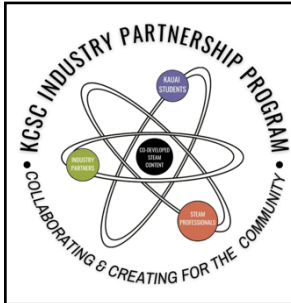
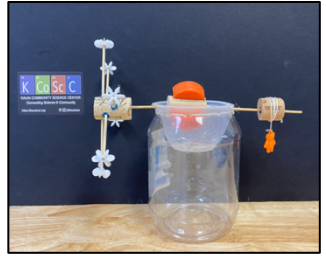


SO MUCH POTENTIAL!

Created by KCSC Interns in the KCSC Industry Partnership Program



KCSC Student Interns, staff, and a team of professionals will meet over the course of the school year to co-develop STEAM content (activities, exhibits and events) directly related to KIUC's West Kauai Energy Project, WKEP, the first ever Solar + Pumped Storage Hydro Project to move Kaua'i beyond 80% renewable energy generation and meet more than 25% of its electricity needs. This activity is the first example of a STEAM content that the students have developed. It speaks to the potential energy of water and hydropower which are both important concepts related to the WKEP. We hope you enjoy it! Learn more here, <https://kauaicsc.org/kcsc-industry-partnership>

THE BIG IDEA

The water wheel converts the potential energy of water into kinetic energy, the energy of motion.

KEY WORDS potential energy, kinetic energy, physics, hydroelectric, renewable energy

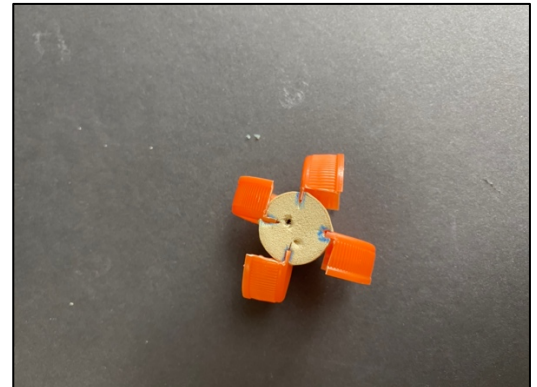
MATERIALS

- Recycled plastic jar (spaghetti sauce/mayonnaise) or bottle with a cylindrical shape
- Recycled fruit cup bowl with a hole in it
- 2 Gatorade caps cut in half – 4 pieces.
- 3 corks cut into pieces
- One long skewer
- 3 shorter skewers, each with a bead glued to one end
- 3 beads
- ~8 inches of string
- 1 larger size bead

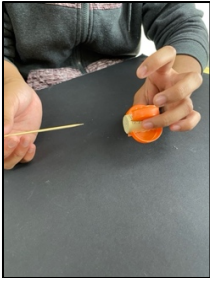
Other materials you will need: Something to hold water to pour onto your water wheel.

METHODS:

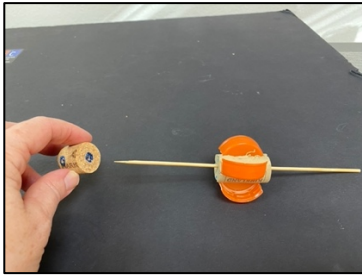
1. Set the smaller recycled fruit cup container into the larger plastic container so that the slots in both sides match up.
2. Put the 4 pre-cut bottle caps into the cork that has pre-cut slits on the edges to complete the water wheel component.



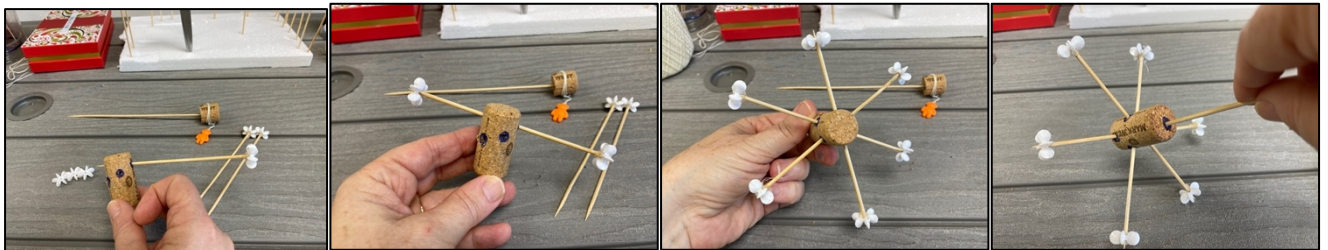
- Slide the water wheel onto the longest skewer through the pre-made hole in the middle of the water wheel cork. Position it in about the middle of the skewer.



- Attach the cork piece that has just one hole through the middle on to one end of the skewer.



- Attach the larger bead to the end of the string provided.
- Tie the string around the cork that you attached to the skewer
- Take other cork with multiple pre-drilled holes and slide the pointed end through the sides of the cork so that the three short skewers with a bead on one end form a “star” around the cork.



- Add the additional 3 beads to the pointy end of the skewer, be careful the point is sharp.
- Slide that cork with the “star” onto the other end of the skewer.
- Take your completed skewer with the water wheel and both end attachments and position it so that it sits in the slits of the two plastic jars.
- You are ready to pour some water on it and see what happens!

Please share pictures of your creations and tag us on Instagram & Facebook.

Check out the KCSC Linktree to keep up with KCSC events & activities.



<https://linktr.ee/kauaicommunitysciencecenter>

DISCUSSION:

You just generated hydropower using the water! Gravity pulls water down toward the earth, and the weight of the water exerts a rotational force on the water wheel. This rotational force provides enough energy to turn the skewer, allowing you to raise items attached to the other cork and make the “windmill” turn around too. More energy is needed to lift heavy items than lighter ones, and by increasing the flow of water you can generate more power. Here are some more things to consider...

- What happens when you stop pouring the water?
- How fast does your object raise?
- If you had a different shaped pedal on the wheel, would it move faster?
- Try attaching a heavier object to lift, did you need more or less water pressure was needed to lift a heavier object? Why?
- If you compare this to lifting a pencil or lifting a full bag of groceries, what do you have to do when you lift the bag of groceries compared to a single pencil?

HYDROPOWER

Hydropower is used as a source of electricity in the United States. Using the same concepts from your experiment, water wheels capture the force of flowing water in rivers and streams, converting it into electricity and sending it into the electrical grid. Hydropower is an example of **renewable energy**, energy that can be continually replenished and uses renewable resources like water to create energy.

Do you know that our utility cooperative on Kauai, Kauai Island Utility Cooperative, KIUC, is a leader in renewable energy production in the country and around the world! KIUC also has hydropower is one of the renewable energy production methods that. Can you name some other types of renewable energy production you might have seen around Kauai and even may have at your house?

FUN FACTS

- Hydropower is one of the oldest forms of energy and has been used by humans since 4000BC
- Water has potential energy due to position above the ground. The higher above the ground the water is, the more potential energy it has.
- There are several forms of potential energy including gravitational, magnetic, electrical, chemical, and elastic potential energy.



KCSC CLIMATE CONNECT: KIUC, Kauai Island Utility Cooperative is leading the way in renewable energy production. This makes a big impact on our climate as KIUC has dramatically reduced the amount of fossil fuels used to power Kauai. Right now, KIUC has 4 hydropower generating systems, 10 solar power generating systems and 1 biomass energy plant that currently provide 67% of Kauai's energy needs and during most sunny days that goes up to 100% renewable power generation. On Kauai we are part of improving the environment everyday thanks to KIUC and their renewable energy production systems.

KIUC's WEST KAUAI ENERGY PROJECT, WKEP

This is a general overview of the West Kauai Energy Project, that will get Kauai to the goal of 100% renewable energy using solar and hydroelectric power.



If you look at the map on the left, we start at the top right of the map, where the water flows from the intakes down to the Puu Lua reservoir.

At the Puu Moe Divide, a structure will be built to regulate the water that flows from the first reservoir, through the upper penstock and through the Puu Opae powerhouse and reservoir.

During the day, the water then continues its journey through the lower penstock and flows down to the Mana powerhouse and reservoir and is pumped back up to Pu'u Opae using the solar power from the BESS, which stands Battery Energy Storage System.

At night, water from the Pu'u Opae reservoir is released and travels through the generators to produce power that is then sent to the grid. The energy storage capabilities from the reservoirs and BESS, plus the hydropower from the ditches and water flow, will help Kaua'i provide power regardless of whether it is daytime or night, sunny or rainy. As the island progresses toward 100 % renewable energy, the WKEP's capabilities provide an important reliability component for Kaua'i.

You can also learn more on WKEP website, <https://www.westkauaienergyproject.com/>

Main Project Components

- Existing Kōke'e Ditch Irrigation System repairs and upgrades
- Existing reservoirs rehabilitation
- New storage tank at DHHL Pu'u 'Ōpae pastoral lots
- Two (2) new sections of buried pipeline
- Two (2) new hydroelectric powerhouses
- New Pu'u Moe regulating structure
- New solar array and battery
- New electric substations
- Improved access roads

