# 8.L.2.1: Biotechnology

8. L: Biotechnology Open Ended Question

1. What is a genome?
2. What is genetic modification?
3. What do you call the process that uses a body cell to create a new organism?
4 How can biotechnology benefit agriculture?
5. Discuss Biotechnology in NC?
6. Name a career in Biotechnology?
7. Pros and Cons of Biotechnology
8. Ethical issues of biotechnology
9. What is genetic engineering?
10. Summarize the advantages and disadvantages of biotechnology in food, water, medicine, shelter and agriculture.

- Bio – (biological) – means living
- Biotechnology - use of living organisms in production with technology and manufacturing processes
- Hybrid - the offspring of two different species produced by humans
    - (Ex: Broccoflower – crossing a broccoli and cauliflower)
- Ethics – the study of what is moral and acceptable.

| Biotechnology | Advantages | Disadvantages/ Ethics | Careers |
|---|---|---|---|
| **Agriculture** – use of biotechnology to produce, grow, and harvest plants. | 1. Improve quality of crops & livestock products<br>2. Create disease resistant crops to increase crop yields.<br>3. Create crops that grow in any climate.<br>4. Control pests | 1. **Fertilizer** – natural (manure) or synthetic chemicals used for plants to grow bigger, faster, and produce more.<br><br>2. **Pesticides** - natural or man-made chemicals used to keep pests off of plants<br>• Both sprayed on plants = then eaten by animals & humans<br>3. **Crop Yields** – how much crop (food) a piece of land produces.<br>– Goal is to increase…<br>– With fertilizer, pesticides, Genetic Modification. | 1. FDA (Federal Drug Administration)<br>2. Farmer<br>3. Horticulturist<br>4. Researcher<br>5. DNR (Department Natural Resources)<br>6. EPA (Environmental Protection Agency) |
| **Food Science** - use of biotechnology to produce seeds and plants. | 1. Increased shelf life in stores<br>2. Increased output<br>3. Disease resistant crops<br>4. Hybrid – the offspring of two different species produced by humans.<br>Ex: Broccoflower – crossing | 1. **Cross breeding** - producing an offspring from parents of two different breeds or species; creates a hybrid.<br>• Salmon engineered to grow faster, may escape, and breed with natural salmon.<br>• Genetically engineered | 1. FDA (Federal Drug Administration)<br>2. Farmer<br>3. Researcher<br>4. Microbiologist<br>5. Biochemist |

|  |  |  |  |
|---|---|---|---|
|  | a broccoli & cauliflower. | plants cross breeding with natural plants.<br>• Cross bred animals are unable to breed. Ex: Mule, liger, cama, zorse, zonkey, wholphin… |  |
| **Genetics** – use of biotechnology with genes, heredity, and the variation of organisms. | 2. DNA testing<br>3. **Forensic Testing** – using science to answer questions in the legal system (Ex: blood testing, toxicology (poisons), fingerprint analysis and DNA testing)<br>4. To treat Genetic Disorders<br>5. Gene Therapy – treatment of disorders caused by genetic anomalies by placing specific engineered genes into patient's cells.<br>6. Stem Cells – transforming stem cells into other types of cells. | 1. **Cloning** – process of making a genetically identical copy.<br>• Clone livestock animals<br>• Clone human organs<br>• Unregulated cloning and crimes<br><br>2. **Genetic Modification** – change of any genetic material (DNA, genes, or chromosomes) to make them able to produce new functions. | 1. Lab technician<br>2. Researcher<br>3. Doctor<br>4. Geneticist<br>5. Fertility Doctor<br>6. Clinical Research scientist<br>7. FDA |
| **Medicine** – use of biotechnology to produce medical drugs and vaccines. | 1. Bacteria used to produce large quantities of…<br>– insulin for diabetic patients<br>– antibiotics<br>2. Fight infectious diseases | 1. Unwanted medical side effects of medical drugs<br>2. Diseases can mutate causing vaccine to stop working | 1. FDA (Federal Drug Administration)<br>2. Pharmacist<br>3. Researcher<br>4. Doctor |
| **Water** - use of biotechnology to clean water. | 1. **Bioremediation** - bacteria or plants use to remove or neutralize contaminants and pollutants in soil or water. | 1. **Eutrophication** – fertilizer gets into water systems, uses up oxygen, and kills fish.<br>2. Bioremediation<br>• Conditions in soil and water must be monitored<br>• All contaminants may not be decomposed | 1. Treatment Plant technician<br>2. DNR (Department Natural Resources)<br>3. EPA (Environmental Protection Agency)<br>4. Wildlife biologist |

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Crop Yield – amount of crops (food) a piece of land produces.
- Goal is to increase crop yields.
- Yield - to produce

Factors that Limit Crop Yields
1. Pests - Insects & animals eat crops
2. Poor soil - low nutrients - nitrogen, phosphorous, & sulfates
3. Diseases - bacteria, mold, fungus -
       - take away nutrients from plants = kill
4. Non-native climates
Factors that Increase Crop Yields
1. Pesticide - natural or man-made chemicals used to keep pests off of plants.
2. Fertilizer - natural (manure) or synthetic chemicals used to help plants grow bigger, faster, and produce more food.
3. Diseases - bacteria, mold, & fungus...
       Option 1 - Pesticides used to kill diseases
       Option 2 – Biotechnology - Genetically modify seeds & plants to resist diseases
4. Non-native climates
        Option 1 - grow non-native crops in greenhouses with controlled temperature, soil, & humidity
        conditions
       Option 2 - genetically modify crops to grow in non-native climates

Ethical Issues of Limiting & Increasing Crop Yields
1. Resistance
       1. Insects & diseases develop resistance to pesticides.  - they no longer work! :(
2. Water Systems
       1. During watering or rainstorm, Fertilizers & pesticides runoff into water systems
       2. Eutrophication - water plants uses up oxygen, kill off all fish
       3. Pesticides - kill off water plants & organisms.  - mutate organisms
3. Poisons
       1. Fertilizers & pesticides are sprayed onto plants
       2. Chemicals get on and into food
       3. Humans & animals eat food  - Chemicals inside of them.
4. Genetic Modification
       1. Cross breeding with native plants
       2. Unknown future effects on plants, animals, & humans.


1.  Which is a potential ethical issue resulting from the use of biotechnology?

    A.  deteriorating the ozone layer

    B.  causing mass extinction of a species

    C.  increasing pollution of natural resources

    D.  introducing a genetically-altered species

2.  Tomatoes are genetically modified to have a longer shelf life, slowing the ripening and softening of the tomato. Which ***best*** describes a concern people have with eating genetically-modified tomatoes?

    A.  Genetically-modified tomatoes do not taste as good as regular tomatoes.

    B.  Genetically-modified tomatoes are more expensive than regular tomatoes.

    C.  The DNA used to modify the tomatoes could change the DNA of the person eating the tomato.

3.  Which is an ethical issue surrounding the use of genetically modified foods?

    A.  cost of production

    B.  long-term health effects

    C.  ability to grow more nutritious foods

    D.  ability to produce a lot of food quickly

4.  What is ***most likely*** the greatest economic benefit for North Carolina from biotechnology?

    A.  improvements in DNA testing leading to more arrests

    B.  fewer people who use laboratory-created human insulin

    C.  increased disease-resistant crops and greater crop yields

5.  Which would ***most likely*** result in the largest economic benefit to North Carolina?

    A.  North Carolina partnering with farmers for use of agricultural biotechnology

    B.  North Carolina being a lead consumer state in pharmaceutical manufacturing

    C.  North Carolina making the world's best-trained work force for biomanufacturing

    D.  North Carolina making a long-standing commitment to biotechnology development

6. Residents of North Carolina presently burn 5 billion gallons of imported petroleum-based liquid fuel per year. How would the state's economy be affected if North Carolina could produce biofuels locally as a replacement?

   **A.** Tax revenues would decrease.

   **B.** Unemployment would increase.

   **C.** The economy would decline due to exports.

   **D.** The economy would improve with new jobs and tax revenue.

7. North Carolina has over 400 biotechnology companies. How would the economy *most likely* change if that number were reduced by half?

   **A.** The economy would decline because of job loss.

   **B.** The economy would suffer as funding for research decreases.

   **C.** The economy would increase due to an increase in production.

   **D.** The economy would improve when the government offers assistance.

8. Biotechnology uses a procedure called genetic engineering. Which *best* describes genetic

   **A.** making artificial DNA in the laboratory from chemicals

   **B.** cutting out pieces of DNA from an organism under a microscope

   **C.** adding DNA from one organism into the DNA of another organism

9. Which is a positive result of the use of biotechnology in agriculture?

   **A.** increased cost

   **B.** increased yield

   **C.** increased use of pesticides

   **D.** increased use of preservatives

**10.** In which area would biotechnology have the greatest effect on agriculture?

    **A.** development of biological weapons

    **B.** development of biopharmaceuticals

    **C.** development of biological pesticides

    **D.** development of biodegradable plastics

**11.** Which project is *most likely* to be worked on by a biotechnician?

    **A.** developing plants with resistance to high temperatures

    **B.** developing architectural designs for houses in floodplains

    **C.** discovering different isotopes of existing elements in the periodic table

    **D.** designing lightweight, strong metallic alloys for use in car manufacturing

**12.** Which area of biotechnology would *most likely* create ethical issues within human society?

    **A.** insulin production by bacteria

    **B.** organ cloning for use in transplants

    **C.** genetic engineering to improve agricultural yields

    **D.** DNA and forensic testing of crime scene evidence

**13.** Which is *most important* when investigating ethical issues in biotechnology?

    **A.** cost of the technology

    **B.** advantage of the technology

    **C.** public opinion of the technology

    **D.** benefits of the technology outweighing the harm

**14.** Farmers use insecticides and fertilizers on their fruit and vegetable crops. Which **best** describes the effect of these chemicals?

    **A.** The crops require less water and nutrients to grow.

    **B.** The crops are more susceptible to insect damage.

    **C.** The crops yield smaller fruits and vegetables.

    **D.** The crops yield more fruits and vegetables.

**15.** Which improvement to agriculture is **most likely** a result of biotechnology?

    **A.** increased land

    **B.** increased fertilizer

    **C.** increased productivity

**16.** A company that creates hair dye would **most likely** employ a biotechnician for which job?

    **A.** researching trends

    **B.** developing new colors

    **C.** creating cost-effective packaging

    **D.** developing a product that will be safe for consumers

**17.** Which **best** describes a controversial issue associated with the use of genetically modified crops?

    **A.** the use of genetically modified crops to increase potential yield

    **B.** the short-term use of genetically modified crops in famine-stricken countries

    **C.** the development of genetically modified crops which are resistant to herbicides

    **D.** the long-term effects which may arise from the use of genetically modified crops

**18.** Which is a benefit of genetically modified foods?

    **A.** The cost of research is included in the cost to the consumer.

    **B.** The cost of food will decrease, and the quality of food will increase.

    **C.** When foods are genetically modified, they no longer need to be studied.

    **D.** When foods are genetically modified, they are completely resistant to disease and drought.


**19.** How can biotechnology affect agriculture on a single plot of land?

    **A.** The land could produce more food than before.

    **B.** The land could produce several harvests at once.

    **C.** The land could require more fertilizer for crops to grow.

    **D.** The land could require moderate temperatures for crops to grow.


**20.** Which is the *most likely* result of having a large number of biotechnology companies located in North Carolina?

    **A.** decrease in available jobs

    **B.** improvement in crop yields

    **C.** increase in antibiotic resistance

    **D.** decrease in vaccine effectiveness


**21.** Which application of biotechnology is of greatest economic benefit to North Carolina?

    **A.** development of livestock that are more domesticated

    **B.** development of livestock that produce higher quality meat

    **C.** development of crops that can be grown in extremely dry environments

    **D.** development of crops that can be grown in extremely low temperatures

**22.** Which would be reduced as a result of the development of pest-resistant crops?

    **A.** use of organic fertilizers

    **B.** use of chemical insecticides

    **C.** practice of crop rotation techniques

    **D.** practice of hydroponic farming techniques

**23.** Which is a concern of scientists when genetically modifying plants?

    **A.** Plants will pass on diseases to animals.

    **B.** There will be a decrease in biodiversity.

    **C.** Plants will have a longer growing season.

    **D.** There will be a decrease in revenue for pesticide manufacturers.

**24.** Which is the *most useful* change made to crops using applications of biotechnology?

    **A.** Crops use more nutrients.

    **B.** Crops need more fertilizer.

    **C.** Crops resist more diseases.

    **D.** Crops take more time to grow.

**25.** Which are *most closely* related to biotechnology?

    **A.** medicine and agriculture

    **B.** construction and engineering

    **C.** water treatment and electricity generation

    **D.** communication and information technology