GM-ENGINEERING BIOPROCESSES. HEALTH CARE. MANUFACTURING INDUSTRY

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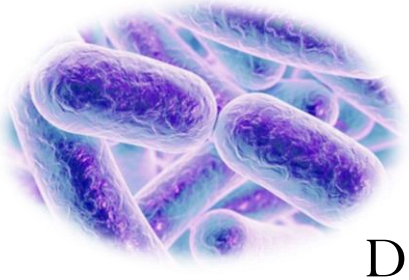
Biotechnology and Health Care

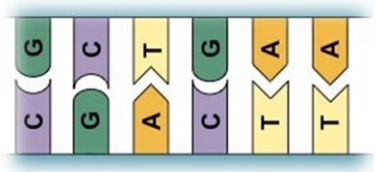
Biotechnology and Health Care – in a broader sense caring about people not the medical aspect.

Human protein production

Today many products are made in vitro by introducing gene sequences into a cell (e.g. *interferon* via bacteriophages, *interleukin* via bacteria).

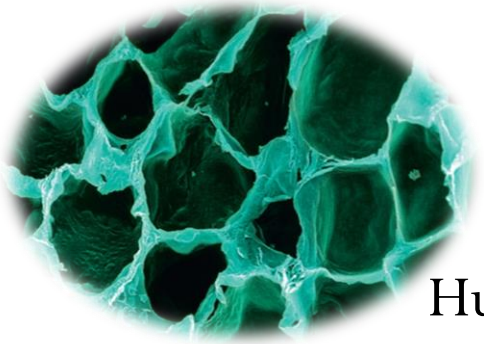


Bacteria



Desired gene sequences

Yeast



Human Body Cells

DWARFIZM

Pituitary dwarfism is a result of a hypo secretion of growth hormone.

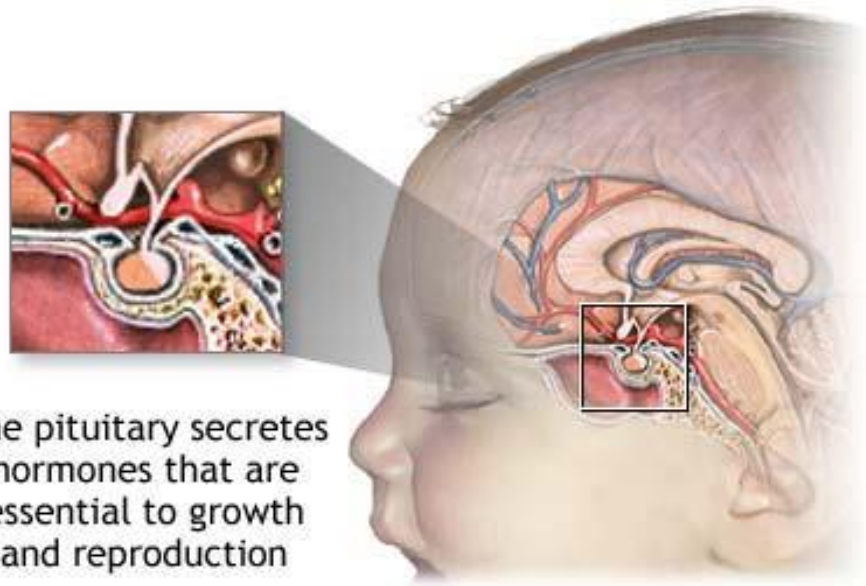
- Long bone growth is slowed, body proportions are normal
- Treatment with growth hormone **may** restore normal growth

The Human Growth Hormones

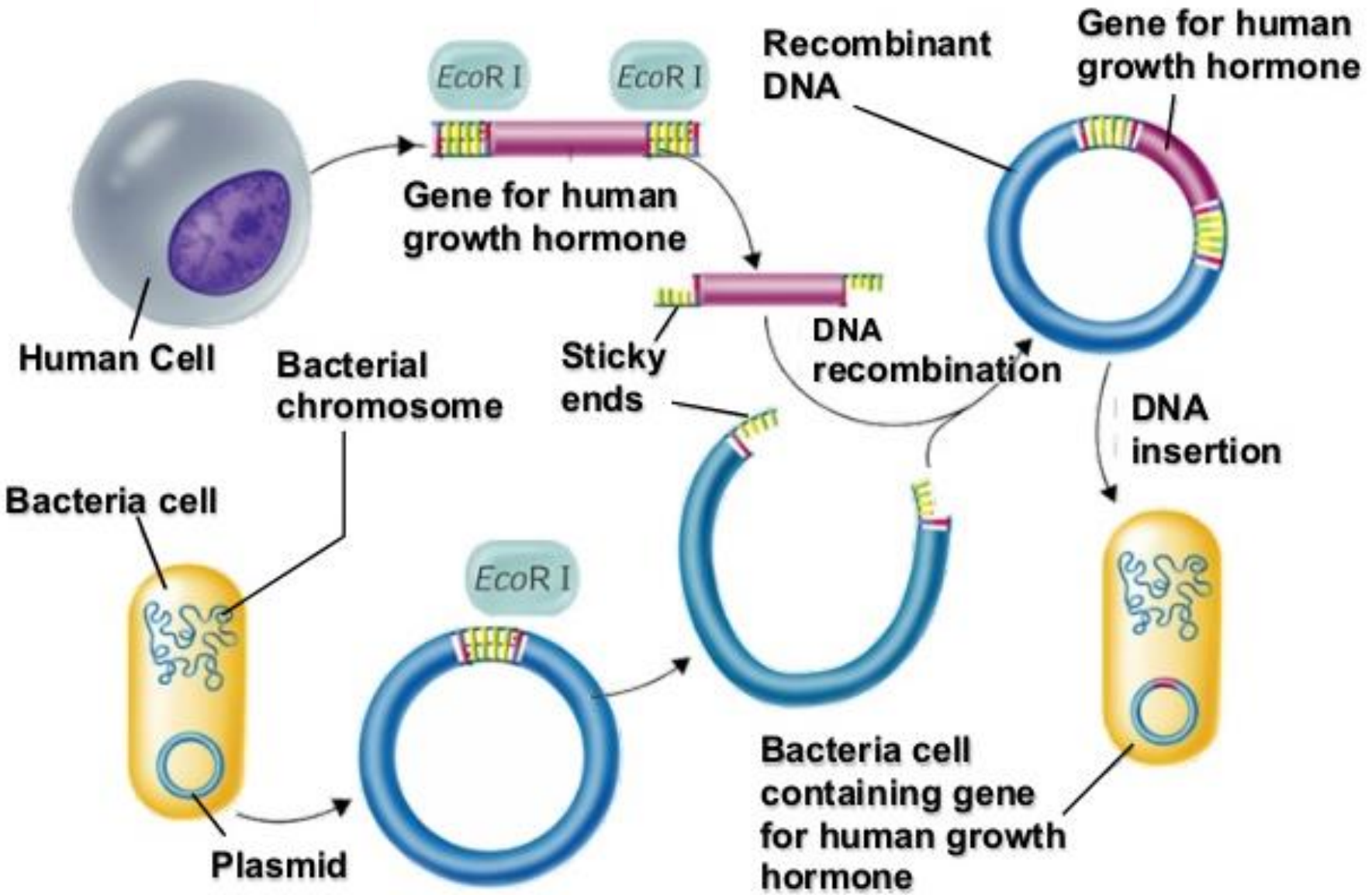
If this hormone from the pituitary gland, is present in reduced quantities in children that they may suffer from dwarfism.

Today, recombinant gene technology uses bacteria in order to produce it on a large scale.

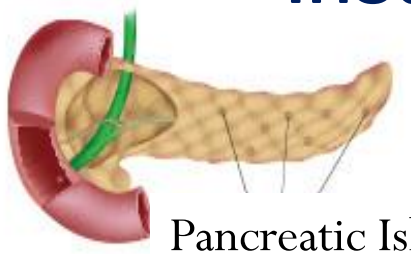
Recombinant Gene Technology



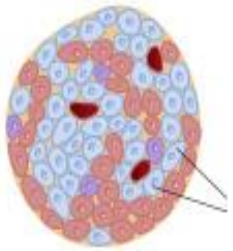
Recombinant DNA Technology in the Synthesis of Growth Hormones



Insulin & Diabete

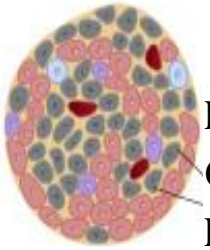


Pancreatic Islets



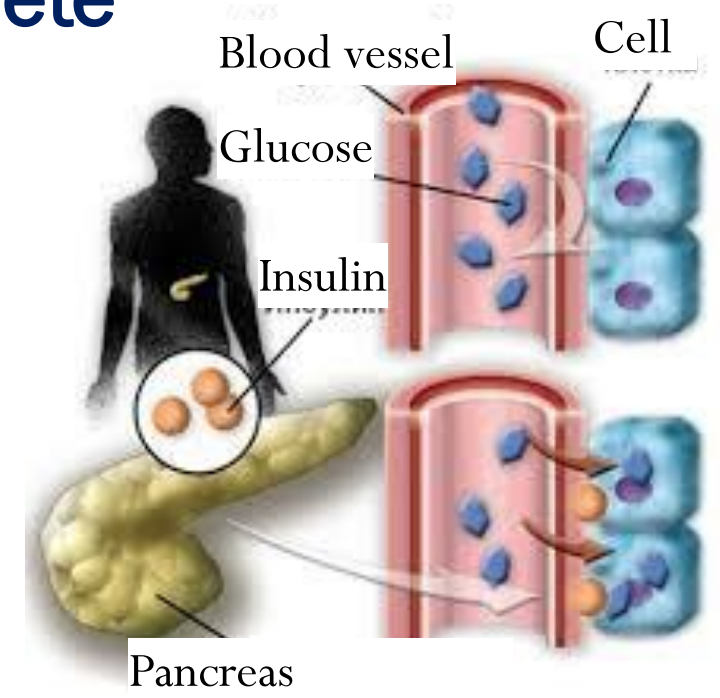
Beta Cells

Normal Islet



Beta Cells Destroyed

Diabete



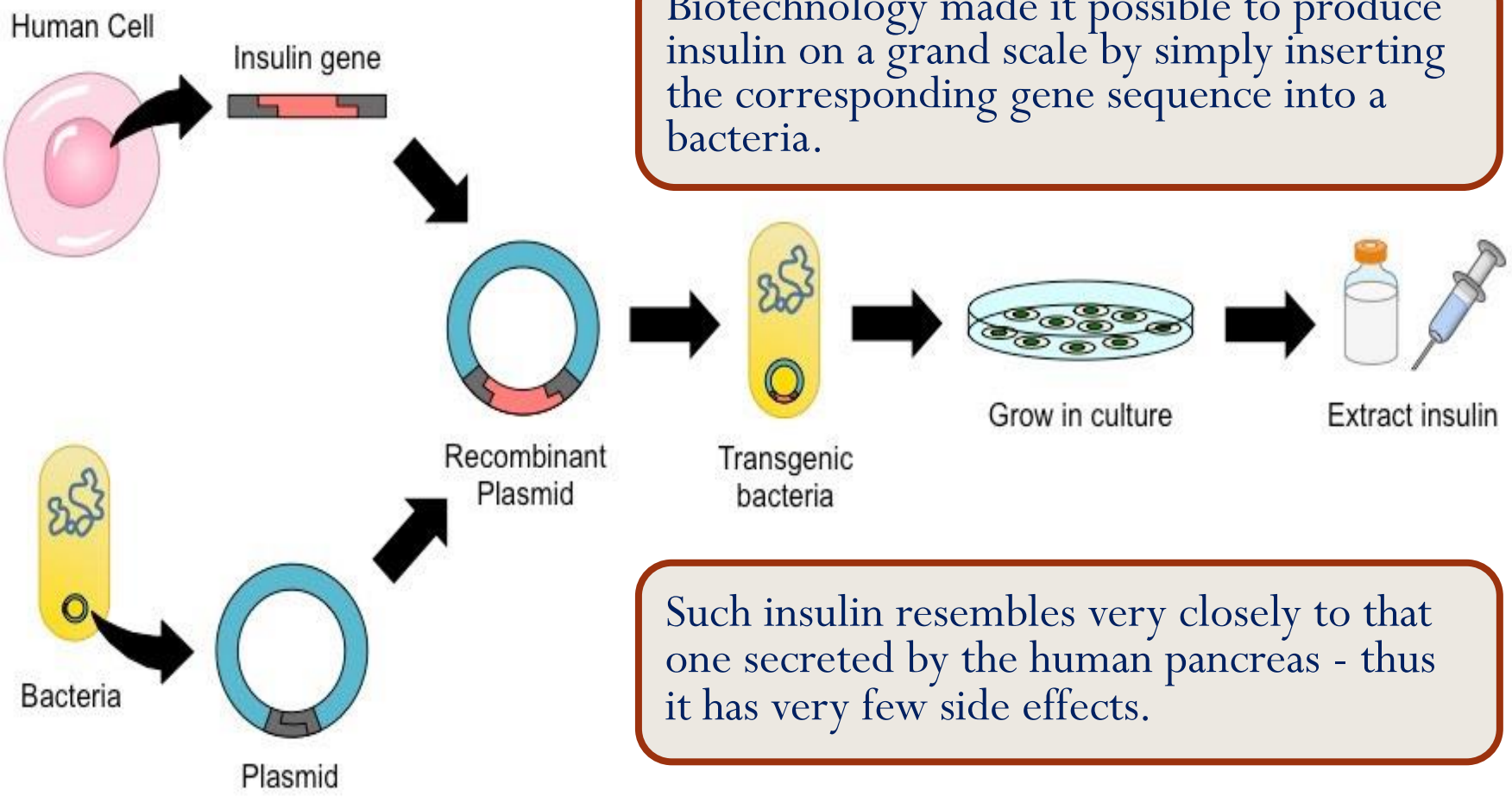
Often such insulin was the cause of allergic reactions in many insulin users.

Insulin used to be extracted from the pancreas of cattle and pigs.

Insuline controls the blood-glucose levels;

Patients suffering with **diabetes** have an insufficient supply of this hormone.

Recombinant DNA Technology in the Synthesis of Human Insulin



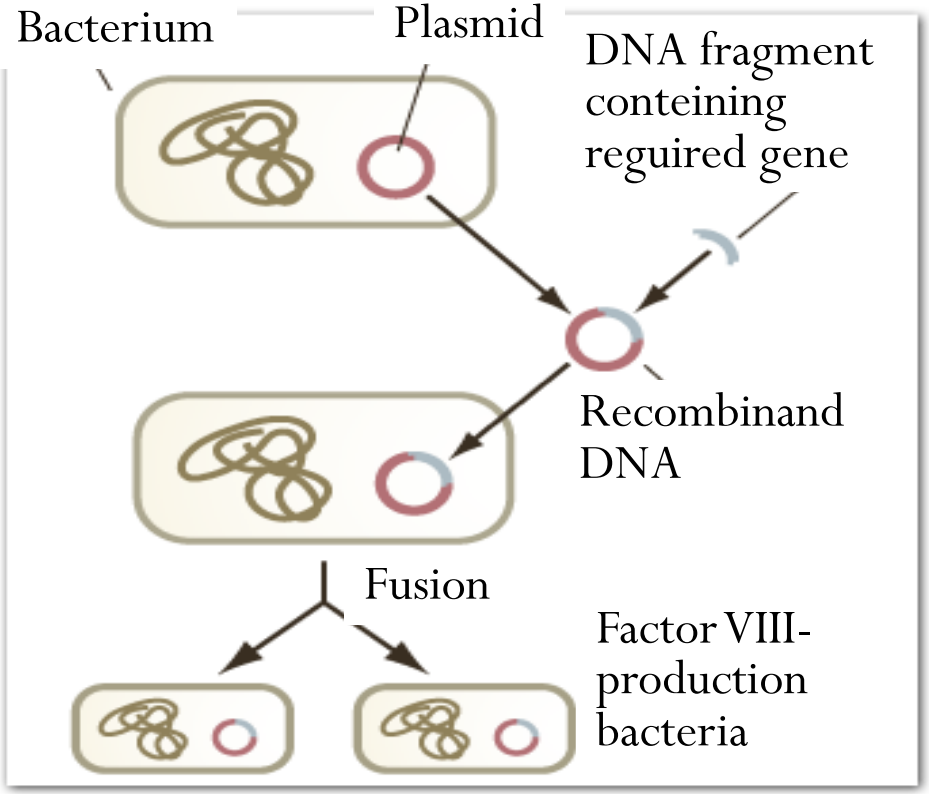
Biotechnology made it possible to produce insulin on a grand scale by simply inserting the corresponding gene sequence into a bacteria.

Such insulin resembles very closely to that one secreted by the human pancreas - thus it has very few side effects.

Hemophilia

Blood vessel **Blood leakage** **Inhability to clotting**

Hemofilia victims are missing clotting factors VIII

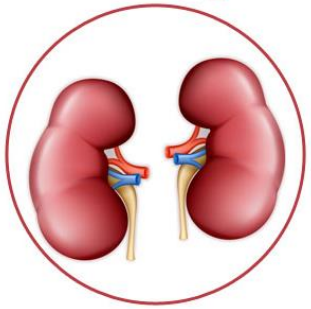


With the help of biotechnology, this factor is produced by bacteria

It has greatly reduced the likelihood of hemophiliacs to contract Acquired Immune Deficiency Syndrome, as previously applied substances originating from blood-plasma donors.

Anemia

Kidney



Kidneys produce hormone Erytropoetin

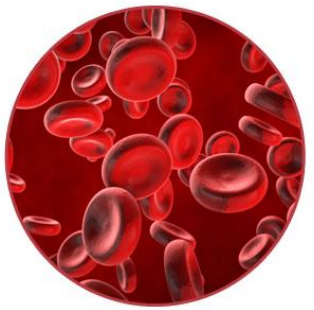
Kidney failure

Bone Marrow

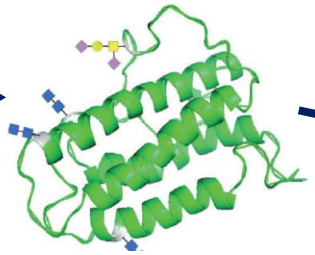
Erytropoetin stimulates bone marrow to produce red blood cells

The amount of Red blood cells decreases

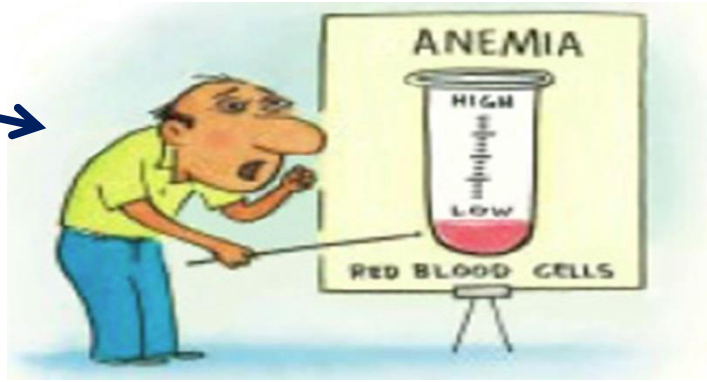
Red Blood Cells



A transgenic Chinese hamster



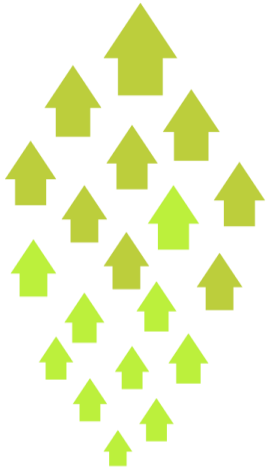
Erytropoetin



In such a way patients suffer from anemia need dialyse and a constant supply of fresh blood transfusions.

Extracting plasma from the animal, isolating the hormone, is a safer way to obtain this hormone, rather than relying again on human donors.

Biosensors

Bioreceptor	Transducer	Amplifier
 Nucleic Acids	 Electrical	 Signal Amplification
 Proteins	 Optical	
 Whole Cells	 Thermistor	

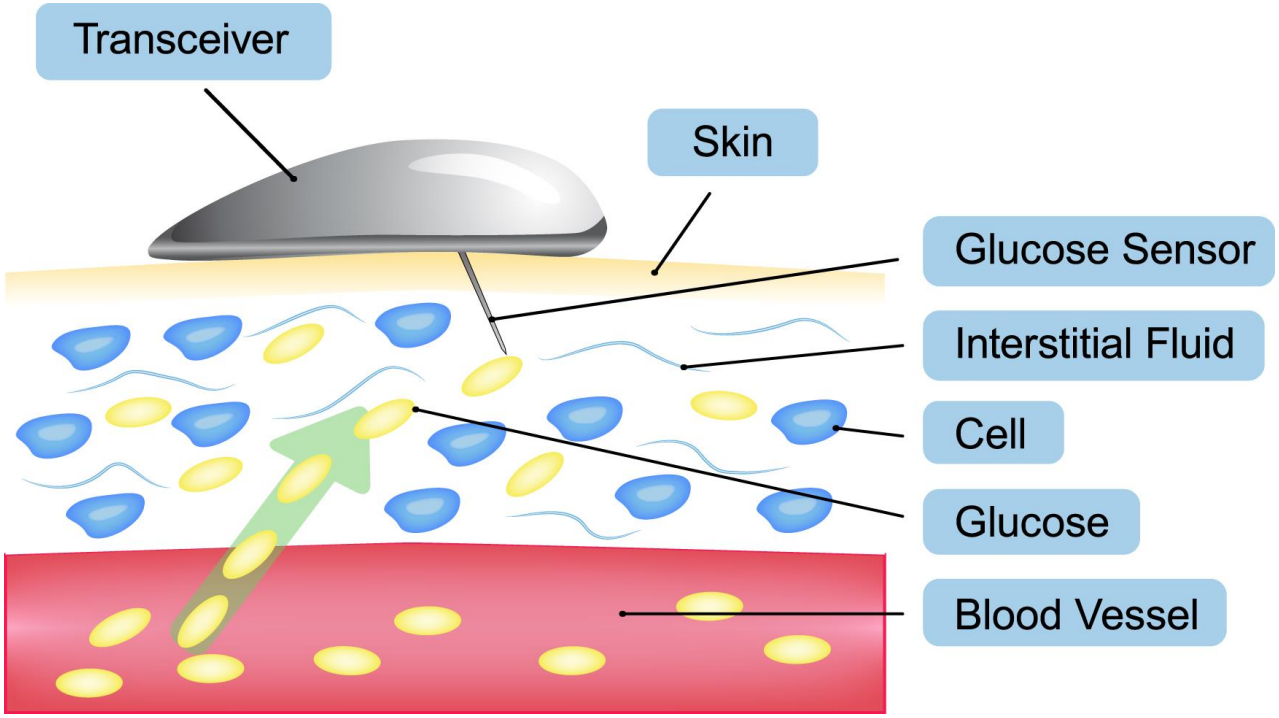
It is a device that utilizes biological components to indicate the amount of a biomaterial

Biosensors are required to respond to changes in the environment. Biosensors are usually very specific and sensitive.

Leland C. Clark Jr. American biochemist, the inventor of the Clarc electrode.

The first experiment to mark the origin of biosensors was carried out by Leland C. Clark (1957).

The modern-day glucose sensor used daily by millions of diabetics is based on his research.

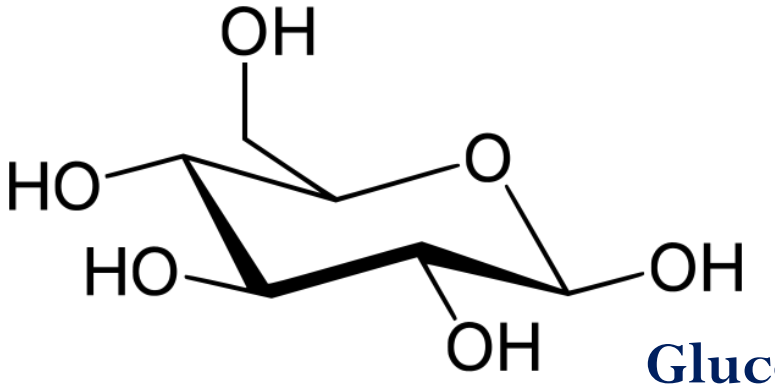


Continuous Glucose Monitoring

Prelude Skin Permeation System

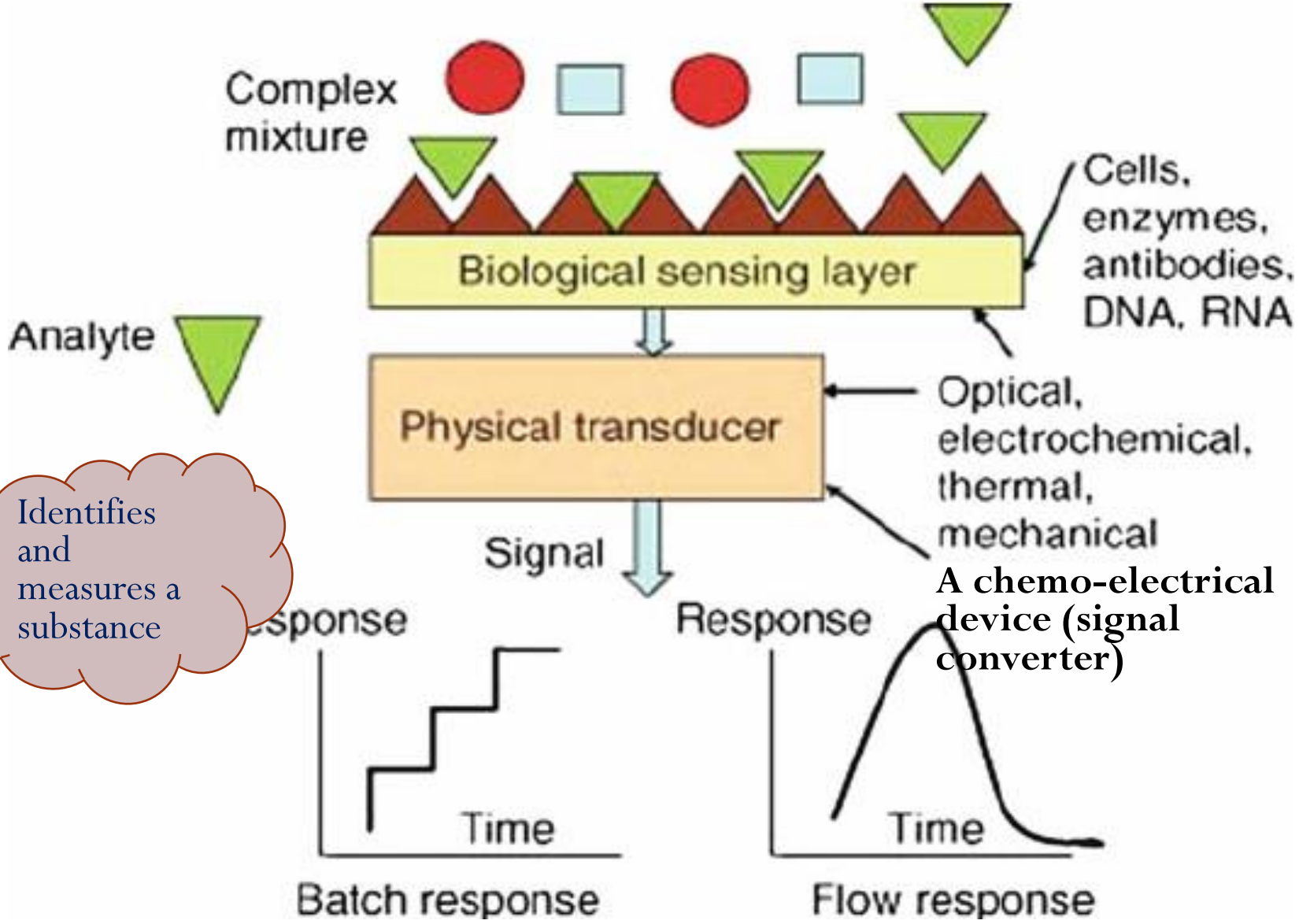
Transdermal Glucose Sensor

Wireless Remote control



Glucose

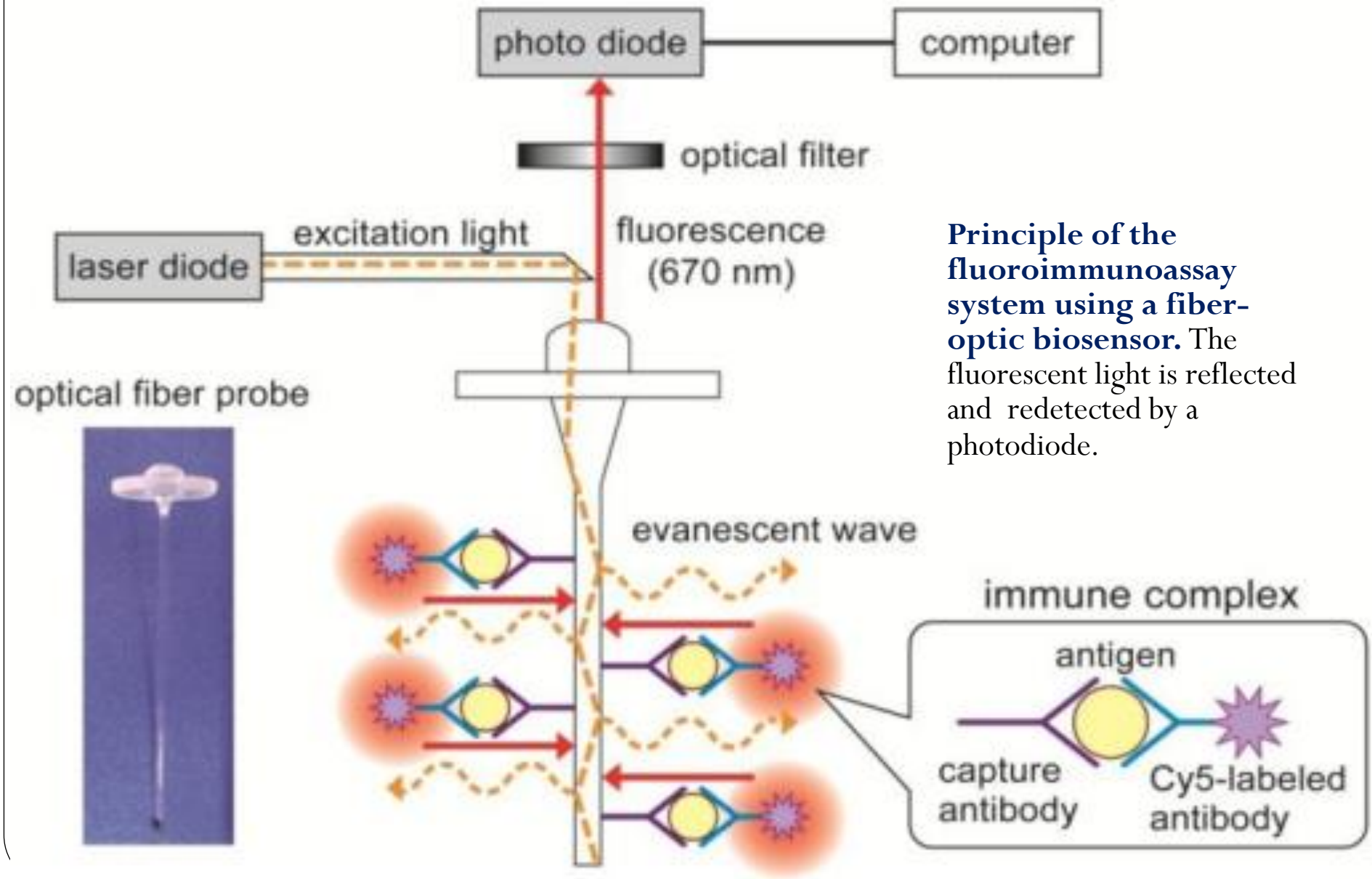
Principle of Biosensor



Principle of Fiber-optical biosensors

- Upon insertion of the tiny fiber into the human tissue and irradiation with visible light, the refracting power of the glass-tissue-blood interface changes drastically.
- A transducer converts the changed pattern of this reflected beam into an electrical signal…

Fiber-optical biosensors are a modern approach



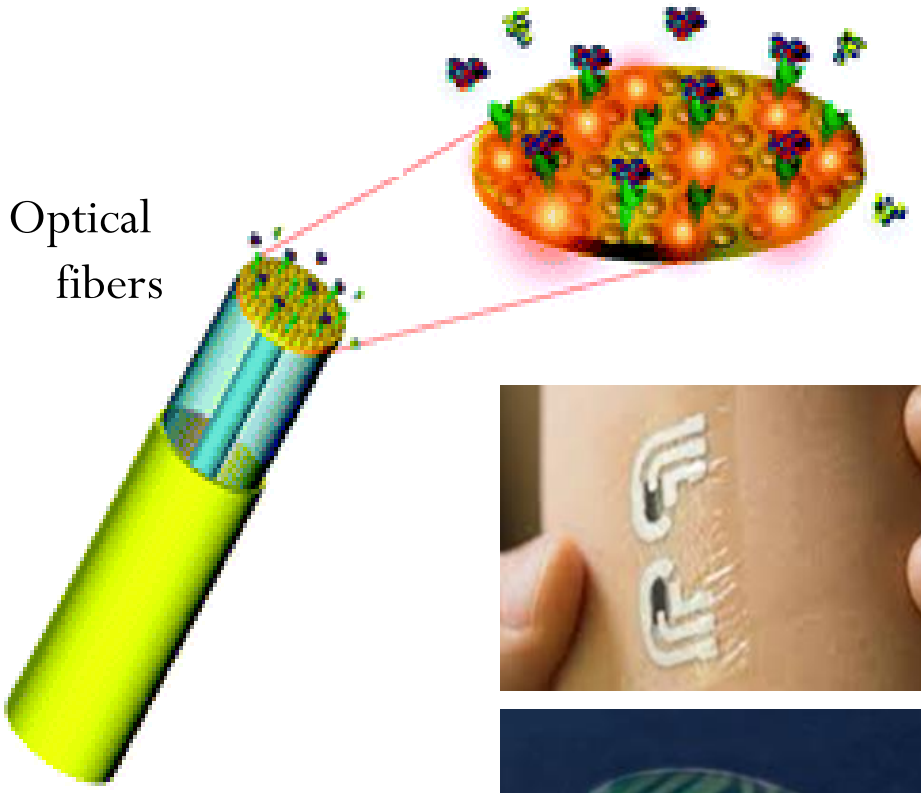
Principle of the fluoroimmunoassay system using a fiber-optic biosensor. The fluorescent light is reflected and redetected by a photodiode.

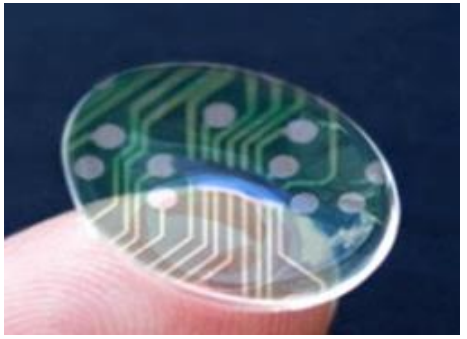
Fiber-optical biosensors: some advantages

Efficiency, accuracy

Low cost, convenience

Promising alternatives to traditional immunological methods for biomolecule measurements.

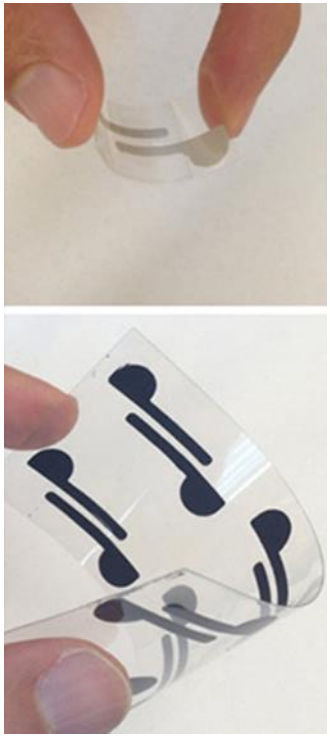


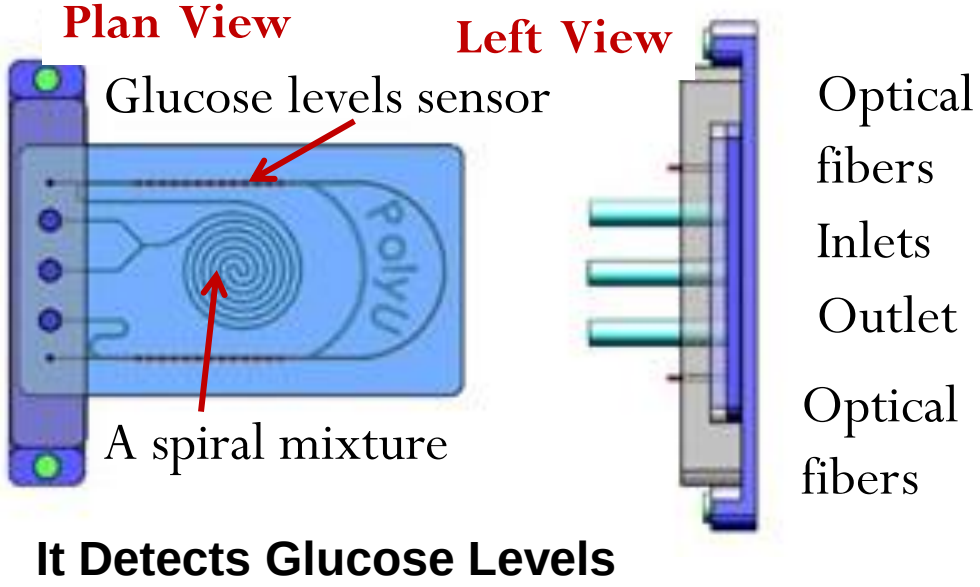


Microchip-biosensors: This is a microchip with a built-in sensor and transducer. e.g. **Gluconic acid microchip-biosensor** .

As glucose oxidizes upon exposure to air, the resulting gluconic acid can easily be detected by the sensor.

The concentration of this acid in blood is directly proportional to the resulting transducer current.

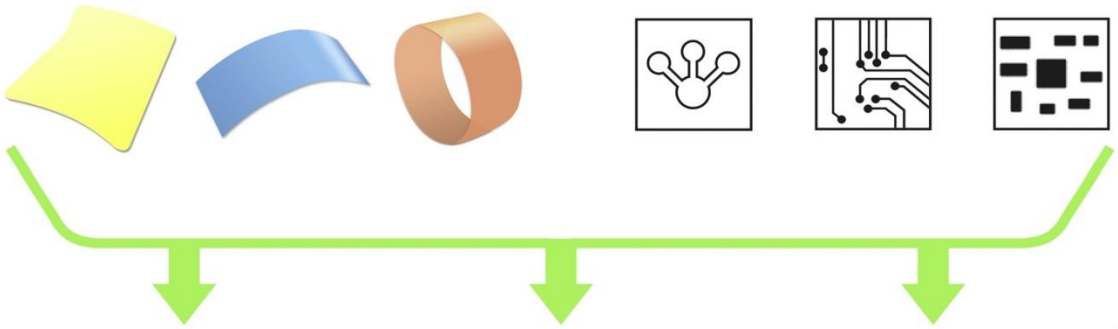




It Detects Glucose Levels

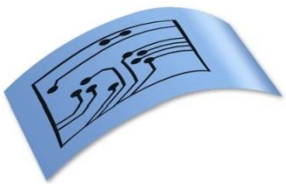
Micro-sensors

Flexible materials



They are intended to be implanted into the skin, acting as an artificial control mechanism.

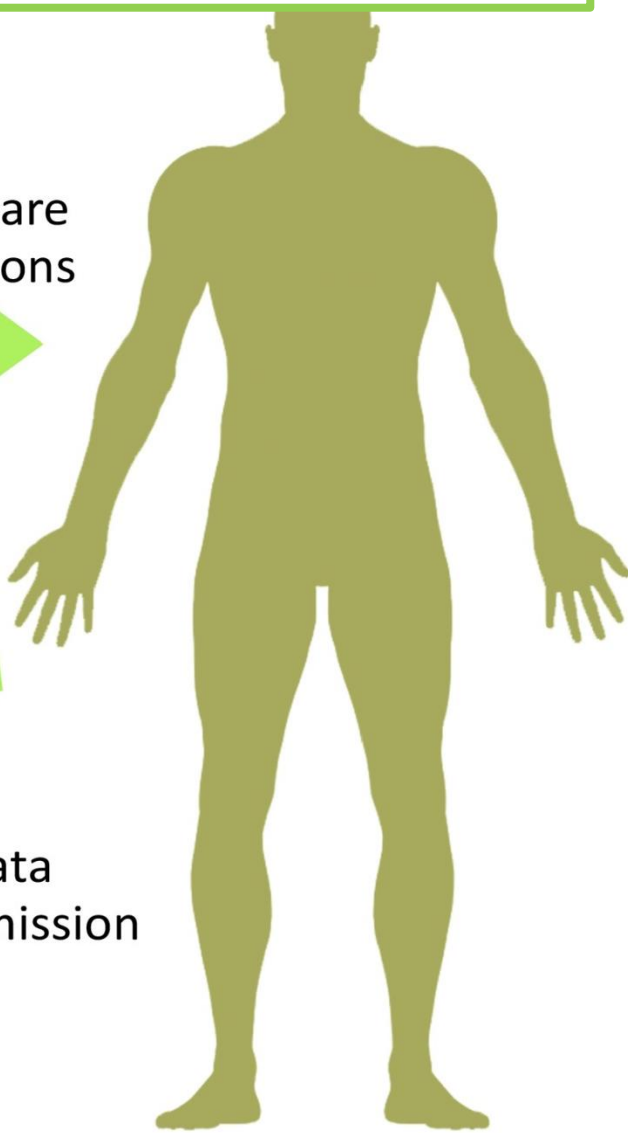
Paper-based devices



Flexible devices

Wearable devices

Healthcare applications



Data transmission

Data processing

Wearable biosensors

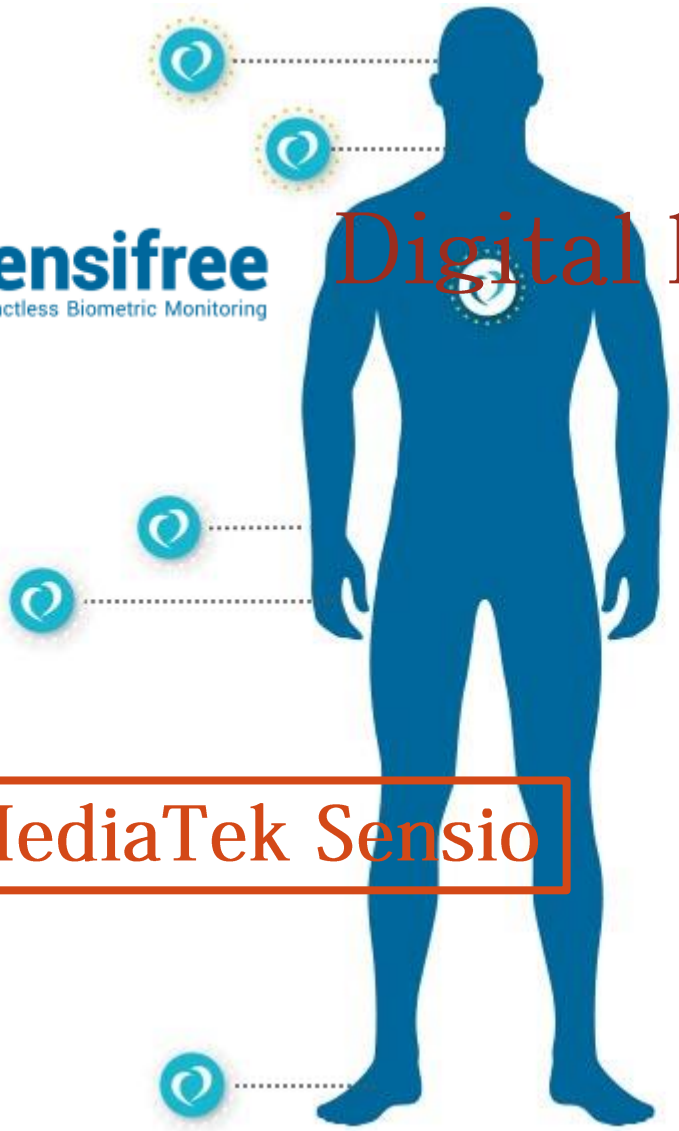
Wearable Sweat Biosensors

Futuristic concepts even suggest that implanting such sensors into the human body might alert the person even before damages occur.

They will have the advantage of not only detecting the signal but also capable of processing that signal in order to suggest / launch counter measures.

Digital health startups

sensifree
Contactless Biometric Monitoring



MediaTek Sensio

Activity Trackers

Smart watches

Smartphones

Interactive shoes

Smart clothing

Nowadays, a range of biometric data can be accurately and continuously collected without the need to touch the human body with the help of digital health startups (biosensors).

Application of Biosensors in Food Industry

Food Safety Diagnostics

- ✓ A reliable method to monitor the quality of the food product, its proper storage.
- ✓ Fermentation reactions: how much sugar, metabolic waste products are built up by microorganisms, pH, nutrients, etc.
- ✓ Detection of bacteria in fast food.
- ✓ Environmental monitoring, in which microorganisms are used to detect explosives, toxics, gasses, etc. and even in forensic sciencelity of the food product.

Other Application of Biosensors

Industry – process monitoring and control, particularly food and drink,

Medicine – diagnostics, metabolites, hormones,

Military – battlefield monitoring of poison gases, nerve agents and people,

Domestic – home monitoring of non acute conditions

Infectious Disease Biosensor

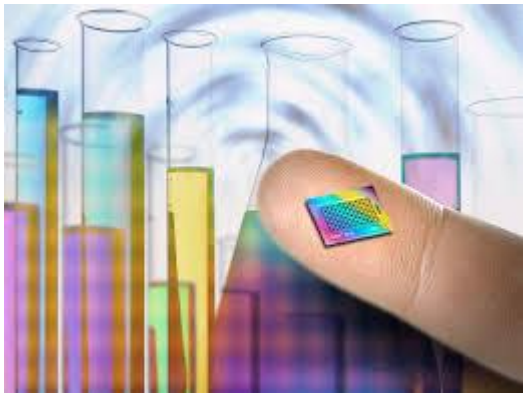
Glucose Monitoring Device

Pregnancy Test

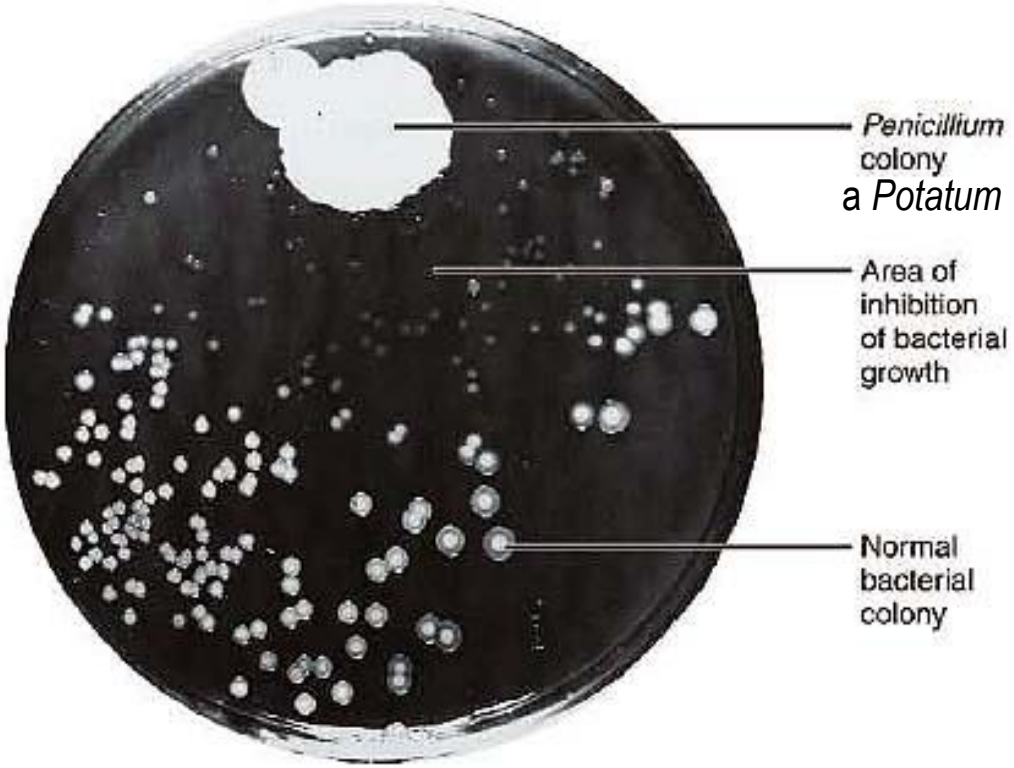
Potential Risks of Biochips

Checking on the health status of the employees:

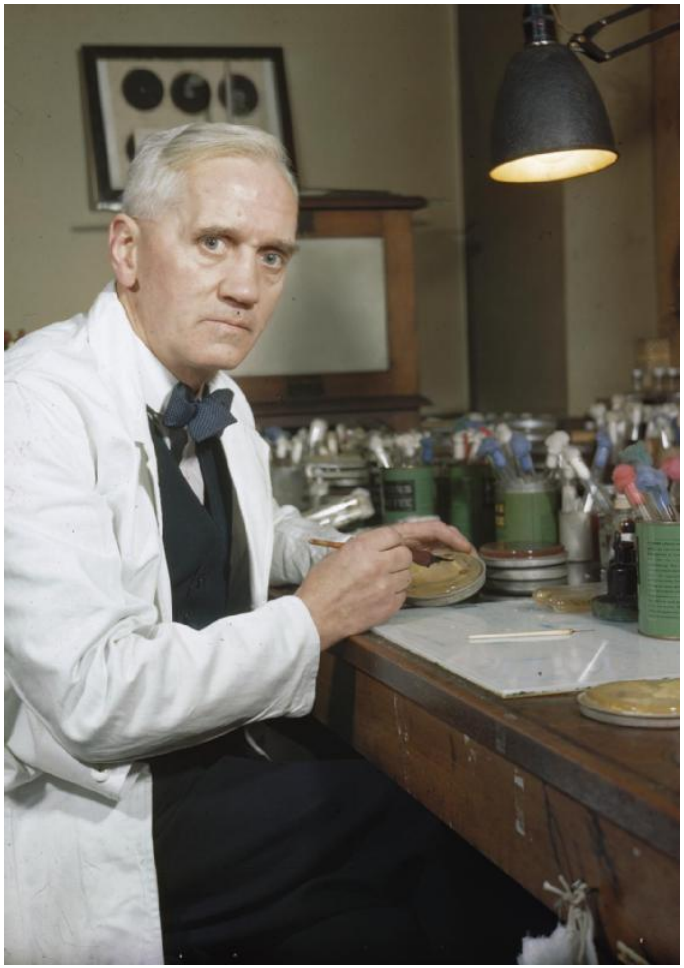
- Biosensors in toilets to monitor the urine levels of employees (sugar, instant pregnancy tests, etc.) for the projection of long term employment status.
- Monitoring sweat of people (against stealing) - everywhere in which employees might take advantage of the company's property for their private use.
- In the insurance industry, to exclude certain individuals from insurance packages, etc.



Produsing Antibiotics:



All instruments were unsuitable for large scale production, but in next years so far biotechnology has made great advances.



Sir Alexander Fleming, discovered antibiotics in 1929.

Why Microorganisms Produce Antibiotics ?

Even though antibiotics are entirely natural products, scientists have to admit that they are not quite sure why microorganisms produce them:

Interspecific competition - but this is only part of the entire story;

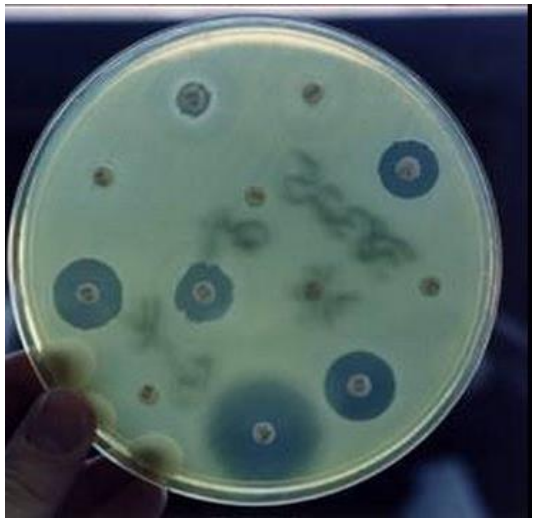
Antibiotics are secondary metabolites - once the microorganism runs out of nutrients, it is capable of breaking them down again to overcome a nutritional short supply

Production of an antibiotic is a metabolic waste product, besides being self-immune it keeps away competing organisms.

Processing an Antibiotic

Biotechnologists induce mutations by inserting extra-species gene sequences while

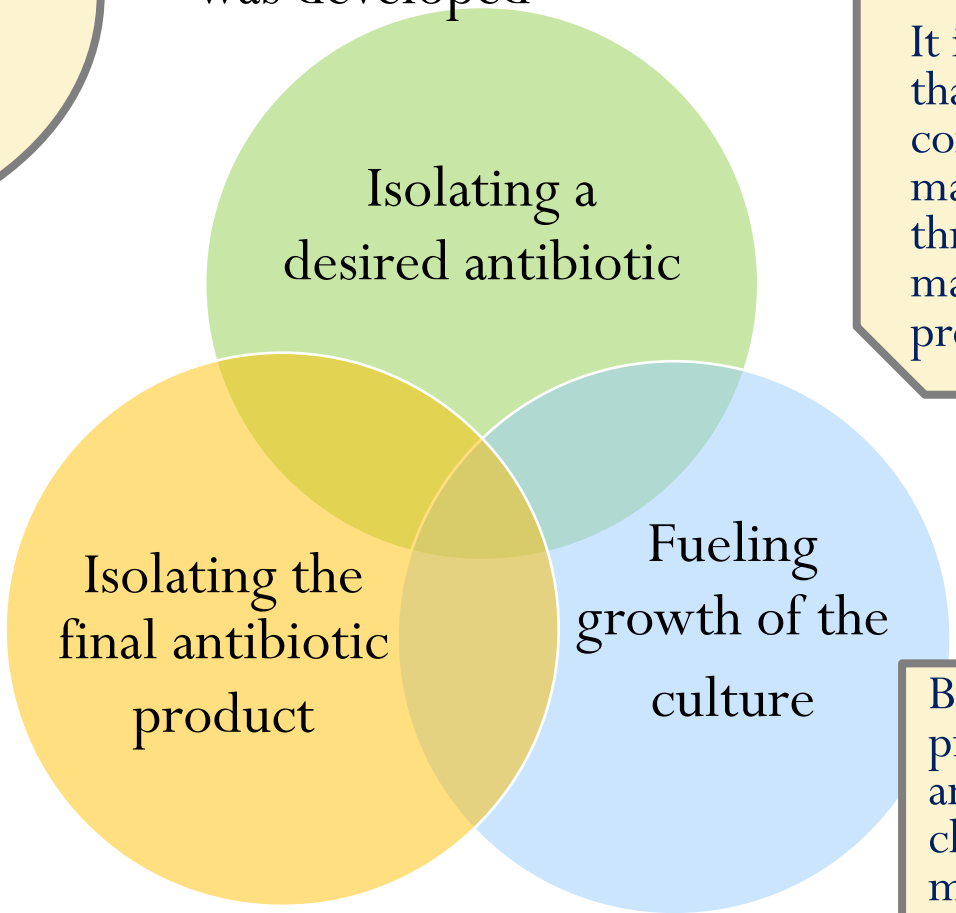
Screening procedures enable the scientist to isolate the correct mutant



Processing an Antibiotic

Although most antibiotics occur in nature, they are not normally available in the quantities necessary for large-scale production.

For this reason, a fermentation process was developed



It is important that sterile conditions be maintained throughout the manufacturing process.

Contamination by foreign microbes will ruin the fermentation.

Biotechnologically produced antibiotics are chemically modified strains of *Penicillin*

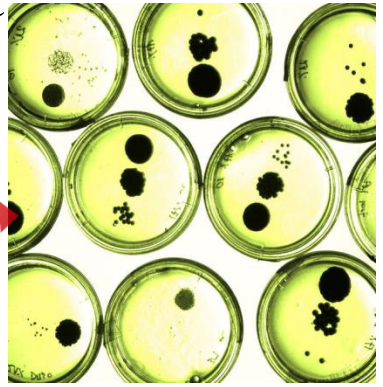
How to Isolate a Desired Antibiotic

Results in a zone of inhibition once it is exposed to it

Microorganisms are kept in Erlenmeyer flask

Aseptic transfer of about 1 cm^3

Selecting an individual colony



Transferring it to several sterile petri dishes

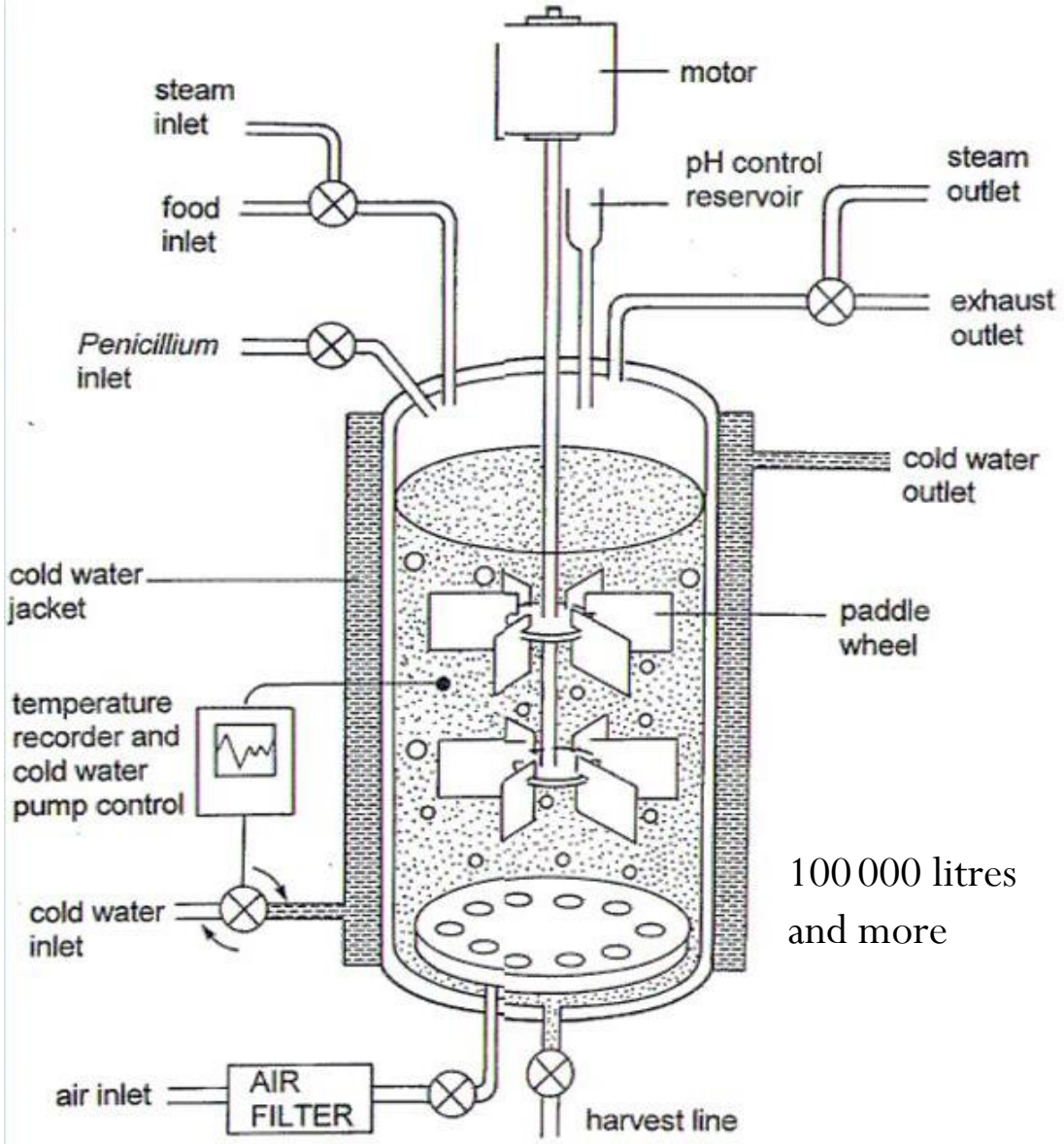
Drying and incubating for about 48 hours

A single colony of the unknown organism is transferred.

Further incubating

Screening by extracting a sample with a selected contaminant that is sensitive to a particular antibiotic

FERMENTATION in Antibiotics' Produsing.

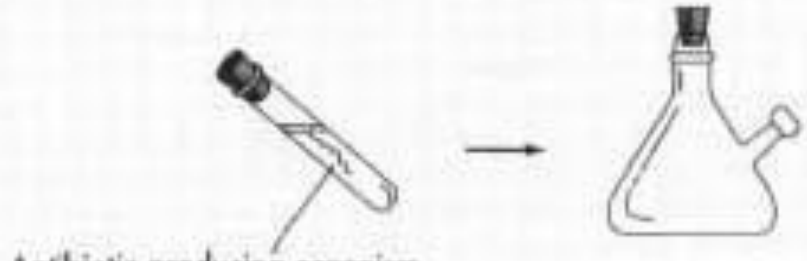


100 000 litres and more

The fermentation conditions with such as temperature, PH, mineral contents should also be maintained.

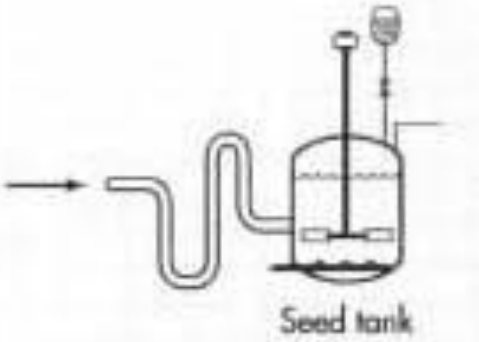
The process starts immediately after the addition of the inoculum strain according to batch procedure.

After the required amount of time, the required antibiotic is produced in the fermenter.



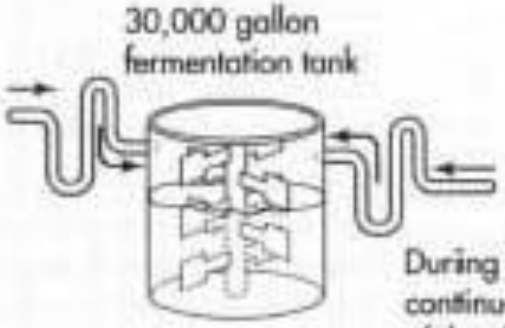
Antibiotic-producing organism

A culture is started by placing the sample of the organism into a shake flask with growth-promoting nutrients.



Seed tank

The seed tank is equipped with mixers to keep the growth medium active, and a pump to deliver sterilized air.



30,000 gallon fermentation tank

During fermentation, the microorganisms continue to grow and excrete large quantities of the desired antibiotic.

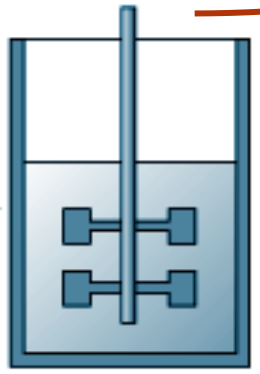
FERMENTATION

ISOLATION, PURIFICATION, AND REFINING

Once the antibiotic is isolated from the fermentation broth and purified using either the ion-exchange or solvent extraction method, a purified powder form of the antibiotic is produced.

PACKAGING AND SHIPPING

Processing an Antibiotic



Fermentor

Solid

Preliminary Treatments

Filtrating

Adsorbtion
Cemical Precipitation
Solvent extraction

Extract

Extraction

Partially purified antibiotic in solutio

Waste solid is filtered, sterilized

Recrystallization
Purification

Dryer

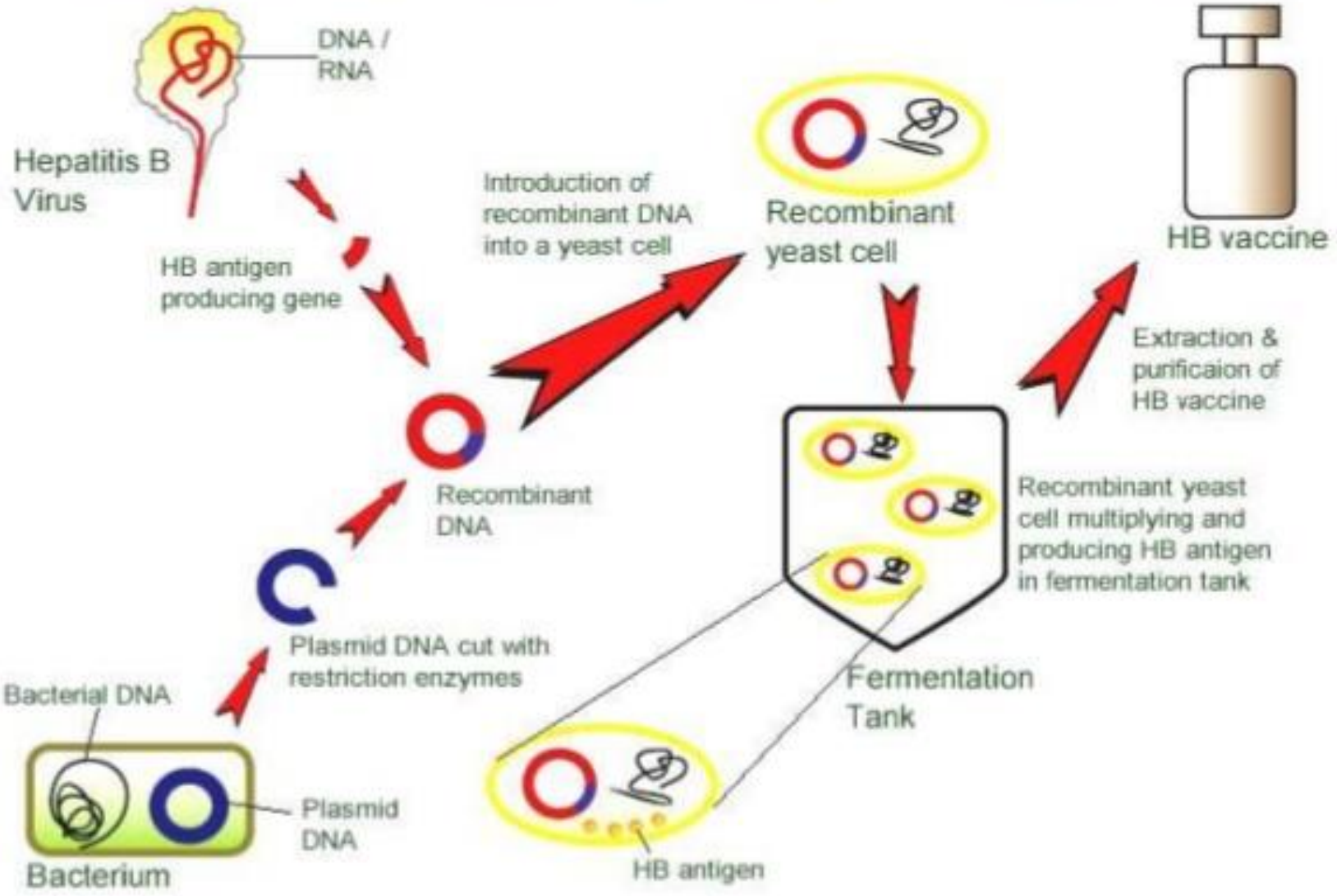
Antibiotic

Animal feed supplement

In order to be produced in a manufacturing scale a new antibiotic must to be low cost, unicable, defferent from similar samples, high effective.

PRODUCTION OF VACCINES

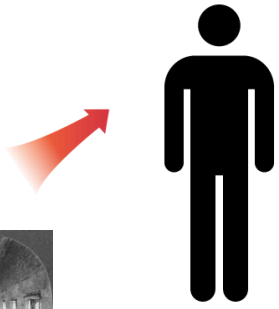
Production of Recombinant HB Vaccine



Biotechnology and the Manufacturing Industry

Problems

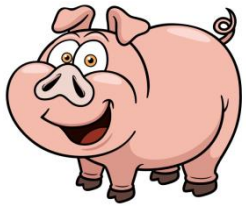
- Enzymes are proteins, they tend to denature at high temperatures and extreme pH's.



Feces and excrements of humans and animals

To soften and de-hair furs

Last centure leather factories



Enzymes of the pig's pancreas became useful substitute.

Modern trends

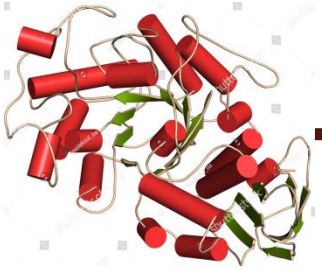
- Enzyme-mediated production methods not only lowers the pressure, temperature, and the amounts of toxic by products, but also lowers operation costs.
- The industry is looking for GM-enzymes that are robust enough to withstand all industrial working conditions; such GM-enzymes are found among the thermophilic, acidophilic, and barophilic archaeal bacteria.

Dr Otto Rohm was one of the first to realize this concept.

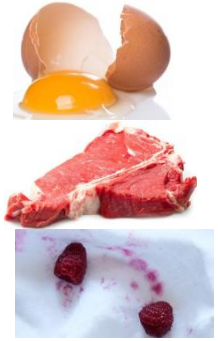
Successful Implementations of Eubacterial Enzymes in Textile Industry Have Already Been Made

A modern washing powder

requires



Amylases and proteases

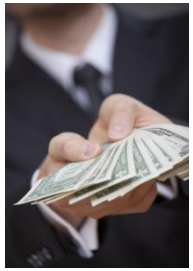


Removing organic stains.

The workers were showing allergic reactions

Amylases Proteases

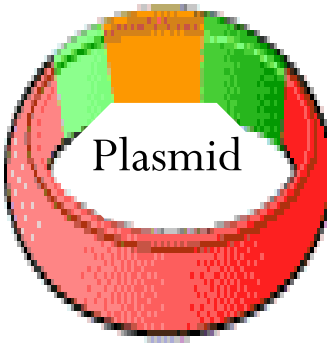
These enzymes had to be encapsulated



To protect the staff from compensation payments.

The textile industry always tried to produce smooth and soft fibers that are pleasant to wear.

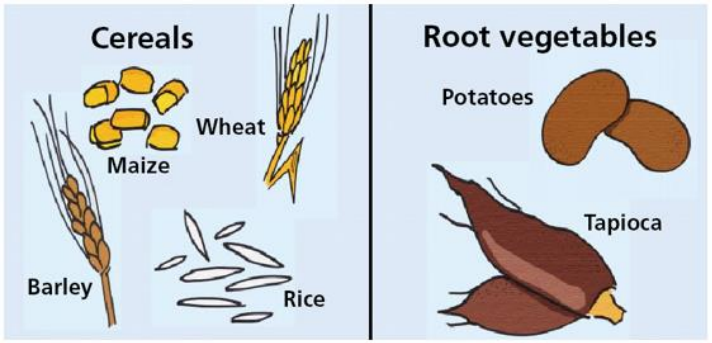
Smooth and soft fibers.



GM-bacterially made amylase

Elevated temperatures during washing cycles.

Resistant



Hydrolysis of starchy raw materials

Removing starchy stains

Successful Implementations of Eubacterial Enzymes in Confectionery Industry Have Already Been Made

Potato starch

Aspergillus niger

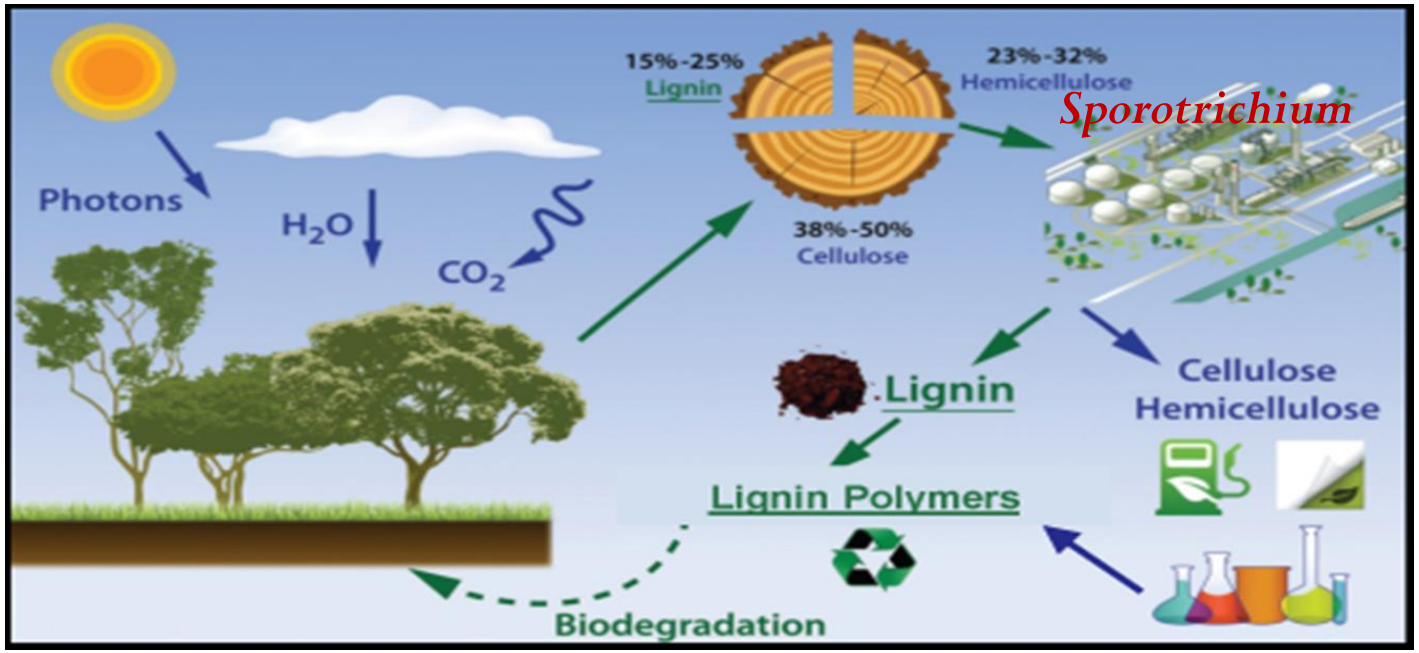
Bacillus subtilis

Glucose syrup

Sugar

In orger to save on expenses

... in agricultural forestry



Reduces the previously useless piles of wood chips

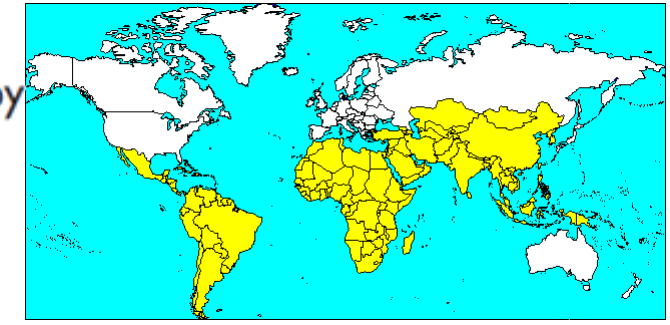
Remaining lignin can then be mixed with glucose

Methane Production with the Help of Agricultural Fermentors

Biogas is:
CO2+CH4

Biogas at 55-87% it consists of methane.

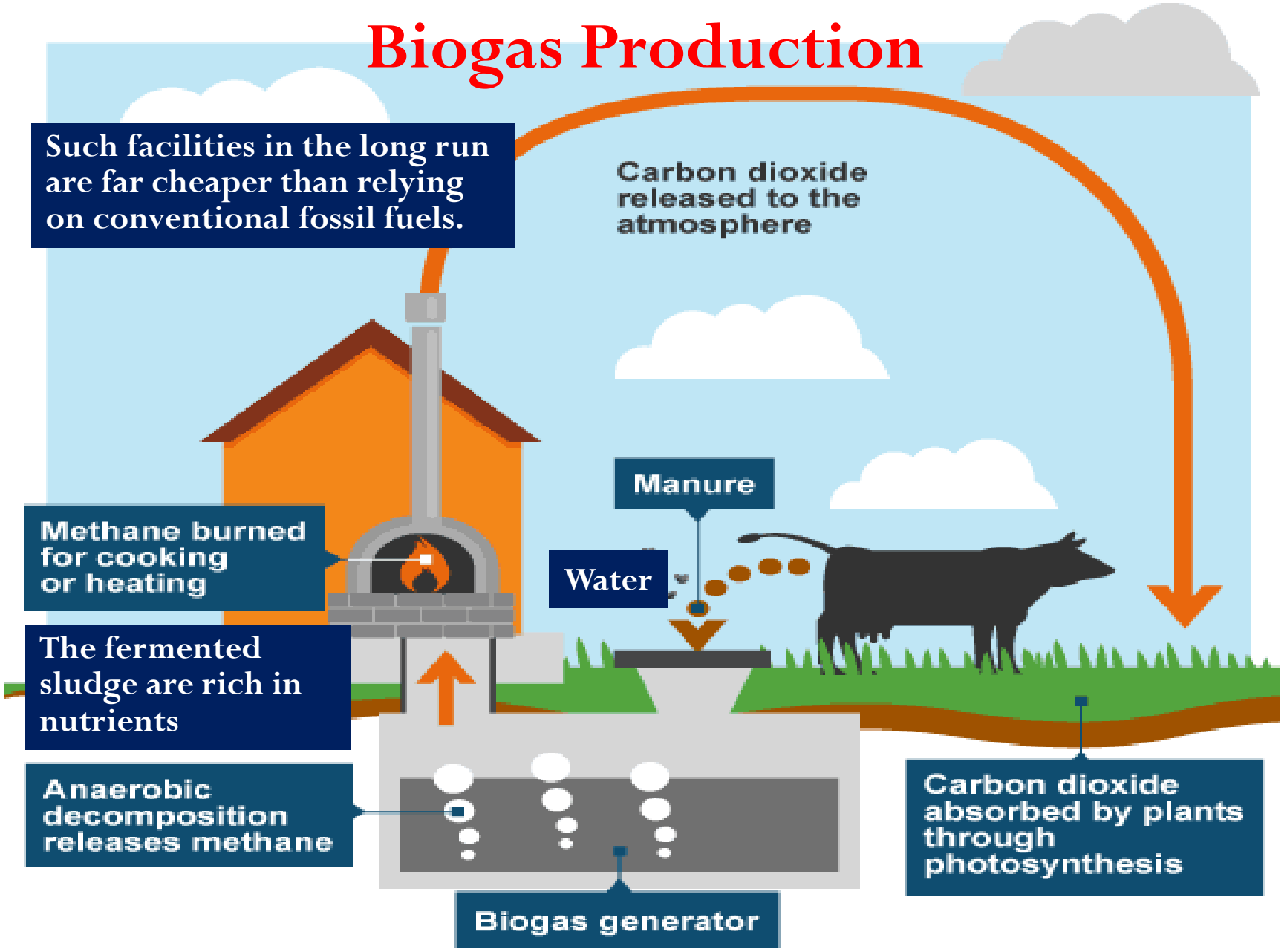
Conventional CH4 production was achieved via the anaerobic decay of organic matter



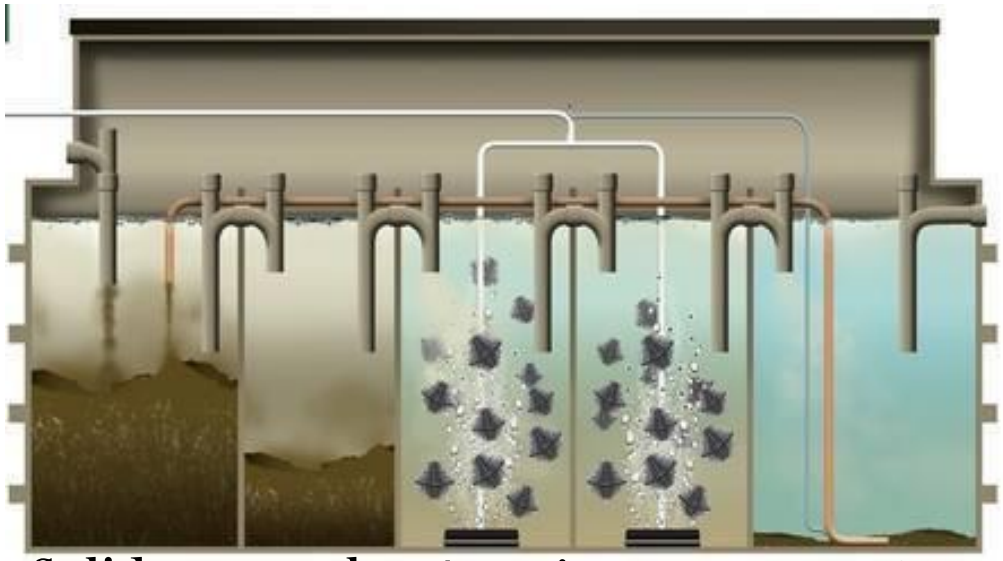
It is of essential importance to lower the dependence on fossil fuel energy sources

Biogas Production

Such facilities in the long run are far cheaper than relying on conventional fossil fuels.



The Production of CH4 on the sewage plant

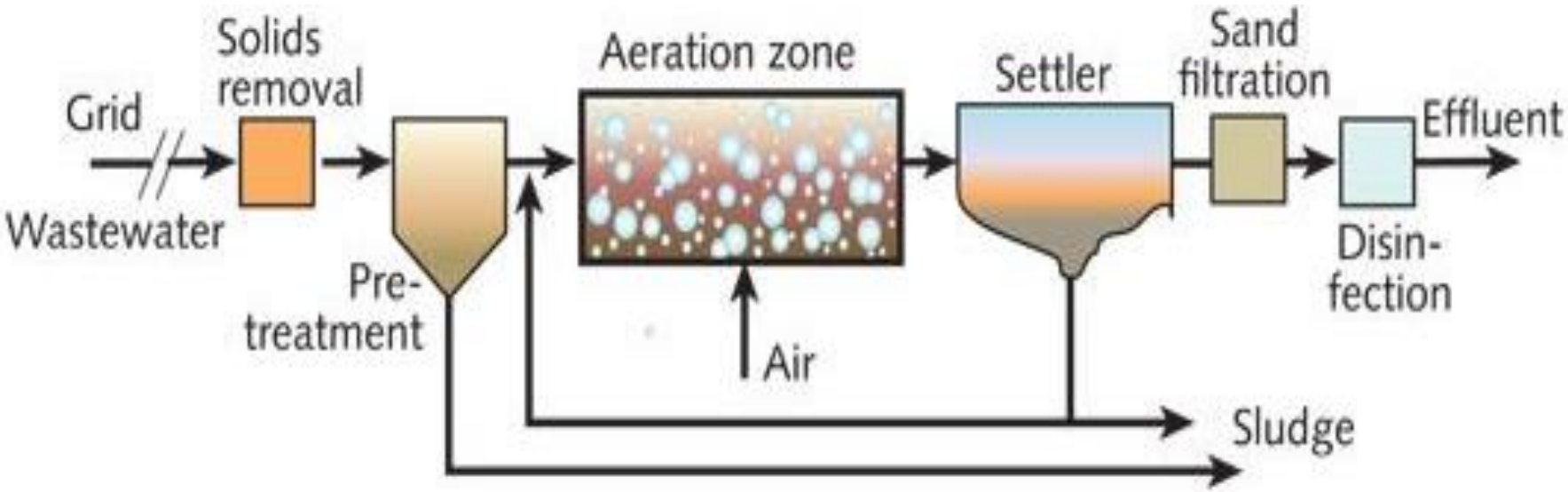


Solids removal Aeration zone Settle

Sewage plant looks like

Treated water can be used for:
Agricultured purposes (60%),
Industrial purposes (30%),
Other purposes (10%).

Activated Sludge Treatment Process



1. To reduce the water content of sewage, it is stored in an anaerobic digester (solid-liquid removel).

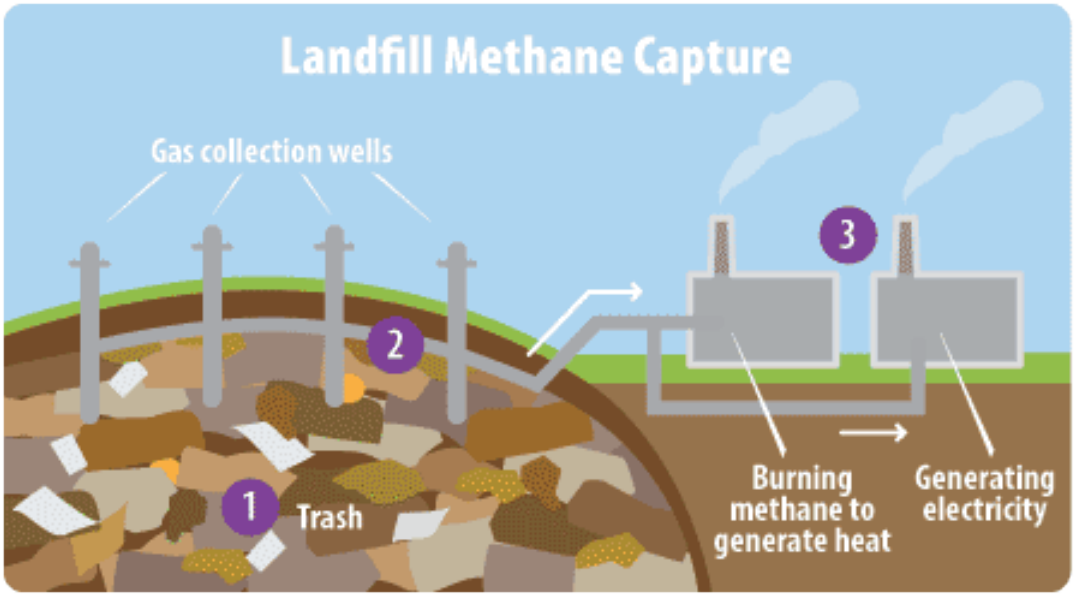
2. Aerobic treatment in which air and microorganisms are added.

3. Generating a sludge that is self-containing and produces the useful byproduct methane.

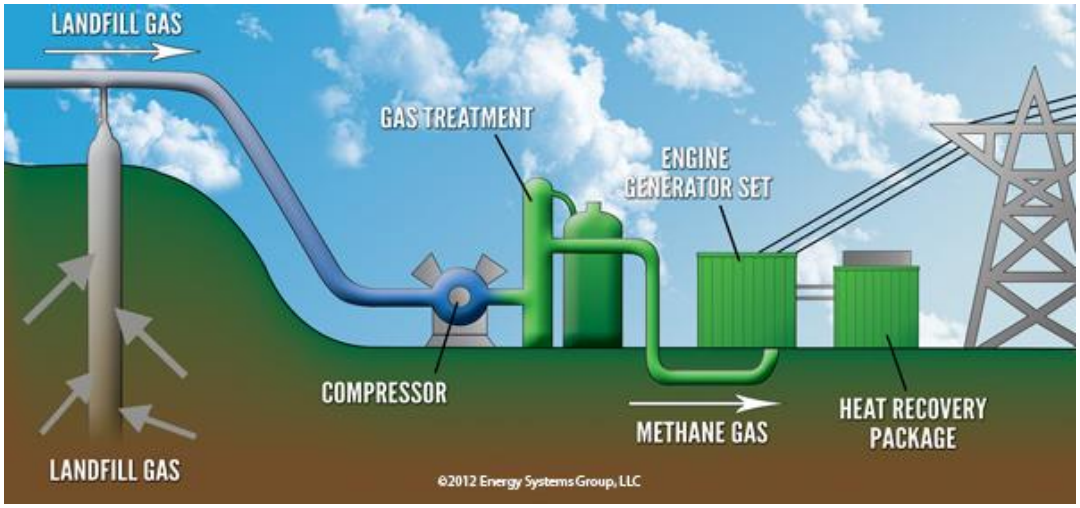
Part of this gas is used to power the sewage plant itself.

Urban Landfills are Another Source in Which Methane is Produced as a Byproduct

CH4 production in that way in which huge amounts of rubbish that occupy large areas of land worldwide.

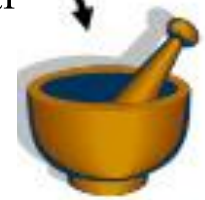


Collecting the methaneous gasses and storing them in tanks provides an other source in which this can be implemented in our daily lives. energy



Making Gasohol or liquefied coal

1. Today's commercial ethanol production begins by grinding corn kernels into a powder



2. It is then heated and liguefied into a starchy "mash"

3. Enzymes break down the "mash" into fermentable sugar

+

4. Yeast is added to ferment the sugar to athanol

+

Gasohol is known already since the 1890

Gasohol is widely used during WWII

Gasohol is made of oils from crops

Distilled alcochol+2-5% gasoline "denaturant"

1. Solid residue, distillers grins, is a by-product used for livestock feed

+

Heat

=

Palm wine

Casaba-roots

Cellulose wastes

Sugar cane

Tequila

Brazil is one of the countries in which gasohol is a common fuel substitute.

Brazil use cheap raw materials, for alcohol distillation.

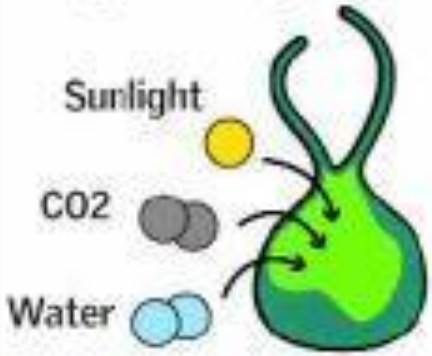
Brazil is becoming one of the first countries that in combination with genetic engineered microorganisms are capable to reduce their dependence on fossil fuels, their financial budget and also CO2 emissions.

Biodiesel from algae

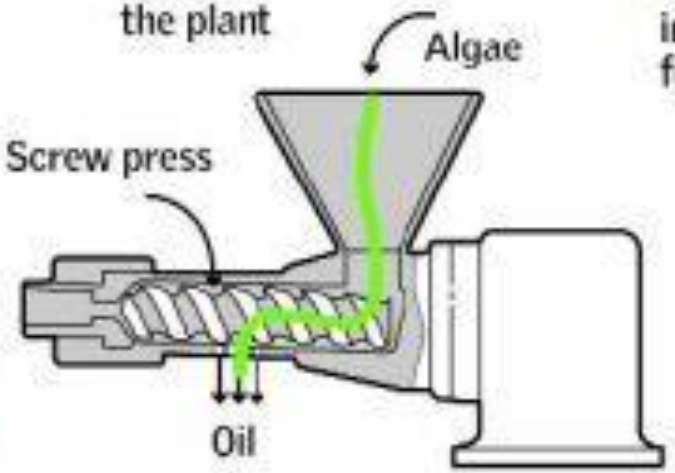
High oil prices and advances in biotech over the past decade have refueled the algae biofuel race.

The process

1 After initial growth, algae is deprived of nutrients to produce a greater oil yield



2 Extraction of oil
A press produces 70-75% of the oils from the plant



3 Solvents used to separate sugar from oil; solvents then evaporate

4 Oil is ready
Can be used as oil directly in diesel engines or refined further into fuel

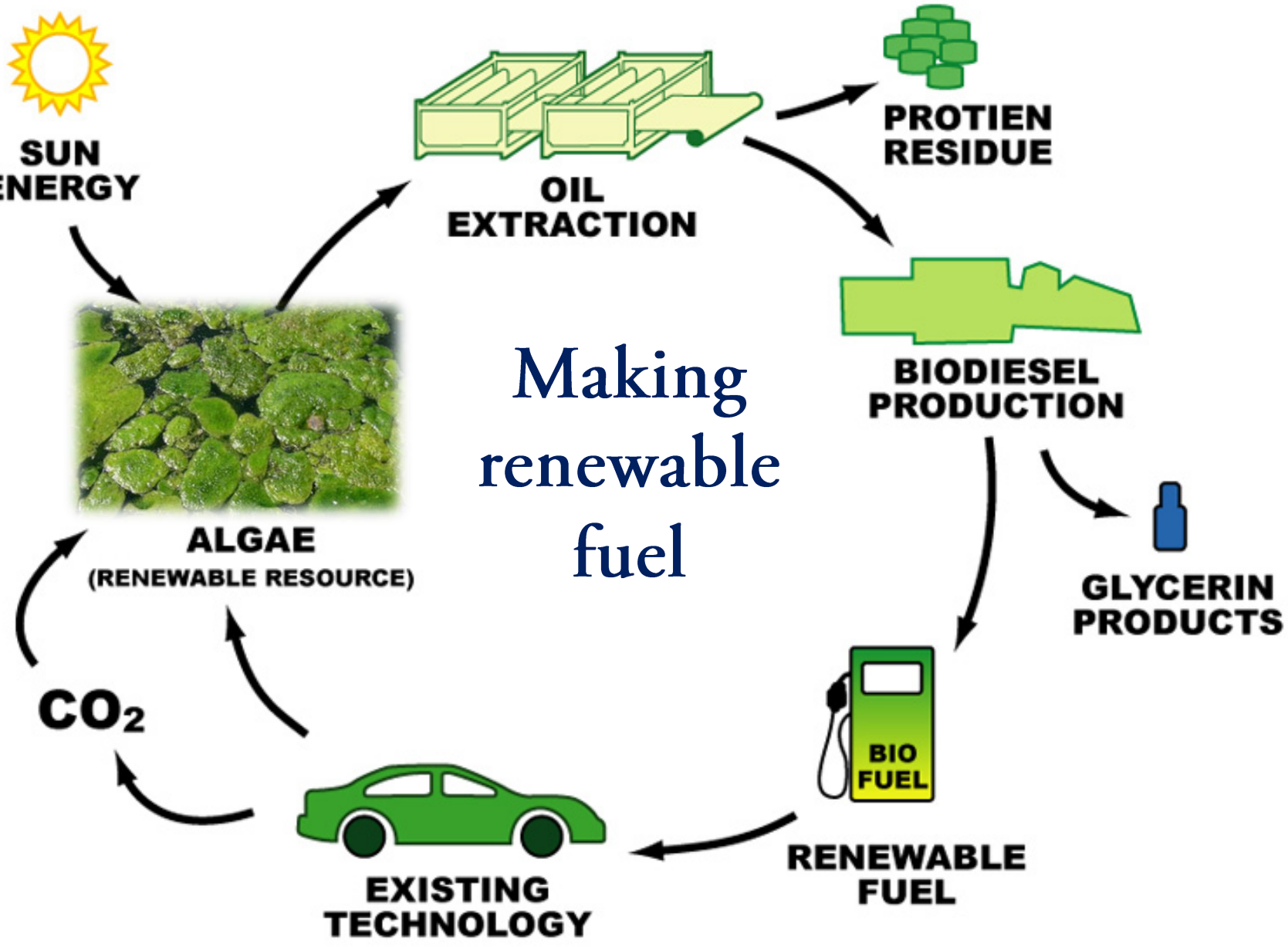
Yield of various plant oils

(Gallons per hectare)

About algae

- Among the fastest growing plants; about 50% of their weight is oil
- Contains no sulfur; non toxic; highly biodegradable
- Algae fuel is also known as algal fuel or oilgae

Making renewable fuel

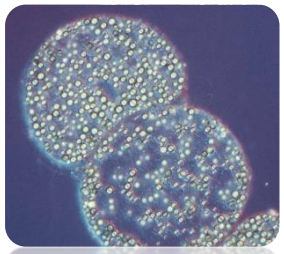


Mining and Biotechnology

Thiobacillus

Low grade *Co, Ni, Pb* ore

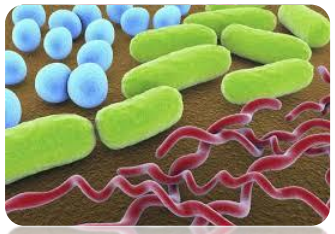
Extraction of metals



Chemo-lithotrophic microorganisms

Native metal form

Metallic ore

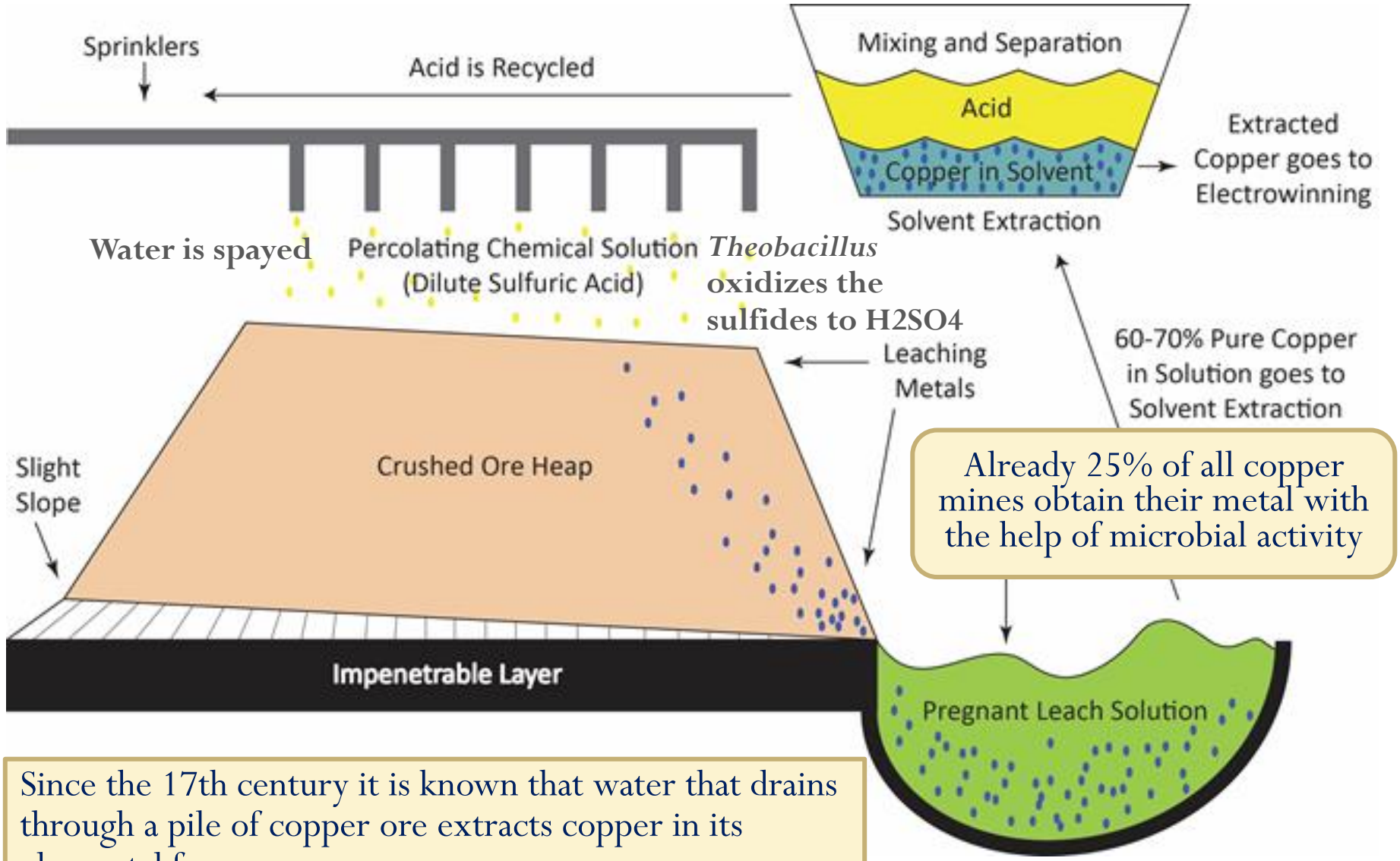


Some bacteria

Old waste piles of mines

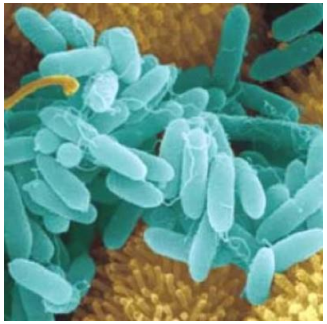
Extraction low levels of metal still enclosed in these ores.

Cooper Mining and Processing



Since the 17th century it is known that water that drains through a pile of copper ore extracts copper in its elemental form.

Uranium Mining



Thiobacillus

Covering Uranium Ore

Uranium metal

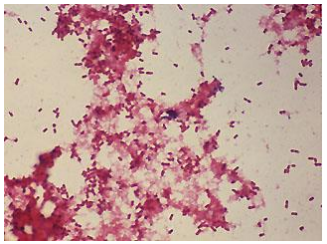
In the 1940's scientists discovered underground lakes that were enriched with radioactive uranium.

Even though the use of uranium remains controversial, mines in Brazil, Australia and in South Africa rely on this method

Modern uranium metal extraction protects humans from the dangers of radiation, trims down the risks to the environment.

New ways of metal extraction have to be less harmful to the environment and of course far cheaper than conventional techniques.

Microbial enhanced recovery

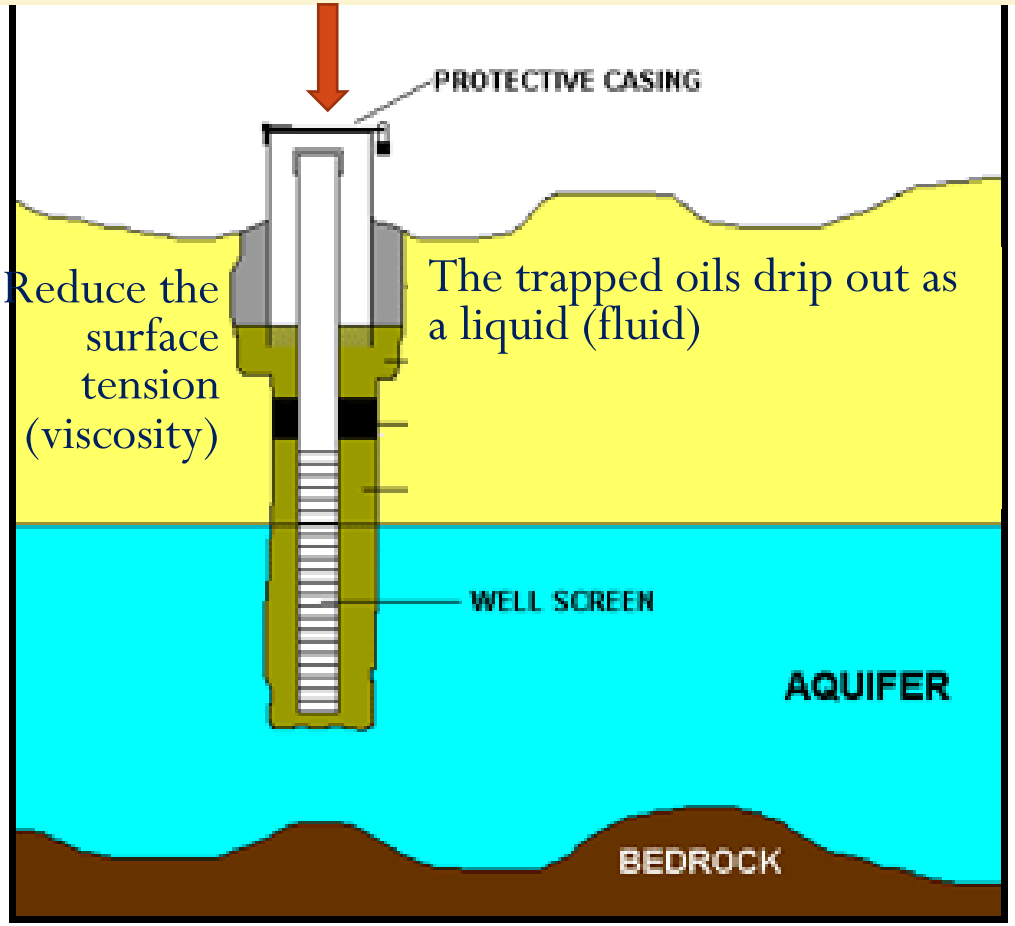


Xanthomonas

Emulsan

So far even the most efficient oil extracting technology is only capable of recovering roughly 50% of the oil from the wells; the rest lies dormant underground.

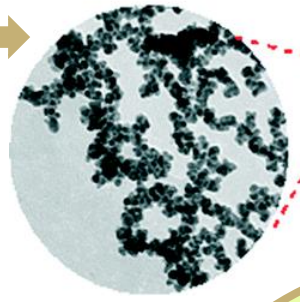
Microorganisms are injected into the well



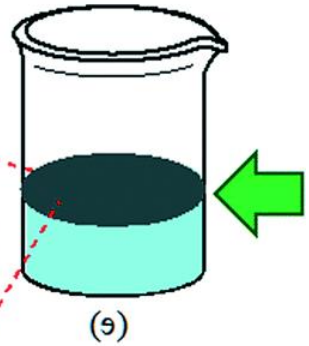
The Protection of the Damaging Effects of Oil-Spills to the Environment

GM-strains of *Xanthomonas, that* digest a distinct type of hydro-carbons

Ability to feed



Oil spill

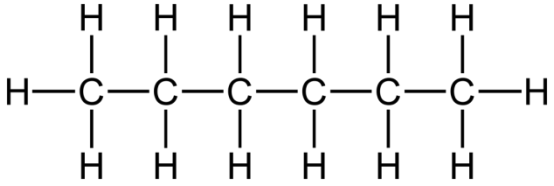


A drawback: these strains work only on the water-oil interface

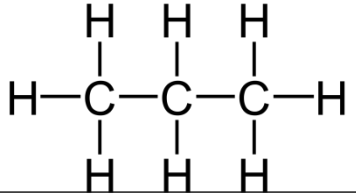
Scientists are already working on a superbug, that is capable of eating up all different sources of oils.

Bacteria will have to break down the oils into smaller fragments. But oil is hydrophobic.

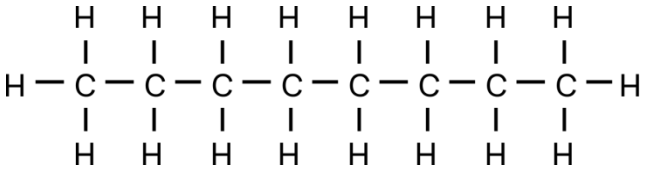
Hexane



Butane

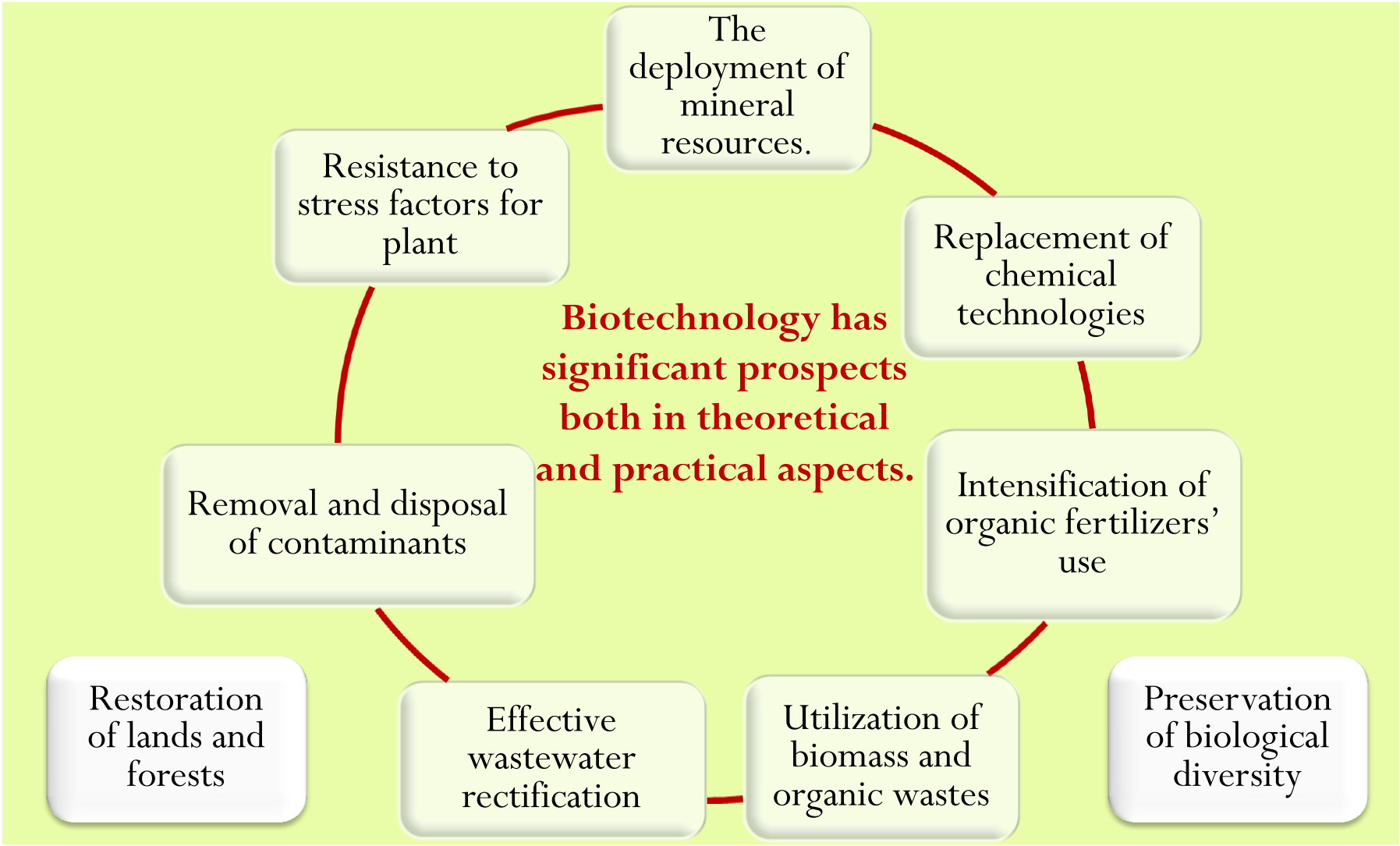


Oktane



CONCLUSION.

The use of biotechnology for solving the environmental problems such as:

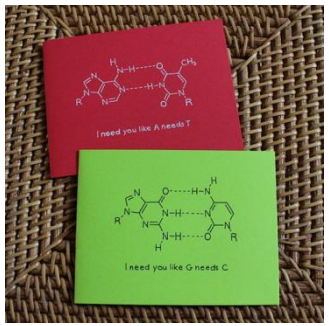


Problems in Terms of Consequences of Biotechnological Practical Appliance

Experiments associated with ovum fertilization (in vitro) and delivery of the test-tube babies

Determination of the social and genetic status of people is social and ethical problem.

The introduction of the genetic research of people



Nucleotide Cards

For professional orientation determining and employment of people.

Due to the possibility of the transparency of genetic examinations' results in society - a problem of people' protection from the adverse genotypes

BIOLOGICAL WEAPONS CONVENTION

Creating New Types of Biological (Bacteriological) Weapons

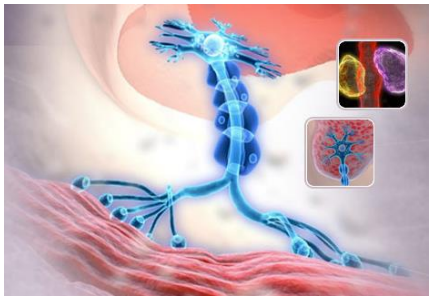
Resistant to modern drugs strains of bacteria and viruses

Causative agents of different dangerous diseases (plague, cholera, tularemia, Cyprus fever, etc).

Difficult to diagnose, easily adapt to any conditions

Cause disease of unknown clinical presentation

High virulence, the ability to stay long in the environment remain unchanged.



Botulinum Toxin

Chimera Viruses

Creating Super Toxins

Using the techniques of biotechnology, it is possible to create super toxins that are capable of mass destruction of living organisms.

New varieties of organisms created by the techniques of biotechnology should be thoroughly tested and evaluated in terms of their impact on human health and the preservation of genetic diversity and ecological balance in the biosphere.

International Campaign to Abolish Nuclear Weapons

Significant is the expansion and strengthening of international cooperation in terms of assessment and risk regulation in the biological objects.

Thank You For Attention