Enzyme Activity Lab

WEBCYTOLOGY
http://library.advanced.org/27819

Name: ________________________________ Date: ___________

Teacher: ________________________________ Period: ___________

Lab #: _______

Aim
To investigate the rate of an enzyme-controlled reaction under varying environmental conditions.

Materials
regular test tubes, colorimeter test tubes, a Spec 20 colorimeter, diluted turnip extract (1 mL of extract per 200 mL of water), guaiacol, distilled water, a stopwatch, hydrogen peroxide (H_2O_2), and a micropipette

Overview
When guaiacol and hydrogen peroxide mix in the presence of peroxidase (an enzyme found in turnips), guaiacol is oxidized and becomes a dark color. The Spec 20 colorimeter measures a change in a solution's transmittance (how well light can travel through the solution). A lower number on the Spec 20 colorimeter indicates that the transmittance of the solution has decreased, so it has become darker. By measuring the rate at which a solution's transmittance changes, you can determine the rate of the enzyme-catalyzed reaction occurring in the test tube.

Procedure

1. Fill a colorimeter test tube with distilled water. Place this test tube in the Spec 20 colorimeter and adjust the readout so that it displays a 100% transmittance.
2. Prepare four regular test tubes with the following: .2 mL of H_2O_2, .01 mL of guaiacol, and 4.7 mL of distilled water. Label these three test tubes A, B, C, and D.
3. Place 1 mL of diluted turnip extract in a colorimeter test tube with 4 mL of water. Label this tube 1. Add the contents of tube A to tube 1. Immediately place tube 1 in the colorimeter and start the stopwatch. Record the transmittance of the solution ever 20 seconds for two minutes.
4. Place .5 mL of diluted turnip extract in another colorimeter test tube with 4 mL of water. Label this tube 2. Add the contents of tube B to tube 2. Place tube 2 in the colorimeter and again record the transmittance every 20 seconds for two minutes.
5. Repeat this procedure for test tube 3 (which contains 2 mL of turnip extract) and test tube 4 (which contains 1 mL of briefly boiled turnip extract).

Observations
Record the data you gathered in the table below.

Transmittance of solutions							
	0s	20s	40s	60s	80s	100s	120s
Tube 1							
Tube 2							
Tube 3							
Tube 4							

On a piece of graph paper, graph the data in this chart. Note the slope of the graph for each of the solutions. This is in indicator of how fast the reaction proceeded.

Questions

1. In which tube did the reaction proceed at the slowest rate? _________________

2. In which tube did the reaction proceed at the fastest rate? _________________

Conclusions
In the space below, explain exactly what caused the differences in reaction rates for each tube.

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Sources of Error
Identify any possible sources of error which may have affected the results of this experiment.

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Osmosis Lab

WEBCYTOLOGY
http://library.advanced.org/27819

Name: ________________________________ Date: ___________

Teacher: ________________________________ Period: ___________

Lab #: _______

Aim
To determine the biological changes that occur to potato cores over a period of time in different solutions and to relate these changes to the phenomenon of osmosis.

Materials
three potato cores, a beaker of distilled water, a beaker of 90% water/10% sucrose, a beaker of 80% water/20% sucrose, a graduated cylinder, a razor, a dissecting needle, a ruler, a balance, and three pieces of aluminum foil

Overview
By placing pieces of a potato into solutions with different concentrations of solute, water may flow into or out of the potato. Knowing whether or not water flowed into or out of the potato will give you an idea of approximately what percentage of a potato is water.

Procedure

1. Using the razor, carefully cut each potato core into a cylinder of about three to five centimeters in length. Make sure that all of the potato cores are the same length and note this length for later use. Also measure and record the diameter of each potato core.
2. Using the balance, measure and record the mass of each potato core.
3. Fill the graduated cylinder with tap water two-thirds of the way up. Measure and record the volume of water in the graduated cylinder. Attach each potato core, one at a time, to the end of the dissecting needle and hold it so that the potato core is completely submerged in the water. Measure and record the water level in the cylinder. The difference in your two measurements is the volume of the potato core.
4. Place one potato core in the beaker with distilled water and label this beaker "100". Place the second core in the beaker of 90% water/10% sucrose and label the beaker "90/10". Place the third core in the beaker with 80% water/20% sucrose and label this beaker "80/20".
5. Cover the top of each beaker with a piece of aluminum foil. Fold the aluminum foil down along the sides of the beaker so that it cannot fall off easily.
6. Allow the beakers to sit for a day.

7. Remove the cores from each beaker using the dissecting needle. Measure and record the length, diameter, mass, and volume of each potato core as you did earlier.

Observations
Record the data you gathered on the first and second day in the table below.

Physical changes in the potato cores									
	100% water			*90% water/10% sucrose*			*80% water/20% sucrose*		
	Day 1	Day 2	Change	Day 1	Day 2	Change	Day 1	Day 2	Change
Length									
Diameter									
Mass									
Volume									

In the space below, record any qualitative changes (in color, texture, etc.) you noticed in the potato cores.

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Definitions of terms
In answering the questions and writing your conclusions, you may wish to use the following terms to make your answer complete.

- diffusion - the movement of molecules from an area of high concentration to an area of low concentration
- osmosis - the diffusion of water
- plasmolysis - a type of osmosis in which water moves out of the material
- deplasmolysis - a type of osmosis in which water moves into the material
- isotonic solution - a solution with equal concentration of solute inside and outside of the material
- hypertonic solution - a solution with more solute in the surrounding environment than in the material
- hypotonic solution - a solution with less solute in the surrounding environment than in the material

Questions

1. In this experiment, why was it important that the potato cores were the same length?

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2. Why was it important to cover each beaker with a piece of aluminum foil?

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3. Into which of the potato cores did water flow? From which of the potato cores did water flow? How can you tell?

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4. Which solutions (if any) were hypertonic, isotonic, or hypotonic? Explain how you know.

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Conclusions
In the space below, write down any conclusions you can draw from this experiment. For example, you may wish to explain how the data you gathered relates to the qualitative changes you observed in the potato cores. You can also estimate what percentage of a potato core is water based on your data.

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Sources of Error

Identify any possible sources of error which may have affected the results of this experiment.

Diffusion Lab

Name: ________________________________ Date: ___________

Teacher: ________________________________ Period: ___________

Lab #: _______

Aim
To determine how surface area and volume relate to one another and how the rate of diffusion varies with the ratio of surface area to volume.

Materials
three cubes of 3% agar-phenolphthalein (1 cm, 2 cm, and 3 cm on a side), 4% NaOH solution, a ruler, a razor, a plastic spoon, a paper towel, and a beaker

Overview
The phenolphthalein in the agar cubes reacts with the NaOH, changing the color of the cube to pink. After the cubes are exposed to NaOH, you will be able to see how far the NaOH diffused based upon the change in color which it caused. This will allow you to determine the relationship between diffusion and the surface area and volume of the cubes.

Procedure

1. Calculate the surface area and volume of each agar cube and record these values in the table below.
2. Carefully fill the beaker with 4% NaOH so that the cubes will be completely submerged when placed in the beaker.
3. Place the three agar cubes in the beaker. After 15 minutes, remove them and place them on a paper towel.
4. Using the paper towel, blot the cubes dry.
5. Use the razor blade to carefully cut each cube in half.
6. Measure the distance across the portion of the cube which did not change color.
7. Calculate the surface area and volume of this portion of the cube and record these values in the table below.

Observations
Record the data you gathered in the table below.

Diffusion into the agar cubes						
Cube size	*Surface area*	*Volume*	*Surface area/volume ratio*	*Size of uncolored portion of cube*	*Surface area of uncolored portion*	*Volume of uncolored portion*
1 cm/side						
2 cm/side						
3 cm/side						

Questions

1. If the length of the side of a cube is increased, the surface area to volume ratio of the cube _________________

2. The rate of diffusion into the cubes is the volume of the colored area divided by the time it took. Calculate the rate of diffusion for each of the cubes.

   Tube #1: ________________
   Tube #2: ________________
   Tube #3: ________________

3. In which of the cubes was the rate of diffusion greatest? _________________

Conclusions
In the space below, write down any conclusions you can draw from this experiment. For example, you may wish to address the question as to why cells are so small (hint: a large cell would have a large surface area for diffusion, but what about the volume?). You can also discuss why many cell organelles have folded membranes as opposed to flat membranes.

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Sources of Error

Identify any possible sources of error which may have affected the results of this experiment.

Digestion of Protein Lab

WEBCYTOLOGY
http://library.advanced.org/27819

Name: ________________________________ Date: ___________

Teacher: ________________________________ Period: ___________

Lab #: _______

Aim
To illustrate the effects of pH on the activity of an enzyme.

Materials
test tubes, test tube holders, a test tube rack, a ruler, a boiling water bath, 1x1 cm squares of exposed and developed film (equally dark all over), distilled water, .5% pepsin solution, .1% NaOH (sodium hydroxide) solution, .8% HCl (hydrochloric acid) solution, pH sticks, and markers.

Overview
Pepsin is an enzyme found in the highly acidic environment of the stomach. It is used to break down proteins into smaller molecules called polypeptides. In this experiment, you will measure the activity of pepsin based upon the change of transparency in the film (which contains proteins that the pepsin will break down).

Procedure

1. Number five test tubes near the top with a marker. Make a mark on each tube 4 cm and 8 cm from the bottom.
2. To tube #1, add distilled water to the first mark and .8% HCl to the second mark.
3. To tube #2, add .5% pepsin to the first mark. Place the tube in the boiling water bath, making sure that the water in the tube is below that water level of the boiling water. After 10 minutes, remove the tube, allow it to cool, and then add .8% HCl to the second mark.
4. To tube #3, add .5% pepsin to the first mark and .1% NaOH to the second mark.
5. To tube #4, add .5% pepsin to the first mark and distilled water to the second mark.
6. To tube #5, add .5% pepsin to the first mark and .8% HCl to the second mark.
7. Using pH sticks, approximate and record the pH of the solution in each of the test tubes by carefully tilting each tube and dipping the pH stick into the solution. Make sure you use a different pH stick for each test tube. Place the used sticks in a special beaker on the side for disposal.
8. To each of the five tubes, add a 1x1 cm square of film. You may have to shake the tubes gently to ensure that the film sinks to the bottom.

9. Place all of the tubes in a 37 degree Celsius water bath. Remove the tubes after 15 minutes.
10. Place the tubes in a test tube rack. Check them every 10 to 15 minutes until the dark color on one of the squares of film has almost disappeared.
11. Carefully remove the film from each tube. Assign each film a number, 1 through 5, where 1 is the least amount of coating and 5 is the most coating. Fill in this information in the chart below. Then, assign a similar rating for the relative pepsin activity, where 1 is the least activity and 5 is the greatest activity.

Observations
Record the data you gathered in the table below.

Pepsin activity				
Tube #	*Contents of tube*	*pH*	*Relative amount of coating*	*Relative pepsin activity*
1				
2				
3				
4				
5				

Questions

1. In this experiment, what was tube #1's purpose?

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2. Did the pepsin in tube #2 have a low activity? If it did, why?

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Conclusions
In the space below, write down any conclusions you can draw from this experiment. Include your initial hypothesis and reasoning as to which tubes would have the greatest and least activity of pepsin, and whether or not the data you gathered supported this hypothesis.

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Sources of Error

Identify any possible sources of error which may have affected the results of this experiment.

Transport Across a Membrane Lab

WEBCYTOLOGY

http://library.advanced.org/27819

Name: ________________________________ Date: ___________

Teacher: ________________________________ Period: ___________

Lab #: _______

Aim

To determine how and under what circumstances materials will transport across the membrane of an egg.

Materials

raw egg, vinegar, Karo syrup, distilled water, three 250 mL beakers, two graduated cylinders, an overflow can, a spoon, a marker, and three pieces of aluminum foil

Overview

Depending upon the concentration of water in an egg and that in its surrounding environment, water may diffuse into or out of the egg. The egg will be placed into three different solutions, each with a different concentration of water, to illustrate this effect.

Procedure

1. Fill the overflow can with enough water so that the egg will be completely submerged when placed in the can. Measure the amount of water in the can, then place the egg into the can and measure the new height of the water. The difference in these two measurements is the egg's volume. Record this value in the table below.
2. Using the graduated cylinder, measure 100 mL of vinegar. Pour this vinegar into a beaker and lable the beaker "Vinegar".
3. Place the egg into the "Vinegar" beaker. Cover the top of the beaker with a piece of aluminum foil. Fold the aluminum foil down along the sides of the beaker so that it cannot fall off easily.
4. Allow the "Vinegar" beaker to sit for two days.
5. After two days, use the spoon to remove the egg and determine its volume using the same procedure as in step #1. Also, pour the contents of the beaker into the graduated cylinder to determine the volume of vinegar remaining. Record these measurements in the table. Also note any qualitative changes (in color, texture, etc.) which occured in the egg.

6. Using the graduated cylinder, measure 100 mL of Karo syrup. Add water to teh graduated cylinder until the solution reaches 150mL. Pour this sugar solution into another beaker and lable the beaker "Sugar solution".
7. Place the egg into the "Sugar solution" beaker. As in step #3, cover the top of the beaker with a piece of aluminum foil and fold it down along the sides so that it cannot fall off.
8. Allow the "Sugar solution" beaker to sit for one day.
9. After one day, remove the egg using the spoon and measure its volume. Also measure the volume of sugar solution remaining in the beaker by using the graduated cylinder. Record these values in the table. Make a note of any qualitative changes which you observe.
10. Use the graduated cylinder to measure 150 mL of distilled water. Pour this into the third beaker and label it "Distilled water".
11. Place the egg into the "Distilled water" beaker. As before, cover the beaker with a piece of aluminum foil and fold it down along the sides.
12. Allow the "Distilled water" beaker to sit for one day.
13. After one day, use the spoon to remove the egg. Measure the eggs volume using the overflow can, and measure the volume of distilled water remaining in the beaker. Record these measurements in the table. Write down any qualitative changes in the egg.

Observations

Record the data you gathered on the first and second day in the table below.

Movement through the egg shell			
	Volume before	*Volume after*	*Change in volume*
egg initially			
vinegar	100 mL		
egg after vinegar			
sugar solution	150 mL		
egg after sugar solution			
distilled water	150 mL		
egg after distilled water			

In the space below, record any qualitative changes you noticed in the egg.

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Definitions of terms

In answering the questions and writing your conclusions, you may wish to use the following terms to make your answer complete.

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- hypotonic solution - a solution with less solute in the surrounding environment than in the material

Questions

1. What was the purpose of covering the beakers with aluminum foil?

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2. The movement of water from an area of high concentration to an area of low concentration is called __________________

3. At which points did water flow into the egg? How can you tell?

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4. At which points did water flow out of the egg? How do you know?

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5. Which solutions (if any) were hypertonic, isotonic, or hypotonic? Explain how you know.

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Conclusions

In the space below, write down any conclusions you can draw from this experiment. You may wish to explain how the data you gathered relates to the qualitative changes you observed in the eggs. You can also discuss some of the implications of your findings; for instance, why fruits and vegetables are sprayed with water at a market.

Sources of Error

Identify any possible sources of error which may have affected the results of this experiment.