Biology 9
Senses Lab

Objectives:

- To understand the anatomy and physiology of several of our senses both through observation and by means of some simple experiments and examinations.

PART 1: The Eye

1. The Blind Spot

- One of the most dramatic experiments to perform is the demonstration of the blind spot. The blind spot is the area on the retina without receptors that respond to light. Therefore an image that falls on this region will NOT be seen. It is in this region that the optic nerve exits the eye on its way to the brain. To find your blind spot, look at the image below or draw it on a piece of paper:

(Directions continue on the next page)

- Close your right eye. Hold the image about 20 inches away. With your left eye, look at the +. Slowly bring the image closer while looking at the +. At a certain distance, the dot will disappear from sight. This is when the dot falls on the blind spot of your retina.
- Reverse the process. Close your left eye and look at the dot with your right eye. Move the image slowly closer to you and the + should disappear.
- This next image allows you to see another way your brain "fills in" the blind spot. Again, close your right eye. With your left eye, look at the +. Slowly move your head closer to the image. The space in the middle of the vertical lines will disappear.

2. Visual Acuity (VA)

- Have your partner stand 20 feet from the posted Snellen eye chart and cover one eye with a hand. As your partner reads each consecutive line aloud, check for accuracy. If this individual wears glasses, give the test twice – first with glasses off and then with glasses on.
- Record the number of the line with the smallest-sized letters to read. If it is 20/20, the person's vision for that eye is normal. If it is 20/40, or any ratio with a value less than one, he or she has less than normal visual acuity (VA). Such an individual is myopic, so a person with 20/40 vision is seeing objects clearly at 20 feet that a person with normal vision sees clearly at 40 feet.
- Repeat this process for each eye. Record the results for YOUR eyes.

	Without corrective lenses	With corrective lenses
VA of right eye	20/___	20/___
VA of left eye	20/___	20/___

3. Astigmatism

- The astigmatism chart tests for defects in the refracting surface of the lens and/or cornea.
- View the chart first with one eye and then with the other, focusing on the center of the chart. If all the radiating lines appear equally dark and distinct, your refracting surfaces are not distorted. If some of the lines are blurred or appear less dark than others, you have at least some degree of astigmatism.

	Without corrective lenses	With corrective lenses
Astigmatism in right eye?	Y/N	Y/N
Astigmatism in left eye?	Y/N	Y/N

4. Color Blindness

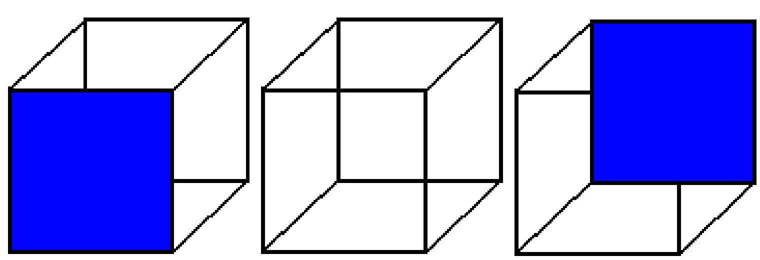
- Ishihara's color blindness plates are designed to test for deficiencies in the cones or color photoreceptor cells. There are three cone types – absorbing red, blue, and green wavelengths respectively. Interpretation of the intermediate colors of the visible light spectrum is a result of simultaneous input from more than one cone type.
- Scan through the book of colorblind plates together with your partners, and check if everyone recognizes the same pattern or number on each page. Record the number of any plates that you missed which may indicate colorblindness.
- Any color vision defects revealed? ____
- If defect revealed, explain.

5. Depth Perception

- Two eyes are better than one, especially when it comes to depth perception. Depth perception is the ability to judge objects that are nearer or farther than others. To demonstrate the difference of using one versus two eyes to judge depth hold the ends of a pencil, one in each hand. Hold them either vertically or horizontally facing each other at arms-length from your body. With one eye closed, try to touch the end of the pencils together. Now try it with two eyes. It should be much easier. This is because each eye looks at the image from a different angle. This experiment can also be done with your fingers, but pencils make the effect a bit more dramatic.
- Here's another way to demonstrate how different images are projected on to each eye. Look at an object in the distance (20-30 feet away). Close one eye, hold up your arm and line up your finger with the object. Now without moving your finger or your head, close the opened eye and open the closed eye. The object in the distance will appear to jump to the side-your finger will no longer be lined up. This shows that different images fall on each eye.

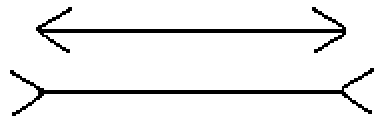
6. Visual Illusions

- What you see is not always what is there. Or is it? The eye can play tricks on the brain. Here are several illusions that demonstrate this point.
- The Magic Cube. Look at the center cube. What side is the front? Is the front as shown on the cube on the right side or is the front as shown on the cube on the left side or is there no front at all?

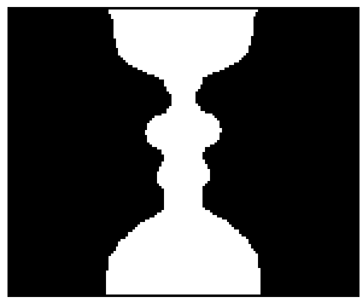


- Which of the lines shown below is longer? ___________________________

Muller-Lyer Illusion

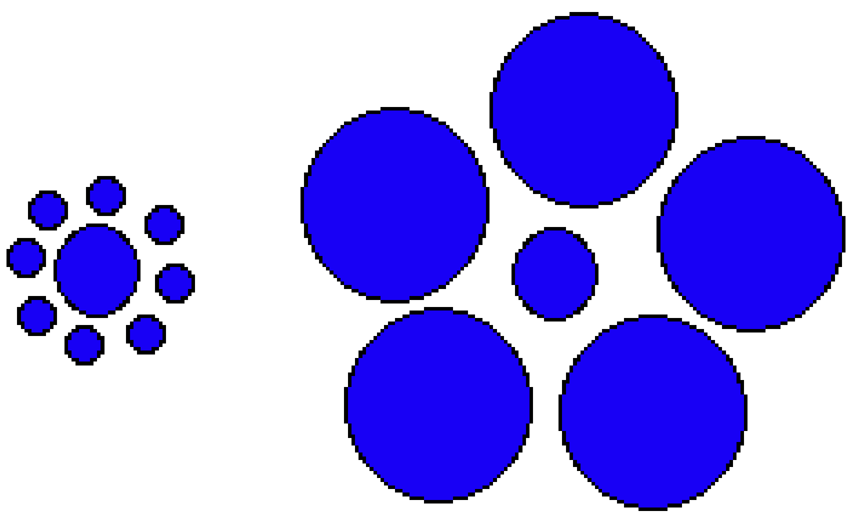


- Measure them. You may be surprised to find out that they are the same length. We see the lines as different because we have been "taught" to use specific shapes and angles to tell us about size.
- Do you see a vase or a face in the figure below? This type of picture was first illustrated by psychologist Edgar Rubin in 1915. Notice that it is very difficult to see both the faces and the vase at the same time. This may happen because we tend to focus our attention on only one part of the image, either the faces or the vase.



- View the circles below. Is the center circle on the right the same size as the center circle on the left? __________
- For many people it appears that the circle that is surrounded by the small circles is larger that the circle that is surrounded by the larger circles. Measure them to see if you are right.

Titchener Illusion



- This illusion shows that our brains judge size by comparing objects to things in the surroundings.

7. Determining Near Point of Accommodation

- Accommodation is a change in the shape of the lens of the eye to obtain maximal sharpness or focus of an image.
- To determine your near point of accommodation, hold a pencil at arm's length in front of one eye. Focus on the tip of the pencil. Slowly move the pencil toward that eye until the tip becomes distorted and is no longer in focus. Have your lab partner use the metric rule to measure the distance from your eye to the pencil at this point, and record the distance below. Repeat the procedure for the other eye.

	Without corrective lenses	With corrective lenses
Near point for right eye	_______	________
Near point for left eye	_______	________

8. Afterimage

- Set in front of you a sheet of black paper and a sheet of white paper.
- Place a small red card on the black paper and stare at the red card for thirty seconds. Now look quickly to the white paper. What do you see? Experiment with all the colors and record your results.

Color	Red	Blue	Green	Orange	Yellow
Afterimage	_____	______	_____	______	______

- What's Happening: Recall that there are three types of color receptors (cones) that are most sensitive to either red, blue or green. When you stare at a particular color for too long, these receptors get "tired" or "fatigued." When you then look at a different background, the receptors that are tired do not work as well. Therefore, the information from all of the different color receptors is not in balance and you see what are described as "afterimages." An afterimage is continual visual sensation perceived even after the physical stimulus is removed.

9. Sheep or Cow's Eye Dissection

Designate a reader to direct the primary dissector(s). Follow the directions below and be sure to locate the **bold** structures.

- Obtain a sheep or cow's eye, gloves, dissection tray/instruments from the cart
- Carefully make an incision in the **sclera** with a scalpel about ¼ inch away from the edge of the **cornea** (watch for squirting aqueous)
- Starting with the hole made by the scalpel, use scissors to cut a circle around the cornea, leaving a ¼ inch border of white sclera
- Remove the cornea and border. This separates the eye into two pieces: a posterior 2/3 and an anterior 1/3.
- From the inside, slowly remove the **lens** and observe the **suspensory ligaments** stretch and break. Note the firmness of the lens and how it delaminates upon rubbing due to its layered onion-like construction.
- Note the two round dark structures – the smoother, more anterior **iris** and the ridged, more posterior **ciliary body**.
- Carefully peel back the cream-colored **retina** (it may have already detached during dissection), and observe the dark **choroid** coat. Note that one portion of the retina stays firmly attached. This is the **optic disc**, where the **optic nerve** (made of **ganglion cell axons**) exits the eye.
    - A lighter blue area on the otherwise dark choroid is the **tapedum lucidum**, which allows for the reflection of light back through the retina a second time, thereby enhancing night vision. Humans do not have this structure.
- Use a forceps to separate the choroids from the sclera

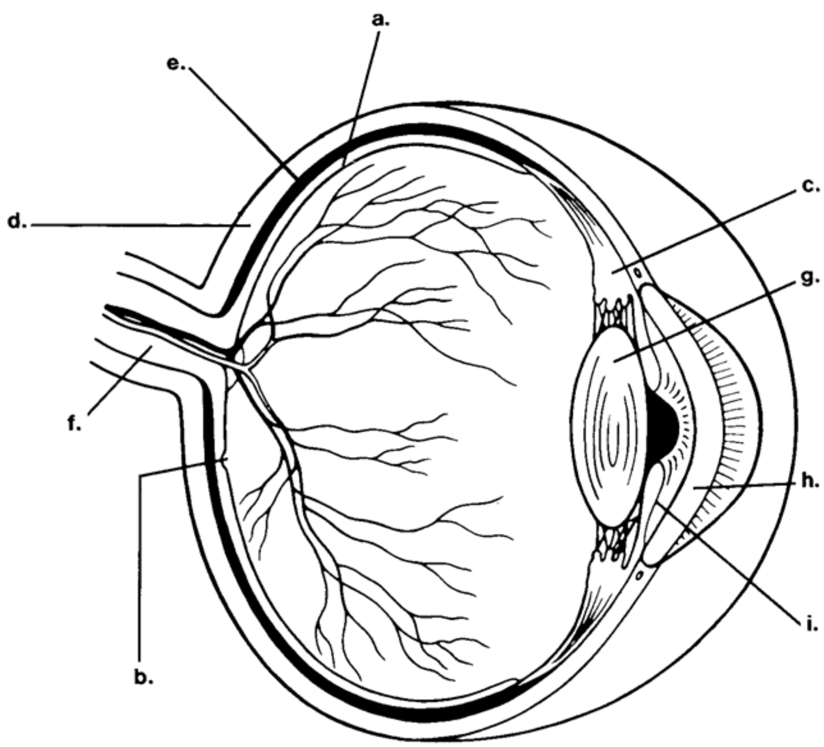
- After viewing the cornea and noting its placement, use scissors to remove the cornea so that the **iris** and **pupil** can be observed from the anterior side
- Dispose of all dissection materials in the appropriate receptacles. Return instrumentation and tray to the cart. Clean your table and wash your hands before continuing with the remaining lab exercises.

10. Anatomy and Physiology of the Eye

- Use your notes/textbook and the provided models to complete the following:

In the following diagram, label the parts of the eye using the following alphabetized list of terms. Using the answer blanks provided, state the name and function of each part of the eye indicated in the illustration.

choroid
ciliary body
cornea
fovea centralis
iris
lens
optic nerve
retina
sclera



Structure	Function
a. ______________________	______________________
b. ______________________	______________________
c. ______________________	______________________
d. ______________________	______________________
e. ______________________	______________________
f. ______________________	______________________
g. ______________________	______________________
h. ______________________	______________________
i. ______________________	______________________

PART 2: The Ear, Hearing, and Balance

1. Locating Sound

- Humans locate the direction of sound according to how fast it is detected by either or both ears. A difference in the hearing ability of the two ears can lead to a mistaken judgment about the direction of sound. Both you and a laboratory partner should perform the following procedure on each other. Enter the data for YOUR ears, not your partner's ears in the spaces provided.
    - Ask the subject to be seated, with eyes closed.

- Then strike a tuning fork together at each of the five locations listed in below. Use a random order.
- Ask the subject to give the exact location of the sound in relation to her/his head.
- Record the subject's perceptions of where the sound is coming from:
  - Directly below and behind the head ________________________________
  - Directly behind the head ____
  - Directly above the head ____
  - Directly in front of the face ____
  - To the side of the head ____
- Is there an apparent difference in hearing between your two ears?__________________

2. Bone Transmission of Sound

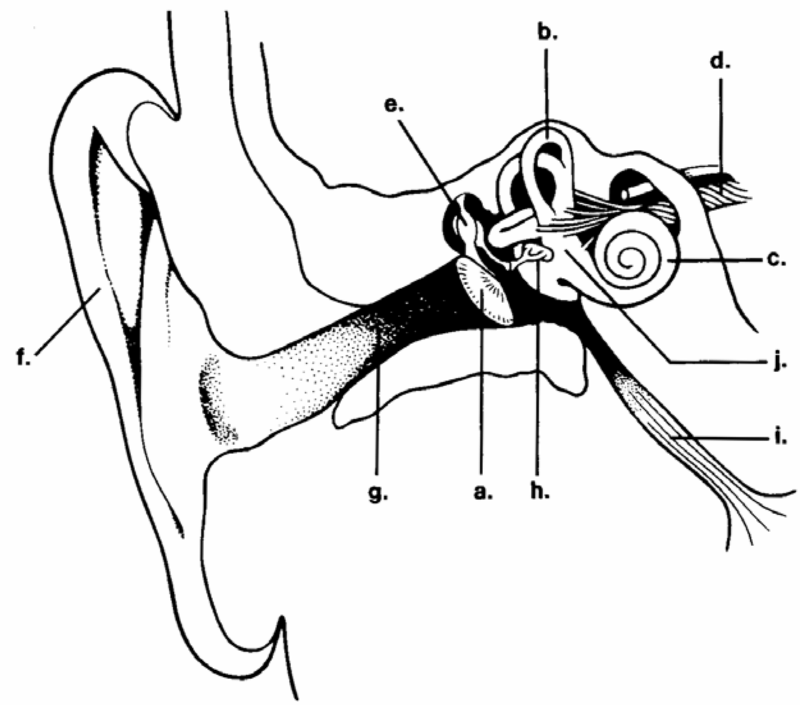
- Plug both ears with cotton and hold a vibrating tuning fork between your teeth. Can you hear it?
- Unplug one ear and repeat. In which ear is the sound more distinct? ______________________
- Unplug both ears, remove the fork from between the teeth, but hold it close to your mouth. Is the sound more or less distinct than when the fork was between the teeth with both ears closed?__________

3. Anatomy and Physiology of the Ear

- Use your notes/textbook and the provided models to complete the following:

Using the following alphabetized list of terms, label the parts of the ear. Using the answer blanks provided, state the name and function of each part of the ear indicated in the illustration.

auditory canal
auditory tube
cochlea
cochlear nerve
malleus (hammer)
pinna
semicircular canal
stapes (stirrup)
tympanic membrane
vestibule



Structure/Function		Structure/Function	
a.	________________	b.	________________
c.	________________	d.	________________
e.	________________	f.	________________
g.	________________	h.	________________
i.	________________	j.	________________

4. Field Sobriety Test

- Stand with your arms lifted to the sides. With the eyes closed, bend your elbows forward and try to touch your nose with your forefingers.
- Now repeat with your eyes opened.

5. Static Equilibrium

- Stand on one foot with your arms lifted to the sides. With the eyes closed, record how long you can maintain your balance (up to a minute).
- Repeat with your eyes opened.

6. Proprioception

- Stand with your arms extended to the sides.
- With the eyes closed, swing your arms forward and bring all the fingertips together.
- Now repeat with your eyes opened.
- Both this and the proceeding tests demonstrate the role of vision in maintaining balance and determining position in space.

PART 3: The Mouth and The Nose, Taste and Olfaction

1. Olfaction

- Utilizing a skull, locate where the olfactory nerve gains entry into the nasal cavity through the floor of the cranium. You can see the olfactory bulbs by viewing the antero-inferior aspect of a model brain. The bony passageway taken by the olfactory nerve through the floor of the cranium has many holes like a sieve or colander and is called the cribiform plate of the ethmoid bone.
- Using the smell tubes, sniff the experimental tubes and try to identify their fragrances. Record your guesses for each tubes *before* peeking at any of the answers.

Tube	Your Guess	Actual
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		

2. Linking Taste and Smell:

- Work with a partner. Obtain the three containers with candies. Choose one partner to do the tasting and the other partner to administer the test. Have the partner taste each of the flavors with their nose plugged and eyes closed and ask them to guess the flavor. Then have the individual smell each of the candies and guess the flavor. You may need to slightly smash the candy to increase the amount of scent produced. Finally have the individual taste each of the candies again with their nose unplugged.
- What happened? How can you explain these results?

PART 4: Senses of the Skin
Two-Point Sensibility

- In many areas of the skin, the nerve endings which respond to touch are so far apart that you identify two sensations as one. The distance between two points when they begin to feel like one is called the "two-point threshold". The distance varies from one area of the body to another and can be determined by using two pin points.
- Have your partner close his/her eyes. Place the points (you can use pencils with sharp points if pins are not available) four inches apart on the inner surface of the forearm. Move the points closer and farther apart, and ask your partner whether they detect one or two points. Measure how far apart the points were when they recognized two sensations as one. Repeat on the back of the neck and on the fingertip.
- Record the two-point threshold on the:
  Forearm: _________ Back of neck: _________ Fingertip: __________

Why does sensitivity vary from one part of the body to another? (Remember the homunculus?)
____