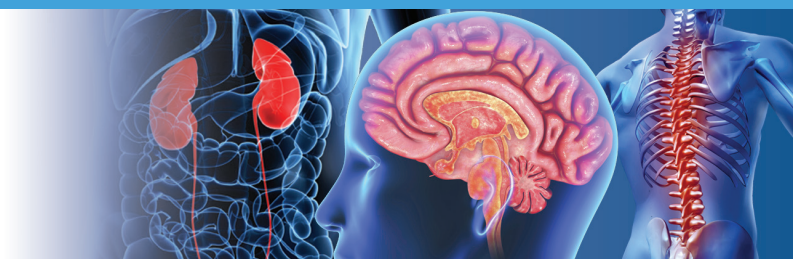
9 Human organ systems



9.1 Human excretory system and excretory products

The biological processes that take place within the cells, produce different products that are useful to the body as well as useless to the body.

As an example let us consider the respiration reaction. In respiration glucose react with oxygen and produce energy, carbon dioxide and water.

Enery is used for the biological processes in the body. But carbon dioxide and water may become harmful to cells when there is an excess amount.

The useless products that are produced during chemical reactions within the cells are known as **excretory products**. You can observe the Figure 9.1 to study about the excretory products in human body.

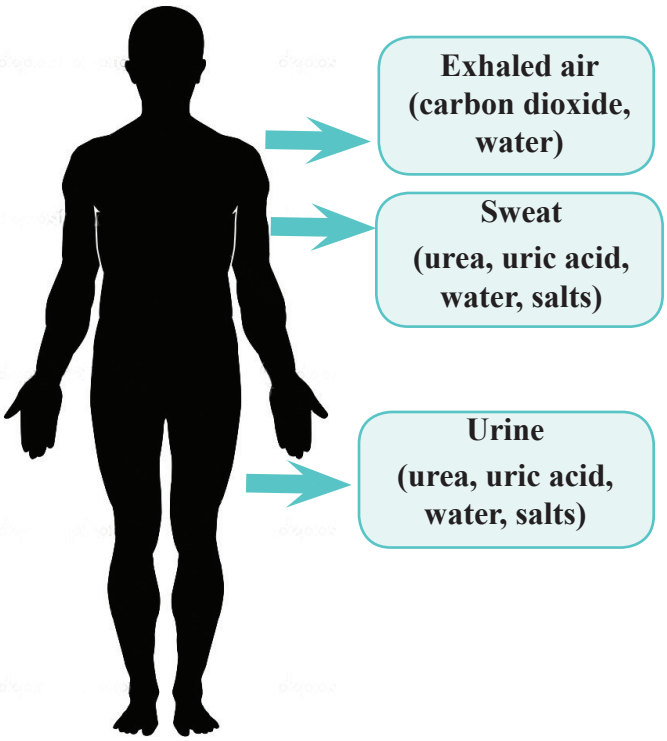


Figure 9.1 ▲ Excretory products of a human

Excretory products can damage the cells when accumulated in excess amount. Some products may be toxic. Therefore, it is very important to remove the excretory products from the body. The process that remove the excretory products from the body is known as **excretion.**

Waste matter remaining after food has been digested is known as faeces. As it is not produced by chemical reactions within the cells in the digestive system, it is not considered as an excretory product.

There are organs and systems that are specialized to perform the function of excretion in human body.

Table 9.1 shows the excretory products, where they are produced and how they are excreted.

Table 9.1

Excretory organ	Excretory products	The form they are excreted
Lungs	Carbon dioxide, water	As exhaled air
Kidneys	Urea, uric acid, salts, water	As urine
Skin	Little amount of urea, uric acid, salts, water	As sweat

Human urinary system

During the chemical reactions which take place in human body cells, nitrogenous by-products are produced. These nitrogenous by-products are excreted from the body through kidneys as urine. Therefore, the urinary system is considered as the main nitrogenous excretory system of human body.

Let us do Activity 9.1 to identify the parts of the human urinary system.

Activity 9.1

You will need:- A model/ diagram of the human urinary system

Method: -

- Observe the parts of the urinary system.
- Draw a diagram and name the parts.

The labelled diagram of urinary system of human is shown in Figure 9.2.

Urinary system consists of four main parts.

- Kidneys
- Ureter
- Bladder
- Urethra

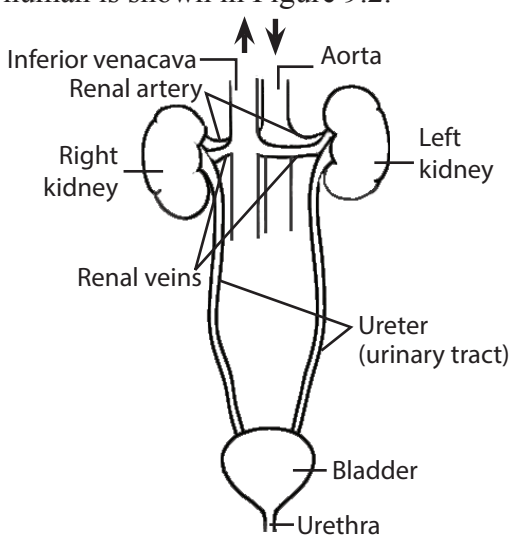


Figure 9.2 ▲ Human urinary system

Figure 9.3 ▲ The way to observe the location of kidneys externally

As shown in Figure 9.3 place your hands on your hips. Then the tips of your thumbs give an indicate the lower end of kidneys.

Kidneys reside against the back muscle in the upper abdominal cavity. They sit opposite each other on either side of the spine. The right kidney is a little bit lower than the left kidney to accommodate the liver.

In an adult each kidney is about 13 cm long and 6 cm wide. Kidneys are bean-shaped organs. Observe Figure 9.4 to get an idea about the external structure of a kidney.

The renal artery supplies blood to the kidney while the renal vein carries away the blood from kidneys.

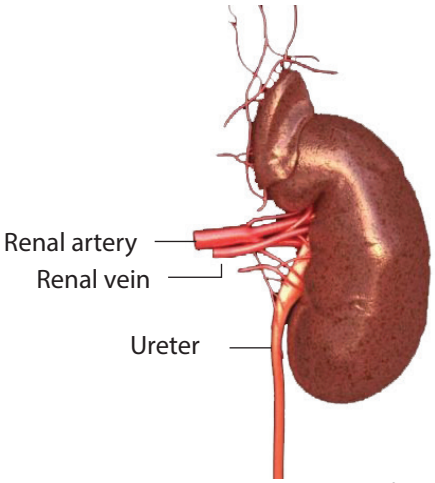


Figure 9.4 ▲ External structure of human kidney

Do Activity 9.2 to study about the internal structure of a kidney.

Activity 9.2

You will need:- A model/photograph of a kidney

Method: -

- Study the internal structure of a kidney using a model/ photograph of a kidney in your laboratory.
- Get the assistance of your teacher.

The labelled diagram of human kidney is shown in Figure 9.5.

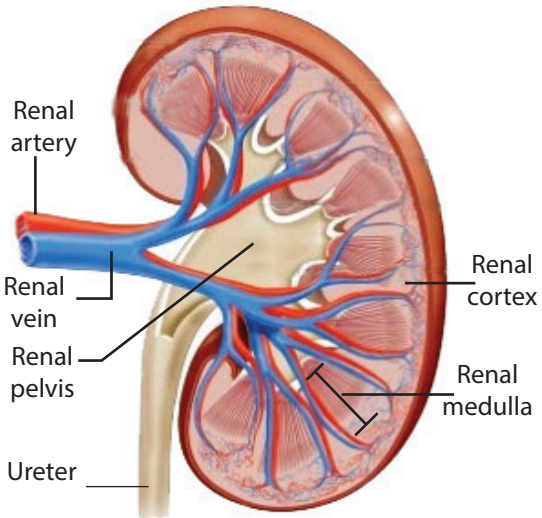


Figure 9.5 ▲ Longitudinal section of human kidney

A kidney consists of two major parts.

- Cortex
- Medulla

Renal cortex consists of lot of blood capillaries. Therefore, it is dark in colour. Within the renal medulla there are triangular shaped structures called renal pyramids. The tips of these renal pyramids are directed to the renal pelvis. The renal pelvis narrows and open into the upper end of the ureter.

Blood with excretory products transported by renal arteries is filtered in the kidneys. The filtered excretory products are carried by the ureter to the bladder and they are temporarily stored in the bladder. The fluid with excretory products is known as urine.

Components of urine

- Water
- Urea
- Salts (more sodium chloride)
- Uric acid

For extra knowledge

Components of urine of a healthy person is given below as percentages;

Water	- about	96%
Urea	- about	2%
Salts	- about	2%
Uric acid	- trace amounts	

Above mentioned values and colour of urine are important in diagnosing kidney diseases.

When the bladder is full, a person urinates through the urethra to eliminate the waste.

If the kidneys are damaged, the process of excretion does not happen the way they should. Some examples of kidney diseases and the reasons are given below.

- **Kidney stones**

Salts such as calcium oxalate deposit in kidneys and form crystalline structures. These structures are known as kidney stones (Figure 9.6). Kidney stones may occur, due to reasons given below.

- Not drinking enough water
- Taking salty diets regularly
- Not passing urine at proper time (when wanted)

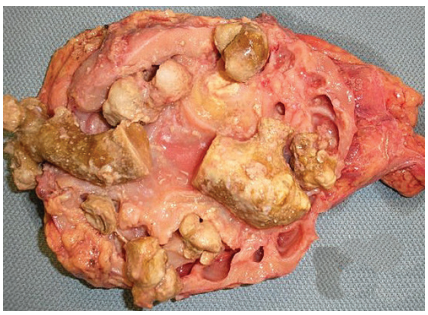


Figure 9.6 ▲ How kidney stones are formed

- **Kidney failure**

Functioning of kidneys get disordered and it is called kidney failure. Due to reasons mentioned below kidney failure may occur.

- Entering of heavy metals and toxic chemicals into the body
- Suffering from diabetes for a long time
- Using drugs for a long time period for certain diseases
- Smoking and taking liquor

- **Kidney infection**

The urethra can be infected by microorganisms and it may cause kidney damage.

Excretory process should be carried out efficiently in the body. For this purpose maintaining healthy kidneys is very important. Following are some tips that should be considered to maintain healthy kidneys.

- Drinking enough pure water daily
- Limit consuming too much salty and sour food (pickle, lime pickle, food with vinegar)
- Quit smoking and liquor

- There is a risk of kidney failure for the persons who suffer from diabetes. Therefore, it is important to control the blood sugar levels.
- If a person takes medications regularly over a prolonged period, he should take them to the prescribed dosage by the physician and should have regular tests to check kidney functions.
- One should concern about the cleanliness of the surrounding area of the urethra because this area can be infected very easily.

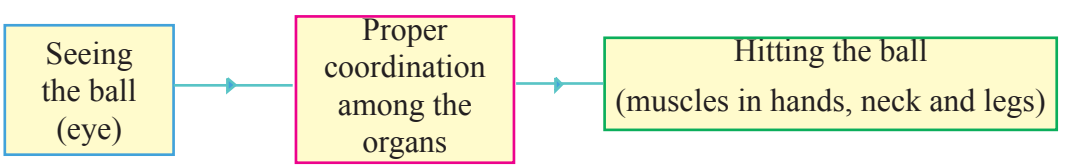
9.2 Nervous system

Imagine how a cricketer hits a ball. We know that he coordinates many organs in the body/ body parts to hit the ball in the proper way. Mainly he coordinates the eyes, hands, legs and neck to hit the ball properly. If these organs do not coordinate in the proper manner his hit will not be successful.

Figure 9.7 ▲ A cricketer hits the ball

Think about which body organs coordinate when you drive or put a thread to a needle.

Following flow chart shows the relevant process of hitting the ball.



According to the above seeing the ball is a sense. It occurs through the sensory organ called the "eye". The eye is the receptor. Hitting the ball is the reaction. Muscles in the eye, neck, hands and legs are used for the reaction.

Let us now focus on how the organs are coordinated in seeing and hitting the ball.

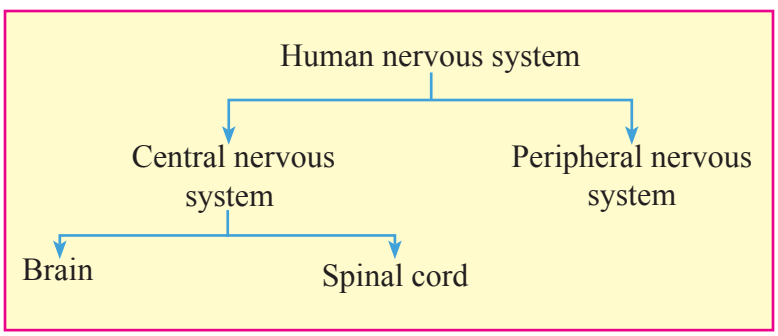
Many changes occur within the internal body of humans as well as in his surrounding environment. Body should react for these changes. To react there should be a very good interaction between the receptors (eye, ear, nose, tongue, skin) and the effectors (muscles and glands). This process is known as **coordination**.

The nerves and hormones are very important in coordination. Coordinating and controlling the various functions of our body by the nervous system is known as **nervous coordination.** Coordinating the body organs by hormones is known as **endocrine coordination.**

Nervous coordination

Let us study about the human nervous system.

Major parts of the human nervous system is given below.



Central nervous system

The two main organs of the central nervous system are the brain and the spinal cord. The central nervous system is better protected in the body. Its main line of defense is the bones. The bones around the brain is known as the skull and there is a spinal made with bones to protect the spinal cord. The skull and spinal column create a hard physical barrier to injury.

Both the brain and the spinal cord are protected by layers of special connective tissues called the **meninges.**

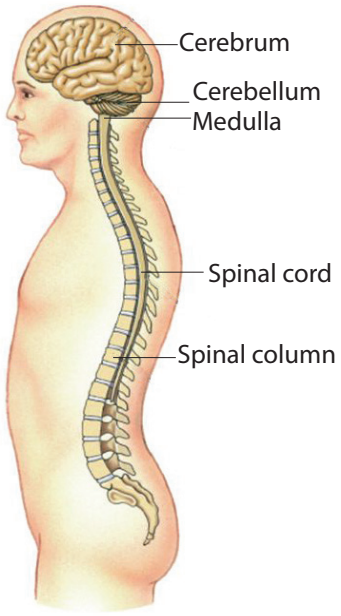
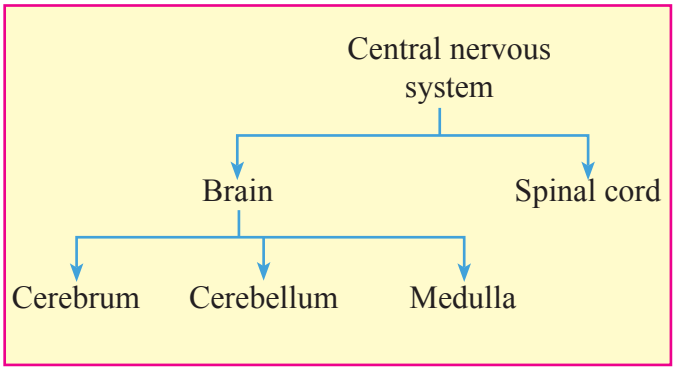


Figure 9.8 ▲ Central nervous system

The meninges are filled with a special fluid called **cerebrospinal fluid**. Some functions of cerebrospinal fluid are given below.

- Absorb shocks
- Supply nutrients
- Prevents the central nervous system from microbial infections



The functions of each part of the central nervous system differs.

- **Cerebrum/cortex** - Controls higher brain functions such as thought, intelligence
  Recognition of senses
  Controls the movements of muscles with the intent to perform a specific action (controlling the voluntary actions)
- **Cerebellum** - Regulation and coordination of body balance
- **Medulla** - Controls the automatic functions (non-voluntary functions) such as heart beat, breathing
- **Spinal cord** - Relays messages from the brain to different parts of the body

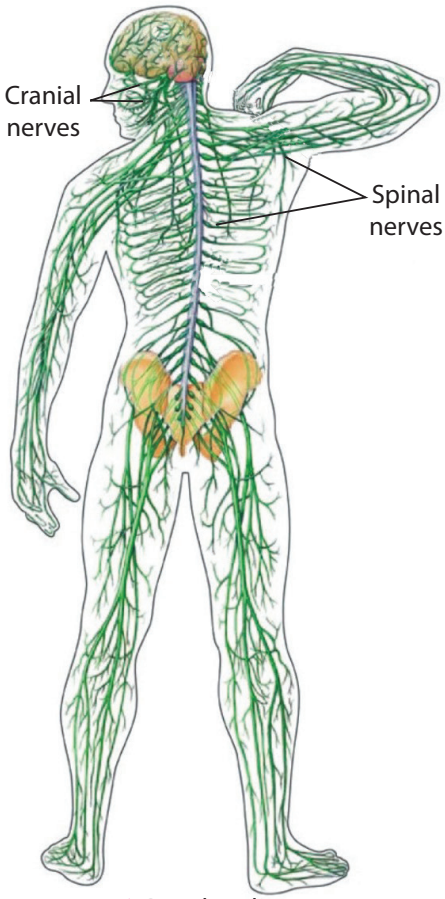


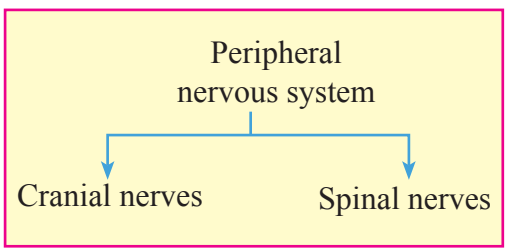
Figure 9.9 ▲ Peripheral nervous system

Peripheral nervous system

All the nerves that lie outside the spinal cord and brain are known as the peripheral nervous system.

The nerves that lead directly from the brain are called cranial nerves. There are 12 pairs of cranial nerves.

The nerves that arise from the spinal cord are called as spinal nerves. In humans there are 31 pairs.



Functions of peripheral nervous system

- Transmitting impulses from receptors to the central nervous system
- Transmitting impulses from central nervous system to the effectors

An electrical signal that travels along a nerve is called an impulse.

Engage in Activity 9.3 to study the speed of impulses in human nerve.

Activity 9.3

You will need:- 30 cm ruler

Method:-

- As shown in Figure 9.10 take the 30 cm ruler to your hand vertically (the "0" of the ruler towards the ground)
- Free the ruler from the hand and ask your friend to catch it.
- Get the reading of the ruler where your friend touched with the hand.
- Repeat this activity with different students.

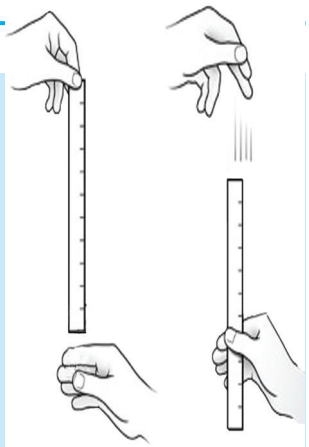


Figure 9.10

You will notice that each student gets different readings.

The dropping of the ruler is recepted from the eyes. The message is transmitted to the brain and is returned to the effector, the muscles of the right hand. Then, the right hand responses.

According to the results of Activity 9.3 the speed of impulses differ from each person.

The most important part of our body are the brain and spinal cord. So, it is very important to take necessary protective measures in day-to-day activities since the nervous system is very fragile.

Some protective measures are given below.

- Maintaining a balanced nutrition from childhood
- Prevent children facing accidents
- During pregnancy mother should get proper nourishment. Considering the baby's physical and mental development
- Be sure to get the correct posture during sports, exercises in daily life and lifting a burden to force
- Control mental stress
- Avoid excessive keeping awake sleepless
- Engage in intelligence development activities

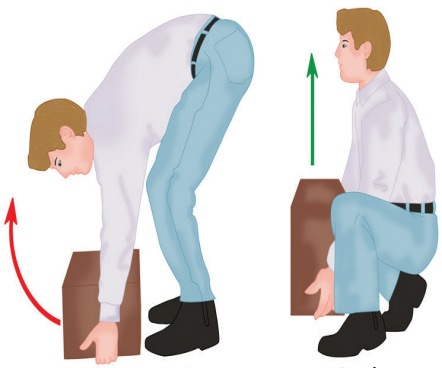


Figure 9.11

- In an accident there is more possibility for spinal cord injuries. Never move anyone who you think have a spinal injury unless it is very necessary. Keep the person absolutely still and safe. Do not allow the body to bend or twist. Keep the person on a wooden flat surface and rush to the nearest hospital.

9.3 Human skin

Skin is the largest organ in our body. It weighs about 4.5 kg and its thickness is about 1-2 mm in an adult. Skin mainly consists with two layers.

- Epidermis
- Dermis

Let us engage in Activity 9.4 to study about the structure of the human skin.

Activity 9.4

You will need:- A diagram/model of the human skin

Method:-

- Identify the main parts of the human skin.
- Draw a cross sketch of the human skin and name the parts.

Structure of the human skin is shown in Figure 9.12.

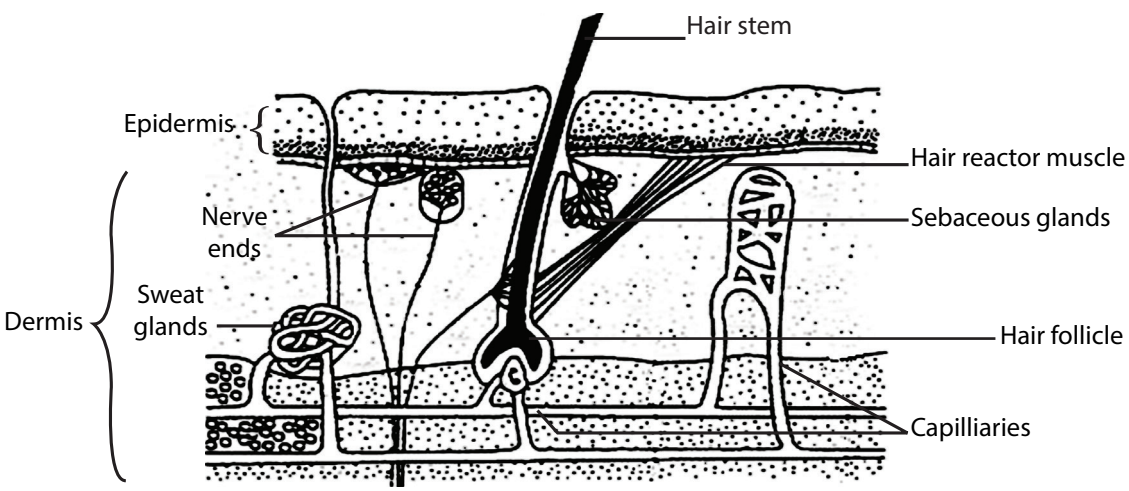


Figure 9.12 ▲ Structure of the human skin

Epidermis

The outer most layer of skin is epidermis. The epidermis is made up of several layers of cells. The epidermis is heeding thousands of dead cells and replenishing daily. Skin colour is due to melanin- a pigment produced in the epidermis to protect us from the sun's ultraviolet rays.

Dermis

The dermis beneath the epidermis contains hair, sweat glands, sebaceous glands, muscles, nerve endings and blood vessels (capillaries). The dermis is thicker than the epidermis.

Beneath the dermis lies the hypodermis.

Functions of the human skin

- **Protective layer of the body**

  The layers of the epidermis minimize water loss from the body and prevent from dehydration

  Melanin pigments in the cells of the skin protects the body from ultra violet rays.

  The secretion from sebaceous gland act as a barrier against microorganism infections. This is a natural defense mechanism.

- **Regulation of body temperature**

  When the temperature increases in the environment than the body temperature the sweat glands secrete sweat to release heat.

  When the atmospheric temperature is lower than the body temperature the blood supply to the surface of the skin is prevented and the body temperature is regulated. The secretion of sweat is minimized.

- **Acting as a sensory organ**

  In the dermis there are nerve endings which detect the pressure, touch and temperature.

- **Synthesis of vitamin D**

  Using the energy of sunlight, vitamin D is synthesized in the cells of the skin.

- **Excretion**

  The sweat glands secrete sweat which consists of urea, uric acid, and ammonium salts. Therefore, skin can be considered as an excretory organ.

There are many functions carried out by human skin. As the skin is exposed to the environment there is a possibility for the skin to be infected by microorganisms and waste materials.

Wipe your face with a tissue paper. You will notice that your face becomes clean and there is dust in the tissue paper. Cleanliness and protection help to maintain a healthy skin.

Following are some tips that help to maintain a healthy skin.

- Eat nutritive diet
  - Vitamin A and E are essential for a healthy skin. Consuming fresh fruits and vegetables helps to supply vitamin A and E to the skin.
  - Drink adequate amount of fresh water daily.

- Be gentle to your skin
  - Bath daily (if the person is not sick).
  - Use a mild soap which does not wipe the oil on your skin.
  - After wash or bath, gently blot the skin with a towel and do not rub against the skin.

- Protection from sun
  - If you are exposing to the sun for a long time period wear clothes that covers your skin well.

- Avoid smoking and smokers
  - Smoking narrows the blood vessels in the skin, reducing blood circulation. The skin cells are starved of oxygen and nutrients. Therefore, the skin loses its strength and elasticity, develops wrinkles and looks older.

- Other factors
  - Wearing cotton dresses
  - Do not exchange your dresses with others
  - Get medical advices for skin disorders such as pimples and warts
  - Manage stress and always try to maintain good mental health

For extra knowledge

Dirty skin is easily infected by microorganisms. Also lack of nutrients lead for skin disorders. Following figures shows some skin disorders.


Pityriasis


Removal of skin


Warts


Acne


Heel getting dry


Eczema

Assignment 9.1

Prepare a booklet on the topic "The importance of taking protective measures for the excretory system, nervous system and skin in day-to-day life."

Summary

- Many biological processes take place in the human body.
- We should maintain proper functioning of the organs and the systems in order to maintain biological processes efficiently.
- The harmful products that are produced during the chemical reactions within the cells of living organisms, are known as excretory products.
- The process which pass the excretory products from the body is known as excretion.
- Kidneys, lungs and skin are the main excretory organs in the human body. The basic nitrogenous excretory organs are the kidneys.
- Other than the kidneys, the lungs and skin too function as excretory organs.
- The urinary system is considered as the nitrogenous excretory system of the human body.
- Eye, ear, nose, tongue and skin are the sensory organs of the human body.
- The effectors of the body response for the senses detected from the sensory organs.
- The process of adjusting the body for the changes in the external and internal environment by inter connecting the receptors and effectors is known as coordination.
- Nerves and hormones are important in coordination.
- Coordination by nervous system is known as nervous coordination.
- The main two parts of the human nervous system are central nervous system and peripheral nervous system.
- Central nervous system consists of brain and spinal cord.
- All the nerves in the body outside the brain and spinal cord are known as peripheral nervous system.
- Central nervous system controls the higher brain functions such as muscle movements, carrying impulses etc.
- Skin is the largest organ in the human body. It consists of two layers called epidermis and dermis.
- It is important to lead a healthy life in order to maintain the proper functioning of the body organs.

Exercise

1. Give short answers.
   i) What do you mean by excretion?
   ii) What are the main excretory organs in the human body?
   iii) Why is faeces not considered as an excretory product?
   iv) What is the main component in urine?
   v) Write three instances that can damage the kidneys.
2. Underline the correct answer.
   i) The nerve endings are in (epidermis/ dermis).
   ii) Inter-connection between the receptors and effectors is known as (homeostasis /coordination).
   iii) There are (meninges layers/pleura…..) for the protection of central nervous system.
   iv) The cerebrum/cortex ..... (controls higher brain functions/ regulates and coordinates of body balance).
   v) All the nerves in the body that lie outside the brain and spinal cord are called as (central nerves/ peripheral nerves).
3. Match the correct answer

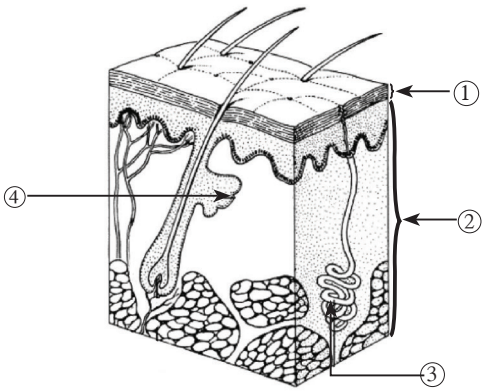
A	B
i) Cerebrum	Controlling the heart beat
ii) Cerebellum	Controlling the movements of muscles with the intent to perform a specific action
iii) Medulla	Transmitting messages between the body and brain
iv) Cerebrospinal fluid	Absorbing shocks
v) Spinal cord	Balancing the body

4. Fill in the blanks using suitable words.

Skin is the ……. organ in the human body. It consists of two layers called ……. and …… There are ……. cells in the epidermis. In some epidemic cells there is a special pigment called …… that determines the skin colour. It protects the skin from sun's …… rays. There are …….. glands and …… glands within the dermis. When there is sunlight skin synthesizes vitamin …… In the skin there are …… that detect pressure, touch and temperature.

5. Write a list of protective measures that can be taken to maintain a healthy skin.

6. Name the parts 1-4 given in the cross section of the skin.



Technical Terms

Excretion	-	බහිස්ස්‍රාවය	-	கழிவகற்றல்
Excretory products	-	බහිස්ස්‍රාවිය ඵල	-	கழிவுப்பதார்த்தங்கள்
Urinary system	-	මෛත්‍ර පද්ධතිය	-	சிறுநீரகத்தொகுதி
Kidney	-	වෘක්කය	-	சிறுநீரகம்
Nervous system	-	ස්නායු පද්ධතිය	-	நரம்புத்தொகுதி
Nervous coordination	-	ස්නායු සමායෝජනය	-	நரம்பு இயைபாக்கம்
Central nervous system	-	මධ්‍ය ස්නායු පද්ධතිය	-	மைய நரம்புத்தொகுதி
Peripheral nervous system	-	පර්යන්ත ස්නායු පද්ධතිය	-	சுற்றயல் நரம்புத் தொகுதி
Brain	-	මොළය	-	மூளை
Spinal cord	-	සුෂුම්නාව	-	முண்ணான்
Impulse	-	ආවේග	-	கணத்தாக்கம்
Dermis	-	චර්මය	-	மேற்தோல்
Epidermis	-	අපිචර්මය	-	உட்றோல்
Hypodermis	-	අධශ්චර්මය	-	அடித்தோல்
Sweat galand	-	ස්වේද ග්‍රන්ථිය	-	வியர்வைச் சுரப்பி
Sebaceous gland	-	ස්නේහස්‍රාවී ග්‍රන්ථිය	-	நெய்ச்சுரப்பி
Hair follicles	-	රෝම කූප	-	மயிர்ப்புடைப்பு