BIOTECHNOLOGY

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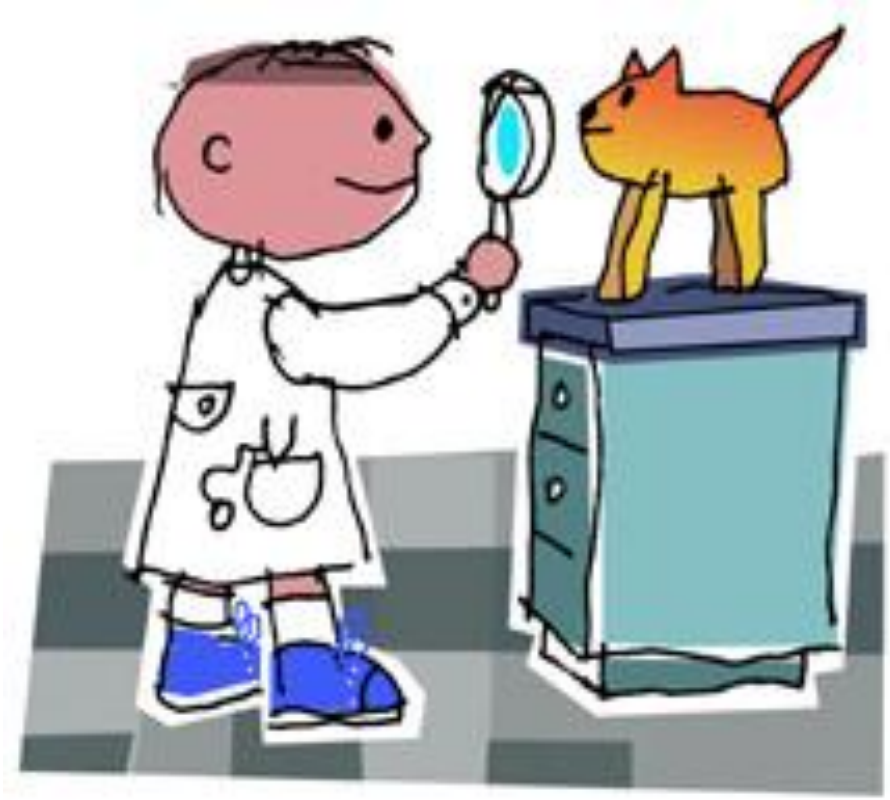
Biotechnology: general impressions



What is Biotechnology?

How about some definitions

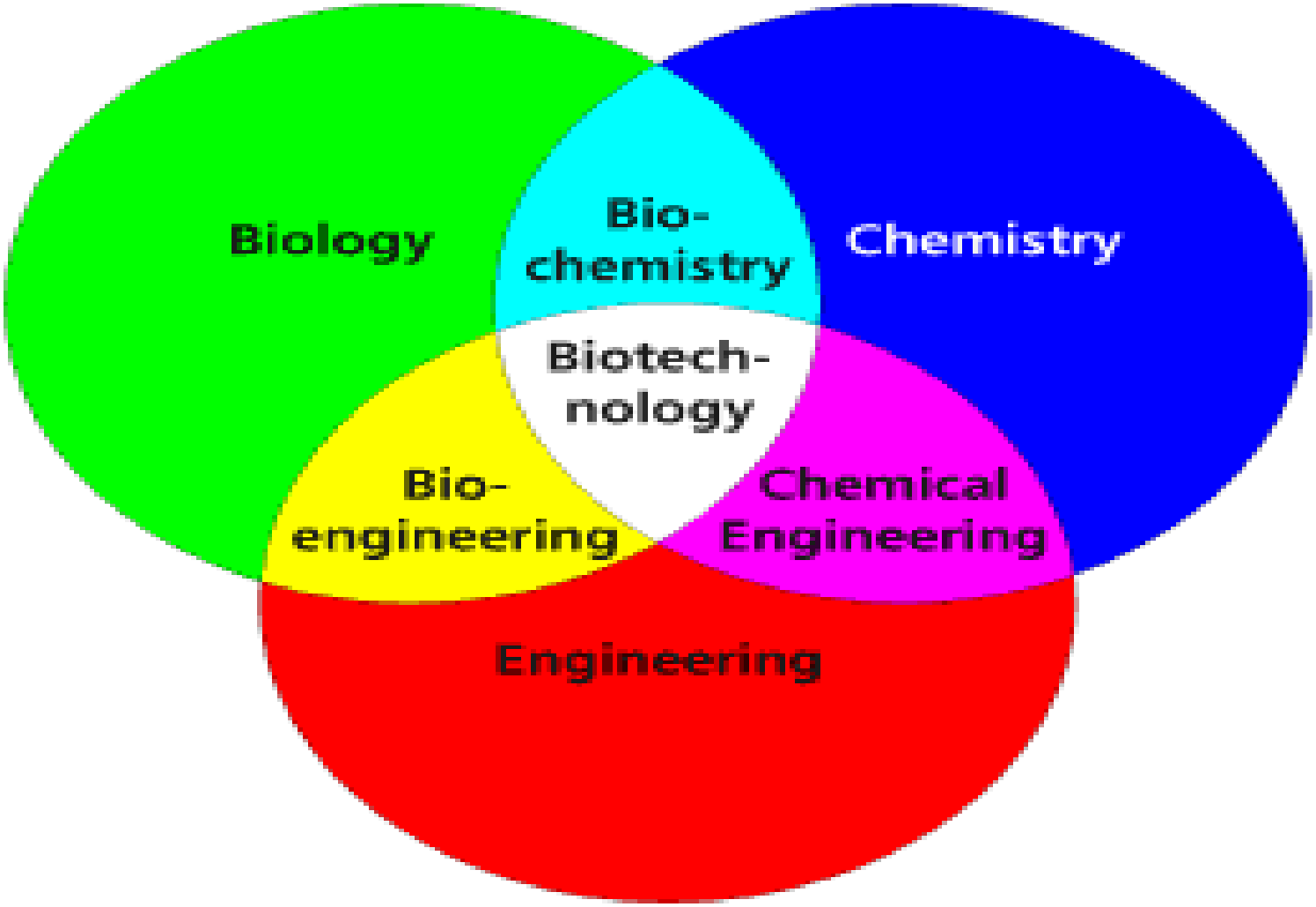
General Definition

The application of technology to improve a biological organism

Detailed Definition

The application of the technology to modify the biological function of an organism by adding genes from another organism

Biology + chemistry + engineering



Bioteknologi merah (*red biotechnology*) adalah cabang ilmu bioteknologi yang mempelajari aplikasi bioeknologi di bidang medis. Cakupannya meliputi seluruh spektrum pengobatan manusia, mulai dari tahap preventif, diagnosis, dan pengobatan.

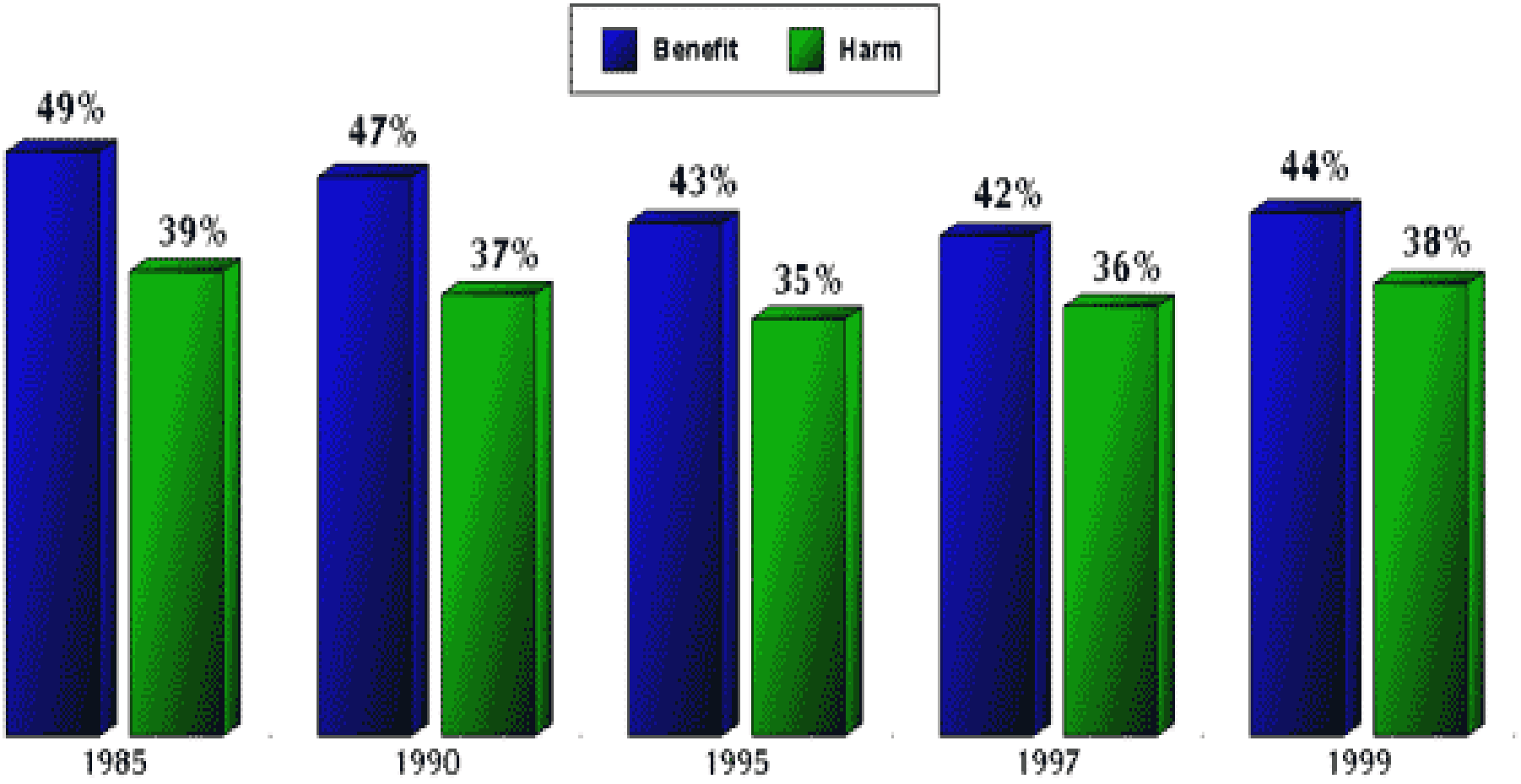
Bioteknologi hijau (*green biotechnology*) mempelajari aplikasi bioteknologi di bidang pertanian dan peternakan. Di bidang pertanian, bioteknologi telah berperan dalam menghasilkan tanaman tahan hama, bahan pangan dengan kandungan gizi lebih tinggi dan tanaman yang menghasilkan obat atau senyawa yang bermanfaat. Sementara itu, di bidang peternakan, binatang-binatang telah digunakan sebagai "bioreaktor" untuk menghasilkan produk penting contohnya kambing, sapi, domba, dan ayam telah digunakan sebagai penghasil antibodi-protein protektif yang membantu sel tubuh mengenali dan melawan senyawa asing (antigen).

Bioteknologi putih (*white biotechnology*) adalah bioteknologi yang diaplikasikan dalam industri untuk proses produksi aneka senyawa kimia (pangan maupun non-pangan), biomaterial, biopolimer, senyawa baru dan bioenergi. Bioteknologi industry memanfaatkan organism (khususnya mikroba) dan enzim untuk menghasilkan berbagai produk di berbagai sektor seperti kimia, pangan dan pakan, kertas dan pulp, tekstil dan energi.

Bioteknologi biru (*blue biotechnology*) disebut juga bioteknologi akuatik/perairan yang mengendalikan proses-proses yang terjadi di lingkungan akuatik.

Biotech: Perception of Benefit vs. Harm

Some persons have argued that the modification of existing life forms through genetic engineering constitutes a serious risk, while other persons have argued that this research may yield major benefits for society. In your opinion, have the benefits...outweighed the harmful results, or have the harmful results...been greater than its benefits?



Source: National Science Foundation

But nature *does not* contain all the *genetic variation* desires

- Fruits with vaccines

- Grains with improved nutrition

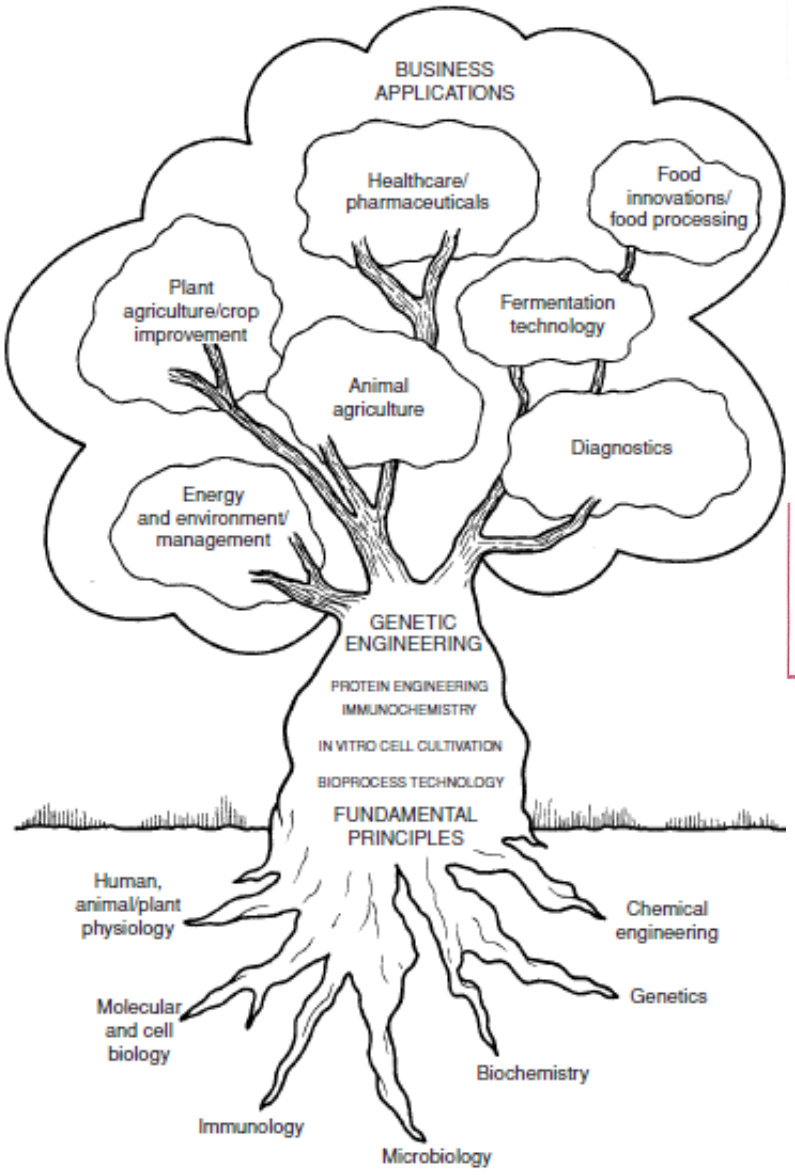
What controls this natural variation?

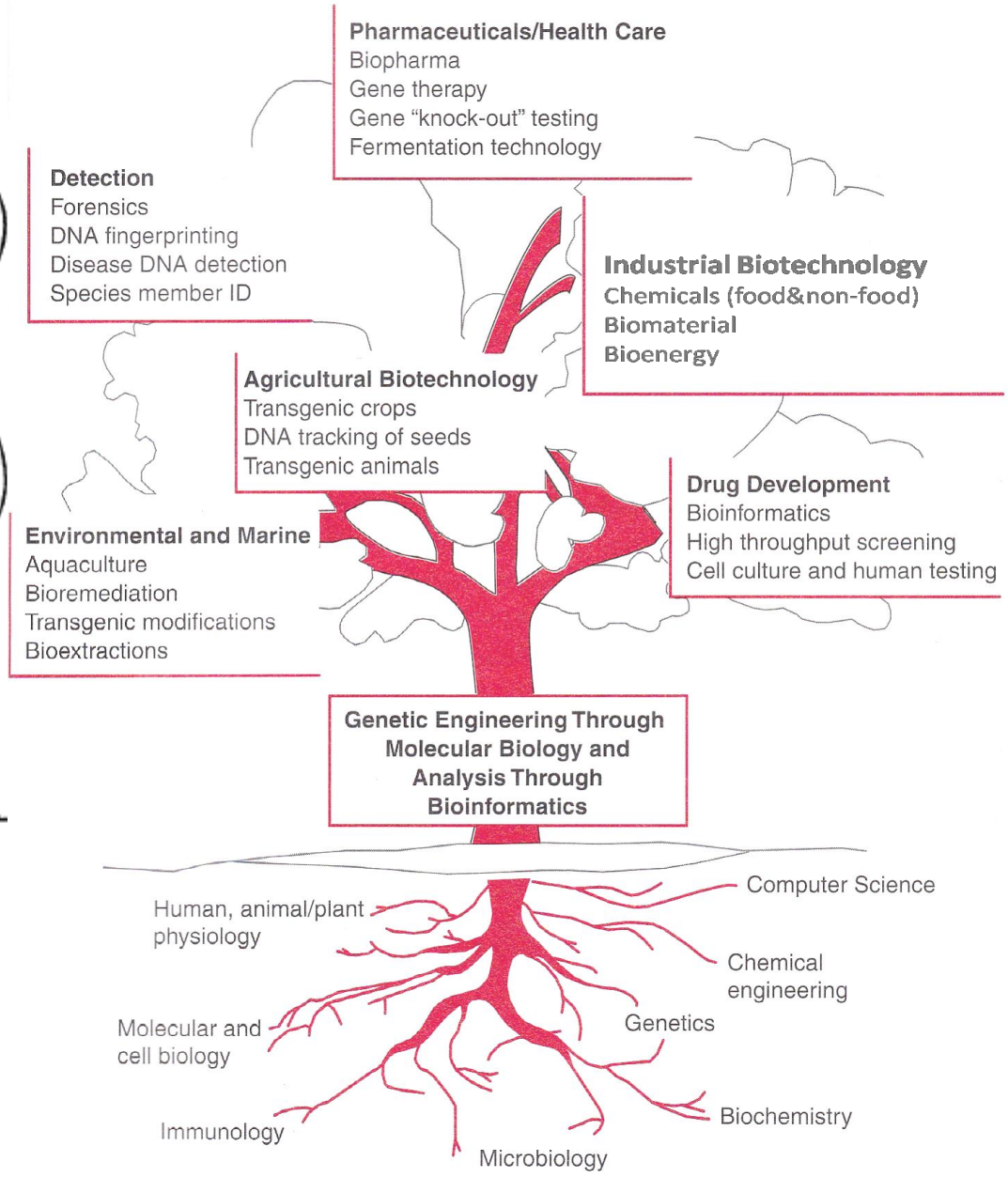
Allelic differences at *genes* control a specific trait

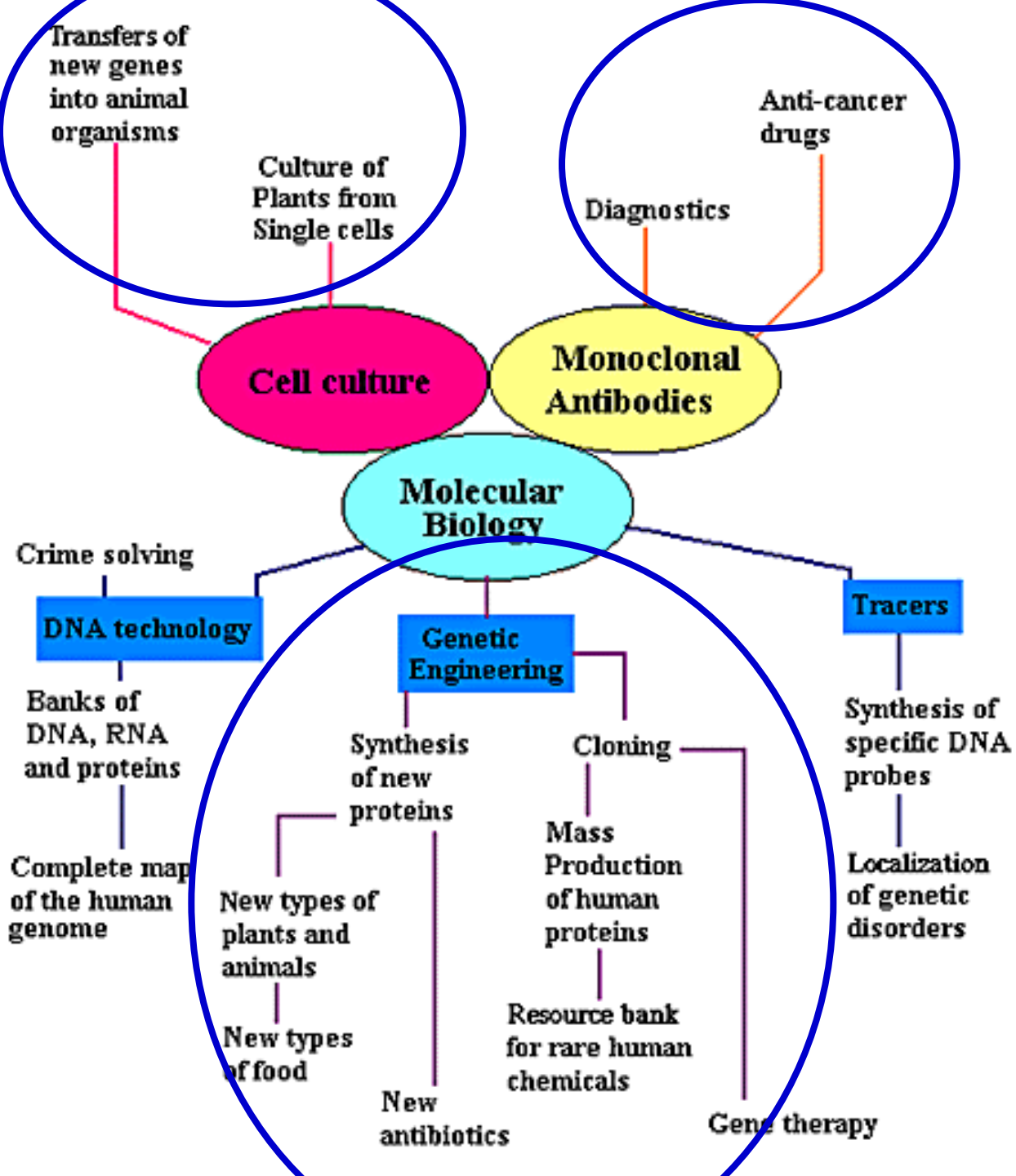
Definitions are needed for this statement:

Gene - a piece of DNA that controls the expression of a trait

Allele - the alternate forms of a gene


BUSINESS APPLICATIONS
Healthcare/ pharmaceuticals
Food innovations/ food processing
Plant agriculture/crop improvement
Fermentation technology
Animal agriculture
Diagnostics
Energy and environment/ management
GENETIC ENGINEERING
PROTEIN ENGINEERING
IMMUNOCHEMISTRY
IN VITRO CELL CULTIVATION
BIOPROCESS TECHNOLOGY
FUNDAMENTAL PRINCIPLES
Human, animal/plant physiology
Chemical engineering
Genetics
Molecular and cell biology
Biochemistry
Immunology
Microbiology


Pharmaceuticals/Health Care
Biopharma
Gene therapy
Gene "knock-out" testing
Fermentation technology
Detection
Forensics
DNA fingerprinting
Disease DNA detection
Species member ID
Industrial Biotechnology
Chemicals (food&non-food)
Biomaterial
Bioenergy
Agricultural Biotechnology
Transgenic crops
DNA tracking of seeds
Transgenic animals
Drug Development
Bioinformatics
High throughput screening
Cell culture and human testing
Environmental and Marine
Aquaculture
Bioremediation
Transgenic modifications
Bioextractions
Genetic Engineering Through Molecular Biology and Analysis Through Bioinformatics
Computer Science
Human, animal/plant physiology
Chemical engineering
Genetics
Molecular and cell biology
Biochemistry
Immunology
Microbiology


Transfers of new genes into animal organisms
Culture of Plants from Single cells
Anti-cancer drugs
Diagnostics
Cell culture
Monoclonal Antibodies
Molecular Biology
Crime solving
DNA technology
Banks of DNA, RNA and proteins
Complete map of the human genome
Genetic Engineering
Synthesis of new proteins
New types of plants and animals
New types of food
New antibiotics
Cloning
Mass Production of human proteins
Resource bank for rare human chemicals
Gene therapy
Tracers
Synthesis of specific DNA probes
Localization of genetic disorders

Genetic engineering biotechnology

aims at modifying hereditary properties of organisms.

These properties are located in the genes of animals, plants, bacteria and viruses.

Genetic engineering

a set of laboratory techniques for isolating genetic material from organisms, cutting and rejoining it to make new combinations, multiplying copies of the recombined genetic material and transferring it into organisms, bypassing the process of reproduction.

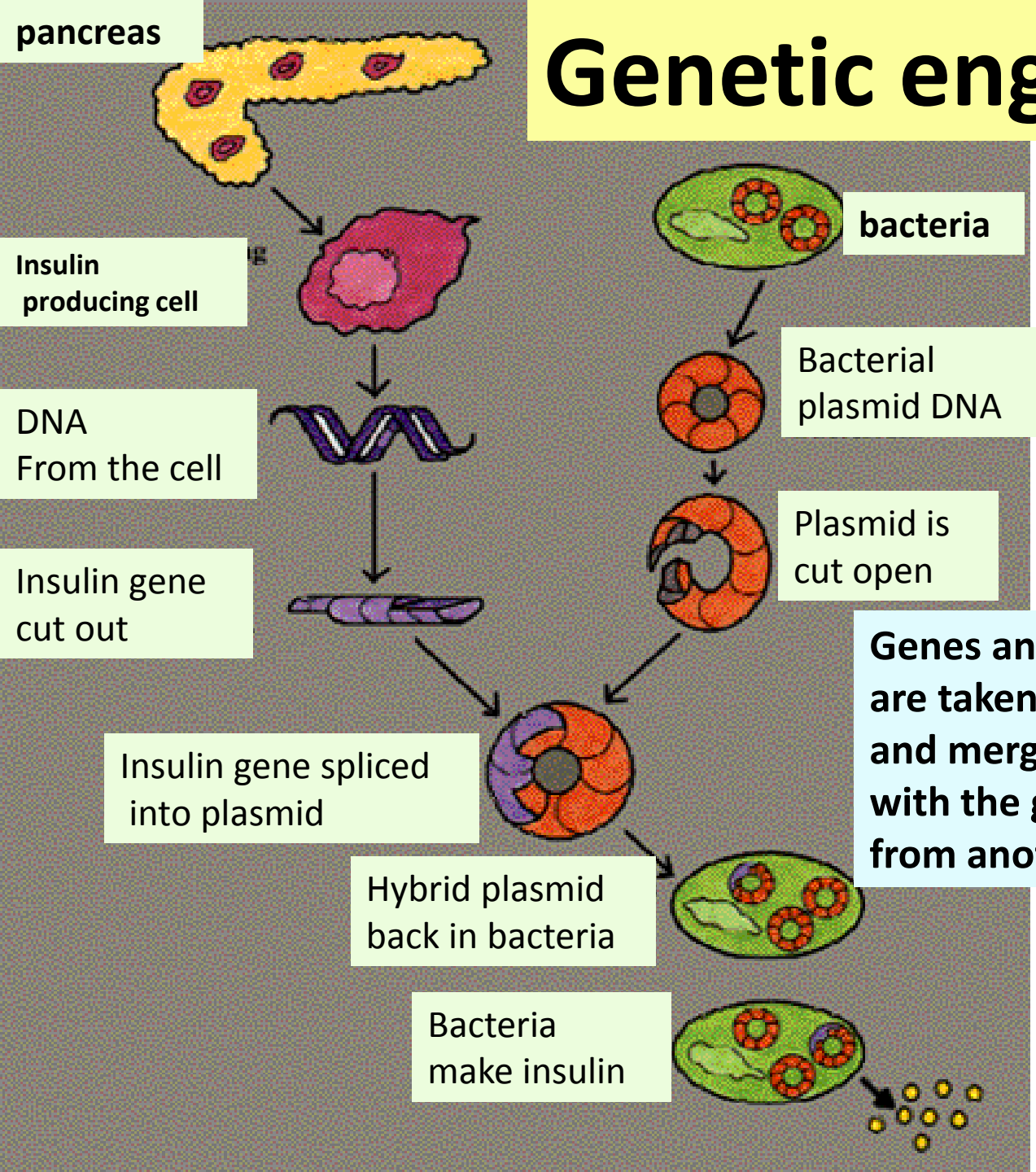
Tissue engineering

approach to repairing or replacing tissue functions with cultivated cells

Gene therapy

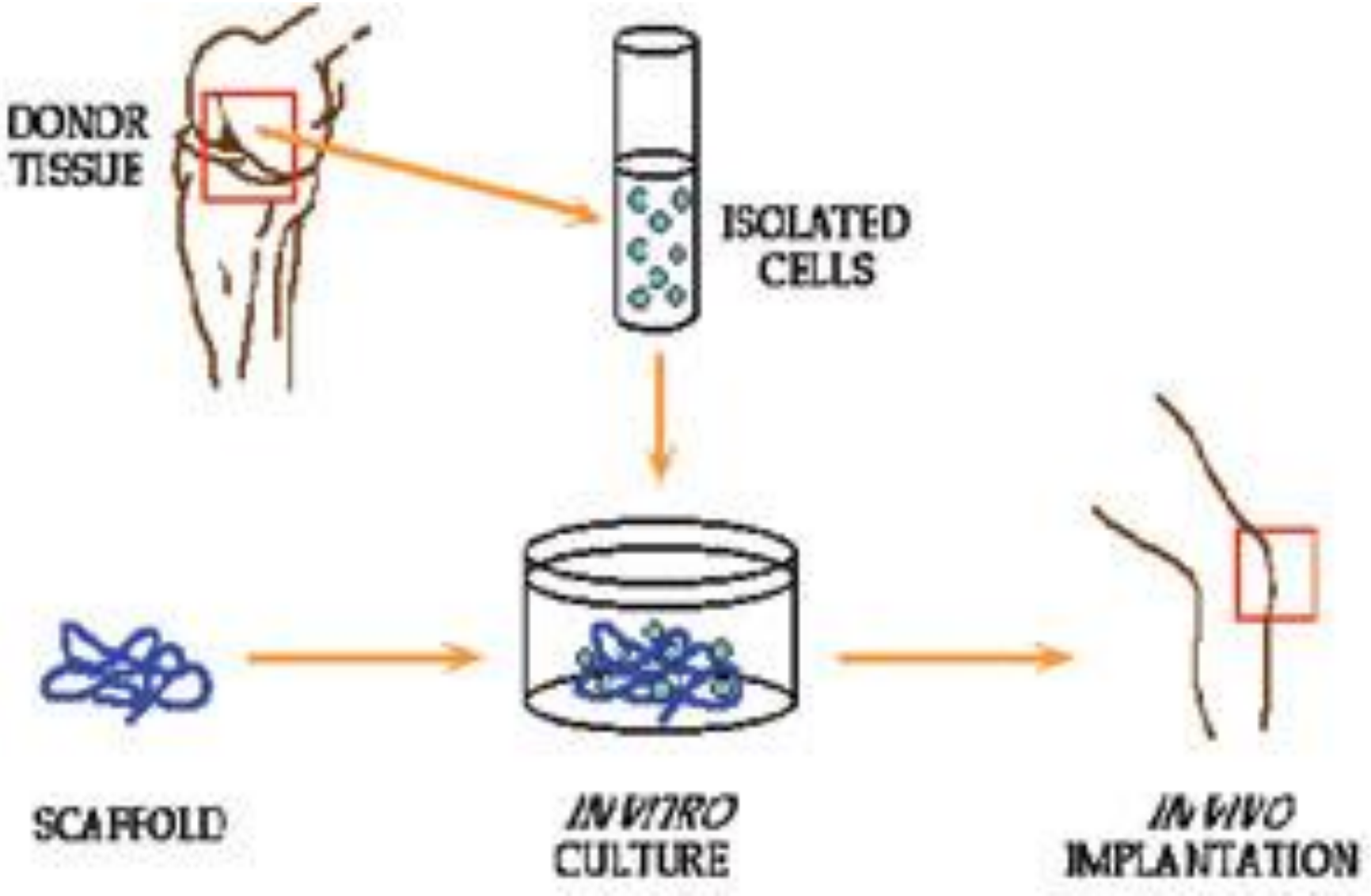
New properties not necessary are alien for engineered genome (we can reintroduce normal gene into diseased human –)

Genetic engineering

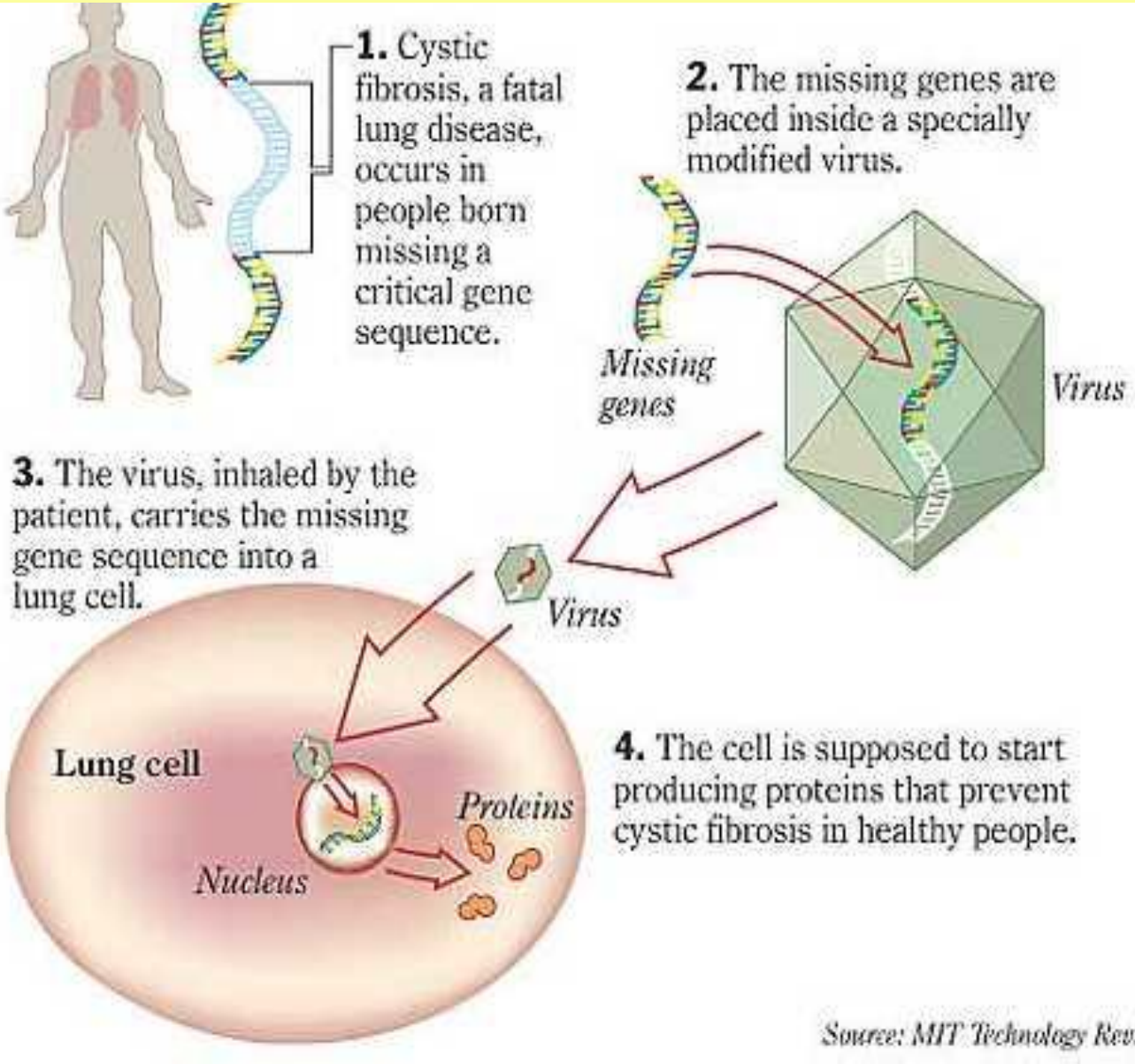


Genes and parts of genes (DNA) are taken from one species and merged with the genetic material from another organism.

Tissue engineering



Gene therapy



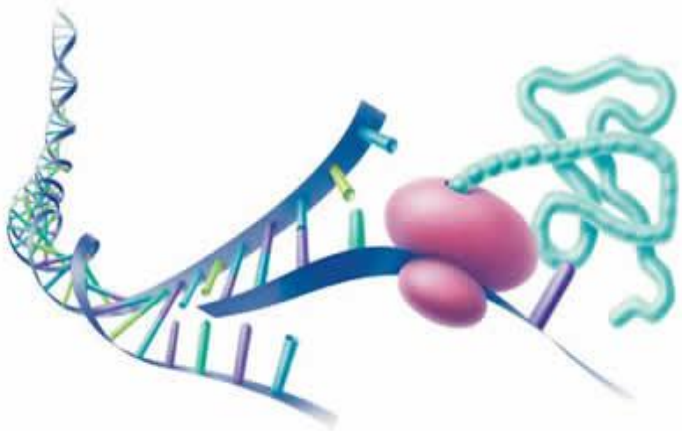

BIOTECHNOLOGY
Hybridization
PCR
Sequencing
Recombinant DNA (cloning)
Basic molecular biology and genetics

Genetic engineering is a mother of biotechnology

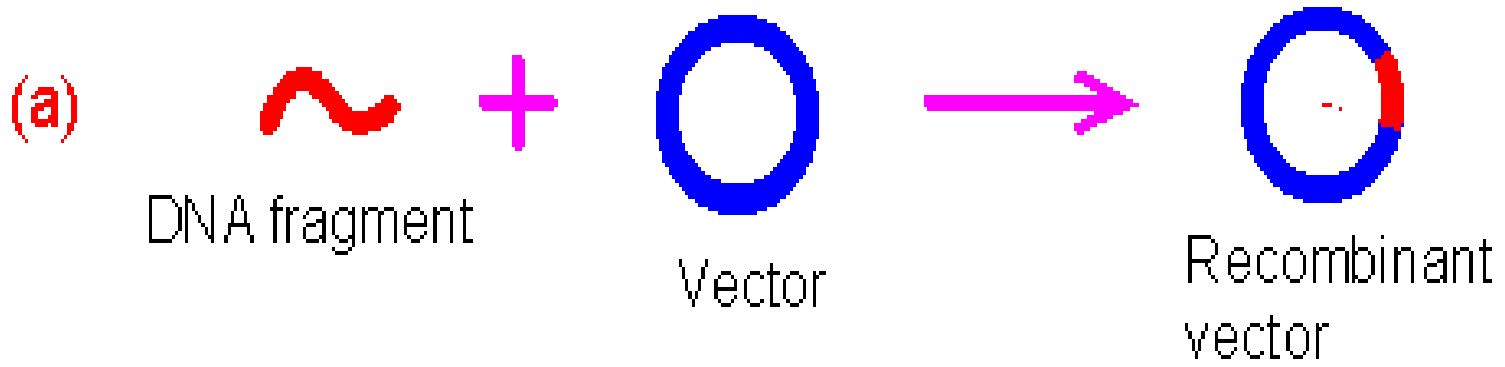
CLONING – the process of moving the gene from the chromosome to autonomously replicating **VECTOR**

VECTOR – a autonomous piece of DNA capable of replicating and being transmitted to daughter cell

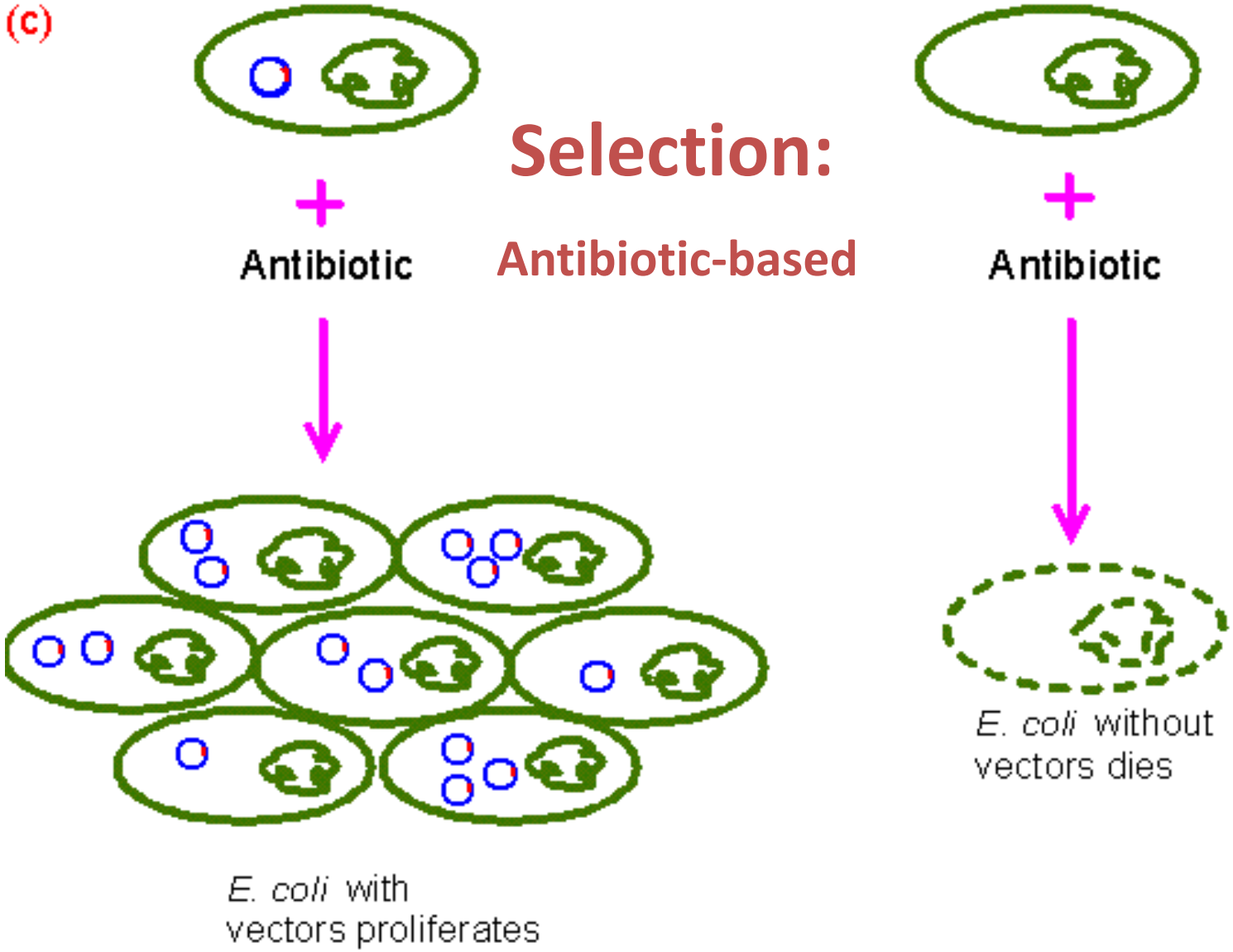
TRANSFORMATION – the process of inserting the **VECTOR** into the cell of interest



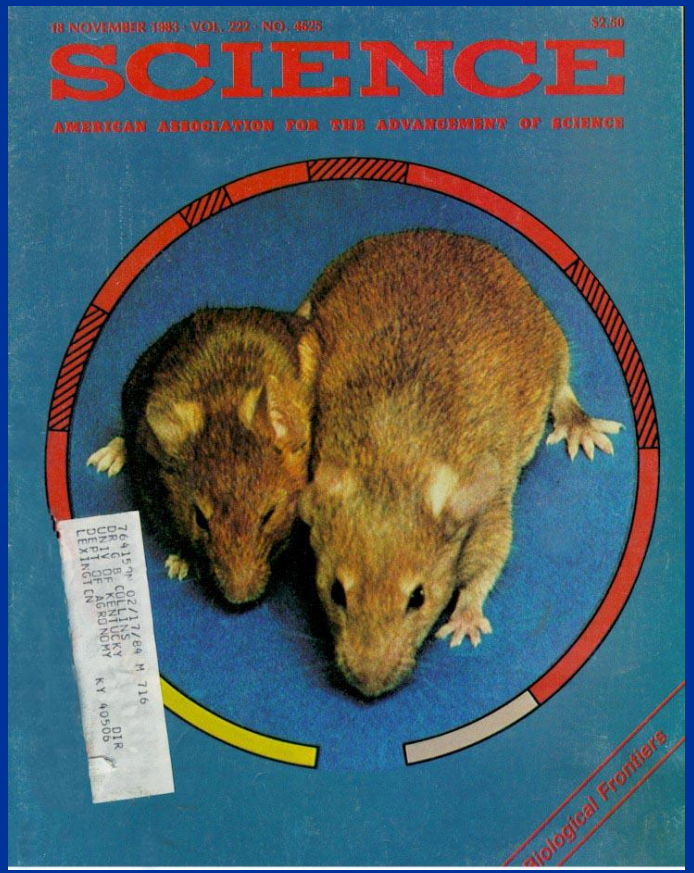
A reminder of molecular basics



A reminder of molecular basics



1983 SCIENCE Cover – Transgenic Mice
1997 TIME Cover - Dolly



Science Vol. 222, Nov. 1983

Time Magazine, March 1997

What are GMO's?

Why is a GMO more dangerous than a conventionally derived cultivar?

Conventional:

Wide Hybridization introduces 100,000 potentially negative genes in order to obtain one desirable disease resistance gene.

Induced mutagenesis has been used for decades to create genetic variants.

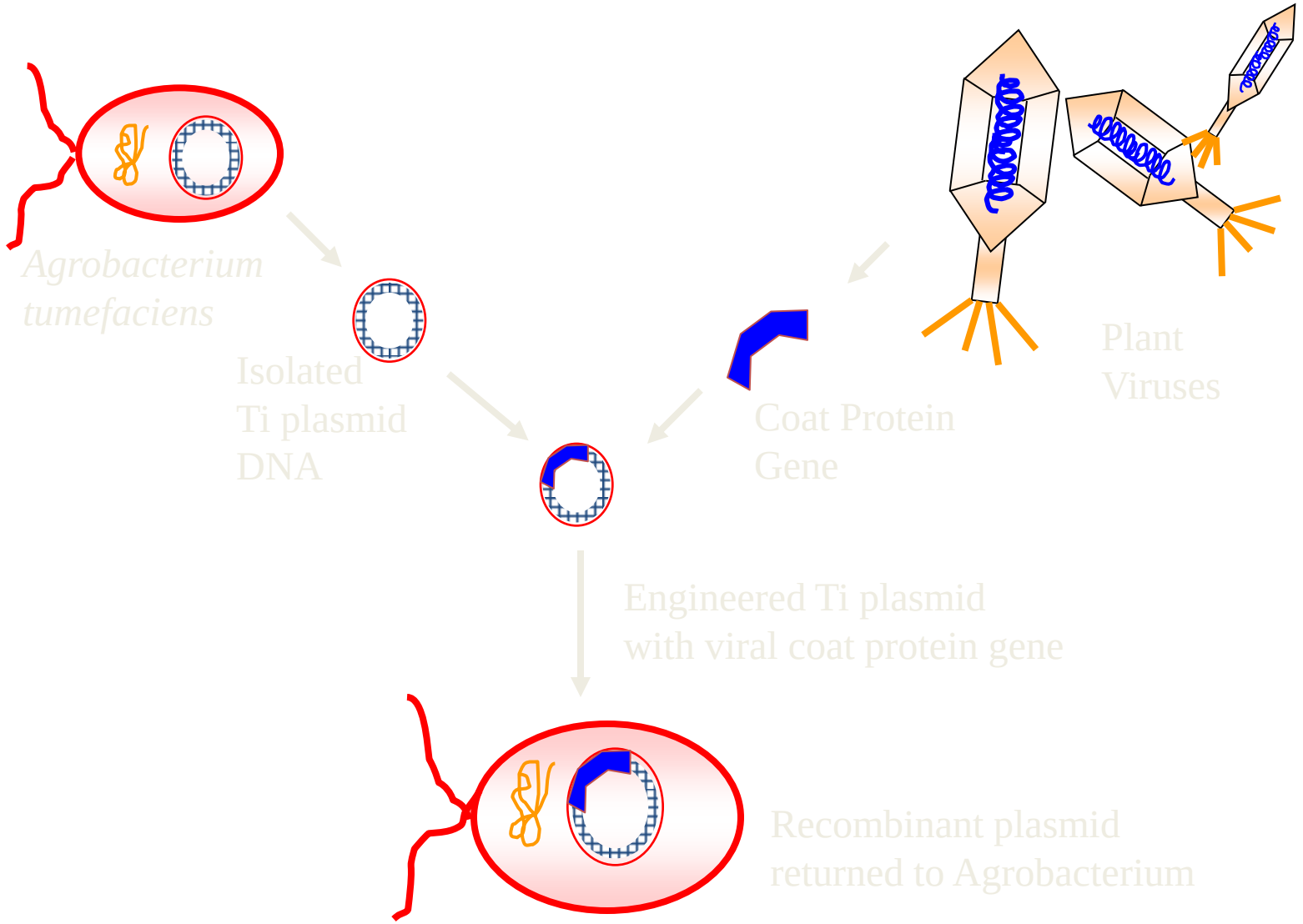
Genetic Engineering:

Introduce one (or a few) foreign “good” genes into the best accepted cultivar background.

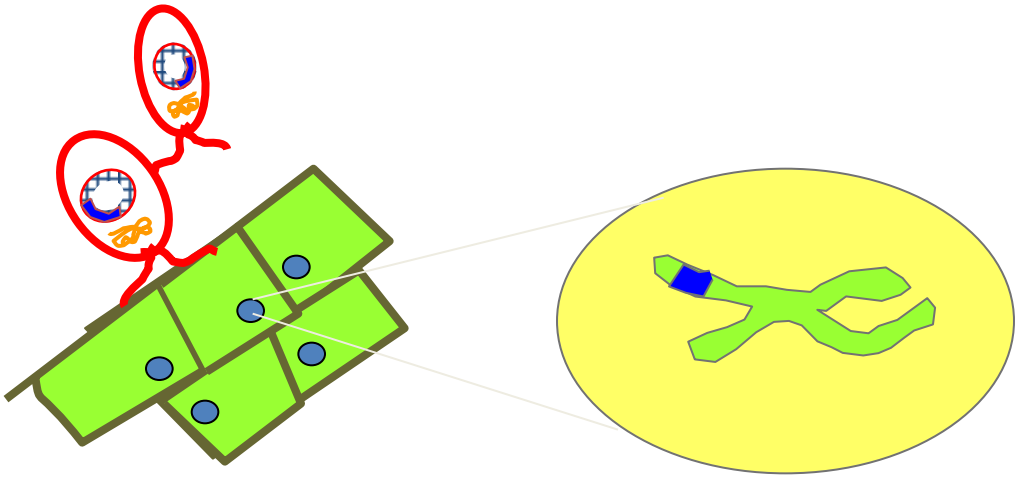
Bt or Disease Resistance genes might enable reduction by 80% of insecticide or fungicide chemical applications.

What are Transgenics and Transgenic Organisms?

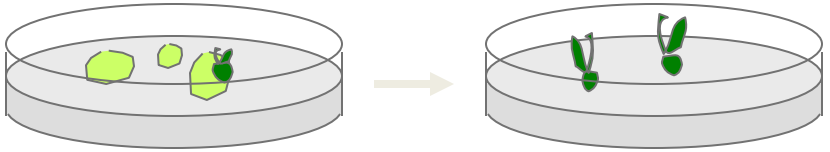
Agrobacterium Transformation – Engineering the bacterium



Agrobacterium Transformation – Plant Transformation

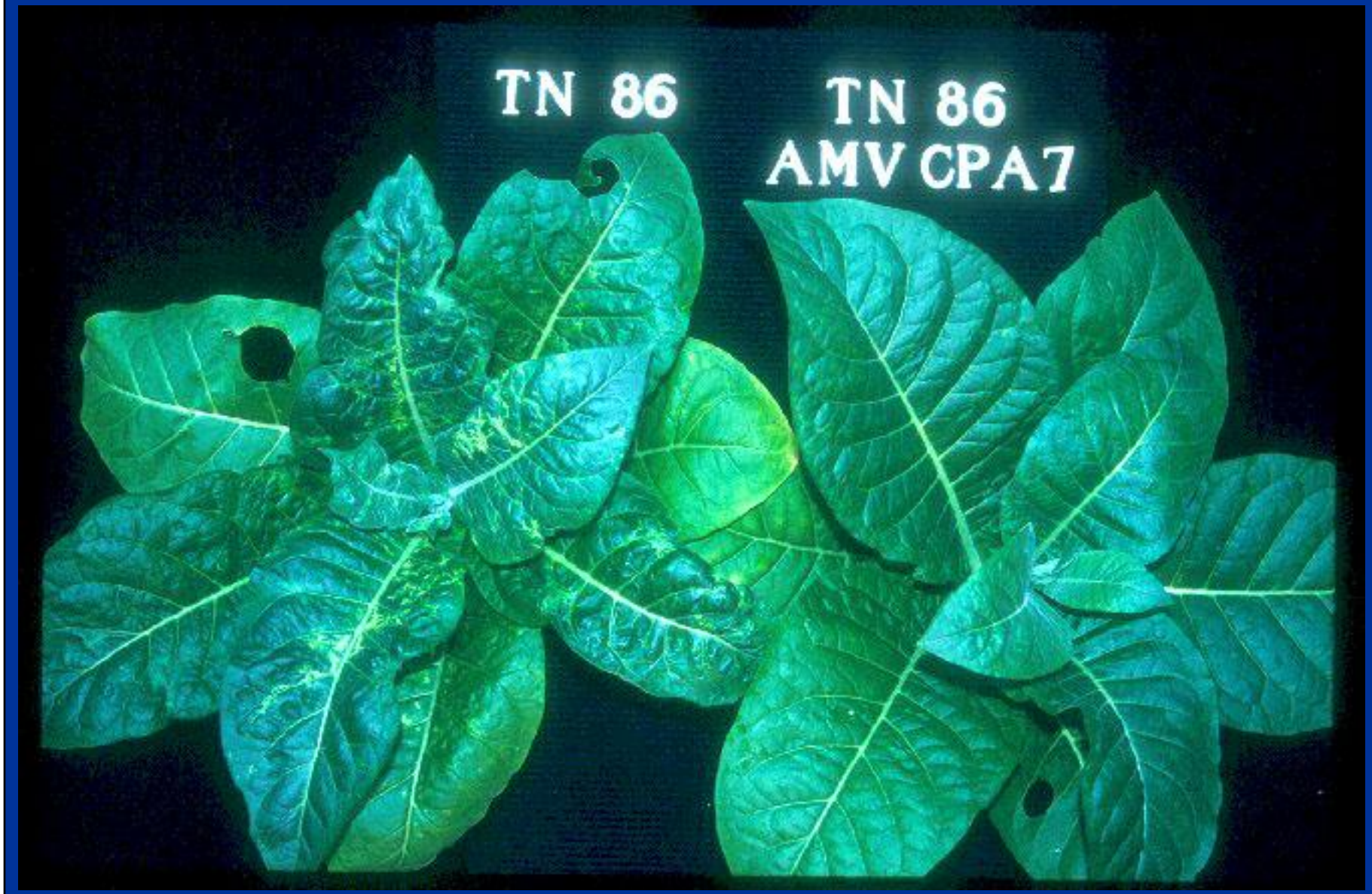


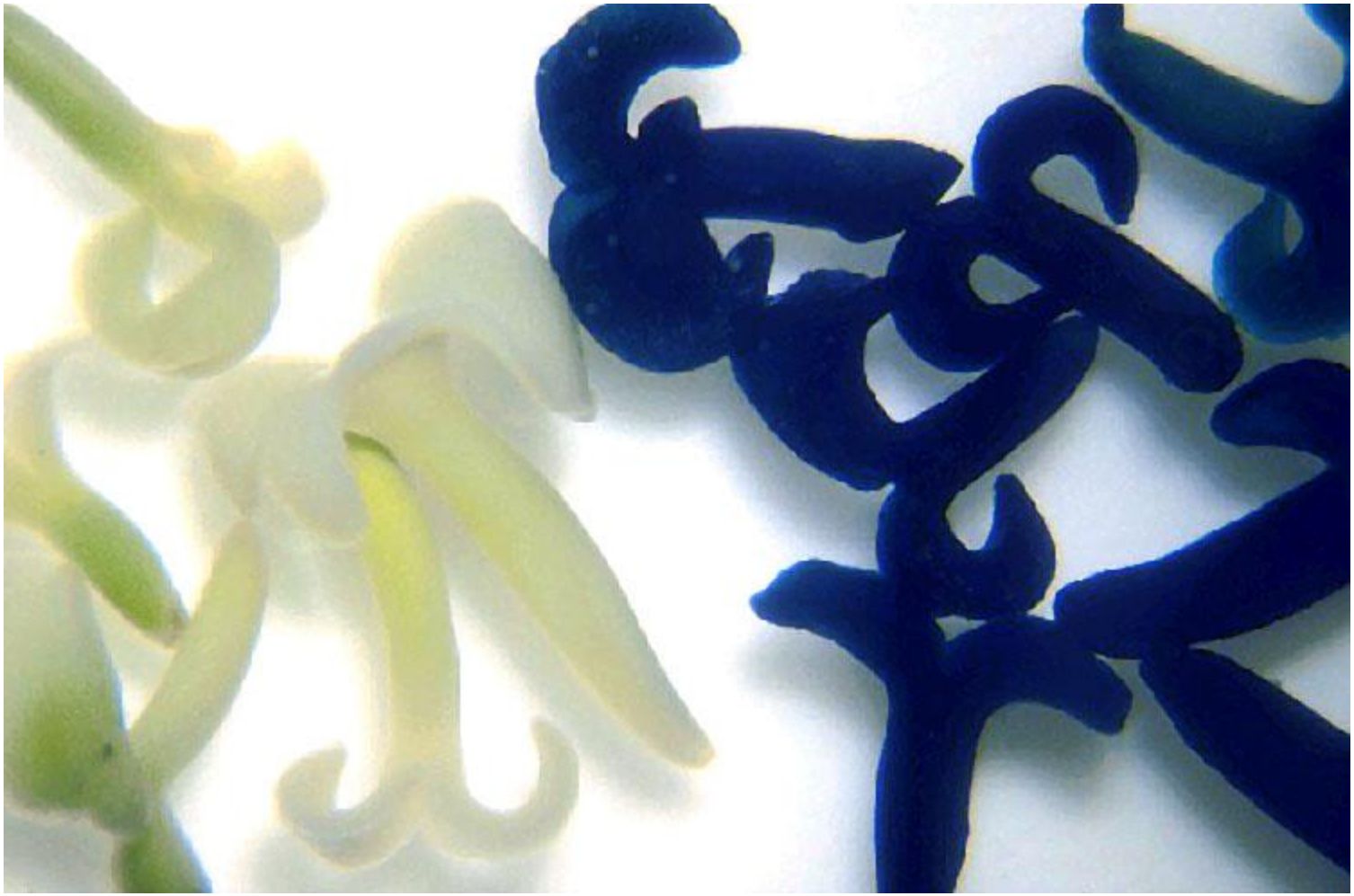
Agrobacterium infects plant cells. Protein gene is transferred into cell chromosome.



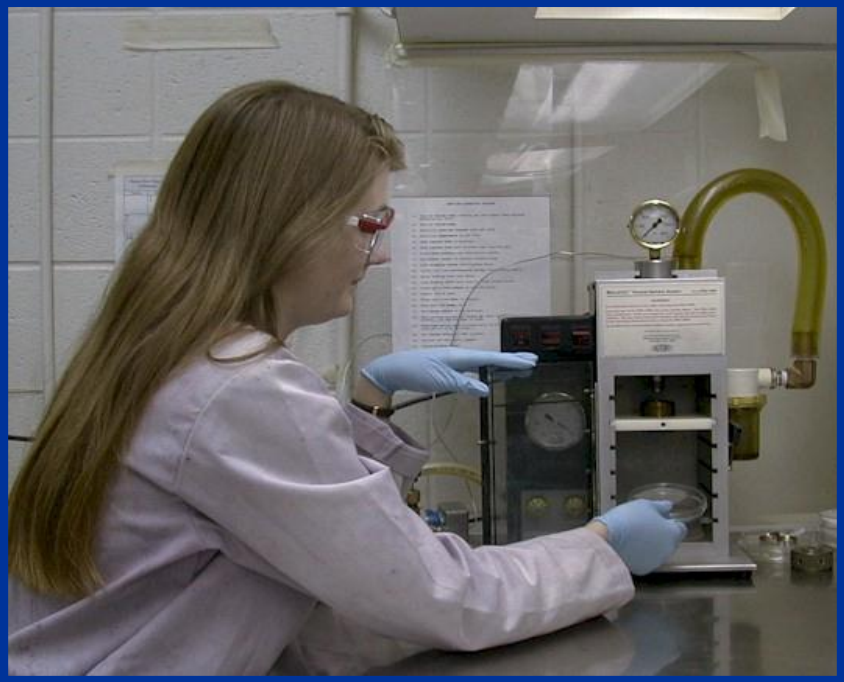
Plant tissue is cultured to produce transformed plantlets with each cell containing transgene.

Generated plant will express resistance if infected with virus.

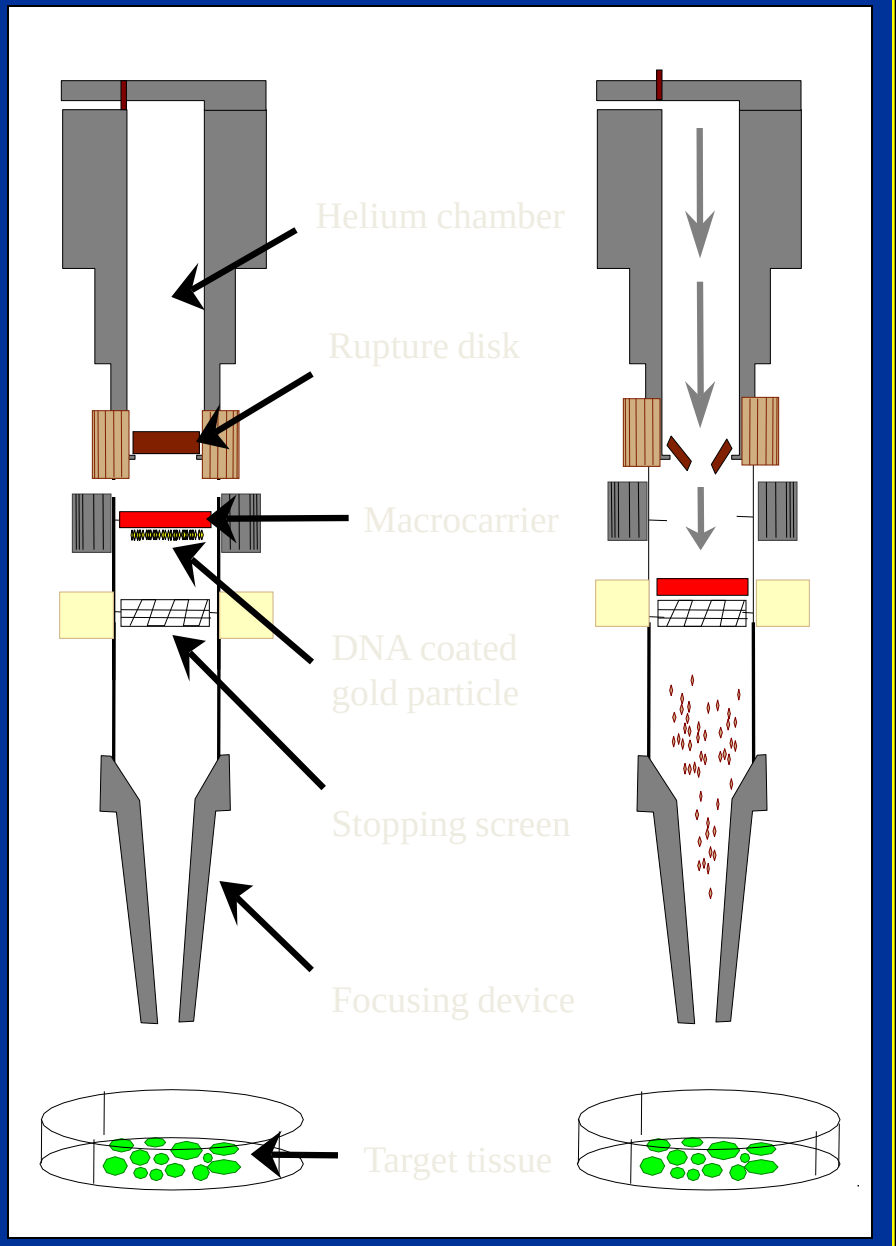

TN 86
TN 86
AMV CPA7



The Gene Gun



PDS1000 Microparticle Delivery System



Modified Plants in Field Trials

Maize	Cantaloupe	Wheat	Carnation	Plum Tree
Potato	Flax	Mellon	Eggplant	Cranberry
Tomato	Chicory	Petunia	Strawberry	Spruce
Soybean	Rice	Cucumber	Barley	Cabbage
Cotton	Poplar	Apple	Peanut	Oilseed Rape
Mustard	Squash	Cauliflower	Eucalyptus	Fodder Rape
Tobacco	Sunflower	Sugarcane	Carrot	Sweet Potato
Sugar Beet	Rapeseed	Sweetgum	Serviceberry	Papaya
Alfalfa	Birch	Walnut	Pepper	Asparagus
Rose	Kiwi	Trefoil	Grape	Chrysanthemum
Canola	Lettuce	Raspberry	Fescue	Watermelon

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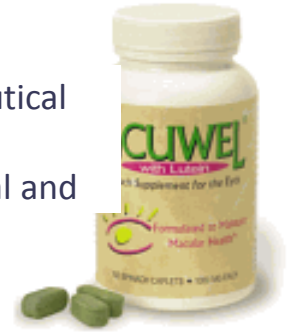

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BIOTECHNOLOGY INDUSTRY ORGANIZATION

Biotechnology Healthcare/Pharmaceuticals Statistics

•More than 325 million people worldwide have been helped by the more than 155 biotechnology drugs and vaccines approved by the U.S. Food and Drug Administration (FDA).

• There are more than 370 biotech drug products and vaccines currently in clinical trials targeting more than 200 diseases, including various cancers, Alzheimer's disease, heart disease, diabetes, multiple sclerosis, AIDS and arthritis .

www.bio.org/er/statistics.asp

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ScienceDaily
Your link to the latest research news

UGA Researchers Use Transgenic Trees To Help Clean Up Toxic Waste Site

Can genetically engineered cottonwood trees clean up a site contaminated with toxic mercury? A team of researchers from the University of Georgia - in the first such field test ever done with trees - is about to find out.

The results could make clearer the future of phytoremediation – a technique of using trees, grasses and other plants to remove hazardous materials from the soil. UGA scientists and city officials in Danbury, Conn., planted on July 16 some 60 cottonwoods with a special gene at the site of a 19th-century hat factory in that northeastern city.

"We hope to see a significant difference in the levels of mercury in the soil within 18 months, perhaps as much as a twofold reduction," said Richard Meagher, professor of genetics at UGA.

The field test is a collaboration between UGA, Western Connecticut State University, Applied PhytoGenetics, Inc., of Athens and the City of Danbury.

http://www.sciencedaily.com/

CNN.com SCIENCE & SPACE

Mice, men share 99 percent of genes

By Marsha Walton
CNN

(CNN) --When it comes to DNA, it turns out there's not that much difference between mice and men.
Mice and humans each have about 30,000 genes, yet only 300 are unique to either organism. Both even have genes for a tail, even though it's not "switched on" in humans.
"About 99 percent of genes in humans have counterparts in the mouse," said Eric Lander, Director of the Whitehead Institute Center for Genomic Research in Cambridge, Massachusetts. "Eighty percent have identical, one-to-one counterparts."
The mouse is the only mammal, after the human, whose genome has been sequenced. The rodent's genetic sequence was published in this week's edition of Nature Magazine

Scientists say mice and humans descended from a common ancestor about the size of a small rat.

www.cnn.com/tech/Science

What Is Bioremediation?

- Bioremediation- using biological processes to solve environmental problems
- Biodegradation- natural processes of microbes in breaking down hydrocarbon materials
- Biodegradable- capable of being decomposed by microbes

How Can Bioremediation Be Used?

- Oil spills
- Wastewater treatment
- Heavy metal removal
- Chemical degradation