Glycolysis (temperature measurement) with Cobra SMARTsense

Biology > Plant Physiology / Botany > Germination, growth, development

Biology > Biochemistry

Applied Science > Medicine > Biochemistry

Difficulty level	Group size	Preparation time	Execution time
medium	-	10 minutes	30 minutes

This content can also be found online at:

http://localhost:1337/c/5f4c80cb7b2768000356b934

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General information

Application

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Experiment set-up

This experiment records the metabolic processes and phenomena such as glycolysis, fermentation, aerobic vs. anaerobic respiration, Pasteur effect. The energy generated by respiration is not fully utilized by the yeast cells. A part is lost as heat. This part can be measured by temperature sensors, whereby the respiration of the yeast cells can be detected.

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Other teacher information (1/4)

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Prior knowledge

The pupils and students should be familiar with the propagation of yeast and the fermentation of sugar by yeast cells.

Scientific principle

Representation of the temperature increase during the fermentation of sugar by yeast cells.

Other teacher information (2/4)

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Learning objective

Pupils and students should realise that a rise in temperature can be measured when sugar is fermented by yeast cells.

Tasks

Pupils and students are to measure the temperature during the fermentation of sugar by yeast cultures and document changes.

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Other teacher information (3/4)

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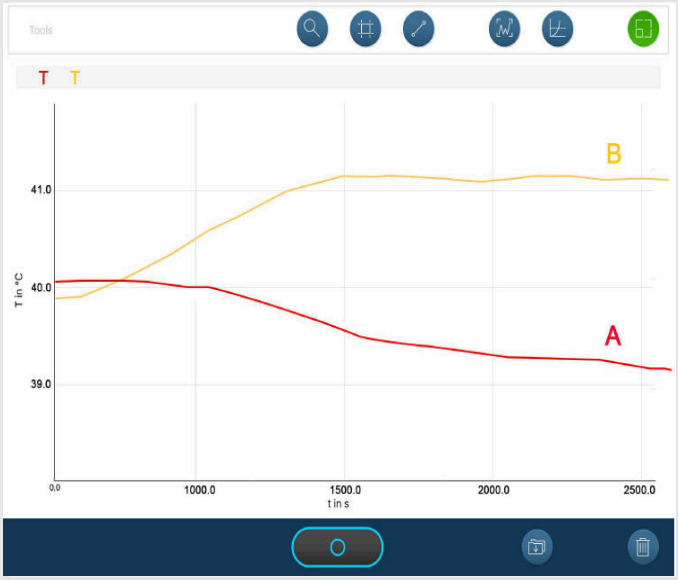
Further information on the results

- The sugar solution was filled into the two thermos flasks at the same temperature. At the start of the measurement, the sugar solution with yeast may not be exactly at 40 °C, as the yeast taken from the refrigerator cools the sugar solution. During the course of the measurement, the sugar solution without yeast cools down (right figure, curve A), while the yeast suspension warms up due to the exothermic course of the reaction (right figure, curve B).



Other teacher information (4/4)

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Notes

- The energy produced by respiration is not fully utilized by the yeast cells. Part of it is lost as heat. Only when the sugar solution is completely fermented after a few hours does the temperature gradually drop. In the control bottle with the sugar solution without yeast, the temperature drops from the beginning.
- The picture on the right shows the bubble formation caused by CO_2-production.

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Safety instructions

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- The general instructions for safe experimentation in science teaching to be applied to this experiment.
- For the H and P phrases, please refer to the corresponding safety data sheets.

Theory

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The baker's yeast used in this experiment (*Saccharomyces cervisiae*) was first described in 1888 by Emil Christian Hansen. In the trade we find them as dry yeast or yeast cubes in the refrigerator.

When the yeast breathes, energy is produced, so it is an exothermic process. This energy is not fully used by the yeast cells, which means that it can be measured by temperature sensors. This allows the activity of the yeast to be displayed.

Glycolysis is the term for the breakdown of simple sugars (monosaccharides) into pyruvate and is one of the oldest processes in the energy metabolism of living organisms.

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Equipment

Position	Material	Item No.	Quantity
1	Cobra SMARTsense Temperature - Sensor for measuring temperature -40 ... 120 °C (Bluetooth)	12903-00	2
2	Portable Balance, OHAUS YA302	49213-00	1
3	Thermos flask	64841-00	2
4	Rubber stopper,d=41/34mm, 1 hole	39261-01	2
5	Beaker, Borosilicate, low form, 1000 ml	46057-00	1
6	measureAPP - the free measurement software for all devices and operating systems	14581-61	1

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Additional equipment

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Position	Art. No.	Designation
1		mobile device (Smartphone / Tablet) or PC with Windows 10
2	14581-61	measureAPP
3		Baker's yeast (cubes)
4		Sugar

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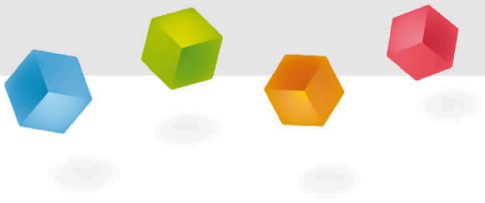

Setup and procedure

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Set-up (1/3)

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For measurement with the **Cobra SMARTsense sensors** the **PHYWE measureAPP** is required. The app can be downloaded free of charge from the relevant app store (see below for QR codes). Before starting the app, please check that on your device (smartphone, tablet, desktop PC) **Bluetooth** is **activated**.

iOS

Android

Windows

Set-up (2/3)

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measureApp user interface

- Turn on the Cobra SMARTsense temperature sensors by pressing and holding the power button.
- Connect the sensors in the measureAPP under the point "Measure" to the device as shown in the figure on the left.
- The Cobra SMARTsense temperature sensors are now displayed in the app.

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Set-up (3/3)

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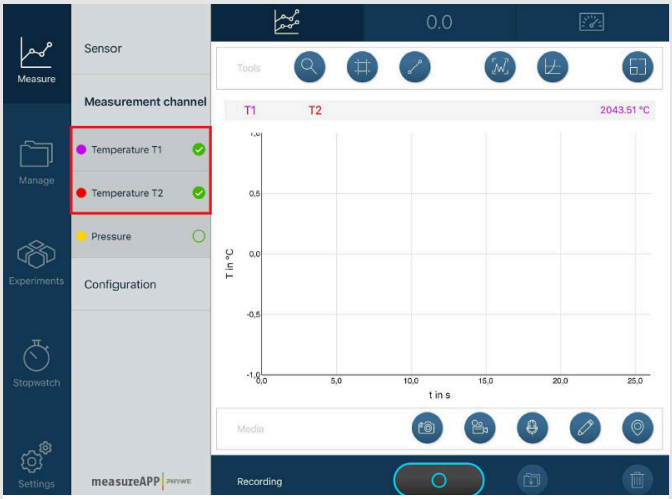
- Set up the devices as shown in the figure for the test setup.
- Get the thermos flasks ready.
- The temperature (T1 and T2) is measured (right figure).



Marked red: Temperature T1 and T2

Procedure (1/2)

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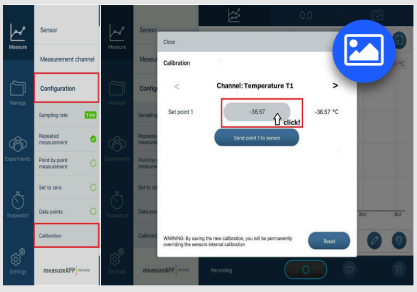
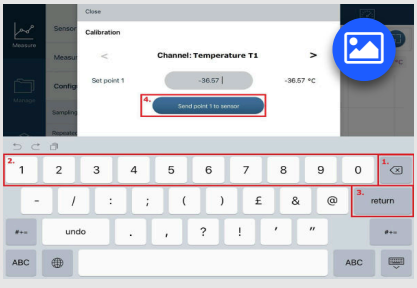
- If the temperature values of the two immersion sensors do not match, calibrate them:
  - go to "Configuration" (Illustration top right)
  - go to "Calibration" (Illustration top right)
  - Click on value (top right illustration)
  - Alternatively you can set / tare the probes to zero ("Set to zero").
- Follow the numbers in the figure below right by clicking with the mouse on the corresponding fields under measureAPP. Enter the correct value with numbers under number 2.





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Procedure (2/2)

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- Repeat the procedure for the second temperature sensor (T2).
- In a 1000ml beaker with 40°C warm water, prepare a sugar solution of about 10%.
- Pour equal parts of the sugar solution into the thermos flasks and add 25 grams of yeast in small pieces to one of the two thermos flasks, dissolving the yeast by swinging or using a glass rod.
- Fit rubber stopper and insert temperature sensors through the hole (see figure "Test setup").
- Start measured value recording. Duration: 60 minutes.

Report

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Task 1

Drag the words to the correct places.

The energy produced by respiration is _____ fully utilized by the yeast cells. Some is lost as _____. Only when the sugar solution is completely _____ after a few hours, the temperature _____ gradually. In the _____ with the sugar solution without yeast, the temperature drops from the beginning.

- fermented
- control bottle
- heat
- sinks
- not

Check

Task 2

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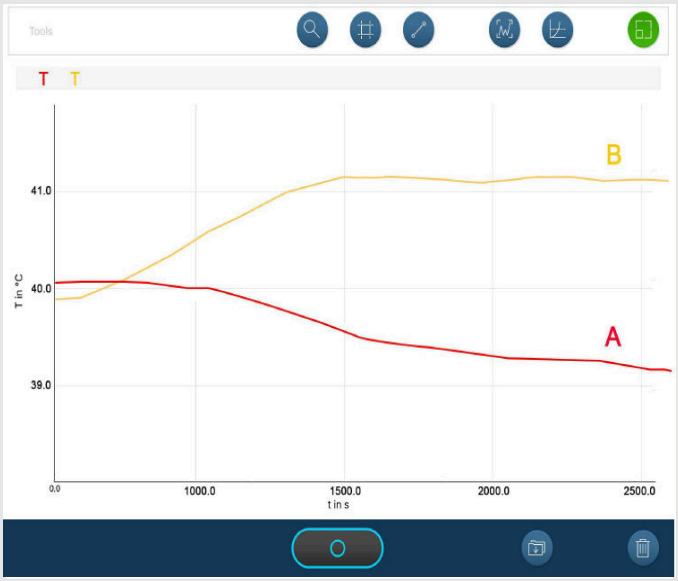
Which of the two curves on the right represents the temperature curve of the yeast suspension?

- Curve A.
- Neither of them.
- Curve B.



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Task 3

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Select the correct statements.

- [ ] The bubble formation that can be observed represents the CO2 production.
- [ ] The bubble formation that can be observed represents the O2 production.
- [ ] The fermentation of sugar by yeast is an exothermic process.
- [ ] The fermentation of sugar by yeast is an endothermic process.

Check

Slide	Score / Total
Slide 18: Energy in heat	0/5
Slide 19: Temperature curve of the yeast suspension	0/1
Slide 20: Fermentation of sugar	0/2

Total amount 0 / 8

Solutions Repeat

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