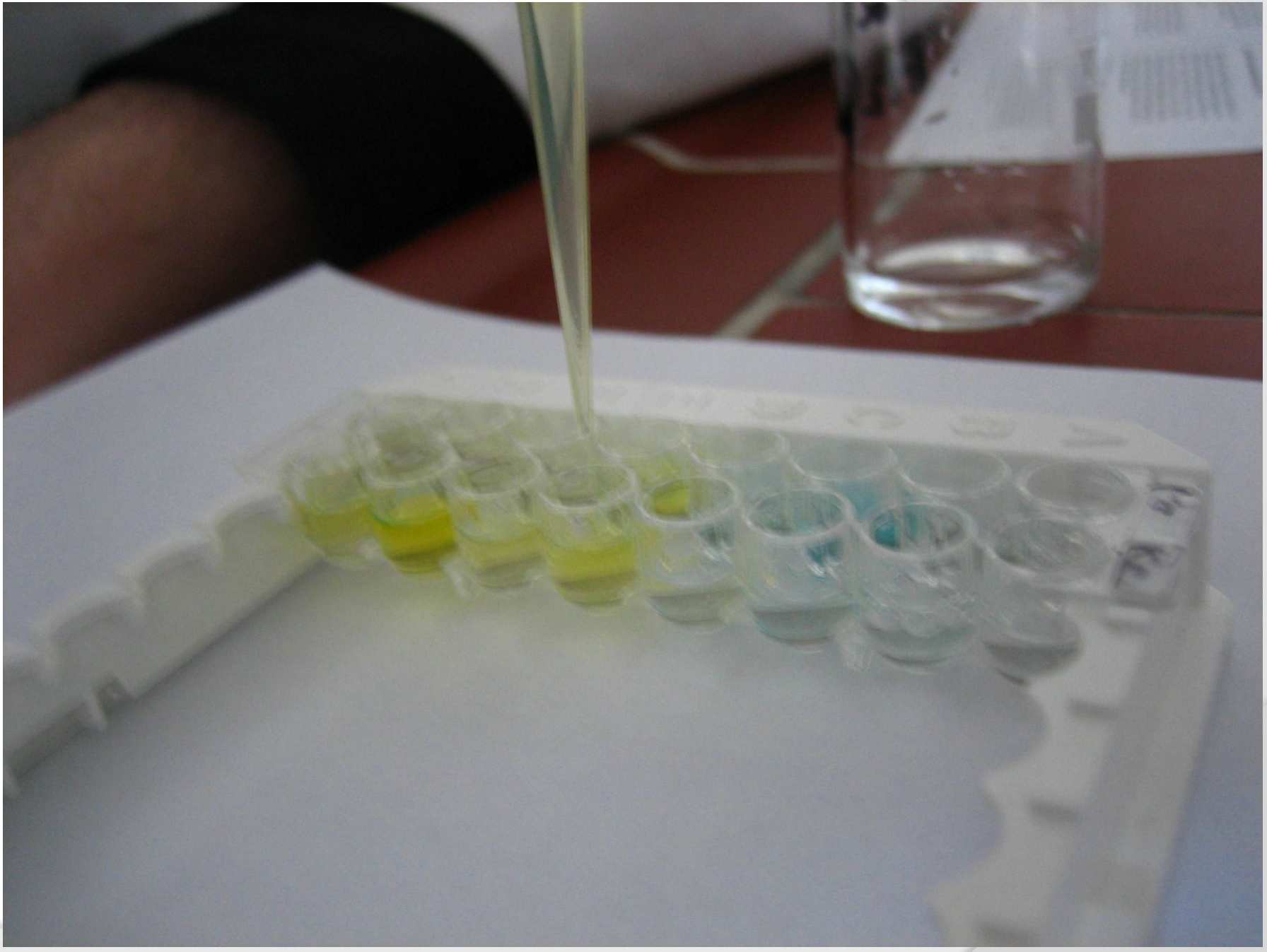


BIOTECHNOLOGY (APPLIED BIOLOGY)

Biotechnology

- The manipulation of organisms or their components to make useful products. (?)
- Biotechnology includes such early practices as selective breeding of farm animals and using microorganisms to make wine and cheese.
- Today, biotechnology also encompasses **genetic engineering**, the direct manipulation of genes for practical purposes.
- Genetic engineering is now applied in agriculture, criminal law, medical research etc.

The Stages of Biotechnology Development

- **Ancient biotechnology-** early history as related to food and shelter; Includes domestication
- **Classical biotechnology-** built on ancient biotechnology; Fermentation promoted food production, and medicine
- **Modern biotechnology-** manipulates genetic information in organism; Genetic engineering

The Areas of Biotechnology

- Organismic biotechnology - uses intact organisms; Does not alter genetic material
- Molecular biotechnology - alters genetic makeup to achieve specific goals
  - Transgenic organism - an organism with artificially altered genetic material

The Benefits of Biotechnology

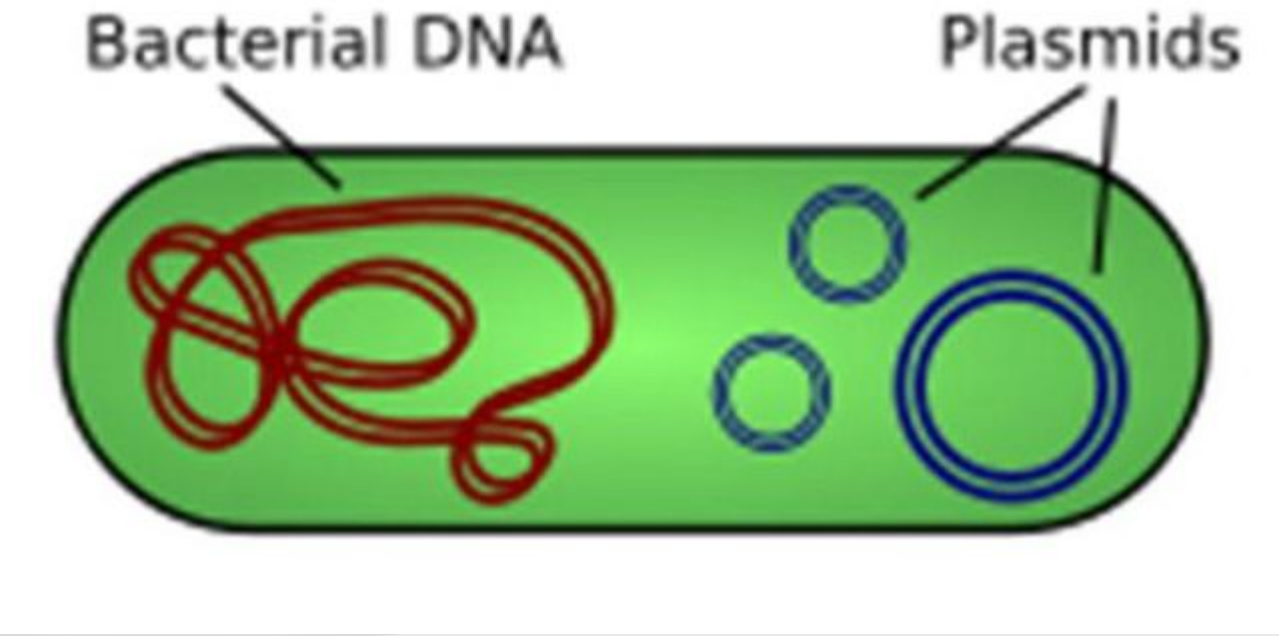
- Medicine
  - Human
  - Veterinary
  - Biopharming
- Environment
- Agriculture
- Food products
- Industry and manufacturing

UNDERSTANDING RECOMBINANT DNA TECHNOLOGY

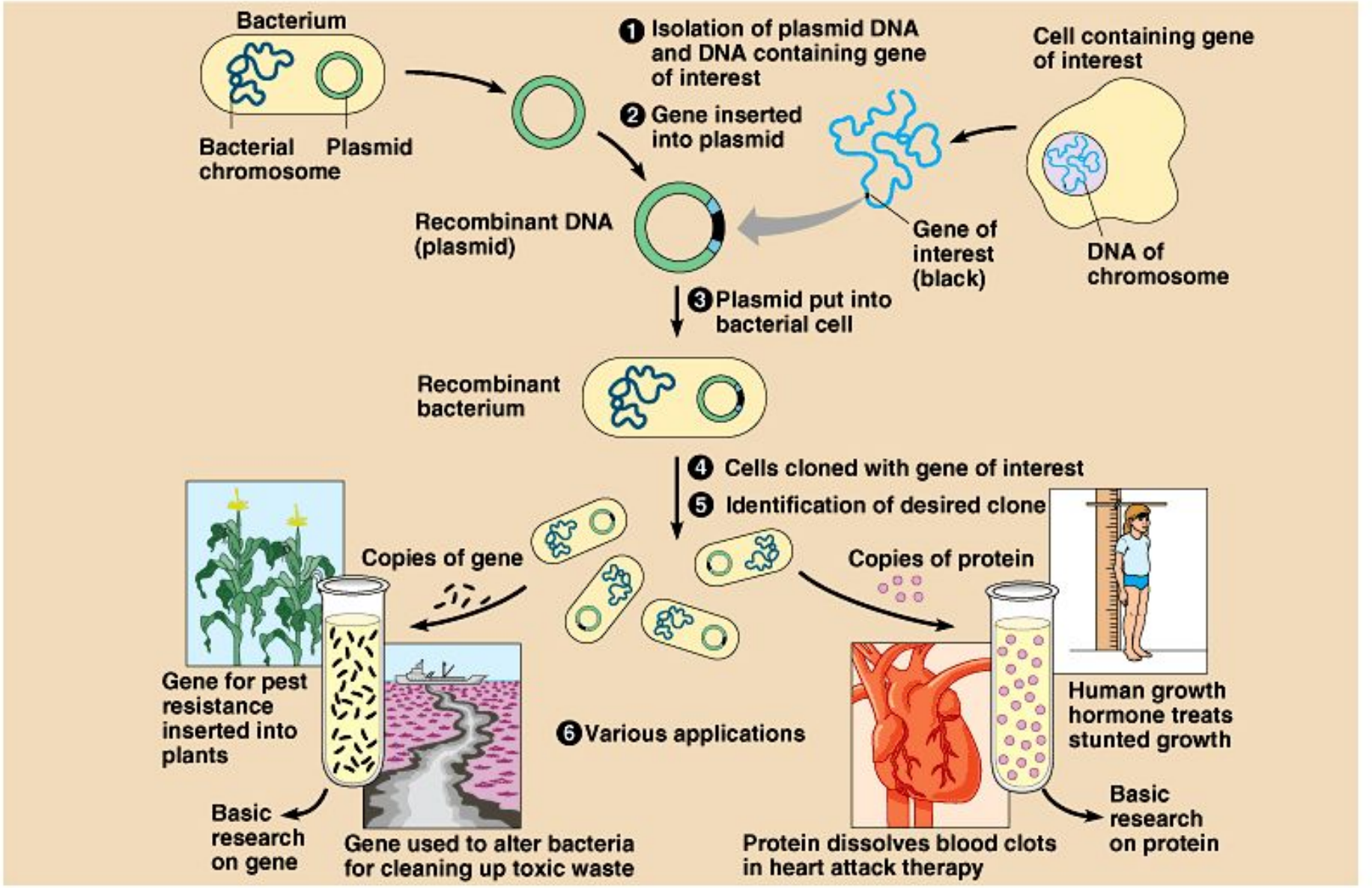
- Recombinant DNA is a DNA molecules formed when segments of DNA from two different sources, often different species, are combined *in vitro (in a test tube).*

DNA cloning

- Methods for preparing well-defined segments of DNA in multiple identical copies.



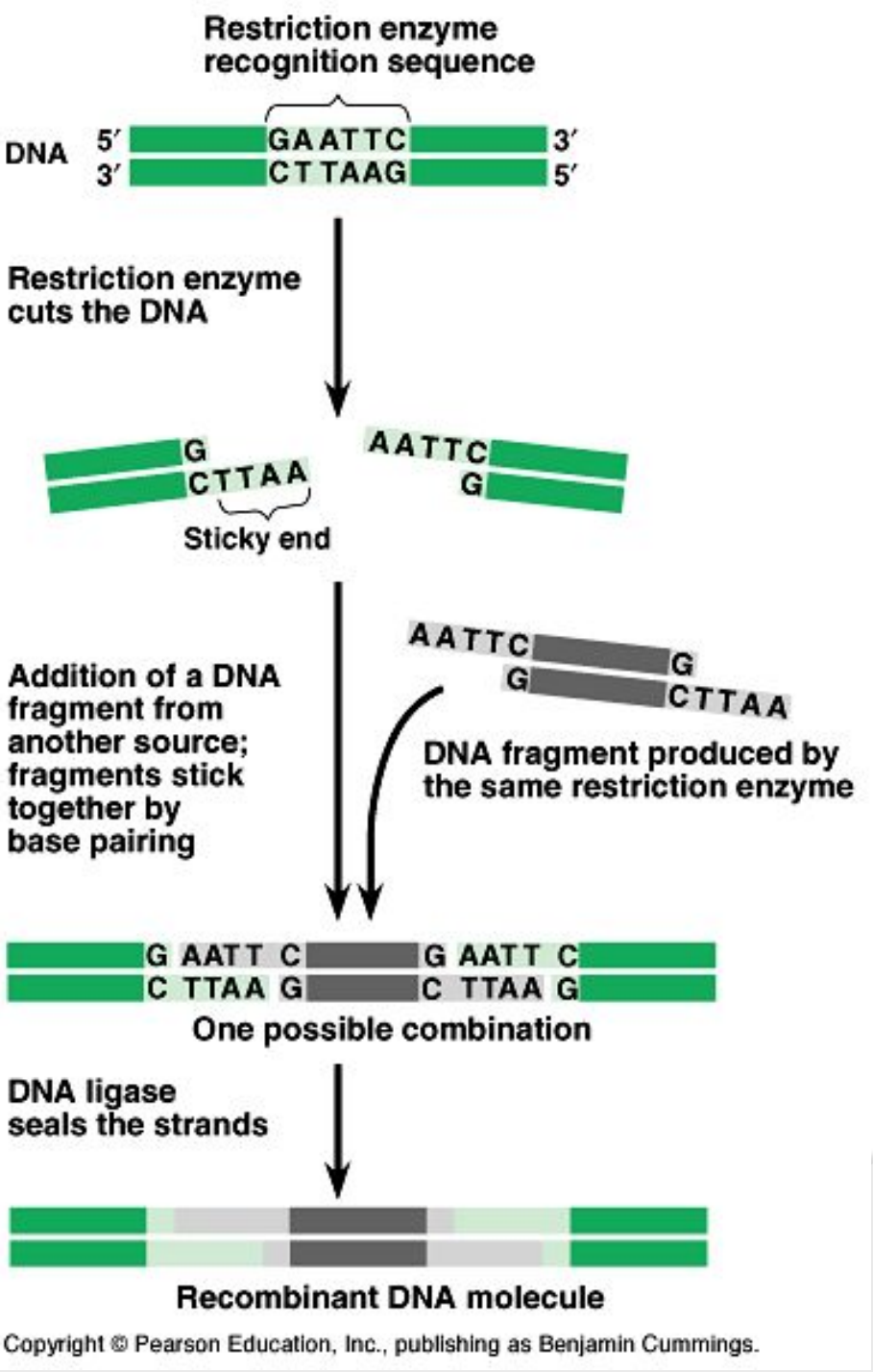
- *Escherichia coli* chromosome is a large circular molecule of DNA.
- In addition, *E. coli* and many other bacteria have **plasmids**, small circular DNA molecules.
- To clone pieces of DNA in the laboratory, researchers first isolate a plasmid from a bacterial cell and insert DNA from another source ("foreign" DNA) into it.
- The resulting plasmid is now a recombinant DNA molecule, combining DNA from two sources.
- The plasmid is then returned to a bacterial cell, producing a *recombinant bacterium.*
- This single cell reproduces through repeated cell divisions to form a clone of cells with foreign DNA and any genes it carries.



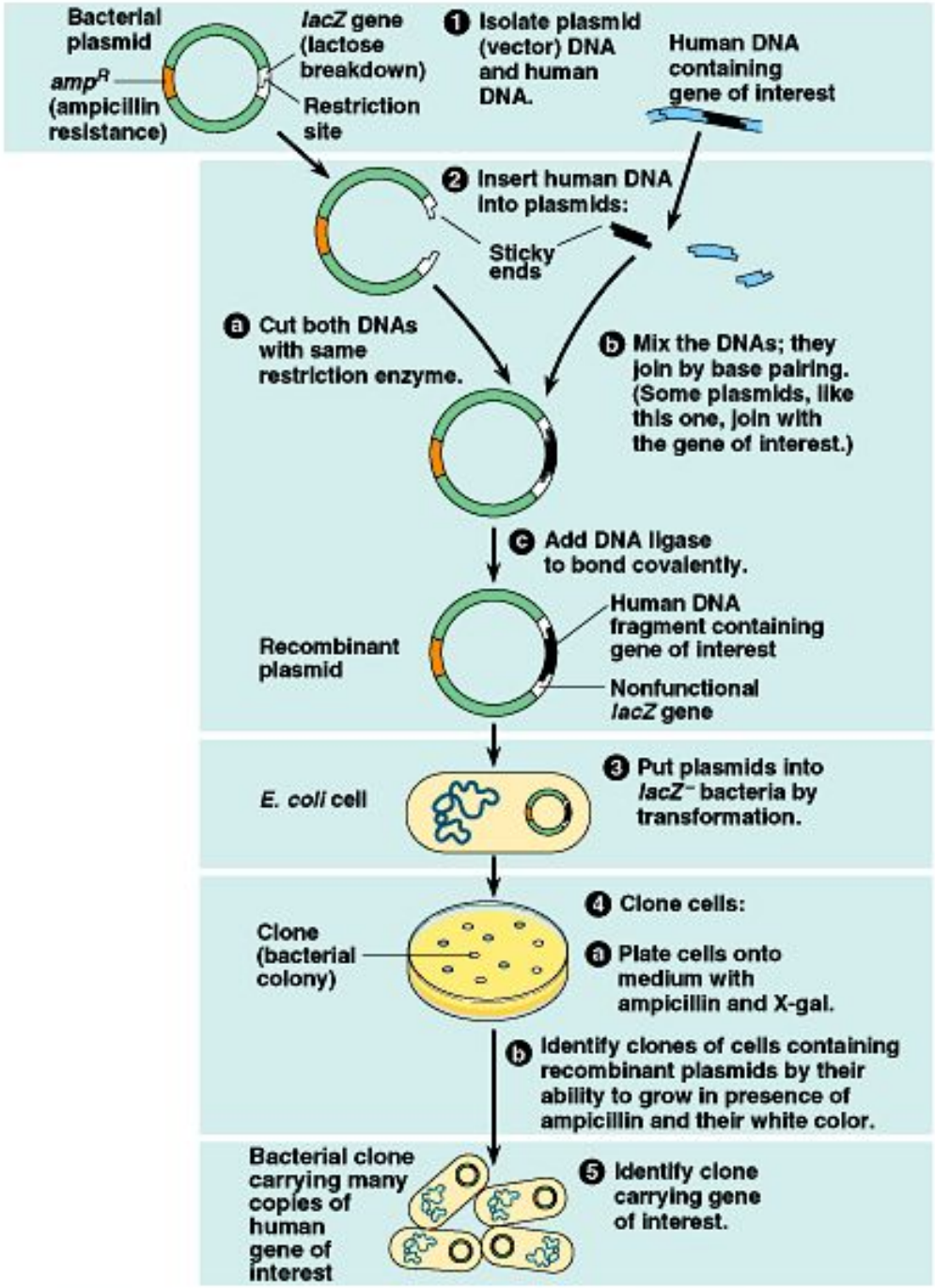
Using Restriction Enzymes to Make Recombinant DNA

- These enzymes cut DNA molecules.
- Each restriction enzyme is very specific, recognizing a particular short DNA sequence, or **restriction site**, and cutting both DNA strands at precise points within this restriction site.

- Restriction enzymes cleave the sugar-phosphate backbones in the two DNA strands in a staggered manner.
- The resulting double stranded restriction fragments have at least one single stranded end, called a **sticky end**.
- These short extensions can form hydrogen-bonded base pairs with complementary sticky ends on any other DNA molecules cut with the same enzyme.
- The associations formed in this way are only temporary but can be made permanent by the enzyme **DNA ligase**.



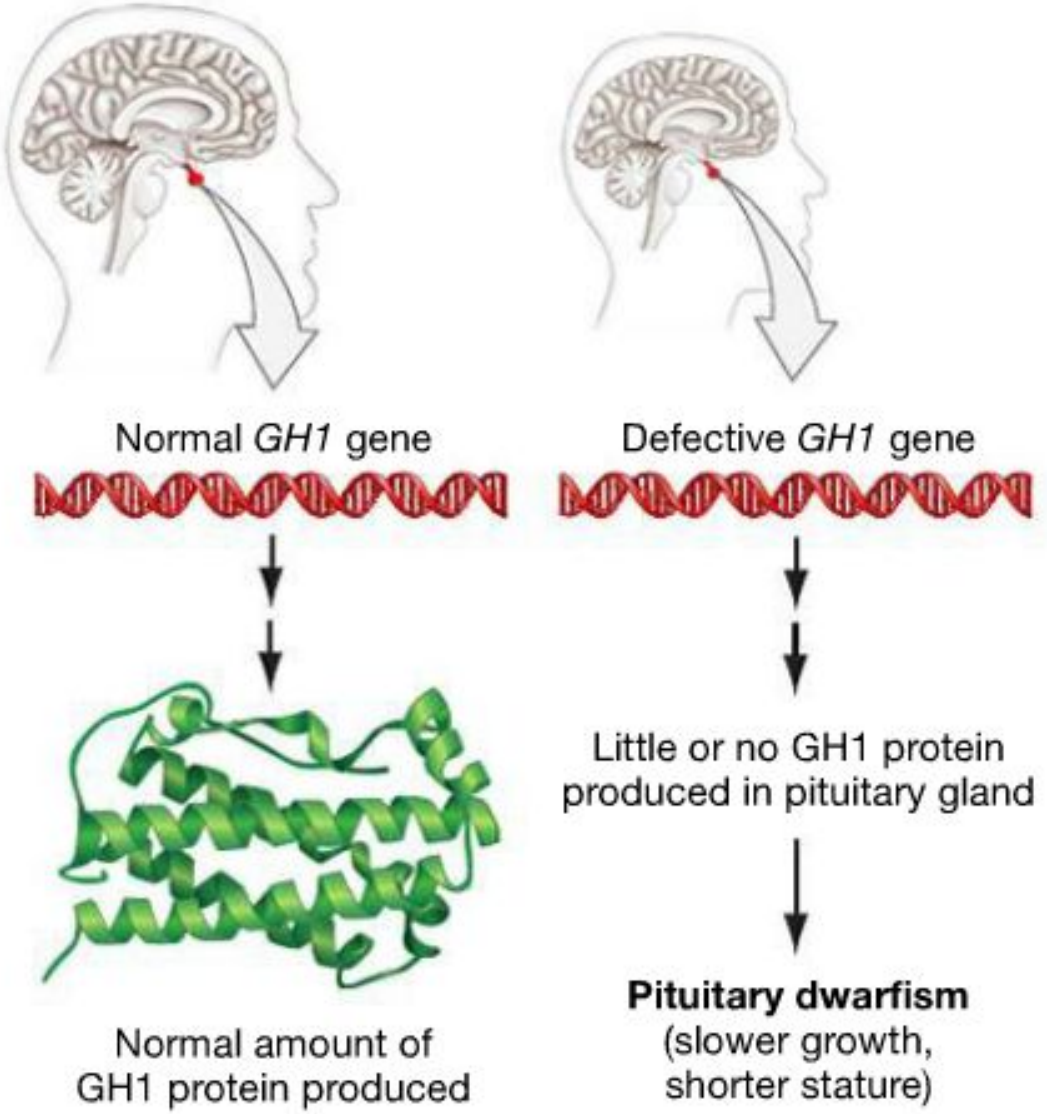
- The original plasmid is called a **cloning vector**, defined as a DNA molecule that can carry foreign DNA into a host cell and replicate there.
- Bacterial plasmids are widely used as cloning vectors for several reasons.
- They can be easily isolated from bacteria,
- manipulated to form recombinant plasmids by insertion of foreign DNA *in vitro,*
- and then reintroduced into bacterial cells.
- Moreover, recombinant bacterial plasmids (and the foreign DNA they carry) multiply rapidly owing to the high reproductive rate of their host cells.



The effort to cure pituitary dwarfism

- Human growth hormone (HGH) is a 191 amino acid protein.
- The gene that code for it is called *GH1*.
- Pituitary dwarfism, type 1, is a chromosomal recessive disorder:
- Damage in *GH1* gene,
- Fail to produce HGH,
- Dwarfism.

(a) *GH1* codes for a pituitary growth hormone.

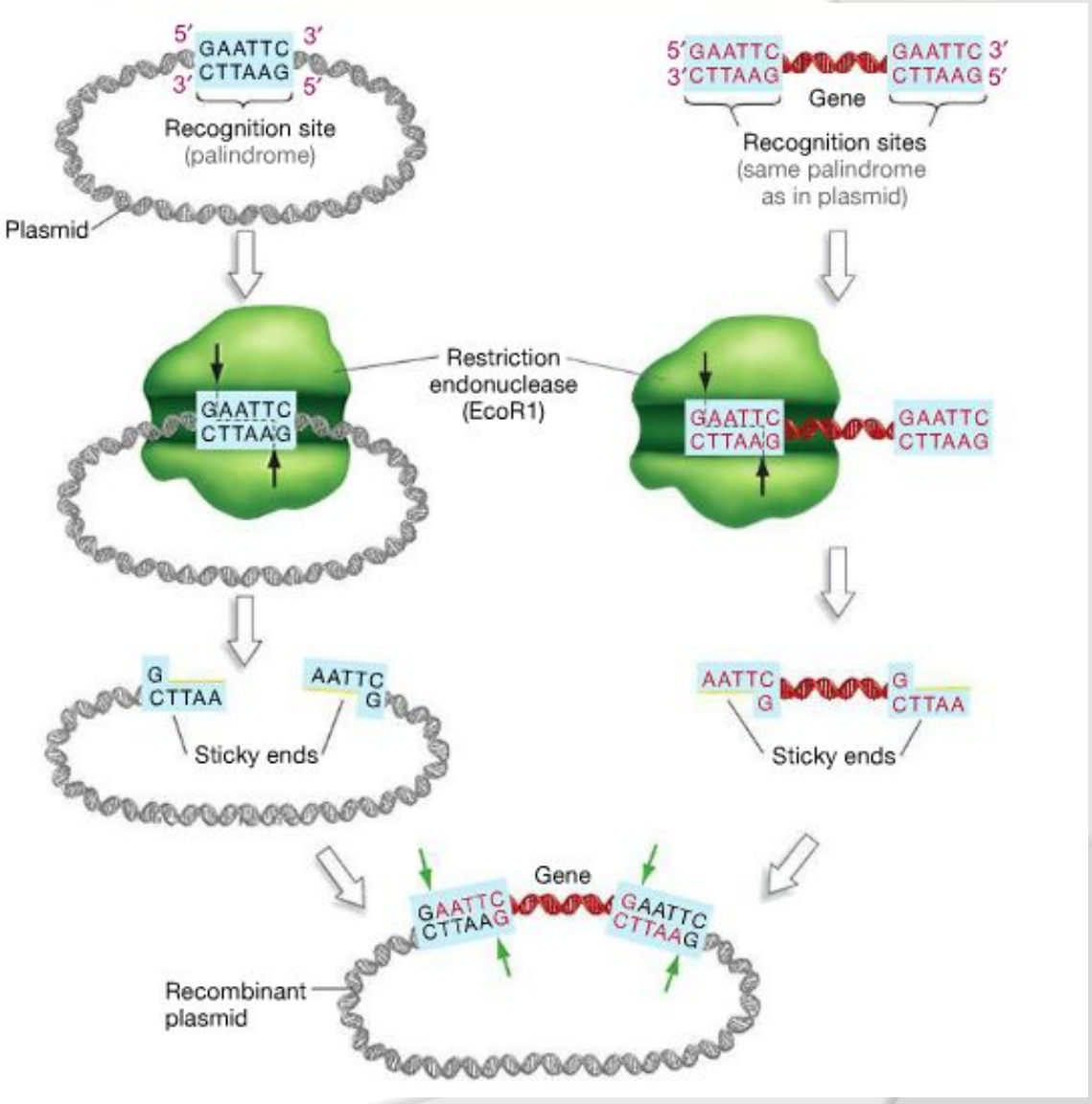


(b) Normal versus GH1-deficient

Steps in engineering a safe supply of Growth Hormone

- A reverse transcriptase is an enzyme that produce DNA according to the information on RNA.
- This DNA molecule is called complementary DNA or **cDNA**.
- Knowing that GH1 is actively transcribed in cells from the pituitary gland, researchers isolated mRNAs to cDNAs.
- These cDNAs correspond to each gene that is actively expressed in pituitary cells.

- DNA cloning: insert DNA of interest into plasmid.
- Insert plasmid into *recombinant bacterium* – transformation.



HW – reports (7 min)

- Human Gene Therapy
- Pharmaceutical Products
- Forensic evidence and Genetic profile
- Agricultural Applications
- Safety and ethical questions raised by DNA technology