

STANDARD OPERATING PROCEDURE:

Performing a lung dissection

Note: To be undertaken only by trained personnel in conjunction with a current Safety Data Sheet (SDS) and site-specific risk assessment.

1. Introduction

Lung dissections are conducted to explore and understand the function of the lungs by examining the internal and external structures, as well as the relationship of the lungs to the heart. Good hygiene practices should be observed at all times. Lungs suitable for dissections include fresh sheep, cow, and ox or pig lungs purchased from a butcher, abattoir or a reputable biological supplier that has passed relevant health inspections. It is best to get them as part of a pluck (heart-lung set) as this allows you to better see the connections of the main blood vessels.

A pluck can be obtained some weeks beforehand and stored in a freezer.

2. Context

- These instructions are for the use of experienced science teachers and technicians and students under close supervision.
- When planning a class dissection activity, it is best to discuss beforehand the type of dissection to be undertaken and warn of the possibility that there may be some blood and odours present during the dissection.
- Demonstrating the dissection to students before they begin is helpful, not only for correct procedure but allows the students to adjust to the appearance of the material and any blood that may be present after the dissection material has been washed.
- Let students know they don't have to participate in the dissection and can be excused from the class. Alternative arrangements can be made for students who don't wish to participate, by giving them worksheets to complete and relocating them to a private study area.

3. Safety notes

- A site-specific risk assessment should take into consideration the maturity of students carrying out the dissection and address risks associated with students using scalpels and other dissection equipment.
- Before the dissection it is recommended the teacher or laboratory technician trial the dissecting instruments (scalpels, scissors and pointed forceps) to establish that they are sufficiently sharp enough and to determine the most appropriate equipment for the task considering the student behaviour.

Fainting: signs and symptoms:

- Fainting may occur during this type of activity. Please read the first aid information in section 7 before conducting the dissection.

- Fainting is caused by a sudden drop in blood pressure. Common causes include heat, pain or distress and the sight of blood.
- The possible symptoms include the following.
 - 'Dizziness
 - Light-headedness
 - A pale face
 - Perspiration
 - Heightened anxiety and restlessness
 - Nausea
 - Collapse
 - Unconsciousness, for a few seconds
 - Full recovery after a few minutes'¹

Handling specimens:

- If using frozen lungs defrost overnight in a refrigerator and use within 24 hours. Consistent with safe food handling procedures, all meat products should be stored below 5°C prior to performing any dissections.
- Good hygiene practices should be observed at all times.
- Keep hands away from the mouth, nose, eyes and face during and after dissection and wash hands immediately after handling dissection material.
- For hygiene reasons lungs must not be inflated by mouth. There is a possibility of inhaling aerosols from the lungs as the air is expelled from the lungs. It is best practice to use a pump, such as a bicycle or foot pump, or a small syringe.

Safety with scalpels and dissecting instruments:

- Store all dissecting instruments securely.
- Care should be taken with sharps such as scalpel blades and scissors. Some school science departments restrict the use of scalpels unless specifically requested by a teacher, and prefer to only issue scissors, probes and forceps to students for dissections.
- It is suggested that the teacher and/or laboratory technician use a scalpel to cut through the finer tubes of the bronchi for students. This removes the need for the students to handle scalpels.
- Ensure students demonstrate responsible behaviour while using scalpels and other dissecting instruments.
- Scalpels should be provided in and returned to a lined container, blade end down.
- Students should not walk around the lab with dissecting instruments, in particular with a scalpel or pointed scissors, forceps or probes.
- To reduce the possibility of stab wounds or cuts from slippage always point sharp instruments such as scalpels and scissors away from yourself and others.
- Hold the instruments so that any sharp points or exposed sharp edges point down onto the dissection board or tray. If there is any slippage when using the instrument, the point/exposed edge will be absorbed by the board/foam or wax tray.

Scalpel blades:

- Only staff should carefully attach and remove scalpel blades using pliers, forceps or a commercial blade remover.

- The scalpel blade size and handle must be compatible, e.g. number 4 handle with number 23 blades.
- Keep the blade in the foil wrapper and attach to the handle with the sharp side of the blade pointing away from the body.
- An alternative is to use disposable scalpels.

4. Regulations, licences and permits

Offal that has passed a health inspection by a meat inspector or produced from a butchers shop, abattoir or biological supplier is suitable for dissection. In some jurisdictions all dissections need to be reported to the school animal ethics committee.

5. Equipment

- PPE (Lab coat/apron [it is recommended to use plastic disposable aprons], safety glasses and gloves)
- Scalpels (optional subject to a site specific risk assessment)
- Scissors, forceps, probes
- Dissecting board covered in newspaper or disposable foam tray
- Newspaper to protect bench and for wrapping biological materials after dissection
- Paper towel
- 250 mL glass beaker
- Plastic or rubber tubing to fit cut trachea
- String, for attaching tubing
- Pump (e.g. balloon or bicycle) to inflate the lungs
- 50 mL syringe
- a large, transparent, plastic bag for when inflating the lungs
- Disinfectant—hospital grade general purpose disinfectant (the label on the front of the pack must state 'hospital grade', which is a general purpose hard-surface disinfectant which will kill micro-organisms).
- 70% v/v ethanol
- Optional: commercially prepared slides of alveoli and microscopes.

6. Operating procedure

Preparation:

- If any blood is associated with the lungs or pluck rinse them in cold running water.
- Prepare disinfectant solution according to manufacturer's instructions. Place disinfectant in a container ready for instruments to be placed at the end of the dissection.
- Ensure students have appropriate PPE.
- Distribute the instruments to students. Scalpels, scissors, forceps and probes should be counted out, and counted in when returned.

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Examining and dissecting the lungs:

1. If using a pluck (heart lung set) arrange the pluck with heart on top on a dissecting board or tray. If still attached identify the (pleural) membrane surrounding the lungs and the pericardium membrane surrounding the heart. **See Figure 1.**
2. Observe the shape, size and colour of the lungs and attached blood vessels leaving and entering the lungs.
3. Observe the diaphragm which may still be attached. It is the sheet of muscle separating the thoracic or chest cavity from the abdominal cavity.
4. Examine the blood vessels associated with the heart and lungs. Identify the arteries which have thick, rubbery walls and the veins which have much thinner walls. Observe the spongy texture of the lung tissue and identify the trachea or wind pipe and the oesophagus (if still attached) which runs in the groove along the trachea. (Note the hooped cartilage rings in the tracheal wall).
5. Insert a length of plastic/rubber tubing into the cut end of the trachea and tie it tightly with a piece of string.
6. Pump some air into the trachea and inflate the lungs. There is a possibility of air escaping from cut surfaces of the lung, so it is best practice to place the lungs inside a large, transparent, plastic bag to stop any aerosols from escaping into the laboratory air. Notice the change in appearance of the lungs before and after inflation. During inflation the lungs become much lighter in colour and almost double in size. **See Figure 2a & 2b.** *Note: the plastic bag is absent for photographic purposes.* Remove the tubing.
7. Using dissecting scissors carefully sever the heart from the lungs by cutting through the blood vessels as near to the lungs as possible. The hearts can be frozen for future dissections. Science ASSIST has developed a standard operating procedure (SOP) for performing a heart dissection, see link to [SOP: Performing a heart dissection](https://assist.asta.edu.au/resource/2837/sop-performing-heart-dissection?search-id=65fed3c) ([https://assist.asta.edu.au/resource/2837/sop-performing-heart-dissection?search-id=65fed3c.](https://assist.asta.edu.au/resource/2837/sop-performing-heart-dissection?search-id=65fed3c))
8. With scissors cut down the trachea until it divides into two tubes called the bronchi. Continue cutting down into one of the bronchus tubes which continues to divide into bronchioles. Using sharp pointed scissors carefully cut down one of these branches of the bronchioles until you can no longer distinguish the tube. These tubes end in tiny sacks called 'alveoli' or 'air sacks' where gas exchange takes place. **See Figure 3a**
9. Observe the structure of the trachea, bronchi and bronchioles and note the size and texture of cartilage rings in the walls of these structures. **See Figures 3b & 3c and Diagram 1**
10. Using scissors cut off the end of one of the lobes. Fill the syringe with air by extending the plunger and insert the end of the syringe into the top of one of the bronchiole tubes. Gently push the plunger down and observe the lung tissue inflate.
11. Cut off a small piece of this spongy lung tissue. Drop in a beaker of water and observe that it floats indicating the tissue still holds a volume of air. Repeat this procedure with a piece of heart tissue or diaphragm muscle and compare the result. **See Figure 4.**
12. Place a commercially prepared microscope slide of alveoli under a microscope and examine its structure.

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Clean up:

- Make sure all instruments are returned.
- All parts of the lung, as well as the disposable foam tray (if used), must be wrapped in newspaper and placed in a dedicated plastic garbage bag along with gloves and disposable aprons (if used). When all waste material is collected, double bag for disposal. Freeze material if unable to dispose of immediately.
- If blood is present on dissecting boards, scissors, forceps, probes, dissecting pins and scalpels they must be immediately soaked in disinfectant. Otherwise wash equipment in hot soapy water and rinse or place in a dishwasher to minimize handling.
- After washing, dissecting instruments can be soaked in 70% v/v ethanol for 20 minutes as an optional additional disinfectant and to avoid rusting.
- Dry all equipment thoroughly.
- Disinfect workplace and wash hands thoroughly.

7. Trouble shooting/emergencies

- **If fainting occurs:** If students start to feel faint, dizzy or nauseous during the dissection lie them down (if possible) and elevate their feet. They can get up slowly after ten minutes. Sending them outside for some fresh air can also help. If they don't recover quickly, always seek urgent medical attention. '***Do not sit the patient on a chair with head between knees***'
- First Aid: See latest SDS of any chemicals used for more detailed information.
 - **If swallowed:** Do not induce vomiting. Rinse mouth with water, and then give water to drink. Seek urgent medical attention.
 - **If in eyes:** Hold open and irrigate with copious quantity of water for at least 15 minutes. Seek medical attention.
 - **If on skin/clothes:** If spilt on skin or clothes quickly wipe off with a dry cloth to absorb as much liquid as possible. Remove contaminated clothes and drench the area with excess water under a safety shower. Seek medical attention.
 - **If inhaled:** Remove to fresh air and seek medical attention if symptoms persist.
 - For further advice contact the Poisons Information Centre on 131126.
- First aid: cuts and lacerations should be washed under running water, in the first instance and referred to the school first aid officer for assessment.
- Any health concerns should be referred to the school first aid officer for assessment, accompanied by the relevant latest SDS if applicable. Follow your school's accident and incident policy and reporting procedures.
- See safety notes if it is necessary to remove broken or used scalpel blades.

8. Waste disposal

- Used and damaged scalpel blades must be placed in an approved sharps container after use.
- Biological material must be wrapped in newspaper, placed in a double plastic garbage bag and sealed for immediate disposal in the industrial bins.

9. Related material

- Risk Assessment.
- Manufacturer's Safety Data Sheet for disinfectant

More detailed information on a lung dissection can be found on the following websites below:

- 'Dissecting lungs', Nuffield Foundation website, <http://www.nuffieldfoundation.org/practical-biology/dissecting-lungs> (May 2009). Class practical or demonstration.
- 'Pluck dissection' STEM Learning website, (15:11 min) <https://www.stem.org.uk/rx33t8>
This is a very good instructional video for teachers/demonstrators.

References:

ⁱ'Fainting', Better Health Channel website, State Government of Victoria:

<http://www.betterhealth.vic.gov.au/bhcv2/bhcarticles.nsf/pages/Fainting> (August 2014)

ⁱⁱSt John Ambulance Australia. 2011. *Australian First Aid*. Barton, ACT

Andrews, C; Naidu, Satya; Laidler, Greg. 2002. *Active science: skills and experiments: book 2*. Oxford University Press: South Melbourne, Vic.

Chemwatch Gold. 2013. *Safety Data Sheet: Hospital grade disinfectant*, Chemwatch website, <http://jr.chemwatch.net/chemwatch.web> (Subscription required.) (Accessed July 2016).

CLEAPSS. 2014. *G268 Dissection: a guide to safe practice*, CLEAPSS website, <http://science.cleapss.org.uk/Resource-Info/G268-Dissection-a-guide-to-safe-practice.aspx> (Subscription required.)

'Dissection safety tips', Flinn Scientific website, <http://www.flinnsci.com/media/396301/dissectionsafety.pdf> (2010)

'Dissecting lungs', Nuffield Foundation website, <http://www.nuffieldfoundation.org/practical-biology/dissecting-lungs> (Accessed July 2016)

'Dissection Safety Policy and Procedures' Flinn Scientific website' <http://www.flinnsci.com/media/948812/sf10490.pdf> (2013)

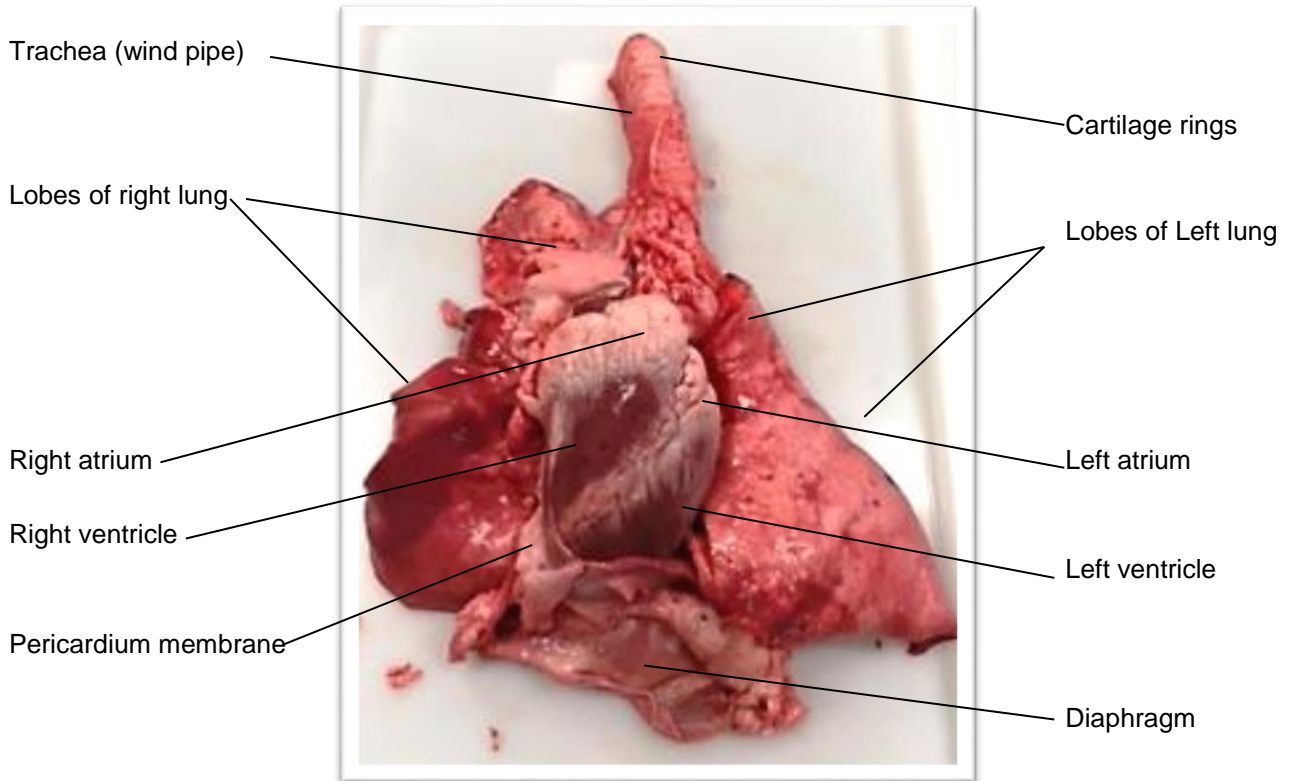


Figure1: The pluck showing the heart-lung arrangement and diaphragm. (Image by K. Szalai 2016)

Figure 2a & 2b: Showing the lungs partially and fully inflated. (Image by K. Szalai 2016)



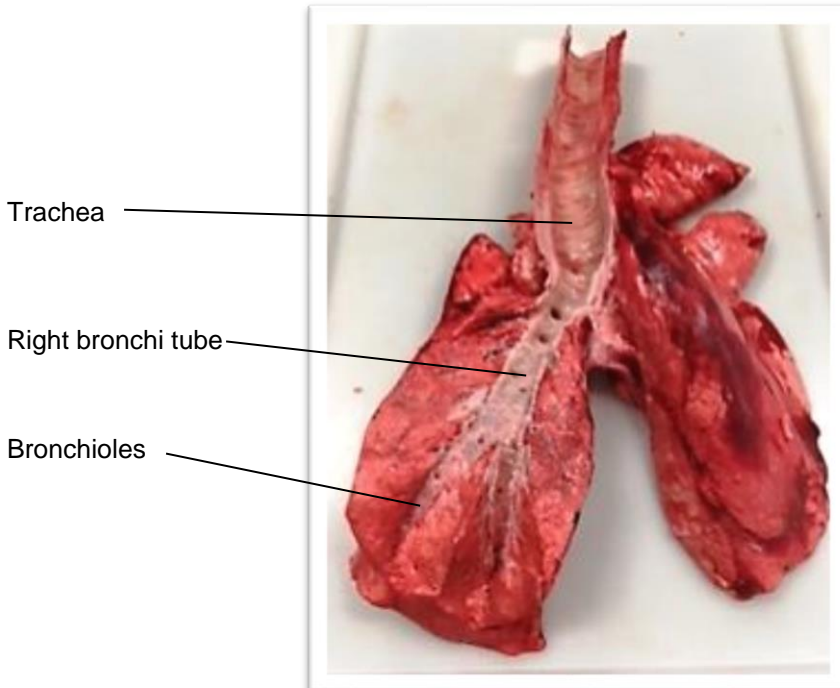


Figure 3a: Shows structure of the dissected right lung and trachea. (Image by K. Szalai 2016)



Figure 3b: Sections of the trachea showing cartilage rings. (Image by K. Szalai 2016)

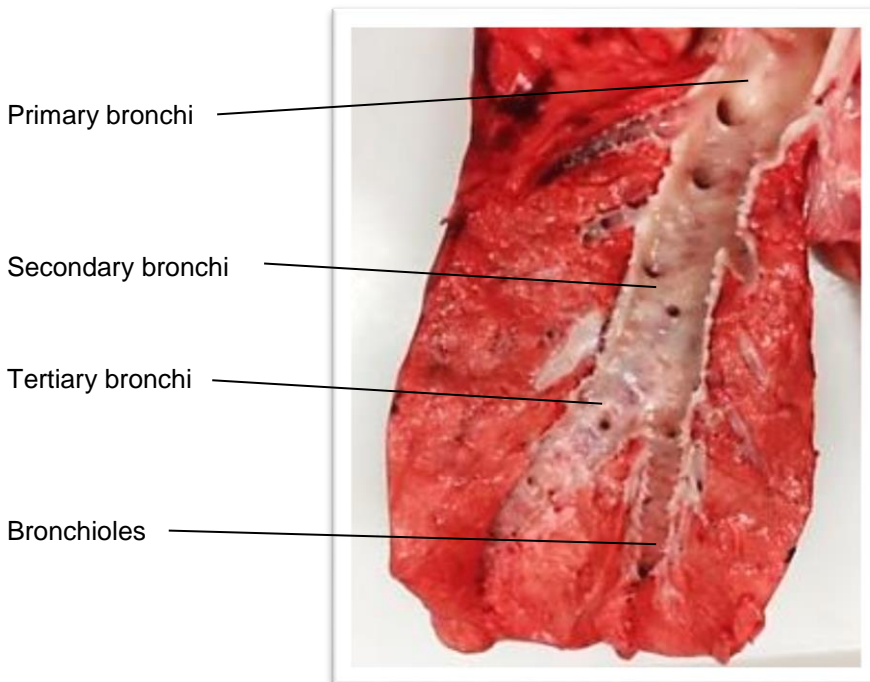


Figure 3c: Shows a close-up of the bronchial tubes and cartilage rings. (Image by K. Szalai 2016)



Figure 4: Shows a comparison between pieces of lung tissue and diaphragm muscle when placed in water. (Image by K. Szalai 2016)

Bronchi, Bronchial Tree, and Lungs

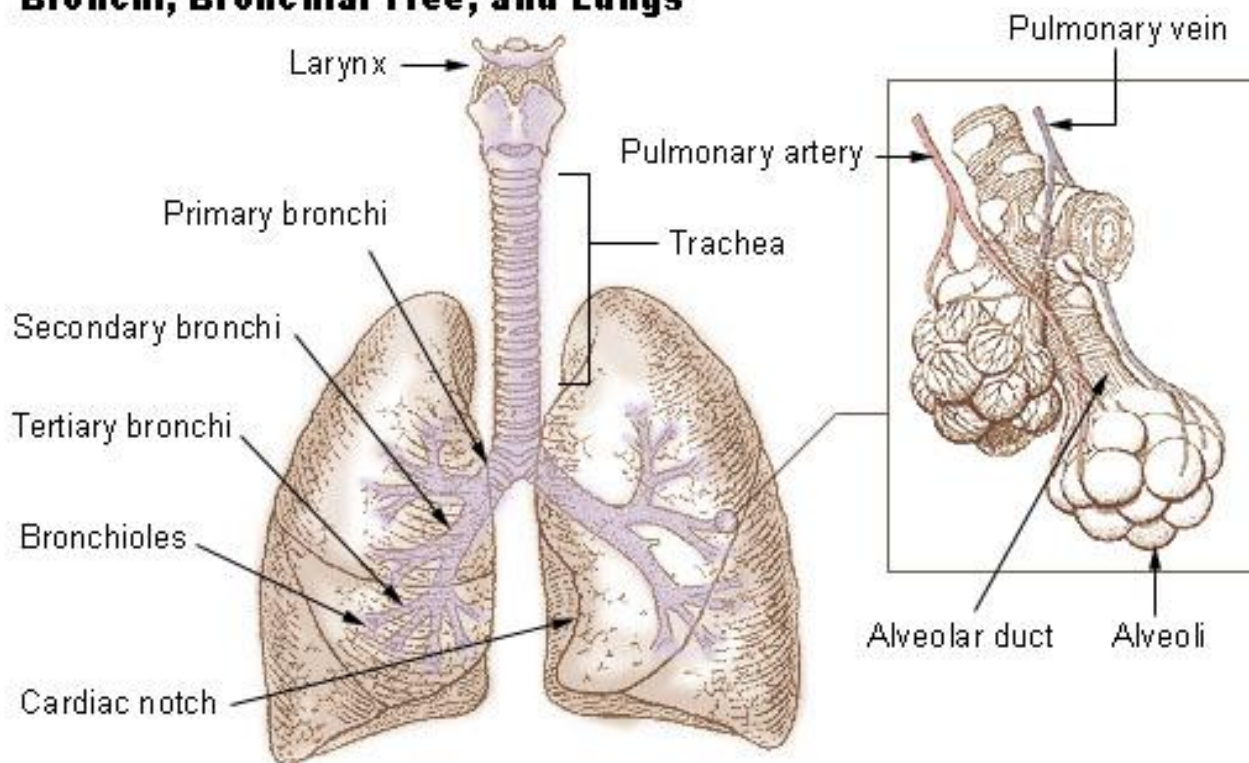


Diagram 1. Labeled structure of the lungs and alveoli.
Wikimedia Commons, lllu_bronchi_lungs.jpg (Accessed July 2016)

Glossary

Alveolar duct – the air passage leading to the alveolar sacs.

Alveoli – tiny air sacs at the end of the bronchioles in the lung where the exchange of oxygen and carbon dioxide takes place.

Arteries – the blood vessels that carry oxygenated blood from the heart to the rest of the body.

Atrium – one of the two blood collection chambers of the heart.

Blood – the liquid that circulates in the blood vessels of many animals.

Blood vessels – the veins, arteries and capillaries through which blood flows around the body.

Bronchi – tubes in the lungs dividing into bronchioles.

Bronchioles – the tubes leading off from the bronchi in the lungs.

Bronchus – one of the two tubes that lead from the trachea to the lungs.

Capillaries – thin-walled blood vessel-like tubes carrying blood to body cells.

Cardiac notch – the deep notch in the alimentary canal at the junction of the oesophagus and the stomach.

Cartilage – flexible connective tissue in animals, including the joints between bones, the rib cage, the ear, the nose, the bronchial tubes and the intervertebral discs.

Diaphragm – the muscle that runs across the base of the chest cavity and separates the thorax and the abdomen. It causes the lungs to expand and contract during breathing.

Heart – the muscular organ that pumps blood around the body.

Larynx – the muscular and cartilaginous structure, lined with mucous membrane, situated at the top of the trachea.

Lungs – inflatable organs used to breathe in oxygen and breathe out carbon dioxide.

Oesophagus – the tube connecting the mouth to the stomach.

Pericardium membrane – the layer of tissue surrounding the heart.

Pleural membrane – the thin layer of connective tissue covering the whole of the lungs.

Pulmonary vein – the large blood vessels that receive oxygenated blood from the lungs and drain into the left atrium of the heart.

Pulmonary artery – the artery that carries deoxygenated blood from the heart to the lungs.

Pluck – heart-lung set from a sheep, pig or cow.

Thoracic – relates to the chest cavity of an animal.

Trachea – the tube through which air enters the lungs from the nose.

Veins – the blood vessels that carry blood in the body or lungs towards the heart.

Ventricle – one of two large chambers that collect and expel blood received from an atrium.

History of reviews

Date	Version Number	Notes
Sept 2016	Version 1.0	
Sept 2016	Version 2.0	Correction to first aid information for eyes