

Investigating the structure of the heart

Guide to Week 1 home practical

Note: You will also need to download a copy of the worksheet to fill out during the practical. You can find this in the step named 'Preparing for the heart dissection practical'.

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Introduction

As you have learnt in the videos on the anatomy and the function of the heart, this four chambered muscular organ pumps blood around the body to deliver vital oxygen and nutrients and remove carbon dioxide and other waste products from the body's tissues.

The heart is actually two pumps that sit side by side (the left and the right). In most healthy humans the left and right sides of the heart are separated by a wall (the septum). The left side of the heart has a smaller left atrium sat on top of the larger left ventricle. As the left ventricle pumps blood from the heart all the way around the body it has a thick muscular wall. The right side of the heart has a smaller right atrium on top of the larger

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right ventricle. As the right ventricle pumps the blood to the lungs it doesn't need to be as muscular as the left side.

Four major blood vessels enter and exit the heart, whilst the actual heart muscle itself is fed by the small coronary arteries, delivering oxygen so that the heart muscle can contract.

The aorta is the main artery of the body, carrying oxygenated blood from the heart to the rest of the body. It is a thick-walled muscular blood vessel that exits from the left ventricle.

The vena cava is the main vein of the body, returning deoxygenated blood back to the heart. It is a thin-walled blood vessel that enters the right atrium.

The pulmonary artery carries blood from the right ventricle to the lungs, whilst the pulmonary vein carries blood from the lungs back to the left atrium of the heart.

Between each chamber are heart valves which prevent the flow of blood in the wrong direction. The mitral valve (bicuspid valve) sits between the left atrium and ventricle whilst the tricuspid valve sits between the right atrium and ventricle. These are the two atrioventricular valves.

The aortic valve sits where the left ventricle exits into the aorta, and the pulmonary valve sits where the right ventricle exits into the pulmonary artery. These are the two semilunar valves. Each valve is prevented from turning inside out by fibrous cords (the chordae tendineae).

Learning objectives

There is more to understanding a topic than just remembering facts. To really understand a topic we first learn the theory then we learn how to apply the theory through practical work. This practical aims to explore the anatomy of the heart including its four chambers and the major blood vessels that enter and exit the heart.

By the end of this practical you should be able to:

- Identify the left and right sides of the heart.
- Identify the major blood vessels as they enter and exit the heart.
- Identify the minor blood vessels that supply the heart muscle.
- Identify the myocardium and understand how the thickness of the heart wall relates to its function.
- Identify the heart valves and chordae tendineae and understand how they prevent backflow of blood.

Assessment

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There is a worksheet for you to complete during the practical. This can be downloaded from the Step named 'Preparing for the heart dissection practical'. You will then be able to use the data you have collected to compare results with other learners in the discussions after the practical.

Health and safety

All of the practicals in this course are optional. Practical work aims to apply the theory already covered, enabling a deeper understanding of the material. If you are unable to, or do not wish to carry out the practicals, it is still recommended that you watch the videos to gain better understanding of the subject, and so that you are able to take part in discussions.

This practical involves working with animal tissue and knives. There are 2 main risks associated with this practical:

- Risk of infection from raw meat.
- Risk of cutting yourself (or someone else) with the knife.

People who may wish to NOT participate in the practical:

- Those having immunosuppressive treatment or an immunosuppressive condition.
- Those with severe eczema or other conditions that damage the protective barrier of skin.
- Those who are or may be pregnant.

If you obtain your animal heart from a source intended as food for human consumption, such as a supermarket or butchers, the risk of infection is reduced.

However standard precautions should be used as though you were handling raw meat in a kitchen:

- It is recommended that you wear an apron to protect your clothes. The use of gloves is optional (you wouldn't wear gloves for cooking but you may not like the smell or feel of the meat), however care must be taken to wash hands thoroughly with warm soapy water at the end of the practical and care must be taken not to touch items around the kitchen or house with contaminated (dirty) hands.
- As for any practical work, avoid eating, drinking, chewing gum, chewing pen lids and directly touching your computer or mobile device during the practical.
- The use of knives should only be carried out by competent adults, and those under the age of 18 should be supervised by a parent or guardian.
- Never use your finger to probe the heart, particularly when cutting open the heart chambers.
- At the end of the practical, dispose of your heart as you would other raw meat. Wash all utensils (knives, pens, plates, trays etc.) with hot soapy water. Wipe down all surfaces with an appropriate disinfectant at the end of the practical.

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- Finally, wash your hands thoroughly with hot soapy water.

Protecting your mobile device

In addition to protecting yourself it is important that you protect your surroundings and equipment.

If you plan on using a mobile device to follow the practical instructions then we strongly recommend that you place the device inside of a clear plastic bag or wrap it with plastic wrap first (and keep it away from the immediate work area). You may need to try different materials to find one that still lets your device work.

Not only will this protect the device from any small splashes but importantly it protects it from being contaminated by dirty fingers. At the end of the experiment you can simply throw away the wrapping, leaving your device clean and uncontaminated.



Figure 1: Appropriately protecting your mobile device

What you will need

Before starting this practical make sure that you have the following items on a tray or plate ready to use:

- Instruction sheet (or mobile device protected appropriately)
- Worksheet
- Pen / pencil to write with

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- Apron
- Gloves (optional)
- Tray, plate or suitable working surface (chopping board used only for raw meat)
- Animal heart (e.g. lamb or chicken): These can be purchased from some supermarkets or butchers. Store as directed on the packaging (usually in a refrigerator for a few days, or freeze if for longer and then defrost before use)
- Weighing scales
- Blunt instrument to probe the heart (eg an old ball point pen for a lamb heart, or a paperclip for a chicken heart)
- Knife
- Ruler
- Access to hot soapy water
- Paper towels
- Suitable disinfectant
- Waste bag

Instructions

- 1. Check that you have all of your materials, including some paper towel and your waste bag, ready to use.**
- 2. Weigh the heart and then place it on the tray or plate.**
- 3. Observing the heart:**
 - a. The first thing to do is to determine which side of the heart is the left and the right and which is front and back.
 - b. Look at the heart and notice the shape, the colour and the texture - does it look smooth or rough?
 - c. The heart may have been damaged during removal for food preparation. Often there will be a slice through it and sometimes when the major blood vessels have been cut through the atria may also have been damaged or removed.
 - d. Locate the large blood vessels at one end. This is the base. The softly pointed part at the other end is the apex.
 - e. From your theoretical knowledge of the heart's structure and its four major blood vessels you may be able to orient the heart just by looking at it, but sometimes this isn't clear as the vessels are often sliced off. You may need to feel the heart to help work out its orientation.

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Figure 2: Orienting the heart

4. Palpation (touch) of the heart:

- a. Pick up the heart and notice how it feels. Is it heavy or light? Soft or firm? Slimy or dry?
- b. From your theoretical knowledge you know that the structure of the left and right sides of the heart are quite different. The left side has a thick muscular wall, whilst the right side has a thinner wall.
- c. Feel the texture of the heart on each side, does one side feel firmer and the other side feel softer?

5. Identification of the four major blood vessels and the smaller coronary arteries:

- a. Locate the four major blood vessels as they enter/exit the base of the heart.
- b. Use your theoretical knowledge of the structure of arteries and veins to try and identify each one. It may not be clear which is which and they may have been sliced through, making it hard to see. We will confirm the identity of each vessel in the next Step.
- c. Try to locate the coronary arteries as they branch from the aorta and wrap around the heart muscle supplying it with oxygenated blood.

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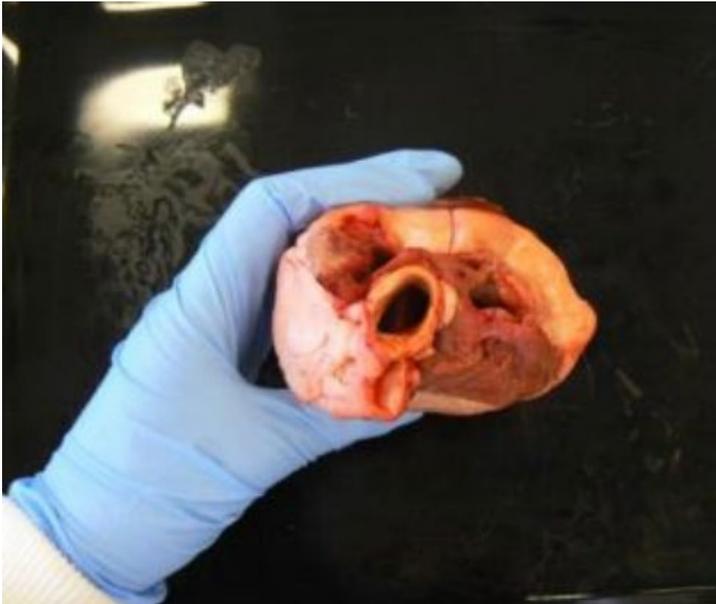
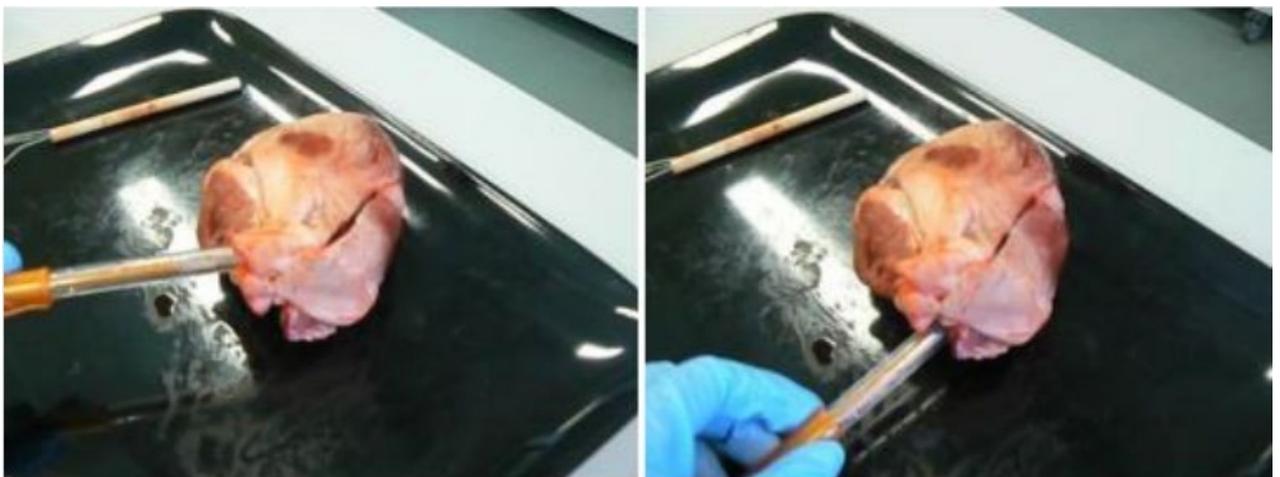


Figure 3: Locating the coronary arteries

- 6. Identification of the four heart chambers through probing the four major vessels, and thus confirmation of the identity of the four major blood vessels:**
 - a. To probe the heart, use the blunt end of a ballpoint pen for the lamb heart (or an opened out a paperclip for the chicken heart).
 - b. Carefully insert the probe into one of the major blood vessels. Feel the heart muscle to see which chamber the vessel leads to. Repeat for each of the 4 major vessels. Does this help you to determine which vessel is which?



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Figures 4.1-4.4: Identifying the four heart chambers

7. Longitudinal slice down the aorta to the apex of the heart (i.e. opening the left ventricle):
 - a. Insert the probe into the aorta and down into the left ventricle.
 - b. **DO NOT use a finger as the probe**
 - c. Carefully use the knife to slice the tissue from the aorta to the apex along the length of the probe.
 - d. Carefully open out the halves.

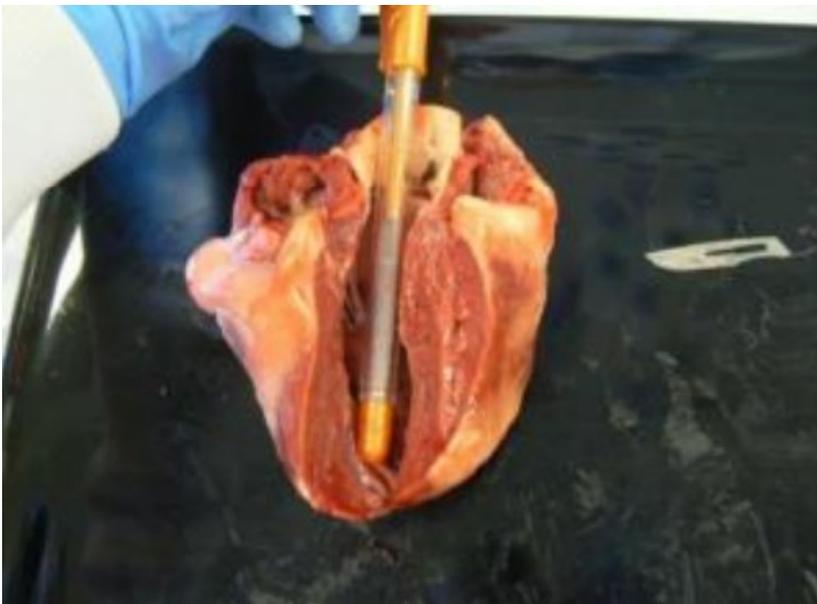


Figure 5: Opening the left ventricle

8. Longitudinal slice down the pulmonary artery (i.e. opening the right ventricle).
 - a. Insert the probe into the pulmonary artery and down into the right ventricle.
 - b. **DO NOT use a finger as the probe**

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- c. Carefully use the knife to slice the tissue along the length of the probe. Carefully open out the halves.

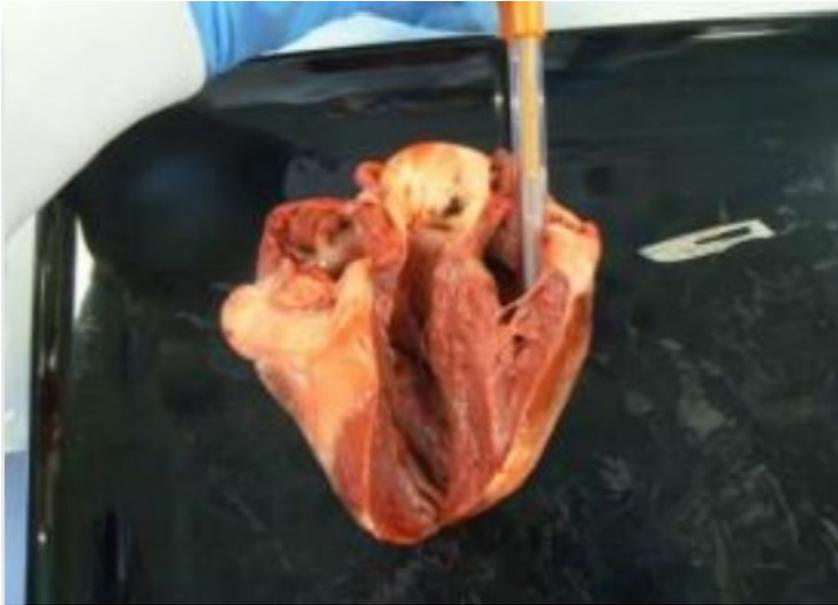


Figure 6: Opening the right ventricle

9. Measure the thickness of the left and right ventricle walls:

- a. Using a ruler, measure the thickness of the left ventricle. Repeat this in at least 3 locations and note the values down.



Figure 7.1: Measuring the left ventricle wall

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Then measure the thickness of the right ventricle in at least 3 locations and note the values down. How do they compare?



Figure 7.2: Measuring the right ventricle wall

10. Identification of the heart valves:

- a. Opening out the heart along the longitudinal slices, locate the fibrous cords (the chordae tendineae). These are attached to the heart valves and prevent the valves from turning inside out.
- b. Count the number of threads on each side of the heart. Note this down. How do they compare?
- c. Follow the chordae tendineae to the heart valves. Count the number of flaps (cusps) on each side of the heart. Note this down. How do they compare?

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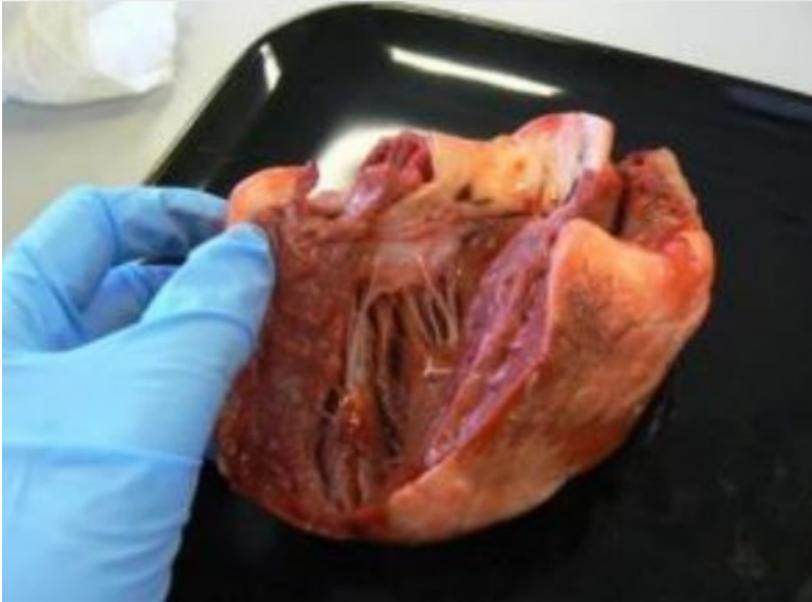


Figure 8: Locating the heart valves

- 11. Leaving the heart on the tray, wash your hands (and the writing pen if you have touched this with dirty hands) with hot soapy water and complete the worksheet.**
 - a. If you need to touch the heart again remember to wash your hands before carrying on with the worksheet.
- 12. Once you have finished the worksheet, dispose of the heart as you would any raw meat.**
 - a. Place the probe and any used paper towel in the waste bag. Wash all utensils with hot soapy water. Clean the work surface with a suitable disinfectant or hot soapy water. Launder the apron if necessary.
 - b. Finally wash your hands with hot soapy water.