



Prize Winner

Science Investigation

Year 5 - 6

Daniel Boucher

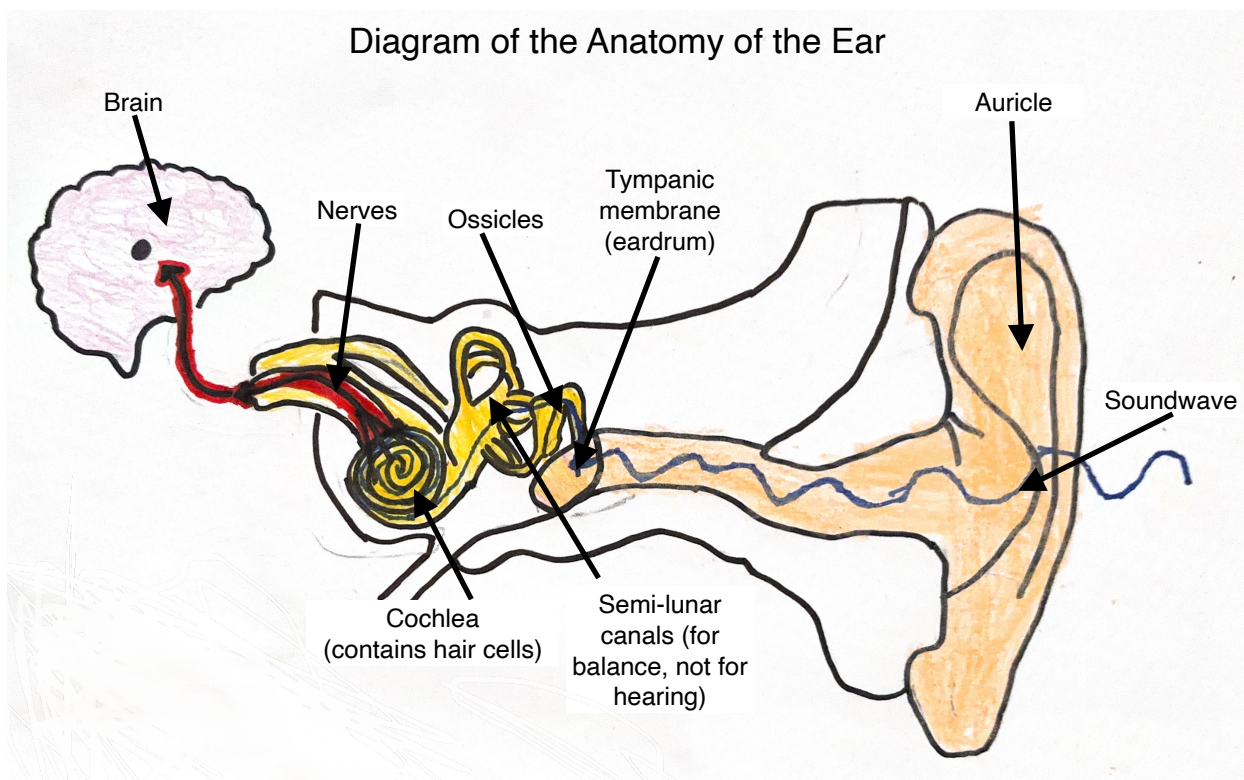
**St Peter's Woodlands Grammar
School**



Science Investigation: Hear Today, Gone Tomorrow

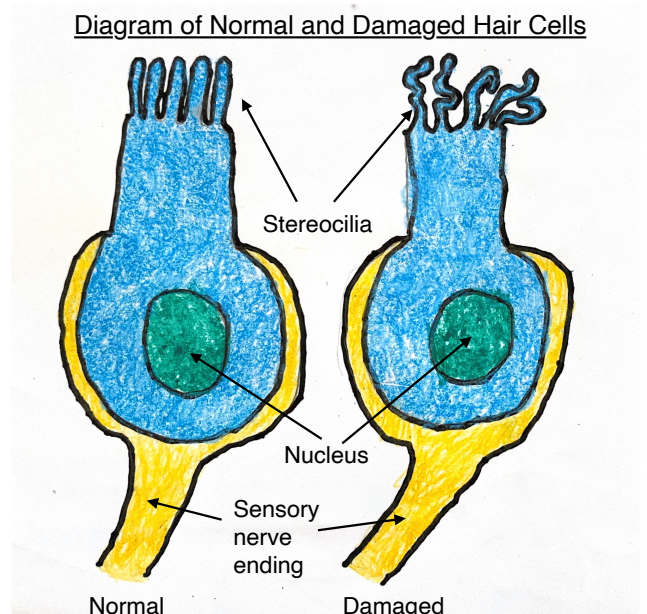
By Daniel Boucher

Background



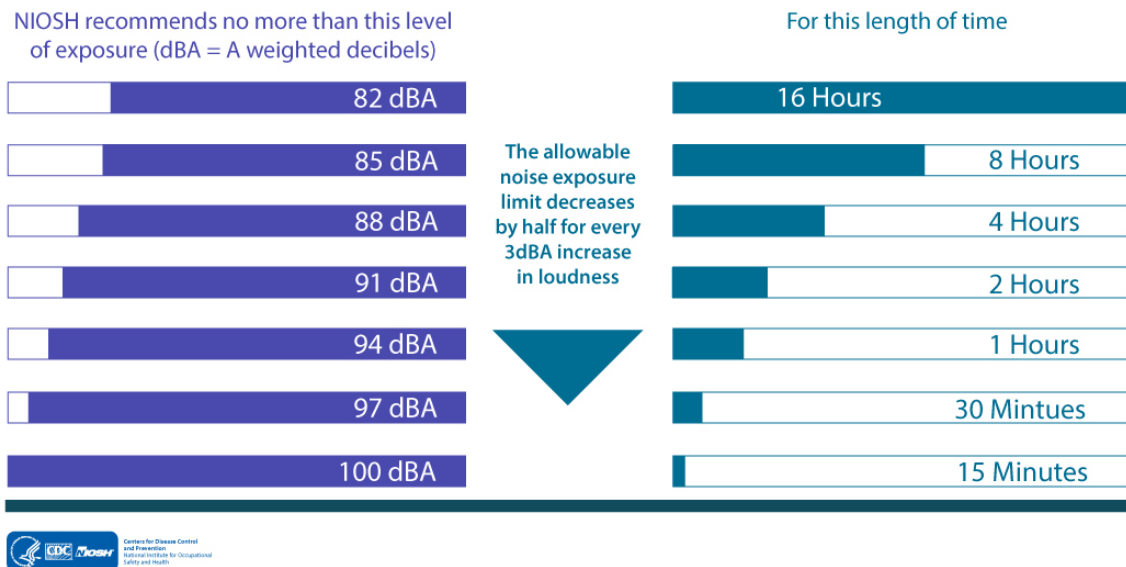
Sound is transmitted by vibrating particles. Sound travels through the outer ear (auricle) into the ear canal. It then vibrates the tympanic membrane (eardrum) and then the malleus, incus and stapes (the smallest bone in the body). It then hits the oval window of the cochlea and makes the hair cells vibrate. Then the hair cells send a signal to the brain via the auditory nerve. Then the brain interprets the signal and tells us what we are hearing.

Hearing damage can depend on the level of noise and also the duration of noise exposure. Safe Work Australia guidelines say that workers must not be exposed to noise of 85dB or higher



over an 8 hour day. They must also not ever be exposed to a noise level above 140dB. This can instantly damage someone's hearing. The chart below shows that for every 3dB increase in noise, the safe length of time someone can experience it for halves. Hearing damage includes permanent or temporary hearing loss and tinnitus (ringing in the ears).

Exposure Level per NIOSH REL



Questioning and Predicting

Aim:

The aim of my investigation is to investigate sound levels at school to see if they are above safe levels.

Hypothesis:

1. I predict that sound levels will be above safe levels
2. I predict that the loudest time of the day will be between 8.00am and 8.45am on Tuesdays, Wednesdays and Thursdays, when I am playing in bands.

Planning and Conducting

Method

I used the National Institute for Occupational Safety and Health (NIOSH) Sound Level Meter app on my iPad to measure sound levels. This app records sound levels and for each recording gives several measurement values. These are the ones that I used in my experiment:

- LAeq - this is the average sound level per second, in A-weighted decibels, which means that the decibels (dB) are adjusted so they are closer to what humans would experience at low sound levels.
- LCPeak - this is the highest level that the sound pressure waves ever got to, in C-weighted decibels. C-weighted decibels are adjusted to how ears respond to loud noises.
- Dose - this is the percentage of the maximum recommended daily total noise exposure that was reached during the recording.

I measured the sound each school day over a two week period, from when I started band in the morning before school, or from when the school day started. The variable that was measured was the different noise exposure each day. I kept the iPad with me when recording to try to see how much noise I was being exposed to, rather than leaving it in other places in the room. I reduced artificial noise exposure by stopping recording when other students were intentionally making loud noise near the microphone. There were some times that sound did not get recorded, which are talked about in the logbook.

Processing and Analysing Data and Information

To analyse the data, I put it into a table which showed the different measurements for each day. Then I worked out the average LAeq (average noise exposure). To do this I worked out the time in seconds for each recording, multiplied the time by the LAeq for each recording, added all of these answers together, then divided by the total number of seconds. I also added up the doses to find out the total dose and I wrote down the highest LCPeak. I compared the results to safe noise exposure levels.

Evaluating and Communicating

Results Summary

What were the main findings?

On Wednesday the 10th of June, the sound levels were extremely high. It was the only day when the school day was louder than band. The reason for this is that the Kindness Convention was on that day. The Kindness Convention was a day where the year level got together, then split into small groups to come up with a solution to a problem in the world. The average sound level that day (LAeq) was 102dB, which can only be safely listened to for about 10 minutes. The LCPeak on that day was 147dB, which is loud enough to instantly cause hearing damage. The total dose that day was 3399%, which is more than 30 times the recommended maximum daily noise exposure, despite the recordings only being for 51 minutes and 48 seconds.

The other main finding was that overall band was louder than the school day. The average band noise was 96.1dB, compared to the average school day level of 85.9dB. 96.1dB can be safely listened to for about half an hour, which is the same length as band practice, but this uses up a large amount of the daily safe dose of noise. On school days without the Kindness Convention the average LAeq was 83.4dB, which is in the safe range. There were still loud times of the day, with LCPeak reaching 144dB on one day, which is above the 140dB safe limit, and LCPeak going over 130 on most days.

How did these compare to your hypothesis?

According to the results, my hypothesis was generally correct. Safe noise limits were exceeded and Band was generally the loudest time of the day. But what I did not expect was that the Kindness Convention was louder than any band day, and I was surprised by how much over the safe noise limits it went.

What were some of the problems with the investigation, and what could be done differently in a similar investigation in future?

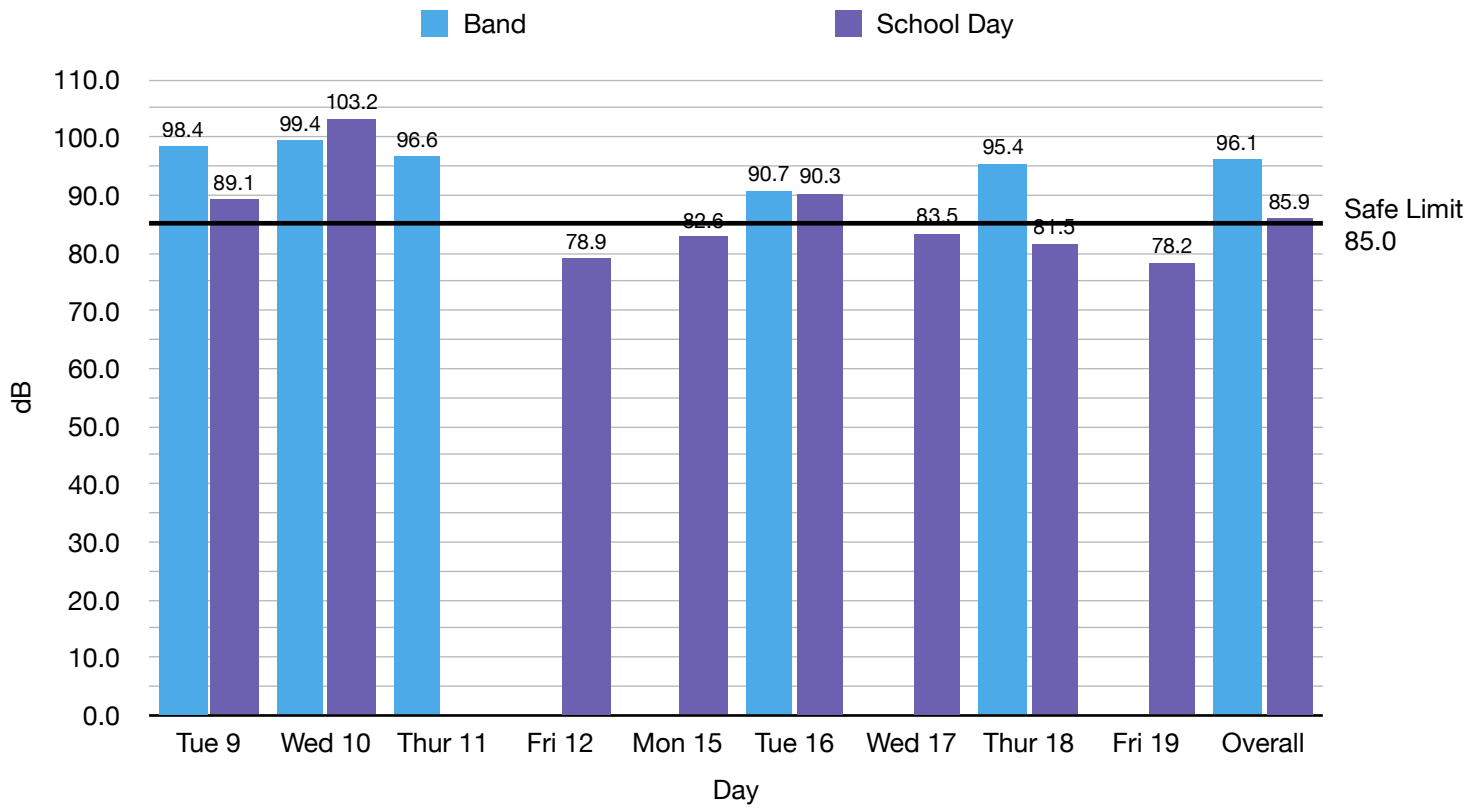
The data that was collected did not show the entire noise exposure over a whole school day. There were times that I forgot to record data. Once my iPad ran out of battery and I lost 3 hours of recordings. When I was not allowed to record by the supervising teacher during Kindness Convention, it meant I missed most of the day with really extreme noise exposure. Also, kids tried to yell into the sound meter and I had to pause the recording several times so that it did not record artificial results that wouldn't have happened normally. These problems could be improved by making it so that the kids in the classroom don't know what is going on. The iPad could be hidden in position in the classroom, but then the noise reaching the iPad might not be the same noise level I am exposed to. Instead of emailing just my usual teachers, I could send the email to all the school teachers in case they become involved in the study. Instead of using the NIOSH app, I could consider a decibel meter which has improved accuracy. However, these are expensive and more difficult to access than the app. The NIOSH app is available to everyone and is accurate to within +/- 2dB.

What recommendations do you have for the school or for other students based on your research?

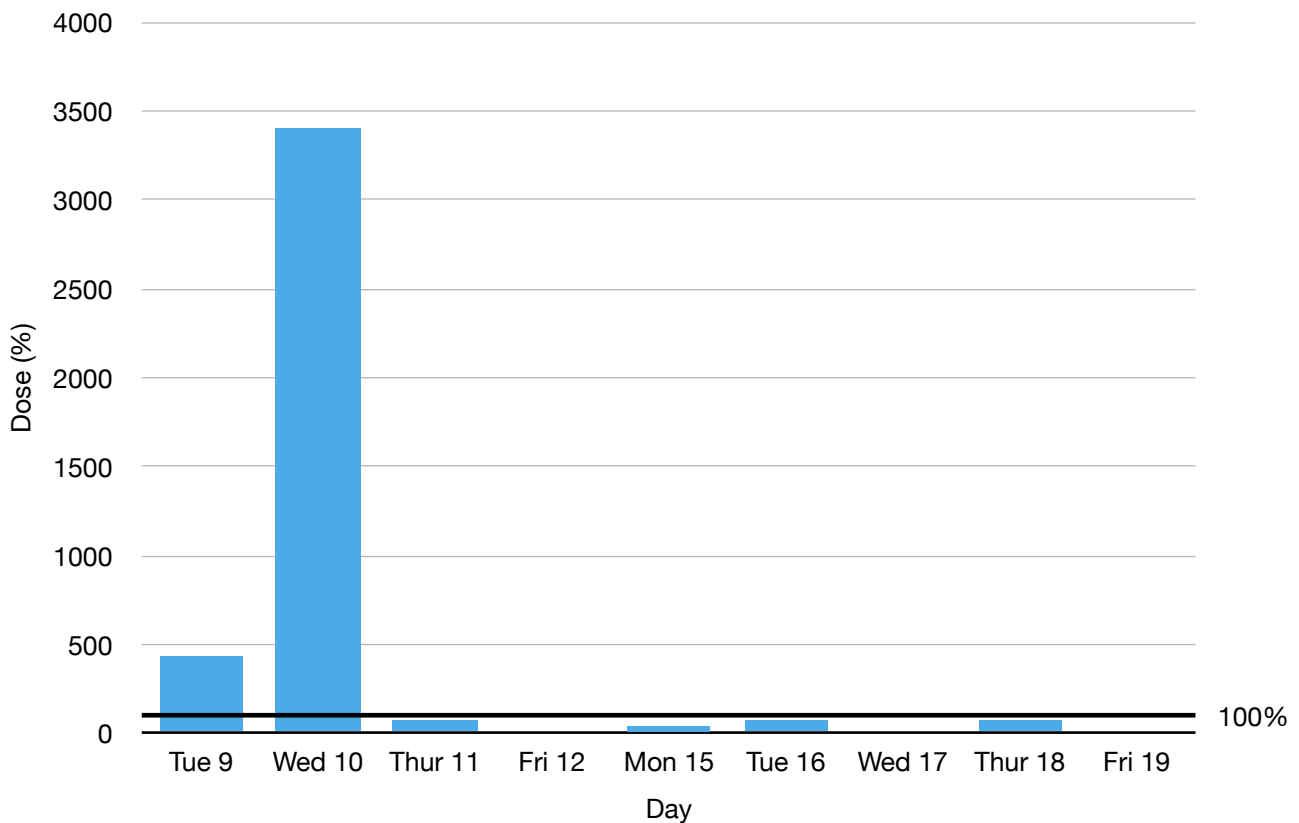
I hope that people reading my investigation will learn that even when noise can seem low, it can actually still be very loud and this can cause hearing damage without you even knowing it. Once you have hearing damage, you lose the ability to hear softer sounds and so people turn up the noise even louder, which causes even more damage. I plan to show my results to my school teachers, principal and classmates so they can be aware of the noise exposure and the risk of hearing damage at school. During times of expected high noise exposure, such as band, students could wear hearing protection such as ear plugs or ear muffs. I also think that the school could lower the noise levels at the Kindness Convention by giving out a prize for the quietest group!

Results Tables and Graphs

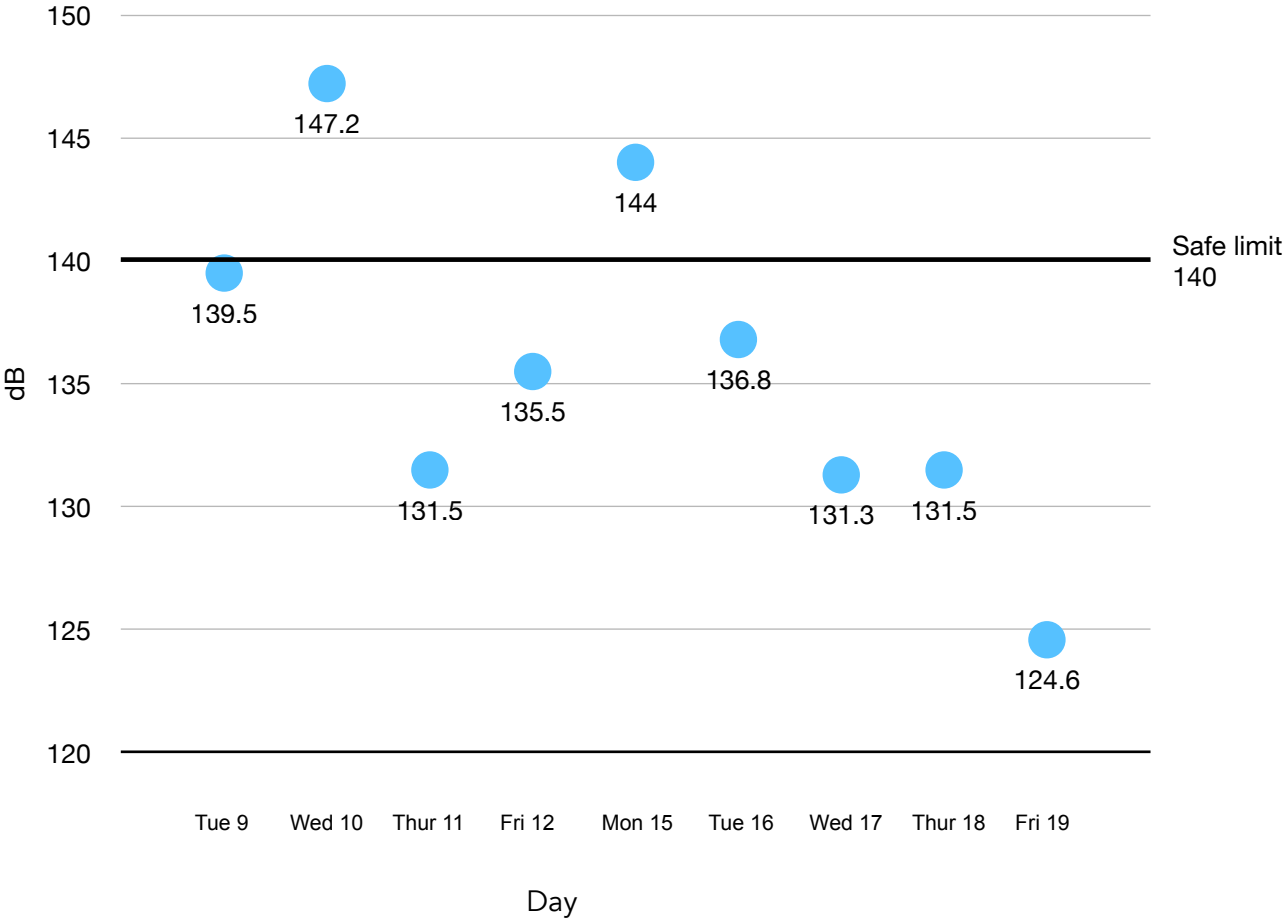
Band Noise Exposure Compared to School Day Noise Exposure



Dose Recorded Each Day



Peak Noise Exposure Each Day (dB)



Results Tables

Day	Date	Time Started	Time Concluded	Duration (hours, minutes + seconds)	Duration (seconds)	LAeq (dB)	LAeq x Duration in seconds	LCPeak (dB)	Dose
Tuesday	09/06/2026	8:09am	8:21am	00:11:37	697	98.4	68584.8	128.1dB	53.3%
Tuesday	09/06/2026	8:31am	8:32am	00:00:14	14	115	1610	139.5dB	48%
Tuesday	09/06/2026	8:32am	8:36am	00:03:04	184	103.3	19007.2	136dB	44.4%
Tuesday	09/06/2026	8:38am	8:39am	00:00:47	47	93.1	4375.7	127.1dB	1%
Tuesday	09/06/2026	9:23am	9:24am	00:00:02	2	75	150	93.6dB	0%
Tuesday	09/06/2026	10:05am	10:06am	00:00:02	2	90.8	181.6	108.6dB	0%
Tuesday	09/06/2026	10:09am	10:55am	00:45:55	2755	88.6	244093	133.1dB	21.7%
Tuesday	09/06/2026	10:55am	11:21am	00:25:28	1528	81.2	124073.6	134.4dB	2%
Tuesday	09/06/2026	11:47am	11:48am	00:00:02	2	76.2	152.4	100dB	0%
Tuesday	09/06/2026	12:04pm	12:05pm	00:00:01	1	106.2	106.2	116dB	0%
Tuesday	09/06/2026	12:06pm	12:09pm	00:02:37	157	108	16956	138.6dB	110.3%
Tuesday	09/06/2026	12:09pm	12:10pm	00:00:31	31	79.5	2464.5	121.7dB	0%
Tuesday	09/06/2026	12:11pm	12:16pm	00:04:44	284	68	19312	109.7dB	0%
Tuesday	09/06/2026	12:18pm	12:53pm	00:34:13	2053	87.3	179226.9	130.9dB	11.5%
Tuesday	09/06/2026	1:43pm	2:16pm	00:32:44	1964	98.1	192668.4	138.1dB	139.7%
Tuesday	09/06/2026	2:28pm	2:29pm	00:00:12	12	74.2	890.4	107.9dB	0%
				Total time	9733	Sum of LAeq x duration	873852.7	Total dose	431.9%
						Average LAeq	89.8	Greatest LCPeak	139.5dB
Before school band practice/ band pack-up	98.4								
School day	89.1								

Day	Date	Time Started	Time Concluded	Duration (hours, minutes + seconds)	Duration (seconds)	LAeq (dB)	LAeq x Duration in seconds	LCPeak (dB)	Dose
Wednesday	10/06/2026	8:11am	8:28am	00:16:21	981	99.4	97511.4	137.4	95%
Wednesday	10/06/2026	8:52am	8:58am	00:05:58	358	92.7	33186.6	121.8	7.3%
Wednesday	10/06/2026	9:52am	9:53am	00:00:07	7	110	770	128.5	5.3%
Wednesday	10/06/2026	9:55am	9:56am	00:00:08	8	106.7	853.6	131.7	1.1%
Wednesday	10/06/2026	9:57am	10:01am	00:03:38	218	109.4	23849.2	139.2	215.5%
Wednesday	10/06/2026	10:00am	10:07am	00:06:05	365	103.2	37668	136.7	84.2%
Wednesday	10/06/2026	10:07am	10:08am	00:00:52	52	125.8	6541.6	146	1919.7%
Wednesday	10/06/2026	10:08am	10:10am	00:01:46	106	116.8	12380.8	144.7	573.8%
Wednesday	10/06/2026	10:10am	10:12am	00:01:47	107	108.9	11652.3	138.9	93.3%
Wednesday	10/06/2026	10:11am	10:14am	00:02:11	131	106.1	13899.1	138.9	60.2%
Wednesday	10/06/2026	10:32am	10:35am	00:02:07	127	97.7	12407.9	130.3	8.2%
Wednesday	10/06/2026	10:34am	10:37am	00:02:32	152	102.9	15640.8	140.7	32.7%
Wednesday	10/06/2026	10:37am	10:39am	00:01:38	98	106.2	10407.6	147.2	43.6%
Wednesday	10/06/2026	10:38am	10:40am	00:01:20	80	106.4	8512	135.8	35.3%
Wednesday	10/06/2026	10:40am	10:41am	00:00:48	48	115.4	5539.2	134.5	184.7%
Wednesday	10/06/2026	10:41am	10:42am	00:00:58	58	106.9	6200.2	133.4	31.1%
Wednesday	10/06/2026	10:42am	10:43am	00:00:08	8	102.3	818.4	123.7	1.3%
Wednesday	10/06/2026	10:42am	10:43am	00:00:05	5	89	445	111.8	0.1%
Wednesday	10/06/2026	2:48pm	2:50pm	00:01:02	62	93.7	5809.4	116.4	1.6%
Wednesday	10/06/2026	3:01pm	3:03pm	00:01:30	90	96.5	8685	139	4.3%
Wednesday	10/06/2026	3:03pm	3:04pm	00:00:47	47	91.6	4305.2	125.2	0.7%
				Total time	3108	Sum of LAeq x duration	317083.3	Total dose	3399%
						Average LAeq	102.0	Greatest LCPeak	147.2
Before school band practice/ band pack-up	99.4								
School day	103.2								

Day	Date	Time Started	Time Concluded	Duration (hours, minutes + seconds)	Duration (seconds)	LAeq (dB)	LAeq x Duration in seconds	LCPeak (dB)	Dose
Thursday	11/06/2026	8:11am	8:19am	00:07:15	435	94.5	41107.5	124	13.5%
Thursday	11/06/2026	8:18am	8:26am	00:07:30	450	97.6	43920	128.5	29%
Thursday	11/06/2026	8:26am	8:34am	00:07:37	457	97.7	44648.9	131.5	29.9%
				Total time	1342	Sum of LAeq x duration	129676.4	Total dose	72.4%
						Average LAeq	96.6	Greatest LCPeak	131.5dB
Before school band practice/ band pack-up	96.6								
School day	Not recorded								

Day	Date	Time Started	Time Concluded	Duration (hours, minutes + seconds)	Duration (seconds)	LAeq (dB)	LAeq x Duration in seconds	LCPeak (dB)	Dose
Friday	12/06/2026	10:18am	12:44pm	02:25:31	8731	77.6	677525.6	122.3	5.1%
Friday	12/06/2026	1:45pm	2:01pm	00:15:32	932	87.4	81456.8	133.7	5.5%
Friday	12/06/2026	2:01pm	2:23pm	00:21:25	1285	81.9	105241.5	135.5	1.9%
Friday	12/06/2026	2:23pm	2:24pm	00:00:02	2	94	188	128.7	0%
				Total time	10950	Sum of LAeq x duration	864411.9	Total dose	12.5%
						Average LAeq	78.9	Greatest LCPeak	135.5
Before school band practice/ band pack-up	Not recorded (no band)								
School day	78.9								

Day	Date	Time Started	Time Concluded	Duration (hours, minutes + seconds)	Duration (seconds)	LAeq (dB)	LAeq x Duration in seconds	LCPeak (dB)	Dose
Monday	15/06/2026	12:49pm	1:46pm	00:56:33	3393	79.6	270082.8	125.4	3.1
Monday	15/06/2026	2:32pm	2:51pm	00:18:48	1128	90.6	102196.8	144	31.1
Monday	15/06/2026	2:50pm	2:52pm	00:01:08	68	101.5	6902	129.7	10.1
				Total time	4589	Sum of LAeq x duration	379181.6	Total dose	44.3
						Average LAeq	82.6	Greatest LCPeak	144
Before school band practice/ band pack-up	Not recorded (no band)								
School day	82.6								

Day	Date	Time Started	Time Concluded	Duration (hours, minutes + seconds)	Duration (seconds)	LAeq (dB)	LAeq x Duration in seconds	LCPeak (dB)	Dose
Tuesday	16/06/2026	8:21am	8:26am	00:04:05	245	93.5	22907.5	123	6%
Tuesday	16/06/2026	8:25am	8:32am	00:06:21	381	88.9	33870.9	131.8	3.2%
Tuesday	16/06/2026	8:33am	8:38am	00:04:49	289	93.8	27108.2	126.3	7.6%
Tuesday	16/06/2026	9:00am	9:24am	00:23:29	1409	85.6	120610.4	129.5	5.4%
Tuesday	16/06/2026	1:42pm	2:28pm	00:45:15	2715	92.4	250866	136.8	52%
				Total time	5039	Sum of LAeq x duration	455363	Total dose	74.2%
						Average LAeq	90.4	Greatest LCPeak	136.8
Before school band practice/ band pack-up	90.7								
School day	90.3								

Day	Date	Time Started	Time Concluded	Duration (hours, minutes + seconds)	Duration (seconds)	LAeq (dB)	LAeq x Duration in seconds	LCPeak (dB)	Dose
Wednesday	17/06/2026	8:44am	8:45am	00:00:03	3	68.6	205.8	92.5	0%
Wednesday	17/06/2026	8:52am	10:09am	01:16:32	4592	83	381136	130.1	9.5%
Wednesday	17/06/2026	10:11am	10:12am	00:00:16	16	83.4	1334.4	120	0%
Wednesday	17/06/2026	10:12am	10:37am	00:24:40	1480	84	124320	131.3	3.8%
Wednesday	17/06/2026	10:36am	10:41am	00:04:17	257	87.7	22538.9	126.2	1.7%
Wednesday	17/06/2026	3:03pm	3:04pm	00:00:43	43	98	4214	126.7	3%
				Total time	6391	Sum of LAeq x duration	533749.1	Total dose	18%
						Average LAeq	83.5	Greatest LCPeak	131.3
Before school band practice/ band pack-up	Not recorded								
School day	83.5								

Day	Date	Time Started	Time Concluded	Duration (hours, minutes + seconds)	Duration (seconds)	LAeq (dB)	LAeq x Duration in seconds	LCPeak (dB)	Dose
Thursday	18/06/2026	8:04am	8:31am	00:26:36	1596	95.4	152258.4	131.5	61.6%
Thursday	18/06/2026	9:00am	10:01am	01:00:36	3636	81.5	296334	122.6	4.5%
Thursday	18/06/2026	2:27pm	2:28pm	00:00:03	3	85.1	255.3	101.6	0%
				Total time	5235	Sum of LAeq x duration	448847.7	Total dose	66.1%
						Average LAeq	85.7	Greatest LCPeak	131.5
Before school band practice/ band pack-up	95.4								
School day	81.5								

Day	Date	Time Started	Time Concluded	Duration (hours, minutes + seconds)	Duration (seconds)	LAeq (dB)	LAeq x Duration in seconds	LCPeak (dB)	Dose
Friday	19/06/2026	8:42am	12:22pm	03:39:57	13197	78.3	1033325.1	124.6	8.5%
Friday	19/06/2026	12:39pm	12:50pm	00:10:55	655	75.8	49649	117.2	0.1%
				Total time	13852	Sum of LAeq x duration	1082974.1	Total dose	8.6%
						Average LAeq	78.2	Greatest LCPeak	124.6
Before school band practice/ band pack-up	Not recorded (no band)								
School day	78.2								

References

Safe Work Australia

Noise

<https://www.safeworkaustralia.gov.au/duties-tool/construction/hazards-information/noise>

Center for Disease Control

NIOSH Sound Level Meter Application for iOS devices - User Guide

<https://www.cdc.gov/niosh/media/pdfs/NIOSH-Sound-Level-Meter-Application-app-English.pdf>

Understand Noise Exposure

<https://www.cdc.gov/niosh/noise/prevent/understand.html>

Honeywell Safety Products USA

Sound Source No 5 (2017)

A- and C- Weighted Noise Measurements

<https://explore.honeywell.com/rs/510-REI-219/images/HON-SoundSource-AC-Weighted-Noise.pdf>

SciShow Kids

Video: How Ears Let Us Hear the World

<https://www.youtube.com/watch?v=6WNHyAXIN8c>

Castle Group Ltd

Video: What is the Difference Between Lpeak and Lmax. A Castle Group Tutorial

https://www.youtube.com/watch?v=XpZOKeL_nqM

Axel Kock

Illustration Showing Tinnitus

<https://www.shutterstock.com/image-illustration/tinnitus-healthy-damaged-hair-cells-inside-1966535728>

Sakurra

Illustration Showing Healthy and Damaged Hair Cells Inside Cochlea

<https://www.shutterstock.com/image-vector/healthy-damaged-hair-cells-inside-cochlea-2373656203>

Word count 1201 (not including headings, logbook, references, graphs and data tables)

Acknowledgements

St Peter's Woodlands Grammar School - for letting me do this investigation at school.

Mum - For encouraging me and helping me learn about how the ear works.

Dad - For encouraging me and helping out with the spreadsheets and graphs.

Oliphant Science 2026: Hear Today, Gone Tomorrow

Daniel's Logbook

Friday 5 June

Today I finished my Oliphant Risk Assessment form.

I read an article about hearing damage. I watched a video about how the ear works and hair cells.

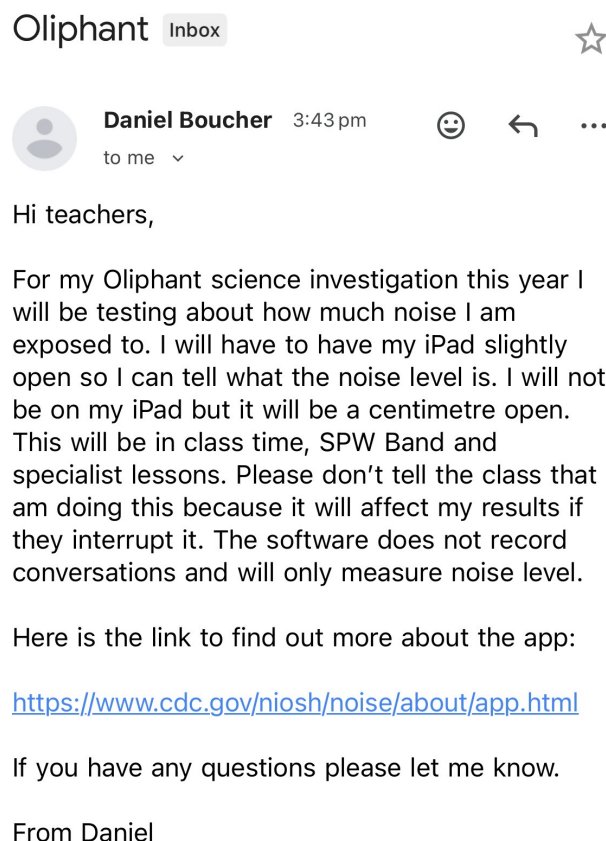
I am going to make a diagram about how the ear works and how it gets damaged by loud noises.

My hypothesis is that the noise at school will be above safe levels and the loudest times will be 8 - 8.45am.

Monday 8 June

I am planning to start my data collection tomorrow. I emailed all my teachers so that they understand what I will be doing and can ask any questions they have.

This is my email:



Tuesday 9 June

I started my recordings today. I had Chapel band practice this morning. In Chapel band, there is one violin, many drummers, two pianists and a choir. I recorded classroom time during Health. I recorded at Chapel and at PE.

I could not record during Music because I was recording my own voice for my ad for Australia, so the NIOSH app would not work when the microphone was already being used. I noticed that I had to pause my recordings multiple times and restart because other kids kept trying to yell into it. Some got told to stop and some kids just forgot about it so the recording could continue as normal.

Wednesday 10 June

I had Keyboard Ensemble practise this morning. This is a group of about 7 electronic keyboard players and one drummer. We had the Kindness Convention today, which was unexpected. I set up my recording and a teacher, who is not one of my usual teachers and who wasn't part of the email, came across and said that I was not allowed to do my recording. I explained my investigation and they said no. I felt sad about that. I did manage to sneak a few recordings in during the day though. These turned out to be very important readings.

Thursday 11 June

I had SPW Band practice this morning. This is a big band, and one I thought would be quite loud. There are many violins, a bass guitarist, many guitarists, 4 pianists, a few saxophone players and many drummers. On Thursdays, we spend most of our time in the classroom rather than specialist lessons. The recordings went well today, there were not many interruptions. I did lose three hours of recordings because my iPad battery ran out! I will have to be careful to check that it is charged in the mornings.

Friday 12 June

I didn't get many recordings today because many kids were trying to yell into the microphone, causing lots of interruptions. Some kids eventually lost interest, some got told off because they were being too noisy. We had double STEM. We also had the student opening of the Dr Pamela Wall Centre and I couldn't take my iPad.

Monday 15 June

I got some recordings today. Kids were still interrupting. I had Japanese and I got to record there.

Tuesday 16 June

I had Chapel band practice this morning. I got some good recordings but kids were still trying to interrupt sometimes and so I had to pause it. I had to keep it slightly open so it would record, and sometimes people would accidentally step on it and it would close, so that caused some pauses in the data collection too. I recorded during the Chapel service.

Wednesday 17 June

I had Keyboard Ensemble practice this morning but I forgot to record! I felt frustrated. I recorded some bits and pieces during classroom time. I recorded part of Art.

Thursday 18 June

I had SPW band practice this morning. I didn't get many recordings today because of kids interrupting it.

Friday 19 June

This was the last day of recording. I didn't record in assembly because I didn't think I would be allowed to have my iPad. I think the noise level there would be similar to when we are at Chapel. I am looking forward to analysing my data.

Saturday 20 June

I made a diagram of the parts of the ear. I found it interesting to learn more about the different parts of the ear. I learned about the auricle, ossicles, tympanic membrane and cochlea. I am going to label it using the computer.

Sunday 21 June

I learned that decibel readings are a logarithmic scale. This is when a graph line, instead of going up in a straight line, it goes up in a curve that gets steeper.

A logarithmic scale is useful because otherwise you'd need to use really large numbers to show loud noises. I included a picture in my report that shows a 3 decibel rise halves the safe listening time. That was interesting. I made some graphs in Pages.

Wednesday 24 June

When analysing the data, I realised that band practices finish at different times each day, so I needed to adjust which recordings were included in the band practice data and which were included in the rest of the school day.

Saturday 27 June

The project is due tomorrow. I still have quite a bit to do. Hopefully I can finish it in time.

That was hard! I really enjoyed it overall. I'm glad I finished! Let's save the ears of the future!

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: Daniel Boucher ID: _____
SCHOOL: St Peter's Woodlands

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

I am going to test my noise exposure at school and home.
I am going to use an app on my iPad that measures in decibels.

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
<u>No risks identified because this app only measures sound, not conversation.</u>	<u>I will get permission from my teacher before conducting the experiment.</u>

(Attach another sheet if needed.)

Risk Assessment indicates that this activity can be safely carried out

RISK ASSESSMENT COMPLETED BY (student name(s)): Daniel Boucher

SIGNATURE(S): [Signature]

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

TEACHER'S NAME: Lisa Harni

SIGNATURE: [Signature] DATE: 16/06/2020