Quipper

Lesson 18.3

Uses of Genetically Modified Organisms

Objectives

At the end of this lesson, students should be able to:

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1. introduce the concepts of genetic engineering;
2. describe the history of genetic engineering;
3. explain the general process of genetic engineering; and
4. enumerate the common products of genetic engineering in society.

GMO Applications

- Genetic modification has extended its applications in the following fields:
    - agriculture;
    - animal production;
    - medicine; and
    - environmental protection.

Genetic engineering procedures include testing of cattle semen.

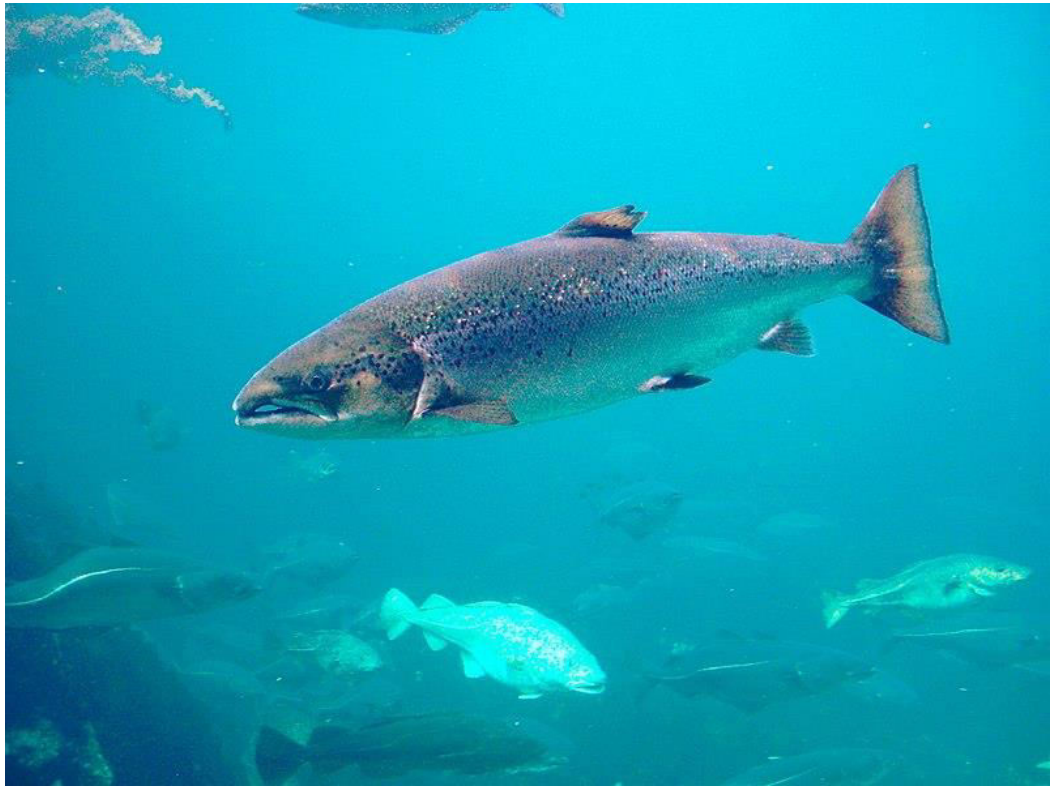
Agriculture

- GM crops have **higher resistance to environmental stressors**, can produce more nutrients, and have longer shelf life.

Larva of *Helicoverpa armigera*, one of the worst insect pests.

Animal Production

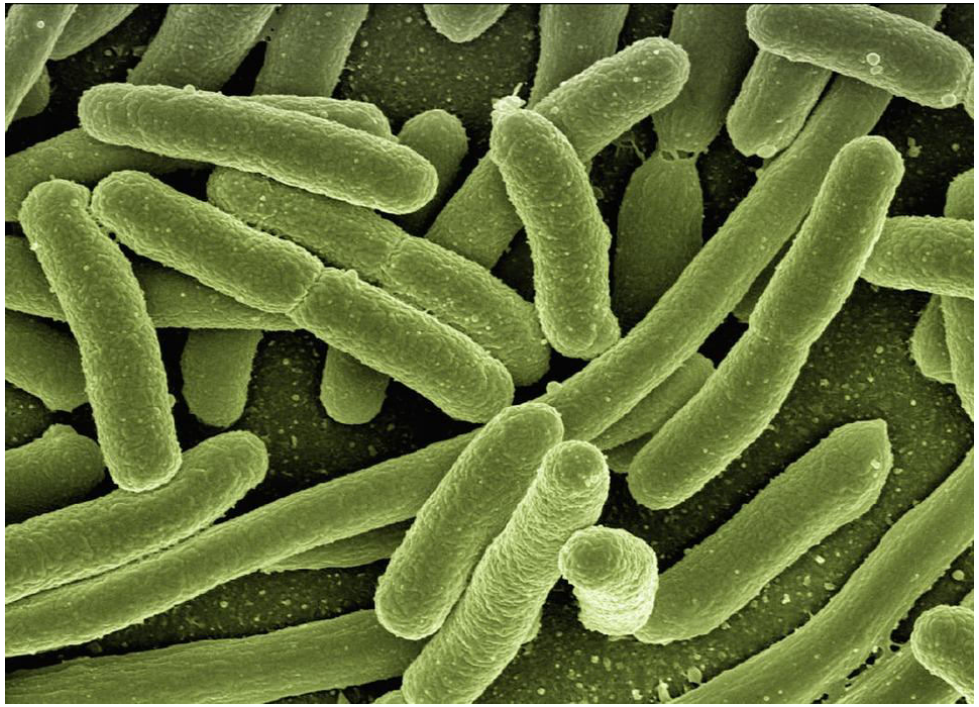
- GM animals have **improved meat quantity and quality and resistance to some diseases.**



The Atlantic salmon is genetically manipulated to grow at higher rates.

Medicine

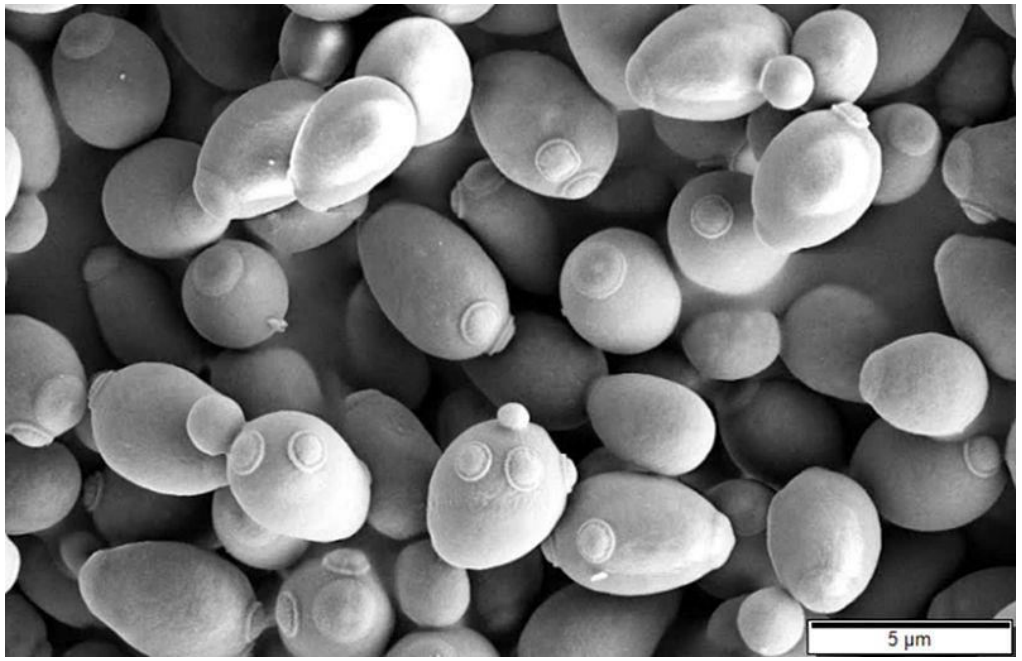
- Some GMOs **can produce hormones, antibodies, and other therapeutic proteins for humans.**



Escherichia coli is genetically engineered to produce human hormone.

Environmental Protection

- Some GMOs have higher capacity for **bioremediation by processing more environmental contaminants.**



Saccharomyces cerevisiae is genetically modified for bioremediation.

Examples of GMO

- **Bt corn** produces Bt toxin (cry1Ab protein) to deter Asian corn borer (*Ostrinia furnacalis*).
- Bt toxin gene comes from ***Bacillus thuringiensis***.

Ostrinia furnacalis larval (left) and adult (right) stages.

Examples of GMO

- **Golden Rice** is modified to produce more beta carotene.
- Genes for **phytoene synthase** and **carotene desaturase** come from daffodils and bacteria, respectively.

Normal rice and Golden rice.

Examples of GMO

- **FLAVR SAVR tomato**
  - Tomatoes are modified to have extended shelf life.
  - It results from **underexpression of polygalacturonase.**

Tomatoes now have delayed ripening.

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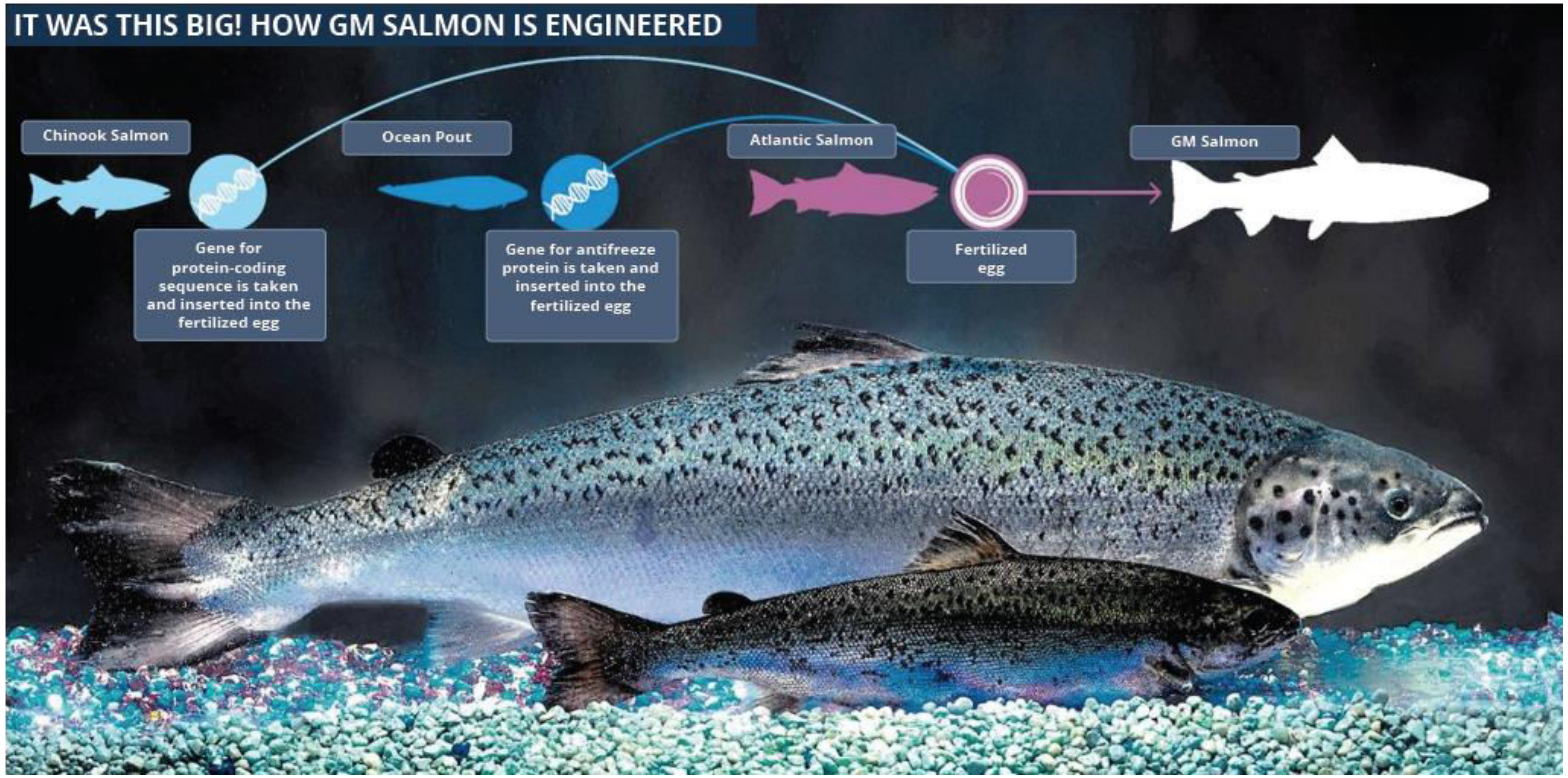
Examples of GMO

- **Arctic salmon** is modified to grow at higher rates.
- It has extra gene for **growth hormone** from the **Chinook salmon**.



The AquAdvantage salmon grows significantly larger than its counterparts.

Examples of GMO

- GloFish
  - ***Danio rerio*** **or zebra fish** is modified to have fluorescent protein from sea anemone.
  - It is a controversial product of genetic engineering.

GloFish is marketed as the world's first GM pet.

Examples of GMO

- **Insulin-producing bacteria**
  - **Insulin** is now produced from **transgenic bacteria** to make it available for Type 1 diabetes patients.

Artificially produced insulin can now be distributed in syringes.

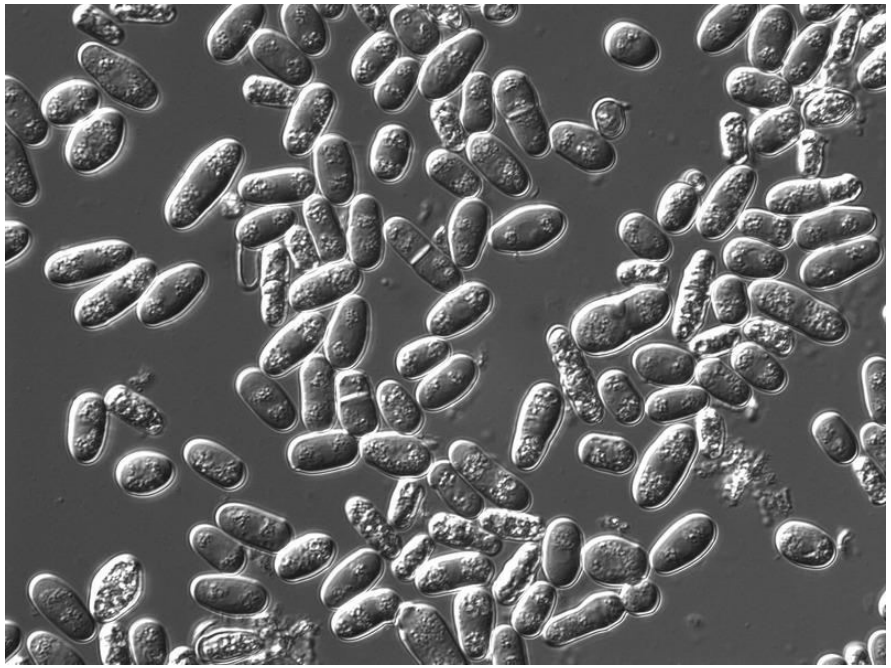
Examples of GMO

- **Bioreactor cows and sheep**
  - Cows and sheep are engineered to produce antibodies and therapeutic proteins for humans.

Sheep blood is extracted and purified for human antibodies.

Examples of GMO

- **Yeast and bacteria**
  - Microorganisms such as **yeasts and bacteria** are modified to have more resistance to extreme conditions.
  - This enhances their capacity for bioremediation.



Yeast cells are modified to increase stress tolerance.

Key Points

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1. **Genetically modified organisms** are revolutionary biotechnological breakthroughs but they have raised various social, ethical, and even political issues.

2. By modifying the genes of **crops and livestock** through genetic engineering, the plants and animals have improved quality in terms of their use.

Key Points

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3	Genetic engineering is commonly used to produce biopharmaceutical drugs in the field of medicine.
4	Genetically modified organisms have posed a lot of **political and ethical issues** especially in the production and consumption of these products.

Determine whether each of the following statements is right or wrong.

1. Insulin is one of the first genetically engineered drug available in the market.
2. Philippines prohibit the availability of GMO products in the country.
3. GMO products can be dangerous to the people consuming the products.
4. GMO medicines can be easily produced through the use of insect as expression vector.
5. Bacteria are common options in genetic engineering in order to express the target genes.

Challenge Yourself

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How can GMO products improve the productivity of farmers?

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