Zero-G Siphon

By Catholic High School Singapore

OUR TEAM

Daniel

Ryan

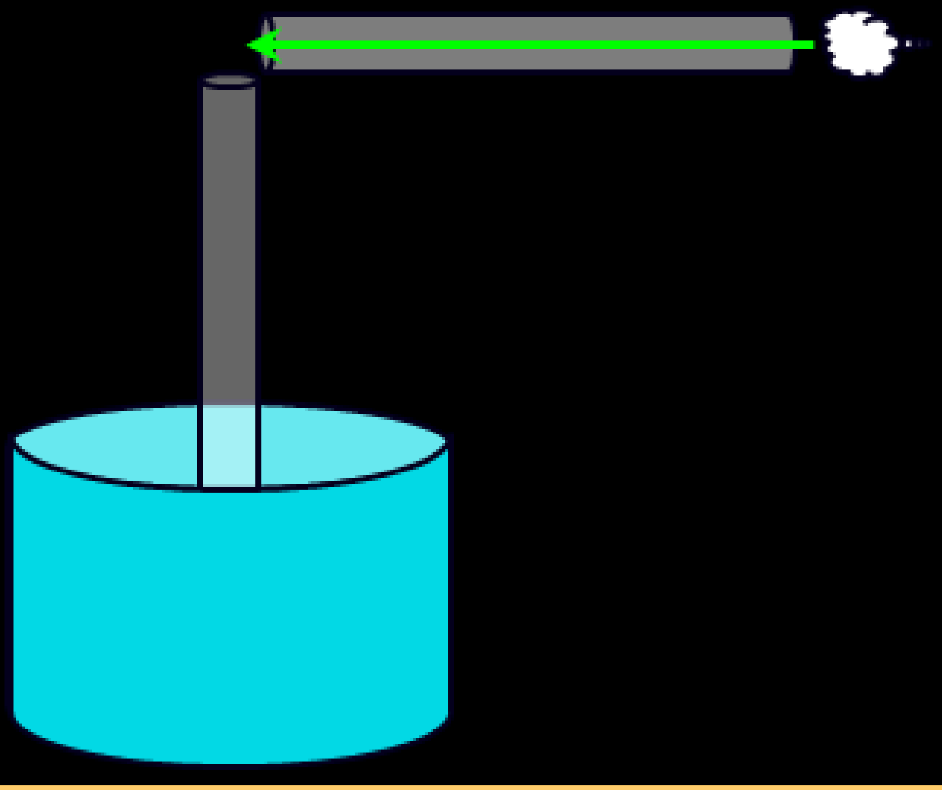
ABSTRACT

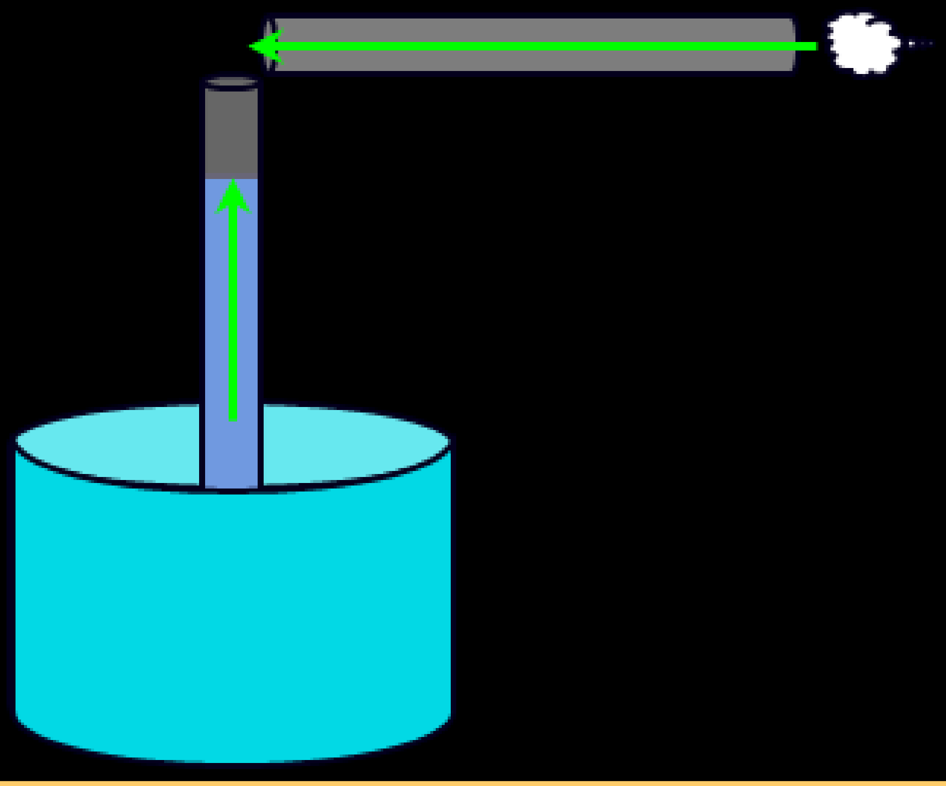
Our experiment aimed to explore the application of Bernoulli's Principle in a microgravity environment. This presentation discusses the experiment, results, how they diverged from the hypothesis, and the implications of these observations in microgravity.

HYPOTHESIS

On earth, when blowing air across the open end of a straw half immersed in a water source, the water in the straw moves upwards until the tip of the straw.

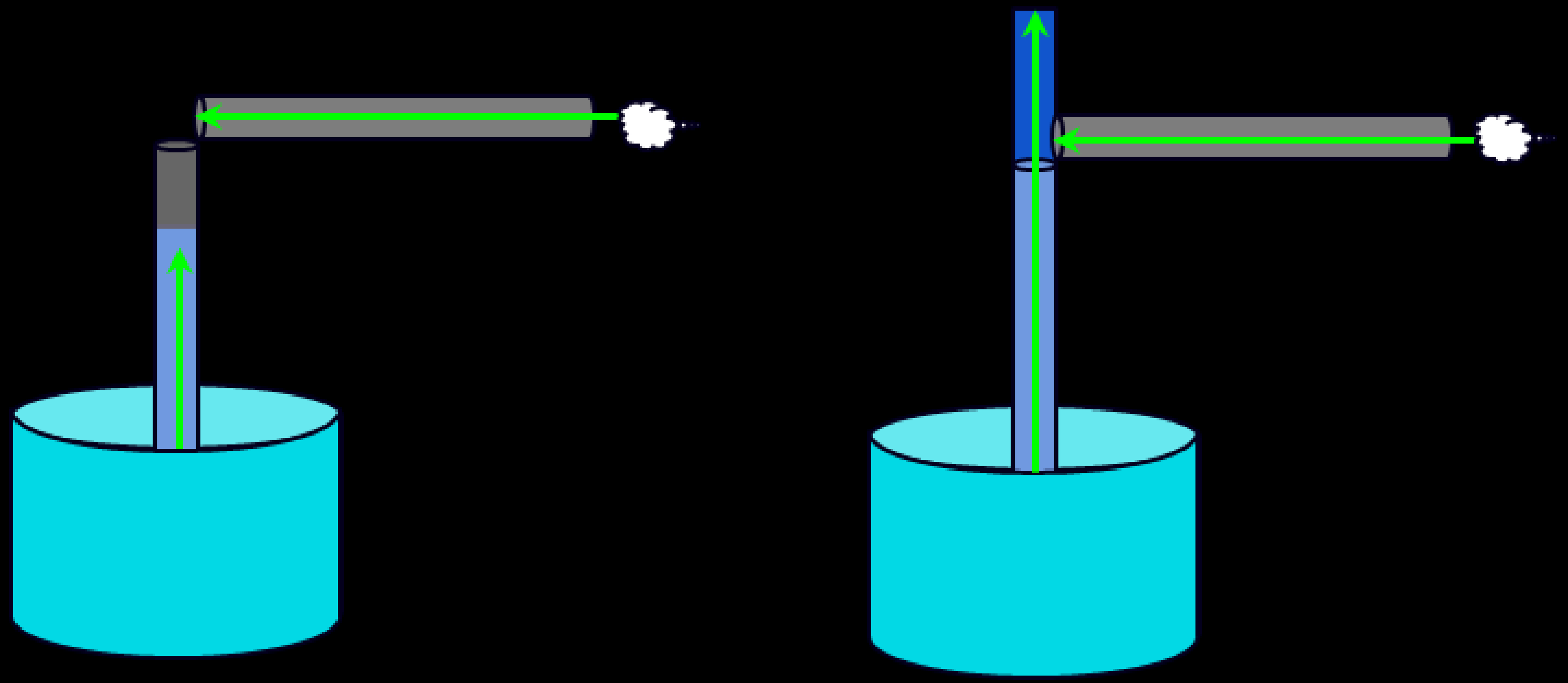
Bernoulli's principle states that an increase in the speed of a fluid occurs simultaneously with a decrease in static pressure or the fluid's potential energy.





HYPOTHESIS

In low-gravity conditions, the water in a vertical straw which is partially immersed in water will be siphoned out in a continuous motion when air is blown across the open end of the straw



PROPOSAL

1. The astronaut blows into the horizontal straw continuously

2. Due to Bernoulli's equation, this would create a region of higher pressure at the water base and lower pressure at the top of the straw, creating a siphon force

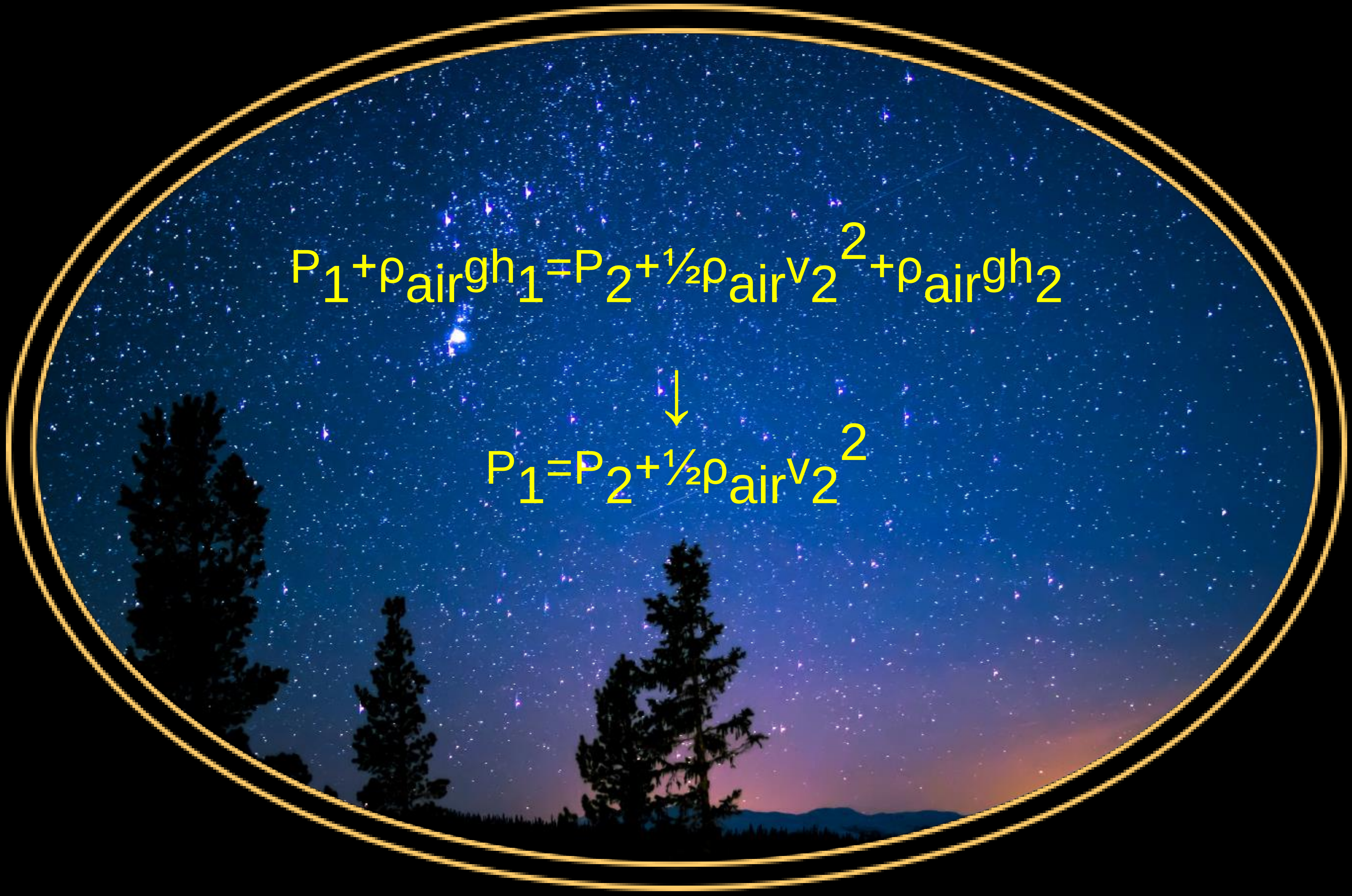
3. This continues until the water reaches the top of the straw

4. After the astronaut stops blowing on the straw, it should continue its motion due to Newton's First Law of Motion, maintaining the siphon.

MICROGRAVITY UTILITY

In Microgravity, Since gravitational acceleration is very small, the change in the waters' gravitational potential energy is negligible.

In Microgravity, Since gravitational acceleration is very small, the change in the waters' hydrostatic pressure is negligible.



$$P_1+\rho_{air}gh_1=P_2+½\rho_{air}v_2{}^2+\rho_{air}gh_2$$

$$\downarrow$$

$$P_1=P_2+½\rho_{air}v_2{}^2$$

What does this do?

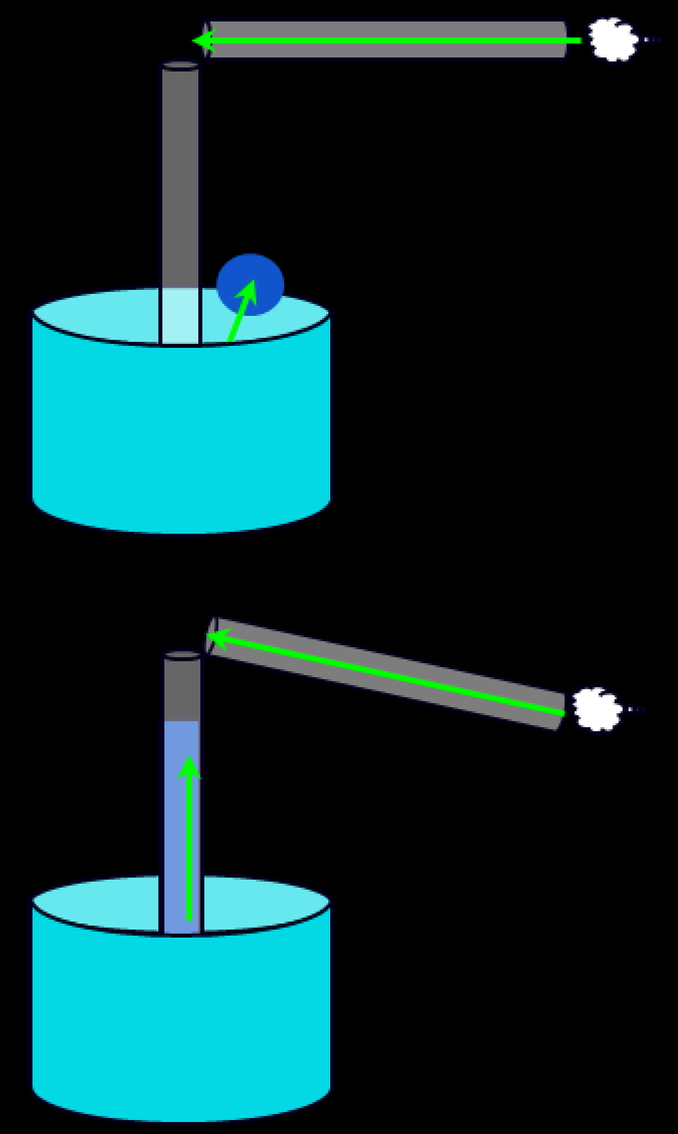
As this simplifies our equation which was derived from the Principle of Conservation of Energy down, it allows us to observe the force generated and understand what affects it (as there are now much fewer variables)

01 RESULTS IN SPACE

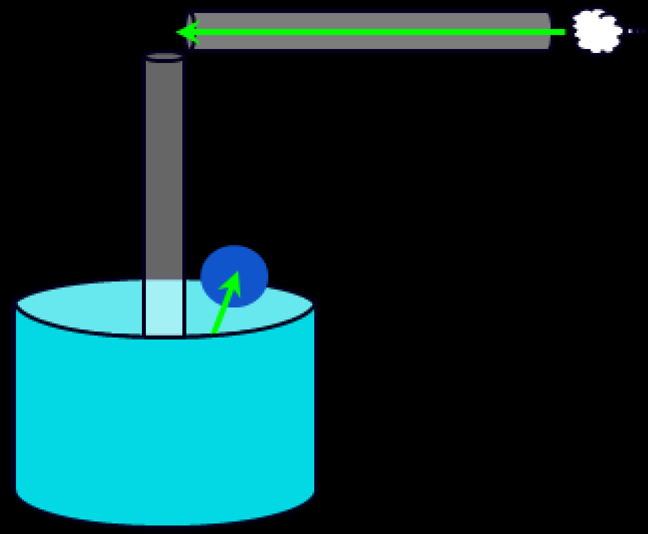
OBSERVATIONS

- When the water in the straw was blown, at first no water was seen drawn out, instead water was displaced from the water container.

- Afterwards, when the angle was shifted, the water in the tube rose but did not manage to leave the tube.



02 WHAT HAPPENED?



Human Error

It is difficult to maintain a completely horizontal straw.

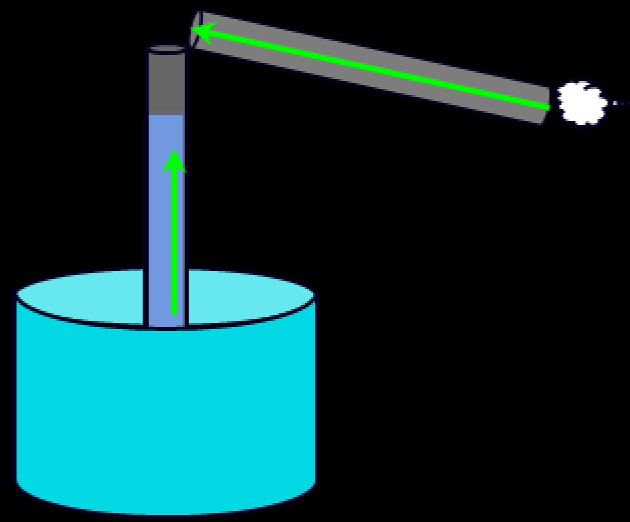
Wrong Airflow

Too large an angle blows air downwards which displaces the water out.

Wrong force!

Instead of the siphon force, the blowing force dominates and siphon effect remains unobserved.

02 WHAT HAPPENED?



Too small an angle

Small angles stop air from going down but the average airflow is slower

Slower Airflow

The slower airflow produces less pressure difference and the siphon force is smaller

Insufficient force!

The siphon force is not enough for the water to reach the top of the straw..

03 CONCLUSION

Contrary to our hypothesis, the experiment revealed that the angle and strength of airflow are also critical in determining the movement of fluids under these conditions. Specifically, when the angle of airflow was 90 degrees or more, air displaced water downwards rather than creating a siphon effect. When the angle was too shallow, the resulting pressure differential was insufficient to lift the water out of the straw.

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IMPLICATIONS

This experiment also implies that continual siphoning of water even in microgravity may be infeasible as even with much effort put in, a continuous siphon could not be achieved.


THANK YOU
Special Thanks to:
Our Mentors Mr Goh, Mr Phua, and Mr Tan