

## 7.016 Recitation 1 – Fall 2018

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### **Summary of Lecture 1 (9/5):**

**Why does biology matter?** Biology in 21st century interfaces with many fields i.e. biochemistry, biochemical engineering, chemistry, computer science, medicine, agriculture, social science and ethics. Understanding biology can help us modernize the agriculture and resolve the growing food demands, combat diseases, design rationale medicine, understand ecosystem and appreciate biodiversity and evolution. The fundamentals of life at the molecular level and the various examples of biological systems and diseases covered throughout this course will help you appreciate why biology truly matters.

**Domains of life:** It is estimated that Earth evolved between 4.5 – 4.6 billion years ago. The critical step in the evolution of life was the appearance of nucleic acids- molecules that could self-replicate. This natural process of membrane formation resulted in the generation of first ancestral cell.

**Bacteria and archaea are prokaryotes.** The cells of prokaryotes are small, have no nucleus or organelles (except ribosomes) and are structurally simple. **Eukaryotes** include single-celled and multicellular organisms. Eukaryotic cells have a nucleus and other organelles.

### **Questions:**

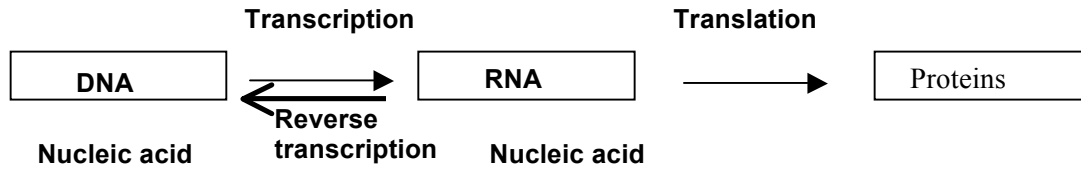
1. Organisms are used as model systems for different biological experiments. Complete the table for each of the model organism.

<b>Organisms</b>	<b>Prokaryote or eukaryote</b>	<b>Uni- or multi-cellular</b>
Bacteria		
Archaea		
Flies		
Mice		

2. Consider three different cell types (neuronal, skin and retinal cells) in humans.

- i. Do all these cell types have the same set of genes (Yes/ No)? **Explain.**
  
- ii. Are the proteins in the retinal cells the same as the proteins in the skin cells? (Yes/ No)? **Explain.**

3. The following schematic represents the flow of genetic information in living cells.



Discuss the above schematic as a group. Then **circle the best option** from the choices below and **explain** why you circled this option. Information, in living cells, mostly flows from...

- DNA-> RNA-> Proteins
- RNA->DNA-> Proteins
- Nucleic acids -> Proteins
- Proteins-> RNA-> DNA
- Proteins -> DNA-> RNA
- Proteins -> nucleic acids

**Solutions to the Questions**

1. Organisms are used as model systems for different biological experiments. Complete the table for each of the model organism.

Organisms	Prokaryote or eukaryote	Uni- or multi-cellular
Bacteria	<i>Prokaryotic</i>	<i>Unicellular</i>
Archaea	<i>Prokaryotic</i>	<i>Unicellular</i>
Flies	<i>Eukaryotic</i>	<i>Multicellular</i>
Mice	<i>Eukaryotic</i>	<i>Multicellular</i>

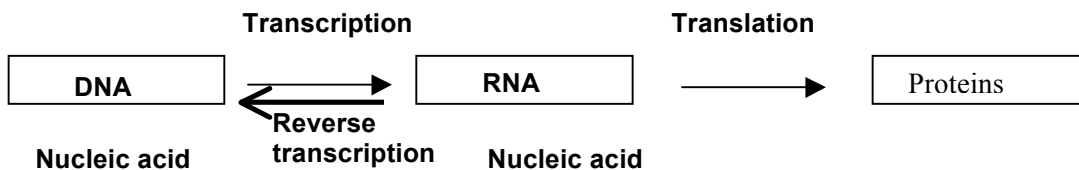
2. Consider three different cell types (neuronal, skin and retinal cells) in humans.

i. Do all these cell types have the same set of genes (Yes/ No)? **Explain.**  
*All the cells in an organism are derived from a single fertilized ovum and therefore have the SAME set of genes.*

ii. Are the proteins in the retinal cells the same as the proteins in the skin cells? (Yes/ No)?  
**Explain.**

*Although all cells in an organism have the same set of genes, the gene expression (a process by which DNA directs the synthesis of proteins) is specific for each cell type and it determines cell structure and functions. Therefore, although some proteins may be common to both retinal and skin cells (i.e. enzymes involved in synthesizing ATP), both retinal and skin cells will have their own UNIQUE set of proteins, which regulate their specific structure and functions.*

3. The following schematic represents the flow of genetic information in living cells.



Discuss the above schematic as a group. Then **circle the best option** from the choices below and **explain** why you circled this option. Information, in living cells, mostly flows from...

- DNA-> RNA-> Proteins (most common)
- RNA->DNA-> Proteins
- Nucleic acids -> Proteins (always true, even for retroviruses, which will discuss later)
- Proteins-> RNA-> DNA
- Proteins -> DNA-> RNA
- Proteins -> nucleic acids

*In most organisms, DNA is the hereditary material. The information in the DNA is first transcribed to mRNA and then translated into proteins (Option a). This is the best option since it holds true for most living organisms. However, as you will later learn in the Recombinant DNA virology lectures, retroviruses such as HIV have an RNA genome, which is reverse transcribed to make a complementary DNA (cDNA). The information in the cDNA is used to make viral proteins through the mRNA intermediate. Also, there are other RNA viruses i.e. Influenza Virus, which can replicate and make proteins without any DNA intermediate (RNA->proteins). Taking these exceptions into account the simplest option is to say that information flows from nucleic acids -> proteins.*

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