



Wizards of Wright

Lesson: BioTech

<p>Background Info for Wizards:</p>	<p>Biotechnology is the science of altering living things to make human life better. Some examples include biofuels, vaccines, pest resistant crops, and lactose free milk.</p> <p>In this lesson, we will be exploring the various ways that biotechnology helps humans. Then we will explore the early days of biotechnology by learning about fermentation.</p> <p><i>Warm up the water in the electric teapots just before starting the lesson. The teapots will automatically turn off when the water is thoroughly heated. The water should stay warm in the pot until needed. Be sure that the electric tea pot is plugged in at a separate supply table.</i></p>
<p>Materials:</p>	<p><u>Student Activity #1</u> Bio Tech Sectors packet Bio Tech Student Worksheet</p> <p><u>Student Activity #2</u> 6 trays (1 per group) 30 clear tall thick plastic cups (5 per group, each labeled #'s 1-5) 30 single packages of yeast (5 per group) 24 packets of sugar (4 per group) 6 teaspoons (1 per group) 6 salt packets (1 per group) Experiment Lab Sheets</p> <p><u>To keep at the supply table:</u> 2 electric teapots 4 teaspoon measuring spoons 2 containers of baking soda 2 small bottles of vinegar</p>
<p>Lesson Time: 75-80 minutes</p>	<p>Introduction: 5 minutes Guided Lesson #1: 5 minutes Guided Lesson #2: 5 minutes Student Activity #1: 20 minutes</p>



	<p>Guided Lesson #3: 10 minutes Guided Lesson #4: 5 minutes Student Activity #2: 20-25 minutes Conclusion: 5 minutes</p>
<p>Learning Targets:</p>	<p>Students will learn that in the field of Biotechnology, scientists are altering living things to better human life.</p> <p>Students will explore various examples of biotechnology.</p> <p>Students will conduct an experiment using yeast and learn about fermentation, which was one of the earliest forms of biotechnology.</p>
<p>Introduction for Students: 5 minutes</p>	<p>Ask the students: Have you ever heard of Biotechnology? As you probably know Bio is short for biology, which is the study of all living things. Technology is another word for tools. Biotechnology then, is a tool that uses biology to make new products.</p> <ul style="list-style-type: none"> - Biotech is broadly defined as applying scientific and engineering principles to produce or modify living organisms for specific purposes. - This can include everything from developing new medicines and crops to creating cleaner energy sources and improving animal welfare. - Food Science, Agriculture, and medicine are the primary applications of biotechnology. - In biotechnology, living organisms are utilized to create useful products and chemicals. <p>Modern biotechnology also provides breakthrough products and technologies to fight diseases, reduce our environmental footprint, feed the hungry, use less and cleaner energy, and have safer, cleaner, and more efficient industrial manufacturing processes.</p> <p>For over ten thousand years, people have been involved in harnessing different biological processes to improve their quality of life.</p>
<p>Guided Lesson #1: 5 minutes</p>	<p>Say to the students: Before you move on to your first activity, let's talk a little more about what Biotechnology is.</p> <ul style="list-style-type: none"> - Biotechnology is a process that uses living cells or microorganisms to make or change products.



	<ul style="list-style-type: none">- It can also be used to improve plants or animals.- Biotechnology can help us find new ways to treat infectious diseases, produce food, and recycle waste.- Biotechnology can include using plants, animals, and bacteria to create new drugs, foods, or other materials.- Common biotechnologies include genetically modified foods, artificial enzymes, and medical treatments such as vaccines and gene therapy.- Biotechnology can also be used to improve crops or livestock. <p>The significance of biotechnology has emerged due to the advancement of extensive research and development. It is a branch of biology with many applications in medicine, engineering, science and technology, agriculture, and other fields.</p>
<p>Guided Lesson #2: 5 minutes</p>	<p>Say to the students: Let's take some time to learn about a few of the biotechnology sectors.</p> <p>Ask students: What do I mean when I say sector?</p> <ul style="list-style-type: none">- Answers may include division, part, area, district, branch, or zone <p>Biotechnology is a huge field of science and study that has grown very quickly and those working in these fields categorized the sectors/branches into a color-coded classification system.</p> <p>There are around 15 sectors of biotechnology. Each are expressed by a different color – today we will explore just some of them.</p> <p>You'll work with your group to learn about the following sectors:</p> <ul style="list-style-type: none">- Red Biotechnology- White Biotechnology- Green Biotechnology- Yellow Biotechnology- Blue Biotechnology- and Grey Biotechnology
<p>Student Activity #1: 20 minutes</p>	<p>(Students will be working in groups of 2-3 for this activity. Ask the teacher if the groups have already been created. If not, wait while he or she does this.)</p>



Say to the students: Your group will receive these packets, (show them the sector packet) so that you can read through the different color sectors and learn about how they are used.

Then your group will get these worksheets (show them the worksheet) to show what you've learned. As a group, you will be matching the biotechnology achievement with their branch of biotechnology by reading the information and clues provided.

Pass out the materials.

Give the groups time to read and match the achievement with the Biotechnology sector based on the clues provided on the worksheet. They will circle the name of the achievement that best matches the clues.

After the groups are finished, have a brief discussion over some of the information they read about in the packet.

Say to the students: Now that you have a good understanding of what the different Biotechnology sectors are, let's go through the answers on your worksheets.

Continue to discuss other parts of the sector if you find it necessary.

Green Biotechnology - One agricultural improvement would be the work done to create frost resistant crops.

Ask students: How would frost resistant crops help humans?

Red Biotechnology – The covid vaccine.

Ask students: What other benefits did you learn about that from Red BioTech?

Yellow Biotechnology - Genetically modified foods.

Yellow Biotechnology has to do with increasing the nutrition found in foods. Over the years, due to over-farming, the nutrition in our foods has decreased. Bioengineers are working hard to fix that.

Blue Biotechnology – More efficient fisheries.

These scientists are concerned with the health of our oceans. They come up with ways to save coral reefs, and to make sure that humans do not overfish.



	<p>White Biotechnology - Pollution free paper manufacturing. Ask students: What do you find most valuable about White Biotechnology?</p> <p>Grey Biotechnology - Bacteria that breaks down plastic. These engineers are working with microorganisms, bacteria, fungus, and enzymes that will break down items like plastic faster. Ask students: Who can explain the term “single use plastic”, why it is something we are worried about, and what we can do to make things different?</p>
<p>Guided Lesson #3: 10 minutes</p>	<p>Ask students: What do stone-washed jeans have in common with bread, cheese, and wine? - They are all examples of manipulating living organisms to create products or new processes. They are all products of biotechnology.</p> <p>Say to the students: Humans have used biotechnology since the dawn of civilization. Egyptians used yeasts to bake leavened bread, the Chinese developed fermentation techniques for brewing and cheese making, and the Aztecs used Spirulina algae to make cakes.</p> <p>Although much of modern biotechnology does deal with manipulating DNA, classical biotechnology began long before we even knew about genes or chromosomes. What began as recipes for production of food now includes technology to enhance everything from farming to pharmaceuticals.</p> <p>What we think of as modern biotechnology began around the end of the nineteenth century. By then, Mendel’s work on genetics was completed and institutes for investigating fermentation along with other microbial processes had been founded by Koch, Pasteur, and Lister.</p> <p>We’ve been talking about modern biotechnology, and how this science is used today, but yeasts are regarded as the first microorganisms used by humans to process food and alcoholic beverages. The technology developed out of these ancient processes has been the basis for modern industrial biotechnology.</p> <p>The use of yeast for food processing and fermentation is traditionally marked as the primary inventive step of biotechnology, dating back several millennia.</p> <p>Ask students: Can anyone explain what happens during fermentation? - It is the chemical breakdown of a substance (often sugar) by</p>



	<p>bacteria, yeasts, or other microorganisms, typically forming gas bubbles and giving off heat.</p>
<p>Guided Lesson #4: 5 minutes</p>	<p>Say to the students: The use of microorganisms to make bread, alcoholic beverages, and cheese are some common examples of the application of biotechnology.</p> <p>Using yeast for fermentation seems to be the beginning of biotechnology. Today we will use the microorganism yeast in our experiment.</p> <p>Ask students: Who can tell me what a microorganism is?</p> <ul style="list-style-type: none"> - Microorganisms are living things that are too small to be seen with just our eyes. They are normally viewed using a microscope. - Bacteria, viruses, and some molds are examples of microorganisms. <p>Ask students: What do you know about yeast?</p> <ul style="list-style-type: none"> - Yeast makes bread rise. - It creates enzymes, which are proteins that speed up chemical reactions in our body. - It is a microorganism. - It gives off carbon dioxide. <p>Ask students: Can anyone explain what it means to say that yeast is dormant?</p> <ul style="list-style-type: none"> - You are waiting for answers like asleep, not moving, not alive, or not working. <p>Explain to students that to use the yeast, it will have to be activated.</p>
<p>Student Activity #2: 20-25 minutes</p>	<p>(Students will be working in groups of 3-4 for this activity. Ask the teacher if the groups have already been created. If not, wait while he or she does this.)</p> <p>Say to the students: Our goal for this experiment will be to find the best fermentation conditions.</p> <ul style="list-style-type: none"> - If the enzymes present in the yeast are released it will create a gas called carbon dioxide. - The carbon dioxide will create bubbles. - This will mean the fermentation process has begun. - If your cup is not producing carbon dioxide, then fermentation is not happening.



	<p>Prior to starting the experiment: Show the students the supply table. Explain that when directed, one student from each group may come up for supplies:</p> <ul style="list-style-type: none"> - 1 tray - 5 cups (labeled #'s 1-5) - 5 packets of yeast - 4 packets of sugar - 1 salt packet - 1 teaspoon - 1 Lab Sheet <p>After prepping their lab area, one person per group may go to the supply table for baking soda and vinegar. <i>(Suggestion: Ask the teacher to stay at the supply table. You must be available to pour the warm water, or at least supervise the students doing so.)</i></p> <p>Explain to the students that for a successful experiment they need to follow all the directions on their instruction sheet.</p> <p>Make sure there is time for all materials to be collected, and for everything to be cleaned up and put away.</p>
<p>Conclusion: 5 minutes</p>	<p>Review with students.</p> <ul style="list-style-type: none"> - Ask them to recall the field of biotechnology sectors, and what they focus on. - Have students list any of the achievements they can. - Have groups share what mixture of fermentation worked the best and why. - Have groups share anything that didn't go correctly in their lab, and why. -
<p>Extension Conversation:</p>	<p><u>Impact of Biotechnology on Society</u></p> <p>The biotechnology sector has revolutionized the way that humans interact with their environment. The ability to genetically engineer plants and animals has led to several innovations in agriculture, medicine, and industry.</p> <p>However, this technology also poses risks to society. Biotechnology can be used to create harmful organisms or products that could be used for terrorism or warfare. As biotechnology becomes more sophisticated, it is important to ensure that these risks are managed effectively.</p>



Biotechnology has the potential to benefit and harm society, and benefits need to outweigh risks. Social implications need to be considered before implementing biotechnological innovations. It is important to consider the social implications of biotechnology.

- Will we start selecting our children's traits based on genetic tests?
- Agriculture: Increased migration to industrialized countries and depleting food supplies were two of the difficulties that the world confronted towards the end of WWII.
- Due to environmental degradation, substantial agricultural lands were no longer cultivable. As a result, a study group was started with the primary objective of assisting countries in increasing their output of food crops using scientific means or, to put it another way, through biotechnology. As a result, it was decided to splice and produce a new brand of crops that is more resilient to all pests, illnesses, and other environmental factors.
- Vaccines: Scientists were able to develop vaccinations to battle a variety of health conditions, including the H5N1 virus and avian flu virus, thanks to breakthroughs in biotechnology. Biotechnology has been at the forefront of finding critical constituents and assessing disease progression; as a result, all vaccines produced today are the result of biotechnology advancements.
- Early detection and diagnosis: Doctors now can help their patients with a much more accurate diagnosis in a short span of time because of biotechnology. As a result, the physician is better able to treat his patient. This can also be due to numerous diagnostic instruments and biotechnology developments.

Information and graphics credited to: <https://www.sciencelearn.org.nz/resources/1204-ancient-biotechnology/>;

<https://kids.britannica.com/kids/article/engineer/399444>;

<https://explorebiotech.com/introduction-tools-and-applications-of-green-biotechnology/>;

<https://explorebiotech.com/everything-need-know-red-biotechnology/>;

<https://explorebiotech.com/about-yellow-biotechnology/>;

<https://explorebiotech.com/know-about-grey-biotechnology/>;

<https://www.azolifesciences.com/article/The-Colors-of-Biotechnology3b-What-do-they-mean.aspx>;

<https://explorebiotech.com/about-white-biotechnology/>;

<https://explorebiotech.com/blue-biotechnology-introduction-and-applications/>;

<https://kids.britannica.com/kids/article/industry/400596>;

https://www.education.com/science-fair/article/biology_foamy/;

<https://www.pasco.com/resources/lab-experiments/1149/1>;



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Educational Outreach
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WPAFBSTEM.com

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<https://kansole.tomahawkchurch.org/does-ph-affect-fermentation;>
https://www.sciencebuddies.org/science-fair-projects/project-ideas/MicroBio_p011/microbiology/yeast-activity-balloons;
<https://www.sutori.com/en/story/cabbage-ph-indicator--WTyzPhoPLypv4tXgCWsA2gYR>
<https://education.nationalgeographic.org/resource/artificial-selection;>
[https://www.yourgenome.org/facts/what-is-selective-breeding/;](https://www.yourgenome.org/facts/what-is-selective-breeding/)
<https://kids.britannica.com/students/article/domesticated-animal/272875;>
<https://education.nationalgeographic.org/resource/domestication;>
<https://kidadl.com/facts/impressive-biotechnology-facts-for-curious-kids;>
<https://www.azolifesciences.com/article/What-is-Biotechnology.aspx;>
<http://clipart-library.com/biotechnology-cliparts.html;>
<https://biotech.ucdavis.edu/blog/biotechnology-rainbow>
<https://biotech.ucdavis.edu/blog/red-meets-green-biotech-plants-medicine;>
<https://www.khanacademy.org/science/ap-biology/gene-expression-and-regulation/biotechnology/a/intro-to-biotechnology;>
[https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3975642/;](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3975642/)
<https://www.lonestar.edu/history-of-biotechnology.htm>