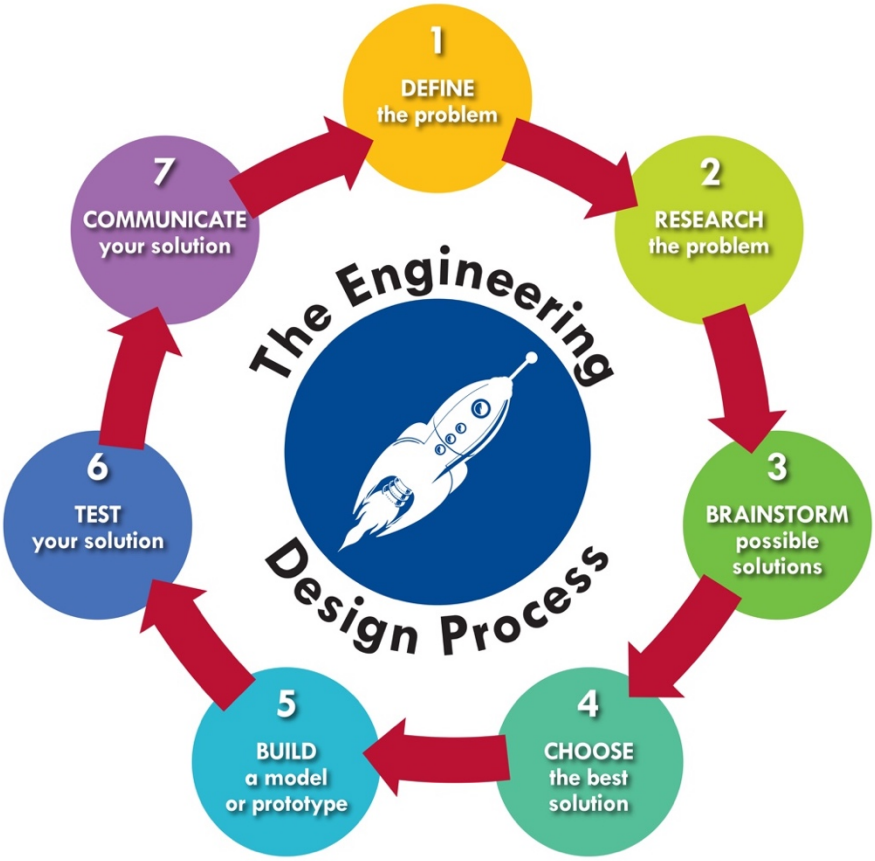
Solve It: A Student STEM Challenge



Topic: AZ Water Resources	**Materials:** • Computers for research • Graph paper
Challenge: To research the source of water coming into your community and come up with a plan to help measure and communicate the amount of water being used in your area.	
Real World Connection: • Interactive Community Water System Map: http://gisweb2.azwater.gov/cws • Arizona Department of Water Resources: http://www.azwater.gov/azdwr/ • Water Pathway Sample Water Audit: https://www.nwf.org/Eco-Schools-USA/Become-an-Eco-School/Pathways/Water/Audit • Google Earth: https://www.google.com/earth/ • STEM Pro Live! with Department of Arizona Water Resources: https://schoolsup.org/stemprolive/	

Define the Problem:	
Guided Questions	Teacher Notes

• What do you have available to work with when designing your solution?
• What would a successful solution look like? How will you know if your design is successful?
• What are your constraints or limitations?
	• Begin by trying to understand what the opportunities for improvement at your school are:
	• Start by researching the source of your water supply coming in to your school.
	  • You can use the interactive map on the Arizona Water Resources website: http://gisweb2.azwater.gov/cws
	• You can collect some data and make observations of the school by completing a Water Audit.
	  • A sample audit with instructions can be found here: https://www.nwf.org/Eco-Schools-USA/Become-an-Eco-School/Pathways/Water/Audit
	• You can have your students use sites like Google Earth to make a scaled map of your school and identify the location and number of sinks, faucets, toilets, and showers are at your school and make a data table. Suggested symbols for coding are:
	  • **A** = Automatic (equipment that must be turned on manually but turns off automatically)
	  • **S** = Sensors (equipment that turns on and off based on the movement of a person)
	  • **M** = Manual (equipment that must be physically be turned on and off by user)
	  • **GPM** = Gallons per minute (faucets and showers)
	  • **GPF** = Gallons per flush (urinals and toilets)
	• Take a look at the water bills for the school and determine how much water is used each year and how much your utility company charges per unit of water.
	• Create a graph showing the type and amount of water

	sources on your school campus. • Establish your parameters (groups, roles, time limit, # of trials, amount of material allowed to use, etc.).
Research the Problem:	
Guided Questions	Teacher Notes
• What is already known about the problem? • What are some current solutions that can be built upon/improved? • What technology is available to help you understand the problem better? • What are some obstacles, challenges connected to your problem?	• Have students research how much water other schools, of similar size, are using. • Have students compare rates for different water utilities companies. • Have students research how the water being used is currently being measured and communicated. • Look at what other schools, communities, families, businesses and companies are doing to monitor their water usage. • Have the students research current innovative ideas for how individuals, families, universities, etc are dealing with water usage.
Brainstorm Possible Solutions:	
Guided Questions	Teacher Notes
• How many ideas can you come up with individually? • How many ideas can you come up with as a group? • How can you use/build on the groups ideas to refine your own?	• Have students individually come up with at least 4 possible designs that they could use in their solution • Have students share designs with a group. **Encourage a variety of ideas and a safe environment.* • Encourage reflection and refinement of ideas
Choose the Best Solution:	
Guided Questions	Teacher Notes
• Which solution(s) could you build using the materials/time you have available? • Which solution(s) could you build considering the constraints/ limitations? • Which solution do you think has the best chance to be successful?	• Have students choose an idea to design and make a plan to build/create (*even if you have no intention to actually build).

	• Have students draw a model of their prototype and label the parts (*if applicable). • List the materials that will be needed to build (*if applicable). • Describe how the materials will be used.
Build a Model or Prototype:	
Guided Questions	Teacher Notes
• What materials will you need? • Does your design meet the lesson objective? • Does your design clearly communicate your selected solution to the problem?	• Revisit the objective and make sure the student's design matches what they chose for their solution to the problem.
Test your Solution:	
Guided Questions	Teacher Notes
• Did you record your observations? • How will you know if your design worked as intended? • How will you know if your design was successful?	• Have students make and record observations during their trial(s). • Encourage students to stay true to their design and not make modifications while testing.
Communicate your Solution:	
Guided Questions	Teacher Notes
• Did your design work as intended? How do you know? • Did it solve the problem that you identified? How do you know? • Do you still think your solution is the best one for the problem? Why or why not? • What would you different if you could do it again? Why?	• *Have students reflect individually first and record responses.* • *Have students share responses with their group then whole class.* • *To make iterations, you will want to re-enter the Engineering Design Process and begin thinking about defining the problem(s) they had with the initial idea.* • *The purpose is to provide a process for them to formalize their thinking and not rely on trial and error to merely accomplish a task.* • *Share your students' designs and ideas with us at: info@mcesa.maricopa.gov*