Day 5 Respiratory & Cardiovascular:

Respiratory System
Be very careful not to damage the heart and lungs while separating the ribs!

**Analysis Questions-Respiratory & Cardiovascular**

Log into QUIA using your Team’s Username and Password provided by your instructor. As your group works on the DAY 5 assignment of the cat dissection, enter your responses to the Analysis Questions into QUIA-Day 5. Your team may save your work from class and return to finish the assignment until the due date (see assignment sheet). When the section is complete, select “submit” to send your Analysis Question responses to your instructor. The reference diagrams in this eBook are also available online so that you can zoom in and out.

**Question 26**
Which structures in the cat help protect the respiratory structures?

**Question 27**
Follow the trachea into the lungs to locate the bronchi. Which structures deep in the
lung are actually responsible for gas exchange?

**Question 28**
Locate the diaphragm. A) What type of tissue is the diaphragm? B) How is the diaphragm important in normal respiratory function?

**Question 29**
How does the respiratory system depend on the circulatory system in regards to gas exchange?

**Cardiovascular System**

**Preparing to Identify the Blood Vessels:**

1. Carefully clear away any thymus tissue or fat obscuring the heart and the large vessels associated with the heart. Before identifying the blood vessels, try to locate the phrenic nerve (from the cervical plexus), which innervates the diaphragm (this may be quite difficult in your cat so do not spend an inordinate amount of time in this pursuit). The phrenic nerves lie ventral to the root of the lung on each side, as they pass to the diaphragm. Also attempt to locate the vagus nerve (cranial nerve X) passing laterally along the trachea and dorsal to the root of the lung.

2. Slit the parietal pericardium and reflect it superiorly. Then, cut it away from its heart attachments. Review the structures of the heart. Notice its pointed inferior end (apex) and its broader superior portion (base). Identify the two atria, which appear darker than the inferior ventricles.
3. Identify the aorta, the largest artery in the body, issuing from the left ventricle. Also identify the coronary arteries in the sulcus on the ventral surface of the heart: these should be injected with red latex. (As an aid to blood vessel identification, the arteries of laboratory dissection specimens are injected with red latex; the veins are injected with blue latex. Exceptions to this will be noted as they are encountered.)

4. Identify the two large venae cavae – the superior and inferior vena cavae – entering the right atrium. The superior vena cava is the largest dark-colored vessel entering the base of the heart. These vessels are called the precava and postcava, respectively, in the cat. However, we will continue to use the terms superior and inferior vena cava. The caval veins drain the same body areas as in humans. Also identify the pulmonary trunk (usually injected with blue latex) extending anteriorly from the right ventricle and the right and left pulmonary arteries. Trace the pulmonary arteries until they enter the lungs. Locate the pulmonary veins entering the left atrium and the ascending aorta arising from the left ventricle and running dorsally near the superior vena cava and to the left of the body midline.
Identifying the Arteries of the Cat:
(Refer to the references diagrams as you study the arterial system of the cat.)

1. Reidentify the aorta as it emerges from the left ventricle. As you observed in the dissection of the sheep heart, the first branches of the aorta are the coronary arteries, which supply the myocardium. The coronary arteries emerge from the base of the aorta as it arches (aortic arch), and identify its major branches. In the cat, the aortic arch gives off two large vessels, the right brachiocephalic artery and the left subclavian artery. The right brachiocephalic artery has three major branches, the right subclavian artery and the right and left common carotid arteries. (Note that in humans, the left common carotid artery is a direct branch off the aortic arch.)

2. Follow the right common carotid artery along the right side of the trachea as it moves anteriorly, giving off branches to the neck muscles, thyroid gland, and trachea. At the level of the larynx, it branches to form the external and internal carotid arteries. The internal carotid is quite small in the cat and it may be difficult to locate. It may even be absent. The distribution of the carotid arteries parallels that in humans.

3. Follow the right subclavian artery laterally. It gives off four branches, the first being the tiny vertebral artery, which along with the internal carotid artery provides the arterial circulation of the brain. Other branches of the subclavian artery include the costocervical trunk (to the costal and cervical regions), the thyrocervical trunk (to the shoulder), and
the *internal mammary artery* (serving the ventral thoracic wall). (Note: These arterial branches may be quite small in the cat and may only be visible as short segments in the general regions in which they run.) As the subclavian passes in front of the first rib it becomes the axillary artery. Its branches, which supply the trunk and shoulder muscles, are the *ventral thoracic artery* (the pectoral muscles), the long *thoracic artery* (pectoral muscles and latissimus dorsi), and the *subscapular artery* (the trunk muscles). In actual fact, you may only notice these arterial branches as they become visible as thin string-like attachments between the muscles you are dissecting. As the *axillary artery* enters the arm, it is called the *brachial artery*, and it travels with the median nerve down the length of the humerus. At the elbow, the brachial artery branches to produce the two major arteries serving the forearm and hand, the *radial and ulnar arteries*.

4. Return to the thorax, lift the left lung, and follow the course of the *descending aorta* through the thoracic cavity. The esophagus overlies it along its course. Notice the paired *intercostal arteries* that branch laterally from the aorta in the thoracic region.

5. Follow the aorta through the diaphragm into the abdominal cavity. Carefully pull the peritoneum away from its ventral surface and identify the following vessels:
   a. **Celiac trunk**: The first branch diverging from the aorta immediately as it enters the abdominal cavity; supplies the stomach, liver, gallbladder, pancreas, and spleen. (Traces as many of these branches to their respective organs as possible.)
   b. **Superior mesenteric artery**: Immediately caudal to the celiac trunk; supplies the small intestine and most of the large intestine. (Spread the mesentery of the small intestine to observe the branches of this artery as they run to supply the small intestine.)
   c. **Renal arteries**: Paired arteries running to the kidneys, which they supply.
   d. **Inferior mesenteric artery**: An unpaired thin vessel arising from the ventral surface of the aorta caudal to the genital arteries; supplies the second half of the large intestine.
**Figure C4.2** Blood vessels below the diaphragm.
Identifying the Veins of the Cat:
(Refer to the references as you study the venous system of the cat. Notice that not all vessels shown on the figure are discussed. Keep in mind that the vessels are named for the region drained, not for the point of union with other vessels.)

1. Reidentify the superior vena cava as it enters the right atrium. Trace it anteriorly to identify veins that enter it:
   a. **Azygos vein**: Passing directly into its dorsal surface, drains the thoracic intercostal muscles.
   b. **Right and left brachiocephalic veins**: form the superior vena cava by their union.

2. Reflect the pectoral muscles, and trace the brachiocephalic vein laterally. Identify the two large veins that unite to form it - the external jugular vein and the subclavian vein.

3. Follow the external jugular vein as it courses anteriorly along the side of the neck to the point where it is joined on its medial surface by the internal jugular vein. The internal jugular veins are small and may be difficult to identify in the cat. Notice the difference in cat and human jugular veins. The internal jugular is considerably larger in humans and drains into the subclavian vein. In the cat, the external jugular is larger, and the internal jugular vein drains into it. Identify the common carotid artery, since it accompanies the internal jugular vein in this region. Also attempt to find the sympathetic trunk, which is located in the same area running laterally to the trachea. Several other vessels drain into the external jugular vein (transverse scapular vein, facial veins, and others.) These are not discussed here but are shown on the figure and may be traced if time allows.

4. Return to the shoulder region and follow the course of the subclavian vein as it moves laterally toward the arm. It becomes the axillary vein as it passes in front of the first rib and runs through the brachial plexus, giving off several branches, the first of which is the subscapular vein. The subscapular vein drains the proximal part of the arm and shoulder. The four other branches that receive drainage from the shoulder, pectoral, and latissimus dorsi muscles are shown in the figure but need not be identified in this dissection.

5. Follow the axillary vein into the arm, where it becomes the brachial vein. You can locate this vein on the medial side of the arm accompanying the brachial artery and nerve. Trace it to the point where it receives the radial and ulnar veins (which drain the forelimb) at the antecubital fossa. Also locate the superficial cephalic vein on the dorsal side of the arm. It communicates with the brachial vein via the median cubital vein in the elbow region and then enters the transverse scapular vein in the shoulder.

6. Reidentify the inferior vena cava, and trace it to its passage through the diaphragm. Notice again as you follow its course that the intercostal veins drain into a much smaller vein lying dorsal to the inferior vena cava, the azygos vein.

7. Attempt to identify the hepatic veins entering the inferior vena cava from the liver. These may be seen of some of the anterior liver tissue is scraped away where the inferior vena cava enters the liver.

8. Displace the intestines to the left side of the body cavity, and proceed caudally to identify the following veins in order. All of these veins empty into the inferior vena cava and...
drain the organs served by the same-named arteries. In the cat, variations in the connections of the veins to be located are common, and in some cases the inferior vena cava may be double below the level of the renal veins. If you observe deviations, call them to the attention of your instructor.

a. **Renal veins**: From the kidneys (it is common to find two renal veins on the right side).

b. **Common Iliac veins**: Unite to form the inferior vena cava.

The common iliac veins are formed in turn by the union of the *internal iliac and external iliac veins*. The more medial internal iliac veins receive branches from the pelvic organs and gluteal region whereas the external iliac vein receives venous drainage from the lower extremity. As the external iliac vein enters the thigh by running beneath the inguinal ligament, it receives the deep femoral vein, which drains the thigh and the external genital region. Just inferior to that point, the *external iliac vein* becomes the *femoral vein*, which receives blood from the thigh, leg and foot. Follow the femoral vein down the thigh to identify the *great saphenous vein*, a superficial vein that courses up the inner aspect of the calf and across the inferior portion of the gracilis muscle (accompanied by the great saphenous artery and nerve) to enter the femoral vein. The union of the saphenous vein and the popliteal vein form the femoral vein. The *popliteal vein* is located deep in the thigh beneath the semimembranosus and semitendinosus muscles in the popliteal space accompanying the popliteal artery. Trace the popliteal vein to its point of division into the *posterior and anterior tibial veins*, which drain the leg.

9. In your specimen, trace the hepatic portal drainage depicted in figure D4.6. Locate the hepatic portal vein by removing the peritoneum between the first portion of the small intestine and the liver. It appears brown due to coagulated blood, and it is unlikely that it or any of the vessels of this circulation contain latex. In the cat, the union of the *gastrosplenic and superior mesenteric veins* forms the *hepatic portal vein*. (In the human, the union of the splenic and superior mesenteric veins forms the hepatic portal vein.) If visible, locate the following vessels, which empty into the hepatic portal vein:

a. **Gastrosplenic vein**: Carries blood from the spleen and stomach, located dorsal to the stomach.

b. **Superior mesenteric vein**: A large vein draining the small intestines and the pancreas.

c. **Inferior mesenteric vein**: Parallels the course of the inferior mesenteric artery.

d. Coronary vein: Drains the lesser curvature of the stomach.

This ends the dissection of the blood vessels of the cat. Properly clean your dissecting tools, tray, work area and sink as well as prepare your cat for storage.

Examine the heart within the thoracic cavity. Note the flap-like atria and the muscular ventricles. Also notice the large blood vessels leading in and out of the heart.
**Question 30**
What is the general job of an atrium? A ventricle?

**Question 31**
Name the protective membrane that surrounds the heart.

**Question 32**
Use the reference diagrams & terms provided below to identify the lettered areas in the diagram below.

A. ___________________  B. ___________________  C. _________________
D. ___________________  E. ___________________  F. _________________
G. ___________________  H. ___________________  I. _________________
J. _________________  K. _________________  L. _________________
M. _________________

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![Diagram of the heart and major blood vessels of the cat.](image)

The heart and the major blood vessels of the cat. A. View of the paraconal side of heart; B, view of the subsinuous side of the heart. The incisions to open the heart are shown.
**Question 33**
Locate the following structures on the heart and describe their functions.

a. vena cava

b. aorta

c. right atrium

d. left ventricle

**Question 34**
How does the blood in a vein generally differ from that of an artery? Which vessels in the heart are exceptions to this rule? Why is this?