

STANDARD OPERATING PROCEDURE:

Performing a rat 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

A rat dissection is conducted to explore the internal structure and function of basic mammalian anatomy. The purpose of this exercise is to explore the alimentary canal of the rat and observe the different parts of the digestive system. By looking at the length of the digestive system of the rat, information about their dietary pattern can be determined, and comparisons made between the rat and other mammals such as omnivores, carnivores and herbivores. Because the rat is a placental mammal and an omnivore it has a body structure very similar to that of humans.

Prior to conducting a rat dissection, teachers should ensure that they are able to meet the requirements of the Schools Animal Ethics Committee (SAEC) in their jurisdiction. It is recommended that they consider the educational objectives for this activity, explore the ethical considerations with students and aim to reduce the total number of rats required for this activity. Students should not be forced to participate in a dissection and alternative activities such as videos and virtual dissections can be used for these students instead, as well as to supplement the actual activity.

Rats that have been humanely euthanised and are disease (or infection) free should be sourced from ethical and licenced suppliers. They can be supplied as freshly euthanised, frozen or preserved specimens. If using preserved rats, obtain and read the safety data sheet (SDS) from the supplier and prepare a site-specific risk assessment. If freshly euthanised or recently defrosted rats are being used, and the dissection is interrupted, the rats can be kept for a short time (no longer than 24 hours) in the coldest part of the laboratory fridge or placed in a freezer. There is potential for bacterial growth.

2. Context

- These instructions are for the use of experienced science teachers, 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 them to adjust to the appearance of the material, and any blood that may be present after 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

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 minutes¹

Handling specimens:

- If using preserved rats, it is important to take note of the preservative solution that the rats are in and the recommended precautions.
 - Rinse the preserved rats under running water immediately upon removal from the preservative solution.
 - Work in a well-ventilated area.
 - It is recommended that people wearing contact lenses should not dissect rats that are in preservative solution. The fumes from the solution can penetrate between the eye and contact lens causing irritation to eyes. It is recommended to wear prescription glasses instead with safety glasses over them OR prescription safety glasses.
- Consider issues such as allergies and chemical sensitivities from handling freshly euthanised or recently defrosted or preserved rats.
- Be aware of possible microbial aerosols and unpleasant odours released from freshly euthanised or recently defrosted rats if the stomach/intestines are accidentally cut.
- If using frozen rats, defrost overnight in a refrigerator beforehand and use within 24 hours.
- 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.

Safety with scalpels:

- Ensure students demonstrate responsible behaviour while using scalpels.
- Only staff should carefully attach and remove scalpel blades. The scalpel blade size and handle must be compatible, e.g. number 4 handle with number 23 blade.
- Keep the blade in the foil wrapper and attach to the handle with the sharp side of the blade pointing away from the body.
- Blades should be removed carefully using pliers, forceps or a commercial blade remover.
- An alternative is to use disposable scalpels.

4. Regulations, licences and permits

Some SAECs may require permission well in advance of the activity being conducted. In some jurisdictions, all dissections need to be reported to the SAEC.

Science ASSIST has developed an information sheet with links to biological safety and jurisdictional SAECs, see [AIS: Links — Biological sciences safety](#)

Rats that have been humanely euthanised and are disease (or infection) free should be sourced from ethical and licenced suppliers.

5. Equipment

- PPE – Lab coat/apron (it is recommended to use plastic disposable aprons), safety glasses and gloves.
- Scalpels
- Scissors
- Forceps
- Probes
- Dissecting pins/needles
- Dissecting boards covered with newspaper. Glazed ceramic tiles, nylon plastic boards, vinyl dissection pads or disposable foam trays are suitable.
- String
- Paper towel
- 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

6. Operating procedure

Preparation

- If any blood is associated with the rats 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, dissecting pins and probes should be counted out, and counted in when returned.

Examining and dissecting the rat

1. First identify all the external structures visible on the head, thorax and abdomen of the rat. **See Figure 1a.**
2. Observe the mouth cavity and teeth of the rat.
3. Place the rat on the dissecting tray on its back. String is used to fasten the limbs of the rat back. Tie string firmly around one wrist, pass the string under the tray and tie it firmly to the other wrist. Repeat with the hind limbs. **See Figure 1b.**
4. Pick up the skin in the middle of the ventral surface using forceps. Cut (see incision lines in figure 1b) the skin and underlying muscles with the blunt end of the scissors pointing downwards. Cut towards to the bottom of the ribs and then in the other direction to the genital openings. Cut across the bottom of the ribs, and then cut out to both the hind legs.
5. Peel back the flap of skin from the underlying muscle and notice the connective tissue between them. Use the dissecting pins to pin out the skin of the rat to the dissecting board. **See Figure 2.**
6. Open up the abdominal cavity by lifting the abdominal wall with forceps, make an incision with the scissors and follow the same procedure as in step 4 above. Be careful that you do not damage any of the abdominal organs by making the incision too deep.
7. Peel back the abdominal wall and pin out revealing the abdominal organs. **See Figure 3.** Examine the digestive organs in situ and identify all the structures in place. Notice the scattered cream coloured fat deposits. Note the size of the liver in proportion to the abdomen.
8. Remove the digestive system by cutting the oesophagus above its connection with the stomach and by cutting the rectum. Notice the way the small intestine and large intestines are twisted over one another. **See Figure 4.**
9. Using your fingers, carefully pull apart the duodenum and colon from the connective tissue by gently tearing the mesentery and carefully stretch out the alimentary canal. Measure the length of the alimentary canal and the rat's body comparing the ratio of these figures. **See Figure 5.**
10. Note the size of the liver and caecum in relation to the rat's body.

(Operating procedure cont.)

11. Remove the liver carefully and compare the colour of the spleen and liver. Note there is no gall bladder in the rat.
12. Observe the exposed kidneys and associated urinary organs, and the reproductive system left behind in the abdominal cavity. **See Figure 6**
13. If time allows for further investigation, open the thoracic (chest) cavity by making a mid-ventral cut using blunt end of scissors cutting forward through the diaphragm muscle and breast bone up to just under the chin of the rat.
14. The diaphragm, which separates the thoracic from the abdominal cavity, can be cut away from the rib cage.
15. Cut away the ribs to reveal the heart surrounded by a thin membrane called the pericardium, the whitish thymus gland that lies directly over the upper part of the heart and the lungs that lay either side of the heart. **See Figure 7.**
16. Remove the heart and thymus gland to locate the trachea (wind pipe) identifiable by its rings of cartilage. The oesophagus lies just underneath the trachea.

More detailed information on a rat dissection can be found on the following websites below.

'Digestive System. Rat digestive system'

<https://ratdissection.wikispaces.com/Digestive+System>

'Rat dissection', www.biologycorner.com/myimages/rat-anatomy

Clean up:

- Make sure all instruments are returned.
- All parts of the rat, 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 be immediately soaked in disinfectant. Otherwise wash equipment in hot soapy water and rinse or place in 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'***ⁱⁱ

- 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.
- 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:** Do not induce vomiting. Rinse mouth with water, and then give water to drink. Seek urgent 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.
- Care should be taken with sharps such as scalpel blades and scissors.
- See safety notes if it is necessary to remove broken or used scalpel blades.
- Store all dissecting instruments securely.
- First aid: cuts and lacerations should be washed under running water, then patted dry and covered with a clean paper towel or tissue in the first instance and referred to the school first aid officer for assessment.

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.
- Specimens preserved in Carolina's Perfect Solution[®] are not subject to hazardous materials regulations or disposal restrictions in Australia. Refer to SDS and treat as above for biological material.

9. Related material

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

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.

'Animal use decisions', WA Department of Education website,
<http://www.det.wa.edu.au/curriculumsupport/animalethics/detcms/navigation/animal-use-decisions/?page=10#toc10> (September 2014)

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

'Digestive System. Rat digestive system', Wikispaces,
<http://ratdissection.wikispaces.com/Digestive+System> (Accessed January 2016)

'Safety note – Preserved specimens', Southern Biological website,
http://file.southernbiological.com/Assets/Products/Specimens/Preserved_Specimens/SafetyNotePreservedSpecimens.pdf (Accessed February 2016)

'Specimens in Carolina's Perfect Solution®', Material Safety Data Sheet, Carolina Biological Supply Company, Southern Biological website,
http://file.southernbiological.com/Assets/Products/Specimens/Preserved_Specimens/PerfectSolutionSpecimens.pdf (April 2011)

Figures

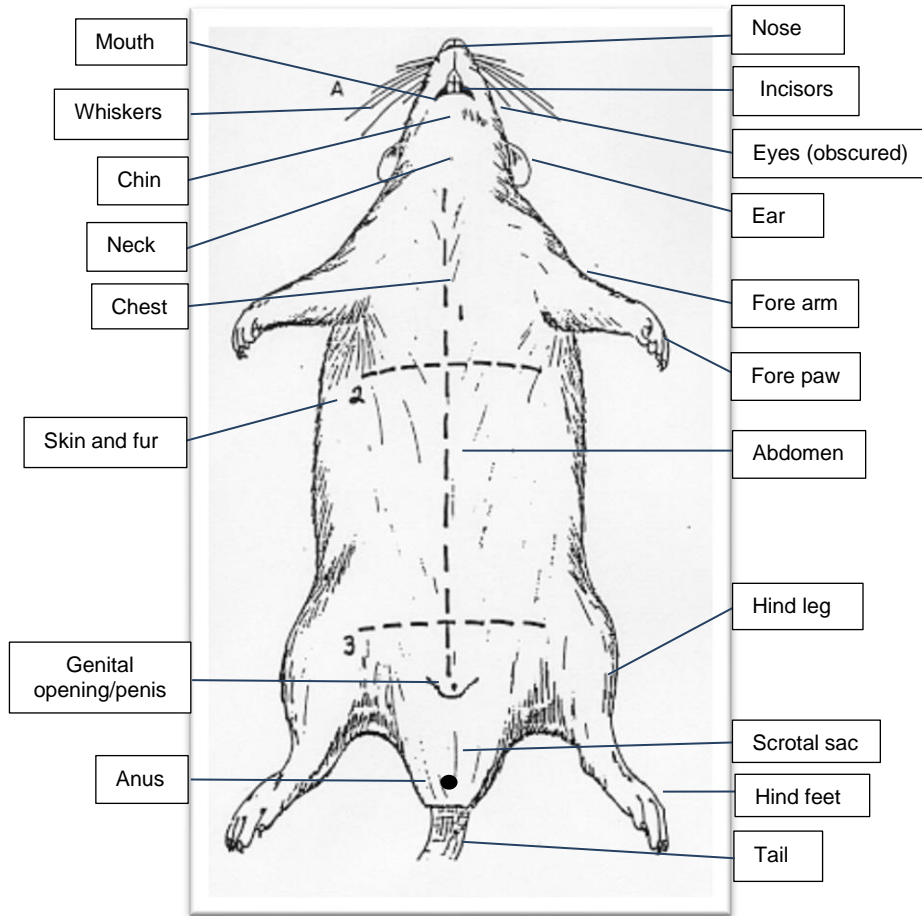


Figure 1a: The external structures visible on the head, thorax (chest) and abdomen including incision lines numbered 1, 2 and 3.



Figure 1b: The dotted lines show the incision lines for dissection of rat. (Image by K. Szalai, 2016)



Figure 2: The abdominal wall exposed. (Image by K. Szalai, 2016)

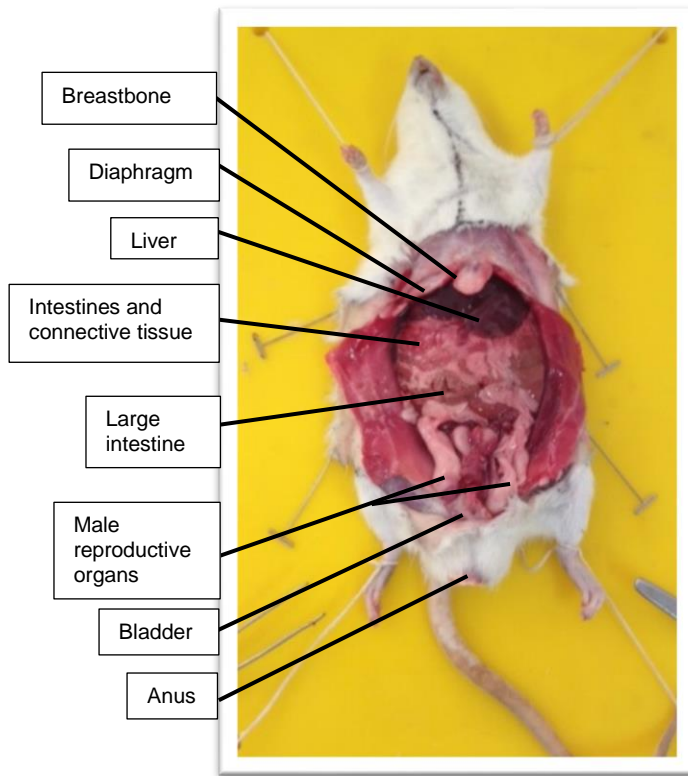


Figure 3: The abdominal organs of the rat in situ. (Image by K. Szalai, 2016)

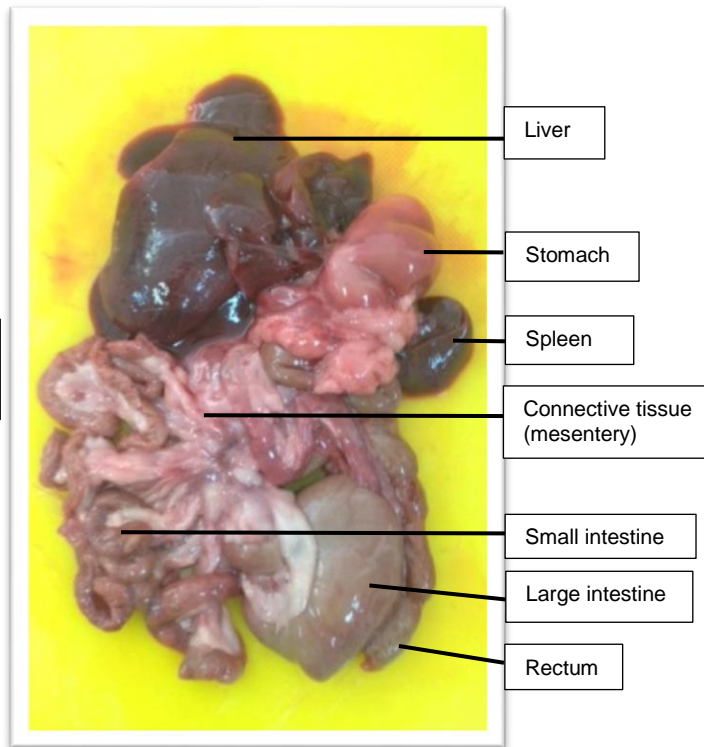


Figure 4: Abdominal organs removed. (Image by K. Szalai, 2016)

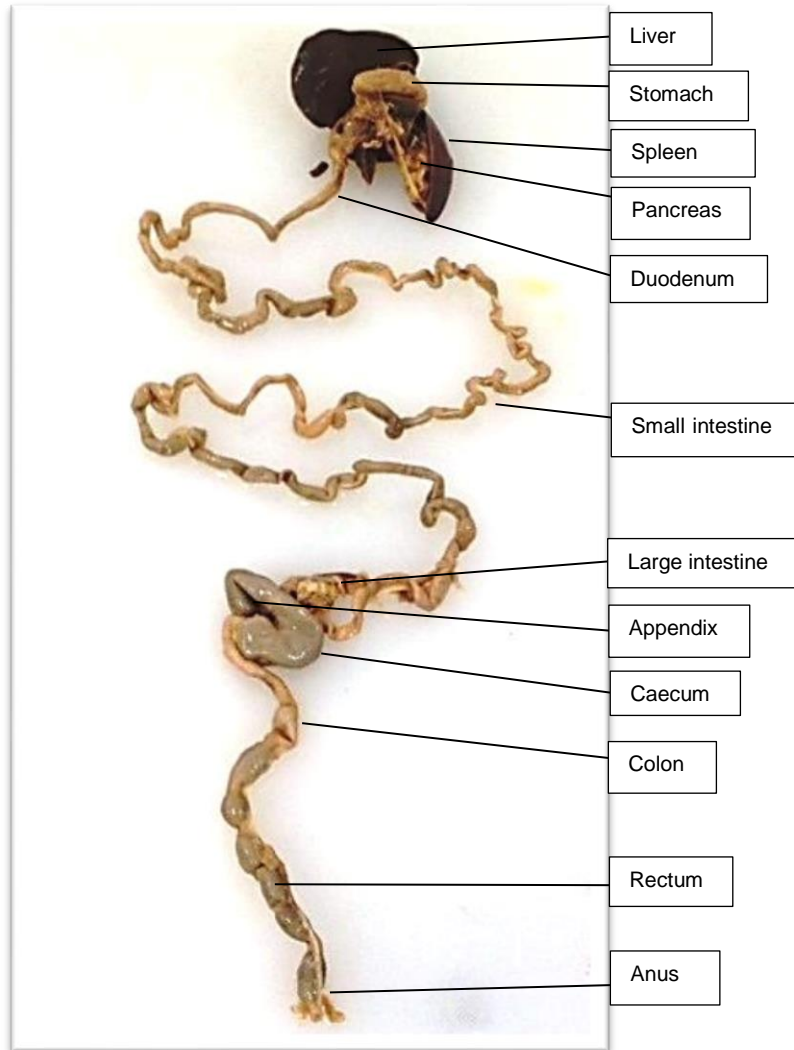


Figure 5: The alimentary canal of the rat with the connective tissue removed. (Image by K. Szalai, 2016)

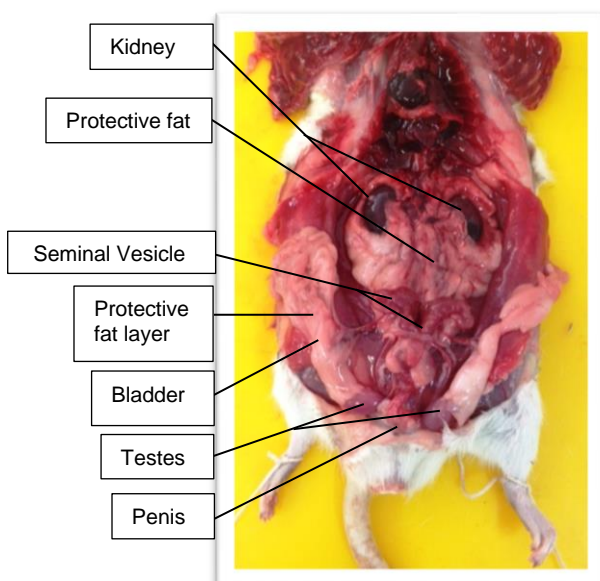


Figure 6: Male Urinogenital system (Image by K. Szalai, 2016)

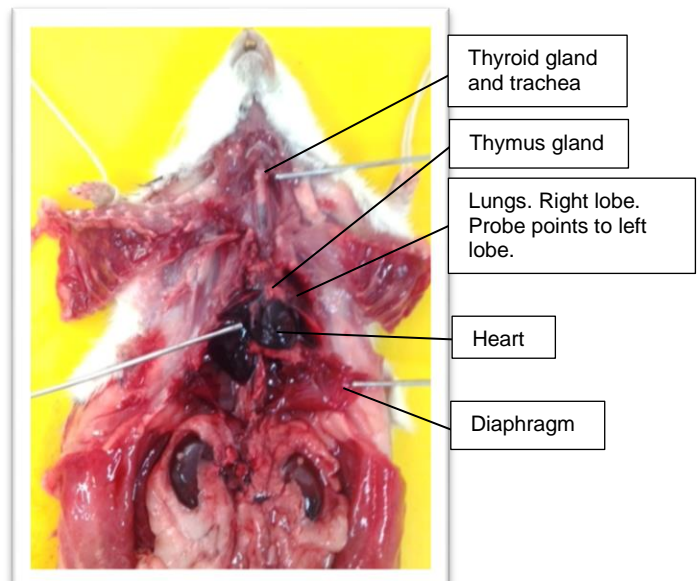


Figure 7: Thorax and neck. (Image by K. Szalai, 2016)

Glossary

Abdominal wall – the lining that encloses the abdominal cavity, consisting mostly of muscle.

Alimentary canal – the tubular passage between the mouth and the anus.

Anus – the last part of the large intestine through which the faeces are excreted.

Appendix – a small tube with only one opening, near the beginning of the large intestine.

Bladder – the organ where urine is stored in the body.

Blood – liquid that circulates in the blood vessels of many animals. It contains plasma, red and white blood cells, platelets, dissolved gases, nutrients, hormones and salts.

Breast bone – the long flat bone shaped in the middle of the chest, forming the front of the rib cage.

Caecum – large organ where the small intestine joins the large intestine.

Carnivore – an animal that eats only meat.

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.

Colon – the section of the large intestine that runs from the caecum to the rectum and absorbs water from faeces.

Connective tissue – animal tissue that supports, connects, and surrounds organs and other body parts.

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.

Digestion – the process of converting large, complex organic molecules to smaller, simpler ones that can pass through cell membranes.

Digestive system – the parts of the body where food is digested.

Duodenum – the top part of the small intestine, where bile and pancreatic juice enter the digestive system.

Faeces – undigested food and bacteria that is stored in the rectum and expelled through the anus.

Gall Bladder – small organ that is located beneath the liver and drains bile into the duodenum primarily to break down fat during digestion.

Heart – muscular organ that pumps blood around the body.

Herbivore – an animal that eats only plants.

Incisors – the two front teeth in each jaw of a mammal used for cutting food.

In situ – in its original place.

Kidneys – the major excretory organs that filter the blood, and maintain the concentration of water and salts in the body. They form urine in which excess salts, water urea and waste products are removed from the body.

Large intestine – the end section of the alimentary canal reaching from ileum to anus and consisting of the caecum, colon, and rectum. Its function is to extract water and form faeces.

Liver – a large organ in mammals that controls the level of nutrients and toxic substances in the blood. Has a digestive function, secretes bile, filters blood, and takes part in many metabolic functions such as the conversion of sugars into glycogen.

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

Mammal – class of warm-blooded vertebrate animals.

Mechanical digestion – the breaking down of large pieces of food into smaller pieces.

Mesentery – a supportive membrane surrounding and giving structure to the inner organs.

Oesophagus – the passage down which food moves between the throat and the stomach.

Omnivore – an animal that eats both plants and animals.

Pancreas – an organ in the body that produces pancreatic juice that helps to digest food.

Penis – male sex organ used to transfer semen and expel urine from the body.

Pericardium – membrane that forms a sac surrounding the heart and attached portions of the main blood vessels.

Placental mammal – the embryo develops in the maternal uterus attached to the tissues of the placenta.

Rectum – the last part of the large intestine where faeces is stored.

Scrotal sac – the sac of skin that holds the testicles.

Seminal vesicle – the gland that secretes seminal fluid in semen.

Small intestine – the part of the intestine between the stomach and the large intestine, consisting of the duodenum, jejunum, and ileum, where digestion of food and most absorption of nutrients take place.

Spleen – organ in the left upper abdomen of humans and other vertebrates that helps to destroy old red blood cells, form lymphocytes, and store blood.

Stomach – a hollow muscular organ where mechanical and chemical digestion takes place.

Testes – male sex organs that produce sperm.

Thoracic –relates to the chest and cavity of an animal.

Thorax – the part of the body between the neck and abdomen, enclosed by the ribs and containing lungs, heart and diaphragm.

Thymus – the organ, located at the base of the neck, and is involved in development of cells of the immune system.

Thyroid gland – endocrine gland located in the neck of human beings and other vertebrate animals that secretes the hormones responsible for controlling metabolism and growth.

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

Ventral surface – the surface of the abdomen or lower body.