UNIT II - ISSUES IN BIOTECHNOLOGY

Lesson 1:   Challenges to Biotechnology

Competency/Objective: Explain the major issues associated with agricultural biotechnology.

Study Questions

    1.   What are the major issues associated with the use of biotechnology in agriculture?

    2.   What are the food safety issues associated with genetically modified foods?

    3.   What are the labeling issues associated with genetically modified foods?

    4.   What are the issues related to releasing genetically altered plants and animals into the environment?

    5.   What are the animal welfare issues raised by agricultural biotechnology?

    6.   What are other moral issues concerning agricultural biotechnology?

References

    1.   *Biotechnology: Applications in Agriculture (Student Reference).* University of Missouri-Columbia: Instructional Materials Laboratory, 1998, Unit II.

    2.   Transparency Masters

        a)   TM 1.1:   Results of the Community Survey
        b)   TM 1.2:   Summary of Data

    3.   Activity Sheets

        a)   AS 1.1:   Community Survey (Instructor)
        b)   AS 1.1:   Community Survey (Student)

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TEACHING PROCEDURES

A.   Introduction

      New technology has always sparked controversy, and biotechnology is no exception. Many ethical
      issues are emerging as genetic manipulation is used more frequently. This lesson will outline some
      current issues in biotechnology.

B.   Motivation

      Bring in two glasses of milk, types of cheese, carrots, tomatoes, or other vegetables. Ask students to
      taste them to see if they can tell a difference. Tell the students that one sample could be a product of
      biotechnology. Ask students if they think that both of the samples are safe. How would they know if a
      food was genetically modified? Would they even care?

C.   Assignment

D.   Supervised Study

E.   Discussions

      1.   Ask students for examples of issues in biotechnology that they have seen in the news.

            What are the major issues associated with the use of biotechnology in agriculture?

            a)   Safety of genetically modified food
            b)   Labeling of genetically modified foods
            c)   Safety of releasing genetically modified organisms into the environment
            d)   Animal welfare issues
            e)   Morality of genetic engineering

      2.   Ask students how they felt when told that the one of the samples of milk, cheese, or vegetables
            might be a product of biotechnology. Discuss the difference between perception of safety and
            actual safety.

            What are the food safety issues associated with genetically modified foods?

            a)   The Food and Drug Administration (FDA) states that genetically engineered foods are as
                  safe as or safer than other foods, since they must meet the same standards; many
                  scientific studies show no differences in the chemical composition of modified and
                  unmodified foods.
            b)   Some consumers, including some restaurants and chefs, have refused to use genetically
                  altered food, because they claim the government has not done enough to ensure their
                  safety.
            c)   Some scientists caution that since no long-term studies have been done on the effects of
                  modified foods on human health, their long-term safety is unknown.
            d)   Other consumers fear that modified foods may have genes that cause allergic reactions
                  or reduce the effectiveness of antibiotics (through the use of antibiotic-resistant genes
                  during the process of genetic engineering).

      3.   Discuss the pros and cons of labeling food as genetically modified.

What are the labeling issues associated with genetically modified foods?

a) Some people argue that the public has a right to know if food has been genetically engineered to be able to make an informed decision about whether to buy it.
1) Some people view genetic modifications as unacceptable for religious reasons.
2) Vegetarians may want to avoid modified foods because they may contain genes taken from animals.

b) The FDA's policy is that since genetically modified foods are no different from other foods, no need exists for labeling them as modified, with two exceptions.
1) The FDA requires a label for foods with a gene that could cause an allergic reaction.
2) The FDA requires a label if genetic engineering makes a significant change in a food's composition.

4. Ask students if they have seen vegetables in a garden cross-pollinate and produce different fruit. Discuss the possible problems associated with releasing genetically altered organisms.

What are the issues related to releasing genetically altered plants and animals into the environment?

a) Releasing genetically modified organisms into the environment may introduce altered genes into native populations, giving them undesired traits.

b) Releasing modified organisms may reduce biodiversity, if unmodified organisms are unable to compete.

5. Ask students to discuss what treating animals humanely means.

What are the animal welfare issues raised by agricultural biotechnology?

a) Some people question whether it is morally right to genetically engineer an animal to alter its natural ability to produce.

b) Some people argue that altering animals to produce pharmaceuticals and other health products for humans is inhumane.

6. Ask students about other ethical reasons that people oppose genetic engineering. Have students complete AS 1.1. Use TM 1.1 to tabulate the results of the surveys. TM 1.2 can be used to further illustrate the results.

What are other moral issues concerning agricultural biotechnology?

a) Some people view genetic manipulation as "playing God," which oversteps the boundaries of what is appropriate for humans.

b) Genetic manipulation may permanently alter the balance of nature.

F. Other Activities

1. Have a spokesperson who favors genetic engineering and one who is against it speak to the class. The Union of Concerned Scientists is a possible source of speakers opposed to biotechnology. University research programs and biotechnology companies such as Monsanto are good sources of biotechnology speakers in favor of genetic engineering. An Internet search may help locate speakers.

2. Have students debate the issue of labeling genetically altered foods. Divide the class into two groups, with one group favoring labeling and the other group opposing it. Have each group collect information that supports its position and then hold a formal debate in class.

3. Have students conduct an Internet search to identify additional issues connected to biotechnology.

G. Conclusion

Agricultural biotechnology promises to raise food production to a new level, but concerns held by the public may slow its acceptance. Food safety and labeling, environmental concerns, and moral issues all need to be addressed so that the public has confidence in the use of biotechnology in agriculture.

H. Answers to Activity Sheet

AS 1.1

Answers will vary.

I. Answers to Evaluation

1. d
2. c

3. Students may give either of the following answers: some people question whether it is morally appropriate to genetically engineer an animal to exceed its natural ability to produce, or some people argue that altering animals for pharmaceuticals and health products for humans is inhumane.

4. Some scientists argue that releasing genetically modified organisms into the environment is dangerous because they may introduce altered genes into native populations, giving them undesired traits. Others argue that releasing modified organisms will decrease biodiversity, because unmodified organisms will be unable to compete.

5. Answers may be either of the following: genetic engineering is "playing God," or genetic engineering could alter the balance of nature.

UNIT II - ISSUES IN BIOTECHNOLOGY   Name _____

Lesson 1:   Challenges to Biotechnology   Date _____

EVALUATION

Circle the letter that corresponds to the best answer.

1.   Which of the following is <u>not</u> a major issue associated with the use of biotechnology?

      a.   The safety of genetically engineered foods for human consumption
      b.   The welfare of animals on which biotechnology is used
      c.   The labeling of modified foods as products of biotechnology
      d.   The exploitation of the microorganisms used in genetic engineering

2.   When does the FDA require products of biotechnology to be labeled?

      a.   Whenever foreign genetic material is introduced into a plant
      b.   Whenever a gene from an animal is introduced into a plant
      c.   Whenever a gene that could cause an allergic reaction is used
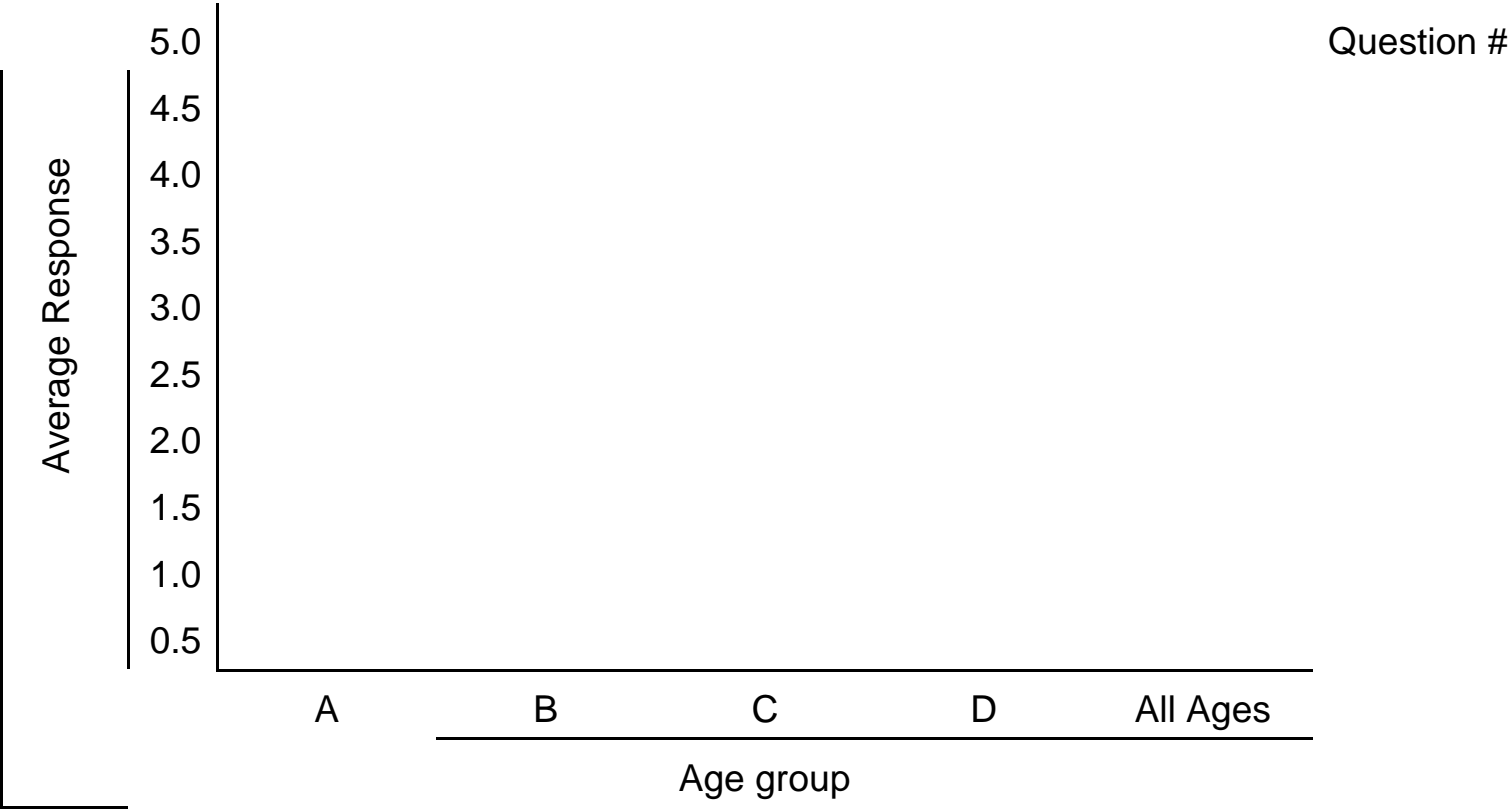   d.   Whenever a gene that is antibiotic-resistant is used

Complete the following short answer questions.

3.   What is one issue raised by people who are concerned about the use of biotechnology on animals?

4.   What are two reasons that some scientists question the safety of releasing genetically modified plants into the environment?

5.   What is one reason that genetic manipulation may be considered morally wrong?

Question Number	Category A <20 yrs old Average Score	Category B 20 - 40 yrs old Average Score	Category C 40 - 60 yrs old Average Score	Category D over 60 yrs old Average Score	Overall Score
1					
2					
3					
4					
5					
6					
7					

Question #

Average Response

5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5

A   B   C   D   All Ages

Age group

Lesson 1:   Challenges to Biotechnology

Community Survey

Objective: Investigate the reactions of the public to agricultural biotechnology.

1.   Give each student four copies of AS 1.1, since they must interview four people.

2.   When they have finished, collect the completed surveys from the students and have them assist in sorting, tabulating, and recording the survey results. TM 1.1 is provided to help tabulate the results of the survey. The results of the survey could also be given to a statistics class for further analysis or assigned to an advanced student for further analysis of the differences in responses by gender.

3.   Sort the surveys by age group: <20 (Group A), 20-40 (Group B), 40-60 (Group C), and >60 (Group D).

4.   Beginning with Group A, write the scores of the first question on the board. Find the average score for the question and record it on TM 1.1. Repeat this process for each age category.

5.   Find the average score for each question using all of the surveys, and record the score in the "Overall Score" column of the transparency.

6.   A bar graph has been included in TM 1.2 that can be used to compare the response for each question.

7.   Interpret the data. An average median score of 2.5 for a statement shows that the community is neutral about it. A score greater than 2.5 shows an attitude that supports the statement. A score less than 2.5 shows an attitude that does not support the statement. Discuss the attitudes revealed by this survey. Is age a factor in the attitudes displayed by the community? What is the overall perception of biotechnology in the community? Discuss the limitations and accuracy of this survey and its results.

      Note: Some statements are positive, while others are stated in a negative form. Response scores must be interpreted in the context of the original form of the statement.

Lesson 1:   Challenges to Biotechnology   Name _____

Community Survey

Objective: Investigate the reactions of the public to agricultural biotechnology.

To understand current societal attitudes toward agricultural biotechnology in your community, use the statements below to survey four people. Survey one person from each age group. Record each person's approximate age and gender and their level of agreement or disagreement with each statement.

Age Group (circle one):   Under 20   20-40   40-60   Over 60

Gender: Male   Female

1.   Foods products from genetically modified plants are safe to eat.

    1   2   3   4
    Strongly disagree   Disagree   Agree   Strongly agree

2.   Genetically modified crops pose no real threat to nature or the environment.

    1   2   3   4
    Strongly disagree   Disagree   Agree   Strongly agree

3.   Genetically modified foods sold in a grocery store should carry a label that states that they are genetically modified.

    1   2   3   4
    Strongly disagree   Disagree   Agree   Strongly agree

4.   Genetically modifying animals is inhumane.

    1   2   3   4
    Strongly disagree   Disagree   Agree   Strongly agree

5.   Genetically modifying plants is morally wrong.

    1   2   3   4
    Strongly disagree   Disagree   Agree   Strongly agree

6.   Genetically modifying animals is morally wrong.

    1   2   3   4
    Strongly disagree   Disagree   Agree   Strongly agree

7.   Genetic engineering will significantly increase food production over the next ten years.

    1   2   3   4
    Strongly disagree   Disagree   Agree   Strongly agree