#### HUMAN BIOLOGICAL SCIENCES 2A

**FACTORS AFFECTING THE**

**RATE OF DIFFUSION**

**INVESTIGATION ONE**

Name: \_\_\_\_\_\_\_\_\_\_\_\_***ANSWER KEY***\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Part A, Research: /15

Part B, Practical: /20

Part C, Assessment: /15

Total Marks: /50 %

HBS2A: Investigation 1

Factors affecting the rate of diffusion

**Part A: Research - Lesson 1**

* 1. Define diffusion and give at least two examples of how diffusion allows a cell to be provided with the substances necessary for life functions. [3]

***Diffusion is the net movement of a substance across a semi-permeable membrane from an area of high conc to low conc (down a conc gradient). It is a passive process. [1]***

***Water / oxygen moves through phospholipid bilayer of cell membrane. Glucose moves through protein channels of cell membrane. [1]***

***Used for respiration to provide energy for growth, repair etc. [1]***

* 1. Describe the structure of the cell membrane and provide examples of how substances may diffuse into a cell. [5]

***Semi-permeable, Phospholipid bilayer, Protein channels, Pores, Antigens/Markers/carbohydrates (glycoproteins), Cholesterol [at least three features 2 marks]***

***Semi-permeable – allows some molecules through but not others [1]***

***Protein channels allow specific molecules to enter or leave [1]***

***Pores allow very small (lipid soluble) molecules through [1]***

* 1. Define the terms hypotonic, hypertonic and isotonic and discuss the influence that these solutions can have on the effectiveness of diffusion. [3]

***Hypotonic - conc of solutes lower outside cell, Hypertonic- conc of solutes higher outside cell, Isotonic – equilibrium [1]***

***Hypotonic – diffusion reduced, Hypertonic – diffusion increased, Isotonic – no net diffusion [2 marks for all three pts, 1 mark for two, 0 mark for one]***

* 1. Discuss the concept of surface area : volume ratio and how this affects the size of cells and consequently the evolution of multi-cellular organisms. [4]

***SA:V describes the amount of available surface area compared with volume.[1]***

***Smaller cells (organisms) will have higher SA:V. [1]***

***Cell maintain small size due to high SA:V allowing for more efficient diffusion of necessary substances in (and wastes out) [1]***

***Multicellular organisms have arisen so they can maintain efficient diffusion into and out of individual cells whilst gaining benefits of being large in size. [1]***

HBS2A: Investigation 1

Factors affecting the rate of diffusion

**RESULTS TABLES**

**A. Influence of time on diffusion**

***Should look something like this…***

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **0 m [1]** | **5 m [1]** | **10 m [2]** | **15m [1]** | **20m [1]** |
| **1cm3**  Vol diffused | **0** | **4.88cm3** | **7.75 cm3** | **8.75 cm3** | **9.32 cm3** |
| % diffusion | **0** | **48%** | **77%** | **87%** | **93%** |
|  |  | | | | |
| **2cm3**  Vol diffused |  | | **2.17 cm3** |
| % diffusion | **27%** |

***Percentage diffusion of 1cm3 at 10 m was 77%, percentage diffusion of 2cm3 at 10 m was 27%. [1]***

***1cm3 has higher SA:V so diffusion is more efficient (faster) as there is more surface area for the potassium permanganate to move into the potato. [1]***

**B. Influence of the chemical concentration on diffusion**

***Should look something like this…***

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **5% [1]** | | **1% [2]** | **0.1% [1]** |
| **1cm3**  Vol diffused | **9.32 cm3** | | **4.50 cm3** | **2.25 cm3** |
| % diffusion | **93%** | | **45%** | **22%** |
|  |
| **2cm3**  Vol diffused |  | **1.12 cm3** | |
| % diffusion | **11%** | |

***Percentage diffusion of 1cm3 was 45%, percentage diffusion of 2cm3 was 11%. [1]***

***1cm3 has higher SA:V so diffusion is more efficient (faster) as there is more surface area for the potassium permanganate to move into the potato. [1]***

**Interpretation of data**

Write a discussion of the results including the following points:

* relation of the effects of time allowed to the diffusion of material into or out of a cell [1]

***Diffusion increases as time increases [1]***

* relation of the concentration of diffusing molecules to the diffusion of material into or out of a cell [2]

***Diffusion will increase when the solution is more concentrated [1] (hypertonic) [1]***

* relation of the surface area: volume ratio of the 'cell' to the diffusion of material into or out of a cell [2]

***A smaller cell has a larger SA:V [1], Diffusion increases as SA:V increases [1]***

* consideration of the significance of cell size on the efficient functioning of the cell [1]

***The smaller the cell the faster the diffusion of necessary substances into the cell (and wastes out of the cell), therefore life functions are more efficient. [1]***

***Minus 2 marks if no reference to practical.***

***Minus 1 mark if there is only one reference to practical.***

HBS2A: Investigation 1

Factors affecting the rate of diffusion

Validation Assessment

1. (a) Calculate the surface area:volume ratio of the following cells using the data provided. [2]

|  |  |  |  |
| --- | --- | --- | --- |
| **Cell** | **Surface area (µm2)** | **Volume (µm3)** | **SA:V** |
| A | 50 | 20 | ***2.5*** |
| B | 15 | 5 | ***3*** |
| C | 0.1 | 0.03 | ***3.33*** |

(b) Based on your calculations which cell would be most efficient at supplying the cell contents with the necessary substances for life processes? [1]

***Cell C***

1. In part A of the practical (Influence of time on diffusion) a cube was not placed into a solution and was classified as the ‘control cube’. Why is a control necessary in an experiment? [1]

***To ensure results obtain are caused by experimental variable/ used as a comparison against***

***experimental variable.***

1. In the same practical, why was it necessary to clean and dry the blade before cutting the next cube? [1]

***To ensure the potassium permanganate does not stain the undiffused area of the potato as it is being***

***cut.***

1. In reality it would be a substance such as glucose that would diffuse into a cell. Considering glucose is not lipid soluble and therefore cannot penetrate the lipid bi-layer, describe how glucose is able to move through a cell membrane. [2]

***Glucose would move through a protein channel [1] from an area of high conc outside the cell [1]***

1. When a patient is dehydrated they are given an intravenous drip of saline solution. Why is it a bad idea to give a person an intravenous drip of pure water? [2]

***Saline solution is same conc (isotonic) as blood plasma [1]***

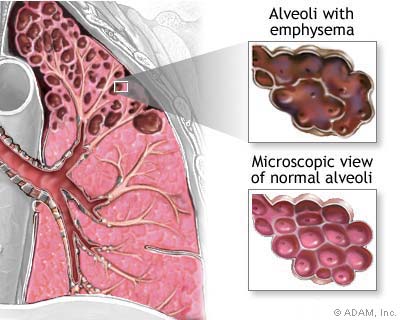
***Pure water would cause water to diffuse into blood cells causing them to burst. [1]***

1. When a person spends a long time in the ocean their fingertips look noticeable shrivelled. Explain what has taken place in the intracellular fluid of the person. [3]

***Ocean water is higher conc (hypertonic) to body fluids [1]***

***Water would diffuse out of body fluids [1]***

***Causing the body fluids to become higher conc in solutes, making the skin appear shrivelled [1]***



1. A person suffering from severe emphysema undergoes oxygen therapy. This involves pure oxygen being pumped through a tube into the lungs. With reference to the diagram on the right explain why pure oxygen in used in the treatment for emphysema (remembering the normal concentration of oxygen in the atmosphere is only 21%). [3]

***Emphysema ruptures alveoli walls decreasing amount of surface area for gas exchange [1]***

***Diffusion of oxygen into lungs is therefore decreased [1]***

***Using pure oxygen (a higher conc) increases diffusion and compensates for lack of SA [1]***