



**BP 605 T. Pharmaceutical Biotechnology (Theory)**

# **Basic Principles of Genetic Engineering**

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# Overview

What genetic engineering is

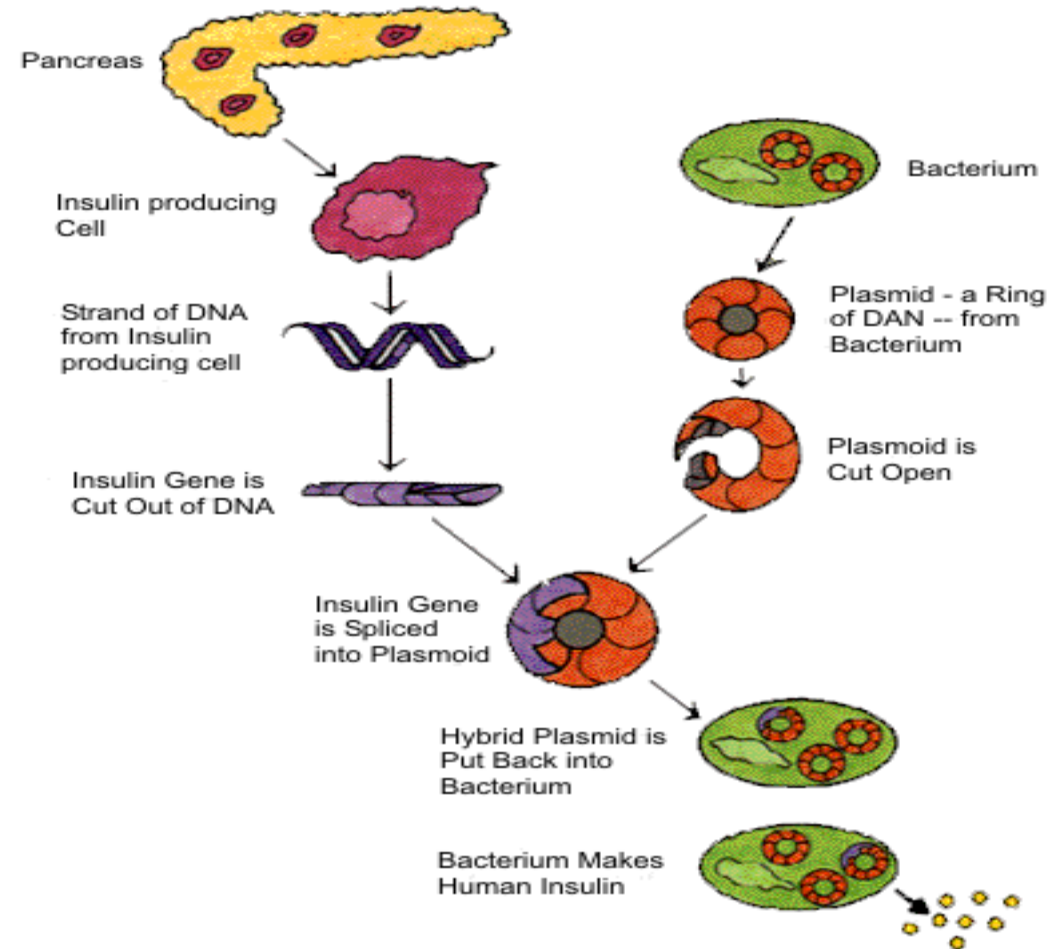
Genetic Engineering process

Genetic Engineering and Applications



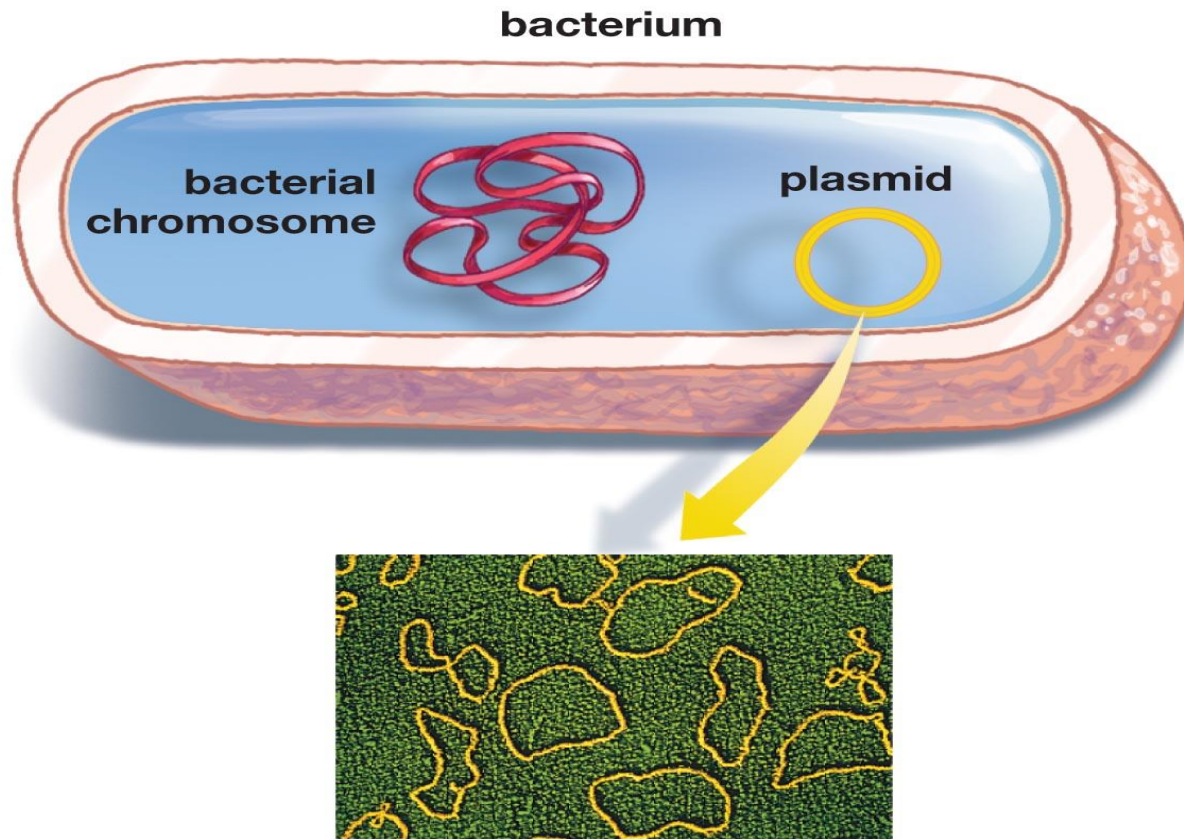
# Genetic Engineering

- DNA from one species is inserted into another species.
- Ex. Human Insulin for diabetics is now made by bacteria cells!





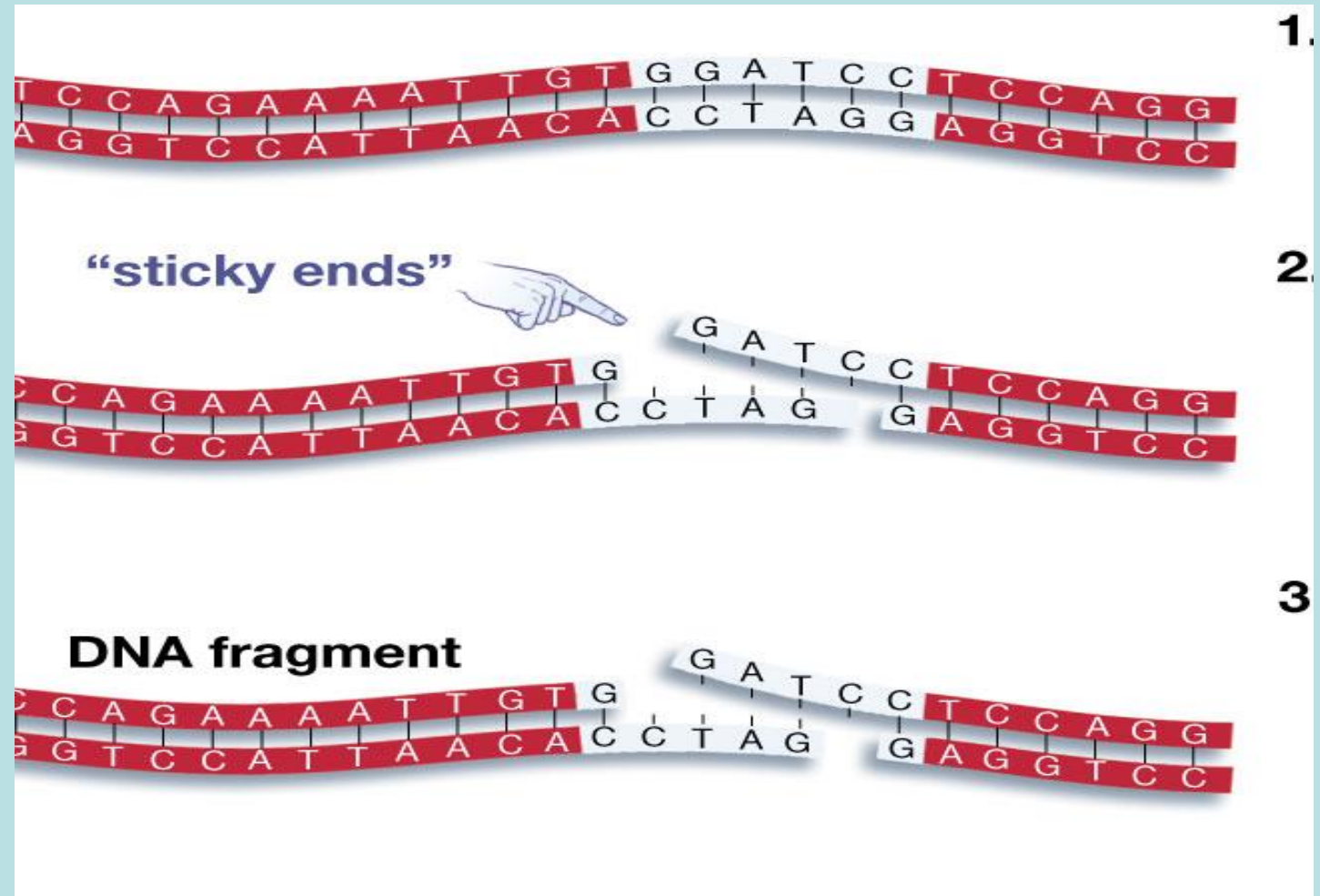
# Wait, what is a plasmid?



A **plasmid** is a small, circular piece of DNA that not only is separate from the chromosome, but can also replicate independently.



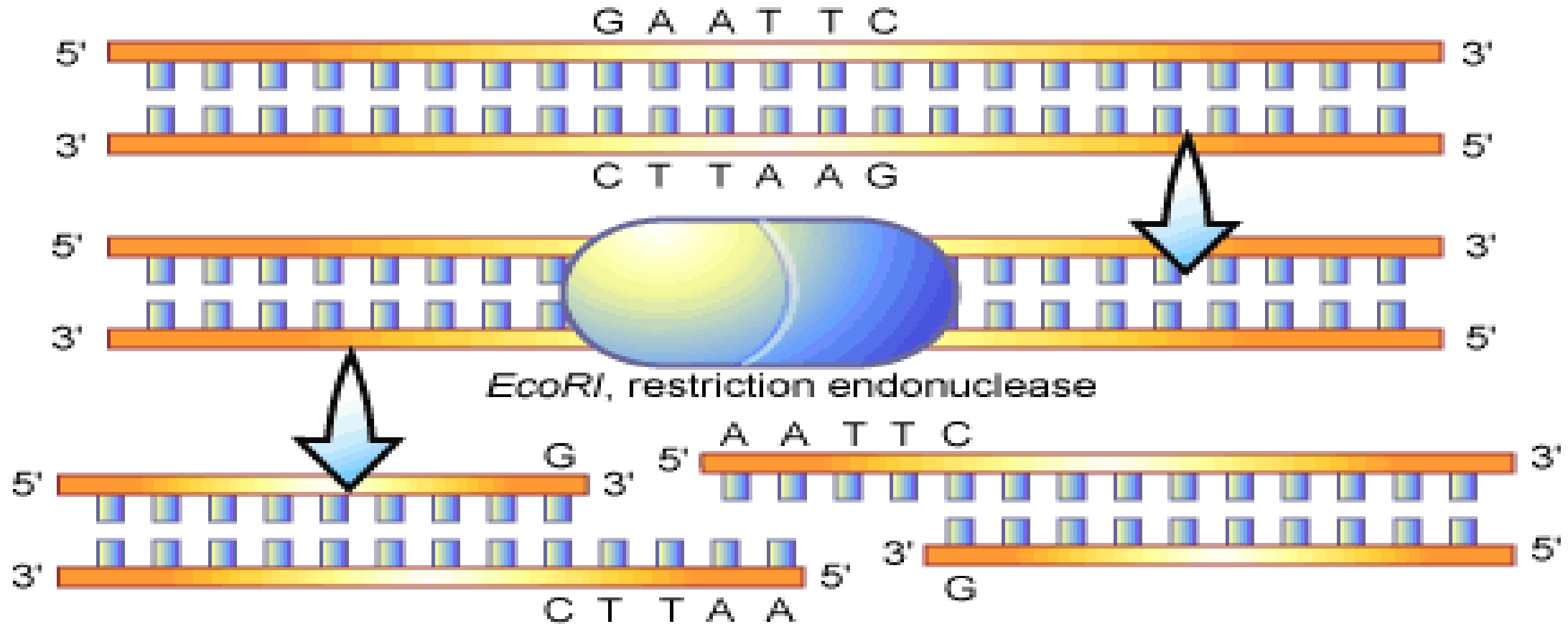
- How do they cut the gene of interest out of the genome?



- Restriction Enzymes!!



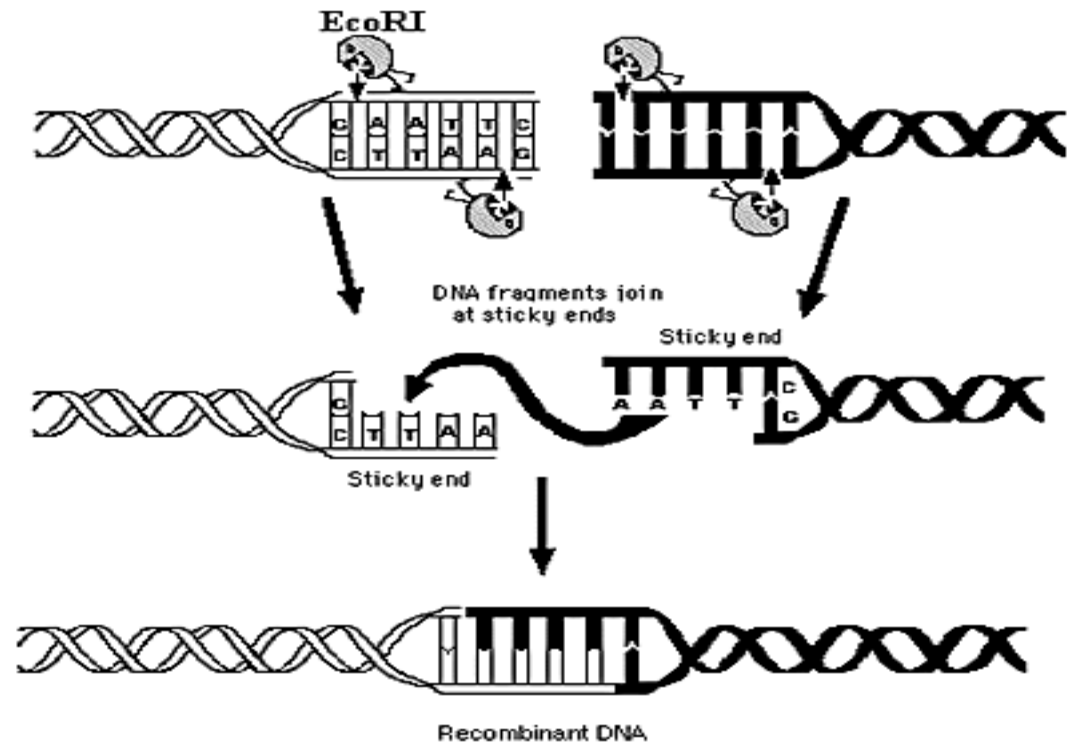
# Restriction enzymes cut DNA at specific sequences in the genome





# Recombinant DNA

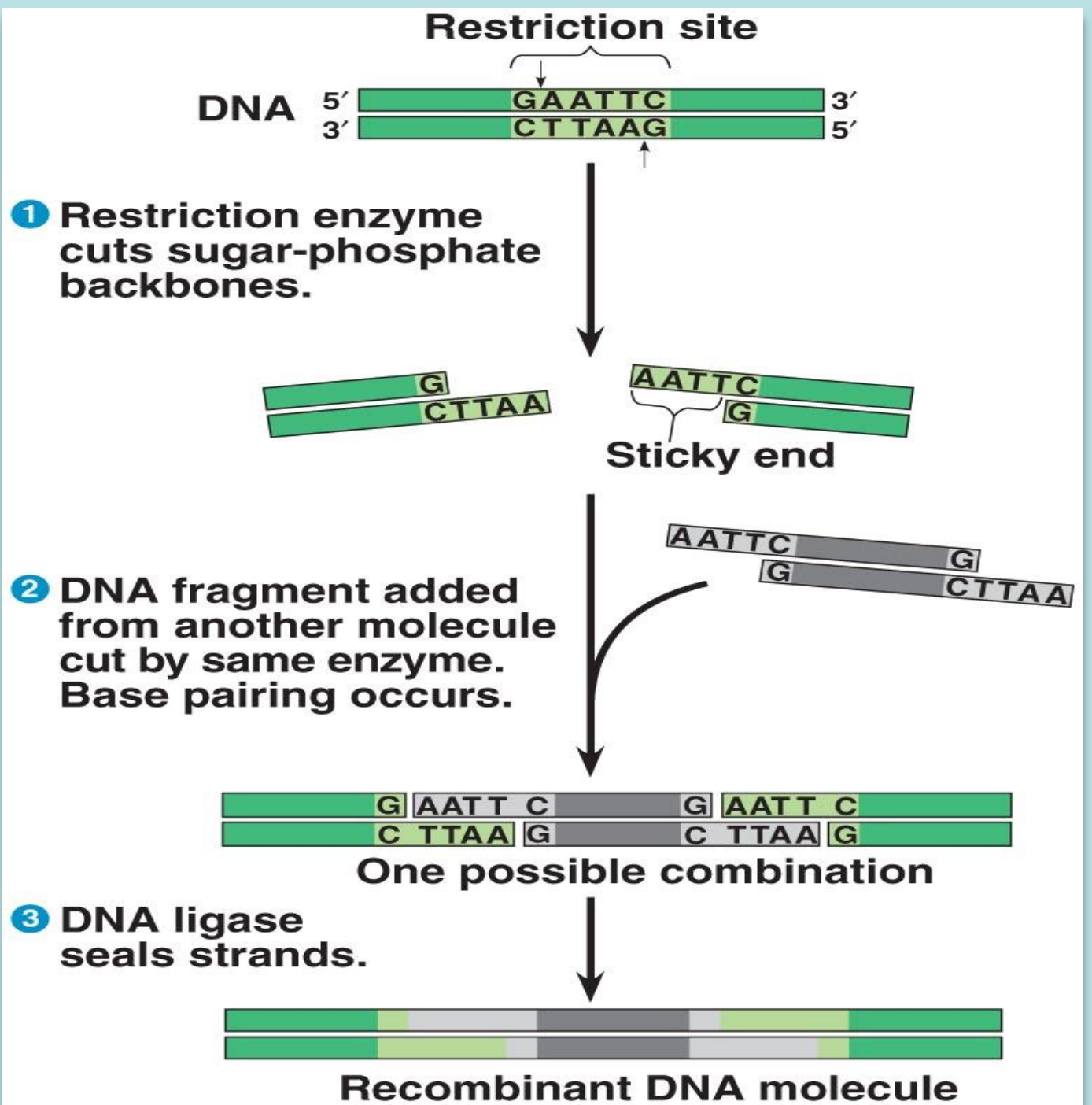
Two pieces of DNA cut with the same restriction enzyme will be able to recombine with each other.



**Restriction Enzyme  
Action of EcoRI**



How does a fragment then get spliced in?







# Insulin

The pancreas, among other functions, produces a crucial hormone called **insulin**.

- This **peptide** hormone (protein) ensures that glucose is taken up by the cells for cellular respiration.
- If the pancreas is defective then the blood sugar levels get dangerously high causing many physiological effects (Diabetes mellitus).
- Using very similar technique as HGH production previously mentioned, scientists were able to use *E. coli* to bioengineer synthetic insulin in 1977.
- Other transgenic organisms used to produce insulin today are yeast (*Saccharomyces cerevisiae*) and a plant called safflower (*Carthamus tinctorius*).





# Plants

- 1) Examples of transgenic plants with resistance to viruses...  
potatoes, tomatoes, tobacco
- 2) Examples of transgenic plants with resistance to insects...  
corn, cotton
- 3) resistance to herbicides
- 4) slow down spoilage in tomatoes
- 5) Extreme example – strawberries that are resistant to drought, salt, insects, viruses, cold and frost, and improved taste



# Golden Rice



The World Health Organization estimates that between 1 and 2 million children die each year from vitamin A deficiency.

- Golden rice is a genetically modified food that is fortified with beta carotene, which the human body converts into vitamin A.
- This transgenic organism is the result of mixing genes from a bacterium and from daffodils into the rice genome.
- It is not currently used due to regulatory issues.
  - *Do you think we should be able to use it?*



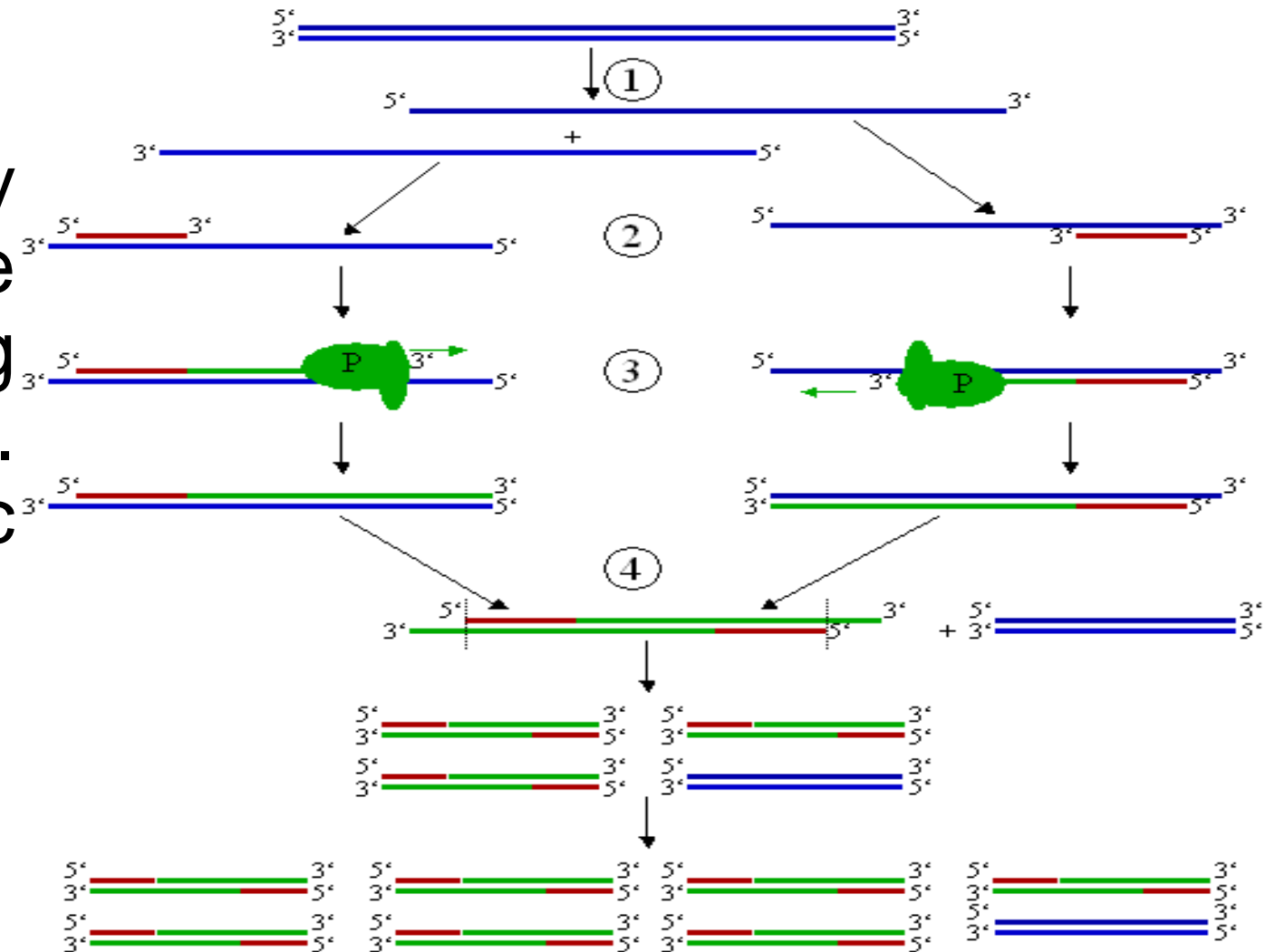
# Animals

- **Bacteria now produce all of the following...**
- **Human growth hormone (HGH)** - (replaced cadaver produced HGH.)
- **Human insulin** (replaced cow and pig insulin for human therapy )
- **Follicle-stimulating hormone** (replaced FSH isolated from menopausal female urine )
- **Factor VIII** (replaced clotting factors taken from human blood.)



# Polymerase Chain Reaction

- PCR – Multiplies a sample of DNA many times in the laboratory using heating and cooling. Useful in genetic testing.





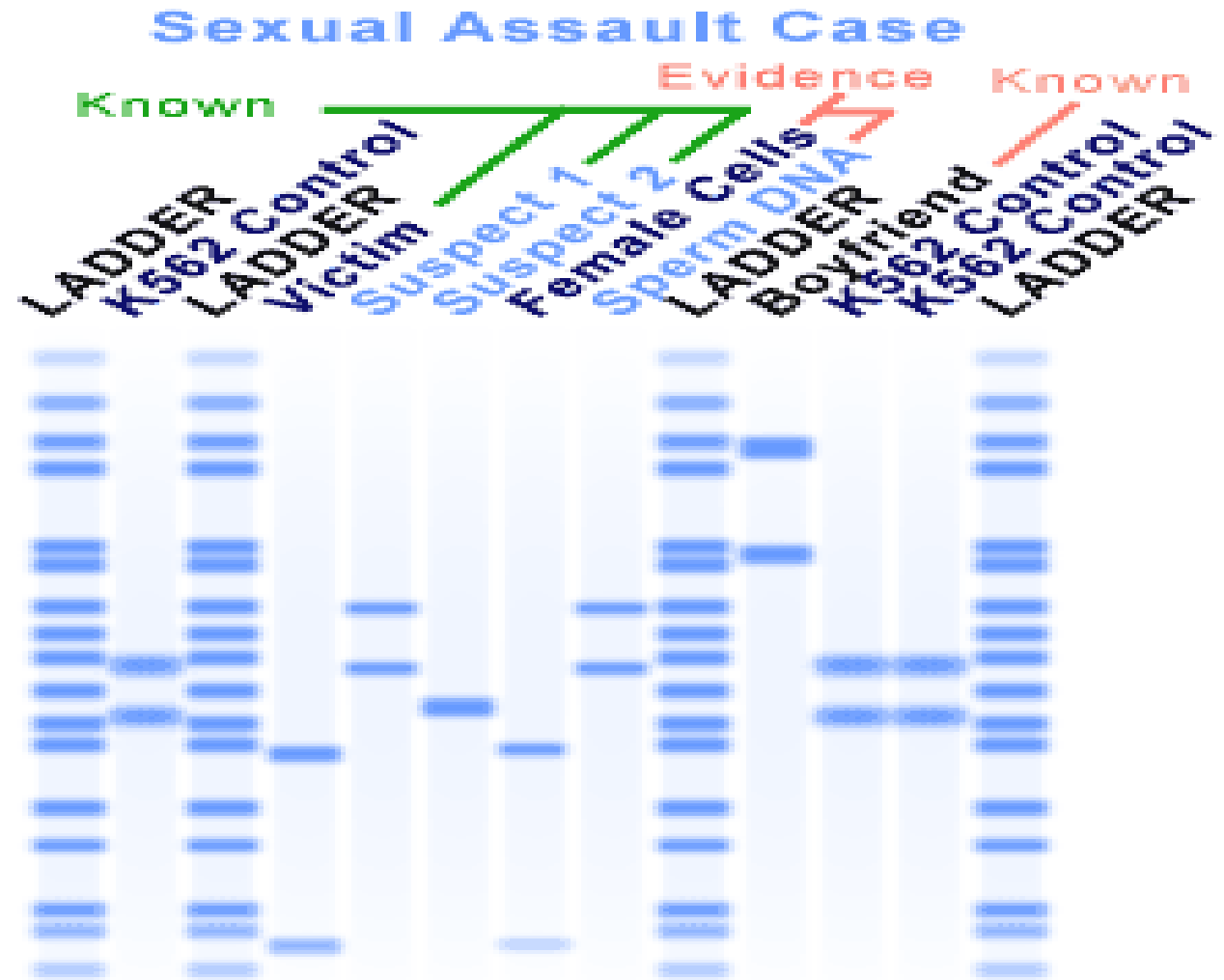
# DNA Fingerprinting

## Gel Electrophoresis

separates pieces of DNA based on size

(after being cut up with restriction enzymes)

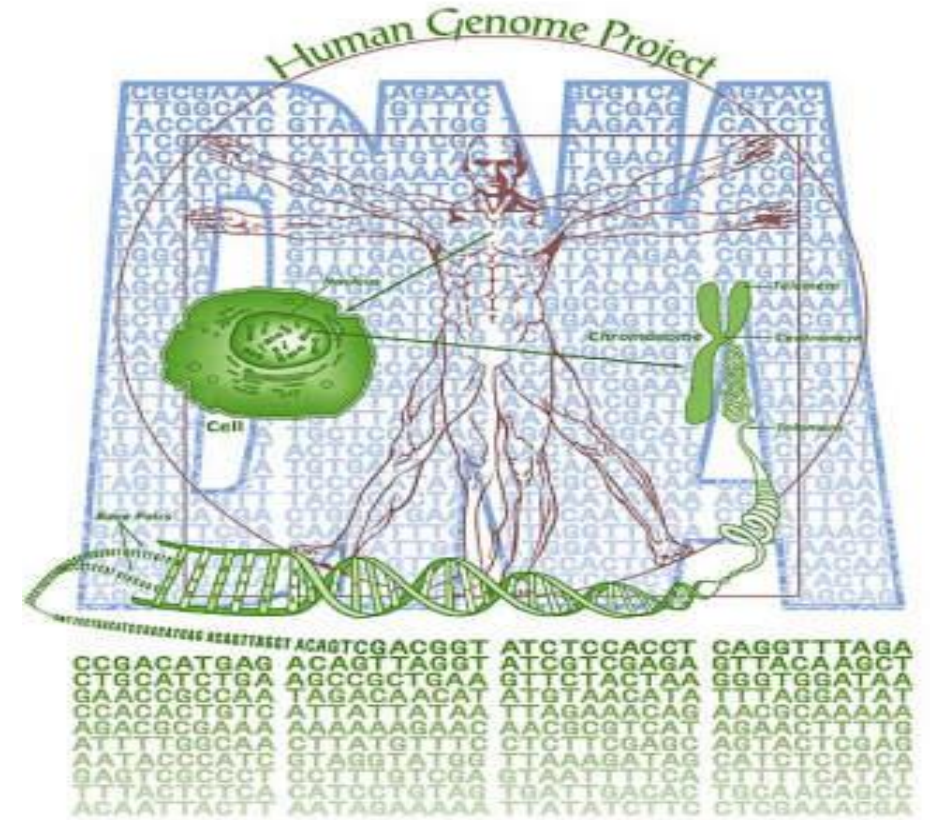
Different people will have different banding patterns. Related individuals will have similar patterns.





# Human Genome Project

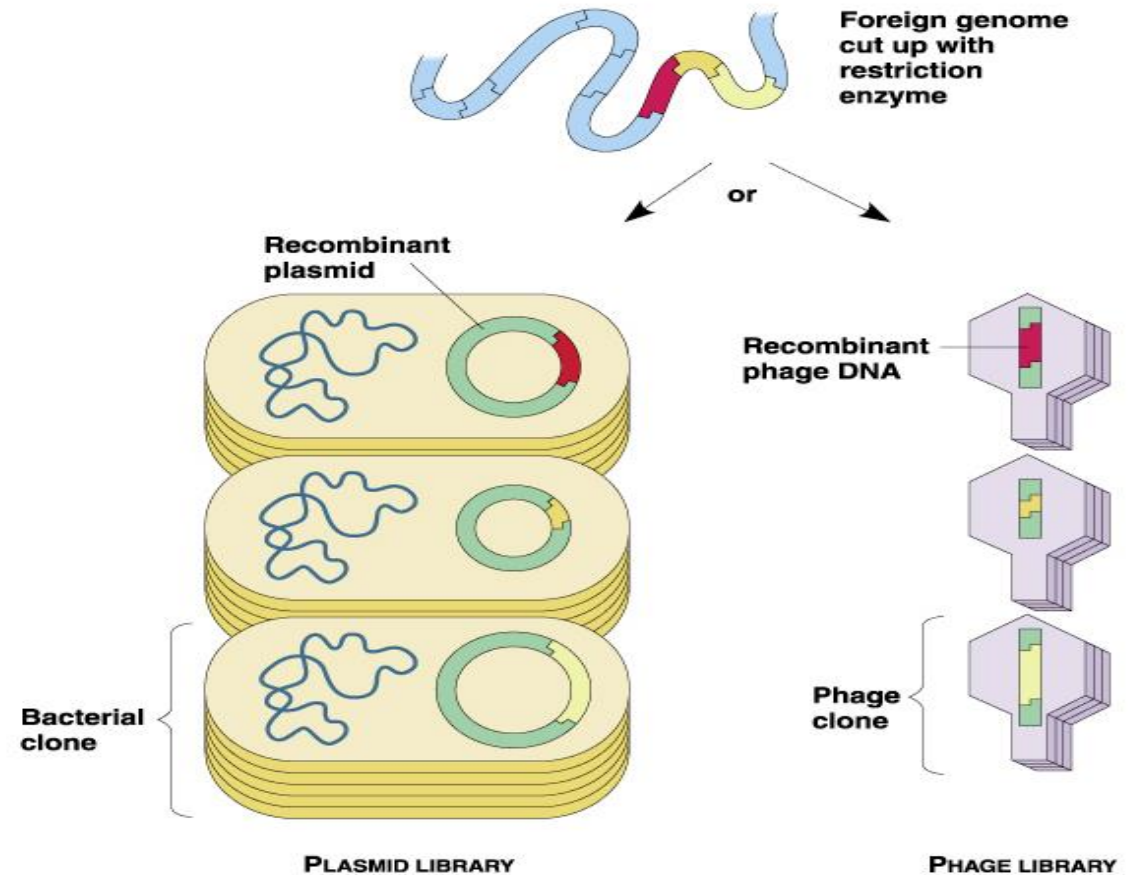
- Started 1988, finished 2001, the entire sequence of bases in human DNA is now known.
- This multi-national effort has led to increased knowledge of ...
  - Human genetic diseases
  - Gene therapies
  - Evolutionary relationships
  - Cellular functions
  - Cancer genes





# Gene Libraries

- Human genes (and other genes of interest) can be stored inside bacteria cells and viruses which can be saved and grown for use in research.
- This may also preserve the genes of endangered or extinct species.







# Pharmaceutical Biotechnology

Concepts and Applications

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For Query



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