MANGROVE MUNIFICENCE JOURNAL

The impact of mangroves on the turbidity of the Parramatta River

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Year 10

Science Journal

Contents

19/07/2016

I have learned this day that I will complete a science research project.

Ah, but what to do?

To what area of science should I apply my efforts? On which humble corner of the universe shall I shine a light, to see what nuggets of knowledge remain forgotten in the dank corners of humanity's understanding?

I do not know. I will consider later.

21/07/2016

Today was an insightful day. I decided upon my avenue of discovery. There are several mangrove copses along the shore of Hen and Chicken Bay. They used to grow all around the bay, but were decimated by the aggressive polluting of the old factories in Concord. They are starting to return, slowly, to the water's edge.

I had considered studying the mangroves in the previous lesson, but did not know what to study and dropped it. However, I retired to the school library to do some research. According to the Canada Bay Council website, the dominant species of mangrove in the area is the Grey Mangrove or *Avicierra marina*. The website also provided a PDF fact sheet on Australian mangrove species. A function of mangroves, it turns out, is to filter run-off and settle sediments in the water. So therefore, a possible experiment could be to record the purity of the water within a mangrove environment and an adjacent stretch of shoreline without mangroves.

The experiment would aim to test the purity of the water based on the increase or decrease of mangroves in the area. Ideally, I would visit, say, three to five mangrove populations around the area and test the turbidity of water within the mangrove population and the turbidity of water by a nearby shoreline without mangroves. I should research what other changes occur to the water such as salt concentration, acidity and presence of organic matter. I should also research whether mangroves are known to have an impact on these variables.

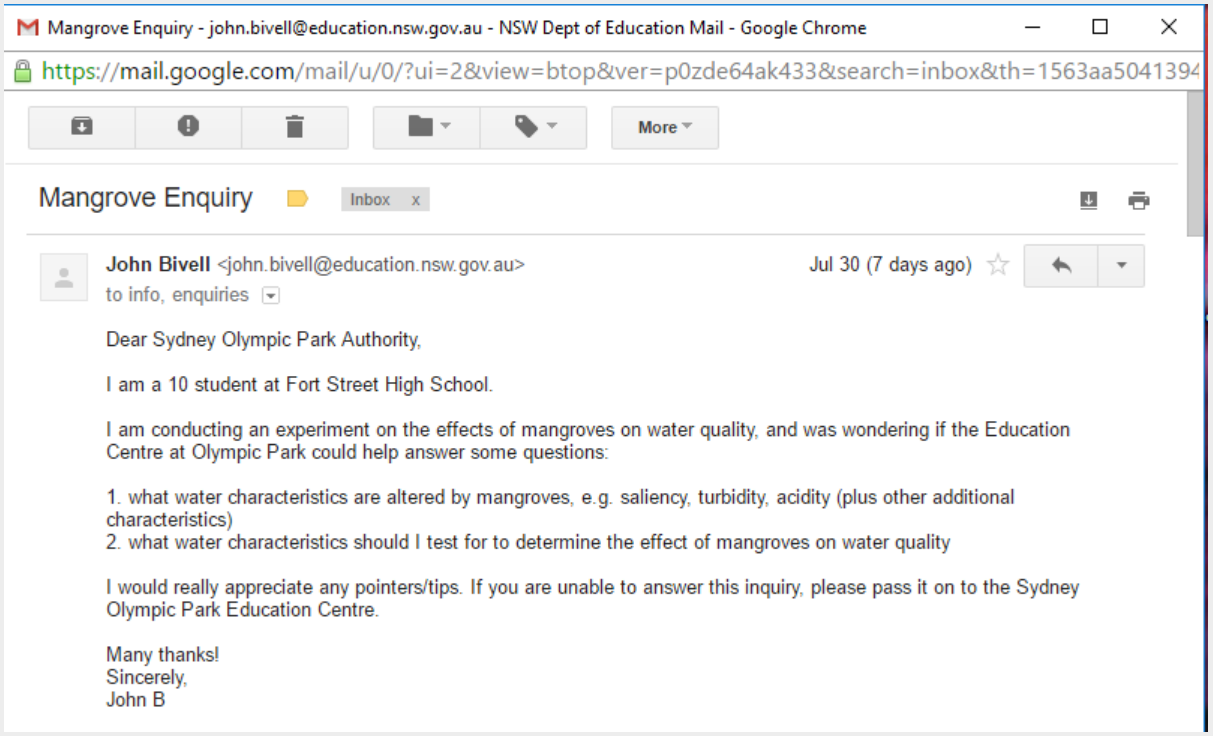
I completed my rudimentary abstract, risk assessment, aim, hypothesis, method and materials today. I am still unsure as to what I should be measuring, so that will undoubtedly undergo some serious editing. My teacher has also recommended a mangrove education centre at Sydney Olympic Park who could give me plenty of tips on where to start and what to measure. I shall check in with them when I am able.

22/07/2016

I included a variables table in my project today. I identified the dependent variable as turbidity and the independent variables as the location of mangrove population and proximity to mangrove population. I should also take into account the weather and tides when I collect and test my samples. I will also need to check with research and the mangrove education centre for what other variables I should test for.

30/07/2016

I emailed the Sydney Olympic Park Authority via their two different emails with some questions about mangroves. Here is a screenshot:



Mangrove Enquiry - john.bivell@education.nsw.gov.au - NSW Dept of Education Mail - Google Chrome

https://mail.google.com/mail/u/0/?ui=2&view=btop&ver=p0zde64ak433&search=inbox&th=1563aa5041394

More

Mangrove Enquiry Inbox x

John Bivell <john.bivell@education.nsw.gov.au> Jul 30 (7 days ago)

to info, enquiries

Dear Sydney Olympic Park Authority,

I am a 10 student at Fort Street High School.

I am conducting an experiment on the effects of mangroves on water quality, and was wondering if the Education Centre at Olympic Park could help answer some questions:

1. what water characteristics are altered by mangroves, e.g. saliency, turbidity, acidity (plus other additional characteristics)
2. what water characteristics should I test for to determine the effect of mangroves on water quality

I would really appreciate any pointers/tips. If you are unable to answer this inquiry, please pass it on to the Sydney Olympic Park Education Centre.

Many thanks!
Sincerely,
John B

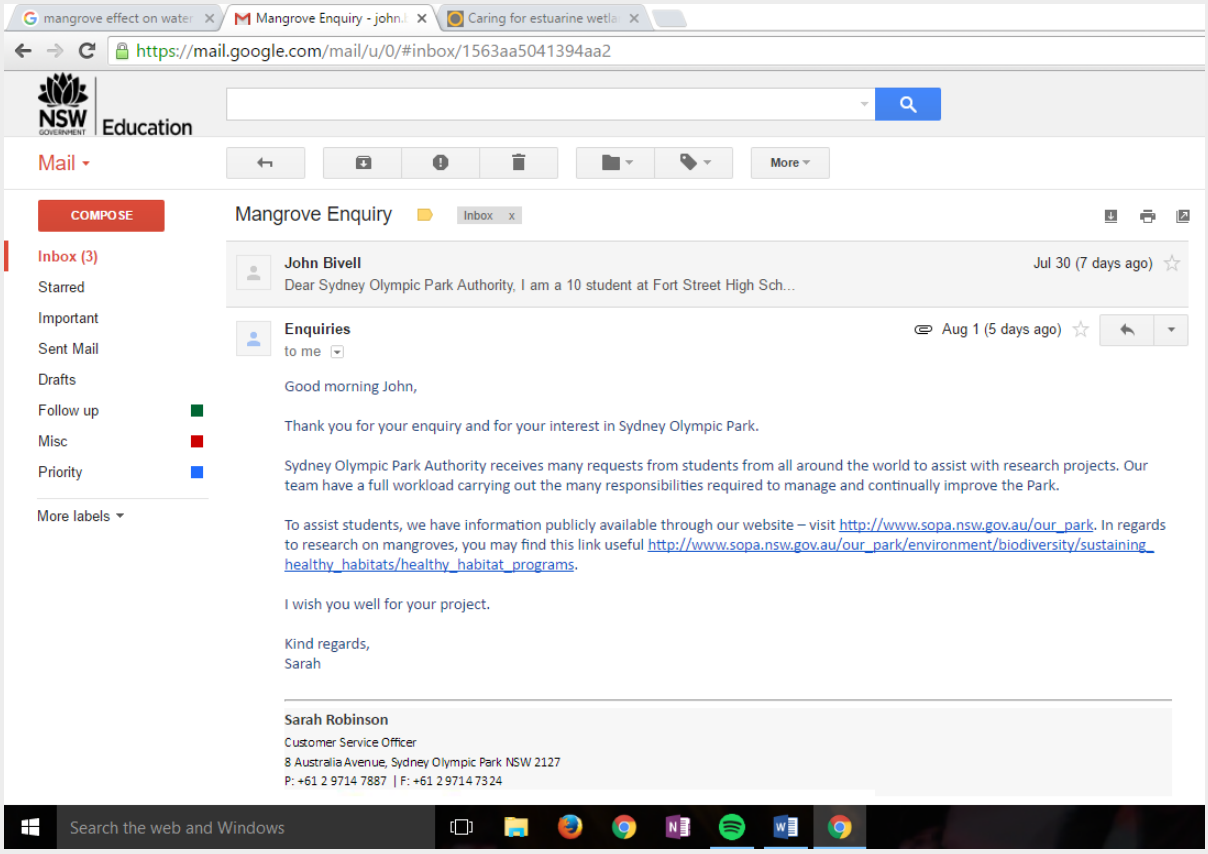
2/08/2016

I have had a brainwave! Rather than testing one sample of water within the mangroves and one sample beside the mangroves, I will instead test samples of water at different distances from the mangroves. This came to me as I was considering how I should structure my results table, and the intervals which distance testing offer would be a far more measurable quantity than simply one sample. Oh, my! I shall alter my variables table to include distance from mangroves as a new factor.

So far, I have not heard back from the Sydney Olympic Park Authority. I shall need to check my email again. I really need to do some background research on the effects of mangroves on the characteristics of water. It is hampering any progress I can make in terms of planning an experiment, accounting for variables, determining what equipment is needed and structuring my draft results.

6/08/2016

The Sydney Olympic Park Authority replied to my email. There is a screenshot include over the page. I perused the links included but did not find any information useful to my investigation. What I need are sources detailing the effects of mangroves on the water in general. These links only provided general information on the mangrove in Sydney Olympic Park and what infrastructure was in place around them.



I added a column to the risk assessment table outlining what risk factor it was, going off the risk rubric. I also created some tables to store all my results in which can then be translated into a line graph using Microsoft Excel.

The major undertaking I completed today was my background research. This took me a few hours which I spread out across the afternoon. I found several articles on mangroves and their effects by searching a few keywords online. I confirmed that mangroves do help to trap sediments and provided two or three scientific studies which had covered this process. I used a website called OzCoasts to provide a general overview of mangroves and their characteristics. It helped clarify some threats to mangroves such as oil pollution. Most importantly, I found out why and through what process sediment trapping occurs in mangroves. It occurs because the mangrove roots create turbulence during high tide which keeps the sediments within the water in suspension. Suspended sediments, I found out, are sediments which are still in the water. During this time, the sediment particles undergo flocculation. My research has told me that flocculation is the combining of smaller particles into larger particles called flocs which, because of their increased weight, can sink to the bottom of a liquid as a sediment. At low tide, the water flow is much slower and the sediments can sink to the bottom without being dragged away with the outgoing water. I referenced one or two articles which documented these processes, as well as the non-scientific websites I used such as OzCoasts and Khan Academy which gave me a layman's understanding of sediments and flocculation.

My research has prompted a shift in my experiment methodology. I should really be testing the turbidity of the water during high tide and during low tide to ensure the process has taken place. Otherwise, I might test during high tide and get a high turbidity reading but receive the opposite result at low tide. This would skew my results. I will take the fluctuation of turbidity with the tides into account and test before and after the high tide. I will still test at different distances from the mangroves to compare to a non-mangrove environment. My research did mention that mangrove forests which underwent land clearing reported more suspended sediments. Following from that, the

two things I will need to do now are alter my method and research the tides of Sydney over the next two weeks so that I can structure my sample taking around that. I have done quite a lot of work today. Now the main task that remains to be done is to conduct my research. I shall devote certain days of the following week to my experiment so that it is done by about halfway through the week after next. Then I shall have plenty of time to repeat my experiment if necessary, write up my results and edit my project to a high level of perfection.

8/08/2016

I changed the method to suit my new experiment plan. It now mandates that I test the water within the mangroves and 10, 20 and 30 metres away. My method also mandates that take my samples before and after high tide to test whether the sediments have settled because of the outgoing tide. My research has shown me that the complex root structure of mangroves causes the sediments brought by high tide to stay in the mangrove forest rather than be re-entrained and flow back out the channel. My new method will now put this research to the test.

9/08/2016

And now the plan for my investigation has taken shape. I have consulted the tide times for Canada Bay where my mangroves are located. The website I used was called Willy Weather and gave me a graph and timetable for the rise and fall of the tides in Canada Bay. I constructed a table of the high tides and low tides I plan to measure:

High Tide	Low Tide
4:39 pm Saturday 13/08/2016	11:24 pm Saturday 13/08/2016
5:30 pm Sunday 14/08/2016	12:13 am Monday 15/08/2016
6:16 pm Monday 15/08/2016	12:56 am Tuesday 16/08/2016

As for my three locations of mangrove populations, I have decided. Locations 1 and 2 are close together on the foreshore of Halliday Park in Five Dock. Location 3 is on the opposite side of Canada Bay about 500 metres from Locations 1 and 2. It is on the shoreline of Bayview Park in Concord. Due to the distance between samples, time will be of the essence. Thankfully, the tides take some time to turn, meaning I have a large window to operate in without the state of the tides changing unacceptably.

This is where my locations are on a map of Canada Bay:

I made sure to cross-reference my tide timetable from Willy Weather against the Australian Bureau of Meteorology. The Bureau of Meteorology uses the tide station at the island of Fort Denison near Potts

Point for its predictions. Their times for the high and low tide were all exactly ten minutes ahead of the times given by Willy Weather for Canada Bay. The ten minute difference is expected because Fort Denison is closer to the sea and would experience an incoming or outgoing tide sooner than Canada Bay, which is farther down the Parramatta River. The consistent ten minute gap means that the times given by Willy Weather are consistent with the readings from the Bureau of Meteorology at Fort Denison, making them a reliable timetable.

I put together two car tow ropes which together equal ~27.5 metres. This is to measure my intervals, which will now be at 0 metres, 5 metres, 15 metres and 25 metres from the mangroves. I have also decided to measure turbidity on the spot rather than collect samples because of the exorbitant number of bottles I would need to carry all the samples home with me. If I take three samples at every interval – of which there are four – at three different locations I would need 36 bottles all up. I would then need to empty and rinse them all by the next high or low tide to begin again. This is excessive – therefore, I will simply carry with me one turbidity flask to measure on the spot. I have adjusted my method and materials accordingly. I might ask my friend if I can borrow his headlamp because many of the low tides occur during the night. The last thing I did today was redraw my results page to accommodate my new experiment setup. I will have three graphs of identical format to the one below:

Mangrove Location 1 (example results table)

Distance (m)	Turbidity of High Tide 1	Turbidity of Low Tide 1	Turbidity of High Tide 3	Turbidity of Low Tide 2	Turbidity of High Tide 3	Turbidity of Low Tide 3
0 (S1)						
0 (S2)						
0 (S3)						
0 (avg.)						
5 (S1)						
5 (S2)						
5 (S3)						
5 (avg.)						
15 (S1)						
15 (S2)						
15 (S3)						
15 (avg.)						
25 (S1)						
25 (S2)						
25 (S3)						
25 (avg.)						

11/08/2016

I set the correct alarms on my phone for every high tide and low tide I will be measuring. Every alarm is set one and a half hours before the turn of the high or low tide. That gives me half an hour to prepare and an hour to sample all the locations. Two locations are a minute's ride from my house, the third location is across the bay at Concord about an eight minute ride away. If I spend 15 minutes per location then I should fit in the experiment every time before the tide turns. Within that 15 minute window per location I have to take the turbidity of twelve samples of river water: 3 within the mangroves, 3 from 5 metres away, 3 from 15 metres away and 3 from 25 metres away. That gives me 1 minute and 15 seconds per turbidity sample. I need to take the river water, test the turbidity, record the result in a logbook and dispose of the water in that time. Should be done. If every location is

covered in 15 minutes that gives me a remaining 15 minutes to reach the locations and set up the measuring rope with the camping pegs every time.

13/08/2016

I conducted my first test today at High Tide 1. I constructed a turbidity flask by using a tall skinny spaghetti container and placing 1 cm marks on the side. I then marked a cross on the bottom. When I set up the measuring line along the shore I realised I had to have the yellow end near the mangroves and the green end farther away because that was the side I measured my 5, 15 and 25 metre increments from. The experiments went quite well with few hitches. I went overtime on the last location and finished around 16 minutes after the turn of the tide. In the future, I will leave myself a full hour to leave the house and take all the samples. I have also attached pegs at the 5, 15 and 25 metre increments so I know where the marks are from in the water without having to scan the length of the rope every time.

When I took my samples, I would wade about 2 two metres into the water. I would then take a sample with my turbidity flask, look through the tube and empty it until I could see the cross I drew on the bottom. I then emptied it out and repeated the process two more times. With three numbers in my head, I wrote them on my clipboard sitting on the sea wall and moved on to the next distance.

15/08/2016

I have been taking samples at the turn of the tide over the past three days. I tested the tide at Locations 1, 2 and 3 at the low tide after dark on the Saturday, arriving home just in time to see Kim Brennan win gold in the women's single scull. After that episode of sample collecting. I decided to forego testing at Location 3. The oysters and high wall made any ascension into the water at low tide too dangerous, and it was too far from the other two locations to be able to test all three mangrove forests in time. Therefore, for the remaining high tides and low tides I have decided to only test Locations 1 and 2.

My testing on Sunday afternoon for High Tide 2 went well – indeed it was quite picturesque. I made it within the turn of the tide. I went to bed early on Sunday night and woke up a little before midnight to test again for Low Tide 2. The constant trek to and from the water and shore through the sticky mud slowed me down quite a bit – however, I still made the measurement within the turn of the tide. It was very peaceful wading in the shallows after dark. I recorded my results on my clipboard, loaded up my bike and retired home.

This afternoon I tested High Tide 3 at Locations 2 and 3. The tide turned at 6:16, and I started testing at Location 1 around 6:10. A previous commitment held me up, and as a result I finished up around 7:00. Thankfully I did not horribly miss the high tide – however, a greater adherence to the time would have benefited the experiment. I noticed, after all this testing, that in many cases I can fill my turbidity flask to the brim and still see the cross at the bottom. This means that I would need a taller turbidity, but with nothing to hand I must use the equipment I have. This is unfortunate and must be mentioned when analysing the reliability, validity and accuracy of my investigation.

Tonight I have an alarm set for 11:26 pm to test Low Tide 3. The tide turns at 12:56 am, so I have given myself a half hour window to get ready and conduct my sampling. This is the last set of samples I will measure for turbidity in my experiment. I plan to write up my results in class tomorrow and start putting together some graphs and charts. Averaging the three samples from each distance and then graphing them as a line graph should illustrate the change in turbidity as we move further away from the mangroves. For example, I will graph High Tides 1, 2 and 3 plus Low Tides 1, 2 and 3 on a single line graph for Location 1. I will then repeat that format for Location 2. Seeing as comparing between

locations would introduce too many uncontrollable variables, I will restrict my comparisons to the status of tides and the different tides I measured.

16/08/2016

This morning I conducted my last set of turbidity testing just past midnight. The results of all my tests have been documented on field paper, extricated from the clipboard and stored underneath a lamp in my lounge room. I plan to plug all the numbers into my project on Wednesday afternoon. I experienced a profound sense of completion and relief as I waded into shore back to the clipboard lying on the grass, having taken my last set of turbidity readings at Location 2 25 metres from the mangroves. It was actually quite satisfying to walk barefoot through the thick mud at night – I felt quite connected to the natural environment of Canada Bay. However, the early mornings and extended testing were harder to enjoy. I am content now to write up my measurements and analyse my results.

18/08/2016

Last night I plugged all my numbers from the clipboard into my results table. It took less time than I expected and I managed to do it before *Gruen* started on ABC. Today in class I found all the averages of my three samples for each distance and location and plugged them into my overall tables. I then opened a new Microsoft Excel sheet and started making smaller tables to compare the high tide and low tide for each location. For example, I would take the averages of the three samples I took at 0, 5, 15 and 25 metres from Location 1 at High Tide 2 and Low Tide 2. I would then use Microsoft Excel to create a line graph and a generic table. I then inserted these two items into the investigation report. Currently, I have completed this process for High Tides 1, 2 and 3 and Low Tides 1, 2 and 3 for Location 1. This was done in class today.

In the afternoon, I completed the final line graphs and tables in Microsoft Excel and inserted them into my report. I also wrote a paragraph describing the results for each line graph and did a number of odd jobs around my investigation report. This included updating my risk assessment to include rocks and oysters, and adding clothes pegs to my materials and method to mark the distance intervals on the rope. I also changed headings and fonts to beautify all the placeholder headings I had used thus far. I also wrote a conclusion for my investigation which currently states that there is no increase or decrease in turbidity as the distance from the mangroves increases at high tide. At low tide there is a slight decrease indicated by a rise in turbidity measurements. I mentioned an outlier in Low Tide 1, Location 1. Finally, I said that there was overall lower turbidity at the low tide than at the high tide, which supported my hypothesis. I updated my hypothesis to take into account my changed experiment, mentioning the different distances as well as different tide circumstances.

It was interesting writing and interpreting my results because a rise in turbidity readings in my table or graph actually showed a drop in turbidity – that is, a drop in sediments suspended in the water sample. It was therefore a little bizarre to write that the turbidity had decreased dramatically when on the graph it had gone straight up. I included a small paragraph at the beginning of my results section which explained this peculiarity.

Right now I only have to write up my discussion – the big fish to fry right now – and reference everything in my bibliography with validity and reliability. The discussion I hope to start in class tomorrow and finish on Saturday. The bibliography is less intensive. That can be completed on Sunday.

20/8/2016

Today I wrote much of my discussion. I split it into subheadings and included an explanation of results, a discussion of my background research and a discussion of the social importance of my experiment. It was interesting because in the end I had to conclude that there was no or a minimal trend connecting water turbidity and the distance from the mangroves. I eventually concluded that mangroves had minimal effect on water turbidity and the difference between high tide and low tide was determined externally. The turbidity of a water body changed with the tides independent of the presence of mangroves, and remained constant throughout.

It was also interesting writing my discussion of social importance because the inconclusive results of my experiment meant that mangroves as a potential purifier of a water body were not viable. My experiment was thus related to an issue of social importance but did not prove that mangroves could address this issue.

21/8/2016

I finished writing my discussion. Ah, joy! My investigation report is almost complete. I wrote a frank assessment of what went wrong in the investigation, what could be improved and any abnormalities that I identified. Additionally, I pondered what future avenues of investigation could be pursued from the results of my experiment. I then analysed the entire experiment for reliability, validity and accuracy.

I referenced the sources I used in the bibliography and assessed their validity. I created a cover page for the experiment write-up. I noticed that other science research projects had witty or catchy names, so I used some alliteration and called my report: Mangrove Munificence. My subtitle was just the experiment title of my investigation. So, I am nearly finished. Only three tasks remain to be done in this project:

- Reference the reliability of my bibliography.
- Give the abstract a once over.
- Read the whole document (check for spelling errors, arrange all the sections neatly, add page numbers)

The science research project is to be submitted by Wednesday. It is Sunday now, so I will knock over the first two tasks on Monday. They are both pretty easy – the abstract will take me two minutes and the reliability section about half an hour. I am busy on Monday so this is the small contribution I will make. On Tuesday I have the whole afternoon to myself – I will proofread the entire document and arrange it neatly with separate pages for every section. This is a scientific report. It must look the part, and read like one too.

22/8/2016

I have assessed all my background research and secondary sources for reliability and accuracy. That took not too long and was the main task to be completed. I checked my abstract – it really didn't need any further changes. I only changed one sentence to mention that I would test at difference distances from the mangroves rather than simply on an adjacent stretch of land. I also rearranged all the sections of my investigation on their own pages and did little bits of housekeeping. I placed the abstract on the title page and changed the headings throughout the investigation. I added an automatic table of contents. I upped the font size for parts of my investigation which were on spacious pages such as my results section. My graphs became a lot bigger, as did my tables. All in all, my science research project is looking pretty neat.

I looked over the winning entries from last year in Earth and Environmental Science. Very impressive work, they were all of a really high standard. It was a little harder to compare my investigation to the third place because hers was a survey, so I mostly referred to the other two. However, I did realise that I needed lots of visuals to enhance my project. My teacher even said I should include a visual reference for my method when describing the turbidity flask setup. So I used many of the photos I took throughout the experiment of equipment, the mangroves and general scenic panoramas. I used them to show my equipment, show the location I was at or provide a sense of what I was doing. I also split my background research into subheadings as the first place winner had done. I appreciated the second place from last year because it was very clean and to the point. First place had lots of detail and information, while third place had plenty of visuals. Very inspiring and informative.

I included an acknowledgements page after my bibliography where I thanked my teacher Mr. Guy and my mother for giving me tips and encouragement. Mr. Guy had mentioned that I should acknowledge any help I received, and I was reminded of this fact by the second place from last year when I was looking over his science research project.

I had planned to edit my science research project tonight for spelling errors; however, I am fairly tired after finishing off and formatting the project, especially considering I played competitive table tennis for the whole day today. It is also better to edit documents in paper form, so my plan is to print off a paper form tonight on scrap paper and bring it to school tomorrow. I can then go over it with my red editor's pen during science in first period and during lunchtime and sport when I have free time. This way I will not waste my concentration as I would if I did it all in a one hour block. It helps refresh my brain and keeps me on the lookout for spelling errors, formatting errors or inconsistencies in my writing.

23/8/2016

I printed off my science research project last night and proofread it on the bus and in science today. I found areas which needed improvement such as my main tables of results. I plan to split them into four smaller tables for 0, 5, 15 and 25 metres from mangroves for each location. My old table setup was in one whole table. Here is my old table format for Mangrove Location 1:

Distance (m)	**Turbidity of High Tide 1**	**Turbidity of Low Tide 1**	**Turbidity of High Tide 2**	**Turbidity of Low Tide 2**	**Turbidity of High Tide 3**	**Turbidity of Low Tide 3**
(Sample No.)	4:39pm Saturday 13/08/16	11:24 pm Saturday 13/08/16	5:30 pm Sunday 14/08/16	12:13 am Monday 15/08/16	6:16 pm Monday 15/08/16	12:56 am Tuesday 16/08/16
0 (S1)	4.5	22	25.5	21	18.5	25
0 (S2)	5.5	14	25	21	17.5	21
0 (S3)	7	5	25.5	20	17	25
0 (avg.)	**5.67**	**13.67**	**25.33**	**20.67**	**17.67**	**23.67**
5 (S1)	8.5	9	26	22.5	23.5	24
5 (S2)	8	15	26	14	22	24
5 (S3)	8	15.5	26	21	23	25
5 (avg.)	**8.17**	**13.17**	**26.00**	**19.17**	**22.83**	**24.33**
15 (S1)	8.5	2	26	22	19.5	24
15 (S2)	8	15.5	26	22	14.5	24.5

15 (S3)	8	22.5	25.5	20.5	14.5	24.5
15 (avg.)	**8.17**	**13.33**	**25.83**	**21.50**	**16.17**	**24.33**
25 (S1)	8.5	24	26	23	16	25
25 (S2)	8.5	24	26	24	14	25
25 (S3)	9	24	26	23	16.5	25
25 (avg.)	**6.67**	**24.00**	**26.00**	**23.33**	**15.50**	**25.00**

Having made the smaller tables, I found that I could not fit them all on the one page. I played around with the old graph seen above and found I could add a row and merge the cells to give a space. This differentiates each graph but still keeps it with the same tide headings up the top, using up less room.

All the editions from my proofreading have been added to the investigation. I also added subheadings to my 'Investigation Review' section of my discussion: 'Investigation Improvements,' 'Directions of Future Research' and 'Explanation of Abnormalities.' The final thing I did was to add axes to my six charts showing the high tide and low tide in line graph format. I named the x-axis 'Distance from mangroves (metres)' and the y-axis 'Turbidity (cm on flask).'

The whole idea of higher turbidity figures equalling lower turbidity is fairly confusing, which is why I wrote many notes and reminders in the results section of the report to help people interpret my data and discussion. I fixed up the table of contents, which had gone a little weird with some formatting shenanigans. I added a few more photos to my background research of the locations where the testing took place because I didn't want my science research project to be all text and graphs.

After much editing, formatting and designing, I believe my science research project to be complete. All up I now have eleven images carefully inserted into my document without moving too much text around. I have created at least five PDF drafts of the project, using them to freeze my document in time and search for any errors or formatting mistakes.

However…

I have scoured my final PDF, and I am happy with it. Everything is in order; all my graphs are centred and the axes have no spelling errors. No text is spilling onto extra pages. The table of contents is – at long last – accurate.

It appears that I am done.

Well, it has been a journey. It has been insightful but confusing. Challenging at times, but at others there was nothing to stop my progress. There were times when I was excited; others when the thought of waking up again to trudge through the mud with my turbidity flask made me groan and want to go back to sleep. It has been an intellectual adventure.

In the end, I learned something. I learned about mangroves. I learned about tides. I learned lots of different words and phrases. I learned how to write a discussion, reference reliability, conduct a risk assessment, draft an abstract and account for variables.

And so, my erstwhile science research project, I bid you a fond farewell. Take care in the big wide world. Be careful. Strive to be happy.

Good bye, my friend. And good luck.