

# Medical Biology

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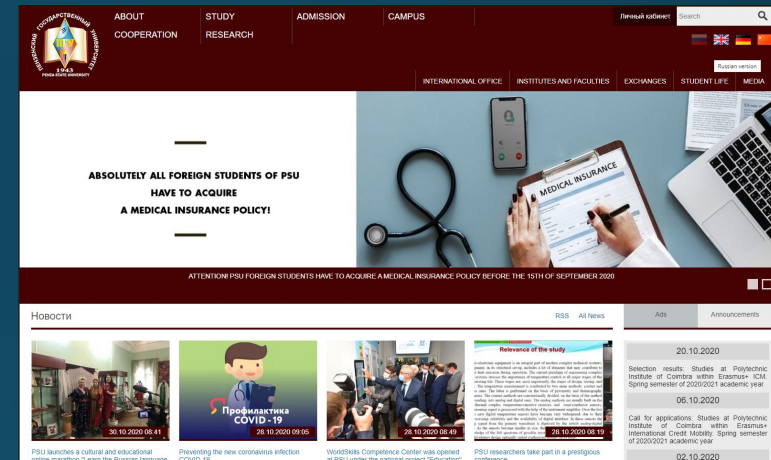
# Course Outline

- Introduction
- Cell biology
- Molecular biology and Biochemistry
- Genetics and Reproduction
- Medical parasitology

# COURSE SCHEDULE

1st class: 8:00 – 9:35  
2nd class: 9:50 – 11:25  
3rd class: 11:40 – 13:15  
4th class: 13:45 – 15:20  
5th class: 15:35 – 17:10  
6th class: 17:25 – 19:00

Typical class lasts 1 hour 35 minutes, including a five-minute break after the first 40 minutes.  
Normal break is 15 minutes.  
Midday break is 30 minutes (between 3rd and 4th classes)



# Course structure

- Lectures  
on Wednesday, 1 week (odd number week)
- Practical lessons  
one lesson every week + one lesson every first or second week, (check your schedule)
- Credit – the end of the 1<sup>st</sup> semester (“pass”/”not pass”)
- Final oral exam – the end of 2<sup>nd</sup> semester (with a “excellent”, “good”, “satisfactory”, “unsatisfactory”)

## EXAMINATION AND ASSESSMENT

Students attend lectures and practical classes (seminars) and do homework. During classes, lecturers check students' knowledge. The five-mark grading system is used, but in practice marks from 2 to 5 are used:

- 2 – “Unsatisfactory” mark
- 3 – “Satisfactory” mark
- 4 – “Good” mark
- 5 – “Excellent” mark

In line with the five-mark grading system, the university applies the point-rating system under which students obtain points for their achievements. The received amount characterises learning outcomes of students during semester. The total amount of points is taken into account during exams and pass-fail exams:

- 0 - 59 points – “Unsatisfactory” mark
- 60 - 72 points – “Satisfactory” mark
- 73 - 86 points – “Good” mark
- 87 - 100 points – “Excellent” mark

# Course Grading

- Total 100% (or points)
- 1<sup>st</sup> semester (two check-points)
  - 1<sup>st</sup> check-point 30 points
  - 2<sup>nd</sup> check-point 30 points
  - Credit 40 points
- 2<sup>nd</sup> semester (two check-points)
  - 1<sup>st</sup> check-point 30 points
  - 2<sup>nd</sup> check-point 30 points
    - Total of 60 points (of daily grades: class attendance, assignments, lab work, tests, etc.)
- Final oral examination (40 points)
  - Total score will be converted to the five grade system

# How to become a successful student?

- Be active and seek for help
- Complete all assignments
- Do not get behind and miss classes
- Advocate yourself (by asking questions and seeking help there is no reason a student cannot be successful)
- Follow laboratory safety guidelines

# Professors

- Kirill Vladimirovich Babeshko

Practical lessons (groups 6, 7, 8, 10, 11)

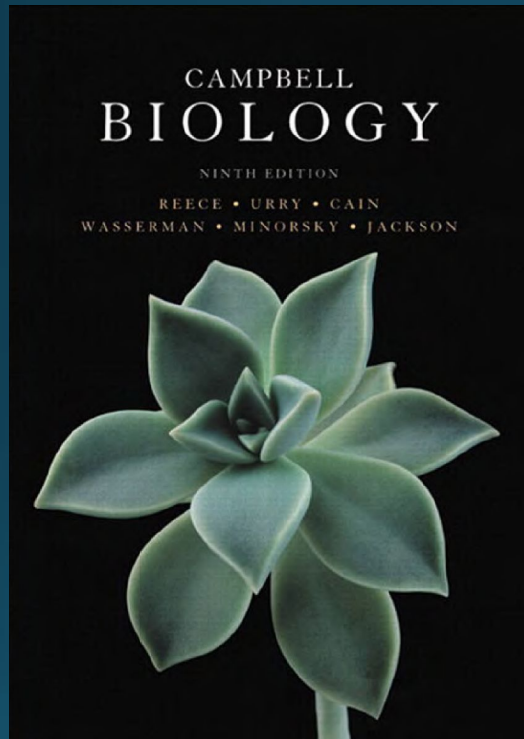
- Elena Aleksandrovna Malysheva

1. Practical lessons (group 1, 2, 3, 4 and 9)
2. Lectures

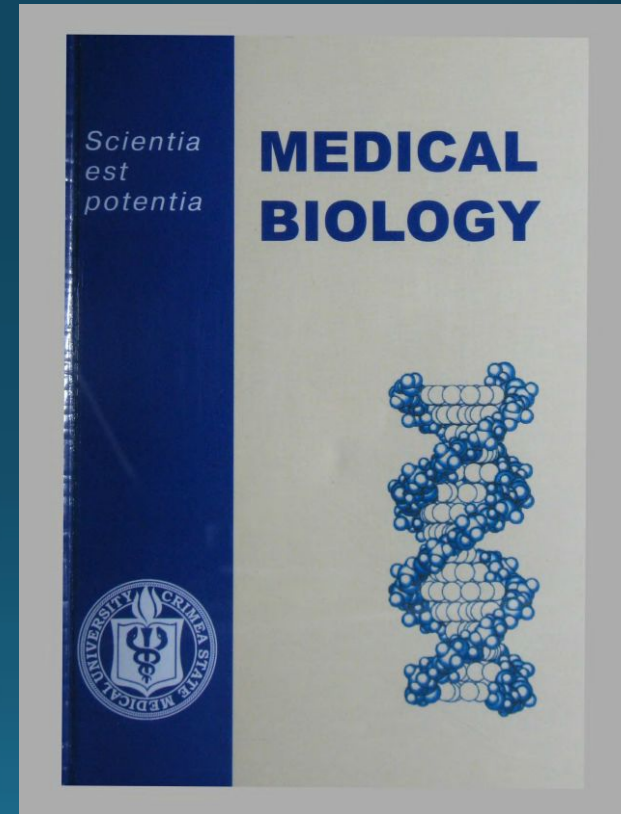


# Literature: Theory

Campbell et al. (2009 and earlier)



Lazarev et al. (2003)



# Literature: Practical classes

- Romanenko O.V. (2008)  
Medical biology: The study  
guide of the practical classes  
course / O.V. Romanenko, O.V.  
Golovchenko, M.G. Kravchuk,  
V.M. Grinkevych; Edited by  
O.V. Romanenko. – Kiev:  
Medicine, 2008. – 304 p.
- Workbooks in the lab

# World wide web

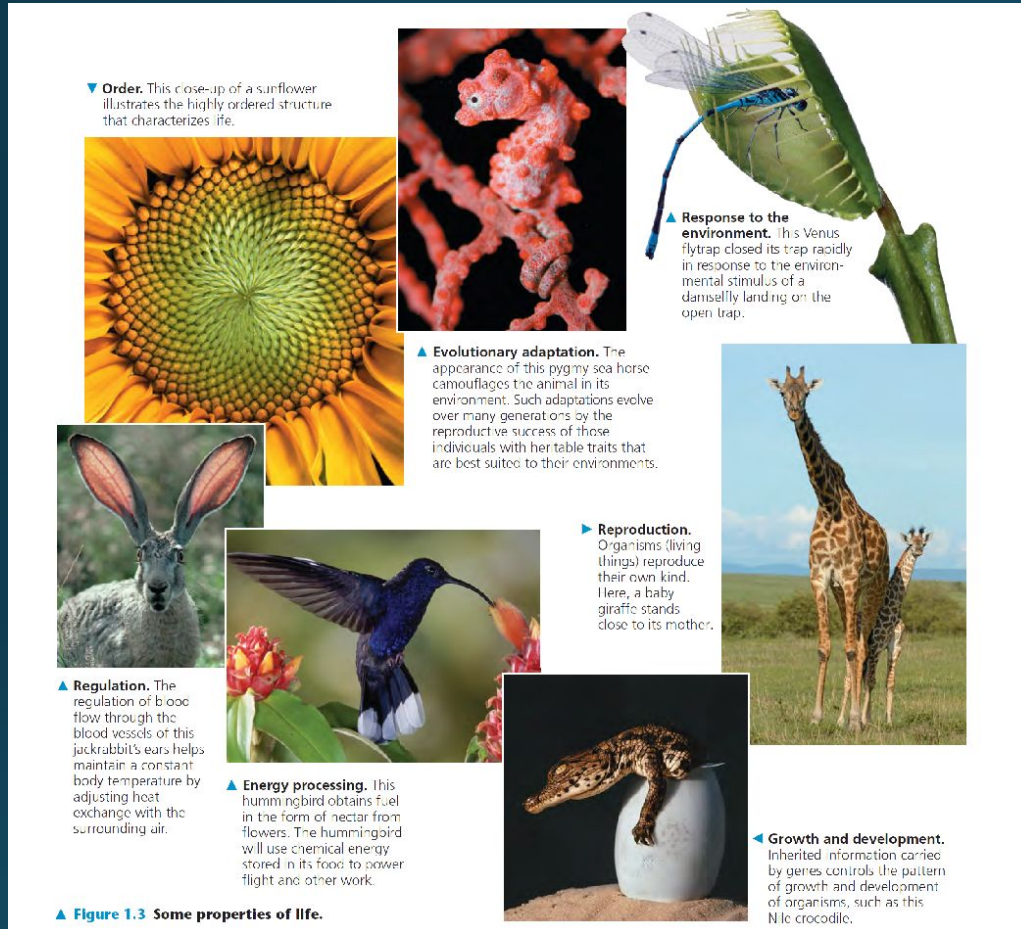


# What is medical biology?

## Why do we need to study biology?

- Biology is the scientific study of life.
- Human beings are living organisms.
  - => their basic structure and functions must be similar to other living organisms
    - What does it mean for you?
- => depend on other organisms and affect them during life-time
  - What does it mean for you?

# Characteristics of life



1. Organization and Cell
2. Regulation and homeostasis
3. Growth and development
4. Energy use and metabolism
5. Reproduction
6. Response to environment
7. Evolutionary adaptations



# Organization and Cell

- All living organisms represent highly ordered structures.
- Most of the living organisms are composed of tiny units which are called cells.
- The cells are the basic units of life.

# Growth and development

- Living organisms are able to increase their size (or get larger), i.e. to grow, thanks to the cell division (formation of new cells) and cell enlargement (the increase cell size).
- Living organisms are able to become more complex over time, i.e. develop.

# Regulation and homeostasis

- Living organisms are able to regulate their internal environment to maintain it in a constant/stable state (homeostasis), e.g. body temperature.



# Energy use and metabolism

- Living organisms need energy in order to maintain their organization and to produce other phenomena associated with life.
- Organisms obtain energy, maintain their organization and perform activities associated with life in the result of the set of life-sustaining chemical transformations within the cells, i.e. metabolism.

# Reproduction

- All living organisms are able to produce new individual organisms
  - ... either asexually from a single parent organism
  - ... or sexually from two parent organisms.

# Response to environment

- Living organisms react to changes in environment.

# Evolutionary adaptations

- Living organisms are able to change over time in response to environment.
- This ability is fundamental to the process of evolution. The evolution leads to adaptations of species to constantly changing environment.

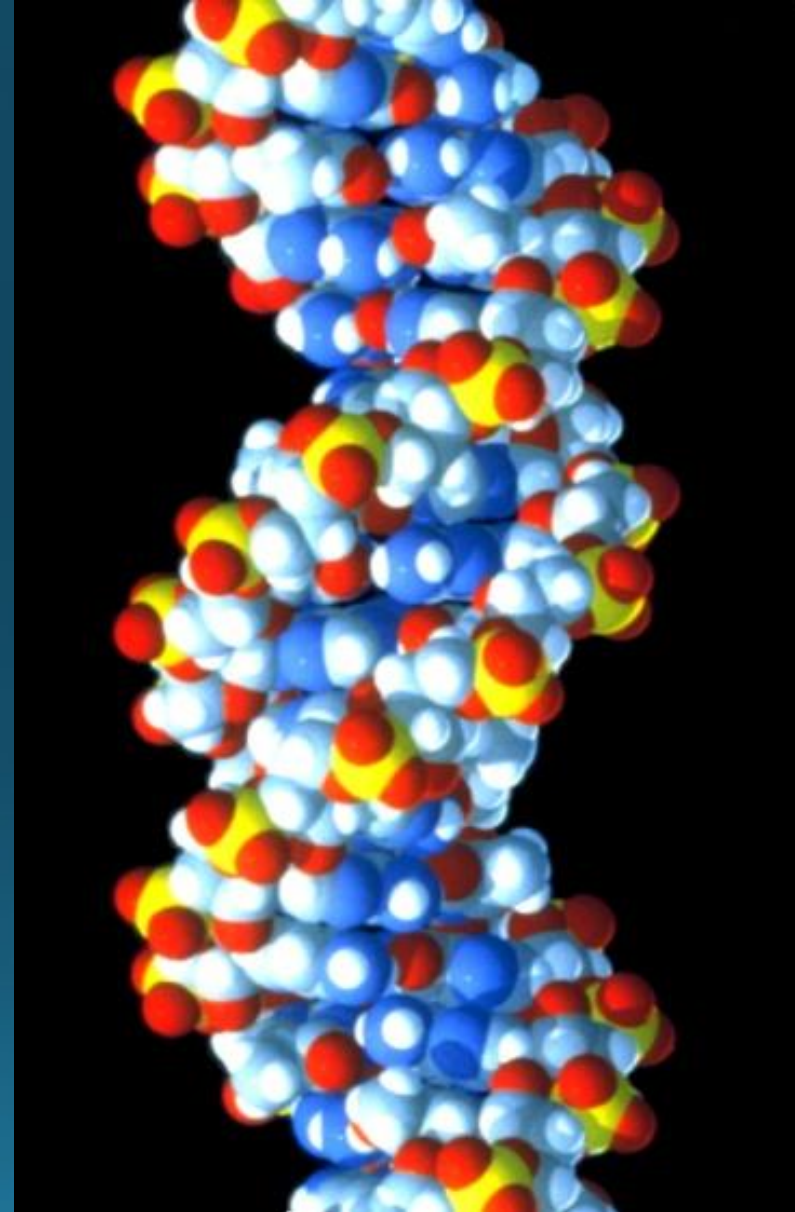
# Levels of Biological organization

- or the hierarchy of life, is the hierarchy of complex biological structures and systems that define life.



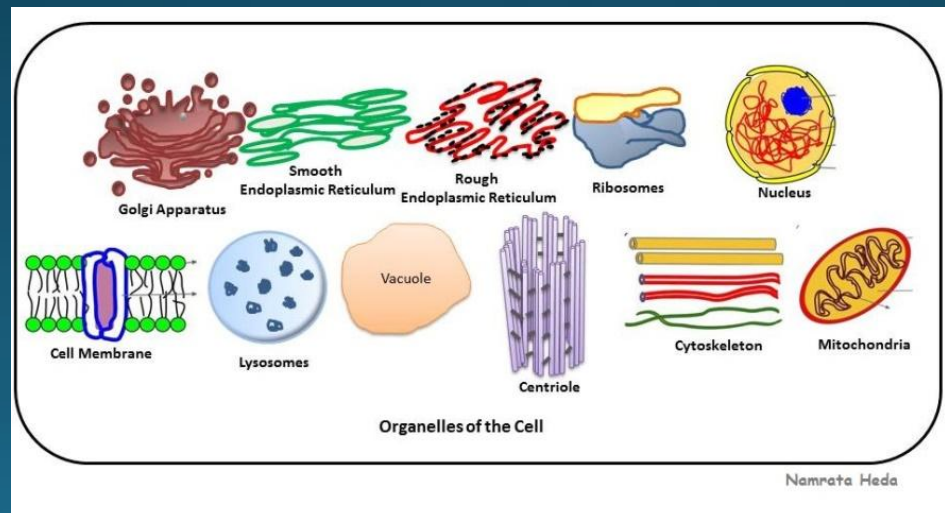
# Molecules

- A molecule is a chemical structure consisting of two or more small chemical units called atoms.
- Medical importance



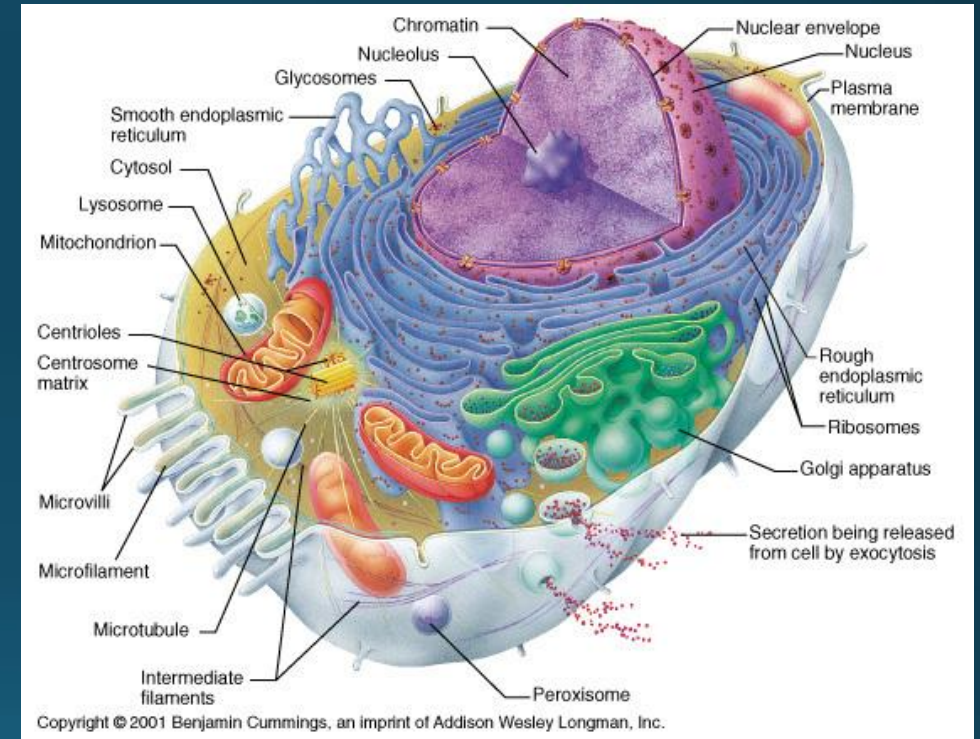
# Organelles

- Organelles("little organ") are specialized structures inside of a cell. Often organelles are "membrane bound" (surrounded by a plasma membrane) but not always!
- Examples of organelles you will become familiar with are the nucleus, mitochondria, endoplasmic reticulum, chloroplast, cilium, vacuole. The line between organelles and molecular assemblies is not clear. Sometimes the ribosome is not considered an organelle because it's not a membrane bound structure.



# Cells

- The cell is the smallest unit of biological organization that biologists consider alive.
- All true cells are surrounded by a plasma membrane, carry out complex chemical reactions, and are at least potentially capable of self reproduction. Cells come in a wide variety of shapes and sizes. Not all cells have a nucleus, but again all true cells have genetic material in the form of DNA.





# Tissues

- A tissue is a group of distinct and similar cells that carry out a specific set of functions.
- For example, muscle tissue is for contraction. Connective tissue is tissue consisting of cells surrounded by a large amount of non living material. Nerve tissue is for the conduction of nerve impulses and secretion of specialized chemicals called neurotransmitters.

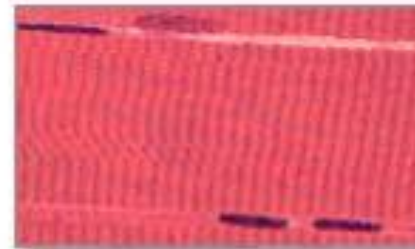
Four types of tissue



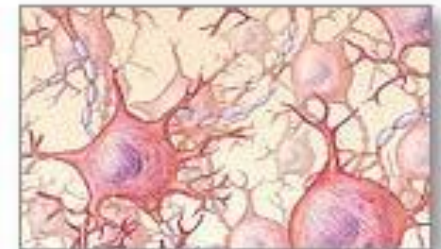
Connective tissue



Epithelial tissue



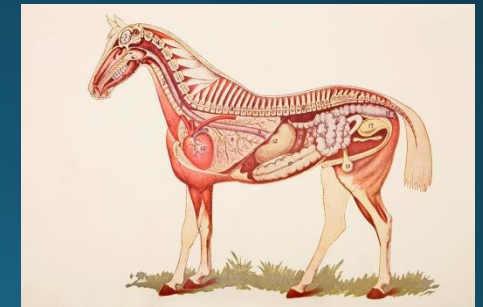
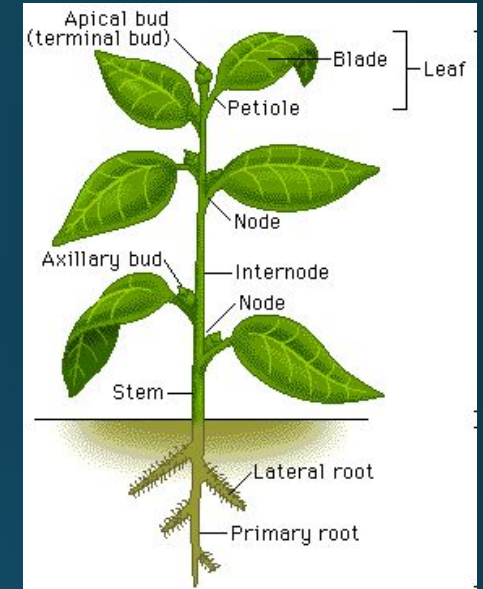
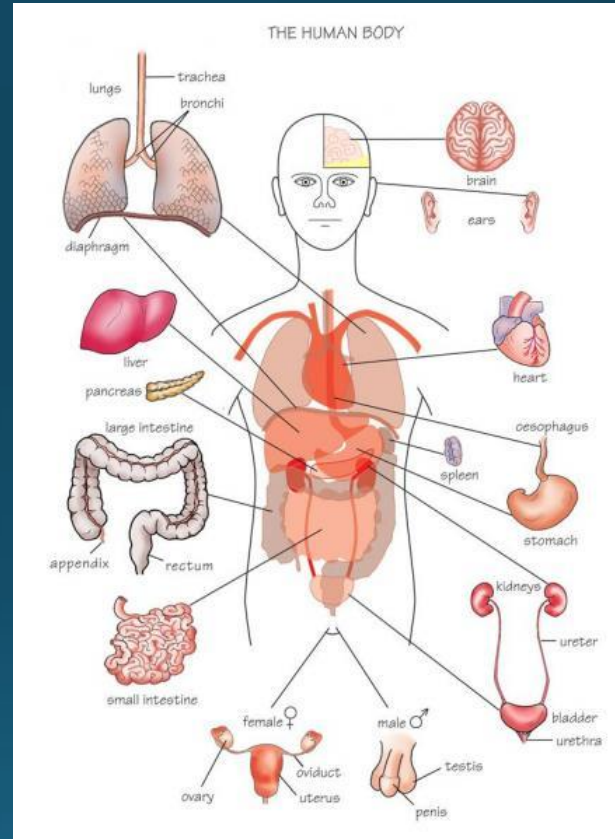
Muscle tissue



Nervous tissue

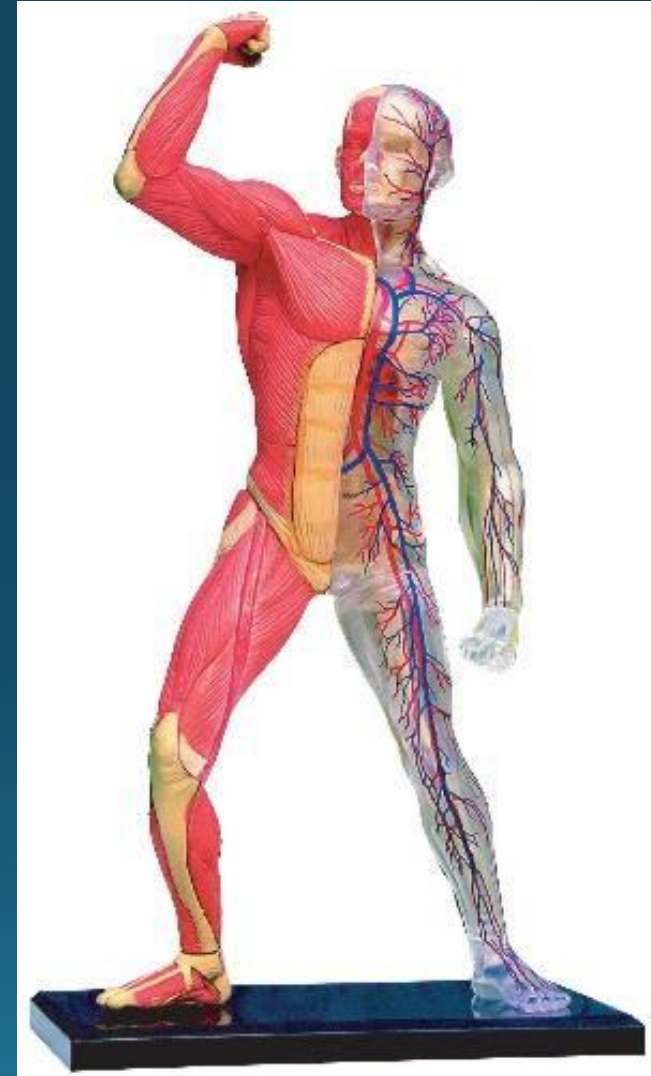
# Organs and organ systems

- Organs are groups of tissues organised together to carry out a particular set of functions. Organs typically have several kinds of tissue. The stomach has an inner lining of tissue that secretes digestive enzymes outside the stomach has several layers of muscle and connective tissue
- Multicellular organisms, especially animals typically are organized into organ systems, groups of organs that function together to carry out broad sets of functions.
- For instance an organ system in humans is the digestive system. Some of the organs in the digestive system are the stomach, liver, small intestine, pancreas.



# Organisms

- The organism or individual is that level of biological organization that has its own distinct existence as a complex, self reproducing unit.
- We are multicellular organisms in that we are made of many highly specialized cells which cannot exist independently of other cells in the organism.
- Many organisms are unicellular, that is consist of a single independent cell.
- Anatomy, physiology





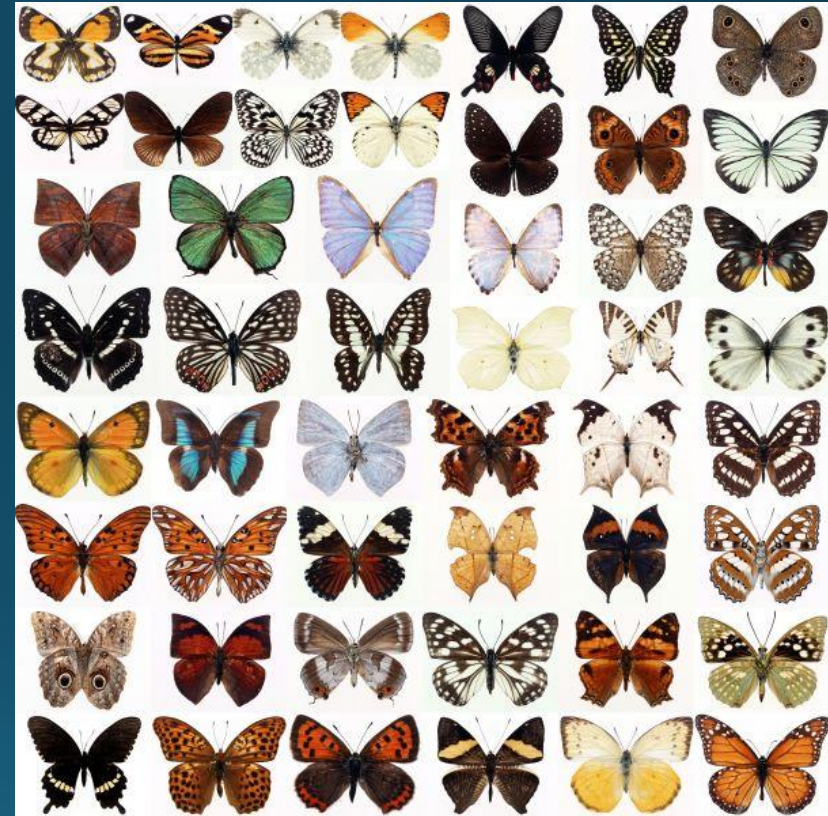
# Populations

- A population is group of freely interacting and breeding individuals of the same species.
- For example, all the bull frogs in a pond can be considered a population of bullfrogs. Typically populations are subdivided into smaller groups: a pack of wolves, pride of lions, colony of ants.
- Population ecology



# Species

- Species is the technical name given for a kind of organisms.
- For example all people are considered to be one species distinct from other primates based on common appearance and more importantly that all races can and do interbreed with each other.
- Taxonomy, systematics





# Ecological Communities

- An ecological community is all the populations of different species living and interacting together in a distinct area (e.g. all the species in a prairie).
- Community ecology



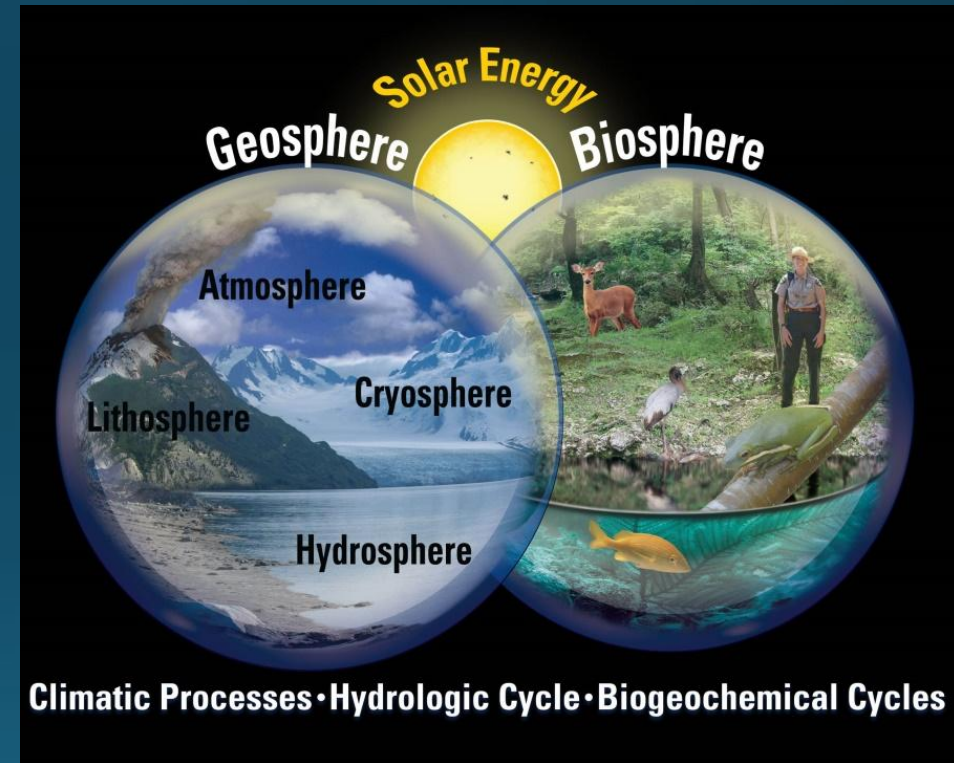
# Ecosystems

- The Earth contains numerous ecosystems.
- Ecosystems are distinguishable groups of species and the abiotic (non-living) components of the environment with which the living creatures interact to create biochemical cycles.
- Examples of ecosystems: ponds, forests, prairies.
- Landscape ecology, ecosystem ecology, environmental sciences



# The Biosphere

- The biosphere is the region on, below, and above the Earth's surface where life exists.
- Living things can be found into the atmosphere, the deepest parts of the ocean, and at least in some areas, microbes live in rock several kilometers below the surface of the earth.
- Biogeography, Macroecology





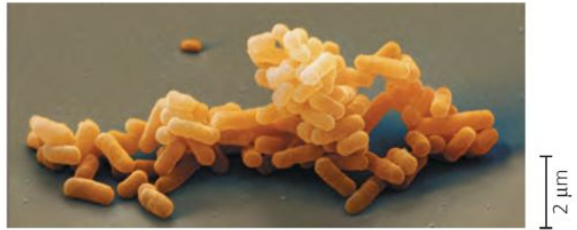
# Levels of biological organization

	Levels	Sciences
1	The Biosphere	Macroecology, biogeography
2	Ecosystems	Ecosystem and landscape ecology
3	Communities	Community ecology
4	Species	Taxonomy, systematics
5	Populations	Population ecology
6	Organisms	Anatomy, physiology
7	Organs and organ systems	Anatomy, physiology
8	Tissues	Histology, physiology
9	Cells	Cytology, physiology
10	Organelles	Cytology, physiology
11	Molecules	Biochemistry, molecular biology

# Three domains of life

▼ **Figure 1.15 The three domains of life.**

**(a) Domain Bacteria**



**Bacteria** are the most diverse and widespread prokaryotes and are now classified into multiple kingdoms. Each rod-shaped structure in this photo is a bacterial cell.

**(b) Domain Archaea**



Many of the prokaryotes known as **archaea** live in Earth's extreme environments, such as salty lakes and boiling hot springs. Domain Archaea includes multiple kingdoms. Each round structure in this photo is an archaeal cell.

**(c) Domain Eukarya**



▲ **Kingdom Plantae** consists of terrestrial multicellular eukaryotes (land plants) that carry out photosynthesis, the conversion of light energy to the chemical energy in food.



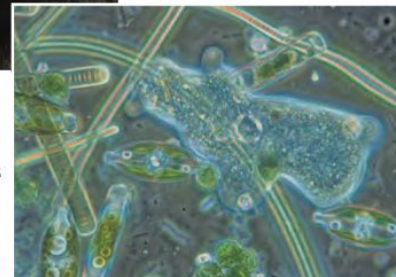
► **Kingdom Fungi** is defined in part by the nutritional mode of its members (such as this mushroom), which absorb nutrients from outside their bodies.



◀ **Kingdom Animalia** consists of multicellular eukaryotes that ingest other organisms.

100 μm

► **Protists** are mostly unicellular eukaryotes and some relatively simple multicellular relatives. Pictured here is an assortment of protists inhabiting pond water. Scientists are currently debating how to classify protists in a way that accurately reflects their evolutionary relationships.



Bacteria and Archaea are prokaryotic (single-celled and microscopic)

Eukarya is eukaryotic (unicellular and multicellular organisms)