Facts About Biotechnology

What is Biotechnology?

BIOTECHNOLOGY is far too diverse and diffuse for any specific definition to be completely satisfactory:

The meaning of the word "Biotechnology" derives form the words:
***Bios* = life, *teuchos* = tool and *Logos* = study of or essence.**

Thus the word literally means: the study of tools from living things. Biotechnology is the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services

BIOTECHNOLOGY is defined as industrial exploitation of biological systems or processes. It includes any technique that uses living organisms or part of it to make or modify products, to improve plants or animals or develop microorganisms for specific uses. (As by DBT, Govt. of INDIA)

Thus

Biotechnology is the applied use of molecular biology and recombinant DNA technology to influence specific biological processes largely related to meeting human needs

The term "biotechnology" was coined in 1919 by Karl Ereky, an Hungarian engineer.

•Biotechnology has been described as "Janus-faced."

•On one, techniques allow DNA to be manipulated to move genes from one organism to another.

•On the other, it involves relatively new technologies whose consequences are untested and should be met with caution.

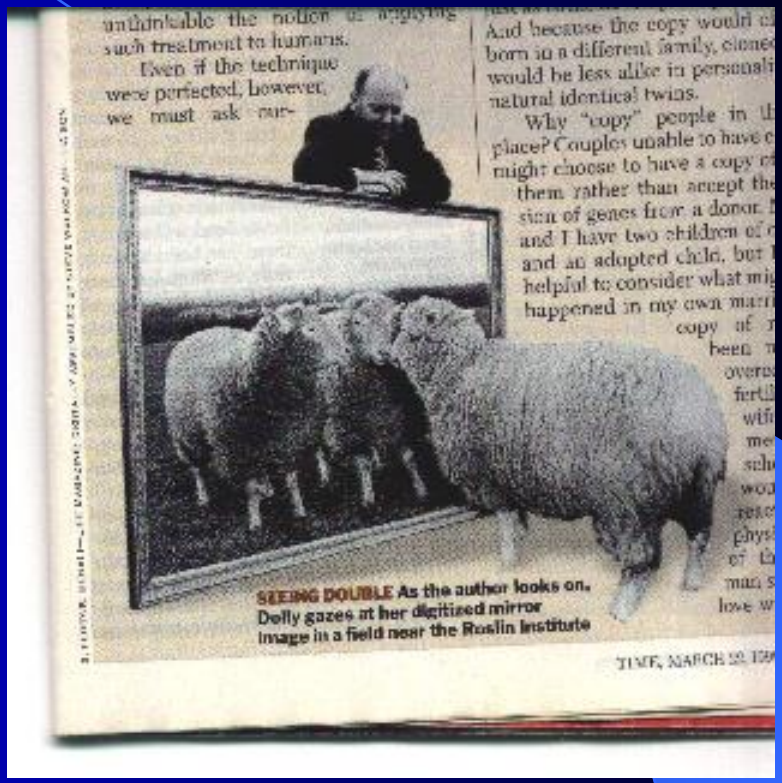
How Old is BIOTECHNOLOGY?

- Dates back to prehistoric era
- Unconscious use of Biotechnology
- Processes in the manufacture of foodstuffs and beverages

❖ Bread and leaven	Before 3000 BC
❖ Fermentation of juices to alcoholic beverages	Before 3000 BC
❖ Vinegar formation from fermented juices	Before 3000 BC
❖ Cultivation of vine in Assyria	Before 2000 BC
❖Manufacture of beer in Sumer and Babylonia and Egypt	3rd century AD

Traveled a long way

From prehistoric era



Present century “Dolly”

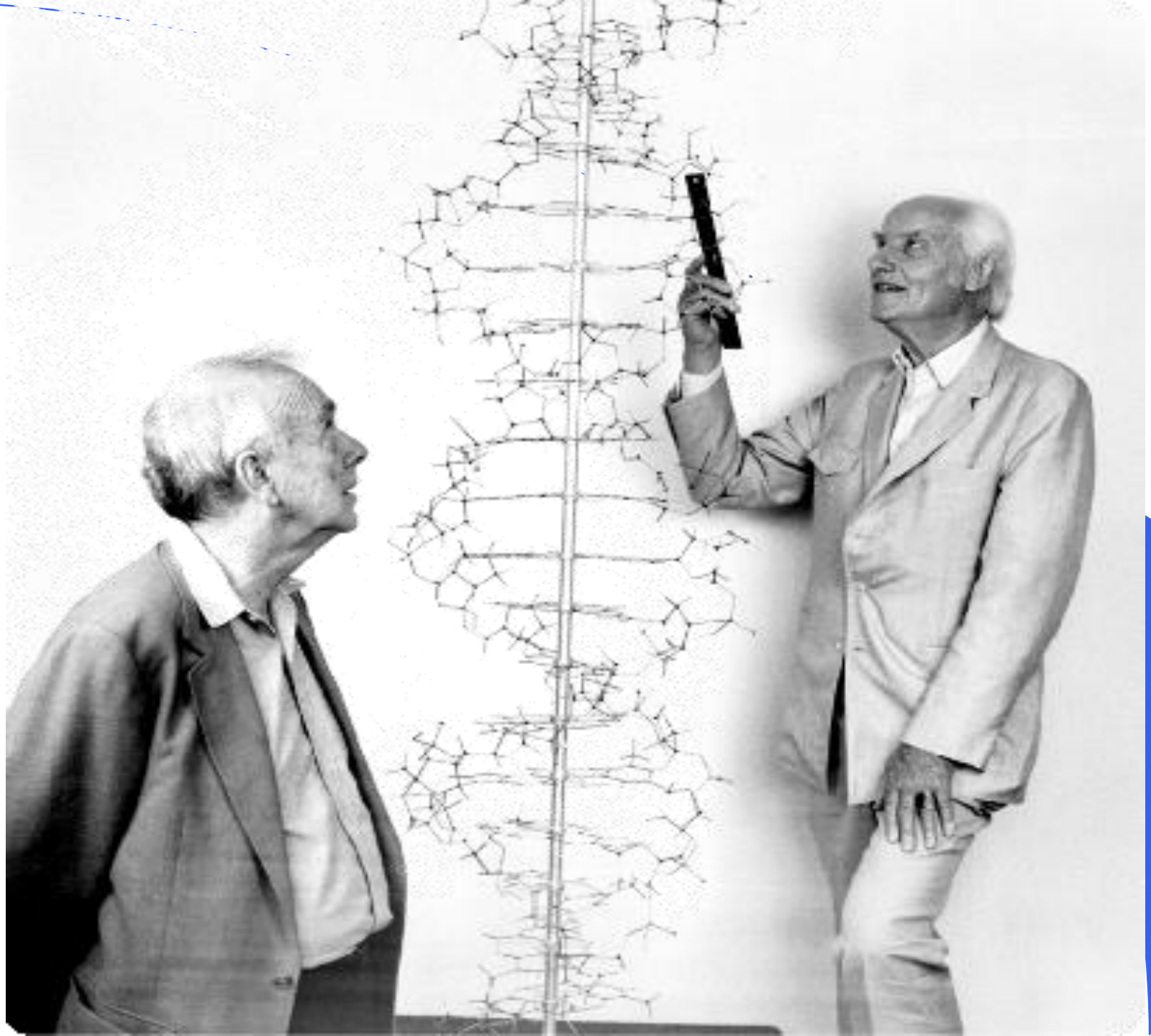
Milestones in the field of Biotechnology

From Mendel To sequencing Human Genome

1866 – Austrian botanist and monk Gregor Mendel proposes basic laws of heredity based on cross breeding experiments on pea plants.

1944 – Oswald Avery, Colin MacLeod and Maclyn McCarty proved that DNA and not protein, is the heredity material in most living organisms, while working with pneumococcus .

1953 – American biochemist James Watson and British biophysicist Francis Crick announces their discovery of the double helix structure of DNA, the molecule that carry genetic code.



Milestones in the field of Biotechnology

1964 – Stanford geneticist Charles Yanofsky and colleagues prove that sequence of nucleotides corresponds exactly to the sequence of amino acids in proteins.

1969 A Harvard Medical school team isolates the first gene.

1973 – American biochemists Stanley Cohen and Herbert Boyer insert gene from an African clawed toad into bacterial DNA. Marks the beginning of "GENETIC ENGINEERING".

1976–The first genetic engineering company, "Genentech" is founded in South San Francisco.

1978– Cloning the gene for human insulin in Genentech

1980 Martin cline and co-workers create first transgenic mouse transferring functional gene from one animal to

Milestones in the field of Biotechnology

1983 Kary Mullis, a biochemist first conceives the so called PCR (Polymerase chain reaction).

1984 Alec Jeffreys, of Britain develops "Genetic Fingerprinting" uses sequences of DNA to identify individuals.

1985 First use of Genetic Fingerprinting in a criminal investigation.

1990 Formal launch of Human Genome Project.

1993 Washington university researchers clone human embryo and nurture it in Petri dish for several days.

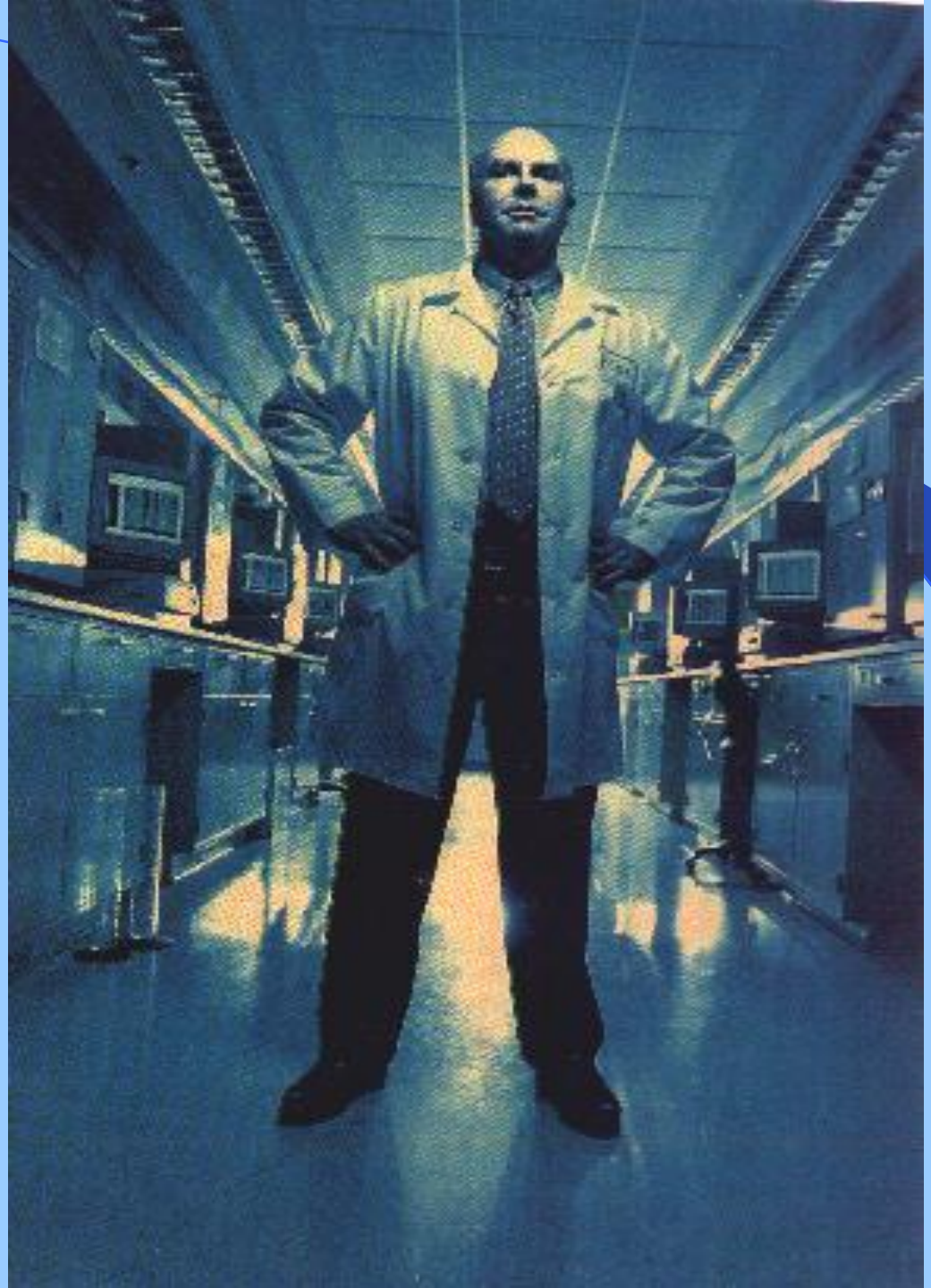
Milestones in the field of Biotechnology

1994 Calgene, Inc., market the FLAVRSAVR tomato - first genetically engineered whole food in the U.S. food supply

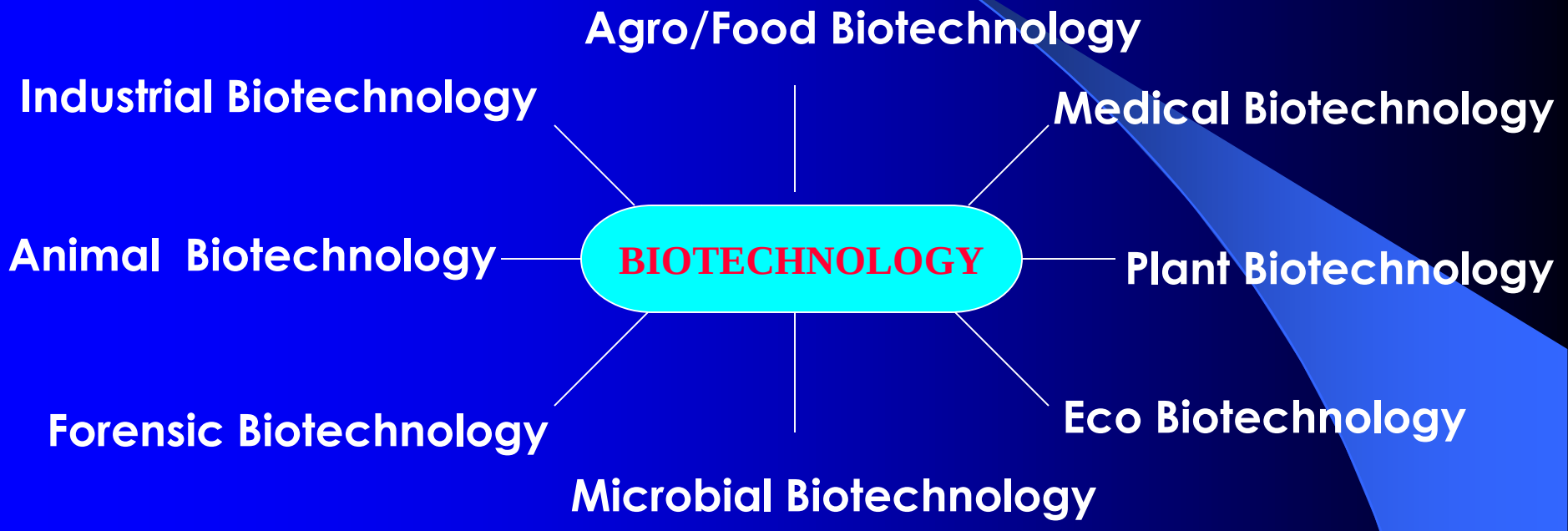
1997 Scotland's Roslin institute, led by embryologist Ian Wilmut Cloned a sheep named "Dolly" from an adult ewe.

1998 Two research team succeed in growing embryonic stem cells.

2003 Human Genome Project completes sequencing of entire human DNA under the supervision of biologist Craig Venter. 35000 genes known to be present.



Different branches of Biotechnology



All Branches Together ——— *Bioinformatics*

Subjects and techniques involved in Biotechnology

- **Today's biotechnology has its "roots" in Chemistry, Physics, and Biology .**

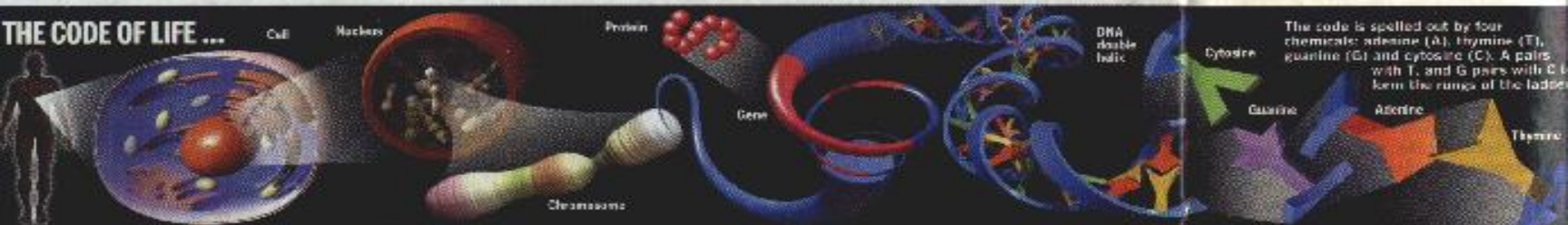
- **The explosion in techniques has resulted in three major branches of biotechnology:**

1. **Genetic engineering,**
2. **Diagnostic techniques, and**
3. **Cell/Tissue techniques.**

Illustrations for TIME by John Craig

THE FUTURE OF MEDICINE

THE CODE OF LIFE ...



The body contains 100 trillion cells

Inside most cells is a nucleus that contains a complete set of the body's blueprints

Those blueprints are twisted into 46 packets called chromosomes

Unravel a chromosome, and you get the long, thread-like molecule called DNA

Within the DNA are the blueprints—called genes—for making proteins

The code is spelled out by four chemicals: adenine (A), thymine (T), guanine (G) and cytosine (C). A pairs with T, and G pairs with C to form the rungs of the ladder

The DNA molecule has a twisted, ladder-shaped structure (the famous double helix). The genetic code can be read in the rungs of the ladder

... AND HOW SCIENTISTS BREAK IT

A small fragment of DNA is cut out of a chromosome

That fragment is cloned to create millions of copies

The cloned fragments are divided into four special solutions, in which they begin to replicate

Each solution contains a chemical "liar" that stops the process when a particular letter is reached. A color dye is used to label the fragments

The partially reproduced fragments are dropped into gel-filled capillaries inside a sequencing machine

An electric charge pulls the fragments down the capillaries; bigger molecules move more slowly than small ones, sorting by size. The sequence is read automatically by a laser as the colored fragments come out the end of the capillaries

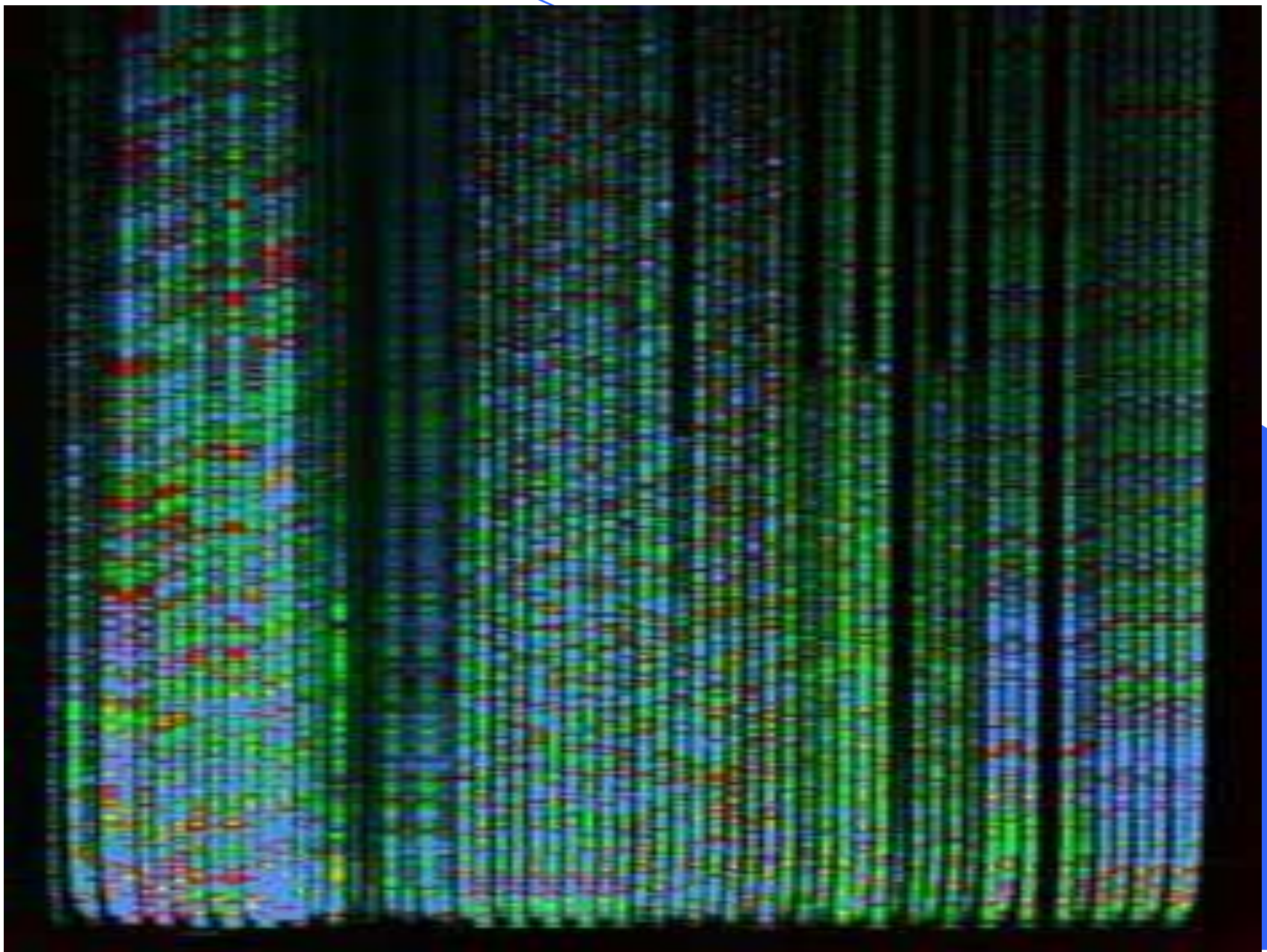
pharmaceutical companies stand to

Gerry, led by maverick scientist Craig

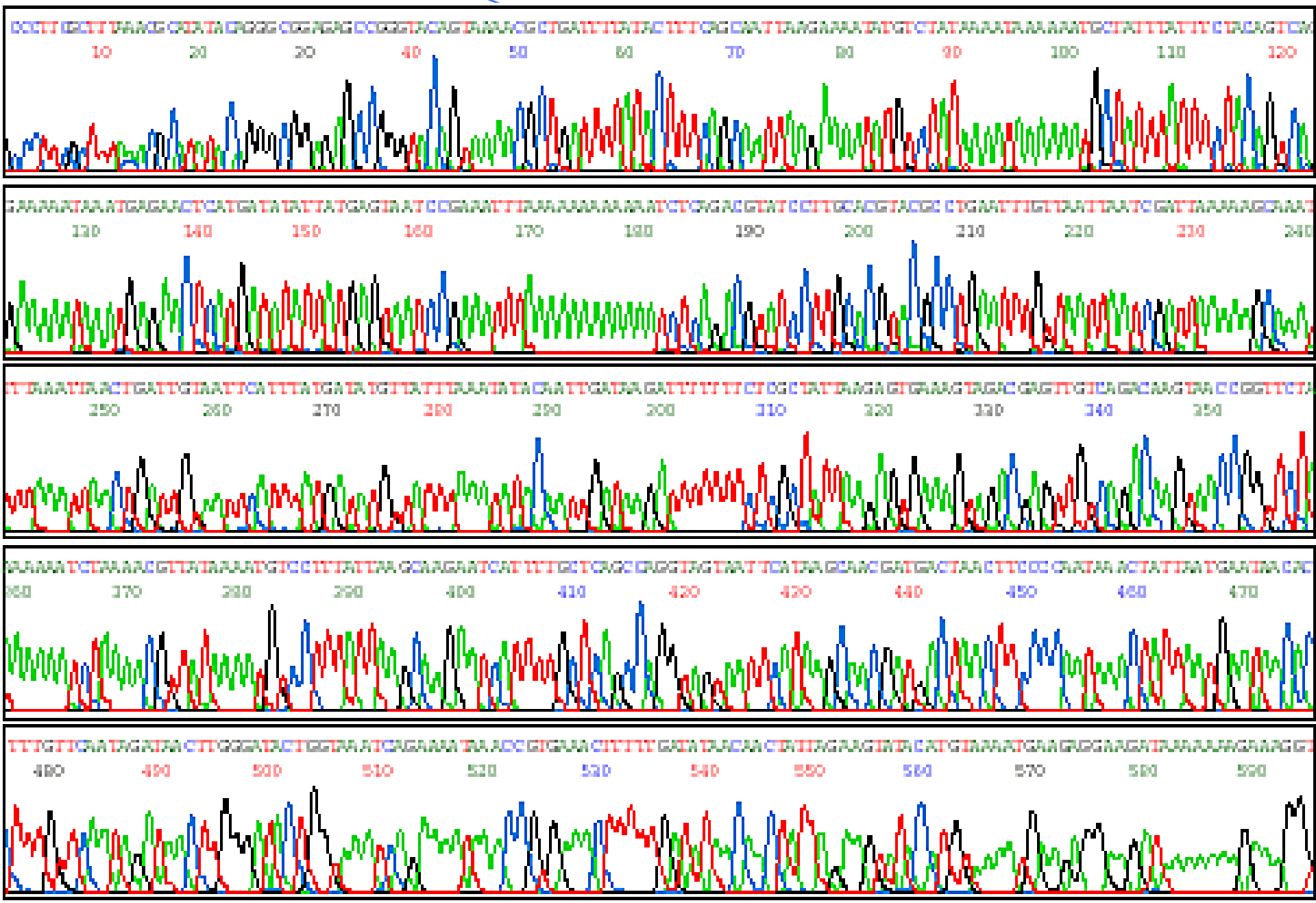
The unassisted march to decode the

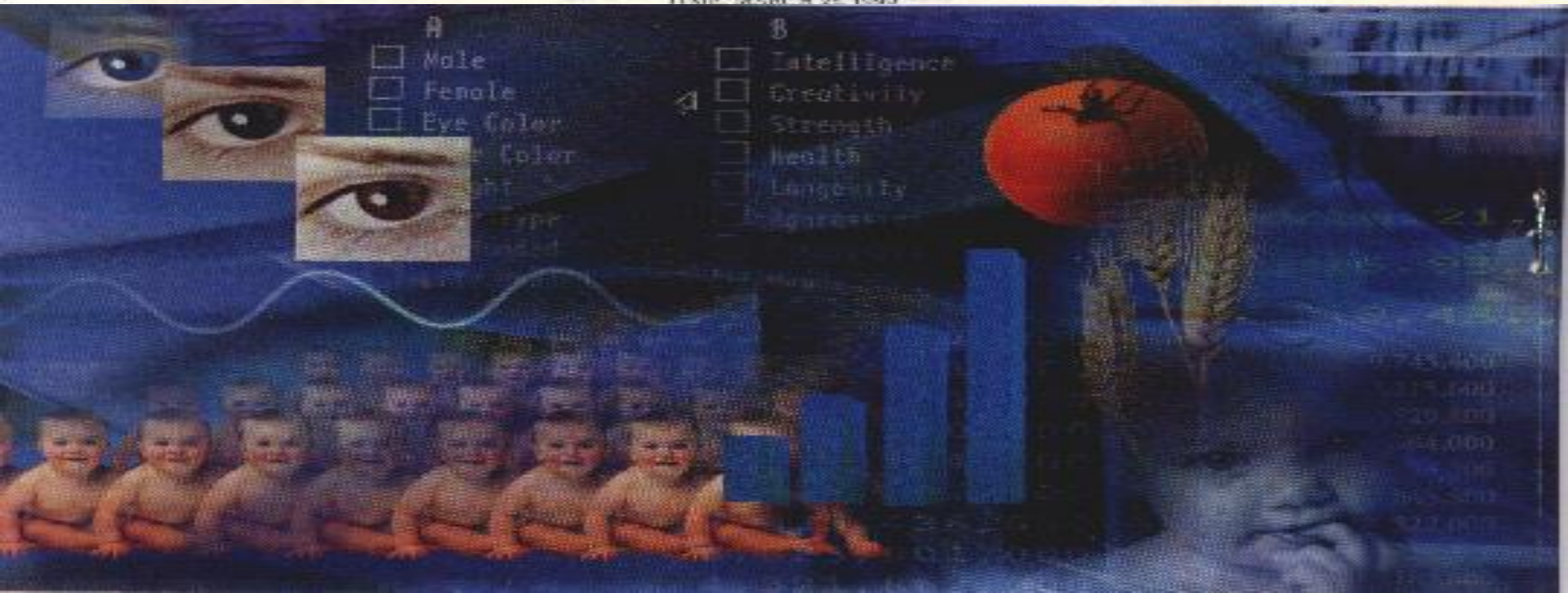
search Institute in Bethesda, Maryl

Sequencing



Long-Read Sequences




A
Male
Female
Eye Color
B
Intelligence
Creativity
Strength
Health
Longevity

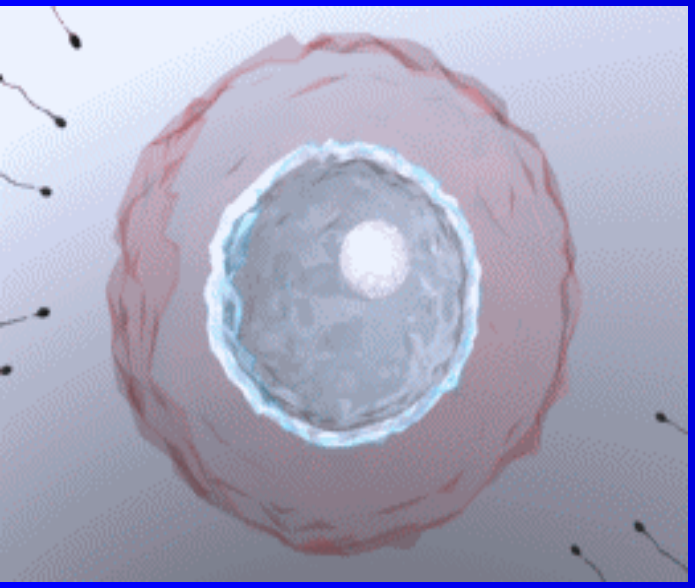
CLONING

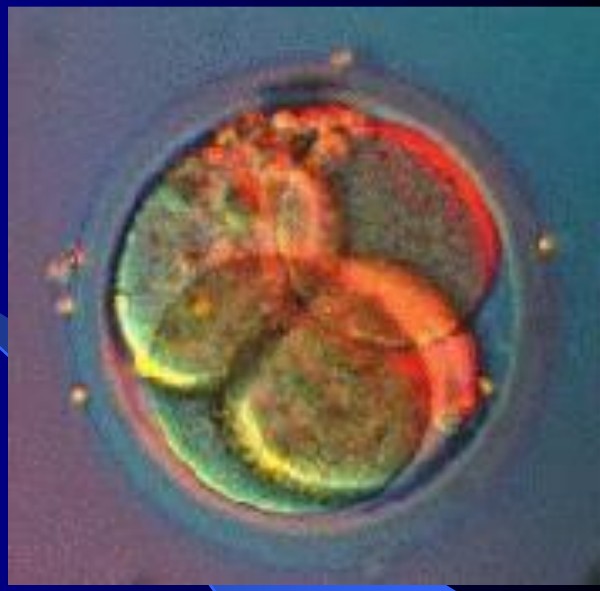
- Cloning is a form of asexual reproduction which involves creating genetically identical genes/cells, plants or animals.
- The procedure of cloning is done by taking a gene from the animal or human and then putting that gene in another animals or human organism.

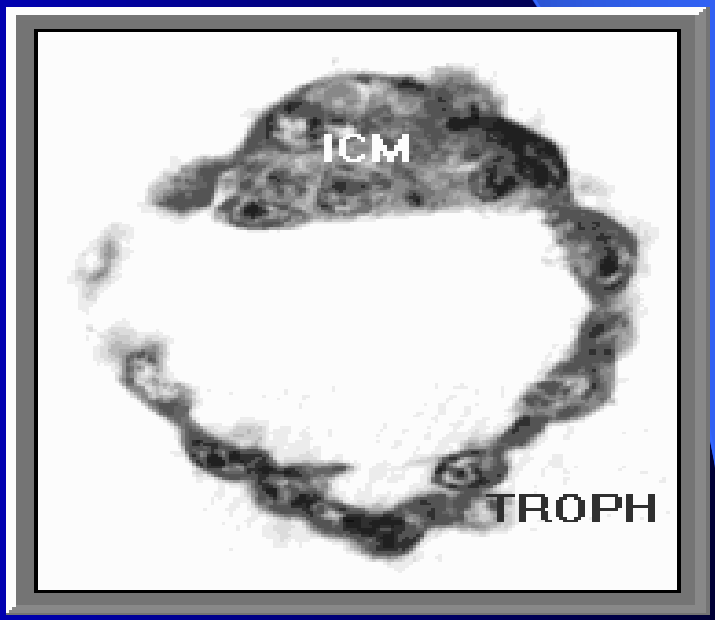
The three different types of "cloning" are:

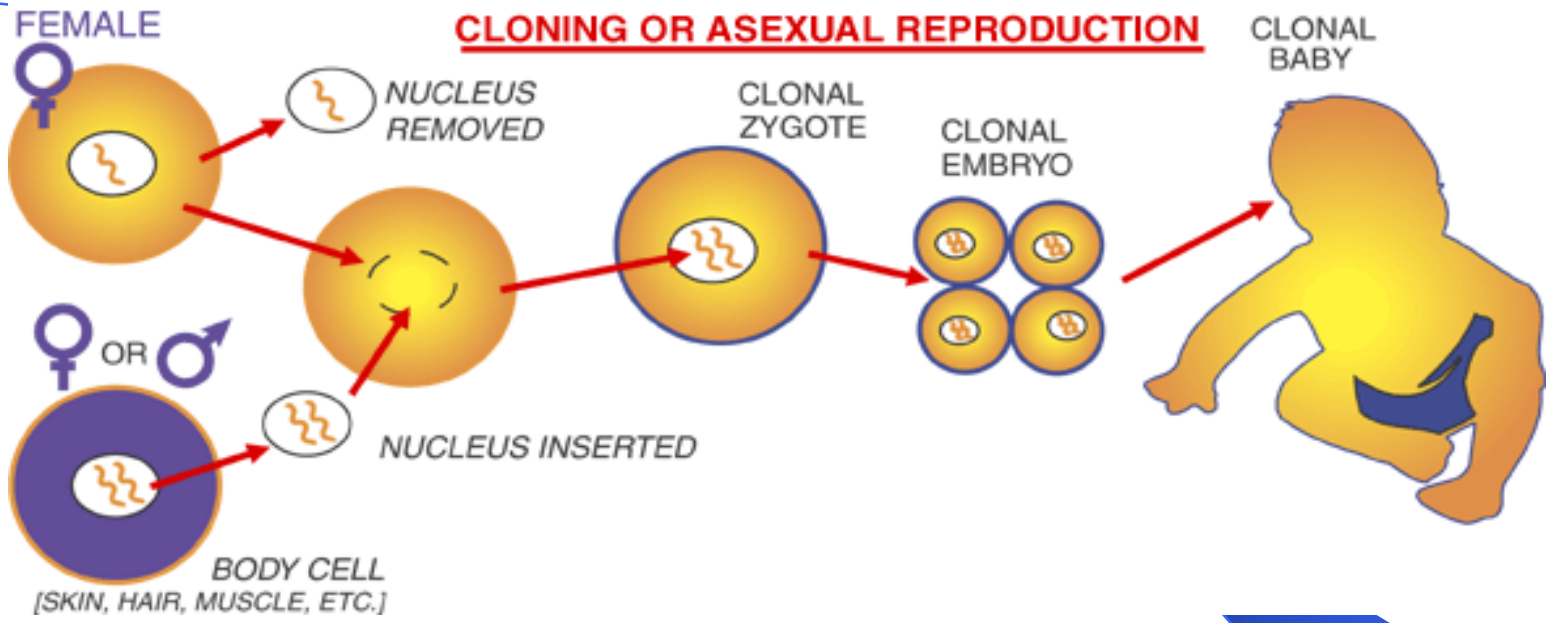
1. **Embryo cloning:** Technique which produces monozygotic (identical) twins or triplets. One or more cells are removed from a fertilized embryo and encouraged to develop into one or more duplicate embryos.
2. **Adult DNA cloning (reproductive cloning):** The DNA from an ovum is removed and replaced with the DNA from a cell removed from an adult animal. Then, the fertilized ovum, now called a pre-embryo, is implanted in a womb and allowed to develop into a new animal.
3. **Therapeutic cloning (biomedical cloning):** uses the cloning procedure to produce a clonal embryo, but instead of being implanted in a womb it is used to generate stem cells or a whole organ for transplant back into the person who supplied the DNA. The goal of therapeutic cloning is to produce a healthy copy of a sick person's tissue or organ for transplant

SEXUAL REPRODUCTION

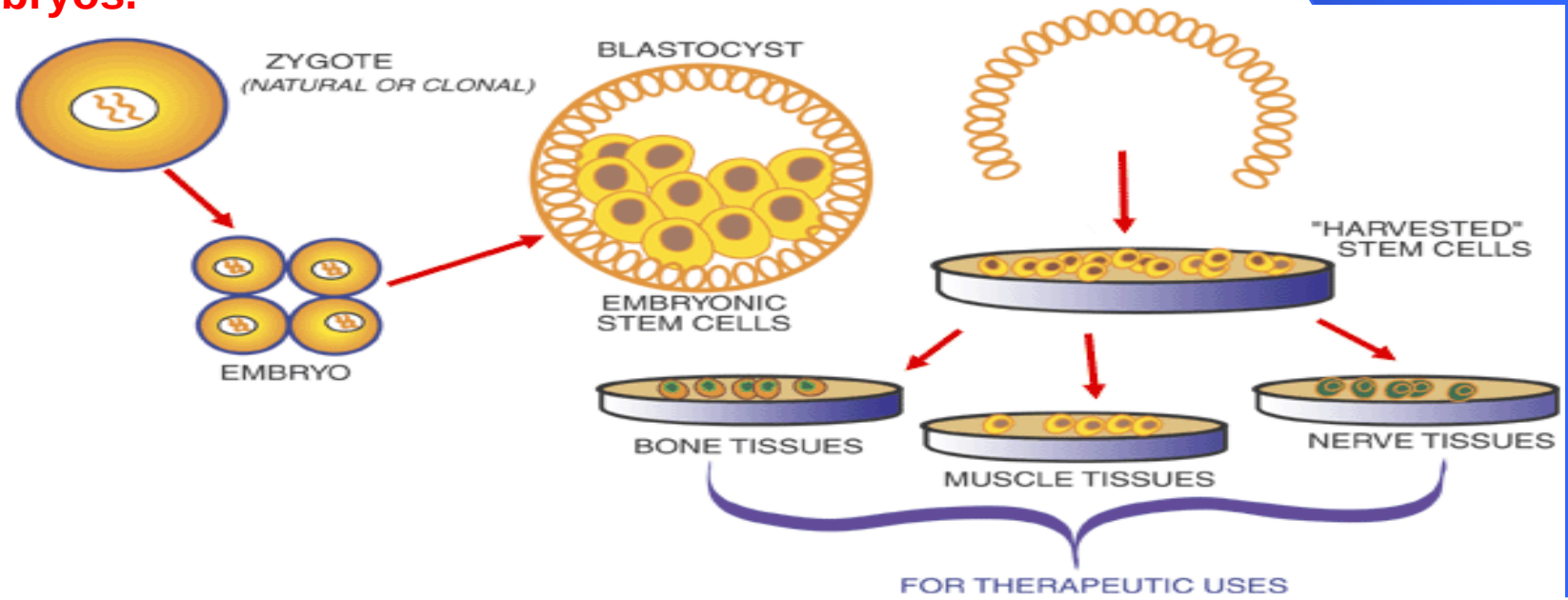








STEM CELLS:are primordial cells capable of developing into a variety of types of cells. Some stem cells are found in the adult body. Others are found in very early embryos.



Five Basic Steps of Cloning

1. A piece of DNA that contains the gene to be cloned is put into a DNA molecule called a vector to produce a recombined DNA molecule.

2. The vector transports the gene to the host cell.

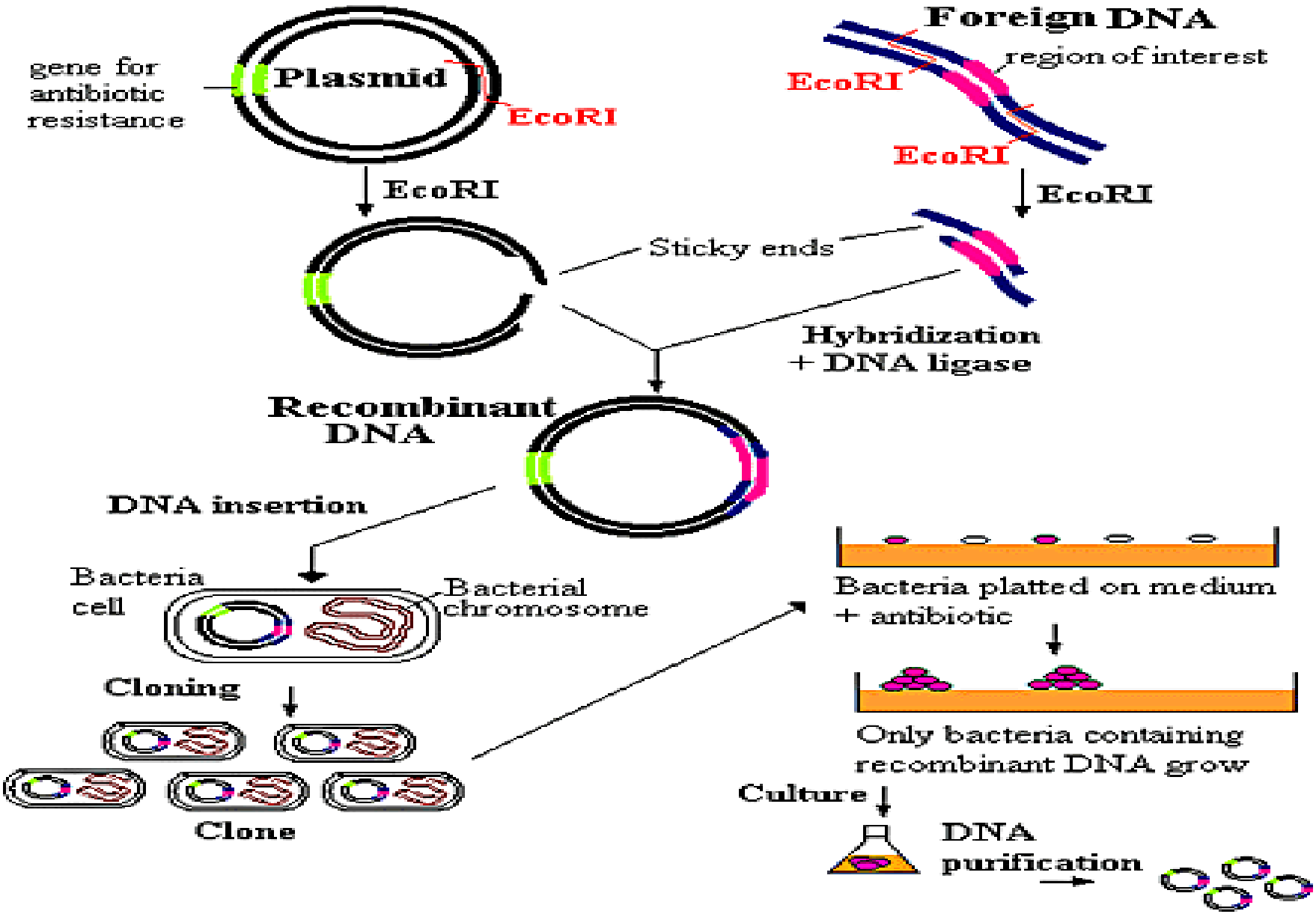
3. In the host cell, the vector multiples and makes many identical copies of itself and also of the gene.

4. When the host divides, copies of the recombined DNA molecules and the gene are now said to be cloned.

5. After many cell divisions, a clone of host cells are produced. Each cell has at least one copy of the recombined DNA, and the genes are cloned.

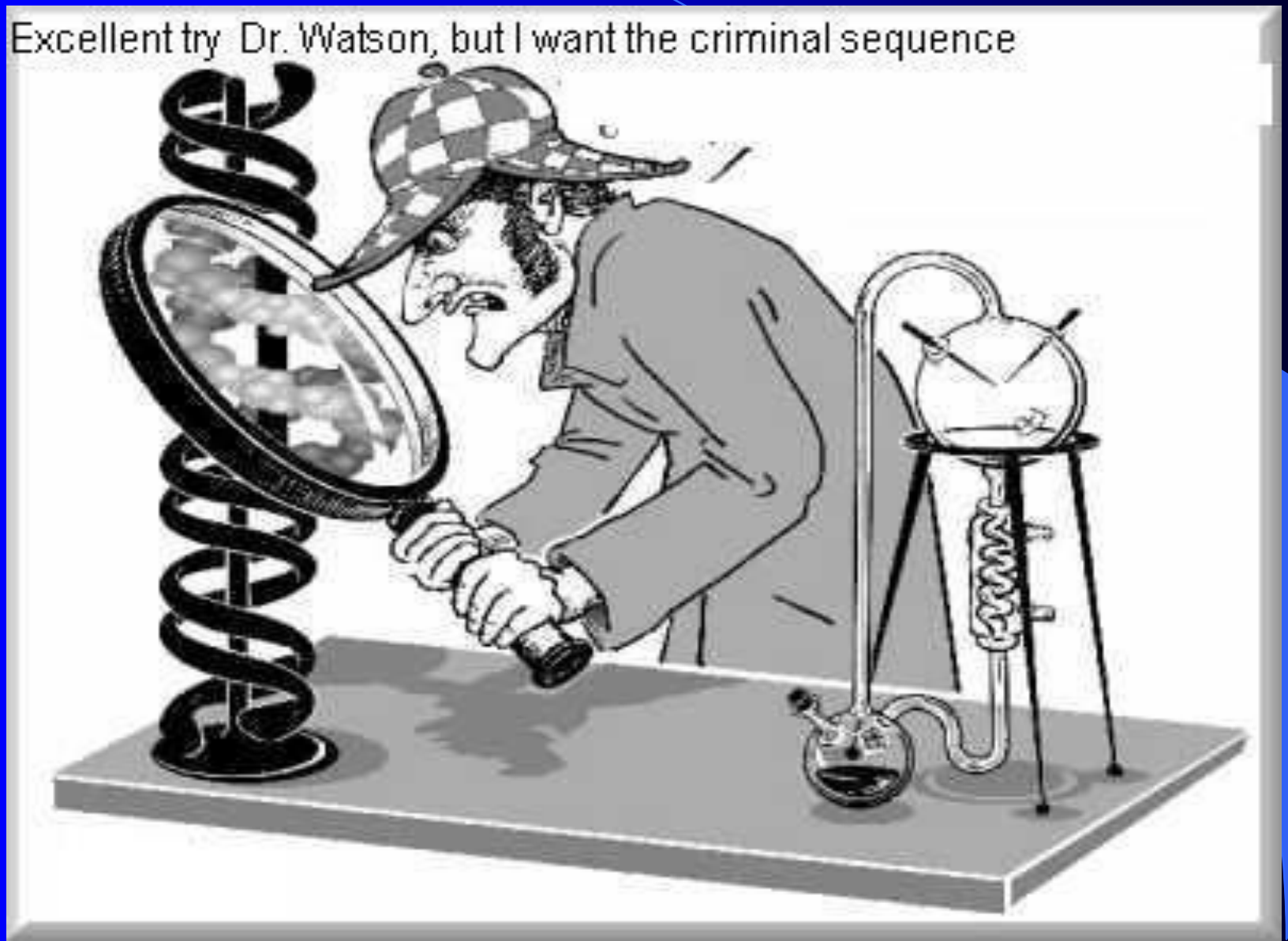
This transfer technique, or embryo twinning, is the basis of this process and results in parent and offspring exhibiting identical gene makeup.

CLONING PROCEDURE

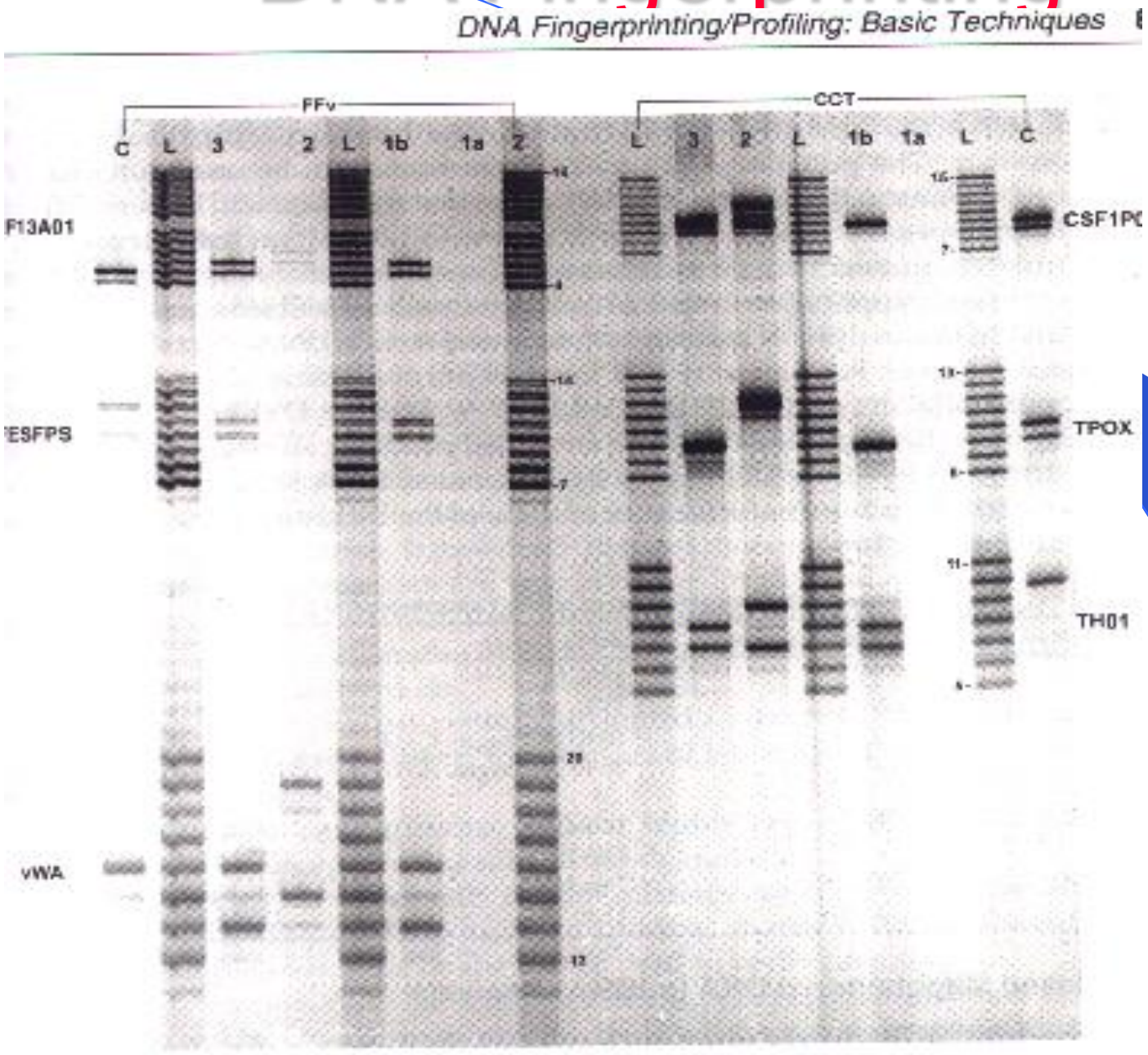


Cloning into a plasmid

Forensic Biotechnology



DNA Fingerprinting



PLANT BIOTECHNOLOGY

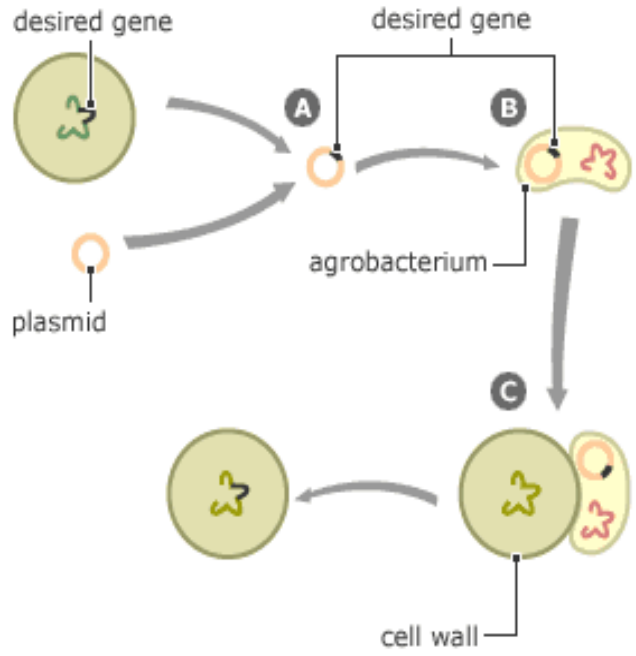
In Pictures: How a plant is genetically modified

Introduction

For centuries plant breeders have cross-bred similar varieties of plant to produce new crops.

Genetic engineering allows scientists to isolate a specific gene for a particular trait – such as resistance to insect attack – in a plant or animal, and transfer it into another plant.

Transferring a gene using a bacterium



Method one - nature's engineer

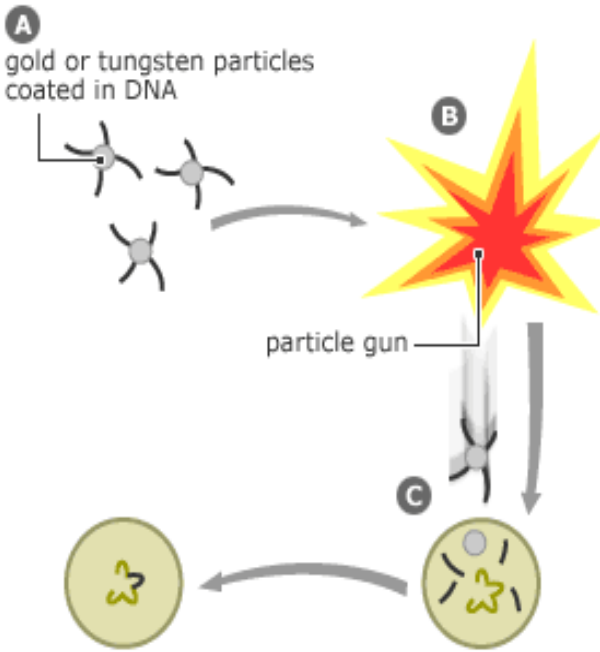
A plant can be modified using a bacterium which naturally inserts DNA into plant cells to cause tumours it can feed off:

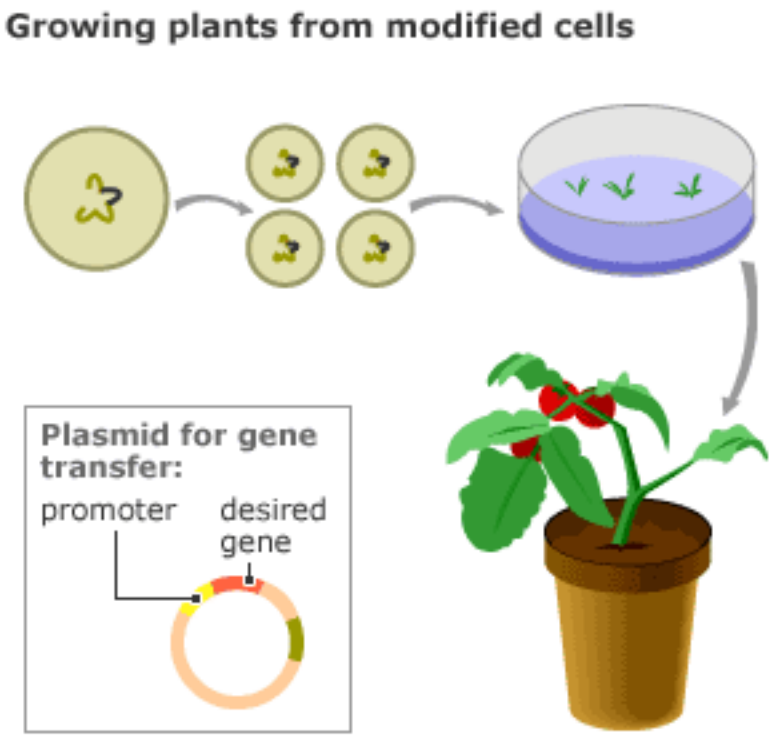
A: Desired gene isolated and placed into DNA section called a plasmid

B: Plasmid transferred into bacterium

C: Bacterium infects plant cells, transferring desired gene into chromosome

Transferring a gene using a particle gun



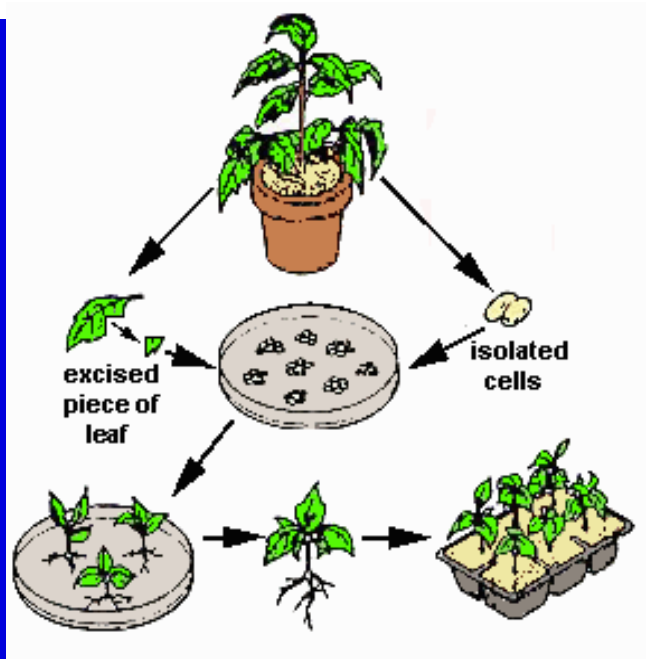


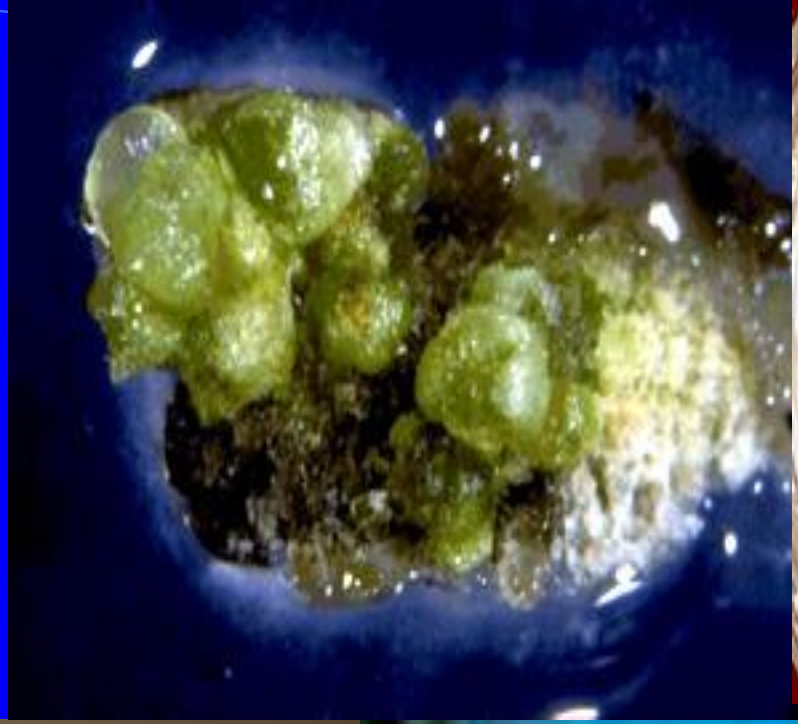
Growing the plants

The modified cells are allowed to divide, creating many copies of themselves. These are grown into plants in a growth medium.

A "promoter" - a trigger which activates the gene – is included with the desired gene on the plasmid.

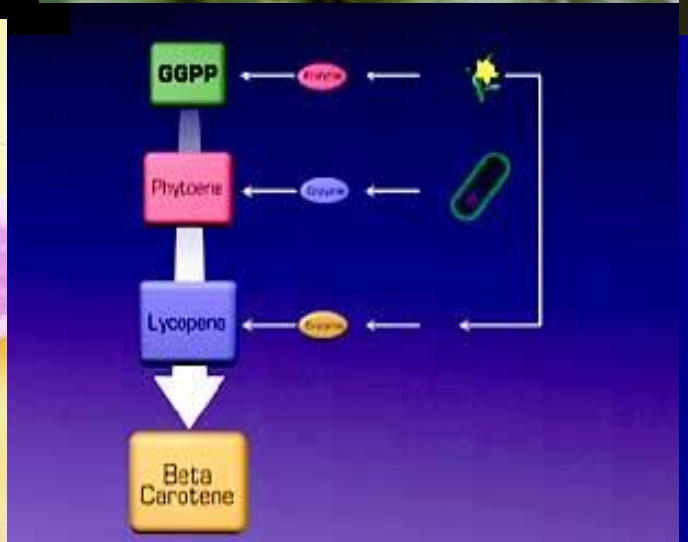
The promoter "switches on" the transferred gene, causing the growing plant to develop the desired trait.

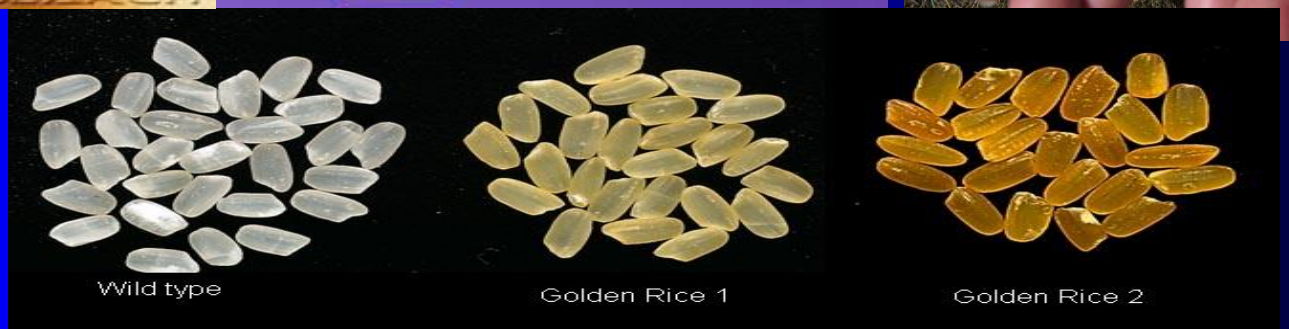





©COPYRIGHT
FOTOSEARCH


©COPYRIGHT
FOTOSEARCH


GGPP
Phytoene
Lycopene
Beta Carotene


Wild type
Golden Rice 1
Golden Rice 2

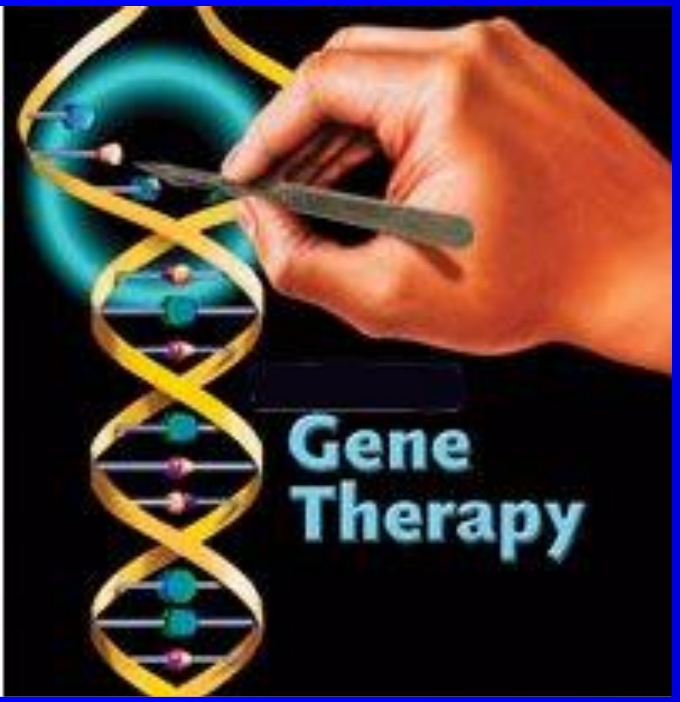
ANIMAL BIOTECHNOLOGY

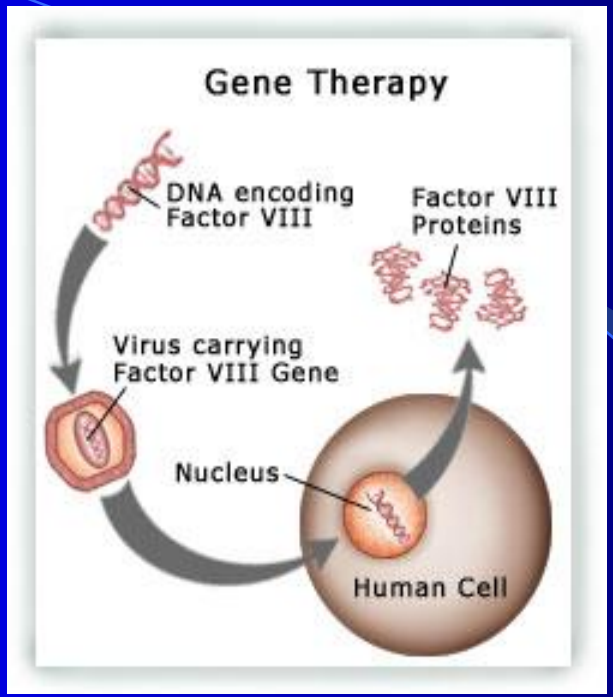
Respective growths of a GM salmon and a non-GM one at the same age (Credit: Aqua Bounty).

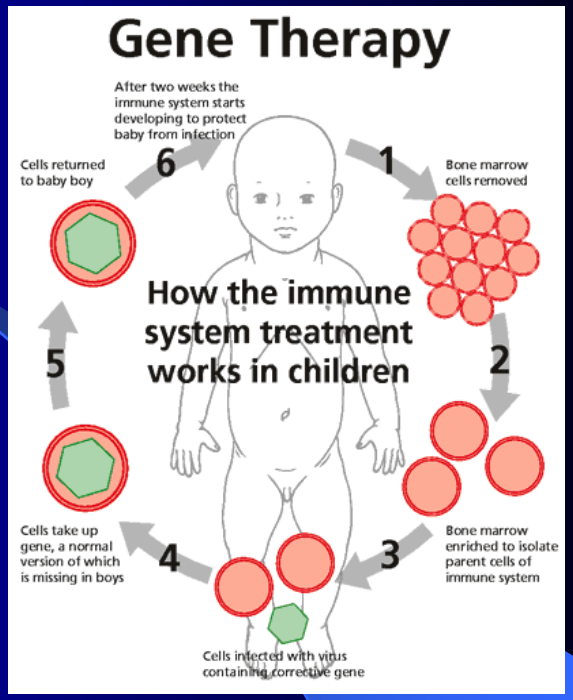
IN Market in 2008

Aqua Bounty Technologies, has created a breed of salmon that grows twice as fast as normal farmed salmon, because they carry part of the genetic code of another type of fish, the ocean pout.

MEDICAL BIOTECHNOLOGY

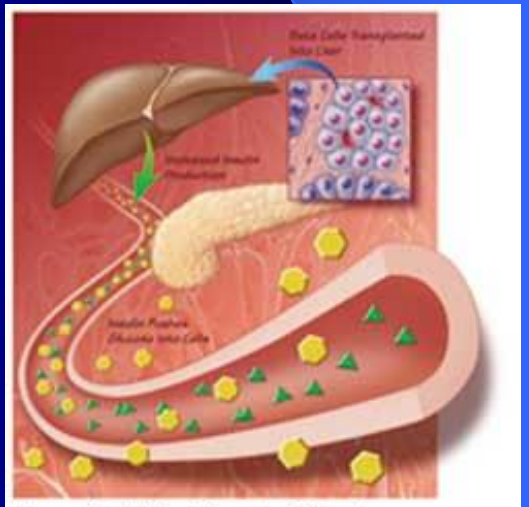






Gene therapy attempts to treat genetic diseases at the molecular level by correcting what is wrong with defective genes

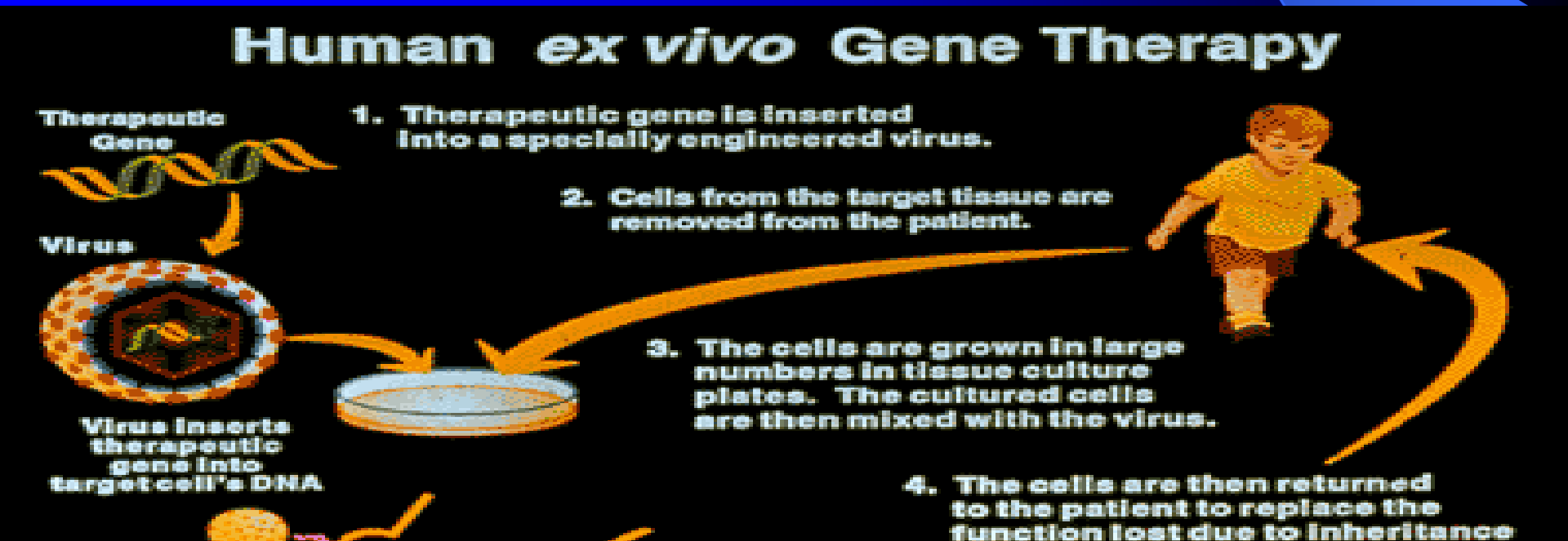
VIRUSES OR LIPOSOMES USED TO TRANSFER



Pancreatic islet cell transplantation from cadaveric donors can eliminate or decrease the need for insulin therapy.

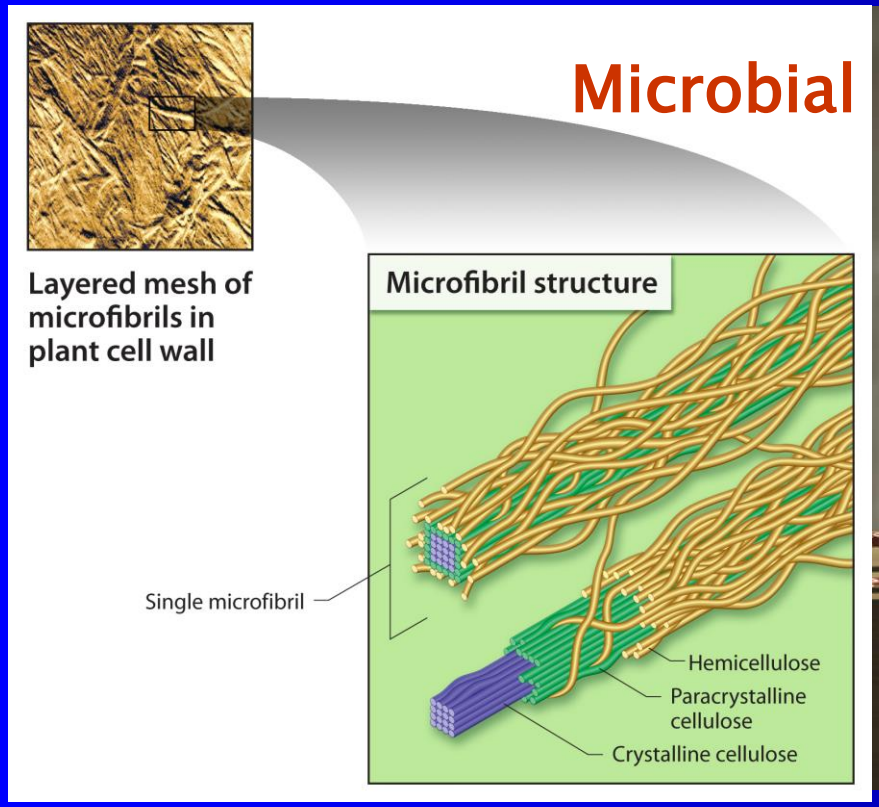
ADA: The First Gene Therapy Trial

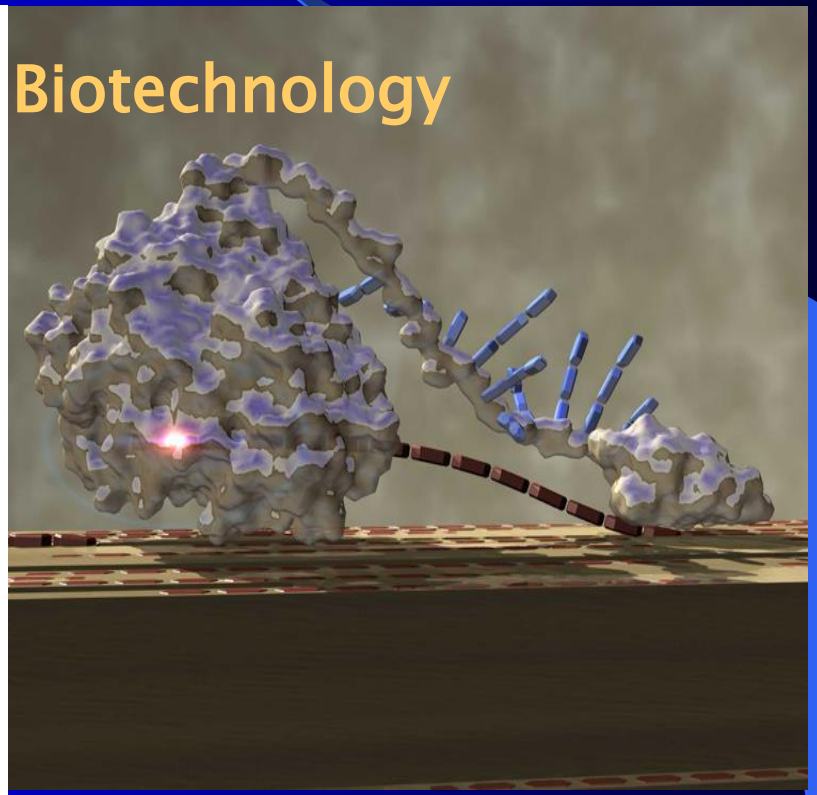
A four-year old girl became the first gene therapy patient on September 14, 1990 at the NIH Clinical Center. She has **adenosine deaminase (ADA)** deficiency, a genetic disease which leaves her defenseless against infections. White blood cells were taken from her, and the normal genes for making adenosine deaminase were inserted into them. The corrected cells were reinjected into her. Dr. W. French Anderson helped develop this landmark clinical trial when he worked at the National Heart, Lung, and Blood Institute.



INDUSTRIAL BIOTECHNOLOGY

MICROBIAL AND ENVIRONMENTAL

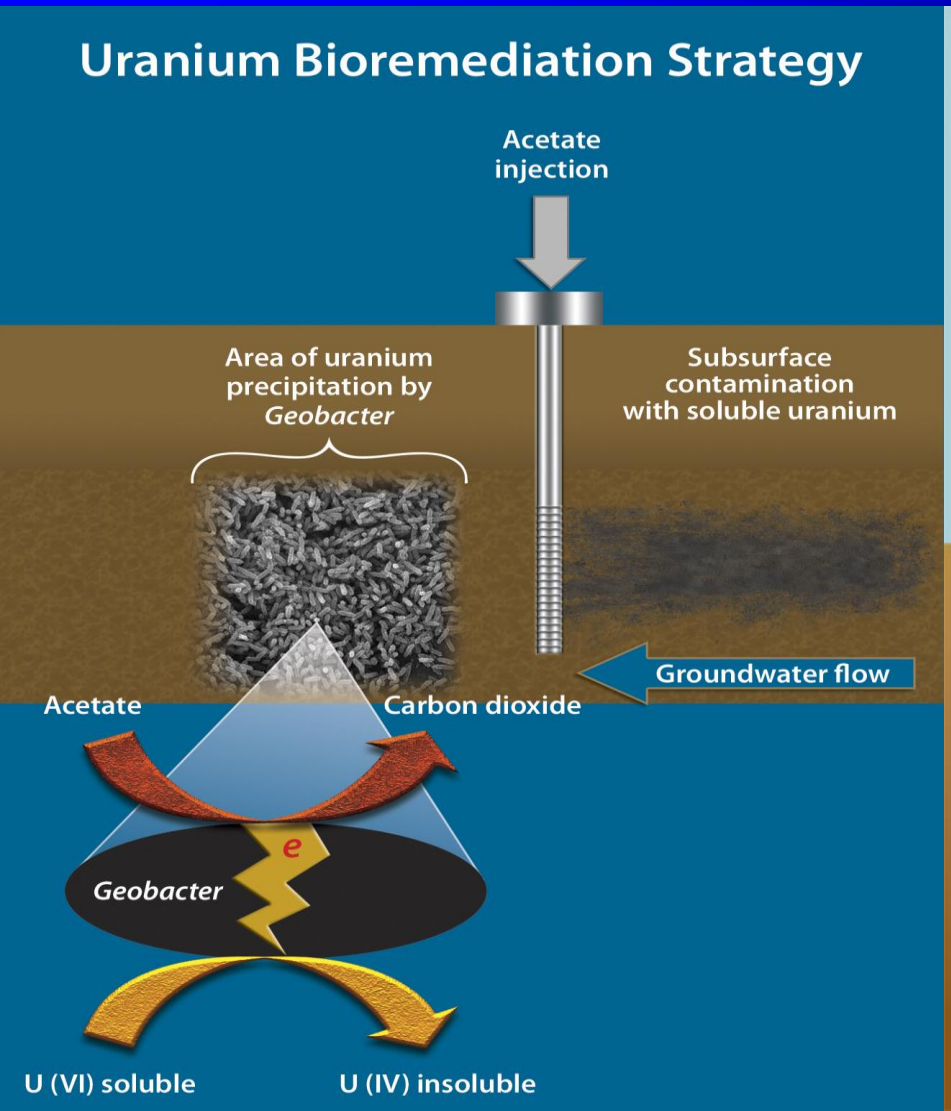


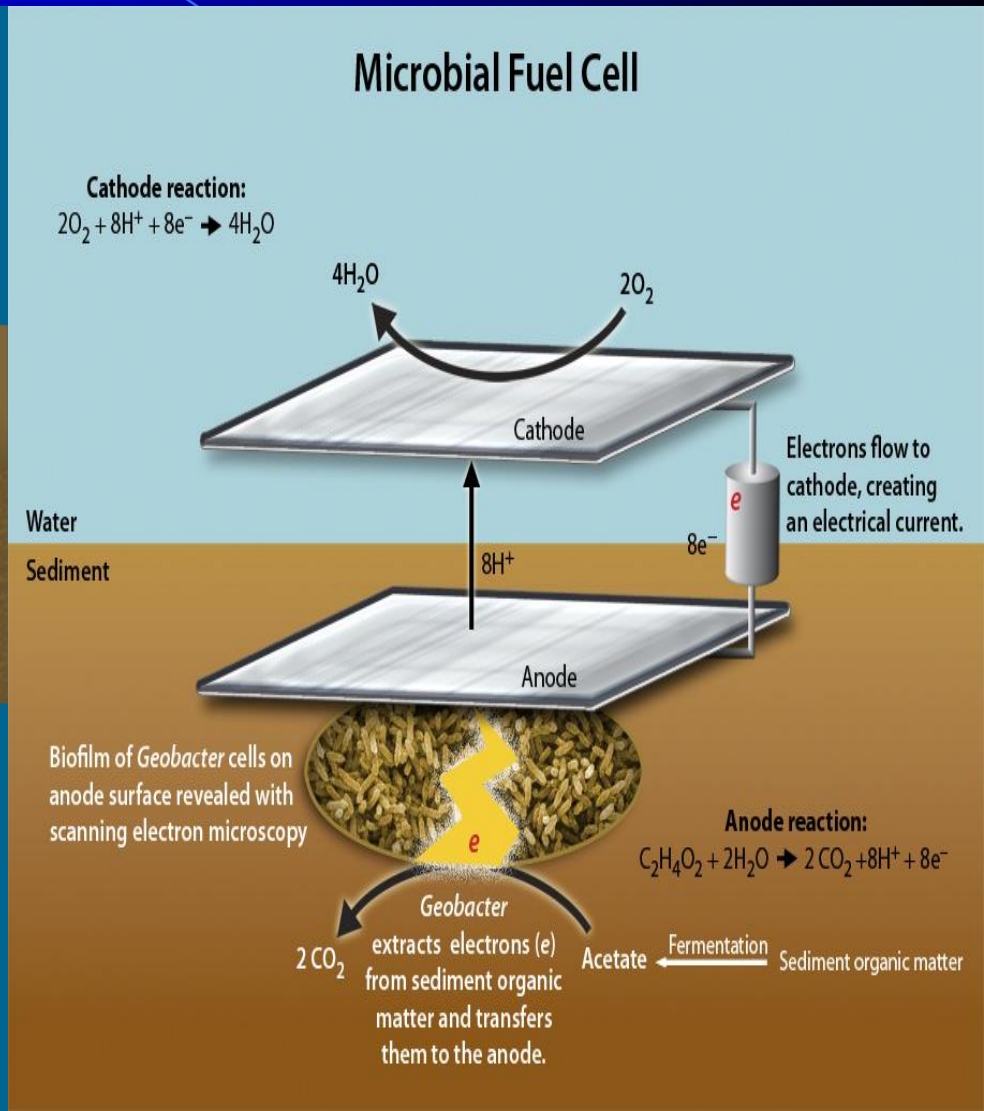


Cellulose: Microbes Process It into Ethanol-Convertible Sugars

ENVIRONMENTAL/ECO BIOTECHNOLOGY

Bioremediation





What is India's stand on Biotechnology?

Indian government is committed to safe use of biotechnology for increasing agricultural productivity and offering benefits to farmers and consumers.

Wouldn't Biotech lead to reduced Biodiversity?

- **Appropriate care and concern for local ecosystems must be taken to harness the potential benefits of biotechnology.**

- **Biodiversity is maintained by what grows wild and the species preserved and maintained by man in gene banks and botanic gardens.**

Carrier Options

- **Those who design the research and plan product development - Ph.D. or an M.D. degree.**

- **The actual research and development is carried out by scientists who hold B.S. or M.S. degree holders.**

- **Some technicians with B.S. degrees**

- **A scope for even undergraduate students who wish to become part in biotechnology research.**

Who can benefit from Biotechnology?

Students
Engineers
Bioethicists
Biologists
Chemists
Physicians
Journalists
Historians
Bankers
Genealogists

Statisticians
Programmers
Psychologists
Legal experts
Moneylenders
Chemical engineers
Computer scientists
Manufacturing experts
Science fiction writers
Human resources personnel

Job Prospects

Government Institutes: DBT, CSIR Labs, Rajiv Gandhi Centre for Development of Education, Science and Technology,Thiruvananthapuram. Horticulture, Agriculture and Dairy Institutes, National Facility for Plant Tissue Repository and the National Bureau of Plant and Genetic Resources, New Delhi.

Private R&Ds and Corporate: Drug companies like Dabur, Ranbaxy, Hindustan Lever, Dr Reddy's Labs, Panacaea Biotech, Cadilla, Lupin Laboratories. Hindustan Lever, Thapar Group, Indo American Hybrid Seeds, Biocon India Ltd., IDPL, Hindustan Antibiotics etc.

Others: Food processing industry, chemical industry and the textile industry.

Biotech Consortium India Ltd: Provides short term training programme for biotechnologists who wish to work in the industry

Salary: In Research Institutes starting Fellowship would be: Rs.5000-7000/month.

In private companies a qualified biotechnologists would find place at Rs 5000-Rs 20,000/month

Placement as: **Horticulture Geneticist, Medicine and Health Care Specialist, Plant Tissue Culture Specialist, Molecular Biologist, Industrial Research and Development, Agriculture and Animal Husbandary and Environmentalist**

CONCLUSIONS

- Biotechnology is an emerging field all over the world. It is this science which will yield the wonder drugs of tomorrow as also new varieties of plants and animals.
- For a person with an academic bent of mind, biotechnology offers a unique opportunity to work in a virgin field. All other branches of science are saturated
- Since scientists can patent the fruits of their research, the possibility of making a name and a large fortune is also not ruled out. The area thus is very exciting and has tremendous possibilities.
- India has the vital ingredient for global success in Biotechnology & pharmaceutical R&D: its scientific manpower. However, we need to harness this talent in an enabling business environment with a pragmatic, entrepreneurial mindset.


THANK YOU
FOTOSEARCH.com