# Frontenac, Lennox & Addington Science Fair

***Expo-sciences de Frontenac, Lennox & Addington***

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# Prefair Report

**4201** **Liam Maycock**

**Div/Cat** **Physical and Math / Senior**

**Title:** **The Coefficient of friction of a tire on different surfaces**

**Summary:** My project involves finding the coefficient of friction of a bike tire on different surfaces. My project used 4 different surfaces, namely: Frozen grass, smooth concrete, tarmac, and medium packed snow. The results were recorded with a tire pressure of 30 psi. The temperature outside was -4 partly cloudy, feels like -10. The time, humidity and wind were also recorded. I used a spring scale to collect my data as it was attached to the middle of the tire and pulled. The tire weight and area of contact were also recorded for the final data. The final aim of my project was to compare my results to factory settings to see the change in accuracy as well as the change in tire due to previous usage. My results matched that of the hypothesis which was the smoothest surface, ice, would have the lowest coefficient of friction, this was followed by the smooth concrete under the cleanest setting of my experimentation. There weren't any outliers in my data that came as a shock, the data had a clear correlation between the setting and the friction result. They also matched similar data that was collected by professionals of the company that made the tires. The supported my data and provided valuable insight into what I would change if I had to repeat the experiment a second time.

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# Prefair Report

**4202** **Jasmina Dennis, Kylie Morrow**

**Div/Cat** **Physical and Math / Senior**

**Title:** **Study of Movement in the Brain**

**Summary:** In our project, we are going to focus on neuroscience and movement that occurs in the brain. We will be using a series of cameras on rugby players to measure the movement of their brain through points of contact. We will focus on the acceleration of the brain. After collecting our data, a predetermined criteria list will help us grade the film, based on what defines a proper and safe tackle. Different body sizes may display different tackle techniques therefore putting different amounts of acceleration on the brain. The purpose of this project is to determine the safest ways of tackling and how different body sizes/tackling techniques influence the movement of your brain and the impact contact can have. We are Queens University, St. Lawrence College, and Rugby Ontario athletes to conduct the study. To get past any ethical concerns, we will provide the athletes that would like to participate with waivers they can sign prior to the training session. We will not be asking athletes to do anything they aren't comfortable with, as it is just a normal training session we are going to film. It is expected the video data will be analyzed and evaluated against a standardized key.
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# Prefair Report

**4203** **Ada Huang**

**Div/Cat** **Physical and Math / Senior**

**Title:** **Effect of Reaction Temperature on Yield of the Esterification Reaction of Methyl Salicylate**

**Summary:** My chemistry experiment revolves around organic chemistry and sought to answer the research question: what is the effect of reaction temperature on the yield of the esterification reaction that synthesizes methyl salicylate (oil of wintergreen)? Esters are chemical compounds that are distinctive for their pleasant smells, and as such are used in a variety of industries and products such as perfumes. The experiment was conducted over the course of five days, with each day focusing on one reaction temperature, with three trials of esterification reactions each. The reaction temperatures used were 20°C, 30°C, 40°C, 50°C, 60°C. Esters are produced through reacting an alcohol with a carboxylic acid. The methyl salicylate (oil of wintergreen) ester was produced through mixing methanol and salicylic acid, adding concentrated sulphuric acid as a catalyst, and placing them in a hot water bath heated to each of the chosen reaction temperatures. After each of the trials of esters were heated for around five minutes, they were taken out and initial observations were taken, specifically the smell or lack of smell of wintergreen (mint smell). The esters were then left to dry out overnight for massing and more qualitative observations the next day in order to determine the amount of ester produced. It was hypothesized that increasing the reaction temperature would result in more ester being produced, which was tested to be correct.

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# Prefair Report

**4204** **Shawn Song**

**Div/Cat** **Physical and Math / Senior**

**Title:** **How does the temperature of a liquid affect its viscosity?**

**Summary:** In my experiment, I cooled/warmed a solution of corn syrup and water to five specific temperatures, dropped a marble into said solution multiple times at each temperature, and determined the average time taken for it to fall 10 cm at terminal velocity. I used this time to calculate the marble's average terminal velocity at each temperature, which I then used to calculate the solution's coefficient of viscosity (an indicator of viscosity) using Stokes' law (a formula that gives a sphere's drag force as a function of speed and coefficient of viscosity). Afterwards, I graphed coefficient of viscosity with respect to temperature to evaluate the variables' relationship. I had initially hypothesized that the solution's coefficient of viscosity would decrease as its temperature increased; temperature is a measure of random kinetic energy in a substance's particles, energy which acts against the intermolecular forces between said particles and causes melting/boiling. Since viscosity (a fluid's tendency to resist motion of bodies inside of it) is caused by intermolecular forces, increasing the temperature of the solution would increase its particles' random kinetic energy, decrease its intermolecular forces, and decrease its coefficient of viscosity. I additionally hypothesized that the coefficient of viscosity would undergo exponential decay as temperature increased, since several characteristics of the exponential decay function reflected the expected behaviour of liquid viscosity. To this end, I used an exponential curve during the regression analysis of my data. After collecting and plotting my data, I found that my hypothesis was correct; my data points fit to an exponential decay curve with a high degree of accuracy. Of course, my project as a whole had a few shortcomings. While my model could accurately predict the coefficient of viscosity between 10 °C and 50 °C (where I collected my data), its accuracy near water's freezing point (0 °C) was questionable; an exponential curve gives a finite y-value for all x-values, but if a liquid freezes to become a solid, it should no longer have a coefficient of viscosity to speak of. My data collection had a few issues as well; I recorded my marble using a single, stationary camera, meaning that it would have recorded the marble at an angle at certain times. Because of this angle, the distance travelled by the marble was prone to inaccurate measurement due to horizontal displacement and solution refraction. Future experiments could potentially explore the behaviour of viscosity near a liquid's freezing point and use two cameras to accurately determine the time that it passes its 10 cm start/end points.

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# Prefair Report

**4205** **Asher Hounsell**

**Div/Cat** **Physical and Math / Senior**

**Title:** **How does the thickness of a barrier impact the sound intensity measured through it?**

**Summary:** Sound is a three-dimensional longitudinal wave, and when it interacts with a material the sound waves partially reflect and partially travel into the material. This scientific exploration of the previous concept involved determining how the thickness of a barrier impacts the sound intensity measured through it. It was hypothesized that as the thickness of the barrier increased, the sound intensity measured would decrease exponentially. Experimentation was performed in an isolated sound environment using sound proofing material, the sound source played a single frequency of constant intensity, and layers of identical foam were added to the barrier for each consecutive test, with tests being repeated to ensure accuracy and minimize uncertainty. As hypothesized, graphical analysis of the data yielded an exponential decay relationship, however, this relationship did not fit the data to a very high degree of accuracy. This discrepancy between the data and the expected relationship led to consideration of possible experimental error which could have impacted the results, such as how during the first few tests the weight of the apparatus caused the foam to crease slightly and potentially not cover the entire area properly, allowing for sound to more easily pass through the barrier. When propagated through the analysis, this artificial increase of sound intensity caused by experimental error would cause the first few data points to be inflated. Accordingly, when these first few data points were not considered in the analysis, the data displayed a much more accurate fit to the proposed exponential decay relationship. These results then led to another experiment to further consider which variables impact the sound intensity measured through a barrier. This secondary experiment was identical to the first, however, used a lower density foam for the barrier, which was hypothesized to decrease the sound intensity to a lesser degree than that of the higher density foam, though still displaying the exponential decay relationship. The graphical analysis of this secondary experiment also appeared to display an exponential decay relationship, and the fit of the data was again made more accurate by not considering the data points subject to more significant experimental error in a separate graphical analysis. In addition to the discovery that sound intensity decreases exponentially through a sound barrier, the analysis of the secondary experiment therefore yields the conclusion that the density of the barrier also impacts the measured sound intensity, with the increase of the material (foam) density seemingly resulting in the decrease of sound intensity measured. Overall, the findings of this experiment are critical considerations for numerous applications in the world today, ranging from the design of sound-proofing material to the architecture of entire buildings and cities, where future continuations of this exploration could involve examining how the three-dimensional shape and structure of the barrier material impacts the transmission of sound intensity.

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# Prefair Report

**4206** **Daniel Zhang**

**Div/Cat** **Physical and Math / Senior**

**Title:** **Permeability of Sound through a Barrier**

**Summary:** How does changing the frequency of a tone affect the tone's ability to permeate through a physical barrier? This question will be explored by conducting an experiment with a tone generator, some barriers of varying thickness and density, and a microphone.

A tone of a certain frequency will be generated at a specified initial intensity, then a microphone will measure the final intensity of the tone after it has passed through a barrier. This will be repeated with different frequencies and barriers to try and find a correlation between sound frequency and permeability.

A few errors that are present in this experiment relate to some variables that are very hard to control. One of the biggest obstacles I encountered was reverberations in the room that caused constructive and deconstructive interference in different parts of the room, which means if the microphone is slightly off-positioned, the results would vary significantly. Efforts have been made to minimize these reverberations by having walls around the experiment made from sound-proof foam.

The findings of this project could have some real-world applications in the realm of sound and technological design, such as integrating these ideas into designs of headsets and earphones to prevent sound leakage.

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# Prefair Report

**4207** **Rowan Engen**

**Div/Cat** **Physical and Math / Senior**

**Title:** **The Heat of Conductivity**

**Summary:** Electrolytic solutions are conductive, and when heated they experience changes in their overall conductivity. The purpose of this experiment was to determine how the rate of change of the conductivity with respect to heat changed across varying concentrations of a solution of distilled water and sodium chloride. It was hypothesized that as the temperature of the solution increased, the conductivity would subsequently linearly decrease. This would create a linear graph of data for each various concentration and the gradient produced by this relationship would become steeper as the concentrations were increased. This hypothesis was then tested in a multi-step process. Firstly, various concentrations of sodium chloride within distilled water were measured which were then placed on a hot plate where the conductivity and temperature were simultaneously measured as the hot plate and the solution itself increased in temperature. Initial experimentation yielded results not predicted in the hypothesis, with the gradient of the relationship between the heat of a solution and its conductivity not changing as the concentration changed. Further experimentation is now theorized to continue this trend, and it is expected that no change in gradient will be noted. The conclusions derived from this experiment will likely have significant applications to numerous aspects of the world today ranging from the consumption of electrolytic drinks to even electrometallurgy.

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