Pumps and siphons (Item No.: P1002600)

Curricular Relevance

Area of Expertise: Physics
Education Level: Age 14-16
Topic: Mechanics
Subtopic: Mechanics of gases
Experiment: Pumps and siphons

Difficulty	Preparation Time	Execution Time	Recommended Group Size
Intermediate	10 Minutes	10 Minutes	2 Students

Additional Requirements:

- Glycerol, 250 ml 30084-25

Experiment Variations:

Keywords:

Task and equipment

Information for teachers

Additional Information

In Experiment 1, the students should make a pressure and suction pump; in Experiment 2, a siphon. The mode of functioning of both should be investigated.

Pumps and siphons (Item No.: P1002600)

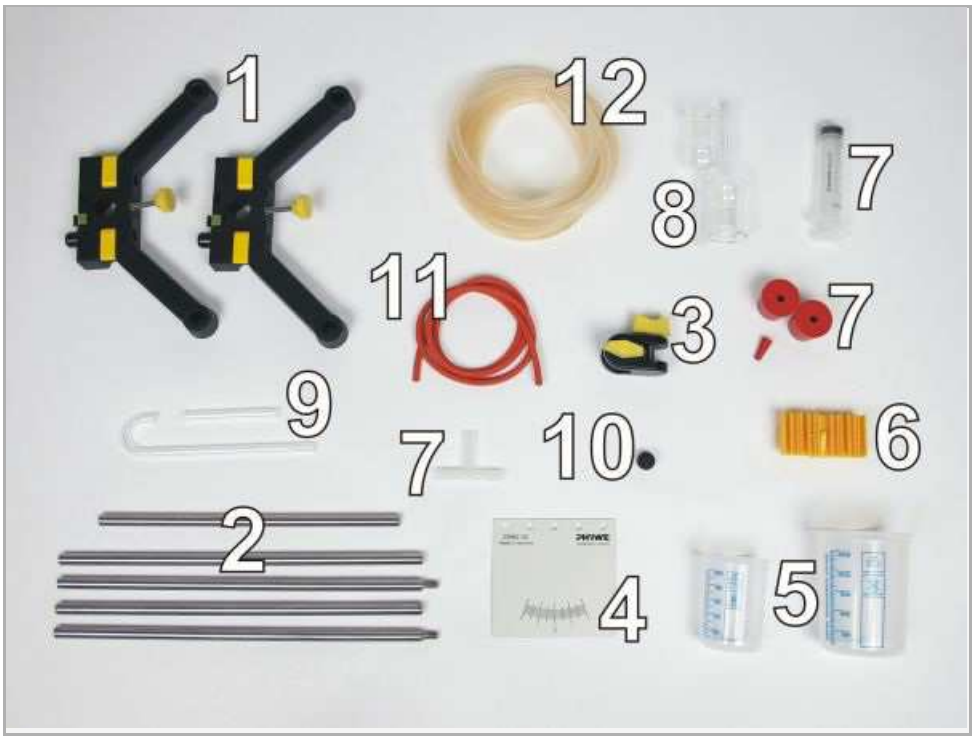
Task and equipment

Task

How do pumps and siphons function?

In this experiment you will set up a pump using the specified parts and study its mode of operation. Then you will set up a siphon and examine its mode of functioning.

Equipment



Position No.	Material	Order No.	Quantity
1	Support base, variable	02001-00	1
2	Support rod, l = 600 mm, d = 10 mm, split in 2 rods with	02035-00	2
3	Support rod, stainless steel, l = 250 mm, d = 10 mm	02031-00	1
4	Boss head	02043-00	1
5	Plate with scale	03962-00	1
6	Beaker, low form, plastic, 100 ml	36011-01	1
7	Beaker, 250 ml, low form, plastic	36013-01	1
8	Glass tube holder with tape measure clamp	05961-00	1
9	Syringe 20ml, Luer, 10 pcs	02591-03	(1)
10	Tubing connect.,T-shape,ID 8-9 mm	47519-03	1
11	Rubber stopper 26/32, 1 hole 7 mm	39258-01	2
12	Rubber stopper, d=9/5mm, w/o hole	39250-00	1
13	Glass bell with tube	03917-00	2
14	Glass tube,hooked, 160x30, 10p	36701-54	(1)
15	Glass tube, straight, l=80 mm, 10/pkg.	36701-65	(1)
16	Rubber ball,diam.15 mm	03921-00	2
17	Rubber tubing, i.d. 3 mm	39279-00	1
18	PVC tubing, i.d. 7mm	03985-00	1
Additional material:			
19	Glycerol, 250 ml	30084-25	1

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Set-up and procedure

Set-up

Experiment 1: pumps

- Connect the two halves of the support base with the 250 mm support rod and tighten the locking levers (Fig. 1).
- Screw the split 600 mm support rods together (Fig. 2).
- Set the two 600 mm support rods into the support base halves and fix them with the locking screws (Fig. 3).

Fig. 1

Fig. 2

Fig. 3

- Fix the plate with scale to one of the support rods using the bosshead (Fig. 4).
- Fix the glass tube holder to the other support rod (Fig. 5).

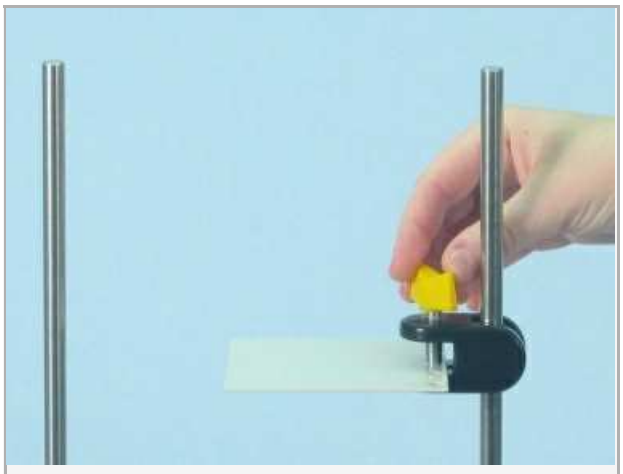

Fig. 4

Fig. 5

- Insert the hooked glass tube in the hole of the rubber stopper (Fig. 6).
- Place a rubber ball into one of the glass bells as a valve, and plug the rubber stopper in the glass bell (Fig. 7).

Fig. 6

Fig. 7

- Fix the glass bell with glass tube to the glass tube holder (Fig. 8).

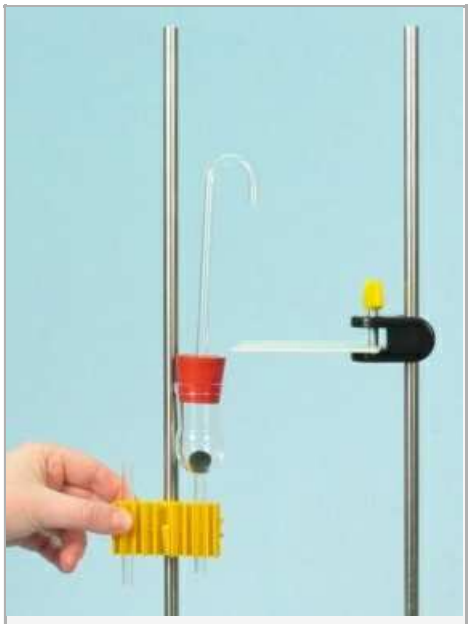

Fig. 8

- Plug the T-shaped connecting piece in the hole of the other rubber stopper (Fig. 9). Attach a short length of silicone tubing to each of the other two ends of the connecting piece (Fig. 10).

Fig. 9

Fig. 10

- Place a rubber ball into the other glass bell and plug the rubber stopper with connecting piece into it (Fig. 11). Connect the T-shaped connecting piece to the glass tube and the other glass bell (Fig. 12).

Fig. 11

Fig. 12

- Slip a piece of rubber tubing, approx. 8 mm long, onto the opening of the glass syringe (Fig. 13) and stick this into the glass tube as shown in Fig. 14.

Fig. 13

Fig. 14

Fig. 15

Experiment 2: siphon

No setup is needed; see procedure.

Procedure

Experiment 1: pumps

- Immerse the lower part of the pump, i.e. the tip of the glass bell, in the water-filled beaker (100 ml).
- Move the piston of the syringe up and down until water flows out of the opening of the hooked glass tube (Fig. 16).
- Observe the behaviour of the two rubber balls while pumping, and note your observationsin the report.


Fig. 16


Fig. 17

Experiment 2: siphons

- Fill the 600 ml beaker with 400 ml of water. Coil a 60 cm piece of silicone tubing spirally into the beaker, making sure that the tubing is completely filled with water (Fig. 18)!


Fig. 18

- Press the rubber stopper into the upper end of the tubing (Fig. 19) and pull the end into the other beaker (Fig. 20). Lift the rest of the tubing far enough out of the large beaker that the tubing forms a large arch above the two beakers.
- Remove the stopper and observe what happens (Fig. 21).

Fig. 19

Fig. 20

Fig. 21

Report: Pumps and siphons

Result – Observations 1

Experiment 1 (pumps):

When the piston is pulled out, the ..... ball closes the corresponding opening.

When the piston is pushed in, the ..... ball closes the corresponding opening.

Result – Observations 2

Experiment 2 (siphons):

What do you see?

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Evaluation – Question 1

Explain why one ball has to close a valve when pressure is being applied, and the other one has to open a valve.

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Evaluation – Question 2

Must the opening of the one valve and the closing of the other valve happen simultaneously? If so, why?

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Evaluation – Question 3

How is the water sucked in?

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Evaluation – Question 4

How high can water be pumped with a suction and pressure pump?

Calculate h_W using the equation $p_0 = \rho_W \times h_W \times g$, where ρ_W = 1000 kg/m^3, g = 9.81 m/s^2 and p_0 = 1013 hPa.

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Evaluation – Question 5

Experiment 2 (siphons):What happens to the water in the large beaker by siphon?

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Evaluation – Question 6

Does the water move only in one direction? If so, which direction?

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Evaluation – Question 7

When does the process stop?

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Evaluation – Question 8

Can water flow uphill?

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Evaluation – Question 9

How can you explain the process?

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