

## Summary of the Lessons 4-6 (autrice Prof.ssa Elisabetta Schietroma)

### GENETIC ENGINEERING

It describes the range of techniques used to **manipulate DNA**. It includes the **transfer of genes** from one species to another to produce **transgenic organisms**. **Recombinant DNA** can be cloned and inserted into host cells using viruses or **plasmids** as **vectors**. The vector contains a selectable marker useful to identify transgenic cells.

Engineered bacteria or yeast can synthesize medically useful products (eg. insulin, vaccine proteins, growth hormone, factor VIII and so on).

Steps:

1. **Removing a gene** from the donor cells → cells containing the gene that is useful are **incubated** with a **restriction endonuclease**. A **restriction endonuclease** cuts the DNA to leave sticky ends.
2. The same **restriction endonuclease** is used to cut open the **plasmid DNA** therefore it has the same sticky ends. The **plasmid DNA** is obtained from bacterial cells.
3. **Transformation** → The plasmids are incubated with the DNA (eg. human insulin gene, or the gene for the light-emitting protein luciferase or the gene for green fluorescent protein – GFP-) obtained from the donor cell and they are also incubated with an antibiotic resistance gene (eg. the ampicillin resistance gene).
4. The DNA fragments from the donor cell and the DNA of the antibiotic resistance gene both bond to the plasmids because of the same sticky ends.
5. The new plasmid is put into a new bacterium.
6. All the bacteria that have taken up the plasmids will grow on media containing the antibiotic, ampicillin. They multiply very rapidly and express the gene they contain (eg. they produce insulin or they produce light according to the cloned gene).

### Examples of biotechnology products

- **Human medicines** → insulin or human growth hormones are produced by bacteria that have been genetically modified with the human gene.
- **Herbicide resistance in crop plants** → oilseed rape resistant to the herbicide glufosinate. When applied to fields of oilseed rape this herbicide would only kill the weeds. The Genetically Modified oilseed rape continues to grow.

- **Additional vitamins in crop plants** → The Genetically Modified varieties of rice (Golden rice) has a high  $\beta$ -carotene content. It will improve the diets of the people who eat it. They will be able to produce vitamin A.
- **Transgenic** sheep can produce milk with an enzyme that is used to treat cystic fibrosis.
- **Transgenic** cattle could produce milk with low cholesterol (high levels of cholesterol in blood increases risk of heart disease).

### **Clones**

Clone → a group of identical plants or animals which get all their genes from one parent.

Dolly, for example, had no father. Her “egg donor” mother was a Scottish Blackface sheep. The nucleus was removed from the egg. A Finn Dorset sheep gives a donor nucleus. This nucleus and the enucleated egg were fused and induced to divide. The embryo was transplanted into a Scottish Blackface sheep. Dolly was born. It was a clone (with exactly the same genes her “gene mother”).