Laboratory #9
Air (a Gas)

Part A: The Best Curve Ball Ever

Concepts
Bernoulli's Principle; Pressure; Velocity

Introduction
In Major League Baseball, some pitchers can throw some amazing curve balls. Throwing a good curve ball take years of practice, strength, and skill to master. In this experiment you will throw a better curve ball than any MLB pitcher!

Procedure
- Put the ping-pong ball in one end of the tube.
- Holding the end with the ping-pong ball, fling the tube in a side arm fashion.
- Repeat until you get the technique down.
- Throw a couple curve balls to your partner.

Part B: The Amazing Levitating Ping-Pong Ball

Concepts
Bernoulli's Principle; Pressure; Velocity

Introduction
In Japan and Europe they have trains that use magnetic levitation that can achieve very fast transportation speeds because there is no ground friction. Here, we will levitate a ping-pong ball by using pressure differences (not in the same way a bullet train does). Once again it will be your job to explain why it works the way it does.

Procedure
- Without turning it on, point the hair dryer straight up.
- Place the ping-pong ball on the end where the air will come out.
- Turn on the hair dryer (cold air only!).
- Point the hair dryer at different angles, and see how close to horizontal you can get before the ball leaves the air stream.
- Feel how high the air flows
- Using your finger, try lightly tapping the ball in the air stream to get a feel for how stable the ping-pong ball is in the stream. Rather than wanting to blow away from the air, it seems to want to stay in the stream. Amazing!

Part C. Wild Horses

Concepts
Surface Area; Pressure; Force

Introduction
In 1654 a famous experiment was performed by Magdeburg to show the power of pressure differences. Two hemispheres were put together. They were joined with nothing but a rubber seal, no glue, no nails, no latches--just a flat piece of rubber was between the edges of the metal half spheres. Then the scientist pumped as much of the air out of the chamber as he could with his primitive vacuum pump. After that, he tied a team of wild horses to each side of the sphere and drove the two teams away from each other (just like the Levi's label). Even under that much force, the two spheres did not come apart!

In this lab you will have the opportunity to see just how strong two hemispheres with a vacuum in the middle can be.

Procedure
- Inspect the two discs to ensure no trickery.
- Hold the disks together with the gasket between them
- Evacuate the air out of the disks.
- Try desperately to pull the disks apart.

Lab Reporting Sheet
Laboratory #9

Name:_____

Date:_____

Part A: The Best Curve Ball Ever

- **If you were a fly on the ceiling looking down wathcing yourself throwing this curve ball, which way would the ball be spinning? (clockwise or counterclockwise)**

- **What is the velocity of the air on one side of the ball compared to the other?**

- **Towards which side does the ball curve? Why?**

- **Draw a picture of this experiment in motion.**

Part B: The Amazing Levitating Ping-Pong Ball

- **Using a picture and words explain why the ball stays in the air stream of the hair dryer.**

- **Why did the ball stay in the air stream before the angle was too steep?**

- **Why did the ball fall out of the air stream when the angle was too steep?**

Part C: Wild Horses

- **Before the disks are joined what pressure is on the inside of a disk? The outside? What is the net pressure?**

- **Before the air is evacuated, but after you hold them together, what is the pressure on the inside of each disk? The outside? What is the net pressure?**

- **After the air is evacuated, what is the pressure on the inside of each disk? The outside?**

- **What is the net air pressure in pounds per square inch (psi)?**

- **What is the surface area of the disk?**

- **What is the force on the outside of the disk? The inside?**

- **How much force would it take to pull the two disks apart (in pounds)?**

- **Apply what you have learned to the case of how straws work when you are enjoying an ice tea. Explain how the tea comes up into your mouth.**