MODULE 1

Objective 1.1 Lesson B

Biotechnology and Root Beer

Engagement and the Scientific Methods

Course
Advanced Biotechnology

Unit
Biotech Basics

Essential Question *How old is biotechnology?*

TEKS
130.364 1A, 1C, 2B, 2E, 2G

TAKS
Bio/IPC 2A, 2B, 2D

Prior Student Learning
Fermentation

Estimated Time
2 hours

Rationale

Making root beer in the classroom is not only a fun way to engage students, but the activity is a great way to review concepts such as fermentation, the scientific methods and the role of microorganisms in production of food. Lab safety can also be introduced.

Objectives

Students will:

- Learn about fermentation and its applications in biotechnology.
- Perform a controlled experiment, select variables and draw conclusions from their observations.
- Make homemade root beer using yeast to supply carbonation.

Engage

- Ask students to provide some examples of biotechnology in the food and beverage industry? Common examples: cheese, carbonated beverages, wine, yogurt, sauerkraut, bread.

- Allow students 5 minutes to find these examples using the Internet. Compile a list of these products in a displayable form to share with other classes.

Key Points

- Refer to Power Point 1.1 Overview of Biotechnology.

Activity

1. Students work in groups of 2.
2. Students complete the **Pre-Lab** section of **Root Beer Fermentation Lab**. This activity allows students to revisit topics they have covered in previous Biology courses. They may use the Internet or a standard Biology textbook.
3. On the day of the lab, place water bottles in a 37˚C water bath to warm the water which is necessary for yeast activation.
4. Students complete procedures in **Root Beer Fermentation Lab**.
5. Label buckets or trays with class name and sections for root beer bottle storage at room temperature in a dark place.
6. Check bottles every few days for tightness. If bottle very firm, it it time to put them in the refrigerator to stop fermentation. WARNING: Bottles will explode upon opening if they are left to ferment to long. Average incubation time is 5-10 days.
7. Students complete **Post Lab Assignment** of Root Beer Fermentation Lab.
8. If this is the first time they will be writing a Science Report for your class, allow peer grading and corrections to ensure quality reports in future lab reports.

Assessment

- Science Lab Report Rubric

Materials

- Root Beer Fermentation Lab
- Science Lab Report Rubric

Accommodations for Learning

- Visit the **Special Populations** section of the CTE Career and Technology Education Website: http://cte.unt.edu/special-pops.

National and State Education Standards

Texas College Readiness Standards

Science Standards

I. A3, A4, B1, C1, C2, C3
III. A1, B1, B2, B3, C1
IV. A1
VI. B1

LAB: Root Beer Fermentation

May turn in ONE per PAIR

Pre-Lab

Create the Introduction paragraphs of your lab report by explain the relationships between using the following terms:

- Paragraph ONE terms: cellular respiration, aerobic respiration, anaerobic respiration, fermentation, lactic acid fermentation, alcohol fermentation
- Paragraph TWO terms: history of root beer, safrole, sassafras

use interent

To receive full credit:

- All terms should be clearly defined and highlighted.
- Include at least 2 images, diagram or pictures related to your topic. Be sure to add captions and sources to each element.

Lab

MATERIALS

- empty ~~2~~ 1 liter plastic bottle
- 2 bottles (.5 liter) spring water
- Brewer's (champagne) yeast
- sucrose (sugar)
- root beer extract
- small cup & large cup
- funnel
- 10mL & 5mL graduated cylinder

PROCEDURE:

~~Each of you will be given a bottle of spring water. This will be the water used to make your root beer and you will pour your root beer back into these bottles to ferment. Your **team of two people** will be mixing your root beer in one empty 2 liter bottle. After it is mixed you will pour your soda back into the 0.5 liter spring water bottles. Each student will have their own 0.5 liter bottle of soda at the end of this process.~~

One member of your team will follow the recipe below. The other member of the team will change ONE variable in the recipe below (amount of yeast, temperature of water, amount of sugar, sugar source, incubation temperature etc….)

The recipe to the right is for EACH root beer sample. Read the procedure and decide which variable will be changed in the second batch of root beer. Mark and record on this document where changes are made.

~~1. Obtain your **warmed** bottles of spring water. The bottles should be heated to about body temperature (37°C).~~

2. Measure 0.125g of dry yeast in a small beaker or cup. Add 25mL of the warm water from your spring water bottles to the yeast so it dissolves. Let stand for at least 5 minutes.

3. While the yeast is dissolving, measure 2 milliliters of root beer extract using a plastic pipette.

4. Measure ~~50 grams of sucrose (table sugar).~~ 1

5. Obtain your clean, empty large ~~2~~ 1-liter soda bottle. This will be your **mixing bottle**. First, pour the sucrose into the 2-liter bottle using a funnel.

6. Next pour the root beer extract into the same 2-liter bottle.

7. Add the dissolved yeast mixture to the same 2-liter bottle.

8. Add the rest of the bottle of warmed spring water into the same 2-liter bottle.

9. Pour the root beer mixture into your empty spring water bottle. **Do not fill the bottle all the way.** Only fill to the point that the straight sides of the bottle start to curve in to the neck. Give your teacher any excess root beer mixture.

10. Close the cap on your bottle **tightly** and hold it upside down for a minute to check for leaks. Label the **cap** with your **initials** and your **class period** on it.

11. Observe and describe the appearance of the root beer on your lab.

12. Give the bottle to your teacher. We will age the root beer for 2–3 weeks at room temperature in a dark place. After that we will refrigerate for 1 week.

13. Refrigeration will stop the fermentation process and kill the yeast. Be sure to check bottles every day for tightness, if they get too pressurized, they will burst.

14. After chilling, get your bottle, open carefully, pour a sample into a cup, and observe and record the appearance of the root beer. Now have a taste.

next class but can start now if you want

Post Lab: Root Beer Fermentation

1. Generate a Science Lab Report using provided rubric.

2. Answer the questions below to be used in your conclusion section.
    a. What was the purpose of the yeast?

    b. Why was the water heated?

    c. Why was the sucrose necessary?

    d. Where did the CO2 come from?

    e. Why did we have to leave the bottle for a few weeks?

    f. What process is the yeast using to make energy? Express this in an equation form.

    g. Briefly observe your bottle. What has happened? WHY?

    h. What happened in your group's experiment? (How did the variable affect the rate of fermentation?)

    i. What was one possible error?

    j. Is safrole still used to make root beer? Why or why not?

    k. Is yeast still used for carbonation of soda drinks? If not, what methods are used instead? Why?

    l. Find another food or beverage product that is made with the help of microorganisms. Describe the process product and the process.

SCIENCE LAB REPORT RUBRIC

IDEAS AND ORGANIZATION

Title	**Title** refers to lab topic. 2	**Title** refers to lab topic. 1	**Title** loosely or does not refer to lab topic. 0
Research and Introduction (How is it made? Science behind the production of root beer)	***Ideas*** are thoroughly researched and presented in your own words. ***Organization*** is logical. Bibliography is included. 2	***Ideas*** are adequately researched and in your own words. ***Organization is*** logical. Bibliography is included. 1	***Ideas*** are inadequately researched and/or are not in your own words. ***Organization*** is not logical. Bibliography not included. 0
Hypothesis (Chose a variable)	***Idea*** for your hypothesis is highly logical and based on your research. 2	***Idea*** for your hypothesis is somewhat logical and/or loosely based on your research. 1	***Idea*** for your hypothesis is not logical and/or is not based on your research. 0
Materials and Procedure (List)	Lists are thorough and ***organized***. Used quantity when appropriate. 2	Lists are complete and ***organized***, but may have some materials, steps or quantities missing. 1	Lists are not complete or ***organized***. Many materials, steps, or quantities missing 0
Data/Results (How will you evaluate your results)	Data is highly ***organized,*** and uses charts, tables, graphs, or diagrams. 3	Data is somewhat ***organized***, and uses charts, tables, graphs, or diagrams. 2	Data is ***disorganized***, or charts, tables, graphs and diagrams not used. 1
Data Analysis	***Ideas*** in analysis are ***organized*** and logically use data to support or reject hypothesis. 6	***Ideas*** in analysis are somewhat ***organized*** and use data to support or reject hypothesis. 4	***Ideas*** in analysis are not ***organized*** or do not use data to support or reject hypothesis . 2
Conclusion	***Ideas*** are highly logical and ***organized***, and rely on research, data, and data analysis to thoroughly answer post lab questions. 7	***Ideas*** are somewhat logical and ***organized***, and rely on research, data, and data analysis to thoroughly answer post lab questions. 5	***Ideas*** are not logical or ***organized***, or do not rely on research, data, and data analysis to thoroughly answer post lab questions. 2

WRITING AND PRESENTATION

Word Choice and Voice	Correctly uses **vocabulary** appropriate to topic and third-person scholarly voice 2	Uses appropriate **vocabulary** with some mistakes and a third-person voice 1	Does not use or incorrectly uses appropriate **vocabulary** and uses first or second-person voice 0
Conventions	Few to no **grammar** mistakes 2	Some **grammar** mistakes, but do not distract from ideas 1	Many **grammar** mistakes, distract from ideas
Presentation	Lab report is extremely **neat and easy to read**. Uses blue or black ink, or Times New Roman font size 12, with 1 inch margins. 2	Lab report is **neat and easy to read.** Uses blue or black ink, or Times New Roman font size 12, with 1 inch margins. 1	Lab report is not **neat or easy to read.** Uses non-blue or black ink or does not follow font and margin specifications. 0

NAME: _____ Total Points: _____/30