

Molecular Basis of Inheritance

Chapter 16

Objectives

- Understand how the structure of DNA was determined
- Understand the role of DNA in the cell and in inheritance

Categorizing the Role

- The function of DNA was first described from tests utilizing microbes and viruses
- Frederick Griffith (1928)
- First to describe **Transformation**: change in genetic and physical composition as a result of assimilation of external DNA

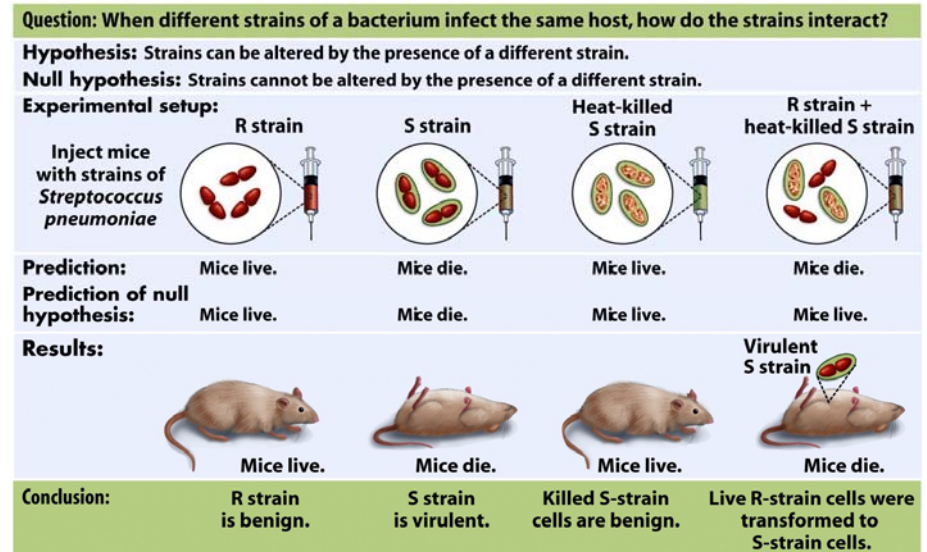


Figure 14-2 Biological Science, 2/e

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- Oswald Avery, Maclyn McCarty, and Colin MacLeod announce that DNA was the transformation agent (1944)

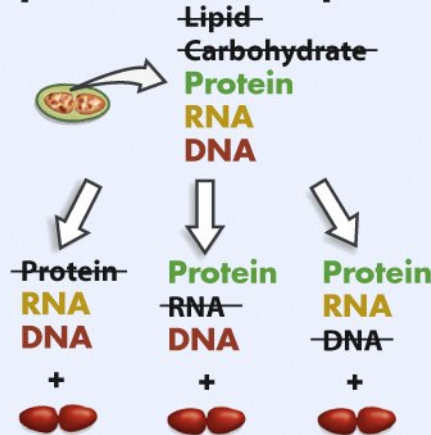
Question: Does the transforming factor consist of protein, RNA, or DNA?

Hypothesis 1: Transforming factor is protein.

Hypothesis 2: Transforming factor is RNA.

Hypothesis 3: Transforming factor is DNA.

Experimental setup:



1. Start with heat-killed *Streptococcus* cells, which contain different types of macromolecules. Remove lipids and carbohydrates.

2. Add enzyme to digest one type of macromolecule in each treatment. Add each treatment to a mixture of R cells.

Prediction: (No explicit prediction; all three alternatives are considered equally likely.)

Results:

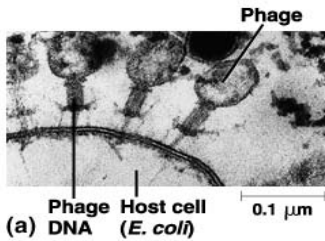
Transformation requires presence of DNA



Transformation Transformation

No transformation

Conclusion: DNA is the transforming factor.



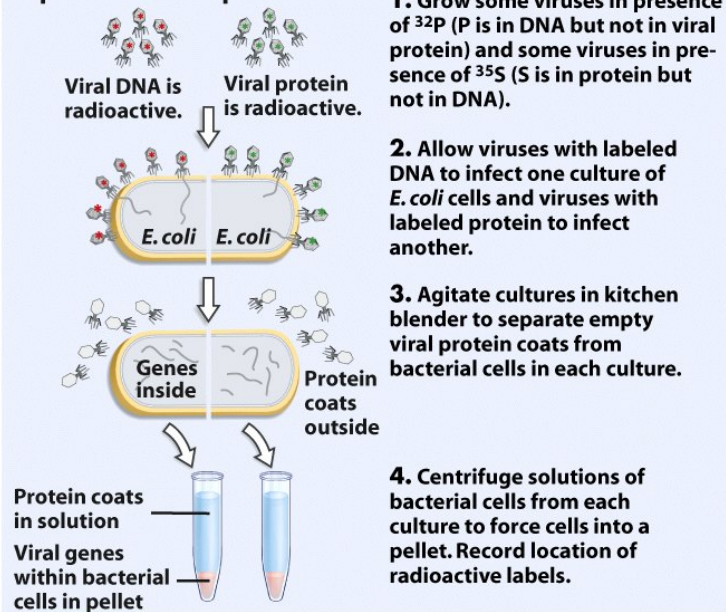
Are Genes Made Of Protein OR DNA?

Question: Do viral genes consist of DNA or protein?

DNA hypothesis: Viral genes consist of DNA.

Protein hypothesis: Viral genes consist of protein.

Experimental setup:



Prediction of DNA hypothesis: Radioactive DNA will be located within pellet.

Prediction of protein hypothesis: Radioactive protein will be located within pellet.

Results:

Radioactive DNA is in pellet



Radioactive protein is in solution



Conclusion: Viral genes consist of DNA. Viral coats consist of protein.



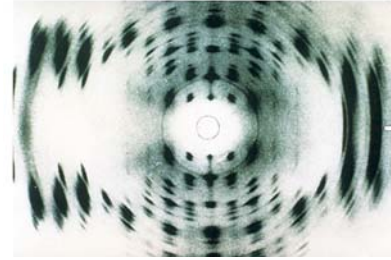
- Alfred Hershey and Martha Chase perform bacteriophage experiments that showed that DNA was injected by Viruses into bacteria (1952)

– Used radioactivity of ^{35}S and ^{32}P

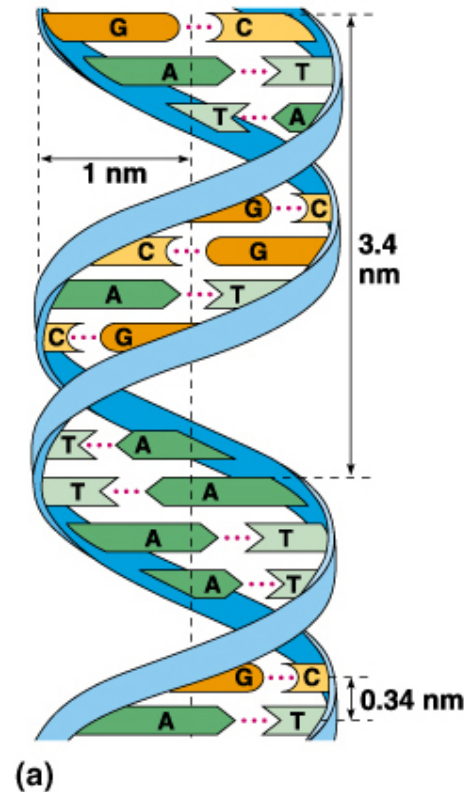
Just one more

- Erwin Chargoff determined that the DNA composition varied from species to species
- Also noted that the ratio of A to that of T and G to that of C were approximately equal (1947)

DNA is a Helix



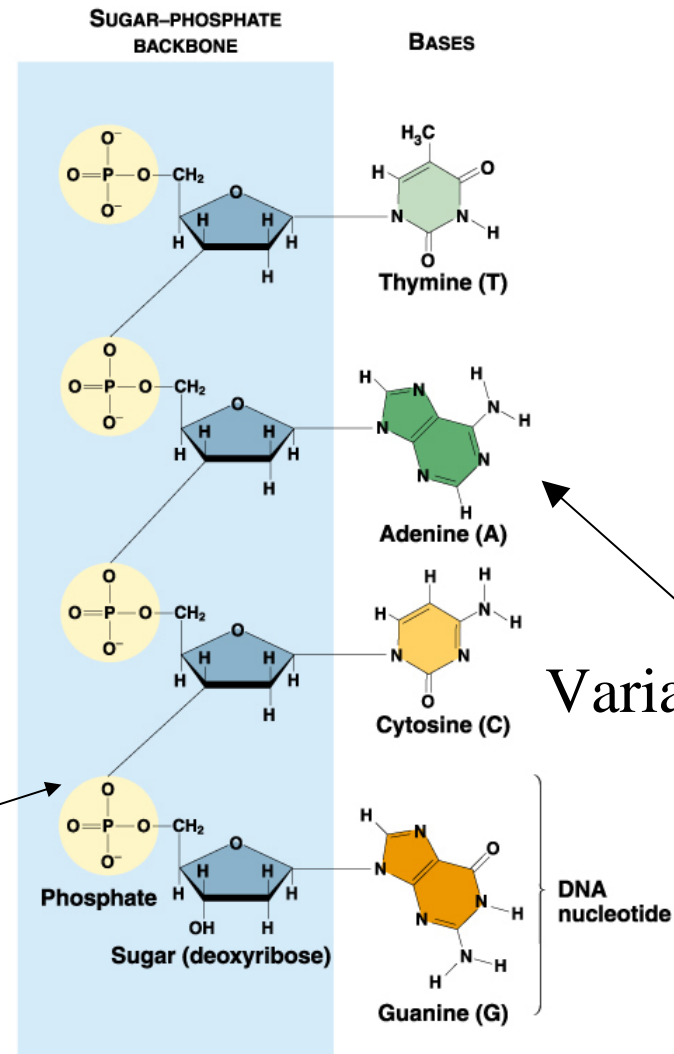
- The three dimensional structure of DNA was first determined with the assistance of X-ray crystallography. Data collected by Rosalind Franklin
- James Watson and Francis Crick described it as a double helix (1953)



Details Of The Structure

- DNA is formed from two nucleotide polymers each with covalent bonds between the sugar and phosphate groups (backbone structure) and variable nucleotide bases capable of Hydrogen bonding

Conserved region



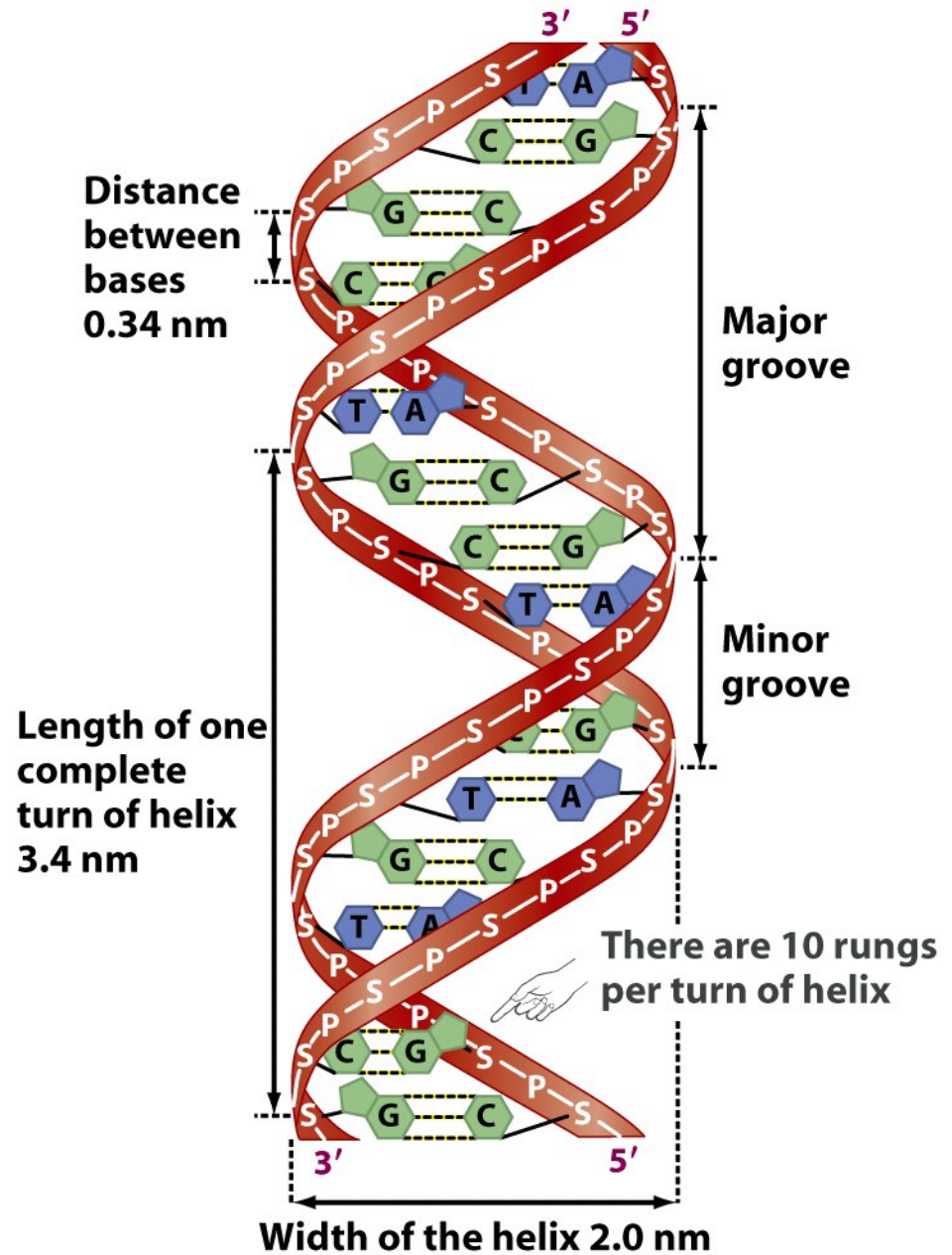
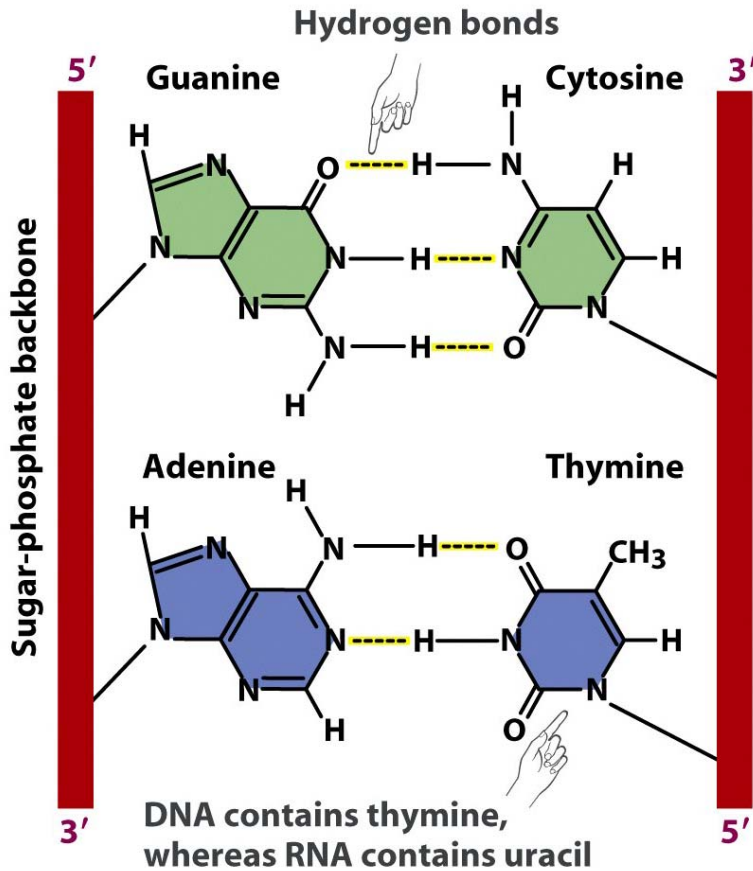
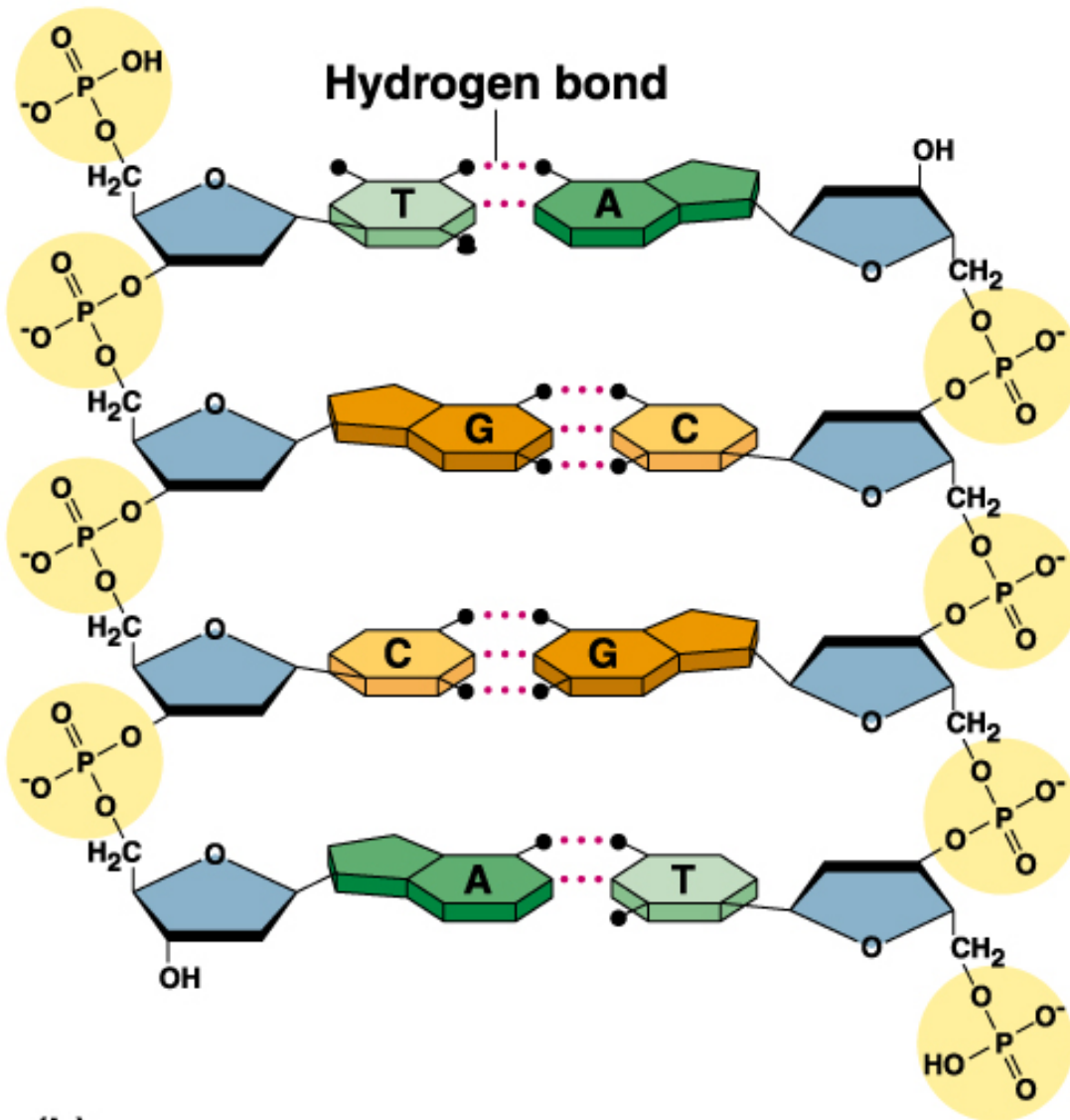


Figure 4-11 Biological Science, 2/e



(b)



(c)

To make it work, the two nucleotide polymers run antiparallel (opposite direction) and are held together by **complimentary base pairing** (A-T and G-C)