

TOPIC 1.1: CELL THEORY

Cell Theory

According to the cell theory:

1. Living organisms are composed of cells (or cell products)
2. The cell is the smallest unit of independent life
3. Cells can only arise from pre-existing cells

Caveats to the cell theory include:

- Striated muscle – composed of fused cells that are multinucleated
- Giant algae – unicellular organisms that are very large in size (~7 cm)
- Aseptate hyphae – lack partitioning and have a continuous cytoplasm

Functions of Life

Organisms consisting of only one cell carry out all the life functions in that single cell

- **M**etabolism
- **R**eproduction
- **S**ensitivity
- **H**omeostasis
- **E**xcretion
- **N**utrition
- **G**rowth



Cell Size

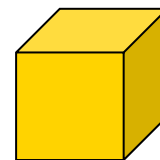
Surface area to volume ratio is important in the limitation of cell size

Cells need to exchange materials with the environment in order to produce the chemical energy required for survival (via metabolism)

- The rate of metabolism is a function of a cell's mass / volume
- The rate of material exchange is a function of a cell's surface area

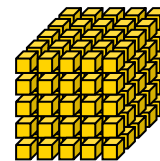
As a cell grows, volume (units³) increases faster than surface area (units²)

- If metabolic requirements exceed material exchange, a cell will die
- Hence, cells must stay small or increase their SA:Vol ratio to survive



Small SA:Vol Ratio

- ↑ metabolic rate
- ↓ material exchange
- Low survival chances



Large SA:Vol Ratio

- ↓ metabolic rate
- ↑ material exchange
- High survival chances

Magnification

Calculating Magnification (MIA):

$$\text{Magnification} = \text{Image Size} \div \text{Actual Size}$$



Calculating Actual Size (AIM):

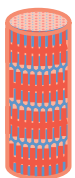
$$\text{Actual Size} = \text{Image Size} \div \text{Magnification}$$



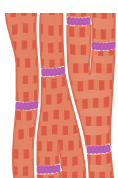
Cellular Organization

In multicellular organisms:

- Cells may be grouped together to form tissues
- Tissues may interact to form functional organs
- Organs may combine to form body systems



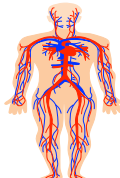
Muscle
(Cell)



Cardiac
(Tissue)



Heart
(Organ)



Vascular
(System)

Microscopes

Light microscopes use lenses to bend light

- Can view living specimens in natural colour
- Have lower magnification and resolution

Electron microscopes use electromagnets to focus electrons

- Can only view dead specimens in monochrome
- Have higher magnification and resolution
- Can show cross-sections (TEM) or surface renderings (SEM)

Emergent Properties

An emergent property is a function that is present in multicellular organisms, but is not present in its individual component cells

Emergent properties arise from synergistic interactions between the individual cells to produce entirely new aggregate functions

An example of an emergent property is the increased levels of antibiotic resistance that can be seen in bacterial biofilms

'The whole is greater than the sum of its parts' – Aristotle