Allegato 5

Modulo Interdisciplinare CLIL
Titolo del Modulo: "Biotechnologies"
Curato da: Prof.ssa Di Venuta Jessica e Prof.ssa Barbara Belfiore

Obiettivi:

1) Conoscere le tecniche di ingegneria genetica e la loro applicazione nei vari campi di ricerca.
2) Conoscere l'utilità di virus e batteri per le applicazioni biotecnologiche.
3) Migliorare le competenze di "Biologia molecolare e di genetica."
4) Migliorare le competenze della lingua inglese.
5) Espandere il patrimonio lessicale in L1 ed L2.

Obiettivi Trasversali

1) Saper collaborare con i compagni e partecipare con interesse alle lezioni
2) Saper attivare strategie di apprendimento e apprendere da prospettive diverse
3) Saper riflettere su quanto svolto e individuare punti di forza e criticità
4) Saper attivare i processi cognitivi superiori: distinguere, confrontare, descrivere, sintetizzare, operare collegamenti.

Prerequisiti

Disciplinari	Linguistici
- Conoscere la struttura e le funzioni degli acidi nucleici - Conoscere i meccanismi dell'espressione genica - Conoscere i cicli vitali di batteri e virus	- Conoscere le principali strutture linguistiche di livello intermedio. - Capire parole o espressioni scritte e orali inerenti al modulo - Enunciare in forma scritta e orale definizioni e proprietà - Eseguire correttamente istruzioni richieste

Competenze disciplinari

Conoscenze

- Le biotecnologie e le loro applicazioni.
- Ruolo degli enzimi di restrizione.
- Le principali tecniche dell'ingegneria genetica.
- Gli organismi geneticamente modificati.
- Le principali questioni bioetiche connesse alle applicazioni del DNA ricombinante.

Abilità

- Acquisire e utilizzare la corretta terminologia nell'ambito della biologia molecolare e dell'ingegneria genetica.
- Analizzare e comprendere dati e informazioni provenienti da articoli scientifici che trattano temi di attualità inerenti le biotecnologie e le loro applicazioni più recenti.
- Collegare le caratteristiche dei microrganismi utilizzati con le caratteristiche dei prodotti ottenuti.
- Comprendere e interpretare le implicazioni sociali ed economiche delle più recenti applicazioni biotecnologiche

Competenze linguistiche

- The first aim for the students is to be able to understand the linguistic function giving directions, understanding tasks which is used to introduce all the activities they have to carry out.

The expression used are concerned with:

- The imperative (complete, work out, find, explain, prove,…)
- To have to…
- The second purpose is to know and to be able to use the microlanguage used in their activities
- The third objective is to be able to produce the language used to express the rules necessary to work out the activities.

Metodologia

- Lezione dialogata
- Lezioni multimediali di ascolto e visione
- Cooperative Learning

L'attività è stata svolta con metodologia CLIL. Tale metodologia prevede un apprendimento fondamentalmente attivo, interazionale e cooperativo. Le fasi in cui è stato diviso il modulo sono le seguenti :

Fase 1 **INTRODUCTION**

a) attività motivazionale di warming up.
b) attività di verifica dei prerequisiti disciplinari mediante Brainstorming
c) attività di contestualizzazione disciplinare

Fase 2 **READING AND LISTENING**

In questa fase gli studenti hanno lavorato in piccoli gruppi secondo uno svolgimento cooperativo e socializzante

Fase 3 **PRACTICE**

In questa fase sono state proposte attività di consolidamento, rinforzo, approfondimento e verifica in cui gli alunni hanno adoperato le conoscenze e le abilità disciplinari e linguistiche obiettivo del modulo.

How is biotechnology changing our lives?

BIOTECHNOLOGIES

Are a group of different technologies using viruses and living organisms. In particular, bacteria and yeast cells are largely used in ricombinant DNA tecnology.
To create a recombinant DNA molecule, a DNA fragment taken from a donor is inserted into a small DNA molecule (the cloning vector).
The recombinant vector is introduced into a host cell, which is grown to form a clone of a new gene or of the protein desired.
A few techniques also use stem cells, unspecialized cells that have the capability of dividing and differentiating into specialized cells. Embryos are a good source of stem cells.

Language skills

- Skimming and scanning a text on viruses, bacteria, yeast and stem cells, as toots in genetic and molecular biology.

Learning objectives

- Recalling previous knowledge.
- Understanding how viruses and living cells can be used as tools in molecular biology and genetics.

Recombinant DNA Technology

1. Gene of interest (DNA) is isolated

(DNA fragment)

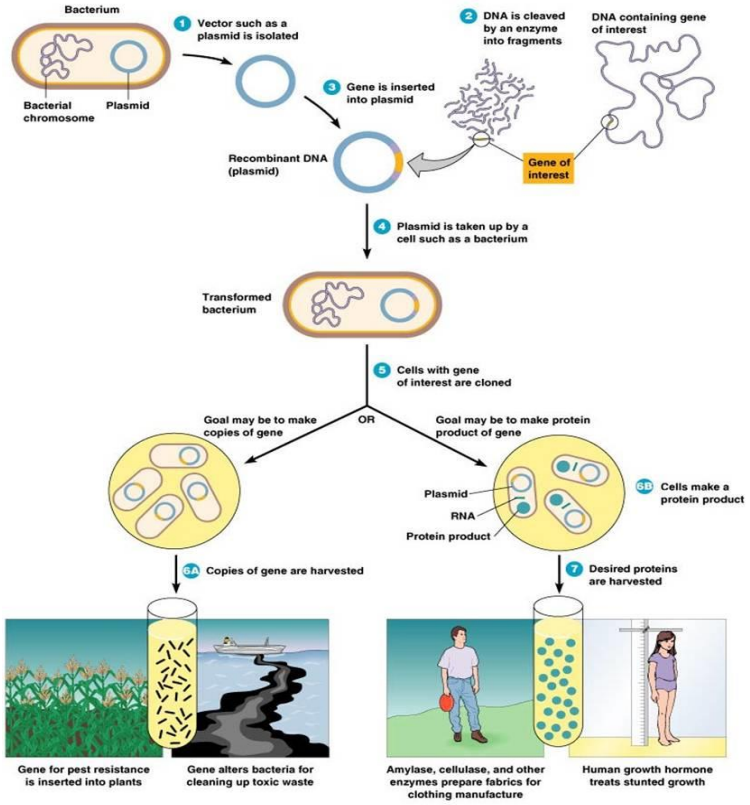
2. A desired gene is inserted into a DNA molecule **(the cloning vector)**

(plasmid, bacteriophage or a viral genome)

3. The vector inserts the DNA into **a new cell,** which is grown to form a **clone**.

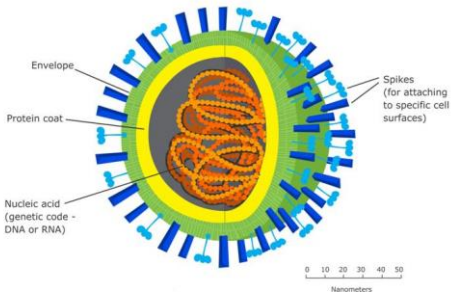
(bacteria, yeast, plant or animal cell)

4. Large quantities of the **protein desired** or of the **gene product** can be harvested from **the clone**.



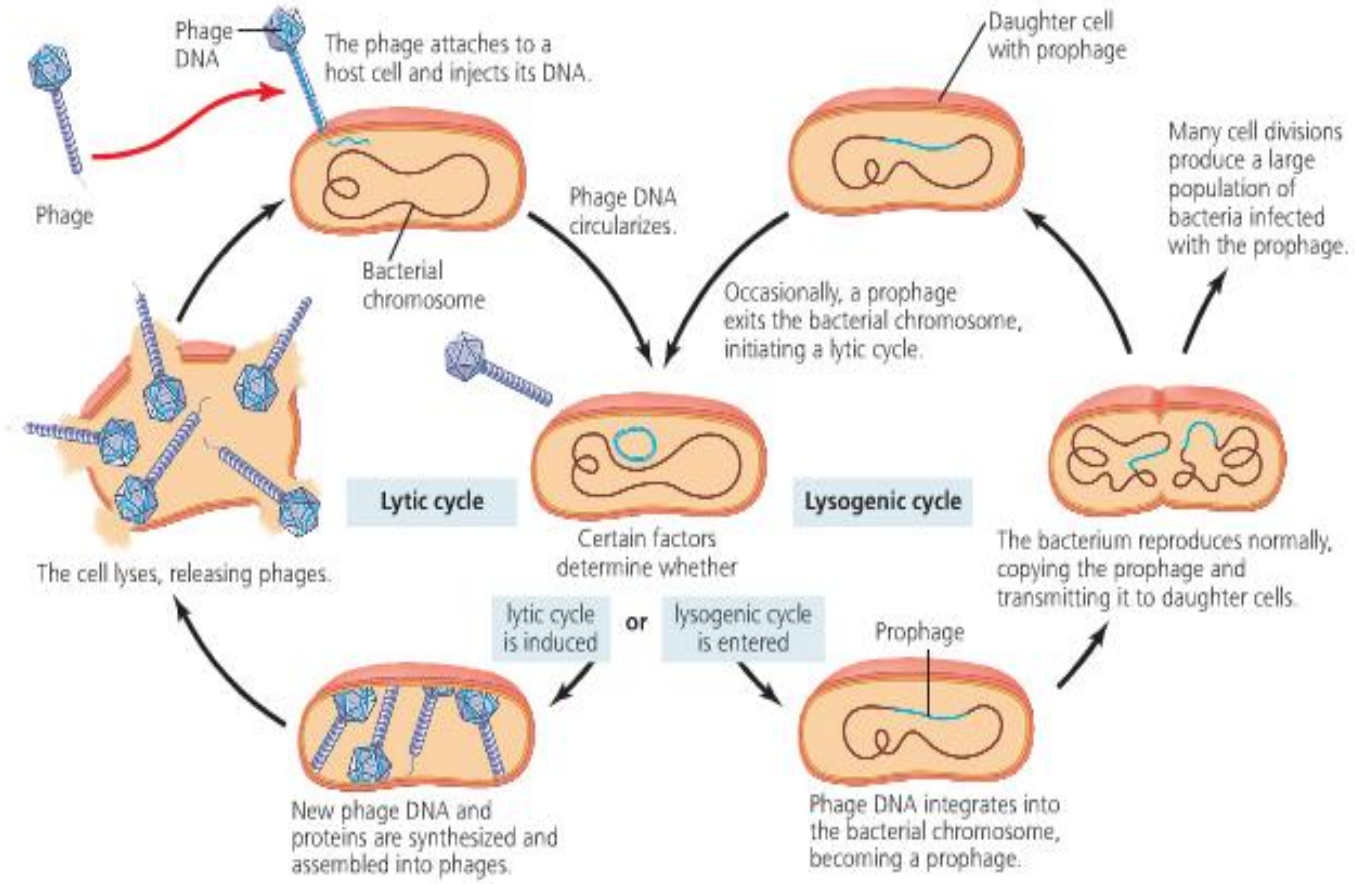
VIRUSES

They are not living organism but microscopic particles.
Consisting of a inner core made up of a nucleid acid (DNA or RNA) surrounded by a protein coat (Capsid).
Certain viruses are termed «enveloped viruses», their capsid is surrounded by a membrane coat.
They replicate only within the living cells of bacteria, animals or plants . They are obligate intracellular parasities .



VIRUS REPLICATION

Viruses recognize specific receptors on the cell membrane and release only their nucleic acid into the host cell cytoplasm, whereas the capside remains outside (bacteriophages). The enveloped viruses enter the host cell entirely**.** Inside the host cell, the nucleic acid directs the synthesis of new viruses, using the cell biochemical apparatus to synthesize various copies of the capsid proteins and replicate the viral nucleic acid, then to produce new virus particles which are released from the infected cell.



VIRUS AND BIOTECHNOLOGY

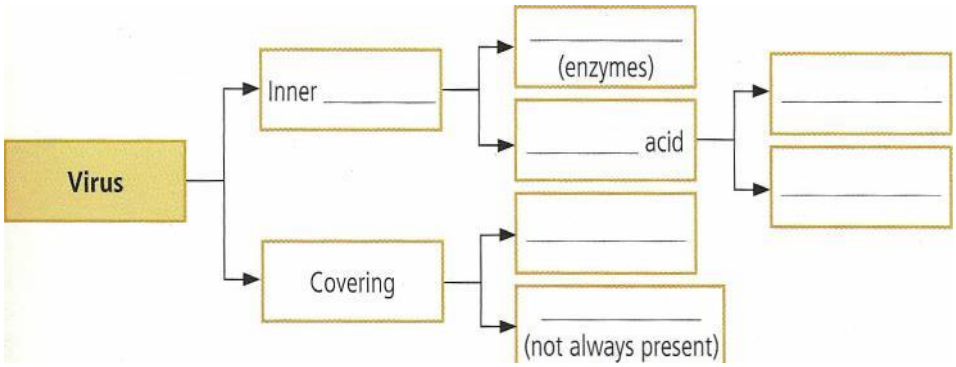
Since viruses introduce their DNA and RNA into cells as part of their replication cycle, they can be used as cloning vectors, to clone large fragments of DNA, or to produce viral vaccines.
The ability of certain viruses to integrate into the cell genome makes these viruses suitable as vehicles, in order to deliver a therapeutic gene directly into the target cell, in gene therapy



Exsercises:

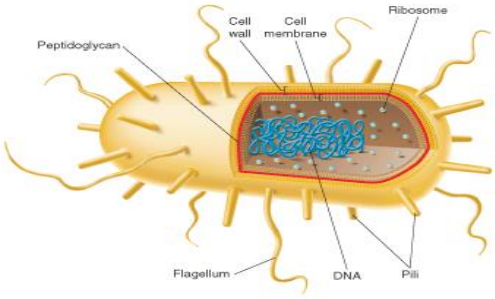
In groups, complete the flow chart below about the structure of viruses, using the words listed. then compare your choice with the other groups.

virus-nucleic-DNA-RNA--proteins-envelope-capsid-core



BACTERIA

Are prokaryotic unicellular organism, used in molecular biology and genetics to clone genes of interest. Possess a cell wall which can be coated by a capsule composed of polypeptides of D-glutamic acid. The cytoplasm contains a bigger chromosomal DNA and smaller circular DNA molecules called plasmids. Organs of locomotion are: pili or one or more flagella.

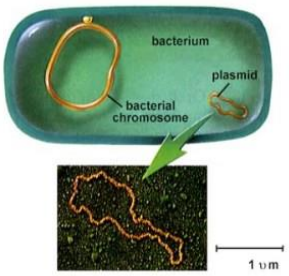


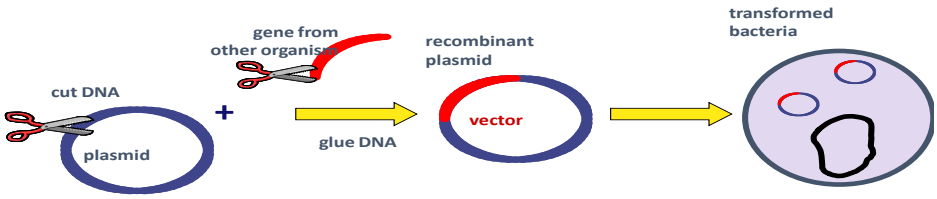
BACTERIA AND BIOTECHNOLOGY

Biotechnology uses bacteria to make antibiotics, insulin, human growth hormone, vitamins, and other drugs.

A way to get genes into bacteria easily:

- insert new gene from other organism into plasmid
- insert plasmid into bacteria
- bacteria now expresses new gene
- bacteria make new protein





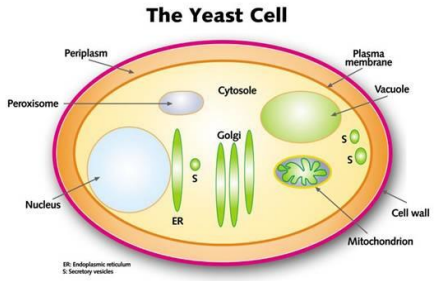
The bacterial DNA is protected from the cleavage by methylation (process by which methyl groups are added to DNA segments). This modification blocks cleavage, since it makes the restriction sites unrecognizable to the restriction enzymes. These restriction enzymes:

- cut DNA at specific sequences (restriction site);
- recognize symmetrical "palindrome" (sequences of four to eight bases that are read in the same way in both directions);
- produces sticky ends that will bind to any complementary DNA.

Bacterial restriction enzymes and plasmids can be easily used in recombinant DNA technology to manipulate DNA of an organism.

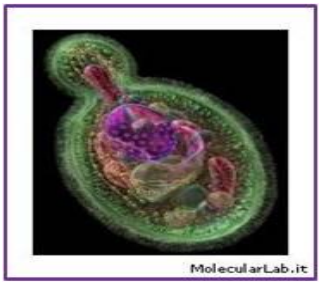
YEAST CELLS

They are eukaryotic unicellular organis



Yeasts reproducing by budding

A bud on the parent cell originates a new yeast cell, as a consequence of a division of the cell on a particular site



They have been used for thousands of years in baking and in alcoholic beverage production





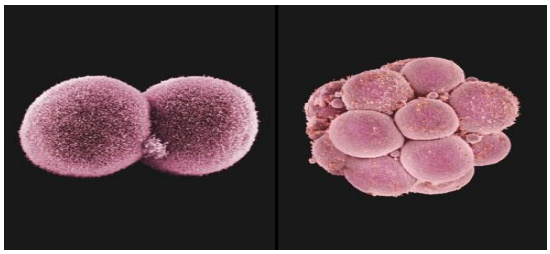
YEAST CELL AND BIOTECHNOLOGY

Since the early 1980s the yeast cells have been widely employed in genetics and molecular biology since they can be easily manipulated and cultured in the laboratory.
The yeast cells are able to perform different eukaryote-specific post-translational modifications, necessary for proteins to achieve a functional shape.
Yeasts are used in research:as protein factories, to express large quantities of eucaryotic proteins;for therapeutic applications;in research to determine their functional and regulatory properties.

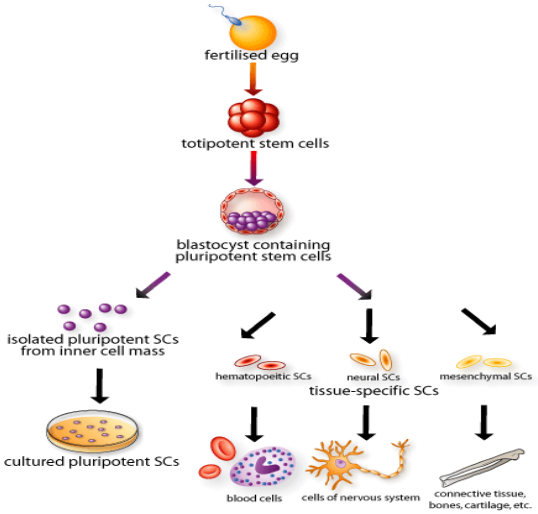
WHY BIOTECNOLOGIES USE YEAST CELLS?

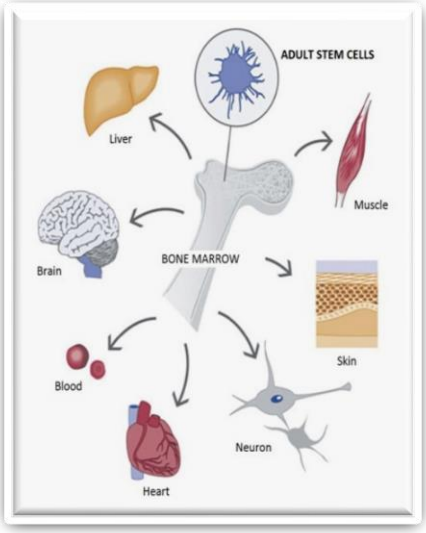
Although bacteria are very useful in cloning ,they are not suitable to express eukatyotic genes, owing to the fact that the processes of transcription and traslation in prokaryotes are too simple, compared with those occurring in eukaryotic cells. The Problem has been solved using yeast cells, wich are able to perform different eukaryote-specific post –traslation modifications necessary for proteins to achieve a functional shape.

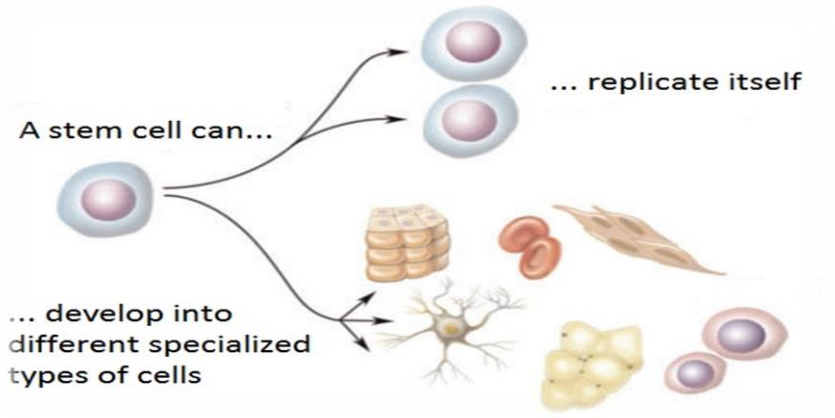
STEM CELLS



They are undifferentiated cells, having the remarkable potential to develop into different specialized cell types in the body.
They play important roles in living organisms. For example, the stem cells present during the earliest stage of development of a human embryo, called blastocysts, give rise to all the specialized cell types present in an organism.
Stem cells are also found in adult tissues and organs, such as bone marrow, muscle and skin.







What do they do?

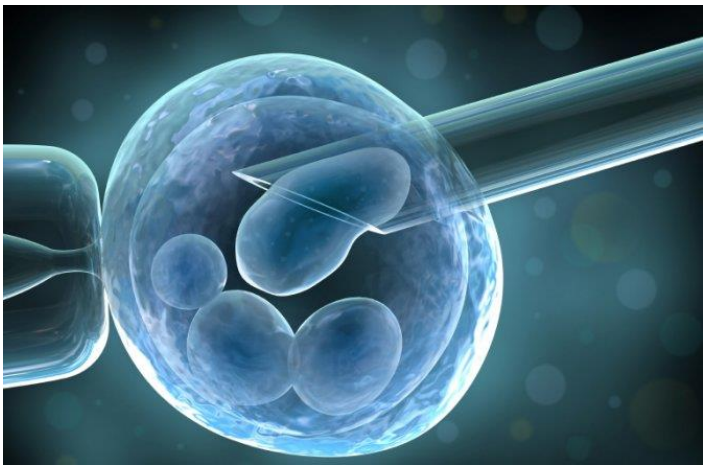
These special cells have the remarkable role of replacing worn out or damaged cell, or act as a repair system, dividing without limits, and replacing the old cells with the new ones, to regenerate the damaged tissue.

Researchers use human stem cells in various ways:

- To study the cellular differentiation: the process where a cell changes from one cell type to another. Most commonly the cell changes to a more specialized type.
- To create tissues that could be used in therapy: tissue culture allows biologists to recreate articular cartilage, nostrils or ears. Thanks to bioreactors, researchers have even managed to create organs with cells from the same organism.
- To test new drugs: human embryonic stem cells are being used to determinate the toxicity of potential pharmaceuticals.

Despite their potential, human stem cells are at center of a fierce debate. Research on embryonic stem cells raises an ethical dilemma.
We must choose between two moral principles:

1) The duty to prevent or relieve suffering
2) The duty to respect the value of human life



EXSERCISES:

2 **Mark True (T) or False (F) and then correct the false statements. Check your choices with your partner.**

	T	F
a. Viruses are living organisms.	☐	☐
b. Some viral nucleic acids are able to integrate into the cell chromosome.	☐	☐
c. Plasmids can be used as cloning vectors.	☐	☐
d. Restriction endonucleases cut the bacterial DNA into small fragments.	☐	☐
e. Yeasts are eukaryotic organisms.	☐	☐
f. Yeasts are less suitable than bacteria to express eukaryotic genes.	☐	☐
g. Human embryos contain stem cells.	☐	☐

UNIT 2 - Recombinant DNA and biotechnology



Learning objectives

- Understanding how a recombinant DNA molecule can be created.
- Identifying and describing some of the current challenges within the field of biotechnology.
- Getting to know about the ethical issues related to the use of biotechnology.
- Reasoning behind the concerns associated with gene therapy and animal cloning.

Language skills

- Listening to and reading texts on recombinant DNA and biotechnology, and comprehending their global meaning.
- Skimming and scanning texts on biotechnology and its applications, and gene therapy.
- Writing about and discussing about GMOs and cloning.

Click on the following link and watch the video twice
http://www.youtube.com/watch?v=Wm6_BBS-KE4
Then answer the following questions. Compare your choices with your partner

1. **What is biotechnology?**
a. The use of chromosomes to enjoy our lives
b. The use of cells to make our lives better
c. A very old technology

2. **What is the body made up of?**
a. Millions of cells
b. Trillions of cells
c. Trillions of shells

3. **What do cells provide?**
a. The structure for the soul
b. The structure for the cells
c. The structure for the body

4. **What do they take in?**
a. Nutrients from food
b. Nutrients from bacteria
c. Nutrients from drinks

5. What do they contain?
a. The blood's material
b. The body's hereditary material
c. The body's material

6. What do almost all cells have?
a. A focus that contains DNA
b. A nucleus that contains DNA
c. The meaning of life

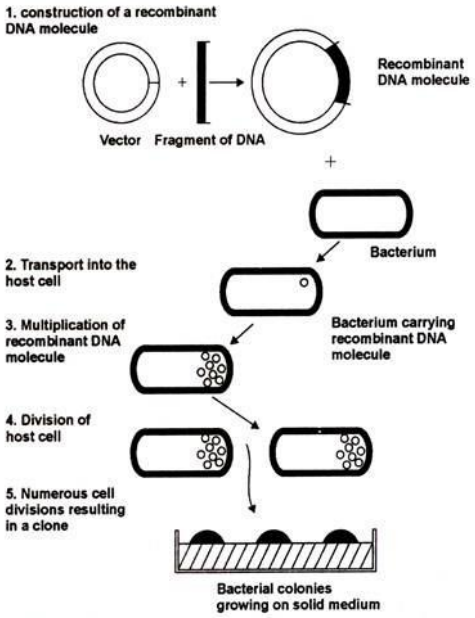
7. What genetic language do cells speak?
a. A genetic language
b. The same genetic language
c. Different genetic languages

8. What answers can biotechnologies give us?
a. To live more
b. To spend less money on medicines
c. To live longer and healthier lives

What is recombinant DNA?

A recombinant DNA molecule is created in a laboratory by combining sequences derived from different genetic sources, so as to generate new combinations of genes. Tecnology of recombinant DNA is based on the following criteria:

1. identify the gene which will be transferred;
2. cut (by restriction enzymes) DNA of the donor in fragments to isolate the gene of interest;
3. divide the fragments of restriction and sequence them;
4. product many identical copies of the gene (genetic cloning or PCR, Polymerasis Chain Reaction);
5. introduce the fragments of DNA in a vector (virus or plasmid);
6. cultivate colonies of bacteria or viruses containing, in each colony, only one fragment of DNA;
7. select the colonies which contain the gene target of our study.



EXERCISES

1 **Listen to paragraph "Procedure" and label the figure using the statements below. Then, check your combinations with your partner.**

recombinant vector • vector and insert cut by the same restriction enzyme • ligation • trasformation • recombinant clones selected on plates • recombinant host cell

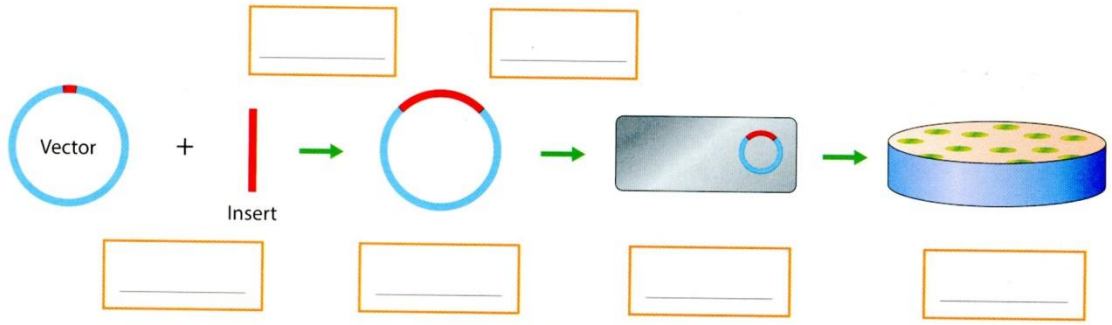


Figure 3. Phases of gene cloning.

2 **Listen to paragraph "How the selection works" and label the following figure choosing from the statements below. Then check your combinations with your partner.**

ampicillin resistance gene • group of restriction sites • recombinant vector • non recombinant vector • blue colonies due to lac Z expression • colourless colonies due to lac Z inactivation • insert

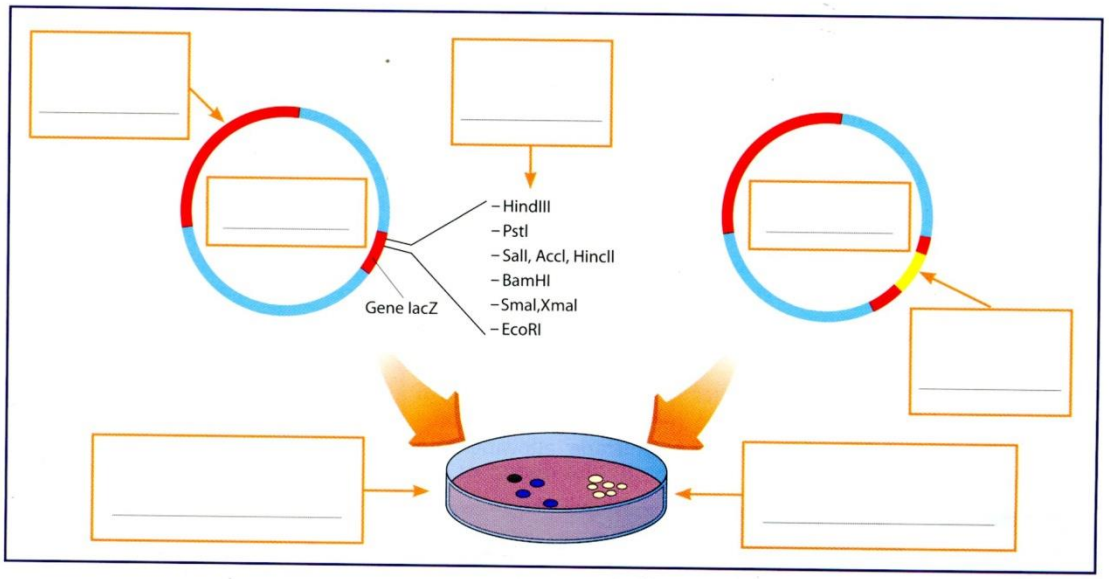


Figure 4. The recombinant clone selection, using lac Z gene as marker.

3 **The "cloning" crossword.**

In groups, use the following definitions to complete the crossword.

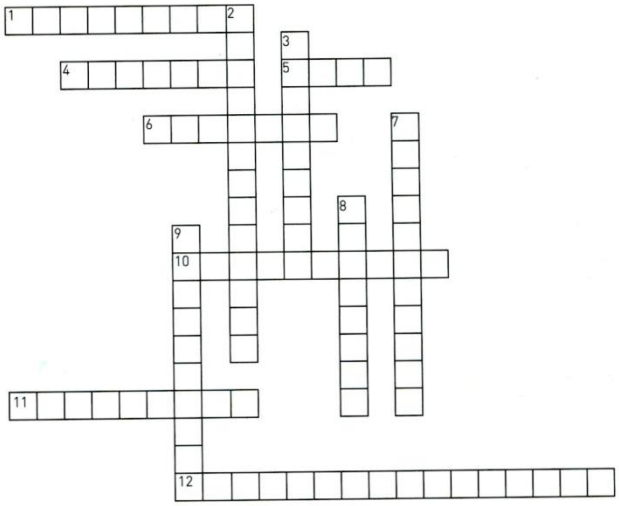
Across

1. Enzyme that forms a covalent bond between two nucleotides.
4. A small circular piece of DNA found in bacteria.
5. A gene encoding the enzyme β-galactosidase.
6. Production of several copies of a certain gene.

10. An organism or cell that contains DNA from a different organism.
11. A gene transferred from an organism to another.
12. A gene introduced into a vector, that confers a trait suitable for artificial selection.

Down

2. Enzymes that cut DNA at specific recognition sequences.
3. The ends of a double stranded molecule terminating in a base pair.
7. The "G" in GMO.
8. A stretch of unpaired nitrogenous bases in the end of a DNA molecule.
9. Cohesive ends generated by several restriction enzymes.

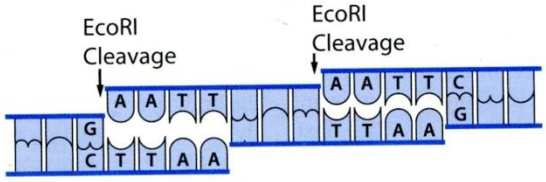


4 **In pairs, match the figures on the left to the descriptions on the right. Compare your choices with your group.**

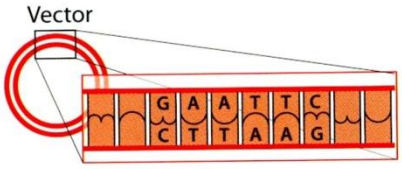
1. Target Sequence



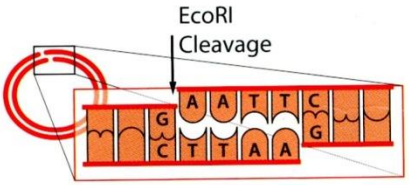
2.



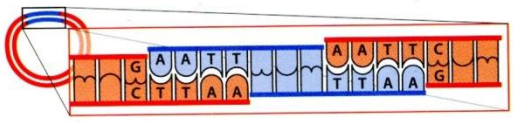
3.



4.



5.



a. Since EcoRI recognizes a single restriction site, after cleavage, the circular vector becomes linearized. Vector DNA contains the same cohesive ends as those found in the fragments to be cloned.

b. Vector DNA before cleavage. The cloning vector has a single restriction site for EcoRI.

c. EcoRI produces staggered cuts. Accordingly, after cleavage, sticky ends are generated in donor DNA fragments.

d. Cohesive ends of the foreign DNA fragment hybridize with the complementary single-stranded sequences of the vector. After the formation of phosphodiester bonds, a circular recombinant vector is generated.

e. Genomic DNA before cleavage. Two palindromic sequences are shown. They represent the recognition sequences for the restriction enzyme EcoRI.

Biotechnology and its applications

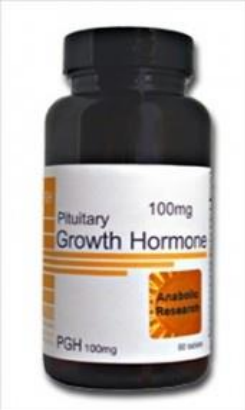
Biotechonlogy refers to the application of technology to modify and improve the biological function of an organism by modifying its genome.

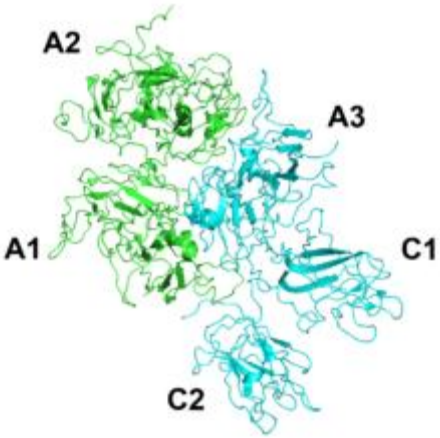
For centuries, people have been using microorganisms, in order to make bread, wine, cheese, and to preserve dairy products. Today biotechonology industry relies on recombinant DNA technology and genetic engineering techniques. Biotechnology embraces different fields: medicine, research, agriculture and environment.

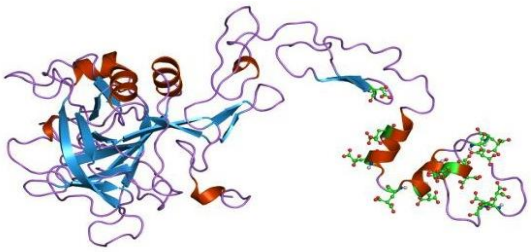
Biotechnology in Medicine and Research

Today, recombinant DNA technology makes it possible to synthesize vaccines or therapeutic products.

Vaccines and medical drugs are produced using transgenic organisms that have been genetically engineered to produce a specific pharmaceutical of interest. These kinds of drugs named biopharmaceuticals: the *recombinant Growth hormone* and the *recombinant Factor VIII and Factor IX* are only three examples.







Growth hormone *Factor VIII* *Factor IX*

Growth hormone GH is a protein hormone secreted by the pituitary gland, which stimulates growth and cell reproduction. Unlike in the past, GH is produced through biotechnology and used in children and adult who suffer from GH deficiency .

Factor VIII and Factor IX

Haemophilia is a genetically inherited disorder caused by the deficiency in two proteins required for blood clotting Factor VIII (haemophilia A) Factor IX (haemophilia B)

People affected by haemophilia need intravenous infusions of these clotting factors, to prevent bleeding episodes

In the past these proteins were obtained from fresh frozen plasma. In this way, deseases like hepatitis B and AIDS could be transmitted. The problem were solved when biologists were able to cloning and product recombinant coagulation factors. To understand how a certain gene works, scientists started to study mice that have been genetically engineered by the inactivation of that gene. In fact, in this way, physical and biochemical characteristics are altered Comparing the obtained data with the normal data from normal mice, it's possible to understand how the gene normally works.

Monoclonal antibodies

Engineered molecules, produced by transgenic rats, that recognize cancer cells mimicking the natural antibodies.

Depending on the kind of tumor to be treated they can be synthesized in several ways and are used to:

- **to mark cancer cells** in particular, to be more easily recognized and eliminated by the immune system;
- **be combined with a radioactive particle**, to provide radiation to the tumor cell;
- to recognize and block the extra copies of the **growth factor receptors** synthesized by cancer cells.

Specific antigens are synthesized thanks to genes cloned from genomic DNA, used to prepare vaccines.

Hepatitis B vaccine, prepared using one of the viral envelope proteins HbsAg (hepatitis B surface antigen), copied by recombinant yeast cells where the gene for HBsAg is inserted.



Biotechnology in Agricolture-GMO Plants

GMO plants can be obtained by manipulating an existing gene, to create a new allele, or by introducing a new gene in a cell or an organism to form a transgenic organism**.**

Genetically modified crops (GMCs, GM crops, or biotech crops) are plants used agricolture, the DNA of which has been modified using genetic engineering techniques. In most cases, the aim is to introduce a new trait to the plant which does not occur naturally in the species. Examples in food crops include resistance to certain pests, diseases, or environmental conditions, reduction of spoilage, or resistance to chemical treatments (e.g. resistance to a herbicide), or improving the nutrient profile of the crop. Examples in non-food crops include production of pharmaceutical agents, biofuels, and other industrially useful goods, as well as for bioremediation.



Why create gmo plants?

1) They are created to make them more resistant to viral desease, insects, and herbicedes
2) To make them more resistant to etreme conditions of temperature, pH or salinity
3) To improve their taste and nutritional values





Colorado Potato Beetle Resistant Potato



This variety of potato is an instance of a genetically engineered potato plant that is able to synthesize its own insecticide, naturally produced by the bacterium *Bacillus thuringiensis*

How to produce Beetle Resistant Potato



They have been produced by introducing the gene encoding the CryIIIA protein from the bacterium into the potato genome, this technique is called *Agrobacterium tumefaciens-mediated transformation*.
The analysis of nutrients did not reveal any signifcant differences between the transgenic lines and the normal potatoes, they are extremely unlike to be allergenic and devoid of any potential toxicity.

Golden rice.

Golden rice is an example of a biofortified crop, having the capacity to produce β-carotene, *a precursor of vitamin A,* in its grains
Rice plants produce provitamin A only in the green tissue, whereas the grains, which are the only edible part, do not.
Thanks to promoter, the gene responsible for beta-carotene synthesis was expressed in the endosperm

Golden rice 2

The anti-GMO criticized that the Golden rice did not have sufficient vitamin A. This problem was solved in 2005 with the production of GOLDEN RICE 2. This variety was able to synthesize obout 20 times more carotenoids than the original Golden rice

- Golden rice was created by transformig rice with two beta-carotene biosynthesis genes:
- *psy* (phytoene synthase) from daffodil
- *crtI* (carotene desaturase) from the soil bacterium *Erwinia uredovora*

The *psy* and *crtI* genes were transferred into the rice nuclear genome and placed under the control of an endosperm-specific promoter, so that they are only expressed in the endosperm.



Dolly the sheep

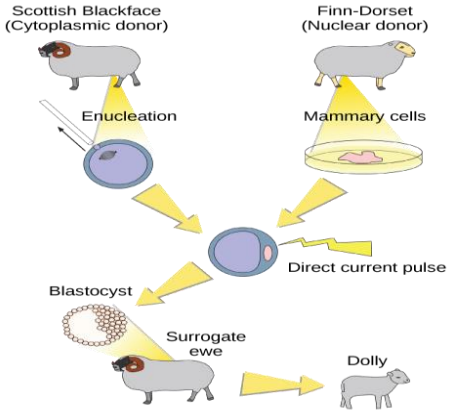


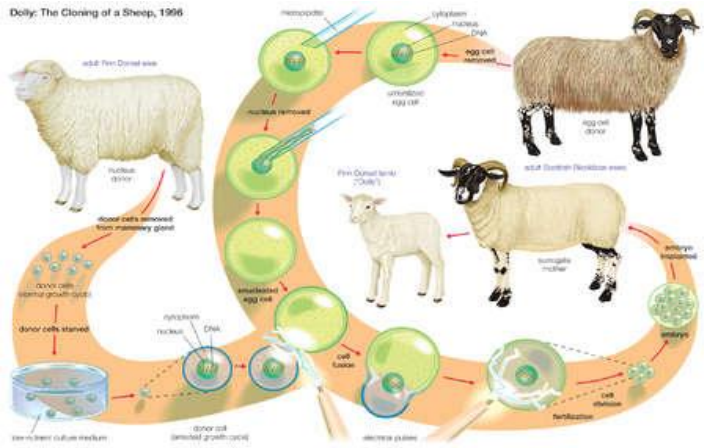
A clone has the same DNA sequence as its parent and so they are genetically identical.
Dolly the sheep, as the first mammal to be cloned from an adult cell, is by far the world's most famous clone. However, cloning has existed in nature since the dawn of life. The plants have been cloned: a cutting is capable of producing a clone of the original plant; identical human twins are they clones.
Several clones had been produced in the lab before Dolly, including frogs, mice, and cows, which had all been cloned from the DNA from embryos.
Dolly was remarkable in being the first mammal to be cloned from an adult cell. This was a major scientific achievement as it demonstrated that the DNA from adult cells, despite having specialised as one particular type of cell, can be used to create an entire organism

How Dolly was cloned

Animal cloning from an adult cell is much more difficult than from an embryonic cell.
So when scientists working at the Roslin Institute in Scotland produced Dolly, the only lamb born from 277 attempts, it was a major news story around the world.

In 1996, University of Edinburgh scientists celebrated the birth of Dolly the Sheep.
The Edinburgh team's success followed its improvements to the single cell nuclear transfer (SCNT) technique used in the cloning process.
Dolly became a global scientific icon and SCNT technology has spread around the world and has been used to clone multiple farm animals.
Professor Sir Ian Wilmut and colleagues worked on methods to create genetically improved livestock by manipulation of stem cells using nuclear transfer







To produce Dolly, scientists used an udder cell from a six-year-old Finn Dorset white sheep. They had to find a way to 'reprogram' the udder cells - to keep them alive but stop them growing – which they achieved by altering the growth medium (the 'soup' in which the cells were kept alive).



Then they injected the cell into an unfertilised egg cell came from a Scottish Blackface ewe which had its nucleus removed, and made the cells fuse by using electrical pulses.
When the research team had managed to fuse the nucleus from the adult white sheep cell with the egg cell from the black-faced sheep, they needed to make sure that the resulting cell would develop into an embryo.
They cultured it for six or seven days to see if it divided and developed normally, before implanting it into a surrogate mother, another Scottish Blackface ewe.
Dolly had a white face.



What happened to Dolly?

Dolly lived a pampered existence at the Roslin Institute. She mated and produced normal offspring in the normal way, showing that such cloned animals can reproduce.
Born on 5 July 1996, she was euthanased on 14 February 2003, aged six and a half. Sheep can live to age 11 or 12, but Dolly suffered from artrithis in a hind leg joint and from sheep pulmonary adenomatosis, a virus-induced lung tumour that is common among sheep which are raised indoors





Why clone sheep?



Dolly the sheep was produced at the Roslin Institute as part of research into producing medicines in the milk of farm animals.
Researchers have managed to transfer human genes that produce useful proteins into sheep and cows, so that they can produce, for instance, the blood clotting agent factor IX to treat haemophilia or alpha-1-antitrypsin to treat cystic fibrosis and other lung conditions.
Inserting these genes into animals is a difficult and laborious process; cloning allows researchers to only do this once and clone the resulting transgenic animal to build up a breeding stock. The development of cloning technology has led to new ways to produce medicines and is improving our understanding of development and genetics.
Since 1996, when Dolly was born, other sheep have been cloned from adult cells, as have cats, rabbits, horses and donkeys, pigs, goats and cattle.
In 2004 a mouse was cloned using a nucleus from an olfactory neuron, showing that the donor nucleus can come from a tissue of the body that does not normally divide.







EXERCISES

1 **Mark True (T) or False (F) and then correct the false statements. Compare your choices with your group.**

		T	F
a.	One of the risks of biopharmaceuticals is their contamination with pathogens.	☐	☐
b.	Recombinant Factor VIII and Factor IX are examples of biopharmaceuticals.	☐	☐
c.	Monoclonal antibodies are as efficient as normal antibodies.	☐	☐
d.	The Colorado Potato Beetle Resistant (Bt) Potato genome contains the CryIIIA protein.	☐	☐
e.	Golden rice is able to synthesize vitamin A in the endosperm.	☐	☐
f.	Golden rice 2 is able to synthesize about 20 times more carotenoids than the original recombinant variety.	☐	☐

2 **In pairs, fill in the following table, including the information from paragraph 2 on agriculture. Then, research and add other three examples of engineered foods. Report your choices to the class.**

Engineered food variety	Genetic modification	Outcome
Colorado Potato Beetle Resistant (Bt) Potato		
Golden rice		

3 **Match the following terms to their definition. Then compare your choices with your partner.**

1. *Golden rice*
2. *Vaccine*
3. *CryIIIA gene*
4. *GMO*
5. *Biopharmaceutical*
6. *Recombinant factor VIII*
7. *Knockout mice*

a. The DNA sequence encoding a natural insecticide in some bacteria.
b. An organism whose genetic material has been modified.
c. Animals whose cells contain a gene which has been made inactive.
d. A substance put into the blood to prevent disease.
e. An injected protein used to cure haemophilia.
f. A drug obtained through transgenic organisms.
g. A variety of biofortified crop.

4 **Put the words below in the correct order. Compare your choices with your partner.**

a. to enhance desired traits/that have been modified/crop plants/refers to/the term "engineered food"/ in the laboratory

b. prevail over the benefits/genetically modified foods/risks of/ most people think that/ to health and the environment

c. in the US/cows/comes from/about a quarter of the milk/injected with a GM hormone,/ sucking on/and honey/bees/comes from/GM crops

d. from animals,/previously extracted/many drugs/ such as insulin,/by recombinant DNA technology/more commonly produced /are now

Glossary

Donor= Donatore
Cloning vector= Vettore di clonazione
Host cell= Cellula ospite
Yeast cell= Lievito
Stem cell= Cellula staminale
Inner core= Nucleo interno
Protein coat= Copertura proteica
Capsid= Involucro(capside)
Enveloped virus= Virus avvolto-coperto
Autonomously= Autonomamente
Target cell= Cellula bersaglio
Plasmid= Plasmide
Metabolic pathway=Percorso metabolico
Foreign DNA= DNA estraneo
Restriction endonuclease= Nucleasi di restrizione
Palindromic=Palindromo
Cleavage=Sfaldamento
Embryo=Embrione
Blastocyst=Blastocisti
Bone marrow= Midollo osseo
Phosphodiester bond= Legame fosfodiesterico
Tranfection= Trasfezione
Strand= Filamento
Blund-end= Estremità piatta-smussata
Sticky-end= Estremità sporgente
Unpaired=spaiato
Staggered cut= Taglio sfalsato
Overhang= Sporgenza
Ligation Phase= Fase di legatura
Aim= Scopo
Basic research=Ricerca di base
Drug=Farmaco
Phenotype=Fenotipo
Suitable= Idoneo
Selectable marker= Marcatore selezionabile
Suitable medium= Mezzo adatto
Human corpse= Cadavere umano
Inherited disorder= Malattia ereditaria
Blood Clotting= Coagulazione
Monoclonal antibody =Anticorpo monoclonale
Cancer cell= Cellula cancerogena