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Odyssey
Oxford Debates for Youths in Science Education

Biotechnology: Health & Environment
Students' Edition

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Introduction

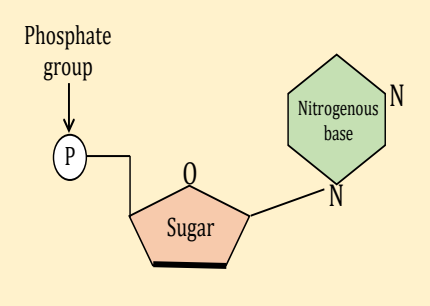
Subject
Biotechnology: Health & Environment
Definitions

Below is your basic glossary, keywords, and pre-existing knowledge of the scientific concepts and procedures to be used in biotechnology for health and the environment. During presentations and videos, write down additional words or scientific concepts that you would like to analyze further.

The letters **'DNA'** abbreviate the English translation of the word **'deoxyribonucleic acid'.** DNA is a molecule. That is, an entity made up of chemically 'joined' atoms, such as a water molecule, is known to be made up of two hydrogen atoms and one oxygen atom. However, DNA is made by atoms of 5 chemical elements: **hydrogen** (H), **carbon** (C), **nitrogen** (N), **oxygen** (O) and **phosphorus** (P). And the truth is that just like water, we can't say for a DNA molecule that it has exactly that many atoms, such as hydrogen, because in all the living organisms, the exact composition of DNA is different.
So, DNA exists differently in everything that has life. And if this 'everything that has life' is made up of many cells, then each of its cells, individually, has an area where its DNA is located. So, DNA looks like a "spinning ladder", a ladder made of H, C, N, O and P. Each step is made of several of these materials. For example, it may consist of 10 carbon atoms (C), slightly fewer nitrogen atoms (N), and a few hydrogen (H) and oxygen (O) atoms.
DNA has four types of scales that play a similar role to that played by music notes. In other words, just by placing notes of music in a row in different ways, we make different melodies, so different sequences of steps mean different DNA. In other words, all DNA is made up of the same 5 'materials', all looking at them from a distance look like revolving stairs, but just how the 5 materials are joined differs from organism to organism. DNA melody is the instructions that a cell 'reads' in order to perform a function. For example, there is a piece of DNA in your DNA that describes cells in your digestive system that make insulin, a substance that will make it easier for glucose to enter the rest of your body's cells. A substance that, in simple words, will help you eat right. In fact, each melody of DNA corresponds to a specific function (e.g. in the production of insulin), whether this DNA is in a fly or in a human. The way DNA is "read" is the same in all living organisms! This is why we can transfer pieces of DNA from one living organism to another. *(The explanation of DNA in very simple words can be found on the openscience website)*
DNA information is stored as a code consisting of four chemical bases: **adenine** (A), **guanine** (G), **cytosine** (C) and **thymine** (T). Human DNA is made up of about 3 billion bases, and more than 99% of these bases are the same in all humans. The order or sequence of these bases determines the available information for building and maintaining an organism, similar to the way in which the letters of the alphabet appear in some order to form words and sentences.

DNA bases pair with each other, A with T and C with G, to form units called base pairs. Each base is also connected to a sugar molecule and a phosphor molecule. Together, a base, sugar and phosphate are called nucleotides. Nucleotides are arranged in two long helixes that form a spiral called a double helix. The structure of the double helix is somewhat like a ladder, with the base pairs forming the steps of the ladder and the sugar and phosphorus molecules forming the vertical side sections of the ladder.

An important property of DNA is that it can reproduce or create copies of itself. Each DNA strand in the double helix can serve as a template for repeating the sequence of bases. This is critical when cells divide because each new cell needs to have an exact copy of the DNA in the old cell. *(Genetics Home Reference, National Library of Medicen, https://ghr.nlm.nih.gov/primer/basics/dna)*



Nucleotides come from the bond, with a covalent bond, of three different molecules. A pentose (sugar with five carbon atoms), a molecule of phosphoric acid and an organic nitrogenous base. **There are two types of nucleic acids, deoxyribonucleic acid and ribonucleic acid, which are best known for their DNA and RNA abbreviations, respectively.**

DNA nucleotides contain the pentose deoxyribose (deoxyribonucleotides), while RNA nucleotides contain the pentose ribose (ribonucleotides). The nitrogenous bases of nucleotides are adenine (A), guanine (G), thymine (T), cytosine (C) and uracil (U). Adenine, guanine and cytosine are found in both types of nucleic acids. Thymine is present only in DNA, while uracil is present only in RNA.

Schematic representation of a nucleotide type. Nucleic acid chains are usually long. This is the reason for their high molecular weight. Long length also justifies the unique property of DNA, being the carrier of all the information an organism needs to build and function. Because each DNA nucleotide can contain any of the bases A, T, G, C, there is, as in amino acid proteins, an unlimited number of different nucleotide sequences, each representing a different polynucleotide chain information. With 1,000 nucleotides, for example, 41,000 different polynucleotide chains can emerge, each with its own nucleotide sequence.

The second type of nucleic acid, RNA, in addition to its differences from DNA in composition (pentose is ribose instead of deoxyribose and one nitrogenous base is uracil instead of thymine), also differs in structure. While DNA is a double-stranded molecule, RNA is essentially single-stranded. In other words, it consists of a simple polyribonucleotide chain. However, sometimes this single-stranded molecule folds in some places. This configuration can be stabilized with hydrogen bonds, which are formed between bases that are complementary to each other (G-C, A-U), although in this case they belong to the same chain (clone). RNA comes in three different types. Messenger RNA (mRNA), transport RNA (tRNA) and ribosomal RNA (rRNA). Each of these types has a special biological role. The RNA messenger transmits genetic information from the encoded DNA to the ribosomes, where the proteins are synthesized. The transport RNA transports amino acids to the ribosomes for use in protein synthesis.

Gene: Every part of the DNA molecule that can be transcribed. Most genes contain information about the composition of a protein. The gene is the basic physical and functional unit of heredity passed on from parents to their children.

Our body is made up of millions of cells. **Most cells contain a whole number of genes. Genes act as a bundle of information and regulate the way our bodies work. They are responsible for most of our features, such as eye color, blood type or height.** We have thousands of genes. We inherit 2 copies of most genes, one copy from our mother and one from our father. For this reason we have similar characteristics to our parents. The genes are found in structures in the form of a thread called **chromosomes**. Usually the human body has 46 chromosomes in most somatic cells.

Chromosomes are inherited from our parents, 23 from our mother and 23 from our father, so we have 2 pairs of 23 chromosomes. Sometimes, a change (mutation) occurs in a **copy of a gene that interferes with its normal function. When the change occurs in a single underlying gene and the person has another normal copy, usually no genetic disease is caused.**

(Modified from brochures created by Guy's and St Thomas' Hospitals in London and the London IDEAS Genetic Knowledge Park,) from the free access website that provides information on genetic testing and links to support groups throughout Europe. http://www.eurogentest.org/index.php?id=529)

Copy: The process by which two exact copies of a DNA molecule are produced.

Reduction: Cell division during which the number of chromosomes is reduced by half.

Transcription: A process in which genetic information in DNA is transferred to an RNA molecule.

Mutations: These are the structural changes that the DNA molecule undergoes due to the influence of biological, chemical and physical factors (Professor, Dr. Konstantinos E. Vorgias. Access here). Automatic mutation occurs suddenly in the population or within a family.

Translation: A process in which proteins (polypeptide chains) are synthesized according to the information contained in an mRNA molecule.

Mitosis: Cell division in which two new cells are produced similar to each other and with the original cell from which they originated.

Human gene mapping: The recording of the sequence of bases of human genetic material, as well as the exact location of genes on chromosomes.

Antibiotics: Chemicals produced by microorganisms that cause the death of other microorganisms or inhibit their growth.

Sterilization: The process of removing or killing all living organisms from a material. It can be done by filtering or using temperature, radiation or chemicals.

DNA imprinting: The analysis of a person's DNA using appropriate restrictive endonucleases, which leads to the identification of that person's identity.

Genome: The total genetic material of a cell. It usually refers to the genetic material of the nucleus.

Genotype: The genetic makeup of an individual. The term is also used to describe alleles for one or more genes.

Biofuels: They are simple organic compounds produced with the help of microorganisms and enzymes from the decomposition of organic materials. These include **ethanol and methane (biogas).**

The raw material for the production of biofuels is **known as biomass.** Biomass is the biodegradable part of products, waste and residues derived from agriculture, forestry, industry and municipal waste. In other words, biomass is the large amount of organic biological material that includes living and dead cells along with their components. Biomass along with fermentation products (such as extracellular enzymes) is the product of the growth of microorganisms in a bioreactor.

Particularly: By biotechnology, we mean all the technical processes that aim to make the best use of the vital properties of living matter, ie both whole organisms and their constituents such as enzymes, with the aim of industrial-mass production of a useful product. in nutrition, medicine, the pharmaceutical industry, the composition industry, etc**.** Thus, the production of already produced products increases and the production of new products with great added value and importance for humanity is promoted. (Katsoni, V. (2006). Thesis. Dissemination of genetically modified crops. Economic importance. Concerns and reservations. TEI of Crete School of Agricultural Technology, Department of Plant Production)

Health biotechnology aims at the discovery and production of new ways of diagnosing diseases and personalized treatments, creating innovative drugs with extensive protein study (proteomics), tackling modern diseases, and improving living standards and living standards. man from the study of his metabolites (metabolic). (Wikipedia, the free encyclopedia)

Biotechnology in agriculture focuses on the management of genetic material for the creation of transgenic organisms (GMOs) that have desirable characteristics, overcoming conventional time-consuming and problematic methods of improvement. As a result, plants that are resistant to various diseases and strains are created more productively, with fewer water and plant requirements for "green plants" to produce a variety of natural products for pharmaceuticals and energy raw materials.

Another branch of biotechnology, reproductive biotechnology, is used to control the proliferation of productive animals through artificial insemination, cryopreservation of genetic material, synchronization of esters, collection and transport of embryos, in vitro reproduction of amphibians, selection of sex, clones and transgenic animals, which also have advantageous features, such as increased milk productivity, increased pest control, and disease. Finally, agricultural biotechnology aims to use techniques for controlled micro-propagation of virus-free plants and to create more environmentally friendly pesticides. (Wikipedia, the free encyclopedia)

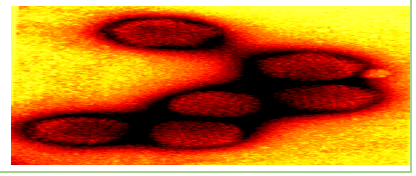
Genetic engineering is the process of transferring specific genes from an organism's chromosome and transplanting them to another organism's chromosome in such a way that it becomes a reproductive part of the new organism. Genetic engineering, also called genetic modification, it is the direct manipulation of an organism's genome using biotechnology. New DNA can be inserted into the host's genome by first isolating and copying the genetic material of interest using molecular cloning methods to create a new DNA sequence, or DNA synthesis, and then inserting it into the body. - host. Genes can be removed using a nuclease (a special enzyme). Gene targeting is a different technique, which uses a homogenous recombination to change an endogenous gene, and can be used to delete a gene, removing exons, adding a gene, or introducing point mutations.

The organism created through genetic engineering is considered to be a **genetically modified organism (GMO)**. The first GMOs were bacteria in 1973. Genetically modified mice were created in 1974. Bacteria that produce insulin were first marketed in 1982 and genetically modified foods have been on sale since 1994. Genetic engineering techniques have been applied in many areas, including research, agriculture, industrial biotechnology and medicine. Enzymes used in detergents and medicines, such as insulin and human growth hormone, can now be made from genetically modified cells,

experimentally genetically modified cell lines and genetically modified animals, such as mice or fish, and zebras used for Genetically modified crops have now been commercialized. (From free encyclopedia, Wikipedia)

Reconstituted DNA: Any DNA molecule created by the binding of DNA fragments, which come from the same or different organisms. Recombinant DNA is used to clone genes, to genetically modify organisms, and generally to develop a variety of Molecular Biology techniques**.**

Gene therapy, as a revolutionary achievement in Molecular Genetics and Biotechnology, is expected to star in the Medicine of this century with the aim of preventing and radically curing various diseases. It relies on the intervention of the genetic characteristics of an organism and creates expectations, which often touch the limits of science fiction and cause awe for the possibilities and applications of this method. It was originally developed as a method of repairing a genetic abnormality by inserting a "therapeutic" gene into an organism in order to replace a defective gene. This original idea has now been extended to other methods with the common feature of altering the genetic makeup of a cell for the purpose of treating the patient. During gene therapy, a patient's body cells are genetically modified, applying a number of different techniques. Selected genetic material of the patient is introduced through special vectors to target cells of the patient. This process is done intra-vivo or ex-vivo, in order to bring about the appropriate molecular genetic changes in the cells, in order to fight the disease and restore the normal phenotype. The genetic material that is introduced into the cells can be: - Specifically cloned human genes (along with those sequences that regulate the expression of these genes).
- Parts of human genes. - Genes from other organisms.
In most cases, gene therapy aims to genetically modify defective cells, which are responsible for a specific disease. In other cases, however, its goal is to activate normal cells, such as e.g. occurs with healthy cells of the immune system. Gene therapy developed rapidly because it made it possible to treat diseases for which there was no effective treatment.*Konstantis, M. 2015. DEVELOPMENT OF BIOTECHNOLOGICAL PHARMACEUTICAL PRODUCTS. [Book Chapter]. In Marcelos, M., Leontaritis, G., Antoniou, A., Konstantis, M., Manolopoulos, E., Pappas, P., Harkitis, P. 2015. Biochemical pharmacology. [electric bibl.] Athens: Association of Greek Academic Libraries. Chapter 10. Available at:http://hdl.handle.net/11419/4254 http://hdl.handle.net/11419/4254*
Gene therapy is based on finding a reliable delivery system to transfer the right gene to the affected cells. The gene must be delivered within the target cells and function properly without causing side effects. Gene delivery that will work properly in the long run is the biggest challenge of gene therapy. Gene therapy is based on finding a reliable delivery system to transfer the right gene to the affected cells. The gene must be delivered within the target cells and function properly without causing side effects. Delivering genes that will work properly in the long run is the biggest challenge of gene therapy.
The next photo presents an adenoid. Viruses are often used by researchers to deliver the right gene to cells. Viruses store their own genetic material in host cells to instruct these cells to make more viruses. In gene therapy, the DNA for the desired gene is introduced into the genetic material of the virus. The virus is made so that it cannot reproduce, but delivers its new genetic material that contains the desired DNA.



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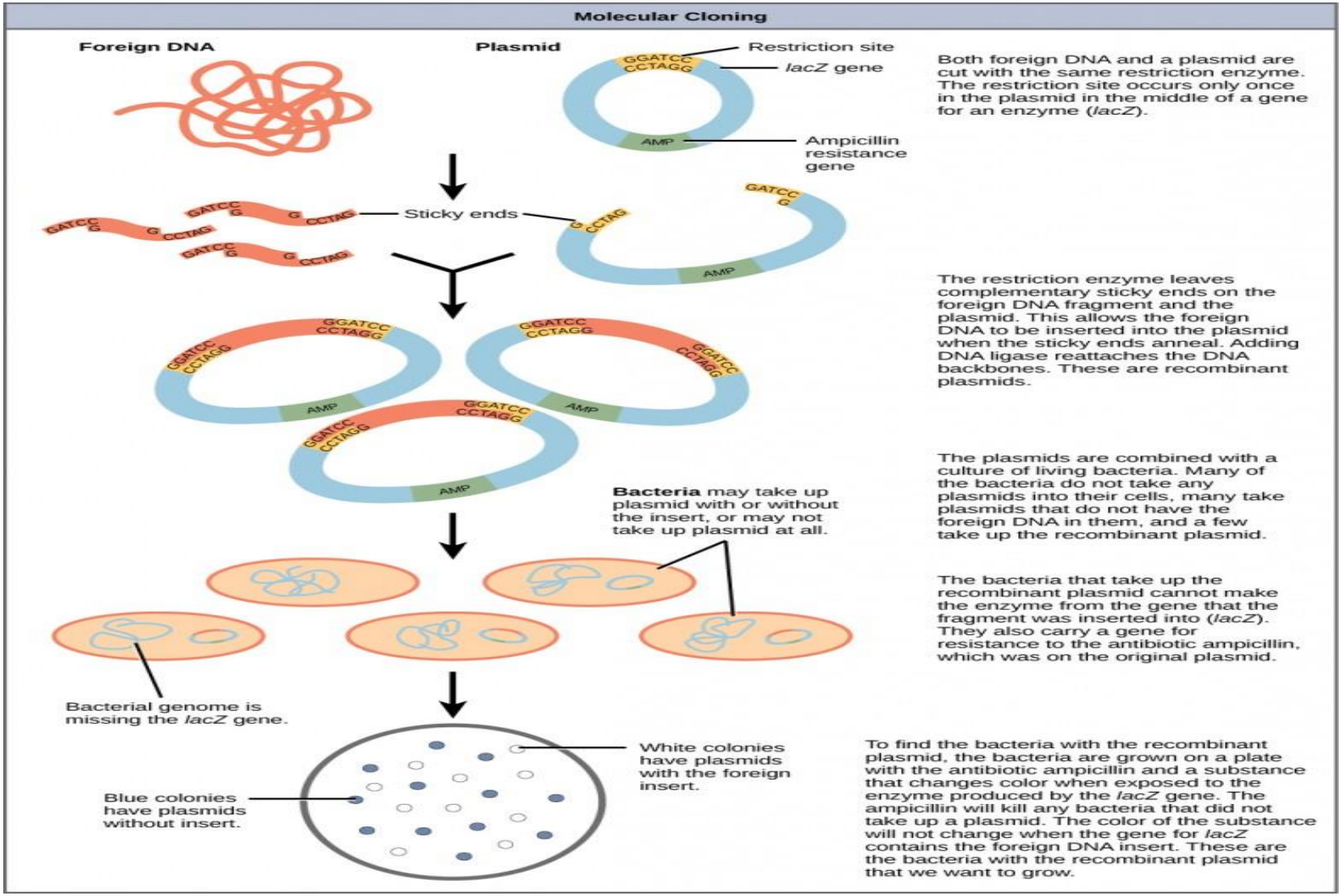

DNA cloning

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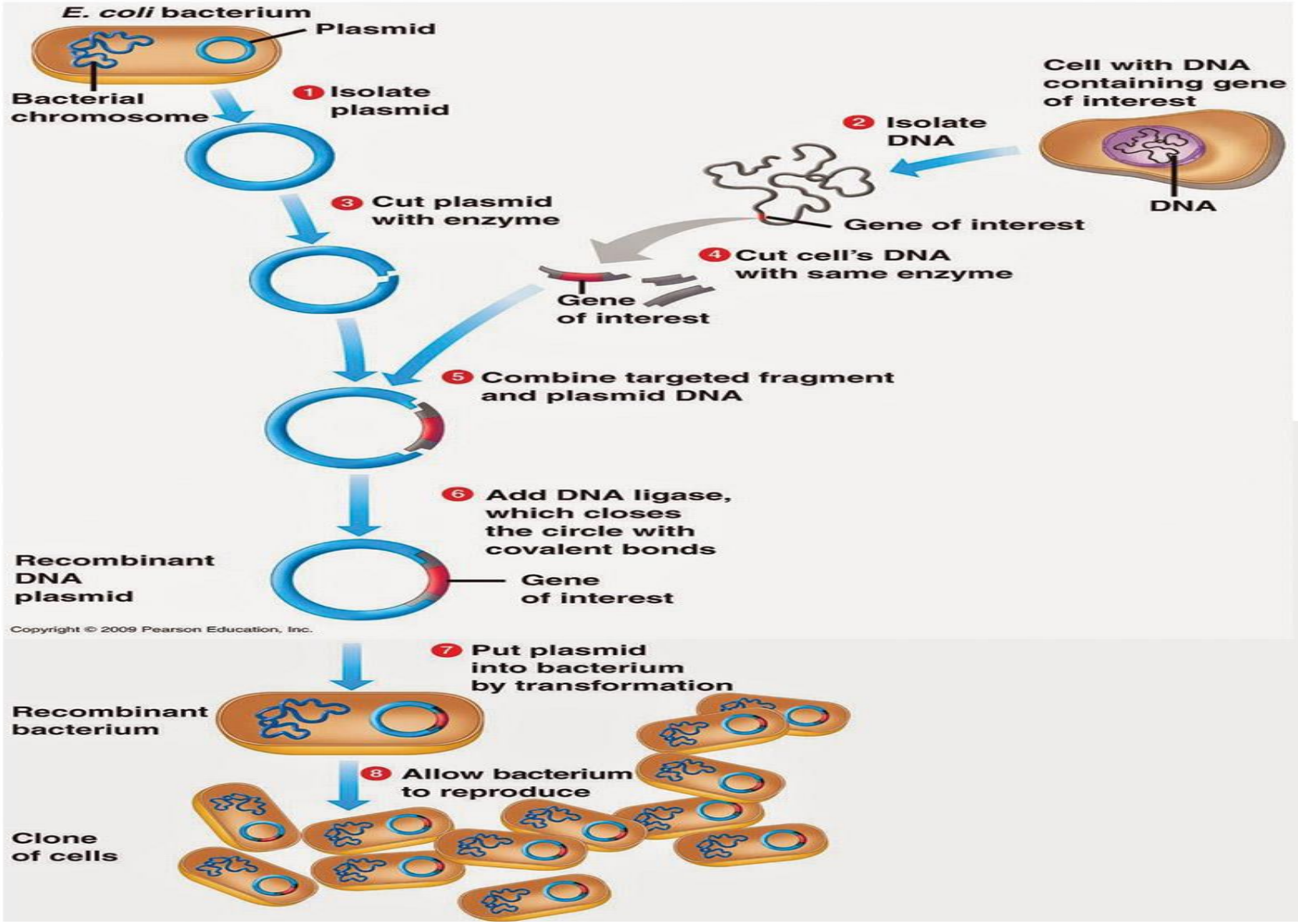

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Genome processing (also called gene processing) is a group of technologies that allow scientists to change the DNA of an organism. These technologies allow the addition, removal or modification of genetic material to specific genome sites. Several approaches to gene processing have been developed. The most recent is known as **CRISPR-Cas9 or CRISPR-associated protein 9. CRISPR-Cas9** was adapted from a natural bacterial genome processing system. Bacteria capture DNA fragments from incoming viruses and use them to make DNA fragments known as CRISPR arrays. CRISPR arrays allow bacteria to "remember" viruses (or close relatives). If the viruses attack again, the bacteria produce RNA fragments from the CRISPR arrays to target the viral DNA. The bacteria then use Cas9 or a similar enzyme to cut the DNA separately, which inactivates the virus. The CRISPR-Cas9 system works similarly in the laboratory. The researchers create a small piece of RNA with a short sequence of "guides" linked to a specific DNA target sequence on a genome. RNA is also bound to the Cas9 enzyme. As with bacteria, modified RNA is used to identify the DNA sequence and the Cas9 enzyme cuts the DNA at the target site. Although Cas9 is the most commonly used enzyme, other enzymes can be used (for example, Cpf1). Once the DNA has been cut, researchers use the cell's DNA repair machines to add or delete pieces of genetic material or to make changes to the DNA by replacing an existing part with a personalized DNA sequence. Genome processing is of great interest in the prevention and treatment of human diseases. Currently, most research on genome processing is being done to understand diseases used by cells and animal models. *(Genetics Home Reference, National Library of Medicen, https://ghr.nlm.nih.gov/primer/genomicresearch/genomeediting).*

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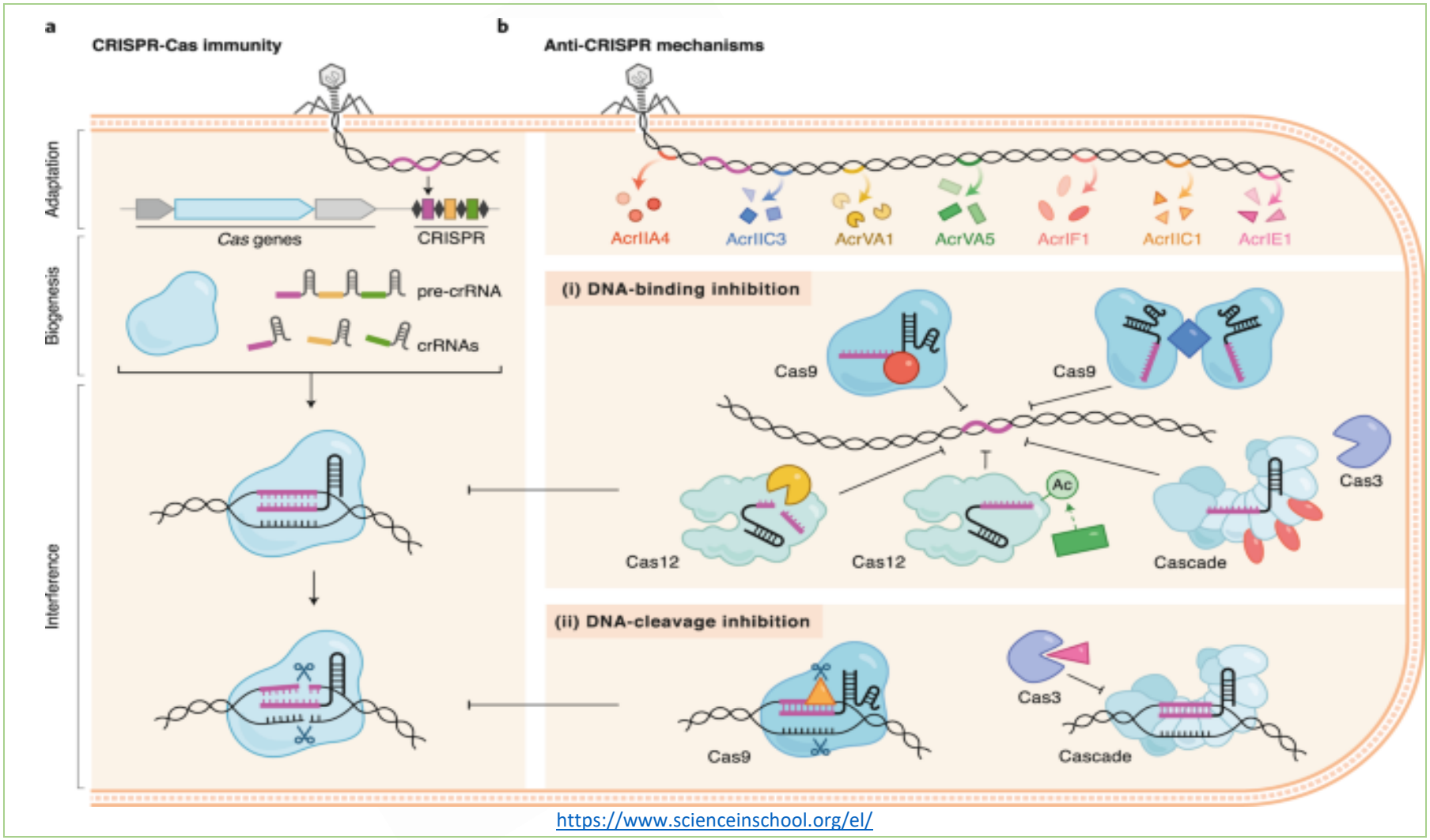

https://www.scienceinschool.org/el/

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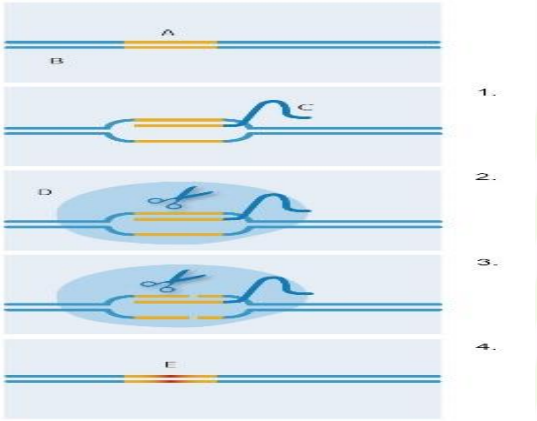
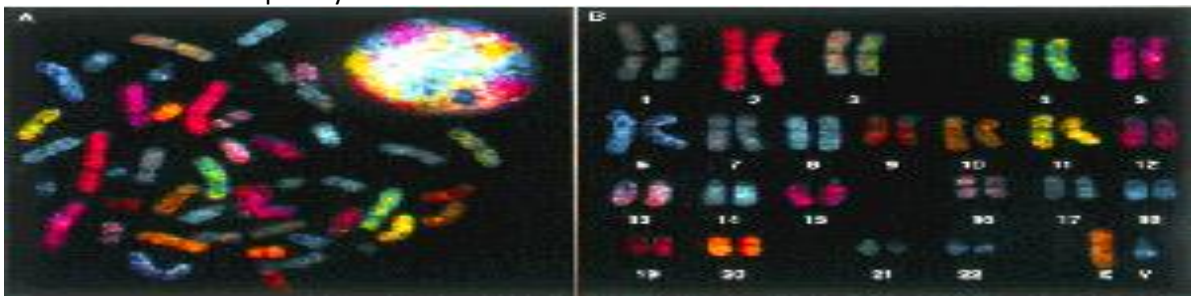


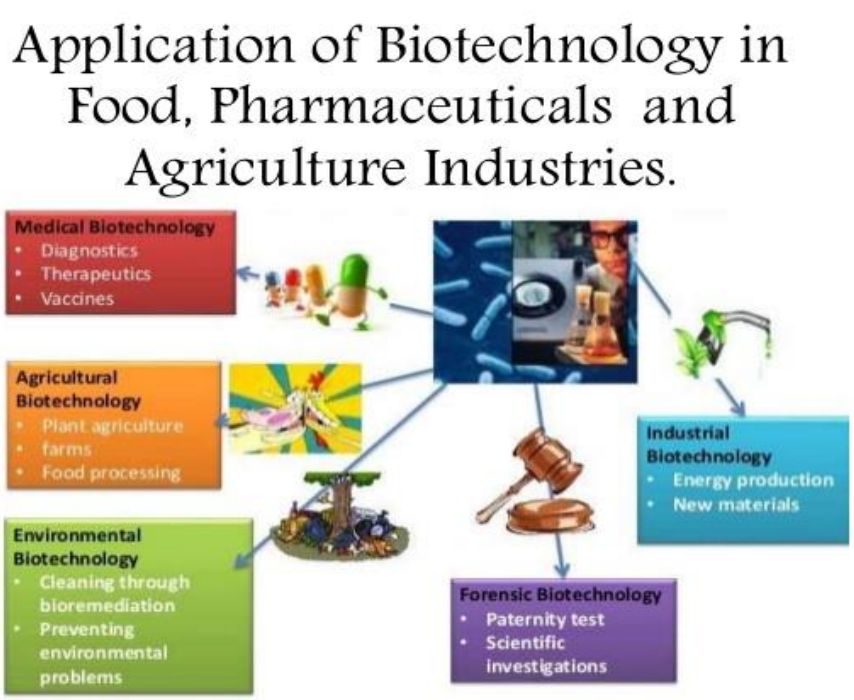
Gene modification using CRISPR-Cas9.
A: Target sequence, B: DNA C: RNA guide D: Cas9 E: New DNA sequence
1. The RNA strand binds to the target DNA sequence
2. The enzyme Cas9 binds to the RNA leader sequence
3. The enzyme Cas9 "cuts" both DNA strands
4. The bacterial repair system inserts new DNA into the "cut" chains, replacing the original DNA sequence.

Image courtesy of Nicola Graf
George Sflomos, B.Sc., M.Sc., Ph.D. –
Areas of interest: Cell biology and molecular oncology.
https://www.scienceinschool.org/el/

PCR (polymerase chain reaction) is a technique used in the laboratory to produce millions of copies of a specific piece of DNA. This area of DNA can be anything that interests the scientist. For example, it may be a gene whose function the researcher wants to understand or a genetic marker that criminologists use to match the suspect's DNA. Typically, the goal of PCR is to enable the DNA region to be analyzed or used in some other way. For example, DNA amplified by PCR can be sent for sequencing, pictured with gel electrophoresis, or cloned into a plasmid for further experiments. PCR is used in many areas of biology and medicine, including research in molecular biology, medical diagnostics, and even some areas of ecology. One method researchers use to study genes and chromosomes is called **"fluorescence in situ hybridization" (FISH).** This long name describes a process that binds fluorescent chemicals (which glow when exposed to a certain light) to DNA fragments whose genes are known. Researchers can then see where the genes on the chromosome are located. Using many colors of fluoridated chemicals, a researcher can "paint" the genes of an entire chromosome. Once a researcher knows that an underlying gene is supposed to be in a chromosome, he or she can use FISH to see if the gene is in the wrong place on the chromosome or is in a completely different chromosome. '



Gel electrophoresis is a technique used to display (directly) DNA fragments.



Bacillus thuringensis (Bt)- organisms: The Bt (there are many types of Bt) is a bacterium (germ) that is naturally found in the soil and produces proteins that are toxic to immature insects (larvae). The insects it targets include beetles, mosquitoes, black flies, caterpillars and moths. Some cultures have been developed to produce the toxin Bt. Bt is commonly used as a biological pesticide. Plants can be given genes that help plant bodies produce substances to fight pests. These native pesticides are called **plant-incorporated protectants (PIPs).** The cultivations which produce Οι καλλιέργειες are often called **genetically modified (GM)**. Some of the crops that can be grown for PIPs are corn, soybeans, cotton, potatoes and plums. Humans are exposed to Bt through their diet or through breathing, skin and eye contact. For example, this can happen when spraying or transporting dust in windy conditions. You may also be exposed after using a product if you do not wash your hands before eating or smoking. Since Bt is commonly found in soils, exposure to pesticides is also possible. (*Perez, J .; Bond, C .; Buhl, K .; Stone, U. 2015. Bacillus thuringiensis (Bt) General Newsletter, National Pesticide Information Center, Oregon University Extension Services. http://npic.orst.edu/factsheets/btgen.html)*

Note: Keywords that do not have a separate reference come from the basic vocabulary of textbooks. High School Biology textbook (Organization of Binding Textbooks, Ministry of Education and Religions, Authors: Mavrikaki, E., Gouvra, M., Kambouri, A.)

Textbook of the Positive Studies Orientation Group of the 3rd grade of the General Lyceum INSTITUTE OF COMPUTER TECHNOLOGY AND EDITION "DIOFANTOS",MINISTRY OF EDUCATION, RESEARCH AND RELIGIONS INSTITUTE OF EDUCATIONAL CULTURAL ASSOCIATION

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Additional presentation resources that analyze the basic concepts of the educational package https://www.slideshare.net/purpleness/ss-16157835, https://www.slideshare.net/annpyl/dna-rna , http://photodentro.edu.gr/lor/r/8521/3092

Introductory questions

After completing the 1st lesson, where the introduction to the subject of the controversy took place (through the material of the presentations and the videos) you are asked to complete the following introductory questions.

1) Biotechnology has been applied since prehistoric times. Do you recognize progress and development in its applications and in which areas of modern societies?

2) What developments are recorded by the applications of biotechnology in the field of health?

3) In the field of health, do biotechnology applications have only positive results? Justify your point of view.

4) "Genetic Engineering represents our most promising thoughts, but also our innermost fears" JEREMY RIFKIN, Author - President of the Foundation
Can you present the two different positions with reference to the respective arguments that support it?

Students' indicative answers

1) Biotechnology refers to any technique that uses living organisms or parts thereof to produce or modify a product or plant or animal or micro-organism for specific uses. In the last three decades, scientific advances in molecular biology have resulted in recombinant DNA technology or "genetic engineering." Furthermore, with the movement / transfer of genetic material, the cloning of living and plant organisms has occurred, i.e.

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Activity sheet

Subject
Biotechnology & Health
1st Debate topic: Biotechnology applications are the enemy of human health

Activity 1.

Based on your preparation for resolving the disagreement over biotechnology applications, prepare a series of arguments, classifying them into those that are clearly in favor of the resolution, against the resolution, and the arguments that can be used by both sides - that is, they are controversial. The questions asked by the teacher in the "Introduction" support the creation of your arguments.

For	"Grey area"	Against

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REAL INCIDENTS

Below you will find the information cards, story cards and question cards. Study carefully and analyze in order to formulate your arguments for the discussion.

INFO CARD 1	INFO CARD 2
CRISPR-Cas9: applications in the field of healthcare. Scientists have already used the CRISPR-Cas9 gene processing technique to cut HIV sequences and prevent them from reproducing in human cell lines. The technique has also been used to remove mutated sequences from mice suffering from Duchenne muscular dystrophy, a weakness that causes muscle weakness, thus raising new therapeutic hopes for patients and their families suffering from it or similar genetic diseases. Recently, pig embryos have undergone extensive gene processing using CRISPR-Cas9 in the hope of providing safer organs for human transplants. **But Chinese researchers in 2015, when they used CRISPR-Cas9 to modify the β-thalassemia gene in 86 human embryos. The technique proved to be rather ineffective, as DNA sequence was successfully altered in less than a quarter of fetuses.** *George Sflomos, B.Sc., M.Sc., Ph.D. – Areas of interest: Cell biology and molecular volume.https://www.scienceinschool.org/el/* *Revolutionary technique of genetic modification of Emmanuela Sarpentier, https://www.embl.org/news/science/1608-charpentier/* *Gene-editing record smashed in pigs. Researchers modify more than 60 genes in effort to enable organ transplants into humans.* *Nature doi:10.1038/nature.2015.18525*	**Insulin medicine as a product of genetic engineering**  Insulin is α hormone produced by the pancreas. Until recently, we took it from the cattle and pig pancreas, after slaughtering them. However, this method has some disadvantages such as the high cost of production, the insufficient produced quantities and the occurrence of allergies due to the fact that the insulin of cattle and pigs is not exactly the same as human insulin. The solution would be to produce human insulin in large quantities and at low cost. Indeed, the scientists isolated the gene responsible for the production of human insulin and introduced it into a bacterium. The new modified genetic material of this bacterium can produce human insulin. As the bacterium multiplies, new bacteria emerge that also carry this gene producing insulin. Using this method, we can, at low cost, produce large amounts of human insulin and offer a solution to the problem of many millions of people. Insulin is a key treatment for patients with diabetes.

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INFO CARD 3	INFO CARD 4
Anti-malarial drug Jay Keasling and his research team (Berkeley University of California) found a way to modify the E. coli bacterium to produce artemisinin, a powerful anti-malarial drug, the most effective treatment for the disease. Poverty-stricken populations report that malaria infects approximately fifty million people each year, and kills up to one million people, most of whom are children under the age of 5. Most importantly, the team developed techniques and innovations that are expected to reduce the cost of artemisinin and allow millions of people infected with malaria to gain access to treatment. The treatment received the Humanitarian Biotechnology Award in 2009. *Publication: http://www.heinzawards.net/recipients/jay-keasling*	 **Hepatitis B vaccines** The translation of mRNA into proteins is used in genetic engineering to produce desired gene products, such as the production of polypeptide immune systems for their use as vaccines (eg, a hepatitis B vaccine). *Applied Clinical Microbiology and laboratory diagnostics. Period B, Volume 14(2), pp.54-57,2009. Article by Siafakas Nikolaos.Cross, D., & Burmester, J. K. (2006). Gene therapy for cancer treatment: past, present and future. Clinical medicine & research, 4(3), 218–227. doi:10.3121/cmr.4.3.218* *https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1570487/*
INFO CARD 5	**INFO CARD 6**
Pharmacognidiomatic With the technology of micro-components and the selection of the appropriate gene chips, the probability of the patient's response to the medication in relation to the expression of gene groups can be determined. The genes used are related to drug metabolism and multifactorial resistance mechanisms. **Pharmacogenidiomatics** is the result of a cross between pharmaceuticals and genetics and deals with the study of the effect of each person's inherited genetic profile on drug response, aiming to individualize treatment in order to achieve the greatest possible efficacy and minimal toxicity. *N. Kapranos D. Rontogianni (2007). Molecular histopathology techniques in Oncology.http://www.onco.gr/documents/Kapranos Rontogianni.pdf*	**Applications of PCR in the diagnosis of viral infectious diseases** Laboratory tests (isolation and virus identification, detection of viral antigens, detection of viral genome by molecular hybridization and detection of specific antibodies) used to confirm the clinical diagnosis of a viral infection due to viral infection, for example. in latent state, presence of non-cytopathogenic strains). However, using PCR can solve almost all of these problems, even if it takes a long time to get results. *Papanastopoulou M. (2018). Polymerase chain reaction (PCR). Description of the method and its application in the detection of viruses. Journal of the Hellenic Veterinary Medical Society, 48(2), 61-69. doi:http://dx.doi.org/10.12681/jhvms.15795* *https://www.mayo.edu/research/departments-divisions/department-molecular-medicine*

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INFO CARD 7	INFO CARD 8
DNA testing as a means of diagnosing and preventing hereditary diseases By carefully examining the DNA we inherited from our parents, scientists are finding the causes of dozens of diseases. Thus, researchers make accurate diagnoses and predictions, design more effective drugs and prevent many painful disorders. Characteristically, scientists have made significant progress in relation to the two deadly genetic diseases of children, cystic fibrosis and muscular dystrophy. The discovery of the defective gene that causes muscular dystrophy (muscle disease) has led scientists to identify a previously unknown protein that plays an important role in all muscle functions. This gives them a clearer picture of how muscle cells work and allows them to diagnose other muscle disorders with great precision, as well as to design new approaches to treatment. In addition, they have identified genetic weaknesses that predispose people to more common diseases, such as various forms of heart disease, breast cancer, diabetes and arthritis.  *Genetic testing-Wikipedia* *Diploma Thesis: Papadakis, M. .Exploration of responsible mutations related to genetic diseases through the study of the genome with new high-performance technologies: analysis of mutations / polymorphisms in new genes and correlation with clinical laboratory findings. DEPARTMENT OF BIOLOGY AND MEDICAL SCHOOL*	**Consequences of human genome mapping** Understanding the structure and function of the genome of humans and other organisms has contributed greatly to enhancing the knowledge of the structure of DNA and therefore to the mapping of chromosomes, which implies the discovery of unknown genes and their involvement in genetic / metabolic diseases. Both the etiology and the pathogenesis of which were completely unknown. The development of molecular diagnostic technology (application of PCR technology, molecular hybridization DNA / RNA or DNA / DNA), which is currently used in the detection of genetic diseases, in the identification of microorganisms and infectious viruses, has also contributed to the recognition of molecular targets for drug development (targeted therapy), but to enhance the ability of thousands of genes to simultaneously express themselves in a tissue or in cells (microarrays - DNA chip technology). These developments provide the possibility of molecular evaluation of the course of a treatment (e.g. anticancer combination therapy) on the expression of a series of oncogenes, something that can be applied in the future to other diseases. *Tsiftsoglou, S. Professor of Pharmacology, Pharmacology Laboratory, Department of Pharmacy, AUTh. Biotechnological drugs, therapeutic cloning and cell therapies. SOCIETY & HEALTH VI.* *Access: https://helios-eie.ekt.gr/EIE/bitstream/10442/384/1/M01.050.08.pdf* *Venter J.C. et al, The sequence of the human genome, Science, 291:1304-1351 (2001).* *Schema M., et al., Quantitative monitoring of gene expression patterns with a complementary DNA microarray Science, 270: 467-450 (1995).*

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INFO CARD 9

The wide range of gene therapy promises a number of innovative therapies in preventing cancer deaths.

Immunotherapy uses genetically modified cells and viruses that have been infected with the virus (viral particles) to stimulate the immune system and destroy cancer cells. Clinical trials of second- and third-generation vaccines have shown encouraging results in a wide range of cancers, including lung cancer, pancreatic cancer, prostate cancer and malignant melanoma. **Oncolytic nicotherapy,** which uses viral particles that replicate inside the cancer cell to cause cell death, is an emerging treatment method that makes great promises, especially with metastatic cancers. **Gene transfer** is a new treatment method that introduces new genes into a cancer cell or surrounding tissue to cause cell death or slow the growth of cancer. This treatment technique is very flexible and uses a wide range of genes and carriers in clinical trials with successful results.

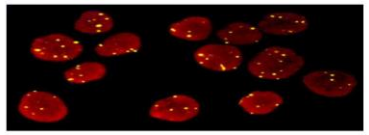
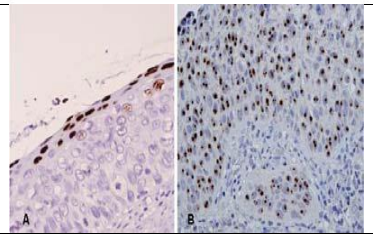
Cross, D., & Burmester, J. K. (2006). Gene therapy for cancer treatment: past, present and future. Clinical medicine & research, 4(3), 218–227. doi:10.3121/cmr.4.3.218
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1570487/

From https://en.sciencedc.com/92030-020508072339-98 Reference to the May Nature Medicine article from the Mayo Clinic Molecular Medicine research led by Kah-Whye Peng, Ph.D., and Stephen Russell, MD, Ph.D.

INFO CARD 10

Clinical applications of PCR-based techniques

- Qualitative and quantitative detection of DNA and RNA viruses.
- Bacterial detection (tuberculosis mycobacterium, chlamydia, urea, plasma, mycoplasma, etc.).
- Detection of gene mutations (cystic fibrosis gene).
- Genotypic determination of histocompatibility antigens (transplants).
- Determination of telomerase activity (TRAP).
- Search for lymphocyte monoclonality by recombinant antigen receptor gene.

	Detection of numerical chromosome 7 abnormalities in breast cancer with FISH.
	Distinguish between formal and integrated HPV DNA in biopsies cervix with in situ hybridization. The hybridization signal has the image of small intranuclear spots and corresponds to a form of the virus embedded in human DNA.

In addition to medical applications, the technique is used in criminology (eg analysis of a person's identity from a hair or a drop of dried blood) or in paleontology (eg for the analysis of DNA residues in fossil material).

Corczyca W, Bedner E, Burfeind P, Darzynkiewicz Z, Melamed MR. Analysis of apoptosis in solid tumors by laserscanning cytometry. Mod Pathol 11:1052-1058,1998
Mullis KB, Ferre F, Gibbs RA. The polymerase chain reaction. Birkhauser, 1994
Stanta G, Schneider C. RNA extracted from paraffin-embedded human tissues is amenable to analysis by PCR amplification. Biotechniques 11:304-308,1991.

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INFO CARD 11	INFO CARD 12
The Human Genome Program and Cancer Prevention Although scientists have known for years that a mutated gene was responsible for hereditary colon cancer, it was difficult to give clear answers because they had little clue as to where it could be between 23 pairs of chromosomes. But since the spring of 1993, using tools from the Human Genome Program, an international team of scientists has come to important conclusions about the location of the gene in most cases of this inherited cancer. These discoveries provide significant hope for how the Human Genome Program is likely to transform medicine, opening up new approaches to prevention. The first beneficiaries will be those families who are at high risk for colon cancer. Specifically, for these families, a simple blood test will determine who is prone to cancer, whether or not they have damaged genes. People who are found to have the "altered gene" are more likely to adopt a low-fat, low-fat diet in the hope of preventing cancer. Annual laboratory tests should also be performed from the age of 30 onwards. Such tests, which will be done regularly, will help doctors detect benign polyps or any wart growths in a timely manner. They can then remove them without becoming malignant. *National Institutes of Health, National Center for Human Genome Research. "The work of the human genome: from maps to medicine." Bethesda, MD: US Department of Health and Human Services, 1995*	**Antibiotic resistance** In recent years, there has been a steady increase in concerns in the scientific community and the general public about the development of antibiotic-resistant bacteria. The problem arose with the emergence of multidrug-resistant bacteria which are now a new form of pandemic. In particular, Greece is one of the European countries with the highest levels of microbial resistance, which is most likely related to the high consumption of antibiotics. Existence of resistance genes is found not only in clinical executives but also in environmental ones, which demonstrates the extent of the problem. The environmental dimension of the problem concerns the transport and spread of resistance genes through the use and transport of antibiotics to the environment. K.pneumoniae is an important pathogenic bacterium, resistant to many antibiotics and is an important source of nosocomial infections associated with high morbidity and mortality due to limited treatment options.  *Niarchos, G. (2015). Diploma thesis: "Microorganisms and antibiotics: Dispersion of resistant bacteria and their corresponding genes in the Aquatic Environment", Technical University of Crete, Department of Environmental Engineering.* *Koupidou, G., (2019). Diploma thesis: "Resistance of Klebsiella pneumoniae to antibiotics". Postgraduate Specialization Diploma. Basic Biological Sciences. Department of Istria, University of Ioannina.*

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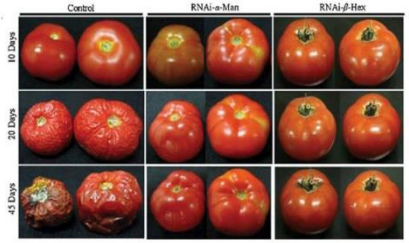
INFO CARD 13

Genetically Modified (GM) foods are responsible for a number of negative health effects

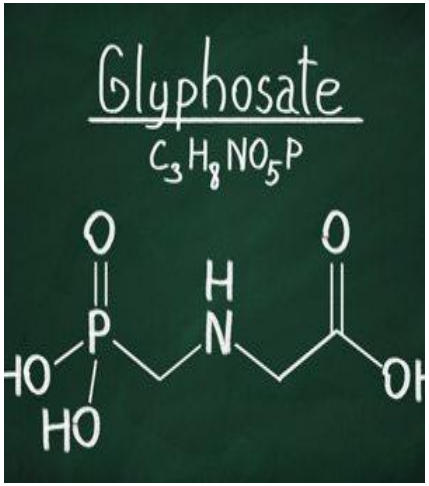
The American Academy of Environmental Medicine (AAEM), issued a warning urging the public to avoid GM foods. In a study, they say that GM foods cause serious negative health consequences, such as rapid aging, severe damage to major organs, immune problems, gastrointestinal dysfunction and disruption of proper insulin regulation. The worst finding in the AAEM report is that GMs can reproduce in the intestinal flora of the body long after they are consumed. Genes in genetically modified organisms carry intestinal bacteria. This reprogramming can cause the intestinal flora to start reproducing, for example, Bt toxin, instead of producing the live bacteria it is supposed to have. The permanent, fatal consequences of these lesions are obvious, as the intestinal flora is vital for life. Doctors at Sherbrooke University Hospital in Quebec, Canada, found Bt toxin in 93% of 30 pregnant women, 80% of their babies' umbilical cord blood and 67% of 39 non-pregnant women. Given that Bt-toxin has been linked to cancer, autism, severe food allergies and autoimmune disease, these findings are absolutely frightening.



'Dangerous toxins from genetically modified plants found in women and fetuses', Jeffrey Smith, Institute of Responsible Technology, 25 May 2011. *http://www.responsibletechnology.org/posts/?p=1412*

INFO CARD 14

Glyphosate as an element of genetically modified crops increases the risk of breast cancer



Genetically modified crops are globally infected with glyphosate and the toxic metabolite AMPA. A worrying new study, published in the journal Food and Chemical Toxicology, shows that glyphosate is capable of stimulating the proliferation of breast cancer cells. This finding is related to those who consume genetically modified foods today. Researchers have found that soy phytoestrogens, known as genistein, produce "extra estrogen" when combined with glyphosate, raising serious concerns about whether GMs contribute to the epidemic levels of breast cancer in countries such as the United States where they are consumed. relatively large quantities.

Siriporn Thongprakaisang, Apinya Thiantanawat, Nuchanart Rangkadilok, Tawit Suriyo, Jutamaad Satayavivad, 'Glyphosate induces human breast cancer cells growth via estrogen receptors' (Chemistry , Medicine Published in Food and chemical toxicology, https://doi.org/10.1016/j.fct.2013.05.057
Recovery: https://www.semanticscholar.org/paper/Glyphosate-induces-human-breast-cancer-cells-growth-Thongprakaisang-Thiantanawat/9337e2bad2f9af3f60b51d87ad1713bdf6b1e79b

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INFO CARD 15	INFO CARD 16
Genetically modified food causes allergic reactions The study *Immune Responses to Farmers after Exposure to Bacillus thuringensis* shows **that there is a high probability of an allergic reaction to individuals due to genetically modified foods from Bt crops** (e.g. corn). In more, exposure to graidust powder can lead to allergic symptoms and respiratory illnes. In this study, a farmers' control program is developed before and after exposure to Bt preparations. It is reported that a number of farmers tested positive for the skin test, and IgE and IgG antibodies were found, the levels of which were higher in those farmers with Bt preparations. It should be noted here that both the positive skin test and the presence of Ig Antianthoma are indicative of an allergic reaction. However, other examples are recorded, which are characteristic of cases of allergic reactions: a) 500 people in Washington and Vancouver reported symptoms influenza and allergies, when exposed to the spray, b) thousands of farm workers in India showed similar symptoms after handling genetically modified cotton Bt. *" Failures and Risks of Bt Crop ". Institute of Science in Society, December 14, 2011. http://www.i-sis.org.uk/Bt_crops_failures_and_hazards.php* *Bernstein JA, Miller M, Tierzieva S, Bernstein DI, Lummus Z, Selgrad MJK, Doerfler DL, Seligy VL. Immune responses in farmers after exposure to Bacillus thuringiensis pesticides. Environmental Health Perspectives 1999, 107.http://www.ehponline.org/members/1999/107p575-582bernstein/bernstein-full.htm* *Bender C, Peck S. .The health symptoms reported during the BTK spray in the spring of 1994 in the capital peripheral area. Environ Health Rev 1996, Summer, 42-44.* *http://www.kathimerini.gr/171711/article/epikairothta/kosmos/ypopto-gia-allergies-to-metallagmeno-kalampoki-bt of Dimitrios Kouretas*	**Genetically modified and transmission of infectious virus.** Most GT cultures use cauliflower 35S (CaMV35S) as a promoter for activating the suggested gene. However, there is a possibility of horizontal transmission of the powerful CaMV35S virus and disease, carcinogenesis, mutagenicity, as well as activation of viruses that are latent or, finally, even the creation of new viruses. CaMV in non-GM foods is not highly contagious and cannot be absorbed by the mammalian gastrointestinal tract, unlike CaMV35S which is found in GM foods and can cause multiple risks. *Genetically modified foods and their effects on health: AA Donna, Laboratory of Forensic Medicine and Toxicology, Medical School, University of Athens, Athens & I.S. Arvanitogiannis, Department of Agriculture, Plant Production and Rural Environment, School of Agricultural Sciences, University of Thessaly, Volos ARCHIVES OF HELLENIC MEDICINE 2009, 26 (6): 727-740* *Hodgson J. Scientists avert new GMO crisis. Nat Biotechnol 2000, 18:13* *Ho MW, Ryan A, Cummins J. Hazards of transgenic plants containing the cauliflower mosaic virus promoter. Microb Ecol Health Dis 2000, 12:6–11*  https://images.app.goo.gl/QRMoadTiGQoSLWBf6

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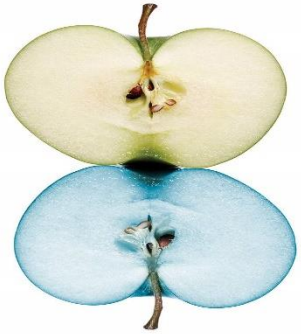
INFO CARD 17	INFO CARD 18
GM modified rice is a source of vitamin A or iron Rice is one of the most basic foods and it is considered very important to improve the quality of nutrition by increasing the content of rice in iron or vitamin A. Lack of vitamin A is one of the most important risks to public health worldwide. According to the World Health Organization, a dietary vitamin A deficiency leads to blindness in about 250,000 to 500,000 children a year. Therefore, increased β-carotene concentration, which is a precursor to vitamin A synthesis, would catalyze the malnutrition problem. Transgenic rice with increased iron content can be created by transporting in the rice the gene for ferritin, which is used to store iron. Indeed, experiments in mice have shown that oral administration of ferritin may be effective in treating anemia. **The genetically modified rice is known as "Golden Rice" as it is considered a gold in nutritional value.** *Golden Rice is an Effective Source of Vitamin A, May 2009, American Journal of Clinical Nutrition 89(6):1776-83 DOI: 10.3945/ajcn.2008.27119* *"Golden Rice", a GMO-product for public good, and the consequences of GE-Potrykus J. Plant Biochem. Biotechnol. (October 2012) 21 (Suppl 1):S68–S75DO*  photo: www.vita.gr	**Genetically modified dairy products increase the risk of colon cancer.** It has been found that 22% of cows in the United States are injected with recombinant (**genetically modified**) bovine growth hormone (rbGH). This hormone increased milk production in these cows by 15%. This milk has been found to contain elevated levels of IGF-1 (insulin-1 growth factors). Humans also have IGF-1 in their system. **But scientists have expressed concern that elevated levels of IGF-1 in humans have been linked to colon cance**  *post Natura News Aurora Geib ,2012, https://www.naturalnews.com/035734_GMOs_foods_dangers.html* *Gendel, "The use of amino acid sequence alignments to assess potential allergen city of proteins used in genetically modified foods," Advances in Food and Nutrition Research 42 (1998), 4562;* *G. A. Kleter and A. A. C. M. Peijnenburg. "Screening of transgenic proteins expressed in transgenic food crops for the presence of short amino acid sequences indentical to potential, **IgE-binding linear epitopes of allergens"** BMC Structural Biology 2 (2002): 819.*

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INFO CARD 19 Facts and data	INFO CARD 20 Facts and data
GM crops & autism Pesticides associated with an increased risk of autism include the herbicide glyphosate, the most common pesticide used worldwide in most genetically modified (GT) crops.  *Early Exposure to Pesticides Linked to Increased Risk of Autism* https://www.gmoscience.org/early-exposure-to-pesticides-linked-to-increased-risk-of-autism/ *Ehrenstein OS von, Ling C, Cui X, et al. Prenatal and infant exposure to ambient pesticides and autism spectrum disorder in children: population based case-control study. BMJ. 2019;364:l962. doi:10.1136/bmj.l962* *Photo: https://geneticliteracyproject.org/2015/01/06/will-my-child-be-born-autistic-if-i-eat-gmos-a-scientists-view/*	**Animal experiments with GT consumption have a very negative effect on their health.** GM potatoes (expressing the GNA lectin) have differentiated stomach cells, which is especially important given that gastric erosion can lead to health-threatening bleeding, especially in the elderly and patients in treatment with non-steroidal anti-inflammatory drugs. Consumption of GT foods can also affect the gut, as studies have shown in rats with GT potatoes that express Bt toxin, which cause rupture, the formation of many nuclei, swelling and increased degradation of the surface cells of the ileum. GT-potato GNA-induced potato growths caused differences in the small and large intestines, while GT Roundup ready soy caused moderate intestinal inflammation in salmon.  *Genetically modified foods: Potential human health effects. In: D'Mello JPF (ed) Food safety: Contaminants and toxins. CAB International, Wallingford Oxon, uK, 2003:347–372.* *Fine structural changes in the ileum of mice fed on delta-endotoxin-treated potatoes and tran-sgenic potatoes. Natural Toxins 1998, 6:219–233.* Photo source: https://countercurrents.org/2018/10/from-gm-potatoes-to-glyphosate-regulatory-delinquency-and-toxic-agriculture/

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INFO CARD 21 Facts and data	INFO CARD 22 Facts and data
Biotechnology turns human life into a merchandise	**Distribution of benefits and harms**
In the United States, the Supreme Court has decided that DNA manipulated by a laboratory can be patented. The basis of this decision was that the altered DNA sequences are not found in nature. Up to this moment, complementary DNA or cDNA has been cited as an example of what could be patented. Acquiring DNA to create altered DNA sequences for profit minimizes human life (or plant and animal life) to profit potential. It also opens the door to ethical issues, such as when human life begins, in order to maximize the dollars and cents that can be earned. Through the genetic manipulation of organisms, biotechnology acquires to some extent divine powers and it is doubtful whether this should happen. It is also ethically questionable whether the use of biotechnology-related genetic modifications can be justified or not. Biotechnology can also become dangerous when used by the wrong people. For example, radical groups may abuse genetic manipulation to create a specific type of virus that can be used for attacks. Thus, biotechnology has the potential to cause great damage if it falls into the wrong hands.	A concern for biotechnology applications, especially in developing countries, is the concept of equitable distribution. Concerns are raised about whether biotechnology products will be provided to those who really need them and whether they will create wealth for the society as a whole. The ability of a technology to increase or decrease the gap between rich and poor is a moral issue. Another challenge is that products from modern biotechnology are imported by private companies. Finally, another concern is whether biotechnology increases technical employment and, consequently, might eliminate ordinary jobs and livelihood as a result of the replacement of traditional activities.
Akhondzadeh, S. (2014). Ethical issues in medical biotechnology. *Avicenna Journal of Medical Biotechnology*, *6*(3), 129. Bhardwaj M, Macer DR. Policy and ethical issues in applying medical biotechnology in developing countries. Med Sci Monit. 2003 Feb;9(2):RA49-54. PMID: 12601306. Mfutso-Bengo JM, Muula AS. Potential benefits and harm of biotechnology in developing countries: the ethics and social dimensions. Afr J Med Med Sci. 2007;36 Suppl:63-7. PMID: 17703567. https://onlinelaw.hofstra.edu/blog/5-ethical-concerns-of-biotechnology-engineering/	Photo Source: https://www.freepik.com/free-vector/bioethics-abstract-concept-vector-illustration-medical-ethics-biological-research-dna-genetic-biotechnology-biotech-researcher-criminal-doctor-scientist-lab-experiment-abstract-metaphor_11663896.htm  Michael C. Falk, Bruce M. Chassy, Susan K. Harlander, Thomas J. Hoban, IV, Martina N. McGloughlin, Amin R. Akhlaghi (2002), Food Biotechnology: Benefits and Concerns, *The Journal of Nutrition*, 132(6), pp. 1384-1390, https://doi.org/10.1093/jn/132.6.1384

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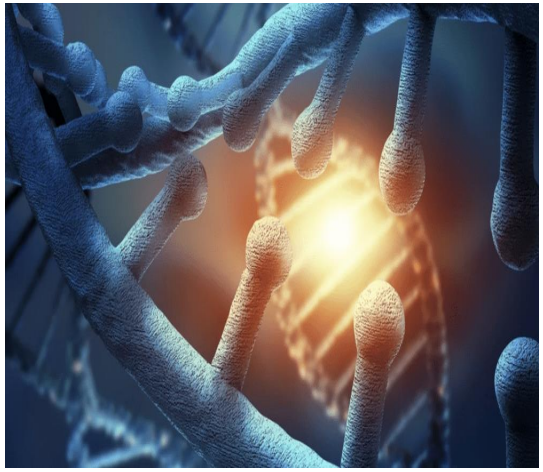
STORY CARD 1

Stem cell therapy saves human lives

Stem cells are used to treat diseases with malignancy, diseases of the hematopoietic and immune systems as well as to restore organ function. For malignant diseases, if one does not have one's own healthy stem cells, then one can receive a tissue donor, who at best is his healthy brother. Autoimmune diseases such as multiple sclerosis, juvenile rheumatoid arthritis, ulcerative colitis, Crohn's disease, and childhood diabetes mellitus are used in the patient's own stem cells, which are stored before the onset of the disease.

In Greece, they have been successfully tested in clinical trials for the treatment of heart failure after a heart attack, chronic obstructive pulmonary disease, cerebral palsy, autism and osteoarthritis. Placental stem cells are used by the child to treat childhood cancer and leukemia. Leukemia manifests itself in acute or chronic form. The acute form manifests itself in the first years of the child's life and for this reason the child's stem cells must be checked for predisposition or pre-leukemia clones. If no pre-cancerous clones are found, this means that the predisposition to leukemia has arisen after the collection of stem cells. Therefore, the child can get his own stem cells. Not all forms of leukemia are manifested in the form of pre-leukemia clones, but they are not automatically associated with pathological findings in stem cells. So, in these cases the child can receive his own stem cells. The chronic form manifests itself at a much older age. For this reason, stem cells are not tested for predisposition and the individual can use his own. The moment of birth is a unique opportunity to collect painlessly and safely stem cells, useful for the child and his family. The stem cells we collect from umbilical cord blood and placenta have zero age and retain their therapeutic and regenerative properties for as long as they exceed the limits of human life, as long as they are preserved as a unique and irreplaceable biological material.The pulp of the new teeth, the wisdom teeth, as well as the teeth that are extracted for orthodontic reasons are sources of taking mesenchymal stem cells. They are a second chance for children who have not stored stem cells during childbirth to cryopreserve stem cells from the new (first) teeth, which begin to be replaced at the age of 6 years. Placental stem cells today, after 25,000 registered donations , without side effects, are considered safe. Because they are the stem cells of the child, there is no risk of transmitting the infectious disease, neither to himself nor to other members of his family.



Therapeutic applications of stem cells revolutionized medicine, similar to that of antibiotics. They offer us an additional therapeutic tool in malignant, hereditary and degenerative diseases. Their reasonable and documented use is expected to help many patients with chronic problems.

Professor of Embryology - Histology, Ms. Kouzi - Koliakou, Access to the post: http://bit.ly/2MTsxqc

International Conference on Stem Cell Developments http://bit.ly/2SPfUQQ

Photo: https://www.advancedsportsandspine.com/10-benefits-of-a-stem-cell-treatment/

Author Panagiota Argyri, Member of I.R.E.S.E., Mathematician, M.Ed. in Teaching and Methodology of Mathematics, M.Sc. in Financial Mathematics

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STORY CARD 2

Treatment of Immune Deficiency (ADA-SCID)

Children born without a strong immune system will be exposed to infections without bone marrow transplantation by compatible donors. A study representing a first case of "treatment" of gene therapy or at least a long-term correction for patients with a fatal genetic disorder was conducted by researchers in Italy. The therapeutic gene called ADA was introduced into the bone marrow cells of such patients in the laboratory, followed by a transplant of genetically modified cells back into the same patients.
The immune system was reconstituted in all six patients treated without obvious side effects, who are now living normally with their families without the need for further treatment.

More detailed chronology of this gene therapy:

The laboratories of Dr. W. French Anderson and Michael Blaese at the National Cancer Institute, Lung and Blood Cancer, and the National Cancer Institute worked together to prove that cells from ADA-deficient patients can be corrected in tissue culture.
1989: The team works with Dr. Steven Rosenberg to test the safety and efficacy of gene therapy in cancer patientsThe team increased tumor-penetrating lymphocytes (TIL cells) from people with fatal malignant cancer melanoma and then processed a virus to place a DNA marker on those cells. These "marked TIL cells" helped researchers learn two things: which TIL cells work best for cancer treatment and that the mechanical virus can be used safely in humans.
1990: Anderson, Blaese and Culver used a virus to deliver the right ADA gene to a four-year-old girl and a nine-year-old girl with ADA deficiency. Each girl received repeated treatments for a period of two years, where they now attend school and live a normal life.
1993: Researchers use gene therapy to treat newborns with ADA deficiency. Normal genes were given to blood cells isolated from the baby's umbilical cord.

Description of ADA deficiency, in Online Mendelian Inheritance in Man, ADA: The First Gene Therapy Trial, from the National Institutes of Health and SCID.net http://www.genetherapynet.com/diseases-treated-by-gene-therapy

Post: US Department of Health and Human Services,National Institutes of Health (https://history.nih.gov/exhibits/genetics/sect4.htm)

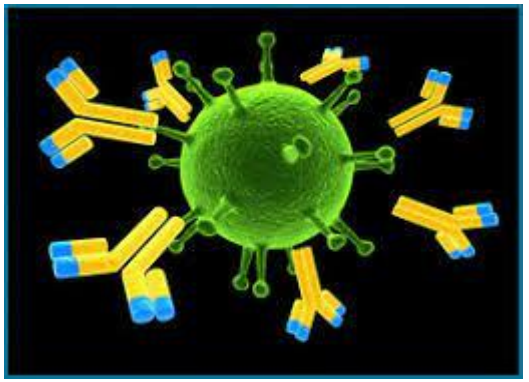

Photo: https://www.jaxallergy.com/allergy-treatments/immune-deficiency/

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STORY CARD 3

Enzyme replacement therapy and Gaucher disease (GD)

A fatty molecule called "glucocerebroside" is usually broken down in the body by the enzyme "glucoerebrosidase". A mutation in the gene for the enzyme glucocorticosteroid causes the enzyme to be less active than normal. Because it does not dissolve, fat accumulates in the spleen, liver and bone marrow of the person with GD. People with GD suffer from anemia, bone damage, swelling of the liver and spleen, and sometimes neurological material damage.

The girl in the two images (before left, then right), received enzyme replacement therapy, a method developed by Dr. Roscoe Brady of the National Institute of Neurological Disorders and Brain Diseases (NINDS). In 1991, another 12 people with Gaucher disease received the purified enzyme (glucoceresosidase), which was isolated from human placental tissue and the treatment was successful. The team of Dr. Roscoe Brady had spent 17 years refining this treatment, in which the reduced enzyme was simply replaced.

US Department of Health & Human Services National Institutes of Health ***https://history.nih.gov/exhibits/genetics/sect3b.htm#4***

STORY CARD 4

Developments in the field of transplants

Scientists have created a human-pig hybrid, which increases the likelihood that they will be able to develop human organs in animals for transplant use. It is the first time that embryos have been produced that combine two large, distant related species. The creation of this so-called chimera - named after the species of beast of Greek mythology - has been hailed as an important first step towards the production of human hearts, livers and kidneys from scratch. Juan Carlos Izpisua Belmonte, who was in charge of the project at the Salk Institute for Biological Studies in La Jolla, California, said: "The ultimate goal is to develop functional and transplantable tissue or organs, but we are still a long way from that. This is an important first step. "

First human-pig 'chimera' created in milestone study. Prospect of growing human organs for transplantation raised by creation of first ever embryos combining two large, distantly related species. https://www.theguardian.com/science/2017/jan/26/first-human-pig-chimera-created-in-milestone-study

The projest has been funded with the support of European Commission within ERASMUS+ program

STORY CARD 5

The connection of GMs with strange diseases

On August 1, 2007, the Centers for Disease Control (CDC) issued the following statement regarding Morgellon's disease: 'Morgellons is an unexplained and debilitating condition that has emerged as a public health problem. People with this condition report a range of symptoms, such as stinging, grains, threads, or black particles that look like spots on or under the skin and / or lesions (e.g. rashes or sores). Some sufferers also report events such as fatigue, mental confusion, short-term memory loss, joint pain and changes in vision. Others suffering from this condition appear to be manifesting insanity and social dysfunction. For example, there are: reduced productivity at work, leading to loss, total disability, family breakdown, divorce, loss of childcare, abandonment at home, and suicidal ideation. The CDC described Morgellon's disease as a disease of unknown origin. Worse, the medical community could not provide information to the public about the cause of the symptoms. After further research**, the data showed that Morgellon's disease was real and may be related to genetically modified foods.**

A research team from Oklahoma State University, led by Dr. Randy Weymore, examined some of the fibers sent to them by patients with the strange Morgellon disease. They found that the fibers of different people looked extremely similar to each other and yet did not seem to match common fibers in the environment. Ahmed Kilani, an infectious disease specialist, claimed to have dissolved two fibers as samples and extracted their DNA and found that they belonged to a fungus. In an even more challenging finding, Vitaly Citovsky, Professor of Biochemistry and Cell Biology at Stony Brook University in New York, discovered that fiber contained the substance Agrobacterium, which was able to genetically transform not only plants but also other human cells. Anonymous samples were given to Professor Citovsky by the Morgellon Research Foundation to investigate the possible presence of Agrobacterium in biopsies from patients with Morgellon's disease. Control reactions included samples provided by healthy donors. Only Morgellons, not healthy individuals, responded positively to these studies. According to Professor Citovsky: 'This observation does not mean that Agrobacterium causes Morgellon or that Morgellon is an infectious disease. However, it encourages future studies to determine (1) the statistical significance of the data, (2) whether Agrobacterium not only exists extracellularly, but also causes genetic transformation of infected tissues, and (3) whether infection of laboratory animals with Agrobacterium is identical to the symptoms of Morgellon.

Background information on the involvement of the Centers for Disease Control and Prevention (CDC) in the investigation of Morgellons disease in the U.S.", published by the CDC, "Skin Disease May Be Linked to GM Food", Whitley Strieber's Unknown Country, Oct. 12, 2007, "Serious Study of Mystery Disease" Whitney Strieber's Unknown Country, Jan. 31, 2008, "GMO Disease Epidemics: (10) Bt-cotton Fiber Disease", Myron Stagman, Ph.D., Portland independent media center, Post: Barbara L. Minton, 2008, https://www.naturalnews.com/023004.html.
Photo: https://pamelamaloney.com/gm-and-morgellons-disease/

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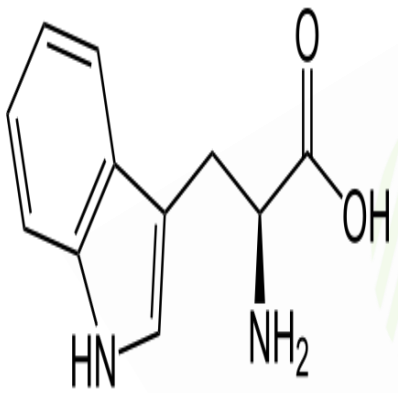
STORY CARD 6



L-tryptophan, produced by genetically modified bacteria, has caused many diseases and deaths.

In 1989-90 there were 37 deaths and about 1,500 cases of eosinophilia-myalgia syndrome (EMS). The only common link between those affected was the consumption of the L-tryptophan dietary supplement. Infected tryptophan particles were produced by a company in Japan that used a genetically modified bacterium designed to overproduce tryptophan. The toxic metabolite was also produced by naturally or non-genetically modified bacterial strains. Most likely the change in the purification step allowed the toxic metabolite to contaminate the tryptophan. L-tryptophan is often sold as a herbal supplement. There are no regulated production patterns for many herbal compounds and some supplements available on the market have been found to be contaminated with toxic metals or other drugs. It is not certain whether L-tryptophan is effective in treating any medical condition. The medicinal use of this product has not been approved by the International Medicines Agency. In fact, a number of side effects are now being recorded.

https://www.newscientist.com/article/mg13217961-300-impurity-blamed-for-food-supplement-deaths/
Drugs.com. Retrieved on 6th May 2019 - Cerner Multum: https://www.drugs.com/mtm/l-tryptophan.html
Learn more about L-tripoph: George M. Kapalka , in Nutritional and Herbal Therapies for Children and Adolescents, 2010
https://www.sciencedirect.com/topics/neuroscience/tryptophan. *Photo source: https://www.wikiwand.com/en/Tryptophan*

STORY CARD 7

Animal experiments reveal infertility or even death of their newborns from GMO consumption

Animal studies have uncovered some notable findings about GMOs: Female rats fed GM soybeans have seen most of their babies die within three weeks compared to the 10% mortality rate of rats fed natural soybeans. Babies who survived the control group with GM foods were also born younger. Male rats fed genetically modified soy showed a change in testicular color from pink to dark blue, as well as altered young sperm and significant changes in their DNA. An Indian buffalo consuming genetically modified cotton seed has experienced various complications, such as infertility, miscarriage, premature delivery and premature uterus. Many of the calves that survived the birth died shortly afterwards.

Mike Adams, the Health Ranger, Editor of Natural News.com «Shock findings in new GMO study: Rats fed lifetime of GM corn grow horrifying tumors, 70% of females die early» https://www.naturalnews.com/037249_GMO_study_cancer_tumors_organ_damage.html ***It is an excerpt from the study entitled:*** *"A Comparison of the Effects of Three GM Corn Varieties on Mammalian Health." http://www.biolsci.org/v05p0706.htm*

STORY CARD 8

Concerns about food safety from a "toxic" gene, hidden in Genetically Modified Crops

A study by the European Food Safety Authority (EFSA) has revealed that the international approval process for genetically modified crops has failed to identify the existence of a gene that may be poisonous. The findings are particularly strong because the work was carried out by independent experts, rather than critics of GM foods. It was led by Nancy Podevin, who had been hired by EFSA, and Patrick du Jardin, of the Plant Biology Unit at the University of Liege in Belgium. They found that 54 of the 86 GT foods approved for commercial cultivation and consumption in the United States, including corn and soy, contained the gene, known as Gene VI. EAAT researchers said that the presence of parts of Gene VI "could lead to unintentional phenotypic changes". These changes include the creation of proteins that are toxic to humans.

https://filonoi.gr/2013/02/18/f-toxiko-gonidio-stis-genetika-tropopoihmenes-kalliergeies/

Photo: https://www.jagranjosh.com/general-knowledge/what-are-the-advantages-and-disadvantages-of-genetically-modified-or-gm-crops-1521034287-1

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QUESTION CARD 1	QUESTION CARD 2	QUESTION CARD 3	QUESTION CARD 4
Are there scientifically substantiated examples of the developments and progress that have been made in the health sector regarding the prognosis and prediction of inherited diseases?	Cancer is a disease that has been on the rise for the last decade. Are there scientific indications and facts to show how much biotechnology applications have contributed to the cure for this deadly disease?	Are there diseases and which, for which in the past there were no medicinal products for its treatment, while today with the help of biotechnology can be cured?	How much, how and in what way has PCR (polymerase chain reaction) contributed to health?
QUESTION CARD 5	**QUESTION CARD 6**	**QUESTION CARD 7**	**QUESTION CARD 8**
What important vaccine discoveries have been made in recent decades with the help of biotechnology applications?	Is there scientific evidence that GMs cause specific diseases?	Why the human genom program is it considered important in medicine?	Is there any scientific evidence that GMs are a source of vitamins and nutrients and therefore beneficial to human health?

QUESTION CARD 9	QUESTION CARD 10	QUESTION CARD 11	QUESTION CARD 12
What scientific evidence is there for a link between breast cancer and the consumption of genetically modified foods?	What are the negative results confirmed by scientific research from animal experiments that consumed GT foods and undermine the treatment of human diseases?	What scientific evidence is there for the link between colon cancer and the consumption of genetically modified dairy products?	Are there any substantiated examples that prove that GTs are responsible for a number of allergic diseases?

QUESTION CARD 13	QUESTION CARD 14	QUESTION CARD 15	QUESTION CARD 16
What scientific evidence exists for the contribution of biotechnology to immunodeficiency therapy (ADA-SCID)?	Has biotechnology contributed to the field of transplants?	Is there scientific evidence for the effects of GTs on health?	In the field of antibiotics, what concerns are there in scientific evidence?

Prepare the arguments for the discussion. A group of students prepares arguments that support one view, or another has contradictory arguments. Use the suggested shape.

Argument 1	Foreseen rebuttals of the other group	Answers to rebuttals

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Argument 2	Foreseen rebuttals of the other group	Answers to rebuttals

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Subject
Biotechnology & Environment
2nd Debate Topic: Biotechnological crops are the enemy of the environment

Introductory questions

1) What reservations and what risks are recorded for biotechnological crops?

2) Are there any environmental benefits from biotechnology applications?

3) How do you comment on the finding of the Indian leader, Mahatma Gandhi that: "The earth produces enough to satisfy the needs of every man, but not his greed" (published) *https://m.naftemporiki.gr/story/343086 ; https://www.kathimerini.gr/709939/opinion/epikairothta/arxeio-monimes-sthles/ayto-poy-dhmioyrgei-kai-gkremizei ;*

Students' indicative answers

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Activity 1.

Based on your preparation for resolving the dispute over biotechnology applications, prepare a series of arguments, classifying them as clearly in favor of the resolution, against the resolution and arguments that can be used by both sides. That is, they are controversial. The questions asked to you by the teacher in the "Introduction" support the creation of your arguments.

For	Grey Area	Against

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INFO CARD 1	INFO CARD 2
Ethanol production as a biofuel product When we think of sugar cane, we associate it with table sugar, the most popular sweetener, known as sucrose. With traditional technologies, cane can yield a variety of products. But with the wonders of modern biotechnology, sugarcane cultivation can be used as an alternative way of producing energy. In particular, sucrose, through fermentation, is widely used to produce ethanol biofuel, which is used as a substitute for gasoline in moving vehicles, known as bioethanol. This means that ethanol provides an alternative to fossil fuels to reduce oil dependence and reduce emissions. **In general, "energy crops"** are a type of biomass used for energy production. This category includes cotton, corn, olive oil, sunflower seeds. wild artichokes, soybeans, etc., which are mainly used for biodiesel production. For the production of bioethanol can be used agricultural products that contain sugars (sugar beet, sugar cane, etc.), starch (cereals, corn, potatoes, etc.), or cellular material (timber, paper waste, etc.). *Thesis: 'Production of bioethanol from biomass' by Poiklis Aik. & Mavrou M., 2012, Technological Educational Institution of Kavala.* http://digilib.teiemt.gr/jspui/bitstream/123456789/1805/1/012012159.pdf  *Photo source: https://www.britannica.com/technology/cellulosic-ethanol*	**G.M. Insect-resistant plants cause a reduction in insecticides and pesticides** **Transgenic technology aims to create plants that produce their own "bio-insecticides"**. For this purpose, a gene has been isolated from the soil bacterium Bacillus thuringiensis, which encodes a protein with natural insecticidal action. The bacterium Bacillus thuringiensis is used as a biological insecticide. This bacterium is grown in bioreactors and then sprayed on crops. Thus, the plants are protected from the action of harmful insects. This process is considered environmentally friendly, as it precludes the use of hazardous chemical insecticides and does not adversely affect the environment. **Typical examples are genetically modified corn and cotton to produce proteins from the bacteria Bacillus thurigiensis (Bt), which kill some pests of these crops (the caterpillar and the beetle).**  *Perez, J .; Bond, C .; Buhl, K .; Stone, ü. 2015. Bacillus thuringiensis (Bt) General Newsletter, National Center for Pesticide Information, University of Oregon Expansion Services. http://npic.orst.edu/factsheets/btgen.html; Ronald P. (2011). Genetically Engineered Crops-What, How and Why. http://blogs.scientificamerican.com/guest-blog/2011/08/11/geneticallv-engineered-crops/; Mendelsohn et.al (2003). Are Bt crops safe? Nature Biotechnology, 21, pp.1003-1009, ; Huang, J. et. al (2005) Insect-resistant GM rice in farmers' fields: assessing productivity and health effects in China. Science, 308, pp.688-690 ; DeMaagd et. al (1999) Bacillus thuringiensis toxin-mediated insect resistance in plants. Trends in Plant Science, 4:9-13.* *Photo source: http://sitn.hms.harvard.edu/flash/2015/gmos-and-pesticides/*

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INFO CARD 3	INFO CARD 4
Horizontal gene transfer threatens ecological balance In maize, pollination occurs mainly through the wind and in a small percentage of bees and insects. But in this way, the biodiversity of an area is at risk, as pollen can travel many kilometers, which means that new features can be incorporated into different species. This means that incorporating the genetically modified gene (through pollen) into conventional or even organic crops can have a devastating effect on the ecological balance. The mutated cotton genes may well, through microorganisms, be found in the lettuces of the adjacent field and survive in the environment for more than two years. The producer who either cultivates conventionally or much more with the methods of Organic Agriculture has huge problems. Without seeking it, even if it is opposed to the mutants, it can thus produce contaminated products. Through unpredictable winds and the uncontrolled transport of pollen by pollen collectors, genetic pollution is very likely and when it is detected then it is irreversible. **Scientists use the term "genetic erosion" to describe the phenomenon.** *Environmental Impacts International Systems for Biotechnology, Horizontal Gene Transfer, February 2000.* *Gebhard, F.& Smalla, K. Monitoring field releases of genetically modified sugar beets for persistence of transgenic plant DNA and horizontal gene transfer, Enviromental Impacts, FEMS Microbiology Ecology, vol.28, Is. 3, 261-272, March 1 '99.*  *https://images.app.goo.gl/tFCdqLnECJUtaudt7*	Biotechnology activities threaten soil fertility The soils, where biotechnological crops are applied, can be used for about 2 or 3 years. However, it will take much longer to restore the fertility of these soils. This means that they will cause great difficulties for crop development in the future. Bt plants directly affect the soil (its content of available nutrients and nutrients) and have the ability to negatively affect biodiversity and even the functioning of the ecosystem. **The negative effects on the soil ecosystem are vital for food production.** *Crystal Ayres post '6 Compelling Pros and Cons of Biotechnology' with access to the website: https://greengarageblog.org/6-compelling-pros-and-cons-of-biotechnology*  https://images.app.goo.gl/XaBAs71yjswy4MB38

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INFO CARD 5	INFO CARD 6
Bt crops negatively affect the ecological processes of nature. The unforeseen consequences of the action of Bt toxin on organisms that are not harmful to crops and, perhaps, are beneficial to them, are one of the most serious ecological hazards. Research shows that Bt toxin can affect beneficial insect predators, which feed on insects found in Bt crops. In the spring of 1999, John Losey, a researcher at Cornell University in the United States, published in the journal Nature the results of his research on the effect of pollen on genetically modified corn, in which the Bt toxin gene was implanted in the Danaus plexip butterfly (monarch butterfly). Losey discovered in laboratory experiments that butterflies fed on wild grass, containing GM corn pollen, ate less than the others, while more than half of the caterpillars died. Finally, the Bt toxin found in plant foliage during harvest falls and sticks to the ground for up to 3 months, adversely affecting the invertebrate populations of the soil, which play key ecological roles. *Hilbeck, A., M. Baumgartner, P.M. Fried, and F. Bigler (1998). Effects of transgenic Bacillus thuringiensis corn fed prey on mortality and development time of immature Chrysoperla carnea Neuroptera: Chrysopidae. Environmental Entomology 27, 460-487* *Losey, J.J.E., L.S. Rayor and M.E. Carter (1999) Transgenic pollen harms monarch larvae. Nature 399, 214.* *Donnegan, K.K., C.J. Palm, V.J. Fieland, L.A. Porteous, L.M. Ganis, D.L. Scheller and R.J. Seidler (1995) Changes in levels, species, and DNA fingerprints of soil micro organisms associated with cotton expressing the Bacillus thuringiensis var. Kurstaki endotoxin. Applied Soil Ecology 2, 111-124, Palm, C.J., D.L. Schaller, K.K. Donegan and R.J. Seidler (1996) Persistence in Soil of Transgenic Plant Produced Bacillus thuringiensis var. Kustaki (-endotoxin. Canadian Journal of Microbiology (in press). More in www.foodfirst.org (Food First Institute for Food and Development Policy) & http://www.wwf.gr/images/pdfs/pe/agriculture_material_metallagmena_10logoiviotehnologia.pdf*	GM plants are resistant to abiotic pressures and climate change **Abiotic pressures** are a major challenge for sustainable food production, as they can reduce potential crop yields by 70%. Drought is considered one of the most harmful abiotic pressures. **Genetic engineering has succeeded in developing genetically modified plant organisms resistant to drought.** These transgenic plants carry genes that resist to abiotic pressures ("abiotic stress"). Using Agrobacterium methods, rice, wheat, corn, sugar cane, tobacco, tomatoes, potatoes, GM cotton, maize are typical examples of GM plants that are drought resistant. In general, crops can be modified faster than conventional crops through biotechnology, thus accelerating the implementation of strategies to deal with rapid and severe climate change. ***Biotechnological crops that are resistant to various abiotic pressures are, also, the best response to climate change, to ensure the production of plant products.***  *More information on "resistant crops":* *http://www.isaaa.org/resources/publications/pocketk/43/default.asp* *Biotechnology and Drought Tolerance Satbir S. Gosal , Shabir H. Wani & Manjit S. Kang Pages 19-54 | Published online: 28 Jan 2009* *https://doi.org/10.1080/15427520802418251* *Photo: https://www.slideshare.net/ShobhaSurbhaiyya/abiotic-stress-responses-in-plants-with-special-reference-to-drought*

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STORY CARD 1

Threats to biodiversity

- Research by the European Environment Agency (March 2003) highlights the risk of many endangered species.
- In Thailand it was observed that 30% of the bee colonies that flew over GM cotton plantations were decimated.
- Thuringia bacillus toxins (a type of biological insecticide) from GM plants can also kill non-harmful species and transport them to higher levels of the food chain by decimating beetles, butterflies, ladybugs that have never been observed , with the toxins of this bacillus in its natural form.

The Environmental Cost (Mutual File, 2001) with reports α) Hilbeck, Baumgartner, Fried & Bigler(1998).Effects of transgenic B.t. corn-fed prey on mortality and development time of immature Chrysoperta carnea .Enviromental Entomology, vol. 27, No. 2, pp. 480-487 β) Losey J.E. (1999) Transgenic pollen harms monarch larvae. Nature, vol. 399, 20 May 1999: 314. Publication of WWF ANTILOGOS IN THE DIAGONIDICAL KALLIERGIES AND THE GENETIC CHANGED PRODUCTS (TRANSFERRED) by Tassos Spyridis, recognized physiognomist, consultant Bitish association for Nutritional Therapy.http://www.wwf.gr/images/pdfs/pe/agriculture_material_metallagmena_antilogos.pdf. Photo: https://greentumble.com/major-threats-to-biodiversity/

STORY CARD 2

Cultivation of Bt plants can support an important goal of sustainable agriculture by reducing insecticides

In Arizona, where a comprehensive Bt cotton pest management program is still being implemented, growers have reduced the use of insecticides by 70% and saved $ 200 million from 1996-2008. The results of six GM crops in the United States showed an increase in the production of 1.8 billion kilograms, increasing the income of growers by 1.5 billion dollars, while at the same time reducing the use of insecticides by 21 billion kilograms. The benefits of Bt crops have also been documented in less developed countries. For example, Chinese and Indian farmers cultivating GM cotton or rice have been able to dramatically reduce insecticide use. A typical example is Monsanto's Arabidos hybrid, called SmartStax, which carries eight different insect and herbicide resistance genes.

Marvier, M., C. McCreedy, J. Regetz and P. Kareiva (2007). A meta-analysis of effects of Bt cotton and maize on non-target invertebrates. Science, 316, pp. 1475-1477.
Naranjo, S. E., and P. C. Ellsworth, (2009). Fifty years of the integrated control concept: moving the model and implementation forward in Arizona. Pest Manag. Sci. 65, pp.1267-1286.
Huttner S.L., Henry I., Miller and Peggy G., (1995). Agricultural Biotechnology: Status and Prospects. Technological Forecasting and Social Change 50, pp.25-39.
Que,Q.,Dell M., Cheryl M. de Fontes, Chengkun He, Nuccio M, Tong Zhu, Yuexuan Wu,Jeng S. Chen and Liang Shi (2010). Trait stacking in transgenic crops. Challenges and opportunities. Syngenta Biotechnology, Inc.pp. 220-229. STUDY OF VASILIKI CHRISTIDI "Bt ARAVOSITOS, KALLIERGIA, ENVIRONMENTAL SCIENCES"» TECHNOLOGICAL EDUCATIONAL FOUNDATION OF KALAMATA

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STORY CARD 3

Biotechnology and the environment: Can biotechnology save the planet?

According to National Geographic, the waste footprint that humanity leaves on our planet is quite extensive. In 2006, the United States produced 251 million tons of garbage. This equates to almost 5 kg of rubbish per person per day. 65% of the rubbish comes from homes and 55% of the rubbish will end up in a landfill. **Biotechnology allows us to create waste products that have better biodegradable properties**, as it allows us to manage landfills more efficiently. In this way we can begin to minimize the waste imprint for future generations. In 2007, a report by the U.S. Environmental Protection Agency, entitled "Pollution Prevention Industry", noted that industrial biotechnology is more efficient, "cleaner" and makes better use of sustainable renewable resources. A 2017 report by the Biotechnology Industrial Innovation Organization noted that: “Since 2007, companies have commercialized products that demonstrate the unique ability of industrial biotechnology to reduce pollution, achieving measurable improvements in energy efficiency and viability of biomass. carbon »

Examples:

- Provectus, Chicago: Offers a range of products used to clean up environmental hazards.
- Carbios French Company: Has developed a way to degrade plastics and recycle them more efficiently.
- •Aemetis (headquartered in Cupertino, California): Convert biomass to low-carbon biofuels (below zero), which uses the availability of more than 1.6 million tonnes of annual waste.
- Boragen (Research Triangle Park in Durham, North Carolina) was one of BioSpace's top universities for 2018. It focuses on developing antibiotic and antifungal antioxidants for agriculture.
- Carbon Engineering (based in Squamish, British Columbia) was founded in 2009 and focuses on marketing technology that captures carbon dioxide directly from the atmosphere and composes it into clean and affordable transport fuels.

BioSpace post (leading the Life Sciences industry as a digital center for news and information sources)https://www.biospace.com/article/biotechnology-and-the-environment-can-biotech-save-the-planet-/

https://images.app.goo.gl/VY9wEYRMuTGp2iBB6 https://images.app.goo.gl/3T9cXjjmSUdq1PCZA

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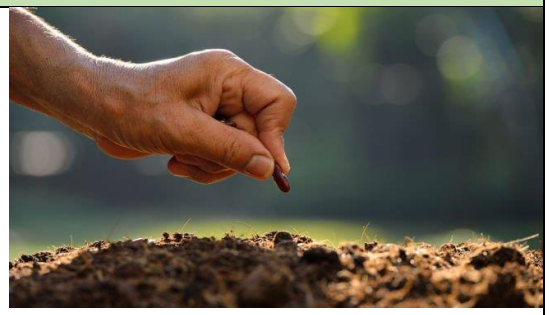
STORY CARD 4

The "exterminator" method is a threat to global food shortages



The multinational Monsanto with a new method (with the creepy title "Exterminator"), has genetically intervened in certain plant species so that they kill their own seeds, that is, it has introduced a "suicide" gene that causes male and female infertility. In this way it has bypassed one of the oldest and most widespread habits of farmers around the world, namely the storage of seeds from each crop. Since the early 1990s, experimental crops have been cultivated using the method of extermination in Europe, Canada and the United States, and some species have already been marketed in North America. The F1 generation hybrid can disperse with its pollen, both the herbicide gene and the suicidal gene for male infertility, which can have devastating effects on agricultural and natural biodiversity. While, in nature, diversity is intensified, genetic modification does just the opposite. Therefore, due to the limitation of diversity, there is a visible risk that the world crops will be infected by a disease and then lead to a global food shortage.

Pentheroudaki C, MSc Biologist. 'Creating GM Plants - Environmental Risks'
http://lyk-aei.reth.sch.gr/yliko/ekdoseis/apopseis1/Apopseis1_dimiourgia_genetika_tropopihmenvn_fytvn.pdf
Photo: https://gmo.geneticliteracyproject.org/FAQ/whats-controversy-gmos-terminator-seeds/

STORY CARD 5

The deadly trap of GM seeds in India

A typical example of farmer fraud, from the multinational companies that produce GTs, which had a serious impact on the economy, is the incident in India, which began with the well-known "green revolution". India's recent economic growth has been attributed to the service industry, but 60% of the workforce remains in agriculture. The Indian government was forced to reform its agricultural policy in the late 1960s, when food import disparities intensified after two years of drought in 1965 and 1966. The World Bank, the Rockefeller Foundation, and the United States Agency for International Development (USAID) have rushed to help them develop high-yield rice and "miraculous" wheat seeds. New price incentives and a more efficient food distribution system have led to the so-called "green revolution". India's product production rose from 72 million tons in 1965-66 to 152 million tons in 1983-84, removing the country's dependence on seed imports.
In addition to planting new seeds, farmers' use of chemical fertilizers jumped from 1.1 million tonnes to more than 12.5 million tonnes in the first decade of the "green revolution", and irrigated land increased from 74 million acres in 1965-66 to 111 million acres in 1988-89. However, in the late 1980s, the "green revolution" began to collapse, as chemical fertilizers made the soil barren. Soil quality deteriorated, leading to zero production and farmers' inability to pay their debts. Three years of drought, beginning in 2001, have fueled the crisis. Under these circumstances, in 1997, 25,000 farmers committed suicide and from 1990-1997 in the state of AndhraPradesh, 4,500 farmers committed suicide.
(*Post :* ***https://inconue.wordpress.com/2008/11/22/seeds-of-suicide/***)

The projest has been funded with the support of European Commission within ERASMUS+ program

STORY CARD 6

Is ethanol a viable solution in biofuels?

Although there are multiple prospects for biofuels, the ethanol from corn and soy biodiesel currently accounts for 99% of biofuels in the United States. The production is expected to increase in 2012 targeting 7.5 billion gallons a year. The amount of corn grown for ethanol in the United States has tripled from 18 million tons in 2001 to 55 million in 2006. The use all of America's current production of corn and soybeans for biofuels, would cover only 12% of the country's gasoline needs and 6% of its diesel needs. Although one-fifth of the US corn crop was used for the ethanol production in 2006, it met only 3% of US total fuel needs. The large-scale production required to provide sufficient harvest quantities, will encourage industrial methods of monoculture of maize and soybeans with severe environmental side effects. Corn production is leading to more soil erosion than any American crop.

Biofuels: The tragic ecological and social example of America Miguel Altieri. Professor of Agricultural Ecology. University of California, Berkeley. Elizabeth Bravo. Network for a Latin America Free from Mutations http://www.biotechwatch.gr/usagofuelsparadigm; http://www.biotechwatch.gr/agrofuels2
Photo: https://www.o2zero.com/post/biotechnology-for-biofuels

STORY CARD 7

Sea pollution

Sea Empress (1996), Braer (1993), Exxon Valdez (1989), Amoco Cadiz (1989), Torey Canyon (1967) are some of the ships that released tons of oil at sea due to an accident. Explosions during submarine oil extraction (Yucatan - Mexico 1979) but, also, other human activities, such as the deliberate release of a huge amount of oil (approximately 1,000,000 m3) after the Gulf War, often pollute the sea with oil.

The layer of oil that accumulates on the surface of the water prevents sunlight and carbon dioxide from penetrating, thus hindering the photosynthesis. In addition, the oil is toxic to fish eggs and the fish themselves suffocate because their gills are blocked by it. Birds that live near these aquatic ecosystems and feed on aquatic organisms die from ingestion of oil. If their plumage is covered by oil, its insulating capacity is destroyed and the bird dies either from the cold or because it cannot fly. Oil spills can be reduced by the action of **decomposers**, which break down the organic compounds in the oil. **With biotechnology methods, effective ways of decontamination are sought.** This will be facilitated by the identification of new bacterial strains with high reproductive capacity, in order to break down the oil quickly. Some species of bacteria can dissolve 70% of an oil slick in five weeks, without which nature would have completed the project in fifty-five years! School C Biology textbook. Teaching unit 6.2, *http://ebooks.edu.gr/modules/ebook/show.php/DSGYM-C103/478/3163,12724/*

Author Panagiota Argyri, Member of I.R.E.S.E., Mathematician, M.Ed. in Teaching and Methodology of Mathematics, M.Sc. in Financial Mathematics

CARD QUESTION 1	CARD QUESTION 2	CARD QUESTION 3
How do biotechnology applications help reduce carbon dioxide? (and consequently protect from the global phenomenon of climate change?)	What features of GM crops contribute to environmental protection?	What characteristics of GM crops contribute to increased production and consequently to the stimulation of the economy?
CARD QUESTION 4	**CARD QUESTION 5**	**CARD QUESTION 6**
What scientific evidence suggests risks to biodiversity from GM crops?	Biotechnological crops are considered a source of reducing malnutrition. On the other hand, there are risks to the phenomenon of global hunger. What scientific evidence supports the above two different positions	What scientific evidence is available for the disruption of ecological balance and processes by GM crops?

Prepare the arguments for the discussion. A group of students prepares arguments that support one view, or another has contradictory arguments. Use the suggested figure.

Argument	Foreseen rebuttals of the other team	Answers to rebuttals

Odyssey
Oxford Debates for Youths in Science Education

Erasmus+

Biotechnology: Health & Environment

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M.Ed. in Teaching and Methodology of Mathematics, M.Sc. in Financial Mathematics

Institute of Geophysics
Polish Academy of Sciences

CENTER FOR THE PROMOTION OF SCIENCE

IRESE

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Biotechnology at the heart of 21st century science

- **The 21st century is characterized by rapid development and discovery of new technological and scientific achievements.**
- **Biotechnology is one of the scientific areas that has experienced rapid growth and progress in the recent years.**
- **The bio-sciences are the ones that play a central role in the development of technology and science and are directly linked to health, the natural environment, agriculture and industry.**

Significant discoveries in the field of biotechnology

1917: Chaim Weizmann uses pure microbiological cultivation in an industrial process to produce starchy acetone that the United Kingdom desperately needed for explosives during World War II.

1928: Alexander Fleming, Scottish biologist and pharmacologist: discovers the Penicillium mold that led to the introduction of penicillin antibiotics.

951: Jack Williamson: American science fiction writer: introduces the term "genetic engineering"

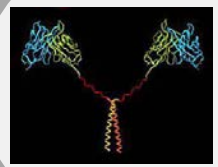
1952: Alfred Hershey & Martha Chase, American geneticists and bacteriologists, confirm the role of DNA in heredity.

1972: Paul Berg American Biochemist: created the first molecules of recombinant DNA

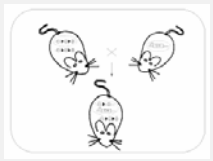
Significant discoveries in the field of biotechnology

1971: Ananda Chakrabarty, an American microbiologist, develops a bacterium capable of breaking down the crude oil she proposed to use to treat oil spills.

1973 – The American biologist, Herbert Boyer, creates the first transgenic organism by inserting antibiotic resistance genes into the plasmid of an E. coli bacterium.



1974: The German biochemist, Rudolf Jaenisch creates a transgenic mouse by inserting foreign DNA into its embryo, making it the world's first transgenic animal.



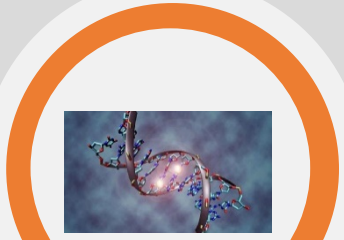
1994: The US Food and Drug Administration approves the first genetically modified food: the tomato

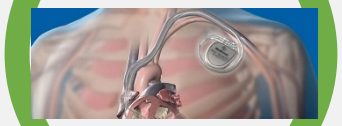
1997: British scientists, led by Ian Wilmut of the Roslin Institute, report cloning the sheep Dolly using DNA from two adult sheep cells.

Significant discoveries in the field of biotechnology

2002: Rice becomes the first crop to express its genome.

Are many experimental methods being developed in the last decade that promise to improve human health or pose many risks?





2001: Creating a plan for the sequence of the human genome. It is an important achievement of Medicine for scientists to decode how this sequence is interpreted by our cells and to understand how the genome works.

2009: The Cedars-Sinai Heart Institute uses modified heart genes to create the first pacemaker in guinea pigs.

Genetically modified products & Ancient biotechnology

Biotechnology in one form or another has been developed since prehistoric times.

The discovery that fruit juices that have been fermented in wine or that milk could be turned into cheese or yogurt, or that beer could be made by fermenting malt and hops solutions, began the study of biotechnology..

When the first bakers found that they could make a soft, spongy bread instead of a hard, thin crust, they were acting as newly established biotechnologists.

The first breeders realized that the different physical characteristics could either be enlarged or lost by mating the appropriate pairs of animals involved in the handling of biotechnology.

Genetically Modified Products: Rules & Legislation

The first genetically modified organisms of plant origin were created simultaneously in Belgium (Gand, Leuven) and in USA, in 1983. We talk about tobacco plants that showed antibiotic resistance.

In 1993, the first modified plant (a type of tomato with slow-ripening characteristics) was commercialized in the United States.

In 1996, the European Union approved the import and use of soybeans in food and feed. This soybean along with modified corn are currently used in various processed foods sold in British stores.

Genetically Modified Products: Rules & Legislation

In 1999, the European Parliament passed a directive on market liberalization and the use of modified seeds, following a study showing that it was not possible to "infect" traditional crops with genetically modified ones.

In January 2003, 21 applications were submitted for the introduction of GMOs in Europe. The EU's expert committee on the food chain has not been able to decide on the use of GMOs.

In Europe, the entry into the GM food market follows the EEC Directive 1829/2003 on GM food and feed. The approach designed by ENTRANSFOOD, which provides guidance on the selection of appropriate methods of controlling the safety of GM foods, requires that their content be fully controlled in important nutrients and anti-nutritional substances.

VIDEO

[The revolution of the human genome]

[Genetic engineering and diseases]

QUESTIONS

- Biotechnology has been practiced since prehistoric times. Do you recognize progress and development in its applications and in which areas of modern societies?
- What are the developments and advances made by biotechnology applications in the health sector?

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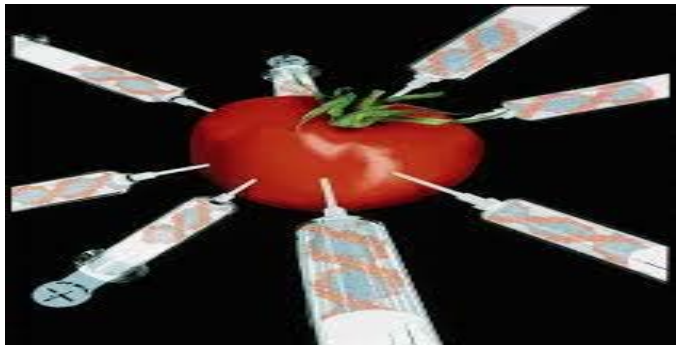
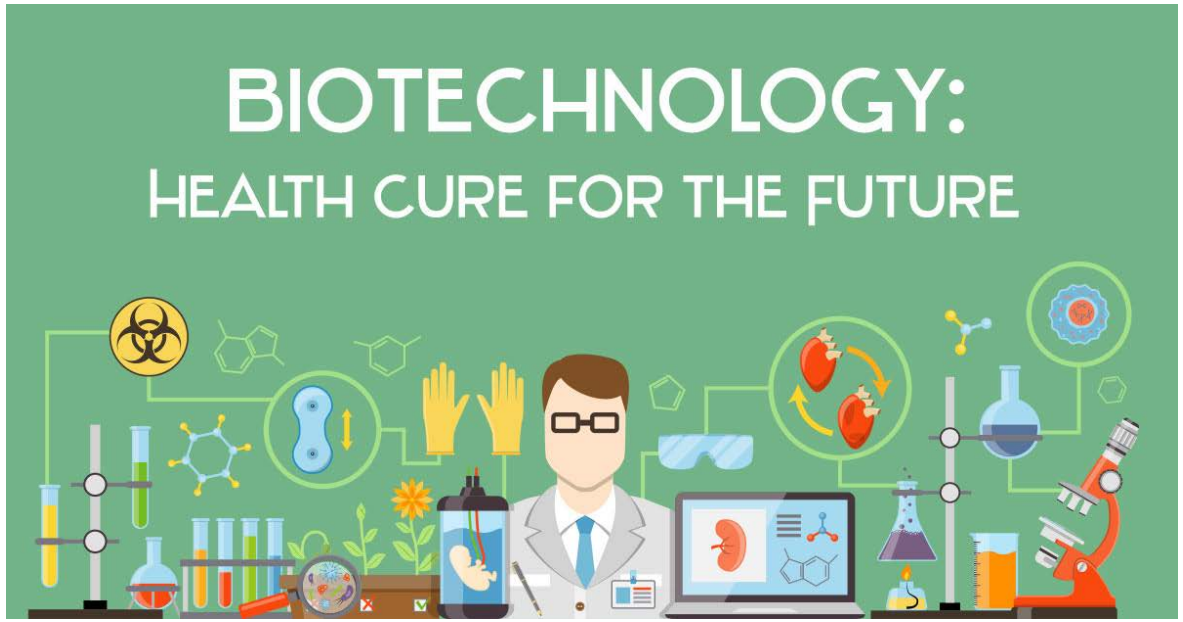
Scientific developments in molecular biology have resulted in recombinant DNA technology or "genetic engineering“.

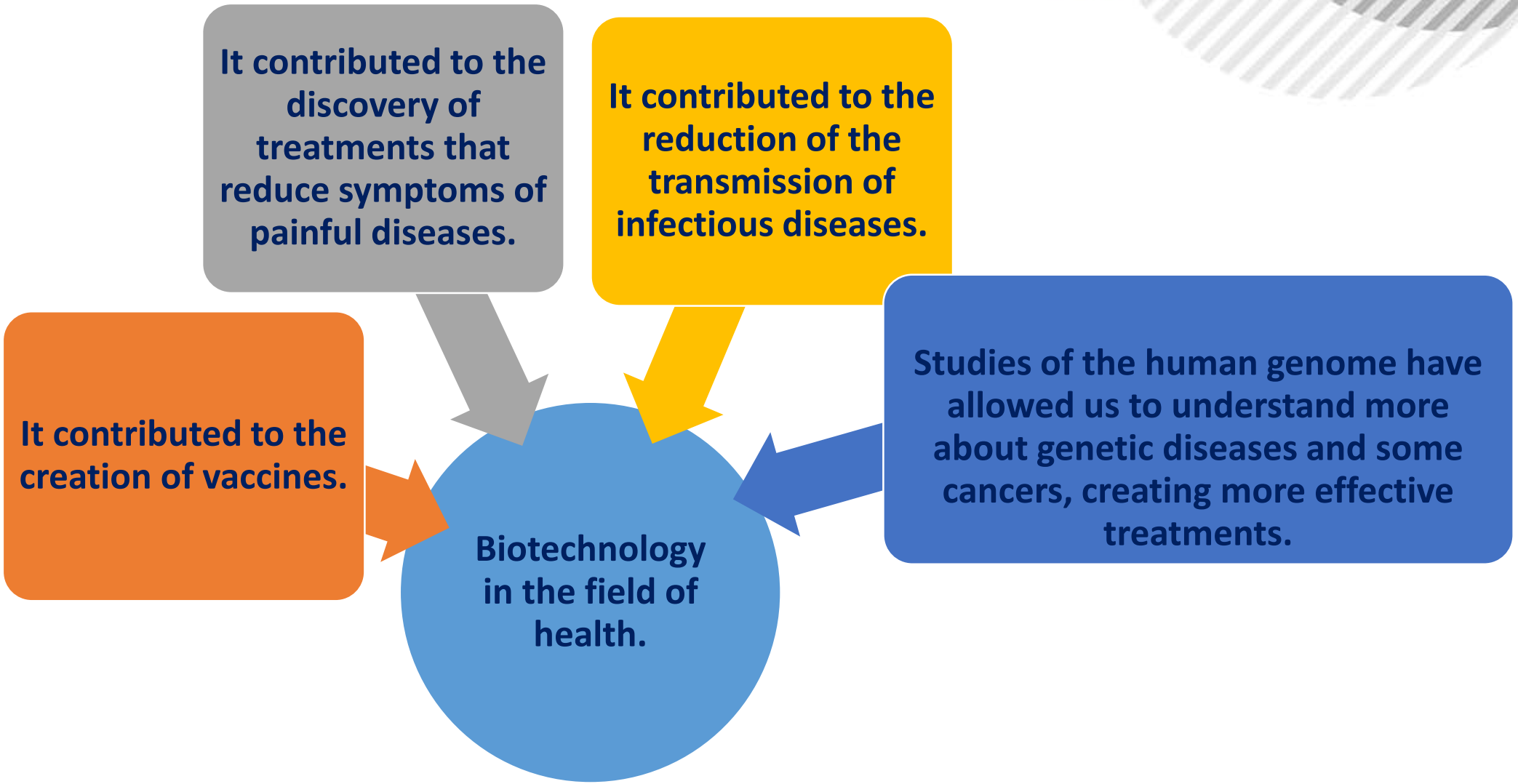
Transfer / transfer of genetic material for cloning living and plant organisms: appearance of GMO-biotechnological agriculture.



- **Are GMOs Good or Bad? Genetic Engineering & Our Food**

- *Do biotechnology applications only have positive health effects?*




It contributed to the discovery of treatments that reduce symptoms of painful diseases.
It contributed to the reduction of the transmission of infectious diseases.
It contributed to the creation of vaccines.
Studies of the human genome have allowed us to understand more about genetic diseases and some cancers, creating more effective treatments.
Biotechnology in the field of health.

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Placing functional genes still does not show clear results.

The health problems of the people are constantly increasing nowadays and the research medical community attributes many responsibilities to the current legislation on genetically modified foods and products.

Genetically modified genes can replace other important genes, instead of mutated genes, causing the development of other forms of disease, compared to the elimination of existing ones.

Genetic engineering as a field of biotechnology is recorded to have irreversible side effects, especially with regard to modified genes.

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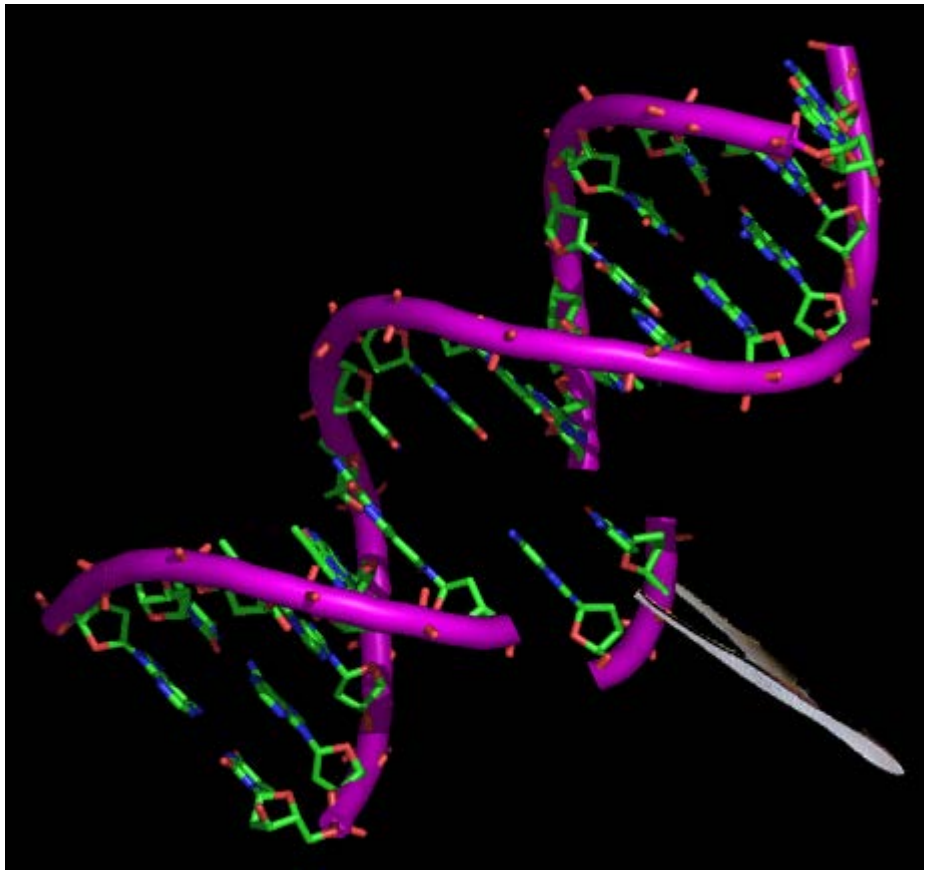
“Genetic Engineering represents our most hopeful thoughts, but also our most inward fears. "

JEREMY RIFKIN, Author - President of the Foundation for Economic Tendencies (USA)



Biotechnology applications are the enemy of human health?

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Biotechnological crops

i) Causing disorders in ecosystems.

ii) Loss and changes in natural variety and genetic differentiation in various life forms.

i) Less use of herbicides and insecticides.

ii) Increased resistance to disease.

iii) Increased food production for the growing human population.

iv) Dealing with the problem of hunger and malnutrition, which currently plagues a very large number of countries worldwide.

Biotechnological crops are the enemy of the environment

The project has been funded with the support of European Commission within ERASMUS+ program

„ Biotechnology: Health & Environment ”

Material for Teachers

With methodological guidelines, a lesson plan and an answer key to worksheets

The educational package: "Biotechnology: Health and Environment" was developed within "Oxford Debates for the education of young people in the field of science" project. It is a key material, which facilitates the achievement of the project's primary goals, including the cultivation of reasoning skills and interest in STEM training. Such a turn is important for students, as in the future it can lead them to a successful scientific career.

When preparing students for the debate, one should not neglect the development of such skills as: communication excellence, argumentation or public speaking. Students should improve their ability to persuade effectively, argue properly, reason accordingly and speak out correctly. Composition of texts, using rhetorical means in oral statements, speaking in accordance with the rules of language culture, text interpretation, public speaking and presentation of texts, discussions and negotiations are of equally of high importance.

In order to achieve the abovementioned goals, the implementation of thematic educational packages should be preceded by classes dedicated to preparation for debating as such. This can be accomplished in consultation with teachers of other subjects and the class teacher. The development of basic communication skills can be included in the class teacher's work plan, and the prepared lesson plans can be used during regular classes. Auxiliary materials can be found in the following documents:

1. **Warm up practice** – Annex No. 2 to the National Framework for the Application of Oxford Debates in School Practice: This document includes the following exercises: active listening, public speaking and debating skills. National frameworks for implementation of Oxford debates in STEM in school practice ;

2. **Lesson plans aimed at general development of debating skills** Annex No. 2 to the National Framework for the Application of Oxford Debates in School Practice. (National frameworks for implementation of Oxford debates in STEM in school practice ;))
3. This material consists of 7 lesson plans prepared by Dr. Foteini Englezou, president of the Hellenic Institute for Rhetorical and Communication Research. Scenarios are a guide to work. It is not necessary to follow all the lessons. The teacher can decide which scenarios (or their selected fragments) are most useful for working with a specific group of students. The document offers the following lesson plans:

    1. Communication skills
    2. Express your scientific argument, not your opinion
    3. Build a valid scientific argument
    4. Searching for evidence
    5. Enhancing students' language skills
    6. Rebuttal and refutation
    7. Fallacies

3. Methodological Guide for Teachers. ODYSSEY: Oxford Debates for Youths in Science Education / https://odyssey.igf.edu.pl/wp-content/uploads/2019/11/%CE%9F4-IN-ENGLISH.pdf

The final stage of preparation for debates based on specific packages is to familiarize students with the principles of debating, described in detail in the abovementioned document.

Biotechnology: Health & Environment

The «Biotechnology: Health & Environment» educational package consists of the following elements::

- Multimedia presentation (Press the following link:
- Video -recording based on the presentation https://youtu.be/3sfcx9H6mtM
- «Biotechnology: Health & Environment» - material for students.
- Worksheets (the same for all packages)).
- «Biotechnology: Health & Environment- material for the teacher (with answer key).

It is recommended to implement the package during a minimum of three lesson units.

The 21st century is characterized by rapid development and discovery of new technological and scientific achievements. Nevertheless, rapid technological and scientific progress has raised concerns and objections in society as to whether they ultimately promote sustainable development or endanger human health and the environment.

Scientific developments at the global level have emerged in the effort of man to tame nature and put it at his service sometimes with positive and sometimes with negative consequences for human societies. The development of Biotechnology is a catalyst in the fields of health, agricultural industry, food industry and significantly affects the improvement of living conditions. Life sciences or life sciences seem to play a central role in the development of technology and science and to be directly and positively related to health, the natural environment, agriculture and industry.

On the other hand, however, there are scientific positions that argue that the rapid development of biotechnology applications carries many risks and that it will emerge as an enemy of society as a whole both in the field of health and the environment.

In this educational guide, the multifaceted presentation of the role of biotechnology is sought, so that students can learn about its methods and applications that are directly related to health and the environment.

For the students of 3rd grade of Gymnasium the educational package could be applied in the context of school activities, innovative creative research projects (projects), groups, but also in any case of enrichment and extension of the teaching of the Biology course, as well as the didactic section of biotechnology is included in the textbook, but is not a syllabus. Similarly, the proposed educational package could be applied to the students of the 1st and 2nd grade of Lyceum based on the pre-existing knowledge from the Biology of the 3rd grade of Gymnasium. In addition, it could be a preparation for the Panhellenic exams of the course of Biology as the teaching unit of biotechnology belongs to the subject.

Lesson 1. Introduction to Biotechnology. What are the benefits and risks of using biotechnology applications for human health and the environment?

With the help of the supervisory material (as appropriate) of the educational guide "Biotechnology: Health and Environment", the students are expected to:

- know the applications of biotechnology in health and the environment,
- focus on the solutions and the advantages they offer in their various fields of application (medicine, pharmacology, industry, cosmetics, agriculture),
- or at the same time be aware of the potential dangers of genetically modified products.

Finally, they will reflect on the future of biotechnology applications that affect our lives.

Lesson 2. "Biotechnology applications are the enemy of human health and the environment" – constructing arguments for and against the resolution

The aim of the second lesson is to formulate as many arguments as possible (both for and against the resolution) that will be used by students during the debate, summarizing the work with the package.

Lesson plan

1. Organizational issues, checking the attendance list, familiarizing with the topic and objectives of the lesson **[5 minutes].**
2. Preparation of arguments: The teacher divides the class into teams of two. Each team receives 12 question cards available in the educational package (materials for the student) and 2 copies of worksheet No. 1 (one for each student individually). Based on the questions, students formulate arguments for the presented thesis, against the thesis and those that are debatable and can be used in the discussion by both parties. Students work together, but each student individually completes his/her worksheet. There are examples of selected arguments for worksheet 1 are in the answer key. **[25 minutes]**
3. Teams: proposition and opposition are formed **[10 minutes].**

Team selection may be executed in 2 forms, each of them having both advantages and disadvantages.

A) Students declare which arguments are closest to their beliefs. The teacher divides the class into teams (each with a similar number of students) in the manner reflecting their convictions.

B) The second method assumes a division similar to the one above, with the difference that ultimately the team consisting of the supporters of a given resolution becomes the "opposition" team, while the opponents of the thesis become “proposition” team. The supporters of such a division assume that it teaches the participants of the debate to a greater extent to use arguments supported by facts and is less based on emotions. Alternatively, division into teams can also be done randomly.

Finally, team selection can also be made by the teacher in a subjective way, ensuring that each team has both leaders and students who require more help, so that both teams have similar “winning potential”. In order to save time for division, the teacher can do it at the beginning of the lesson, for

example by distributing worksheets number 1 to the students, printed on sheets of different colour or marked in some other manner.

1. The teacher distributes worksheets number 2 to the students (one for each student) and explains the homework. An example of a filled-out worksheet is available in the answer key.
2. Students in each team read prepared arguments in accordance with the assignment to a given group. Each student receives 1 argument, which he/she will develop (as homework) according to the guidelines in worksheet No.2.
3. Each team also appoints 3 people who will present the arguments prepared by the entire group. Students decide the order of their speeches. During the debate, other team members who are not directly involved in the debate, fill out worksheet
4. Summary of the lesson, evaluation of students' work **[5 minutes].**

Lesson 3. Debate

During the final lesson, the teams conduct a debate according to the guidelines contained in the " Methodological Guide for Teachers. ODYSSEY: Oxford Debates for Youths in Science Education". / https://odyssey.igf.edu.pl/wp-content/uploads/2019/11/%CE%9F4-IN-ENGLISH.pdf

It takes 45 minutes in total to conduct a full debate. During the debate, the teacher does not comment on the arguments or indicate the fallacies made by the students on an ongoing basis.

An exercise-based debate should be structured as follows:

1. Opening of the debate by the moderator/chairperson [3 minutes].
2. Initial vote by the audience [2 minutes].
3. 1 st Researcher-Debater of the A research-team: Constructive Speech [4 minutes].
4. 1 st Researcher-Debater of the B research-team: Constructive Speech [4 minutes].
5. Cross-fire between the researchers-debaters (1) of both research teams [3 minutes].
6. 2 nd Researcher-Debater of the A research-team: Rebuttal Speech [4 minutes].
7. 2 nd Researcher-Debater of the B research-team: Rebuttal Speech [4 minutes]
8. Cross-fire between the researchers-debaters (2) of both research teams [3 minutes].
9. Preparation time for the Summary and Final Rebuttal by both research teams [2 minutes].
10. 3 rd Researcher-Debater of the A research-team: Summary Rebuttal [2 minutes].
11. 3 rd Researcher-Debater of the B research-team: Summary Rebuttal [2 minutes].
12. Grand Cross-fire between the researchers-debaters (1 & 2) of both research-teams [3 minutes].
13. 3 rd Researcher-Debater of the A research-team: Final Focus Rebuttal [2 minutes].
14. 3 rd Researcher-Debater of the B research-team: Final Focus Rebuttal [2 minutes].
15. Final vote by the audience / Short written feedback [3 minutes].
16. Presentation of the results by the moderator [2 minutes].

If the debate takes place during extra-curricular activities, then it is recommended to devote, for example, 90 minutes for this part. This will allow you to prepare the room for the debate, recall the rules, conduct the debate and discuss its course and finally evaluate the work of students.

In terms of classroom conditions, it would be ideal to allocate two adjoining lesson units to the debate. Taking into account the school circumstances, organizational difficulties and the inability to devote too many lessons to content extending the core curriculum, the debate can be conducted in one lesson, while maintaining high discipline in time. In this case, it is recommended that during the next lesson with the class additional 10 minutes are spent discussing the debate, pointing to strengths and mistakes made by the participants of the debate.

In this format, 6 students (3 from each team) actively participate in the debate. The teacher may also appoint a moderator from among the students and a time keeper. The rest of the students will receive worksheet number 3. Their task will be to listen carefully to the debate and to note the opposing team's strengths and areas for improvement, and to justify their choice. Completed worksheet no. 3 may be the basis for issuing a grade for activity in the lesson for students who did not take part in the debate directly, but participated in its preparation and were active observers of its course.

The projest has been funded with the support of European Commission within ERASMUS+ program

Worksheet no. 1 Questions and indicative answers

The educational package contains a set of questions to help prepare arguments for discussion on the resolution. On their basis, prepare a set of arguments and group them into those that are clearly in favor of the resolution, against the resolution, and those arguments that can be used by both teams. Write them down in the appropriate parts of the table.

FOR	„GREY AREA"	AGAINST
PART A **Is there scientific evidence that GMs cause specific diseases?** Rapid aging, severe damage to major organs, immune problems, gastrointestinal dysfunction and impaired insulin regulation, including allergies, autism (IC. 9.10,11,12,13,14,15,16, SC.4,5,6). **What scientific evidence is there for a link between breast cancer and GM food intake?** Glyphosate is able to stimulate the growth of breast cancer cells (IC.10). **What are the adverse effects that scientific research has confirmed from experiments on animals that have consumed GM foods and are messages of undermining the treatment of human diseases?** • GM tomato Flavr Savr & erosion of the gastric mucosa and necrosis. • The GM potatoes & differentiation of stomach cells.	**PART A** **Has biotechnology contributed to the field of transplants?** Laboratory studies develop human organs in animals for use in transplants. Juan Carlos Izpisua Belmonte, who led the project at the Salk Institute for Biological Studies in La Jolla, California, said: "The ultimate goal is to develop functional and transplantable tissue or organs." (SC. 4, IC.1). **For the field of antibiotics, what concerns do scientific data record?** In recent years, there has been a steady growth of concern in the scientific community and the general public regarding the development of antibiotic resistance in bacteria. Presence of resistance genes is found not only in clinical strains but also in environmental ones, which indicates the extent of the problem (SC.1)	**PART A** **Are there scientifically substantiated examples of developments and advances in the health sector regarding the prognosis and prediction of inherited diseases?** DNA study and testing allows researchers to make accurate diagnoses and predictions and design more efficient medicines (IC.7). **Cancer is a disease that has been on the rise for decades. Is there scientific evidence and facts that show how much the applications of biotechnology have contributed to the treatment of this deadly disease?** Gene therapy for the treatment of cancer by isolating substances in the cancerous tissue and blood of patients. In particular, with immunotherapy and therapeutic treatment. (IC.8, 9) **Are there any diseases for which, in the past, there were no medicines for its treatment, while today, with the help of biotechnology, they can be cured?**

- Consumption of GM food & effects on the intestine.
- GM & neonatal mortality, infertility, genetic system dysfunctions (IC.10,12, 14,**16** , SC6).

What scientific evidence is there for a link between colorectal cancer and the consumption of GM dairy products?
Elevated IGF-1 levels in humans have been linked to colon cancer. IGF-1 is found in the milk of bovine animals treated with genetically modified hormone (IC.14).

Are there any proven examples to prove that GMs are responsible for a number of allergic conditions?
GM enzymes, found as additives in detergents, food, cosmetics, medicines and other daily chemicals, cause allergies, according to a study published in the journal Occupational and Environmental Medicine (IC. 11).

PART B

What scientific evidence points to risks to biodiversity from GM crops?
"Genetic erosion" with horizontal gene transfer, where new traits can be integrated into different species. The incorporation of the GM gene (via pollen) into conventional or even K.pneumoniae is an important pathogenic bacterium, resistant to many antibiotics.

The human genome program is one of the results of biotechnology applications. Why is it considered important in the field of medicine?
Deciphering the human genome is the smart card with which doctors will read our biological code. Thus, they can detect mutations in our genes, which make us vulnerable to certain diseases, and therefore, it is a valuable tool for the diagnosis and treatment of diseases related to them. (IC. 8, 11).

PART B

What characteristics of GM crops contribute to the increase of production and, consequently, to the stimulation of the economy?

Biotechnological crops are resistant to various abiotic pressures. This is the best response to climate change, to ensure the production of plant products, without the risk of unpredictable disasters from droughts or heat waves. In addition, foods with high nutritional value are produced (e.g. enriched with vitamins, proteins or vegetable oils, with reduced content of saturated fats, with improved preservation properties, with content of medicinal substances) (IC. 6, SC. 4, 5).

By modifying the bacterium E. Coli. and the production of artemisinin found the anti-malarial drug, as well as the drug for diabetics, with the discovery of insulin.

How much, how and in what way has PCR (polymerase chain reaction) contributed to health?
Innovative method for providing laboratory test results, where in many cases they were problematic due to various pathological causes. (IC. 6, 10).

What important vaccine discoveries have been made in recent decades with the help of biotechnology applications?
The use of vaccines has led to the disappearance of deadly diseases from our planet, such as plague, typhoid, hepatitis B. In addition, they can be an important shield of primary protection against some forms of cancer, such as cervical cancer. and liver (IC. 4,5).

What is the scientific evidence for the contribution of biotechnology in the treatment of immune deficiency (ADA-SCID);
Gene therapy, where a therapeutic gene called ADA was inserted into the bone marrow cells of such patients, followed by a transplant of the genetically engineered cells. The immune system is reorganized (SC.2).

organic crops can have a devastating effect on the ecological balance. Typical examples of scientific reports: a) Report of the European Environment Directorate, (March 2003) b) Research in the USA. (1999). (IC. 3,4, KI.1) **What scientific evidence is there for disturbing the ecological balance and processes of GM crops?** The unintended consequences of the action of Bt toxin on organisms that are not harmful to crops and, perhaps, are beneficial to them, is one of the most serious ecological risks. (IC.5, KI.1).	**Biotechnological crops are considered a source for reducing malnutrition. On the other hand, however, there are dangers to the phenomenon of global hunger. What scientific evidence supports the above two different positions?** Biotechnological crops that are resistant to various abiotic pressures, ensure rich production of plant products. -"Exterminator" technology is a threat to global food shortages. (IC.6, KI. 4)	**Is there any scientific evidence that GMs are a source of vitamins and nutrients and therefore beneficial to human health?** «Golden Rice» (IC.8) **PART B** **How do biotechnology applications help reduce carbon dioxide? (and consequently in the protection against the global phenomenon of climate change?)** "Energy crops" are a type of biomass used to produce energy. Fermented sucrose is widely used to produce the biofuel of ethanol, which is used as a substitute for gasoline in moving vehicles, known as bioethanol. This means that ethanol provides an alternative to fossil fuels to reduce dependence on oil and reduce pollutant emissions. (IC.1, KI. 3, 6). **What characteristics of GM crops contribute to the protection of the environment?** a) Transgenic technology aims to create plants that produce their own "bio-insecticides". This procedure is considered environmentally friendly as long as it excludes the use of hazardous chemical insecticides and does not lead to adverse effects on the environment. c) Industrial biotechnology and organic production are more efficient, cleaner and make better use of sustainable renewable resources (reference: Report from the Biotechnology Industrial Innovation Organization (BIO), 2017) (IC. 2, KI. 2)

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Worksheet no. 2 -Examples of argument

Based on the materials provided by the teacher, prepare arguments for discussion. One group of students prepares arguments supporting the resolution, the other one - opposing arguments. Use the proposed template.

ARGUMENT nº 1

Argument with reasoning	Foreseen rebuttals of the other group	Answers to rebuttals
Genetic engineering, as a key field of biotechnology, interferes with the natural evolution of living organisms with negative consequences. In simple terms, geneticists can "cut and paste" genes from one organism to another, so that the shape of that organism changes in their attempt to replace genes that cause certain diseases or in their attempt to develop certain natural characteristics. For example, genes can be introduced into a plant to produce toxins against certain harmful insects. It is understood that in this way other important genes can be replaced instead of the mutated genes, causing the development of other forms of disease, as opposed to the elimination of existing ones. And on the other hand, who guarantees and who allows such interventions in human nature and the inherent kinship characteristics that genes carry? Why should geneticists intervene and change heredity at the risk of developing new diseases instead of treatments?	Whatever concerns about new diseases as a result of the application of genetic engineering, research studies, such as immunotherapy and oncolytic nicotherapy, argue that with the advancement of biotechnology in medicine, they can be cured. Indicatively, organs of the human body that have organic damage or pathogenesis (transplants) can be replaced, but most of the diseases can be easily avoided by isolating the exact gene that causes them. (CRISPR-Cas9).	Yes, but the evidence points to animal experiments. So, it is not certain if there are side effects in humans from the treatments that have been applied in the field of medicine. For example, CRISPR-Cas9: in the field of healthcare, where it tries to cut the sequence of disease-causing genes (eg HIV) through gene processing is in the testing phase, with no clear results in humans, as it has been tested for the removal of mutant sequences from mice suffering from Duchenne muscular dystrophy and into pig embryos in the hope of improving the field of transplantation. Finally, there are still many reservations about the human genome program, and the damage that can be done to already healthy genes.

ARGUMENT nº 2.

Argument with reasoning	Foreseen rebuttals of the other group	Answers to rebuttals
Genetically modified foods, as a result of applications of biotechnology, pose risks to human health, such as allergies, new diseases, increased chances of developing some forms of cancer. For example, ingredients from genetically modified products (Bt toxin, glyphosate) and, in particular, genetically modified dairy products increase the risk of breast cancer and colon cancer.	But biotechnology applications are a powerful weapon in protecting human health. In particular, new vaccines prevent diseases and known diseases are treated with new drugs. Let us not forget that thanks to the contribution of biotechnology, the drug against eleonosis has been created. Hepatitis B vaccines have also been developed. This means that biotechnology can make the biggest contribution to whatever diseases you claim are caused by genetically modified animals.	Antibiotics, which are admittedly a major breakthrough in biotechnology in the field of medicine, have proven to be ineffective in many cases, as in recent years there has been concern in the scientific community and the general public about the development of antibiotic resistance in bacteria. The problem arose with the emergence of multidrug-resistant bacteria which are now a new form of pandemic. Specifically, Greece is one of the European countries with the highest levels of antimicrobial resistance, a fact that is most likely associated with high consumption of antibiotics.

ARGUMENT nº 3.

Argument with reasoning	Foreseen rebuttals of the other group	Answers to rebuttals
Biotechnology applications are indeed very dangerous for the environment. Disruption of biodiversity and ecological balance by genetically modified crops can lead to destructive consequences in nature. As can happen, for example, by transferring the genetically modified gene to conventional or even biological cultures or by transferring the Bt toxin to other living organisms that are extremely beneficial to balancing nature's processes.	On the other hand, our team believes that biotechnology applications are beneficial to the environment, as biotechnology protects it by reducing gaseous pollutants, due to reduced use of pesticides or the production of bioethanol as fuel.	Scientific progress has led crops to a new form, to produce improved and more products. Transgenic plants are resistant to climate change and need fewer insecticides and fertilizers. But no one can predict the consequences of such interventions. Greed for the most and the best damages the balances of nature. Interventions for changes in natural diversity and genetic differentiation are often contrary to the laws of ecology. Sometimes, however, interventions in nature, such as the use of solar or wind energy, contribute to lower energy consumption and therefore to the reduction of carbon dioxide that contributes the most to climate change.

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Worksheet no. 3

Name and surname: …… Class……. Team: Proposition/Opposition

During the debate, hear and observe carefully the speeches of the debates from the other team. Then, evaluate which speech convinced you the most and which areas of your opponents' speech should be improved.

1. In terms of argumentation (e.g. the quality of the arguments presented, credibility of the data and scientific evidence) in the rival team I was most convinced by the speaker No. .....

Reason:

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2. In terms of the style of presentation and communication with the audience (e.g. confident, persuasive, authentic and dynamic posture, moderate gestures, assertive voice variety, good eye contact with the audience, use of moderate humor, friendly and professional approach to all participants, effective use of body language) in the rival team I was most convinced by the speaker No. .....

Reason:

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Indicate the element of the rival team's performance that requires improvement. Justify your answer.

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Reason:

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