

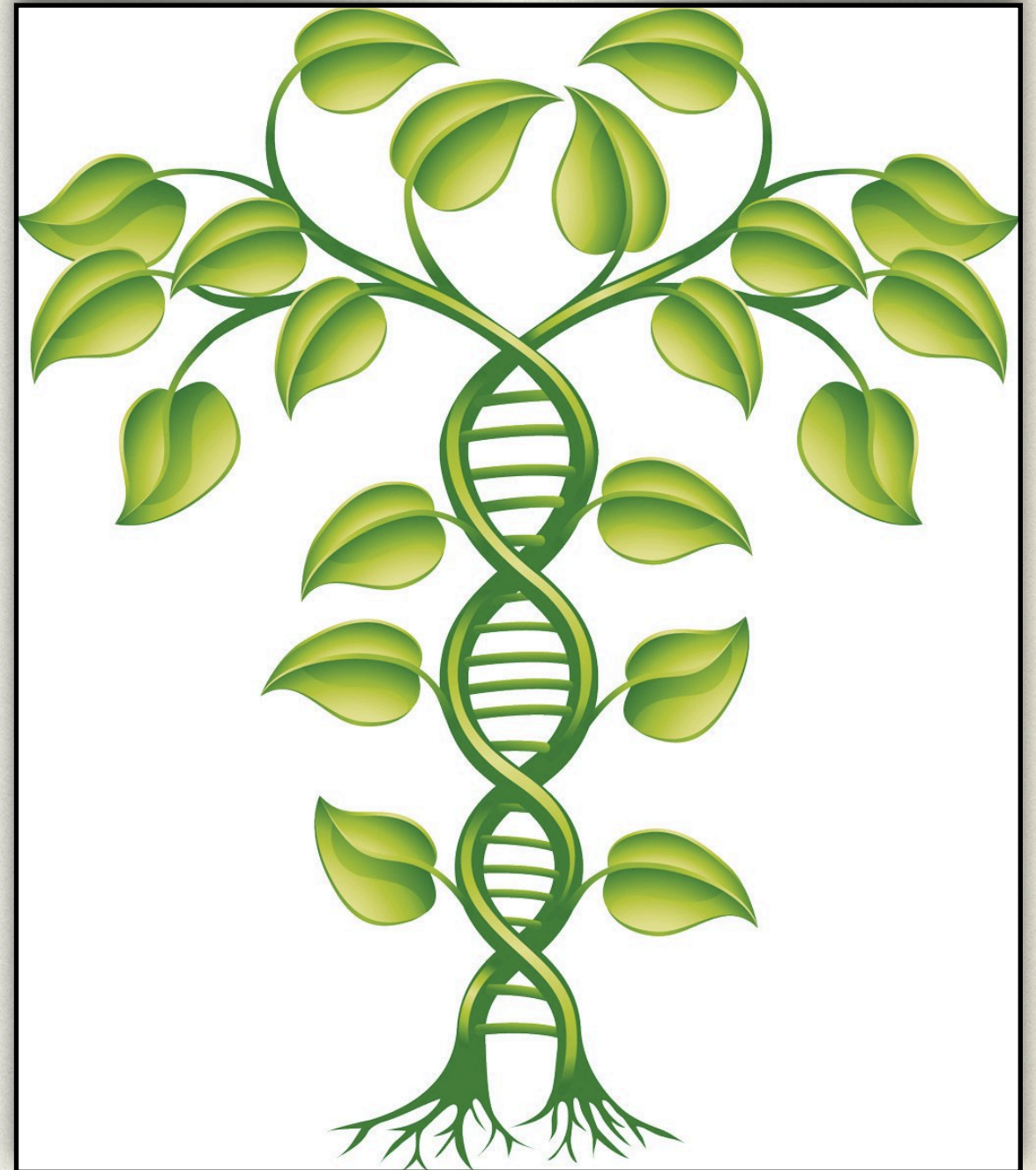
# BIOTECHNOLOGY

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# INTRODUCTION

- In 1919, Hungarian agri engineer Karl Ereky coined the term 'Biotechnology'
- Defined as technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use.





Feed the World

Major Areas

Fuel the World

Heal the World



Molecular biology

Bio-engineering

Over-lapping  
fields

Bio-  
manufacturing

Biomedical  
engineering

Molecular  
engineering



Genomics

Applied  
Immunology

Frontier  
Areas

Recombinant  
gene tech

Pharmaceuticals

Diagnostics



# GENETIC ENGINEERING

- Aka rDNA technology, deals with the production of new combinations of genetic material (artificially) in the laboratory.
- Techniques to alter the chemistry of genetic material, to introduce these into host organisms, & thus, change the phenotype of the host.
- Maintenance of sterile ambience is crucial to enable the growth of desired microbes/eukaryotic cells in large quantities



# GENETIC ENGINEERING

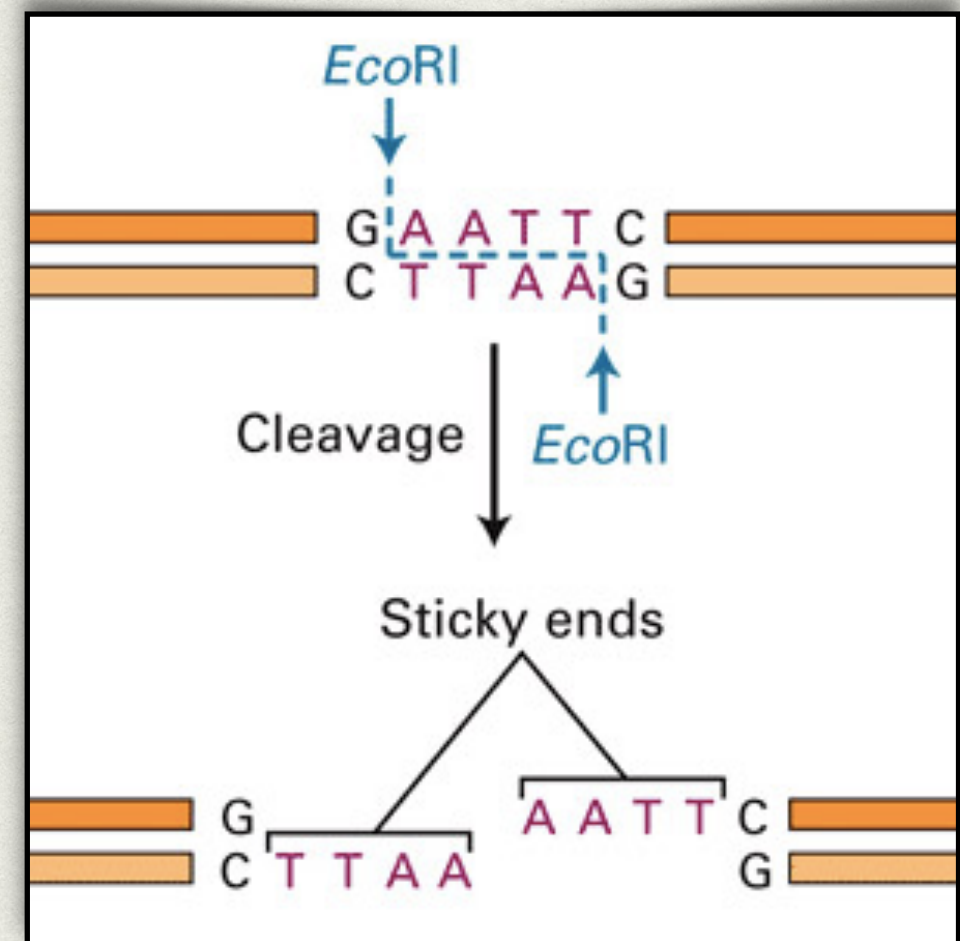
- Overcomes the limitation of traditional hybridisation techniques, where undesired genes get multiplied along with desired genes
- Origin of replication- the DNA sequence in the chromosome, responsible for initiating replication
- Cloning involves linking the alien DNA with 'origin of replication'





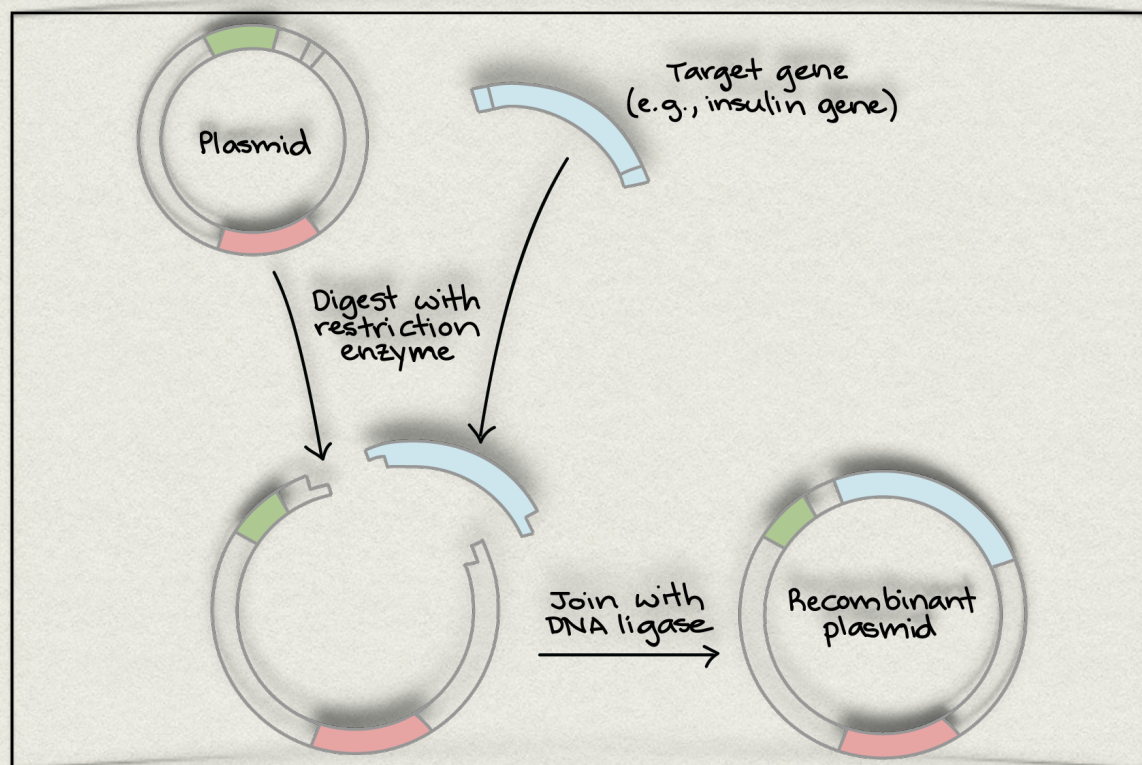
# RESTRICTION ENZYMES

- These are 'Molecular Scissors'
- Belong to a class of enzymes called 'Nucleases'
- Cut the strand of DNA a little away from centre of palindrome sites, leaving single stranded portions at the ends called 'Sticky ends'
- These ends can be joined together using 'DNA ligase'





# CLONING VECTORS



- Serve as a vehicle to carry foreign DNA sequence into a given host cell
- Should be relatively small in size
- Should have a unique restriction endonuclease recognition site
- Most common are Plasmids & Bacteriophages



Isolation of DNA

Fragmentation of DNA

By Restriction  
Endonucleases

Isolation of desired DNA fragment

Ligation of DNA fragment into a vector

Transferring the rDNA into the host

Culturing host cell (large scale) & extraction of desired product



# POLYMERASE CHAIN REACTION (PCR)

- A technique used in lab to make millions of copies of a particular section of DNA in vitro
- Developed by Karry Mullis in 1983
- It relies on a thermostable DNA polymerase, Taq polymerase (Thermus aquaticus- heat tolerant bacterium), & requires DNA polymers designed specifically for the DNA region of interest
- In PCR, the reaction is repeatedly cycled through a series of temperature changes, which allow many copies of the target region to be produced
- Routinely used in DNA cloning, medical diagnostics & forensic analysis of DNA



# STEPS

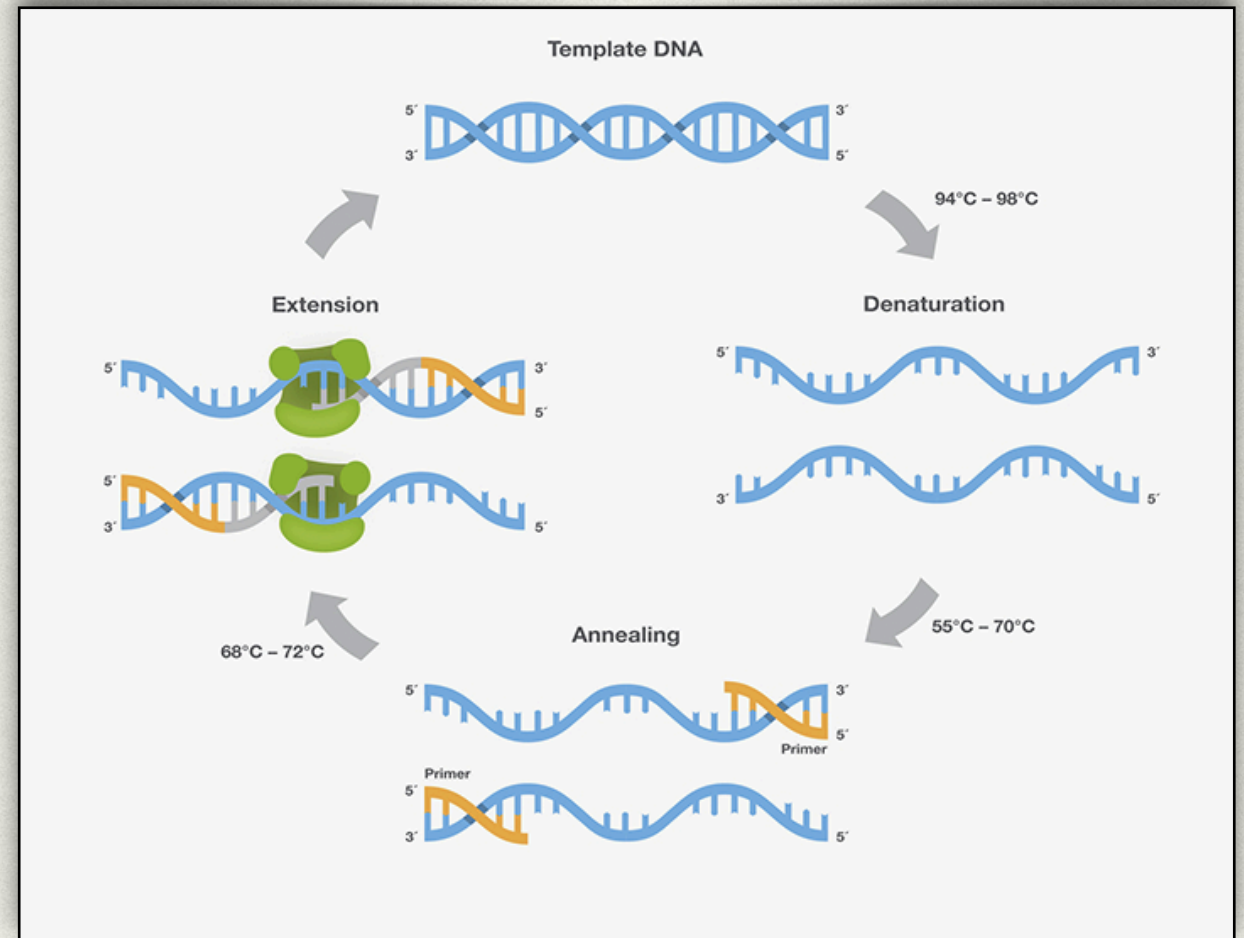
Denaturation



Annealing



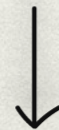
Extension





# THE PCR PROCESS

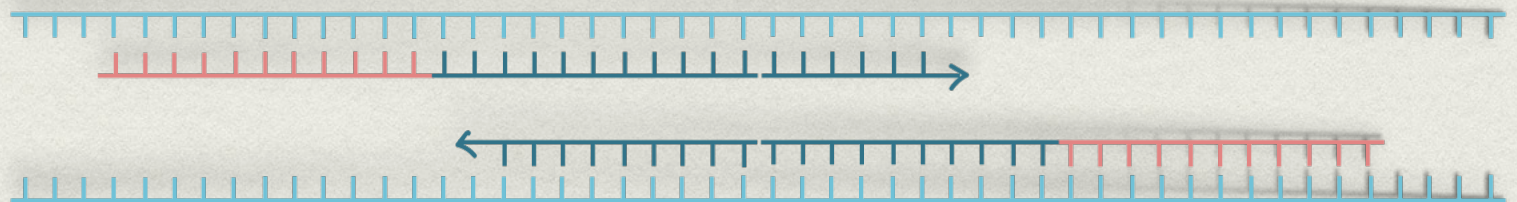
Template  
DNA



Primers bind  
to template



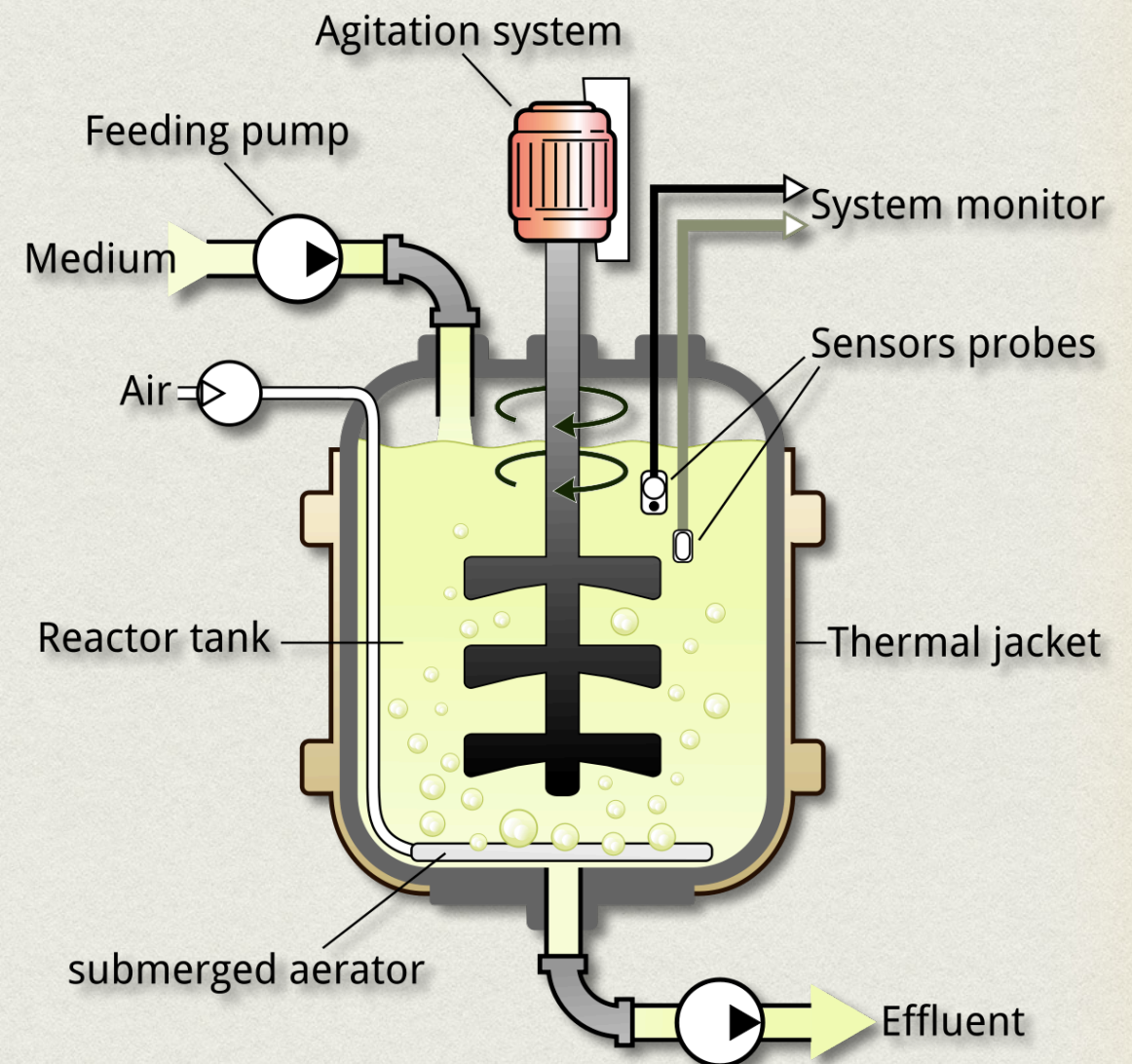
Taq polymerase  
extends primers





# BIOREACTOR

- Large volumes of cultures can be processed, so as to produce large quantities of gene copies
- Vessels in which raw materials can be biologically converted into specific products, individual enzymes, etc. using microbial plant, animal or human cells
- Provides optimum growth conditions





# APPLICATIONS IN AGRICULTURE

Organic agriculture

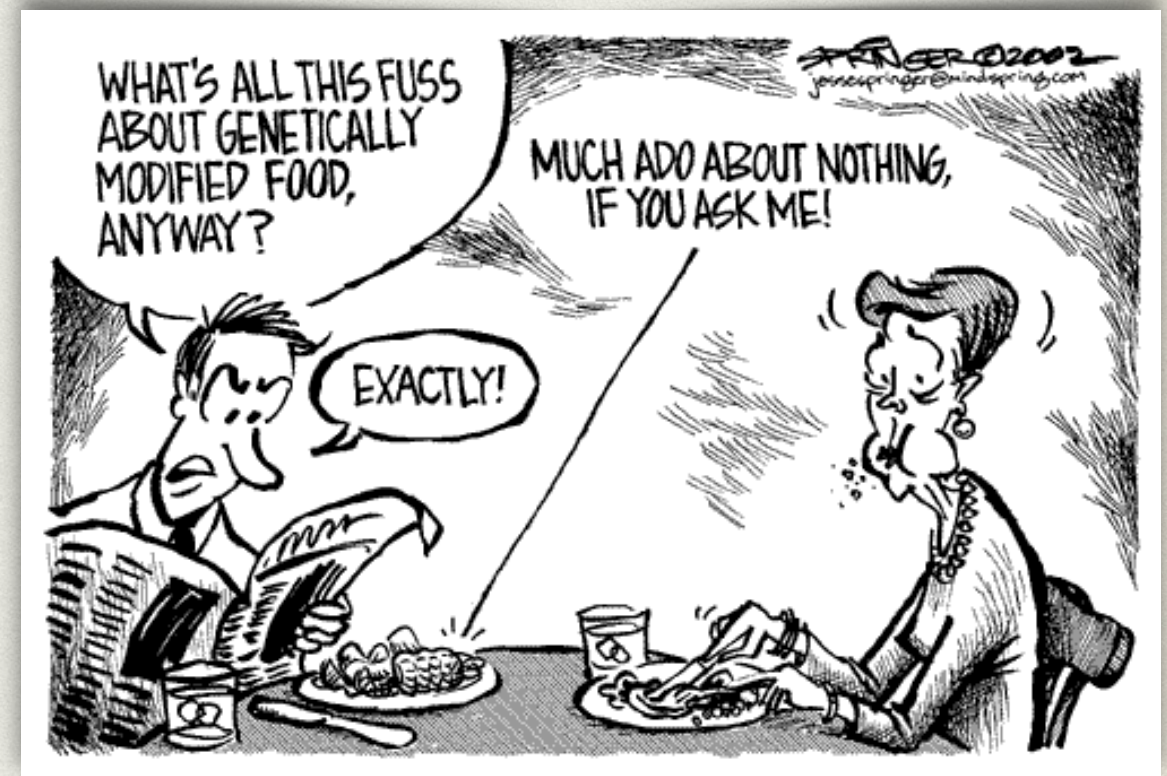
Agro-chemical based agriculture

Genetically-engineered crop-based agriculture



# GMO

- Plants, bacteria, fungi and animals whose genes have been altered by manipulation are GMOs.
- cry1AC from *Bacillus thuringensis*, pest resistant plants





Enhanced  
nutritional value

Reduced post-  
harvest losses

High efficiency of  
mineral usage

Advantages  
in agriculture

Tolerance to abiotic  
stresses

Less reliance on  
chemical pesticides



# APPLICATIONS IN MEDICINE

- Enabled mass production of safe & effective drugs
- Genetically-engineered insulin
- Gene therapy allows correction of gene defect when diagnosed in child or embryo



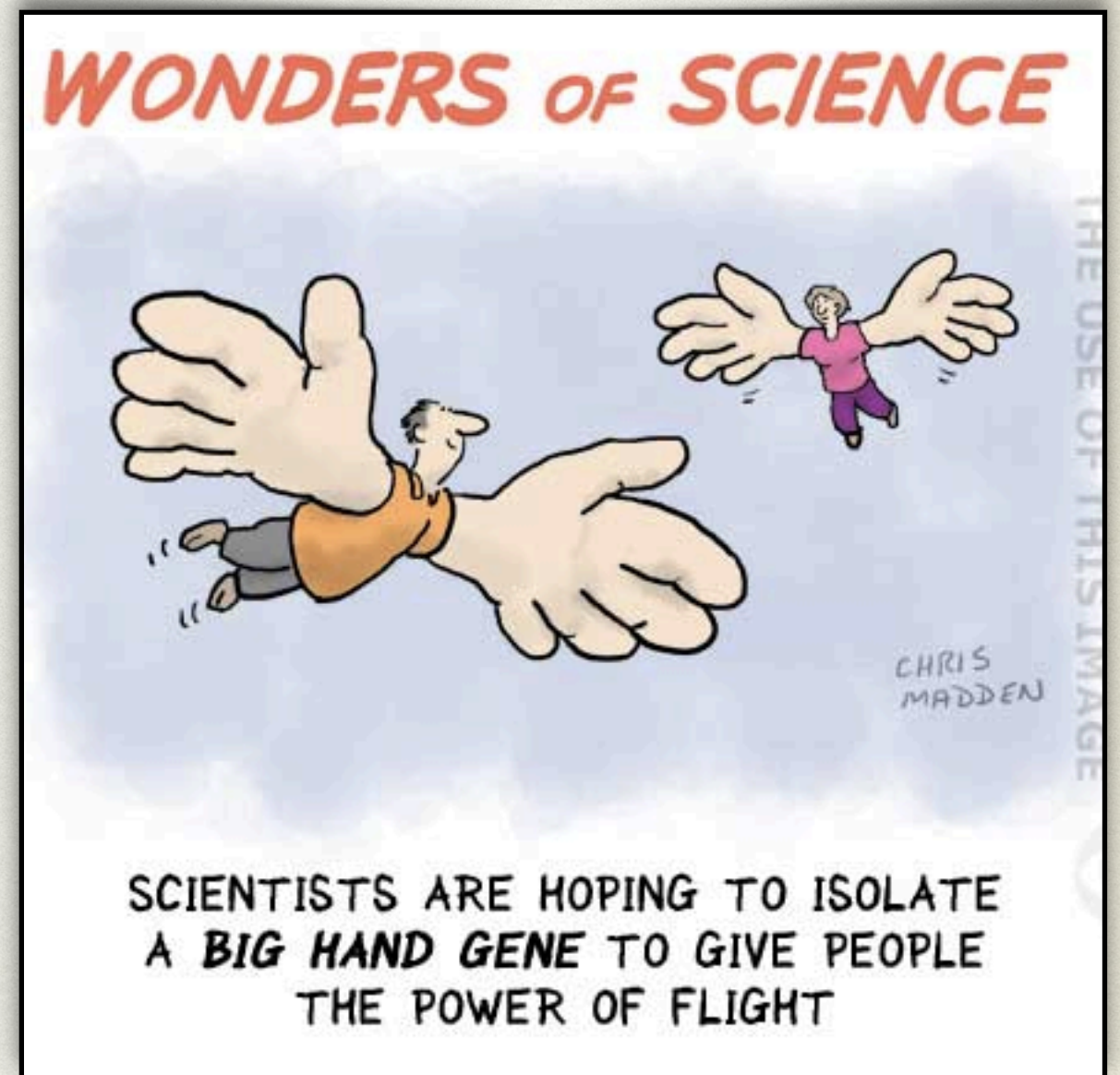
# MOLECULAR DIAGNOSIS

- PCR- Very low concentration of a bacteria or virus can be detected by amplification of their nucleic acid
- ELISA- Based on principle of Ag-Ab interaction



# TRANSGENICS

- Animals that have their DNA manipulated to possess & express an extra (foreign) gene
- Advantages- to study normal physiology, diseases, produce useful biological products, test vaccine safety & chemical safety testing





# HOW ARE TRANSGENICS CREATED?

- Micro-injection of DNA in pro-nuclei of fertilised egg, then implanted into oviduct of surrogate mother
- Inserting DNA into embryonic stem cells, then micro-injected into embryo
- Infecting an embryo with viruses that carry a DNA of interest. Used to manipulate a single gene; removing/knocking-out target gene—> ‘Knock-out’ animal



# KEY-WORDS

GEAC

Bio Piracy

Bio Patent



“Once we accept our limits, we go beyond them.”

**-Albert Einstein**