

The respiratory differences between germinating seeds and ungerminated seeds

Purpose

Using Borderless Lab 365 platform to observe and compare the respiration changes from ingeminating seeds and germinating seeds through recording the changes of oxygen and carbon dioxide concentration.

Introduction

- Seeds is the form that plants use to confront the bad or unsuitable living environment. Germination is a necessary process for plants to relieve from low-activity seeds into higher-activity seedlings.
- Germination allows plants to start a new round of life cycle. Before germination, living seeds mainly relies on the energy resources stored in the cotyledons, and after the germination, seedlings start to make their own energy through photosynthesis with the help of new-grown leaves.
- Since all the life activities generally start to function, the intensity of respiration would rise with the process of germination.
- In this experiment, it is to verify whether the germinating seeds have a stronger respiration effects than the ungerminated seeds.
- Students should aware that more time the experiment is repeated (3 times at least); the experiments results are expected to be more accurate.

Apparatus and Material

- "Borderless Lab 365" Platform
- 40 Green bean seeds (Choose 40 healthy green beans similar in size and weight with no infection and then separated into two groups, ungerminating and germinating for comparison)
- Germinating device
 - a. A plastic round container
 - b. Proper amount of cotton tissues
 - c. Water sprayers
- Measuring devices
 - a. A dark box composed of aluminum rectangular framework covered by thick paper wall to block the light (creating a whole dark environment and prevent the possible influence of photosynthesis)
 - b. Oxygen concentration sensors and carbon dioxide concentration sensors



Fig. 1 O₂ sensor



Fig. 2 CO₂ sensor

Procedure

Preparation (by PolyU staff)

1. Prepare germinated seeds

Put tissues under the other 20 beans. Spray proper amount of water over the tissues and wait 24 hours for the germination of beans in the dark environment. Seal the containers again after germinating. Then, put sensors into the containers.

2. Prepare the green beans (as ungerminated seeds)

20 dry green beans are put into plastic container. Seal the containers after putting the oxygen sensor and carbon dioxide sensor inside the container.

3. Put the containers of both green beans and germinated seeds into two dark boxes separately. Turn on the sensors and read the primary figures of the oxygen and carbon dioxide until the reading is stable.

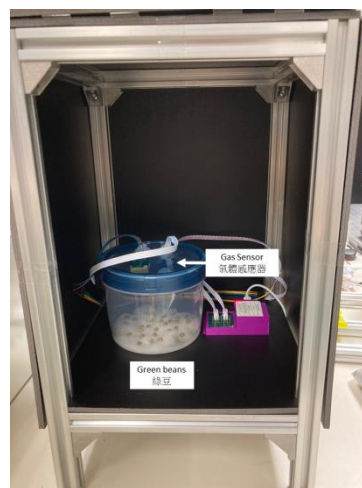


Fig. 3 Experimental setup of each room. There are two rooms in this experiment, green beans as ungerminated seeds, and germinated seeds with tissues.

Procedure to be conducted by students

4. Log in the experiment module “Respiration” on the Borderless Lab 365 platform.
<https://stem-ap.polyu.edu.hk/remotelab/>
5. Enter different rooms and export oxygen concentration and carbon dioxide in the dark environment for 15 hours of both groups of green beans.

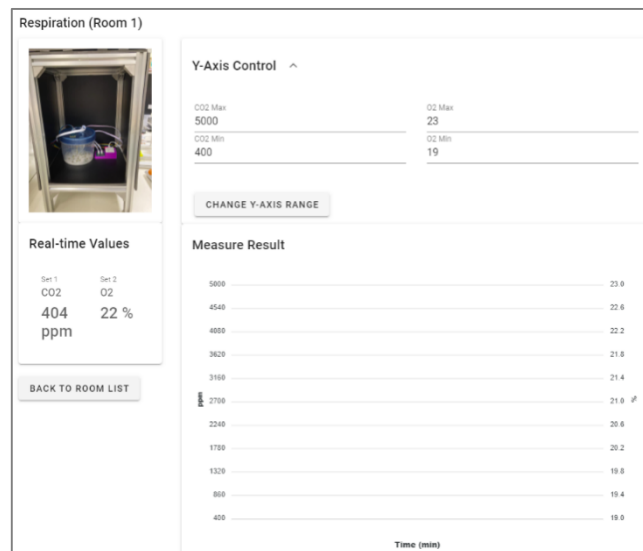


Fig. 4 User Interface of respiration.

6. Press “LOGOUT” on the left when you complete the experiment.

Results

1. Record the figures of the ungerminated seeds and germinating seeds

Seeds Time(h)	Ungerminated seeds		Germinating seed	
	Concentration of oxygen	Concentration of carbon dioxide	Concentration of oxygen	Concentration of carbon dioxide
1 st hour				
2 nd hour				
3 rd hour				
4 th hour				
5 th hour				
6 th hour				
7 th hour				
8 th hour				
9 th hour				
10 th hour				
11 th hour				
12 th hour				
13 th hour				
14 th hour				
15 th hour				

2. Plot two graphs of concentration of gases against time for ungerminated and germinated seeds.

Discussions

- After plotting the graphs, figure out the maximum slope of the line concentration of oxygen and concentration of carbon dioxide of both germinating seeds and ungerminated seeds.
- Figure out the maximum speed of respiration of both germinating seeds and ungerminated seeds. Compare which one is bigger.
- Explain the answer in Question 2. (Tips: you may consider the changes in cell number, function and activity while germination.)
- Apart from germination, list other factors that would affect the intensity of respiration.
- After putting the beans in the darkness for 15 hours in total, the seedlings were suddenly put under the light. What is the possible changes of the plot of "concentration of gases against time" (in the next 30 seconds)? Sketch without specific numbers.