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| **TEXAS CTE LESSON PLAN**[www.txcte.org](http://www.txcte.org) |
| **Lesson Identification and TEKS Addressed** |
| **Career Cluster** | Science, Technology, Engineering & Mathematics |
| **Course Name** | Principles of Biosciences |
| **Lesson/Unit Title** | Biotechnology, Science, Technology, and Ethics |
| **TEKS Student Expectations** | **130.403. (c) Knowledge and Skills**(2) Students will be able to analyze, evaluate, and critique scientific explanations by using empirical evidence, logical reasoning, and experimental and observational testing, including examining all sides of scientific evidence of those scientific explanations, so as to encourage critical thinking by the student(A) The student is expected to determine interests and aptitudes through conversations with biotechnology professionals (B) The student is expected to identify career options in the field of biotechnology(C) The student is expected to identify reliable sources of career information(D) The student is expected to research interests, knowledge, educational level, abilities, and skills needed in a biotechnology-related occupation |
| **Basic Direct Teach Lesson**(Includes Special Education Modifications/Accommodations and one English Language Proficiency Standards (ELPS) Strategy) |
| **Instructional Objectives** | The students will be able to:* Define and describe biotechnology
* Recall historical and important events involving biotechnology
* Identify occupations in the biotechnology industry
* Describe the importance of biotechnology to improvements in the quality of life
* Evaluate moral and ethical issues involving biotechnology
* Apply higher order thinking and analysis skills to defend a controversial position
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| **Rationale** | After completing this lesson, students will demonstrate they have a broad understanding of the field of biotechnology by completing the biotechnology quiz. |
| **Duration of Lesson** | Teacher’s Discretion |
| **Word Wall/Key Vocabulary***(ELPS c1a,c,f; c2b; c3a,b,d; c4c; c5b) PDAS II(5)* | The key vocabulary in this lesson plan is in a separate document in the lesson plan attachment section. |
| **Materials/Specialized Equipment Needed** | **Instructional Aids:*** Definitions, Key Figures, and Major Historical Developments handout for each student
* Biotechnology quiz and quiz key

**Materials Needed:*** Any cereal product (actual or picture)
* A picture(s) of domesticated animal(s)
* Technical Report and Presentation Rubric for each student

**Equipment Needed:*** Computer with internet access
* Projector
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| **Anticipatory Set**(May include pre-assessment for prior knowledge) | * **SAY:** Today we are going to be talking about one of the most important fields of technology that exists. Historically, biotechnology primarily involved the food we eat, but more recently biotechnology involves our health and health care.
* **ASK:** Does anyone know how long biotechnology has existed?
* **SAY:** 10,000 years
* **SHOW:** Any cereal product.
* **SAY:** This is a product that is the result of biotechnology.
* **ASK:** Can anyone tell me how many different elements of biotechnology went into the development of this product?
* **SAY:** Crop selection, pesticide and fertilizers, vitamin and mineral enrichment, even genetic engineering through DNA manipulation.
* **SHOW:** A picture of any domestic animal (dog, horse, cow, etc).
* **ASK:** Historically, how have we performed biotechnology on this animal?
* **SAY:** Breeding.
* **ASK:** How do we perform biotechnology today?
* **SAY:** Cloning, genetic engineering.
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| **Direct Instruction \*** | Outline | * Instructor Notes
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| I. Start With The Definition of BiotechnologyA. Students should know that some forms of biotechnology have been around for thousands of yearsB. Current biotechnology is heavily dependent upon laboratory experiments and equipmentII. HistoryA. Arguably, no field of science has improved global human health more.B. Current biotechnology research and development rely heavily on recombinant DNA.C. Biotechnology fields and categories overlap to some degree, but involve different types of information.D. More than 325 million people worldwide have been helped by the more than 150 biotechnology drugs and vaccines approved by the U.S. Food and Drug Administration.III. Classification of BiotechnologyA. Fields of study and employment B. Processes involved in research and developmentC. Categories such as diagnostics or therapies, medical or agriculturalV. Ethical and Social ConsiderationsA. There are a number of controversial elements to biotechnology.B. There are often no definitive answers to some of the controversy.C. There are a huge number of Internet- based sources that look at both sides of an issue.D. The nature of this field is almost uniquely suited for students to perform individual or team based research.E. Research can lead to a written report or a verbal presentation.VI. Assign Student Research and/or PresentationA. Evaluation according to assessment rubric | * It is designed to give background and general information; however, the lesson is designed around student research. The intention is to prepare the students for their research.
* History can be amplified and covered in more depth at teacher’s own discretion. The definitions and historical figures handout include a timeline that provides a guide.
* There are a variety of different ways to classify and categorize all of the different elements of biotechnology.
* Students should be able to find a field or topic that they find interesting and have an opinion on.
* Leverage their interest to get them to perform the work involved with researching and analyzing both sides an issue.
* Distribute Technical Report and Presentation Rubric to each student. (Teacher may modify the assessment rubric provided with this lesson as needed.)
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| **Guided Practice \*** | Introduce some of the ways to categorize and classify different elements to the broad field of biotechnology.  |
| **Independent Practice/Laboratory Experience/Differentiated Activities \*** | Independent practice will primarily involve individual or team-based student research, but can also involve reviewing the handout on definitions, key figures, and major historical breakthroughs. |
| **Lesson Closure** | * **Question:** What is the major focus of biotechnology today?
* **Answer:** Manipulation of DNA through genetic engineering.
* **Question:** What is the difference between diagnostics and therapy?
* **Answer:** Diagnostics tests for the presence or absence of a disorder, therapy treats thedisorder.
* **Question:** What are the two categories of agricultural biotechnology?
* **Answer:** Crops and livestock. (These can be further subdivided.)
* **Question:** What are two other types of technology that are used to develop and improvebiotechnology?
* **Answer:** Microelectronic technology and nanotechnology. (There can be other answers.)
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| **Summative/End of Lesson Assessment \***  | **Informal Assessment:*** Notes and definitions that are assigned as board work can be graded. As students perform research, give grades for milestones or stages of completion.

**Formal Assessment:** * Quiz based on definitions, key figures, and major historical breakthroughs.
* The research paper or presentation will be the major component of formal assessment. Quality of research and presentation will be assessed with Technical Report and Presentation Rubric.
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| **References/Resources/****Teacher Preparation** | **Teacher Preparation:*** Perform some background research using internet resources, including those given in the lesson plan. Because of the ethical and moral issues involved in biotechnology, this material is particularly well suited to independent or team based student research.

**References:*** Daugherty, E. (2006). Biotechnology: Science for the New Millennium. EMC Publishing.
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| **Additional Required Components** |
| **English Language Proficiency Standards (ELPS) Strategies** |  |
| **College and Career Readiness Connection[[1]](#footnote-1)** |  |
| **Recommended Strategies** |
| **Reading Strategies** |  |
| **Quotes** |  |
| **Multimedia/Visual Strategy****Presentation Slides + One Additional Technology Connection** |  |
| **Graphic Organizers/Handout** |  |
| **Writing Strategies****Journal Entries + 1 Additional Writing Strategy** |  |
| **Communication****90 Second Speech Topics** |  |
| **Other Essential Lesson Components** |
| **Enrichment Activity**(e.g., homework assignment) | Have a student do in depth research on any one of a variety of topics: labeling bio engineered foods, genetically modified foods, cloning, patenting DNA, what is DNA, recombinant DNA, methods to treat cancer or HIV. You can have a student pick (or be assigned) any one of dozens of historical figures and people who have made important contributions to biotechnology to perform in depth research. You can have students research the various fields involved in biotechnology, like forensics. |
| **Family/Community Connection** |  |
| **CTSO connection(s)** | SkillsUSATechnology Student Association |
| **Service Learning Projects** |  |
| **Lesson Notes** |  |

1. Visit the Texas College and Career Readiness Standards at <http://www.thecb.state.tx.us/collegereadiness/CRS.pdf>, Texas Higher Education Coordinating Board (THECB), 2009. [↑](#footnote-ref-1)