You CAN do it!

Experiments with soda cans, plastic bottles, and other household items

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(Materials used are in **bold**)

1. The Leydenfrost phenomenon and thermonuclear fusion

Fig. 1
The soda can bottom, prepared for the Leydenfrost phenomenon

The first phenomenon can be shown with a **soda can bottom**, which is cut off the can (Fig. 1). To show the phenomenon, put the soda can bottom over an **alcohol burner**, or other heating device. The concave side should be on the top. If it becomes enough hot, drop a bit of **water** onto the hot surface. As the water touches the hot surface, a part of it evaporates. This "vapour-cushion" protects the water drop from immediate evaporating. If we wait a little, another interesting phenomenon can be seen: The water drop begins to oscillate, and beautiful standing waves arise on it.

We can simulate the fusion with water drops. Form the soda can bottom into a special shape (it is easy with a steel ball): A little hill in the centre and a little pit on the top of the hill (Fig. 2 a, b). The hill plays the role of the Coulomb potential. Put this gadget over the heat source, and heat it up. Put a water drop onto the top of the hill, this will be one of the nuclei. Drop the other "nucleus" onto the side of the gadget, so it can run towards the first. If the second one has enough kinetic energy, it can "climb" the "Coulomb potential", and the two nuclei can fuse together.

Fig. 2 a
The soda can bottom, prepared for the fusion modelling

Fig. 2 b
The cross section view of the soda can bottom

2. Another way to show thermonuclear fusion

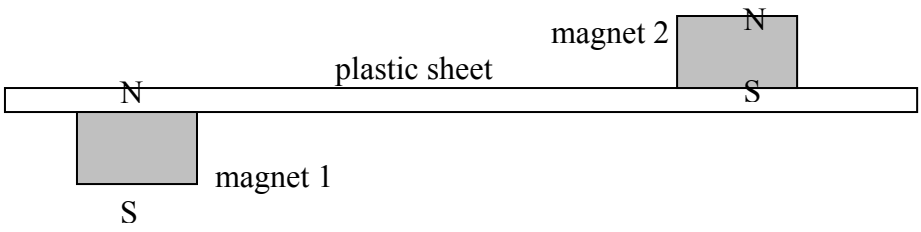

Fig. 3

If we place a **strong magnet** under a **plastic sheet**, and another above it in the same direction (see Fig. …), from far they repel each other, but if they are close enough, there is pull between them – just like between the nuclei. Push the upper magnet slowly towards the lower: it avoids the other, because of the push between them. Give the "nucleus" a little more speed: if it is in the right direction, the "fusion" occurs.

3. Modelling a meteoric front

For this experiment we need a boxy, transparent **plastic bottle**. Cut off the narrower side of the box, and pull a **rubber balloon** onto the original opening of the bottle. Mix some **salty water**, colour it with **food colouring**, and pour it into the balloon. Place the bottle and the rubber balloon onto a table. Be careful not to spill the salted water from the balloon into the box. If it happens, wipe it out with a dry cloth. The opening of the balloon should be over the salt water level in the balloon. Then pour **clear water** into the box. This will represent the warm air, the salty water will be the cold air. Now push the balloon gently, so the salty water can come out. If you push it constantly and gently, the "cold front" will crawl under the "warm air".

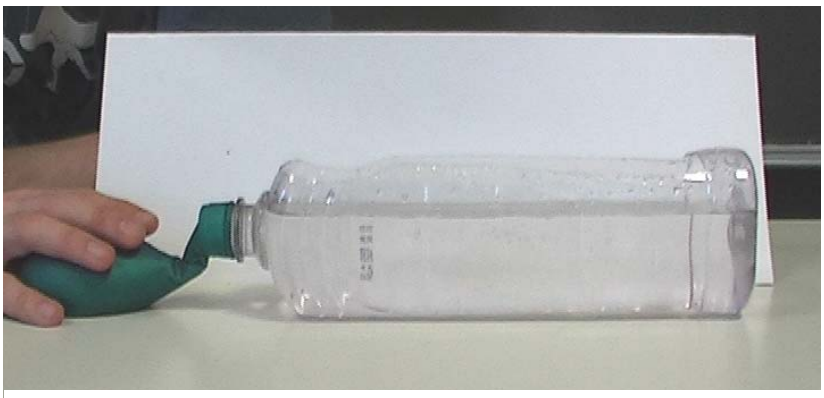

Fig. 4
Modelling a meteoric front

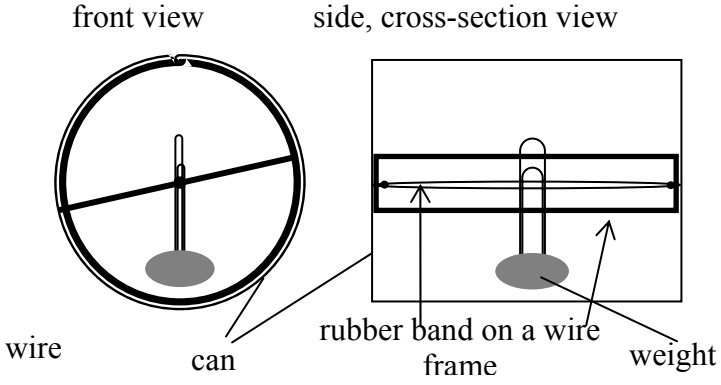

Fig. 5
The assembly of the faithful can

4. The faithful can

This little toy shows energy transformation in a surprising way. If you roll it away, it rolls back to you. The trick is, that inside the **can** there's a **little weight (e.g. plasticine)**, on a **rubber band**. The rubber band is fixed at the centre of the can on a **wire frame**, and the weight hangs on it with the aid of a **paper**

clip. If you roll away the can, the weight winds up the rubber band. The kinetic energy transforms into potential energy. When all of the kinetic energy is transformed (a little part of it becomes heat), the can stops, and rolls backwards. The gadget works better, if the rubber band is stronger (e.g. two bands together), and the weight is heavier. The assembly is shown on fig. 5.

5. The simplest air table

Get **a bottle with flat sides**. Drill small holes into the biggest side, in constant distances, close to each other. The diameter of the holes should be about 0.5 mm, the distance between them about 0,5 cm. The precise drilling is easier if you stick a square patterned paper onto the box, and drill the holes at the intersections of the lines. After the drilling the paper has to be removed, and the surface has to be smooth. If the holes are ready, cut off the ends of a **rubber balloon**, and connect a **hairdryer** to the neck of the bottle with this "rubber tube". The hairdryer must be a type, which can blow cold air too, otherwise the bottle will melt. If you aren't using this hairdryer for drying, you can disassemble the heating wire.

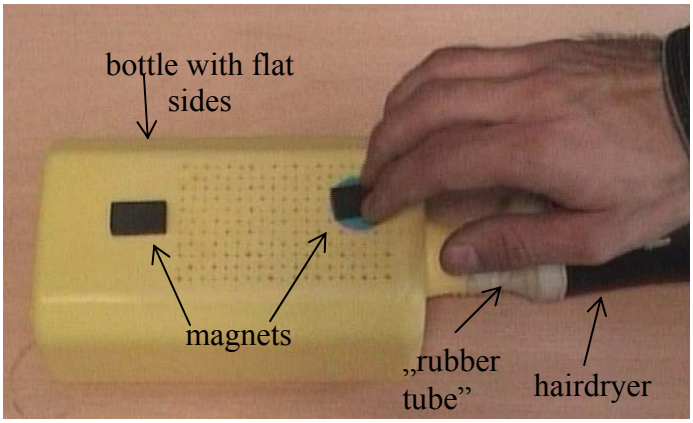

Fig. 7
The air table

Put the box onto a table, with the pitted side up. Start the hairdryer, and put a little, flat thing onto the pitted area. If it is not too heavy and not too light, it will float on the air cushion.
Showing the Rutherford experiment, and thermonuclear fusion:
Get two **magnets** with flat and smooth sides, which can repel each other, if they are lying on their flat sides. Drop a little piece of metal (e.g. **a paper clip**) into the bottle, and stick it onto the pitted side with one of the magnets, according to fig 7. Start the hairdryer, and put the other magnet onto the pitted surface. If it doesn't float on the air cushion, try to glue a little **cardboard paper** plate onto it (a little bigger, than the magnet), so it can float on the plate.
If you push the floating magnet gently towards the fixed one, the floating one avoids the other, just like the α particle did it in the Rutherford experiment. If you give more speed, the magnet jumps onto the other – fusion occurred.

6. Cloud in a bottle

Get a big, transparent **plastic bottle**. You will need **a pump** too, which has a simple ending (not with a screw). Make a non-return valve of a **plastic tube**. The tube should be closed on one end, about 8-10 cm long, and with a diameter that's a little bigger than the mouth of a **rubber balloon**. Drill two little holes (opposite to each other) close to the opened end of the tube. Drill a little hole through **a cork** that fits into the neck of the plastic bottle. This hole should be less in diameter than the end of the pump. Cut off the "mouth" of a rubber balloon, and cut off the ball part of it too. With this short rubber tube, connect the cork to the opened end of the plastic tube (fig. 8). Fix the position of the rubber balloon part with the cut-off "mouth" of the balloon. Now the non-return valve is ready.

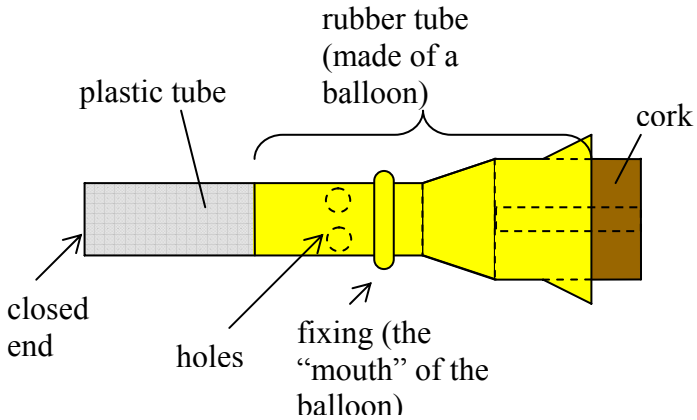

Fig. 8
The non-returning valve

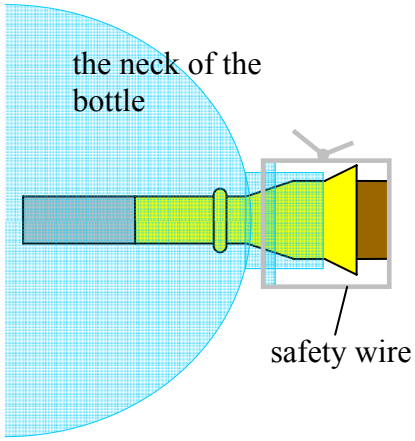

Fig. 9
The valve in the bottle

Pour some **water** into the bottle and shake it. Insert the valve, and make a "**safety wire**" to fix the cork (fig. 9), otherwise the air pressure could push it out. Attach the cork to the bottle with a bit of string. Insert the end of the pump and pump up the bottle, until you see that the cork wants to come out. Take off the safety wire carefully (the pressure can be really high!) and quickly release the pressurized air. The adiabatic cooling causes condensing in the bottle, and the water vapour becomes visible inside. This "cloud" can be denser if, before pumping, a burning **match** is dropped into the bottle (a little water must be in the bottle to put out the match). The smoke of the match helps the water to condense.

7. An easy way to show the Magnus effect (Magnus pendulum)

Make (or get) an empty **paper cylinder** (about 5-6 cm in diameter), and hang it onto an about 2 m long **rubber band**. The centre of mass of the cylinder should be in the line of the rubber band. Hang up the gadget with the free end of the rubber band. Twist it many times. Turn it aside as a pendulum in a big angle (70-80 degrees) and release. The paper cylinder begins to rotate while the pendulum swings, and because of the Magnus effect, its trajectory bends. After a little time, the pendulum becomes a conic pendulum: The resultant of the pressure and gravitational forces points towards the centre of the circle, because the pressure force is always perpendicular to the velocity vector.