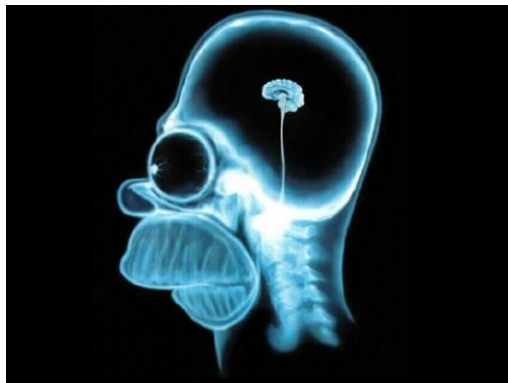
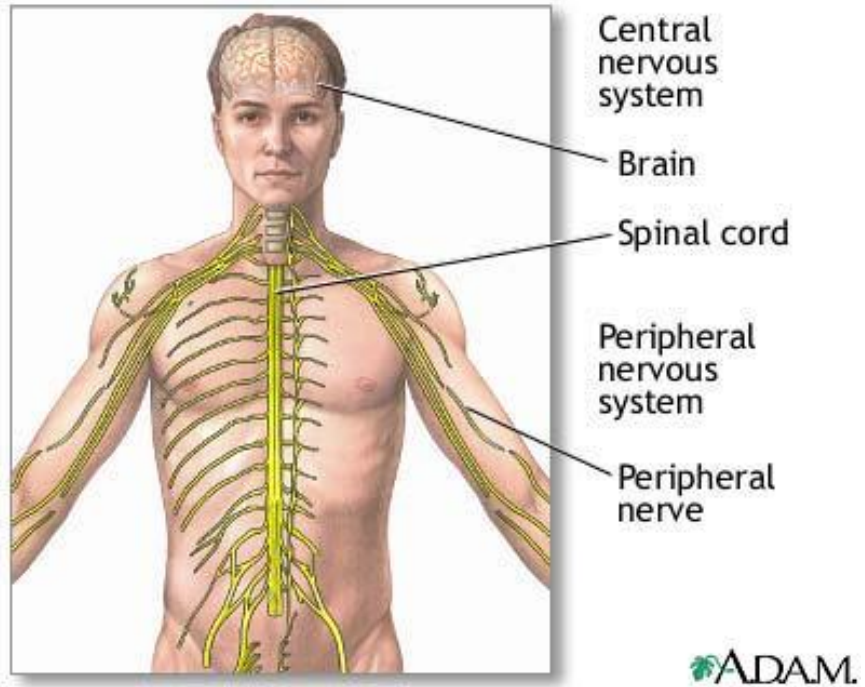


CHAPTER 19

The Nervous System



Chapter 19 Objectives

Section 1: How the Nervous System Works

1. Describe the basic functions of the nervous system.
2. Differentiate between the central and peripheral nervous systems.
3. Describe the functions of the 2 main subdivisions of the peripheral nervous system.
4. Define an impulse.
5. Locate and describe the functions of each of the following parts of a neuron: cell body, dendrite, axon, synapse.
6. Explain how a nerve impulse moves across a synapse.
7. Differentiate between sensory neurons, motor neurons, and interneurons.
8. Locate and describe the function of several different types of receptors.
9. Explain the function of effectors.

Section 2: Divisions of the Nervous System

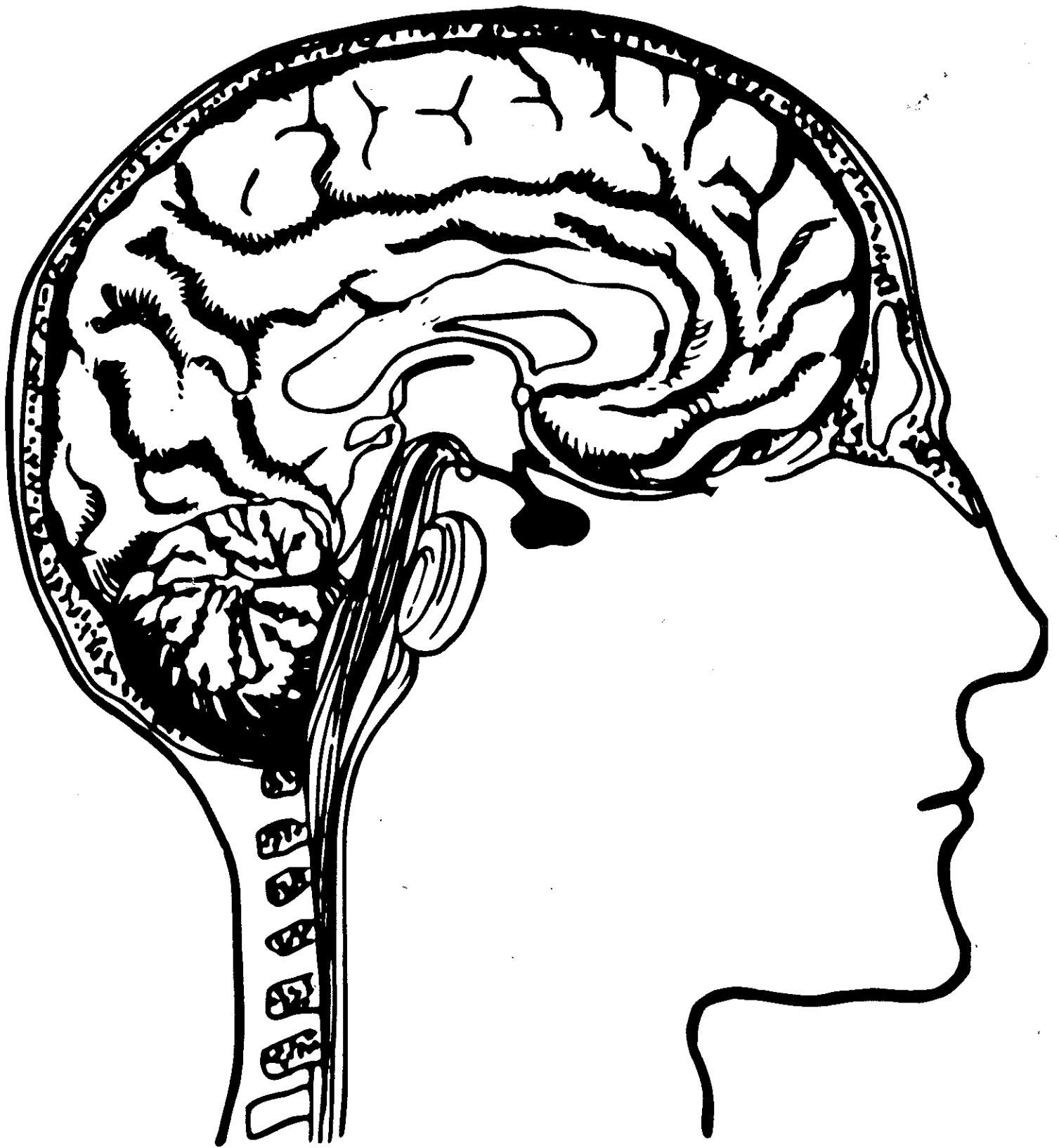
10. Describe the structures and function of the Central Nervous System
11. Describe the structures and functions of the Peripheral Nervous System
12. Compare the somatic and autonomic nervous systems of the Peripheral nervous system
13. Explain 2 ways the nervous system can be injured
14. Locate and describe the functions of each of the following parts of the brain: cerebrum, cerebellum, medulla / brain stem, spinal cord
15. Explain how the brain and spinal cord are protected.
16. Differentiate between a reflex and a response.
17. List the steps involved in a reflex action.
18. Explain why reflexes are protective.

Section 3: The Senses

19. Describe how your eyes enable you to see
20. Locate and describe the functions of each of the following parts of the eye: sclera, cornea, aqueous humor, iris, pupil, lens, ciliary muscle, vitreous humor, retina, fovea, blind spot, choroids, optic nerve
21. Differentiate between nearsightedness and farsightedness
22. Describe how you hear and maintain your sense of balance
23. Locate and describe the functions of each of the following parts of the ear: pinna, auditory canal, eardrum, semicircular canals, cochlea, auditory nerve.
24. Describe how your sense of smell and taste work together
25. Describe how your skin is related to the sense of touch

Section 4: Alcohol and Other Drugs

26. Define the following terms:
 - a. drug
 - b. drug abuse
 - c. tolerance
 - d. addiction
 - e. withdrawal
 - f. stimulant
 - g. depressant
 - h. hallucinogen
 - i. anabolic steroid
 - j. alcoholism
27. Name the immediate and long term effects of drug abuse
28. Identify some commonly used abused drugs and how each affects the body
29. Describe how alcohol abuse affects the body
30. Differentiate between prescription and over-the-counter drugs.



Directions: Find the best match for each of the items below:

- | | | |
|---------------------|---------------------------------|-----------------------------|
| a. Left hemisphere | b. Motor neurons | c. Autonomic nervous system |
| d. Dendrite | e. Cerebrum | f. Autonomic nervous system |
| g. Hemispheres | h. Cerebrospinal fluid | i. Neurotransmitter |
| j. Neuroanatomy | k. Sensory neuron | l. Rapid eye movement |
| m. Meninges | n. Synapse | o. Cerebellum |
| p. Medulla | q. Brain & spinal cord | r. Axon |
| s. Right hemisphere | t. Central NS & Periripheral NS | |

- _____ 1. structure of the nervous system
- _____ 2. 2 major parts of the nervous system
- _____ 3. 2 major divisions of the CNS
- _____ 4. 2 halves of the brain
- _____ 5. carries info to CNS from the sense organs
- _____ 6. carries info. From CNS to muscles
- _____ 7. division of the nervous system that controls smooth muscles and glands (involuntary)
- _____ 8. part of the brain that controls thinking
- _____ 9. part of the brain that controls muscle coordination and balance
- _____ 10. part of the brain that controls breathing and heartbeat
- _____ 11. side of the brain that controls math and logic
- _____ 12. side of the brain that controls visual imagery and music
- _____ 13. the fluid that surrounds and protects the brain
- _____ 14. the membranes that surround the brain
- _____ 15. the type of sleep in which we dream
- _____ 16. the division of your nervous system that is most important during a "fight or flight" reaction
- _____ 17. the part of a neuron that carries info into the cell body
- _____ 18. the part of a neuron that carries info away from the cell body
- _____ 19. the small gap between neurons
- _____ 20. the thing required for a message to cross a nerve synapse

Movie Focus Questions
Brain and Nervous System: Your Information Superhighway

1. What percent of your body weight does your brain take up?
2. What percent of your body's blood supply goes to the brain?
3. How much does the human brain weigh?
4. How many neurons are in the brain?
5. What are the two main parts of the Nervous System?
6. What are the two parts of the Central Nervous System?
7. What are the two parts of the Peripheral Nervous System?
8. What are the three types of neurons?
9. What are two things the left side of the brain is linked to?
10. What are two things the right side of the brain is linked to?
11. What are the 4 main parts of the brain?
12. What are 5 functions of the cerebrum?
13. What is the 2nd largest part of the brain?
14. What are 3 functions of the cerebellum?
15. What two conditions do psychiatrists think the cerebellum is responsible for?
16. What connects the brain to the spinal cord?

17. How large is the brain stem?
18. What are two functions of the brain stem?
19. How long is the spinal cord?
20. What is the spinal cord encased in?
21. What is the name of the liquid protection for the brain and spinal cord?
22. What are electrical impulses in the NS called?
23. What are the 4 types of brain waves?
24. What do alpha waves determine?
25. What is the most basic sense?
26. How many taste buds are on your tongue?

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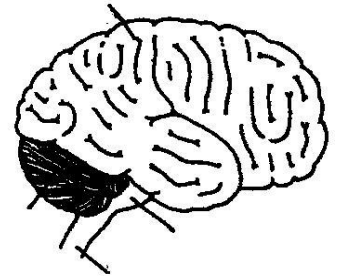


"Hold everything! — My left
brain just kicked in!"

Lab Observation: Sheep Brains

PART A: The Whole Brain

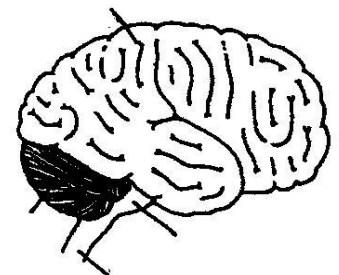
1. Complete this sentence: A sheep brain is about the size of a/an _____.
2. Pick up the preserved brain. Handle it gently – brains are expensive! A fresh brain feels much softer than this preserved one and would fall apart if you handled very much. Does this brain feel solid or hollow? _____
3. How much fat is on the brain? (none, some, or a lot) _____
4. Can you find any blood vessels? _____
5. Can you find any muscle tissues? _____
6. Decide how the brain would be positioned inside a living sheep. Compare it with the drawing on the right. Label the top, bottom, front and back on the drawing.
7. How many major sections of the brain do you see on the diagram to the right? ____ Can you locate these sections on your sheep brain? ____



PART B: Brain Parts

1. The cerebrum is the largest part of the brain. It is divided into two halves. Complete the following sentence: The cerebrum looks like _____.
2. Compare the two halves of the cerebrum. Are they (circle one)
EXACTLY ALIKE VERY SIMILAR SOMEWHAT ALIKE DIFFERENT
3. Behind the cerebrum is the cerebellum which is about the size of a/an _____.
4. Other than size, list two ways the cerebellum looks different from the cerebrum.

5. Just below the cerebellum is the medulla. Hold the brain so you can see the medulla. The medulla narrows to form the _____.
6. Label the cerebrum, cerebellum medulla and spinal cord on the drawing to the right.



7. Look at the underside of the brain. You should see a structure that resembles a cross. These are the ends of the optic nerves just before the nerves enter the brain. What did the optic nerves connect to before they were cut? (be specific) _____
8. You may be able to find the parts of the sheep brain that are involved with the sense of smell. Look at the underside of the brain for two protruding “flaps” of tissue toward the top. Could you locate them? _____
9. How do you think the size of your brain would compare with the size of the sheep brain? A human brain would be (larger or smaller) _____.
10. Imagine that tonight one of your parents asks you, “What does a sheep brain look like?” How would you answer?

11. Return your sheep brain to its bag, clean up your station and notify your teacher.
12. Once your teacher has approved your lab station, you may remove your gloves and wash your hands.



THE PARTS OF THE BRAIN

Directions: Fill in the following chart with information about the following brain parts from your iPod.



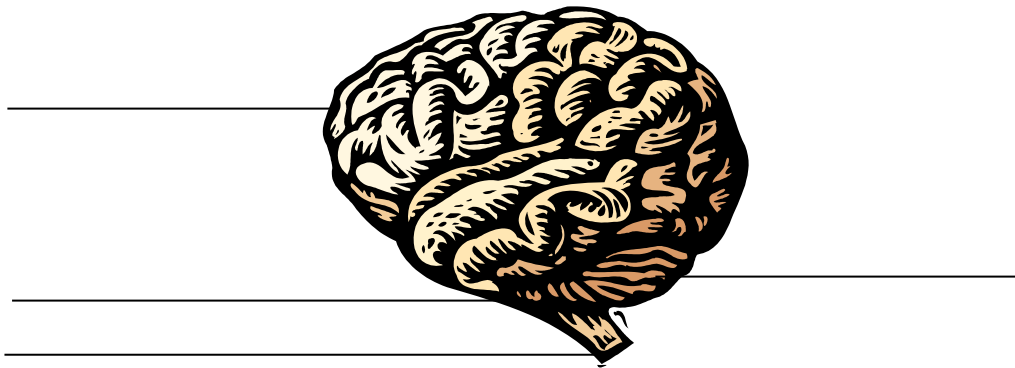
The Brain: Parts and Functions

Step 1 Directions: Label the diagram of the brain with the following parts:

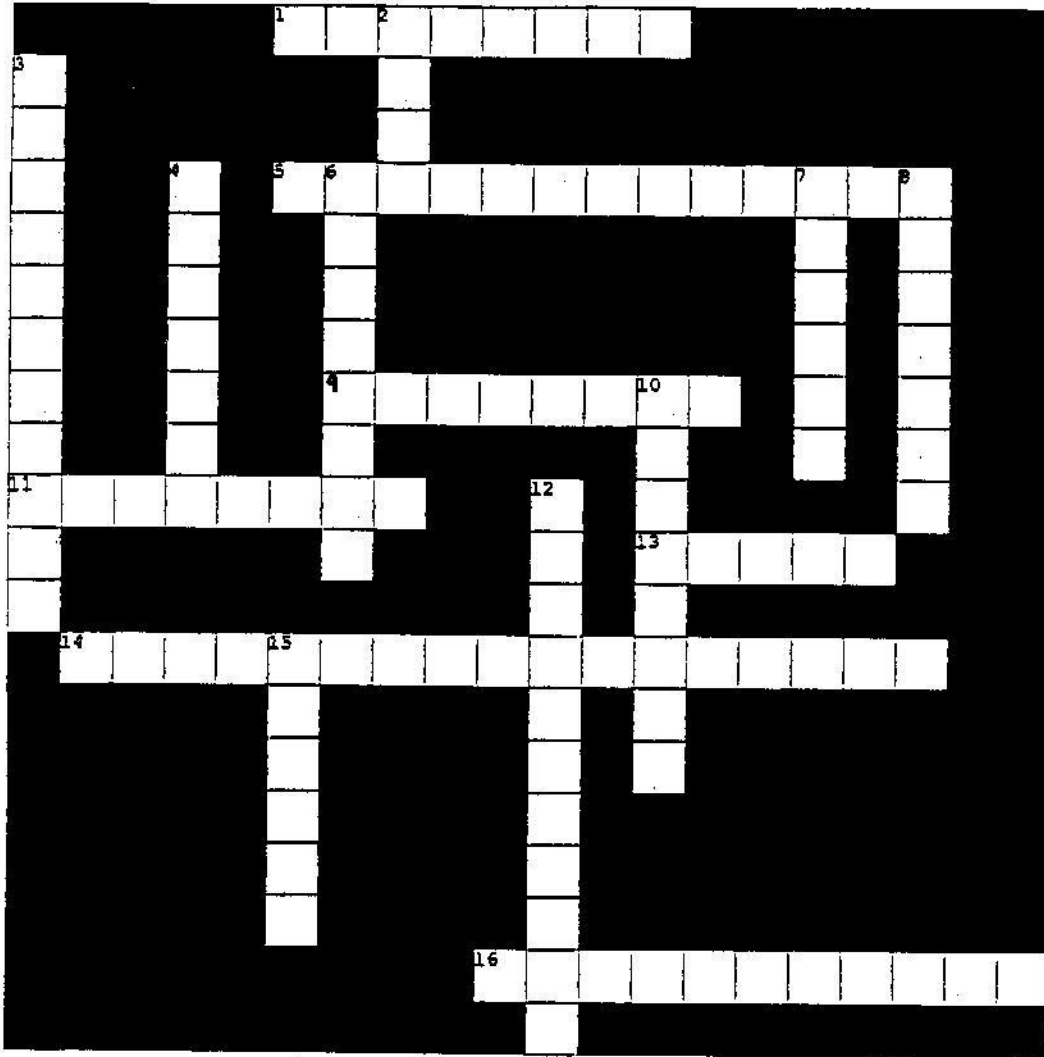
CEREBRUM
SPINAL CORD
CEREBELLUM
MEDULLA

Step 2 Directions: Under each label, write the letter of the brain functions controlled by that particular area of the brain.

- | | |
|------------------------|-------------------|
| a. sight | i. talking |
| b. balancing | j. reflexes |
| c. muscle coordination | k. heart rate |
| d. voluntary actions | l. smelling |
| e. involuntary actions | m. moving |
| f. thinking | n. hearing |
| g. emotions | o. blood pressure |
| h. breathing | p. memory |



NEURONS



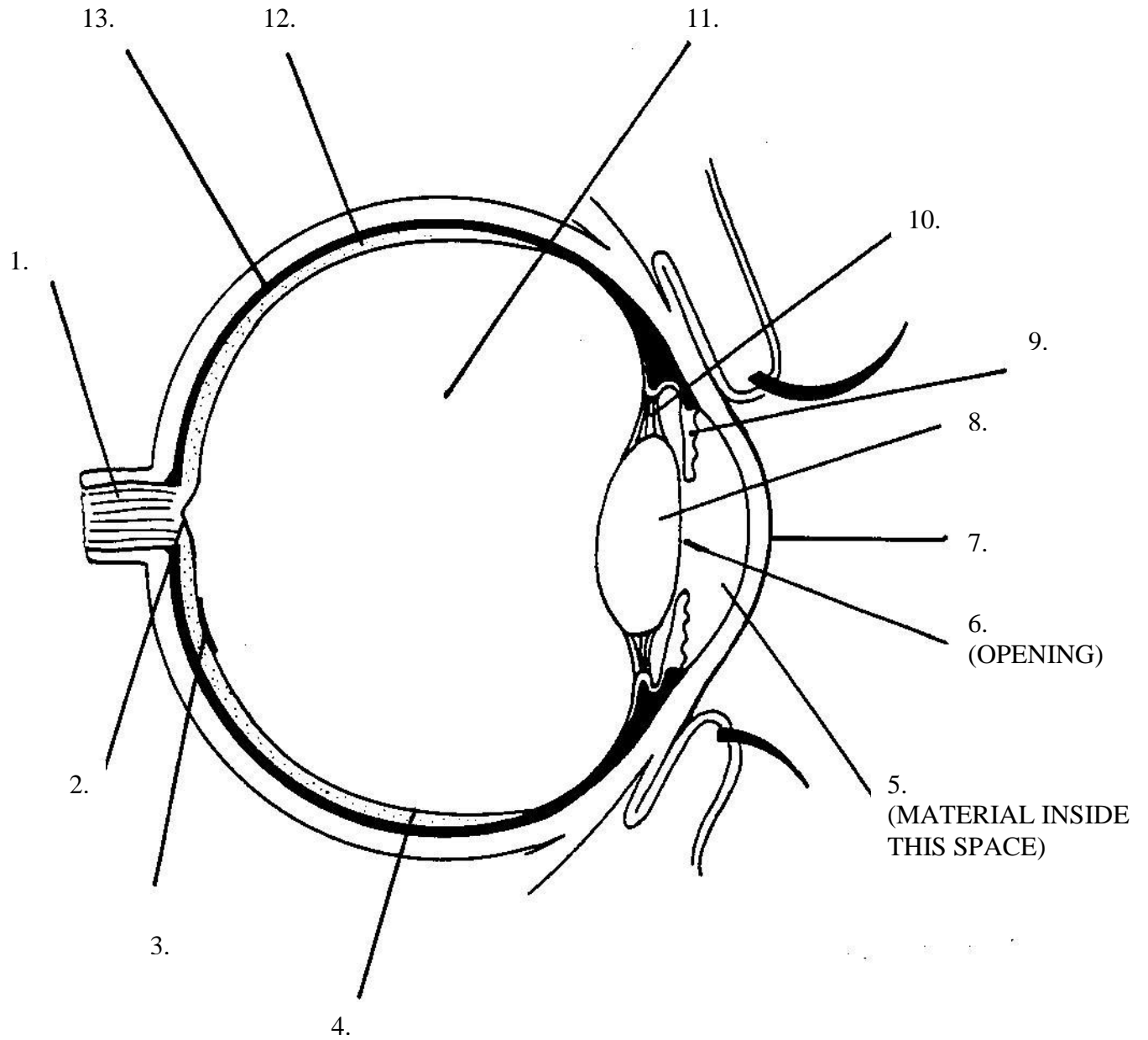
ACROSS

1. Action of an effector that does involve the brain
5. carries impulse from receptor to brain or spinal cord
9. central part of a neuron
11. detects stimulus
13. chemicals that can affect neurotransmitters
14. chemicals that can carry impulses between neurons
16. neuron that decides what to do with messages from sensory neurons

DOWN

2. Branches leading away from neuron
3. Carries message from brain or spinal cord to effector
4. Electrical signal sent through a neuron
6. Muscle or gland that responds to a motor neuron
7. Action of effector that does not involve the brain
8. Control center of the neuron
10. Branches leading into nerve cell
12. Receptors
15. Direction of impulse flow in a neuron

INTERNAL EYE STRUCTURE



Lab Dissection: Cow Eyes



Your eye is one of the most complex organs of your body. Much could be learned about the eye functions if you could look inside a human eye and study its parts. This is not a very practical approach, but you could study a cow's eye. Cow eyes are very much like human eyes but they have another advantage – they are *bigger* than human eyes.

Strategy:

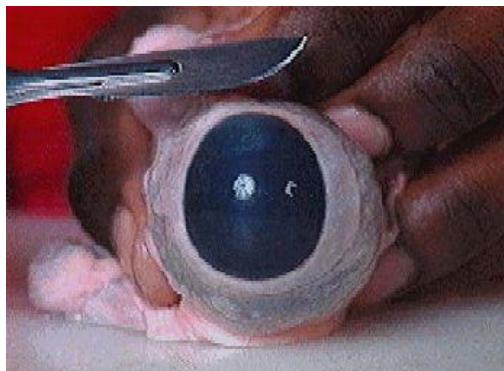
4. You will dissect a preserved cow eye.
5. You will identify the most important parts of the eye.
6. You will describe the function of these eye parts.

Materials:

1. preserved cow eye
2. dissecting pan
3. cutting knife or scissors

Procedure:

1. Cut away as much of the surrounding muscle tissue of the eye that you can with scissors.
2. Locate the optic nerve at the back of the eye. It can be seen as a white, round, pencil-thick bundle of nerves surrounded by a dark-colored layer of muscle tissue.
3. You are now ready to cut into the eye. Using your scissors, puncture the eye to start a cutting hole.
CAUTION: use extreme care when puncturing the eye. As always, make sure the tip of the scissors point away from you and could not possibly puncture your hand or finger when pressure on the scissors is applied.
4. Insert one blade of the scissors through the hole and proceed to cut around the eye. Use Figure 1 as a guide for cutting open the eye.
5. As you cut around the eye, a jellylike material will probably fall out. This is the vitreous humor, a transparent jelly that fills the inside of the eye. The lens is a marble-shaped structure that may also fall out of the eye.



Alcohol-Related Traffic Deaths

Traffic accidents are the leading cause of death in the United States for children under age 15. Between 1985 and 1996, there were 35,547 children under age 15 killed in traffic accidents. Alcohol was involved in 8,482 of these deaths. Of the children killed in alcohol-related crashes, 68 percent were passengers in a car, 22 percent were pedestrians, and 8 percent were bicyclists.

The table below shows the ages of people who died in traffic accidents caused by drunk drivers in 1997 and 2001.

Age Group	Number of Deaths Involving Drunk Drivers	
	1997	2001
Under 16	670	584
16-20	2,096	2,366
21-24	2,053	2,421
25-34	4,031	3,800
35-44	3,356	3,709
45-54	1,862	2,382
55-64	905	1,039
65-74	604	558
Over 74	454	481
Total	16,031	17,338

Directions: Answer the following questions

1. For which age group did the number of traffic deaths due to drunken drivers increase by the most? How many more deaths were there in this age group in 2001 than 1997?
2. By about what percent did the total number of traffic deaths involving drunk drivers increase between 1997 and 2001?
3. About how many people died each day in 2001 due to traffic accidents involving drunk drivers?
4. How many people under age 16 were killed by drunken drivers in 1997 and 2001 combined?
5. What are three ways that the number of deaths due to drunken driving could be reduced?

Name _____

Directions: Answer the following questions in complete sentences. You will need to answer questions with 3-4 sentence answers. You may work on these throughout the course of the assignment. Your final submission will be due on **Monday April 22nd**. Please submit electronically one of two ways: Share via Google Docs or email to Mrs. Parsons as an attachment from Notability. There will be a **5 point deduction** from your final grade if you do not submit electronically. This grade is worth a **QUIZ GRADE**.

1. What does Phineas do for work?
2. What kind of man was Phineas Gage before his accident?
3. How did Phineas' accident happen?
4. What injury did Phineas sustain during the accident?
5. How is Phineas acting right after the accident once he gets back into town?
6. In the 1800s, what do scientists know about bacteria and infections?
7. What is the difference between the beliefs of 'Whole Brainers' and the 'Localizers'?
8. Describe the general theories and beliefs of Phrenology.
9. Once Phineas leaves Cavendish, what are three of the experiences he has?
10. After Phineas 'recovers' from the accident, what kind of behavior does he exhibit?
11. Describe Phineas' physical state when he arrived in San Francisco and what ultimately killed him.
12. What happened to Phineas' body after he died?
13. Who are the Damasios and what do they do?
14. After the Brainvox images, why do they refer to the entry angle of the tamping iron as 'Phineas' incredible luck'?
15. In your opinion, was Phineas Gage's accident significant to Brain Science? Why or why not?

COW'S EYE dissection



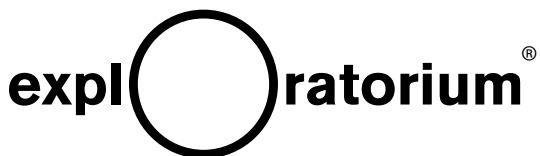
Dissecting a Cow's Eye Step-by-Step Instructions

One way to figure out how something works is to look inside it. To learn about how your eyes work, you can *dissect*, or take apart, a cow's eye.

Safety first!

You'll be using a scalpel or a razor to cut the cow's eye. Be careful. A scalpel or razor can cut you as easily as it cuts the cow's eye.

Whenever you handle raw meat (whether it's a cow's eye or a steak), you wash your hands thoroughly afterward to wash away any bacteria you picked up from the meat. If you have cuts on your hand, we also recommend you wear gloves so that no bacteria from the cow's eye infects your cut.



Visit the Cow's Eye Dissection online:
<http://www.exploratorium.edu/coweye>

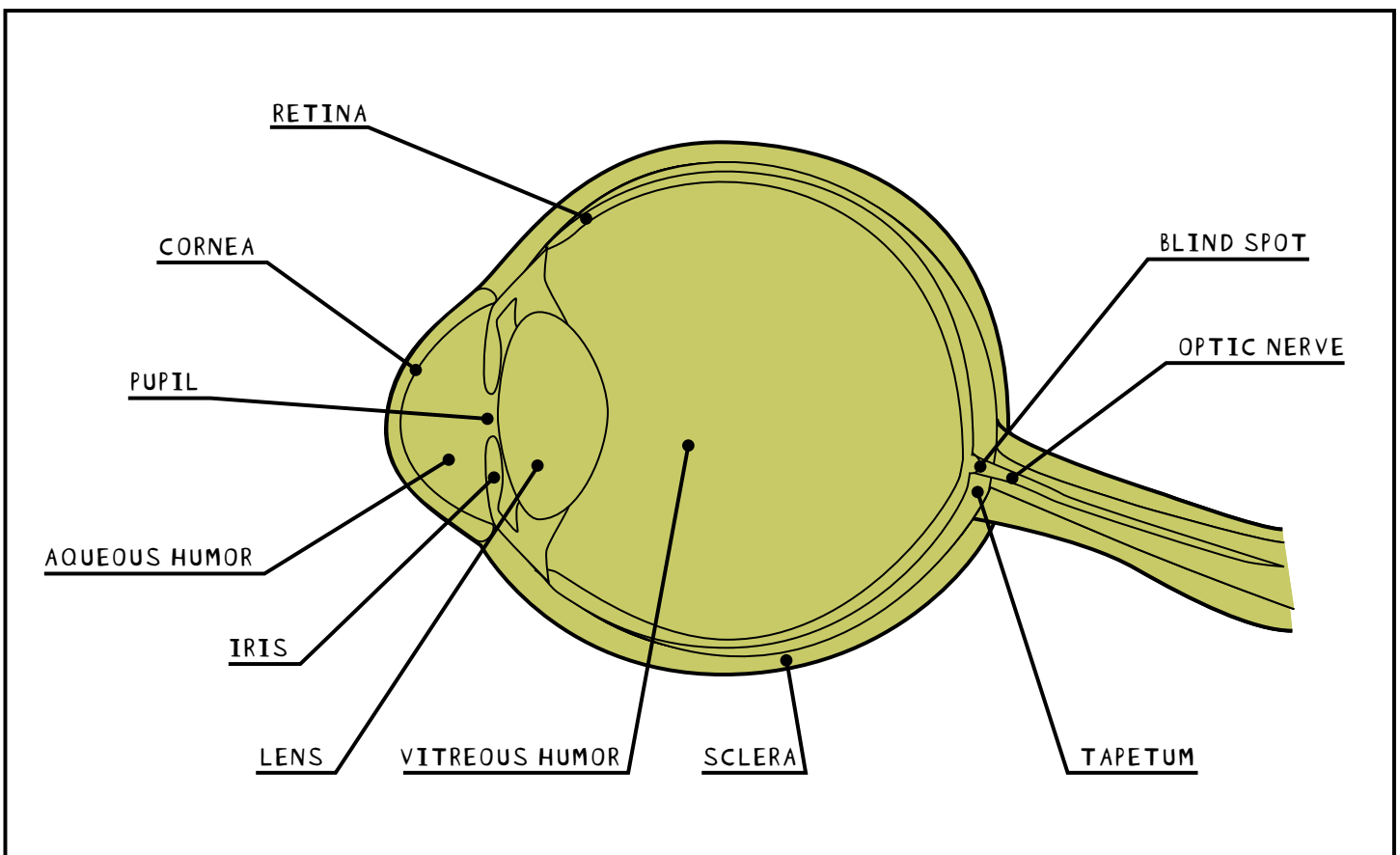
COW'S EYE dissection

Here's what you need:

- One cow's eye for every two participants
- One single-edged razor blade or scalpel for every two participants
- Scissors (optional)
- Wax paper and paper towels
- Plastic garbage bag
- A cutting board or other surface on which you can cut
- A sheet of newspaper
- Soap, water, and paper towels for cleaning up

Here's where to get cows' eyes:

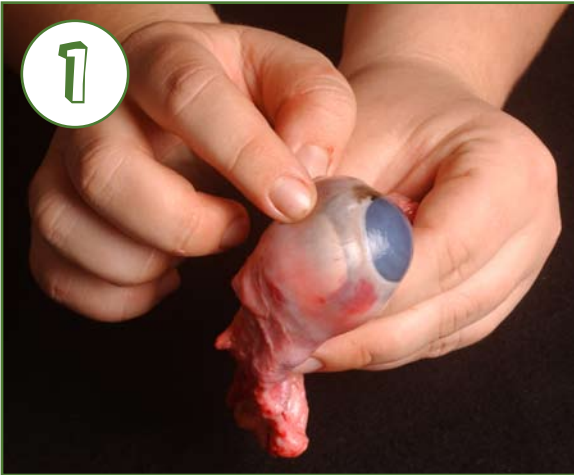
You can order cows' eyes at a butcher shop or purchase them directly from a slaughterhouse. Try to get eyes with the muscles and fat still attached. If possible pick up the cows' eyes the day of the dissection; eyes are easier to cut when they are fresh.



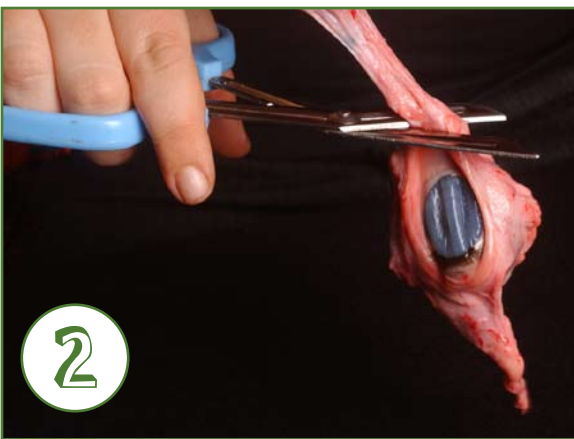
This diagram shows the parts of the eye. Can you find these parts in a cow's eye?

COW'S EYE dissection

Here's what you do:



Examine the outside of the eye. See how many parts of the eye you can identify. You should be able to find the whites (or _____) the tough, outer covering of the eyeball. You should also be able to identify the fat and muscle surrounding the eye. You should be able to find the covering over the front of the eye (the _____). When the cow was alive, the cornea was clear. In your cow's eye, the cornea may be cloudy. You may be able to look through the cornea and see the **iris**, the colored part of the eye, and the _____, the dark oval in the middle of the iris.



Cut away the fat and muscle.



Use a scalpel to make an incision in the cornea. (Careful—Don't cut yourself!) Cut until the clear liquid under the cornea is released. That clear liquid is the _____. It's made of mostly of water and keeps the shape of the cornea.

COW'S EYE dissection



Use the scalpel to make an incision through the _____ the middle of the eye.



Use your scissors to cut around the middle of the eye, cutting the eye in half. You'll end up with two halves. On the front half will be the _____.

The cornea is made of pretty tough stuff—it helps protect your eye. It also helps you see by bending the light that comes into your eye.

Once you have removed the cornea, place it on the board (or cutting surface) and cut it with your scalpel or razor. Listen. Hear the crunch? That's the sound of the scalpel crunching through layers of clear tissue. The cow's cornea has many layers to make it thick and strong. When the cow is grazing, blades of grass may poke the cow's eye—but the cornea protects the inner eye.



The next step is to pull out the _____. The iris is between the _____ and the _____. It may be stuck to the cornea or it may have stayed with the back of the eye. Find the iris and pull it out. It should come out in one piece. You can see that there's a hole in the center of the iris. That's the _____, the hole that lets light into the eye. The iris contracts or expands to change the size of the pupil. In dim light, the pupil opens wide to let light in. In bright light, the pupil shuts down to block light out.

COW'S EYE dissection



The back of the eye is filled with a clear jelly. That's the _____, a mixture of protein and water. It's clear so light can pass through it. It also helps the eyeball main-tain its shape.

Now you want to remove the **lens**. It's a clear lump about the size and shape of a squashed marble.



The _____ of the cow's eye feels soft on the outside and hard in the middle. Hold the lens up and look through it. What do you see?



Put the **lens** down on a newspaper and look through it at the words on the page. What do you see?

COW'S EYE dissection



Now take a look at the rest of the eye. If the **vitreous humor** is still in the eyeball, empty it out. On the inside of the back half of the eyeball, you can see some blood vessels that are part of a thin fleshy film. That film is the **retina**. Before you cut the eye open, the vitreous humor pushed against the retina so that it lay flat on the back of the eye. It may be all pushed together in a wad now.

The retina is made of cells that can detect light. The eye's **lens** uses the light that comes into the eye to make an image, a picture made of light. That image lands on the retina. The cells of the retina react to the light that falls on them and send messages to the brain.



Use your finger to push the retina around. The retina is attached to the back of the eye at just one spot. Can you find that spot? That's the place where nerves from all the cells in the retina come together. All these nerves go out the back of the eye, forming the _____, the bundle of nerves that carries messages from the eye to the brain. The brain uses information from the retina to make a mental picture of the world.

The spot where the retina is attached to the back of the eye is called the _____. Because there are no light-sensitive cells at that spot, you can't see anything that lands in that place on the retina.

COW'S EYE dissection



Under the retina, the back of the eye is covered with shiny, blue-green stuff. This is the **tapetum**. It reflects light from the back of the eye.

Have you ever seen a cat's eyes shining in the headlights of a car? Cats, like cows, have a tapetum. A cat's eye seems to glow because the cat's tapetum is reflecting light. If you shine a light at a cow at night, the cow's eyes will shine with a blue-green light because the light reflects from the tapetum.



Look at the other side of the back of the eye. Can you find the **optic nerve**? To see the separate fibers that make up the optic nerve, pinch the nerve with a pair of scissors or your fingers. If you squeeze the optic nerve, you may get some white goop. That is myelin, the fatty layer that surrounds each fiber of the nerve.

Clean-up

When you're done dissecting the cow's eye, wrap all the pieces of the eye in plastic and throw them away. If you used a razor blade, dispose of it properly. A razor blade is only good for one or two dissections.

Glossary

aqueous humor

A clear fluid that helps the cornea keep its rounded shape.

blind spot

The place where all nerves from the retina join to form the optic nerve. Each eye has a blind spot where there are no light-sensitive cells.

cones

One kind of light-sensitive cell in the retina. Cones give you color vision in bright light.

cornea

A tough, clear covering over the iris and the pupil that helps protect the eye. Light bends as it passes through the cornea. The cornea begins bending light to make an image; the lens finishes the job.

iris

A muscle that controls how much light enters the eye. It is suspended between the cornea and the lens. A cow's iris is brown. Human irises come in many colors, including brown, blue, green, and gray.

lens

A clear, flexible structure that makes an image on the eye's retina. The lens is flexible so that it can change shape, focusing on objects that are close up and objects that are far away.

myelin

The fatty layer that surrounds each nerve fiber.

optic nerve

The bundle of nerve fibers that carry information from the retina to the brain.

pupil

The pupil is the dark circle in the center of your iris. It's a hole that lets light into the inner eye. Your pupil is round. A cow's pupil is oval.

retina

The layer of light-sensitive cells at the back of the eye. The retina detects images focused by the cornea and the lens. The retina is connected to the brain by the optic nerve.

rods

One kind of light-sensitive cell in the retina. Rods respond in dim light.

sclera

The thick, tough, white outer covering of the eyeball.

tapetum

The colorful, shiny material located behind the retina. Found in animals with good night vision, the tapetum reflects light back through the retina.

vitreous humor

The thick, clear jelly that helps give the eyeball its shape.