Cell Diffusion

Summary

During this lesson, students will observe diffusion in a model of a cell. The students will also determine how surface area to volume ratios impact the rate of diffusion.

Time Frame

1 class periods of 90 minutes each

Group Size

Pairs

Life Skills

Thinking & Reasoning

Materials

Red cabbage, also available in powered form.
Knox Jello (enough for paris of students to make 1cm^3, 2cm^3, and 3cm^3 jello blocks)
Amonia (diluted to 20%)
Small plastic cups to submerse jello
Small white paper plates
Spoons and knives
Rulers

Background for Teachers

Diffusion is the process of moving particles along a concentration gradient. One of the ways that cells get materials in and out is by cellular diffusion. In cells, diffusion occurs across the porous cell membrane, an organelle that allows materials in and out of the cell. When particles are small enough, they can diffuse without energy, this is called passive diffusion. When larger molecules need to get in or out of the cell, it typically requires energy and the use of special proteins. This is called facilitated diffusion.
Cells vary greatly in size, yet all cells need to diffuse materials in and out of the cell. Nerve cells are the biggest cells known and are up to 12 m long in the Giant Squid.
Larger cells need more nutrients yet have a harder time getting all the nutrients they need by diffusion because in large cells the surface area to volume ratio is greatly reduced. Therefore there is less surface area for nutrients to diffused but a larger volume to support.

Student Prior Knowledge

Students should already know how to calculate volume and surface area of a cube. Students should also know about the cellular membrane and how it allows substances in and out of the cell.

Intended Learning Outcomes

1. Use Science Process and Thinking Skills
    a. Observe objects and events for patterns and record both qualitative and quantitative information.
    d. Select the appropriate instrument; measure, calculate, and record in metric units, length, volume, temperature and mass, to the accuracy of instruments used

3. Demonstrate Understanding of Science Concepts and Principles
d. Solve problems appropriate to grade level by applying scientific principles and procedures.
4. Communicate Effectively Using Science Language and Reasoning
a. Provide relevant data to support their inferences and conclusions.

Instructional Procedures

Before Class
Chop and boil the red cabbage for at least 10 min. Decant and save the purple water. This is the pH indicator.
Prepare the Knox Jello by the direction on the package, however, half of the water should be replaced with cabbage juice. So if a packet require 4 cups of water, add 2 cups of water and 2 cups of cabbage juice instead. Make enough jello for each pair of students to have the amount described in materials section. Cover and refrigerate overnight.
Dilute the ammonia to 20%
In class
Provide the students with the appropriate amount of jello. Have the students carve out 1cm^3, 2cm^3 and 3cm^3 jello chunks.
Note our student had a difficult time doing this take with a ruler. We found that if we had cut square pieces of paper out that were 1cm x 1cm, 2cm x 2cm and 3cm x 3cm and they laid them on top of the jello that this helped them quite a bit.
Once the jello cubes are cut, put the cubes into the small plastic cups and cover the jello with 20% ammonia. Time for 5 or 15 min. Ammonia will diffuse to a measurable amount after 5 min, but if you want to do comparisons, have half of the class remove their cubes at 5 min and the other half at 15 min.
After the jello cubes have been in the ammonia for the appropriate amount of time, remove with a spoon and place onto the white paper plate. cut the cub in half and measure from the edge of the jello to the end of the green line (the purple cabbage jello will turn green when in contact with ammonia). Record in the distance changed for each cube in the student lab notebooks.
Calculate the volume of the jello where diffusion did not occur. A worksheet is attached that has instructions on how the students may be able to do this. They could also record this table into their lab notebooks.
Have the students reflect on the differences in diffusion rates among the different sizes of cells.

Assessment Plan

Students will construct a data table showing their calculated rates of diffusion and make comparisons of the diffusion rates among the different sizes of cells.

Bibliography

Cell Surface Area vs Volume
http://www.mcgrawhill.ca/school/applets/sf10/unit3/surfacearea.html
Cellular diffusion
http://www.tiem.utk.edu/~gross/bioed/webmodules/diffusion.htm

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