Logbook for Erik & Sebastian's Science fair project 2025

Sunday, February 2, 2025
-We discussed what the project is going to be and decided to do it on musicians getting hearing loss. We also started on our problem, hypothesis, background research and our manipulated variables.

Wednesday, February, 6
-We worked on our background research slides.

Saturday, February 15
-We went to Michaels and searched for a box that we would later be soundproofing. We found one made of wood that will fit a phone inside as a decibel meter.
-We are also trying to find some acoustic foam that we will be using to soundproof our box. We tried our neighborhood, some friends of our parents who are musicians and facebook marketplace and amazon.

Sunday, February 16
-We added onto our hypothesis and problem and we completed some background research slides.
We looked at these websites for some information and learned about sound and hearing loss.
https://www.mayoclinic.org/diseases-conditions/hearing-loss/symptoms-causes/syc-20373072
https://www.twinkl.ca/teaching-wiki/sound

-We also did some trials with the decibel meter apps that we found and the pure tone generator. We like DecibelX better than the NOISH one because it's easier to read the data.
-Then we ran into a problem with the decibel meter because we couldn't get the data off the phone but Sebby's dad had an idea that we could screen record it and then read the Hz and the decibel reading off the screen recording because we cannot see it in real time because it is in the box.

-We're trying some other sources for acoustic foam
-We tested this online tone generator
https://www.szynalski.com/tone-generator/
-We are designing where we'll be placing the phones - 1 in the box, 1 at a set distance from the speaker.
-we have to remember to keep the volume the same every time for the output.
-remember to run a control with no earplug, just the phone in the box.

Monday, February 17
-We are looking at some research studies about musician hearing loss to get some further background information.
-https://www.frontiersin.org/journals/public-health/articles/10.3389/fpubh.2025.1472134/full
-https://sandiegohearing.com/which-musicians-are-most-at-risk-of-hearing-loss/

This website is helping us learn more about tone and pitch
-https://www.schoolofrock.com/resources/music-education/the-7-key-elements-of-all-music

We are organizing our timeline of what we need to get done:
-Background research
-which tones should we test? And how many?
-Finding acoustic foam
-Scanning our ears
-Building the model
-Gathering the earplugs and headphones
-Collecting data
-Entering it into a table
-Making conclusions

Tuesday, February 18
-Sebastian's dad's friend Mitayo came and taught us how to use a 3D scanner. He taught us how to scan our ears and use the 3D modeling platform to advance the model from a lot of tiny dots to a fully connected 3D model of our ears. Our plan is to 3D print our ear models and attach them on the outside of our box.
-The scanner worked by little lights inside the camera that shine infrared lights onto an object that cameras inside the scanner see the reflected light and create an object on the computer software in dots then you can update it to make a fully connected 3D model of our ears.
-We both got a chance to scan each other's ears and if anyone moved at all it would make the 3D scan mess up and overall it was a very cool experience.

Wednesday, February 19, 2025
-We completed all of the things we needed to finish for the background research slides.

Friday, February 21
-we worked on the background research and added some photos

Sunday, February 23
-We are working on the procedure

-scan our ears using a 3D laser scanner
- use a 3D printer to print the model 3D ears
-get sound proof material we are using different types of thick fabric from home
-get a box
-trace the sides of the box onto a foam matt then cut out the pieces of the foam mats to use as an extra layer for soundproofing the box
-glue the foam matt to the inside of the box
-cut the fabric and glue it to the inside of the box
-drill a hole in the box the same diameter as our ear canals - what size??

-mount our ear onto the box - ?how??
-download DecibelX app onto 2 I-Phones
-open the pure tone generator on the computer and connect the computer to a bluetooth speaker
-gather the different types of hearing protection
-place one phone inside the sound proof box with the microphone facing the ear canal and screen record the decibel app
-set the speaker a set distance from the box - we need to pick the distance maybe 10cm.
-place the 2nd phone on the table with the microphone end ___?cm from the front of the speaker. Turn on the decibelX app
-turn on the bluetooth speaker to 100 % volume
-turn the tone generator to 50%? And keep the volume the same for all the trials
-play a 100 hz tone, 500 hz tone and a 2,000 hz tone - for 5 or 10 seconds each?
-in a table record the decibel reading from outside the box for each tone and type of ear protection
-do a controlled trial to know how much sound the box cancelled - no earplug
-repeat the test with each ear protection type by doing the 3 tones with each ear protection in a row.
-stop the screen recording and watch the video
-record the hz for each tone and hearing protection on the table
-Then go back and repeat the whole test again 2 more times so that you have done it 3 times.
-subtract the decibel level outside the box by the decibel level inside to determine the noise reduction from each type of hearing protection.

Wednesday Feb 26
-we used the 3d scanned ear to print the 3d models of our ears on the 3d printer
-we were surprised to see how different they looked from each other
-we had to figure out how to mount the ear and decided to use double sided tape in case we want to switch the ear
-we cut foam using the box sides as templates and fit that into the box to sound proof
-used a drill to drill a hole where the ear canal is - measured the same size as the ear canal by tracing the ear canal onto to box - it was 1cm
-tested with earplugs and it worked but Erik's ear scan had a little blooper which made it too hard to fit the earplugs so we're using Sebby's ear

Thursday Feb 27
-we added foam blocks to the inside of the box to hold the phone level with the ear canal inside the box.
-we did a few sample trials to test the positions of the different things. If the outside phone is too close we can't fit the overear headphones on so we moved the phone back a bit.
Then we tested a trial with no earplugs
-speaker 100%, 15% on tone generator - tone 440hz - 79.1db outside - 64.7 inside = 14.4 difference

-we searched online to see what the decibel reduction of a human skull is and it's 20db so we decided to add foam to the outside as well. we worked on the sound proof box by using foam playmats that we traced and cut to the right size and glued to the box on the outside.
-we tested again with the same distances - 81.4-61.7 = 19.7 db reduction. This is close to 20 db so we're happy.
-tomorrow we're going to do our full set of trials
-our distances are: outside phone 4.2cm from table top, 8cm from end of microphone ned of phone to bottom edge of box, 15cm from edge of speaker to outside phone microphone. 25cm from speaker edge to box edge

Friday Feb 28
-we took photos of our experiment
-we started the trial
-we used a screen recording continuously but it turned off after 16min
-we discovered the airpods can't go in noise cancelling mode in the model ear because it doesn't seal well enough so we left them out
-we did trial 1 with the box perpendicular to the ear and saw that we weren't seeing much difference between the different types of hearing protection vs control
-we thought maybe the box was at the wrong angle because when you whisper you cup at the front of the ear so we put the phone inside and moved the box but that didn't help
-we wrapped the box in extra thick felt and material
-we looked up where the microphones are on the iphone model and covered up the 2 that weren't at the bottom with tape and made sure the one on the bottom is right next to the inside of the ear in the box. We also added a lot of felt inside the box to decrease the noise scattering around the box. The background noise on the screen recording in the box was about 40 db.
-we tried moving the phone and speaker to side by side right in front of the ear to try to improve the readings. We also put a foam mat covered in a towel on the table to try to decrease the sound transmitting through the table.
-We did 2 trials with these and it was a bit all over the place for the numbers we got.
-we tried to think of how to direct the noise more at the ear. We found the speakers inside the speaker and put the speaker inside a box with the speaker side angled out to make a megaphone that we angled at the ear. And then the phone outside angled right at the speaker.
-also we attached a straw to the microphone on the phone with tape and made sure that was right inside the ear canal in the box.
-we're having issues with the screen recording turning off after 10 minutes.
-also the airpods don't fit in the ear well because it's plastic instead of soft.
-we tried going ot the basement where it's carpeted and there's less background noise. We made a noise barrier structure with couch pillows and soft blankets. This really reduced the background noise down to 30 db instead of 40
-we ran another trial with this and it was a bit better, but it's really hard to lean into the fort to hold the headphones on
-tomorrow we're going to build a fort and surround it with blankets and try to do the trials again

Saturday Mar 1

-we made a pillow and blankets fort to create a sound proof chamber
-this decreased the background noise from 40 db to 25-30 db
-we've done 4 more trials and now noticed that outside db readings are very consistent, it's the inside readings that are differing - this we have learned is the user error side with is really important because sometimes it is making the sound louder which means in real life if you don't have earplugs in properly then you could be damaging your hearing.
-also the high frequency sound is louder inside the box on all the controls because the ear is acting as a megaphone to funnel the sound into the box.
-we did 5 more trials, collected the data and made sheets for this. Also we made a table.
-we looked at the data and came up with conclusions.

March 2, 2025

TOLKO

2 - Angle, felt inside, mic covered, straw.

	out	in wrapped	
	84.0	72.6	73.3
cntl	94.9	81.6	83.9
	95.9	94	~~88.7~~ 96.7
Foam	84.0	66.4	~~dup~~ 72.
	94.2	72.7	81.6
	96.2	70.9	94
Xtrec	83.7	66.7	
	94.3	77.9	
	95.4	69.5	
overear	85.7	70	
	94.0	77.9	
	101.4	65.7	
Airpod - off -	84.2	71.4	
	94.5	79.9	
	96.9	81.8	
Transp.	84.3	71.7	
	94.0	79.6	
	98.6	89.2	
Bose - off	- 84.6	73.8	
	- 93.2	84.3	
	- 97.6	96.1	
Bose - NC	- 85.0		
	- 93.5		
	- 100.9		

error in video.

TOLKO (3) day on mics, felt inside, angled close

		out	in.
Cntl	-	82.2	66.6
	-	93.3	77.7
(double)	-	90.	89.2
Foam	-	82.7	63.4
	-	93.3	59.2
	-	88.5	69.7
xtrel	-	82.0	62.9
	-	93.9	66.8
	-	88.9	67.9
overear	-	83.6	65.5
	-	91.1	78.3
	-	96.0	70.1
Airpod off	-	84.2	68.6
	-	91.7	70.9
	-	93.6	85.9
Trans	-	83.9	68.7
	-	90.5	66.7
	-	92.3	86.1
Bose off	-	83.5	62.0
	-	90.7	56.3
	-	97.1	81.5
NC ~~Trans~~	-	83.9	66.8
	-	90.8	70.0
	-	97.4	76.6

TOLKO

(4) - straw taped, put inside, speaker in box, setup as per signs

Foam	-	85.7	70.2
	-	88.8	78.2
	-	75.3	54.2
Cntrl	-	85.1	79.9
	-	89.2	80.9
	-	74.8	83.5
Xmas	-	85.2	69.5
	-	89.1	75.5
	-	75.0	64.0
Overear	-	84.8	75.7
	-	87.9	70.8
	-	72.4	67.7
Airpod off	-	84.8 84.1	82.5
	-	87.6 89.0	83
	-	73.3 76.1	80.5
Trans	-	84.8 88.9	82.4
	-	88.6 89.5	83.7
	-	73.1 76.0	81.1
Bose off	-	85.1 84.6	62.7
	-	85.5 87.1	75.2
	-	75.3 75.2	84.8
Bose NC	-	84.8 84.8	58.1
	-	84.1 85.8	56.1
	-	73.7 76.0	65.5

Constant @ 55 in background

TOLKO

Trial 8

save as 5+6+7+

10 59 am screen record

	Outside	Inside
Fannie	81.0	81.4
	85.2	68.2
	76.7	55.9
Control	81.0	84.6
	85.3	80.2
	76.3	85.1
Xtree	81.0	80.9
	84.3	68.6
	77.3	68.2
Overcar	80.0	82.6
	81.4	78.0
	75.3	72.8
AP off	80.2	84.4
	83.0	79.6
	77.0	84.4
AP transp	80.2	84.4
	83.0	79.6
	76.4	84.2
Box off	79.6	76.7
	79.8	81.7
	78.8	73.6
Box NC	79.5	71.2
	80.2	75.2
	78.5	68.3

TOLKO

Trial 7 - same as 6. 1048 - 1058 Video

	Outside	Inside
Foam	- 82.1	70.6
	- 87.1	60.7
	- 79.0	59.3
Control	- 82.1	81.1
	- 87.0	80
	- 78.9	87.8
Xtree	- 81.9	71.1
	- 86.5	68.0
	- 78.9	74.4
Overear	- 80.8	76.4
	- 83.4	76.3
	- 74.8	74.9
Ap off	- 81.2	79.7
	- 86.1	77.1
	- 77.8	84.3
Ap trans	- 81.2	79.6
	- 85.9	76.7
	- 77.4	85.2
Bose off	- 80.1	69.2
	- 85.6	74.8
	- 75.5	84.4
Bose NC	- 80.8	71.4
	- 84.7	68.3
	- 75.9	75.0

TOLKO

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Trial 6 — ~~Blanket~~ Foot Cushion

Background Noise 28-35

Foam	84.9	71.1
	89.0	70.0
	72.4	55.8
Control	83.5	82.9
	89.1	83.6
	72.8	87.1
Xma Steel	-83.4	77.9
	-89.3	81.0
	-72.7	86.1
Over ear	-82.8	81.2
	-86.8	83.6
	-72.6.	~~87.8~~
AP off	-83.7	82.4
	-88.7	81.7
	-74.3	83.8
Traps	-83.5	82.1
	-88.6	81.6
	-74.0	84.1
Bose off	-82.0	~~77.2~~ 63.6
	-87.2	~~88.0~~ 77.2
	-71.8.	~~78.2~~ 88.0
NC	-81.9	71.0
	-87.2	69.0
	-70.2.	79.4

TOLKO

(5) all same as 4 but all on bagnet carpet in pillows and blanket

Baseline 28-32 db vs 40s

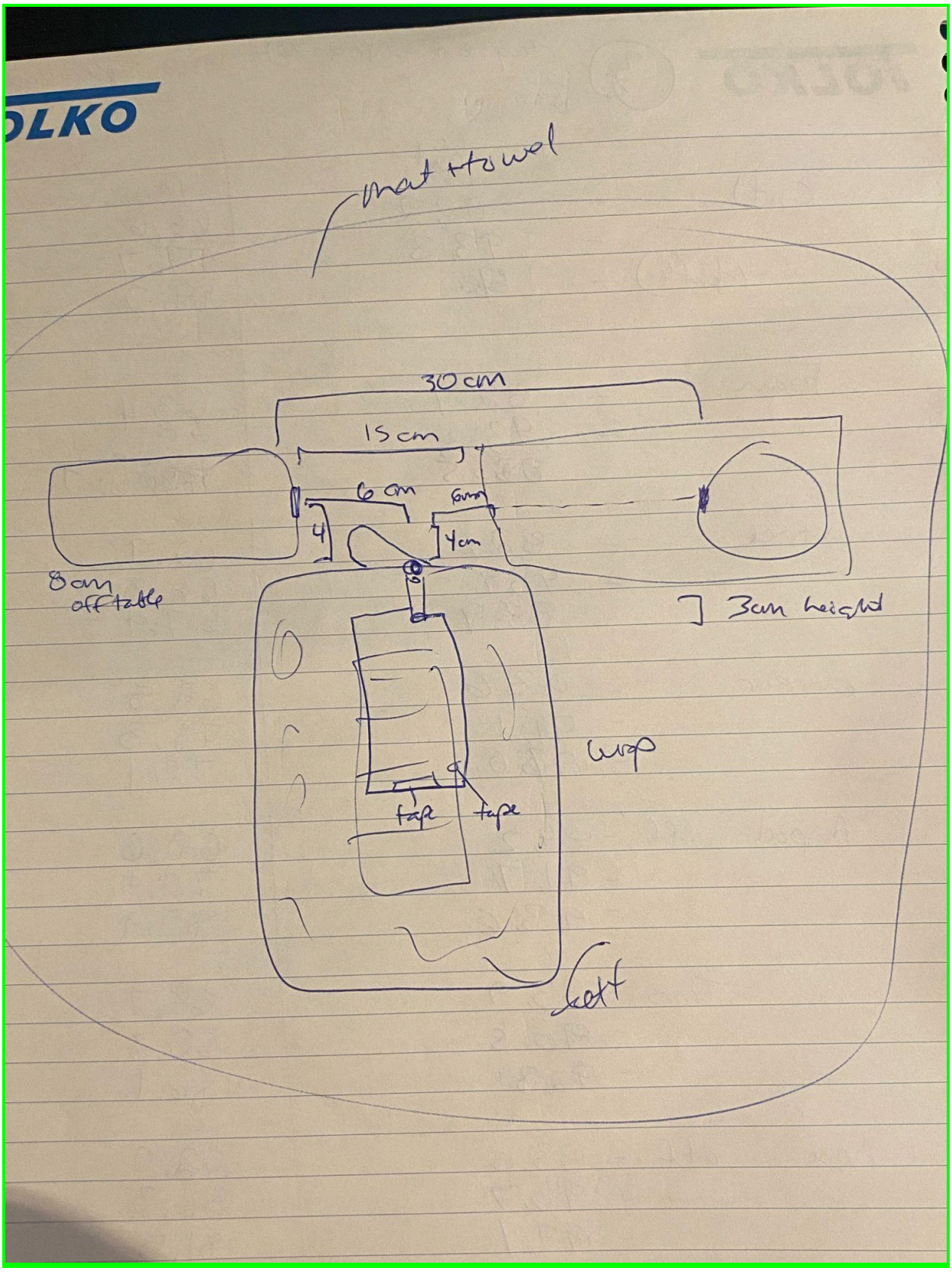
Foam	- 88.4	~~79.5~~	74.1
	- 90.0	~~75.4~~	75
	- 85.3		56.7
Cntry	- 98.4	~~74.1~~	88.6
	- 86.1	~~85.4~~	84.1
	- 85.3	~~56.4~~	92.7
Xmas	- ~~87.6~~	~~84.5~~	78.5
	- 85.2		79.4
	- 84.7		75.9
overear	- [redacted]	84.5	76.0
	- [redacted]	81.3	75.1
	- [redacted]	68.9	56.7
AP off	- 84.8		88.6
	- 83.6		84.1
	- 78.4		92.7
AP transparent	- 85.6		78.5
	- 83.6		79.4
	- 78.7		75.9
Box off	- ~~88.1~~	87.5	71.2
	- 86.8	84.6	79.6
	- 84.1	82.1	90.0
Pure NC	- 86.2		~~70.1~~
	- 84.8		62.4
	- 77.2		78.4

TOLKO

same as 5678

Trial 9

	Outside	Inside
Faarne	-80.1	-77.4
	-86.0	84.1
	-73.4	51.0
Control	-80.0	83.3
	-86.7	92.2
	-73.9	73.3
Xmas tree	-78.5	76.2
	-87.7	86.1
	-72.7	59.9
Overear	-78.6	81.8
	-92.7	92.0
	-69.1	58.0
AirPod off	-78.8	83.6
	-86.5	94.0
	-70.4	74.8
Airpod Transp	-79.1	83.6
	-86.3	94.6
	-70.5	73.3
Bose off	-79.3	78.8
	-84.4	79.3
	-71.2	68.6
Bose NC	-78.5	79.0
	-88.5	79.6
	-68.9	64.2


mat + towel
30 cm
15 cm
6 cm
6cm
4
4cm
8cm
off table
3cm height
wrap
tape
tape
foot

				Outside	Inside	Difference
control	100hz		45 deg	72.5	64.3	8.2
foam	100hz		45deg	71.9	63.7	8.2
control	100 hz		45 deg, louder	79.6	69.7	9.9
foam	100 hz		45 deg, louder	80	66.3	13.7
control	100hz		45 deg, on towel	78.3	65.5	12.8
foam	100hz		45 deg, on towel	78.5	60.5	18
foam	100hz		45 deg, on towel, clay	93.2	79.5	13.7
foam	500hz		45 deg, towel, clay, wrapped	78.4	59.3	19.1
foam	500hx		45 deg, towel, clay, wrapped, straw on inside	97	79.7	17.3
foam	500hz		45 deg, towel, clay, wrapped, straw on inside, speaker on chair	77.1	69.3	7.8
foam	440hz		45 deg, towel, clay, wrapped, straw on inside, clay on other 2 mics, mons	66.1	50.9	15.2
foam		440	45 deg, towel, clay, wrapped, straw, felt layers inside, moved speaker and	90.6	62	28.6
control		440	45 deg, towel, clay, wrapped, straw, felt layers inside, moved speaker and	89.2	67	22.2

100 Hz

Type			Outside									Inside									Difference									Difference between test and control									
of protection	Trial #	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9	
		90 degrees																																					
Control		72.1	84	82.2	85.1	88.4	83.5	82.1	81	80		60.7	72.5	68.6	79.9	88.6	82.9	81.1	84.6	83.3	11.4	11.5	13.6	5.2	-0.2	0.6	1	-3.6	-3.3	-1.1										AVG
Foam		72	84	82.7	85.7	88.4	84.9	82.1	81	80.1		57.2	72.7	63.4	70.2	76.1	71.1	70.6	81.4	77.4	14.8	11.3	19.3	15.5	12.3	13.8	11.5	-0.4	2.7	7.98	3.4	-0.2	5.7	10.3	12.5	13.2	10.5	3.2	6	9.08
Silicone		72.1	83.7	82.6	85.2	87.6	83.4	81.9	81	78.5		56.8	66.7	62.9	69.5	78.5	77.9	71.1	80.9	76.2	15.3	17	19.7	15.7	9.1	5.5	10.8	0.1	2.3	5.56	3.9	5.5	6.1	10.5	9.3	4.9	9.8	3.7	5.6	6.66
Overear		73.1	85.7	83.6	84.8	84.5	82.8	80.8	80	78.6		63.4	70	65.5	75.7	76	81.2	76.4	82.6	81.8	9.7	15.7	18.1	9.1	8.5	1.6	4.4	-2.6	-3.2	1.74	-1.7	4.2	4.5	3.9	8.7	1	3.4	1	0.1	2.84
Airpod Pro - normal		72.2	84.2	84.2	84.1	84.8	83.7	81.2	80.2	78.8		62.4	71.4	68.6	82.5	88.6	82.4	79.7	84.4	83.5	9.8	12.8	15.6	1.6	-3.8	1.3	1.5	-4.2	-4.7	-1.98	-1.6	1.3	2	-3.6	-3.6	0.7	0.5	-0.6	-1.4	-0.88
Airpod Pro - transparency		72.7	84.3	83.9	83.9	85.6	83.5	81.2	80.2	79.1		63.6	71.7	68.7	82.4	78.5	82.1	79.6	84.4	83.6	9.1	12.6	15.2	1.5	7.1	1.4	1.6	-4.2	-4.5	0.28	-2.3	1.1	1.6	-3.7	7.3	0.8	0.6	-0.6	-1.2	1.38
Bose -normal/off		73	84.6	83.5	84.6	87.5	82	80.1	79.6	79.3		61.2	73.8	62	62.7	71.2	63.6	69.2	76.7	78.8	11.8	10.8	21.5	21.9	16.3	18.4	10.9	2.9	0.5	9.8	0.4	-0.7	7.9	16.7	16.5	17.8	9.9	6.5	3.8	10.9
Bose - noise cancelling		73.2	85	83.9	84.8	86.2	81.9	80.8	79.5	78.5		60.5		66.2	58.1	70.1	71	71.4	71.2	79	12.7		17.7	26.7	16.1	10.9	9.4	8.3	-0.5	8.84	1.3		4.1	21.5	16.3	10.3	8.4	11.9	2.8	9.94

500 Hz

Type			Outside									Inside									Difference																		
of protection	Trial #	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9											
Control		78.8	94.9	93.3	89.2	86.1	89.1	87	85.3	86.7		63.1	81.6	77.7	80.9	84.1	83.6	80	80.2	92.2	15.7	13.3	15.6	8.3	2	5.5	7	5.1	-5.5	2.82										
Foam		78.5	94.2	93.3	88.8	86	89	87.1	85.2	86		62.7	72.7	59.2	73.2	75	70	60.7	68.2	84.1	15.8	21.5	34.1	15.6	11	19	26.4	17	1.9	15.06	0.1	8.2	18.5	7.3	9	13.5	19.4	11.9	7.4	12.24
Silicone		79.3	94.3	93.9	89.1	85.2	89.3	86.5	84.3	87.7		62.4	77.1	66.8	75.5	79.4	81	68	68.6	86.1	16.9	17.2	27.1	13.6	5.8	8.3	18.5	15.7	1.6	9.98	1.2	3.9	11.5	5.3	3.8	2.8	11.5	10.6	7.1	7.16
Overear		77.8	94	91.1	87.9	81.3	86.8	83.4	81.4	87.7		56.5	77.9	78.3	70.8	75.1	83.6	76.3	78	92	21.3	16.1	12.8	17.1	6.2	3.2	7.1	3.4	-4.3	3.12	5.6	2.8	-2.8	8.8	4.2	-2.3	0.1	-1.7	1.2	0.3
Airpod Pro - normal		78.8	94.5	91.7	89	83.6	88.7	86.1	83	86.5		62.2	79.9	70.9	83	84.1	81.7	77.1	79.6	94	16.6	14.6	20.8	6	-0.5	7	9	3.4	-7.5	2.28	0.9	1.3	5.2	-2.3	-2.5	1.5	2	-1.7	-2	-0.54
Airpod Pro - transparency		79.4	94	90.5	89.5	82.6	88.6	85.9	83	86.3		62.1	79.6	66.7	83.7	79.4	81.6	76.7	79.6	94.5	17.3	14.4	23.8	5.8	3.2	7	9.2	3.4	-8.2	2.92	1.6	1.1	8.2	-2.5	1.2	1.5	2.2	-1.7	-2.7	0.1
Bose -normal		79.8	93.2	90.7	87.1	84.6	87.2	85.6	79.8	84.4		61.2	84.3	56.3	75.2	79.6	77.2	74.8	81.7	79.3	18.6	8.9	34.4	11.9	5	10	10.8	-1.9	5.1	5.8	2.9	-4.4	18.8	3.6	3	4.5	3.8	-7	10.6	2.98
Bose - noise cancelling		79	93.5	90.8	88.8	84.8	87.2	84.7	80.2	88.5		59.7		70	56.1	62.4	69.7	68.3	75.2	79.6	19.3		20.8	32.7	22.4	17.5	16.4	5	8.9	14.04	3.6		5.2	24.4	20.4	12	9.4	-0.1	14.4	11.22

2000 Hz

Type			Outside									Inside									Difference																		
of protection	Trial #	1	2	3	4	5	6	7	8	9		1	2	3	4	5	6	7	8	9	1	2	3	4	5	6	7	8	9											
Control		84.9	95.9	90	74.8	85.3	72.8	78.9	76.3	73.9		67.2	94	89.2	73.5	92.7	87.1	87.8	85.1	73.3	17.7	1.9	0.8	1.3	-7.4	-14.3	-8.9	-8.8	0.6											
Foam		86.2	96.2	83.5	75.3	85.3	72.4	79	76.7	73.4		63.8	70.9	69.7	54.2	56.7	55.8	59.3	55.9	51	22.4	25.3	13.8	21.1	28.6	16.6	19.7	20.8	22.4		4.7	23.4	13	19.8	36	30.9	28.6	29.6	21.8	29.38
Silicone		87.4	95.1	88.9	75	84.7	72.7	78.9	77.3	72.7		64.3	69.5	67.9	64	75.9	86.1	74.4	68.2	59.9	23.1	25.6	21	11	8.8	-13.4	4.5	9.1	12.8		5.4	23.7	20.2	9.7	16.2	0.9	13.4	17.9	12.2	12.12
Overear		85.9	101.4	97	72.4	68.9	72.6	74.8	75.3	69.1		56.5	65.7	70.1	67.7	56.7	75.4	74.9	72.8	58	29.4	35.7	26.9	4.7	12.2	-2.8	-0.1	2.5	11.1		11.7	33.8	26.1	3.4	19.6	11.5	8.8	11.3	10.5	12.34
Airpod Pro - normal		82	96.9	93.6	76.1	78.4	74.3	77.8	77	70.4		69.7	81.8	85.9	80.5	92.7	83.8	84.3	84.4	74.9	12.3	15.1	7.7	-4.4	-14.3	-9.5	-6.5	-7.4	-4.5		-5.4	13.2	6.9	-5.7	-6.9	4.8	2.4	1.4	-5.1	-0.68
Airpod Pro - transparency		82.4	98.6	92.3	76	78.7	74	77.4	76.4	70.5		64.7	89.2	86.1	81.1	75.9	84.1	85.2	84.2	73.3	17.7	9.4	6.2	-5.1	2.8	-10.1	-7.8	-7.8	-2.8		0	7.5	5.4	-6.4	10.2	4.2	1.1	1	-3.4	2.62
Bose -normal		82.8	97.6	97.1	75.2	82.1	71.8	75.5	78.8	71.2		57.8	96.1	81.5	84.8	90	88	84.4	73.6	68.6	25	1.5	15.6	-9.6	-7.9	-16.2	-8.9	5.2	2.6		7.3	-0.4	14.8	-10.9	-0.5	-1.9	0	14	2	2.72
Bose - noise cancelling		83.7	100.9	97.4	76	77.2	70.2	75.9	78.5	68.9		60.5		76.6	65.5	78.4	79.4	75	68.3	64.2	23.2		20.8	10.5	-1.2	-9.2	0.9	10.2	4.7		5.5		86.4	9.2	6.2	5.1	9.8	19	4.1	8.84

Trial 1 - initial set up at 90 degrees, parallel

Trial 2 & 3 - clay on mics, felt inside, whole box wrapped, angled close

Trial 4 - straw on mic, felt inside inside, speaker in box, angled all perpendicular. on table upstairs.

Trial 5, 6, 7, 8, 9 - basement, carpet, on towel and foam, new setup, in blanket and pillow chamber

			OUTSIDE (dB)						INSIDE (dB)						DIFFERENCE OUTSIDE - INSIDE							DIFFERENCE TEST - CONTROL					
100 Hz	Type of protection	Trial #	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5	AVERAGE		1	2	3	4	5	AVERAGE
	Control		88.4	83.5	82.1	81	80		88.6	82.9	81.1	84.6	83.3		-0.2	0.6	1	-3.6	-3.3	-1.1							
	Foam		88.4	84.9	82.1	81	80.1		76.1	71.1	70.6	81.4	77.4		12.3	13.8	11.5	-0.4	2.7	7.98		12.5	13.2	10.5	3.2	6	9.08
	Silicone		87.6	83.4	81.9	81	78.5		78.5	77.9	71.1	80.9	76.2		9.1	5.5	10.8	0.1	2.3	5.56		9.3	4.9	9.8	3.7	5.6	6.66
	Overear		84.5	82.8	80.8	80	78.6		76	81.2	76.4	82.6	81.8		8.5	1.6	4.4	-2.6	-3.2	1.74		8.7	1	3.4	1	0.1	2.84
	Airpod Pro - normal		84.8	83.7	81.2	80.2	78.8		88.6	82.4	79.7	84.4	83.5		-3.8	1.3	1.5	-4.2	-4.7	-1.98		-3.6	0.7	0.5	-0.6	-1.4	-0.88
	Airpod Pro - transparency		85.6	83.5	81.2	80.2	79.1		78.5	82.1	79.6	84.4	83.6		7.1	1.4	1.6	-4.2	-4.5	0.28		7.3	0.8	0.6	-0.6	-1.2	1.38
	Bose -normal/off		87.5	82	80.1	79.6	79.3		71.2	63.6	69.2	76.7	78.8		16.3	18.4	10.9	2.9	0.5	9.8		16.5	17.8	9.9	6.5	3.8	10.9
	Bose - noise cancelling		86.2	81.9	80.8	79.5	78.5		70.1	71	71.4	71.2	79		16.1	10.9	9.4	8.3	-0.5	8.84		16.3	10.3	8.4	11.9	2.8	9.94
500 Hz	Type of protection	Trial #	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5	AVERAGE		1	2	3	4	5	AVERAGE
	Control		86.1	89.1	87	85.3	86.7		84.1	83.6	80	80.2	92.2		2	5.5	7	5.1	-5.5	2.82							
	Foam		86	89	87.1	85.2	86		75	70	60.7	68.2	84.1		11	19	26.4	17	1.9	15.06		9	13.5	19.4	11.9	7.4	12.24
	Silicone		85.2	89.3	86.5	84.3	87.7		79.4	81	68	68.6	86.1		5.8	8.3	18.5	15.7	1.6	9.98		3.8	2.8	11.5	10.6	7.1	7.16
	Overear		81.3	86.8	83.4	81.4	87.7		75.1	83.6	76.3	78	92		6.2	3.2	7.1	3.4	-4.3	3.12		4.2	-2.3	0.1	-1.7	1.2	0.3
	Airpod Pro - normal		83.6	88.7	86.1	83	86.5		84.1	81.7	77.1	79.6	94		-0.5	7	9	3.4	-7.5	2.28		-2.5	1.5	2	-1.7	-2	-0.54
	Airpod Pro - transparency		82.6	88.6	85.9	83	86.3		79.4	81.6	76.7	79.6	94.5		3.2	7	9.2	3.4	-8.2	2.92		1.2	1.5	2.2	-1.7	-2.7	0.1
	Bose -normal		84.6	87.2	85.6	79.8	84.4		79.6	77.2	74.8	81.7	79.3		5	10	10.8	-1.9	5.1	5.8		3	4.5	3.8	-7	10.6	2.98
	Bose - noise cancelling		84.8	87.2	84.7	80.2	88.5		62.4	69.7	68.3	75.2	79.6		22.4	17.5	16.4	5	8.9	14.04		20.4	12	9.4	-0.1	14.4	11.22
2000 Hz	Type of protection	Trial #	1	2	3	4	5		1	2	3	4	5		1	2	3	4	5	AVERAGE		1	2	3	4	5	AVERAGE
	Control		85.3	72.8	78.9	76.3	73.9		92.7	87.1	87.8	85.1	73.3		-7.4	-14.3	-8.9	-8.8	0.6	-7.76							
	Foam		85.3	72.4	79	76.7	73.4		56.7	55.8	59.3	55.9	51		28.6	16.6	19.7	20.8	22.4	21.62		36	30.9	28.6	29.6	21.8	29.38
	Silicone		84.7	72.7	78.9	77.3	72.7		75.9	86.1	74.4	68.2	59.9		8.8	-13.4	4.5	9.1	12.8	4.36		16.2	0.9	13.4	17.9	12.2	12.12
	Overear		68.9	72.6	74.8	75.3	69.1		56.7	75.4	74.9	72.8	58		12.2	-2.8	-0.1	2.5	11.1	4.58		19.6	11.5	8.8	11.3	10.5	12.34
	Airpod Pro - normal		78.4	74.3	77.8	77	70.4		92.7	83.8	84.3	84.4	74.9		-14.3	-9.5	-6.5	-7.4	-4.5	-8.44		-6.9	4.8	2.4	1.4	-5.1	-0.68
	Airpod Pro - transparency		78.7	74	77.4	76.4	70.5		75.9	84.1	85.2	84.2	73.3		2.8	-10.1	-7.8	-7.8	-2.8	-5.14		10.2	4.2	1.1	1	-3.4	2.62
	Bose -normal		82.1	71.8	75.5	78.8	71.2		90	88	84.4	73.6	68.6		-7.9	-16.2	-8.9	5.2	2.6	-5.04		-0.5	-1.9	0	14	2	2.72
	Bose - noise cancelling		77.2	70.2	75.9	78.5	68.9		78.4	79.4	75	68.3	64.2		-1.2	-9.2	0.9	10.2	4.7	1.08		6.2	5.1	9.8	19	4.1	8.84

Sunday March 2

-we added photos of our logbook and photos of our experiment to the presentation
-working on final presentation for printing
-the flexible ear looks good but we don't have time to do a bunch of trials with it. If we go to cities we'll try with the flexible ear ot compare