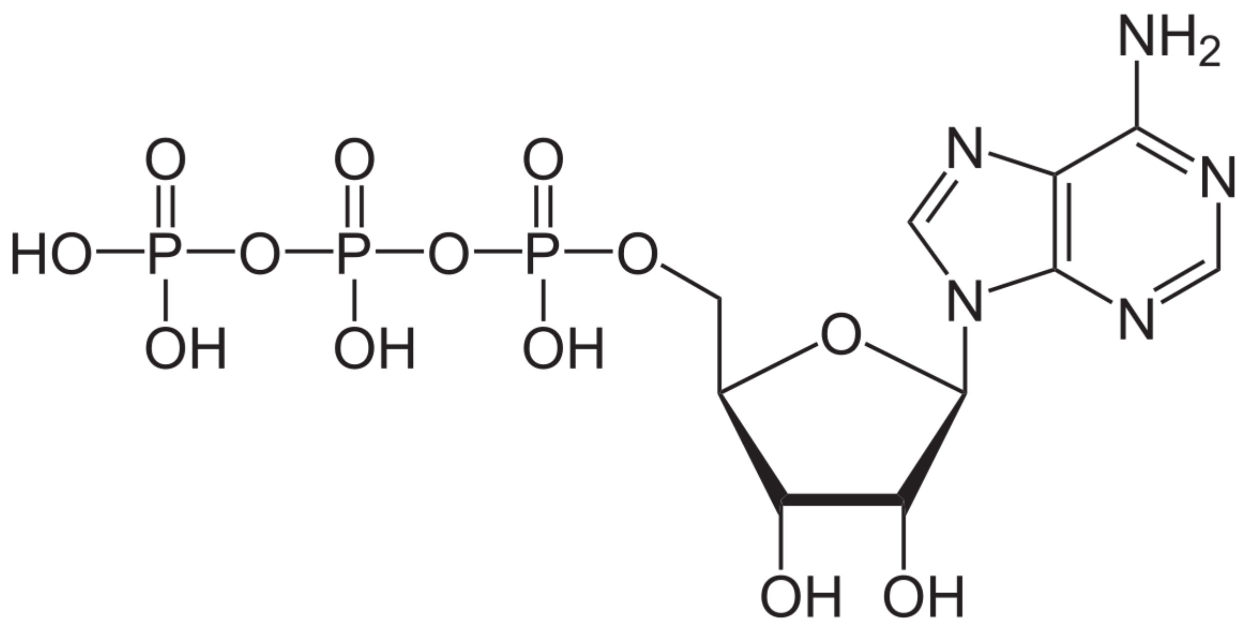
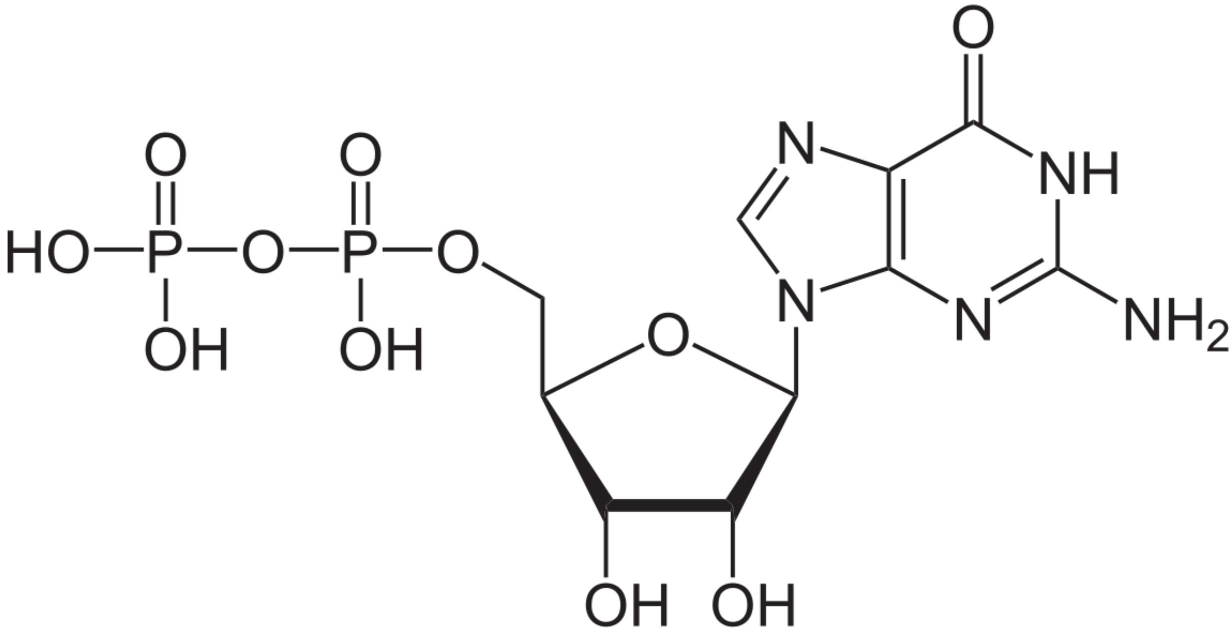
ZUBAIR KHADIJAH ATINUKE
18/mhs06/058
Medical laboratory science
Clincal Biochemistry and Xenobiotics
BCH 202

1.Draw the structures of the ffg; ATP , GDP, CDP,UTP, double stranded DNA
2.Differentiate between DNA and RNA clearly
3.Explain the biosynthesis of calcitriol
4.write on coenzymes.and the coenzyme form of riboflavin
5Write on the characteristics components of nucleotides and the nucleoside units on RNA
6.Structure of cholesterol and cortisol
7.Review vitamins and different form, write on metabolism of one known vitamin to its active form
8.glycolipids,its variuod form and structure
9.Detail write up on cell and functions of important cell organelles

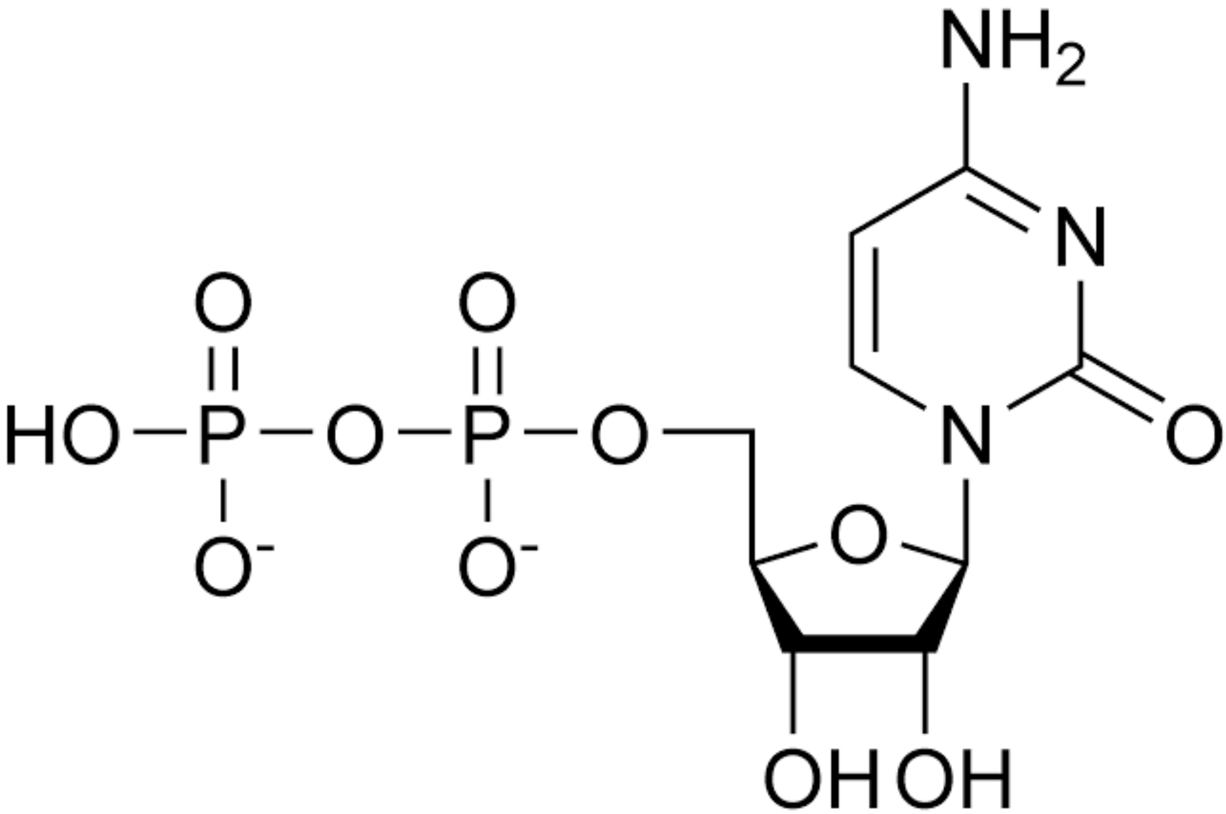
Answer
1. ATP structure



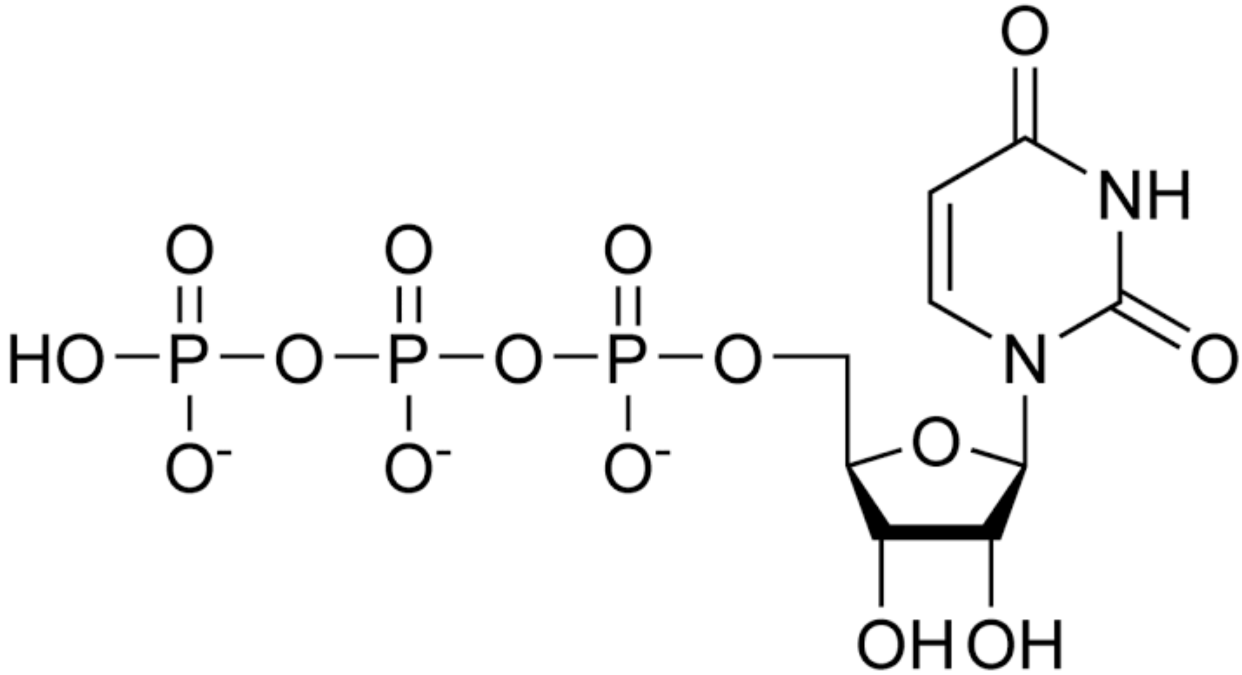
GDP structure



CDP structure



UTP structure



Double stranded DNA

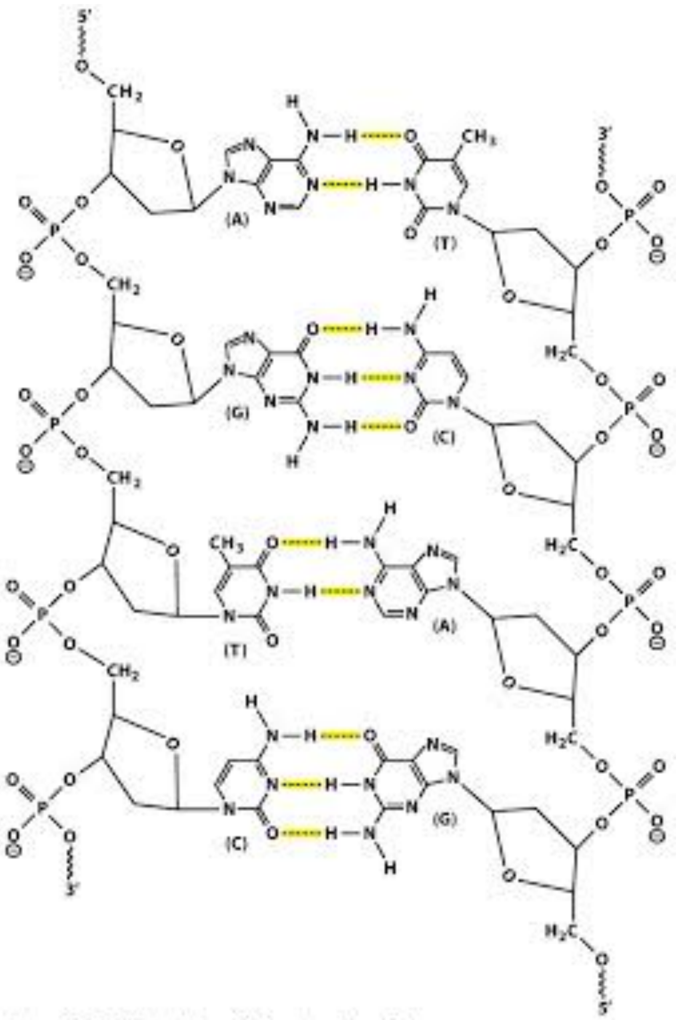


Figure 19-12 Principles of Biochemistry, 4/e
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2. Both DNA and RNA are used to store genetic information, but there are clear differences between them.

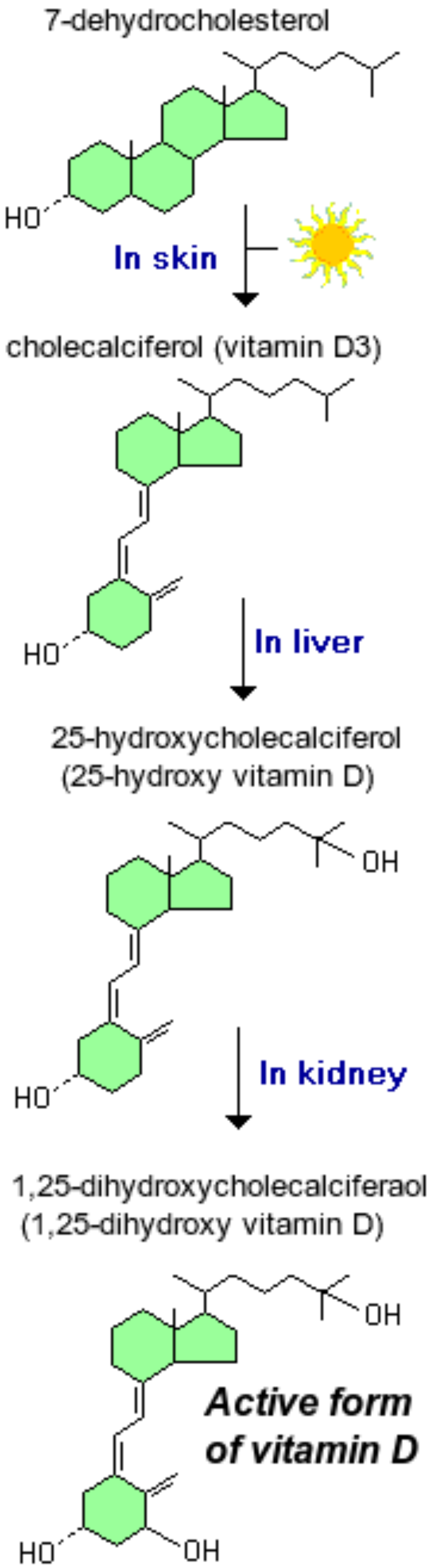
Main Differences Between DNA and RNA		
Comparison	**DNA**	**RNA**
Name	DeoxyriboNucleic Acid	RiboNucleic Acid

Function	Long-term storage of genetic information; transmission of genetic information to make other cells and new organisms.	Used to transfer the genetic code from the nucleus to the ribosomes to make proteins. RNA is used to transmit genetic information in some organisms and may have been the molecule used to store genetic blueprints in primitive organisms.
Structural Features	B-form double helix. DNA is a double-stranded molecule consisting of a long chain of nucleotides.	A-form helix. RNA usually is a single-strand helix consisting of shorter chains of nucleotides.
Composition of Bases and Sugars	deoxyribose sugar phosphate backbone adenine, guanine, cytosine, thymine bases	ribose sugar phosphate backbone adenine, guanine, cytosine, uracil bases
Propagation	DNA is self-replicating.	RNA is synthesized from DNA on an as-needed basis.
Base Pairing	AT (adenine-thymine) GC (guanine-cytosine)	AU (adenine-uracil) GC (guanine-cytosine)

Reactivity	The C-H bonds in DNA make it fairly stable, plus the body destroys enzymes that would attack DNA. The small grooves in the helix also serve as protection, providing minimal space for enzymes to attach.	The O-H bond in the ribose of RNA makes the molecule more reactive, compared with DNA. RNA is not stable under alkaline conditions, plus the large grooves in the molecule make it susceptible to enzyme attack. RNA is constantly produced, used, degraded, and recycled.
Ultraviolet Damage	DNA is susceptible to UV damage.	Compared with DNA, RNA is relatively resistant to UV damage.

3. The biosynthesis of calcitriol

Bioactive vitamin D or calcitriol is a steroid hormone that has long been known for its important role in regulating body levels of calcium and phosphorus, and in mineralization of bone. More recently, it has become clear that receptors for vitamin D are present in a wide variety of cells, and that this hormone has biologic effects which extend far beyond control of mineral metabolism.



Structure and Synthesis

The term vitamin D is, unfortunately, an imprecise term referring to one or more members of a group of steroid molecules. Vitamin D3, also known as cholecalciferol is generated in the skin of animals when light energy is absorbed by a precursor molecule 7-dehydrocholesterol. Vitamin D is thus not a true vitamin, because individuals with adequate exposure to sunlight do not require dietary supplementation. There are also dietary sources of vitamin D, including egg yolk, fish oil and a number of plants. The plant form of vitamin D is called vitamin D2 or ergosterol. However, natural diets typically do not contain adequate quantities of vitamin D, and exposure to sunlight or consumption of foodstuffs purposefully supplemented with vitamin D are necessary to prevent deficiencies. Vitamin D, as either D3 or D2, does not have significant biological activity. Rather, it must be metabolized within the body to the hormonally-active form known as 1,25-dihydroxycholecalciferol. This transformation occurs in two steps, as depicted in the diagram to the right:

1. Within the liver, cholecalciferal is hydroxylated to 25-hydroxycholecalciferol by the enzyme 25-hydroxylase.
2. Within the kidney, 25-hydroxycholecalciferol serves as a substrate for 1-alpha-hydroxylase, yielding 1,25-dihydroxycholecalciferol, the biologically active form.

Each of the forms of vitamin D is hydrophobic, and is transported in blood bound to carrier proteins. The major carrier is called, appropriately, vitamin D-binding protein. The halflife of 25-hydroxycholecalciferol is several weeks, while that of 1,25-dihydroxycholecalciferol is only a few hours.

4. Coenzymes

These are cofactors that are loosely bound to enzymes. They're organic in nature. A cofactor is an additional non-protein or metallic ion component required by enzyme for their optimum activity. Coenzyme is any of a number of freely diffusing organic compounds that function as cofactors with enzymes in promoting a variety of metabolic reactions. Coenzymes participate in enzyme-mediated catalysis in stoichiometric (mole-for-mole) amounts, are modified during the reaction, and may require another enzyme-catalyzed reaction to restore them to their original state. Examples include nicotinamide adenine dinucleotide (NAD), which accepts hydrogen (and gives it up in another reaction), and ATP, which gives up phosphate groups while transferring chemical energy (and reacquires phosphate in another reaction). Most of the B vitamins (see vitamin B complex) are coenzymes and are essential in facilitating the transfer of atoms or groups of atoms between molecules in the formation of carbohydrates, fats, and proteins.

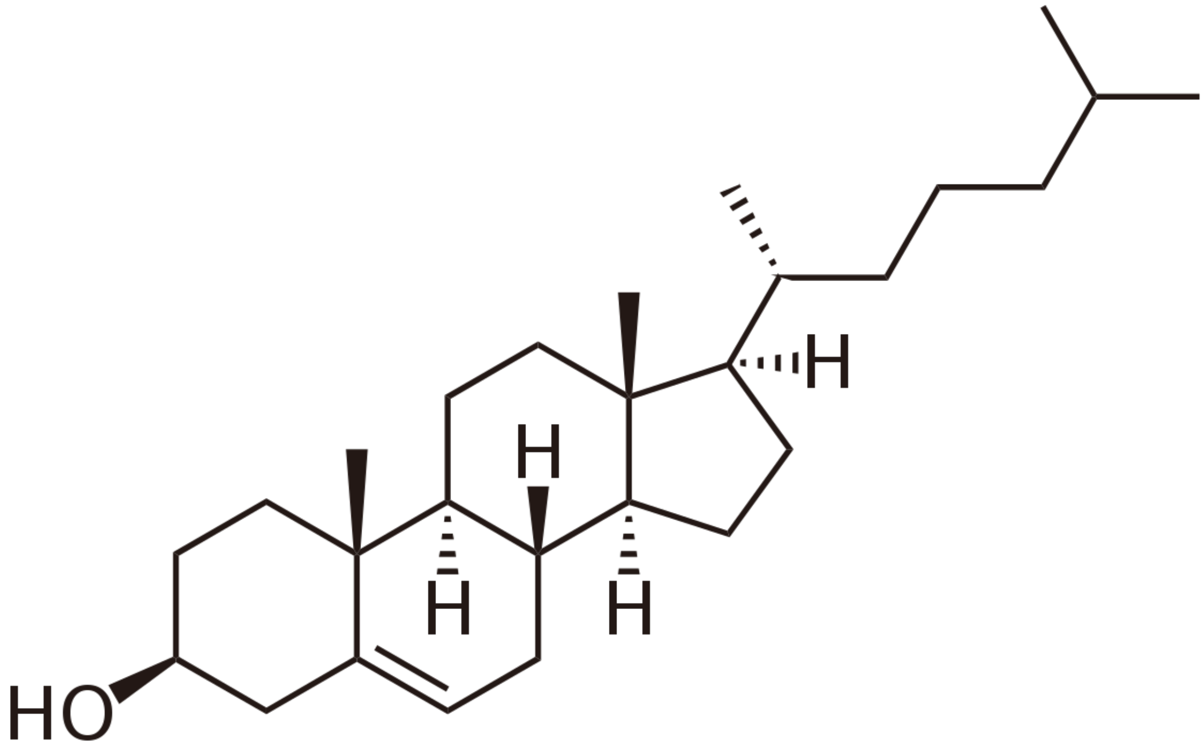
RIBOFLAVIN

Riboflavin (also known as vitamin B2) is one of the B vitamins, which are all water soluble. Riboflavin is naturally present in some foods, added to some food products, and available as a dietary supplement. This vitamin is an essential component of two component of two major coenzymes, flavin mononucleotide (FMN; also known as riboflavin-5'-phosphate) and flavin adenine dinucleotide (FAD). These coenzymes play major roles in energy production; cellular function, growth, and development; and metabolism of fats, drugs, and steroids [1-3]. The conversion of the amino acid tryptophan to niacin (sometimes referred to as vitamin B3) requires FAD [3]. Similarly, the conversion of vitamin B6 to the coenzyme pyridoxal 5'-phosphate needs FMN. In addition, riboflavin helps maintain normal levels of homocysteine, an amino acid in the blood.

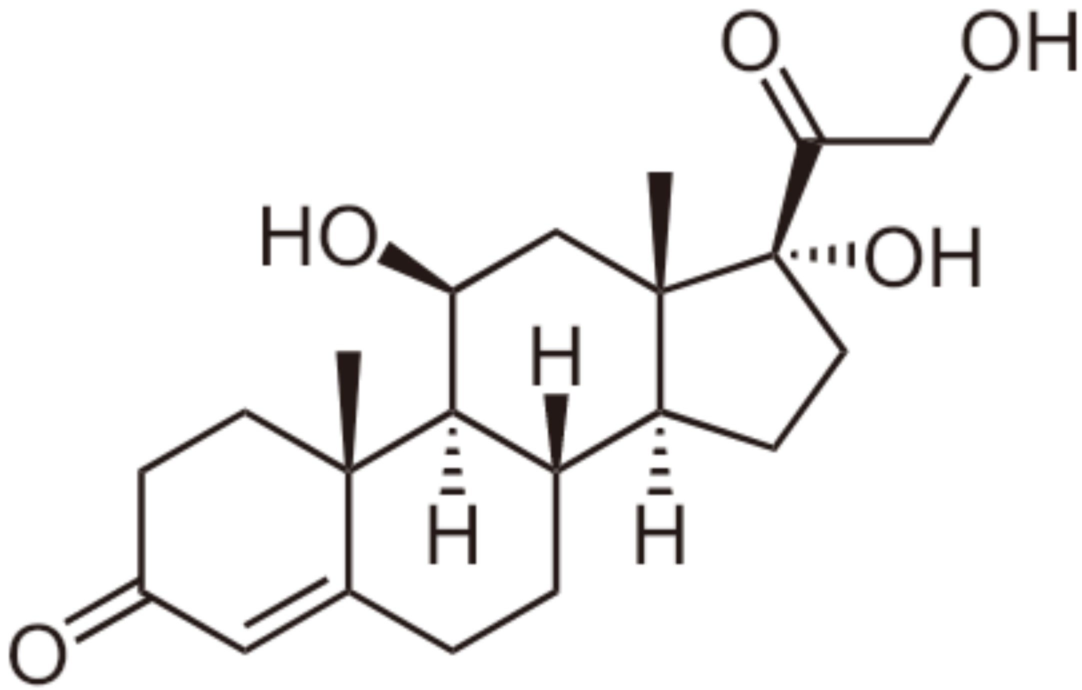
5. characteristics components of nucleotides and the nucleoside units on RNA

RNA is typically single stranded and is made of ribonucleotides that are linked by phosphodiester bonds. A ribonucleotide in the RNA chain contains ribose (the pentose sugar), one of the four nitrogenous bases (A, U, G, and C), and a phosphate group. The subtle structural difference between the sugars gives DNA added stability, making DNA more suitable for storage of genetic information, whereas the relative instability of RNA makes it more suitable for its more short-term functions. The RNA-specific pyrimidine uracil forms a complementary base pair with adenine and is used instead of the thymine used in DNA. Even though RNA is single stranded, most types of RNA molecules show extensive intramolecular base pairing between complementary sequences within the RNA strand, creating a predictable three-dimensional structure essential for their function

6.



Structure of cholesterol



Structure of cortisol

7. Vitamins are organic nutrients that are required in small quantities for a variety of biochemical functions and which generally cannot be synthesised by the body and are therefore supplied by the diet. There are 13 vitamins the body needs. They are; Vitamin A, B vitamins (thiamine, riboflavin, niacin, pantothenic acid, biotin, vitamin B-6, vitamin B-12 and folate) Vitamin C, Vitamin D, Vitamin E, Vitamin K

Water-soluble vitamins

Water-soluble vitamins travel freely through the body, and excess amounts usually are excreted by the kidneys. The body needs water-soluble vitamins in frequent, small doses. These vitamins are not as likely as fat-soluble vitamins to reach toxic levels. But niacin, vitamin B6, folate, choline, and vitamin C have upper consumption limits. Vitamin B6 at high levels over a long period of time has been shown to cause irreversible nerve damage.

A balanced diet usually provides enough of these vitamins. People older than 50 and some vegetarians may need to use supplements to get enough B12.

Water-soluble vitamins

Nutrient	Function	Sources
Thiamine (vitamin B1)	Part of an enzyme needed for energy metabolism; important to nerve function	Found in all nutritious foods in moderate amounts: pork, whole-grain or enriched breads and cereals, legumes, nuts and seeds
Riboflavin (vitamin B2)	Part of an enzyme needed for energy metabolism; important for normal vision and skin health	Milk and milk products; leafy green vegetables; whole-grain, enriched breads and cereals
Niacin (vitamin B3)	Part of an enzyme needed for energy metabolism; important for nervous system, digestive system, and skin health	Meat, poultry, fish, whole-grain or enriched breads and cereals, vegetables (especially mushrooms, asparagus, and leafy green vegetables), peanut butter
Pantothenic acid	Part of an enzyme needed for energy metabolism	Widespread in foods

Biotin	Part of an enzyme needed for energy metabolism	Widespread in foods; also produced in intestinal tract by bacteria
Pyridoxine (vitamin B6)	Part of an enzyme needed for protein metabolism; helps make red blood cells	Meat, fish, poultry, vegetables, fruits
Folic acid	Part of an enzyme needed for making DNA and new cells, especially red blood cells	Leafy green vegetables and legumes, seeds, orange juice, and liver; now added to most refined grains
Cobalamin (vitamin B12)	Part of an enzyme needed for making new cells; important to nerve function	Meat, poultry, fish, seafood, eggs, milk and milk products; not found in plant foods
Ascorbic acid (vitamin C)	Antioxidants ; part of an enzyme needed for protein metabolism; important for immune system health; aids in iron absorption	Found only in fruits and vegetables, especially citrus fruits, vegetables in the cabbage family, cantaloupe, strawberries, peppers, tomatoes, potatoes, lettuce, papayas, mangoes, kiwifruit

Fat-soluble vitamins

Fat-soluble vitamins are stored in the body's cells and are not excreted as easily as water-soluble vitamins. They do not need to be consumed as often as water-soluble vitamins, although adequate amounts are needed. If you take too much of a fat-soluble vitamin, it could become toxic.

A balanced diet usually provides enough fat-soluble vitamins. You may find it more difficult to get enough vitamin D from food alone and may consider taking a vitamin D supplement or a multivitamin with vitamin D in it.

Fat-soluble vitamins

Nutrient	Function	Sources
Vitamin A (and its precursor*, beta-carotene) *A precursor is converted by the body to the vitamin.	Needed for vision, healthy skin and mucous membranes, bone and tooth growth, immune system health	Vitamin A from animal sources (retinol): fortified milk, cheese, cream, butter, fortified margarine, eggs, liver Beta-carotene (from plant sources): Leafy, dark green vegetables; dark orange fruits (apricots, cantaloupe) and vegetables (carrots, winter squash, sweet potatoes, pumpkin)

Vitamin D	Needed for proper absorption of calcium; stored in bones	Egg yolks, liver, fatty fish, fortified milk, fortified margarine. When exposed to sunlight, the skin can make vitamin D.
Vitamin E	Antioxidant; protects cell walls	Polyunsaturated plant oils (soybean, corn, cottonseed, safflower); leafy green vegetables; wheat germ; whole-grain products; liver; egg yolks; nuts and seeds
Vitamin K	Needed for proper blood clotting	Leafy green vegetables such as kale, collard greens, and spinach; green vegetables such as broccoli, Brussels sprouts, and asparagus; also produced in intestinal tract by bacteria

Metabolism of thiamin you thiamin pyrophosphate

Thiamine metabolism begins in the extracellular space, being transported by a thiamine transporter into the cell. Once in the intracellular space, thiamine is converted into thiamine pyrophosphate through the enzyme thiamin pyrophosphate kinase 1. Thiamine pyrophosphate is then converted into thiamine triphosphate, again using the enzyme thiamin pyrophosphatekinase 1. After this, thiamine triphosphate uses thiamine-triphosphatase to revert to thiamine pyrophosphate, which undergoes a reaction using cancer-related nuceloside-triphosphatase to become thiamine monophosphate. This phosphorylated form is a metabolically active form of thiamine, as are the two other compounds, derivatives of thiamine, mentioned previously. The enzymes used in this pathway both stem from the upper small intestine. Thiamine is passed mainly through urine. It is a water-soluble vitamin, which means it dissolves in water and is carried to different parts of the body but is not stored in the body.

8. Glycolipids are lipids with a carbohydrate attached by a glycosidic (covalent) bond. Glycolipids are widely distributed in every tissue of the body, particularly in nervous tissue such as brain. Their role is to maintain the stability of the cell membrane and to facilitate cellular recognition, which is crucial to the immune response and in the connections that allow cells to connect to one another to form tissues. Glycolipids are also found on the surface of all eukaryotic cell membranes, where they extend from the phospholipid bilayer into the extracellular environment.

Classes of Glycolipid.
Glyceroglycolipids
  a. Galactolipids
  b. Sulfolipids
Glycosphingolipids
  a. Cerebrosides: which includes; Galactocerebrosides, Glucocerebrosides, Sulfatides.
  b. Gangliosides
  c. Globosides
  d. Glycophosphosphingolipids
  e. Glycophosphatidylinositols.

Glyceroglycolipids is defined as a sub-group of glycolipids characterized by an acetylated or non-acetylated glycerol with at least one fatty acid as the lipid complex. Glyceroglycolipids are often associated with photosynthetic membranes and their functions. The subcategories of glyceroglycolipids depend on the carbohydrate attached.

a. Galactolipids: are a type of glycolipid whose sugar group is galactose. It is described as galactose sugar attached to a glycerol lipid molecule. They are found in chloroplast membranes and are associated with photosynthetic properties. They are the main part of plant membrane lipids where they substitute phospholipids to conserve phosphate for other essential processes. These chloroplast membranes contain a high quantity of monogalactosyldiacylglycerol (MGDG) and digalactosyldiacylglycerol (DGDG).
They also assume a direct role in photosynthesis, as they have been found in the X-ray structures of photosynthetic complexes.

b. Sulfolipids: Sulfolipids are a class of lipids which possess a sulfur-containing functional group in the sugar moiety attached to a lipid. An important group is the sulfoquinovosyl diacylglycerols which are associated with the sulfur cycle in plants. It is an abundant sulfolipid which is composed of a glycoside of sulfoquinovose and diacylglycerol. In plants, sulfoquinovosyl diacylglycerides (SQDG) are important members of the sulfur cycle. Other important sulfolipids include sulfatide and seminolipid, each of which are sulfated glycolipids.

Glycosphingolipids: a sub-group of glycolipids based on sphingolipids. They may be considered as sphingolipids with an attached carbohydrate. These glycolipids consist of amino alcohol “sphingosine”. The amino group of sphingosine is esterified by a fatty acid and one more sugar units are attached to the hydroxyl group of sphingosine. They are a part of the cell membrane. They consist of a hydrophobic ceramide part and a glycosidically bound carbohydrate part. This oligosaccharide content remains on the outside of the cell membrane where it is important for biological processes such as cell adhesion or cell–cell interactions. Glycosphingolipids are widely distributed in every tissue of the body, particularly located in nervous tissue such as brain and are responsible for cell signaling.

Glycosphingolipids play also important role in oncogenesis and ontogenesis.

Sphingosine

a. Cerebrosides: Cerebrosides is the common name for a group of glycosphingolipids called monoglycosylceramides which are important components in animal muscle and nerve cell membranes. They consist of a ceramide with a single sugar residue at the 1-hydroxyl moiety. The sugar residue can be either glucose or galactose; the two major types are therefore called glucocerebrosides (glucosylceramides) and galactocerebrosides (galactosylceramides). Galactocerebrosides are typically found in neural tissue, while glucocerebrosides are found in other tissues.

-Galactocerebrosides: a type of cerebroside with galactose as the saccharide moiety

-Glucocerebrosides: a type of cerebroside with glucose as the saccharide moiety; often found in non-neural tissue.

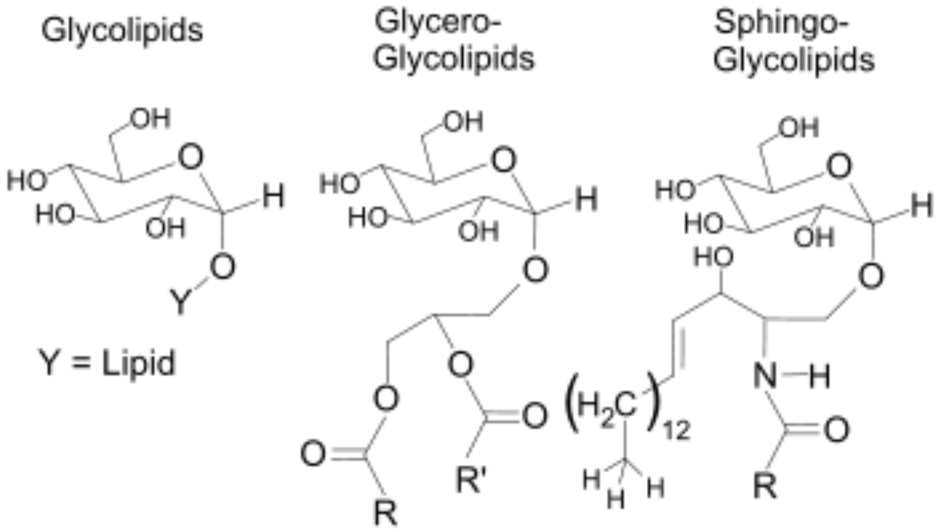
-Sulfatides (ceramide + monosaccharide + sulfate): are cerebrosides in which the monosaccharide contains a sulfate ester. It is a class of glycolipids containing a sulfate group in the carbohydrate with a ceramide lipid backbone. They are involved in numerous biological functions ranging from immune response to nervous system signaling.

b. Gangliosides (cerebroside + oligosaccharides + NANA): the most complex animal glycolipids derived from glucocerebrosides. They contain negatively charged oligosacchrides with one or more sialic acid residues; which is usually N-acetylneuraminic acid (NANA) attached to ceramide. More than 200 different gangliosides have been identified such as GM1, GM2, GM3 etc. They are most abundant in nerve cells.

c. Globosides (ceramide + oligosaccharide) : it contain two or more sugar molecules attached to ceramide. These glycolipids are important constituents of the RBC-membrane and are déterminants of the A,B,O blood group system. They have a variety of functions; failure to degrade these molecules leads to Fabry disease.

d. Glycophosphosphingolipids: are complex glycophospholipids from fungi, yeasts, and plants, where they were originally called "phytoglycolipids". They may be as complicated a set of compounds as the negatively charged gangliosides in animals.

e. Glycophosphatidylinositols: a sub-group of glycolipids defined by a phosphatidylinositol lipid moiety bound to a carbohydrate complex. They can be bound to the C-terminus of a protein and have various functions associated with the different proteins they can be bound to.



9. Cell

Cells are the basic building blocks of all living things. The human body is composed of trillions of cells. They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions. Cells also contain the body's hereditary material and can make copies of themselves.

Cells have many parts, each with a different function. Some of these parts, called organelles, are specialized structures that perform certain tasks within the cell. Human cells contain the following major parts, listed in alphabetical order:

Cytoplasm

Within cells, the cytoplasm is made up of a jelly-like fluid (called the cytosol) and other structures that surround the nucleus.

Cytoskeleton

The cytoskeleton is a network of long fibers that make up the cell's structural framework. The cytoskeleton has several critical functions, including determining cell shape, participating in cell division, and allowing cells to move. It also provides a track-like system that directs the movement of organelles and other substances within cells.

Endoplasmic reticulum (ER)

This organelle helps process molecules created by the cell. The endoplasmic reticulum also transports these molecules to their specific destinations either inside or outside the cell.

Golgi apparatus

The Golgi apparatus packages molecules processed by the endoplasmic reticulum to be transported out of the cell.

Lysosomes and peroxisomes

These organelles are the recycling center of the cell. They digest foreign bacteria that invade the cell, rid the cell of toxic substances, and recycle worn-out cell components.

Mitochondria

Mitochondria are complex organelles that convert energy from food into a form that the cell can use. They have their own genetic material, separate from the DNA in the nucleus, and can make copies of themselves.

Nucleus

The nucleus serves as the cell’s command center, sending directions to the cell to grow, mature, divide, or die. It also houses DNA (deoxyribonucleic acid), the cell’s hereditary material. The nucleus is surrounded by a membrane called the nuclear envelope, which protects the DNA and separates the nucleus from the rest of the cell.

Plasma membrane

The plasma membrane is the outer lining of the cell. It separates the cell from its environment and allows materials to enter and leave the cell.

Ribosomes

Ribosomes are organelles that process the cell’s genetic instructions to create proteins. These organelles can float freely in the cytoplasm or be connected to the endoplasmic reticulum