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CLASS OF 2007
FOR NEDWIDEK
ST. LAB CRIBS - 1 OF 6

Diffusion Through a Membrane

Objectives

- Demonstrate how to test for simple sugars and starch using chemical indicators
- Explain diffusion through a membrane
- Describe the permeability of a model membrane for glucose, starch, and Starch indicator Solution
- Predict what would happen if cells are places in solution having different concentrations
- Explain how the diffusion of water plays a role in several real-world situations
- Prepare wet-mount slides using appropriate stained techniques
- Make observations of biological processes

Things to Remember

- Molecules are constantly moving
- Molecules move in straight lines unless deflected by other molecules or obstacles
- Diffusion is overall movement of molecules from a area of greater concentration to an area of lower concentration
- Osmosis if diffusion of water specifically
- Diffusion continues until molecules are equally distributed
- Cell membranes are selectively permeable
- Membrane permeability changes depending on inner or external environment of cell

Tasks

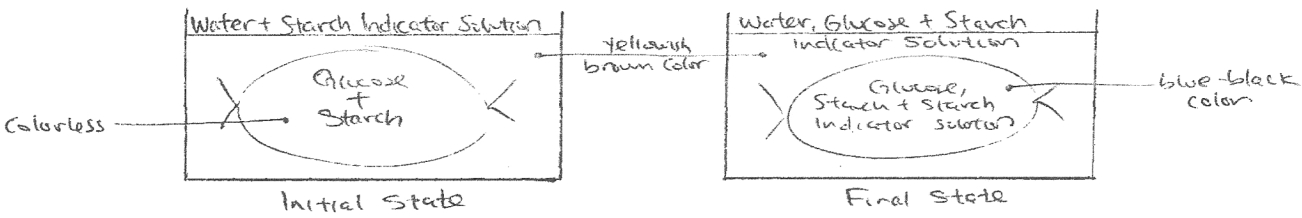
- Create model cell membrane using dialysis tubing filled with glucose solution in a beaker with water
- observe color changes (diffusion) when water is added with Starch Indicator Solution
- Test color changes of distilled water, starch, and glucose with blue-colored Glucose Indicator Solution, and Amber-colored Starch Indicator Solution
- Observe onion cell changes in solutions of distilled water, and salt solution

Abstract

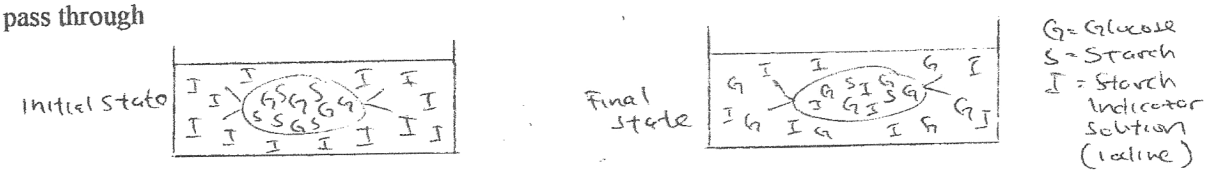
This activity is designed to help students learns about the process of diffusion. In Part 1, students will build a model 'cell' using dialysis tubing or a plastic bag and use simple chemical tests to investigate he selective permeability of the membrane. In part 2, students will add salt and distilled water to red onion cells and observe the effects

Sample Answers

- Based on you knowledge of diffusion, predict what will happened to the substances inside and outside of the 'cell.' -glucoses will move out of the 'cell' and starch may move out too
- Blue glucose indicator solution w/ water = blue
  Blue glucose indicator solution w/ starch = blue
  Blue glucose indicator solution w/ glucose = green, brown, red, or orange
  Amber starch indicator solution = amber
  Amber starch indicator solution = blue-black
  Amber starch indicator solution = amber
- Heat a clean test tube of glucose indicator solution by itself and another test tube of the glucose by itself. Heating solutions by themselves would prove whether or not either of them changes color when heated.
- Observe change in color in the 'cell' and the beaker – colorless milky white to blue-black
- Yes, color changed color when 10 drops of the solution in the beaker is transferred to a clean test tube and tested with glucose indicator solution. Test result is positive.



- Iodine diffuses into the 'cell' causing the starch to change colors
- No starch diffused out of the 'cell.' The contents of the beaker did not change color
- Yes, glucose diffused out of the 'cell.' When the water surrounding the 'cell' was tested 20 minutes, the result was positive
- Iodine and glucose diffused through the membrane
- Starch did not diffuse through the membrane
- The membrane would allow for small particles to pass through. Large particles such as starch could not pass through



- Typical red onion cell mounted in water

- The cell contents shrink away from the cell wall in a salt solution

- The water moved out of the cell, causing the cells to decrease in volume
- The cells get larger/contents expand as water diffuses back in

Analysis

- During part 1 of the lab activity, one group of students followed the directions incorrectly. They poured starch indicator solution into the cell and filled the beaker with starch and glucose solution. State how their results would differ from those obtained by students in the class who followed the directions correctly – The color change to black-blue would occur in the beaker, rather than within the cell
- Organisms could be harmed by high levels of salt from roadways. Salt could damage or kill plants. Diffusion would cause the water inside the plant cells to leave the cells.
- When a person in the hospital is given and IV, it is typically a salt solution with about the same water concentration as human body tissues. Explain how the use of distilled water in place of this saline solution would be expected to upset the patient's homeostasis. – The process of diffusion would cause water to enter the person's blood cells, causing them to swell. This could lead to the destruction of the blood cells.
- Many fresh water one celled organisms have structures called contractile vacuoles. These structures collect and pump out excess water that accumulates in the cell. The process that causes water to flow into these organisms is diffusion or osmosis. Contractile vacuoles would be of little value to one celled organisms living in salt water oceans because diffusion causes excess water to enter the cells of fresh-water organisms. The excess water must be removed. In salt water, the concentration of water outside is either the same as or less than the concentration of water in the cells, so there is no excess water to be removed.
- The salt from movie theater popcorn may cause water to leave the cells of the mouth and throat due to diffusion causing a person to be thirsty and buy soft drinks, which in turn, makes them even thirstier with all the sodium in the drink
- In many animals, glucose, rather than starch is transported by the blood through the body to all the cells. Starches in many foods are digested to yield glucose. The digestion of starch to glucose is necessary because its molecules are too large to diffuse across a cell membrane. The starch would not be able to diffuse from the intestine into the blood and from the blood into the cells. Glucose is small and soluble, so it is able to diffuse.

FUNG/NED
ST. LAB CRIBS
3 OF 6

Making Connections

Tasks

- Check resting pulse rate
- Check pulse rate after different exercises
- Compare pulse rates with other people
- Test relation between fatigue and muscle performance by squeezing clothespin

Abstract

'Making Connections' is a lab activity with two parts. Part A introduces students to two simple techniques: taking a person's pulse and squeezing a clothespin to measure muscle fatigue. Once students have mastered the two techniques and have collected relevant data, they proceed to Part B, which describes a situation in which conflicting claims are made.

In Part B, the students evaluate the conflicting claims by designing and performing a controlled experiment. Educationally, part B is actually the more important part of the activity, because students learn how to design and use a controlled experiment as a means of evaluating claims that may not be supported by scientific evidence.

Sample Answers

- An increased pulse rate indicates that the heart is beating at a higher rate. A higher pulse rate means that blood is moving more rapidly throughout the body
- When muscles are active, cells use nutrients and oxygen at a higher rate and produce waster chemicals and heat more rapidly. Describe how the interaction of two or more body systems helps to maintain homeostasis during periods of high muscle activity.
  - -the respiratory system takes in oxygen, which is transported to cells by the circulatory system. As cells use oxygen at a higher rate, an increased heart rate would get the oxygen to the cells more quickly
  - -as muscle cells increase their activity, they produce waste products at a higher rate. These wastes are carried to the excretory system by the blood (circulatory system) more efficiently when the heart rate increases
- A student in your class suggests that when most people watch exciting sporting events on television, their pulse rate increase. What is a reliable way to find out if this statement is correct? – conduct a controlled experiment to determine if the student is right
- What specific evidence would you need in order to determine if what the student suggests in the previous question can be supported? – you would need to see the results of an experiment where a group of people had their pulse rates measured while they watched both exciting sporting events and other less exciting television shows. The results would have show a significant difference in pulse rates between the two groups

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ST. LAB CRIBS
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Relationships and Biodiversity

Tasks

- Observe characteristics of different plant species
- Gather structural and molecular evidence to determine which plant species is most closl related to the hypothetical species, Botana curus
- Use this evidence to decide which plant species is most likely to serve as a source of the important substance Curol

Abstract

This lab activity is a simulation that introduces the use of structural and molecular evidence for developing hypotheses about evolutionary relationships between several hypothetical plant species. Students collect and analyze the data to determine which species is most closely related to a valuable but endangered species. Students also explore the importance of preserving biodiversity

Morphology evidence

Test 1 – possible specimens of plant samples

- Botana curus – Juniper
- Species X – Spruce
- Species Y – Pine
- Species Z – Yew

Test 2 – possible specimens of seed samples

- Botana curus – Celery seed
- Species X – whole black pepper
- Species Y – mustard seed
- Species Z – sesame seed

Test 3 – possible specimen of cross sections

- Botana curus stem cross section – herbaceous monocot stem
- Species X stem cross section – herbaceous dicot stem
- Species Y stem cross section – herbaceous dicot stem
- Species Z stem cross section – herbaceous monocot stem

Analysis

- Species Z is most closely related to Botana Curs and therefore likely to produce Curol because both species have the following similarities:
  - -enzyme for making Curol or reaction in enzyme test
  - -blue, yellow pink pigments
  - -scattered arrangement of vascular bundles
  - -no difference in the amino-acid sequence of proteins
  - -4 similar sized DNA fragments when cut with DNA cutting enzyme
- Depending on student's original hypothesis, whether the addition of molecular evidence supports or refutes the hypothesis that you made earlier based on structural evidence only may vary
- Molecular evidence is more helpful than structural evidence in making decisions about relationships between species. Organisms can look alike on the surface (have similar size, shape, and color) but have many hidden molecular differences
- List characteristics that all four species have in common
  - -have needles (or flowers or leaves)
  - -have seeds
  - -green pigment that separate to blue and yellow
  - -some common aspects of DNA code
  - -common amino-acid sequence
- Biological explanation for the common characteristics these species share – these common characteristics are most likely due to common ancestry, similar genes or evolution

- Branching tree diagram 2 best represents the relationships among the four species because it shows Z and Botana curus closer together
- Additional evidence you might use to further support your hypothesis about the relationship between Botana curus and Species X, Y, Z
  - -results of using indicators for other enzymes
  - -comparisons of amino-acid sequences of other proteins
  - -comparisons of DNA fragments using other DNA cutting enzymes or other genes
  - -comparisons of the internal or microscopic structure of plants and seeds
  - -comparisons of fossil records

Biodiversity arguments

- Three examples of human activities that could endanger Botana curus
  - -destruction of natural habitats which could mean that the species has no place to live
  - -pollution, which could poison the species
  - -over harvesting or overgrazing by herbivores, which could reduce the population to dangerously low levels
- Three reasons why it might be important to preserve Botana curus
  - -it may be useful for agriculture purposes that we haven't discovered yet
  - -it could have other medical purposes that we haven't discovered yet
  - -other species may depend on it
- Three arguments people might make for not preserving Botana curus
  - -it will be expensive to save
  - -it is small and grows slowly
  - -we may not succeed in saving it if we try

FUNG/NED
STD LAB CRIBS
6 OF 6

The Beaks of Finches

Objectives

- Learn how structural differences may affect the survival rate of member within a species
- Simulate competition for resources among different species of organisms
- See the role of the environment as a selecting agent

Things to Remember

- Charles Darwin used the finch species found on the Galapagos Islands as evidence of natural selection

Tasks

- Work with different tools (tongs, tweezers, clothespin, chopsticks etc.) to model finch beaks
- Compete with other finch species to see which beak is best adapted for obtaining specific food on particular 'islands'

Abstract

Students will simulate natural selection by using different tools to see which are best adapted for the task of picking up seeds and transporting them from one container to another. They will use different tools representing beak variations in finch species to pick up seeds, which represent food on different islands

Hypothetical Data Summary

Round 1: Feeding with no competition
Round 2: Feeding with competition
Round 3: Feeding with increased competition

Average seeds collected in Round 1 < Round 2 > Round 3
Seeds collected in Trial 2 (either partner) $\geq$ seeds collected in Trial 1

Analysis

- It is very unlikely that all of the beaks within a species of finch are exactly alike. Random mutations and new gene combinations resulting from sexual reproduction are the source of beak variations. Three beaks variations that could randomly appear and further improve chances of survival when feeding on small seeds may include traits such a being small and light and having a nonskid surface
- Fewer should survive when competing for food at the same dish. Increased competition has an adverse effect on seed gathering
- Were the types of beaks that were successful on the new island the same as the types of beaks that were successful on the original island? – no, because the size difference in the seeds favored different types of beaks
- Simulation of concepts involved in natural selection
  - Variation – different beaks, different size seeds
  - Competition – more than one bird feeding at one bowl
  - Struggle for survival – each bird trying to get enough seeds to survive
  - Adaptation – particular characteristics of beaks
  - Environment – students, seeds, and the dishes where competition occurs
  - Selecting agent – type of beak available for feeding and/or type of seed available
- The island would need to have both large and small seeds available to support large population of both Large Ground Finches and Small Ground Finches
- How could you use the materials provided in this lab to test your explanation – put many large and small seeds in the same large dish. Then run trials using tools from the 'large-seed survivors' and tools from the 'small-seed survivors' to compete for seed in the dish