Genetic Engineering

13-2 Manipulating DNA

- For thousands of years, humans have used **selective breeding** to allow plants and animals with desired characteristics to produce the next generation.
- e.g. dog breeds, disease resistant potato crops

How do molecular biologists make changes to DNA?

The Tools of Molecular Biology

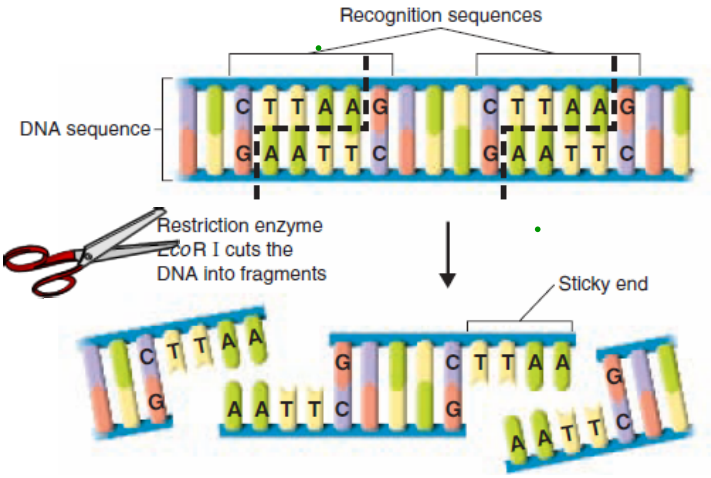
- **Genetic Engineering**: the process of making changes in the DNA code of living organisms.

DNA Extraction

- The cells are opened up, and DNA is separated from other cell components using enzymes and filtration.

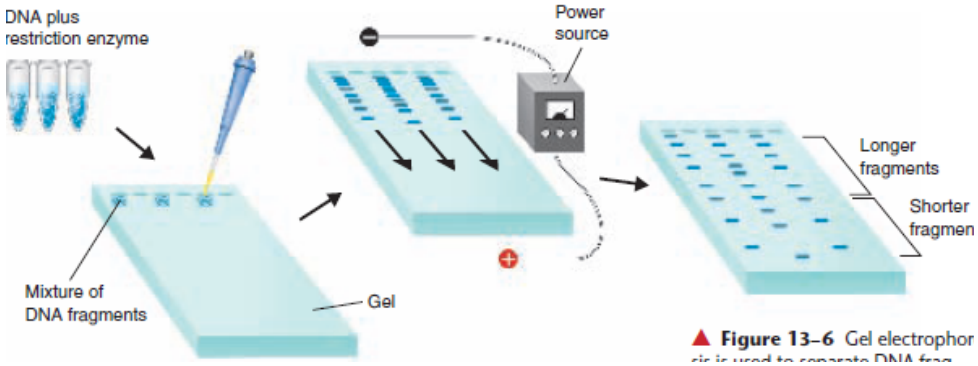
Cutting DNA

- DNA molecules from most organisms are very large, so we must cut them using restriction enzymes.
- **Restriction enzymes** are chemicals that cut DNA at specific sequences, just like tiny scissors

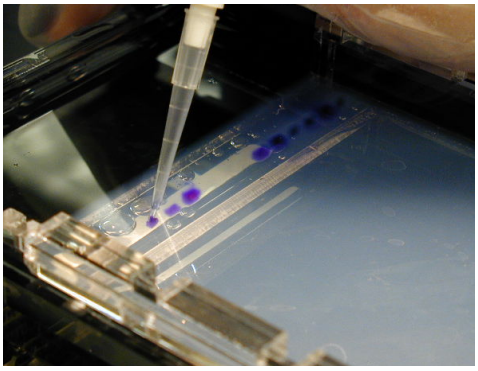


Separating DNA

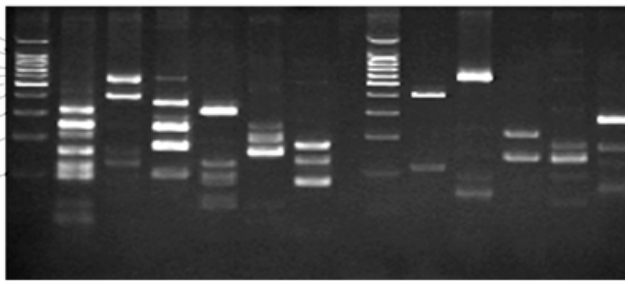
- In **gel electrophoresis**, a mixture of DNA fragments is placed at one end of a porous gel, and an electric current is passed through.
- Because DNA is negatively charged, it moves toward the positive end.
- Small DNA fragments move farther and faster.
- Result - "bands" are separated and can be compared to sequences of other individuals.



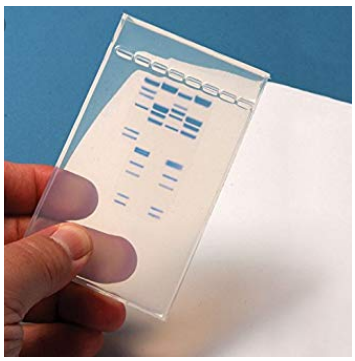
▲ **Figure 13–6** Gel electrophor



Loading the gel

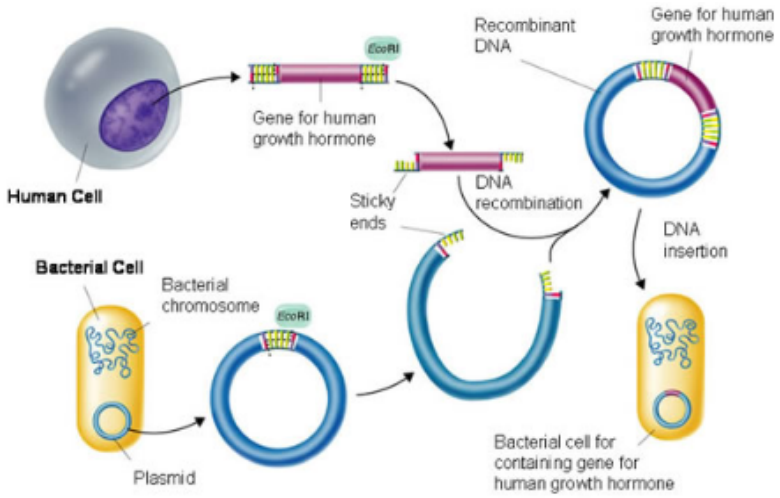


- A dye is usually added to make the bands more visible.
- Some dyes will fluoresce under UV light, allowing photos to be taken.



Cutting and Pasting

- Short sequences of DNA can be assembled in the lab using enzymes and machines.
- Synthetic DNA can be joined to natural sequences using enzymes resulting in **recombinant DNA**.



Making Copies

https://www.youtube.com/watch?v=VD5qEVTsjTc

- The **polymerase chain reaction** (PCR) technique allows biologists to make many copies of a DNA sequence or gene.

1) DNA is heated to separate the two strands.
2) DNA is cooled to allow binding of **primers** (short sequences of complementary DNA), which provide a place for DNA polymerase to start.
3) The copies of DNA then serve as templates for more copies.
4) 30 - 40 cycles can produce millions of DNA copies!

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