
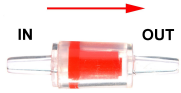
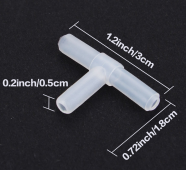
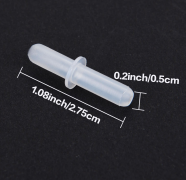



Learning Objective: Students obtain a feeling for what vacuum is and how/why different objects behave in a vacuum environment.

Supplies per group:

Vacuum jar supplies per group:

1	32 oz mason jar 12/\$10 at QFC	
2	2 one-way or check valves 10/\$7 on Amazon common pet-store item	
1	Tees Common pet-store item 25 tees/25 connectors total for \$6 on amazon	
1	Hose connector Common pet-store item Will be attached to jar lid to connect hose	
4 1" pieces	Tubing, 3/16 inner diameter, 5/16 outer, vincon pvc (from UW chemistry stockroom, 0.12/ft)	
1	100 ml syringe. Note 150 ml is suggested but these are expensive! 10/\$9 on Amazon (also \$1.08/syringe in UW chemistry stockroom)	
	Drill- for drilling hole in lid. Hot glue gun for attaching hose connector to lid. This will be pre-done.	

Items for experiments: Marshmallows, balloon, kitchen timer, water (may not be possible), carbonated water (may be easier), shaving cream, a feather , bubble wrap

Worksheet for observations

Instruction sheet for assembling the vacuum chamber

5 minute group introduction:

Ask the group: What is in outer-space?

You should get answers like stars, planets, comets, etc.

But what there are huge distances between all of these objects. What is between?

Vacuum, that is, nothing. (now technically there are still fundamental particles due to radiation- but this is beyond the scope of this lesson).

Ask the students what is around us right now? (answer is air). Tell them we are going to create chambers in which we are going to remove the air and we will see what happens to objects inside.

Break into groups and make the vacuum chamber

Experiment with items in the room. Use your worksheet to record your observations. Here we provide explanations.

- 1) Marshmallow should get bigger. Then if air is let in, it should return to normal size. The reason is that the air pockets inside the marshmallow expand into the vacuum taking the marshmallow molecules with them.
- 2) Shaving cream: again- pockets of air are trapped in the cream and expand
- 3) Balloon- the air inside the balloon is expanding now that there is no outside pressure to push back.
- 4) Water- if the vacuum is good enough, you may be able to see it boil.
- 5) Feather- the feather should drop more quickly in the vacuum chamber as there is no air pushing up on the feather.
- 6) Egg timer- the sound should go away as sound travels in air (pressure waves).
- 7) Bubble wrap: should pop as the air inside the bubbles expands into the vacuum.
- 8) Carbonated water: the bubbles should escape more quickly.

Wrap up (6 minutes):

Ask the students what they learned about today. Reinforce the idea that vacuum is the absence of air/gas.

Video on the worlds larger vacuum (3-4 minutes)

<https://www.youtube.com/watch?v=E43-CfukEgs>

On-line resources:

Video this lesson is based on:

See <https://www.youtube.com/watch?v=qFzzN3oUUHE>

Video on the vacuum of space:

https://www.youtube.com/watch?v=iSe_R87kF6U

Video on what would happen to an astronaut if they got a hole in their suit

https://www.youtube.com/watch?v=pm6df_SExVw