Topic 1 - A Hair Raising Dilemma

Medicine from The Environment ***- Willow bark*** *contains* ***salicylic acid****.* ***Hippocrates*** *- now known as the 'Father of Medicine' - as early as 400B.C. - recommended willow bark be used to treat pain and fever. First Nations people used willow bark tea as a medicinal drink. A synthetic version of salicylic acid -* ***acetylsalicylic acid*** *- was developed by the Bayer company in 1898 and* ***Aspirin*** *was born. Other medicines derived from plants found in the environment include:*

- Echinacea Purposa - extract from the purple cornflower stimulates the immune system.
- Check out other medicines developed from plants in the environment at:
Grade 7 'Science Focus' Notes - (Unit 2 - Topic 1)

Take Two Pebbles …

The process of digestion breaks down the chemicals present in food. The molecules are small and soluble, which can then pass through membranes into your blood. These chemicals (nutrients) are then carried throughout your body to the cells which need them for energy, growth, body building and cell repair. Our body needs about 25 different chemicals for normal growth. The complex organization of these chemicals produces **organic compounds** which contain Carbon, as well as mostly Oxygen and Hydrogen. Substances that do not contain Carbon are called **inorganic compounds.** The organic nutrients, which come primarily from green plants, are classified into four major groups.

Classes of Organic Compounds	Description and role in nutrition	Typical dietary sources
Carbohydrates	- are organic molecules made up of atoms of carbon, hydrogen, and oxygen - energy source for metabolism	sugar, starch, cellulose, glucose - rice, grains, potatoes, fruits
Lipids	- are compounds composed of many carbon, hydrogen, and oxygen atoms - storage of unused chemical energy	fats, oils and waxes - vegetable oils, nut oils, some dairy products
Proteins and Amino Acids	- proteins are organic compounds made up of amino acids (each protein has its own unique number, combination and arrangement of amino acids) - functions include growth and repair, as well as a source of energy	enzymes - meat, eggs, dairy products, legumes, nuts
Nucleic Acids	- large complicated molecules that play a major role in heredity and in controlling the cell's activities	DNA (deoxyribonucleic acid) RNA (ribonucleic acid)

Nutrients, made up of elements and compounds, help living organisms survive. Plants obtain carbon, oxygen and hydrogen from the air, and nitrogen, phosphorus, potassium, magnesium, calcium and sulfur from the soil. These nine elements are called macronutrients (because they are in needed in large quantities) are essential for plants to grow. There are other elements that are also needed, but not in large quantities. These elements are called trace elements.

The macronutrient elements are essential components in enzymes (which are special protein molecules that regulate chemical reactions in living organisms) and vitamins (large organic molecules which help enzymes function properly. The body cannot manufacture these macronutrients. It can only get them from food.

16 naturally occurring elements are present in all living organisms. Green plants require 18 elements for proper growth and functioning, while humans need 25 elements, which are used by for growth and function. The process of taking in the nutrients (elements and compounds) we need is called ingestion.

These compounds are broken down chemically in the digestive system by a process called hydrolysis. A substance that has been broken down by hydrolysis has been hydrolyzed.

(example) Maltose + Water ------ » Glucose

$C_{12}H_{22}O_{11} + H_2O$ ------ » $2C_6H_{12}O_6$

Nutrients such as glucose and amino acids are then absorbed through cell membranes and into the bloodstream, which carries them to where they will be used or stored.

Nutrient	Importance in Plants	Importance in Humans
Nitrogen (N)	- proteins & chlorophyll - leaf and stem growth	- composition of proteins & nucleic acids - growth and repair of tissue
Phosphorus (P)	- root and flower growth - cellular respiration & photosynthesis	- composition of bones, teeth & DNA - metabolic reactions
Potassium (K)	- stimulates early growth - starch and protein production - disease resistance - chlorophyll production & tuber formation	- muscle contraction & nerve impulses
Magnesium (Mg)	- chlorophyll structure - photosynthesis	- composition of bones & teeth - absorption of calcium & potassium
Calcium (Ca)	- cell wall structure - cell division	- composition of bones & teeth - blood clotting - muscle & nerve function
Sulfur (S)	- production of fruits and grains	- protein synthesis - enzyme activation - detoxification
Sodium (Na)		- helps regulate nerve impulses in nerves and muscles
Important micronutrients (trace elements) include:		
Chlorine	- helps regulate water balance, plays a role in cell membrane function, part of the hydrochloric acid in stomach that helps digest foods	
Iron	- crucial part of red blood cells, regulating oxygen transport	
Zinc	- essential component in enzymes which regulate formation of proteins and carbohydrate metabolism	
Iodine	- major component in thyroid hormones which regulate metabolism	
Selenium	- component of antioxidant enzyme that helps decay of cell function	
Copper	- promotes iron absorption and utilization - component of many enzymes - helps regulate nerve activity	
Manganese	- component of some enzymes involved in bole formation and protein metabolism	
Fluorine	- helps regulate calcium deposition	
Chromium	- activates vitamin B_3 to control use of blood sugar in energy production	
Molybdenum	- key component of 3 enzymes that regulate metabolism	
Cobalt	- component of vitamin B_{12}, which helps regulate red blood cells	

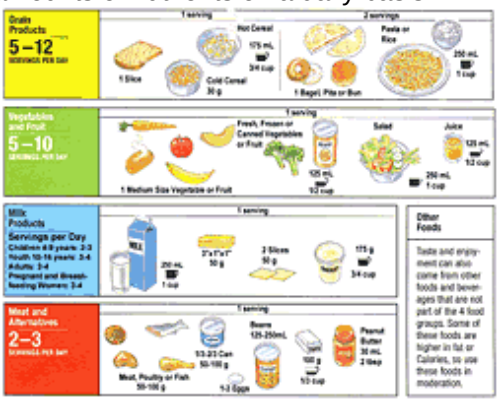
A Balanced Approach

A micronutrient may be present in larger amounts than normal. If this occurs it can have harmful effects. Not enough of an element can also have harmful effects.

The optimum amount of a substance is the amount of that substance that provides an organism with the best health.

Taking medication can affect chemical reactions going on in your body and can also correct a chemical imbalance, relieving nagging or painful symptoms or discomforts as a result of not having the optimum amounts of the chemicals you need for good health.

Canada's Food Guide helps you to maintain proper health and take in the right amounts of nutrients on a daily basis.



The Root Source

All living organisms need a constant supply of raw materials and energy to produce new cells for growth, to repair damage and to maintain proper health. Plants take in inorganic compounds to make organic compounds. Consumers use the organic compounds made by plants for their energy, growth and repair. When organisms take in these compounds, other substances are also taken. These substances may be harmless or harmful. By knowing how plants use each element, agriculturalists can diagnose deficiencies and excesses, and act accordingly, to alleviate the problem.

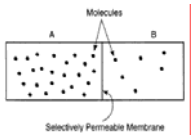
Problem: yellow striping on lower leaves & soil test indicates high levels of potassium and low levels of magnesium

Analysis: potassium is interfering with the plant's ability to absorb magnesium

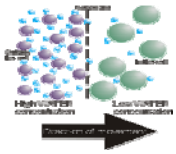
Solution: stop applying fertilizer containing potassium and apply more fertilizer with magnesium

(Nutrient comparison Chart Table 3.3 Science Focus p. 182)

Nutrients enter the roots by diffusion - the movement of molecules from an area of high concentration to an area of low concentration. This action continues until the areas are equal concentrations. (No energy is required for this to occur).



Water moves through plants by a special type of diffusion, called osmosis. In this process, water moves through the walls of the plant's roots from an area where there are more water molecules to an area where there are fewer water molecules. As the plant uses the water it draws more up from its roots.



Plants need high concentrations of some nutrients in their roots. These nutrients may have higher concentrations in the roots than in the surrounding soil. To maintain these high concentrations, plants move more nutrients into their roots from areas of lower concentration (in the soil) by a process called active transfer. This process requires energy. Where organisms live affects how and when they can obtain the nutrients they need. Some organisms get the nutrients they need often by restricting other organisms from getting the same nutrients (reducing the competition). A substrate is a material on which an organism moves or lives. Some organisms attach themselves to the substrate, while others obtain their nutrients from their substrate.

Red single-celled algae survive on a substrate that is near freezing, low in nutrients and often acidic.

Tubeworms can survive on the floor of the ocean where lava is rising to the surface - "hot smokers' - and many harmful chemicals (like hydrogen sulfide) are being dissolved in the water nearby.

Commercial Fertilizers

The three numbers on a bag of fertilizer refer to the percentage of nitrogen, phosphate and potassium that is available to plants from that bag of fertilizer.

This product contains:
5 % nitrogen, 10 % phosphate and 5 % potassium.

The other 80 percent of what's in this bag typically will contain some micronutrients and filler material, which allows for even application of the nutrients across the area where the fertilizer is used.

Issues Emerging From High Productivity

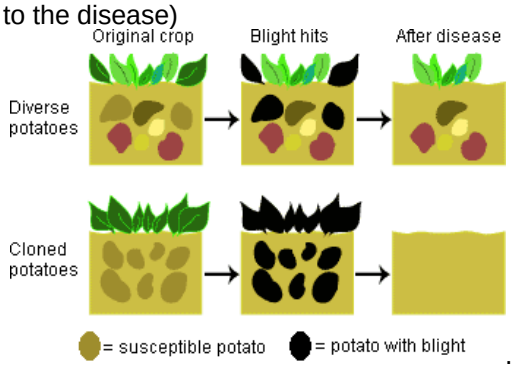
Until the early 1900s, plants received their nitrates exclusively from nature. The artificial production of fertilizers increased the nitrogen levels available to plants in the soil. This has increased the amount of nitrogen in the environment by as much as 140 million tons per year.

Nitrogen is used by plants for increased plant growth. Crop production has doubled worldwide due to the use of artificial fertilizers and high-yield varieties.

Food production has increased worldwide as a result in most countries. Great isn't it! – But wait: Consider the following –

- It takes a lot of water and fertilizer to produce a crop of high-yield varieties (VERY EXPENSIVE) for farmers.

- *Monoculture* – The planting of only one crop increases the chance of disease spreading through the entire crop. (a variety of crops allows for some of the crops to be resistant to the disease)



- Chemical agents used to protect the crop (pesticides and herbicides) reduce the amount of damage, but they are costly and have harmful effects on the environment.