d. The sense organs and receptors

Our body has sense organs that respond to different types of stimuli. These sense organs are listed in Table 3.3.

Table 3.3 Sense organs and their location

Sense organ	Location of sensory receptors
Taste	tongue surface
Smell	top of nasal cavity
Vision	retina in the eyes
Hearing	ear drum and auditory nerve
Touch/pressure	skin
Pain	skin; throughout body
Temperature	skin; throughout body

The endocrine system

The human body has a second system that is involved in control and coordination. This is the **endocrine** system. It consists of various **glands** that release **hormones** (special chemical messengers) directly into the bloodstream and bodily fluids (vascular system). The vascular system carries these

hormones to various organs or cells around the body which are then stimulated to respond. The endocrine system is important in controlling growth, metabolism and reproduction. Figure 3.22 shows the location of some important endocrine glands. The **pituitary gland** at the base of the brain is an important gland in that it controls and stimulates many other glands. The pituitary gland releases many hormones, including those that regulate skin pigmentation, re-absorption of water in the kidneys and excretion of milk in nursing mothers.

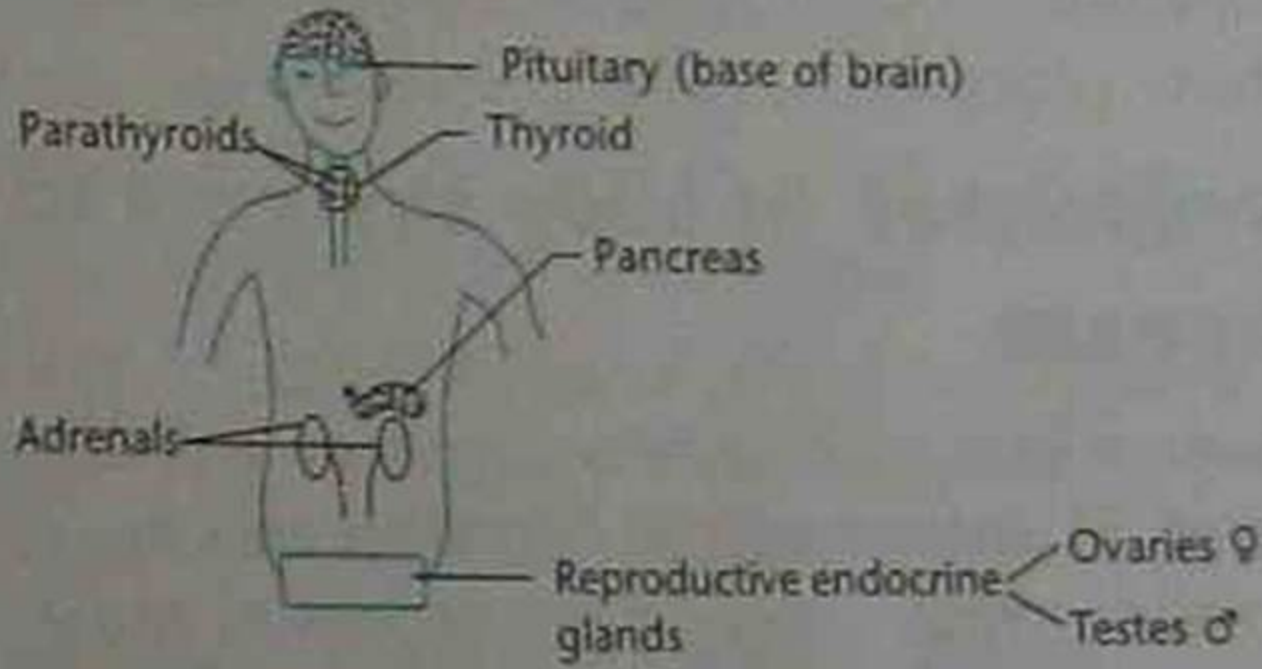

Figure 3.22 Locations of endocrine glands

Table 3.4 lists some important endocrine glands and some of the functions controlled or affected by the hormones they produce.

Table 3.4 Some important functions of the endocrine glands

Endocrine gland	Hormone	Function of hormone
Pituitary	growth hormone	stimulates growth and DNA synthesis
Pancreas	insulin	stimulates glucose uptake in all cells
	glucagon	stimulates the liver to break down glycogen into glucose
Thyroid	thyroxine	stimulates metabolism and heart rate
Adrenal	adrenalin	stimulates heart rate and blood pressure
Parathyroid	parathyroid hormone	stimulates calcium ion release in bones

Example. Control of glucose levels in the blood

The pancreas produces two important hormones called **insulin** and **glucagon**. Insulin reduces glucose levels in the blood by stimulating body cells to take up glucose. Glucagon acts in the reverse way. When blood glucose levels are too low, glucagon stimulates the liver to break down its stored glycogen into glucose, which is then released into the blood and body fluids. Together these two hormones keep glucose levels regulated. The disease called **diabetes** is caused by a failure of cells in the pancreas to produce the correct levels of these glucose-regulating hormones.

Responses of body systems to disease

Disease in a multicellular organism is the result of **abnormal cell function** and the breakdown of one or more organs or body systems.

Diseases of the human body can be classified as **infectious** or **non-infectious**.

- **Infectious diseases** are caused by **pathogens**. Pathogens are disease-producing microorganisms (microbes) such as bacteria, viruses, protozoa and some fungi. These pathogens enter the body in a variety of ways and their activities disrupt its proper functioning. Infectious diseases (eg. measles, HIV and diphtheria) can be passed from one person to another.

- **Non-infectious diseases** have a variety of causes.
  - **Genetic diseases** may have several causes. During the life of an organism the process of cell reproduction and cell differentiation may go wrong. This may occur because the **genetic code** on the chromosomes is **not copied correctly** prior to cell division. The new cells therefore receive faulty copies of the code. Sometimes

chromosomes do not divide correctly and some cells inherit additional copies while others receive less than the normal number. The normal number of chromosomes in human cells is 46. Down syndrome is caused by cells receiving an extra copy of chromosome-21 attached to the end of chromosome-15. Thus Down syndrome sufferers have 47 chromosomes. Another genetic disease is haemophilia. It is a blood

chromosomes. Another genetic disease is haemophilia. It is a blood disease passed from one generation to the next due to the inheritance of a faulty gene.

- **Environmental agents** (eg. toxic chemicals, high-energy radiation, viruses) may damage the chromosomes, leading to changes or mutations in genes. **Some organ or tissue diseases** such as **cancer** are caused by mutations of the genetic code by agents in the environment such as toxic chemicals, atomic radiation or viruses.

- **Physiological diseases** such as giantism are also non-infectious. They are caused by organs failing to work properly.

Non-infectious diseases cannot be passed on to another person.

Infectious diseases

Figure 3.23 shows some examples of microbes. Not all microbes cause disease. Some have a beneficial role in the body (eg. in the production of vitamins) and in the environment (eg. as decomposers).

Bacteria ha

Bacteria belong to the **Kingdom Monera**. Their cells are very simple and their single coiled strand of DNA is not contained within a nuclear membrane like the cells of multicellular organisms. Bacteria may have many shapes, such as spheres, rods and spirals, as well as chains of spheres and rods. Pathogenic bacteria can damage the cells of the host by producing poisons (toxins). Bacteria multiply very rapidly at body temperature. Every 20–30 minutes,

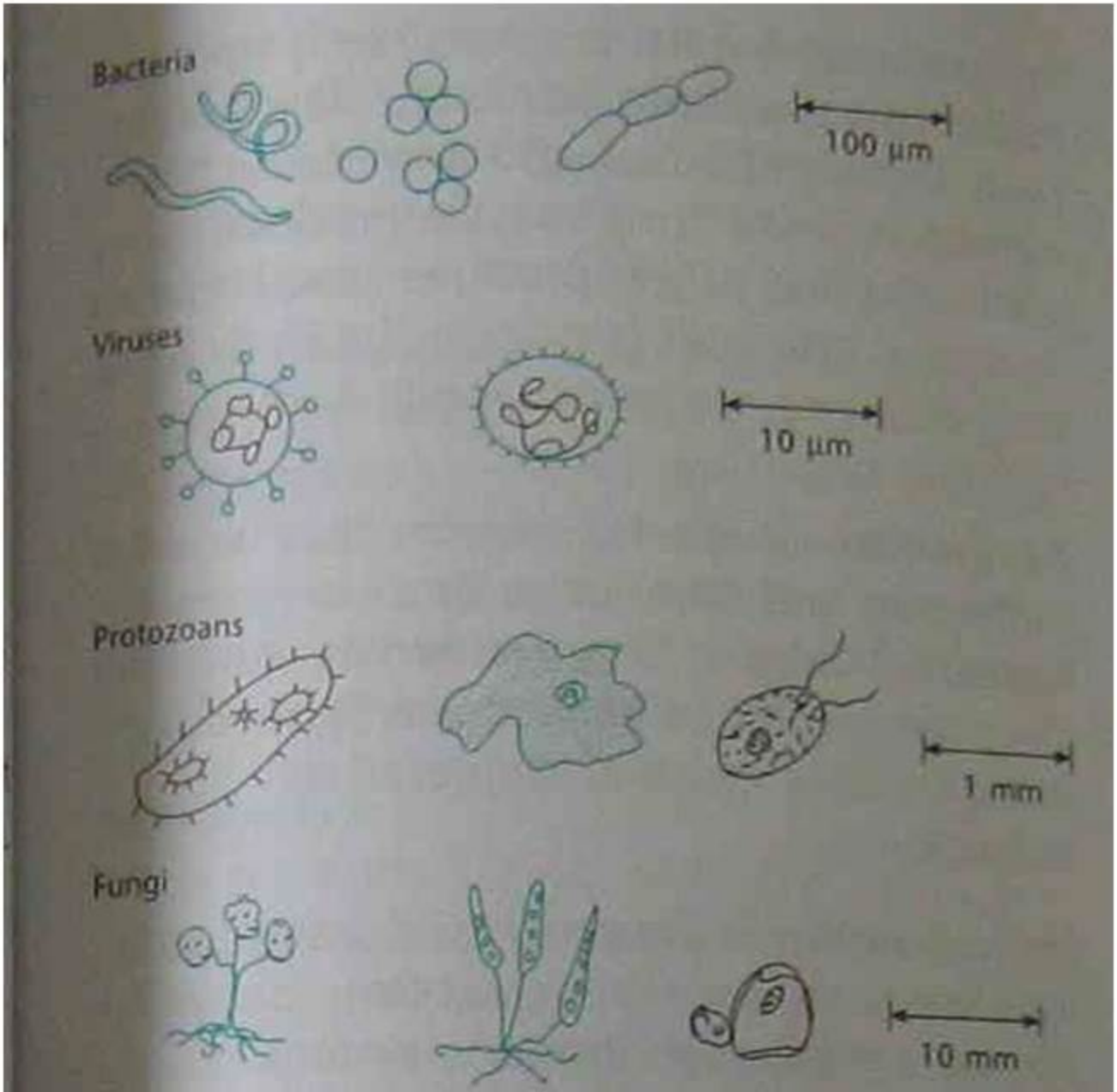

Figure 3.23 Examples of microbes

each bacterium cell divides by mitosis and produces two new bacteria. Over the course of a day the number of bacteria becomes quite large and their toxins start to disrupt the body.

Viruses are not classified into the five major kingdoms of living things as they are not cellular life forms. They consist of particles that are usually made up of bundles of genetic material inside a protein coat. They invade a host and use the nucleus of the

host to complete their reproduction. Eventually the host cell dies and splits open to release thousands of new viral particles, which then infect other cells.

Protozoans belong to the **Kingdom Protista.** They are single-celled microbes with their DNA inside a nucleus. They vary widely in shape, and mainly live in water or in moist soil. They can reproduce asexually or sexually. Not all protozoans are pathogenic.

Fungi

protozoans are pathogenic.

Fungi are mostly multicellular organisms. The **Fungal Kingdom** is distinct from plants, as fungi do not produce their own food by photosynthesis. The parasitic fungi reproduce sexually or asexually. They are abundant in soil. The fungi that cause disease in humans tend to attack the skin, hair, nails and moist membranes.

Table 3.5 classifies some infectious diseases according to the type of microbe that causes the disease.

Resisting the attack of microbes

The human body resists attack by pathogenic microbes in a variety of ways. The body provides barriers to microbe entry. If microbes enter, then white blood cells of the immune system attack the invaders. Time is very important. The immune system must defeat the pathogens before they overwhelm the body. Disease and even

Table 3.5 Common infectious diseases

Disease	Pathogen	Transmission	Symptoms of the disease
Salmonella food poisoning	bacterium	eating contaminated food	diarrhoea; inflammation of the intestine; nausea
Tuberculosis	bacterium	inhaling infected droplets in the air; drinking contaminated milk	lesions form in lungs producing fever and coughing
Malaria	protozoan	protozoan enters human during a mosquito bite	severe fevers; shivering; sweating; nausea; reoccurs periodically
Mumps	virus	contact; inhalation of infected droplets	swollen salivary glands in cheek/neck; fever
Measles	virus	contact with infected people; inhalation of infected droplets	red spots (rash) on face and body; fever
Tinea	fungus	contact of the foot with infected areas (eg. communal bathing)	itching and blistering of skin between toes; cracking of skin

death may result if the body's defences cannot overcome the invasion.

1. Barriers to microbe entry

- **Acidic environments.** Acids are secreted onto the skin and acids are produced in the stomach and kill many of the microbes or slow down their reproduction. Urine is also acidic and this prevents microbes entering the body via the urethra. The highly acidic gastric juices in the stomach kill many microbes.

- **Mucus linings.** Our airways are lined with a sticky mucus that traps microbes that may be inhaled.
- **Hairs and cilia.** The respiratory tract is lined with cilia (microscopic hairs) that trap microbes.

2. Phagocytes

Phagocytes are **white blood cells** that attack foreign substances, including microbes. The phagocytes engulf and destroy the microbes. **Pus** is the remains of dead phagocytes and microbes.

A fever is often associated with the action of white blood cells. The increased temperature of the body helps to destroy some microbes.