ASK HERZL

Program Title: Build an Irrigation System

Program Tagline: Build your own irrigation system

Target Audience: Middle annd High School

Grade: 6 - 12th

Length of Program: 1 hour 30 minutes

Goal: This lesson focuses on how through the centuries man has had the need to move water from one place to another. Engineered irrigation has had a major impact on people all over the world. Throughout this lesson, students will work in teams to design and build a system to move water from one source to two different delivery areas. The challenge is to move two cups of water for at least three feet and distribute it evenly in two separate containers. They will work with everyday items, develop a plan, build their "irrigation" system, and test their system. Students will then evaluate the effectiveness of their own irrigation systems and those of other teams, and present their findings to the class.

Materials:
History of Irrigation Resource
Ethical Implications of Irrigation Resource
Design Your Own Irrigation System Worksheet
Water basin and water for testing student irrigation systems
One set of materials for each group of students:
Straws, cardboard or paper cups or bowls, clay, tubes, aluminum foil, rubber bands, tape, jars, toothpicks, glue, paperclips, plastic piping, tape, and other materials

Implementation:

1. Show students the various Student Resource Sheets. These may be read in class or provided as reading material for the prior night's homework.
2. Divide students into 2-3 groups providing a set of materials per group.
3. Explain that students must work as a team to design an irrigation system to move two cups of water a distance of at least three feet. The team has a goal of splitting the water into two separate containers of exactly one cup each.
4. Next, teams will test their irrigation system to see how it works. Students will measure how much water is gathered in each of the two destination containers and see how close their water is to the goal of one cup in each container. Teams may test their systems three times and count the most successful test.
5. Teams then complete an evaluation/reflection worksheet and present their findings to the class.

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History of Irrigation Resource

Irrigation is a system that artificially routes water to an area where it is not naturally present. More common applications include providing water to remote or dry land for growing crops. Irrigation is frequently used to compensate for periods of anticipated or emergency drought, but also is used to protect plants against frost. Irrigation systems are also used to help suppress the growth of weeds in rice fields. There are many different irrigation techniques to route water from a source to its destination. Usually, uniformity in water placement is a goal, especially for growing crops.

Irrigation History

Archaeologists have found evidence of irrigation at work in Mesopotamia and Egypt as far back as the 6th millennium BCE, where barley was being grown in areas where the natural rainfall was inconsistent or not necessary sufficient to support the crop. In the Zana Valley of the Andes Mountains in Peru, archaeologists have found the remains of three irrigation canals which were radiocarbon dated to place their development at the 4th millennium BCE, the 3rd millennium BCE, and the 9th century CE. At the moment, these canals are considered the earliest examples of irrigation systems found. In addition, advanced irrigation and water storage systems were developed by the Indus Valley Civilization in Pakistan and North India. Because extensive agriculture was required, an innovative network of canals was developed to support irrigation. There also is evidence of the ancient Egyptian pharaoh Amenemhet III in the 12th dynasty using the natural lake of the Faiyum Oasis as a reservoir to store water to be used during dry seasons. The lake would swell annually due to the annual flooding of the Nile River. Egypt received little rainfall, so the Nile was a logical source of water.

Roman Aqueducts

The ancient Romans constructed many aqueducts to route water to cities and other sites. These aqueducts are considered to be one of the greatest engineering feats of the ancient world. Many of the ancient aqueducts are still in use today. They served several functions including providing potable water and supplying water to baths and fountains. Water was then routed into the sewers, where they helped remove waste.

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Ethical Implications of Irrigation Resource

Irrigation can route water to fields, help crops overcome drought, provide drinking water, and support waste removal. But, how do engineers and others decide which use of water is the most important? What are the ethical considerations that must be reviewed to strike a balance of fairness?

For example, what if one farmer routed a river to serve his or her own crops and in doing so prevented his neighbors from receiving any river water? Or, if water was routed to a company that stood to make a great deal of money from a profitable manufacturing facility, but in order to provide enough water for their process, all water would be diverted from local farmers who might lose their livelihood. What would be fair? Engineers are continually faced with ethical considerations when building structures, designing systems, and improving products.

Engineering does not have a single standard for ethical conduct because approaches vary somewhat by discipline. For example, a biomedical engineer might be concerned with respecting the feelings of a patient, or would want to pay particular attention to the reliability of a product such as an artificial heart. A civil engineer would consider safety and strive to develop a bridge that is not only safe, but also cost effective. A bridge could be over constructed, be safer than it would ever need to be, and be over budget as well.

Question:

1. Can you think of an example of how a team of engineers might have to address ethical considerations related to the environment when building an irrigation system?
2. What do you think the team would have to investigate before starting construction?

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Design Your Own Irrigation System Worksheet

You are part of a team of engineers who have been given the challenge of developing an irrigation system that will carry two cups of water across a distance of three feet and split the water into two separate destination containers. If your system works, you'll end up with exactly one cup of water in each of your destination containers. How you accomplish the task is up to your team!

Planning Stage
Meet as a team and discuss the problem you need to solve. Then develop and agree on a design for your irrigation system. You have been provided with many items you may use to construct your system. As a team, come up with
a plan and draw your design in the box below. Be sure to indicate the materials you anticipate using. Present your design to the class. You may choose to revise your team's plan after you receive feedback from the class.

Construction Phase
Build your irrigation system. During construction you may decide you need additional items or that your design needs to change. This is okay -- just make a new sketch and revise your materials list. You may want to trade items with other teams or request additional materials from your teacher.

Testing Phase
Each team will test their irrigation system to see how it functions. You'll have three chances to test your system. At the end of each test, you will measure the amount of water in each of the destination containers. Remember, your goal is to end up with one cup of water in each. Your best attempt will be the one that counts. Be sure to watch the tests of the other teams and observe how their different designs worked.

Evaluation Phase
Evaluate your team's results, complete the evaluation worksheet, and present your findings to the class.

Use these questions to evaluate your team's results:

1. Did you succeed in creating an irrigation system to split the two cups of water into two separate destination containers? What was your best result?

2. If your system failed, what do you think went wrong?

3. What was unique about either the design or construction of the irrigation system that had the best results in this challenge in your classroom?