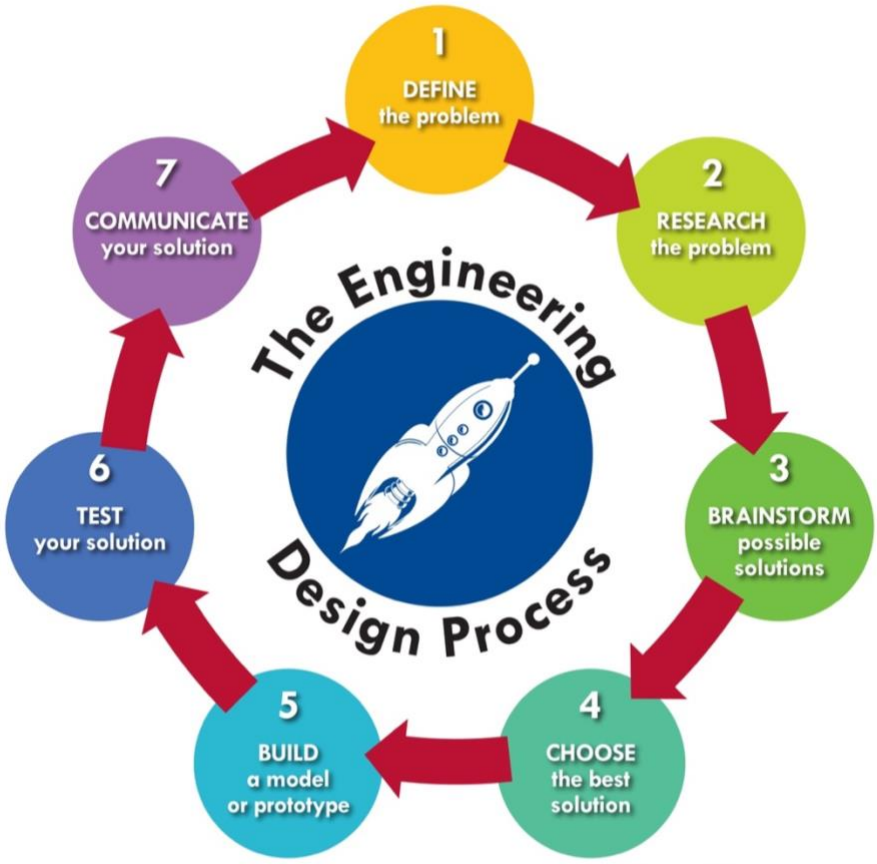
Solve It: A Student STEM Challenge



Topic: Water Quality **Challenge:** Design a better tool used to provide clean drinking water to residents in Arizona.	**Materials:** • Dirty Water sample- 400ml per group (You can add: Lawn fertilizer or potting soil, salt, newspaper, coffee grounds, laundry detergent) • 2 liter bottle- 1 per group • Coffee filter- 1 per group • Sand- approx. 1 cup per group • gravel (small) - approx. 1 cup per group • rock (large) - approx. 1 cup per group • rice- approx. 1 cup per group • cotton balls- approx. 1 cup per group • packing peanuts- approx. 1 cup per group • tape

Real World Connection:

- Arizona Department of Environmental Quality (ADEQ): http://legacy.azdeq.gov/environ/water/standards/index.html
- Safe Drinking Water Act: https://www.epa.gov/dwstandardsregulations/background-drinking-water-standards-safe-drinking-water-act-sdwa
- Aquifer water quality standards: http://apps.azsos.gov/public_services/Title_18/18-11.pdf
- 2016 Water Quality Report: https://www.phoenix.gov/waterservicessite/Documents/wsdprimarywqr.pdf
- Arizona Water Watch: http://www.azdeq.gov/programs/azww
- STEM Pro Live! with Odysea Aquarium Life Support Team: https://www.youtube.com/watch?v=GOqtoOpMlSA

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Sequence of Instruction	
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 showing sample of water from school faucet/drinking fountain and have student make observations/inferences. • Show source "dirty" water sample and have student make observations/ inferences. • Have students compare/ contrast water samples • Show students the available filtration materials. • Have students define what they think the problem is. • 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 what pure water is and what is safe for human consumption. • Use 2016 Water Quality Report to identify what substances are currently found in AZ water. • Have students research current tools used to provide clean water
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 a design to make a plan to build. • Have students draw a model of their prototype and label the parts. • List the materials that will be needed to build. • 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 students 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*