Quarantine Science

THE SCHOOL 21 JOURNAL OF SCIENTIFIC RESEARCH COMPLETED DURING LOCKDOWN

Featuring

Curious consequences of surface tension	**Good vibrations**	**A cold conundrum**	**Little g confirmed**	**Cold brew**
A paper by Zak which explore the effect of temperature on surface tension of water	A paper by Aliyah exploring how we can understand the physics of improvised musical instruments	A paper by Yusuf investigating why frozen water floats on liquid water	A paper by Acacia seeing if you can confirm that acceleration due to gravity on Earth is $9.81 m/s^2$	A paper by Kristian finding evidence to support the particle model from his kitchen

Also includes papers on pendulums, hearing, combustion, projectiles and osmosis

Foreword

This journal presents the work of a small group of students from School 21 who wanted to explore what science they could do at home. The idea that science is the preserve of ‘men in white coats’ and doesn’t exist outside of laboratories is dangerous and if left unchecked will create a disconnect between science and society. These pupils will tell you that science is more than a body of knowledge, more than something that happens in a lab and more open for all to experience than stereotypes might suggest. They have developed their scientific writing, knowledge of how to plan and conduct an experiment and how to innovate to work with what is available. The result is a collection of 13 reports detailing experiments conducted in their homes.

From a teachers point of view looking at what these year 9 pupils have produced working with the limitations of equipment, environment and access to support is impressive. Their commitment to critiquing each other's work, redrafting and working independently has really impressed me. It has been a challenge trying to communicate at a distance and keep in touch with how pupils are developing their knowledge and reports. It has by no means been a flawless process and I would like to thank the pupils who took part for being such great Quarantine Scientists.

H Marson
Science Teacher

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What causes frozen water to float?	Yusuf
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What affects the surface tension of water?

Author: Zak

Summer 2020

Introduction

Context

The discovery of hydrogen bonding has been accredited to many people such as T.S Moore,T.F Windmill and Wendell Latimer with Linus Pauling naming it “hydrogen bonding” (Wikipedia and LSBU) all of whom contributing to what we now know about hydrogen bonding.

In 1891 Agnes Pockels discovered the influence of impurities on the surface tension of fluids doing the dishes in her own kitchen and went on to publish her findings and this simply shows how easy it was to experiment with surface tension even back then(Wikipedia 2020)

Before I even begin my findings I would like to say I have been surprised by the amount of science experiments you can do at home and the amount of science that is involved in simple everyday things,

As I am working from home there are certain restrictions around the kind of experiments I can do and this is due to the lack of scientific equipment I have at home. However I chose this experiment because you could recreate this experiment at home very easily with little to no equipment.

Before I delve deeper into the science of this experiment I would like to clarify some of the words in the questions as even I did not know them before my research.To put it very simply surface tension is the strength of the surface due to the bonds between hydrogen atoms (Khan Academy 2020).

Literature review

As I briefly touched on, hydrogen atoms have bonds and these bonds on the surface of a liquid allow some objects to sit on the surface and the reason this is interesting is because an object with a higher density should sink when placed in a liquid but this doesn't occur.

The reason these hydrogen bonds occur is due to cohesion which essentially means water and other liquid molecules are attracted to each other and due to their attraction there is a pull on the atom from different directions ultimately making all of the atoms closer and as there is no molecules above them the molecules on the surface have a stronger bond to each other (Khan Academy 2014).

I would also like to clarify the definition of one more word being adhesion which is the attraction water molecules have to other materials such as the container they are stored in (Khan Academy 2014)

So far I have introduced you to surface tension but now I would like to further discuss the effects on surface tension beginning with temperature.

When the temperature of water increases the surface tension decreases and the reason for this is that the increase of temperature weakens the cohesive bonds that exist. In turn when the temperature of water decreases surface tension increases and this just further proves that the surrounding environment does affect surface tension and this is due to how adhesive water molecules are.

The another factor which can affects surface tensions in water are surfactants and this occurs when they come into contact with the water molecules at the surface and they try to stop the intermolecular interactions and due to the fact the interactions between water molecules and surfactant molecules are fewer and weaker this will then cause the surface tension to decrease.

I am doing this experiment to determine whether the hydrogen bonds in water can allow a q-tip or paper clip to sit at the surface regardless of the tension.I would also like to determine whether the temperature of the water plays an important role in how long the q-tip or paper clip can sit on the surface.

Planning

Variables

Independent Variable: I will change the temperature of the water every time to see how much it affects surface tension.I will also try to add a surfactant (soap) into the water as well to see its effect on surface area.

Dependent Variable:I will measure how long an object will sit at the surface and how this is affected by the temperature of the water it sits in.I will also use the same method with the surfactant.

Control Variables: The thing that will stay consistent throughout my experiment is the amount of water in each cup as well as the device I will use to measure how long the objects can sit on the surface.

Hypothesis and Prediction
My hypothesis is that the stronger the surface tension the more the weight can sit at the surface and I predict as I increase the surface tension (by changing temperature and other factors) you will see the amount of weight that can sit at the surface increases or decreases.
I predict that the hotter the water the weaker the surface tension will be and I will think it is because of the disruption the increased molecular will cause.

I also think that the colder the water the longer the q-tip/paperclip can sit on the surface and I think this is due to the we

Equipment List
A Cup
Water
A paper clip/hair clip/cotton swabs
A fridge to make the water colder
A microwave to make the water hotter
A timer/stopwatch
Another Human

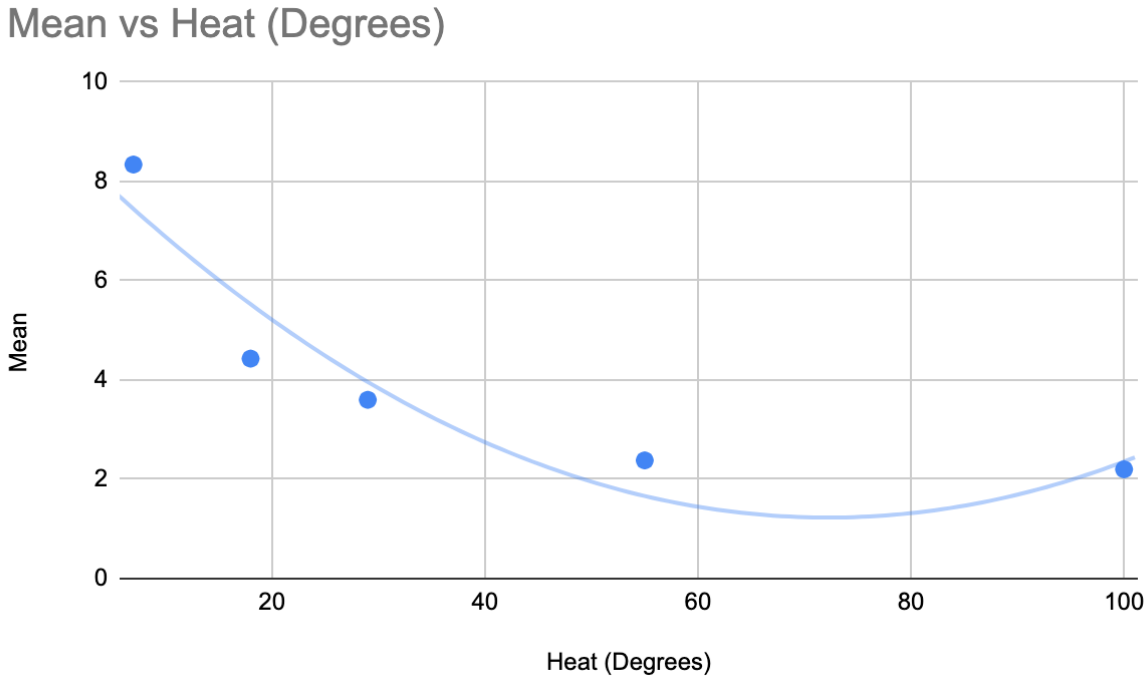
Method
1. First I will fill both of my cups with water and try to get the same

size cup so your experiment will be more accurate.
2. I will preheat or pre cool the water in each cup. I would advise you to use a thermometer to allow you to check the exact temperature of the water
3. Then I will prepare my clock to make sure I start at the right time
4. I will then simultaneously drop both paperclips/cotton swabs in their bowls of hot/cold water
5. While this is happening another person will start a timer
6. Then we wait to see and make sure you are focused on the bowls so you can stop the timer at the exact right time.
7. When you get all of your results you should note the times of each 3 attempts
8. Once you have all three attempts written down you need to find the mean of the three.This will tell you the average time so you can make a conclusion of your findings

I don't know if they sink as time goes on but I am interested to see and this is the reason I am timing this.

Results

Tables with data
Picture of my google sheets:



Heat (Degrees)	Time Taken For Q-Tip To Sink (Seconds)			
	Attempt 1	Attempt 2	Attempt 3	Mean
100	2.22	2.29	2.19	2.20
55	2.39	2.41	2.36	2.38
29	3.75	2.88	3.45	3.60
18	4.43.	4.40	4.45	4.43
7	8.34	8.29	8.39	8.34

Pictures

This is the cup I used and although I didn't have the most accurate way to measure the volume of the water I tried to fill both to the top.

This is the bowl I used and for both bowls I tried to fill them up by an inch.

Discussion

Evaluation of method:

During my experiment I did find an anomaly and to ensure that this would not affect my result I highlighted it and when finding my mean I used the other two attempts which were far more accurate.

I will admit some of the equipment wasn't the most accurate but the reason I used them is because everyone can use them and my work shows you can do science experiments anywhere.

I tried to be the fair when comparing both bowls and i used the equipment throughout to ensure the experiment's integrity.
I asked for help from someone else as well so we could start the timer at the right time and I think this helped to ensure we maintained accuracy throughout the experiment.

All of my attempts,at the same temperature, were very similar and weren't very far apart and this was because I tried to ensure the experiment was consistent throughout.However I did have an anomaly which wasn't similar to my other attempts and I could tell it was an anomaly as there was a considerable difference between it and my

other attempts.

The trend (as temperature increases surface tension decreases) that occurred in my experiment was also found by the University of Florida in an article they published in 2013 and they came to the same conclusion I did.(Cited at the bottom)

How I conducted my experiment was that I got different bowls of water (same size bowls) which had varied temperatures and I put a paperclip on the surface.I allowed them to sit for 3 seconds (roughly) before applying a single drop of surfactant (soap) and measured how long it took for the paperclip to sink.

Conclusion:
The results of my experiment showed q-tip or paperclip was able to sit better on the bowl with the colder water and I saw less penetration in the bowl with the colder water than the bowl with the hotter water.In Bowl A I also realised the cotton swab was sitting higher than Bowl B. To conclude,my experiment proves that temperature does affect surface tension and the strength of surface tension due to the increase or decrease of intermolecular forces.

If you are thinking about replicating this experiment I would advise you to not use q-tips but instead use paper clips as many other scientists have found it easier to use paper clips.

Although I believe that the q-tips may have made my experiment less accurate they are still something everyone could easily find at home making this experiment a lot easier.

My conclusion from the experiment I conducted was that the hotter the water the less time the paperclip would sit on the surface once a drop of surfactant was applied.

When it was this experiment I tried a second one using a paperclip soap and water where I looked at the effect of temperature when a surfactant was applied and the colder the water the longer it took for the surfactant to break the hydrogen bonds at the surface of water.

This second experiment (in my opinion) was more accurate as I had the same amount of soap every time using teaspoons and to check the temperature of the water I checked the average.

I also made sure I had someone on the timer to make sure I started it at the right time.

I would lastly just like to clarify the reason hotter liquid particles have lower surface tension;the reason is that intermolecular movement due to increasing heat disrupts the cohesion of the hydrogen atoms therefore weakening the bonds and decreasing the surface tension.

Glossary

Word	Definition
Adhesion	Is the fact that water molecules are attracted to other materials for example a container
Cohesion	is the fact that water molecules and other liquid molecules are attracted to each other
Surface Tension	Surface tension is the strength of the surface due to the bonding of hydrogen atoms
Intermolecular	Between the molecules

Literature cited

https://blog.biolinscientific.com/what-are-surfactants-and-how-do-they-work Biolin Scientific (2018)

https://fsz.ifas.ufl.edu/surfacetensionandcapillarity/html/en_tension.htm Florida Universiy (2013)

https://sciencing.com/detergent-break-surface-tension-5452223.html Sciencing (2018)

https://sciencing.com/changing-temperature-affect-viscosity-surface-tension-liquid-16797.html Sciencing (2018)

http://www1.lsbu.ac.uk/water/water.html (LSBU 2020)
https://docs.google.com/document/d/11sG9MurnuuQPWIpO6ndo_7VkO9nNdyFiL_kSCIfaLwk/edit (Wikipedia 2020)

https://www.youtube.com/watch?v=pmagWO-kQoM (Khan Academy 2014)

What causes frozen water to float?

Author : Yusuf

Summer 2020

Introduction

Context

In this experiment I will be testing how density between different liquids change if they are frozen. We will test density with very little equipment and no need for a laboratory. I have always wondered why ice floats on water although it is heavy and is the solid form of water so I expected it to be more dense. However, this experiment shows that ice is less dense than water as it floats. This experiment will test if this is true for some other liquids to. We will use limited equipment that we have at home and will require very little as we are confined to using equipment due to lockdown. I will use items such as water which I will get from the tap, a salt water solution consisting of 2 tablespoons of salt, olive oil and washing up liquid.

Literature review

In this experiment we will be making frozen versions of a liquid and test if it will float inside of the same liquid. As we all know ice floats on water. But why is this? As science explains to us it is due to the object being less dense then the liquid it floats on. What this can tell us is that frozen water is less dense then water itself. Why is this strange? As we know solids have a very compact organisation between its particles. This would mean it will usually be more dense than liquids and gases. In this experiment we will be testing if all solid versions of liquids are less dense then its previous form. What i want to discover is whether it is the case for all liquids or a phenomenon for water only. By freezing different liquids and testing if they float i will be able to find out. We will be freezing liquids like water, water mixed with salt, olive oil and washing up liquid.

The main point of this experiment is to show how ice has a less dense structure compared to its liquid form water. This is due to the hydrogen

covalent bond water has. When water is a liquid its particles are constantly moving and forming bonds and breaking up very quickly. The kinetic energy in every particle will make it move around quicker and break bonds faster. However the colder the water is the slower these particles move as they have less kinetic energy to move around and this will mean it takes longer to break bonds between each particle. As water gets colder it makes it so the particles form bonds more often then they break and this will lead to a less dense structure between the particles. Furthermore, with liquid water the hydrogen bonds formed between oxygen and hydrogen is also a polar bond. Additionally, when water is frozen the hydrogen bonds begin to distance. Slowly as water is frozen the hydrogen bonds become far apart this leads to space between particles and makes frozen water less dense. Frozen water then is 9% less dense then water and causes it to be able to float on water and This is water when frozen, less dense but with a structured pattern between each particle. As the ice has become less dense than water this will lead to it being able to float.

This feature of ice is very strange as you can tell. You would expect that a solid would be more dense than its liquid form as the particles are very compact and only vibrate on the spot whereas a liquid has particles moving around each other and particles are only close together but not as close as solids(BBC Bitesize). However this is not true for water and this is quite a phenomenon and in this experiment we want to test whether this is the case for other liquids or is it just the case for water or not.

As we are in lockdown, I am unable to do this test with many liquids and I am unable to test as many liquids or use as many liquids as desired. I am only able to use resources at my house such as tap water and can not test whether a lot of other liquids have this feature and am not able to test this to its limits. I expect that this is the case for some other liquids and hopefully in my experiment I can record other phenomena with solid versions being less dense than its liquid form.

Planning

Variables

Independent Variable: The substance to be frozen

Dependent Variable: Whether or not different liquids float or not when frozen and placed in the liquid form. We will compare the solid form to its liquid form and see if it floats or not. If it floats it is less dense and if it sinks it is more dense.

Control Variables: When putting the frozen version into the liquid version in each different liquid there will roughly be the same amount. The amount of salt added to the frozen ice and the amount of salt in the liquid water it could cause the ice to melt or perhaps make the density of the ice more or less. How much time each one is left outside of the refrigerator as it may start melting. Making sure they freeze for equal amounts of time and making sure each is fully frozen.

Hypothesis

When frozen the particles have less energy to break bonds between each other and this will cause the particles to be closer together to make it more dense and as it will be solid the particles will be very close and will have very minimal movement and kinetic energy.

Additionally I predict any liquid that has a polar bond will float. Further more why i believe water will float is due to the hydrogen bonds it has and this will lead to particles being more distanced and be less dense.

I predict only the regular tap water will freeze as it may be a phenomenon and one of very few liquids which when frozen are less dense. I believe that when washing up liquid is frozen it will cause the

particles to be very close together and make the frozen washing up liquid much more dense than its liquid form.

Equipment List:

- Volume Measuring Jug
- Water
- Cups
- Salt
- Teaspoon
- Washing up liquid
- Ice tray
- Olive oil
- Salt water solution

What I would have also used:

- Shampoo
- Hand sanitizer (liquid ones)
- Fizzy drinks
- Water with many different items mixed into it like sugar.
- Honey

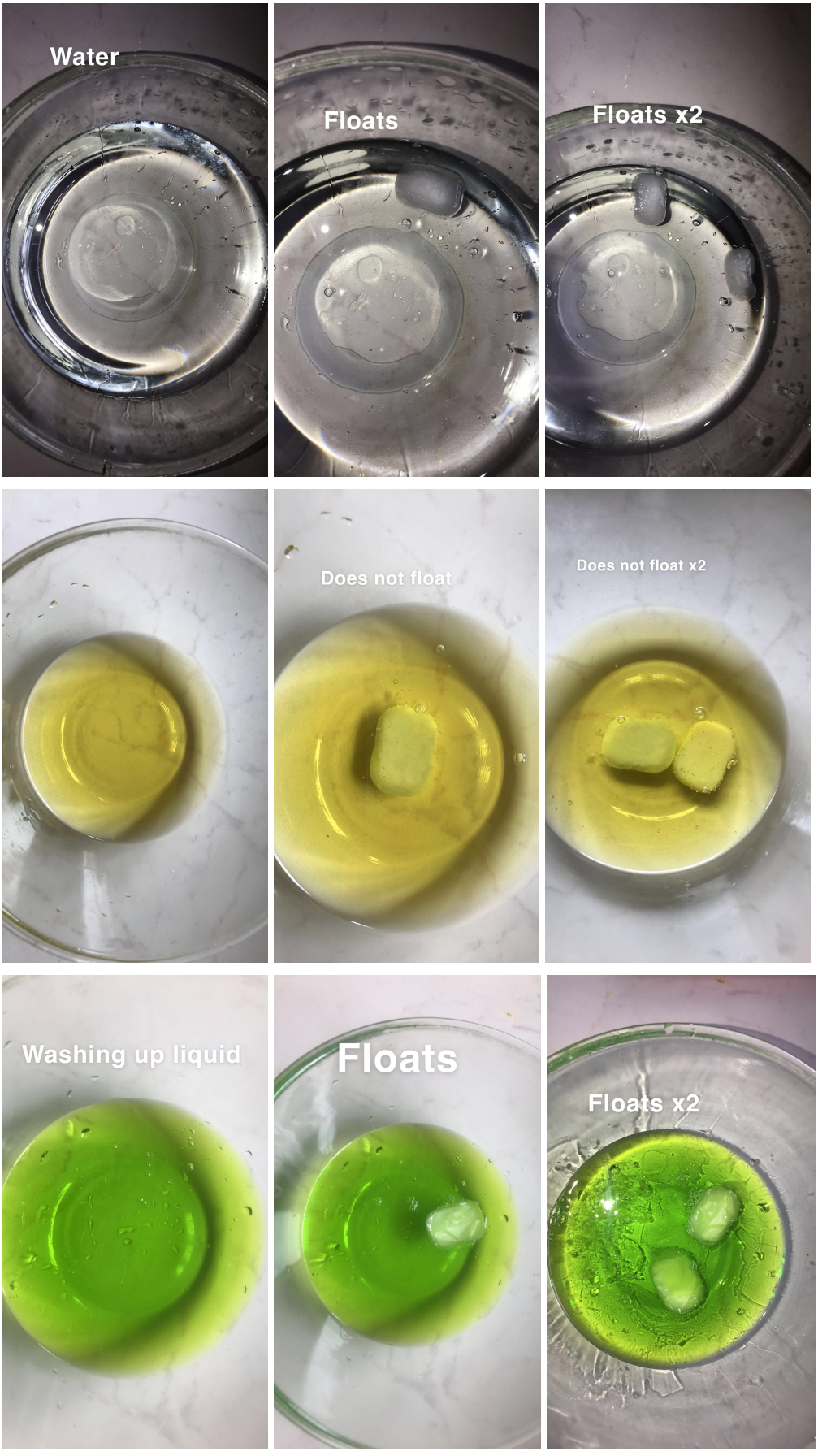
Method

1. I will pour each liquid into the ice tray. 2 of each. For the salt water solution there will be 2 teaspoons of salt
2. I will freeze them overnight
3. In the morning i will pour the liquids into separate cups
4. Check if they have frozen
5. If they are i will test one by one with someone to record and see if they each float
6. Taking them out the ice tray each frozen liquid will go into the same liquid cup
7. I will give each one 30 seconds to test if they will sink or float
8. I will repeat this process twice and record it in a table.

Results

Liquid	Floats Yes/No	Floats Yes/No (second try)
Water	Yes	Yes
Water with salt	Yes	Yes
Washing up liquid	Yes	Yes
Olive oil	No	No

Pictures


Water
Floats
Floats x2
Does not float
Does not float x2
Washing up liquid
Floats
Floats x2

Discussion

Evaluation of method

In my experiment I was very successful. I think my method was very good as I got results that I saw were common with the I made sure to give the frozen versions some time to sink and then I recorded my results. I made sure to do it twice just incase of anomalies. Due to me doing it twice it led to me being sure of my results and what i discovered was that the first time was the same as the second. However. If i was to repeat the experiment i would just put each liquid in different ice trays. Also I would use a smaller bowl as I used a lot of the liquids to fill the bowl which they were floating in. Other than the amount of equipment i used the experiment went as planned. However if i was able to use a laboratory i think this experiment would have been much easier to carry out. There are many ways to find an objects density and as we was stuck in our homes we could not use such

equipment that would have made it easier. My only things I would have loved to have done is use more of a variety of liquids that i did not have already. Due to lockdown restrictions i was not able to get my hands onto many liquids but I listed some liquids that would have been very fun and interesting to test.

Conclusion

In conclusion I have got results that I expected. In my hypothesis i predicted that only tap water would float. However this was not the case and i have discovered something new and while being confined in my house. I was surprised that the majority of liquids floated and it proved my hypothesis wrong and showed water is not the only liquid with this weird phenomenon.

I think there was nowhere to go wrong in the way I performed the experiment. However next time i would give more water with salt and perhaps put each liquid in separate ice trays as some of the liquids looked like they mixed. What I have learnt is that a weird property of some liquids is that when frozen and solid they are less dense than when they were liquids. This is a very interesting fact and it links to a lot of real life things such as like why icebergs float.

Literature cited

- Hydrogen covalent bonds. TedEd(2013). Accessed last 29/06/20 (https://ed.ted.com/lessons/why-does-ice-float-in-water-george-zaidan-and-charles-morton at 1:30)
- Solids having very compact structures BBC bitesize (no year but accessed in 29/06/20) (https://www.bbc.co.uk/bitesize/guides/zcsdgdm/revision/1 In the table describing solid liquids and gases structures)
- A lot of references from the video and also I am slightly copying how she performs the experiment with the way she uses certain liquids and how she performs the actual experiment. The open university(2014) accessed 29/06/20

(https://www.youtube.com/watch?v=zKb_AkU-qAk&list=PLhQpDGfX5e7CuUkPlpiW7agdJvdbdTPma&index=6)
- Hydrogen Polar Bonds Ted-ED(2013) accessed 05/07/20. (https://www.youtube.com/watch?v=ASLUY2U1M-8)
- Hydrogen bonds Amoeba Sisters(2016) accessed 05/07/20 (https://www.youtube.com/watch?v=3jwAGWky98c)

How does temperature affect the rate of diffusion?

Author :Kristian

Summer 2020

Introduction

Context

I'm working with products I have found in my house and doing an experiment which will determine whether the temperature plays a role in the rate of diffusion.Im also doing this because even in a time of such restrictions you are able to continue your learning.

Literature review

The kinetic particle theory explains the properties of solids, liquids and gases. There are also energy changes which occur when a change in state is shown. In addition the random movement of fluid particles is the appearance of Brownian motion.
Also solids,liquids and gases have different amounts of energy.This is due to their arrangement and movement.
For example the a solid is compact and regularly arranged whereas the gases is spread out with a random arrangement.

Planning

Variables

Independent Variable: The temperature of the water.
Dependent Variable: The time taken for the cross to be hidden
Control Variables: If the variables were not to be controlled it would cause an unfair test and could cause one cross to be hidden earlier than

another.An example is when the tea bags are dropped in.This is important because if not put in at the same time one might dissolve quicker than the other causing an unfair test.

Prediction

I predict that the cross of the tap water will hide the cross last.I think this is because of the particles as particles move faster in a substance with a greater temperature.

Equipment List

Tea bags , glasses , kettle , paper , pen.

Method

1. Get equal sized glasses. A.measure the volume the glasses to ensure that they are identical.
2. Place the glasses above the crosses marked on a piece of paper. A.Spread the glasses out equally so that it's clear and no mistakes are made.
3. Fill the glasses with equal amounts of water. A.Use a measuring jug for accurate amount of water.
4. Attempt to place the tea bags in the water at the same time. A. Use the help of an adult to secure the tea bags being dropped at the same time.
5. Await for the results. A.Have a timer beside you and keep an eye on each glass.

Results

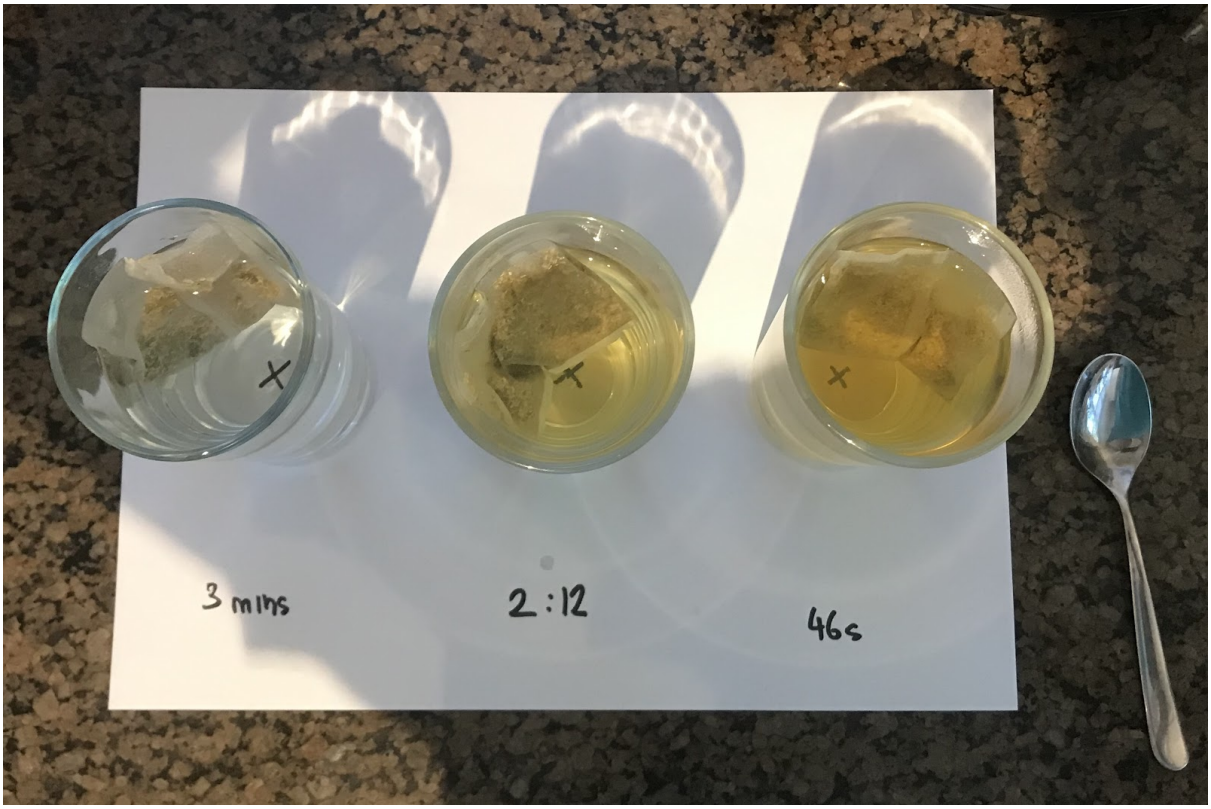
Table 1: Time taken for the cross to be hidden

WATER USED	TEMPERATURE OF WATER(degree Celsius)	ATTEMPT 1	ATTEMPT 2	ATTEMPT 3
TAP WATER	20	204 seconds	210 seconds	212 seconds
MIX OF TAP AND KETTLE WATER	60	132 seconds	151 seconds	152 seconds
KETTLE WATER	100	46 sec	49 sec	45 sec

Pictures -

BEFORE:

AFTER:



Discussion

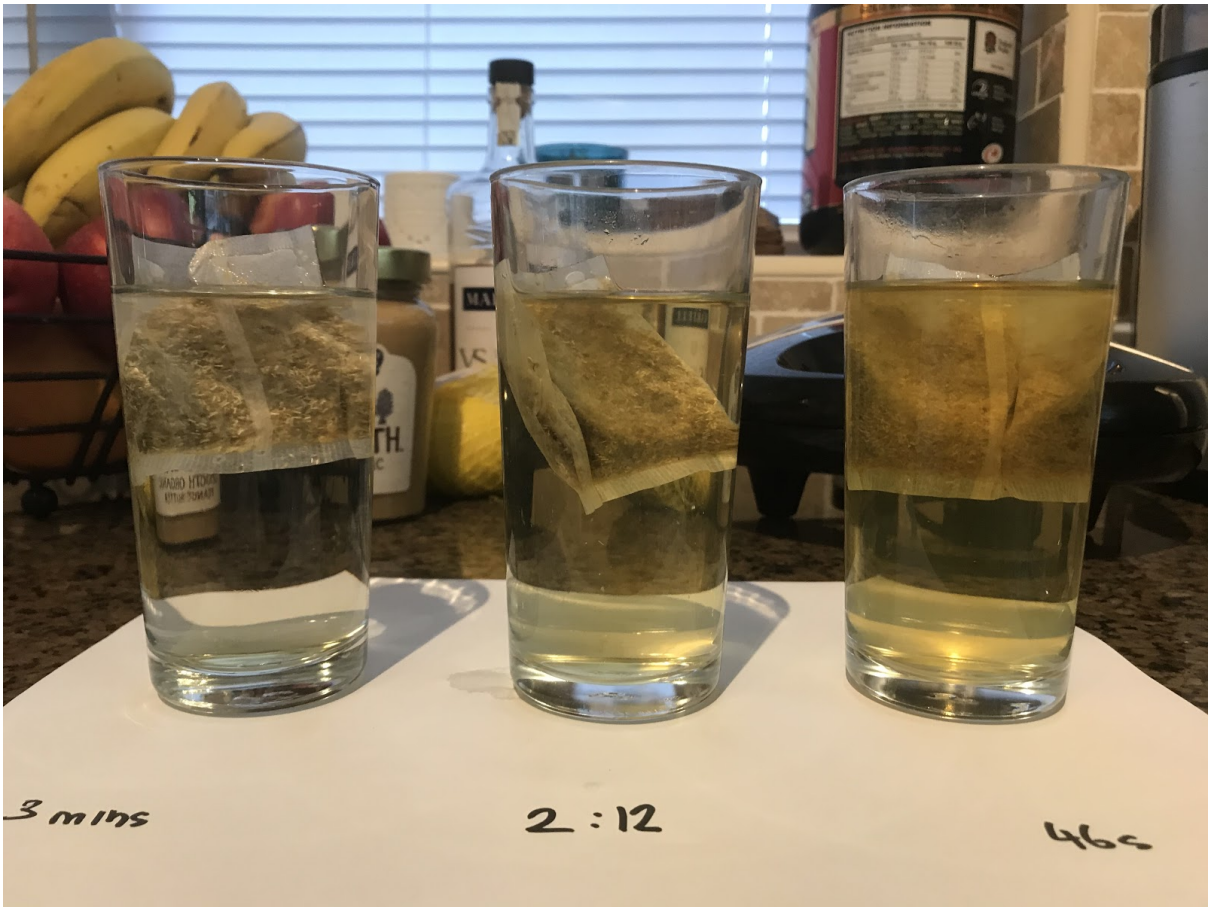
Evaluation of method
In my opinion I have met and achieved my goal of investigating whether the temperature of water can affect the rate of diffusion.

Conclusion
In conclusion I have summed up that my prediction was correct.Meaning the higher the temperature, the higher the rate of diffusion.

Literature cited

https://www.bbc.co.uk/bitesize/guides/zgr2pv4/revision/1

Appendix



There was an immediate reaction on the kettle boiled water .

What frequency of sound can glasses filled by different amounts make?

Author: Aliyah

Summer 2020

Introduction

This experiment is going to occur in the grounds of my house due to lockdown so it may not be the best by reason of limitations such as : not having the right equipment and not being assisted.
The reason I want to do this experiment is because I find it interesting to know the reason behind what happens and why it happens also to discover what frequency of sound can bottles filled by different amounts of water.
Relating to the subject I know that sound is a form of wave energy that moves outwards from vibrating bottles, pitch is how low or high the sound is and pitch is determined by the frequency of the sound.
I think that the more liquid in the bottle the lower the pitch is because when you blow across the top of the bottle you set the air molecules vibrating and produce sound waves.
The pitch of the sound is determined by how fast the bottle and its contents vibrates.

Planning

Variables

Independent Variable: The depths of water in different glasses or bottles.

Dependent Variable: Tapping each of the glasses of bottles to see the

reaction of it.

Control Variables: To make sure that I hit the glass with the same impact and the same object. The type of glass I'm using is a glass cup about 12 centimeters tall.

Hypothesis

I think that the more liquid in the bottle the lower the pitch is because when you tap across the top of the bottle you set the air molecules vibrating and produce sound waves.
This experiment will determine tapping the bottle causes the bottle and its contents to vibrate at a frequency that is audible to the human ear. The pitch of the sound is determined by how fast the bottle and its contents vibrate.

Equipment List

5 glasses
Different water levels using an app called phyphox.
App on a device (phyphox) to measure the frequency of the water.

Method

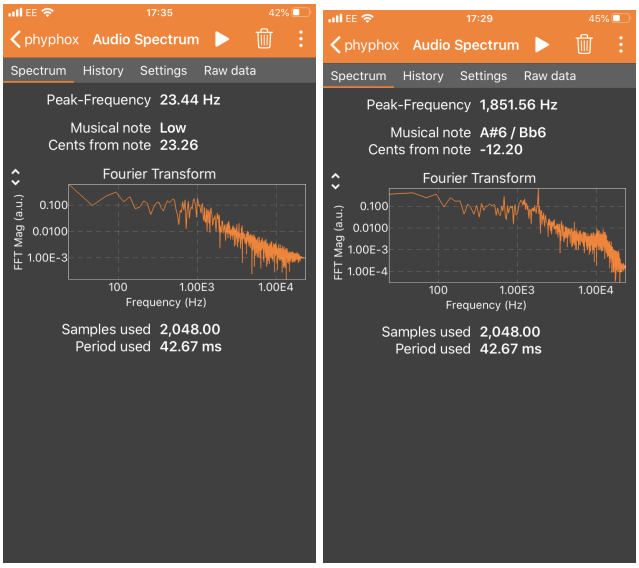
1. Pour same temp water into identical glasses (5) get something to tap it with (fork).
2. Use the app to see what the pitch and frequency of the different water levels are.

Results

Tables with data

Independent Variable (units)	Dependent Variable (units)			
	Attempt 1 hz	Attempt 2 hz	Attempt 3 hz	Mean hz
11.5cm	1307.8	1851.56	1851.56	1670.306’
8.9cm	23.44	23.44	23.44	23.44
7cm	679.65	1851.56	679.65	419697.468
5.7cm	1851.56	1851.56	1851.56	1851.56
2.5cm	46.88	70.31	70.31	63.16’

Pictures:



Discussion

From this I have discovered that the more water I added to a glass the deeper the pitch was and the less water I added the higher the frequency of the pitch was based on what I’ve heard.

Glossary

Word	Definition

vibrating	move continuously and rapidly to and fro.
pitch	the quality of a sound governed by the rate of vibrations producing it; the degree of highness or lowness of a tone.
frequency	the rate at which something occurs over a particular period of time or in a given sample.
Molecules	a group of atoms bonded together, representing the smallest fundamental unit of a chemical compound that can take part in a chemical reaction.

How does angle of launch affect projectile range?

Author: Aaron

Summer 2020

Introduction

Literature review

Throwing a ball to a friend or shooting a cannon are both examples of projectile motion. Gravity is a force that acts upon objects, drawing them towards the center of the Earth at 9.81 m/s2. Horizontal motion happens when an object is acted upon by an outside force, and it will stay in motion until acted upon by another force, including hitting the ground. Newton's Third Law of Motion says that an object will stay in motion unless acted on by an outside force, so this means that there is no acceleration in the horizontal direction.

The angle at which something is thrown or shot also affects how far it will travel, because what goes up must come down.

Context

Usually, I would have done this experiment outside with a proper target, but as it is in quarantine, I just used a whiteboard and a pen. As many people rely on projectiles, the angle is important as it controls the latitude and longitude of the projectile itself. It could go very far or very high. This is an investigation into how the angle affects the ark of the projectile to go.

Planning

Variables

Independent Variable: the angle I shoot the crossbow at.

Dependent Variable: the same crossbow, the same distance

Control Variables: I feel like if done unfairly, it messes up the whole experiment, like aiming at the wrong place will give false and yield amazingly different results.

Hypothesis

I think that the higher you aim, the higher the dart will go but there is a point and then it will have a steady decrease.

Equipment List

Write what you will use - my crossbow, a whiteboard marker and a whiteboard

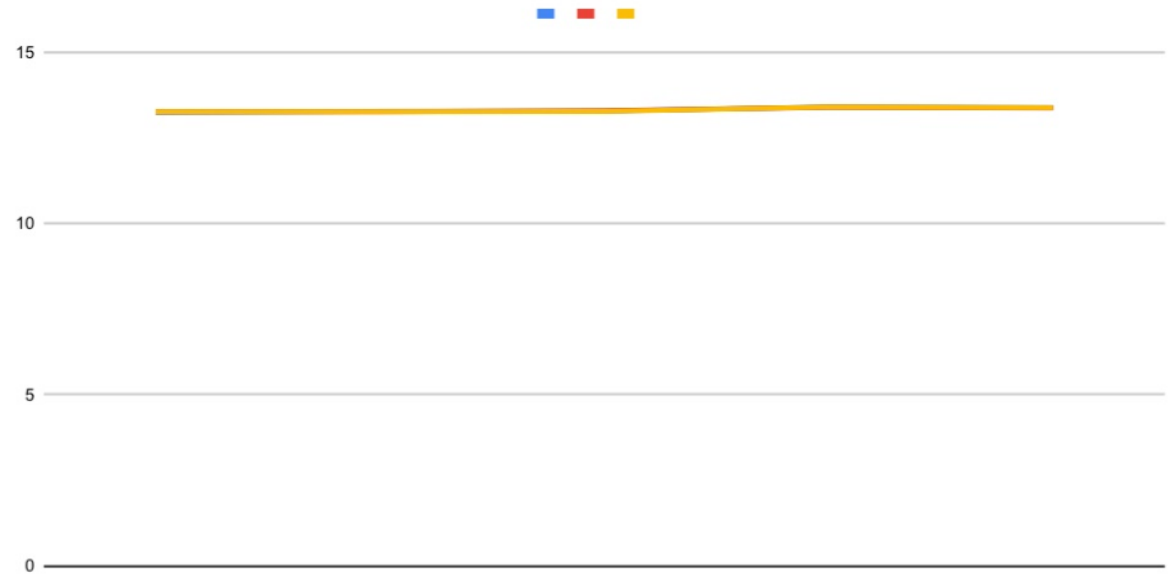
Method

1) Put a protractor horizontally next to you so 0 degrees is equal to the horizon and 90 degrees is straight up.
2) Draw 5 dots in a vertical row on the whiteboard with the marker.
3) Put the whiteboard in one place.
4) Move back and remember where you stand.
5) Then aim at the bottom spot and fire, where it lands, draw an x.
6) Go back to where you stood before and aim at the spot above the one you last shot at
7) Record where it lands and measure the distance between the dot and the x.
8) Repeat for all other dots and see the pattern.

Results

Tables with data

Launch angle from ground (degrees)	Distance travelled (cm)			
	Attempt 1	Attempt 2	Attempt 3	Mean (rounded to the nearest hundredth of a ft)
0	13.26	13.28	13.28	13.27
10	13.29	13.28	13.28	13.28
20	13.3	13.31	13.29	13.3
30	13.42	13.41	13.42	13.41
40	13.4	13.39	13.44	13.4



But as you can tell from my graph, the angle doesn't make a huge difference but it makes a difference nevertheless.

A picture of my results

Discussion

Conclusion

So in conclusion, the angle at which you launch something affects the ark of the projectile and therefore the height. The optimum angle to fire my projectile is 120 degrees. But I found out that, if you aim too high, your projectile will fall short.

Evaluation.

I feel like my research was perhaps limited by my choice of projectile. As I chose crossbow, if I went any lower than 90 degrees, the projectile would simply fall out. If someone tried to do this experiment, they would struggle to get all the steps correct. Because you have to do all the steps in roughly the right way. And they are very complicated. Fortunately, I did not experience any anomalies. But as we are in lockdown, I am working from my home and as such, I had to deal with my ceiling. And because of this, I could not aim above 40 degrees without hitting it. This would be solved if I could do this outside but due to quarantine, I cannot.

Literature cited

https://www.education.com/science-fair/article/aim-shooting-projectile-target/

How does the volume of a jar affect the burn time?

Author: Umar

Summer 2020

Introduction

In this report you will read about an experiment done in my house. It was not as easy as doing an experiment in a lab however
I was able to do an experiment with household items.
We are doing this experiment to learn about combustion and to see how to do it at home with things you have.

A combustion reaction is a reaction that occurs when a substance reacts with oxygen, releasing energy in the form of heat and light.(study.com) Joseph Priestley carried out an experiment that showed that plants produce oxygen. He put a mint plant in a closed container with a burning candle. The candle flame used up the oxygen and went out. After 27 days, Priestley was able to re-light the candle. ... This gas is oxygen.(bbc bitesize)

Planning

Variables

Independent Variable: volume of jar containing air.
Dependent Variable: Time taken for the candle to go out.
Control Variables: The starting temperature inside the jar

Hypothesis

Candles use oxygen in the air for combustion.

Prediction

My prediction is that the candle in the small jar will go out first and then the candle in the large jar will go out last. I think the candle in the larger jar will stay lit for longer because there would be more oxygen in the jar.

Equipment List

Two small round candles (same size) , one large jar , one small jar , timer , matchbox for fire source.

Method

1 . Drop in the candles carefully whilst lit.
2 . You and your partner close the jars at the same time.
3. Quickly be ready to press the timer.start the stopwatch exactly when the jar is placed over the candle.
4. Note down time when the first candle goes out.
5 stop timer when 2nd candle goes out.
6. Do this using a 100, 200, 300, 400 and 500 ml jar and repeat 3 times

Results

Table 1: Time taken for candles to go out in different size jars

Jar	Time (seconds)		
small jar	11	13	13
large jar	26	25	26

Pictures. -

Discussion

The method is short, simple and easy to understand . I think anybody should be able to do this experiment at home.

Conclusion

To conclude my experiment I would say I found that the larger the jar the more volume there is which means there's more oxygen. Which meant the smaller the jar the less oxygen there is. Which led to the candle in the smaller jar going out first. As the jar size increases the time the candle stays lit decreases.

Evaluation

To summarise I think the method I used was very good and worked well. I think the accuracy of my experiment was good.

Glossary

Word	Definition
combustion	the process of burning something.

Literature cited

Bbc bitesize
Study.com

Appendix

Additional photos or data

How to prove that the Gravitational Field Strength of Earth is 9.8m/s?

Author: Acacia

Summer 2020

Introduction

Context

In this report, I will be testing how to prove that the gravitational field strength is 9.8m/s using household items considering we are in lockdown. The experiment that I am carrying out would be simple with household items and would seem rushed. Also, the equipment used in the method would not be scientific equipment used from labs and is a simple and safe experiment that anyone can do at home. I wanted to do this experiment as it seems like a very complicated topic but it can be proven only using items from home. This shows that not all scientists would need expensive equipment.

Literature review

Gravitational field strength is a model to measure the gravitational force placed on an object that is in a gravitational field. Any object that contains mass causes a gravitational field strength. The effect is only significant to large objects like planets and much more weak on smaller objects. One example of a gravitational field is the moon and earth. The gravitational field strength of earth is 9.81(n/kg) which is the same as the acceleration due to gravity. Galileo Galilei, “this father of modern physics” was the first to develop the discovery acceleration due to gravity. He used objects to show that the objects continued to pick up a speed. His hypothesis to this experiment was “A falling body accelerates uniformly: it picks up equal amounts of speed in equal time intervals, so that, if it falls from rest, it is moving twice as fast after two seconds as it was moving after one second, and moving three times as fast after three seconds as it was after one second.” This was Galileo’s Law of

Falling Bodies. His conclusion was that all objects were accelerating at a constant rate. Which he then followed on and the change in height of a falling object is given by a quadratic expression-**at^2+bt+c**.
Acceleration due to gravity also known as the “Big G” is the acceleration that’s gained by an object because of gravitational force.A simple way to calculate the acceleration due to gravity would be to free fall. This free fall method is simple which would only need a tennis ball,ruler and a stopwatch. This method will prove that anyone can do this experiment at home and will also prove a different way of viewing science.

Planning

Variables

Independent Variable: The height above the ground from which the item will be released
Dependent Variable: the duration it took to reach the ground.
Control Variables: the object used won’t be changed.

Hypothesis

My hypothesis is that the value of g would be very close to 9.8m/s. I don’t believe it would be exactly 9.8m/s.

Equipment List:
-tennis ball
-measuring tape/ruler
-stopwatch

Method

1. First, we would need to set up the experiment place so the measuring tape/ ruler is staying up.

2. Start the stopwatch exactly when you have dropped the ball and

stop it when it has reached the floor

3. Continue doing this 3 times and then change your height by 10cm each time.

4. Eliminate all the anomalies and calculate the average for each height.

5. Record the results onto a table.

6. We would use the following **SUVAT** equations (s=ut+½ at^2) to prove that g is 9.81m/s^2.**S**= Displacement. **U**=Initial Velocity. **V**= Final Velocity. **A**= Acceleration. **T**=Time.

7. Plot a graph and draw a straight line.

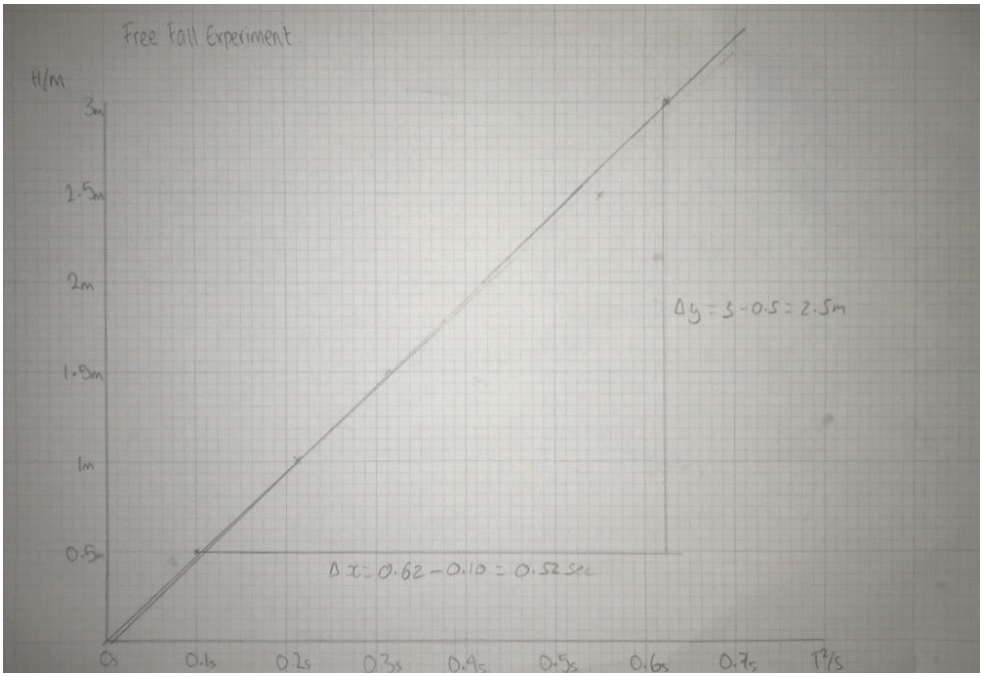
8. Calculate the gradient of the straight line.

Results

Tables with data

		Time			
Height (H/m)	**T1 - (s)**	**T2 - (s)**	**T3 - (s)**	**Average (s)**	**T^2 (s)**
0.5	**0.31**	**0.32**	**0.3**	**0.31**	**0.10**
1.0	**0.45**	**0.48**	**0.46**	**0.46**	**0.21**
1.5	**0.55**	**0.56**	**0.56**	**0.56**	**0.31**
2.0	**0.64**	**0.63**	**0.67**	**0.64**	**0.42**
2.5	**0.71**	**0.75**	**0.74**	**0.73**	**0.54**
3.0	**0.78**	**0.80**	**0.78**	**0.78**	**0.62**

The graph



Discussion

Evaluation of method

The uncertainties on the experiment would be I needed two people to do this experiment (1 for the stopwatch and 1 to drop the ball) but only 1 person did the experiment so I suppose that my answer is not close to 9.8m/s. In this experiment, I repeated the free fall 3 times to make it a fair test and the values were all similar and didn't have any anomalies.

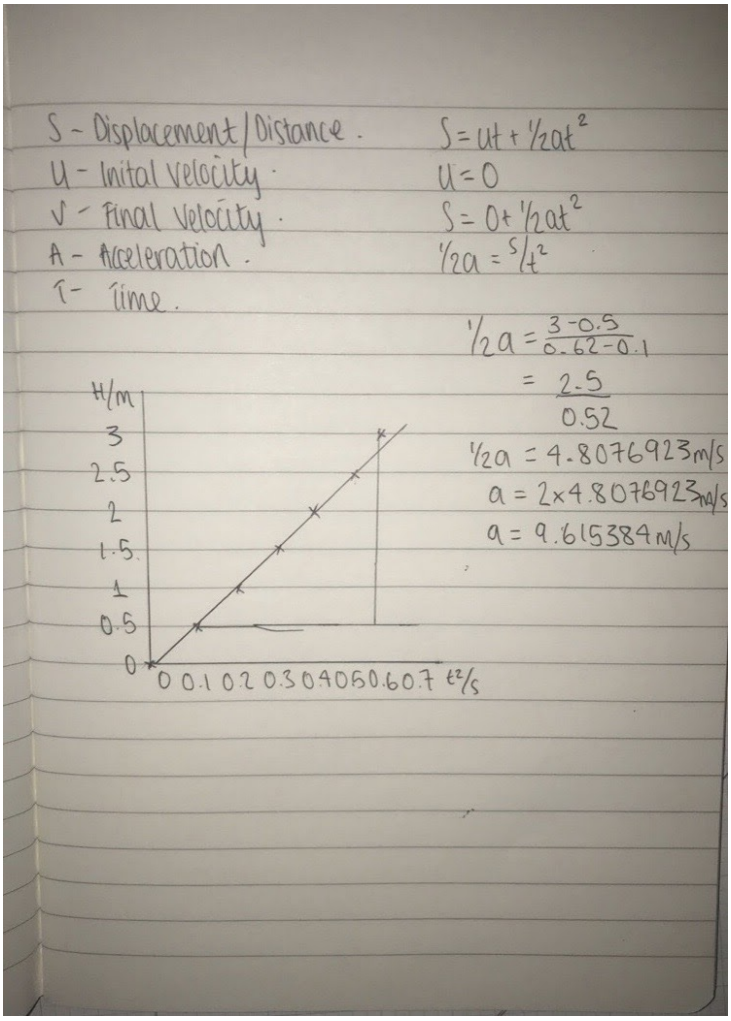
Conclusion

From this experiment, I have discovered that the free fall method proves that the gravitational field strength would be close to 9.8m/s. The data supports my hypothesis. The trend in this data would be the positive correlation as it matches into a straight line.
As the independent variable (the height) increases, the dependent variable (the time taken to reach the ground) also increases.

Glossary

Word	Definition
Gravitational Field	The force of attraction between two objects
Anomalies	The number that doesn't fit in and seems odd.

Appendix



How does speed affect the range of a projectile?

Author: Matei

Summer 2020

Introduction

Context
Due to the lockdown, I have been shown some difficulties whilst doing everyday activities. I had to use a limited range of equipment, which might have not shown the most accurate answer. I also had to factor outside factors or sources that could affect my data compared to a controlled environment of that in a laboratory. I wanted to perform this experiment as I am always eager to find out about new things and wanted to find out about how angles affect distance and what would be the best angle to kick a ball at.

Literature review
"Through science, we know that the faster a projectile is, the less time it takes to reach its target. Both the velocity (speed) and the angle of trajectory are important in this experiment.
A free-falling object has an acceleration of 9.8 m/s/s, downward (on Earth). This numerical value for the acceleration of a free-falling object is such an important value that it is given a special name. It is known as the acceleration of gravity - the acceleration for any object moving under the sole influence of gravity" (The Physics Classroom- Projectile Motion)
Projectile motion is a form of motion experienced by an object or particle (a projectile) that is projected near the Earth's surface and moves along a curved path under the action of gravity only (in particular, the effects of air resistance are assumed to be negligible). This curved path was shown by Galileo to be a parabola. Because of the object's inertia, no external horizontal force is needed to maintain the horizontal velocity component of the object. Taking other forces into account, such as friction from aerodynamic drag or internal propulsion such as in a rocket, requires additional analysis. (Wikipedia- Aerodynamic Drag, Projectile Motion, Inertia)" From this, we learn that in order for a projectile to be able to be launched and move, it needs projectile motion, so when the projectile is launched from different

angles, it will give different values shown through the distance travelled. We also have to consider the fact that the projectile can either be launched by a spring or released by ramp. As the projectile is launched, its momentum and propulsion will be overcome by the gravitational pull of the Earth's core, leaving a parabola. As stated above, rockets also depend on this principle as they turn chemical energy to kinetic energy to leave the Earth's atmosphere.

Planning

Variables

Independent Variable: The angle of trajectory.
Dependent Variable: The initial velocity, the range of the projectile (distance travelled from the starting point to the end point)
Control Variables: the same projectile, same surface If we would have a different projectile or a different terrain that would give eronated data and would eventually lead to a wrong conclusion.

Hypothesis

My hypothesis is that if the object is released at around a right angle, then the gravity will pull the ball down and increase its speed, meaning it will have a higher speed and travel more distance compared to the projectile being released at the straight angle 0. That same speed will make the ball roll faster on the ramp and leave it at a faster speed compared to one that would remain stationary at the angle 0. Therefore, I predict that the higher the angle, the more distance is travelled.

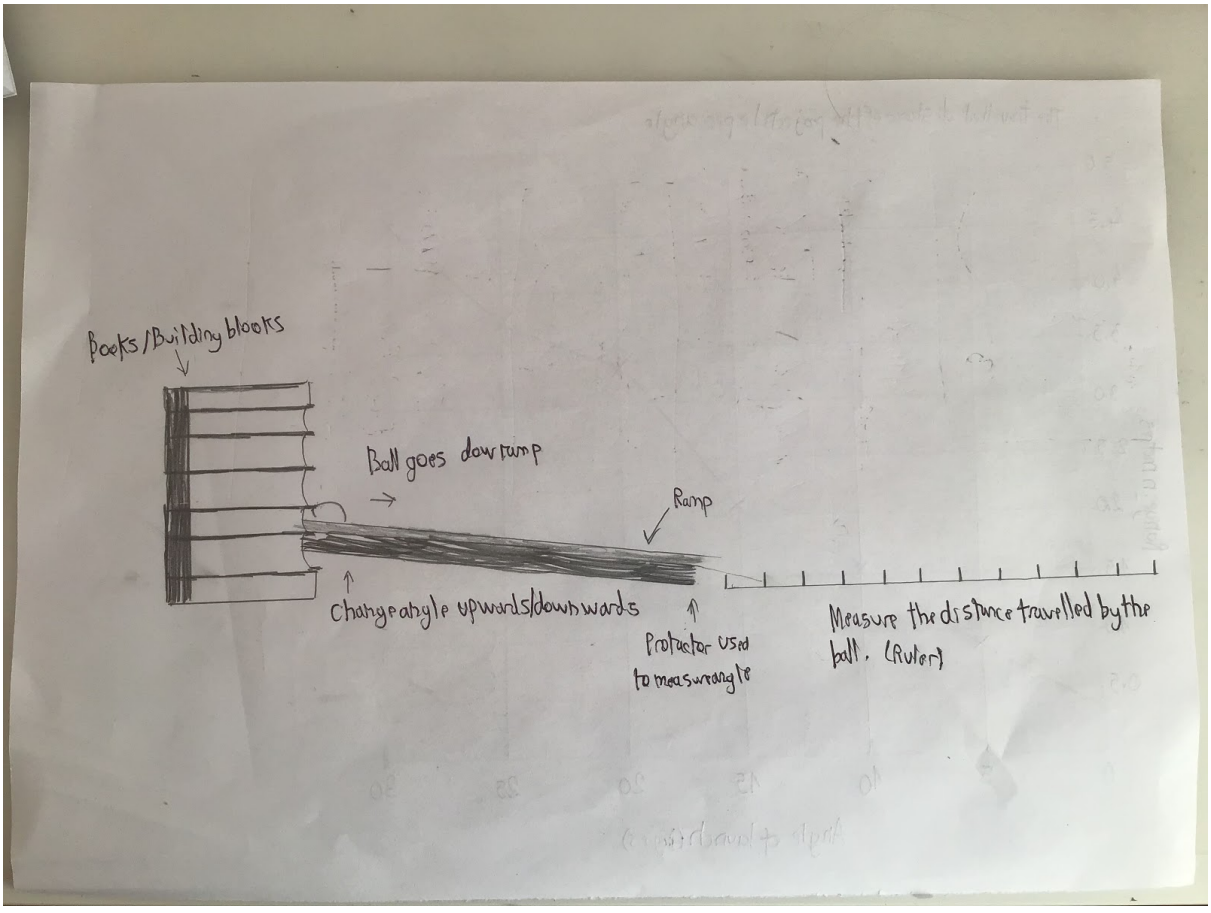
Equipment List

30cm ruler
A smooth ball
Objects to gain height (books)
Ramp (solid unbendable cover)

Method

1. Stack the books or your own building blocks to around 50cm (You can decide your own height as long as your ramp can reach the top)
2. Place the ramp so that it leans on the books (At different parts for each angle)
3. Make sure to leave space to be able to let the ramp sit at the angles 10, 15, 20, 25 and 30.
4. Put the ball at the top of the ramp and let go of it.
5. Measure the distance and the time the ball took and plot it down.(From the point from where the ball leaves the ramp and the point at hitch it rests and measure to 2 decimal places)
6. Repeat the experiment three times and plot down the data on a graph.

Diagram



Results

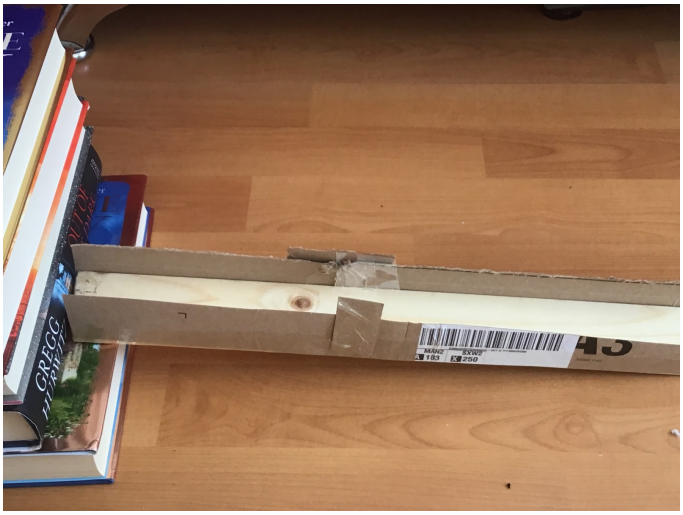
Tables with data

Angle (Degrees)	First Try (Metres)	Second Try (Metres)	Third Try (Metres)	Average (Metres)
10	1.48	1.43	1.62	1.51
15	1.98	2.13	2.4	2.17
20	3.54	3.28	3.23	3.35
25	3.69	3.75	0.97	3.72
30	4.83	4.85	4.15	4.61

I have identified an anomaly during the third attempt on the 25 degree angle, so I left it alone and found the average metres travelled from the first two tries. I believe that this experiment could've been more accurate as we have to factor the possibility of the surface being uneven and the change in wind. I believe we could've had a less dented ramp and not so bouncy ball. If the conditions weren't correct, then we would get eronated data that would eventually lead to the wrong conclusion and would give off false data that could be used in the future by another scientist for different purposes.

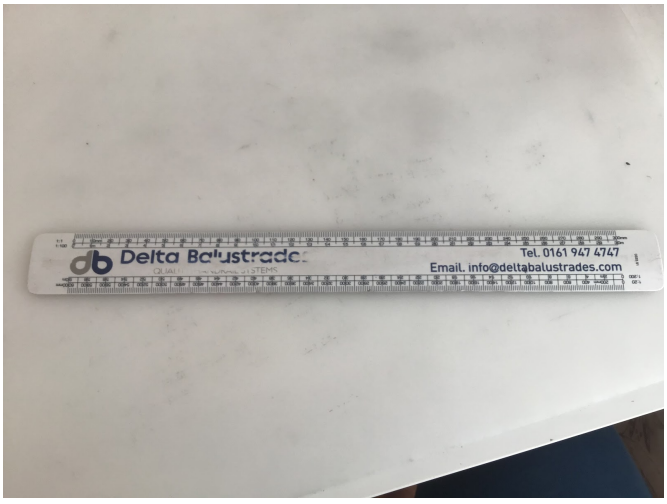
Pictures

(The launch height)

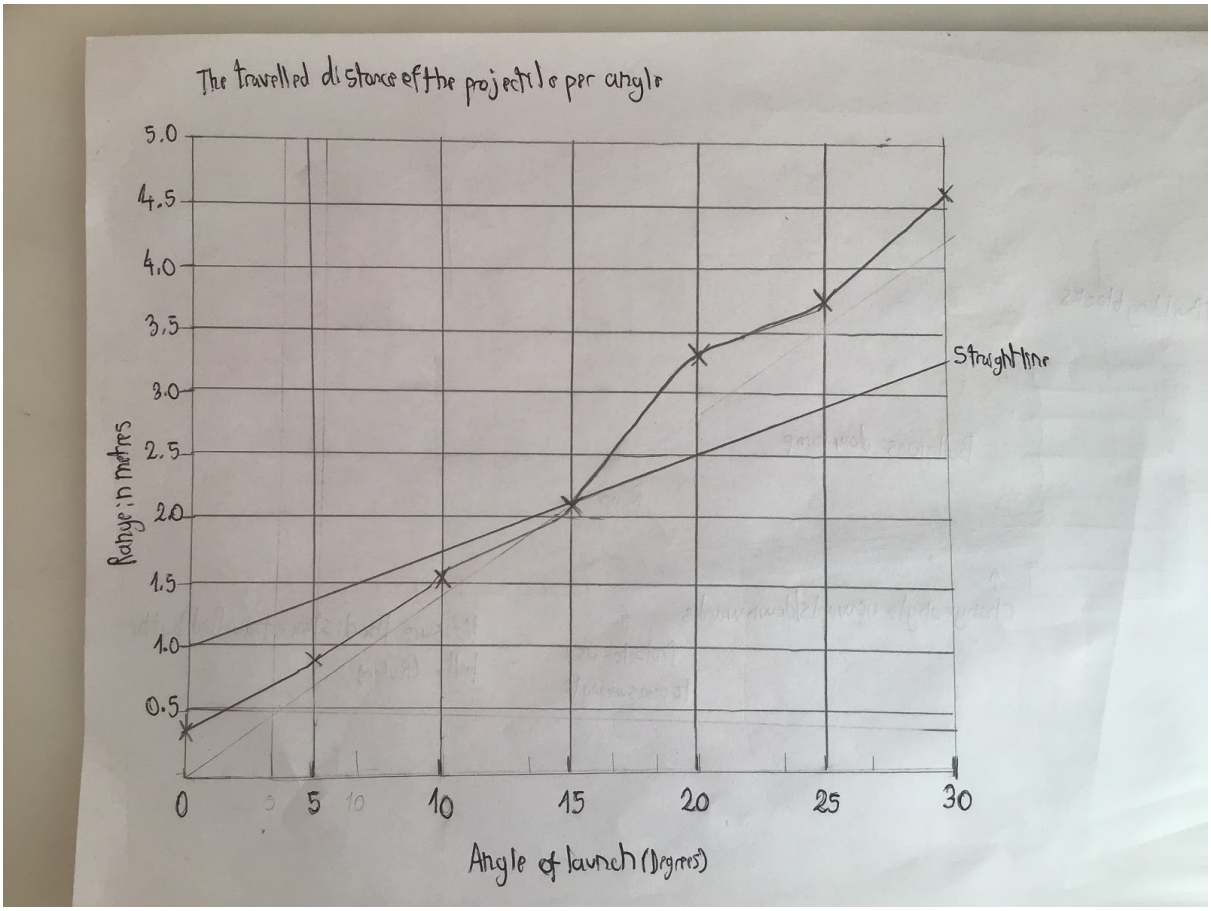


(Ramp- 41 cm long)

(Ball)



(Ruler)



Graph; I have compared this graph from one from a different scientist to check if my data was accurate per my experiments and findings. (MrPhysics)

Discussion

I believe that the method could've been easier if we had scientific environments and equipment. We had to factor wind and the launch surfaces so that they would be solid.

From the experiment we deduced that the higher the angle of the ramp(plank) the higher the speed of the projectile (As the Angle or Launch increases, the Range increases as well) and therefore, travelling a larger distance due to the received kinetic energy, meaning that the prediction I made was correct, therefore I have obtained the data that I wanted to receive from this experiment.

Glossary

Word	Definition
parabola	A symmetrical open plane curve formed by the intersection of a cone with a plane parallel to its side. (The path of a projectile under the influence of gravity follows a curve of this shape)
inertia	It is the force that keeps stationary objects at rest and moving objects in motion at constant velocity.
aerodynamic drag	The force of an object that resists its motion through a liquid is known as drag. When the fluid is a gas (like air), it is known as air resistance or “Aerodynamic Drag”.

Literature cited

https://www.physicsclassroom.com/class/1DKin/Lesson-5/Acceleration-of-Gravity **(The Physics Classroom)**
https://en.m.wikipedia.org/wiki/Projectile_motion **(Wikipedia)**
https://mrsphysics.co.uk/n5/wp-content/uploads/2017/08/N5PhysicsAssignment2017Candidate1.pdf **(MrPhysics)**

How does length affect the period for a pendulum?

Author: Julian

Summer 2020

Introduction

In this project we explored experimenting during lockdown due to covid 19 and is it possible with limited resources and minimal equipment.i hope this essay proves that you are able to experiment under any circumstance with equipment from our day to day lives.Italian scientist Galileo Galilei was the first to study the properties of pendulums, beginning around 1602.Galileo discovered the crucial property that makes pendulums useful as timekeepers, called isochronism; the period of the pendulum is approximately independent of the amplitude or width of the swing.

1657, Christian Huygens, a physicist and mathematician from the Netherlands, succeeded in producing the first clock based on Galileo's findings. The pendulum clock then became the standard time-keeping instrument. Large clocks were developed, including the famous London clock tower Big Ben, which has continued to work as an efficient timepiece ever since it was built.

Before I start I would like to explain to you about how the pendulum works. Its weight is suspended from a pivot so that it can swing freely When a pendulum is displaced sideways from its resting, equilibrium position(a state of physical balance), it is subject to a restoring force due to gravity that will accelerate it back toward the equilibrium position,going back and forth .

To investigate the relationship between the period of a simple pendulum with its length.i will cut the string every time and see how long it takes for ten swings.

Planning

Independent Variable: I will change the length of the string by 10 cm Every time .

Dependent Variable:I will measure the string using a ruler to ensure my outcome is as accurate as possible and also time every trial using a stopwatch

Control Variables: The thing that will stay consistent throughout my experiment is the weight of the play doh / clay,the type of string .

Hypothesis
I think that the shorter the string the less time spent on 10 swings since a pendulum with a longer string has a lower frequency, meaning it swings back and forth less times in a given amount of time than a pendulum with a shorter string.
I predict that the longer the string will be the time of the 10 swings will increase due to the lower frequency

Equipment list:
plasticine/play doh
1Thread
Ruler
tape
Scissors
Watch/timer

Method

1. add a ball of plasticine at the bottom of your string and make sure it is stable
2. tape the end of the string to a table or a shelf
3. next complete the first experiment for the longest amount of string (let go from shelf height to keep it fair every time and count how long it would take for ten swings using a timer or a watch.
4. then use a calculator to measure 10 cm off the string and cut it off stick it back to the table using tape or a heavy object that would keep it down and do the same as with number 3 with all the other steps (let go of the same height and count swings)
5. then gather data you have got into a table

Results

Try 1: length of thread 20 cm
time taken for 10 swings = 10.5 sec

Try 2: length of thread 30 cm
Time taken for 10 swings =11.85 sec

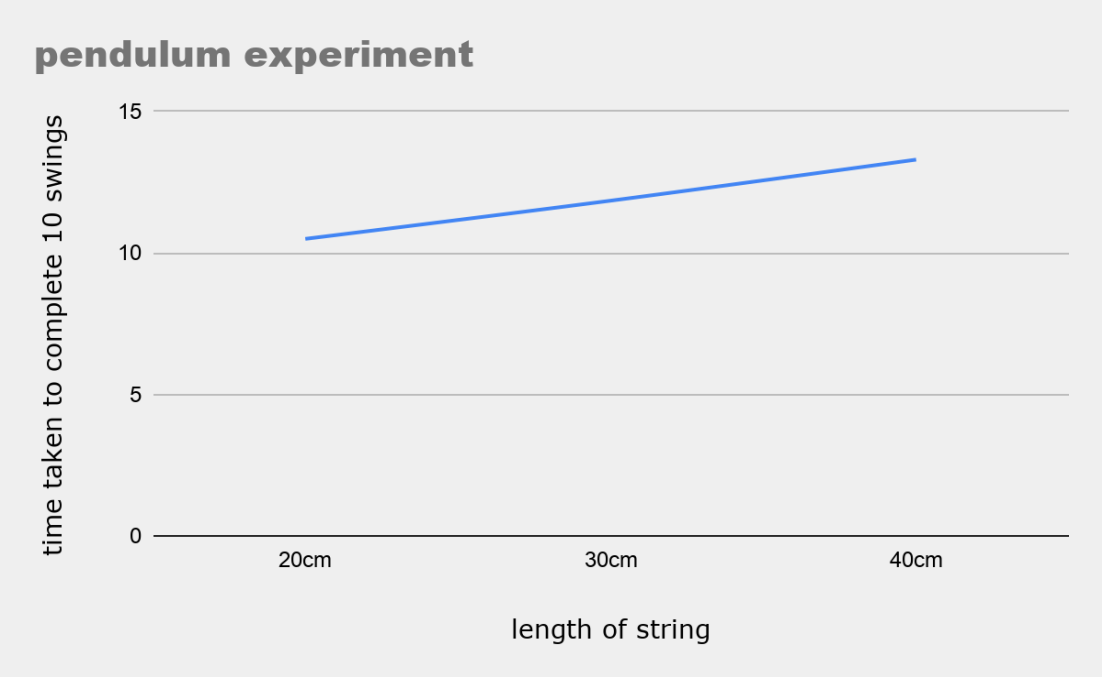
Try 3: length of thread is 40 cm
time taken for 10 swings =13.30 sec

Length of string	Time taken to complete 10 swings
20cm	10.5
30cm	11.85
40cm	13.30

Conclusion

My hypothesis was correct and The longer the length of the string , the longer the period of oscillation since It has a lower frequency which causes it to swing less than the shorter string with a higher frequency causing it to swing more times in the time given

Graph



As the independent variable increases so does the dependent variable which is shown by the increasing length of the string the time if the swings also increases.

Glossary

Word	Definition
equilibrium	a state of physical balance
Pivot	A central point or a pin
oscillation	movement back and forth at a regular speed

Literature cited

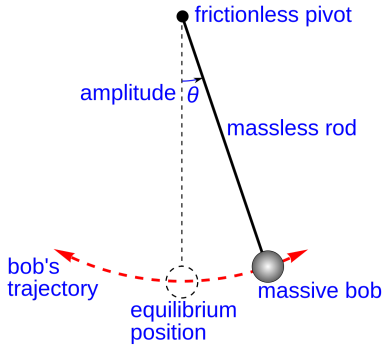
https://en.m.wikipedia.org/wiki/Pendulum

https://www.google.com/search?q=how+was+the+pendulum+discovered

https://www.google.com/url?q=https://en.m.wikipedia.org/wiki/Pendulum&usg=AFQjCNGIOY_xVErUkyJoRZoyIjxhIWybwQ

Appendix

Pictures:



How does the temperature of water affect the rate of diffusion?

Author: Jaunte

Summer 2020

Introduction

While I am doing this experiment I will be in my home as we are in lockdown. This experiment is to show that you can still practice science at home even with limitations.

This report is about me performing an experiment while being in lockdown. This experiment wasn't that difficult and you should be able to do it at home too.

Planning

Variables

Independent Variable: temperature of water
Dependent Variable: Time taken for tea to diffuse
Control Variables: Tea bags

Prediction

I think that the teabag in hot water will diffuse faster than the tea in cold water.

Equipment List

Two teabags(same size and shape), 2 cups(preferably see through) a

stopwatch or timer, a pen,paper and a kettle.

Method

1 . Boil the kettle and pour the hot water into one of your cups.
2 . put some regular room temperature water into the other cup.
3. get ready to press the timer.
4. You and a friend are going to then drop the two teabags into the cups of water one in the hot one and the other in the cold one.
5.record the time taken for the both of them to diffuse.
6.write down the results which one was quicker.

Results

Table 1: Time taken for tea to diffuse

	Time (seconds)
Hot water	94
Cold water	273

Discussion

The experiment is fun, interactive and let’s you be in charge. It's an easy way to do science at home.

Conclusion

The tea diffusion rate was faster in the hot water than the cold water. This is because the temperature of the water affects the rate of diffusion.

Glossary

Word	Definition
Prediction	A statement, forecasting what would happen under specific conditions.
diffusion	The movement of a substance from an area of high concentration to an area of low concentration.
Independent variable	a variable whose variation does not depend on that of another.
Dependent variable	a variable whose value depends on that of another.
Control variable	a constant and unchanging standard of comparison in scientific experimentation.

Literature cited

Bbc bitesize

Appendix

Additional photos or data

Which is the best method for finding the gravitational field strength of Earth?
Author: Blagovest
Summer 2020

Planning

Variables

Independent Variable:height dropped from
Dependent Variable:time take fall
Control Variables:Do experiment in a room with no wind

Hypothesis

We know that if the ball is closer to the ground it will travel faster.

I think that the lower the height the faster the time.

Equipment List


Stopwatch,tennis ball,ruler{30 cm}

Method

1.Put the ruler standing up.

2.Get a second person to start and stop the stopwatch.
3.Measuare the top of the tennis ball to be at 10cm.
4.Drop the ball.
5.Put the time in the table.
6.Do the same thing for 20,30,40 and 50cm(avoid standing on chairs,get another person to help you drop the tennis ball)

Results

At 3

	At 1 /sec	**At 2 /sec**	**At 3/ sec**
10cm	**0.19**	**0.16**	**0.15**
20cm	**0.25**	**0.18**	**0.18**
30cm	**0.28**	**0.26**	**0.26**
40 cm	**0.32**	**0.29**	**0.28**
50cm	**0.37**	**0.33**	**0.31**

Conclusion

The height changes the time needed for the ball to come down.

How does concentration of a solution affect the rate of osmosis?

Author: Kajus

Summer 2020

Planning

Variables

Independent Variable: the water between the 2 cups
Dependent Variable: water
Control Variables: say what the impact on your results would be if you didn't control them. If i did not control the amount of the cucumber the results won't be correct

Equipment List

Write what you will use - be detailed, add sizes or other relevant information. (e.g. 30cm ruler)

Cucumber
Peeler
Knife
Cup
Water
Cup (Water)
Spoon
Salt
Distilled water (boiled water - cooled)
Scale
Timer

towel/napkin

Method

1. Get a cucumber and peel the cucumber
2. then cut the cucumber in two small equal slices so they weigh about the about the same so the experiment is more accurate
3. then get 2 cups fill one cup with distilled water and fill another cup with water with 2 spoons of salt
4. Then put the cucumber piece in one cup and the other cup at the same time (remember the weight it had)
5. after a hour or 2 take out the cucumber, dry it and weigh the cucumber and write the results
6. You should repeat the 5'th step about 3 times and note the weight in a table/graph

Hypothesis

My prediction is that the cucumber will go in both of the cups and the salt cup will decrease the cucumbers weight
My hypothesis is when the cucumber is added to the solution the weight will change as the time changes

My prediction is that the cucumber will change weight as the time changes

How does age affect the range of frequencies you can hear?

Author: Aaliya

Summer 2020

Introduction

Context

In lockdown
Since we're in lockdown there's not really any stuff to do for experiments however you can still manage to do them with things at home. When you do experiments they don't need to require expensive technology you can even use the bare minimum like me. In this experiment I will be playing a video to older people and also younger people to see if age affects the range of frequencies you hear.
I wanted to learn more about sound waves and the reason as to why older people's hearing changes throughout the years.

Literature review

Hearing loss happens when you get older. It's when the hair cells in your inner ear begin to die and when the more they die the more worse your hearing loss gets.

Planning

In this report I will be recording the tests I've done for my experiment. The experiment is going to be about if older people can hear less than younger people. The range of Frequencies of sound people can hear is

about 20Hz to 20 000 HZ.
The range is smaller in old people especially with higher frequencies.I will be testing as many people as I can with a video that tests increasing the frequency until they can no longer hear it and record their age and the range.