Biomimicry water capture

by Lyla Thomas and Marjorie Mendez

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Abstract

For our engineering project we took inspiration from desert life to make a rainwater capture device. We wanted our product to be made with items accessible to everybody and easy to make. Using inspiration from the desert agave we used long pointed leaves arranged in a rosette shape to execute our design, we also used a scale inspired design to catch stray drops. Our project proved to be successful and our design captured half a cup more water than a bucket by itself. Our invention is affordable and easy to make and if produced on a large scale could help people collect water.

Question

What is the most cost efficient design to capture water using easy to find materials and desert-inspired biomimicry?

Purpose Statement

The purpose of this project was to create an easily accessible way for people to capture rainwater, using biomimicry. We became interested in this concept while learning about biomimicry in school last year. We were learning about desert life using different techniques to capture and store water. We were interested to see if we could make a design that could capture water using those techniques, but still keeping it available for everybody. If we succeed in making a working design, it could be used for people who might not otherwise have a way to access water.

Background Research

Water is one of the most important parts of life; it is essential to all living things on Earth. Water *capture* is what allows plants and many animals to live. Although humans are not specifically adapted to capture water, we can take inspiration from the natural world using biomimicry. In this, we will discuss what biomimicry is, which plants and animals our project is inspired by, and the challenges of implementing biomimicry projects in the real world.

You may be asking yourself, "What is biomimicry?" Biomimicry is the imitation of designs and processes found in nature. Humans can greatly benefit from the designs organisms have refined over hundreds to thousands of years. A great example of biomimicry is Velcro. Velcro was originally invented when a Swiss electrical engineer was walking through the forest with his dog and noticed how xanthium burrs stuck to animal fur and clothes. Under closer inspection, he found that the burr was composed of thousands of tiny hooks. This inspired modern-day Velcro.

Rattlesnake skin, one of our project's inspirations, was recently found by scientists to have an effective water-capture mechanism. They found that water droplets hitting rattlesnake scales break into smaller droplets and tend to stick to the scales better. When looked at under a microscope, scientists found that the scales sported a network of tiny channels. The channels help rattlesnakes become rain buckets.

Background Research

Another desert life form we are using for this project is the agave. The agave is a type of succulent commonly found in the sonoran desert. The agave is excellent at capturing water due to its natural rosette shape. The agave's long pointed leaves spiral into a rosette shape, which funnels water straight to the roots of the plant without wasting water.

Biomimicry is a complicated concept that hasn’t been perfected yet, but scientists and engineers are working hard to make biomimicry the better alternative to other engineering techniques. Biomimicry is a way of using adaptations in nature for new day inventions, however most engineers just aren’t educated in the type of science needed to develop such inventions. The information needed to understand certain concepts in nature might not be common knowledge to most engineers. While biomimicry is used as a way of creating climate conscious innovations the resources needed tend to be expensive and hard to find. Biomimicry isn’t perfect but it's necessary if we plan on making long term fixes to engineering today.

Materials

- Cardboard
- Duct Tape
- Hot glue
- Bubble wrap
- Wax paper
- Plastic sheets
- Round quart-sized tupperware with lid
- Screwdriver
- Cardstock
- Scissors

Procedure

Step 1. Cut out eight, eight inch, plastic agave leaves
Step 2. Cut out eight, eight inch, cardstock agave leaves
Step 3. Covered the paper side of the cardstock agave leaves in wax paper
Step 4. Made fourteen holes in a circle shape in the center of lid
Step 5. Made eight holes on the outer rim of the lid
Step 6. Traced a circle using the rim of the lid on cardboard
Step 7. Traced another circle an inch around the other circle
Step 8. Cut the both circles out, making a donut shape
Step 9. Cover cardboard with wax paper
Step 10. Attach donut shape toe outside of lid using duct tape
Step 11. Using duct tape on the front, taped the sixteen leaves to the outer plastic lid, alternating from paper to plastic, place the paper leaves a little more in, and the plastic leaves a little more out
Step 12. For the paper leaves, taped a three inch by one inch plastic piece on the back to keep it up
Step 13. For the plastic leaves, taped a three inch by one inch plastic piece on the front and back to keep them up
Step 14. Cut out twelve, three and a half inch pieces of plastic in a triangle shape
Step 15. Taped the small triangles in a circle on the lid inside the circle of larger leaves
Step 16. Attached 8 pieces of bubble wrap to the back of leaves and outside of cardboard loop using hot glue, each bubble wrap piece should be eight and a half by three and a half inches, the pieces will overlap
Step 17. Attach lid to container
Step 18. Set outside
Step 19. Done

Results/Data

Using our creation, we captured half a cup more of water than just a bucket.

Prototype

Bucket

Results/Data

Something we would improve on, on next designs, is using plastic for all the leaves instead of paper. The paper absorbed water, meaning we could have captured more water, if we'd had enough plastic.

Before Pouring Water

After Pouring Water

Lab Notes

While testing our prototype we noticed that after about 10 seconds the cardstock began to wrinkle and fold, the wax paper hadn't provided as much protection as we had hopes and thus absorbed a bit of water. If we were to improve our design we would only use plastic sheets rather than paper and plastic.

Conclusion

Our prototype ended up doing exactly what we wanted to. Using a rattlesnake skin and agave leaf design, we ended up capturing a half cup more of water. The agave leaf design especially helped funnel the water to the bucket. Our prototype did meet our criteria, we made a design spending under $20 and captured more water, then just setting out a bucket. Our process of testing this design was not perfect and the environment was not well controlled. We were outside with a hose on the shower setting, sparing the design in a clockwise manner to replicate rain. In many ways human error or weather could have swayed the results. In another test we would love to use entirely plastic leaves or another, eco friendly, material. We would also love to test it in actual rain, seeing if it does, really, capture more.

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