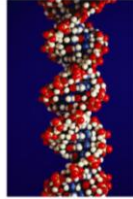


DNA The Genetic Material



Scientific History

- The march to understanding that DNA is the genetic material
 - T.H. Morgan (1908)
 - Frederick Griffith (1928)
 - Avery, McCarty & MacLeod (1944)
 - Erwin Chargaff (1947)
 - Hershey & Chase (1952)
 - Watson & Crick (1953)
 - Meselson & Stahl (1958)

1908 | 1933

Chromosomes related to phenotype

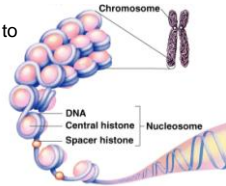
- T.H. Morgan's Experiment
 - working with *Drosophila*
 - associated phenotype with specific chromosome
 - white-eyed male had specific X chromosome



1908 | 1933

Genes are on chromosomes

- Morgan's conclusions
 - **genes are on chromosomes**
 - but is it the protein or the DNA of the chromosomes that are the genes?
 - initially proteins were thought to be genetic material... Why?



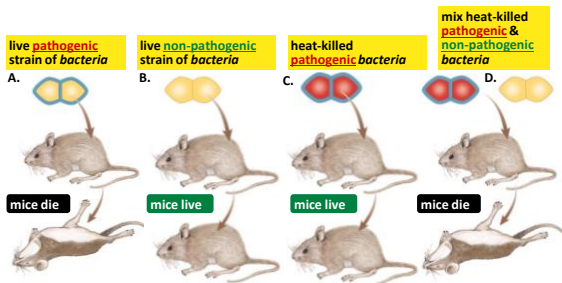
1928

The “Transforming Principle”

- Frederick Griffith's Experiment
 - *Streptococcus pneumonia* bacteria
 - was working to find cure for pneumonia
 - **harmless live bacteria (“rough”) mixed with heat-killed pathogenic bacteria (“smooth”) causes fatal disease in mice**
 - a substance passed from dead bacteria to live bacteria to change their phenotype
 - “Transforming Principle”



The “Transforming Principle”



Transformation = change in phenotype
 something in heat-killed bacteria could still transmit disease-causing properties

1928

The "Transforming Principle"

• Frederick Griffith's Conclusions

- a substance passed from dead bacteria to live bacteria to change their phenotype, which he called the "Transforming Principle"

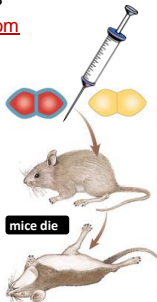


1944

DNA is the "Transforming Principle"

• Avery, McCarty & MacLeod's Experiments

- purified both DNA & proteins separately from Streptococcus pneumonia bacteria
 - which will transform non-pathogenic bacteria?
- injected protein into bacteria
 - no effect
- injected DNA into bacteria
 - transformed harmless bacteria into virulent bacteria



1944 | ???!

Avery, McCarty & MacLeod

• Conclusion

- first experimental evidence that DNA was the genetic material



Oswald Avery



Maclyn McCarty



Colin MacLeod

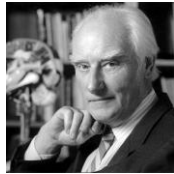
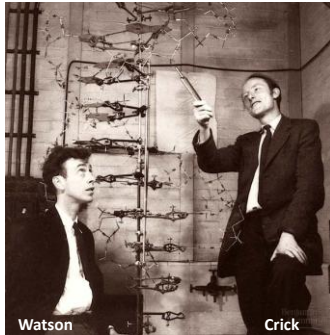
1953 | 1962

Structure of DNA

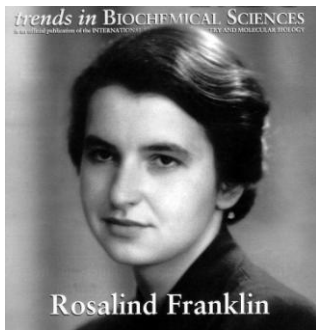
- Watson & Crick's Conclusions
 - developed double helix model of DNA
 - other leading scientists working on question:
 - Rosalind Franklin
 - Maurice Wilkins
 - Linus Pauling



Watson and Crick

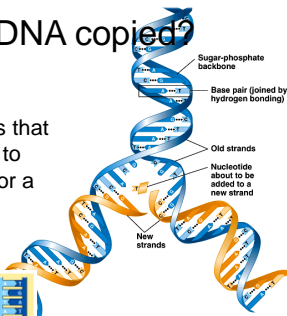


Rosalind Franklin (1920-1958)



But how is DNA copied?

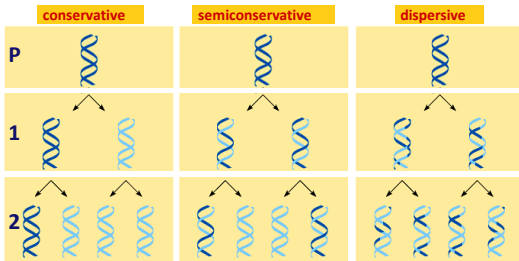
- Replication of DNA
 - base pairing suggests that it will allow each side to serve as a **template** for a new strand



"It has not escaped our notice that the specific pairing we have postulated immediately suggests a possible copying mechanism for the genetic material." — Watson & Crick

Models of DNA Replication

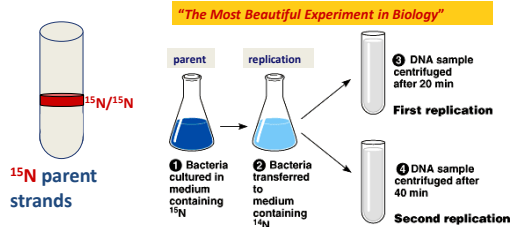
- Alternative models
 - become experimental predictions



1958

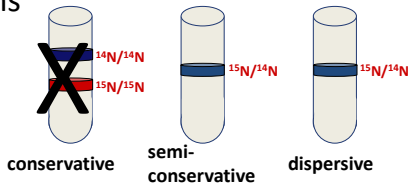
Semiconservative replication

- Meselson & Stahl's Experiment
 - label "parent" nucleotides in DNA strands with heavy nitrogen = ^{15}N
 - label new nucleotides with lighter isotope = ^{14}N

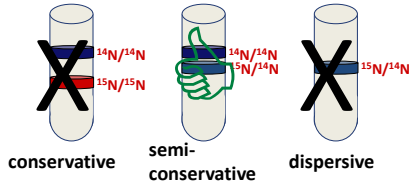
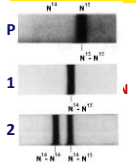


Predictions

1st round of replication



2nd round of replication



Meselson & Stahl

- Conclusions
 - DNA replication is semi-conservative



Scientific History

- March to understanding that DNA is the genetic material
 - T.H. Morgan (1908)
 - genes are on chromosomes
 - Frederick Griffith (1928)
 - a transforming factor can change phenotype
 - Avery, McCarty & MacLeod (1944)
 - transforming factor is DNA
 - Erwin Chargaff (1947)
 - Chargaff rules: A = T, C = G
 - Hershey & Chase (1952)
 - confirmation that DNA is genetic material
 - Watson & Crick (1953)
 - determined double helix structure of DNA
 - Meselson & Stahl (1958)
 - semi-conservative replication
