HOLY SPIRIT PREPARATORY SCHOOL

AP Biology

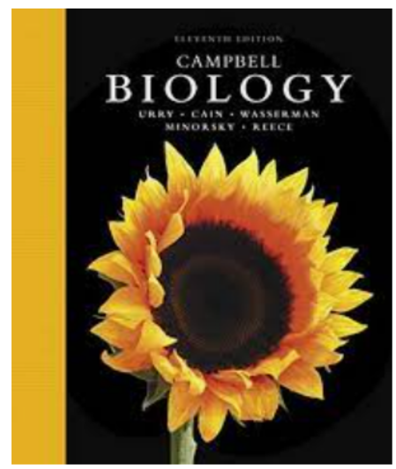
Summer Assignments

Academic Year - 2022-2023

Course Information

Department: STEM

Class Description: The AP Biology course is an introductory college-level biology course. Students cultivate their understanding of biology through inquiry-based investigations as they explore the following topics: evolution, cellular processes, energy and communication, genetics, information transfer, ecology, and interactions. The primary emphasis in this course is to examine science as a process rather than memorizing terms and technical details. This course is structured around the four Big Ideas (Evolution, Energy Processes, Information, and Interactions) which are detailed in the AP Biology Course Description. The modern theory of evolution will be explored in the context of the teachings of the Church and will serve as the unifying theme across the entire scope of this class. At the end of each unit, all material will be tied to this theory.



Textbook or Materials Required (Picture of book included):

Campbell BIOLOGY, 11th Edition

ISBN 10: 0134093410

Contact *cnannis@holyspiritprep.org* for any questions

Summer Assignment

Learning objectives

- Explain the purpose of learning about biology as it pertains to an integrated life of faith

Details of Assignment

- Read chapter 1-3
- Complete the Unit 1 packet alongside Unit 1 of your textbook.
    - Be prepared to have a test within the first week of school over Unit 1.
- Read the provided passage entitled *Meditation in a Toolshed* by C.S. Lewis. Annotate the passage and be prepared to discuss on the first day of school (Wednesday, August 17th).

TOPIC 1.1 Structure of Water and Hydrogen Bonding

ENDURING UNDERSTANDING **SYI-1** Living systems are organized in a hierarchy of structural levels that interact.

LEARNING OBJECTIVE
SYI-1.A Explain how the properties of water that result from its polarity and hydrogen bonding affect its biological function.

ESSENTIAL KNOWLEDGE
SYI-1.A.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule.

SYI-1.A.2 Living systems depend on properties of water that result from its polarity and hydrogen bonding.

SYI-1.A.3 The hydrogen bonds between water molecules result in cohesion, adhesion, and surface tension.

Why is water polar?

Draw a water molecule. Label its charges.

Draw a representation of the cohesion of water molecules

Because it is polar, water can form _______________ bonds.

Briefly explain: how do plants take advantage of adhesion and cohesion to transport water?

Draw a representation of the adhesion of water molecules

Water is a ‘universal solvent’ - what does that mean?

How does the polarity of water give it this ‘solvent’ property?

This property of water makes it so important to life. Provide two specific biological examples of water being used as a solvent to support life.

TOPIC 1.2 Elements of Life

ENDURING UNDERSTANDING **ENE-1** The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.

LEARNING OBJECTIVE
ENE-1.A Describe the composition of macromolecules required by living organisms.

ESSENTIAL KNOWLEDGE
ENE-1.A.1 Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.

ENE-1.A.2 Atoms and molecules from the environment are necessary to build new molecules—

a. Carbon is used to build biological molecules such as carbohydrates, proteins, lipids, and nucleic acids. Carbon is used in storage compounds and cell formation in all organisms.

b. Nitrogen is used to build proteins and nucleic acids. Phosphorus is used to build nucleic acids and certain lipids.

List the elements that make up each macromolecule:

Carbohydrates	Lipids	Proteins	Nucleic acids

What element is the basis for all organic molecules? __________

Draw a heterotroph beside an autotroph. Add to the drawing showing how each one obtains Carbon, and how the two organisms are linked by the Carbon cycle.	Draw a Plant beside an Animal. Add to the drawing showing how each obtains Nitrogen, and how they are linked (include a Decomposer where needed).

TOPIC 1.3 Introduction to Biological Macromolecules

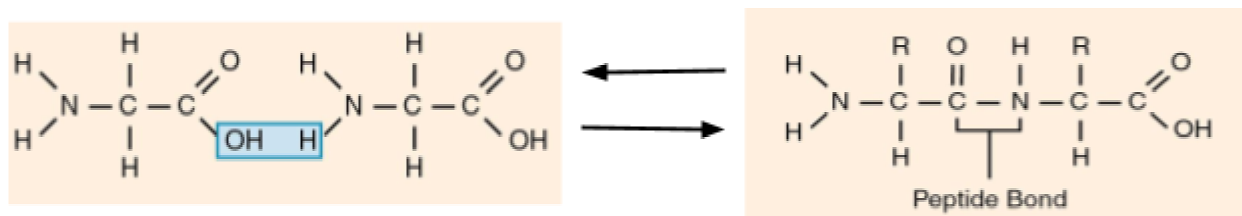
<table>
<tr><td colspan="2">ENDURING UNDERSTANDING SYI-1 Living systems are organized in a hierarchy of structural levels that interact.</td></tr>
<tr><td>LEARNING OBJECTIVE
SYI-1.B Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules.

ESSENTIAL KNOWLEDGE
SYI-1.B.1 Hydrolysis and dehydration synthesis are used to cleave and form covalent bonds between monomers.

X The molecular structure of specific nucleotides, carbohydrate polymers, and amino acids is beyond the scope of the AP Exam</td><td>Look at the diagram of the chemical reaction below.

What is the name of the chemical reaction going from left to right? _________________

What is the name of the chemical reaction going from right to left? _________________



What does ‘dehydration’ literally mean (its word parts)? ____________________
Why is this a good word to describe the process of dehydration synthesis?

What does ‘hydrolysis’ literally mean (its word parts)? ______________________
Why is this a good word to describe the process of hydrolysis?</td></tr>
</table>

TOPIC 1.4 Properties of Biological Macromolecules

ENDURING UNDERSTANDING **SYI-1** Living systems are organized in a hierarchy of structural levels that interact.

LEARNING OBJECTIVE
SYI-1.B Describe the properties of the monomers and the type of bonds that connect the monomers in biological macromolecules.

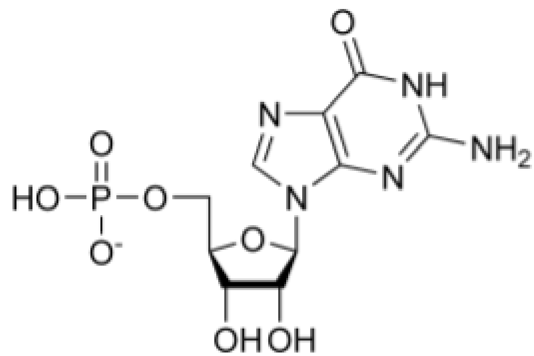
ESSENTIAL KNOWLEDGE
SYI-1.B.2 Structure and function of polymers are derived from the way their monomers are assembled—

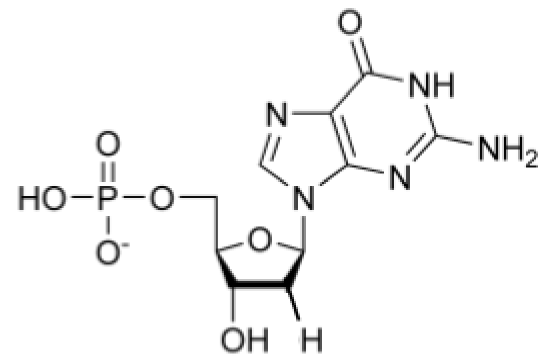
a. In nucleic acids, biological information is encoded in sequences of nucleotide monomers. Each nucleotide has structural components: a five-carbon sugar (deoxyribose or ribose), a phosphate, and a nitrogen base (adenine, thymine, guanine, cytosine, or uracil). DNA and RNA differ in structure and function.

b. In proteins, the specific order of amino acids in a polypeptide (primary structure) determines the overall shape of the protein. Amino acids have directionality, with an amino (NH2) terminus and a carboxyl (COOH) terminus. The R group of an amino acid can be categorized by chemical properties

Nucleic Acids

Consider the name 'de-oxy-ribose' and study the structure of each nucleotide below. Which image is the ribose nucleotide? Which is the deoxyribose nucleotide? Highlight the single difference between them.

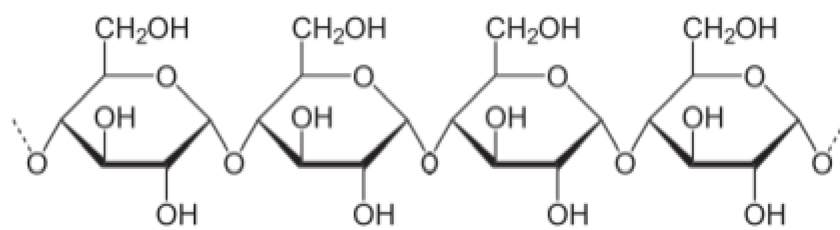




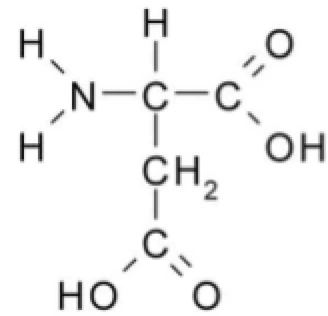
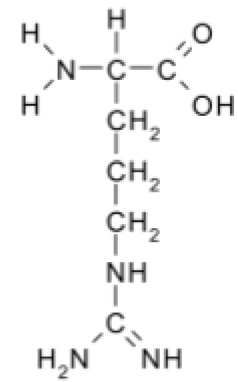
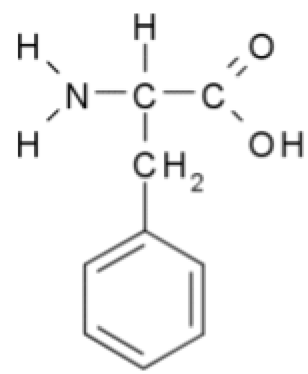
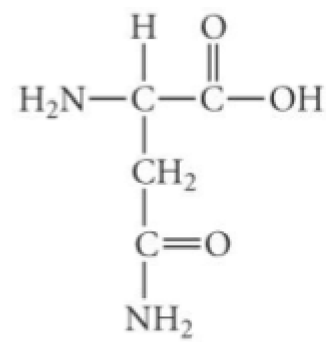
For each nucleotide monomer, circle and label the phosphate, sugar, and nitrogen base. Which part actually carries the coded biological information?

Carbohydrates

Circle a single sugar monomer.

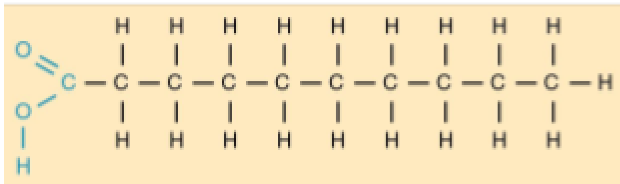


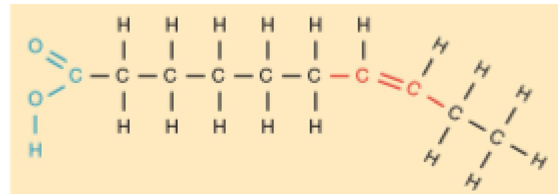
Proteins

(hydrophobic, hydrophilic, or ionic), and the interactions of these R groups determine structure and function of that region of the protein. c. Complex carbohydrates are comprised of sugar monomers whose structures determine the properties and functions of the molecules. d. Lipids are nonpolar macromolecules— ● Differences in saturation determine the structure and function of lipids. ● Phospholipids contain polar regions that interact with other polar molecules, such as water, and with nonpolar regions that are often hydrophobic. *X The molecular structure of specific lipids is beyond the scope of the AP Exam*	In one amino acid, circle and label the Amino terminus and Carboxyl terminus. For each amino acid, draw a square around the R group. Draw a heart <3 between the two amino acids with R groups that would be attracted to each other, and would cause the amino acid chain to fold so that they would be together. Put a star beside the R group that would cause that part of the amino acid chain to fold into itself, away from water.  (-) charge  (+) charge  non-polar  polar

Lipids

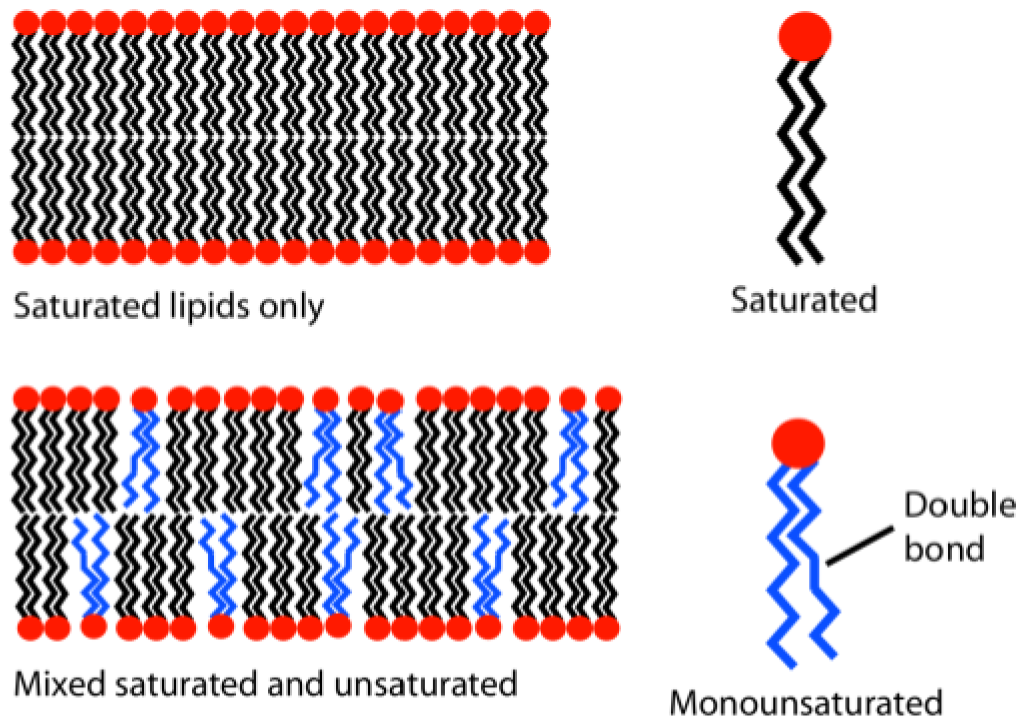
Consider what the word ‘saturated’ means. Which of these fatty acid chains is fully saturated with Hydrogen (a saturated fat)? Which is the Unsaturated fat?





In cold temperatures, phospholipid bilayers with saturated fatty acid tails are more rigid, while phospholipid bilayers with unsaturated fatty acid tails maintain the fluidity and flexibility that cells require.

Based on the shape of each fatty acid tail, explain why this is the case.



TOPIC 1.5 Structure and Function of Biological Macromolecules

ENDURING UNDERSTANDING **SYI-1** Living systems are organized in a hierarchy of structural levels that interact.

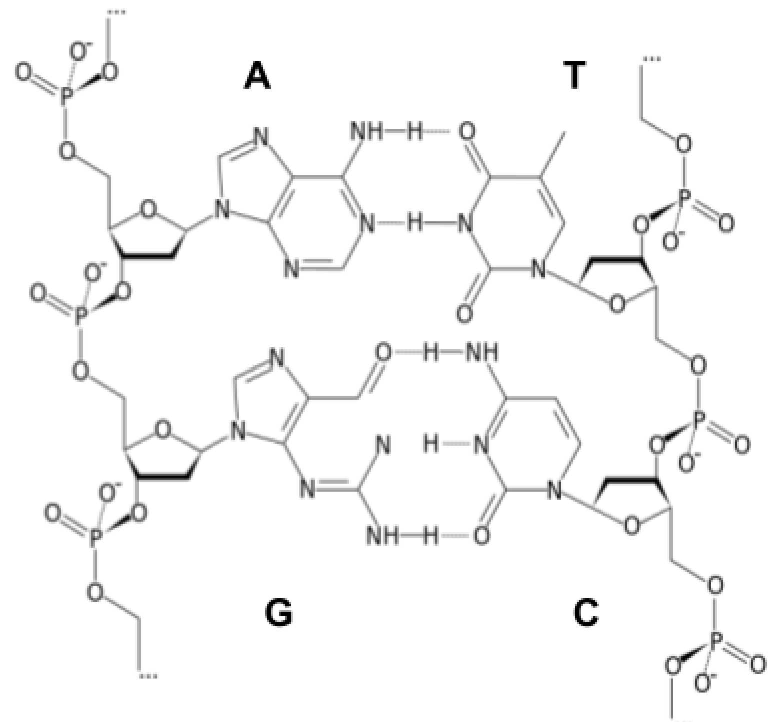
LEARNING OBJECTIVE
SYI-1.C Explain how a change in the subunits of a polymer may lead to changes in structure or function of the macromolecule.

ESSENTIAL KNOWLEDGE
SYI-1.C.1 Directionality of the subcomponents influences structure and function of the polymer—

a. Nucleic acids have a linear sequence of nucleotides that have ends, defined by the 3’ hydroxyl and 5’ phosphates of the sugar in the nucleotide. During DNA and RNA synthesis, nucleotides are added to the 3’ end of the growing strand, resulting in the formation of a covalent bond between nucleotides.

b. DNA is structured as an antiparallel double helix, with each strand running in opposite 5’ to 3’ orientation. Adenine nucleotides pair with thymine nucleotides via two hydrogen bonds. Cytosine nucleotides pair with guanine nucleotides by three hydrogen bonds.

Nucleic Acids
Choose a color for the phosphate groups and a different color for the sugars - color each of them. This is the
__________ - ___________
backbone.



Label the 5’ and 3’ end of each strand (read the essential knowledge if you need help!)

Add a ‘nucleotide’ to each strand by drawing a rectangle to represent it - be sure you add them to the appropriate end (5’ or 3’)!

What bond did you just draw to connect your new nucleotides?
____

Choose a color for hydrogen bonds. Highlight the two bonds between the A - T and the three bonds between the G - C.

Which strand of DNA would be more stable (less likely to separate into two strands)? Explain why.

TCTTAGATTAT AGAATCTAATA	GGATCGCCGAT CCTAGCGGCTA

<table>
<tr>
<td>c. Proteins comprise linear chains of amino acids, connected by the formation of covalent bonds at the carboxyl terminus of the growing peptide chain.

d. Proteins have primary structure determined by the sequence order of their constituent amino acids, secondary structure that arises through local folding of the amino acid chain into elements such as alpha-helices and beta-sheets, tertiary structure that is the overall three-dimensional shape of the protein and often minimizes free energy, and quaternary structure that arises from interactions between multiple polypeptide units. The four elements of protein structure determine the function of a protein.

e. Carbohydrates comprise linear chains of sugar monomers connected by covalent bonds. Carbohydrate polymers may be linear or branched.

ILLUSTRATIVE EXAMPLE § Cellulose versus starch versus glycogen</td>
<td>Proteins

Draw a very simple diagram that represents each level of structure to protein folding.
<table>
<tr><td>Primary</td><td>Secondary</td></tr>
<tr><td>Tertiary</td><td>Quaternary</td></tr>
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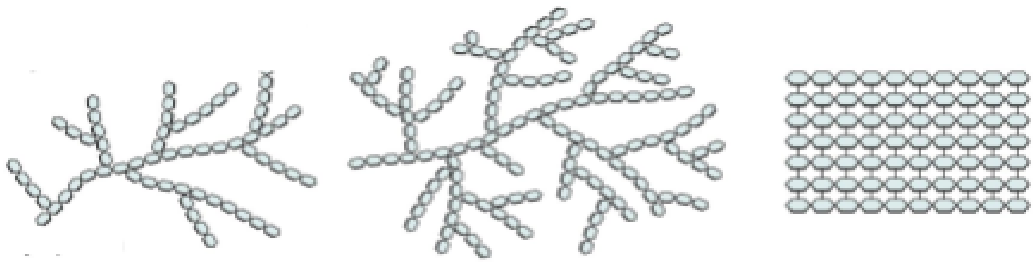
Carbohydrate

In the diagram, circle one sugar monomer.

Use your textbook or some other resource to identify and label the starch, glycogen, and cellulose molecules. Also indicate the function of each.



TOPIC 1.6 Nucleic Acids

ENDURING UNDERSTANDING **IST-1** Heritable information provides for continuity of life

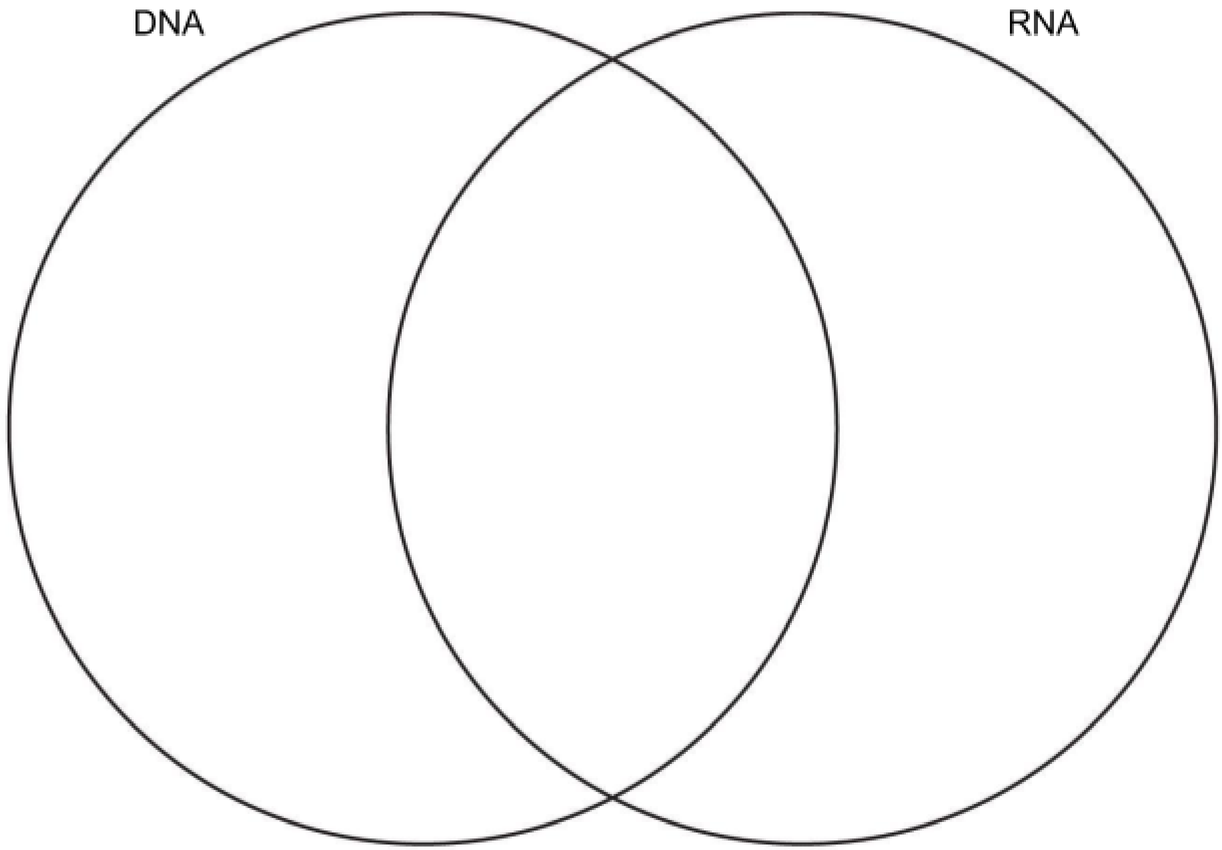
LEARNING OBJECTIVE
IST-1.A Describe the structural similarities and differences between DNA and RNA.

ESSENTIAL KNOWLEDGE
IST-1.A.1 DNA and RNA molecules have structural similarities and differences related to their function—

a. Both DNA and RNA have three components—sugar, a phosphate group, and a nitrogenous base—that form nucleotide units that are connected by covalent bonds to form a linear molecule with 5' and 3' ends, with the nitrogenous bases perpendicular to the sugar-phosphate backbone.
b. The basic structural differences between DNA and RNA include the following:

- DNA contains deoxyribose and RNA contains ribose.
- RNA contains uracil and DNA contains thymine.
- DNA is usually double stranded; RNA is usually single stranded.
- The two DNA strands in double-stranded DNA are antiparallel in directionality.

Use the information in the standards on the left to compare DNA and RNA. Then come up with at least three additional similarities or differences between them (consider location, size, function)



+JMJ+

+JMJ+

Meditation in a Toolshed

C. S. Lewis

I was standing today in the dark toolshed. The sun was shining outside and through the crack at the top of the door there came a sunbeam. From where I stood that beam of light, with the specks of dust floating in it, was the most striking thing in the place. Everything else was almost pitchblack. I was seeing the beam, not seeing things by it.

Then I moved, so that the beam fell on my eyes. Instantly the whole previous picture vanished. I saw no toolshed, and (above all) no beam. Instead I saw, framed in the irregular cranny at the top of the door, green leaves moving on the branches of a tree outside and beyond that, 90 odd million miles away, the sun. Looking along the beam, and looking at the beam are very different experiences.

But this is only a very simple example of the difference between looking at and looking along. A young man meets a girl. The whole world looks different when he sees her. Her voice reminds him of something he has been trying to remember all his life, and ten minutes casual chat with her is more precious than all the favours that all other women in the world could grant. He is, as they say, "in love". Now comes a scientist and describes this young man's experience from the outside. For him it is all an affair of the young man's genes and a recognised biological stimulus. That is the difference between looking along the sexual impulse and looking at it.

When you have got into the habit of making this distinction you will find examples of it all day long. The mathematician sits thinking, and to him it seems that he is contemplating timeless and spaceless truths about quantity. But the cerebral physiologist, if he could look inside the mathematician's head, would find nothing timeless and spaceless there—only tiny movements in the grey matter. The savage dances in ecstasy at midnight before Nyonga and feels with every muscle that his dance is helping to bring the new green crops and the spring rain and the babies. The anthropologist, observing that savage, records that he is performing a fertility ritual of the type so-and-so. The girl cries over her broken doll and feels that she has lost a real friend; the psychologist says that her nascent maternal instinct has been temporarily lavished on a bit of shaped and coloured wax.

As soon as you have grasped this simple distinction, it raises a question. You get one experience of a thing when you look along it and another when you look at it. Which is the 'true' or 'valid' experience? Which tells you most about the thing? And you can hardly ask that question without noticing that for the last fifty years or so everyone has been taking the answer for granted. It has been assumed without discussion that if you want the true account of religion you must go, not to religious people, but to anthropologists; that if you want the true account of sexual love you must go, not to lovers, but to psychologists; that if you want to understand some 'ideology' (such as medieval chivalry or the nineteenth-century idea of a 'gentleman'), you must listen not to those who lived inside it, but to sociologists.

The people who look *at* things have had it all their own way; the people who look along things have simply been brow-beaten. It has even come to be taken for granted that the external account of a thing somehow refutes or 'debunks' the account given from inside. 'All these moral ideals which look so transcendental and beautiful from inside', says the wiseacre, 'are really only a mass of biological instincts and inherited taboos.' And no one plays the game the other way round by replying. 'If you will only step inside, the things that look to you like instincts and taboos will suddenly reveal their real and transcendental nature.'

That, in fact, is the whole basis of the specifically 'modern' type of thought. And is it not, you will ask, a very sensible basis? For, after all, we are often deceived by things from the inside. For example, the girl who looks so wonderful while we're in love, may really be a very plain, stupid, and disagreeable person. The savage's dance to Nyonga does not really cause the crops to grow. Having been so often deceived by looking along, are we not well advised to trust only to looking at?—in fact to discount all these inside experiences?

Well, no. There are two fatal objections to discounting them all. And the first is this. You discount them in order to think more accurately. But you can't think at all—and therefore, of course, can't think accurately—if you have nothing to think about. A physiologist, for example, can study pain and find out that it 'is' (whatever is means) such and such neural events. But the word pain would have no meaning for him unless he had 'been inside' by actually suffering. If he had never looked along pain he simply wouldn't know what he was looking at. The very subject for his inquiries from outside exists for him only because he has, at least once, been inside.

This case is not likely to occur, because every man has felt pain. But it is perfectly easy to go on all your life giving explanations of religion, love, morality, honour, and the like, without having been inside any of them. And if you do that, you are simply playing with counters. You go on explaining a thing without knowing what it is. That is why a great deal of contemporary thought is, strictly speaking, thought about nothing—all the apparatus of thought busily working in a vacuum.

The other objection is this: let us go back to the toolshed. I might have discounted what I saw when looking along the beam (i.e., the leaves moving and the sun) on the ground that it was 'really only a strip of dusty light in a dark shed'. That is, I might have set up as 'true' my 'side vision' of the beam. But then that side vision is itself an instance of the activity we call seeing. And this new instance could also be looked at from outside. I could allow a scientist to tell me that what seemed to be a beam of light in a shed was 'really only an agitation of my own optic nerves'. And that would be just as good (or as bad) a bit of debunking as the previous one. The picture of the beam in the toolshed would now have to be discounted just as the previous picture of the trees and the sun had been discounted. And then, where are you?

In other words, you can step outside one experience only by stepping inside another. Therefore, if all inside experiences are misleading, we are always misled. The cerebral physiologist may say, if he chooses, that the mathematician's thought is 'only' tiny physical movements of the grey matter. But then what about the cerebral physiologist's own thought at that very moment? A second physiologist, looking at it, could pronounce it also to be only tiny physical movements in the first physiologist's skull. Where is the rot to end?

The answer is that we must never allow the rot to begin. We must, on pain of idiocy, deny from the very outset the idea that looking at is, by its own nature, intrinsically truer or better than looking along. One must look both along and at everything. In particular cases we shall find reason for regarding the one or the other vision as inferior. Thus the inside vision of rational thinking must be truer than the outside vision which sees only movements of the grey matter; for if the outside vision were the correct one all thought (including this thought itself) would be valueless, and this is self-contradictory. You cannot have a proof that no proofs matter. On the other hand, the inside vision of the savage's dance to Nyonga may be found deceptive because we find reason to believe that crops and babies are not really affected by it. In fact, we must take each case on its merits. But we must start with no prejudice for or against either kind of looking. We do not know in advance whether the lover or the psychologist is giving the more correct account of love, or whether both accounts are equally correct in different ways, or whether both are equally wrong. We just have to find out. But the period of brow-beating has got to end.

From *God in the Dock: Essays on Theology and Ethics*