

Are Pea Seeds Purchased in a Store Alive?

In this task, you will measure a biological activity of pea seeds that are: a) dry, b) soaked in water, c) cooled down by water with ice and d) heated to room temperature once again.

What you need




- 150 ml of pea seeds bought in a store
- Vernier CO₂-BTA carbon dioxide concentration sensor
- ice cubes
- cup or other container for soaking the seeds



Questions and tasks


1. The sensor shows the concentration in ppm (parts per million). What is the percentage of 100,000 ppm? How many ppm corresponds to 0.1%?
2. Connect the CO₂ sensor and switch it to a higher range (100,000 ppm). It is necessary to wait for about a minute, until the sensor "heats up" and starts to show the value of 400 ppm or more (depending on how stale the air in the room is). While the sensor "heats up", go to Step 3.
3. Before measuring, let one dose of pea seeds soak in a cup of water - measure 150 ml of pea seeds in a container supplied with the CO₂ sensor (container has a scale from 0 to 250 ml). Put the seeds into a cup or other suitable container and fill it with water at room temperature.
4. Set the measurement time to 300 seconds, the frequency can be left at the default value of one measurement every 4 seconds.
5. Add 150 ml of dry pea seeds in the measuring container supplied with the sensor once again.
6. Insert the sensor into the container; this leads to sealing of the container.



7. Start the measurement and turn on the automatic scale (in LabQuest choose *Graph > Autoscale Once*, in Logger Lite choose the icon ) utilize the whole area of the graph.
8. When the measurement is finished, store the latest run by clicking on the icon of a drawer .
9. Return the dry seeds back into the bag; pour out the water from the soaked seeds and put the wet seeds into the measuring container. Seal the container by the sensor and start a second measurement.
10. During the second measurement, prepare a mix of water and ice in a cup. This will be used to cool the seeds down before the third measurement.
11. When the measurement is finished, save the data series by clicking on the icon of a drawer .
12. Pour the seeds into the cup with ice and water and let it cool down for 5 minutes.



13. After five minutes, pour out the water with remnants of ice and put the seeds into the measuring container. Seal the container by the sensor and start a third measurement.

14. After the third measurement, save the data series by clicking on the icon of a drawer 
15. Put the seeds in a cup and fill the cup with water of about room temperature and let the seeds warm up for about 5 minutes.
16. Pour out the water, put the seeds into the measuring container and perform the fourth and also the last measurement.

Evaluation of the experiment

Display all four measurements in one graph. Describe what the experiment shows.

Notes for teachers

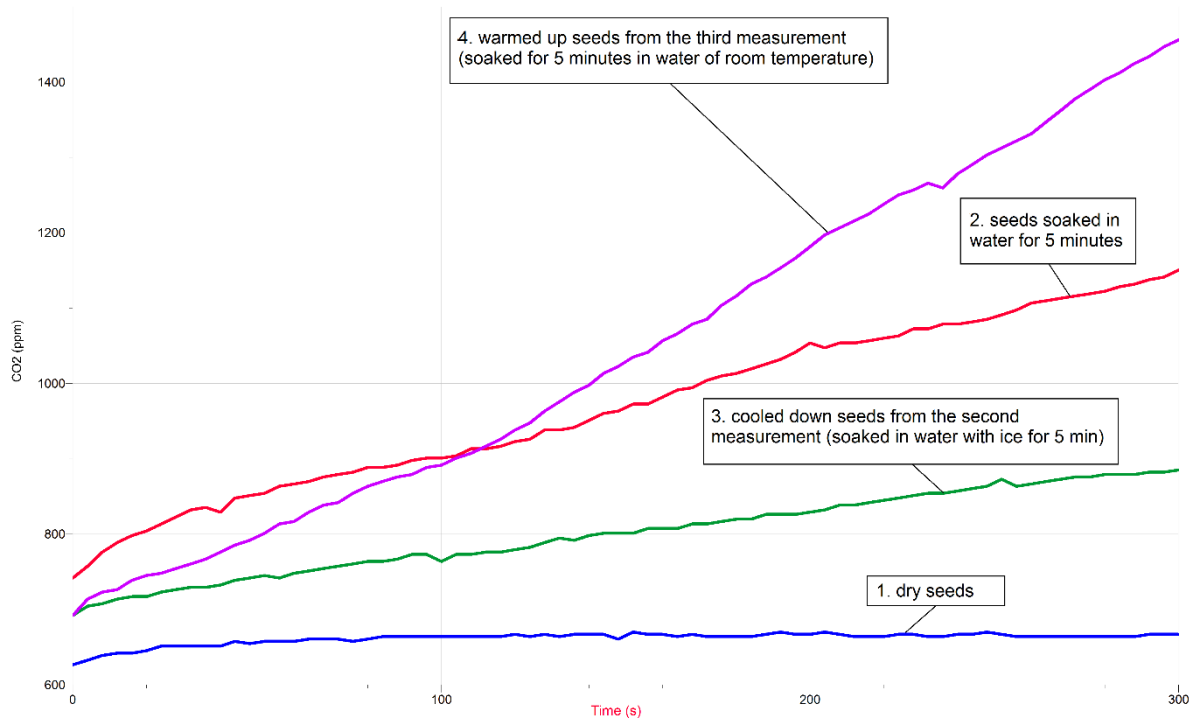
The concentration of 100,000 ppm (parts per million) is 10%. The value of 1000 ppm corresponds to 0.1%.

The experiment could be performed with a smaller amount of pea seeds; the curves would not be as steep. A large amount is appropriate considering that the whole experiment should be easily and convincingly performed during one lesson.

The picture shows a dry pea seed, sold in a store, on the left, and a pea seed soaked in water for a few minutes on the right.



Typical measurement results are as follows:



Dry seeds do not seem to indicate any biological activity. To activate it, it is necessary to soak the seeds in water. Soaked seeds begin to breathe – they produce carbon dioxide. Cooling down the seeds results in decreasing their biological activity; it can be increased again by warming the seeds up.