

Supplementary Materials



WPI



Interactive Environmental Education: Developing an African Village Exhibit



Submitted by:

Zachary Estrella
Jeremiah Leonard
Guilherme Motta Baracchini
Nicole Sherlock

Submitted to:

Shane French, Sponsor Liaison
Subik Baso, Sponsor Liaison
Professor Lorraine Higgins, Advisor
Professor Erin Ottmar, Advisor

Submitted on: December 13, 2016

An Interactive Qualifying Project submitted to the faculty of the Worcester Polytechnic Institute
in partial fulfillment for the requirements for the Degree of Bachelor of Science

Supplemental Materials A: Authorship

Team Editor: Nicole Sherlock

Team Designer: Jeremiah Leonard

Report

Section	Primary Author(s)	Primary Editor(s)
Abstract	Nicole, Zachary	Guilherme, Jeremiah
Environmental and social justice: Global threats	All	All
Background: Climate change as a global issue		
Impact of climate change in Australia	Jeremiah, Guilherme	Nicole, Zachary
Water and food security in Australia and Africa	Guilherme, Jeremiah, Nicole	Zachary
Conflict minerals in Africa and Australia: Mines of Injustice	Zachary	Jeremiah, Nicole, Guilherme
Objective 1		
Developing and piloting the survey instrument	Nicole	Jeremiah, Guilherme, Zachary
Participants and administering the survey	Nicole, Zachary	Guilherme, Jeremiah
Coding and analyzing the survey results	Zachary	Nicole, Jeremiah, Guilherme
Survey results (all categories)	Zachary	Nicole, Jeremiah, Guilherme
Objective 2		
Gathering personal stories through roundtable discussions	Nicole, Jeremiah	Zachary, Guilherme
Objective 3		
Taking a hands-on approach	Nicole	Jeremiah, Guilherme,

to education		Zachary
Designing an effective educational exhibit: Principles of design	Nicole	Jeremiah, Guilherme, Zachary
Broaden and build: Using emotions to inspire action	Nicole	Jeremiah, Guilherme, Zachary
Identifying design ideas by visiting successful exhibits	Nicole	Jeremiah, Guilherme, Zachary
Objective 4		
Developing initial prototype interactives and signage	Nicole	Jeremiah, Guilherme, Zachary
Designing the layout of the exhibit	Nicole	Jeremiah, Guilherme, Zachary
Objective 5		
Testing the prototype with visitors	Nicole	Zachary, Guilherme, Jeremiah
Observations of visitors	Nicole	Zachary, Guilherme, Jeremiah
Visitor feedback	Nicole	Zachary, Guilherme, Jeremiah
Visitor suggestions for improvement	Nicole	Zachary, Guilherme, Jeremiah
Our recommendations	Nicole, Guilherme, Jeremiah	Zachary
Conclusion	Jeremiah	Nicole, Zachary, Guilherme

Deliverables

Activity or Sign	Primary Builder	Primary Painter
Well Activity	Zachary	Zachary
Dam Activity	Jeremiah and Zachary	All + Shane
Beads Activity	Jeremiah	Jeremiah

“What can you do?” Activity	Nicole	Nicole, Zachary
Mining Activity	Zachary	Zachary, Jeremiah
Harvesting Activity	Nicole, Zachary	Nicole, Guilherme
Big 5 Animals	Guilherme	Guilherme
Welcome to the African Village	Guilherme	Guilherme

Supplemental Materials B: CERES Mission and Practices

The CERES mission is the betterment of the local community; to positively influence change in Melbourne so that people live in a way that benefits others and the environment. CERES endeavors to accomplish this goal through its sustainability education and training programs, its focus on urban organic community food systems, and its investment in exploring sustainable technologies. CERES believes that by connecting, teaching, training, and working together, it is possible to build local and global awareness and strengthen the movement in search of economic, social and environmental sustainability (CERES, 2016).

CERES actively engages the local and global community through its excursion, incursion, and professional development training programs. In excursion programs, CERES welcomes field trips to their site where children of all ages can engage in activities centered on culture and sustainability. Their incursion programs are similarly focused; instead of inviting students to their site, however, CERES educators visit schools throughout Victoria to teach about environmental sustainability methods. CERES also offers both professional development for teachers and vocational training for other adults, encouraging involvement and education to community members of all ages (CERES, 2016).

Presently, four cultural villages exist at the Community Environment Park: an Indonesian Village, an African Village, an Indian Village, and an Aboriginal Village. These exist as educational tools for excursions and non-formal visits to CERES. In March-May 2016, an IQP team from WPI initiated the process of developing interactive elements and interpretive materials for these village exhibits, with a main focus on the Indonesian village (Bukowski, Griffin McLoughlin, & Teixeira 2016). Their primary method of creating engaging and memorable material was the implementation of interactive elements within the exhibits. In order to cater to the different learning styles of visitors, these interactive portions were designed to incorporate the use of multiple senses. Since the primary audience of these exhibits are expected to be families and school groups, the exhibit must be easily understood by children, with a targeted minimum age of comprehension of seven years old. The designed prototype Indonesian village used thematic visuals and an easy-to-follow route to promote continuity in the exhibit. The key to educating these groups in a fashion congruent with other CERES initiatives is to use specific methodologies that follow the “Heart, Head & Hands” approach; developing passion, utilizing interaction and building understanding in the audience (Bukowski, Griffin McLoughlin, & Teixeira 2016).

Supplemental Materials C: Survey Questions

1. How old are you?
2. Have you ever spend six or more consecutive months of your life in a country other than Australia? (Yes/No)
3. If yes, where?
4. Do you believe in climate change? (Yes/No)
5. Do you believe certain environmental issues can be attribute to climate change? (Yes/No)*
6. What do you believe to be the cause or causes of climate change?*
7. Can you think of any direct effects of climate change in Australia?*
8. Can you think of any direct effects of climate change in Africa?*
9. Can you think of any water issues in Australia?
10. Can you think of any water issues in Africa?
11. Can you think of any issues with farming or food supply in Australia?
12. Can you think of any issues with farming or food supply in Africa?
13. Can you think of any direct effects of mining on Australia's people or environment?
14. Can you think of any direct effects of mining on Africa's people or environment?
15. Have you done anything about climate or environmental issues?
16. Can you think of any minerals used to make mobile phones?
17. Do you know where any minerals used to make mobile phones come from?
18. Can you think of any ways the mining of minerals used to make mobile phones impacts people and the environment?
19. What features or characteristics do you look for when purchasing a mobile phone?

*Question was only asked if the respondent answered "Yes" to question four.

Supplemental Materials D: Additional Survey Results

104 total surveys, 52 at CERES and 52 at Federation Square. Results shown by count.

How old are you?								
18-24	25-34	35-44	45-54	55-64	65+			
16	30	26	12	11	9			
Have you ever spent 6 or more consecutive months of your life in a country other than Australia?								
No	Africa	Asia	Europe	North America	Oceania	South America		
32	2	22	40	13	10	4		
Do you believe in climate change?								
Yes	No							
100	4							
Do you believe certain environmental issues can be attributed to climate change?								
Yes	No							
100	0							
What do you believe to be the cause or causes of climate change?								
Human-general	Emissions	Industry	Nature	Other				
39	77	15	11	15				
Can you think of any direct effects of climate change in Australia?								
Weather Changes	Environment Changes	Water Security	Other	No				
57	54	27	8	28				
Can you think of any direct effects of climate change in Africa?								
Weather Changes	Environment Changes	Water Security	Other	No				
18	28	33	17	45				
Can you think of any water issues in Australia?								
No	Drought or shortage	Quality	Access	Flooding	Other			
15	64	19	5	12	26			
Can you think of any water issues in Africa?								
No	Drought or shortage	Quality	Access	Flooding	Other			
18	54	35	5	4	13			
Can you think of any issues with farming or food supplies in Australia?								
Climate/Environmental issues affecting farmers	Climate/Environmental issues affected by farmers	Economic stresses	Crop/Livestock quantity issues	Chemical usage	Other	No		
37	26	14	10	9	17	19		
Can you think of any issues with farming or food supplies in Africa?								
Climate/Environmental issues affecting farmers	Climate/Environmental issues affected by farmers	Economic stresses	Crop/Livestock quantity issues	Chemical usage	Other	No		
31	15	9	6	2	15	29		
Can you think of any direct effects of mining on Australia's people or environment?								
Damaging the environment	Creating Jobs	Exploiting local and native people	Other	No				
93	9	24	11	19				
Can you think of any direct effects of mining on Africa's people or environment?								
Damaging the environment	Creating Jobs	Exploiting local and native people	Other	No				
35	0	43	5	38				

Have you done anything about climate or environmental issues?								
Sustainable lifestyle practices	Donations	Voting	Volunteer	Protest	Other	No		
99	9	10	11	4	5	12		
Can you think of any minerals that are used to make mobile phones?								
Assorted metals	Assorted non-metals	No						
76	13	48						
Do you know where any minerals used to make mobile phones come from?								
Africa	Australia	Asia	Europe	North America	South America	No		
35	19	19	0	3	2	37		
Can you think of any ways the mining of minerals used to make mobile phones impacts people and the environment?								
Damaging the environment	Creating Jobs	Exploiting local and native people	Other	No				
55	3	24	1	37				
What features or characteristics do you look for when purchasing a mobile phone?								
Brand	Durability	Functionality	Hardware	Environmental Concerns	Second Hand	Affordability	Other	None
21	10	37	19	3	6	13	1	13

Supplemental Materials E: Pre-developed Questions for Roundtable Discussions

The following questions were prepared prior to discussions in order to spur conversation. They were not used as a script and not all questions were addressed in each discussion.

Hello! We are students working with CERES Community Environment Park to educate the public about environmental issues in Africa and Australia through a cultural village exhibit. The idea behind this discussion is to get as accurate information as we can on topics related to environmental issues in Africa and the personal effects that these issues may have, especially from people with a different insight than ours. We will be taking notes and talking to you during the discussion. Please talk to us in the manner you feel the most comfortable. Also, feel free to abstain if you don't feel comfortable in answering! The answers will only be used with your approval, and you have the right to review them before their publication. Thank you for your participation!

1. How do you think climate change is affecting the African population?
2. According to your experience and/or knowledge, what do you think are the main obstacles repudiating the advance of environmental-friendly laws and actions?
3. Do you think there are any political, economic, social, religious, etc, interests involved?
4. According to your experience and/or knowledge, how do you think important and rare minerals such as gold, diamond, tantalum, and coal are affecting societies in Africa?
5. What interests do you believe are driving these effects?
6. After discussing the previous questions, do you think those are the most concerning social and environmental problems in Northern Africa?
7. How do you think that the problems related to climate change in Africa can be related to the ones in Australia?
8. Do you think that the over-extraction of minerals in Africa can affect Australia in any way?
9. Are the social impacts of mining minerals in Africa relatable to any problems in Australia?
10. What age range applies to you?
Under 12 13-24 25-36 37-48 49-60 Over 60
11. What is your country of origin? (N/A if you prefer not to answer)

Supplemental Materials F: Notes from Roundtable Discussions

Discussion 1

Location: Victoria University

Date: 10/25/2016

Number of Participants: 8

Notes:

- Recording start -> 12:58pm
- Important time marks
 - Discussion starts: 1:06pm - 8 minutes into the recording
 - Climate change
 - Coffee: begins at 1:08pm (10 minutes in), ends at 1:09 (11 minutes in)
 - Ethiopia, Sudan: 1:11pm (13 minutes in)
 - Food imported: 1:13pm (15 minutes in)
 - Great topic and perspective about climate change: 1:16pm (18 minutes in)
 - Minerals: 1:19pm (21 minutes in)
 - Firewood: 1:21pm (23 minutes in)
 - Privatization: 1:22pm (24 minutes in)
 - Water scarcity: 1:26pm (28 minutes in)
 - Review: 1:40pm (42 minutes in)
 - Crops: 1:41pm (43 minutes in)
 - Burkina climate plastic: 1:49pm (51 minutes in)
 - War: 1:51pm (53 minutes in)
 - Heavy stuff: 1:55pm (57 minutes in), ends 1:59 (1 hour 1 minutes in)
 - Colonization: 2:12pm (1 hour 14 minutes in)
 - African division: 2:20pm (1 hour 22 minutes in)
- Some countries in Africa do not allow people to come to Australia (1:02pm)
 - Reason why many people move and get the status of refugee
- There is an African Association (Afro Society) at the Uni, which they all are a part of
- They don't get why we are here
 - Having a hard time getting the project at first, something to improve in the next meetings
- One of them does not see climate change
 - ⅘ believe in climate change
 - "I just don't see it"
 - Have bigger issues to worry about

- ~80% did not have electricity
 - Use firewood for everything, making the everything dry and less green
 - “If there is God then [climate change] shouldn’t happen”
- In South Sudan, cows have been dying due to climate change
 - Probably because of water, and the country used to be rich in terms of “cows”
- Ethiopia: driest year in 30 something years
 - Most villages didn’t have drinking water
 - Had to get it from other places
 - Remembers having hand-pump well in community
 - Have to buy bottled water, can’t drink tap water
- West Africa: packaged food, very rarely will eat fish or meet, at least fresh
- Not enough resources sometimes
- Climate change is not that big because people have a lot of other things to worry about, they have struggle “surviving” at some points
 - It’s a scientific thing and people are religious and just don’t believe it sometimes
 - It’s going to be a big problem in Africa since there is a lot of waste
- Tribal wars distract people while outsiders take the minerals and destroy the land (1:20)
- Firewood: companies bought pieces of land and locals can’t used firewood because of that, since it’s private
- Privatization is ruining/changing people’s lives drastically
- Colonization: like Portuguese did with Brazil, like politicians currently do with the favelas
- Water scarcity: Getting water directly from the river at times with big containers
 - Pump wells are also used
 - Usually women get water
- Crops: sometimes they didn’t have supplies to do anything about climate change, so they just had to wait for everything to get better
 - Safety net: supply food to be sustained for some months
 - Food is stored whenever there are good years/months
 - This doesn’t exist in Sudan and people there rely on people overseas and whatnot
 - Burkina: people were used to the “rough water” and you had to buy plastic bags with water and people just threw them away in the streets
 - Because the land was dry, they had to buy food from other countries
 - During long periods of drought, people have to wait for foreign aid and depend on neighbors/ relatives to help out
 - People send a lot of money back home to support their families
- A lot of refugees going into Africa, which makes the problems worse, since they don’t even have the infrastructure even for themselves, let alone for extra people from outside

- They have a very high economic delta, difference between rich and poor

Discussion 2

Location: Cafe Lalibela

Date: 10/25/2016

Number of Participants: 2

Both from Ethiopia- different regions

Climate change

- Getting hotter and dryer
- Eucalyptus trees are making environment more dry
 - Friend group plants native trees/ plants
 - Community level organization
 - Little priority from government
 - Only care about big towns
- Use firewood for everything
 - Building houses
 - Heat
 - Cooking
 - Forest is getting dry, killing all the trees
- 3 months of rain in Northern Ethiopia- June- September
 - Farmers plant crops and wait seven months
 - Only enough for plants
 - Defines production for the whole year
 - Little or no irrigation
- Major crops: lentil, barley, teff
 - Subsistence farming
- Adaptation/ Combative Strategies
 - Abay Dam on the Nile
 - Hydropower
 - Irrigation system
 - Help with economy
 - Can sell power to other countries
 - Replace firewood

Discussion 3

Location: CERES Community Environment Park

Date: 11/8/2016

Number of Participants: 1

Important crops: Sorghum, Teff, Maize, Corn

Unemployment is high

Temperatures are definitely increasing

- “Village could be brighter”
 - Usage of more colors, attractive designs
 - Ndebele
 - Zulu
 - Have pictures of different groups or tribes from Africa
 - Red clay floor
 - Grass design
 - Windshield around campfire
 - Bamboo to cover fence
 - Have a map of Africa
 - “Representation of ‘the big 5’ animals”
 - Five most sought after “big game” of the hunting/poaching culture within Africa
 - Lion, elephant, rhino, buffalo, leopard
- Climate change was noticeable
 - It affects Africa more than any other continent
 - Droughts and storms threaten civilizations and food security and production
 - Maize is the staple crop
 - Corn is also very common and is imported from Australia
 - Botswana has a similar idea to the ‘safety net’ in Ethiopia
 - The government created paid activities for people who needed help, so they got paid to contribute to the community
 - They also have a labor-based drought relief project
 - Government takes leading role in fighting climate change
 - There are drought-resistant seeds
 - Sorghum - ancient seed
- Mineral mining
 - Companies get the minerals without contributing to the communities around the sites

Soil is wasted and destroyed, wages are low, and profits are ‘internationalized’

Discussion 4

Location: Victoria University

Date: 11/15/2016

Number of Participants: 2

Notes:

- Introduced ourselves and our project, the purpose of these discussions
- From Sudan
 - From South Sudan, left in 1992 (5-6 years old)
 - Lived in Uganda (refugee camp)
 - Lived in Kenya (lived for 2 years)
 - Applied for settlement and given opportunity to come to Australia (2002-2003)
 - Had no citizenship anywhere, government of Sudan could not organize
 - Granted visa and moved to AUS in 2004 (18 years old)
 - Lucky that he was allowed to start high school, dropped out of school a year later to find work
- In Kenya, living in town / slum area a few kilometers away from town
 - Sewage running around
 - Pay \$10 for the month, which was reasonable at the time but not everyone could afford even that
 - Asked people who came here before (cousin in 1999) for financial support
- Where did you get your water?
 - There was a container where they put water in
 - Sometimes there would be no water or there would be limits set on how much water people could use
 - Used to go to the bush for toilets, no inhabitants in the bushland
 - Turn off electricity during the day, turn it on at night
- Where did you get food?
 - Supermarkets to go buy flour and beans
 - Very cheap price, they are more expensive now
 - If there is no money, you don't buy anything
 - Have to go a whole day without eating
 - Used to happen a lot
 - Going back to Uganda, cousin who was here (Australia) used to support them
 - There was a time where his telephone was disconnected, life became horrible because they did not have his support
 - Had a broad community nearby
 - If someone was seen dying, they would come give necessary support

- Had to talk to other relatives in South Sudan
- “If you are lucky enough to have a cow, you would sell the cow”
- There was no food for them, they couldn’t pay the rent for three months
- When he was reconnected, cousin gave 10,000 Ugandan shilling
 - Gave choice to use on food and rent or to travel back to northern Uganda
 - Dad came back from South Sudan and started calling them to give them money
 - 9 people ended coming to Australia with them
- Went back in 2012-2013
 - Went all the way to the village to see what was happening
 - Didn’t know his own village, it was so destroyed from the war
 - Went to neighboring towns, never had the chance to see his own hometown
 - Reunited with some of the relatives
 - Do not have the full connections to know what was happening (who lived/ died, war)
 - Bought some cows and sent some money to in laws
- Before they came here, there was no contact- can’t call anyone, only use radio if they have money
 - Had never spoken to anyone
 - Left village in 1991, no networks- still can’t talk to anyone in the village
 - No internet, telephone or anything
- Did the issues with the minerals affect you in any way?
 - No, the only thing that affected me was the tribal conflict
 - There are certain places you can’t go to if you are in different tribes
 - Too risky to go out/ leave the hotel
 - Can’t go out at night
 - Goes back at 6:00
 - Restrictions
- What do you see as the driving factors for the wars?
 - “More political than tribal”
 - Superiority, tribes want to be leaders and there are issues with that
 - For their own political gain
 - Global issue is that the tribes can’t coexist with the politicians influencing the decision
 - Has a friend here from a different tribe
 - Can talk and visit and be friends with him in Australia
 - Couldn’t be friends in SS, politicians polarize situation for their own gain, say that he will be killed

- Has his own life/ family than older people
 - Mentality is still the old way/ same behavior
 - Kill you whether you are related, black or white
 - You have to do whatever they say otherwise you get in trouble
- How do you hear about these conflicts?
 - There is dysfunction in department or with ministers
 - Don't do their job
 - If they have money, they will go to the villages and help the people
 - In 2013 when the war broke out, it started as a political problem but people started to learn killing yourself cant help
 - Politicians don't help the tribe- help their kids
 - Politicians lie that people from other tribes are killing people from their tribes, people get so angry and go and kill the other people
 - Don't have a leader, just go start fighting and investigating
 - Not educated, don't do the analysis
 - From the start of the war, people don't listen to people who try to tell them the real causes of the war
 - Tells people it's the fault of the politician
 - If you tell people the opposite of what they think, they don't like you
 - If you can't stop something alone, you better keep quiet
 - Gain momentum or get power
 - You might become victim of your own knowledge, get killed for telling them
 - What do the politicians get out of it?
 - Wealth
 - Resources are channeled into buying weapons, etc.
 - There is always political affiliation
 - Whatever comes in to help save the people who are dying is taken by the politicians
- Do you see climate change affecting Africa in any way?
 - There are tropical areas that are not much affected by climate
 - There are areas that are very dry
 - Not a very big concern back in the country, not a priority
 - In SS, the temp is always very high, might be a contributing factor to CC
 - Always 38-40
 - Used to have a rainy season, now it takes until after june
 - Used to start in April
 - Planting season is delayed and shorter
- "A day in the life"
 - Went to high school, was in the second year (year 8)

- Was supposed to finish and go to advanced level, stopped and resumed studies
- How would you get there in the mornings?
 - Used to wake up at 5:30-6, walk like 1 hour
 - In village, an elder person would come to wake you up
 - No alarm or electricity, get used to it
 - In primary school, there was a scholarship program from Denmark
 - Worked hard to get good marks and earn scholarship
 - Scholarship was given to someone else under his name
 - He didn't miss a single day of school, working to earn it
 - After 1993-1994, he was taken back to school and some things motivated him
 - See educated people dressed up, someone who is rich and has it all
 - During the time of the struggle, guy who was leading struggle was a fair bit older
 - Why don't i become someone, become educated and become a leader
 - Why not me?
 - Started committing himself to school in year 4
- Did you have any siblings?
 - Yes, went to the same school except one
 - One was taken by a program sponsored by UN
 - Free food, uniform and courses
- What else did you have for chores?
 - No lunch, no morning tea- no food at school
 - After school, he would walk home an hour
 - Used to play soccer after school, but it would get dark quickly (6pm)
 - Wrap a balloon in bandage and use as soccer ball
 - If you have petrol, use lamp to study until 8
 - If you have nothing, only study during school time or weekend
 - Usually on weekend
 - Build your own house so you don't have many chores
 - Mud walls
 - Mud-bricks are too technical
 - No windows
 - Had to heat it at times, would get cold at night
 - Don't do any inside the house
 - If people are outside the compound (eating time), you stay until like eight and then goes to bed
 - Everyone starts their day as early as 5:30am

- Would see the sun coming up at 6am
- Sleep at 7-8pm, so you are ready to wake up early
- No light in the house that he used to sleep in
- When he went to the hotel, got back to Australian time because there was light
 - Wifi, TV, lights
 - Stay up until 2am
- What did your parents do?
 - Parents used to work
 - Dad used to be cop/ judge
 - Mother used to work at a brewery, clean house, cook
 - Men didn't cook in Africa, it was the woman's duty
 - 1993-1998, never had a chance to get money
 - If you have \$1 you were rich
 - After relatives went to US and AUS, would send money
 - \$50 AUS was enough to buy horses and food for the family
 - It was too hard to get money
 - Everything was run by UN, got free food and basic public family healthcare
 - If you were really sick, you had nowhere to go
- Are there anythings you went through that you think Aus have no idea what it's like?
 - Being in the village with no light/ electricity
 - Being a refugee
 - No privileges
 - Only day to day life in that country
 - Had to face discrimination in the country
 - Rebel would kill innocent people for their knowledge/ who stated anything they would do
 - Here (in Australia), if you commit a crime you pay for the crime
 - In Africa, you don't pay for any crimes, you just run away
 - There was so much conflict, government would come and bombard places they lived/ camps and would kill so many people in the village
 - Australia is place of opportunity
 - Insecurity is not as much of an issue
 - Government is here to protect them
 - Social security benefit
 - Not in Africa
 - Most people wouldn't have a chance to go to school simply because opportunities were buried
 - Try so hard to do something for yourself, get denied opportunity

- Committed himself and worked so hard to get scholarship, was not able to get it
- Here, you can do whatever you want in school, get whatever degree you want
- When he got here, worked to get to university and study more (got masters)
 - So different than what he would have thought
 - Would have been lucky to get one degree in SS
 - Now has masters in public health
- Within our four topics
- Conflict
 - In early 1999-2000, before moved to Kenya, younger brother and himself were walking 2 hours and caught
 - Were lucky enough to be let go
 - Part of the conflict
 - Conflict will never stop in SS
 - Since they lived in SS, now there would be issues between friends
 - Has so many friends from different tribes, no issues between them here
 - One close cousin who came to Australia in 1999, another cousin was killed in 2013 when they went home
 - Painful to remember them
- Second participant comes at 4:30
 - Describes project
 - Trying to get people to think about the different conditions between Af and Aus
 - Uganda, then went to live most of life in Kenya in refugee camp
 - Work for UN in 2002-2009 until he arrived in Aus
 - Working as head chef in cafeteria
 - Start as cleaner in kitchen, promotion
 - Got resettled in Aus, (Brisbane to Sydney to Melbourne)
 - Moved to Sydney to get back to school
 - A lot of setbacks, needed help with computers to college
 - Did hospitality and worked at conversion center
 - Hospitality was a background, wanted to do logistics
 - Double majored in Sydney in hospitality and logistics
 - Looking forward to getting to work
 - What situation did you live in Kenya?
 - A normal human being doesn't want to be called a refugee
 - Isolated area, really hard and hot
 - Given allowance
 - Can't run air condition

- Area is flat, so would flood when it rained
 - Was a head chef- remembers the whole road cut off for a week because of flood
 - Had to get food airdropped from somewhere else
 - Within a week, had to manage to improvise what he could do to make sure people could eat
- Area is bigger than VU campus
 - 120 staff working there, big operation
 - Breakfast, lunch and dinner
- Compared to here (Australia)
 - Knows what he wants to achieve
 - Saw the best from UN
 - Hopes to be a logistic manager somewhere
 - Deviating from hospitality
 - Limiting at national level
 - Wide area of international employment
 - Wants to go back to Africa
 - In connection with UN staff
 - Served UN secretary
 - Wants to give back to refugee community
 - Start in Aus, get sponsor and go oversea
- Family is still in Africa
 - Sends money that supports them
 - Keeps working and studying
 - Needs to support himself in order to support them
 - They would love to come here, but it's extremely hard
 - Govt won't allow anyone dependent
- Did you go to school in kenya?
 - Finished year 12, did a little college
 - School started at 9am
 - Go to school in the morning, school was very far
 - Had to walk a long distance
 - Do without lunch at school, didn't eat until 4pm
 - That was the hardest
 - Lunch wasn't provided, couldnt afford/ go to get food
 - A lot of people dropped out if they weren't passion enough
 - Sometimes you don't have any sandals, had to walk barefoot on hot sand
 - Can't afford even shoes sometimes

- Sometimes you don't see it, but when you've seen a developed area and go back you see a big difference
- What kept you motivated?
 - Mom wanted the best out of him
 - Dad was killed during war (12 years old)
 - Mom wouldn't allow him to get married at 15 (when some people did) until he was responsible for himself, pushing him for the best
 - Will pay off, hopes to go visit and celebrate achievement
- Day-to-day chores
 - Not much you can do after school
 - Only tried to read with lantern lamp
 - Wind when blow it out
 - Years 1-12, didn't bother reading outside of school
 - With war, sometimes you have to look for where to sleep, to go to a city to get protection to sleep
 - If the rebel comes, they would take you to bush and you would be recorded
 - Here in AUS, have a lot of time to read whenever and do whatever you want
 - Only think about surviving and what to eat
 - Don't think about that here
- Climate change
 - Dadaab- it was always hot
 - Winter there is spring
 - Rains and flood
 - No food no where to go
- Food and water scarcity
 - A lot of programs to provide food, water sanitation, shelter and protection for refugees
 - Welfare programs
 - Food is not enough for itself
 - Give you two (ten?) cups of beans and ten cups of ___ to last a week
 - Kenyan govt doesn't allow salaries as a refugee
 - Pay incentives to buy supplementary food (give refugees employment)
 - When working at UN compound, gave his supplementary food to other refugees
 - Best thing UN has done
 - Rate of crime would go higher
 - People would steal just to get something to eat
 - Had to walk/ work for water

- In the compound, tried to group people according to nationality
 - Stay in a block
 - Within those blocks, there were would be something in the center to get water
 - Won't find water in a well in a desert in the compound
 - In Africa, would dig to create well for water
 - Camel, camel milk
- Comparing australian life to african
- Is there anything you think australians have no idea about
 - Back home, there are some problems
 - Could survive on their own if there was no war
 - Land is fertile, could grow food, keep cattle
 - Parent would plan to provide opportunities for children
 - Sell cattle to send child to car
 - Don't think of driving cars or anything
 - When war came in, has brought development in city
 - People starting building commercially within city
 - Run, leave villages for cities for protection
 - Need to pay rent for accommodations
 - Increase poverty within region
 - Media puts it higher, people are okay
 - Standard of living is a lot lower
 - If i'm given a chance to advise within govt / give advice back to government, can give a lot of advice on infrastructure on how they can improve living standard to be comparative
 - Life is hard when the war is there
 - Only thinking about not being killed and what to eat
 - If there is no war, you can go home and dig
 - If there is no war, have a lot of cattle
 - During war, they're taken
 - Increases poverty level
 - If there is no war, life is good, there is not much stress
 - Here, you need to think of paying rent, electricity, bills
 - There, if you can work a little bit
 - You get food from the garden, can cook and eat
 - Given time, if they could reduce corruption and get a more stable government, they can fight corruption, Africa will grow and be one of the best countries
 - Have all of the resources there
 - Need to change the structure of education
 - Need more research

Supplemental Materials G: Additional Background Information on Informal Learning

Examples of Informal Learning Institutions

Several informal learning strategies have been implemented into educational exhibits and exhibits on environmental sustainability with success, fostering interest and encouraging further exploration of the topics presented. In addition to the educational information that museums convey, the interactivity fosters curiosity and further exploration of concepts presented. A study conducted by Callanan in 2011 shows that museums “can promote intrinsic motivation for learning, support visitors to develop their ‘personal agendas,’ and help visitors make their own personal connections with the materials;” furthermore, the contrast in social structure between museums and a traditional classroom setting “encourages collaboration, family engagement, and peer interaction” (Callanan, Cervantes, Loomis, 2011, p.651). Museums and exhibits allow visitors to shape their own educational experiences based on their curiosity and interests.

Institutions of informal learning such as museums and educational exhibits often employ “hands on” or “interactive” methods of teaching in order to present the material in a way that engages visitors and educates them about the topic in a meaningful way. These experiential learning strategies enable visitors to develop existing knowledge, discover real-life examples, gain an alternate perspective about the topics and issues presented, and apply problem-solving skills of their own to the activity at hand (Ballantyne, 2004). The Exploratorium in San Francisco includes several interactive “playful” components, including a hopscotch mirror activity and a space-filling blocks exhibit to help visitors discover different geometric and spatial orientation concepts. Environmental exhibits such as the “Exploring Trees Inside and Out” exhibit at Philadelphia’s “Please Touch Museum” and the “Urban Tree House” at the Children’s Museum of Manhattan Sussman Environment Center employ a variety of hands-on teaching methods to promote environmental and sustainability education. The activities presented, including crawling through a log to teach about the ecosystems that rely on fallen trees and exploring material cycles to better understand why it’s important to recycle, allow the children to establish connections between the exhibits and their real life purposes or applications. By providing a range of conceptual and material content, establishing connections and dependences between issue topics, and emphasizing a dynamic, interactive, processes of presentation, these exhibits successfully establish a relationship between engagement and understanding (Warburton, 2003). These exhibitions enable visitors to develop an understanding of the desired educational concepts through memorable and impactful hands-on interactions.

More on Effective Exhibit Design

As presented in “Designing an Effective Educational Exhibit: Principles of Design,” the first criterion for effective exhibit design discusses the importance of having an attractive exhibit that draws the visitors into the exhibit. Tucker, Bricker, and Huerta (2011) support this emphasis on the initial appeal or attraction, describing an effectively designed exhibit as something “capable of attracting a visitor’s attention from a distance, appealing to his or her senses, and drawing that individual into a physical space that creates wonder and curiosity” (p.8). The second criterion emphasizes the value that having a clearly defined layout, or effective signage throughout the exhibit, can add to the visitor’s experience. The third criterion relates to the

presentation style of the information or concepts throughout the exhibits. While interactive features are proven to be effective in drawing attention and conveying impactful information, Allen and Gutwill (2004) note that too many features may lead to misunderstandings of the material or the participant feeling overwhelmed as one of their five common pitfalls of designing an interactive exhibit; having too many interactives may cause visitors to confuse the priority of an exhibit's many elements, miss a main learning objective of the exhibit, and disrupt the display or another's interactions. This is congruent with Allen's claim in "In Principle, In Practice: Museums as Learning Institutes" (2007) that avoiding "cognitive and sensory overload" by limiting physically interactive features is an important challenge that needs to be considered when designing a museum as a learning institution (p.44).

By identifying that the exhibit must appeal to all demographics of visitors, the third criterion also allows for recognition of the valuable role that parents have in their children's learning, especially in informal settings. The NRC notes that "children who participated with their parents discussed evidence over longer period of time and in a more focused manner" when compared to children interacting alone (p.149). The Philadelphia/ Camden Informal Science Education Collaborative (PISEC) elaborates on this theme and the importance of family participation in a discussion of seven characteristics that make an exhibit successful and family friendly: multi-sided, multi-user, accessible, multi-outcome, multi-modal, readable, and relevant. In alignment with the criteria of successful exhibits described above, these characteristics show the importance for the ability of a family to cluster around the display and interact comfortably, the ability of the exhibit to foster group discussion and appeal to different learning styles and knowledge levels. Other factors include the arrangement and comprehension of the text, and the strengths of linking visitor's existing knowledge and experience to that covered in the exhibit.

As discussed in "Using Emotions to Inspire Action," eliciting emotions through presentation of relevant, meaningful, or surprising information is a successful strategy to making an exhibit memorable and impactful. The NRC recognizes the underlying idea that "promoting or supporting a variety of emotional responses (surprise, puzzlement, awe) and a variety of processing modes (observation, discovery, contemplation) increases the likelihood of connecting with a greater variety of people and encouraging them as learners" (NRC, 2009, p.128).

Evaluating Exhibit Success and Engagement

Several methods have been developed to measure an exhibit's success in fostering engagement and interest within visitors, often involving a combination of observation and formal evaluation techniques. Screven (1990) describes the three major processes to evaluate the effectiveness of an exhibit. Front-end evaluation occurs before the exhibit design process begins, focusing on visitor preconceptions about the presented content and defining overall exhibit objectives and design criteria. Formative evaluation occurs throughout the design and prototyping stages, exploring visitor reactions to the displays and their specific formats, as well as the overall effectiveness of conveying the desired information. During this stage of development, the prototype and evaluations may go through several iterations based on visitor feedback. The final stage of evaluation, summative evaluation, occurs after the opening of the exhibit and evaluates the overall success and learning outcomes of the exhibit.

The APE project conducted at the Exploratorium in San Francisco involved developing and evaluating several exhibits at the Exploratorium using formative evaluation techniques, with the overall aim of increasing participation. The report discusses the role that exhibits have in

fostering active prolonged engagement (A.P.E.), describing the characteristics of visitors that fall in each category (Exploratorium, 2016). Active visitors are those who decide their own paths through the exhibit space, often disregarding suggested instructions. Prolonged visitors spend more time at each exhibit and get more involved with interactives than at other exhibits. Engaged visitors interact with a variety of stations throughout the exhibit, building on their actions and experiences as they travel from one station to the next. Similarly, Barriault and Pearson have developed a technique to measure the effectiveness of exhibits that will be referenced in the evaluation of the model villages at CERES. The purpose of their method is to gauge how interactive an exhibit is based on visitor involvement. “The learning behaviors can be grouped into three categories that reflect increasing levels of engagement and depth of the learning experience” (Barriault, Pearson, 2010). These three categories are labeled in the article as initiation, transition, and breakthrough behaviors. By recording the percentage of visitors who engage in each behavior, the effectiveness of the exhibit can be displayed in a graph, this is demonstrated in Figure 1.

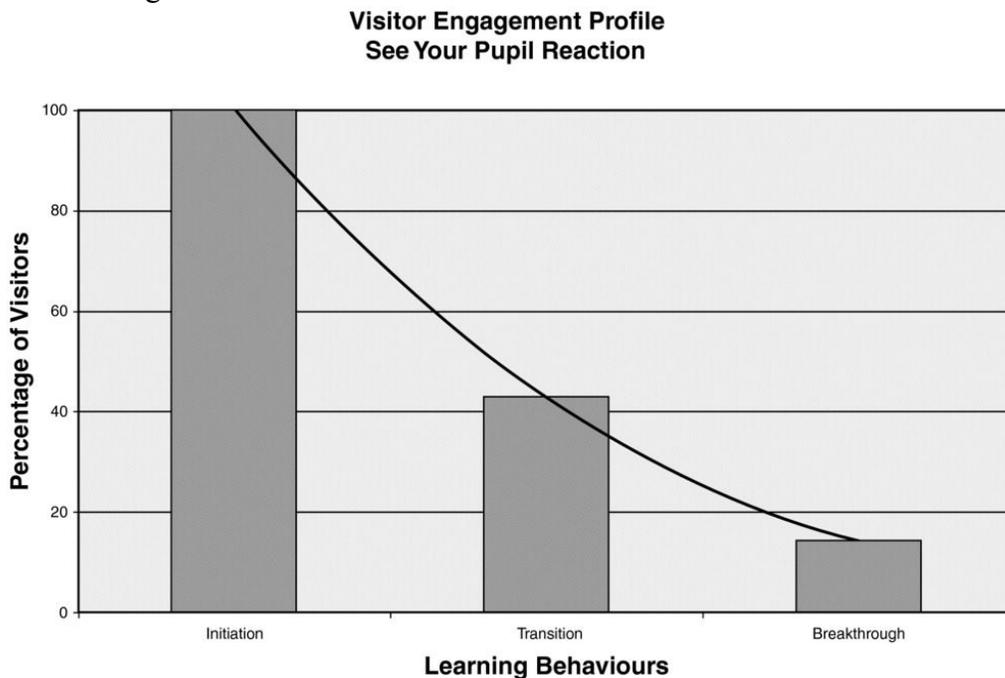


Figure 1: Measuring figure engagement in “See Your Pupil” exhibit (Barriault, Pearson, 2010)

Initiation learning behaviors are the initial steps taken towards an exhibit being both engaging as well as a beneficial learning experience, seen when a participant first interacts with an exhibit. These behaviors draw the visitor’s attention and are a crucial part in the visitor’s decision whether or not they want to engage in the exhibit and be committed to participating. If a visitor is just beginning to engage in the activity, or watching others as they engage in the activity, they are displaying initiation behavior.

Transition behaviors are most noticeable by people who are enjoying the exhibit. This level of behavior is not reached if a visitor starts to engage in the exhibit but leaves before completing it. Transition behaviors are often displayed when a participant is experimenting to try different outcomes, and directly interacting with the concepts of the display.

The final marked stage of engagement in an exhibit is usually observed during or after participation, these are called breakthrough behaviors. Noted actions associated with this behavior are the discussions of past experiences and applications of concepts from the display to their everyday lives. These actions show the visitor's willingness to see the importance of the exhibit as well as to draw connections that require an understanding of the ideas presented. When referring to past experiences and using gained knowledge, Barriault and Pearson learned from the display that "a visitor's interaction with an exhibit becomes a meaningful learning experience that takes full advantage of the exhibit's learning opportunities." (Barriault, Pearson, 2010).

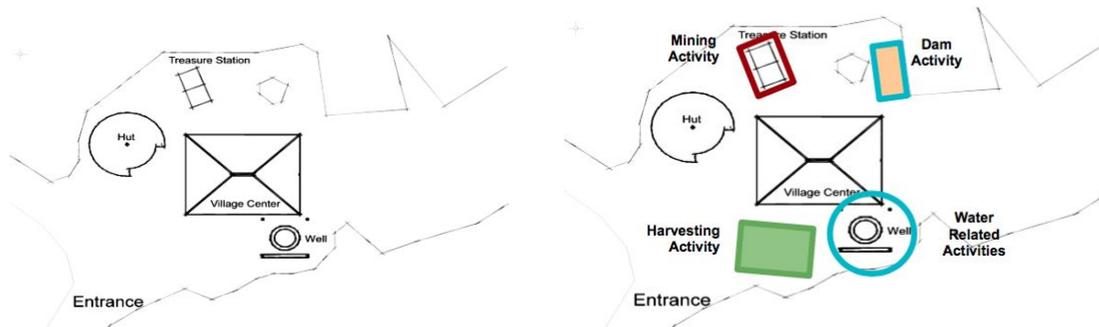
Supplemental Materials H: Notes from Discussion with Exhibit-Design Professional

The following notes were compiled from a discussion with a professional who is involved in design at Werribee Open Range Zoo.

1. Rustic and simplistic theme
 - 1.1. Wanted to make it as close as possible to Africa, in a “survivor” kind of way
 - 1.2. Stuff handmade or recycled
 - 1.2.1. Also close to CERES’s objectives since they are an environmental org
2. “Only 5% of people will read signs”
 - 2.1. Try to make things as visual or interactive as possible, or make the readable signs immersive
 - 2.2. Try to get the message across with visuals
 - 2.2.1. EX: Litres of water
3. Make stuff as tall as the kids, because they will be the ones mainly interacting with the exhibition
4. Make the village an immersive experience, with local aspects of Africa
 - 4.1. Village gathering spots
 - 4.2. Usage of logs, drums, wooden boxes or crates, etc, as seats
 - 4.3. Drums
 - 4.4. Fireplace
 - 4.5. Hand pumps, wells, etc
5. Create areas that make people curious
 - 5.1. Like the salon in the Werribee African Village, which was something unexpected but accurate, which people found to be fun and took pictures
6. During the summer, they have African bands or live music playing in the village
7. They’ve tried to serve African food; however, “the visitors wanted chips”
8. Try to make the exhibit something as “permanent” as possible
 - 8.1. Set ups and teardowns everyday so the material isn’t stolen, durable materials, minimalistic (people can’t lose their stuff in it)
9. Colors
 - 9.1. Kids like colorful stuff, helps them relate ideas
 - 9.2. Parents would tell the kids what each color represents
 - 9.2.1. “Red = blood or nourishment
Blue = water
Yellow = animal skin”
10. No specs that aren’t relevant to the visitors, they won’t remember those
 - 10.1. EX: scientific names of animals, too specific locations, etc

11. Food
 - 11.1. “Make a fake food selling stand where kids can sell fruits, meat, etc”
 - 11.2. Fake crop planting
12. Mobile phones
 - 12.1. “There are more cellphones than people in the Congo”
13. Water
 - 13.1. Water in Australia vs Water in Africa

Supplemental Materials I: Designs for Prototypes and Signage

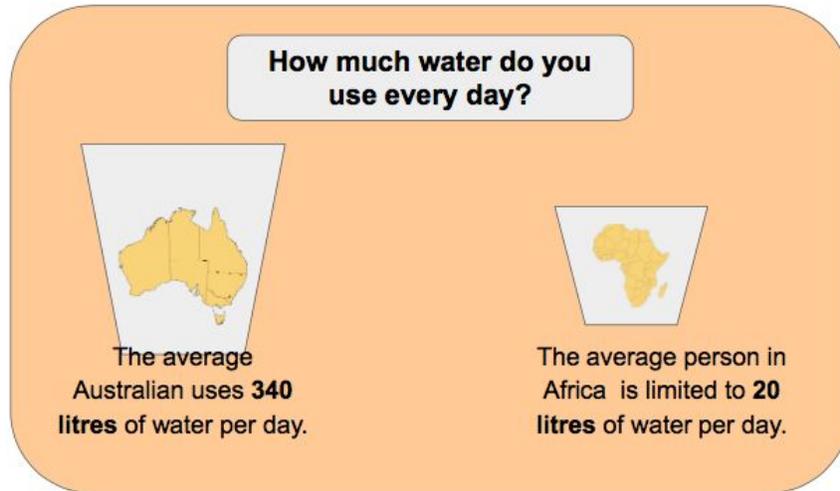


Models of Original Layout of African Village and Placement of Prototypes

Presenting Water Scarcity Activity 1: Well Activity and Signage

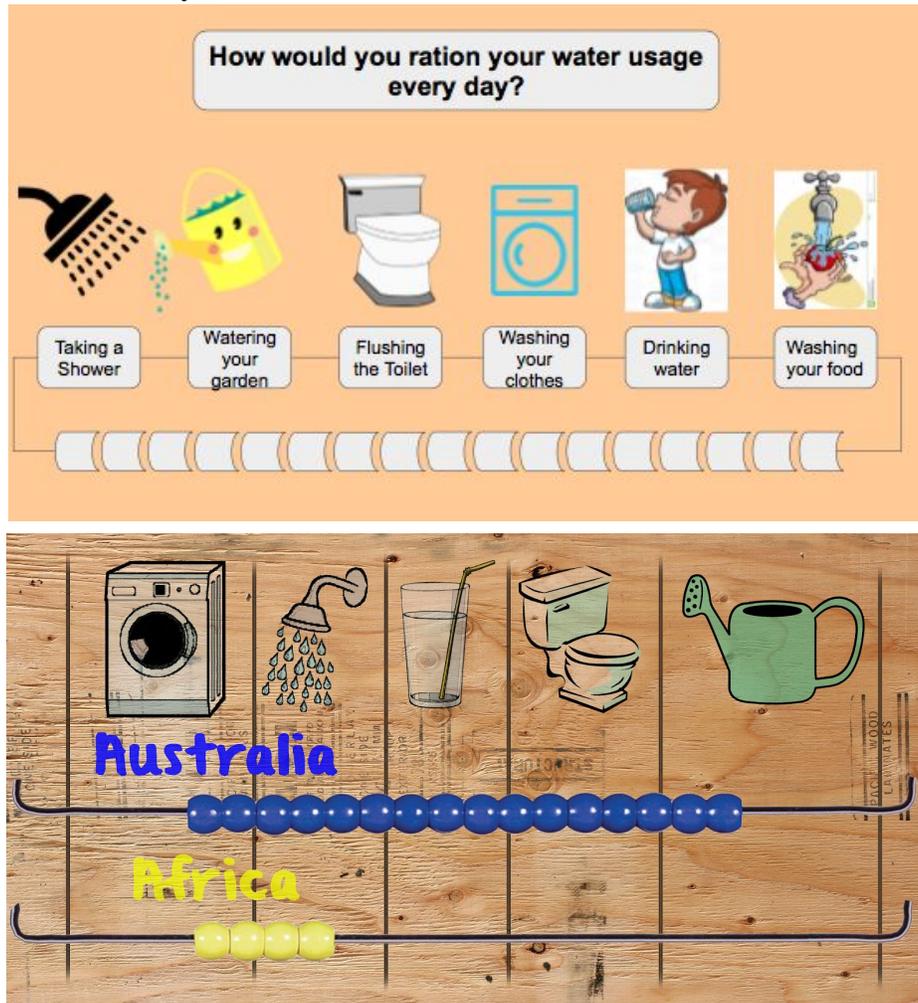


Design for well activity. This will compare the amount of water used each day in Australia versus Africa, with the buckets filled with cement. The buckets used will depict the 17:1 ratio of water usage.



Concept for signage and key messages to be presented in the well exhibit.

Activity 2: Beads Activity



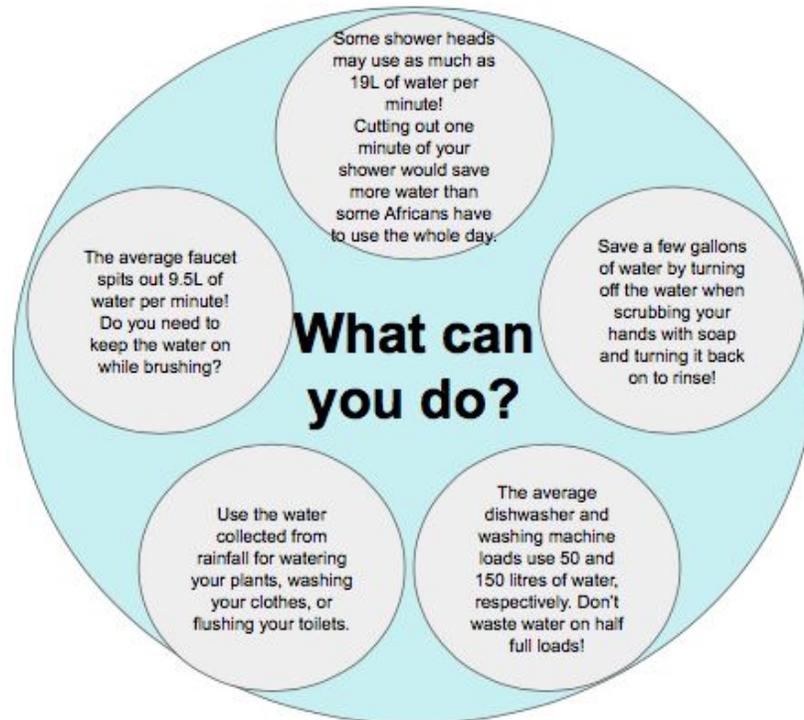
Concept and design for bead activity. Users use beads to ration their daily water for each task.

Could you imagine not having enough water to drink everyday?

In many countries in Africa, climate change is having detrimental effects on Africans' access to clean, potable water. If there is a water source nearby, such as a river or hand-pump well, women may walk over an hour carrying a large tank of water back to her community. When there is not a water source as a result of serious drought or water shortage, many communities have water imported to them in large containers that are placed at the centers of the villages. Limits may be placed on how much water people are able to take each day, or people may arrive to find the container empty. Could you imagine not having enough water to drink or complete simple, everyday tasks?

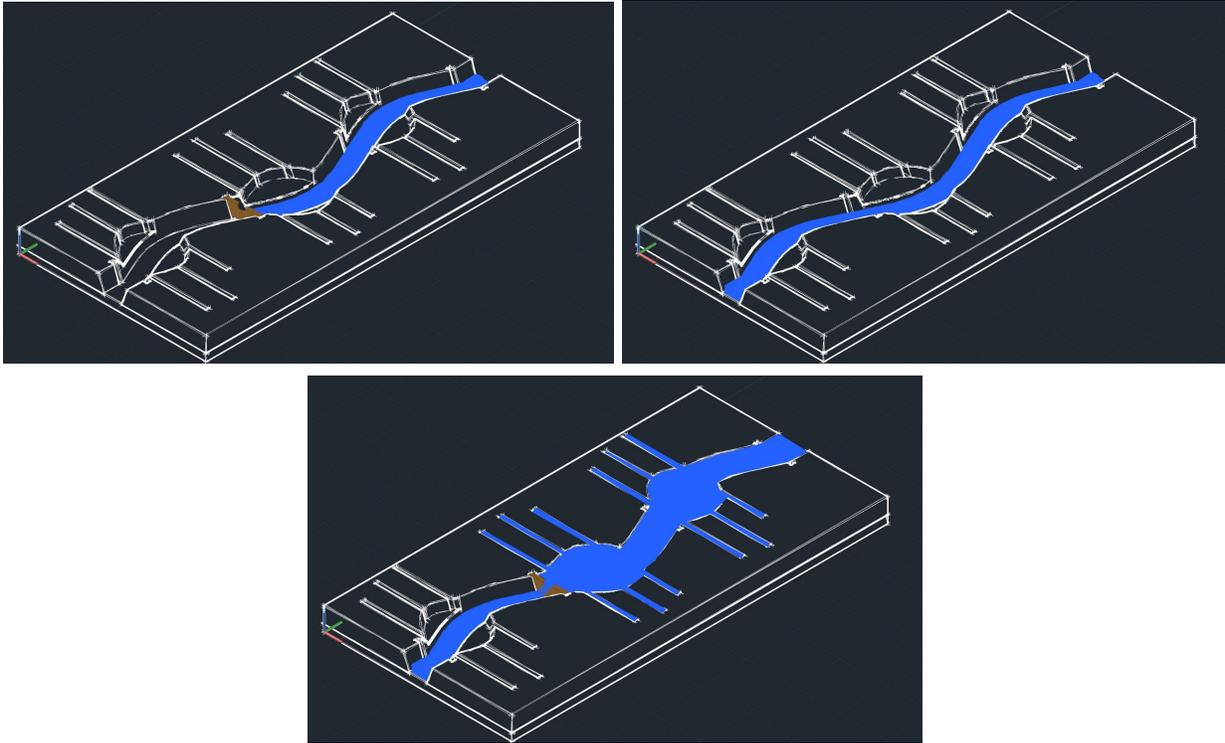
Concept for sign accompanying beads activity. The purpose of this sign was to evoke emotions in the visitors by describing in detail how water scarcity affects communities and how they cope with this issue.

Activity 3: “What can you do?” Water Conservation



Concept design for the water conservation activity. The user would read the initial strategy, then spin it up to read how these simple changes can make a large difference in water usage.

Activity 4: Dam Activity



Design for dam activity. Three pieces of cut-out wood would be layered. The placement of the dam would allow water to fill the irrigation channels.

Grand Ethiopian Renaissance Dam



The GERD will help Ethiopians replace their current source of energy (wood burning) to hydropower produced from the dam for cooking and heating homes the dam will thus:

- Decrease regional deforestation.
- Make water supply more predictable and flood seasons safer.
- Allow farmers to grow a greater quantity and more diverse set of crops.
- Help Ethiopia's economy by selling electricity to surrounding countries.

Design for signage providing information about GERD. The text and map will be printed onto cardboard in the prototype, and painted onto wood in the final version.

Presenting Food Scarcity
Activity 5: Harvesting activity



Design for harvesting activity. Visitors would collect the crops from the field in a bucket.

With the changing climate, there has been a 15% decline in rainfall during the main growing seasons in Africa since 1980.

Shorter Rainy Seasons = Less Rainfall = Fewer Crops

Pretend you are a farmer in Ethiopia and harvest them here!!



What can you do?

Stop wasting your food!

Australians waste between eight and ten billion dollars worth of food each year, or 4 million tons of food!!!



Consider a home or community garden!!

Visit CERES Community Gardens for ideas on how to start your own!!

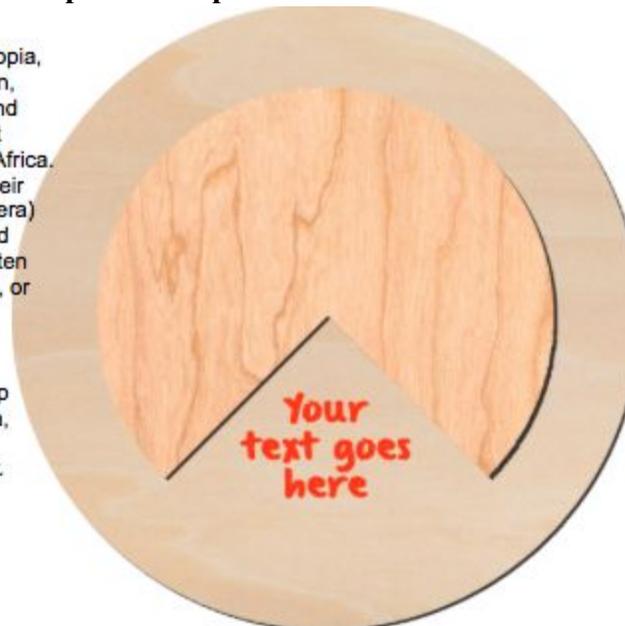


Concepts for signs for harvesting activity. We wanted to express how climate change is negatively affecting countries such as Ethiopia, and provide instruction for our activity. In addition, we wanted to relate this to the amount of the food that Australians waste every day, and encourage change in visitor behavior.

Activity 6: Staple Crops in Ethiopia

Teff is considered a "super grain" in Ethiopia, as it is high in protein, calcium, and iron, and thrives in the difficult climates present in Africa. It is used to make their traditional bread (injera) and numerous baked goods, or can be eaten on its own, steamed, or boiled.

Maize is the most important cereal crop produced in Ethiopia, producing over 6 million tons per year. As the cheapest source of caloric intake, making it an important crop for food security.

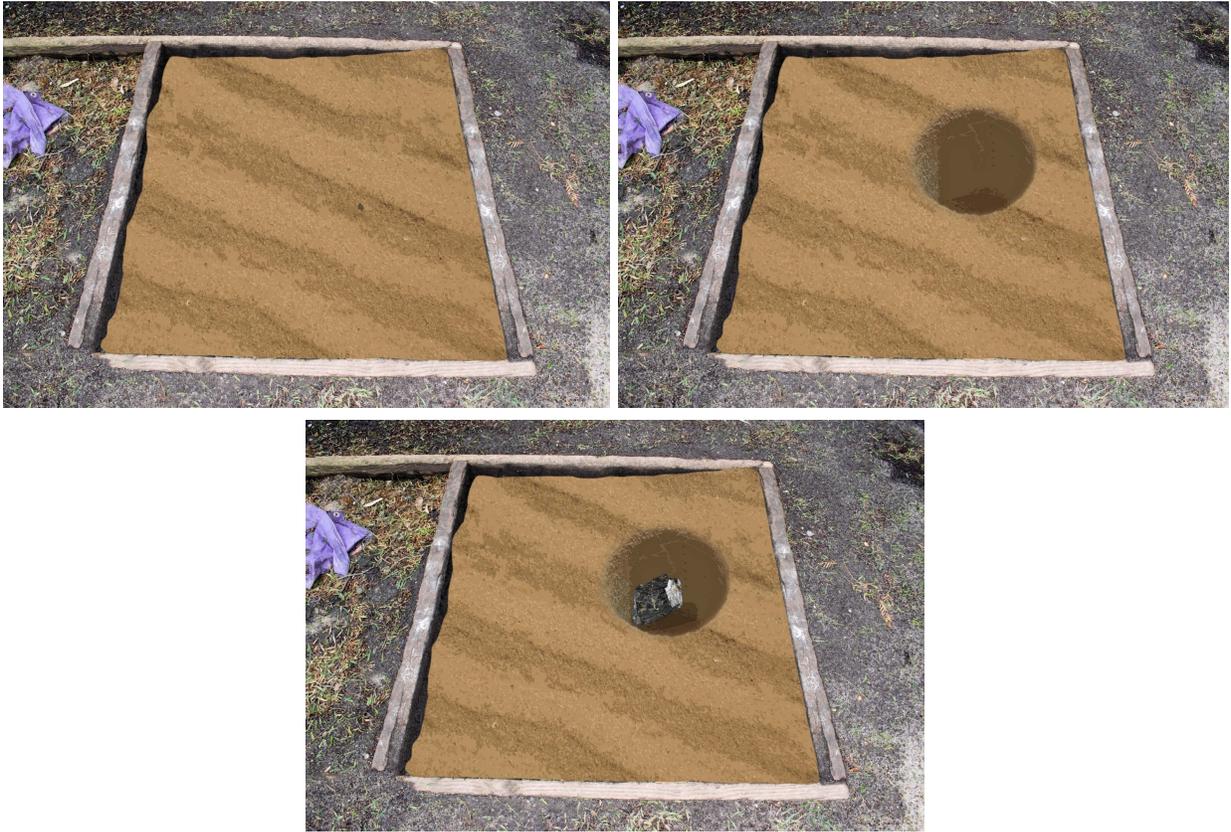


Approximately 4 million tons of sorghum is produced in Ethiopia annually, making it the second most important cereal crop in this region. It's large success comes from its ability to grow in dry and infertile soil.

Ethiopia produces the world's most barley for area. Barley is used for different types of bread, pastas, and pancakes, and made into a malt for beer and whiskey. Barley beer is one of the main sources of cash for the area.

Presenting Conflict Minerals

Activity 7: Presenting Conflict Mineral Mining



Concept for conflict mineral mining activity. The visitor would dig and find the rocks representing conflict minerals in the sandbox.

Did you know?

Coltan is used in electronic devices like cell phones.

This mineral often comes from places like the Democratic Republic of the Congo, where it is mined using child labor and funds violent militia groups.



Concept for sign to accompany mining activity, providing information on the social justice issues related to conflict minerals.



COLTAN

The metal "tantalum" comes from this mineral. Tantalum is used to make electronic devices, like mobile phones.

DIAMOND

Diamonds are a very hard crystals often used as gemstones and in industrial applications.

GOLD

This shiny precious metal is used to make jewelry and electronic devices, among other things.

COAL

This black and hard rock can be burned as a fossil fuel to produce heat and energy.

Design and information presented in conflict mineral flip-up activity. The visitor finds the mineral in the sandbox, finds its picture on the flip-door, and flips it for information.

What can you do?



Recycle your old mobile phones in the Indonesian Village!!!

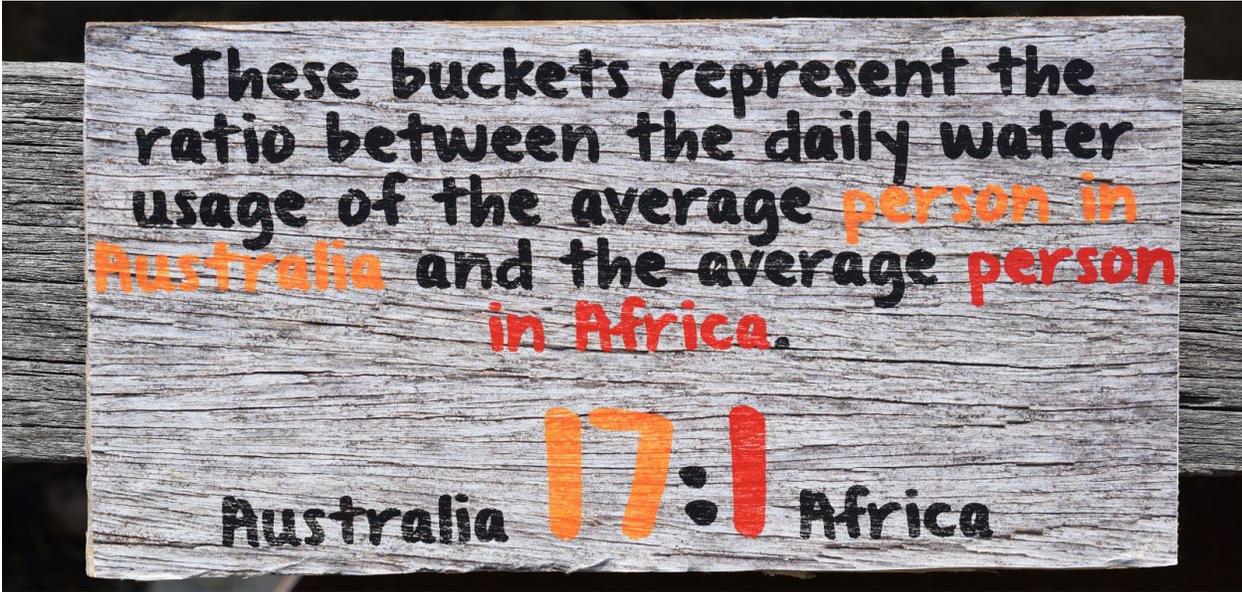
The average Australian has 1.33 mobile phones, which may or may not be in use. If you have one (or two) lying around, please consider recycling your cell phones so the minerals can be reused and there is less demand.

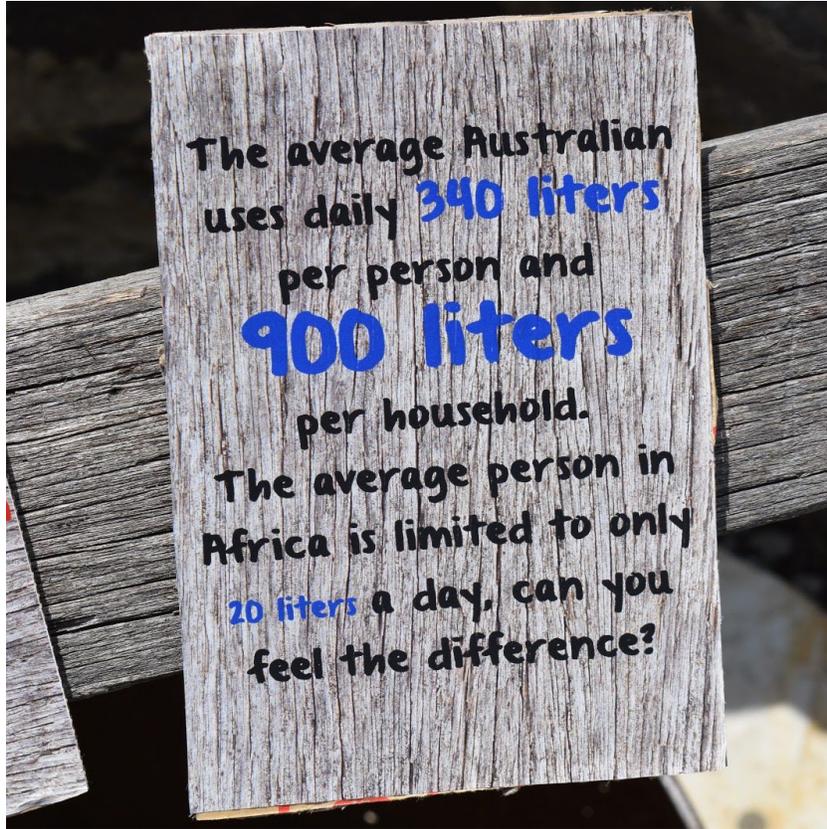
Recycling Mobile Phones = Less Demand for Minerals = Less Mining = Less Social Injustice

Concept for sign accompanying conflict mineral activity. This encourages visitors to be more aware of how simple actions, such as recycling mobile phones, can make a difference.

Supplemental Materials J: Additional Pictures of Prototypes and Signage

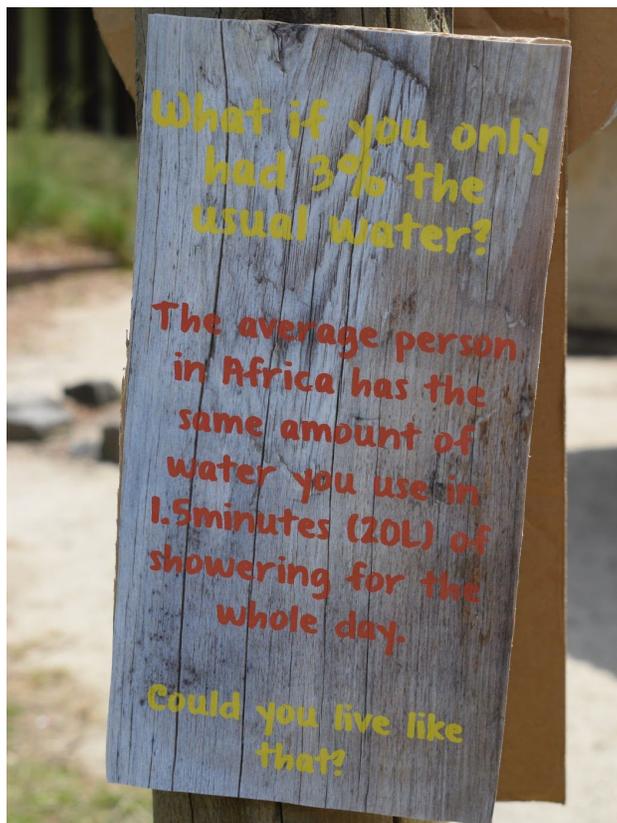
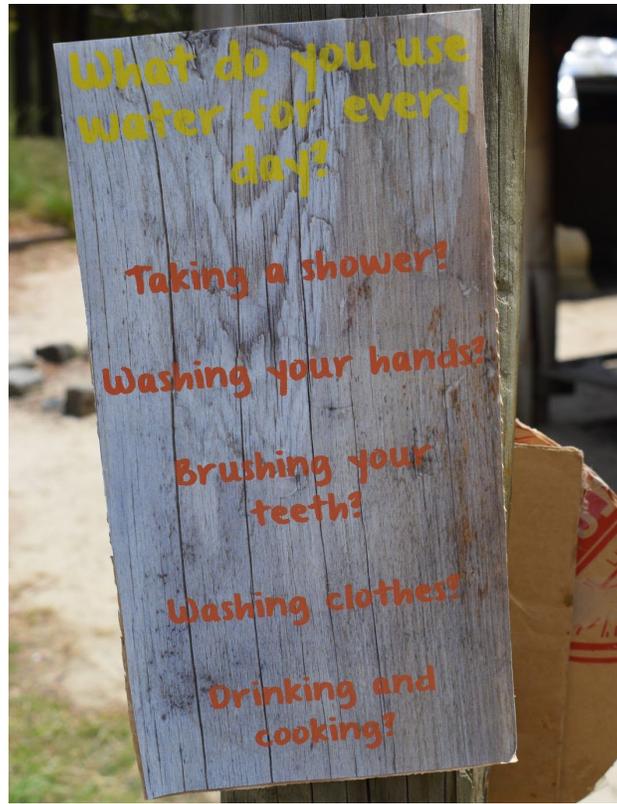
Activity 1: Well Activity

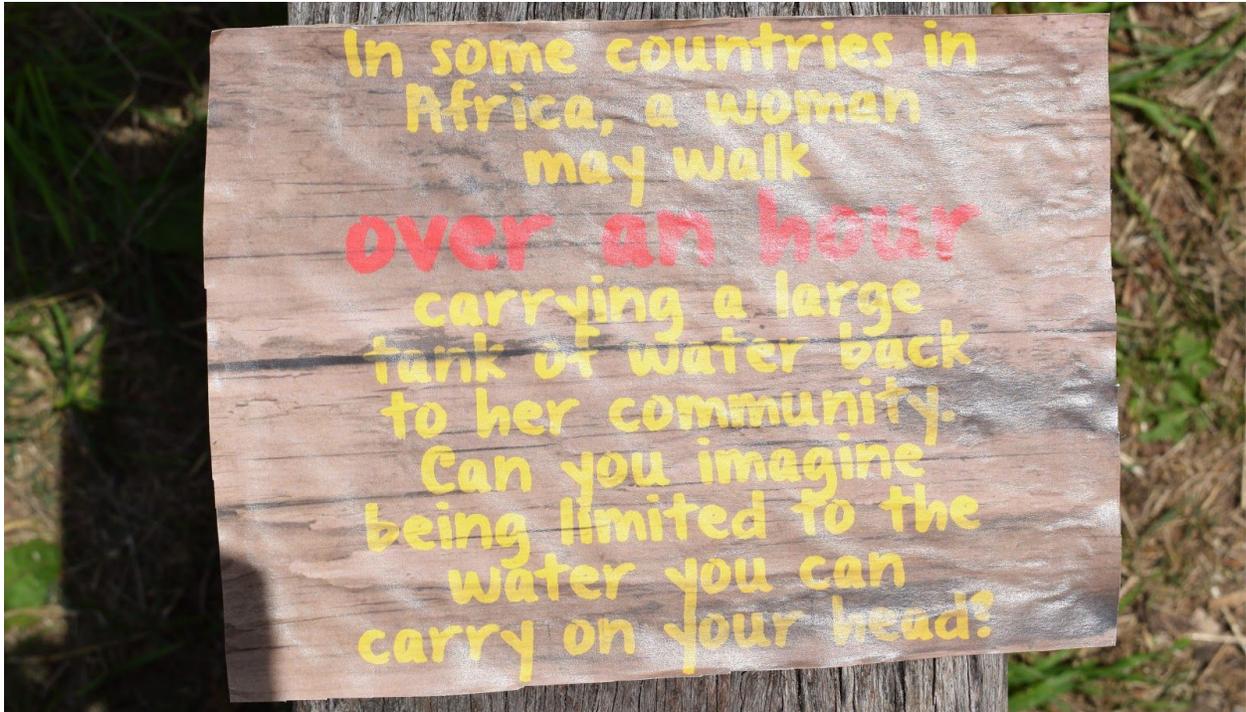




Activity 2: Beads Activity





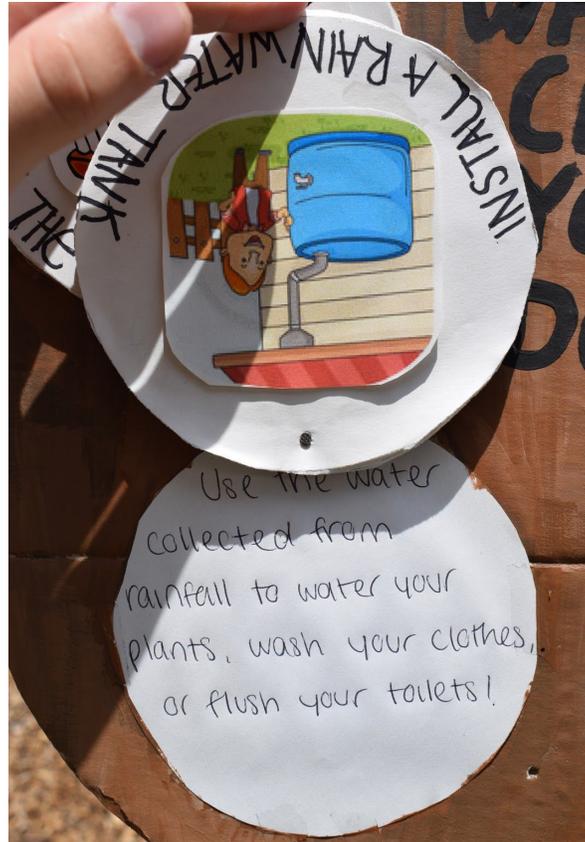


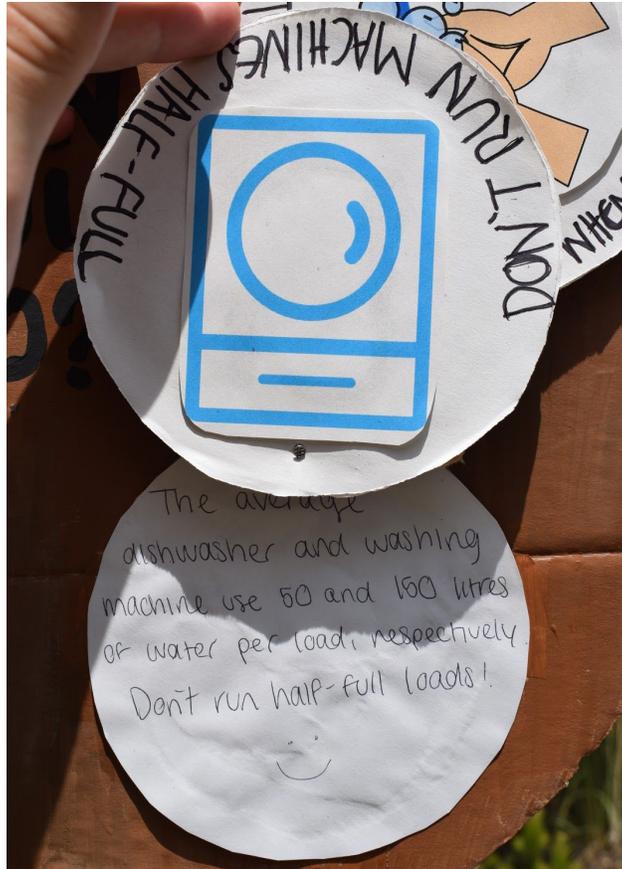
Signage accompanying beads activity.

Activity 3: "What can you do?"



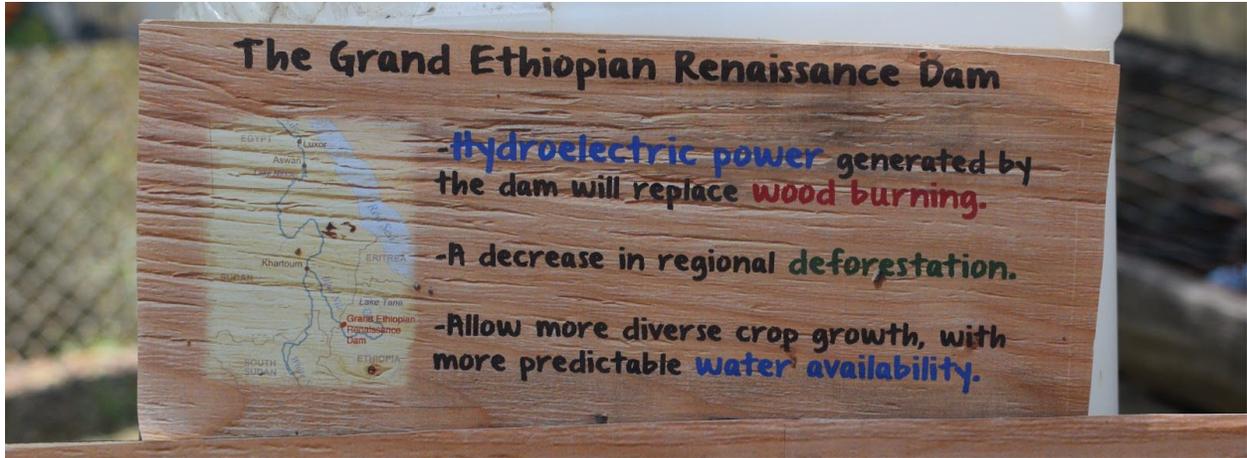






Activity 4: Dam Activity





Activity 5: Harvesting Activity





There has been a 15% decrease in rainfall in Ethiopia since 1980.

Less **rain** means less **crops!**

Can you harvest these Ethiopian crops?



Could you imagine not having enough food to eat everyday?

With **shortening rainfall seasons** in some regions of Africa, there's a lot **less food** available.

Can you imagine going to school without a lunch? Can you imagine not having dinner as well?



Activity 6: Staple Crops of Ethiopia Activity







Supplemental Materials K: Standard Observation Sheet for Prototyping

This chart will be used during the formative evaluation of the prototype village exhibit. Observations will be noted of the visitor's interactions with the exhibit in terms of the usability of the interactive and the emotions elicited during use.

Subject Interest	Total interest	Some interest	Easily distracted	No interest
Prototype usage	No difficulty	Little difficulty	A lot of difficulty	Inoperable
Subject Emotion	Joy	Curiosity	Focus	Anger
	Confusion	Disinterest	Frustration	Fear

Supplemental Materials L: Additional Debriefing Questions for Prototyping

Hello! We are students working with CERES Community Environment Park to educate the public about environmental issues in Africa and Australia through a cultural village exhibit. Could you please answer some questions about the exhibit to help us improve its success?

1. Are there any improvements in general (format, text, display) or related to the activities that you would like to recommend?
2. Did you find the exhibits engaging and interactive?
3. How effectively do you think the exhibit is presenting information?
4. Did the display inspire you or make you think about your lifestyle in anyway?
5. Could you relate to any of the information presented in the exhibit?
6. What do you think are the key messages presented in this exhibit?
7. How old are you and your child?

Supplemental Materials M: Plans and Suggestions for Implementation

General African Village Additions

Planting High Grass (Elephant Grass)

Contact: Horticulture team at Werribee Zoo

Red Clay Path

Contact: Earth Aspects in Hopper's Crossing

Hanging older items in the huts

Contact: KYO in Ocean Grove

www.kyo.net.au

Post with Beads

Contact: BeadWORKS Kenya

Map of Africa

Painting of existing village

Well Activity

Plan:

Using recycled containers and a pulley system of sorts we want to compare the weights of water used by Australians vs. Africans on a daily basis. Because the actual amount of water per day (around 400 liters) is much too heavy to actually lift, the visual volume of the buckets will be as much a comparison as the weight. From what we have researched, an average Australian uses ~17 times as much water as an average person in Africa, and it might be even higher. Using the pre-existing bar across the well in the picture above we will either sand in two channels for the rope, or buy a couple pulleys to hang from just underneath. The pulleys are quicker, but the sanding would be free. On the well, two holes would be drilled for two larger eyehole screws, these would be glued/cemented in place. The eyeholes should be roughly the same diameter as the rope. Weight in the buckets/pails would be cement or rocks that are painted blue. Ideally it would be cement as that would stay in the bucket and be harder to vandalize while the weight stays the same.



After going through the eyeholes, the rope would be knotted with enough length so the buckets can rest on the bottom of the well, this is so the rope is not under constant strain and leaves the buckets out of reach. Rubber could be added to the bottom of the buckets, either inner tubes or shoe soles, so that if the rope was dropped it wouldn't hit too hard to crack the pail. The rope would have two knots, one nearest the eyehole and another about half a meter after at the end of the rope. Both of these knots should be sealed in some way so they can't be unraveled.

Facts we want to get across:

Australians use more water than Africans

What Australians use water for vs. what Africans use water for

Parts:

From CERES supply:

- Bucket (paint cans)
- Cement
- Paint
- Rope

To buy:

- Eyehole screws
- Glue/cementing agent

Timeline

Task	Time Required	People Required	Parts/Tools
<p>Prepping inner tubes. Using the intertubes cut them so they are one long tube, make sure to cut off the metal stem region. Make a loop that is just under the circumference of the bottom of the bucket (buckets will be different sizes) keep looping the tube within that original loop with glue in between each layer. This could take multiple inner tubes for the larger bucket.</p>	10 minutes work + glue drying time.	1-2	Buckets rubber inner tubes glue(weather-proof) Clamps Scissors
<p>Adding tubes to the bucket. Once the glue has dried, drill into the bucket. Using wire wrap the inner tubes so they are snug to the bottom of the bucket in several places. Pulling the wire into the bottom of the bucket and twisting them to stay taught. They will be locked into place later with cement.</p>	20 minutes	1-2	Buckets Drill Wire
<p>Putting Cement into the bucket. Mix cement in a large ~5 gallon bucket. MAKE SURE WE HAVE A PLACE TO PUT UNUSED CEMENT. Carefully weigh the bucket as we add cement, the ratio must stay the same and it can't be too heavy. Pour into both buckets.</p>	45 minutes +Cement curing time	2 people	Buckets Cement Water Mixing stick Trowel (to move cement) Rocks
<p>Knotting the rope. Measure the required length of rope to reach from the bucket on the ground of the well over the frame and to the well wall with a meter extra. Tie a knot several centimeters from the lip of the well and another at the very end of the rope. Don't attach to the bucket yet.</p>	10 minutes	1	Rope Buckets hands
<p>Final attachment for non-prototype. Drill two holes in the bottom of the frame. Drill two holes in the rim of the well. Put an eye hole screw in each hole, make sure they are tight. The eye hole screw on the frame should be larger as they need to allow the rope to move freely and must support the bucket weight. For the well this might work best with some rubber cement in the hole or real cement. Run the ropes through each hole in turn and then tie to the bucket tightly.</p>	25 minutes +rubber cement curing time	1-2	Rope Buckets Drill Eye-hole screws Rubber cement
<p>Final Attachment for prototype. Tie the ropes to the bucket and throw the rope over the frame. This will be harder to pull on each bucket and will wear the rope down.</p>	5 minutes	1 person	Rope Buckets Hands
<p>Create a flip-info thing. Cut pairs of wooden squares. Using the jigsaw and some thin sheet wood. Prototype use cardboard signs- did not make them flip.</p>	20 minutes	1-2	Wood jigsaw
<p>Adding text. With one piece as the top and one as the bottom, put the question or image on the top and the answer or information underneath. Do this using paint. Prototype use paper printouts on cardboard.</p>	1-2 hours + Paint drying time.	1-2	Paint Paintbrushes Printer Paper
<p>Putting together. Drill two holes in the top of each piece, attach four eye hole screws. Using rope/twine attach the top and bottom so they can flip up.</p>	45 minutes	1-2	Eye hole screws Drill Tape

Attaching to the exhibit. Use glue to attach to the side of the well. Make sure it's attached firmly, maybe use rubber cements.	30 minutes +glue drying time.	1-2	Glue Tape
--	-------------------------------------	-----	--------------

Planting Activity

Plan:

Using PVC or some other method of tubing, we will place around 10 tubes in the ground. In a nearby container or bucket, (we used a cardboard box for the prototype) there will be several stalks of assorted plants, these will be either fake or real/similar plants. The prototypes used bamboo stalks that were painted green.



The holes can be hand dug, preferably in a way that makes the land look tilled. This can be done with a shovel and hoe. Unlike an actual tilled field, the dirt should be hard packed in so that it doesn't lose shape too easily.

With the holes and piping in place we'll have a metal bucket of sorts, any recycled material bucket shape should do fine. The stalks could be painted sticks, plants such as Teff, Maise/Corn, Sorghum and Barley. Since many of these plants have thicker ends on the stalks

these could be made by wrapping the ends in cloth and sealing them with glue so they don't unravel, these can then be painted the according color to each plant. For the prototypes, we painted cardboard representations of these crops and taped/glued them to the stalks.

Nearby, possibly on the holding post would be an interactive sign providing more information about each of these crops. In the prototype, we used a wheel to provide this information, where the visitor could spin the wheel to reveal more information of the crop and its usage in Ethiopia, as well as a picture of the plant.

Parts:

- PVC for holes
 - Not very expensive, bunnings or find around the area CERES might have some.
- Sticks
 - We used bamboo sticks.
- Paint and Lacquer
 - Used paint at CERES.
 - Need something to waterproof our designs.
- Wood
 - For the wheel, this will have to be nicer wood, but CERES might have some.
- Post and wire
 - Hopefully CERES has both, or we can use a pre-existing post and add the wire
- Cloth

- Either found around CERES or buying cheap clothing/cloth from an op-shop.

Tools: We'll assume CERES has access to all tools we'll require.

Drill

Wire cutters

Shovel

Hoe

Paint brushes

Task	Time Required	People Required	Parts/Tools
<p>Dig holes and add piping. Straightforward, dig 20-30 holes and put in piping. Cut PVC piping using a pipe cutter, each should be about 20-25 cm, doesn't need to be specific.</p>	2 hours	1-2	Pipe cutter Trowel PVC pipe
<p>Make the plants. Using dowels. Or sticks, use cloth wrappings to wrap one end of the rod object in a way to represent the plant. Could also optionally use real corn stalks. Tear cloth and wrap to build up. Then seal the wrapping so it doesn't come undone. Make more than there are holes. Prototype used bamboo sticks and cardboard.</p>	2 hours	1-2	Sticks Cloth Sealant
<p>Paint the plants.</p>			

Mineral Activity

Plan:

Part of this activity would be to move the current mud-bricking activity that is in place within the village. That section is not aligned with either the fence or the central hut and so it takes up a lot of space in the middle of the ground. If we could move it to the side in line with the fence we could make more room for our mineral activity.

The design is a wooden box with sand in it and painted rocks found in the bottom. These painted rocks represent each mineral. The rocks will be adhered to the bottom of the pit somehow so they aren't stolen removed and thrown around. On the side, or possibly, on the fence behind the activity there will be a flip board for each mineral asking "What is this" Flip it to get some answers on the mineral.

Facts we want to get across:

Children mine these minerals

They are used in cellphones

Recycle your phones

Parts we need:

- Wood
 - CERES should have this
- Nails
 - CERES should have this?
- Rocks
 - The world should have this
- Paint
 - CERES should have this
- Sand
 - We'll either buy this or find at CERES

Tools:

Paint Brushes

Drill/hammer

Timeline

Task	Time Required	People Required	Parts/Tools
Paint Rocks. Using the CERES colors available paint each rock a corresponding color to the mineral it represents. Gold:Gold, Diamond:Blue, Coal:Black, Tantalum:Grey. Paint two sets of rocks	30 minutes	1-2 people	Paint Rocks Paintbrushes
Box. Make a box from wood from treated wood that is rot resistant so we can put it in the ground. Dimensions around 1mx1m and about 30cm deep. Either with hammer and nail or with screws.	45 minutes	1-2	Wood Screws Drill Hammer Nails
Box into ground. Dig a hole in the ground just under 30 cm deep so the box will be slightly raised. Make sure there is a place to put the dirt. Make the whole slightly larger than the box. Place the box in and make sure to pack dirt in around the sides. Put the box against the fence.	1 hour	1-2	Shovel Wheelbarrow The box level
Adding sand and Rocks. Glue the rocks to the bottom of the box. Throw the sand on top	45 minutes +glue drying time	1-2	Sand Rocks
Adding signs. Cut four pairs of wood in squares. Glue the painted rocks on the outside piece. Attach by drilling four holes and using eye hole screws and tying together with twine. Prototype painted pictures of rocks on cardboard, and used cardboard to make flips.	45 minutes +glue drying time	1-2	Rocks Cement/glue Wood Eye Hole screws Drill
Paint the signs. “Can you find these minerals?” On the outside, the name and what it’s used for on the inside.	1-2 hours +paint drying thing	1-2	Paint Paintbrushes Wood
Hang the signs. With the fence behind the box we can hang these informational flips off the chain link using wire. Prototype placed on stakes surrounding box.	30 minutes	1	Wire Signs Wire cutter

Supplemental Materials N: Revisions and Recommendations

11/30 Test with CERES Sponsors and Advisers

12/1 Test with CERES staff and visitors

12/2 Test with CERES visitors

Recommendations for Improvement:

Overall:

- Needs more signage for instructions surrounding each activity
- Needs more signage for more information
- Map of Africa with countries labelled

Well-Exhibit

- Put maps on the inside/ top of the buckets rather than the sides to make them easier to see
- Use jugs or barrels to show how much water 340 litres actually is

“What Can you do?” Water Conservation Sign

- Change circles to raindrops

Dam Exhibit

- Should present some of the negative effects as well
 - Displacing people
 - Damaging the environment
- Need instructions so people are not afraid to move it

Conflict Minerals

- Glue rocks to the bottom of the sandbox
- Need a sign with more information on the specific conflicts

Food waste

- Use plates or something to show a food ratio/ represent how much food is wasted

Harvesting activity

- Need more instructions to clarify what they are supposed to do

Revisions made prior to day two of pilot testing:

Rephrasing

- Rephrase from “Africans” to “people of Africa” in “What can you do?” Water conservation sign

- Rephrase “The average African” to “The average person in Africa” in “What if you only had 3% of the usual water?” sign
- Change “In many countries” to “In some countries”

Typos

- Fixed typo in “among” in conflict mineral
- Fixed typo in “decrease” in food waste sign
- Changed “tons” to “tonnes”
- Add apostrophe in “there’s”
- Fix “liters” to “litres” in well activity
- Change “faucet” to “tap” in water “What can you do?”

Placement

- Switch placement of food waste information sign with the crop-wheel sign
 - Crop wheel should go closer to post, information sign should go near entrance

Additions

- Added sign providing more information on water usage in Australia vs. Africa
- Added sign by the well exhibit to show that this is the ratio, not the amount
- Added sign on harvesting box to say “collect your harvests here”

Supplemental Materials O: Responses to Prototyping Debriefing Questionnaire

This is a synthesis of all responses gathered.

Are there any improvements in general (format, text, display) or related to the activities that you would like to recommend?	A connecting story through the exhibit. Larger animal murals. Water play activities. Plastic grass. Organize related activities better (crops, beads, well, dam).
	No. "The activities are really great."
	The crops should have more information about them/ food scarcity. Don't put maize in the front. We could have a mosaic map to fit into CERES and invite people in/ get people to come around the corner.
	Use "litres," make harvest box more evident, remove water in well
	Loved digging in sand pit, have done similar things and could spend hours digging
	Referring to dam: have similar (but bigger) thing next to the children's hospital. child loves to get into everything and is very hands on
	No, it was great.
	Make signage more clear. Make sure the dam is functioning properly.
	More obvious barriers between villages.
	More directions (bead and harvesting activities). Include a tiered "What can you do?"
	Bigger. Make harvesting instructions stand out.
	Further development of water activities. Sandbox was a great activity. Add digger to sandbox. Use of plastic grass.
	Clarify the regions that you are talking about. (Maps)
	Beads were more related to the well. Make it well to beads to "what can you do?"
	Establish a boundary between Indian and African villages.
	"We just liked it."
	Story to guide through. Curious about infrastructure.
Make animals bigger. Tried to take the bucket.	
Did you find the exhibits engaging and interactive?	Yes: 21 No: 0
	"Cute little display dam."
	Good amount of info
	Water usage
	Crops

	Water, dam, visuals.
How effectively do you think the exhibit is presenting information?	Appropriate amount of info. Grade 3 literacy. Good.
	"It's really good." (She has) a four year old who would want to know more and would ask a lot of questions.. Why Ethiopia? Why don't they have food?" Suggests map of Africa with the countries labeled.
	Very effective. The activities are simple and hands-on. They show basic things that we forget about that are related to us too.
	Would like to see a reflection portion, like what they do when teaching in the villages
	Really good for parents and older children
	Interactive- while he is playing, we can read the information to him
	Well is less engaging.
	Really well.
	Good. Should add more artifacts, photographs, and things that make it feel like an actual home in a village.
	Quite clear, not overly complicated.
	Pretty effective, especially the water activities.
	Good.
	Very effective.
	Good amount of information.
	Literally level grade 3.
	Nothing had too much info.
	Good.
Very.	
Did the display inspire you or make you think about your lifestyle in any way? How come?	"Yes" (without explanation): 7
	Water usage (Bead).
	Comparing how much water she uses vs the average Australian. "I don't think I use that much but I probably do." She owns above the average mobile phones, so could relate to that.
	Gives good picture of how we live here and how luxurious we have it
	It would, especially if stronger connections were made. For example, asking "What's in your phone?" in conflict minerals.
	Water waste and usage.
	No. Has been to Ethiopia recently, so was already exposed to these issues.
	Start simple, but go further. Should include tiered examples of change.

	Sees potential for this to happen for people who haven't been exposed to it.
	Water usage. Thought about sustainability regarding phones. Made person proud of her choices.
	Water usage, beads.
	Already have worked with.
	Water usage.
Could you relate to any of the information presented in the exhibit?	Water. From Zambia
	Particularly the water activities, we throw in so many washes for the kids and take long showers.
	Yes- especially the water and mineral exhibits.
	Yes, good link between activities and information.
	Definitely the minerals station- where our resources come from and how they impact other communities, the poor working conditions that exist, etc.
	Yes- definitely thinking about how much we use.
	Yes, all of it was eye opening.
	Yes, but it could be stronger. Have 3 stages in a defined route. Pose a question and introduce the topic, give information about it, and then show what you can do.
	Yes, especially the decrease in rainfall, recycling old mobile phones. (Had been to Ethiopia).
	Yes, not everyone grows food.
	Yes.
	Yes, especially the water usage.
	Yes, especially the phone exhibit.
	Water.
	From Zambia.
	Have smart appliances.
	Yes.
What do you think are the key messages presented in this exhibit?	Africa gets by on a lot less. Conservation.
	"We have it so good" We should be more thoughtful about how we use our resources.

	Does a good job comparing Australia and Africa-- the things we take for granted.
	Uneven resources, directly relate to life (phone), value what you've got
	Water waste, the lack of empathy for other countries and cultures. Children think their experiences are the same that everyone has, so it's important to show these differences.
	Understanding livelihoods in Africa and how they are affected and how they affect the environment
	How wasteful we are, how we have very little understanding we have about water waste and we need to take care about how much water we use.
	Consumption patterns and differences. We need to reduce our water usage.
	Decrease in rainfall and water.
	The resources we use, and uneven resource distribution.
	Differences in resource use and access, social justices.
	Don't waste water.
	There are things we can do. "We can be the change."
	Sustainability and world awareness
	Excessive use of water.
	Conservation. Not great for city kids.
	Africa gets by on a lot less. Crops were fun.
	Being more conscious about water and food waste.
How old are you and your child?	29, 32
	18 months (child), 37
	37
	2.5 (child), 32
	16 months (child), 32
	4, 40
	47, 73
	61, 71
	30
	24
	21, 22
	20, 22

	33, 2.5
	4, 7
	24, 32
	33, 34
Other Notes:	<p>Child loved the beads, dam, and sandbox. Kept playing with the bead station while the mom was actually using it, kept spinning the circles for the water activity while the mom was going through and reading them, then letting him spin them down. We showed the dam like three times because the child loved playing in the water/ picking up the dam and watching it all rush out. Got to the sandbox and another child was sitting playing with the rocks, but he still played in the sand and the mom was interested in the signage.</p> <p>About the conflict minerals: "It's like a treasure hunt"</p> <p>About bead activity: "Does the washing machine really use 150 litres?" while her child was lifting the buckets out of the well.</p> <p>Don't say faucet here... say tap!</p> <p>Drinking water on beads needs to be more clear. (Only drink 2 litres of water each day, but the 10 litres represents drinking, cooking, and cleaning.)</p> <p>Children like playing with the water in the dam. Table should be shorter so they can reach and maybe bigger for them to crawl on/ through</p> <p>At conflict minerals: "you've got to find stuff, its like a treasure hunt" while one kid is digging and one is playing with the flip charts- throwing rocks in the mudbrick area, taking all of the small rocks out excitedly even though they aren't anything.</p> <p>Going in hut: "it echos" and sat down in it for a while. We should include information about mudbrick huts in African villages or about CERES (using cans for roof)</p> <p>Crops: Mom understood it better and told child what to do, child not really putting them in the box- young kid tries to put it in well.</p> <p>Child is loving the crops- picking them up and trying to put them back in the ground, in the bucket, and is carrying them around. Crops should be cut smaller to make it easier for small kids and the spikes on the side should be cut off because the kid was waving it close to his face.</p> <p>Mom is reading all of the signs to the child at each exhibit.</p> <p>At well: "That's a bit of an eye opener."</p> <p>Asked about dam's effects on the environment. Didn't see the flip board on the minerals section at first. The kid was usually more joyful than the mom, who was more curious and reading more. They didn't harvest the crops.</p> <p>Really liked the bucket activity, liked the dam activity as well but less so.</p> <p>Lower table for the dam. Lower beads. Crop got stuck. Kid took rock and tossed it in the dirt. Point out how many rocks are there. Tossed sand out of the box. Showed curiosity about hut and village centre. "Crops go in the well?". Parent interested in well description while kids were playing. Didn't notice rotating sign. "What's teff?". Crops became weapons. Adults broke the spinwheel (unguided). Put a 'spin here' sign on spinwheel. Parents walk kids through. Couldn't figure out the diamond. Dam was hard to turn on. Kids kept drinking the water from the dam. Wasn't sure of what to do in the dam activity.</p> <p>Headed into the hut first. Checked out the sweat lodge. Walked around and didn't touch anything, Went into storage closet. "What's a mineral?". Sanitation. Kenya sand-dam.</p>

	Showed curiosity. Read signs more than interacted, maybe because they were adults and didn't have kids. People at the market don't usually want to walk all the way to the village.
--	---

Supplemental Materials P: Additional References

- Allen, S., and Gutwill, J. (2004). Designing science museum exhibits with multiple interactive features: Five common pitfalls. *Curator*, 47(2), 199-212.
- Ballantyne, R. (2004). Young students' conceptions of the marine environment and their role in the development of aquaria exhibits. *GeoJournal*, 60(2), 159-163.
- Barriault, C., & Pearson, D. (2010). Assessing Exhibits for Learning in Science Centers: A Practical Tool. *Visitor Studies*, 13(1), 90-106. doi:10.1080/10645571003618824
- Bourke, L. (2015). Australia's carbon emissions jump in 2015. Retrieved October 06, 2016, from <http://www.smh.com.au/federal-politics/political-news/australias-carbon-emissions-jump-in-2015--20151225-glv017.html>
- Bulkeley, H. (2000). Common knowledge? Public understanding of climate change in Newcastle, Australia. *Public Understanding of Science*, 9. Retrieved September 14, 2016, from <http://www.res.ku.edu/~crgc/NSFWorkshop/Readings/Common Knowledge.pdf>
- Bukowski, A., Griffin, C., McLoughlin, G., Teixeira, J. (2016). Developing an Exhibit to Promote Cultural and Environmental Awareness in CERES's Cultural Village (Undergraduate Interactive Qualifying Project No. E-project-050116-214836). Retrieved from Worcester Polytechnic Institute Electronic Projects Collection: <https://web.wpi.edu/Pubs/E-project/Available/E-project-050116-214836/>
- Callanan, M., Cervantes, C., Loomis, M. (2011). "Informal Learning" *WIREs Cogn Sci*, 2: 646–655. doi:10.1002/wcs.143
- Centre for Education and Research in Environmental Strategies. (2015). Annual report 2014-2015 (Annual Report. Victoria, Australia)
- Centre for Education and Research in Environmental Strategies. (2016). Welcome to CERES. Retrieved September 13, 2016, from <http://ceres.org.au/about/>
- Centre for Education and Research in Environmental Strategies. (2015). Annual information statement 2015 (Annual Information Statement No. 60133437610). Victoria, Australia: Australian Charities and Not-for-profits Commission.
- Centre for Education and Research in Environmental Strategies. CERES Community Environment Park 2016. Retrieved from www.ceres.org.au
- Centre for Education and Research in Environmental Strategies. (2014) CERES Environmental Management Plan (EMP). Retrieved from http://ceres.org.au/wp-content/uploads/2015/07/EMP_Aug_2014_web.pdf

- Centre for Education and Research in Environmental Strategies. (2015). Financial report for the year ended 30th June 2015 (Annual Financial Report No. 60133437610). Victoria, Australia: Australian Charities and Not-for-profits Commission.
- Devlin, J. (June 2014). "Is Water Scarcity Dampening Growth Prospects in the Middle East and North Africa?" Brookings. Retrieved from <https://www.brookings.edu/opinions/is-water-scarcity-dampening-growth-prospects-in-the-middle-east-and-north-africa/>
- Escape the Winter Chill by Exploring Trees Inside and Out at Please Touch Museum in Philadelphia. (2010). Health & Medicine Week, 3955.
- Elmahdi, A., Hardy, M. (2015). "The Role of Water in Australia's Uncertain Future". The Conversation. Retrieved from <https://theconversation.com/the-role-of-water-in-australias-uncertain-future-45366>
- Exploratorium. (2016) Fostering Active Prolonged Engagement: The Art of Creating APE Exhibits. http://www.exploratorium.edu/vre/ape/ape_intro.html
- Falk, H., Dierking, D., & Foutz, S. (2007). In principle, in practice: Museums as learning institutions. Lanham: AltaMira Press.
- Lovgren, S. "Global Warming May Unleash "Sand Seas" in Africa, Model Shows." National Geographic. National Geographic Society, 29 June 2005. Web. 25 Sept. 2016
- Manhattan Museum Brings Environmental Exhibit to Children (1993). World Wastes, 36(9), 54.
- Muttarak, R., and Lutz, W., (2014). Is Education a Key to Reducing Vulnerability to Natural Disasters and Hence Unavoidable Climate Change? Ecology and Society 19(1): 42.
- Rennie, J., and McClafferty, P. (1993). Learning in science centres and science museums: A review of recent studies. Research in Science Education, 23(1), 351.
- Schlenker, W., and Lobell, D. B. (2010). Robust negative impacts of climate change on african agriculture. Environmental Research Letters, 5(1), 014010. doi:10.1088/1748-9326/5/1/014010
- Semenza, C., Hall, E., Wilson, J., Bontempo, D., Sailor, J., & George, A. (2008). Public Perception of Climate Change. American Journal of Preventive Medicine, 35(5), 479-487. doi:10.1016/j.amepre.2008.08.020
- Stoner, C., and Russell-Chapin, L.. "Creating a Culture of Diversity Management: Moving from Awareness to Action." Business Forum 22.2 (1997): 6-12. ProQuest. Web. 26 Sep. 2016.

- The Philadelphia-Camden Informal Science Education Collaborative (PISEC). (1998). Family Learning in Museums: The PISEC Perspective. Philadelphia, PA: The National Science Foundation.
- The World Bank. (2016). <http://www.worldbank.org>
- Thomas et al., 2005 D.S.G. Thomas, M. Knight, G.F.S. Wiggs “Remobilization of southern African desert dunes by twenty-first century global warming” *Nature*, 435 (2005), pp. 1218–1221
- Tropp, H., Falkenmark, M., & Lundqvist, J. (2006). Water Governance Challenges: Managing Competition and Scarcity for Hunger and Poverty Reduction and Environmental Sustainability. Human Development Report 2006, Water for Human Development. Retrieved September 25, 2016, from <http://hdr.undp.org/sites/default/files/siwi.pdf>
- Tucker, M., Bricker, J., & Huerta, A. (2011). An approach to measuring the impact and effectiveness of educational science exhibits. *Journal of Applied Communications*, 95(2), 6+.