**Fetal Pig Dissection**

**Introduction:**

Today, we begin a new chapter in our study of biology. In the first half of the year we looked at how the smallest units of life work, reproduce and pass on their genes. During the next several months we are going to look at how larger organisms meet the characteristics of life. The biggest emphasis will be on making the connections between structure and function within these organisms.

To begin our study of the connections between structure and function we are going to examine the anatomy of a fetal pig. The pigs we will dissect in this class were never born. Their mother passed away and their bodies were prepared so that we might learn. This gives all of us a tremendous responsibility. Because these pigs gave their lives for our learning we must be compelled by their sacrifice to learn as much as we can out of respect. Should you choose to disrespect your pig in any way, your transgression will be met with serious consequences, including dismissal from class for the day, failure on class grades, or failure on quizzes and tests.

That being said, I honestly expect nothing but wonderful behavior from everyone. All of you have demonstrated so much maturity during this year that I think this will be one of the highlights of our class.

**Structure:**

This unit is entirely hands-on. You will work in pairs to dissect and learn from your pig. You are responsible for your pig and its’ well-being at all times. The grade for this unit will be broken down into three basic parts.

1) **Homework grade:** you will receive a homework packet, which will be collected at the end of the unit. This packet will be graded for accuracy and effort. I would try and spend a half-hour on it every night.

2) **Practical grade:** there will be a practical quiz and a practical test during this unit. These assessments will have you identify structures (and some functions) of the pig anatomy from several of our pigs. Your preparation for these will consist of following through the dissection manual exactly and locating every structure.

You will all have tons of questions during the next few weeks. But, keep in mind that I am one person and I cannot answer everyone’s questions at once. Just be patient with me and polite to each other and I will be able to work with each group. Also, if your group can help others with their questions I encourage you to do so. Thanks so much, this is really going to be great!

-Mr. Elenbaas
**Organs and Parts you need to know on The Pig**

When learning these structures, it is helpful for you to learn them in a way that makes sense, i.e. in the way they are connected by function. For example, the urinary system: the **kidney** is connected to the **ureter**, which is connected to the **urinary bladder**, which is connected to the **urethra**.

Below is a list of organs, which I tried to put into general sections based on function.

<table>
<thead>
<tr>
<th>Digits</th>
<th>Diaphragm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Umbilical cord</td>
<td>Lungs</td>
</tr>
<tr>
<td>Anal opening</td>
<td>Trachea</td>
</tr>
<tr>
<td>Urogenital opening</td>
<td>Larynx</td>
</tr>
<tr>
<td>Mammary gland</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Subclavian veins</td>
</tr>
<tr>
<td>Tongue</td>
<td>Anterior vena cava (precava)</td>
</tr>
<tr>
<td>Teeth</td>
<td>Brachiocephalic veins</td>
</tr>
<tr>
<td>Glottis</td>
<td>Internal and external jugular veins</td>
</tr>
<tr>
<td>Epiglottis</td>
<td>Posterior vena cava (postcava)</td>
</tr>
<tr>
<td>Esophagus</td>
<td>Renal veins</td>
</tr>
<tr>
<td>Stomach</td>
<td>Coronary vein</td>
</tr>
<tr>
<td>Pyloric valve</td>
<td>Common iliac vein</td>
</tr>
<tr>
<td>Small intestine:</td>
<td>Umbilical vein</td>
</tr>
<tr>
<td>Duodenum, jejunum, ileum</td>
<td></td>
</tr>
<tr>
<td>Caecum</td>
<td>Pulmonary artery</td>
</tr>
<tr>
<td>Large intestine:</td>
<td>Umbilical arteries</td>
</tr>
<tr>
<td>Colon, rectum</td>
<td>Aortic arch</td>
</tr>
<tr>
<td>Liver</td>
<td>Ductus arteriosis</td>
</tr>
<tr>
<td>Gall bladder</td>
<td>Brachiocephalic artery</td>
</tr>
<tr>
<td>Spleen</td>
<td>Common carotid arteries</td>
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<tr>
<td>Pancreas</td>
<td>Subclavian arteries</td>
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<td></td>
<td>Intercostal arteries</td>
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<tr>
<td>Ovary</td>
<td>Renal arteries</td>
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<tr>
<td>Uterine tubes</td>
<td>Iliac arteries</td>
</tr>
<tr>
<td>Uterine horns</td>
<td>Thoracic aorta</td>
</tr>
<tr>
<td>Uterus</td>
<td>Abdominal aorta</td>
</tr>
<tr>
<td>Vagina</td>
<td>Coronary artery</td>
</tr>
<tr>
<td>Urogenital sinus</td>
<td>Left and right ventricle</td>
</tr>
<tr>
<td>Vulva</td>
<td>Left and right atrium (or auricle)</td>
</tr>
<tr>
<td>Processus vaginalis</td>
<td>Pericardium</td>
</tr>
<tr>
<td>Epididymis</td>
<td>Meninges</td>
</tr>
<tr>
<td>Testis</td>
<td>Cerebrum</td>
</tr>
<tr>
<td>Ductus deferens</td>
<td>Cerebellum</td>
</tr>
<tr>
<td>Penis</td>
<td>Medulla oblongata</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>Olfactory bulb</td>
</tr>
<tr>
<td>Ureter</td>
<td>Thymus</td>
</tr>
<tr>
<td>Kidney</td>
<td>Thyroid</td>
</tr>
<tr>
<td>urethra</td>
<td></td>
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</tbody>
</table>
Fetal Pig Lab

Check off each organ/structure as you locate it on your pig. Answer questions where indicated.

I. External Anatomy of the Pig
   A. Age:
      i. By using this table and measuring the length of your pig in mm you can determine the approximate fetal age of the pig. This is the number of days since its’ father’s sperm fertilized its’ mother’s egg. Measure your pig from snout to rump (this does not include the length of the tail)

<table>
<thead>
<tr>
<th>Size (mm)</th>
<th>cm</th>
<th>Age (days since fertilization)</th>
</tr>
</thead>
<tbody>
<tr>
<td>11</td>
<td>1.1</td>
<td>21</td>
</tr>
<tr>
<td>17</td>
<td>1.7</td>
<td>35</td>
</tr>
<tr>
<td>28</td>
<td>2.8</td>
<td>49</td>
</tr>
<tr>
<td>40</td>
<td>4.0</td>
<td>56</td>
</tr>
<tr>
<td>220</td>
<td>22.0</td>
<td>100</td>
</tr>
<tr>
<td>300</td>
<td>33.0</td>
<td>Full term (112-115)</td>
</tr>
</tbody>
</table>

   ii. How old is your fetal pig? ____________________________

B. External features of the body:
   i. ____ Head
   ii. ____ Neck
   iii. ____ Trunk
   iv. ____ Tail
v. Appendages

1. Head of the Pig:
   a. _____ Eyes: Are they open yet? _________
   b. _____ Ears
   c. _____ Nostrils
   d. _____ Mouth: Can you see the tongue? ______

2. Appendages:
   a. _____ Digits: How many digits does the pig have on each foot? _____________________________
   b. Note that the first digit (thumb) is missing and the second and fifth digits are reduced in size. How many digits does the pig walk on, on each foot? _____________________________

3. Trunk:
   a. _____ Thorax: The body cavity that extends from the neck to the diaphragm (the chest area)
   b. _____ Sternum: The bone in the center of the chest to which the ribs attach in front.
   c. _____ Abdomen: Body cavity posterior to the thorax
   d. Umbilical cord: Still partially attached to the ventral side of the abdomen. This used to be attached to the placenta in the womb of the mother.
   e. _____ Mammary glands: Nipples or teats found on the ventral surface. How many mammary glands does your pig have? Why are there so many?
   f. Anal opening: Located directly under (ventral) to the tail.

4. Sex determination: You are responsible for knowing the reproductive structures on both a male and female pig.
First, determine the sex of your pig. Then find a group to partner with that has a pig of the opposite sex. You will be responsible for showing each other the relevant parts.

a. Female external anatomy:
   i. _____ Urogenital opening: Found immediately ventral to the anal opening; this opening can be recognized by a fleshy protuberance (vulva).

b. Male external anatomy:
   i. _____ Urogenital opening: Look for a small hole just posterior to the base of the umbilical cord.
   ii. _____ Scrotal sacs: Two slight swellings behind the hind legs.
   iii. _____ Penis: This is the muscular tube lying under the skin, running posteriorly from the urogenital opening. You can feel this under the skin.

What is the sex of your pig? ___________
Who will be your partner group? __________
Do male pigs have mammary glands? __________

II. Digestive System: You are about to begin your examination of the alimentary canal, consisting of: mouth, pharynx, esophagus, stomach, small intestine, large intestine, and a number of glands (liver, pancreas)

A. _____ Mouth: This is the opening of the digestive system. Cut jaws starting at the corners of the mouth and cut all the way through the cartilage to the ears. Deepen your cuts until the mouth opens freely. Do not cut into the back of the throat.
   i. _____ Tongue
ii. ___ Papillae: Bumps on the surface of the tongue

iii. ___ Teeth: How many teeth can you count in your pig’s mouth?
   1. Do both jaws move up and down or just one? ________

iv. ___ Pharynx: The throat (back of mouth)

v. ___ Epiglottis: The small white tab found at the back of the pharynx. This is made of cartilage. The jaw must be open very wide to see this.

vi. ___ Esophagus: Only the opening, or glottis, of the esophagus is visible at this stage. It lies beyond (dorsal to) the epiglottis. It is essentially, the opening.

vii. ___ Larynx: Not visible yet, but feel for the “Adam’s apple” from the outside of the pig’s throat. You will see this when the throat area is dissected later.

B. ___ Abdominal cavity: Now you are ready to examine the viscera (internal organs) of the abdominal cavity. Read through all of the steps first, then go through them again performing each step.

   i. Place pig on its dorsal side (belly up)

   ii. Lift the thin wall of the abdomen above the umbilical cord, holding it away from the internal organs. Insert the fine point of your scissors, or scalpel, through the wall of the abdomen where lifted. Cut through the skin and muscle to the cavity. Always cut with an upward motion to avoid damaging the internal organs.

   iii. Cut in a straight line own the midline of the pig from the umbilical cord to the bottom of the sternum. DO NOT CUT THROUGH THE RIBS or DIAPHRAGM.

   iv. Refer to the diagrams below for help on the following directions:

      1. Cut around the umbilical cord. The umbilical vein extends from the inside of the umbilical cord to the liver, the large grown organ in the abdomen. You will have to cut the umbilical vein, but note it first.
2. **Female Only**: Join the cuts from either side of the umbilical cord at a point just posterios to the cord. Then, continue this cut down between the legs.

3. **Male Only**: Do not join the cuts from either side of the umbilical cord. Instead, continue the two cuts separately toward the posterior of the animal, between the hind legs. This is to avoid cutting the penis, which is just below the skin.

v. In both cases, just in front of the hind legs, cut laterally through the body on either side. Make another two lateral cuts at the top of the abdomen, exposing but not damaging the diaphragm. You should now have two flaps which can be opened sideways to expose the internal organs of the abdomen.

vi. Remove and throw away any stray pieces of red or blue latex inside the abdominal cavity. Drain the “juice” and gently rinse out the abdominal cavity of your pig.

vii. As demonstrated in class, fasten the pig to the dissecting tray with two pieces of string.

C. **Abdominal Organs**: You are now ready to locate the following abdominal organs.
i. ____ Mesentery: Thin membrane covering the organs. You cut through this when opening the abdominal cavity.

ii. ____ Liver: Large reddish brown organ at the anterior end of the abdominal cavity.

iii. ____ Gall bladder: Gently lift the liver at the posterior end. You will see a greenish, or colorless, sac on the underside of the liver. This is where a digestive juice called bile is stored.

iv. ____ Stomach: A bag-like structure best seen lifting the liver further.

v. ____ Pancreas: Lift the stomach from its posterior end. The pancreas is a gray or yellowish mass that has the texture of cauliflower. As a part of the digestive system, the pancreas secretes digestive enzymes like pepsin. It also secretes a hormone called insulin.

vi. ____ Pyloric valve: A hard swelling at the exit of the stomach where it connects to the small intestine. Feel for this.

vii. ____ Small intestine: Light colored mass of tubing leading directly from pyloric valve; connects with large intestine. Different sections in order of flow are called: duodenum, jejunum, and ileum.

viii. ____ Large intestine: Darker-colored sometimes green mass of tubing found in the abdomen. Made of two parts.

1. ____ Colon: First part of large intestine, tightly coiled and green in color.

2. ____ Rectum: Posterior part of large intestine that leads to the anal opening. It is straight, not coiled. To see it, push aside the colon.

ix. ____ Caecum: A dead end pouch at the junction of the small and large intestine. This organ is homologous to the appendix in your body. This can be very hard to find, try tracing the path of the small intestine until it reaches the large.
x. ____ Spleen: A long, flat, brownish organ located near the stomach on the pig’s left side (this is not a digestive organ, it stores blood and functions in the immune system)

xi. ____ Anal opening: Ventral to your pig’s tail.

xii. What is missing? How does the food get from the mouth to the pig’s stomach? _______________________________

III. **Urogenital System:** The urinary system is closely linked to the structures of the reproductive system in both the male and female pig. When we refer to both of these systems collectively we use the term urogenital. Remember, regardless of the sex of your pig, you are expected to know the systems of both the female and male.

A. **Urinary System:**

i. ____ Kidneys: two bean shaped structure located on the dorsal wall of the abdomen.

ii. ____ Mesentary: shiny membrane covering the kidneys and lining the body cavity. Remove the mesentery and carefully expose the kidneys and ureters.

iii. ____ Ureters: thick white tubes running posteriorly from the kidneys to the urinary bladder. These carry the urine from the kidneys to the bladder.

iv. ____ Urinary bladder: the storage organ for urine. This is an elongated sac lying between two large blood vessels called the umbilical arteries. The outermost tip of the urinary bladder leads to the umbilical cord. Look for the entrance of the ureters into the bladder at the base of the bladder, at the opposite end from the umbilical cord.

v. ____ Urethra: The tube that runs from the urinary bladder into the urogenital sinus in the female pig and through the penis in the male (See reproductive systems for more on these structures). You will
probably not see much of the urethra until you dissect the reproductive system.

B. **Female Reproductive System:** Grabbing both hind legs, carefully crack the pelvis, splaying each leg far to the side. Next, carefully cut through the pelvis bone between the hind legs, so the legs will lie flat. Do not damage the tissues lying beneath the bond.

i. ___ Ovaries: Two small bean-shaped bodies in the lower part of the abdomen. You must move the intestines aside in order to see them.

ii. ___ Uterine tubes: Lift an ovary with a probe and look on the underside of the ovary for a tiny, coiled tube.

iii. ___ Uterine horns: The uterine tubes broaden into thicker, flatter tubes, this is where the embryos develop in pigs (not in the uterus as in human). These are homologous organs to the fallopian tubes in women.

iv. ___ Uterus: Somewhat v-shaped structure formed at the junction of the two uterine horns. Unlike the human, this is not the site of embryo development.

v. ___ Vagina: A thick muscular structure which is a posterior continuation of the uterus. You will have to push apart the severed pelvic bones and clear away membrane so that you can trace the uterus to the vagina.

vi. ___ Urethra: Tube which extends from the bottom of the bladder and joins with the vagina to form the urogenital sinus in the female pig. This is not a reproductive structure in the female pig.

vii. ___ Urogenital sinus: Located about an inch from the posterior end of the female pig; the junction of the vagina and the urethra. This tube leads to the urogenital opening in the female pig.

viii. ___ Urogenital opening: Opening to the urogenital sinus; found ventral to the anal opening in the female pig.
ix. **Vulva:** Fleshy protuberance found at the covering/opening of the urogenital system.

C. **Male Reproductive System:** cut through the pelvic bone in the area between the top of the hind legs so that the legs will lie flat. Do not harm the underlying structures

i. **Processus vaginalis:** This is an elongated membranous sac that contains the testis. To find it, cut the surface skin and muscle close to the place where the hind leg joins the body (at the location of the scrotal sacs). The processus vaginalis can now be slipped out. Carefully do this on each side of the pig.

ii. **Testis:** Cut open the membrane of one of the processus vaginalis to reveal the small brown organs where sperm are produced.

iii. **Epididymis:** Tiny, tightly coiled white tubes alongside the testis. This is where the sperm are stored.

iv. **Ductus deferens:** A continuation of the epididymis; leas from the epididymis to the ureter. Follow the ductus deferens (a super-thin, white cord) as it loops over the ureter near the attachment of the ureter to the bladder. This cord joins the ureter on its dorsal wall.

v. **Penis:** This is a tricky dissection. Feel for the penis (a muscular tube) running under the skin just posterior to the umbilical cord. Remove the covering of the skin and trace the penis through the pelvic bond. The penis is a continuous tube that runs from the base of the bladder to the urogenital opening.

vi. **Urethra:** Tube leading from the base of the bladder, continuous within the penis.
IV. **Respiratory System:**

A. Dissection of the neck and thoracic cavity

i. _____ Diaphragm: Flat muscle at the base of the thoracic cavity, attached to body wall. This separates the thoracic cavity from the abdominal cavity.

Now, cut through the rib cage with scissors on a line from the diaphragm to just to the right of the sternum (breastbone) up to your pig’s chin. It is critical the you cut only the ribs so as not to damage the delicate tissues below. Make two lateral cuts just posterior to the front legs to make new flaps. You have now cut through the diaphragm to expose the thoracic cavity more clearly.

ii. _____ Thymus: The thymus gland fills much of the throat area and may extend over the heart. Confirm with the teacher that you have found this. Then you can remove some of the thymus to give you a clear view of the neck region. The thymus is a part of the endocrine system, not the respiratory.

B. **Respiratory System:** Review the structures you have already observed

i. _____ Nostrils

ii. _____ Mouth

iii. _____ Epiglottis

In the neck, where you have just dissected, find:

iv. _____ Larynx: the voice box, or Adam’s apple; an enlarged white structure in the throat.

v. _____ Thyroid gland: brownish bean-shaped structure at the base of the larynx. This is an endocrine gland that produces hormones, which control metabolism. This is not a respiratory organ.

vi. _____ Trachea: The “windpipe” a tube leading from the larynx to the lungs.

vii. _____ Rings of cartilage: You can feel and see these rings on the trachea. They hold the trachea open for constant air flow.
viii. ____ Esophagus: Push aside the trachea and note a smaller, more flexible tube lying dorsal to the trachea. This tube carries food from the mouth to the stomach and is not part of the respiratory system.

The esophagus is part of the ________ system.

Why doesn’t the esophagus need rings of cartilage?

_________________________________________

In the thoracic cavity, find:

ix. ____ Lungs: Spongy and uninflated. Note the lobes into which they are divided. Cut a small piece of lung tissue and place in a beaker of water. Does the tissue float or sink? ______

Why? ________________________________

Now insert a straw into the trachea and blow to inflate the lungs. Cut another piece of lung tissue (preferably a piece that turned very white) and place in water. Does it float or sink? ______

Why? ________________________________

V. **Circulatory System**: the directions left and right refer to your pig’s left and right, not your own.

A. External anatomy of the heart

i. ____ Heart: lies in the center of the chest between the lungs.

ii. ____ Pericardium: tough membrane covering the heart. Remove it.

iii. ____ Left ventricle: large chamber on the lower left side of the heart (pig’s left). Pumps oxygenated blood out of the aorta to the body.

iv. ____ Right ventricle: also called the right auricle. Dark red flap on the upper part of the hear lying over the right ventricle. Pumps deoxygenated blood through the pulmonary artery to the lungs.
v. ____ Coronary artery: (Pink) Artery running diagonally down the ventral side of the pig’s heart from its upper left to its lower right. Separates the two ventricles.

vi. ____ Left atrium (auricle): Dark red flap on the upper part of the heart lying over the left ventricle. It receives oxygenated blood from the lungs and is emptied into the left ventricle.

vii. ____ Right atrium (auricle): Over the right ventricle. It receives deoxygenated blood from the body and is emptied into the right ventricle.

B. Blood vessels attached to the heart

i. ____ Pulmonary artery: Large, hard, white tube leading out of the right ventricle, lying between the two atria. This branches into a left and right branch, one for each lung.

ii. ____ Aorta: Large, hard, white tube whose base is covered by the pulmonary artery. It leads out of the left ventricle, arches through the branches of the pulmonary, and turns posteriorly to head down through the thoracic and abdominal cavities.

iii. ____ Aortic arch: Curved part of the aorta that comes out of the heart. Note that two arteries branch from the (top) of the arch to send blood to the head and upper body.

iv. ____ Ductus arteriosus: This is a special structure found only in the fetus; it short circuits the usual flow of blood to the lungs by sending blood from the pulmonary artery directly into the aorta. To find it, follow the pulmonary artery up from the heart into its left branch. There you will see a short connection to the aorta. This closes after birth, when the lungs begin to function.

v. ____ Anterior vena cava: Also called the pre-cava, this is the large vessel entering the right atrium.

vi. ____ Posterior vena cava: Also called the post-cava. Lift the heart up towards the head of your pig. The postcava runs from the abdominal cavity, through the diaphragm into the right atrium.
C. The Venous System: This system is injected with blue latex. All of the bones and muscle tissue between the heart and neck must be carefully removed in order to see the blood vessels clearly. Remember, veins carry blood toward the heart from the body. Arteries carry blood from the heart toward the body. Blood in the veins is rich in (O₂/CO₂) __________ and poor in __________. Blood in the arteries is rich in __________ and poor in __________. Exceptions to this rule are the pulmonary artery and the umbilical arteries and veins. Why? _____________________

i. Veins above the heart
   1. ____ Anterior vena cava
   2. ____ Brachiocephalic vein: Also called the innominate vein. Follow the precava up to the point where it parts into two branches. Each of these short branches is a brachiocephalic vein.
   3. ____ Internal jugulars: A pair of veins, on either side of the throat close to the larynx; they drain blood from the head.
   4. ____ External jugulars: A pair of veins parallel and lateral to the internal jugulars; they drain blood from the face and jaws.
   5. ____ Subclavian veins: These bring blood back from the front legs. Follow them out of each foreleg.

ii. Veins below the heart:
   1. ____ Posterior vena cava
   2. ____ Renal veins: Veins running from the two kidneys. Note where they join the posterior vena cava.
   3. ____ Common iliac veins: These drain the legs and join to the postcava. They may be poorly injected and hard to see. They may appear as thin brown vessels alongside the pink iliac arteries in the leg.
4. Umbilical veins: This is the vein you first cut when opening the abdominal cavity; locate the remaining stub as it leaves the umbilical cord and also the stub where it enters the liver.

   a. Where did the umbilical vein come from? Was this blood rich in oxygen or poor in oxygen?

D. The Arterial System: This system is injected with red latex. Many arteries have the same names as the veins. They also run parallel to the veins. You can think of the circulatory system like a divided highway. The roads are parallel with the cars traveling in opposite direction.

   i. Pulmonary artery
   ii. Aortic arch
   iii. Aorta
   iv. Brachiocephalic artery: The first branch leaving the aortic arch and going anteriorly. This artery divides in to the carotic and subclavian arteries.
   v. Common carotid arteries: One runs up either side of the trachea. They deliver blood to the head.
   vi. Subclavian arteries: Branches of the brachiocephalic that run in to the right and left forelegs.
   vii. Thoracic aorta: Portion of the aorta that runs through the thoracic cavity. Push the heart and lungs way over to one side of your pig to see the large, hard, white vessel that runs along the dorsal wall from the heart to the abdomen.
   viii. Intercostal arteries: Tiny branches of the thoracic aorta running parallel to each rib.
   ix. Abdominal aorta: Continuation of the thoracic aorta that runs into the abdominal cavity. Move the viscera (guts) to see it.
   x. Renal arteries: Run from the abdominal aorta to the kidneys.
   xi. Iliac arteries: Run from the abdominal aorta to the hind legs.
xii. Umbilical arteries: You will find these to the right and left of the urinary bladder.

1. Is the blood found in the umbilical arteries rich or poor in oxygen? _________________________________

E. **Internal Anatomy of the Heart:** To open the heart hold the heart up with its posterior end pointing towards you. Using your scalpel, cut the heart open in such a way as to separate the ventral (bottom) side from the dorsal (top) side. DO NOT cut the heart into right and left halves.

i. Chambers: Examine the chambers within the heart – you may want to remove some of the hardened latex that fills these.

ii. Foramen ovale: A little hole between the right and left atria that exists only in the fetal heart. This closes at birth. Why?