

# Molecular Inheritance

DNA Structure and Replication

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## Key Studies

- Evidence that DNA transformed bacteria
  - Fredrick Griffith
    - Pneumonia in Rats

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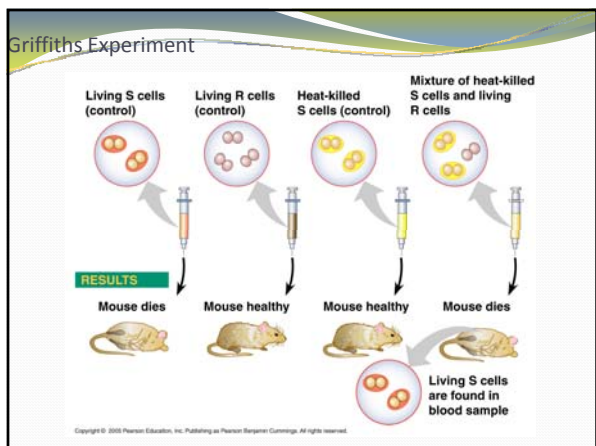
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## Transformation

- Griffith couldn't prove that it was DNA.
- 1944 Avery, McCarty, and Macleod discovered it to be DNA.
  - Did clarifying tests on Griffiths Experiment that further supported DNA as the material of inheritance.
    - cell extract + RNAase (RNA digesting enzyme) + mouse → mouse dies
    - cell extract + DNAase (DNA digesting enzyme) + mouse → mouse lives
    - cell extract + protease (protein digesting enzyme) + mouse → mouse dies
    - cell extract + lipase (lipid digesting enzyme) + mouse → mouse dies

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## Viral DNA

- Alfred Hershey and Martha Chase
  - Used T-2 Viruses that attack bacteria to study what actually caused the viruses to be able to make new copies of themselves.

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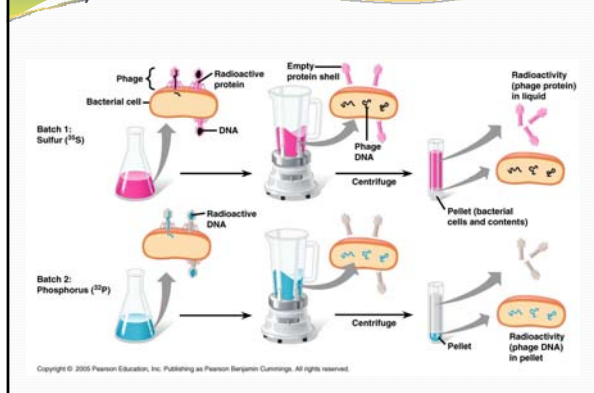
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## Hershey and Chase



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### Chargaff's Data

- Erwin Chargaff
  - in 1947 analyzed the base composition of various organisms.

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### Chargaff

Table 3-2 Data Leading to the Formulation of Chargaff's Rules

Source	Adenine to Guanine	Thymine to Cytosine	Adenine to Thymine	Guanine to Cytosine	Purines to Pyrimidines
Ox	1.29	1.43	1.04	1.00	1.1
Human	1.56	1.75	1.00	1.00	1.0
Hen	1.45	1.29	1.06	0.91	0.99
Salmon	1.43	1.43	1.02	1.02	1.02
Wheat	1.22	1.18	1.00	0.97	0.99
Yeast	1.67	1.92	1.03	1.20	1.0
<i>Hemophilus influenzae</i>	1.74	1.54	1.07	0.91	1.0
<i>E. coli</i> K2	1.05	0.95	1.09	0.99	1.0
Avian tubercle bacillus	0.4	0.4	1.09	1.08	1.1
<i>Serratia marcescens</i>	0.7	0.7	0.95	0.86	0.9
<i>Bacillus schatz</i>	0.7	0.6	1.12	0.89	1.0

source: After E. Chargaff et al., *J. Biol. Chem.* 177 (1949).

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### Franklin's Data

- Three groups in the 1950's were working on DNA.
  - Linus Pauling (Cal Tech)
  - Maurice Wilkins and Rosalind Franklin (Kings College London)
  - James Watson and Francis Crick (Cambridge)

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### Franklin's Data

- Franklin took an Xray photo of a crystal of DNA.
- Watson and Crick used the data to deduce the structure of DNA.

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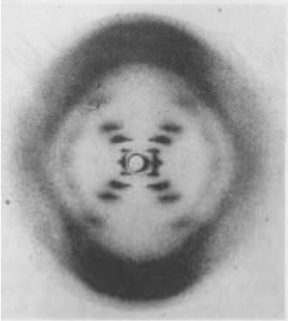
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### Franklin's Xray



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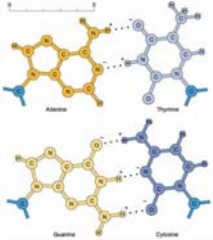
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### Watson and Crick

- Double Helix
- Base Pairing Rule
  - Pyrimidine with Purine
    - Pyrimidines
      - Cytosine
      - Thymine
    - Purines
      - Adenine
      - Guanine



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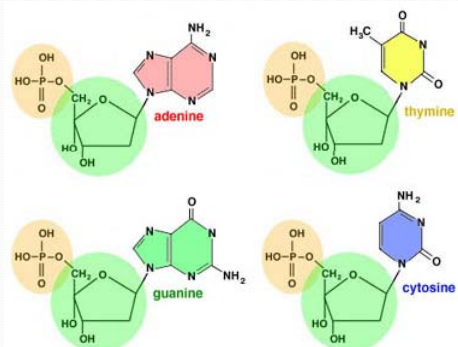
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Watson and Crick




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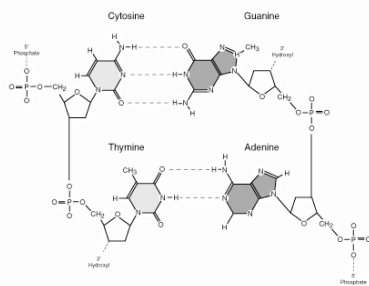
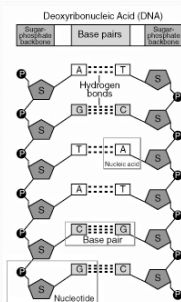
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Watson and Crick




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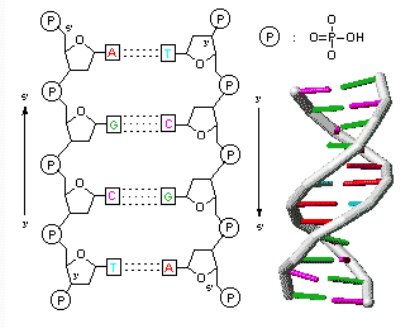
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Watson and Crick




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### DNA Replication

- Three possibilities
  - Semiconservative
  - Dispersive
  - Conservative

Semiconservative

Conservative

Random dispersive

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### Meselson and Stahl

- Experiment
  - E coli grown for many generations with  $N^{15}$ .
    - These nitrogens were incorporated into their nucleotides
  - Transfer these bacteria to  $N^{14}$  agar.
  - Extract DNA after one generation
  - Extract after two
  - Run in a  $CsCl$  gradient and centrifuge.

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### Results

Controls

Incubation of heavy cells in  $^{14}N$

First generation

Second generation

$^{15}N$

$^{14}N$

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### DNA Replication

- Copying the DNA
- Occurs in S phase of cell cycle
- Fast, Accurate, Complex

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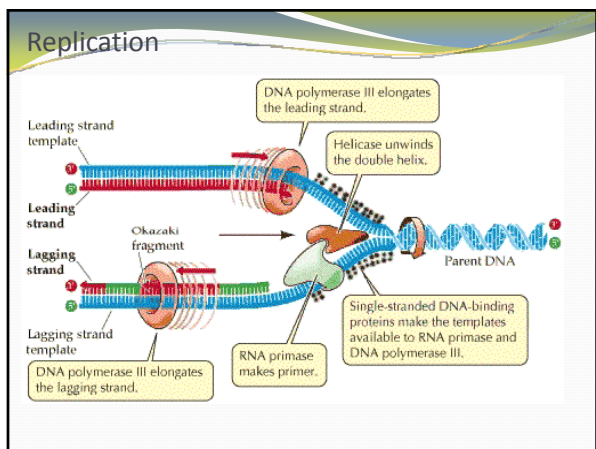
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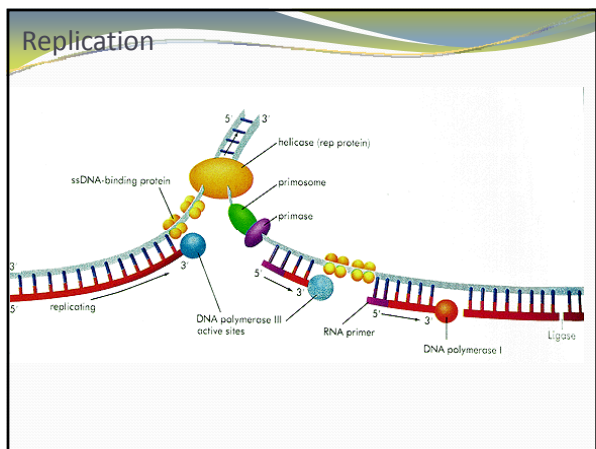
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Replication Animations

- <http://www.tracy.k12.ca.us/thasadvbio/DNAReplication.swf>
- <http://www.tracy.k12.ca.us/thasadvbio/DNA.SWF>

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Problems with Replication

- Telomere's
  - What happens at the end of the chromosomes?

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Issues With Telomere's

### Telomerase

5' TTGGGG **Telomere Template**

1. Hairpin formed; RNA Primer added

2. Hairpin extended; RNA primer removed

3. Gap filled

4. Hairpin removed

**Replicated Telomere**

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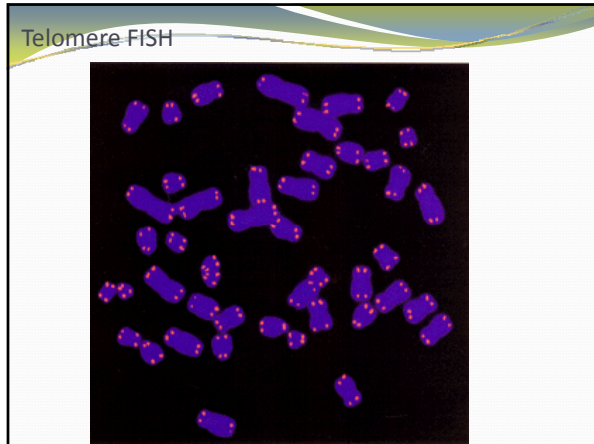
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