Agricultural Biotechnology

by

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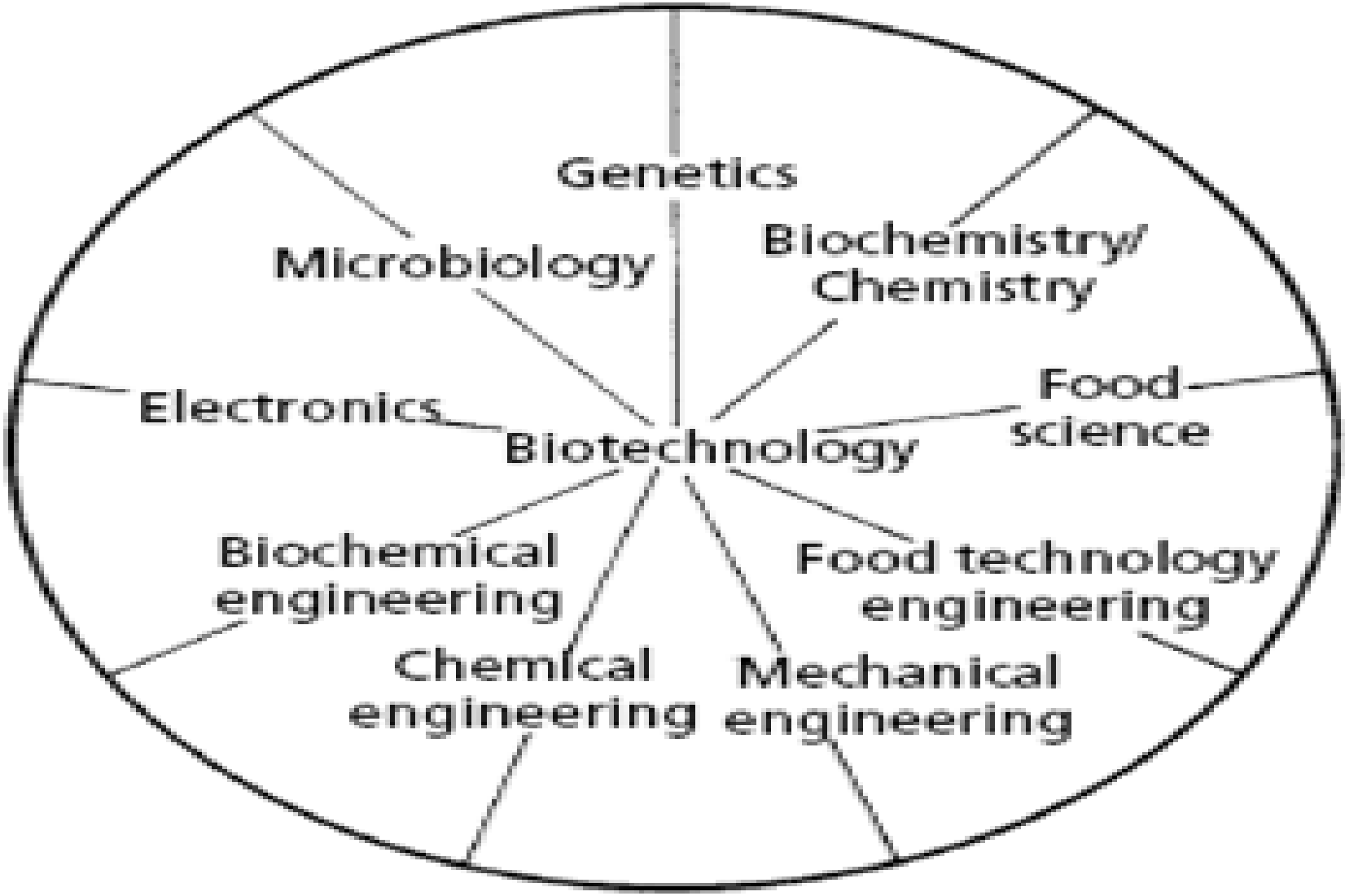
What is biotechnology?

Some selected definitions of biotechnology

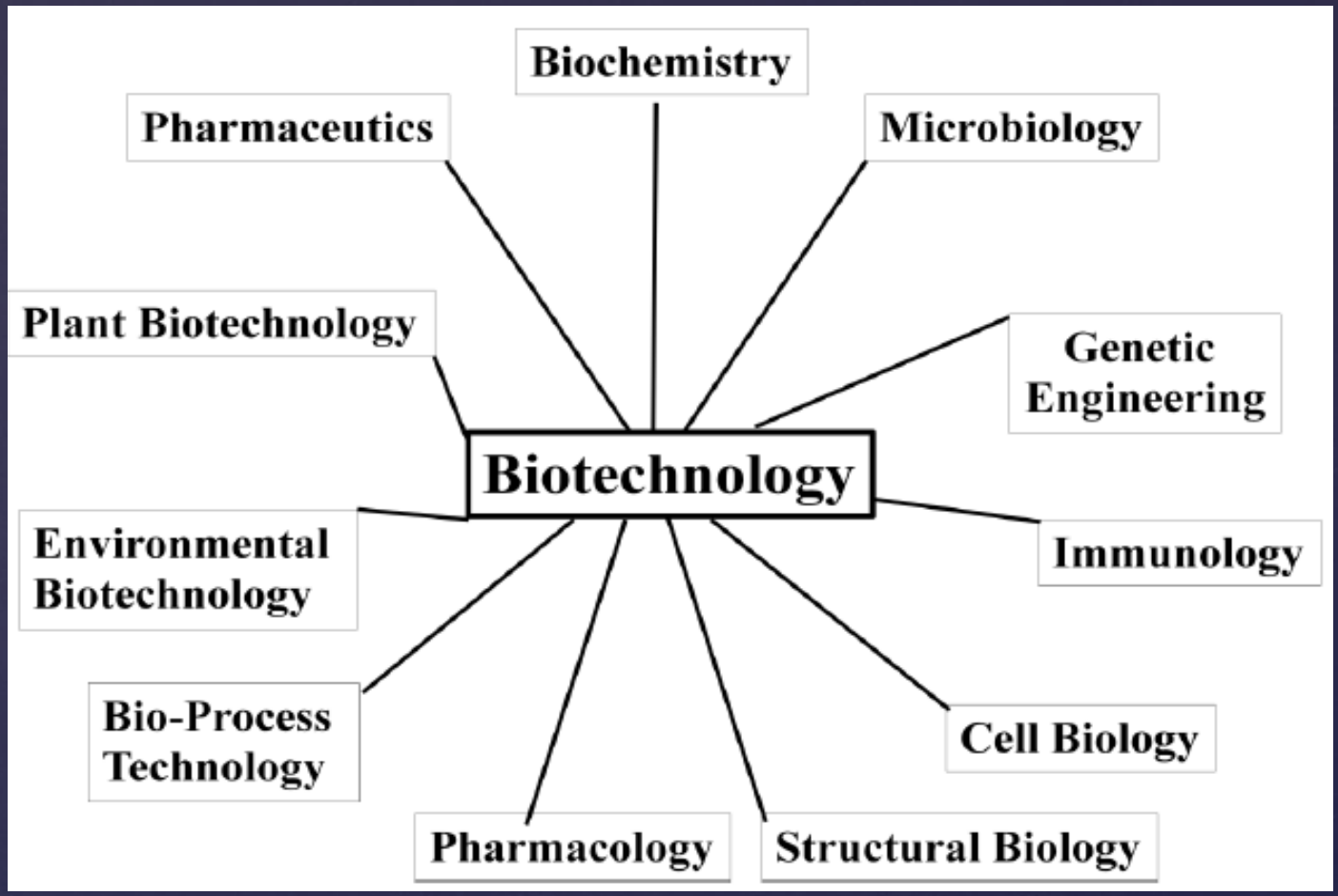
-A technology using biological phenomena for copying and manufacturing various kinds of useful substances.

-The application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services.

-Use of genetic engineering for the production of useful materials



Different subjects or areas of biotechnology



Different Science fields contributing into the advancement of biotechnology

One of the biggest problems facing the world today is population growth, especially in developing nations. Conventional agriculture may not be able to provide sufficient supply of food and, in particular, protein. However, productivity is increasing throughout the world in all branches of agriculture. Biotechnological innovations will accelerate this trend.

Agricultural Biotechnology

- Insertion of gene(s) to improve:

– Taste and nutrition

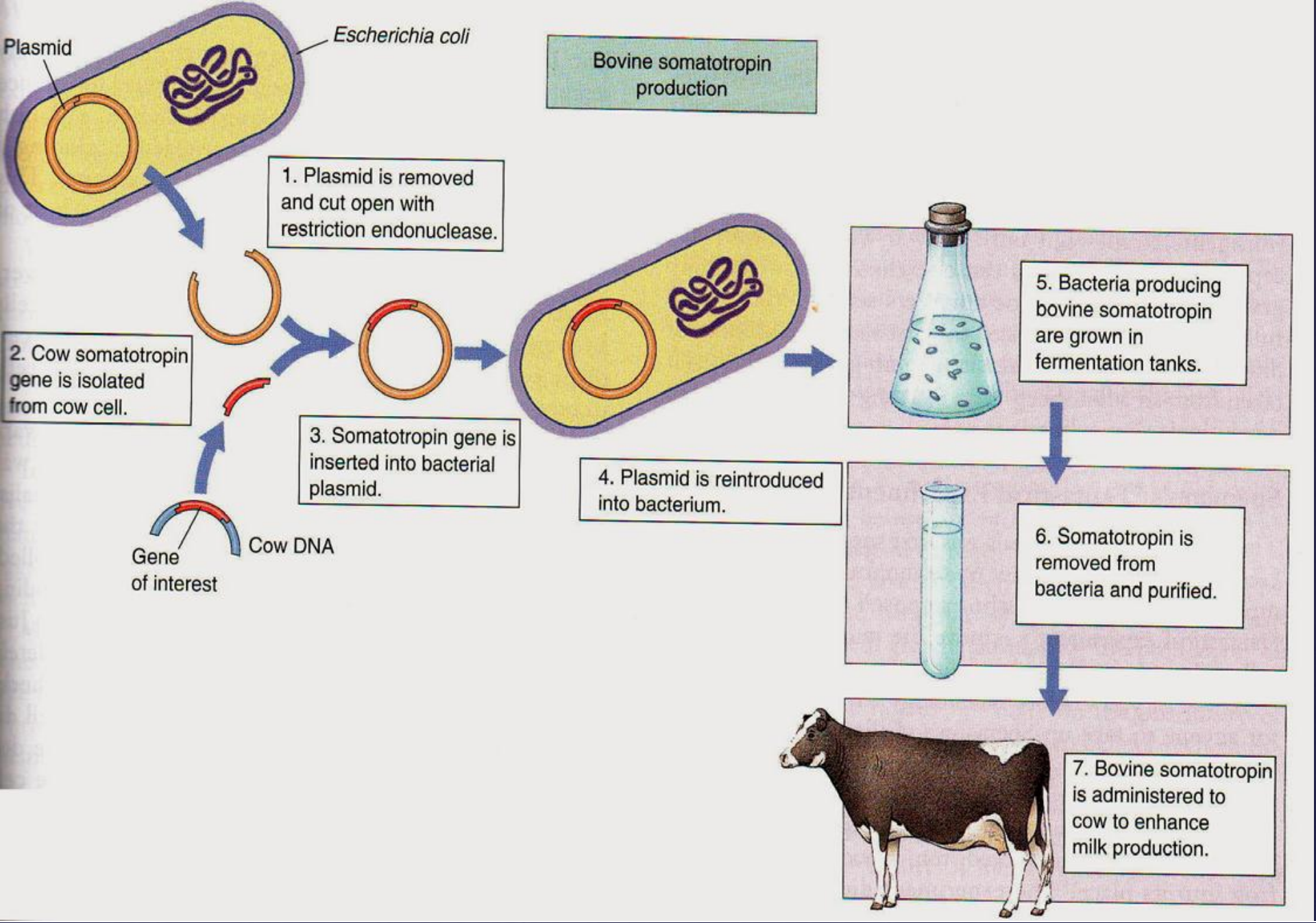
– Crop yield

– Crop hardiness

–Reduced dependency on fertilizers, pesticides, etc.

Genetically engineered farm animals

The pituitary gland of animals secretes growth hormones which can have major influence on how the animal grows and, in lactating animals, on milk production. In the 1980s the gene responsible for bovine growth hormone (somatotropin) production (BST) was successfully isolated and transferred into bacterial cells to produce large quantities of BST. When cows were injected with about 30 mg BST there was significant increase in milk production (10–30%).



Recombinant Bovine Somatotropin (rBST)

Single Cell Protein (SCP)

The use of microbes as protein producers has also gained wide experimental success. This field of study has become known as single cell protein production (SCP) and reflects the fact that most microorganisms used as producers grow as single (bacteria, yeast) or filamentous fungi and algae individuals rather than as complex multicellular organisms such as plants or animals.

Applications of SCP:

1.Cheese industry: the huge amounts of whey that otherwise are dumped as sewage (can contaminate drinking water), are further processed by GM-yeast that use up the remnant lactose, proteins, and vitamins. Nowadays, the resulting product is used as food supplements for cattle.

2.Sugar industry: molasses the end product in sugar refinery used by GM-bacteria to obtain a cattle food supplement.

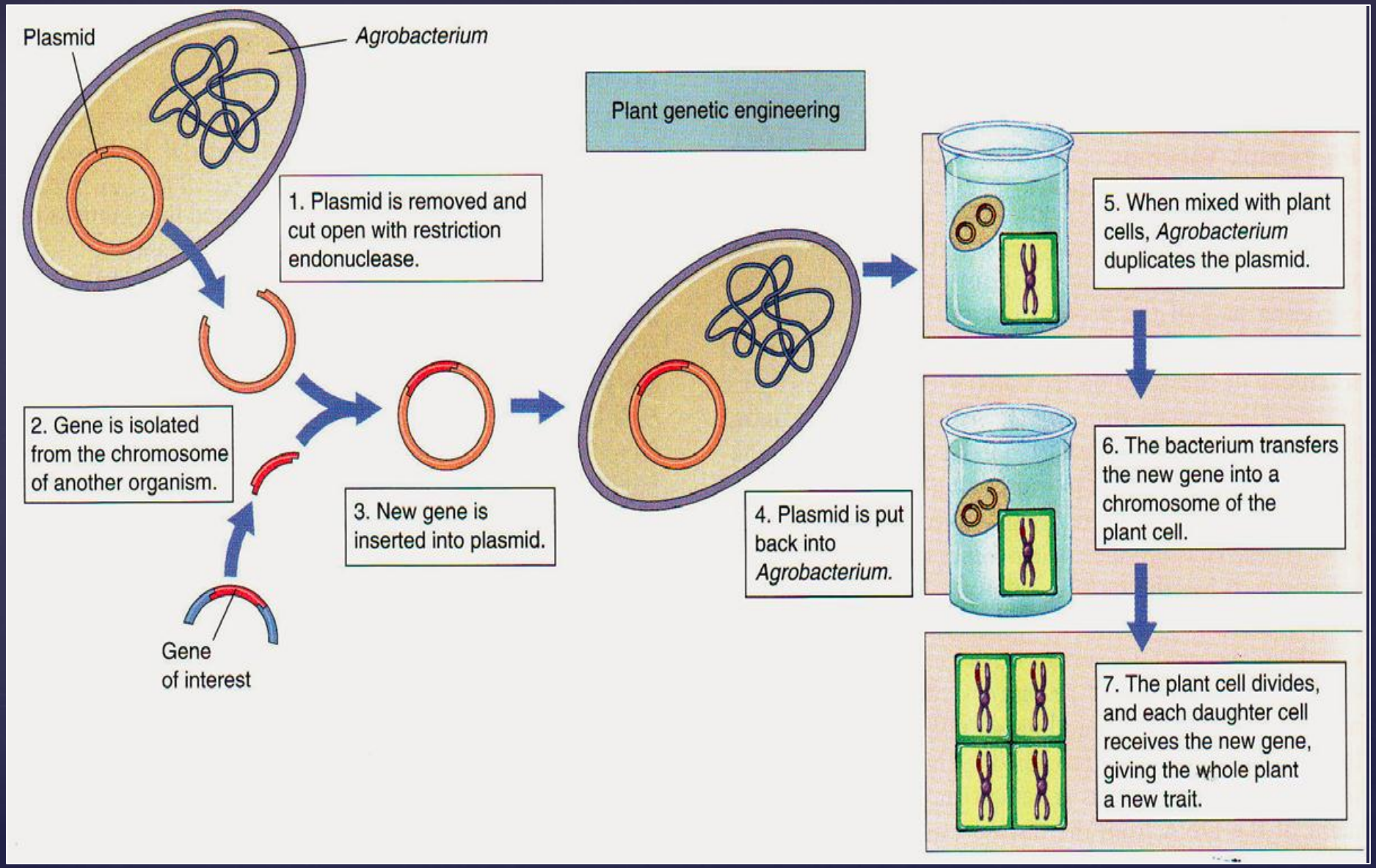
3.Sulphite liquor: a waste product of paper mills contains low levels of sugar; feeding GM-fungi with this low-level nutrient, yields bio-degradable waste.

4.Natural gas: with the help of GM-methanous bacteria, this gas can be converted to long-chain hydrocarbons; i.e. liquid fuel;

5.Alkanes: straight chained alkanes are waxy oil; GM-modified bacteria that converts alkanes into primary substrates for the synthetic protein production.

Biotechnology in plant sciences

Genetic Engineering has allowed us to produce genetically modified plants with diversified properties such as resistance against **pest, drought, and abiotic stress**. These are few selected examples of advancement in the plant sciences due to technological contributions of biotechnology. Ti Plasmid a successful vector for plant cells, isolated from tumor-inducing bacteria of plant able to integrate in the DNA of infected plant cells. With the Ti Plasmid, we can make transgenic crop with desirable traits (as above, see below).

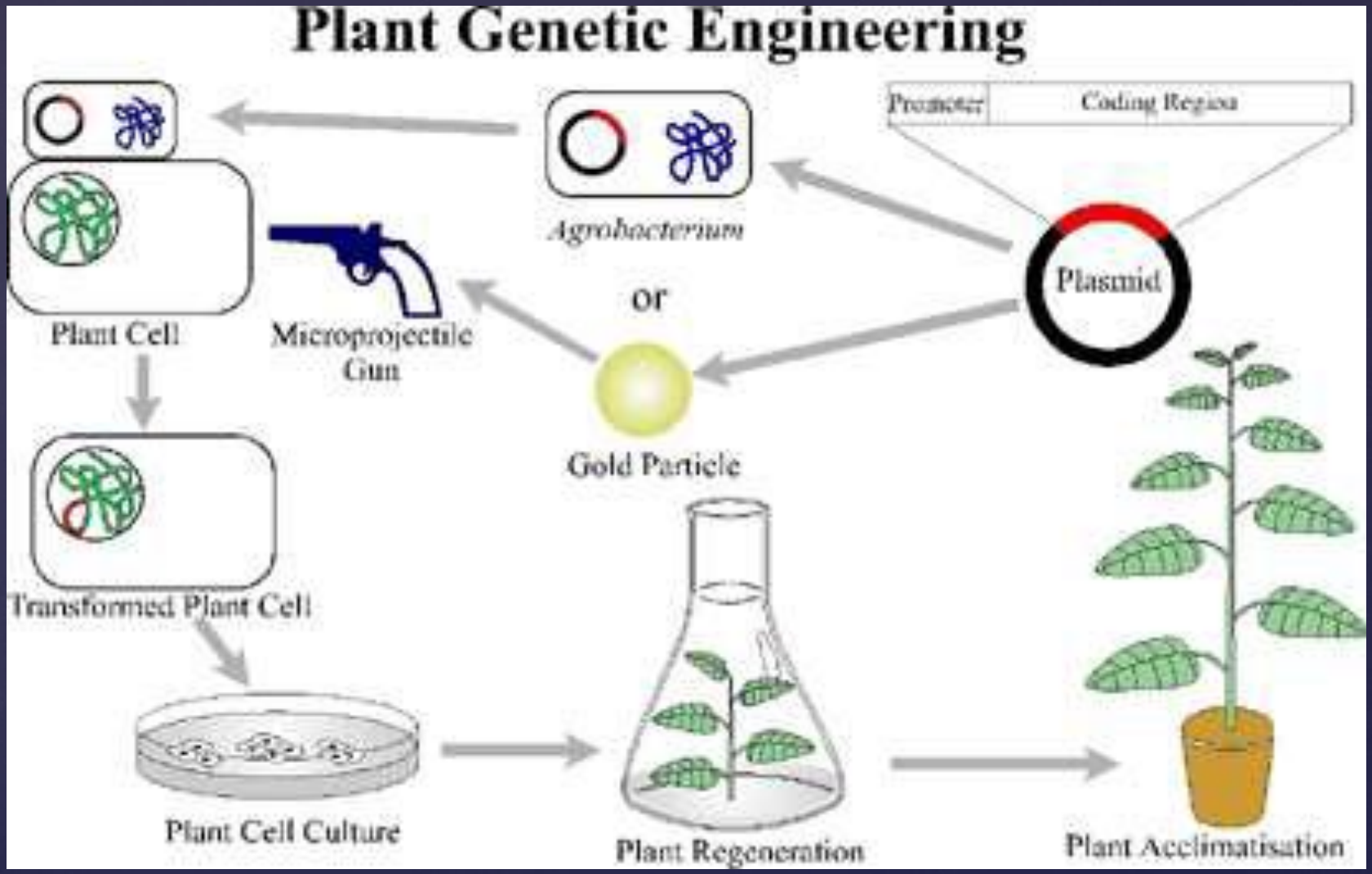


Transformation using *Agrobacterium tumefaciens* is the most common plant engineering method

Particle Bombardment

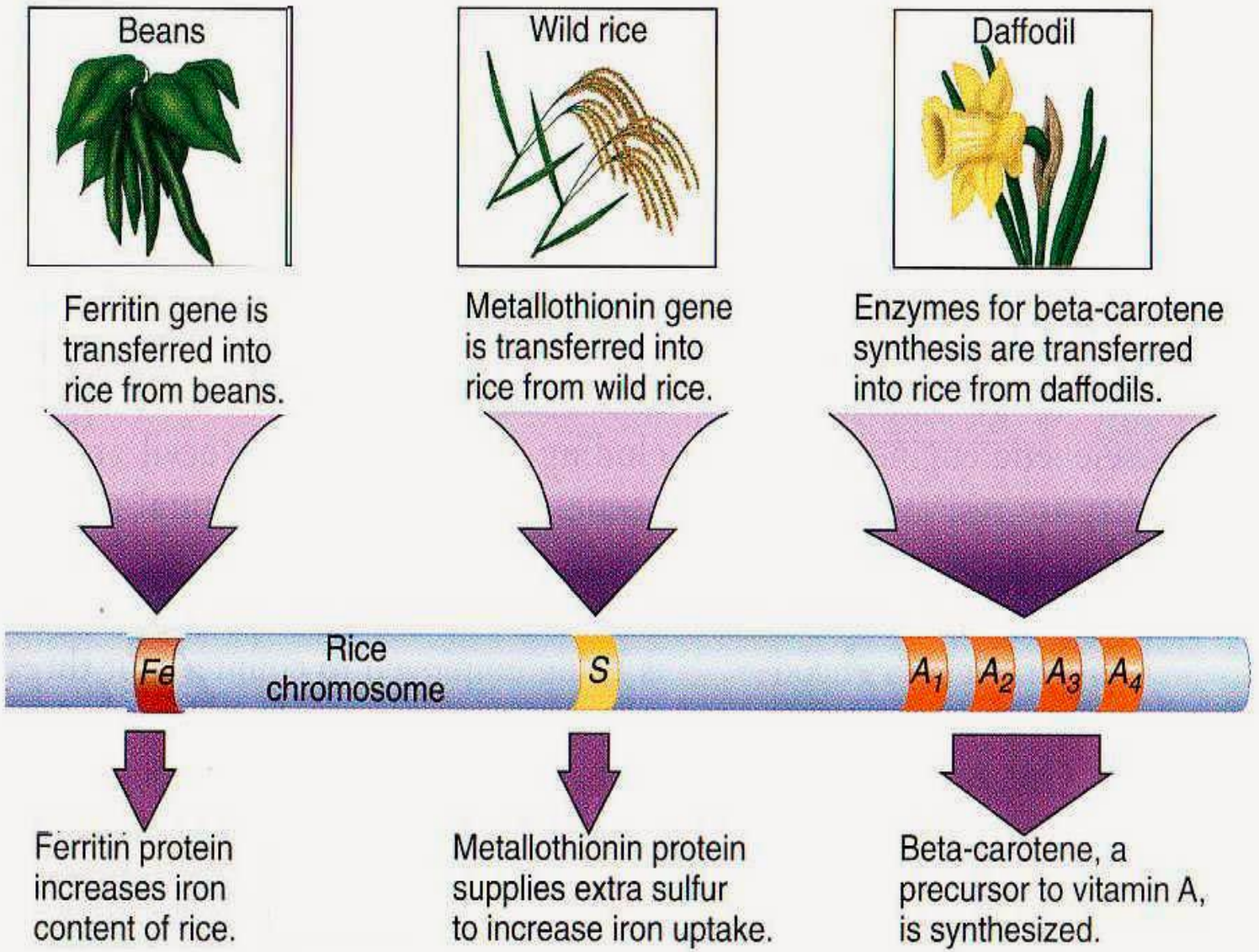
-Gold particles coated in plasmid DNA are 'fired' into plant cells using a gene gun.

-Gets past cell wall and hopefully hits nucleus.


Plant Genetic Engineering
Agrobacterium
Plant Cell
Microprojectile Gun
or
Plasmid
Gold Particle
Transformed Plant Cell
Plant Cell Culture
Plant Regeneration
Plant Acclimatisation

Improving nutritional values: ex. transgenic rice

Problems of natural rice are too little iron, vitamin A and sulfur. Sulfur is required for iron uptake and absorption, rice has very little of it. Transgenic rice offers the promise of improving the diets of people in rice-consuming countries, where iron and vitamin A deficiencies are a serious problem.



Genes transfer to rice chromosome from other plants

Biofuels

Fuels made from biological processes

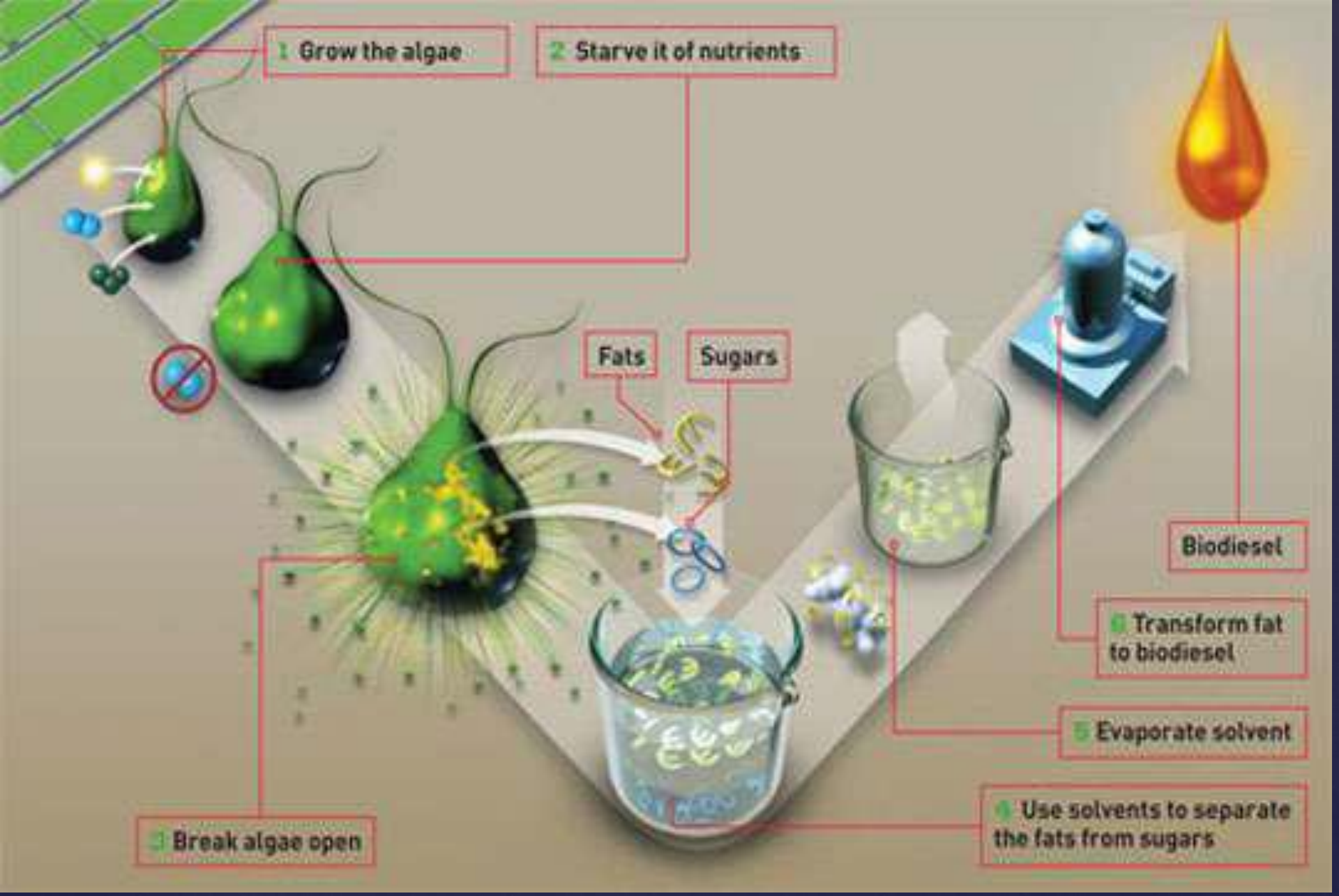
Ethanol Biofuels: produced through fermentation of starches and sugars

- Corn is the major source of starch and sugar in the U.S.
- Other sources include sugar cane and vegetable oil

Biodiesels: Produced by reacting animal and plant fats with alcohol (esterification)

-Almost exclusively algae, which produce oil in their cell walls

-The algal oil is refined into usable fuel using esterification.



Biodiesel Production

THANK YOU