Case Studies in Design Informatics 1

Co-Design

Dorsey Kaufmann
dkaufma2@ed.ac.uk

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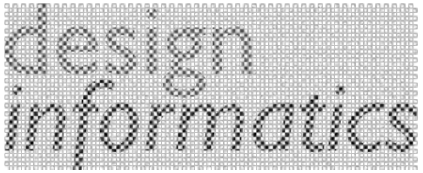
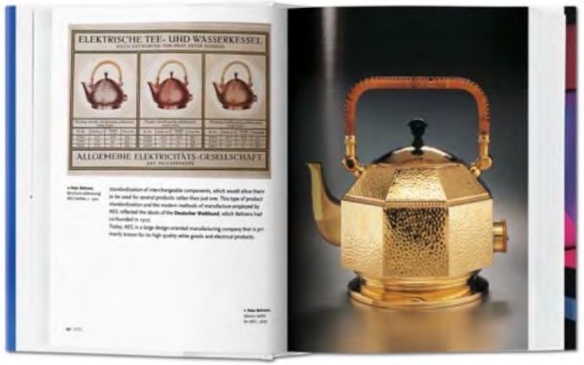


In today's lecture…

1. Co-design theory
2. Co-design in practice
3. Helicopter Research
4. Equity-centered Community Design

Co-Design Theory

A very brief history of design



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A very brief history of designing interactive technologies

Bundesarchiv, Bild 183-1989-0130-010
Foto: Grubitzsch (geb. Raphael), Waltraud | 30. Januar 1989

Grubitzsch (geb. Raphael), Waltraud. Copyright terms and licence:CC-Att-SA-3 (Creative Commons Attribution-ShareAlike 3.0)

Since the 1970s, it's been recognized that to "design" complex interactive systems, you need expertise across multiple fields and disciplines:

- Expertise about how people think – psychology (perception, cognitive, ecological, social)
- Expertise on how people physically interact (human factors)
- Expertise on how people talk and communicate and interact (linguistics, ethnography)
- Expertise on how the systems work (computer science, AI)
- Expertise on how to translate this into user interfaces (interface and interaction design).

But… what expertise is missing?

the person who uses the technology!

Why should we involve users in the design process of new technologies (and products, services, systems) that they use, work and live with?

https://miro.com/app/board/uXjVJuJdv9U=/?share_link_id=525454138418

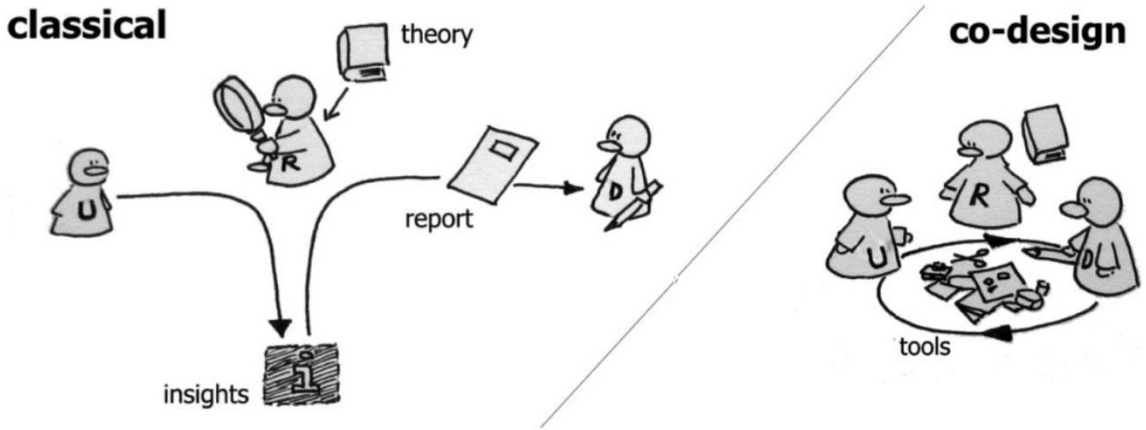
Student Questions

- What makes co-design different from traditional user-centered design?
- How does the shift from user-centered design to co-design change the role of the designer, researcher, and user?

Co-design – what is it?

"[an] approach towards computer systems design in which the people destined to use the system play a critical role in designing it."

- Shuler & Namioka, 1993, p.xi. Participatory design: Principles and Practices



User = expert in experience and a creative agent
Researcher/Designer = expert in facilitation and technical knowledge

Sanders & Stappers. 2008. Co-creation and the new landscapes of design.

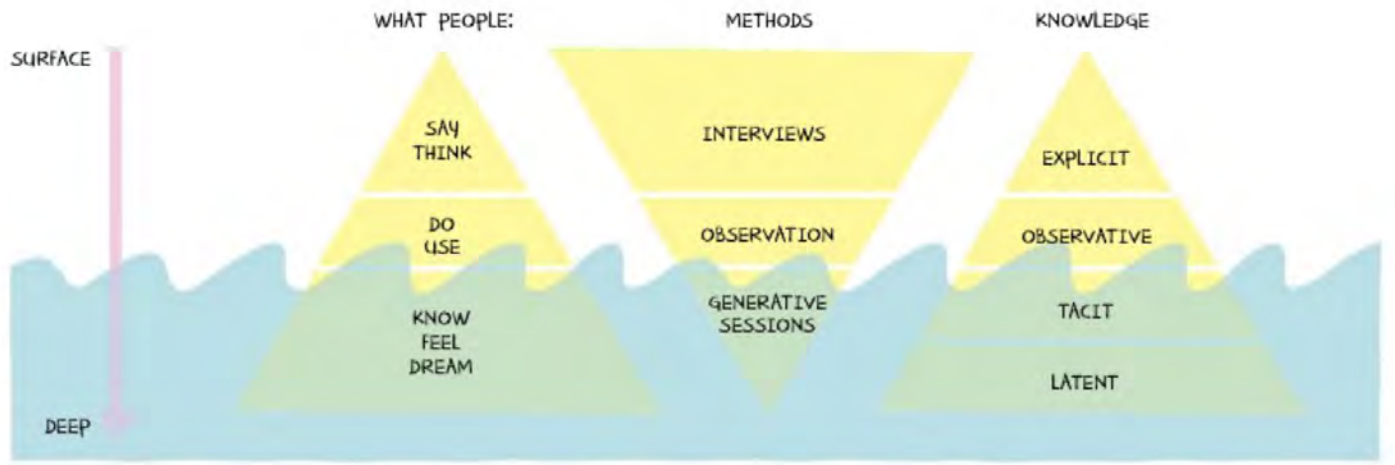
Workshops in co-design

'… workshops are usually held to help diverse parties ("stakeholders") communicate and commit to shared goals, strategies, and outcomes (e.g., analyses, designs, and evaluations, as well as workplace-change objectives). Workshops are often held at sites that are in a sense neutral – they are not part of the software professionals' workplace, and they are not part of the workers' workplace.'

- Muller, 2003, p.1060. Participatory design: The third space in HCI

- "future workshops" - Kensing and Madsen. 1991. Generating visions. Future workshops and metaphorical design.

Say, Do, Make



Sanders & Stappers. 2012. Convivial toolbox: Generative research for the front end of design.

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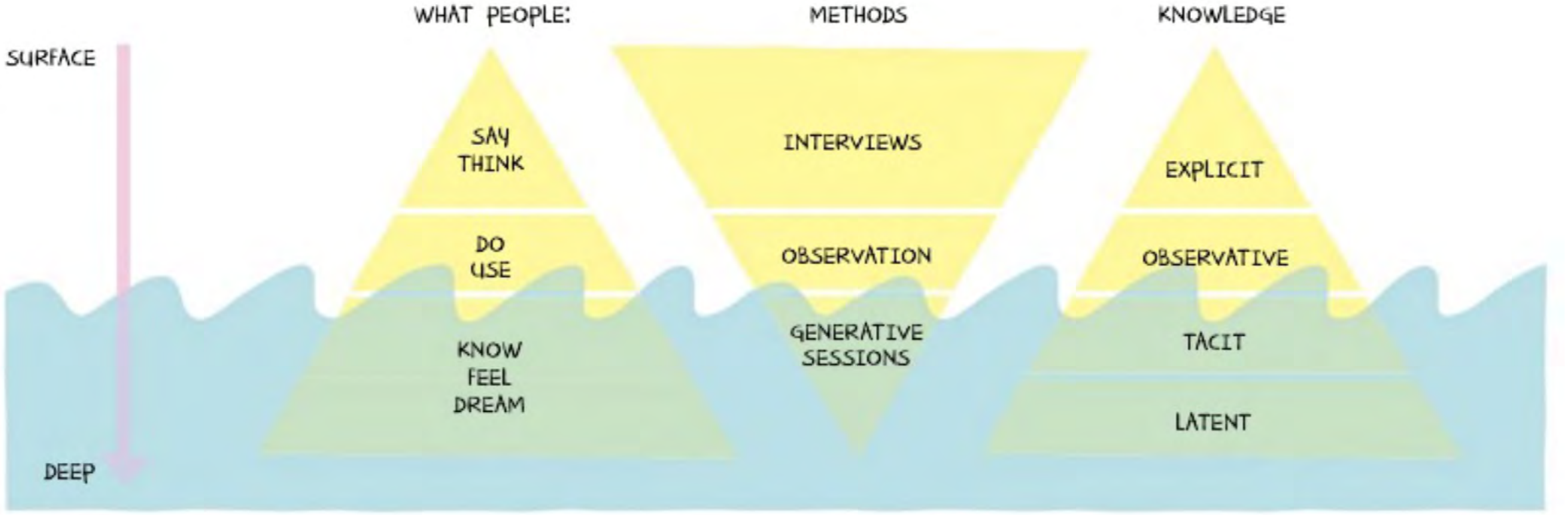
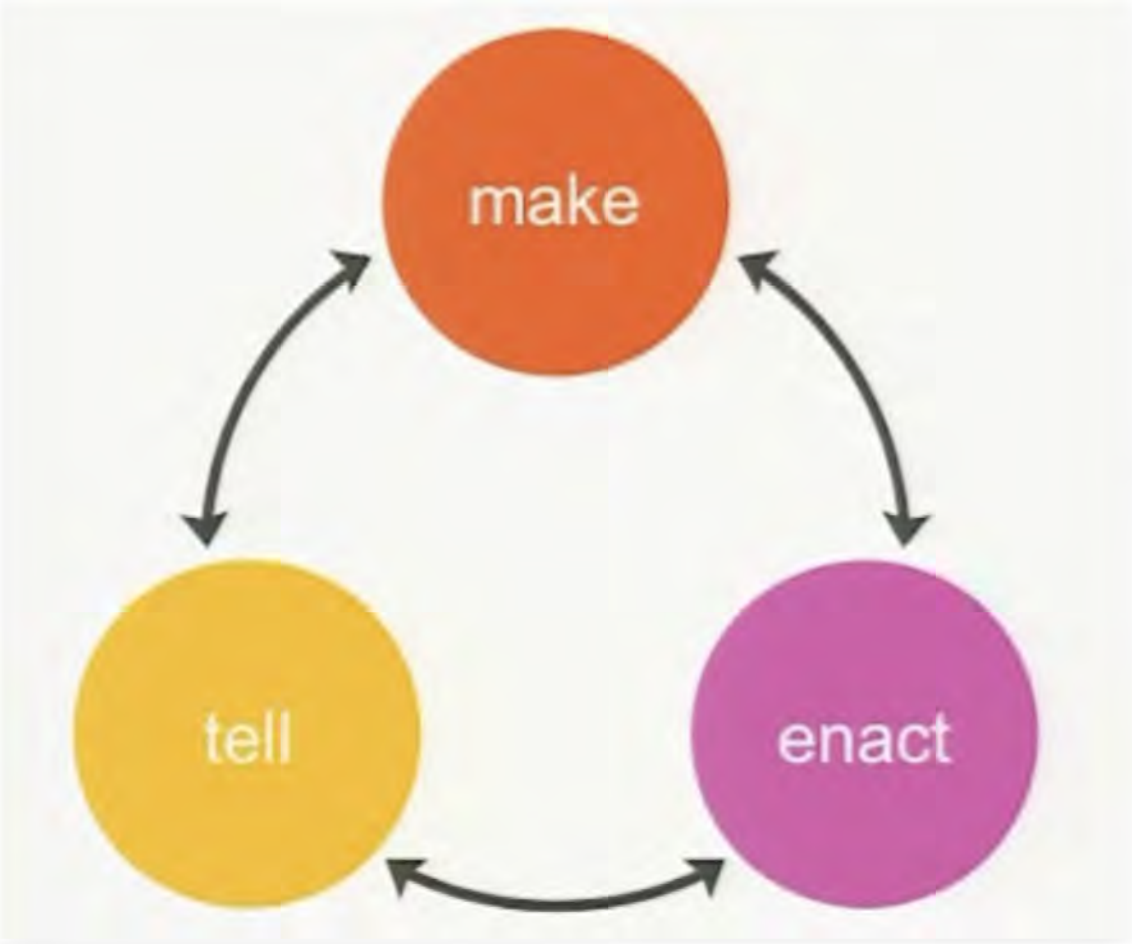
Say, Do, Make



Sanders & Stappers. 2012. Convivial toolbox: Generative research for the front end of design.

Make, Enact, Tell



You can break down "Make" methods further and think about them as:

- **Make** – inviting people to "make" things that representing their knowledge, their feelings, their dreams
- **Enact** – inviting people to enact ideas and the things they make, to try things out, to walkthrough future situations
- **Tell** – inviting people to tell us stories, about their lives now but also their lives in the future and how their future lives might change through the things they have made and enacted

Sanders & Stappers. 2012. Convivial toolbox: Generative research for the front end of design.

Co-Design Practice

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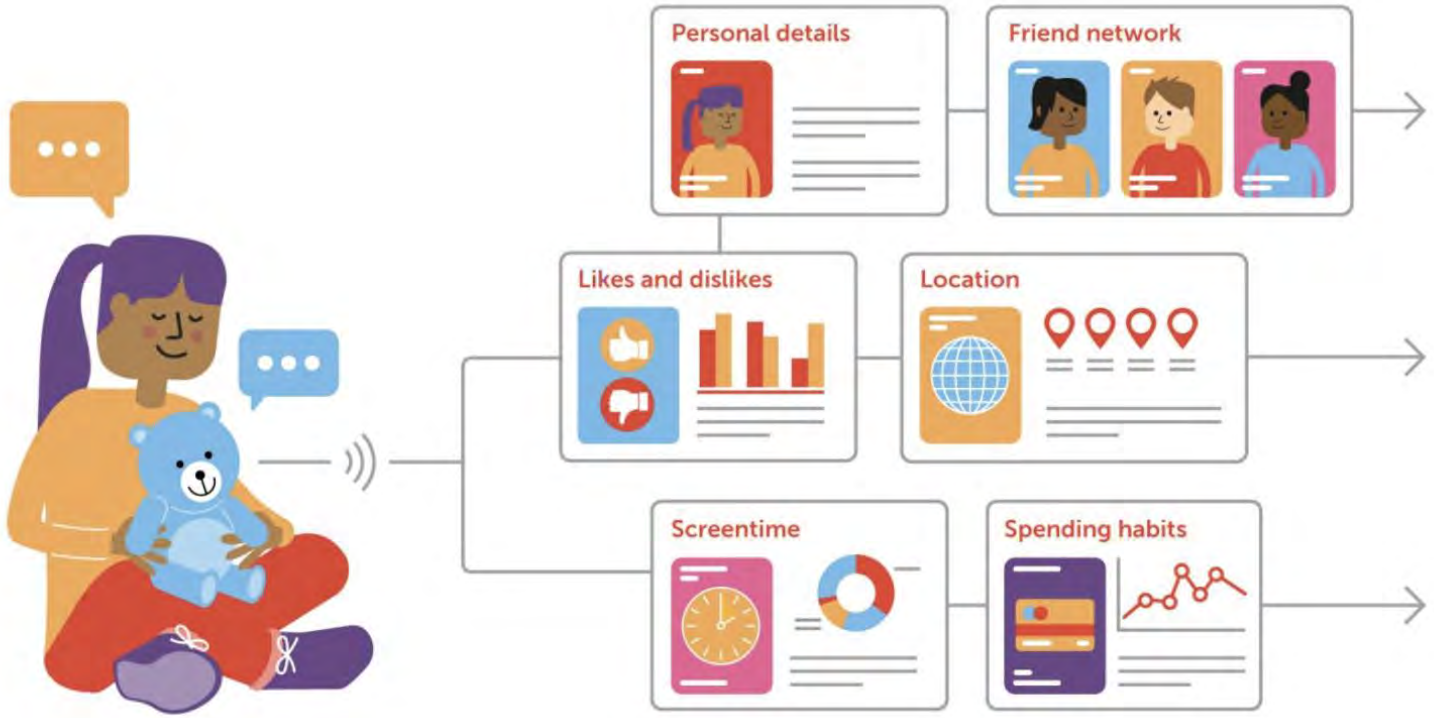
NEW PROJECT: GRASPING DATA. EMPOWERING YOUNG CHILDREN TO UNDERSTAND AND BENEFIT FROM THEIR PERSONAL DATA

3 Sep 2024



RESEARCH AREAS

Children & Technology

RESEARCH TEAM

Project Lead: Professor Andrew Manches

Project Co-Leads: Dr Cara Wilson, Dr Uta Hinrichs, Professor John Vines, Professor Stephen Brewster, Dr Dorsey Kaufmann, Professor Lydia Plowman

Post Doctorate Research Assistants: Dr Ayça Atabey, Dushani Imesha Perera, Dr Andres Ramirez-Duque

Project Administrator: Megan Baker

Project Partners: SSERC, Edinburgh Zoo, Glasgow Science Centre

KEY CONTACT

Professor Andrew Manches

FUNDING

UKRI's cross-research council responsive mode round 1 pilot scheme, University of Edinburgh, fEC £1,201,829.

DATES

1 Jan 2025 - 31 Dec 2026

Research Objectives

- Explore how young children understand the idea of "data"
  - Focus on personal data relevant to children on an individual level
  - Focus on real-world learning environments: home, schools, zoo, science centre…
  - Highlight the value of personal data for personal use, rather than privacy issues
  - Explore children's perspective on what data is or may be which may broaden canonical views
- Device methods to engage children in understanding their personal data by **co-designing data representations**
  - Children as co-designers, rather than receivers of data representations
  - Co-design of data representation activities
  - Co-design of data representations as keepsakes and for exploration

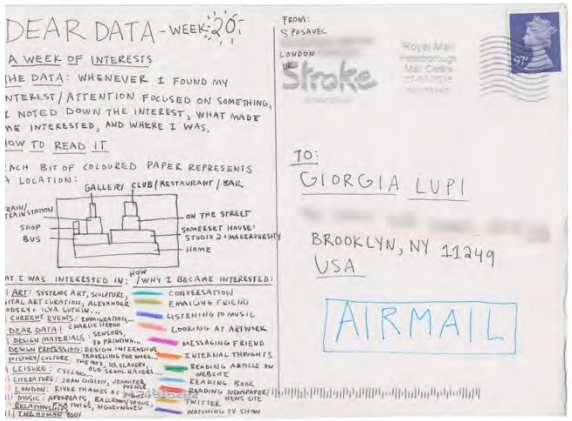
Research Questions

1. How can we evaluate young children's understanding of personal data?
2. What is children's interest in and understanding of different types of personal data?
3. What are the benefits of actively constructing physicalizations of personal data with children?
4. How feasible is it to co-create interactive physicalizations of personal data with children?

Dear Data

Lupi & Posavec

Data collection & sketching activity focusing on personal data and experiences and capturing those through hand-drawn visualization.



Data Badges

Panagiotidou et al.

Modular and intuitive design approach to construct an own badge to represent the academic skills

Constructive Data Vis

Samual Huron et al

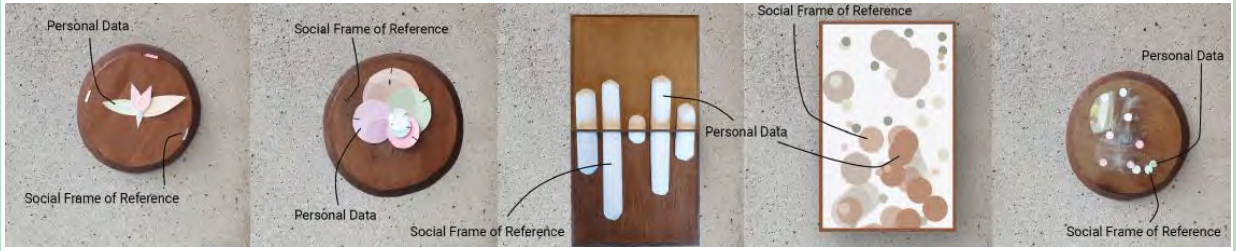
An approach to creating visualizations that is simple, yet expressive and dynamic, allowing people with little pre-knowledge about visualization (tools) to engage in visualization processes. Typically (physical) tokens are provided to represent one data unit.

Ecorbis

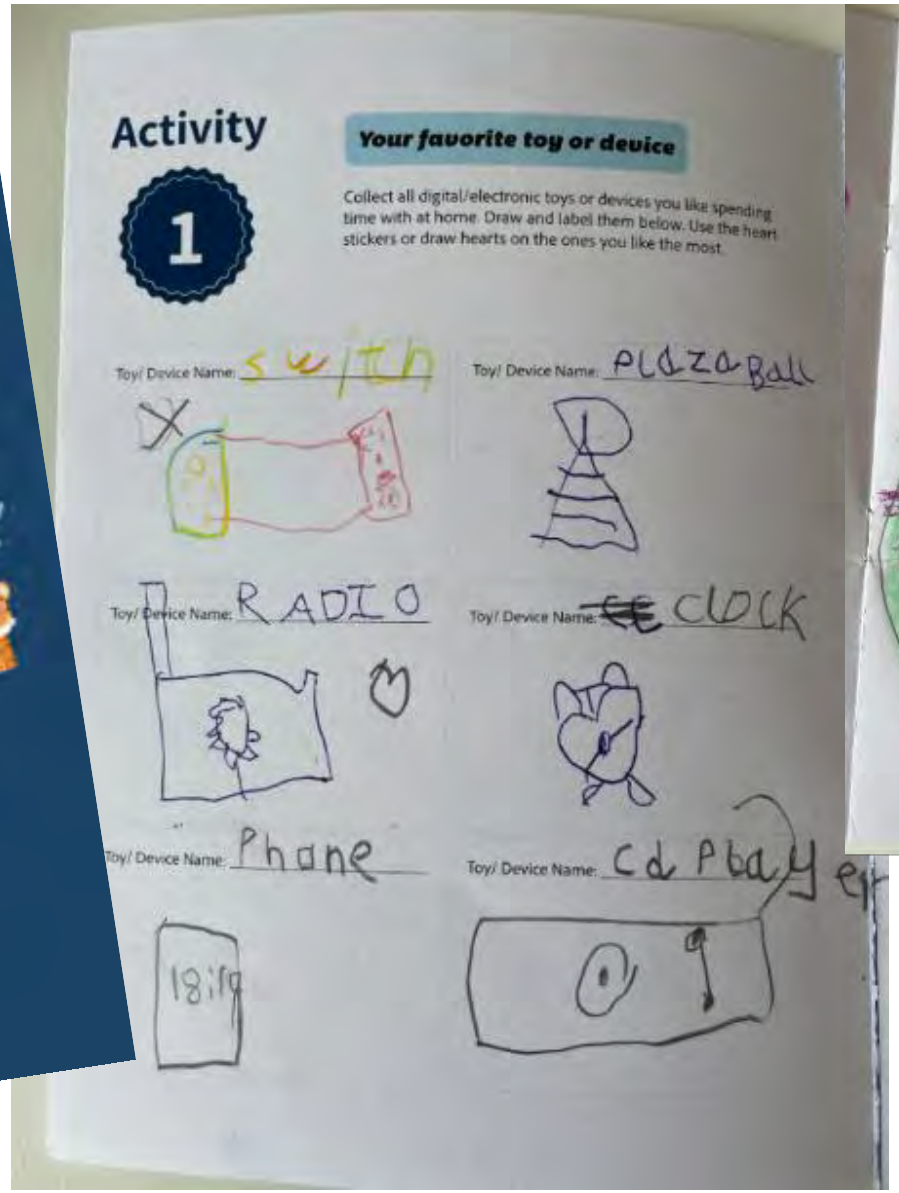
Stegers et al.

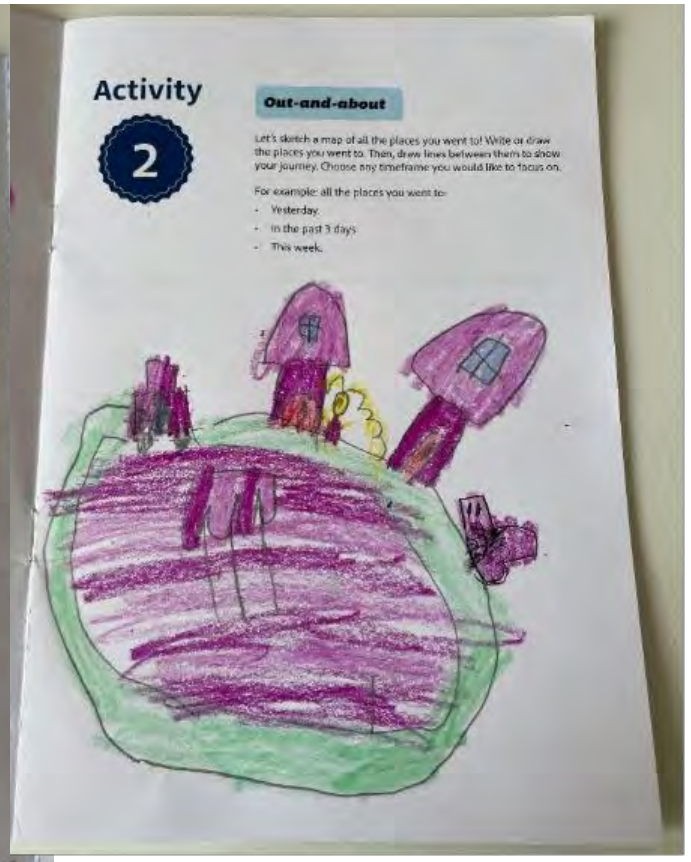
Diary study & sketching activity to explore how to visualise climate impact of household actions.

Experience prototyping was used to analyse and determine the design principles.



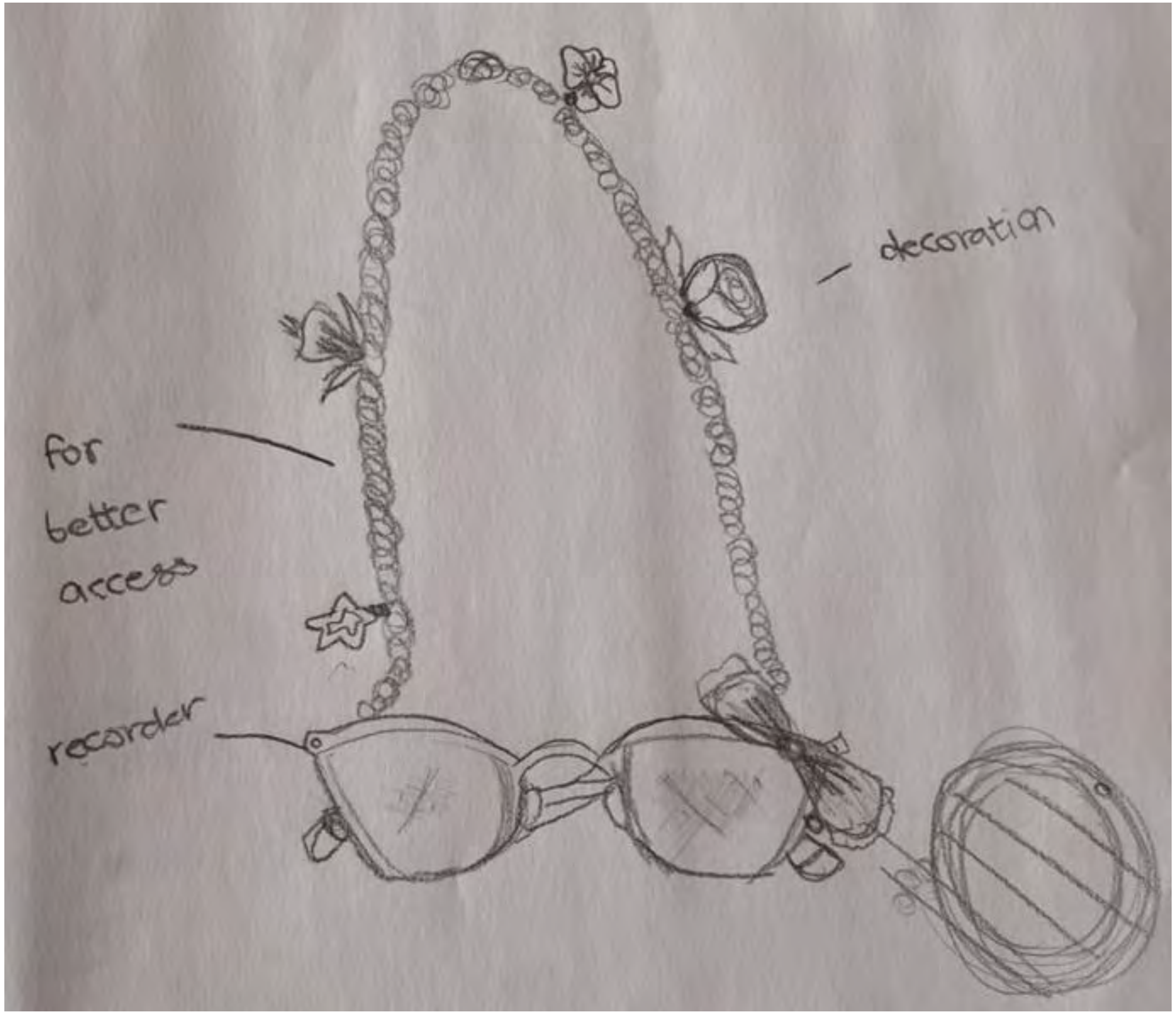

My Data Safari Adventure
Let's find out what makes us unique!


Activity
1
Your favorite toy or device
Collect all digital/electronic toys or devices you like spending time with at home. Draw and label them below. Use the heart stickers or draw hearts on the ones you like the most.
Toy/ Device Name: switch
Toy/ Device Name: PLAZA Ball
Toy/ Device Name: RADIO
Toy/ Device Name: CLOCK
Toy/ Device Name: Phone
Toy/ Device Name: Cd Play


Activity
2
Out-and-about
Let's sketch a map of all the places you went to! Write or draw the places you went to. Then, draw lines between them to show your journey. Choose any timeframe you would like to focus on.
For example: all the places you went to-
- Yesterday
- In the past 3 days
- This week.

"You can see how many beads there are. And you can also see this is taller, right? So you can directly see that Mommy did more than me" (P4)

"It was fun because we made stuff. So maybe some more making might have been even more fun"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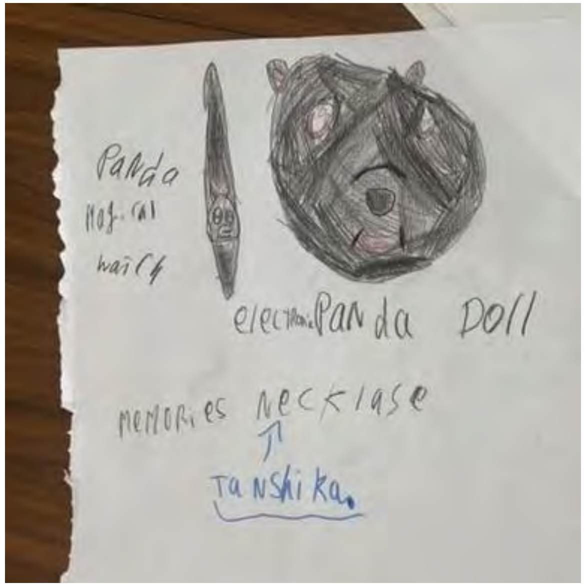
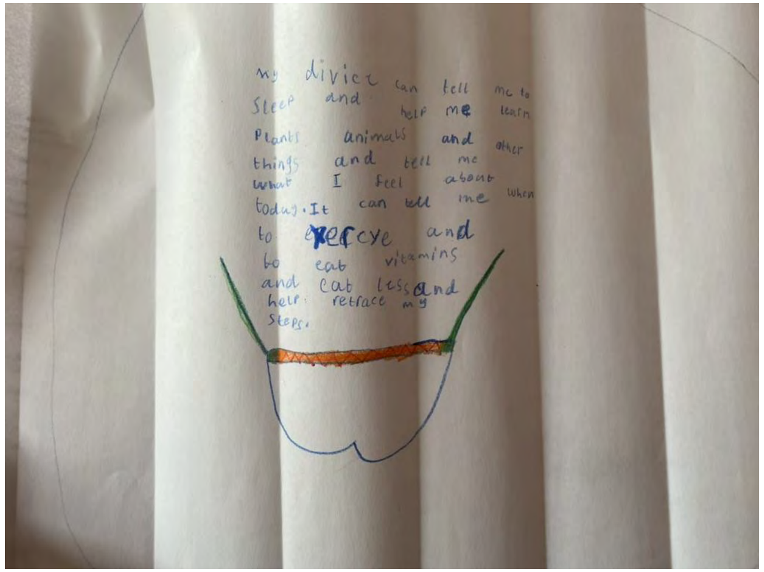
for better access
recorder

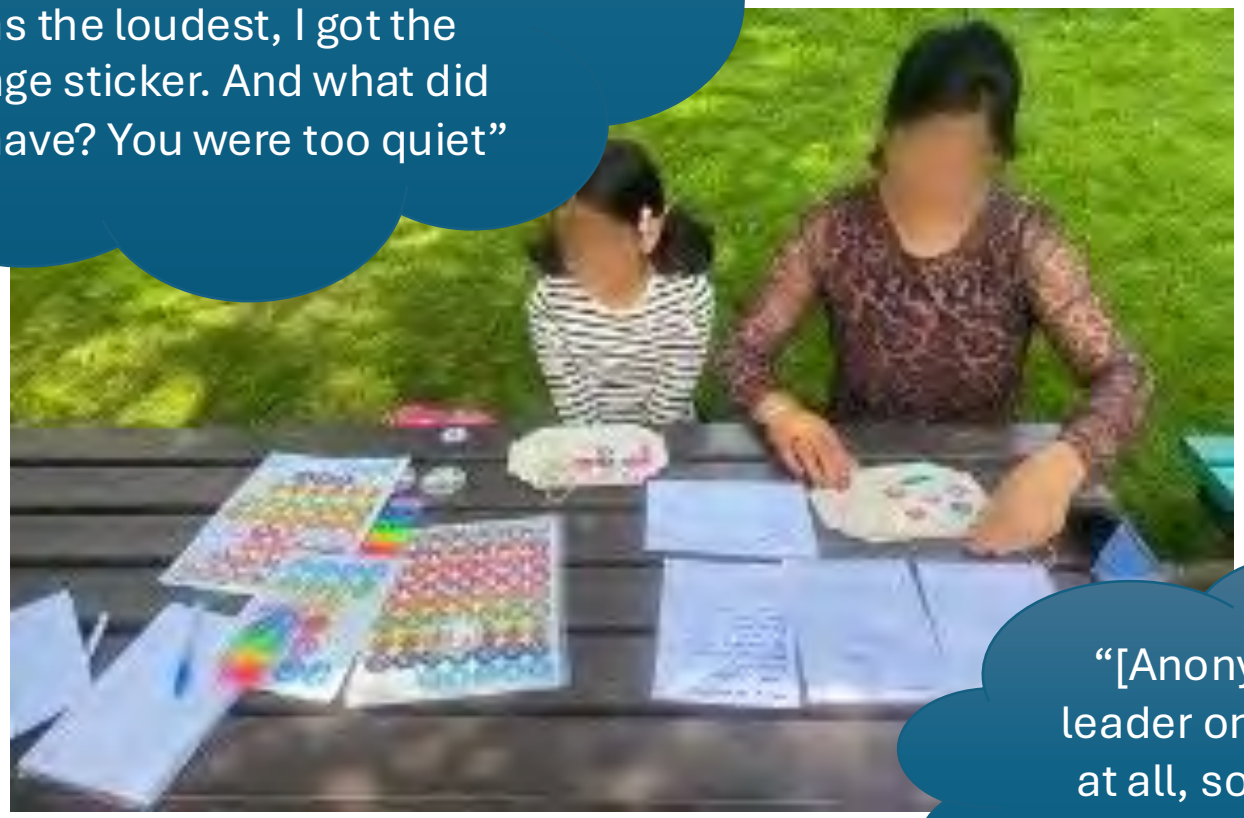

Panda
Magical
watch
electronic Panda Doll
memories necklase
Tanshika.

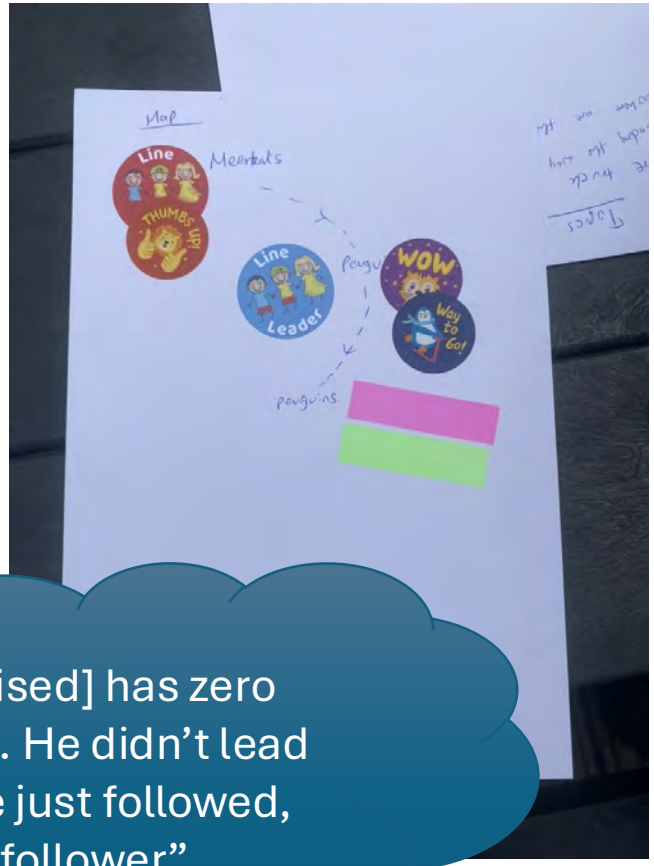

my divice can tell me to sleep and help me learn plants animals and other things and tell me what I feel about today. It can tell me when to exercye and to eat vitamins and eat less and help retrace my steps.

Exploring Curiosity in Personal Data

Zoo Tour

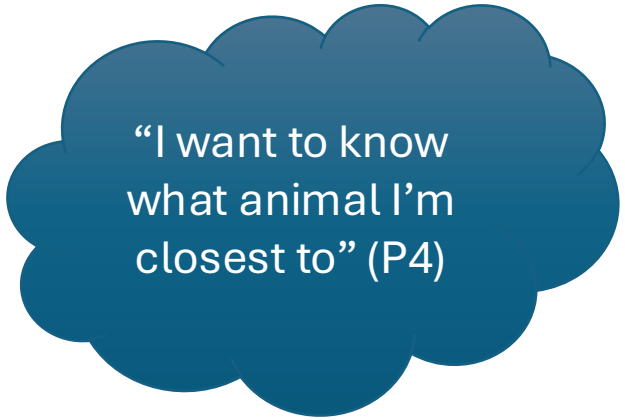
“Do you remember what this one was? [pointing to the orange sticker on the plaque] I was the loudest, I got the orange sticker. And what did you have? You were too quiet”



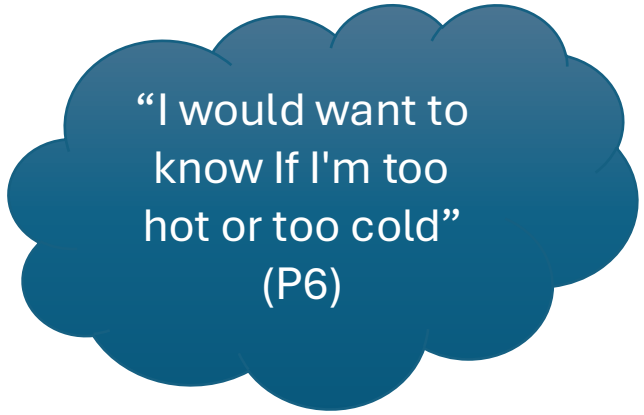


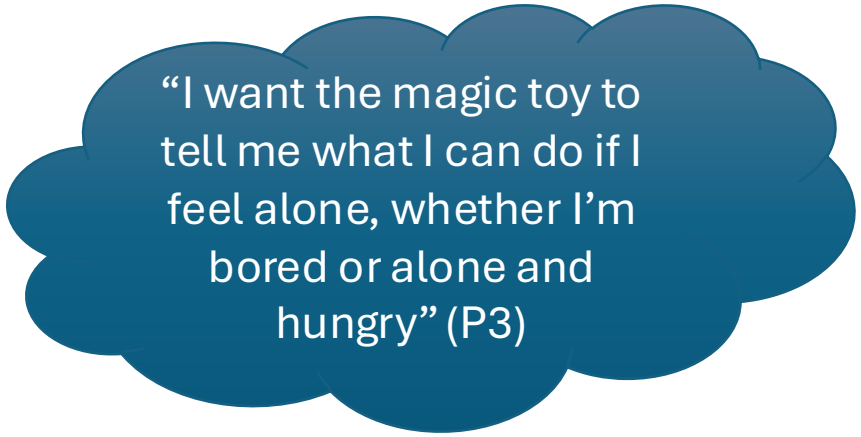
“[Anonymised] has zero leader ones. He didn’t lead at all, so he just followed, just a follower”

- Imagining and Speculating Data
  - Factual Data

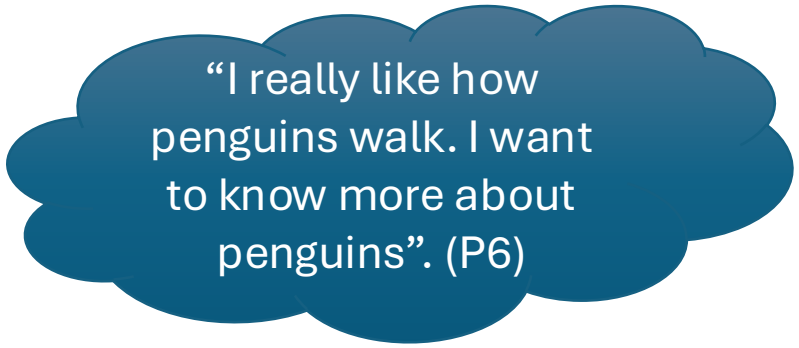


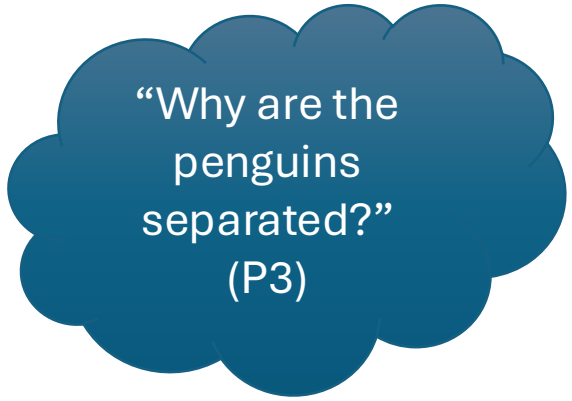
- Imagining and Speculating Data
  - Personal Data
    - Body temperature
    - Emotions
    - Fun activities to do
    - Terrain types and effort

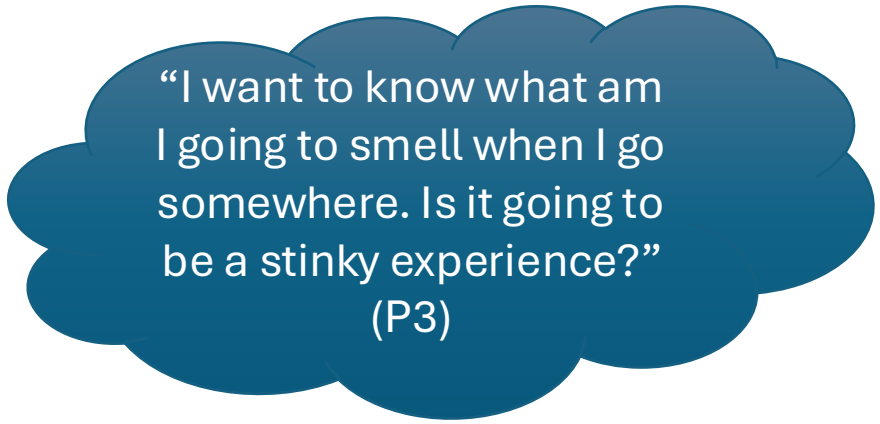




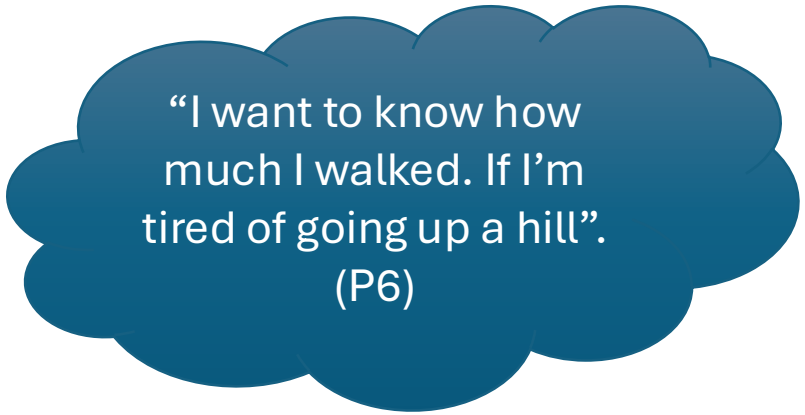
- Reflection After the Zoo Tour : Curiosity About the Zoo.
  - Curiosity about the facts on animals and the zoo

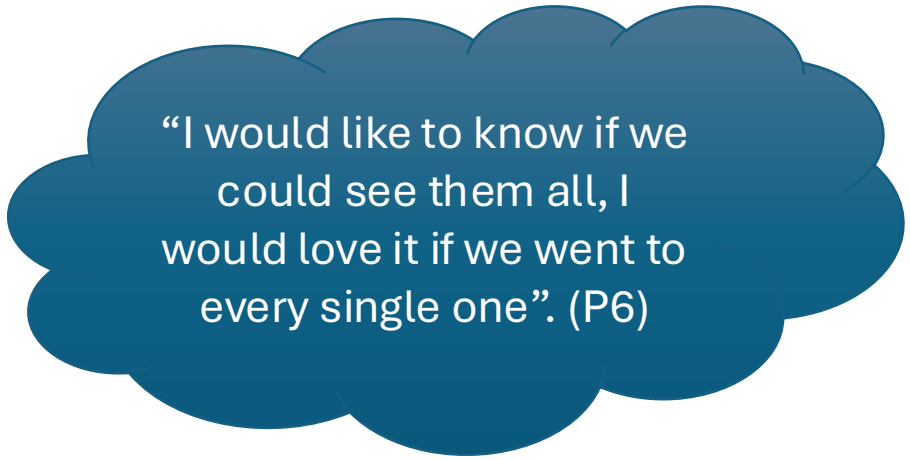




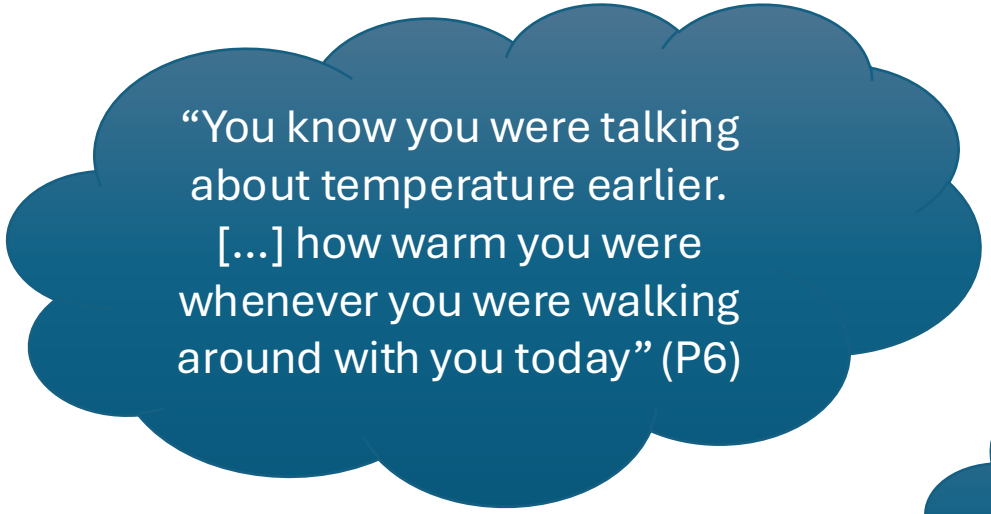


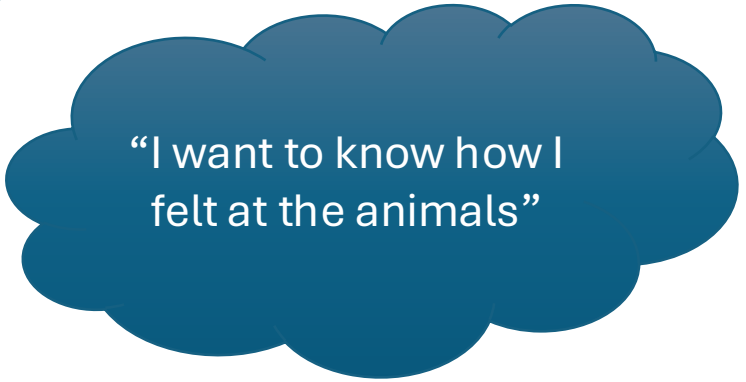
- Reflection After the Zoo Tour : Curiosity About the Zoo.
  - Curiosity about personal movement





- Reflection After the Zoo Tour : Curiosity About the Zoo.
  - Curiosity about physical attributes

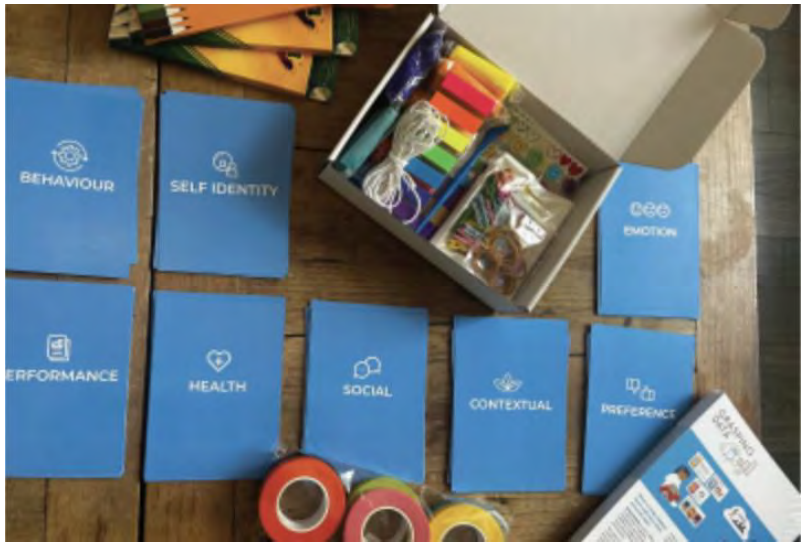




Student Question

- When designers shift from being the dominant force to facilitators, and users participate as partners in co-creation, who decides which parts to move forward with and how they should be presented?

Project Outputs so far



Play-based Activity

Sharing your Data: How personal is too personal?

Card-based activity that allows the exploration of different types of personal data and levels of sensitivity.

The activity invites participants to reflect on personal data they have generated recently based on structured prompts in the form of cards. Participants are then invited to physicalize their own data, in addition to data of others participating in the activity.

Pilot Zoo Activity

My Data Safari Activity

We invite families to take a tour through the zoo carrying data badges and sensors

- Visit Data construction stations throughout the zoo
- Final visualization station where they reflect on their visit

Data Physicalization

Shape-Changing Tangibles

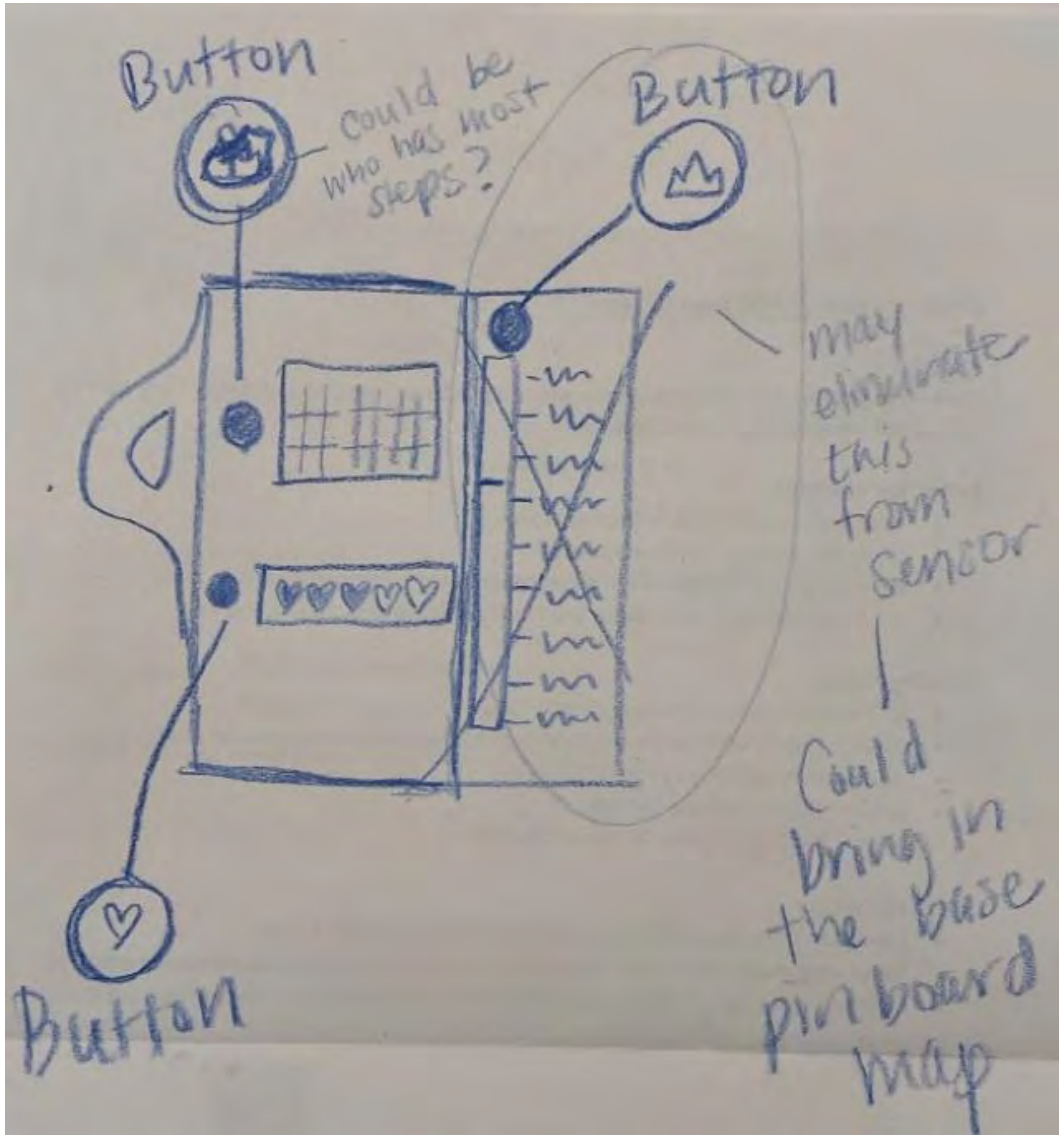
We analyse how children interpret shape-changing objects through play and conversation, exploring the metaphors they map onto their personal data and the meanings they construct.

DATA CAPTURE TOOL

DATA CONSTRUCTION - MY ZOO TRIP TOOLKIT

Data Capture Tool (continuous capture of data)

- Heart rate
- Step count
- Location (GPS)
- Form factor
  - Small, handheld or wearable device
  - Small display to check-in on data on-the-spot
- Other design considerations
  - Scalability in terms of costs
  - Sustainability & maintenance
  - All-in-one device or multiple devices?


Button
could be who has most steps?
Button
may eliminate this from sensor
Could bring in the base pinboard map
Button

Data Construction Toolkit – Data in Focus

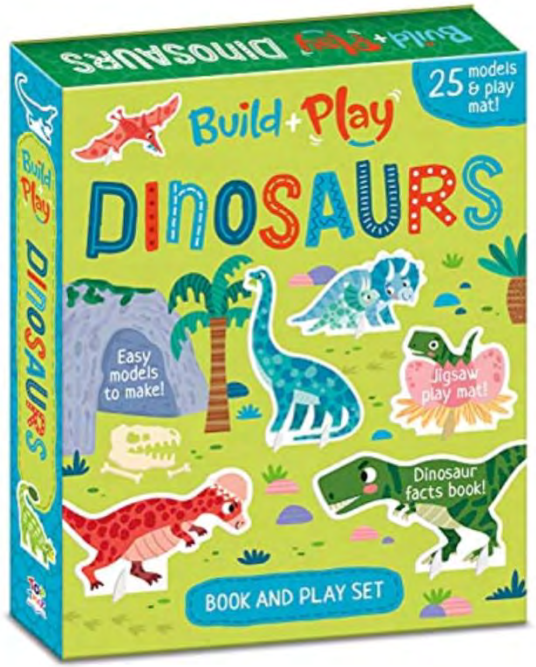
- Emotion/preference ratings
  - How excited were you to see/how scary did you find [lion/giraffe/hippo]?
- Animal-activity related data capture
  - Can you roar like a lion?
  - Who can touch their nose with their tongue like a giraffe?
  - How smelly did you find the Hippos?
- Check-in from hand-held sensors (heartrate, step count)

Design Considerations

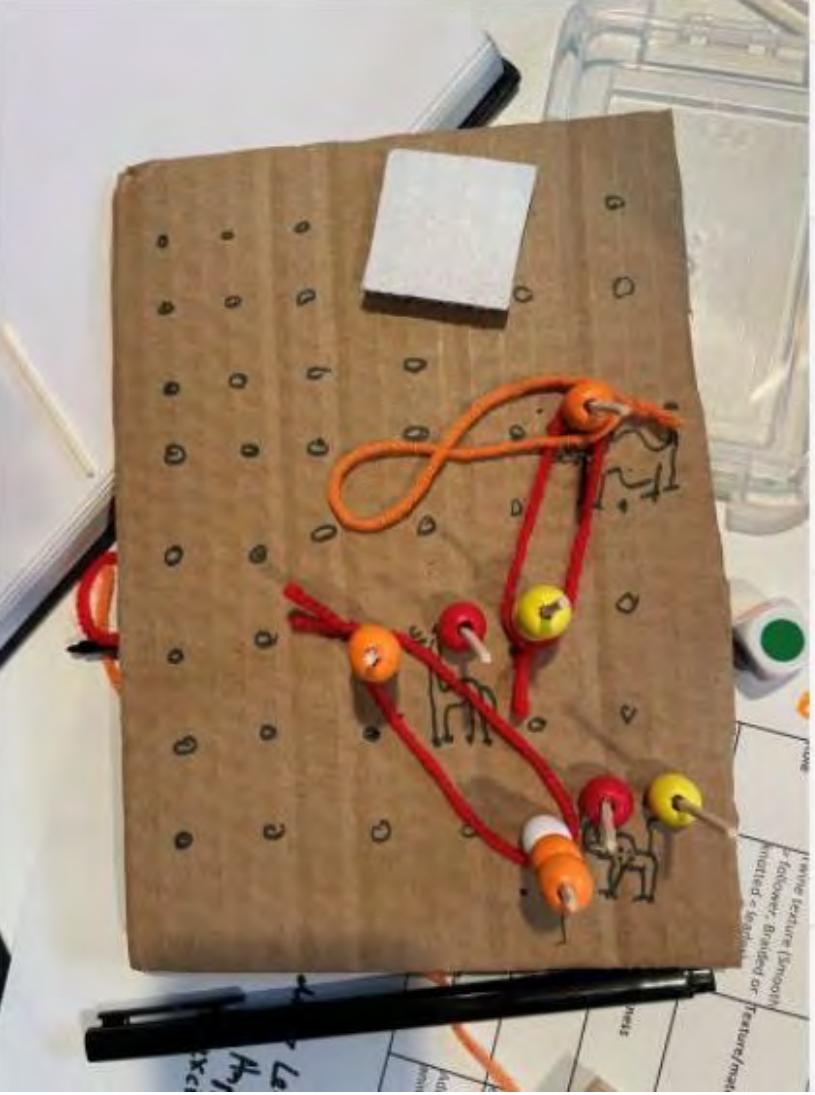
- Invites for "making on-the-go"
- End result should be
  - A constructed physicalization to help people reflect on their zoo visit
  - A memento that families/groups would like to take home
- Form factor of toolkit
  - Fun
  - Portable and light
  - Robust
  - Enable "making-on-the-go"
  - Sustainable material that is easily available
  - Scaleable to large amounts of visitors

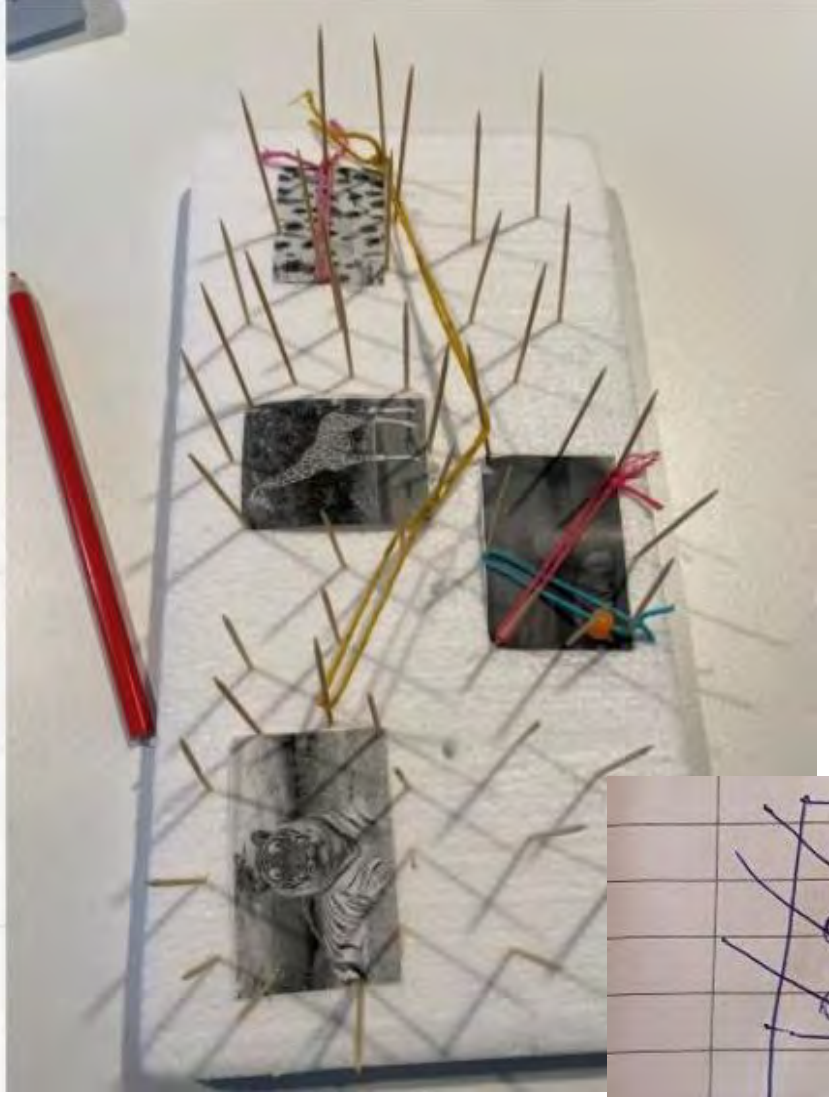

PINBALL

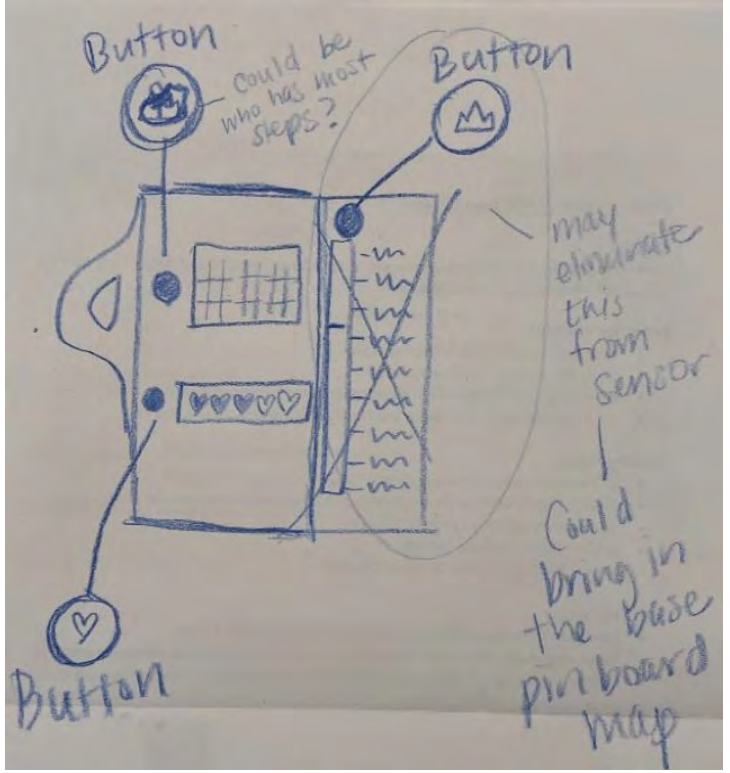

ES PRATIQUES
AU FAB LAB


Build+Play DINOSAURS
25 models & play mat!
Build+Play
DINOSAURS
Easy models to make!
Jigsaw play mat!
Dinosaur facts book!
BOOK AND PLAY SET


INTELLIGENT MAGNETIC BUILDING TILES SET
Enhance the Intellectual Development and Creative
INTELLIGENT MAGNETIC BUILDING TILES SET



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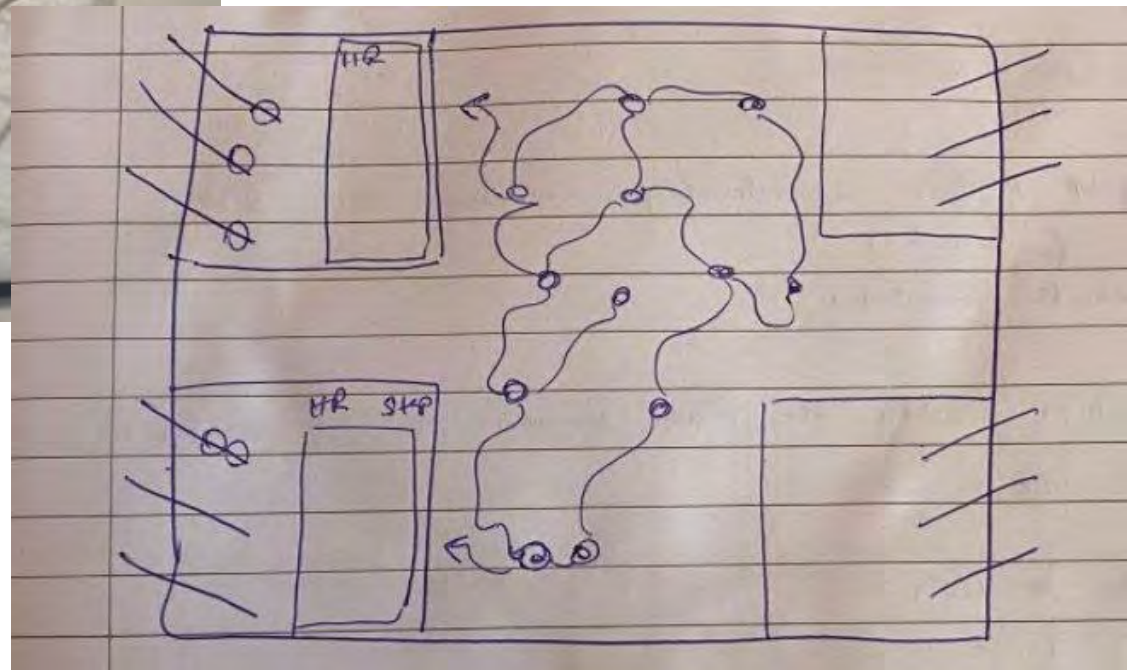
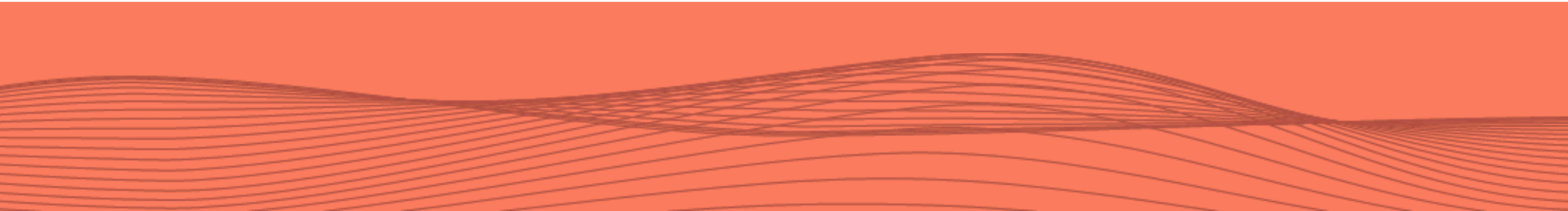

HR
HR STEP

Student Questions

- The authors said that everyone has creativity, but in real life, many people are not used to expressing their ideas or feel that they "don't understand design." What can designers do to help these people feel confident and willing to take part in the co-design process?
- What can we do to help people feel comfortable contributing ideas, especially if they don’t see themselves as “creative”?
- How can co-creation be meaningfully practiced when designers and participants have unequal power, skills, or access to technology?

Workshop to Prototyping: Identifying web vis requirements from participatory stakeholder activities



Health Opportunity Wellness Landscape

Our team conducted a Creative Visualization Opportunities (CVO) Workshop to…

- Determine what our stakeholders want out of a visualization/ what will be most useful to them in their area of expertise
- Understand how our stakeholders navigate through existing maps and what features are most useful to understanding environmental risk, vulnerability and resiliency
- Determine the best, most intuitive features that we can incorporate into the HOWL interface design

STAKEHOLDER GROUPS

14 participants total

Government
n=5

Arizona Dept. of Health Services

Arizona Dept. of Environmental Quality

City of Tucson

Agency for Toxic Substances and Disease Registry (n=2)

Community
n=5

Sierra Club

Project Harvest promotora

Arizona Community Health Workers Association

University of Arizona Cooperative Extension

ADEQ Community Involvement Coordinator

University
n=4

Communications and Cyber Technologies (n=2)

Cooperative Extension Specialist

CyVerse Data Science Institute

HOWL Vis Team Research Questions:

1. What are our stakeholder needs, how do they differ based on different areas of expertise?
2. How do we create an online interface that folds in most or all of our stakeholder interests/ needs?

CVO Workshop Activities

- Wishful thinking/ Barrier removal discussions
- Storyboarding Activity
- Visual Analogies Activity

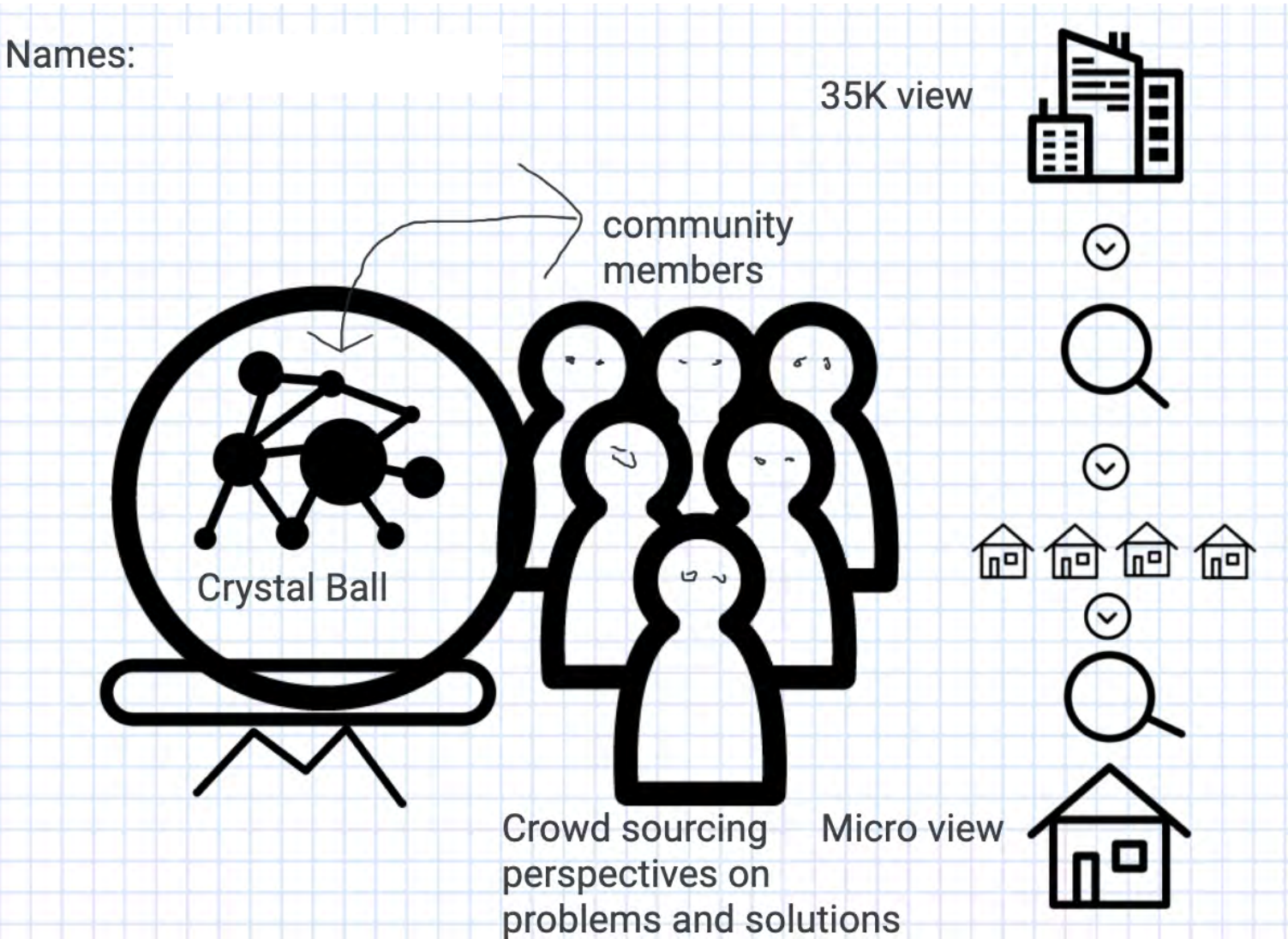
Wishful thinking/Barrier removal

- Participants were asked discussion questions in their stakeholder groups.
  - *What would you like to **know** to succeed in your work's or life mission?*
  - *What would you like to **do more** of in your work or community?*
  - *What **barriers/constraints** may prevent the ideas we mentioned earlier?*
  - *Are there **tools, data, visualizations, projects, or collaborations** that would help lift these barriers?*

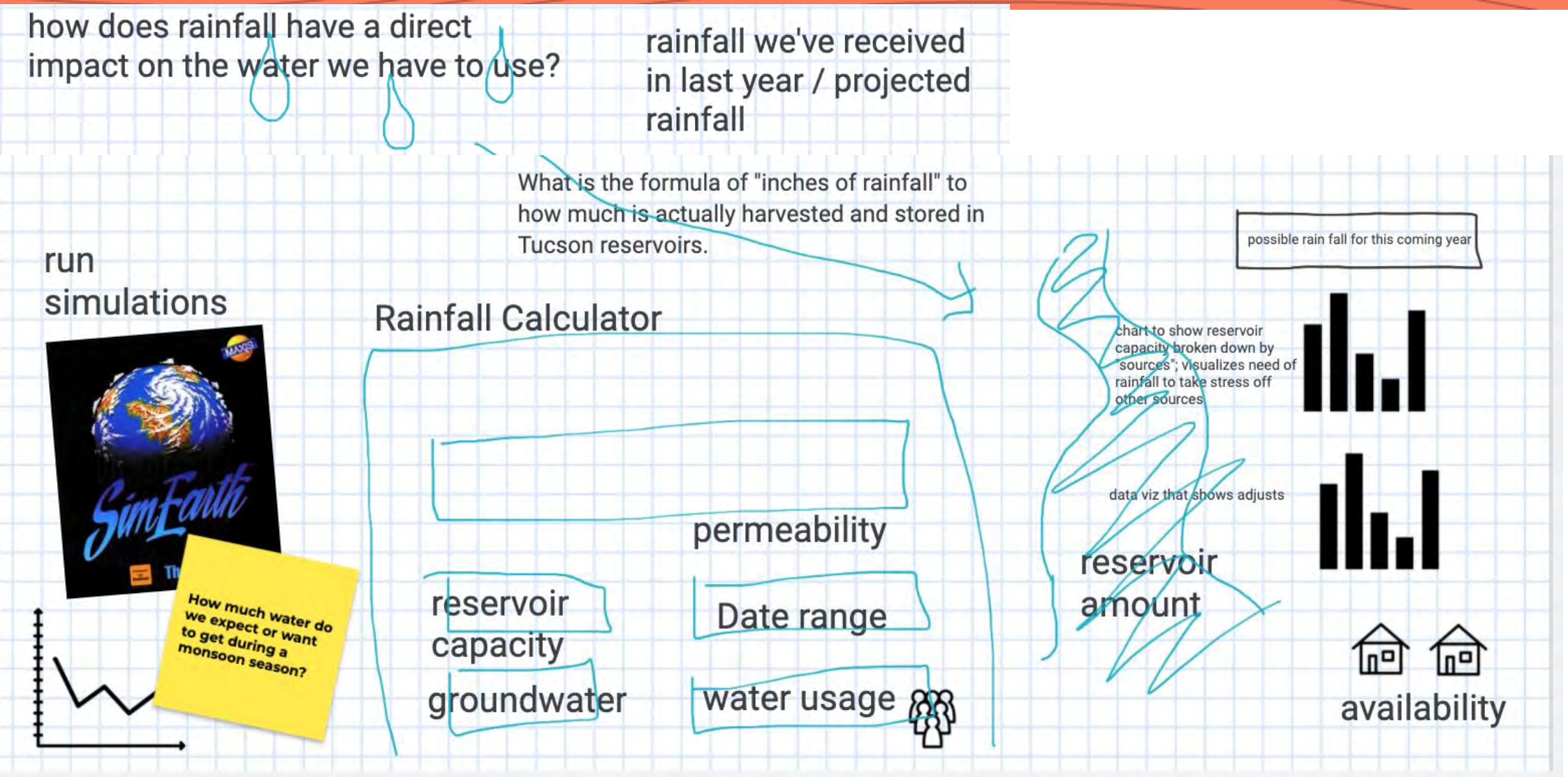
Storyboarding Activity

- Based on the previous discussions, participants partnered up to draw an ideal data-vis tool that would help you know more, see more and do more of the activities you'd like to accomplish.
  - *How could a tool or visualization system help realize the ideas previously discussed?*

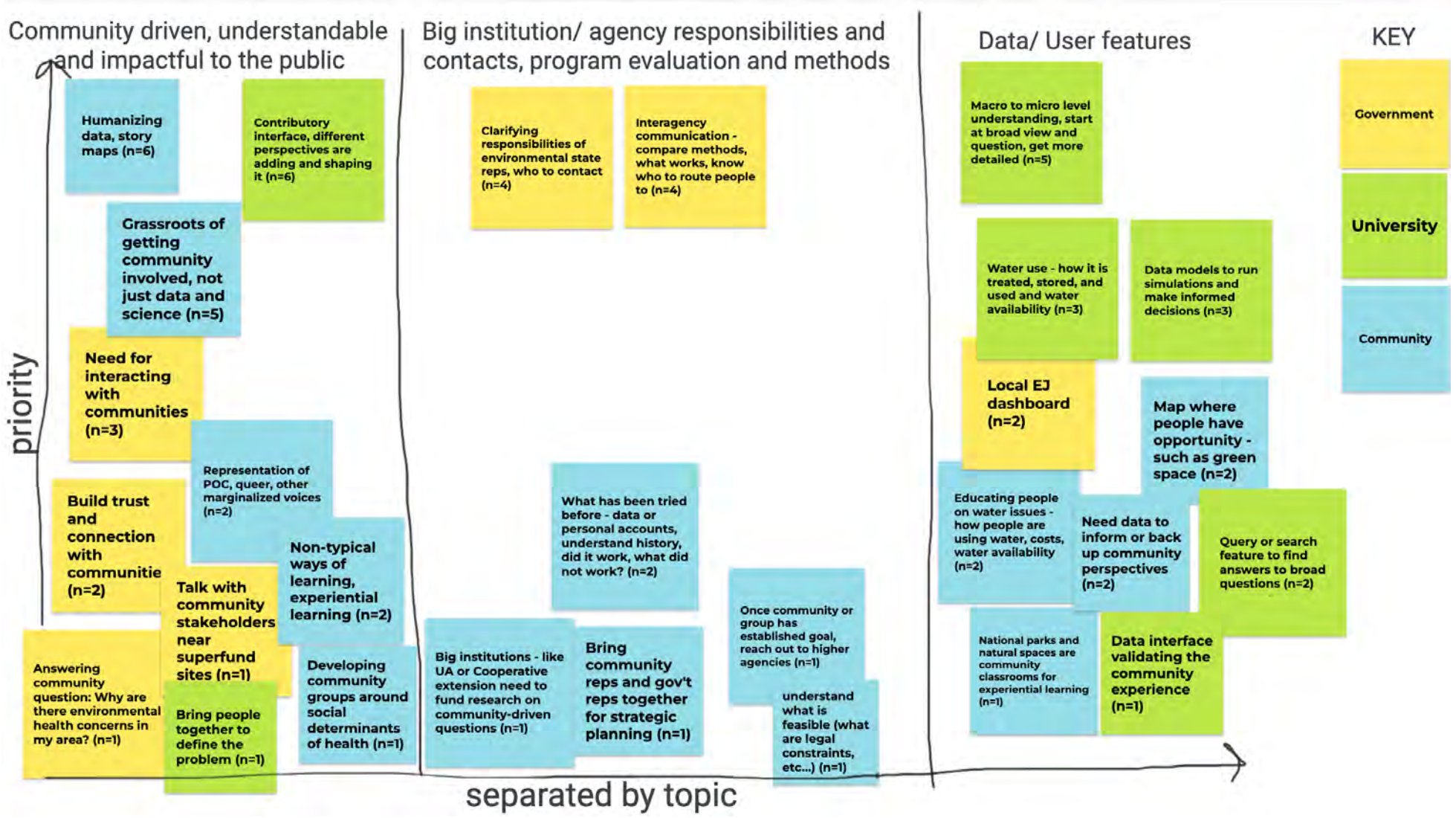
Storyboards



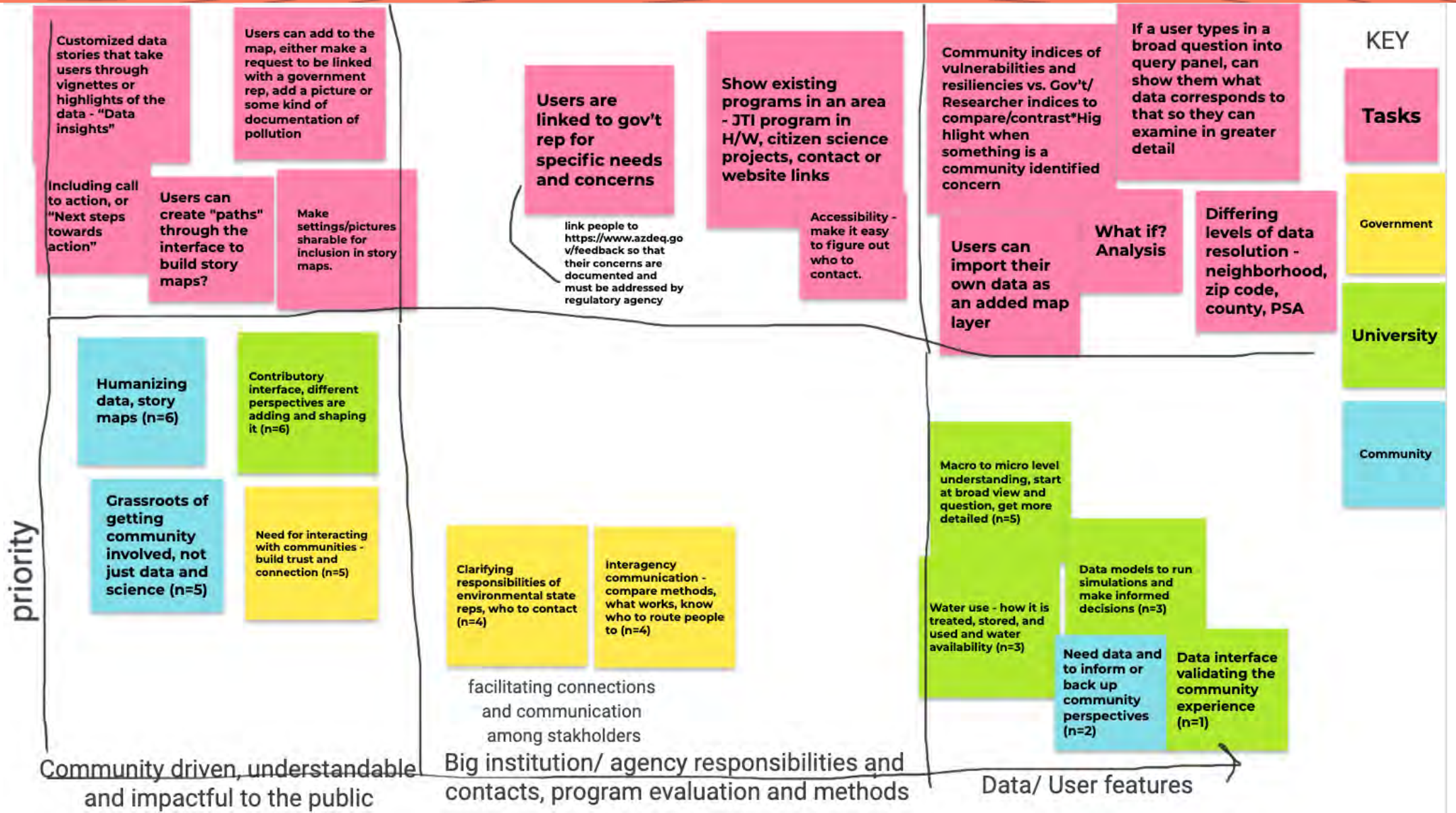
Storyboards



Analysis – Create a user story map



Identifying tasks from top discussion themes



Visual Analogies (VA)

- *"Now, we're going to do a different activity where you can explore existing mapping interfaces on environmental health and social well-being. We have a survey afterwards where you will reflect on specific aspects of the interface.*

Visual Analogies Activity

- Participants explored an existing mapping interface on environmental health and social well-being with their partner. They chose one of three given:
  - *The CDC's National Environmental Public Health Tracking Network*
  - *The EPA's Environmental Justice Screening tool*
  - *The Opportunity Atlas by Harvard and Brown University.*

- Participants took a survey afterwards where they rated specific aspects of the interface and prioritized which features they thought we should focus on as we build the HOWL tool.

Survey

Rate each feature/ attribute below on a 1 to 5 scale based on how helpful it was to your initial question.

1 = no, did not work at all/ was very confusing,
2 = no, did not work well/ was confusing,
3 = worked ok, wasn't that useful or confusing,
4 = yes, worked well/ was useful,
5 = yes, worked very well/ was very useful.

Now, prioritize each feature/attribute on a 1 to 5 scale based on what you think is most important to develop in the HOWL mapping tool.

1 = least important,
2 = less important,
3 = neither important nor irrelevant,
4 = important,
5 = very important.

Data Query and Loading (Use...
Tutorial and getting started to...
Data resolution (Users can sel...
Data interpretation (Users are ...
Data comparison (Users can c...
Map customization (Users can...
Methods (Users can find the ...
Interface and Map Navigation ...
Terminology Explanation (The...
Metadata (Users are able to fi...
Engaging Story-telling (User is...
Share/saving/downloading dat...
Loading times (There is some ...

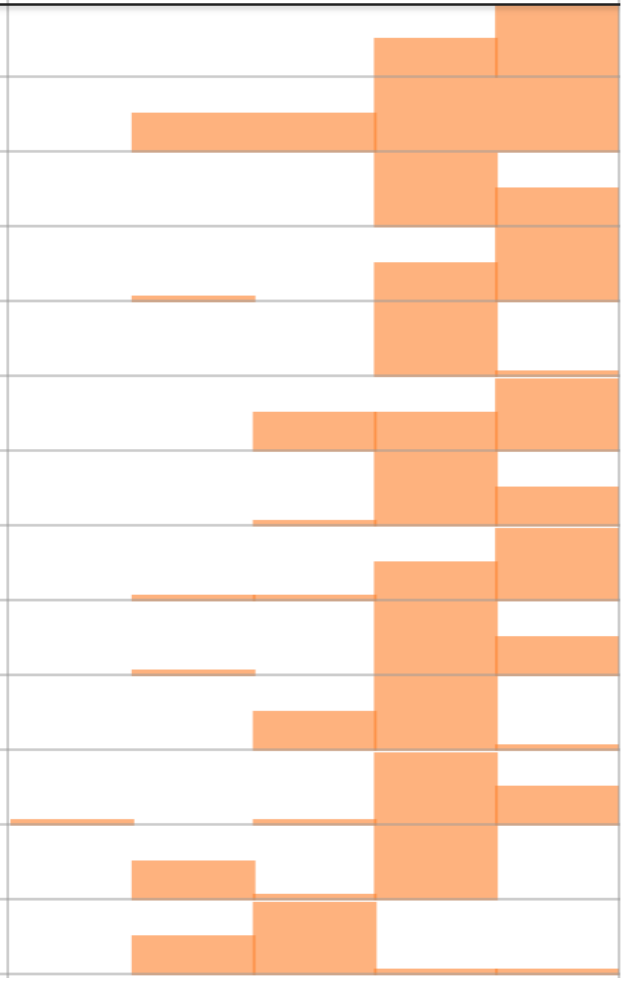
VA findings – Transcripts of conversations

- Transcripts of dialogue between partners were useful to determine what worked well and what was the most frustrating about the interfaces.
  - Minimize loading times of data sets (n=5)
  - Information saturation is overwhelming to users (n=4)
  - Legend should be clear so that it is easy to find (n=3)
  - Location search by is preferred to search your own address or neighborhood (n=3)

VA Survey Findings

- **Opportunity Atlas** was rated the lowest for all features at **2.23**, followed by **EJ Screen (2.27)**, and **CDC's EPH tracking** was rated the best at **3.48**.
  - **Opportunity Atlas – 2.23 overall**
    - Best features: Meta data, Data comparison, Map customization, and Data resolution (2.67)
    - Worst features: Terminology (1.33), Interface and Map Navigation, Data Interpretation, and Engaging Storytelling (1.67)
  - **EJ Screen – 2.27 overall**
    - Best features: Map customization (4), Meta data, Data resolution (3)
    - Worst features: Engaging story-telling (1) , Data comparison, Loading times (1.5)
  - **CDC's EPH Tracking – 3.48 overall**
    - Best features: Methods, Meta data, Loading times (4.5)
    - Worst features: Data Interpretation, Engaging Storytelling, Sharing/saving/ downloading data (2.5)

Findings

Variable	Average	Median	
Data Query and Loading (Use...	4.71	5	
Tutorial and getting started to...	4.43	5	
Data resolution (Users can sel...	4.29	4	
Data interpretation (Users are ...	4.29	5	
Data comparison (Users can c...	4.17	4	
Map customization (Users can...	4.14	4	
Methods (Users can find the ...	4.14	4	
Interface and Map Navigation ...	4.00	4	
Terminology Explanation (The...	4.00	4	
Metadata (Users are able to fi...	3.86	4	
Engaging Story-telling (User is...	3.71	4	
Share/saving/downloading dat...	3.29	4	
Loading times (There is some ...	3.14	3	

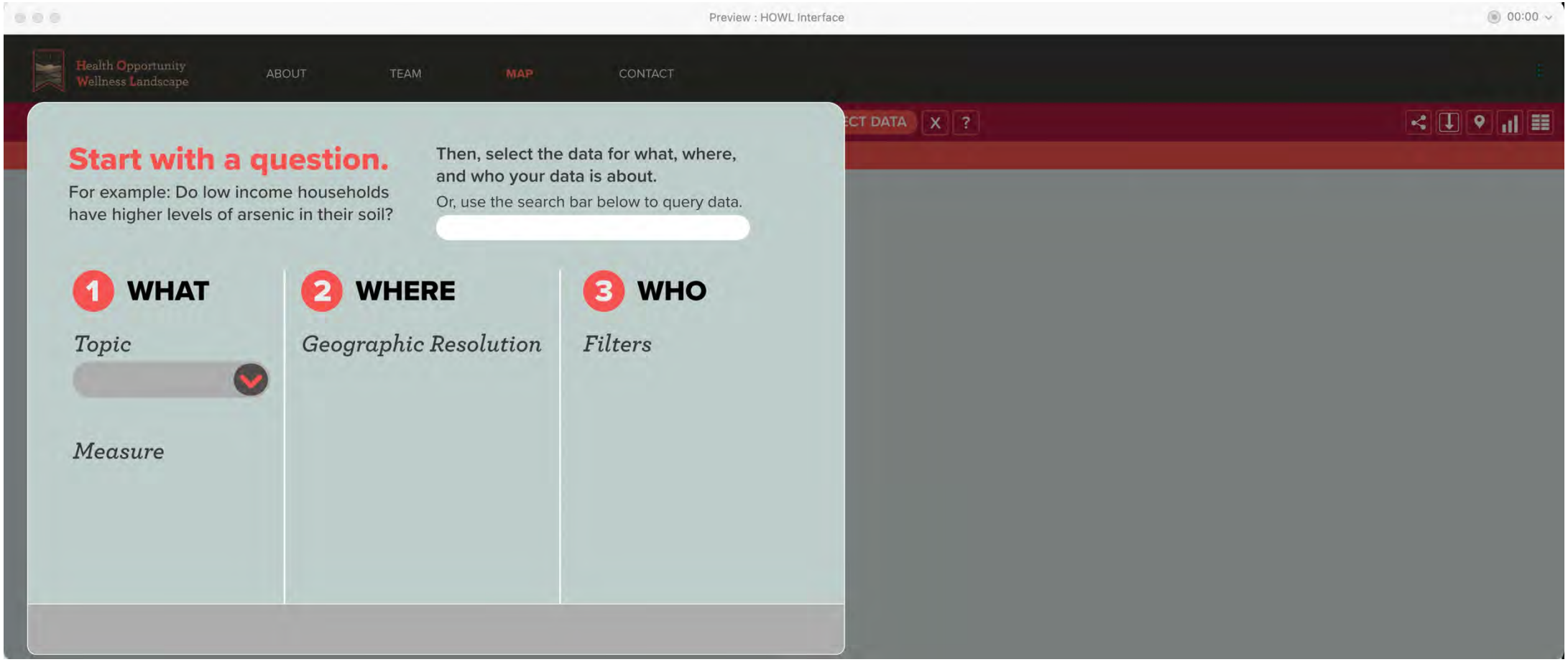
Most Important Features to develop in HOWL

- **(5 = most important, 1= least important)**
  - **Data Query and Loading** – avg. rating **4.71**
    71.4% said it was very important (100% important)
    (so users can intuitively find and search for the data they want to see and load it onto the map)

  - **Tutorial and getting started tour** – avg. rating **4.43**
    71.4% said it was very important (71.4% important)
    (show users how to navigate the interface)

  - **Data Interpretation** – avg. rating **4.29**
    57.1% said it was very important (85.7% important)
    (so users are guided through the data and can interpret it and understand the units and measures)

Develop web prototype



Break

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design informatics

Helicopter Research

Helicopter Research

https://youtu.be/k5LBbt24pf8?si=WUA57edvyiZ-yp5f&t=258

What do we need to carefully consider when involving people in a co-design process?

https://miro.com/app/board/uXjVJuJdv9U=/?share_link_id=525454138418

Equity-Centered Community Design

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design informatics

Equity-Centered Community Design (ECCD)

Antionette Carroll, Founder of Creative Reaction Lab

DEFINING + ASSESSING THE TOPIC/ COMMUNITY NEEDS

INVITING DIVERSE CO-CREATORS

RAPID PROTOTYPING

TESTING + LEARNING


Chaparral Gulch
Agua Fria River
Former Iron King Mine Property
Storm/Flood Drainage
Humboldt
Main Tailings Pile (Upper)
Main Tailings Pile (Lower)
1964 Blowout
Dross
Tailings mixed/buried with soils carried in storms
Smelter Tailings Swale
Former Humboldt Smelter
Deep Flood Plain Of Mixed Tailngs
© 2013 Google
25-foot high DAM holds back tailings


a. CRUSHING & GRINDING


c. SLAG D


b. SMELTING


d. WIND EROSION OF MINE TA

DEFINING + ASSESSING THE TOPIC/ COMMUNITY NEEDS

- Question raised by the community
  - “What is the quality of my harvested rainwater?”
- This question drives the research being conducted

Community Participation in the Scientific Research Process.

Steps in Research	Community Role and Activity
Choose or define question(s) for study	• Questions are derived from: community needs assessment, community advisory boards, non-governmental organizations in the area, and/or ongoing interactions with local community members

Families are harvesting rainwater to:

- Conserve water
- Reduce heat island effect
- Increase green space
- Irrigate gardens
- reduce heat island effect



Image Credits: Flor Sandoval and Ann Marie Wolf, Sonora Environmental Research Institute

Image Credit: Margaret Dewey

Are there pollutants in harvested rainwater? Can I use the harvested rainwater for my garden?

Can pollutants get trapped in soils?

Do plants accumulate these pollutants?

INVITING DIVERSE CO-CREATORS

- **Working with community members who are economically and racially diverse**

- **Local community health educators, or *promotoras*, ensure the community's interests inform design process and project outcomes**

Community Participation in the Scientific Research Process.

Steps in Research	Community Role and Activity
Gather information and resources	• Need assessment was conducted in rural community • Informal gatherings were used to identify interested community members • Promotoras identified and trained

Imelda Cortez

Margaret Dewey

Theresa Foley

People who share similar social backgrounds or life experiences are sharing information with peers - Promotoras

Lisa Ochoa

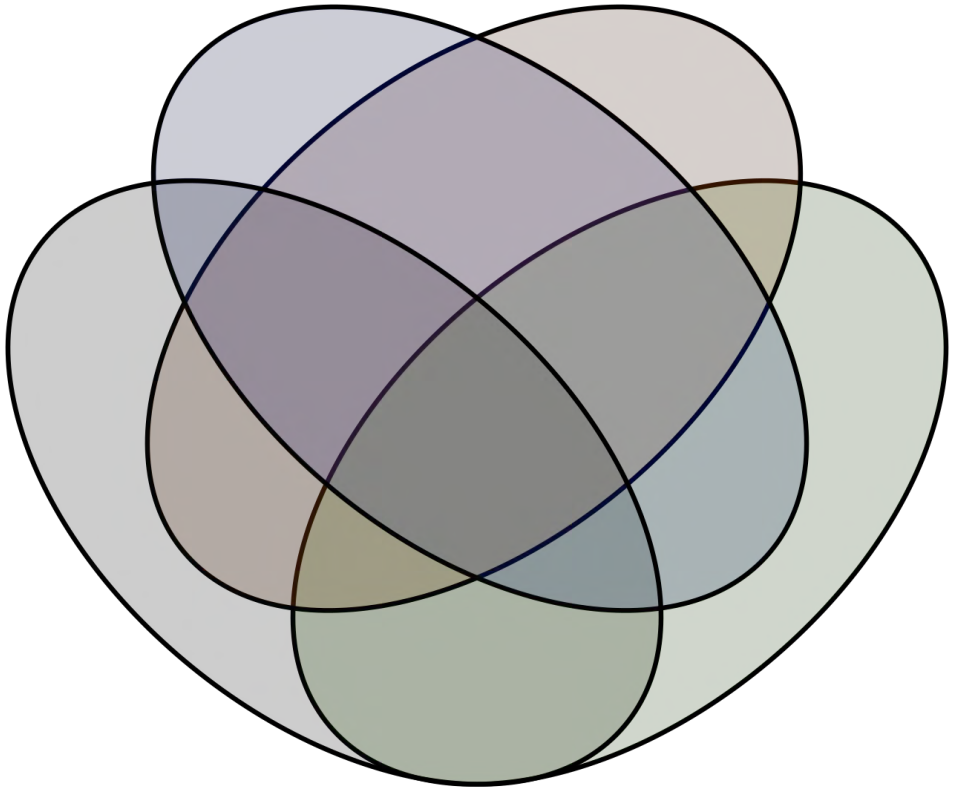
Aviva O'Neil

Miriam Jones

Palmira Henriquez

Project Harvest Participants (N= 148) and Intersectionalities

- 51% participants from low-income households
- 55% do not have a college degree
- 50% self-identify as people of color (42% Latin@/Hispanic)
- 25% speak Spanish as their dominant language
- 47% of participants were from rural communities



RAPID PROTOTYPING

- Conduct Formative Evaluation
  - Iterative analysis, design, development, and implementation in real settings with your users.
  - This allows for production and testing of hypotheses that can be used to validate design decisions.

Formative Evaluation to Inform Placed-based Design

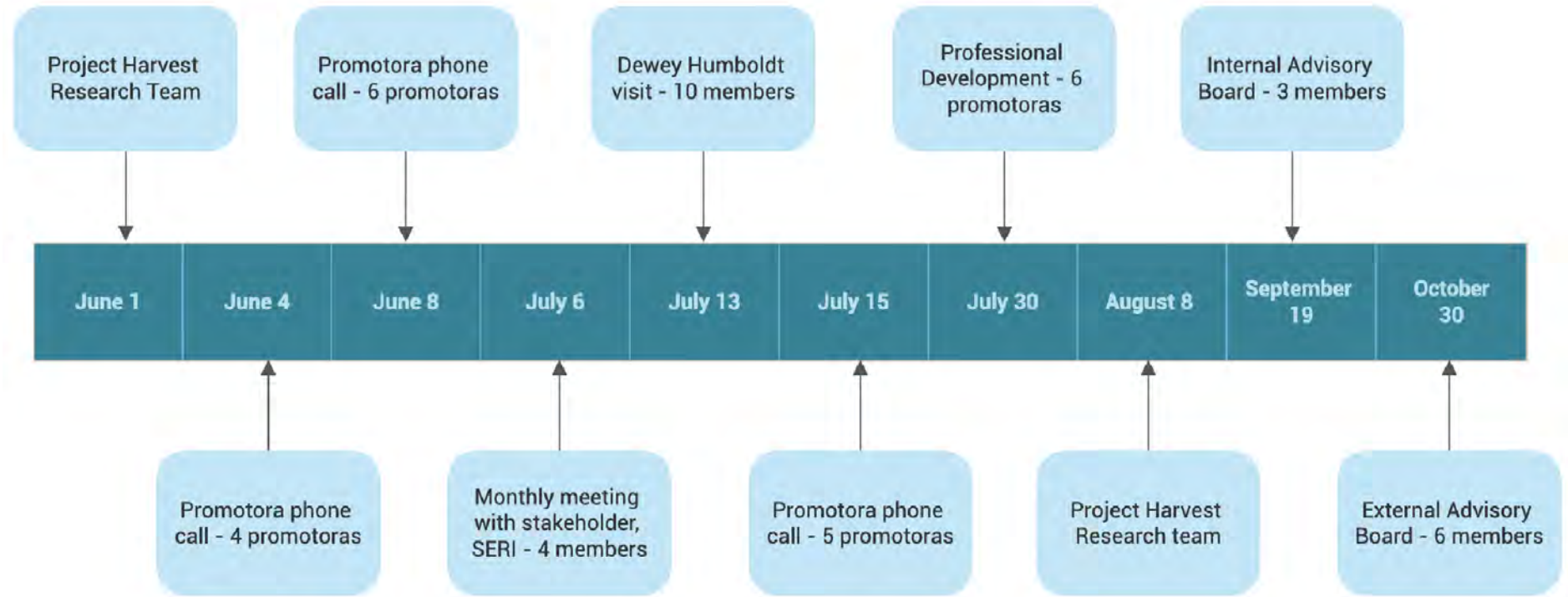
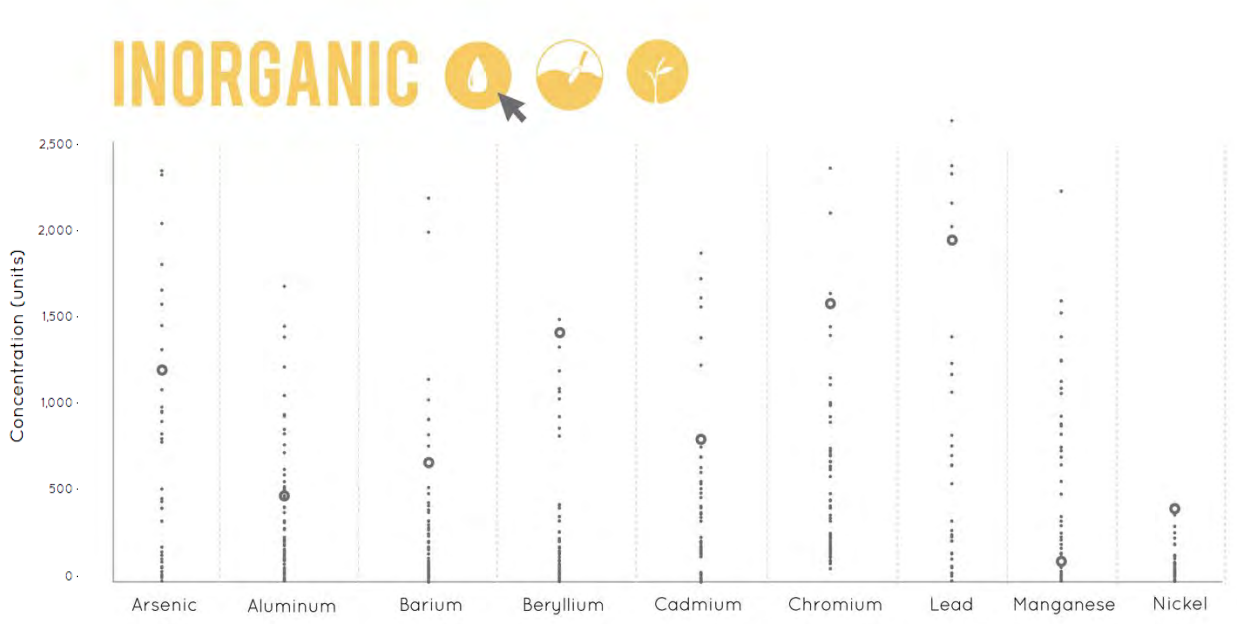


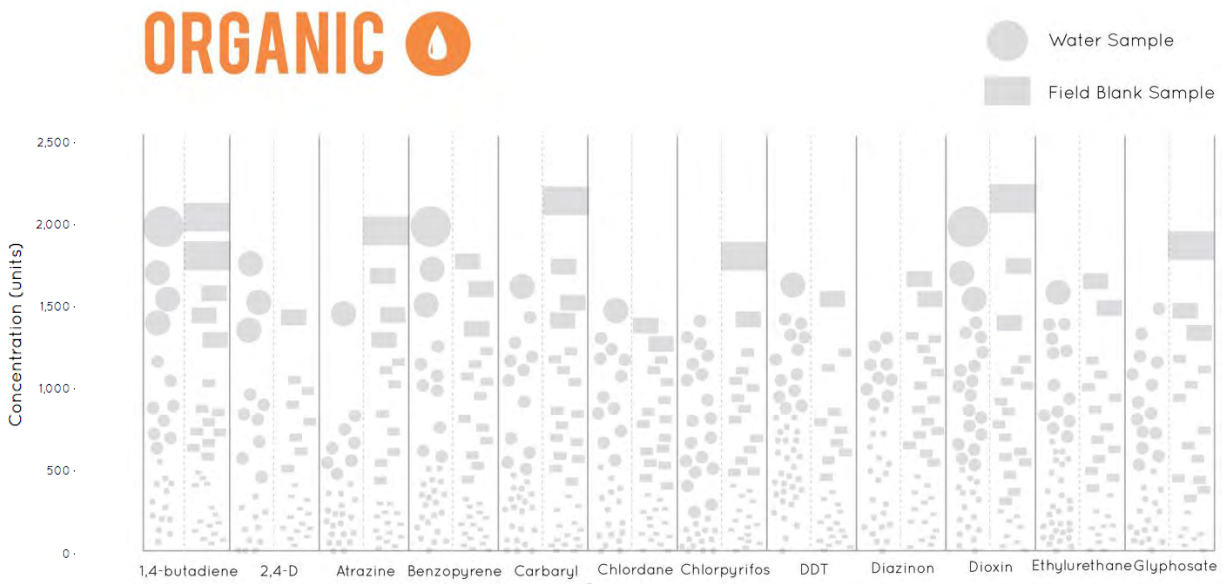
Figure Prepared By Dorsey Kaufmann

TESTING + LEARNING

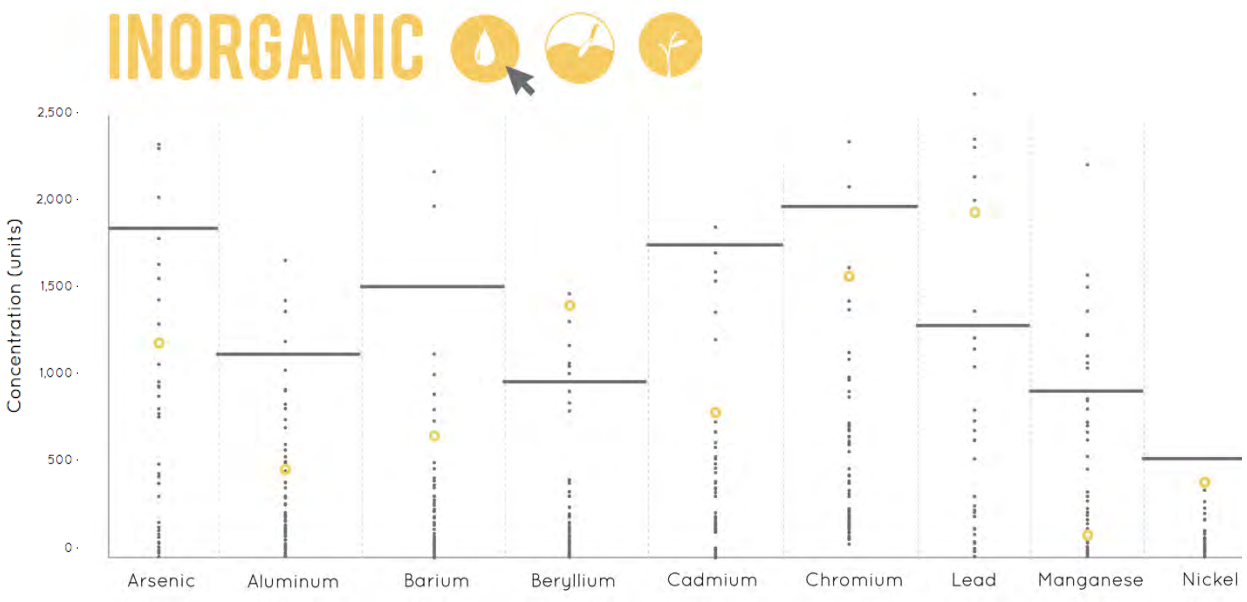
- As we are showing new iterations of design, we are incorporating the feedback from previous formative evaluation sessions

USING SHAPE

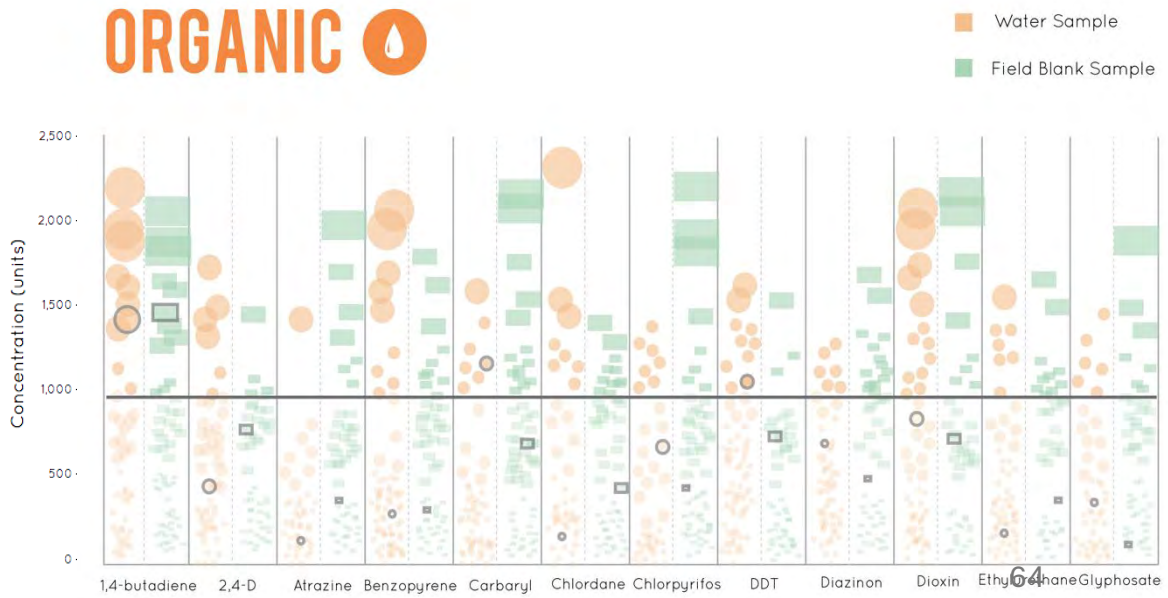


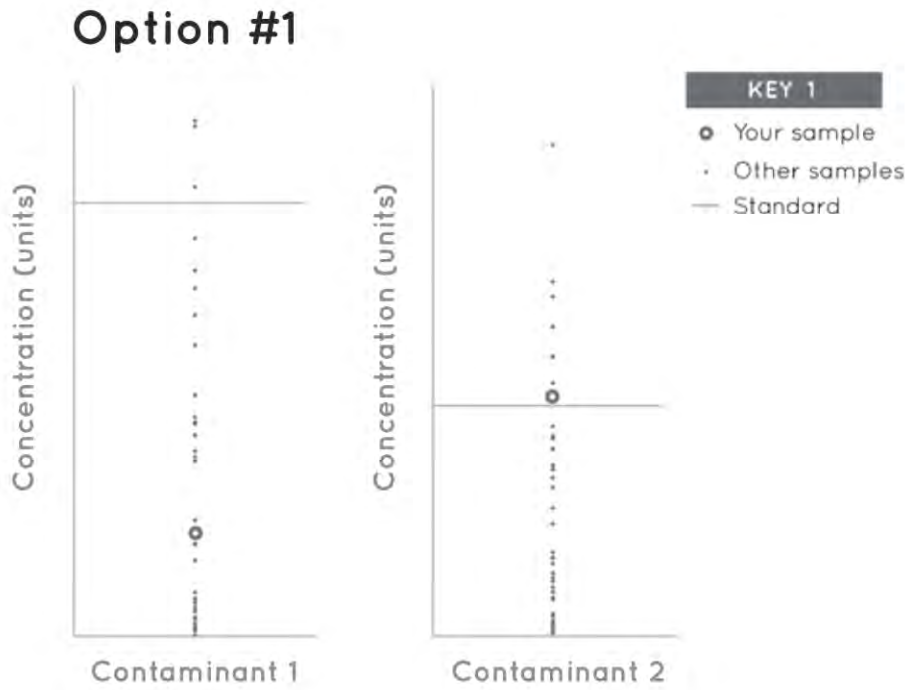


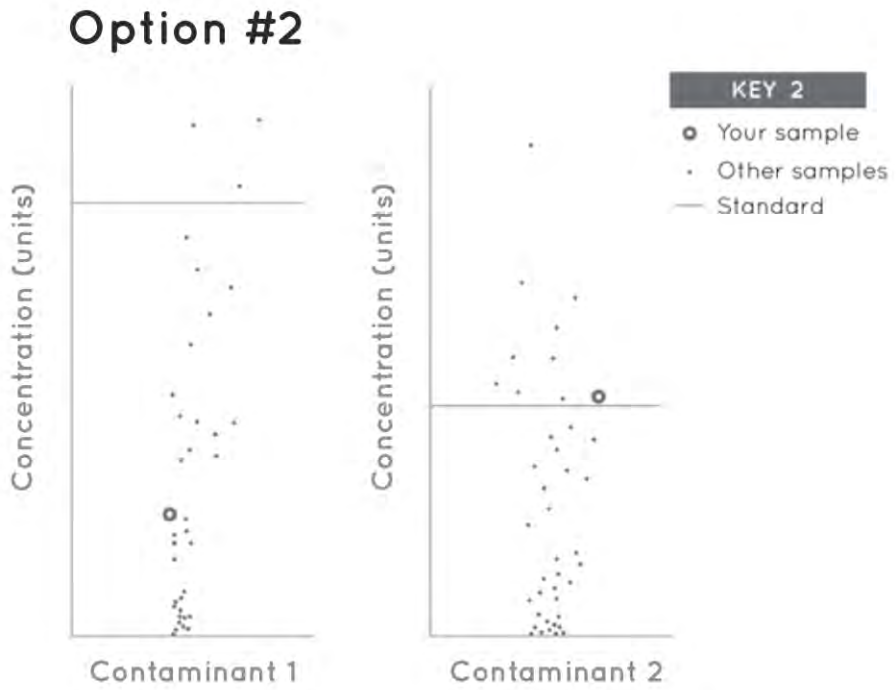
USING COLOR

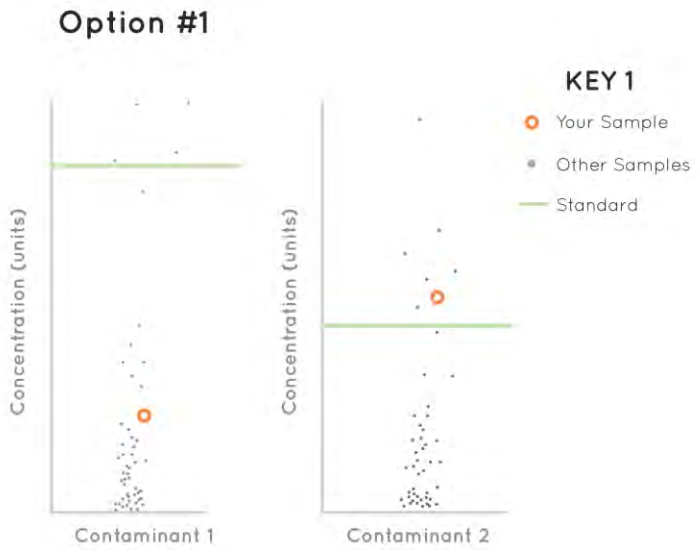


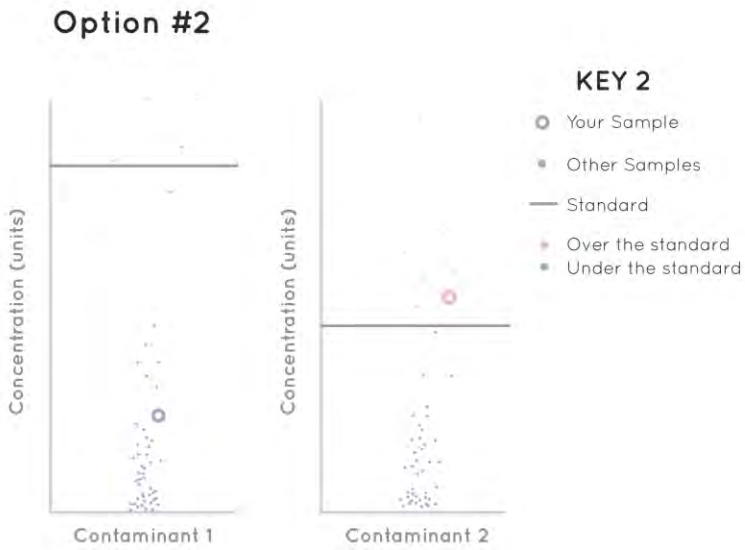
USING COLOR and SHAPE

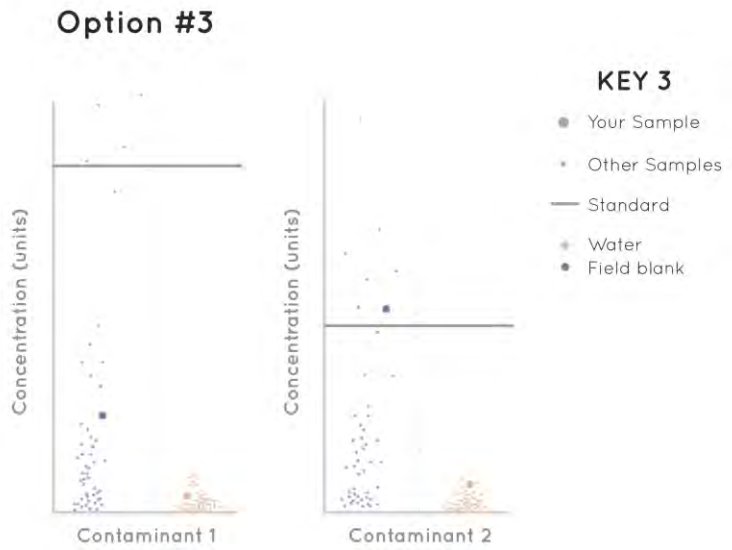




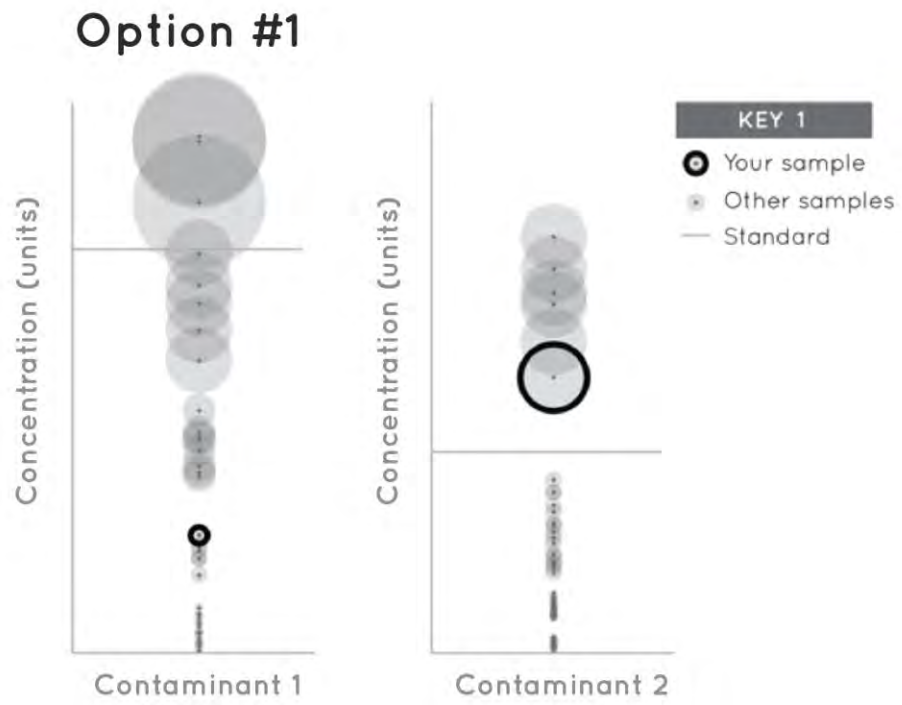


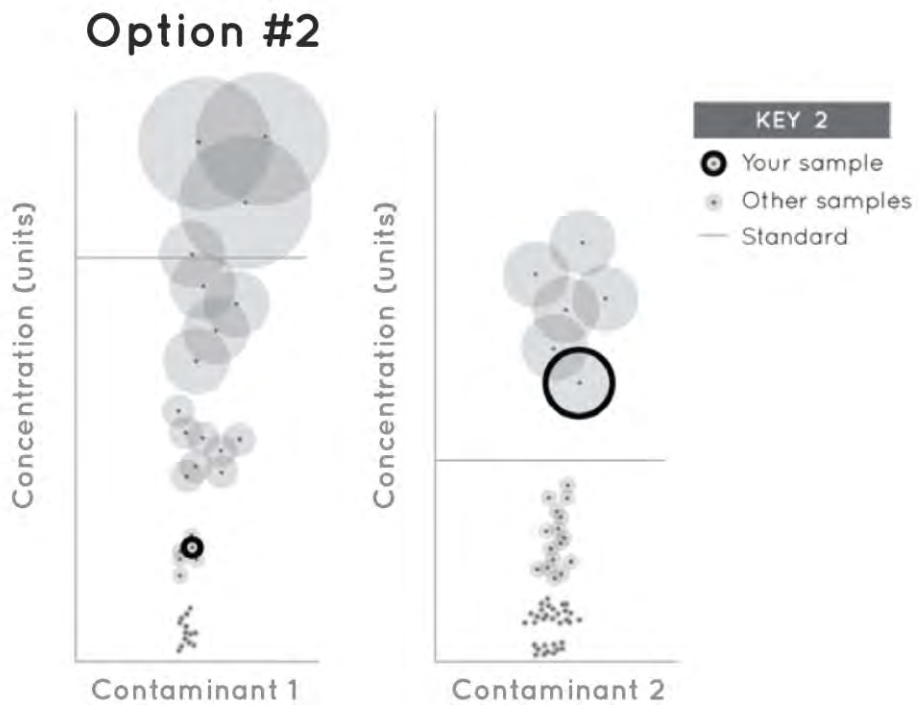


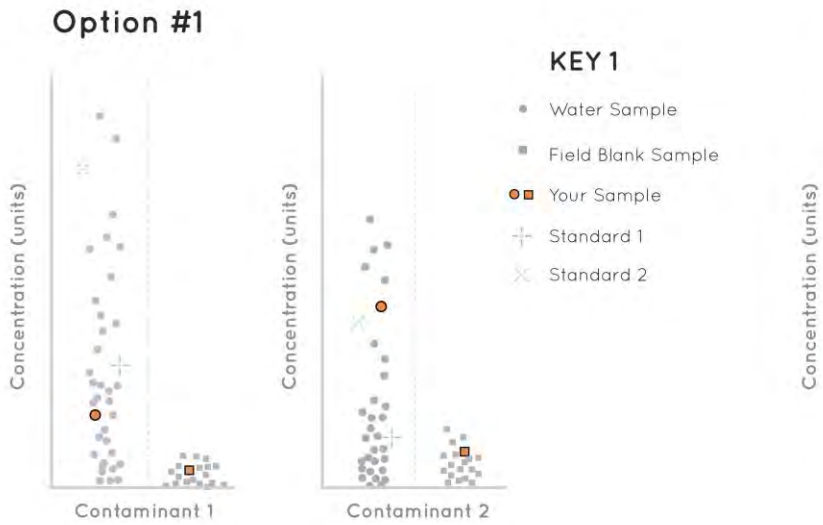


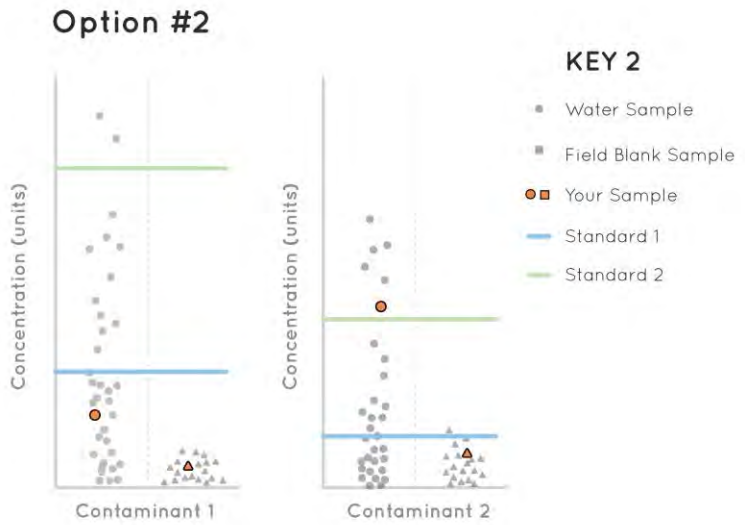


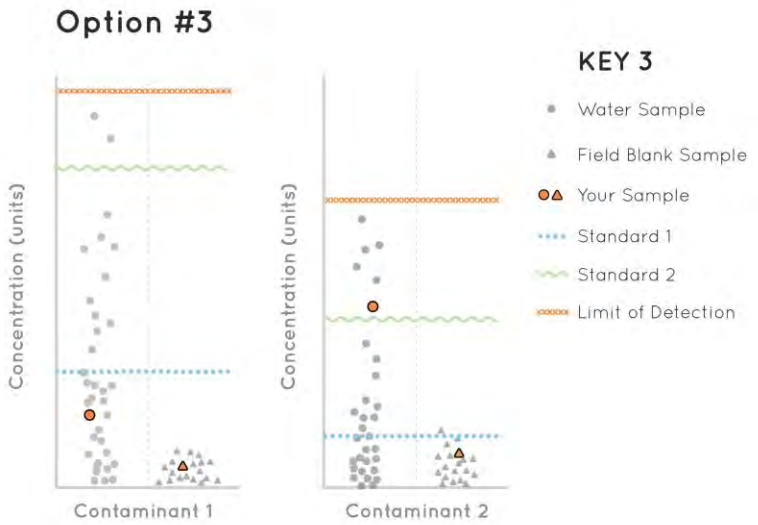
Figures Prepared By Dorsey Kaufmann



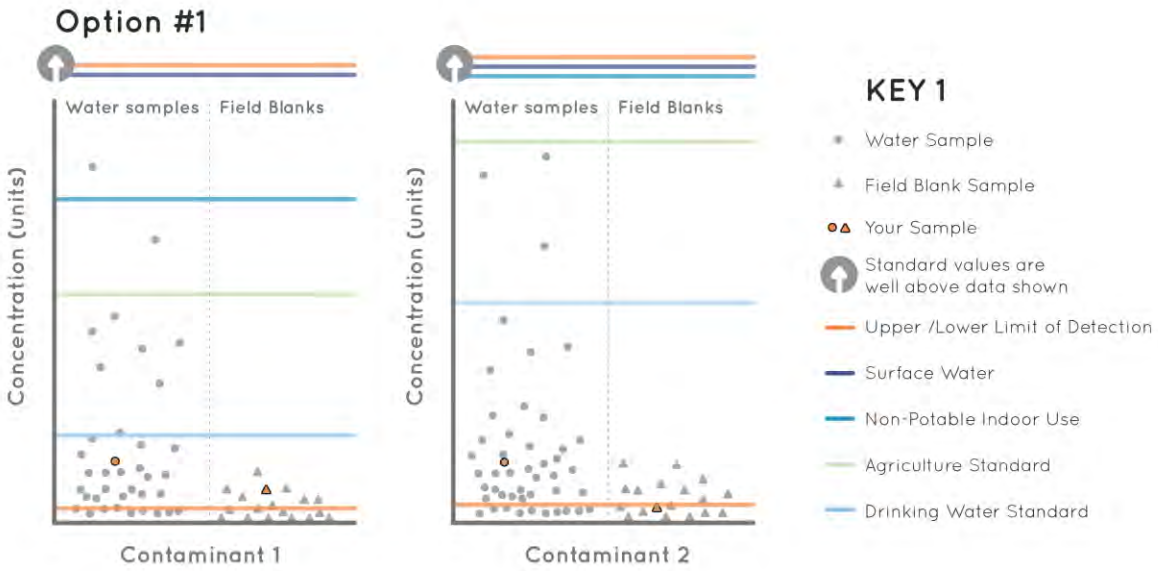


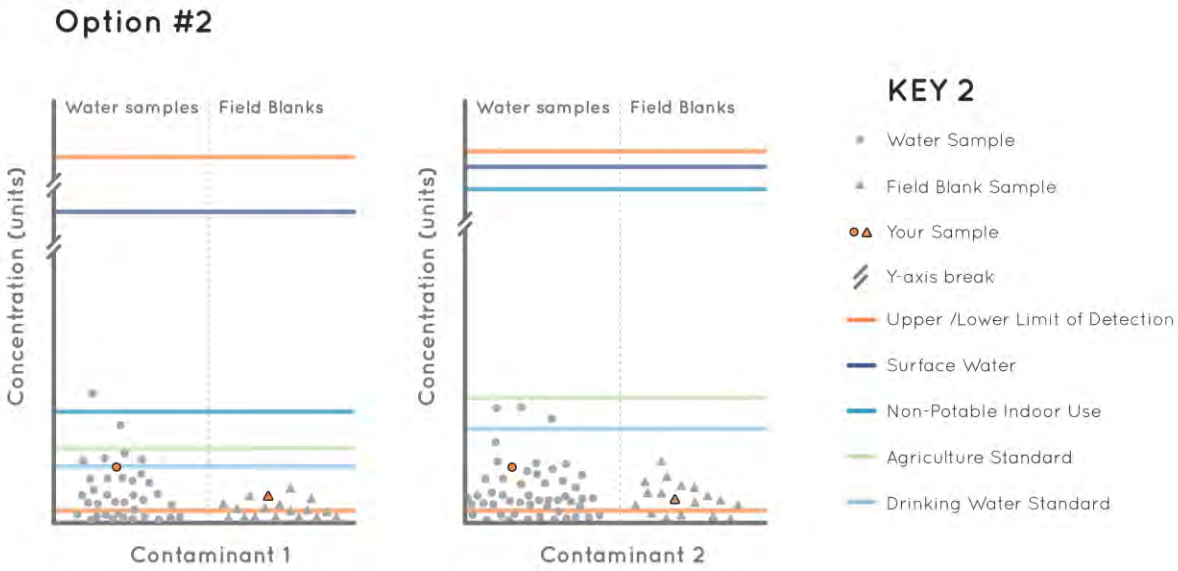






Figures Prepared By Dorsey Kaufmann

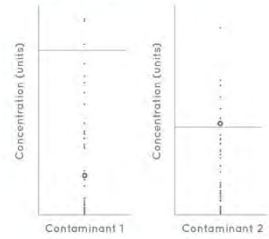




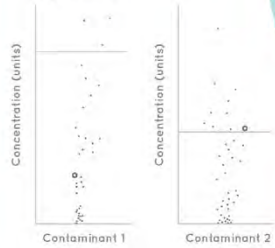
Figures Prepared By Dorsey Kaufmann

1

Option #1



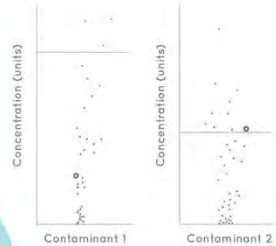
Option #2



Scattered data points are preferred because it implies results of the whole community.

2

Option #1



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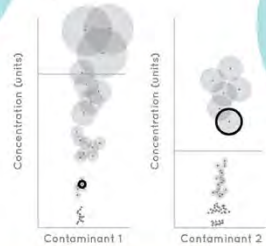
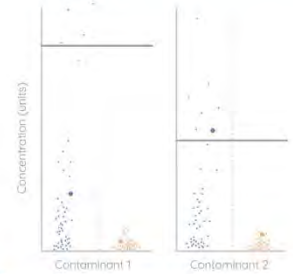


"[Option 2] gives a lot more weight and alarm to higher regions of the graph, even though there are many points in the lower levels."

3

Option #1



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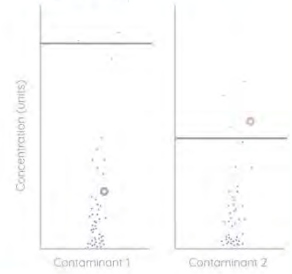
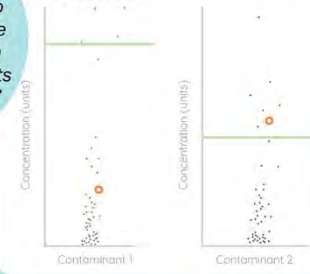


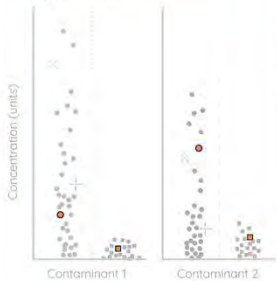
Option #3



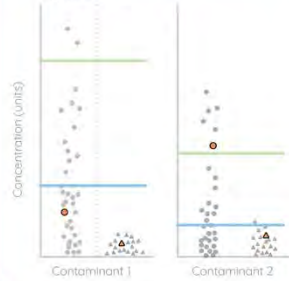
Color should highlight the individual samples. When every data point has a color, finding the individual sample is more difficult.

4,5

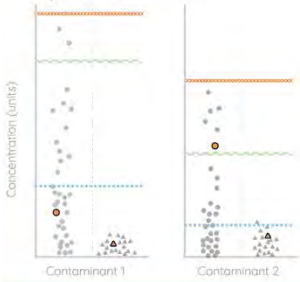
Option #1



Option #2



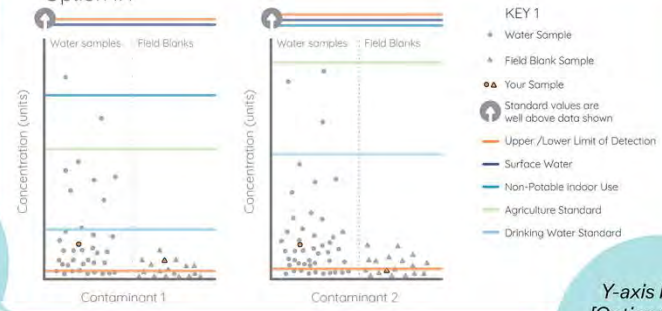
Option #3



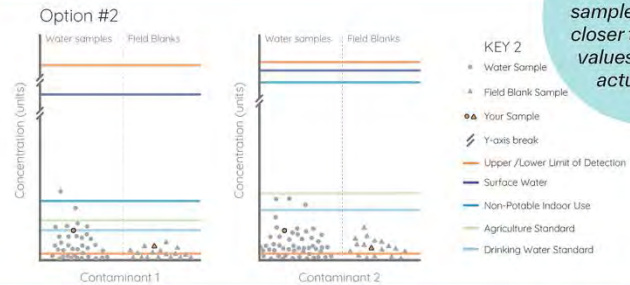
Standards should be represented by colored lines. Shape can differentiate sample types.

6

Option #1



Option #2



Y-axis breaks [Option 2] show sample values are closer to standard values than they actually are.

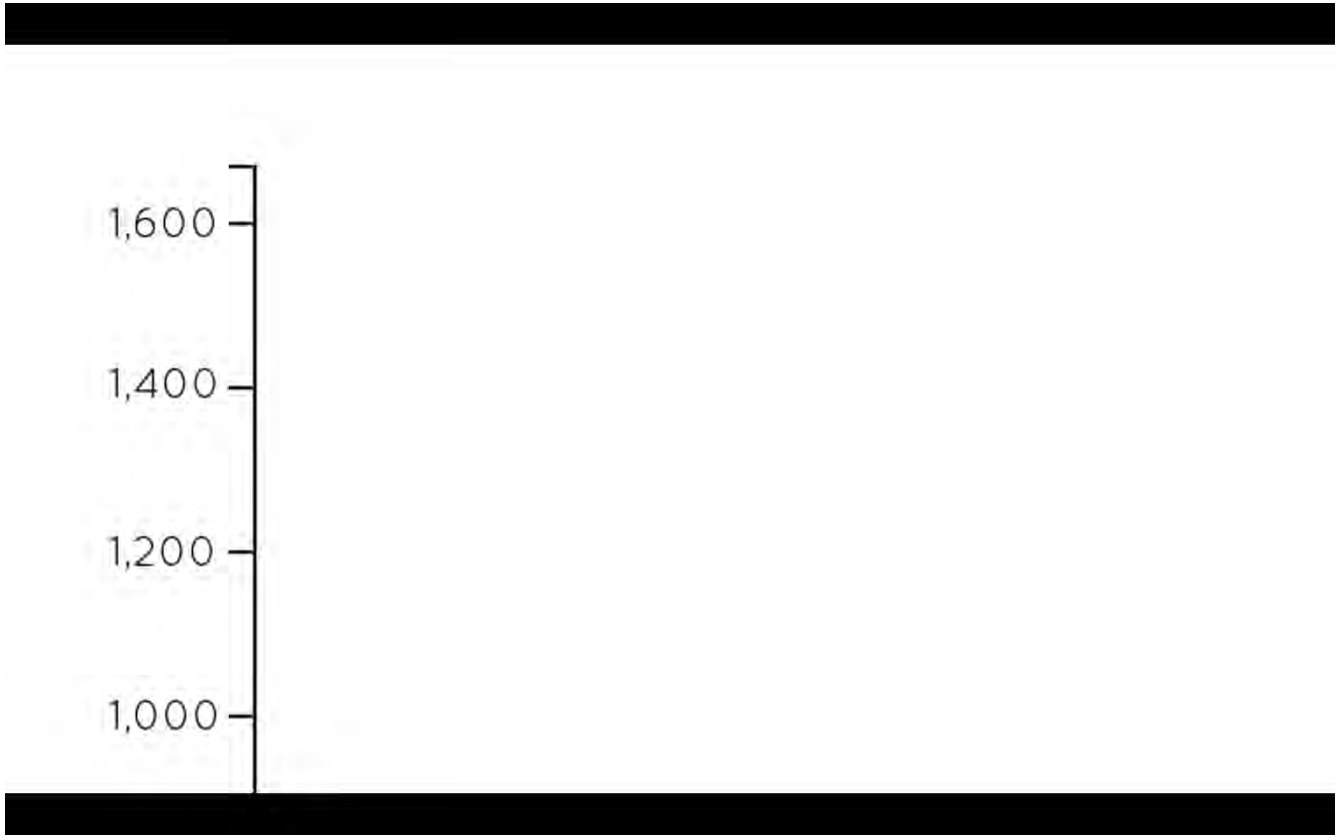
How do you use your harvested rainwater?

Different standards/advisories were selected based on:

- How Project Harvest participants **currently** use their harvested rainwater
- Promotora recommendations and preferences
- Availability of useful standards or advisories

How do you use your water?
Look for the corresponding standard, advisory, and/or guideline on the graph to see if your rainwater sample is below or above the value, represented by a colored line.

- Drinking Water Standard
- Agricultural Irrigation Standard
- Livestock and Poultry Standard
- Surface Water - Partial Body Standard
- Surface Water - Full Body Standard
- Non-potable Indoor Use of Harvested Rainwater Guideline
- Lifetime Health Advisory
- World Health Organization Drinking Water Quality Guideline



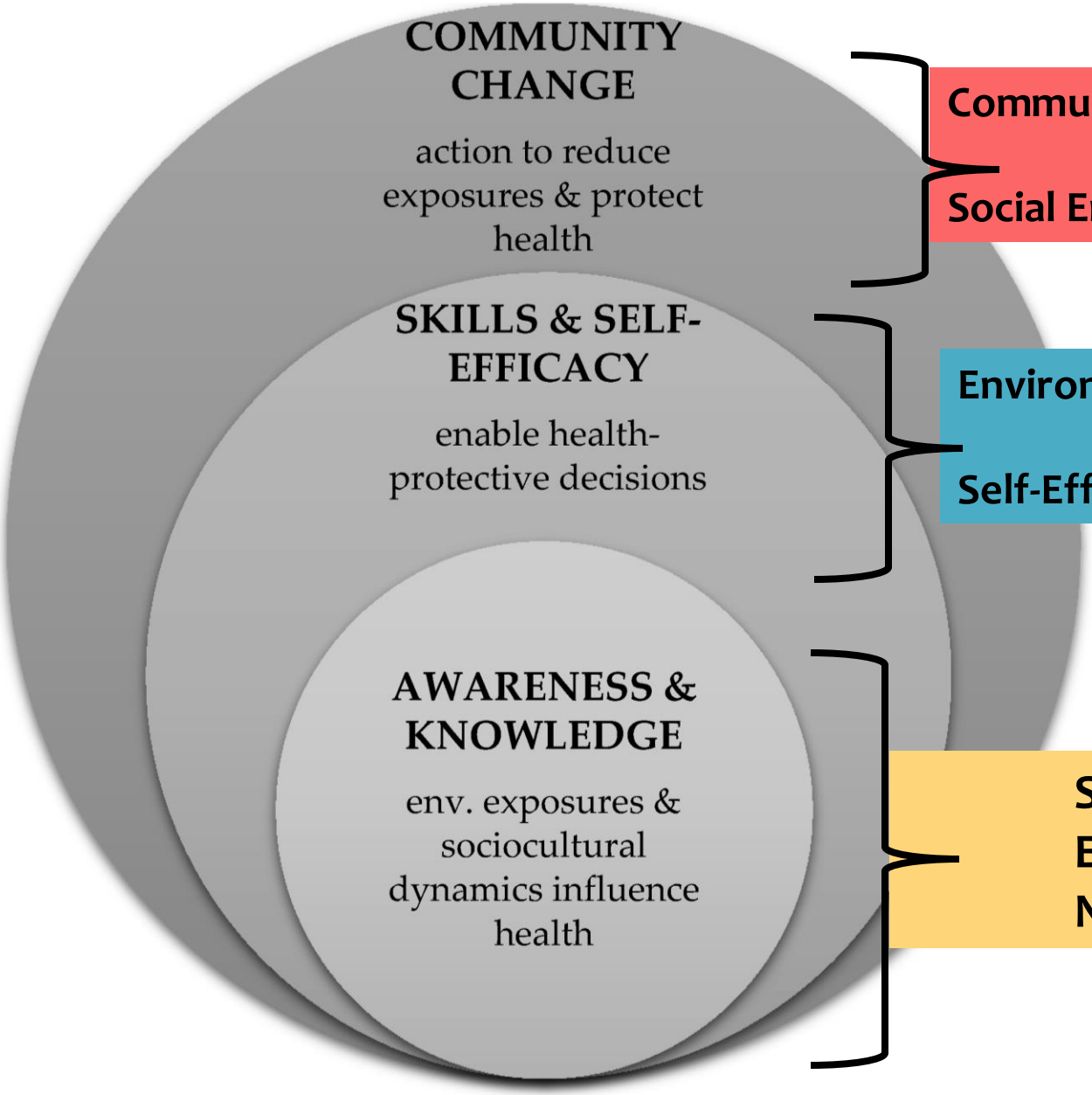


Figure 1 from Gray, 2018

ENVIRONMENTAL HEALTH LITERACY

Community Building

Social Engagement

Participants:

- Are talking to others about data sharing events
- Reported building partnerships as a benefit of the project

Environmental Health Action

Self-Efficacy

- Participants are reporting increases in environmental health awareness

Scientific literacy
Environmental Literacy
Numeracy

- Participants are correctly interpreting their data
- Participants are using evidence-based information to gardening practices

Slide prepared by Mónica Ramírez-Andreotta

Student Questions

- In one's own design or research work, how to make sure that diverse community voices are truly involved and not just "consulted"?
- If not everyone can be a co-designer, when should community members have real decision power, such as a vote or a veto, beyond ideation?
- The Equity Centered Community Design Field Guide emphasizes addressing systemic inequities in the design process. How can co-creation methods be adapted to ensure that equity and inclusion remain central rather than symbolic in collaborative projects?

What are the limitations of co-design?

https://miro.com/app/board/uXjVJuJdv9U=/?share_link_id=525454138418