

BIO 111 - Principles Of Life I: Biomolecules, Genetics And Evolution

Varsha 2026

Nisha N Kannan
&
Ullasa Kodandaramaiah



BIO 111: Modules

- Overview of Biology
- Biomolecules
- Genetics
- Evolutionary Biology

BIO 111 – Principles of Life I: Biomolecules, Genetics and Evolution

(Varsha 2026)

Ullasa Kodandaramaiah

Module: Overview of Biology

Part I: What is life? Scales of Biology

What is Biology?

Study of life, living things

What is life?

Life

- Difficult to define life
- *Assemblage* of molecules
- Life is a set of *processes*, not a thing or an event
- Can be described in terms of characteristics or features

'Emergent' properties: Whole is more than the sum of parts

e.g. A car is made of parts. The way the parts are assembled is what makes a car function

Letters by themselves mean nothing, but can come together to start a revolution!

- Similarly molecules get assembled in various ways to give rise to living things
- Hierarchical
 - e.g. Molecules assemble to make up parts of a cell, cells assemble into organs, organs assemble into an individual

Characteristics of life

Features or properties

- I. Cellular organization
- II. Metabolism
- III. Homeostasis
- IV. Response to stimuli
- V. Growth and development
- VI. Reproduction & Heredity
- VII. Evolution

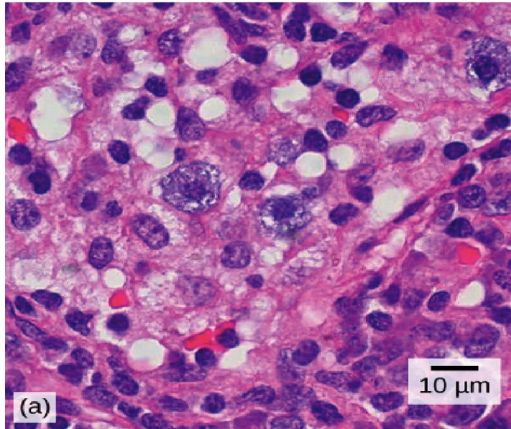
(Note: Not all biologists describe life using the above processes, some do it in slightly different ways)

I. Cellular organization

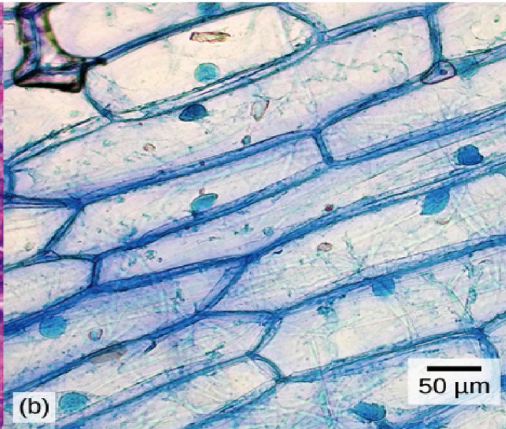
Cells – basic building blocks of all living organisms

- Contained space that isolates reactions from the surrounding environment
- Smallest unit that can perform all the processes of life

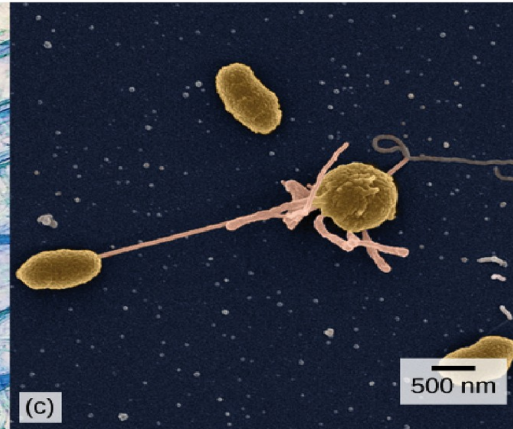
Human sinus cells



Onion cells



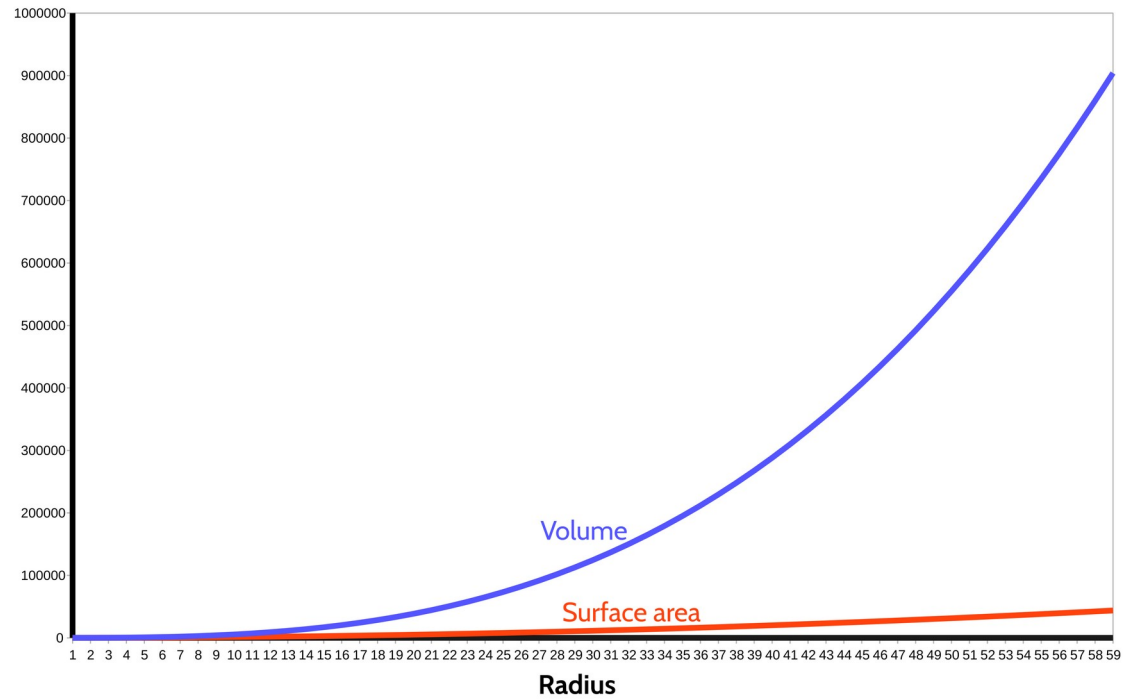
Bacterial cells



- **Unicellular (e.g. bacteria)** versus **Multicellular** (cell specialization)
e.g. Skin cells, Muscle cells
- Cells always small* (size of organism related to cell number)
As size increases, volume increases much more rapidly than surface area, hence diffusion time increases

**rare exceptions*

Volume and surface area for a sphere



(Reading) Exercise

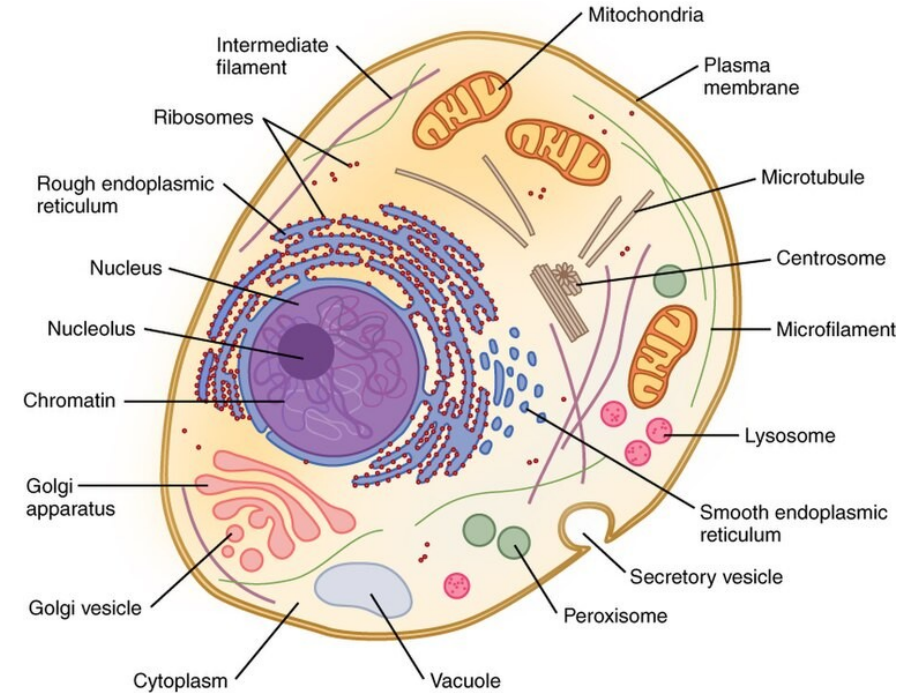
- Rarely, cells are so large that they can even be seen with the naked eye. *Which are the largest cells found in nature?*

Cell

All cells have a **cell membrane** (also called **plasma membrane**), which is the border between the inside of the cell and the external environment

- Extremely important feature. *Why?*
- Cells contain molecules (proteins, carbohydrates, lipids, nucleic acids, water)

- Within the cell membrane, cells have various **organelles** and the **cytoplasm**
- Each organelle has a different function.
- For e.g *mitochondria* are the 'power houses' of cells where energy is produced from food



Source:
penstax.org/books/anatomy-and-physiology/pages/preface

DNA and Genes

- Organisms have chromosomes, which contain the genetic material, usually DNA.
- Genes are regions of the chromosome, and contain information for all of the processes of life
- The diversity of life is due to variation in genes among organisms

II. Metabolism

Sum of all chemical processes in an organism

- Obtain and use energy
 - for cellular processes
 - for making the building blocks of the cell
- Eliminate waste

“Life is an organized state of chemical reactions”

III. Homeostasis

Regulation - Keep internal conditions relatively constant under changing environmental conditions

In other words, maintenance of a stable body condition

Ex. body temperature, salt concentration

Metabolic processes are involved in these mechanisms.

IV. Response to stimulus

Respond to Changes in environment

- E.g. Amoeba moving away from light
Some animals hibernating when winter arrives

V. Growth and Development

- **Growth:** Result of cell division (formation of two cells from one) and cell enlargement (cells enlarge as they mature)
- **Development:** Maturation

Single cell → Cell cluster → Differentiation (specialization)

VI. Reproduction & Heredity

- Reproduction, Replication
- **Asexual** reproduction: e.g. cell division in bacteria
- **Sexual** reproduction: Fusion of male and female gametes.
 - E.g. egg and sperm in animals
 - pollen and ovule in plants
- Viruses: can only reproduce in their hosts

Heredity

Transfer of genetic information from parent to offspring during reproduction

i.e. transfer of *genes*

- In asexual reproduction, the offspring gets the exact copies of the parent

Some interesting reproductive strategies

- Many female birds, rabbits and reptiles can store sperm for months
- Females of many species, including some mantises and spiders, feed on the male immediately after mating
- Some fish can switch sex in days



Photo: Nick Hobgood/Wikimedia

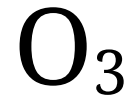
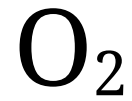
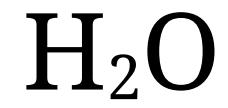
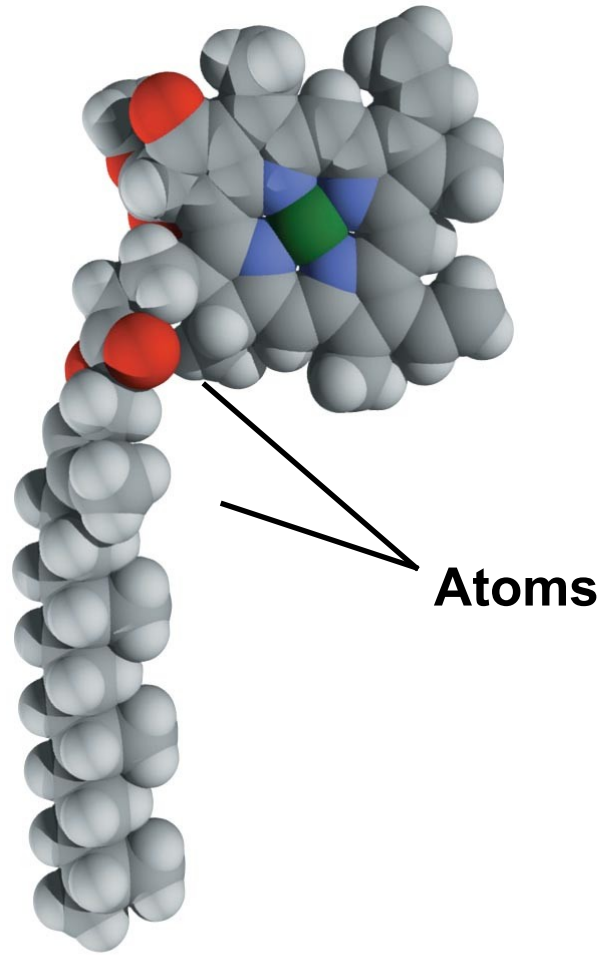


Photo: Oliver Koemmerling/Wikimedia

VII. Evolution

- Evolution ~ change
- *Biological evolution*, loosely speaking, is change in groups of organisms over the course of generations
- **Adaptations** are the result of evolution

Scales of Biology



Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.

Molecules

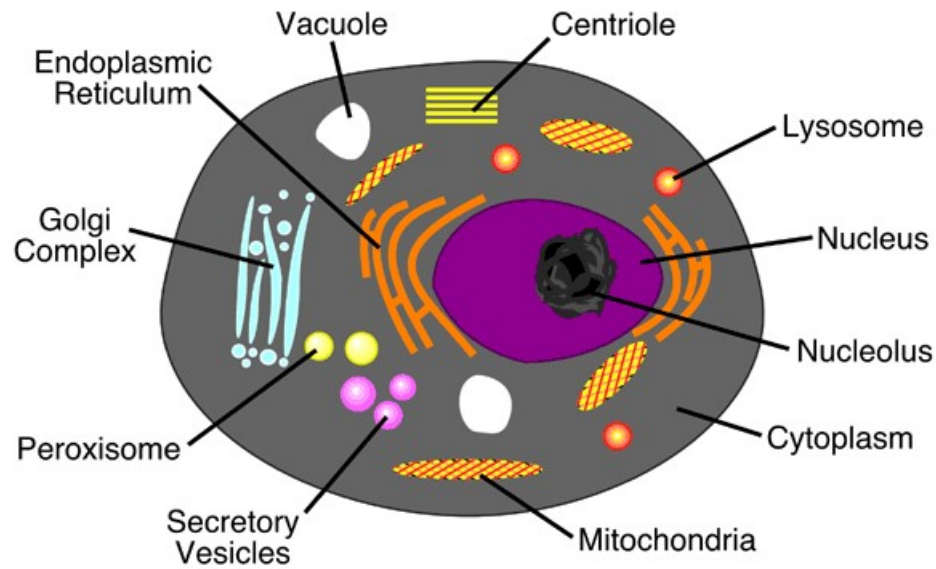
Organelles (subunits of Cells)

(e.g. Chloroplast - photosynthesis)



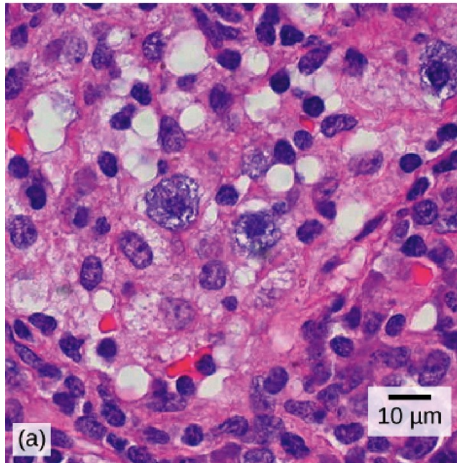
Cells

- basic
building
blocks of
life

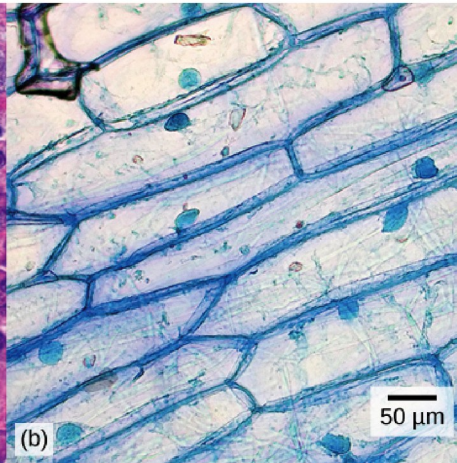


Source: <http://www.physicalgeography.net/fundamentals/6a.html>

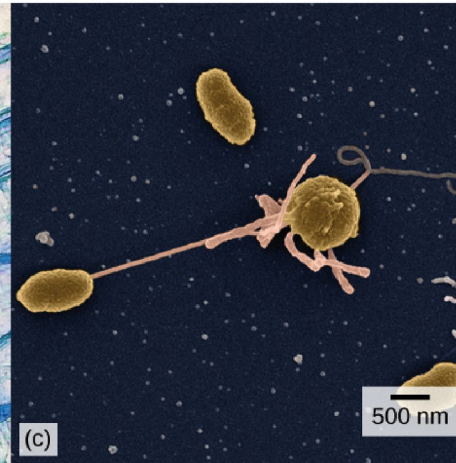
Human sinus cells



Onion cells

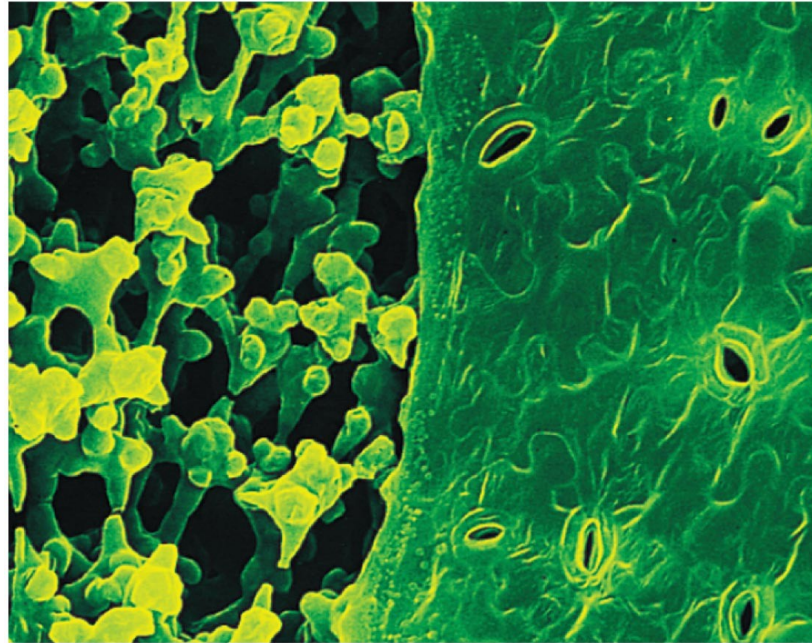


Bacterial cells



Source: <https://www.khanacademy.org/science/biology/structure-of-a-cell/introduction-to-cells/a/intro-to-cells>

Tissues - group of similar cells with a common function



Copyright © 2008 Pearson Education, Inc., publishing as Pearson Benjamin Cummings.

50 μm

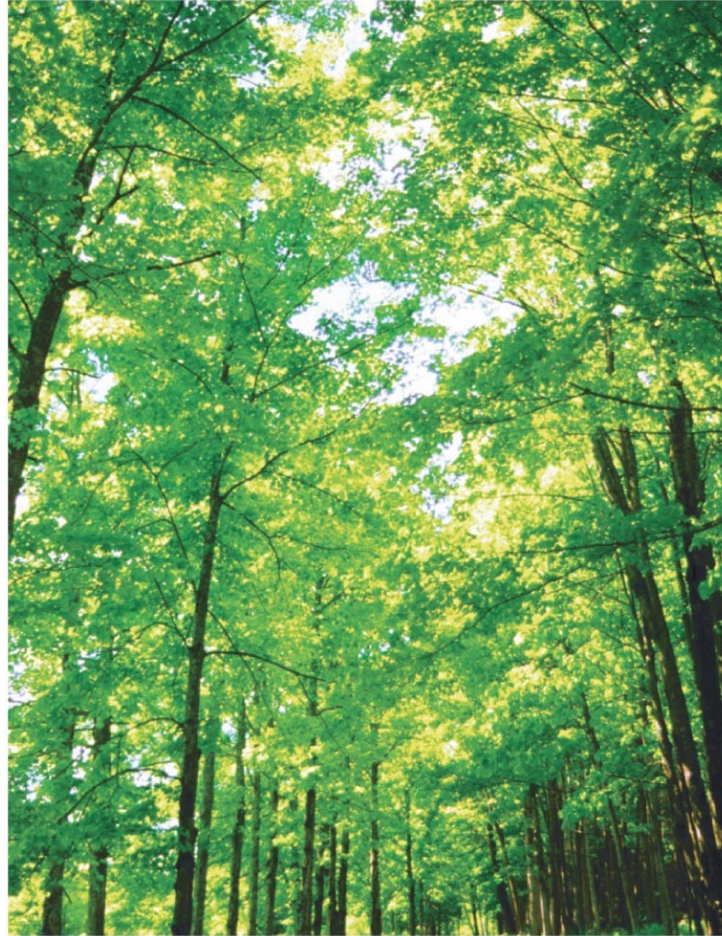
Organs



Organisms (Individuals)



Populations - All individuals of a species living in an area)



Community - Populations of all species in an area



Ecosystems - Community AND non-living environment



Environment

- Biotic – living things
- Abiotic – non-living matter

The biosphere

Zone of life on earth.
Sum of all ecosystems



Scales of Life

