

# BIOLOGY



TEXTBOOK



**АСТАНА**  
К И Т А П

Bakhtiyor Ermetov  
Adlet Sagintayev  
Bayram Kenci  
Aliya Akhmetova  
Lazzat Nuraliyeva  
Akaisha Jilkaidarova  
Nazerke Karimova

Approved by the Ministry of Education and  
Science of the Republic of Kazakhstan

# BIOLOGY

## Grade 8

1<sup>ST</sup> EDITION

**АСТАНА**  
ASTANA

Astana 2017

UDC 373.167.1(075.3)  
LBK 28.0 я 72  
В 60

Ermetov B.  
**BIOLOGY, Grade 8: Textbook/** Bakhtiyor Ermetov, Adlet Sagintayev, Bayram Kenci,  
B 60 Aliya Akhmetova, Lazzat Nuraliyeva, Akaisha Jilkaidarova, Nazerke Karimova  
– Almaty: Астана-кітап, 2017. - 160 p.  
ISBN 978-601-7415-63-1

UDC 373.167.1(075.3)  
LBK 28.0 я 72

ISBN 978-601-7415-63-1

Copyright notice  
© Астана-кітап, 2017  
All Rights Reserved

# Table of Contents

## PREFACE

## CHAPTER 1.0

### 1.1 CELL STRUCTURE AND TYPES

### 1.2 PLANT AND ANIMAL TISSUES

### Problems

## CHAPTER 2.0

### 2.1 MONOMERS AND POLYMERS

### 2.2 CARBOHYDRATES AND LIPIDS

### 2.3 PROTEINS

### Problems

## CHAPTER 3.0

### 3.1 DIVERSITY OF PLANTS

### 3.2 KINGDOM FUNGI

### 3.3 MONOCOTS AND DICOTS

### 3.4 ARHROPODS AND CHORDATES CLASSES

### Problems

## CHAPTER 4.0

4.1 DIGESTIVE SYSTEM

4.2 STRUCTURE, FUNCTION AND HYGIENE OF TEETH

4.3 DIGESTIVE ORGANS

4.4 PREVENTION OF GASTROINTESTINAL DISEASES

Problems

**CHAPTER 5.0**

5.1 LYMPHATIC SYSTEM

5.2 BLOOD AND ITS FUNCTIONS

5.3 BLOOD CELLS

5.4 IMMUNITY. HUMORAL AND CELL-MEDIATED  
IMMUNITY

5.5 INFECTIOUS DISEASES

5.6 IMMUNITY, TYPES OF IMMUNITY

5.7 BLOOD TYPES

5.8 HEART AND BLOOD VESSELS

5.9 CIRCULATORY SYSTEM TYPES

5.10 PHYSICAL EXERCISES AND THE HEART

5.11 DISEASES OF HUMAN CIRCULATORY SYSTEM

Problems

**CHAPTER 6.0**

6.1 GAS EXCHANGE

6.2 BREATHING

6.3 LUNG CAPACITY

Problems

**CHAPTER 7.0**

7.1 HUMAN URINARY SYSTEM

7.2 SKIN

7.3 SKIN DISEASES

Problems

**CHAPTER 8.0**

8.1 LOCOMOTION SYSTEM

8.2 BONE STRUCTURE

8.3 JOINTS

8.4 MOVABLE JOINTS

8.5 MUSCLES

8.6 HYPODYNAMIA

8.7 BIOMECHANICS OF MOVEMENT

Problems

**CHAPTER 9.0**

9.1 EYE STRUCTURE

9.2 HEARING

9.3 RECEPTORS

9.4 ENDOCRINE GLANDS

9.5 DISEASES OF THE ENDOCRINE SYSTEM

9.6 SKIN RECEPTORS

9.7 THERMOREGULATION

Problems

**CHAPTER 10.0**

10.1 CELL DIVISION TYPES

10.2 ANIMAL REPRODUCTION

10.3 LIFE CYCLES OF MOSSES AND FERNS LIFE CYCLE OF THE FERN

10.4 LIFE CYCLES OF GYMNOSPERMS AND ANGIOSPERMS

Problems

**CHAPTER 11.0**

11.1 EMBRYONIC DEVELOPMENT

Problems

**CHAPTER 12.0**



12.1 ROLE OF INHERITANCE AND VARIATION IN EVOLUTION

12.2 SELECTIVE BREEDING

12.3 ORIGIN CENTERS OF DOMESTIC PLANTS AND ANIMALS

12.4 CROPS AND DOMESTIC ANIMALS OF KAZAKHSTAN

Problems

**CHAPTER 13.0**

13.1 ECOSYSTEM

13.3 INTERRELATION BETWEEN LIVING THINGS

Problems

**CHAPTER 14.0**

14.1 PRESERVING AND MAINTAINING BIODIVERSITY

14.2 ECOLOGICAL PROBLEMS OF KAZAKHSTAN

Problems

ANSWERS

Glossary

Reference



# PREFACE

Natural science is an exciting and very useful subject. This textbook will show you all the beauty of it and will help you become true explorers. The main aim of this book is to answer the fundamental question: “What is science and what is its importance in our life?”

Starting from the first pages, you will realise that this textbook is completely different from any other usual textbook full of theoretical passages and formulas. Every chapter contains useful information, curious facts, tasks for individual and group work. You will also learn how to conduct research and experiments yourselves, search for information, make your own discoveries.

One more valuable feature of this textbook is the language. Every sentence has been carefully chosen so that it is not difficult for you to understand science in the English language. Each page contains translations of all the important terms, both in Kazakh and Russian. This textbook will not only help you improve your English, but it will also make you a part of a big international science community.

Please pay attention to the structure of this textbook. Remember: a textbook is no longer the only source of information in the modern world. With the help of carefully selected tasks, you are going to learn such important skills as critical thinking, problem solving, information analysis, creativity, imagination, teamwork, digital literacy etc.

If you have any questions, suggestions or ideas regarding the contents of this book, please feel free to contact us:

via email: [admin@astanakitap.kz](mailto:admin@astanakitap.kz)

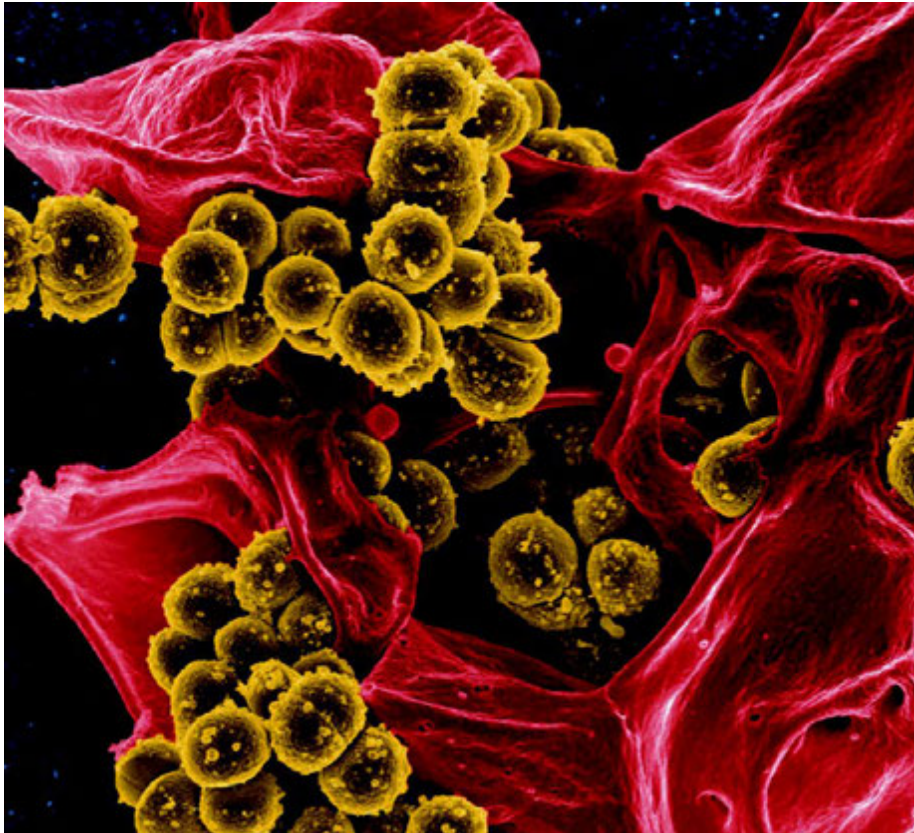
via telegram app: [@astanakitap](https://www.instagram.com/astanakitap)

Best regards,

team of authors, “Астана-кітап”

# CHAPTER 1.0

## Cell biology



# 1.1 CELL STRUCTURE AND TYPES

## You will:

---

- compare structures of different types of cells.

## Stimulating question

---

A human body has an average of 75 trillion cells. More than 75 million bacteria are living in and on our body. How is this possible that we have more bacterial cells than our own cells?

## Key terms

---

Organelles are parts of the cell which has its own function; Prokaryotic cell (pro-before, karyon-nucleus) is cell without a nucleus; Eukaryotic cell (eu-true, karyon-nucleus) is a cell with a nucleus.

## Text

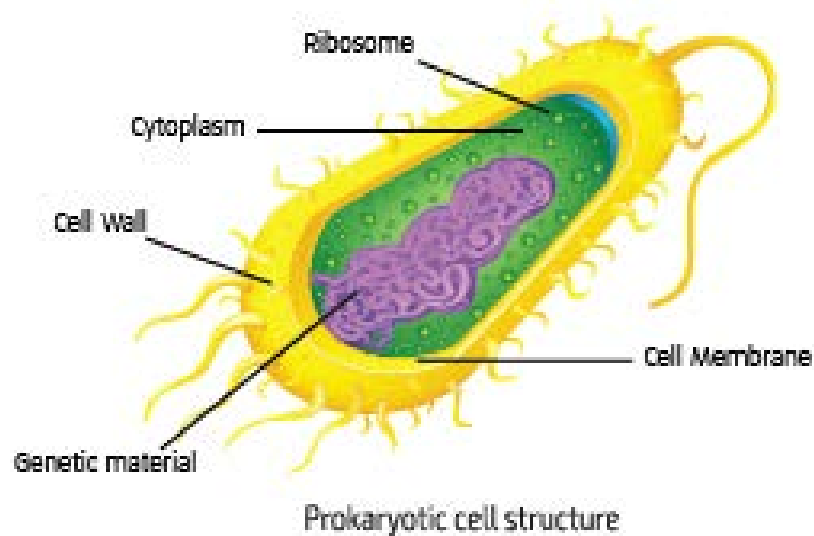
---

A cell is a basic unit of life. All living organisms are made of one or more cells.

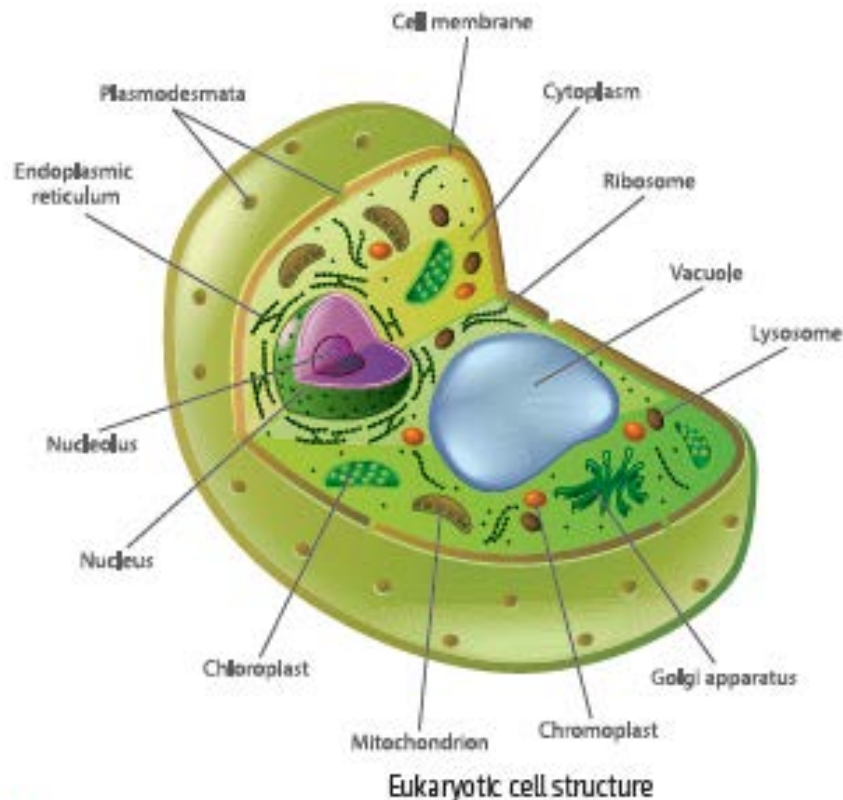
There are two types of cells: prokaryotic cell and eukaryotic cell.

Prokaryotic cells are bacterial cells. They have a cell wall, cell membrane, cytoplasm, ribosome and genetic material in the

cytoplasm. The genetic material is not covered by a membrane in prokaryotic cells, so they do not have a nucleus.



Eukaryotic cells are protists, fungi, plant and animals cells. Eukaryotic cells have a cell membrane, cytoplasm with many organelles and nucleus. Eukaryotic cells are 20-100 times bigger than prokaryotic cells.



Cell membrane covers the cell. It controls transport of materials in or out of the cell. Plant, fungi and some protists cells have a cell wall outside the cell membrane. It is hard and protects the cell.

Inside cell is filled with cytoplasm. Cytoplasm includes liquid part and cell organelles. Every organelle has its own function. Those organelles are: -Ribosomes: tiny organelles which produce proteins; -Mitochondria: produce energy for the cell activities; -Chloroplast: plant organelle which makes photosynthesis; -Endoplasmic reticulum: makes and transports materials like proteins and lipids within the cell;

- Golgi apparatus: receives, modifies and packs materials produced by endoplasmic reticulum; then these materials are transported to the cytoplasm or outside of the cell;

- Lysosomes: small sack like organelles with digestive enzymes inside, makes intracellular digestion;
- Vacuole: storage organelle, covered by a thin membrane.

## Activity

---

1. You are the mayor of the city called Cellorda (Cell Orda). Tell us about your city and citizens!
2. Who lives in Cell Orda?
3. Some enemies want to attack Cell Orda. Soldiers protect the city. Who are they?
4. Now you have problems with energy supply. Who will find the energy needed for Cell Orda
5. Work in groups. Show your city's life by roleplaying with your group.

## Literacy

---

1. Active cells or cells which need lots of energy have more mitochondria in them. Write three human cells with large numbers of mitochondria in them.
2. A chloroplast is a kind of plastid; some plant cells have chloroplasts, some do not. Guess which plant cells do not have chloroplast.

## Career

---

### Microbiologist

Bacteria can be useful and harmful. Microbiologists study these bacteria. They use good things from bacteria; they can make food or pharmaceuticals. Some bacteria can cause illnesses. Microbiologists study them and help people not to be ill.

## Facts

---

- “Sociable” cell is nerve cell, which can connect up to 10000 cells.
- The smallest Bacteria is Mycoplasma diameter of about 0.2-0.4 $\mu\text{m}$  (1mm=1000 $\mu\text{m}$ , micrometer).
- The longest is Blue whale’s nerve cell is 10-30 meter long.

## Terminology

---

- cell membrane - жасуша мембранасы / клеточная мембрана;
- cell wall - жасуша қабықшасы / клеточная стенка;
- chloroplast - хлоропласт
- eukaryotic cell - эукариотты жасуша / эукариотическая клетка;
- genetic material - генетикалық материал / генетический материал
- mitochondria - митохондрия;
- nucleus - ядро;
- organelle - органелла;
- prokaryotic cell - прокариотты жасуша / прокариотическая клетка;
- ribosome - рибосома;
- vacuole - вакуоль.



# 1.2 PLANT AND ANIMAL TISSUES

## You will:

---

- be able to classify animals and plant tissues.

## Key terms

---

Cell - the smallest functional and structural unit of life; Tissue - group of similar cells which do the same function;

Microscope - a tool for observing small objects;

Fixed slides - prepared microscope slides.

## Text

---

Cells with the same form and function make tissues. Animals and plants have different types of tissues.

### **Plant tissues**

Meristematic tissue - has rapidly dividing cells that help in plant growth

Dermal tissue - covers and protects plant body

Mechanical tissue - gives hardness to plants and prevents from breaking

Ground tissue - does photosynthesis, stores food and useful materials

Vascular tissue - transports materials inside plant organism

Secretory tissue - produces flower nectar, smell

### **Animal tissues**

Epithelial tissue - covers and protects the body and internal organs

Connective tissue - connects organs, gives hardness and protection, and helps in transportation of materials in the animal body

Muscular tissue - movement of the animal body and body organs

Nervous tissue - controls all body processes by nerve impulses. It makes up brain and nerves.

## **Lab works**

---

### **Structure of different tissues**

#### **Pre-lab questions:**

1. There are many types of tissues. What makes them similar to each other?
2. Which of the plant and animal tissues do the same work?
3. Guess where muscular tissues work in the body.

#### **Methods and Materials:**

Microscope, prepared fixed slides of plant and animal tissues.

### Procedures:

1. Observe fixed slides under low magnification
2. Observe fixed slides under high magnification and draw what you see.
3. Compare different tissues and discuss it with your friends.

### Results:

Plant tissue name	Picture

Animal tissue name	Picture

### Safety precautions:

1. Before using microscope read instructions.
2. Call teacher if you break microscope slide, do not touch it.

### Post-lab questions:

1. Explain the structure of the animal muscular tissue.
2. Explain the structure of plant meristematic tissue.
3. How is the structure of muscular tissue connected with its functions? Explain your answers.

## Maths in Biology

---

To find how many times you magnified an object using a microscope, use the following formula:

Total magnification = ocular lens x objective lens

Find the magnifications of an object with an ocular marked 10X and objectives marked 5X, 15X, 30X and 60X.

## Facts

---

Some tissues contain dead cells, But still these cells are very useful: in plant tissues they transport water, in human skin they protect cells from harmful ultraviolet lights.

## Terminology

---

- connective tissue - дәнекер ұлпа / соединительная ткань;
- dermal tissue - жабын ұлпа / покровная ткань;
- epithelial tissue - эпителий ұлпасы / эпителиальная ткань;
- function - қызметі / функция;
- ground tissue - негізгі ұлпа / основная ткань;
- meristematic tissue - түзуші ұлпа / образовательная ткань;
- muscular tissue - бұлшықет ұлпасы / мышечная ткань;
- nervous tissue - жүйке ұлпасы / нервная ткань;
- secretory tissue - бөлуші ұлпа / выделительная ткань;
- vascular tissue - өткізуші ұлпа / проводящая ткань;
- to magnify - үлкейту / увеличивать.

# Problems

## Test questions with one right answer

1. Which type of tissue makes photosynthesis and stores materials?

- A) Connective tissue
- B) Mechanical tissue
- C) Muscular tissue
- D) Ground tissue
- E) Epithelial tissue

2. Which type of tissue protects from harmful ultraviolet light?

- A) Nerve tissue
- B) Secretory tissue
- C) Muscular tissue
- D) Ground tissue
- E) Epithelial tissue

3. Most organelles are found inside the cell membrane. Which cell part is located outside of the cell membrane?

- A) Cytoplasm
- B) Cell wall

C) Nucleus

D) Mitochondria

E) Plastids

4. Not found in bacterial cells:

A) Cell membrane

B) Cell wall

C) Nucleus

D) Ribosome

E) Cytoplasm

### **Test questions with several (max 3) right answers**

1. Types of connective tissue:

A) Brain

B) Blood

C) Root

D) Heart

E) Skeletal muscle

F) Tissue of bones

G) Stem

H) Leaves

2. Tissues which have dead cells:

- A) Meristematic tissue
- B) Epithelial tissue
- C) Nervous tissue
- D) Connective tissue
- E) Vascular tissue
- F) Muscular tissue
- G) Secretory tissue
- H) Dead tissue

3. Organelles of a prokaryotic cell:

- A) Cell membrane
- B) Cell wall
- C) Plastids
- D) Vacuole
- E) Mitochondria
- F) Ribosome
- G) Nucleus
- H) Chloroplast

## **Matching**



1. Match tissues with function:

1. Meristematic tissue
2. Dermal tissue
3. Ground tissue

- A) Helps plant to grow.
- B) Protects plant.
- C) Produces nectar.
- D) Makes photosynthesis.
- E) Transports materials.
- F) Stores food.

2. Match organelles with function:

1. Mitochondria
2. Ribosomes
3. Plastids

- A) Transport materials
- B) Make protein
- C) Produce energy
- D) Store carbohydrates
- E) Do photosynthesis
- G) Control processes in the cell



# CHAPTER 2.0

## Chemistry of life



# 2.1 MONOMERS AND POLYMERS

## You will:

---

- learn differences between monomers and polymers.

## STQ

---

When you eat qazi, your body cells use it to produce energy. Food is bigger than a cell. How does it fit into a tiny cell?

## Key terms

---

Monomer (“mono” means one; “mer” means part) is a molecule that can be bonded to other identical molecules to form a polymer;

Polymer (“poly” means many; “mer” means part) is a large molecule or macromolecule composed of many repeated parts or monomers;

Organic compound is a compound which contains carbon (C) and hydrogen (H).

## TEXT

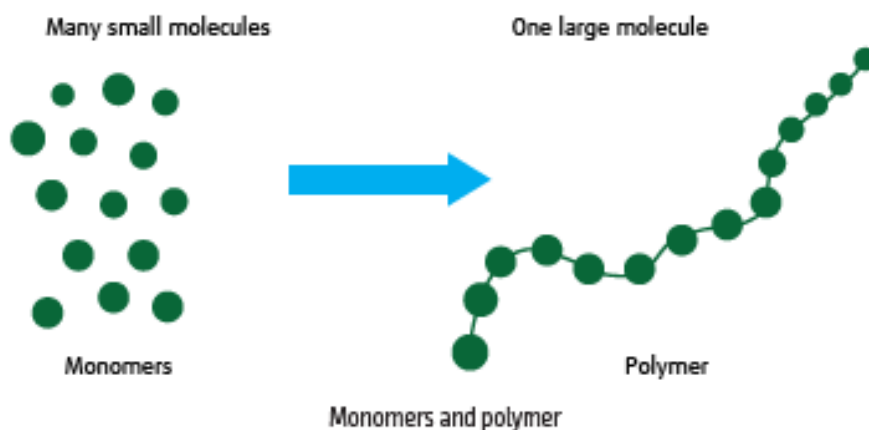
---

Qazi (horse meat) and most food types in the world are made of organic compounds. Large organic compounds are called macromolecules. All living cells contain

macromolecules. There are four main classes of biological molecules: carbohydrates, lipids, proteins and nucleic acids.

Three of these biological molecules are called polymers. They are carbohydrates, proteins, and nucleic acids. Lipids are not polymers. Polymers consist of smaller repeating similar blocks, linked together. These small blocks are called monomers. Some monomers, also have their own functions.

Qazi is also made of polymers. These polymers break down into monomers in digestive organs. Monomers are small enough to enter the cell.



## Facts

---

Our body gets macromolecules from food. Fruits and vegetables are rich in carbohydrates; egg and meat are rich in proteins; liquid oils are rich in lipids.

## Activity

---

1. Divide into groups of four students.
2. A teacher will give every group mixed collection of different things: paperclips, beads, shirt buttons, etc.

3. Find analogs for monomers from these things. Explain your choice. How many different monomer analogs did you find?
4. Construct polymer analogs from those monomers. You can use any additional tool to bind monomers.
5. Explain your polymer analog.

## Literacy

---

1. Assume that train is a polymer, what will be its monomer? How will these monomers be connected to one another?
2. What analogs of polymers can you give from daily life? (For ex. A notebook is a polymer; pages are monomers).

## Research time

---

How monomers do link together or how polymers break down? Interview your chemistry teacher. Ask questions about building up and breaking down reactions. Write a short conclusion.

## Chemistry in Biology

---

### Artificial polymer

In daily life, we use plastic bags: polyethylene. It is also a polymer of ethylene. Polyethylene is used for the packaging of many products: all sorts of drinks, household chemical goods, and cosmetic products. Polyethylene usage needs recycling because decomposition of plastics takes minimum 700 years and it pollutes the environment.

## Terminology

---

- carbohydrate - көмірсу / углевод;
- decomposition - ыдырау / разложение;
- environment - қоршаған орта / окружающая среда;
- lipid - липид;
- nucleic acid - нуклеин қышқыл / нуклеиновая кислота.
- to construct - салу, құрау / строить;



## 2.2 CARBOHYDRATES AND LIPIDS

### You will:

---

- understand biological functions of carbohydrates and lipids.

### STQ

---

Why carbohydrates and lipids are important for the human body?

### Key terms

---

Carbohydrate is a macromolecule which consists of carbon, hydrogen and oxygen atoms;

Lipid is a biological molecule which does not dissolve in water.

### Facts

---

Fats can be good or bad for our health. Good fats are useful for your heart and clean blood vessels. Bad fats increase the risk of heart stroke by blocking blood vessels with fat.

### TEXT

---

#### Carbohydrates

The most common example of carbohydrate is glucose. It is the main source of energy in cells.

Sucrose is another example of carbohydrate. It is the component of table sugar.

Carbohydrates can store energy. Plant cells store energy in the form of starch.

Animal cells store energy in the form of glycogen.

Some carbohydrates are components of cells. The cell wall of plants is made of cellulose carbohydrate.

Another example is chitin. It is a component of fungi cell wall and arthropods exoskeleton. Cellulose and chitin give hardness to cells.

Sucrose is the main component of table sugar.

## **Lipids**

Butter which you eat in the breakfast and sunflower oil used to cook food are examples of lipids. Lipids are not polymers and are not composed of repeating blocks.

### **Types of lipids:**

- Phospholipids are the building blocks of a cell membrane.
- Fats in animals and oils in plants are energy storages of these organisms. We use these lipids as food. Sheep tail fat and seed oils are examples.
- Under skin fat in animals is used to keep the body warmth.

- Wax is a special lipid, it melts above 45o C. Honeycomb of bees is made of beeswax, plants stop water loss using leaf wax.

## Research time

---

To find or show starch in food iodine is used. Iodine's color is red-brown when it reacts with starch, iodine changes its color. Take potato and apple, cut them into two pieces. Drop few droplets of iodine onto the potato and the apple. Does iodine change its color? Explain why.

## Activity

---

Do lipids dissolve in water? Test it:

1. Mix 50 ml of oil with 150 ml of cold water, do the same with hot water. Wait 5 minutes and see changes.
2. Mix 50 ml of oil with 150 ml of alcohol. Wait 5 minutes and see changes.
3. What differences did you see in 3 different mixtures? Explain.

## Literacy

---

1. Give examples of carbohydrates in our daily life. Which food contains more carbohydrates?
2. Carbohydrates can be good or bad for our health. Which do you think are good, or bad? Explain your answer.
3. How is obesity related to lipids and carbohydrates?

## Terminology

---

- cellulose - жасұнық / целлюлоза;

- chitin - хитин;
- to dissolve - еріту / растворять;
- exoskeleton - сыртқы қаңқа / экзоскелет;
- fat - май / жир;
- fiber - талшық / волокно;
- obesity - семіздік / ожирение;
- source - қайнар көз / источник;
- starch - крахмал;
- wax - балауыз / воск.

## 2.3 PROTEINS

### You will:

---

- learn the biological functions of proteins.

### STQ

---

Newborn babies need to drink breast milk. They continue drinking it for just a few months. Why is milk so important for babies?

### Key terms

---

Amino acid is a monomer of proteins;

Protein is a macromolecule made up of amino acids;

Denaturation is the destruction of protein structure.

### Facts

---

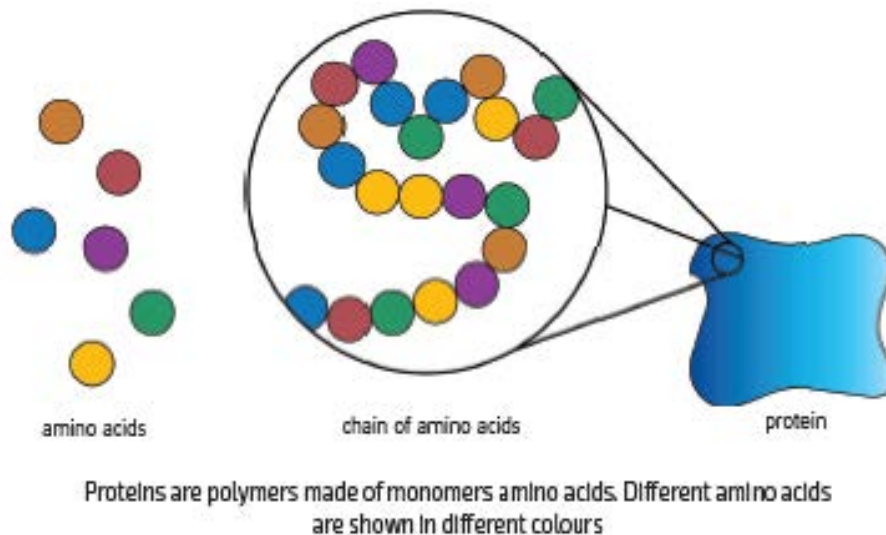
Our muscles are mainly made of proteins; our hair and nails are made of protein keratin; our skin colour, hair and eye colours given by protein melanin.

### Text

---

One of the components of milk is proteins. Proteins are large polymers with vital importance for the body. Proteins consist of monomers - amino acids. There are 20 different types of amino acids, which make up thousands of different proteins.

Proteins are polymers made of monomers amino acids. Different amino acids are shown in different colours.



Proteins in organisms have many functions:

- Building blocks. Proteins are main components of cells. If we take water out of the cell, 50% of remaining mass will be proteins.
- Transport. Proteins transport molecules in an organism. For example, hemoglobin protein transports oxygen in the blood.
- Movement. Muscle cells have many proteins. They help muscles to contract and relax.
- Regulation. Proteins can start or end different processes in the cell. Some human hormones are made of proteins.
- Protection. Some proteins kill harmful bacteria and viruses in the human body.
- Energy. Proteins sometimes are used as energy source. They are only used when a person does not eat for a long period, and organism runs out of carbohydrates and lipids. This is very dangerous for human health.
- Pigment. Protein melanin gives human skin color, hair, and eye color.

As you see proteins have many functions, and they are very important for human body.

We mainly get proteins from meat, eggs, cheese, milk, legumes and other food sources.

## Activity

---

You are a dietitian at the hospital. You have three patients who need your advice on their diet:

1. A swimmer who participates in the Olympics. He needs a diet to make his muscles better.
2. A woman wants to be slim. She needs a diet which keeps her fit.
3. By looking at staff member's blood analysis, you concluded that he has a high risk of heart attack. He also needs a special diet.

Suggest a healthy diet for each of your patients. Explain your answer.

## Literacy

---

1. What do ribosomes need to make new proteins?
2. Word "Protein" is derived from Greek word proteios, which means "primary" or "holding the first place". Why is this term used for protein?
3. Why using proteins as an energy source is dangerous for our health?

## Facts

---

While you are reading this text, your eye muscles are moving with the help of proteins actin and myosin. Another protein in

eyes is called rhodopsin. It helps to see this information.

## Research time

---

Denaturation is damage to protein structure. Denatured protein cannot work properly. Do the following experiments to observe denaturation of proteins:

Ovalbumin is a protein of egg white.

Take two eggs. Boil one of them. Then crack them into different dishes. Are they same? Describe what happened with egg white.

Explain what happens in denaturation with your own words.

## Terminology

---

- amino acid - аминқышқылы / аминокислота;
- to crack - жару, сындыру / расколоть;
- denaturation - денатурация;
- dietitian - диетолог;
- heart attack - инфаркт, жүрек талмасы / инфаркт;
- legume - бұршақтұқымдастар / бобовые;
- protein - ақуыз / белок;
- remaining - қалған / оставшееся;
- to run out - біту / заканчиваться.



# Problems

## Test questions with one right answer

1. Glucose and galactose are examples of:

- A) Disaccharides
- B) Polysaccharides
- C) Monosaccharides
- D) Double sugars
- E) Lipids

2. Monomer of protein is:

- A) Triglyceride
- B) Amino acid
- C) Glucose
- D) Carbohydrate
- E) Lipid

3. Quick energy source for animals is:

- A) Carbohydrates
- B) Lipids
- C) Proteins

D) Amino acids

E) Fats

4. Plants like sugar beets store the energy source as the simple sugars. Some plants as potato and grains store them as complex sugar which is called?

A) Glycerol

B) Glucose

C) Starch

D) Amino acid

E) Fat

### **Test questions with several (max 3) right answers**

1. Which of the followings are carbohydrates?

A) Olive oil

B) Glucose

C) Butter

D) Lactose

E) Keratin

F) Albumin

G) Glycogen

H) Cholesterol

2. Which of the followings contain lipids?

- A) Table sugar
- B) Butter
- C) Maltose
- D) Wax
- E) Seed oil
- F) Albumin
- G) Keratin
- H) Glycogen

3. Which of the followings are monomers?

- A) Glucose
- B) Fructose
- C) Amino acid
- D) Sucrose
- E) Keratin
- F) Albumin
- G) Nucleic acid
- H) Lipid

## Matching

1. Substances are found in the structure of:

1. Cellulose
2. Chitin
3. Myosin

A) Muscles

B) Blood

C) Bone

D) Exoskeleton

E) Wood

F) Skin

2. These proteins are found in:

1. Ovalbumin
2. Casein
3. Keratin

A) Hair

B) Blood

C) Egg

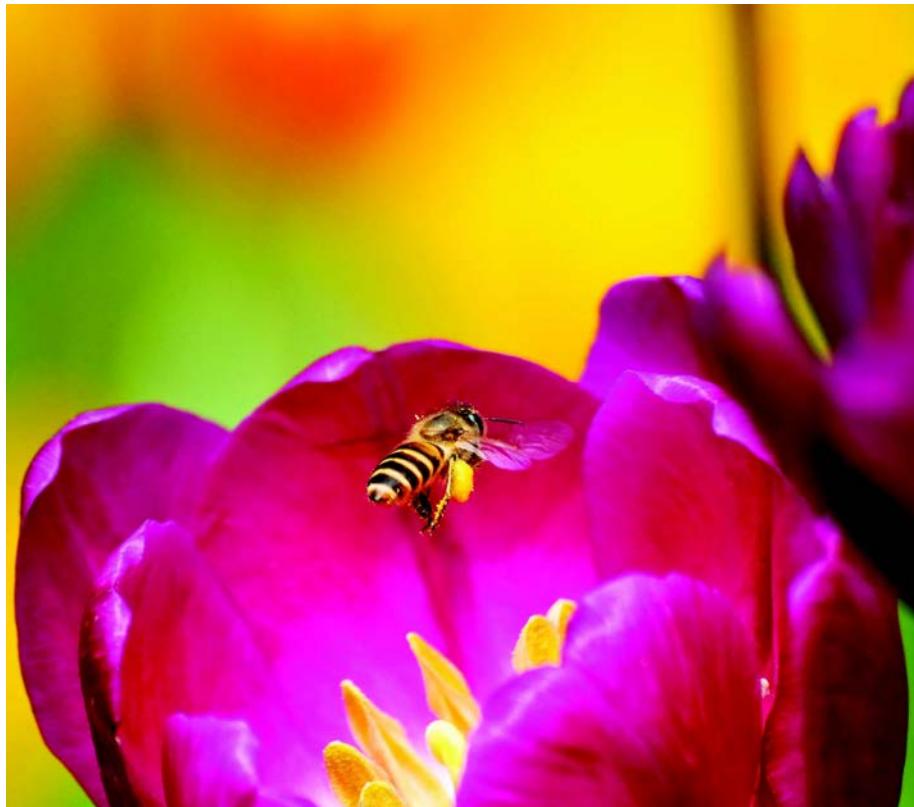
D) Milk

E) Bone

F) Teeth

# CHAPTER 3.0

## Diversity of living things



## 3.1 DIVERSITY OF PLANTS

### You will:

---

- be able to distinguish algae, mosses, ferns, angiosperms, and gymnosperms from each other.

### Key terms

---

Lower order plants are plants that do not have true roots, stems, and leaves;

Higher order plants are plants that have true roots, stems, and leaves;

Vascular plants are plants which have a specialized vascular tissue;

Nonvascular plants are plants without vascular tissue.

### Text

---

Plants are very important in our daily life. We eat them; we present them as a gift to people we love, we use them to make different things like paper, wood, etc. They are everywhere on the Earth, humans and other organisms cannot live without plants.

There are many different types of plants. They live in/on water and land.

Plants are divided into different groups by having or not having some plant structures like tissues, organs, seeds, and

flower.

Plants are divided into two major groups: higher and lower order plants.

PLANTS				
LOWER ORDER PLANTS	HIGHER ORDER PLANTS			
Have no true roots, stems and leaves	NONVASCULAR PLANTS	VASCULAR PLANTS		
	Have primitive roots, stems and leaves	Don't make seeds	Make seeds	
		Have roots, stems and leaves	Nonflowering	Flowering
	ALGAE	MOSESSES	FERNS	GYMNOSPERMS



## Facts

You know that pine trees stay green all year round. Other trees lose their leaves in autumn and stay without leaves in winter. Pine trees also lose their spikes (leaves) as they grow, but they replace them step by step all year around.

Other evergreens are junipers which can be found in Southern Kazakhstan.

Junipers grow slowly and live up to 1000 years. They are endangered species and are recorded in Red Data Book of

Kazakhstan. Junipers are preserved in AksuZhabagly reserve.

## Lab works

---

### Comparison of different plant groups

#### Pre-lab questions:

1. Why human beings and other organisms can't live without plants?
2. What are the main differences between higher and lower order plants?
3. What are the main differences between gymnosperms and angiosperms?

#### Methods and Materials:

Herbarium of algae, mosses, ferns, angiosperms and gymnosperms, magnifying glass, toothpick

#### Procedures:

1. Observe given herbaria using a toothpick and magnifying glass.
2. Fill table below with your observations.

#### Safety precautions:

1. Be careful with herbaria.
2. Do not play with toothpicks.

#### Results:



Plant	Body form	Leaves	Roots	Seeds	Flower
Algae					
Moss					
Fern					
Gymnosperm					
Angiosperm					

### Post-lab questions:

1. Why do angiosperms need flowers?
2. What is the function of each plant organ?
3. Why are mosses not as big as other plants?

## Terminology

---

- algae - балдырлар / водоросли;
- angiosperm - жабықтұқымды / покрытосеменное;
- endangered - жойылу қауіпі бар / под угрозой исчезновения;
- fern - қырықжапырақ / папоротник;
- gymnosperm - ашықтұқымды / голосеменное;
- higher order plants - жоғары сатыдағы өсімдіктер / высшие растения;
- juniper - арша / можжевельник;
- landscaping - көгалдандыру / озеленение;
- lower ordered plants - төменгі сатыдағы өсімдіктер / низшие растения;
- moss - мүк / мох;
- needle - ине / игла;
- nonvascular - түтіксіз / несосудистое;
- pine - қарағай / сосна;
- to distinguish - ажырату / различать;
- to preserve - сақтау / сохранять;

- vascular - түтікті / сосудистое.

## 3.2 KINGDOM FUNGI

### You will:

---

- learn characteristics of fungi.

### STQ

---

Why were fungi originally classified as plants?

### Key terms

---

Fungi - eukaryotic organisms with properties of both plants and animals;

Heterotroph - an organism that feeds on ready food;

Decomposer - an organism that breaks down dead organisms.

### Facts

---

“Curse of the Pharaoh”

Scientists died after opening a pharaoh’s tomb. Some people believed that it was revenge of pharaoh. But in fact they died of fungi *Aspergillus* spores that caused infection in their lungs.

### Text

---

Amanita is a poisonous mushroom. Fungi are eukaryotic organisms which have properties of both plants and animals. They do not move and never stop growing like plants. They are heterotrophic and do not do photosynthesis like animals. Fungal cell walls are made of polysaccharide chitin.

Yeasts are unicellular microscopic fungi. They are used in daily life in the production of bread. Yeasts are also used in the production of alcohol.

Molds are also microscopic fungi. They can be unicellular or multicellular. They are decomposers, that means to feed on dead organisms. There are many types of molds, and they grow on different food, some even grow on walls. Molds produce toxins; it is very dangerous to eat them. Examples: Aspergillus, Penicillium, and Mucor.


Mushrooms are multicellular fungi. Most of the mushroom body is actually under the ground. They have branched structures. Like roots of plants. They take in water and other nutrients. Only the reproductive structure is above the ground.

Some mushrooms we use as food, we call them edible mushrooms. Some are poisonous, so it is dangerous to eat them. They can cause death.

## Activity

---

Mushrooms can be edible or poisonous. Some of them are very similar to each other. Research their differences. Find out which of them are edible or poisonous

MUSHROOMS		DIFFERENCES
 <p>Champignon</p>	 <p>Death cap</p>	
 <p>False chanterelle</p>	 <p>Chanterelle</p>	
 <p>False honey agaric</p>	 <p>Honey agaric</p>	

## Literacy

---

1. Draw a table and show which features do fungi have in common with animals, and which features do fungi have in common with plants.
2. Why do we use yeasts in bread production?
3. How can we protect/keep away bread and other food from molds?

## Research time

---

### Grow your own mold.

1. Take any slice of bread. Put it into a jar and close it. Wait for one week and observe what happens to the bread.

What is the color of mold? Does it change its color over time?

2. Write a 200-250 words essay about the importance of mold in nature as decomposers.

**IMPORTANT:** While and after doing research DO NOT OPEN jar, later throw it. Mold produces toxins which are dangerous to human health.

## Facts

---

### Nobel prized fungi

Scientist Alexander Fleming saved a lot of people by discovering antibiotic penicillin which is taken from Penicillium mold. It stops many infections by killing bacteria.

## Terminology

---

- champignon - қозықұйрық / шампиньон;
- chanterelle - түлкіжем / лисичка;
- false chanterelle - жалған түлкіжем / ложная лисичка;
- false honey agaric - жалған түбіртек / ложные опята;
- death cap - боз арамқұлақ / бледная поганка;
- decomposer - шірітуші, ыдыратушы / редуцент, разлагатель;
- honey agaric - түбіртек / опята;
- mold - зең саңырауқұлақ / плесень;
- revenge - кек алу / месть;
- tomb - мола, қабір / могила;
- toxin - токсин, у, уыт / токсин, яд.

## 3.3 MONOCOTS AND DICOTS

### You will:

---

- differ monocot and dicot plants.

### Key terms

---

Flowers produce nectar and odor to attract insects. Later seeds are formed in the flowers.

Angiosperms are flowering plants;

Cotyledon is a part of the seed that will grow into the leaves;  
Dicot is a plant with two cotyledons;

Monocot is a plant with one cotyledon.

### STQ

---

Banana and orange are fruits. Onion and carrot are vegetables. However, from a biological point of view, banana is closer to onion than to orange. How can this be explained?

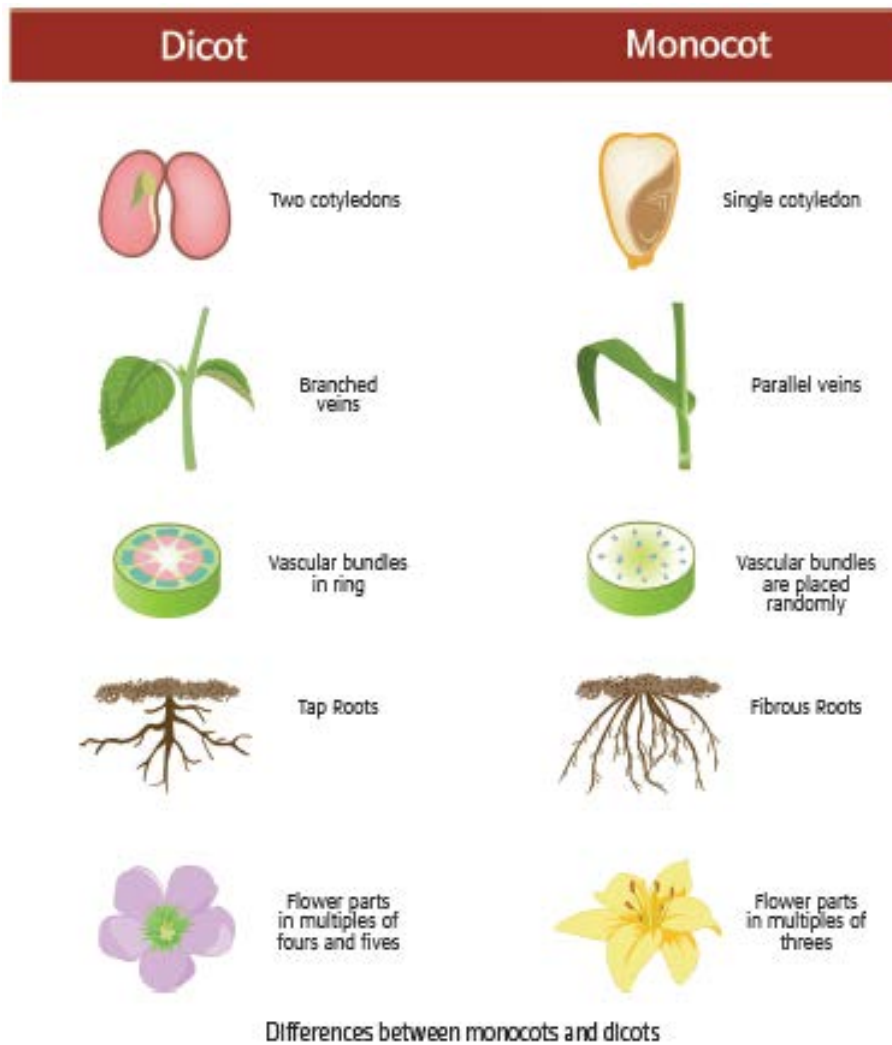
### TEXT

---

Banana, onion, orange, and beet all are flowering plants or Angiosperms. The flower is a beautiful and attractive organ of these plants. The main function of a flower is the reproduction. Insects flying from flower to flower carry pollens and pollinate them. After pollination, reproduction

occurs. Flowers produce nectar and odor to attract insects. Later seeds are formed in the flowers.

Seeds of flowering plants are covered with structure, which protects the seed and has nutrients for the seed. This structure is known as fruit. Flowering plants are divided into two groups: dicots and monocots. Their differences are shown in the image.



## Facts

---



## World's oldest tree

Old Tjikko is 9,550 years old spruce found in Sweden. Which is named after the founder's dog.

## Lab works

---

### Monocot and Dicot plants.

#### Pre-lab questions:

1. Give three examples of Monocot and Dicot plants.
2. Explain the importance of flower for the plant.
3. What is the function of leaf venation?

#### Methods and Materials:

magnifying glass, toothpicks, two plants.

#### Procedures:

1. Observe your plants with the magnifying glass
2. Fill the table below.

#### Safety precautions:

1. Be careful with magnifying glass. Do not break it.
2. Do not play with toothpicks.

#### Results:

Plant structures	Plant 1	Plant 2
Root type		
Leaf venation		
Flower petal numbers		
Seed type		

### Post-lab questions:

1. Did you see any difference in the form and structure of stems of given plants? Explain your answer.
2. Which of the plants is monocot? Explain your answer.
3. Which of the plants is dicot? Explain your answer.

## Facts

---

Usually, people remove all seeds while eating. However, most seeds of vegetables and fruits are edible and useful. For example, watermelon seeds are effective in recovering health after illness and sharpening the memory. Raw pumpkin seeds help the brain activity. But be careful not to eat too much.

## Research time

---

Take any plant from home. Define if it is monocot or dicot by observation its characteristics. Write a report about it.

## Terminology

---

- cotyledon - тұқым жарнақ / семядоля;
- dicots - қосжарнақтылар / двудольные;
- monocots - даражарнақтылар / однодольные;
- pollen - тозаң / пыльца;
- pollination - тозаңдану / опыление;

- pumpkin - асқабақ / тыква;
- recovering - қалпына келтіру / восстановление;
- spruce - шырша / ель
- venation - жүйкелену / жилкование;
- watermelon - қарбыз / арбуз.

## 3.4 ARHROPODS AND CHORDATES CLASSES

### You will:

---

- learn differences between

### Key terms

---

Backbone is the bone on the back side of the body;

Arthropods have segmented body, jointed limbs, and exoskeleton;

Chordates are any animal that has a spinal cord.

### Facts

---

#### Desert dormouse

This species was first found in Kazakhstan in Betpak-Dala Desert and were given name *Selevinia betpakdalaensis*.

### Text

---

#### Arthropod characteristics

All insects, spiders, scorpions are members of phylum Arthropoda. Their limbs are segmented. Limbs can be used for swimming, walking, grabbing, etc.

Arthropods do not have a backbone. Their body is covered with a hard exoskeleton made of chitin. Their body can be divided into several parts such as head, thorax, and abdomen. In some different arthropods, head and thorax fuse and form cephalothorax. Arthropods have different classes.

## Lab works

---

### Comparison of different Arthropoda classes.

#### Pre-lab questions:

1. Give examples of Arthropods you are familiar with.

#### Methods and materials:

Magnifying glass, toothpicks, gloves, different arthropod examples, one for each class: Crustacea, Arachnida, Insecta. Images of these organisms can be used instead of live or dead organism.

#### Procedures:

1. Look at three arthropods and observe them.
2. Fill the table below.

#### Results:

<u>name -&gt;</u>	<u>Crustacea</u>	<u>Arachnida</u>	<u>Insecta</u>
Body parts			
Number of legs			
Antennae			
Eye type			
Special external features			
Size in cm			
Habitat			

### Post-lab questions:

1. Are body parts of arthropods related to their lifestyle?  
Explain your answer.

### Safety precautions:

1. Be careful while working with different arthropods.

## Text

---

### Chordate characteristics

Animals such as horse, dog, fish, snake, and frog are chordates. They have backbones. Their skin is not hard. The skeleton is inside of the body. This type of skeleton is called endoskeleton. There are different classes and types of chordates.

## Lab works

---

### Pre-lab questions:

1. Give examples for Chordates which you see in daily life.

### Methods and materials:

Magnifying glass, toothpick, fish, bird, cat.

### Procedures:

1. Observe three organisms and compare them.
2. Fill the table below.

### Results:

<u>name -&gt;</u>	<u>Fish</u>	<u>Bird</u>	<u>Mammal</u>
Body covering			
Body parts			
Limbs			
Habitat			
Ears			
Size (in cm)			
Specific external features			

### Post-lab questions:

1. Are body structures of chordates related to their lifestyle? Explain how.

## Facts

---

### Molting

The same way as we change the size of clothes when we grow, arthropods change their exoskeleton too. Their exoskeleton is hard and does not grow. When arthropods grow, a new soft exoskeleton is formed under their old one. Then they crack and leave old exoskeleton. This process is known as molting.

## Research time

---

Draw the same table and fill information about amphibians and reptiles. Find information about them from books and internet.

## Terminology

---

- abdomen - құрсақ / брюшко;
- segmented - бөлшектенген / сегментированный;
- cephalothorax - баскөкірек / головогрудь;
- limbs - қол-аяқ / конечности;
- molting - түлеу / линька;
- thorax - көкірек / грудь.



# Problems

## Test questions with one right answer

1. What makes gymnosperm different from angiosperm?

- A) lack of flower
- B) presence of flower
- C) lack of leaves
- D) presence of root
- E) lack of root

2. Which pair of following terms are suitable for next sentence:

Thin filaments which are called \_\_\_\_\_ grow, branches and form\_\_\_\_\_.

- A) root, mycelium
- B) hyphae, mycelium
- C) mycelium, root
- D) mycelium, hyphae
- E) root, hyphae

3. What is the function of fruit?

- A) to give food and to protect seeds

- B) to protect leaves
- C) transport of nutrients
- D) transport of water
- E) to store waste products

4. Which part of dicots and monocots are different from each other?

- A) seed
- B) stem venation
- C) root
- D) petals number
- E) all of the above

### **Test questions with several (max 3) right answers**

1. Which of the following plants are members of angiosperms?

- A) pine-tree
- B) rose
- C) mosses
- D) ferns
- E) sunflower
- F) lily

G) juniper

H) spruce

2. What are the main difference between chordates and arthropods?

A) they have different skeleton structure

B) arthropods lack digestive system

C) arthropods are prokaryotes

D) chordates are unicellular

E) they have different limbs number

F) only chordates have circulatory system

G) they have different sense organs

H) they have different types of antennae

3. Which one of the following organisms are members of chordates?

A) butterfly

B) crocodile

C) fly

D) mosquito

E) fish

F) human

G) bee

H) spider

## Matching

1. Match group of organisms with examples:

1. fungi

2. arthropod

3. dicots

A) ferns, mosses

B) mushrooms, Penicillium

C) pine, fern

D) bee, crab

E) apple, orange

F) apple, lily

2. Which of the followings are examples of classes of arthropods?

1. Crustacea

2. Arachnids

3. Insecta

A) scorpion

B) crab

C) shark

- D) golden fish
- E) snake
- F) grasshopper

# CHAPTER 4.0

## Nutrition



# 4.1 DIGESTIVE SYSTEM

## You will:

---

- distinguish digestive systems of earthworm, cow and human.

## Key terms

---

Digestion - breaking down food into small particles;

Crop - an organ used for storing food;

Gizzard - an organ used for grinding food;

Stomach - saclike organ which stores and digests food.

## STQ

---

A human, a cow, and an earthworm have different digestive systems. How do these differences affect their feeding style?

## Facts

---

If you swallow food and hang upside down the food will not go back. Because of a wavelike process called peristalsis. The muscles in your esophagus contract and relax by pushing the food down to the stomach. Do not try to do this!

## Text

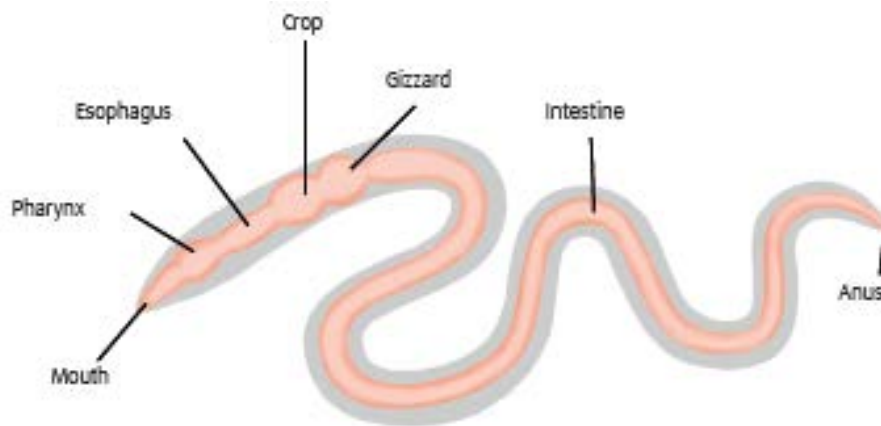
---

As we learned, food consists of different molecules. Some of these molecules are too big to enter our cells. They break down into small parts.

This process is called digestion.

In animals and humans, digestion occurs in several organs. These organs together make digestive system. Digestive organs differ in organisms.

Earthworm lives in soil and eats dead organisms. It takes in food with soil particles through the mouth. Food passes through pharynx and esophagus to crop. In crop, it is stored and moistened. Then food goes to gizzard, where it breaks down into smaller parts by the help of soil. These small parts are taken to cells in the intestine. Undigested food goes out with soil particles into the soil.



A cow eats plants that have cellulose in cells. Cellulose is hard compound and takes a long time to digest. That's why cows have long digestive tract.

It consists of 4 stomachs. Eaten food passes through an esophagus and first enters two stomachs: rumen and reticulum. Both have prokaryotes that help cow to digest

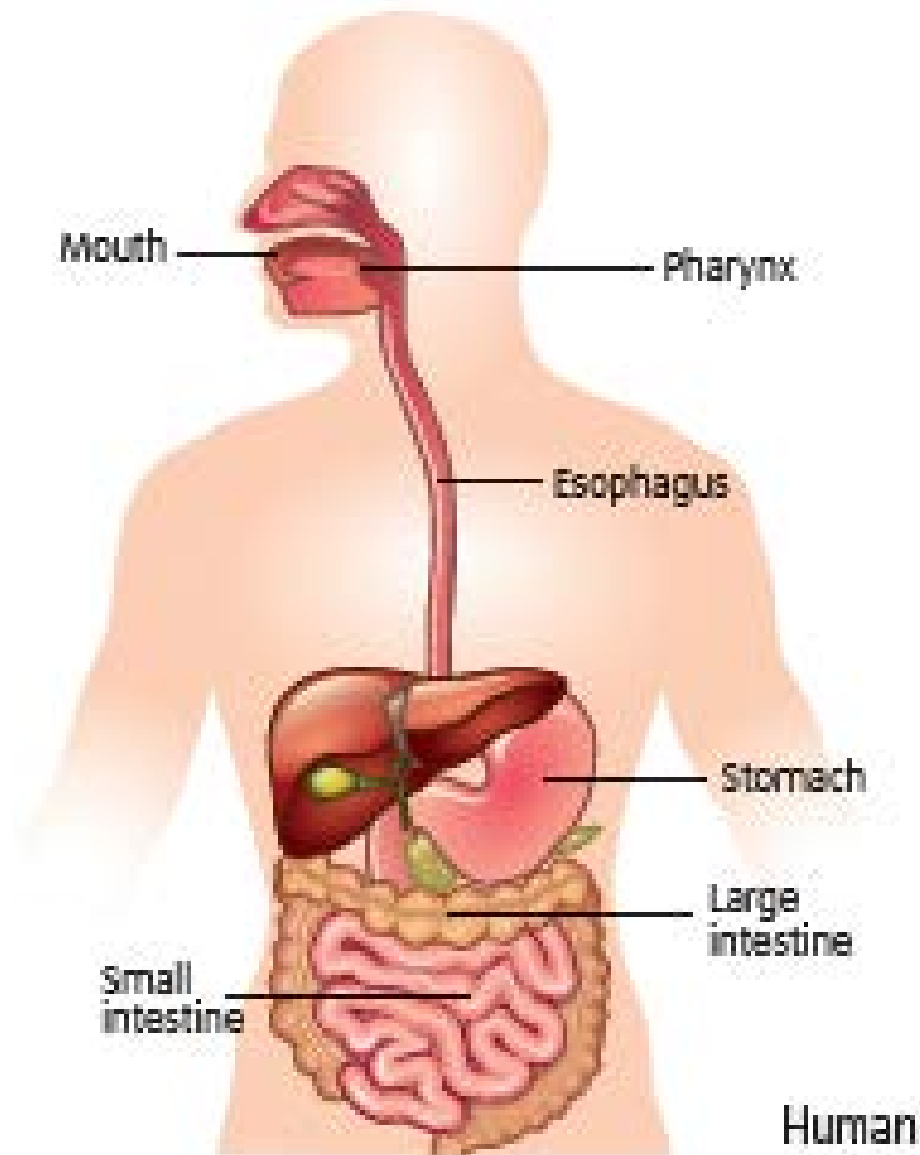


cellulose. Cow rechews food many times from these stomachs.

So, it looks like they are always chewing something even if there isn't any food. Later food is passed to next pair of stomachs: omasum and abomasum and digested there. Digested food is taken to cells in the small intestine.

In human, digestion starts in the mouth. Then food goes through the pharynx and pipe-like esophagus into the stomach. Unlike cows, we have only one stomach. Then food goes into small and large intestines.

Food is digested in stomach and small intestine. Blood takes digested materials in the small intestine.



## Research time

---

Construct the models of earthworm, cow and human digestive systems. Present your models and explain parts of the digestive systems to your classmates.

## Activity

---

Work in pairs!

1. Make 30 cards. On 15 cards write “cow” 8 times and “earthworm” 7 times. Put them into three columns on the left side.
  1. Write the organs of cow and earthworm on 15 cards. Put them into three columns on the right side.
  2. By taking cards from each side, match the organ with its organism. If they match, keep taking next cards. If they do not, give your turn to your classmate.
2. In next activity, put organs in the right order. Show it to your teacher.

## Literacy

---

1. Why does human body not have four stomachs like cows?
2. Why earthworms eat food with soil particles?
3. How do microorganisms help to digest food?

## Terminology

---

- abomasum - ұлтабар/ сычуг;
- crop - жемсау / зоб;
- earthworm - шұбалшаң / дождевой червь;
- esophagus - өңеш / пищевод;
- gizzard - бұлшықетті қарын (құстарда) / мускулистый желудок (у птиц);
- intestine - ішек / кишечник;
- omasum - қатпаршақ/ книжка;
- pharynx - жұтқыншақ / глотка;
- to chew - шайнау / жевать;
- reticulum - жұмыршақ/ сетка;
- rumen - месқарын/ рубец;

- stomach - асқазан / желудок;
- to contract - жиырылу / сокращаться;
- to swallow - жұту / глотать.

## 4.2 STRUCTURE, FUNCTION AND HYGIENE OF TEETH

### You will:

---

- learn different teeth types and how to take care of your teeth.

### STQ

---

Dentists tell you to brush your teeth twice a day. Why is it important?

### Key terms

---

Milk teeth - temporary teeth of a young mammal which fall out as the permanent teeth emerge;

Permanent teeth - the second set of teeth in mammals that grow as the milk teeth are shed.

### Facts

---

Unlike humans, sharks have 40 sets of teeth. Giraffe has only lower teeth, and the largest mammal blue whale has no teeth.

### Text

---

Digestion starts in our mouth where teeth cut and break down food into smaller pieces.

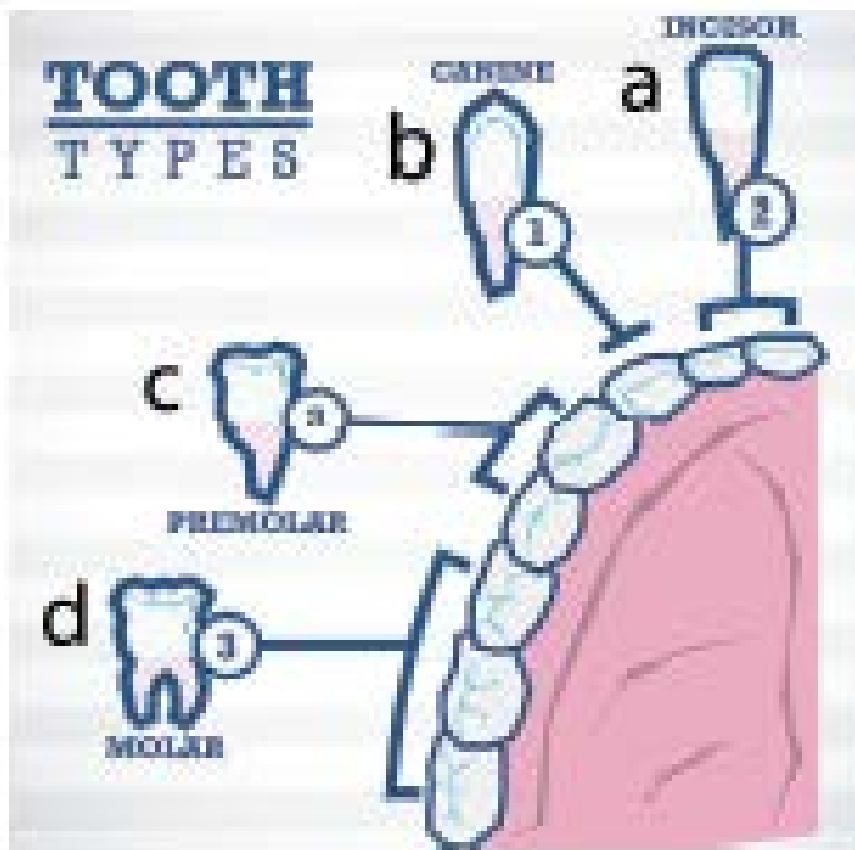
A tooth is covered with enamel. It protects the teeth from bacteria and damage. Enamel is the hardest material of the human body. There is dentin under the enamel. Under dentin, there is a pulp cavity. Pulp cavity has nerves and blood vessels.

Human has two sets of teeth. The first set is known as milk teeth. They start growing one by one when the baby is six months old. By 30 months most children have 20 milk teeth.

The second set is permanent teeth. Milk teeth start to drop from the age 7, and new teeth grow. By 8 years most people have permanent teeth. By 17 years most people have full-mouth of permanent teeth. An adult human has about 28-32 permanent teeth.

In the adult human mouth, there are four different types of teeth.

- a. Incisors bite and cut food.
- b. Canines rip and tear food apart. They are the sharpest.
- c. Premolars chew and grind food.
- d. Molars also chew and grind food.



## Research time

---

Teeth hygiene is important for our health and daily life. Food and drinks may damage our teeth. To see their effect do the following activity:

1. The shell of an egg has a structure similar to our teeth. Take five eggs and different drinks (coffee, juice, tea, water, coke) and five glasses.
2. Put eggs and drinks into glasses. Observe them with magnifying glass daily. Make observations for one week.
3. Write a report about your observations.

## Career

---

## Dentist

The dentist is a doctor who is specially trained to care for and treat teeth.

## Activity

---

A cavity may form anywhere on teeth including surface between them. Cleaning between teeth is called flossing. Do the following activity to understand its importance!

1. Take a glove and chocolate butter.
2. Wear a glove on the one hand and add chocolate butter to your fingers.
3. Close your fingers tightly and brush them with water.
4. Open fingers and look what is left between fingers. How effective is the flossing? Discuss it.

## Activity

---

1. Take a bite of an apple. Which teeth did you use for biting? What about for chewing?
2. Take another bite and use your incisors (front teeth) for chewing. How did you chew with your incisors?
3. Bite the apple using only your molars. Can you take a bite without incisors?
4. Write in one sentence what you have learned in this activity.

## Literacy

---

1. Which type of teeth are well developed in predators?
2. What happens when we do not brush our teeth?
3. Why there are more permanent teeth than milk teeth?



## Facts

---

Braces are used to treat jaw or tooth alignment problems.

## Terminology

---

- to bite - тістеу / кусать;
- canines - сойдақ тістер / клыки;
- dentine - дентин;
- enamel - тіс кіреукесі / эмаль;
- flossing - тіс арасын жіппен тазалау / чистка нитью между зубов;
- incisors - күрек тістер / резцы;
- molars - үлкен азу тіс / большие коренные зубы;
- premolars - кіші азу тістер / малые коренные зубы;
- pulp cavity - пульпа қуысы / полость пульпы;
- set - жиынтық / набор;
- to emerge - шығу / появляться, выходить;
- to shed - түсу / выпадать, сбрасывать.

## 4.3 DIGESTIVE ORGANS

### You will:

---

- understand the structure and functions of digestive system organs.

### Key terms

---

Salivary glands - glands which produce saliva;

Small intestine - narrow upper part of the intestine where digestion of food ends and absorption starts;

Large intestine - back part of the intestine that is wider and shorter than the small intestine.

### Facts

---

If we measure the area of small intestine it would be 0,6 m<sup>2</sup>. But the inner wall of intestine is folded with fingerlike structures called villi. When these villi are unfolded, actual area is 250 m<sup>2</sup>, which is same with a tennis court. These structures increase the surface area of small intestine to absorb more food at one time.

### STQ

---

The food that you eat reaches all cells in your body. What path does food take from the mouth to the cells?

### Text

---

Digestion starts in the oral cavity. There, teeth cut food into smaller pieces; tongue helps in tasting and mixing food. Salivary glands produce saliva. Saliva is a liquid. It starts digesting carbohydrates. Also, it kills bacteria.

Then, food goes to the pipelike esophagus. It does not digest food. Esophagus only transfers food from mouth to stomach.

The stomach is a large organ. Glands of stomach produce gastric juice. Gastric juice contains hydrochloric acid (HCl). This acid kills bacteria. Also, gastric juice digests proteins.

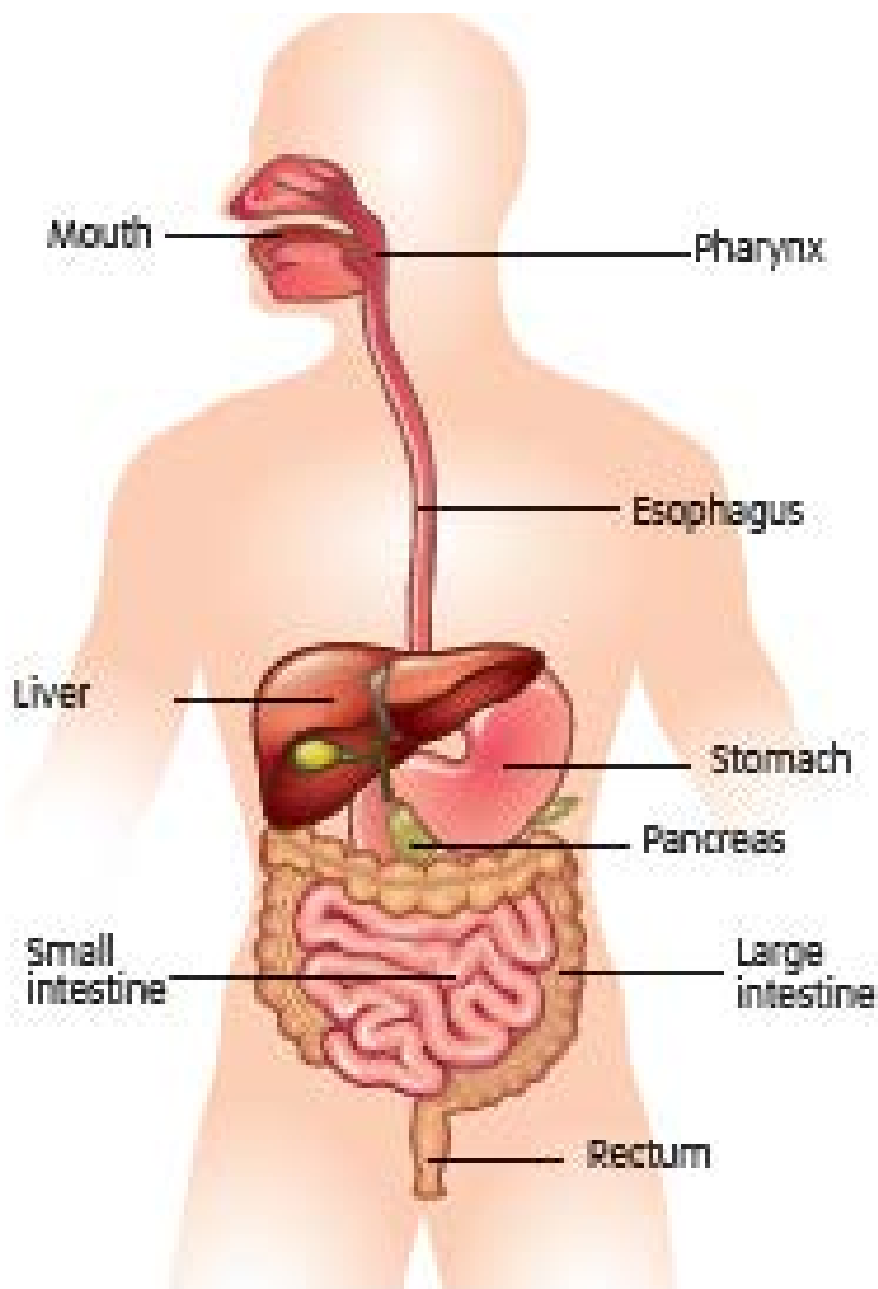
From stomach, food goes to small intestine. The small intestine is a long organ. It digests proteins, carbohydrates, and lipids. Also, it absorbs digested food. The liver helps intestine to digest food. It secretes bile into the intestine. Bile helps to digest lipids.

Also, there is an organ called pancreas. It secretes pancreatic juice into the intestine, which also helps in digestion.

From small intestine, food goes to large intestine. It does not digest food but absorbs water.

Undigested food is temporarily stored in the rectum and removed from the organism.

The inner lining of the small intestine has fingerlike projections called microvilli.



Human digestive organs

## Activity

---

Work in pairs. Measure and cut knitting threads according to the information in the table (length of digestive system organs). Use different colored threads for different digestive

organs. Then connect them and explain how food travels down digestive track.

Digestive organ	Length
Mouth	8 cm
Esophagus	25 cm
Stomach	15 cm
Small Intestine	4-6 m
Large Intestine	1.2 m

## Literacy

---

1. What is digested in the esophagus? Explain your answer.
2. The small intestine is longer than large intestine. Explain how it is related to their functions
3. If a person has problems with liver, he or she is advised not to eat fatty food. Explain why.

## Career

---

### Dietitian

Dietitians are qualified health professionals that diagnose and treat dietary and nutritional problems. Dietitians help both healthy and sick people to choose food and meals suitable for their lifestyles.

## Research time

---

Our stomach digests all food that we eat. The main ingredient of gastric juice is hydrochloric acid. This ingredient is highly acidic so that it can dissolve even metals. But how

this powerful acid doesn't digest the stomach itself? How does stomach stay undamaged from this acid? List at least two reasons.

## Terminology

---

- acidic - қышқылдық / кислый;
- bile - өт / желчь;
- fold - қатпар / складка;
- gastric juice - қарын сөлі / желудочный сок;
- large intestine - тоқ ішек / толстый кишечник;
- liver - бауыр / печень;
- micorvilli - ұсақбүрлер /микроворсинки;
- pancreas - ұйқы безі / поджелудочная железа;
- projection - өскін / вырост;
- rectum - тік ішек / прямая кишка;
- saliva - сілекей / слюна;
- small intestine - аш ішек / тонкая кишка;
- to transfer - тасымалдау / перевозить;
- villi - бүрлер / ворсинки.

## 4.4 PREVENTION OF GASTROINTESTINAL DISEASES

### You will:

---

- learn causes of gastroenteric diseases.

### Key terms

---

Food poisoning - becoming ill after eating spoiled food;

Nausea - sickness of the stomach, an involuntary impulse to vomit;

Diarrhea - an intestinal disorder that causes waste products pass from your body frequently in a loose state.

### Career

---

A gastroenterologist is a doctor who diagnoses and treats diseases of the digestive system. Usually, they diagnose diseases using endoscope. It is a thin tubular structure that is used to look at digestive organs with its camera. Patients swallow it, and doctors look inside to make the right diagnosis.

### STQ

---

Why we don't eat spoiled food?

## Text

---

Eating spoiled food can cause food poisoning. If you eat spoiled food, you should take the food out. You should drink warm water and try to vomit.

If we do not wash fruits and vegetables before eating, harmful microorganisms can enter our body (with the food). These microorganisms can cause diseases like cholera, typhoid, and dysentery.

Also, if you do not wash your food properly, or if you eat raw meat, parasitic worms can enter your body. These worms cause stomachache and nausea.

Gastroenteric diseases cause stomachache pain, headache, fever, malaise, vomiting and diarrhea Regularly wash your hands, dishes and food surfaces with warm water before and after handling or preparing food. Remember to clean under fingernails and use soap. Always wash raw foods like fruits and vegetables.

Cook food at a safe temperature. We can kill harmful organisms in most foods by cooking food to the right temperature.

According to its type, food should be stored in a refrigerator or a fridge. For example, risky foods such as milk, dairy products, and fish should never be left at room temperature.

Respect 'Best before' or 'Use by' dates. Some foods display dates by which they should be used. When these dates have passed the food are no longer fresh.

Do not taste food if you are not sure. Even if it looks and smells fine, it may not be safe to eat. Food left at room



temperature for too long may contain bacteria.

## Activity

---

According to the article below, a group of students had a picnic in Mashat Canyon. They took salads and other food from home but forgot to take drinking water. So they used the water from the river. Students had a great time at the canyon. But when they came back in the evening, most of the students felt sick. They had pain in stomach with nausea or vomit, headache, and fever. All of them went to the hospital by ambulance. Now imagine that you are a doctor of those patients and answer following questions:

1. What is their problem? What did cause that problem? Show reasons for a problem related to water, fruits, and food. How will you treat them?
2. Write your recommendations for picnic preparation.

## Literacy

---

1. It is advised to wash hands before and after a meal. Why washing hands after the meal is necessary?
2. Why is it advised to vomit after food poisoning?
3. Why does human become weak during food poisoning?

## Facts

---

Bacteria spores survived on poorly preserved, or canned foods produce toxin. This toxin causes poisoning and muscle paralysis. This illness is called botulism.

## Research time

---

Choose one gastroenteric disease (except food poisoning) and make a poster. The poster should include causes, symptoms, and treatments.

## Terminology

---

- cholera - тырысқақ / холера;
- dysentery - қантышқақ / дизентерия;
- fever - безгек, қалтырау / лихорадка;
- gastroenteric diseases - асқазан-ішек аурулары / желудочно-кишечные заболевания;
- headache - бас ауру / головная боль;
- nausea - лоқсу / тошнота;
- raw meat - шикі ет / сырое мясо;
- spoiled - бүлінген, бұзылған / испорченный;
- to treat - емдеу / лечить;
- typhoid - іш сүзегі / брюшной тиф;
- vomit - құсу / рвота.

## 4.5 VITAMINS

---

### You will

---

- learn the importance of vitamins and healthy products.

### Key terms

---

Vitamin - organic molecule essential for body processes;  
Avitaminosis - total deficiency of one or more vitamins;

Hypovitaminosis - deficiency of one or more vitamins;

Hypervitaminosis -excess amount of intake of one or more vitamins.

### STQ

---

Why doctors recommend vegetables and fruits instead of chocolate and candies?

### Research time

---

Choose one avitaminosis disease and find it's picture of its symptoms.

---

Bring picture to the class and ask your classmates to guess it. Start like this "If you do not have a vitamin \_\_\_\_\_, you will have following symptoms" and show the picture.

### Text

---

Vitamins are organic molecules. They are important for human body processes. If there are not enough vitamins, a human becomes ill.

Our organism cannot produce most of the vitamins. People take them with food. We name vitamins by alphabet letters: A, B, C, D, etc. There are two classes of vitamins:

1. Lipid-soluble vitamins do not dissolve in water. Examples, A and D.
2. Water-soluble vitamins dissolve in water. Examples: B and C.

We need vitamins every day. When we do not take vitamins for a long time, we have avitaminosis disease. When we have less than normal amount of vitamins, we have hypovitaminosis. Taking too many vitamins is also harmful. It causes hypervitaminosis.

Vitamin	Avitaminosis disease	Symptoms	Daily intake
A	Night blindness	weak vision in dim light, slow vision adaption between bright and dim light conditions	800 mg
B	Beriberi	weight loss, emotional disorder, weakness and pain in the limbs, rapid heart rate	1.4 mg
C	Scurvy	weakness, feeling tired, poor weight gain, damaged gum and loss of teeth	60 mg
D	Rickets	soft bones and teeth	5 mg

## Labwork

---

### Pre-lab questions:

1. What is the function of vitamin C?
2. What kind of food products have high amount of vitamin C?

### **Methods and materials:**

Water, test-tubes, test-tube rack, plastic pipettes (one for each juice), 10 x 10 cm piece of white card as a background, Iodine solution, starch, eye protection, fruit juices to test (orange juice from a market, orange, lemon, etc.).

### **Procedures:**

1. To prepare starch solution put two teaspoons of starch into a glass of cold water and mix.
2. Add 10 ml of starch solution into a test tube.
3. Add one drop of iodine solution. A blue-black color will appear.
4. Hold the white card behind the test-tube.
5. Keep the white card in place - add the juice drop by drop. COUNT THE DROP NUMBER.
6. Stop after every five drops to shake the tube.
7. Keep adding juice until the blue-black color has gone. COUNT THE DROP NUMBER.
8. Keep the first test-tube so you can compare with others.
9. Test all juices in the same way.

### **Results:**

1. Write experiment results into the table below.

Fruit juice or other drink	Number of drops
Orange juice from market	
Squeezed orange juice	
Squeezed lemon juice	
Other drink	

## Important info

1. Iodine may react both with starch and vitamin C, but if vitamin C and starch are found in the same solution iodine reacts with vitamin C first and then with the starch.

## Post-lab questions:

1. Which products have the highest and lowest amounts of vitamin C? Explain your answer.
2. Do your results match with the information on the juice packaging?

## Terminology

---

- beriberi - бери бери ауруы / бери бери;
- healthy gum - сау тіс жиегі / здоровые десны;
- hypervitaminosis - витамин артықшылығы / гипervитаминоз;
- hypovitaminosis - витамин жетіспеушілігі / гиповитаминоз;
- lipid-soluble - майда еритін / жирорастворимый;
- rickets - мешел ауруы / рахит;
- scurvy - цинга;
- water-soluble - суда еритін / водорастворимый.

# Problems

## Test questions with one right answer

1. The process in which your esophagus muscles relax and contract by pushing the food into your stomach.

- A) digestion
- B) metabolism
- C) peristalsis
- D) chewing
- E) absorption

2. Organ of the digestive system which is used for grinding food:

- A) stomach
- B) esophagus
- C) intestine
- D) crop
- E) gizzard

3. Part of the tooth that protects it from the bacteria and contain calcium:

- A) pulp
- B) root canal

C) neck of the tooth

D) gingiva

E) enamel

4. The tool of a gastroenterologist:

A) endoscope

B) hummer

C) blood pressure meter

D) stethoscope

E) thermometer

### **Test questions with several (max 3) right answers**

1. Choose food poisoning prevention rules:

A) brushing teeth

B) washing hands before and after the meal

C) taking the shower

D) cooking food in the safe temperature

E) drinking any water

F) respect “best before” or “used by” dates

G) keeping food in room temperature

H) using one dish over and over without washing



2. False about small intestine:

- A) digests carbohydrates
- B) digests lipids
- C) digests proteins
- D) produces saliva
- E) has villi
- F) absorbs digested food
- G) removes wates
- H) produces HCl acid

3. Digestive organs common for a cow, human and earthworm:

- A) intestine
- B) crop
- C) esophagus
- D) stomach
- E) rumen
- F) pharynx
- G) gizzard
- H) teeth

## Matching

1. Match organs with functions:

1. large intestine

2. teeth

3. esophagus

A) produce gastric juice

B) produce bile

C) absorb water

D) breaks down large part of the food

E) digest carbohydrates

F) transport food into the stomach

2. Match organism with unique digestive organs structure:

1. cow

2. earthworm

3. human

A) gizzard

B) intestine

C) canines

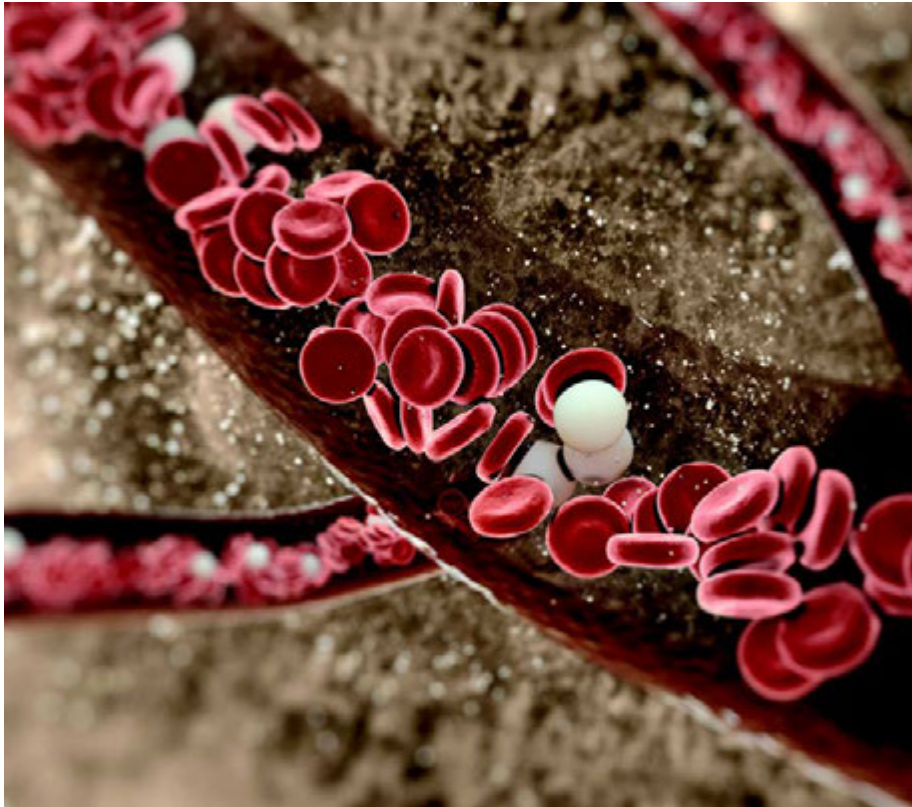
D) small intestine

E) 4 stomachs

F) teeth

# CHAPTER 5.0

## Material transport



# 5.1 LYMPHATIC SYSTEM

## You will:

---

- describe the lymphatic system and the relationship between the blood and tissue fluid and lymph.

## Key terms

---

Lymph - the fluid that circulates through lymphatic system;

Lymphatic system - network of tissues and organs that help the body to get rid of toxins, waste and other unwanted materials;

Tissue fluid - fluid between cells.

## Facts

---

It is interesting to know that unlike blood circulatory system, your lymphatic system does not possess any pumping organ for the movement of lymph through its network of channels.

## STQ

---

Why is edema formed in our body?

## Text

---

The lymphatic system is closely associated with the circulatory system. It has 3-basic functions:

- Transportation of excess body fluid to the bloodstream;
- Protection of body against disease-causing agents;
- Absorption of fats from the small intestine.

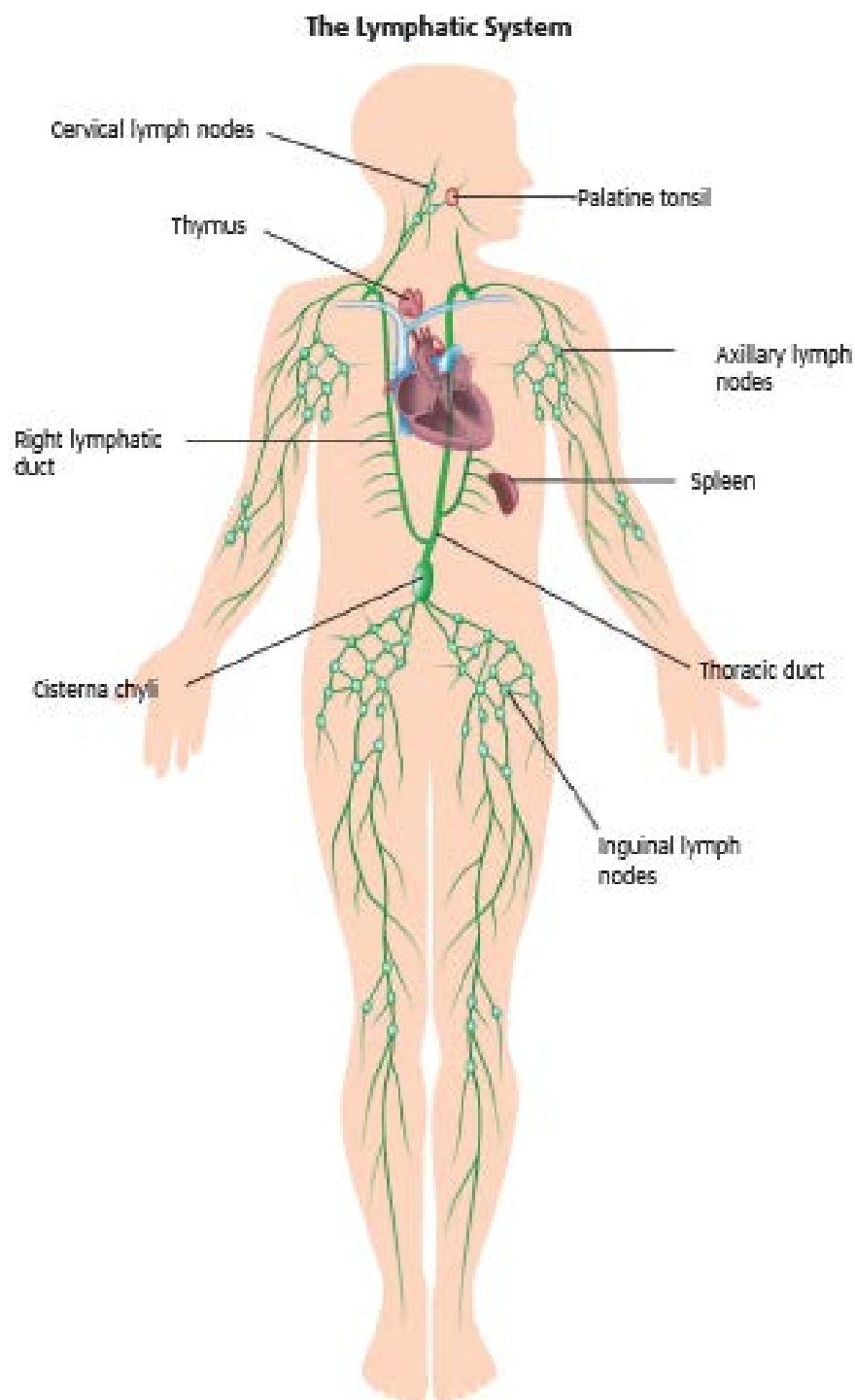
Like your circulatory system, the lymphatic system has a network of vessels that circulate fluids. It transports excess fluid leaving from capillaries back to the bloodstream. So lymphatic system prevents fluid accumulation in the tissues. Diseases of the lymphatic system are very dangerous. Find some examples. The lymphatic system plays an important role in the regulation of body fluid homeostasis. If the lymphatic system does not work, tissue fluids accumulate in interstitial spaces. This condition is called as edema. Why are they so dangerous?

The lymphatic pathway begins as lymphatic capillaries; these microscopic close-ended tubes merge to form larger lymphatic vessels. Lymphatic vessels are similar to veins but thinner. Like veins, they have valves that help prevent lymph backflow. Large lymphatic vessels lead to specialized organs called lymph nodes. Finally, larger vessels join with veins of the circulatory system in the thorax.

The lymphatic system is also home to pathogen-fighting cells. Lymph nodes work like filters to remove pathogens that could make you sick.

Lymph nodes are located along the lymphatic pathway. They have a large number of lymphocytes that fight invading microbes. Normally, lymph nodes are small and round, and you do not notice them. But when they're active they get larger (like tonsils located in the neck), it means your immune system is working.

After digestion of nutrients, their monomers are passed from the small intestine into the capillary vessels. But the pathways of lipid monomers are different; lymphatic capillaries absorb them.



## Activity

---

Create a life-sized drawing of the lymphatic system. Start by getting a large piece of bulletin board paper or butcher paper in any light color. Lie down on the paper and have a partner trace your body's outline in pencil.

Use a dark-colored marker, crayon or paint to draw in and label the lymph nodes and lymphatic vessels located all over the body. Note how lymph nodes vary in size.

## Literacy

---

1. What is the function of lymph?
2. What is the difference between blood and lymph?
3. Which cells are present in the lymphatic system?

## Facts

---

**A One Way Street** Unlike blood, which the circulatory system allows the flow through the body in a continuous loop, the lymph fluid superhighway will only flow in one direction. It flows upwards towards the neck within its own system.

## Terminology

---

- edema - ісіну / отёк;
- absorption - сіңіру / всасывание, абсорбция;
- lymph - лимфа;
- valve - қақпақша / клапан;
- backflow - кері ағын / обратное течение;
- lymph nodes - лимфа түйіндері / лимфоузлы;

- tonsil - көмегей безі / миндалина.



## 5.2 BLOOD AND ITS FUNCTIONS

### You will:

---

- understand the functions and structure of blood;

### STQ

---

Why doctors analyze the blood of a patient who has symptoms like vomiting, stomachache, diarrhea, etc.?

### Key terms

---

Blood is a body fluid which delivers needed substances to organs;

Plasma is the liquid part of blood, which contains water and nutrients;

Anemia is when a human has a low number of erythrocytes.

### Facts

---

Blood color depends on proteins it uses to carry oxygen.

Red color - hemoglobin: human and the majority of vertebrates.

Blue - hemocyanin: spiders, crustaceans, some mollusks, octopus, and squid.

Green - Chlorocruorin: some segmented worms, some leeches, some marine worms.

Violet - haemerythrin: marine worms including peanut worms and brachiopods

## TEXT

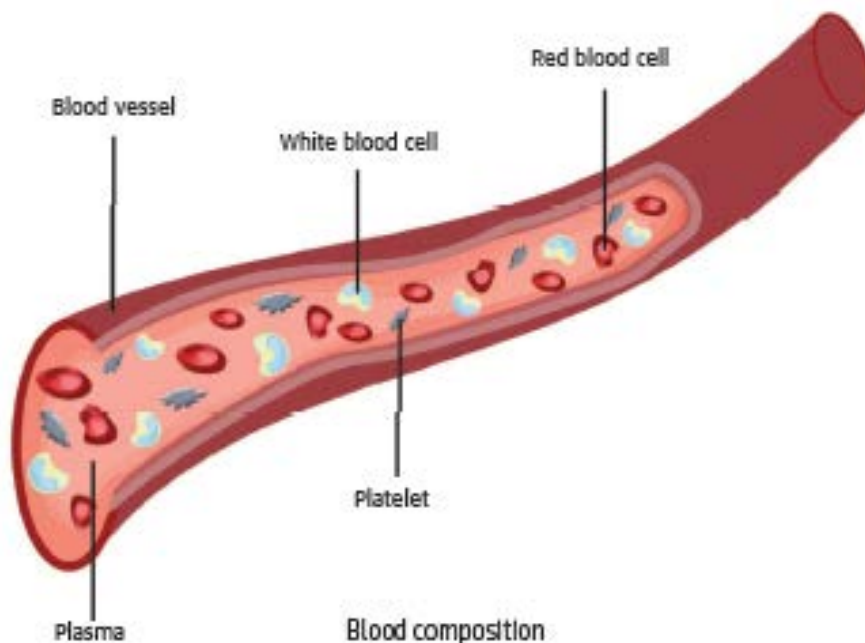
---

Blood is a fluid which flows in our body through vessels. In an adult human body, there are about 5-5.5 liters of blood. Even though blood looks like a liquid, it is not fully liquid. It is composed of liquid part plasma and blood cells: erythrocytes, leukocytes, and platelets. 45% of blood are cells, 55% is plasma.

Blood has following functions:

1. Transport: blood transports important substances in human body.
  - hemoglobin transports oxygen in erythrocytes; carbon dioxide is transported mainly by plasma - minerals and nutrients such as glucose, amino acids and vitamins are transported from digestive organs to all parts of the body - hormones that are secreted by special organs in the body are transported to target tissues and cells
  - waste materials from cells are transported to excretory organs
2. Maintaining balance: blood helps maintain internal balance by regulating pH, water, and temperature levels.
3. Defense: leucocytes destroy invading viruses, bacteria and other foreign substances in the blood.

Clotting: during injury, blood loss is prevented due to the platelets. Blood has clotting capability.



## Activity

---

Imagine you are a doctor. Almas comes to you and says he feels sick. He has weakness and pale skin. You tell him to test his blood. On the picture, you have his blood analysis. What do you think of his problem? Explain your answer.

**BLOOD ANALYSIS REPORT**

Astana city hospital #1  
Koshkarbayev street, 66, 010000, Astana, Kazakhstan

**LABORATORY REPORT**

Name Almas Ospanov Patient ID PAC001  
Date 11/11/2017 8:32 Age 13  
Doctor Dauren Samatov Gender Male

**COMPLETE BLOOD COUNT**

Test name	Result	Normal range	Units
Hemoglobin	9	11.0-16.0	g/dL
Red blood cells	2	3.5-5.5	10 <sup>6</sup> /uL
White blood cells	6.7	4.5-11	10 <sup>3</sup> /uL
Platelets	256	150-450	10 <sup>3</sup> /uL

Digitally signed by  
*Dr. Dauren Samatov*

## Research time

---

When we have a low number of erythrocytes, it is called anemia. It causes problems with oxygen transportation. Because of this, we feel weak and dizzy. Also, our skin becomes pale. Every third person in Kazakhstan has anemia. Think about how anemia might be cured.

## Literacy

---

1. If there is not enough iron element in your food, what will happen to your body? Explain your answer.
2. Imagine you work in a hospital. You take a blood analysis report of a patient. How can you understand if he is sick? Explain your answer.
3. You ate an apple today. Which part of blood carries nutrients to your organs? Explain your answer.

## Terminology

---

- anemia – қаназдық / анемия;
- erythrocyte – эритроцит;
- hemoglobin – гемоглобин;
- homeostasis – гомеостаз;
- leukocyte – лейкоцит;
- nutrients – қоректік заттар / питательные вещества;
- plasma – плазма;
- platelet – тромбоцит;
- range – диапазон, көлем / диапазон, область.

## 5.3 BLOOD CELLS

### You will:

---

- investigate features of blood cells of different organisms.

### Key terms

---

Erythrocytes -are red blood cells, which carry oxygen;

Leukocytes - are white blood cells, which protect the organism; Platelets - are blood cells, which stop bleeding.

### Facts

---

Human blood contains metallic atoms including iron, chromium, manganese, zinc, lead, and copper. You may also be surprised to know that blood contains small amounts of gold. The human body has about 0.2 milligrams of gold that is mostly found in the blood.

### Text

---

There are three types of blood cells in human body. They are erythrocytes, leukocytes, and platelets.

Erythrocytes are red blood cells. They have flat round shape (disk shape). There are approximately 5 million erythrocytes in 1 mm<sup>3</sup> (1 ml) of blood. They contain a protein called hemoglobin, which carries oxygen from lungs to the organs.

Leukocytes are white blood cells. They have an irregular shape. Leukocytes protect the body from pathogens and infectious diseases. Some leukocytes of a healthy adult are between 4500 and 11000 in 1 mm<sup>3</sup>. This number changes during the day.

Platelets are also known as thrombocytes. They are blood cells, which help stop bleeding by blood clotting. In 1 mm<sup>3</sup> of blood, there are approximately 250000 platelets.

## Lab works

---

### Blood cell forms

#### Pre-lab questions:

1. What is the function of erythrocytes, leukocytes, and platelets?
2. What is the difference in structure between human and frog blood cells?

#### Methods and Materials:

Micro preparations of human and frog blood cells, microscope.

#### Procedures:

1. Observe the cells under the microscope.
2. Draw pictures of human and frog blood cells into the table below and compare them.

#### Results:

Organism	Cell	Picture
Human	Erythrocytes	
	Leukocytes	
	Platelets	
Frog	Erythrocytes	
	Leukocytes	
	Platelets	

## Post-lab questions:

---

1. What is the difference in forms between erythrocytes, Erythrocytes, leukocytes, and platelets platelets, and leukocytes?
2. What is the difference in forms between human and frog blood cells?
3. Why are blood cells of human and frog different?

## Facts

---

Unlike other types of cells in the body, mature red blood cells do not contain a nucleus, mitochondria, or ribosomes. The absence of these cell structures leaves room for the hundreds of millions of hemoglobin molecules found in red blood cells.

## Research time

---

Erythrocytes, leukocytes, and platelets have different forms. Use play dough and construct blood cells. Show your cells on the next lesson and explain how their forms help to do their functions.



## Terminology

---

- to bleed - қансырау, қанау / кровоточить;
- blood clotting - қан ұюы / свертывание крови;
- iron - темір / железо;
- lead - қорғасын / свинец;
- mature - жетілген / зрелый;
- pathogen - ауру туғызатын / возбудитель болезни;

## 5.4 IMMUNITY. HUMORAL AND CELL-MEDIATED IMMUNITY

### You will:

---

- characterize the functions of different types of leukocytes; - compare humoral and cellular immunity.

### Key terms

---

Phagocytes are leukocytes, which digest viruses and bacteria;

B cells are leukocytes that provide humoral immunity;

T cells are leukocytes that provide cell-mediated immunity.

### Facts

---

An allergy is the immune system getting things wrong. An allergy is caused when the body overreacts to an allergen that it really should ignore. The immune system goes into overdrive when exposed to allergens, such as pollen, nuts or animal fur and produces the side effects of watery eyes, headaches, and swelling.

### STQ

---

How does your body protect itself against infections? Have you ever wondered how your body protects itself from getting sick?

## TEXT

---

As you know, every country, such as Kazakhstan, has security forces (army and police) to defend their people against external and internal enemies. In the same way, your body has special defense mechanism called immune system. This defense system attacks and destroys pathogens. A pathogen is a disease-causing agent, such as bacteria and virus.

The immune system is a team of organs, tissues, and cells that work together to keep your body healthy. It works better; if you eat healthy food and do exercises.

White blood cells, also called leukocytes are part of this defense system.

There are several types of fighting cells. The main two types are:

1. Phagocytes which digest invading pathogens
2. Bacteria
2. Lymphocytes which allow the body to remember and recognize pathogens. There are two types of lymphocytes which are named as B lymphocytes and T lymphocytes.
  - B Lymphocytes produce enormous numbers of special proteins called antibodies that are carried by body fluid. They specifically react with a foreign antigen. This type of response is called antibody-mediated immunity or humoral immunity.
  - T lymphocytes directly attach to kill the foreign invader, such as bacteria. This direct cell-to-cell contact is named cell-mediated immunity

Leukocytes are found in lots of places in your body, including your spleen, an organ in your belly that filters blood and helps fight infections. Like other 51 blood cells, leukocytes are produced in the red bone marrow.

## Research time

---

You have a sniffle and cough. It seems like you are becoming ill. You seem to be short on white blood cells.

Write a help wanted ad on the paper, so you can hire some more leukocytes to help you healthy.

Take a look at some ads from a newspaper or the Internet to get ideas.

- Job description (what white blood cells have to do the job)
- Qualifications (skills that white blood cells need to have)
- Benefits (what cells will get for doing a good job)

## Facts

---

Your Immune System Can Be Self-Destructive. This happens when you develop autoimmune disorders. Crohn's disease and rheumatoid arthritis are two common autoimmune disorders in which the immune system destroys its healthy tissues. This happens when white blood cells fail to make a difference between disease-causing pathogens and the body's normal cells.

## Activity

Work in groups. Each group should show a sketch of functions of different leukocytes. Notice the differences

between different leukocytes and try to guess which group is showing.

## Literacy

---

1. What is the difference between B cells and T cells?
2. What should we do to increase immunity?
3. What is the function of phagocytes?

## Terminology

---

- bone marrow - сүйек кемігі / костный мозг;
- humoral immunity - гуморальдық иммунитет / гуморальный иммунитет;
- to invade - басып кіру / вторгаться;
- lymphocyte - лимфоцит;
- phagocyte - фагоцит;
- to recognise - тану / распознавать;
- spleen - қөкбауыр / селезенка;
- cell-mediated immunity - жасушалық иммунитет / клеточный иммунитет.

## 5.5 INFECTIOUS DISEASES

### You will:

---

- learn the features of infectious diseases;
- understand the prevention and treatment of infectious diseases.

### STQ

---

Why do doctors suggest wearing a mask to prevent the spreading of flu?

### Key terms

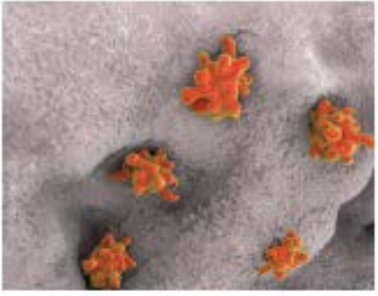
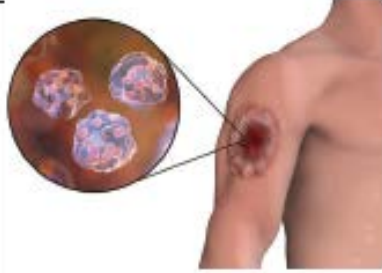

---




Infectious disease - a disease which spreads quickly between organisms.

### Text

---

Many diseases of human, animals, and plants are caused by microorganisms such as fungi, bacteria, virus or protists. Microorganisms can infect vital organs and lead to problems in body functions. Diseases become infectious when they spread quickly among organisms. It is important to learn ways of their prevention to avoid getting infected with them. Some diseases caused by microorganisms.

<p><b>PROTIST</b></p>		<p>Amoebic dysentery is a disease caused by <i>Entamoeba histolytica</i> that results in bloody diarrhea and abdominal pain. Entamoeba parasite invading intestine is shown in the image.</p>
		<p>A protist called Leishmania causes leishmaniasis. Symptoms are skin ulcers, fever, low red blood cells, enlargement of spleen and liver. It is spread by the bite of the sand fly. Patients are given antibiotics.</p>
<p><b>FUNGI</b></p>		<p>Late blight (potato blight) is caused by a kind of water mold. It destroys tomato and potato plants. Infected plants may rot within two weeks. It caused famine in the history.</p>

<p><b>VIRUS</b></p>		<p>Herpes caused by a virus. Symptoms are cold sores on the face, mouth, throats, and genitals. Spread by the direct contact with body fluids. Patients are treated with antiviral medicine.</p>
<p><b>BACTERIA</b></p>		<p>Cholera caused by bacteria. Symptoms are diarrhea vomiting and muscle cramps. it is spread by contaminated water and food. Patients must be given water or slight sweat and salty solutions due to the water and mineral loss from the body by diarrhea. Antibiotic are also used.</p>
		<p>Diphtheria caused by bacteria symptoms are a sore throat, fever, cough. it is spread by direct contact between people or by air. Patients are given antibiotics.</p>

## Facts

---

African trypanosomiasis is a disease caused by microscopic *Trypanosoma* parasites. It is transmitted by the tsetse fly which is mostly found in subSaharan Africa. It gets its nickname 'sleeping sickness' because symptoms can include a disturbed sleep pattern. Sleeping sickness is curable with medication but is fatal if left untreated.



## Facts

---

Canker sores develop in the mouth as small white or yellow wounds with a red border. It can be found on the tongue, inside cheek areas, lips, gum line and throat area.

This inflamed tissue is caused by bacteria and gives discomfort or pain while talking, brushing your teeth, or eating. Regularly brushing and flossing teeth can help to prevent canker sore.

## Activity

---

Imagine that you are a microorganism detective. Choose one disease from the table, and make a poster about it. In the poster give information about microorganism causing this disease. What can be done to prevent the spreading of this disease? Make a prevention strategy and present it to the class.

## Literacy

---

1. Is there any relationship between hygiene and preventing infectious diseases? Explain your answer with examples.
2. Which of the illnesses have you studied in this chapter is the most common in your country?
3. Why is it advised to change your medical face mask every 2 hours?

## Terminology

---

- abdominal - құрсақ, қарын / брюшной;
- canker sore - жара, ойық жара / язвенная болезнь;

- cholera - тырысқақ / холера;
- contaminated - кірленген / загрязненный;
- cough - жөтел / кашель;
- diphtheria - күл ауруы / дифтерия;
- fever - безгек / лихорадка;
- late blight - фитофтороз;
- rot - гнить / шіру;
- skin ulcers - тері жарасы / язва кожи;
- spleen - көкбауыр / селезенка;
- spread - тарау / распространяться.

## 5.6 IMMUNITY, TYPES OF IMMUNITY

### You will:

---

- assess the role of vaccination in the prevention of diseases.

### STQ

---

How does your body gain immunity?

### Key terms

---

Active immunity is immunity in an organism resulting from its own production of antibody or lymphocytes;

Passive immunity is immunity resulting from the injection of antibodies or lymphocytes from another organism.

### Facts

---

There is no cure for HIV/AIDS; antiretroviral drugs can only improve and strengthen the patient's immune system, not cure the disease.

### Text

---

Your body gains immunity by two main ways:

## **Active immunity**

In active immunity, the body produces its own antibodies against pathogen or antigens. Your body uses two ways for the developing of active immunity: -naturally: when a person is infected with a pathogen, the immune system fights against pathogen and produces antibodies; -artificially: when the person is vaccinated.

## **Passive immunity**

In passive immunity, the body does not produce its own antibodies. Ready antibodies can be taken from a person who recovered from the illness or passed from mother to baby through the milk during breastfeeding.

## **Vaccine**

A vaccine is a substance made up of weakened, dead, or some incomplete parts of pathogens. When injected, the vaccine causes an immune response, so body acts like it is infected and produces antibodies.

## **Types of vaccines**

Different processes make vaccines. Vaccines may contain:

- Weakened live viruses which cannot make illness.
- Killed microorganisms or viruses
- Inactivated toxic substances
- Small parts of a pathogens

## **Research time**

---

Write a report about which immunity is more effective active or passive.

## Facts

---

In the past 60 years, vaccines helped eradicate one disease (smallpox) and close to eradicating another (polio).

## Activity

---

Think about advantages and disadvantages of mass vaccination. Divide into groups and prepare for a debate.

## Literacy

---

1. What is the difference between passive and active immunity?
2. What is artificial and natural immunity?
3. Which cells play a major role in immunity?

## Terminology

---

- injection - егу / инъекция
- artificial - жасанды / искусственный
- natural - табиғи / естественный
- breastfeeding - емізу / грудное вскармливание
- to recover - қалпына келтіру / восстанавливать
- to acquire - алу, иелену / приобретать
- collapses - жаппай күйреу / коллапс, разрушение
- to eradicate - түбінен жою / искоренять

## 5.7 BLOOD TYPES

### You will:

---

- explain the mechanism of agglutination and rhesus conflict.

### STQ

---

What makes our blood different from others?

### Key terms

---

Blood type is a class of human blood based on presence or absence of specific antigens; Rh factor is a specific antigen present on the surface of red blood cells;

Agglutination - clumping of red blood cells.

### Facts

---

After needing 13 liters of blood for surgery at the age of 13, a man named James Harrison pledged to donate blood once he turned 18. It was discovered that his blood contained a rare antigen which cured Rhesus disease. He has donated blood a record 1,000 times and saved 2,000,000 lives.

### Text

---

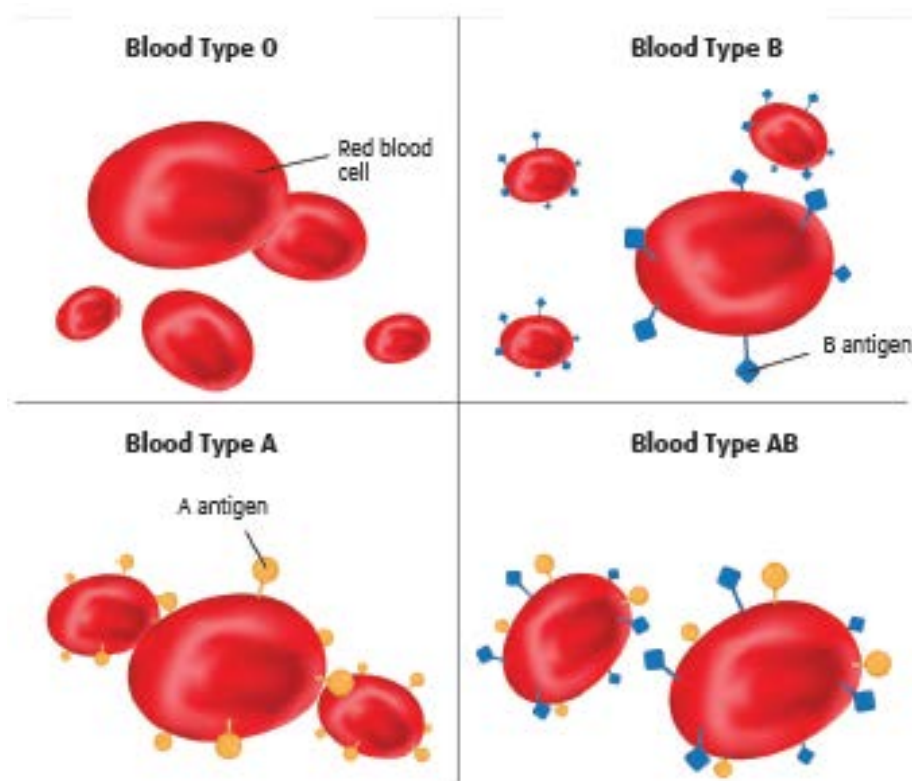
#### ABO system blood types

What makes one blood type different from another? A secret is hiding in the microscopic markers (also called antigens) on the surface of red blood cells (RBC).

Our body uses these antigens (special proteins and sugars) to know if the blood cells are from our own system or not.

After a blood transfusion, our body decides to accept or reject the new blood by examining these microscopic markers.

Based on the type of markers, there are four main blood groups: Type A Blood. This blood type has a marker known as “A”; Type B Blood. This blood type has a marker known as “B”; Type AB Blood. The blood cells of this type have both A and B markers; Type O Blood. This blood type has neither A or B markers.



## Rh factor:

Some people have another marker (marker D or Rh factor) on the RBC in their blood. People who have the Rh factor are Rh-positive. Those who do not have the Rh factor are Rh-negative.

Finally, the different markers found in blood make up eight possible blood types: A Rh+, A Rh-, B Rh+, B Rh-, AB Rh+, AB Rh-, O Rh+, O Rh-.

## Blood transfusion.

If a patient with A blood type is given B blood, the patient immune system will recognize B blood as an enemy and produce antibodies against B antigens on RBC. This process causes agglutination or clumping, of red blood cells. Agglutination can block small blood vessels, and this leads to organ damage and death.

Blood types	Antigens on red blood cells	Antibodies in plasma	Can receive blood from	Can donate blood to
A	A	Anti-B	O and A	A and AB
B	B	Anti-A	B and A	B and AB
AB	A and B	-	O, A, B, and AB	AB only
O	-	Anti-A and Anti-B	O only	O, A, B, and AB
Rh+	D or Rh	-	Rh+ and Rh-	Rh+ only
Rh-	-	Anti-Rh	Rh- only	RH- and Rh+

## Activity

---

Needed materials: 4 plastic cups, droppers, slides, red and blue food coloring, water.



Take four plastic cups and mark them as “O,” “A,” “B” and “AB”. Then put a few drops of red food coloring in the cup “A,” a few drops of blue food coloring in the cup “B,” and a few drops of each red and blue in the cup “AB.” Do not put any food coloring in the cup “O.” Fill cups about halfway with water. Now you have four different blood types.

Next, add a drop of one blood type to the clean slide. This will be the recipient’s blood, then put another blood type on that slide. This will be the donor’s blood. If the color in the slide does not change recipient can receive the blood from the donor. Do this for all blood types and fill the donor-recipient compatibility table.

## Literacy

---

1. Who can be a universal donor or recipient?
2. Why is it dangerous to give wrong blood type to a person?
3. What is your blood type? Which blood types can be given to you?

## Research time

---

Work in groups. Each of the students in the group should find their blood types by asking a school nurse. Then construct a chart using a table above who can donate blood to whom. Explain your answer.

## Terminology

---

- agglutination - агглютинация;
- antibody - антидене / антитело;
- antigen - антиген;
- clumping - жабысу / слипание;

- compatibility - үйлесімділік / совместимость;
- donor - донор;
- recipient - қан алушы / реципиент.

# 5.8 HEART AND BLOOD VESSELS

## You will:

---

- describe the structure of the heart and blood vessels in animals;
- establish the relationship between the structures of the walls of blood vessels and their functions.

## Key terms

---

Heart is a muscular organ, which pumps the blood;

Arteries are blood vessels that transport blood from the heart; Capillaries are blood vessels that connect arteries and veins;

Veins are blood vessels that transport blood to the heart.

## Text

---

The human circulatory system consists of heart and blood vessels. The heart pumps the blood and blood moves to organs through vessels.

The human heart is a muscular organ, which is located in the thoracic cavity of the organism. Human heart consists of four chambers: two ventricles and two atria. Valves divide ventricles and atria. These valves prevent blood from going back. Blood from atria moves to ventricles.

Ventricles pump blood out of the heart into organs. That is why ventricle walls are much stronger than atria walls.

From the heart, blood goes to blood vessels. There are three main types of blood vessels: arteries, capillaries, and veins.

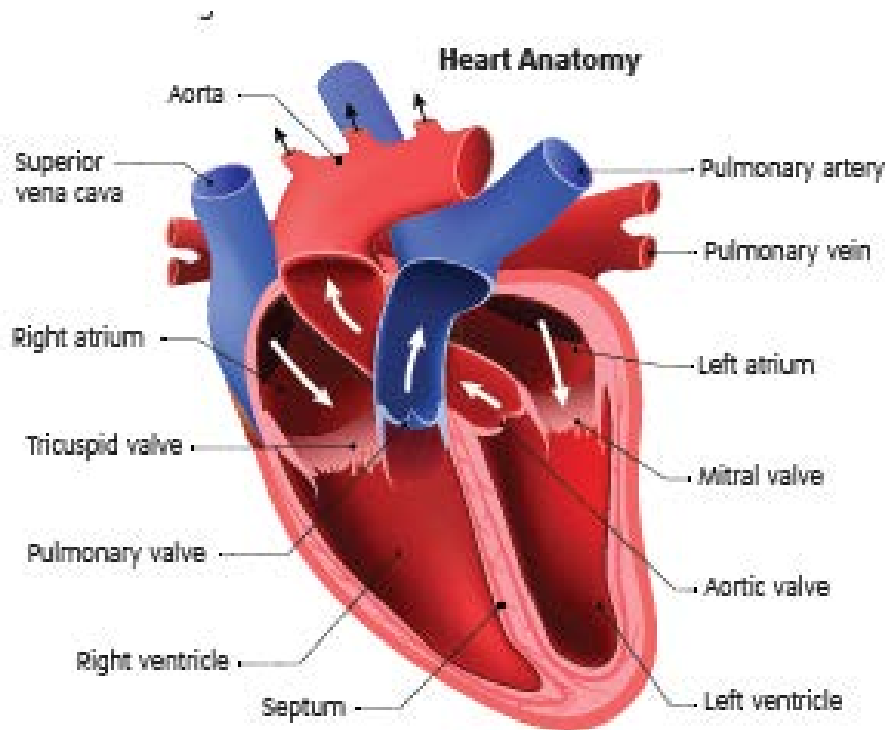
Vessels coming from the heart are called arteries, and those that come to the heart are called veins. The small network of capillaries connects arteries and veins.

Arteries have dense, smooth and elastic walls, an essential part of which are smooth muscles. The structure of the walls allows the arteries to withstand a great deal of pressure, under which blood goes out of the heart.

In the capillaries an exchange of gases and substances between the blood and tissues takes place. Walls of capillaries are very thin. It helps oxygen and nutrients enter the tissues and wastes go out of the tissues into the capillaries.

Capillaries merge into larger veins, the largest of which flow into the heart.

The walls of the veins are thinner than the walls of the arteries and the blood pressure in them is small. Veins contain valves, which prevent blood from going in opposite direction.



## Earthworm circulatory system.

An earthworm has a very small body. So, it does not have a heart. Instead of the heart earthworm has small blood vessels at the posterior end of the body. These vessels pump the blood through the body. Blood passes through two main blood vessels: dorsal and ventral. Crosspieces link them.

## Mollusks circulatory system

Mollusks are bigger than earthworms. So, they have a heart. It consists of one ventricle and one or two atria. Blood vessels pour blood into a body cavity, where blood interacts with organs and tissues. Then blood is collected into vessels again.

## Arthropods circulatory system

Arthropods have a tubular heart on their back. Their blood, also, does not always move through vessels. Vessels open into the body cavity, and blood interacts directly with organs and tissues. Then blood is collected into vessels again.

## Activity

---

Compare circulatory organs of Annelida, Mollusca, Arthropoda, and Mammals. Construct and fill a comparison table.

Organism	Heart	Blood vessels
Annelida		
Mollusca		
Arthropoda		
Mammals		

## Facts

---

The heartbeat of a person changes during his life (bpm – beats per minute):

Newborn (0 to 11 months): 70 to 160 bpm

One to four years: 80 to 120 bpm  
 Five to nine years: 75 to 110 bpm  
 Children 10 years and up and adults (non-athletes): 60 to 100 bpm  
 Adults (athletes): 40 to 60 bpm

## Research time

---

Compare blood structure of Annelida, Mollusca, Arthropoda, and Mammals. What is similar and different in their blood? Why are they different? Find the answers and write a report.

## Literacy

---

1. Why circulatory systems of earthworm, mollusks, arthropods and human are different?
2. Tell the path of the blood from your right leg to the lungs.
3. What would happen, if there were no valves?

## Terminology

---

- artery - күретамыр / артерия;
- atria - жүрекше / предсердие;
- capillary - қылтамыр / капилляр;
- chamber - камера;
- to establish - орнату / устанавливать;
- vein - көктамыр / вена;
- ventricle - қарынша / желудочек;
- vessel - тамыр / сосуд.

# 5.9 CIRCULATORY SYSTEM TYPES

## You will:

---

- describe circulatory system types of animals.

## STQ

---

What is the path of an oxygen molecule from lungs to a brain cell?

## Key terms

---

Open circulatory system - blood is not enclosed in the blood vessels, but is pumped into a cavity;

Closed circulatory system - blood always moves inside blood vessels;

Pulmonary circulation - the movement of deoxygenated blood from the heart to lungs, and oxygenated back to the heart; Systemic circulation - the movement of oxygenated blood from the heart to all organs, and deoxygenated blood back to the heart.

## Facts

---

Entire trip of blood around your body takes about 20 seconds only.



## Text

---

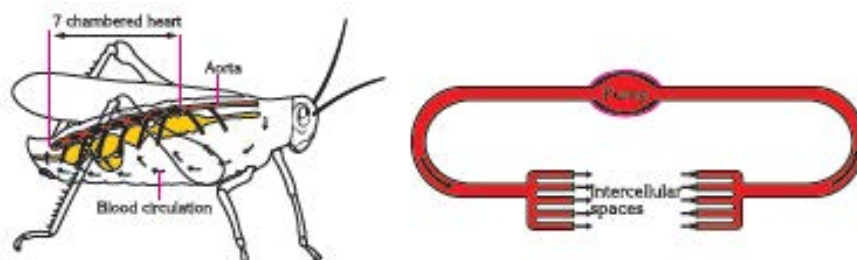
Circulatory system carries needed materials such as oxygen and nutrients and waste materials such as carbon dioxide and urea in animals.

A true circulatory system has heart, blood and blood vessels.

In animals, there are two types of circulatory system: open circulatory system and closed circulatory system.

### Open circulatory system (OCS).

An open circulatory system consists of a pump (heart), arteries and veins. In organisms with an OCS, such as arthropods and mollusks, blood is pumped into an artery, from the artery to the body cavity, then to veins (after a material exchange between the blood and body cells), and back to the heart.



Grasshopper has open circulatory system

### Closed circulatory system (CCS)

In the closed circulatory system, there are capillaries between arteries and veins. Capillaries are very tiny blood vessels. They are the site of material exchange. Blood never leaves

the blood vessels. Organisms with closed circulatory systems are segmented worms, cephalopods, and all vertebrates.



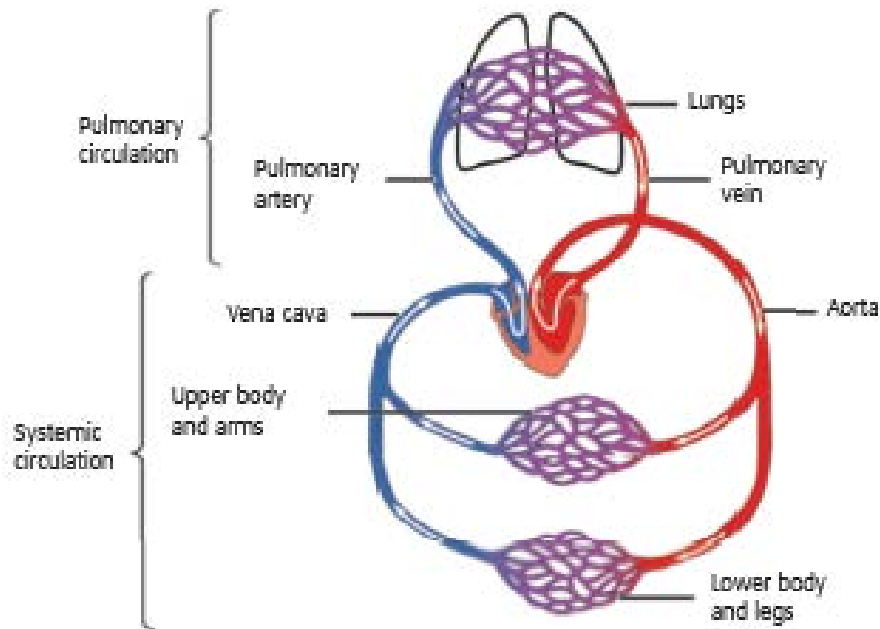
Earthworm is the most primitive animal with closed circulatory system.

## Blood circulation in human.

A human circulatory system includes two circulations: pulmonary circulation and systemic circulation.

- Pulmonary circulation occurs between heart and lungs. Deoxygenated blood leaves right ventricle, by pulmonary arteries goes to lungs, in lung capillaries gas exchange occurs, by pulmonary veins oxygenated blood returns to heart (left atrium).
- Systemic circulation occurs between the heart and other body organs.

Oxygenated blood leaves left ventricle to aorta, aorta divides into arteries and blood goes to all parts of the body except lungs. Gas exchange occurs in capillaries of organs; deoxygenated blood is carried back to the heart by veins. Vena cava pours deoxygenated blood into the right atrium.



## Research time

---

Research closed and open circulatory systems. Write advantages and disadvantages of both circulatory systems.

## Activity

---

Using colored threads construct models of open and closed circulatory system. Glue it to the paper and write all of the parts of circulatory systems.

## Literacy

---

1. Blood is entering arm artery. How many capillary beds (networks) will this blood pass until it reaches the left ventricle?
2. How nutrients reach cells if blood never leaves the vessels?

3. What is the difference between oxygenated and deoxygenated blood?

## Terminology

---

- aorta - қолқа тамыр / аорта;
- arthropod - буынаяқты / членистоногое;
- deoxygenated - веналық қан / венозная кровь;
- mollusk - ұлу / моллюск;
- oxygenated - артериялық қан / артериальная кровь;
- pulmonary - өкпелік, өкпеге тән / легочная;
- pulmonary circulation - кіші қанайналым жүйесі / малый круг кровообращения;
- pump - сорғы / насос;
- systemic - үлкен қанайналым жүйесі / большой круг кровообращения;
- urea - несепнар / мочеви́на;
- vena cava - қуыс вена / полая вена.

# 5.10 PHYSICAL EXERCISES AND THE HEART

## You will:

---

- study the effect of physical exercises on the work of the heart and its recovery.

## Key terms

---

Pulse is a rhythmic beating in the arteries caused by the beating of the heart.

## Facts

---

On the 70th day of complete immobility, the size of the heart decreases by 13-18%.

## Text

---

Normal work of the heart is promoted by physical exercises and work.

During physical work, the amount of blood flowing through the heart muscle increases, the supply of oxygen and nutrients improves. This helps to strengthen the heart muscle and improves it. With a decrease in physical activity, the heart muscle weakens.

Physical exercises and sports games, which get complicated with age, train the muscles of the body. At the same time, the

heart muscle grows, develops and trains. In children, the growth of the network of blood vessels is slower than the growth of the heart. So the heart makes extra efforts to push blood through the vessels. In this period, you need physical activity, but within the limits of each child's abilities.

## Lab works

---

### The influence of physical activity on heart

#### Pre-lab questions:

1. What is a pulse?
2. What is the function of the heart?

#### Methods and Materials:

Stopwatch, or timer.

#### Procedures:

1. Place your first two fingers on the opposite wrist and try to find your pulse.
2. Measure your pulse for 6 seconds. Multiply the result by 10 and write the number in the table below.
3. Do any physical activity for 15 minutes.
4. Measure your pulse for 6 seconds after 1, 5, 10 and 15 minutes of physical activity.
5. Multiply your results by 10 and write the numbers into the table below.

#### Results:

Time	Pulse
At rest	
1 minute	
5 minutes	
10 minutes	
15 minutes	

### Post-lab questions:

1. How did your pulse rate change after physical activity?  
Explain why.
2. Why athletes have a stronger heart?
3. What will happen if you do physical activities every day?

## Research time

---

Repeat the labwork you did in class at home using different physical activities. Fill in the same table. Compare two tables and write a report. Post a picture of you doing the exercise at home in social networks using hashtag #strongheart.

## Terminology

---

- ability - қабілет / способность
- effort - күш салу / усилие
- flow - ағу, ағын / течь, поток
- immobility - әрекетсіздік, қимылсыздық / неподвижность
- to increase - арттыру / увеличить
- influence - әсер ету / влияние
- physical exercise - дене жаттығуы / физическое упражнение
- to promote - жоғарылату, дамыту / продвигать
- pulse - пульс, тамыр ырғағы / пульс

- stopwatch - секундомер
- timer - таймер
- wrist - білек / запястье



# 5.11 DISEASES OF HUMAN CIRCULATORY SYSTEM

## You will:

---

- describe the causes and symptoms of circulatory system diseases.

## Key terms

---

Hypertension - high blood pressure;

Heart attack - blocking of heart arteries which bring to death of heart muscles;

Stroke - the death of brain tissue occurred as a result of artery blockage.

## STQ

---

Many of the elder people in Kazakhstan are suffering from hypertension. Why?

## Text

---

Normal functioning of the circulatory system is important. If the heart stops working we die. There are many circulatory diseases which affect the functioning of the heart and other organs.

Disease name	Explanation	Causes	Symptoms
Tachycardia	fast heart rate at rest (more than 100 beats per minute)	stress, high blood pressure, smoking, alcohol, fever, too much caffeine	shortness of breath, dizziness, fast pulse rate, pain in the chest
Hypertension or high blood pressure	blood pressure is too high	genetic factors, obesity, endocrine problems, alcohol	(in some people) headaches, shortness of breath, nosebleeds
Arteriosclerosis	arteries become narrow and lose their elasticity	poor diet, too much fatty food, high blood pressure, diabetes, smoking	(depend on which arteries affected) chest pain, pain in legs or arms, fatigue, confusion
Cardiac ischemia	blood flow to the heart is reduced, preventing from receiving enough oxygen	arteriosclerosis, blood clot, stress, cold temperature, cocaine	neck pain, shoulder pain, fast heartbeat, nausea, sweating, fatigue
Heart attack	blood flow to the heart is blocked, can damage or destroy part of the heart muscle	smoking, hypertension, diabetes, obesity, stress, lack of physical activity, old age	pressure and pain in the chest, nausea, shortness of breath, cold sweat, fatigue
Stroke	blood supply to part of the brain is stopped or reduced; brain cells start to die	smoking, obesity, physical inactivity, alcohol, drugs, smoking, hypertension, diabetes, heart problems	trouble with speaking, paralysis of the face, arms and legs, numbness, headache, trouble with walking

## Facts

---

While heart beats, it produces small amounts of electricity. Electrocardiography (ECG or EKG) is the process of

recording the electrical activity of the heart over a period using electrodes placed on the skin.

## Activity

---

First aid during the stroke is very important. Getting help fast can prevent disability and death from stroke. On the image, you can see how to learn if a person has the stroke.

1. Discuss stroke signs and symptoms with your partner.
2. Build special methods on how to recognize a stroke.
3. Try this out with your partner, and let your partner try it on you.
4. What to do to prevent stroke? What advice can you give to your classmates, relatives, and parents?

## Literacy

---

1. Learn first aid actions to do during a heart attack.
2. How can energy drinks affect the circulatory system?
3. Men over 40-45 years, women over 50-55 years tend to have more circulatory problems. Why in men do these problems occur much earlier than in women?

## Research time

---

Some common factors can affect the formation of circulatory system diseases. These factors are:

- Genetic factor
- Poor diet
- Lack of physical activity
- Using some chemicals or drugs

Divide into four groups; every group must prepare a project on how one of the factors can affect the circulatory system. Make the list of advice for your parents, relatives, and classmates.

## Terminology

---

- arteriosclerosis - атеросклероз;
- cardiac ischemia - жүректің ишемиялық ауруы / ишемическая болезнь сердца;
- confusion - білместік, түсінбестік / путаница;
- dizziness - бас айналуы / головокружение;
- fatigue - шаршау / усталость;
- fever - дене қызуының көтерілуі / жар;
- headache - бас ауруы / головная боль;
- heart rate - жүректің соғу жиілігі / ритм сердцебиения;
- nausea - жүрек айну / тошнота;
- nosebleed - мұрынның қанауы / носовое кровотечение;
- obesity - семіру / ожирение;
- tachycardia - тахикардия.

# Problems

## Test questions with one right answer

1. Blood cells are produced by:

- A) Brain
- B) Heart
- C) Stomach
- D) Bone marrow
- E) Kidney

2. 55% of blood is/are:

- A) Erythrocytes
- B) Leukocytes
- C) Platelets
- D) Plasma
- E) Water

3. Type of immunity of newborn baby:

- A) passive artificial
- B) passive natural
- C) active artificial

D) active natural

E) no immunity

4. The secretion of antibodies by B lymphocytes provide:

A) humoral immunity

B) passive artificial

C) cell-mediated immunity

D) passive natural

E) active artificial

### **Test questions with several (max 3) right answers**

1. Contain valves:

A) Artery

B) Lymphatic vessels

C) Tonsil

D) Heart

E) Spleen

F) Vein

G) Lymph nodes

H) Capillary

2. Show animals with open circulatory system:

A) Octopus

B) Fish

C) Bee

D) Bird

E) Crab

F) Lizard

G) Oyster

H) Bear

3. Organs that help immune system:

A) Spleen

B) Blood vessel

C) Intestine

D) Thymus

E) Brain

F) Heart

G) Lung

H) Lymph nodes

## Matching

1. Match blood cells with their functions:

1. Phagocytes

2. T cells

3. B cells

A) Blood clotting

B) Destroy antibodies

C) Ingest harmful pathogens

D) Kill invaders

E) Transport oxygen

F) Make antibodies

2. Match blood groups with antibodies:

1. O

2. AB

3. B

A) anti-B

B) anti-A anti-B

C) A antigen

D) none of them

E) anti-A

F) B antigen



# CHAPTER 6.0

## Respiration



# 6.1 GAS EXCHANGE

## You will:

---

- understand mechanisms of gas exchange.

## STQ

---

How does air move into your lungs?

## Key terms

---

Gas exchange - transfer of gases between the organism and environment;

Lungs -respiratory organ in the thorax used to breathe air;

Alveoli - tiny air sacs within the lungs where the exchange of oxygen and carbon dioxide takes place.

## Facts

---

In both lungs of an adult, there are about 300 million alveoli.

## Text

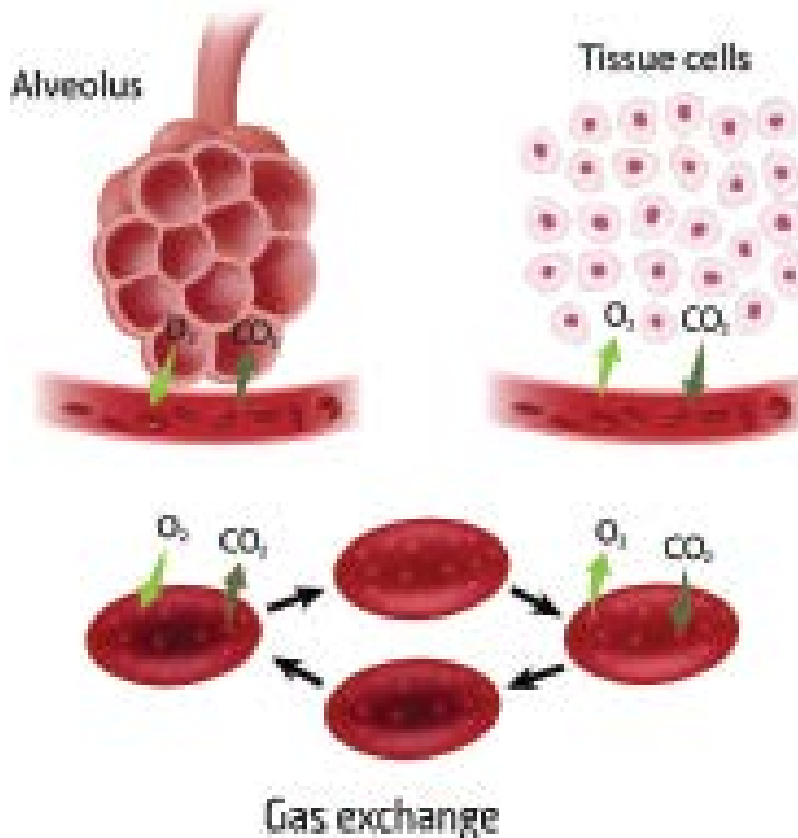
---

Air comes in our body through the respiratory system. Starting from the nasal cavity, it passes through trachea and bronchus into lungs. Lungs consist of small bubbles called alveoles.

Many capillaries cover alveoli. There, exchange of gases between blood and inhaled air occurs. Lung capillaries have less oxygen than air. So, oxygen passes from air into alveoli into the blood. There it links with hemoglobin. Then it passes to organs by blood. Organs have less oxygen than blood.

Oxygen passes from the blood into organs easily. Organs use oxygen to produce energy and carbon dioxide.

There is less carbon dioxide in blood than in organs. That is why carbon dioxide can pass into blood easily. Then blood transports carbon dioxide into lungs. Lung alveoles have less carbon dioxide than blood. So, carbon dioxide passes from the blood into alveoli. Then it is exhaled into the atmosphere.



## Activity

---

### Why do we need alveoli?

Take three terminology dishes from your teacher filled with terminology inside. Also, you need two tubes with diameters of 2 and 4 mm, food dye and a pipette.

1. Use the tube with 4 mm diameter and make seven holes in the first dish evenly.
2. Then use the tube with 2 mm diameter and make 14 holes in the second dish.
  - NOTE: you can make those tubes yourself using carton paper.
3. Do not make any holes in the last dish.
4. Make a solution of food dye and water. Using a pipette fill holes of the first dish with the solution. Count how many droplets you put into holes.

Put the same amount of solution into other dishes. Observe results after 15 minutes.

The holes in jelly express alveoli in lungs. The colored solution is like oxygen in alveoli. Using observation's results explain what happens to oxygen in the lungs?

As you know, the volume of solution in the first dish is the same as in second and third. Use results and explain why it is better to have smaller holes in the lung than big holes.

## Facts

---

Breathing through the mouth can, over time, create a shrinking of the jaw, resulting in crooked teeth. It is also the biggest cause for children developing a lisp when they talk.

## Research time

---

When airplanes face dangerous situations, emergency masks drop down. How do the masks work and what are they needed for? Do research and write 200-250 words essay about it.

## Literacy

---

1. What would be if alveoli were as big as lungs? Explain your answer.
2. Anemia is the disease when a human does not have enough hemoglobin in the blood. Explain why do people become weak during anemia?
3. What happens in our lungs when we hold breath underwater?

## Terminology

---

- alveoli - альвеолалар (өкпе көпіршіктері) / альвеолы;
- trachea - кеңірдек / трахея;
- bronchi - бронх;
- lisp - сақау / шепелявый;
- exhale - дем шығару / выдох;
- gills - желбезек / жабры;
- gas exchange - газ алмасу / газообмен;
- inhale - демді ішке алу / вдох;
- to respire - тыныс алу / дышать.

## 6.2 BREATHING

### You will:

---

- understand mechanisms of breathing.

### STQ

---

Put your hand on your chest. Breathe slowly. Why is your hand (or your chest) moving?

### Key terms

---

Breathing mechanism - the process of inhalation and exhalation;

Diaphragm - dome-shaped muscle which helps respiration by separating thoracic and abdominal cavities;

Intercostal muscles - muscle groups that are located between the ribs.

### Facts

---

Inhaling other people's smoke is called passive (second-hand) smoking. It is about four times more toxic than active smoking.

Tobacco smoke contains more than 7,000 chemicals, and 70 of them cause respiratory cancers. So try to stay away from the smoking area.

## Text

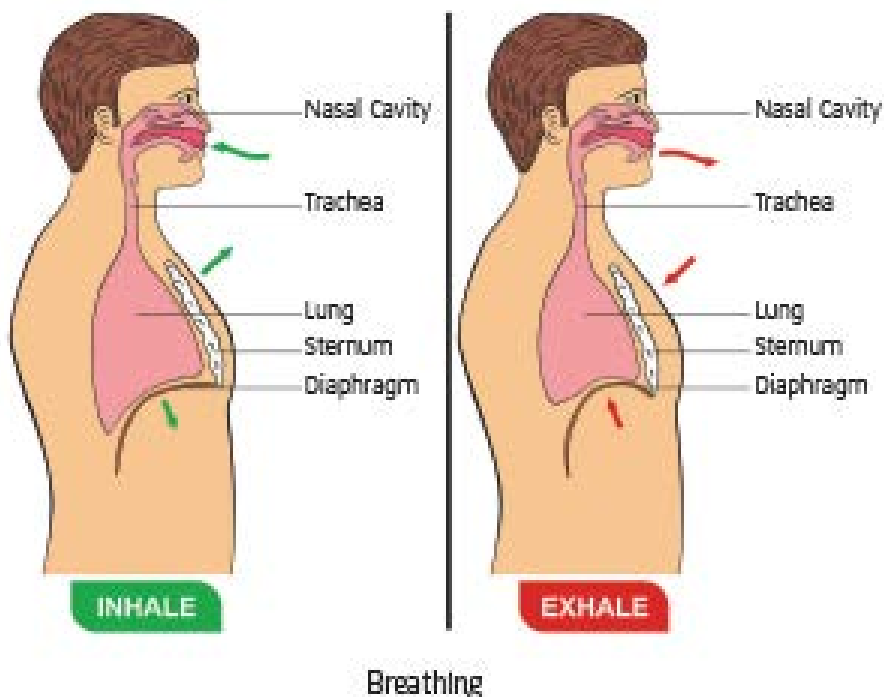
---

Human needs to breathe. Breathing is taking air in and out of the lungs.

Taking air in is called inhale. Taking the air out is called exhale. Two types of muscles work during breathing: intercostal muscles and diaphragm.

When we inhale, intercostal muscles move your chest upward. Diaphragm goes down. This helps to make our lungs' volumes bigger. Also, the pressure in lungs decreases and air comes into the lungs.

When we exhale, intercostal muscles go down. Diaphragm goes up. This makes your lungs' volume smaller. The pressure in lungs increases and air goes out of the lungs.



## Facts

---

In babies, lungs fill the thorax, and a large number of lungs are found in midback while babies are laying on their backs. So when they breathe, their lungs can expand only into the abdomen.

## Research time

---

Respiration rate is the number of breaths taken per minute (a breath is one inhalation and one exhalation). Count breath made per minute and record results.

## Activity

---

### How does diaphragm help us to breath?

1. Take a balloon and slide its neck to vent slot of a bottle. Also, left parts of the balloon should be hanging inside of the bottle.
2. Cut the bottom of the plastic bottle and another balloon. Then stretch balloon sheet over the bottom of the bottle. Using sellotape, stick balloon sheet there. Tie balloon's neck.
3. Now gently pull the balloon down that covers the bottom of the bottle. Observe what happens and record results. Then bring it back to the previous position. What happens now?

Show following structures on your model:

- lung
- diaphragm
- thorax cavity



## Literacy

---

1. Why do we start to breath faster during physical activities?
2. Using plastic bottle lung model describe what happens when we inhale.
3. What is the percent of oxygen and carbon dioxide in the inhaled air? Is it different from the exhaled air?

## Terminology

---

- chest cavity - кеуде қуысы / грудная полость;
- diaphragm - көкет / диафрагма;
- sellotape - жабысқақ қағаз / скотч;
- sternum - төссүйек / грудинка;
- intercostal muscles - қабырғаралық; бұлшықеттер / межреберные мышцы;
- pressure - қысым / давление;
- respiratory cancer - тыныс алу жолдарының обыры / рак дыхательных путей;
- respiration rate - тыныс алу жиілігі / частота дыхания.

## 6.3 LUNG CAPACITY

### You will:

---

- calculate vital lung capacity and respiratory minute volume.

### Key terms

---

Tidal volume - the volume of gas inhaled or exhaled in each respiration, during normal, regular breathing;

Vital capacity - the greatest amount of air that can be forced from the lungs after maximum inhalation.

### Facts

---

The left lung is slightly smaller than the right lung to allow the place of the heart.

### Text

---

An average person can take in 500 cm<sup>3</sup> air by calm inhale. The same amount of air goes out of the lungs by calm exhale. This amount of air is called tidal volume of lungs.

Vital capacity is the amount of volume breathed out after the deepest inhale. It differs between women and men. Also, it differs between ages and physically stronger and weaker people. An average person's vital capacity is 3500 cm<sup>3</sup>.

Another important number is respiratory minute volume. It is the volume of air inhaled or exhaled per minute.

## Lab works

---

### Lung capacity measurement

#### Pre-lab questions:

1. Why physically trained people have high vital capacity?
2. What is the difference of vital capacity between different ages? Explain why.
3. Which muscles participate in breathing process?

#### Methods and Materials:

balloon, ruler.

#### Procedures:

1. Measuring tidal volume: press the balloon so that it does not have any air in it. First normally inhale air, then exhale it into the balloon. Hold the end of the balloon. Do not let any air out! Measure the diameter of the balloon. Do the same for three times. Using the formula below, calculate the volume of the balloon:

o

$$V = \frac{4}{3} \pi r^3$$

- r - radius of the balloon;
  - p - constant number (p =3.14).
2. Measuring the vital capacity: repeat the procedure, but this time inhale as much air as you can, and exhale as much as you can. Do it three times. Calculate the volume using the same formula.
  3. Measuring respiratory minute volume: use the formula below:

◦

$$RMV = V_T f$$

- V - tidal volume;
  - f - frequency number of inhales per minute.
4. Sit down and stand up 10 times. Jump 10 times. Now measure tidal volume, vital capacity and respiratory minute volume.
  5. Calculate average values and fill the table.

## Results

		Trial	1	2	3	Average
<b>Before exercise</b>	Tidal volume	Balloon Diameter				
		Volume				
	Vital capacity	Balloon Diameter				
		Volume				
	Respiratory minute volume	Frequency				
		Volume				
<b>After exercise</b>	Tidal volume	Balloon Diameter				
		Volume				
	Vital capacity	Balloon Diameter				
		Volume				
	Respiratory minute volume	Frequency				
		Volume				

### Post-lab questions:

1. Why there was the difference in volumes before and after exercise? Explain your answer.
2. Why did you measure the balloon by ruler three times? Explain.
3. Why is there the difference between tidal volume and vital capacity?

### Facts

---

A healthy lung is pink, smooth and shiny while smoking lung is black, bumpy and dull. Smoking damages alveoli by filling with toxins and narrows air passageways so that it is more difficult to get air in and out of the chest. All of these reduce

the vital capacity of the lungs. It occurs even in young people who have only been smoking for a short time.

## Research time

---

Find two adults, one who smokes and one who doesn't. Measure their vital volume capacity and compare. Draw the same table for these adults. Write conclusion about your observations.

## Terminology

---

- bumpy - кедір-бұдыр / неровный;
- capacity - сыйымдылық / вместимость;
- dull - күңгірт, солғын түсті / тускый;
- frequency - жиілік / частота;
- respiratory minute volume - минуттық тыныс алу көлемі / минутный объем дыхания;
- smooth - тегіс / гладкий;
- tidal volume - тыныс алу көлемі / дыхательный объем;
- trial - сынақ / попытка;
- vital capacity - тіршілік сыйымдылығы / жизненная емкость.

# Problems

## Test questions with one correct answer

1. The smallest part of the respiratory system:

- A) Lung
- B) Bronchi
- C) Trachea
- D) Bronchiole
- E) Alveoli

2. Which organ is NOT related to respiratory system?

- A) Gills
- B) Lungs
- C) Stomach
- D) Bronchi
- E) Air sacs

3. Amount of volume breathed out after the deepest inhale:

- A) Tidal volume
- B) Respiratory minute volume
- C) Respiration

D) Exhale

E) Vital capacity

4. In which part of the respiratory system hemoglobin takes oxygen?

A) Bronchi

B) Bronchiole

C) Trachea

D) Alveoli

E) Nasal cavity

### **Test questions with several (max 3) correct answers**

1. What can affect the vital capacity volume of lungs?

A) Gender

B) Size of foot

C) Age

D) Colour of skin

E) Bones

F) Weight

G) Height

H) Mass



2. What happens when diaphragm contracts (becomes straight)?

- A) Lung volume decreases
- B) Lung volume increases
- C) Pressure in lungs increases
- D) Pressure in lungs decreases
- E) Air goes out of the lungs
- F) Air comes into the lungs
- G) Intercostal muscles contract
- H) Intercostal muscles relax

3. NOT part of respiratory system:

- A) Esophagus
- B) Mouth
- C) Nose
- D) Trachea
- E) Lungs
- F) Diaphragm
- G) Liver
- H) Bronchi

## Matching

1. Match following animals suitable respiratory structures:

1. Amphibians

2. Mammals

3. Birds

A) Gills

B) Trachea

C) Lungs

D) Lungs and air sacs

E) Skin

F) Tube like structure

2. Match following terms with the definition:

1. Exhale

2. Inhale

3. Gas exchange

A) Holding the breath in lungs

B) Taking the air out of the body

C) Taking water to lung

D) Taking air into the body

E) Occurs between nephrons and blood

F) Occurs between alveoli and blood Answer following questions

# CHAPTER 7.0

## Excretion



# 7.1 HUMAN URINARY SYSTEM

## You will:

---

- learn the structure of human urinary organs.

## STQ

---

Why do some people need to use dialysis machine?

## Key terms

---

Kidneys - the pair of the beanshaped organ which filters blood and makes urine;

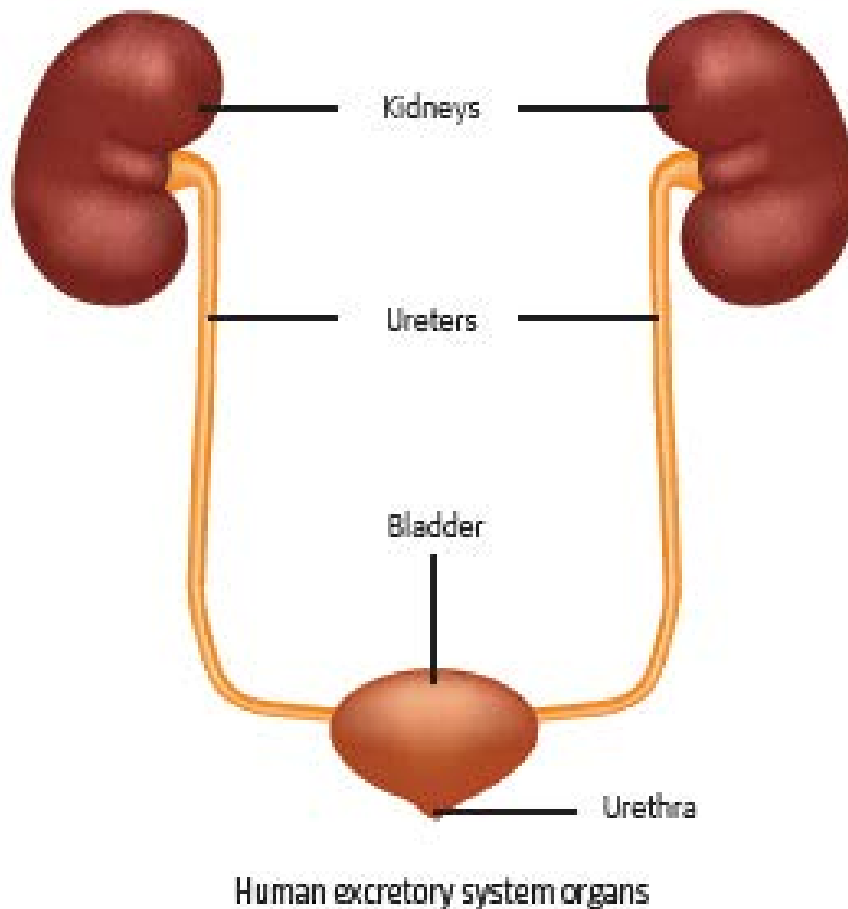
Excretion - the process of elimination of wastes from the body;

Urine -liquid waste excreted by the kidneys, in humans being a yellowish, slightly acid.

## Text

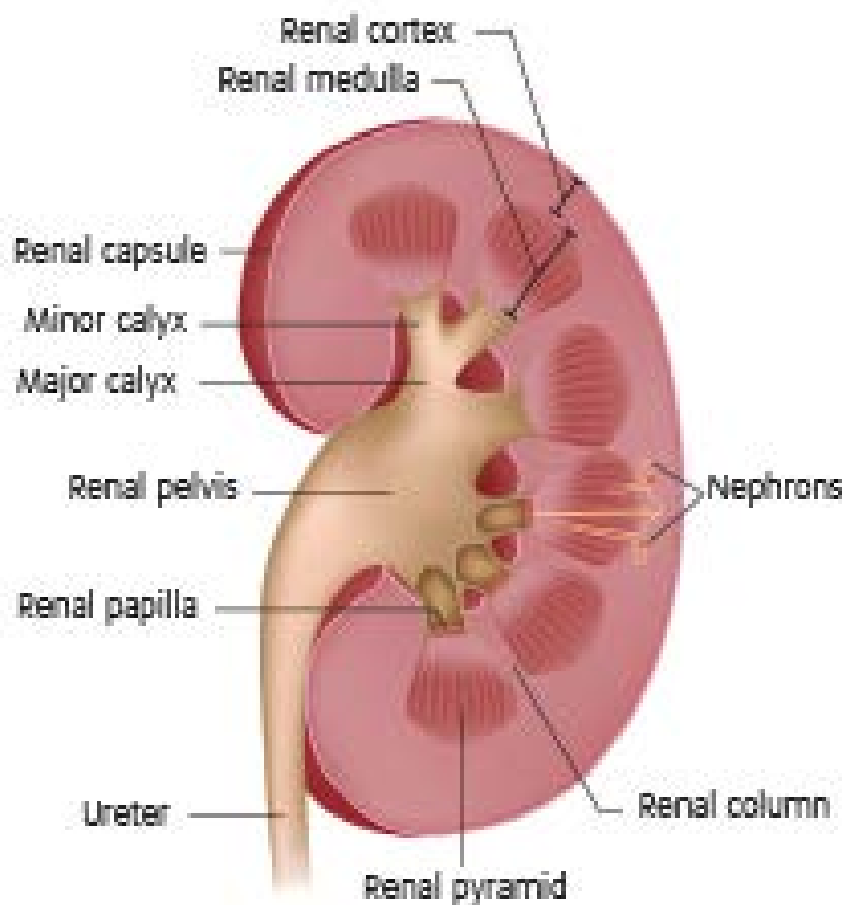
---

Human excretory system organs Kidneys weight only 1 percent of the total body weight, but they The excretory system is a system that removes excess water and consume 25 percent of its energy. unnecessary products. The human urinary system consists of kidneys, ureter, urinary bladder, and urethra.



Kidneys are a pair of organs. It consists of two layers: outer renal cortex and inner renal medulla. The main structural unit of the kidney is nephron.

The nephron consists of tubules. Nephron filters blood and forms urine. Then this urine passes through



## Activity

---

### Working kidney model

1. Take 2 bottles and cut them in halves. Make a hole on cap and place tubes into it. Then stick bottles with tubes going to funnel on board like shown on the picture. Fill the bottles with filter papers.
2. Take red colored water with some beads in it. Pour water into each bottle and observe what happens. Do all materials in water leave the bottle? Why is it important?

If here red colored water with beads is blood with blood cells, show kidneys, ureters and urinary bladder in your model.

## Career

---

### Nephrologist

Nephrologists are kidney doctors. They care and treat kidney diseases. Some treatments for kidneys are dialysis machine and kidney transplantation.

## Research time

---

Dialysis is the process of cleaning the blood when the kidneys no longer function. Do research how this machine works. How frequently patients need to clean their blood by dialysis? Can dialysis replace kidneys at all?

## Literacy

---

- 1. Some people live with only one kidney. How does this affect their lifestyles?**
- 2. How are waste materials and water transported to kidneys?**
- 3. Why do doctors ask for the urine test if you are ill?**

---

## Terminology

---



- dialysis - диализ;
- kidney - бүйрек / почка;
- kidney stones - бүйрек тастары / почечные камни;
- nephrologist - нефролог;
- unnecessary - қажетсіз / ненужный;
- ureter - несеппағар / мочеточник;
- urethra - зәр шығару өзегі / мочеиспускательный канал;
- urinary bladder - қуық / мочевого пузыря.

## 7.2 SKIN

### You will:

---

- understand the structure and functions of the skin.

### Key terms

---

Epidermis - the outermost layer of the skin;

Dermis - thick layer of skin under epidermis;

Hypodermis - the deepest part of the skin which contains fat cells.

### Facts

---

#### Melanin the colour code

Human skin color is different because of melanin. It is a protein produced by the skin. When you go out in sunny weather, your body makes more melanin to protect you from the Sun rays, making your skin darker. Some people lack melanin. It is a genetic disorder called albinism.

### STQ

---

Why do people with light skin suffer from sunlight more than people with dark skin?

### Text

---

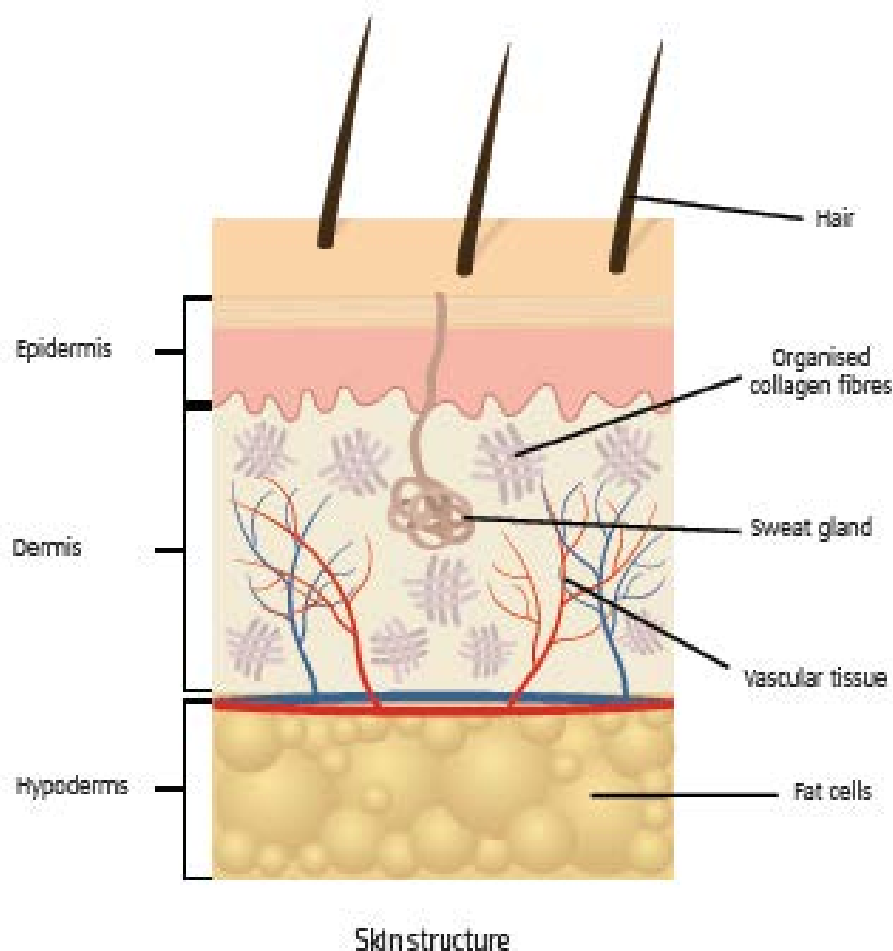
Skin is an outer cover of the body. It consists of three layers: epidermis, dermis, and hypodermis.

The epidermis is an outer layer of the skin. It consists of dead cells and protects the body from bacteria and viruses. Also, it keeps water inside the body.

Under the epidermis, there is a layer called dermis. It has receptors, cells which feel the pain, temperature, pressure, etc. Also, dermis has sweat glands and sebaceous glands. Sweat glands produce sweat. Sebaceous glands produce oil. The dermis has blood and lymph vessels. They transport nutrients into the skin.

The deepest part of the skin is hypodermis. It consists of fat cells. They store energy. Also, fat cells keep heat inside the body.

Skin protects other tissues from damage. Also, skin excretes excess water and salt by sweat.



## Activity

Our skin produces a natural oil that leaves prints behind when your fingers touch a surface. They are called fingerprints. There are no two people who have same fingerprints. So, forensics help police to find criminals by their fingerprints left at the crime scene. To collect fingerprints, you need baby powder and a paint brush.

Spread a small amount of powder over fingerprint left on the glass and remove carefully excess powder using the brush. To

take powdered fingerprint using sellotape, stick sellotape to fingerprint and pull it off.

Then wrap tape back to save your fingerprint.

Take four volunteers and ask them to rub a small amount of hand cream.

Wear rubber gloves and give them one object to hold. However, nobody should see who touched particular object. Then give that objects to 4 groups. Moreover, they should find who have touched them. To make more interesting you can make your own crime story and give roles to classmates.

## Research time

---

Look at your body. Have you noticed that skin is much thicker on soles than on eyelids? Why should it be much thicker on soles than in other parts of the body?

Then look at the skin around elbows and knees. You will see that it is much looser than the skin on arms or legs!

Can you guess why is it so?

Finally, skin on your palm is much firmer than on the back of your hand.

Do you know why is it so? Write a conclusion.

## Facts

---

Skin is the largest organ in the body. Skin occupies approximately 1.73 square meters to cover our flesh and bones.

## Literacy

---

1. Why do people living in a hot climate have darker skin?
2. Why does epidermis not need blood supply?
3. What do kidneys and the skin have in common?

## Terminology

---

- albinism - альбинизм;
- collagen fibers - коллаген талшықтары / волокна коллагена;
- excess - артық / лишний;
- firmir - қатты / твёрдый;
- fingerprint - саусақ ізі / отпечаток пальца;
- forensics - криминалистика;
- receptor - рецептор;
- sebaceous gland - май бездері / сальные железы;
- sweat glands - тер бездері / потовые железы.

## 7.3 SKIN DISEASES

### You will:

---

- understand the symptoms and treatment of skin diseases.

### Key terms

---

Scabies - skin disease with itching and small raised red spots, caused by the itch mite;

Tetter - any of various eruptive skin diseases;

Acne - an infl ammatory disease of the sebaceous glands.

### STQ

---

Suppose your skin became rough. Its color changed into red and brown. What happened to your skin?

### Research time

---

It is important to wash your face every morning and before sleep. Research this topic and discuss it with your friends. Suppose your skin became rough. Its color changed into red and brown. What happened to your skin?

### Text

---

#### Scabies

## **Causes**

Itch-mite causes scabies. It can pass from person to person after physical contact.

## **Symptoms**

The main symptom is itching, especially during the night and after a shower. Also, red dots appear on the skin. It starts from fingers, elbows, etc.

## **Treatment**

To cure scabies, people use cream and lotions. These lotions kill the itch-mite. People who contacted sick person should also take treatment from scabies.

## **Acne**

### **Causes**

The main cause is hormonal change during puberty. It causes sebaceous glands to produce more oil. As a result, pores are blocked with dead skin and oil.

### **Symptoms**

Pimples and clogged pores on the face.

### **Treatment**

People use products to clean their skin. These products may include benzoyl peroxide or salicylic acid. These chemicals reduce the production of oil by sebaceous glands.



## **Tetter**

### **Causes**

Infection caused by different microorganisms. Depending on the microorganism, there are different types of tetter.

### **Symptoms**

Areas of red or brown color with itching appear on the body. Skin becomes rough.

### **Treatment**

Different types of tetter need different treatments. If the cause of the tetter is a virus, then you need to take antiviral medications. If fungi cause it, then take antifungal medications, etc.

## **Dark spots**

### **Causes**

The main cause of dark spots is excess doses of ultraviolet light. Ultraviolet light activates production of melanin. Melanin gathers in certain areas of the skin

### **Symptoms**

Symptoms are dark spots on the skin.

### **Treatment**

People use creams to cure dark spots. These creams fade the effect of melanin.

## Activity

---

Work in groups of 4 students. Imagine that you are a doctor. Study 4 diseases given in the text and write recommendations with your team to prevent each type of skin disease.

## Facts

---

You might be surprised to know that you have acne treatments right in your kitchen. An amazing feature of plants is that they can cure several diseases.

Rub acne with raw garlic several times a day; it helps in relieving the pain and also heals acne fast.

Clean your skin and apply lemon juice with a cotton ball. The acid in lemon helps to flush out the pores and keeps the skin to look beautiful.

## Career

---

### Dermatologist

A dermatologist is a doctor who treats diseases of the skin.

## Literacy

---

1. Why is it recommended to wash and iron bedclothes once a week?

2. Why do doctors suggest us to sleep in pajamas? Explain your answer.
3. What is not recommended during scabies disease?

## Terminology

---

- bedclothes - төсек орын жабыны / постельное белье.
- dark spots - қара дақтар / темные пятна;
- dermatology - дерматология;
- eruptive - бөрітпелі / сопровождаемый сыпью;
- inflammation - қабыну / воспаление;
- itch-mite - қышыма кенесі / чесоточный зудень;
- puberty - жыныстық жетілу / половое созревание;
- tetter - теміреткі / парша;
- rough - кедір-бүдір / грубый;
- scabies - қышыма / чесотка;

# Problems

## Test questions with one right answer

1. An organ that stores urine:

- A) kidney
- B) urinary bladder
- C) urethra
- D) ureter
- E) skin

2. Main function of the urinary system:

- A) crystallize salts and soil
- B) keep waste in the body
- C) remove excess water and waste products
- D) get oxygen to body cells
- E) protect the body from bacteria

3. Which one of the followings can help if a person has acne?

- A) grape
- B) lemon
- C) aloe

E) cucumber

D) garlic

4. Function of kidney:

A) Takes in oxygen

B) Filters blood

C) Produces sweat

D) Produces hormones

E) Digests food

### **Test questions with several (max 3) right answers**

1. Show skin layers:

A) dedermis

B) dermis

C) endodermis

D) epidermis

E) mesodermis

F) ectodermis

G) hypodermis

H) hyperdermis

2. Nephron:

- A) is a unit of lungs
- B) is found in kidneys
- C) oxygenate blood
- D) makes urinary bladder
- E) is found in lungs
- F) consists of tubules
- G) consists of alveoli
- H) filtrates the blood

3. True about melanin:

- A) Gives colour to skin
- B) Secretes sweat
- C) Produced by leukocytes
- D) Amount determines the skin colour
- E) Helps to feel pain
- F) Stores fat
- G) Protects body from UV lights
- H) Produces hair cells

## **Matching**

1. Match skin functions with suitable explanations:

1. Barrier
2. Protects
3. Removes

- A) body temperature
- B) nutrients
- C) against microbes
- D) from ultraviolet light
- E) waste products
- F) against darkness

2. Match given definitions with terms:

1. The process of cleaning blood when kidneys are not functioning

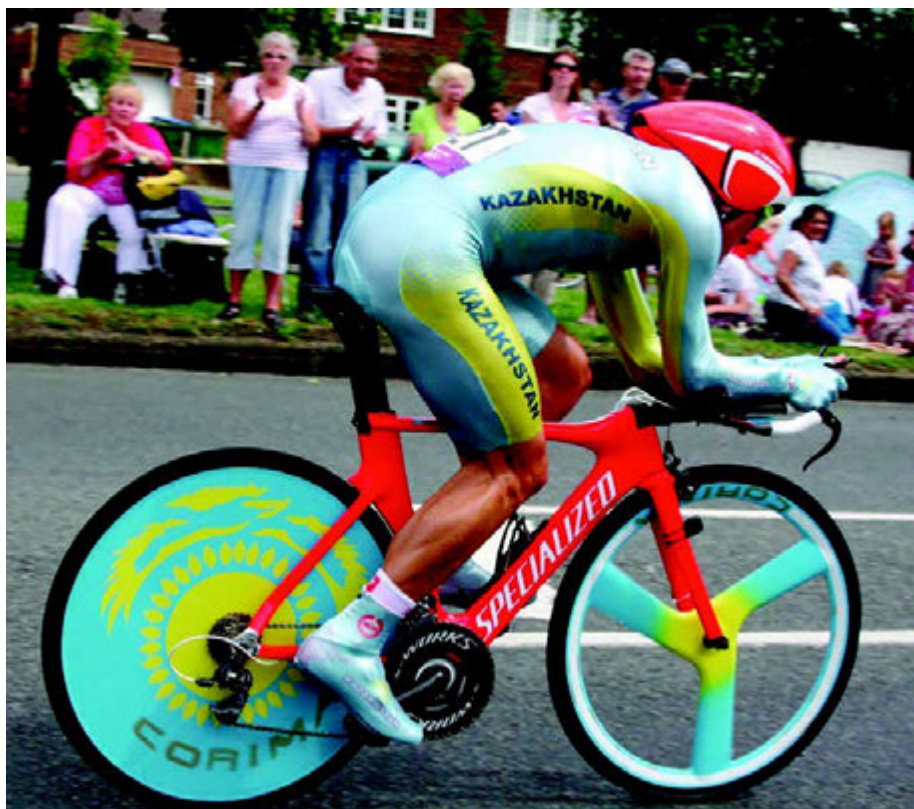
2. Consists of two layers: outer renal cortex and inner renal medulla

3. Long tubular structure

- A) Renal pelvis
- B) Dialysis
- C) Bladder
- D) Kidney
- E) Ureter
- F) Urethra

# CHAPTER 8.0

## Movement





# 8.1 LOCOMOTION SYSTEM

## You will:

---

- learn the functions of locomotion system;
- learn the parts of the human skeleton.

## STQ

---

How does our skeleton move?

## Key terms

---

Bone - the hard and calcified connective tissue forming the skeleton of most vertebrates; Muscle - a body tissue that can contract and produce movement; Axial - situated in or on an imaginary line about which a body rotates;

Appendicular - related to arms and legs.

## Facts

---

Babies have 300 bones while an adult human has 206. At birth, some of the bones are made partly of flexible cartilage to allow fewer bone breaks while growing and learning to crawl, walk and run. One good example is the 'soft spot' on baby's head. Baby's skull stays soft and flexible allowing five bones to overlap each other during the birth.

## Text

---

Locomotion system consists of bones and skeletal muscles. Bones link together and make a skeleton. Muscles are attached to bones and provide movement.

The functions of locomotion system are:

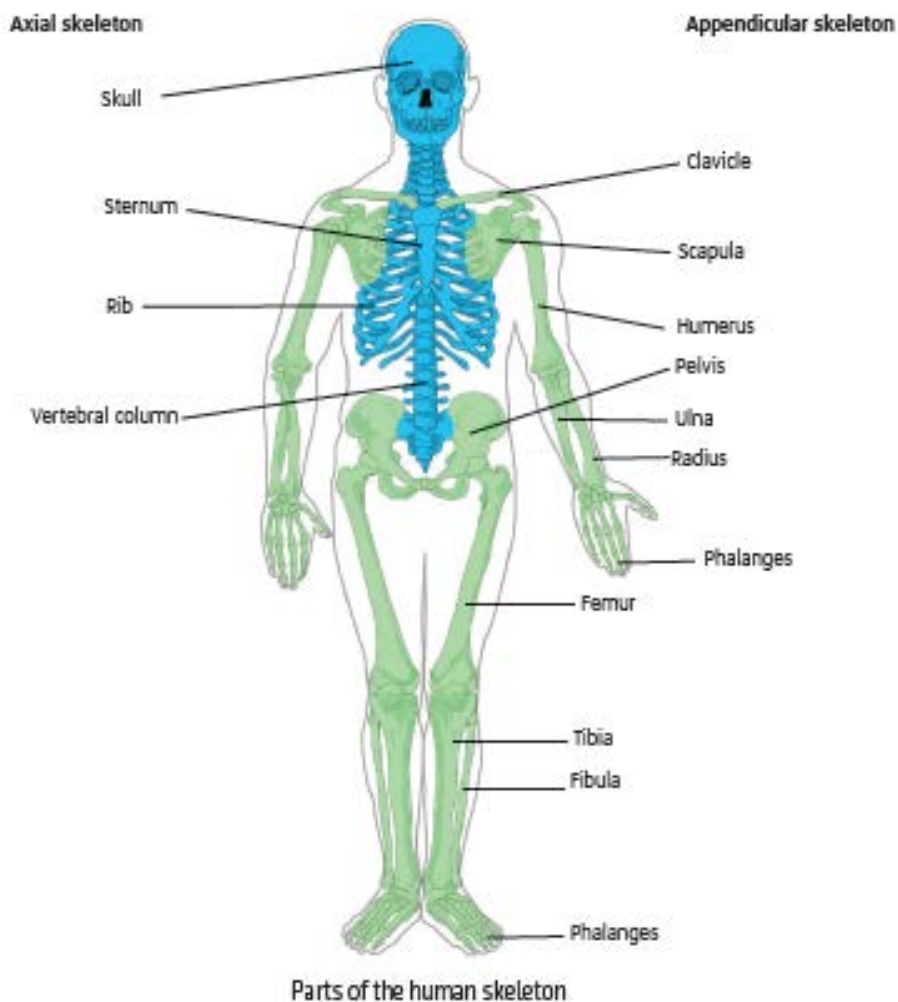
- Movement: Muscles contract and relax to produce force. This force is applied on to the skeleton so that skeleton moves.
- Protection of internal organs: Rib cage protects heart and lungs. The vertebral column protects the spinal cord, and another structure, the skull protect the brain
- Support: The bones of the spine, pelvis, and legs enable people to stand upright, supporting the weight of the entire body.
- Production of blood cells: Red blood cells and white blood cells and platelets are produced by red bone marrow which is found in bones.
- Storage of minerals: The skeleton stores some minerals, such as calcium and phosphorus. These minerals give a certain strength to the skeleton and also are used in many metabolic activities, as needed. Of the human body's calcium, 99% is stored in the bones.

In an adult human skeleton, there are 206 bones. The skeleton is composed of bone and cartilage developed from connective tissue.

The skeleton is divided into two main parts: the appendicular skeleton and the axial skeleton.

- The axial skeleton consists of the skull, backbone, ribs, and sternum.
- The appendicular skeleton: consists of the bones of the arms and legs and the shoulder and pelvic girdles.

Human locomotion system consists of bones and skeletal muscles



## Research time

Use one of the materials like pasta and toothpick. Then construct your skeleton as shown below. Label bones and answer following question:

What are the longest and strongest bones in your body? Why? Explain your answer.

## Activity

---

Take a picture of the human skeleton. Cut it into pieces. Then take small labeling papers and write the names of bones on those papers, now you can try to reassemble parts of skeleton together. Finally, label the bones with their names which you have written into small labeling papers.

## Terminology

---

- bone - сүйек/ кость;
- cartilage - шеміршек/ хрящ;
- girdle - белдеу / пояс
- muscle - бұлшықет/ мышца;
- pasta - макарон;
- pelvic girdle - жамбас белдеуі / тазовый пояс
- to provide - қамтамасыз ету/ обеспечивать;
- to reassemble - қайта жинау/ собрать;
- red bone marrow - қызыл сүйек кемігі/ красный костный мозг;
- rib - қабырға/ ребро;
- skeleton - қаңқа/ скелет;
- skull - бассүйек/ череп;
- shoulder girdle - иық белдеуі / плечевой пояс
- spinal cord - жұлын/ спинной мозг;
- spine - омыртқа/ позвоночник;
- sternum - төссүйек/ грудная кость;
- strength - беріктік/ прочность;
- toothpick - тіс тазалағыш/ зубочистка.

## 8.2 BONE STRUCTURE

### You will:

---

- study the chemical composition, macro- and microscopic structure of the bone.

### Key terms

---

Spongy substance -dense part of the bone, which provides the strength of bones;

Periosteum -a thin, dense connective tissue with which the bone grows together.

### Facts

---

#### Rethink your drink

Many of fizzy drinks contain phosphoric acid which decreases the absorption of calcium in the body. Deficiency of calcium make bone weak, so it breaks easily. So rethink your choice the next time you buy a fizzy drink.

### STQ

---

What can be found inside our bones?

### Text

---

Bone consists of connective tissue. The composition of bone tissue includes inorganic and organic substances. Inorganic substances include calcium and potassium salts; Organic substances are mainly proteins.

Organic substances provide elasticity of the bone (its flexibility and elasticity).

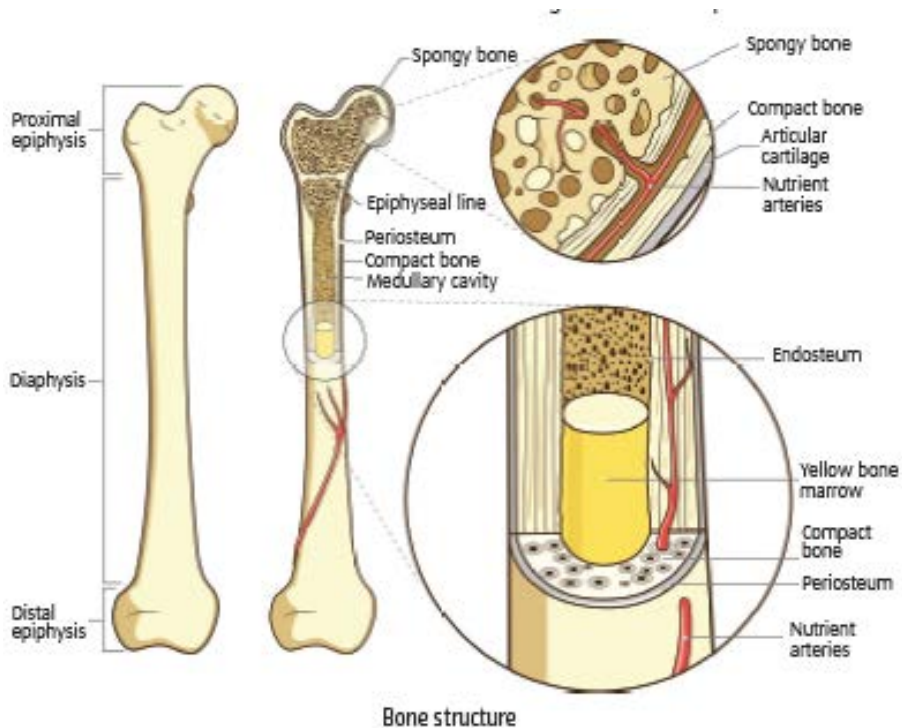
The strength of the bone is provided by combining the hardness of its inorganic compounds with the elasticity of the organic. The bones of a growing organism are flexible, and the bones of an adult (but not old) are strong.

A dense spongy substance forms the heads of the tubular bones. The spongy substance is formed by bone crossbars, crossing in the directions by which the bones experience the greatest stretching or compression. This structure of spongy substance also provides strength and lightness of bones.

The space between the bars in the spongy substance of the heads of the tubular bones is filled with a red bone marrow, which is a hemopoietic organ - blood cells are formed in it.

Short bones are formed mainly by a spongy substance. The same structure has flat bones, of which such parts of the skeleton are composed of scapula, ribs.

The bone along the entire length, up to the head, is covered with a periosteum - a thin, dense connective tissue with which the bone grows together. The nerves and blood vessels pass through the periosteum. The head of the bone is covered with articular cartilage and has no periosteum.



## Lab works

### Pre-lab questions:

1. Why are bones hard and elastic at the same time?  
Explain your answer.
2. Give examples how bones protect our inner organs.

### Methods and Materials:

Gloves, three bones: one normal raw bone, one previously fried bone (in the oven for 1 hour), one bone previously put in vinegar overnight. A teacher prepares bones.

### Procedures:

1. Observe three bones and compare their characteristics.

**Results:**

Bone	Fried bone	Vinegar bone	Normal bone
Fragility			
Elasticity			
Stiffness			

**Safety precautions:**

1. Be careful with vinegar. It is very dangerous! Do not try the lab-work at home.

**Post-lab questions:**

1. Which of these three bones do have less organic molecules? Explain your choice.
2. Which one does have less inorganic molecules? Explain your choice.
3. Explain the importance of balance between organic and inorganic molecules in bone?

**Research time**

---

Arthritis is a disease, which causes painful inflammation and stiffness of the joints. It is very common to elder people. Find causes of arthritis and how to prevent it. Present a poster to your friends.

**Career**

---



## Archeologist

An archaeologist is a scientist who studies human history digging up their remains. Using skeleton bones, he identifies a period of life, gender, culture, and age.

In 1970, Kemel Akishev studied Saka pyramids in Issyk kurgan. He found Golden Warrior in golden armor. The armor has 4000 golden decorations on it.

## Terminology

---

- dense - тығыз/ плотный;
- to digging up - қазбалау/ раскапывать;
- elasticity - серпімділік/ эластичность;
- fragility - сынғыштық/ хрупкость;
- fried - қуырылған/ жареное;
- remains - қалдықтар/ останки;
- scapula - жауырын/ лопатка;
- spongy - кеуекті/ губчатый;
- stiffness - қаттылық/ жесткость;
- tubular - түтікшелі/ трубчатый;
- vinegar - сірке су/ уксус.

## 8.3 JOINTS

### You will:

---

- compare the type of joint between bones.

### STQ

---

Why can your shoulder move more than your fingers or jaws?

### Key terms

---

Joint - the area where two bones are attached to permit body parts to move;

Fixed joint- joint between two bones that do not move;

Semi movable joints - joints between bones where motion is limited.

### Facts

---

The hyoid is a horseshoe-shaped bone in the throat, situated between the chin and the thyroid cartilage.

### Text

---

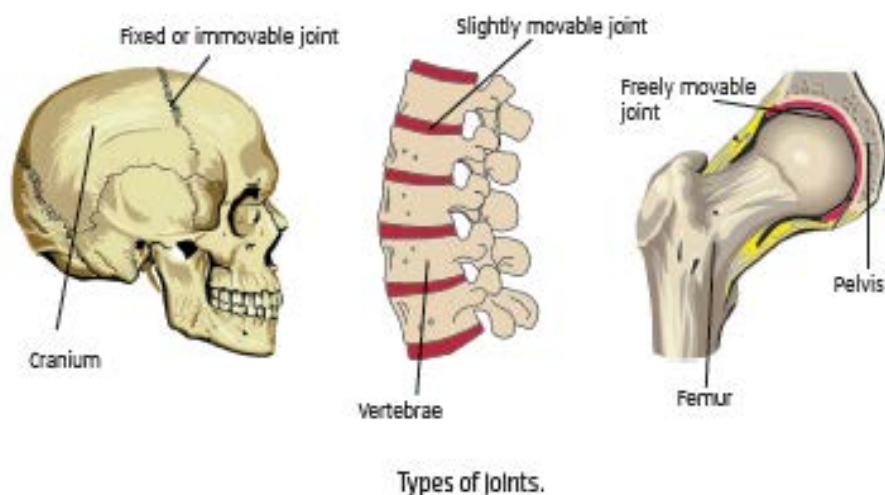
It's also the only bone in the human body not connected to another bone.

Joint connect bones. There are different types of joints.

Joints between bones in our cranium cannot move. These bones are bound tightly. This joint is called a fixed joint.

Some joints can move, but they do not move freely. These joints are called semi-movable joints. Example of the semi-movable joint is joint between bones of our vertebra.

The third type of joint is movable joint. For example, joints in our hands or legs. You can move your hand freely in any direction.



## Activity

Take an egg tray and cut its ten segments separately. Then make two holes from lateral sides of them. Use cotton discs with a hole in the center. These disks should have equal sizes with segments of egg tray.

Then using thick thread go through holes of egg tray segments and disks.

Disks should be found between egg tray segments. Finally tie thread.

Also, now you have a model of the vertebral column. Segments are vertebra, and cotton disks between them are intervertebral discs. Try to make some movements with it: bend, turn to sides.

1. The vertebral column consists of 33 bones. Find out each part (different colors) joint type.
2. What would happen, if vertebrae had movable joints?
3. How do you think why intervertebral disks are found between vertebrae?
4. Suppose what kind of movement could be done if there was only one long bone instead of 33?

## Literacy

---

1. Why do we need immovable joints?
2. Give three examples of movable joints in the human body.
3. Which movable joint can rotate 360 degrees in your body?

## Facts

---

Regular physical activity increases the strength of your joints. It decreases the chance of injuries to your ankles, knees, and hips.

---

---

## Research time

---

One of the traditional games of Kazakh people is asyk. Asyk is a bone taken from domesticated animals like sheep, goat, and cow. This game was and is still popular among young children and had an important educational role. By playing this game, children improve qualities like sharp-sightedness, courage, and accuracy. From which part of skeleton asyk is taken? What is the role of this bone in animals? What are the rules of the asyk game? Find asyk and play with your friends.

## Terminology

---

- courage - батылдық / мужество;
- cranial - бас сүйек / череп;
- to crawl - еңбектеу / ползать;
- direction - бағыт / направление;
- joint - буын / сустав;
- lateral - бүйір жақ / боковой;
- movable - қозғалатын / подвижный;
- to overlap - жабу / перекрывать;
- to reduce - азайту / уменьшать;
- to rotate - айналдыру / вращать.

## 8.4 MOVABLE JOINTS

### You will:

---

- learn the structure of movable joints.

### STQ

---

Why don't the bones of a movable joint hit each other when you walk?

### Key terms

---

Ball and socket joint - a joint that allows rotary movement in every direction;

Hinge joint - a joint between bones that allows movement along one axis to flex;

Pivot joint - a joint in which bones rotate around a single axis.

### Facts

---

Be in tune with your body.

Do you want to jump higher, run faster, and be able to move without pain? You can reach it by doing regular exercises. Inactivity, illness, and injury cause joints to stiff which leads to chronic pain.

Staying active and stretching regularly help to prevent this. Here are some exercises.

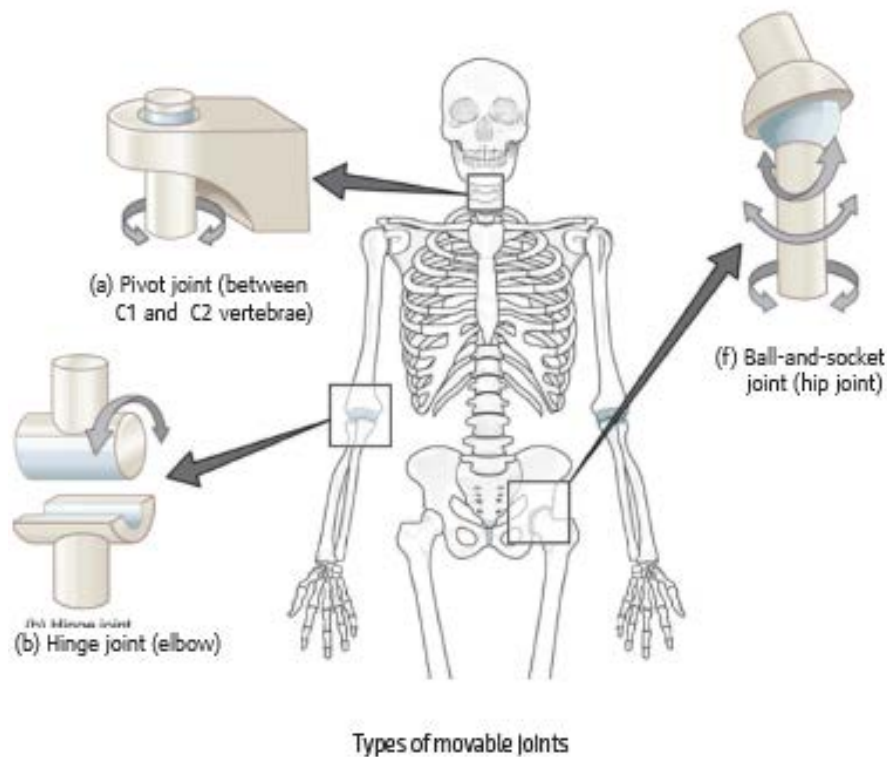
## Text

---

The most common type of joint in the body is movable joint. It allows free movement of limbs and head. Cartilage covers each bone tip in the movable joint. It is very smooth and elastic. It saves joint from friction. Also, movable joint contains a fluid called synovial fluid. It also decreases friction. In order not to lose synovial fluid, the movable joint is covered and protected by a joint capsule.

There are different types of movable joints:

1. Ball and socket joint is a joint which can move in any direction. Your shoulder is an example. You can raise your hand up, put them down, move them forward and backward.
2. The hinge joint is a joint which can move only in one direction. For example your jaw. You can move it only up and down, but can not move it right or left.
3. Pivot joint allows rotation. For example, you can move your head from side to side. You can rotate it to a different direction.



## Research time

---

### Immovable challenge

Take a breathtaking challenge with your friends! This challenge will show that you cannot survive a long time without movable joints! Find any stick and tie it along with your arms. Then try to do the following activities with your friend and record results on the checklist:

- brush your teeth;
- wash your face;
- comb hairs;
- wear clothes;
- write message;
- hug someone.



Then change it to your legs and try to do the next:

- walk;
- pick something up from the ground;
- sit down on a chair;
- run away from the dog;
- play football.

Record the results.

## Activity

---

A teacher prepares Movable Joints card with listed activities.

- Throw a ball;
- Play basketball;
- Do illustrate;
- Kick a ball;
- Do push-ups;
- Dance a flash mob;
- Hop on one leg;
- On a jump rope.

You can add your own activities. Then group into three teams and take Movable Joints cards to demonstrate Activity on in it. Other two teams should guess it correctly. Then team list at least three bones and two joints used to do the Activity.

## Literacy

---

1. Elbow has two joints. Name those joints and give their functions (bending and rotating).
2. Explain how it would affect our movement if we had hinge joint instead of pivot joint in the neck?
3. What Problems may occur if the joint capsule is damaged and synovial fluid runs out?

## Terminology

---

aid - көмектесу / помощь

backward - артқа / назад

to flex - бүгу / сгибать

forward - алға / вперед

friction - үйкеліс / трение

joint capsule - буын қапшығы / суставная капсула

rotation - айналу / вращение

stretching - созылу / растягивание

synovial fluid - синовиаль сұйықтығы / синовиальная жидкость

## 8.5 MUSCLES

### You will:

---

- learn different types of muscles.

### Key terms

---

Myocytes (muscle fiber) - the type of cell found in muscle tissue;

Cardiac muscle - muscle found only in heart;

Smooth muscle -involuntary muscle tissue in the walls of internal organs;

Skeletal (striated) muscle - a muscle that is connected to bones.

### Career

---

#### Massage therapist

Massage therapist helps people with pain, stress and physical diseases by massaging muscles.

He knows how the body muscles interact with one another and perform specialized techniques that help to relax and manipulate muscles.

### STQ

---

Can you control your stomach muscle?

## Text

---

Muscles are part of locomotion system. Their main function is movement.

Muscles consist of cells called myocytes, or muscle fibers. They are long fibers. Myocytes combine and make muscular tissue. There are three types of muscular tissue: smooth, skeletal and cardiac.

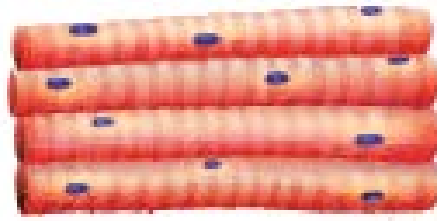
Skeletal muscles are muscles we move with. We can control them. For example, muscles of legs, hands or head. Skeletal muscles consist of a bunch of muscles bound together - fibers. Muscle fibers of skeletal muscles are striated. Connective tissue covers the muscle. Muscle binds to bone with the tendon.

Cardiac muscle is a muscle of our heart. We cannot control cardiac muscles. It moves fast and does not stop. Cardiac muscles are also striated.

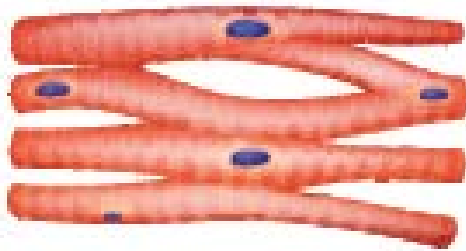
However, muscle fibers of cardiac muscle are closely connected to each other. Sometimes they form branches.

Smooth muscles are muscles in our interior organs, such as the stomach, vessels, etc. We cannot control them. They move independently. Smooth muscles are not striated. They move slowly.

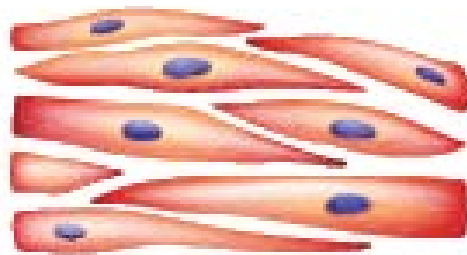
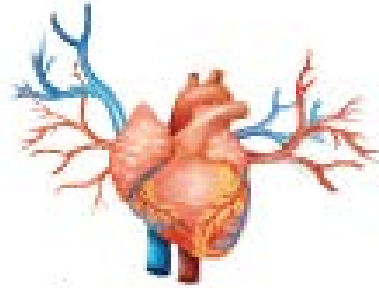
## Types of Muscle Cells



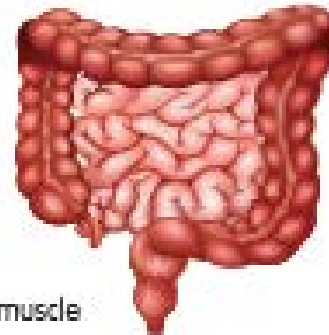
Skeletal muscle



Cardiac muscle



Smooth muscle



## Lab works

---

### Pre-lab questions:

1. Why do we not feel the movement of our stomach?
2. Why do muscles need lots of blood supply? Explain.

### Methods and materials:

microscope, fixed slides of muscle cells.

### Procedures:

1. Observe fixed slides under low magnification.
2. Observe fixed slides under high magnification and draw what you see.
3. Compare different tissues and discuss it with your friends.

### Results:

Fixed slide #	Picture
1	
2	
3	

### Safety precautions:

1. Before using microscope read instructions.
2. Call teacher if you break microscope slide, do not touch it.

### Post-lab questions:

1. Match numbers with muscle types. Explain your answer.
2. Why do skeletal muscle fibers have many nuclei?

## Facts

---

Our face includes 60 muscles. When you smile, you use 17 muscles in your face but 43 muscles when you frown. So it is better and easier to smile than frown.

Qajymuqan Munaytpasuly was very strong, and he is the first professional wrestler in Kazakh history. He won 58 medals and became World Champion in 1910.

## Research time

---

### #TrainMuscleChallenge

Doing muscle exercises prevents many diseases. Choose one exercise and do it with all your classmates. Shoot it on video and post to Instagram with #TrainMuscleChallenge. Challenge others

## Terminology

---

smooth - тегіс / гладкий;

skeletal - қаңқалық / скелетный;

cardiac - жүрекке қатысты / сердечный;

striated - көлденең-жолақты / поперечно-полосатый;

tendon - сіңір / сухожилие;

frown - тұнжырау / хмуриться;

straw - шырын түтікшелері / соломинка;

twine - тоқыма жібі / бечевка;

knot - түйін / узел;

to fuse - қосылу / сливаться.



## 8.6 HYPODYNAMIA

### You will:

---

- understand the result of lack of exercise.

### Key terms

---

Hypodynamia - decrease in strength or power;

Metabolism - the sum of all chemical reactions in our body.

### STQ

---

What are the benefits of physical exercise for your body?

### Career

---

#### Physical trainer

A physical trainer helps people of all ages to live a healthy lifestyle. They safely improve people's physical condition through exercises and proper diet.

### Text

---

Physical exercise is good for our body. When you do, physical exercise muscles need more nutrients than usual. Blood brings these nutrients. Regular physical work makes muscle fibers grow. If people exercise a lot, they become stronger.

Muscles need systematic training. It affects many other organs, such as heart, lungs, etc. Physical exercises accelerate blood flow. Nutrients go faster to organs and tissues. Metabolism occurs faster. Toxins go out of the organism faster.

Lack of physical training brings to a hypodynamia. Nowadays everything is computerized. People do not need to work much. Computers and machines do most of the work. Heart, lungs, and vessels become weak. Immunity weakens. A human can become ill easier. Other psychological and physical diseases develop in the organism.

## Facts

---

How to treat flat feet?

1. Wear shoes with a suitable arch that support your feet.
2. Wear orthotics.
3. Watch your weight and lose weight if necessary.
4. Massage and straighten your feet.

## Research time

---

Do you have flat feet?

Flatfeet is a deformation of bones of feet that completely contact with the ground. So feet cannot properly support the body. If flat feet are not treated, you may even need surgery to fix it. What factors make your feet flat? Moreover, what kind of consequences does it cause? Make a report about it.

## Activity

---

### Good posture challenge

Sit up straight! Stop slouching! We all have heard it a billion times by now.

You have right posture when you keep your bones and joint in the right alignment. So it helps you to use your muscles efficiently, preventing strain and overuse of bone and muscles. Discuss with classmates in groups, the problems resulting from the wrong posture.

When you are standing with the right posture, you should be able to draw an imaginary straight line from your earlobe through your shoulder, hip, knee and the middle of your ankle.

Enter a posture competition with your classmates. Try to spend time at school with good posture. Student loses the competition when forgets to walk with right posture. The last left student will be the winner! However, do not make it just a challenge, make it a lifestyle!

Color your feet with the watercolor set. Put your colored foot down to paper and take a footprint. Find out if you have flatfeet looking at the picture below.

## Literacy

---

1. Why is it important to wear comfortable shoes?
2. Is training enough to avoid obesity? Explain your answer.
3. How does modern technology affect our physical activity?

## Terminology

---

accelerate - жеделдету / ускорение;

consequences - салдары / последствие;

curvature - қисықтық / искривление;

flatfeet - майтабан / плоскостопие;

posture - денені түзу ұстау / осанка;

proper - дұрыс / правильный;

rehabilitation - оңалту / реабилитация;

to strain - керу / напрягать.

# 8.7 BIOMECHANICS OF MOVEMENT

## You will:

---

- learn biomechanical features of human movement.

## STQ

---

How can people walk on two legs and keep balance?

## Key terms

---

Bipedalism - using two feet of standing and walking;

Lordosis - an inward curving of spine;

Kyphosis - an outward curving of the spine.

## Facts

To take one step, we use 200 muscles. Here are primary muscle groups involved in walking.

-The quadriceps raise and push forward thighs and legs and leg.

-The hamstrings move your legs backward.

-The gluteal muscles complete the backward movement of the step.

-The calf muscles are small but are very important in taking a step.

## Text

Human walk on two legs. It is called bipedalism. Human skeleton and muscles structure allows human to walk on two legs.

There are features of the skeletal system for bipedalism:

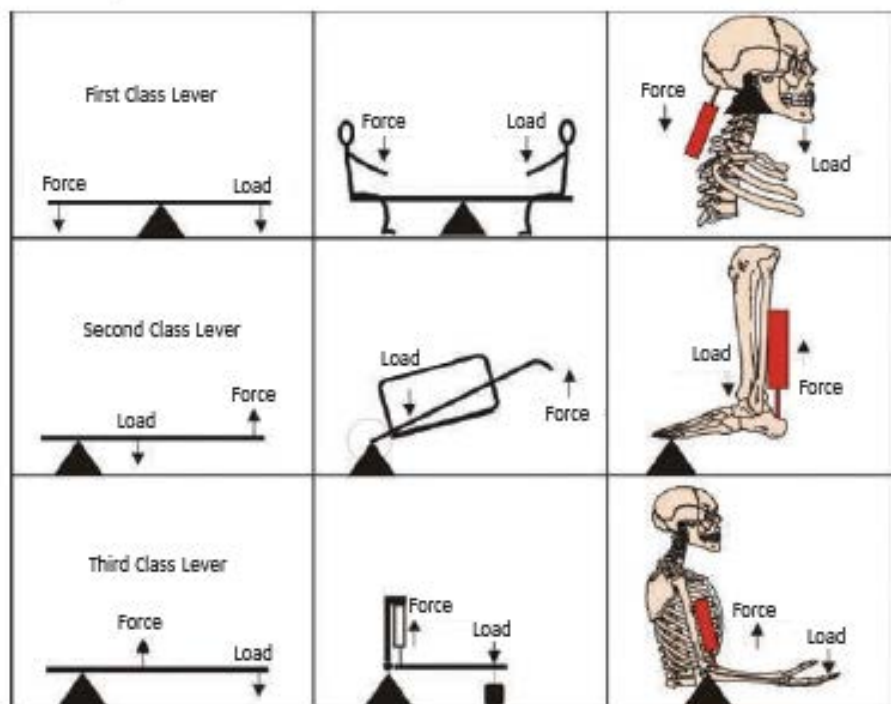
1. The human vertebral column is S-shaped. It has curves: two lordosis and two kyphosis. These curves act like spring during the walk. It softens walking.
2. Mass of lower vertebrae is greater than the mass of higher vertebra. It is because of most of the weight loads on these parts of the vertebral column.
3. Bones of upper limbs are smaller and lighter than lower limbs. It decreases the load. Also, lower limbs give more support to the body.

Our body uses physical laws to hold different positions. One of them is a lever. Mass of the body or an object is the force. Center of mass is a pivot.

Muscles make an effort to balance and hold the body. There are three different lever types. All of them are used in our body.

1. First Class Lever: the pivot is between the force and the load. An example is our head.
2. Second Class Lever: the load is between the pivot and the force. An example is our feet.

3. Third Class Lever: the force is between the pivot and the load. An example is our arm.



## Career

---

### Bioengineer

A bioengineer is a scientist who uses knowledge of engineering and uses it in health care. He makes medical devices, artificial body parts, and organs.

## Activity

---

Using the information above make body levers using a ruler, an eraser as load and a pyramid. Use your hand as force and see how body levers work. Place all materials as shown below.

Place pyramid below in the middle of the ruler. Then put an eraser on one end of the ruler. Loaded with eraser the end lays down. However, if you use your hand's force, both ends will be equal. This body levers hold our head from falling in front.

Now make other types of body levers.

## Literacy

---

1. Why a person gets shorter during the day?
2. What are the differences between human and cat skeleton?
3. What are the benefits of bipedalism?

## Research time

---

You are About 1 Centimeter Taller in the Morning than in the Evening!

During the day, cartilage in some body parts compresses a little. However, when we sleep, cartilage renews back. Measure your height early in the morning and in the evening, then record. Compare results. Which of your body parts are affected?

## Terminology

---

application - қолдану / употребление;

calf muscles - балтыр бұлшықеттері / икроножные мышцы;

to compress - қысу, сығу / компресс, сжимать, сдавливать;



gluteal muscles - жамбас бұлшықеттері / ягодичные мышцы;

hamstrings - тізе асты сіңірлер / подколенные сухожилия;

levers - шығырлар/ рычаги;

load - жүк / нагрузка;

quadriceps - төртбасты бұлшықет / четырехглавая мышца;

vertebral column - омыртқа жотасы / позвоночник.

# Problems

## Test questions with one right answer

1. Red bone marrow produces:

- A) lipid
- B) blood cells
- C) bone cells
- D) nerve cells
- E) muscle cells

2. Type of joint that connects vertebrae:

- A) semi movable
- B) fixed
- C) moveable
- D) ultra movable
- E) None of the above

3. Show heart muscle:

- A) skeletal
- B) fiber
- C) cardiac

D) smooth

E) striated

4. Newborn babies have about \_\_\_\_\_ bones.

A) 100

B) 206

C) 300

D) 500

E) 600

### **Test questions with several (max 3) right answers**

1. Locomotion system functions:

A) protects inner organs

B) helps in movement

C) produces hormones

D) controls body activities

E) protects the body from microbes

F) responsible for reflexes

G) forms blood cells

H) removes undigested food

2. Difference between baby bones and adult bones:

- A) Some baby bones are partly made of cartilage
- B) Babies have more bones than adults
- C) Baby bones are more fragile than adult bones
- D) As babies grow their bones separate from one another
- E) Adults have soft spots on their heads
- F) Old people bones have more elastic fibers than baby bones
- G) Adults have more elastic bones than babies
- H) As babies grow, their bones fuse together

### 3. Parts of movable joint:

- A) ligament
- B) tendon
- C) muscle
- D) synovial fluid
- E) red bone marrow
- F) joint capsule
- G) cartilage
- H) yellow bone marrow

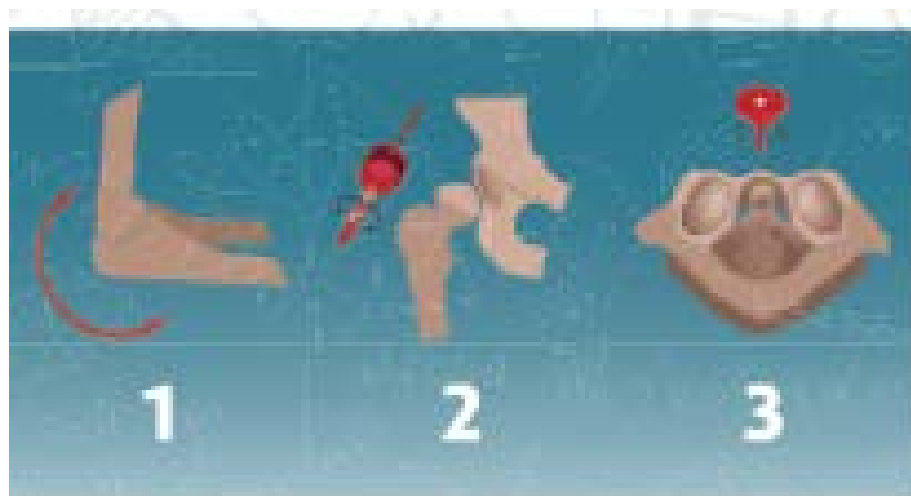
## Matching

1. How are these bones connected to each other?

1. Skull bones
2. Ribs to the sternum (chest)
3. Humerus to the scapula (shoulder)

- A) Immovable joint
- B) Slightly movable joint
- C) Tendon joint
- D) Movable joint
- E) Ligament joint
- F) Cartilage joint

2. Find movable joint type for following examples:



- ◆ A) Hinge
- B) Condylloid
- C) Plane

D) Saddle

E) Ball and socket

F) Pivot

# CHAPTER 9.0

## Coordination and regulation



# 9.1 EYE STRUCTURE

## You will:

---

- explore the features of visual perception.

## Key terms

---

Sclera - white and the outermost layer of the eye;

Cornea - transparent part of the eye that covers iris;

Retina - the innermost layer of the eye containing light-sensitive receptors.

## Facts

---

Be careful with to your eyes

1. Avoid eye strain by 20-20-20 rule. Every 20 minutes, look at something 20 feet (6 meters) away for 20 seconds
2. Wear sunglasses to protect your eyes from harmful UV rays.
3. Make sure that your eyes are level with the screen. Work in welllit areas and limit your time looking at electronic.
4. Visiting an eye doctor regularly helps to protect your sight and lets you see better.
5. Eat useful food like carrots and fish to keep eyes healthy.



6. Often blink to prevent drying of eyes.

7. Regularly do exercises as shown in the picture to prevent eyeProblems.

## Text

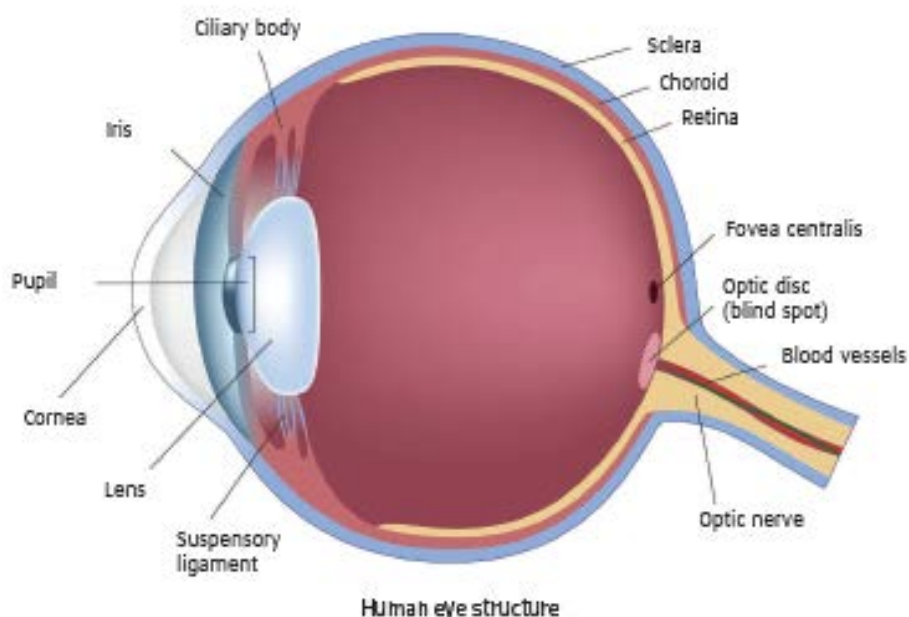
---

Vision helps human to analyze the world. We see things, colors, processes using eyes. An eye is a complicated organ. It consists of three layers: inner, outer and middle.

The outer layer consists of sclera and cornea. The sclera is a white layer. It protects eyes from damage. The cornea is a transparent layer.

The middle layer consists of three parts: iris, ciliary body, and choroid. The ciliary body holds the lens of an eye. The lens focuses incoming light. Iris has eye coloring pigments. In the middle of the iris, there is an opening called pupil. Light is entering through this opening. Choroid has blood vessels. They bring nutrients to the eye.

The inner layer is a retina. It has cells called receptors. They receive information from outside and transfers it to our brain.



## Facts

---

Newborns do not produce tears. They make crying sounds, but the tears do not start flowing until they are about 4-13 weeks old.

## Lab works

---

### Eyesight

#### Pre-lab questions:

1. What is the importance of eye and why we should take care of it?
2. Which eye structure determines a person's eye color?
3. What are similarities between eyes and camera?

**Methods and materials:**

Sivtsev table, tape-measure.

**Procedures:**

1. Print Sivtsev table on three A4 papers on landscape orientation.
2. Put it on the wall. 10th line of the table should be on the level of your eyes.
3. Illuminate the table with the lamp.
4. Stand 5 meters away from the table.
5. Close one eye and read the letters.
6. If you do not see the letter, come closer to 0.5 meters. Repeat until you see the letter.
7. Measure your eyesight using the formula:  $V=d/D$

where,

V - eyesight;

d - distance, when you see the letter;

D - distance, where you started the measurement.

**Results:**

d	D	v

## Post-lab questions:

1. Describe the path of light passing through the eye to retina?
2. How do eyes take nutrients?
3. Why does human have two eyes?

## Career

---

### Ophthalmologist

An ophthalmologist is a medically trained doctor who is an expert in diagnosing, treating and preventing eye diseases.

## Terminology

---

pupil - қарашық / зрачок

lens - көз бұршағы / хрусталик

iris - нұрлы қабық / радужная оболочка

complicated - күрделі / сложный

transparent - мөлдір / прозрачный

to blink - жыпылықтау / моргать

well-lit - жақсы жарықтандырылған / хорошо освещенный

retina - торлы қабық / сетчатка

sclera - ақ қабықша / склера, белковая оболочка

outermost - ең сыртқы / самый внешний

contagious - жұқпалы / заразительный

to determine - анықтау, белгілеу / определять

## 9.2 HEARING

### You will:

---

-explore the characteristics of auditory perception.

### Key terms

---

Outer ear - collects and transmits sound waves to middle ear;

Middle ear - makes sound signals stronger;

Inner ear - responsible for hearing and maintaining balance.

### Facts

---

Ears help to keep balance. The inner ear has three fluid-filled tubes called semicircular canals.

When you move your head, the liquid in tubes moves too and sends signals to the brain about your position. The brain sends a message to muscles to keep balance. Find semicircular canals in ear structure picture.

### Text

---

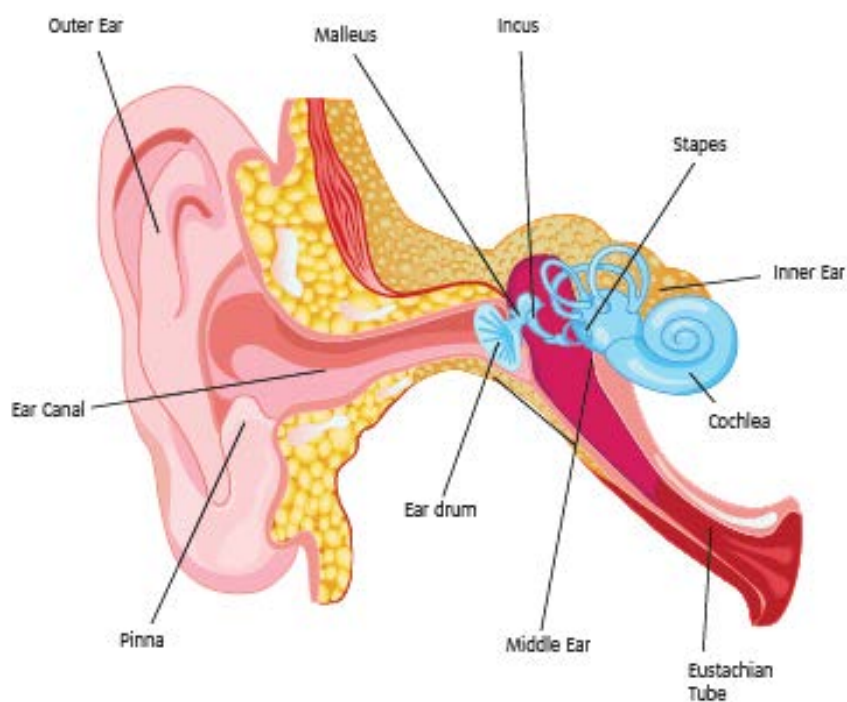
People use sounds to communicate. Also, humans need to hear sounds to be aware of the danger. We hear with our ears. The ear consists of three parts: the outer ear, middle ear, and inner ear.

The outer ear consists of the external pinna and the ear canal collects the waves and sends them to the ear canal. There, sound waves hit the eardrum.

In the middle ear, there are three bones. They accept vibrations from the eardrum and send to the inner ear. Also, middle ear has a eustachian tube.

It connects ear and pharynx. This tube equalizes the pressure inside and outside of the eardrum.

The inner ear consists of the cochlea and semicircular canals. There are special receptors in the cochlea. They send information from sound vibrations to the brain.



## Facts

---

Your ears never shut down, not even while you are sleeping. They still hear sounds, but these sounds do not register with your brain. This would explain why sometimes you will suddenly wake up whenever you hear a slight sound.

## Lab works

---

### Hearing

#### Pre-lab questions:

1. Why does ear produce earwax?
2. What is the role of the pinna in hearing?
3. What is the role of eustachian tube?
4. What parts are located in the inner ear?

#### Methods and materials:

ticking watch, ruler.

#### Procedures:

1. Before starting the experiment class should keep total silence.
2. Put watch to your left ear.
3. Close your right ear.
4. Move away from the watch from your left ear.
5. Stop when you do not hear the ticking sound.



6. Measure the distance from your ear to the watches.
7. Do the same procedure with the second ear.

### Results:

	Left ear	Right ear
Distance (cm)		

NOTE: The normal hearing the distance between 10-15 cm.

### Post-lab questions:

1. Describe the pathway of sound waves passing through the ear to the brain?
2. How is the shape of pinna related to hearing?
3. Which part of the ear takes sound waves and turns them into vibrations?

## Facts

---

Take care of your hearing

## Literacy

---

1. Loud sounds can damage the ear and lead to hearing loss. The sound level must not exceed 85 decibels (dB).
2. Do not insert objects into the ears. They may injure the ear canal or eardrum also can cause ear infections. Earwax is the ear's mechanism for self-cleaning.

3. If you have Problems with your hearing or ear pain visit an otolaryngologist.

## Career

---

An otolaryngologist is a doctor who examines conditions, diagnoses and treats diseases of ear, nose, and throat. Hearing loss is an important health issue. It is the third most common disease after cancer and heart disease. The otolaryngologist may suggest hearing aid for people with this problem.

## Terminology

---

cochlea - ұлулы дене / улитка;

ear canal - сыртқы есту жолы / слуховой канал;

eardrum - дабыл жарғағы / барабанная перепонка;

earwax - құлық / ушной воск;

eustachian tube - Естахийев түтігі / Евстахиева труба;

pinna - құлақ қалқаны / ушная раковина;

semicircular canals - жартыдөнгелекше өзектер / полукружные канальца;

to injure - зақымдау / повредить

## 9.3 RECEPTORS

### You will:

---

- learn structures of visual and hearing receptors.

### STQ

---

How does our body receive information from outside world?

### Key terms

---

Receptor - cell able to respond to light, heat, or other external stimulus and transmit signals to sensory nerves;

Photoreceptor -receptor sensitive to light;

Hair cell - receptor sensitive to sound vibration.

### Research time

---

Colour blind person cannot distinguish between certain colours, usually between greens and reds, and sometimes blues. In very rare cases people see only in black and white.

In order to check colour blindness Ishihara's colour blind plates are used. Visit website below and test yourself for colour blindness:

<http://www.colour-blindness.com/ishihara-38-plates-cvd-test/>

## Text

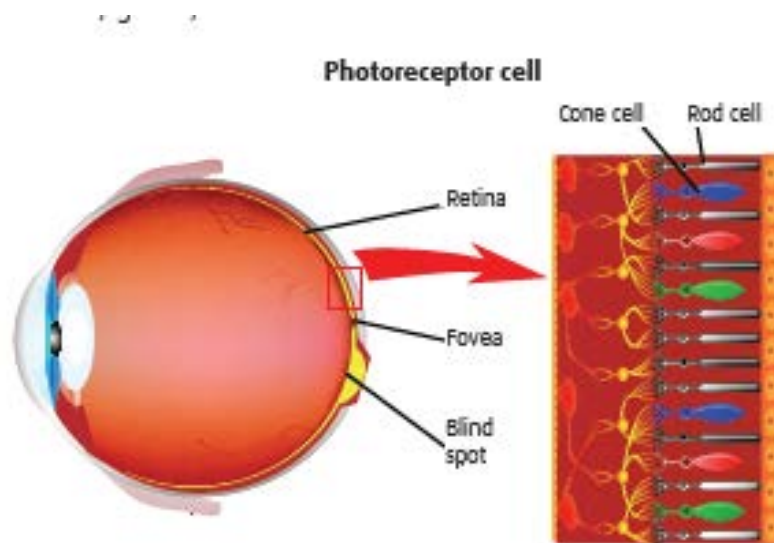
---

Receptors are cells which receive information from outside and send it to the brain. They are found in all parts of human body, mostly in sensory organs.

There are different receptors in different organs. Their structures are different because they accept different information.

Receptors that accept light are photoreceptors. They are rods and cons.

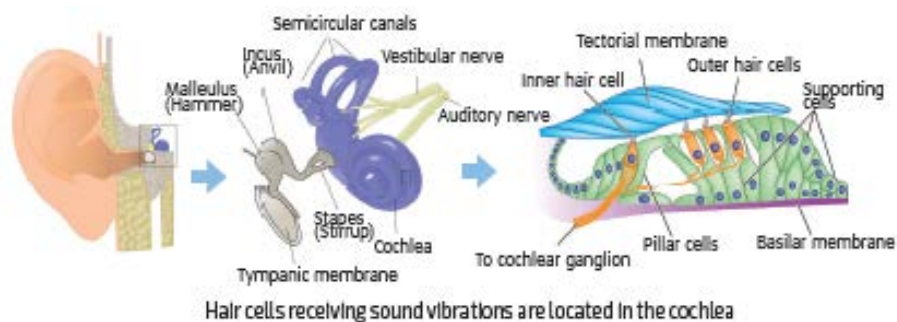
Rods are sensitive to light. They do not distinguish color. They work mostly during the night. Cones give us color vision. They are most active during the day. There are three types of cones. Each type of cone is sensitive to different colors: red, green, blue.



Sound waves travel through 2 types of matter: gas and solid. Sound travels through the air in ear canal till eardrum. This is called air conduction. After eardrum, sound waves travel through ear bones as solid. This is called solid conduction.

Ear bones vibrate with sound waves and send this vibration into the cochlea.

There are special hearing receptors in cochlea called hair cells. They accept information about vibrations inside the cochlea. Then hair cells send these information to the brain.



## Lab works

---

### Finding blind spot

#### Methods and materials:

blind spot papers, three flashlights, cellophane tapes of three different colors: red, green and blue, scotch tape, ping-pong ball, 3 A5 sized cardboards.

#### Procedures:

1. Hold image with the right hand. Close your left eye and look at the square with your right eye.
2. Slowly bring the page closer to you. At a certain distance, the red dot will disappear.

### **Post-lab questions:**

1. Why don't we notice disappearing objects in the blind spot?

### **Mixing colors**

#### **Procedures:**

1. Wrap red cellophane tape to the first flashlight so that it can produce red light. Use scotch tape if necessary. Do the same with other cellophane tapes and flashlights.

2. Put flashlights (a) as on scheme, turn them on and close them with cardboards (b). Then put ping-pong ball (c) in about 20 cm away from flashlights.

3. Open cardboards one by one and observe the change of colors on pingpong ball shadow. Try mixing colors.

### **Post-lab questions:**

1. How to produce white color by mixing red-blue-green colors?

### **Air and solid conduction**

#### **Procedures:**

1. Work in pairs. Ask your partner to tap slightly on a desk and listen to it. Then, lay your ear on a desk and ask to tap again.

2. Later ask your partner to make heavy taps and listen to both positions.

3. Record your observations on table below.

### Results:

Activity	Sound observations
Light taps heard through air	
Light taps heard through desk	
Heavy taps heard through air	
Heavy taps heard through desk	

### Post-lab questions

1. Whales can hear one another from 1500 km away. How is this possible?

## Physics in biology

---

The sound is a mechanical wave. It can travel through any gas, liquid or solid matter. In human, sound waves enter the ear and turn into vibration. The range of human hearing is between 20Hz and 20,000Hz (hertz).

## Terminology

---

rods - таяқша тәрізді жасушалар / палочки;

cons - колба тәрізді жасушалар / колбочки;

hair cells - түкті жасушалар / волосковые клетки;

colour blindness - дальтонизм;

blind spot - соқыр дақ / слепое пятно;

conduction - өткізгіштік / проводимость;

hertz - герц;

vibration - діріл, тербеліс / вибрация;

wave - толқын / волна;

stimulus - тітіркендіруші / раздражитель.



## 9.4 ENDOCRINE GLANDS

### You will:

---

- determine the location of the endocrine, exocrine and mixed glands;
- explain main functions of glands.

### Key terms

---

Hormone - chemical messenger produced by glands that regulate theActivity of target organ; Endocrine gland - organ that secretes hormones into the blood; Exocrine gland - organ that secretes molecules into or out of body cavities;

Mixed gland - secretes substances into blood and body cavity.

### STQ

---

Sultan Köse is the tallest man in the world. His height is 251 cm. Chandra Bahadur Dangi is the shortest man in the world. His height is 54.6 cm. Why do these two people have different heights?

### Text

---

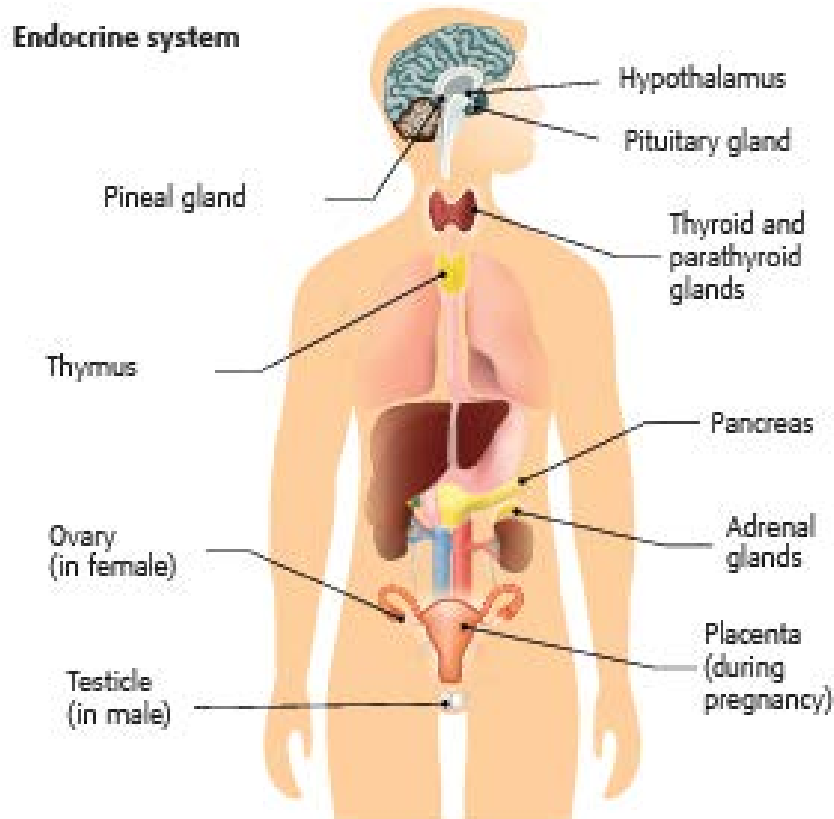
Glands are organs that synthesize different molecules and secrete them outside. There are two main types of glands: exocrine and endocrine.

Exocrine glands secrete molecules into body cavities or out of the body. Glands inside our mouth, stomach, and intestine secrete enzymes. These enzymes neutralize pathogens and help to digest food. Lacrimal glands secrete tears. Tears clean eyes and kill bacteria. Sweat glands produce sweat. Sweat cools the body in hot temperatures. Also, excess salt and water are removed from the organism.

Endocrine glands secrete molecules called hormones into the blood. Hormones regulate body organs. They go through blood to organs they regulate. Then they start and end different processes done by the organs. Organs regulated by hormones are known as target organs.

There are some glands, which are both endocrine and exocrine. These glands are called mixed glands. For example, pancreas. It secretes hormones insulin and glucagon into the blood. These hormones regulate the concentration of glucose in the blood. Pancreas also produces enzymes into the intestine. These enzymes help in food digestion.

Though stomach is not a part of the endocrine system, it releases the hormones ghrelin and gastrin, where the first one induces hunger, and the second one stimulates the secretion of gastric juice.



Gland	Hormone	Function
Pituitary gland	Growth hormone	Stimulates growth and bone formation
Thyroid gland	Thyroxine	Accelerates metabolism and heart rate
Adrenal glands	Epinephrine (adrenaline)	Increase blood pressure, glucose level
Pancreas	Insulin	Controls glucose concentration in blood by converting excess glucose into glycogen
Testes	Testosterone	Stimulates formation of secondary male gender characteristics
Ovary	Estrogen	Stimulates formation of secondary female gender characteristics

## Activity

---

Thyroid gland	Adrenaline	Male organism	Heart
Ovary	Blood pressure	Thyroxine	Female organism
Pancreas	Testes	Insulin	Metabolism
Pituitary gland	Estrogen	Bone	Adrenal gland
Testosterone	Growth hormone	Glucose	

Make word cards by words given above. Students take cards randomly. Then they show their cards and divide into a group of hormones, organs, and glands. Glands should find their hormones. Once pair matches, hormone student walk into the classroom to find its organ. Organs stand frozen in different place of the classroom. Then, organ tells what happens to him when that hormone comes. Remember that thisActivity should be done fast! After that, you can change cards and repeat theActivity.

## Literacy

---

1. How does the endocrine system work with other body systems?
2. When does insulin level increase in blood?
3. Testes produce sperm cells and testosterone. What type of gland is this? Explain your answer.

## Facts

---

Increase your hormones of happiness

1. Serotonin controls mood. It flows when you feel important and absent when you feel lonely. Take gratitude by helping people, because it helps you to feel important.

2. Endorphin is released in response to pain and stress, to help lighten worry and depression. Laughter is one of the easiest ways to produce endorphin.

## Research time

---

When you see a snake outdoors, usually you will run away so fast that nobody can catch you. This is our common reaction to danger. It is called fight or flight response. This response helps us to protect ourselves from danger. What changes occur in our body when we are scared? Which hormone is responsible for this? Write about your memories of flight and fight response.

## Terminology

---

adrenal glands - бүйрек үсті безі / надпочечники;

lacrimal gland - көз жасы безі / слезная железа;

ovary - аналық бездері / яичники;

pituitary gland - гипофиз;

to release - бөліп шығару / выделять;

to synthesize - синтездеу / синтезировать;

testes - ұрық бездері / семенники;

thyroid gland - қалқанша безі / щитовидная железа.

## 9.5 DISEASES OF THE ENDOCRINE SYSTEM

### You will:

---

- learn the diseases of pancreas and thyroid gland.

### Key terms

---

Myxedema - a disease caused by the deficiency of thyroxine;  
Grave's disease - a disease caused by overproduction of thyroid hormone;

Diabetes - a disease caused by the deficiency of insulin.

### STQ

---

What is diabetes and how is it treated?

### Text

---

Hormones regulate organism. If they do not work properly, the human gets ill. Hormones sometimes may not work properly or may overwork.

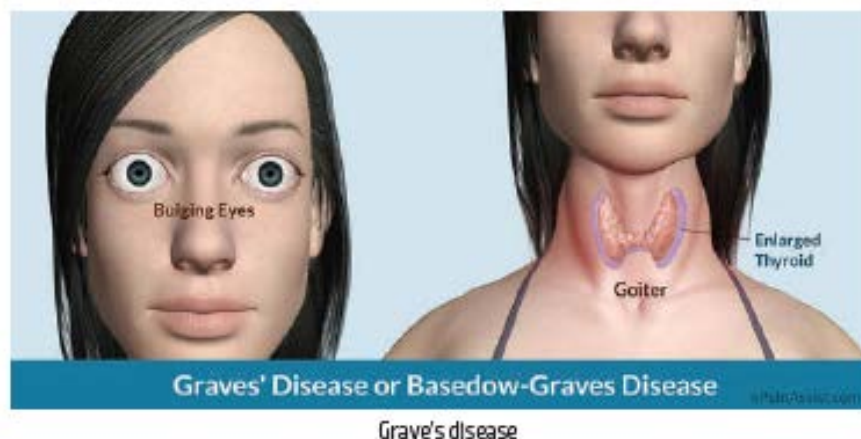
When thyroid gland does not produce enough thyroxine, it is myxedema disease. People with myxedema have lower metabolism rate, lower body temperature, blood pressure, etc. The human face becomes pale.

Thyroid gland overworks it is called Grave's disease. Human eyes become large. Blood pressure and heart rate increase. The human becomes anxious and gets tired fast. People with Grave's disease eat a lot but do not gain weight. To cure this disease, doctors cut part of the thyroid gland.

The pancreas secretes hormones insulin and glucagon. Insulin decreases the amount of glucose in the blood. If insulin does not work properly, the concentration of glucose in blood increases. This disease is called diabetes. People with diabetes want to drink much. Also, they lose weight. Doctors give insulin for patients to cure diabetes.

Most people with diabetes need to check their blood sugar levels regularly. Meters are devices that test your blood sugar. A small, sharp needle used to take a drop of blood from the fingertip. Patient drips the blood on the test strip.

Then, the patient puts the test strip into a meter that shows blood sugar levels. An average blood sugar level before the meal is min 4 mmol/L and max six mmol/L. After the meal, it can be under 7.8 mmol/L.



## Activity

---

Take any endocrine disorder. Divide into groups by 2-3 students and prepare a poster. Keep in mind that poster should have information about the disease as shown below:

- discovery in short
- photos
- symptoms
- treatment

On the next lesson make a gallery with all posters of the class. Use sticking papers to stick to the best posters. Remember that one student can give his or her choice to only one poster. A poster that collects the most stickers will be the winner.

Work in pairs, where one student is a doctor; one is a patient. The patient takes a card from the teacher where the certain endocrine disease is written. Without telling the name of the disease, the patient should tell and show symptoms of the disease. The doctor should find the disease and suggest treatment for it.

## Literacy

---

1. Why does myxedema disease occur?
2. What Problems can be caused by overproduction of hormones?
3. In markets, we can see special products for diabetic people. What are the common characteristics of these products?



## Career

---

### Endocrinologist

An endocrinologist is a doctor who has specialized in the endocrine system. They diagnose and treat hormone-related diagnose and imbalances caused by endocrine glands.

## Research time

---

Iodine is an important element for thyroid gland function. If babies or pregnant women do not get enough iodine, it will result in mental retardation. This disease is called cretinism. Make a prediction what amount of iodine can lead to mental retardation or other health issues.

Make a list of food products that have iodine.

## Terminology

---

anxious - мазасыз / беспокойный, тревожный

overproduction - керек мөлшерден артық шығару /  
перепроизводство

sharp - өткір / острый

discovery - жаңалық ашу / открытие

to drip - тамшылау / капать

mental retardation - ақыл-ес кемтарлығы / умственная  
отсталость

to secrete - бөліп шығару / выделять

to diagnose - тексеру, диагностикалау / диагностировать.

## 9.6 SKIN RECEPTORS

### You will:

---

- explore the sensitivity of the skin.

### Key terms

---

Thermoreceptors -receptors respond to changes in temperature;

Mechanoreceptors - receptors respond to vibration, pressure, or other mechanical stimuli;

Nociceptors - receptors respond to pain.

### STQ

---

What happens if we do not have pain receptors?

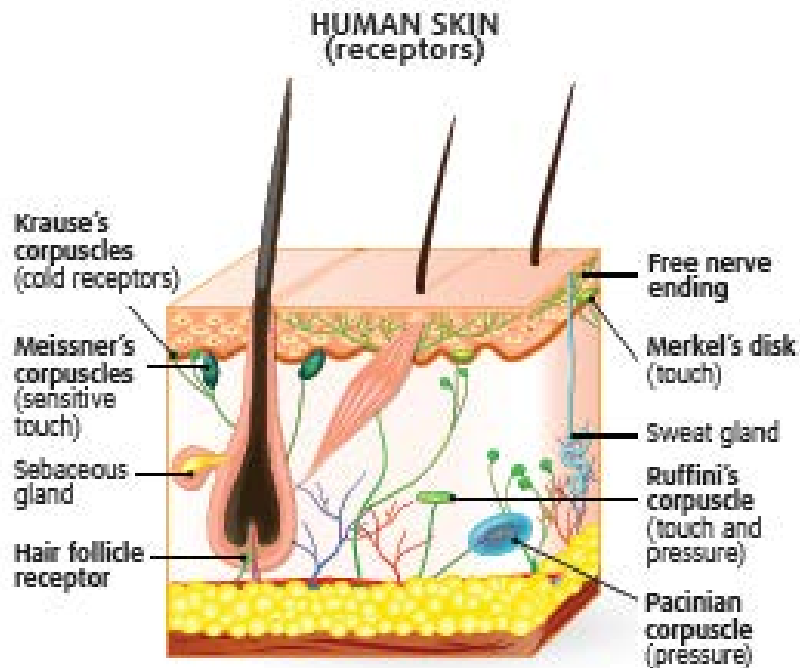
### Text

---

We can feel everything with our hands. It is because our skin has receptors.

Receptors are cells which take information from outside and send signals about it to the brain. There are three types of receptors in the skin: thermoreceptors: they accept information about temperature (cold or hot); mechanoreceptors: they accept information about pressure and touch nociceptors: they accept information about pain.

Skin receptors help people detect form and size of an object. Also, nociceptors help humans to be safe. You always take your hand away if you feel pain.



## Lab works

---

### Sensitivity

#### Pre-lab questions:

1. What if we do not have receptors in the skin?
2. Can you feel moisture with your skin? Explain your answer.
3. Is it good not to feel pain? Explain your answer.

#### Methods and materials:

Pair of dividers, ruler.

**Precautions:**

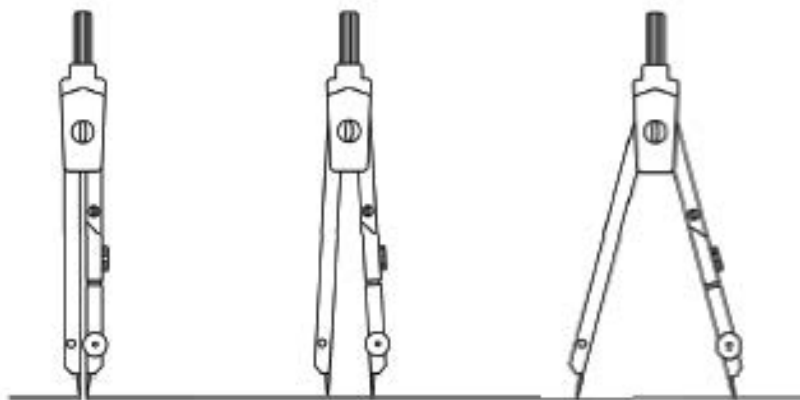
1. Be careful with dividers. Do not push too hard.

**Procedures:**

1. Work in pairs. The first student closes both eyes.
2. The second student should bring two legs of dividers as close as possible and touch the outer side of the palm of the first student.
3. The second student then should increase the distance between the legs of the dividers to 1 mm and touch the outer side of the palm again.
4. The second student should continue increasing the difference between the legs of the dividers until the first student senses two touches.
5. Repeat the experiment with the inner side of the palm.
6. Repeat the experiment with an elbow.

**Results:**

	Outer side of the palm	Inner side of the palm	Elbow
Distance where you feel two touches in mm			



### Post-lab questions:

1. Why do you feel it as one object when the dividers tips are close to each other?
2. Which region of observed skin is most sensitive? Explain your answer.
3. Why do we also feel pain when we pour something hot on our skin?

## Facts

---

The first sense developed in human embryo is touch. You have 5 million touch receptors in the skin, and 3000 of them are found in fingertips. These touch receptors in fingertips play a very important role for blind people.

They use these receptors even for reading and writing. There is a special alphabet called Braille. It is a system of touch

reading and writing by raised dots.

## Research time

---

Work in pairs. Ask your partner to turn his back to you. Touch his back using your some fingers in different areas of the back. Ask how many fingers there are. You can do that with different numbers of fingers. Can he find them correctly?

After asking him to close his eyes. Touch his palm with your fingers and ask how many fingers there are. Compare the results and explain the reasons.

## Terminology

---

back - арқа / задняя часть;

blindfold - көзін байлау / повязка на глаза;

to detect - табу / найти;

divider - циркуль;

dot - нүкте / точка;

fingertip - саусақ ұшы / кончик пальца;

moisture - ылғал / влажность;

palm - алақан / ладонь;

sensitivity - сезгіштік / чувствительность.

## 9.7 THERMOREGULATION

### You will:

---

- describe skin role in maintaining a constant temperature of warm; - describe blooded animals.

### STQ

---

The body temperature of polar bears is 37C. How do they maintain this temperature at North pole?

### Key terms

---

Thermoregulation - regulation of temperature when environment changes;

Cold-blooded animals - animals with unstable temperature;

Warm-blooded animals - animals with constant temperature.

### Facts

---

Why do we shiver?

When you feel cold, the receptors in your skin send messages to your brain telling you to need to warm up. Your brain sends messages to your muscles to contract fast.

This causes shaky limbs and jaws muscles twitch making your teeth chatter. This shaking produces heat.



## Text

---

The temperature of the animal body depends on the temperature of the environment and internal body activity. Animals feel temperature by special cells in the skin called thermoreceptors. They accept information about the temperature outside and send the information to the brain. There are two types of animals:

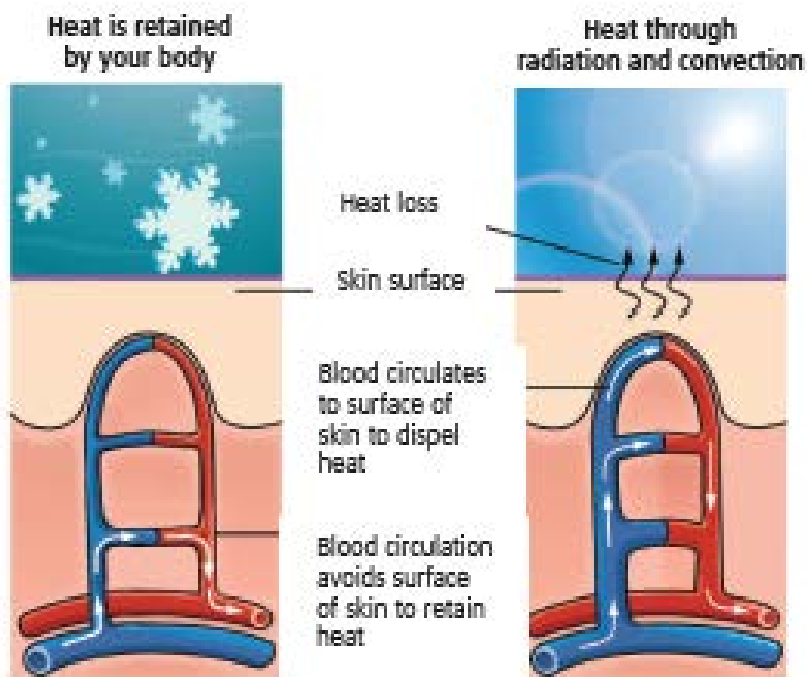
1. Cold-blooded animals: The temperature of these animals depends on outside temperature. They cannot control their temperature. For example fish, amphibians and reptiles.

2. Warm-blooded animals: The temperature of these animals is constant and does not depend on outside temperature. They control their temperature. For example birds and mammals.

Thermoregulation is the process that helps warm-blooded animals control their temperature and keep it constant. Many organs play a role in thermoregulation, but the main organ is skin.

During hot weather, the body needs to cool itself. So, blood vessels of skin expand, and more blood goes through them. This releases energy out of the body. That is why your skin becomes red in hot weather. Also, the skin produces sweat during hot weather. Sweat contains water, which cools the body. These processes help the organism to decrease the temperature and avoid overheating.

During cold weather, the organism needs to produce more heat. First of all, it is done by movement: rubbing hands, stamping feet. Also, blood vessels of skin become smaller. Less blood goes through them, and less heat is released outside. Skin becomes pale.



## Activity

Adaptation is a loss of receptor sensitivity as the result of long-term exposure. For example, if you take a hot shower, at the first you have a strong sense of hot water. However, after a while, you do not sense it so hard, because your skin adapts to that temperature. To see that, try the following experiment.

The most sensitive heat receptors are found in the elbows, nose, and fi ngertips, while cold receptors are found on the chest, chin, nose, fi ngers, and the upper lip.

Take three dishes with water that have different temperatures (10, 25, 400.). First, put your hands into dishes with 10 and 400. Wait for a little and record the changes on your skin. How do both hands change their color? Why?

Explain your answer. How much time does it take for you not to sense cold or hot?

Then put both of your hands into the water with 25.0 temperature. Was there any change in temperature perception? Explain.

## Research time

---

Living organisms have different strategies for thermoregulation. Make a research and fill the table. One example for behavioral strategies is how elephants make water spray to cool down on a hot day.

Strategies	Function	Seen in
Goosebumps		
Fur		
Fat layer		
Changing behavior		

## Literacy

---

1. Why do we drink more water during hot weather?
2. How do penguins control their temperature in the Antarctic?
3. Warm blooded-animals eat more than cold blooded-animals. Explain why.

## Terminology

---

behavior - мінез-құлық / поведение

cold-blooded - суыққанды / холонокровный

exposure - ұшырату / воздействие

goosebump - түршігу / мурашки

to shiver - қалтырау / дрожать

to stamp - жер тебіну / топать

thermoregulation - терморегуляция

twitch - жұлқу / подергивание

warm-blooded - жылықанды / теплокровный.

# Problems

## Test questions with one right answer

1. During conjunctivitis, white of the eye becomes:

- A) Yellow
- B) Purple
- C) Blue
- D) White
- E) Red

2. Pinna is part of:

- A) Tongue
- B) Ear
- C) Eye
- D) Skin
- E) Nose

3. Rods and cones are located in:

- A) Cochlea
- B) Retina
- C) Sclera

- D) Iris
- E) Choroid

4. Organ of the endocrine system:

- A) Heart
- B) Gland
- C) Stomach
- D) Kidney
- E) Lung

### **Test questions with several (max 3) right answers**

1. TRUE about ears:

- A) Cone cells receive audio waves
- B) Have photoreceptor cells
- C) Receive sound waves
- D) Have smallest bones of the human body
- E) Can detect chemicals in the air
- F) Can detect chemicals in food
- G) Protects the body from microbes
- H) Has got three main parts

2. True about sensory receptors:

- A) Receive information and send to heart
- B) All receptors have the same structure
- C) All receptors receive the same information
- D) Rods and cones are photoreceptors
- E) Skin has got thermoreceptors
- F) Tongue has got chemoreceptors
- G) Nose receptors control body balance
- H) Mechanoreceptors of eyes located on the retina

### 3. Hormones:

- A) neutralize microbes
- B) clean eyes
- C) filtrate the blood
- D) stimulate growth
- E) accelerate heart rate
- F) fight with germs
- G) give colour to skin
- H) receive information

## **Matching**

1. Match actions with suitable receptors:

1. Choosing deodorant
2. Listening to music
3. Choosing green cup for tea

A) Thermoreceptors

B) Mechanoreceptors

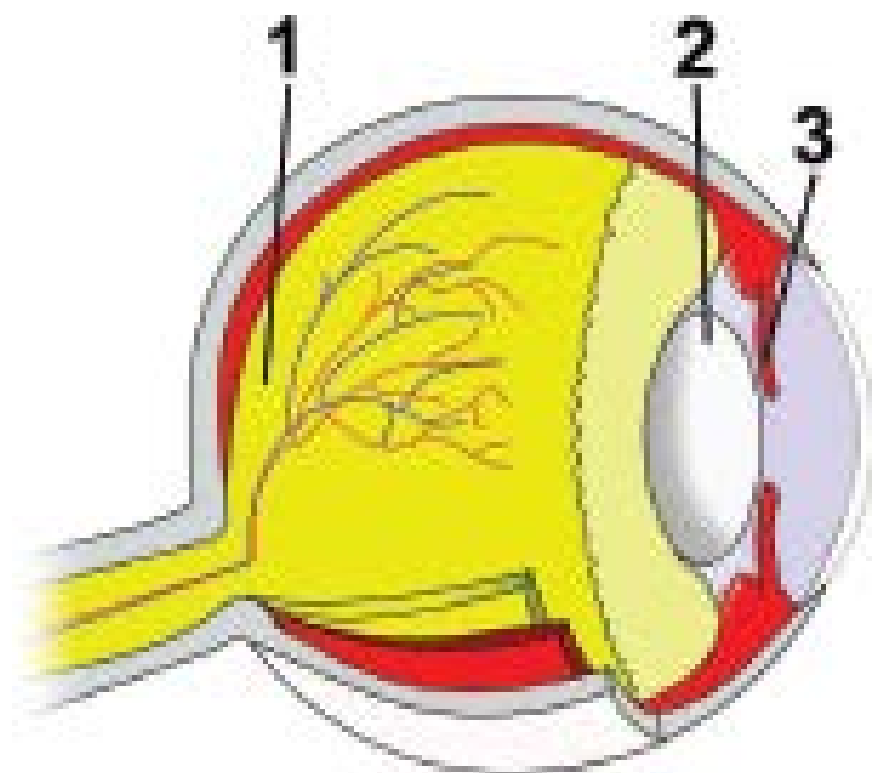
C) Cones

D) Rods

E) Chemoreceptors

F) Pain receptors

2. Label parts of the eye with it functions:





- A) Focuses on object
- B) Contains receptor cells
- C) Contains blood vessels
- D) Controls the size of the pupil
- E) Light passes through it
- F) Pain receptors

# CHAPTER 10.0

## Reproduction



# 10.1 CELL DIVISION TYPES

## You will:

---

- explain the importance of mitosis and meiosis for growth and development of plants and animals.

## STQ

---

Imagine you cut your skin. After some time this wound is healed. What happens during this healing process?

## Key terms

---

Mitosis - a division of the cell into two identical cells, each containing the same number of the chromosome;

Meiosis - a division of the cell, resulting in four cells, each containing half number of chromosome.

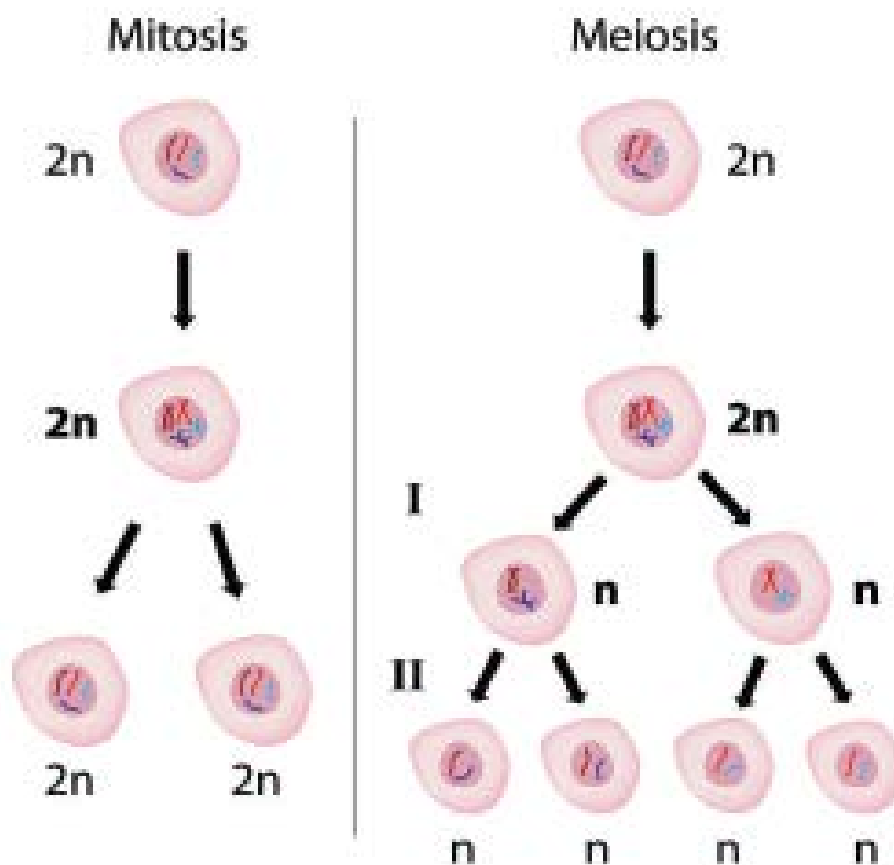
## Text

---

Cell division is the process of formation of new cells. Before cell division, a cell grows, prepares needed materials and stores energy. There are two types of cell division: mitosis and meiosis. Mitosis is a process when one diploid cell ( $2n$ ) divides and forms two identical diploid cells ( $2n$ ). Newly formed cells are known as daughter cells. Mitosis occurs in body cells. By mitosis, organisms grow, repair body parts, and reproduce asexually. Meiosis occurs two times and forms four haploid cells. Two divisions are meiosis I and meiosis II. By meiosis sperm and egg cells are produced.

Chromosomes are structures inside the nucleus, which contain genetic information. Body cells have two times more chromosomes than reproductive cells. Reproductive cells have  $n$ , or haploid, number of chromosomes. Body cells have a  $2n$ , or diploid, number chromosomes. In human skin cell there are 46 ( $2n$ ) chromosomes, sperm cell 23 ( $n$ ); in dog liver cell there are 78 ( $2n$ ) chromosomes, egg cell 39 ( $n$ ).

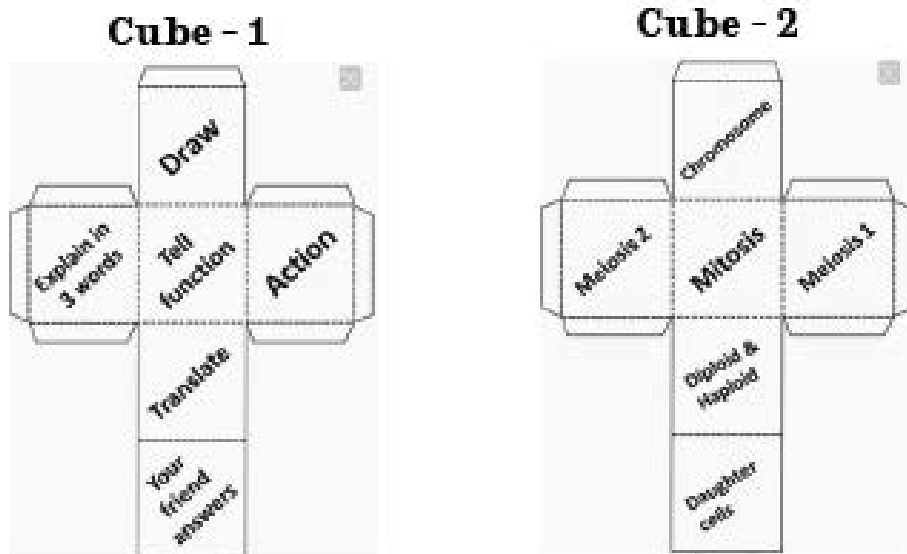
Meiosis occurs only in reproductive cells. During meiosis diploid cell divides Sperm and egg cells are produced by meiosis.



## Activity

## LET'S PLAY DICES!

1. Use a paper to make cubes shown below. Write words on the paper and fold it.



2. Now throw dices and do the action on cube-1 to explain word on cube-2 that falls to you.

## Research time

---

Research scientific materials and write a 150-200 words essay on the topic: “What would be if there wasn’t any mitosis in life?”

## Maths in Biology

---

If a cell fully divides in 30 minutes, how many cells will be produced from one cell in 12 hours?

## Literacy

---

1. What occurs if reproductive cells are formed by mitosis?  
Explain.

2. Why is regeneration not done by meiosis?

3. Cells formed by mitosis are known as daughter cells.  
Explain why?

## Terminology

---

genetic information - генетикалық ақпарат / генетическая информация;

cancer cell - рак жасушасы / раковая клетка;

injury - жарақат / травма;

diploid - диплоидты / диплоидный;

haploid - гаплоидты / гаплоидный;

sperm cell - аталық жыныс жасушасы / сперматозоид;

egg cell - аналық жыныс жасушасы / яйцеклетка.

# 10.2 ANIMAL REPRODUCTION

## You will:

---

- compare reproduction types of animals.

## STQ

---

Hydra does not need a partner to have an offspring. How is this possible?

## Key terms

---

Asexual reproduction - reproduction involving one parent and offspring are identical to the parent;

Sexual reproduction - reproduction involving two parents and offspring are genetically different.

## Text

---

Reproduction is when a parent organism produces new offspring. There are two types of reproduction: asexual and sexual reproduction.

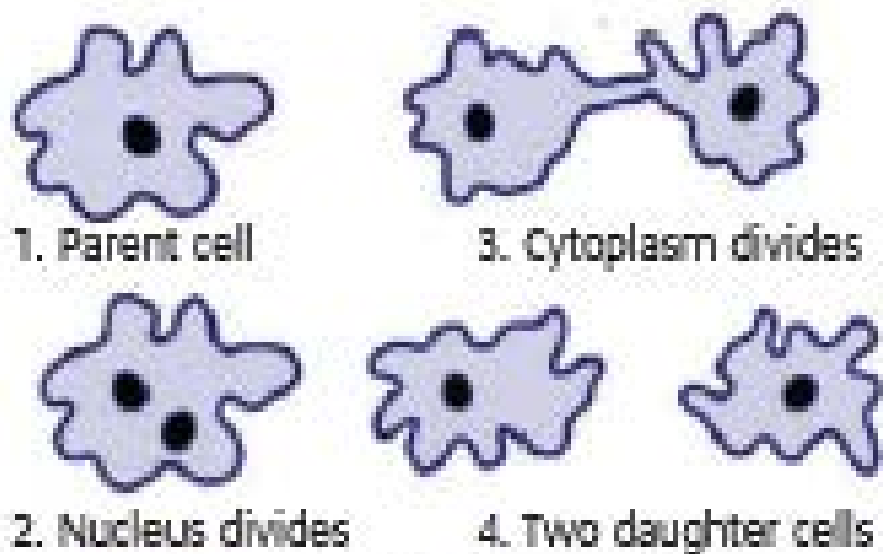
In asexual reproduction, only one parent produces new offspring. In sexual reproduction, two parents of the same species produce new offspring.

There are different animals with different body forms. Some, like a hydra, have very simple body structure, some very complex. Animal reproduction methods are also very different.

## Asexual reproduction in animals

Asexual reproduction occurs by mitosis. Newly formed offspring is identical with parent organism. Types of asexual reproduction, which can be seen in animals: binary fission, budding, and fragmentation.

Binary fission is seen in protists. It is when a single organism (cell) divides into two daughter organisms (cells).

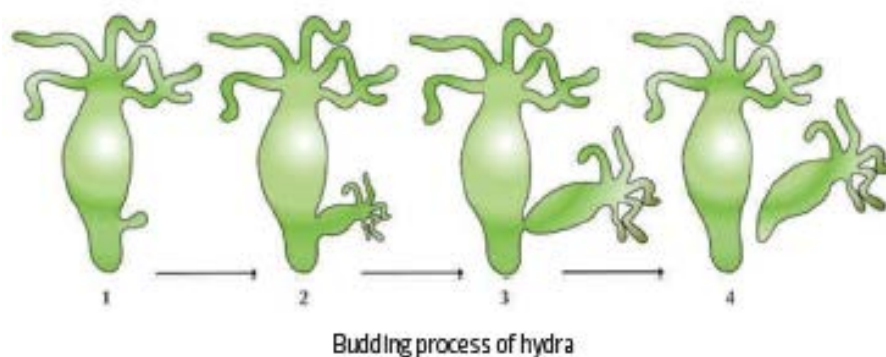


### Binary fission by amoeba

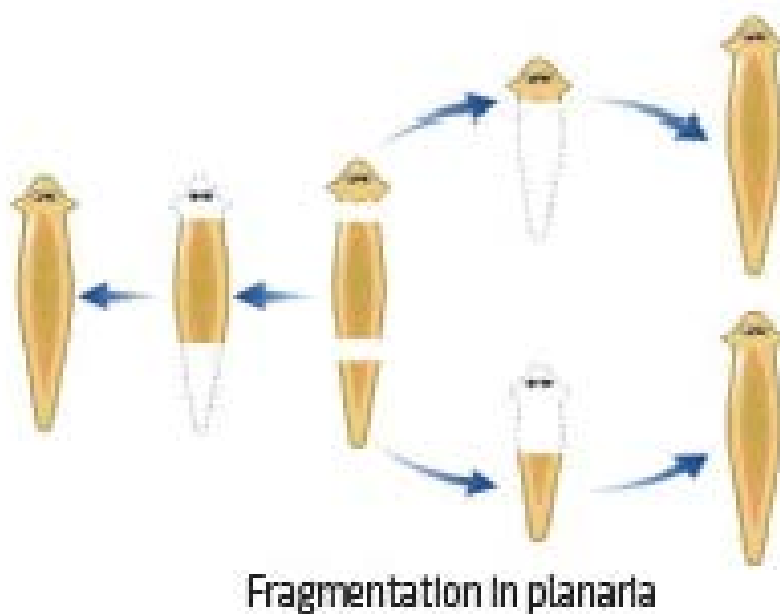
Budding is seen in hydras and jellyfish. During budding some cells on parent organism start to divide and later will form small outgrowth, called bud. This bud grows and detaches from parent organism and starts its own life. In some



organisms like corals, buds do not detach and live with parent organism.



Fragmentation is when parent organism is split into fragments, and every fragment gives rise to a new organism. It is seen in hydras, planaria, flatworms, and sea stars.



## Sexual reproduction in animals

Sexual reproduction occurs in reproductive cells or gametes. Gametes are formed by meiosis. Male gametes are called sperm cells; female gametes are called egg cells. These cells fuse and form a new organism. New organism forms by a mixture of genes from both parents, so not identical to parents. Some protists, like paramecium, and all multicellular animals can reproduce sexually.

## Literacy

---

1. Why do complex animals not reproduce asexually?
2. Some organisms can produce both male and female gametes. They are known as hermaphrodites. Give three examples of hermaphrodite animals.
3. Which reproduction method produces more offspring in short time?

Mother cat with kittens. Sexual reproduction brings to genetic diversity of the offspring.

## Facts

---

Sea star spends its first three years as a male and next three as a female.

## Research time

---

As you can notice from the text, all simple animals use asexual reproduction while complex animals reproduce sexually. Why can't animals that have complex structure reproduce asexually? Give at least two examples. Moreover, why do organisms need to reproduce instead of living forever?

## Terminology

---

binary fission - екіге бөліну / бинарное деление;

budding - бүршіктену / почкование;

fragmentation - бөлшектену / фрагментация;

gamete - гамета;

hydra - гидра;

offspring - ұрпақ / потомство;

paramecium - кірпікшелі кебісше / инфузория.

# 10.3 LIFE CYCLES OF MOSSES AND FERNS

## LIFE CYCLE OF THE FERN

### You will:

---

- explain the features of asexual and sexual generations as in mosses and ferns.

### Key terms

---

Sporophyte - the form of a plant in the alternation of generations that produces asexual spores; Gametophyte - the sexual form of a plant in the alternation of generations.

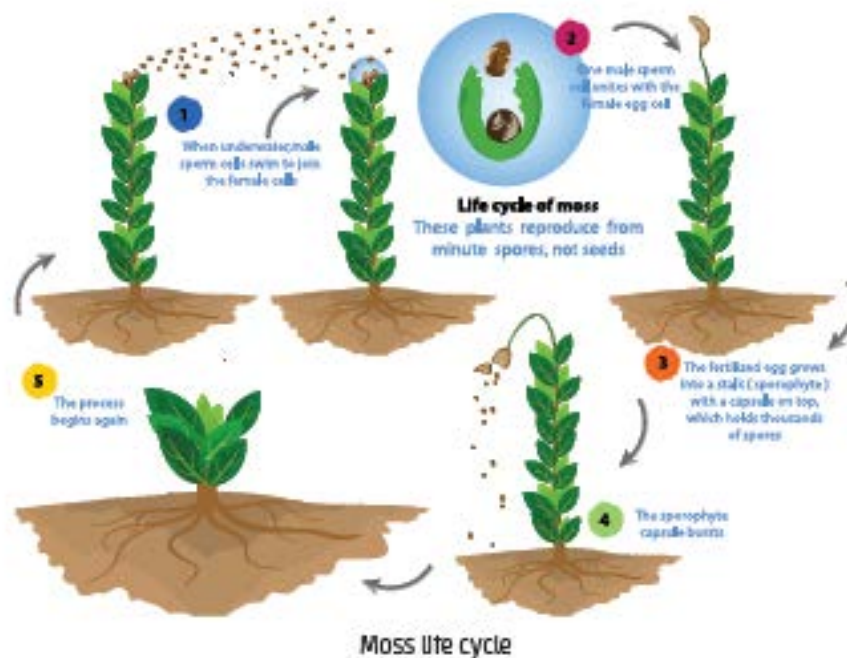
### Text

---

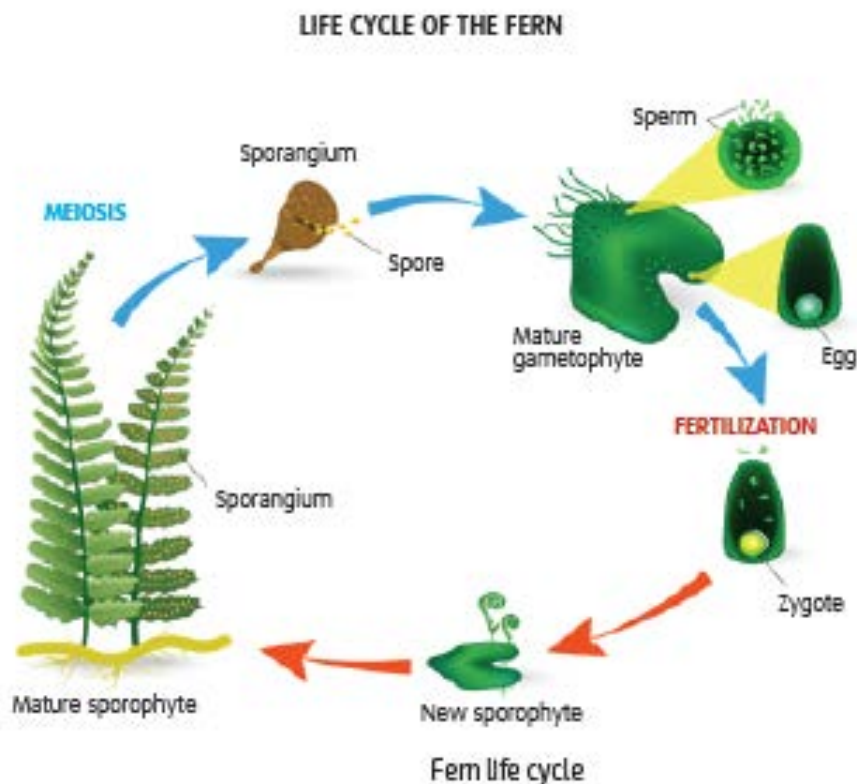
The life cycle of most plants takes two generations. Plant life begins with germination of spores. A spore grows into a gametophyte, an organism which produces gametes. Gametes are fertilized and become sporophyte, an organism which produces spores. Then the cycle starts again.

Sporophyte and gametophyte generations have some differences, sporophyte plant is diploid ( $2n$ ), it produces spores ( $n$ ) with meiosis. Gametophyte plant is haploid ( $n$ ), it produces gametes with mitosis. Both sporophyte and gametophyte generations have different external appearances.

Mosses are plants which do not have flowers and seeds. They lack transport system, so they absorb water by the whole body. They reproduce by spores. Spore germinates and forms leafy gametophyte. Gametophyte has organs for sexual reproduction. These organs produce sex cells: sperm cell and egg cell. Sperm cell swims to egg cell and fertilizes it. Zygote grows and forms sporophyte. Sporophyte plant grows on the gametophyte. Sporophyte consists of stalk and sporangium. Inside sporangium capsule spores are formed.



Ferns are also spore-bearing plants. In favorable conditions, spore grows into a heart-shaped leaf-like gametophyte. It is very small, with a size of 3-8 mm, and only one cell thick. Under gametophyte, it has sex organs, which produce sperm cell and egg cell. Sperm cells fertilize egg cells and form zygote. Zygote grows into a sporophyte. It has got many leaves. Under leaves, there are sporangia where spores are produced.



Mosses are plants which grow on rocks near water. What is the importance of water in their life cycle? Mosses and ferns have great ecological importance. Mosses colonize the barren rocks and exposed areas of hills. They make it suitable for growing other plants by depositing humus soil and plant debris. Ferns filter toxins, and it is a bioindicator which shows clearness of environment. Mosses and ferns have similarities in their life cycles. However, in mosses gametophyte plant is dominant, in ferns sporophyte plant is dominant. So the leafy plant we see as mosses is gametophyte, fern with blade leaves is sporophyte.

## Activity

Draw a Venn diagram into your notebook. Fill the diagram related to the life cycles of fern and moss. Compare their

gametophyte and sporophytes. Write the common. Fill both sides of the diagram with differences of each plant.

## Facts

---

Eco-graffiti is a beautiful piece of art which grows mosses on the wall. Visit the link below and make your moss graffiti.

<http://www.wikihow.com/MakeMoss-Graffiti>

## Maths in Biology

---

Calculate the number of spores in 3 square meters that could be released by moss. Here the density of plant is 100 plants per square meter, and the average number of spores released by one plant is 10 000.

## Research time

---

Work in groups and make a model of fern/mosses life cycle using plasticine.

## Literacy

---

1. Why do mosses and ferns need spores?
2. What is the importance of sexual reproduction in mosses and ferns?
3. What is the difference between gametophyte and sporophyte?

## Terminology

---

alternation - кезектесу / чередование;

humus soil - қарашірік / чернозём;

dominant - басым / доминантный;

to bear - тасу / нести.



# 10.4 LIFE CYCLES OF GYMNOSPERMS AND ANGIOSPERMS

## You will:

---

-explain life cycle features of gymnosperms and angiosperms.

## Key terms

---

Gymnosperm - nonflowering plants having naked seeds not enclosed in an ovary;

Angiosperms - flowering, the fruit-bearing plant having seed in a closed ovary.

## STQ

---

Why do plants form flowers?

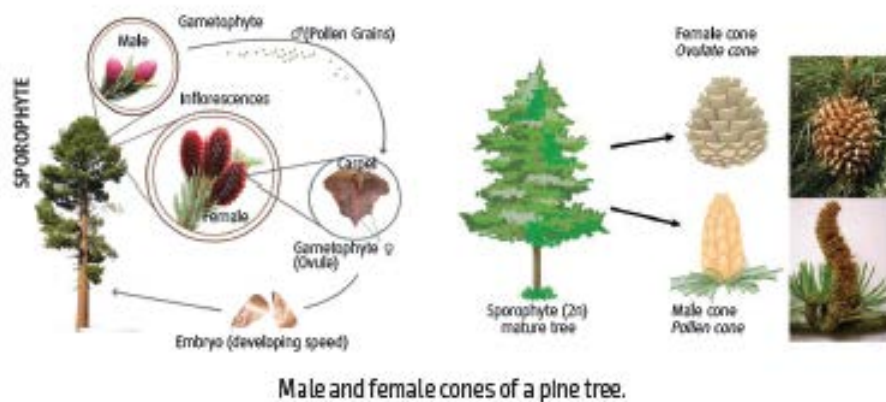
## Text

---

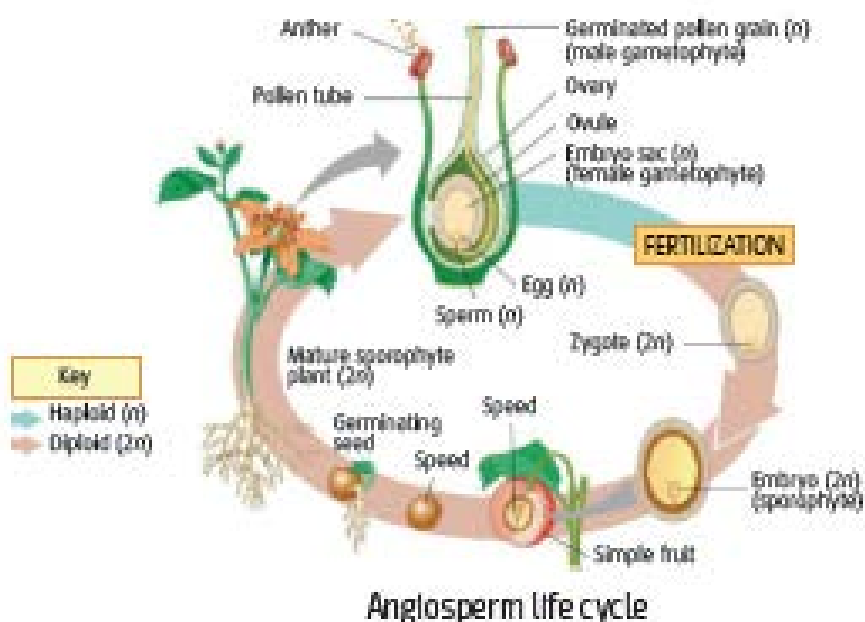
Gymnosperms and angiosperms are seed plants. In both plant groups sporophyte is dominant. Gametophytes are pollens and ovule.

Gymnosperms are non-flowering plants like pine, cedar, and juniper. Pine is an evergreen tree with needle-like leaves. It has male and female cones. Male cones produce pollen.

Pollen reaches female cones by the wind. When pollens reach the ovule in a female cone, pollination occurs. After pollination, it takes about a year for an egg to mature, only after that fertilization occurs. Fertilized ovule becomes a seed. After fertilization, cones are closed. When seeds are mature, cones open again and disperse seeds. In favorable conditions, seeds germinate and form new pine tree.



Angiosperms are flowering plants and most abundant plants on Earth. Rose, wheat, apple tree are some examples. These plants reproduce by flowers. The zygote develops into an embryo inside Anther Germinated pollen grain (n) (male gametophyte) the seed. Reproductive organs called stamens and female reproductive organs called carpels. Stamens produce pollen. Carpels produce eggs. During pollination pollens reach carpel. Sperm cells reach ovule, and double fertilization takes place.



## Activity

### Why do pine cones open and close?

Female cones open only in dry and warm conditions, to spread seeds. In cold and humid weather they close.

1. Take three jars and put a cone in each of them 2. Put warm and cold water into two different jars and label them. In the third jar, put only a cone.
3. Wait for 20 minutes and observe changes every 5 minutes. Which of the cones open first? Which of them stay closed tightly? Explain your answer.

Take open and closed cone. Then try to take each scale and look at its base. In which cone can you find a seed?

## Facts

---

Jack pine cones only open in extreme circumstances such as forest fires. Only after fire their tightly sealed cones open and seeds disperse.

## Research time

---

Take a tulip flower and observe reproductive structures using a magnifying glass. Watch anther and stamen. Draw a picture of it and label its parts. Can you see pollen on it? Do research how to grow a tulip. If it is possible, plant your tulip and organize a flower corner in your room. Then describe the life cycle of a tulip.

## Literacy

---

1. How do forest fires help seed germination?
2. Why are there more angiosperms than gymnosperms on Earth?
3. Are there any extra roles of fruits except for seed dispersal?

## Engineering in Biology

---

Dandelion seed inspired the making of the first parachute. Fluffy structures slow the fall of a dandelion seed on the ground, just like a parachute slows the fall of man.

## Terminology

---

cone - бұр / шишка;

abundant - кең таралған / обильный;

wheat - бидай / пшеница;

stamens - аталық / тычинка;

carpels - аналық / пестик;

humid - ылғалды / влажный;

circumstance - жағдай / обстоятельство;

dandelion - бақбақгүл / одуванчик;

dispersal - таралу / распространение.

# Problems

## Test questions with one correct answer

1. Human epithelial cells have \_\_\_\_\_ chromosomes.

A) 23

B) 24

C) 48

D) 46

E) 42

2. Occurs by meiosis?

A) Budding

B) Binary fission

C) Fragmentation

D) Growth

E) Formation of sperm cell

3. Fragmentation is NOT seen in:

A) Planarian

B) Annelida

C) Hydra

D) Frog

E) Seastar

4. Gymnosperms reproduce by:

A) cones

B) bulb

C) pines

D) fruits

E) flowers

### **Test questions with several (max 3) right answers**

1. Occurs by/after mitosis:

A) cell division

B) formation of sperm cells

C) formation of the egg cell

D) formation of body cells

E) formation of identical cells

F) sexual reproduction

G) fusion of cells

H) asexual reproduction

2. Binary fission is seen in:

- A) hydras
- B) sponges
- C) bacteria
- D) amoeba
- E) fungi
- F) gymnosperms
- G) yeasts
- H) paramecia

3. True about angiosperms:

- A) cones are used for reproduction
- B) flowers are used for reproduction
- C) reproduce by spores
- D) flowers have reproductive structures
- E) always evergreen
- F) seeds have endosperm
- G) reproduce by binary fission
- H) have needle-like leaves

## Matching

1. Match functions with flower parts:



1. Male reproductive structure

2. Attract insects

3. Fertilization occurs in

A) Receptacle

B) Sepal

C) Anther

D) Petal

E) Ovule

F) Style

2. Match type of asexual reproduction with the organism:

1. Binary fission

2. Fragmentation

3. Budding

A) Amoeba

B) Virus

C) Hydra

D) Snake

E) Shark

F) Planaria

# CHAPTER 11.0

## Embryonic Development



# 11.1 EMBRYONIC DEVELOPMENT

## You will:

---

- learn stages of embryonic development;
- describe tissues and organs that are formed from different germ layers.

## Key terms

---

Development - growth from one cell to a multicellular organism; Blastula - an early stage of development, single-layered ball like structure;

Gastrula - three-layered structure formed after blastula;

Organogenesis - formation of organs of the embryo.

## STQ

---

How does a microscopic single-celled zygote develop into a baby?

## Research time

---

Different factors affect the development of the embryo in mother's womb. For example, alcohol and cigarettes can harm some organs, so does radiation. Research impacts of

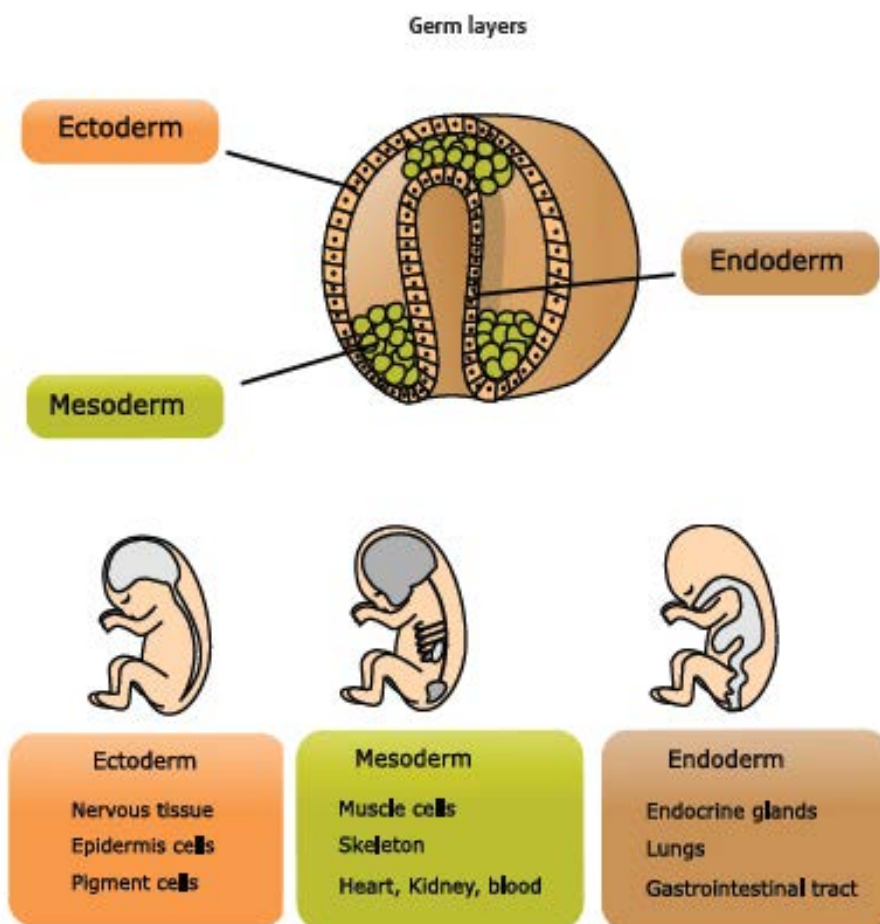
bad habits and radiation to the embryo. Pass your report to your teacher.

## Text

---

Embryonic development is the process of growth from one cell to multicellular organism. After the reproduction, male and female cells join together. This process is called fertilization. The cell formed after fertilization is called a zygote. Then the zygote starts to divide.

After 5 to 7 divisions, a hollow ball of cells called blastula is formed. Then cells continue to divide and three-layered structure forms. It is called gastrula. It has three layers: ectoderm, mesoderm, and endoderm. From these three layers tissues, separate and organs are produced. This process is called organogenesis. After gastrula, neural organs are formed. This stage is called neurula.



## Activity

---

Let's make a model of embryonic development!

1. Take plasticine. Make a ball that is 10 cm in diameter. It is a zygote.
2. Divide and make two balls but they should be 5 cm in diameter and join them.
3. Divide again and make four cells that are 2.5 cm in diameter. Join them. Continue to work till you have 32-celled blastula.

4. Make a gastrula with obvious three germ layers using different colors for each layer.

## Facts

---

Twins can be identical or fraternal. If twins are boy and girl, also if they do not look like much they are fraternal twins. They develop from two different female cells which are fertilized by two different male cells. Identical twins form when blastula splits into two or more. Identical twins look alike and are of the same gender. Sometimes they are mirror images of each other. For example, one is often left-handed, while the other is right-handed. They may also have birthmarks on the opposite sides of their bodies. In some cases, organs also are reversed, with the heart on the right and liver on the left.

## Literacy

---

1. Jellyfish have only endoderm and ectoderm layers. Which organs do not they have?
2. How many divisions are needed to make blastula? Show your calculations.
3. Dogs can give birth to several puppies at once. How is this possible? Explain your answer.

## Terminology

---

birthmark - мең / родинка, родимое пятно;

development - даму / развитие;

division - бөлу, бөліну / разделение, деление;

fertilization - ұрықтану / оплодотворение;

fraternal twins - екіжұмыртқалы егіздер / неидентичные (многояйцовые) близнецы;

gender - жыныс / пол;

identical twins - біржұмыртқалы егіздер / идентичные (однойяйцовые) близнецы;

layer - қабат / слой;

organogenesis - мүшелердің жасалуы / органогенез.

# Problems

## Test questions with one right answer

1. The cell formed after fertilization:

- A) Blastula
- B) Gastrula
- C) Zygote
- D) Egg
- E) Embryo

2. Formation of organs:

- A) Development
- B) Fertilization
- C) Growth
- D) Organogenesis
- E) Differentiation

3. Develop from endoderm:

- A) Muscle cells
- B) Gastro vascular tract
- C) Nerve tissue



D) Skeleton

E) Epidermis cells

### **Test questions with several (max 3) right answers**

1. Choose INCORRECT statements:

A) Fraternal twins are formed from divided zygote

B) During cleavage, cell division occurs without cell growth

C) During cleavage, newly formed cells start to grow

D) Zygote is a single-celled embryo

E) Fertilization is the stage of embryonic development

F) Formation of three germ layers occur at the end of gastrulation

G) Embryo in blastula stage has two cell layers

H) Fertilization is the process when sperm and egg fuse

2. Identical twins are:

A) Generally different in gender

B) Generally look different

C) Develop from one pair of male and female gametes

D) Develop from two pairs of male and female gametes

E) Generally look alike each other

F) Can be a mirror image of each other

G) Always have birthmarks in opposite parts of their bodies

H) Always have birthmarks in same place of their bodies

## Matching

1. Match given explanations with suitable terms:

1. inner layer

2. outer layer

3. middle layer

A) exoderm

B) endoderm

C) ectoderm

D) epiderm

E) mesoderm

F) derm

2. Match embryo development terms given below with suitable answer:

1. double layered structure

2. three layered structure

3. fertilized single cellular structure

A) egg

B) zygote

C) organ

D) blastula

E) morula

F) gastrula

3. Match organs with embryonic layers:

1. lung

2. heart

3. brain

A) endoderm

B) exoderm

C) derm

D) epiderm

E) mesoderm

F) ectoderm

# CHAPTER 12.0

## Inheritance and variation



# 12.1 ROLE OF INHERITANCE AND VARIATION IN EVOLUTION

## You will:

---

-discuss the role of heredity and variation in evolution.

## STQ

---

Why do we look like our parents?

## Key terms

---

Evolution - the process of change and conservation of different organism characteristics from generation to generation;

Variation - the ability of an organism to change and acquire new features;

Inheritance - the ability of an organism to store and transmit features from parents to offspring.

## Facts

---

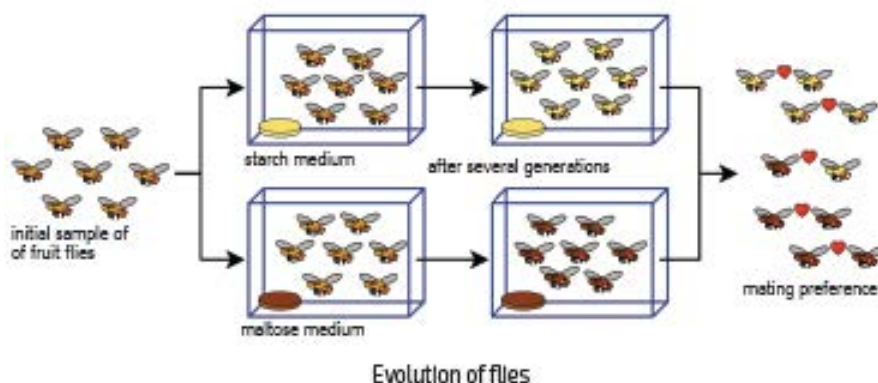
A species of fruit fly was kept in complete darkness for 57 years (1400 generations) showed genetic alterations that were favorable to survival in that environmental condition.

## Text

During reproduction, some characteristics of organisms are conserved within one species. Other characteristics, on the other hand, are different in offspring and parents. These two features are called inheritance and variation.

Inheritance is the ability of an organism to store and transmit features from parents to offspring. Variation is the ability of an organism to change and acquire new features.

Inheritance helps to preserve certain characteristics of species. However, the environment always changes. Climate and landscape can change, and the organism needs to adapt to the environment. Variation helps in adaptation. Adaptation helps organisms to survive in these changing world.



Inheritance and variation are connected with evolution. Evolution is the process of change and conservation of different organism characteristics from generation to generation. New features and characteristics of organisms occur as a result of variation. Then these characteristics are transmitted from parents to offspring. Accumulation of many new features gives rise to new species.

## Activity

---

All people are human and belong to the same species. Your classmates may have different eye color and hair color. Some are boys, and some are girls. Also, they can be tall or short. The differences between living things of the same species are called variation. Some variation within a species is inherited, and some results from the environment.

Now find inherited variations in your class and record results in the table.

№	Inherited variations in human	Examples
1	eye colour	
2	skin colour	
3	hair colour	
4	lobed or lobeless ear	
5	ability to roll tongue	
6	gender	
7	height	
8	blood groups	

## Facts

---

We have some traits similar to mother, some of the father. This is explained by the type of genes. Genes are paired in our organism: one gene from father, one from mother. From these pairs one can be strong, known as a dominant gene, one can be weak, known as a recessive gene. For example, having dimples is a dominant, not having is recessive.

## Literacy

---

1. How does variation affect our social life?
2. How does sexual reproduction help variation?
3. Does environmental variation pass to the next generation?

## Research time

---

Variation caused by surrounding is called environmental variation. Plant and animal features can be affected by factors like climate, diet, temperature, etc. For example, flower color of hydrangeas changes according to the acidity of the soil.

If the soil is acidic, its flower color is blue. If the soil is alkaline, it is pink. Environmental variation affects only the appearance of organisms. Find other examples of environmental variations.

## Terminology

---

inheritance - тұқым қуалау / наследование;

variation - көптүрлілік / вариация, изменчивость;

to conserve - сақтау / сохранить;

alkaline - сілтілі / щелочной;

feature - ерекшелік, сипаты / особенность.



## 12.2 SELECTIVE BREEDING

### You will:

---

- describe the importance of selective breeding.

### STQ

---

How can we breed a herd of big and meaty sheep?

### Key terms

---

Selective breeding - intentional mating of organisms by a human to produce offspring with desirable characteristics or elimination of a trait.

### Facts

---

Arharomerinos are a good example of selective breeding in Kazakhstan. It is a hybrid of Argali (mountain sheep) and Merino sheep. This breeding gave a quality in both meat and fur.

### Text

---

Selective breeding is the intentional reproduction of plants and animals with desired features. It helps people to keep and breed only needed organisms. The number of small and weak animals and plants decreases.

Selective breeding of big cows for meat. In every generation of cows you only choose biggest cows and reproduce them,

until you have a herd of big cows.

There are two methods of selective breeding: massive and individual.

Mass selection is selecting for a sort, or breed, of plants and animals. It does not choose any special feature such as height, or color. Parents are not chosen. For example, if you want hound dogs, you choose two hound dogs and cross them. You do not look at their height, color, or weight. As a result, you will have a hound dog puppy.

Individual selection is used for selection of a particular feature in an organism, such as height, or weight. If you want small, miniature hound dog, you choose two smallest hound dogs and cross them. From their offspring, you select smallest of them and cross them again. In the end, you will have a miniature hound dog.



Selective breeding of big cows for meat. In every generation of cows you only choose biggest cows and reproduce them, until you have a herd of big cows.

## Activity

---

Assume that we have 4 dogs with given traits:

	Dog 1	Dog 2	Dog 3	Dog 4
<b>Coat length</b>	short coat	short coat	long coat	long coat
<b>Ear shape</b>	pointed ears	floppy ears	floppy ears	floppy ears
<b>Speed</b>	fast	slow	fast	slow
<b>Vision</b>	bad vision	good vision	good vision	bad vision
<b>Strength</b>	strong	weak	weak	weak
<b>Smell</b>	not sensitive to smell	sensitive to smell	not sensitive to smell	sensitive to smell
<b>Behavior</b>	friendly	aggressive	aggressive	aggressive

Divide into five groups. Assume you are a breeder. You have five clients who look for dogs with special characteristics. You have only four dogs.

Which dogs do you need to breed to satisfy each of your clients? Explain your choice. Draw new breeds of dogs.

Clients: hunter, fireman, policeman, fashion designer, blind person.

## Literacy

---

1. Why is selective breeding useful for farmers? Explain your answer.
2. How does individual selection help to improve features of an organism?
3. Which method of selection takes a long time to occur?

## Facts

---

Maize cobs uncovered by archaeologists show the evolution of modern maize over thousands of years of selective breeding.

Selective breeding generated the broad diversity of corn varieties that are still grown around the world today.

## Research time

---

Make a poster that includes information about plants or animals selectively bred in Kazakhstan.

Posters must include the following information:

- characteristics of selected breeds
- scientists and breeders
- economical importance

Then, bring your poster to class and evaluate each other's work with classmates by giving stars.

## Terminology

---

to breed - тұқым; шағылыстыру / разводить;

desirable - қажет, қалаулы / желательный;

to eliminate - жою / устранить;

floppy - епсіз, қолайсыз / неповоротливый;

hound dog - тазы ит / собака-гончая;

intentional - әдейі, қасақана / намеренно, умышленно;

massive - топты, жаппай / массивный;

selective - іріктемелі / избирательный.

## 12.3 ORIGIN CENTERS OF DOMESTIC PLANTS AND ANIMALS

### You will:

---

- study centers of origin of cultivated plants and domesticated animals.

### STQ

---

Where was the first cow domesticated?

### Key terms

---

Domestication - the process of bringing animals or plants under human control;

Cultivation - is the act of caring for or raising plants.

### Facts

---

Kazakhstan is the origin of apple trees. Our forests contain a wide range of apples that other countries have not yet faced.

Researchers around the world specially visit Kazakhstan to learn about a different specimen of apple trees. They gather individual seeds and store in banks.

### Text

---

Origin centers of cultivated plants Different organisms have developed in different areas. Russian scientist Nikolay Vavilov studied origins of cultivated plants. He suggested that different plants originated in different areas of the planet. He identified 7 centers of origin of cultivated plants:

1. South Asian: rice, sugar cane, citrus, eggplant, mango, cucumber.
2. East Asian: millet, buckwheat, tea, soy, plum, apple, pear.
3. South West Asian: wheat, peas, rye, onions, garlic, grapes.
4. Mediterranean: olives, oats, beets, cabbage, turnips, radish.
5. Abyssinian: coffee, durum wheat, mustard, flax.
6. Central American: corn, cotton, pepper, pumpkin, cocoa, tomato, sunflower.
7. South American: potatoes, tobacco, pineapple, peanuts, cinchona.

American scientist Jack Harlan also studied cultivated crop origins. Harlan agreed broadly with Vavilov's idea that many cultivated plants are from few geographic locations. However, Harlan preferred the term Center of diversity to Vavilov's term Center of origin, because while the centers of crop diversity are known and mapped, the origins of crops cannot be identified.

Origin centers of domestic animals Animal domestication centers are different.

1. Sino-Malay: pig, hen, duck.

2. Hindustani: dog, hen, bee.

3. South-West Asian: cattle, horse, sheep, goat, camel, pigeon, pig.

4. Mediterranean: cattle, horse, sheep, camel, pigeon, rabbit, duck, goose.

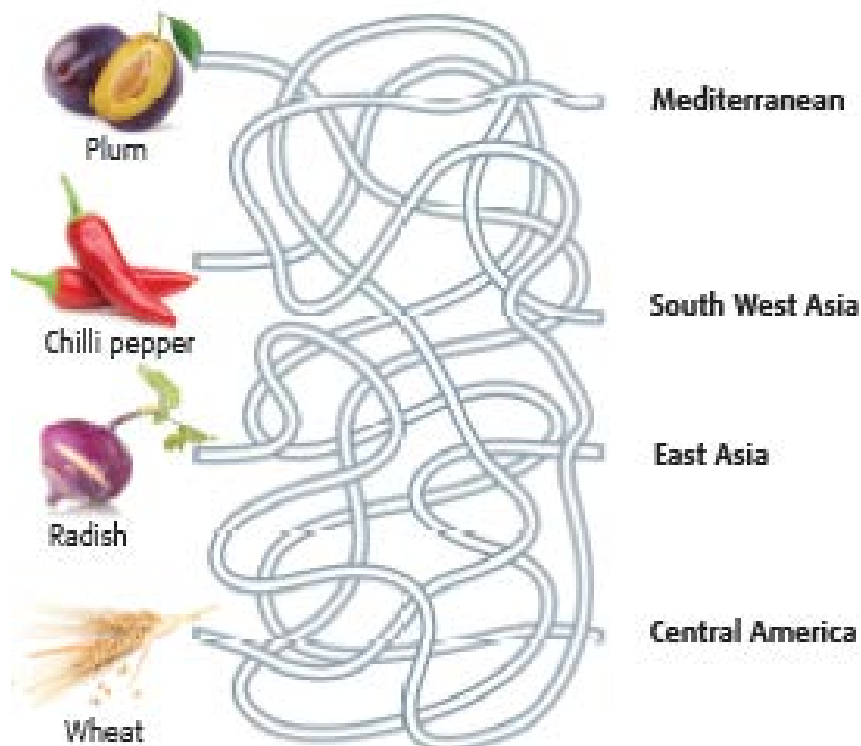
5. South American: llama, turkey, guinea pig, alpaca.

6. African: ostrich, guinea fowl, cat, dog, donkey, pig.

## Activity

---

Match plants with their originated areas. Make your own matching puzzle for your friend.



## Literacy

---



1. What are the two artificial methods which are used to change animals and plants for human benefit?
2. How are animals and plants spread around the world?
3. How are animals domesticated?

## Research time

---

Which fruit or vegetable do you like the most? Have you ever wondered where its origin is? Make a poster about your favorite fruit or vegetable.

The poster must include: information about fruit/vegetable, its image, origin history and reasons why do you love it.

## Facts

---

Nowadays there are so many peculiar pets that are kept in homes such as foxes, cockroaches, skunks.

## Terminology

---

Abyssinian - Абиссинаялық / Абиссинский;

buckwheat - қарақұмық / гречиха;

cinchona - хина;

eggplant - баялды / баклажан;

flax - зығыр / лен;

Mediaterranean - Жерорта теңіздік / Средиземноморский;

millet - тары / просо;

mustard - қыша / горчица;

oat - сұлы / овес;

specimen - үлгі / образец;

turnip - шалқан / репа.

# 12.4 CROPS AND DOMESTIC ANIMALS OF KAZAKHSTAN

## You will:

---

-explore the varieties of important crops and domestic animals.

## Key terms

---

Breeding - to produce plants or animals under controlled conditions;

Crop - cultivated plant that is grown on a large scale.

## Research time

---

1. Go to a farm trip on the weekends and observe domestic animals there.

Where are they kept? What do they eat? How much of food do they need for a day? What about for winter? Why do farmers keep them? How much of products do domestic animals give?

Ask questions above from farmers. Write a with 200-250 words essay about your trip and try to answer questions given above.

2. Take a photo with animals you saw on the trip. Upload photo which you like the most on Instagram and add hashtags given on image above.

## STQ

---

Why are there different types of cows in Kazakhstan?

## Text

---

Breeders in Kazakhstan created many new forms of animals and plants.

For example, Alatau breed of cattle is a special breed created by Kazakh breeders. It gives more than 4100 litres of milk per year. Siberian type of meat-wool breeds of sheep gives more meat and wool than ordinary sheep.

Also, there are chickens which give 239-269 eggs per 72 weeks. There are more breeds of horses, ducks, geese, fish created in Kazakhstan.

Kazakh breeders create not only animal breeds, but also plant varieties.

These plants are more resistant to harsh environment. Also, they give more harvest.

## Activity



---




1. Answer the following questions.

1. Why are different breeds created?
2. How people create new breeds?
3. What characteristics in breeds attracted breeders?

2. Now Look at the pictures below. You can see sorts of different crops and domestic animals of Kazakhstan.

Compare these animals and plants. Write characteristics of them into the table.

Animals and plants	Characteristics
 <p data-bbox="375 709 532 743">Alatau breed</p>	
 <p data-bbox="375 1020 716 1054">Kazakh white-headed breed</p>	

 <p>Kazakh arharomerinos</p>	
 <p>Winter wheat</p>	
 <p>Summer wheat</p>	

## Facts

---

Scientists of Kazakhstan have created more than 400 sorts of crops. For example, 38 sorts of potato breeding allowed use in a country like “Astana”, “Miras”, “Tamasha”.

## Facts

---

Did you know that in one tree there can be different fruits? Plant grafting is a procedure in which parts of plants are joined together making them unite and continue growing in one plant. The art professor created the tree which contains 40 different fruits by bud grafting. The tree contains fruits like peaches, apricots, plums, cherries, and nectarines.

## Literacy

---

1. You are an owner of a milk company. What kind of cow breed do you need for your company? Explain your answer.
2. Which features help winter wheat to survive in winter?
3. Sheep are not only used as meat, wool and leather source. We take their meat and use their manure. What is their manure used for?

## Terminology

---

cattle - ірі қара мал / крупный рогатый скот;

crop - өнім / урожай;

harsh - ауыр / трудный, суровый;

harvest - егінді жинау / уборка урожая;

leather - былғары, тері / кожа;

trip - саяхат / поездка;

wool - жүн / шерсть.

# Problems

## Test questions with one right answer

1. Cannot be inherited from parents to the child:

A) Eye colour

B) Ear type

C) Scar

D) Blood type

E) Height

2. Selective breeding type in which special trait is chosen:

A) Massive

B) Active

C) Passive

D) Individual

E) General

3. Studied origins of cultivated plants:

A) Vavilov

B) Sechenov

C) Timiryazev



D) Pavlov

E) Harlan

4. Kazakhstan is the center of origin of:

A) Orange

B) Banana

C) Potato

D) Apple

E) Carrot

### **Test questions with several (max 3) correct answers**

1. NOT the centers of origin of cultivated plants:

A) South Asia

B) East Asia

C) Mediterranean

D) Caspian

E) Abyssinian

F) Central American

G) Syberian

H) South American

2. Show types of selective breeding:

A) domestication

B) cultivation

C) inherited

D) individual

E) environmental

F) mass

G) physiological

H) adaptation

3. Domestic animal breeds of Kazakhstan:

A) Angus cattle

B) Kostroma cattle

C) Arharomerinos sheep

D) Belgian blue cattle

E) Brangus cattle

F) Alatau cattle breed

G) Kholomogory cattle

H) Altai sheep

## **Matching**

1. Match centers of origin with cultivated plants:

1. South West Asian

2. Abyssinian

3. South American

A) coffee, mustard

B) olives, oats

C) rice, sugar cane

D) potatoes, tobacco

E) garlic, onion

F) tomato, sunflower

2. Match domestic animals with their center of origin:

1. Duck

2. Camel

3. Llama

A) Sino-Malay

B) Hindustani

C) South-West Asian

D) Mediterranean

E) South American

F) African

# CHAPTER 13.0

## Biosphere



# 13.1 ECOSYSTEM

## You will:

---

- understand the overall ecosystem structure;
- compare water and land ecosystems.

## STQ

---

Can organisms live without nonliving things?

## Key terms

---

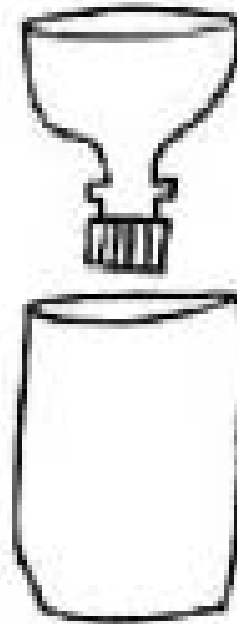
Ecosystem - groups of living organisms interacting with its environment.

## Research time

---

**How do nonliving factors affect ecosystems?**

Construct your Bottle Ecosystem. For this, you will need a plastic bottle, gauze, cotton thread, sand and soil, small rocks, live fish and a living plant. Instructions are given by images below:



Answer following questions:

-Is this a real ecosystem?

-How does water affect living organisms in an ecosystem?

-How do organisms depend on one another in given ecosystem?

## **Text**

---

An ecosystem is a complex structure, where living organisms and their environment interact with each other. The ecosystem consists of biotic and abiotic factors.

Biotic factors are living things in an ecosystem. They are animals, plants, fungi, and microorganisms.

Abiotic factors are nonliving part of an ecosystem. It includes temperature, climate, water, and soil.

There are two groups of ecosystems: terrestrial ecosystems and aquatic ecosystems.

Terrestrial ecosystem is the ecosystem that is found only on landforms.

One of the main factors affecting this ecosystem is the availability of water. Terrestrial ecosystems have more light and less pollution than water ecosystems. Types of terrestrial ecosystems are desert, forest, mountain and grassland ecosystems.

Aquatic ecosystem exists in the body of water or inside water. It includes aquatic flora, fauna and water properties. Types of aquatic ecosystems are marine and freshwater ecosystems.

## **Activity**

---

Terrestrial ecosystem	Animals	Plants	Example in Kazakhstan
Desert	Lizard, rat, fox, rabbit, antelope, snake, tortoise	Cactus, sagebrush	Altin-Emel, Betpak-Dala, Moyinkum
Forest	Deer, bear, wolf, mouse, squirrel, birds	Coniferous plants, deciduous plants, ferns, mosses and fungi	Katon-Karagay, Burabay
Mountain	Tiger, rabbit, wolves, sheep, mountain goat	Lichen, shrubs and some flowering plants	Altai, Tian Shan, Karatau mountains
Grassland	Deer, mouse, giraffe, lion, cheetah, hyena	Flowering plants, shrubs, grasses	Saryarka

Aquatic ecosystem	Animals	Plants	Example in Kazakhstan
Freshwater	Crocodiles, frogs, fishes, ducks, leech, otter	Algae, water lily	Balkhash lake, Syr Darya river
Marine	Dolphin, seal, sea star, cnidarians, turtle, fishes	Mostly algae and phytoplankton	Aral and Caspian Seas

Divide into several groups and choose one type of ecosystem which you like the most. Use geographical information about ecosystems and construct a model of that ecosystem. You can make a more specific model like Altin-Emel with animals and plants living there. Here are some examples below. Present your model in front of your class.

## Facts

---

David Latimer has grown a garden in a sealed bottle. He used a big bottle and put sprout and soil with dead materials and made a closed ecosystem. After 12 years in 1972, he opened the bottle and added a bit of water and never did it again.

This garden is thriving because it has its water cycle.



## Geography in Biology

---

Studying ecosystem includes understanding living organisms from biology and location with its climate from geography.

Divide into several groups and choose one type of ecosystem which you like the most. Use geographical information about ecosystems and construct a model of that ecosystem. You can make a more specific model like Altin-Emel with animals and plants living there. Here are some examples below. Present your model in front of your class.

## Literacy

---

1. How is water important for land ecosystem? Explain with examples.
  2. What are advantages and disadvantages of water ecosystems?
  3. Choose one ecosystem and explain why certain animals live especially in this ecosystem?
- 

## Terminology

---

aquatic - сулы / водяной;

desert - шөл, шөлейт / пустыня;

forest - орман / лес;

freshwater - тұщы су / пресная вода;

grassland - шалғын / луг;

interact - өзара әрекет жасау / взаимодействовать;

marine - теңіз / морской;

sagebrush - жусан / полынь;

shrub - бұта / кустарник;

sprout - өркен / росток.

## 13.2 POPULATION

---

### You will:

---

- describe the main characteristics and features of population structure;
- establish the causes of population size changes on the example of a predator-prey relationship;
- explore different survival strategies of organisms.

### Key terms

---

Population - the group of organisms of the same kind living in one geographic area.

### STQ

---

In 1859 24 rabbits were introduced to Australia. Just in 10 years, their number increased up to 2 million. Why did their population size increase so rapidly?

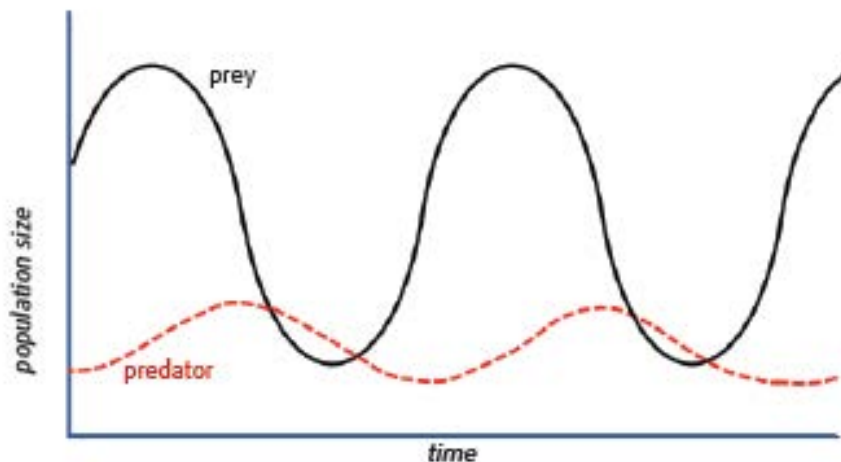
### Text

---

A population is the group of organisms of the same kind living in one geographic area. The population of organisms may change according to the time. For example population of insects in summer and winter is not the same.

The population size of organisms is different. Its size depends on such factors as birth rate, death rate and density of population.

In an ecosystem, populations live in relationship with one another. A change in one population affects other populations. This can be seen best by the relationship between predator and prey populations.



If prey population grows, predator population grows too because of more food supply. Growing predator number will eventually bring to reduce in some prey. So there will be less food for predators, and predator number will be reduced. A small number of predators will bring to the growth of prey population and so on.

K and R strategies of survival Animals that reproduce with R-Strategy produce many offspring, but a few of them survive. On the other hand, animals that reproduce with K-strategy produce a few offspring with the chance of higher survival. For example, r-strategists, such as the fish, lose most of the offspring very quickly, but K-strategists, such as mammals, can raise most of their offspring to elder age, K-strategists animals are born with high parental care instinct which is very important for the survival of their young.

## Activity

---

Both predators and prey use different survival strategies. Predator species are adapted for hunting; they survive if they catch enough food. Prey species on the opposite must be well adapted to escape or hide to survive.

Work in pairs. Choose any predator while your friend should take its prey. Then you as a predator should tell about your strategies how to catch your prey.

Moreover, your friend should describe what kind of strategies he would use to save himself.

Predators	Preys
Cheetah	Gazelle
Wolf	Rabbit
Cat	Mouse
Bear	Fish
Frog	Insects
Eagle	Fox

## Literacy

---

1. How does food availability affect birth and death rate in populations?
2. What else except birth and death rate affect population size? Explain your answer.

3. Plants protect themselves against animals. What are the protective mechanisms of plants against animals?

## Facts

---

To look, act, smell or sound like something else, such as another organism or object is called mimicry. Animals use this form of protection to cheat predators and increase their chances of survival. For example, butterflies on their wings have an image of a false head for defense against predators.

## Terminology

---

density - тығыздық / плотность;

onager - құлан / кулан;

predator - жыртқыш / хищник;

prey - олжа / добыча;

relationship - қарым-қатынас / взаимоотношение.

# 13.3 INTERRELATION BETWEEN LIVING THINGS

## You will:

---

- describe interaction types between organisms;
- explain how living organisms adapt to changes in environmental conditions.

## Key terms

---

Oppositional relationship - the action of opposing;

Symbiosis - close interactions between two or more different species.

## Facts

---

Lichens are a symbiosis of fungi and algae. Fungi give an algae water and minerals, while algae give fungi organic compounds.

## STQ

---

Can different organisms be friends or enemies?

## Text

---

All living things on Earth depend on one another and live in interaction.



Interacting organisms can harm one another (“-” - minus sign), can be useful (“+” - plus sign), or can show no influence (0 - zero sign). Interactions can be oppositional or symbiotic.

The oppositional relationship is when organisms or group of organisms oppose one another to survive.

Types of oppositional relationship are predation and competition.

-Predation (+/-) - is when one organism hunts and eats another organism. The organism hunting is called predator, the organism being hunted is called prey. Fox is a predator; the rabbit is prey.

-Competition (-/-) - is when organisms compete for the same food or resources. Here both organisms may harm each other.

A sheep and a goat compete for grass.

A long-term interaction between 2 different organisms is known as symbiosis. There are several types of symbiotic relationship:

-Mutualism, +/+ condition, when both organisms benefit. Bees carry pollens and help plants to pollinate; plants produce nectar to feed bees.

-Commensalism, +/- condition, when one organism gets the benefit, another organism is not affected. Pilot fish is small in size and swims below shark fish.

When shark kills a prey, pilot fish eats small remained parts from prey.

-Parasitism, +/- condition, when one organism gets the benefit (parasite), other organism is harmed (host). An example is a head louse, a human parasite that lives between human hair.

## Animal adaptations

Animals and plants are adapted to the conditions of the environment in which they live. Animals can live in many different places in the world because they have special adaptations to the area they live in. Animals depend on their physical adaptations to:

- obtain food

- keep safe
- build homes
- withstand weather
- attract mates

These adaptations make it possible for the animal to live in a particular place and in a particular way.

Examples of the basic adaptations:

- a shape of a bird's beak
- color of the fur

- the thickness or thinness of the fur
- the shape of the nose or ears

## Activity

---

### Crocodile game

Divide into two teams, and each group shows one type of relationship between two or several organisms without

words. Another team should correctly guess it. For example, one student can show a rabbit, and other can be a fox or wolf. The second group should answer that it was predation. Then, the second group takes it to turn and show their symbiosis example.

## Literacy

---

1. Find more examples of a symbiotic relationship. Explain how these organisms are related.
2. Explain the relationship between human and domestic animals.
3. Sometimes parasites do not kill their hosts. Why is it important for them to keep their host alive?

## Career

---

### Wildlife biologists

Wildlife biologists perform scientific research to study how species interact with each other and the environment. They protect and conserve wildlife species and also help maintain and increase wildlife populations.

## Research time

---

### Adaptation competition

An adaptation is a physical or behavioral characteristic that allows an organism to survive in its environment. For example, polar bears have thick fur and fat layer to protect from freezing.

Try to find as many examples of adaptation as possible with your deskmate. Then enter a contest with your class. A couple that explains more examples of adaptation win the contest.

## Terminology

---

adaptation - бейімделу / адаптация;

barnacle - мұртаяқты шаян / усоногий рак;

benefit - пайда / выгода;

competition - жарыс / конкуренция;

head louse - бит / вошь;

hunting - аң аулау / охотничество;

lichen - қына / лишайник;

opposite - қарама-қарсы / против, напротив;

shrimp - асшаян / креветка.

# Problems

## Test questions with one correct answer

1. Which one is NOT a biotic factor?

- A) Oak tree
- B) Streptococcus
- C) Rabbit
- D) Mountain
- E) Amoeba

2. White shark belongs to this ecosystem:

- A) Marine
- B) Forest
- C) Desert
- D) Freshwater
- E) Mountain

3. The group of organisms of the same kind living at one geographic area:

- A) Species
- B) Ecosystem
- C) Population

D) Community

E) Biosphere

4. Which of the following is an example for oppositional interaction between living things?

A) Commensalism

B) Mutualism

C) Symbiosis

D) Competition

E) Parasitism

### Test questions with several (max 3) correct answers

1. True about ecosystem given on picture below:



A) Biodiversity is very reach

- B) It is type of terrestrial ecosystem
- C) Most of the animals that live in such ecosystem active at night
- D) Most of the animals that live in such ecosystem active at day
- E) Lizards, snakes, rodents are typical for this type of ecosystem
- F) Algae and phytoplanktons make most of the fl ora of this ecosystem
- G) Plants of this ecosystem have very large leaves
- H) Most of the year is rainy in this ecosystem

2. Show unrelated animal pairs:

- A) Rabbit and wolf
- B) Zebra and lion
- C) Fox and wolf
- D) Sheep and goat
- E) Tick and dog
- F) Fish and cow
- G) Penguin and hippo
- H) Shark and zebra

3. FALSE about population:

- A) The number of individuals can be different in populations
- B) Numerous changes in one population can affect other populations
- C) Time can affect population size
- D) If prey population will increase, predator population will decrease
- E) If predator numbers increase, prey numbers decrease
- F) Different populations can live at one place
- G) Population is a group of different organisms living at the same place
- H) Only group of mammals can be called as population

## Matching

1. Match organism relationship types with suitable explanation:

- 1. Competition
- 2. Mutualism
- 3. Parasitism

- A) +/-
- B) +/0
- C) -/0
- D) -/-



E) +/+

F) 0/0

2. Match these locations with a suitable ecosystems:

1. Altyn-Emel

2. Burabay

3. Caspian Sea

A) Desert

B) Forest

C) Grassland

D) Mountain

E) Freshwater

F) Marine

# CHAPTER 14.0

## Human impact on environment



# 14.1 PRESERVING AND MAINTAINING BIODIVERSITY

## You will:

---

- discuss the reasons of preserving and maintaining biodiversity;
- understand the importance of seed banking.

## Key terms

---

Conservation - looking after the environment so that animals and plants can live there.

## Text

---

All living organisms have a certain place in the ecosystem. If human activities or natural disasters destroy their habitat, then they may not be able to survive. Example of some animals that humans hunted to extinction is Steller's Sea Cow, Great Auk.

Reasons to keep biodiversity of organisms:

1. Every species is unique, and each of them is important for ecology.
2. Preserving biodiversity supports important resources on a local and global scale.

3. By conserving biodiversity, local politics can cooperate with nature savers to make income by using cultural resources.

We should make nature reserves and other protected areas, where people are not allowed to do any harm to the environment or to the animals and plants that live there.

To keep biodiversity of plants, many countries have developed seed banks.

A seed bank is a place where seeds of different plants are stored. There are about 1,400 seed banks around the world, but the most famous is the Svalbard Global Seed Vault, in Norway. It is home to nearly half a million specimens from around the world.

Seed banks are needed to store seeds.

## Activity

---

### A school nature reserve

Divide into three groups. Take 4 square meters of territory in your school. Then make a map of the territory. The best landscape plan will be a map according to which the class will plant plants. Then bring a plant from home and plant it in place according to the map. It can be a fruit tree or decoration flower and bushes. Then tell why you chose that plant to grow it in school. How can it be useful? Take care of your territory with your class.

## Facts

---

Przewalski's horse declined as its habitat was lost due to human interference. The last sighting of this wild horse was in the Gobi Desert of Mongolia in 1969. The Przewalski's horse has endured a long road to recovery, increasing population by only 15 to more than 400 in the wild today.

## Research time

---

Tole bi is a Kazakh orator of senior zhuz who stayed alone when everyone moved during the invasion of jongars. Jongar's kontayshi was angry with the fearless action of Tole bi and sent a man to him. Tole bi said that he could not move anywhere when he has a nest of swallows in his house. "It is not right to ruin somebody's home," he said. This was a great lesson to kontayshi who said "He is so wise. How can I ruin his home after all? Do not touch anybody of his ail" and turned back. Research proverbs and traditions about nature conservation.

## Literacy

---

1. What can you do to preserve the biodiversity as a student?
  2. Is it easy to preserve animal biodiversity or plant biodiversity? Explain your answer.
  3. Do zoos help to preserve the biodiversity of animals?
- 

## Terminology

---

proverb - мақал-мәтел / пословица;

to destroy - жою / уничтожить;

extinct - жойылып кеткен / вымерший;

disaster - апат / катастрофа;

biodiversity - көптүрлілік / биоразнообразие;

invasion - басып кіру / вторжение.

## 14.2 ECOLOGICAL PROBLEMS OF KAZAKHSTAN

### You will:

---

- Discuss the causes and solutions of environmental Problems in Kazakhstan.

### Key terms

---

Pollution - the condition in which air, soil, and water are contaminated by foreign substances.

### STQ

---

What was the reason for closing Semey nuclear site by Nursultan Nazarbayev in 1989?

### Text

---

Nature changed very much in the last century. The main reason for this is irresponsible human activities.

Growth in human population size leads to usage of more places for agriculture to supply people with food. They used many chemicals to kill insects protecting crop or minerals to make the crop grow. Also, human used agricultural lands for years without any opportunity for recovery of soil. This made soil polluted, and some lands even became desert.

Also, they used rivers and other water resources for agriculture that decrease the volume of many seas and lakes where those rivers flow. For example, the water level of Aral sea decreased by 24 meters and reduced in the area when people used its rivers for agriculture. Some waters were polluted by wastes of factories like the Caspian Sea with oil.

Aral sea water levels in 1989 and 2014 Factories are polluting the air with emitted gases or heavy metals. For example, lead pollution in Shymkent, Oskemen, and Ekibastuz are results of industrial wastes. Heavy metals in air cause respiratory diseases and plant death. In water, heavy metals kill plants and animals living there.

There was nuclear testing in Semey which left radiation that makes water, soil and everything else dangerous to use due to mutation, etc.

All the pollution (air, water, soil, etc.) of nature lead to global natural disasters like climate change, hurricane, flood, and extinction of biodiversity.

## Activity

---

All the garbage that we throw away can be used more than once. It is called recycling. Recycling is an important factor in the conservation of natural resources and the environment. The world population is growing, and we must act fast as the amount of waste we create is increasing all the time. It is necessary for us if we want to leave this planet beautiful for our future generations. So, let's save our planet by recycling.

Divide into groups. Each group takes three big trash bags. One trash bag will be only for papers, second for plastics and last for cans or glasses.



Design bags and put them in the school corners. Find recycling companies and give them filled bags for reuse.

## Literacy

---

1. Describe a habitat near your house or school that is under threat from human activities and suggest what could be done.

2. Which city has the most ecological problems in Kazakhstan? Defend your choice.

3. Which material can be recycled in your school?

## Facts

---

To save Aral sea, Kazakhstan government built a dam Dike Kokaral in 2005. Dam is built between North Aral and South Aral, so Syrdariya water pours only into North Aral. Since then water level of North Aral has risen, and salinity is decreased. Below you can see water level change from 2005 to 2006.

## Research time

---

Work in a group with four students.

Take any pollution or an ecological problem of Kazakhstan which

concerns you the most. Prepare a good exhibition stand which will increase awareness of this problem.

Organize a public presentation in school with your class. Here are some main ecological problems of Kazakhstan:

- radiation from nuclear testing sites • the reduction of the Aral Sea • desertification of former agricultural land
- pollution of the Caspian Sea with oil
- lead pollution of soil and water 151

## Terminology

---

agriculture - ауыл шаруашылығы / сельское хозяйство;

emitted - шығарылған / выпущенный;

exhibition - көрме / выставка;

extinction - жоғалу, қырылып кету / вымирание;

garbage - қоқыс / мусор;

heavy metal - ауыр метал/тяжелый металл;

industrial - өнеркәсіптік / промышленный;

irresponsible - жауапкершіліксіз / безответственный;

nuclear - ядролық, атомдық / ядерный, атомный;

pollution - ластану, кірлену / загрязнение;

radiation - радиация;

recycling - қайта өңдеу / переработка.

# Problems

## Test questions with one correct answer

1. Taking care about environment to make possible life for flora and fauna

A) Conservation

B) Ecology

C) Biodiversity

D) Pollution

E) Extinction

2. Show animal which is extinct because of human uncontrolled hunting

A) Steller's sea cows

B) Dinosaurs

C) Mammoth

D) Sable tube tigers

E) Dingo dogs

3. Lead pollution is high in

A) Kokshetau

B) Astana

C) Zhezkazgan

D) Shymkent

E) Semey

4. Wild animal that was near to extinction because of human

A) Przewalski horse

B) Sea caws

C) Great Auk

D) Leopard seal

E) Wildebeest

### **Test questions with several (max 3) correct answers**

1. Used for biodiversity conservation

A) Zoo

B) Botany parks

C) Oranjerie

D) Conservancy area

E) Seed bank

F) Red book

G) Black book

H) Dendropark

2. Can affect negatively aquatic animals

A) Uncontrolled use of river water

B) Planting artificial forests

C) Building apartments

D) Acid rains

E) Smoke

F) Heavy rains

G) Using pesticides

H) Oil spills in oceans and seas

3. Which one of the following data are not related to Semipalatinsk Test Site?

A) 1949-1989 years

B) First Lighting

C) 29 August

D) 456 nuclear tests

E) Radiation

F) Hiroshima

G) 6 August 1945

H) Enola Gay

## Matching

1. Match terms with their definitions

1. Seed bank
2. Red book
3. Conservancy area

- A) Botany garden
- B) Store seed to preserve genetic diversity
- C) Preserve and enhance species
- D) List of endangered species
- E) Area for entertainment with animals
- F) List of world's popular species

2. Match pollutions with their causes

1. Soil pollution
2. Water pollution
3. Air pollution

- A) Planting trees
- B) Using pesticides
- C) Building zoos
- D) Oil spills in oceans
- E) Factories and cars
- F) Recycling of garbage

# ANSWERS

<b>1. CELL BIOLOGY</b>	1	2	3	4
Answers for the test questions with one right answer	D	E	B	C
Answers for the test questions with several answers	B, F	B, E	A, B, F	
Matching questions	1-A, 2-D, 3-F	1-C, 2-B, 3-E		
<b>2. CHEMISTRY OF LIFE</b>	1	2	3	4
Answers for the test questions with one right answer	C	B	A	C
Answers for the test questions with several answers	B, D, G	B, D, E	A, B, C	
Matching questions	1-E, 2-D, 3-A	1-C, 2-D, 3-A		
<b>3. DIVERSITY OF LIVING THINGS</b>	1	2	3	4
Answers for the test questions with one right answer	A	B	A	E
Answers for the test questions with several answers	B, E, F	A, E, G	B, E, H	
Matching questions	1-B, 2-D, 3-E	1-B, 2-A, 3-F		
<b>4. NUTRITION</b>	1	2	3	4
Answers for the test questions with one right answer	C	E	E	A
Answers for the test questions with several answers	B, D, F	D, G, H	A, C, F	
Matching questions	1-C, 2-D, 3-F	1-E, 2-A, 3-C		
<b>5. GROWTH AND DEVELOPMENT</b>	1	2	3	4
Answers for the test questions with one right answer	C	D	B	A
Answers for the test questions with several answers	A, D, F	C, E, F	A, C, E	
Matching questions	1-B, 2-C, 3-E	1-D, 2-F, 3-B		
<b>6. MATERIAL TRANSPORT</b>	1	2	3	4
Answers for the test questions with one right answer	D	D	B	A
Answers for the test questions with several answers	B, D, F	C, E, G	A, D, H	
Matching questions	1-C, 2-D, 3-E	1-D, 2-B, 3-A		
<b>7. RESPIRATION</b>	1	2	3	4
Answers for the test questions with one right answer	E	C	E	D
Answers for the test questions with several answers	A, C, F	B, D, F	A, G, B	
Matching questions	1- E, 2-C, 3-D	1- B, 2-D, 3-F		
<b>8. EXCRETION</b>	1	2	3	4
Answers for the test questions with one right answer	B	A	D	B
Answers for the test questions with several answers	B, D, G	B, F, H	A, D, G	
Matching questions	1-C, 2-D, 3-E	1-B, 2-D, 3-E		

<b>9. MOVEMENT</b>	1	2	3	4
Answers for the test questions with one right answer	B	A	C	C
Answers for the test questions with several answers	A, B, G	A, B, H	D, F, G	
Matching questions	1-A, 2-B, 3-D	1-A, 2-E, 3-F		
<b>10. BIOPHYSICS</b>	1	2	3	4
Answers for the test questions with one right answer	C	A	A	A
Answers for the test questions with several answers	B, D, F	B, D, E		
Matching questions	1-A, 2-B, 3-D	1-A, 2-E, 3-F		
<b>11. COORDINATION AND REGULATION</b>	1	2	3	4
Answers for the test questions with one right answer	E	B	B	B
Answers for the test questions with several answers	C, D, H	D, G, H	C, D, E	
Matching questions	1-E, 2-B, 3-C	1-B, 2-A, 3-D		
<b>12. REPRODUCTION</b>	1	2	3	4
Answers for the test questions with one right answer	D	E	D	A
Answers for the test questions with several answers	A, D, E	C, D, H	B, E, F	
Matching questions	1-C, 2-D, 3-E	1-A, 2-F, 3-C		
<b>13. INHERITANCE AND VARIATION</b>	1	2	3	4
Answers for the test questions with one right answer	C	D	A	D
Answers for the test questions with several answers	D, G	D, F	B, C, F	
Matching questions	1-E, 2-A, 3-C	1-A, 2-C, 3-E		
<b>14. MICROBIAL DISEASES</b>	1	2	3	4
Answers for the test questions with one right answer	D	A	B	E
Answers for the test questions with several answers	B, C, D	A, D, G	D, F, G	
Matching questions	1-A, 2-D, 3-E	1-F, 2-B, 3-A		
<b>15. BIOSPHERE</b>	1	2	3	4
Answers for the test questions with one right answer	D	A	C	D
Answers for the test questions with several answers	B, C, E	F, H, G	D, G, H	
Matching questions	1-D, 2-E, 3-A	1-A, 2-B, 3-F		
<b>16. HUMAN IMPACT ON ENVIRONMENT</b>	1	2	3	4
Answers for the test questions with one right answer	A	A	D	A
Answers for the test questions with several answers	D, E, F	A, B, H	B, E, H	
Matching questions	1-B, 2-D, 3-C	1-B, 2-D, 3-E		



# Glossary

## A

---

**Abdomen:** The part of the body of a vertebrate containing the digestive and reproductive organs; the belly.

**Absorption:** Take up or take in; The sponge absorbs water well

**Acid:** A chemical that reacts easily with other substances and turns litmus paper red; less than 7 on the pH scale

**Acne:** inflammatory disease of the sebaceous gland

**Active immunity:** is immunity in an organism resulting from its own production of antibody or lymphocytes

**Agglutination:** adhesion of separate parts

**Albinism:** Albinism is a range of disorders varying in severity. They are all caused by a reduction or absence of the pigment melanin, often causing white skin, light hair, and vision problems

**Alveoli:** tiny air sacs found in a lung which is used for gas exchange

**Amino Acid:** A molecule that joins with other amino acids to form proteins

**Analyze:** Think about the different parts of a problem or situation to figure out how it is related to the whole.

Angiosperms: flowering plants  
Arteriosclerosis: a disease of the arteries characterized by the deposition of fatty material on their inner walls.

Artery: Blood vessel that carries blood away from the heart

Arthropods: animals with segmented body, jointed limbs and exoskeleton

Asexual Reproduction: Reproduction that happens without sex; one organism creates one or more organisms

Atom: The smallest unit of a substance that has all of the properties of that substance

Atrium: upper chamber of heart that receives blood from the body and lungs

## **B**

---

Backbone: the row of connected bones that go down the middle of the back and protect the spinal cord.

B cells: a kind of lymphocyte that provide humoral immunity

Bacteria: The kingdom of life which has no cell membrane or nucleus and is always unicellular

Beriberi: a disease causing inflammation of the nerves and heart failure, ascribed to a deficiency of vitamin B1.

Bile: a yellow or greenish liquid that is made by the liver and that helps the body to digest fats.

Biological classification: Organization of how living things are related to each other

**Biology:** The study of living things  
**Blastula:** early stage of development, two-layered ball like structure

**Body cell:** All of the cells in an organism not involved in reproduction

**Bond:** An electrical force that links atoms together

**Bronchi:** major air passages of the lungs which diverge from the windpipe.

## C

---

**Canines:** a pointed tooth between the incisors and premolars of a mammal.

**Calorie:** Measure of energy, usually contained in food

**Cancer:** Disease where cells grow in an uncontrolled way

**Capillaries** are blood vessels that connect arteries and veins

**Carbohydrate:** An essential chemical in all cells that is broken down to form sugars; glucose, sucrose, lactose, galactose

**Carbon Dioxide:** Molecule made up of one carbon and two oxygens, produced by animals and other organisms; main contributor to manmade global warming

**Cell:** The basic structural and functional unit of all organisms

**Cell differentiation:** A process where cells change to perform different roles

**Cell division:** A process where one cell becomes more than one cell

**Cell membrane:** Surrounds the cell and keeps it together; also decides what material enters and leaves

**Cell organelle:** Parts of the cell that perform specific functions

**Cell wall:** The stiff outer layer of a cell that protects the cell and gives it shape

**Cellular respiration:** The process where organisms get energy from organic molecules

**Cellulose:** a substance that is the main part of the cell walls of plants and that is used in making various products (such as paper)

**Characteristic:** A distinguishing quality of something; generosity is one of his best characteristics

**Chloroplast:** Organelle in plants and some other organisms which is responsible for photosynthesis

**Chest cavity:** internal space of chest where heart and lungs are located.

**Chitin:** a kind of polysaccharide which is found in the structure of fungi cell walls and insect skeleton.

**Closed circulatory system:** blood is contained inside blood vessels, circulating unidirectionally.

**Compound:** A chemical combination of two or more atoms (of different elements)

**Consumer:** Living thing that eats other living things

**Cotyledon:** part of the seed that will grow into the leaves.

**Covalent Bond:** A type of chemical bond where electrons are shared between the atoms

**Crop:** organ used for storage of food in birds.

## D

---

**Decomposer:** A type of living thing that survives by consuming dead organic matter

**Denaturation:** change of the structure of protein by heat or an acid.

**Dentine:** hard dense bony tissue forming the bulk of a tooth, under the enamel.

**Development:** growth from one cell to multicellular organism

**Dermis:** thick layer of skin under epidermis

**Differentiation:** Process where cells grow and become different than their mother cell

**Diffusion:** Where molecules spread out until they are evenly distributed in a medium, such as the air

**Diaphragm:** a large flat muscle that separates the lungs from the stomach area and that is used in breathing.

**Diarrhea:** an intestinal disorder that causes pass waste from your body very frequently and in liquid state

**Dicot:** plant with two cotyledons(seed leaves)

**Digestion:** breaking down food into small particles

**DNA:** Abbreviation for deoxyribonucleic acid, which contains the genetic instructions for all forms of life

**Dominant:** A genetic characteristic that is always expressed by the organism

**Donor:** a person who gives some of their blood or a part of their body to help someone.

## **E**

---

**Ectoderm:** the outermost layer of cells or tissue of an embryo in early development

**Eczema:** inflamed skin characterized by redness, itching, and scaly.

**Edema:** a condition characterized by an excess of watery fluid collecting in the cavities or tissues of the body.

**Enamel:** the white, compact, and very hard substance covering and protecting the dentin of a tooth.

**Endoderm:** the innermost layer of cells or tissue of an embryo in early development.

**Embryology:** The study of how organisms develop; the more closely related two organisms are, the more similar they are as they develop

**Endoplasmic reticulum:** Organelle that produces proteins and fats

**Energy:** The property of something's ability to do work

**Environment:** The complex of physical, chemical, and biotic factors (e.g., climate, soil, living things) that act upon an

organism or an ecological community and ultimately determine their forms and survival

Epidermis: outermost layer of the skin Erythrocyte: are red blood cells, which carry oxygen

Esophagus: the part of the digestive system which connects the throat to the stomach.

Eukaryote: A type of organism that has a true nucleus in its cell(s)

Excretion: process of elimination of wastes from the body

Excretory system: a system that removes excess water and unnecessary products. It consists of kidneys, ureter, urinary bladder, and urethra.

Exhalation: movement of air out of lungs.

Exoskeleton: external skeleton that supports and protects an animal's body.

## **F**

---

Fern: seedless, nonflowering vascular plant which lives in tropical to temperate regions.

Fiber: a thin, threadlike structure.

Fixed joint- joint between two bones that doesn't move

Fluid: Anything that flows; both gases and liquids are considered fluids

Food poisoning: becoming ill after eating spoiled food

Forensics: science that use of scientific knowledge or methods in solving crimes

Fraternal twins: twins those are developed from two zygotes.

Fungi: The kingdom of living things that are eukaryotic and make their own energy; mushrooms, yeast, molds

## G

---

Gametes: The cells that are responsible for sexual reproduction; sperm, eggs

Germ: A small organism that causes disease Gizzard: a muscular, thick-walled part of a bird's stomach for grinding food.

Gills: respiratory organ of aquatic animals.

Goggles: A safety device used whenever the eyes could be injured by a chemical or physical experiment

Golgi apparatus: Organelle that packages proteins and fats so that they can leave the cell

Growth: The increase of size of an individual; can also be the presence of something

Gymnosperm: a group of plant that have seeds unprotected by an ovary or fruit, including the conifers, cycads, and ginkgo.

## H

---

Heart attack: blocking of heart arteries which brings to death of heart muscles



Heterotroph: Living thing that needs to consume other organisms for food

Homeostasis: Maintenance of a constant internal environment in an organism.

Humoral immunity: antibody-mediated immunity

Hypertension: high blood pressure

Hypodermis: the deepest part of the skin which contains fat cells

## I

---

Identical twins: twins that are produced from a single zygote.

Incisor: tooth at the front of the mouth, adapted for cutting and biting.

Inflammation: physical condition in which part of the body becomes reddened, swollen, hot, and often painful.

Immunity: Ability to completely fight off disease

## J

---

Joint: the area where two bones are attached for the purpose of permitting body parts to move

## K

---

Kingdom: Most general classification of living things (sometimes placed under “Domains”)

## L

---

**Large intestine:** end part of the intestine that is wider and shorter than the small intestine.

**Leukocyte:** white blood cells, which protect the organism

**Leukemia:** Cancer of the blood or bone marrow

**Lichen:** A combination of a fungus and an algae that help each other

**Life cycle:** The series of stages in form and functional activity through which an organism passes between origin and expiration

**Limbs:** an arm or leg of a person or four-legged animal, or a bird's wing.

**Lipid:** Refers to a group of fats that cannot be dissolved in water

**Liquid:** The state of matter where the particles are loose and form the shape of their container but do not necessarily fill up the container

**Living thing:** An organism

**Lymph:** fluid that circulates through lymphatic system

**Lymphatic system:** network of tissues and organs that help rid the body of toxins, waste and other unwanted materials.

**Lymphocyte:** A lymphocyte is a type of white blood cell that is part of the immune system. There are two main types of lymphocytes: B cells and T cells.

**Lysosome:** Organelle that digests food and waste in the cell

## M

---

**Macromolecules:** a molecule containing a very large number of atoms, such as a protein, nucleic acid, or synthetic polymer.

**Meiosis:** The process of cell division which produces four sex cells (gametes) from one cell

**Metamorphosis:** A marked and more or less abrupt developmental change in the form or structure of an animal (e.g., butterfly or frog) occurring subsequent to birth or hatching

**Microorganism:** A small organism that is only visible underneath a microscope

**Microscope:** Instrument used to observe things that are smaller than can be seen with the naked eye

**Micro preparations:** prepared microscope slides

**Mitochondria:** An organelle in all eukaryotic cells which is responsible for energy production

**Mitosis:** The process of cell division which produces two body cells from one cell

**Molar teeth:** a grinding tooth at the back of a mammal's mouth.

**Molecule:** The smallest unit of a substance that is the combination of one or more atoms

**Monera:** Kingdom of life made up of bacteria (prokaryotes)

Mold: a soft, green or grey growth that develops on old food or on objects that have been left for too long in warm, wet air.

Monocot: plant with one cotyledon

Monomer: identical units that join together to form polymer

Multicellular: Made up of more than one cell

Multicellular Organisms: Organisms that are made up of more than one cell

Muscle: a body tissue that can contract and produce movement

## N

---

Nausea: sickness at the stomach, an involuntary impulse to vomit an atom; fission, fusion

Nonvascular plant: plants without vascular tissue such as mosses.

Nucleic acid: In the nucleus of a cell, there are two major types of nucleic acids: DNA and RNA Nucleotides: These are found on a strand of DNA or RNA as a sequence of bases

Nucleus: In biology, this refers to the middle of a cell; in physical science, this refers to the center of an atom

Nutrient: Any molecule that is needed for an organism to survive

## O

---

Objective: Based upon fact

Observation: Noticing or paying attention

Offspring: Children, of any organism

Open circulatory system: organisms with open circulatory system have open ended vessels. Blood leaves the vessels and enters to the body space.

Order: Classification of living things between Class and Family

Organ: Group of tissues that perform a certain function

Organ system: Group of organs that together perform a common function

Organelle: Part of a cell that performs a function for the cell

Organic: Comes from living things

Organic molecule: A molecule that contains carbon atoms bonded together

Organism: A living thing that can live and reproduce independently

Organogenesis: formation of organs

## **P**

---

Passive immunity: the immunity resulting from the injection of antibodies or lymphocytes from another organism

Peristalsis: the involuntary constriction and relaxation of the muscles of the intestine or another canal, creating wave-like

movements which push the contents of the canal forward.

Permanent teeth: second set of teeth in mammals that grows as the milk teeth are shed

Phagocytes: leukocytes which digest viruses and bacteria

Photosynthesis: The process that happens in plants and some other organisms which takes the sun's energy and turns it into usable energy;  $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{Light} = \text{C}_6\text{H}_{12}\text{O}_6$  (glucose) +  $6\text{O}_2$

Plasma: liquid part of blood.

Pollen: the fertilizing element of flowering plants, consisting of fine, powdery, yellowish grains or spores, sometimes in masses.

Pollination: the transfer of pollen from the anther to the stigma.

Polymer: large molecule or macromolecule composed of many repeated parts

Premolar: situated in front of the molar teeth.

Producer: Living thing that makes its own energy from the sun

Prokaryote: A type of living thing that is single-celled and has no true nucleus

Protein: A sequence of amino acids

Protist: Kingdom of life made up of single-celled eukaryotes

**Pulmonary circulation:** movement of blood from the heart to the lungs for oxygenation, then back to the heart again.

**Pulp:** soft part of the tooth where blood vessels and nerves are found.

**Pulp cavity:** the space within a tooth that contains the pulp.

**Pulse:** the regular beating of the heart, especially when it is felt at the wrist or side of the neck.

## R

---

**Reaction:** When one or more substances are changed into other substances

**Regeneration:** The process that creates something over again

**Reproduce:** To create more of creating offspring

**Reproduction:** The process of creating offspring

**Research:** Discovering information that other scientists have already published

**Resistance:** (Biology) Ability to fight off some amount of disease

**Respiratory minute volume:** the amount of inhaled or exhaled air in a minute.

**Resource:** A supply of something that can be used when needed

**Respiratory rate:** rate of breathing

Ribosome: Organelle that reads the mRNA to produce proteins

## S

---

Sebaceous gland: (oil gland) a small gland in the skin which secretes a lubricating oily matter (sebum) into the hair follicles to lubricate the skin and hair.

Salivary glands: glands which produce saliva

Saturated: Completely full; for a solution, the most amount of solute that can be put into the solvent

Scabies: skin disease with itching and small raised red spots, caused by the itch mite.

Semi movable joints: joints between bones in which the motion is limited

Sexual reproduction: The combination of two individuals (genetically) to form one or more new organisms

Small intestine: narrow upper part of the intestine where digestion of food completes and absorption starts

Species: A very specific classification of organisms; all members of a species can mate together

Spleen: an abdominal organ involved in the production and removal of blood cells in most vertebrates and forming part of the immune system.

Starch: A kind of storage polysaccharide found in plants.

Stem cell: A type of cell that can turn into any other type of cell.



**Sternum:** Flat bone that connects ribs to each other forming the front part of rib cage.

**Stimulus:** Anything that affects an organism

**Stomach:** saclike organ which store and digest food

**Stroke:** death of brain tissue occurred as a result of artery blockage

**Substance:** A type of matter that has the same properties; water, oxygen, carbon dioxide, diamond

**Systemic circulation:** movement of blood from the heart through the body to provide oxygen and nutrients to the tissues of the body while bringing deoxygenated blood back to the heart.

## T

---

**T cells:** leukocytes that provide cell-mediated immunity

**Tetter:** any of various eruptive skin diseases

**Tidal volume:** volume of gas inhaled or exhaled in each respiration, during a normal, regular breathing

**Tissue:** Group of cells that perform a similar function

**Tissue fluid:** fluid between cells

**Tonsil:** either of two small masses of lymphoid tissue in the throat, one on each side of the root of the tongue.

**Toxin:** a poisonous substance and especially one that is produced by a living thing

Trachea: a large membranous tube reinforced by rings of cartilage, extending from the larynx to the bronchial tubes and conveying air to and from the lungs; the windpipe.

Typhoid: an infectious bacterial fever with an eruption of red spots on the chest and abdomen and severe intestinal irritation.

## U

---

Ultraviolet: A form of electromagnetic radiation that has more energy than visible light; most ultraviolet light is usually blocked in our atmosphere by ozone

Unicellular: Made up of one cell

Urinary bladder: a membranous sac in many vertebrates that serves for the temporary retention of urine and discharges by the urethra.

Urine: liquid waste excreted by the kidneys, in humans being a yellowish, slightly acid

Urea: a substance found in urine and also made from ammonia,

Ureter: a muscular duct or tube conveying the urine from a kidney to the bladder or cloaca

Urethra: the duct by which urine is conveyed out of the body from the bladder, and which in male vertebrates also conveys semen.

## V

---

Vacuole: Organelle that stores nutrients in the cell

**Vascular:** relating to or denoting the plant tissues (xylem and phloem) which conduct water, sap, and nutrients in flowering plants, ferns, and their relatives.

**Vena cava:** any of the large veins by which in air-breathing vertebrates the blood is returned to the right atrium of the heart.

**Ventricle:** one of two sections of the heart that pump blood out to the body.

**Veins:** are blood vessels that transport blood to the heart

**Vessel:** tube shaped structure that carries blood in the body.

**Virus:** A small particle that contains DNA or RNA and is able to reproduce only inside of a living cell

**Vital capacity:** greatest amount of air that can be forced from the lungs after maximum inhalation

**Vitamin:** organic molecule essential for body processes

## **W**

---

**Wax:** an oily organic compound insoluble in water but soluble in organic solvents; essential structural component of living cells (along with proteins and carbohydrates)

## **Y**

---

**Yeast:** an organism of the kingdom Fungi lacking chlorophyll and feeding on organic matter; ranging from unicellular or multicellular organisms to spore-bearing syncytia

## **Z**

---

Zygote: Combination of a sperm and egg cell

# Reference

1. Biology grade 8, Bayram KENCI, Bakhtiyor ERMETOV, Elmira OSPANKULOVA and others, Астана кітап publishing, Almaty 2016, 308 pages
2. Biology grade 9, Bayram KENCI, Ilyas SAKIMOV, Timur ZHIGITBAYEV and others, Астана кітап publishing, Almaty 2016, 166 pages
3. Campbell Biology (Tenth edition), Jane B. Reece, Lisa A. Urry, Michael L. Cain and others, Pearson education publishing, USA 2014, 1484 pages
4. Modular system Cytology, Bayram KENCI, Osman ARPACI, Musa ÖZET and others, Zambak publishing, Istanbul 2010, 221 pages
5. Holt Biology, George B. Johnson, Peter H. Raven, Harcourt School, 2006
6. Longman Biology for IGSE Phil Bradfield and Steve Potter, Longman Publishing 2004, 266 pages.
7. Life, Ricki Lewis, Bruce Parker, Douglas Gaffin, Marielle Hoefnagels Mc Graw Hill publishing 2007, 1102 pages
8. Biology ,Solomon, Berg, Martin, Thomson publishing 2006, 1108 pages
9. Cambridge international AS and A level biology, Mary jones, Richard Fosbery, Jennifer Gregory, Denis Taylor, CAMBRIDGE publishing 2013 , 510 pages

# BIOLOGY

## Grade 8

**Authors:**

Bakhtiyor Ermetov  
Adlet Sagintayev  
Bayram Kenci  
Aliya Akhmetova  
Lazzat Nuraliyeva  
Akaisha Jilkaidarova  
Nazerke Karimova

**Edited by:**

Aidyn Tussyubzhanov

**Designed by:**

Yelnar Beimish

**Cover design:**

Darkhan Berdibayev

