Bench Lab- Population Dynamics with Yeast

As organisms reproduce, die, and move in and out of an area, their populations fluctuate. In a closed population, organisms do not move in and out of an area, so their populations change only through *natality*, or births, and *mortality*, or deaths of individuals. Yeast are very small, rapidly reproducing organisms. They can experience dramatic population changes over a relatively short time. In this experiment, a population of yeast will be given a small amount of food and placed in a closed environment. Organic materials will not enter or leave the environment—only inorganic gases will be allowed to be exchanged. The population of yeast can be monitored by measuring the *turbidity*, or cloudiness, of the medium that contains the yeast.

To measure the yeast population, you will be using the Colorimeter. In this device, light from an LED light source will pass through the medium containing yeast and strike a photocell. Photons of light that strike a yeast cell will be reflected away from the photocell and will make the medium appear more turbid. The Colorimeter monitors the light received by the photocell as either an *absorbance* or a *percent transmittance* value. The absorbance value is proportional the population of yeast present in the medium.

OBJECTIVES

In this experiment, you will

- Use a Colorimeter to monitor a closed population of yeast.
- Use a microscope to monitor a closed population of yeast.
- Compare the population estimates obtained using the two different techniques.
- Practice making dilutions for population counts.

MATERIALS

LabQuest or Chromebook
Dropper pipet
Graph paper
Colorimeter
Microscope
Test tubes & rack
Microscope slide and cover slip
Cuvette
Cotton swab

PRE-LAB ACTIVITY

Your instructor will be placing a small amount of yeast in a closed environment containing food at the start of the experiment. Predict how the yeast population might change over a long time period. Each group at your table will monitor this daily over the next two weeks. You will need to share data with other members of your table when it is your day to collect data.

PROCEDURE

Prepare the Colorimeter- If instructed to do so by your teacher, one team should prepare the Colorimeter. The equipment will be located on a Lab Resource Bench (left of the fridge) for use by all of the class teams. Prepare a *blank* by filling a cuvette 3/4 full with just water.

To correctly use a cuvette, remember:

- Wipe the outside of each cuvette with a lint-free tissue.
- Handle cuvettes only by the top edge of the ribbed sides.
- Dislodge any bubbles by gently tapping the cuvette on a hard surface.
- Always position the cuvette so the light passes through the clear sides.

PROCEDURE (Continued)

Measure the yeast population

Connect the Colorimeter to the LabQuest or Chromebook interface.

The first team at your table should perform the following steps.

- Obtain a 2.5 mL yeast sample and control sample from your instructor.
- Add 2.5 mL of distilled water to the sample to dilute it 50%.
- Mix and transfer 2.5 mL of the diluted yeast into a clean, dry cuvette.
- Place a cuvette lid on the cuvette.
- Use this same cuvette each time you take readings.
- You are now ready to collect absorbance data for the yeast.

Quickly perform these steps:

- Mix the cuvette contents until all air bubbles are removed from the clear sides of the cuvette.
- Wipe the outside of the cuvette with a tissue and place it into the Colorimeter.
- Wait for the absorbance value in the meter to stabilize.
- Record the absorbance value in Table 1.
- Remove the cuvette from the device.

Measure the yeast population with a Microscope

- Mix the yeast in the cuvette.
- Using a dropper pipet, withdraw a small amount of culture and transfer one drop onto a clean microscope slide.
- Place a clean cover slip over the culture. Do not allow air bubbles to get trapped. The liquid should barely fill the area under the coverslip, but should not ooze out.
- Place the slide on a microscope and focus it under low power. Refocus near the center of the slide under high (40×–45×) power. If there are too many cells to count, you will need to make a dilution. If a dilution must be made, follow the steps below:
    - Mix the yeast in the test tube used to make the latest dilution and transfer 0.5 mL of yeast into a clean, dry test tube.
    - Add 4.5 mL of water to the 0.5 mL of yeast. This will make a 1/10 dilution.
    - Mix the contents thoroughly.
    - Record the dilution in your notebook.
- Record the final dilution of yeast. If undiluted, then record 1/1. If one dilution was made, record 1/10. If two dilutions were made, then record 1/100 (1/10 × 1/10).
- Have one team partner count the number of yeast cells in one field of view. Be sure to count each cell—a yeast bud counts as a cell. If you see a clump of cells, estimate the number of cells in the clump.
- Record the appearance of the yeast cells and the odor of the tube in your notebook.
- Calculate the count of yeast in the original sample. To do this, divide the final count of yeast by the dilution factor.
- Record the result in Table 1.
- Move the slide to a different field of view. Have another team member count the number of yeast cells in this field of view.
- Average the values from both of the team members and record the average value in Table 1

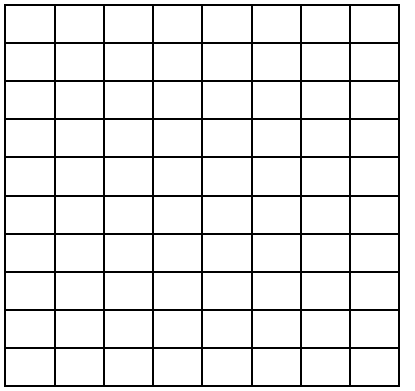
DATA

Table 1				
	Absorbance	Microscopic Count		
Day	Group	Member 1	Member 2	Average
0				
1				
2				
3				
4				
5				
6				
7				

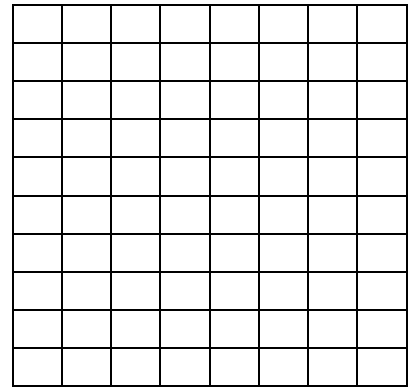
GRAPHING THE DATA

Graph the colorimeter absorbance values and microscope count averages versus the days tested.

Absorbance



Avr. Microscope Counts



QUESTIONS

- Compare the plot of yeast population obtained from the absorbance readings with that from a microscopic count. Describe the similarities and differences among the plots.
- How do your results compare to that obtained from the class average? If there are any differences, explain how the differences might have occurred.
- Could you tell whether a yeast cell was dead or alive during this experiment? How might this affect your results?
- What factors encouraged the growth of yeast in this experiment? Explain.
- What factors limited the growth of yeast in this experiment? Explain.
- How did your prediction compare with your results?