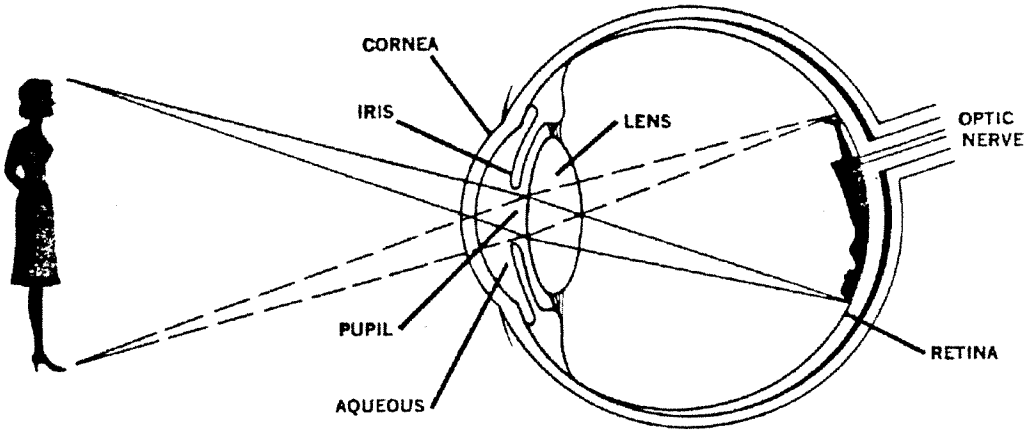
NAME_____ DATE_____ PERIOD_____

Vision Investigation



Background: The world around us is bathed in light. The sense organ that we use to sense light are the eyes. Remember however, that it is actually the brain that "sees". As light strikes an object—a girl, for example—in a person's field of vision, the light rays are reflected from the girl to his eyes. The rays pass through the *cornea* or clear front window, the *aqueous* or watery liquid behind the cornea, the *pupil* or opening in the colored *iris*, and the *lens*. The lens of the eye bends the light rays as they pass through it, and focuses them on the *retina* or rear inner lining of the eye which contains optic nerve cells. The lens operates much as a camera lens focuses light rays on a film. The retina then relays the light ray image through the *optic nerve* to the brain. Though the image is received upside down because the lens has inverted it, the brain interprets it correctly and the viewer sees the girl right side up.

If a person's eyeball is too long and the image in focus falls in front of the retina, he will be nearsighted. If the eyeball is too short and the image falls behind it, he will be farsighted. If the cornea has an imperfect curvature, he will have astigmatism. Properly prescribed eyeglasses or contact lenses are the only means of correcting these visual faults.

In this laboratory investigation you will have a chance to discover how the eye works. Working with a partner, you will observe several physical limitations of the eye as well as many interesting optical illusions.

VISUAL ACCOMMODATION – NEAR POINT

The distance from the eye to the nearest object that can be easily seen is your near point. To determine this point, place one hand over the right eye and focus the other on the head of a pin that is held at arm's length. Gradually bring the pin closer...until it can no longer be seen clearly. Have you partner measure this distance and record response below. Repeat with the other eye and record.

Record distance of near point	
Right Eye	**Left Eye**

1. How does the pin look at arm's length? _____

_____

2. What happens when the pin is brought closer toward the eye? _____

_____

3. Why does the pin go out of focus at a certain distance? _____

_____

4. Compare your near point with your partner's near point. Are they the same or different? Why or why not? _____

_____

PUPIL SIZE

Allow a bright light to fall on your eyes and then look at a dark surface away from the light (Your partner will observe your pupils. Next cover your right eye with your hand. After your eye has been "in darkness" for one minute, open your eye. Have your partner make observations about the reaction of your pupil and record on your response sheet.

Draw the pupil of the eye under these circumstances	
With Light	**Without Light**

1. What type of change did you notice about the pupil of your partner? _____

_____

2. Why do you think this change occurred? _____

_____

3. What did you notice about the pupil after your partner opened his/her eyes? _____

_____

FIELD OF VISION

Look through a pinhole in a sheet of paper at a bright light. Close the left eye and note the size of the illuminated field. Now open your eye. Record your observations below.

1. Compare the size of the illuminated field when the left eye was closed and when the left eye was open? _____

_____

2. Why do you think the field was smaller? (momentarily) _____

AFTERIMAGES

PART I: Stare for one minute at a brightly lit piece of red paper provided by your teacher. Now close your eyes. Do you see any pattern that resembles the one on the paper? Record your observations below. Repeat the same procedure using the green, white and black paper. Record what happens.

Record "after images" color you see	
Color of Paper	**After Images**
Red	
Green	
White	
Black	

PART II: Stare at the center of each of the images (one at a time) for at least 60 seconds. Do not move your eyes around and try not to blink. After staring at them look at a while background and blink several times..

1. What happened with the Canadian and American flags? _____

_____

2. Relate what you see with these optical illusions to a photographic negative. _____

_____

BINOCULAR / STEREOSCOPIC VISION

PART I: While looking at a single object with both eyes, press gently on the left eyeball and cause it to rotate inward (gently). Record observations and answers below.

1. Describe what you saw when you focused on a distant object and explain. _____

_____

PART II: Now try holding both index fingers about ½ inch apart and about 8 to 10 inches in front of your eyes. Focus on some distant object using both eyes. Draw the image that you see. Now close your right eye and draw that image. Do the same with the left. (Your fingers will be out of focus with a sausage-shaped segment between them. The "segment" appears because your eyes are converging on a distant object which you see clearly. Because of properties of the eye, you cannot see distant and near objects clearly at the same time. When the eyes are focused on distant objects, the eyes are not aimed in exactly the same line for close objects. Thus the brain receives two very different views of the finger which it fuses in a way that does not make sense.)

Both eyes open	Right eye closed	Left eye closed

RETINAL IMAGE

To observe the formation of the retinal image....hold both index fingers in front of your face in the median plane, so that they are aligned*. Hold one finger at your near point and the other as far away as possible. Focus on the far finger. Is the near finger double? Close the right eye. Which finger disappears? Repeat above– this time focus on the near finger. Which image disappears? Record observations below*

** median plane– a line that vertically divides your face in half*

**aligned– to adjust or form a line*

1. While focused on the far finger, what happens to the near finger? _____

_____

2. Which finger disappears when you close your right eye? _____

3. While focused on the near finger, what happens to the far finger? _____

_____

4. Which finger disappears when you close your right eye? _____

COLOR SENSITIVITY ON THE RETINA

Sit in a chair facing a blank wall and focus on a distant point. Do not turn your head or move your eyes during the entire test. Your partner will show you a series of brightly colored cards mounted on sticks (provided by teacher). Your partner will wave them up and down in a jiggling motion.. (partner or person conducting test: slowly pass them in front toward the outer margin of the range of vision on one side)

You are also to indicate to the point at which you can no longer tell what the color is. Your partner will be changing cards to try and keep you on your toes. Measure the approximate angle at which the loss of color occurs. Is it the same for all the colors? Record data and observations below.

Color Sensitivity		
Color of Paper	**Point where color isn't visible 1st time**	**Point where color isn't visible 2nd time**
Red		
Green		
White		
Black		

1. Define Peripheral Vision: _____

_____

2. What is the degree of your peripheral vision? _____

_____

3. Is the point of color loss the same for all of the colors? _____

_____

4. Which colors had a greater angle of visibility? Why? _____

_____

5. Which colors had a smaller angle of visibility? Why? _____

_____

6. Compare your results with results of your classmates. What did you notice? _____

_____

VISUAL ACUITY

Stand 20 feet away from the Snellen Eye chart. This spot should be marked for you. Cover the left eye and read down as far as possible. Repeat with the right eye. Your partner will record your results below. If you can read 20/20, your vision is considered normal (record information regarding the smallest line read)

1. Which eye has greater visual acuity? Why? _____

_____

2. Why does one eye have greater acuity than the other? _____

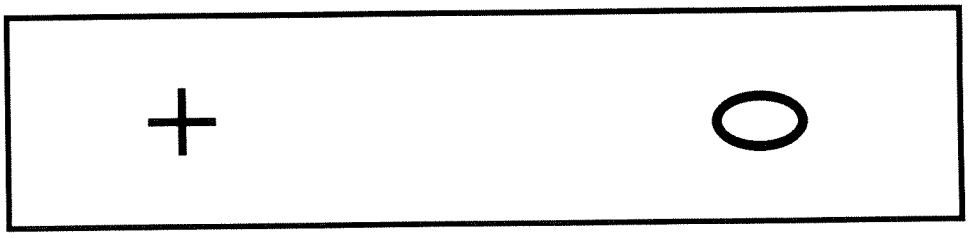
_____

3. What do the numbers 20/20 stand for? _____

_____

BLIND SPOT DETERMINATION

We see best only when we see objects straight on. The images fall on the fovea, a tiny spot where the light-responsive cells are concentrated. Your blind spot is an area on the retina where there are no light-responsive cells. This is the point where the optic nerve leaves the eye.



Hold the paper with a cross and circle about 20 inches from your face, directly in front of the RIGHT eye. You should be able to see both figures with the LEFT eye shut. Keeping the left eye closed, slowly bring the paper closer to your face. KEEP THE RIGHT EYE FOCUSED ON THE CROSS. When the circle disappears, stop and have your partner measure the distance. Record and answer the questions.

(A graph will be prepared with class data..... X = distance and Y = # of students)

BLIND SPOT DETERMINATION	
Eye	**Measurement (cm)**
Right eye	
Left eye	

1. Define fovea: _____

_____

2. Why does the object disappear when it is brought a certain distance from the eye? _____

_____

3. Compare your results with those of other classmates. Are they similar/different? (explain) _____

_____

_____

DOMINANT EYE

One eye works harder in all the "seeing" that you do. The dominant eye is the 'leader' and the other is the 'follower'. Look through a tube with both eyes at some distant object. Hold the tube steady and close your right eye. Now close your left eye. If the object you saw through the tube with both eyes still remains inside the tube when one eye is closed, the eye that is viewing the object is your dominant eye. Answer the questions below.

1. Which is your dominant eye? _____

2. Record the results of other members of the class and fill in the percentage chart of how many students are right dominated or left dominated.

PERCENTAGE DOMINANT (RIGHT OR LEFT)		
#'s	**Left eye**	**Right eye**
# of males		
# of females		
Total students in class		
% in class		

DEPTH PERCEPTION

The field of vision of the left eye is different from that of the right eye. The blending of the two different views of the same object enable us to judge distances of objects automatically. The left and fight image blends together to give a sense of depth.

Being able to determine how far away an object is depends on both eyes working together as a team. Close both eyes, ask your partner to hold the pencil away at arm's length. Open your left eye and quickly but gently touch the pencil tip with your finger tip. Close your left eye and have your partner change the position of the pencil. Next, quickly but gently touch the pencil tip with your right eye open. Record your observations and answer the questions.

1. Are you able to touch the pencil with your right eye closed? _____

2. Are you able to touch the pencil tip easily with your left eye closed? _____

3. Why did you miss the tip of the pencil with one eye closed but can touch it easily with both eyes open? _____

_____

_____

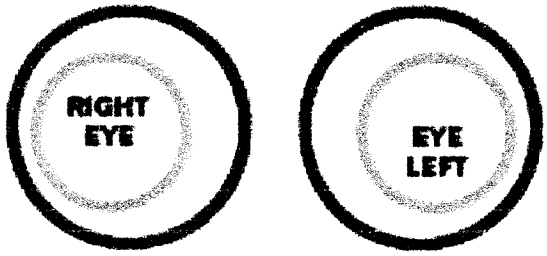
4. Is it safe to drive with one eye injured? Describe what might happen? _____

_____

PARALLEL-VIEWING

One method of "3d viewing" is known as parallel-viewing. You have already seen one example of this in the Binocular/ Stereoscopic Vision section of this lab. The famous "Frankfurter Experiment" demonstrates exactly how the eyes are used during parallel-viewing. If this experiment is successful, you'll see a miniature 'frankfurter' floating in the air.

One method for parallel-viewing is as follows:



- Bring your forefinger up about six inches in front of your nose. Focus both eyes on it.
- While focusing on your finger, notice what has happened to the circles above. You should see four circles. Keep focusing on your finger, but at the same time observe the four circles.
- Move your finger slowly toward the picture above (still focusing on it!) until you see the two middle circles slide together and merge into one figure. The combined figure is composed of two concentric circles. The inside circle pops toward you in 3D.
- You are using your finger to help you. Make a subtle shift of your attention from your finger to the figures (pictures) when you find the right focal point. Get your finger down and out of the way once you get the combined 3D figure.
- This takes most people several tries, especially the first time. If you have problems, play with the positioning of your finger and the shift of attention from your finger to the 3D figure. Slowly move your finger back and forth until you find the position that gives you the 3D image.
- At first, the 3D image might come in blurry. Relax a little, give your mind a chance to organize itself and the 3D image should come in sharp and clear.

(What about those words "RIGHT and "LEFT"? They indicate which eye is seeing which circle. The words are harder to get than the circles, so don't worry if they're a little blurry or wiggle around a bit. However, it one word consistently disappears then the corresponding eye may be turning off of "suppressing." You might have faulty binocular)two-eyed) vision.)

Observe the 3D images provided by the teacher and answer the questions below.

1. Were you successful 'seeing' in 3D? What special techniques did you find most helpful? _____

_____

2. Why do some people call 3D viewing "Gymnastics for the Mind"? _____

_____

_____

COLOR VISION

The notion of color implies several parameter– light, matter, physiology and inner mind. Perception of colors is then inherently subjective and can vary from one person to the other according to numerous factors, such as conditions of observation but also health state or emotive reactions.

Even for subjects having a normal vision of colors, the numerous spectral hues vary from those seen by other persons. If some people pick up a stone next to the beach, their description of its color is bound to be subject to discussion– for instance it will be described as blue-colored by some and greenish by others. Even the primary colors which seem pure– red, yellow, green, and blue– are subject to variation more or less significant; I.e. a "pure" yellow will appear as greenish to some people or more orange-colored to other people.

The interpretation of color is absolutely unique for each individual and it can also change according to one's age, one's experiences and a lot of other cultural or physiological parameters.

Color vision test are used:

- To identify and differentiate inherited and acquired deficiencies
- To select staff for occupations requiring a good color vision

The methods which are mostly used are:

- The recognition of figures or symbols contained in dots. This method allows a quick screening.
- The arrangement of caps in a natural color order which allows the deficiency to be accurately determined.
- Color matches made by special adjustment instruments

Observe the four vision test cards provided by the teacher. This is an example of the classic colorblindness tests you may be familiar with. Start with the demonstration card and follow the directions below.

- *Try and find a circle, star, and/or square on the demonstration card, card #1, and card #2.*
- *Try and find a dog, boat, balloon or car on card #3.*

(correct answers are on the backs of each of the cards)

1. Did you correctly identify all of the symbols on the four cards? If not what colors did you have trouble with? _____

_____

2. One male in twenty suffers from some form of color blindness, but only one in several hundred females are color blind. Why?

_____

3. Many people think anyone labeled as "colorblind" only sees black and white– like watching a black and white movie or television.

Why is this a big misconception? _____

4. What professions do you think might be dangerous for color-blind people, and which forms of colorblindness do you think would

be the most dangerous? _____

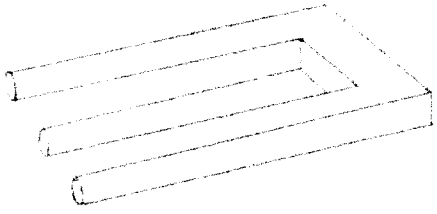
OPTICAL ILLUSIONS

Illusory works of art have a curious fascination. They represent a triumph of art over reality. They are illogic masquerading as logic. Why do illusions capture our interests? Why have so many artists gone to the trouble to produce them? Mountain climbers say they scale mountains "because they are there". Perhaps we seek illusions because they aren't there.

Observe the "optical illusions" provided by the teacher and answer the questions below.

1. Some optical illusions are simply clever pictures meant to fool our perceptions by placing unfamiliar forms in front of us, while others play games with the mechanics of our eyes. This explains why things aren't always as they appear to be. In which images are your eyes playing tricks on you and which is your brain playing tricks on you?

2. Observe the simple optical illusion called Schuster's conundrum. How many 'prongs' does this fork have? _____
Redraw the illusion for yourself in the space provided below



Schuster's Conundrum

Drawing