Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**I CAN** distinguish between living and nonliving things based on characteristics.

List the six characteristics of living things.

Period: \_\_\_\_Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Does Yeast Use Energy?**

**Scientific Investigation to Test for Metabolism**

* To begin to answer the question "Is yeast alive?” you will test whether the grains of yeast have one of the characteristics of living things -- the ability to **use energy** (eat!).
* To metabolize “something” such as food, means to change the food into a form that can be used by the organism. This process requires energy.
* We will test whether yeast can metabolize sugar and produce a gas, carbon dioxide. If yeast produces a gas when we “feed” it sugar, it’s alive. If no gas is produced, then it does not metabolize (**use energy**) and we can conclude that it has one characteristic of living things.

**I. Purpose:**

The purpose of this experiment is to determine if yeast **uses energy** (metabolizes) and produces a gas when sugar is available.

**Research Question:** Does yeast metabolize sugar and produce a gas?

**Predictions**: A. Do you expect yeast to produce a gas when sugar is available? \_\_\_\_\_\_\_\_\_\_

 B. Do you expect yeast to produce a gas when no sugar is available?\_\_\_\_\_\_\_\_

**Hypotheses**: Write your hypotheses.

**\*1.** Do you expect yeast to produce a gas when sugar is available? *(Ex: If sugar is added to yeast, then the yeast will--or will not-- produce a gas by metabolism).*

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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2. Do you expect yeast to produce a gas when no sugar or other food is available? (*Ex. If sugar is NOT added to yeast, then the yeast will--or will not-- produce a gas by metabolism*). \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**II. Materials:**

 ---4 test tubes ---2 sugar packet- ---1 100 mL beaker of 40 mL warm water--105o-115o F (41o– 46o C).

 ---1 test tube rack ---1 stirring stick -- 4 balloon 1 ½ tsp of yeast

**III. Procedure:**

1. Set up four test tubes in a test tube rack.
2. Test tubes **1 and 2** will both have yeast, sugar and water.

 Test tubes 3 and 4 will both have **only** yeast and water, with **no sugar**.

1. Fill a beaker with 40 mL of warm water--105o-115o F (41o – 46o C).

 Add the contents of one container of yeast, the 40 mL beaker (or ½ packet of dry yeast)

 a **LITTLE BIT AT A TIME**, stirring the yeast in thoroughly before adding more.

 Stir by carefully swirling mixture with the wooden stick, being careful not to splash it out of the beaker.

1. Pour the yeast solution from the beaker into each of the four test tubes, filling each test tube evenly—about 10 mL in each tube.
2. Add 1 packet of sugar to **test tube 1 and the other packet of sugar to test tube 2.**

 **Do not add sugar to tubes 3 and 4.**

1. Cover the opening of test tubes 1 and 2 with a RED balloon and test tubes 3 and 4 with a BLUE balloon. **Red=yeast + sugar, BLUE=yeast only**. The balloons will catch any gas that is formed.

 Using the balloon to seal the end of the tests tube, hold a finger over the end of each test tube and shake it vigorously to thoroughly mix the contents.

1. Observe the test tubes and record your observations carefully in the table on the next page.

 Then, every 5 minutes for 25 minutes, observe what occurs in the test tubes and any changes in the balloons which cover each test tube, and record your observations.

8. If the yeast grains are capable of metabolism, it will take some time to produce enough carbon dioxide to see the change in the balloons. Be patient and make careful observations.

 While you are waiting for this change, record your observations every 5 minutes in the table.

 Between recording observations, work on answering the Lab Experiment Questions provided on the back of the yeast Observations and Questions Sheet.

9. After observation, remove the balloons from the test tubes. Rinse out the test tubes, beaker, and stirring stick in a sink. Clean up your lab area and return test tube racks, beakers, and other equipment as you found it.

**IV. Data:**

**Data Table** – record descriptive observations of each test tube at 5-minute intervals in the boxes below

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 0 minutes | 5 minutes | 10 minutes | 15 minutes | 20 minutes |
| Test tube 1\_\_\_\_\_\_\_ |  |  |  |  |  |
| Test tube 2\_\_\_\_\_\_\_ |  |  |  |  |  |
| Test tube 3\_\_\_\_\_\_\_ |  |  |  |  |  |
| Test tube 4\_\_\_\_\_\_\_ |  |  |  |  |  |

**B. Diagram:** Draw a picture of the results of your tubes. Make sure you show if the balloons were inflated or not, and label your test tubes. Take your time. IT MUST BE IN **COLOR**!!

**FORMATIVE PART OF THE YEAST LAB (20% of grade)**

**Post Lab Questions:**

1. Discuss what you saw during the lab **AND** explain how this leads to evidence that yeast is alive.

2. Write down which parts of the experiment are the independent and dependent variables, and which part is the control group.

 control\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 independent variable\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 dependent variable\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Read the article “How does yeast help bread rise?” outloud with your elbow partner and answer the following: When you make bread, if you just mix flour, sugar and water, the dough does not rise, and the bread will be flat and hard. If you include yeast in the bread dough, then the dough rises and the bread is bigger and fluffier. Explain how the yeast helps the bread dough to rise in at least 2 complete sentences.

**V. Conclusion:**

The purpose of this lab is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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I accept or reject \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_my hypothesis (see page 2, \*#1) because \_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

A possible source of error was that \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

To fix that error, next time \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

This LAB relates what we are learning in class now because \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

The most interesting part of this lab was \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Background**

 Microorganisms include bacteria, fungi and viruses. Viruses can only grow and reproduce inside other living cells and therefore is not considered to be a living organisms. Yeast is in the kingdom of fungi. Yeasts are tiny egg shaped single celled fungi which can only be seen with a microscope. They are so small that 1 gram of yeast contains 20,000,000,000 (twenty billion) cells! The species of yeast which you are going to use is called *Saccharomyces cerevisiae* which means “sugar eating brewer” and it is an easy and safe microorganism to work with.

 When yeast, humans, and other living organisms use energy (eat), they break down high-energy molecules like sugar to get the energy they need and give off a gas called carbon dioxide as a byproduct of this reaction.

 Yeast cells use a variety of sugar molecules to obtain energy. This process which is called fermentation is a chemical process that produces two useful products, carbon dioxide and ethanol. In bread baking the yeast ferments sugars available from the flour and added sugar. The carbon dioxide gas cannot escape but the elastic and stretchable dough inflates as the bread “rises.” The alcohol vaporizes during baking. In brewing the sugar is provided by fruit with added sugar or by the natural breakdown of starch into sugar in barley grain as it germinates. The alcohol remains in solution to form the wine or beer and the carbon dioxide escapes from the solution.

***After reading the background above, answer the following questions.***

1. Yeast is classified into which kingdom? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. Humans use yeast every day. Name two common uses of yeast.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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3. When you are looking at a grain of yeast in your lab, explain why you are NOT just looking at ONE single celled organism.\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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4. Is *Saccharomyces cerevisiae* dangerous to work with? \_\_\_\_\_\_\_\_\_\_\_\_\_\_

5. Do you think that the little brown grains of yeast are alive? \_\_\_\_\_\_\_\_

Why or why not?\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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6. To find out whether yeast is alive, we first need to think about what makes something alive. Write down the six characteristics of living organisms that we have learned.

 a.

 b.

 c.

 d.

 e.

 f.

**Circle above which characteristic of life we observed in the Yeast Lab.**