DNA

What is the major component of all cells?

Why would protein synthesis be important?

- cellular structures
- enzymes
- cell membrane structures
- organelles
- direct all other cellular activities

What substance directs protein synthesis?
DNA

What molecule responsible for all cell activities and contains the genetic code?
DNA

Genetic Code
method cells use to store the program that is passed from one generation to another

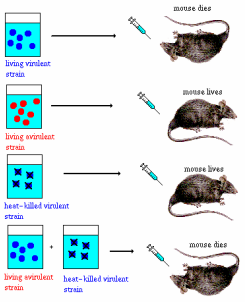
DISCOVERY OF THE GENETIC CODE

1928: Frederick Griffith
Experiment 1

1. Grew 2 strains of bacteria on plates
   - smooth colonies- caused disease (**virulent**)
   - rough edge colonies-did not cause disease (**avirulent**)
2. Injected into mice

Results:
- smooth colonies: died
- rought colonies: lived

Conclusion:
bacteria didn't produce a toxin to kill mice

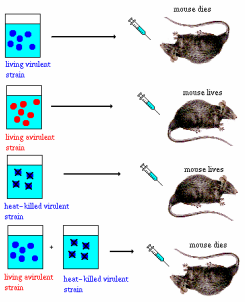


Griffith Experiment 2

1. Injected mice with heat killed virulent strain
2. Injected mice with non -virulent strain + heat killed virulent strain

Results:
- heat killed: lived
- mixed strains: mice developed pneumonia

Conclusion:
heat killed virulent strain passed disease causing abilities to non virulent strain



After Experiment

Cultured bacteria from dead mice and they grew virulent strain.

Griffith hypothesized that a factor was transferred from heat killed cells to live cells .

TRANSFORMATION

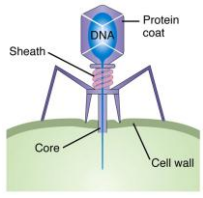
1944: Avery (et al)

1. Repeated Griffith's experiment with same results.
   - result: transformation occurred
2. Did a second experiment using enzymes that would destroy RNA.
   - result: transformation occurred
3. Did third experiment using enzymes that would destroy DNA.
   - result: no transformation

CONCLUSION
DNA was transforming factor

1952: Hershey / Chase
- studied how viruses (bacteriophage) affect bacteria.

Bacteriophage
Virus composed of DNA core and protein coat



animation

How Bacteriophages Work

1. bacteriophage attaches to surface of bacteria and injects DNA
2. bacteria makes phage DNA
3. bacterial cell bursts
4. sends out new phages

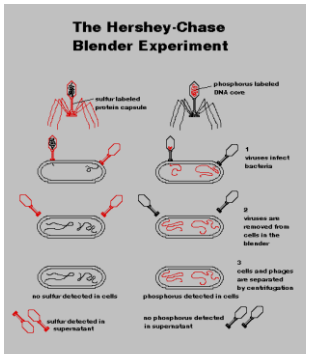
Hershey Chase Experiment

1. They labeled virus protein coat with radioactive sulfur
2. They labeled virus DNA with radioactive phosphorous

Result
observed that bacteria had phosphorous

*** virus injected bacterial cells with its phosphorous labeled DNA***

Conclusion
DNA carried genetic code since bacteria made new DNA.

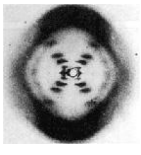


DISCOVERY OF STRUCTURE OF DNA


Francis Crick James Watson Maurice Wilkins Rosalind Franklin

Early 1950's: Rosalind Franklin (English)

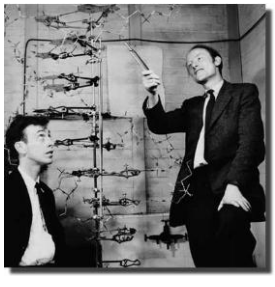
x ray evidence:
X pattern showed that fibers of DNA twisted and molecules are spaced at regular intevals on length fiber.



Maurice Wilkins: x ray diffraction, worked with Franklin

1950's Watson (American) & Crick (English)

double helix model
won Nobel prize in 1962



DNA

- double strand of nucleotides
- may have 1000's of nucleotides in 1 strand (very long molecule)
- bases join up in specific (complementary) pairs:
  - complementary pairs (base pairing rules)

1 **purine** bonds with 1 **pyrimidine** on one rung of the ladder connected by a weak H bond

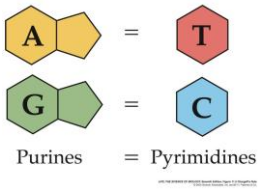
C - G
A – T

Order of nucleotides not important, proper complementary bases must be paired.

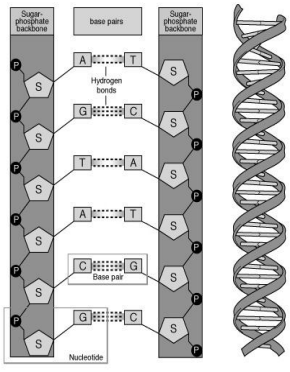
Same time period:

Chargaff (American biochemist)

Chargaff's Rule:



STRUCTURE OF DNA



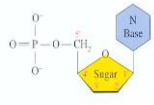
Composed of:

A. Phosphate
B. Deoxyribose sugar (5 C)
C. 4 Nitrogenous bases

- Purines
  - Adenine A
  - Guanine G
- Pyrimidines
  - Thymine T
  - Cytosine C

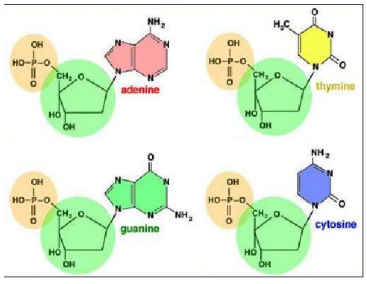
D. bases attached to sugar
E. bases attached to each other by weak H bond

Nucleotide Structure



Sugar
Base
Phosphate

Purines Pyrimidines



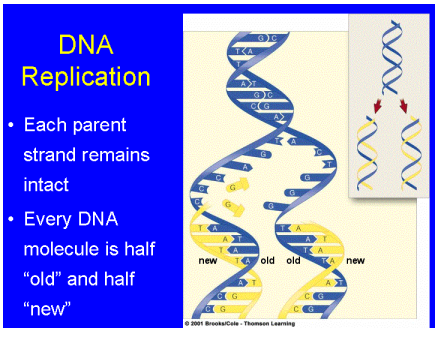
REPLICATION OF DNA

Process of duplication of DNA

- Before cell can divide a new copy of DNA must be made for the new cell
- **Semiconservative replication**: each strand acts as a template (pattern) for new strand to be made

End Result:
one old strand, one new daughter strand

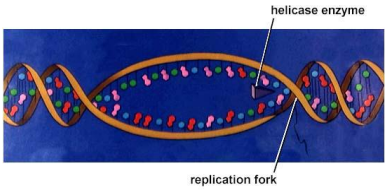
DNA REPLICATION
Semiconservative Replication



Steps of Replication

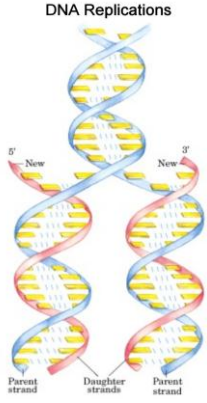
1. DNA molecule unwinds 2 strands at various points on the strand (breaks H bonds so strand unwinds)

   - **replication forks**: two areas on either end of the DNA where double helix separates



2. Enzyme moves along each of DNA strand and adds complementary bases of nucleotides floating freely in nucleus

Each time DNA replicates the newly formed strands are shorter .



Solution to End Replication Problem

telomeres: regions of repeated non coding sequences at end of chromosomes (protective sacrificial ends)

- become shorter with repeated cell divisions
- once telomeres are gone, coding sections of chrom. are lost and cell does not have enough DNA to function

Like the hard ends on your shoelaces, telomeres are the protective bits of DNA at the ends of your chromosomes.

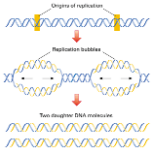
telomere theory of aging

- **telomerase**: special enzyme that contains an RNA template molecule so that telomeres can be added back on to DNA (rebuilds telomeres)

** found in:
Cancer cells - immortal in culture
Stem cells
** not found in most differentiated cells

Speed of Replication

- Multiple replication forks- replication occurs simultaneously on many points of the DNA molecule
- Would take 16 days to replicate 1 strand from one end to the other on a fruit fly DNA without multiple forks
- Actually takes ~ 3 minutes / 6000 sites replicate at one time
- Human chromosome replicated in about 8 hours with multiple replication forks working together



Accuracy and Repair

- Cell has proofreading functions
- DNA polymerase can remove damaged nucleotides and replace with new ones for accurate replication
- RNA does not have this ability- reason RNA viruses mutate so much
- DNA damaged by heat, radiation, chemicals and other factors

Importance of DNA

1. Controls formation of all substances in the cell by the genetic code
2. Directs the synthesis of specific strands of m RNA to make proteins

RNA (Ribonucleic acid)

Another nucleic acid takes orders from DNA
Used in protein synthesis