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# BIOLOGY 12 — LESSON 1

Monday: 3-4pm
Tutorial

"learning.fnec.ca" → moodle address

## What is Biology?

→ the study of Life

| (biotic) Living | (abiotic) Non-Living |
|---|---|
| tree | rock |
| bacteria | fingernails |
| | hair |
| embryo | |
| virus | |

## CRITERIA FOR LIFE:

- gas exchange
- reproduce
- grow
- composed of cells
- adapt to environment
- acquire energy
- respond to stimuli

Homeostasis → maintain internal environment

April 16, 17th

LESSON 2

UNIT 1: CELL BIOLOGY

→ The cell is the building block of life.

## CELL THEORY:

1) All organisms are composed of one or more cells.
2) Cells are the basic unit of structure & function in organisms.
3) All cells come from pre-existing cells.
   - no spontaneous generation

Louis Pasteur's disproved spontaneous generation.

## CELL TYPES

1) Prokaryotic - no internal membrane structures
   ex. Bacteria
2) Eukaryotic - contain membrane bound internal structures (organelles)

**Plant Cells**
- cell wall and plasma membrane
- angular edges

**Animal Cells**
- plasma membrane only
- rounded edges

# Organelles of the Eukaryotic cell

Plasma membrane: made of phospholipids
- separates the internal environment from the external
- selectively permeable: allows some molecules to pass through while blocking others.

Nucleus: large, round object
- brain of the cell, stores DNA as chromatin
- filled with nucleoplasm, surrounded by a nuclear envelope which contains nuclear pores allow messages to be sent and received.

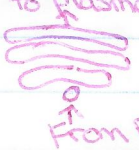
LESSON 3

Nucleolus: round, dark structure inside the nucleus.
- site of ribosome production

Ribosomes: site of protein production, produced in nucleolus
- composed of a large subunit and a small subunit 
- can be found 1) free floating
  2) joined together (Polysomes)
  3) attached to the Endoplasmic Reticulum (ER)

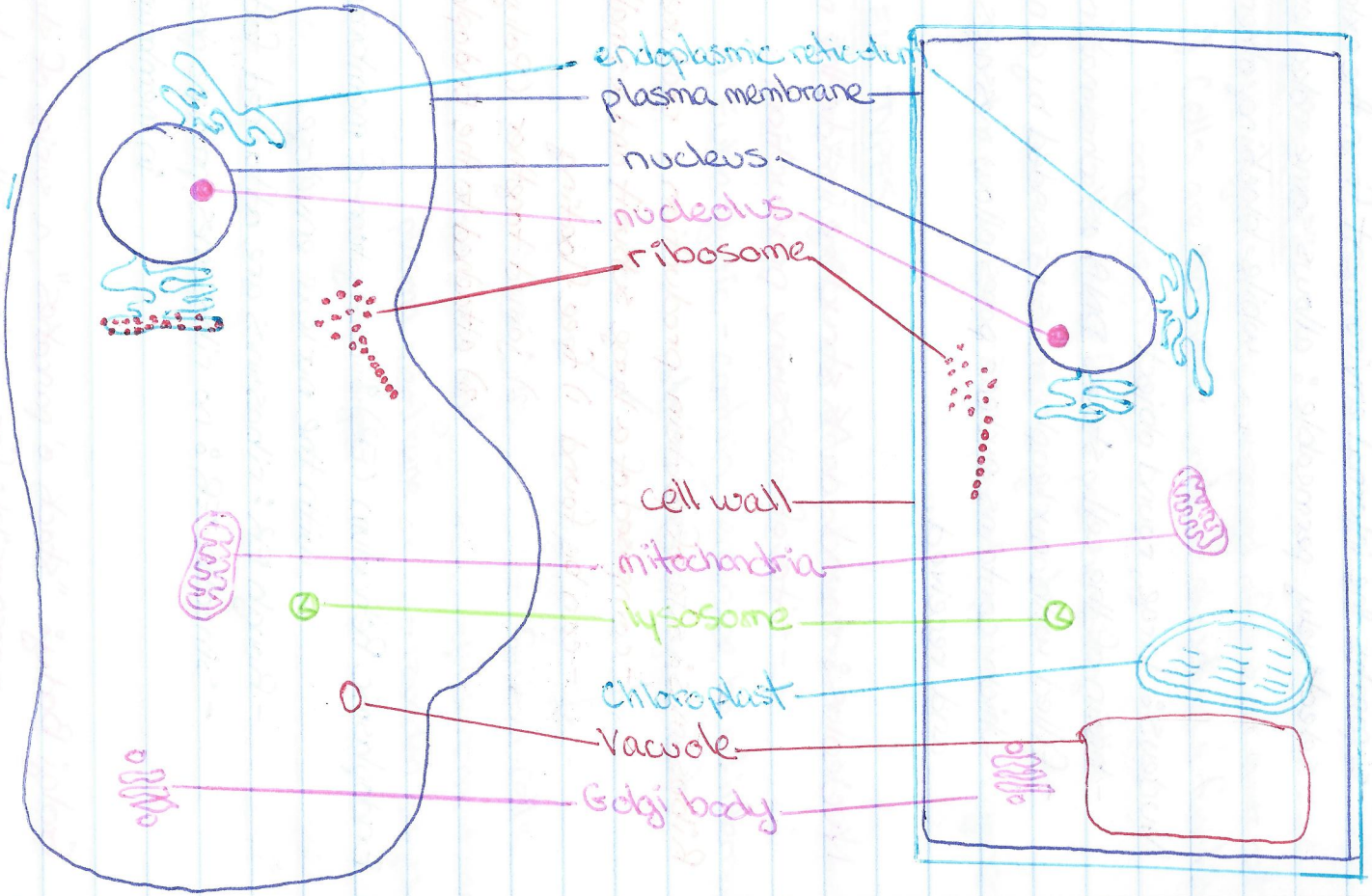
Endoplasmic Reticulum (ER): a system of membranes continuous with the nuclear envelope.
- Rough ER: ribosomes are attached, folds & modifies proteins
- Smooth ER: no ribosomes, produce phospholipids used in membrane construction.

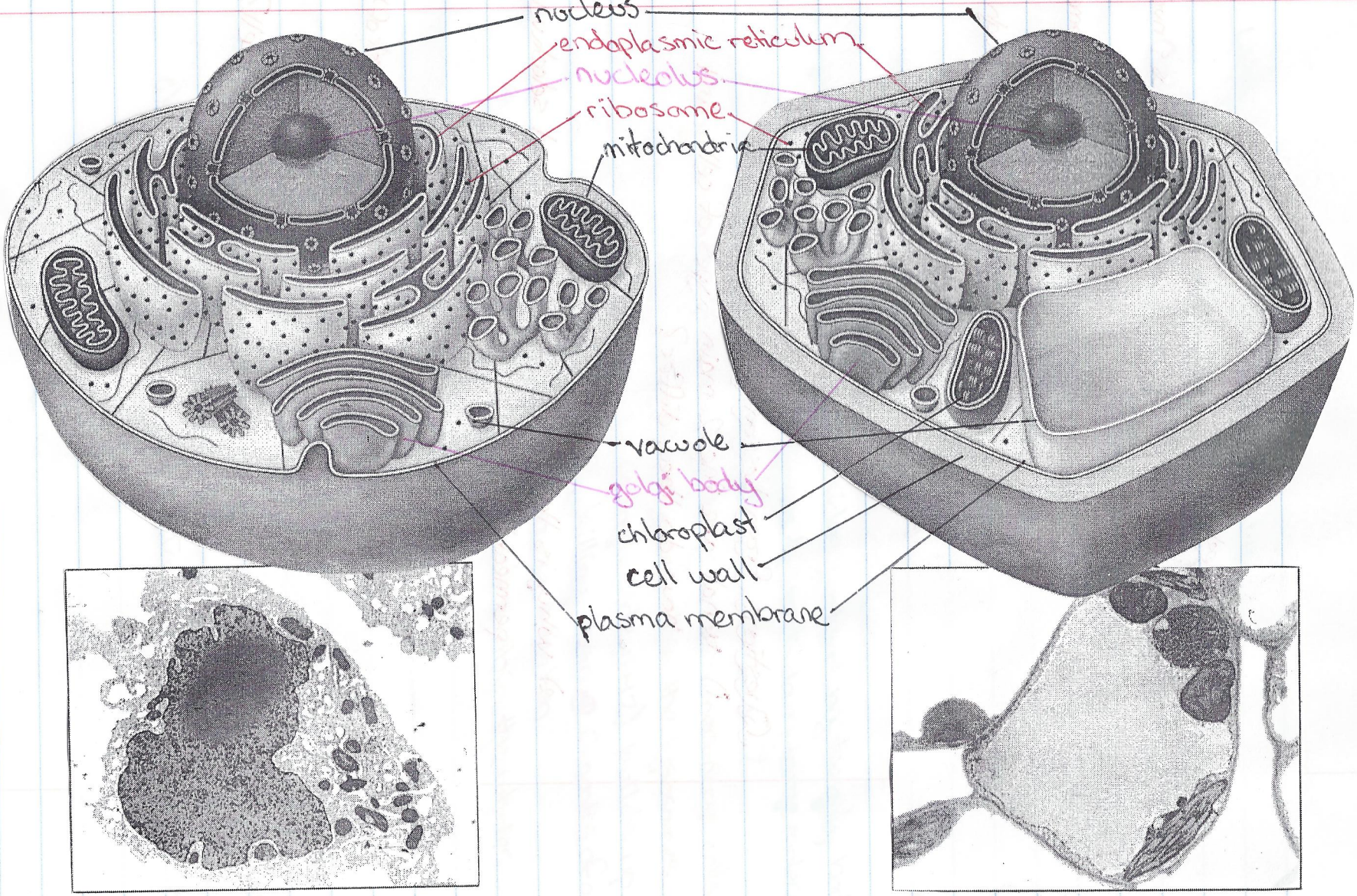
Golgi Body: "stack o' pancakes", a series of stacked membranes
- responsible for packaging cell products for export.



ANIMAL CELL

PLANT CELL




nucleus
endoplasmic reticulum
nucleolus
ribosome
mitochondria
vacuole
golgi body
chloroplast
cell wall
plasma membrane

## Review Questions

1) What is the difference between the nucleus & nucleolus?

2) Describe the 3 locations you may find a ribosome.

3) What is the difference between smooth and rough ER?

## Questions from Lesson 2

1) What are the 2 main types of cells and how do they differ?

2) Why is the plasma membrane termed selectively permeable?

3) How does the nucleus send messages to the rest of the cell?

4) Why is the nucleus termed the "Brain" of the cell?

LESSON 4 ORGANELLES CONT...

Cell Wall: plant cells only
- protective layer, made of cellulose located outside of the plasma membrane.
- provides strength to the plant.
- prevents the cell from bursting when storing large amounts of water.

TURGOR PRESSURE: pressure exerted by water on the cell wall.

Lysosomes: small membrane vesicles produced by the golgi body.
- contain digestive enzymes to break down large molecules.
- the "stomach" of the cell.

Tay-Sach's Disease: genetic disorder when nerve cells lack a digestive enzyme within the lysosomes.
- a large molecule (ganglioside GM2) builds up in the nerve cells, killing them @ 6 months of age: vision loss, muscles weaken
- a red spot (cherry spot) within the whites of the eyes is an indicator.

Review Questions

4) What is turgor pressure?

5) Why do plants need a cell wall, while animal cells do not?

6) Which body system does Tay-Sachs disease affect?

LESSON 5

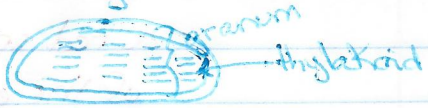
Mitochondria: the power house of the cell
- creates energy for the cell (and ur bodies) by converting sugar (glucose) into ATP (usable energy)
- has an outer membrane and a highly folded inner membrane.

- high energy cells (Brain or muscle) would contain more mitochondria, require more energy.
- contains DNA

Chloroplasts: plant cells only
- site of photosynthesis

$$6CO_2 + 6H_2O \xrightarrow{\text{sunlight}} C_6H_{12}O_6 + 9O_2$$

- has double membrane with internal discs (thylakoids) organized into stacks (grana) (granum)




- also contains a small amount of DNA

Vacuole: present in plants (large) and animals (small)
- large fluid storage area.
- stores mostly water.
- some waste products and toxins are stored here, transported by lysosome vesicles.

Create Flash Cards for 11 Cell Structures

| front | back | |
|---|---|---|
| Name | Diagram | Structure: |
| | | Function: |

LESSON 6

## ORGANELLE COOPERATION

- Create as many groups as you can of organelles whose functions are related.

ex. Chloroplasts and Mitochondria
- combine functions to produce energy
- chloroplasts trap energy of the sun and use it to produce glucose (photosynthesis)
- plants store excess glucose as starch.
- In animals glucose must be consumed.
- a molecule of glucose contains too much energy to be used at once.
- the mitochondria releases the energy slowly and stores it in ATP molecules. (glycolosis)

ex. Ribosomes, ER, and Golgi Body
- all 3 are involved in protein synthesis.
- proteins are a vital molecule for our bodies (hair, nails, skin, muscle, digestive enzymes)

1) Ribosomes: organize the building blocks (amino acids), into long chains (polypeptides)
2) ER: the ribosomes are attached here so they can feed the polypeptides directly in.
   - the shape of a protein determines its function
   - protein is packaged in an ER vesicle and sent to the Golgi Body.
3) Golgi Body: modifies and packages the final protein to ensure it reaches its final destination.

ex. Lysosomes and Vacuoles
- waste produced by lysosome digestion is stored in the vacuole.

Review Questions
1) Why do cells break glucose down into ATP?

2) Where do animals get their glucose from?

3) How do proteins benefit your body?

4) Which organelles are involved in protein production?

5) Why do ribosomes attach themselves to the ER?

LESSON 7

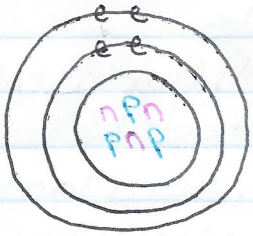
# Chemistry Review

**Matter**
(anything that has mass and takes up space)

- pure substances
  - elements
    - 1 atom type
  - compounds
    - ionic
    - covalent
- mixtures
  - heterogeneous
  - homogenous

## Atom Structure

- made up of protons, neutrons and electrons → nucleus




## Ionic Compounds

- molecules held together by opposite electric charges.

metal + non-metal

$Cu^{+2}Cl^{-2}_2$

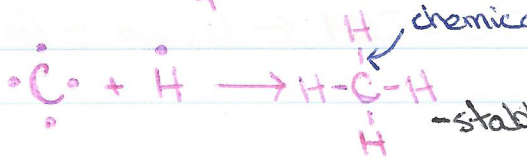
- stable because negative charges & positive charges are equal.

## Covalent Bond

- molecules held together by sharing electrons

non-metal + non-metal

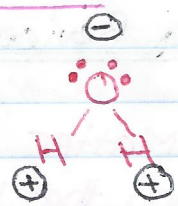
$CH_4$



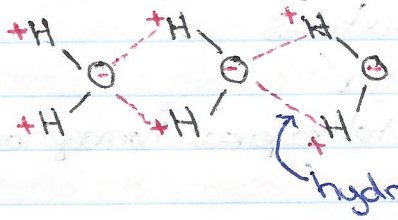

- stable b/c it has 8 electrons.

# BIOLOGICAL MOLECULES

Water $H_2O$



- a polar molecule b/c it has positive and negative "poles"




- hydrogen bonds form between $H_2O$ molecules b/c opposite charges attract.

***water is essential to life for many reasons:**

1) solid water is less dense than liquid water.
   - ice floats

Why is it vital to earth that ice can float?
- life would not exist b/c ice would sink, raise water levels, flood land, killing organisms.
- ice acts as an insulator for aquatic habitats, preventing total winter kill.

2) water has a high heat capacity
   - it takes a lot of energy to change the temperature of water.
   - our bodies (and the earth) are mostly water, the temperature is stabilized by water.

LESSON 8

3) High heat of vaporization
   - a lot of energy is needed to vaporize water.
   * sources of water do not easily evaporate.
   * slows dehydration
   * sweat & cools animals off

4) Water is a solvent (will dissolve most matter)
   - chemical reactions occur quickly in our bodies.

5) Water molecules are adhesive and cohesive.
   - allows syphoning (blood circulation, water transport in plants)

hydrophilic° water loving, dissolves in water
hydrophobic° water fearing, does not dissolve in water.

6) Water has a high surface tension.
   - water striders can walk on water.


## ACIDS

- a compound that donates a $H^+$ ion.
- formulas have hydrogen on the left

$HCl$ - hydrochloric acid
$CH_4$ - methane NOT an acid

$$HCl(s) + H_2O(l) \rightarrow H^+ + Cl^- + H_2O(l)$$

## BASES

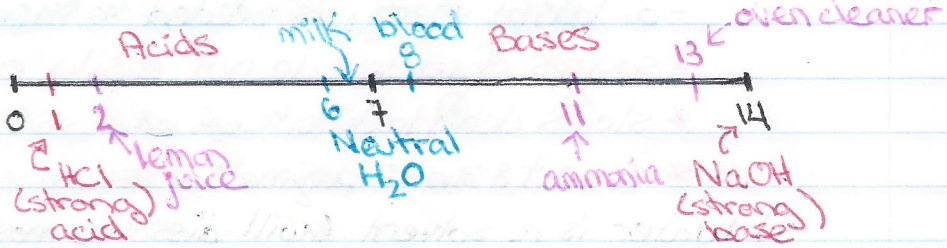
- compounds that donate a hydroxide ion ($OH^-$)

$NaOH$ - sodium hydroxide

$$NaOH(s) + H_2O(l) \rightarrow Na^+ + OH^- + H_2O(l)$$

## pH Scale

- measures the strengths of acids & bases.




- each increase in pH equals a power of 10 increase in strength.
  - HCl (pH 1) is 10x stronger than lemon juice.
  - Oven cleaner (pH 13) is $10^2$ times stronger than ammonia (pH 11) (100x)
  - Ammonia is 1000x stronger than blood.

## Review Questions

1) What happens to the concentration of hydrogen ions ($H^+$) in a beaker of pure water when an acid is added to it?

2) Give an example of a name and chemical formula of an acid.

3) What would be the pH of the water before adding an acid?

4) What happens to the pH of the solution as you add an acid to it?

5) If you begin with pure water that has a pH of 7 and add an acid until the solution had a pH of 4, how many more times acidic is the new solution compared to the pure water?

# Introduction to Chemistry & Biological Molecules Written Assignment

1. Define the following terms.
   a) element - substance consisting entirely of one type of atom.
   b) atom - basic unit of matter.
   c) matter - anything that takes up space and has ~~volume~~ mass.
   d) covalent bond - bond formed by the sharing of electrons between atoms.
   e) ionic bond - bond formed when one or more electrons are transferred from one atom to another.
   f) hydrogen bond - bond formed between $H_2O$ molecules because opposite charges attract.
   g) acid - compound that forms hydrogen ions ($H^+$) in solution.
   h) base - compound that produces hydroxide ions ($OH^-$) in solution.
   i) pH scale - measurement system used to indicate the concentration of hydrogen ions ($H^+$) in solution; ranges from 0 to 14.
   j) buffer - weak acid or base that can react with strong acids or bases to help prevent sharp, sudden changes in pH.
   k) hydrophilic - water loving, dissolves in water
   l) hydrophobic - water fearing, does not dissolve in water.
   m) atomic mass - the relative mass of an atom.
   n) atomic number - the number of protons in an atoms nucleus.

2. 

3. Molecule consists of multiple atoms to make a compound, atom consists of only 1 type of atom.

4 6 main properties of water.

1) solid water is less dense than liquid water.
2) water has a high heat capacity
3) high heat of vaporization
4) water is a solvent
5) water molecules are adhesive and cohesive.
6) water has a high surface tension

5 Acids: HCl pH 1
lemon juice pH 2
milk pH 6.5

Bases: Oven cleaner pH 13
NaOH pH 14
Ammonia pH 11

## LESSON 9

**Buffers** - molecules that absorb (react with) $H^+$ and $OH^-$ ions.

$H^+$ → acids  $OH^-$ → bases

* our bodies need to maintain a constant pH.

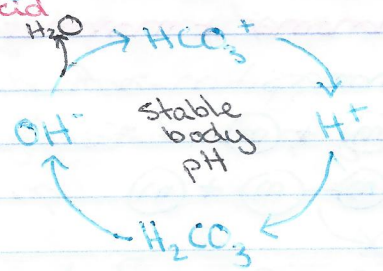
Acidosis: condition where blood pH is too low ↑ $H^+$

Alkalosis: condition where blood pH is too high ↑ $OH^-$

ex. bicarbonate

$HCO_3^-$ (bicarbonate) $+ H^+ \rightarrow H_2CO_3$

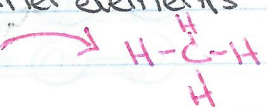
$H_2CO_3$ (carbonic acid) $+ OH^- \rightarrow H_2O + HCO_3^-$

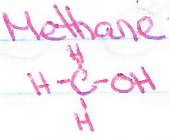



## LESSON 10

### Organic vs. Inorganic Molecules

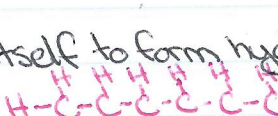
**ORGANIC**: always contain CARBON
- originate from living sources
- also contain HYDROGEN
- may also contain other elements

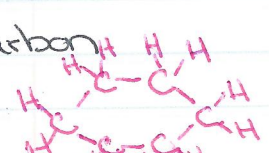
ex. $CH_4$ Methane → 

$CH_3OH$ methanol → 

- carbon can link to itself to form hydrocarbon chains or rings.

$C_6H_{14}$ hexane





INORGANIC: may contain carbon or hydrogen but not both.

ex. $CO_2$, $H_2O$, NaCl

POLYMER MOLECULES

→ biological molecules are usually quite large.

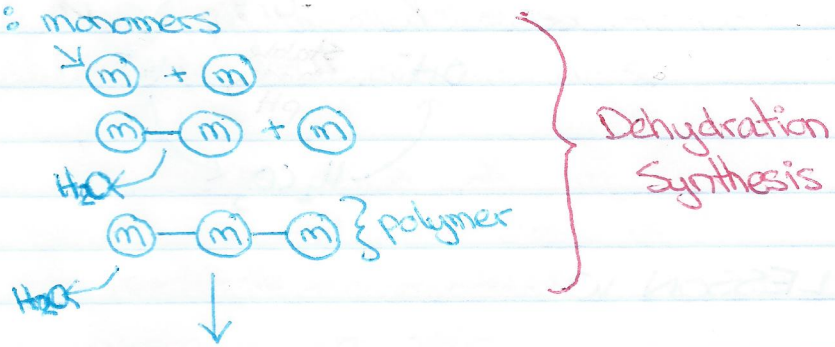
→ polymers are large molecules formed by joining single, smaller molecules (monomers) together repeatedly.

ex. - cellulose is a polymer of glucose monomers.

- polymers are made through a <u>dehydration synthesis reaction.</u>

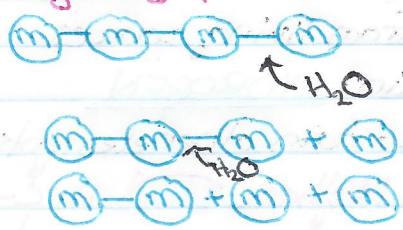
monomer + monomer → polymer + water

(m): monomers




HYDROLYSIS: is the breakup of polymers into their monomers.

ex. digesting proteins into amino acids.




- dehydration synthesis and hydrolysis are opposite to each other.

## Comprehension Questions

1) Label as organic or inorganic

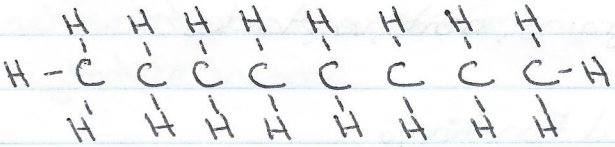
a) $CH_4$ organic

b) $MgCl_2$ inorganic

c) $NO_2$ inorganic

d) $C_6H_{12}O_6$ organic

2) Draw a diagram of $C_8H_{18}$ as a hydrocarbon chain.



3) In one or two sentences, compare dehydration synthesis reactions with hydrolysis reactions.

- opposite of each other
- dehydration synthesis forms polymers while hydrolysis breaks them up.

LESSON 11

## CARBOHYDRATES

carbon, hydrogen, oxygen.
1° 2° 1°

- organic
- poly
- glucose
- food
- healthy
- grains, fruits, vegetables

- diabetes
- starch
- calories
- spaghetti
- essential to life

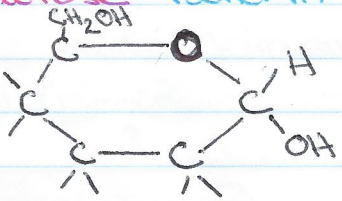
### General Function:

1) short term energy storage in plants and animals.
2) structural support for plants and protection for animals.
3) cell recognition - allows recognition of foreign invaders.

### 3 main Categories of Carbohydrates exist:

1) Monosaccharides (simple sugars)
   - consist of one carbohydrate monomer.

glucose - blood sugar
fructose - fruit sugar
galactose - found in milk




- monosaccharides are the monomers used to build larger carbohydrate polymers

2) Disaccharides

- 2 monosaccharides undergo dehydration synthesis to form a disaccharide.

ex. glucose + glucose $\underset{\text{hydrolysis}}{\overset{\text{dehydration synthesis}}{\rightleftharpoons}}$ maltose + $H_2O$

maltose - 2 glucose monomers (beer sugar)

sucrose - glucose + fructose (table sugar)

lactose - glucose + galactose (milk sugar)

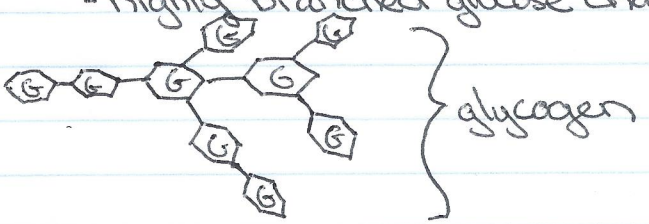
↳ lactose intolerance is the body's inability to hydrolize lactose.

3) Polysaccharides

- complex carbohydrates, large polymers built from monosaccharides.

starch - energy storage in <u>plants</u>
- polymer built of glucose monomers
- potatoes, yams, corn, pasta

glycogen - energy storage in <u>animals</u>
- built of glucose monomers
- highly branched glucose chains




* stored in the liver, some in muscle cells.

cellulose - structural support for <u>plants</u> (cell wall, wood)
- polymer of glucose monomers
- source of fiber in our diets
- bonds between glucose are unable to be broken by human digestion.

chitin - structural support for some <u>animals</u> (exoskeleton)
- polymer of glucose monomers
- insects, lobsters, crabs

LESSON 12

## LIPIDS (Fats and Oils)

- good fats & bad fats
- Omega 3 fats - heart attack
- oils, steroid, fatty acids,
- unsaturated vs. saturated
- peanut butter oils
- phospholipid bilayer.
- animal fat and vegetable oil
- butter, lard
- calories

GENERAL FUNCTION:

1) Long term energy storage
2) Components of cell membranes
3) Insulation / protect major organs

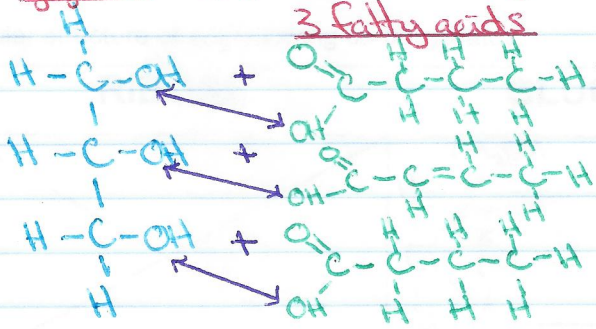
* all lipids are hydrophobic "water-fearing", do not dissolve in water.

General Structure:

- composed of glyceral and fatty acids

glycerol 1 glyceral + 3 fatty acids ⇌ (dehydration synthesis / hydrolysis) triglyceride + $3H_2O$

↳ fats & oils

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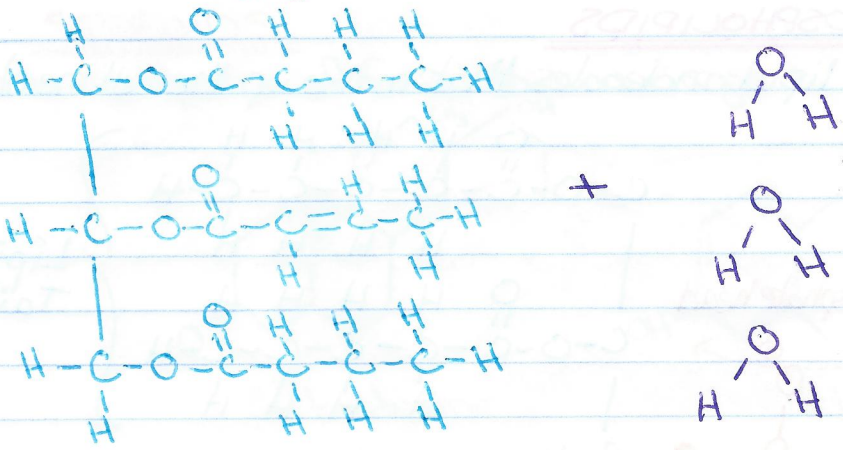
Triglyceride + $H_2O$



Saturated fatty acids have no double bonds
(saturated with hydrogen)
- allows triglycerides to pack tightly together, forming solid fats. (animal fats)

Unsaturated fatty acids have double bonds in the carbon tail.
- loosely packed triglycerides are liquid (oils, usually plant derived)
ex. canola oil, sesame oil, nut oils, olive oil

**First Nations » BI12 » Resources » Lipids Written Response Questions**

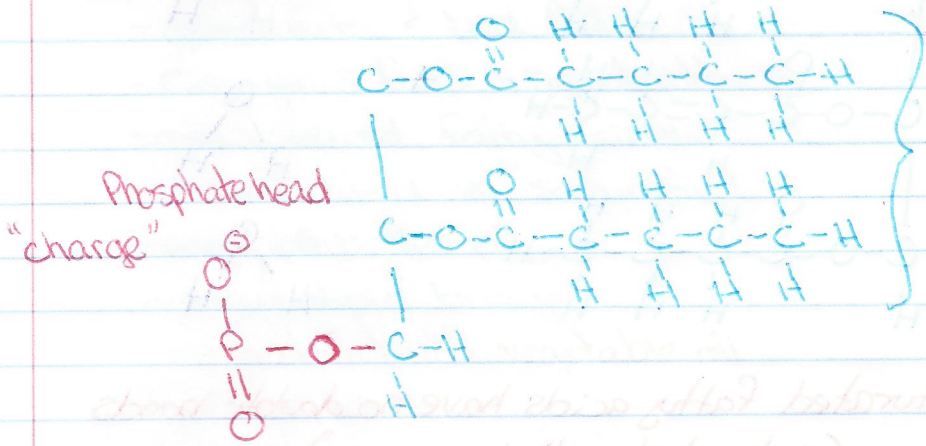
1. What two subunits combine to make a fat?
1 glycerol + 3 fatty acids
2. Suppose you are viewing a model of a fatty acid. How can you determine if the model represents a saturated or an unsaturated fat?
presence of double bonds indicates unsaturated.
3. What process is responsible for forming fats?
dehydration synthesis
4. Name two different types of steroids.
testosterone and estrogen
5. Why are fats referred to as triglycerides?
tri refers to 3 fatty acids, glyceride refers to glycerol
6. Phospholipids are special fat molecules that make up most of the cell membrane. How do the structure of phospholipids and neutral fats differ?
Triglycerides | Phospholipids
3 fatty acid tails attached to glycerol | - hydrophilic head - hydrophobic tail | 2 fatty acid tails and phosphate attached
7. Describe the basic structure of a steroid, and identify how steroids differ in structure from each other.
fused carbon rings. Differ in type and location of functional groups to glycerol
8. Name two reasons why cholesterol is important in our bodies.
→ stabilizer, makes other steroids.

↳ to be completed after Lesson 13

LESSON 13

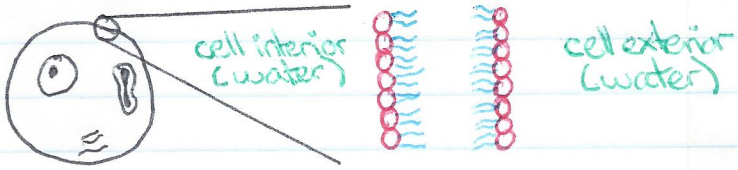
## PHOSPHOLIPIDS

- lipid molecules that make up the cell membrane.



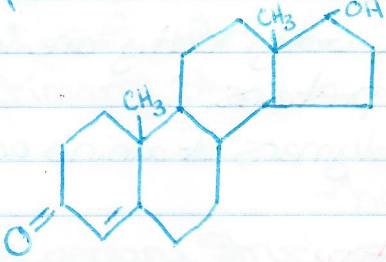


- When 2 phospholipids meet, the heads are repelled by the tails.
- naturally arrange themselves into a "bilayer"

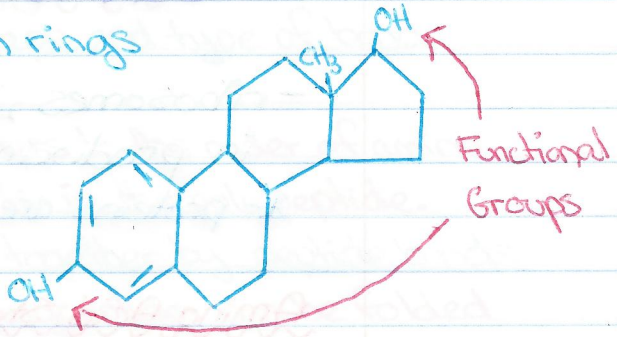


## STEROIDS

- composed of fused carbon rings




Testosterone




Estrogen

* steroids differ in the type and location of functional groups.

Cholesterol: functions as a stabilizer in cell membranes, also used to make other steroids.

LESSON 14

## PROTEINS

- meat, eggs, beans, amino acids, muscle, energy, nuts, yogurt, seeds, peanut butter, quinoa, tofu, protein supplements.

GENERAL FUNCTIONS:

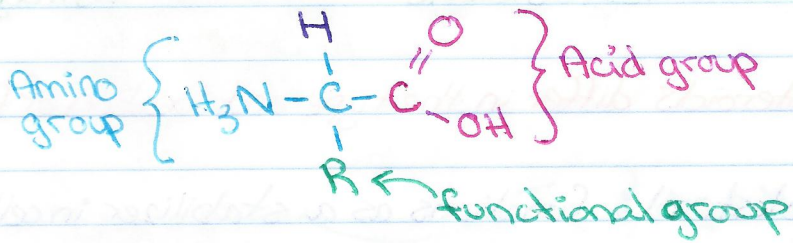
1) Oxygen transport (hemoglobin)
2) Provides structure to a. skin, ligaments, tendons (collagen)
   b. hair, nails, baleen (keratin)
3) Muscle contraction (actin & myosin)
4) Chemical messengers (hormones)
5) Enzymes - speed up chemical reactions (lactase)

LESSON 15

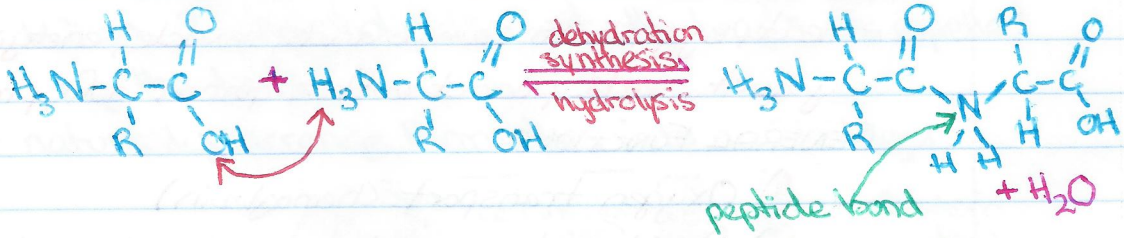
- ribosomes, ER, Golgi body are involved in producing proteins.

* proteins are polymers of amino acid monomers.

## Amino Acid Structure




- there are 20 different amino acids each with a specific functional group.




a.a + a.a ⇌ dipeptide + water

- a long chain of many amino acids is called a polypeptide.

## LEVELS OF PROTEIN STRUCTURE

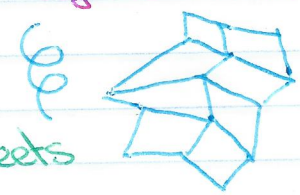
→ each level will have a shape and type of bond associated with it.

1) Primary Structure: refers to the order of amino acids in the polypeptide.
   - held together by peptide bonds

2) Secondary Structure: polypeptides can be folded by the ER into shapes.

a. helices

b. pleated sheets

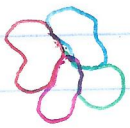


hydrogen bonding holds these shapes into place.

3) Tertiary Structure: how the helices or sheets are arranged in 3D space.

disulfide bonds hold tertiary structures together.

4) Quartenary Structure: describes how tertiary structures can be arranged 3dimensionally



covalent bonds hold these structures together

## Review Questions

1) What monomer makes proteins? amino acids
2) What is the bond type for each level of protein structure?
   primary-peptide, secondary-hydrogen, tertiary-disulfide, quartenary-covalent
3) How many of the monomers are there & how do they differ?
   20 amino acids, each with a different functional group.

LESSON 16

NUCLEIC ACIDS - are polymers composed of nucleotide monomers.

General Function:

1) store and transmit genetic information

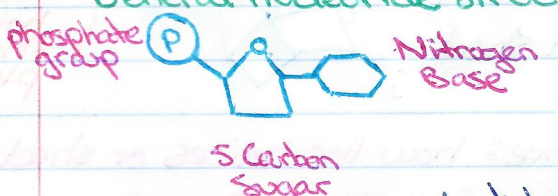
DNA: deoxyribose nucleic acid

RNA: ribose nucleic acid

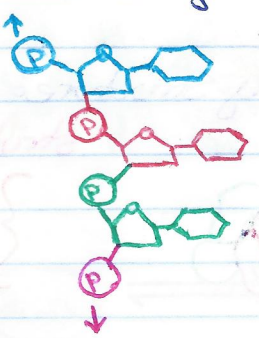
2) usuable energy currency within the cell.

ATP: adenosine triphosphate

General nucleotide structure:




- nucleotides form polymers through dehydration synthesis with the phosphates connecting to the sugars.



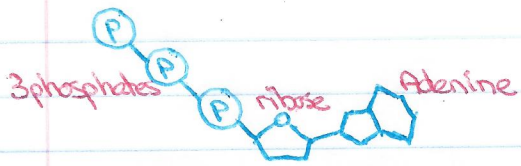

Comparing DNA with RNA:

| DNA | RNA |
|---|---|
| - 5 carbon sugar is "deoxyribose" | - 5 carbon sugar is "ribose" |
| - forms a "double helix" ↙ a double strand of nucleotide polymers twisted around itself. | a single strand of nucleotide polymers. |
| Nitrogen Bases: 1) Adenine 2) Guanine 3) Cytosine 4) Thymine | Nitrogen Bases: 1) Adenine 2) Guanine 3) Cytosine 4) Uracil |

cont...

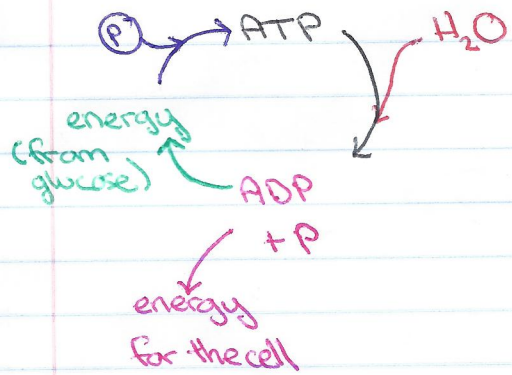
| DNA | RNA |
| --- | --- |
| - location: mainly in nucleus | - produced in the nucleus, located in both nucleus & cytoplasm. |

ATP: Adenosine Triphosphate → a single nucleotide with a 5 carbon sugar (ribose), a nitrogen base (adenine) and 3 phosphate groups.




- energy is stored in the bonds between phosphates.
- $H_2O$ is added to the last phosphate bond to hydrolize it and release energy.

LESSON 17



# Written-response Questions

## Instructions

1. What do the letters ATP stand for?

Adenosine Triphosphate

2. Describe the three subunits that make up an ATP molecule.

1) 3 phosphate groups
2) Nitrogen base (adenine)
3) 5 Carbon sugar (ribose)

3. Why must ATP molecules be created in a cell? Why can't glucose molecules be used on their own?

created in mitochondria found in a cell.
ATP contains a small, useable amount of energy.
Glucose molecules contain too much.

4. How is energy created from an ATP molecule?

The last P bond is hydrolyzed releasing energy.

5. Once a molecule of ATP is broken down to release energy, is it no longer available to the cell? Explain.

ADP reforms into ATP with energy from Glucose.
It is recycled.

6. Both nucleic acids are composed of many nucleotides. Nucleotides are composed of three main parts. Name these three parts.

1) 1 phosphate group
2) Nitrogen base
3) 5 Carbon sugar

7. DNA has four different types of bases (named bases because their presence raises the pH of a solution). Name these bases.

Adenine, Guanine, Cytosine, Thymine

LESSON 19

In a solution, the dissolved substances are the solutes. The substance dissolving the solutes is termed the solvent.
ex. In a salt water solution, the salt is the solute, and the water is the solvent.

* When living cells are placed in a solution, water will move in a predictable way.

Isotonic to the cell
water moves into and out of the cell equally.

Hypertonic to the cell
Net movement of water is out of the cell. Cell will shrivel.
Cell lysis will occur (Death)

Hypotonic to the cell.
Net movement into the cell.
Cell will swell and burst.
Cell crenation will occur (Death)

Plant Adaptations to Concentration Differences

- the cell wall prevents plant cells from bursting when placed in pure water.
- when water enters a cell, it is taken up by the vacuole which swells, putting pressure on the cell wall. (Turgor Pressure)

Animal Adaptations to Concentration Differences

- animal cells are surrounded by body fluid which our bodies can control the solute concentration of.
- the kidney is the organ that controls the levels of dissolved solutes in our blood and other body fluids.

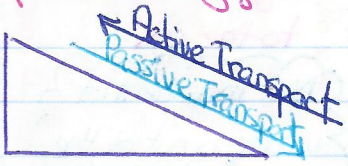
## Factors affecting the rate of Passive Transport

- diffusion, facilitated diffusion and osmosis have different rates depending on:
  1) Temperature ↑ temp ↑ rate
  2) Concentration ↑ conc ↑ rate
  3) Pressure ↑ pressure ↓ rate
  4) Molecule size - smaller molecules can fit through the phospholipid bilayer and diffuse faster.

LESSON 20

## Active Transport

- cells move some molecules against the concentration gradient.
- This requires energy (ATP)




- protein pumps are one method
- An example is the "sodium potassium pump" Na/K pump
- this transmembrane pump moves 3 $Na^+$ ions out of the cell and 2 $K^+$ ions of the cell.

Q1. How many of each ion and in what directions does the pump move?

Q2. Describe how the protein pump actually moves these ions from one side of the membrane to the other.

- $Na^+$ bind to the pump from cell interior
- ATP is used
- pump changes shape, releases $Na^+$ to the exterior.
- $K^+$ binds to the pump.
- shape of the pump returns to normal, $K^+$ is released.

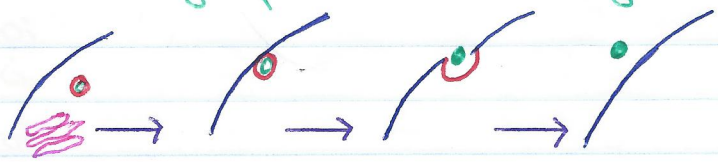
Q3. What is the role of ATP in this process?

# LESSON 21

- $3Na^+$ moved out, $2K^+$ are moved in
- the inside of the cell becomes negatively charged.
- this creates an electrical potential across the membrane
- nerve cells and muscle cells use the electrical potential to function.

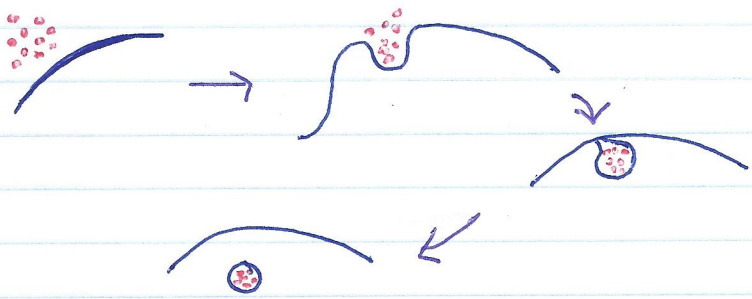
## Exocytosis

- active transport moving large molecules out of the cell.
  ex. golgi body releasing a veside (exo = exterior) containing a protein and releasing it outside the cell.



## Endocytosis

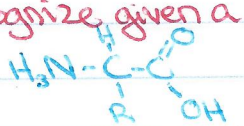
- the cell engulfs large particles
  2 Types: a) Phagocytosis - engulfing large particles (ex. bacteria)
  b) Pinocytosis - engulfing a number of smaller particles (ex. liquids)



## Instructions

1. How is active transport different from facilitated transport?
   Active transport requires energy to move against the concentration gradient.
2. What special mechanism maintains a higher than normal sodium ion concentration on one side of certain cell membranes and a higher than normal potassium ion concentration on the other side of the cell membranes? Describe this special mechanism and the number of sodium ions and potassium ions involved in one cycle of this mechanism.
3. Distinguish between phagocytosis and pinocytosis.
4. A biochemist working on a banana leaf is studying the plant's cells. The chemist finds that the concentration of phosphates inside the cells is about 125 mg/L while the concentration of phosphates outside the cell is only 15 mg/L.
   A. In which direction would you predict the phosphate molecules will move? Explain.
   B. The chemist finds that the cells are actually accumulating more and more phosphates. What method of transport is at work? Explain.

# Unit 1: Cell Biology

1. Living vs. Non-living
2. Plant cell / animal cell
3. Organelles (structure, function, recognize from diagram)
4. Chemistry - ionic or covalent bond
   - acids & bases
   - pH scale
5. Biological Molecules 1) What is the monomer?
   2) Recognize, given a molecule image.
   ex.  Amino Acid

   Carbohydrates
   Lipids (fats, oils, phospholipids, steroids)
   ↳ differences, structure, function, recognize.
   Proteins - levels of structure (types of bonds)
   Nucleic Acids - nucleotide monomer
   - DNA, RNA, ATP (compare, contrast, recognize)
6. Transport Across Membranes
   Passive: diffusion, facilitated diffusion, osmosis (hyper, hypo, isotonic)
   Active: $Na^+/K^+$ pump, exocytosis, endocytosis (pino vs. phago)