

BIOL 300 – Foundations of Biology  
Summer 2017 – Telleen  
Exam #3 Study Guide

As mentioned in class, Exam 3 will now cover only material through the end of Biotechnology. This corresponds to Chapters 9 and 10 in the textbook. *Evolution and Natural Selection will be covered on Exam 4 instead!*

Disclaimer: This outline is designed to help you organize the major topics that we have covered since the last exam and help you study. However, you need to be familiar with all of the material covered in class, not just the general topics listed here. This study guide is meant to be used in conjunction with the lecture outlines and your own notes, not as a substitute for them.

### I. DNA Structure

- A. Know approximately when and how DNA was shown to be the genetic material, including the basic experiments that proved it. Also, why was protein assumed to be the genetic material for so long?
- B. Be able to describe the basic model of DNA structure proposed by Watson and Crick (which got them the Nobel Prize). Know what evidence they used to produce the model. Know the structure of the backbone, the orientation of the two DNA chains relative to each other, the different types of nucleotides, general structures of the nucleotides, base pairing, how hydrogen bonds play a role, etc.
- C. Understand the implications of the double helical structure of DNA, including what it means for replication of DNA

### II. RNA, the Genetic Code, and Proteins

- A. Be able to describe the Central Dogma of Molecular Genetics and how it shows the transfer of information from DNA to RNA to Protein.
- B. Know how the structure (and properties) of RNA differ from DNA.
- C. Know the major different types of RNA present in cells and their roles.
- D. Be able to describe how information in DNA is **transcribed** into RNA.
- E. Be familiar with the genetic code and be able to translate a DNA or RNA sequence into an amino acid sequence. Also, know why the genetic code is 'degenerate'
- F. Know what START and STOP codons are, as well as how they relate to **ORFs**.
- G. Understand in general terms how protein synthesis (i.e. **translation**) occurs. Particularly, what types of molecules are involved.

### III. Mutations and Gene Structure/Regulation

- A. Know the general structure of a gene and the roles of the different parts.
- B. Know what introns/exons are
- C. Understand generally how the expression of genes is regulated

- D. Know the different types of mutations that we discussed in class and how mutations can alter genes and produce different phenotypes. This includes both how we describe changes in DNA, as well as the consequences of those changes!

#### IV. Biotechnology

- A. Define **biotechnology**, **genetic engineering**, and **recombinant DNA**.
- B. What is meant by “cloning a gene”? How is that similar/different than reproductive cloning (e.g. Dolly the sheep)?
- C. What is the purpose of **gel electrophoresis**?
- D. Explain why **plasmids** are useful in recombinant DNA construction and genetic engineering.
- E. Define **restriction enzyme** and **DNA ligase**. Explain how these two enzymes are used to make recombinant DNA.
- F. Define a **vector** and explain its use in recombinant DNA
- G. Explain how recombinant DNA technology can be used to introduce foreign genes into bacteria.
- H. Describe useful applications derived from recombinant DNA technology.
- I. What is CRISPR? How can this system be used for “gene editing”?
- I. Describe **PCR (polymerase chain reaction)** and explain the advantages and uses of this technique.
- J. Define **genomics** and **bioinformatics**. Describe potential applications of these technologies.