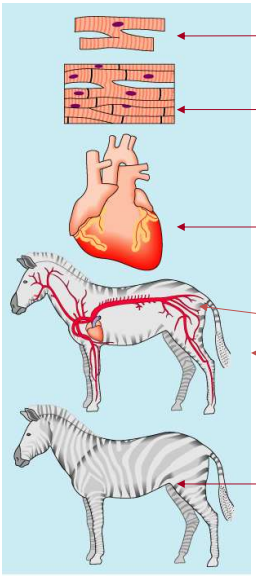
SLE 132 – Form and Function
Cells, Tissues and Organs

Learning Objectives

- What are the four tissue types possessed by animals?
- Describe each type of tissue giving examples of their composition and position in an animal
- How are tissues formed into organs?

The hierarchy of biological organisation



Cellular level - muscle cell

Tissue level - muscle tissue

Organ level - heart

Organ system level
- cardiovascular system

Organism level
- many organ systems

Specialised cells grouped into tissues

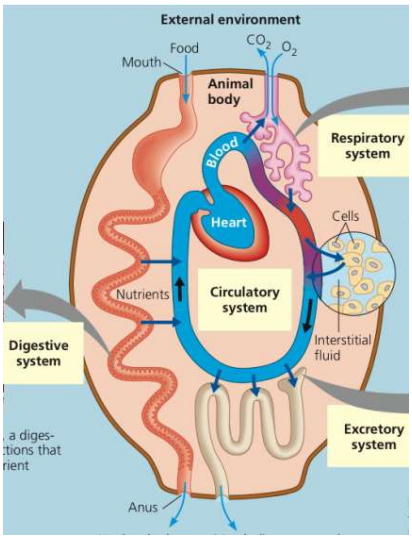
- Tissues – groups of cells with a common structure and function
- Different cells and tissues have different structures suited to their different functions (**form is suited to function**)

  – cells are held together by an extra-cellular matrix

- In animals there are 4 major tissue categories:
  - **Epithelial** - Lining
  - **Connective** - Connecting
  - **Nervous** – Sensory/communication
  - **Muscle** - Contractile

Epithelial cells

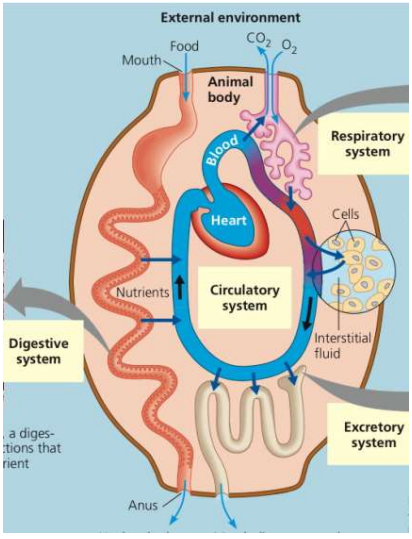
- Line external surfaces
- But think of a body as a doughnut, rather than only inside and outside.
- E.g. from mouth to anus is technically outside, and thus lined with epithelial cells.
- **Surfaces open to the environment will have epithelial cells**



DEAKIN COLLEGE

Epithelial Cells

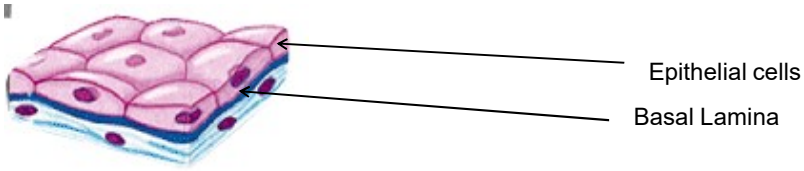
Where are the epithelial cells here?



DEAKIN COLLEGE

Epithelium

- covers body surfaces (eg. epidermis of skin)
- lines internal organs (eg. lungs, blood vessels)
- forms a protective layer (barrier)
- in some cases, forms a site of exchange of gases, liquids or compounds
- movement (via cilia) especially of foreign materials
- secretion of mucus, enzymes

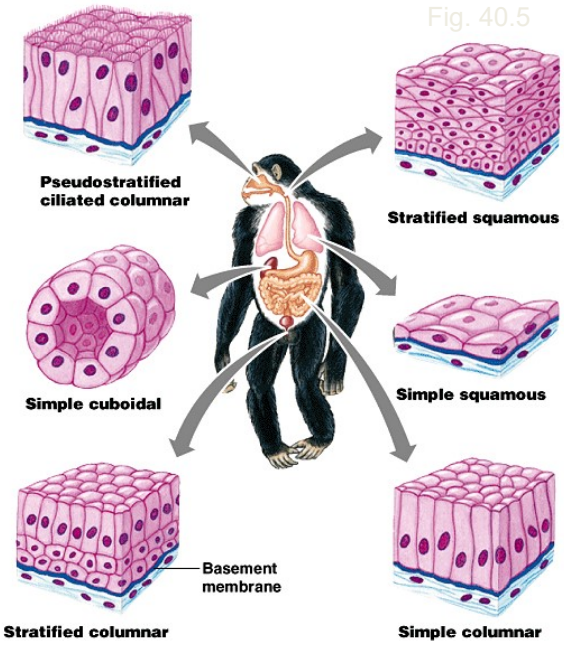


- Epithelial cells sit on a basement membrane (or Basal Lamina) which attaches epithelium to underlying tissue.
- Basal Lamina provides support to epithelia and acts as a filter allowing only water and small molecules through
- Regenerates itself quite readily, layers are regularly shed & replaced by new cells

Epithelial tissues are sheets of tightly packed cells

<u>classified by shape:</u>
- squamous
- cuboidal
- columnar

<u>classified by number of layers:</u>
- simple
- stratified

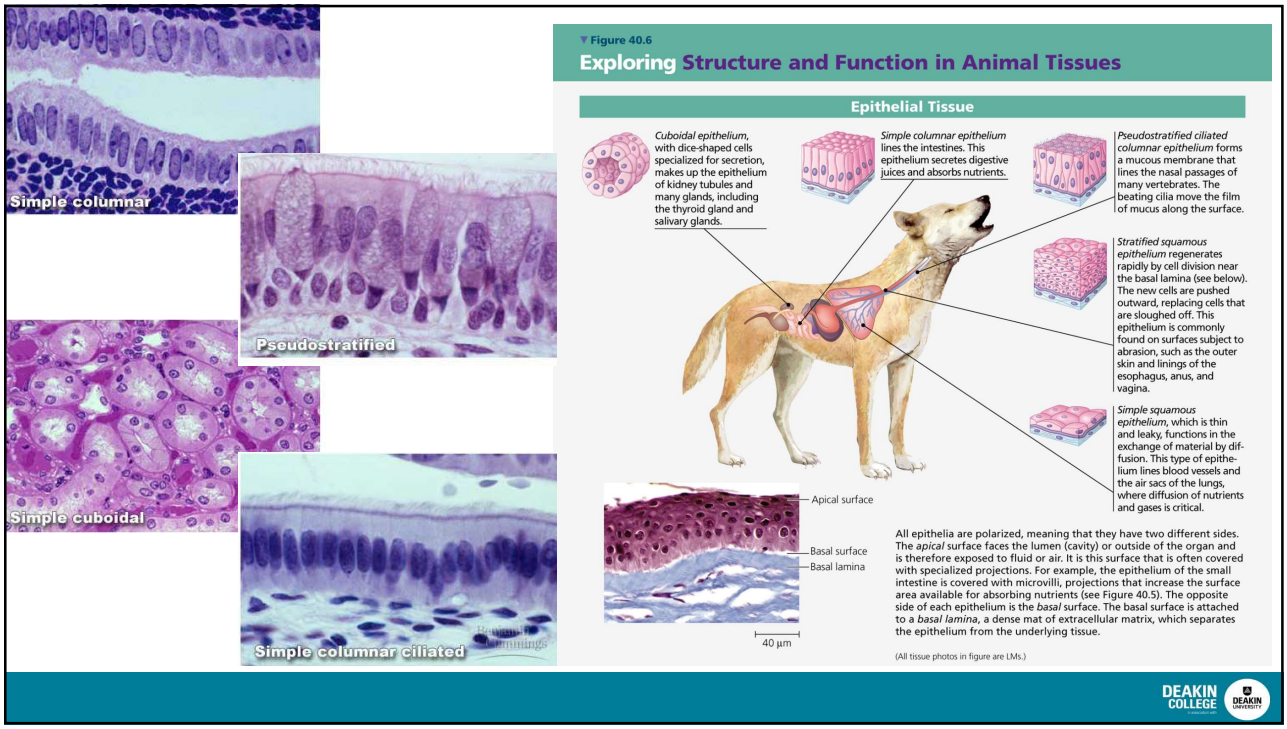


DEAKIN COLLEGE

Epithelial cells

- Think about the shape and structure (form) of the epithelial cells to understand their function:
  - <u>Single layers of cells</u> tend to be for exchange, as molecules can easily pass through.
  - <u>Multiple layers</u> of cells tend to be for protection of underlying surfaces
  - Have distinct sides, **apical** side faces the cavity or lumen, the **basal** side is attached to the basement membrane

DEAKIN COLLEGE



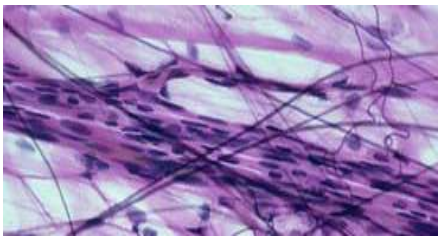
Use the information and link on the previous slide to help you complete the table below.

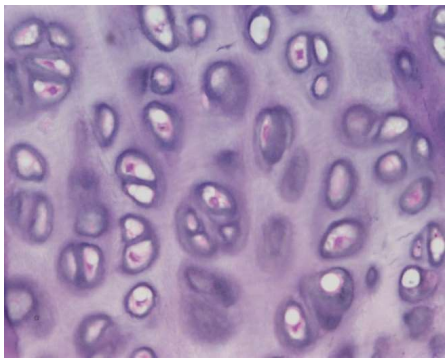
	Squamous	Columnar	Cuboidal
Simple			
Stratified			
Pseudo Stratified Ciliated	N/A		N/A

Connective tissue

- **Connective tissue** mainly binds and supports other tissues
- It contains **sparsely packed cells scattered throughout an extracellular matrix**
- The matrix consists of fibres in a liquid, jellylike, or solid foundation attached to a basement membrane

- There are 6 major types of connective tissue which perform various functions:
  loose connective tissue, fibrous connective tissue adipose tissue, cartilage, bone, and blood.

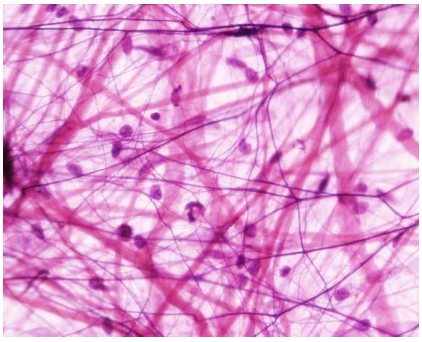




Loose connective tissue

- Holds organs in place and attaches epithelial tissue to underlying tissues

- **Collagenous fibres** - strength and flexibility
- **Elastic fibres** – stretchable
- **Reticular fibres** – joins connective tissue to other tissue



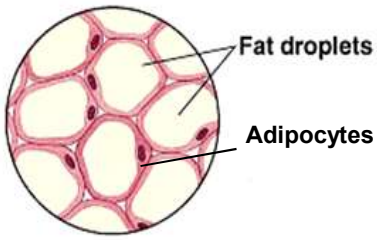
Fibrous connective tissue

- Large amounts of collagen, relatively few cells and low extra cellular matrix
- Strong and slightly flexible, found in joints etc.
- Tendons
  (connect muscles to bone)
- Ligaments
  (connect bones together)

Fibrous connective tissue

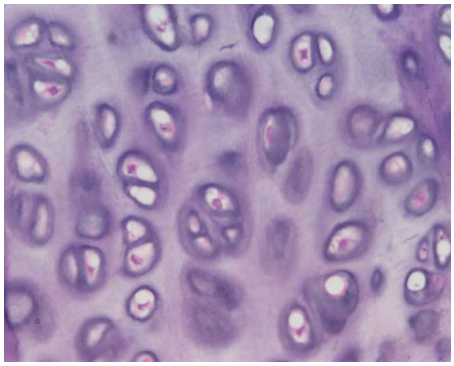
Adipose tissue

- Contain few fibres and little matrix
- Adipose is also called fat, and is composed of adipose cells
- Adipocytes collect and store fat in the form of triglycerides.
- Long term energy storage



Cartilage

- Cartilage is composed of specialized cells called **chondrocytes** that produce a large amount of ECM, mostly of **chondroitin sulfate**



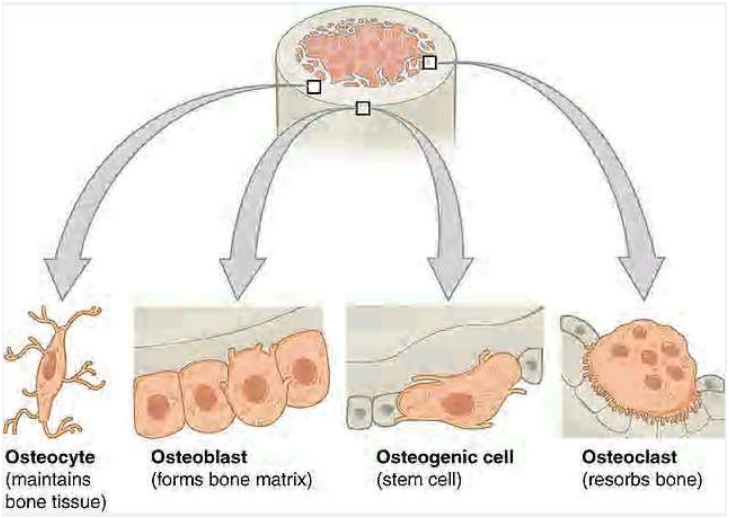
- Flexible connective tissue found in ears, nose, ribcage, trachea etc.
- Less dense and rigid than bone but provides more support than muscle

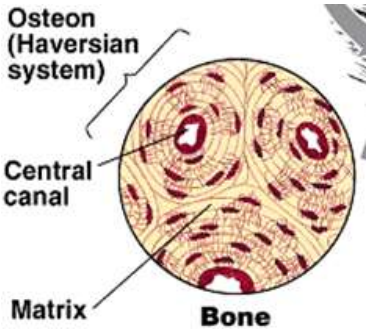
Bone

- Bone tissue is a mineralized connective tissue.
- Formed by osteoblasts, that deposit a matrix and also release calcium, magnesium, and phosphate ions
- Ions combine into crystalline mineral structure
- Arranged in circular layers around a central canal

- **Osteoblasts** - build bone
- **Osteoclasts** – breakdown bone
- **Osteocytes** – control cell, release of minerals, hormones

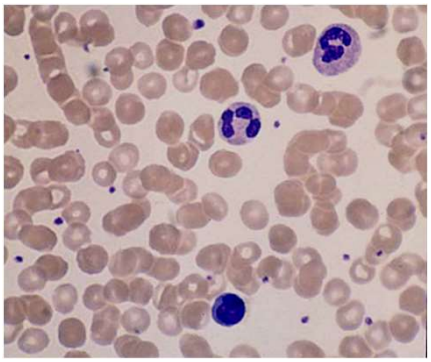
Bone



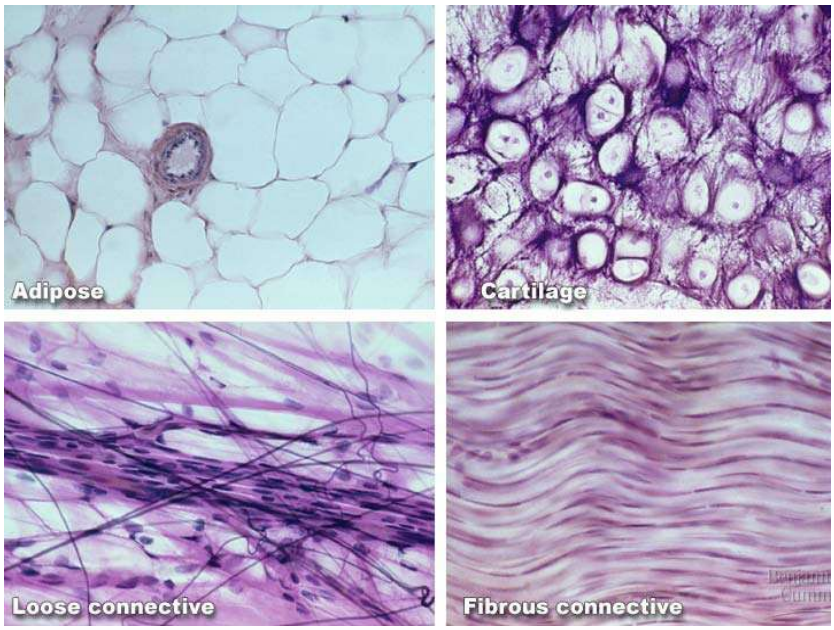


Blood

- Blood is a connective tissue mostly made up of the fluid ECM, Plasma (which is mostly water)
- Red blood cells, white blood cells and platelets
- Mostly involved in transport of substances.
- E.g. gasses - O_2 and CO_2



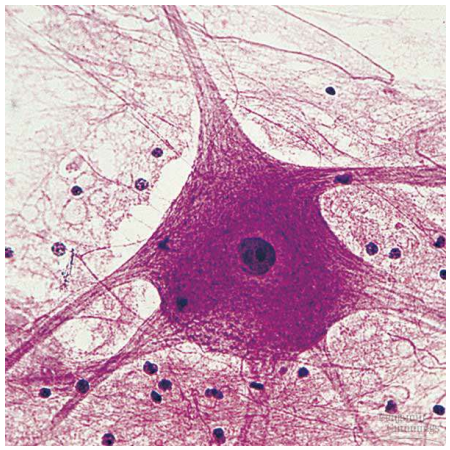
These tissues demonstrate the connection between structure & function



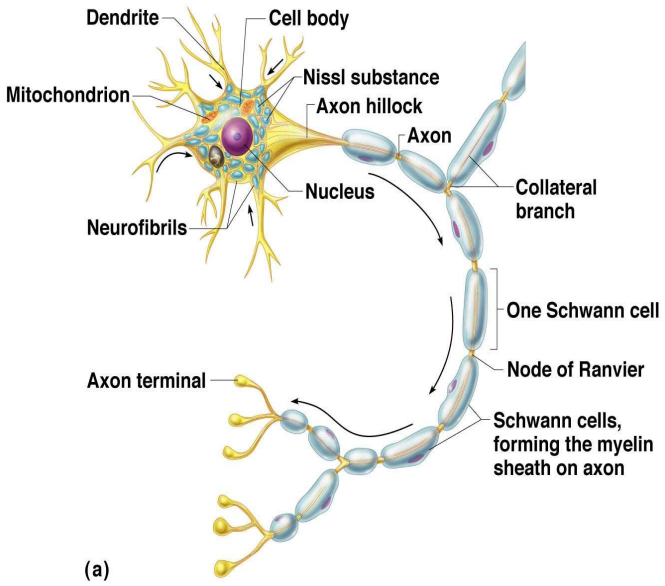
Activity 2 – connective tissue

Use your text book to help you complete the activity on moodle.
(10 minutes)

- **Nervous tissue** senses stimuli and transmits signals throughout the animal
- Nervous tissue contains:
  - **Neurons**, or nerve cells, that transmit nerve impulses
  - **Glial cells**, or **glia**, that help nourish, insulate, and replenish neurons



Nerve cells (neurons) are the basic units of the nervous system. A neuron consists of a cell body and two or more extensions called dendrites and axons. Dendrites transmit impulses from their tips toward the rest of the neuron. Axons, which are often bundled together into nerves, transmit impulses toward another neuron or toward an effector, a structure such as a muscle cell that carries out a body response. The supporting glial cells help neurons function properly.



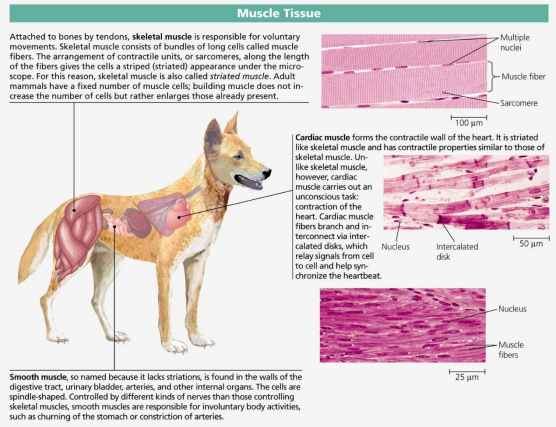
Muscle tissue

- Muscle tissue consists of long muscle cells containing highly organised micro-filaments which produce contraction– shortening of the cells (we will explore the function in class in Week 6).

- **Skeletal muscle**
  - striated cells
  - voluntary control

- **Smooth muscle**
  - no striations
  - distinct cells
  - involuntary

- **Cardiac muscle**
  - striated,
  - branching cells
  - involuntary



Activity 3 – muscle tissue

Use figure 40.5 page 905 from the text book or on the slide below to help you complete activity 3 available on moodle.

So which tissue type is the most abundant in most animals?

- Epithelial
- Connective
- Nervous
- Muscle

In most animals tissues combine to make organs

- organs are the functional units of animals
- groups of organs work together as organ systems
- eg: the stomach

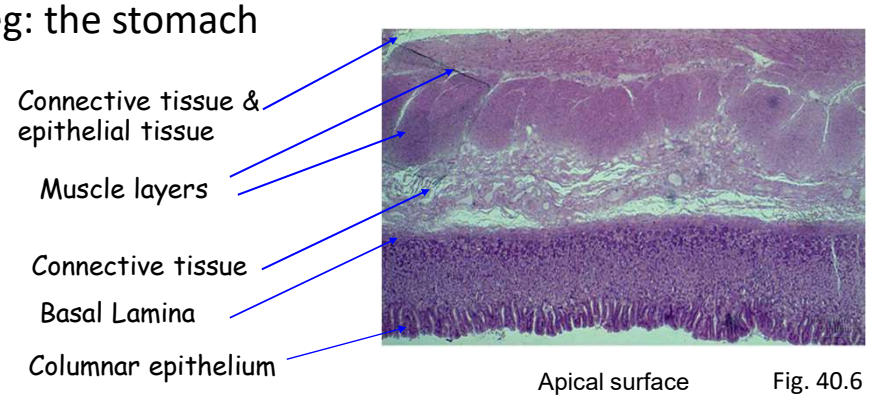


Fig. 40.6

A different view of the stomach wall

Using a scanning electron microscope (SEM)

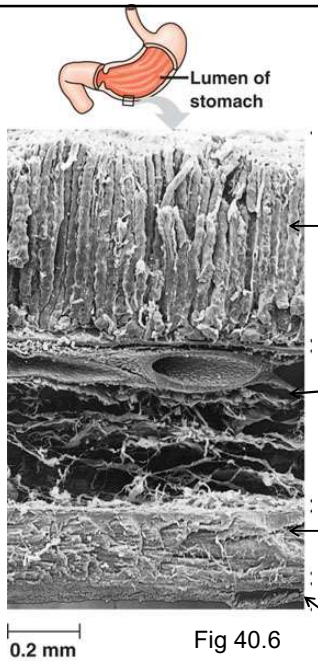


Fig 40.6

Quick Question

1. What is stratified cubiodial epithelium composed of?

a) Several layers of box like cells
b) A hierarchical arrangement of flat cells
c) A tight lager of square cells attached to a basement membrane
d) An irregularly arranged layer of pillar-like cells
e) A layer of ciliated, mucus-secreting cells

Quick Question

2. Adipose is a type which tissue?

a) Epithelial tissue
b) Connective tissue
c) Muscle tissue
d) Nervous tissue

Quick Question

3. Which of the following tissues lines the exterior of an animals body?

a) Connective
b) Smooth Muscle
c) Nervous
d) Epithelial
e) Adipose

Quick Question

4. Collagenous fibres are primarily found in which type of animal tissue?

a) Connective
b) Striated muscle
c) Nervous
d) Epithelial
e) Smooth muscle