and end up in distinct cells after cell division.

Anaphase is the phase in which the sister chromatids separate. The sister chromatids are pulled apart by the shortening of the microtubules of the spindles, similar to the reeling in of a fish by the shortening of the fishing line. At the end of anaphase, each pole of the cell has a complete set of chromosomes, identical to the amount of DNA at the beginning of G_1 of the cell cycle.

Telophase is essentially the opposite of prophase. The chromosomes begin to unwind in preparation to direct the cell's metabolic activities. The spindle begins to break down, allowing a new nucleus to form. This is followed by cytokinesis, the division of the cytoplasm, resulting in two genetically identical cells, ready to enter G_1 of the next cell cycle.

Vocabulary

cell cycle
A repeating series of events, during which the eukaryotic cell carries out its necessary functions, including metabolism, cellular growth, and division, resulting in two genetically identical daughter cells.

cell division
Process of cell formation from the division of older cells.

chromosome
Coiled structure of DNA and histone proteins; allows for the precise separation of replicated DNA; forms during prophase of mitosis and meiosis.

gene
A segment of DNA that contains the information necessary to encode an RNA molecule or a protein.

mitosis
The division of the nucleus into two genetically identical nuclei. This type of reproduction is asexual reproduction.

Hepatitis B

(adopted from: www.who.int and www.liver.ca)

Key facts

- Hepatitis B is a viral infection that attacks the liver and can cause both acute and chronic disease.
- The virus is transmitted through contact with the blood or other body fluids of an infected person.
- About 600 000 people die every year due to the consequences of hepatitis B.
- Hepatitis B is an important occupational hazard for health workers.
- Hepatitis B is contagious. Hepatitis B is preventable with the currently available safe and effective vaccine.
- Hepatitis B is a potentially life-threatening liver infection caused by the hepatitis B virus. It is a major global health problem. It can cause chronic liver disease and chronic infection and puts people at high risk of death from cirrhosis of the liver and liver cancer.

More than 240 million people have chronic (long-term) liver infections. About 600 000 people die every year due to the acute or chronic consequences of hepatitis B.

A vaccine against hepatitis B has been available since 1982. Hepatitis B vaccine is 95% effective in preventing infection and its chronic consequences, and was the first vaccine against a major human cancer.

Transmission

In highly endemic areas, HBV is most commonly spread from mother to child at birth, or from person to person in early childhood.

Perinatal or early childhood transmission may also account for more than one third of chronic infections in areas of low endemicity, although in those settings, sexual transmission and the use of contaminated needles, especially among injecting drug users, are the major routes of infection.

The hepatitis B virus can survive outside the body for at least seven days. During this time, the virus can still cause infection if it enters the body of a person who is not protected by the vaccine.

The hepatitis B virus is not spread by contaminated food or water, and cannot be spread casually in the workplace.

The incubation period of the hepatitis B virus is 75 days on average, but can vary from 30 to 180 days. The virus may be detected 30 to 60 days after infection and persists for variable periods of time.

How do I get hepatitis B?

A person who has acute or chronic hepatitis B can spread the infection to other people through his/her blood and other body fluids or by sexual contact. The hepatitis B virus is found mainly in the blood, semen, and vaginal fluid of an infected person. Saliva is also a body fluid but the virus concentration is 1,000 to 10,000 times less than what is found in the blood.

You may risk exposure to hepatitis B through unprotected sex, tattoos, piercings, pedicures, manicures or medical procedures with improperly sterilized equipment, sharing personal hygiene items with an infected person (e.g. razors, toothbrushes, nail clippers) or providing emergency first aid in which you come in contact with blood or other body fluids
For a short video this topic, click on the link: http://www.streamingwell.com/how-do-you-get-hepatitis-b-video.html

Symptoms
Most people do not experience any symptoms during the acute infection phase. However, some people have acute illness with symptoms that last several weeks, including yellowing of the skin and eyes (jaundice), dark urine, extreme fatigue, nausea, vomiting and abdominal pain.

Diagnosis
It is not possible, on clinical grounds, to differentiate hepatitis B from hepatitis caused by other viral agents and, hence, laboratory confirmation of the diagnosis is essential. A number of blood tests are available to diagnose and monitor people with hepatitis B. They can be used to distinguish acute and chronic infections.

Treatment
There is no specific treatment for acute hepatitis B. Care is aimed at maintaining comfort and adequate nutritional balance, including replacement of fluids that are lost from vomiting and diarrhea.

Some people with chronic hepatitis B can be treated with drugs, including interferon and antiviral agents. Treatment can slow the progression of cirrhosis, reduce incidence of HCC and improve long term survival. Treatment, however, is not readily accessible in many resource-constrained settings.

Liver cancer is almost always fatal and often develops in people at an age when they are most productive and have family responsibilities. In developing countries, most people with liver cancer die within months of diagnosis. In high-income countries, surgery and chemotherapy can prolong life for up to a few years.

People with cirrhosis are sometimes given liver transplants, with varying success.

Prevention
The hepatitis B vaccine is the mainstay of hepatitis B prevention. WHO (World Health Organization) recommends that all infants receive the hepatitis B vaccine as soon as possible after birth, preferably within 24 hours.

The birth dose should be followed by 2 or 3 doses to complete the primary series. In most cases, 1 of the following 2 options is considered appropriate:

- a 3-dose schedule of hepatitis B vaccine, with the first dose (monovalent) being given at birth and the second and third (monovalent or combined vaccine) given at the same time as the first and third doses of DTP vaccine; or
- 4 doses, where a monovalent birth dose is followed by 3 monovalent or combined vaccine doses, usually given with other routine infant vaccines.

Cell Cycles and Hepatitis B
Practice Questions

1. Why do cells reproduce?

2. When a cell divides in Mitosis, two new cells are created. Compare these new cells to the original cell in terms of their appearance, their organelles, and their functions. (ie. being identical or different)

3. Why do you think DNA is packed together even more tightly into chromosomes when a cell divides?

4. What is the purpose of mitosis in the normal life span of a cell? (circle one):

   Growth Reproduction

5. What is the purpose of interphase in the normal life span of a cell? (circle one):

   Growth

   Reproduction

6. In mitosis, the new produced cells are identical, but smaller. We call this type of production (circle one):

   Asexual reproduction

   Sexual reproduction

7. The length of a cell cycle depends on the function of the cell. Which cell has the shortest life span and which is the longest?

   brain cell skin cell blood cell

   shortest longest

8. How can the body replace the damaged cells of a body organ (e.g. liver)?

9. Is Hepatitis B caused by: Bacterium Virus

10. Hepatitis B affected: Kidney Liver Pancreas

11. Hepatitis B is contagious. True False

12. How can a person become infected by Hepatitis B? Explain your answer.

Task 2: Chemical Naming and Hazards

Naming and Writing Chemical Compounds

A chemical compound is a substance formed from two or more elements chemically united in fixed proportions. Sometimes we have the formula (ie. RbI) to name, sometimes we have the name (aluminum oxide) and must create the formula. See the attached periodic table for all known elements to date.

Chemical compounds can be divided into two basic types, ionic and covalent. Ionic compounds are easily recognized because they contain a **metal** and a **non-metal**. Covalent compounds are those which contain only non-metals. The periodic table included shows which elements fall into each class.

The term "**ionization**" refers to the use of heat, electricity, chemicals, discharge or radiation in order to transform atoms that are neutral to atoms with either a positive or negative electric charge. The names for ionic compounds are very simple. The first part of the name is simply the name of the metal element. The second part of the name is the name of the non-metal element, with the ending changed to the suffix **ide**. For example, consider the compound Al_2O_3. While the subscripts (small numbers - bottom right) indicate that the compound consists of two atoms of aluminum and three atoms of oxygen, these numbers do not affect the name. The first part of the name would be aluminum. For the second part of the name, we drop the ending on oxygen and add –ide, thus it becomes **oxide**. The name of the compound is then **aluminum oxide**.

When compounds are formed, the combination must have a total electrical charge of 0. See the list of Common Ions and there charges below. We'll practice this as we go.

List of Common Ions		
Name	**Symbol**	**Charge**
Aluminum	Al	+3
Calcium	Ca	+2
Carbonate	CO_3	-2
Chloride	Cl	-1
Copper	Cu	+1, +2
Cyanide	CN	-1
Gold	Au	+2
Hydride	H	+1
Hydrogen Carbonate	HCO_3	-1
Hydroxide	OH	-1
Iodide	I	-1
Iron	Fe	+2, +3

Lithium	Li	+1
Magnesium	Mg	2+
Mercury	Hg	+2
Nitride	N	-3
Oxide	O	-2
Phosphate	PO_4	-3
Potassium	K	+1
Rubidium	Rb	+1
Silver	Ag	+1
Sodium	Na	+1
Sulfide	S	-2
Sulphate	SO_4	-2

Type I Binary Compounds

For Type I binary compounds the metal present can be found in either ***Group 1*** or ***Group 2*** on the periodic table. The naming system for this type of compound is found below. All compounds must have balanced (equal + and -) electrons, meaning their charges add up to 0. Please see the list of Common Ions above to find the charges for each element.

Rules for naming Type I binary compounds

1. The cation is always named first and the anion second.
2. A simple cation (obtained from a single atom) takes its name from the name of the element.
3. A simple anion (obtained from a single atom) is named by taking the first part of the element name (the root) and adding the letters "IDE."
4. Write the name for the compound by combining the names of the ions.

Examples:

Name the compound RbI.

- Rb is the chemical symbol for rubidium. (+1 charge)
- I is the chemical symbol for iodine, whose root is "iod." Add the "ide" ending to get iodide. (-1 charge)
- Put the pieces together to get the name rubidium iodide. (+1 + {-1} = 0 charges balance)

Name the compound CaO.

- Ca is the chemical symbol for calcium and has a +2 charge.
- O is the symbol for oxygen, whose root is "ox." Add the "ide" ending to get oxide and has a -2 charge.
- Put the pieces together to get the name calcium oxide. (+2 + {-2} = 0 charges balance)

Rules for Writing Formulas from Compound Names

Write the formula for potassium sulfide. The oxidation (charge) states are NOT the same. (See the list of common ions provided.)

- The chemical symbol of potassium is **K**. K is in the 1st column of the periodic table, therefore, it has a charge of +1.
- Sulfide is derived from sulfur, whose symbol is **S**. Its charge is -2.
- So far we have… K S. (remember: K +1 charge, S -2 charge)
- The total positive charge must balance the total negative charge. Therefore, we need 2 K atoms to give a total positive charge of +2. This balances the -2 charge of the sulfur.
- Putting it all together we have **K_2S**. (the subscript 2 means 2 K atoms required)

Type II Binary Compounds

For Type II binary compounds the metal present is **NOT** found in either Group 1 or Group 2 on the periodic table. The naming system for this type of compound is found below.

Rules for naming Type II binary compounds

1. The cation is always named first and the anion second.
2. A simple cation (obtained from a single atom) takes its name from the name of the element. Include a Roman numeral to indicate the oxidation number (charge) on the metal cation. The Roman numerals are used to show the charge of transition metals because some elements have more than one possible **oxidation state**.

Explanation:

Some metals have the ability to form differently charged ions. For example, Iron can form 2+ or 3+ ions. If you simply gave the name iron chloride, you would not know which charge the iron ion possessed.
A Roman numeral is to indicate the charge of the iron in this compound.
Iron (II) means the iron has a 2+ charge
Iron (III) means that the iron has a 3+ charge

So, when given the name iron (II) oxide, it would have a chemical formula of FeO. WHY?
The Iron (II) has a charge of +2 which balances with the oxide with a charge of -2.

Iron (III) oxide would have a chemical formula of Fe_2O_3. WHY? Iron (III) has a charge of +3. Oxide has a charge of -2. To balance this out, we must add atoms so both positive and negative charges = 0.

So……. Fe (+3) + Fe (+3) = Fe_2 gives us + 6 charge

O (-2) + O (-2) + O (-2) = O_3 with a combined -6 charge

So……. The formula for the name Iron (III) oxide is Fe_2O_3.

Another example:

Name the compound $FeCl_2$.

- Fe is the chemical symbol for iron.
  - Fe is not in the 1st or 2nd column; therefore a Roman numeral is needed in the name. We'll come back to that shortly.
- Cl is the chemical symbol for chlorine, whose root is "chlor." Add the "ide" ending to get chloride.
- At this point we have **iron (??) chloride**. But which "iron" is it?
- To find the Roman numeral…
  - Find the charge of the anion.
    Cl has a -1 charge.
  - But, there are 2 Cl atoms (How do you know? Look at CL_2 from original formula)
    2 times -1 = -2. <--- total negative charge.
  - Balance total negative charge with total positive charge.
    The total negative charge of -2 **must be** balanced with a total positive charge of +2 for iron.
  - The iron with a charge of +2 is called iron (II), therefore
- Put the pieces together to get the name iron (II) chloride.

For more information, check out this youtube video:
https://www.youtube.com/watch?v=URc75hoKGLY

Chemical Naming Practice Questions

Name the following chemical compound formulas below each one:
Hint: Refer to your list of common ions above.

$MgCl_2$ Li_2O K_3N

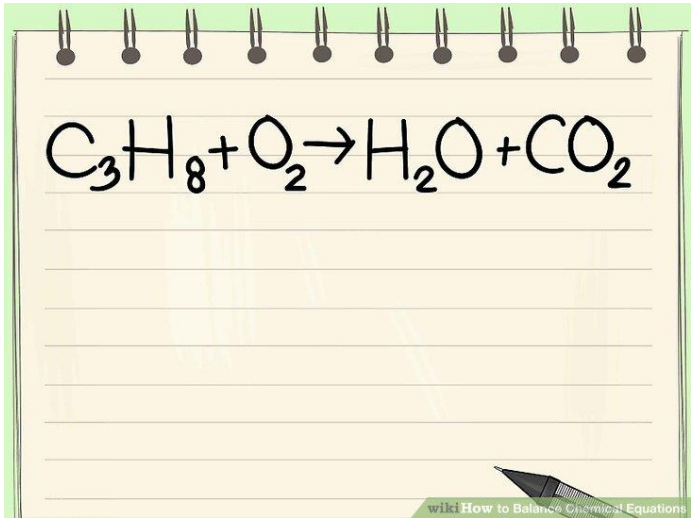
Now create the formulas for the following compound names:
Hint: Refer to your list of common ions above.

Aluminum Oxide Sodium Chloride Copper (II) Oxide

Balancing Chemical Equations

A chemical equation is a written symbolic representation of a chemical reaction. The reactant chemical(s) are given on the left-hand side and the product chemical(s) on the right-hand side. The law of conservation of mass states that no atoms can be created or destroyed in a chemical reaction, so the number of atoms that are present in the reactants has to balance the number of atoms that are present in the products. Follow this guide to learn how to balance chemical equations differently.

Traditional balance



Write down your given equation. For this example, you will use:

$C_3H_8 + O_2 \dashrightarrow H_2O + CO_2$

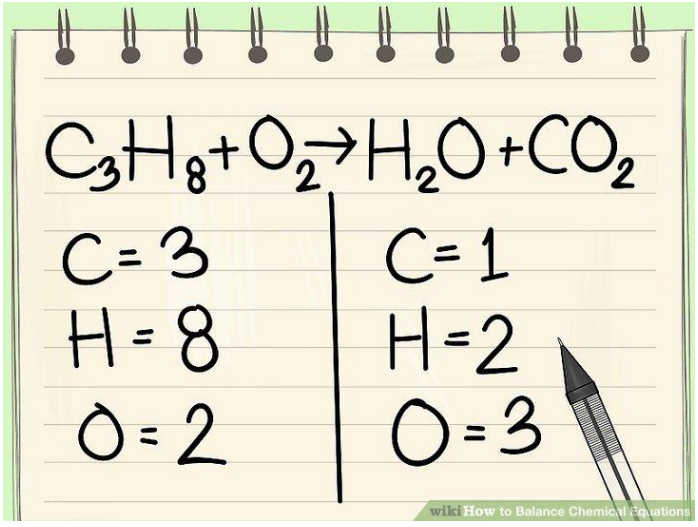
This reaction occurs when propane (C_3H_8) is burned in the presence of oxygen (O_2) to produce water (H_2O) and carbon dioxide. (CO_2)

2

Write down the number of atoms per each element that you have on each side of the equation.

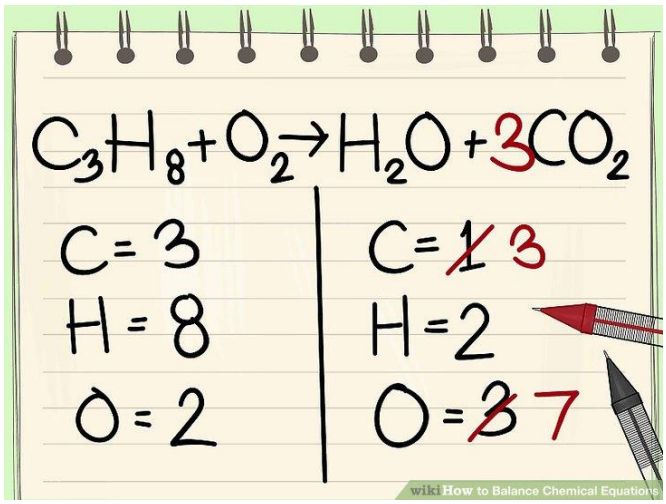
Look at the subscripts next to each atom to find the number of atoms in the equation.

Left side: 3 carbon, 8 hydrogen and 2 oxygen.
Right side: 1 carbon, 2 hydrogen and 3 oxygen.



3 Always leave hydrogen and oxygen for last

Add the coefficient 3 to the single carbon atom on the right of the equation to balance it with the 3 carbon atoms on the left of the equation. This will also change the oxygen atoms of $3CO_2$. (3x2=6 atoms of oxygen + the other 1 = 7)

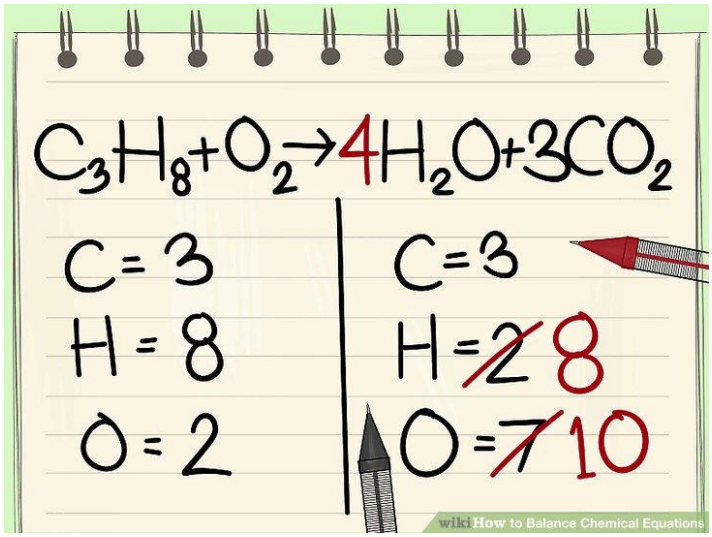


$C_3H_8 + O_2$ --> H_2O + **3**CO_2

The coefficient 3 in front of carbon on the right side indicates 3 carbon atoms just as the subscript 3 on the left side indicates 3 carbon atoms.

In a chemical equation, you can change coefficients, but you must never alter the subscripts.

4



Balance the hydrogen atoms next.

You have 8 on the left side. So you'll need 8 on the right side.

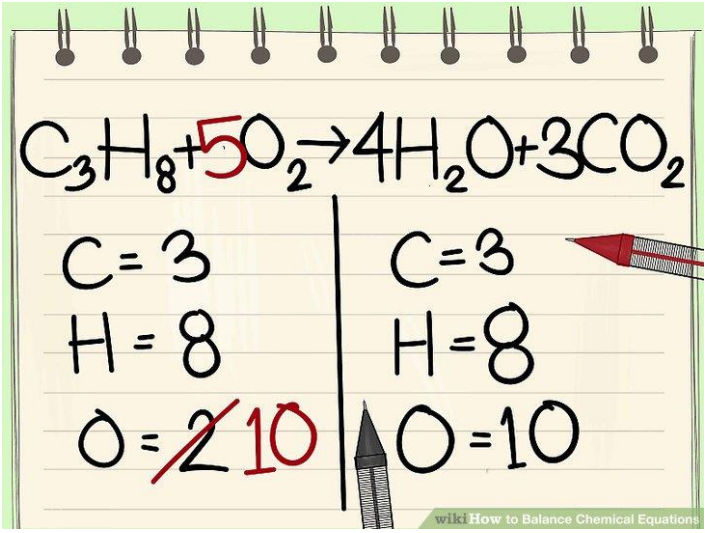
$C_3H_8 + O_2$ --> **4**H_2O + $3CO_2$

On the right side, you now added a 4 as the coefficient because the subscript showed that you already had 2 hydrogen atoms.

When you multiply the coefficient 4 times by the subscript 2, you end up with 8.

Now we have 4 atoms of oxygen ($4H_2O$) and 6 oxygen atoms with the carbon dioxide (3 x 2) ($3CO_2$). 4 + 6 = 10

5



Balance the oxygen atoms.

Because you've added coefficients to the molecules on the right side of the equation, the number of oxygen atoms has changed. You now have 4 oxygen atoms in the water molecules and 6 oxygen atoms in the carbon dioxide molecules. That makes a total of 10 oxygen atoms on the right side.

Add a coefficient of 5 to the oxygen molecule on the left side of the equation. You now have 10 oxygen atoms on each side.

C_3H_8 + **5**O_2 --> $4H_2O$ + $3CO_2$.

The carbon, hydrogen, and oxygen atoms are balanced.

Your equation is complete.

Balancing Chemical Equations
Practice Questions

Now let's practice what we have learned on Balancing Chemical Equations.

Practice counting the atoms per each element.

$2\ Na + 2\ H_2O \longrightarrow 2\ NaOH + H_2$	
Left Side	Right Side
__ Na – sodium atoms	__ Na – sodium atoms
__ H – hydrogen atoms	__ H – hydrogen atoms
__ O – oxygen atoms	__ O – oxygen atoms

Is this equation balanced then?

Practice counting and then balancing the following chemical equations.
Hint: set up a left and right side chart as above.

1. $Na + Cl_2 \rightarrow NaCl$

2. $FeO + C \rightarrow Fe + CO_2$

3. $Xe + F_2 \rightarrow XeF_6$

4. $KOH + CO_2 \rightarrow H_2O + K_2CO_3$

5. __ HgO → __ ____ + O_2

Types of Chemical Reactions

There are 3 main types of chemical reactions: displacement, decomposition and synthesis.
Displacement is a reaction where one or more elements take the place of another element in a compound. There are 2 kinds of displacement reactions: Single displacement where one element takes the place of another and Double displacement, where 2 ions of 2 different compounds exchange places. Eg.
Decomposition is a reaction where one compound breaks down into 2 or more simpler compounds. Eg. Creating a reaction where water breaks down into 2 separate elements: Hydrogen and Oxygen.
Synthesis is a reaction where 2 or more reactants combine to produce a new product. Eg. Water is the product of the synthesis of hydrogen and oxygen.

Your Turn: Look at the chemical reaction that you just balanced earlier
$2HgO \rightarrow 2\ Hg + O_2$ What kind of chemical reaction is occurring?

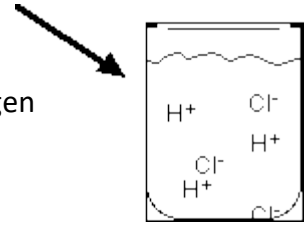
2HgO --> 2Hg + O2 is a decomposition reaction, in which **mercury oxide** is decomposed into the element **mercury** and **oxygen** gas. A **decomposition** reaction is one in which a more complex substance is **broken down** into its simpler components.

Acids Bases and pH Scale

I. Acids

Acids are ionic compounds (a compound with a positive or negative charge) that break apart in water to form a hydrogen ion (H^+).

The strength of an acid is based on the concentration of H^+ ions in the solution. **The more H^+ the stronger the acid.**
Example: HCl (Hydrochloric acid) in water
MEMORY TIP: Hydrochloric acid is STRONG, therefore, acids form Hydrogen ions in water.



Characteristics of Acids:
**Acids taste sour
**Acids react strongly with metals (Zn + HCl)
**Strong Acids are dangerous and can burn your skin

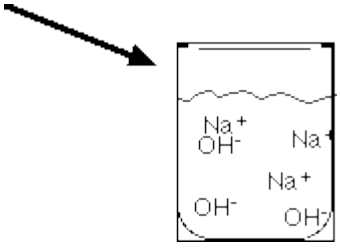
Examples of Acids:
**Vinegar 3
**Citrus Fruits
**Stomach Acid (HCl)

II. Bases

Bases are ionic compounds that break apart to form a negatively charged hydroxide ion (OH^-) in water.

The strength of a base is determined by the concentration of Hydroxide ions (OH^-). **The greater the concentration of OH^- ions the stronger the base.**

Example: NaOH (Sodium Hydroxide-a strong base) in water



Solutions containing bases are often called ***alkaline*.

Characteristics of Bases:
**Bases taste bitter
**Bases feel slippery
**Strong bases are very dangerous and can burn your skin

Examples:
** Lye (Sodium Hydroxide)
** Ammonia
** Chlorine Bleach

III. Neutralization Reactions

When acids and bases are added to each other they react to neutralize each other if an equal number of hydrogen and hydroxide ions are present.
When this reaction occurs -salt and water are formed.

$HCl + NaOH \rightarrow NaCl + H_2O$
(Acid) (Base)---(Salt) (Water)

IV. pH Scale and Indicators

**The strength of an acid or base in a solution is measured on a scale called a pH scale.

**The pH scale is a measure of the hydrogen ion concentration. It spans from 0 to 14 with the middle point (pH 7) being neutral (neither acidic or basic).
Any pH number **greater than 7** is considered a **base** and any **pH number less than 7** is considered an **acid**. 0 is the strongest acid and 14 is the strongest base.

Indicators-- An indicator is a special type of compound that changes color as the pH of a solution changes, thus telling us the pH of the solution.

Litmus paper is used to test whether the given solution is acidic or alkaline in nature. Litmus is a water-soluble mixture of different dye types extracted from lichens.
Blue litmus paper turns red under acidic conditions and red litmus paper turns blue under basic or alkaline conditions, with the color change occurring over the pH range 4.5–8.3 at 25 °C (77 °F).

HERE'S A MEMORY TIP:

Remember: Bases turn litmus paper **B**lue, (bases and blue start with B)
so the litmus paper must start as red.

Therefore, the opposite is true for Acids.

Acids turn litmus paper Red so it must start as blue. As long as you remember the tip above, you can figure out acids pretty quickly.

Acids and Bases Practice Questions

Use the PH Scale provided in the table below to complete the following chart. Keep in mind that any substance with a PH of **less than 7 is an acid**. A substance with a **PH of 7 is neutral**, and a **PH of 8 or higher is a base.**

Product	**Base, Neutral, or Acid?**	**Litmus Paper Test** (stated as "_____turns _____")	Hydrogen **(H+)** or Hydroxide **(OH-) Ions Present**
bleach			
diet cola			
vinegar			

pH Scale	Values of some common substances	pH Scale	Values of some common substances
13.5	household lye	6.7	milk
12.6	Bleach	6.2	corn
11.5	ammonia	5.0	boric acid
10.2	Milk of magnesia	4.2	orange juice
9.3	borax	3.39	Diet cola
8.4	baking soda	2.8	vinegar
8.0	sea water	2.2	lemon juice
7.4	blood	0.3	battery acid
7.0	distilled water (Neutral)		

Working Safely with Acids and Bases

Although the base bleach and the acids diet cola and vinegar are chemicals commonly found in the average household, when working with any chemical, precautions need to be taken in order to prevent injury. Vinegar, for example, in a higher concentration is the same product used in weed spray and latex paint. While vinegar is safe for consumption, it will sting your eyes if not carefully handled. Weed spray and paint require even more precautions, including ensuring they are safely stored out of reach of children.

There are several ways that harmful chemicals can enter the body. The first way a chemical can enter the body is through **ingestion**, and although it may seem obvious not to ingest chemicals, it can be inadvertently done by treating your lawn with pesticides and then forgetting to wash your hands before you eat. The second point of entry is through **inhalation**, and this is easily avoidable by using a respirator when working with chemicals. Finally, chemicals can enter the body through **absorption**. Absorption can occur through the eyes, skin, or mouth.

Imagine that you are a parent bringing your child to an in-home daycare provider. During some renovations occurring in the bathroom near the children's play area, all of the contents of the bathroom cupboards (cleaners, prescription and over the counter drugs, etc.) are in a box that has been left on the floor outside the bathroom. You ask how the daycare provider will ensure your child's safety throughout this process. The daycare provider states, "Oh, don't worry, we have another bathroom that the kids can use."

What other concerns, though, still need to be addressed? (Please include the 3 ways that chemicals can enter the body in your answer.)

Neutralization

You may have noticed on the PH scale provided that water (pH 7) is the neutral point in the scale: everything on one side of it is a base and everything on the other side of it is an acid. Therefore, the process of neutralization is when an **acid and a base react together** and the outcome is always **water + a salt** (there are actually many different types of salts).

In the following example, hydrochloric acid (HCl) is reacting with the base potassium hydroxide (KOH).

$$HCl + KOH \longrightarrow H_2O + ClK$$

Notice that the chemical formulas of both reactants have H in them (which gives us the H_2 part of water), and that there is an oxygen atom (O) in potassium hydroxide. When we put those atoms together, we have the water (H_2O) that always occurs in a neutralization, and the leftover chemical formula for this particular salt is ClK (or salt of potassium chloride).

Now, on a blank piece of paper, write

HCl + KOH ⟶ ☐ + ☐

and try to complete the blanks based on your memory of how a base and an acid neutralize each other by forming water and salt bi-product. Try not to look at this sheet until you are ready to check your answer.

Try repeating this process a few times, perhaps even over a few days, to make sure that you remember that during a chemical reaction between a base and an acid, you will always have water as a product (and the other chemical that is left will be a type of salt).

*Note: for additional practice with balancing chemical equations, go to http://chemistry.about.com/od/chemicalequations/a/How-To-Balance-Equations.htm

(downloadable worksheets and answer sheets available there)

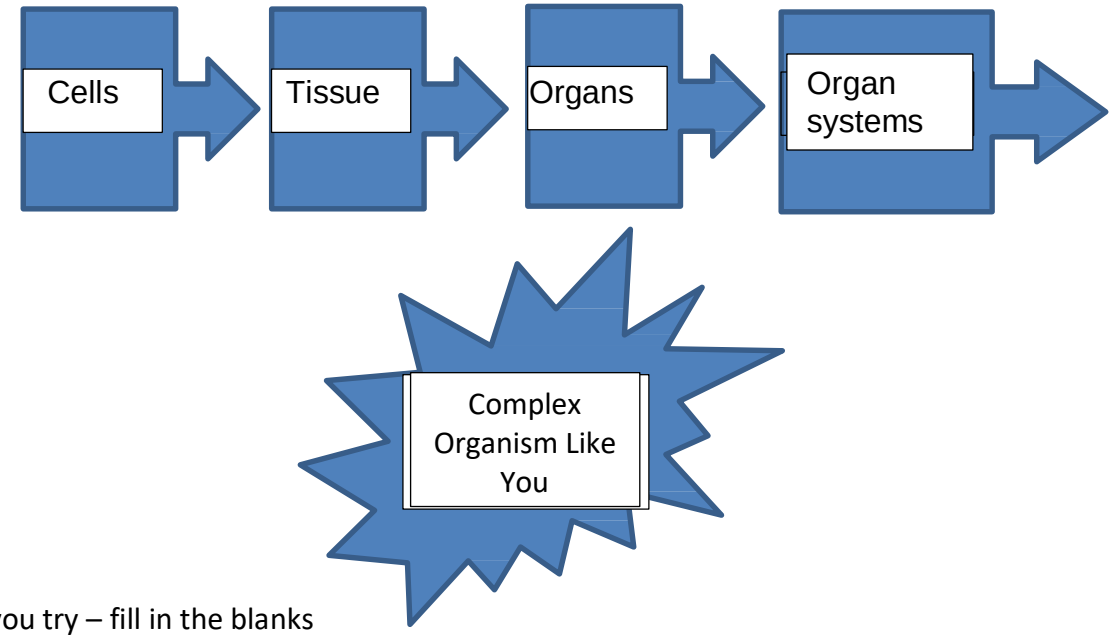
Task 3: Tissues and Organs and Biochemical Hazards

(Adapted from www.qldscienceteachers.com) _

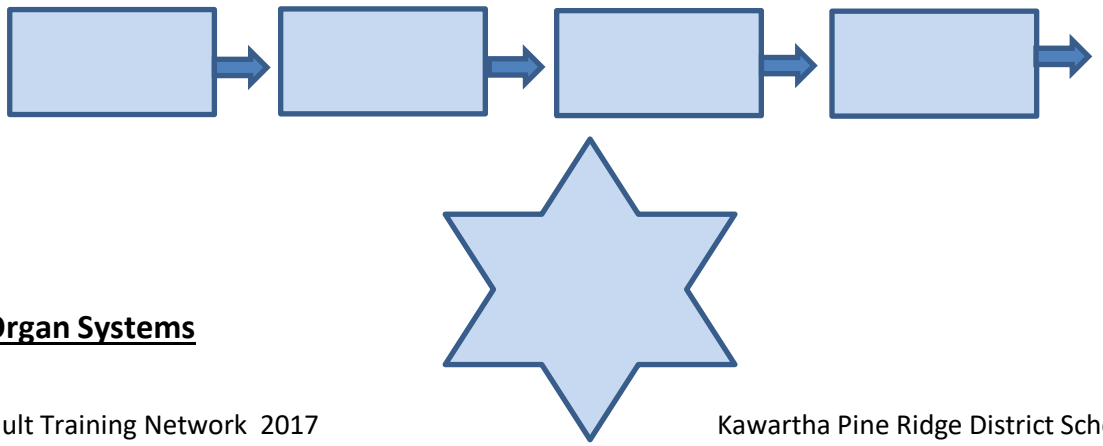
Each of our bodies started as a single cell. That one cell multiplied many times to ultimately create your complex body. Not only did that one cell divide many times, it also differentiated to become different types of cells: nerve cells, muscle cells, skin cells, blood cells, bone cells, etc.

Cells can group together to form tissue. When tissues group together they create an organ. When organs group together they create an organ system.

To review the hierarchy of development, then:



Now you try – fill in the blanks



Organ Systems

A Focus on The Respiratory System, The Circulatory System, and the Digestive System
(taken from Science Links 10, McGraw-Hill Ryerson, 2010)

The **respiratory system** is responsible for carrying oxygen to the blood and removing carbon dioxide from the blood. The process of taking in oxygen and then releasing carbon dioxide is referred to as a "**gas exchange**," and it happens every time that you breathe. In order for this **gas exchange** to be possible, though, many different organs need to work together. In fact, it is only after air reaches the lungs (which is a process that includes many steps itself), that the actual exchange of gases can occur. Within the lungs are the **alveoli**, and it is here—with the help of the **capillaries**—that **red blood cells** can pick up oxygen and deliver it to the cells in your body. The red blood cells also release carbon dioxide back into the lungs, and when we exhale we release them completely.
If this is sounding like a fairly layered and complex process, it's because breathing—which is just one essential function of the body—*is* a layered and complex process. Yet our bodies preform this task, through the cooperative work of the different organs involved in the respiratory system, over and over again for many years.

The **circulatory system** also plays a key role in getting our bodies the oxygen they need. You see, the cells in our body require a constant supply of oxygen too (it's for more than breathing!), and it is our blood that brings oxygen to our cells. The **circulatory system** pumps blood throughout our body, ensuring that blood (and therefore oxygen and other nutrients) is getting transported to all of our cells.

The **digestive system** is also a marvel. It is 10 metres long and involves **ingestion** (the process of taking food into the body), **digestion** (the process of breaking down food physically and chemically), **absorption** (the process of the nutrients getting absorbed into the blood), and finally, with the help of the **excretory system**, it ends with **elimination** (the process of passing waste from the body). This whole process, from ingestion to elimination, takes approximately 20 to 30 hours.

More about Organ Systems (taken from Science Links 10, McGraw-Hill Ryerson, 2010)

Most of the tasks in the body need the support of two or more organ systems working together (as we just read about regarding the function of eliminating waste from the body, which results from the digestive and excretory systems working together). For another example, let's look at cellular respiration, which is the process of changing stored energy into usable energy. This task requires oxygen and food. The **respiratory system** brings oxygen into the lungs when you breathe. The **digestive system** breaks food down into nutrients such as glucose.
Now the **circulatory system** enters the picture. It transports glucose and other nutrients from the **digestive system** to the cells. The **circulatory system** also transports oxygen from the lungs to the cells. Now the cells have what they need for cellular respiration: oxygen and glucose.

The teamwork doesn't end there, however. The **circulatory system** also transports carbon dioxide waste from the cells to the lungs of the **respiratory system**. Through gas exchange in the lungs, the carbon dioxide waste is removed from your body when you breathe out.
Like most of the tasks that are required so that our bodies can function well, cellular respiration can be compared to the way that a relay race works. Each runner in the race represents a different organ system, and they all have to work together to perform the task of passing the baton seamlessly from one to another. If one of the runners in a relay falls out of the race, the entire process breaks down. Similarly, if within the task of cellular respiration, one of the organ systems involved is unable to complete its job, the whole process breaks down and the bodies health quickly begins to deteriorate.

Biohazards

WHMIS (Workplace Hazardous Materials Information System) is required training in many workplaces. Perhaps, then, you are already familiar with a lot of the symbols intended to warn people of the potentially hazardous chemicals around us. Here is the complete set of 2015 WHMIS symbols that you may find on label of hazardous chemicals at work and at home.

	**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.

WHMIS: WHAT YOU NEED TO KNOW

A **Material Safety Data Sheet** (MSDS) is a document that gives detailed information about the nature of a chemical, such as physical and chemical properties, health, safety, fire, and environmental hazards of a chemical product. In addition to giving information about the nature of a chemical, an MSDS also tells how to work safely with a chemical and what to do if there is an accidental spill.

Spill Clean-Up and Waste
Disposal Cleanup:

Eliminate all sources of heat, flames and sparks. Ventilate area if necessary. Don proper personal protection. Absorb or neutralize liquids. Wash affected area with soap and water. Ensure that the garbage disposal of cleanup materials is made in an appropriate container.

Waste Disposal:
If spill cannot be safely contained, evacuate area and contact Environmental Protection Services (Hazardous Materials). Generators of hazardous wastes are responsible for properly packaging and labelling such wastes. Contact Environmental Protection Services to arrange for disposal.

Tissues, Organs and Biochemical Practice Questions

True of False? (If the answer is false, use the space provided underneath to input the correct information.)

1.) The order of complexity is tissue, cells, organs, organ systems, complex being.

True False

2.) The **circulatory system** brings oxygen to the blood.

True False

3.) The **circulatory system** transports oxygenated blood throughout our bodies.

True False

4.) **Gas exchange** occurs when you breathe in oxygen and breathe out carbon monoxide.

True False

5.) The **digestive system** with help from the **circulatory system** performs the job of eliminating waste from the body.

True False

6.) The WHMIS symbol for **corrosion** is the skull and cross bones.

True False

7.) Using the title list provided, match the correct category of hazard with the correct symbol.

Flammable	Poison/Toxic	Gas Under Pressure	Reactive/Exploding
			
			

Short Answer

What steps should be taken when cleaning up hazardous material? Why are these steps important?

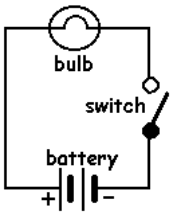
Task 4: Electricity

Part A: Electricity

In order to have electricity there are certain components needed in a circuit which is the pathway for electric current to flow. Electrons are the negatively charged particles that move through the circuit.

The components of an electric circuit would include:

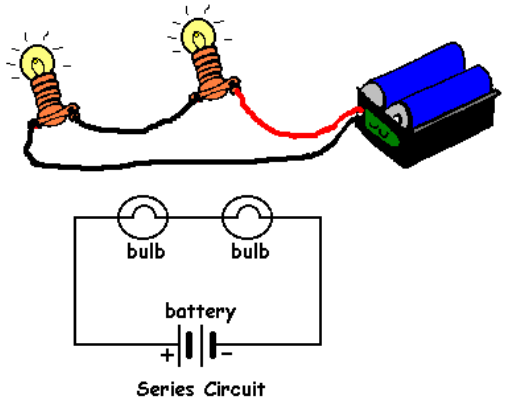
- A bulb (load/ resistance)
- Connecting wires
- Battery (power source)
- A switch



There are **two types** of electric circuits:

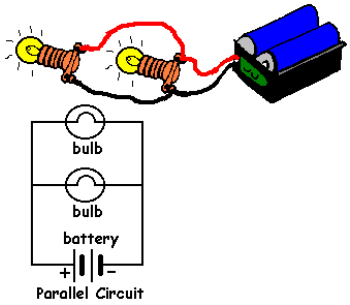
Series Circuit

-Only has ONE path for the flow of electrons.



Parallel Circuit

-More than one path for the flow of electrons.



Electron flow = current represented by the letter (I).

Electrons are so tiny that electrons are grouped into units called COULOMB

(C). 1 COULOMB = 6.25×10^{18} electrons

Each electron carries a negative charge (Q).

So, to calculate current:

Current (I) = charge

(Coulombs)

time (secs)

$$I = \frac{Q}{t}$$

= Amperes or amps (A)

Therefore, current is measured in amps.

The current in an electric circuit is created by the flow of the electrons which happens because of the power source. The power source has both a positive and negative terminal.

The "Push" of the battery/ power source is known as the **potential difference** or **voltage**.

Resistance
As the electrons travel through the circuit, they meet obstacles that hinder them. These obstacles, such as the light bulb are called **resistors.**

Resistance is measured in units called OHMS (Ω).

Fuse
A fuse is a protective device for breaking an electric circuit. A fuse consists essentially of a metal strip or wire that melts at a lower temperature than the wire and other components in the rest of the circuit. When the current flowing in the circuit becomes too strong, it heats the fuse so that it melts, breaking the circuit.

The fuse protects a circuit from a surge of electricity.

Direct Current (DC) versus Alternating Current (AC)

Direct Current (DC) – current always flows in the same direction between the positive and negative terminals. Batteries, fuel cells and solar cells all produce direct current (DC).

Alternating Current (AC)- the direction of the current reverses or alternates, 60 times per second (US) or 50 times per second (Europe). The advantage of the alternating current is it is relatively easy to change the voltage of the power using a transformer.

Therefore, in Ontario Alternating Current (AC) is used. Small appliances, like a toaster, microwave, and hair blow dryer require 110V. Larger appliances like stoves and clothes dryer require 220 V.

Electricity Practice Questions

1. What are the two types of electric circuits and how are they different?

2. Define current and indicate what current is measured in.

3. Voltage is created from what component of a circuit?

4. Explain the difference between Direct Current (DC) and Alternating Current (AC).

5. What kind of electricity can be found in residential dwellings?

6. Small appliances found in a typical household require which voltage?

220V 110V 330V

7. Resistance is measured in what unit?

meter ohm volt

8. How does a fuse protect an electrical circuit

Part B: Calculating the Cost of Hydro

Ontario Hydro has implemented Time-of-Use rates for the cost of electricity in most areas. This means depending on the time of day electricity is used; it can be a higher cost or lower cost to use electricity.

The cost of electricity is calculated in kilowatt hours with this formula:

Watts required by the appliance x amount of time used in hours ÷ 1000 x cost factor

Sample Rates:

Time Frame in a day	**Cents/Kilowatt hour**
7am- 11am	10.8
11am – 5pm	9.2
5pm – 7pm	10.8
7pm – 7am & on weekends	6.2

To calculate the cost input the information into the formula.

Note: Time needs to be expressed in terms of hours. So when time is given in minutes express in fraction and or decimal form of an hour.

Examples:

a) 15 minutes = 15/60
   15÷60= 0.25 or ¼ of an hour.

b) 6 minutes = 6/60
   6÷ 60 = 0.1 or 1/10 of an hour

c) 12 minutes = 12/60
   12÷ 60= 0.2 or 1/5 of an hour

Calculating the Cost of Hydro Practice Questions

A) Calculate the cost of cooking a pork chop using a toaster oven that requires 1250W for 14 minutes around 6:15pm for supper. Refer to the rate chart for the cost factor.

B) Now, what would the cost of cooking the pork chop be using a 900W microwave for 5 minutes? How much money would be saved?

C) List some benefits to using electricity in the off peak hours, 7pm until 7am and on weekends. Why would the use of electricity in the off peak hours be beneficial?

Task 5: Nutritional Health

Click on the link below or view a hard copy to learn how **Canada's Food Guide** can help you and your family know how much food you need and what types of foods are better for you.
http://www.hc-sc.gc.ca/fn-an/alt_formats/hpfb-dgpsa/pdf/food-guide-aliment/print_eatwell_bienmang-eng.pdf

Recommended Number of Food Guide Servings per Day

	Children			Teens		Adults			
	2-3	4-8	9-13	14-18 Years		19-50 Years		51+ Years	
	Girls and Boys			Female	Male	Female	Male	Female	Male
Vegetables and Fruit	4	5	6	7	8	7-8	8-10	7	7
Grain Products	3	4	6	6	7	6-7	8	6	7
Milk and Alternatives	2	2	3-4	3-4	3-4	2	2	3	3
Meat and Alternatives	1	1	1-2	2	3	2	3	2	3

Determine your recommended number of food servings from the guide above. For example:

If you are a 35 year old woman you should aim to have:

- 7-8 vegetables and fruit
- 6-7 grain products
- 2 milk and alternatives
- 2 meat and alternatives
- 30 - 45 mL (2 to 3 Tbsp) of unsaturated oils and fats

If you are very active and need more food, choose extra Food Guide Servings from the four food groups.

Task 5: Nutritional Science Practice Questions

Here is a list of food items that were eaten by a male between the ages of 19-50 in the course of one day. Assume that each item amounts to one serving of food, unless another quantity is specifically stated.

Morning	Afternoon	Evening
-2 cups of coffee with double cream -orange juice -blueberry muffin -bowl of cereal -banana	-ham sandwich on whole wheat bread with mayonnaise -potato salad -yogurt -chocolate milk -mixed nut granola bar	-2 hotdogs on white buns -French fries -2 pops -veggies and dip -a slice of pie

Based on this information, record the number of servings this individual:

- is recommended to eat,
- has actually eaten, and
- the difference between the two

Food Groups	Recommended Servings	Actual Servings Eaten	Difference
Vegetables and fruit			
Grain products			
Milk and alternatives			
Meat and alternatives			

Give some healthy eating advice, based on **the Make Each Food Guide Serving Count…** information. Make two suggestions on ways to improve his diet and provide a reason for each suggestion.

Are there any items in the list of foods that he has eaten that you were unable to score as a serving in the any of the 4 food groups? If so, which items were they?

Read the **Eat well and be active today and every day!** section of the food guide. Identify three items that he should cut out of his diet in order to avoid health problems.

While he was eating his sandwich, this man read the nutritional information listed on his loaf of bread. Refer to the Read the label section of the food guide and see what kind of information is contained in the labels for most food items.

His bread label said that each serving (2 slices) contained 28g carbohydrates/sugars (10%) and 2.5 grams of fat (8%).

i.) Calculate the difference in grams **and** percentages for these two nutrients.

_____g -_____g =_____g _____% -_____% =_____%

ii.) Why is there a big difference in the number of grams yet only a small difference in the daily value.

Congratulations, you have finished the prep work for the Workplace Science Assessment. Good luck on your assessment!