2007 Mid-Columbia Regional Science and Engineering Fair

March 8-10, 2007

IN RECOGNITION OF ACHIEVEMENT

American Chemical Society

HAS AWARDED

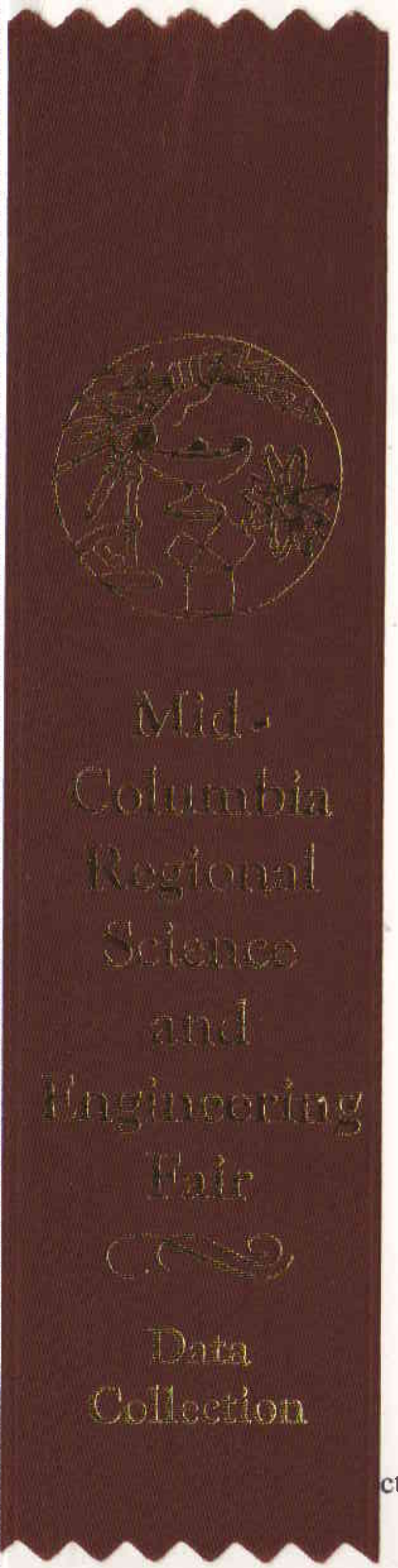
Victor Peng

Hanford High School

First Place for Chemistry, Highschool

Director Joyce E. Stark

President Robert Riech



2007 Mid-Columbia Regional Science and Engineering Fair

March 8-10, 2007

AWARD OF DISTINCTION

Presented to

Victor Peng

of

Hanford High School

for

Data Collection and Analysis

ctor Joyce E. Stark

President

U. S. Metric Association

AWARD
to

Victor Peng

for the best use of

SI

The International System of Units
in a
Science Fair Project
at the

Mid-Columbia Regional Science and Engineering Fair
Science Fair

Lorelle Young | 3/8/2007 | William Hooper
President | **date** | **William Hooper**
Science Fair Coordinator

Question

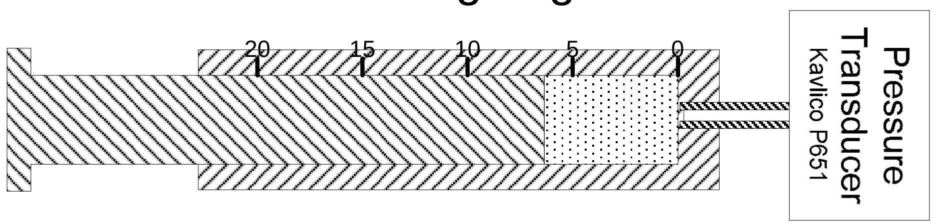
Do all gases behave according to the ideal gas law?

Hypothesis

I think that all gases behave according to the ideal gas law.

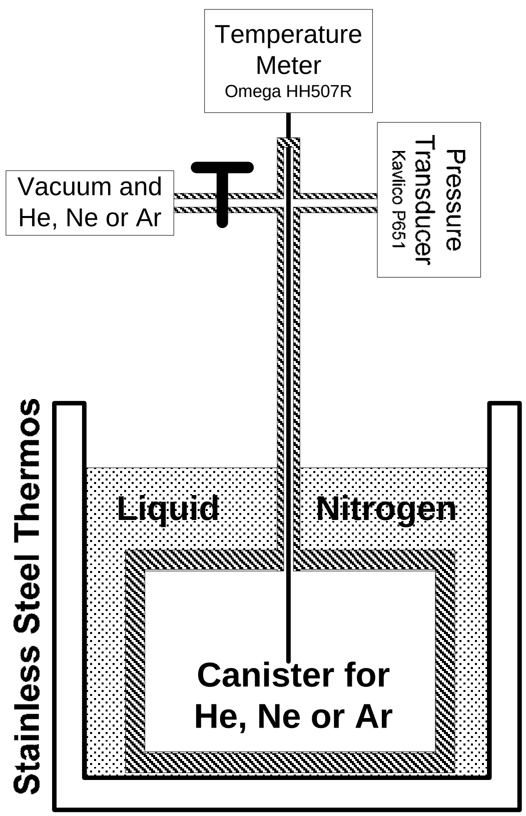
Volume vs. Pressure Procedure

1. Fill the syringe with helium.
2. Attach the syringe to the pressure gauge and seal so that the volume is 15 mL and the pressure is 1 atm; record this measurement.
3. Adjust the volume to 5, 7.5, 10, 12.5, and 20 mL, and record pressure.
4. Repeat steps 2-3 for starting helium volume of 10 and 5 mL.
5. Repeat steps 1-4 for neon and argon gases.



Pressure vs. Temperature Procedure

1. Vacuum out all of the gas inside the canister, and fill it with helium.
2. Put canister into a thermos containing liquid nitrogen, and record the temperature and pressure readings once they stabilize.
3. Record 2 more temperature and pressure readings in 2 minute intervals.
4. Repeat steps 2-3 for dry ice, ice water, and boiling water.
5. Repeat steps 1-4 for neon and argon gases.



Pressure vs. Weight Procedure

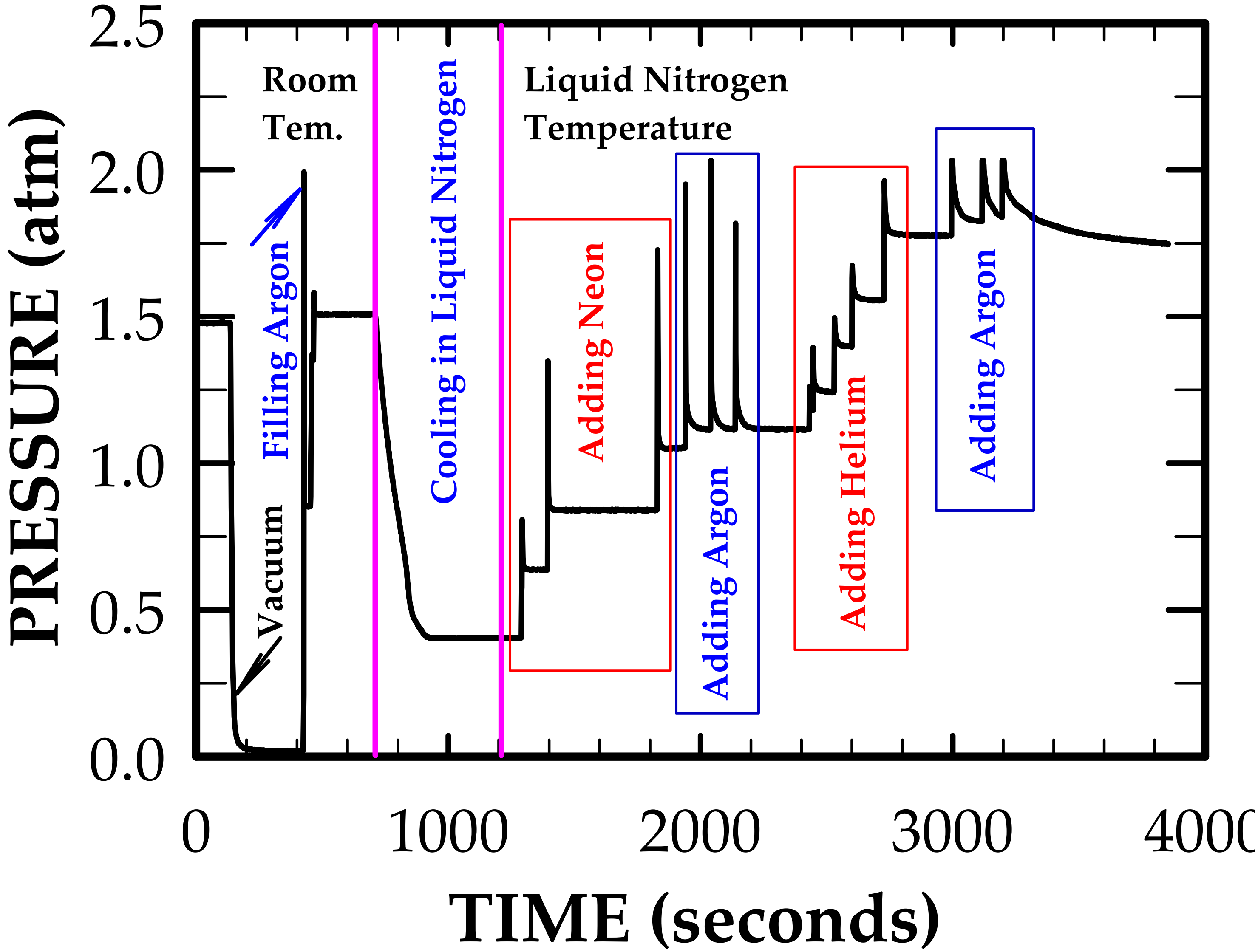
1. Vacuum the canister assembly, and fill it with helium to about 2 atm.
2. Close the valve, and disconnect the gas tubing and other wires.
3. Weigh the canister assembly using a scale.
4. Reattach the canister assembly, and carefully vacuum out helium to about 1.6 atm. Weigh the canister assembly.
5. Repeat step 4 for 1.2, 0.8, and 0.4 atm.
6. Completely vacuum out the helium inside the canister, and weigh it.
7. Compute the helium weight for each pressure.
8. Repeat steps 1-7 for neon and argon gases.

Conclusion

My experiment showed me that my hypothesis was partly correct and partly incorrect. All gases behave according to the ideal gas law if the temperature is above their critical temperature and pressure is not excessively high. The critical temperature for helium and neon is very low, so they basically behave according to the ideal gas law. Yet, the temperature of liquid nitrogen is lower than argon’s critical temperature; this means that when the canister (filled with argon) was put into the liquid nitrogen, argon didn’t behave according to the ideal gas law. Argon actually became a liquid when in liquid nitrogen, and the ideal gas law says that gases cannot become liquid. Argon does behave according to ideal gas law though when temperature is at or above dry ice temperature.

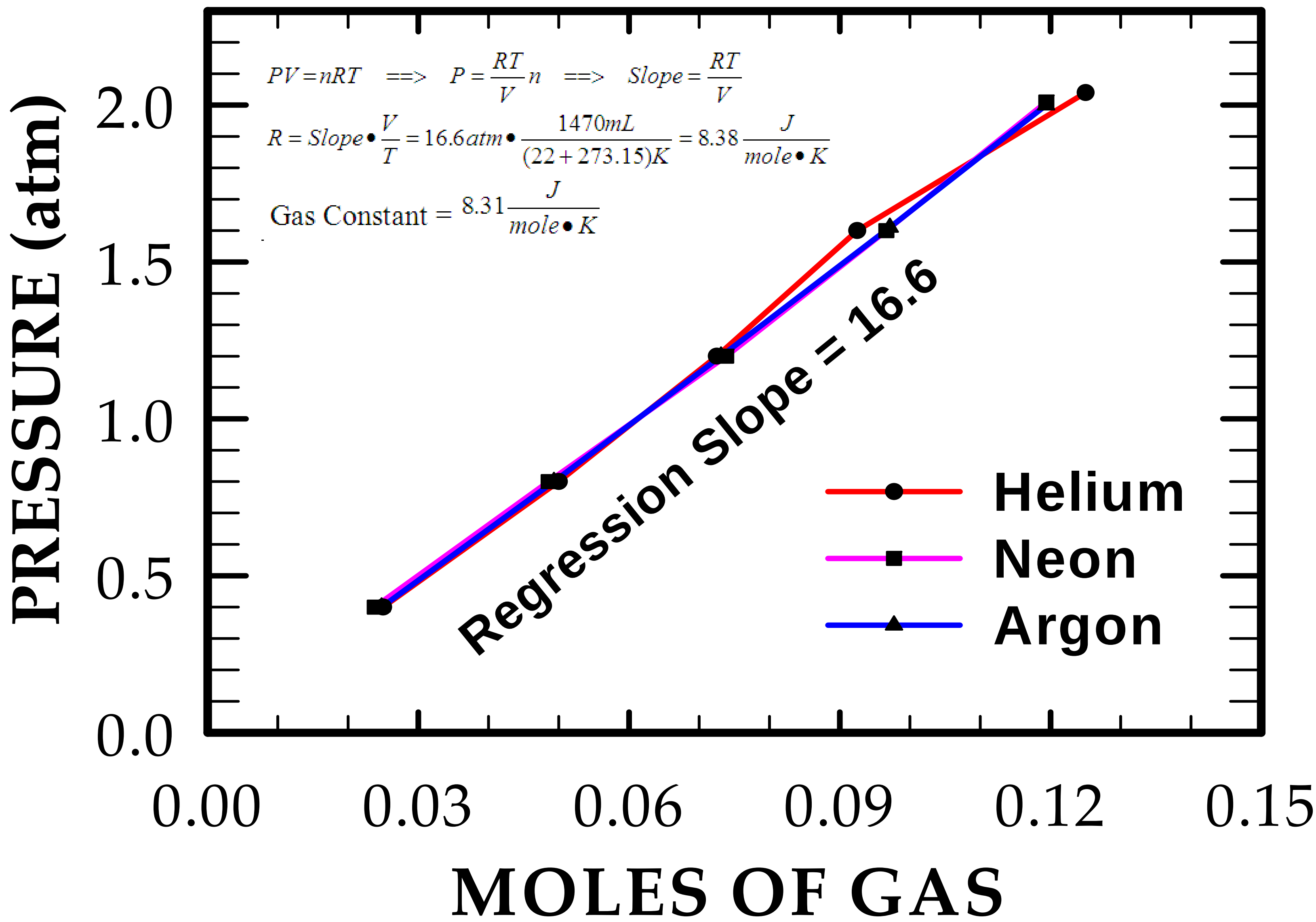
Application

My experiment can be applied to the real world. It can possibly help teachers explain the behavior of gases and the ideal gas law to their students. Also, it can help scientists better understand gases especially helium, neon, and argon when they experiment. One can remove argon from a helium and argon mixture by cooling to liquid nitrogen temperature to liquefy the argon, and neon signs are filled with neon less than 1 atmosphere of pressure to prevent explosion since neon expands when the sign is on.

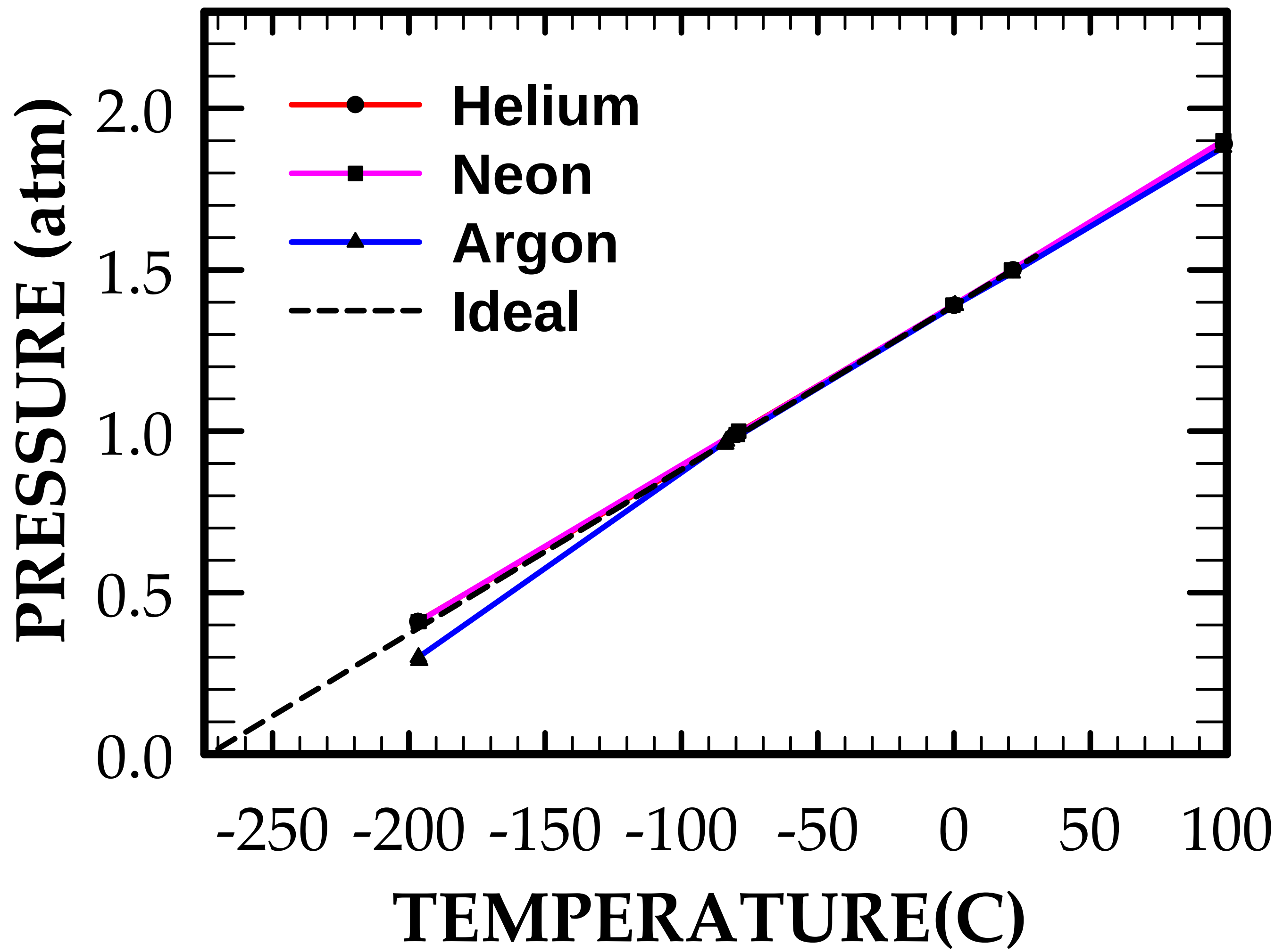


Room
Tem.
Cooling in Liquid Nitrogen
Liquid Nitrogen
Temperature
Filling Argon
Vacuum
Adding Neon
Adding Argon
Adding Helium
Adding Argon
PRESSURE (atm)
TIME (seconds)
2.5
2.0
1.5
1.0
0.5
0.0
0
1000
2000
3000
400(

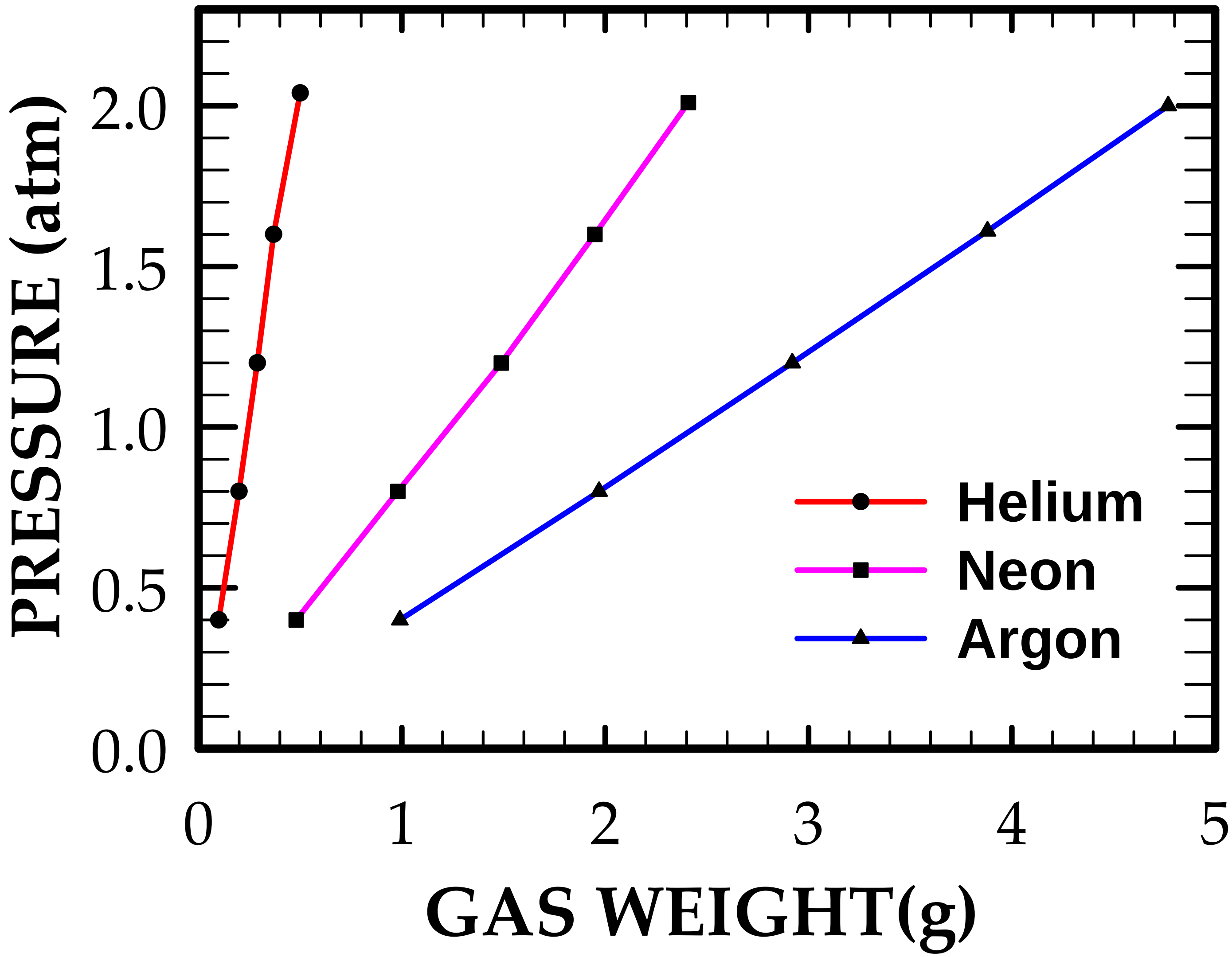
Gas Constant



Argon Not Ideal



Pressure vs. Weight



CHRISTINE O. GREGOIRE
Governor

STATE OF WASHINGTON
OFFICE OF THE GOVERNOR
P.O. Box 40002 • Olympia, Washington 98504-0002 • (360) 753-6780 • www.governor.wa.gov

September 28, 2005

Victor Peng
c/o Christ the King School
1122 Long Ave
Richland, WA 99352

Dear Victor

Congratulations on being selected as a semi-finalist in the Discovery channel's Young Scientist Challenge. You are among the few students nationwide to receive this special distinction, and I am sure that it is a tremendous source of pride for you and your family.

I commend you for your project that examines the diffusion rate of ammonia in various materials. Your research could have an impact in numerous areas of science and medicine in the years to come. I admire your intellectual curiosity and your commitment to excellence. You have a most promising future in the world of science.

Again, congratulations and best wishes for success in all of your future endeavors.

Sincerely,

Chris

Christine O. Gregoire
Governor

DO NOT STAPLE

Peng

Last Name

Part III. Essay Questions

Please type your responses using a 12-point font and double spacing on separate sheets of paper. (Do not use the back of any sheet.) Please put your name in the top right hand corner of each sheet and at the start of each essay, please write or rephrase the main question before your answer.

The essay questions are about the science fair project you presented during the current school year at a Science Service-affiliated fair. Your responses will help the judges evaluate your science fair project and your ability to write clear, concise explanations of the scientific process you followed.

Team members: The team must answer questions 1a. *and* 1b. and complete all essay questions together.

1. a. **Explain your science project.** (**500 word maximum; please provide a word count**)

Consider the following questions in your answer:

- What was your hypothesis (or your experimental question)?
- What were your methods?
- What conclusions did you reach?
- What help did you receive and who helped supervise your work?
- How did you get the idea?

b. **TEAMS ONLY.** Please explain the role(s) of each member of the team in planning, conducting, and presenting the science fair project. How did you decide to work together? How did it improve the project to have 2-3 members working on it? **(200 word maximum)**

2. Visual Aid In addition to your essay, please provide a visual aid for the evaluators and judges that help explain your project. It can be an illustration, diagram, graph, chart, data, or any other visual aid that can be presented on one piece of paper, but **may not be** audio, video, or text other than captions. **It should not include any photographs of yourself.** The visual aid must be presented on one 8 1/2” by 11” piece of paper. Entries are photocopied for evaluators, but judges will view any color images presented. (Evaluators recommend not providing a photo of your project board as it is too small to read and therefore does not provide any additional information about the project.)

3. Evaluate your science fair project. (250 word maximum; please provide a word count)

Consider the following questions in your answer:

- What did you learn from doing this project?
- Did questions or problems arise that you were not expecting?
- How would you improve this project?
- What question would you ask next if you were to continue to explore this topic?

4. Communicate about your science fair project. (500 word maximum; please provide a word count)

The DCYSC is attempting to discover the best science communicators. In this essay, we are assessing your ability to communicate about your project simply, effectively and creatively. (i.e. the “average person” can understand and would want to learn more about your project). You may choose one of the following two options. Please remain factual about your project and the benefits or importance it may have. The judges will read these essays looking for clarity, accuracy, enthusiasm and originality.

a. You have been asked to write an article about your project in the local newspaper emphasizing the significance or importance of your project. To be published, your article should explain why your project is something that the community should care about and/or why it might have some impact on them.

OR

b. Describe what you have actually done to communicate your project to others outside of presenting your project at your science fair.

Victor Peng

Explain your science project (521 words)

Have you ever wondered how quickly ammonia diffused in air, water, and solid? Well, I did. I came up with the question, “Will ammonia diffuse the quickest in air, water, or solid?” for my school’s science fair. I hypothesized that ammonia would diffuse quickest in air. From a website my science teacher told my class to look over, I got inspired by an idea of fragrance diffusion in air. I came up with three diffusion media for my project: air, water, and solid. With my dad’s help, I decided that gelatin could be a good choice as a solid, but I didn’t know what substance could diffuse in all three of the media. After discussing with my dad, I found out that ammonia could diffuse in all of the media.

To start this project, I gathered my materials and research. My project consisted of three parts. The first was air diffusion. My dad helped me with cutting/machining of plastic gutters and windows (Figure 1) and supervised my work throughout for safety. I got four pieces of pH paper. Each pH paper consists of four colors, and each color changes when ammonia passes by it (Figure 2). Then, I put one piece of pH paper under each window and covered each window with a clear plastic block. After that was done, I got my stopwatch and ammonium hydroxide and started the experiment. I put 10 ml of ammonium hydroxide into a dish at one end of the pipe (filled with air) with a syringe (Figure 1). After the experiment, my dad helped to clean the pipe with a compressed air gun.

Water diffusion is the second part of my project. I kept everything the same for the water diffusion except that I filled the pipe with tap water and didn’t close the windows with plastic blocks. Tap water did not change the color of the pH paper much (Figure 2), and the ammonium hydroxide’s bad smell was less when injected in the water. After each water diffusion, my dad helped to suck the water out of the pipe with a vacuum and further clean the pipe with a garden hose.

Next, came the solid diffusion. I bought gelatin powder, a measuring cup, and a glass tray. I made gelatin following instructions on the gelatin powder box, in the glass tray. After gelation. I put five pH papers at different distances. Ammonia was injected in a hole I cut in the gelatin at one end of the tray (Figure 3).

Ammonia diffused much faster in air than in water (Figure 4). There is more diffusion rates variation in the air. This project proved my hypothesis that ammonia diffuses quickest in air. Ammonia diffused nearly 40,000 times faster in air and 3,000 times faster in water than in solid (Figure 5). This project was a great experience for me.

Visual Aid

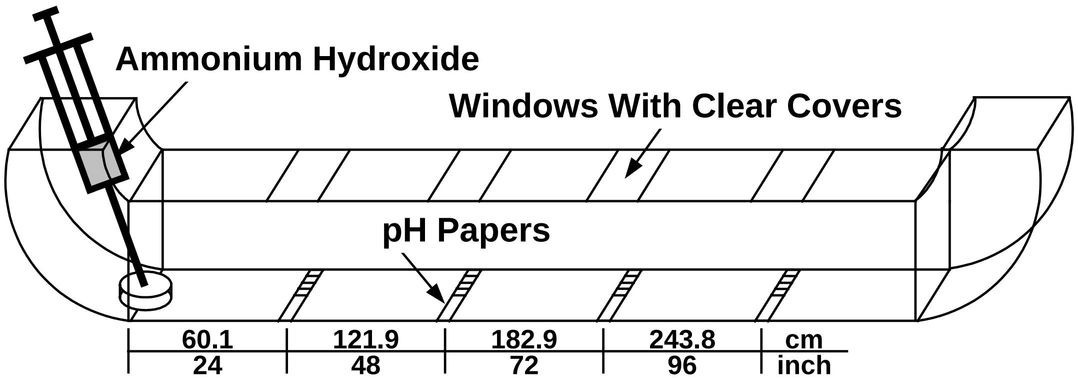


Figure 1. Experimental setup for both air and water diffusions. (Note: The pipe used was a 10-foot plastic gutter with elbows sealing the ends.

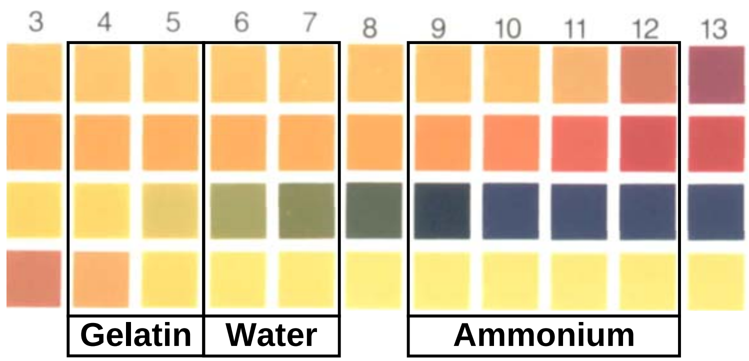


Figure 2. Colors of pH paper as a function of pH. (Note: pH papers were moistened with water before used for detecting ammonia in the air.)

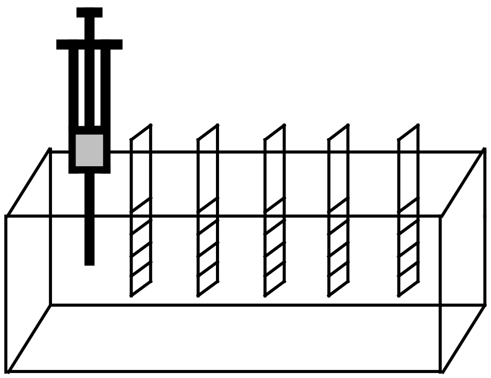


Figure 3. Experimental setup for gelatin diffusion.

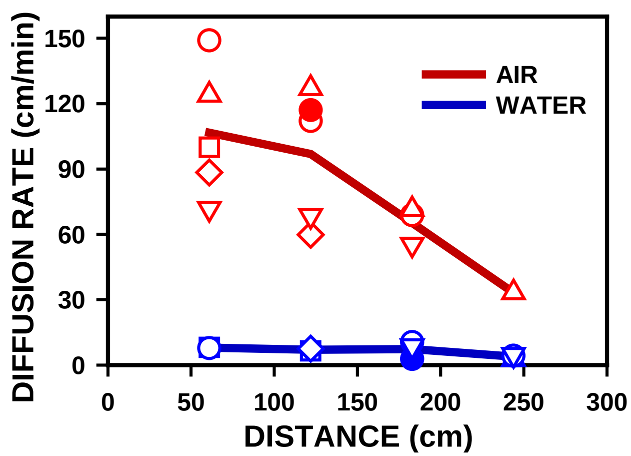


Figure 4. Rates of ammonia diffusion in air and water.

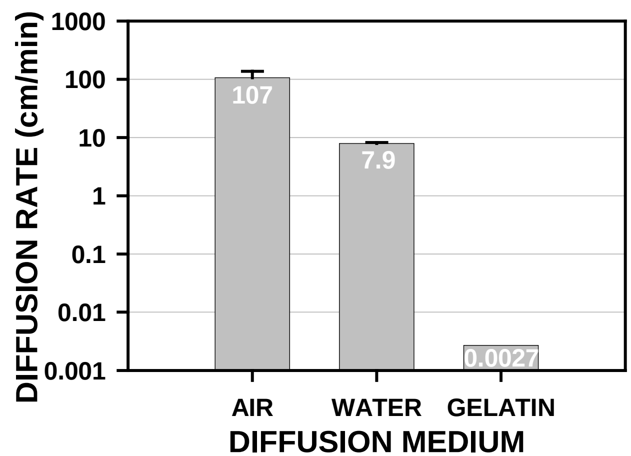


Figure 5. Average beginning diffusion rates of ammonium in air, water and gelatin (log plot).

Victor Peng

Evaluate your science fair project

One of my biggest challenges was that the data points in each diffusion experiment varied. I repeated measurements up to six times to get a reliable average. There were also other problems. Two of those happened in the air diffusion: not using fresh ammonium hydroxide and not closing the first window tight on two different runs. For water diffusion, I did not know how to empty water out of the pipe since it would bend when I lifted due to weight of water. To solve this problem, my dad helped to suck water out of the pipe with a vacuum first and then further clean it with a garden hose. I also encountered problems during the gelatin diffusion experiment. The gelatin became mold, and I had to kill the bacteria with alcohol spray.

Although my project had many problems, it turned out to be a good learning experience for me. My project has taught me a great deal about diffusion. Diffusion can be complex. For example, air fragrance may have to diffuse out of a porous wall before diffusing throughout a room.

There could be some improvements. One improvement is having shorter diffusion distances so that I could have more accurate data points. Another improvement could be having a large gate to isolate the ammonium hydroxide for instant release, so that the starting times would be more accurate. I want answers to questions such as “What influences diffusion rates?” and “Can I test diffusion in higher dimensions?”

Victor Peng

Communicate about your science fair project

I was very satisfied with the outcome of my science fair project. My project is about "Ammonia Diffusion Rates in Air, Water, and Solid". It demonstrates how quickly ammonia diffuses in each diffusion medium. The science fair at my school and at Mid-Columbia increased my scientific knowledge and thoughts, and I believe that science fairs can impact other people in the same way they impacted me.

In terms of significance, my project brings up important issues. Diffusion is the main basis of my project, and diffusion is a big part of physical sciences. My project will expand knowledge on the matter of diffusion. There are several diffusion media, and the diffusion media in my project were air, water, and solid. There are also a great number of substances that can diffuse in a medium. The diffusion substance in my project was ammonia (ammonium hydroxide). This substance diffused in all three of my project's media. Ammonia diffused nearly 40,000 times faster in air and 3,000 times faster in water than in gelatin. I now understand diffusion medium has greatest influences on diffusion rate for a given substance. Another fact that I observed is that since ammonia diffused the quickest in air, it diluted the quickest in air, as well. This is probably why my mother would have more than one plug-in air fresheners in different part of a larger room. The ammonia had actually either diffused the longest in water or solid (gelatin). I believe that these observations apply to every other diffusion substance and medium.. For example, it takes much less time to marinate sliced meat than chunk meat since slicing reduces the diffusion distance for the marinating sauce. The sauce diffusion into meat is similar to ammonium diffusion into gelatin. Even medical/chemical substances can be diffused through the skins using patches such as nicotine patches and birth control patches, and through tissues using controlled-release implants such as Norplant. Dr. Sanjay Gupta explained a great deal in “Taking your medicine – by a patch” (CNN.com).

It is very important to be knowledgeable about diffusion and physical sciences because it will help people make intelligent scientific inferences, and sooner or later benefit people in scientific businesses and colleges that are close with the study of science. My project can have a great impact on the community in a few ways. One way is that it might make the community have a greater interest and appreciation for science. Another is that it may inspire people to come up with science fair projects about diffusion and related subjects that will present even more new ideas to the community. My project received second place within my school. Because of this, I was sent to represent Christ the King Middle School at the Mid-Columbia Science Fair where I received more awards including second place in the seventh grade Physical Sciences competition. This whole experience has not only taught me a lot about diffusion and impacted me to be more intrigued with science but has also given me valuable experience that will hopefully help me in the future.

Mid-Columbia Regional Science and Engineering Fair

March 10-12, 2005

Victor Peng

Christ the King School

In recognition of achievement has been awarded

Second Place

7th Grade Physical Sciences

Director *Joyce E. Stark*

President *Robert Fieck*

YOUNG SCIENTIST CHALLENGE 2005

Discovery CHANNEL

THIS CERTIFIES THAT

Victor Peng

of

Christ the King

HAS BEEN NOMINATED FOR THE

DISCOVERY CHANNEL YOUNG SCIENTIST CHALLENGE

IN RECOGNITION OF AN OUTSTANDING ABILITY TO COMMUNICATE SCIENCE.

Judith A. McHale

JUDITH A. MCHALE
PRESIDENT AND CHIEF EXECUTIVE OFFICER,
DISCOVERY COMMUNICATIONS, INC.

Lori Gilmour Dillman

FAIR DIRECTOR