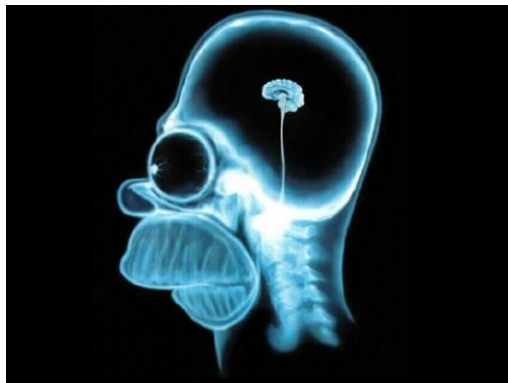
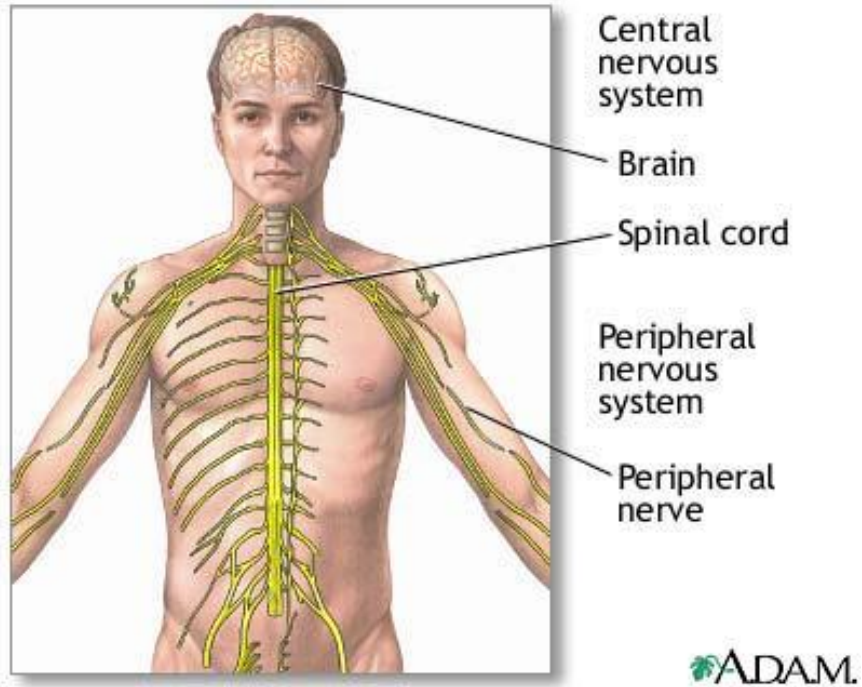


CHAPTER 19

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

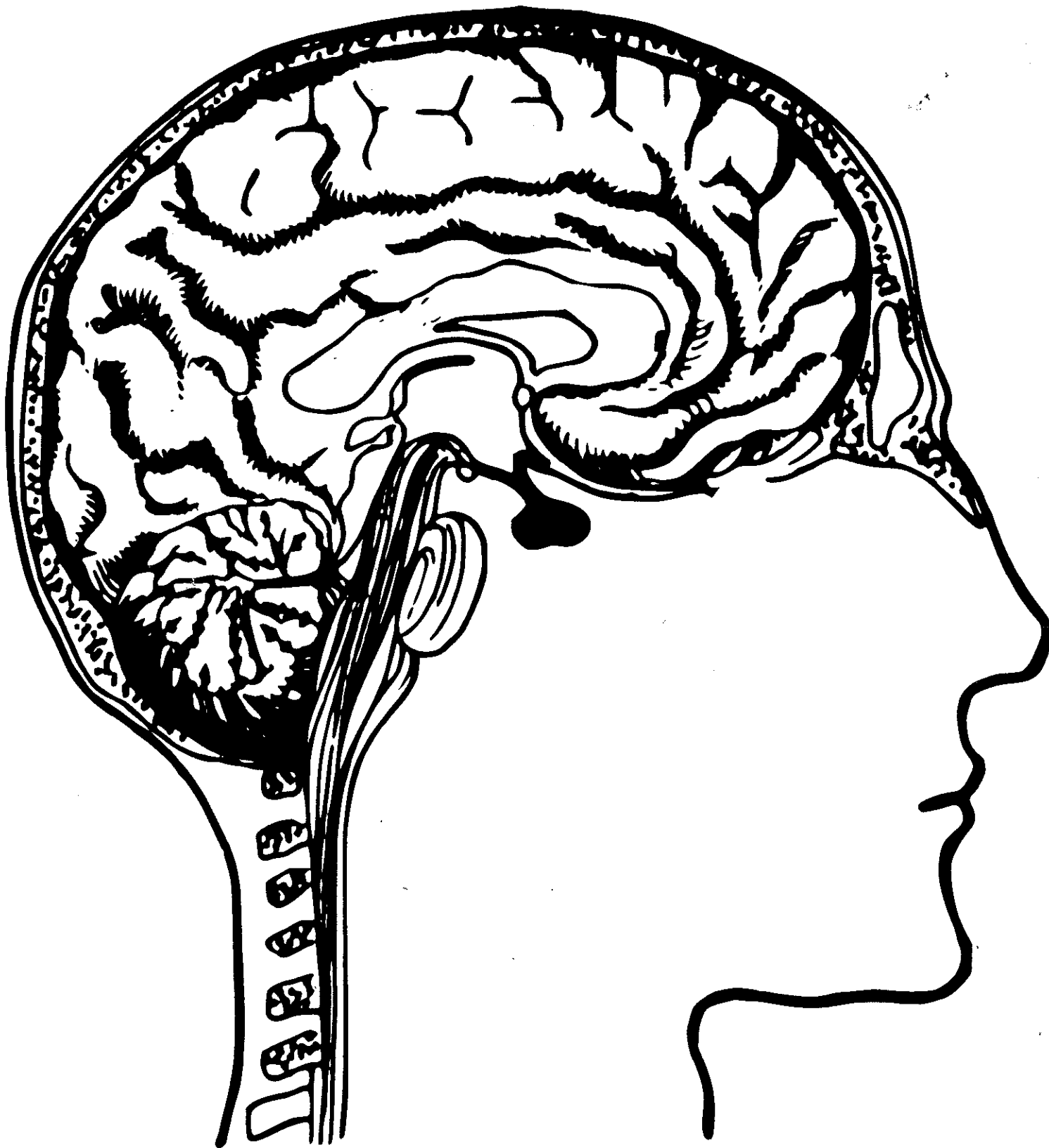
26. Define the following terms:
 - a. drug
 - b. drug abuse
 - c. tolerance
 - d. addiction
 - e. withdrawal
 - f. stimulant
 - g. depressant
 - h. hallucinogen
 - i. anabolic steroid
 - j. alcoholism
27. Name the immediate and long term effects of drug abuse
28. Identify some commonly used abused drugs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

**iPad ACIVITY:
NERVOUS SYSTEM**

Directions: Research answers the following questions using your iPad apps such as Anatomy 3D; Click on the “Anatomy 3D” application, then click on “Encyclopedia” and “Nervous system;” or online at Kidshealth.org: <http://goo.gl/uzzke8>



1. What is the nervous system composed of?
2. What two categories are the nervous system divided into?
3. What type of neurons make up the peripheral nervous system?
4. What are the two parts of the central nervous system?
5. Once the sensory neurons process information, where are the signals sent to?
6. With what two things do the neurons transmit impulses to other neurons?
7. What is the largest part of the nervous system?
8. What is the central nervous system covered with?
9. What protects the brain and spinal cord, respectively?
10. What is the main function of the peripheral nervous system?
11. What are the 2 divisions of the peripheral nervous system?
12. What is the function of the somatic nervous system?
13. What are the 3 divisions of the autonomic nervous system?
14. What is the function of the sympathetic nervous system?
15. What is the function of the parasympathetic nervous system?
16. What is the function of the enteric nervous system?



Welcome to Neuroscience for Kids!

<http://faculty.washington.edu/chudler/neurok.html>

You should now be on the page that contains the Table of Contents.

Click on "Explore the Nervous System".

Click on "Brain Basics".

Click on "Divisions of the Nervous System". Answer the following questions about the nervous system using this page only. Do not click on any "hot-spots" that will take you away from this page.

1. What is neuroanatomy?
2. Name the 2 major parts of the nervous system.
3. What are the two major divisions of the central nervous system?
4. What 2 kinds of cells does your brain contain?
5. What are the 2 major parts of the peripheral nervous system?
6. Give the function of the somatic nervous system.
7. Give the function of the autonomic nervous system.
8. Give the function of the enteric nervous system.
9. What are the hemispheres of the brain?

10. How do hemispheres of the brain communicate?
11. Differentiate between a sensory and a motor neuron.
12. List the major functions of the following portions of your brain:
 - a. Cerebral cortex
 - b. Cerebellum
 - c. Brain stem (medulla)

Go back to the "Explore the Nervous System" page. Under "Brain Basics" find the headline that says "1 brain or 2? Split Brain Experiments". Click on it. Answer the following questions using this page only.

1. Describe the types of things controlled by the left hemisphere of your brain.
2. Describe the types of things controlled by the right hemisphere of your brain.

Go back to the "Explore the Nervous System" page. Find the headline that says "The Ventricles and CSF". Click on it. Answer the following questions using this page only.

1. What is CSF?
2. List 4 functions of CSF.
3. What is hydrocephalus?

Go back to the "Explore the Nervous System" page. Find the headline that says "The Brain During Sleep". Click on it. Answer the following questions using this page only.

1. What are 2 basic forms of sleep?
2. What occurs during REM sleep?
3. According to the chart, about how many times a night do you dream?
4. Why do researchers suppose that we sleep? (2 reasons)

Go back to the "Explore the Nervous System" page. Under "The Spinal Cord" find the headline that says "The Knee Jerk Reflex". Click on it. Answer the following questions using this page only.

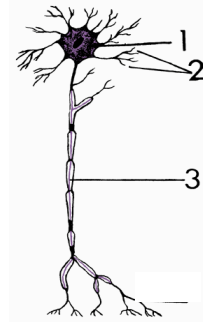
1. What is a monosynaptic reflex?

Go back to the "Explore the Nervous System" page. Click on the "Peripheral Nervous System". Find the headline that says "The Autonomic Nervous System". Click on it. Answer the following questions using this page only.

1. What are the functions of the autonomic nervous system?
2. Is the autonomic nervous system voluntary or involuntary?
3. In what 2 situations is the ANS most important?
4. Name 2 general types of body structures that the ANS controls.

Go back to the “Explore the Nervous System” page. Click on “The Neuron” and find the headline that says “Millions and Billions Cells: Types of Neurons”. Click on it. Answer the following questions using this page only.

1. Draw a simple diagram of a nerve cell. Label the dendrites, axon, and cell body.
 - 1.
 - 2.
 - 3.



2. What is the function of:
 - a. Dendrites
 - b. Axons

Go back to the “Explore the Nervous System” page. Find the headline that says “Neurotransmitters and Neuroactive Peptides”. Click on it. Answer the following questions using this page only.

1. What is a synapse?
2. How do impulses cross a synapse?

Go back to the “Explore the Nervous System” page. Look for the heading “Drug Effects” and find the headline that says “Alcohol”. Click on it. Answer the following questions using this page only.

1. What class of drug is alcohol? (stimulant, depressant, or hallucinogen)
2. List 3 effects of chronic alcohol use.
3. List 5 effects of FAS.
4. What is a possible effect of light alcohol usage during pregnancy?

Go back to the “Explore the Nervous System” page. Look for the heading “Drug Effects” and find the headline that says “Amphetamines”. Click on it. Answer the following questions using this page only.

1. What type of drugs are amphetamines?
2. List 6 short-term effects of amphetamines.
3. List 6 long-term effects of amphetamines.

Go back to the “Explore the Nervous System” page. Look for the heading “Drug Effects” and find the headline that says “Caffeine”. Click on it. Answer the following questions using this page only.

1. What type of drug is caffeine?
2. List 4 effects of moderate doses of caffeine.
3. List 3 withdrawal symptoms of caffeine.
4. How much caffeine is necessary for dependence?

Go back to the “Explore the Nervous System” page. Look for the heading “Drug Effects” and find the headline that says “Cocaine”. Click on it. Answer the following questions using this page only.

1. List 4 immediate effects of cocaine.
2. What happens to the cocaine user after about an hour?
3. What do users do after this?
4. List 3 effects of withdrawal?

5. List 7 neurological and behavioral problems associated with cocaine use.

Go back to the "Explore the Nervous System" page. Look for the heading "Drug Effects" and find the headline that says "LSD". Click on it. Answer the following questions using this page only.

1. What class of drug is LSD?
2. List 7 behavioral effects of LSD.
3. What is tolerance?
4. What happens when a person becomes tolerant to a drug?

Go back to the "Explore the Nervous System" page. Look for the heading "Drug Effects" and find the headline that says "Marijuana". Click on it. Answer the following questions using this page only.

1. What class of drug is marijuana?
2. Marijuana affects areas of the brain that are involved with doing 4 things. Name them.
3. List 6 low dose effects of marijuana.
4. List 4 high dose effects of marijuana.

KidsHealth.org: Teens and Learning Disabilities
<http://kidshealth.org/en/teens/learning-disabilities.html#>

Answer the following questions regarding learning differences in young adults.

- [What Are Learning Disabilities?](#)
- [What Are the Signs of Learning Disabilities?](#)
- [What Causes Them?](#)
- [How Do You Know It's a Learning Disability?](#)
- [Coping With a Learning Disability](#) List a few strategies recommended for managing school responsibilities and learning

Name _____

Subject _____

Date _____

Adolescent Brain

Exercise: Answer the following focus questions using the online video Inside the Teenage Brain & article “Interview with Dr. Giedd.” <http://www.pbs.org/wgbh/pages/frontline/shows/teenbrain/>

1. Dr. Giedd, a neuroscientist, researches adolescent brain development at what institute?

2. According to Dr. Giedd, what is the most surprising result of recent brain studies?

3. By age _____ the brain is 95% of its adult size.

4. Complete this sentence: The grey matter, the thinking part of the brain, continues to thicken as

5. The “pruning down phase” is based on what principle?

6. What happens to the cells and connections that are not made?
Explain how this relates to the need for practice in sports, the arts, playing an instrument, or academics.

7. The part of the brain that sits behind your forehead is called the

8. What is the function of the prefrontal cortex (or frontal lobe)?

9. Choose one of these selections to complete the sentence: In the adolescent stage, the prefrontal cortex is **(fully developed, *not* fully developed)**.

10. List a few ways adolescents can gain skills in these functions to minimize negative consequences of an under-developed prefrontal cortex.

11. What does Dr. Giedd consider “cruel irony?”

Conclusion:

Summarize what the research means for student learning in areas they choose to focus their attention.

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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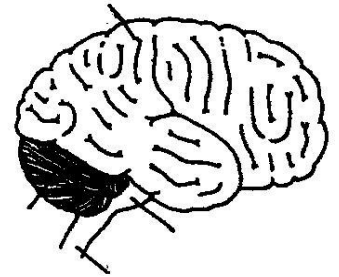


"Hold everything! — My left
brain just kicked in!"

Lab Observation: Sheep Brains

PART A: The Whole Brain

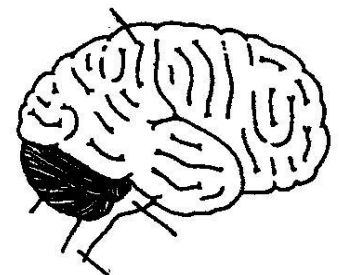
1. Complete this sentence: A sheep brain is about the size of a/an _____.
2. Pick up the preserved brain. Handle it gently – brains are expensive! A fresh brain feels much softer than this preserved one and would fall apart if you handled very much. Does this brain feel solid or hollow? _____
3. How 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.



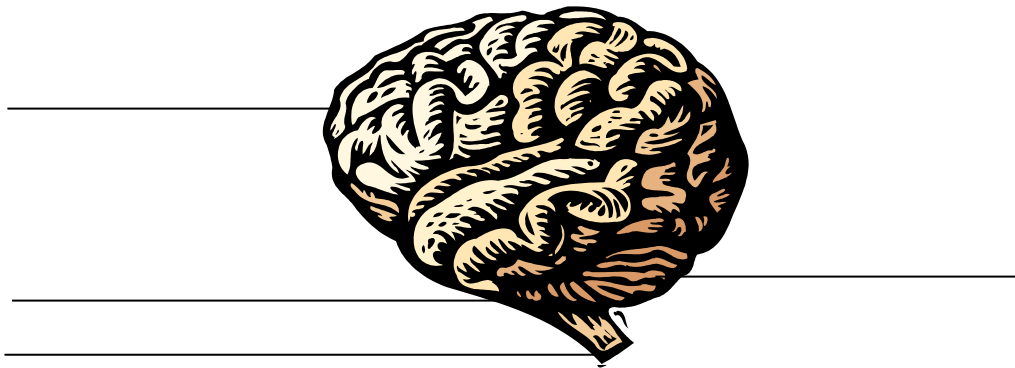
The Brain: Parts and Functions

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.

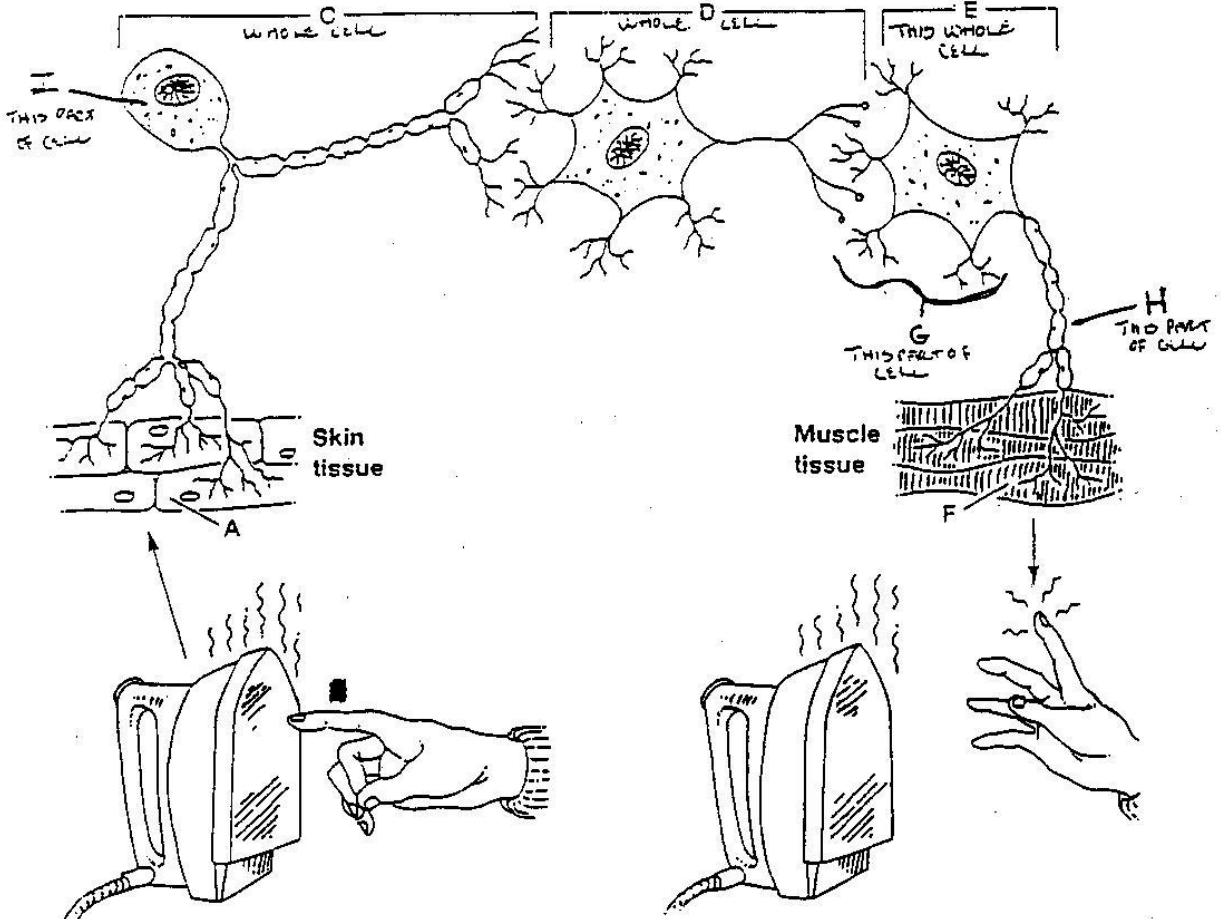
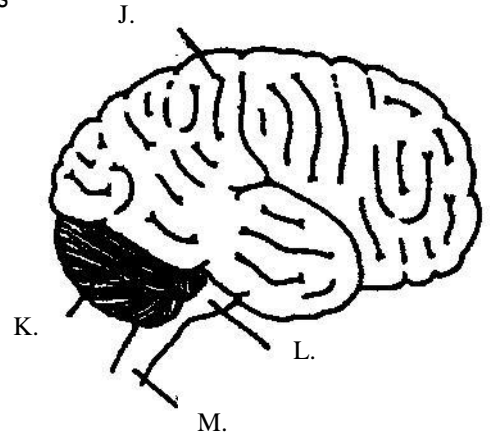
- | | |
|------------------------|-------------------|
| a. sight | i. talking |
| b. balancing | j. reflexes |
| c. muscle coordination | k. heart rate |
| d. voluntary actions | l. smelling |
| e. involuntary actions | m. moving |
| f. thinking | n. hearing |
| g. emotions | o. blood pressure |
| h.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



REVIEW

Directions: Match the term of description to its location on the two diagrams

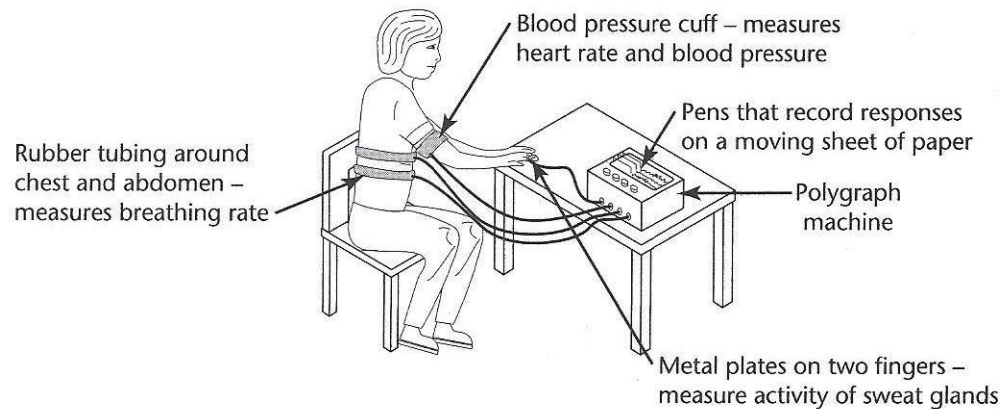
1. Effector
2. Motor neuron
3. interneuron
4. receptor
5. dendrites
6. axon
7. cell body
8. carries messages from interneurons to effectors
9. carries messages from receptors to interneurons
10. main part of a neuron (contains nucleus)
11. detects stimuli
12. decides what to do with messages from sensory neurons
13. carries impulses away from cell body
14. causes a response (muscle or gland)
15. carry impulses into neuron
16. controls thought and reason
17. controls muscle coordination and balance
18. controls reflexes
19. controls involuntary actions
20. controls emotions



POLYGRAPH TEST

A polygraph, or lie detector test, is sometimes used to help determine whether a person is telling the truth. In such a test, the subject (the person being tested) is connected to a polygraph machine that records information about his or her body. This information includes such things as heart rate, blood pressure, breathing rate, and sweat gland activity. An examiner (the person giving the test) asks the subject a series of questions. As the subject answers, the machine records changes in the subject's body. The examiner uses these changes to determine whether the subject has answered the questions truthfully.

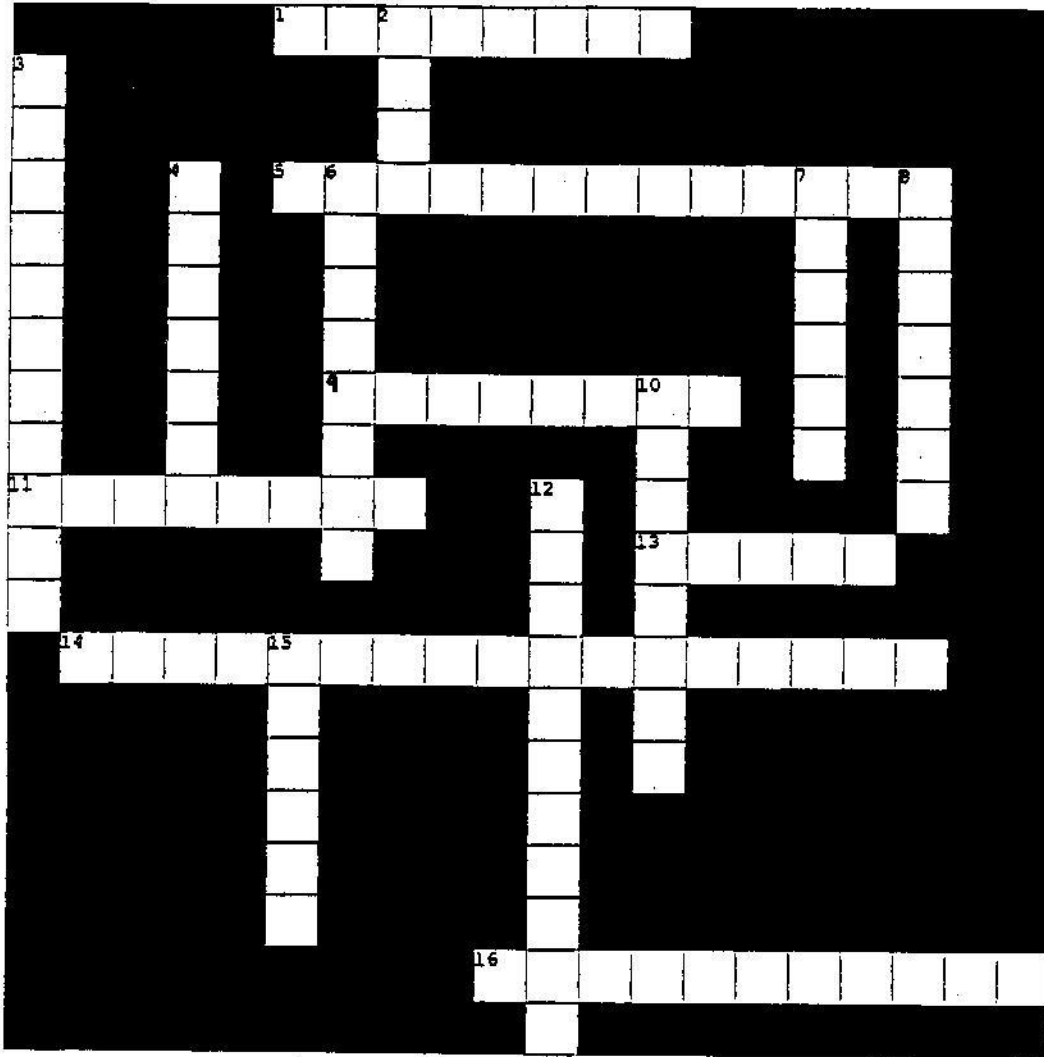
The polygraph test relies upon responses to the subject's nervous system. If the subject gives an untruthful answer, fear of being caught in a lie triggers several responses that are largely involuntary. For example, fear may cause the subject's heart rate to increase or even skip a beat, and these changes would be recorded by the polygraph. However, if there is disagreement among scientists about how reliable polygraphs are. Some studies have shown that conditions such as lack of sleep or the use of some types of drugs can affect the results of a polygraph test.



Directions: Answer the following questions.

1. Why do you think it is important that a polygraph measures responses that are largely involuntary instead of responses that are voluntary?
2. Sometimes subjects are given a “practice test” that will record their body's response telling a lie. In this test, the examiner tells the subject to think of a number between one and ten and to answer “no” to all questions. Then, the examiner asks “Is the number one?”, “Is the number two?”, and so on, until the examiner has asked the question for all the numbers one to ten. Why is this a good practice test?
3. Name a voluntary response and an involuntary response of the nervous system during a polygraph test.

NEURONS



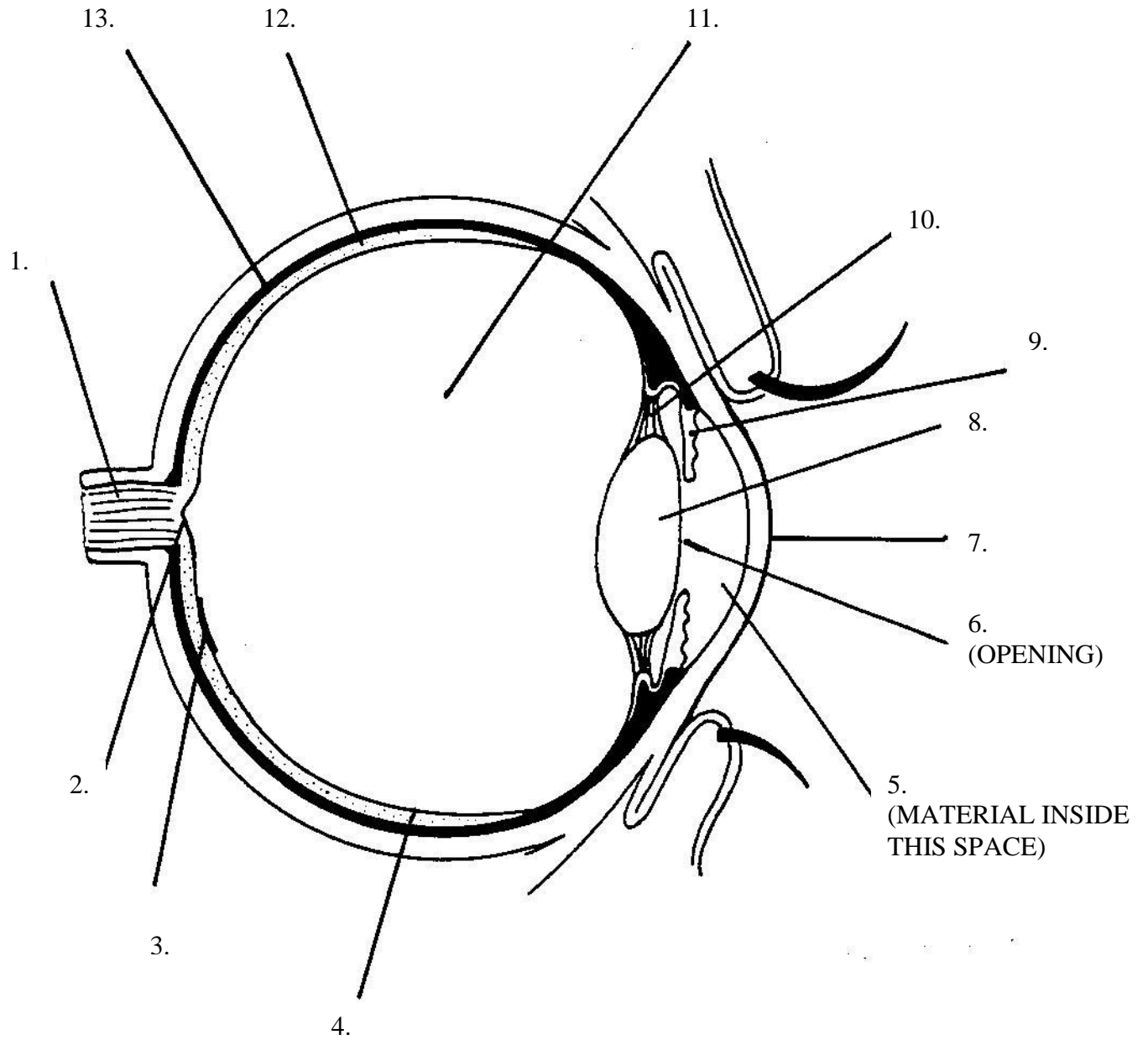
ACROSS

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:

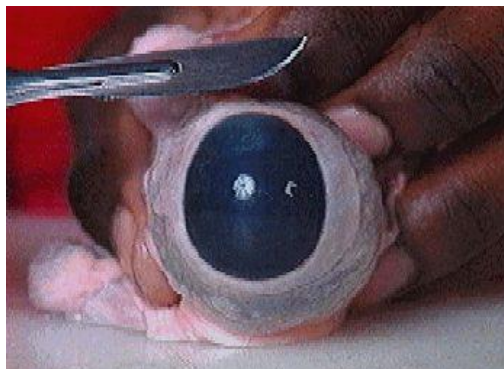
4. You will dissect a preserved cow eye.
5. You will identify the most important parts of the eye.
6. You will describe the function of these eye parts.

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.

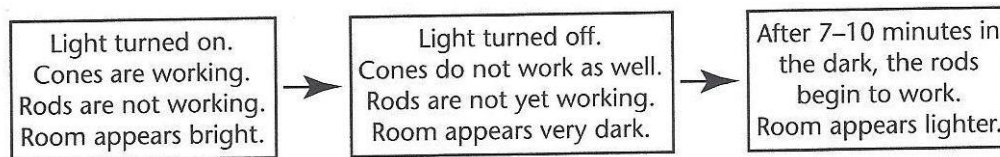


COLOR VISION, COLORBLINDNESS

Receptor cells called cones enable you to see color. The human eye has three different types of cones. People who are colorblind are missing at least one type of cone cell. Most people who are colorblind can see colors. They just can't see as many colors as a person with all three types of cones. In addition, some colors may appear different to a person who is colorblind than to a person who has all three types of cones.

Because there are three types of cones, there are also three types of colorblindness. For example, people who do not have red cones cannot see red light. As a result, they cannot distinguish between the colors red and green. Those who do not have blue cones cannot see blue light; they cannot distinguish between the colors blue and yellow. People who lack green cones cannot see green light.

Everyone is colorblind during some part of their life. For example, you were born colorblind. Cones cells don't start working until a person is about 4 months old. You also become colorblind in dim light. You may have noticed that when you first turn off your bedroom light at night, you can't see anything at all. Then after a few minutes, the room seems to get lighter. The flowchart below shows why this happens.



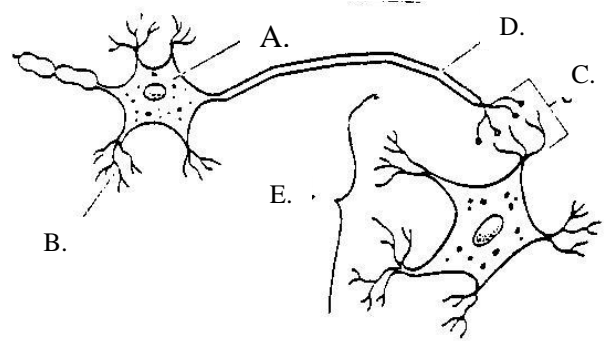
Directions: Answer the following questions.

1. Why does a darkened room appear to get lighter after a few minutes?
2. One way scientists have learned about colorblindness is by studying people who are colorblind in one eye, but have full color vision in the other eye. Such people are able to describe how colors appear to a person who has colorblindness in both eyes. How do you think they are able to do this?
3. What problem might a person who lacked red cones have at a traffic light? What is a possible solution to this problem?
4. The taillights of some cars and motorcycles appear very dark brown to some people with colorblindness. Why could this be dangerous?
5. Suppose a person's eyes have no cones at all. How would this affect his or her color vision?

MATCHING: Neurons, Brain, Eye and Ear

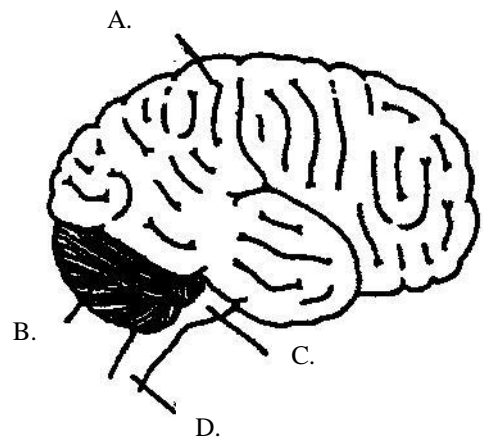
Neuron:

1. axon end
2. end that gives off a neurotransmitter
3. neuron
4. sends impulses into cell body
5. synapse
6. end that receives a neurotransmitter
7. cell body
8. carries impulses away from cell body
9. part that contains the nucleus
10. dendrite end



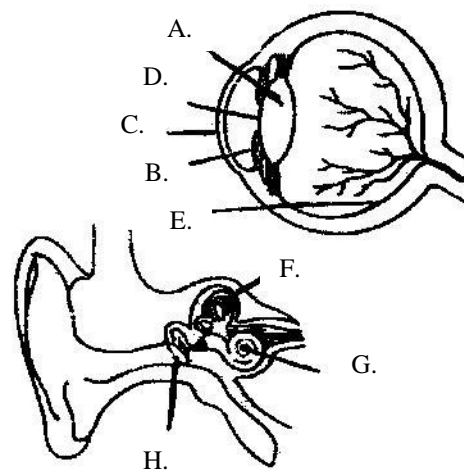
Brain:

11. controls thought and reason
12. spinal cord
13. involved in reflexes
14. cerebrum
15. controls breathing and heartbeat
16. stores memory
17. carries messages to the brain
18. cerebellum
19. controls blood pressure
20. memory storage
21. involved in reflexes
22. protected by vertebrae
23. controls involuntary actions
24. medulla
25. controls muscle coordination and balance
26. interprets messages from sense organs



Eye & Ear:

27. part of the eye that detects light energy and converts it into nerve impulses
28. cochlea
29. vibrates when sound hits it
30. lens
31. regulates the amount of light coming into the eye
32. cornea
33. organ that translates vibrations into nerve impulses
34. clear outer coating at the eye opening
35. pupil
36. semicircular canals
37. hole leading into the interior of the eye
38. iris
39. responsible for balance
40. focuses light
41. retina
42. eardrum



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?