IB Biology Higher Level
Summer Assignment

Ms. Chulapatrcheevin
vchulapatrcheevin@tustin.k12.ca.us

Hello lovely students! Welcome to IB Biology, Higher Level. To prepare for the rigor of the year ahead you will be completing the following assignments. Remember, IB Biology is about approaching the study of life with curiosity, and seeing the complexity, mystery and beauty of the natural world. Enjoy your assignments, name your plants, and don't wait until the end of August!

All parts of your summer assignment are due the first day of school: August 22, 2017.

Part I: Read Topic 2, Cells (p. 12 – 42) and complete the attached Topic Guide. You will find materials such as digital textbooks, additional packets, and supplemental resources on our haiku page at: https://tusd.haikulearning.com/vchulapatrcheevin/ibbiologyhl

Part II: Experimental Inquiry. You have received 20 pinto beans. Over the summer, you must germinate, grow, and perform an experiment on at least five (5) bean plants. Document the entire course of your experiment with pictures.

Write a formal lab report which includes: research question, background, description of variables (independent, dependent, controlled), hypothesis, materials, procedures, data tables, data processing (example: standard deviation), conclusion (discuss trends in your data) & evaluation (discuss improvements to your experiment).

Bonus Assignment (optional):

Choose one or more of the following, each written response should be at least one page, single spaced.

1. Go to the tide pools/snorkeling /scuba diving. Take a photo of yourself. Take photos of 5 organisms and explain the limiting factors that might affect them, their special adaptations, and in which tidal zone they would be found.

2. Visit a zoo/botanical garden/aquarium. Attach ticket stub and take a picture with a sign to show evidence you were there. Take pictures of 5 different animals/plants there and describe the biome in which they live in and any special characteristics/adaptations they have.

3. See a science movie (science fiction is fine). Attach the ticket stub and take a photo of you being there (or in front of your TV). Describe 5 science themes you were able to find while watching the movie.

4. Explore your backyard/neighborhood. Take a photo with 5 plants/animals that are native to southern California. Discuss the organisms' adaptations and where you found them. How do you know they are native species?

5. Go on a nature hike (*suggestions: Peter's Canyon, Irvine Regional, Crystal Cove, etc.*) Take a photo with a sign to show that you were there. Take pictures of 5 different plants/animals you see. Write about your hike. You should discuss the biome in which you are in and any characteristics, special adaptations you find in the plants/animals. See anything interesting? What trails did you go on? Did you get lost?

6. Volunteer at an animal shelter for 4 hours. Take a photo and have a staff member sign off that you volunteered. Write me a summary discussing what you did, what you thought, any of the animals you liked and ideas of how you could help animals in other ways.

7. Go to a Science Museum. Attach the ticket stub and take a photo with one of their signs. Write a summary of 3 of your favorite exhibits and why they were your favorite.

IB Biology Name_____
Topic 2 Guide: Cells

1. State the *functions of life*, as demonstrated by all living organisms.

2. Define the following terms, with examples:
   Unicellular

   Multicellular

   Acellular

3. State some examples of *modern technology* that have confirmed cell theory.

4. Outline the three fundamental statements of *cell theory*

i. Cells are the smallest units of life
ii.
iii.

5. Outline the significance of the work of these scientists in forming cell theory.

i. Antonie van Leuwenhoek
ii. Robert Hooke
iii. Louis Pasteur and Robert Remak

6. Describe how the following examples might be exceptions to cell theory.
   a. Muscle cells and fungal hyphae

   b. Viruses

   c. Amoebae

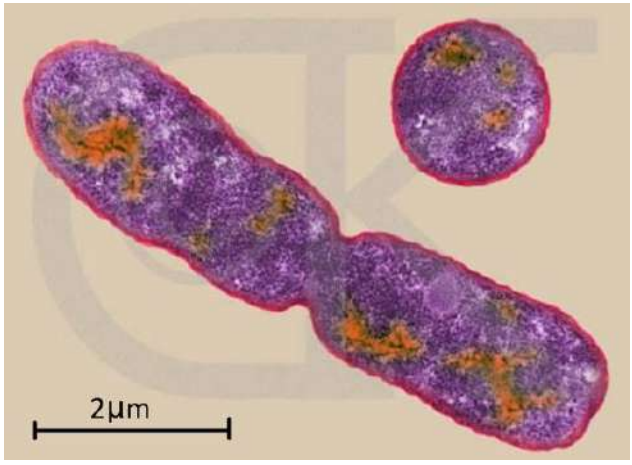
7. Complete this table of SI units of length:

Unit	Abbreviation	Metric Equivalent	
		Whole	scientific notation
kilometer	km	1 000 m	10^3 m
	m	1 m	1m
centimeter	cm		10^{-2} m
	mm	0.001 m	10^{-3} m
micrometer	µm	0.000 001 m	
nanometer	nm		10^{-9}m

8. The diagram below shows the characteristic rod-shaped structure of *E. coli* bacteria.

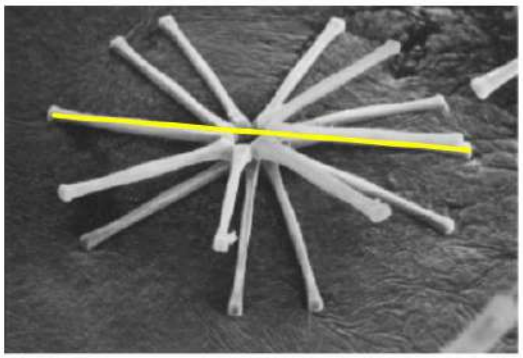
   a. Calculate the *magnification* of the image.

   b. State the method (shown here) by which bacteria reproduce.



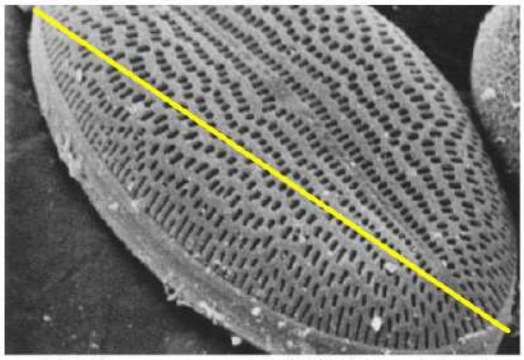
9. Calculate the *actual size* of the structures delineated in yellow.

Diatom x 1,000



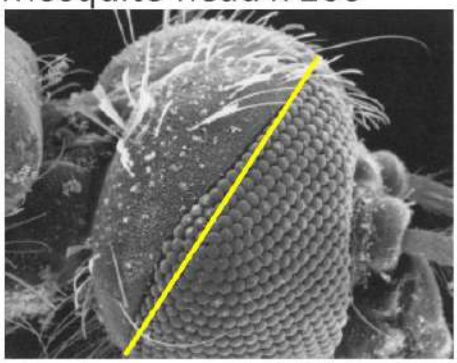
http://www.mos.org/sln/SEM/diatom.html

Diatom x 5,000



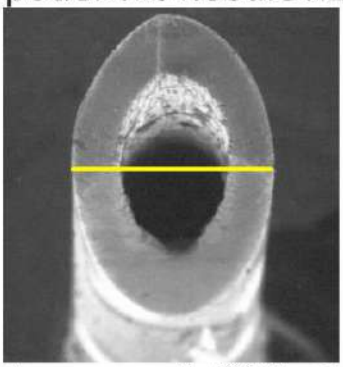
http://www.mos.org/sln/SEM/diatomb.html

Mosquito head x 200



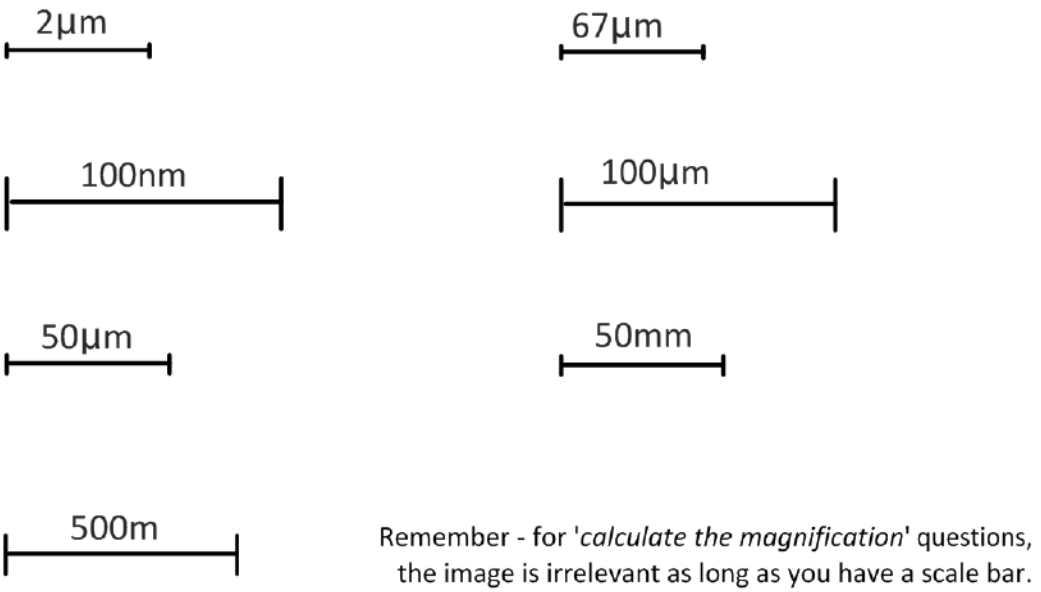
http://www.mos.org/sln/SEM/mhead.html

Hypodermic needle x100



http://www.mos.org/sln/SEM/needle.html

10. *Calculate the magnification* of these scale bars:



Remember - for '*calculate the magnification*' questions, the image is irrelevant as long as you have a scale bar.

11. What is the magnification of these images?

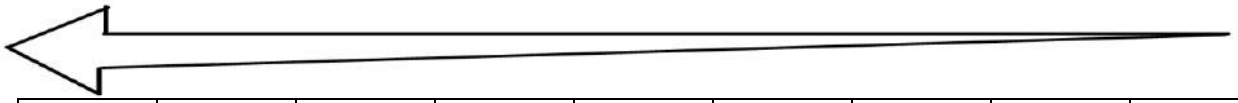
    a. Scale bar 10µm measures 40mm on the image.

    b. Scale bar 5µm measures 25mm on the image.

12. A micrograph has a scale bar of 2µm, which measures 40mm on the image. Measuring the maximum length of the cell in the image, the ruler reads 180mm. How long is the cell?

13. A student views an image of a cell magnified 350 times. The image is 250mm long. What is the actual length of the sample in the image?

14. Compare the sizes of these structures. Use SI units.



Plant cell	Animal cell	nucleus	bacteria	Mito-chondria	virus	ribosome	Membrane thickness	molecules

15. Use some of these electron microscope resources to view molecules, cells and structures and to practice calculating magnifications and actual sizes.

    Virtual Electron Microscope: **http://virtual.itg.uiuc.edu/**

    Microscopy UK: **http://www.microscopy-uk.org.uk/**

16. As the volume of a cell increases, what happens to…? (increase/ decrease)

    a. Production of waste products.

    b. Usage of nutrients and oxygen.

    c. The surface area: volume ratio.

17. State the advantages of maximizing the *surface area: volume ratio* in a cell.

18. List some adaptations used by cells to maximize SA:Vol ratio.

19. List some adaptations used by multicellualr organisms to maximize SA:Vol ratio

20. Describe how a large SA:Vol ration can be harmful or costly to small animals.

21. Describe how the invasive *Caulerpa* algae genus break the rules of SA:Vol.

22. Unicellular organisms carry out all the functions of life, multi-cellular organisms differentiate and show emergent properties.
    a. Describe what is meant by the term *emergent properties*.

    b. Outline the advantages of cells differentiating to carry out specific functions.

23. All cells in a living organism carry the same genetic information.
    a. Define *stem cell*.

    b. Define the following types of stem cells.

    Pluripotent

    Multipotent

    Nullipotent

    c. List two types of stem cell that can come from liver stem cells.

24. Outline the process of cell differentiation that leads from an uncommitted stem cell to a specialized cell, including the role of gene expression. A flow chart might help.

25. Outline the relationship between structure and function in three types of specialized cells.

Specialized cell	**Structure vs function**
Sperm cell	*Very small, low energy to produce. Hydrodynamic head with digestive enzymes to aid fertilization of the egg. Rotor section and tail to aid swimming.*

26. Complete the table below to explain two ways in which stem cells can be used in medicine.

	Therapeutic cloning	**Stem cell transplants**
Used to treat		
Brief method:		
Ethical considerations		

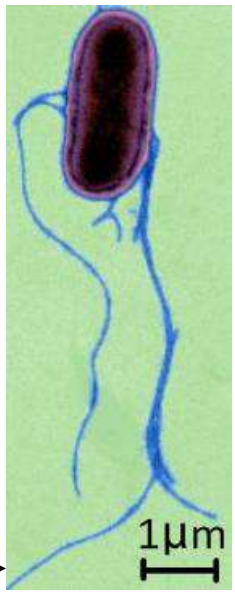
27. *S.typhi* and *Escherichia coli* are examples of prokaryotes.
    a. Define *prokaryote*.

    b. Draw and label the ultrastructure of a generalized prokaryote. *Include cell wall, plasma membrane, pili, flagella, nucleoid (naked DNA), ribosomes and a scale bar.*
    c. State the function of each of the labeled parts.

28. is is an electronmicrograph of the bacterium *Salmonella typhi*.
    a. Calculate the magnification of the image.

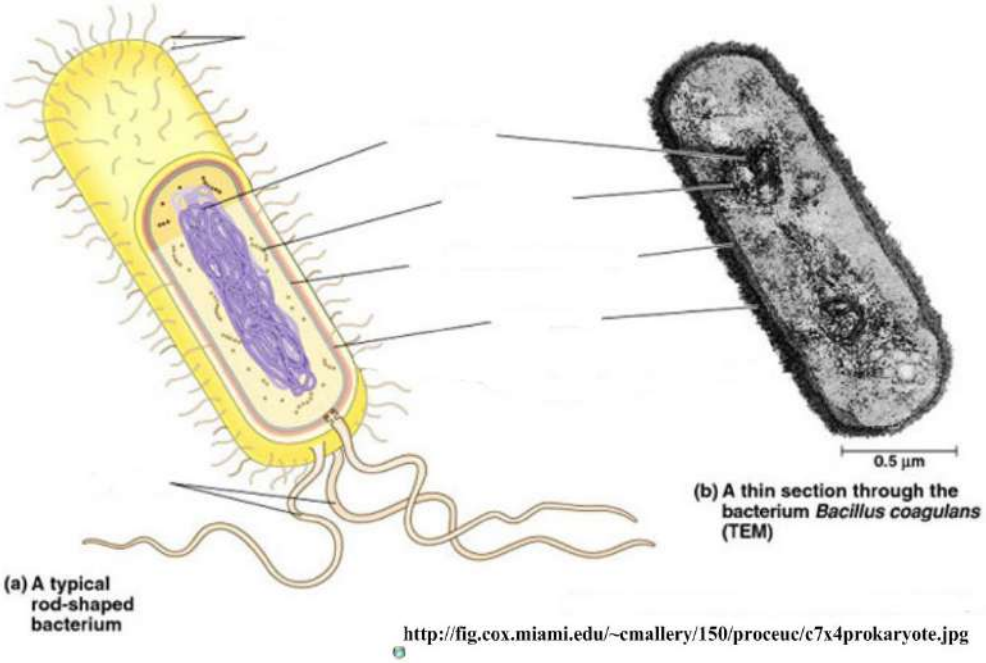
    b. Calculate the length of the cell body.

    c. State the name and function of this structure. →



d. State the method by which prokaryote cells reproduce.

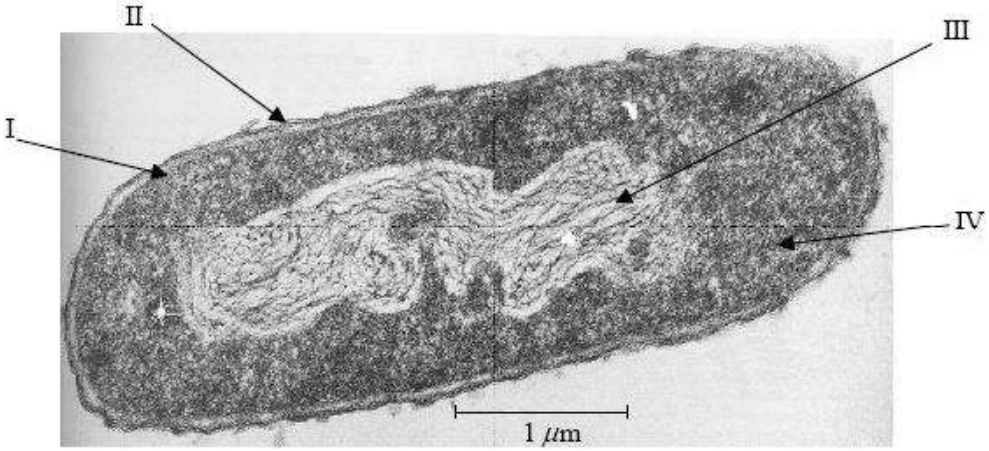
29. Identify the labeled structures in this diagram and transmission electron micrograph.



http://fig.cox.miami.edu/~cmallery/150/proceuc/c7x4prokaryote.jpg

30. This image is a transmission electron micrograph of a bacterium.

a. Identify the labeled structures



[Source: Stephen Wolfe, *Biology of the Cell*, (1995) 2nd edition, Brooks Cole, page 5]

b. Calculate:

i. The magnification of the image

ii. The maximum length of the bacterium.

31. Plant and animal cells are eukaryotic.
    a. Define *eukaryot*e.

    b. Evidence for Cell Theory: Outline the role of Robert Brown in forming cell theory.

32. Compare prokaryote and eukaryote cells.

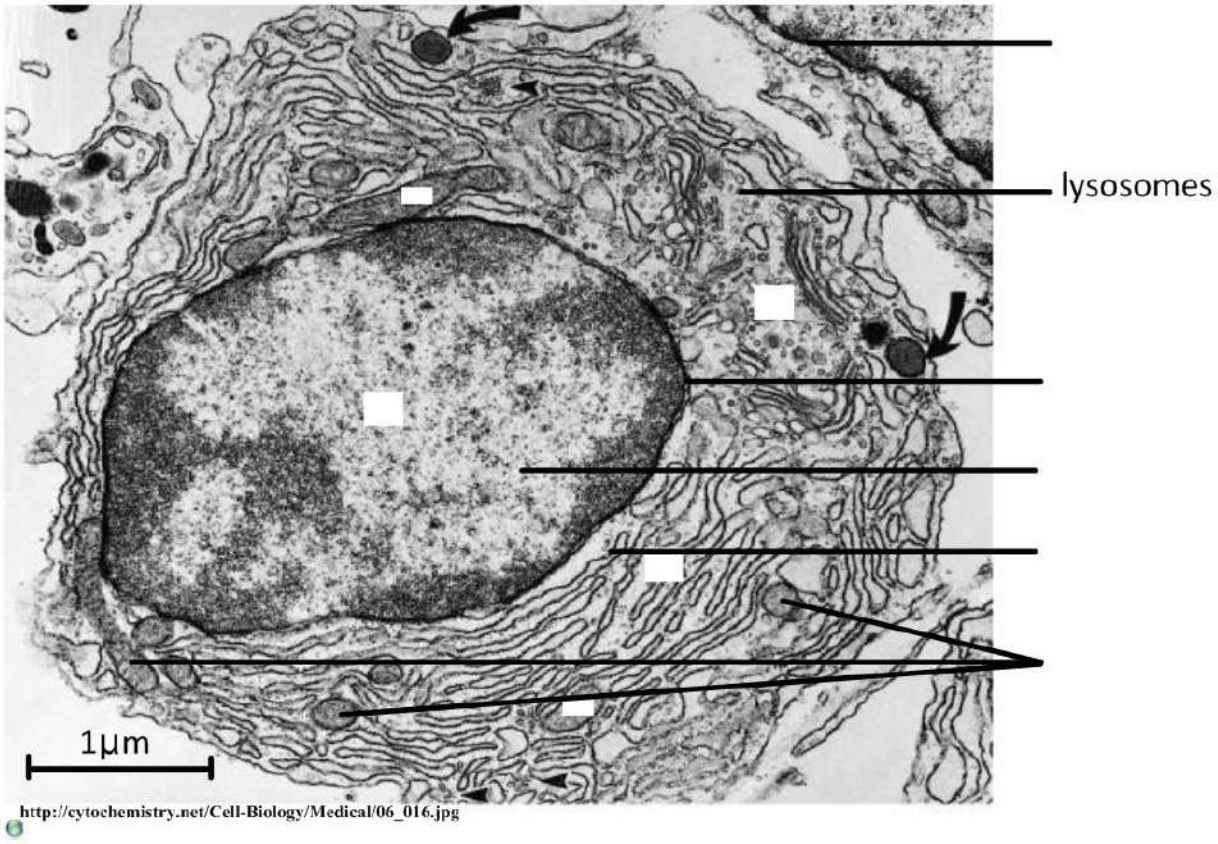
Prokaryote	**Eukaryote**
70S (small) ribosomes	80S (large) ribosomes
	True nucleus contains DNA
No mitochondria	
Cell parts	Organelles in discrete membranes
	Internal membranes enclose organelles
	10-15µm in diameter

33. Compare the structures of plant and animal cells, using clear, labeled diagrams.
    Include *annotations on the functions of each organelle* and *scale bars* to show size.

34. Outline the functions of these eukaryotic organelles:

Organelle	**Structure (description)**	**Function of organelle**	**Draw it**
	Region of the cell containing chromosomes, surrounded by a double membrane, in which there are pores.	Storage and protection of genetic information on chromosomes.	
Ribosome	Small spherical subunit consisting of two subunits, some attached to membranes, others free.		
	Spherical organelles surrounded by a single membrane, containing hydrolytic enzymes.	Digestion of structures ad molecules that are not needed in the cell.	
	Organelles surrounded by two membranes, the inner of which is folded inwards.		
	Double-membrane containing layers of membranes (thylakoid stacks) and the pigment chlorophyll.		
	Large, folding membrane structure found close to the nucleus, with ribosomes attached to some surfaces.		
	Large, folded membrane structure found close to the plasma membrane, often with vesicles budding off the outer edge.		

35. The image below shows a TEM micrograph of a liver cell.
    a. Identify the labeled structures.



    b. Calculate the magnification of the image.

    c. Calculate the maximum diameter of the nucleus.

36. *Extracellular components* are materials or structures which extend beyond the plasma membrane. Outline the role of an extracellular component in a *plant cell* and an *animal cell*.

    Plant:

    Animal:

37. Specialised cells are adapted to suit their function.
    a. In the space below, draw and label three specialized cells (two animal, one plant), outlining the relationship between *structure and function* in each case.

Diagram	**Structure vs function**

    b. Explain how cells differentiate from stem cells to become specialized.

38. Define the *plasma membrane*.

39. Draw and label a simplified (2D) diagram of the plasma membrane.
    Include: phospholipid bilayer, integral and peripheral proteins, glycoproteins and cholesterol.
    Why is it described as a *bilayer*?

40. List six functions of the plasma membrane.

41. Explain why the plasma membrane described as a *fluid mosaic model*.

42. State the functions of these plasma membrane components.

    a. glycoproteins

    b. cholesterol

43. Match the following *membrane proteins* with their functions:

Channel/ carrier proteins	used in cell surface reactions
Protein pumps	binding cells together
Receptor proteins	communication between cells
Enzymes	passive transport across the membrane
Adhesion proteins	active transport across the membrane
Neurotransmitter receptors	hormone binding and recognition

44. Draw a single phospholipid molecule. Label the *hydrophobic* and *hydrophilic* sections.

45. Explain how hydrophobic and hydrophilic properties of the phospholipid bilayer allow a membrane to maintain its structure.

46. Define *selectively permeable* in the context of the plasma membrane.

47. Define *diffusion*.

Define *osmosis*.

48. Distinguish between *solute, solvent* and *solution*.

49. List four ways to **maximize the rate of diffusion** of a substance across a membrane.

50. Outline the conditions required for the following methods of membrane transport:

	Concentration gradient	Selectively permeable membrane.	Membrane proteins	ATP (source of energy)
Simple diffusion	yes	Yes	no	no
Osmosis		Yes		
Facilitated diffusion		yes		
Active transport		yes		

51. State the membrane transport methods used by the following molecules:

    Water:

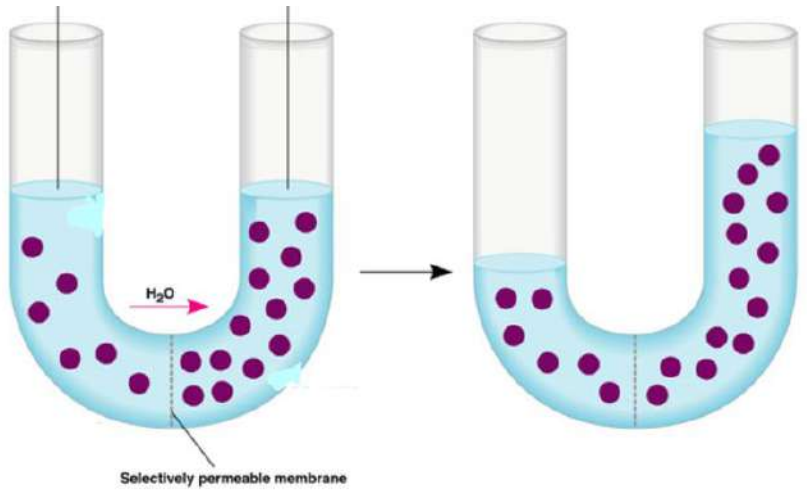
    Non-polar molecules *(with the concentration gradient):*

    Polar molecules *(with the concentration gradient):*

    Any molecule *against* the concentration gradient:

    Macromolecules:

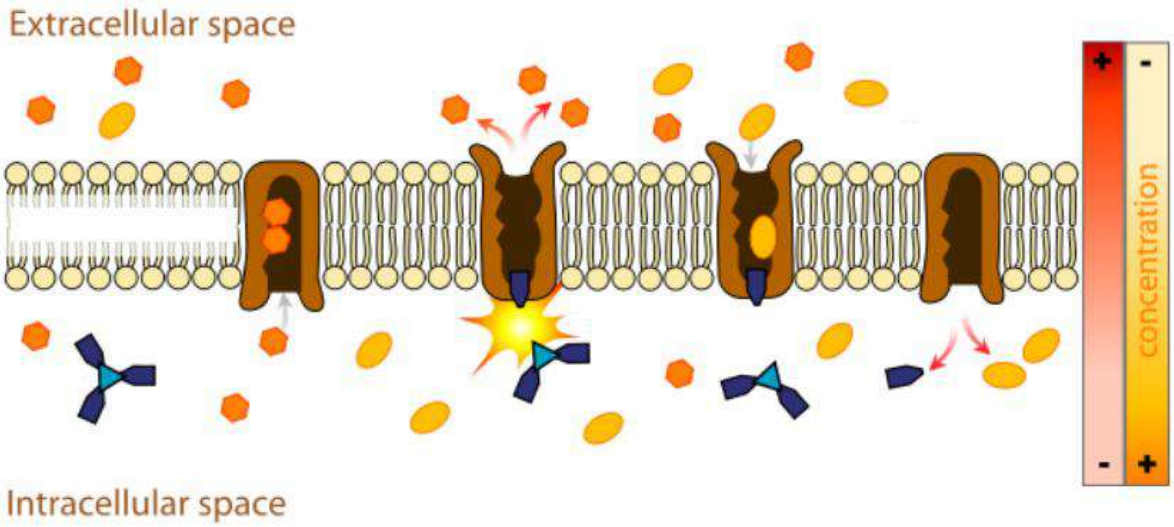
52. Explain what is happening in this diagram:



53. Explain how osmosis can lead to plasmolysis, using a labeled diagram.

54. ATP is the source of energy for active transport. Explain how ATP releases energy, using a simple diagram.

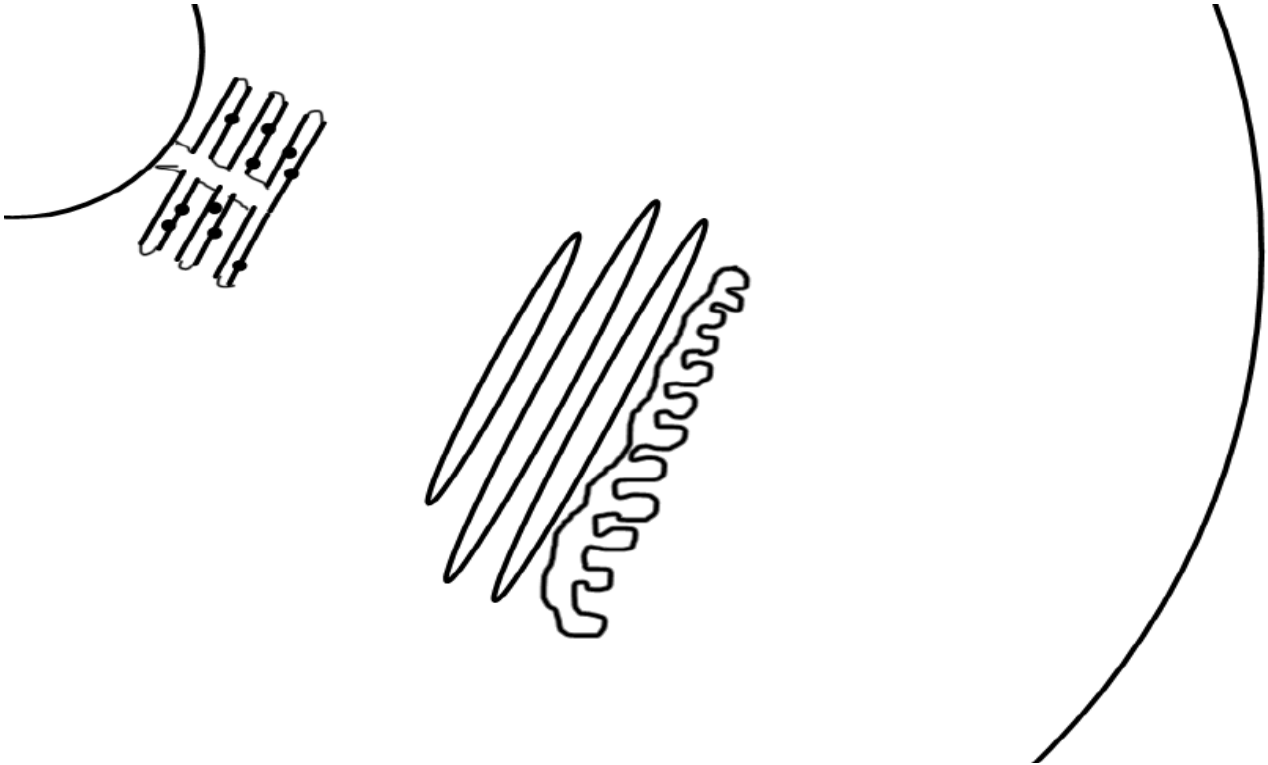
55. Annotate the diagram below to show how a *protein pump* is used in active transport of molecules across a plasma membrane. The Na^+/K^+ pump is an example.



56. Define *macromolecule*. Give one example of a macromolecule produced in the cell.

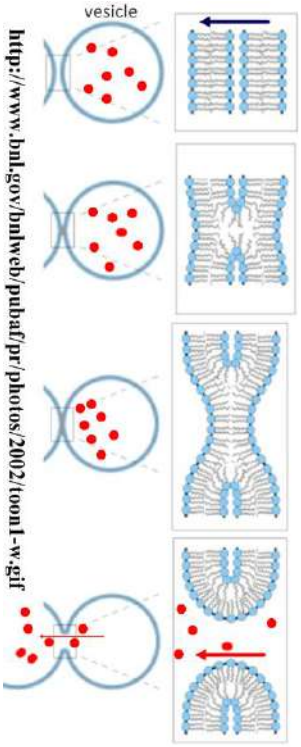
57. Define *vesicle*.

58. Complete and annotate the diagram below to show the process of vesicle transport of a protein molecule through a eukaryote cell. Begin with protein synthesis in the Rough ER and finish with *exocytosis though the plasma membrane*. Label all organelles shown.



59. Distinguish between *exocytosis* and *endocytosis*.

60. Describe how the plasma membrane breaks and reforms during exocytosis and endocytosis. How does the fluidity of the membrane allow this?



61. Define the following:

Cell cycle	
Interphase	
Mitosis	
Cytokinesis	
Apoptosis	
Necrosis	
Diploid	
Haploid	

62. Distinguish between *cell division* and *mitosis*.

63. Other than maintaining optimum cell size, list four processes involving division by mitosis.

64. Explain why eukaryotes need to use mitosis in cell division when prokaryotes do not.

65. Identify the outcome of one division by mitosis.

	Number of daughter cells	**Nucleus**
A.	2	Haploid
B.	2	Diploid
C.	4	Haploid
D.	4	Diploid

66. Draw and label a pie chart to show the relative amount of time spent in each phase of the cell cycle, including the stages of interphase and mitosis, as well as cytokinesis.

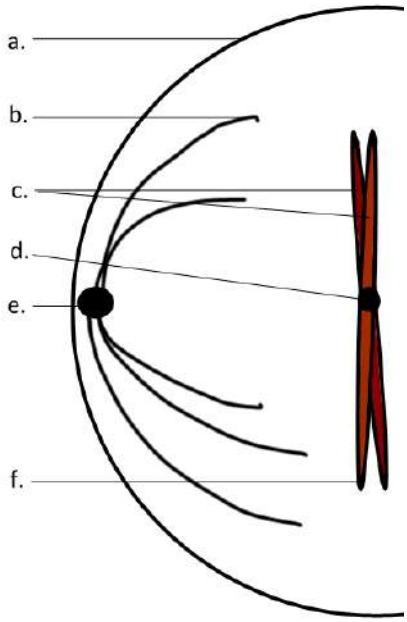
67. Outline the stages of interphase.

Stage	**Events**

68. List three metabolic reactions that occur during interphase.

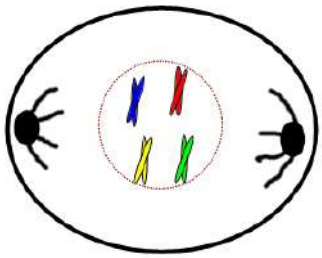
69. Label the diagram.

a	Plasma membrane
b	
c	
d	
e	
f	telomeres



70. Distinguish between *chromosomes* and *chromatids*.

71. Outline the stages of mitosis of an animal cell with a chromosome number of four.

	Diagram	**Outline**
Prophase		
Metaphase		
Anaphase		
Telophase		

72. Explain how mitosis leads to two genetically identical nuclei.

Chromosome number	
S-phase	
DNA Replication	Semi-conservative, complementary base-pairing results in fewere mistakes and copies of all genes in all new chromosomes.
Metaphase	
Anaphase	

73. Distinguish between *mitosis* and *cytokinesis*.

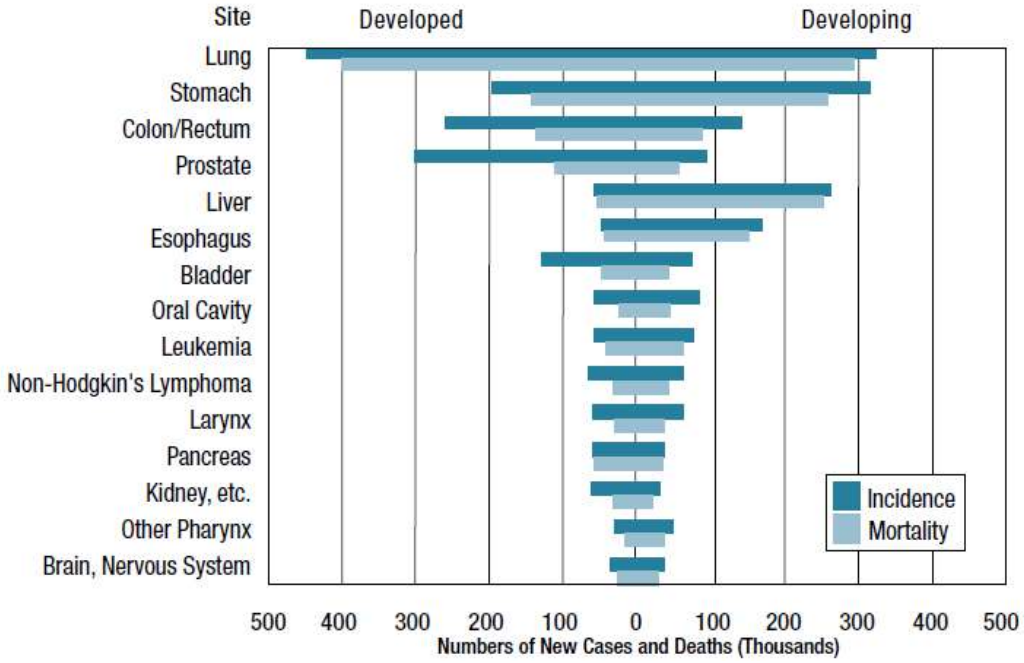
74. Cancer is an increasing global health concern, related to problems with cell division.
    a. Define tumor.

    b. State the locations or tissues where tumors:
        i. Can possibly occur.

        ii. Are most likely to occur

    c. Outline the role of the P53 gene and how it can be affected by carcinogens.

75. The following data are taken from a CA – a journal for cancer clinicians, 2009. The graph below compares the incidence and mortality for the 15 most common cancers in males, in the developing and developed worlds.



a. Distinguish between incidence and mortality.

b. Use the graph to estimate these **total global** statistics:

Type of cancer	Incidence (thousands)	Mortality
Lung		
Prostate		

c. Using the data from *c.,* calculate and compare the survival rates for lung and prostate cancer.

d. List three cancers which have higher prevalence rates in developed countries than in developing. Can you suggest reasons for this?