WEEK 7

UNIT 2_5 :NUCLEIC ACIDS	**Where?** **How long?**	***Explanations*** ***/Questions***
Introduction Nucleic acids are the information storage devices of cells. They occur in two forms: deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). DNA is found in the nucleus of eukaryotes and the cytoplasm or nucleoid of prokaryotes and functions as the molecule of heredity. RNA molecules are synthesized on DNA templates and participate in protein synthesis in the cytoplasm. Both DNA and RNA are linear, unbranched polymers of subunits termed nucleotides. ***Expectation*** This lesson provides an overview of the chemical nature of the nucleotides and nucleic acids found in most cells . In addition , it will provide to students with the understanding and appreciation of the main differences between DNA and RNA and how the differences influence their respective functions ***Course outline*** Nucleotides DNA structure RNA structure	10 minutes	Where is this from? Before embarking on a description of nucleotide and nucleic acid structures, let us examine the biological importance of this class of molecules and find out why their structural principles should be known at the atomic level.
Learning outcomes At the end of this unit, you should be able to: • Define and describe nucleotides as building blocks of nucleic acids • Identify key features that differentiate nucleic acids • Identify and explain how nucleotides are linked together to form nucleic acids • Recognize the difference between RNA and DNA and draw structures of a ribonucleotide and deoxyribonucleotide.		

ACTIVITY AHEAD OF LESSON: NUCLEIC ACIDS		30 minutes	**To student**
Purpose:	This introduction to nucleic acids , their structure and how they form phosphodiester bond.		Note anything you do not understand for asking questions during face to face teaching
Over to you:	Click to this link and read the content		
Activity:	Perform quiz activities related to the lesson.		

Commented [TN1]: Where is a quiz???

Nucleic acids are polymers of individual nucleotide monomers.

NUCLEOTIDES

Each nucleotide consists of three major parts:

- a five-carbon sugar (pentose);
- a flat, heterocyclic, nitrogen-containing organic base
- a negatively charged phosphate group, which gives the polymer its acidic property.

Pentose sugar:

- In RNA : β-D-ribose
- In DNA : 2-deoxy-β-D-ribose.

The purines are

- Adenine (A)
- Guanine (G).

The pyrimidines are

- Cytosine (C),
- Thymine (T) in DNA
- Uracil (U) in RNA.

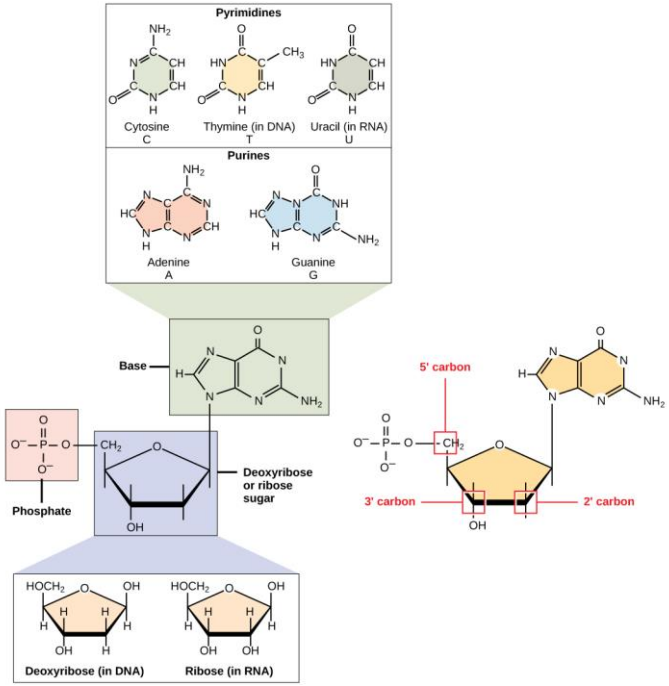


Figure 2.22: Three components comprise a nucleotide: a nitrogenous base, a pentose sugar, and one or more phosphate groups. OpenStax Biology 2nd Edition, Biology 2e. OpenStax CNX. Feb 13, 2019. Accessed on February 27, 2019. https://cnx.org/contents/jVCgr5SL@15.3:EGAbdYfO@10/3-5-Nucleic-Acids

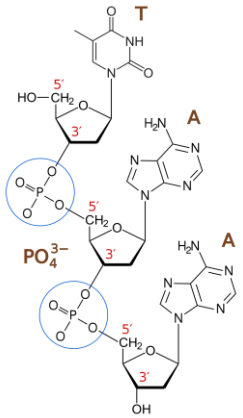
20 minutes

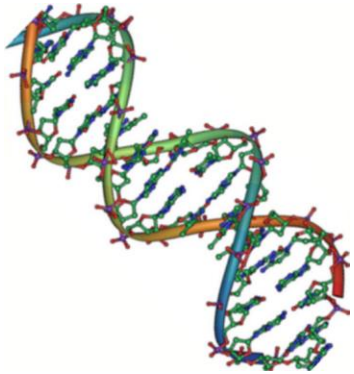
Notes to tutor

Explain the difference between the β-D-ribose and the 2-deoxy-β-D-ribose. Monomers of DNA differ from that in RNA in the absence of oxygen at the carbon 2

Carbon residues in the pentose are numbered 1′ through 5′ (the prime distinguishes these residues from those in the base, which are numbered without using a prime notation). The base is attached to the ribose's 1′ position, and the phosphate is attached to the 5′ position. When a polynucleotide forms, the incoming nucleotide's 5′ phosphate attaches to the 3′ hydroxyl group at the end of the growing chain.

IN CLASS ACTIVITY: NUCLEOTIDE VS NUCLEOSIDES		30 minutes	Do no to use the internet Discuss in group.
Purpose:	Compare and contrast nucleotide and nucleoside		
Over to you:	Use your laptop and go to the internet search the definition of nucleosides.		
Activity:	Using a comparison chart differentiate nucleotide and nucleoside Select one group to draw the structure of nucleotide and another group the structure of nucleoside. Discuss their relevance in medicine.		

Nucleotide polymerization		20 minutes	**Note to tutor**
When a nucleic acid polymer forms the 5′-phosphate group of one nucleotide unit is joined to the 3′-hydroxyl group of the next nucleotide with the release of water and forming **a phosphodiester bond**. A nucleic acid**,** then, is simply a chain of five-carbon sugars linked together by phosphodiester bonds with an organic base protruding from each sugar. **Figure 2.23. Phosphodiester bonds between nucleotides.** By Kes47. July 4th,2010. Accessed February 27, 2019. https://commons.wikimedia.org/wiki/File:Phosphodiester_Bond_Diagram.svg			Explain: The 5’ to 3’orientation of a strand of nucleic acid refers to the *ends* of the strand, not the orientation of the individual phosphodiester bonds linking its constituent nucleotides

DNA DNA molecules in organisms exist not as single chains folded into complex shapes, like proteins, but rather as double chains. Two chains are held together by hydrogen bonds where adenine pair only with thymine (in DNA) or with uracil (in RNA), and cytosine pair only with guanine. The bases that participate in base-pairing are said to be complementary to each other. Two DNA polymers wind around each other to form a **double helix structure.**  **Figure 2.24:** DNA structure, the two strands in DNA run in opposite direction. By OpenStax, Biology. OpenStax CNX. Nov 7, 2018. Accessed February 15,2019.https://cnx.org/contents/GFy_h8cu@11.6:yxeAKc4X@9/Nucleic-Acids	20 minutes	**Note to tutor** Project this video about DNA double helix

RNA

RNA is similar to DNA, but there are some differences. RNA molecules contain ribose sugars in which the number 2 carbon is bonded to a hydroxyl group. In DNA, this hydroxyl group is replaced by a hydrogen atom. RNA molecules utilize uracil in place of thymine. RNA is single stranded while DNA is double stranded.

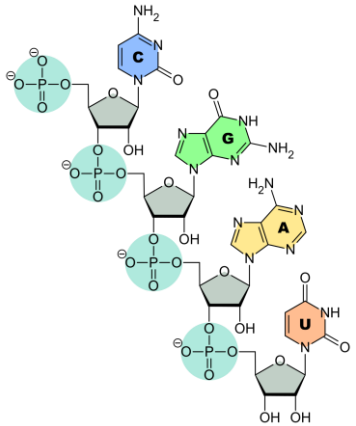


Figure 2.25: Single stranded RNA with ribose sugar that has a hydroxyl group at the 2′ carbon. By Sponk. March25,2010. Accessed November 28,2018. https://commons.wikimedia.org/wiki/File:RNA-Nucleobases.svg#/media/File:RNA Nucleobases.svg

Types of RNA

There are several different types of RNA with different roles , that occurs in different forms within organisms. There are four types of RNAs that have important role in protein synthesis are:

- **Messenger RNA** acts as the "working copy" of the gene coding for a protein. The mRNA carries the information from the genome in the nucleus to the cytosol where protein synthesis occurs.
- **Ribosomal RNA** participates in the structure of ribosome. rRNA, ribosomal proteins and Mg^{++} constitute ribosome. The ribosome is made of two subunits big and small. The rRNA ensures the proper alignment of the mRNA and the ribosomes.
- **Transfer RNAs** are the adaptor molecules in proteins synthesis. They have a three-base region (anticodon region) that recognizes and hydrogen bonds to the complementary codon in mRNA, which specifies a particular amino acids.
- **MicroRNAs (miRNA)** are the smallest RNA molecules and their role involves the regulation of gene expression by interfering with the expression of certain mRNA messages .

20 minutes

For Tutors

Just for information to students read this link about types of RNA.

IN CLASS ACTIVITY: NUCLEIC ACIDS STRUCTURES			
Purpose:	This is to assemble the different component nucleic acids	30 minutes	
Over to you:	Sit in groups and open the associated files PPT then follow instructions.		
Activity:	The slide from the PPT file display the components of the four nucleotides found in DNA The slide 3 from the PPT file displays the four nucleotides. Arrange them so that they are attached together and form a small nucleic acid strand. Rename the file with your group number in front of the title (e.g: 3-Nucleic acid Activity if you are group in group 3) , save the file and submit it in the LMS.		

LABORATORY PRACTICALS : LABORATORY REPORT REVIEW 1			
Purpose:	This is a to provide feedback of all laboratory report done from week 1 up to now	120 minutes	To tutors : Make sure that students have submitted their laboratory report on time. Report must have been reviewed then feedback will be provided during this time.
Over to you:	Lab tutors will be available to discuss specific questions about students report, general areas of confusion and offer advice offer general advice to the lab experiments.		
Activity	A global correction of the report will be organized as a special lecture and will be focused on the observed errors repeatedly present in submitted reports.		

Anticipated time required for Unit 2.5 activities :

Theory : 2h all activities + 2h self-learning

Practical : 2h

Reference

Griffith, F. (1928). The Significance of Pneumococcal Types. *The Journal of Hygiene*, *27*(2), 113–159. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/20474956

HERSHEY, A. D., & CHASE, M. (1952). Independent functions of viral protein and nucleic acid in growth of bacteriophage. *The Journal of General Physiology*, *36*(1), 39–56. Retrieved from http://www.ncbi.nlm.nih.gov/pubmed/12981234