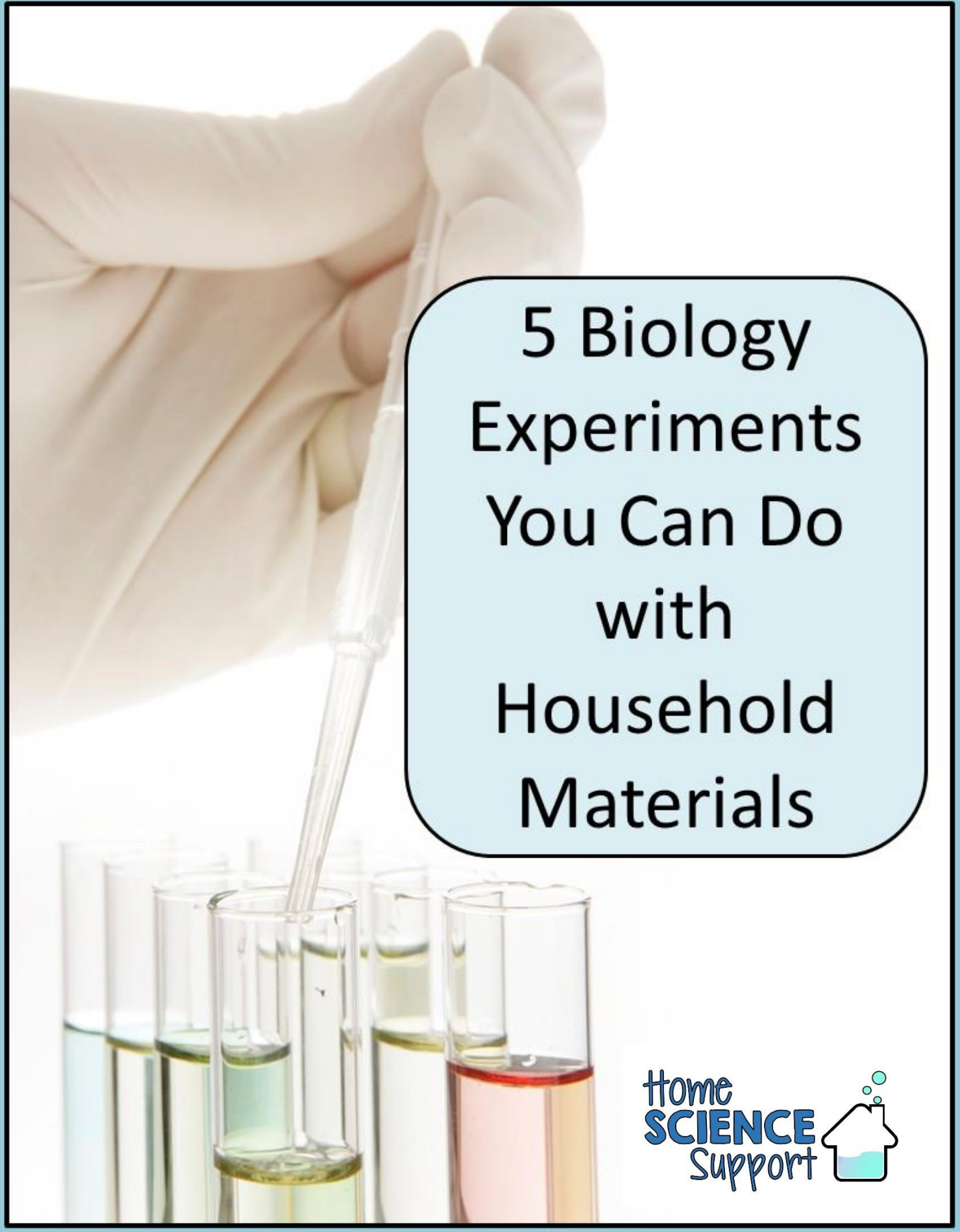


5 Biology Experiments You Can Do with Household Materials

Home SCIENCE Support

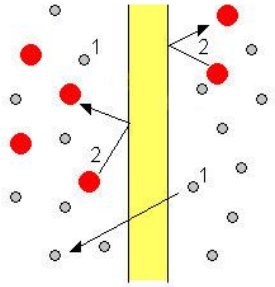
OSMOSIS LAB

Background:

Osmosis is the diffusion of water through a membrane. Osmosis is as simple a concept as diffusion, but can seem much more complicated to students.

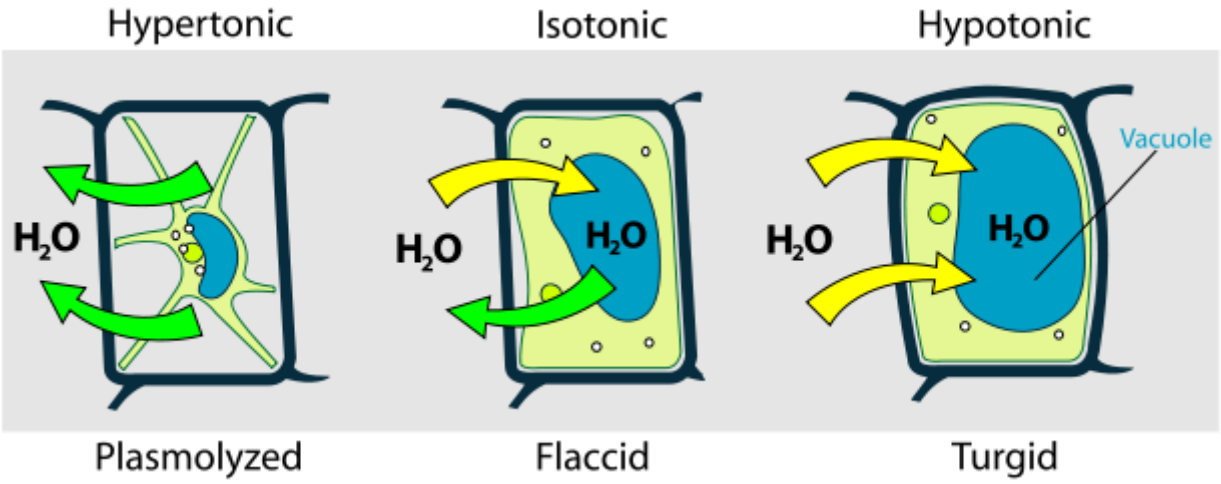
Some membranes are selectively permeable, meaning that they will only allow some molecules to pass through, usually small molecules. Because H_2O is a small molecule, water can pass through a membrane and get trapped on one side because the other particles are unable to get across to equalize the concentration.

It looks like this:



Because the concentration of solute (red) is higher on the left side, the water (grey) will move to the left side as well to create the same solute to solvent concentration on both sides. Consequently, the left side of the membrane will actually fill with water until it does not look balanced with the other side. In fact, it is precisely because the water molecules are trying to balance that they fill up one side.

There are 3 types of solutions caused by different amounts of solute outside a plant cell:



Materials:

1 potato cut into ½ inch slices
Salt
2 cups
Distilled water or tap water

Procedure:

Pour about ½ cup of water into each cup.

Mix about 1 teaspoon of salt into one of the cups.

Put one potato slice in each cup and leave for 2 hours or up to overnight.

Adaptations:

-Students can test the movement of various solutes such as sugar or food coloring to determine whether they are able to permeate the cells.

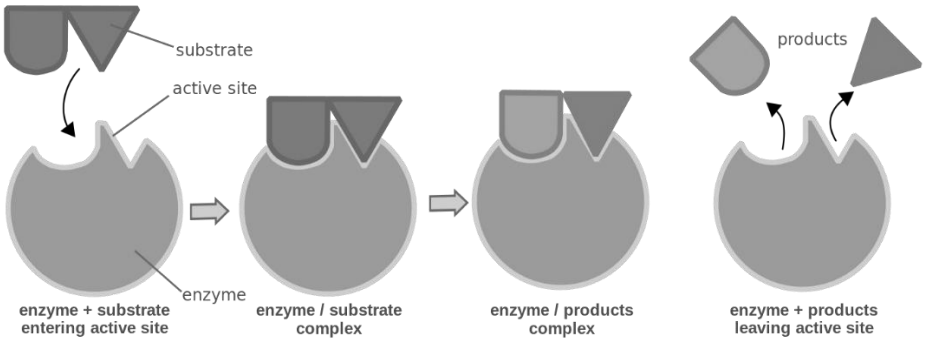
-An additional lab using dialysis tubing (you could also use very cheap sandwich bags) can be performed to see the movement of iodine molecules through a semi-permeable membrane. Here is a link to a lab like this:
https://www.colchesterct.org/uploaded/Curriculum/dialysistube_lab_for_diffusion_and_osmosis.doc

ENZYME LAB

Background:

Enzymes are a special type of protein that performs extremely important functions within our bodies and those of all other living organisms. They are responsible for carrying out **chemical reactions** within our cells that either join atoms and molecules together or break them apart. The function of an enzyme is to make these naturally-occurring processes happen more quickly and with a lower requirement of energy.

Enzymes are like a lock and the **substrate** that enters at the beginning of the chemical reaction is like a key. Each enzyme is specifically shaped to accept only one type of substrate. The portion of the enzyme that attaches to the substrate is the **active site**. After a substrate attaches to the active site of the correct enzyme, it is converted into a product, which leaves the enzyme. The enzyme facilitates this process and is not used up or changed.



One of the common enzymes found in both animals and plants is called **catalase**. Catalase is used to break down hydrogen peroxide that occasionally builds up within our cells. Hydrogen peroxide is a waste product of reactions that occur within our body. If it were allowed to build up, it would be fatal. Thankfully, our cells contain catalase, which breaks down the hydrogen peroxide into harmless hydrogen gas and oxygen gas.

$$H_2O_2 \rightarrow H_2 + O_2$$

Materials:

Part 2:

small disposable cups or test tubes
test tube rack (optional)
1 large potato
blender
water
spoon
hydrogen peroxide
vinegar
measuring spoons

Procedure:

Line up 3 cups.

Cut your potato into 1 inch chunks. You don't need to peel it.

Put HALF of the potato chunks into the blender and add ¼ cup of water.

Blend on high until the mixture is the consistency of oatmeal.

Put about 1 teaspoon of the potato mixture into the 3 cups. You can discard the rest of the potato mixture in the blender, but you might want to set it aside for later in case you need to (or want to) redo the experiment.

Next, add 1 teaspoon of water to cup 1.

Add 1 teaspoon of vinegar to cup 3.

As quickly as possible, add 1 teaspoon of hydrogen peroxide to the last 2 cups.

Adaptations:

-Submerge the blended potato in varying temperatures of water to see the effect of the temperature on the reaction.

-Add varying pH solutions to the blended potato prior to adding the hydrogen peroxide to see the effect of pH on the reaction.

-Dilute the hydrogen peroxide solution with water to varying concentrations in order to determine the minimum concentration required for the reaction to run at the same rate as with 100% hydrogen peroxide.

FERMENTATION LAB

Background:

Cellular respiration occurs in the **mitochondria** of cells. The goal of cellular respiration is to break down glucose to create energy.

The first step of the respiration process is called glycolysis, and it is here that the glucose molecule is broken in half. From this point, the molecules created go through the **Citric Acid Cycle (or Kreb's Cycle)**, which produces carbon dioxide and alters the structure of the molecules. These molecules then pass into the **Electron Transport Chain**, which converts the molecules (in combination with oxygen) into large amounts of ATP.

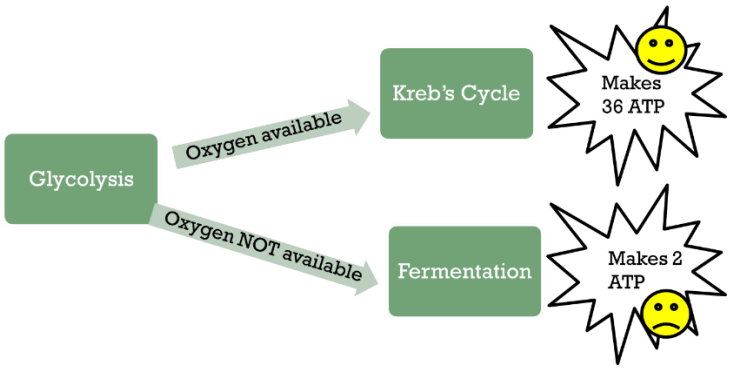
The overall equation for cellular respiration is:

$6O_2 + C_6H_{12}O_6$ (glucose) → $6CO_2 + 6H_2O$ + energy

If oxygen is not available to the cell, the Electron Transport Chain cannot work and the cell instead goes through the process of **fermentation**.

There are two types of fermentation. Which one proceeds is dependent upon the type of organism using the process. Both of these fermentation processes yield much less energy that traditional respiration. Yeast and bacteria use **alcoholic fermentation**, which produce carbon dioxide and ethanol as by-products.

Lactic acid fermentation is used by animal cells, and is the process that your cells use when you require too much from them while working out. The soreness you feel is a result of lactic acid fermentation.



Materials:

1 packet of yeast (2 ½ tsp)
½ cup warm water
½ cup cereal (crushed)
Snack-sized zipper baggie

Procedure:

Put yeast, warm water, and crushed cereal into the plastic bag.

Remove all the air, then seal the bag.

Mix the ingredients well by squishing them around together.

Let the bag sit for 1-2 hours.

Adaptations:

Try different types of cereal to determine if the amount of sugar has an effect on the speed of the reaction.

EXTRACTING DNA LAB

Materials:

91% or 100% isopropyl alcohol
(This can be easily found in any grocery store or pharmacy in the first-aid section.)
1-2 fresh strawberries or thawed frozen strawberries
One sealable sandwich bag
2 tsp. dish soap (any brand)
¼ tsp. table salt (preferably non-iodized)
Water
Kitchen strainer
Small beaker or clear cup & bowl
Wooden skewer, toothpick, or tweezers to pick up DNA strands

Procedure:

Put 1-2 strawberries in a sandwich bag, seal, and squash into a paste.

Add 2 tsp. dish soap, ¼ tsp. salt, and 6 Tbsp. water to the bag. Remove excess air and squash to mix.

Strain strawberry mixture to remove large pieces.

Pour an amount of isopropyl alcohol equal to the amount of strawberry juice slowly down the side of the cup so that it settles on top of the strawberry juice. Let the solutions sit for about a minute.

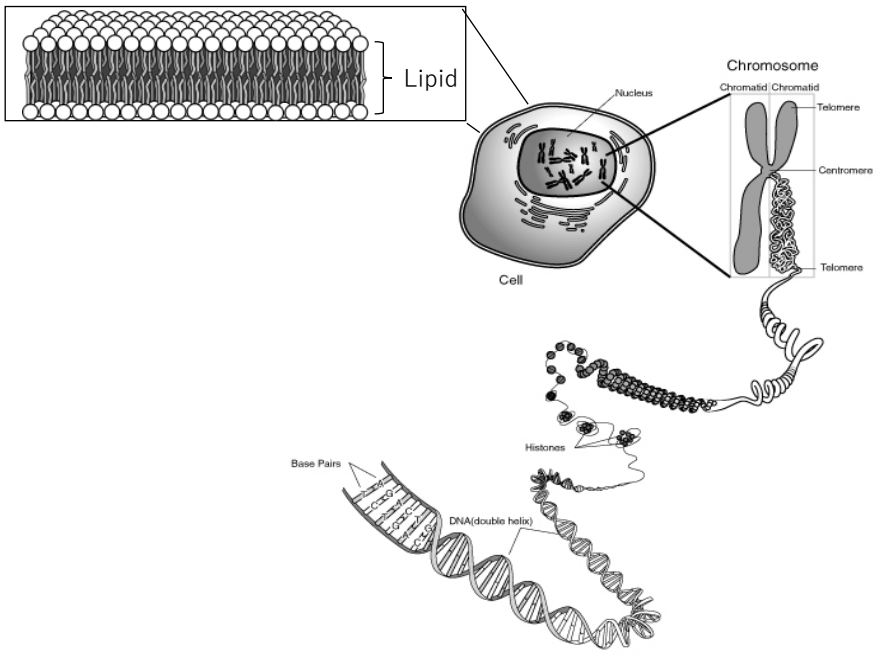
Use a wooden skewer to pull out the strands of filmy DNA.

Adaptations:

-Students may vary the amount of type of each material to see the effect on the amount of DNA produced.

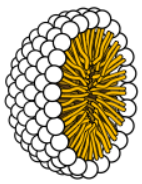
-Students may want to try blending other types of fruits or vegetables to see the amount of DNA produced.

WHAT IS HAPPENING



The strawberry DNA is wound into chromosomes inside each cell. The DNA is wrapped around proteins called <u>histones</u> to create the chromosomes without tangling the individual DNA strands.

Dish soap is a polar solution, which attracts <u>lipids</u>, such as those that make up the strawberry cellular membrane, which is a lipid bilayer. The soap molecules are then able to <u>break up the cell membrane and nuclear membrane</u>, which protect the DNA.



Micelle "bubble" created when the soap breaks up the lipid bilayer.

The same thing happens when you wash a greasy pan.

The salt is used to <u>remove the histones</u> from the DNA, which allows the chromosomes to unwind, providing more DNA strands for observation.

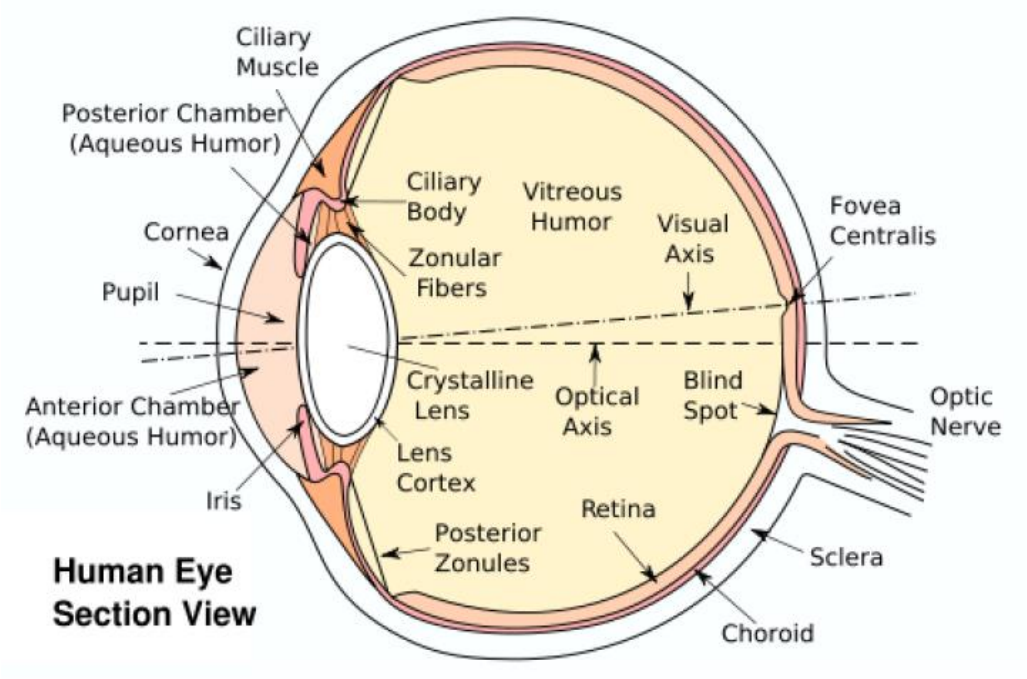
Isopropyl alcohol is used to <u>attract the DNA</u> to the surface. The DNA is insoluble in the alcohol, however, so it will remain as a separate layer in the cup. The insolubility is increased by making the alcohol ice cold.

VISION LAB

Background:

Your eye focuses light through the lens and creates an image on your retina (the back of your eye), much like a camera does. That image is converted into electrical pulses and sent you your brain through the optic nerve.

Strangely, because this optic nerve attaches to the back of your eye, you actually can't see anything at that point on your retina, which we call a **blind spot**. Your brain, however, is so advanced that it compensates for this and you don't notice it.



Materials:

Index cards with a plus sign and an O marked on them.

Procedure:

Pick up a blind spot test card (with an + and 0 on it). Hold the card with the + on the left and the 0 on the right. Hold it at arm's length. Cover your left eye and look at the + using your right eye. With your left eye still closed, slowly move the card closer to you until the 0 disappears. If you continue to move the card closer to you, it will reappear. This will work with your left eye, too.

Adaptations:

-Students can try another activity to test the distribution of rods and cones within their eyes. Rods detect light and cones detect color.

Here is the procedure for this quick activity: Work with a partner for this activity. Open an envelope of colored cards. Look straight ahead and have your partner SLOWLY bring a colored card up from behind your head into your peripheral vision. AS SOON AS YOU DETECT A CARD IS THERE, TELL YOUR PARTNER TO STOP. See if you can determine what color the card is.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