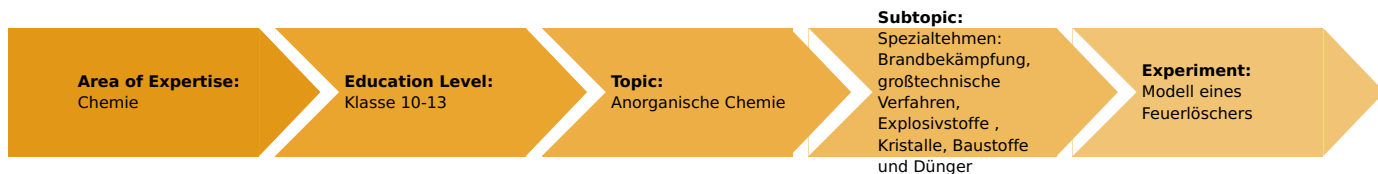


Model of a fire extinguisher (Item No.: P7154000)

Curricular Relevance



Difficulty



Easy

Preparation Time



10 Minutes

Execution Time



10 Minutes

Recommended Group Size



2 Students

Additional Requirements:

Experiment Variations:

Keywords:

Fire extinguisher

Task and equipment

Information for teachers

Learning objectives

- The flame-smothering action of carbon dioxide is used in fire fighting.
- In foam extinguishers carbon dioxide is produced and sprayed onto the burning substances as foam which has a density greater than air.

Notes on set-up and procedure

Preparation

The concentrated hydrochloric acid is diluted with approximately the twofold volume of water. Before class pour the sulphuric acid into the 50 ml beakers. The required sodium carbonate solution should be saturated.

Remarks on the students' experiments

The stopper must be held down tightly during the experiment. Inform the students that the angled tube must not be pointed toward their fellow students.



Hazard and Precautionary statements

Hydrochloric acid:

H314:	Causes severe skin burns and eye damage.
H335:	May cause respiratory irritation.
H290:	May be corrosive to metals. Kann Metalle korrodieren.
P280:	Wear protective gloves/protective clothing/eye protection/face protection.
P301 + P330 + P331:	IF SWALLOWED: rinse mouth. Do NOT induce vomiting. I
P309 + P310:	If exposed or if you feel unwell: Immediately call a POISON CENTER or doctor/physician
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Sodium carbonate:

H319:	Causes serious eye irritation.
P260:	Do not breath dust.
P305 + P351 + P338:	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.

Hazards

- Hydrochloric acid is caustic. If it splashes onto your skin, rinse the area with abundant water!
- Wear protective glasses!
- Petrol is highly flammable. Remove the bottle from the experimental area!
- Lubricate rubber-glass connections with glycerol. Insert the glass tubes and the dripping funnel by turning them without applying force!

Note

Any commercial shampoo can be used for this experiment.

Remarks on the method

The students should work in small groups in this experiment. However, the ignition of the petrol and the addition of acid should be performed concurrently by two groups, if possible. In any case, practise the use of an industrial fire extinguisher subsequent to this experiment, since knowledge of such devices should be part of the course of instruction according to the Materials Safety Act. Through appropriate discussion of the problem in Exercise 4, it should become clear that, in a strict sense, not the presence of carbon dioxide, but rather the exclusion, i. e. the absence, of oxygen is responsible for smothering the flames.

Waste disposal

- Dispose of the residual petrol as flammable organic waste.
- Pour the sodium carbonate solution into the collection container for acids and alkalis.

Model of a fire extinguisher (Item No.: P7154000)

Task and equipment

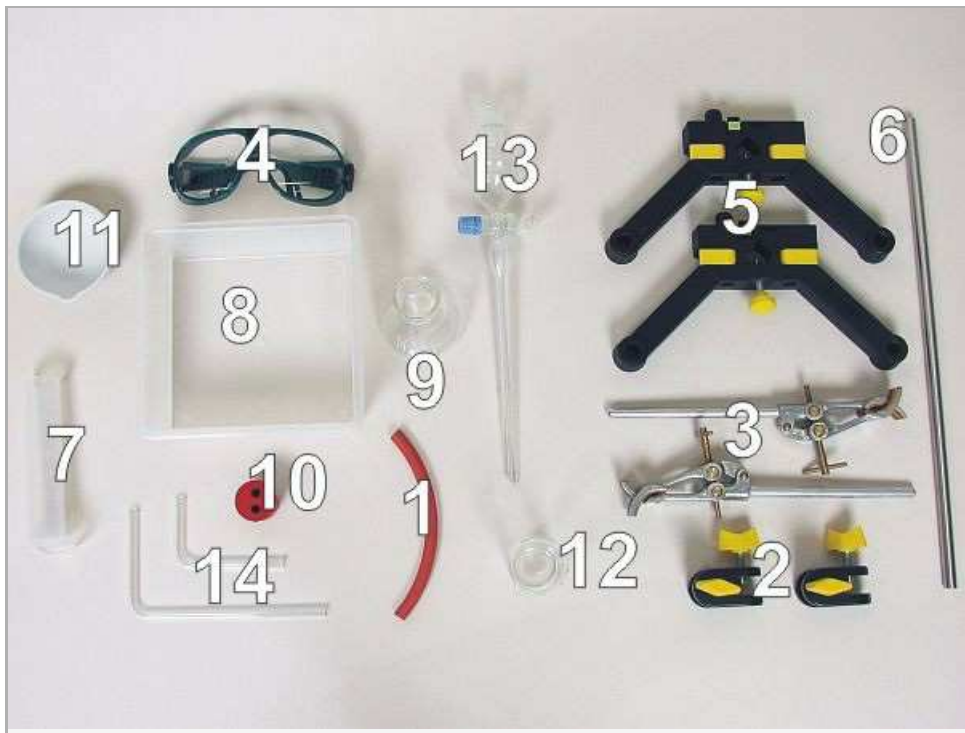
Task

How can the properties of carbon dioxide be used?

Construct a model of a foam fire extinguisher.



Equipment



Position No.	Material	Order No.	Quantity
1	Rubber tubing, i.d. 6 mm	39282-00	1
2	Boss head	02043-00	2
3	Universal clamp	37715-00	2
4	Protecting glasses, clear glass	39316-00	1
5	Support base, variable	02001-00	1
6	Support rod, stainless steel, l=370 mm, d=10 mm	02059-00	1
7	Grad.cylinder,high,PP,50ml	46287-01	1
8	Dish, plastic, 150x150x65 mm	33928-00	1
9	Erlenmeyer flask 100 ml, wide-neck SB 29	36428-00	1
10	Rubber stopper 26/32, 2 holes 7 mm	39258-02	1
11	Porcelain dish, 75ml, d = 80 mm	32516-00	1
12	Glass beaker DURAN®, tall, 50 ml	36001-00	1
13	Dropping funnel with drip nozzle, 50ml	36912-00	1
14	Glass tube,right-angled, 10 pcs.	36701-52	(1)
14	Glass tubes, right-angled, 10	36701-57	(1)
	Butane burner f.cartridge 270+470	47536-00	1
	Butane cartridge CV 300 Plus, 240 g	47538-01	1
	Glycerol, 250 ml	30084-25	
	Sodium carbonate, anhyd. 250 g	30154-25	
	Sulphuric acid, 95-98% 500 ml	30219-50	
	Stand.petrol b.p.65-95 C 1000 ml	31311-70	
Additional material			
	Shampoo		

Set-up and procedure

Set-up

Hazards

- Hydrochloric acid causes burns. If it splashes onto your skin, rinse the area with abundant water!
- Wear protective glasses!
- Petrol is highly flammable. Remove the bottle from the experimental area!
- Lubricate rubber-glass connections with glycerol. Insert the glass tubes and the dripping funnel by turning them and without applying force!



Set-up

Set up the support stand according to Fig. 1 and Fig. 2.

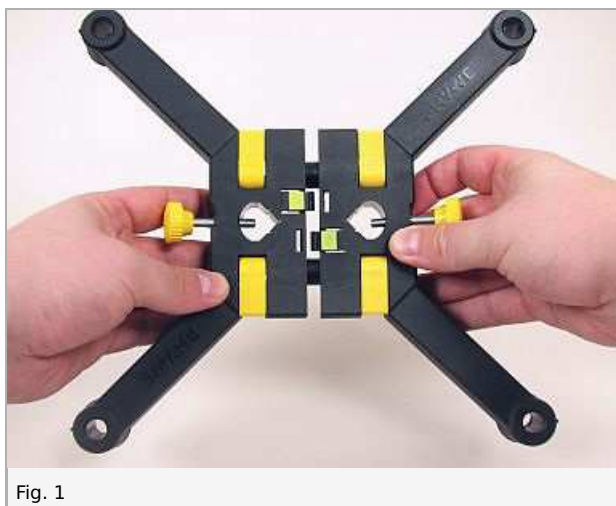


Fig. 1



Fig. 2

Clamp the Erlenmeyer flask to it such that the flask stands securely on the working surface (Fig. 3 - Fig. 5).

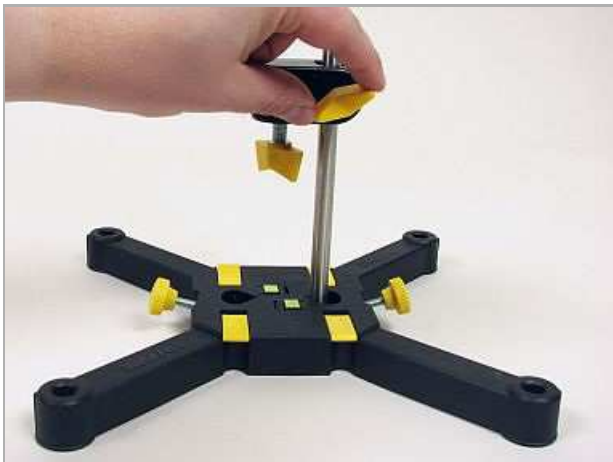


Fig. 3

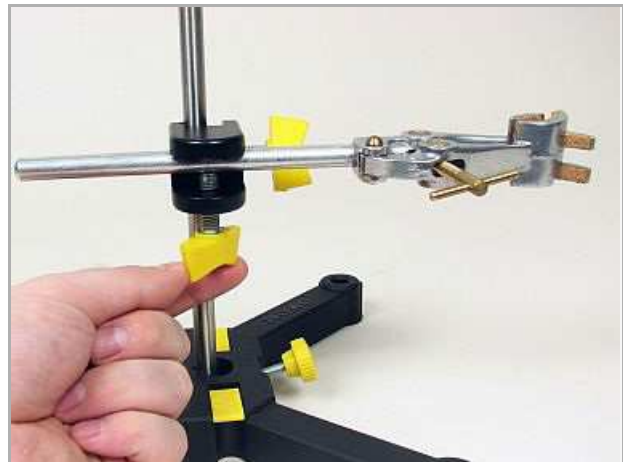


Fig. 4



Fig. 5

Pour 80 ml of the sodium carbonate solution into the Erlenmeyer flask (Fig. 6), add a dash of shampoo to it (Fig. 7) and mix the two solutions (Fig. 8).



Fig. 6



Fig. 7



Fig. 8

After adding a drop of glycerol to one of the holes, twist the long, right-angled glass tube into the stopper until it is approximately one centimetre above the solution's surface when the flask is sealed (Fig. 9). Subsequently insert the separatory funnel into the second hole such that a part of its outlet tube extends beyond the stopper (Fig. 10) and seal the flask (Fig. 11).

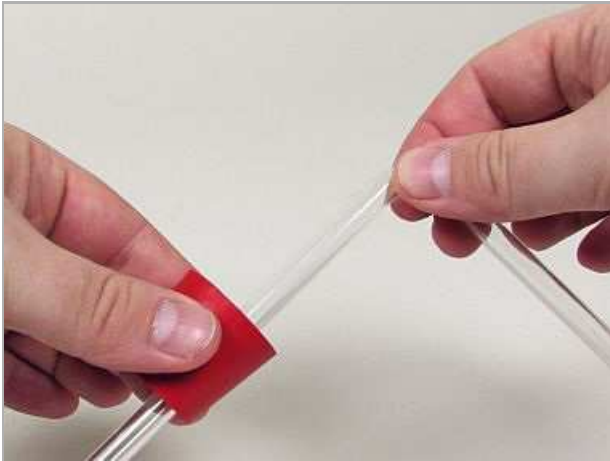


Fig. 9

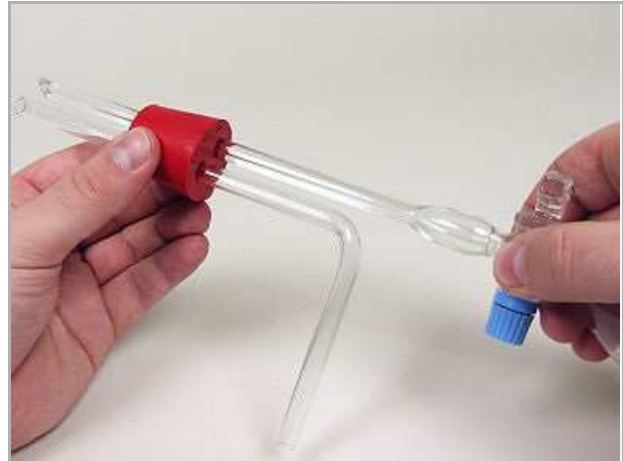


Fig. 10



Fig. 11

Secure the dripping funnel with a universal clamp (Fig. 12 - Fig. 14).

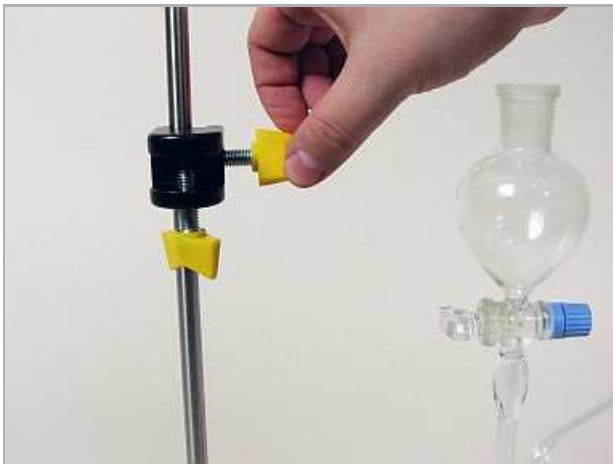


Fig. 12

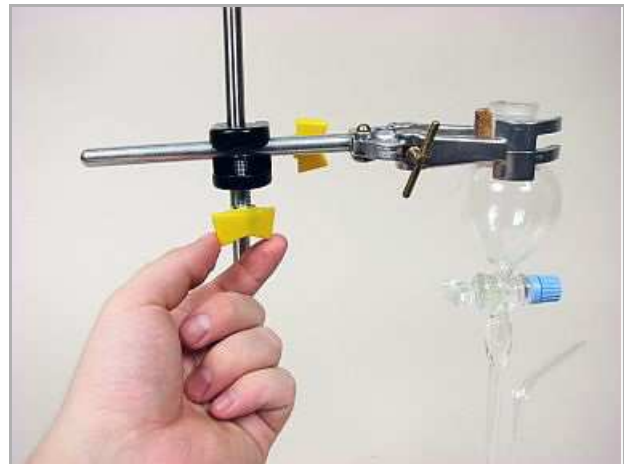


Fig. 13

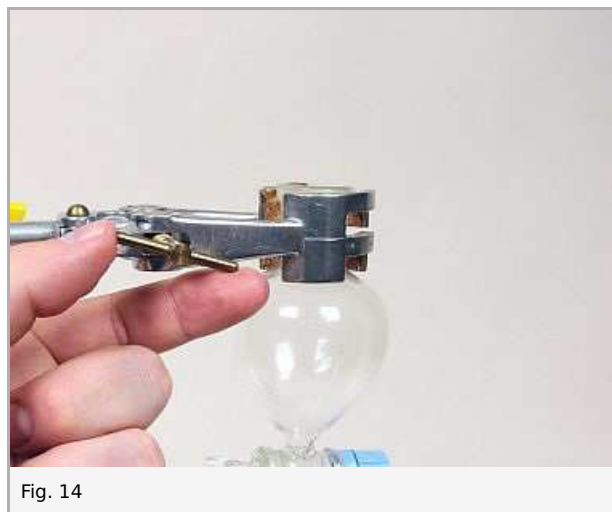


Fig. 14

Connect the long, angled glass tube to the short, right-angled glass tube with a piece of tubing such that the latter's opening faces downwards (Fig. 15 + Fig. 16). Then place the plastic dish under the discharge opening of the right-angled tube (Fig. 17).



Fig. 15

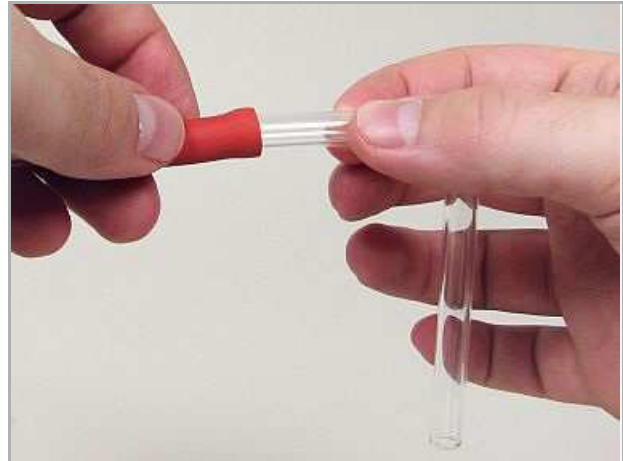


Fig. 16



Fig. 17

Procedure

Procedure

Close the stopcock of the separatory funnel (Fig. 18). Measure out 40 ml of hydrochloric acid in the graduated cylinder and pour it cautiously into the separatory funnel (Fig. 19).

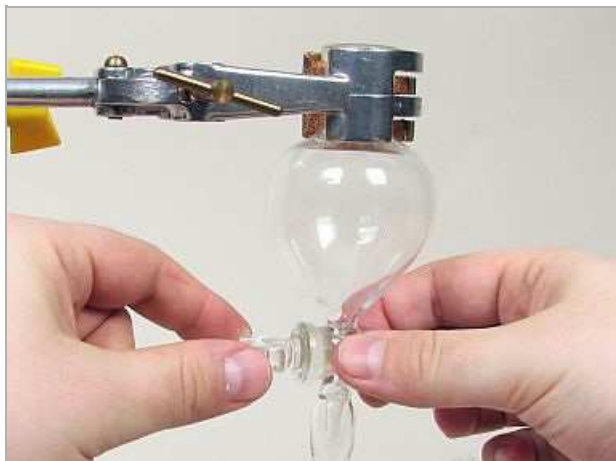


Fig. 18



Fig. 19

Add 1 to 2 ml of petrol to the porcelain dish with the pipette (Fig. 20). Ignite the petrol in the porcelain dish and open the stopcock (Fig. 21). Press the stopper tightly into the flask; hold it in place during the reaction.



Fig. 20

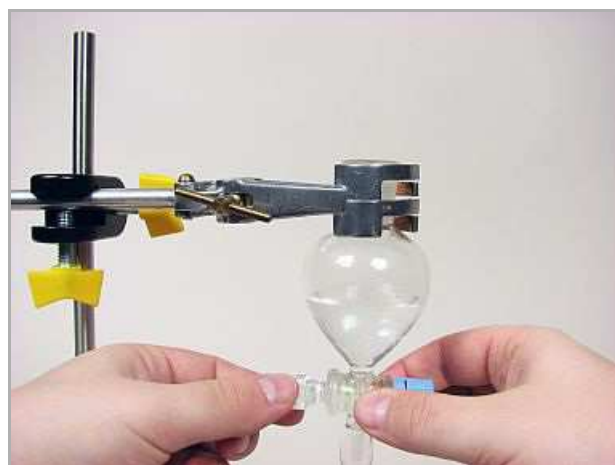


Fig. 21

Waste disposal

- Pour the residual petrol into the collection container for flammable organic substances.
- Dispose of the sodium carbonate solution in the container for acids and alkalis.

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Report: Model of a fire extinguisher

Result - Observations

Note your observations.

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Evaluation - Question 1

Interpret your observations. Using them, describe the mode of operation of a fire extinguisher.

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Evaluation - Question 2

Sketch the construction of such a fire extinguisher (textbook).

Evaluation - Question 3

Why are fire extinguishers not operated with nitrogen?

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