BACKGROUND

CONVENTIONAL SCIENTIFIC RESEARCH HAS BECOME TOO EXCLUSIONARY FOR THE AVERAGE PERSON TO AFFORD AND PARTICIPATE IN

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OPEN SCIENCE AND DIY SCIENCE CAN BE A MORE INCLUSIVE APPROACH TO SCIENTIFIC PRACTICE
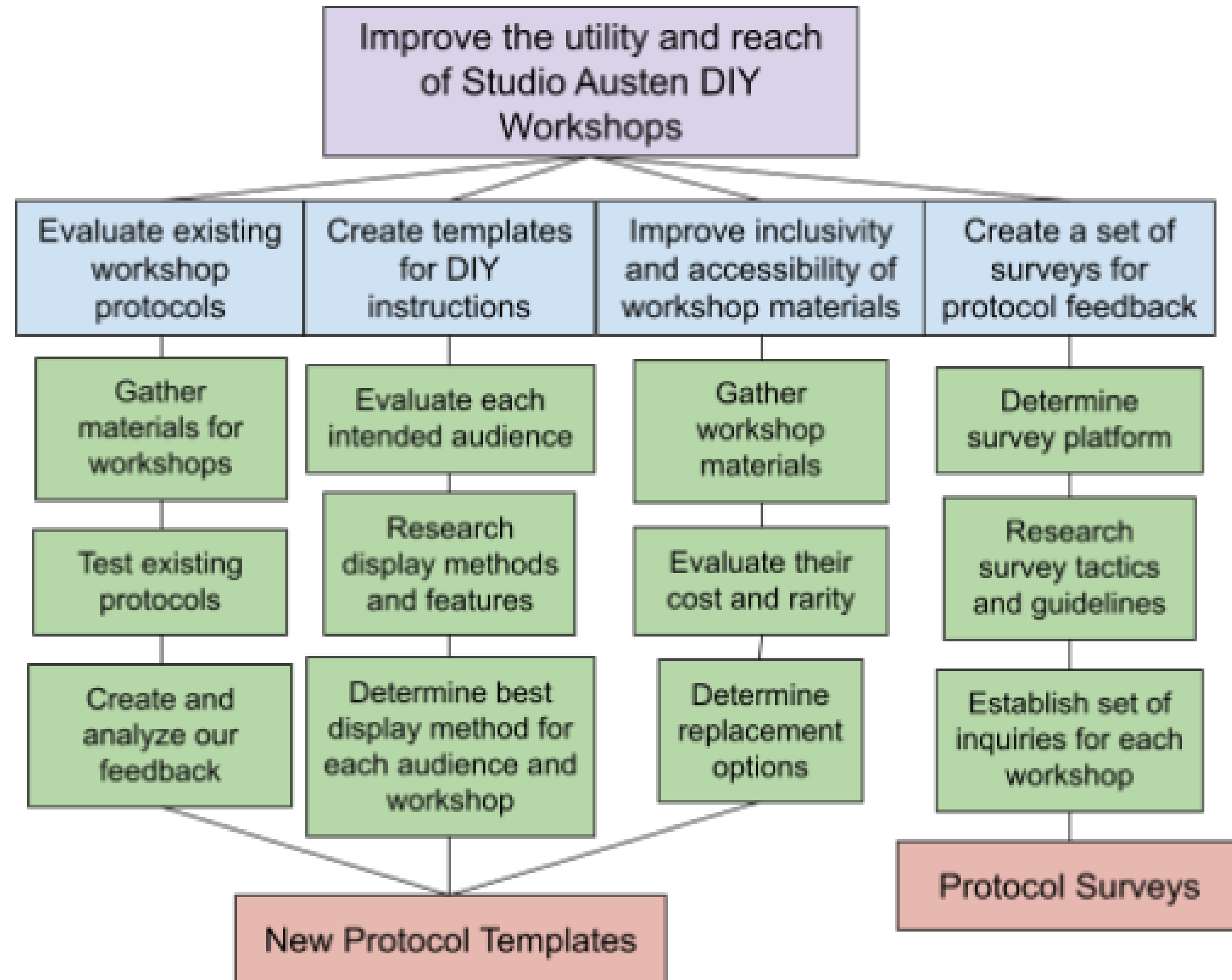

"Citizen Science supports oceanographic research projects that help expand the understanding of the world's oceans"

STUDIO AUSTEN HAS CREATED INCLUSIVE DIY WORKSHOPS THAT HAVE THE POTENTIAL TO RAISE GLOBAL ENVIRONMENTAL AWARENESS

METHODS

OBJECTIVE 1: PERFORM AND FAMILIARIZE OURSELVES WITH THE WORKSHOPS

PART 1

- Gathered all materials
- Performed each protocol using existing methods

PART 2

- Performed and analyzed workshops with guidance from our sponsor
- Performed some of the workshops to Studio Austen's intern

OBJECTIVE 2: CREATE TEMPLATES FOR WORKSHOP PROTOCOLS

PART 1

- Investigated favorable display methods that:
  - Has a strong backbone
  - Flows well
  - includes guidance images and diagrams

How to build a spectrometer at home

DOI: 10.1201/menods.4595623

Table of Content :

- List of Hardware
  - How to assemble the hardware
- Software
  - Setup the Arduino IDE
  - Using Python for plotting

Hardware

To build a spectrometer, you need :

1. Arduino Uno Rev3 : https://store.arduino.cc/arduino-uno-rev3
2. Hamamatsu C12880MA MEMS Micro-spectrometer: https://www.hamamatsu.com/eu/en/product/type/C12880MA/index.html
3. C12880MA Breakout Board https://groupgets.com/manufacturers/getlab/products/c12880ma-breakout-board-v2
4. Breadboard and jumpers

PART 2

- Researched technical writing to allow us to:
  - make the instructions as inclusive as possible
  - make the purpose of the workshop as understandable as possible

Steps for analysis

- Set up your spectrometer. If you're working on a Mac you can use Photo Booth to take photos with a USB camera. On recent Windows systems you can use the Camera App.
- Take spectrum with CFL lamp to calibrate the instrument and upload to spectralworkbench.org
- Calibrate spectrum by aligning the green and blue markers (instructions on-line)
- Replace the CFL lamp with a halogen light source. Be careful not to disturb the spectrometer.
- Fill a cuvette with your filtrate
- Take spectrum with the halogen light source
- Fill a cuvette with your pure solvent (diethyl ether or ethanol)
- Take spectrum with the halogen light source
- Upload spectra to spectral workbench.org
- Calibrate spectra with calibration taken from the CFL lamp
- Subtract solvent spectrum from filtrate spectrum to gain the spectrum of the extracted chemicals
- Compare spectra with published spectra to identify chemicals present

OBJECTIVE 3: IMPROVE AND ENSURE THE ACCESSIBILITY OF DIY WORKSHOP MATERIALS

PART 1

- Research average cost and accessibility of workshop materials
- Evaluate potential replacements
- Create a table containing average cost of materials

DIY Hydrophone Materials Cost

Material	Cost	
piezos (10 pack)	$	6.99
Microphone cable	$	2.56
Electric jack plug	$	5.99
Hot glue gun	$	14.00
Wire stripper	$	2.99
Silicone seal dip	$	7.97
Total	$	40.50

Spectrometer Analysis Materials Cost

Material	Cost	
Spectrometer (provided)	$	-
cuvette (4 pack)	$	39.99
CFL Lamp	$	4.95
Halogen Lamp	$	1.98
Filtrate sample	$	-
Solvent Sample	$	-
Total	$	46.92

NOTE: Filtrate and solvent are from Extraction

Microplastic Extraction Materials Cost

Material	Cost	
Microplastics	$	-
Distilled Water (1 Gal)	$	0.99
Magnets	$	7.99
Plastic Bag	$	-
Testing Tube (Kits)	$	15.00
Magnetite (100g)	$	8.62
Oil (100 mL)	$	5.49
Electronic Microscope	$	24.99
Total	$	63.08

Chlorophyl Extraction Materials Cost

Material	Cost	
Leaves/Parsley	$	-
Acetone	$	4.03
Measuring Cylinder	$	3.99
Filter Paper (100 pack)	$	7.99
Funnel	$	5.61
Pipette	$	1.99
Glass container/Bowl	$	-
Total	$	23.61

Density Column Materials Cost

Material	Cost	
Honey	$	2.99
Agave Syrup	$	1.79
Dish Soap	$	1.33
Distilled Water (1 Gal)	$	0.99
Vegtable Oil (100mL)	$	5.49
50 mL Graduated Cylinder	$	3.99
Plastics	$	-
Total	$	16.58

NOTE: Anything without a price is a common household item
These are estimates. Prices may vary.

OBJECTIVE 4: CREATION OF SURVEYS FOR PROTOCOL FEEDBACK AFTER IMPLEMENTATION

PART 1:

- Investigated survey platforms
- Chose the best platform based on
  - features of the platform
  - sponsors guidelines
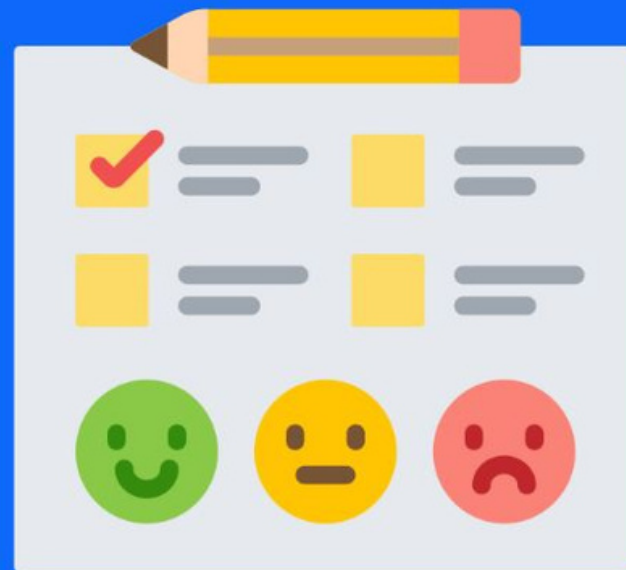
PART 2:

- Researched survey guidelines
  - Tactics on how to create a proper set of inquiries
  - how to obtain constructive feedback

RESULTS: OPTIMIZING THE INCLUSIVITY OF WORKSHOPS THROUGH TECHNICAL WRITING

RESEARCH ON WRITING TECHNIQUES

PART 1:

Performed an interview with a specialist in technical writing.
- "taking information that audiences don't understand and putting it in a way that they can understand it".
- Addressed the magical number 7, plus or minus 2 rule.

PART 2:

- Recognized what audience we were writing for.
- It was determined that our audience had to be as broad as possible.

7 ± 2
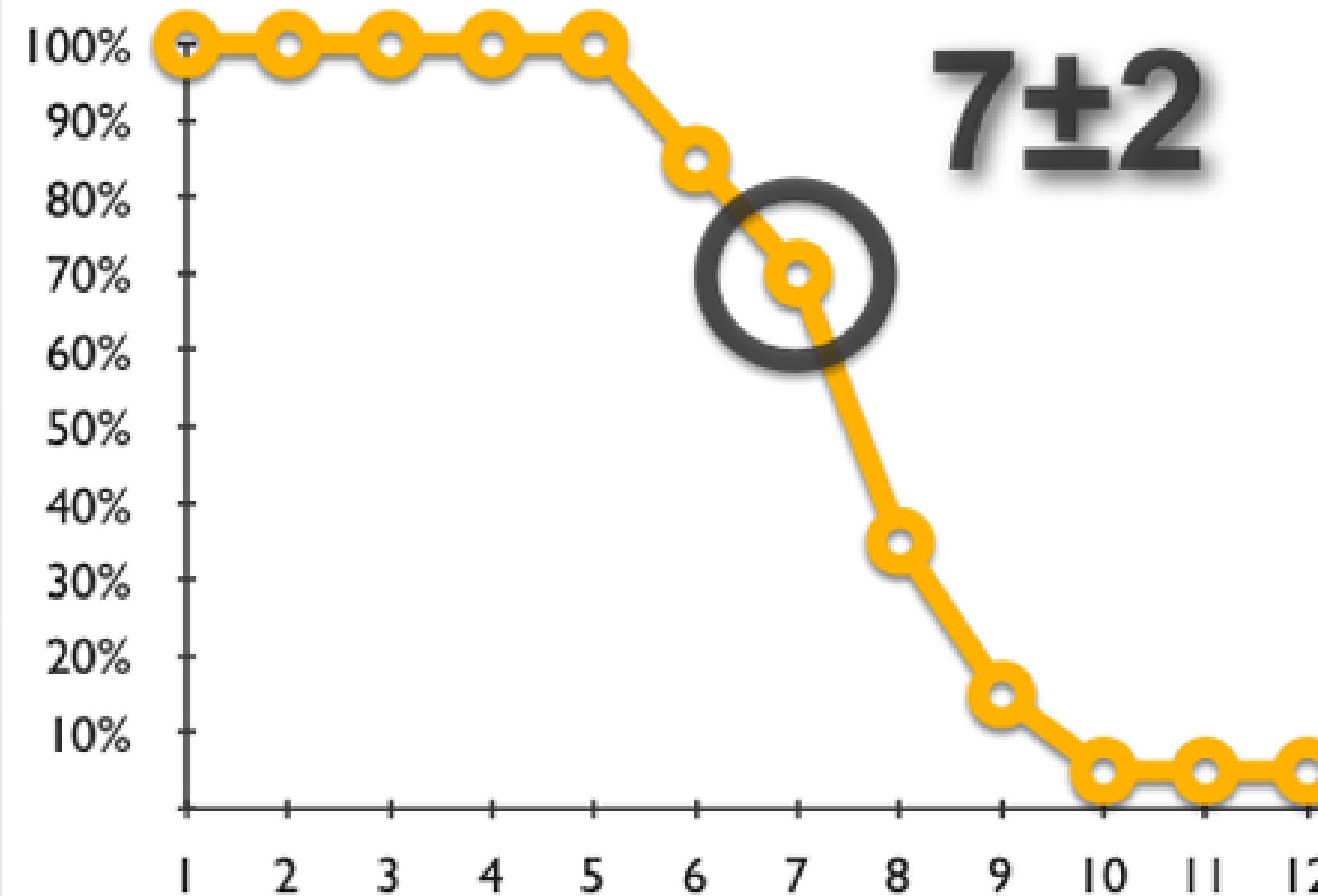
CREATION OF PROTOCOL TEMPLATES

WHY TEMPLATES?

- different platforms would be explored
- 3 templates were created, where only one would be selected

DIY Hydrophones

Created by: Kat Austen
Written by: Vasil Bozdo, Jose Rivera, and Ryan Trongone

What are hydrophones and why do we use them?
This will be the introduction of the lab describing what hydrophones are and what they are used for. This will also describe what a piezo is and how it works.(all in the notes from the experiment)

Materials:

- 2 piezos
- Microphone cable (between 1.5 and 2 meters)
- Electric jack plug
- Hot glue gun
- Hot glue
- Soldering Iron
- Solder
- Wire stripper
- Silicone
- Audio recorder
- Headphones (with male audio jack)

Protocols:

1. Plug in and heat up the soldering Iron
2. Cut a length of microphone wire between 1.5 and 2.5 meters.
3. Strip the wire approximately 3 cm on each end. Refer to image 1 in appendix B.
4. Cut the cotton down to the wire base. Then twist the ground wire (without plastic) to create a solid ground on both sides of the microphone wire. Refer to image 2 in appendix B.
5. Using the electric jack plug, unscrew the back of the jack. There are 3 sections of the jack, the ground, and two signals. Refer to image 3 in appendix B. place the back of the jack that was unscrewed on the microphone wire. Solder the ground of the microphone wire to the ground of the jack, and the two signals of the microphone wire to the signals of the jack. For solder instructions and tips, refer to appendix A. Make sure that none of the wires are touching each other, or the jack will not work. Refer to image 4 in appendix B.
6. Slide the back of the jack back on. Be careful not to pull any of the wires free.
7. Place a piezo in the testing grid with each wire in a different section. On the other side of the testing device, match the ground and the signal wires together. After placing the

TEMPLATE USED FOR THE PROTOCOLS

WHY THIS TEMPLATE?

The following template was selected because:
- displays pleasant graphical design
- provided an adequate organization
- easy to manage by our sponsor if changes are needed in the future

DO-IT-YOURSELF HYDROPHONES

In this practical workshop, we make DIY hydrophones and use them to explore the sounds of nearby underwater environments

PURPOSE

To draw attention to the levels of human-generated noises that have increased at a staggering rate over the last sixty years. The main causes of oceanic noise pollution are:

Explosives | Airguns | Military Sonar | Shipping Traffic

IMPACT

Man-made sonar emanations disorientate cetaceans, sea turtles, and fish to such an extent that they end up being driven out of their natural habitats, or even suffering shoal collapse.
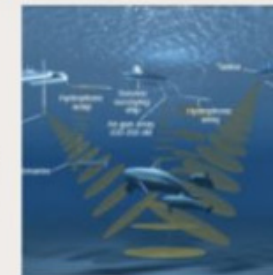
SOLUTIONS

Exhibits like the Coral Empathy Device use recordings from hydrophones in noise-polluted areas to invoke empathy within participants towards underwater environments.

OVERVIEW

We are using piezo elements to make DIY hydrophones (underwater microphones), in order to listen to sounds in nearby bodies of water.

Feel free to provide feedback on the protocols for this workshop using the QR code survey provided. For more information on Studio Austen's participatory work and exhibits, visit (www.katausten.com).

Materials and step-by-step instructions for succcessful piezo connection and audio jack wiring with diagrams included

List of Materials
- 2 piezos
- Microphone cable (between 1.5 and 2 meters)
- Electric jack plug
- Hot glue gun (with glue sticks)
- Soldering Iron (with solder)
- Wire stripper
- Silicone seal dip

PART 1:

Microphone Cord Wiring

1. Cut a length of microphone wire between 1.5 and 2.5 meters and cut outer wire to expose the signals and ground wire.
2. Strip the wire at least 3 cm on each signal wire.
3. Cut the cotton down to the wire base. Then twist the ground wire (without plastic) to create a solid ground on both sides of the microphone wire.

PART 2:

Audio Jack Wiring

1. Using the electric jack plug, unscrew the back of the jack. There are 3 sections for connecting wires on the jack, the ground, and two signals.
2. Place the back of the jack that was unscrewed on the microphone wire through the back in order to be able to screw it back on after the jack is installed.
3. Using the wiring diagram below, place the respective microphone signal wires and ground wire through the holes in the correct wiring sections and twist the ends to ensure a strong connection before soldering.
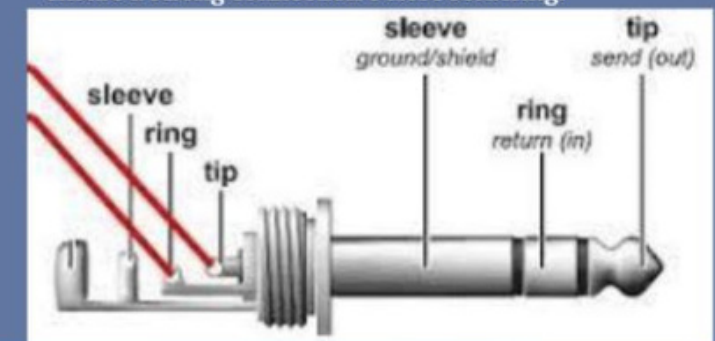
# OUR FINAL PROTOCOL FORMAT

FORMATTING

- the prior format could not fit templates on a full page.
- bifold format was used

CHLOROPHYLL EXTRACTION

In this practical workshop, we will extract chlorophyll from leaves using acetone

OVERVIEW

Plants are organisms that differently from animals, produce their own food. This is possible due to a certain chemical that is inside of them, named chlorophyll. This chemical is responsible for absorbing the sunlight, and along with carbon dioxide and water, plants are able to go through a process called "photosynthesis", in which plants produce oxygen as well as glucose, their source of energy.

PHOTOSYNTHESIS
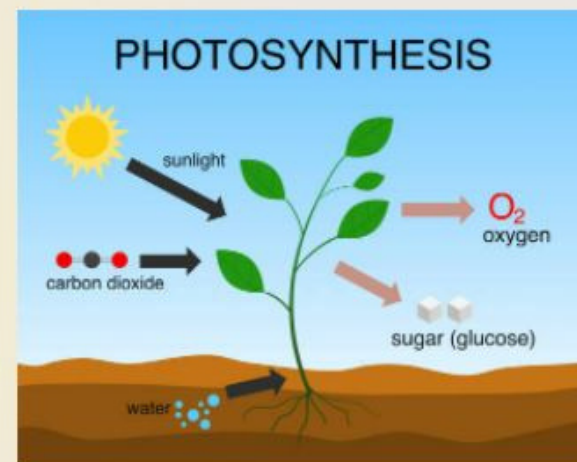
PURPOSE

Parsley is a great source of chlorophyll, which can be extracted from its leaves. Chlorophyll can be beneficial to our health. Chlorophyll is an antioxidant which can reduce cell damage in our bodies, detoxify our blood, boost immune system and it is believed to even be able to prevent certain cancers.

Feel free to provide feedback on the protocols for this workshop using the QR code survey provided or click here. For more information on Studio Austen's participatory work and exhibits visit (www.katausten.com).

RESULTS: CONVEYING THE PURPOSE OF STUDIO AUSTEN'S WORKSHOPS

HYDROPHONES WORKSHOP AND LISTENING PRACTICES

Only one change of materials was made:
- 3-wire piezo
- Better sound
- More durable connection
- 90 cent price difference per piezo

LISTENING PRACTICES

In this practical workshop, we will use recording devices to explore the sounds of environment

OVERVIEW

Hearing is one of our senses, however, listening is something we don't practice enough. We often disregard a number of sounds as "background noise". These sounds range from the loudest to the faintest. Being able to identify a single sound is just as important as recognizing that it's there. All these sounds together identify an environment.
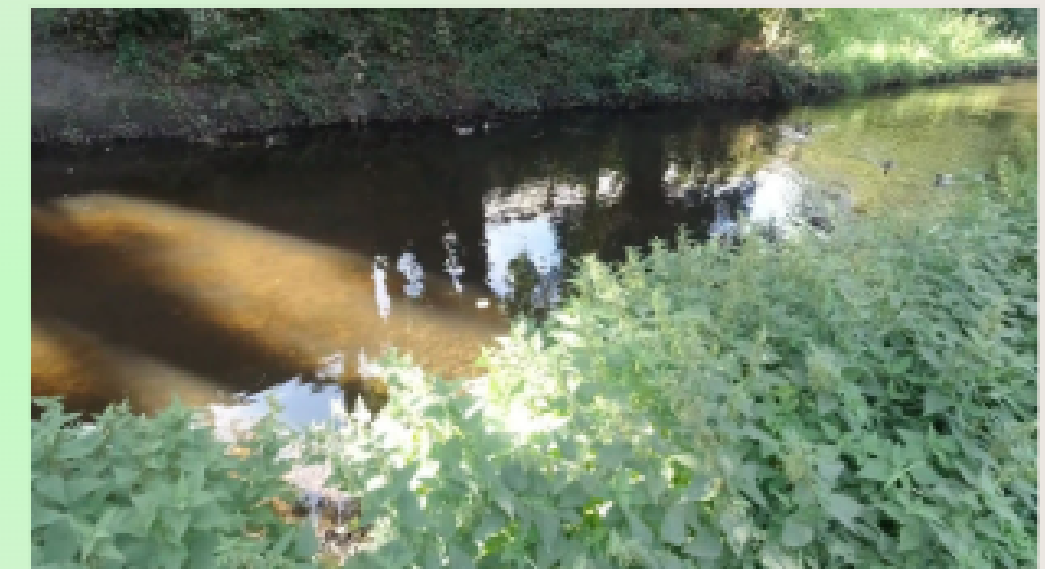
MICROPLASTIC EXTRACTION AND DENSITY COLUMN

- Convey dangers to the environment and humans
- Elaborate on the excessive amounts in oceans
- Plastic density variation
- Fionn Ferreira Method
- Motivate people to contribute with ease
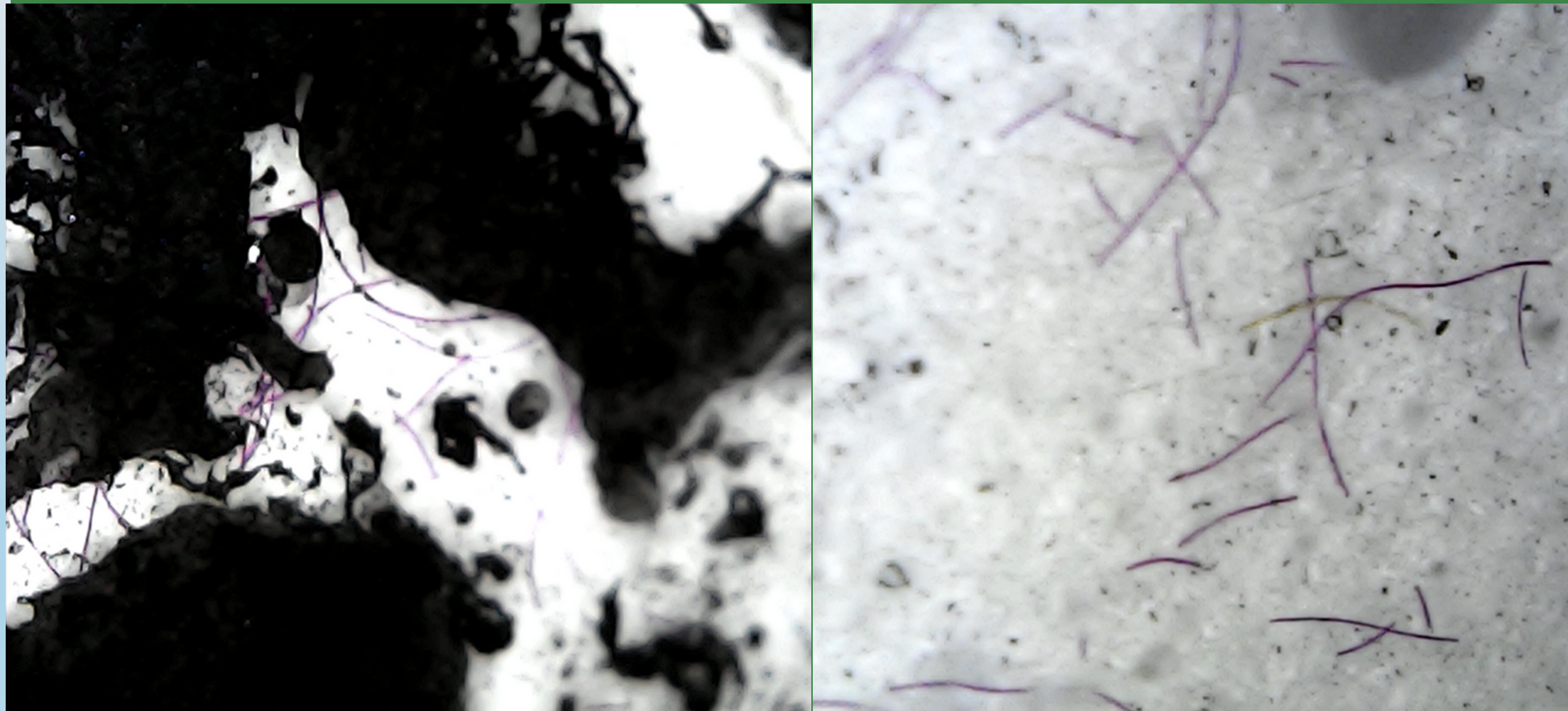
FUTURIUM DENSITY COLUMN

In this practical workshop, we make density columns using fluids with varying densities to identify plastics by their density

WHAT IS PLASTIC?

Plastics are a polymer that contains long chains with little linking between the chains, making them very malleable. they are usually synthetic or involve human processing to increase plasticity.

WHY IS PLASTIC DANGEROUS?

As plastic is broken down, it is unable to decompose, but instead, it breaks into many small particles called microplastics. These act as toxic sponges which are about one million times more toxic than the water around it, which creates serious concerns regarding the contamination of food that humans consume.

CHLOROPHYLL EXTRACTION AND SPECTROSCOPY DOCUMENTATION

- Explains benefits of natural extracts like chlorophyll
- Potential to increase life expectancy
- Participation in research with no laboratory needed
- Changes the relationship between participants and scientific research due to increased inclusivity


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Acetone_FinalSpectrum
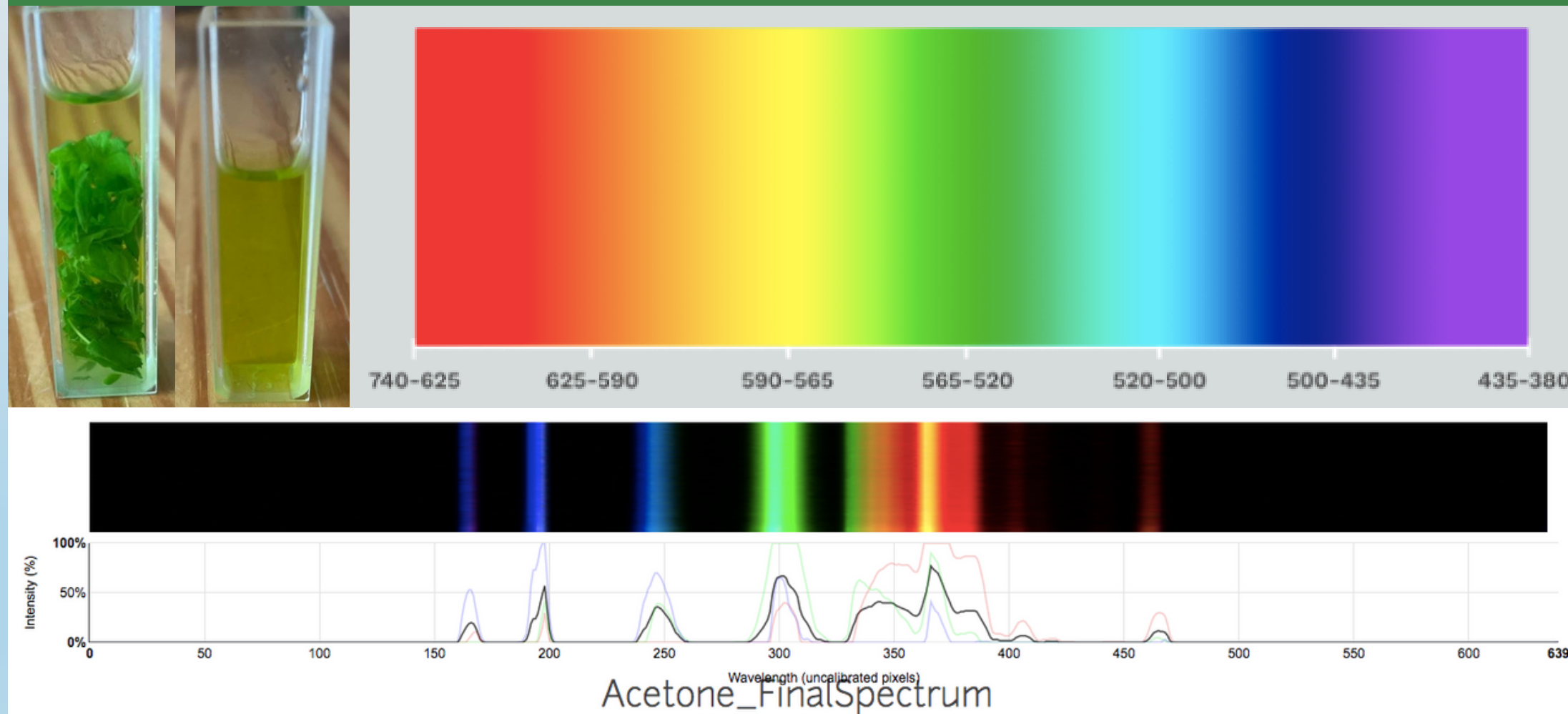
SPECTROSCOPY DOCUMENTATION

In this practical workshop, we use DIY spectrometers to capture, measure, and analyze different light spectra to find specific molecules

HOW DOES A SPECTROMETER WORK?

The design of a modern spectrometer is an assembly of a slitted screen, a diffraction grating and a photodetector. The screen allows a beam of light into the interior of the spectrometer, where the light passes through the diffraction grating. The grating splits the light into a beam of its component colors, similar to a prism. The light then reflects onto a detector that picks up individual wavelengths.
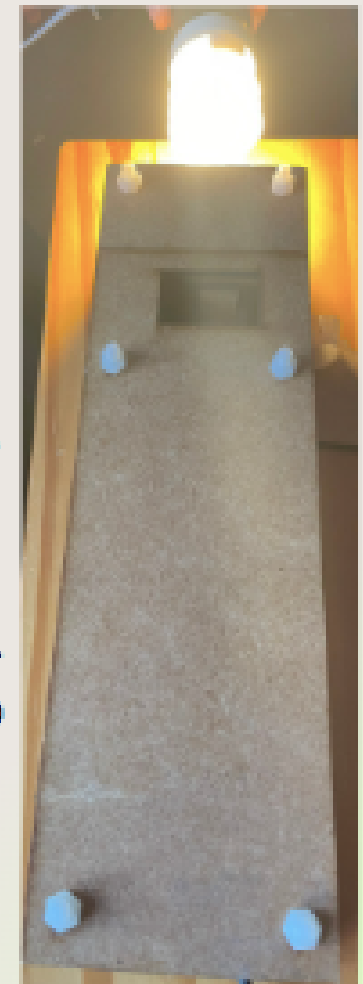
RESULTS: CREATING AN EFFECTIVE SURVEY FEEDBACK SYSTEM
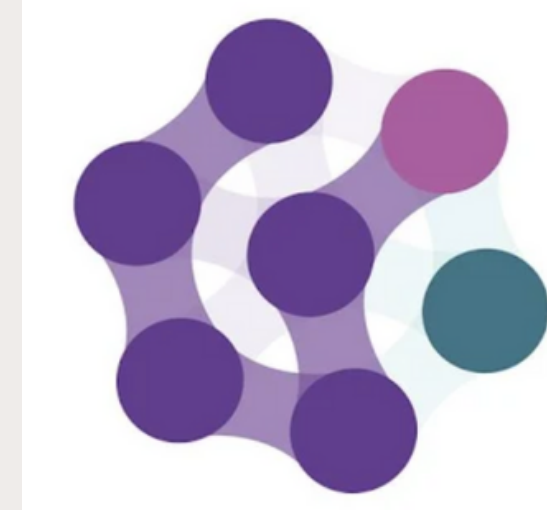
CHOOSING A SURVEY PLATFORM

Google forms:
- original option.
- not viable due to servers.

Epicollect 5:
- has many features other forms do not have.
- all European servers.

IMPLENTING INCLUSIVE FEATURES INTO OUR SURVEY CREATION PROCESS

Creating Questions:

- Had to be careful with wording to prevent cognitive bias.
- Couldn't ask how the workshops affected their view on the environment
- Formed questions around the actual workshop

Accessibility:

- Over 62 million Germans have a mobile smart phone
- Qr Codes are extremely easy to access with a mobile phone
- Many forms, such as Covid-19 forms, are already all around Berlin.

PLEASE DO NOT SCAN

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CONCLUSION: OUR IMPACT ON STUDIO AUSTEN WORKSHOPS MOVING FORWARD

THE DELIVERABLES OF OUR PROJECT WILL HELP STUDIO AUSTEN'S REITERATIVE PROTOCOL IMPROVEMENT PROCESS IN THE FUTURE

#1

Improved workshops are published with optimized display methods and technical writing skills to help participants understand the protocols and their potential effect on the environment

#2

#3

Studio Austen collects and analyzes feedback provided by participants through the survey system created to ensure a participant's potential impact on the matter is retained and that the protocols are understood

THANK YOU!

- STUDIO AUSTEN
- KATHERINE FOO
- DANIEL DIMASSA

IMAGE CITATIONS

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