

Chapter 4

Body organisation

Unit 1A

Unit content

Body systems

The body is organised from cells into tissues, organs and systems. The major body systems are the digestive, excretory, skeletal, muscular, respiratory, circulatory, nervous, endocrine, immune and reproductive systems and are related to life processes.

Organisation:

- hierarchy of organisation in the body
- introduction to tissue types and cell organisation
- location of organs associated with each body system in the body.



Figure 4.1 Although cells are the individual building blocks of the human body, they are organised into groups with particular functions

Your body is a mass of cells—about 75 trillion of them—but it is not a disorganised mass. Your cells are arranged in a particular way that allows each one to contribute to the functioning of the whole body.

Each human develops from just one cell, the fertilised egg cell. That cell divides repeatedly and, by a process called **differentiation**, the new cells become specialised for particular functions. There are about 200 different types of cells in the human body.

The structural organisation of the body

The body is organised on four structural levels. At the lowest level is the **cell**—the basic building block. Cells are specialised to carry out different functions. Muscle cells are able to shorten in length; red blood cells are able to transport oxygen; cells of mucous membranes secrete mucus; and so on. Cells with similar specialisations that carry out a common function are grouped together into tissues.

Tissues are the second structural level. Groups of muscle cells make up muscle tissue, groups of nerve cells make up nervous tissue and groups of bone cells form bone.

At the third level of organisation, different types of tissues work together as **organs**. An organ is normally made up of two or more tissues. The stomach is an organ with lining tissue on the inside and muscular tissue in the wall; the heart is an organ made up of muscular tissue and nervous tissue.

The highest level of organisation is the **system**. A system is a group of organs that work together for a common purpose. For example, the role of the respiratory system is to supply the blood with oxygen and to remove carbon dioxide from the blood. Some of the organs that make up the respiratory system are the lungs, diaphragm, muscles between the ribs, windpipe, larynx and nose.

The body systems are all integrated into the one living thing, the **organism** (see Fig. 4.2).

Tissues

A tissue is a group of cells that are similar in structure and that work together to carry out a particular task. The structure of the tissue and the function that it performs can be used to classify it into one of four basic types. These four basic types of tissue are epithelial tissue, connective tissue, muscular tissue and nervous tissue.

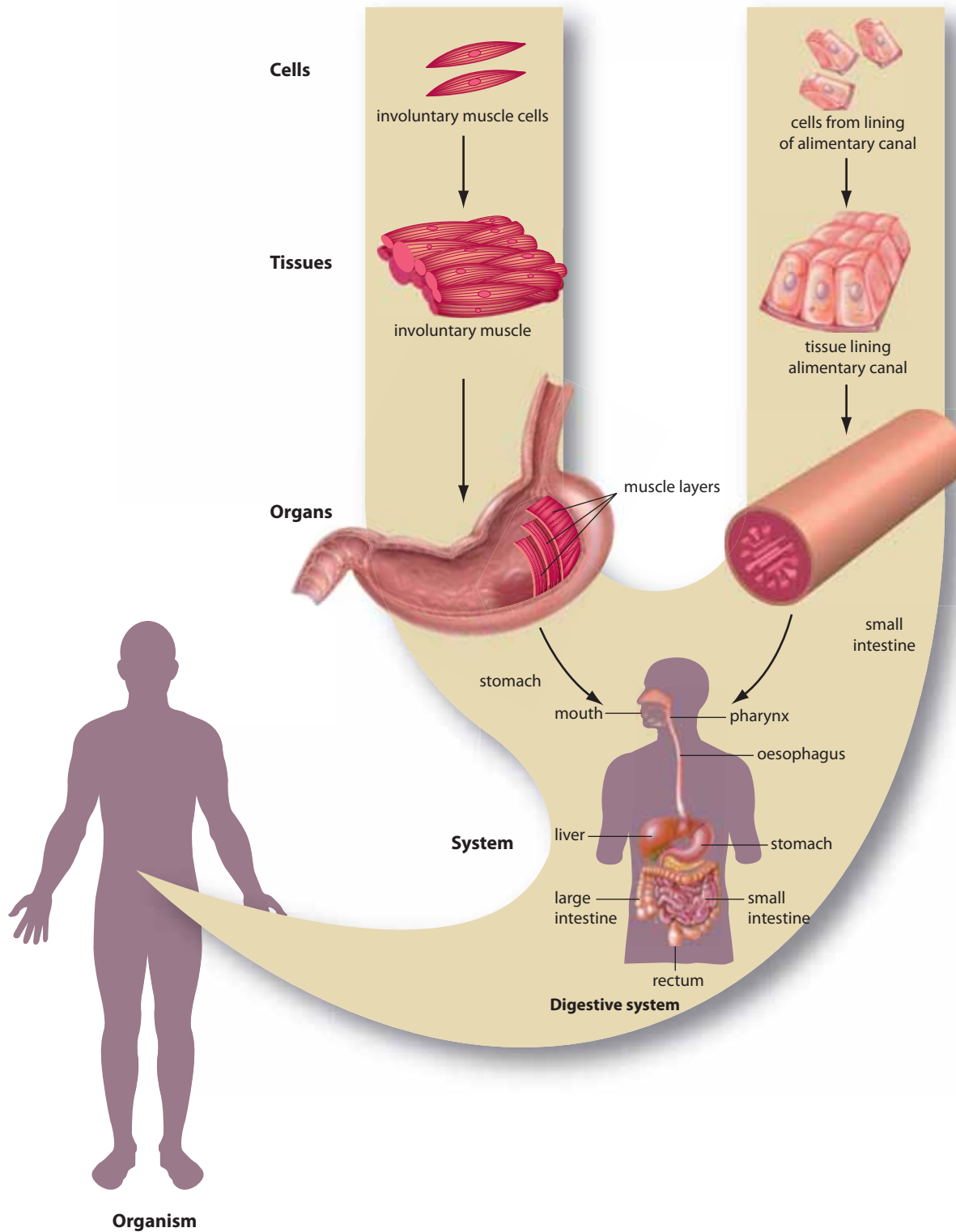


Figure 4.2 The levels of structural organisation of the human body

Epithelial tissue

Epithelial tissue, or **epithelium**, is a covering or lining tissue. The outer layer of the skin is an epithelial tissue. Organs like the heart, kidneys, intestines, liver and lungs are covered with epithelium. It also lines the inside of organs, so the inner layer of the heart, stomach, intestines and other hollow organs is made up of epithelium.

The cells that make up epithelium are very closely joined together. They vary in shape from thin and flat to column-shaped and cube-shaped depending on the particular tissue. The cells that line the inside of your mouth are an example of thin, flat epithelial cells. Because they fit very closely together they form a very smooth surface.

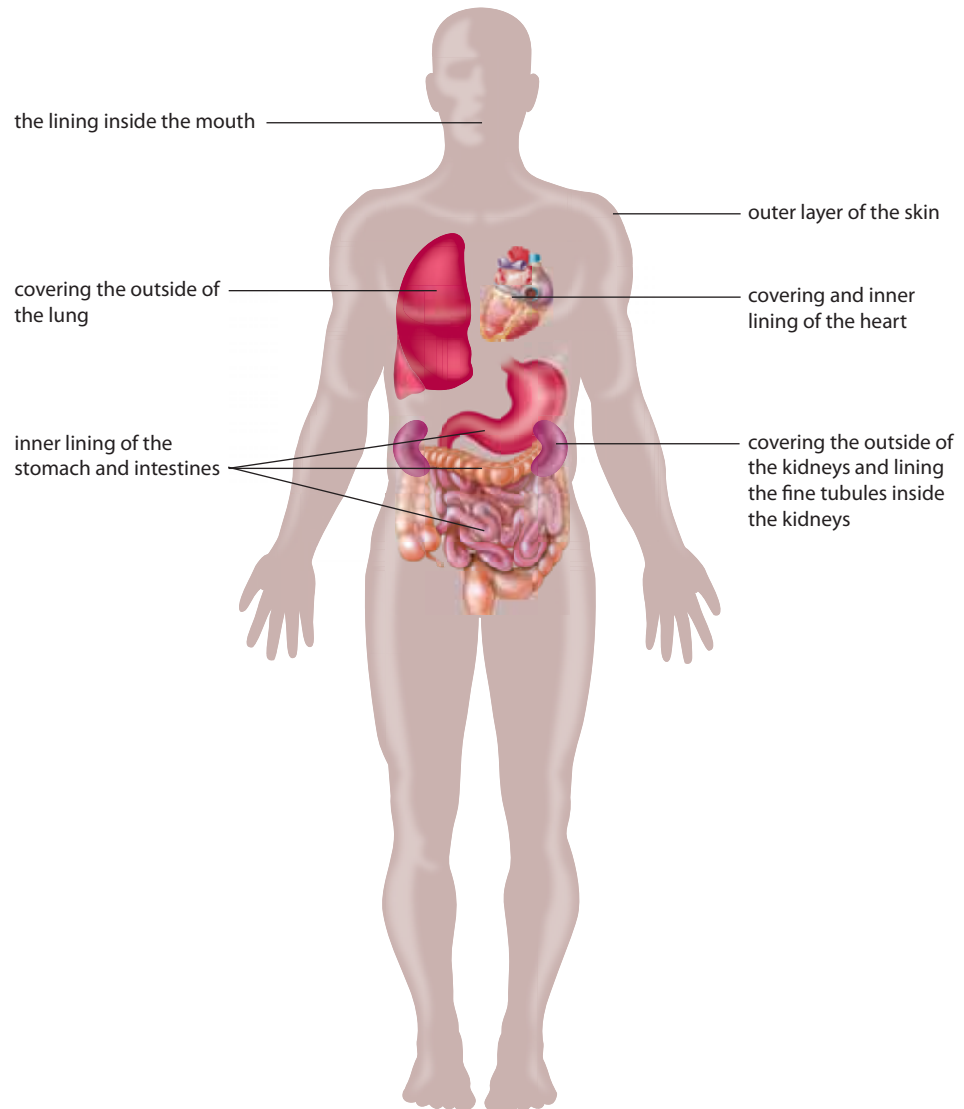


Figure 4.3 The location of some epithelial tissues

Connective tissue

Connective tissue provides support for the body and helps to hold all the body parts together. One of the characteristics of connective tissue is that the cells are not close together like they are in epithelium. They are separated from each other by large amounts of material that is not made of cells. This non-cellular material is called **matrix**.

Connective tissues include bone, cartilage, tendons, ligaments and fat storage tissue. Blood is often classified as a connective tissue. The matrix of blood is the liquid in which the blood cells are suspended.

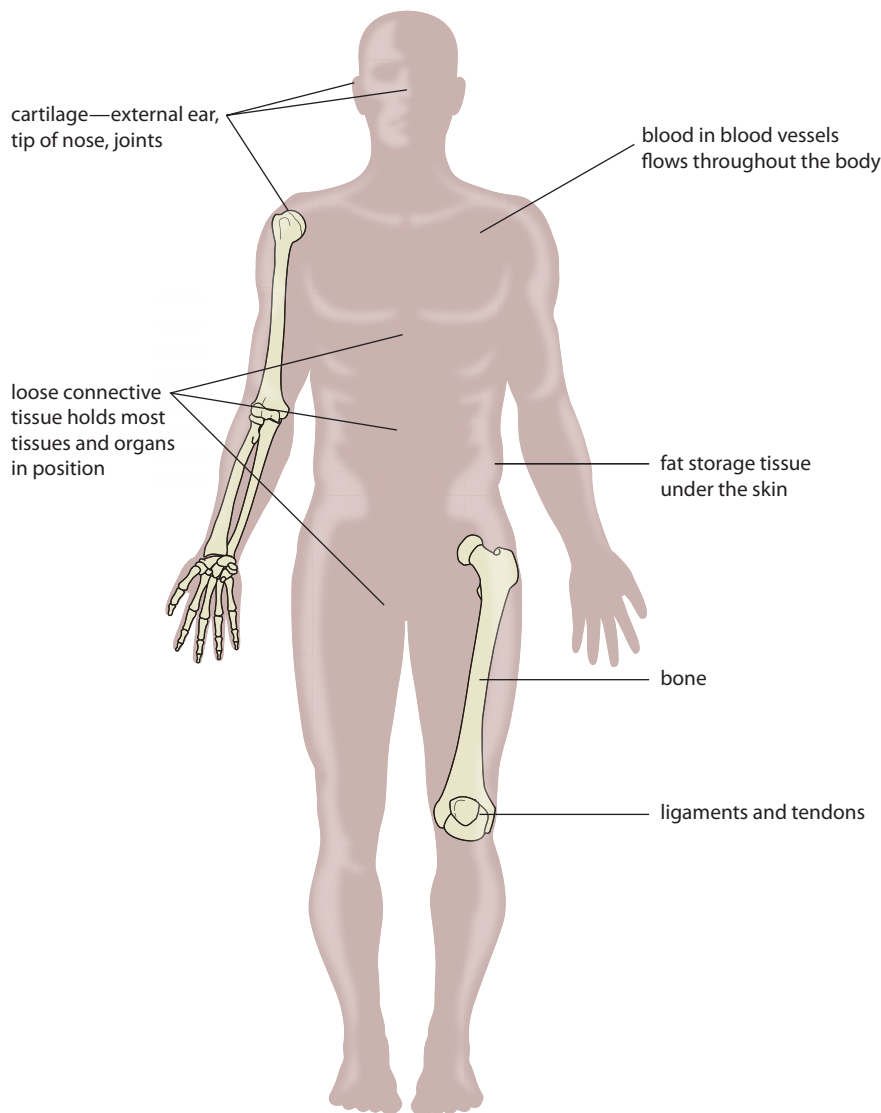


Figure 4.4 The location of some connective tissues

Muscle tissue

The cells of muscle tissue are long and thin and are often called **muscle fibres**. They are able to respond to a stimulus by contracting and becoming shorter. There are three different types of muscle tissue.

Skeletal muscle tissue makes up the muscles that are attached to bones. These are the muscles that you can feel in your arms and legs. We have voluntary control over these muscles so that we can move parts of our bodies when necessary.

Involuntary muscle is made up of cells that we cannot contract voluntarily. This type of muscle is found in the walls of the stomach and intestines, in the walls of blood vessels, in the iris of the eye, in the uterus and in many other organs.

Heart muscle makes up most of the heart. When heart muscle contracts it pumps the blood. Heart muscle cannot be voluntarily controlled.

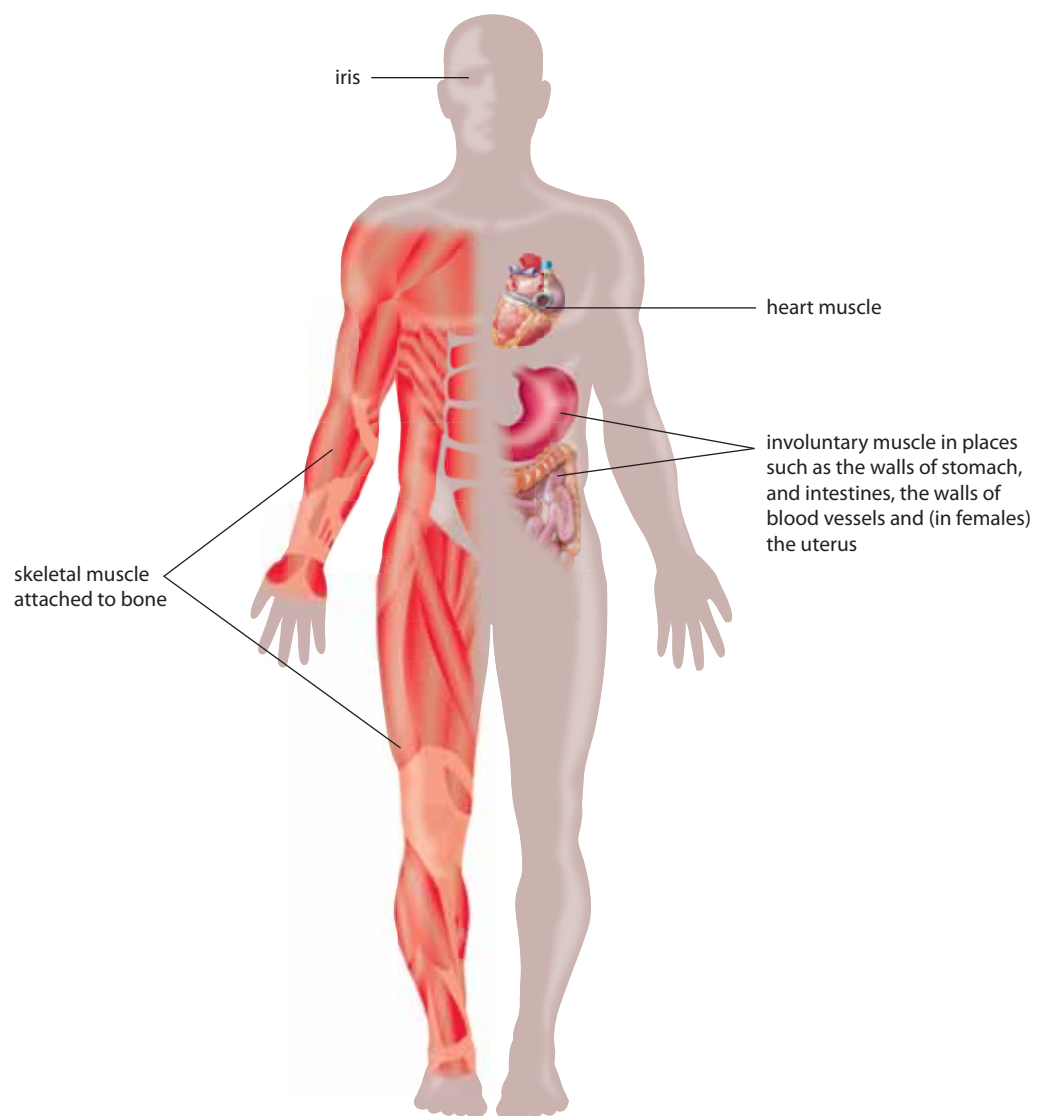


Figure 4.5 The location of some muscle tissue

Nervous tissue

Nervous tissue is made up of specialised nerve cells that are called **neurons**. Neurons have long projections from the body of the cell. When part of a neuron is stimulated messages can be carried along these projections from one part of the body to another.

Nervous tissue is found in the brain, the spinal cord and in the nerves.

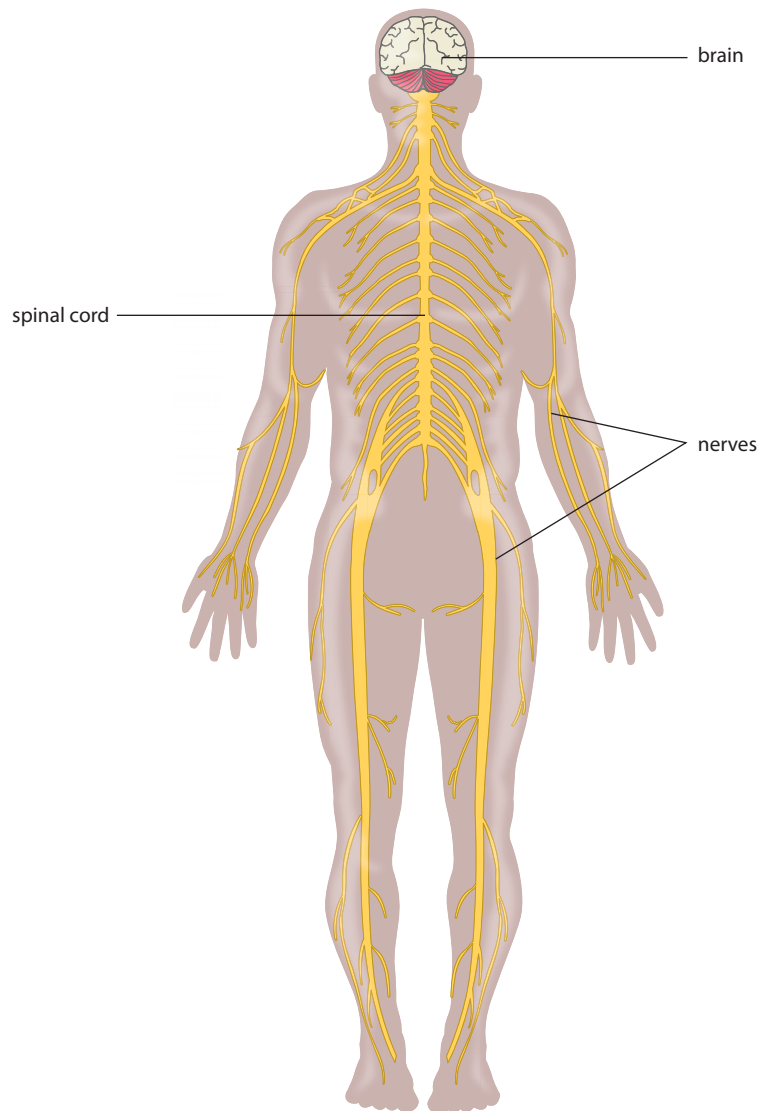


Figure 4.6 The location of nervous tissue

Organs

Organs are body structures that are made up of two or more types of tissue. The tissues of an organ work together to carry out a particular task.

For example, the heart is mostly muscle tissue but it is covered and lined with epithelium. It also contains nervous tissue to make the muscle contract. All of these tissues work together to pump the blood, which is a connective tissue.

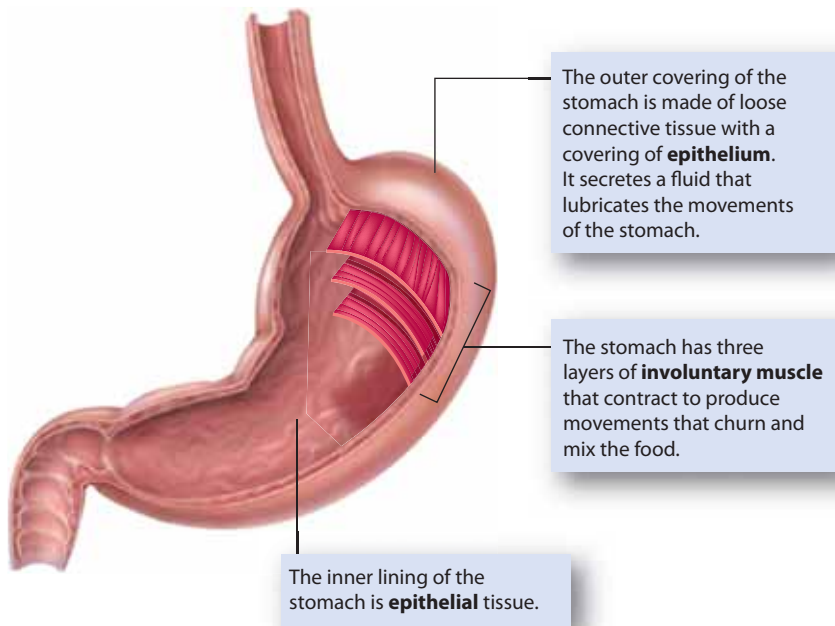


Figure 4.7 The stomach is an organ made up of a number of tissues

Organs are distinct structures that usually have a recognisable shape. For example, you are probably familiar with the shape of the heart, the stomach, the lungs or the brain, all of which are organs.

Some large organs have smaller organs within them. The skin is the largest organ in the body but within it are many smaller organs like the sweat glands, nerves, hair and nails.

Systems

The various organs are organised into body systems, sometimes called **organ systems**. A system is a group of organs that work together to carry out a particular task.

For example, the role of the digestive system is to break down food and to absorb it into the blood. Some of the organs that work together to allow the digestive system to carry out these tasks are the mouth, stomach, intestines and liver.

The main systems of the body and their functions are shown in Table 4.1.

Table 4.1 The major systems of the body and their functions

Body system	Main function
Digestive	Intake, breakdown and absorption of food
Respiratory	Intake of oxygen and removal of carbon dioxide
Circulatory	Transport of nutrients, oxygen and wastes to and from the cells
Excretory	Removal of wastes
Nervous	Detection of changes in the environment and coordination of body activities
Endocrine	Regulation and coordination of many body functions
Skeletal	Support of and protection for body parts
Muscular	Movement and support
Immune	Protection against infection by micro-organisms
Reproductive	Production of new individuals

In addition to the major functions of systems listed in Table 4.1, most of the systems have secondary functions. For example, the bones of the skeletal system store minerals and produce blood cells as well as providing support and protection. The circulatory system is involved in protection against disease in addition to being the body's transport system.

Each of the systems will be discussed in more detail in the chapters that follow.

There is a good overview of the tissues, organs and systems of the body at <http://web.jjay.cuny.edu/~acarpi/NSC/14-anatomy.htm>

The organism

All of the body systems work together in an integrated way to produce a functioning organism—a living human being. No system can work in isolation; they all depend on each other. Heart muscle needs oxygen, which the respiratory system supplies; brain cells need nutrients that are absorbed by the digestive system and transported by the circulatory system, and so on.

Some organs are a part of more than one system. The pancreas is part of both the digestive system and the endocrine system. Organs such as the pancreas further contribute to the integration of the parts of the body.

Working scientifically



Activity 4.1 Looking at tissues

In this activity you will use your microscope skills to observe some of the cells and tissues described in this chapter. You may need to refer to Activity 3.1 (on page 31) again when setting up the microscope.

You will need

Microscope and microscope lamp; prepared slides of tissues

What to do

When looking at cells on the prepared slides, remember that they have been stained to show up the structure of the cell and its contents. Many slides contain more than one tissue. If you are uncertain which cells to look at, you may need to check with your teacher.

I Epithelial tissues

Look at some epithelial cells scraped from the inside of the cheek. If you have already done Activity 3.1 you may be able to skip the cheek cells.

1. Draw a few of the cells and write a description of them.
2. Estimate the size of an individual cell.
3. Explain how the structure of the cells is suited to their function of providing a smooth lining to the inside of the cheek.

You can see photographs of tissues at <http://www.cedarville.edu/academics/sciencemath/sullivan/histology/imagemenu.htm>

II Connective tissues

Look at a slide of cartilage.

4. In what ways does cartilage tissue differ from the cheek cells that you observed?
5. How is the structure of cartilage suited to its function of providing structural material that is firm but flexible?

Fat storage tissue is called adipose tissue. Examine a slide of adipose tissue.

6. Draw a few cells from adipose tissue and write a description of them.
7. Estimate the diameter of one adipose cell.
8. How is the structure of adipose tissue related to its function of fat storage?

III Muscular tissue

Examine a slide of skeletal muscle fibres.

9. Draw part of a skeletal muscle fibre and write a description of it.
10. Why are muscle cells known as fibres?
11. How many nuclei are present in the fibre that you have drawn?
12. Why is skeletal muscle sometimes known as *striped* or *striated* muscle?

Studying your observations

13. List the cells that you have seen in order from smallest to largest.
14. Write a brief paragraph explaining the relationship between the structure and function of tissues.

Activity 4.2 Touring the tissues

Imagine that you are the size of a red blood cell and you are taking a group of other tiny people on a tour of the tissues of the body. Describe what you would tell the tourists about the appearance, structure and function of the tissues that they would see.



REVIEW QUESTIONS

1. Describe the levels of structural organisation in the human body.
2. (a) What is a tissue?
(b) List the four basic tissue types and give an example of each.
3. (a) What is the function of epithelial tissues?
(b) Give examples of where epithelial tissues are found.
4. (a) What is the function of connective tissues?
(b) Give examples of connective tissues and their locations in the body.
5. Explain the differences in function between the three types of muscle tissue.
6. Describe the function of nervous tissue.



APPLY YOUR KNOWLEDGE

1. List all the types of tissue that would be present in one of your fingers. For each tissue explain the function it has in the finger.
2. Choose two body systems and list the organs that are a part of each of those systems.
3. Although cells are the functional units of the human body, there are levels of organisation below the cell. Suggest what these lower levels of organisation might be.
4. Sketch a large outline of the human body. On your sketch draw the major organs in each of the systems listed in Table 4.1.