



# Levels of Organisation

Organisation is one of the defining features of living things. Organisms are organised according to a hierarchy of structural levels (below), each level building on the one below it. Atoms are organised into complex molecules such as proteins. These form

the components of cells. Some organisms consist of single cells, but others are collections of many cells, organised into tissues and organs. Hierarchical organisation allows the grouping of specialised cells together to perform a particular function.

In the spaces provided for each question below, assign each of the examples listed to one of the levels of organisation as indicated.

1. **Animals:** *adrenaline, blood, bone, brain, cardiac muscle, cartilage, collagen, DNA, heart, leucocyte, lysosome, mast cell, nervous system, neurone, phospholipid, reproductive system, ribosomes, Schwann cell, spleen, squamous epithelium.*

(a) Organ system: nervous system  
reproductive system

(b) Organs: brain, heart, spleen

(c) Tissues: blood, bone, cartilage,  
Cardiac muscle sq. epithelium

(d) Cells: leucocyte, Schwann cell,  
mast cell, neuron,

(e) Organelles: lysosome,  
ribosomes

(f) Molecular level: adrenaline  
collagen, DNA,  
phospholipid

2. **Plants:** *cellulose, chloroplasts, collenchyma, companion cells, DNA, epidermal cell, fibres, flowers, leaf, mesophyll, parenchyma, pectin, phloem, phospholipid, ribosomes, roots, sclerenchyma, tracheid.*

(a) Organs: Flowers, leaf,  
roots

(b) Tissues: collenchyma, mesophyll  
parenchyma, phloem, sclerenchyma

(c) Cells: companion, epidermal,  
tracheid, fibres

(d) Organelles: chloroplasts  
ribosomes

(e) Molecular level: cellulose, DNA,  
pectin,  
phospholipid

## The Organism

A complex, functioning whole that is the sum of all its component parts.

### Organ System Level

In animals, organs form parts of even larger units known as organ systems. An organ system is an association of organs with a common function e.g. digestive system, cardiovascular system, and the urinogenital system.

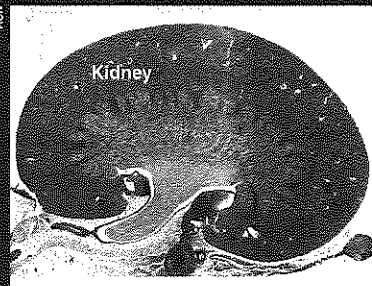


## Organ Level

Organs are structures of definite form and structure, comprising two or more tissues.

**Animal examples include:** heart, lungs, brain, stomach, kidney.

**Plant examples include:** leaves, roots, storage organs, ovary.

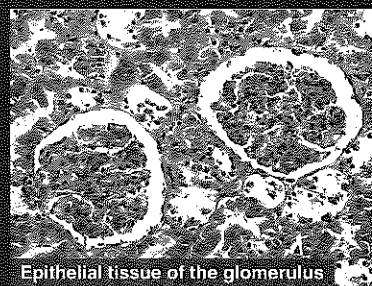


## Tissue Level

Tissues are composed of groups of cells of similar structure that perform a particular, related function.

**Animal examples include:** epithelial tissue, bone, muscle.

**Plant examples include:** phloem, chlorenchyma, endodermis, xylem.

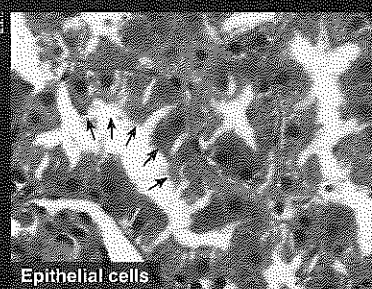


## Cellular Level

Cells are the basic structural and functional units of an organism. Each cell type has a different structure and function - the result of cellular differentiation during development.

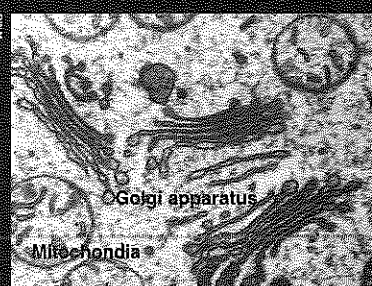
**Animal examples include:** epithelial cells, osteoblasts, muscle fibres.

**Plant examples include:** sclereids, xylem vessels, sieve tubes.



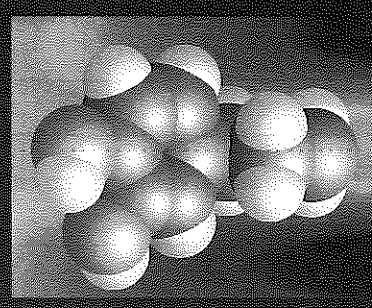
## Organelle Level

Many diverse molecules may associate together to form complex, highly specialised structures within cells called cellular organelles e.g. mitochondria, golgi apparatus, endoplasmic reticulum, chloroplasts.



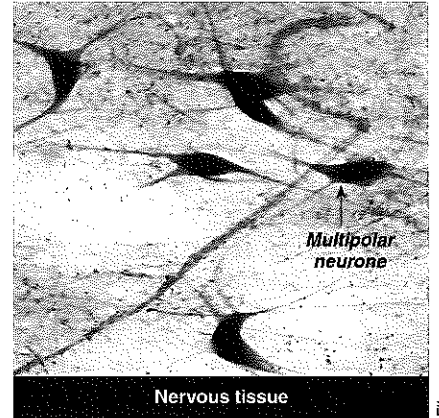
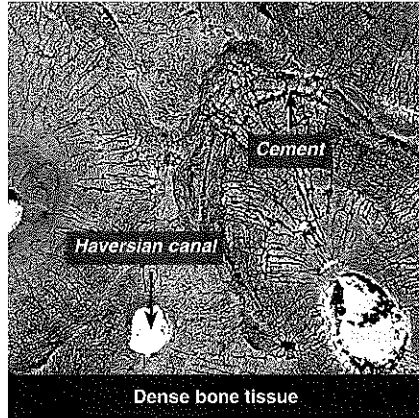
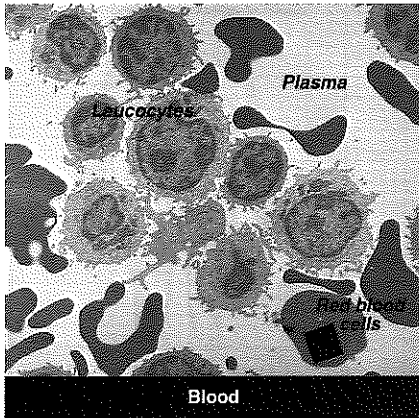
## Chemical and Molecular Level

Atoms and molecules form the most basic, level of organisation. This level includes all the chemicals essential for maintaining life e.g. water, ions, fats, carbohydrates, amino acids, proteins, and nucleic acids.



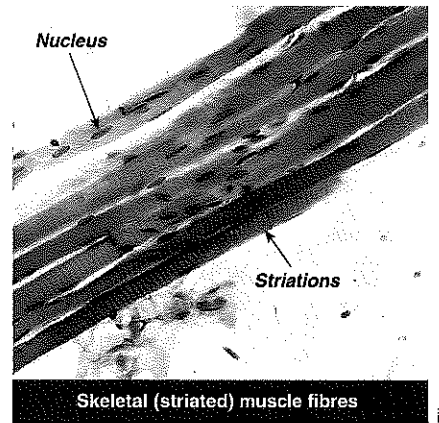
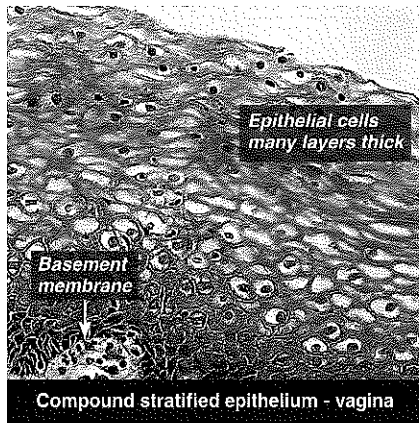
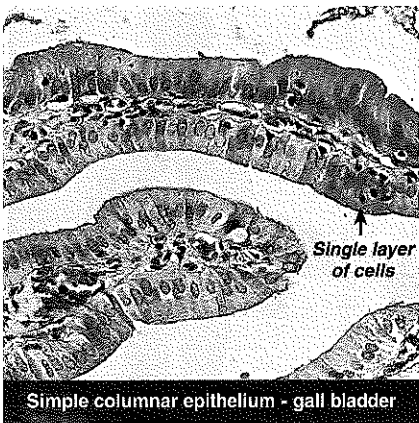
The study of tissues is called **histology**. The cells of a tissue, and their associated intracellular substances e.g. collagen, are grouped together to perform particular functions. Tissues improve the efficiency of operation because they enable tasks to be shared amongst various specialised cells. **Animal tissues** can be divided into four broad groups: **epithelial tissues, connective tissues, muscle, and nervous tissues**. Some

features of animal tissues are described below. Plant tissues are divided into two groups: simple and complex. Simple tissues contain only one cell type and form packing and support tissues (e.g. parenchyma). Complex tissues contain more than one cell type and form the conducting and support tissues of plants (periderm, xylem, phloem). Examples of these are illustrated elsewhere: (topics *Transport and Excretion, Gas Exchange*).



**Connective tissue** is the major supporting tissue of the animal body. It comprises cells, widely dispersed in a semi-fluid matrix. Connective tissues bind other structures together and provide support, and protection against damage, infection, or heat loss. Connective tissues include dentine (teeth), adipose (fat) tissue, bone (above) and cartilage, and the tissues around the body's organs and blood vessels. Blood (above, left) is a special type of liquid tissue, comprising cells floating in a liquid matrix.

**Nervous tissue** contains densely packed nerve cells (neurones) which are specialised for the transmission of nerve impulses. Associated with the neurones there may also be supporting cells and connective tissue containing blood vessels.



**Epithelial tissue** is organised into single (above, left) or layered (above) sheets. It lines internal and external surfaces (e.g. blood vessels, ducts, gut lining) and protects the underlying structures from wear, infection, and/or pressure. Epithelial cells rest on a basement membrane of fibres and collagen and are held together by a carbohydrate-based "glue". The cells may also be specialised for absorption, secretion, or excretion. Examples: stratified (compound) epithelium of vagina, ciliated epithelium of respiratory tract, cuboidal epithelium of kidney ducts, and the columnar epithelium of the intestine.

**Muscle tissue** consists of very highly specialised cells called fibres, held together by connective tissue. The three types of muscle in the body are cardiac muscle, skeletal muscle (above), and smooth muscle. Muscles bring about both voluntary and involuntary (unconscious) body movements.

3. Explain the advantage of the organisation seen in living things: \_\_\_\_\_

**Organization allows a grouping together of particular specialized cells and tissues to perform particular functions. This improves efficiency of function because different tasks can be shared amongst specialized cells. Energy is saved in not maintaining non-essential organelles in cells that do not require them.**

4. Give an example of an organ system in an animal, stating the organs, tissues, and specialised cells that comprise it:

Organ system: circulatory systems (cardiovascular/lymphatic) Organs: Heart, lymphoid organs (spleen, tonsils etc)

Tissues: Lymph, blood, lymphatic and blood vessels, lymphoid tissues, cardiac muscle, connective tissues

Specialised cells: red blood cells, leucocyte (white blood cells of various types e.g. lymphocytes, phagocytes), platelets, cardiac muscle cells.

5. Describe the main features of the following animal tissues:

(a) Epithelial tissues: Single or multiple layers of simple cells forming the lining of internal and external body surfaces. Cells rest on a basement membrane of fibers and collagen and may be specialized.

(b) Connective tissues: Supporting tissue of the body, comprising cells widely dispersed in a semi-fluid matrix (or fluid in the case of blood and lymph).

(c) Muscle tissue: Dense tissue comprising highly specialized contractile cells called fibers held together by connective tissues.

(d) Nervous tissue: Tissue comprising densely packed nerve cells specialized for transmitting electrochemical impulses. Nerve cells may be associated with supportive cells (e.g. Schwann cells), connective tissue, and blood vessels.