SASTA OLIPHANT SCIENCE AWARDS

Prize Winner

Scientific Inquiry

Year 7-8

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THE EFFECT OF SURFACE TENSION OF DIFFERENT TYPES OF LIQUIDS IN THE LIFE OF AQUATIC INSECTS

HOW DOES THE POLLUTED WATER IMPACT THE SURFACE TENSION AND THUS NEGATIVELY AFFECT THE LIFE OF AQUATIC INSECTS?

SCIENTIFIC REPORT

Introduction

Water is essential for life to exist on Earth. Several creatures depend on it for survival, making it their habitat. Walking on the water is like a miracle to us humans, but for some insects, it is part of their existence. The life of the water strider is an example of how the surface tension of water affects the life of water insects and their life cycle. Lowering the water quality can affect the ability of aquatic insects to move on the water's surface. In addition, its quality is crucial for water insects' well-being and the aquatic ecosystem's health.

Title

The effect of surface tension of different types of liquids in the life of aquatic insects.

Research Question

How does the polluted water impact the surface tension and thus negatively affect the life of aquatic insects?

Observation

There are several water insects adapted to live in aquatic environments. Water strider can walk on top of water due to the factor of high surface tension and their hydrophobic legs to help them stay above water (Water Science School 2019). They have very fine hairs on the undersides of their legs that trap air and repel water. The scientific term for this is called superhydrophobic (Pike 2017). Some water insects called backswimmers swim upside-down in freshwater, rowing their hairy hind legs under the water (Imbler 2021). They use oar-shaped back legs to row, and they breathe using an air bubble that clings to their abdomen like a personal scuba tank. Oxygen from the water diffuses into the bubble, keeping the insect's air supply fresh (Sharp 2022).

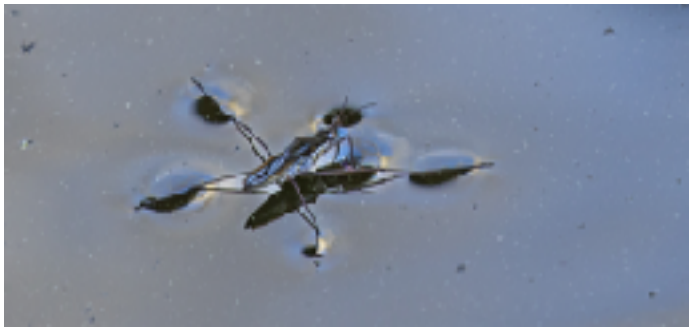


Figure1:Water strider walk above the surface (Dhliwayo 2022)

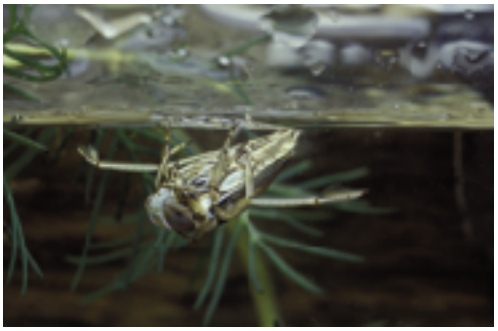


Figure 2: Backswimmer can move below the water surface (Museum Victoria collection 2024)

Surface tension helps water spiders walk on water. The force of surface tension balances the spider's weight, helping it to walk on water. Surface tension affects the top layer of water, causing it to behave like a stretched elastic sheet. It occurs because the attraction between water molecules is not balanced at the liquid surface (Hu and Bush 2003).

Figure 3: Water spider (Hu and Bush 2003)

Figure 4: Water spider robot (Hubner 2024)

I wonder how water insects and this insect-shaped robot can take advantage of surface tension. Also, I noticed that Water insects have been rated from 1 to 10 according to their sensitivity to pollution. They are grouped into 4 categories. They can be very sensitive, (eg. stonefly nymph, Alderfly larva) sensitive (eg. water mite, diving beetle), tolerant (eg. side swimmer, mosquito larva), and very tolerant (eg. back swimmer, water strider) (Streamwatch waterbed guide n.d). In Adelaide, water insects can live in ponds or streams which includes water spiders, water boatmen, water scorpions, etc. Quality of water is very important for them and other macroinvertebrates.

Background information:

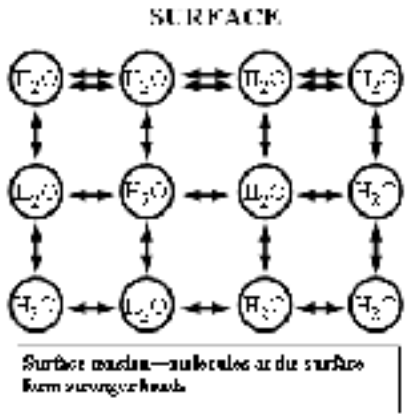
Macroinvertebrates are sensitive to different chemicals and physical conditions including pollution, dissolved oxygen level and temperature. Some can tolerate a wide range of conditions, including water spiders, backswimmers, water striders, etc. These insects take advantage of surface tension.

Surface tension

Surface tension could be defined as the property of the surface of a liquid that allows it to resist an external force, due to the cohesive nature of the water molecules (Water Science School 2019). The cohesive forces between liquid molecules are responsible for the phenomenon known as surface tension (Water Science School 2019).

Agnes Pockels was a pioneer in the field of surface tension and the measurement of surface films. She discovered the science of it in fluids by simply doing the dishes in her kitchen. Pockel's story is one of curiosity, determination and meticulous scientific inquiry (Sharp 2019).

Figure 5: Agnes Pockels (Millar 2012)



There are two types of molecules in a sample of water. Those on the outside are called exterior, and those on the inside are called interior. The interior molecules are attracted to all the molecules around them, whereas the exterior molecules are only attracted to those on the surface area and below the surface. As a result, the energy state of the molecules on the inside is much lower than that of the molecules on the outside (Bashyal 2022).

Figure 6: Water molecule interaction (Water Science School 2019)

The surface tension of a substance is indirectly proportion to temperature and is affected by the addition of impurities (Kaushik 2019). When the temperature increases, the surface tension decreases until it reaches zero (Bashyal 2022). A surfactant is a chemical that reduces its surface tension when added to a liquid (Gatenby 2022). Cleaning products break up the surface tension of water which is harmful to the water insects (Ampt 2000). Surface tension is caused by liquid particle intermolecular forces. The higher the intermolecular forces of attraction, the higher the liquid's surface tension (Bashyal 2022).

Paper clips made of steel, which is a higher density than water, can float on the water's surface (Water Science School 2019). Small objects like paper clips will float on the surface of the liquid because of surface tension. It will do this until it breaks through the top layer of the water molecules. Water surfaces have an invisible skin caused by surface tension (Ampt 2000, p.g 14; Water Science School 2019).

Figure 7: Paperclip on water (Water Science School 2019)

Aim

Water's surface tension will affect the life of aquatic insects that can walk on the water's surface. My experiments investigate the variation in water quality that affects aquatic insects that float on water according to the concept of surface tension. This investigation also reflects on the impact of water quality and the life of aquatic insects.

Hypothesis

Hypothesis 1	Hypothesis 1: If the number of paper clips a cup can hold is high, then the surface tension of the liquid will also be high.
Hypothesis 2	Hypothesis 2:If the number of drops of liquid on the coin is high, then the surface tension of the liquid will increase

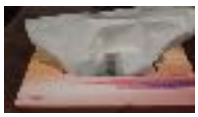
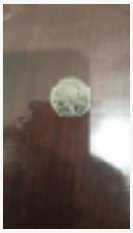
Variables

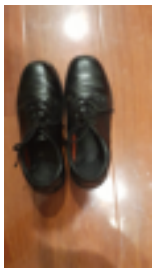
Experiment	Independant Variable	Dependant Variable	Controlled Variable
Experiment 1	The number of paperclips needed before the liquid spills.	Surface tension	Volume of the liquid, size of the paperclip, size of measuring cup
Experiment 2	Number of drops the coin can hold.	Surface tension	Coin, type of dropper

Materials and Equipment for all 3 experiments

	Materials						
1	Tap water 	2	Dirt water 	3	Hot water 	4	Sunflower oil 
5	Mustard oil 	6	Coconut oil 	7	Olive oil 	8	Dishwasher liquid 

	Materials						
9	Hand wash 	10	Fabric conditioner 	11	Laundry liquid 	12	Body wash 
13	Mango juice 	14	Apple juice 	15	Pomegranate juice 	16	Food colour 
17	Vinegar 	18	Soda water 				

	Equipment						
1	Paperclip 	2	Spoon 	3	Tissue 	4	40ml cup 
5	250cup 	6	Transparent cup 	7	Glass eye dropper 		20cent coin 

	Personal protective Equipment				
1	Gloves 	2	Enclosed shoe 	3	Mask 
4	Protective glass 	5	Apron 		

Risk assessment for both experiments

	Potential Hazards	Safety Measures
1	Liquids can spill and cause trip hazards.	Make sure to clean up after each experiment.
2	Hazardous liquids can get in the eye.	Wear glasses (PPE)
3	Liquids can get on cloths and stain it.	Wear the apron (PPE)
4	Liquids can get in hands of young children.	Keep young children away from the liquids.
5	There are sharp objects	Keep young children away from sharp objects and wear gloves.

Procedure

Experiment 1

1. Take the measuring cups of 40ml.
2. Take the testing liquids in each cup with the quantity mentioned in the table below.
3. Fill the liquid into the measuring cup of 40ml.
4. Drop paper clips gently one at a time to each of the measuring cups.
5. Count the paper clips as you go.

6. Continue dropping the paper clips until it overflows from the measuring cup.
7. Record the number of paper clips in your recording book.

The below table shows the amount of solution and concentration of the liquids

Number	Type of liquid	Amount of water	Concentration
1	Tap water	40ml	100%Tap water
2	Dirty water	40ml	100% Dirty water
3	Hot water	40ml	100 % Hot water 100°c
4	Sunflower Oil	30ml	10ml Oil add to tap water
5	Mustard Oil	30ml	10 ml add to Tap water
6	Coconut Oil	30ml	10 ml add to Tap water
7	Olive Oil	30ml	10 ml add to Tap water
8	Dishwash Liquid	30ml	10 ml add to Tap water
9	Hand wash	30ml	10 ml add to Tap water
10	Fabric conditioner	30ml	10 ml add to Tap water
11	Laundry liquid	30ml	10 ml add to Tap water
12	Body wash	30ml	10ml add to Tap water
13	Mango juice	30ml	10ml 99.7% reconstituted juice add to Tap water
14	Apple juice	30ml	10ml reconstituted 99% juice add to Tap water
15	Pomegranate	30ml	10 ml 100% juice add
16	Food colour	30ml	10 ml add to Tap water
17	Vinegar	30ml	10 ml add to Tap water
18	Soda water	40ml	100% soda water

Experiment 2:

1. Take the measuring cups of 40ml.
2. Take the testing liquids in each 40ml measuring cup with the quantity mentioned in the table of concentration*.
3. Get a 20-cent Australian coins and place them on a small piece of tissue.
4. Place the tissues and coins on a levelled and flat surface.
5. Get a glass eye-dropper and fill it with the liquid that was labelled from the 40ml measuring cup.
6. Using the glass eye dropper, carefully drop the liquid onto the 20-cent Australian coin. Do this for the rest of the liquids and make sure to count the drops taken.

7. Once the coin overflows with the liquid, record the number of drops taken.

* Table of the amount of liquid concentration same as experiment 1

Tables

Experiment1 (based on the number of paperclips held by each cup)

Number	*Name of liquid*	*Trail 1 (number of paperclips)*	*Trail 2 (number of paperclips)*	*Trail 3 (number of paperclips)*	*Average*
1	Tap water	61	62	63	62
2	Hot water	39	38	37	38
3	Dirty water	30	31	30	30
4	Sunflower oil	38	38	36	37
5	Mustard oil	30	30	32	31
6	Coconut oil	28	27	27	27
7	Olive oil	30	31	30	30
8	Dishwasher liquid	36	37	37	37
9	Hand wash	43	41	43	42
10	Fabric conditioner	28	29	27	28
11	Laundry liquid	27	26	27	27
12	Body wash	45	46	47	46
13	Mango juice	32	30	32	31
14	Apple juice	37	30	30	32
15	Pomegranate juice	42	41	41	41
16	Food colouring	29	31	30	30
17	Vinegar	30	31	30	30
18	Soda water	22	21	20	21

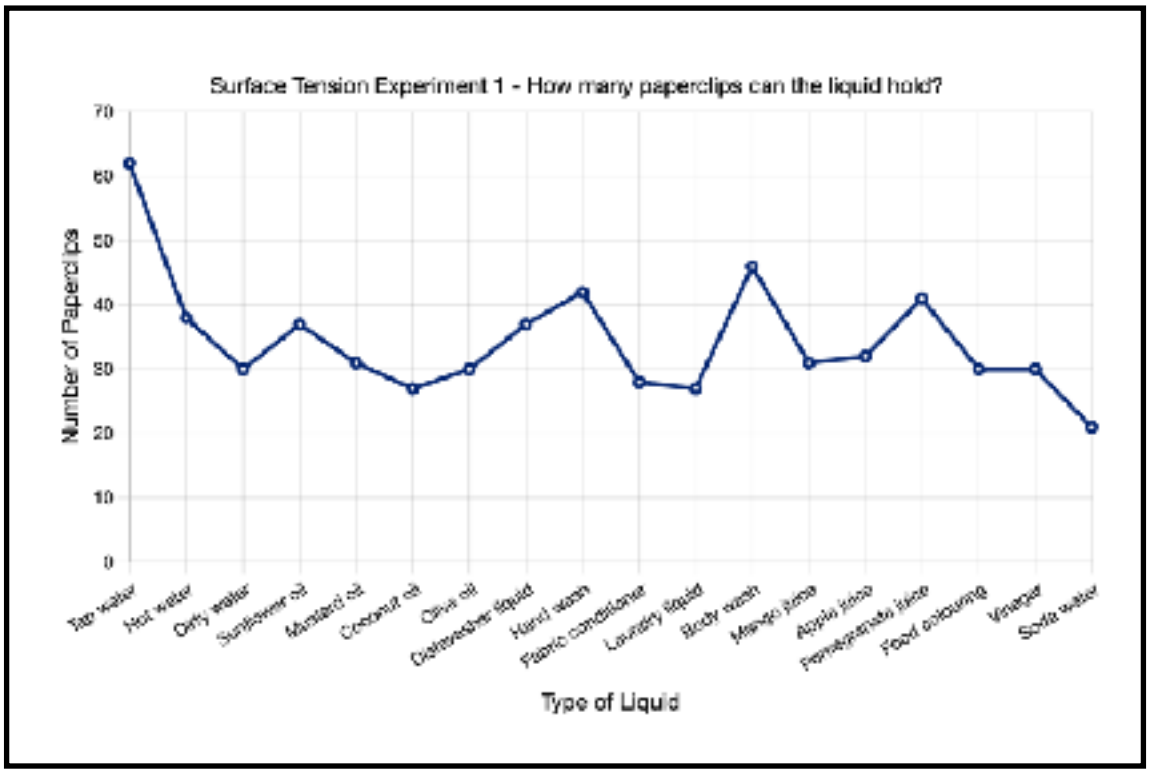
Experiment 2: (based on the number of drops held by the coin)

Number	*Name of liquid*	*Trail 1 (number of drops)*	*Trail 2 (number of drops)*	*Trail 3 (number of drops)*	*Average*
1	Tap water	63	60	61	61
2	Hot water	39	39	38	39
3	Dirty water	36	35	35	35
4	Sunflower oil	34	32	35	34
5	Mustard oil	36	34	35	35
6	Coconut oil	29	30	30	30
7	Olive oil	33	32	32	32
8	Dishwasher liquid	34	32	32	33
9	Hand wash	28	26	28	27
10	Fabric conditioner	32	31	30	31
11	Laundry liquid	34	36	36	35
12	Body wash	37	36	34	36
13	Mango juice	23	22	23	23
14	Apple juice	29	28	26	28
15	Pomegranate juice	31	33	35	33
16	Food colouring	29	30	28	29
17	Vinegar	28	30	29	30
18	Soda water	16	20	18	18

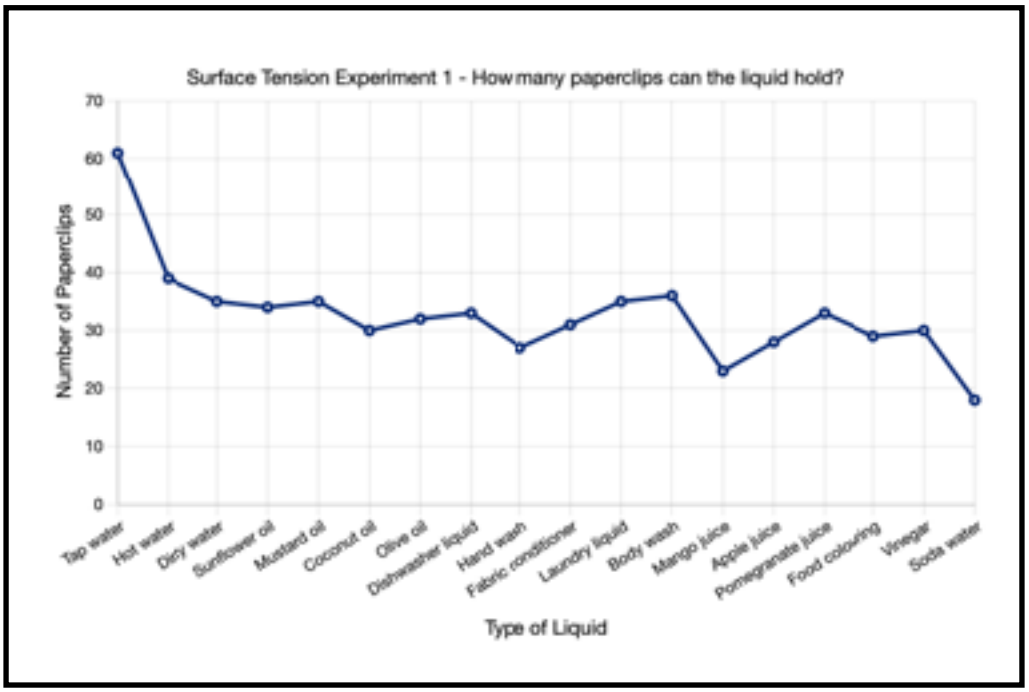
Graph

Experiment 1

Surface tension



Experiment 2



Data Analysis

Experiment 1:

My data supports my hypothesis. The tap water had the highest surface tension compared to other types of liquids. The liquid that had the least surface tension was the soda water. This was because it had gas fizzing on the surface of it and was a delicate dance of surface tension. In the case of the oil, I took four different types of it. The coconut oil had the lowest surface tension and the mustard oil had the highest surface tension. As for the soapy waters, body wash had the highest surface tension, whereas laundry liquid had the lowest. The mango juice is an example of citric and malic acid and the apple juice is an example of malic acid. Pomegranate juice is mostly made of citric, isocitric, tartaric and malic acid. In the case of surface tension, pomegranate juice had the highest and mango juice had the lowest surface tension.

Experiment 2:

My data supports my hypothesis. The tap water had the highest surface tension compared to other types of liquids. The liquid that had the least surface tension was the soda water. As for the oils, mustard oil had the highest surface tension and coconut oil had the least surface tension. From the category of juices, pomegranate juice had the highest surface tension and mango juice had the least surface tension.

Discussion and Evaluation

Tap water had higher surface tension compared to other liquids in my experiments. When several other liquids were added, the surface tension was broken. This means the molecules are no longer attached. When I warmed the tap water to 100°C, it was less dense, because the increased space between the fast-moving molecules decreased the density, which means that the surface tension must be low, as the lower the density, the lower the surface tension. Also, the nature of the liquid severely impacts the surface tension. Surfactants reduce the surface tension by disrupting the hydrogen bonding between water molecules. Steel is eight times denser than water so it should sink. However, here we have a little paperclip floating happily like a water bug on the surface.

How are these findings useful to aquatic insects and their habitat?

Pollutants like oil spills, detergents, coloured water, acidic water and wastewater can seriously harm aquatic insects living in freshwater. Oil spills make it difficult for water insects that live on the water surface to float and can cover their bodies, making it hard to move and breathe. Detergents decrease the water surface tension and can be toxic, destroying the insect's protective layers and breathing systems. Coloured water blocks the sunlight, which disrupts the food chain, while acidic water releases harmful chemicals that can hurt the water insects. Wastewater containing heavy metals and harmful nutrients can create a toxic condition for water insects to live in and also can lead to oxygen-depleting algae blooms. These pollutants affect either the chemical or physical

structure of the water system and thus change the surface tension, leading to the destruction of habitat.

In my experiment, I created an oil spill using sunflower oil, mustard oil, coconut oil and olive oil. Detergent chemicals are created with dishwashing liquid, hand wash, laundry liquid, fabric conditioner and body wash. For coloured water, I used the red food colouring liquid. I used vinegar and juices to make an acidic liquid. For wastewater, I used a mud mixture (dirty water).

What other related questions could be further investigated?

What are the effects of different liquids with varying pH levels on the growth rates of aquatic insects?

What are the factors that lead to the absence of water striders in the waterbodies of Adelaide?

Errors and improvement:

One improvement that could have been considered is the temperature. This may have caused errors in my experiment because surface tension is high with cold temperatures. When experimenting, the liquid temperature varied. An example is coconut oil. It was not in its liquid condition when experimenting, so I heated it for 20 seconds before experimenting. It's important to ensure that the temperature of the liquids used in the experiment is consistent to obtain accurate results. Another error that could have occurred was the size of the drops. When conducting the second experiment, while I was pouring drops onto the coin, the drop size could have differed with could have caused errors with my results. However, the overall sizes were fine and were moderately controlled.

Limitation:

One of the limitations I encountered was the lack of a stalagmometer. Its principle is to measure the weight of drops of a fluid of interest falling from a capillary glass tube, and thereby calculate the surface tension of the fluid. This can accurately measure the surface tension. Additionally, if I had access to actual water insects, they could have been used in the investigation to monitor their movement and determine when there is a change in the surface tension.

Conclusion

Water quality significantly impacts the ability of water insects to walk on the water surface as demonstrated by the difference in behaviour and movement observed in clean versus polluted samples. Maintaining clean, high-quality water is essential for supporting healthy water insect populations and preserving the interstate of aquatic ecosystems. Lately, there has been news about the water quality. “Tap water is now getting less pure than before and potential cancer-causing chemicals are being found in it”, which was said in 9 News Australia by Dr Marian Lloyd Smith. This was the importance of my scientific report. I used a tiny water insect to illustrate why water quality is so vital, not just for the insects themselves, but for all living creatures, including us. The smallest changes in water quality can have a massive impact on insects, humans, and the world as a whole. This serves as a huge reminder of the connections of all life and the urgent need to protect our water sources.

Word count: 2020 words without including titles, headings, figure captions, tables, log book and references

References:

Websites:

1. Water Science School, 2019, “*Surface Tension and Water*”, USGS, viewed 15 May 2024, <https://www.usgs.gov/special-topics/water-science-school/science/surface-tension-and-water>
2. Sue Pike, 2017, “*Water Striders Hang out on Water Surface*”, Sea cost online, viewed 15 May 2024, <https://www.seacoastonline.com/story/news/local/2017/07/25/water-striders-hang-out-on/20081858007/>
3. Sabrina Imbler, 2021 “*You won’t believe how these beetles walk on water*”, The New York Times, viewed 16 May 2024, <https://www.nytimes.com/2021/07/26/science/upside-down-water-beetle.html>
4. Nicole Sharp, 2022 “*Backswimmers*”, FYFD, viewed 16 May 2024, <https://fyfluiddynamics.com/2022/10/backswimmers/>
5. Mashona Dhilwayo, 2022 “*Walking on Water*”, Roads Ends Naturalist, viewed 17 May 2024, <https://roadsendnaturalist.com/tag/water-striders/>
6. Museums Victoria Staff, 2024 “*Notonectidae Backswimmer*”, Museums Victoria Collections, viewed 17 May 2024, <https://collections.museumsvictoria.com.au/species/8484>
7. David Hu and John Bush, 2003, “*Surface Tension Helps this Spider Walk on Water*”, NSF, viewed 17 May 2024, <https://www.nsf.gov/news/special_reports/water/popup/wg_spider.htm>
8. Bob Huber, 2024, “*Bug Robots Might be the Smallest and Fastest Ever*”, Futurity, viewed 26 May 2024, <https://www.futurity.org/tiny-insect-like-robots-speed-3168142/>

9. Streamwatch waterbed guide, n.d, "*Greater Sydney Streamwatch Data Portal*", Streamwatch, viewed 18 May 2024, <https://biocollect.ala.org.au/streamwatch-sydney>
10. Sarah Millar, 2012, "*150th Birthday of Agnes Pockels*", Chemistry Views, viewed 16 May 2024, <https://www.chemistryviews.org/details/ezine/1453259/150th_Birthday_of_Agnes_Pockels>
11. Jyoti Bashyal, 2023, "*Amazing Properties of Water*", Science Info, viewed 18 May 2024, <https://scienceinfo.com/amazing-properties-of-water/>
12. Kaushik, 2019, "*Factors Affecting Surface Tension*", Physics Forum, viewed 19 May 2024, <https://www.physicsforums.com/threads/factors-affecting-surface-tension.980986/>
13. Gatenby, 2022, "*Guide to Surface Tension, Surfacants and Micelles*", CSC Scientific Company Inc, viewed 19 May 2024, <https://www.cscscientific.com/csc-scientific-blog/a-beginners-guide-to-surface-tension-surfactants-and-micelles>
14. Kristen Hall-Geisler, 2023, "*What Exactly is Sea Foam?*", How stuff works, viewed 30 May 2024, <https://science.howstuffworks.com/environmental/earth/oceanography/sea-foam.htm>
15. Dr Karl, 2013, "*The Secret of Sea Foam*", ABC Science, viewed 30 May 2024, <https://www.abc.net.au/science/articles/2013/04/23/3740716.htm>
16. NASA, n.d, "*Surface Tension*", NASA, viewed 18 May 2024, <https://www.nasa.gov/wp-content/uploads/2018/06/stemonstrations_surface-tension.pdf?emrc=ea60d9>
17. Matthew L. Miller, 2024, "*7 Cool Facts About Water Striders*", Cool Green Science, viewed 19 May 2024, <https://blog.nature.org/2017/04/10/7-cool-facts-water-striders-skippers-pond-skaters-weird-nature/>
18. Kim Pullen, 2012, "*Walking on Water…a miracle?*", CSIRO scope, viewed 20 May 2024, <https://blog.csiro.au/walking-on-water-a-miracle/>
19. Laboratory of Behavioural Ecology and Evolution at Seul National University, 2023, "*Examining How the World's Largest Water Striders Jump on Water*", Phys.org, viewed 22 May 2024, <https://phys.org/news/2023-07-world-largest-striders.html>

Books:

1. Jane Kinchey, 2019, *A Focus on Freshwater Environments, Redback Publishing, Australia*
2. Peter Amps, 2000, *Waters Worlds Fresh Water*, Australian Museum, Australia
3. Adam Hibbert, 1999, *A Freshwater Pond, Mandrake, Australia*
4. Michael and Jane Pelusey, 2006, *A Water report Water Quality,* Macmillan Library, Australia
5. Liz Lee Heinecke, 2020, *Chemistry for Kids,* Quarto US, US
6. John Gooderham and Edward Tsyrlin, 2002, *A Waterbed Book: A Guide to the Freshwater Macroinvertebrates of Temperature Australia*

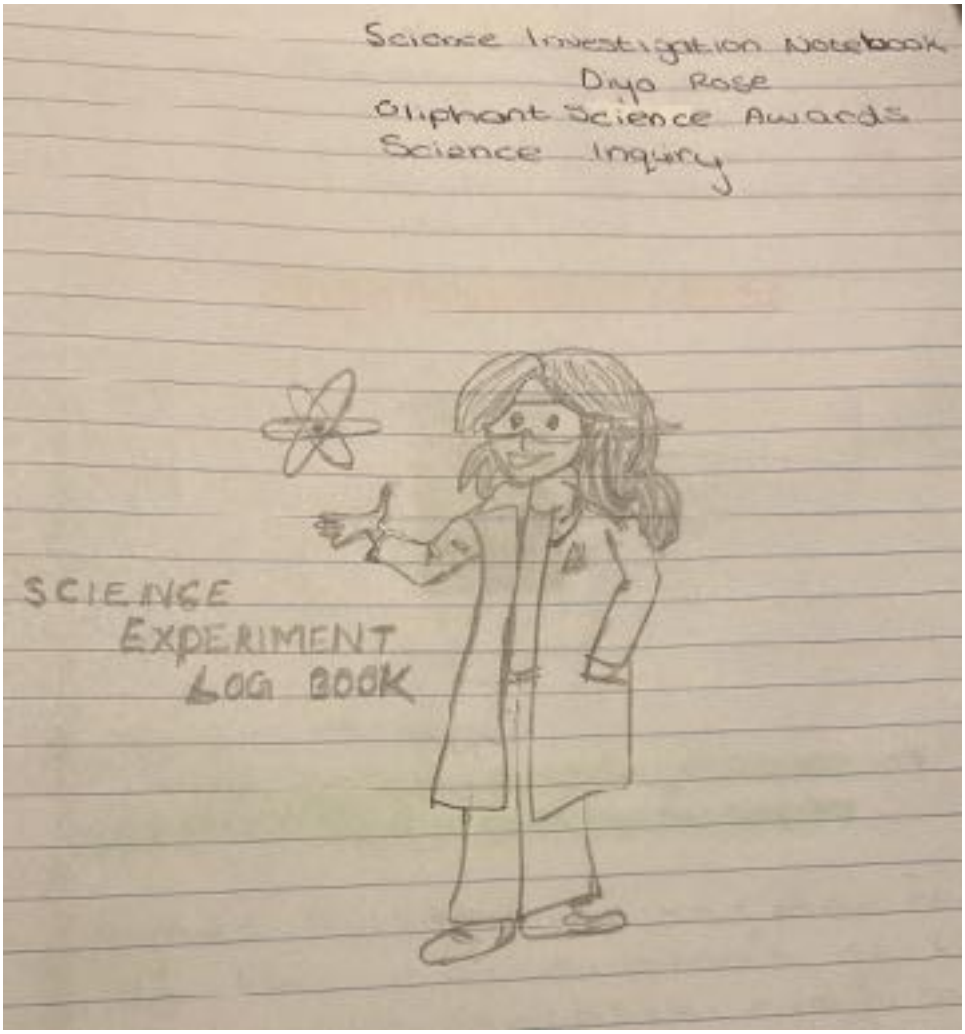
Videos:

1. This is Why Water Striders Make Terrible Lifeguards, 2017, YouTube/Motion Picture, Deep Look, San Fransisco

2. AwA Water Spider, 2019, YouTube/Motion Picture, Adventures with Ambrose, Munmorah State Conversation Area
3. Backswimmer Insects Drag Prey Into the Upside Down, 2022, YouTube/Motion Picture, Deep Look, San Fransisco
4. Jumping on Water: Robotic Water Strider, 2015, YouTube/Motion Picture, Harvard University, USA

Logbook:

13-05-2024



13/05/2024

Today I am starting my Scientific Inquiry journey about surface tension. Firstly, I researched who discovered surface tension and it was Agnes Pockels. I was inspired by her life story and how she investigated it. Let me introduce her.

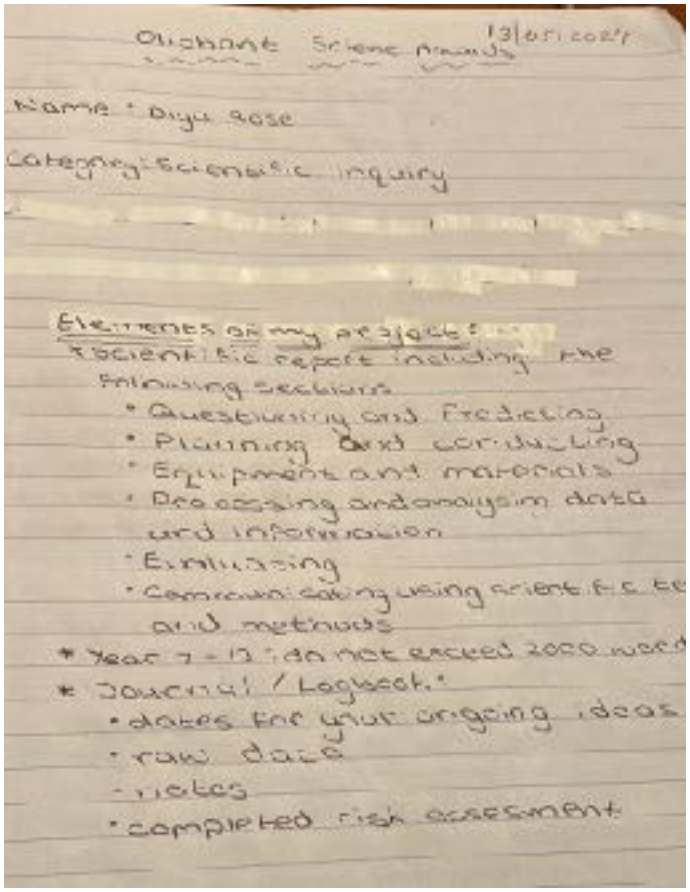
AGNES POCKELS

Agnes Pockels:-

Main achievement: Pioneer of surface tension research

Agnes Pockels was inspired by the observations of the dishwater (Kolatzki n.d). She made major contribution to the understanding of surface tension without formal scientific training. She accomplished all of this not in a scientific lab but from her kitchen. Pockel's story is one of curiosity, determination and meticulous scientific inquiry (Sharp 2019)

13-05-2024

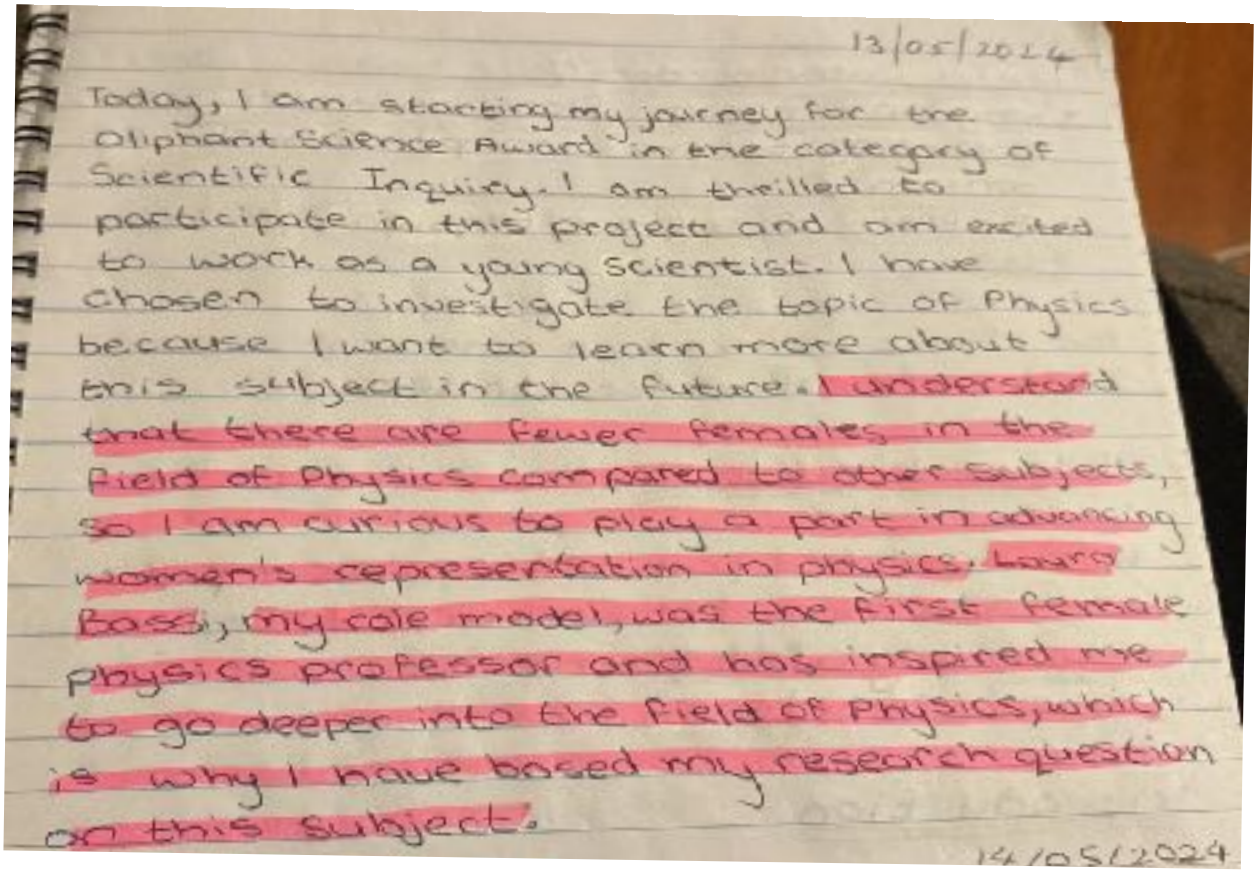


Oliphant Science Awards 13/05/2024

Name : Diya Rose

Category: Scientific Inquiry

Elements of my project:
- Scientific report including the following sections
  - Questioning and Predicting
  - Planning and conducting
  - Equipment and materials
  - Processing and analysing data and information
  - Evaluating
  - Communicating using scientific terms and methods
- Year 7 - 13 : do not exceed 2000 words
- Journal / Logbook:
  - dates for your ongoing ideas
  - raw data
  - notes
  - completed risk assessment



13/05/2024

Today, I am starting my journey for the Oliphant Science Award in the category of Scientific Inquiry. I am thrilled to participate in this project and am excited to work as a young scientist. I have chosen to investigate the topic of Physics because I want to learn more about this subject in the future. I understand that there are fewer females in the field of Physics compared to other subjects, so I am curious to play a part in advancing women's representation in physics. Laura Bassi, my role model, was the first female physics professor and has inspired me to go deeper into the field of physics, which is why I have based my research question on this subject.

14/05/2024

Surface tension

14-05-2024

When starting my project, I wanted to focus on the surface tension of different liquids. Here are a few of my topic ideas

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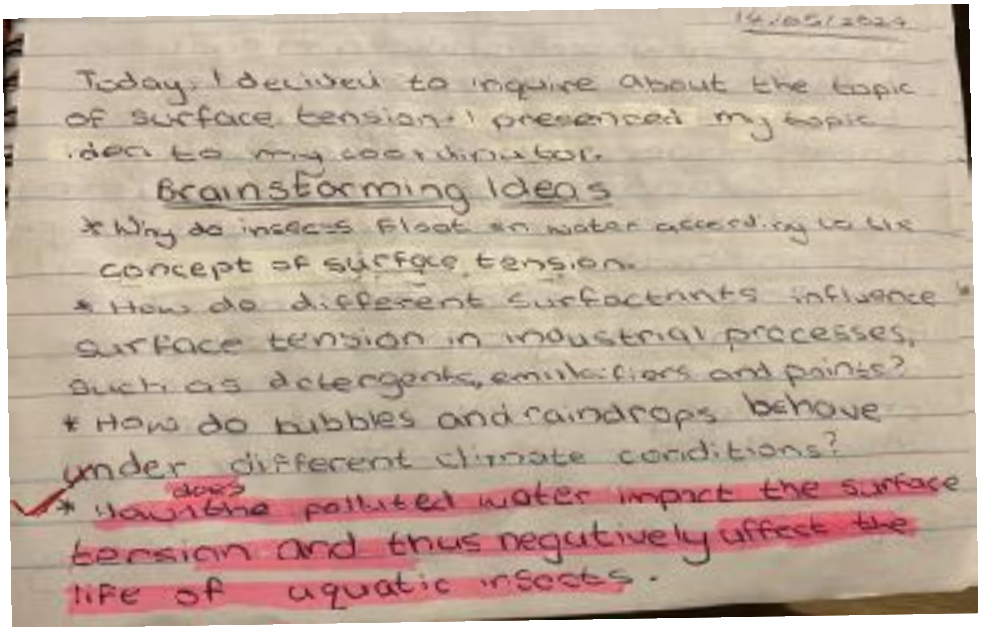

Today I decided to inquire about the topic of surface tension. I presented my topic idea to my coordinator.

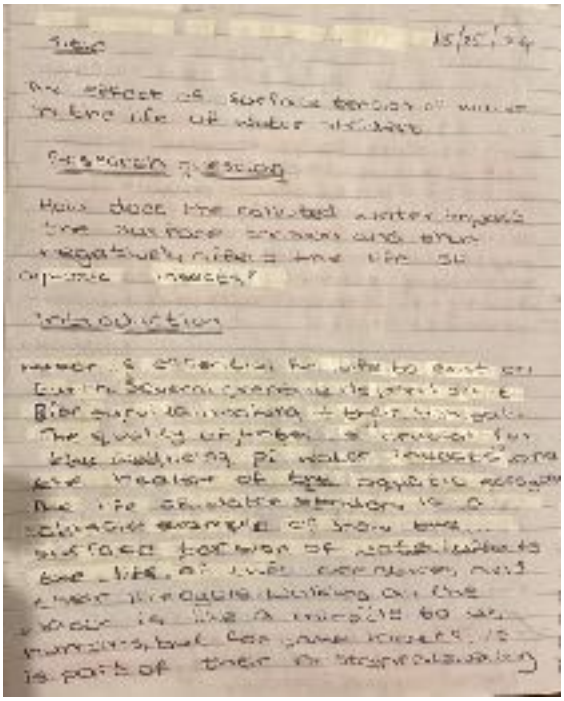
Brainstorming Ideas

* Why do insects float on water according to the concept of surface tension.
* How do different surfactants influence surface tension in industrial processes, such as detergents, emulsifiers and paints?
* How do bubbles and raindrops behave under different climate conditions?
* How does the polluted water impact the surface tension and thus negatively affect the life of aquatic insects.

15-05-2024

Generating Ideas:

Originally, I thought to investigate my scientific report on water striders, but then I realised that there were none in Adelaide, so I changed my topic to water insects.


15/5/24

The effect of surface tension of water in the life of water insects

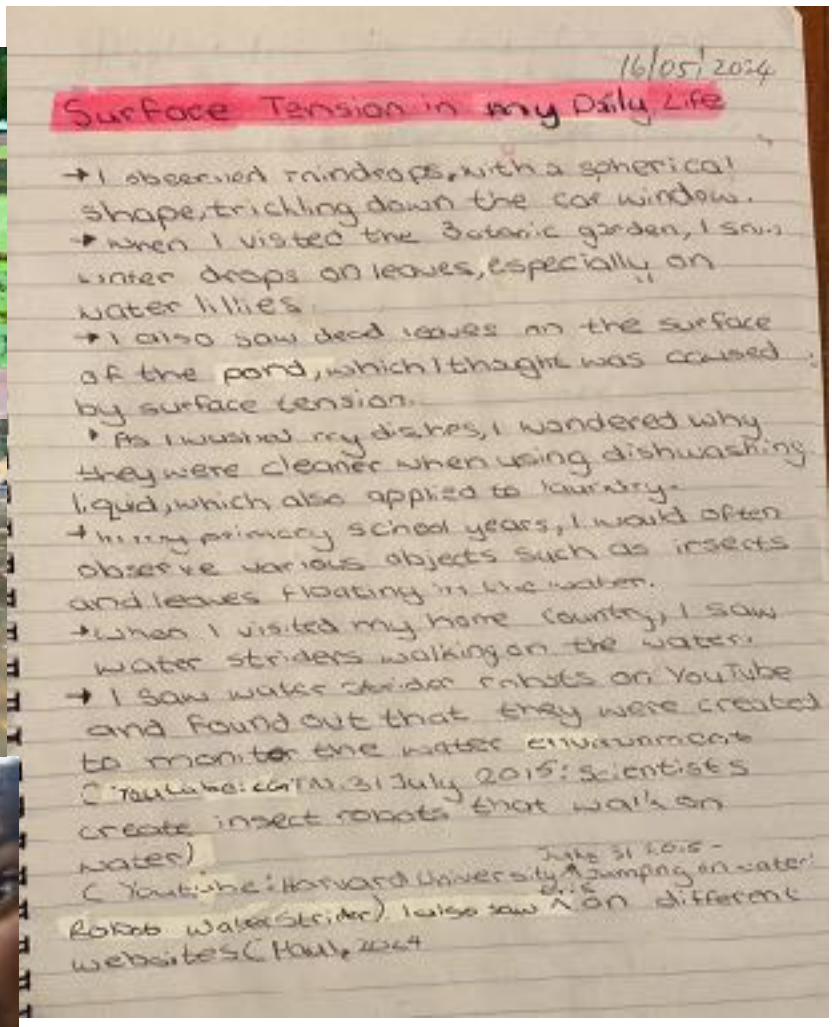
Research question

How does the polluted water impact the surface tension and thus negatively affect the life of aquatic insects?

Introduction

16-05-2024

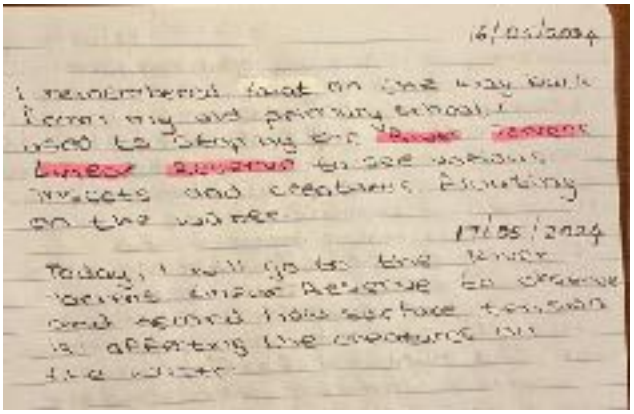
In my daily life, I observed examples of surface tension of water. I collected some photos for my science inquiry.



17-05-2024

I remember in my childhood when I went to school, I always passed a creek called the Linear Creek. I used to see things in the water, so I decided to go there to observe any water insects.

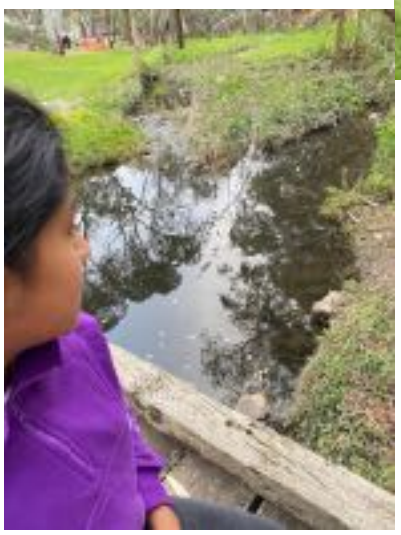
17-05-2024

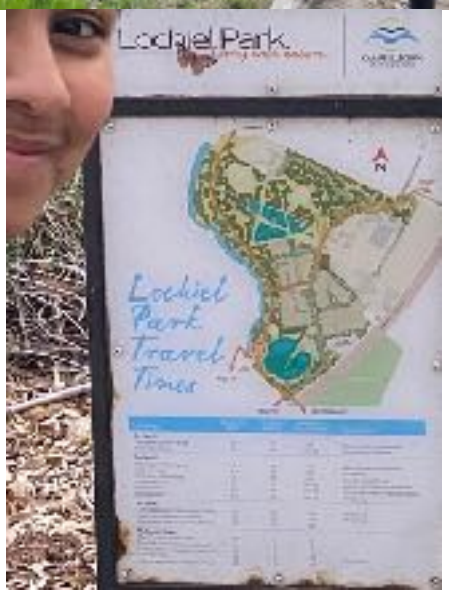


18-05-2024

After visiting the creek, I called my grandpa, who is a retired Physics professor, and I got knowledge about surface tension from him.

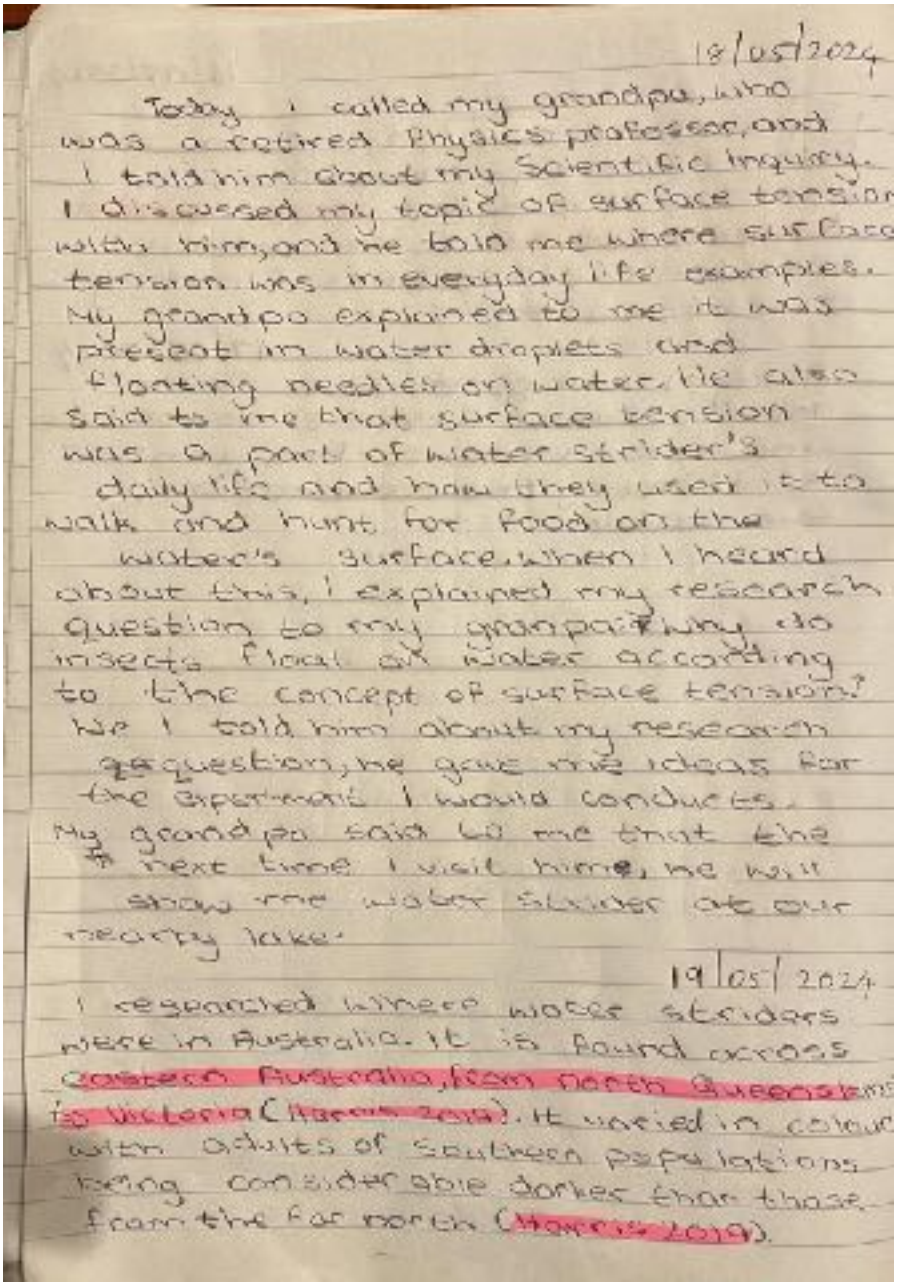
Today I went there to take photos.





19-05-2024

I researched where water striders were in Australia and watched some YouTube videos. The best example I found to understand surface tension was using water striders.



18/05/2024

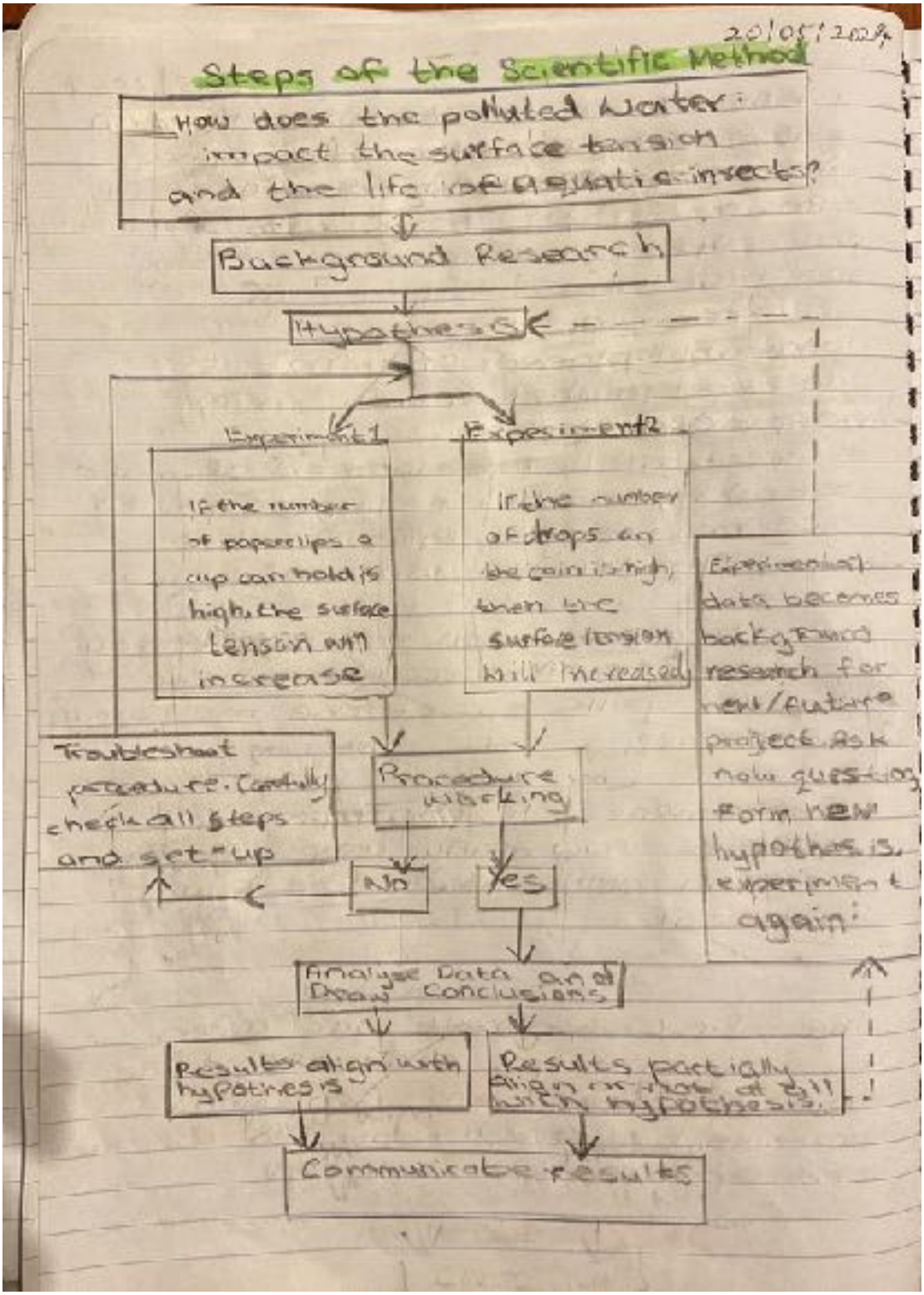
Today I called my grandpa, who was a retired Physics professor, and I told him about my Scientific Inquiry. I discussed my topic of surface tension with him, and he told me where surface tension was in everyday life examples. My grandpa explained to me it was present in water droplets and floating needles on water. He also said to me that surface tension was a part of water strider's daily life and how they used it to walk and hunt for food on the water's surface. When I heard about this, I explained my research question to my grandpa. Why do insects float on water according to the concept of surface tension? We I told him about my research question, he gave me ideas for the experiment I would conduct. My grandpa said to me that the next time I visit him, he will show me water strider at our nearby lake.

19/05/2024

I researched where water striders were in Australia. It is found across coastal Australia, from north Queensland to Victoria (Hoese 2019). It varied in colour with adults of southern populations being considerable darker than those from the far north (Hoese 2019).

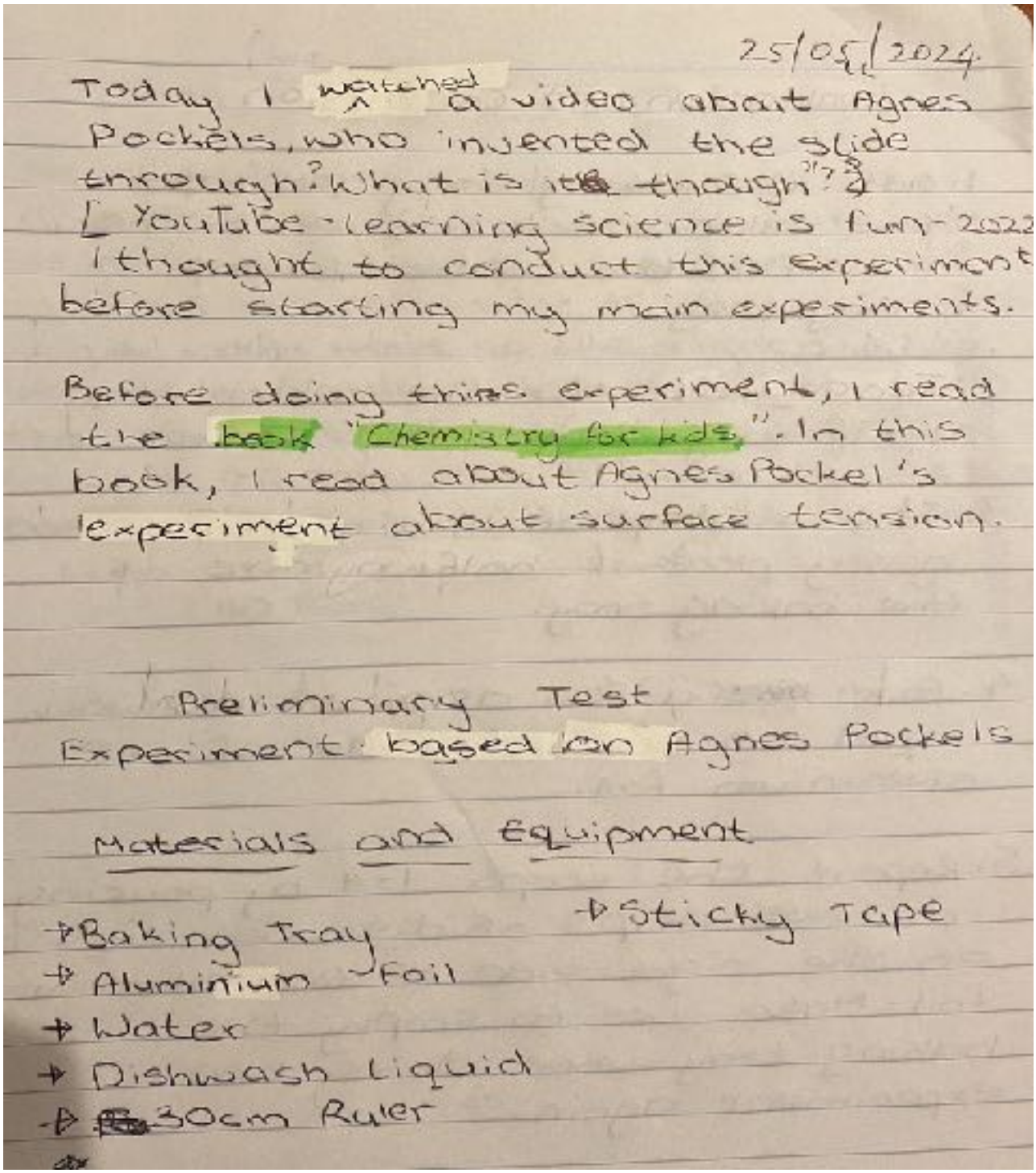
20-05-2024

Before I started my experiments, I made a flowchart for my science inquiry report.



25-05-2024

I tried an experiment based on Agnes Pockel's test. Also, I read a book, which was named "Chemistry for Kids".Preliminary test 1:



25/05/2024

Today I watched a video about Agnes Pockels, who invented the slide through. What is it though??

[YouTube - Learning Science is Fun - 2022

I thought to conduct this experiment before starting my main experiments.

Before doing this experiment, I read the book "Chemistry for kids". In this book, I read about Agnes Pockel's experiment about surface tension.

Preliminary Test

Experiment based on Agnes Pockels

Materials and Equipment

- Baking Tray
- Aluminium Foil
- Water
- Dishwash Liquid
- 30cm Ruler
- Sticky Tape

Procedure:

1. Get the baking tray and tape the ruler on a side of it. This is to find the centre of the baking tray.

2. Pour water into the baking tray half-way.

3. Tear a strip of aluminium foil and gently place it in the centre of the baking tray.

4. Put a few drops of dishwash liquid on the left side of the aluminium foil.

5. Repeat the steps 1-4 by pouring a few drops of dishwash liquid on the right-side of the aluminium foil. Make sure to empty the baking tray when doing the experiment again.

As I poured the dishwashing liquid, I noticed that the aluminium foil moved. For instance, if I poured the dishwashing liquid on the left side of the aluminium foil, it would move to the right and vice versa. I also observed that when I tried the same thing without emptying the tray, it did not work. This was because the surface tension had already been broken.

PHOTOS

26-05-2024

Preliminary test 2 for comparing the surface tension of water to other liquids

If the surface tension of the water is high, the time aquatic insects (paper clips) can stay on it will be longer

Procedure

1. Label the transparent cups and pour the adequate amount of cold tap water.
2. Tear a piece of tissue and place the paperclip on it.
3. Gently place the tissue and paperclip onto the water surface. The tissue paper will slowly go down leaving the paperclip on the surface of the water. The tissue paper is used to get the paper clip on the surface of the water because, without it, the paper clip will likely sink to the bottom of the cup as soon as it is placed.
4. Turn on the stopwatch to see how long surface tension can hold the paperclip on the surface of the water.
5. Once the paper clip sinks, stop the stopwatch and record how long it took.
6. Repeat steps 1-5 by conducting trials again for reliability and changing the type of liquid used.

Preliminary test 2: How long will a liquid hold a paperclip in 10 minutes? (10 min*60 = 600 second)

*I did this experiment with Items at home with the resources that I had.

Number	Name of liquid	Trail1
1	Tap cold water	>600 second
2	hot water	>600 second
3	Dirt water	1second
4	Oil	<1second
5	Soapy Water	<1second
6	Juice	3second
7	Food colour	100 second
8	Vinegar	1second

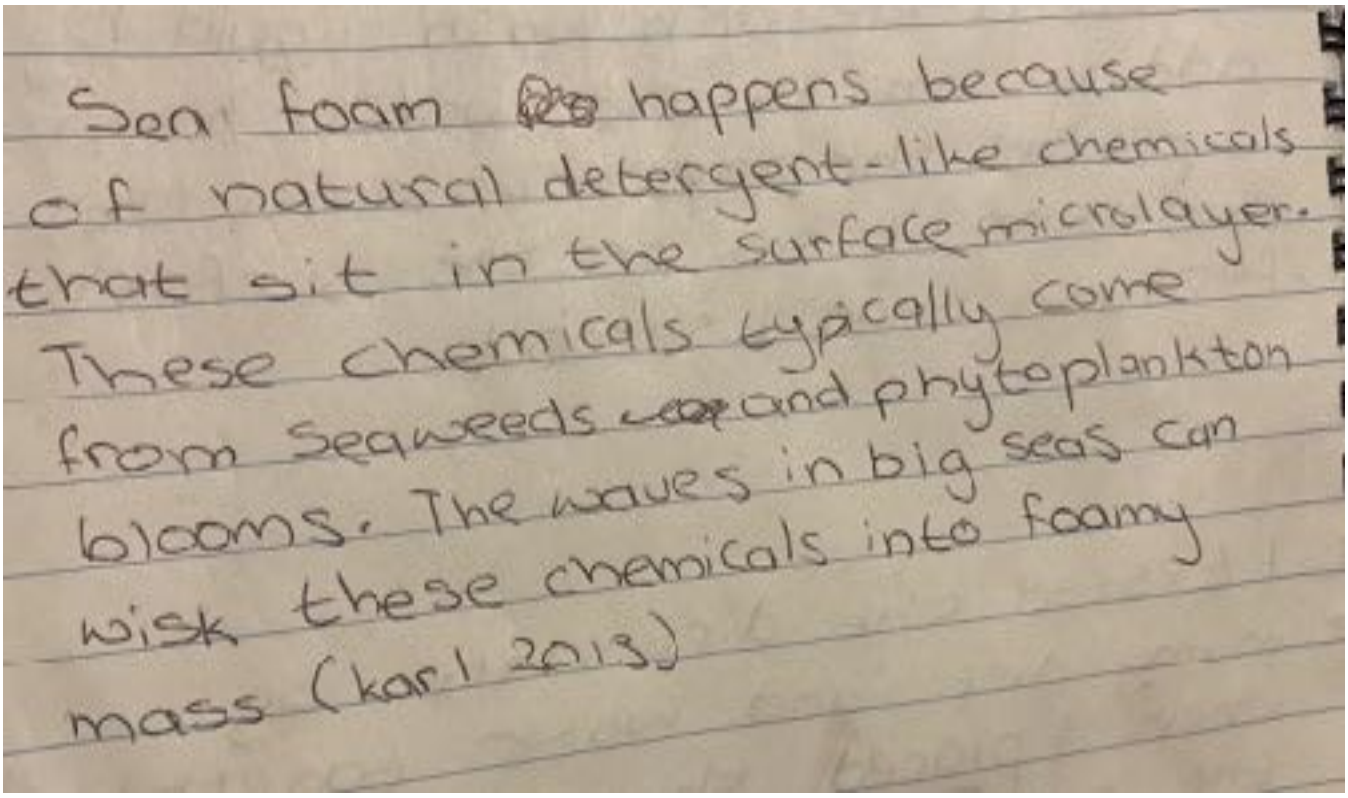
I concluded that tap water has the highest surface tension. It can hold the paperclip for the most time.

27-05-2024

Curious question?

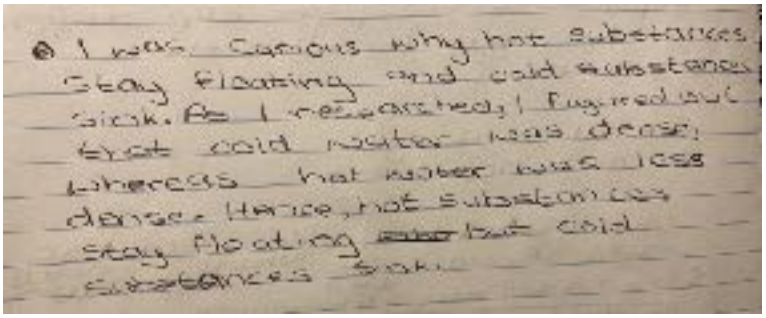
When testing soapy water some bubbles on the surface formed. I thought about why this was happening. I remember seeing sea foam on the beach one day. I took an old photo from my mum's mobile.

I researched the seafoam phenomena.



28-05-2024

When I was doing my experiment, to check how long a paperclip can last on a liquid, I found something interesting with the hot and cold water.



Again Curious?

When I was doing my experiment, to check how long a paperclip can last on a liquid, I found something interesting with the hot and cold water. When the paperclip was on the surface of both waters, the tissue had sunk. However, a few seconds later, the tissue in the hot water came to float, but the tissue in the cold water still was sunken.

Molecules in hot water move faster and are farther apart than the molecules in room-temperature water. This is why objects in hot water float.

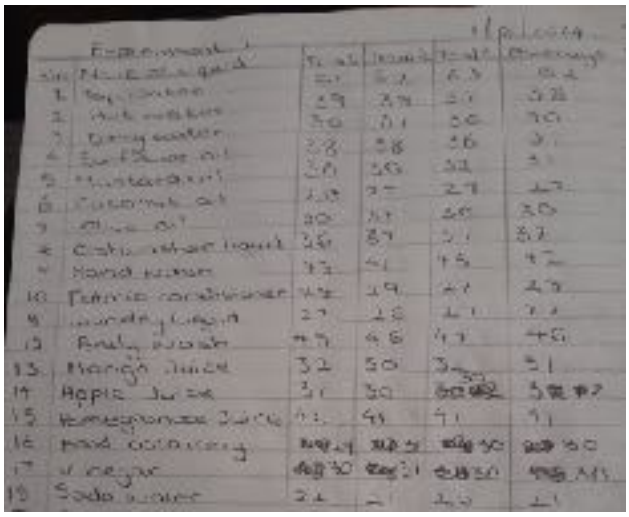
Reference: (ACS 2023)

1-06-2024

Critical thinking:

My cousin told me if I used the stalagmometer, my data would be more reliable and accurate. I checked with my teacher. However since I did not have access to it, I used the glass eye dropper. I started my experiment. I purchased a few items including Mango juice, Pomegranate juice, Mustard oil, Olive oil, Coconut oil, fabric conditioner, laundry liquid, an eye dropper and other liquids.

* The procedure was given previously.









Surface tension

I conclude that water can hold the most paper clips compared to other liquids.

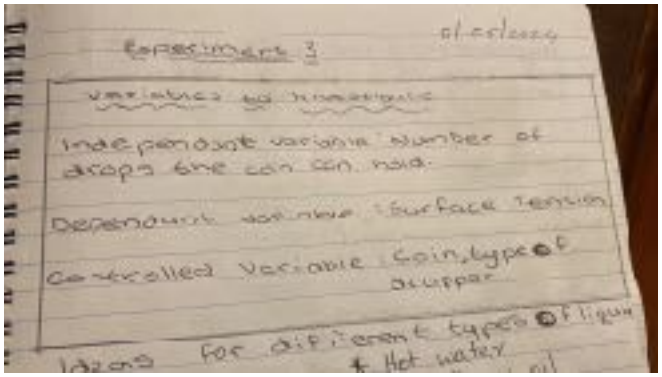
* Table, graph, analysis and evaluation were shown previously.

8-06-2024

Experiment 2

Today, I thought about proving my facts using another experiment. I decided to do this one based on the number of drops with my hypothesis being: If the number of drops of liquid on the coin is high, then the surface tension of the liquid will increase.

* The procedure was given previously.



Surface tension

* Table, graph, analysis and evaluation were shown previously.

My second experiment was also successful because my data supported my Hypothesis.

9-06-2024 to 25-06-2024

During these days I edited my scientific report

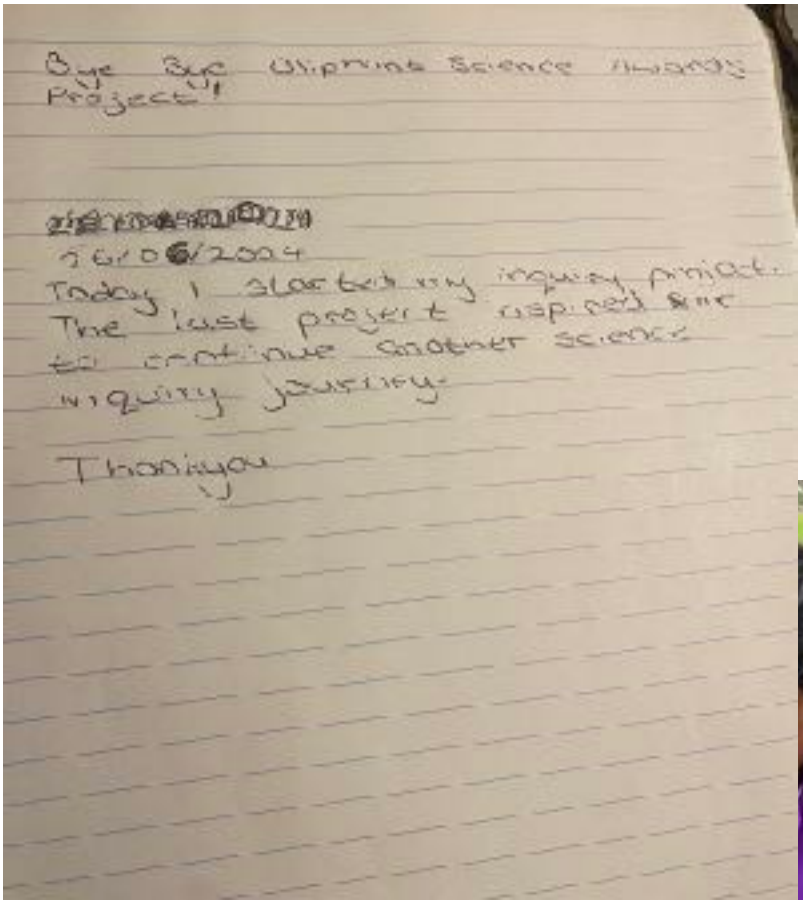
Surface tension

FINISHED MY SCIENTIFIC ENQUIRY ✅

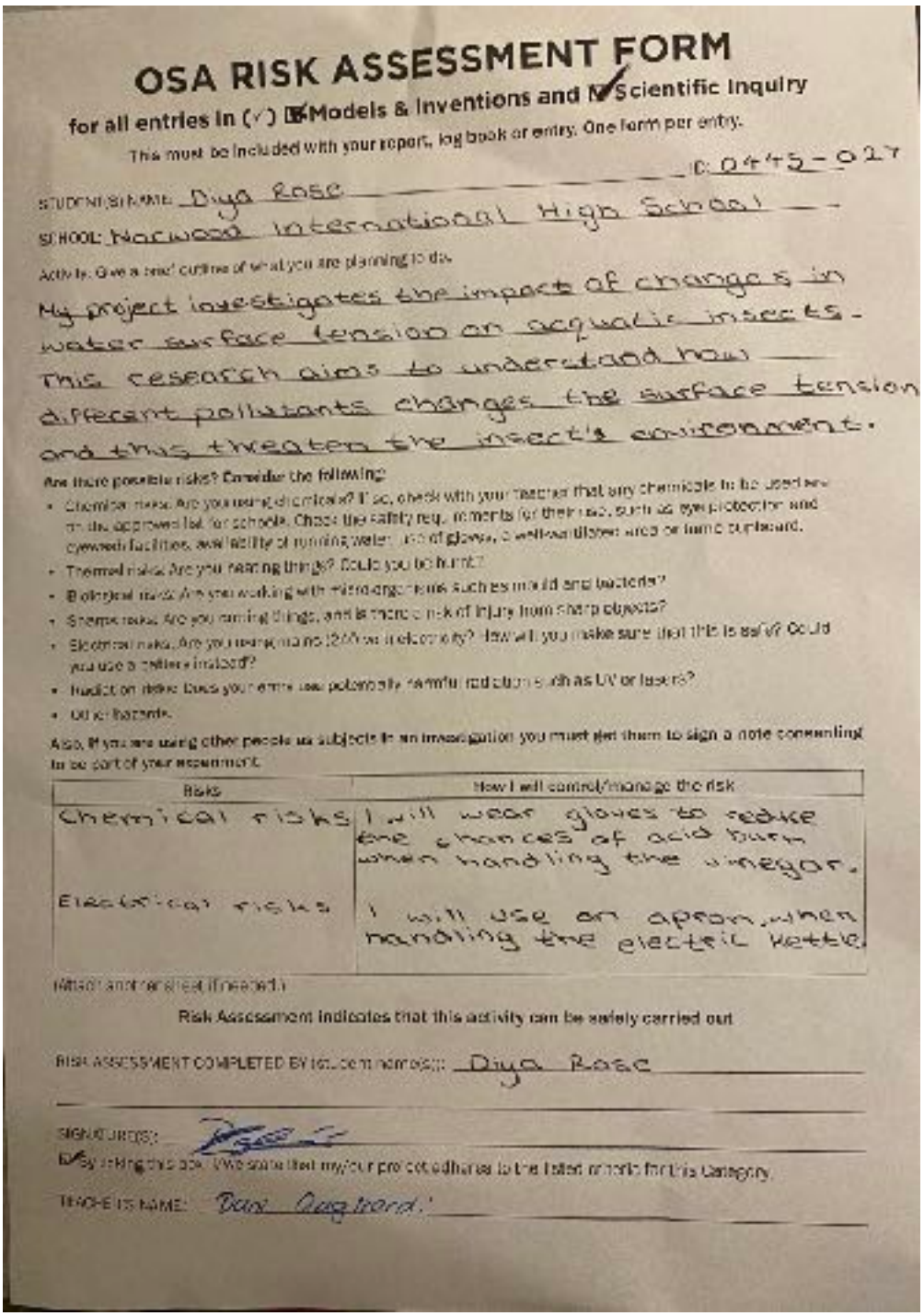
Acknowledgement:

Thank you to my teachers for their continuous support and encouragement throughout this project. I also want to thank my parents for guiding me and taking me to different places, including Linear Park, for observations. A special thank you to my grandpa for providing valuable advice and information. Thank you to my little brother for helping me set up the stopwatches on the iPad. Lastly, I want to express my appreciation to my cousin Harry, who is in Year 11, for sharing his physics record book featuring experiments, including one on surface tension using a

stalagmometer. I'm looking forward to conducting higher level experiments in our science lab.



The risk assessment form is on the next page



OSA RISK ASSESSMENT FORM

for all entries in (✓) ☐ Models & Inventions and ☑ Scientific Inquiry

This must be included with your report, log book or entry. One form per entry.

STUDENT(S) NAME: Diya Rose ID: 0445-027

SCHOOL: Nacwood International High School

Activity. Give a brief outline of what you are planning to do.

My project investigates the impact of changes in water surface tension on aquatic insects. This research aims to understand how different pollutants changes the surface tension and thus threaten the insect's environment.

Are there possible risks? Consider the following:

- Chemical risks. Are you using chemicals? If so, check with your teacher that any chemicals to be used are on the approved list for schools. Check the safety requirements for their use, such as eye protection and eyewash facilities, availability of running water, use of gloves, a well-ventilated area or fume cupboard.
- Thermal risks. Are you heating things? Could you be burnt?
- Biological risks. Are you working with microorganisms such as mould and bacteria?
- Sharps risks. Are you cutting things, and is there a risk of injury from sharp objects?
- Electrical risks. Are you using mains (240v) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks. Does your work use potentially harmful radiations such as UV or lasers?
- Other hazards.

Also, if you are using other people as subjects in an investigation you must get them to sign a note consenting to be part of your experiment.

Risks	How I will control/manage the risk
Chemical risks	I will wear gloves to reduce the chances of acid burn when handling the vinegar.
Electrical risks	I will use an apron when handling the electric kettle.

(Attach additional sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Diya Rose

SIGNATURE(S): Diya Rose

☑ By ticking this box I/We state that my/our procedures is the listed or safe for this category.

TEACHER'S NAME: Dan Aagaard

Surface tension

Surface tension