Chemistry in the Classroom – Lesson Implementation and Reflection

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April 15, 2020
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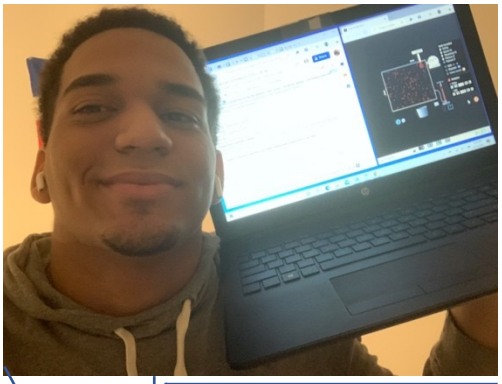
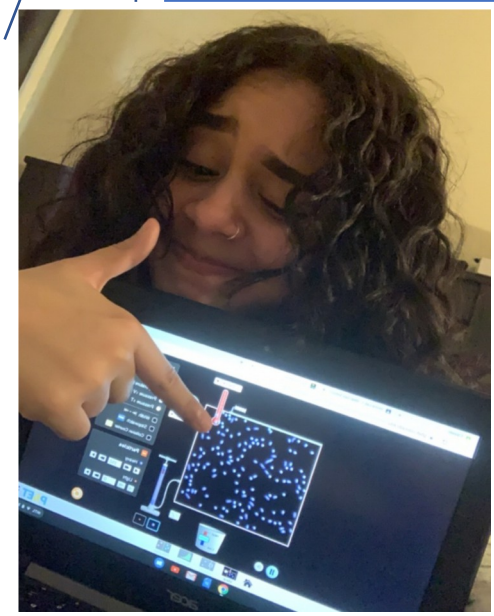
Link for Gas Simulation Activity using PhET Solutions

https://phet.colorado.edu/sims/html/gas-properties/latest/gas-properties_en.html



I learned a lot using the simulations. I led a class on Charles Law showing how I got the date and

I like the gas simulation lab because it makes me understand the relationships between variables. Its like I can see the



Descriptions

The activity chosen for the Lesson Implementation was accessed using the PhET Gas Simulations Resource. The online lab was divided into six parts: Play, Boyle's Law, Charles' Law, Gay Lussacs' Law, Avogadro's Hypothesis, and an Inquiry discovery.

At the top left, student Ceaser Guerrero shows off his remote learning and shares his experience, and at the bottom left, student Maylen Rodriguez demonstrates her working on the play section and sharing her learning experience.

On the right side of the page are the students highlighted work samples. The top right shows a

Part 3. Charles' Law – to be completed by April 2, 2020

Purpose: to determine the relationship between volume and temperature (with everything else constant).

Procedure: You get to design how to test the purpose. Write down the settings you put the simulator to.

Please note: if you want to hold pressure constant, the container must have something in it first. Add particles, then hold pressure constant. If you hold pressure constant before adding particles in the container (P = 0 atm), the program will attempt the impossible, by trying to hold the pressure at 0 atm.

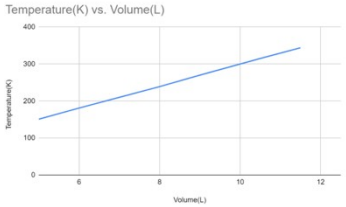
1. What is the independent variable?
Volume
2. What is the dependent variable?
Temperature
3. What 2 factors are being held constant?
Pressure and # of particles.

Make a data table to collect at least 8 pieces of data over a large range. Be sure the data table has the proper components (title, units, gridlines, etc).

Table 3: Volume and Temperature of a gas with pressure constant at ___**5.8atm**___ and Particles constant at __50____

Volume (L)	5.0L	6.0L	7.0L	8.0L	9.0L	10.5L	11.5L	12.5L
Temperature(K)	151K	181K	210K	239K	270K	315K	344K	376K

Make a graph of the Charles' Law relationship. Be sure your graph has all of the proper components.



7. Describe the relationship of Charles' Law. Be sure to include the variables and constants in your answer.
As the TEMPERATURE increases, the VOLUME increases, while the PRESSURE is held constant. As the TEMPERATURE decreases, the VOLUME decreases, While the PRESSURE is held constant. The graph represents a DIRECT relationship between TEMPERATURE and VOLUME.

Part 4. Gay-Lussac's Law

Purpose: to determine the relationship between pressure and temperature (with everything else constant).

Procedure: You get to design how to test the purpose. Write down the settings you put the simulator to.

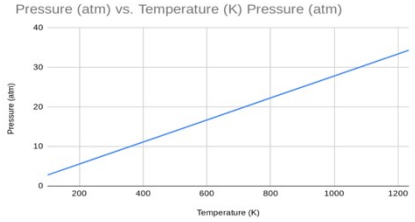
1. **What is the independent variable? The independent variable is Temperature.**
2. **What is the dependent variable? The dependent variable is Pressure.**
3. **What 2 factors are being held constant? 2 factors that are held constant are the Volume and the number of particles.**

Make a data table to collect at least 8 pieces of data over a large range. Be sure the data table has the proper components (title, units, gridlines, etc).

Table 4: Temperature (K) V. Pressure @ Constant Volume

Temperature (K)	100K	220K	330K	480K	625K	815K	945K	1234K
Volume (atm)	2.8	6.15	13.35	13.35	17.4	22.7	26.3	34.35

6. Make a graph of the relationship of Gay-Lussac's Law. Be sure your graph has all of the proper components.



7. Describe the relationship of Gay-Lussac's Law. Be sure to include the variables and constants in your answer.
Temperature as the independent variable (along the horizontal or x axis) and Pressure the dependent variable (along the vertical or y axis). As the Temperature increases, the Pressure increases, and Volume is constant. The graph describes the relationship between Temperature and Pressure.

Debra Dirksen in her article “Hitting the Reset Button” posits the argument that the reset button in education is formative assessment (Dirksen 2011, Pg. 30). Students enjoy learning at their own pace and being able to make mistakes and learn from them. Dirksen asked a sophisticated primer consisting of two questions: “How can we build into instruction the idea that failure is an integral part of learning?” and “How can we build hope through failure instead of teaching students to fear failure?” (Dirksen 2011, Pg. 26). PhET Simulations offer students this ability to fail and hit the reset button.

What motivated me to attempt this lesson is that “PART 1” asked the students to engage in “PLAY”. The resource developers understand that students have to develop a comfortability with the simulation. There are so many operating parts and in order to truly grasp the relationships between variables, students needed the time to fail and try again, very different from giving a “quiz” or an exam”. Because we were all in a remote learning situation, I am able to provide more authentic feedback to students and feedback that is guided by the questions they individually have from their learning.

A survey of the research conducted on computer simulations and its use in STEM learning by Smetana and Bell, posits “… that simulations can be as effective, and in many ways more effective, than traditional (i.e. lecture-based, textbook-based and/or physical hands-on) instructional practices in promoting science content knowledge, developing process skills, and facilitating conceptual change” (Pg. 1). The reason I highlighted the two students and their work on the cover page, is because they are English Language Learners and struggle with grasping science academic vocabulary. As noted by Smetana and Bell, these students began increasing their proficiency in science content knowledge and their fluency with using academic vocabulary. They participated more in their live sessions, Ceaser Guerrero guest lectured through their “shared screen” feature on google meet, and Maylen led help groups to assist some of her peers that struggled with language acquisition. In addition, when these students took their Gas Laws quiz on Google Forms, Ceaser scored a 100, and Maylen scored a 90.

While the resource offers so many opportunities for teaching and learning, there is always room for improvements or extensions. As noted in a class posting, stoichiometry is one of the most difficult topics to get our students engaged in. This particular resource did not incorporate NASA resources directly, however, a great extension would be to use the gas simulation to demonstrate the behavior of the gas particles within the Mars Oxygen ISRU Experiment, MOxIE (Rodriguez). Jet propulsion is very much correlated to gas stoichiometry. Providing a visual for the already abstract concept of balancing equations will aid in developing deeper conceptual understandings of gases.

Conclusively, my students and I are learning a lot from each other in this remote learning situation. Students are enjoying the ability to pace their learning, they generate great questions that lead to deeper understanding of the content, and most importantly, they are enjoying learning because they are actively involved in acquiring knowledge.

References

Dirksen, D. J. (2011). Hitting the Reset Button: Using Formative Assessment to Guide Instruction. Phi Delta Kappan, 92(7), 26-31.

Rodriguez, B. (n.d.) The Air Up There: Making Space Breathable. Retrieved from: https://www.jpl.nasa.gov/edu/teach/activity/the-air-up-there-making-space-breathable/

Smetana, L.K., Bell, R.L. (2011). "Computer Simulations to Support Science Instruction and Learning: a critical review of the literature." International Journal of Science Education, Vol. 34 (9), Pgs. 1337 – 1370.