

CHAPTER 13 - GENETIC ENGINEERING

Basic Biotechnology



Biotechnology Today

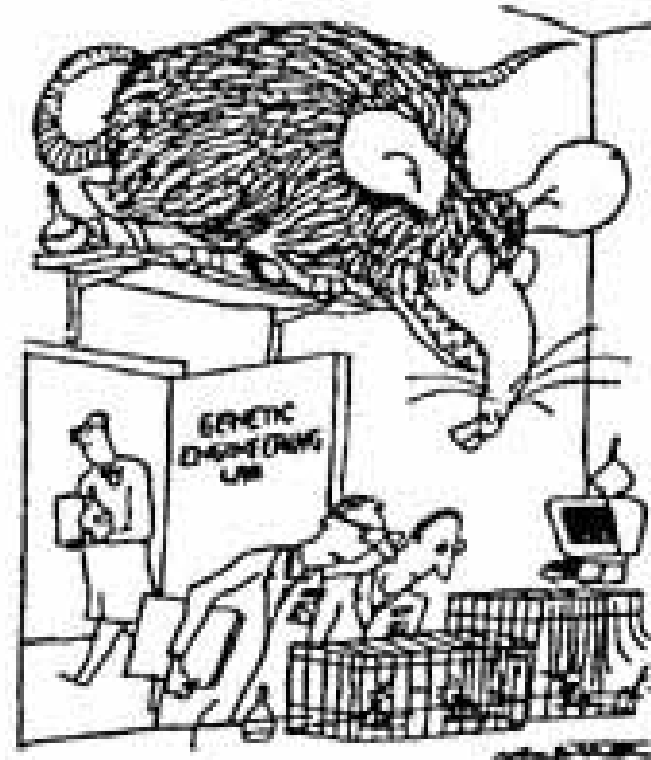
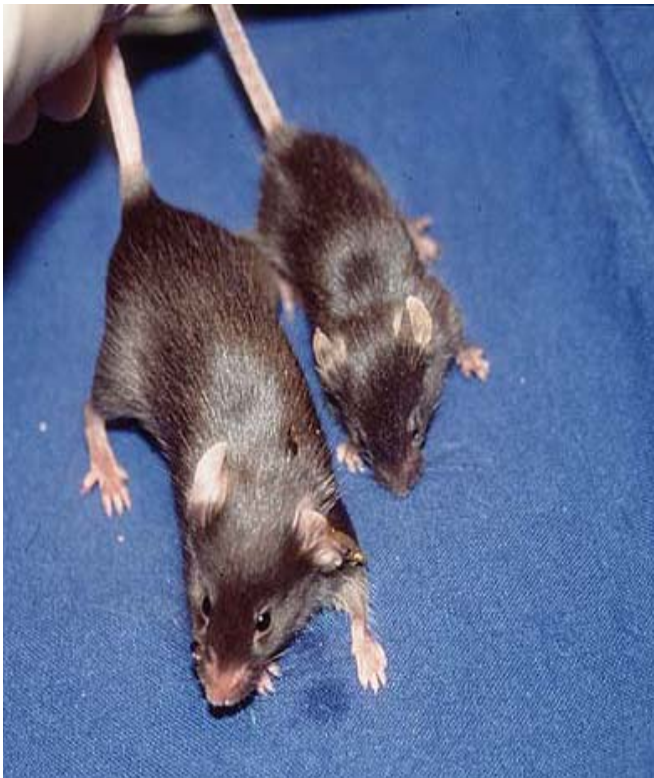
- ▶ Genetic Engineering involves...
 - Manipulating DNA
 - A set of “tools” are used to...
 - Cut DNA
 - Separate DNA
 - Paste DNA
 - Make copies of DNA



Biotechnology Today

▶ Genetic Engineering Uses...

- Analyzing individuals' DNA
- Transformation of DNA in organisms' cells
- Biomedical products
- Agricultural products

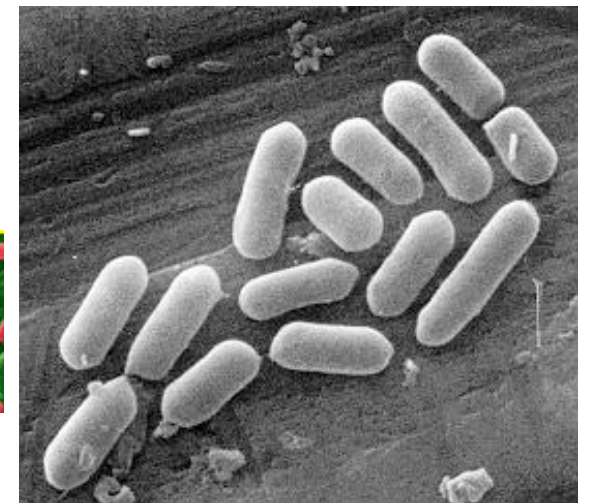
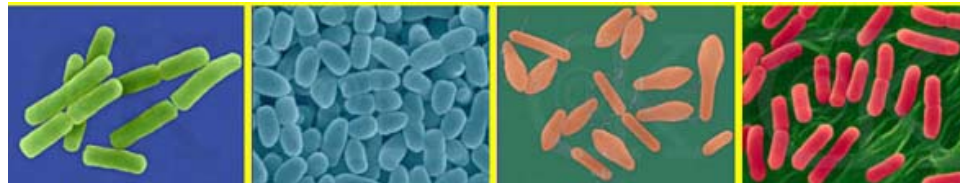
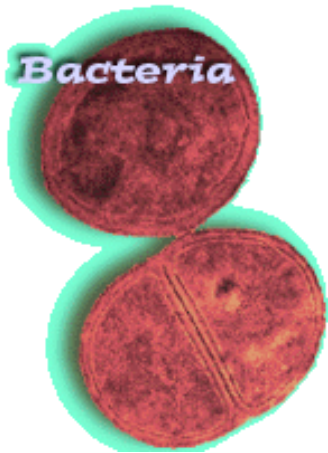
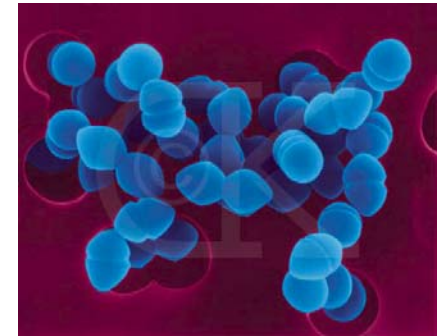


"How disappointing . . . they don't appear to have grown at all."

BACTERIA -

Used often in genetic engineering!

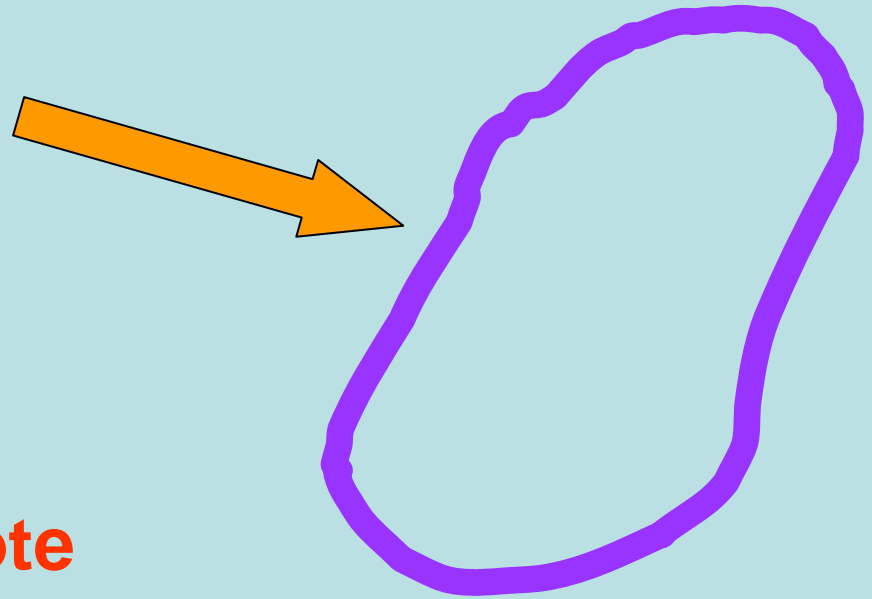
- Single-celled prokaryotes
- Reproduce by mitosis
- Rapid growth
- Dominant form of life on Earth & incredibly diverse!



Bacterial Genome and Plasmids

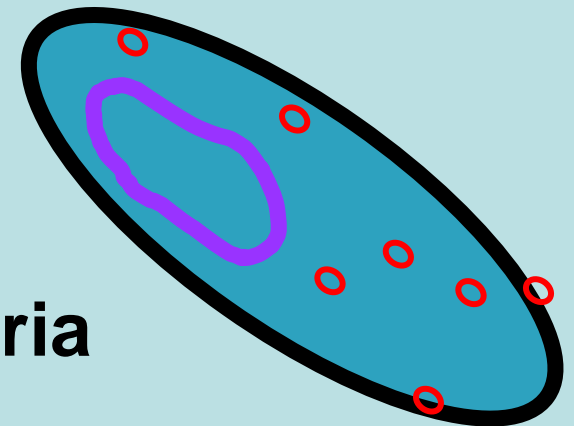
- ▶ Their **genome** is a single circular chromosome

- **haploid**
- **~4 million base pairs**
 - **~4300 genes**
 - **1/1000 DNA in eukaryote**



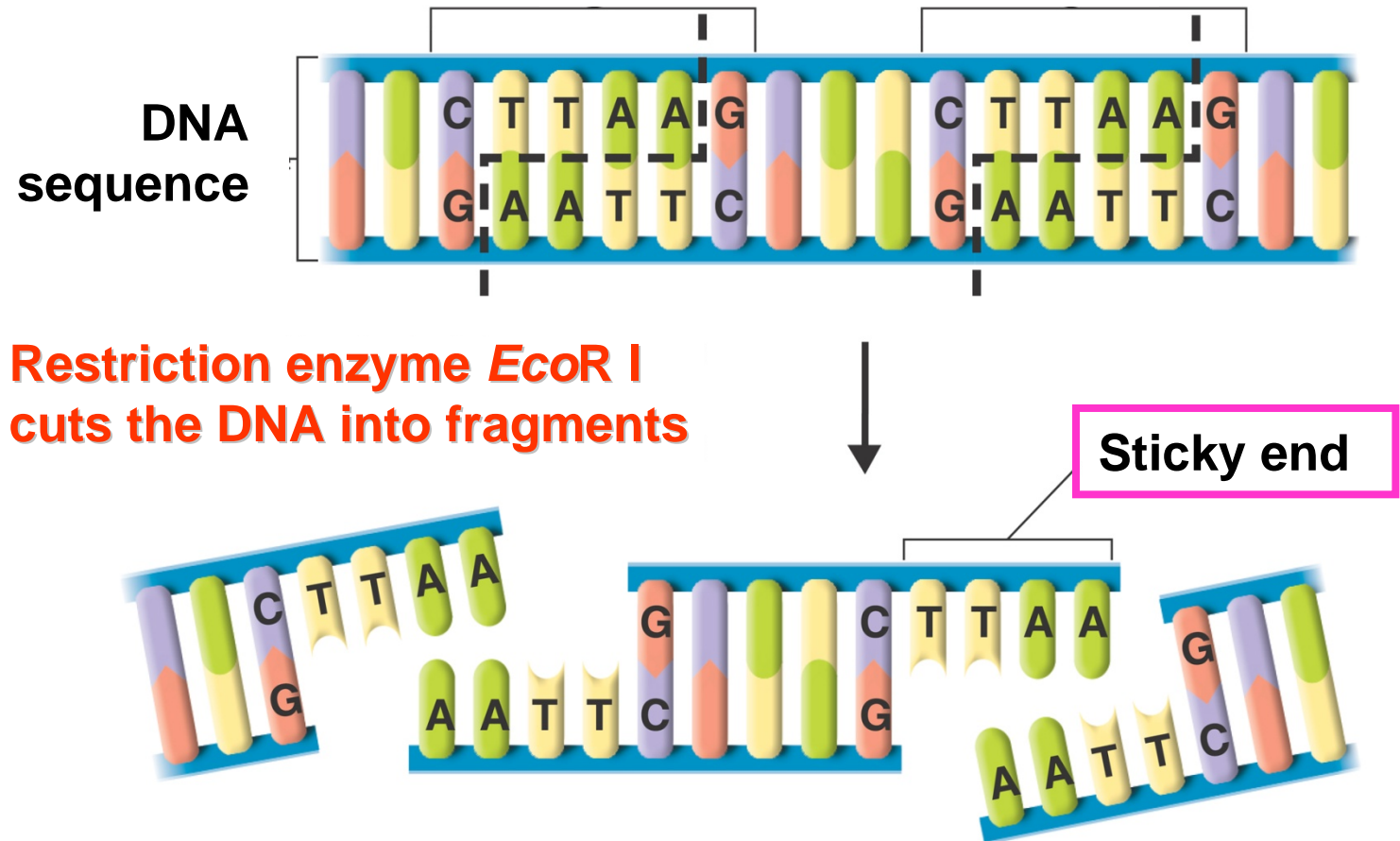
- ▶ **Plasmids** are additional small circular pieces of DNA

- 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.

cut sites ↓ gene you want ↓ cut sites

```

TTGTAACGAATTC TACGAATGGTTACATCGCCGAATTCACGCTT
AACATTGCTTAAGATGCTTACCAATGTAGCGGCTTAAGTGCGAA
  
```

↓

```

AATTC TACGAATGGTTACATCGCCG
sticky ends GATGCTTACCAATGTAGCGGCTTAA
  
```

isolated gene

cut sites ↓ chromosome want to add gene to ↓

```

AATGGTACTTGTAACG AATTC TACGATCGCCGATTCAACGCTT
TTACCAATGAACATTGCTTAA GATGCTAGCGGCTAAGTTGCGAA
  
```

DNA ligase joins the strands

Recombinant DNA molecule

sticky ends stick together

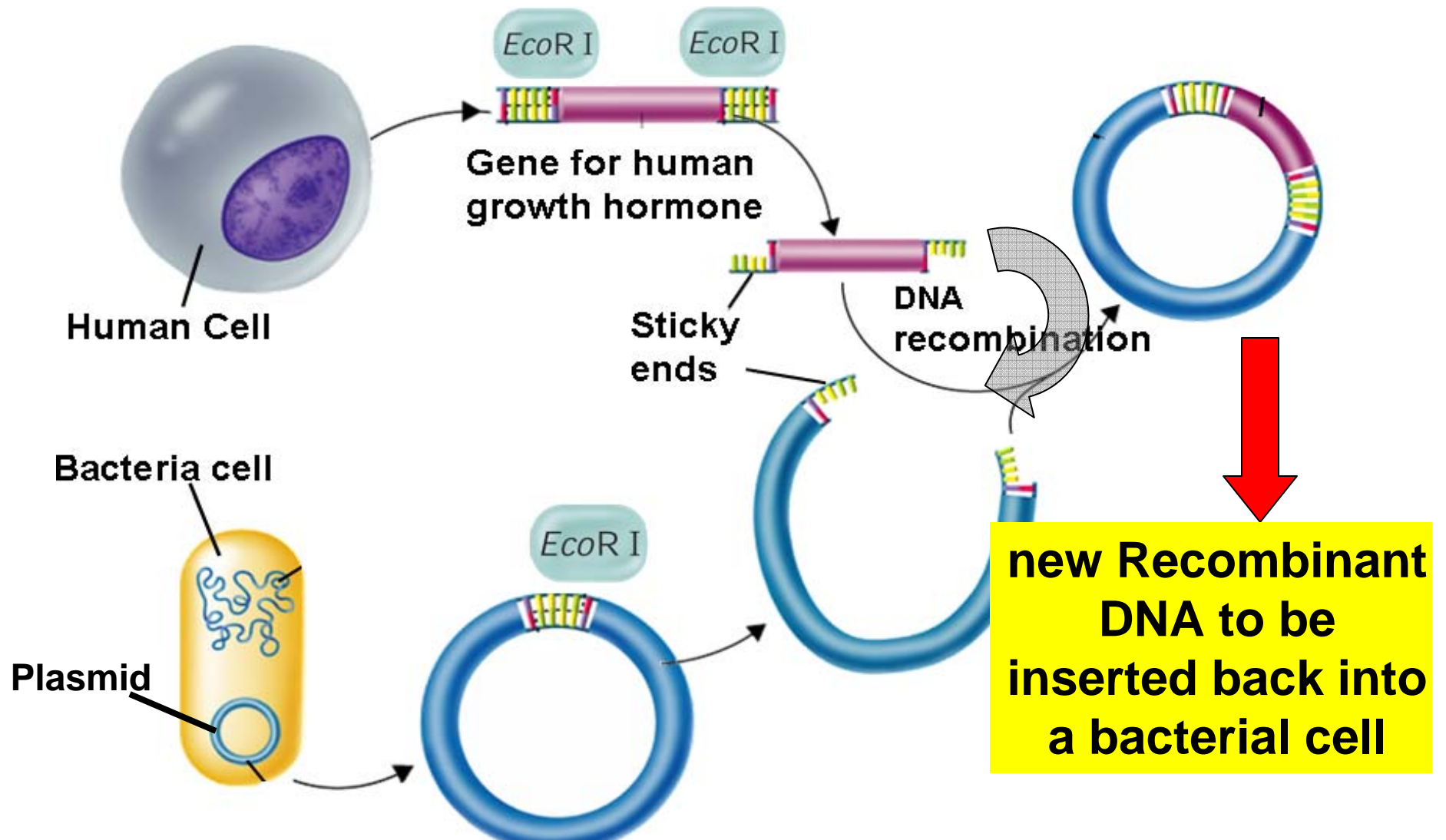
chromosome with new gene added

```

TAACGAATTC TACGAATGGTTACATCGCCGAATTC TACGATC
CATTGCTTAAGATGCTTACCAATGTAGCGGCTTAAGATGCTAGC
  
```

- Step 2 – Making Recombinant DNA

- Recombinant DNA has DNA from two different species or cells.

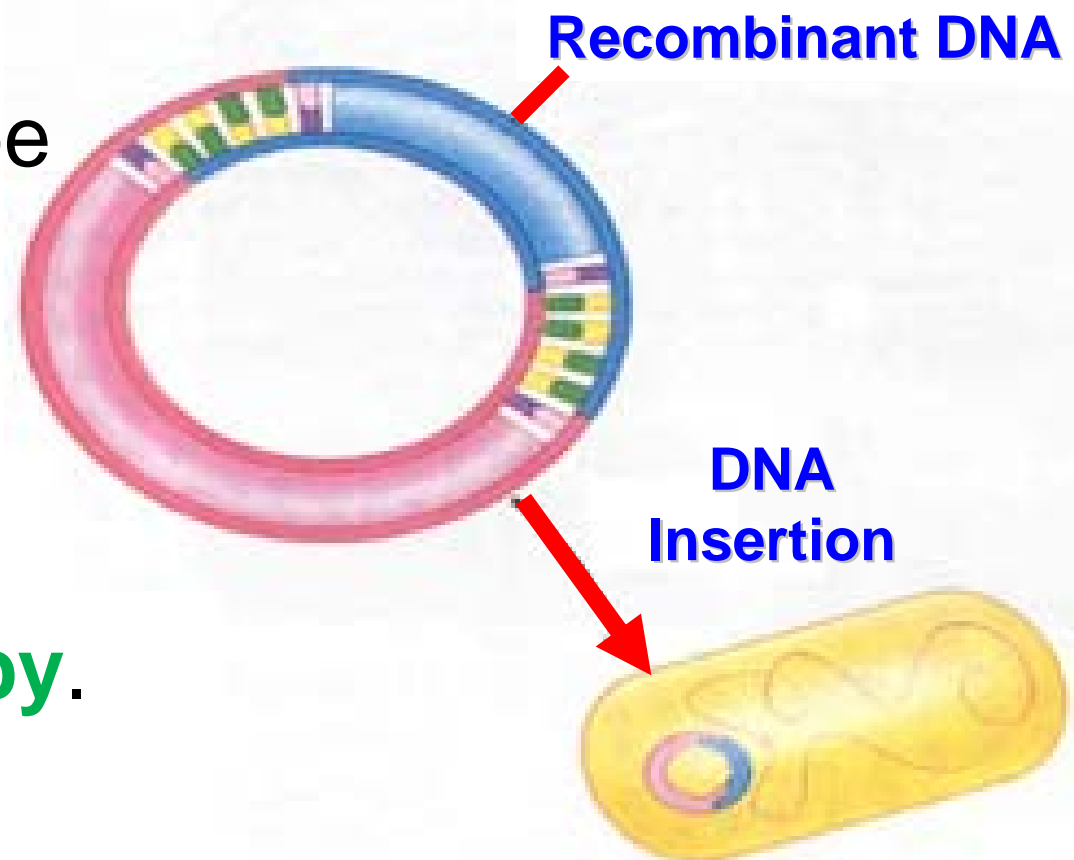


- **Step 3 – Transformation: inserting the DNA into a cell**

- 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**.

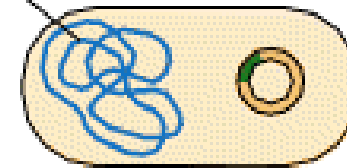


Recombinant
DNA



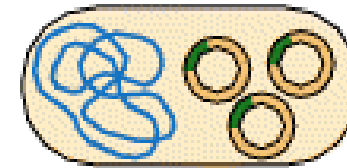
Insert into
cell

Bacterial
chromosome

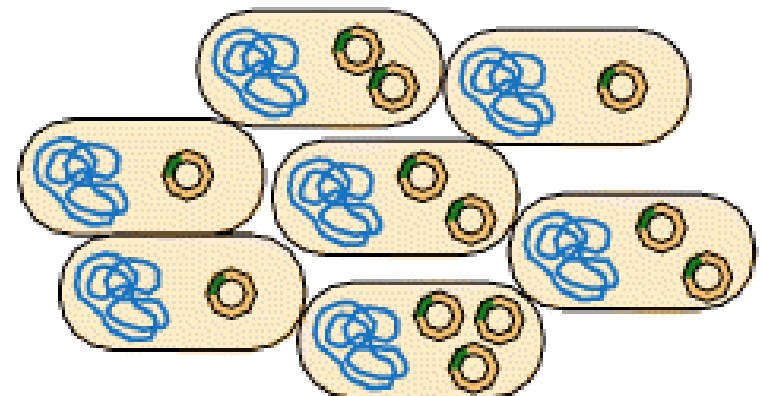


Transformed
E. coli cell survives

Independent
plasmid replication



Cell multiplication

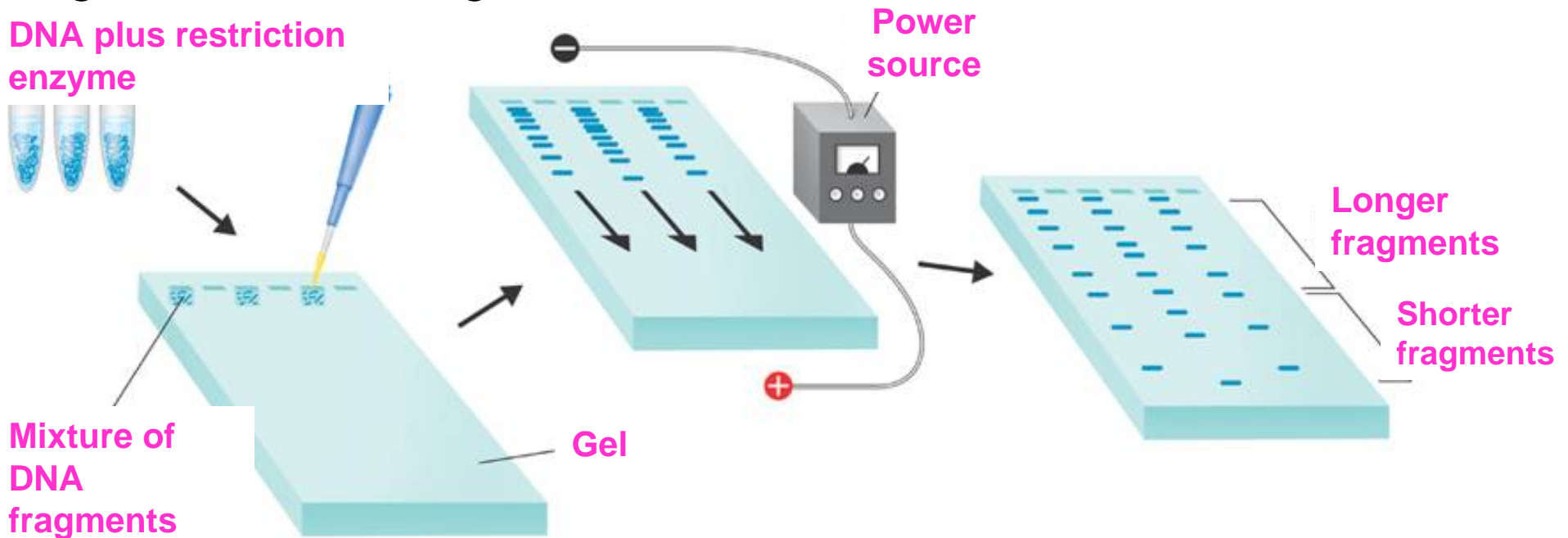


Colony of cells each containing copies
of the same recombinant plasmid

- 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)

