GREAT DNA EXPERIMENTS IN HISTORY

1928: Griffith’s experiment
2 types of bacteria

1 killed mice
1 did not kill mice
Griffith used heat to kill the disease-causing bacteria & they did not make mice sick.

Griffith mixed the heat-killed bacteria with bacteria that did not kill the mice & the mice died

Transformation occurred because 1 bacteria changed into the other

Conclusion: A gene from the heat-killed bacteria was transferred to the harmless bacteria.

1944 Avery’s Experiment
Scientists skeptical of Griffith’s findings
Avery destroyed DNA in the bacteria & no genetic information was passed on

Avery destroyed everything in the bacteria except the DNA & the genetic info was passed on
Conclusion: DNA stores & transmits genetic info.

What is the gene made of, nucleic acid or protein?

1952 Hershey & Chase
Made protein in a cell glow to see if the cell passed on protein to its offspring.
It did not.
Hershey & Chase made nucleic acid glow to see if the cell passed on nucleic acid to its offspring.

Conclusion: genetic material is nucleic acid, not protein

Chargaff’s Rule
Chargaff discovered that there are always equal percents of A’s & T’s and equal percents of G’s and C’s in DNA
DNA = deoxyribonucleic acid

DNA is a long double-stranded molecule
DNA is shaped like a double helix (a twisted ladder)

A Nucleotide is made of 3 molecules:
Phosphate, Sugar, Base →
- phosphate group
- 5 carbon sugar (deoxyribose) shaped like a pentagon in the picture to the right.
- nitrogenous base (A, G, C, T)

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

The Structure of DNA
backbone = chain of sugars & phosphates (the rails of the ladder)
nitrogenous bases connect the 2 backbones (the steps of the ladder)

Rosalind Franklin – 1950s Studied DNA with X-rays
Watson & Crick – 1953 figured out that DNA is in the shape of a double helix
DNA REPLICATION

DNA Replication: make an exact copy of DNA

Nitrogenous base pairs (nucleotides) are held together by **hydrogen bonds**.

DNA only replicates right before cell division
DNA has a 5’ end and a 3’ end. Complementary strands of DNA run in opposite directions.

**Steps of Replication**
1. **Helicase** (enzyme) unzips the DNA by breaking the hydrogen bonds between the nitrogenous base pairs
2. DNA **polymerase** attaches new nucleotides to the unzipped DNA
3. DNA **ligase** joins small fragments into a continuous chain
4. Now there are 2 identical copies of DNA

TRANSCRIPTION AND TRANSLATION

The whole point of DNA is to make proteins
DNA is the 'blueprint' for making proteins
A ribosome is a factory for making proteins

How does information go from the DNA inside the nucleus to the ribosome outside the nucleus? RNA! RNA copies DNA information, then goes outside the nucleus to the ribosome.

RNA = ribonucleic acid
A single strand
Sugar = ribose

**3 Types of RNA**
- **mRNA**: messenger from DNA to rest of cell
- **rRNA**: makes up ribosomes
- **tRNA**: transfers amino acids to ribosome

**Transcription**

copying part of DNA into a strand of **mRNA**
RNA polymerase separates DNA into 2 strands and adds nucleotides to form mRNA

RNA uses **U** instead of **T**
DNA nucleotides GCTA
RNA nucleotides GCUA
**Translation**

*Translation*: a ribosome building a protein based on the information in mRNA

mRNA carries instructions to join together amino acids
mRNA must go from the nucleus to a ribosome

**Steps of Translation**
1. After transcription mRNA is released from the nucleus
2. mRNA attaches to a ribosome
3. mRNA codons are read by the ribosome & the proper amino acid is brought by tRNA (transfer RNA)
4. Translation begins with a start codon (MET)
5. tRNA carries an amino acid to attach to mRNA codons (tRNA has **anticodons**. Look at the anticodons matching up to mRNA codons in the picture to the right. The CCC anticodon matches up to the GGG codon on mRNA)
6. The ribosome forms a peptide bond between the amino acids to form a chain
7. tRNA continues bringing more amino acids
8. The amino acid chain continues to grow until a stop codon is reached (A protein has been born!)

**How mRNA is read**

mRNA is read 3 letters at a time
Each group of 3 letters is called a **codon**
1 codon codes for 1 amino acid

**SUMMARY OF TRANSCRIPTION AND TRANSLATION**

We start with a DNA code: AAGTCA
It is **transcribed** into mRNA: UUCAGU
The mRNA leaves the nucleus and goes to the ribosome
The ribosome **translates** the mRNA into two amino acids: Phenylalanine and Serine
The result is a chain of amino acids: A protein. A real protein is made of hundreds of amino acids.