

HOW A VACUUM CLEANER WORKS

How to make a vacuum cleaner 2

Attach the cardboard to the motor

15.

Insert the motor into the bottle and tape around it

16.

Using scotch tape, attach the cardboard base to the bottom of the cut bottle

17.

Connect the crocodile clips to the batteries

18.

Connect one crocodile clip to the motor

19.

Insert the straw into the cap hole, and use hot glue to seal around the opening

20.

21. Connect the last crocodile clip

The motor starts!

22.

Vacuuming!

23.



מכון ויצמן למדע
הזרוע החינוכית של מכון ויצמן למדע

$$\operatorname{tg} \alpha = \frac{\sin \alpha}{\cos \alpha}$$

$$\pi = 3.14$$



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The Scientific Explanation

To understand how a vacuum cleaner works, we first need to understand what pressure is.

Pressure is a force (per unit area) which particles of matter exert, both on each other and on objects and other substances around them. Even at this very moment, air particles are continuously bumping into you and exerting pressure on you.

The pressure depends on many factors, one of which is the number of particles per unit volume, that is, the substance's density. When the number of particles increases while the volume does not, the pressure will increase. And it also works the other way around:

When we decrease the number of particles in a certain volume, the pressure drops.

When particles are allowed to move between regions with different pressures, they will always move from regions with high pressure, where there are many particles, to low-pressure regions, in order to equalize pressures.

And now, to the vacuum cleaner we built:

Before we started rotating the fan blades, the air pressure outside the bottle was equal to the air pressure inside. Starting the motor and rotating the fan blades in the appropriate direction removed some of the air particles from the bottle. As a result, fewer particles remained inside, so the air pressure inside the bottle decreased compared with the air pressure outside of it. Then, to equalize pressures, air particles began to move from outside the bottle into it through its cap. Any dirt in the cap's vicinity is sucked in along with the air. This is precisely the basic principle of operation behind professional vacuum cleaners (which use vacuum to clean). Vacuum is a space devoid of matter, and is therefore the lowest possible pressure that can be obtained.