# Review Guide for BIOL 150 Lab Exam 1
Montgomery College; Rockville Campus

Please note that questions in this document are a guide to prepare for Lab Exam 1. None of the questions are going to be copied and pasted on your exam by your instructor. Please print a copy and bring it with you to any of the review sessions you're planning on attending. Use it even if you cannot make to any of the sessions offered this semester.

Microscopy (1B)
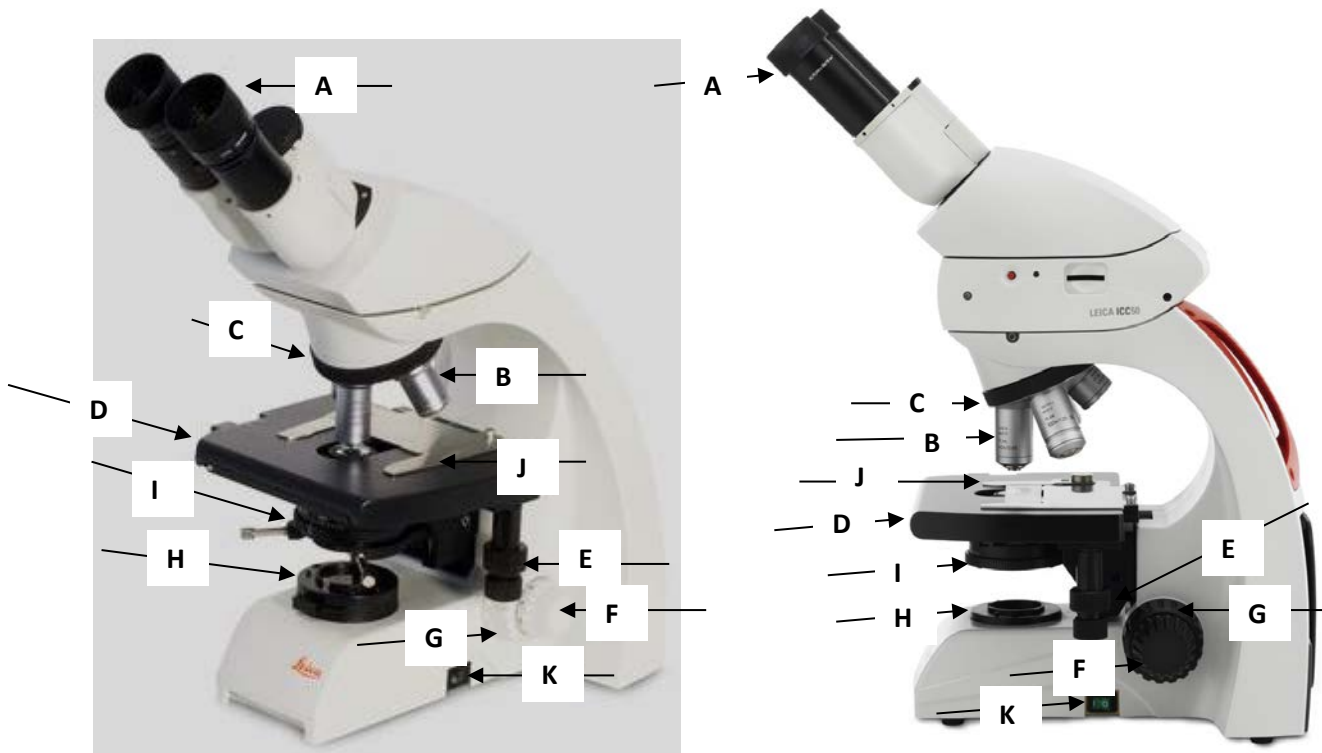
Leica DM750 on YouTube: https://www.youtube.com/watch?v=YFtjnE6t9xY
https://youtu.be/lo2aC_m2vyo

Letter	Name	Function
A		
B		
C		
D		
E		
F		
G		
H		
I		
J		
K		

Q.1.   Why do you think that the microscope is a very important instrument for studying biological specimens?
        Because cells are very small to see (um size)

Q2.   What changes do you expect to observe (size of the image, intensity of light, field of view, depth, resolution, etc.) as you go from *lower to higher* magnification?
        SIZE: increases
        Intensity of light: decreases
        Field of view: decreases
        Depth: decreases
        Resolution: increases (ability to distinguish between two points)

Q3.   Compare the advantages and disadvantages of observing a specimen at total magnifications of 40X and 400X.
        At 40x: advantage is you can see a bigger part of your specimen
            : disadvantage is lower magnification and resolution
        At 400x: advantage is higher magnification and resolution
            : disadvantage is that you see less of your specimen

Q4.   If the diameter of field of view of a light microscope at 40X magnification is 6000 micrometer (microns), what would be the field of view diameter at 400X magnification?
        Diameter x magnification = constant
        D x 400 = 6000 um x 40
        D = 600 um

Q5.   Fill in the following:
        A) 3 mm = __3000__ µm   C) __0.5___mm = 500 µm

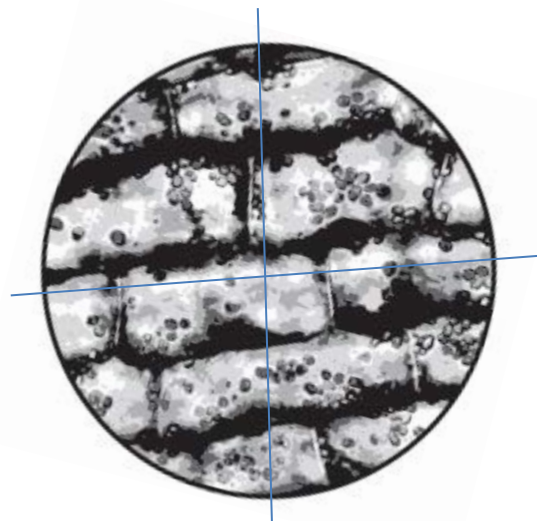   B) __4__ mm = 4000µm   D) 0.25 mm = __250_µm

Q6.   The photograph on your right is a view of *Elodea* cells at 1,000x magnification using a compound light microscope that has field of view of **5,000 μm at 40x magnification**. Use this to determine the length and width of these *Elodea* cells.

      d (1000) = (5000 um)(40)

      d = 200 um

      length of 1 cell = 50% of diameter = 100 um

      width of 1 cell = 1/5 of diameter (20%) = 40 um

Organic Molecules of Life (2)

Q7. What are the four major classes of organic molecules produced by living   organisms?
    Carbohydrates, lipids , proteins , nucleic acids

Q.8. What is a monosaccharide? Why are all monosaccharides and most disaccharides reducing sugars?
    Monomers of carbohydrates. They have a carbonyl group.

Q.9. What is meant by the term reduction? What is a reducing agent?

    Reduction is gaining electrons. A reducing agent is a substance that

    donates electrons: becomes oxidized.

Q.10.   What is meant by the term oxidation? What is an oxidizing agent?

    Oxidation is losing electrons. Oxidizing agent is a substance that takes

    electrons from another substance: becomes reduced

Q.11.   Both Benedict's and Barfoed's solutions are made from the same ingredient. Why are their reaction capabilities different?
    Barfoed's is more acidic: <u>only monosaccharides</u> are reducing in acidic conditions.

Q.12.   Suppose you have performed Benedict's assay with glucose. Which molecule/ion has become oxidized? Which one has become reduced?
    Glucose is oxidized (loses electrons) – Cu^{2+} becomes reduced to Cu^+

Q.13.   In solution, chain and ring forms of glucose molecule exist in equilibrium. Explain this statement.

Alternate between the two forms in solution

Q.14.   Both fructose and glucose are reducing sugars. When these two simple sugars become chemically bonded, a disaccharide, sucrose, is formed. Why is sucrose not a reducing disaccharide?

    The carbonyl group is not available even if one of the rings opens to a chain

Q.15.   What are the monosaccharides and *reducing* disaccharides that you assayed in lab?

    Glucose, fructose, galactose, and **lactose and maltose**.

Q.16.   What is the difference between *reducing* disaccharide and *non-reducing* disaccharides?

Non-reducing disaccharides do not have a carbonyl group.

Q.17.   Write three names of polysaccharides and their function in cells.

Cellulose, starch, glycogen, chitin. Starch and glycogen give energy. Cellulose and chitin are structural.

Q.18.   If you completely hydrolyze a starch molecule, what would you produce?

Glucose.

In questions 19-23, select your answers from the list below
   a) sucrose
   b) maltose
   c) starch
   d) glucose
   e) egg albumin

Q.19.   This substance gives a negative Benedict's assay, a negative Barfoed's assay, a positive iodine assay and a negative Biuret assay.

   Answer   c

Q.20.   This substance gives a positive Benedict's assay, a positive Barfoed's assay, a negative iodine assay, and a negative Biuret assay.
   Answer   d

Q.21.   This substance gives a positive Benedict's assay, a negative Barfoed's assay, a negative iodine assay, and a negative Biuret assay.

   Answer   b

Q.22.   This substance is positive in Biuret assay and negative in all other assays.

   Answer   e

Q.23.   All the assays (Benedict's, Barfoed's, iodine, and Biuret) on the substance were   negative.

   Answer   a

Q.24.   Benedict's assay tests for   reducing sugars   .

   a.   A positive reaction for Benedict's assay produces   red (also cloudy green)   color.

   b.   Barfoed's assay distinguishes between   monosaccharides   and reducing disaccharides

Q.25.   A protein solution can be identified by performing the Biuret   assay.

   The solution turns   violet   if the assay is positive.

   This color forms because of the presence of   peptide bonds   in proteins

Scientific method (1A & 1D)

A group of scientists working for Company Y want to test a new chemical that they believe will act as a sunscreen and prevent sunburn. The same amount of lotion is applied to each person in the same size area and the test subject's arm is exposed to direct sunlight. The amount of redness is measured every 5 min for a total of 30 min.

For each person tested, 3 different lotions are applied to the test subject's arm:

    I.   a lotion with the new sunscreen chemical called **SunX**

    II. a lotion with a different active sunscreen chemical that the company currently sells successfully called **Sun Kissed**

    III. a lotion that has all the same ingredients as the sunscreens, except it has no active sunscreen chemical

27. What question is being asked in the experiment above?

Is SunX a better sunscreen than Sun Kissed?

28. What hypothesis is being tested in the experiment described above? **Read entire description above carefully!**

SunX is a more effective sunscreen than SunKissed.

SunX will prevent redness more than SunKissed.

  A. A hypothesis must be testable and falsifiable. Is the hypothesis you wrote above testable? **Explain**.

Yes it is testable. We can measure redness which will tell us how effective the sunscreen is.

  B. Is the hypothesis you wrote above falsifiable? **Explain.**

Yes it is. It can be shown to be wrong, or not supported.

29. What is the prediction based on this hypothesis? (Remember a prediction is written as an "If…, then…." statement.)

If I apply SunX on people's arms I will get less redness than if I apply SunKissed.

30.   A. What is the independent variable in this experiment? **Why?**

Type of sunscreen. What we are testing (part of our hypothesis). The thing we <u>change</u>. The factor we are testing.

    B. What is the dependent variable in this experiment? **Why?**

Amount of redness: what we <u>measure</u>. Depends on the independent variable.

31. A. For this experiment, which group of patients is the experimental group (1, 2 or 3)? **WHY?**

Group 1: is getting the SunX (the new sunscreen).

 B. Which group of patients is the negative control (I, II or III)? **WHY?**

Group III is missing the independent variable.

C. Which group of patients is the positive control (I, II or III)? **WHY?**

Group 2 is the positive control: already known to be a sunscreen.

32.   Based on the graph, is Sun X a more effective sunscreen than Sun Kissed? **Explain** how you came to your conclusion.

SunX is a better sunscreen: hypothesis is supported.

Titles of graph and axes should allow the reader to quickly understand what information is in the graph. Write a "good" title for this graph.
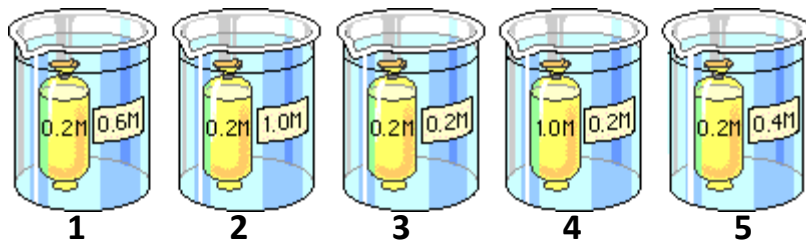

Effectiveness of sunscreen types
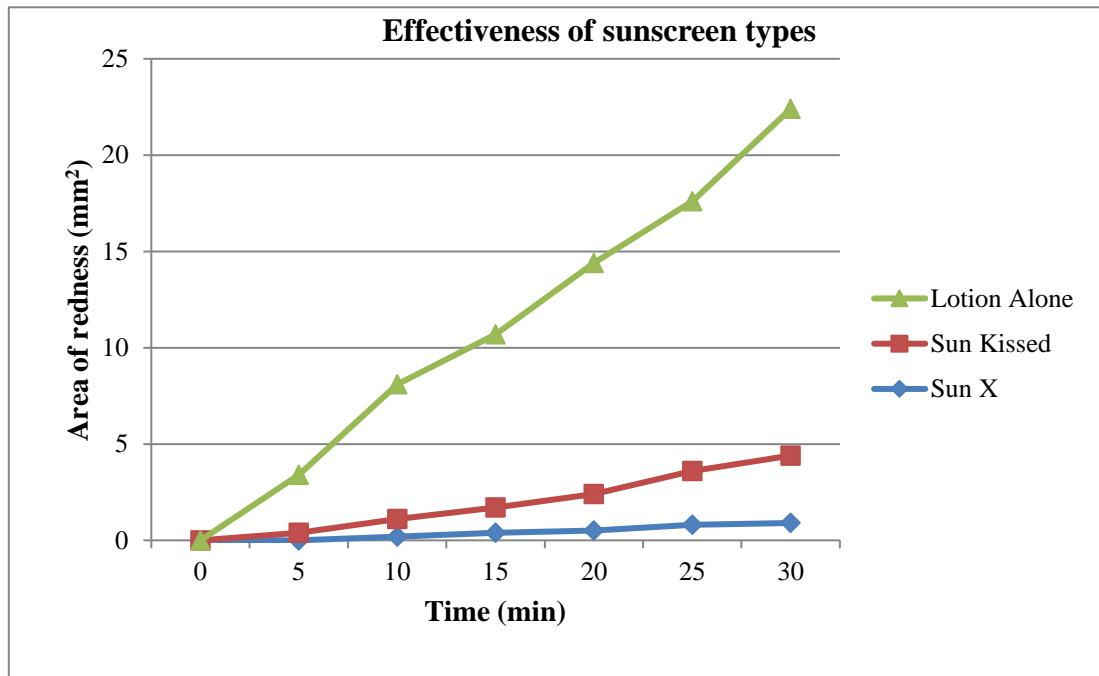
Osmosis and diffusion (4B)

Study the set of five beakers shown here to answer questions 1 – 3:

33. Which beaker(s) contain(s) a solution that is **hypertonic** to the bag?

1. Beaker 3
2. Beakers 2 and 4
3. Beakers 1, 2, and 5
4. Beaker 4
5. Beakers 3 and 4

34. Which bag would you predict to show the least change in mass at the end of the experiment?

1. The bag in Beaker 1
2. The bag in Beaker 2
3. The bag in Beaker 3
4. The bag in Beaker 4

5. The bag in Beaker 5

35. Arrange the beakers in order of the mass of the bags inside them after the experiment has run for *30 minutes*. List bags from lightest to heaviest.

1. 1, 2, 3, 4, 5
2. 1, 5, 2, 3, 4
3. 4, 3, 2, 5, 1
4. 3, 2, 1, 4, 5
5. 2, 1, 5, 3, 4

36. A dialysis bag (permeable to water but not to sucrose) is filled with a sucrose solution and placed in a beaker containing 30% sucrose solution. The bag's initial weight was 15 g, and after 15 minutes it weighed 17g. Calculate the percent change in weight of the dialysis bag. After 45 minutes, the same bag weighed 20g. What is the cumulative percent change in weight of the bag at that point?

% change = [(mass at current time – original mass)/original mass] x 100 =[(17g -15 g)/15g]x 100 = 13%

[(20g-15g)/15g]x100 = 33%

37. Assume that you have a 20 M glycerol stock solution. You need to make 5 different solutions for your experiment: 0 M or no glycerol, 2.5 M glycerol, 5 M glycerol, 7.5 M glycerol and 10 M glycerol. In each experiment you will need to make 50 ml of the diluted solution. Show your calculations for each solution:

C1V1 = C2V2   (20M)V1 = (5M)(50ml)   V1= 12.5 ml -> H2O = 50-12.5 = 37.5 ml
(20M)(V1) = (10M) (50ml)   V1 = 25 ml

Final concentration of solution	Amount of 20 M (ml) glycerol stock solution	Amount of water (ml)= total - stock	Final volume of the solution (ml)
0 M glycerol	0	50	50
5 M glycerol	12.5	37.5	50
10 M glycerol	25	25	50

Table 1:The potato plugs were weighed (in grams) at 20 minute intervals and their mass recorded in the table below.

	0 minutes	20 minutes	40 minutes	60 minutes
0.0M glucose	**5.3**	**5.5**	**5.7**	**5.8**
0.2M glucose	**5.7**	**5.7**	**5.8**	**5.8**
0.4M glucose	**5.5**	**5.0**	**4.8**	**4.6**
0.6M glucose	**5.6**	**5.0**	**4.7**	**4.4**

Table 2: **Calculate the cumulative percent change for each time point and fill in Table 2.**

	0 minutes	20 minutes	40 minutes	60 minutes
0.0M glucose	0	5.5-5.3/5.3]x100= 3.77	[5.7-5.3/5.3]x100= 7.55	9.43
0.2M glucose	0	0	1.75	1.75
0.4M glucose	0	-9.09	-12.7	-16.4
0.6M glucose	0	-10.7	-16.1	-21.4

Slope = (9.43-3.77)/(60-20) = 0.14

38.   *Why do you have to calculate cumulative percent change?*

The pieces are not exactly the same. This way we can compare them.

Using the attached piece of graph paper plot the **cumulative percent change in weight of potato cores over time** for each solution.

a) What is the dependent variable? _____cumulative percent change in mass_____

b) What is the independent variable? ___time_____

c) Is the independent variable quantitative? ____yes_____

d) Is the independent variable continuous? _____yes_____

e) What kind of graph would be best to use? Circle one below.

Bar Graph   **Line Graph**
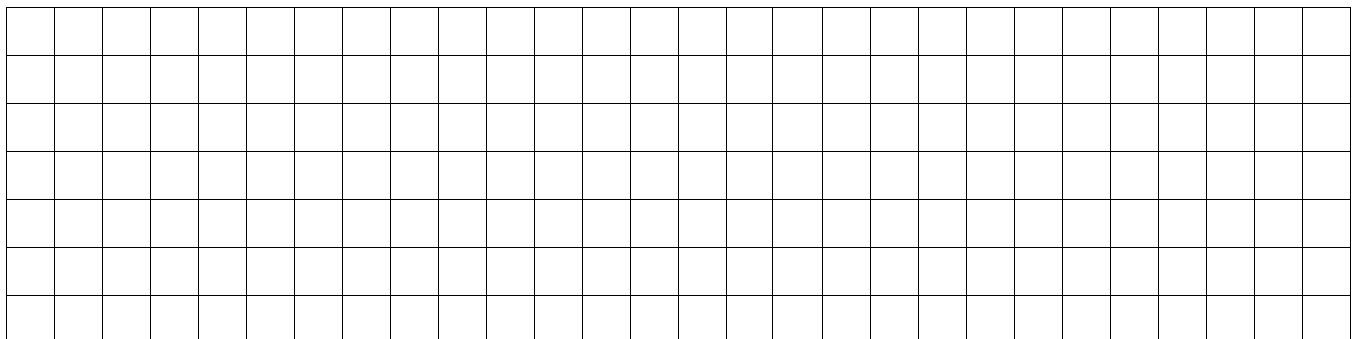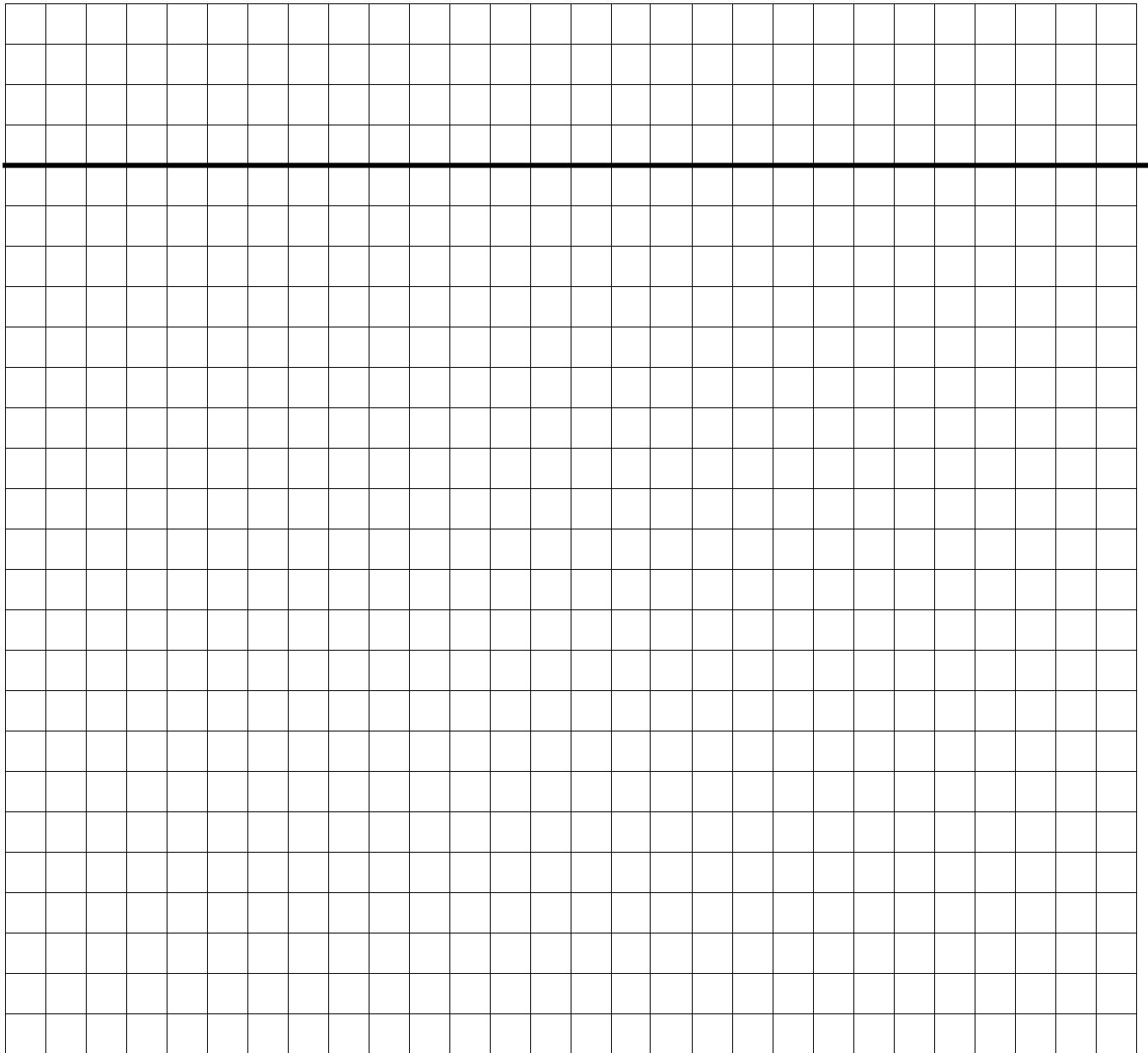
f) Explain your choice of graph

Use the TAILS checklist and graph all 3 lines on the following piece of graph paper.

☐ Title   ☐ Labels
☐ Axes   ☐ Scale
☐ Intervals

8

Next, calculate the rate of percent change for each glucose concentration by calculating the slope of each line on your graph. Include the units with your rate calculations. Fill out Table 4

NOTE: Please use cumulative percent change for each concentration @ t20 as Y_1 and @t60 as Y_2. Use the time points 20 (X_1) and 60 (X_2) cumulative percent change in mass to calculate the slope of the line.

Slope = $\underline{Y_2-Y1(gm)}$ = rate of percent change in mass
                        X_2-X_1 (min)

Table 4:Rate of Percent Change in Mass

Concentration	Rate of Change (gms/min)
0.0M glucose	0.14
0.2M glucose	0.044
0.4M glucose	-0.18
0.6M glucose	-0.27

Using the graph paper attached, plot the **rate of change (gms/min) versus glucose concentrations (M)**. Make a line graph and connect the dots.

39. ***What can you tell from this graph that you couldn't tell from the previous graph?***

   a) What is the dependent variable? _____Rate of change in mass (g/min)_____

   b) What is the independent variable? ____[glucose] (M)___

   c) Is the independent variable quantitative? ____yes_____

   d) Is the independent variable continuous? _____yes_____

   e) What kind of graph would be best to use? Circle one below.
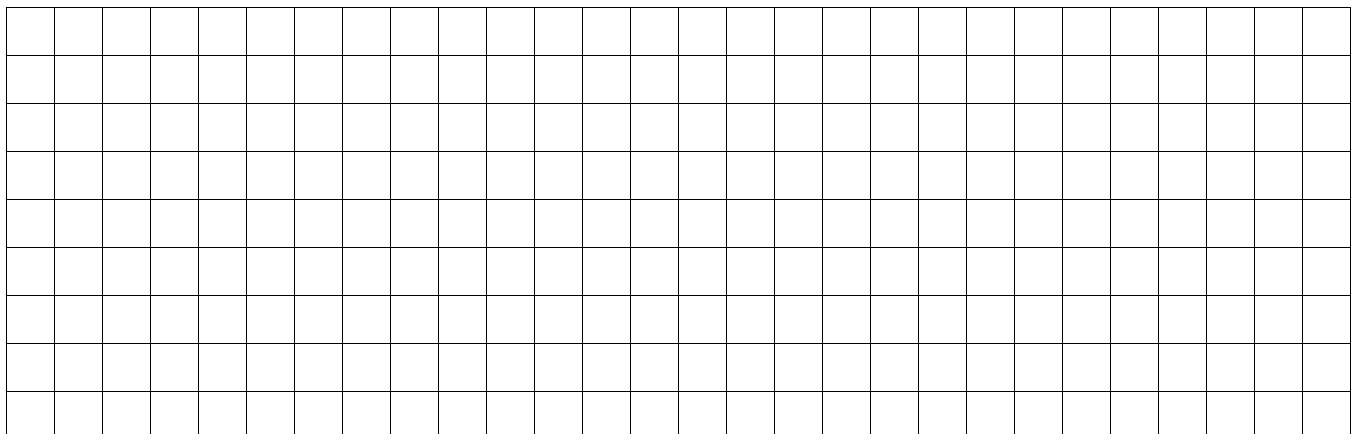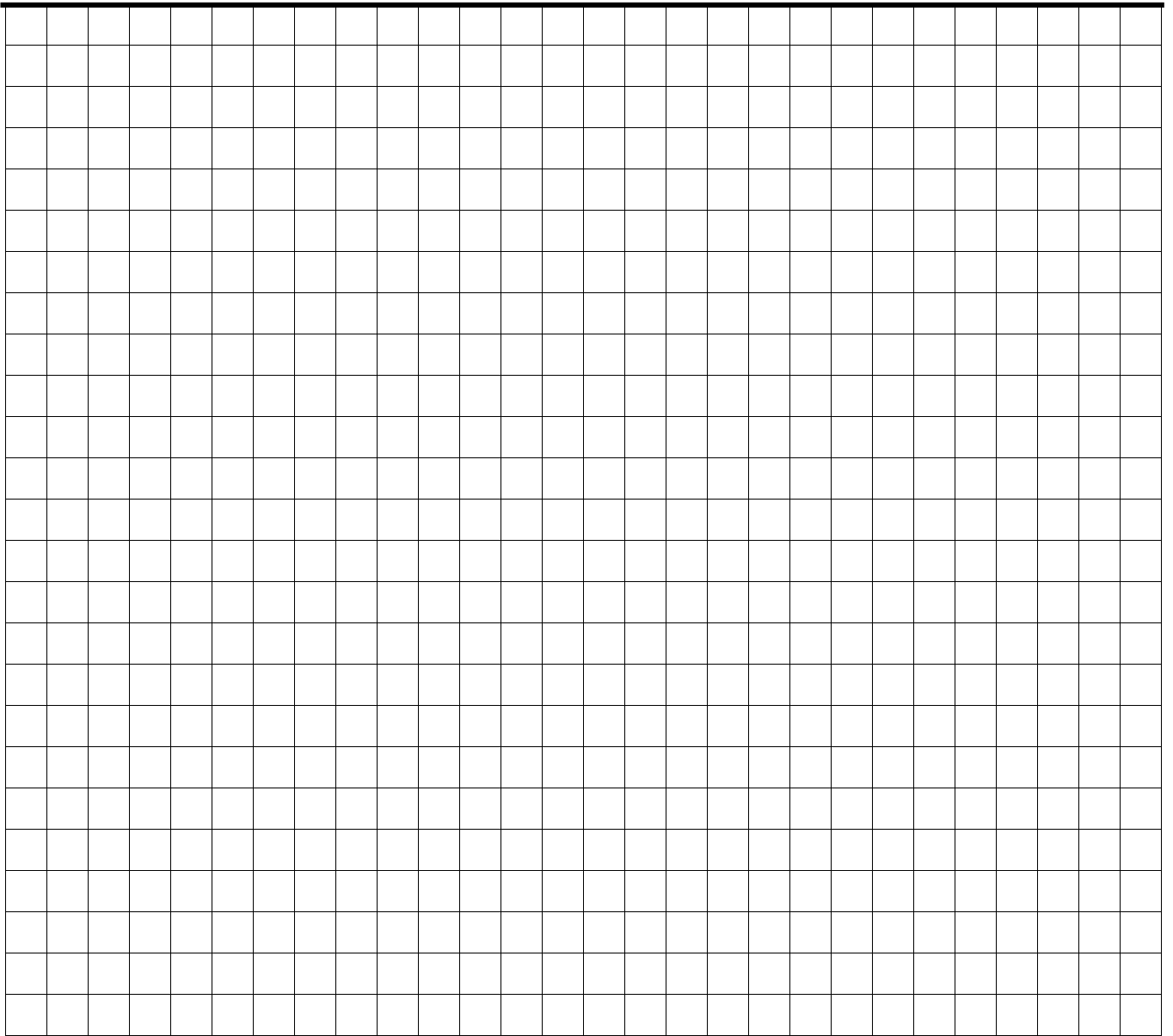
   Bar Graph   Line Graph

   f) Explain your choice of graph

   Both variables quantitative

Use the TAILS checklist and graph all 3 lines on the following piece of graph paper.
   ☐ Title   ☐ Labels
   ☐ Axes   ☐ Scale
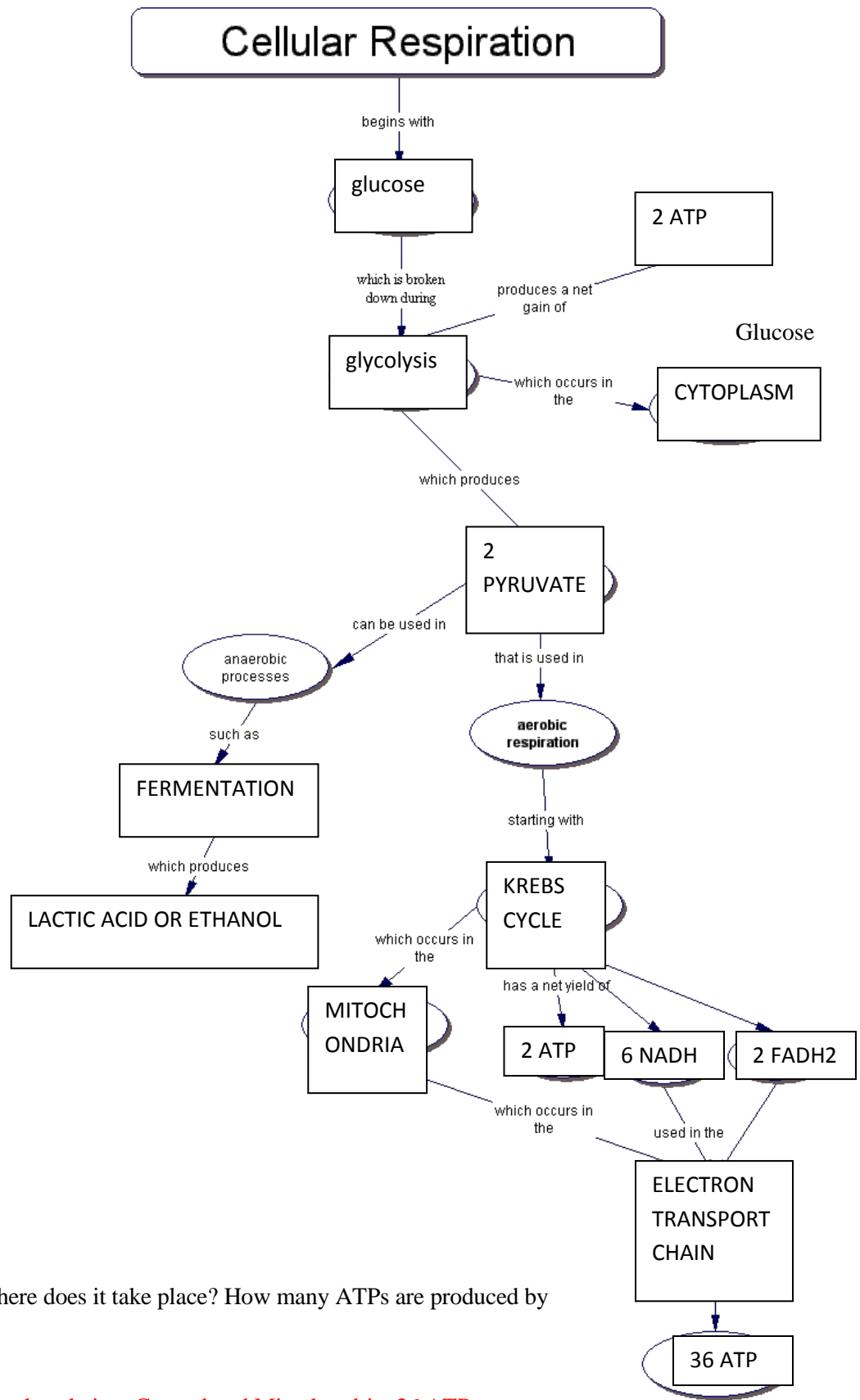   ☐ Intervals

Cellular respiration (5A)

http://www.phschool.com/atschool/phbio/active_art/cellular_respiration/

WORD BANK

2 ATP
2 ATP
36 ATP
6 NADH
2 FAD

Electron transport chain
Mitochondrion

Cytoplasm
Fermentation
Glycolysis
Pyruvate
Lactic acid or ethanol
Kreb's Cycle

Cellular Respiration

begins with

glucose

which is broken down during

produces a net gain of

2 ATP

Glucose

glycolysis

which occurs in the

CYTOPLASM

which produces

2 PYRUVATE

can be used in

that is used in

anaerobic processes

aerobic respiration

such as

starting with

FERMENTATION

KREBS CYCLE

which occurs in the

which produces

has a net yield of

LACTIC ACID OR ETHANOL

MITOCHONDRIA

2 ATP **6 NADH** **2 FADH2**

which occurs in the

used in the

ELECTRON TRANSPORT CHAIN

36 ATP

Q.40. What is aerobic respiration? Where does it take place? How many ATPs are produced by

aerobic respiration?

Glycolysis, Krebs cycle, Oxidative Phosphorylation. Cytosol and Mitochondria. 36 ATP

Q. 41. What is fermentation? Where does it take place? What is the advantage of fermentation? What is the

disadvantage of it? What is the difference between complete cellular respiration and fermentation?

Anaerobic process: glycolysis + 1-2 steps to oxidize the electron carriers. In the cytoplasm. Advantage: energy can be produced without oxygen. Disadvantage is that only 2 ATP is produced (compared to 36 of aerobic process).
Aerobic process vs anaerobic. Long process vs short process. Much more energy vs little energy.

Q.42. Complete the summary equation for cellular respiration : Carbon dioxide, oxygen, water, glucose, energy(ATP & heat)

____C6H12O6__ + __6O2__---------> __6CO2_ + __6H2O__+ 36ATP

Q.43. In the cellular respiration experiment, you determined metabolic rate by measuring:
   a) the volume of O_2 produced over time
   b) the amount of glucose consumed over time
   c) the volume of O_2 consumed over time
   d) the volume of CO_2 consumed over time
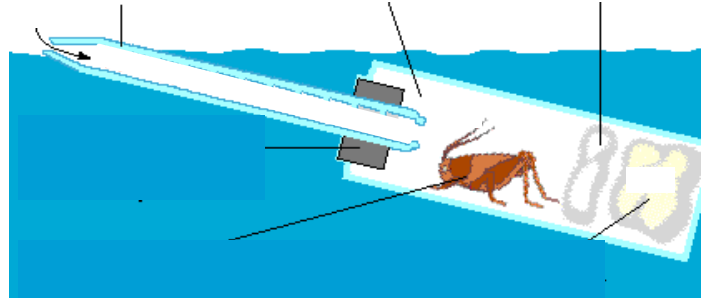
Q. 44   Why was the respirometer submerged into water? **Why did water move *into* the respirometer? What is the role of KOH in this experiment?**

Water moves in because O2 pressure is lower as organisms are consuming the O2. Role of KOH is to remove the CO2.

http://www.phschool.com/science/biology_place/labbench/lab5/images/crkresp2.gif

Q. 45.   Explain the effect of germination (versus non germination) on pea respiration. How do seeds stay alive without leaves and chloroplast?

They are using cellular respiration to make ATP: using the stored starch in the seeds. They are not doing photosynthesis.

Q.46.   Calculate the metabolic rate of 10 crickets that weighed 2.5 gm and consumed 2 ml of oxygen in 6 min.

Metabolic Rate = (ml O2/time)/mass = [(2 ml/6 min)(60 min/h)]/2.5g = 8 ml/h/g

Q.47. What is the relationship between the body size and metabolic rate?

Inverse relationship: the bigger the body size the lower the metabolic rate.

Q. 48.   If respiration of *25gm cold blooded reptile and 25 gm warm blooded mammal* at 10^0C were compared, what results would you expect? Explain

The warm blooded mammal would have a higher metabolic rate at this temperature (much colder than normal body temperature).

An experiment to measure the rate of respiration in crickets and mice at 10 °C and 25 °C was performed using a respirometer, an apparatus that measures changes in gas volume. Respiration was measured in mL of O_2 consumed per gram of organism over several five-minute trials and the following data were obtained.

Temperature	Average respiration (mL O_2/g/min)	
	Cricket	**Mouse**
10^{0}C	0.0013	0.0518
25^{0}C	0.0038	0.0231

Q. 49.   According to the data, the crickets at 25ºC have greater oxygen consumption per gram of tissue than do the crickets at 10ºC. This trend in oxygen consumption is the opposite of that in the mice. The difference in trends in oxygen consumption among crickets and mice is due to their
(A) relative size
(B) mode of nutrition
(C) mode of internal temperature regulation
(D) mode of ATP production

Q.50. What is the relationship of metabolism with surrounding temperature in ectothermic and homeothermic animals? Explain your answer.

Ectotherms have lower metabolic rate at low temperature and increase their metabolism as the temperature rises. Homeotherms have higher metabolic rate at low temperatures as they use some energy to warm up their bodies.

Photosynthesis (6)

Q.51. What is photosynthesis and which *organ* of the plant carries out photosynthesis? Name the *organelles* where
(i) complete cellular respiration and (ii) photosynthesis occur? What are the products of photosynthesis?

Leaves do photosynthesis. Organelles for cellular respiration: cytoplasm and mitochondria. Organelles for photosynthesis: chloroplasts.

Q.52.   Complete the summary equation for Photosynthesis : Carbon dioxide, oxygen, water, sugar, energy(light), chlorohyll

___6CO2_ + 6H2O___+ light + chlorophyll----------> __C6H12O6_ + ___6O2

Q.53. How many pigments did you find in plant leaf extract? Where are the pigments located in. What are they?

4 pigments: chlorophyll a, chlorophyll b, <u>carotenes</u>, xanthophyll. They are in the thylakoids of chloroplasts.

Q. 54. **Plant pigments absorb mostly light of <u>violet,</u> <u>blue</u>, and**
 <u>Red</u> colors. Plants perform highest photosynthesis by using wavelengths of
 <u>Violet</u> color light because it is absorbed <u>more strongly</u> and wavelengths of this color contain
 highest <u>energy</u> among all other wavelengths of visible light spectrum.

Q. 55. Discuss the importance of photosynthesis in the sustenance of life on planet Earth.   Why is chlorophyll green? What the absorption spectra tell us about chlorophyll pigment?

Produces food and oxygen for all/most aerobic organisms. Also removes CO2. It does not absorb the green part of the light spectrum (500-570 nm).

Link for the spectrophotometer used in our lab: https://www.youtube.com/watch?v=kVC3D0pYkR4
How the spectrophotometer works: https://www.youtube.com/watch?v=naaLjuzYME0

Q.56. What are the factors that affect differential movement of pigments by paper chromatography? Paper chromatography was done on a chloroplast extract using acetone as a solvent. At the end of the chromatography it was found that the solvent traveled 20 cm from the origin and a pigment molecule traveled 17 cm from the origin. Calculate the Rf value of the pigment molecule.

Rf = dp/ds = 17/20 = 0.85

Chromatography is a method of separation of mixtures.

Molecular weight (size): the smaller the faster

Solubility (polarity). Solvent is acetone/ether: more hydrophobic (less polar) will dissolve better, the faster they will move.

Attraction to paper: the less it is attracted the faster it is going to be

Q57. What did we measure to calculate the rate of photosynthesis? Why did we use $NaHCO_3$ in the experimental set up?

O2 production over time. We measured the amount of time it took to produce 0.1 ml O2. The sodium bicarbonate will release CO2 in the solution.

Q 58.Following data was collected in your last lab to determine the *effect of light intensity on the rate of photosynthesis*. Calculate the rate of photosynthesis and plot a graph with the data (identify the dependent and independent variables and don't forget TAILS)

Rate = 0.1 ml/time = [0.1 ml/30 min](60 min/h)= 0.2 ml/h

Wattage	Total Time Elapsed	Amount of Oxygen Produced	Rate of photosynthesis (**ml of O_2/hr**))
50	30 min	0.1 ml	0.2
100	15 min	0.1 ml	0.4
200	7 min	0.1 ml	0.86
300	8 min	0.1 ml	0.75