Yeast Populations in a Closed Ecosystem
9/09

Integrated Science 3

Redwood High School **Name:** ______ **Per:** ______

■ Background

Yeast, *Saccharomyces cerevisiae,* are unicellular fungi. Because of their small size and rapid reproductive rates they are ideal organisms for studying the dynamics of populations. Humans also find them quite useful for a variety of purposes, including baking bread and brewing beer. In this lab, you will observe a test tube population of yeast cells growing in a broth medium. This type of population is a closed population, whose changes are entirely dependent on a combination of birth rate and death rate. In contrast, open systems can also increase or decrease in size as organisms enter and leave. In nature, open populations are much more common. Conditions in a closed population are not as complex, and the study of population growth rates is easier than in open systems.

In this laboratory experiment, we are interested in comparisons of total yeast populations under different experimental conditions. As you will soon see, these actual populations will reach into the billions of individual organisms, far too many to be actually counted. As a result, population studies (as well as many other types of scientific work) rely on samples of the larger population to generate the experimental data. By making cell counts from small portions of the entire population, it is possible to accurately estimate the entire population. This method is called *sampling*. To assure the accuracy of these statistical estimates, it is necessary to closely follow standardized sampling procedures, including the averaging of results from a number of sample counts. The success or failure of this experiment and its data analysis will rest largely on your team's ability to follow the standard sampling protocols and perform the subsequent data calculations to arrive at a total population for your culture.

■ Experimental Design

1. Each team will receive a yeast culture and analyze yeast population growth over eight days. The culture consists of the following: 25 ml of sterile yeast medium (made from distilled water, dextrose sugar and peptone protein) and 0.1 ml of stock yeast culture. Dextrose is a nutrient source and peptone provides structural proteins for the yeast. This culture is grown in a sterile culture flask, plugged with cotton to permit the exchange of gas while preventing contamination by other organisms (primarily bacteria and fungus). The cultures will be grown under "room conditions".

2. Each team will be assigned a culture with a different amount of dextrose sugar: 2%, 3%, 4%, 5% or 6%. The culture with 4% dextrose will serve as the control, as it contains the recommended amount.

■ Procedures

1. Complete an experimental organizer for this experiment.

2. Receive your yeast culture. Label the flask with team name, % dextrose and period.

3. These cultures contain a fast growing population of living organisms, resulting in dramatic changes from one 24hr period to the next. Consequently, data must be collected almost every day for a total of eight days. Plan with the other members of your team for data collection on Wednesdays for even periods, Thursday for odd periods, and on the weekend as instructed by your teacher. Only one member of each lab team needs to be present on the non-class data collection sessions.

4. Record your data in the provided data table for each day of data collection. Record class data on the provided data table for each day of data collection.

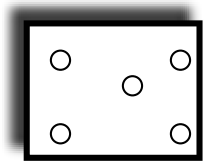
5. On a separate sheet of paper, create a Laboratory Notebook Entry for each day of data collection. Be sure to include drawings/diagrams and identify any procedural errors your team may have made.

■ Sampling Protocol

* *Stopping contamination by other microorganisms - organisms that will compromise your culture - is a major challenge when doing this type of work. Other microorganisms will also use the yeast medium as a source of nutrients; and in some cases devour the yeast. As a result, it is of utmost importance that you strictly follow all sterile protocols.*

1. **Go To The Designated Sterile Sampling Station:**
   - Swirl your team's flasks to mix the culture. This will evenly distribute the yeast.
   - Using a sterile dropping pipet, transfer 1 drop from the culture tube to a microscope slide. Return any culture medium left in the dropping pipet to the culture tube. Place the pipet in the used container. Quickly replace the cotton plug.
   - Carefully place a clean cover slip over the drop, trying not to trap any air bubbles.
   - Find the yeast at 40X, then at 100X, and finally at 400X. Count the yeast at 400X. **Note:** Yeast cells are difficult to see if the light is too bright (adjust the diaphragm to control the amount of light that reaches the slide).

2. Each team member will count, and record, five fields of view (two opposite corners and the middle). Make certain you are observing yeast cells and not other material.
   - ➢ *Choose a field of view with little or no clumping.*



3. Average your teams five counts. Record this value on your raw data table.
   - ➢ *Once the average cell count meets or exceeds ____ , record ____ as your average cell count.*

4. Average team A average with team B average and record this value on your raw data table. In addition, report this value on the class data table.

5. Using class data average cell count values, calculate the following for all levels of the independent variable:

   ➢ **Cells/ml:**

$$\frac{\text{cells}}{\text{ml}} = \frac{\text{average count}}{\text{field of view volume (mm)}^3} \text{ x } \frac{1000\text{mm}^3}{\text{ml}}$$

field of view volume = π x radius^2 x height radius= .2mm, height = .1mm

   ➢ **Population/culture**

$$\text{population per culture} = \frac{\text{cells}}{\text{ml}} \text{ x culture volume (ml)}$$

   ➢ **24 hour growth rate**

$$\text{24 hour growth rate (as a percent)} = \frac{\text{(current day population - previous day population)}}{\text{previous day population}} \times 100$$

■ Data and Results

Construct a graph displaying time vs. yeast population. The graph will contain five curves, one for each level of the independent variable.

■ Discussion

Write a discussion analyzing the results for this experiment. Refer to the Lab Report Format on page 2 in the Guidelines for Experimental Research.

■ Design Outline

Title:

Hypothesis:

Independent Variable:

□ Continuous □ Discontinuous

Levels of I.V. (indicate control treatment):					
# of trials you will conduct for each treatment:					

Dependent Variables: describe **quantitative** and **qualitative** data

Quantitative Measurements (include units):

Qualitative Measurements:

Constants: