Osmosis: potato and sucrose solution assignment

Investigation of Factors Affect Osmosis in Potatoes Aim The aim of the following experiment was to investigate the effect of?? varying the concentration of sucrose solution on osmosis in a potato. Preliminary Experiments One preliminary experiment was done before the main experiment. From?? the preliminary, we were trying to find out how osmosis actually?? occurred in potatoes, and gave us a vague idea on what the main?? experiment would be like. This preliminary will aid my prediction, which is stated below. The?? following apparatus was used for the preliminary: 1 large potato (skin intact) * 3 boiling?? tubes * Set of cork borers * Scalpel * Balance (accurate to 2 decimal places) * Distilled water * 0. 5M?? sucrose solution * 1. 0M sucrose solution * Dropping pipette * Boiling tube rack * Measuring cylinder (accurate to 1cm3) * White tile Take a large uncooked potato, with the skin still on, and with the?? cork borer, cut out three “ tubes” of potato. Do this onto a white?? tile, so you don’t cut your fingers or wreck the bench. Take a ruler?? and measure these tubes, and, if necessary, cut off any excess until?? they are all the same length.

The same potato must be used; otherwise?? it will not be a fair test (because different potatoes may have?? different osmotic properties). To ensure the experiment is as safe as possible, ensure you don’t?? injure yourself using the cork borers. Also, we are using a sharp?? knife, so caution is needed there. Even though the?? sucrose solutions?? aren’t poisonous, we are not 100% sure, therefore no sucrose solution?? will enter us. Weigh the three tubes of potato, and record down the mass. Take the?? three boiling tubes, and fill 1 with 10cm3 of 1M sucrose solution, one?? with 10cm3 0. M sucrose solution and one with 10cm3 of distilled?? water. Label each tube clearly,

then drop each potato tube into each boiling?? tube, one tube per boiling tube. Place the boiling tubes in a rack and?? leave for 24 hours. After 24 hours, drain the solution and dry off any excess solution?? with paper towels from the potato. Then, reweigh the tubes, and?? calculate the percentage change: These are the results from the preliminary: Tube Start Length (cm) End Length (cm) % Change A (water) 4 4. 2 5 B 4 4. 1 2. 5 C 4 4. 3 7. 5 D (sucrose) 4 3. 6 -10 E 4 3. 5 -12. 5 F 4 3. 7 -7. These results show clear evidence of osmosis. In tubes D-F, water was?? lost (hence the potato chips decreased in size) because the water?? potential is lower, therefore water moves down the concentration?? gradient into the sucrose solution. In A-C, water was gained because?? the water potential is higher, therefore water moves up the?? concentration into the potato. Although the above results show clear evidence that osmosis has?? occurred, it is difficult to draw an conclusion from these results. The primary reason for this is because we didn’t take any repeat?? results.

A better preliminary would be to do 3 tests for each?? concentration, then take a repeat. Prediction I alreeady know that osmosis is the net movement of water molecules?? from a weaker solution into a stronger solution, through a partially?? permeable membrane. In this case, the tiny holes in the membrane of?? the potatoes will allow the water molecules to pass through in and out?? of the solution and the potato, depending on the concentration of the?? sucrose solution. When the water concentration is lower in the tissue, the water will go?? inside the tissue of the potato, and the potato will gain weight.

If?? there is very little difference in the two water concentrations, there?? should not be a big change in weight. If there is a higher?? concentration of water in the potato, the water will go out of the?? potato through the membrane by osmosis. In the distilled water, I think that the water is more concentrated in?? the potato, and therefore the water should transfer from the water to?? the potato, making the potato bigger in size, and heavier in weight. With the potato in molar solutions of sucrose, I do not think there?? will be much change in the weight of the potato. This is because there?? is not much difference between the two substances.

I believe that the?? weight and the size of the potato will not be altered much. The 1. 0M solutions of sucrose, similar to the 0. 5M solution of sucrose?? should produce similar results. The 1. 25M solution of sucrose, I?? think, should make a big difference now, noting that it should be a?? large difference between the two concentration gradients. The weight?? should decrease. The difference between the water concentration in the potato and the?? 2M solution of sucrose is big, so the water in the potato should be?? transferred from the potato, through the permeable membrane, to the?? solution surrounding the potato by osmosis.

Therefore, the weight of?? the potato will increase greatly. The potato tissues are surrounded by?? a stronger solution, therefore it will probably shrink. However,?? because of such high concentrations of sucrose, the water can diffuse?? all the way, throughout the two substances, equalling the concentration gradient of the two substances. I think that in this experiment, the weight of the potato will start?? decreasing when it is tested on 0. 5M solutions of sucrose and greater?? due to the difference in the water

concentrations of the two?? substances. Equipment List 18 standard test-tubes to hold the sucrose solution plus the potato. * 5cm3 syringe (accurate to 0. 5cm3) – to accuratly measure the sucrose?? solution. * Distilled water – for the 0M test, and to make up other concentrations. * A standard potato – to provide the chips. * Cork borers – to bore chips out of the potato. * Test tube racks – to hold the test tubes. * 1M sucrose solution – for the 1M test. * Beaker – to stand test-tubes in that won’t fit into the rack. * Scalpal – to cut the potato. * Sticky labels – to label the tubes so you can distinguish which tube?? holds which concentration. White tile – to cut the potato onto. * Forceps (broad point) – to pick up the chips of potato off the table?? and drop them into the beaker. * Ruler (accurate to 1mm) – to measure the chips. Safety Safety is a primary factor in this experiment. We are using a scalpel,?? which has the potential to harm people. Therefore, we will take great?? care with the scalpel, and always cut onto a white tile. This avoids?? cutting your fingers, and it also avoids wrecking the bench. Cork?? borers can cut skin as well, so we must take care with these as well. We will always cut onto a white tile.

Although the sucrose solutions are harmless, we will ensure that no?? liquid enters our bodies internally, as there may be other chemicals?? in the solution. The solution has been prepared in a scientific?? environment, not a sterile one. Method Take 18 clean test tubes and label them. Use any suitable labelling?? method, but label them with the concentration and the test tube?? name/number. Take a potato, and, using the cork borer, cut out 18?? tubes of potato and place them in a beaker of water, ensuring that?? they don’t dry up during the preperation time. Prepare the sucrose solutions.

I am testing 6 different oncentrations, O, O. 25, 0. 5, 0. 75, 1 and 1. 25M. The 0M is just?? distilled water. To prepare the different concentrations of solutions,?? just mix up sucrose solution and water in different ratios. In each?? test tube, there should be 5cm3 of solution. Make sure all the potato chips are all a universal size. Measure them?? out on a ruler and cut off any excess using the scalpel. Fill each?? test tube with the solution (there should be 18 test tubes, with 3?? test tubes of the same solution – this allows an average). Take the potatoes out of the water and dry them off using a paper?? towel.

Weigh each potato tube, and write this result down in a table. Leave the potato tubes for 24 hours, in a place where it cannot be?? disturbed, then, re-weigh the potato tubes and record the results down?? in a table. Width (mm) Length (mm) Mass (g) Concentration Before After Before After Before After 0M 5 8 33 36 0. 57 0. 48 0. 25M 5 8 33 35 0. 72 0. 91 0. 5M 5 7 33 35 0. 64 0. 71 0. 75M 5 6 33 32 0. 73 0. 81 1M 5 4 33 34 0. 65 0. 68 1. 25M 5 4 33 30 0. 68 0. 85 Concentration Average change in Width (mm) Average change in Length (mm) Average change in Weight (g) 0M 3 3 0. 09 0. 25M 3 2 . 19 0. 5M 2 2 0. 07 0. 75M 1 1 0. 08 1M 1 1 0. 03 1. 25M 1 3 0. 17 Concentration Percentage Change In Mass (%) 0M -9 0. 25M +19 0. 5M +7 0. 75M +8 1M +3 1. 25M +17 Analysis This graph shown on the previous page gives the line of best fit for?? the percentage change in mass of the potato chips over the course of?? the 24-hour experiment. The graph is a curve that slopes downwards and?? does not go through the origin. Because the line is not straight and?? does not pass through the origin, it means that the

percentage gain?? and loss in mass and concentration are not directly proportional.

However, there is a pattern on my graph, and this is, as the?? concentration of the solution increases, the percentage change in mass?? decreases. The graph shows that the percentage gain and loss in?? inversely proportional to the concentration. The gradient does change?? in my graph. It gets less steep as X axis gets bigger. From the line?? of best fit that has been added in, it can be seen that some of my?? points were very close to creating a perfectly smooth curve (there are?? a few anomilies, which are circled). This shows that my results are?? fairly reliable, but 100% accurate.

It shows that the potato cells increase in mass in solutions with a?? high water concentration and decrease in mass in solutions with a low?? water concentration. My results also match with my initial?? predictions. This graph of the change in mass helps prove the point of complete?? plasmolysis, whereby the potato cannot expand and take in any more?? water. As you can see as the molar concentration increases the change?? in mass decreases. From right to left the first two points on the?? graph are very spread out indicating that there was a large change in?? the mass.

This decreases throughout the increasing molar concentration?? until the change is minuscule (about 0. 02g). This graph above shows a clear indication that there was an overall?? decrease in mass during the experiment. At the point 0. 00 M the line?? for after the experiment is above the line for before the experiment?? unlike any of the others. This is because the water potential of the?? sugar solution is higher than that of the potato

chip. Evaluation The experiment was very successful in my opinion. I obtained a large?? quantity of very accurate results from which I was able to create an?? informative graph.

I think I took easily enough results for the amount?? of concentrations that I was using, and the time that I used for the?? experiment to last was enough to allow sufficient osmosis to occur. However if I was to repeat the experiment I might well increase the?? time of the result to allow more osmosis to happen and possibly find?? out the saturation point of the chips. The range of concentrations was?? adequate but I would possibly create more concentrations if I repeated?? the experiment so that I would have more varied results, i. e. 0. 0m,?? 1. 15m, 1. 20m, and so on. The cutting of the potatoes was the most difficult part of the?? experiment as although I was recording my results by mass, it could?? well have affected the surface area and so the overall rate of?? osmosis. If I were to repeat the experiment I would have possibly?? found a machine to cut the potato as it would ensure that all potatoes?? would be the same weight and dimensions. As well as the potato I could?? have found a more accurate way to measure out the solutions and to?? determine the molar concentrations.

Perhaps I could have used a?? burette. This would ensure that I have an accurate amount of fluid in?? each test tube. I could also weigh each chip on a more accurate scale,?? e. g. not to 2 decimal places but to 3 decimal places. There were not any out of the ordinary results, but some were not as?? close to the line as others. This may have been caused by human error. With all this said I think that the experiment was truly successful?? and I was

very pleased with the complete comparison of my results with?? my initial prediction.