

Engineering Design

Engineering is about solving challenges by building something new or repurposing something that is already in existence. Youth love engineering activities because they are hands-on and they can use their imagination. To translate the activity into a learning opportunity which can be applied anywhere, including the school day, please select on process, either the Solution Fluency Model or the Inquiry Model to ensure youth understand the process of learning, rather than simply jumping into a task because it is fun and exciting. Be sure they follow the process you select and you can see evidence of each of the steps **BEFORE** they have the supplies and are randomly trying to meet the challenge without being intentional in their solution finding process.

Transforming Activities Into Learning Opportunities

We believe engaging young people in any task is more than ½ the battle. If they find a task fun, relative, and challenging, we can count on engaging young people. Lee Watanabe-Crockett talks about visiting a classroom and the children were engaged in an engineering project. The challenge was to build the tallest possible tower using only straws and tape, which would be free standing and hold a tennis ball on top. He describes the energy and joy in the room, but when he asked the teacher, “What are they learning?” there was no answer.

Hands-on, minds-on activities can be transformed into learning opportunities by adding a process which can be utilized not only in the current circumstance, but in other situations as well. Watanabe-Crockett suggests the utilization of the Solution Fluency Model which has six steps: define, describe, dream, design, deliver, debrief. In his book, *Literacy Is Not Enough: 21st Century Fluencies for The Digital Age*, he describes the Solution Fluency Model which you can see in the table below. A second format, The Inquiry Model, follows a similar pattern: ask, imagine, plan and organize, build and test, review and revise. This Model will also be further explored in this document.

Both these models require critical thinking, collaboration, communication, and creative problem solving. Adding the words, “Use the Solution Fluency Model” or “Use the Inquiry Model” in front of an Engineering Design Challenge (or most any other assignment) transforms the activity into a learning opportunity. Youth will have the opportunity to practice and learn both process and content.

Inquiry Model

The Inquiry Model consists of five (5) steps. The graphic below depicts those steps.



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Step 1, Ask requires the learner to answer each of these questions:

- What is the challenge or SITNA (Situation in Need of Attention) we are trying to solve?
- What do we believe are the criteria for success in this challenge?
- When asked, “What do we already know about ...”, what is our response?
- What do we have to work with—supplies and materials?
- Is there any real-world application for our solution?

Step 2, imagine, requires responses to these questions:

- What’s possible? What can I “see” in my imagination?
- Have I seen anything similar to solve another different or similar challenge?
- Are there any specialty materials we might need? If we have those materials will it make a difference?
- We will discuss many possible solutions. How will we decide which one to try?

Step 3, plan and organize, requires the team to consider these questions:

- What will a solution look like? Can we draw a picture of our prototype? What materials and supplies do we think we will utilize to make our prototype?
- We are a team. How will each member contribute to the completion of the project? How will we best utilize everyone’s talents?
- As a team, we will have many different ideas. How will we resolve conflict and tension so no one feels unheard or marginalized?



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If our design, when completed as a prototype, isn't successful, what's our back-up plan?
How will we "go back to the drawing board"?

Step 4, build and test, requires teams to consider:

What are the steps we need to put in place so we can accomplish this task?

Will we work on the project all together, or will we divide up the project into pieces and each person or group work on just their piece? If we do that, how will we put everything together?

We have identified criteria for success, how will we go about testing our product against these criteria? What data will we collect and how will we collect it?

If our test indicates we were not successful in meeting our criteria, what will we do?

Step 5, review and revise, evokes these questions:

Did we select the correct data? If yes, what does it tell us?

What adjustments do we need to make to our prototype or solution, so it would better meet our Criteria for Success?

What we do differently next time? What changes would we make? Let's revisit the model and after review and revise, let's start with what we've done and then repeat the process again. It is important to understand that design is an iterative process.

Solution Fluency Model

Solution Fluency Model

Define	Discover	Dream	Design	Deliver	Debrief
What is the SITNA—what are we supposed to do?	What do we need to know and learn so we can find a fundamental solution to the SITNA?	What do we want the fundamental solution to look like?	What are the steps we will take to make that happen?	Just "Do It" and then debrief against the criteria you established	How will we know we were successful—determined BEFORE delivery?



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Step 1, while the first, is also one of the most important steps to ensure the problem which is the focus is the actual problem you are trying to solve. Too many times the failure to define the challenge correctly and in enough detail can lead to false starts and not following the advice of “measure twice and cut once”. **Step 2**, discover, encourages people to determine what they need to know in order to solve the problem. This is about asking questions and wondering and being curious about what they know, what they need to know. **Step 3**, dream, is about imagining what a perfect solution would look like in action—not only look like but sound like and feel like as well. The more detailed the “dream”, the better handle the person or team has on the problem to be solved. **Step 4**, design, is about planning and laying out a road map so not only the team knows what steps they are taking and what the end solution will be, but as an advisor or mentor, you can understand what the team is trying to accomplish. **Step 6**, debrief, has two parts. **Part A**, determining the criteria for success, happens **PRIOR** to Step 5, which is deliver. Criteria for Success are the means by which the team will measure their success, it defines the outcomes and results they will be looking to accomplish. Preparing those criteria in advance of “deliver” is critical, and then once **Step 5**, deliver, is accomplished, moving to **Step 6** to debrief and determine next steps is essential.



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Candy Heart Towers

Background Information: Candy hearts, ones with messages to the person who will eat the heart, make these treats even more fun. Candy hearts come in a variety of sizes. For this investigation, plan on having different sizes so youth can choose to use one size or combine the sizes. These hearts are also known as conversation hearts and can be ordered from Amazon or look for them at the Dollar Store.

Challenge: Design and create a tower out of candy message hearts

Possible Criteria for Success: tower is free standing, tower is 6" tall or more, candy hearts are the only supply utilized

What you will need:

- Candy hearts
- Rulers
- Paper plate
- Paper
- Pencils
- Colored pencils



What you will do:

1. Assemble the teams. Review the Inquiry Model or the Solution Fluency Model which youth are to apply in the planning and execution of this challenge.
2. Ask the children:
 - a. What are some different things you can do with candy hearts?
 - b. In constructing a candy heart tower, do you think it would be better to use one or more than one size heart? Why do you answer as you do?
 - c. Thinking about a candy heart tower, what is your prediction as to how many hearts high your tower could be? Why do you answer as you do?
3. Share with them the materials they have to work with
4. Explain their challenge is to build a tower using only candy hearts
5. Divide the group into teams of 3-4 and distribute the supplies
6. Give children the opportunity to work on the tower, following the process of one of the models and recording each step on the paper. Encourage them to draw pictures.



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7. When complete, have them share with others.

Debrief:

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

The second step is to reflect on what has been learned. Here are some questions which may help youth reflect.

1. What question did we answer or problem did we solve?
2. How did your work help you meet your criteria for success?
3. Did the criteria place constraints on materials, time or cost?
4. In what ways did your drawing guide your work?
5. How could it have been more helpful?
6. What data did you collect?
7. In what ways was it the data needed?
8. What other data could you have collected?
9. What did you learn from the data you collected?
10. When you look at your solution compared to the solution of others, which do you think more successfully met the criteria for success and met any constraints on the solution?

Step three is to determine how the information gained in this Design Challenge can be used during the next one.

Note: For older youth have them build several different towers and record both predictions as to how tall it will be and the actual height. After 4-5 towers (all different) have them calculate the mean (the average), the mode (the height which most often occurred), the median (the trial which is in the middle of the towers) and the range (the lowest to the highest.)



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Cupid's Challenge #1

Background Information: In classical Roman mythology, Cupid is considered the “god of love.” Cupid has wings and a quiver of magic arrows which he shoots at someone (or maybe two someones) and when the magic arrows strike the person, instead of injury, the person or persons fall in love.

Challenge: Design and construct a target of cups, allocating points to each cup, and accurately hit as many cups as you can (getting the most points possible) by hitting the cup with an arrow (Q-Tip) which you launch through a straw.

Possible Criteria for Success: must earn 25 points, target must stay in tact, everyone on the team must hit the target at least once, target formation should include multiple opportunities for scoring points.

What you will need:

Invite youth to bring any recyclable items from home (water or soda bottle lids, plastic containers like for yogurt, other items they think they may need to meet the challenge.) Save these items if they are unused to add to your maker space supplies.



- Small 2-ounce cups (10 for each team)
- Straws (ones big enough for a Q-Tip to move through)
- Q-Tips
- Copy of hearts with numeric values on them (attached)

What you will do:

1. Assemble the teams. Review the Inquiry Model or the Solution Fluency Model, which youth are to apply in the planning and execution of this challenge.
2. Ask the children these questions:
 - a. What sort of formation might you use with your 10 cups to create a target?
 - b. What do you think you could do to be as accurate as possible when you launch your “arrow”?
 - c. How will you assign a point value to each of the cups in the target?
3. Explain to children will be using the supplies to build a target out of 10 cups, assigning point values to each cup, and then launching “arrows” at the target and earning points.



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4. Explain they will conduct at least three separate tests of the target and points they earn shooting the “arrows” and hitting the target.
5. Brainstorm 3 criteria for success that everyone will agree to work toward, no matter what they are making
6. Explain they have one day to complete the challenge

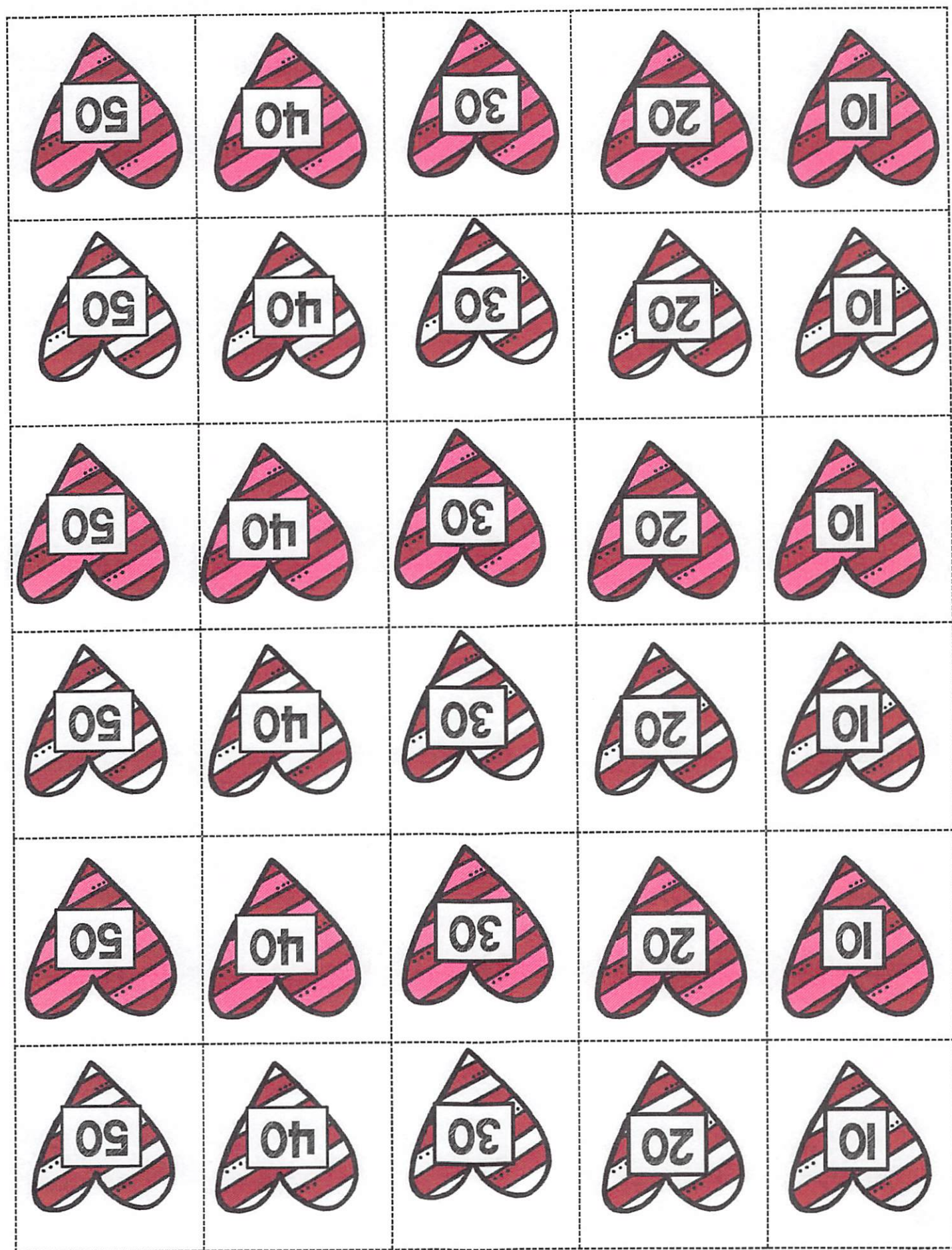
Debrief:

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

The second step is to reflect on what has been learned. Here are some questions which may help youth reflect.

1. What question did we answer or problem did we solve?
2. How did your work help you meet your criteria for success?
3. Did the criteria place constraints on materials, time or cost?
4. In what ways did your drawing guide your work?
5. How could it have been more helpful?
6. What data did you collect?
7. In what ways was it the data needed?
8. What other data could you have collected?
9. What did you learn from the data you collected?
10. When you look at your solution compared to the solution of others, which do you think more successfully met the criteria for success and met any constraints on the solution?

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Cupid Challenge #2

Background Information: Not only is it important for Cupid to be accurate (like in the last challenge), Cupid must also be able to launch the arrow for as far as necessary. When people know that Cupid is nearby, they can try to avoid the arrow. As a result, Cupid may need to be

“sneaky” and launch the arrows from quite a distance from the target.



Challenge: Launch Cupid’s arrows to achieve the farthest distance. Do 8-10 trials.

Possible Criteria for Success: Q-Tip arrows travel a minimum of five feet, learn the force which needs to be applied for maximum distance to be achieved, over half of the “arrows” land more than 5 feet from the launch pad.

What you will need:

- Straws (be sure they are big enough to accommodate the Q-Tip arrows)
- Q-Tips
- Measuring Tape
- Paper, pencil, colored pencils to record data

What you will do:

1. Assemble the teams. Review the Inquiry Model or Solution Fluency Model which youth are to apply in the planning and execution of this challenge.
2. Ask the children these questions:
 - a. Why is accuracy important for Cupid? (Challenge 2)
 - b. Why is distance important for Cupid? (This challenge)
 - c. What strategies might you use to ensure both accuracy and distance?
3. Share the challenge with the children
4. Brainstorm 3 criteria for success that everyone will agree to work toward, no matter how they do this project.
5. Demonstrate different ways to ensure distance. Discuss each of the strategies.
6. Invite teams to complete the Inquiry Process to create the apple tree.



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Debriefing

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

The second step is to reflect on what has been learned. Here are some questions which may help youth reflect.

1. What question did we answer or problem did we solve?
2. How did your work help you meet your criteria for success?
3. Did the criteria place constraints on materials, time or cost?
4. In what ways did your drawing guide your work?
5. How could it have been more helpful?
6. What data did you collect?
7. In what ways was it the data needed?
8. What other data could you have collected?
9. What did you learn from the data you collected?
10. When you look at your solution compared to the solution of others, which do you think more successfully met the criteria for success and met any constraints on the solution?

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What's Up With Candy Hearts?

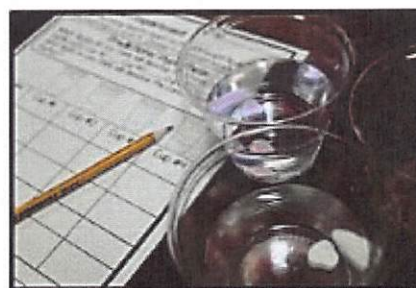
Background Information: When candy hearts come into contact with different liquids, the reactions of the candy hearts can be similar or very different. The reactions often depend on the liquid itself. In this experiment youth will observe the different reactions of candy hearts and a minimum of 4 different liquids which could include water, oil, vinegar, lemon juice, soda, orange juice, chicken broth and any other liquid you can think of.

Challenge: Observe and record what occurs when candy hearts are placed in different liquids over time

Possible Criteria for Success: time the amount of time it takes the candy heart to dissolve, order the time to dissolve from shortest to longest and compare to predictions, determine "why" different substances dissolve the candy heart in shorter or longer time frames

What you will need:

- Candy hearts
- Clear plastic cups (10-16 ounce cups)
- Water
- Oil
- Vinegar
- Lemon juice
- Soda
- Orange juice
- Chicken broth
- Pencil and recording sheet



What you will do:

1. Assemble the teams. Review the Inquiry Model or the Solution Fluency Model which they are to apply in the planning and execution of this challenge.
2. Explain their task is to observe and record what occurs when candy hearts are placed in different liquids over time
3. Brainstorm the Criteria for Success with the children, agreeing upon 3 criteria
4. Ask children these questions:
 - a. Which of the liquids do you predict will dissolve the candy heart the most quickly? Why do you answer as you do?
 - b. Do you think the color of the heart will make a difference in the dissolve rate? Why do you answer as you do?



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- c. How will you label the cups? Why do you think labeling the cups with the name of the liquid is important?
5. Explain they will have one day for this project

Debriefing

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

The second step is to reflect on what has been learned. Here are some questions which may help youth reflect.

1. What question did we answer or problem did we solve?
2. How did your work help you meet your criteria for success?
3. Did the criteria place constraints on materials, time or cost?
4. In what ways did your drawing guide your work?
5. How could it have been more helpful?
6. What data did you collect?
7. In what ways was it the data needed?
8. What other data could you have collected?
9. What did you learn from the data you collected?
10. When you look at your solution compared to the solution of others, which do you think more successfully met the criteria for success and met any constraints on the solution?

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Candy Heart Experiment

Label each cup with the name of the liquid you have placed in each cup

Observation Notes

Time	Cup #1 Liquid Name	Cup #2 Liquid Name	Cup #3 Liquid Name	Cup #4 Liquid Name
15 minutes				
30 minutes				
1 hour				
2 hours				

Results:



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Candy Heart Sling Shot

Background information: Sling shots have been around for a very long time. In ancient days the slingshot was used as a weapon when hunting for food and also when trying to protect yourself. The concept of a slingshot is to increase the force or power behind launching a projectile. A sling shot allows the shooter to focus the force on a very narrow spot so the force is intensified.

Challenge: Design and redesign as necessary a sling shot which can launch candy hearts considering both accuracy and distance.

Possible Criteria for Success: candy heart hits the target at 4', 5' and 6', all members of the team hit the target 3 out of 5 trials, number of materials utilized

What you will need:

- Craft Stick—regular or jumbo
- Candy hearts
- Rubber bands
- String
- Elastic
- Target
- Measuring tapes
- Recording sheet
- Pencil

What you will do:

1. Assemble the teams. Review the Inquiry Model or the Solution Fluency Model which youth are to apply in the planning and execution of this challenge. Mind them they need to draw their sling shot BEFORE they build it
2. Explain their task is to build a sling shot which launch candy hearts both accurately and for distance
3. Share with them the materials they may use—brainstorm different ways to create a sling shot
4. Brainstorm the Criteria for Success with the youth, agreeing upon 3 criteria
5. Ask children these questions:
 - a. What are some uses of a sling shot?





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- b. Why do you think accuracy is important? How would you define accuracy?
- c. Why do you think the distance a sling shot projectile can travel is important?
- 6. Explain they will have one day for this project
- 7. Explain teams will design and create a sling shot which will meet the Criteria for Success the group agreed upon

Debriefing

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

The second step is to reflect on what has been learned. Here are some questions which may help youth reflect.

- 1. What question did we answer or problem did we solve?
- 2. How did your work help you meet your criteria for success?
- 3. Did the criteria place constraints on materials, time or cost?
- 4. In what ways did your drawing guide your work?
- 5. How could it have been more helpful?
- 6. What data did you collect?
- 7. In what ways was it the data needed?
- 8. What other data could you have collected?
- 9. What did you learn from the data you collected?
- 10. When you look at your solution compared to the solution of others, which do you think more successfully met the criteria for success and met any constraints on the solution?

Step three is to determine how the information gained in this Design Challenge can be used during the next one.



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Valentine Candy Catapult

Background information: This engineering project provides youth with another opportunity to build a catapult. Learning from the previous investigations, the youth will want to build a catapult which is accurate and will send projectiles quite a distance. This catapult will be launching Heart Candy or cotton balls which will look like snowballs.

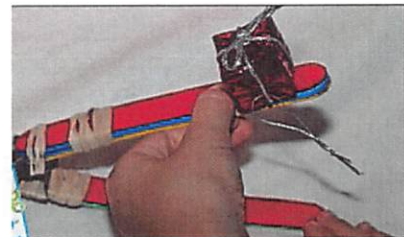
Challenge: Design and create a catapult that will launch candy hearts. The catapult must fly the candy hearts far and accurately.

Possible Criteria for Success: catapult launches candy heart a minimum of 5 feet, catapult can “fire” 5 candy hearts in 60 seconds, catapult can launch more than one candy heart at a time

What you will need:

Invite youth to bring any recyclable items from home (water or soda bottle lids, plastic containers like for yogurt, other items they think they may need to meet the challenge. Save these items if they are unused to add to your maker space supplies.

- Craft sticks
- Rubber bands
- Clips
- Plastic spoons
- Heart Candy or Cotton Balls for snowballs
- Rulers
- Paper and pencil



What you will do:

1. Assemble the teams. Review the Inquiry Model or the Solution Fluency Model which youth are to apply in the planning and execution of this challenge.
2. Explain their task is to build a catapult which will launch candy hearts or cotton balls with both accuracy and distance.
3. Share with them the materials they have to use—brainstorm different ways to make the catapult
4. Brainstorm the Criteria for Success with the children, agreeing upon 3 criteria
5. Ask the children these questions:
 - a. What did you learn from the last time we made catapults?
 - b. What do you believe will be the most challenging part of this build?
 - c. How will you determine if your catapult is accurate?



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6. Explain they will have one day for this project
7. Explain they will be successful if the team members all participate in this project.

Debriefing

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

The second step is to reflect on what has been learned. Here are some questions which may help youth reflect.

1. What question did we answer or problem did we solve?
2. How did our work meet the criteria for success?
3. Did the criteria place constraints on materials, time or cost?
4. In what ways did our drawing guide our work?
5. How could it have been more helpful?
6. What data did we collect?
7. In what ways was it the data needed?
8. What other data could we have collected?
9. What did we learn from the data we collected?
10. When we look at our solution compared to the solution of others, which do we think more successfully met the criteria for success and meet any constraints on the solution?

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Spaghetti and Marshmallow Tower (Alternative to Eiffel Tower)

Background information: Building towers is fun but can also be frustrating if the tower won't stand up. It is important to consider how you can reinforce a tower, especially one made from something like spaghetti which can break easily, at each level of the tower. Youth are encouraged to consider how to make the tower stable first and then tall.

Challenge: Design and construct a tower using spaghetti and marshmallows and other supplies to make the tower more stable.

Possible Criteria for Success: height of the tower, how long the tower will free-stand on its own, the number of materials used in the build

What you will need:

Invite youth to bring any recyclable items from home (water or soda bottle lids, plastic containers like for yogurt, other items they think they may need to meet the challenge. Save these items if they are unused to add to your maker space supplies.

- Spaghetti
- Miniature marshmallows
- Craft sticks
- Straws
- Tape
- Glue sticks
- Ruler
- Tape
- Paper
- Straws

What you will do:

1. Assemble the teams. Review the Inquiry Model or the Solution Fluency Model which youth are to apply in the planning and execution of this challenge.
2. Explain their task is to create a tower using predominantly spaghetti and miniature marshmallows.
3. Share with them the materials they have to use—brainstorm different ways to build a tower which will stand alone
4. Brainstorm the Criteria for Success with the children, agreeing upon 3 criteria
5. Ask the children these questions:
 - a. What are some ways you can reinforce spaghetti so it is less likely to break?



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- b. What other materials could you use other than marshmallows to hold the spaghetti together as a tower?
 - c. What do you think the challenges will be with this tower? How might you keep those challenges from derailing your tower?
6. Explain they will have one day for this project
7. Explain when finished they will assess their tower based on the Criteria for Success

Debriefing

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

The second step is to reflect on what has been learned. Here are some questions which may help youth reflect.

1. What question did we answer or problem did we solve?
2. How did our work meet the criteria for success?
3. Did the criteria place constraints on materials, time or cost?
4. In what ways did our drawing guide our work?
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10. When we look at our solution compared to the solution of others, which do we think more successfully met the criteria for success and meet any constraints on the solution?

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Eiffel Tower

Background Information: Paris, France is often called the "City of Love". One of the most iconic features in Paris which the whole world knows, is the Eiffel Tower. The plan was to build a tower 300 meters high as part of preparations for the World's Fair of 1889.

The wager was to "study the possibility of erecting an iron tower on the Champ-de-Mars with a square base, 125 meters across and 300 meters tall". Selected from among 107 projects, it was that of Gustave Eiffel, an entrepreneur, Maurice Koechlin and Emile Nouguier, both engineers, and Stephen Sauvestre, an architect, that was accepted.

Emile Nouguier and Maurice Koechlin, the two chief engineers in Eiffel's company, had the idea for a very tall tower in June 1884. It was to be designed like a large pylon with four columns of lattice work girders, separated at the base and coming together at the top, and joined to each other by more metal girders at regular intervals. The tower project was a bold extension of this principle up to a height of 300 meters - equivalent to the symbolic figure of 1000 feet. On September 18 1884 Eiffel registered a patent "for a new configuration allowing the construction of metal supports and pylons capable of exceeding a height of 300 meters".



In order to make the project more acceptable to public opinion, Nouguier and Koechlin commissioned the architect Stephen Sauvestre to work on the project's appearance.

Challenge: Build a replica of the Eiffel Tower using newspaper or other paper, that is able to stand on its own.

Criteria for Success: free standing, use only two supplies, stands 3 feet tall, able to withstand a breeze caused by a fan.

What you will need:

- Newspaper or other paper
- Straws
- Pipe Cleaners
- Rulers
- Pencils (unsharpened to use for supports if desired)



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- Craft sticks
- Other recyclables as needed

What you will do:

1. Bring youth together and share the challenge with them
2. Review the Inquiry Model which they are to apply in the planning and execution of this challenge.
3. Divide the group into workgroups of 3-4 youth
4. Distribute the supplies
5. Brainstorm the Criteria for Success
6. Explain they may fold, tear, bend, or roll the paper to make the tower. Explain they are creating to best meet the criteria for success they identified.
7. Ask the children these questions:
 - a. What do you notice about the Eiffel Tower when you look at a picture of it?
 - b. Why do you think this Tower is so well known?
 - c. What do you think will be a way to support the tower from top to bottom? Why do you answer the way you do?
8. Explain they will have one day for this project
9. Explain they will be assessing the work they've done against the Criteria for Success

Debriefing

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

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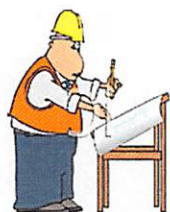
1. What question did we answer or problem did we solve?
2. How did our work meet the criteria for success?
3. Did the criteria place constraints on materials, time or cost?
4. In what ways did our drawing guide our work?
5. How could it have been more helpful?
6. What data did we collect?
7. In what ways was it the data needed?



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8. What other data could we have collected?
9. What did we learn from the data we collected?
10. When we look at our solution compared to the solution of others, which do we think more successfully met the criteria for success and meet any constraints on the solution?

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February 28th All

Cupid's Dilemma

Background information: It's Cupid's busiest time of year and he has a MAJOR dilemma! He has injured one of his wings and cannot fly to Lover's Lane. There is a wide river that separates his house and Lover's Lane and he needs a way to get across the river so that he can deliver his arrows on time.

Challenge: Construct a floating structure that will get Cupid to his destination on Lover's Lane.

Possible Criteria for Success: device can hold Cupid, device can move across water, device can help raise Cupid in the air so he has a good target for his arrows, Cupid's deadline in amount of time, to deliver the arrows

What you will need:

Invite youth to bring any recyclable items from home (water or soda bottle lids, plastic containers like for yogurt, other items they think they may need to meet the challenge. Save these items if they are unused to add to your maker space supplies.



- Marshmallows
- Toothpicks
- Craft sticks
- Paper and pencil
- Colored pencils
- Painter's tape
- Glue sticks
- Straws
- Small pool with water

What you will do:

1. Assemble the teams. Review the Inquiry Model or the Solution Fluency Model which youth are to apply in the planning and execution of this challenge.
2. Explain their task is to create a floating device which will get Cupid to Lover's Lane in time to deliver his arrows
3. Share with them the materials they have to use—brainstorm different ways to build a device which can float across the river



Engineering Design

4. Brainstorm the Criteria for Success with the children, agreeing upon 3 criteria
5. Ask children these questions:
 - a. Other than floating across the river, how else might Cupid make it to Lover's Lane?
 - b. Why do you think Cupid's mission is time sensitive? Why do you think as you do?
 - c. What do you think will be the best way to meet this challenge?
6. Explain they will have one day for this project

Debriefing

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

The second step is to reflect on what has been learned. Here are some questions which may help youth reflect.

1. What question did we answer or problem did we solve?
2. How did our work meet the criteria for success?
3. Did the criteria place constraints on materials, time or cost?
4. In what ways did our drawing guide our work?
5. How could it have been more helpful?
6. What data did we collect?
7. In what ways was it the data needed?
8. What other data could we have collected?
9. What did we learn from the data we collected?
10. When we look at our solution compared to the solution of others, which do we think more successfully met the criteria for success and meet any constraints on the solution?

Step three is to determine how the information gained in this Design Challenge can be used during the next one.



Engineering Design

January 31st Rock Tower TK-K to 3rd Grades

Background information: Earth has a crust. It is mostly covered by water, soil, and plants. But under that, the Earth's crust is rock. Rocks can be big or small, and rocks can be rough or smooth. Rocks can be found outside in a garden or on a bridge. Rocks can be found inside a home on the floors or fireplaces. Rocks come in a variety of colors and can be tumbled and polished to show their beauty. Rocks are everywhere. In the desert, animals use rocks to give them a vantage point so they can see further than if they are on the ground. Animals also use rocks to hide under and to protect them from danger.

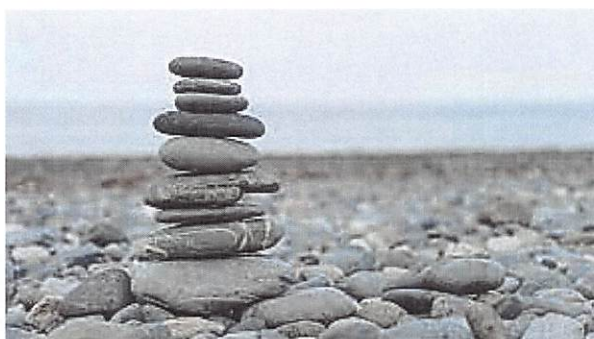
Challenge: Design and construct a tower of rocks which a lizard could sit atop or hide under

Possible Criteria for Success: height of the tower (up to your knees?), length of time tower must stand, must support a lizard....

What you will need:

Invite youth to bring any recyclable items from home (water or soda bottle lids, plastic containers like for yogurt, other items they think they may need to meet the challenge. Save these items if they are unused to add to your maker space supplies.

- Rocks of different sizes and shapes
- Walk through the playground or grounds and find rocks to add to what you are providing
- Any other materials children ask for



What you will do:

1. Assemble the teams. Review the Inquiry Model which they are to apply in the planning and execution of this challenge.
2. Explain their task is to create a tower using only rocks that a lizard might sit upon
3. Share with them the materials they have to use—brainstorm different ways to build a rock tower.
4. Brainstorm the Criteria for Success with the children, agreeing upon 3 criteria
5. Ask the children these questions:
 - a. Where do rocks come from?
 - b. What shapes and sizes are your rocks?
 - c. Are your rocks smooth or rough?



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- d. What would happen if you put a big rock on a small rock?
- e. What will help your tower to stay standing?
6. Explain they will have one day for this project
7. Explain the winning teams will be the teams that design and create a rock tower which will meet the Criteria for Success

Debriefing

When the challenge is finished it is important to debrief the engineering process with the youth. The debriefing process begins with a quick review of what was done. Since this is a group project have the group review.

The second step is to reflect on what has been learned. Here are some questions which may help youth reflect.

1. What question did we answer or problem did we solve?
2. How did our work meet the criteria for success?
3. Did the criteria place constraints on materials, time or cost?
4. In what ways did our drawing guide our work?
5. How could it have been more helpful?
6. What data did we collect?
7. In what ways was it the data needed?
8. What other data could we have collected?
9. What did we learn from the data we collected?
10. When we look at our solution compared to the solution of others, which do we think more successfully met the criteria for success and meet any constraints on the solution?

Step three is to determine how the information gained in this Design Challenge can be used during the next one.