SCIENCE NORTH SCIENCE NORD
SUDBURY, ONTARIO, CANADA

Gas Law Calculator	Grade 11 Chemistry

Lesson Plan

Coding Tool	Scratch
Cross-curricular	Math

Big Ideas

F2. Investigate gas laws that explain the behaviour of gases, and solve related problems

- Block coding in Scratch
- Boyle's Law, Charles' Law, and Gay-Lussac's law

Specific Expectations

F2.3 solve quantitative problems by performing calculations based on Boyle's law, Charles's law, Gay-Lussac's law, the combined gas law, Dalton's law of partial pressures, and the ideal gas law

Description

In this lesson, students will create a program in Scratch to solve problems using one of Boyle's, Charles' or Gay-Lussac's laws. Once they have created the first program, they can modify it to create the other two laws.

Materials

- Scratch
- Internet-capable device

Computational Thinking Skills

- Variables
- Loops
- Conditional Statements

Introduction

Scratch code is a form of "block coding" created by MIT for use in schools that you may already be familiar with. (If not, see "What is Scratch" at https://www.youtube.com/watch?v=jXUZaf5D12A)

We recommend you create a teacher account at https://scratch.mit.edu/educators#teacher-accounts so you can better manage the use of Scratch in your classroom, though that is beyond the scope of this lesson plan.

Though primarily used for creating games and game-like programs, Scratch can also be used to calculate mathematical operations. In this case we are going to try solving the equations of the aforementioned gas laws. A walkthrough in how to do this in Scratch is provided on the associated handout and a sample of the project can be accessed on Scratch with this link: https://scratch.mit.edu/projects/451122922

Action

Before progressing to far, it's important that students know each of the gas laws being presented; Boyle's, Charles' and Gay-Lussac's Law.

While gases have a wide difference in chemical properties, the gas laws help quantitate how gases behave in terms of pressure, volume, temperature and amount.

Boyle's Law (Pressure Volume) states that the volume of a given amount of gas held at constant temperature varies inversely with the applied pressure when temperature and mass are constant:

$P_1V_1 = P_2V_2$

Charles' Law (Temperature Volume) states that the volume of a given amount of gas at constant pressure is directly proportional to the Kelvin temperature:

$V_1T_2 = V_2T_1$

Gay-Lussac's Law (Pressure Temperature) states that the pressure of a given amount of a gas at constant volume is directly proportional to the Kelvin Temperature:

$P_1T_2 = P_2T_1$

When the three laws are written this way, it is apparent that their format, and therefore how they can be coded, are very similar. With this in mind, there are a couple ways this lesson can be approached. One is to assign students a specific law each and have them figure out how to program it. The other would be to create a program together and challenge students to replicate the program for a second, or even third gas law. The objective of course being that the calculator created can take three inputs and provide the missing variable.

Consolidation/Extension

Extension:

- To extend chemically, add Avogadro's law and/or the ideal gas law.
- To extend in coding, add some error protection. As the code has been written, nothing keeps the user from inputting too many variables!

Assessment

Assess the accuracy of the calculators that students make. This can be done by assigning some quantitative gas law problems and having students solve them.