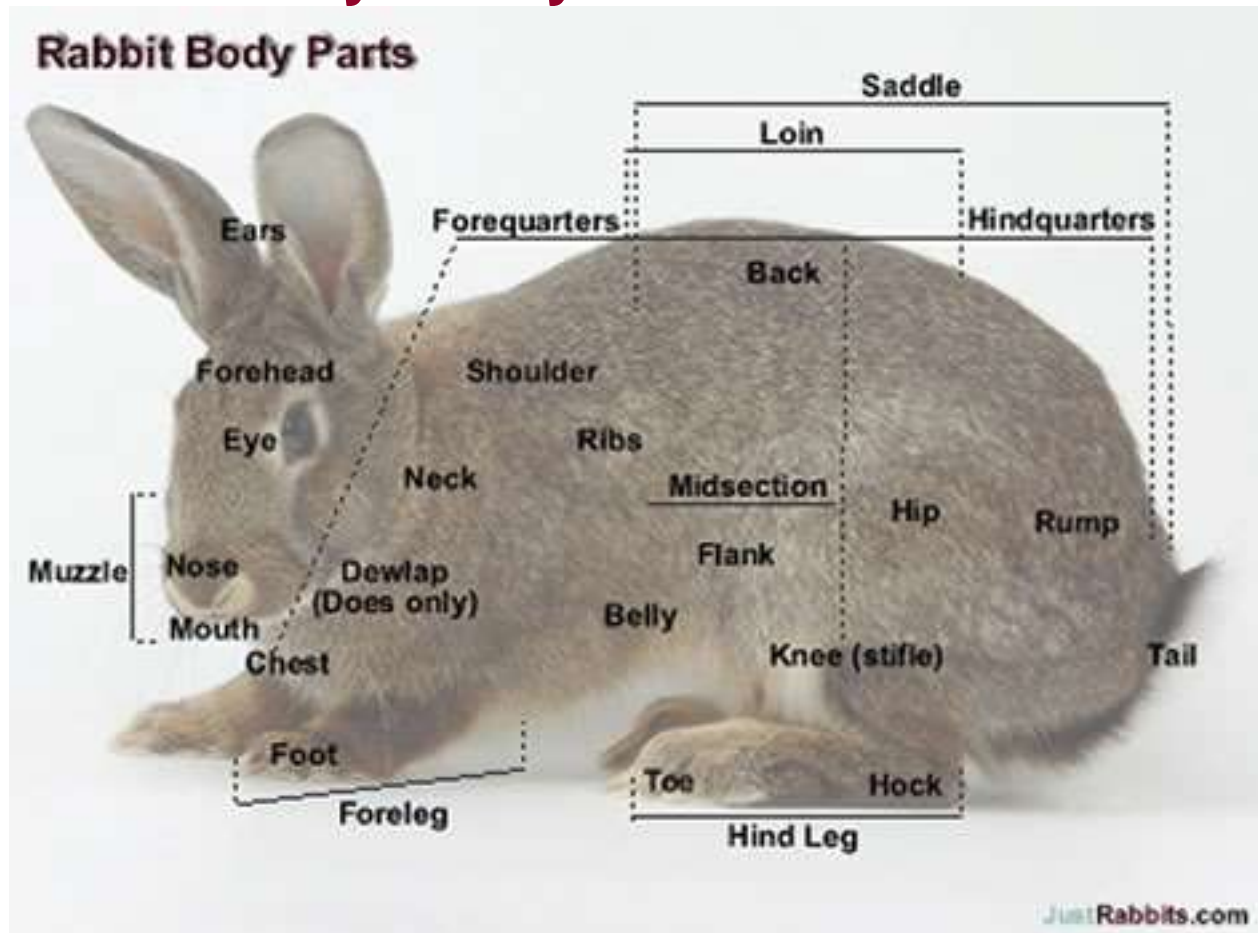


# Rabbit Anatomy - Rabbit Body Systems

## Rabbit Anatomy - Body Areas

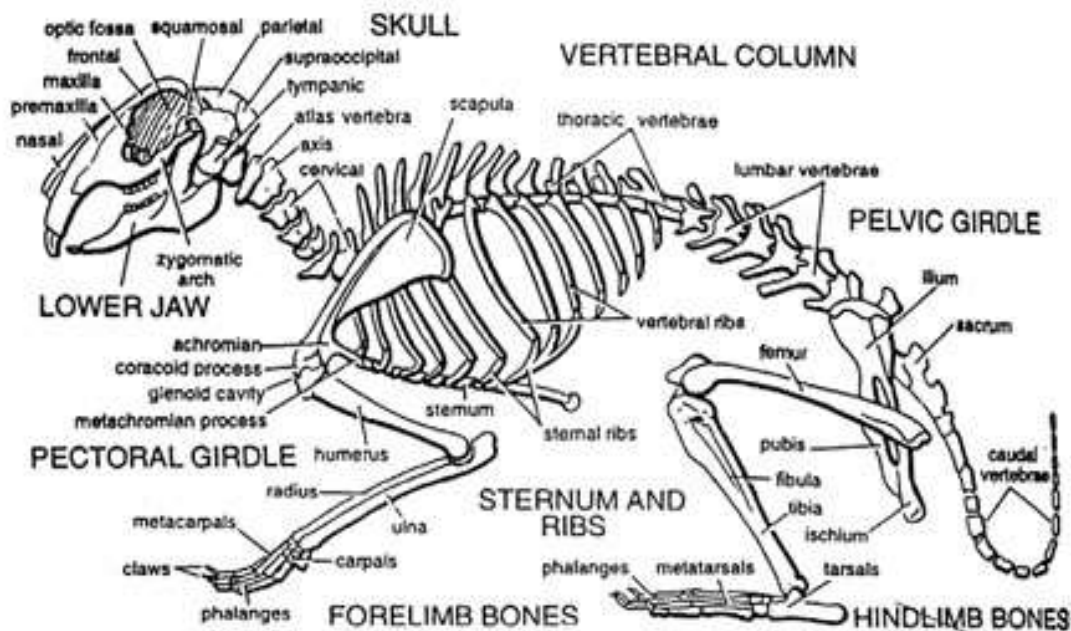


## Rabbit Anatomy - Systems

1. Rabbit Skeletal System
2. Rabbit Muscular System
3. Rabbit Digestive System
4. Rabbit Respiratory System
5. Rabbit Cardiovascular System
6. Rabbit Urogenital System
  - A) Urinary System
  - B) Reproductive System
7. Rabbit Dental System
8. Rabbit Sense System
  - A) Eyes
  - B) Nose
  - C) Ears

# Rabbit Anatomy - Skeletal System

## Rabbit Skeleton

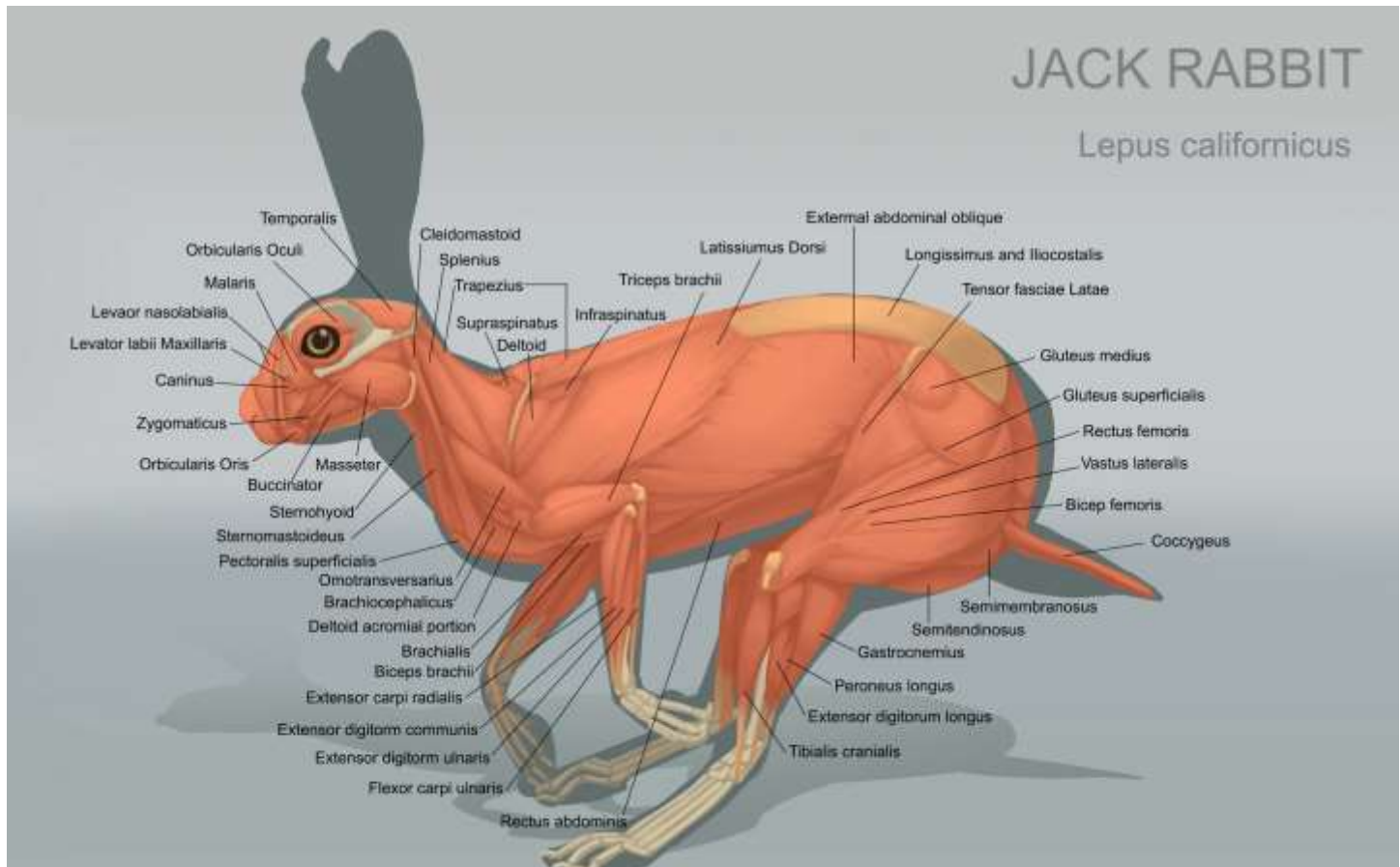


The rabbit has a delicate skeleton compared with other mammals. It makes only 8% of the body weight, as compared to 12 to 13% in cats.

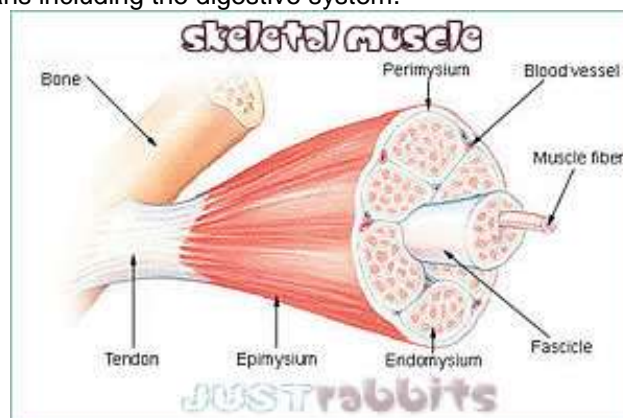
Here are some other important points to note about the rabbit skeletal system:

- There are 46 bones that make up the spinal column alone, 7 cervical (the neck), 12 thoracic (the chest), 7 lumbar (the lower back), 4 sacral (the pelvis) and 16 coccygeal (the tail).
- A rabbit's bones have extremely thin cortices and are easily shattered.
- The lumbar vertebrae are elongated to allow for considerable flexion and extension during hopping, but this makes them susceptible to fracture.
- The powerful hind limb musculature and light skeleton enable powerful jumping over long distances.
- The hopping movement is made possible due to the hind legs being longer than the fore legs. Most of the elongation is below the stifle (the knee) in two bones, the tibia and fibula. The tibia is also prone to fracture.
- Rabbit's hind legs can kick out with extreme force and if they struggle when they are picked up, or even when they stamp their feet violently on the ground, they are prone to fracture of their backbones (usually the 7th lumbar vertebra) and damage their spinal cord.
- Rabbits have 7 tarsal bones (the ankle) and 4 digits on both hind legs, and 9 carpal bones (the wrist) and 5 digits on both fore legs. Each digit has an associated toenail.
- Weakened bones and bones affected by osteoporosis are easily injured or broken.
- Various types of spinal deformations have been observed in a rabbit's anatomy. The degree of curvature is variable and may range from mild and barely visible to severe and causing gait problems. The origin of these congenital deformations is not well understood, they include:
  - **hemivertebrae** - abnormal birth defect in which the vertebra fails to develop completely. As a result of the growth defect of the spine, a wedge-shaped vertebra develops, and neighboring vertebrae expand or tilt to fit the deformity
  - **spondylosis** - a condition of the spine marked by stiffness of a vertebral joint
  - **kyphosis** - humplike curvature of the spine
  - **lordosis** - abnormal, increased degree of forward curvature of any part of the spine)
- These conditions may relate to a number of factors, a lack of calcium in the food, improper absorption of calcium in the intestine, lack of exercise, wrong posture due to being kept in a small cage, or defective genes. Female rabbits appear more frequently affected by these spinal abnormalities than males. It is linked to their higher needs in calcium, especially during pregnancy and lactation.
- Rabbits suffering from weak muscles and poorly mineralized bones and/or bone degeneration are at increased risk of spine fracture when there is an inadequate support of the heavily muscled hindquarters, walking on a slippery floor, or twisting of the lumbosacral junction when frightened or restrained.

# Rabbit Anatomy - Muscular System

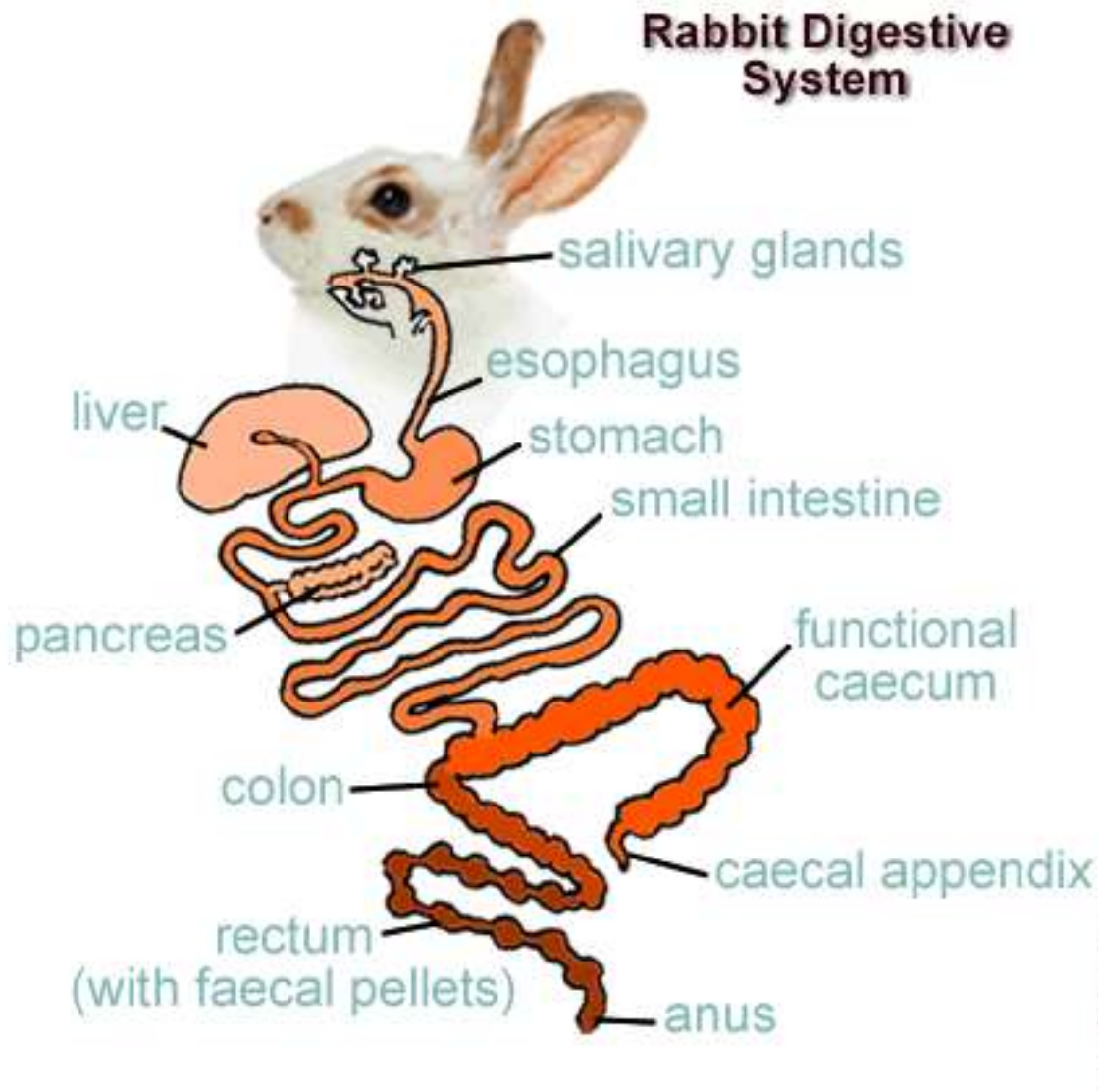


- Wild rabbits are very athletic animals that are built to move rapidly in order to find food, water, find or fight mates, or flee predators over greater distances to find a hiding place.
- This daily exercise strengthens the locomotive muscles, fortifies the muscles in their heart and lungs and increases their resistance against stress.
- Just like us, exercise is wonderful for fortifying muscle and bones, it will stimulate blood circulation and the activity and functioning of other organs including the digestive system.



- The vertebrae of the spine provide support for the back. If this is accompanied by poorly developed transversospinalis spine muscles and trunk muscles, the normal balance of the spinal structure and the biomechanics can be altered, which can lead to degenerative processes.
- Deformations appear that will prevent the development of a good locomotric activity.
- Intrinsic muscle imbalance leads to degenerative changes of the lumbar vertebrae, even changes to femoral head have been observed in rabbits that lack exercise.
- The rabbit muscular system, like in any vertebrate, is controlled by the nervous system, it's the basic concept of any muscular system. Muscles are controlled through electrical signals between the body's parts and the brain.

# Rabbit Anatomy - Digestive System



- As total herbivores, rabbits have an extremely long digestive tract in order to process their food in the most efficient way.
- The whole of a rabbit anatomy has evolved to survive on a very poor diet, the digestive tract especially. A special feature of the process, known as caecotrophy, is a remarkable way the rabbit 'recycles' waste fecal matter in order to extract any nutrients that may have been missed on the first, second or even third time round in the digestion system.
- The whole digestive system of the rabbit is huge and may account for between 10-20 per cent of its total body weight.

## ***Let's follow the process through the rabbit's anatomy...***

### **Stomach**

- In an adult rabbit the total length of the alimentary canal is 4.5 to 5 m. After a short esophagus there is a simple stomach which stores about 60-80 g of a rather pasty mixture of feedstuffs.
- Food eaten by the rabbit quickly reaches the stomach where it remains for a few hours, and although in an acid environment it has little chemical change.

## Liver & Pancreas

Two major glands secrete into the small intestine: the liver and the pancreas.

- Bile from the liver contains bile salts and many organic substances but no enzymes. Bile aids digestion catalytically.
- The reverse is true of pancreatic juice which contains a sizable quantity of digestive enzymes allowing the breakdown of proteins (trypsin, chymotrypsin), starch (amylase) and fats (lipase).

## Small Intestine

- If the small intestine of a rabbit were laid out it would be more than 10 times the length of the rabbit.
- The contents of the stomach are gradually 'injected' into the small intestine in short bursts, by strong stomach contractions.
- The small intestine is about 3 m long and nearly 1 cm in diameter. The contents are liquid, especially in the upper part. Normally there are small tracts, about 12 cm long, which are empty. The small intestine ends at the base of the cecum. This second storage area is about 40-45 cm long with an average diameter of 3-4 cm. It contains 100-120 g of a uniform pasty mix with a dry matter content of about 20 percent.
- As the contents enter the small intestine they are diluted by the flow of bile, the first intestinal secretions and finally the pancreatic juice. After enzymatic action from these last two secretions the elements that can easily be broken down are freed and pass through the intestinal wall to be carried by the blood to the cells.

## Large Intestine

- The large intestine is made up of the cecum and colon. The cecum is very large, (about 10 times the volume of the stomach, and about 40 per cent of the total volume of the gastrointestinal tract).
- The colon separates the large and small fiber particles. The large particles of indigestible fiber are moved straight through the colon to form the hard droppings. The smaller fiber particles and other small incomplete digested food particles are moved backwards (by special muscles in the colon called haustrae).
- This 'slurry' enters the cecum where it is broken down and fermented.

## Cecum

- The particles that are not broken down in the small intestine enter the cecum after less than 2 hours. There they have to stay for about 2 to 12 hours, while they are attacked by bacterial enzymes.
- Elements which can be broken down by this new attack (mainly volatile fatty acids) are freed and in turn pass through the wall of the digestive tract and into the bloodstream.
- Very near the end of the small intestine, at the entrance to the cecum, begins the exit to the colon. The cecum has a blind pouch branching off from the small intestine-colon axis. Physiological studies show that this blind pouch-reservoir forms part of the digestive tract: the contents circulate from the base to the tip passing through the center of the cecum, then return towards the base, along the wall.
- The content of the cecum is then evacuated into the colon. Approximately half consists of both large and small food particles not already broken down, while the other half consists of bacteria that have developed in the cecum, fed on matter from the small intestine.

## Colon

- The colon is about 1.5 m and follows on from the cecum, it is creased and dented for about 50 cm (proximal colon) and smooth in the terminal section (distal colon).
- The rabbit's digestive tract is virtually the same as that of other monogastric animals, however in the rabbit anatomy, the digestive tract has a uniqueness that lies in the dual function of the proximal colon.
- If the cecum content enters the colon in the early part of the morning it undergoes few biochemical changes.
- If the caecal content enters the colon at another time of day the reaction of the proximal colon is entirely different.
- 

## Colon Dual Action

- Successive waves of contractions in alternating directions begin to act; the first to evacuate the content normally and the second to push it back into the cecum.

The dual action of the colon produces two types of excrement: soft and hard.

- **Hard Pellets (fecal droppings)**

These are round, relatively dry and composed mostly of undigested fiber. Normal fecal droppings are round balls, dark to light brown in color, and fairly uniform in size. They are slightly moist when fresh but dry out quickly. If you examine them closely, or break one apart (they should crumble relatively easily), you will see the tiny rectangles of undigested plant fiber that they are formed from.

- Droppings that are small, very dark in color, or irregularly shaped are a signal that your rabbit is not processing enough fiber through his digestive tract. This may be because the diet is too low in fiber or because another problem has slowed down the travel of food through the digestive system. If your rabbit stops producing any droppings, the gut may have completely stopped processing food; this should be treated as a potentially life threatening emergency and you should seek urgent veterinary attention.



Some rabbits eat their fecal pellets, this is normal as long as they are also eating the caecotrophes.

- **Soft Pellets (caecotrophes)**

The colon wall secretes a mucus which gradually envelops pellets formed by the wall contractions. Under the varying pressure and rhythm of contractions the content is squeezed like a sponge.

Most of the liquid part, containing soluble products and small particles of less than 0.1 mm, is forced back into the cecum. These pellets gather in elongated clusters and are called soft or night pellets (caecotrophes).

The soft pellets are recovered by the rabbit directly upon being expelled from the anus. To do this the rabbit twists itself round, sucks in the soft feces as they emerge from the anus, then swallows without chewing them.

By the end of the morning there are large numbers of these pellets inside the stomach, where they may comprise three quarters of the total content.

From then on the soft pellets follow the same digestive process as normal feed. Considering the fact that some parts of the intake may be recycled once, twice and even three or four times, and depending on the type of feed, the rabbit's digestive process lasts from 18 to 30 hours in all, averaging 20 hours.

- Half the soft pellets consist of imperfectly broken-down food residues and what is left of the gastric secretions, and half of bacteria. The latter contain an appreciable amount of high-value proteins and water-soluble vitamins. The practice of caecotrophy therefore has a certain nutritional value.

The composition of the soft pellets and the quantity expelled daily are relatively independent of the type of feed ingested, since the bacteria remain constant.

In particular, the amount of dry matter recycled daily through caecotrophy is independent of the fiber content of the feed. The higher the crude content of the feed and/or the coarser the particles, the sooner it passes through the digestive tract.

### **Digestible & Indigestible Fiber**

The dual action of the colon requires fiber but if the feed contains few large particles and/or it is highly digestible, most of the caecal content is pushed back to the cecum and loses elements which nourish the 'normal' bacteria living in the cecum.

This would appear to increase the risk of undesirable bacteria developing in this impoverished environment, some of which might be harmful.

Therefore it is advisable to minimize roughage in the feed, enabling the rabbit's digestive process to be completed fairly rapidly.

In theory, roughage is provided by the crude fiber content of the feed, as this is normally rather hard to digest. However, certain fiber sources (beetroot pulp, fruit pulp in general) are highly digestible (digestibility of crude fiber varies from 60 to 80 percent).

For this reason recommendations are now made on quantities of indigestible crude fiber to be fed

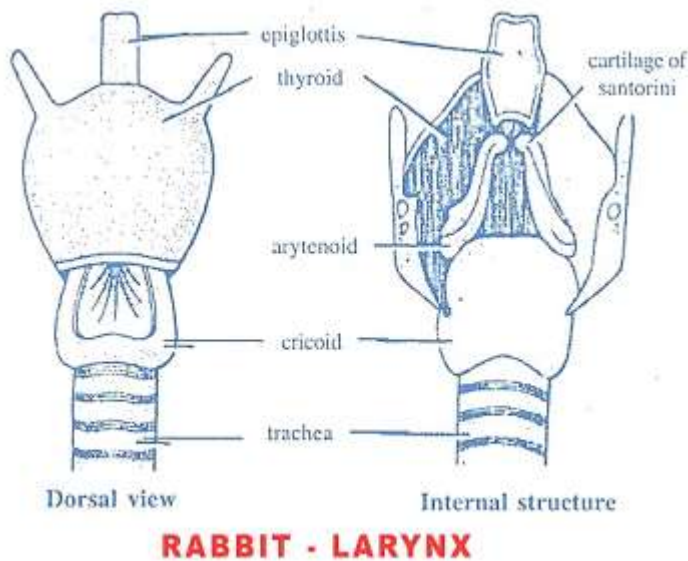
### **Adrenaline Effects**

The digestive process of the rabbit appears to be highly dependent on adrenaline secretions.

Hypersecretion associated with stress slows down digestive activity, and entails a high risk of digestive ailments.

Stress can be brought about by a number of factors, some that you may not even have considered. For example, a simple change in brand of food pellets can stress your rabbit, also children chasing them to try and pick them up can also cause an upset to their eating habits.

# Rabbit Anatomy - Respiratory System



Rabbits are nasal breathers. Blocking their nasal passages for any reason, including oral examinations, can lead to respiratory compromise due to the ineffectiveness of mouth breathing.

- If a rabbit is breathing through its mouth, it is in severe respiratory distress.
- The rabbit has a small chest cavity compared with the size and weight of its digestive system.
- Rapid breathing may sometimes be a symptom of pain elsewhere in the body, and is seen in rabbits with bladder stones or womb cancer.
- The nasal passages are in close proximity with the maxillary dental arcade, and changes in either the nasal passages or molar tooth roots may affect each other adversely.
- Diseases invading the nasal passages may alter bone structure, and may ultimately lead to molar tooth movement and malocclusion; conversely, molar abnormalities and root elongation may impinge on nasal passages and compromise respiration.
- The respiratory channel is separated from the food channel by the presence of the palate. The respiratory system of a rabbit comprises nasal chambers, larynx, trachea, bronchi and lungs.

## Respiratory Organ & Related Parts:

### Nasal chamber:

- The air passes through the external nares into two large respiratory passages, which are hollow cavities present above the plate. The respiratory passage is divided into right and left halves by the mesethm bone. Each side, the respiratory passages is divided into two regions: An anterior nasal chamber & A posterior respiratory tube.
- The nasal chamber is bounded dorsally by nasal bone and ventrally by hard palate. The turbinals, very much folded scroll like bones, are present within the nasal chambers. The turbinals are covered by richly vascular, glandular and ciliated epithelium. One respiratory tube opens behind the soft palate through the internal nares into the pharynx directly and that too very close to the glottis.
- The nasal chambers serve as very efficient filters, i.e. it removes fine and coarse dust particles, germs etc. through mucous covering the turbinals. It helps to warm up the air before it is to be inhaled and enters the lungs. Due to the covering of sensory epithelium, it also helps in the detection of smell.

### Larynx

- The pharynx opens into a larynx or sound box through the glottis. The larynx leads into a trachea. This is the anterior end of the windpipe or trachea.
- The larynx is a cylindrical box like structure. Inside the larynx, there is a cavity known as laryngeal chamber, which contains vocal cords. These vocal cords can be set into vibration by the passage of air over them to produce the 'voice' – in rabbits mainly a squeak.

## Trachea

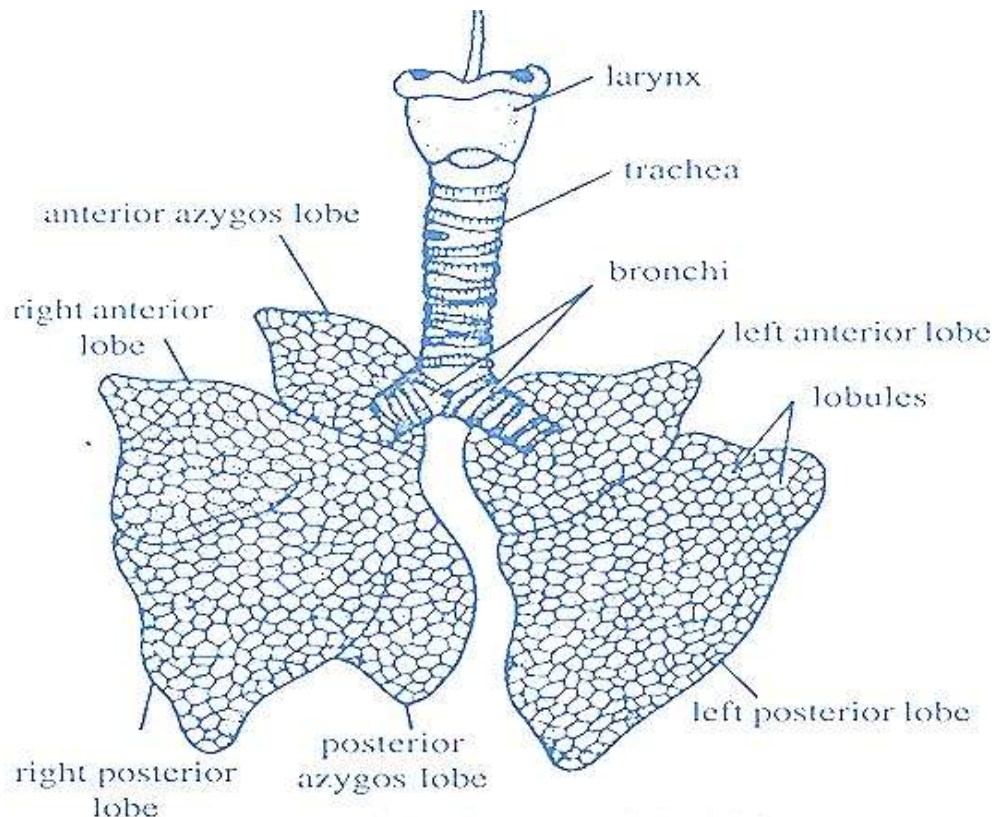
- After larynx, the trachea is a long respiratory tube extending through the neck into the thoracic cavity. It is lined internally by ciliated cartilaginous rings. These 'c' shaped cartilaginous rings help to prevent the collapse of trachea and to keep it expanded allowing free passage of air to and from the lungs.
- The mucous glands present in the wall of trachea help keep its inner surface moist and hold dust particles and bacteria. Thus only the clear air is allowed to pass into the lungs. The dust particles are swept towards the pharynx by cilia.
- The rabbit trachea is deeply recessed within the oral cavity behind the torus of the tongue. The trachea itself is narrow relative to body size.

## Bronchi

- The thoracic cavity is small in comparison with the large abdominal cavity. Because of the small thoracic cavity, rabbits have more referred upper airway and bronchial sounds and may sound somewhat harsh.
- In the thorax, the trachea divides into left and right bronchi which enter the lungs. The bronchi possess the similar structure as the trachea. After entering in to the lungs, each bronchus divides into many thinner branches, called bronchioles.
- Which again divide into finer branches of less diameter known as respiratory bronchioles. Each respiratory bronchiole divides again into many finer branches, called alveolar ducts or infundibulum. The alveolar ducts end in small hollow air sacs, known as alveolar sacs. Each alveolar sac is formed of many small thin walled hollow alveoli or air cells.
- The respiratory bronchiole alveolar duct, alveolar sac and alveoli are devoid of cartilaginous rings but their walls possess cilia.
- There is a network of capillaries of pulmonary artery and pulmonary vein around each alveolus. This complicated branching increases the total respiratory surface and allows the air to penetrate into every portion of the lungs.

## Lungs

- The lungs are soft compact and spongy mass of tissues lying in the pleural cavity within the thorax. Each lung is covered by a fold of coelomic epithelium, which is in contact with the organ (visceral pleura). Each lung is divided into lobes. The right lung has four lobes. But left lung has got two lobes.



## LUNGS OF RABBIT



# Rabbit Anatomy - Cardiovascular System

## Function of the Cardiovascular System

By circulating blood throughout the body, the cardiovascular system functions to supply the tissues with oxygen and nutrients, while removing carbon dioxide and other metabolic wastes.

As oxygen-rich blood from the heart flows to the tissues of the body, oxygen and other chemicals move out of the blood and into the fluid surrounding the cells of the body's tissues.

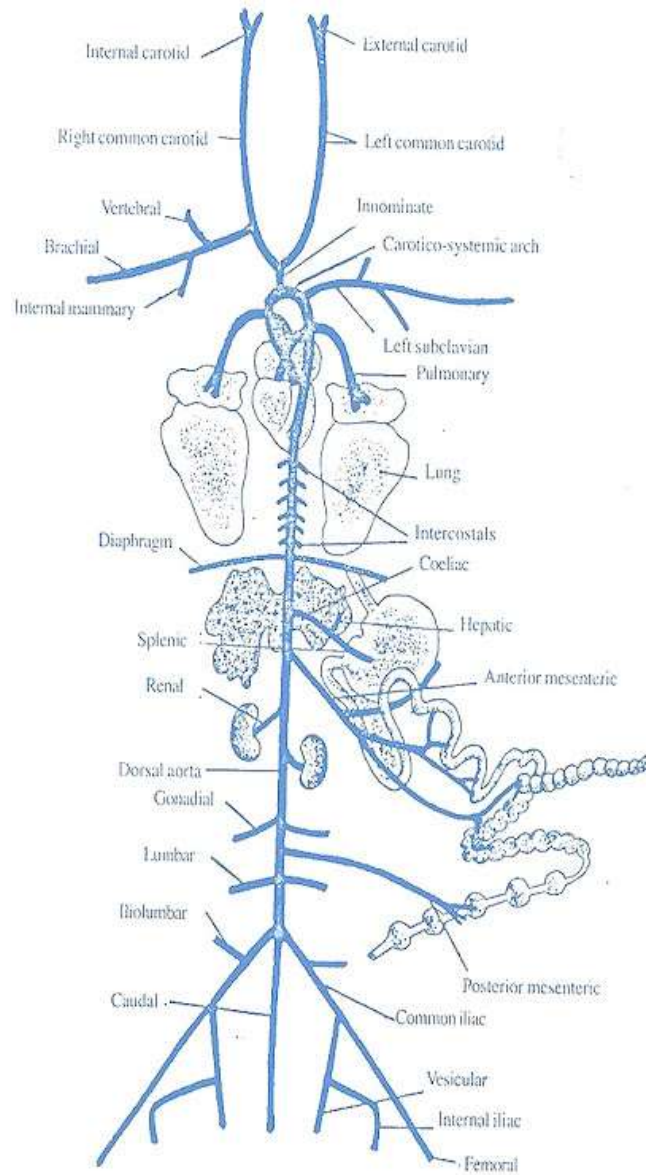
Waste products and carbon dioxide move into the blood to be carried away. As blood circulates through organs such as the liver and kidneys some of these waste products are removed.

Blood then returns to the lungs, receives a fresh dose of oxygen and gives off carbon dioxide. Then the cycle repeats itself.

This process of circulation is necessary for continued life of the cells, tissues, and ultimately the whole organism. Up and down the evolutionary ladder, there are different forms of cardiovascular systems with different levels of efficiency, but they all perform this same basic function.

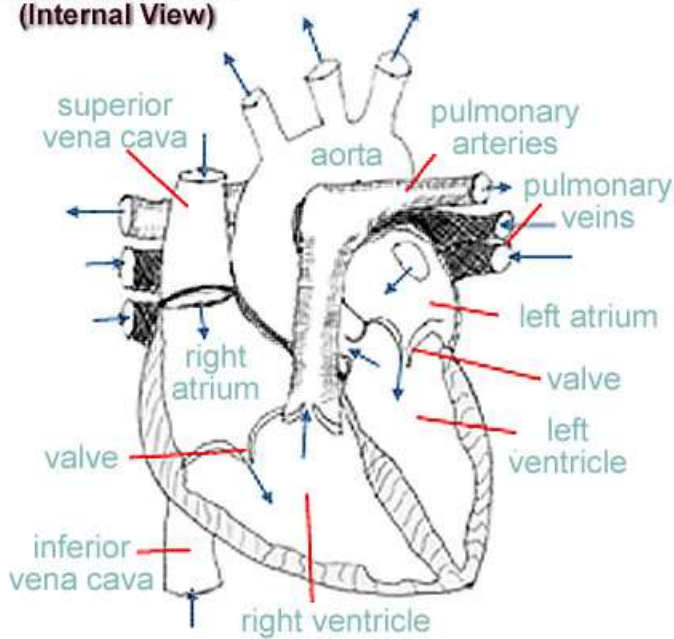
However the cardiovascular system of rabbits is slightly unique.

- Both the right and left atrioventricular valves are bicuspid in rabbits.
- The heart is small relative to total body size, comprising only 0.3% of the body weight.
- Rabbits have the most muscular pulmonary artery of any species, which contributes to their predisposition for pulmonary hypertension.
- Other vessels in rabbits are thin-walled, and prone to collapse and hematoma formation with venipuncture. The external jugular vein provides the main route for venous drainage from the head, as compared to the internal jugular vein in most mammals.
- There is a lack of anastomoses between the external and internal jugular veins. This is clinically significant because ligation or thrombosis of the external jugular vein can lead to temporary exophthalmos. Ligation of the external carotid artery will cause ocular necrosis on that side.



**ARTERIAL SYSTEM-RABBIT**

**Mammalian Heart (Internal View)**



1K+

## Let's take a closer look at the different areas:

### The Heart:

#### **Chambers**

The rabbit heart is divided into two sides; the left side pumps the blood to the body, and the right side pumps blood to the lungs.

- The left side is more muscular than the right as it needs to generate enough pressure to pump blood round the entire body of the rabbit.
- The right side receives blood carrying carbon dioxide (waste product) and pumps it to the lungs. This carbon dioxide is then expelled from the lungs as the rabbit breathes out.

In return, oxygen is transferred to the bloodstream from the lungs. The oxygenated blood passes to the left side of the heart where it is pumped to the body, leaving the heart through a large vessel called the aorta.

#### **Valves**

Between each chamber of the heart there are special valves which ensure that the blood does not flow backwards between beats. The characteristic "lub-dub,lub-dub" heart sounds heard through a stethoscope are the result of vibrations caused by the closing of the respective valves.

#### **Electrical Nodes**

There are two different electrical nodes, or groups of specialized cells, located in the cardiac tissue.

1. The first is the sinoatrial node (SA), commonly called the pacemaker. The pacemaker is embedded in the wall of the right atrium. This small patch of tissue experiences rhythmic excitation and the impulse rapidly spreads throughout the atria, causing a muscular contraction and the pumping of blood from the atria to the ventricles.
2. The other node, the atrioventricular (AV) node, relays the impulse of the SA node to the ventricles. It delays the impulse to prevent the ventricles from contracting at the same time as the atria, thus giving them time to fill with blood.
  - The cycle of contraction of the heart muscle is called a heartbeat, the rate of which varies greatly between organisms. The average heart rate of a rabbit is about 205 beats per minute. The normal range can vary from 123 to 304 beats per minute. Which, if you compare to a human, at an average heart rate of 70 beats per minute, you can see why a rabbit's heart can be easily affected by change or stress.
  - Heart failure can occur in a similar way to those of man. Their arteries can become 'furred up', affecting the function of the heart.
  - Rabbits that are fed a high calcium diet can develop calcification of the aorta. This results in a loss of elasticity of the blood vessel wall and leads, ultimately, to heart failure.

### Vessels:

A blood vessel is a hollow tube for transporting blood. There are three main types of blood vessels:

1. Arteries
2. Capillaries
3. Veins

These main blood vessels function to transport blood through the entire body and exchange oxygen and nutrients for carbon dioxide and wastes.

#### **Arteries**

- The arteries carry blood away from the heart, and are under high pressure from the pumping of the heart. To maintain their structure under this pressure, they have thick, elastic walls to allow stretch and recoil.
- The large pulmonary artery carries deoxygenated blood from the right ventricles to the lung, where it gives off carbon dioxide and receives oxygen.
- The aorta is the largest artery. It carries oxygenated blood from the left ventricle to the body.
- The arteries branch and eventually lead to capillary beds.

#### **Capillaries**

- The capillaries make up a network of tiny vessels with extremely thin, highly permeable walls.
- They are present in all of the major tissues of the body and function in the exchange of gases, nutrients, and fluids between the blood, body tissues, and alveoli of the lungs.

#### **Veins**

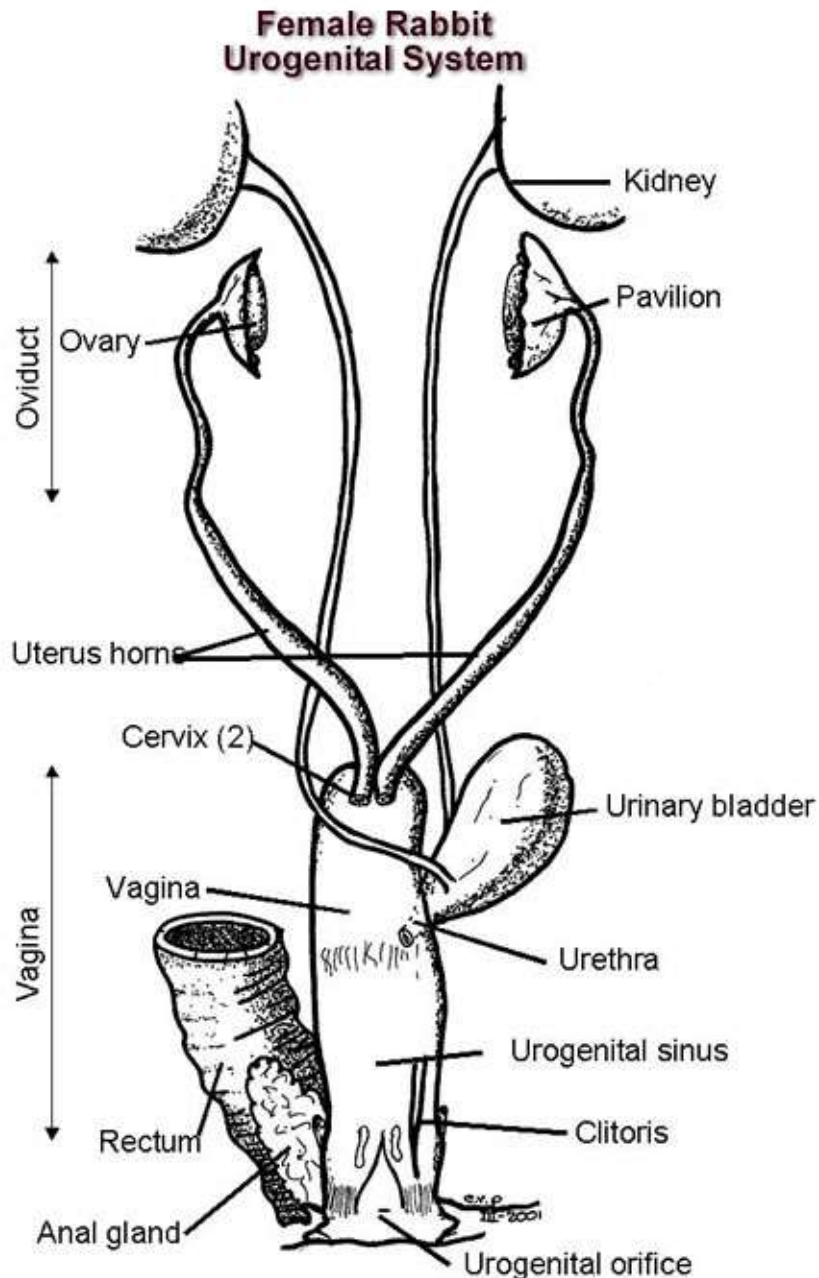
- At the opposite side of the capillary beds, the capillaries merge to form veins, which return the blood back to the heart.
- The veins are under much less pressure than the arteries and therefore have much thinner walls.
- The veins also contain one-way valves in order to prevent the blood from flowing the wrong direction in the absence of pressure.
- The pulmonary vein returns oxygenated blood from the lungs to the left atria.
- The vena cava returns blood from the body to the right atria.
- The blood that is returned to the heart is then recycled through the cardiovascular system.

# Rabbit Anatomy - Urogenital System

## The Female Rabbit Urogenital System

In a female rabbit the urogenital system consists mainly of the following:

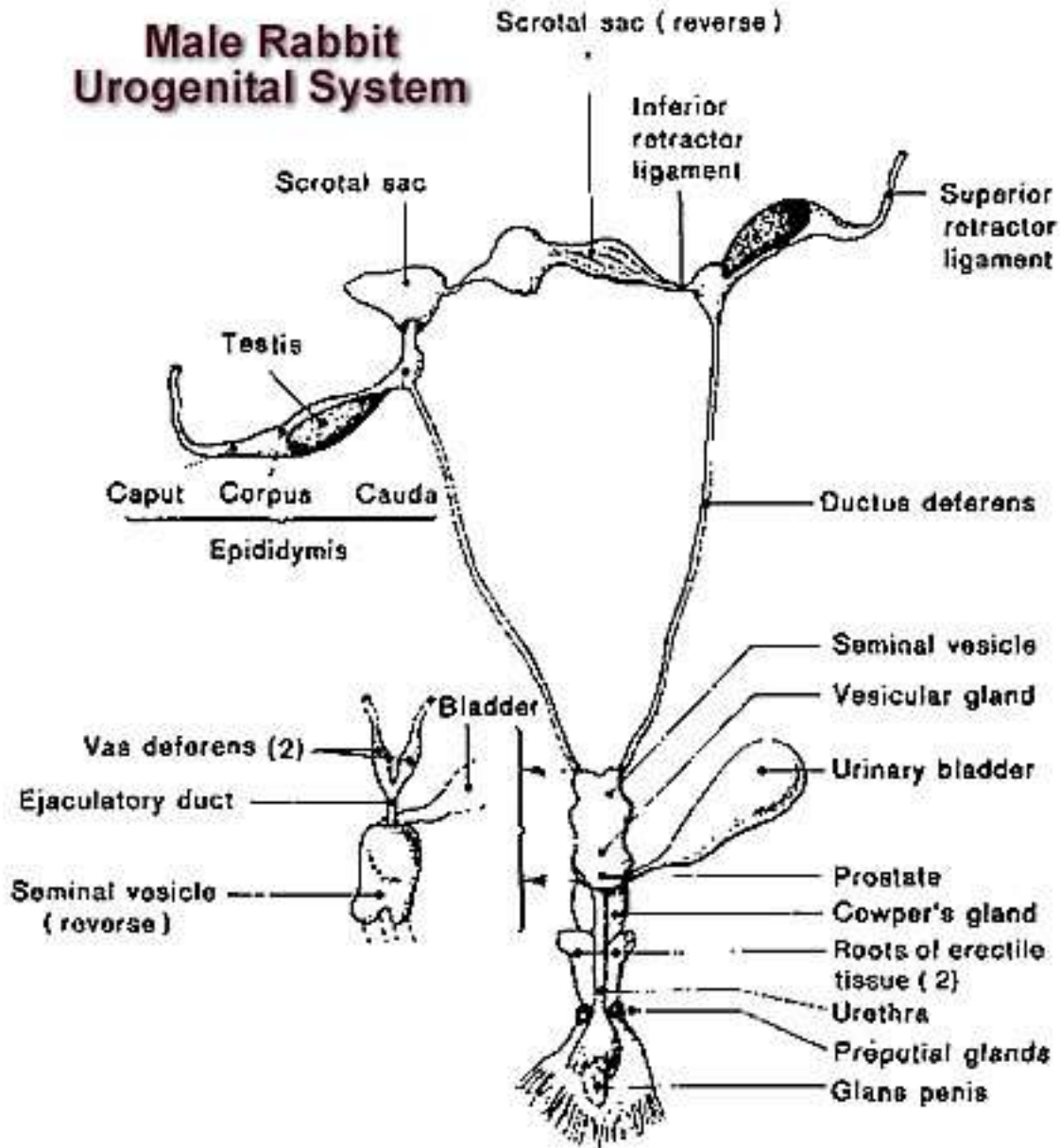
- ovary
- infundibulum
- oviduct
- uteri
- cervix
- vagina
- urogenital sinus
- mammary gland



## The Male Rabbit Urogenital System

In a male rabbit the urogenital system consists mainly of the following:

- scrotum
- testes
- epididymis
- vas deferens
- urethra
- prostate
- bulbourethral glands
- penis



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# Reproductive System

## Female Reproductive System

- The reproductive organ of the female rabbit is considered a little primitive. Indeed, the split two-horned system is only observed in monotreme egg laying mammals and in lagomorphs (pika, hare and rabbit).
- The organ is held in place by a broad ligament that is anchored at 4 points under the vertebral column.
- Sex differentiation occurs during the embryonic phase, on the 16th day post fertilization. The ovaries grow from an aggregate of cells that is lying near the original testes. The development of the ovaries is accompanied by the degeneration of the testes.
- The development of the ova (female reproductive cell) starts around the 21st day and continues till birth, around the 30th day. The first ova and follicles start to develop only 13 days after birth.
- The reproductive organ of the female rabbit is duplex: the uterus is formed by two independent horns, split over their whole length. Each horn possess its own cervix.
- The ovaries, ellipsoid bodies that have a maximal length of 1-1.5 cm, are located at the end of the uterus, right under the kidneys. They are hidden by the mesometrium (portion of the broad ligament that separates and encloses the uterus) and fat.
- The vagina does not present any particularities. This part of the reproductive tract is large, with the urethra joining halfway, at the level of the vaginal vestibule.
- At the end of the vagina, the glands of Bartholin and prepuccial glands can be recognized.
- Female rabbits do not have an estrus (heat) cycle with regular periods of heat (estrus), as do other small animals like dogs or cats. In fact, adult female rabbits, (does) are considered to be more or less always in estrus and are *induced ovulators*, (or 'reflex ovulators'), which means that **intercourse stimulates ovulation**. Then after about 40 seconds of mating, the egg is emitted for fertilization. A certain cycle does nevertheless exist. The presence of the estrogen hormone will influence the size and the color of the vulva.
- Most female rabbits are receptive to a male and prone to mate when their vulva is colored reddish/purple, and will refuse to mate when their vulva is pale and small.
- However, this is no clear indication though, as some female rabbits will mate when their vulva is pale and small.
- To avoid problems related to mating, health (ovarian adenocarcinoma, endometritis) or/and unwanted litter, ovariectomy is recommended, starting at the age of 6 months.
- The breed of the rabbit must be taken into account, before performing the operation.

## Sexual Maturity

- The age at which sexual maturity is reached depends on the size and the breed: while small and middle sized rabbits become adult between 4 and 6 months, it may take between 5 to 8 months for giant breeds.
- As a rule, it is considered that a rabbit is adult and able to reproduce when it has reached 75 to 80% of its adult size.

## Male Reproductive System

- The reproductive tract of a male rabbit is similar to most mammals.
- The testes of male rabbits are located within hairless scrotal sacs which are located cranial to the penis. Paired testes produce sperm, which become fertile as they are transported through the epididymis.
- Passage through the entire epididymis takes approximately 4-7 days, and the resulting spermatozoa are stored in the tail of the epididymis, or cauda region.
- Upon sexual excitement, this sperm is transported through the ductus deferens to the pelvic urethra.
- It is then mixed with fluids from the accessory sex glands, and ejaculated through the penis. Most rabbits ejaculate a volume between 0.5-1.5 ml of semen.
- Differentiating males from females can be difficult, as the anogenital distance is the same in males and females, however eversion of the cranial orifice will reveal either a circular entrance to the penis or a slit entrance to the vagina.

# Urinary System

## Urinary Tract

The urinary tract of the rabbit is similar to that of other mammals.

The upper urinary tract is comprised of:

- **the kidneys** (one each on the left and right side of the body) and
- **the ureters** (tubes that connect the kidneys to the urinary bladder)

The lower urinary tract is comprised of:

- **the urinary bladder** (simple collection bag for urine) and
- **the urethra** (the tube connecting the bladder to the outside of the body and is the pathway for urine to travel during urination)

Urine is formed as blood goes into the kidneys and is filtered of waste products.

Depending on the hydration status of the rabbit, urine is diluted or concentrated as the kidneys allow more or less water into the urine.

Once formed, urine travels through collecting ducts in the kidney to the ureters. Via the ureters, urine flows to the urinary bladder.

When the rabbit is ready to urinate, the muscles of the bladder contract and the sphincter at the exit hole relaxes and urine is expressed out of the bladder and through the urethra and to the outside of the body.

In males, the urethra travels through the penis and is a long tapering tube.

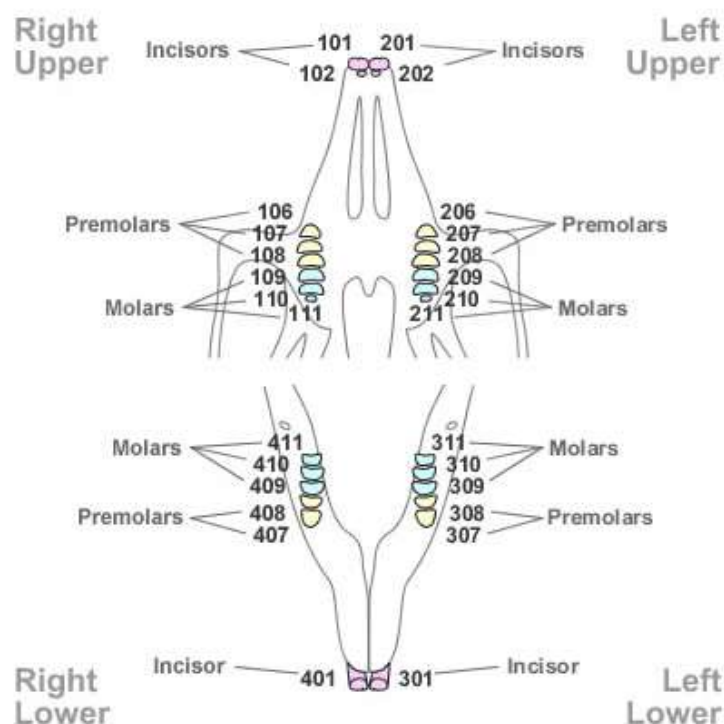
In females, the urethra is short and wide and ends in the vagina.

## Urine Colour

The urine of rabbits may be orange or brownish red in color. This has been attributed to dietary compounds, plant pigment, or stress. The color production is usually intermittent, but may be mistaken for hematuria.

The calcium excreted in the urine may lead to a chalky or cloudy appearance to the urine, and calcium carbonate or calcium oxalate crystals may routinely be present in normal urine.

# Rabbit Anatomy - Dental System



The dental arrangement of rabbits also comes under the umbrella of rabbit anatomy and physiology of rabbits. This part of the rabbit anatomy has evolved for efficient chewing of their bulky, fibrous natural diets.

### Diet

- Monocotyledonous plants such as grasses contain large numbers of phytoliths, highly abrasive silicate deposits which cause marked wear of the teeth.
- Since grass plants are low to moderate sources of dietary energy, large quantities must be eaten for animals to survive. The combination of fibrous structure and their abrasive nature requires prolonged chewing, promoting tooth wear.

### Continual Growth

- Lost tooth substance must be replaced to maintain chewing efficiency, and in rabbits, this is possible because the permanent teeth remaining in a life-long growth phase.
- These continuously growing teeth do not form anatomical roots, so the unerupted part of the teeth are like the “reserve crowns” of larger herbivores.
- All of a rabbit’s permanent teeth grow and erupt continuously.

### Two Sets of Teeth

- Rabbits are **diphyodont**, having two recognizable sets of teeth. A set of small or deciduous teeth, which erupt in utero, are replaced by a fuller set of larger teeth by about one month of age.
- The deciduous dental formula is:  
 $2 \times 2/1 \ 0/0 \ 3/2 = 16$ .  
The deciduous incisors are often shed before or around the time of birth, whilst the last of the deciduous premolars are replaced by permanent teeth by Day 35.
- The adult rabbit dental formula is:  
 $2 \times 2/1 \ 0/0 \ 3/2 \ 3/3 = 28$ .  
Lagomorphs (rabbits, hares, and pikas) all possess two sets of maxillary incisor teeth: large first incisors and smaller peg-like incisors positioned directly behind to the first ones.
  - Rabbits and rodents both lack canine teeth. A long **diastema** or gap sits between the incisors and premolars in both rabbits and rodents.

### Cheek Teeth

- The mandibular cheek teeth of rabbits grow and erupt at approximately 3 to 4 mm per month. Maxillary teeth grow and erupt at a slightly slower rate. This wear is dramatically faster than occurs in large grazing animal such as the horse whose cheek teeth wear and erupt approximately 3 mm per year.
- In rabbits the cheeks fold in behind the incisors separating the front of the oral cavity from the more caudal section, thereby permitting separate function of the incisors and back teeth.
- Premolars and molars are commonly referred to as “**cheek teeth**” since they tend to have similar structures and work together as a functional unit.
- The cheek teeth consist of three maxillary and two mandibular premolar teeth on each side, with three molars in each jaw quadrant.
- They are aligned to form nearly straight dental arcades, with oral surfaces of adjacent teeth contacting to create a continuous chewing surface. This chewing surface wears to create a serrated pattern due to the folded structure of the teeth, parallel layers of enamel and dentine in upper and lower teeth wearing at different rates as the jaws are moved side to side during chewing.
- Adjacent teeth are kept in contact by the converging arrangement of the teeth, those towards the extremities of the arcades tending to move inwards.
- This creates problems when a tooth is lost or extracted from the middle of an arcade, as the adjacent teeth tip into the defect creating gaps and irregularities in the occlusal surface. These gaps become packed with food leading to progressive periodontal disease, and the occlusal surfaces no longer wear normally promoting malocclusion.
- Since the teeth do not meet one on one, extraction of opposing teeth will make matters worse not better.

# Rabbit Anatomy - Sense Organs

## Natural Senses & Instincts

The pet rabbit may be domesticated now, but they never lose their natural senses that their wild ancestors perfected. If rabbits are let out in the wild, they would go back to their natural ways of living - if they're not eaten by a bird of prey or hungry fox!

Rabbits are hard-wired to live in groups in which they establish social hierarchies.

The main sensory organs in the rabbit anatomy consist of:

- **the eyes** - vision
- **the nose** - smell
- **the ears** - hearing

There is of course, touch and taste but I'm just going to outline the main three above for the purposes of explaining general rabbit anatomy.

## Eyes



- A rabbit spends his days eating, sleeping and staying away from creatures looking for a tasty lunch. For this reason, rabbits may not be able to focus as well as people, but they can pick up any movement and make a hasty retreat.
- A rabbit's field of vision is immense. He has large eyes that are located on the sides and upper part of the head, enabling each eye to see more than one half of a circle. Together, they can see in every direction. Therefore, a rabbit can see an approaching predator and be on the lookout for an escape route simultaneously.
- The rabbit visual system is designed—not for foraging and locomotion—but to quickly and effectively detect approaching predators from almost any direction.
- Because the eyes are placed high and to the sides of the skull, it allows the rabbit to see nearly 360 degrees, as well as far above their head.
- Rabbits tend to be farsighted, which explains why they may be frightened by an airplane flying overhead (Thinking it is a predator from the sky).
- Despite their large field of vision, rabbits have reduced depth perception as well as a limited degree of close-up vision. If you think about it, rabbits don't need to know exactly what is coming at them. Any sudden movement will elicit flight. Even though their close-up vision is not the best, rabbit eyes are designed to see moving objects far in the distance. This allows them to see a predator approaching at a great distance, and gives them ample time to run away. Most rabbits won't hang around to fight.
- Intense light blinds a rabbit, as he has restricted contraction of his pupils. Rabbits have limited color perception, although it is widely thought that they can distinguish between red and green.
- Sunset is the optimal time of day for a rabbit to see.
- Rabbits enjoy being petted, but remember it is important to move slowly as they can't see very well up close.
- Never approach a rabbit from the back, as this is reminiscent of being attacked by a predator.



## Nose

- The twitch of a rabbit's nose is a very obvious characteristic, and very important to its survival. Not only does it draw air in to fill its lungs and breathe, in the same way as we do, but it also helps the rabbit detect danger, and identify friends and potential mates.
- When we smell something, our nostrils expand, lifting upwards and outwards. The same thing happens in rabbits, but is more obvious because they are constantly sniffing the air, rather than just breathing it in.
- Rabbits have over fifty million receptor cells in their nose, compared to our meagre six million. These enable rabbits to detect predators well before they may even see them.
- Rabbits, like many other animals, have two types of scent detection cells in their nose.
- **Olfactory sensory cells** detect ordinary airborne odors, while a specialized group, **the Jacobson Organ**, pick up heavy moisture-borne molecules and pheromones. (Moist air carries more scent).
- When rabbits breathe in, their split top lip parts and moistens the air as it passes. This enhances any scent and helps the rabbit discover more about the world around it – who is nearby, friend, foe or female ready to be mated, or any food source.
- As rabbits communicate mainly through scent, a good sniff of each other no doubt is a bit like a long chin-wag over coffee!
- The nasal membrane is very sensitive to perfumes, chemicals and dust, and these agents can cause upper respiratory problems for the rabbit.
- The sense of smell in a rabbit is present at birth, allowing a newborn to find his mother's teat. Rabbits shift their noses up and down when trying to identify a scent; this is called 'nose blinking'.

## Ears



- Rabbits hear pretty much in our range but they also hear much higher pitched sounds which include rodents, bats, bugs, some bird noises and lots of mechanical or electrical sounds we can't hear.
- Hearing is the most vital sense within the rabbit anatomy. The auditory system is used to detect predators, as well as to help a rabbit perceive the area around him.
- Acoustics also help to overcome the reduced visual abilities by allowing the rabbit to navigate without difficulty. Sound waves bounce off objects, allowing the rabbit to recognize the arrangement of his surroundings.
- Most rabbits have large, erect ears. When alert, the ears move forward and backward as they attempt to pinpoint the danger. They can move their ears independently of each other to help them hear if danger is approaching. It's the rabbit's own built-in radar system.
- When the rabbit is relaxed, the ears lie along his back, but they are quite responsive to noise. The slightest sound can be detected from very far away. The shape of a rabbit's ears allow them to pick up sounds over 2 miles away. Rabbit ears are long so it can be down low in the grass but leave its ears sticking up to hear clearly.
- Lop-eared rabbits also have good hearing but do not do as well in the wild as rabbits with erect ears. Ear position is important in rabbit language, even in lop ear breeds—watch their ears carefully