# DNA and RNA

# SB2a

- Students will analyze how biological traits are passed on to successive generations.

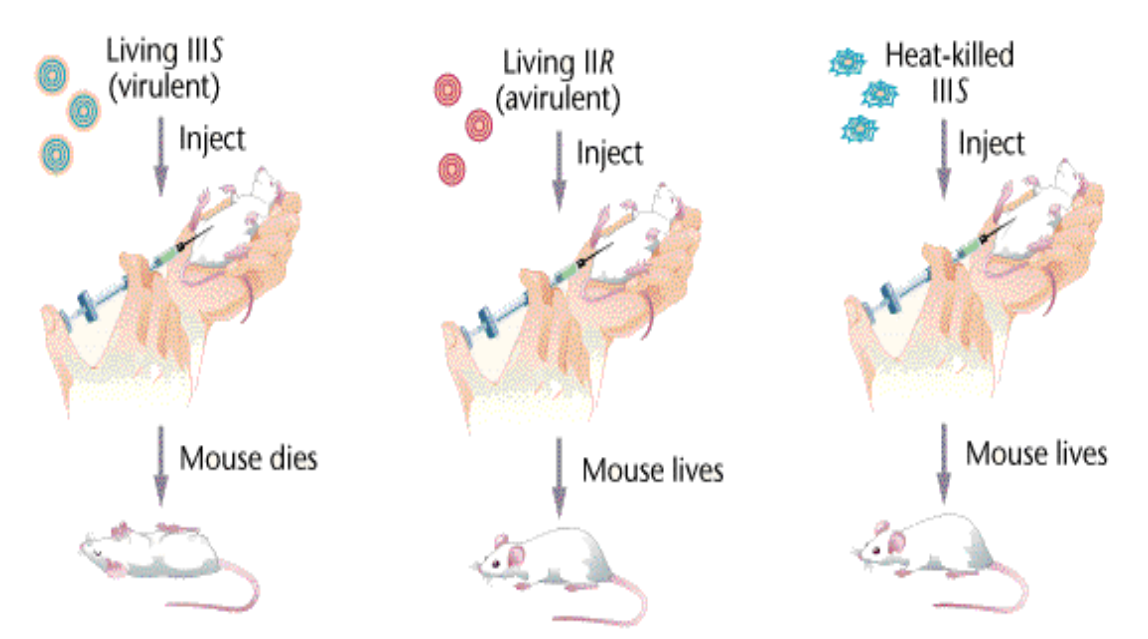
a. Distinguish between DNA and RNA

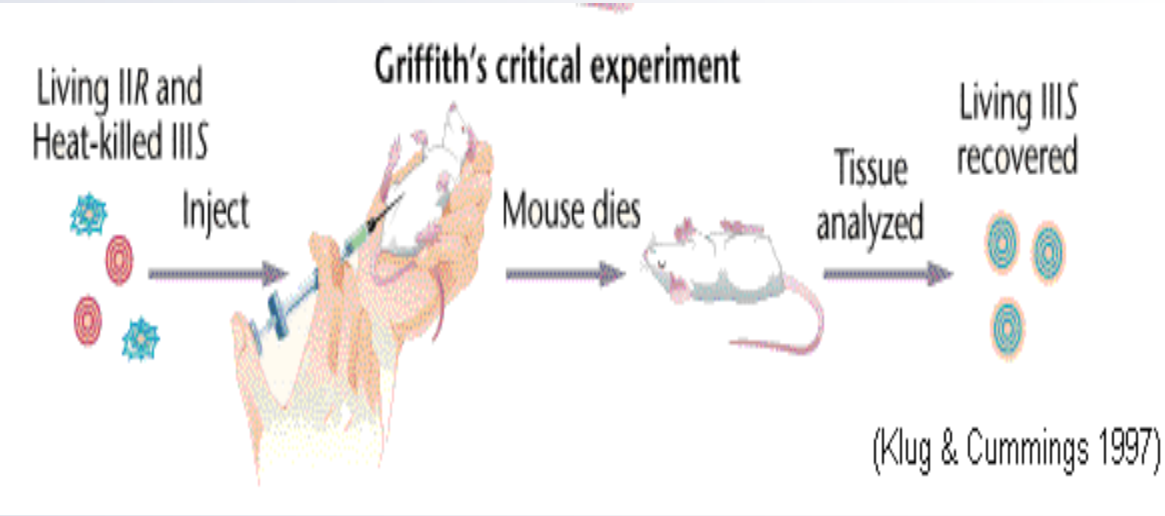
# Essential Question

- Why is there a difference in structure and function between DNA and RNA?

# Griffith's Experiment

- Mice injected with the disease causing bacteria died.
- Mice injected with the harmless bacteria lived.
- Mice injected with the heat-killed disease causing bacteria also lived.
- Griffith then mixed the live harmless bacteria with heat-killed disease causing bacteria.
- Mice injected with this combination died.



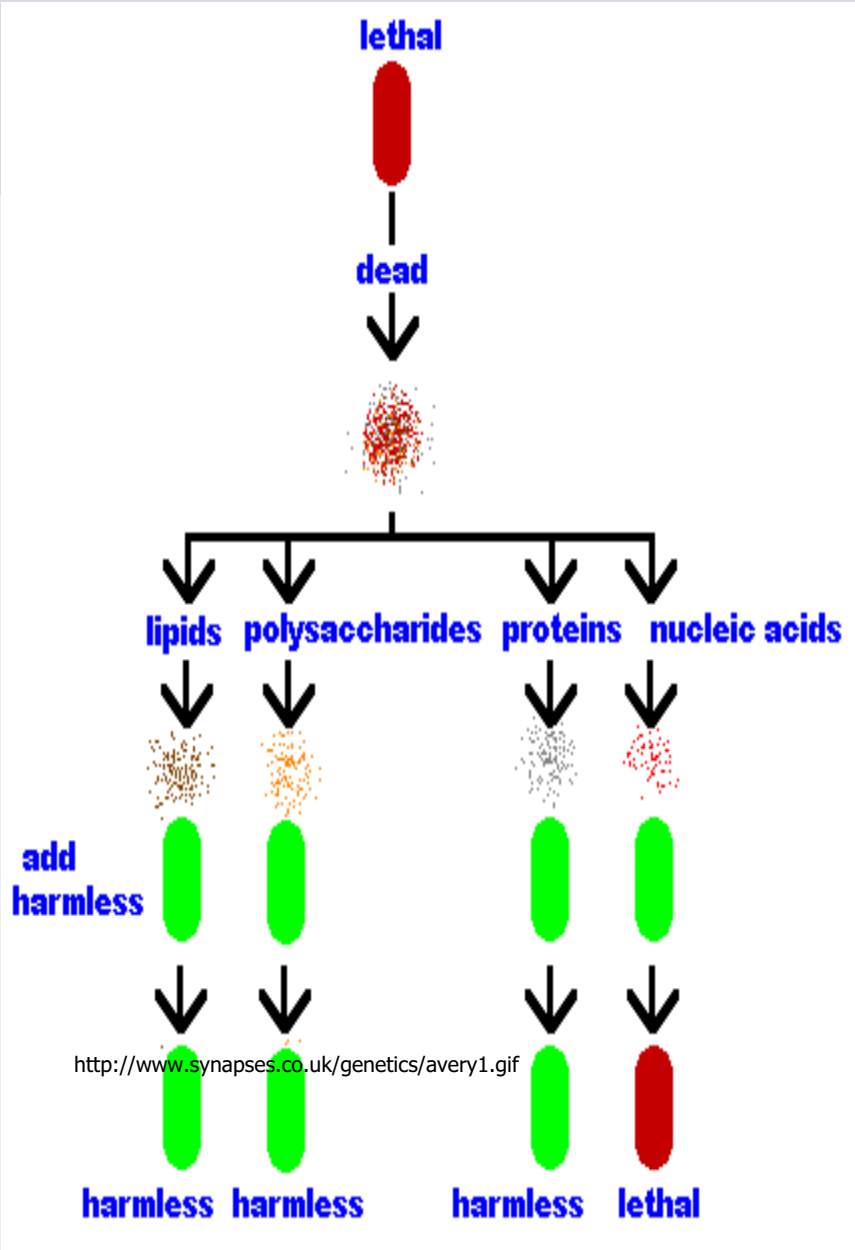

http://www.mun.ca/biology/scarr/Fg10_03smc.gif

- Based on his results, Griffith hypothesized that when the harmless and heat-killed bacteria where mixed, some factor was exchanged between them, making the live harmless bacteria deadly.

- Transformation – process in which one strain of bacteria is changed by the gene(s) of another bacteria

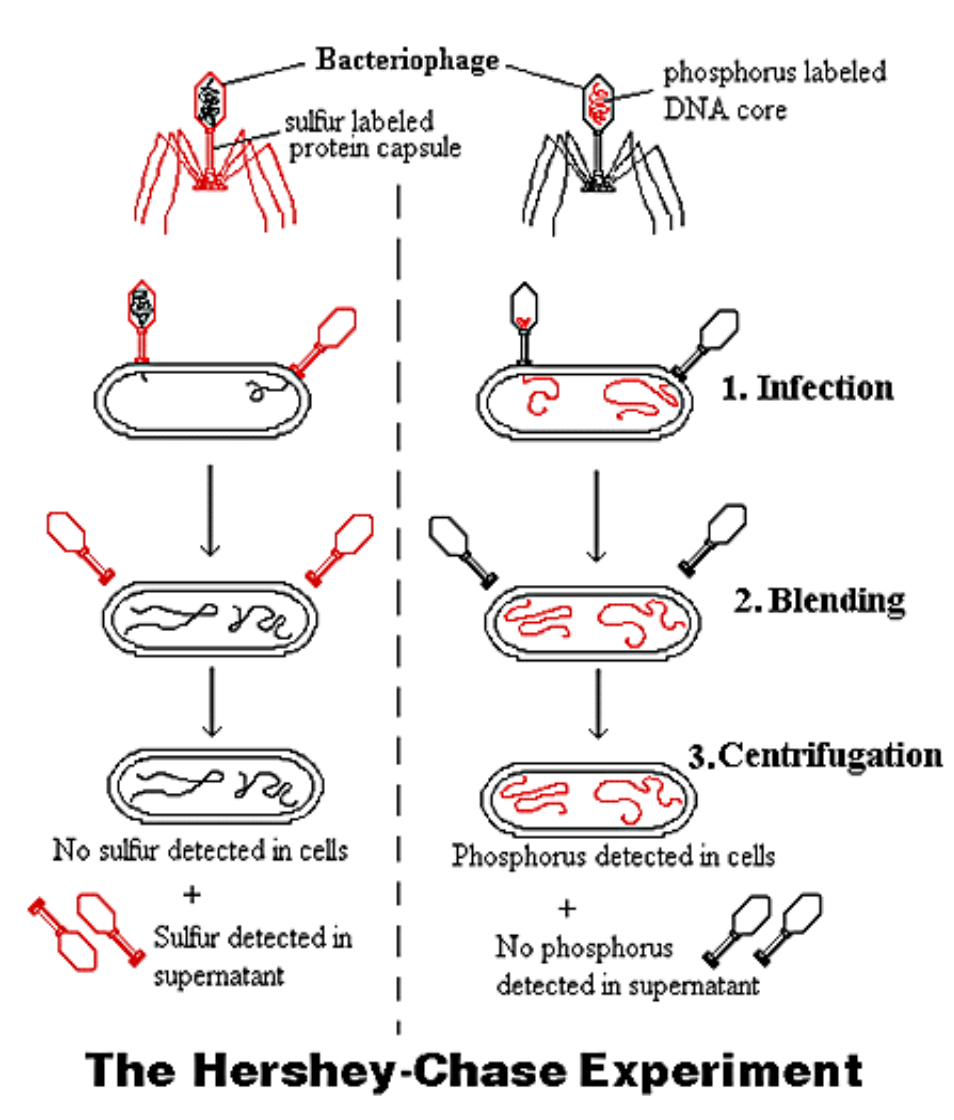
# Avery modifies Griffith's experiment.

- In 1943, conducted an experiment similar to Griffith's, except they used enzymes to selectively destroy molecules one at a time.
- When they injected harmless bacteria with only lipids, carbs, or proteins: transformation did not occur.
- When they used the nucleic acids (DNA): transformation did occur, the bacteria became lethal.
- This helped to determine that DNA stores and transmits genetic information.



# Hershey and Chase

- (1950) conducted experiments with bacteriophages (viruses that attack bacteria) to determine if genetic information is carried on proteins or DNA.
- These findings further supported the conclusions of Avery's experiment & specified that genetic material is DNA and NOT protein.




http://www.accessexcellence.org/RC/VL/GG/images/HERSHEY.gif

## Table 12.1 Summary of Hershey-Chase Results

| Group 1 (Viruses labeled with $^{32}P$) | | Group 2 (Viruses labeled with $^{35}S$) | |
|---|---|---|---|
| Infected Bacteria | Liquid with Viruses | Infected Bacteria | Liquid with Viruses |
| • Labeled viral DNA found in the bacteria | • No labeled DNA | • | • Labeled proteins found |
| • Viral replication occurred | • | • Viral replication occurred | • No viral replication |
| • New viruses contained $^{32}P$ | | • | |

New viruses did not have a label

No viral replication

No labeled viral proteins

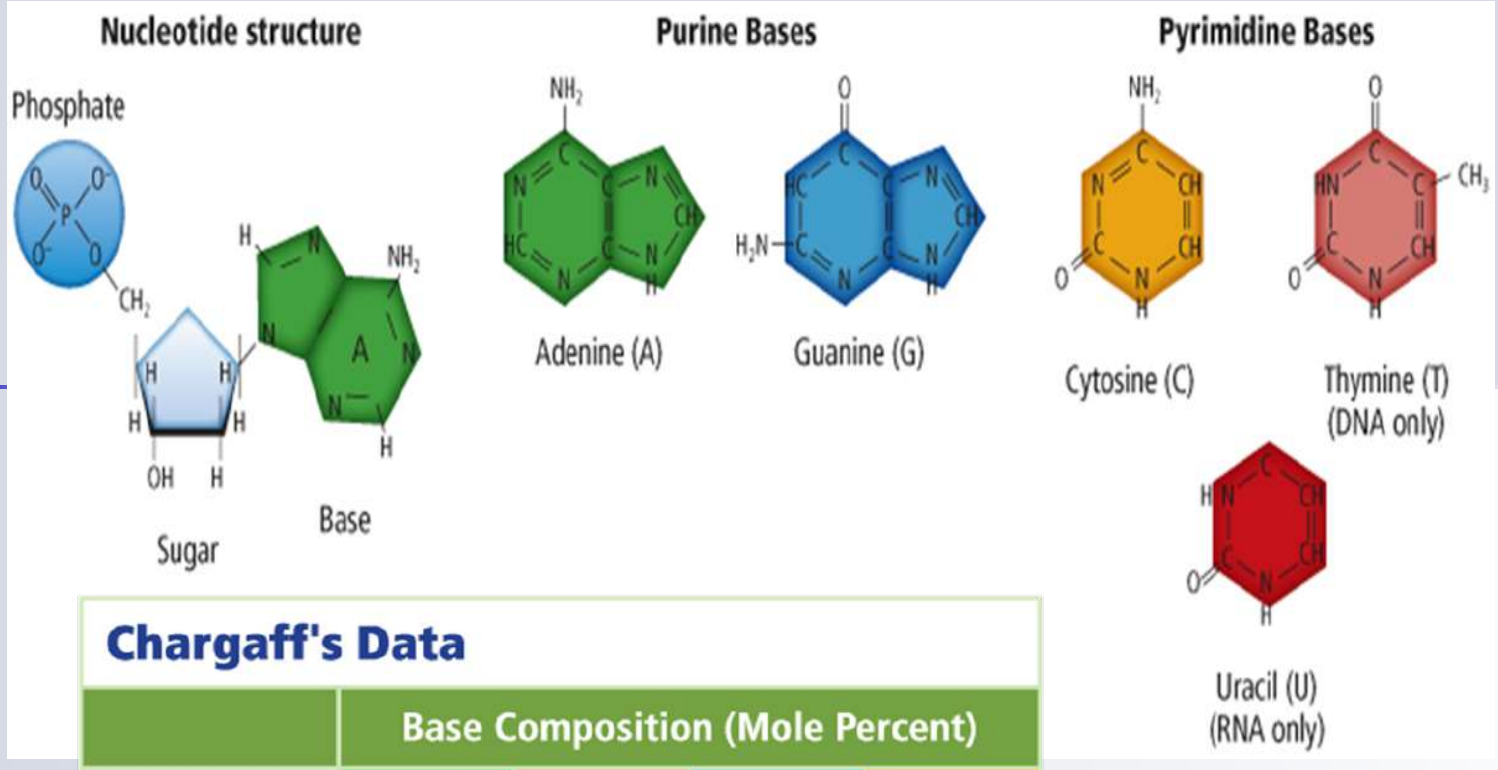
*Drag each option to its corresponding group*

Reset Submit Show me

# Chargaff's Rule

- Chargaff determined that in any sample of DNA:
  - The # of adenines (A) = the # of thymines (T)
  - The # of cytosines (C) = the # of guanines (G)
- Thus in DNA, the bases A and T pair together, and C and G pair together.

http://www.educarm.es/templates/portal/administradorFicheros/webquest/herencia/chargaff.jpg

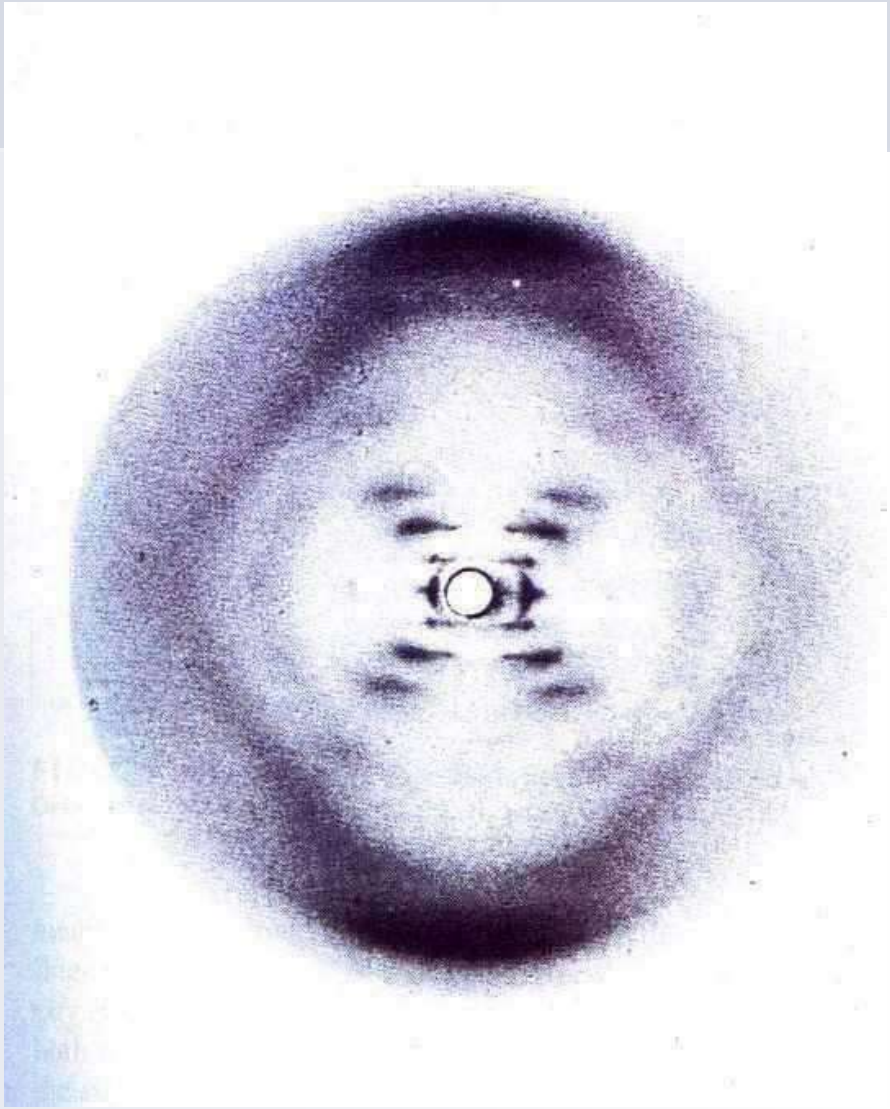



## Chargaff's Data

| | Base Composition (Mole Percent) | | | |
|---|---|---|---|---|
| **Organism** | **A** | **T** | **G** | **C** |
| ***Escherichia coli*** | 26.0 | 23.9 | 24.9 | 25.2 |
| **Yeast** | 31.3 | 32.9 | 18.7 | 17.1 |
| **Herring** | 27.8 | 27.5 | 22.2 | 22.6 |
| **Rat** | 28.6 | 28.4 | 21.4 | 21.5 |
| **Human** | 30.9 | 29.4 | 19.9 | 19.8 |

# Rosalind Franklin

- Franklin used x-ray diffraction to create pictures of DNA's molecular structure



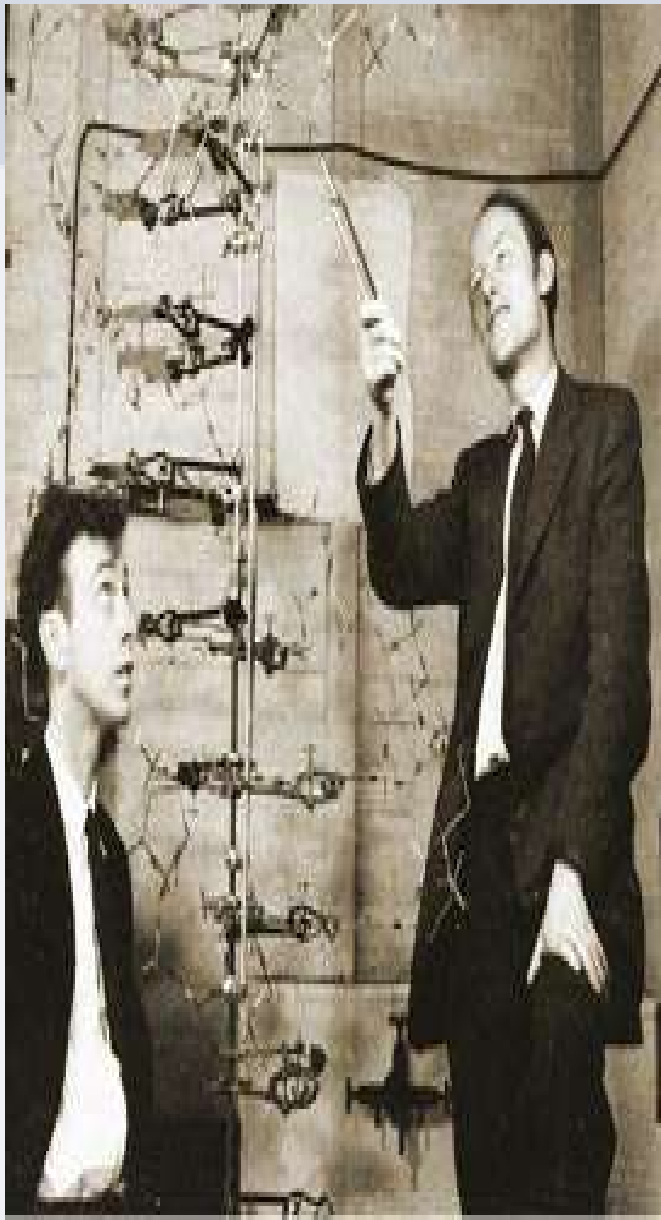
http://www.safarikscience.org/biologyhome/7_dna/6_xray_diffraction.jpg

# Watson and Crick

- Determined the structure of DNA in 1953 using their data and the work of previous scientists.

- Watson got a sneak peak at Franklin's X-ray images and used them with other evidence to determine DNA's structure.

http://teachers.sduhsd.k12.ca.us/lolson/images/watson_crick.jpg



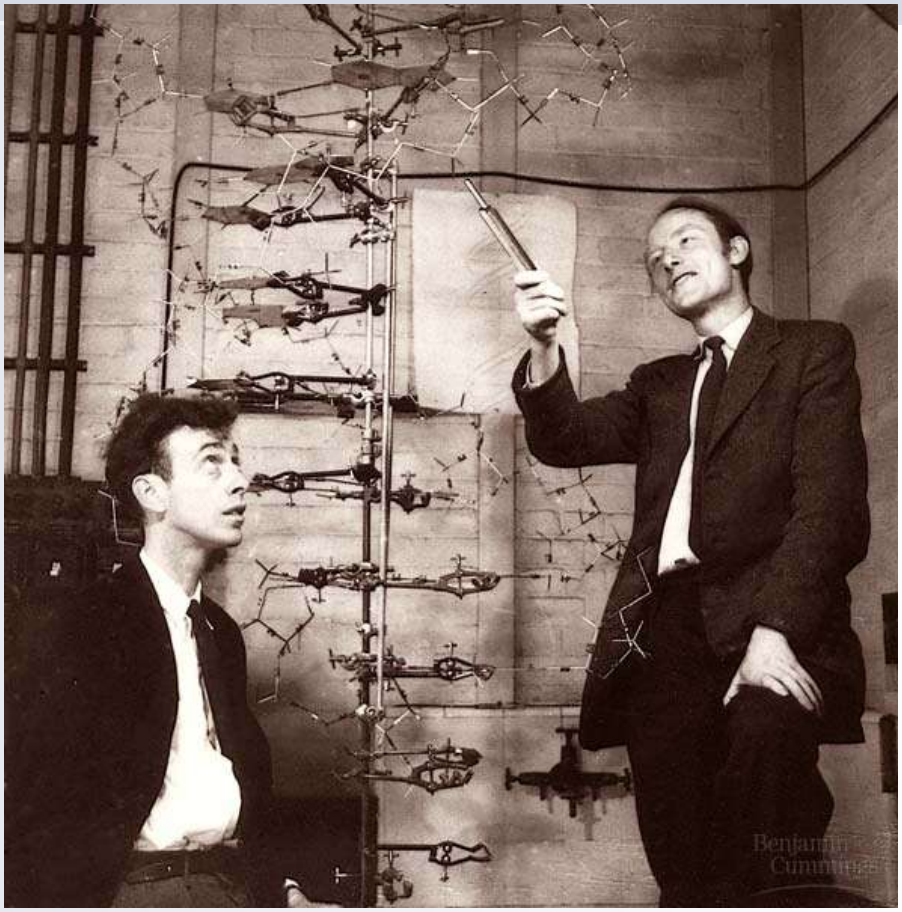
# DNA

# What is DNA?

- Deoxyribonucleic Acid
- Genetic Information
- Stores and transmits all information needed for the existence of living organisms
- Each cell in a multicellular organism has the same exact copy of DNA

# Shape of DNA

- Double Helix
  - Like a twisted ladder
- Shape discovered by James Watson and Francis Crick in 1953
  - This discovery changed genetics and our lives



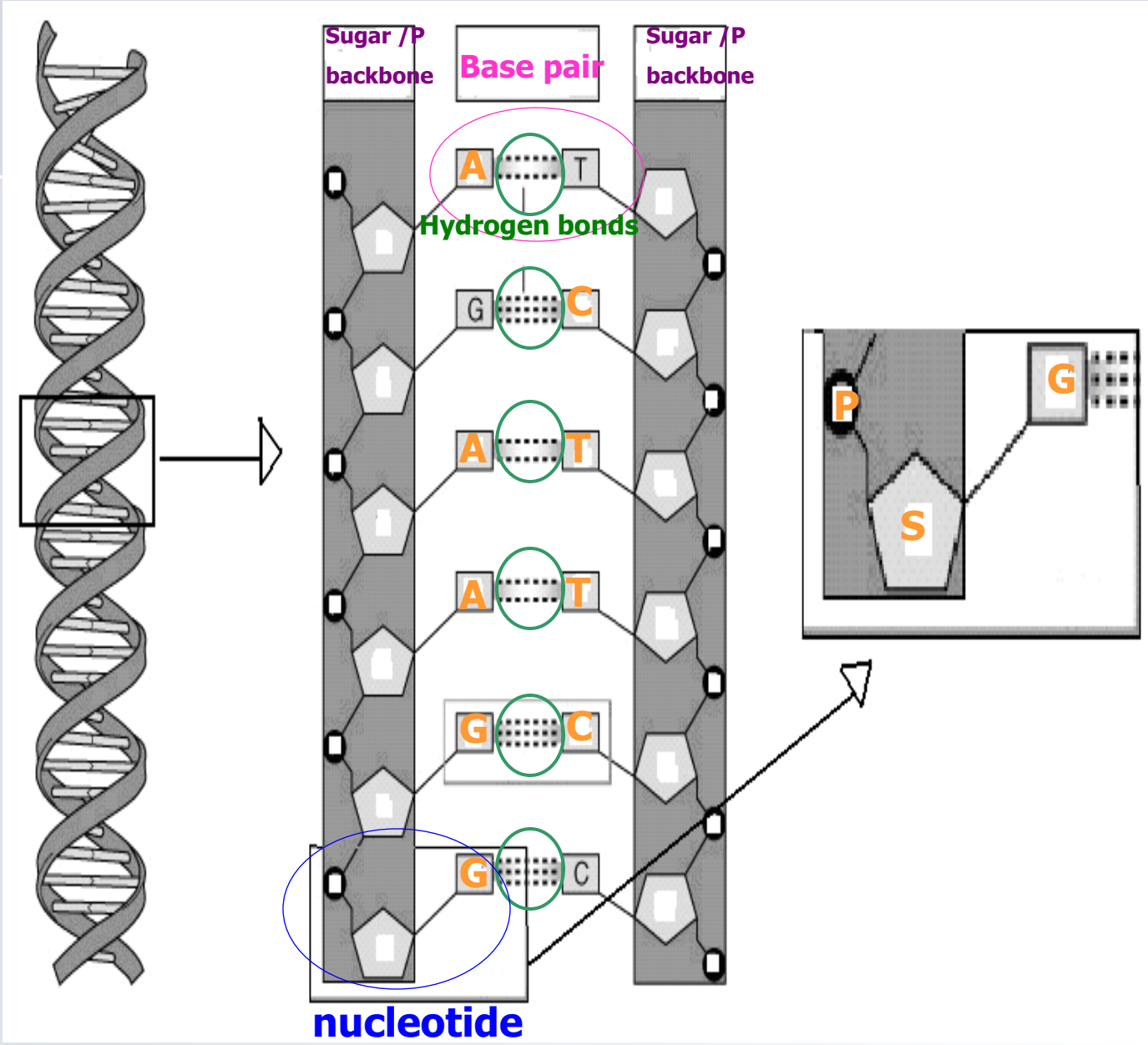
# The Structure of DNA

3 parts:

- Deoxyribose – 5 carbon sugar
- Phosphate
- Nitrogen base

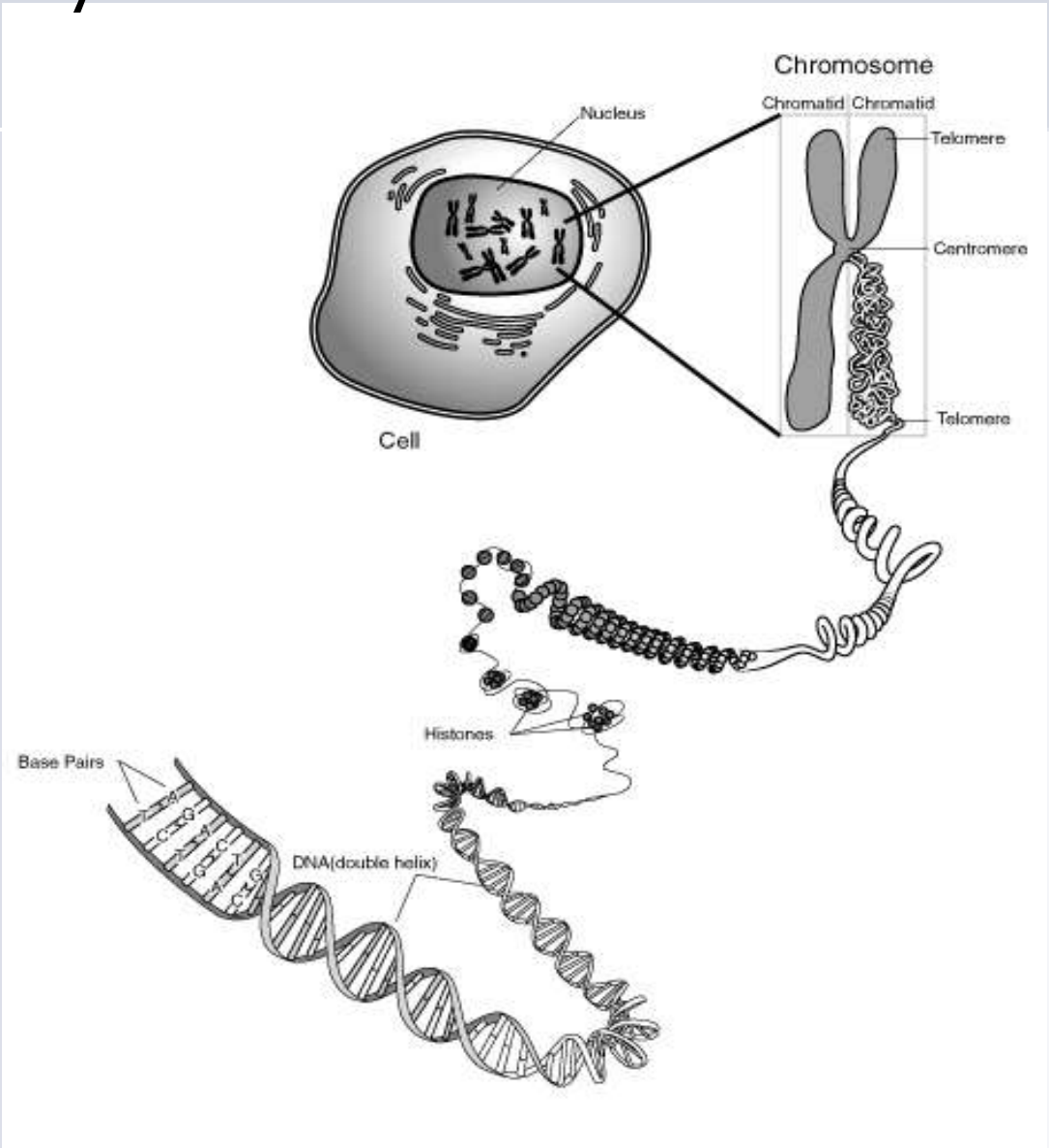
a/k/a nucleotides

- Hydrogen bond between nitrogen bases
- Covalent bond on backbones



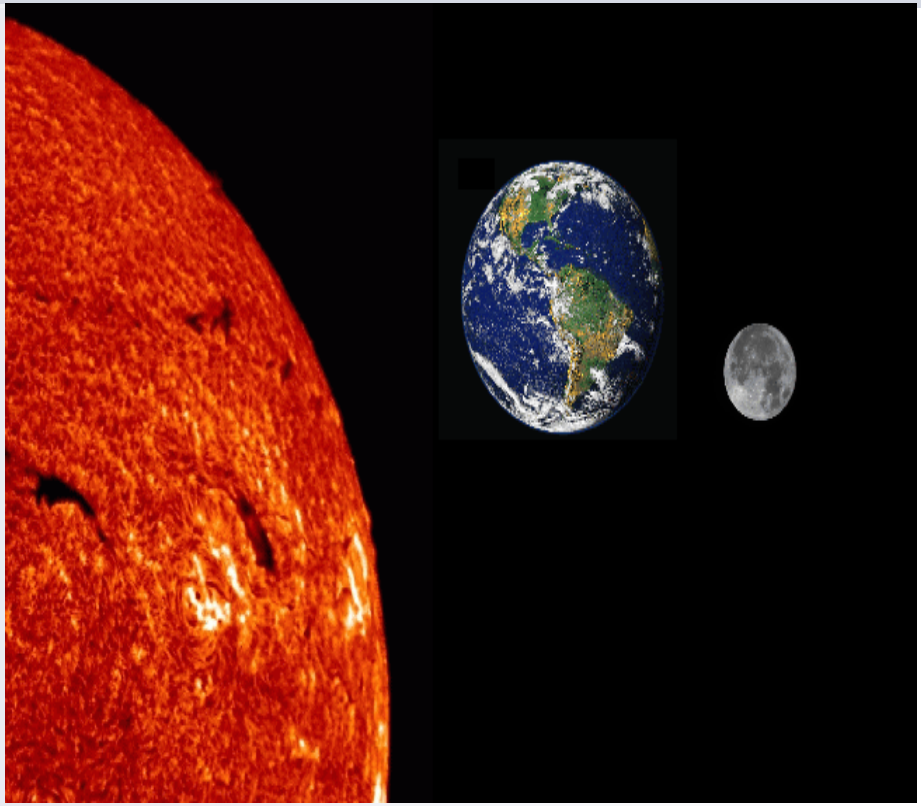
# How is DNA stored in our cells?

- Very tightly coiled into chromosomes



# Just how much DNA/ genetic information is in our cells?

- If all the DNA in your body was put end to end, it would reach to the sun and back over 600 times.
- (93 million miles - one way)
- If you unwrap all the DNA you have in all your cells, you could reach the moon 6000 times!
- Over 99% of our DNA sequence is the same as other humans'.

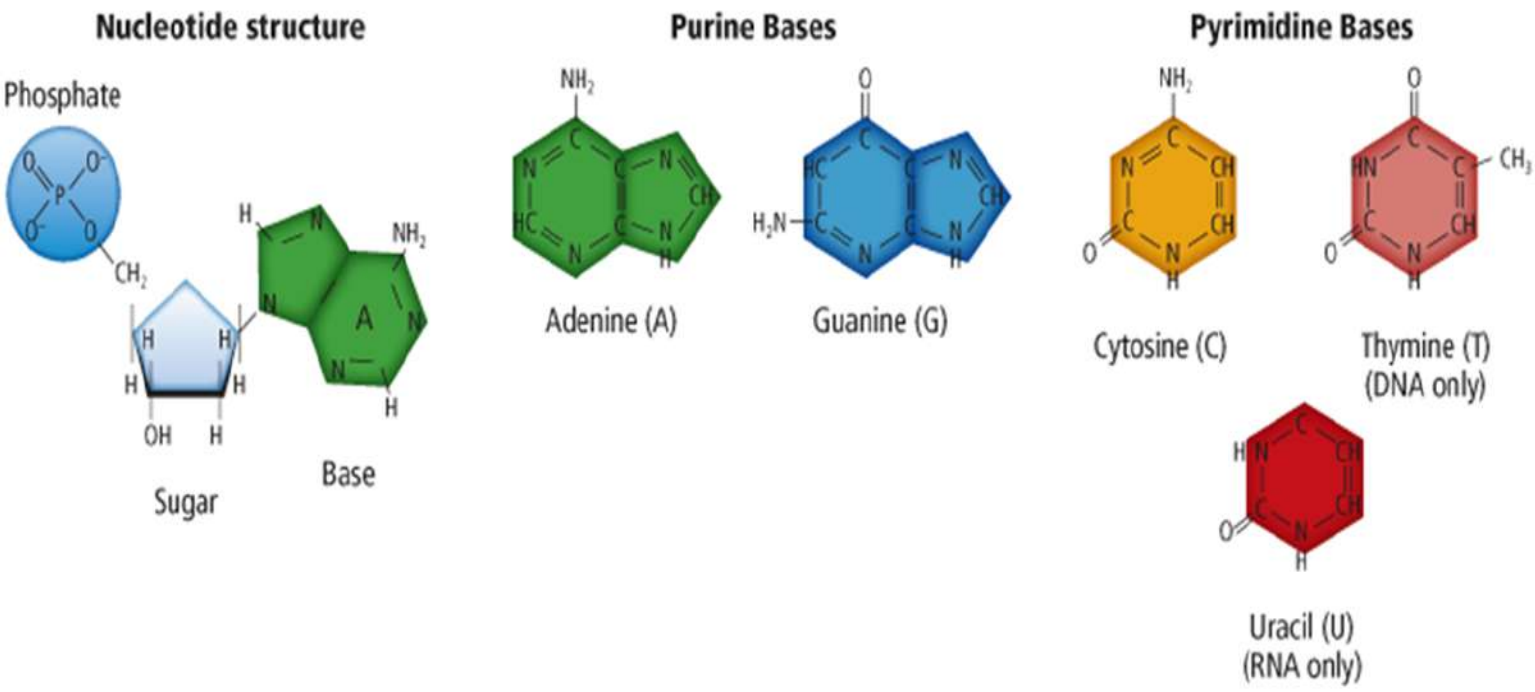


- If all three billion letters in the human genome were stacked one millimeter apart, they would reach a height 7,000 times the height of the Empire State Building.

# Types of Nitrogen Bases

PurinesPyrimidines

- Adenine (A)- Thymine (T)
- Guanine (G)- Cytosine (C)



# Base Pairing

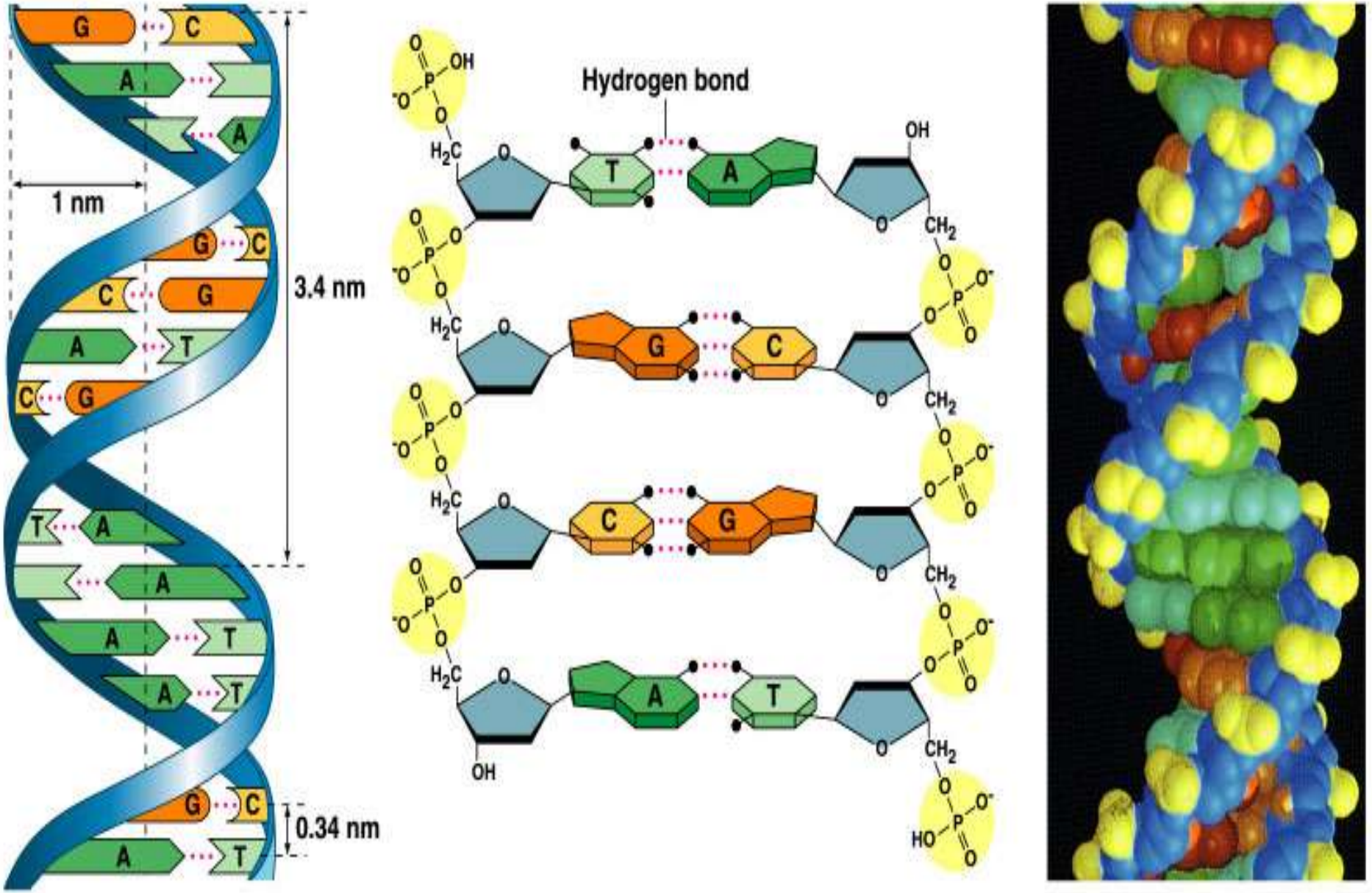
- Adenine and Thymine always bond together (A-T, T-A)
- Guanine and Cytosine always bond together (G-C, C-G)

- Practice

A-T-C-T-T-C-G-C-T-A-A-A

# More Practice

- A A C G A T C
- A T C G C G A
- T G G C A G T
- C G A T A C A
- GTCGATC




(a) Key features of DNA structure

(b) Partial chemical structure

(c) Space-filling model

# RNA

# What is RNA?

- Ribonucleic Acid
- Single strand
- Job – Read the DNA
- RNA carries out the work of DNA
  - DNA is the blueprint
  - RNA is the Contractor/Builders

# Structure of RNA

- 3 parts
  - Ribose – 5 carbon sugar
  - Phosphate
  - Nitrogen Bases (nucleotides)
    - Same as in DNA except for Thymine
    - Adenine (A)
    - Cytosine (C)
    - Guanine (G)
    - Uracil (U) – this bonds with Adenine

# RNA Practice

(DNA Strand) A-T-A-C-G-C-T-T-T-A-A-A

(RNA Strand)

# 3 Types of RNA

- mRNA – messenger RNA
- rRNA – ribosomal RNA
- tRNA – transfer RNA

# mRNA

- mRNA goes into the nucleus and gets the message from DNA
  - Does this through the process called Transcription
- Every 3 nucleotides = codon

# rRNA

- Ribosomal RNA is found in the ribosomes
- rRNA reads (translates) the mRNA so the DNA command can be carried out
- rRNA also helps to assemble all parts received from tRNA

# tRNA

- Transfer RNA
- Gets the message from rRNA and obtains the necessary parts
- Transports them to the ribosome
- The 3 nucleotides on the bottom of the tRNA = anticodon
  - These match the codon

## Comparison of Three Types of RNA

| Name | mRNA | rRNA | tRNA |
|---|---|---|---|
| Function | Carries genetic information from DNA in the nucleus to direct protein synthesis in the cytoplasm | Associates with protein to form the ribosome | Transports amino acids to the ribosome |
| Example |  |  |  |

## Table 12.2 Comparison of Three Types of RNA

| Name | mRNA | rRNA | tRNA |
|---|---|---|---|
| Function | | | |
| Example |  |  |  |

Associates with protein to form the ribosome

Transports amino acids to the ribosome

Carries genetic information from DNA in the nucleus to direct protein synthesis in the cytoplasm

*Drag each option to its corresponding type of RNA*

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