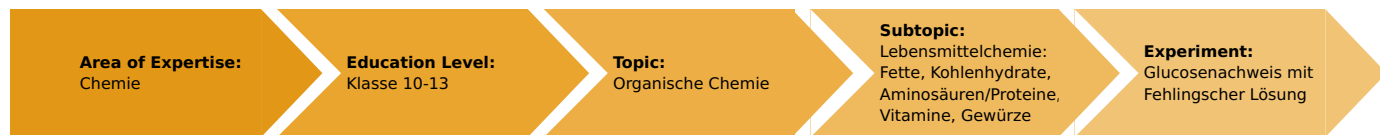


# The detection of glucose with Fehling's solution

(Item No.: P7186800)

## Curricular Relevance



### Difficulty



Intermediate

### Preparation Time



10 Minutes

### Execution Time



20 Minutes

### Recommended Group Size



2 Students

### Additional Requirements:

### Experiment Variations:

### Keywords:

carbohydrate, tests for glucose, Fehling's test

## Task and equipment

## Information for teachers

## Additional Information

Sugar is normally given a name which shows its origin, grape sugar from grapes, beet sugar from sugar beet, milk sugar from milk. It is natural to ask if these sugars are all the same or if they differ.

## Notes on content and learning objectives

- Glucose (= grape sugar) can be detected with Fehling's solution and so be differentiated from sucrose.
- Vegetable foods, such as fruits, fruit juices and honey, contain glucose.

## Notes on the method

The term grape sugar – glucose and "normal" sugar – sucrose, and their molecular structure, should be worked on in a classroom discussion.

Further detection methods for glucose are given in the experiment "Reducing properties of glucose".

## Fundamentals and remarks

The most important monosaccharides, glucose and fructose, act as reducing agents in alkaline solution. The disaccharides lactose (milk sugar) and maltose (malt sugar) also have reducing properties. All of them are in an open chain aldehyde or ketone form in alkaline solution. They react with Fehling's solution by reducing the copper(II) ions to copper(I) oxide.

Sucrose does not react with Fehling's solution, as this disaccharide of fructose and glucose (2,1 glycosidic linkage) has no free aldehyde or ketone groups.

## Hints on going deeper

- The reducing properties of the aldehyde groups of grape sugar are utilized in the silver-plating of glass (silver mirror test).

## Notes on set-up and procedure

### Preparation:

This experiment also allows the reducing properties of other sugars, such as fructose and lactose, to be demonstrated. The dried fruit should be chopped up as small as possible. The fruit juice used should not be too strongly coloured.

## Notes on the students experiment:

Ensure that the same amounts of Fehling's solutions I and II are pipetted in.



## Hazard and Precautionary statements

Fehling's solution I

H411: Toxic to aquatic life with long lasting effects.  
P273: Avoid release to the environment.

Fehling's  
solution II:

H314: Causes severe skin burns and eye damage.  
P280: Wear protective gloves/protective clothing/eye protection/face protection.  
P305 + P351 + P338: IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses if present and easy to do – continue rinsing.  
P309 + P311: IF exposed or you feel unwell: Call a POISON CENTER or doctor/physician.

## Hazards

- Fehling's solution is harmful to health when swallowed and can cause burns when it contacts skins.
- Wear protective glasses and protective gloves!

## Waste disposal

When the test tubes have cooled, filter their contents. Put the precipitates which are filtered off into the container for heavy metal waste. Pour the filtrates into the container for solutions of heavy metal salts.

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## Task and equipment

### Task

#### How can glucose be detected?

Determine which foods contain glucose.



Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
3	Ring with boss head, i. d. = 10 cm	37701-01	1
4	Wire gauze with ceramic, 160 x 160 mm	33287-01	1
5	Glass beaker DURAN®, short, 400 ml	36014-00	1
6	Test tube rack for 12 tubes, holes d= 22 mm, wood	37686-10	1
7	Test tube, 180x18 mm,100pcs	37658-10	(8)
8	Test tube holder, up to d 22mm	38823-00	1
9	Test tube brush w. wool tip,d25mm	38762-00	1
10	Wash bottle, 250 ml, plastic	33930-00	1
11	Pipette with rubber bulb	64701-00	6
12	Spoon, special steel	33398-00	1
13	Labor pencil, waterproof	38711-00	1
14	Protecting glasses, clear glass	39316-00	1
	Butane burner f.cartridge 270+470	47536-00	1
	Butane catridge CV 300 Plus, 240 g	47538-01	1
	Fehling's solution I 1000 ml	30079-70	1
	Fehling's solution II 500 ml	30080-50	1
	D(+)-glucose 1000 g	30237-70	1
	Water, distilled 5 l	31246-81	1
	Boiling beads, 200 g	36937-20	1
Additional material			
	Fume cupboard		
	Fruit juice (e.g. apple juice)		
	Sugar (normal household sugar)		
	Dried fruit (chopped up)		

## Set-up and procedure

### Set-up

### Hazards

- Fehling's solution is harmful to health when swallowed and can cause burns when it contacts skins.
- Wear protective glasses and protective gloves!



### Setup

Number four test tubes from 1 to 4 and stand them next to each other in the test tube rack. The remaining four test tubes label from 1A to 4A and stand them also in the test tube rack (Fig. 1).



Fig. 1

Assemble the stand as shown in figures 2 to 6. Fasten the support ring to the support rod and place the wire gauze on it. Adjust the height of the support ring so that the flame of the burner just reaches the wire gauze.



Fig. 2



Fig. 3



Fig. 4



Fig. 5



Fig. 6

Half-fill a 400 ml beaker with water and add a few boiling stones (Fig. 7). Heat it to boiling, then put it aside. Extinguish the bunsen burner flame!



Fig. 7

## Procedure

Put the following substances in the test tubes 1 to 4, respectively: A spatula tip of glucose, a spatula tip of sugar, a few pieces of dried fruit and fruit juice up to a height of 3 cm.

Add distilled water to test tubes 1 to 3, each to a height of 3cm. Place test tube 3 in the prepared hot water bath for approx. 2 minutes.



Fig. 8

Use a pipette with rubber bulb to pipette Fehling's solution I into the test tubes 1A to 4A, each to a height of 2cm. Add the same amount of Fehling's solution II to the test tubes 1A to 4A.

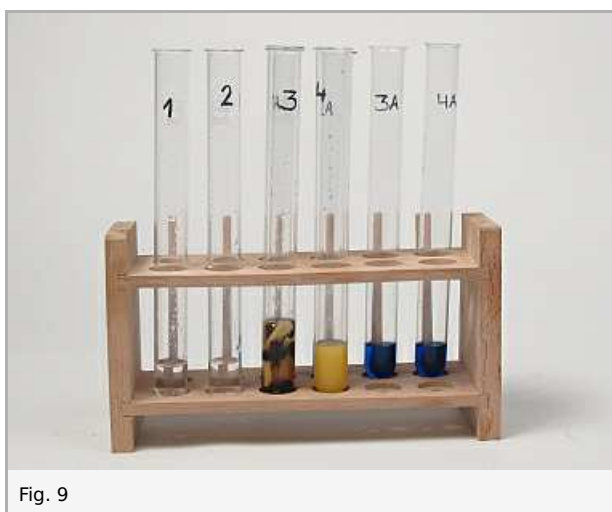


Fig. 9

Pipette 4 to 6 drops of the liquids in test tubes 1 to 4 into the corresponding test tubes 1A to 4A, e.g. glucose solution from test tube 1 to test tube 1A.

Place the test tubes 1A to 4A in the prepared beaker of hot water.  
Note any changes of colour or formation of precipitates in the test tubes.

## Waste disposal

When the test tubes have cooled, filter their contents. Put the precipitates which are filtered off into the container for heavy metal waste. Pour the filtrates into the container for solutions of heavy metal salts.



# Report: The detection of glucose with Fehling's solution

## Result - Table 1

Note your observations in the following table.

Test tube	Food	Test with Fehling's solution
1	Glucose	1
2	Sugar	1
3	Dried fruit	1
4	Fruit juice	1

## Evaluation - Question 1

Draw conclusions from your observations.

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### Evaluation - Question 2

Formulate the reduction of  $\text{Cu}^{2+}$  ions to  $\text{Cu}^+$  ions.

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### Evaluation - Question 3

Name more foods which contain glucose.

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### Evaluation - Question 4

Complete the following statements.

1. On mixing equal volumes of Fehling's solution I and II, a ..... coloured solution is obtained.
2. Glucose, dried fruit (or an extract) and fruit juice react when heated with Fehling's solution I + II to form a ..... precipitate.
3. With sugar there is ..... reaction.

### Evaluation - Question 5

Name the type of reaction which is the basis for the detection of glucose.

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### Evaluation - Question 6

Give the reason for the negative reaction with sugar.

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