



WORKBOOK

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Subject: Chemistry

Class: 3.X

Topics:

1. Introduction biochemistry
2. Sacharides
3. Lipids
4. Proteins
5. Enzymes
6. Nucleic acids
7. Metabolism
8. Heterocycles
9. Hormones
10. Nobel Prizes in chemistry
11. Food



INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ

VOCABULARY

Topic 1: Organic acids and their derivatives

- **acid** – a proton donor (a source of hydrogen ions, H^+)
- **acid ionization constant** – the value of the equilibrium constant expression for the ionization of a weak acid
- **acid-base indicator** – a chemical dye whose colour is affected by acidic and basic solutions
- **acidity constant** – the equilibrium constant for proton transfer to water; for an acid HA, $K_A = [H_3O^+][A^-]/[HA]$ at equilibrium
- **amide** – an organic compound in which the $-H$ group of a carboxylic acid is replaced by a nitrogen atom bonded to other atoms
- **amino acid** – a carboxylic acid that also contains an amino group
- **amino group** – the functional group $-NH_2$ characteristic of amines
- **carboxyl group** – consists of a carbonyl group bonded to a hydroxyl group – $COOH$
- **carboxylic acid** – an organic compound that contains a carboxyl group and is polar and reactive
- **condensation reaction** – occurs when two smaller organic molecules combine to form a more complex molecule, accompanied by the loss of a small molecule such as water
- **ester** – the product of the reaction between a carboxylic acid and an alcohol and having a formula $RCOOR'$
- **esterification** – the formation of an ester
- **fat** – an ester of glycerol and carboxylic acids with long hydrocarbon chains; fats act as long-term energy storage in living systems
- **fatty acid** – a carboxylic acid with a long hydrocarbon chain
- **functional group** – an atom or group of atoms that always react in a certain way in an organic molecule
- **hydrogen bond** – a link formed by a hydrogen atom lying between two strongly electronegative atoms (O, N or F). The electronegative atoms may be located on different molecules or in different regions of the same molecule
- **nitrile** – an organic compound containing $-CN$ functional group
- **pH** – a mathematical scale in which the concentration of hydronium ions in solution is expressed as a number from 0 to 14; the negative logarithm of the hydrogen ion concentration of a solution; acidic solutions have pH values between 0 and 7, basic solutions have values between 7 and 14, and solutions with a pH of 7,0 is neutral
- **zwitterion** – a form of an amino acid in which the amino group is protonated and the carboxyl group is deprotonated

Topic 2: Chemistry of natural substances

- **amino acid** – a carboxylic acid that also contains an amino group
- **amino group** – the functional group $-NH_2$ characteristic of amines
- **biochemistry** – the study of the chemistry of living things
- **carbohydrate** – an organic molecule that contains the elements carbon, hydrogen, and oxygen in a ratio of about two hydrogen atoms and one oxygen atom for each carbon atom



- **denaturation** – the name given to the process of unfolding of a protein when the forces holding the polypeptide chain in shape are broken
- **disaccharide** – forms when two monosaccharides bond together
- **disulphide link** – an S – S link that contributes to the secondary and tertiary structures of polypeptides
- **DNA** – deoxyribonucleic acid
- **essential amino acid** – an amino acid which an organism needs to ingest because it is necessary for nutrition and cannot be synthesized in the body
- **fatty acid** – a long-chain carboxylic acid that usually has between 12 and 24 carbon atoms and can be saturated (no double bonds), or unsaturated (one or more double bonds)
- **furanose** – a five member ring structure containing four carbon atoms and one oxygen atom; is a simple sugar molecule
- **glycosidic bond** – a covalent bond that joins a carbohydrate to another functional group or molecule
- **hormone** – a signal molecule that tells cells whether to start or stop a reaction
- **kinase** - an enzyme that transfers a phosphate group from one molecule to another substrate
- **lipid** – a biological compound that contains a large proportion of C-H bonds and less oxygen than in carbohydrate; commonly called fats and oils
- **lyase** – an enzyme that catalyses a reaction which adds or removes a group from one molecule to form a double bond or new ring by a process other than hydrolysis or oxidation
- **monosaccharides** – the simplest carbohydrates, which are aldehydes or ketones that also have multiple hydroxyl groups; also called simple sugars
- **nitrogenous base** – heterocyclic base containing nitrogen that forms the base part of nucleotide molecule (example: cytosine, adenine...)
- **nucleic acid** – a large polymer containing carbon, hydrogen, and oxygen, as well as nitrogen and phosphorus; found in all plant and animal cells
- **nucleoside** – a compound formed from a nucleotide base and five-carbon sugar (examples: cytidine, uridine, adenosine...)
- **nucleotide** – the building blocks of nucleic acids; each consists of a simple sugar, a phosphate group, and a nitrogen-containing base
- **oligosaccharide** – a saccharide polymer with a small amount of component sugar molecules
- **peptidase** – an enzyme that initiates the hydrolysis of a peptide bond to form peptide chains
- **peptide** – a chain of two or more amino acids linked by peptide bonds
- **peptide bond** – the amide bond that joins two amino acids
- **phospholipid** – a triglyceride in which one of the fatty acids is replaced by a polar phosphate group
- **polypeptide** – a linear polymer chain of amino acid molecules
- **polysaccharide** – a complex carbohydrate, which is a polymer of simple sugars that contains 12 or more monomer units
- **primary structure** – the sequence of amino acids in the polypeptide chain of a protein
- **protein** – a polymer formed from small monomer molecules linked together by amide groups
- **quaternary structure** – the manner in which neighbouring polypeptide units stack together to form a protein molecule
- **RNA** – ribonucleic acid

- **saponification** – the hydrolysis of the ester bonds of triglyceride using an aqueous solution of a strong base to form carboxylate salts and glycerol; is used to make soaps
- **saturated fat** – any lipid which contains no carbon-carbon double bonds. Natural saturated fats often come from animal sources.
- **secondary structure** – the manner in which a polypeptide chain is coiled, example α -helix, β -sheet
- **starch** – a polysaccharide used by plants for energy storage; consists of glucose molecules chained together by glycosidic bonds
- **steroid** – a lipid with distinctive four-ring structure
- **tertiary structure** – the shape into which the α -helical and β -sheet sections of a polypeptide are twisted as a result of interactions between peptide groups lying in different parts of the primary structure
- **triglyceride** – forms when three fatty acids are bonded to a glycerol backbone through ester bonds; can be either solid or liquid at room temperature
- **vitamin** – an organic molecule required in small amounts; there are fat-soluble and water-soluble types
- **wax** – a type of lipid that is formed by combining a fatty acid with a long-chain alcohol; is made by both plants and animals
- **zymogen** – a type of protein that can be biochemically transformed within an organism into an enzyme. Zymogens typically transform into enzyme that catalyse processes that break down other proteins.

Topic 3: Metabolism and regulation of metabolism

- **active site** – on an enzyme, the pocket or groove that can bind a substrate taking part in a reaction
- **aerobic** – a metabolic process that takes place only in the presence of oxygen
- **anabolism** – refers to the metabolic reactions through which cells use energy and small building blocks to build large, complex molecules needed to carry out cell functions and for cell structures
- **anaerobic** – a metabolic process that takes place in the absence of oxygen
- **ATP** – adenosine triphosphate, the energy storage molecule in cells
- **biochemistry** – the study of the chemistry of living things
- **catabolism** – refers to metabolic reactions that break down complex biological molecules for the purpose of forming smaller building blocks and extracting energy
- **cellular respiration** – the process in which glucose is broken down in the presence of oxygen gas to produce carbon dioxide, water, and large amounts of energy
- **coenzyme** – an organic molecule that assists an enzyme in catalysing a reaction
- **decarboxylase** – a lyase which catalyzes a reaction to add or remove a carboxyl group from a compound
- **decarboxylation** – a chemical reaction which removes carbon dioxide from a substrate
- **dehydrogenation reaction** – a reaction that eliminates two hydrogen atoms, which form a hydrogen molecule of gas
- **electron transport chain** – the controlled release of energy from glucose by the step-by-step movement of electrons to lower energy levels
- **enzyme** – a highly specific, powerful biological catalyst



- **fermentation** – the anaerobic process of generating energy from glucose
- **law of conservation of energy** – law which states energy cannot be created or destroyed, but may be changed from one form to another
- **metabolism** – name giving to the sum of all the chemical reactions necessary for the life of an organism
- **metabolite** – any chemical compound produced as a result of metabolism or a metabolic reaction
- **photosynthesis** – the complex process that converts energy from sunlight to chemical energy in the bonds of carbohydrates
- **respiration** – the complex series of enzyme-catalyzed reactions that are used to extract chemical energy from glucose
- **substrate** – the name given to a reactant in an enzyme-catalyzed reaction

Topic 4: Chemistry around us

- **addition polymerization** – occurs when all the atoms present in the monomers are retained in the polymer product
- **condensation polymerization** – occurs when monomers containing at least two functional groups combine with the loss of a small by-product, usually water
- **elastomer** – an elastic polymer (rubber)
- **Freon** – represents several different chlorofluorocarbons; damage ozone layer
- **greenhouse effect** – the greenhouse effect refers to the effect of water and carbon dioxide absorbing outgoing infrared radiation, raising a system's temperature. The term is generally used with reference to the Earth's temperature, although it can also be applied to other systems, such as greenhouses and automobiles
- **greenhouse gas** – a gas present in the atmosphere that absorbs and emits infrared radiation (examples: water vapour, carbon dioxide, nitrous oxide, ozone)
- **macromolecule** – a molecule with a very large number of atoms. Macromolecules have more than 100 component atoms
- **monomer** – a molecule from which a polymer is made
- **ozone** – an allotrope of oxygen containing three oxygen atoms O_3
- **PCB (polychlorinated biphenyl)** – a class of compounds containing 2 to 10 chlorine atoms bonded to a biphenol molecule. PCBs are commonly used as dielectrics in electric transformers
- **polymerization** – a reaction in which monomer units are bonded together to form a polymer
- **polymers** – large molecules formed by combining many repeating structural units (monomers); are synthesized through addition or condensation reactions and include polyethylene, polyurethane, and nylon
- **primary pollutant** – a pollutant directly introduced into the environment (SO_2)
- **secondary pollutant** – a pollutant formed by the chemical reaction of another species in the environment (SO_3 from the oxidation SO_2)
- **smog** – a combination of the words smoke and fog. It is a form of air pollution formed from the emissions from combustion reacting with sunlight to produce secondary pollutants
- **smoke** – a colloid comprised of solid particles and gases associated with the products of incomplete combustion and air



- **thermoplastic** – a type of polymer that can be melted and molded repeatedly into shapes that are retained when it is cooled
- **thermosetting** – a type of polymer that can be molded when it is first prepared but when cool cannot be remelted
- **vulcanization** – a nonreversible chemical reaction between sulphur or another agent and rubber in which cross-links are formed between the molecular chains in the rubber

1. BIOCHEMISTRY INTRODUCTION

Biochemistry is the science in which chemistry is applied to the study of living organisms and the atoms and molecules which comprise living organisms. Take a closer look at what biochemistry is and why the science is important.

WHAT IS BIOCHEMISTRY?

Biochemistry is the study of the chemistry of living things. This includes organic molecules and their chemical reactions. Most people consider biochemistry to be synonymous with molecular biology.

WHAT TYPES OF MOLECULES DO BIOCHEMISTS STUDY?

The principal types of biological molecules, or biomolecules are:

- carbohydrates
- lipids
- proteins
- nucleic acids

Many of these molecules are complex molecules called polymers, which are made up of monomer subunits. Biochemical molecules are based on carbon.

WHAT IS BIOCHEMISTRY USED FOR?

- Biochemistry is used to learn about the biological processes which take place in cells and organisms.
- Biochemistry may be used to study the properties of biological molecules, for a variety of purposes. For example, a biochemist may study the characteristics of the keratin in hair so that a shampoo may be developed that enhances curliness or softness.



- Biochemists find uses for biomolecules. For example, a biochemist may use a certain lipid as a food additive.
- Alternatively, a biochemist might find a substitute for a usual biomolecule. For example, biochemists help to develop artificial sweeteners.
- Biochemists can help cells to produce new products. Gene therapy is within the realm of biochemistry. The development of biological machinery falls within the realm of biochemistry.

WHAT DOES BIOCHEMIST DO?

Many biochemists work in chemistry labs. Some biochemists may focus on modeling, which would lead them to work with computers. Some biochemists work in the field, studying a biochemical system in an organism. Biochemists typically are associated with other scientists and engineers. Some biochemists are associated with universities and they may teach in addition to conducting research. Usually their research allows them to have a normal work schedule, based in one location, with a good salary and benefits.

WHAT DISCIPLINES ARE RELATED TO BIOCHEMISTRY?

Biochemistry is closely related to other biological sciences that deal with molecules. There is considerable overlap between these disciplines:

- Molecular Genetics
- Pharmacology
- Molecular Biology
- Chemical Biology

2. SACHARIDES

Glycemia is the concentration of glucose in the It is usually expressed in mmol/l/..... . Glycemia normal values are from 3,3 – 5,5 mmol/l. is low concentration of glucose in the blood. is high blood concentration of glucose.

1. WRITE DOWN A HAWORTH PROJECTION OF THE STRUCTURE FOR α -D-GLUCOPYRANOSE:

2. SIGNS AND SYMPTOMS OF HYPOGLYCEMIA:

-
-
-



-
-

3. SIGNS AND SYMPTOMS OF HYPERGLYCEMIA:

-
-
-
-

4. WHICH MAIN HORMONES REGULATE THE CONCENTRATION OF BLOOD GLUCOSE?

↓.....

↑.....

5. DIFFERENCES BETWEEN *TYPE 1 DIABETES* AND *TYPE 2 DIABETES*:

<i>TYPE 1 DIABETES</i>	<i>TYPE 2 DIABETES</i>

3. LIPIDS

All lipids are in water: that is the one property they have in common. That is why they are soluble in

TYPES OF LIPIDS:

-
-
-
-
-



BIOLOGICAL FUNCTION OF LIPIDS:

-
-
-
-

FATS and OILS

= esters of and fatty acids.

- Palmitic acid
- Stearic acid
- Oleic acid
- ω-3 acids
- ω-6 acids

Since there are three fatty acids attached to glycerol, these lipids are known as triglycerides.

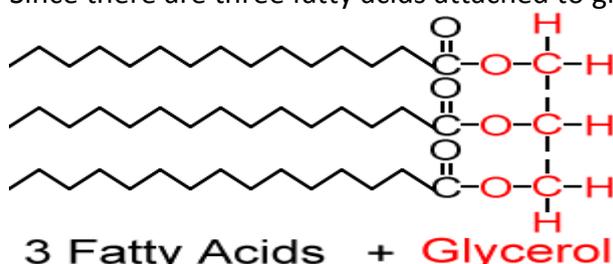


Fig. 1. TAG (www.wikipedia.org)

FATS: triacylglycerides of saturated fatty acids only.

- animal origin – e.g. (pork),(beef), or

OILS: triacylglycerides of both saturated and unsaturated fatty acids – double bond

- plant oils +!!!

REACTIONS OF FATS AND OILS

1. HYDROLYSIS

a) ACIDIC

b) ALKALINE – SAPONIFICATION

c) SPONTANEOUS – HYDROLITIC RANCIDITY

2. OXIDATION

= it is a slow process that can be accelerate by the presence of light, transition metals, free radicals, microorganisms (germs) – products are aldehydes, ketones and volatile acids that have a disgusting smell – oxidative rancidity.



3. HYDROGENATION OF OILS

An unsaturated oil can be raised by hydrogenation of the liquid oil to form a solid MARGARINE.

WAXES

= esters of fatty acids with an alcohol with high relative molecular mass e.g. hexadecan-1-ol or octadecan-1-ol

Plant waxes:

-

Animal waxes:

-

PHOSPHOLIPIDS AND GLYCOLIPIDS:

STRUCTURE:

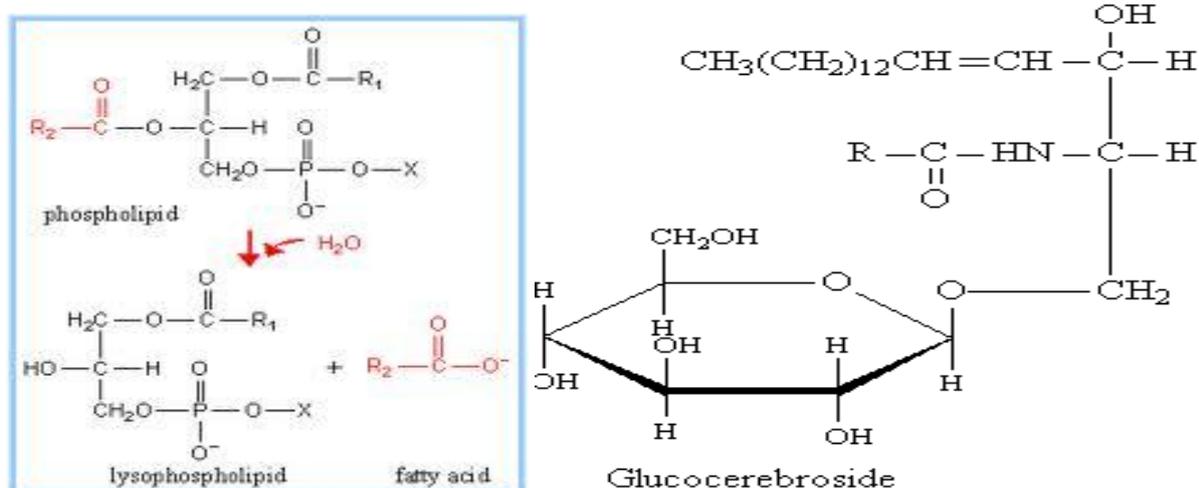


Fig. 2. Phospholipids and Glycolipids (www.wikipedia.org)

BIOLOGICAL FUNCTIONS:

-
-
-
-
-

STEROIDS AND TERPENES

Do not contain any fatty acid. Residues – still classified as lipids.

STEROIDS

are terpenoid lipids characterized by a carbon skeleton with four fused rings: STERANE.

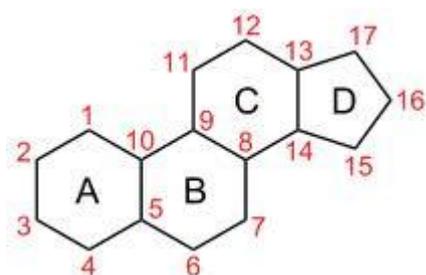


Fig. 3. Sterane (www.wikipedia.org)

Steroids vary by the functional groups attached to the sterane. Hundreds of distinct steroids are found in plants, animals and fungi:

- Insect steroids – e.g. ecdysterone which controls the ecdysis = and of arthropods.
- Vertebrate steroids
 - a) cholesterol, which is an important component of cell membranes. It is synthesized in liver and is used for synthesis of other substances e.g. sex hormones, vitamin (.....) and bile acids. It is also the principal constituent of the plaques implicated in atherosclerosis!!!!
 - b) sex hormones that produce sex differences or support reproductivity. They include androgens, estrogens and progestagens.

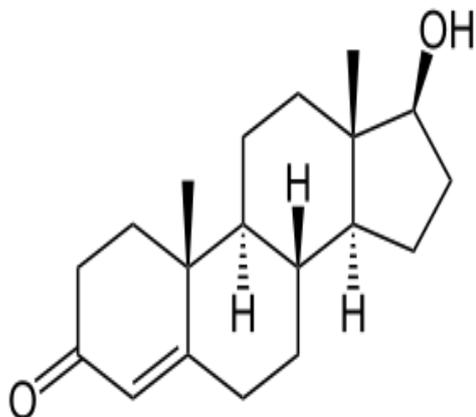


Fig. 4. Testosterone (www.wikipedia.org)

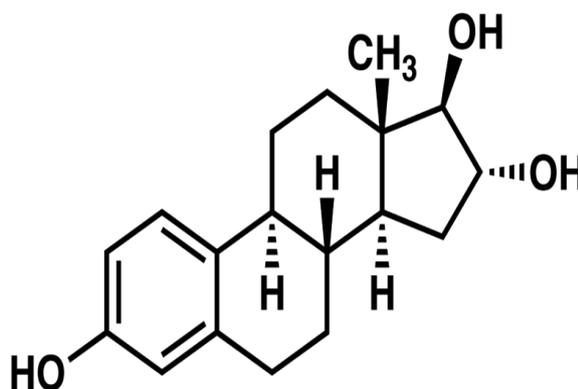


Fig. 5. Estriol (www.wikipedia.org)

c) corticosteroids include glucocorticoids and mineralocorticoids. Glucocorticoids regulate many aspects of metabolism and immune function, whereas mineralocorticoids help maintain blood volume and control renal excretion of electrolytes.

-
-
-

2. NEGATIVES OF DENATURATION:

-
-
-
-

3. WHAT DOES IT MEAN DENATURATED ALCOHOL?

4. WHAT DOES IT MEAN NATIVE STATE OF PROTEIN?

5. Some proteins can be denatured by 2-mercaptoethanol via its ability to cleave disulfide bonds in proteins:

a) WRITE DOWN CHEMICAL FORMULA OF 2-mercaptoethanol

b) WHICH STRUCTURE OF PROTEINS DEPENDS ON DISULFIDE BOND?

5. ENZYMES

= are globular proteins that catalyze chemical reactions in
 Enzymes are selective for their substrates and speed up only a few reaction from among many possibilities.

1. DESCRIBE THE FOLLOWING GRAPH:

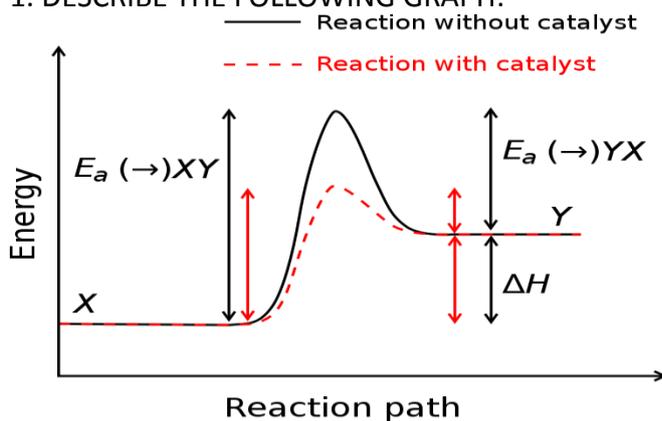
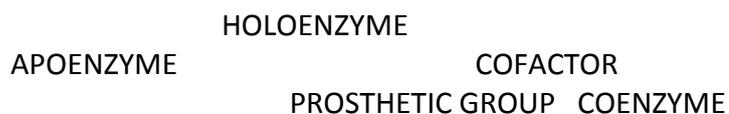


Fig. 6. Graph of Catalytic Reaction (www.wikipedia.org)



2. STRUCTURE OF ENZYMES:

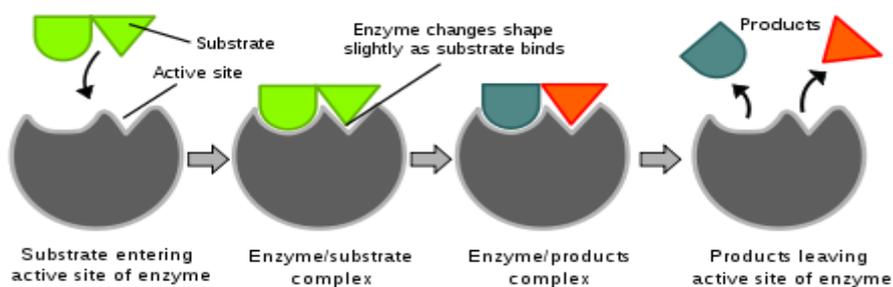


3. CLASSES OF ENZYMES:

-
-
-
-
-
-

4. DESCRIBE THE FOLLOWING MECHANISMS OF ENZYMATIC CATALYZE:

a).....



b).....



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Fig. 7. Mechanisms of Enzymatic Catalyze (www.wikipedia.org)

5. DESCRIBE THE FOLLOWING GRAPH OF ENZYMIC KINETICS:

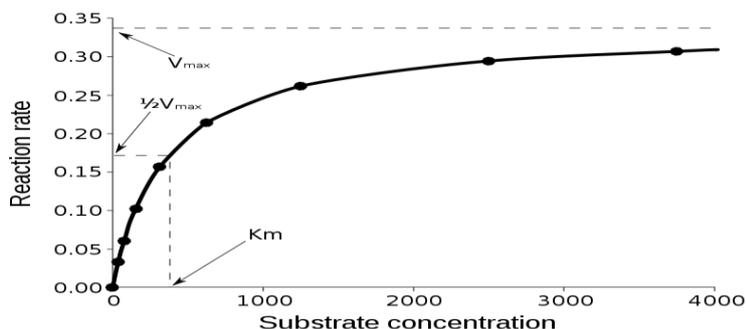


Fig. 8. Graph of Enzymatic Kinetics (www.wikipedia.org)

6. INHIBITION

a) competitive inhibition –

b) uncompetitive inhibition –

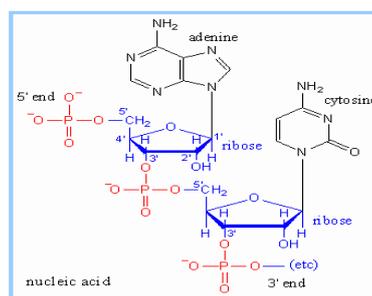
c) mixed inhibition –

6. NUCLEIC ACIDS

DNA is a long polymer made from repeating units called The structure of DNA was discovered by J.D. Watson and It consists of two helical chains, each coiled round the same axis in the shape of a The DNA secondary structure is stabilized primarily by between nucleotides. The DNA segments carrying genetic information are called

1. NUCLEOTIDE STRUCTURE OF :

a) DNA



b) RNA

Fig. 9. Nucleic Acid (www.wikipedia.org)



2. REWRITE FORMULAE OF COMPLEMENTARITY BASE PAIRING WITH HYDROGEN BONDS.

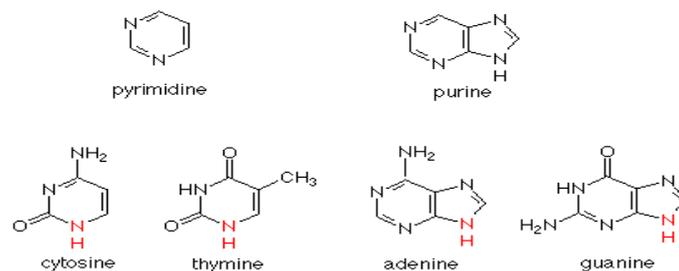


Fig. 10. Nitrogen Bases (www.wikipedia.org)

3. BIOLOGICAL FUNCTION OF:

- DNA
- mRNA
- tRNA
- rRNA

4. WATCH THE FOLLOWING VIDEOS:

<http://www.youtube.com/watch?v=-mtLXpgiHL0&feature=related>

<http://www.youtube.com/watch?v=4PKjF7OumYo&feature=fvst>

7. METABOLISM

A) BASIC LEVEL

- Complete set of reactions carried out by an organism:
 - catabolism
 - metabolism
 - anabolism
- Metabolic reactions that synthesize complex molecules:
 - catabolism
 - metabolism
 - anabolism
- Energy form in living cells:
 - sunlight
 - ATP
 - glucose
 - glycogen
- Metabolic reactions that break down complex molecules:
 - catabolism
 - metabolism
 - anabolism
- Starch is broken down into glucose monomers:
 - catabolism
 - anabolism
- Amino acids are linked by peptide bonds to form proteins:
 - catabolism
 - anabolism
- The proteins in food are broken down into amino acids:
 - catabolism
 - anabolism
- DNA is synthesized from nucleotides:
 - catabolism
 - anabolism
- Free fatty acids combine with glycerol to make triglyceride:
 - catabolism



b) anabolism

10. Photosynthesis:

a) catabolism

b) anabolism

11. Respiration:

a) catabolism

b) anabolism

B) UPPER LEVEL

1. Glycolysis is _____.

a) the lysis of glucose in chloroplasts

b) the synthesis of pyruvate in mitochondria

c) the breakdown of glucose to form two molecules of pyruvate

d) the synthesis of glucose from two molecules of pyruvate

e) the breakdown of starch to form glucose

2. How many molecules of ATP would be produced from 20 molecules of glucose at the end of fermentation?

a) 40

b) 100

c) 30

d) 20

e) 10

3. If oxygen is present after glycolysis, pyruvate is transported to the mitochondria, converted to acetyl-CoA, and broken down further in the

_____.

4. In eukaryotic cells, glycolysis occurs in the _____, and cellular respiration occurs in the _____.

a) chloroplasts, mitochondria

b) cytoplasm, chloroplasts

c) mitochondria, cytoplasm

d) cytoplasm, mitochondria

5. Respiration is the process of gas exchange (breathing in oxygen and breathing out carbon dioxide); cellular respiration is the process of _____.

a) cellular cooling

b) cellular reproduction



- c) cellular gas exchange
- d) production of ATP via the electron transport system

6. The energy-harvesting reactions of glycolysis produce two molecules of _____, two molecules of _____, and two molecules of _____.

- a) ATP, glyceraldehyde-3-phosphate, pyruvate
- b) pyruvate, glyceraldehyde-3-phosphate, water
- c) ATP, NADH, pyruvate
- d) glucose, carbon dioxide, water

7. In eukaryotic cells, the enzymes for the Krebs cycle are located in the _____, and those for the electron transport system are located in the _____.

- a) cytoplasm, cell wall
- b) mitochondrial matrix, inner mitochondrial membrane
- c) inner mitochondrial membrane, matrix
- d) plasma membrane, cytoplasm

8. The figure below depicts an overview of glucose metabolism. Label the reactions indicated.

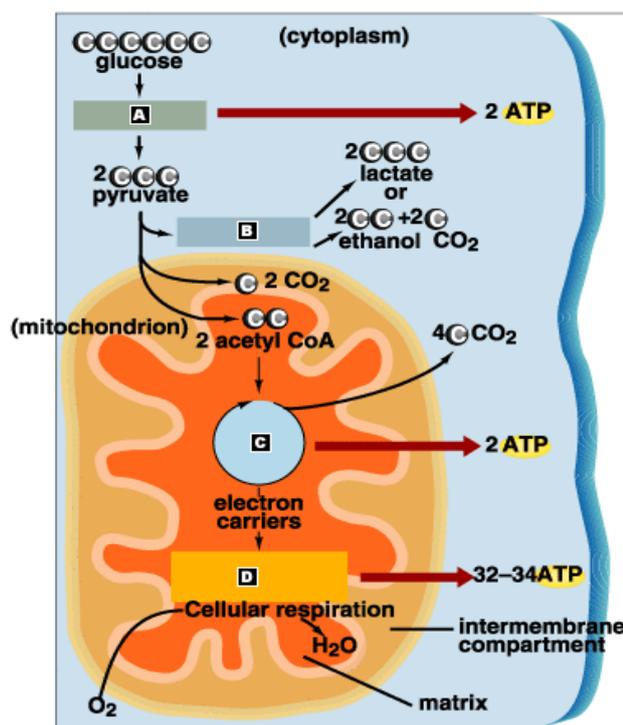


Fig. 11. Metabolism of Glucose (www.wikipedia.org)

- a) fermentation
- b) Krebs cycle
- c) glycolysis
- d) electron transport system

9. The initial biochemical reactions that break down glucose without the use of oxygen are called _____.

10. The process that causes lactate buildup in muscles during strenuous exercise is:

- a) Krebs cycle
- b) fermentation
- c) glycolysis
- d) respiratory electron transport

11. The production of what molecule marks the end of glycolysis and the beginning of cellular respiration?

- a) pyruvate
- b) citrate
- c) acetyl CoA
- d) Coenzyme A (CoA)

12. _____ is the process in which ATP is formed when hydrogen ions move down their concentration gradient through ATP-synthesizing enzymes.

13. At the beginning of most recipes for bread, you are instructed to dissolve the yeast in a mixture of sugar (sucrose) and hot water, in some cases with a small amount of flour. Within a short time, this yeast mixture begins to bubble and foam, perhaps to the point of overflowing the container. What is happening?

- a) The bubbles are detergents that yeast produce to help them digest the proteins in the flour.
- b) The bubbles are oxygen produced by yeast as they grow.
- c) The bubbles are carbon dioxide that yeast produce as they break down the glucose and produce ATP via fermentation.
- e) The bubbles are water vapor produced as the hot water evaporates.

14. Photosynthesis and glucose metabolism are related because _____.

- a) the products of photosynthesis are the raw materials for glucose metabolism
- b) the raw materials of photosynthesis are the same as the raw materials of glucose metabolism
- c) the products of glucose metabolism are the raw materials for photosynthesis
- d) the products of photosynthesis are the same as the products of glucose metabolism
- e) both the first and second answers are correct



15. The majority of ATP produced in aerobic respiration comes from:

- a) photosynthesis
- b) the Krebs cycle
- c) chemiosmosis
- d) glycolysis
- e) fermentation

16. Two different molecules of energy storage are formed by the reaction depicted below. Match the molecule with its formation site in the reaction.

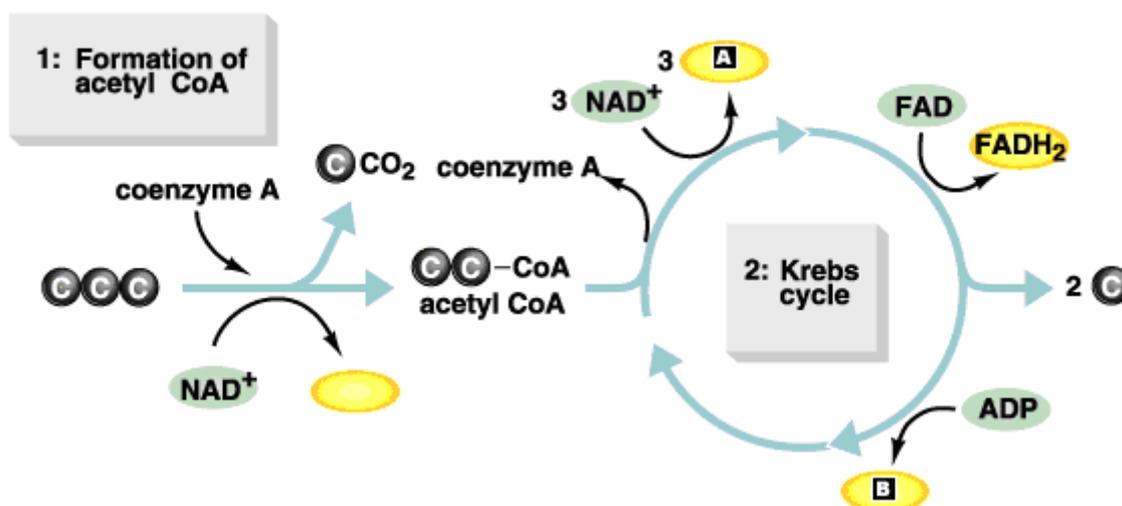


Fig. 12. Krebs Cycle (www.wikipedia.org)

- a) ATP
- b) NADH

17. Where does respiratory electron transport occur?

- a) cytoplasm
- b) matrix of mitochondria
- c) inner membrane of mitochondria
- d) stroma of chloroplast
- e) outer membrane of mitochondria

18. Where is the majority of ATP produced?

- a) in the cytoplasm of a cell
- b) on the rough endoplasmic reticulum

- c) in the aqueous fluid surrounding all cells
- d) in the mitochondria of a cell

19. Which molecules are produced in glycolysis and used in fermentation?

- a) glucose, ATP, and NAD⁺
- b) pyruvate and ATP
- c) acetyl CoA and NADH
- d) pyruvate and NADH
- e) lactate, ATP, and CO₂

20. Which of the following statements concerning fermentation is (are) true?

- a) Fermentation occurs in either aerobic or anaerobic conditions.
- b) Fermentation produces additional ATP.
- c) The end product of fermentation in human cells is ethanol.
- d) Fermentation, like glycolysis, occurs in the cytoplasm of cells.
- e) all of the above
- f) none of the above

21. Why does death result from any situation that prevents a person from breathing?

- a) Oxygen is needed for cellular respiration, so lack of oxygen prevents cells from making sufficient ATP for essential cellular functions. Cells die as a result, eventually leading to death of the individual.
- b) Glycolysis requires oxygen in order to produce ATP, so lack of oxygen prevents cells from making sufficient ATP.
- c) Oxygen is necessary for both fermentation reactions and cellular respiration. So lack of oxygen prevents cells from making sufficient ATP.

8. HETEROCYCLES

Allergy is a disorder of the immune system often also referred to as *atopy*. Allergic reactions occur to normally harmless environmental substances known as allergens; these reactions are acquired, predictable, and rapid. Strictly, allergy is one of four forms of hypersensitivity and is called *type I* (or *immediate*) hypersensitivity. It is characterized by excessive activation of certain white blood cells called mast cells and basophils by a type of antibody known as IgE, resulting in an extreme inflammatory response. Common allergic reactions include eczema, hives, hay fever, asthma, food allergies, and reactions to the venom of stinging insects such as wasps and bees.



Mild allergies like hay fever are highly prevalent in the human population and cause symptoms such as allergic conjunctivitis, itchiness, and runny nose. Allergies can play a major role in conditions such as asthma. In some people, severe allergies to environmental or dietary allergens or to medication may result in life-threatening anaphylactic reactions and potentially death.

A variety of tests now exist to diagnose allergic conditions; these include testing the skin for responses to known allergens or analyzing the blood for the presence and levels of allergen-specific IgE. Treatments for allergies include allergen avoidance, use of anti-histamines, steroids or other oral medications, immunotherapy to desensitize the response to allergen, and targeted therapy.

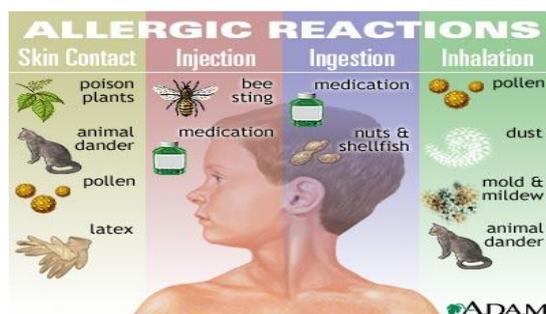


Fig 13. Allergy (www.wikipedia.org)

Histamine

Histamine is a biogenic amine involved in local immune responses as well as regulating physiological function in the gut and acting as a neurotransmitter. Histamine triggers the inflammatory response. As part of an immune response to foreign pathogens, histamine is produced by basophils and by mast cells found in nearby connective tissues. Histamine increases the permeability of the capillaries to white blood cells and other proteins, in order to allow them to engage foreign invaders in the affected tissues. It is found in virtually all animal body cells.

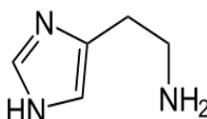


Fig. 14. Histamine (www.wikipedia.org)

- WATCH: a) http://www.youtube.com/watch?feature=player_detailpage&v=y3bOgdvV-M
 b) http://www.youtube.com/watch?feature=player_detailpage&v=G9D-Vfmbt4s

9. HORMONES

1. Listen to the following explanation of PTSD: www.youtube.com/watch?v=tqxiEe0RH-Y

2. Read the following article about connection of stress and diseases:

Stress can significantly affect many of the body's immune systems, as can an individual's perceptions of, and reactions to, stress. The term psychoneuroimmunology is used to describe the interactions between the mental state, nervous and immune systems, as well as research on the interconnections of these systems. Immune system changes can create more vulnerability to infection, and have been observed to increase the potential for an outbreak of psoriasis for people with that skin disorder.

Chronic stress has also been shown to impair developmental growth in children by lowering the pituitary gland's production of growth hormone, as in children associated with a home environment involving serious marital discord, alcoholism, or child abuse.

Studies of female monkeys at Wake Forest University (2009) discovered that individuals suffering from higher stress have higher levels of visceral fat in their bodies. This suggests a possible cause-and-effect link between the two, wherein stress promotes the accumulation of visceral fat, which in turn causes hormonal and metabolic changes that contribute to heart disease and other health problems.

3. Answer the questions or tasks:

a) What does it mean abbreviation PTSD?

b) When is PTSD developed?

c) What are the symptoms of PTSD?

d) Explain the term arousal:

e) Name four diseases which are connected with chronic stress:



f) What are the main stress hormones (3)?

10. THE NOBEL PRIZES IN CHEMISTRY

The Nobel Prize in Chemistry 2009

Speed Read

At first sight it seems simple enough: DNA makes RNA makes protein, and, by extension, you and me and every living thing. But this 'central dogma of biology', as [Francis Crick](#) famously called it, requires some stupendously complicated machinery to make it happen, and much of the last half century of research has been devoted to unravelling the apparatus that builds life. Nobel Prizes have recognized a number of the triumphs along the way, among them [Watson](#), Crick and [Wilkins](#)' decipherment of the helical structure of DNA and [Roger Kornberg](#)'s uncovering of the workings of the enzyme RNA polymerase, which turns DNA into RNA. Now, the 2009 Nobel Prize in Chemistry recognizes three people who have made major contributions to understanding the nature of the machine that translates the RNA code into protein: the ribosome.

Venki Ramakrishnan, Thomas Steitz and **Ada Yonath** took the view that in order to be able to understand the ribosome, we have to be able first to visualize it. Using X-ray crystallography, an imaging technique in which the diffraction patterns formed by X-rays passing through a crystal of a substance are used to piece together that crystal's atomic structure, they independently set out to 'solve' the structure of the ribosome. The tasks of preparing suitable ribosomal crystals for diffraction, and of interpreting the resulting X-ray diffraction patterns from such large and unsymmetrical entities, were at first widely viewed as impossible. But in 1980 Ada Yonath, working with the ribosomes of heat-loving bacteria that she thought might be especially robust, succeeded in preparing the first useful crystals of the larger of the ribosome's two subunits. This marked the beginning of two decades of intense activity during which better and better crystals and images were obtained, and numerous technical hurdles were overcome, culminating with the publication of high resolution structures for both subunits in 2000. Further elaboration of the ribosomal structure has followed, with these and other groups contributing to our overall picture of how this molecular factory works to assemble protein chains.

As the target of 50% of known antibiotics, the bacterial ribosome is a structure of major therapeutic importance. With antibiotic resistance on the increase, it is hoped that an



understanding of precisely how antibiotics interact with the ribosome will allow the design of new antibiotics to tackle drug-resistant bacteria. Ramakrishnan, Steitz and Yonath have all imaged the molecular interactions between ribosomes and antibiotics, providing key data to help guide structure-based drug design of new antibiotics.

By [Adam Smith](#), Editor-in-Chief, Nobelprize.org

Look up, how many women were awarded by Nobel Prize in Chemistry in its history (Ada Yonath is one of them).

Listening: Nobel Prize in Chemistry in 2008

1. How many scientists were awarded by Nobel Prize in Chemistry in 2008?

2. What does it mean abbreviation GFP?

3. What has applications been of GFP?

4. How many amino acids create GFP?

References: 1. www.youtube.com Nobel Prize in Chemistry 2008: Who won it and why?

2. www.youtube.com Nobel Prize in chemistry in 2008-Periodic Table of Videos

3. www.nobelprize.org – Chemistry (year 2008 and 2009)

11. CHEMISTRY, FOOD and LANGUAGE

How much do you know about food? Answer the questions in this quiz.

1. Which of these words means *to reduce food to small sherds by rubbing it along or sharp surface*?

a) chop b) grate c) dice d) slice

2. Which of these cooking methods is the healthiest way of preparing food?

a) fry b) boil c) roast d) bake e) steam f) barbecue

3. You should always swallow food before you chew it.



a) true b) false

4. What do we call someone who does not eat meat?

5. Which of these words means *to drink slowly*?

a) gobble b) sip c) gulp d) slurp

6. Choose the correct word in the following sentence.

My mother has a wonderful **receipt/recipe/recite** for roast chicken.

7. Eggs, cheese and milk contain a lot of **vitamin C**?

a) true b) false

8. To **eat a balanced diet** and to **go on a diet** have the same meaning.

a) true b) false

9. Rearrange these letters to form a word which gives the name of a substance which is found in food like meat and eggs, and which helps your body to grow and stay healthy:

noprite

10. Foods which are high in fibre and low in fat are better for you.

a) true b) false

11. Which of the following is most important for the development of healthy bones and teeth?

a) calcium b) carbohydrates c) cholesterol d) calories

12. What is the difference between the following expressions?

a) to **cut down on something** b) to **give something up**

.....
.....
.....

13. Complete the following sentence with an appropriate preposition.

a) I can not eat this meat. It's gone

b) I do not want to eat at home tonight. Let us eat

c) I am fond Mexican food.

d) She invited me dinner.

e) I prefer eating at restaurants eating at home.

f) What are we having lunch?

14. From the list of foods below, choose ones which are: **sweet/salty/hot and spicy/sour/ bland or tasteless/bitter/fresh/stale**

a) curry

b) boiled rice

c) a new loaf of bread

d) an old loaf of bread

e) sugar

f) a packet of peanuts

g) a lemon

h) dark chocolate





INVESTICE DO ROZVOJE VZDĚLÁVÁNÍ