DNA Replication

Learning Outcome B5

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- Describe DNA replication

Student Achievement Indicators

Students who have fully met the prescribed learning outcome are able to:

- Describe the three steps in the semi–conservative replication of DNA:
  - ✓"unzipping" (DNA helicase)
  - ✓complementary base pairing (DNA polymerase)
  - ✓joining of adjacent nucleotides (DNA polymerase)
- Describe the purpose of DNA replication
- Identify the site of DNA replication within the cell

Review of DNA & RNA

- Chromosomes are made up of DNA and proteins.
- Early scientists did not know if DNA or proteins were responsible for providing genetic material
- Experiments were done using the T2 virus (Type 2 virus).
- This type of virus is known as a bacteriophage because it is a virus that has the ability to infect bacteria.

Review of DNA & RNA

- Viruses are composed of an inner nucleic acid core and outer protein coat known as a capsid.
- Viruses enter bacteria and reproduce.
- Researchers thought if they could determine which part of the virus enters the bacterium and reproduces more viruses, they could determine whether genes were made up of DNA or protein.

Experiment #1

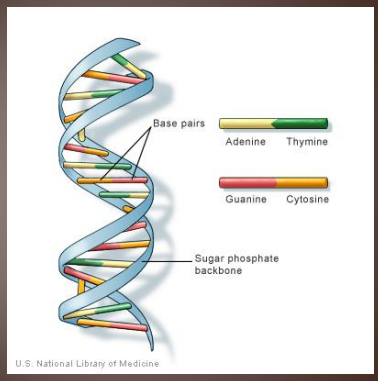
- The bacteriophage's DNA was labeled with radioactive phosphorus
- These phages were allowed to attach to and inject their genetic material into *E.Coli*.
- The culture was then agitated in a kitchen blender to remove whatever remained of the bacteriophages on the outside of e bacterial cells.
- The culture was then centrifuged, so that the bacterial cells collected at the bottom of the centrifuge tube.
- Most labeled DNA was found in the cells and not in the liquid medium.

Experiment #2

- The bacteriophage's capsids (proteins) were labelled using radioactive sulphur.
- The phages were allowed to attach to and inject their genetic material into *E.Coli*.
- The culture was then agitated in the kitchen blender to remove whatever remained for the bacteriophage on the outside of the bacterial cells.
- The culture was then centrifuged, so that he bacterial cells collected at the bottom of the centrifuge tube.
- The labeled proteins were found in the liquid medium and not in the cells.
- This means that the DNA of a virus not he protein enters the host where viral reproduction occurs.
- Therefore DNA not protein contains the genetic material

DNA Structure

- James Watson & Francis Crick - determined the structure of DNA
- Built a model that would explain how DNA can vary from species to species land from individual to individual.
- Discovered DNA replication – DNA's ability to make copies of itself
- Daughter cells and/or offspring receive a copy
- DNA is a polymer (more than one) of nucleotides
- There are four nitrogen bases
  - ✓ adenine
  - ✓ guanine
  - ✓ cytosine
  - ✓ thymine

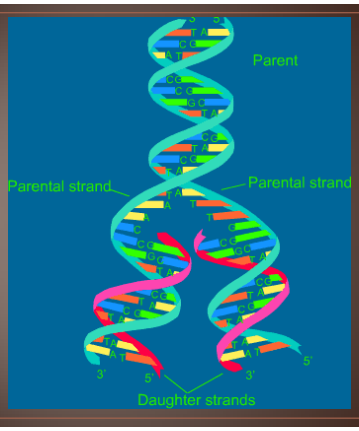


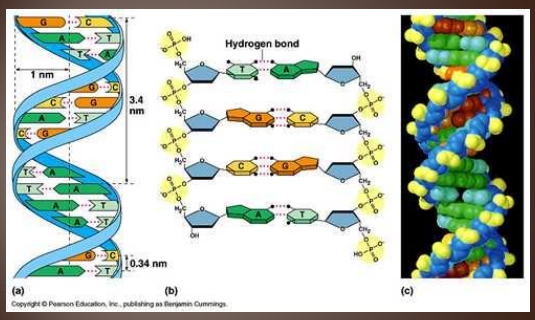
DNA Structure

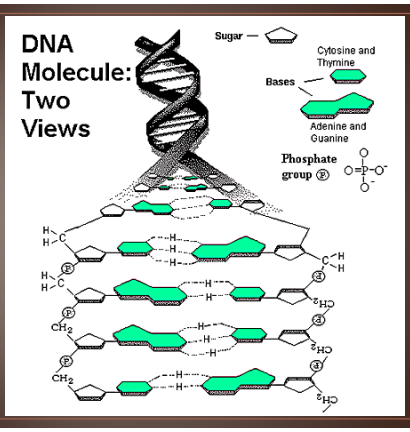
- The backbone of nucleic made up of a sugar-phosphate backbone.
- DNA has a 5 carbon sugar containing oxygen – deoxyribose sugar
- RNA has a 5 carbon sugar that does NOT contain oxygen – ribose sugar
- Regardless of species, the number of purines (A & G) equals the number of pyrimidine's
- (C & T)
- Nitrogen bases pair via complementary base pairing: A = T and G = C
- X-Ray diffraction photographs of DNA showed that DNA is a double helix with a constant diameter and regularly stacked bases.

DNA Replication

- An exact copy of DNA is made with the aide of the enzyme DNA polymerase.
- Double stranded DNA is ideal for replication because each strange can be used as a template for the formation of a new complementary strand.
- Each old (parent) strand acts as a template for a new (daughter) strand.







Steps in DNA Replication

1. DNA polymerase "unzips" the twisted double helix and splits the hydrogen bonds between the complementary nitrogen bases.
2. Now we have two identical single strands
3. New complementary nucleotides mover into place from via complementary base pairing
4. Nucleotides are always present in the nucleus and cytoplasm
5. When replication is complete; there are two identical double helix molecules

Cancer & DNA Replication

- Cancer is characterized by rapidly dividing cells
- Chemotherapy stops DNA replication and therefore cell division
- Some chemotherapeutic drugs are analogs that have similar but not identical structure to the four DNA nitrogen bases.
- When these analogs are mistakenly used by cancer cells to synthesize DNA, replication stops and cells dies off