Cell size surface area- volume essay

Cell Biology- Osmosis, Cell Size and Diffusion and Enzymes 1. 0 INTRODUCTION Cells are the basic building blocks of all living things. They provide structure for the body, take in nutrients from the food, convert those nutrients into energy, and carry out specialized functions. Cells also contain the body’s genetic material and can make copies of themselves. A cell is also a metabolic compartment where many different chemical reaction occur. There are two types of cells, eukaryotic and prokaryotic.

Prokaryotic cells are usually unicellular, while eukaryotic cells can either exist as a single celled organism or be found in multicellular organisms. The unicellular and multicellular organisms are linked to cell size and surface area to volume ratio. The experiment for cell size and diffusion was set to see how and how much water can go to the cells. This movement of water is called Osmosis. Osmosis is the movement of water molecules from an area of low concentration (lots of water) to an area of high concentration (little water) through a semi permeable membrane, demonstrated in ‘ figure 1’.

A semi permeable membrane is a membrane that only lets selected molecules to pass through it. In a plant water is taken into the roots by the process of Osmosis. This is because the cells inside the roots have a higher concentration of solutes than the soil outside the roots, water diffuses from an area on high concentration to an area of low concentration. When a large volume of water enters the cell, it swells causing the membrane to push against the cell wall which is called turgor pressure. When the water moves out of the cell, the membrane shrinks away from the cell wall and becomes a loose cell, plasmolysis.

This causes the plant to wilt, as the cells can no longer provide support for the leaves. Figure1. How Osmosis works As already known, proteins in our cells do many things. One of the most important things they do is act as an enzyme. An enzyme is a biological catalyst, and a biological catalyst is something that changes chemical reactions without being changed itself. Enzymes are the catalysts for chemical reactions. They work by lowering the activation energy of a reaction therefore making the reaction easier to proceed to the products… this increases the reaction rate.

Chemical reactions keep our bodies going, without them, we'd die. So enzymes are very, very important. Enzymes are not changed when they perform their function as seen in ' figure 2'. This means that the same enzyme can be used over and over again. Some enzymes may even be used repeatedly on the same set of small molecules to build a long chain of repeating subunits. As with all proteins, the shape of an enzyme is what determines its function. An organism has the ability to make many different enzymes, and each enzyme has one particular function.

There are enzymes in all the tissues and fluids of our bodies and these enzymes are very specific. The substances they work on are called substrates. The factors effecting enzymes shape of a molecule are substrate concentration (salinity), pH, temperature, activators and inhibitors. This process is called denaturing and will also make the enzyme less effective, possibly even useless. Figure 2. An Animated Demonstration of How Enzymes Work 2. 0 Cell Size and diffusion 2. 1 AIM To determine the influence of the surface area : volume ratio on the effectiveness of the rate and percentage of diffusion in various cell sizes. . 2 HYPOTHESIS If the agar

cubes are reactant to the Hydrochloric Acid, then the cube will become clear because the acid is defusing the cubes and the clear parts are the indicator of the cell size and surface area to volume ratio. As the size of the cell increases, so does the surface area and volume. 2. 3 APPARATUS * 3 cubes of Agar with NaOH & phenolphthalein indicator (1cm3, 2cm3, 3cm3) * 200-250mL 2M HCl solution * 250mL beaker * forceps * glass petri dish * scalpel * paper towel * ruler * stopwatch * calculator * safety glasses 2. Experimental Design and Procedure In the experiment to find the surface area to volume ratio, the cells were represented by three cubes of different sizes, 1cm, 2cm and 3cm. The hydrochloric acid is what represents the raw materials. When the cubes are placed in to the hydrochloric acid they will diffuse making the indicator clear. Because the sizes are different, the rate of diffusing varies. The acid will diffuse into the cubes at the same rate but in a given time period it will reach a greater proportion in the smaller cube as to the bigger cube.

Eventually the acid reaches the centre of the 1cm cube but in the same time period it does not reach the centre of the 2cm and 3cm cubes. This is because when volume is to large compared to the surface area or if the surface area-to-volume ratio is too small, like the 3cm cube, diffusion cannot occur at high enough rates to supply its raw materials to the whole volume of the cell which will make the cell unable to become larger. * Place all three cubes of agar in the beaker using forceps/fingers. Position the cubes so that they are touching neither the sides of the beaker or another cube. Carefully pour 100-150mL (or until cubes are fully immersed) of HCl into the beaker and leave for ~5min (or until the smallest cube has completely lost colour),

timing with the stopwatch accurately * While waiting, construct a results table to show the surface area and volume of each cube, surface area : volume ratio, calculations, and space for the volume of the diffusion calculations. * Upon 5min (or saturation of smallest cube) remove all cubes from the beaker carefully using forceps, and place in glass petri dish. Rinse cubes under water (gently). * Return HCl to waste container (see your teacher) Using the scalpel and forceps to hold agar gel, carefully cut each cube in ? making sure to clean the blade in fresh water and drying with paper towel in between cutting cubes. * Using a ruler, measure the distance HCl travelled (diffused) through each of the agar cubes. This will be the amount of ‘ clear’ perimeter around the pink/brown centre. * Record all results & observations in your table, return equipment, and clean your prac station. Volume = clear volume, Volume Diffused = Clear total volume – Pink volume, Volume Undiffused = Volume of Pink cube. 2. 5 RESULTS Table 1.

Results of SA: Vol Experiment. | Agar Cube| SA (cm2)| Volume (cm3)| SA : Vol (simplified)| Volume Diffused (cm3)| Volume Undiffused (cm3)| Percentage Diffused %| Trial #1| 1cm| 6| 1| 6: 1| 1| 0| 100%| | 2cm| 24| 8| 3: 1| 7. 271| 0. 729| 91%| | 3cm| 54 | 27| 2: 1| 20. 141| 6. 86| 75%| Graph1. Cell Size and Surface Area to Volume Ratio. This graph represents the cell size diffusion and the surface area to volume ratio. The biological principles that have been used are photosynthesis and cellular respiration. This experiment had to show a relationship with enzymes for those processes to occur. 2. DISCUSSION When the cubes were placed in the hydrochloric Acid, the acid defused the cubes making the indicator clear so that it was visible to see how the surface area and the volume of the cubes vary depending on the

size of the cube. The acid diffused into each cube at the same rate but it reached to a much greater proportion in the smallest cube making it all clear. The volume of the cell increases faster than the surface area when the cell grows, therefore decreasing its surface area to volume ratio. This means, the greater the size of the cell the less surface area it has related to the volume.

Therefore my Hypothesis was supported. 2. 7 CONCLUSION As a cell size increases, surface area compared to volume is smaller. If the cell's volume is continuously increased, diffusion will no longer be an effective way to transport materials to the inside of the cell. The effectiveness of the cells rate of metabolism is dependent on diffusion of required nutrients, and diffusion is determined by the size of the cell. 3. 0 Osmosis 3. 1 AIM To find the intracellular solute concentration of potato cells by observing osmosis through changes in mass of potato cells. 3. 2 HYPOTHESIS

The potato chip in the test tube with only H2O will have the highest mass compared to the other potato chips in the test tubes with different amounts of solute concentration because water diffuses from high concentration to low concentration. So if there is more water outside, then that means that more water will be moving in the cell increasing the mass. 3. 3 APPARATUS * 5 test tubes * Beaker * Ice-cream bucket * Measuring tube * Potato chips * Water * The three different types of concentrated solution * Scale * Safety glasses 3. 4 EXPERIMENTAL DESIGN & PROCEDURE

To see the movement of Osmosis, the experiment that was being tested was Osmosis in potato cells. The investigating is of how a different solute

concentration in a cell extracellular space impacts the rate of osmosis, and the relative mass of the cell. The potato chips are models of plant cells. The sugar solutions that were made were: 0. 1M = 3. 4g sucrose in 100mL water, 0. 3M = 10. 3g sucrose in 100mL water, 0. 5M = 17. 1g sucrose in 100mL water, and 0. 7M = 23. 9g sucrose in 100mL water. Firstly, a 10cm length of masking tape was numbered 105 at 2cm intervals, then cut to label 5 separate test tubes held in a test tube rack.

A 5mL graduated measuring cylinder was then used to measure 5mL of 0. 1M stock sucrose solution, and poured into test tube 1 using a filter funnel. Percentage mass change = (Difference in mass x 100) divided by Original mass Table 2. Results to the Osmosis Experiment 3. 5 RESULTS Test Tube| Sucrose Solution (M)| Mass Before (g)| Mass After (g)| Sugar Solution Remains (mL)| Percentage Change in Mass (%)| 1| 0. 1| 3. 35g| 3. 51g| 9. 6mL| 4. 78%| 2| 0. 3| 3. 16g| 3. 12g| 9. 6mL| -1. 26%| 3| 0. 5| 3. 28g| 2. 84g| 9. 8mL| -13. 41%| 4| 0. 7| 3. 28g| 2. 73g| 10+ aprox. 10. 4mL| -16. 77%| 5| Distilled Water/ H2O| 3. 6g| 2. 91g| 10+ approx 10. 4mL| -10. 74%| The potato chip that was placed in distilled water should have been the heaviest because of what was stated in my hypothesis. Perhaps the equipment was contaminated because it was the last test which obviously should have been the first. Graph 2. The Percentage Change in Mass This graph is showing the percentage change in mass of the five potatoes in tubes of water with different amounts of sucrose solution. 3. 6 DISCUSSION The Hypothesis for this experiment was contradicted by the results and was not as expected based on the biological theory.

As known from the principle of plasmolysis, if the water concentration outside the cell is low, meaning the sugar concentration is therefore high by comparison, that means that the water in the cell is high and water moves from high to low, meaning that water would leave the cell. So as the water levels increased so should have the potato because water was moving into the cell. In this experiment the biological theory became false as the potato in only H2O decreased -10. 74% which is a very strange Osmosis reaction. The first potato chip in the test tube became the only reaction in the experiment to support the biological theory.

It had 0. 1m in sucrose solution and increased 4. 78% in mass. The first potato chip may have been the only successful test in the experiment because it was the first one to be proceeded which means it defiantly had a clean measuring tube and wasn't contaminated as the others may have been. 3. 7 CONCLUSION The movement of water is always from high concentration to low concentration. When a cell appears ' bloated', the system is hypotonic and in turgor. When a cell appears shrivelled the system is hypotonic and in plasmolysis. When a cell reaches equilibrium of equal concentration inside and outside the cell, it is known to be isotonic. . 0 ENZYMES 4. 1 AIM The reaction, 2H2O2 2H2O + O2 will be used to investigate how the pH of a substrate will influence the rate of enzyme activity using raw lamb liver and household detergent representing the reaction to find the overall reaction rate. 2. 2 HYPOTHESIS If the liver is placed in a really high pH level, or in a really low pH level, then the rate of the reaction will decrease because the temperature will denature the enzyme. 2. 3 APPARATUS * Solutions of hydrogen Peroxide at different pH

levels of 1, 3, 5, 7, 9, 11 * Detergent Stop watch * 1 x 10mL measuring cylinder * Sharp knife * Forceps * Fresh liver * 1 x 100mL measuring cylinder * 2 x teat pipettes * Distilled water * Cutting block 2. 4 EXPERIMENTAL DEIGN AND PROCEDUE To see how Enzyme activity works, In the experiment liver was used as a source of catalase, the oxygen was given off as a gas, and when detergent was added to the substrate foam was formed. The volume of the foam produced in the given time is what was used as a measure of the enzyme activity. 1. Cut 6 cubes of liver each approximately 1cm x 1cm x 1cm 2.

Use the 10mL measuring cylinder and teat pipette to measure 9mL of hydrogen peroxide with a pH of 1 into the 100mL measuring cylinder 3. Add two drops of detergent and swirl to mix 4. Using the forceps, take one cube of liver and place it in the measuring cylinder. 5. After 2 minutes, record the total volume of the foam in the cylinder and record your data in a table 6. Repeat this same procedure with the other 5 solutions of hydrogen peroxide. Make sure to rinse the glassware carefully between procedures Reaction Rate (mL/Min) = (Average total volume – 10) divided by 2 . 5 RESULTS Table 3. Results of the Enzyme Experiment 3. 35g| 3. 51g| 9. 6mL| 4. 78%| 3. 16g| 3. 12g| 9. 6mL| -1. 26%| 3. 28g| 2. 84g| 9. 8mL| -13. 41%| 3. 28g| 2. 73g| 10+ aprox. 10. 4mL| -16. 77%| 3. 26g| 2. 91g| 10+ approx 10. 4mL| -10. 74%| Substrate pH| Group 1| Group 2| Group 3| Av. Total vol. (mL)| Av. Vol – 10 (mL)| Reaction Rate (mL/Min)| 1| 20| 17| 17| 18| 8| 4| 3| 100| 85| 92| 92. 33| 82. 3| 41. 15| 5| 150| 140| 145| 145| 135| 67. 5| 7| 145| 145| 125| 138| 128| 64| 9| 125| 125| 121| 124| 114| 57| 11| 40| 22| 20| 27. 3| 17. 3| 8. 65| Graph 3. The Overall Average

This graph is showing the reaction rate of the pH levels which was the measurement of the height of the foam from the detergent that was added to indicate the oxygen that was given off as a gas. The volume of the foam produced in the given time of 2 minutes is what gave the measurement of enzyme activity. Graph 4. A Comparison of all the Tests This graph is showing all the different reaction sizes from all the tests that were made with the six different substrates of pH. 2. 6 DISCCUSION My hypothesis in this experiment was supported because the lamb liver did denture when the pH became too high or too low.

It was found that the enzyme with the pH 5 had the highest amount of foam which represented the reaction rate because the detergent made the reaction visible and something for us to measure evidently. It also showed how enzymes work and how they can only properly function in the right pH or temperature, and it was made clear of this when the reaction occurred and the height of the foam was measured after the time given of 2 minutes. 2. 7 CONCLUSION From the experiment that was taken place, it can be seen that the Enzymes activities reaction rate denatures if the pH is too high or too low.

The experiment also provided information that an enzymes neutral pH is around pH 5. BIBLIOGRAPHY John Kyrk, 2013, Cell Biology Animation, Batavia, http://www. johnkyrk. com/ Flinn, 2013, Cell Size and Diffusion, http://www. flinnsci. com/teacher-resources/teacher-resource-videos/see-it-in-action-videos/biology/cell-size-and-diffusion,-fb1638/ Regina Bailey, Diffusion and Passive Transport, http://biology. about. com/od/cellularprocesses/ss/diffusion_3. htm CliffsNotes, Enzymes,

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