Name: _____ Period: _____

Mammalian Brains

Problem: What relationship is there between the brain structure of a mammal and the mammal's lifestyle?

Background: The brain coordinates all activities of the nervous system. The brains of vertebrates have three basic parts: the *cerebrum*, the *cerebellum*, and the *brain stem*. The cerebrum governs the processes of memory, thought, and judgment, and initiates complex behavioral responses. It includes centers for processing sensory information, including optical (vision-related) and olfactory (smell-related) information. The brains of mammals have separate optic and olfactory lobes, which are highly developed in some species, to carry out these functions. The cerebellum receives impulses from the cerebrum and receptors in the body and produces coordinated muscle movement and balance. The brain stem is connected directly to the spinal cord. The part of the brain stem directly above the spinal called, called the *medulla*, controls vital functions such as heart rate, blood pressure, and breathing. In this lab you will observe and compare the brain structures of some mammals and other vertebrates.

Procedure:

1. Look carefully at the illustrations that show the brains of human, sheep, rabbit, bird, reptile, and fish. (Optional: If your teacher wishes you to do so, examine various preserved vertebrate brains and dissect them to observe their structure and parts. **CAUTION:** *If you do dissections, be very careful using sharp instruments. Avoid breathing fumes. Wash your hands when you have completed the dissections.*)
2. Compare the various brains. (Note: The diagrams are not drawn to scale.) Compare the size of the cerebrum to the size of cerebellum. Compare the sizes of the optic and olfactory lobes and regions to the size of the whole brain. Record your observations in Data Table 1.

Observations:

Data Table 1: Comparison of brains

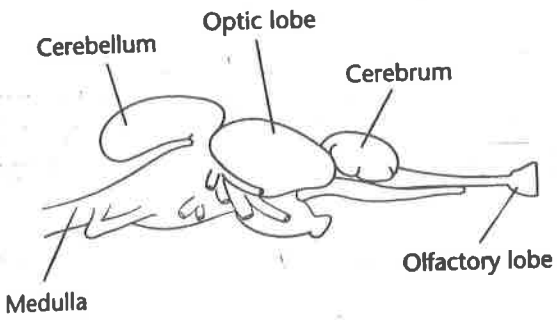
Relative Size	Fish	Bird	Reptile	Rabbit	Sheep	Human
Cerebrum to cerebellum						
Cerebellum to whole brain size						
Optic lobe to whole brain						
Olfactory lobe to whole brain						

Analyses and Conclusions

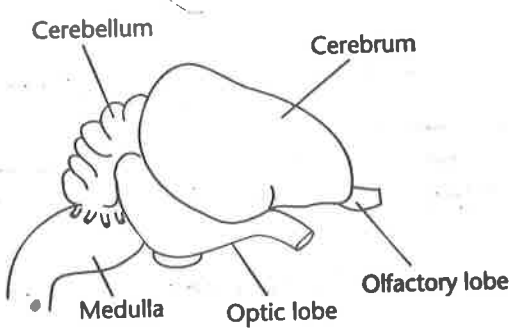
1. The drawings provided in this lab do not show the actual sizes of the brains for comparison. Do you think that showing the actual brain is important for understanding the anatomical and functional relationships among these organisms? Explain why or why not.
2. Of all organisms, humans have the most highly developed reasoning power. Infer the aspect of human brain structure that supports this fact.
3. Which of the organisms do you think has the poorest sense of smell? Infer what other abilities enable this organism to survive.
4. The ability to fly requires quick reflexes and excellent coordination. Which feature of a bird brain can you inter makes this special ability possible?
5. On the basis of brain structure, which vertebrate- bird, reptile, or fish- can you infer is likely to have the most highly developed sense of sight? Explain your answer.
6. Which vertebrate- rabbit, bird, reptile, or fish- can you infer is likely to have the most highly developed sense of smell? Explain your answer.

Going Further → Develop a hypothesis: Based on the results of this lab, develop a hypothesis about whether or not other internal body structures of vertebrates would show the differences related to the lifestyles of the animals.

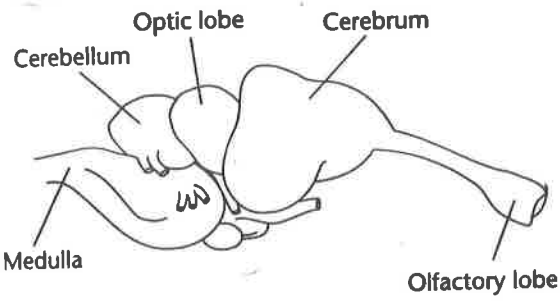
Fish



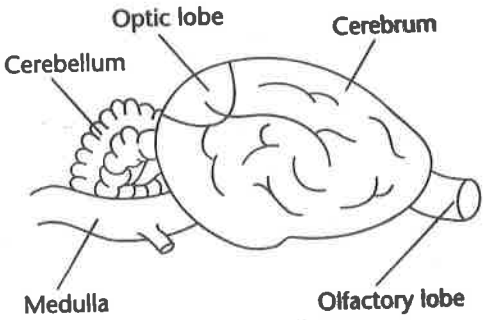
Bird



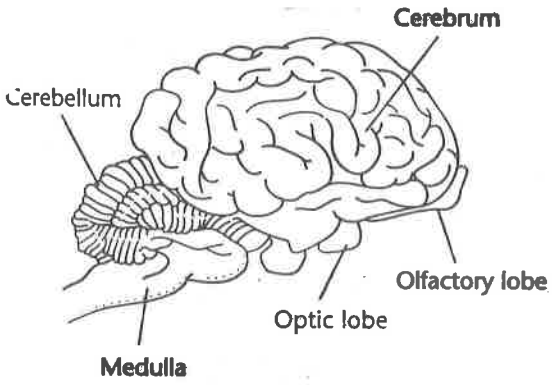
Reptile



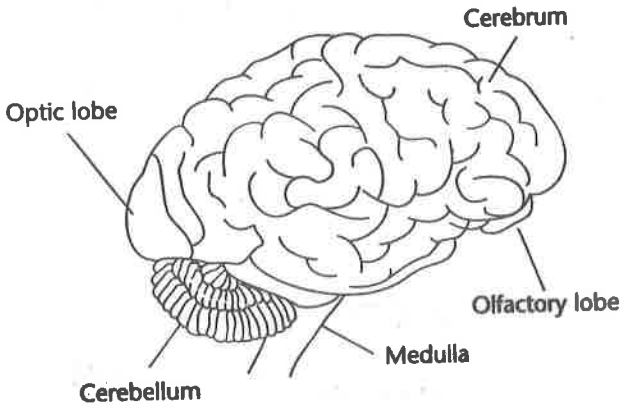
Rabbit



Sheep



Human



Name

ENDOCRINE SYSTEM DISORDERS

A STUDY OF HOMEOSTASIS

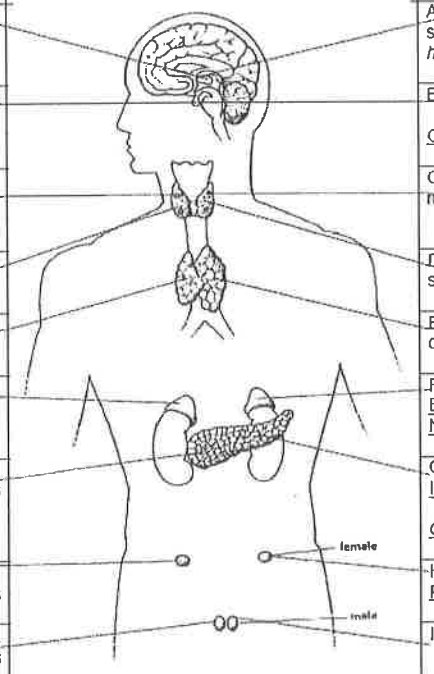
INTRODUCTION

The endocrine system consists of a group of glands and organs that regulate and control various body functions by producing and secreting hormones. The glands of the endocrine system do not have ducts but rather release their hormones directly into the bloodstream. The endocrine system is the slow message system of the body. The major glands of the endocrine system, each of which produces one or more specific hormones, are the hypothalamus, the pituitary gland, the thyroid gland, the parathyroid glands, the islets of the pancreas, the adrenal glands, the testes in men, and the ovaries in women. During pregnancy, the placenta also acts as an endocrine gland in addition to its other functions.

Hormones are chemical substances that affect the activity of another part of the body (called target tissue). In essence, hormones serve as messengers, controlling and coordinating activities throughout the body. Upon reaching a target tissue, hormones bind to receptors, much like a key fits into a lock. Once the hormone locks into its receptor, it transmits a message that causes the target site to take a specific action. Hormone receptors may be within the nucleus or on the surface of the cell.

Ultimately, hormones control the function of entire organs, affecting such diverse processes as growth and development, reproduction, and sexual characteristics. Hormones also influence the way the body uses and stores energy and control the volume of fluid and the levels of salts and sugar (glucose) in the blood. Very small amounts of hormones can trigger very large responses in the body. Most hormones are proteins. Others are steroids, which are fatty substances derived from cholesterol.

Although hormones circulate throughout the body, each type of hormone influences only certain organs and tissues. Some hormones affect only one or two organs, whereas others have influence throughout the body. For example, thyroid-stimulating hormone (TSH) produced in the pituitary gland, affects only the thyroid gland. In contrast, thyroid hormone produced in the thyroid gland, affects cells throughout the body and is involved in such important functions as regulating growth of cells, controlling the heart rate, and affecting the speed at which calories are burned. Insulin, secreted by islet cells of the pancreas, affects the metabolism of glucose, protein, and fat throughout the body.

Endocrine System Gland/Structure	Endocrine System	Hormone and Function
A. Hypothalamus		A. Connects endocrine and nervous systems *homeostasis*
B. Pituitary Gland		B. Master gland – controls other glands Growth Hormone – stimulates growth
C. Parathyroid		C. Parathyroid Hormone – controls calcium metabolism
D. Thyroid		D. Thyroxine - Control metabolism and stimulate growth
E. Thymus		E. Thymosin – Immune system development
F. Adrenal Gland		F. Stress Epinephrine – cope with stress Norepinephrine – increase heart rate
G. Pancreas		G. Sugar metabolism Insulin – lower blood sugar Glucagon – increase blood sugar
H. Ovaries		H. Estrogen – female sex hormones Progesterone
I. Testes		I. Testosterone – male sex hormone

PROCEDURE

Determine the endocrine abnormality presented. Each of the people described has a disorder of the endocrine system. It is your task to read over the symptoms and identify the following:

A. Name of the disorder
B. The hormone that is malfunctioning
C. The gland that produces the identified hormone
D. If there is a hyper or hypo secretion of the identified hormone

Gland	Hormone	Effects of Over Secretion (Hypersecretion)	Effects of Under Secretion (Hyposecretion)
Anterior Pituitary	Growth Hormone	*Giantism (in childhood).* The individual grows tall but is normally proportioned. Mental development is not affected. *Acromegaly (in adults).* The individual has abnormally large hands and feet and enlarged facial structures. Mental processes are not affected.	*Dwarfism.* This affects individuals in childhood. They are small but normally proportioned. Adult sexual development often does not occur.
Adrenal Cortex	Aldosterone, Cortisol	*Cushing's Disease.* The individual has excess fat deposits in the upper body, a puffy face, excess growth or facial hair, and a high blood glucose level. A decreased immunity to disease also occurs.	*Addison's Disease.* The individual cannot maintain a normal blood glucose level. They become sluggish, weak, lose weight and develop increased skin pigmentation. Their tolerance to stress is reduced. Without medication, the disease causes death.
Thyroid	Thyroxine	*Hyperthyroidism.* The individual is nervous, irritable, loses weight and cannot sleep. Often, their eyes protrude. Hyperthyroidism is often accompanied by a goiter, or enlarged thyroid.	*Cretinism (in infancy).* The individual is a *dwarf* whose body parts are out of proportion. Mental retardation occurs. *Hypothyroidism (in adults).* The individual is sluggish and gains weight.
Parathyroid	Parathyroid Hormone	*Hyperparathyroidism.* Individual has bone pain, bones can become brittle (osteoporosis), other symptoms are the development of gastric ulcers and pancreatitis and development of kidney stones.	*Hypoparathyroidism (very rare).* Symptoms can range from mild tingling in the hands and fingers to severe forms of muscle cramps and convulsions.
Pancreas (Beta Cells)	Insulin	*Diabetic shock.* The blood glucose level falls dangerously, and convulsions, unconsciousness and death may occur if untreated.	*Diabetes.* The individual has an abnormally high blood glucose level, becomes dehydrated, loses weight and cannot resist infection. If untreated, can cause death. *Type I* - Juvenile onset prior to age 15 *Type II* - Adult onset after age 40.
Pancreas (Alpha Cells)	Glucagon	Abnormally high blood glucose level. Results are similar to diabetes.	Abnormally low blood glucose levels. Also known as *hypoglycemia.*

DATA TABLE:

1. A 40 year old male with twitching muscles, spasms and convulsions.	7. A 36 year old male who is 8 feet tall with large hands, feet & jaw and had normal growth as a child.
A.	A.
B.	B.
C.	C.
D.	D.
2. A 20 year old female who is 4 feet tall with all body parts in proportion.	8. A female living in a developing nation with no access to medical care with a large neck growth.
A.	A.
B.	B.
C.	C.
D.	D.
3. A thin male with bulging eyes, who is having trouble sleeping.	9. A child with decreased mental capacity, stunted growth and body parts out of proportion.
A.	A.
B.	B.
C.	C.
D.	D.
4. A 45 year old woman with brittle bones that fracture easily.	10. A male who is 8 feet tall with all body parts in proportion.
A.	A.
B.	B.
C.	C.
D.	D.
5. A 40 year old female who is thin with flushed skin, rapid pulse, increased body temperature, sweating and increased skin pigmentation.	11. A 10 year old male who can't gain weight, has difficulty fighting infections and has a fasting blood glucose level of 260 (normal is 85-90).
A.	A.
B.	B.
C.	C.
D.	D.
6. An 18 year old female with a puffy face, low blood glucose and a recently developed dark facial hair.	12. A 45 year old female with a history of dieting continues to gain weight, complains of feeling cold and is often tired.
A.	A.
B.	B.
C.	C.
D.	D.

ANALYSIS QUESTIONS

1. What is the function of the endocrine system?
2. Hormones and receptors are often described to be like a "lock and key". What does this mean? How does it apply to the endocrine system?
3. Name two other examples that are often described as being like a "lock and key" in biological systems. How are they similar to the endocrine system? How are the different?
4. Although hormones circulate throughout the whole body, why is it that each type of hormone only influences certain organs?
5. In human embryonic development, the default pathway of development is the female pathway meaning that all embryos will develop into females unless different signals are received to develop into a male. These signals are called defeminization and masculinization and rely on the presence of testosterone. In order for these processes to occur, the target organs of the developing reproductive system must have hormone receptors that can receive testosterone. What would happen if the developing embryo had a mutation in the gene that coded for testosterone receptor protein? Justify your answer.

Cell Receptor Laboratory

Name _____ Date _____ Per. _____

Cell receptors are imbedded in the cell membrane and will attach to specific chemicals. Once this specific chemical fits into the receptor, it will release a message to the cell's nucleus and instruct it to do something. Cell receptors are very specific, like antibodies. As a matter of fact, some receptors are antibodies that imbed themselves into the cell membrane.

Many chemicals will bind to the cell receptors. The male hormone **testosterone** will bind to cell receptors on muscle cells and tell them to increase growth, but will not fit into cell receptors for nerve cells. The female **hormone prolactin** will fit into breast cells and trigger milk production. Mast Cells contain sacks of **histamine**. Sometimes substances like pollen or bee venom will fit into the receptors and the histamine will be released. This is an **allergic** response. If you can get **antibodies** from your blood stream to bind to these **allergens** first, before they reach the mast cells, you can avoid the allergic reaction.

T-Lymphocytes (Immune Cells), have receptors called **CD4**. Immune chemical messengers called **Interleukins** will bond here and tell the cell what to do. H.I.V. will also bind at CD4 and shut down the cell. When CD4 T-Lymphocytes have a count lower than 200 per uL, the patient develops AIDS.

Some **steroids** are artificial hormones. Often they have many negative side affects since they trigger off growth in cells. People taking steroids for muscle growth may induce the cells to grow uncontrollably, this is cancer. Fertility drugs are hormones (**FSH**) that initiate a woman's ovary to generate more eggs. Unfortunately, it may elicit ovarian cancer. Women that have ovarian cancer in their family are usually advised not to use fertility drugs.

Purpose: To understand how cell receptors work..

Materials: Scissors and glue sticks.

Procedures:

1) On the next two pages are different cells with receptors.
2) Cut out the different chemical messages on the following page and glue them into the appropriate site.
3) Under each cell, fill in the name of the cell and what will happen to it.

Analysis Questions: Write out each question and answer in full sentences.

1) List all the messengers that could not be used and explain why they were not used.

2) What cell could have received more than one of the messengers? How do you know?

3) What is an interleukin?

4) If a woman adopts a newborn baby, how could her doctor initiate her body to produce milk so she could breastfeed?

5) What is histamine?

6) How could steroids and fertility drugs trigger cancer?

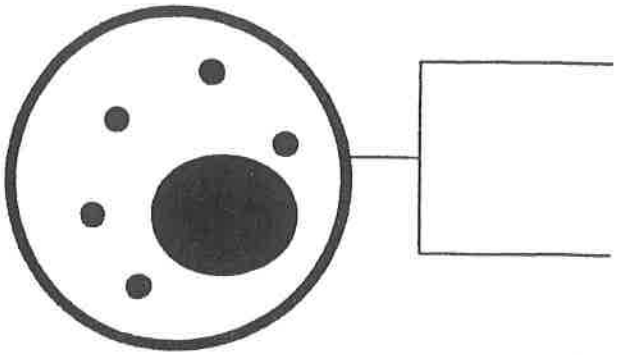
Below is a chart showing different pollen levels on different summer days and the histamine levels of a particular patient.

	Tree pollen	Grass pollen	Ragweed pollen	Patient's histamine level
6/30	high	low	none	0.3 ng/mL
7/4	high	moderate	none	0.5 ng/mL
7/19	moderate	high	none	0.3 ng/mL
8/15	low	moderate	low	1.2 ng/mL
8/30	none	low	high	2.5 ng/mL

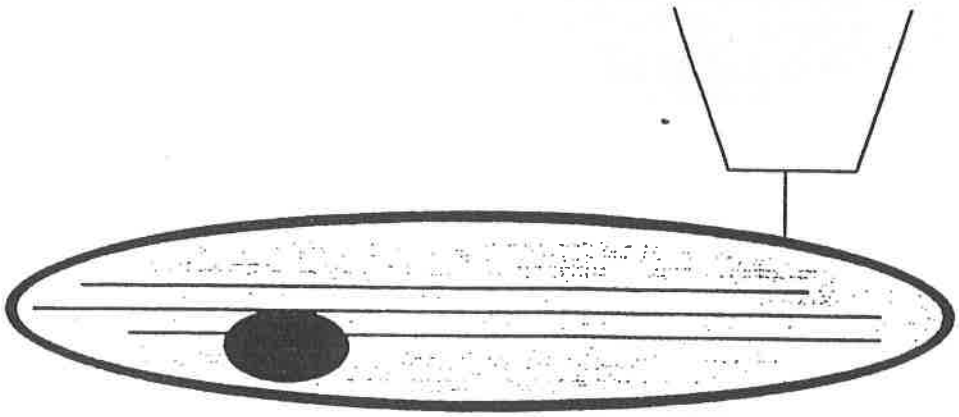
7) Which type of pollen is this patient most allergic to? How do you know?

8) If most people had the same allergy as the patient above and you were an unscrupulous pharmacist, when would you raise the price of anti-histamine medications?

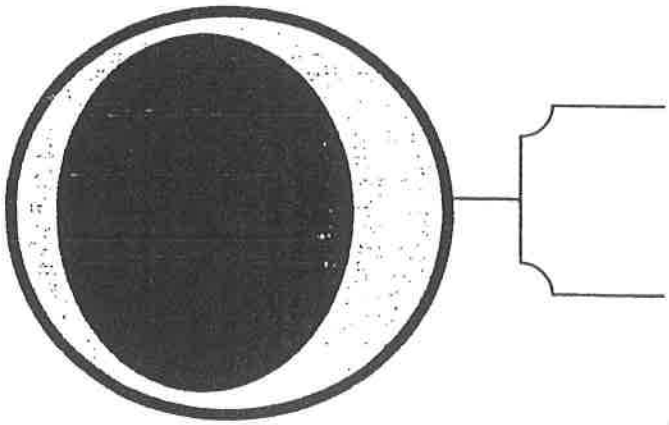
Cells and membrane receptors



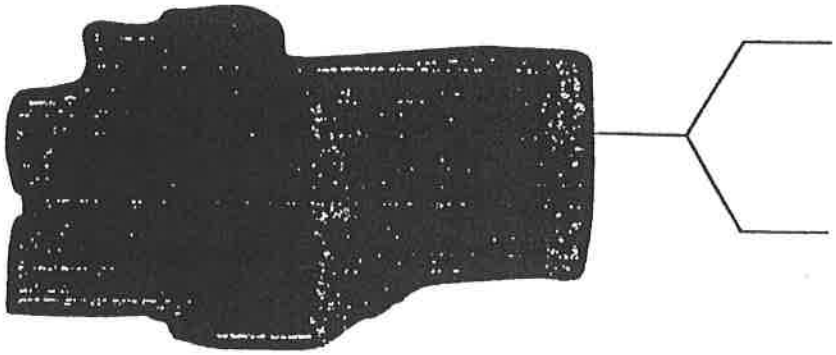
Cell Name_____
Action_____



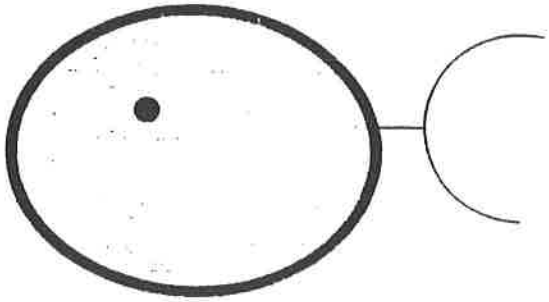
Cell Name_____
Action _____



Cell Name _____
Action _____

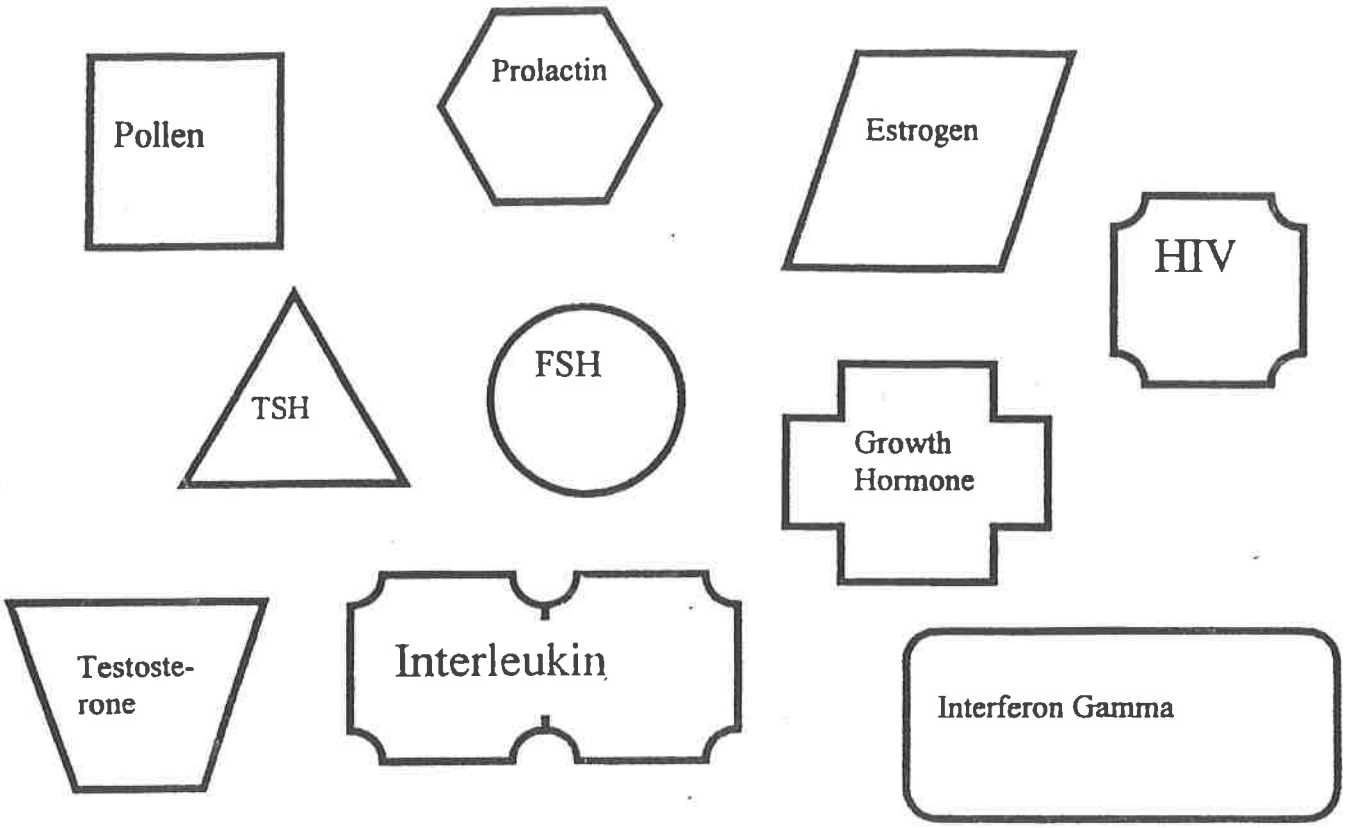


Cell Name _____
Action _____

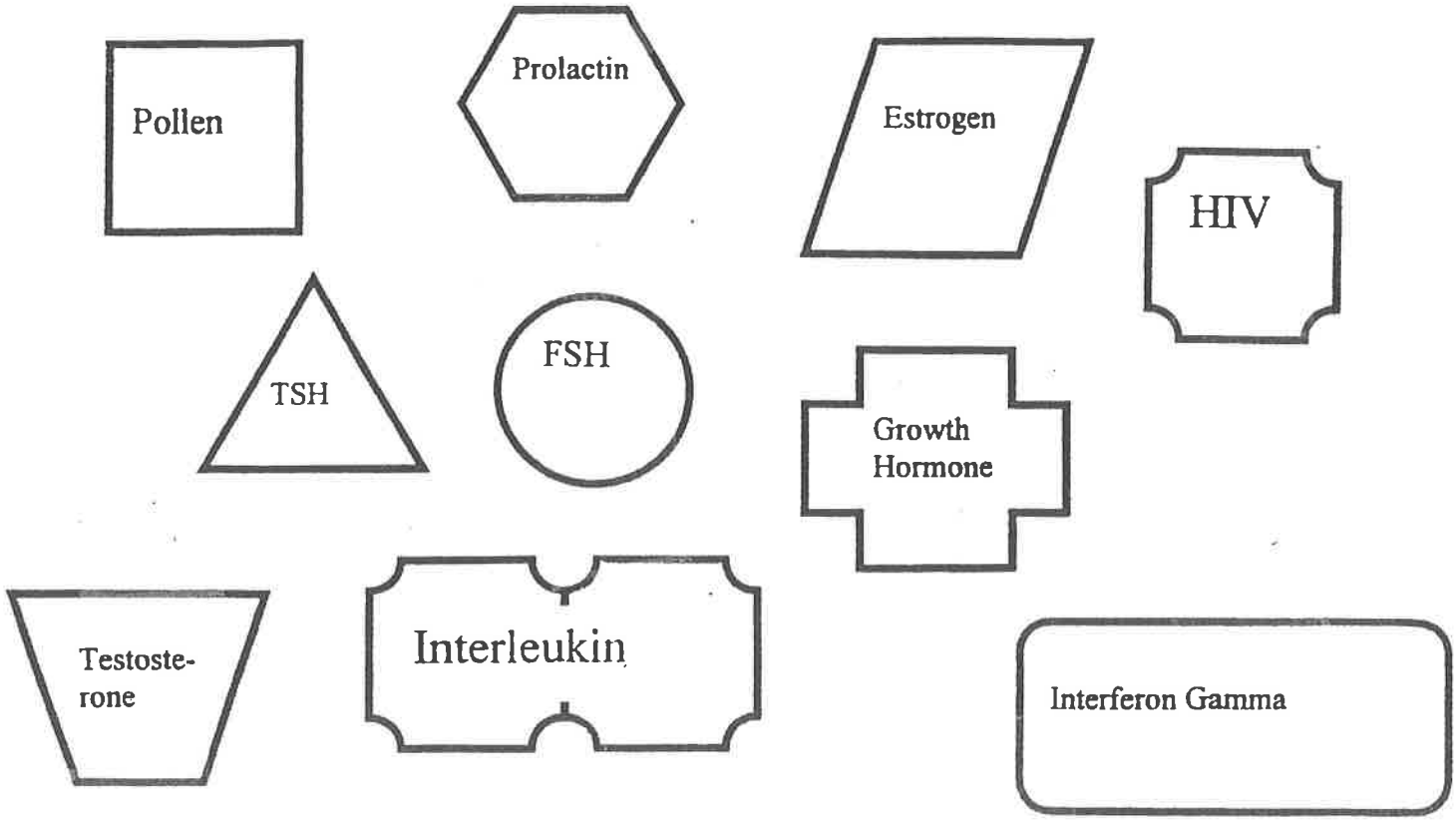


Cell Name _____
Activity_____

Hormones & other messengers



Hormones & other messengers



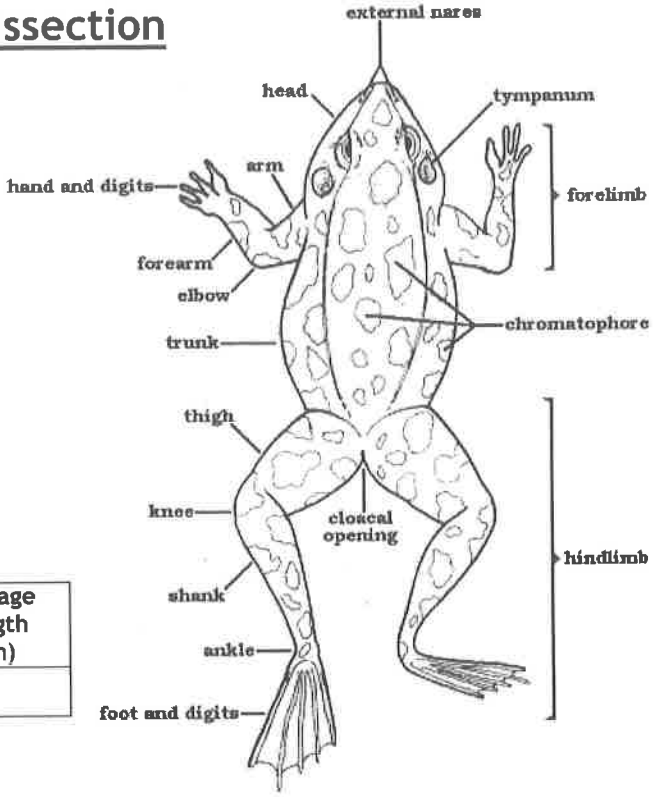
Frog Dissection

Frog External Anatomy

1. Observe the dorsal and ventral sides of the frog.
   Dorsal side color _____
   Ventral side color_____

2. Examine the hind legs. How many toes are present on each foot? _____ Are the toes webbed?_____
3. Examine the forelegs. How many toes are present? _____Are the toes webbed? _____
4. Use a ruler to measure your frog, measure from the tip ofthe head to the end of the frog's backbone (do not include thelegs in your measurement). Compare the length of your frog to other frogs and complete this chart in your notebeook.

My frog	Frog 2	Frog 3	Frog 4	Average Length (cm)



5. Locate the frog's eyes, the nictitating membrane is a clear membrane that attached to the bottom of the eye. Use tweezers to carefully remove the nictitating membrane. You may also remove the eyeball. What color is the nictitating membrane? _____What color is the eyeball? _____
6. Just behind the eyes on the frog's head is a circular structure called the tympanic membrane. The tympanic membrane is used for hearing. Measure the diameter (distance across the circle) of the tympanic membrane. Diameter of tympanic membrane _____cm
7. Feel the frog's skin. Is it scaley or is it slimey?

Anatomy of the Frog's Mouth

Procedure: Pry the frog's mouth open and use scissors to cut the angles of the frog's jaws open. Cut deeply enough so that the frog's mouth opens wide enough to view the structures inside.

1. Locate the tongue. Does it attach to the front or the back of the mouth? _____
2. In the center of the mouth, toward the back is a single round opening. This is the esophagus. This tube leads to the stomach. Use a probe to poke into the esophagus.
3. Close to the angles of the jaw are two openings, one on each side. These are the Eustachian tubes. They are used to equalize pressure in the inner ear while the frog is swimming. Insert a probe into the Eustachian tube. To what structure does the Eustachian tube attach? _____
4. Just behind the tongue, and before you reach the esophagus is a slit like opening. (You may need to use your probe to get it to open up). This slit is the glottis, and it is the opening to the lungs. The frog breathes and vocalizes with the glottis.
5. The frog has two sets of teeth. The vomarine teeth are found on the roof of the mouth. The maxillary teeth are found around the edge of the mouth. Both are used for holding prey, frogs swallow their meals whole and do NOT chew.
6. On the roof of the mouth, you will find two tiny openings, if you put your probe into those openings, you will find they exit on the outside of the frog. These are the nostrils. Draw the frogs mouth. Label each of the structures underlined above.

Frog Internal Anatomy Dissection Instructions

1. Place the frog in the dissecting pan ventral side up.
2. Use scissors to life the abdominal muscles away from the body cavity.
   Cut along the midline of the body from the pelvic to the pectoral girdle.
3. Make transverse (horizontal) cuts near the arms and legs.
4. Life the flaps of the body wall and pin back.
   *If your specimen is a female, the body may be filled with eggs and an enlarged ovary. You may need to remove these eggs to view the organs.

Locate each of the organs below:

Fat Bodies --Spaghetti shaped structures that have a bright orange or yellow color, if you have a particularly fat frog, these fat bodies may need to be removed to see the other structures. Usually they are located just on the inside of the abdominal wall.

Peritoneum A spider web like membrane that covers many of the organs, you may have to carefully pick it off to get a clear view

Liver--The largest structure of the the body cavity. This brown colored organ is composed of three parts, or lobes. The **right lobe**, the **left anterior lobe**, and the **left posterior lobe**. The liver is not primarily an organ of digestion, it does secrete a digestive juice called bile. Bile is needed for the proper digestion of fats.

Heart - at the top of the liver, the heart is a triangular structure. The **left and right atrium** can be found at the top of the heart. A single **ventricle** located at the bottom of the heart. The large vessel extending out from the heart is the **conus arteriosis**.

Lungs - Locate the lungs by looking underneath and behind the heart and liver. They are two spongy organs.

Gall bladder--Lift the lobes of the liver, there will be a small green sac under the liver. This is the gall bladder, which stores bile. (hint: it kind of looks like a booger)

Stomach--Curving from underneath the liver is the stomach. The stomach is the first major site of chemical digestion. Frogs swallow their meals whole. Follow the stomach to where it turns into the small intestine. The **pyloric sphincter valve** regulates the exit of digested food from the stomach to the small intestine.

Small Intestine--Leading from the stomach. The first straight portion of the small intestine is called the **duodenum**, the curled portion is the **ileum**. The ileum is held together by a membrane called the **mesentery**. Note the blood vessels running through the mesentery, they will carry absorbed nutrients away from the intestine. Absorption of digested nutrients occurs in the small intestine.

Large Intestine--As you follow the small intestine down, it will widen into the large intestine. The large intestine is also known as the **cloaca** in the frog. The cloaca is the last stop before wastes, sperm, or urine exit the frog's body. (The word "cloaca" means sewer)

Spleen--Return to the folds of the mesentery, this dark red spherical object serves as a holding area for blood.

Esophagus--Return to the stomach and follow it upward, where it gets smaller is the beginning of the esophagus. The esophagus is the tube that leads from the frogs mouth to the stomach. Open the frogs mouth and find the esophagus, poke your probe into it and see where it leads.

STOP! If you have not located each of the organs above, do not continue on to thenext sections!

Removal of the Stomach: Cut the stomach out of the frog and open it up. You may find whatremains of the frog's last meal in there. Look at the texture of the stomach on the inside. What did you find in the stomach? Measuring the Small intestine: Remove the small intestine from the body cavity and carefully separate **the mesentery** from it. Stretch the small intestine out and measure it. Now measure your frog. Record the measurements below in centimeters.

Frog length: _____ cm Intestine length _____ cm
Urogenital System - The frog's reproductive and excretory system is combined into one system called the urogenital system. You will need to know the structures for both the male and female frog

Kidneys - flattened bean shaped organs located at the lower back of the frog, near the spine. They are often a dark color. The kidneys filter wastes from the blood.

Testes - in male frogs, these organs are located at the top of the kidneys, they are pale colored and roundish.

Oviducts - females do not have testes, though you may see a curly-q type structure around the outside of the kidney, these are the oviducts. Oviducts are where **eggs** are produced. Males can have structures that look similar, but serve no actual purpose. In males, they are called vestigial oviducts.

Bladder - An empty sac located at the lowest part of the body cavity. The bladder stores urine.

Cloaca - mentioned again as part of the urogenital system - urine, sperm and eggs exit here.

Analysis:

1) Why do the think the placement of the eyes are beneficial to the survival of the frog?
2) The frog has different colors on the bottom (ventral side) and top (dorsal side). How do you think this helps the frog survive in its environment?
3) Why do you think it may not be important for the frog to have well-developed and large lungs?
4) Do you feel you have a better understanding of the human body now that you have experience the texture and structure of the frog's organs? Explain.

Name_____
Frog Dissection Alternate Assignment

Visit the website: www.mhhe.com/biosci/genbio/virtual_labs/BL_16/BL_16.html

Or type: "Virtual Fog Dissection" into google and the secong link will bring you to the same website. Use the website as a guide to answer the following questions. TURN ON SOUND!

Click on Introduction

1) Click on "Why Dissect". How do you think the anatomy of a frog and a human are similar?

2) Click on "Natural History".

   Describe the frog's skin:

   What does "dorsal" mean?

   Frogs and humans are both members of what phylum? What subphylum?

   What does "amphibia" mean? Why do frogs have this name?

   What is the scientific name of the Leopard frogs?

Go back to the main menu and click on: External Anatomy

1) How does the frog's coloration help it survive?

2) What do the following terms mean? Dorsal, Ventral, Anterior, Posterior, Head, Torso

3) Why is skin important for the health of the frog? Why must it be moist?

4) What are tympanic membranes?

5) What is the cloaca?

6) Describe the difference between forelimbs and hindlimbs.

Click on Internal Anatomy and perform the virtual dissection

What is the largest organ of the digestive system?

What is the long twisted tube?

How do frogs exchange gases?

What are fat bodies used for?

The frog skeleton is made up of two regions. Describe them.

1. Describe the procedure you would use to cut the frog to expose the organs to view. You may include drawings to explain the technique.

2. Describe the inside of the frog's mouth. What structures are visible and what are their functions? You may also include drawings.

3. Describe what you first see when you open the body cavity of the frog. What organs are obvious? Which organs may require a more thorough inspection?

4. Compare a male to a female frog. How can you tell the difference?

Part 2 – Research the controversy surrounding frog dissections. Below, summarize your findings. Include an introduction, 1 paragraph presenting two arguments for dissections, one paragraph presenting two arguments against dissections, and 1 paragraph stating your opinion.(or type this)