Engineers Needed: Help Tamika Save the Farm

Tamika Saves the Farm

by

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Table of Contents

Book Introduction

Helpful Suggestions

As you read through how to help Tamika, here are a few things to keep in mind. If you are not sure what a word means, or would like to play games with the vocabulary in this book, check out Quizlet. All the words are underlined and can be found using the QR (quick response) code:

http://quizlet.com/_ek1qr

We are also going to be using a lot of QR codes and so can you! If you create your own website and want to share it with other people, make a QR code here :

http://www.qrstuff.com/

The chapters in this transmedia book contain several activities to be completed by future engineers. All chapters work best when every engineer has access to the internet using QR codes or links. Having access to a smart device such as a smartphone, iPad, tablet, or computer to link to these digital resources will simplify the process and allow the assisting engineers to focus on the projects in the book.

Some of the projects in this book provide a template for a 2D cutter. Having a 2D cutter and the downloadable software for it to create the manipulatives for several projects will allow the enigeeners to maximize the oppurtunities in this book. If you do not have a 2D cutter, you can still print the provided outlines and make the objects. Once you have made the objects, try to improve on the idea by making your own 2D outline at:

htthttp://www.silhouetteamerica.com/?page=software
http://www.cricut.com/home/

As you go through this book you will be making several projects based on your own creativity and research. Consider taking pictures and making notes on your designs, maybe make a website to share your projects with other people in one easy location. A website is a good place to demonstrate what you can do. There are many free websites you can use. Consult your family or teacher first. A few examples are websiteMaker, Google Sites, or even Facebook.

If you are having too much fun, and your parents do not believe you are doing something educational, just tell them to to look at the Common Core standards or the Texas Essential Knowledge and Skills standards for the information about organisms and the environment. The projects also include applications related to the math requirements, so share the math you have done too.

Common Core Standards
Authors: National Governors Association Center for Best Practices, Council of Chief State School Officers
Title: Common Core State Standards
Publisher: National Governors Association Center for Best Practices, Council of Chief State School Officers, Washington D.C.
Copyright Date: 2010

Texas Essential Knowledge and Skills (TEKS)
http://ritter.tea.state.tx.us/rules/tac/chapter112/index.html

For additional information about cutter patterns like the ones created and used in this book, go to http://www.craftsulove.co.uk/silhouette.htm.

Recommended Materials

Below is a listing of the minimum resources needed to successfully complete the assignments. Feel free to experiment with other items, or give the engineers the option to bring in additional items that they think would be useful. Use whatever resources you have and let the students experiment with what they think might work.

Chapter 1:

- Misc. materials like water bottles, milk cartons, stinrg, etc.
- Measuring tools
- A place to keep an on-going record everything learned and made
  - ex: Google Site, Google Slides, journal, or binder

Chapter 2:

- Silhouette 2D cutter
- cardstock paper
- instructions to make a cup

Chapter 3:

- Irrigation Museum webquest
- Silhouette 2D "Y" project printout
- cardstock paper
- the cup made in chapter 2
- paper towels for cleanup

Chapter 4:

- Silhouette 2D cutter
- Silhouette 2D software
- cardstock paper
- coffee filters

cups
pebbles of different sizes
dirty water (ex: soil and water mix)

Chapter 5:
hose (like the kind used for fish tanks)
beakers or graduated cylinders
a paint pan or pie pan with a hole that matches the size of the hose (think about the topography of the model farm)
glue, tape, plumbers clay and/or other apoxy to hold the paint pan and hose together without leaking
3D printer (optional)
sand or dirt

Chapter 6:
supplies to create desalination project:
bowl
cup
plastic wrap
epsom salt
small rock

Chapter 7:
sand
dirt
plastic paint roller pan with simulated farm or other containor

Chapter 8:
containers
potting soil
seeds
water

Projects Per Chapter

Below is a listing of the projects that are outlined and can be done with this book. Feel free to pick and choose projects that align with your learning environment.

Chapter 1:

start a portfolio to show everything you learn - could be a website, journal, Google Slide show

amount of water usage for each students family at home

a raing guage made from recyling materials - can be tested outside

Chapter 2:

Energy use for a farm

Summary of what the crop needs

An oragami paper cup

a 2D printed and folded cup

Chapter 3:

WebQuest Report

Chapter 4:

A diagram showing the water cycle - with an explination of how pesticed might move through the water

A water filtration system made with cups and other materials

Chapter 5:

model farm using a filtration systems

a new filtration system can be 3D printed

Chapter 6:

Website game screen capture final city and summarize what was learned desalination project with reflection

Chapter 7:

Answering questions, researching, and projecting what farming will look like in the future

Chapter 8:

design and/or build a containor for a mini garden or plant

Chapter 1: Introduction to the Farm

Tamika, an engineer, was getting her morning coffee and found herself in line behind an old friend from middle school. They begin talking and she discovers that her old friend inherited a farm from his father. The farmer was a little distressed about the future of his farm. His crops are dying and the price for water is getting expensive. Tamika realizes that her old friend needs help, and she has some engineers that would be perfect to help with the challenge.

Tamika comes to you and your team to enlist your help as future engineers. The first step is to visit the farm and determine what the needs are. Your specific goals while at the farm are to consider what the farmer needs to grow his crops, lower his water bill, and what things can be done to help the farmer overall. He has a corn farm, but has friends with different types of crops. He encourages different engineering teams to do focus on the same problems, but for different types of crops. You will create a model and try out any potential solution before you show the farmer and Tamika. For each problem, explain how your proposed solution will work to solve the different challenges as you explore the farm, and do not forget to consider the potential impact on the environment.

http://astansell.com/Engineers-NeededWebsite/Activities/Water-Usage.apk

http://www.sfwmd.gov/portal/page/portal/xweb%20-%20re-lease%203%20water%20conserva-tion/computer%20your%20use%20calculator

Tamika wants to make sure everyone understands how much water is used. Not only by a farm but also by people daily in their homes. She asks that each engineer goes home and tracks the amount of water they use at home and then share this information tomorrow when they return to the farm. To help you figure out how much water is used, she provides a website that can help you with the formulas.

If you are surprised by the amount of water your family uses daily, check out the EPA website below for some helpful ways to save more at home! You can also make some models of rain gauges with the 2D software that you may be able to implement at home. What kind of shapes would make the best rain gauges? What items can you recycle at home into rain gauges?

http://www.epa.gov/WaterSense/kids/index.html

Chapter 2: Welcome to the Farm

When you arrive at the farm you take a good look around at all the different things on the farm. The land is fairly flat, but you notice it does have a slight incline to one side. The ground looks very dry and the crops are still very small. The farmer notices your interest and tells you that the main crop he grows is corn. He is growing corn as an alternative fuel source, but that is a story for a different day. He does encourage you to find out how much energy it takes just to water the crops. He insists that the amount is shocking! Try calculating the energy usage for an average farm of your type of crop with the help of the website to the right. Also, do some research on the other needs of your crop.

http://ipat.sc.egov.usda.gov/

The farmer tells you that he was talking to some other farmers and they are all interested in whatever solutions you come up with. They want to share with you some of the things that have already been done, and what their land is like, in hopes that one of the solutions you come up with may work for one of their farms, if not this one. Some of the other farmers are even willing to look into growing different crops if you can create a better system for them to do so. He encourages you to research some background information about farming before you begin.

Water is an important resource for plant development. Every plant needs different amounts of water and we should consider a variety of factors including, the soil type, the climate, and the season. Plants only use about 5% of the water they absorb for physiological growth, which means that while sprinklers give out a lot of water, a significant portion is lost to runoff or being recycled into the water cycle. Tamika suggests that you spend some time reviewing the water cycle and what recycling is all about.

http://youtu.be/twGev010Zwc

http://www.epa.gov/safewater/kids/flash/flash_watercycle.html

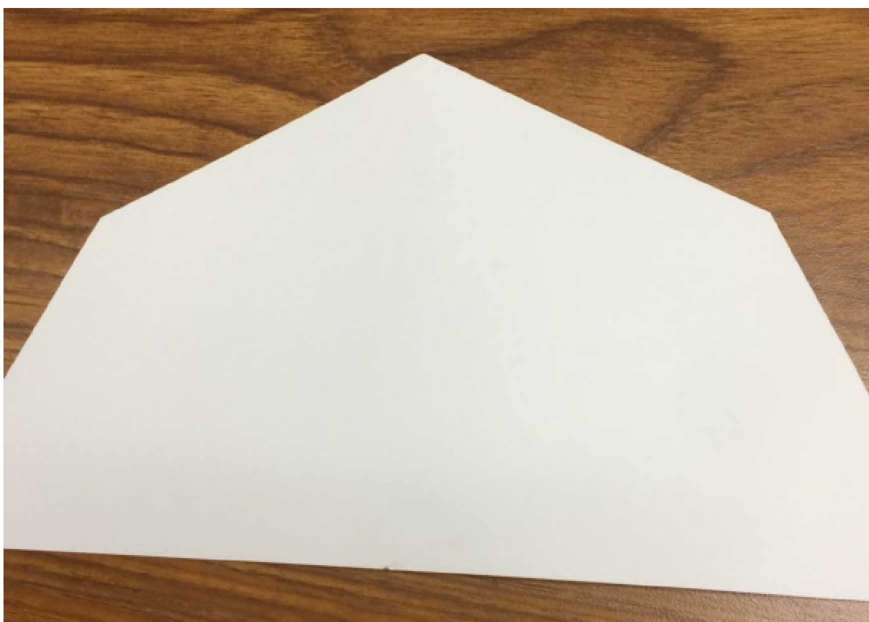
http://kids.niehs.nih.gov/index.htm

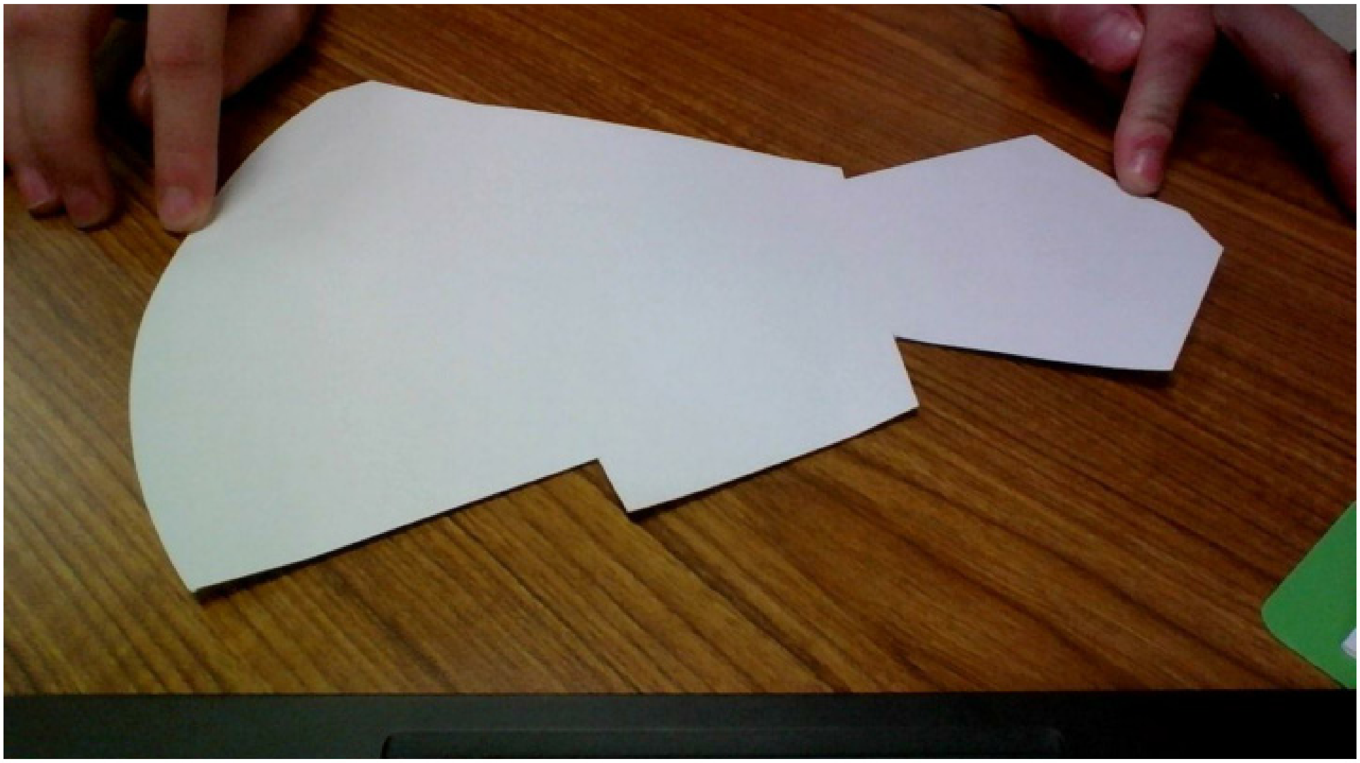
h http://astansell.com/EngineersNeededWebsite/Activities/WaterUsage.apk

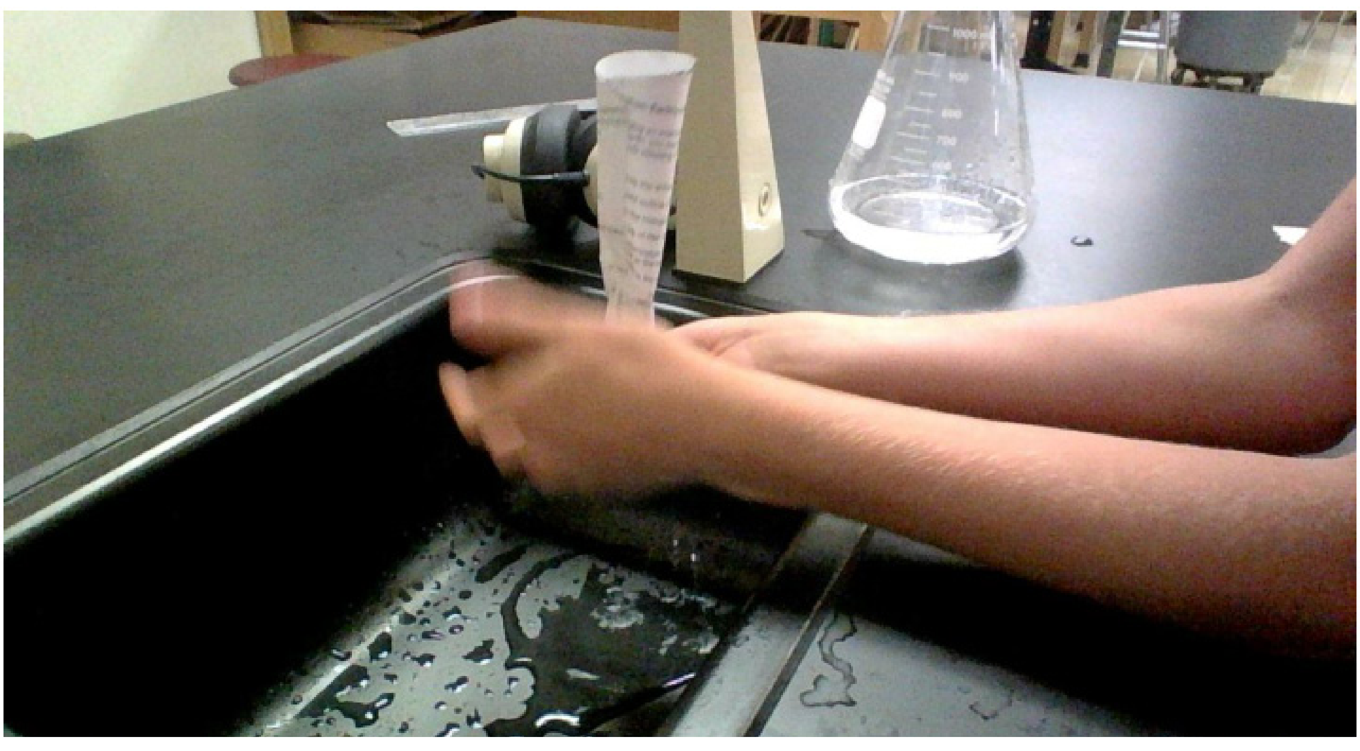
The need for water requires that farmers have the ability to collect water in different ways. Thinking about how much water plants need, your first job is to create a paper cup that can hold as much water as possible with the fewest resources available. Try to make it out of one sheet of paper, without glue or tape. Get creative with folding.

After you are successful with your oragami cup, Tamika challanges you to to use a 2D cutter softwware to design a new cup. While the folded cup is great, it can not be mass produced like a 2D cup could be. To help you on the road to designing a structure, Tamika gives you the following directions for a cup she knows how to make out of a single sheet of paper. She also provides you with the 2D pattern to cut and fold if you do not have a 2D cutter. (See the Resources at the back of the book.)

Once you test your cup, can you think of a better way to make the cup? Work with your engineering group to see if you can design a better cup and compare your results. Consult your engineering lead for any additional <u>criteria</u> or <u>constraints</u> for your cup redesign.







Chapter 3: Irrigation Through the Years

When you made your water cup, did you wonder how you would make the cup bigger to work for a farm or where and how the first irrigation systems developed? Where did we get the modern irrigation systems that water and grow our crops today? Tamika decides to have your team find out more about the history of irrigation.

Tamika starts talking with the future engineers, who had questions about how to capture and use water in much larger spaces then in the palm of your hand. As you get closer you can hear Tamika describing the history of our modern irrigation system. She explains that the first irrigation systems were developed in 6000 BCE. Both the Egyptians and Mesopotamians (citizens of present day Iraq and Iran) used the waters of the flooding Nile or Tigris/Euphrates rivers to irrigate their crops. The flood waters, which occurred July through December, were diverted to fields for 40 to 60 days. The water was then drained back into the river at the right moment in the growing cycle.

Throughout history, different civilizations have modified the Egyptian irrigation system. These simple water diversion techniques evolved into dams and canals. In 2000 BCE the Romans created the first cement and crushed rock pipeline. Between 1792 and 1750 BCE the Babylonian King Hammurabi was the first to institute water regulations in his kingdom. Waterwheels and windmills were invented between 700 BCE and 500 CE. (Remember, the years decrease with BCE and increase with CE so that means it was a 1200 year spread.) By the 1800's irrigation had made it to the America's. The first residential sprinkler was patented in San Francisco by John Gibson in 1872.

Take a look at this 1876 engineering patent submitted by G.H Copping. It is unclear if the sprinkler ever went into production, but there certainly is some resemblance to the sprinklers we use in our yards today.

http://www.irrigationmuseum.org/photos/Museum_Archive146.jpg

Tamika takes out her cell phone and shows the group some pictures. She explains that modern farming surface irrigation looked something like this in an 1880 California orange grove, like this in a 1938 California strawberry field, and like this in a 1975 Nebraska crop field.

http://www.irrigationmuseum.org/photos/IA-005.jpg

http://www.irrigationmuseum.org/photos/IA-005.jpg

http://www.irrigationmuseum.org/photos/pivot_compare_old_style.jpg

Tamika tells your group that you can learn much more about the general history of irrigation by visiting the online Irrigation Museum. Follow the QR code to visit the site.

http://www.irrigationmuseum.org//Default.aspx

WebQuest Break!

Complete this WebQuest as you look through the information you find there. (WebQuest details are also included in the Resources section.)

http://astansell.com/EngineersNeededWebsite/webQuest.htm

As you reflect on what you have learned from the Irrigation Museum website, you remember that one of the main goals of the farmer's irrigation system is to move water to various parts of the field. You mention this to Tamika and she suggests that the team create a simulation irrigation system just to visualize how you might disperse water to the crops.

Tamika gives you the list of supplies you will need. She asks that you collect the cup you made in chapter 2, a printout of the "Y" project from the 2D cutter, (There is also a cut and fold version in the Resources section.) water, and some paper towels. First, fold the 2D cutter design to create a "Y" shape. Next, take the cup you created in Chapter 2 and fill it with water. Position the "Y" with the "V" portion facing into the bowl. Angle the "Y" so that the tail portion is higher than the "V" portion. Pour the water from the cup into the tail of the "Y" and watch it flow down and separate into the "V".

Look at your irrigation system closely. How can you improve on this system so that water can be dispersed to other areas on the farm? Talk with the other future engineers about your idea. What suggestions do they have to bring water to the crops?

A straight pipe with water hoses spraying water rotate around a stationary spigot to irrigate crops.

Chapter 4: Irrigation Considerations

While creating your last project and testing it in the fields, you can not help but notice all the insects and bugs that seem be around the crops. As you watch the farmer for a while, you see that he spends a great deal of time going through and trying to get the bugs away from the corn. A future engineer on your team notices the same thing and asks the farmers why he does not use pesticides. The farmer tells you he has been thinking about using some pesticides that are safe on fruits and vegetables, but has some hesitations. With all the water runoff from his farm, he does not want the chemical filled water to go in the aquifers or nearby lakes and streams. He shows you a demonstration that was shared with some other engineers.

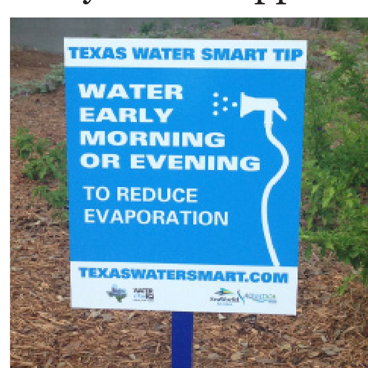
http://www.teachertube.com/viewVideo.php?video_id=295407

The farmer confides in your team that if there was a process to capture the run-off and reuse it in such a way that will not get in pollute drinking water, then he would happily do so. He knows that it is possible to treat water once it is captured, and he would also save money by reusing the same treated water. He refers you to the source on the right to learn more about treated water.

http://water.epa.gov/learn/kids/drinkingwater/watertreatmentplant_index.cfm

Tamika seems to have the worst timing ever for wanting coffee! She is asking the farmer to show her where he keeps his coffee pot and coffee related items! Your team is not a fan of coffee, but Tamika insists that you follow her into the house anyways. On the way, she has your team grab a handful of various sized pebbles and dirt that make up the road and walkways.

Once inside Tamika pulls out a few coffee filters and cups. She then asks your team to wash the pebbles. Tamika instructs you to replicate a water filtration system using the items she hands you while she mixes some of the dirt with water. Your engineer lead gives you additional items that might help in the process. Your goal is to create a filtration system that helps the water come out cleaner than the dirty water that Tamika is currently creating. Your engineering lead encourages you to do some research, and write out your design idea before making your working model, as the farmer does not keep many coffee supplies in his house at one time. You may use a 2D cutter to personalize different filters. Does adding holes of various sizes at different positions increase the filtration and water flow? What other things might help?



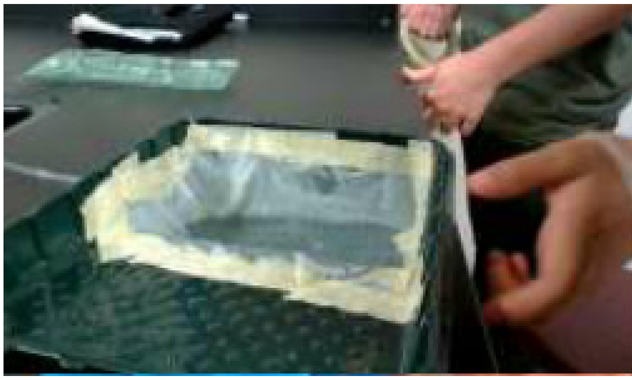
Chapter 5: Methods of Collecting Water

Women in Haiti draw water from an underground storage tank. The water is collected from rain runoff using pipes that direct the rain into the tank.

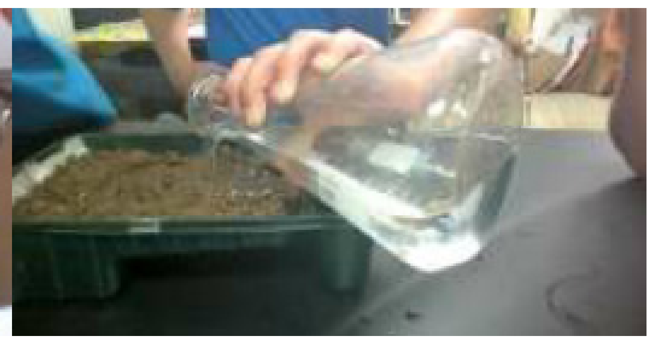
The farmer is impressed by your proposed filtration system. He is also willing to use your filtration system and some chemicals to really treat the water and to recycle all the water he can. However, he still does not see how it will be possible with a farm.

Tamika gives you some sand, dirt, a plastic paint roller pan, and some other materials to simulate a farm with a water filtration system. She instructs you to create a model of the farm, including a water filtration system in the design of the farm. She encourages you to consider underground or aboveground systems, whatever you think will work best. Then you will test the water filtration system, improving it till your lead engineer sees a difference in the water quality. The weather forecast shows that heavy rain should be coming in a few months, so be sure that your model can handle a sudden amount of water being added. If it can not move the water quickly, you will need to find a way to store it and redirect the water to go through your system. Tamika suggests using your rain gauge to help you track the water after it has moved through your model.

Using a paint pan, sand, and dirt, make a model of what the farm looks like. Get the help of an adult to put a hole in the bottom flat section of your pie pan that has the same <u>circumference</u> and <u>diameter</u> of the hose. Where you place the hole should be based on the water capture system you design. If you have any recycled materials that you think might help like empty milk containers, consider using them.

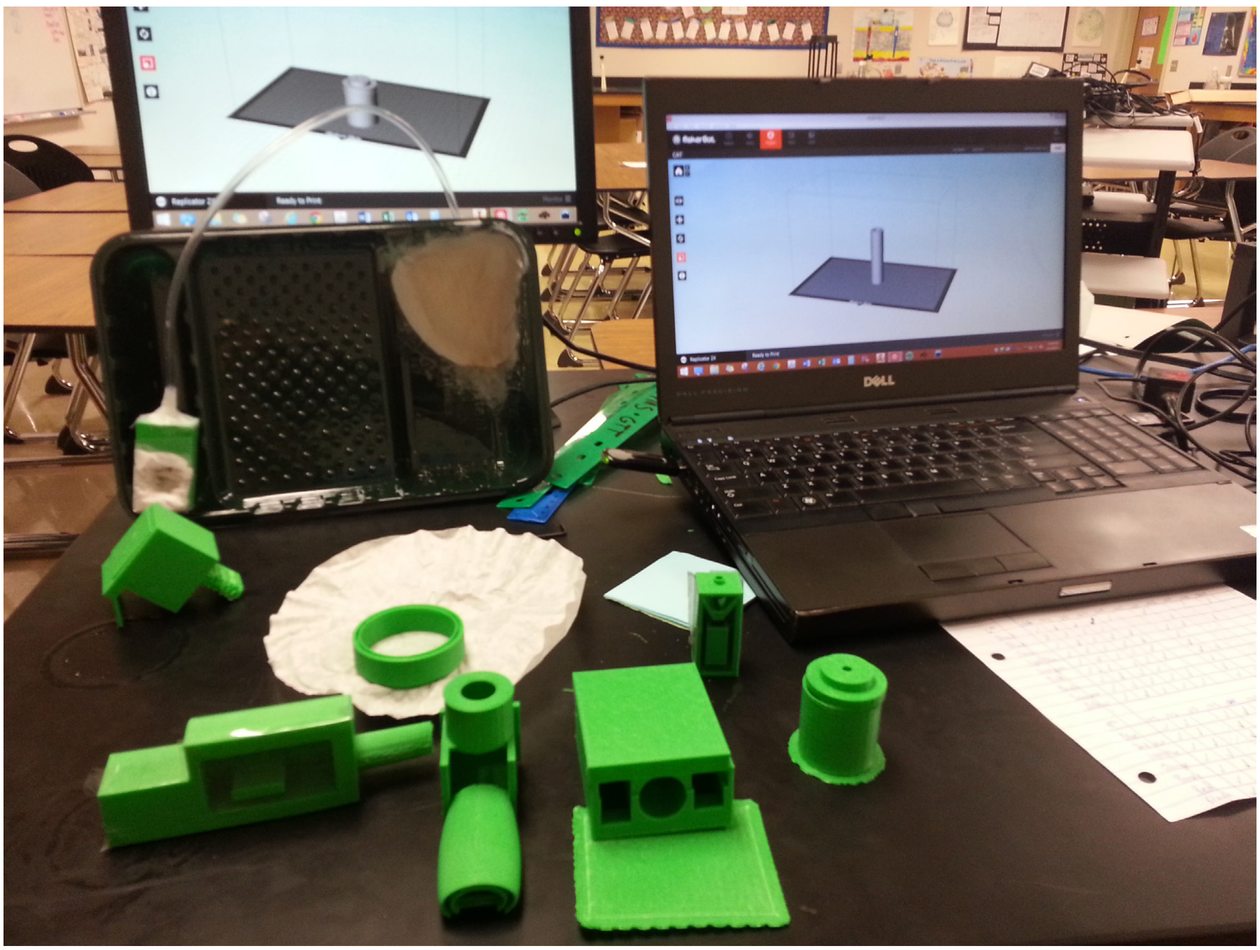




The farmer has been so impressed by your models so far he says he is willing to modify his farm in anyway that you show will be helpful through your research and models. Once the water capture system has been tested, run it through your filtration system to show the whole process.

If you have access to 3D software and a 3D printer, try designing some of your own parts to create a water capture system that not only captures the water, but allows the hose/pipes to capture the water to be used again. This will take some creativity and research, be sure you are working with your engineering lead and team. Once you have created your model, use a cup or graduated cylinder to pour water across your farm to test your water capture system model.



Chapter 6: Using Salt Water for Crops

The next day Tamika asks all the engineers to form into groups.   As the engineers mingle and move into their groups, you overhear a conversation between two future engineers, Eric and Sonia. "What is the big deal with all of this water conservation?" asks Eric. "Don't they know that about 70% of the earth is covered in water. Why can't we just use the water from the oceans?" he states.

You decide to join in on the conversation. "Doesn't ocean water have a lot of salt in it?" Sonia asks. You think about what the farmer said when he described pesticides running into the drinking water. Is the salt good or bad for the plants, you wonder.   You add, "What about the salt running into the drinking water, like the pesticides?" "Now that you mention it", says Eric, "what would happen with all that salt?"

The three of you decide you want to do an additional experiment to see if you can answer some of these questions. You set out to find Tamika and ask her if you have time to do some additional experiments. You want to see what would happen if salt or ocean water was used for irrigation instead of ground water. When you find her and tell her your idea she states, “Oh, you mean desalination! Thats a great idea.”

Tamika explains that it is not salt that is the problem. All plants need a little bit of salt. It is too much salt that causes the problem. The excess salt interferes with the plant’s tissues and creates a chemical reaction that causes plants to stop growing, turn brown, and die. Basically, the effect that salt has on plants is that it can actually cause them to die of thirst. When water is fresh, the roots are very permeable. The roots absorb the water easily. When the water has excess salt in it, the salt will actually suck the water out of the plants, causing them to dehydrate and die. Tamika explains that too much salt can have a bad effect on plants. “Too much salt isn’t very good for people either”, she states.

To see how salt and particles can be removed from seawater, Tamika directs you to the Water Island game. Go to the site and click on Desalination Water to build your own desalination plant.

http://www.seqwater.com.au/education/water-island-game

After playing the game, get together with other future engineers to build your own, simple desalination experiment. You will need a bowl, cup, epsom salt, plastic wrap, and a small rock. Follow the instructions on the Science Fair adventure site to see how you can desalinate water into fresh water.

http://www.sciencefairadventure.com/ProjectDetail.aspx?ProjectID=155

Once you complete the experiment, talk with the other engineers about how desalination works. What would the farmer have to do at his farm to use seawater to water his crop? Do you think that using seawater is an option for the farmer?

In some countries salt is sold by the scoop or in bulk. This image from a market in Haiti shows a pan of salt with a can to scoop up how much you want to buy.

Desalination makes salt water drinkable and ready to use for irrigation.

Chapter 7: Your Own Farm

Now that you are becoming a local expert on farms and irrigation, why not try your hand at your own garden? Consider the types of fruits or vegetables you like and see if you can adapt some of your ideas to create your own garden from recycled materials you have around the house. Can you use items like the bottom of a milk container and some other plastic food containers to make your plant bed and water capture system? Can you create your own water filtration system to help capture rainwater to use with your garden? Now that you are an experienced agricultural engineer, use what you know to get fresh fruits and vegetables for your family! Be sure to read the seed packets to find out where they grow best and when to plant them.

Chapter 8: The Future of Water Conservation

The farmer is so impressed with everything you have designed and made for him, that he wants to know what the next steps should be for his farm. He asks if you can do some research and give him a presentation on the future of farming methods. What are people already doing and what do you think the best types of farming are for the future? How will water be conserved and is there any way to harvest energy as well as crops? You also inspired him to do some of his own research and he wants your expert opinion.

http://farmenergy.org/success-stories

To help other farmers, he would like you to create a website or blog that shows the research you have done and what ideas you have for the future of farming. Make sure your engineering lead has access to your website or blog so they can help provide you feedback as you go.





Resources

2D Cutter or Print and Fold Cup Instructions from Chapter 2

If you are using the 2D cutter pattern that ends with .studio, simply open the file using the Silhouette Studio software and follow the instructions for "cutting".

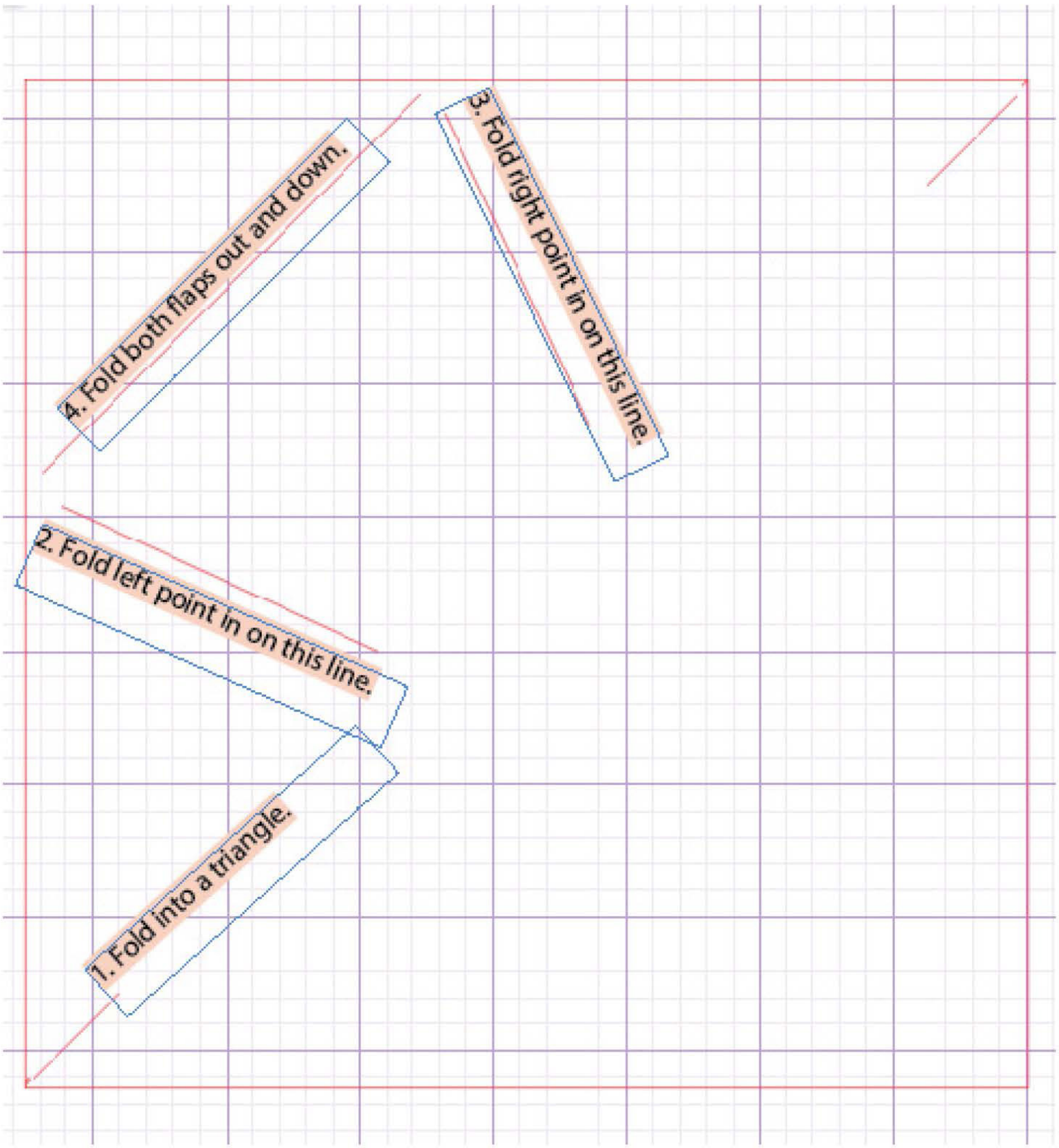
If you do not have a 2D cutter available, copy the pattern of the Cup from the next page to card stock paper. (A minimum weight of 67 lb. is suggested.) Solid lines on the pattern mean they are to be cut. Dashed or dotted lines are where you fold the card stock.

The steps for the cup have been numbered on the pattern as listed.

1. Fold the paper into a triangle shape by pretending that the dashed lines continue accross the page.
2. Looking at the triangle with the middle point up in the shape of a pyramid, fold the left point into the middle at the dashed line.
3. Next, fold the right point into the middle at the dashed line. It will be accross the left point you just folded.
4. Now fold each of the top points you have to the outside and down to form the top edge of the cup. Press on the edges and use your finger to open the top of the cup.

Print and Fold Cup Pattern from Chapter 2

Chapter 2



2D Cutter or Print and Fold "Y" Project Instructions from Chapter 3

If you are using the 2D cutter pattern that ends with .studio, simply open the file using the Silhouette Studio software and follow the instructions for "cutting".

If you do not have a 2D cutter available, copy the pattern of the "Y" from the next page to card stock paper. (A minimum weight of 67 lb. is suggested.)

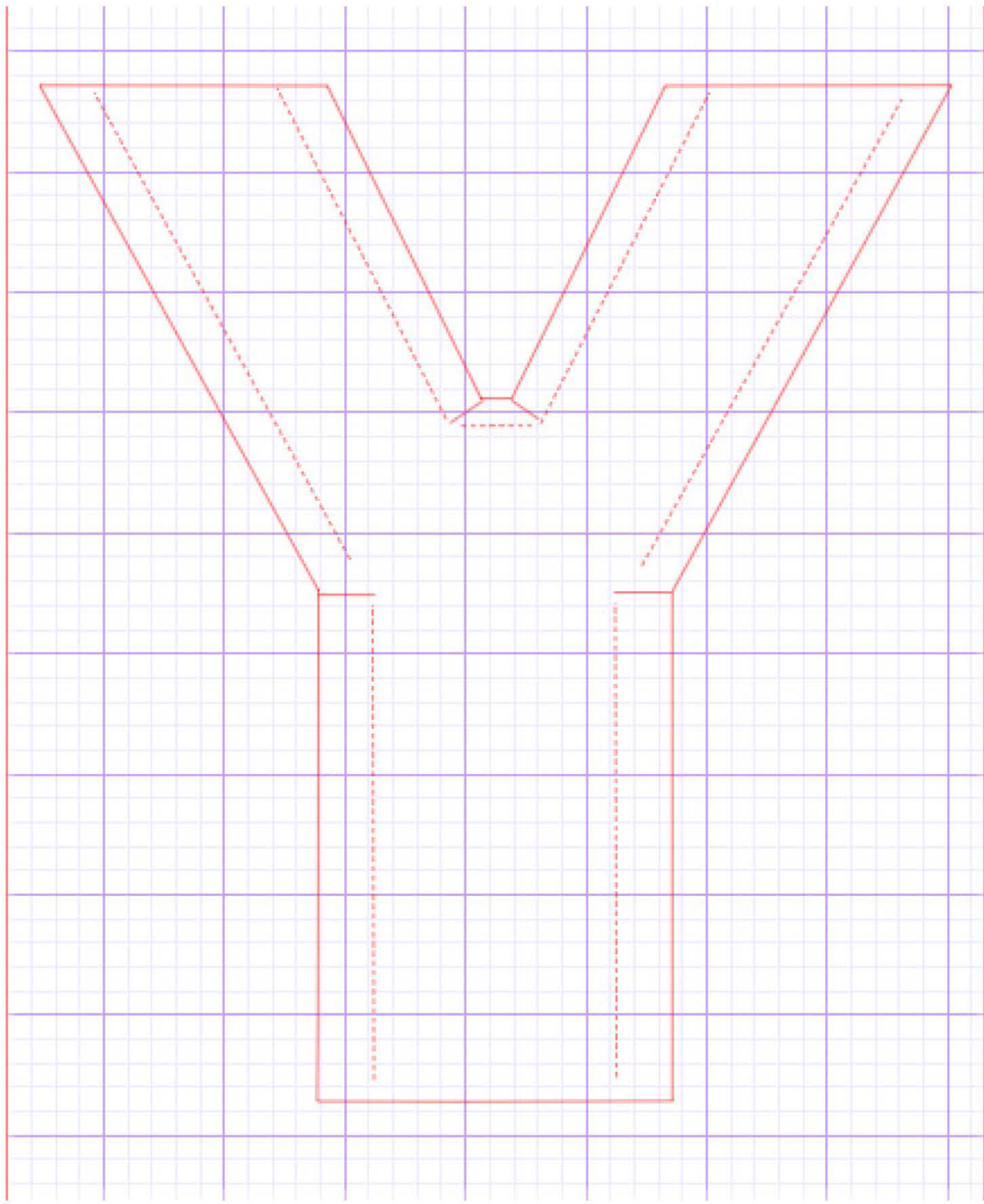
The steps are listed.

1. Cut out the "Y" along the outside edges of the pattern.
2. Clip into the "Y" on the two side lines and again at the inside of the V at the top of the "Y".
3. Next, fold the paper up 90 degrees along both sides of the "Y" along the dashed lines.
4. Also fold the paper up 90 degrees on the folds on the inside of the V at the top of the "Y". Be sure to fold the middle of the V up also.

You should now have a shape that is similar to a trough.

“Y” Project Print and Fold Cutout Pattern from Chapter 3

“Y” Project Print and Fold Cutout Pattern from Chapter 3



Webquest for Chapter 3

Introduction

In your quest to find out more, you decide to follow Tamika's advice and visit the Irrigation Museum website on the left. You can also use the books website to do this WebQuest.

http://www.irrigationmuseum.org//Default.aspx

http://astansell.com/EngineersNeededWebsite/webQuest.htm

The Task

This webquest will provide you with instructions and assignments to help you learn more about the information you'll find at the online Irrigation Museum. After completing the webquest, you will have a better understanding of where irrigation began and where it is going.

As a future engineer you will:

•Search through the timeline for historic markers,

•Answer questions and find information,

•Create a mind map using a computer software, such as Google Drawing and,

•Watch the “California Water” video to see what they are doing at the International
Center for Water Technology.

You will need:

•To open the Irrigation Museum website

•To be able to login to a free Google account through your school account or with parent supervision and find the Google Drawing app

•Access to a printer or place to keep your electonic documents

•A piece of paper, notebook, or Google Doc to write your notes and answer questions.

The Process

If you remember from Tamika’s explanation, irrigation began in Egypt in 6000 BCE. So what happened after that? Put on your engineer hat, complete these tasks, and you’ll find out more.

1. Take out a piece of paper, your notebook, or Google Doc to answer questions and take notes.
2. Go to the Irrigation Museum website by following this link:

http://www.irrigationmuseum.org or using the QR code on the left side of this page.

3. Click on to the “Timeline” link at the top of the page. Leave the slider on the “Pre-1800’s” option.
4. Read through the information listed under this timeline and answer the following questions:

    A. When was the first major irrigation project created? Under what king was it created?

    B. The first use of this is now called a pump. What is it and what year was it created?

5. Next, move the slider through the remaining timeline decades and look at the history. What do you find interesting? Write down at least one interesting thing from each timeline.
6. Go to the mind mapping website, like bubbl.us. (https://bubbl.us/) or Google Drawing (QR on the left to Google apps). Create a mind map using each one of the interesting things you listed from the timeline. Ask your teacher how they would like to see your mind map. You can print the mind map or save it as a picture to e-mail/post/turn-in.

http://www.google.com/intl/en/about/products/

7. Go back to the Irrigation Museum website.
    - Follow the link on the right OR
    - Click on the "Video/Media" link at the top of the website.
    - Click on the "California Water" link.
    - Under the "Links" option, click on "Play: California Water".
    - Watch the video.

http://www.irrigationmuseum.org/mediaplayer.aspx?m=huell_calif_water.wmv&t=California%27s+Water

Evaluation

Make sure you complete all of the steps above. When you are done, show your teacher your notes and be sure you have turned in your mind map.

Conclusion

Now that you are an expert in the history of irrigation, check back with Tamika and the team by returning where you left off in chapter 3 of your book.

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