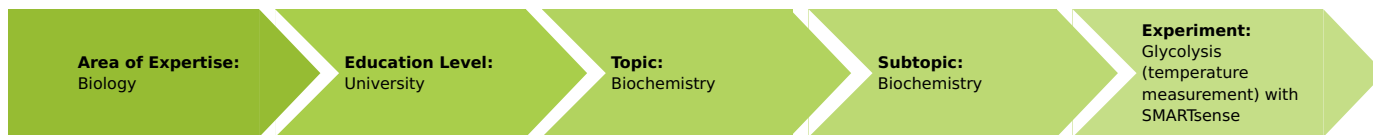


Glycolysis (temperature measurement) with Cobra SMARTsense (Item No.: P4110569)

Curricular Relevance



Difficulty



Intermediate

Preparation Time



10 Minutes

Execution Time



30 Minutes

Recommended Group Size



2 Students

Additional Requirements:

- Fresh baker's yeast, cube
- Refined sugar
- Tablet
- PHYWE measureAPP

Experiment Variations:

- with Computer with USB port, Windows

Keywords:

Glycolysis, Yeast fermentation of sugar, Temperature measurement, Respiration energy

Information for teachers

Principle

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



Fig.1: Experimental setup

Equipment

Position No.	Material	Order No.	Quantity
1	Compact Balance, OHAUS TA 302, 300 g / 0.01 g	49241-93	1
2	Thermos flask	64841-00	2
3	Immersion probe NiCr-Ni, steel, -50...400 °C	13615-03	2
4	Rubber stopper, d=41/34mm, 2 holes	39261-02	2
5	Beaker, low, BORO 3.3, 1000 ml	46057-00	1
6	Cobra SMARTsense - Temperature, - 40 ... 120 °C	12601-10	2
Additional material:			
	Tablet		
	PHYWE measureAPP		
	Fresh baker's yeast, cube		
	Refined sugar		

Android

iPad



Task

- Investigate the temperature increase during the fermentation of sugar by yeast cells.

Glycolysis (temperature measurement) with Cobra SMARTsense (Item No.: P4110569)

Overview

Task

- Investigate the temperature increase during the fermentation of sugar by yeast cells.



Fig. 1. Experimental set-up

Equipment

Position No.	Material	Order No.	Quantity
2	Compact Balance, OHAUS TA 302, 300 g / 0.01 g	49241-93	1
3	Thermos flask	64841-00	2
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Additional material:			
	Tablet		
	PHYWE measureAPP		
	Fresh baker's yeast, cube		
	Refined sugar		

Android

iPad



Set-up and procedure

Set-up


- Set up the equipment as shown in Fig. 1.
- Turn on the Cobra SMARTsense Temperature sensors by pressing the power button. Ensure that Bluetooth is activated on your device.
- Provide the thermos flasks.
- Open the PHYWE measure App  and select both sensors "Temperature" under the tab 'Sensor'



Fig. 2: Selecting the sensor Temperature

- The temperature will be measured (T1 and T2).

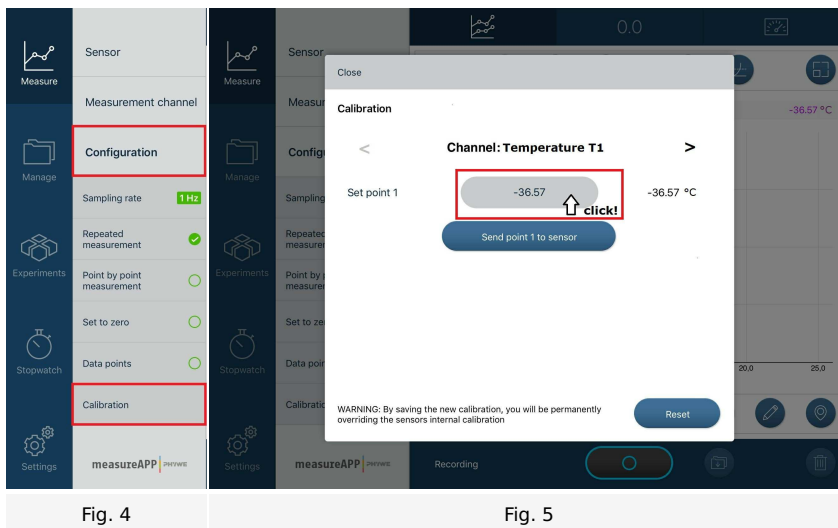


Fig. 3: Measurement of the temperature

Procedure

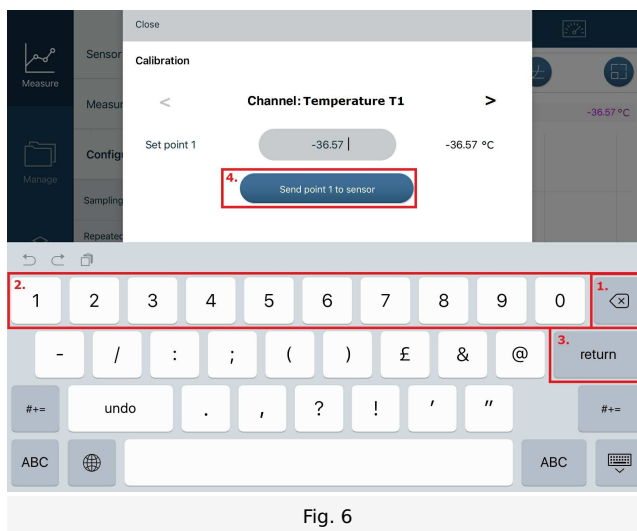
- If the two immersion probes do not show the same temperature values, then they must be calibrated:
 - go to "Configuration" (Fig. 4)
 - then go to (scroll down if necessary) "Calibration" (Fig. 4)
 - Click on the value (Fig. 5)



You can alternatively set each of them to zero / tare them ("Set to zero").



- Follow the numbers in figure 6 by clicking on the appropriate buttons in measure APP. Enter the right value with digits under number 2.

Repeat the procedure for the second probe (T2).



- Use 40 °C hot water to prepare an approx. 10% sugar solution in the 1000 ml beaker.
- Fill equal amounts of the sugar solution into the Dewar vessels. Add 25 grams of yeast, in small pieces, to one of the Dewar vessels. Dissolve the yeast with a swirling motion of a glass rod while it is being adding.
- Fit the rubber stoppers on and ease the temperature probes through the boreholes (Fig. 1).
- Start measured value recording  (runtime about 60 minutes; Stop: ).

Theory and evaluation

Results

- The sugar solution had the same temperature as it was filled into the two Dewar flasks. The sugar solution containing yeast can be slightly cooler at the start of measurement since the yeast was taken from the refrigerator and so had a cooling effect on it. During the course of measurement the sugar solution without yeast cools (Fig. 7A) but the yeast suspension gets warmer because of the exothermic course of the reaction (Fig. 7B).



- If measurement is carried out for a long time, it can be seen that it takes several hours before the temperature of the yeast suspension starts to decrease.

Notes

- The yeast cells do not completely utilize the energy generated by respiration. A part of it is lost as heat. The temperature only starts to slowly drop after several hours, the time needed for the sugar solution to be completely fermented. The temperature drops right from the start in the blank Dewar flask.
- This experiment enables a discussion to be carried out on metabolic processes and phenomena such as glycolysis, fermentation, aerobic vs. anaerobic respiration, the Pasteur effect.



Fig. 8: Froth formation during CO₂ production