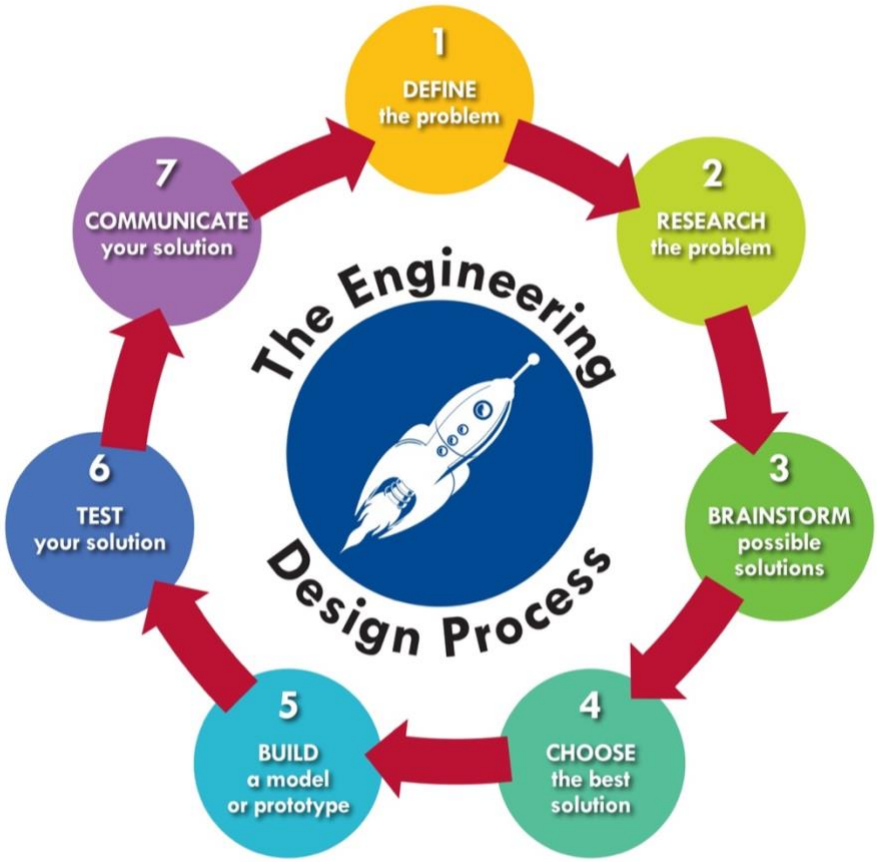
Solve It: A Student STEM Challenge



Topic: Conservation and Recycling	**Materials:** • Timers • Computers for research • Latex gloves • Graph paper • * Possible Items for identification- Glass bottle, Plastic bottle, Aluminum can, Paper, Plastic bags, Newspaper, Paper towel, Orange or Banana peel • Colored construction paper (x6 different colors)
Challenge: To research the type and amount of items currently being thrown away at your school and improve or design a better system to Reduce, Re-use, or Recycle those items.	

Real World Connection:

- Arizona Department of Environmental Quality: Municipal Recycling Data- http://www.azdeq.gov/node/2353
- Arizona Municipal Recycling Data Report: 2016- http://static.azdeq.gov/wqd/recy/2016_recycling_data.pdf
- Time it takes for garbage to decompose- https://www.des.nh.gov/organization/divisions/water/wmb/coastal/trash/documents/marine_debris.pdf
- STEM Pro Live! with OdySea Aquarium:

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Sequence of Instruction

Intro activity-

Objectives:

1. Develop an understanding that the problems related to recycling continue after the items are out of sight.
2. Understand that different types of materials take different lengths of time to decompose.

Materials:

- Construction paper (x6 colors)
- Collector cards
- Demonstration items: Glass bottle, Plastic bottle, Aluminum can, Plastic bag, Newspaper, Orange/Banana peel

Idea:

The students need an opportunity to experience what it feels like to be responsible for "disposing" of various materials. They also need to understand that the items we throw away each day will decompose at different rates so certain materials create problems that future generations will have to deal with if we do not deal with it properly.

Resource Chart:

Color	Represents	Time to "pass"	*Time to Decompose	# of cards needed	*Annually Recycled (tons)
	Glass Bottle	37 Hours	1 Million Years	6	14755
	Plastic Bottle	5 minutes	450 Years	3	7371
	Aluminum Can	60 seconds	150 Years	4	9193
	Plastic Bag- Misc. waste	30 seconds	15 Years	29	71306
	Newspaper	10 seconds	6 Weeks	44	108941
	Orange/ Banana Peel	5 seconds	3 Weeks	15	37086

Collector Cards:

Plastic Bottle Collector:

- *Stay in your current location in the room*
- *Only accept cards that are your color*
- *Do not announce that you are a collector or what you are looking for*

Plastic Bag Collector:

- *Stay in your current location in the room*
- *Only accept cards that are your color*
- *Do not announce that you are a collector or what you are looking for*

Aluminum Can Collector:

- *Stay in your current location in the room*
- *Only accept cards that are your color*
- *Do not announce that you are a collector or what you are looking for*

Newspaper Collector:

- *Stay in your current location in the room*
- *Only accept cards that are your color*
- *Do not announce that you are a collector or what you are looking for*

Glass Bottle Collector:

- *Stay in your current location in the room*
- *Only accept cards that are your color*
- *Do not announce that you are a collector or what you are looking for*

Orange/Banana Peel Collector:

- *Stay in your current location in the room*
- *Only accept cards that are your color*
- *Do not announce that you are a collector or what you are looking for*

Recycling "Hot Potato" looks like this:

You will need to cut out squares of colored paper to represent the different items thrown away that need to be recycled. I chose 6 colors/items off of the Arizona Municipal Recycling Data report. Feel free to change the number and colors based off of the size of your class and materials you have available. I would recommend 100 cards be distributed so that you can demonstrate that each card represents 1% of the total amount we have to dispose of each year. For instance, I would cut out 4 green cards because metal makes up 4% of the total weight of annually recycled materials.
*Take a look at the resource chart for more specifics.
You will also want to print and cut out the 6 "Collector cards" in color or on colored paper. These will be given to 6 students in your room who will represent specific recycling centers available.

So first begin by passing out the 6 collector cards and let the students know their role and rules:

- Their **role** is to exclusively collect the materials listed on their card…seems simple.
- The **rules** are:
  - They have to stay in their current location in the room
  - Only accept cards that are their color
  - Do not announce that they are a collector or what they are looking for but they can respond to individuals who ask

Next, passing out the 100 cards to the remaining students in the classroom. Try to vary the colors by mixing them up.

The students will have 10 minutes to get rid of all of their cards. They can either pass them to another student to have to deal with or choose to find a "collector".
*In order to show that different materials decay at different rates, you will need to place a chart up on the wall to show that there is time restrictions on passing a card.

Depending on the color of the card, the students will have to wait the appropriate time to pass. Cards are passed 1 at a time and only after waiting the listed time.
For instance: Once the game begins, the student can wait 5 seconds and then pass 1 orange card to another student to deal with or go find the collector looking for orange cards. The time then re-sets to pass their next card (waiting an additional 5 seconds for orange, 10 seconds for blue, 30 for red, etc.). Which means they have to be strategic in how they pass their cards.
The goal is to get rid of all of your cards by the end of the 10 minutes.
At the end of the time, have the students bring their remaining card back to their seat for an individual then whole group reflection.

Reflection Questions:

1. How many of your cards did you end up with? How did you feel about how successful you were in getting rid of your cards?
2. How many of your cards did you pass to another student? Why did you choose to make somebody else deal with your card instead of taking it to a collector?
3. How many cards did you pass to a specific collector? Why did you take the extra time to bring it to a collector?
4. How many extra cards were passed to you? How did you feel about having to take care of other people's cards?

Wrap up by showing pictures off or bringing in real Demonstration items (Glass bottle, Plastic bottle, Aluminum can, Plastic bag, Newspaper, Orange/Banana peel) to show what the colors represented. Share the data on how much of these items are collected each year to be recycled and the time it will take each of those items to decompose in landfills.
This should give your students the background needed to begin Defining the Problem at your school with the type and amount of items currently being thrown away at your school so they can improve or design a better system to either Reduce, Re-use, or Recycle those items.

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. Some ways you can have students do this include:
	  • Observe the type and amount of items being thrown away in your room /school /community.
	  • Take a look at the current process for collecting and recycling materials at your school and in your area.
	  • Determine the number of students in the school and conducting a survey on how often and how many students recycle at their

	houses; including what materials they recycle. • Create a graph showing the type and amount of materials that are being thrown away, including data on how long those materials will take to decompose in a landfill. • Identify which materials on your campus are most likely going to create long term issues if a solution is not identified to reduce, re-use, or recycle. • 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 others schools are doing to reduce, re-use, and recycle items on their campus and how it impacts their community. • Look at what other big businesses and companies are doing to conserve and recycle items. • Have the students research current innovative ideas for how individuals, families, universities, etc are dealing with conservation and recycling.
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 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*