Chapter 13 - Genetic Engineering

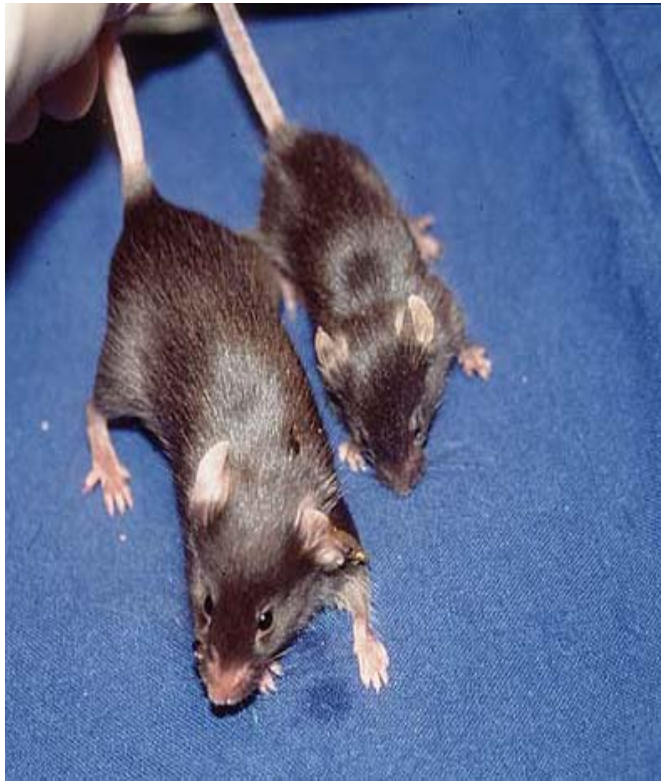
Basic Biotechnology

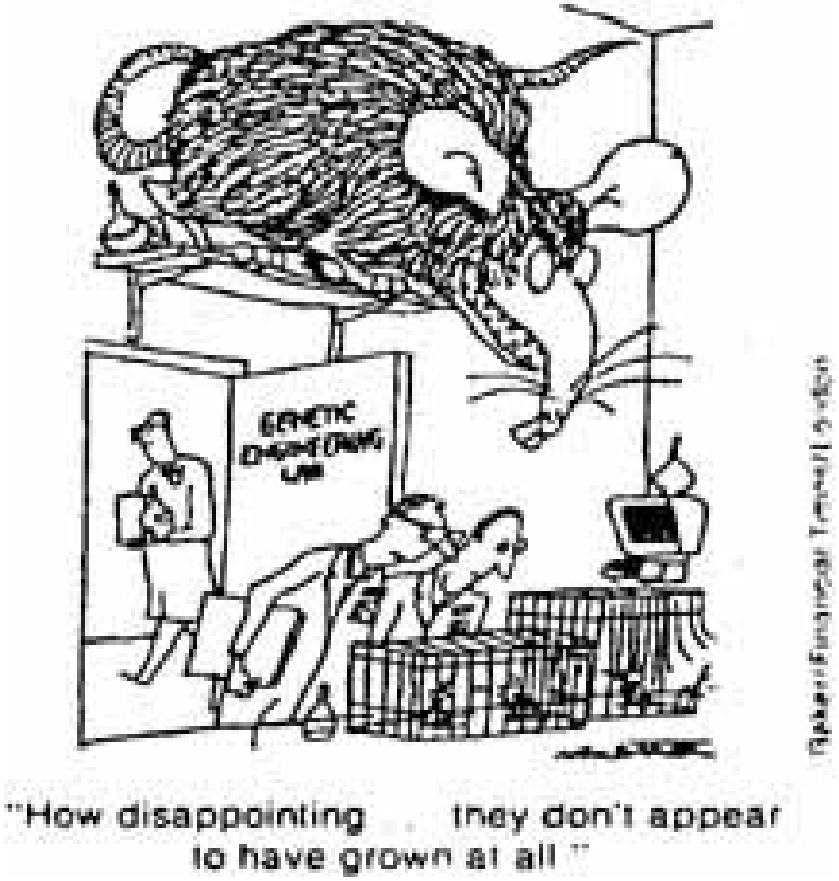
Biotechnology Today

- <u>Genetic Engineering involves…</u>
  - Manipulating DNA
  - A set of "tools" are used to…
    - Cut DNA
    - Separate DNA
    - Paste DNA
    - Make copies of DNA

Biotechnology Today

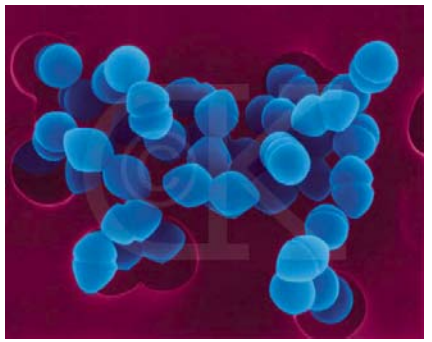
- Genetic Engineering Uses…
  - Analyzing individuals' DNA
  - Transformation of DNA in organisms' cells
  - Biomedical products
  - Agricultural products

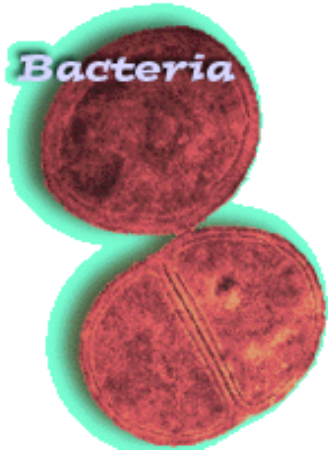


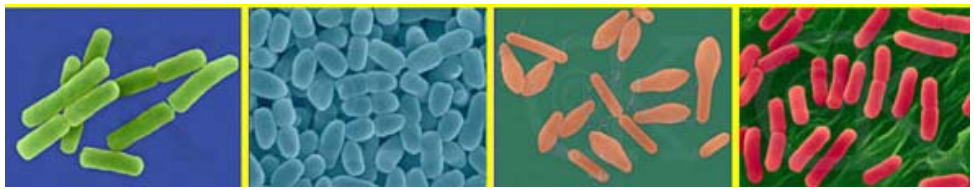


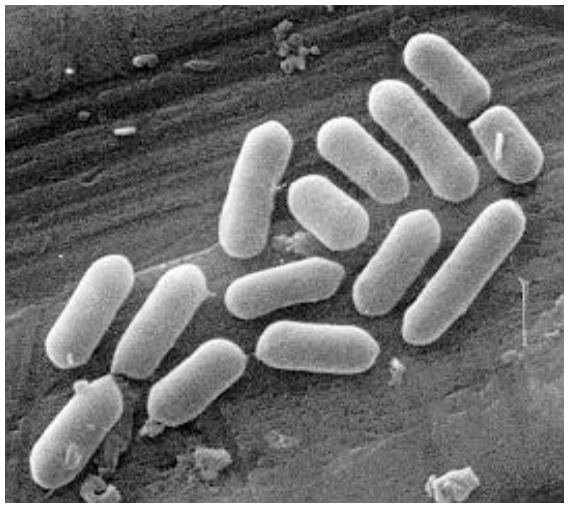
BACTERIA –
Used often in genetic engineering!

- Single-celled prokaryotes
- Reproduce by mitosis
- Rapid growth
- Dominant form of life on Earth & incredibly diverse!



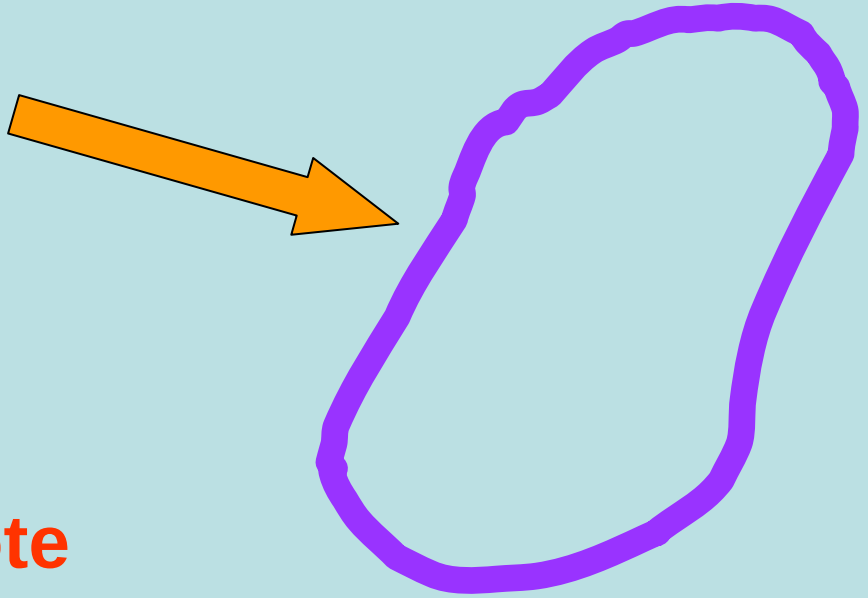




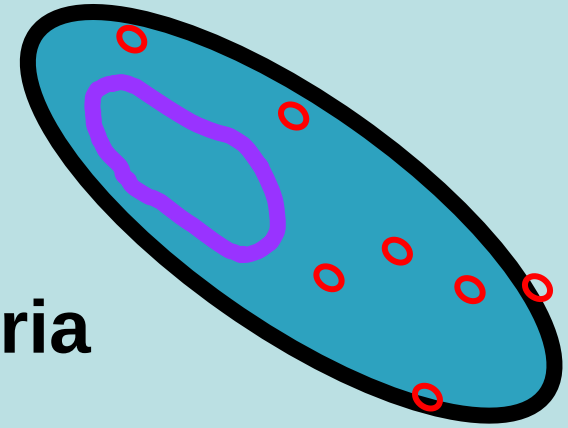


Bacterial Genome and Plasmids

- Their genome is a single circular chromosome
  - haploid
  - ~4 million base pairs
    - ~4300 genes
    - 1/1000 DNA in eukaryote

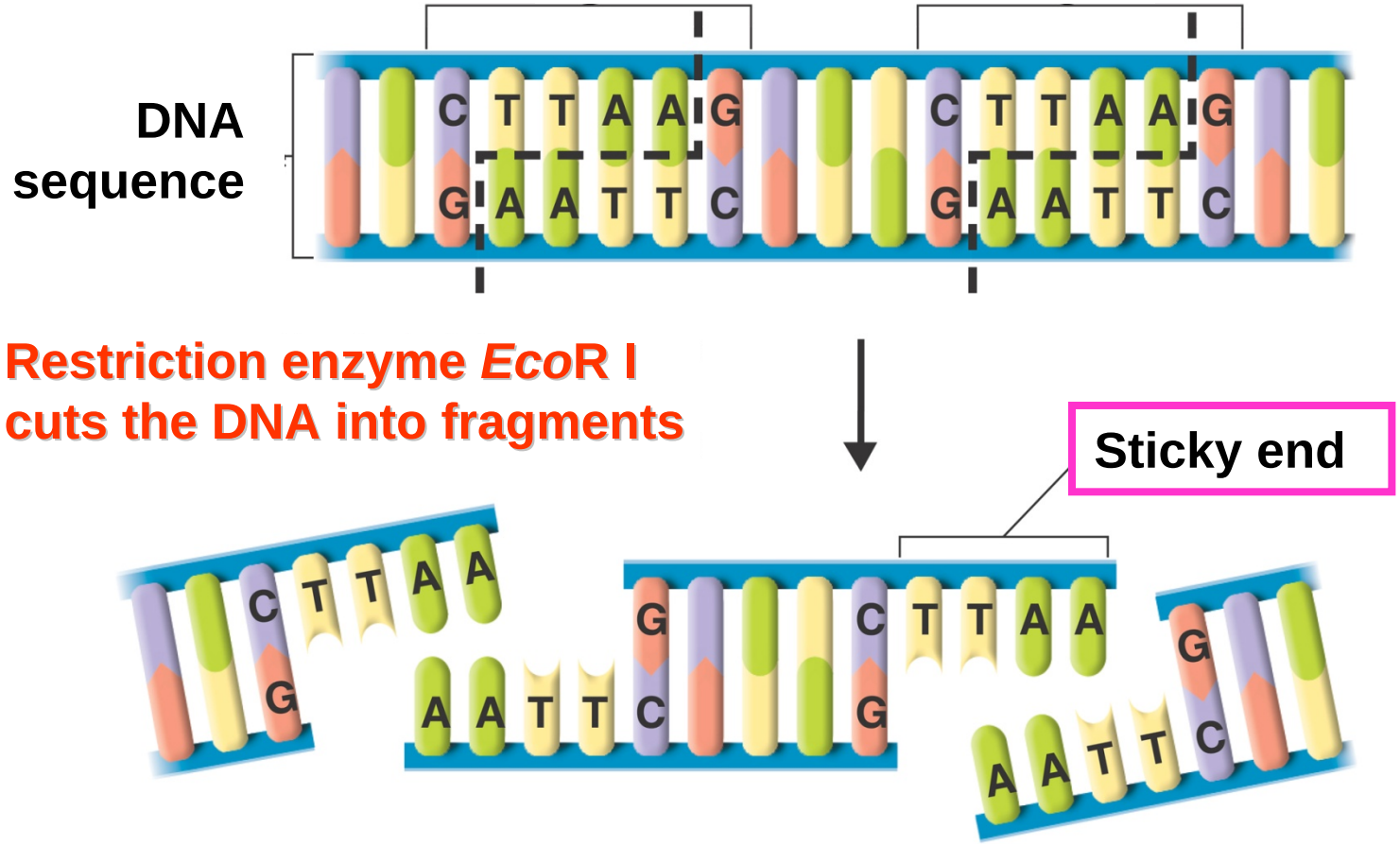


- Plasmids are additional small circular pieces of DNA
  - self-replicating
  - carry extra genes
  - can be exchanged between bacteria & imported from the environment
  - Easy to insert genes into plasmids

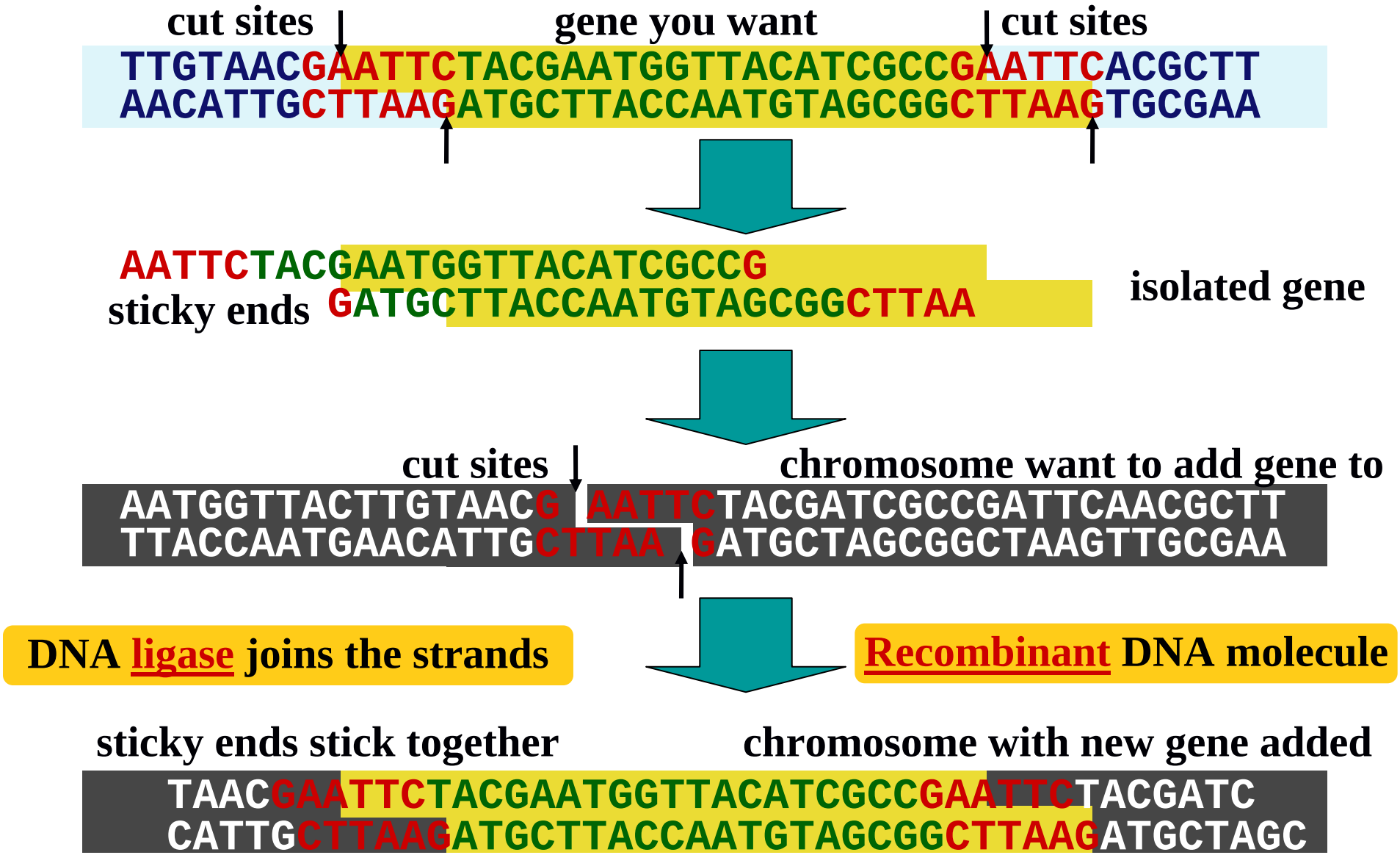


How Does Genetic Engineering Work?

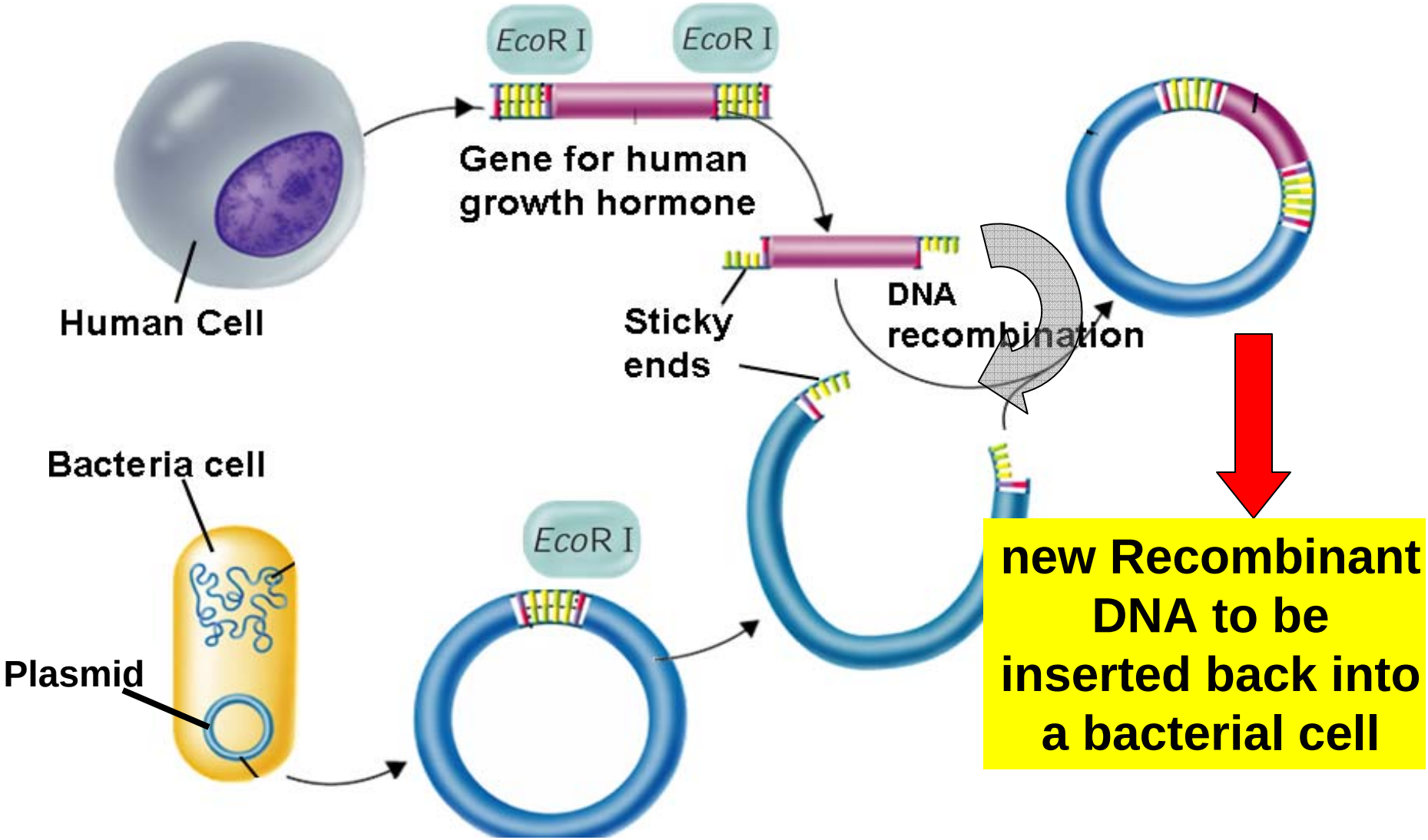
- **Step 1 – Cut the DNA** - A **restriction enzyme** cuts DNA at a specific sequence of bases to isolate a specific gene. You cut a plasmid with the same restriction enzyme as you did the gene you want.



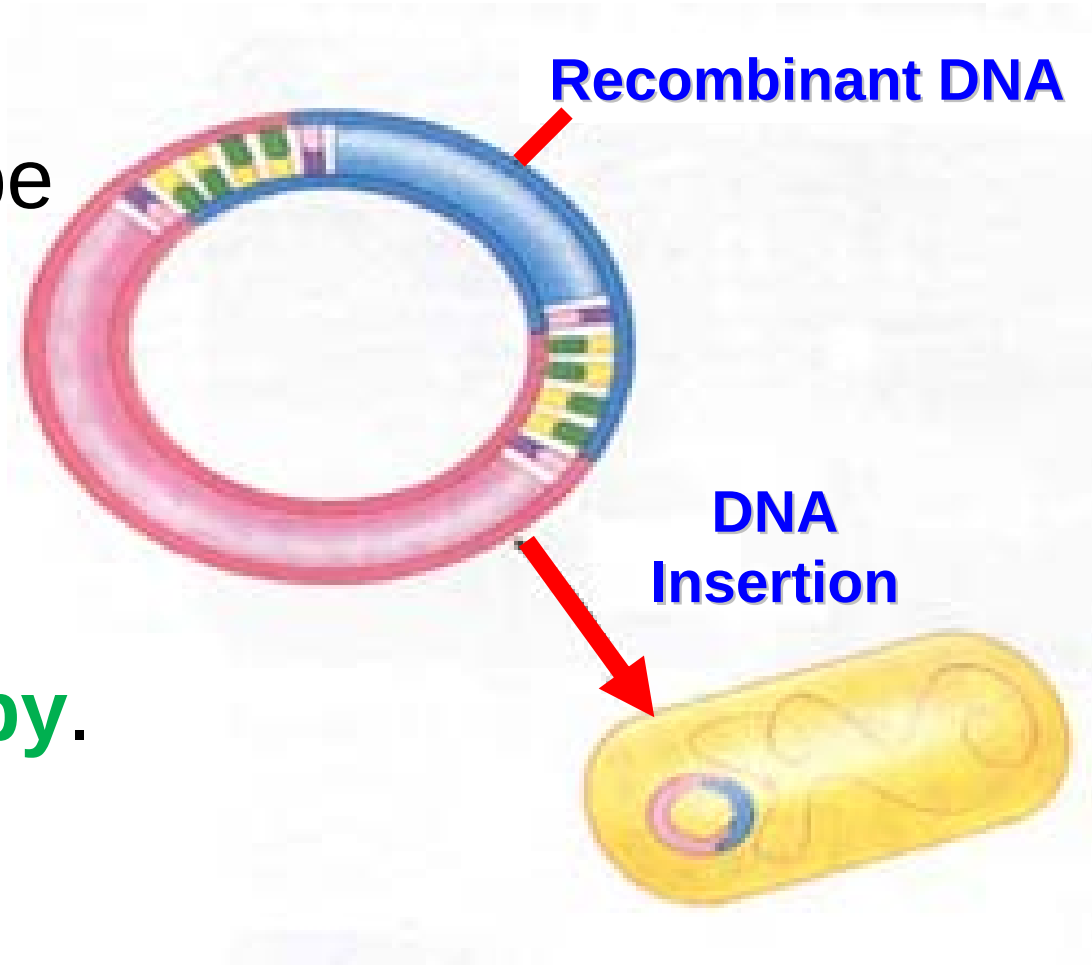
- **Sticky ends help glue genes together.**



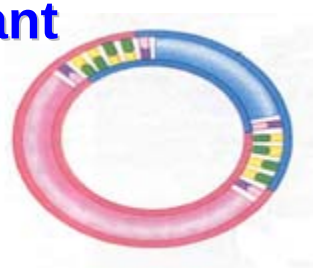
- **Step 2 – Making Recombinant DNA**
- **Recombinant DNA** has DNA from two different species or cells.



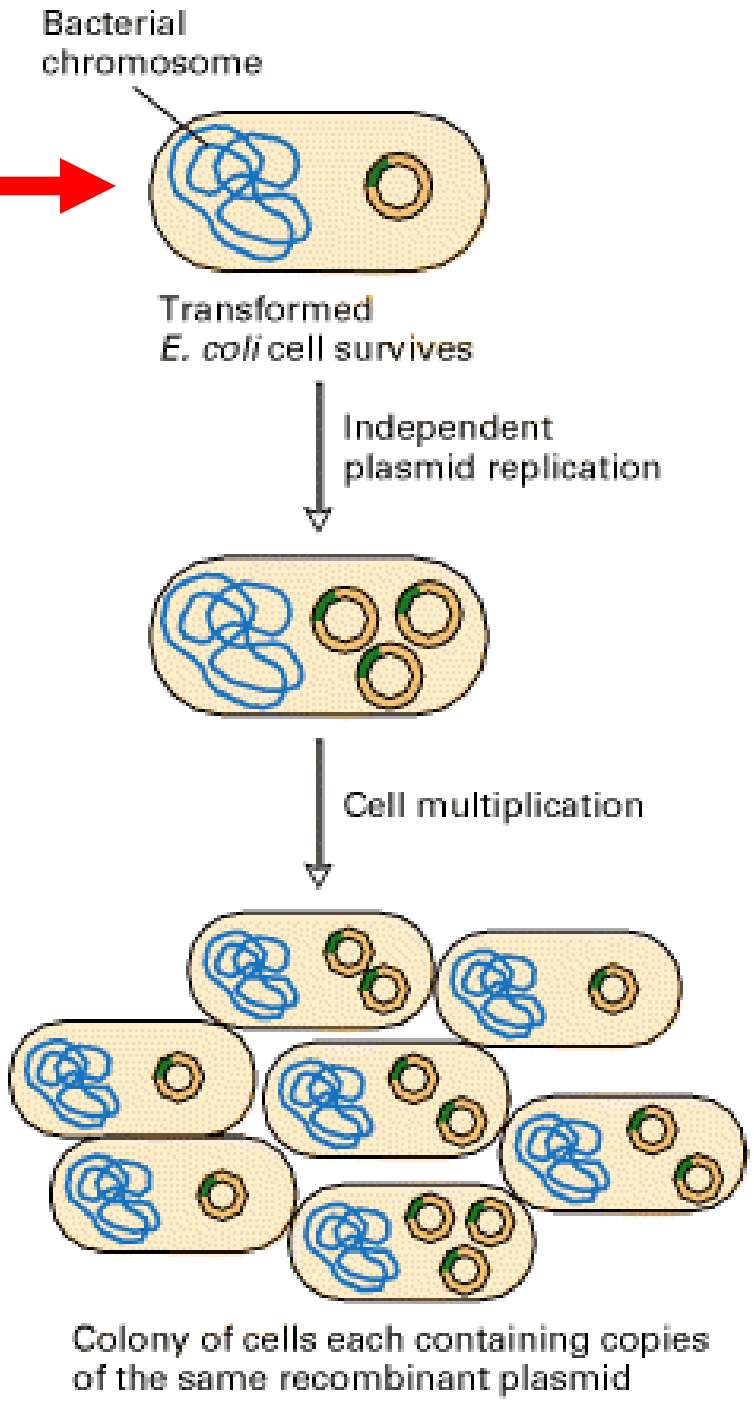
- **<u>Step 3</u> – Transformation: inserting the DNA into a cell**
  - Recombinant DNA is put into bacterial cells and gets incorporated into the cell's DNA.
  - Recombinant DNA can also be injected into plant or animal cells.
  - Can be used for **gene therapy**.



Recombinant DNA



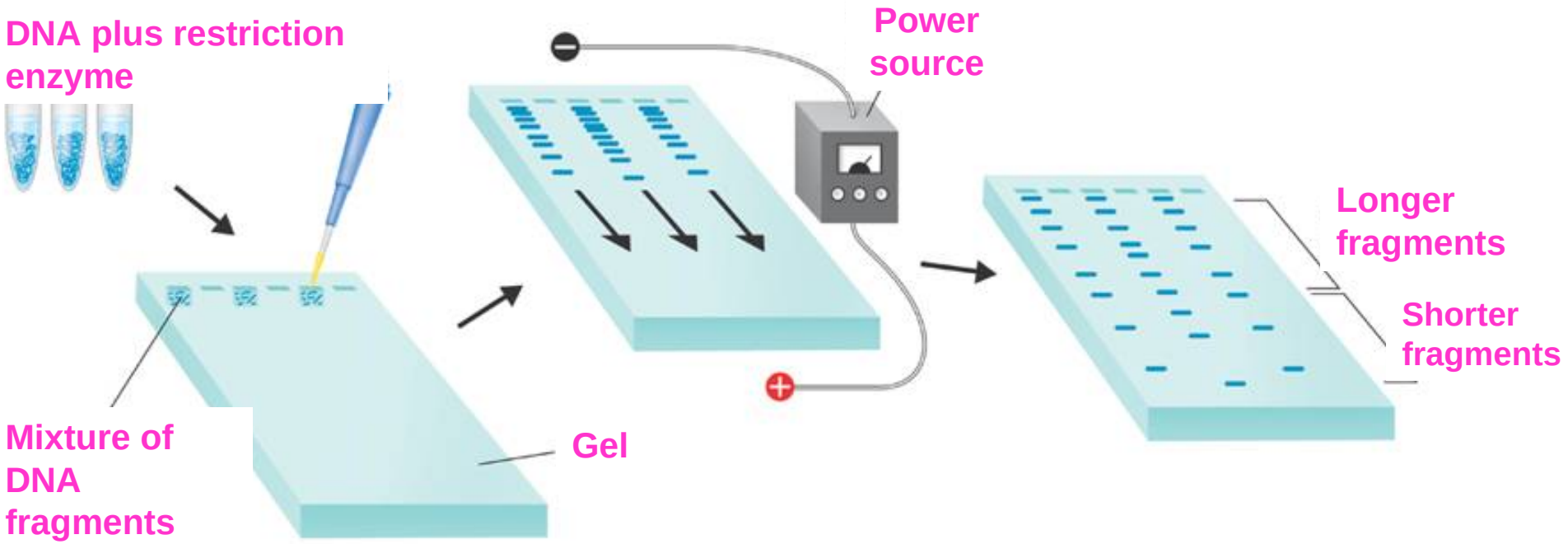
Insert into cell



- **Step 4 –**
  Gene Cloning
  - Many copies of the gene of interest are made each time the host cell divides.

Gel Electrophoresis – used to separate DNA fragments.

- 1st - Cut DNA sample with restriction enzymes (everyone's DNA will be cut at slightly different places creating different size pieces of DNA)
- 2nd - DNA fragments poured into the gel.
- 3rd - Electric voltage moves DNA fragments across the gel
- 4th - Longer fragments of DNA don't migrate as far across the gel as shorter fragments.



DNA Fingerprint – Unique to every individual!

- Used in criminal investigations, paternity, etc.
- Very small amounts of DNA are needed & can come from blood, saliva, hair, urine, etc.
- Use a process called PCR (polymerase chain reaction to increase the amount of DNA)