

DNA—the thread of life
Biol 100 – K.Marr

1. Topics this lecture

- DNA structure and Replication
- Chapter 10 in *Essential Biology* by Campbell et al
- 2. Lab 7. Modeling DNA Structure, DNA Replication and Protein Synthesis** Read the introduction carefully
- [This week](#): Part 1 (through page 9) – modeling DNA Structure and Replication
- [Next week](#): Part 2 – modeling transcription and translation

Cystic fibrosis—a genetic disease

1. View Cystic Fibrosis Case Study Movie

- available @ lecture page of class website

2. Optional Reading

- Cystic Fibrosis Foundation Website: <http://www.cff.org>
- Welsh, M.J. and A.E. Smith. Cystic fibrosis. *Scientific American*, December 1995

Cystic Fibrosis: autosomal recessive

Most common lethal genetic disease

- 1 in 2000 children is born with CF in U.S.
- Untreated children die by age 5
- Ave. life expectancy: ~27 yrs
- Special diet + daily dose of antibiotic prevent infection

Carriers of CF gene:

- Hispanics: 1 in _____
- African Americans: 1 in _____
- Asian Americans: 1 in _____
- Caucasian of European descent: 1 in _____
- Why the higher rate in Caucasians of European descent?
- What is the adaptive value of the CF allele?

Outline for Next few Lectures

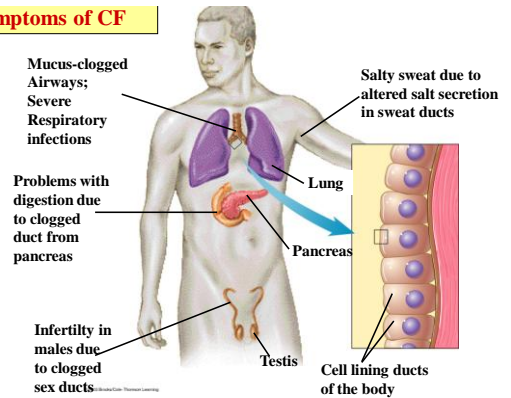
Chapter 10—Molecular Biology of the Gene

- Cystic Fibrosis Case Study
- Central Dogma of Biology
- Structure of DNA
- Replication of DNA
- Protein Synthesis
 - Transcription = Reading of DNA to make RNA
 - Translation = Reading of mRNA by ribosomes to make protein

Chapter 12—DNA Technology

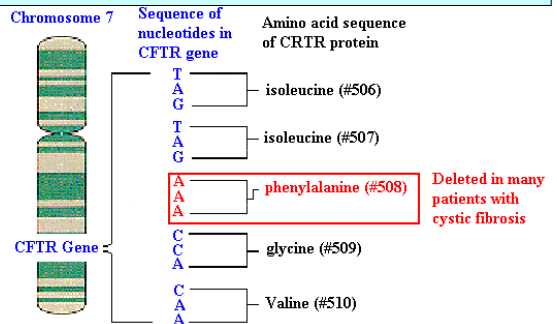
- Application of Gene Therapy and biotechnology to cystic fibrosis

Symptoms of CF



Cystic Fibrosis

- A single faulty protein is connected to the symptoms
- In 1989 the gene was mapped to chromosome #7



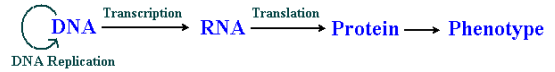
Our Goal

- To determine the connection between the symptoms associated with cystic fibrosis and DNA
- Let's revisit the central dogma of biology...

Central Dogma of Biology

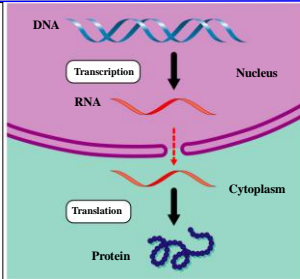
- Genes interacting with _____ determine the _____ of an Organism

DNA $\xrightarrow{?}$ Characteristics
 Genotype $\xrightarrow{?}$ Phenotype

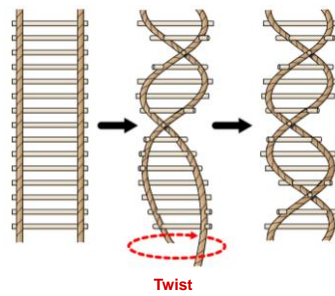


Central Dogma of Biology

- DNA specifies the synthesis of proteins in two stages
- 1. **Transcription** _____
- 2. **Translation** _____
- Let's learn a bit about the structure of DNA



DNA is like a rope ladder twisted into a spiral

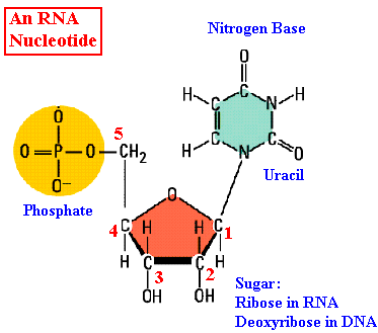


DNA Structure

- Consists of 2 strands joined together by weak hydrogen bonds
- Rungs of the ladder are hydrogen bonded N-bases

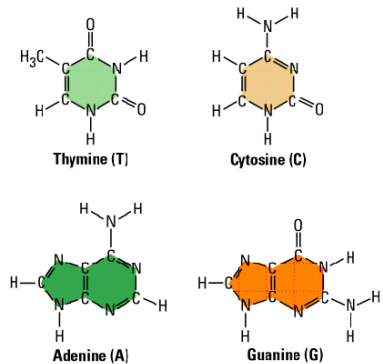
DNA and RNA: Polymers of Nucleotides

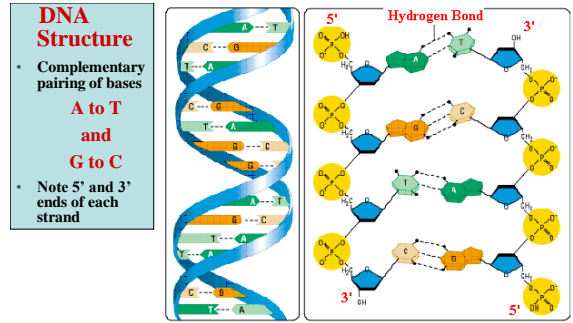
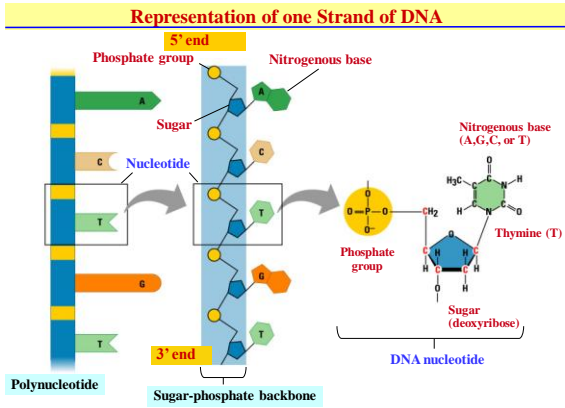
- Nucleotide:** _____ + _____ + _____
- Note carbon numbers on sugar
- Nucleotides join to form a sugar-phosphate backbone



- Nitrogen Bases found in DNA & RNA**

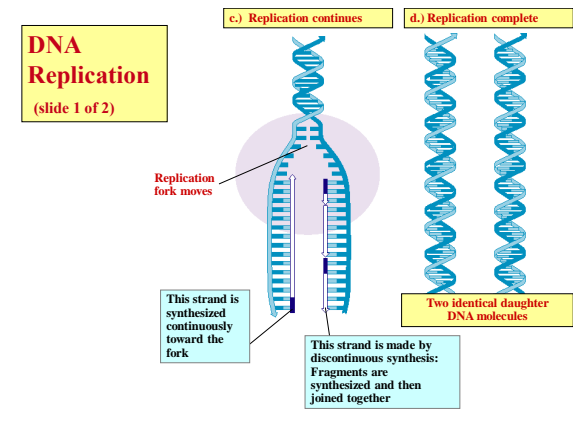
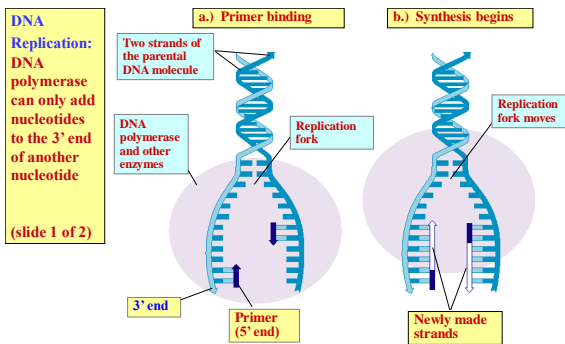
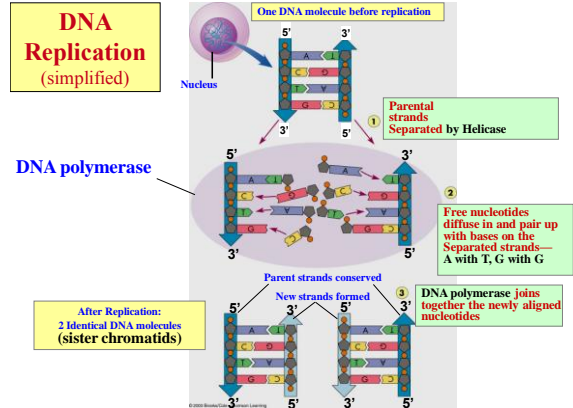
- Uracil replaces thymine in RNA





It's in the genes...

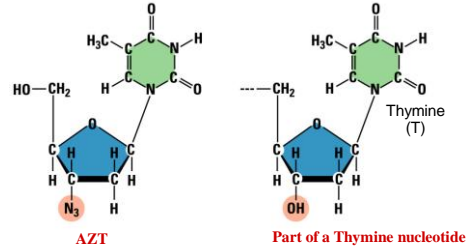
- What's a gene?
 - _____
 - _____
- The kind of proteins an organism makes helps to determine its phenotype
- Genes are...
 - copied during _____
 - passed to offspring _____
- Genes can change or mutate – how?
 - View animation of DNA Replication
 - available at the lecture section of class website



DNA replication Self-test Questions

1. When during the cell cycle does it occur?
2. What do we start with?
3. What do we end with?
4. Where in a cell does DNA replication occur?
5. What's needed for DNA replication to occur?
6. What is the sequence of events?
7. Why is DNA replication said to be semi-conservative?
8. What does proofreading mean in terms of DNA replication?
9. What does the proofreading during DNA replication?

How do nucleotide analogues work to stop DNA replication in cancer cells and HIV?
The drug AZT, below, is effective at preventing the spread of HIV. How?



DNA can be damaged by ultraviolet light

1. **Enzymes (e.g. DNA polymerase) can repair the damage.**
 - Is the damage always repaired? Consequences?
2. **Why does burnt skin peel? What gene is involved?**
3. **Role of Apoptosis?**
4. **Role of p53 gene?**
 - Advantages of peeling?
 - Disadvantages?

