

National Science Content Standards:

E: Science and Technology

F: Science in Personal and Social Perspectives

G: History and Nature of Science

ACTIVITY: FIND A PROBLEM, DESIGN A SOLUTION

OBJECTIVE:

To introduce students to the concept of humanitarian design as a means of producing innovative and effective solutions to community needs, whether they be social, physical, health-related, safety, or educational. To enable students to think of their own creativity as a tool for good. To demonstrate how successful products for the developing world are collaborative efforts between communities and designers. To encourage cooperative problem-solving.

DESCRIPTION:

After reading the background information, students will read about several actual inventions or designs. They will form community councils and decide which design would best alleviate their community's most pressing problems, which they will identify based upon the background reading. Students will present their chosen design and an argument on its behalf to the class.

In the optional **Extension Activity**, students will identify a community need that they believe is NOT met by the listed products/systems, or could be better solved with another product or system. They will then cooperatively design a solution, preferably using local materials and labor.

If you were a designer, what solution would you create?

INSTRUCTIONS:

In the first part of this activity you will go through the process of selecting a product for your community. In the optional extension activity, you will design that product.

1. **Form small village councils** of four or five people. Councils will represent different villages, but your villages will share the same background, and therefore the same issues.
2. Read the following background, review the options as a group, and then follow the next steps below.

BACKGROUND:

You live in a small village in the Makueni District of the Ukambani region in South Eastern, Kenya. Your people are the Akamba tribe, the fourth largest ethnic community in Kenya.

Your village has gone through some hard times. It has suffered a great deal from recent droughts, or extended dry periods. Temperatures can be as high as 40 degrees Celsius



(104 degrees Fahrenheit), and rainfall has been unpredictable and inadequate for healthy crops and filling watering holes. Farmers in your village grow mostly maize (a type of corn) - which unfortunately does not fare well in droughts - but also millet, sweet potatoes, pumpkin, beans, cassava, yams and other vegetables. Most families have their own small garden plots which women traditionally manage, supplying much of the food their families eat. (Large plantations within 100 miles grow sugarcane, coffee, and tea.) Many villagers are also pastoralists, herding goats especially and sometimes cows.

Most homes have cooking fires inside their main room, which causes a lot of smoke and therefore respiratory (breathing) problems for children and adults. Women who suffer from acute asthma have trouble working their gardens, and children who likewise suffer cannot easily walk the long journeys to school or to fetch water. Virtually no homes here have indoor plumbing (the local health center has a toilet) and most people use uncovered latrines (outdoor pits) or outhouses for human waste.

The regional river, the Athi, has almost completely dried up, so have its small tributaries, or streams. The local pond, shared by several villages, is no longer stream-fed, but rather fills during the rainy season. Rain can fall very heavily during the rainy seasons from March to May and November to December but the amount of rainfall varies year to year and recently has been far too little to keep streams running and water holes full. Local deforestation (the over-cutting down of trees) for cooking fires and other building purposes has caused widespread erosion and hurt the ground's ability to retain water, so increasingly rain does not make it to the underground water table.

The local pond has very little water left, and the water quality is never dependable – often contaminated by the many roaming animals, or improper discarding of garbage. Several years ago, an AID organization dug a borehole, a deep well, with a solar-powered pump to access the underground water. Unfortunately, there was no money available for repairs and when the pump failed, it was not fixed. Then, thieves stole the solar panel so the pump no longer has a power source to remove the water. The small amount of remaining water sitting in the well became fetid, and a breeding ground for mosquitoes and other pests.

Of course the villagers need clean water, for drinking, cooking, cleaning, watering the crops, and the livestock. The burden falls mostly upon the village girls to retrieve it. There is a small spring about 12 kilometers away (about 7 miles) and a well almost 8 kilometers beyond that. The well is fairly clean, but people come from miles around and the water level is getting low. Also, since so many people need water, the wait is very long and girls can be bullied out of their place in line. The spring can be smelly and brown, but it is closer! Girls trudge for miles carrying water. It is often a happy social time, but can be exhausting and unsafe. Trucks drive at high speeds, sometimes there are thorns, rocks or even broken glass on the road, and occasionally wild animals are on the prowl. It is unsafe for girls to walk home in the dark. The water is usually carried on the head or on the hip in five gallon containers, often causing injuries.

For further information on Kenya and/or this region in particular, explore the following links:

<http://allafrica.com/stories/201107130539.html>

<http://softkenya.com/county/makueni-county/>

<http://www.telegraph.co.uk/news/telegraphchristmasappeal/6720175/Charity-appeal-bringing-water-to-Kenya-drought-ridden-valleys.html>

http://www.unep.org/dewa/africa/kenyaatlas/PDF/KenyaAtlas_Chapter2.pdf

NEXT STEPS:

Your council has an opportunity to work with an organization that will design and donate something to help your village. How can you best help your suffering village? What design/product would you choose to help solve some of your people's problems? Read the following invention descriptions then follow the instructions below.

INVENTION OPTIONS: (The following are real inventions, designed to alleviate real problems.)

1. **A mobile phone charger** that is powered by a bicycle. Most people in Kenya do not have electricity but many have mobile phones they can't easily charge. Now they can charge a cell phone by riding a bike! Bernard Kiwia, an electrician and school teacher, worked with the organization Global Cycle Solutions to design a phone charger made from old bike and radio parts.
2. **A Hippo-Roller**. A plastic heat-resistant container in the shape of a wheel that can be filled with 20 gallons of water and pushed or pulled by a metal handle. Designed by Pettie Petzer & Johan Jonker and improved by Imvubu Projects and Project H, the Hippo Water Roller can push or pull water over long distances and rough terrain, eliminating injuries from carrying water and making transportation of larger volumes of water possible.
3. **Sugarcane or corn cob charcoal**. Charcoal made from the waste product fibers remaining after juice has been squeezed from sugar cane, or from the cobs and stalks of corn. Burns more cleanly than wood. This bio-mass charcoal was designed by students and MIT Professor Amy Smith at MIT's D-Lab in 2004. Using sugarcane coal reduces the number of trees cut down for firewood and reduces the carbon released in the air when heating and cooking.
4. **Rain catchment systems**. Containers collect the rain that hits the ground and evaporates, overflows latrines, or floods leaky houses. Water running off metal roofs is collected in large cisterns that are strategically placed collect water. When possible, a series of pipes or tubing direct this water to gardens, animal troughs, or home use. (Rain water harvesting has been around for centuries, but newer systems have been developed more recently.)

HOLD A VILLAGE COUNCIL MEETING AND FOLLOW THE STEPS BELOW:

- **Review** your village's story as a group.
- **Identify** your village's problems with a highlighter and then make a list of the problems.
- **Review** the invention options together as a group.
- **Discuss and decide** among your council which is the most pressing problem and which design provides the best solution. (You may research more about each product if you have time and resources. See below for helpful questions about each product and links for further research.)
- **Ask yourselves:**
 - How would the design help you and your community? Who specifically would it help?
 - Might it create more problems?
 - How would you determine who gets to use the product and when?

- What would your villagers do with the product when it breaks or reaches the end of its usable life?
- **Once your council has chosen the “solution”, write the name of the design on a sheet of paper. Answer** the above questions and present your argument to the class. If possible, create a persuasive PowerPoint presentation that highlights your community’s needs, your group’s choice of most pressing need, the solution your group has selected and the reasons supporting that choice.

EXTENSION: Design Your Own Solution. In the same group, become a creative council. Envision a product, device or system that will alleviate a source of suffering or challenge for your village. The product might already be invented and in existence, or create your own!

Remember to answer the following questions in the process:

- **How** will this help?
- **Who** will this help?
- Can we easily find the materials to create this product?
- If it is a product that already exists, is the manufacturing process environmentally friendly or does it create a lot of waste and pollution?
- Can the product be fixed if broken (is anyone trained to repair it?)?
- What are the ongoing costs required to keep the product working? Where will that money come from?
- When it reaches the end of its useful life, can it be recycled? Upcycled (repurposed)?

During the brainstorming process, teachers can decide whether or not to share the below information with their class once they have begun their discussions.

Further information and helpful questions for reviewing products/designs.

1. **Bike-powered phone charger.** Ideas: Could girls use phones if they are in danger or can’t make it home before nightfall. Could they ride bikes to fetch water? (i.e. hitching up a wagon or basket?) Does the village have bikes that could be shared? Although the charger is made from easily attainable parts, is there someone trained to fix them when they break? Will they get stolen?

Research the bike-powered phone charger and designer by exploring the following:
<http://vimeo.com/37753889>; http://www.youtube.com/watch?v=0_1plfSx-GQ;
<http://www.designother90.org/cities/solutions/bicycle-phone-charger>

2. **Hippo Roller.** Could this device make it easier for girls, women and others to carry water long distances? Could this device prevent painful ailments from carrying heavy water jugs on heads and backs? Would all village households receive a roller? What if the journey to the water source is up-hill or rocky – will this product work? Can small girls (10-years-old) manage this device?

Research the Hippo Roller and designer by reading exploring the following:
<http://www.hipporoller.org/>; <http://www.graham.umich.edu/pdf/dow-hippo.pdf>;
<http://www.projecthdesign.org/>; <http://www.treehugger.com/treehugger-radio/emily-pilloton-discusses-the-hippo-roller-and-other-designs-for-humanity-part-one.html>

3. **Bio-mass charcoal.** Could this product prevent people from cutting down so many trees, therefore helping the erosion problem, and improving the soil? Could this fuel

decrease the sicknesses related to smoke inhalation? (This charcoal makes smoke too, is it cleaner than wood?) Is this product simple enough to create? Are the ingredients easily found? Are there tools or equipment needed to make this? Will making this product create more waste or is it using materials that would otherwise be thrown away?

Research bio-mass charcoal by reviewing this article: <http://cads-cdsa.org/local-projects/congo-development-initiative/corn-waste-charcoal-briquettes/Corn%20cob%20charcoal%20info>

Also see: <http://other90.cooperhewitt.org/design/sugarcane-charcoal>.

4. **Rainwater catchment system.** Would this enable villagers to store or “harvest” water that might otherwise evaporate or be wasted as run-off? Could this decrease the number of times villagers would have to retrieve water from far-away sources? Would this prevent villagers from using contaminated surface water sources (ponds, water holes) that are used by animals and buckets that carry pollutants? How much would these cost to maintain? Could the village use one large cistern, or could each villager receive a smaller household-size system? What if the corrugated roof metal has lead in it, will the water become contaminated? Will this product work if the villagers have thatch roofs, not metal? What if the water in the container becomes polluted or dries up, and can this be prevented? Does enough rain come often enough to make these an effective tool in supplying water to the community?

Research rainwater catchment systems by exploring any of the following links:

<http://www.unep.org/gc/gcss-viii/Kenya-IWRM.pdf>

<http://www.lboro.ac.uk/well/resources/fact-sheets/fact-sheets-htm/drh.htm>

<http://www.amshaafrica.org/component/content/article/115.html>

<http://www.kwaho.org/t-rain-harvest.html>