Name:

IB Biology HL 2 Summer Assignment

Due: Sept. 16, 2024

Course Title: IB Biology HL Pt. 2

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Purpose of Assignment: To provide students with a headstart with their Unit 1 Guided reading notes.

Estimated time to complete Assignment: 3 hrs

Due date and method of assessment for Assignment: Sept. 16, 2024. The assignment will count as a homework grade. If you do not finish this assignment over the summer, you will still have time to complete it when we return to school. The idea is that you get an opportunity to get ahead.

Instructions for Assignment:

1. You will need your **textbook** to complete this assignment. If you are new to W-L, email me and I can get you a copy of the textbook over the summer.
2. You need to **PRINT** this document.
3. This is a **handwritten** assignment and will only be accepted in hard copy form. You may use a pen/pencil or coloring pencils for diagrams.
4. If you do not have access to a printer, email me, and will make a hard copy for you over the summer.

Name:

Unit 1 Cells (HL2)

Origin of Cells p.40

A2.1.1 Conditions on early Earth and the pre-biotic formation of carbon compounds

Include the lack of free oxygen and therefore ozone, higher concentrations of carbon dioxide and methane, resulting in higher temperatures and ultraviolet light penetration. The conditions may have caused a variety of carbon compounds to form spontaneously by chemical processes that do not now occur.

1. Describe the pre-biotic atmosphere gathered from evidence found in ancient rocks:

Condition	**Amount (high/low/none)**	**Why?**
Oxygen		
Methane		
Carbon Dioxide		
Temperature		
Ocean pH		
Ozone		
UV light		

2. Describe how a soup of carbon compounds could have formed spontaneously on the pre-biotic Earth.

3. List some of the building blocks of life that could have spontaneously formed on the pre-biotic Earth.

4. Explain how the appearance of living organisms changed the composition of the atmosphere on this planet.

A2.1.2 Cells as the smallest unit of self-sustaining life

Discuss the differences between something that is living and something that is non-living. Include reasons that viruses are considered to be non-living.

5. List 4 pieces of evidence that can help us regard cells as living.

1.	
2.	
3.	
4.	

6. By looking at the evidence above, why are viruses considered non-living?

A2.1.3 Challenge of explaining the spontaneous origin of cells

Cells are highly complex structures that can currently only be produced by division of pre-existing cells. Students should be aware that catalysis, self-replication of molecules, self-assembly, and the emergence of compartmentalization were necessary requirements for the evolution of the first cells.

7. Explain the challenge of explaining the spontaneous origin of the first cells after disproving the theory of spontaneous generation.

8. Describe the developments required for the origin of cells:

1.	Catalysis
2.	Self-Assembly
3.	Compartmentalization
4.	Self-Replication

NOS: Students should appreciate that claims in science, including hypotheses and theories, must be testable. In some cases, scientists have to struggle with hypotheses that are difficult to test. In this case, the exact conditions on pre-biotic Earth can't be replicated and the first protocells did not fossilize.

9. Explain the difficulties in testing hypotheses relating to the origin of cells.

A2.1.4 Evidence for the origin of carbon compounds

Evaluate the Miller-Urey experiment.

10. Describe the JBS Haldane Hypothesis on the origin of life.

11. Describe the setup of the Miller-Urey experiment.

12. Evaluate the results of the Miller-Urey experiment. Did it plausibly explain the spontaneous formation of carbon compounds on Earth before life evolved?

A2.1.5 Spontaneous formation of vesicles by coalescence of fatty acids into spherical bilayers

Formation of a membrane-bound compartment is needed to allow internal chemistry to become different from that outside the compartment.

13. Explain the reaction of phospholipids found in the “soup” of carbon compounds when they mix with water. What could have they assembled into?

14. Describe the differences in the internal chemistry of a vesicle and its surroundings.

A2.1.6 RNA as a presumed first genetic material

RNA can be replicated and has some catalytic activity so it may have acted initially as both the genetic material and the enzymes of the earliest cells. Ribozymes in the ribosome are still used to catalyze peptide bond formation during protein synthesis.

15. Explain the reasoning as to why RNA is presumed to be the first genetic material.

Characteristics of RNA	Reasoning
Self- Replicating (catalytic)	
Some viruses have RNA	
Large subunit of ribosome composed of 2 RNA molecules	

A2.1.7 Evidence for a last universal common ancestor

Include the universal genetic code, and several hundred types of genes. Include the likelihood of other forms of life having evolved but becoming extinct due to competition from the last universal common ancestor (LUCA) and descendants of LUCA.

16. What does it mean for the genetic code to be Universal?

17. What is the implication that the genetic code is Universal?

18. Define LUCA.

19. Describe how many origins of life are predicted to have occurred and what has happened to the descendants of such lineages.

A2.1.8 Approaches used to estimate dates of the first living cells and the last universal common ancestor

Students should develop an appreciation of the immense length of time over which life has been evolving on Earth.

20. Describe where the earliest evidence has been located and how far back they date.

21. Explain how stromatolite is formed and how dating it can give us an estimate of when LUCA and the earliest cells first appeared.

22. Explain using the table below, how scientists use Carbon dating and genomic information to date the origins of life and LUCA.

Carbon Dating	
Genomic Information	

A.2.1.9 Evidence for the evolution of the last universal common ancestor in the vicinity of hydrothermal vents

Include fossilized evidence of life from ancient seafloor hydrothermal vent precipitates and evidence of conserved sequences from genomic analysis.

23. How long ago did LUCA live on this planet?

24. Explain what the identified 355 protein families in LUCA's genome tell us about its metabolism and the environment in which it lived.

A2.2.12 Origin of eukaryotic cells by endosymbiosis

Evidence suggests that all eukaryotes evolved from a common unicellular ancestor that had a nucleus and reproduced sexually. Mitochondria then evolved by endosymbiosis. In some eukaryotes, chloroplasts subsequently also had an endosymbiotic origin. Evidence should include the presence in mitochondria and chloroplasts of 70S ribosomes, naked circular DNA, and the ability to replicate.

AOS: Students should recognize that the strength of a theory comes from the observations the theory explains and the predictions it supports. A wide range of observations are accounted for by the theory of endosymbiosis.

25. Define the endosymbiotic theory.

26. List the evidence that chloroplasts and mitochondria were once free-living prokaryotes.

1.	
2.	
3.	
4.	
5.	
6.	
7.	

A2.2.13 Cell differentiation as the process for developing specialized tissues in multicellular organisms

Students should be aware that the basis for differentiation is different patterns of gene expression often triggered by changes in the environment.

27. Explain the process of cell differentiation.

28. What is the difference between housekeeping genes and genes that switch on and off?

29. What is gene expression?

A2.2.14 Evolution of multicellularity

Students should be aware that multicellularity has evolved repeatedly. Many fungi and eukaryotic algae and all plants and animals are multicellular. Multicellularity has the advantage of allowing larger body size and cell specialization.

30. Describe what you notice about the evolution of multicellularity.

31. Give examples of multicellular organisms.

32. Give 3 advantages of being multicellular.

A1.1.7 Extraplanetary origin of water on Earth and reasons for its retention

The abundance of water over billions of years of Earth's history has allowed life to evolve. Limit hypotheses for the origin of water on Earth to asteroids and reasons for retention to gravity and temperatures low enough to condense water.

33. Explain the unlikelihood of water being on Earth when the planet formed.

34. Explain the most widely supported hypothesis on the origin of water on planet Earth.

35. List the reasons for the retention of water on planet Earth.

1.	
2.	

A1.1.8 Relationship between the search for extraterrestrial life and the presence of water

Include the idea of the “Goldilocks zone”.

36. Explain the “Goldilocks zone” metaphor in relation to a habitable zone around a star.

37. State the number of planets within our galaxy within a Goldilocks zone and its implications.

Cell Structures

B2.2.4 Adaptations of the mitochondrion for the production of ATP by aerobic cell respiration

Include these adaptations: a double membrane with a small volume of intermembrane space, large surface area of cristae, and compartmentalization of enzymes and substrates of the Krebs cycle in the matrix.

38. Describe 4 adaptations of the mitochondrion for production of ATP by aerobic cell respiration.

1. Outer membrane	
2. Inner membrane	
3. Intermembrane space	
4. Matrix	

B2.2.5 Adaptations of the chloroplast for photosynthesis

Include these adaptations: the large surface area of thylakoid membranes with photosystems, small volumes of fluid inside thylakoids, and compartmentalization of enzymes and substrates of the Calvin cycle in the stroma.

39. List 4 features of the chloroplast.

1.	
2.	
3.	
4.	

40. Describe 3 adaptations of the chloroplast for Photosynthesis.

1. Large area of thylakoid membranes	
2. Small volume of fluid inside thylakoids	
3. Thylakoids distributed throughout the stroma	

B2.2.6 Functional benefits of the double membrane of the nucleus

Include the need for pores in the nuclear membrane and for the nucleus membrane to break into vesicles during mitosis and meiosis.

41. Explain the need for a nuclear pore and state the names of the molecules that come in and out of the nucleus.

42. Explain the need for the nuclear membrane to break off into vesicles during mitosis and meiosis.

B2.2.7 Structure and function of free ribosomes and of the rough endoplasmic reticulum

Contrast the synthesis by free ribosomes of proteins for retention in the cell with synthesis by membrane-bound ribosomes on the rough endoplasmic reticulum of proteins for transport within the cell and secretion.

43. Describe the structure of a ribosome. (composition, size, subunits)

44. Compare the function of free and bound ribosomes

	Free Ribosomes	Bound Ribosomes
Function		

B2.2.8 Structure and function of the Golgi apparatus

Limit to the roles of the Golgi apparatus in the processing and secretion of protein.

45. Describe the structure of the Golgi apparatus.

46. Describe the 2 proposed models to explain how proteins move through the Golgi apparatus.

1. The Vesicle Transport Model	
2. The Cisternal Maturation Model	

B2.2.9 Structure and function of vesicles in cells

Include the role of clathrin in the formation of vesicles.

47. Describe the structure and general function of vesicles.

48. Describe the role of clathrin in the formation of a lattice of pentagons and/or hexagons in vesicles.

49. Describe two general reasons why vesicles can be used to move materials around inside cells.

	Reason	Example
1.		
2.		

B2.3.7 Adaptations to increase surface area-to-volume ratios of cells

Include flattening of cells, microvilli and invagination. Use erythrocytes and proximal convoluted tubule cells in the nephron as examples.

50. Describe the adaptations used by the following cells to increase surface area to volume ratio.

	Adaptations
Red Blood Cells	Shape/Size:
Proximal convoluted cells in the nephron of the kidney	Shape/Size: Microvilli: Invaginations:

B2.3.8 Adaptations of type I and type II pneumocytes in alveoli

Limit to extreme thinness to reduce distances for diffusion in type I pneumocytes and the presence of many secretory vesicles (lamellar bodies) in the cytoplasm that discharge surfactant to the alveolar lumen in type II pneumocytes. Alveolar epithelium is an example of a tissue where more than one cell type is present, because different adaptations are required for the overall function of the tissue.

51. Describe the adaptations used by the following cells to increase surface area to volume ratio for diffusion.

	Adaptations
Type I pneumocytes in aveoli	Function: Shape/Size: (extreme thinness)
Type II pneumocytes in alveoli	Function: Shape/Size: (Lamella bodies)

B2.3.9 Adaptations of cardiac muscle cells and striated muscle fibres

Include the presence of contractile myofibrils in both muscle types and hypotheses for these differences: branching (branched or unbranched), and length and numbers of nuclei. Also, include a discussion of whether a striated muscle fibre is a cell.

52. Describe the adaptations of cardiac muscle cells and skeletal striated muscle cells.

	Cardiac	Skeletal
Function		
Location		
Length(short/long)		
# of Nuclei		
Striations (yes/no)		
Branched/Unbranched		
Mitochondria(more/less)		

53. Discuss why there is a debate whether or not a muscle cell can be considered a cell or not. (# of nuclei/size).

B2.3.10 Adaptations of sperm and egg cells

Limit to gametes in humans.

54. Describe 3 structures/adaptations that enable egg cells to receive one sperm (and no more) during fertilization.

1. Zona pellucida	
2. Binding proteins in plasma membrane	
3. Cortical granules	

55. Describe 3 structures/adaptations of the egg cells which provide the resources needed for the zygote and then the embryo to develop.

1. Yolk	
2. Mitochondria	
3. Centrioles	

56. Draw and label the structure of the human egg cell below. Include the diameter of the cell.

57. Describe 3 structures/adaptations that allow sperm cells to swim rapidly.

1. Tail	
2. Midpiece with mitochondria	
3. Head	

58. Describe 3 structures/adaptations that allow sperm cells to insert their nucleus into the egg cell.

1. ZP3 glycoproteins	
2. Acrosome	
3. Binding proteins in the inner acrosomal membrane	

58 (b) Draw and label the structure of the human sperm. Include the diameter of the cell

Cell Membranes

B2.1.11 Relationships between fatty acid composition of lipid bilayers and their fluidity

Unsaturated fatty acids in lipid bilayers have lower melting points, so membranes are fluid and therefore flexible at temperatures experienced by a cell. Saturated fatty acids have higher melting points and make membranes stronger at higher temperatures. Students should be familiar with an example of adaptations in membrane composition in relation to habitat.

59. Identify the relationship between the fatty acid composition of a lipid bilayer and its effect on its fluidity.

	Double bonds in lipid chain(yes/no)	Hydrocarbon chains (straight/kinks)	Melting point (high/low)	Effect on membrane Fluidity, Flexibility and permeability
Saturated Fatty Acid				
Unsaturated Fatty Acid				

60. State what determines the ideal ratio of saturated to unsaturated fatty acids.

61. List one example of an organism whose membrane is adapted to its habitat.

62. Draw a saturated and unsaturated fatty acid membrane below

UnSaturated Membrane	Saturated Membrane

B2.1.12 Cholesterol and membrane fluidity in animal cells

Students should understand the position of cholesterol molecules in membranes and also that cholesterol acts as a modulator (adjustor) of membrane fluidity, stabilizing membranes at higher temperatures and preventing stiffening at lower temperatures.

63. Describe the position of the cholesterol molecule in the cell membrane (including the position of the hydroxyl group).

64. Explain how cholesterol acts as a modulator (adjustor) of membrane fluidity at different temperatures.

High Temperature	
Low Temperature	

65. Explain the functional role of cholesterol on the membrane

Effect on Water soluble molecule	
Effect on peripheral proteins	

B2.1.13 Membrane fluidity and the fusion and formation of vesicles

Include the terms “endocytosis” and “exocytosis”, and examples of each process.

66. Explain how vesicles are formed using the cell membrane and if ATP is needed.

67. Describe the contents and direction of movement of vesicles made by endocytosis.

68. What is the difference between 2 types of endocytosis (Pinocytosis & Phagocytosis)?

69. List 3 examples of vesicles made by endocytosis in the:

Placenta	
Amoeba/Paramecium	
White Blood Cells	

70. Describe the contents and direction of movement of vesicles made by exocytosis.

71. Describe 3 examples of vesicles made by exocytosis in the:

Secretory Cells moving protein content	
Unicellular organisms expel water via contractile vacuoles	
Area of plasma membrane	

B2.1.14 Gated ion channels in neurons

Include nicotinic acetylcholine receptors as an example of a neurotransmitter-gated ion channel and sodium and potassium channels as examples of voltage-gated channels.

72. Define Ion Channels.

73. Describe the function of two types of Ion Channels: (bioninja has a great summary)

	Function	Example
Voltage-gated Ion channels		
Ligand-gated Ion channels		

B2.1.15 Sodium–potassium pumps as an example of exchange transporters

Include the importance of these pumps in generating membrane potentials.

74. Define an antiport (antitransporter or exchange transporter).

75. Describe the process of active transport using a sodium-potassium pump protein used by nerve cells (neurons) to establish an electrochemical gradient across the membrane (resting potential).

1. Sodium binds	
2. ATP hydrolysis	
3. Potassium binds	
4. Pump reset	

B2.1.16 Sodium-dependent glucose cotransporters as an example of indirect active transport

Include the importance of these cotransporters in glucose absorption by cells in the small intestine and glucose reabsorption by cells in the nephron.

76. Define carrier proteins.

77. Explain how a carrier protein cotransporter moves an ion (Na+) along its concentration gradient while moving a solute (glucose) against its concentration gradient.

78. Give 2 examples in the human body where cotransporters play an important role.

B2.1.17 Adhesion of cells to form tissues

Include the term “cell-adhesion molecules” (CAMs) and the understanding that different forms of CAM are used for different types of cell–cell junction. Students are not required to have detailed knowledge of the different CAMs or junctions.

79. Define cell adhesion and CAM’s.

80. Describe some of the processes in which CAM’s play an important role (including metastasis).

81. Explain how different forms of CAM’s are used for the 3 different types of cell–cell junction.