The Little Yeast that Could
(Cellular Respiration in Yeast)

Some background

Yeast have been used for centuries to produce foods like bread, beer and wine. In all these cases, we exploit the ability of yeast to ferment sugar, a process which releases carbon dioxide and produces ethyl alcohol. In 1857 Louis Pasteur noticed that yeast consume more glucose under anaerobic conditions than they do under aerobic conditions. This is now called the Pasteur effect in his honor.

Cellular respiration is the set of the metabolic reactions that the cells use to convert the energy in nutrients into ATP. The process involves electrons being passed from one molecule to the next in a chain of reactions. Remember, when a molecule loses an electron it is oxidized and when it accepts an electron it is reduced. In order for ATP to be synthesized from ADP and P, energy must be transferred to ADP to allow for the attachment of the third P. This process occurs continually in most cells. The pathway of electrons follows a succession of electron transport molecules which causes a transfer of protons across the inner mitochondrial membrane. The resulting proton gradient can be used to do work. In this case, the work is the transfer of energy to ATP. The flow of electrons is proportional to the rate of cellular respiration.

Your mission . . .

. . . should you choose to accept it, is to determine whether cellular respiration occurs faster under aerobic or anaerobic conditions.

1. Start with a hypothesis.
2. Using yeast, 2,6 dichlorophenol indophenol solution (DPIP), and any other materials you might need, design an experiment to achieve this mission. In designing your experiment, make sure you think about what data to collect and how to collect it. Also, identify the dependent and independent variables and consider appropriate control groups and controlled variables.

Follow-up questions

3. What variables did you have to control?
4. Imagine the kind of data you would collect in your experiment and record some of this fictitious data. How could you tell if your data support or reject your hypothesis?
5. Think of another question that might come up if you were to perform this experiment that could be answered with further work.

Rubric

The activity will be assigned a score out of 5. One point is awarded for each of:

- Is there a clear protocol described?
- Have the controls been identified?
- Have controlled variables been identified?
- Were data recorded and used to support or rejct the hypothesis?
- Did the student pose a question for further study?