Science 10: Course Review

Unit 1: Chemistry

1. The following scientists are associated with models of the atom. Describe their model.
   a. Rutherford ~ 'Solar System model' → to account for the deflection of alpha (+) particles. Centre of every atom has a positively charged nucleus. Nucleus accounts for majority of mass, electrons orbit around nucleus, in solar system like pattern. (neutron = no charge, but similar mass to a proton.
   b. Dalton ~ 'Billiard Ball model' → to explain the interaction of chemicals. Matter is composed of small, indivisible particles (atoms), atoms of the same element are identical in mass & size. Atoms are in constant motion & reactions change the way that atoms are arranged.

   * c. Bohr ~ "bullseye" / energy levels ~ electrons orbit specific orbitals called energy levels / election cells, transitions of electrons to higher energy levels requires energy, and transitions to lower energy levels produce electromagnetic radiation.

   d. Thomson ~ 'Raisin Bun Model' → to explain negative charges in the atom: Atom = positively charged sphere where negatively charged electrons are embedded.
   -Atom has no charge

2. Complete the following table

don't need to know this

Subatomic Particle	Relative Charge	Symbol	Location	Mass (g)
proton	positive (+1)	p^+	nucleus of atom	1.67×10^{-24}
neutron	no charge (0)	n^0	nucleus of atom	1.67×10^{-24}
electron	negative (-1)	e^-	outer region of atom	9.11×10^{-31}

3. What is the atomic number? How is it related to number of protons? Where is it located on periodic table? The atomic # is the number of protons in the nucleus of an atom of a particular element. It is located on the top left hand corner of each element, on the periodic table.

4. What is atomic mass? Where is it located on periodic table?
   Atomic mass is the mass of one mol of atoms of an element, expressed in g/mol and is located in the top right corner of each element. = p+n = (n°)

tope? Explain using an example.

An Isotope is an atom that has the same number of protons, but different numbers of neutrons; therefore having a different mass. Ex ~ carbon 12 & carbon 13. ~but are chemically alike.

6. Using nuclear notation, indicate the atomic number, mass number (of the most common isotope) and symbol of the following atoms.

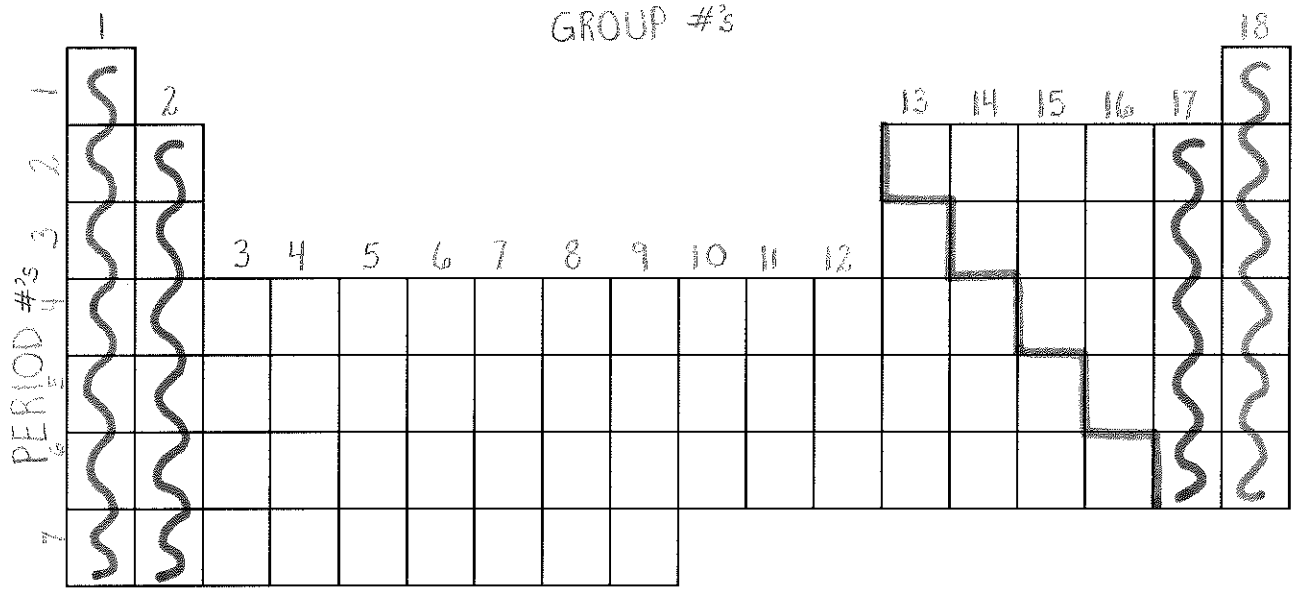
Fluorine 19.00 1- 9 F	**Sodium** 22.99 1+ 11 Na	**Argon** 39.95 18 Ar	**Magnesium** 24.31 2+ 12 Mg

7. Using nuclear notation, indicate the atomic number, mass number and symbol of the following isotopes.

Carbon-12 12 6 C	**Carbon-13** 13 6 C	**Carbon-14** 14 6 C

8. Complete the following tables and then place the labels on the periodic table.

Label	Definition / Characteristic
Period	a horizontal row in the periodic table.
Group	a vertical column in the periodic table.
alkali metals	consists of elements in group 1
alkaline earth metals	consists of elements in group 2
halogens	consists of elements in group 17
noble gases	consists of elements in group 18
staircase	



9. Use your periodic table to complete the following:

	Element Name	IUPAC Symbol	Atomic Number	Group Number	Period Number	Metal (m) or Nonmetal(nm)	Family/Series Name
1.	chlorine	Cl	17	17	3	(nm)	halogens
2.	magnesium	Mg	12	2	3	(m)	alkaline earth metals
* 3.	zinc	Zn	30	12	4	(m)	transition metals
4.	nitrogen	N	7	15	2	(nm)	----------
5.	iodine	I	53	17	5	(nm)	halogens
* 6.	gold	Au	79	11	6	(m)	transition metals
7.	Sodium	Na	11	1	3	(m)	alkali metals
* 8.	thorium	Th	90	3	7	(m)	actinoids

10. Fill in the following prefixes on the table below.

Number	Prefix	Number	Prefix
1	mono-	6	hecta-
2	di-	7	hepta-
3	tri-	8	octa-
4	tetra-	9	nona-
5	Penta-	10	deca-

11. Summarize the three rules for naming and writing the formula for binary molecular compounds.

#1 ~ use the name of the element farthest to the left on the periodic table.
#2 ~ use the name of the element farthest to the right on the periodic table. (attach -ide to end).
#3 ~ attach a 'prefix' to each name (# of atoms per molecule). → no 'mono' for 1st element.

12. Write the correct chemical name for each of the following molecular compounds:

	Chemical Formula	Chemical Name
1.	O_2 (g)	oxygen
2.	$P_2O_{5(s)}$	diphosphorous pentaoxide (solid)
3.	HCl (g)	hydrogen chloride
4.	$NH_{3(g)}$	ammonia (gas)
5.	N_2Cl_4 (l)	dinitrogen tetrachloride (liquid)
6.	$ICl_{5(s)}$	iodine pentachloride (solid)
7.	CH_4 (g)	methane

13. What is an ion?

An ion is an atom or group of atoms that carry a (+) or (-) electrical charge.

14. In which states/form do you find ions? (solutions or solids or gases etc)

Solids (s), & solutions (aq).

15. What type of compounds have ions (ionic, molecular, acid,base?) why? Give and example

Ionic, acids, bases.

16. Complete the following table

	English Name	International Symbol	Number of Protons	Number of Electrons	Number of electrons gained	Net Charge
1.	neon atom	Ne	10	10	none	0
2.	lithium ion	Li	3	2	lost 1	1+
3.	Silver ion	Ag	47	46	lost 1	1+
4.	Sulfur ion	S	16	18	gained 2	2-
5.	Silicon atom	Si	14	14	0	0
6.	arsenic ion	As	33	36	gained 3	3-
7.	cesium ion	Cs	55	54	lost 1	1+
8.	Zinc ion	Zn	30	28	lost 2	2+

17. State the rules for writing the names of binary ionic compounds, and give an example

First, use the full name of the cation (usually metal). Then put the name of the anion (usually non-metal), & add -ide to the ending. NO PREFIXS for ionic compounds.

18. Write the correct chemical name for each of the following ionic compounds:

	Chemical Formula	Chemical Name
1.	$SrCl_{2(s)}$	Strontium chloride
2.	$RbBr_{(s)}$	rubidium bromide
3.	$Na_2O_{(s)}$	Sodium oxide
4.	Al_2S_3 (s)	aluminum sulfide
5.	$ZnCl_2$ (aq)	zinc chloride
6.	$MgCl_2$ (aq)	magnesium chloride

7.	$CoCl_{2(s)}$	Cobalt (II) chloride
8.	$TiO_{2(s)}$	titanium (IV) oxide
9.	$Cu_2O_{(s)}$	Copper (I) oxide
10.	$SnS_{(s)}$	tin(II) sulfide

19. What is a polyatomic ion? Give an example.

a polyatomic ion consists of 2 or more different atoms joined together by covalent bonds, either containing a (+) or (-) charge.

Ex = carbonate (CO_3^{2-})

20. Complete the following chart.

Chemical Formula		Name of Compound
1.	$AlCl_{3(s)}$	Aluminum chloride
2.	$NaI_{(s)}$	Sodium iodide
3.	$MgO_{(s)}$	magnesium oxide
4.	$K_2S_{(s)}$	potassium sulfide
5.	$CaF_{2(s)}$	Calcium fluoride
6.	$GaBr_{3(s)}$	gallium bromide
7.	$MgCO_{3(s)}$	magnesium carbonate
8.	$Na_2SO_{4(s)}$	Sodium sulfate

21. Identify the properties of ionic and molecular compounds

Ionic	Molecular
State at room temp: "Solid" (hard, brittle, crystal lattice shape).	~ Solid, liquid, or gas!
melting point = high!	~ low
attraction between molecules: strong crystal lattice.	~ weaker
Conductivity when solid? ~ No, molecules held rigidly in crystal lattice shape.	~ NO

Conductivity when dissolved in water or melted?

~ Yes, electrolyte (ions form).

tend to be non-electrolytes.

25. Fill in the following chart

	Acids	Bases
pH	less than 7. (<7)	greater than 7. (>7)
Litmus	turns blue litmus red.	turns red litmus blue.
bromthymal blue	~yellow~	~blue~
phenolphthalein	~colourless~	~pink~/purple
conductivity	Conductive when in solution	conducts electricity ✓
reaction with metal	yes, to produce hydrogen gas.	don't react with zinc/yes
Solubility	yes, to some degree.	Some soluble in water (slightly soluble)
Taste	Sour!	bitter!

26. Complete the following chart

	ionic (i) molecular (m) or acidic (a)	Chemical Formula	Solubility (high or low)	Chemical Name
1.	ionic	$PbI_{2(s)}$	low	lead (II) iodide
2.	acidic	$HMnO_4$ (aq)	High	permanganic acid
3.	ionic	$NaHS_{(s)}$	----------	Sodium hydrogen sulfide
4.	acidic	H_2SO_3 (aq)	High	sulfurous acid
5.	molecular	$H_2O_{2(l)}$	----------	hydrogen peroxide
6.	ionic	Ti_2O_4 / TiO_2 (s)	High	titanium (IV) oxide
7.	acidic	$HCl_{(aq)}$	High	hydrochloric acid
8.	acidic	$H_2S_{(aq)}$	High	hydrosulfuric acid
9.	ionic	Ga_2S_3 (s)	low	gallium sulphide
10.	acidic	H_2SO_4 (aq)	High	sulfuric acid

27. Write balanced chemical equations for the following reactions (include the states of matter)

water → hydrogen + oxygen

$2H_2O_{(l)} \rightarrow 2H_{2(g)} + O_{2(g)}$

Decomp.

nitrogen + hydrogen → ammonia

$N_{2(g)} + 3H_{2(g)} = 2NH_{3(g)}$

Form.

sulfuric acid + aqueous sodium hydroxide → water + aqueous sodium sulphate

$H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow 2H_2O_{(l)} + Na_2SO_{4(aq)}$

2HOH

DR

aluminum + aqueous copper (II) nitrate → copper + aqueous aluminum nitrate

$2Al_{(s)} + 3Cu(NO_3)_{2(aq)} \rightarrow 3Cu_{(s)} + 2Al(NO_3)_{3(aq)}$

SR.

chlorine + aqueous potassium bromide → bromine + aqueous potassium chloride

* $Cl_{2(g)} + 2KBr_{(aq)} \rightarrow Br_{2(l)} + 2KCl_{(aq)}$ ✓

8R

28. Balance the following chemical reactions:

a. $1\ Ni_{(s)} + 2\ HCl_{(aq)} \rightarrow 1\ NiCl_{2(aq)} + 1\ H_{2(g)}$

b. $1\ Ca(OH)_{2(s)} + 2\ HCl_{(aq)} \rightarrow 1\ CaCl_{2(aq)} + 2\ HOH_{(g)}$

c. $1\ Cl_{2(s)} + 2\ NaBr_{(aq)} \rightarrow 1\ Br_{2(l)} + 2\ NaCl_{(aq)}$

d. $2\ Cr_2O_{3(s)} \rightarrow 4\ Cr_{(s)} + 3\ O_{2(g)}$

e. $2\ Fe_{(s)} + 6\ HCl_{(aq)} \rightarrow 2\ FeCl_{3(aq)} + 3\ H_{2(g)}$

(f.) $2\ C_3H_{6(g)} + 9\ O_{2(g)} \rightarrow 6\ CO_{2(g)} + 6\ H_2O_{(g)}$

C - ~~6~~ 6
H - ~~12~~ 12
O - ~~18~~ 18

C - 6
H - 12
O - 18

g. $1\ P_{4(s)} + 6\ F_{2(g)} \rightarrow 4\ PF_{3(l)}$

29. For each of the following, **classify** the reaction type and predict the **balanced chemical equation**. Provide the **word equation** as well.

a. $4Al_{(s)} + 3O_{2(g)} \rightarrow 2Al_2O_3$

(formation)

aluminum (s) + oxygen (g) → aluminum oxide

b. $2Ag_2O_{(s)} \rightarrow 4Ag\ (s) + O_2\ (g)$

(decomposition)

Silver oxide (s) → Silver (s) + oxygen (g)

(c.) $Br_{2(l)} + 2KI_{(aq)} \rightarrow I_2\ (s) + 2KBr\ (aq)$

(single replacement)

bromine + potassium iodide → iodine + potassium bromide

d. A strip of zinc metal is placed into a copper (II) nitrate solution.

$Zn_{(s)} + Cu(NO_3)_{2\,(aq)} \longrightarrow Cu_{(s)} + Zn(NO_3)_{2\,(aq)}$

Zinc + copper (II) nitrate ---> copper (II) + zinc nitrate

- Single replacement

e. $BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow 2NaCl_{(aq)} + BaSO_{4\,(s)}$

barium chloride + Sodium sulfate ⟶ sodium chloride + barium sulfate

- double replacement.

23. Calculate the molar mass of the following substances ✳

Na_2SO_4 $= 2 \times Na = 2 \times 22.99 = 45.98$ $= 1 \times S = 1 \times 32.07 = 32.07$ $= 4 \times O = 4 \times 16.00 = 64$ $45.98 + 32.07 + 64 = 142.05$ g/mol	H_2O $= 2 \times H = 2 \times 1.01 = 2.02$ $= 1 \times O = 1 \times 16.00 = 16.00$ $16.00 + 2.02 = 18.02$ g/mol	calcium hydroxide = $Ca(OH)_2$ $= Ca \times 1 = 40.08 \times 1 = 40.08$ $= O \times 2 = 2 \times 16.00 = 32$ $= H \times 2 = 2 \times 1.01 = 2.02$ $40.08 + 32 + 2.02 = 74.1$ g/mol
tetraphosphorus pentaoxide ~ P_4O_5 $P \times 4 = 4 \times 30.97 = 123.88$ $O \times 5 = 5 \times 16.00 = 80$ $123.88 + 80 = 203.88$ g/mol	$MgSiO_3$ $= 1 \times Mg = 1 \times 24.31 = 24.31$ $= 1 \times Si = 1 \times 28.09 = 28.09$ $= O \times 3 = 3 \times 16.00 = 48$ $24.31 + 28.09 + 48 = 100.4$ g/mol	NH_3 ammonia $1 \times N = 1 \times 14.01 = 14.01$ $H \times 3 = 3 \times 1.01 = 3.03$ $14.01 + 3.03 = 17.04$ g/mol

24. Answer the questions in the following table.

How many moles in 15 g of silicon? $n = \frac{m}{M}$, so $n = \frac{15}{28.09}$ $m = 15$g $M = 28.09$ mol $n = 0.533997864...$ $n = 0.53$mols	How many moles in 1670 g of hydrocholic acid? $n = \frac{m}{M}$, so $n = \frac{1670}{36.46}$ $m = 1670$g $M = 1.01 + 35.45 = 36.46$ $n = 45.80362041...$ $n = 45.80$ moles	How many moles in 25 g of sodium chloride? $n = \frac{m}{M}$, so $n = \frac{25}{58.44}$ $m = 25$g $M = 22.99 + 35.45 = 58.44$ $n = 0.427789185...$ $n = 0.43$mols

What is the mass in grams of 7.30 mol of calcium chloride?	What is the mass in grams of 5.32 mol of calcium hydroxide?	What is the mass in grams of 3.00 mol of carbon monoxide?
$m = nM$ $CaCl_2$ $n = 7.30$ $M = (2 \times 35.45) + 40.08$ $= 110.98$ $7.30 \times 110.98 = 810.154$ $= 810\ g$	$Ca(OH)_2$ $m = nM$ $n = 5.32$ $M = 40.08 + (2 \times 1.01) + (16 \times 2)$ $= 74.1\ g/mol$ $m\ 74.1\ g/mol \times 5.32 = 394.212$ $m = 394g$	CO $n = 3.00\ mol$ $M = 12.01 + 16 = 28.01$ $m = Mn$ $28.01 \times 3 = 84.03$ $m = 84.03g$

Switch the 2 metals

Unit 2: Physics

1. Define work. Include the work equation.

   The transfer of mechanical energy from one object to another.

   ~ $W = f \times d$, or work = force x distance.

2. A weightlifter exerts a force of 883 N on a barbell over a distance of 0.65 m. How much work did the weightlifter do on the barbell?

   $W = fxd$

   $f = 883\ N$

   $d = 0.65\ m$

   $W = 883 \times 0.65 = 573.95$

   $W = 5.7 \times 10^2\ J$

3. With a single pulley, you lift a crate. If you exerted a force of 455 N and did 3276 J of work, how far did you lift the crate?

   W / f d

   $W = fxd$, so $d = \frac{W}{f}$, so $d = \frac{3276\ J}{455\ N}$, $= 7.2\ m$

   $W = 3276\ J$

   $f = 455\ N$

   $d = 7.20\ m$

4. What are the two laws of thermodynamics? Why can't perpetual motion machines exist?

   #1 ~ Energy cannot be created or destroyed, but can be transferred from one form to another or transferred from one thing to another.

   #2 ~ Cannot convert 100% thermal energy to work.

   ~

5. Sometimes students of science describe the laws of thermodynamics in a humorous way. They claim that the first law can be stated, "You can't get something for nothing." They state the second law as, "you can't even break even." Explain how these statements are somewhat appropriate for the laws of thermodynamics. "You can't get something for nothing," is implying that you can't have something created or destroyed without having matter to begin with. "You can't even break even" because you can't convert 100% thermal energy to work. (under 100%) = always less, not even breaking even.

6. Explain the difference between scalar and vector quantities. Give two examples of each type of quantity.

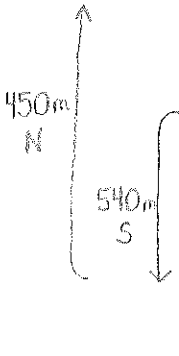
Scalar ~ a quantity describing magnitude, not direction! (Ex: time, distance, & average speed).

Vector ~ a quantity describing both direction & magnitude. (Ex: displacement, average velocity, & acceleration.)

7. Compare and contrast displacement and distance.

distance is the total measurement of an object's movement, and displacement is the measurement of an object's travel and the direction of travel; however displacement measures the "shortest distance from start to finish."

8. A student rides her bike 825 m north and stops to talk to a friend. She then rides 382 m north but realizes tat she was supposed to pick up a book at another friend's house. She rides 540 m south. After picking up the book, she rides 1450 m north. What distance did the student ride? What was her displacement?



distance (Δd) = 825m + 382m + 540m + 1450m = $\boxed{3197\ m = \Delta d}$

$\vec{\Delta d}$ = 825 + 382 = 1207 − 540 = 667m $\quad \Delta d = 3.20 \times 10^3$ m

1450 + 667 = 2117

$= \boxed{2.12 \times 10^3\ m = \vec{d}}$

9. State the definition of speed and velocity in words and in mathematical formulas.

Speed ~ the distance travelled by an object in a specific time (scalar quantity), and uses distance & time. $\left\{ v = \frac{\Delta d}{\Delta t} \right\}$

Velocity ~ uses displacement ^ ^ ^ ^ ^, & is a vector quantity. $\left\{ \vec{v} = \frac{\vec{\Delta d}}{\Delta t} \right\}$

10. A turtle walks 0.44 m [E] in 3.5 min. What was the turtle's velocity?

$\vec{v} = \frac{\vec{\Delta d}}{\Delta t}$ $\quad \vec{\Delta d} = 0.44\text{m [E]}$ $\quad \Delta t = 3.5\ \text{mins} \times 60 = 210\text{s}$

So, $\vec{v} = \frac{0.44}{210} = 0.0021$ m/s or 2.1×10^{-3} m/s

$\times \boxed{\vec{v} = 2.1 \times 10^{-3}\ \text{m/s [E]}}$

11. If you walk an average velocity of 1.4 m/s [S], how long will it take you for you to go 2.1 km [S]?

$\vec{v} = \frac{\Delta \vec{d}}{\Delta t}$, so $\Delta t = \frac{\Delta \vec{d}}{\vec{v}}$, so $\frac{2100\text{m}}{1.4\text{m/s}} = 1500$

$\Delta t = 1.5 \times 10^3\ \text{s}$

$\Delta \vec{d} = 2.1\text{ km} \times 1000 = 2100\text{m}$, $\vec{v} = 1.4\text{ m/s [S]}$

12. Explain how you could use a graph of position versus time to find the velocity of an object or person.

To find the velocity on a position vs time you can divide the distance by the time or go slope = $\frac{\text{rise}}{\text{run}}$ to find velocity.

13. Define acceleration.

~ Acceleration is the change of an object's speed or velocity during a time interval. $\left\{ \vec{a} = \frac{\Delta \vec{v}}{\Delta t} \right\}$

14. A car slows from 27 m/s [W] to 10.0 m/s [W] before reaching a highway exit. If it took the car 6.5 s to reach the exit after starting to slow down, what was the car's acceleration?

$\vec{a} = \frac{\Delta \vec{v}}{\Delta t}$ / $\vec{a} = \frac{v_f - v_i}{\Delta t}$, so $\vec{a} = \frac{-17\text{m/s}}{6.5\text{s}} = -2.615384615...$

$\Delta \vec{v} = 10.0 - 27 = -17$

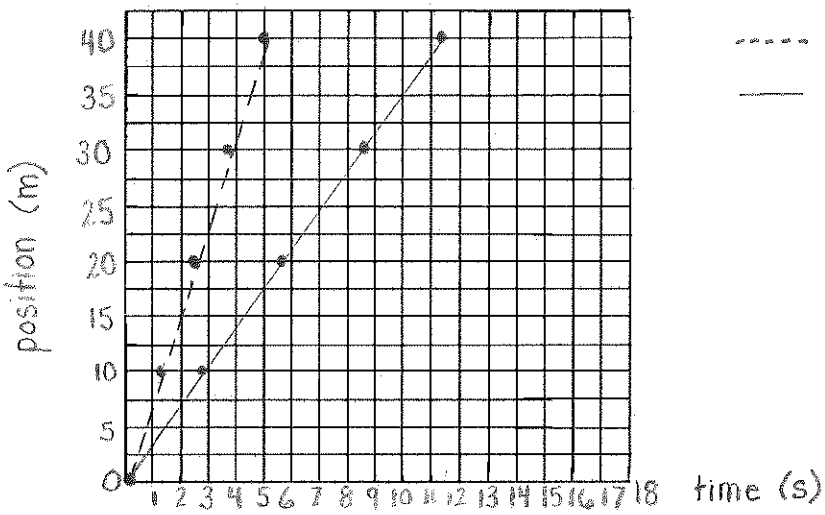
$\Delta t = 6.5\text{ s}$

$\vec{a} = 2.6\text{ m/s}^2\text{, [E]}$

15. In an experiment on the school track, two students try to run at constant velocities. They use the portion of the track that goes directly north. A timer records the time for each runner as he and she pass each 10m mark. The times are recorded in the following table.

Time for runner #1 (s)	Time for runner #2 (s)	Position (m)
0	0	0
1.3	2.9	10
2.5	5.7	20
3.8	8.6	30
5.0	11.4	40

a. Plot a position versus time graph for each runner.



b. Use the graph to determine each runners average velocity.

runner 1 - $\frac{pf-pi}{tf-ti} = \frac{40-0}{5-0} =$ 8.0 m/s runner 2 - $\frac{40}{11.4} = 3.508771193$

$=$ 3.5 m/s

c. How well did the runners achieve a constant velocity? Explain how you determined your answer from the graph.

runner 2 = $\frac{40}{11.4} = 3.51$ $\frac{30}{8.6} = 3.49$ $\frac{20}{5.7} = 3.51$ $\frac{10}{2.9} = 3.45$ fairly constant velocity

runner 1 = $\frac{40}{5} = 8$ m/s $\frac{30}{3.8} = 7.89$ $\frac{20}{2.5} = 8$ m/s $\frac{10}{1.3} = 7.69$ m/s fairly constant velocity

d. Was either runner accelerating? Explain how you determined your answer from the graph.

Yes, both runners were accelerating, because both lines went straight up.

16. What properties of an object determine its kinetic energy?

the properties of mass (kg) and velocity (speed)^2 = m/s

17. A 5.4 kg bowling ball is rolling at 1.8 m/s. What is the kinetic energy of the bowling ball?

$E_k = \frac{1}{2} mv^2$, so $E_k = 0.5 \times 5.4\,kg \times 1.8^2 = 8.748$

$m = 5.4\,kg$

$g = 9.81\,m/s^2$

$v = 1.8\,m/s$

$\boxed{E_k = 8.7\,J}$

18. How fast would a 0.250 kg billiard ball have to be rolling to have the same kinetic energy as the bowling ball in the previous question?

$E_k = 8.748$ $E_k = \frac{1}{2}mv^2$, $v = \sqrt{\frac{2E_k}{m}} = \sqrt{\frac{8.748 \times 2}{0.250}}$

$m = 0.250\,kg$

$v = 8.365644028$

$v = ?$

$\boxed{v = 8.37\,m/s}$

19. If you double the mass of a moving object, but keep everything else the same, what happens to the kinetic energy of the object?

The kinetic energy will be doubled!

20. What happens to an object's kinetic energy when you do negative work on the object.

~The force doing the work is directed opposite to the direction of the motion of the object.

~When negative work is done it removes kinetic energy from an object.

21. Define each of the following types of potential energy. Provide an example of each.

a. Elastic potential energy ~ the energy stored in an elastic object when work is done to distort the shape of the object.

b. Chemical potential energy ~ energy stored in the chemical bonds of compounds.

c. Nuclear potential energy ~ energy stored in the nucleus of an atom; when rearranged HUGE energy is produced.

d. Gravitational potential ~ energy stored in an object as a result of its height or vertical position.

22. In the mountains, 872 kg of snow and ice fall from the edge of a glacier down to the valley 197 m below. What was the gravitational potential energy of the snow and ice relative to the valley just before the snow and ice began to fall?

$E_{g(p)} = mg\Delta h$, so $E_{g(p)} = 872 \times 9.81 \times 197 = 1685201.04$

$m = 872$ kg

$g = 9.81\ m/s^2$

$\Delta h = 197$ m

$\boxed{E_{g(p)} = 1.69 \times 10^6\ J}$

23. How high would you have to lift your 0.55 kg textbook to give it 119 J of gravitational potential energy?

$E_{g(p)} = mg\Delta h$ / $h = \frac{E_{g(p)}}{mg}$, so $h = \frac{119\ J}{0.55\ kg \times 9.81} = 22.05541655$

$m = 0.55$ kg

$E_{g(p)} = 119$ J

$\boxed{\Delta h = 22\ m}$

24. A 200.0 kg roller coaster car is sitting motionless at point A, 15.0 m above the ground. If the car starts to roll down the track, what will its speed be when it reaches point B, 6. 0 m above the ground.

$15 - 6 = 9$

$E_g = E_k$

$E_g = mg\Delta h = 200 \times 9.81 \times 9 = 17658 = E_k$

$E_k = \frac{1}{2} mv^2$ $v = \sqrt{\frac{217658}{200}} = 13.2883$

$\boxed{v = 13\ m/s}$

25. Define efficiency in words and in the form of a mathematical formula.

Efficiency is the ratio of useful output energy to the total input energy multiplied by 100 percent.

$$\sim \text{efficiency} = \frac{\text{useful output energy}}{\text{total input energy}} \times 100\ (100\%)$$

26. A 102 kg soapbox derby car starts at the top of a hill. The starting point is a vertical distance of 40.0 m higher than the finish line. The car is going 11 m/s when it crosses the finish line. With what efficiency did the car convert its gravitational potential energy into kinetic energy?

efficiency = $\frac{\text{useful output energy}}{\text{total input energy}} \times 100$, so eff. = $\frac{6171\ J}{40024.8\ J} \times 100$

$= 15.41794088...$

$E_k = \frac{1}{2}mv^2$

$E_{g(p)} = mg\Delta h$

efficiency = 15%

$m = 102\ kg$

$g = 9.81\ m/s^2$

so, $E_{g(p)} = 102 \times 9.81 \times 40.0 = 40\,024.8\ J$

$\Delta h = 40.0 m$

$v = 11\ m/s$

so, $E_k = 0.5 \times 102 \times 11^2 = 6171\ J$

27. A light bulb is 5.2 percent efficient and it emits a total of 6.24×10^3 J of light energy, how much electrical energy does it use?

$6.24 \times 10^3 = 6240$

Efficiency = $\frac{\text{useful output energy}}{\text{total input energy}} \times 100$

electrical energy = 1.2×10^5 J

so, 5.2% or $\frac{0.052}{1} = \frac{6240}{x}$ $= \frac{0.052x}{0.052} = \frac{6240}{0.052} = 120000$

28. State the form of the input energy and the useful output energy for each of the following devices.

a. A battery

input = chemical output = electrical

b. Lawnmower

input = chemical output = mechanical

c. A laptop

input = electrical output = light

d. An automobile horn.

input = mechanical?

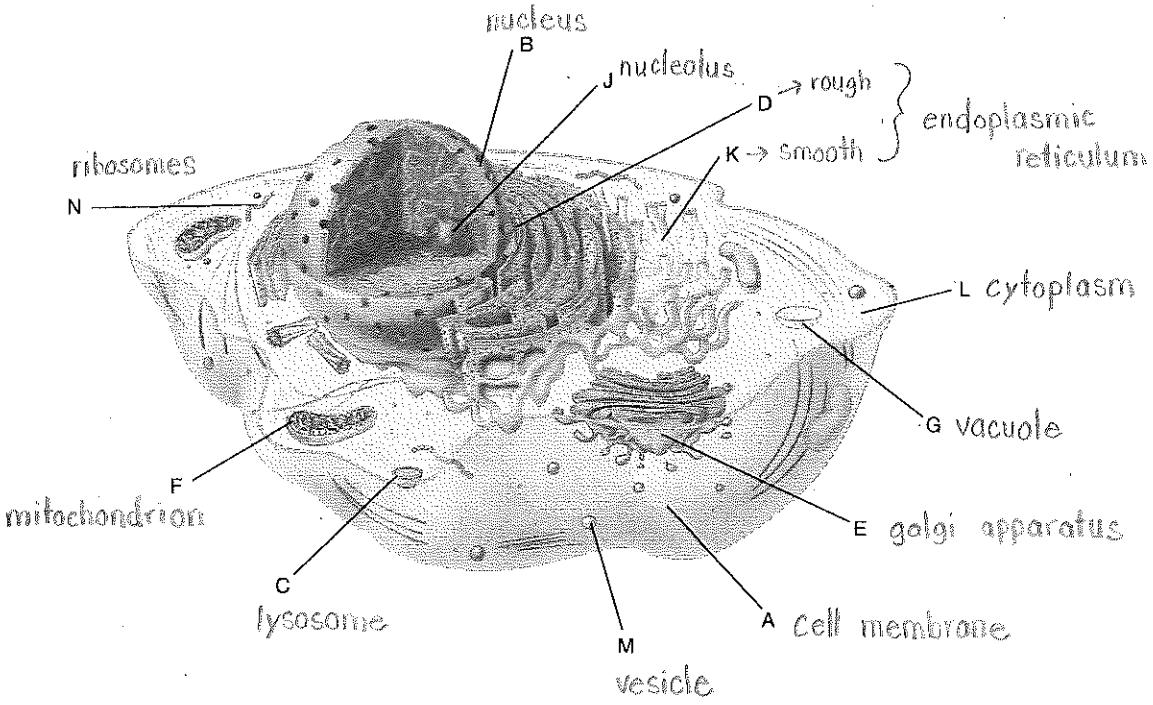
output = sound

Unit 3: Biology

1. Describe how to bring a specimen into focus using a microscope.

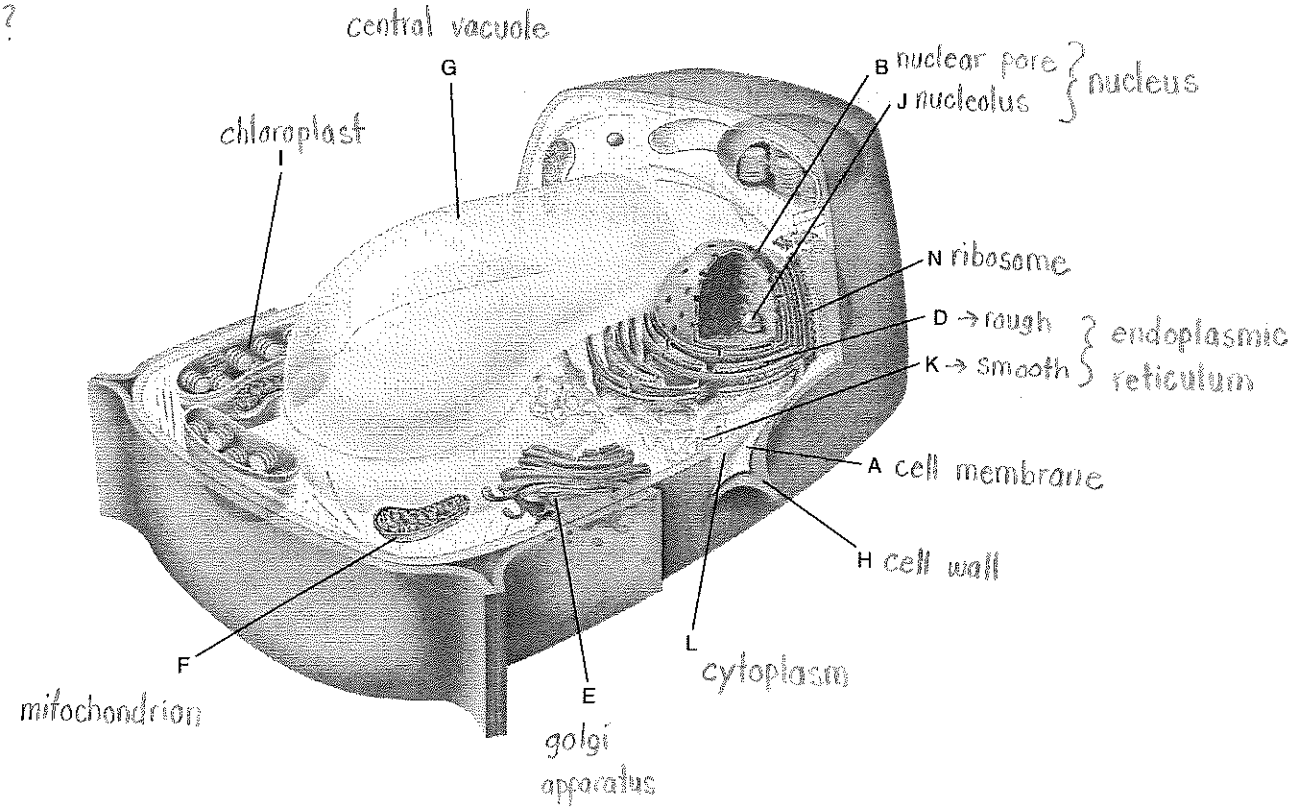
   Use the course adjustment knobs, it moves the stage up & down quickly to focus image.

2. Label the following animal cell



3. Label the following plant cell.

L? N? K?

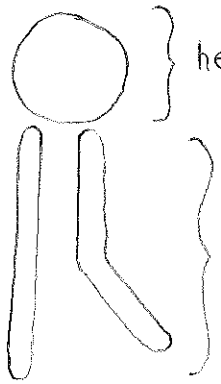


4. Look at the table below. The left column has a list of organelles. In the centre column, fill in the function of each organelle. In the right column, state whether the organelle is found in animal cells, plant cells, or both types of cells.

Organelle	**Function(s)**	**Found in animal cells, plant cells, or both**
cell membrane	protective barrier, allows for transport, interaction with other cells (permeable) → like a filter!	both animal & plant cells. (inside cell wall).
Cell wall	Able to withstand large pressure changes and still maintain shape. (protects inner cell).	only plant cells.
* Cytoplasm	The jelly-like substance in a cell; in which organelles are suspended.	Both animal & plant cells.
Nucleus	Holds the DNA, control center. Nuclear pores for transport of DNA / genetic material	Both animal & plant cells.
* Nucleolus	The area in the nucleus of a cell where ribosomes are produced.	Both animal & plant cells.
* nuclear envelope	The double-membrane surrounding the nucleus of a cell.	Both animal & plant cells.
Vacuole	Store up water; allows for pressure changes within a plant cell. (stores fluid).	Both animal & plant cells.
* smooth endoplasmic reticulum	part of the endoplasmic reticulum without ribosomes, where lipids are synthesized, and proteins or lipids are packaged in vesicles for transport to other parts of the cell.	Both animal & plant cells.
* rough endoplasmic reticulum	part of the endoplasmic reticulum with attached ribosomes, where proteins are synthesized.	Both animal & plant cells.
Ribosomes	Site of protein synthesis; they make proteins from DNA. (DNA comes from the nucleus.)	Both animal & plant cells.
Golgi apparatus	Receives substances from the endoplasmic reticulum & 'packages' materials up into vesicles for transport.	Both animal & plant cells.

lysosome	Digestive enzymes / protects against bacteria, destroys damaged cells. ~ proteins.	Only in animal cell.
mitchondria	Place for 'cellular respiration' which a byproduct is energy = powerhouse! (photosynthesis reversed). $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O +$ energy = cellular respiration.	Both plant & animal cells.
chloroplast	Completes photosynthesis, that's IT! ~ Sun energy $+ H_2O + CO_2 \rightarrow C_6H_{12}O_6 + O_2$	Only in plant cells.

5. Draw a diagram of a phospholipid include the following terms: hydrophilic and hydrophobic.



head → hydrophilic (nitrogen, Phosphate, glycerol)

tail → hydrophobic (CH_2)
fatty acids

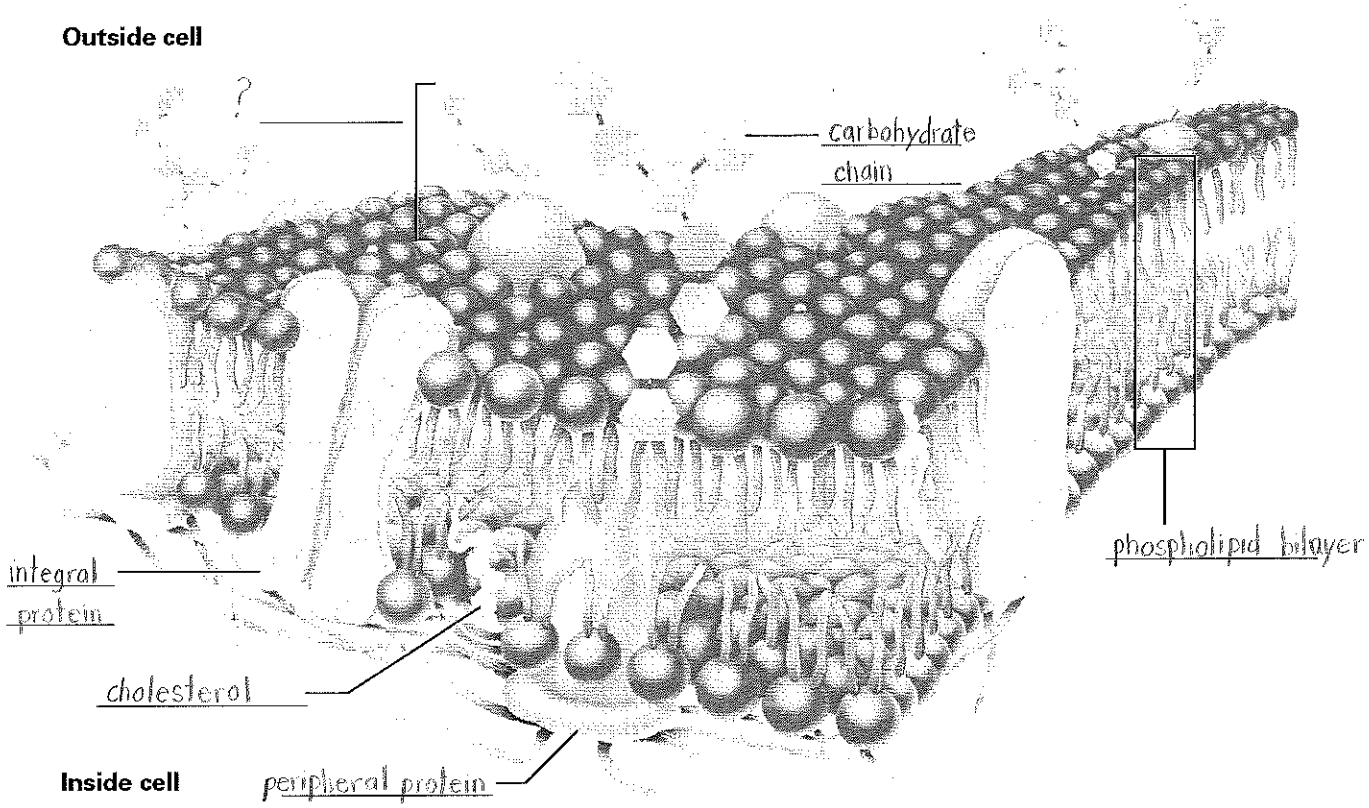
6. Describe the structure of a cell membrane. What kinds of molecules does it contain? How do these molecules interact with each other?

The structure of the cell membrane is like the fluid mosaic model & it contains phospholipids, proteins (carrier/channel), carbohydrates and sugars all suspended in a fluid-like substance, in a semi-permeable membrane.

7. Define semi-permeable? Why is it important for the cell membrane to be semi-permeable?

Semi-permeable membranes allow water & nutrients to pass through while excluding all other molecules. It is important because then unwanted materials can't enter the cell & the cell won't lose valuable nutrients or become dehydrated.

8. Label the following diagram



9. What is the fluid mosaic model? Why is it important?

The fluid mosaic model is a model of a membrane. "Fluid" means that molecules within the membrane are in constant motion (phospholipids & proteins move past eachother). Gives membrane's flexibility. (pg. 293)

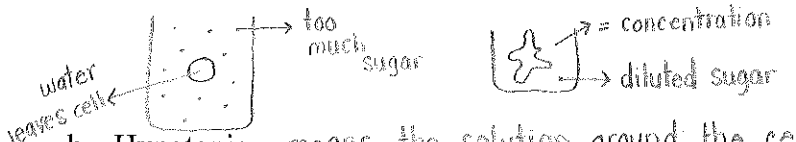
10. Define the following terms:
    a. Passive transport ~ the movement of substances across the cell membrane along their concentration gradient; does not require an input of energy.
    b. Diffusion ~ the movement of particles from an area of high concentration to low concentration.
    c. Osmosis ~ the movement of water molecules across a membrane from an area of higher concentration to low concentration.
    d. Facilitated diffusion ~ the use of transport proteins to aid the diffusion of particles across the cell membrane.

11. What limits would be placed on cells that depended entirely on diffusion to transport materials in and out of the cell? If the cell's supply of nutrients was cut off it would have no other way of obtaining food, & it could not take in water.

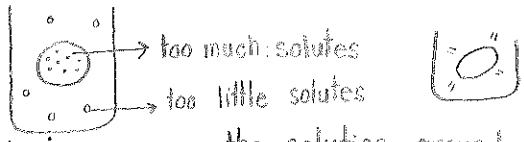
12. Distinguish between osmosis and diffusion
diffusion is the movement of particles from high concentration to low concentration, & osmosis is the specific diffusion of "water" particles.

13. What is a concentration gradient
a concentration gradient is the difference in concentrations of a substance between 2 areas.

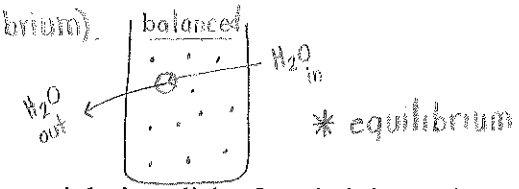
14. Define the following terms and draw a picture of a cell under these conditions
a. Hypertonic ~ means the solution around the cell has more solutes than inside the cell. So water flows out of the cell.



b. Hypotonic ~ means the solution around the cell has less solutes than inside the cell. So water flows inside / enters the cell.



c. Isotonic ~ means the solution around the cell is equal as inside the cell. So water flows in and out of the cell at a constant rate. (equilibrium).



15. A raisin is left overnight in a dish of apple juice. The next day the raisin was swollen.

a. Was the apple juice hypertonic, hypotonic or isotonic relative to the inside of the raisin?

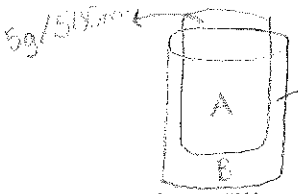
~ HYPOTONIC!

b. Describe what happened to the raisin using key terms like hypertonic, hypotonic, isotonic, concentration gradient. the raisin & apple juice has high concentration because the cell was placed in a hypotonic solution, so solute concentration was ~~high~~ outside & lower inside.

c. What will happen to the raisin if it continues to sit in the apple juice.

it will burst / explode.

16. A student has two beakers, each containing one litre of water. She dissolves 10g of sugar in beaker A, and 50g is beaker B. She then removes 500mL of the solution from beaker A and places it inside the bag made of dialysis tubing. She immerses the bag in 500mL of the solution from beaker B.
    a. Which solution has the higher solute concentration? Draw a picture to illustrate your answer.



Beaker B has the higher solute concentration.

    b. Will osmosis occur? If so, in which direction?

Yes, because the 2 solutions want to reach equilibrium, the water from beaker A will diffuse into beaker B to dilute the solution.

17. What is active transport?

Requires ATP energy to move particles from low concentration to high concentration.
(moving substances across the cell membrane against concentration gradient.)

18. Distinguish between passive and active transport:
    a. What kinds of materials does each process transport?

Passive ~ electrically charged ions and other certain molecules, & some cases micro-organisms.
active transport ~ brings molecules into cell.

    b. What cell structures are involved in each type of transport?

Passive ~ channel & carrier proteins. Selectively permeable membrane
Active transport ~ protein carriers carry molecules from low to high.

    c. Give one example of each type of transport occurring in the plant vascular system.

Passive ~ Stomata during gas exchange. (water vapour)

Active ~ brings nutrients into the plant from soil when there's a higher concentration within the plant.

19. Describe the process of
    a. Endocytosis ~ used by cells to take in substances, in which the membrane folds in, encloses the item in a sphere, then pinches off as a vesicle.

    b. Exocytosis ~ used by cells to expel compounds to the surroundings by fusing the membrane of a vesicle/vacuole with the cell membrane, & then releasing the contents into the cell's environment.

20. Why is the surface areas to volume ration for cells important? What does cell shape have to do with that ratio?

The ratio shows how much a cell can exchange. Cells are small because transport accross the membrane is more efficient that way. For efficient transport at a cell's surface, the cell must have a large surface area in relation to it's volume.

ratio = amount of SA per unit volume of an object / collection of objects.

21. How might having a particularly high surface area-to-volume ration benefit a cell? Would it influence a cell's ability to perform certain functions? Explain why or why not.

~ The greater the surface area to volume ratio, the more efficient cell transport will be, because by giving the cell more space to transport oxygen, nutrients, wastes, and would overall increase it's absorption.

22. In kidney dialysis, it is essential for the dialysis tubing to (a) have pores of the right size and (b) be immersed in a solution with the right solute concentration. Explain how problems with each of these two conditions might affect the filtering of a patients blood.

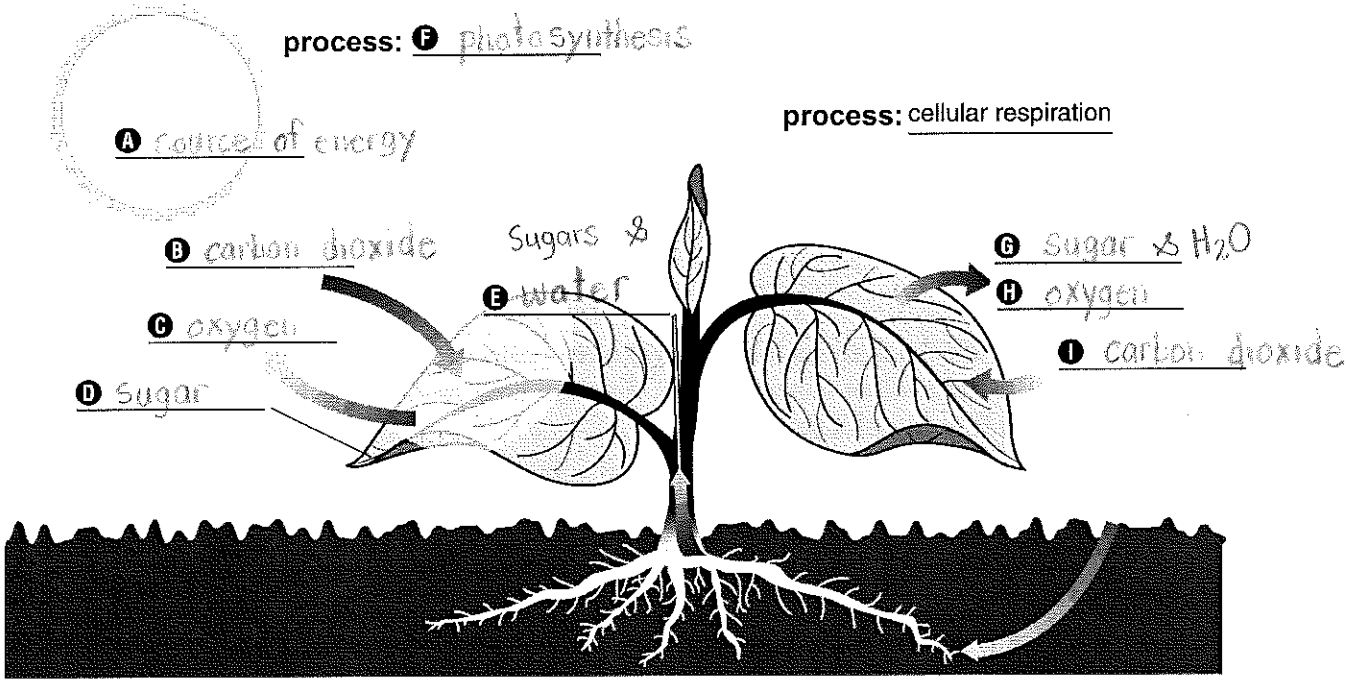
If the pores aren't the right size other things could exit the blood instead of waste, for example proteins or blood cells. If the solution doesn't have the right solute concentration it could cause salt & water to exit the blood.

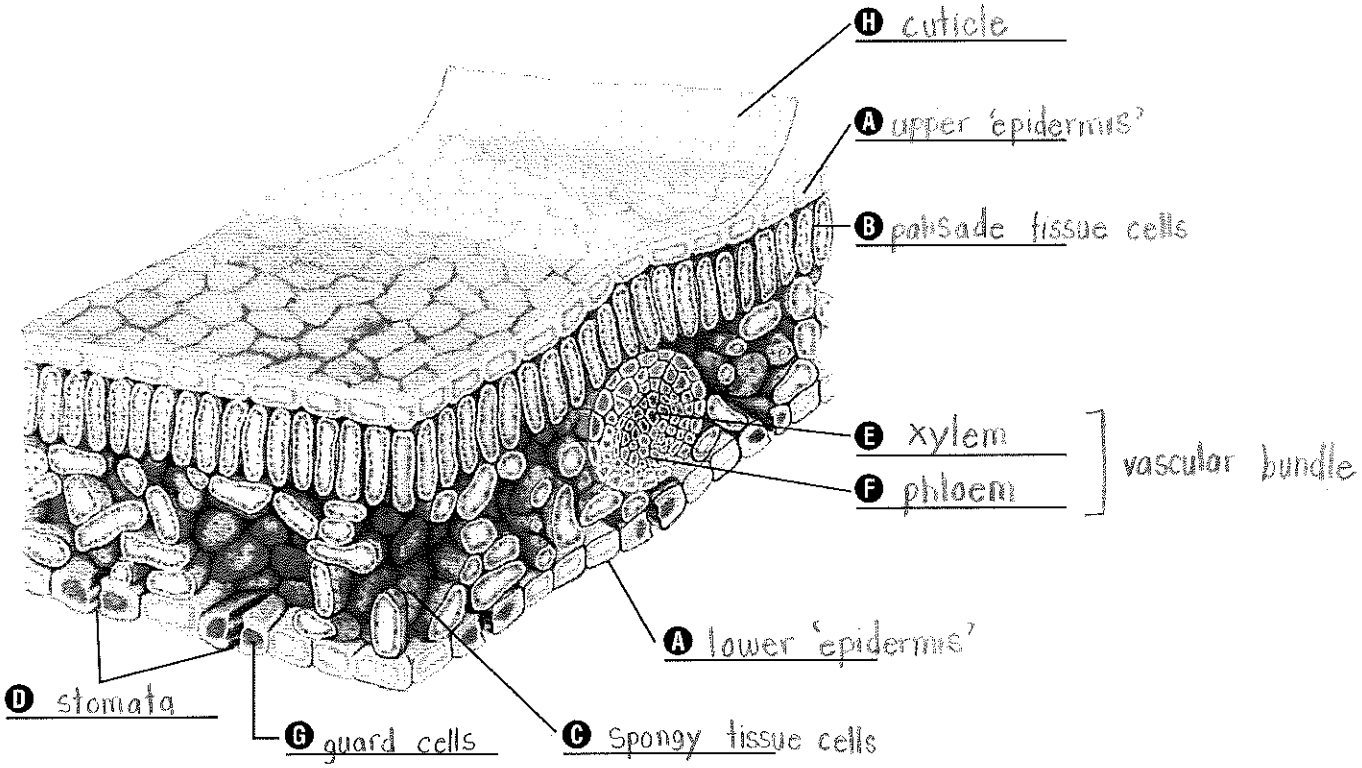
23. List the **four** levels of organization in organisms and give one example of each.

Level	Example
Cells	Heart Cell
tissues	Heart tissue
organs	Heart
organ systems	Circulatory system

24. Fill in the blanks on the diagram below using the following terms. You may need to use some terms more than once.

photosynthesis	Carbon dioxide	source of energy
Water	oxygen	Sugar





26. The leaf of the plant has many specialized cells. In the table below provide the main function for each of the following cell tissues.

Plant Tissue Cells	Function
Epidermis	~ a protective outer layer of cells covering the leaves, roots & stems.
Cuticle	~ a waxy substance coating the epidermis of plants, which prevents the evaporation of water.
Spongy Tissue	~ photosynthetic plant cells that are loosely packed to enable gas exchange, located below the palisade tissue cells in a leaf.
Stomata	~ a small opening in the epidermal layer of a leaf that allows gases in and out.
Guard Cells	~ cells located on either side of the stoma, that change shape to open or close the opening in order to allow gases in and out.
Palisade Tissue	~ photosynthetic plant cells that are found in a distinct layer under the leaf's upper surface.
Vascular Bundles	~ collection of vascular tissues (xylem & phloem); provides a system of vessels for the transport of water, minerals, and sugar throughout a plant.
Xylem	~ plant vascular tissue that carries water & minerals from the roots to the leaves.
Phloem	~ plant vascular tissue that carries sugars produced by the leaves to various parts of the plant.

27. Why are the palisade tissue cells found closer to the upper side of the leaf than the lower side of the leaf? Relate your answer to the role of the palisade tissue cells.

Palisade tissue cells are used for photosynthesis, therefore they need to absorb sunlight, and in order to do that they must be closer to the top of the leaf, & they are packed with chloroplasts.

28. Describe the diffusion of gases in the leaf (carbon dioxide and oxygen).

Carbon dioxide comes into the leaf & oxygen is released, all through the stomata. And water vapour diffuses out of the leaf through the stomata as well. direction of movement depends on concentration gradient.

29. Define Transpiration ~ transpiration is the evaporation of water from the leaves.

30. When is the stomata most often open? Describe adaptations the plant may have when the environment is hot and dry.

Stomata are most often open in the day; unless they're used to dry conditions, then at night, but they're most often open in a wet/humid environment because water loss is not an issue. In hot/dry places, plants have adapted to have less stomata, so they loose less water.

31. How to the guard cells open and close?

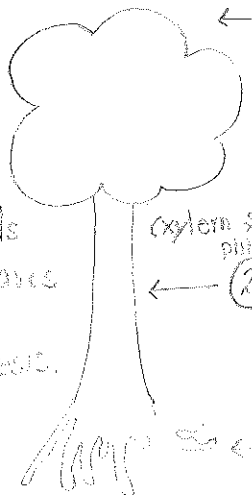
Light striking the leaf stimulates the guard cells to accumulate potassium ions by active transport. As the # of particles increases in the guard cells, water enters by osmosis, & the guard cells swell up which makes the cells bulge outwards & open the stomata.

32. What is turgor pressure? ~ turgor pressure is water pressure within plant cells that allows guard cells to remain rigid, or control of the stomata.

33. Compare and contrast adhesion and cohesion

Cohesion is the tendency of water molecules to stick/attract to other water molecules, & adhesion is the tendency of water molecules to stick to certain surfaces.

34. Describe the path of a water molecule as it moves from the soil, into a plant, and out of the plant as water vapour. Use key terms like osmosis, hypertonic, hypotonic, adhesion, cohesion, turgor pressure, transpiration.



(3) leaves ~ transpiration occurs & helps pull water up the stem. When a water molecule transpires out the stomata it pulls all the other water molecules up (conga line). (dehydrated) closed stomata = low turgor pressure, stomata open when turgor pressure in guard cells is high.

plant needs water in leaves for photosynthesis.

(xylem & phloem)

(2) Stem ~ cohesion & adhesion are properties of water that help water to move up the stem. cohesion ~ attraction of water molecules to other molecules. adhesion ~ attraction of water molecules to other substances (stem.)

(1) roots
- osmosis ~ water enters roots by osmosis
- root pressure ~ build up of water in roots, that helps 'push' water up against gravity.

35. What is phototropism? How could you test a plant for phototropism?

The growth of a plant towards a light source (photo = light, tropism = movement)

36. What are auxins and how do they work with regard to phototropism.

auxins are plant growth hormones produced in plant tips. ("to grow"). You can plant 2 plants side by side, & cover the tip of one but leave the other and see how each one leads! (towards the light).