
Cellular Respiration in Yeast

How does temperature affect the rate of cellular respiration in yeast?

Objectives

- Describe how temperature affects the rate at which living systems reorganize energy and matter.

Materials and Equipment

- | | |
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| • Computer or mobile device | • Stirring rod |
| • Wireless Optical Dissolved Oxygen Sensor | • Activated yeast suspension*, 10-15 mL |
| • Photosynthesis Chamber with bar magnet & lid | • Ice water bath* |
| • Beaker, 50- or 100-mL | • Warm water bath* |
| • Beaker, 250-mL | • Waste beaker |
| • Graduated cylinder, 100-mL | • Rinse bottle filled with distilled water |
| • Graduated cylinder, 10-mL | |

*Shared among student groups

Safety

Follow regular laboratory safety precautions.

Procedure

Part 1 - Setup

1. Set the transparent tank ④ in the base ③ where the angled portion ⑤ is near the base notch ⑥ as shown in Figure 1. If the tank does not fit, rotate it and try again.

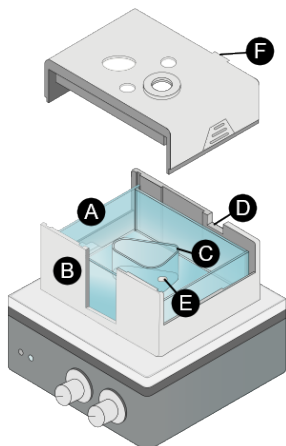


Figure 1. Photosynthesis chamber and lid

2. Set the system upon the magnetic stirrer as shown. Add the magnetic stir bar to the inner chamber ①.
3. Squeeze both sides of the lid and align the lid tab ⑦ with the base notch. Slide the lid onto the base to close the chamber.

4. Remove the rubber boot from the end of the probe by turning it clockwise while looking at the probe.

NOTE: The probe tip has a sensitive membrane. Try not to let anything contact the end of the probe except the water samples in Part 2.

5. Use the O-ring © as shown in Figure 2 to set the probe about 1" deep into the inner chamber. Observe the probe through the side opening ④ to check for the correct depth. There should be enough space for the stir bar to avoid striking the probe, and the probe should not be touching the tank floor.

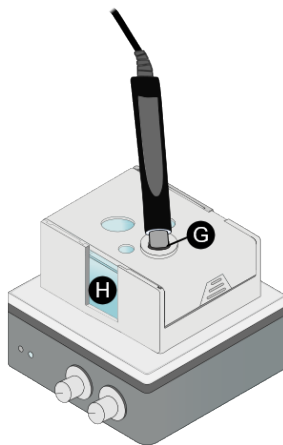





Figure 2. Use the O-ring to adjust sensor height

6. Remove the probe. Hold the base steady, then gently squeeze the sides of the lid to remove it. Practice opening and closing the chamber lid until you are comfortable working with it.

Part 2 - Effect of Temperature on Yeast Respiration Rate

1. Select Sensor Data in SPARKvue.
2. Connect the optical dissolved oxygen (ODO) sensor to your computer or mobile device. Make sure only the DO₂ Concentration (mg/L) measurement is selected ☒ and select the Graph template .
3. Set up the Photosynthesis Chamber as described in Part 1. Open the lid.
4. Add 170.0 mL of room temperature tap water to the outer chamber, then add 60.0 mL of room temperature tap water to the inner chamber.
5. Align the system so the bar magnet is centered on the magnetic stirrer. Turn on the stirrer to a medium speed.
6. Close the chamber and insert the Optical Dissolved Oxygen (ODO) probe in the lid. Check to make sure the probe is submerged about 1" deep into the inner chamber.
7. Use the smaller beaker to collect about 10 mL of activated yeast. Stir the suspension before taking your sample.
8. Measure 3.0 mL of yeast suspension.
9. Start collecting data, then carefully pour the yeast suspension into the largest available lid hole.
10. Allow data collection to continue for 2 minutes, then stop collecting data.
11. Use the Coordinates Tool  to determine the initial and final dissolved oxygen concentration and time elapsed. Enter the results in Table 1.
12. Turn off the stirrer. Remove the ODO probe from the chamber and rinse it thoroughly with distilled water.

13. Empty the contents of the chamber into the waste beaker. Retrieve the bar magnet. Rinse the chamber and magnet with distilled water.
14. Repeat steps 3 through 13 with cool tap water; use the larger beaker to bring water to your work area.
15. Repeat steps 3 through 13 with warm tap water. Replace the boot on the end of the ODO probe when you are finished.
16. Make sure all 3 runs are selected ☒ in the graph legend.
17. Scale  the graph showing all 3 runs. Sketch the results in Graph 1. Add a title and label the x- and y-axes with appropriate units. Fill out the key.
18. Calculate the change in dissolved oxygen concentration (in mg/L) for each condition according to the following equation; enter the results in Table 1.

$$\text{Change in DO}_2 \text{ Concentration} = \text{Final DO}_2 \text{ Concentration} - \text{Initial DO}_2 \text{ Concentration}$$
19. Calculate the yeast respiration rate (in mg/L·s) for each condition by dividing the change in DO₂ Concentration by the time elapsed. Enter the results in Table 1.

Data Collection

Graph 1:

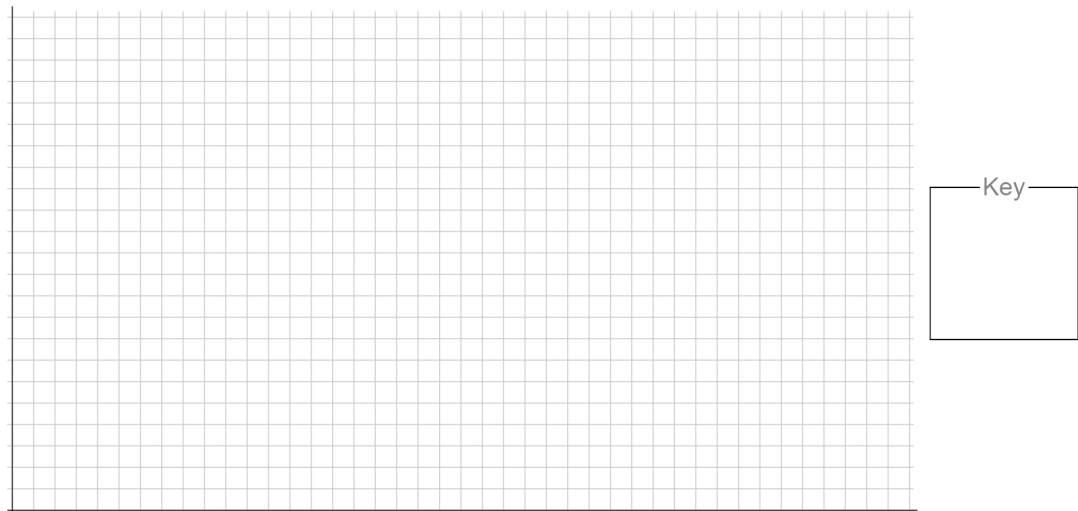


Table 1. Respiration rate of yeast at different temperatures

Condition	Initial DO ₂ concentration (mg/L)	Final DO ₂ concentration (mg/L)	Time elapsed (s)	Change in DO ₂ concentration (mg/L)	Respiration rate (mg/L·s)
Room temperature					
Cool temperature					
Warm temperature					

Questions and Analysis

1. In which temperature did the DO_2 level decrease most rapidly? What does this indicate about the environmental needs of yeast? Support your answer with data.
2. Why is oxygen consumption a good measure of respiration rate in yeast? Include a description of how oxygen molecules are consumed and recombined during cellular respiration.
3. If oxygen is not present, respiration can still occur in yeast cells. What is that process called? What additional end products are produced?
4. Explain the difference in the amount of energy produced in aerobic versus anaerobic respiration.
5. Humans are warm-blooded mammals. If we measured respiration in humans, what kind of environment would demand the highest rate of oxygen consumption? Explain your answer.