Probing the Cell – Cell Membranes and Osmosis

Transformation Lab Hints

These podcast episodes were made available by a generous grant from the State Chancellor's office under the SB-70 Quick Start Grant program. In a nutshell, this grant is going to allow us to bring science to students who are interested in doing science, specifically in the area of biotechnology. What you may not be aware of is that the United States is seriously hurting in science. We don't rank within the top 20 nations. California is 49th out of 50 states. 13% of students (00'30") entering 4 years schools graduate with a degree and less than 2% do a science degree on top of that. Simply put, a little bit of science can go a long way! Use this Biology 107 course as a gatekeeper course. It will introduce you to a variety of applications. Make sure that you focus on the material. These lab exercises are pertinent and relevant, and will help you to multitask and really work effectively in a real job setting. They can also help you prepare for quizzes and they have significant (1'00") lecture overlap. So make sure that you spend some time reviewing these podcasts. Texts for the podcasts are available on the biotechnology outreach site @ www.canyons.edu/host/biotechoutreach/

Remember that 107 (1'30") is a significant course. Try to make your mark in this course. If you do well in science, you will continue

to do well in other academic courses and ultimately get a career and options that are at your choosing. **Remember that science is good for you!**

This podcast is the second in the series on "Probing the Cell" and is entitled "Probing the Cell/ Osmosis". What we are going to be looking at specifically in this podcast is the idea (2'00") of the cell membrane and how we model or characterize the cell membrane. So remember that that this is the second part of the "Probing the Cell" series of podcasts and make sure that review both podcasts to get a clear picture on how to work the labs quickly and effectively. That said then, the first key idea you want to look at is some key terms. Remember terms such as "solute", "solvent", "concentration gradient", "diffusion", and "osmosis", as well as the ideas of hypertonic, isotonic, and hypotonic should all be (2'30") reviewed very patiently so that you get a clear understanding of what these terms are. Theses terms are used freely throughout science. So it is very important that you understand them. I will review a few of them with you very quickly.

Solute is simply the substance that it dissolved in a solution (i.e. salt in salt water). Solvent is the substance doing the dissolving (i.e. the water in salt water). Concentration gradient simply means that there is more of something in one area that there is in another area. The rule of entropy or the second (3'00") law of thermodynamics

states that where there is no energy present things will naturally go from high concentration to low concentration or follow what we call the concentration gradient. Of particular interest is the movement of water and particularly when water moves across a semi-permeable membrane. If this sounds familiar this is exactly what happens in a cell. Movement of water across a semi-permeable membrane is a special type of diffusion that biologists call osmosis. (3'30") The relative movement of water then is affected whether the solution is hypertonic, isotonic, or hypotonic. Hypertonic solution means that the surrounding solution is saltier than the cell and hypotonic solution means that the surrounding solution has fresher water than the cell. Isotonic means that salt concentration is equal on both the inside of the cell and the exterior solution. These terms are important because the flow of water is (4'00") an extremely important factor determining the overall health of the cell.

The first thing that you want to do in this lab is to set up a dialysis tubing cell model. Essentially this dialysis tubing is identical to the dialysis tubing used in kidney dialysis but instead it is much larger and allows biologists to model the cell and to figure out what substances move in what direction and under what forces. So this said, we are going to take and add to a dialysis piece of tubing a (4'30") solution of substance A. This is mentioned in your lab manual,

which is 25% glucose, 5% albumin, and 1% starch. We will then seal the bag. A real quick hint on how to do this: If you tie one end of the bag shut, just like you are tie say your shoe by making a simple knot and then if you try to open up the bag, put the solution in, and tie the other end shut using some fishing line, this makes it works a little more quickly and it helps to have two people doing this. (5'00") You want to make sure that you have 2 or 3 ml of solution A inside of the bag and that the bag is sealed. Leaking is going to destroy your experiment. So make sure that there is no leaking going on and place the bag with solution A in it into a container with solution B which has distilled water and iodine. Now what you are going to do is that you are going to wait. Diffusion and osmosis are not instantaneous events. They take a little bit of time.

So the idea there is that you want to make sure that the reagents have time to react. What you begin (5'30") to discover then over the next half an hour to an hour is that the different substances move across the membrane according to their relative size and the chemical reaction is proof. Now remember that there are only 5 substances in this reaction series: starch, glucose, albumin inside the bag, water and iodine outside the bag. It should be fairly easily done by you to figure if the bag is (6'00") hypertonic. Is the bag hypertonic or is the water around the bag hypertonic? Which direction should the

water move? What are the relative sizes of these substances? So for instance, does the iodine go inside of the bag and react with the starch or do the starch come out of the bag and react with the iodine? Well, what is your evidence for that? If it was a blue reaction that tells you where the reaction is occurring. Remember that the iodine, when the reaction starts, will turn blue and if the iodine is smaller (6'30"), it should go inside the bag and turn the interior of the bag blue. If the starch is smaller, the starch should be outside of the bag to come in contact with the iodine. So as I said, the idea with this exercise is to predict what is going to happen.

Now, you want to start this exercise early because it takes about half an hour to occur and after that half an hour is gone, you will have plenty of time to do the other exercises which are to simply look at some cells (7'00") that have been put under salt water under the microscope. You can also do this dynamically. You take a piece of elodea, add it to a slide, and then put some salt water on one side of the slide (you have a couple of drop of salt water on one side of the slide). While this is happening, you will basically be putting the slide under focus and you will put a small piece of paper towel on the other side of (7'30") the slide, opposite to the salt water. What this will do is that it will pull the salt water from underneath the slide and if you are very cautious, very careful, you can actually watch the content of

the cell shrink down. Remember that the *Elodea* cells, like little square boxes, their contents have chloroplast in them and are easily identified. You should see the contents of the box shrink down. The box itself should not change size because it is made of cellulose and does not change its size as much as the volume of the box changes. (8'00") Again, the contents should readily change volume.

That said then, this lab is a particularly excellent lab because it forces you to think critically about the material. Again remember to use the key terms when describing what is happening in that bag. You should be able to say the relative sizes of everything in the bag and outside of the bag. Most importantly provide evidence as to why that is the case, do not simply say: "it's hypertonic, it is (8'30") hypotonic, that's bigger, that's smaller". That is meaningless. What is important is your evidence for that. So make sure that you spend some time looking at this very simple lab, which gives you extremely useful theories and ideas. In fact, for you folks intending to go into allied health care, the basic theory covered here is all the theory really necessary for one to understand how to set up any dialysis machine. So this is an excellent example of a very simple scientific process such as a cell (9'00") membrane osmosis lab being very usefully conceptually. I hope that you understand how a very useful part of science can apply it to a very broad range of applications.

A couple of quick hints on time management: Remember to start the exercise early. It says that it takes about a full hour but sometimes you can tell within a half hour what the reaction is. Remember to test the outside of the bag for the presence of glucose and protein as directed by your instructor and record the presence of the starch and iodine (9'30") reaction by the blue reaction that takes place.

This concludes our podcast episode for the day. If you would like to get more podcasts, they can be attained at www.canyons.edu/host/biotechoutreach/

If you would like specific information on a range of programs in (10'00") technical science, College of the Canyons leads the area in technical science training. If you want information on chemistry, you can contact Kathy Flynn, chemistry department chair, at (661) 362-3998 or reach her at kathy.flynn@canyons.edu

Information on our engineering program can be reached via David Martinez, engineering department chair, at (661) 362-3007. His email is (10'30") david.martinez@canyons.edu

Lastly, you can reach Jim Wolf, biology program director, at (661) 362-3092 and Jim's email is jim.wolf@canyons.edu

Remember to continue pursuing your career in biotechnology and to apply all of the things that you have learned because seriously, we need science students, seriously……..