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Prefair Report

2201 **Patrick Keay**

Div/Cat **Physical and Math / Junior**

Title: **How Long Should Your Hockey Stick Be?**

Summary: Google tells me that the best length for a hockey stick is about two thirds of a person's height if you want to shoot as hard as possible. That is usually at about a person's nose. I want to test if that rule of thumb is right. My hypothesis is that the rule of thumb is not right.

At two thirds of your height your hands are about shoulder width apart which is the most comfortable shooting position. Your stick needs to be at the right height to give you the most mechanical advantage to shoot as hard as possible.

To test for the best length of your hockey stick I had ten people shoot wrist shots with five varying sized sticks. Each person shot with each stick three times to ensure that the shots they took with each stick were as hard as they could shoot. I used a hockey shot meter that measured how hard your shot is in kilometres per hour. I tested to see which stick worked the best for each person. I found which stick they shot the hardest with then I compared the length of the stick with the two thirds of your height rule of thumb.

I found that the rule of thumb is too long. On average the people in my test shot harder with a stick that was shorter than two thirds of their height. I then figured out how much slower people shoot if their stick is as long as the rule of thumb says. I did my test for people who shoot right and left and for people with different levels of skill at hockey. The rule of thumb is a worse length for people who shoot left and for people with less experience playing hockey.

If the people in my study use a stick as long as the rule of thumb their shot will be slower than their hardest possible shot by about as much as the difference between the hardest shooter in the NHL skills competition and the slowest shooter.

My hypothesis that the rule of thumb you get from Google about how long to cut your hockey stick is not a good rule is correct.

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Prefair Report

2202 **Abhinav Sharma**

Div/Cat **Physical and Math / Junior**

Title: **Growing Crystals.**

Summary: My Summary is that I will be growing homemade crystals with potassium aluminium sulfate dodecahydrate and potassium chromium sulfate dodecahydrate. I will be growing 2 crystals and I will be shaking one crystal every day at a designated time and leave the other one untouched then keep shaking one for 7-9 days and leave the other one. The material will be 400ml of water 100g of potassium aluminum and 12g potassium chromium a string a pencil and a beaker and a little bit of nail polish for protection.

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Prefair Report

2203 **William levy**

Div/Cat **Physical and Math / Junior**

Title: **Astreriod mining: A solution to a future problem**

Summary: "In everyday life there is something that all humans use that is often overlooked, that's right ore and minerals, it's is almost everything and is so widely used that it is often forgotten but that's an issue because minerals are a limited resource and humans are using then up fast but there is one place that ores and minerals are very plentiful, space in particular asteroids. Since asteroids are just unformed planets most of them contain minerals some of them are highly coveted. At first, this seems like an absurd notion that humans could ever achieve this and much less have it be financially long term success but with the right technology that is right around the corner it may be a future possibility.

Many people when they think of asteroid mining they think of actual humans in space mining with outer worldly tech, but what a more plausible solution is automation. A cheaper and more cost-effective solution is to send probes out to space, then to land on an asteroid, collect and store the minerals and return to earth. This at face value seems like it could never be successful economically but, asteroids are a trillion, nay, a quadrillion dollar business and if probes are sent to harvest the minerals of the larger more valuable asteroids they are easily profitable. But let's not get too ahead of ourselves because as valuable as those asteroids are most of them in our galaxy is the asteroid belt which is an issue. This is because nothing humans have ever made has made it to the asteroid belt... and come back to a more plausible possibility is that humans harvest the asteroids in the area between the moon and the earth. But the thing is that improving artificial intelligence is constantly improving and planned manned missions to Mars in the 2020s are signaling to a new rise in the interest for space. And even though there is a lot of interest in the field no attempts have been made so far but, there are some planned missions to test the space mining probes on nearby asteroids in the early to mid-2020s. On top of that, the planned "Gateway" space station around the moon could be a great site for refueling to farther out expeditions.

In conclusion, the potential for an asteroid is astronomical and in our lifetime we will see a developed system when asteroids will be center stage not only for the technological side but also the economic side. Even though it seems like an unrealistic idea now within 20 to 30 years it will become a powerhouse and create the world's first trillionaire.

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Prefair Report

2204 **Victor Chowdhury**

Div/Cat **Physical and Math / Junior**

Title: **Guitar Jingle: Discovering the Locations of Harmonics**

Summary:

Question / Hypothesis

The main idea of my study is to investigate which standing wave patterns can be produced on a guitar string by playing harmonics and also to identify the locations of harmonics on the guitar and relate them to the string lengths. I have predicted that the harmonics will be located at equal divisions of the open string. This would mean that the first harmonic would divide the string in half, the second into three equal parts, the third into four equal parts, the fourth into five equal parts, and so on. I also predicted that the harmonic locations would stay the same for all six strings since they are all the same length.

Design / Method

To record the positions of the harmonics, a table representing the guitar fretboard was created, which would be used to mark down the locations of the harmonics. The lowest E string was selected and starting at the twelfth fret, a harmonic was tried to be played by lightly damping the string above the twelfth fret. If a harmonic was heard, then that location would be marked in the data table with a filled-in black circle. If a harmonic was not heard, then that location was marked in the data table with an open circle. These steps were continued on the low E string for all frets, from fret 11 down to fret 1. The steps were then repeated for the other five strings. Then, to relate the location of the harmonics to the length of the strings, the length of one string was measured from the nut to the bridge with the tape measure, then a data table for each string was made.

Observations

After testing the first couple of strings, I quickly realized that my hypothesis was correct and the harmonic locations stayed constant throughout all the strings, however, after the first five or so harmonics had been found, it became increasingly difficult to locate the next ones, as there were decimals included into the equation. After locating as many harmonics as possible, I discovered that the harmonics were located at equal divisions of the string, also known as node points in physics.

Interpretation / Conclusions / Applications

I think that the harmonics were played by lightly applying pressure on a string at a nodal point of one of the overtones because it allows the finger to immediately damp all overtones that do not have a node near the location touched, thus letting the lowest-pitch overtones dominate the resulting sound. I also believe that the location of the harmonic was always at an equal distance because on a wavelength, the antinodes must always be equal, and the node points have to divide the standing wave to be able to hear the harmonic and its overtones.

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Prefair Report

2205 **Joëlle Drolet, Roxanne Jolicoeur**

Div/Cat **Physical and Math / Junior**

Title: **La Bille 'Flottante'**

Summary: "Notre projet consiste à voir le fonctionnement de la force centrifuge plus facilement et d'une façon moins compliqué. Nous allons vous expliquer ce qu'est l'effet centrifuge grâce à une expérience, cette expérience va aussi vous aider à comprendre. Nous allons faire flotter une bille. Mais, elle ne flotte pas tout simplement par magie, c'est grâce à la force centrifuge que la bille va y parvenir! L'effet centrifuge est une force qui agit sur un corp, ça le pousse à s'éloigner du centre de rotation grâce à un mouvement circulaire. La première est de faire tourner une bille dans un verre à cognac, au début, cela semble bien simple, mais vous allez voir, il y a pleins d'explications qui explique comment que ça fonctionne.

Ce projet est constitué de deux expériences! Et oui! Afin d'approfondir notre expérience, nous avons aussi une deuxième expérience, un deux dans un! Nous allons essayer la même expérience mais avec un verre différent. Pour les deux expériences, on utilise; une bille, un verre à cognac, un verre normal, une surface plate et un napperon.

Afin de rendre notre projet plus intéressant, nous avons mis des faits intéressant ici et là! Nous pensons que c'est une vraiment bonne expérience à montrer à ce genre de public vu que c'est un sujet très fascinant et très vaste. C'est intéressant de voir comment de choses autour de toi sont impliqué dans la science!

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Prefair Report

2206 **Russell Reid**

Div/Cat **Physical and Math / Junior**

Title: **The Fermi Paradox-Is There Anyone Out There?**

Summary: "QUESTION / HYPOTHESIS

What type of relationship exists between the Fermi paradox and human space travel?

It is hypothesized that the results of a study conducted on alien life, referring to the Fermi paradox, could affect the future journeys of humans. If it is discovered that there is no alien life out there, that we are the only ones, and that the Great Filter is real, and will eventually destroy us, then all efforts would go toward helping our situation.

RESEARCH FINDINGS

In my research, I found that the Fermi paradox has many explanations. There is the theory that we are alone in the universe, that we have passed the filter unscathed, but there are no other civilizations that can contact us because they have all gone extinct because of the Great Filter, and we cannot contact them. There is also another explanation that we are behind the filter, and we are really in deep trouble. This means that nuclear war or another event, like a meteor impact, could kill us before we can contact extrasolar civilizations. These events, mainly the nuclear war, could be feasible in the coming years, especially considering world politics these days.

There is also the explanation that the conditions in the universe are just starting to be sufficient to create life, and there is no Fermi paradox. This would explain why we have not seen any Type III civilizations on the Kardashev scale (more on that later), or why we haven't seen any messages from outer space. The Kardashev scale is a scale invented by Nikolai Kardashev in 1964. It originally included 3 steps, but people have since expanded it.
Type I-harnessing all of the energy of its home planet. This could be achieved by recycling everything and using renewable everything. Right now, humans are at around 0.73 on the Kardashev scale, so we are not a Type I civilization.
Type II-completely using all the energy output of a star. This civilization would probably be an interstellar civilization. Some ways that this could be possible are a Dyson sphere or swarm, a structure or structures surrounding a star to generate energy.
Type III-capable to use all the energy in the home galaxy. This could be achieved by having Dyson spheres on all the stars in the galaxy.

INTERPRETATIONS / CONCLUSIONS

From the research listed here, I have concluded that the Fermi Paradox might have something to do with human space travel, but it could be that there is no Fermi paradox, and we are just worrying about nothing. Although, if the Fermi paradox is real, and ahead of us, which I think is unlikely because in this case, no civilization would be able to contact each other, and we have tried to contact aliens (even though we have no idea it has worked), and there are few instances of anomalies in radio waves, like the "Wow!" signal. There might be alien life out there, but it is bound to be so different from us."

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Prefair Report

2207 **Sanjana Sinha**

Div/Cat **Physical and Math / Junior**

Title: **VA-T-IL TOMBER OU FLOTERA-T-IL?**

Summary: "QUESTION:
Pourquoi certaines choses tombent-elles au fond et certaines choses flottent-elles sur l'eau?
HYPOTHESE / CONJECTURE:
Tous les corps, livrés à eux-mêmes, tombent au sol, à l'exception de certains dont le poids est contré par une autre force
EXPERIENCE:
OBSERVATION:
INFERENCE:
CONCLUSION:
EXPERIENCE DE GALILEE:
Selon la légende, c'est ce que Galilée a montré en 1589 à partir de son expérience dans la tour de Pise. Si vous négligez la résistance de l'air, les objets tombant près de la surface de la Terre chutent avec la même accélération approximative de 9,8 mètres carrés par seconde (9,8 m / s, ou g) en raison de la gravité terrestre. Ainsi, l'accélération est la même pour tous les objets et, par conséquent, leur vitesse augmente également à un taux constant. Étant donné que la force exercée sur un objet est égale à sa masse multipliée par g, les objets les plus lourds ont une plus grande force (poids). Les objets plus lourds, cependant, ont également plus d'inertie, ce qui signifie qu'ils résistent mieux aux déplacements que les objets plus légers (première loi de Newton), de sorte que les objets plus lourds ont besoin de plus de force pour les faire avancer au même rythme.
LE PRINCIPE D'ARCHIMEDE:
Principe d'Archimède: Tout objet, totalement ou partiellement immergé dans un fluide, est soutenu par une force égale au poids du fluide qu'il déplace. Poids de l'eau nécessaire pour flotter - Poids de l'objet (Observation 2) Aussi, (Observation 3) Par conséquent , la coque du navire est conçue pour déplacer / pousser de l'eau (volume en poids d'eau nécessaire pour flotter - volume déplacé x densité de l'eau déplacée) nécessaire pour le faire flotter avant que la montée des eaux due au poids du navire ne le recouvre. Ainsi, la ligne de chargement en eau de mer du navire est plus basse que la ligne de chargement en eau douce, l'eau de mer a plus de densité que l'eau douce.
APPLICATIONS:
La flottabilité peut être utilisée pour soulever des objets, contre la gravité, pour les déplacer d'un lieu à un autre, par exemple des navires de charge.
"

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Prefair Report

2208 **Clara Bédard, Maelly Kossonou**

Div/Cat **Physical and Math / Junior**

Title: **Comment est-ce que les satellites font pour rester en orbite**

Summary: "Pour la foire scientifique, nous avons décidé de faire une recherche sur les satellites... La majorité des personnes savent ce qu'est un satellite cependant, ils ne savent pas comment ces derniers font pour rester en orbite autour de la Terre ou autour de différentes planètes ou étoiles.... C'est ce que nous allons vous expliquer aujourd'hui...

Pour commencer, nous allons vous expliquer la différence entre les satellites artificiels et les satellites naturels... De plus, nous allons aussi vous expliquer qu'est-ce qu'une orbite.

Ensuite, nous allons commencer la recherche et vous montrer nos informations et preuves scientifiques.

Pendant toute la présentation, nous allons utiliser cette deuxième question afin de que vous puissiez mieux comprendre: «Est-ce qu'un satellite en orbite est plus semblable à un avion en vol ou à une balle de tennis propulsée par le coup foudroyant d'Eugénie Bouchard?»

Puis, nous allons vous expliquer comment le satellite peut être comparé à la balle de tennis et non à l'avion... Nous allons aussi vous expliquer en détail comment le satellite reste en orbite et quelles forces opèrent...

Pour conclure, cette recherche, ayant comme but de trouver comment les satellites font pour rester en orbite a été utile car, elle a bien répondu à notre question et nous avons eu des réponses claires....

"

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Prefair Report

2209 **Olivia Mclellan, Andrea Wang**

Div/Cat **Physical and Math / Junior**

Title: **Ashteroid**

Summary: "QUESTION / HYPOTHESIS:
How does weight and size affect distance?
We think that the acceleration and momentum will make the basketball go out the furthest because it does have a greater mass and speed. When we say "size", we mean how much contact and surface area. In our experiment, we think momentum will be our main factor and maybe acceleration. Momentum is the motion of a moving body, measured as a product of its mass and velocity/speed. The greater the speed is, the larger the force is. The basketball has the most mass, so then the basketball does have a greater momentum compared to any other ball.

DESIGN / METHOD:
Our experiment is called "Ashteroid". We will be having 6 different weighted balls in 3 different categories. 2 in the smaller and lighter section, 2 in the heavy, and medium section and the other 2 in the bigger and heavier. The balls are a tennis ball, baseball, styrofoam ball, bouncy rubber ball, volleyball and basketball acting like an asteroid moving, crashing and hitting towards "Earth". "Earth" is a cardboard mat filled with ash particles in a small circle, just like the land. The impact of the balls will cause the dust particles to disperse, depending on size, momentum and speed. We would add a vasoline circle around the ash so when the balls drop, the ash would stick.
After we drop the balls, one at a time, at 0.75 meters, they would crash into the cardboard mat. The ash would fly out and stick to the vaseline circle and some particles will go beyond. We measure the distance from the center of the cardboard mat, and out. We didn't use specks of particles far away from the cardboard because maybe the balls didn't affect that. We found the average distance of each ball and also, the distance of the furthest group of particles.

OBSERVATIONS:
We noticed that the heavier and larger circumference it is, it would go out further. Every time we went up a ball heavier, the ball made the ash take up the whole vaseline circle and some ash even went out beyond the circle.

INTERPRETATION / CONCLUSIONS / APPLICATIONS:
This experiment did answer our question. " How does weight and size affect distance?" The answer is momentum. Since the basketball did make the ash disperse the furthest, this means that momentum would answer our question. The basketball also did take up more surface area and made more contact. The weight didn't matter because all of the balls landed at the same time even the tennis ball and basketball landed at the same time. Gravity pulls down all the object at the same pace when there is air resistance.This is why weight doesn't matter that much. Weight does change momentum and this does affect the transfer of energy from the ball to the dust. The conclusion is that size is a small factor, but momentum is the main one.

"

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Prefair Report

2210 **Max Ma**

Div/Cat **Physical and Math / Junior**

Title: **the battery of potato**

Summary: "Hypothesis
The study performed a question: can the voltage of one vegetable or fruit make a 220v bulb shine? Why can it make voltage? It is hypothesized that the bulm can not shine.
I used voltmeter to show what voltage is one potato and a cup of orange juice. A potato's voltage is about 0.7v-0.5v, the orange juice's voltage is about 0.9v. If we add more potatoes or orange juice, the number will be high as multiply. But one potato or one cup of orange juice can not make a 220V bulb shine. So my hypothesized was right. Why is it can make voltage, The principle is simple. The connected voltmeter with copper on one side and aluminum (zinc or iron) on the other.Using potatoes to provide the acid needed for the chemical reaction allows the electrons to move continuously from copper to zinc. And it caused voltage. use the copper coins and zinc pieces, and the cardboard with submerged by vinegar. copper coins use for the copper part, the zinc pieces is use for zinc. those two metals with the vinegar can making the electric moving. but the battery, witch is the voltage produced by the potatoes. one potatoes voltage is about 0.7V. if want to make a 220V bulb to shine, that will be at least 315 potatoes to make it."

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Prefair Report

2211 **Owen Maclennan**

Div/Cat **Physical and Math / Junior**

Title: **How does the amount and type of fertilizer used affect the rate in which a plant grows?**

Summary: Question/ Hypothesis

This experiment was designed to determine how type and amount of fertilizer affects the growth of a plant. My hypothesis is that plants that are watered with 1L of water that has ½ tsp of miracle grow dissolved in it will grow faster than the other plants with different amounts and types of fertilizer.

Design

18 bean seeds were placed in their own, separate pots. The plants were divided into six groups, each with different types and amounts of fertilizer. There were three plants with ⅛ tbls of bone meal, three with 1/16 tbls of bone meal, three watered with water that had ¼ tsp of miracle grow dissolved per liter, three with ½ tsp of miracle grow per liter, three with 1 tsp of miracle grow dissolved per liter and three with water with no fertilizer as the control group. All plants were watered daily with tap water mixed with their amounts of miracle grow. The average height of each group was measured every week for 5 weeks.

Observations

At the time of writing this progress update only 4 out of 5 weeks had passed. However it was quite clear that the amount of miracle grow did have a large impact on the rate in which the beans grew. The average height of the control plants at the end of the fourth week was 21.3 cm whereas the average height of the plants watered with ¼ tsp of miracle grow is 33.6 cm. In this case the added miracle grow benefits the plants however the plants watered with ½ tsp of miracle grow had a smaller average height of 17.6 cm. Plants watered with 1 tsp of miracle grow had the smallest average height of 1.6 cm. Although the amount of miracle gro used did affect the height of those plants, the amount of bone meal did not affect the plants. The average height of the plants with 1/16 tbsp had an average height of __ cm and the plants with ⅛ tbsp of bone meal had an average height of __ cm. The amount of bone meal did not massively effect the height of plants. However a few days after taking these measurements the plants with 1 tsp of miracle grow all died.

Interpretations / Conclusions / Applications

My conclusions for the results found are that the amount of miracle grow used does affect plant growth however bone meal does not. Over time it seems that high amounts of miracle grow can kill a plant. These results can be used to help people choose what type of fertilizer they will use for their plants if any at all.

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Prefair Report

2212 **Arnav Agarwal**

Div/Cat **Physical and Math / Junior**

Title: **Phases of the Moon and Stars**

Summary: "Moon Phases and the Stars
By: Arnav Agarwal
Hypothesis
The main idea of my study is to see if there are more stars that are visible in the sky when the moon is bigger or smaller. My question is how does the phase of the moon affect the number of stars that are visible in the sky? I hypothesise that the bigger the moon is, the less stars you will see. This is because if the moon is bigger then there will be more light in the sky which will cause less stars to be visible.

Method
For about 2 moon cycles (which are about 27-28 days each) at 7:30 PM, I will be going outside and looking at the stars. I know my data won't be as precise as a computer and that there are millions of stars in the sky; But, I count the stars that the average person would be able to see . There are websites that can tell me what the phase of the moon is and how much of it is showing (For example, click here). I have recorded my data in a spreadsheet.

Observations
After almost 2 moon cycles I looked at my spreadsheet and saw that there was a very steady increase and decrease for the percentage of the moon. In my spreadsheet there is a trendline, this trendline has a steady increase, which means that the moon is getting larger at a constant rate. I found out that the larger the moon is, the less stars you will be able to see.

Conclusions
I think this is because there is more light when the moon is larger which makes it harder to see the light from the stars.

Note: Work in progress

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Prefair Report

2213 **Lucy Zhang**

Div/Cat **Physical and Math / Junior**

Title: **Melting Styrofoam with Acetone**

Summary: Since a styrofoam cup melts in acetone (nail polish remover) and does not melt in water, how much water can i add to acetone for it to melt the styrofoam cup?
I think when you add 90 mL of pure acetone to 10 mL of water and 80 ml to 20ml will work and I am not sure about 70mL of acetone. I think this because even with a little bit of water, it should work. Starting off with a few Styrofoam cups, put the amount of acetone needed in the bowl and put the cup in open end down in the acetone. Push the cup downwards so it doesn't float up, and see what happens. After the cup has dissolved, take another bowl and put desired amount acetone in and add a bit of water. Observe the reaction between the styrofoam and the acetone. If the cup dissolves, try adding more water and less acetone and record what percent of acetone is and the percent of water.
I noticed that before the cup dissolved, it started to bubble and fizz. After it dissolves, the substance was a sticky and slime like substance but it was stretchy as well. work in progress..

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Prefair Report

2214 **Blake Conod, Antoine Carrier**

Div/Cat **Physical and Math / Junior**

Title: **Cristallisation**

Summary: Cristallisation

Est-ce possible d'accélérer le processus de cristallisation? Quelle réaction chimique aurons-nous?

Nous voulons mieux comprendre les produits chimiques ainsi que la cristallisation. Nous voulons également mieux comprendre les liquides en surfusion.

D'après nos recherches préliminaires, une réaction exothermique provoque la solidification du vinaigre et du bicarbonate de soude. Le sous-produit de cette réaction est la chaleur. Nous pensons que la solution d'acétate de sodium est surfondue et que le contact avec les cristaux provoque le changement d'état à l'état solide.

La démarche:
1.Mélange quatre tasses de vinaigre et quatre cuillères à soupe de bicarbonate de soude dans un pot.
2.Cuire votre solution à feu doux à moyen pendant environ une heure. Vous voulez le réduire à 1 tasse ou moins.
3.Enlevez quelques cristaux du pot et gardez-les pour plus tard.
4. Versez votre acétate de sodium dans un récipient en verre et placez-le au réfrigérateur pendant 30 à 45 minutes.
5.Puis mettez quelques cristaux que vous avez pris du pot dans le ver pour commencer la réaction.

Nous avons pu voir que la solution doit être très concentrée pour cristalliser et que les cristaux ne forment pas dans tout le liquide, mais qu'une partie du liquide reste liquide et ne devient pas solide. Nous avons dû faire bouillir la solution de sodium d'acétate à plusieurs reprises et la solution n'a quand même pas cristallisé au complet. Quand l'acétate est formé, nous pouvons la fondre puis la recristalliser plusieurs fois. Par exemple dans certains chauffe-mains le sodium d'acétate est utilisé. Un petit morceau de métal est utilisé comme nuclide pour commencer la réaction. Ce métal quand touché se brise en petits fragments pour commencer la réaction. Dans notre cas nous utilisons des cristaux pour commencer la réaction du liquide en surfusion. Nous avons remarqué que les cristaux attachés au verre ou au pot sont difficilement enlevables. Quand tu ajoutes de l'eau nous présumons que les cristaux se dilatent dans l'eau à une vitesse extraordinaire puisqu'au toucher de l'eau les cristaux disparaissent. Pour la prochaine fois, nous pourrions créer une invention ou le sodium d'acétate est utilisé ou nous pourrions utiliser d'autres outils pour pouvoir mieux décrire ce que nous voyons et regarder d'autres questions que nous nous sommes posées pendant l'expérience.

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Prefair Report

2215 **Jialin Luo**

Div/Cat **Physical and Math / Junior**

Title: **Mixing Pigment vs Light**

Summary: My question was why mixing pigments and lights have different results. I chose to do this because I wondered why computers and software had different primary colours than paints, dyes, and printer ink.

First, I had to understand why we saw colour in the first place.

White light is a combination of all the colours of the spectrum, and black is the absence of light. Different colours of visible light have different wavelengths. When light reflects off an object, that object can either absorb or reflect colours of the spectrum. The colours that it absorbs, we don't end up seeing, and the colours that it reflects are the colour(s) that it appears as.

Also, the primary colours of light are red, green, and blue, and the secondary colours are magenta, yellow, and cyan. The primaries for pigments are magenta, yellow and cyan, often simplified as red, yellow and blue, and the secondary colours are red, green and blue.

Now that I understood the basics of colours of light and pigment, I did some research to find the answer to my question. I found that mixing colours of lights is called additive mixing, and mixing colours of pigments is called subtractive colour mixing.

Mixing light is called additive mixing because the more colours you mix in, the more wavelengths you add. That's why when all the colours are mixed together, you create white.

Mixing pigment is called subtractive mixing because the more colours you mix in, the fewer wavelengths there are. An example is if you mixed red and yellow paint-the red paint absorbs every colour except for red, which it reflects, and that is why it appears red to us. The same thing happens with the yellow paint: it absorbs every colour except for red and green light, which when mixed together, make yellow. However, when you mix the red and yellow paint together, the green light that the yellow paint reflects is actually absorbed by the red paint, thus making it subtractive colour mixing (you lose the number of wavelengths reflected). That is also why we need so much more yellow than red to achieve an orange colour. When you mix all the colours of pigment together, you achieve black, and white is the absence of colour in this case.

It is no coincidence that the primary colours of light are the secondary colours of pigment and vice versa. This is because the colours of light are like a first step before you see the colour of the pigment. For example, a yellow shirt appears yellow when light shines on it because the dyes in the material absorb all colours except for red and green, which is reflected back to us. However, if you shined blue coloured light onto the yellow shirt, it would appear black, as there is no red or green light to reflect.

Based on my research, I can confidently answer that mixing pigments and lights have different results because of subtractive and additive mixing.

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Prefair Report

2216 **Mattea Reid**

Div/Cat **Physical and Math / Junior**

Title: **Opposites Attract**

Summary:

Question/Hypothesis

This experiment was created in order to test if heat affects magnets. It is believed that the magnets will work better heated because when matter is heated the particles spread farther apart. This is thought to enlarge the magnetic field of the magnets.

Design/Method

Several tests were conducted to test this theory. All these tests were done with magnets at two different temperatures: room temperature and hot. The first test was to see how close a magnet has to be to a paperclip for the paperclip to stick to it: a paper clip is placed on the ground next to a ruler taped to the wall. A room temperature magnet is then lowered slowly down the ruler, and when the paperclip sticks to it, the height is recorded. This is then repeated with a hot magnet. The second test was to see how many paperclips in a line one magnet could hold -this was also done with magnets at two different temperatures. For the third and final test, a magnet is place is boiling water then dropped into a bowl of paperclips. The amount of paperclips on the magnet is recorded. The test is repeated with room temperature water. All three tests were repeated three times.

Observations

Overall the experiment showed that magnets prefer colder temperatures. The third test was done with the hottest magnets followed by the second test, then the first test. This showed, since the hot magnets from the first test were at the lowest temperature, the difference between the hot magnets' results and the room temperature magnets' results was barely noticeable. In the second test, the results were clear but not very dramatic. It was obvious that the magnets were stronger at room temperature but there still wasn't a huge difference in the amount of paper clips picked up. The third test's results were very dramatic as the amount of paper clips picked up by room temperature magnets was nearly double the amount of paper clips picked up by hot magnets.

interpretations/conclusions/application

With these results it can be concluded that magnets seem to prefer cooler temperatures, contradicting the predicted results. The reason behind these results is that in a magnet, the positive and negative charges are lined up in an orderly fashion. If you heat a magnet, then the energy from the heat pushes the electrons into a more random orientation. Therefore, you don't have the positive and negative parts as well lined up - so less "concentration" in certain areas of positive and negative charges. If you cool the magnet then there is less random movements of electrons and the magnet has more ordered regions of positive and negative charges, so higher magnetic strength from the higher concentration of charges.

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Prefair Report

2217 **Quinn Venditt**

Div/Cat **Physical and Math / Junior**

Title: **Rainbow Expansion: How does the heat produced from different colours of light effect thermal expansi**

Summary:

Question and Hypothesis

I conducted this experiment because I wanted to see how different colours of light affected thermal expansion and contraction. I hypothesized that the light with more red and orange tones in the light would cause the water to expand more due to darker colours converting coloured light to heat more efficiently.

Design Method

I began by creating a bottle with measurements on the sides so I could easily observe the expansion. Mad the same markings on a straw. On one side, markings every two centimeters, and on the other, every five. The bottle was filled with water of a certain colour that corresponded to the colour of light, all that water was left to sit out 5-6 hours before it was used in a test, to guarantee that it was room temperature. I placed the bottle in a completely dark room at the same time of day for each test to try and make every test as similar as possible. A coloured light bulb was plugged in and put next to the light bulb for three hours. I recorded the amount of water in the bottle and expansion every 30 minutes. In the end I found that the red-toned lights didn't cause the most thermal expansion to occur in the water, but the ones with more lighter tones such as green and yellow. In a strange phenomenon with one of the tests, the blue light caused the water to contract as opposed to expand. despite being in the same room and setting as every over test. It was the only colour to experience this. I originally hypothesized that the blue light would cause the water to expand little to none, this is because blue is not as good as converting light to heat as the other colours.

Conclusions/interpretations

After doing this experiment I feel it safe to say that my hypothesis was wrong and that red-toned light due not cause the most thermal expansion or produce the most heat. Yes red is a hot colour, yellow is often hotter, but it is worse at converting heat which is what lead me to think the red would cause more expansion. Yellow is often a hotter naturally occurring colour. An example of this is stars. The newest and coolest stars are often red, but as they heat up and get older, they turn more yellow. When using cameras that uses infrared light, yellow is often used to symbolize the hottest colour. The order of the amount of expansion in the colours (yellow, Green, Orange, Red, Purple, blue) is the order of how much yellow-tones each colour contains. With yellow containing mostly/all yellow tones, and blue containing hardly any. I think this experiment has some useful data that can be used in the future. It can help people like botanists in their work space. When growing plants they can use lights that have more yellow tones as opposed to blue or red.

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Prefair Report

2218 **Neila Azimi**

Div/Cat **Physical and Math / Junior**

Title: **Saving Heat One Layer at a Time!**

Summary: Building and designing an energy efficient house is an important topic because as the world's population grows the need for more energy in housing and transportation increases and this has many negative effects on the environment. Better heat and energy conservation will result in more environmentally friendly homes and an eco friendly community. This is especially an important topic in countries with cold climates, where a lot of energy is used in heating buildings. Making our homes greener and building more efficient houses have been a topic of study for many years and is a very broad subject. There are many different ways of changing and improving the design of existing homes such as using renewable energies like solar panels, windmills, etc.
In this project I would like to focus on finding better and more efficient insulation to conserve heat and energy. I have built a prototype house using wood and a layer of common insulation (R-3.0, Insulation, Thickness: ½"). Then I investigated using different materials such as cotton, bubble wrap (contained air), shredded paper and sponges, as an added layer of insulation to improve the heat conservation. I have placed an energy lamp as a source of heat inside the house, to warm up the house to 30 °C. When the desired temperature was reached the heating was stopped. The time that the house with a specific insulation, gained heat to 30 °C as well as the time that it took to lose the heat and cool down to 22 °C were recorded. This process has been repeated using various layers of added insulation to compare and investigate the best possible option to increase the heat conservation in our existing house design. The results have been represented and discussed in detail in my presentations and as charts and tables.

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Prefair Report

2219 **Emily Monaghan**

Div/Cat **Physical and Math / Junior**

Title: **Slip, sliding away**

Summary: The purpose of this experiment was to find out if there was a better way of making icy roads less slippery in the winter. Presently, the city uses a combination of salt and sand. While salt melts the ice, sand provides traction, making it less slippery.

It is hypothesized that applying substances to the ice will make it less slippery, and that more of each substance will be less slippery than less of each substance.

Baking trays were filled with water and left outside to freeze on a level surface. A hook was screwed into a hockey puck and weights were put on top. Then, using a force meter, a pulling force was applied to the hockey puck until it began to move. The reading on the force was measured. This test was done 10 times at 5 minutes, 10 minutes and 15 minutes. Then the tests were repeated with different treatments on the ice including: salt, sand and ice melter (using different force meters when needed).

A second measurement approach involved using a meter stick to measure how high one end of each tray was required to be lifted in order to move the hockey puck.

Treatments included several different concentrations of salt, sand and ice melter as well as a control. Separate measurements for each treatment were made at 5, 10 and 15 minute intervals.

Through testing, I found that 30g of salt at five minutes performed the best by far, because it took the most force to pull the hockey puck, and the most height to make it slide. I also found that in all cases the longer the salt was left on the ice the more slippery it became. This was most probably due to the fact that after some ice melted there was water sitting on the ice which made it even more slippery.

I also found that the results of the sand changed slightly after different amounts of time. This may have been because the sand was left inside making it warm. Therefore, it melted the ice, this created mud which was more slippery. Overall sand was less slippery than salt, ice melter and regular ice.

Ice melter was more slippery than every other substance and 30g was even more slippery than regular ice. This may have been for the same reason that 30g of salt was slippery, or it could be a result of the ice melter coming in round balls, which rolled underneath the hockey puck.

In conclusion, the lower quantity of sand (6g) worked the best on average. The city might find this of some use, but they also have to take into account the economic, and environmental effects of snow and ice clearance. If I were to continue with my experiments, I would look at different variables like: combinations of treatments, a change in temperature and ice melter that wasn't round, to see if they would make a difference in my results.

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Prefair Report

2220 **Jordan Huddleston**

Div/Cat **Physical and Math / Junior**

Title: **The Effect of Colour on Temperature**

Summary: Question/Hypothesis: The purpose of this experiment was to determine if when water was being heated, if the colour of the water had an effect on its temperature over time. Of the six colours used in this test (red, orange, yellow, green, blue, & violet), it was hypothesized that the colour violet would have the highest temperature compared to the other colours at the end of testing due to it having the most energy and therefore absorbing more photons of light.

Design/Method: 150ml of water was placed into a glass which would then have 8 drops of food colouring placed into it of the targeted colour (multiple types of food colouring was applied in certain cases to achieve the needed colour.). A light containing an incandescent light bulb with a wattage of 100 was placed directly over the water. The base temperature of the water in all cases was 24 degrees Celsius. Once the light was turned on, a timer would be started simultaneously. The temperature would be checked in ten minute intervals, with five of these intervals being recorded. This test was done six times with six different colours (red, orange, yellow, green, blue, & violet).

Observations: At the end of testing most, but not all results were the same as hypothesized. Not all results will be shown, only the first interval check and the last. Red: 10 minutes = 30°C, 50 minutes = 41°C. Orange: 10 minutes = 32°C, 50 minutes = 41°C. Yellow: 10 minutes = 34°C, 50 minutes = 42°C. Green: 10 minutes = 38°C, 50 minutes = 48°C. Blue: 10 minutes = 36°C, 50 minutes = 44°C. Violet: 10 minutes = 38°C, 50 minutes = 47°C.

Conclusions: Through testing, it was found that the colour of water when heated played a large role in its temperature over time. It was also confirmed that a colours place on the visible light spectrum may cause it to be hotter, or colder in temperature over time. Not all is perfect, two important variables were the potential reason for why two of the colours had a different result then originally hypothesized. Variable 1.The distance from the light to the water. The colour orange was hypothesized to have a higher temperature then red, however it had the exact same temperature at 50 minutes at 41°C. Through reviewing pictures of the colours being heated, it was noticed that the light on the colour orange was noticeably higher, or farther away from the water source then the other colour to be done before it (red). This issue was the potential reason for the low temperature of orange. Variable 2.The transparency of the colour. The colour green used in the water was a previously mixed version which mixed equal amounts of blue & yellow. This meant that the green was very opaque which resulted in the colour being darker, absorbing more light as heat, and potentially being the reason for it having a higher temperature then violet (more transparent).

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Prefair Report

2221 **Minraj Gill**

Div/Cat **Physical and Math / Junior**

Title: **Viscosity Verification**

Summary:

Question/Hypothesis

In my experiment, I am testing the theory of velocity. Velocity's the measurement of how fast an object can go in a given direction and how fast the molecules can slide past one another. My experiments testing the speed of the marble going through the syrups. I am testing which liquid is most viscous when heated and cooled. I will be testing how accurate this method is. It's hypothesized that the liquid in which is least viscous when heated will also be least viscous when cooled and vice versa. It's also hypothesized that maple syrup will be least viscous with Corn syrup following and honey being most viscous.

Design/Method

In the beginning of the experiment I started with heated corn syrup and I put 200ml into a cylinder and I dropped a marble into it and timed how long it took for it to reach the bottom of it. I repeated the same process with the cooled corn syrup. I then did the same process with the hot maple syrup and the cooled syrup. After that I repeated the process with honey. I recorded all observations and any faults that I saw. I washed and dried the cylinder every time.

Observations

I observed that maple syrup was the least viscous liquid when heated as well as cooled. It was what I had hypothesized as from my previous knowledge, I knew that it was a very runny liquid which poured out quite fast. This helped me infer that it would be the least viscous liquid. My cold liquids were at a temperature of 15°C and my warm liquids were 45°C. My results for corn syrup, it took 11.43 seconds for heated and 1.42 minutes for cooled. The data for Maple syrup is .43 seconds for heated and 1.73 seconds for cooled.The results for Honey are 7.52 seconds for heated and 1.51 minutes for cooled. The warmed liquids are a lot less viscous than the cooled ones. This is due to the particle theory of matter which explains that warmer liquids are less dense and viscous than cooler ones as the particles are moving faster and are more spread out. Cohesion and adhesion also play a huge part in my experiment as they are the two factors of velocity. They cause the molecules to cling together. An experimental error that may have occurred is that some water could have been left in the cylinder from washing it which could have made a slight difference in the recorded times. Another possible error is that the temperature may have slightly changed while I was setting up the timer before I did the experiment.

Interpretation/Conclusions/Applications

In conclusion, Maple is the least viscous followed by corn syrup and honey. Also the heated version of the liquid is a lot less viscous than the cool one. There was room for a few little experimental errors, though not one big enough to throw all the results off.

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