SASTA OLIPHANT SCIENCE AWARDS

SOUTH AUSTRALIAN SCIENCE TEACHERS ASSOCIATION

Prize Winner

Models & Inventions

Year 9-10

Steven Girgis

Prescott College Southern

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.

NAME: Steven Girgis ID:_____

SCHOOL: Prescott College Southern

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

We are planning to make a wind tunnel to levitate a model plane (aerofoil).

The model will be used to demonstrate Bernoulli's Principle and how it applies to flight. The wind tunnel could be used to test the lift on a range of models (by varying wind speed and angle of the model to the wind).

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 micro-organisms 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 (240 volt) electricity? How will you make sure that this is safe? Could you use a battery instead?
- Radiation risks: Does your entry use potentially harmful radiation 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
Heat (soldering)	Sought a qualified electrician to do the soldering
Electrical	All items (fan and LED light strip) powered by a USB powerpack - no high currents used) Wiring done by a qualified electrician
Sharps (Scalpel)	The plastic was cut using a scalpel - inv. safety glasses and teachers supervision.
Mechanical (mass and power of model)	Use of low mass and low power fan to prevent risk of physical injury

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Steven Girgis

SIGNATURE(S): _____

☒ By ticking this box, I/we state that my/our project adheres to the listed criteria for this Category.

TEACHER'S NAME: Brenton Banham

SIGNATURE: Brenton Banham DATE: 9/8/2021

Contents:

Folio for Oliphant project

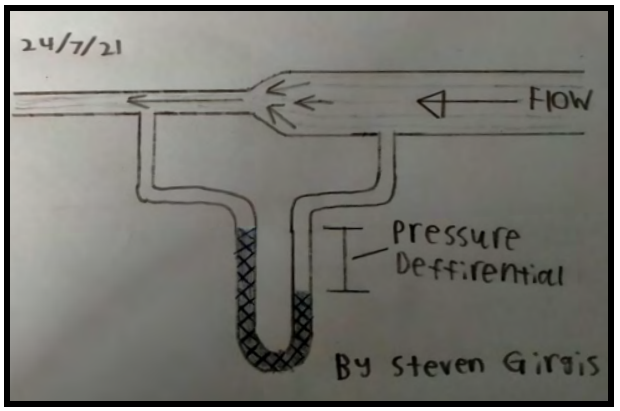
Checklist:

1	A completed Risk Assessment for Models & Inventions form.	DONE
2	The scientific principle demonstrated by your model or used in your invention.	DONE
3	How the entry was made, including any adult help needed in its construction	DONE
4	Any problems that occurred and how you overcame those problems.	DONE
5	How to operate your model or invention.	DONE
6	Journal	DONE

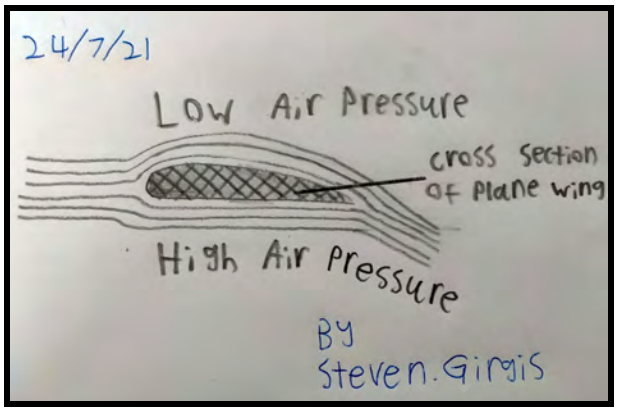
Contents:

Contents:

The scientific principle demonstrated by my model:



This Wind tunnel project was designed to demonstrate Bernoulli's principle. The principle states that with the increased speed of a fluid, the pressure decreases as seen in the sketch of a venturi to the right. When Bernoulli's principle is applied to an airfoil, the air pressure below the airfoil is greater than the air pressure above the airfoil. This is because the air above the airfoil speeds up as it clings to the upper surface of the airfoil.



The clinging effect between the air and the upper surface of the airfoil is known as the Coanda effect. This effect directs the air in a downwards direction which in turn generates lift. A diagram displaying this aspect is shown to the right. An even greater lift can be generated by increasing the airspeed or increasing the airfoil angle of attack. These lift strategies are demonstrated by my model wind tunnel. Increasing the fan speed will generate greater lift force from the model plane whilst increasing the wings angle of attack will also increase the lift force.

How the entry was made / solutions for the problems encountered:

Clear plastic cylinder - Required a flexible, transparent, strong material that would fit the fans. Originally sourced clear acetate sheet from Menzel Plastics which proved to be too brittle. Subsequent plastic was purchased from Bunnings.

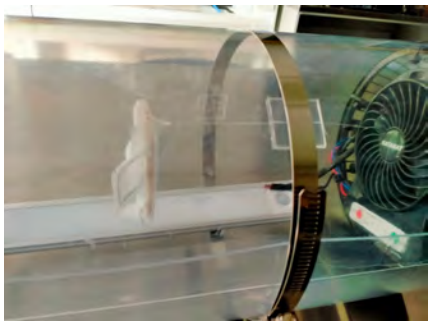
Cutting Plastic - it was unclear how the plastic was going to get cut. A motorised scroll saw or even a handheld jigsaw could snap the plastic sheet. A scalpel and metal ruler were used instead.

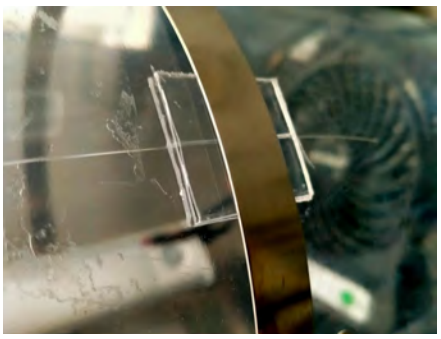
Straps - Tried a variety of materials to strap the cylinder including elastic bands, string. Settled upon hose clamps for their strength, durability and finish.

Light - a light source was needed, the tunnel was very dark from the inside. A bar light was needed to brighten up the surroundings.

Contents:

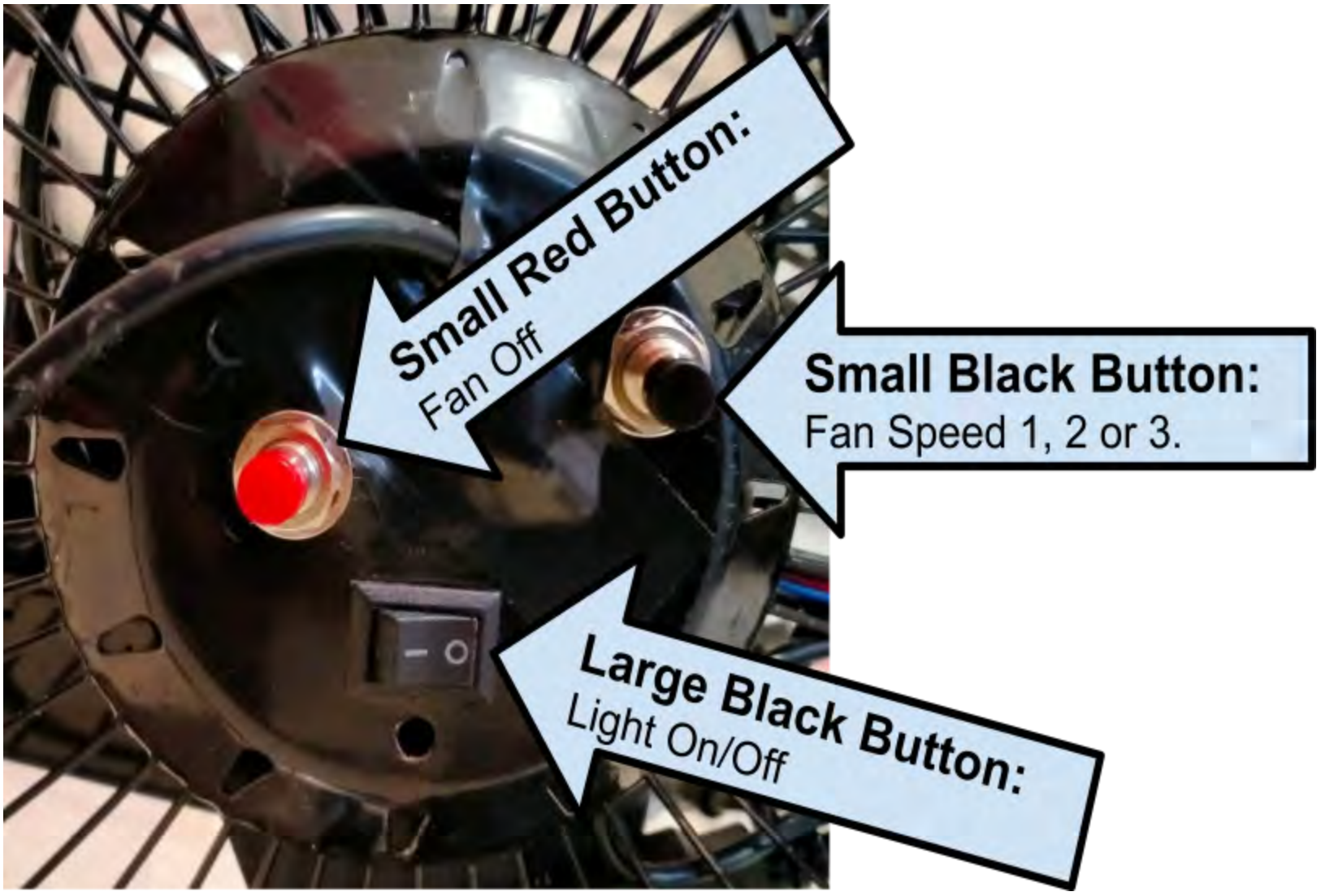
The wind tunnel exterior was originally made from clear plastic bought from Menzel Plastics. Unfortunately, the plastic has snapped as it was too rigid to be curved enough. A solution was to get a further ideal plastic sheet and a bar light from Bunnings to compensate for the previously broken piece of plastic. My teacher and parents have assisted in supervising me when cutting the plastic with a scalpel and Stanley knife whilst wearing safety glasses. The black metal frames located on either end of the wind tunnel were from an old scrapped fan that was later taken apart to accommodate for the wiring of the new fan and light switches. The wiring of the new fan and bar light was done at Force Electronics. Making the plane was a large problem. It needed to be light because the fan was a weaker USB as opposed to a large pedestal fan. My teacher has kindly lent me a thin roll of 1mm thick foam. A plane shape was drawn, cut out and put together to achieve the final product.





Contents:

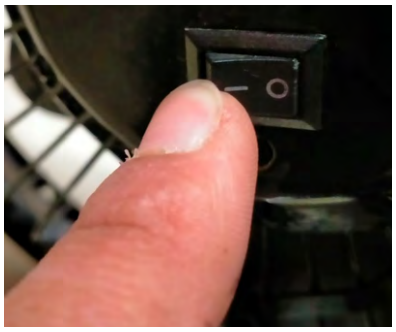
How to operate the model:



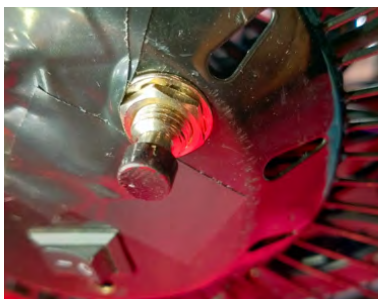
Contents:

1) Plug the external USB cable into a power source.

2) Press the Large Black Button to turn the light on/off.

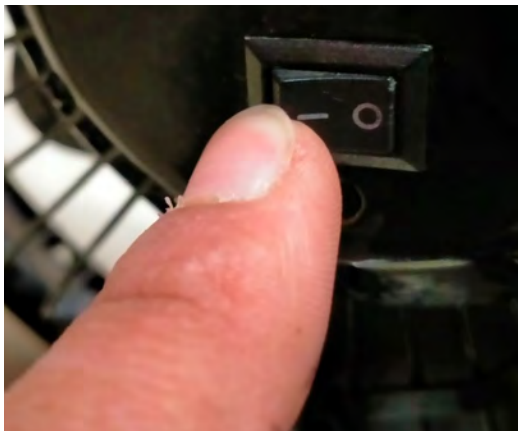


3) Press the Small Black Button to turn the fan on. Press it again for speed 2 and then again for speed 3.

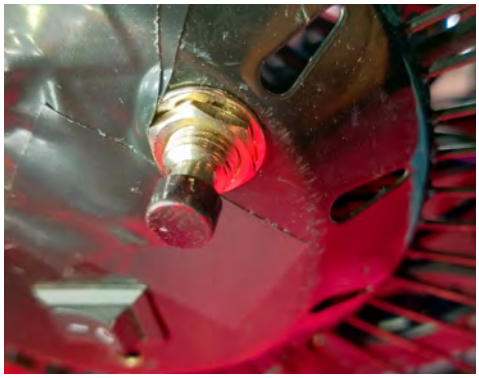


4) Press the Small Red Button to turn the fan off.

Contents:

Step 1:	Ensure you have a USB power port ready. A device, wall outlet or power bank will run the wind tunnel perfectly fine.	
Step 2:	Plugin the external USB cord located on the control panel that is on the left side of the wind tunnel. Ensure it is securely plugged in to prevent the fluorescent bar light from burning out.	
Step 3:	Once the USB cable is plugged in, turn the large black switch on. This allows the fan to charge and will turn the light on.	

Contents:

Step 4:	To turn the fan on press the small round black button to start speed 1. Press it again for speed 2 and again for speed 3. To turn the fan off press it again to turn it off. A light will appear on the side of the fan. Make sure to turn this light off by pressing the black switch again.	
Step 5:	Once pressed, the red switch will emergency shut down the fan. This switch doesn't affect the bar light or any of the other components.	
Step 6:	To pack up ensure to press the red emergency button to shut down the fan. Next, turn the rectangle black switch to the off position to turn the bar light off. Now you are able to plug out the wind tunnel from the electrical source.	

By Steven Girgis

24/7/21

Contents:

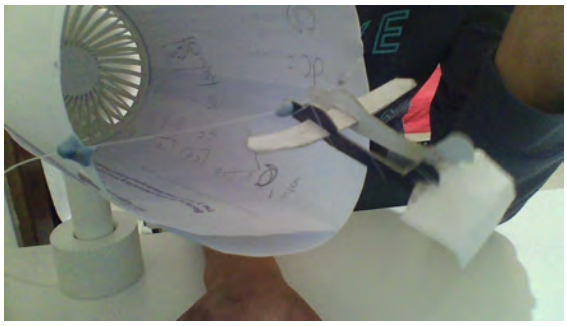
Journal:

Jun 7, 2021

Today I have started to research all the substantial fans that could be used for my project. Although having a pedestal fan is better, you would run into an electrical risk with 240V mains power. Such a large fan would also result in a less practical design in terms of portability. A powerful USB fan was required alternatively. In this photo is a fan that was bought from cheap as chips. It's less powerful than the larger fans but it is cheap and rechargeable.

Jun 11, 2021

Today I have made a temporary plane and wind tunnel. I have rapped scrap paper around the circumference of the fan. The plane was made from a tissue box with a small paper elevator. The plane model was attached to the paper through a fishing line and glue tack.



Contents:

Jun 12, 2021

Today a small model plane is being designed. My teacher has given me a substantial role of 1mm foam that the plane is going to be made from. Sketches were drawn for all the parts of the plane as seen in the second image. Later the plane was assembled and additionally, some pieces of thin pop sticks were used to allow for extra support. The final product is in the third image to the right.



Jun 15, 2021

Today I have used my current fan that I have bought to test different designs and most importantly, see what scientific principles and effects I could demonstrate. I have made a temporary wind tunnel to see what I can levitate and help me gain some experience for making the permanent product. The small plane models were ready for testing. As seen in the third photo, the plane wasn't lifting off properly due to increased weight and a weak fan. It was then clear that more research was needed to find a more powerful and reliable USB fan.

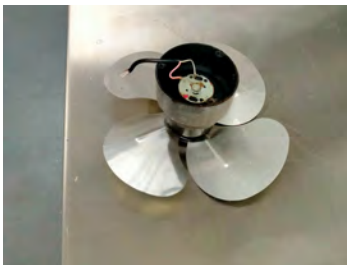


Contents:

Jun 16, 2021

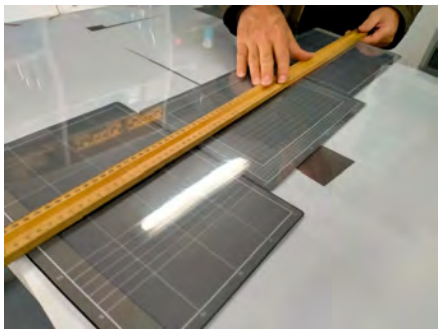
Today I found an old broken fan stacked at the back of my wardrobe. I utilised it by using it as the diameter of my wind tunnel. I have been able to do this by removing the internal fan motor and blade from the black metal frame. I decided to have plastic as the outside cylinder of my wind tunnel as it is clear and more affordable. I have spoken to my parents about buying a sheet of plastic from Menzel Plastics. I have given the circumference of the Metal black fan cover to my parents. They will buy a thin piece of plastic that would best suit my measurements for the tunnel.





Jul 1, 2021

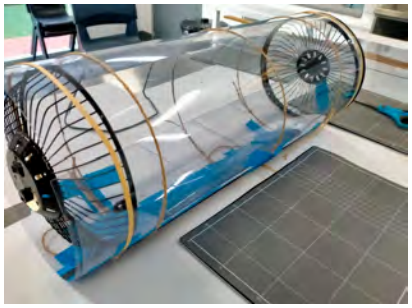
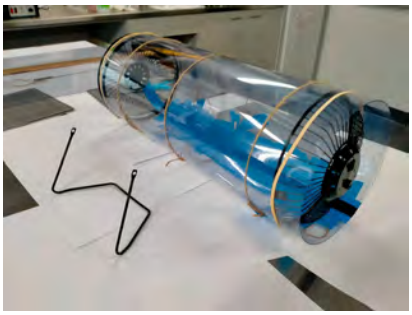
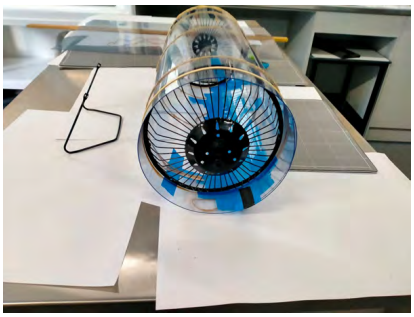
I have finally received my plastic a few days ago. I have worked after school in the science lab with the teacher's supervision. A scalpel and ruler along with safety gear were needed to cut through the rigid plastic safely to avoid injuries. Cutting boards were placed under the plastic whilst it was being cut. This was to protect the table from underneath.

Contents:

Jul 2, 2021

Today I have the piece of plastic that has been previously cut. It is ready to get forced into the shape of a cylinder. I got my teacher to help me with this part. He held the plastic in a cylinder shape for me whilst I tied it so that it doesn't expand and pop. extra durable and thicker rubber bands were used with strings as a temporary hold until we have got a permanent seal. The metal templates from the old fan were put into place. This would help us understand the size of the project and therefore would help us know what sized plane we could levitate as well as what size fan we would need.

Jul 8, 2021

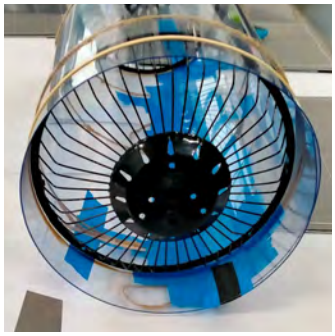
Today was Thursday late shopping and therefore lots of things were being brought for the project. I have used double-sided adhesive tape to stick the wind tunnel. I have also bought hose clamps to permanently help the adhesive tape so that it doesn't come off over time. I have also bought a powerful black fan and hope that it will be powerful enough to better levitate the model. An expensive bar light was also bought to assist with the lighting. Black tape was used to cover the edges of the tube as they were quite rough from being cut with the scalpel. To power the light and the fan from one cable I needed a 2 port USB hub. I have connected everything and they both charge perfectly.


Contents:

Jul 9, 2021

Today I have tried to put everything together so that it is more visible how everything is going. Unfortunately, I have found that the metal templated from the old fan is blocking the way from the internal switches. By this, I mean that the switch for the bar light and the fan are inside the tunnel. This means that every time you wanted to turn the fan or light on, you would need to open the metal brackets. The solution is external switches. I went to Force Electronics as they are a team of qualified electricians and will handle hobby projects like mine with extreme care. They have very friendly service and even gave me a slight discount on request. It cost me over $100 dollars but it was better than risking burning out the light or fan motor. They have wired up external switches from the light and fan to the outside panel. Once I got home I made all the wiring tidier by adding cable ties to the wires.



Jul 10, 2021

Now I have started to achieve the point where it is easy to imagine what the final wind tunnel will look like. I have started to think about the background. I and my teacher have discussed that the best option would be to get a black corflute as the colour black would make the white model stand out. I have gone shopping at bunning and was surprised that they had full stock on black corflute! I bought 90-degree brackets along with small black screws so I could cut the **corflute** to make the background. The images below show the process of making the backdrop.



Contents:

Jul 19, 2021

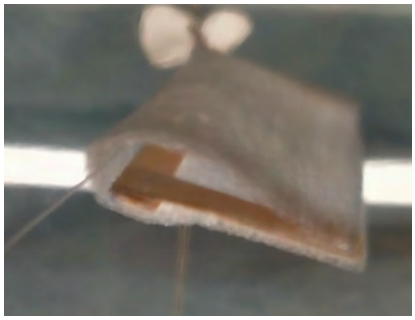
After a nice long holiday break, it was time to start working again. I have already set the adhesive tape to hold the plastic but have decided to continue tightening the hose clamps even more. The plastic was too rigid to be so flexible and it ended up snapping. I was left crying and heavily upset from my parents whilst also feeling ashamed of myself with the worthless months of hard work that I have dedicated out of my own time. That night was the night before school started from the holidays. I told my dad what happened and he took me to bunnings immediately. Thankfully they had a more flexible plastic for sale but it wasn't as clear though. Lucky I bought the bar light to brighten up the inside! I will always remember my dad for what he did to me that night despite mum not wanting me to go because she wanted me to sleep early for school tomorrow.

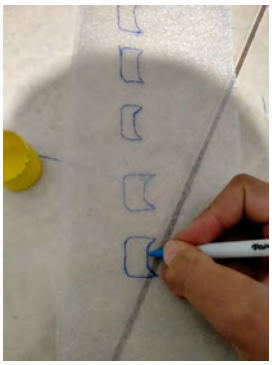
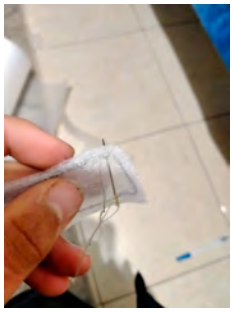
That same night after buying the supplies, the same process that was done on the original plastic was then repeated for the second time. After everything was repeated the plastics all looked identical apart from the old one being broken. The newer plastic was significantly better than the old one as it was less rigid and more flexible.

Contents:

Jul 26, 2021

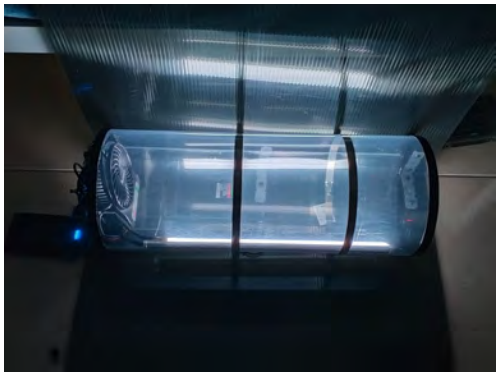
Today my goal is to complete the model aeroplane that is going to get levitated. In order to do this, I needed to make it as light as possible so it can levitate well. I twisted the really thin florist wire that I have bought. This makes a more rigid and powerful double layered wire. That wire was sown around the wing of the plane so that would give me the ability to bent the aeroplane wing to help make it as realistic and efficient as possible. An airfoil was also tested to see how it relates lift factors to Bernoulli's principle.



Jul 29, 2021

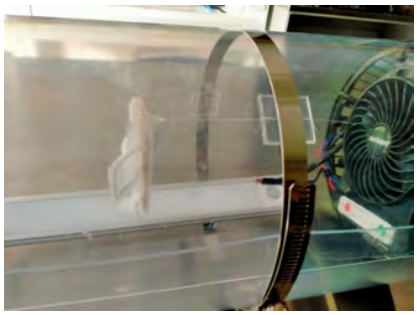
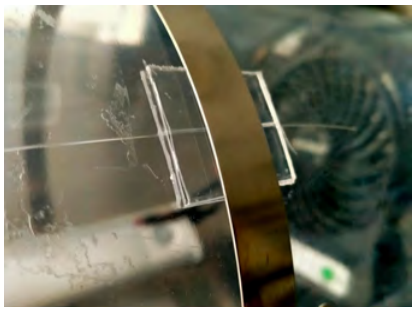
Today I am finalising the online part for the oliphants projects. This includes drawing diagrams, finishing touches on some parts that could be improved and other factors as well. I have installed the bar light which proves to give stunning views during the night when it is contrasting with the black core flute! I have also brought a drillbit today as I needed to make holes in my wind tunnel so I could put the string through that would hold my aeroplane model. This will need to be done tomorrow as today my project is at school in my teacher's room.



Contents:

Aug 5, 2021

Finally, today I have to stick the thin string that will be holding the model plane to the wind tunnel. I have struggled to find solutions to stick the string. My conclusion was to stick the string using double-sided tape to force the string against the tube. To cover the other side of the double-sided tape I have used leftover pieces of plastic from the tube to cover them up as seen closely in mage 2. I have placed one of the hose clamps over the double-sided tape and plastic to help keep it pinned against the tube. This will prevent the double-sided tape from coming off.


By Steven Girgis

7/6/21 - 5/8/21