

THE RAT DISSECTION (MAMMALIA) P530

©BBUMBA PATRICK
Bumbax22@gmail.com

INTRODUCTION

Rats are *vertebrates or backboned animals* and also mammals. Mammals share many common characteristics such as *body hair*, *mammary glands* and *specialized teeth*.

Some internal features common to all mammals are *diaphragm*, *a four-chambered heart* and *similar specialized systems*.

By observing the *internal* and *external anatomy* of the rat, you will be able to learn more about these common traits shared by mammals.

DISSECTION TERMINOLOGY

1. Anterior –toward the head
2. Posterior – toward the tail
3. Dorsal – toward the backbone
4. Ventral – toward the belly
5. Lateral – toward the side
6. Medial – toward the midline
7. Proximal – lying near the point of reference
8. Distal – lying further away from the point of reference

Tools used in dissection

- ✓ Tweezers / forceps
- ✓ Scissors
- ✓ Scalpel
- ✓ Pins
- ✓ Probe
- ✓ Dissecting dish/board

N.B: *The teacher should ensure that the learners know all these basic instruments and there usage*

STARTER ACTIVITY FOR

Complete the following questions as you interact with the

1. Observe the dorsal and ventral side of the specimen; which structures can you identify?
Dorsal side ----- Ventral side -----
2. Is the specimen male or female?----- which structures indicate the sex of the specimen identified ----- identify the number of each identified structure;-----

3. Examine the hind legs. How many toes are present on each foot? -----
----- 4. Describe the structure of the fore and hind foot; (a) fore foot -----
----- (b) hind foot -----
----- 5. Use a ruler to measure your rat, measure from the tip of the head to the end of the rat's tail; measure the tail alone. Compare the length ratio of whole body and tail with that of tail alone. -----

IDENTIFYING EXTERNAL ANATOMY

1. Nostrils – allows air into the trachea, found at the anterior of the rat's body
2. Teeth – 2 incisors for biting and tearing and 6 molars for chewing
3. Eyelid – one upper and one lower to protect the eyeball
4. Nictitating Membrane – a third lid-like transparent membrane that covers the eyeball
5. Vibrissae – whiskers that are extremely sensitive to touch and possibly changes in air pressure
6. Pinnae – external ears used to sense sound
7. Forelimbs – front legs used for grasping and holding
8. Hind-limbs – back legs used for running, climbing and jumping; are more powerful than forelimbs
9. Digits – finger-like projections on limbs
10. Digital Pads – swollen, thickened skin located on tips and bases of digits

11. Foot Pads – swollen, thickened skin on the sole of each foot
12. Urethral Aperture (female only) – opening for release of urine in females
13. Vaginal Aperture (female only) – female genital opening
14. Anus – posterior opening located at base of tail for excretion of solid waste
15. Urinogenital Aperture (male only) – opening of the penis; discharges urine and sperm
16. Scrotum (male only) – a double pouch that contains two testes
17. Mammary Papillae – 12 nipples used for

Note: The body is divided into a head and trunk, separated by the neck region. On the head region, locate and be able to identify on the rat each of the external features listed above.

To examine the teeth, you will have to make an incision / cut through each cheek with your scissors and pry open the mouth with your probe.

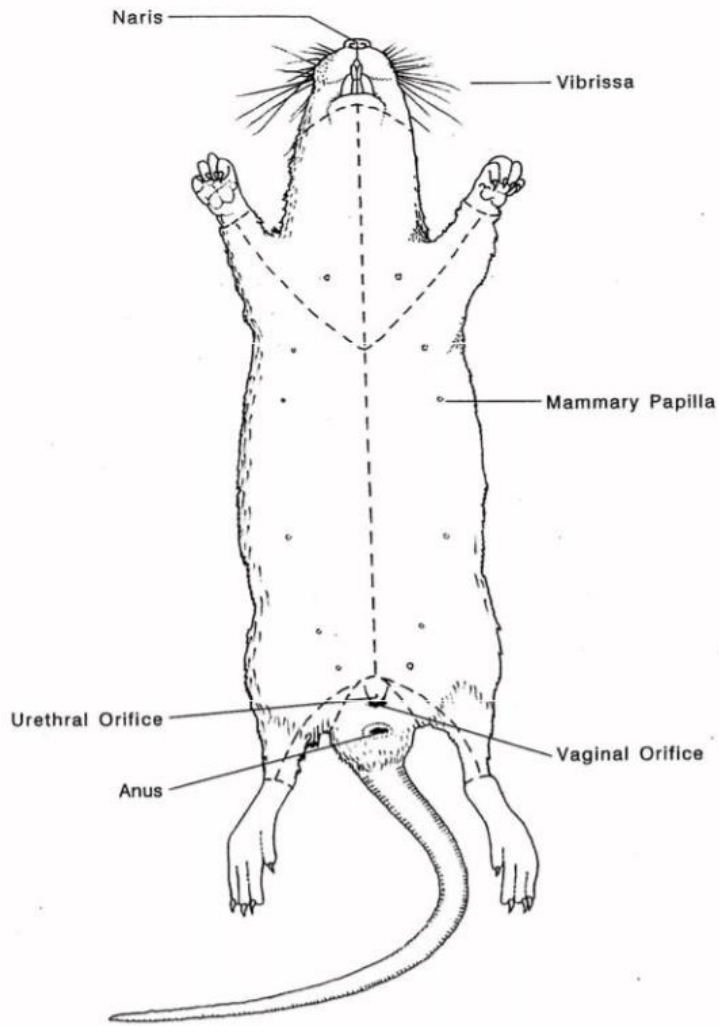
Write the dental formula of the rat -----

The tail is sparsely covered with hair and bears reptile-like scales of epidermal origin. There are **two pairs** of appendages attached to the trunk, the *hind limbs arising from the pelvic region* and the *forelimbs arising from the shoulder region*. On each of these **feet**, are the **digits**, **digital pads**, and the **foot pads**.

STRUCTURES VISIBLE ON THE VENTRAL SURFACE

- On the ventral surface of the trunk region are two rows of mammary papillae, which extend from the armpit region to the groin region on either side of the midline. In rats there are usually 12 pairs which are most prominent in pregnant or lactating females.
- Also, visible on the ventral surface is the anus just beneath the base of the tail. Slightly *anterior to the anus are the urinogenital openings*. In females there are *two separate openings*: the *anterior urethral aperture* leading from the *urinary system* and the more *posterior vaginal aperture* leading from the *reproductive tract*.
- In males the urinary and reproductive systems share a single opening (urinogenital aperture) at the *tip of the penis* which is hidden in a fold of skin (*prepuce*) located between the prominent scrotum.

Ventral surface of the female rat



Short notes:

Classification of the rat

Kingdom: Animalia

Phylum: Chordata

Class: Mammalia

Order: Rodentia

Family: Muridae

Genus: Rattus

Species: *Rattus norvegicus* (white rat)*Rattus rattus* (black)

NOTE: *organisms belonging to the same group of classification; bear common features from which taxonomists base to place it as shown below*

Identification of the rat: A rat is a mammal**Reasons:**

- Posses external ear lobes/pinnae
- Body/skin is covered with fur
- Posses a post anal tail
- Posses nipples

NB: internal features such as

Possession of a diaphragm; Heterodont teeth, should not be given as reasons for identification as these are not visible externally though they are characteristics of mammals

Reasons for phylum chordata,

- post anal tail
- Pentadactyl limb from more than one body part
- Spinal cord after dissection
- Presence of vertebral column felt from the back

Reason for class Mammalia

- Body covered with fur
- External ear lobes
- External genitalia ie possession of scrotal sac in males and vaginal opening in female
- Separate anal and genital opening
- Nipples leading from mammary glands for female rats

Reasons for order Rodentia

- Presence of vibrissae
- Possession of chisel-shaped teeth with two inner incisors in upper jaw

Reasons for family Muridae

- Possession of head with pointed snout
- Possession of naked soles
- Possession of scaly tail with very fine, scanty and short hairs

Reasons for speciesBody skin covered with white fur (*Rattus norvegicus*)**Body divisions**

The body of the rat is divided into 3 regions namely; **Head, Neck and the Truck**, which is all covered with a skin

The skin

- It is covered with fur/hairs that help the animal to maintain body temperature

Short notes

STRUCTURES OF THE EXTERNAL ANATOMY, THEIR DESCRIPTION, POSITION WITH THEIR SIGNIFICANCE TO THE RAT

Head

Description

- ✓ It *Tapers anteriorly* where the mouth is small and bounded by soft upper and lower lips, *and broad posteriorly* therefore the head is *cone shaped*.

Significance

- ✓ It gives the animal a streamlined shape which helps it to move easily without much interference with air resistance

Features on the **head** include: **eyes, ears, nostrils,**

Eyes: Position and structure

- Eyes are located *dorso-laterally* on the head. Small pair of eyes, round shaped with a slit like opening boarded by two flaps of skin called eye lids.
- They are large with movable lower and upper lids with eyes lashes. At the corners of the eyes are nictitating membranes.

Significance

- Position gives the animal a *wide field of view* in the habitat helping it to detect prey and predators from a wide area
- The nictitating membranes can be moved across the eyes to wash them of foreign particles
- The eye lashes protect the eye from entry of dust and small insects
- Movable eye lids to allow opening and closure of the eye

Ear lobes (pinnae)

Position: Dorso-laterally located on the head at the posterior end behind the eyes to trap sound waves from a wider area of the environment

Description of ear lobe structure

- Large, funnel shaped, flexible with prominent blood vessels on the inner surface covered with less hair at the opening into the auditory canal

Significance

- Large to collect sound waves from a wider area of environment
- Funnel shaped to trap more sound waves via auditory canal to the middle ear
- Flexible to be easily turned in all directions to trap sound waves
- Prominent blood vessels for easy radiation of heat its hot
- Covered by short scanty hair to allow loss of heat by radiation of heat when it's hot
- Inner surface bears relatively long hair to prevent foreign particles from entering into the ear

Mouth: it is Ventral-anteriorly located on the head below the nostrils; **Significance** - For easy ingestion of food

Description of Structures of the rat's mouth

- ✓ Triangular, lower lip is movable and shorter exposing the lower incisors, upper lip is fixed and longer,
- ✓ longitudinally divided into two halves by a cleft exposing the upper incisors. The upper lip is folded
- ✓ Diastema separates freshly ingested food from food that has been chewed.
- ✓ -lower incisors are longer, curved inwards, chisel shaped and hard
- ✓ Upper, incisors are shorter curved inwards, chisel shaped hard

Adaptations of the lips to their function

- ✓ The lower lip is shorter exposing the incisors for easy gnawing of food materials
- ✓ The lower lip is movable to prevent ingested food from falling out of the mouth
- ✓ The upper lip is longer to prevent ingested food from falling out of the mouth
- ✓ The upper lip is suspended into two halves by a cleft exposing the upper incisors for easy gnawing of food materials
- ✓ The upper lip is folded inwards in the diastema to separate freshly ingested food

Adaptation of the incisor teeth to their function

- ✓ The lower incisors are long to interlock with the upper incisors during cutting/gnawing of food
- ✓ They are curved for interlocking with upper incisors
- ✓ Chisel-shaped with upper edge for cutting food materials
- ✓ Hard to cut materials of varying hardness

DRAWING OF THE BUCCAL CAVITY AND PHARYNX OF THE RAT

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

TONGUE

Attachment

At posterior end of the lower jaw in the pharyngeal region

Significance

For easy manipulation of food into a bolus and for easy swallowing

Description of tongue structure

Long, moistened, rough, elastic flattened broad at the base

Relating structure to function

- Long for efficient manipulation of food into a bolus
- Moist to soften food for easy rolling of food into a bolus
- Dorso-ventrally flattened to expose more taste buds for tasting food
- Broad at the base for firm attachment
- Flexible for efficient rolling of food
- Rough for physical digestion during manipulation

Nostrils

Anteriorly located on snout above the mouth

Significance

- For efficient exchange of gases
- For easy detecting smell of food
- For detecting chemical substances

Description of nostril structure

- Small opening, inner lining is moist, comma-shaped

Significance

- Open for free entry and exit of gases and free entry of chemicals to the olfactory centre
- Small for entry of exit of large particles
- Moist inner surfaces for efficient sense of smell

VIBRISSAE/WHISKERS

Description of vibrissae structure

- Long, stiff, thick arranged in the rows

Relating structure to function

- Long to detect changes at a distance stiff and thick to prevent distortion

DRAWING OF THE LATERAL VIEW OF THE HEAD OF THE RAT

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

DRAWING OF THE VENTRAL VIEW OF THE HEAD OF THE RAT

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

A PAIR OF FORE LIMB

- Ventrally attached to the anterior end of trunk

Description of the Structure

- Short and stout; one joint in the main limb axis, ends in four well developed digits
- The fifth is reduced to a stub/pollex with a short figure at the inner border
- The digits are jointed with varying length
- They are spread out, digits end in pointed, hard, long curved claws, with five pads in the palm
- The palm is short

Significance

- Short for easy digging of burrow and absorbing shock
- Joint for flexibility during locomotion
- Digits are jointed for firm attachment (grip) and flexibility
- Digits are free to increase surface area for support during locomotion
- Long jointed curved claws for defense and digging burrows
- Soft pads for firm grip on smooth surfaces and to reduce noise when moving not to alert enemies

DRAWING OF THE FORELIMB OF THE RAT

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

DRAWING OF THE PALM (FORE FOOT) OF THE RAT

<p>The Hind limbs</p> <ul style="list-style-type: none">Ventrally attached at the posterior end of the trunk <p>Structure</p> <ul style="list-style-type: none">Two joints in the main limb axis, long, massive thigh, end in five well developed digitsJointed digits for varying length, spread outward, digits end in long, pointed, curved hard clawsSix soft pads elongated with hairless sole <p>Adaptations of the hind limbs to its survival</p> <ul style="list-style-type: none">Long to provide propulsive forces and flexibility during locomotionMassive thigh to generate a strong propulsive force during locomotion and pulling soil behind during digging burrowsDigits spread to provide support during locomotionJointed with varying length for firm gripSoft pads for firm grip on smooth surface and to reduce noise to prevent alerting enemiesLong, pointed, hard claws for firm grip on rough surface, protection against enemies	<p>DRAWING OF THE VENTRAL VIEW OF THE HIND LIMB OF THE RAT</p>
<div><p>THE TAIL</p></div> <p>Position: Dorso-laterally attached to the end of the truck</p> <p>Description: Broad at the base, tapering posteriorly/long and hairy, flexible, with scales which appear in rows</p> <ul style="list-style-type: none">Scanty hair, hard, and covered by a greasy substance <p>Adaptations of the tail</p> <ul style="list-style-type: none">Long enough for balancing the body during locomotionLong enough for whipping of enemiesBroad at the base for firm attachment to the trunkTapering posteriorly for air resistance during locomotionLong to cover the whole body to chase away vectors from all parts of the bodyLong to provide support during locomotion in an elevated head positionFlexible to easily be turnedScanty hair for sensitivityScales to protect the tail against abrasionHard to inflict pain on the enemy during whippingCovered by a greasy substance making it water proof to reduce water loss by evaporation	<p>DRAWING OF THE HIND FOOT OF THE RAT</p>
	<p>DRAWING OF THE TAIL OF THE RAT</p> <div><p>Marking points</p><p>Title</p><p>Magnification</p><p>Neatness</p><p>Outline</p><p>Drawing</p><p>Labeling</p></div>

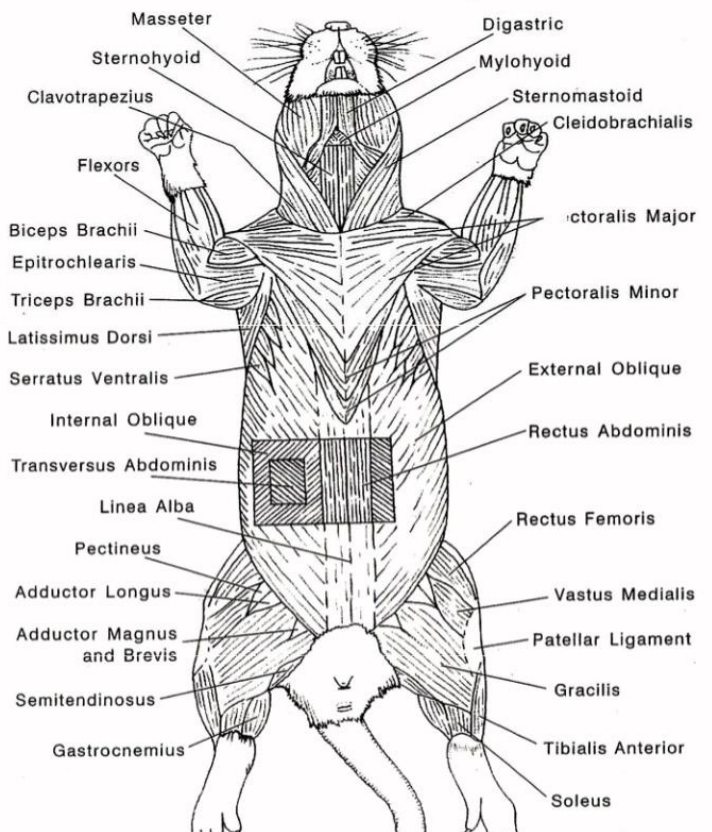
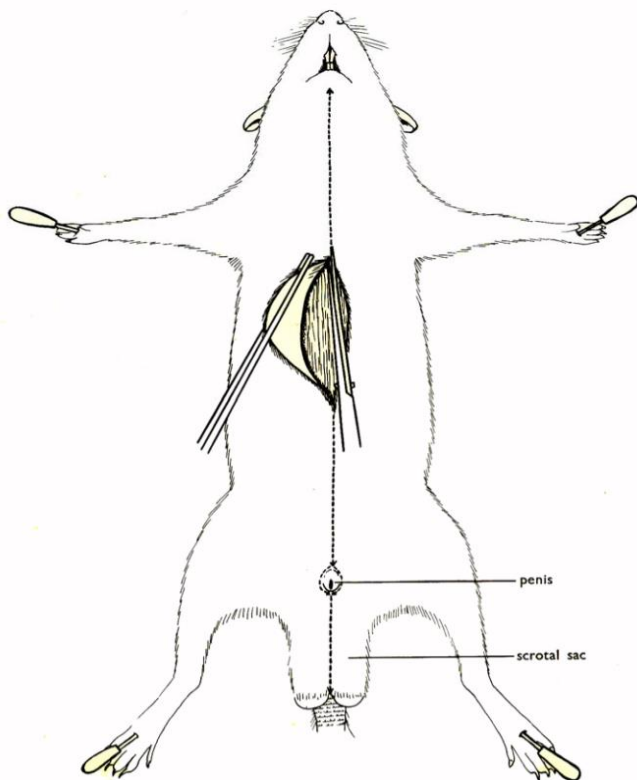
<div>Structure<div>Nipples</div><ul style="list-style-type: none">Pointed, cylindrical projection from the main body surface, hairless and occurs in 6 pairs<div>Vulva (in females)</div><div>Description of Structure<ul style="list-style-type: none">Round, elastic, with moist inner lining</div><div>Adaptations<ul style="list-style-type: none">Moist to reduce friction during copulationOpen to allow exit of materials and fertilization to take place</div><div>Structure<div>Scrotal sac (in males)</div><ul style="list-style-type: none">Elongated, swollen covered by a flap of skin baring scanty hair, hanging outside the body cavity<div>Significance<ul style="list-style-type: none">Swollen for storing and production of more sperm cellsCovered by scanty hair to maintain favourable temperature for sperm production</div></div> </div>	<div>Penis (in males)</div> <div>Structure</div> <p>Posteriorly; located below the tail</p> <ul style="list-style-type: none">Is covered in a sheath of skin called prepuce protecting it from mechanical damagePenis is short for efficient copulation <div>Anus</div> <div>Description of structure</div> <p>Small, round opening, elastic, with moist inner lining</p> <div>Significance<ul style="list-style-type: none">Open to allow exit of feecal matterElastic to allow exit of relatively large sizeMoist to reduce friction during movement of materials</div>
<div>SEX IDENTIFICATION OF THE RAT</div> <div>MALES: Have a projection, the penis with retractable prepuce<ul style="list-style-type: none">Scrotal sacs, and prepuce covering the penis</div> <div>Drawing of the ventral view of the male rat showing structures for sex identification</div>	<div>FEMALES</div> <ul style="list-style-type: none">Vulva, clitoris, teatsVulva and clitoris on the ventral sides of the groinHave a longitudinal slit, the vulva, on the ventral side of the groinhave four pairs of teats on the ventral side of the abdomen, which bear outlets of the mammary glands <div>Drawing of the ventral view of a female rat showing structures for sex identification</div>

Observing systems in the internal anatomy

The rat can be used to observe many systems in the investigations done depending on the questions given. Therefore, it is important that directions for dissections *be followed exactly*. **Do not remove any organ or structure unless you are directed to do so.** It is important to remember that dissecting does NOT mean “cut up”; in fact, it means “to expose to view”. *Careful dissection techniques are needed to observe all the structures and their connections to other structures.* You will not need to use a scalpel as it is not the best tool for dissection. **Scissors** serve better because the point of the scissors can be pointed upwards to prevent damaging organs underneath. **ALWAYS** raise structures to be cut with your forceps before cutting, so that you can see exactly what is underneath and where the incision should be made. Never cut more than is absolutely necessary to

DISSECTING A RAT TO PIN BACK THE SKIN SO THAT SUPERFICIAL STRUCTURES INCLUDING MUSCLES, SALIVARY GLANDS, LYMPH NODES, BLOOD VESSELS, NERVES WITHIN THE NECK, THORAX, ABDOMEN, FORE AND HIND LIMBS AND SKIN ARE EXPOSED

- Place the rat with its ventral side upper most facing upwards on a dissecting dish or board while stretching the body, fix pins through the feet
- Slit the skin along the mid-ventral line. Continue to cut forward to the level of the lower lip and backwards as far as the anus, passing on either side of Urogenital parts while cutting, keep the scissors as horizontal as possible to avoid cutting the body wall under the skin.
- Pull aside the skin loosening it from the body wall by using fingers. Be careful not to tear the nerves and muscles in the axillary region. The muscle on the ventral side is exposed



Throat and Oral Cavity

Be able to identify the structures illustrated on the drawing on the right side. The structures indicated are components of a variety of organ system.

Parotid Gland - *the major salivary gland. Its function is to secrete saliva containing starch digesting enzymes.*

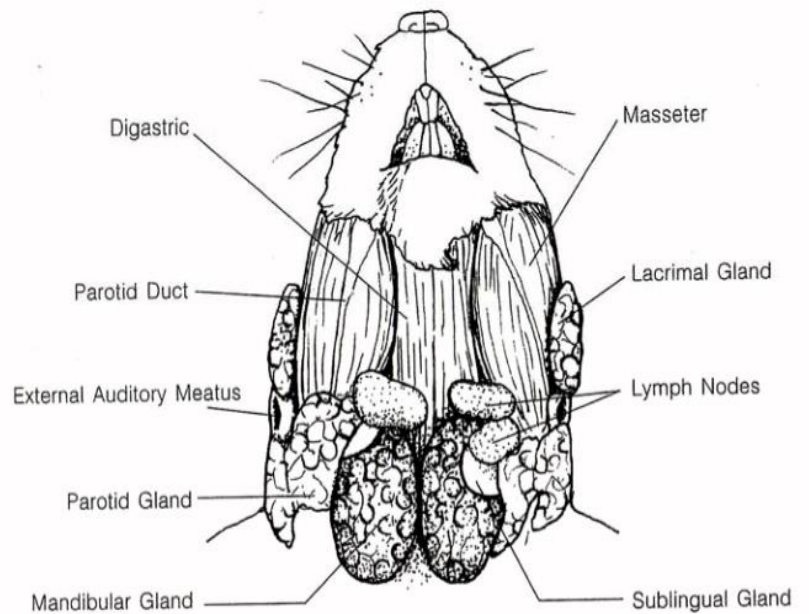
Parotid duct - *empties saliva from the Parotid Gland into the oral cavity.*

Mandibular gland - a salivary gland that secretes a thick mucous.

Sublingual gland - *a small salivary gland that empties into the oral cavity behind the lower incisors.*

Lymph Nodes - *part of the immune system.*

Lacrimal Gland - *secretes lacrimal fluid (tears) to lubricate the eye.*



Drawing showing the superficial structures of a rat with skin exposed to show muscles, lymph nodes, salivary glands within the neck, thorax and abdomen

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

Displaying the internal structures within the abdominal cavity of the rat

Procedure

- Pin the rat to a dissecting board, ventral surface and head pointing away from you
- make a mid-ventral **incision** through the skin and cut forward as far as backwards to the anus
- cut either side of the urogenital openings, and then free the skin from the underlying body wall
- stretch the skin and pin it back to expose the body cavity
- adjust the position of the pins through the legs so that the knees are fully extended
- lift the abdominal wall with forceps and make a mid ventral incision through the wall and cut forward as far as the xiphoid cartilage and backwards up to the genital structures
- stretch the abdominal wall and pin it back to expose content of the abdominal cavity

Relationships between structures in the thoracic cavity


- ✓ *Note the position of the multi-lobed lungs on either side of the heart and the position of the diaphragm and ribs.*
- ✓ The **heart** lies within **the pericardial cavity** formed from parietal pericardium.
- ✓ The surface of the heart is covered **with visceral pericardium**.
- ✓ Make sure you can distinguish between these two types of pericardium. Also make sure that you can distinguish between the parietal and visceral pleura.

The alimentary canal: This depicts greater differentiation into the regions than that of lower vertebrates. It consists of the mouth, oesophagus, stomach, duodenum, ileum, caecum, colon, rectum and anus

Drawing showing the alimentary canal of a rat and associated organs in the undisturbed condition (in

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

<p>Structure in relation to function</p> <p>The oesophagus</p> <p>It is a long tube that leads through the neck and thorax to the stomach. It is muscular and lined with stratified epithelium tissue internally</p> <p>Longitudinal folds close the lumen except when swallowing. At the distal end is a valvular arrangement, the cardia, which prevents regurgitation of food from the stomach</p> <p>The stomach</p> <ul style="list-style-type: none"> • A large ovoid sac lying transversely across the abdomen beneath the diaphragm. It acts as; • A temporary store of food giving chance for action of enzymes • A site for the digestion of proteins • A site for the absorption of water • The stomach wall has plentiful of vascular/blood supply and has thick bands of unstriated muscle. The mucus membrane is perforated with gastric pits, the cells of 	<p>Duodenum and Ileum</p> <ul style="list-style-type: none"> • Its total length is about 2.5 m and is highly thrown into folds called villi that increase surface area for food absorption • Bile ducts from the gall bladder and pancreatic ducts from the pancreas open into the duodenum to release bile and pancreatic juices that enhance digestion of food substrates in any of the following ways; • Emulsification of fats (bile salts) • Neutralizing acidic chime from the stomach making the pH suitable for enzyme action • Secreting digestive enzymes to act on fats and starch
<p>Organs and glands associated with the alimentary canal</p> <p>1. The liver</p> <p>It is the largest organ in the body</p> <p>It is hung from the diaphragm by a double sheet of peritoneum, which encloses the whole organ</p> <p>It is divided into five (5) lobes, which include; from right to left</p> <ul style="list-style-type: none"> • The caudate lobe, overlapping the kidney • A right central lobe (contains the gall bladder) • A left central lobe • A left central lateral lobe • A small dorsal spigelian lobe 	<p>pancreas</p> <p>This is an endocrine and exocrine organ that appears as small scattered masses of pink tissue, in the mesentery, between the loops of the duodenum. Its ducts open into the duodenum, secreting pancreatic juice which contains enzymes that digest starch and fats, together with the bicarbonate ions that make the pH suitable for the enzyme action</p>
<p>14 ©Bbumba 2017</p>	<p>Drawing showing position of the pancreas of the rat</p> 

The respiratory system

- ✓ Return to the pharynx and trace the pathway air would take from the nasopharynx into the laryngopharynx, through the glottis, larynx, trachea, and **bronchi** into the lungs.
- ✓ Gently reflect the heart and lung and try to find where the bronchi enter the lungs. Avoid damage to any of the blood vessels in this region. Cut off a piece of the lung and note all the small channels.
- ✓ Within the lung the bronchi divide repeatedly forming thin walled spaces, **alveoli**, where gas exchange occurs.
- ✓ The movement of air into and the lungs is controlled by increasing the size of the pleural cavity as the muscular **diaphragm** contracts enlarging this space. When the diaphragm relaxes, it curves into the pleural cavity reducing the size of the space and forcing air out of the lungs.

- ✓ Air passes through the nostrils where it is filtered by the nasal hairs and warmed and moistened by its passage through the turbinal and nasal passage. It enters the pharynx, where except during swallowing the glottis is open.
- ✓ The larynx and the trachea are kept open by cartilages, which in the case of the larynx are the thyroid, cricoids and arytenoids cartilages. In case of the trachea, the cartilages are a series of rings incomplete dorsally, the defect being closed by trachealis muscle.

Drawing showing the structure of the larynx

Drawing of the superficial structures in the neck

<p>Structure in relation to function</p> <p>Trachea</p> <p>Description of Structure</p> <ul style="list-style-type: none"> • The trachea is cartilaginous • Rigid • Ringed • Hollow/open/tubular • Cylindrical • Contains c shaped cartilage rings ventrally and smooth trachealis muscles dorsally <p>Structure of the cartilage ring</p>	<p>Diagram showing the general structure of the respiratory organs of a rat in situ</p>
<p>Relation to function</p> <ul style="list-style-type: none"> • The trachea is rigid to keep it open/support it in place • The trachea is cartilaginous with intervals of non-cartilaginous rings for its flexibility • The trachea is ringed to keep it open • The trachea is tubular to allow air passage <p>Lungs structure and appearance</p> <ul style="list-style-type: none"> • Lungs are soft/sponge-like • Red/pink in colour • Consists of numerous air sacs <p>Relation to function</p> <ul style="list-style-type: none"> • Softness/sponge-like nature allows for easy distention with air • Red/pink colour indicates rich blood supply, implying efficient gaseous exchange in air sacs <p>The numerous air sacs increase surface area for gaseous exchange</p>	<p>Diaphragm</p> <p>Shape and structure</p> <ul style="list-style-type: none"> • Dome-shaped • Has a central tendon and a peripheral muscular portion <p>Relation to function</p> <ul style="list-style-type: none"> • contraction of peripheral muscles flattens the dome, increasing volume of the thorax (decreasing thoracic pressure) to allow air into lungs • relaxation of the muscles creates a dome shape that reduces volume of the thorax, pushing air out of the lungs

The blood vascular system

In the rat, there is a double circulation as it is in other mammals, with the heart at the centre of the system.

There is;

- A systemic circulation, which supplies and drains all parts of the body except the lungs
- A pulmonary circulation supplying and draining the lungs

Displaying arteries supplying the alimentary

Procedure

- ✓ Push the liver forward and deflect the whole of the stomach and intestines to the right of the specimen and stretch the mesentery
- ✓ Running in the mesentery are 3 unpaired arteries, to gut. Coeliac, anterior mesenteric, and posterior mesenteric; they are all branches of dorsal aorta.
- ✓ Coeliac and anterior mesenteric arteries arises at about the level of the left kidney, while the posterior mesenteric artery, arises where the aorta splits into the leg arteries
- ✓ Remove any fats covering the **proximal end** of the three arteries to show their origin from the dorsal aorta

The heart and the great vessels

Position and shape

- ✓ The heart lies ventrally in the thorax. It is pear shaped, with the apex posterior and tilted to the left and base, anterior, giving way to the origin of the great vessels.
- ✓ The heart is divided into **4 chambers** with the ventricles appearing much larger than the auricles because of their thick muscular walls that provide a strong force in pumping blood

Drawing showing the heart and great vessels in situ

Arterial blood supply to different parts of the body

Head, neck and fore limbs

Blood to the neck, head and forelimbs travels in main blood vessels that originate from the arch of the aorta. They include

- ✓ The innominate artery on the right. Divides into right subclavian artery(which supplies the right fore limb) and the right common carotid artery which divides into external carotid and internal carotid arteries to supply the head on the right side
- ✓ The left common carotid artery proceeds directly from the dorsal arm of the arch of the aorta and continues as the brachial artery to supply the left forelimb

Drawing showing the heart and blood vessels that supply the head, neck and fore limbs

Short notes:

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

The alimentary canal and accessory

Blood to the **alimentary canal** and **accessory glands** travel in branches of the dorsal aorta, these include

- ✓ The **coeliac artery**, just below the diaphragm, divides into **three branches**, namely
- ✓ The **gastric artery**-to the stomach
- ✓ The **splenic artery**-to the spleen
- ✓ The **hepatic artery**

- ✓ Anterior **mesenteric artery**, a single blood vessel that **supplies** the **intestines** and the **pancreas**
- ✓ Posterior **mesenteric artery**, which arises at the point where the aorta **divides into two**. It supplies the rectum.

Drawing showing the blood vessels that supply the alimentary canal and accessory glands

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

Hind limbs

The **dorsal aorta** divides terminally into **two** branches, the **common iliac arteries** which give several branches to supply organs in the **groin and hind limb** on the respective side. Branches include;

- i) **external iliac artery** which divides into;
 - Pudendal artery, which supplies the skin and muscles around the anus
 - Epigastric artery, supplies muscles of the abdomen
 - Femoral artery which supplies the thigh and continues as the popliteal artery to supply the leg
- ii) Internal iliac artery which supplies the muscles and in the groin

Drawing showing blood vessels that supply the hind limbs and the groin

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

Drawing showing the blood vessels supplying the digestive system with blood (arteries) when the digestive system is displaced to the right of the rat

Short notes/teacher's comment:

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

Venous drainage

A) Head, neck and forelimbs

- Blood from the head, neck and forelimbs returns to the heart via the left and right anterior vena cava with different tributaries as shown below.

Drawing showing the blood vessels that return blood from the head, neck and fore limbs back to the heart of the rat

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

Alimentary canal

From the alimentary canal, blood full of nutrients passes via the hepatic portal vein through the liver to the posterior vena cava via the hepatic veins to the heart

The hepatic portal vein has several tributaries that collect blood from different parts of the alimentary canal. They include;

- ✓ **Lino-gastric vein**-drains the stomach
- ✓ **Duodenal vein**-drains the duodenum
- ✓ **Posterior mesenteric vein**-drains the rectum and large intestine

Drawing showing blood vessels that return blood from the alimentary canal and accessory glands back to the heart

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

THE VENOUS BLOOD VESSELS DRAINING THE ALIMENTARY CANAL

The veins draining the alimentary can be displayed carefully by displacing carefully the bulk of the ileum and the stomach to the left side of the rat. The duodenum is deflected slightly down wards.

Drawing showing the blood vessels removing blood from the digestive system back to the heart when the digestive system is displaced to the left, exposing the venous blood vessels of the rat

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

Note: The alimentary canal must be removed before any dissection of the urinogenital system and abdominal vessels can be carried out.

Procedure for removing the alimentary canal of the rat

- ✓ Ligature the coeliac and anterior mesenteric arteries and the hepatic portal vein
- ✓ Cut each vessel distal to the ligature continue to cut through the oesophagus where it enters the stomach and cut through the rectum where it disappears under the urino-genital organs
- ✓ Cut through the suspensory mesenteries so as to remove the whole of the gut, spleen and pancreas but leave the liver

Displaying the urino-genital system of a male rat

Procedure

- ✓ Open up the abdominal cavity and pin back the skin and cut the body wall in a usual way
- ✓ Remove the alimentary canal following the procedures illustrated before
- ✓ Remove the fat from the kidneys and those covering the ureters using the blunt forceps
- ✓ With scissors, cut open one of the scrotal sacs, with forceps grasp or get hold of the testis or fat attached to it and draw it forwards. This pulls up the bottom of the scrotal sac

Note that the epidermis is attached to the bottom by the gubernaculum

- ✓ Cut through the pelvic girdle and remove the layer of muscles covering the tubes leading to the urinogenital openings, beneath this muscle lies the pubis
- ✓ Remove the connective tissue from the region between the scrotal sacs sufficiently to expose the anal canal and the muscles

Note that in the male rats there is just one urino-genital opening at the end of the penis

Drawing showing the urino-genital system and its blood circulation in a male rat

Procedure

- ✓ Open the abdominal cavity. Pin back the skin and cut back the body wall in the usual way. In the female rat, notice the mammary glands adhering to the inside of the skin
- ✓ Remove the alimentary canal in the usual way
- ✓ Remove the pubis, by cutting through the pelvic girdle as in male rat. This will expose the narrow urethra beneath which is the more bulbous vagina. In the process grip the clitoris and pull it gently so that the urethra is held away from the pelvis.
- ✓ Lift the oviducts and remove the mesovarium from them sufficiently to expose the ureters but be careful not to cut any blood vessels.
- ✓ Try to remove fat from the kidneys and ureters. Leave the fat around the ovaries and those attached to the oviduct, but displace it so that these structures may be observed
- ✓ *Note in the female rat, there are separate urinary and genital openings; the urinary opening is just above the genital one*
- ✓ *If the rat is pregnant the much expanded uterus will be seen to contain a variable number of embryos. These can be removed and examined. In removing them notice the umbilical cord and placenta*

Opening up the posterior blood vessels including blood circulation of the hind limbs and the other posterior organs of the rat

Procedure

- ✓ Remove the alimentary canal
- ✓ Cut through the pelvic girdle
- ✓ In males, cut the ureters, pin the bladder, seminal vesicles, and rectum out of the way and remove the right fat body
- ✓ In female rats, pin the rectum and lay the vagina and bladder and pin it out of the way, clear away the remains of the mesentery and fat to display the aorta and posterior vena cava fully.
- ✓ Trace the blood vessels through the groin by casing away the muscles and connective tissue with forceps or simply trim it with scissors, in males the blood vessels can easily be traced in the right groin

Short notes:

Venous drainage of the hind limbs and the groin

Short notes/teacher's comments:

Marking points

- ✓ Title
- ✓ Magnification
- ✓ Neatness
- ✓ Outline
- ✓ Drawing
- ✓ Labeling

EXAMINATION QUESTIONS

©BBUMBA PATRICK
Bumbax22@gmail.com

1. You are provided with specimen K (rat) which is freshly killed
 - (a) Describe the structure of the whiskers and tail and relate each to significance for successful survival in its habitat. (06 marks)
 - (b) Dissect the specimen to display the contents of the abdominal cavity. Displace the alimentary canal to the right. Cut out the caecum and rectum without breaking much of the mesentery. Draw and label the blood vessels supplying blood to the remaining part of the alimentary canal and structures of the urinary system on the left of the specimen. (18 marks)
 - (c) By further dissection, expose structures of the thoracic region in their undisturbed state. Continue to clear away any tissues from around and anterior to the heart to expose vessels within the neck region that supply blood to the head region, respiratory tract without removing neck glands. Draw and label the visible vessel and structures mentioned within the region of dissection including the glands. (17 marks)

2. You are provided with specimen T. carry out the dissection of the specimen using the following procedure. Pin the animal with ventral side uppermost. Remove the skin of the thoracic region including the neck. Lift the xiphoid cartilage and cut along the lower edge of the rib cage. Tie the xiphoid cartilage. Pull it back ward and pin it down. Cut along the side wall of the thorax on both sides to remove the rib cage. This should expose the blood vessels, nerves, respiratory tract and glands in the region.
 - (a) Draw the neck region and label fully
 - (b) Locate the trachea, examine it and describe its structure
 - (c) How is the structure of the trachea related to its function

3. You are provided with a freshly killed mammal.
 - (a) Dissect the specimen to display the heart, arteries and veins of the thorax.
No dissection of the neck is required (at this stage)
Do not remove or displace the right lung
Make a labeled drawing of your dissection

4. You are provided with a freshly killed specimen labeled F.
 - (a) Study the external features of the specimen and list 3 observable features that enable the specimen to colonize land
 - (b) Measure the length of the tail and that of the tail plus the rest of the body
Calculate the ratio of the length of the tail to length of the tail plus rest of the body
 - (i) Suggest the significance of this ratio in the life of the animal
 - (c) Dissect the specimen to clearly display the structures lying posterior to the diaphragm without displacing any organ.

Draw and label your dissection

 - (d) Dissect the specimen further to display the blood vessels that drain blood from the thigh of the left hind limb and kidney back to the heart

5. You are provided with a freshly killed animal Q.

(a) Examine it and answer the following questions

- (i) Classify the animal from phylum to order, giving observable characteristics for your classification.
- (ii) Open the mouth of the animal and examine the teeth. What special adaptation do the teeth reveal?
- (iii) Work out the dental formulae of the animal