- Biotechnology in our life -

POSTER PROJEKTJAHR 2016/2017

des von der Europäischen Union unterstützen internationalen Projektes

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Vaccines

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Microbial plastic degradation
Wastewater treatment plant

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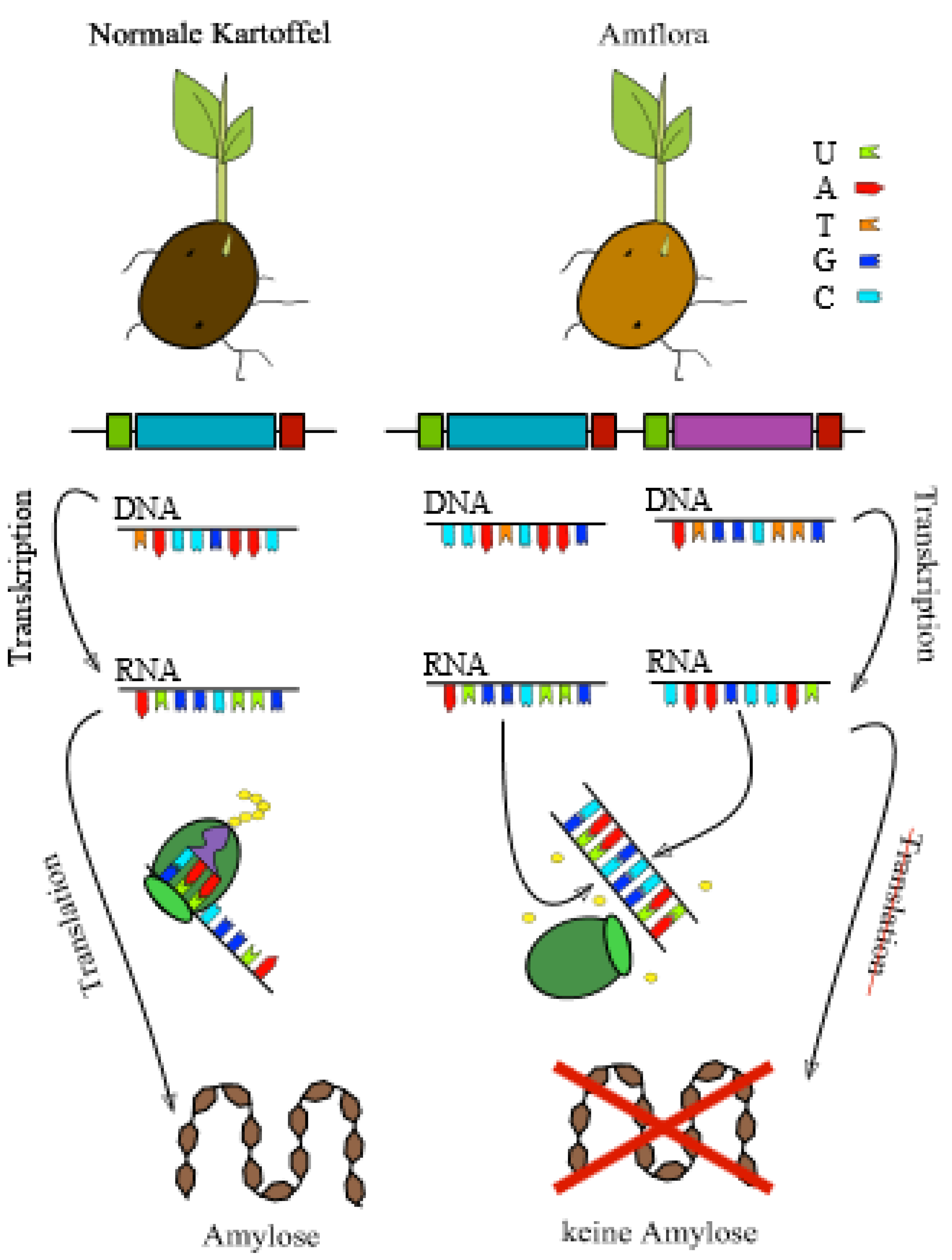
Amflora

Paula-Ming and Victoria

How was it created?



Free picture on: https://commons.wikimedia.org/wiki/File:Amflora_mechanism.svg

What is it?

The GM starch potato Amflora owned by BASF has been genetically modified to inhibit the production of one of the two starches naturally occurring in potatoes so that it contains more then 99 % of amylopectin but conventional potato starch consists of 80 % amylopectin and 20 % amylose. It also contains an antibiotic resistance gene as marker.

Benefits of growing Amflora

- The decrease of the cost of production, less money spent on pesticides and insecticides it actually saves money.
- Better for the environment: In Amflora production less energy, water and chemicals are used. Less chemical used to resist pests.
- They use less pesticides so it is better for farmers’ health.
- High in nutrients: the protein packed potato.
- It makes paper and yarn glossier and stronger.
- Reduction of soil erosion.
- Better quality potatoes.

How EU reacted to Amflora?

The GMO Panel had given a positive opinion on Amflora despite its antibiotic resistance because of the "low usage" level of the antibiotics in question. Since this was challenged, the EU Commission asked the European Medicines Agency (EMEA) to provide an opinion as well. This appears to be the first time that another EU authority was asked to provide additional assessments. In 2007, EMEA concluded that assumptions of the GMO panel on how the antibiotics in question were used were wrong.

Nevertheless, in a second assessment the GMO panel together with the Biohazard panel came to the conclusion that they still saw no reasons for concern. Even so - and for the first time - a minority of the scientist on the panel came to differing conclusion then the rest of the panels.

An application has also been filed for the food and feed approval of Amflora, to allow the pulp to be used in animal feeding.

European countries which have used Amflora:

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Biotechnology and Cotton

Felix, Elli

Cotton in our lives

We need cotton for….

https://pixabay.com/p-153368/?no_redirect

T-shirts

https://pixabay.com/de/teddyb%C3%A4r-pl%C3%BCschb%C3%A4r-herz-spielzeug-778800/

Soft toys

https://de.wikipedia.org/wiki/Handtuch#/media/File:Zusammengelegte_Handt%C3%BCcher.jpg

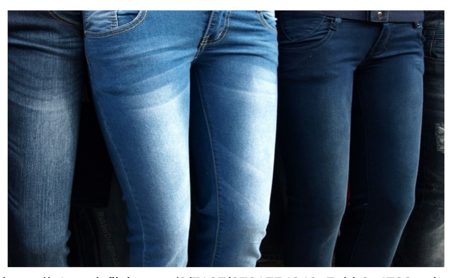
Towels

https://pixabay.com/p-690048/?no_redirect

Suits

https://upload.wikimedia.org/wikipedia/commons/e/ea/Jersei-coll-alt.jpg

Pullover



https://c1.staticflickr.com/8/7187/6791754240_7abb2c4783_z.jpg

Jeans

-You all have to agree that we all have something out of cotton at home.
-So cotton is one of the main fibre that we going to use for everything in the world of clothes.
-Because of that, cotton is used by about 2,5 percent of the world wide Agricultural floors.
-Cotton is mainly grown in the US, China and India

Growing cotton is a hard job

https://upload.wikimedia.org/wikipedia/commons/thumb/5/5f/Pectinophora_gossypiella_1321029.jpg/640px-Pectinophora_gossypiella_1321029.jpg

Varmints, like the bollworm destroy the pants.

http://s0.geograph.org.uk/geophotos/02/38/27/2382705_7b6d1610.jpg

Weeds effect the growing of the plants in a negative way

https://pixabay.com/p-153368/?no_redirect

The cotton plant needs about 2.000 litres of water to produce the cotton for a t-shirt.

https://upload.wikimedia.org/wikipedia/commons/7/7a/2DU_Kenya_86_(5367322642).jpg

Cotton is normally produced with bad working conditions.

-The farmers get a very bad price for the cotton.
-They work under hard conditions
-The price for cotton is going down because of the cheap and more efficient production in in China and the US.
-The genetic engineering change the way of production an the proportion of the rich and the poor countries.

Top Cotton Producing Countries In The World

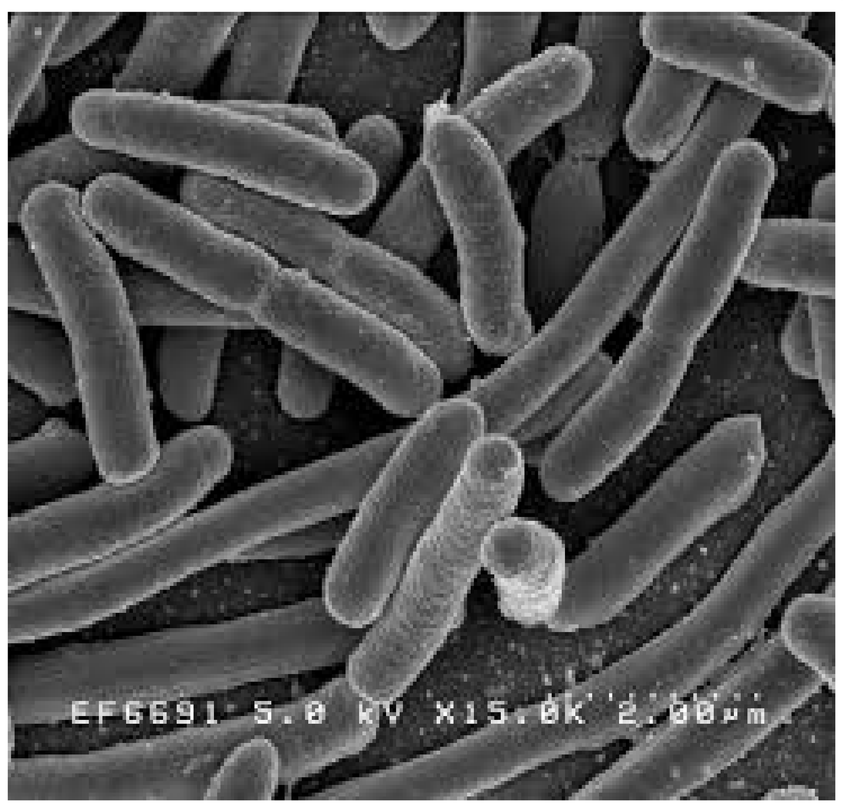
Rich countries producing cotton:
-China
-United States
-Brazil
-Australia

Poor countries producing cotton:
-India
-Pakistan
-Uzbekistan
-Turkey
-Turkmenistan
-Mexico

The farmers from the small and poor countries can not buy the expensive genetically modified seeds. Because of that they are not longer competitive with the farmers from the other countries like China.

Solution to bollworm by genetic engineering :

We take the *Bacillus thuringiensis*



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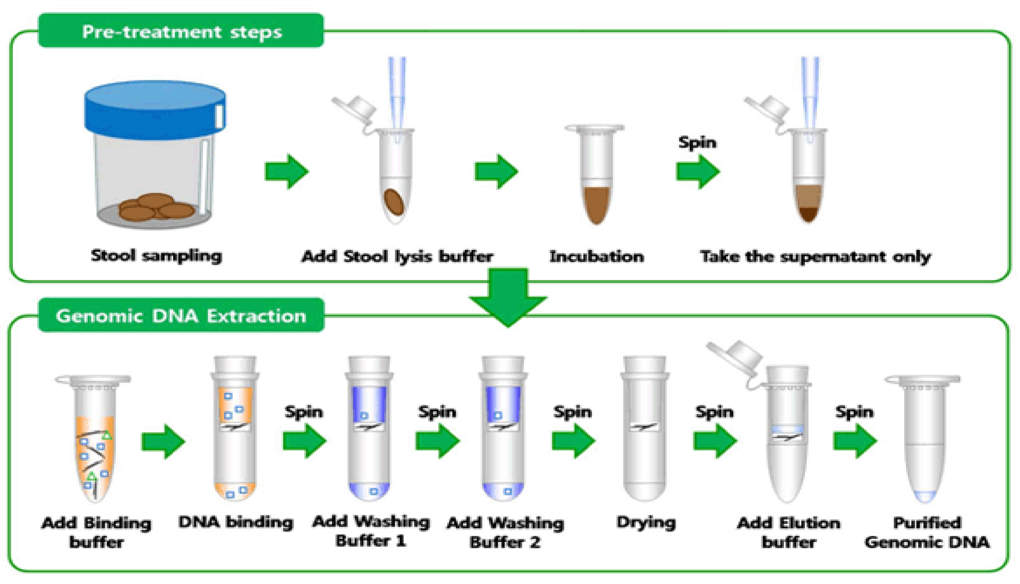

http://eng.bioneer.com/images/products/Stool_DNA_Extraction_Kit_02.gif

ps://pixabay.com/p-163710/?no_redirect

We extract the DNA from the *Bacillus thuringiensis*

We have to build this part of DNA into the cotton

The cotton is now able to produce the poison to resist the Bollworm.

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Pharming in plants

Anniek and Michele

Pharming, a combination between the words *farming* and *pharmaceutical,* refers to the insertion of genes that code for a pharmaceutical into an organism that does not have them in its genome.

Plants have been the basis for medical treatments through much of human history. We know from *'Ebers Papyrus'* that Egyptians knew a lot about how to use plants as medications. Such traditional medicine is still widely practiced today: in fact, in China, about 50% of the total use of medicines is from herbal preparations.

WHY USING PLANTS?

We can do pharming in bacteria, in yeasts, even in cultures of mammalian cells, but pharming in plants is the most economic and efficient way to produce molecules for medical purposes.

Factor	Transgenic plants	Plant cell cultures	Bacteria	Yeast	Mammalian cell culture	Transgenic animals
Production costs	Low	Medium	Low	Medium	High	High
Product quality	High	High	Low	Medium	High	High
Time effort	High	Medium	Low	Medium	High	High
Productivity	High	Medium	Medium	Medium	Medium	High
Contamination risk	No	No	Yes	No	Yes	Yes
Storage	RT	-20°C	-20°C	-20°C	N_2	N_2

RT = Room temperature N_2 = In liquid nitrogen

Adapted from Fischer et al., 2000; created by Michele Di Palma

IS THIS DANGEROUS?

Pharming in plants is not dangerous for us: there are no pathogens carried by plants which can infect humans. However, if these molecules were produced open-air, they could be released in the environment, devastating it. That is why these plants must be cultivated in greenhouses.

Free picture on https://en.wikipedia.org/wiki/Agroinfiltration

HOW IS PHARMING IN PLANTS DONE?

Plants are genetically modified through *agroinfiltration* (using a bacteria which usually infects plants), *gene gun* or *electroporation*. After that the plant starts to produce the pharmaceutical in its seeds, chloroplasts or elsewhere. Then the molecules produced are harvested and then purified.

WHAT CAN WE PRODUCE?

In 1982 the first antibiotic resistant tobacco plant was produced. Now, we can produce different kinds of specific molecules used to treat diseases: vaccines, hormones, cytokines, antibodies and other proteins. For example, *ZMapp*, a pharmaceutical used to treat *Ebola virus disease*, has been produced in a tobacco plant too.
Another interesting application is the production of *edible vaccines*: we can modify plants so that they produce a vaccine in their fruit or in other parts we can eat. Maybe one day we could treat diseases or prevent them just by eating the fruit we like the most!

Created by Anniek Bodewes and Michele Di Palma

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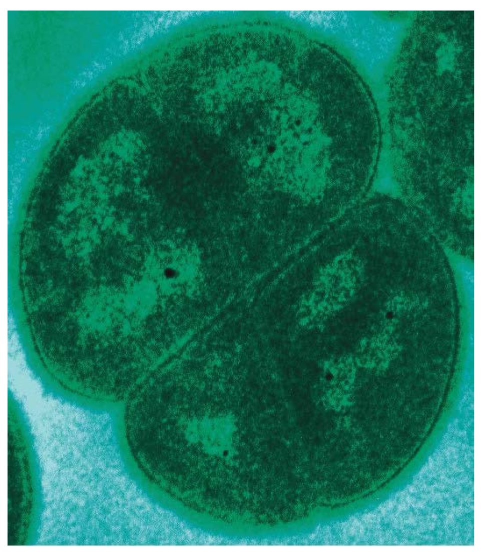
Microorganisms as cleaning compounds

Stella and Angela

How microbes are used to clean waste?

Microbes are nature's ultimate garbage disposal, consuming the dead, decomposing and inert material that litters Earth's surface. The contamination cleanup strategy called bioremediation is using naturally occurring or genetically modified microbes to clean up our messes. Scientists are designing or deploying microbes to purge sites of contaminants such as oil, radioactive waste, gasoline and mercury.



Deinococcus radiodurans
Free picture on: https://upload.wikimedia.org /wikipedia/commons/7/73/Deinococcus_radiodurans.jpg

Free picture on: https://commons.wikimedia.org /wiki/File:Radioactive_keeper_drums.JPG

Deinococcus radiodurans

Deinococcus radiodurans is an extremophilic bacterium, one of the most radiation-resistant organisms known. It can survive cold, dehydration, vacuum, and acid. It is developed for the treatment of mixed radioactive wastes containing ionic mercury. The ability of a microorganism to resist the toxic effect of metals is frequently associated with its ability to transform those metals to less soluble and less toxic chemical states.

Alcanivorax borkumensis

Alcanivorax borkumensis is a rod-shaped bacteria that relies on oil to provide it with energy. Petroleum oil is toxic for most life forms and pollution of the environment by oil causes major ecological problems. *A. borkumensis* is capable of degrading oil in seawater environments. The bacteria use alkanes as their source of energy.

Oil spill in San Francisco Bay
Free picture on: https://commons.wikimedia.org /wiki/File:Oil_spill_in_San_Francisco_bay.jpg

How scientists plan to clean up plastic waste?

Scientists have worked out the best way of removing the millions of tons of plastic waste floating in the oceans. About eight million tons of plastic waste such as food packaging and plastic bottles are being washed into the oceans each year. A team of scientists in Japan, led by Shosuke Yoshida of Kyoto University, has recently discovered a species of bacteria that can degrade a plastic called PET. The bacteria could nearly completely degrade a thin film of PET after six weeks at a temperature of 30 degrees Celsius. Also, if *Idionella sakaiensis* 201-F6 were to be applied, it would likely only help plastic pollution on land.

Free picture on http://www.publicdomainpictures.net/view-image.php ?image=103899&picture=plastic-water-bottles

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Microbial degradation of plastic

Annalaura and Luna

PLASTIC WASTE ISSUE

Plastic is used for almost every product or aim. Durability, which is its best quality, is also its main flaw: plastic takes many centuries to degrade into the environment. Therefore, plastic waste disposal is a big issue nowadays.

Free picture at https://commons.wikimedia.org/wiki/File:YoffGarbage.jpg

Traditional methods of plastic disposal

Plastic usually gets landfilled, recycled or burned.
Landfilling is the least convenient method since the substances that compose plastic are not recovered.

Free picture at http://www.wikiwand.com/en/Landfill

Burning plastic makes it possible to use energe that comes from the heat, but releases toxic gasses into the atmosphere.

Recycling seems to be the best method, given that plastic can be made from plastic and not from oil.

Free picture at https://commons.wikimedia.org/wiki/File: Facility_for_collecting_and_recycling_plastic_containers.JPG

Bioremediation

This is a process through which polluted environments can be cleared. Microorganisms are used to transform harming substances into non toxic ones. This is a method that could be useful for ecosystems that have already been damaged.

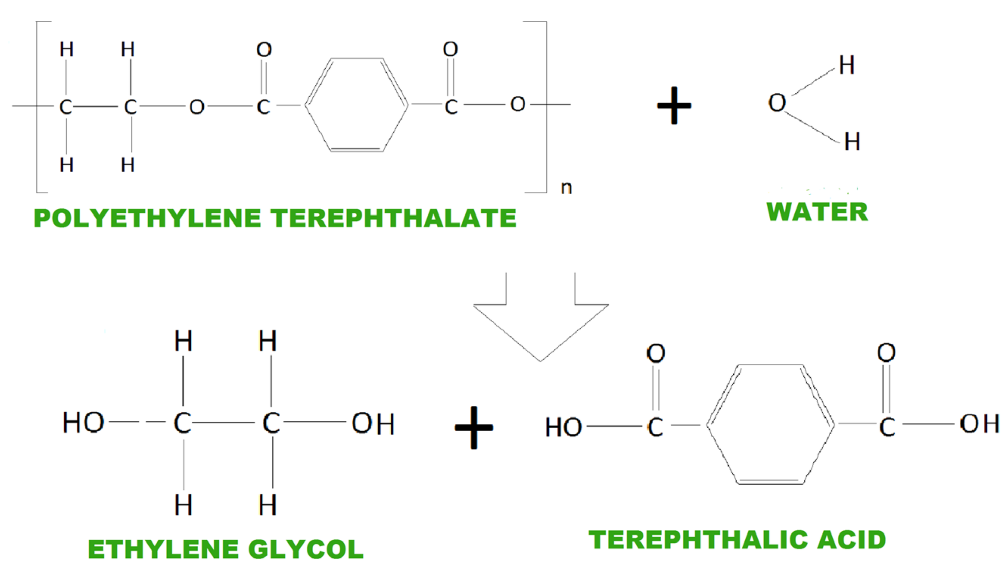
Bioremediation: PUR and fungi

In 2008 a group of researchers from Yale University examined various species of endophytic fungi. They discovered that *Pestalotiopsis Microspora* can grow on and degrade Polyurethane as a sole carbon source, both in aerobic and anaerobic conditions, through an enzyme which is similar to a serine hydrolase.

Therefore, this microorganism might be used for the clearing of environments contaminated with polyurethane.

Bioremediation: PET and bacteria

Ideonella Sakaiensis is a bacterium that has been discovered in 2016 to degrade PET. It utilizes two enzymes, ISF6_4831 and ISF6_0224, and water to produce terephthalic acid and ethylene glycol from PET. These substances are no threat to the environment.



Picture from Annalaura Coltro

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Bio-wastewater treatment plant

Norman Butte (Germany), Scott (England)

The impacts of waste water!

Environmental impact:

- Contamination of surface water
- Damage of wildlife habitats
- Contamination of the soil
- Damage of the eco-system
- Pollution of the oceans

Economic impact:

- Decline of the fishing industry and the boat-tour/cruise industry due to water conditions

https://de.wikipedia.org/wiki/Fischsterben#/media/File:Toter_Fisch.jpg

How does a Bio-wastewater treatment plant work?

The bio-wastewater treatment can be subdivided in to three different steps:

Mechanical cleaning is the first step to treat wastewater. First of all, a big rake cleans the water from most waste such as rocks, leaves and hygiene products. The collected waste is burned thereafter.

Following a sand filter purifies the sewage from small particles like sand, glass, and gravel.

During the last step of mechanical cleaning a clarifier is used to remove 30 % of the organic waste.

Biological cleaning is the second step.

The sewage is conducted in the aeriation tank in which many bacteria live. The bacteria live in the activated sludge. They clean the water from other organic waste and cut the carbon compounds: for example, azotic is decomposed form ammonium and with the help of other bacteria and oxygen oxidized to nitrate.

Afterwards the waste water goes in the secondary sedimentation tank. There, the activated sludge settles on the ground. Partly the activated sludge goes back in the aeriation tank while the other sludge is led in digestion tanks. In the digestion tanks methane is produced under anaerobic conditions. The methane is used thermal.

Through these two steps of the wastewater treatment - the mechanical and the biological cleaning - the water is cleaned up to 90-95 %.

During the **chemical cleaning** phase the rest will be cleaned. It involves cleaning the water from phosphorus. This is necessary to protect the rivers from too much nutrients getting into the water system.

https://de.wikipedia.org/wiki/Abwasser#/media/File:2012-05-28_Fotoflug_Cuxhaven_Wilhelmshaven_DSCF9562.jpg

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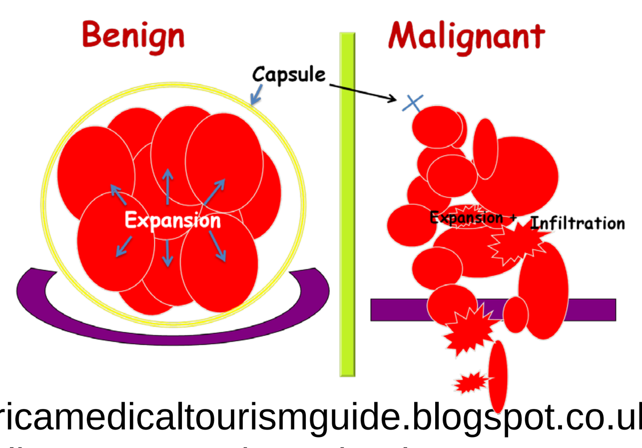
Biotechnology and Cancer

Melissa and Nadia

What is cancer?

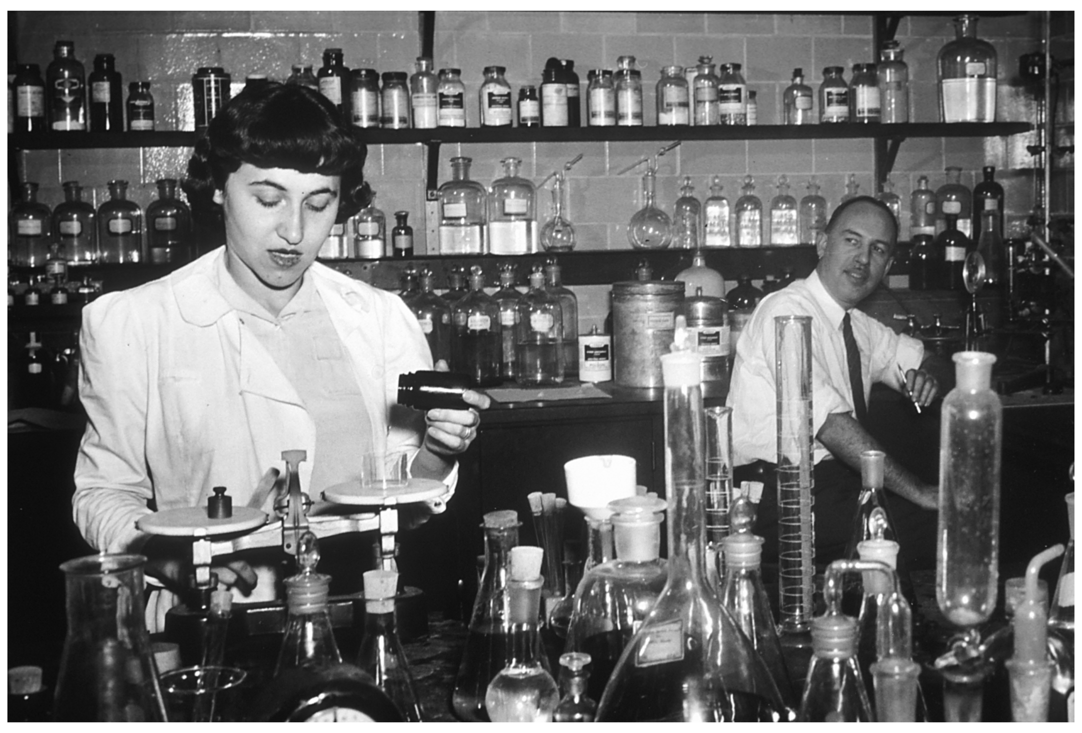
Cancer is formed when body cells begin to divide without stopping and spread into surrounding tissue. This leads to abnormal, old and damaged cells surviving when they should be broken down by lysosomes, while new cells form unneccessarily and divide to form tumours.
Tumours can be solid masses of tissue or they can flow within the blood. They can also be either malignant or benign.



http://indoafricamedicaltourismguide.blogspot.co.uk/2015/11/benign-tumor-vs-malignant-tumor-know.html

Cancer cells are less specialised than normal cells and can ignore signals telling them to stop dividing or begin apoptosis. They can also influence their microenvironment to transform normal cells into blood vessels, in order to supply tumours with oxygen and nutrients for growth.

History of cancer treatment



https://commons.wikimedia.org/wiki/File:Chemotherapy.jpg

Chemotherapy has been used since the 1940s and 1950s. It was discovered during World War II whilst carrying out studies on mustard gas.

Radiotherapy, which was first used to treat cancer in 1896, is another common cancer treatment method.

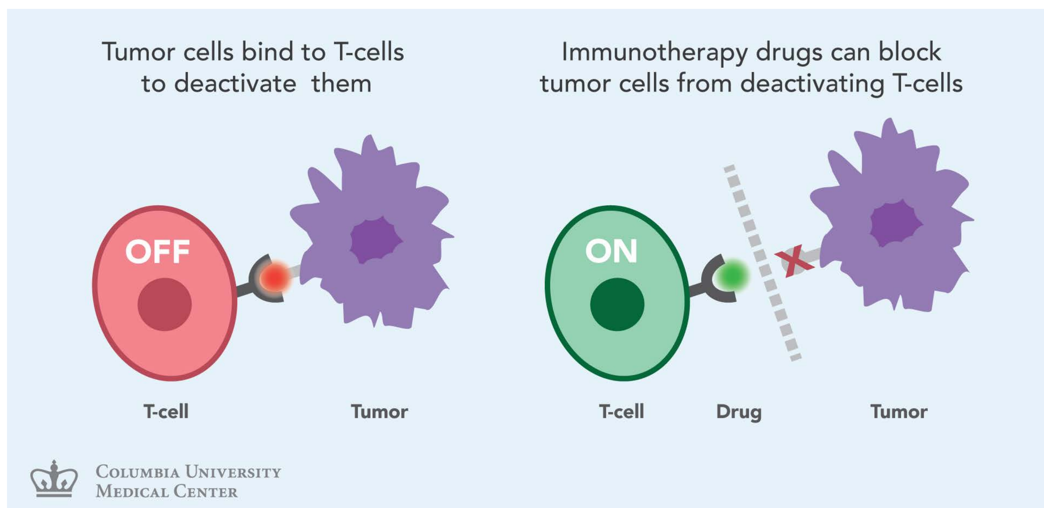
The main issue of these methods is that they target all cells, not just cancer cells which can damage healthy cells and cause many side effects.

Biotechnology and cancer

Biotechnology has a very important role in the development of antitumor mechanisms. Scientists are using vaccines against some molecules that are mutated in cancer cells.

Immunotherapy

Immunotherapy is a process where our immune system's T cells are removed and genetically modified to attack cancer cells, and then placed back into the body via veins.
Merch and Bristol Myers Squibb have created checkpoint inhibitors, which have saved up to 60,000 people. These remove molecular brakes which stop our T cells from seeing cancer as an enemy.



http://newsroom.cumc.columbia.edu/cancer-immunotherapy/

Gene Therapy

Gene Therapy is a method of immunotherapy. It can be defined as the insertion of genes into an individual's cells and tissues to treat a disease, in this case cancer.

http://www.cgdsociety.org/genetherapy

A carrier, called a vector must be used to deliver the gene to the patient's cells. The most common type of vectors are genetically modified viruses. Target cells become infected with the vector and then the vector unloads the genetic material, containing the modified gene into the target cell.
The damaged genes may be:

- Genes that encourage the cell to multiply
- Genes that stop cells multiplying
- Genes that repair damaged genes

Some of these gene faults may cause cancer so gene therapy can be used to correct these genes and therefore reduce the growth of tumours.
Gene therapy may also be used alongside chemotherapy and radiotherapy to make cells more susceptible to these treatments.

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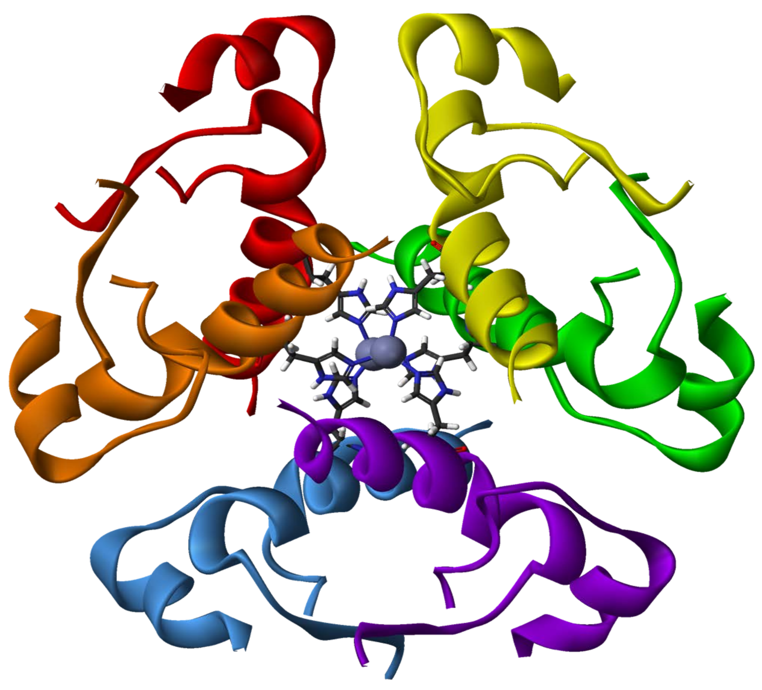
Insulin produced by bacteria

Charlotte and Jakob

Insulin

Insulin is a hormone made by the cells in the pancreas. It gets produced when there is an high blood sugar level due to the metabolic process of degrading carbohydrates into sugar and it basically enables the cells to take up the sugar so they can create energy.
This procedure can be disturbed by several diseases. These diseases may create the need of artificial insulin. Due to the years the possibilities and ways to produce artificial insulin have changed. They went from animal insulin to insulin produced by bacteria. But how can we tell a bacteria to produce a human gene ? And why are they able to express an human gen even if there procedures are totally different ? We want to answer these and other question with our work about artificial insulin.



Taken from: https://commons.wikimedia.org/wiki/File:Human-insulin-hexamer-3D-ribbons.png On Monday 27th february 2017

Diabetes

Diabetes mellitus(also called sugar disease) is a metabolic disease where the body is unable to take up the sugar out of the blood in to the cells. With about 422 million patients in the world in 2014 diabetes is an extreme common disease. Diabetes can be divided into two different types. They have different causes and different times when they usually occur. Both types cause the need of artificial insulin.

	Type 1	Type2
Age	Mainly Children and Youth just rarely adults	Adults from the age of 40 extremly rarely youth
Cause	Genetic predisposition Autoimmune disease	Genetic predisposition Extreme overweight
Symptoms	- Extreme thirst - Frequent urination - Loss of weight - Tiredness	- Usualy no major complications - Changes in the bloodvessels - Diseases of the primary nerve system
Treatment	- Lifelong Insulintherapie - Train a health life	- Train a healthy lifestyle - Regular exercise - Insulintherapie

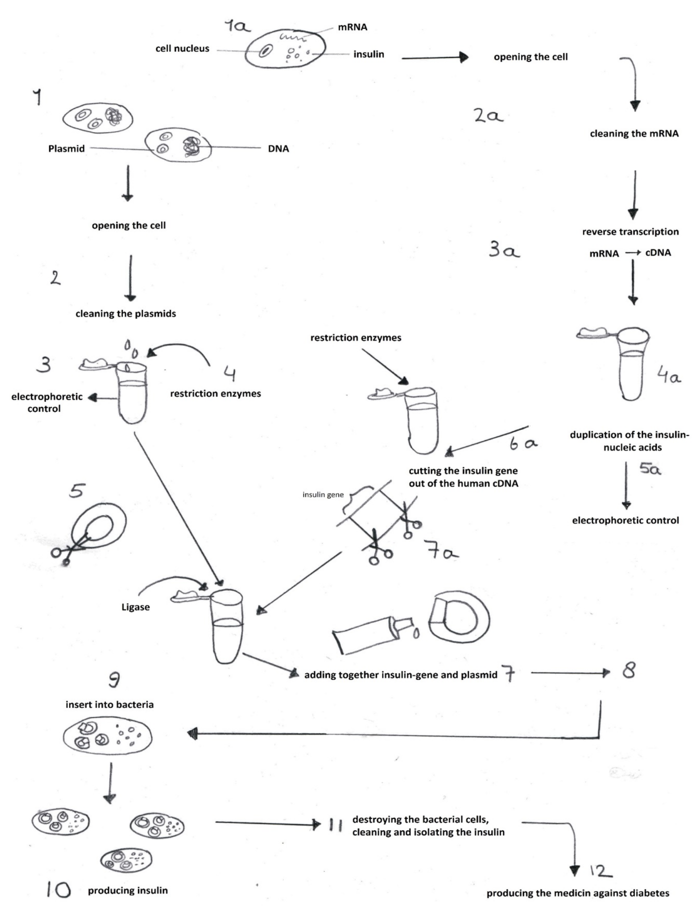
History

1869 Paul Langerhans discovered the islets, cells in the human pancreas.
1889 Oskar Minkowski and Josef von Mering trigger diabetes by removing the pancreas from a Dog
1906 Georg Ludwig Zülz injected a secretion from a cows pancreas to treat diabetes. Partly successful.
1916 Nicolae Paulescue first isolates insulin from pancreas tissue.
1921 Frederick Banting and Charles Best extracted the pure insulin and called it „Isletin"
1928 Oskar Wintersteiner proofed that Insulin is a protein
1963 first chemical syntheses of the Protein Insulin
1971 Blundell and his team clarified the 3D structure of Insulin
1982 Human Insulin was first produced by genetically modified bacteria
2017 investigations will go on to improve the quality and availability of insulin. And tomorrow maybe the day where another great discovery changes our whole understanding of insulin.

Insulin produced by Bacteria

The whole production of insulin today is done by bacteria.

But we cant just tell the bacteria to produce insulin. We need to change their



drawn by Charlotte de Jonghe and Jakob Lindemann

DNA and put the human insulin gene inside. There for we use plasmids. That are additional rings of DNA which bacteria can take up.
By using restriction enzymes we cut these plasmids open and basically glue the targeted gene in. Afterwards the plasmid can be put in to the bacteria through holes in their membrane created by chemicals. Afterwards the bacteria closes the holes itself and starts to express the new gene.

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Vaccines

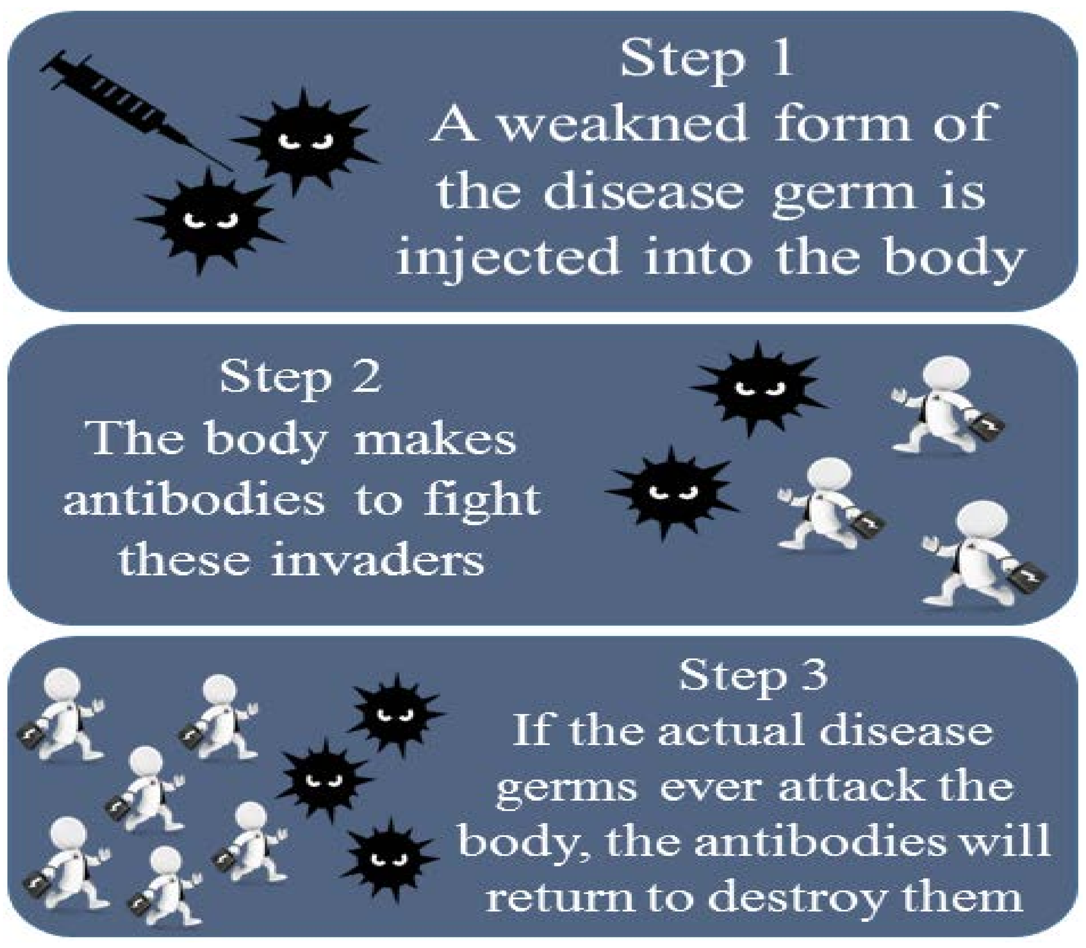
Susanna and Oliver

What are vaccines?

A vaccine is a biological preparation used to produce or improve immunity against a particular disease. By inoculating killed or weakened disease-causing microorganisms the production of antibodies is stimulated.

How do vaccines work?

Vaccines help develop immunity by imitating an infection. This type of infection, however, does not cause illness, but it does cause the immune system to produce T-lymphocytes and antibodies.



Picture created by Susanna Gobbi

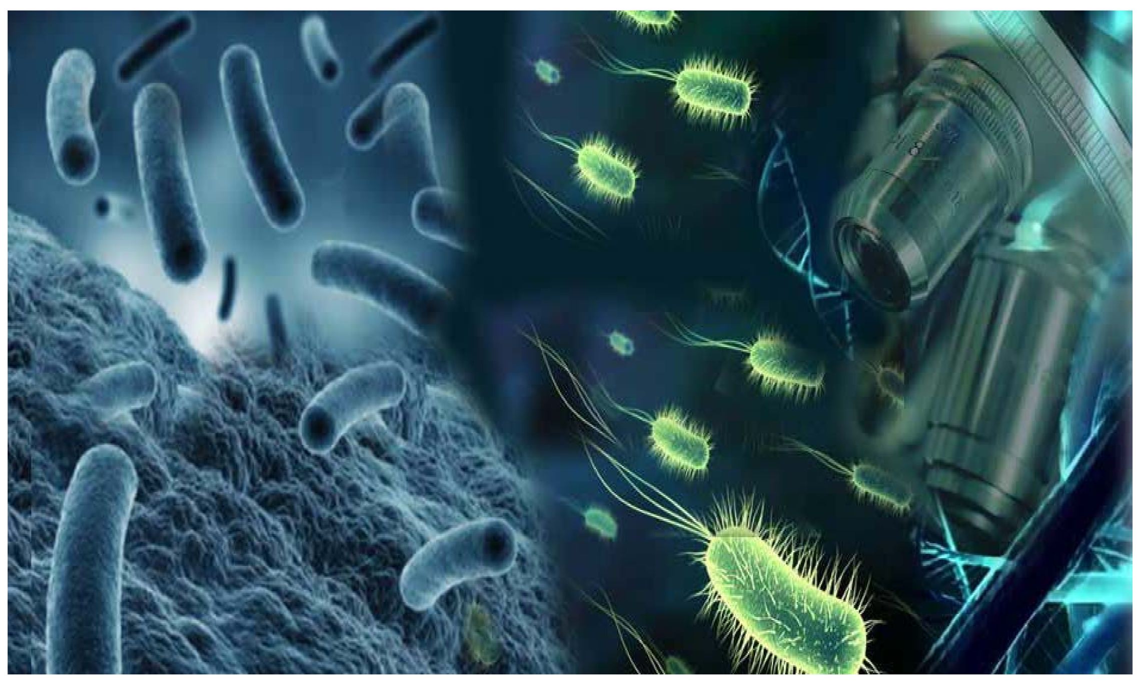
How are vaccines produced?

Biotechnology is used in three different ways in the development of vaccine:

1. Use of monoclonal antibodies for immunopurification of antigens: Once antigen is purified, it is used for developing a vaccine against a pathogen.

2. Use of cloned genes for the synthesis of antigens: cloned genes have been used for the synthesis of antigens leading to the preparation of vaccines.

3. Synthetic peptides as vaccines: vaccines can also be prepared through short synthetic peptide chains.



Free picture on: https://commons.wikimedia.org/wiki/File:Microbiologyezgrup.jpg

Vaccines in use

- **living**: it uses live-attenuated organisms and they contain modified strains of a pathogen (bacteria or viruses) that have been weakened but are able to multiply within the body.
- **non-living vaccines:** they are based on whole killed pathogens or components of them. They are very efficacious and allowed the control.

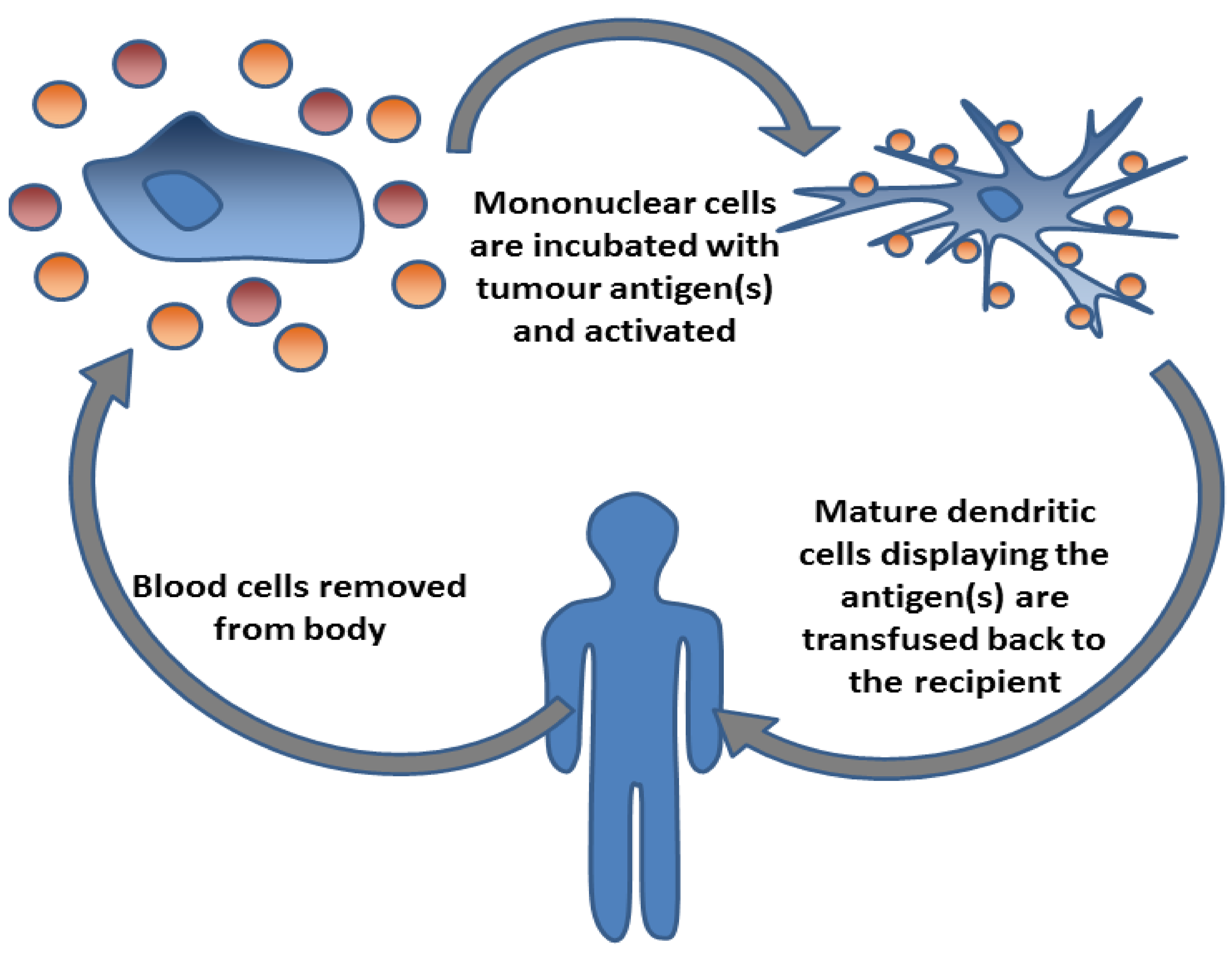
Reverse vaccinology

Reverse vaccinology is an innovative technique for the development of new vaccines through the sequencing of the genome of the pathogen.
This technique consists in:

- extracting entire bacteria genomes
- Identifying the antigens
- study on the biological role of each protein
- genes are rapidly cloned in order to produce the proteins they encode
- proteins are evaluated for their ability to cause an immune response
- isolate a dozen of antigens to be subjected to further analysis

Experimental: These are a number of innovative vaccines in development.

Dendritic cell vaccines



Free picture on https://commons.wikimedia.org/wiki/File:Dendritic_cell_therapy.png

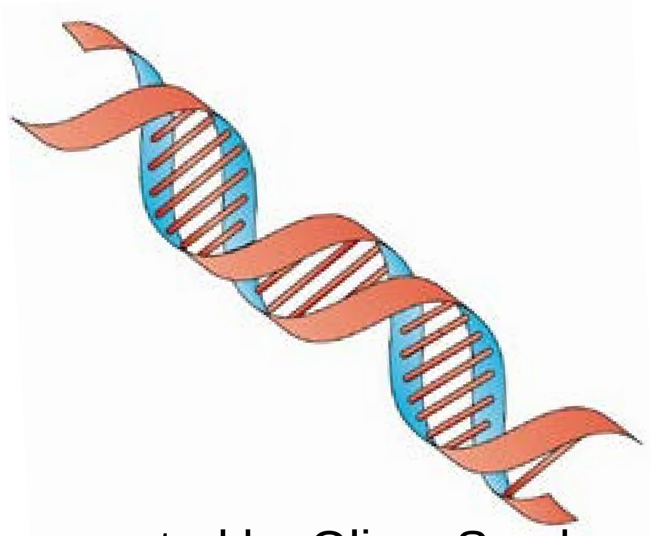
Plants as bioreactors for vaccine production

Transgenic plants have been identified as promising expression systems for vaccine production.

Free pictures on: https://pixabay.com/it/frutta-banane-png-giallo-estirpare-1218133/
https://pixabay.com/it/siringa-tiro-ago-vaccinazione-1884787/

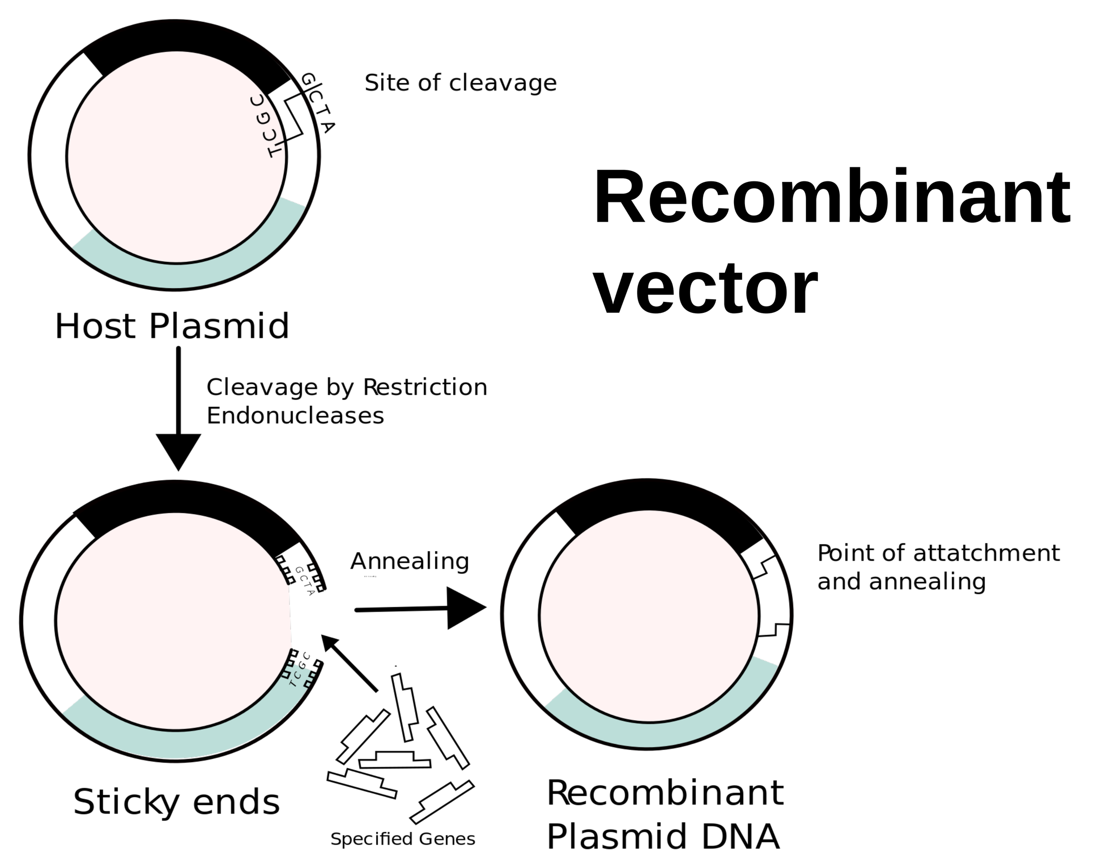
DNA vaccination

The proposed mechanism is the insertion of viral or bacterial DNA into human or animal cells.



Picture created by Oliver Sumberg

Recombinant vector



Free picture on: https://commons.wikimedia.org/wiki/File:Recombinant_formation_of_plasmids.svg

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BIOFUELS - AN OVERVIEW

Claudio and Mar

WHY SHOULD WE USE BIOFUELS ?

There are many problems about the current energy sources:

- The lack of sources
- The irregular distribuition
- The environament problem

Searchers are working on different projects in order to solve these problems. **Biofuels** might be a solution.

Biofuels are fuels obteined from biomasses, which are the biodegradable part of agriculture products, forestry industrial residues.

Free pictures on: https://commons.wikimedia.org/

Biofuels have not always been the same, but they have developed in time. There are four generations.

WHICH ARE THE DIFFERENT GENERATIONS?

The **first generation** is composed of fuels made using crops like soy, sugar cane and corn. The main problem is the competitiveness with the crops cultivated for food purposes.

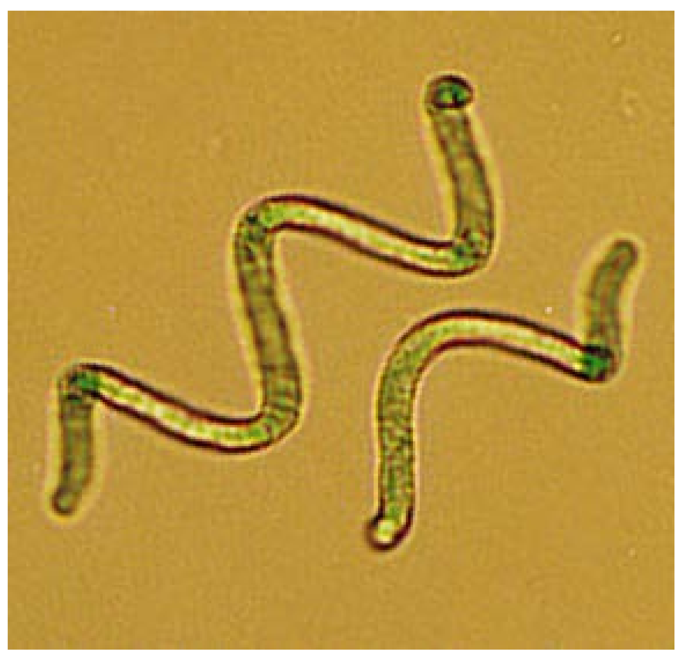
Free picture on https://www.flickr.com/photos/unitedsoybean/10478924204

The **second generation** uses the cellulosic waste obtained from woods and food industry. The most important second generation biofuel is bioethanol which is an alcohol obtained from fermentation of monosaccharide and polysaccharide.

The main problem of the second generation is the cost of processing the cellulosic waste. They are trying to decrease the price of the process by using specific enzymes.

The **third generation** uses algae in order to create biomasses just using solar energy and de CO_2.

Biodiesel made from algae oil (instead of plant oil) is an example for a third generation biofuel. This oil can be extracted from *Spirulina platensis.* Afterwards the oil is chemically transformed to biodiesel.



Free picture on: https://commons.wikimedia.org /wiki/File:Spirul2.jpg

The last step of the biofuel evolution is the **fourth generation**. It's very similar to the third one, but there's one big difference: it implies genetic modified organisms which use more CO_2.
This way we obtain two advantages: we both gain energy and reduce the dioxide carbonic rate.

There would be many effects linked with the spread of biofuels:

- There would be a big change in the energetic economy because many countries would start to use them.
- The increase in the value of waste because people would start to consider it more important.
- The diffusion of the green culture, with people starting to pay more attention to nature and see it not only as a useless think but also as a nice resource.

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Bioplastics

Michiel and Nina

What are bioplastics?

Bioplastics, or bio based polymers, are plastics that are made from renewable biomass sources, such as vegetables fats and oils, corn starch, or microorganisms. There are many different types of bioplastic. The most common ones are starch-based plastics and PLA (polylactic acid). Some, but not all, bioplastics are designed to biodegrade. Biodegradable bioplastics can break down in either anaerobic or aerobic environments, depending on how they are made. Bioplastics can be composed of starches, cellulose, biopolymers and a variety of other materials.

In the past few years, there has been a lot of improvement in the bioplastic industry. Because of the climate change and the gigantic problems with plastic waste a lot of people are looking for a new way of producing better plastics, bioplastics are ideal for this. Therefore it is estimated that the use of bioplastics will increase tremendously in the future.

Advantages of bioplastic

- Bioplastics are cheaper than normal plastics
- They are biodegradeble which means that they can naturally break down in the environment. This will massively help with the plastic pollution
- The production of bioplastic is way less harmfull for the environment than the production of normal plastic

The market of bioplastics

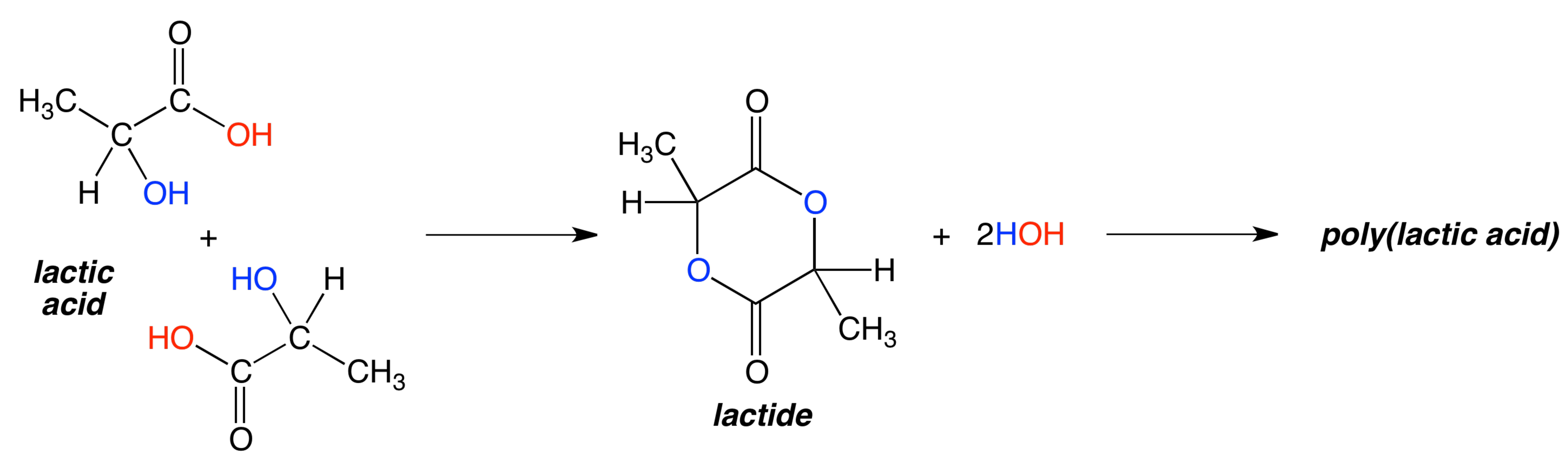
Altough some types of bioplastic are used right now, the market of bioplastics is still very small. But the market for bioplastics is increasing rapidly. In the years 2000 to 2008 the market inceased by 600 %, and it is also predicted that the market will increase another 300% form 2014 to 2021.

The future of bioplastics

The future of bioplastics looks very promesing. As mentioned before it is estimated that the use of bioplastic will increase tremendously. There is also a lot of innovation happening in the bioplastic industry and it is expected that the production costs of bioplastics will get a lot cheaper in the future.
Looking further ahead, some of the second generation bioplastics manufacturing technologies under development employ the "plant factory" model, using genetically modified crops or genetically modified bacteria to optimise efficiency.

The production of bioplastics

The most common used bioplastic today is PLA (polylactic acid). To make this corn or other raw materials are fermented to produce lactic acid, which is then polymerized to make PLA.
The lactic acid is put into a reactor and converted into a type of pre-plastic under high temperature and in a vacuum. This pre-plastic will then be broken down in to the building blocks of PLA. Out of these ‘‘building blocks’’ the bioplastic will be put together.



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Who cleans my laundry?

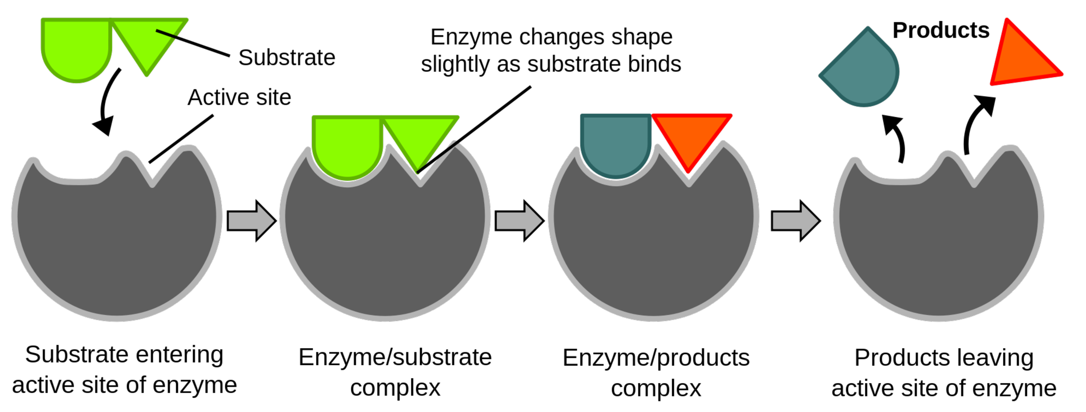
Katy and Joosep

What are enzymes?

Enzymes are macromolecular bio-logical catalysts.

Enzymes accelerate, or catalyze, chemical reactions, without being used up themselves.

How do enzymes work?



https://commons.wikimedia.org/wiki/File:Induced_fit_diagram.svg

The molecules at the beginning of the process upon which enzymes may act are called substrates and the enzyme converts these into different molecules, called products.

What are detergents?

Laundry cleaning processes include washing usually with water, containing detergents or other chemicals.

The washing will often be done at a temperature above room temperature to increase the activities of any chemicals used and the solubility of stains, and high temperatures kill microorganisms that may be present on the fabric.

How do detergents work?

1) The surfactant mixes with water.
2) The Hydrophobic ends attach themselves onto the grease.
3) The Hydrophilic ends attach themselves onto water molecules.
4) The surfactant and dirt is pulled away by the water molecules during the rinse cycle.

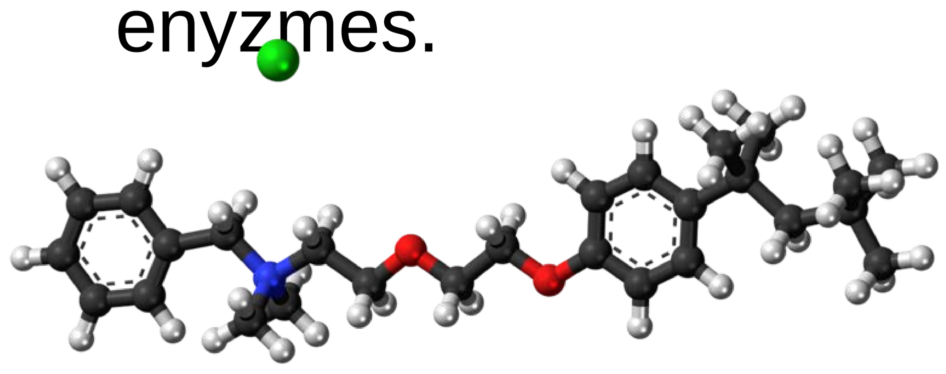
Enhanced detergents for the future

Things to achieve:

1) Elimination of water pollution from phosphates.
2) Lower temperature needed to wash clothes.
3) Energy savings.
4) More efficient enzymes.

Controversial aspects:

1) Requirement for better equipment which is more expensive.
2) The process itself takes time.
3) Requires more funding.
4) Expensive to make perfect conditions for enyzmes.



https://commons.wikimedia.org/wiki/File:Benzethonium-chloride-3D-balls.png

Genetically modified enzymes

A single bacteria or fungus is able to produce only a very small portion of the enzyme, but billions of microorganisms, however, can produce large amounts of enzymes.

The process of multiplying microorganisms by millions is called fermentation. Fermentation is a metabolic process that converts sugar to acids, gases, or alcohol. Proteases, enzymes that break down proteins, are particularly important in detergents.

https://www.pexels.com/photo/beer-brewery-company-factory-273716/

https://commons.wikimedia.org/wiki/File:Winery_with_fermentation_tanks.jpg

The manufacturers of laundry detergents use subtilisin, which is 274 amino acids long. Methionine is at the 222 position. The problem with methionine is that it oxidizes fast and when it's inactive, it prevents the subtilisin from breaking down the proteins in stains.

To overcome this, scientists use genetic engineering to replace methionine 222 with another amino acid, which is chemically synthesised by DNA fragments, as a result 19 new genes are created. In conclusion the cleaning becomes more efficient.

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