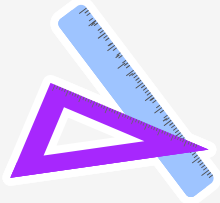
Section 2: DNA Technology

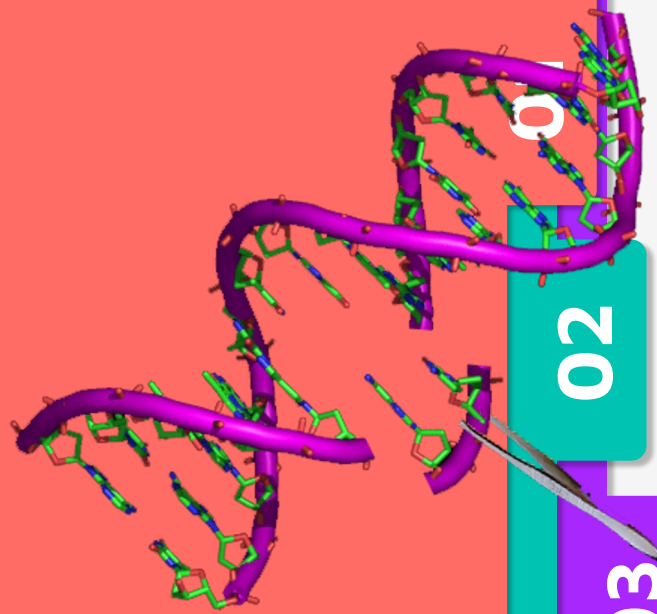
Researchers use genetic engineering to manipulate DNA.



GENETIC ENGINEERING

Genetic engineering is technology that involves manipulating the DNA of one organism in order to insert the DNA of another organism.

The inserted DNA of another organism is known as ***exogenous DNA.***



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GENETIC ENGINEERING

Genetically engineered organisms are used to:

1. Study the expression of a particular gene
2. Investigate cellular processes
3. Study the development of a certain disease
4. Select traits that might be beneficial to humans.

01

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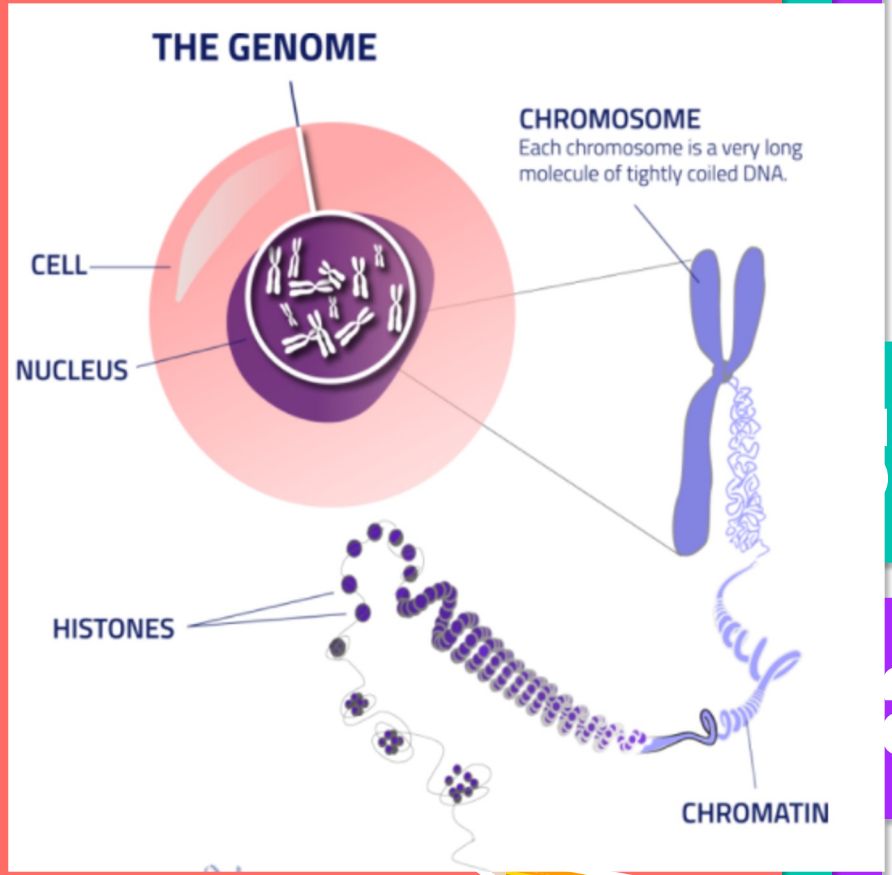
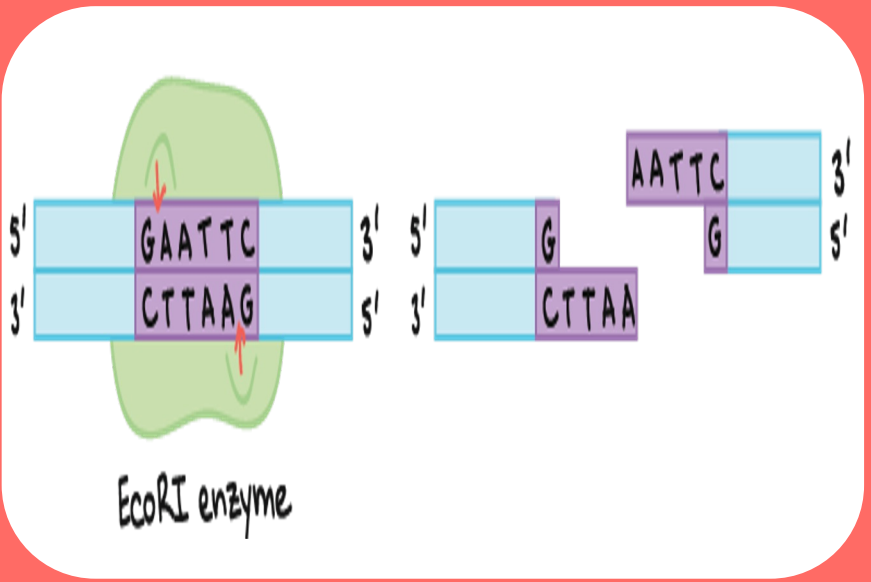
DNA TOOLS

- Genetic engineering can be used to increase/decrease the expression of specific genes in selected organisms.
- An organism's **genome** is the total DNA in the nucleus of each cell.
- DNA tools can be used to manipulate DNA and to isolate genes from the rest of the genome.



DNA TOOLS – Restriction enzymes



- **Restriction enzymes** are proteins that recognize and bind to specific DNA sequences and cleave the DNA within that sequence.
- They are used as a defense mechanism by bacteria against viruses.
- Scientists use restriction enzymes as powerful tools for isolating specific genes or regions of the genome.

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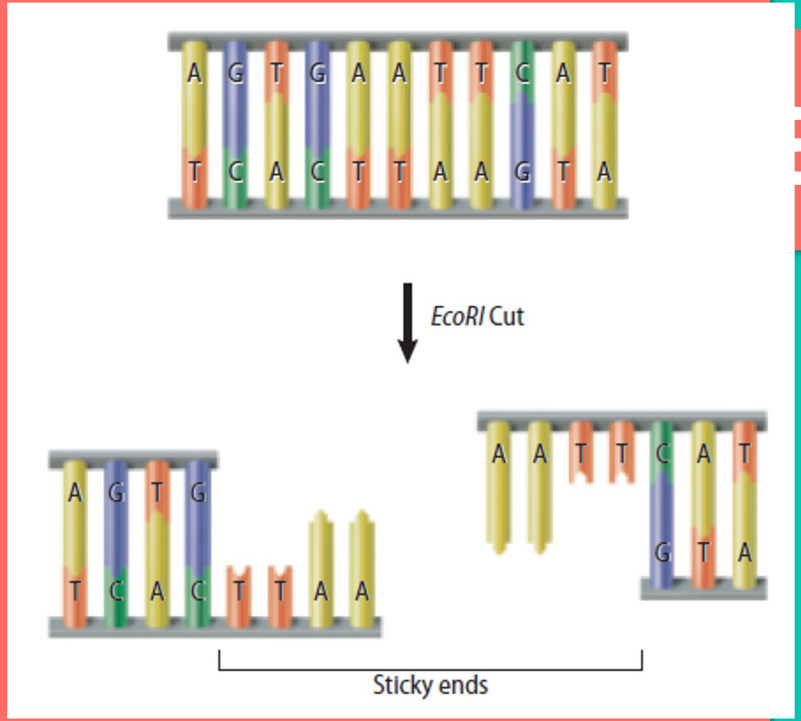
DNA TOOLS - EcoRI

EcoRI is a restriction enzyme that specifically cuts DNA containing the sequence GAATTC.

Sticky ends are single stranded DNA sequences at the end of fragments.

Can be reattached to complementary strands.



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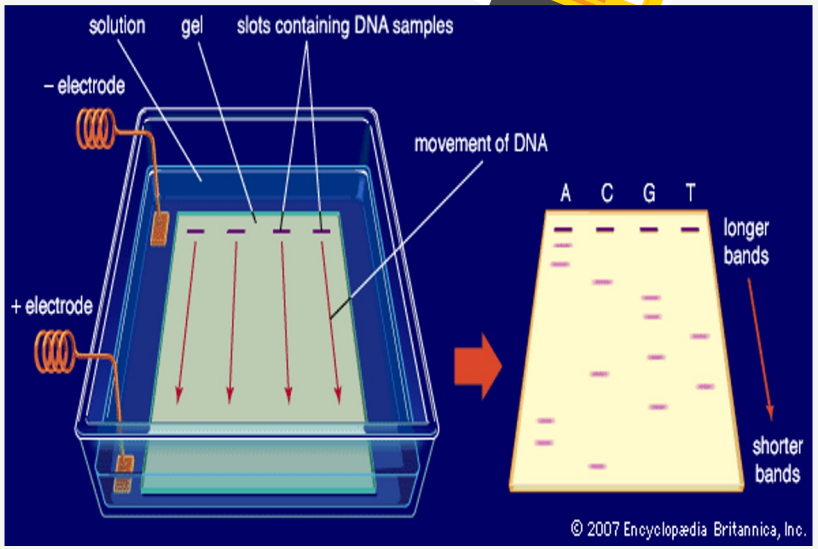
DNA Tools

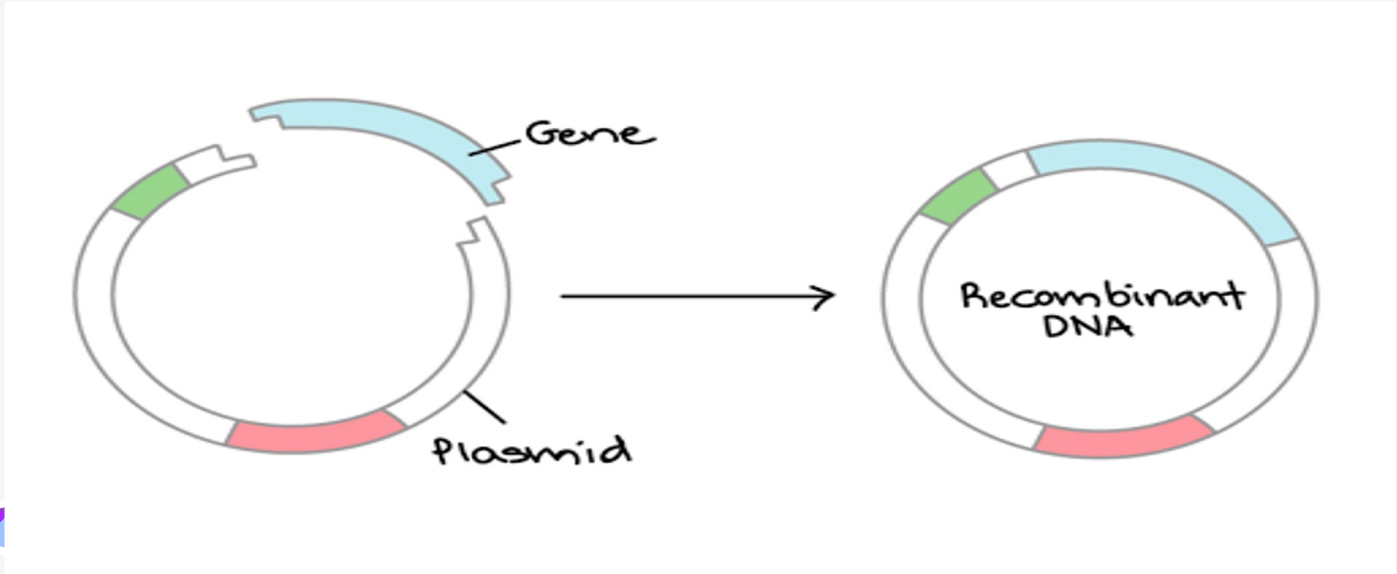
Gel electrophoresis

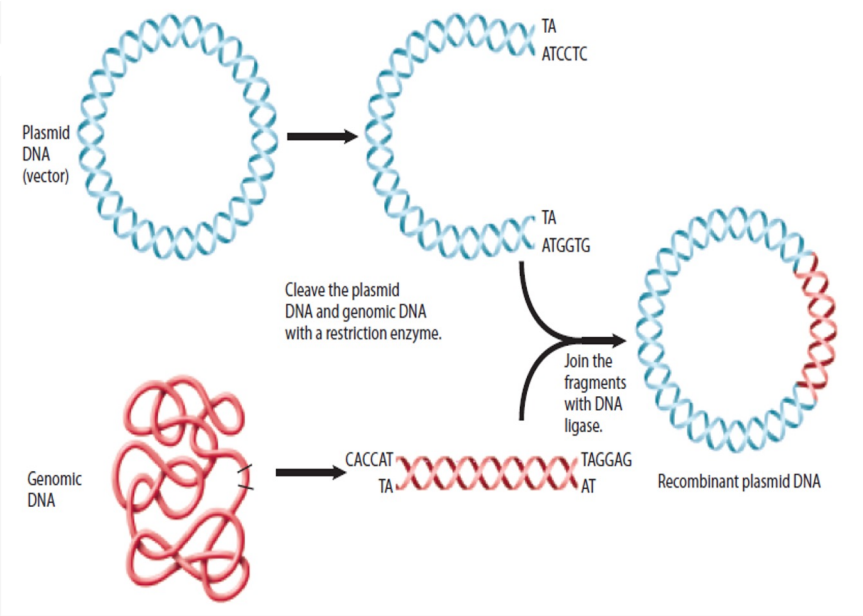
- An electric current is used to separate DNA fragments according to the size of the fragments in a process called gel electrophoresis.
- When an electric current is applied, the DNA fragments move toward the positive end of the gel.
- The smaller fragments move farther faster than the larger ones.
- The unique pattern created based on the size of the DNA fragment can be compared to known DNA fragments for identification.



Recombinant DNA Technology

- DNA fragments from different sources can be combined to make new DNA molecules.
- The newly generated DNA molecule with DNA from different sources is called **recombinant DNA.**





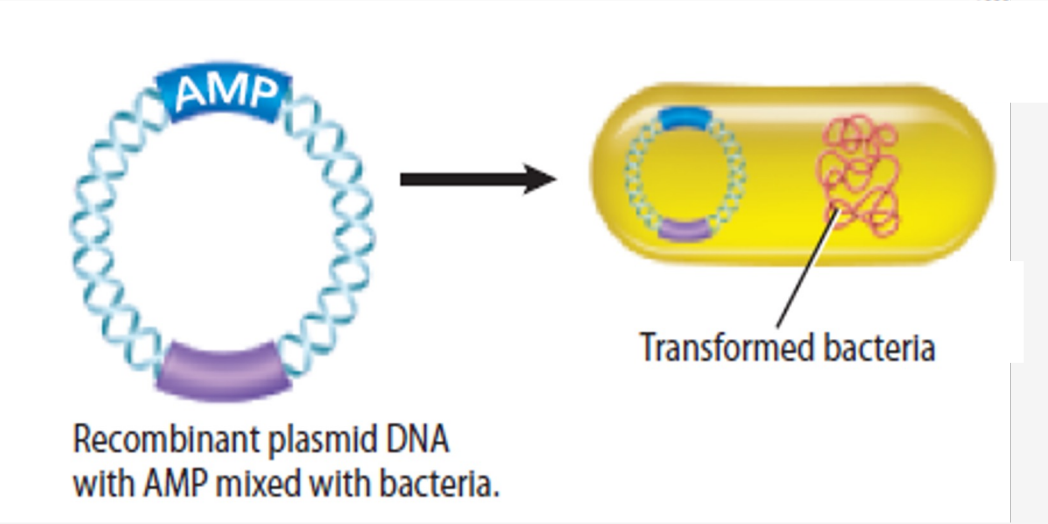
Recombinant DNA Technology

- Recombinant DNA is placed into bacterial cells for study via a carrier.
- Common carriers include viruses and plasmids – small, circular, double-stranded DNA molecules that occur naturally in bacteria and yeasts.
- DNA ligase, a cellular repair enzyme, attaches the recombinant DNA to the plasmid.

Recombinant DNA Technology

Gene cloning

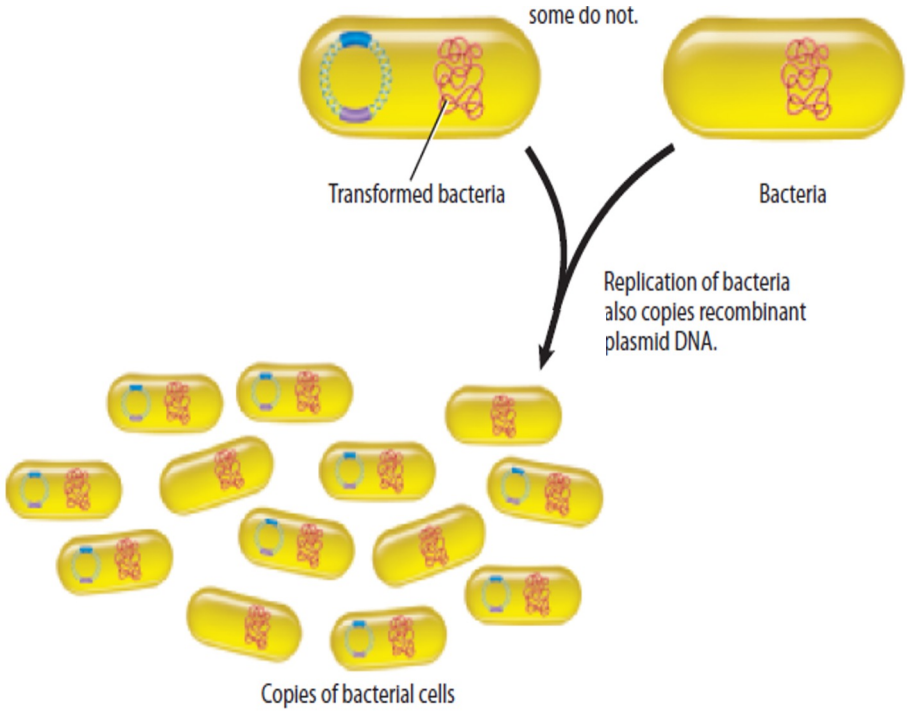
- To make a large quantity of recombinant plasmid DNA, bacterial cells are mixed with recombinant plasmid DNA.
- Some of the bacterial cells take up the recombinant plasmid DNA through a process called transformation.



Recombinant DNA Technology

Gene Cloning

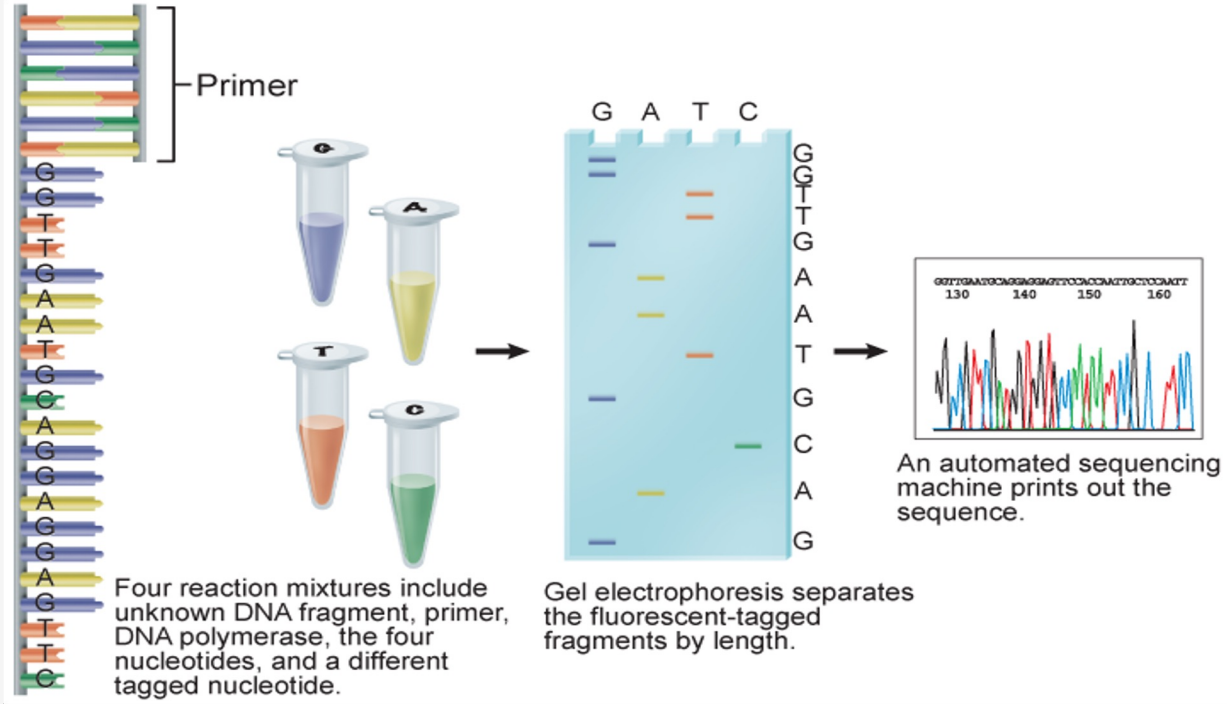
- Bacteria that take up the plasmid make copies of the recombinant DNA during cell replication.
- Large numbers of identical bacteria containing recombinant DNA can be produced through this process called cloning.



Recombinant DNA Technology

DNA sequencing

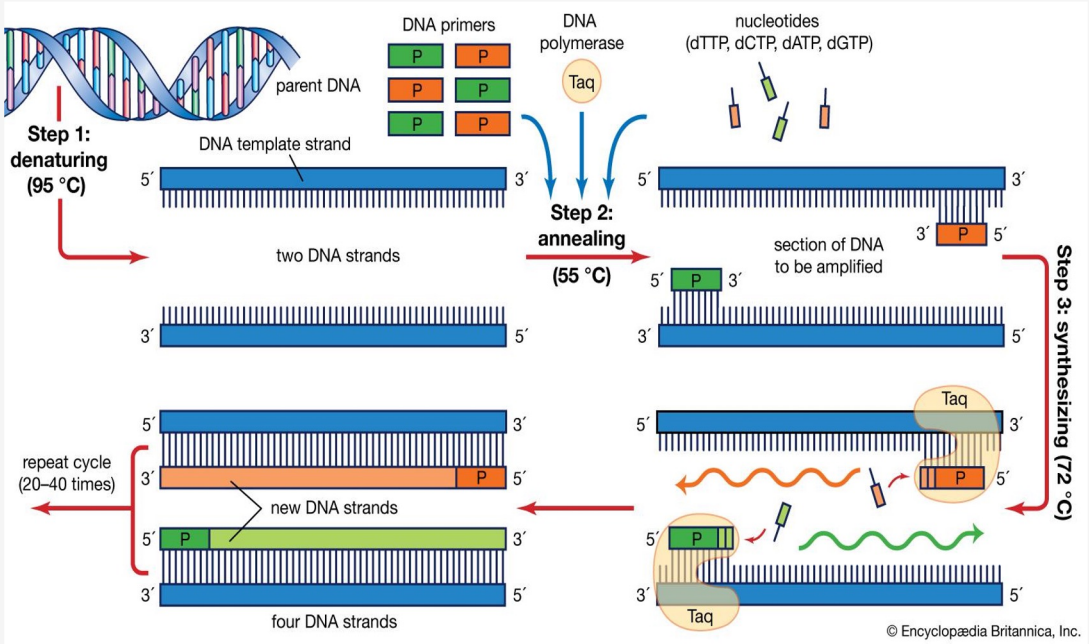
- Scientists study DNA sequences with DNA fragments, DNA polymerase, fluorescently labeled nucleotides, and gel electrophoresis.



Recombinant DNA Technology

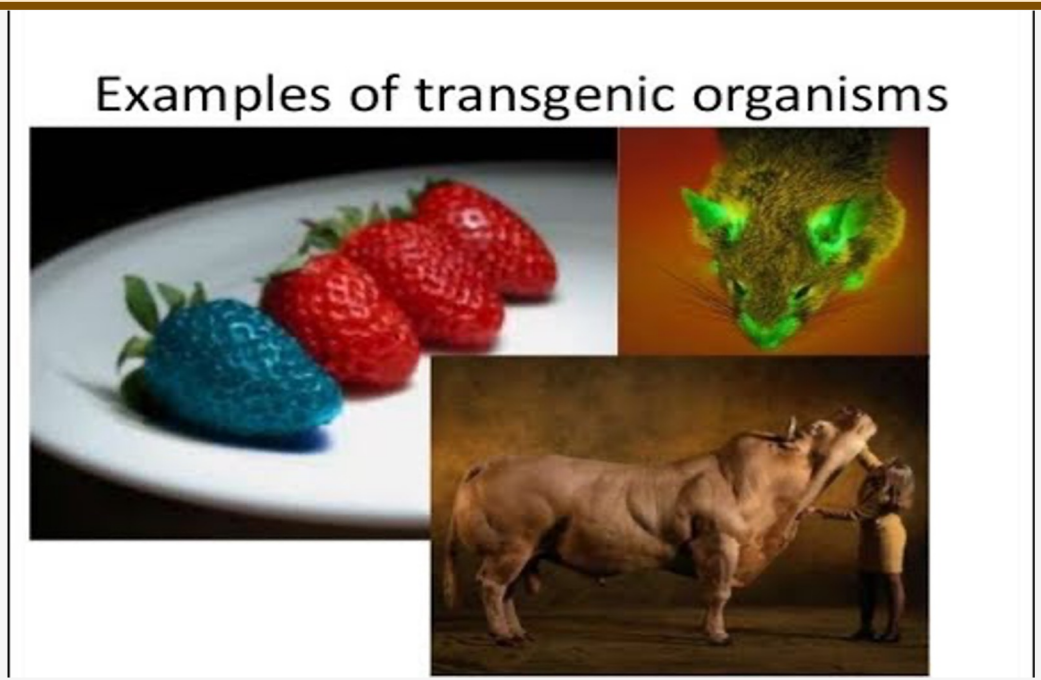
Polymerase chain reaction

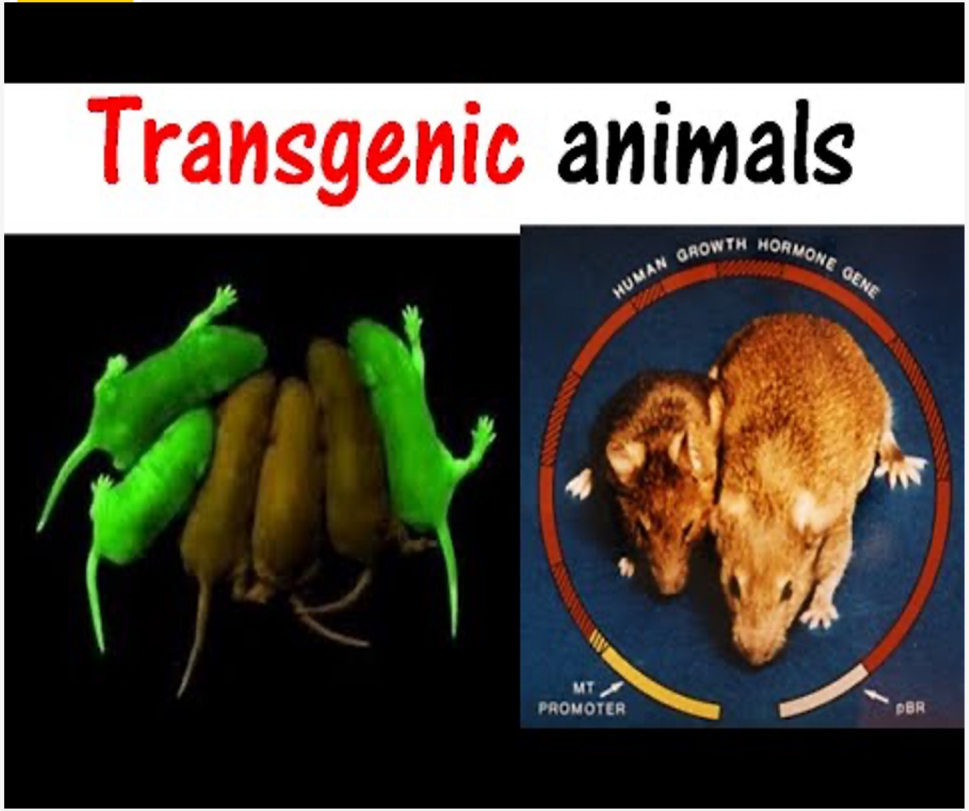
- Once the sequence of a DNA fragment is known, a technique called the polymerase chain reaction (PCR) can be used to make millions of copies of a specific region of a DNA fragment.
- PCR can copy or amplify a single DNA molecule numerous times for use in analysis.



Biotechnology

- Biotechnology is the use of genetic engineering to find solutions to problems.
- Organisms with genes from other organisms are called transgenic organisms.
- Transgenic animals, plants, and bacteria are used for research, medicine, and agriculture.





Biotechnology

Transgenic animals

- Scientists produce most transgenic animals in laboratories for biological research.
- They are used to:
  - Study diseases
  - Improve food supply
  - Improve human health
  - Be potential sources of organs for transplant

Biotechnology

Transgenic plants

- Frequently genetically engineered for resistance against insect or viral pests.
- Other transgenic plants are designed to:
  - Reduce allergic reactions in humans
  - Contain increased vitamin and mineral content
  - Resist extreme weather
  - Produce vaccines or biodegradable plastics

Biotechnology

Transgenic bacteria

- Transgenic bacteria can:
  - Produce insulin and growth hormones
  - Slow the formation of ice on crops
  - Clean up oil spills
  - Decompose garbage

- For example: insulin and clotting factors in blood are now made by bacteria.

THANKS!