STEM-A-THON!
Get Caught Engineering

A Bundle of Engineering Activities

Why Engineering?

Get Caught Engineering was created to inspire elementary students to explore the world of engineering and apply the design process to problem solving. After investigating what is already available in this area, we found there are some great materials but they are either dedicated to gifted and talented classes, for after school programs, or are lengthy units that are too expensive or too time consuming. **Get Caught Engineering** has been developed to introduce all children to engineering concepts in a teacher friendly approach that easily integrates into subject areas. Simple low cost materials, lesson templates, and teacher tips all add up to user friendly activities that will inspire children to consider engineering as a cool career choice, and a reason to pursue math and science classes during their school years.

The engineering profession is concerned within ten years there will not be enough engineers to meet America's needs. Studies show that the time to inspire students' interest in these fields is at the elementary level. Through introductory engineering lessons, elementary level teachers can plant the seeds of inspiration for future engineers for our country.

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with
Get Caught Engineering
Bulletin Board and Center Display Pieces

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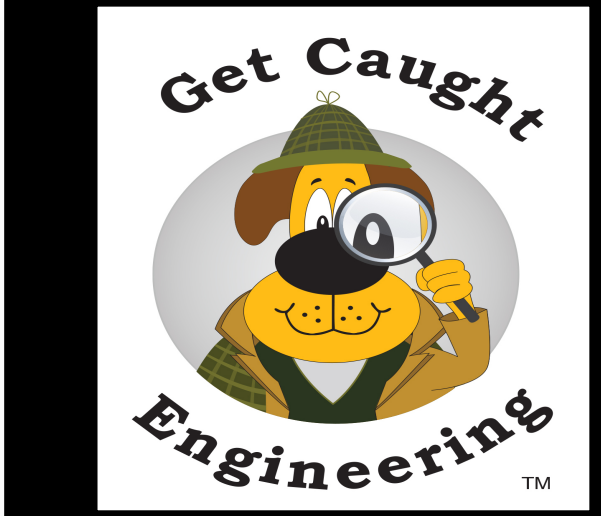
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A Novel Idea: STEM Character Statues

Mechanical, Material, and Structure Engineering

Calling all P.I.s …PROBLEM INVESTIGATORS!

The town of STEM-a-lot is erecting a museum that will have an exhibit displaying statues of their favorite story characters. These statues must not only be dressed in authentic clothing but must have at least one moving part. A structure to hold the statue upright must also be designed. They know that as an engineer, you have the skills to build a prototype for this structure. We are counting on your skills with the five P's: **problem solving, planning, perseverance, patience,** and **presentation** as you **engineer** an answer!

Here's the problem:

We need you to develop a prototype of a character statue . You must use what you know about your chosen character to dress them in clothes they would have worn. After you design your statue, you need to design a stand to hold the it upright. Your statue must have one moving part.

Your materials:

construction paper
brads
bendable straws
rubber bands
craft sticks
scissors
masking tape and plastic tape
coffee stirs
glue
pipe cleaners
toothpicks

Ask:

1. What do you know about the character that you have chosen?

_____

_____

2. Have you ever seen a stand for a doll ? What do they look like?

_____

_____

Imagine:

What are some ways you can make your statue move?

_____

_____

Plan:

Sketch your team's design

Create:

Build the prototype following your design

Test

Evaluate your statue

Does it have at least one moveable part? **Yes** **No**

Does the stand hold it upright? **Yes** **No**

Improve

If your statue did not meet your criteria, how will you change it?

_____

_____

_____

Patience (Keep Trying)

Look at your statue again.

Does it have a part that moves? **Yes** **No**

Does the stand hold it upright? **Yes** **No**

If your statue still doesn't move or stand up, what will you change to fix this?

_____

_____

Look at your statue again

Does it have a part that moves? **Yes** **No**

Does the stand hold it upright? **Yes** **No**

Presentation

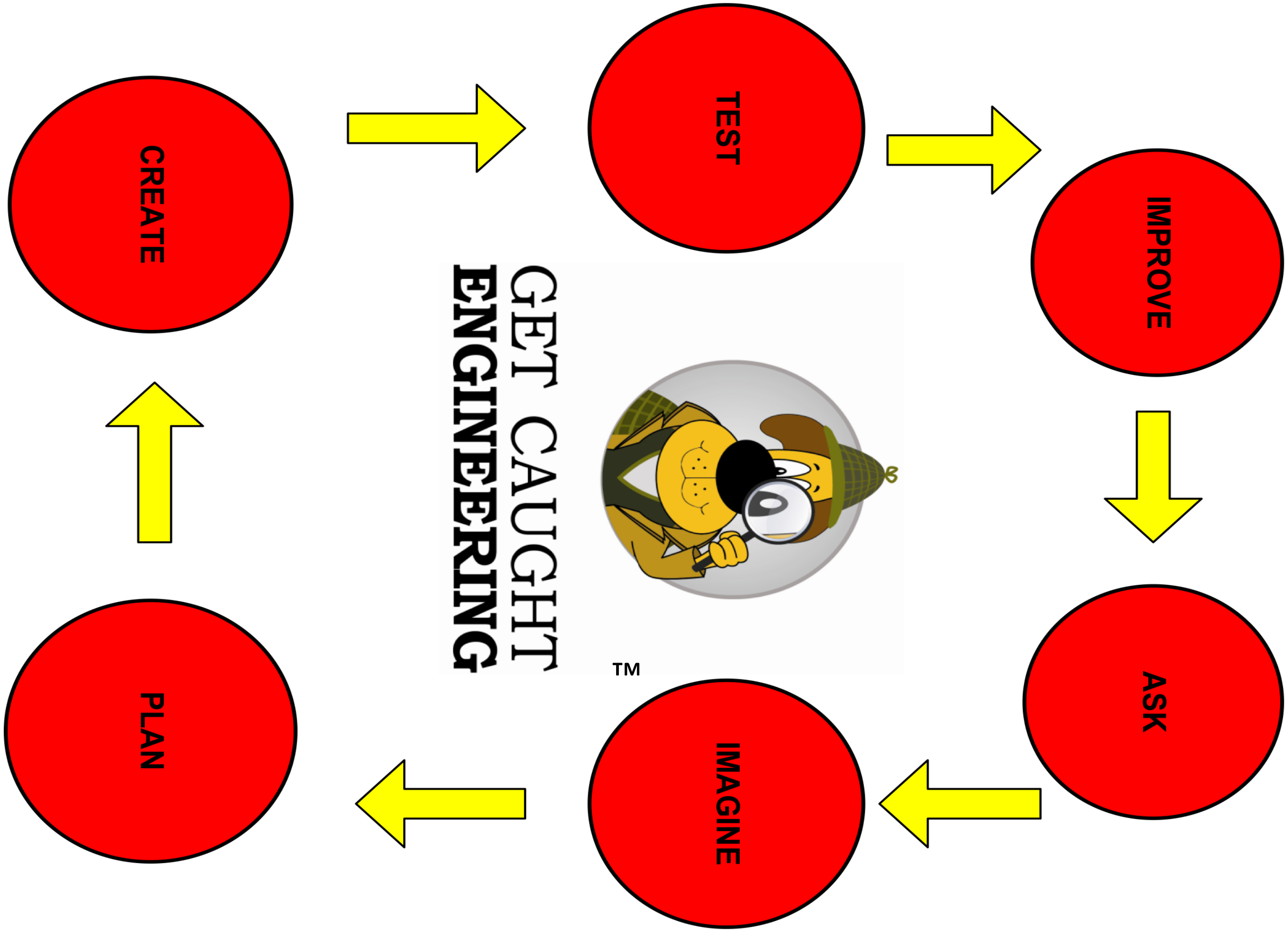
Prepare a presentation that:

Explains your plan and why you chose that design

Shows how you solved problems

Shares how you persevered

Gives examples of your team's patience



RUBRIC				
	No Evidence	Some Understanding	Good Understanding	Excellent Understanding
Brainstormed ideas				
Created and labeled a sketch to use a blueprint				
Evaluated how to make it better				
Completed Presentation				

Teacher Notes

This activity can be used with any story character that your students are studying. For younger students, it can be used as a stand alone project. For older students, it can be a part of a larger writing project. Although it is written for the statue to have one moving part, teachers can specify what specific part should move i.e. the right arm, and can even specify an action such as removing a hat or saluting. Characters could hold objects that represent their specific accomplishments.

Before you begin the activity, decide on how many groups you will have and who will be in each group. We recommend that each group be composed of 3 or 4 students. Consider each of your students' strengths and weaknesses as you form groups. The dynamic within each group can dictate whether or not they are successful. This lesson has been written to allow the students to choose from a variety of materials that will be offered. Teachers can choose to make the problem more challenging by limiting the number or amount of materials available. Students can also be provided a budget with a corresponding price list for supplies. Upper students could also be challenged to compute the cost of their doll and stand.

Introduce the Design Process

Pass out a copy of the Get Caught Engineering Design Process so the students can refer to them throughout the activity. Tell the students that the Engineering Design Process gives engineers a framework to help them solve problems. Although the process looks like a continuous circle, most times, engineers do not make it all the way to the test step without many times going back to earlier steps.

It is suggested that this is a good time to address that the solution will not come easily and it is expected that several designs will have to be created in order to be successful. Engineers expect to fail during the process and perceive failure as merely a step that leads them to the solution.

"I am not discouraged, because every wrong attempt discarded is another step forward" Thomas Edison

Ask

Before engineers can plan and design a solution to a problem, they first need to totally understand the problem and know what all of the constraints are.

Define the word constraint and have the students compile a list of constraints for this activity. Write the list on a large piece of paper or on the Smart Board. This list should be kept posted in an area that the students can continually refer to it.

Encourage the students to ask questions about the requirements of the solution to the problem. In some cases, you may need to model a question that might be asked. Ask the students which part of the statue should move. What are ways this can be accomplished? It would be a good idea when working with younger students to ask them about doll stands and other supportive structures they might have seen.

Show the students the materials that will be available for their use during this activity.

Plan

Have individual students write and sketch their ideas and solutions. Drawings should be detailed and labeled. Once every student has several ideas, assign students to their groups. Each member should have an opportunity to share their ideas while the others consider the pros and cons of each idea. It is important for the teacher to set this expectation at the beginning of the first meeting of the groups. The group should decide upon a design and create a detailed, labeled drawing.

Create

Once the group has produced a detailed plan and drawing they can gather their materials and proceed.

As the students create, circulate among the groups to evaluate how they are progressing.

As they build, the students will face and need to overcome many problems. It can be frustrating for students to have repeated failures; therefore it is recommended to end the first "creating" session with a discussion of how things are going. Reiterate to the students that engineers fail many times before they succeed and just like real engineers, they are continually learning while they are failing.

As you walk around you may need to help students focus on what specific parts of their design are working and what specifically is not working. In our experience some groups continually start over rather than pinpoint the flaw in their design.

Encourage group members that are having great difficulty coming up with a plan that works. Invite them to walk around the room and look at others' designs. You may have to have a discussion with the class that this is not cheating, rather a communication of ideas.

Test

Students will evaluate their statue and their stand throughout the process.

Redesign or Improve

If a group is meets all of the requirements, ask them to discuss and plan with their group members how the statue and stand can be improved. If their statue and stand aren't meeting minimum requirements, encourage the team to focus on the part that isn't working. Ask them if it is a problem with how they built their statue or stand, or is the problem with the design? Have the group go back and either work on the statue or stand or begin to redesign their statue or stand.

Reflection

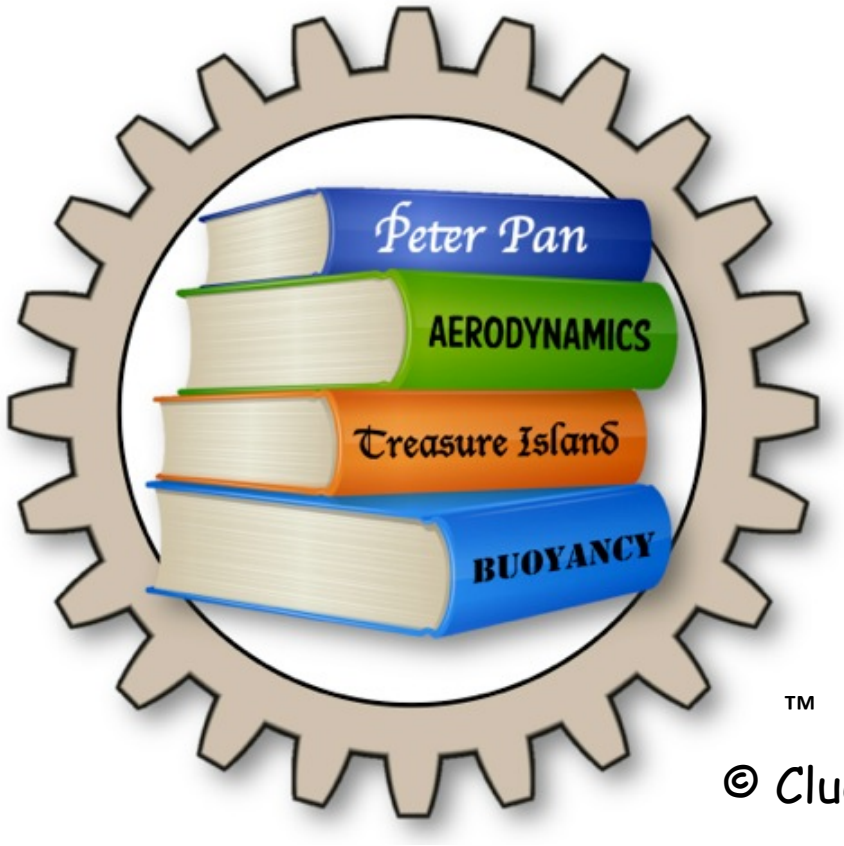
It is helpful for the students to reflect on their experience once the activity is over. They should reflect upon not only their solution but also to the workings of their group. Questions to ask are:

- What went well?
- What didn't work? Include not only design but group interaction
- What would you do differently next time?

Get Caught Engineering™

Presents:
Classical Engineering

Wizard of Oz
An Engineering Exploration of Structures



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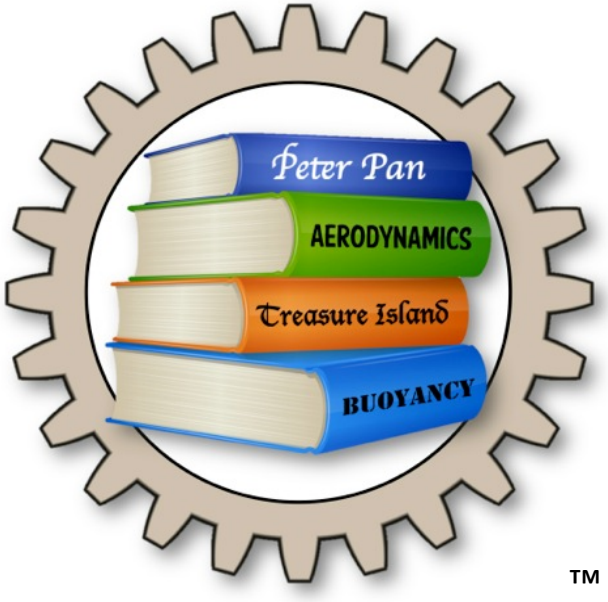


Dorothy, in The Wizard of Oz, lives in Kansas where there are a lot of tornadoes. The story begins when a tornado hits the farm she lives on. This tornado lifts up her house and transports her to the land of Oz. Upon returning from Oz, Dorothy would like to live in a house that will be able to withstand another tornado. She is looking for engineers to design and build a prototype for her new house. We are counting on your skills with the five P's: **problem solving, planning, perseverance, patience,** and **presentation** as you **engineer** an answer.

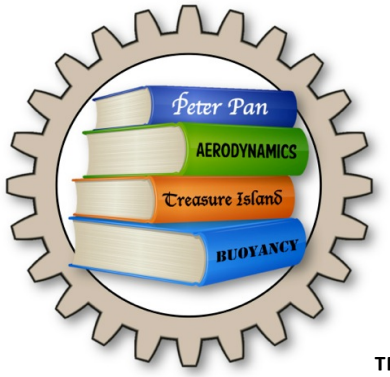
Here's the problem:

We need for you to develop a prototype for a house that can withstand a tornado. Use what you know about structural design to build a structure out of provided materials that will withstand a tornado (hairdryer on high) for 60 seconds. The house must:

- Have four walls, a ceiling and a door
- Be tall enough for "Dorothy" (a 6" doll) to stand up in
- May not be taped to the table

Your materials:

- straws
- Craft sticks
- Pipe cleaners
- toothpicks
- 2 pieces of 8 ½" X 11" paper
- paper clips
- tape
- 5 Index cards
- Scissors



Problem Solving

Ask:

What do you know about materials suitable for building? Are all shapes equally strong?

_____
_____
_____
_____

Imagine:

What are some ideas you can try as you design your house?

_____
_____
_____
_____
_____

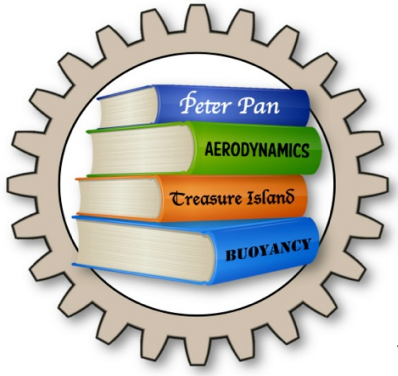
Planning

Plan:

Sketch your team's design

Create:

Build the prototype following your design



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Perseverance

Test

Test your house with the hair dryer

Did it withstand the wind for 60 seconds? Yes No

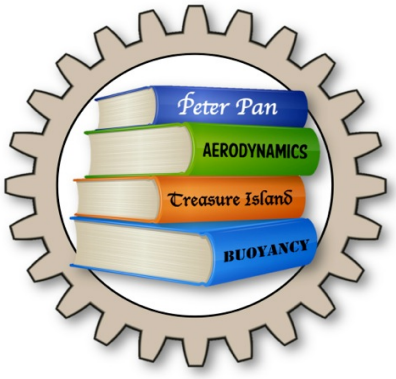
Improve

If your house did not meet your criteria, what will you change?

_____

_____

_____



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Patience

Patience (Keep Trying)

Test your house again.

Did it withstand the wind for 60 seconds? Yes No

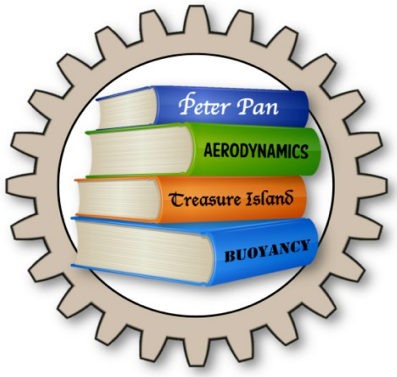
If your house does not meet your minimum criteria, what additional changes can you make to meet the criteria? If it did, can you engineer it to withstand the wind for a longer period of time?

_____

_____

Test the house again.

How long did it withstand the wind? _____



TM

Presentation

Prepare a presentation that:

Explains your plan and your design

Shows how you solved problems

Shares how you persevered

Gives examples of your team's patience

RUBRIC				
	No Evidence	Some Understanding	Good Understanding	Excellent Understanding
Brainstormed ideas				
Created and labeled a sketch to use a blueprint				
Evaluated how to make it better				
Completed Presentation				

Teacher Note

This activity is designed to allow students to apply what they know about structures. Students will need to investigate the strengths of various shapes and apply that knowledge to the problem. If your students are unfamiliar with these concepts, it is suggested that pictures of various buildings be available to the students.

Before you begin the activity, decide on how many groups you will have and who will be in each group. We recommend that each group be composed of 3 or 4 students. Consider each of your students' strengths and weaknesses as you form groups. The dynamic within each group can dictate whether or not they are successful. This lesson has been written for the materials offered to be limited and handed to them in a kit. Teachers can choose to make the problem more challenging by placing a dollar amount on each item, giving the students a budget and have them purchase materials wanted. Upper students could be challenged to compute the cost of their structure, per inch.

Introduce the Design Process

Pass out a copy of the Get Caught Engineering Design Process so the students can refer to it throughout the activity. Tell the students that the Engineering Design Process gives engineers a framework to help them solve problems. Although the process looks like a continuous circle, most engineers do not make it all the way to the test step without going back to earlier steps.

It is suggested that this is a good time to address that the solution will not come easily and it is expected that several designs will have to be created in order to be successful. Engineers expect to fail during the process and perceive failure as merely a step that leads to the solution.

"I am not discouraged, because every wrong attempt discarded is another step forward" Thomas Edison

Ask

Before engineers can plan and design solution to a problem, they first need to totally understand the problem and know what all of the constraints are. Define the word constraint and have the students compile a lit of constraints for this activity. Write the list on a large piece of paper or on the Smart Board. This list should be kept posted in an area that the students can continually refer to it. Encourage the students to ask questions about the solution to the problem. In some cases, you may need to model a question that might be asked. Ask the students what they know about structures. Show the students the materials in their kit that will be available for their use during the activity.

Plan

Have individual students write and sketch their ideas and solutions. Drawings should be detailed and labeled. Once every student has several ideas assign students to their groups. Each member should have an opportunity to hare their ideas while the others consider the pros and cons of each idea. It is important for the teacher to set this expectation at the beginning of the first meeting of the groups. The group should decide upon a design and create a detailed, labeled drawing.

Create

Once the group has produced detailed plan and drawing they can gather proceed. As the students create, circulate among the groups to evaluate how they are progressing. As they build, the students will face and need to overcome many problems. It can be frustrating for students to have repeated failures; therefore it is recommended to end the first “create” session with a discussion of how things are going. Reiterate to the students that engineers fail many times before they succeed and just like real engineers, they are continually learning while they are failing.

As you walk around you may need to help students focus on what specific parts of their design are working and what specifically is not working. In our experience some groups continually start over rather than pinpoint the flaw in their design.

Encourage group member that are having great difficulty coming up with a plan that works. Invite them to walk around the room and look at others' designs. You may have to have a discussion with the class that this is not cheating, rather a communication of ideas.

Test

As students feel that they are ready, they can test the strength of their structure by having the teacher blow the hair dryer on it for several seconds.

Redesign or Improve

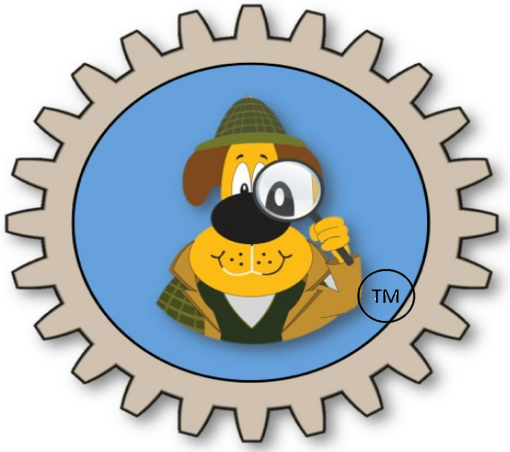
If a group's house does not hold steady against the blow drier, have the group analyze the structural elements for weakness.

If the house falls over, they must redesign and rebuild. Encourage the team members to focus on what is working and what specifically is keeping them from being successful. Is the flaw in the design or in the way the structure was built?

Those students who have successfully solved the problem can be encourage to make improvements to make the structure more stable.

"SWOOSH!"

Straw Rocketry
with
Aeronautical Engineering



Engineering Energizers!

Quick Classroom Lessons to Activate the Design Process

Teacher Notes and Materials List

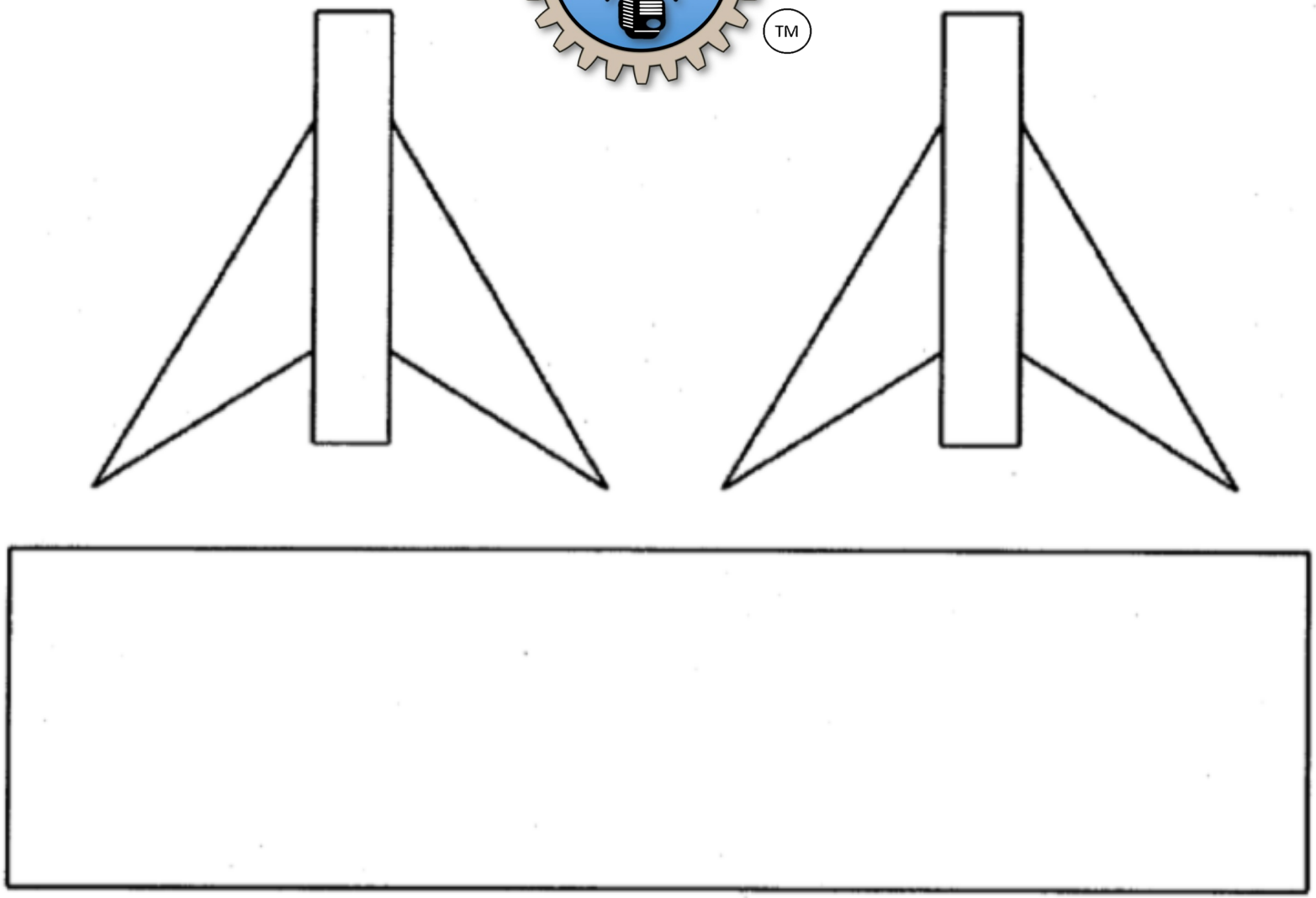
Time: One Hour

Materials:
- one new sharpened pencil
- one soda straw
- template for rocket body and fins
- ¼ inch tape
- scissors

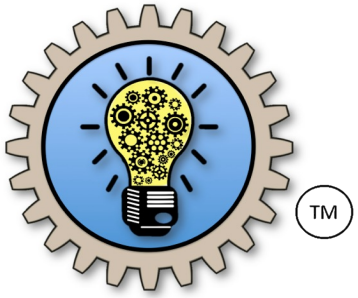
Using a template, a straw, and a pencil, students will decorate and build a simple rocket propelled by blowing through the straw. Students can engineer their rocket's propulsion by moving the fins or changing the length of the body of the rocket. To add rigor, measurements can be made and data collected adjustments are made to the rocket.

Swoosh! Soda Straw Rocketry

- Color and decorate the rectangle and fins on the template. This will form the body tube of your rocket
- Carefully cut out the rectangle and wrap the rectangle around a #2 pencil, lengthwise. Tape the rectangle so that it forms the tube.
- Carefully cut out the two fin units and place the small rectangle piece between the two fins to match with the end of your body tube. Tape it to the body tube. Tape the tube about 1/4" above the end of the tube. Be careful not to tape anything directly to the pencil. Do the same thing for the other fin unit, but tape it on the other side of the pencil, so you have a matching set.
- Bend each fin unit to form a right angle (90 degrees) to the tube.
- At the sharpened end of your pencil, twist the top of the body tube into a nose cone
- Remove the pencil and replace it with a soda straw. Blow into the straw to launch your rocket.
- Record the distance that it flies.



Think...Create...Think...



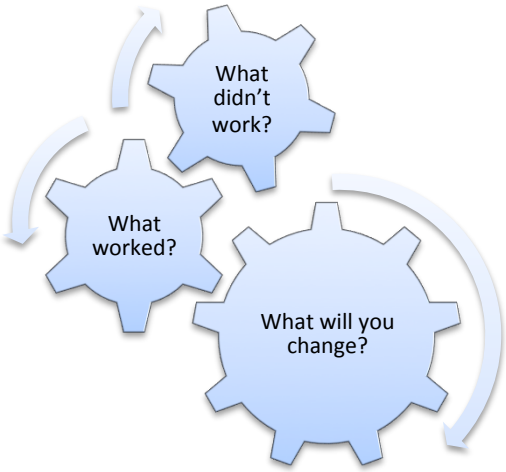
...Think...Create...Think

My Design

WHAT I ENGINEERED!

How far did your rocket fly?

What changes will you make?



Wind Which Way?
An Engineering Exploration of Structural Materials

Get Caught Engineering
CLUE Resources LLC

Calling all P.I.s …PROBLEM INVESTIGATORS!

The children in the town of STEM-a-lot would like to know which way the wind is blowing each day. They would like you to design and build a prototype of a wind vane for their town. They know that as an engineer, you have the skills to build a prototype for this structure. We are counting on your skills with the five P's: **problem solving, planning, perseverance, patience,** and **presentation** as you **engineer** an answer!

DAY ONE:

Here's the problem:

Using what you know about materials and how a wind vane works, create a structure that will rotate in the wind and point into the wind.

Your materials

- Straws
- cups
- tape
- rubber bands
- beads
- foam pieces
- dowling
- paper
- pins

Problem Solving

Ask:

What do you know about wind vanes?

_____

_____

Where are wind vanes used?

_____

_____

Looking at the different materials. Which ones do you think have the best properties for building a wind vane?

_____

_____

Imagine:

What are some ideas you can try as you design your structure? How does that information help you design your structure?

_____

_____

_____

_____

Plan:

Sketch your team's design

Create:

Build the prototype following your design

Test

Test your structure

Does it rotate when you blow on it? **Yes** **No**

Does it have a pointer? **Yes** **No**

Improve

If your structure did not meet your criteria, what will you change?

_____

_____

_____

Patience (Keep Trying)

Test your windmill again

Does it rotate when you blow on it?	**Yes**	**No**
Does it have a pointer?	**Yes**	**No**

If your structure does not meet your minimum criteria, what additional changes can you make to meet the criteria?

_____

_____

_____

Presentation

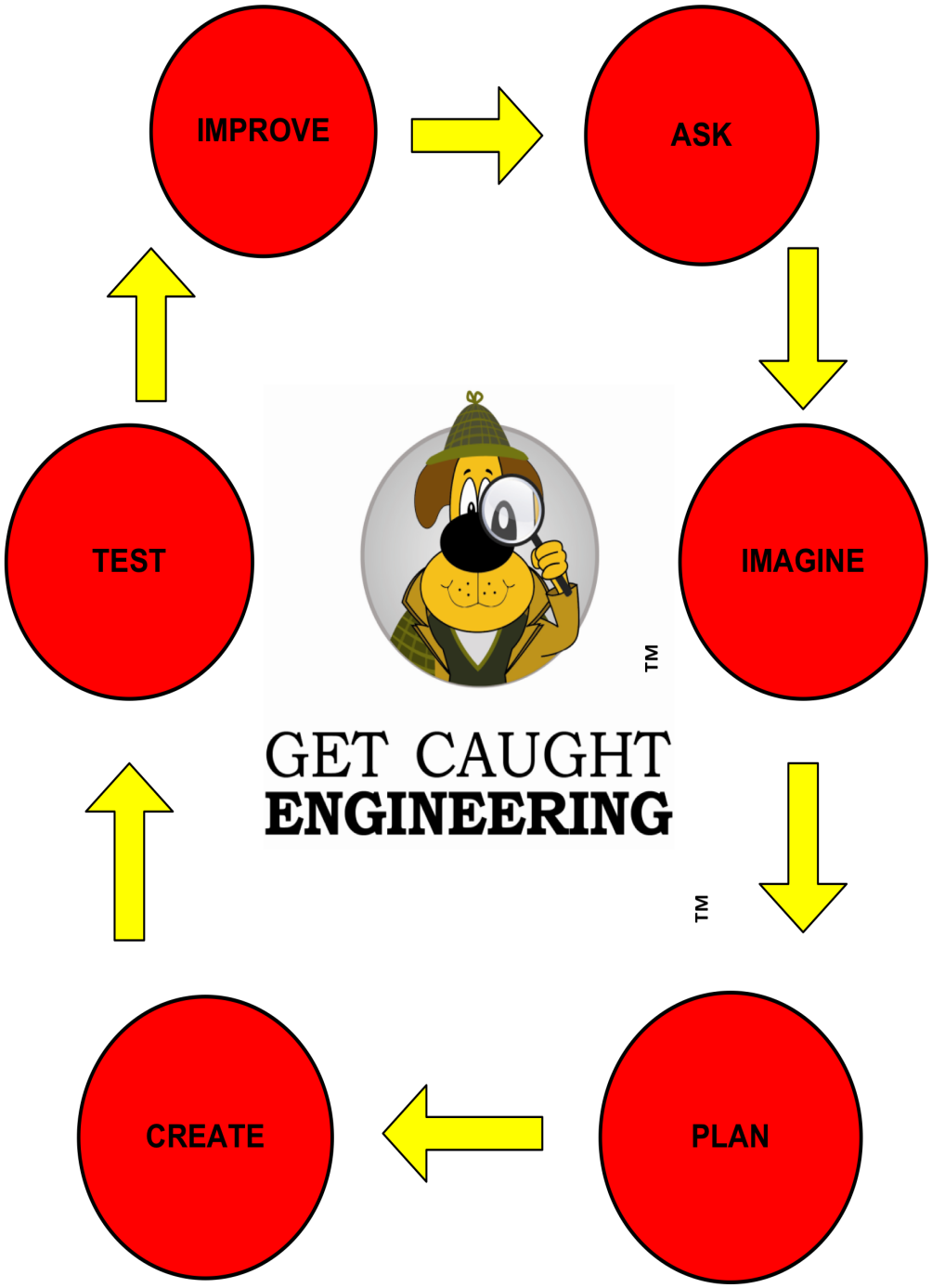
Prepare a presentation that:

Explains your plan and why you chose this design

Shows how you solved problems

Shares how you persevered

Gives examples of your team's patience


IMPROVE
ASK
IMAGINE
PLAN
CREATE
TEST
GET CAUGHT
ENGINEERING
TM
TM

RUBRIC				
	No Evidence	Some Understanding	Good Understanding	Excellent Understanding
Brainstormed ideas				
Created and labeled a sketch to use a blueprint				
Evaluated how to make it better				
Completed Presentation				

Teacher Notes

This engineering activity is designed to allow students to apply what they know about structures, materials, and wind vanes. It can be integrated into a weather unit or a unit on force and motion.

Before you begin the activity, decide on how many groups you will have and who will be in each group. We recommend that each group be composed of 3 or 4 students. Consider each of your students' strengths and weaknesses as you form groups. The dynamic within each group can dictate whether or not they are successful. This lesson has been written to allow the students to choose from a variety of materials that will be offered. Teachers can choose to make the problem more challenging by limiting the number or amount of materials available. Students can also be provided a budget with a corresponding price list for supplies. Upper students could also be challenged to compute the cost of their structure.

Introduce the Design Process

Pass out a copy of the Get Caught Engineering Design Process so the students can refer to them throughout the activity. Tell the students that the Engineering Design Process gives engineers a framework to help them solve problems. Although the process looks like a continuous circle, most times, engineers do not make it all the way to the test step without many times going back to earlier steps.

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Ask

Before engineers can plan and design a solution to a problem, they first needs to totally understand the problem and know what all of the constraints are.

Define the word constraint and have the students compile a list of constraints for this activity. Write the list on a large piece of paper or on the Smart Board. This list should be kept posted in an area that the students can continually refer to it.

Encourage the students to ask questions about the requirements of the solution to the problem. In some cases, you may need to model a question that might be asked.

Ask the students what they know about structures, materials and wind vanes. Ask them why some one would want to know the direction of the wind. Ask them what materials they think would work well in a wind vane.

Show the students the materials that will be available for their use during this activity.

Plan

Have individual students write and sketch their ideas and solutions. Drawings should be detailed and labeled.

Once every student has several ideas, assign students to their groups. Each member should have an opportunity to share their ideas while the others consider the pros and cons of each idea. It is important for the teacher to set this expectation at the beginning of the first meeting of the groups.

The group should decide upon a design and create a detailed, labeled drawing.

Create

Once the group has produced a detailed plan and drawing they can gather their materials and proceed.

As the students create, circulate among the groups to evaluate how they are progressing.

As they build, the students will face and need to overcome many problems. It can be frustrating for students to have repeated failures; therefore it is recommended to end the first “creating” session with a discussion of how things are going. Reiterate to the students that engineers fail many times before they succeed and just like real engineers, they are continually learning while they are failing.

As you walk around you may need to help students focus on what specific parts of their design are working and what specifically is not working. In our experience some groups continually start over rather than pinpoint the flaw in their design.

Encourage group members that are having great difficulty coming up with a plan that works. Invite them to walk around the room and look at others' designs. You may have to have a discussion with the class that this is not cheating, but rather a communication of ideas.

Test

As students feel that they are ready, they can test their structure. Does it rotate?

Redesign or Improve

If a group is successful, ask them to discuss and plan with their group members if the structure can be improved.

If the structure is unsuccessful, encourage the team to focus on the part that isn't working. Ask them if it is a problem with how they built the structure or is the problem with the design? Have the group go back and either work on the structure or begin to redesign their structure.

Reflection

It is helpful for the students to reflect on their experience once the activity is over. They should reflect upon not only their solution but also to the workings of their group. Questions to ask are:

- What went well?
- What didn't work? Include not only design but group interaction.
- What would you do differently next time?

Marbles on the Fast Track!

An Engineering Exploration of Force and Motion

Calling all P.I.s …PROBLEM INVESTIGATORS!

The town of STEM-a-lot wants to develop an amazing roller coaster ride for their new amusement park. They are looking for engineers to design and build a prototype for the ride. We are counting on your skills with the five P's: **problem solving, planning, perseverance, patience,** and **presentation** as you **engineer** an answer.

Here's the problem:

We need you to develop a prototype for the ride. Use what you know about the properties of force, motion, gravity and right angles to build a structure that has a track on which a marble can travel. You will be awarded points as follows:

- 2 Point for each centimeter of height
- 3 Points for each 90 degree angle
- 5 points for each marble that stays on the entire length of the track
- 10 points for each marble that lands in a container at the end of the track

Your materials:

- 10 straws
- 10 pipe cleaners
- 5 index cards
- 24 cm of masking tape
- 1 small paper cup
- 5 paper clips
- 2 rubber bands
- 6 cm of string
- Marble

Ask:

What do you know about force, motion, and gravity?

_____

_____

_____

Imagine:

What are some ideas you can try as you design your roller coaster? How does that information help you design your ride for the marble?

_____

_____

_____

_____

_____

Plan:

Sketch your team's design

Create:

Build the prototype following your design

Test

Test your marble on the test track

Does it travel the length of the track? Yes No

Did the marble land in the cup? Yes No

How many 90 degree angles are on your track?_____

How high is your structure?_____cm

Improve

If your track did not meet your criteria, what will you change?

_____

_____

_____

Patience (Keep Trying)

Test your marble on the track again.

Does it travel the length of the track? Yes No

Did the marble land in the cup? Yes No

How many 90 degree angles are on your track?_____

How high is your structure?_____cm

If your track does not meet your minimum criteria, what additional changes can you make to meet the criteria?

_____

Test the marble on the track again.

Does it travel the length of the track? Yes No

Did the marble land in the cup? Yes No

How many 90 degree angles are on your track?_____

How high is your structure?_____cm

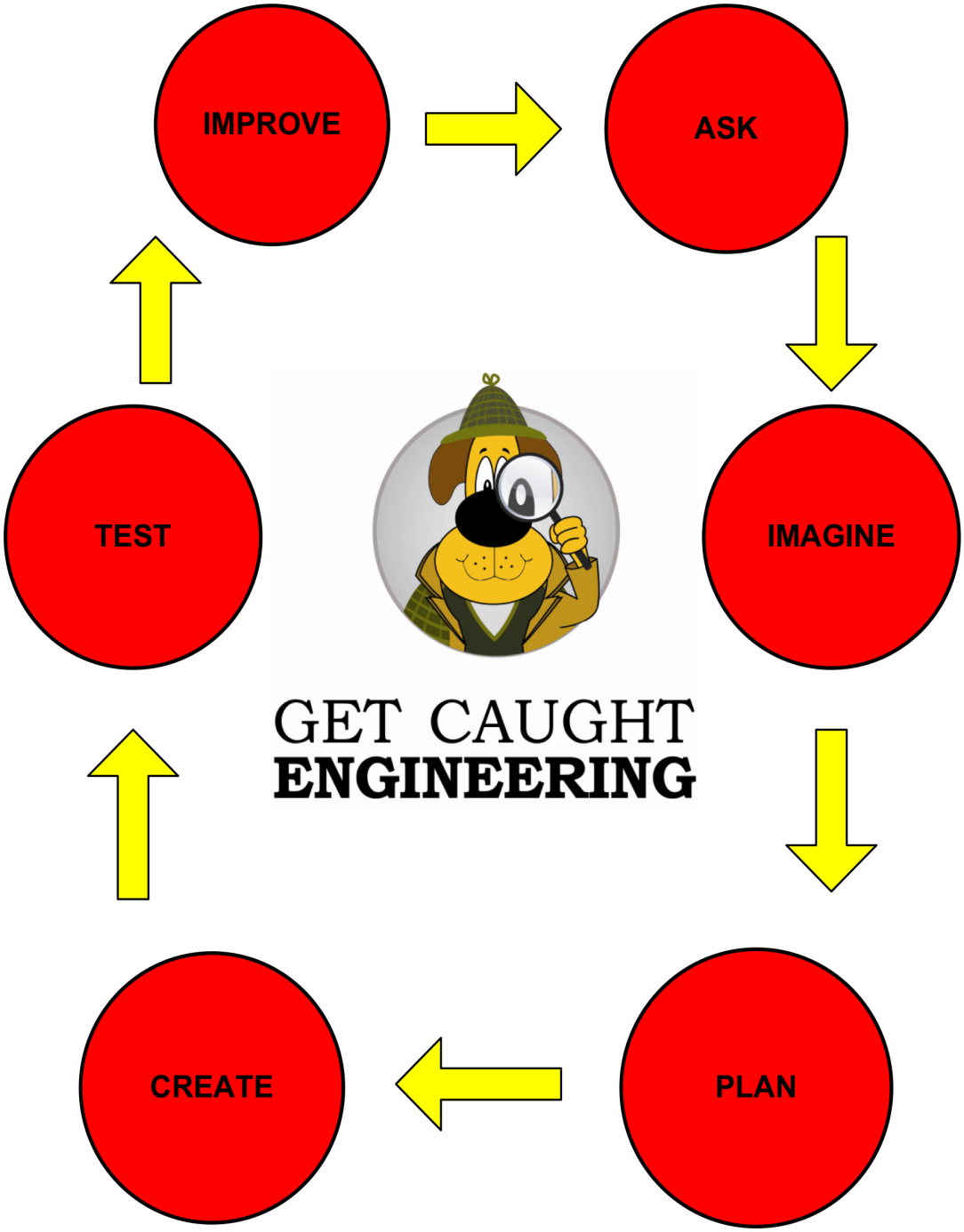
Prepare a presentation that:

Explains your plan and your design

Shows how you solved problems

Shares how you persevered

Gives examples of your team's patience



RUBRIC				
	No Evidence	Some Understanding	Good Understanding	Excellent Understanding
Brainstormed ideas				
Created and labeled a sketch to use a blueprint				
Evaluated how to make it better				
Completed Presentation				

Teacher Notes

This activity is designed to allow students to apply what they know about force, motion, gravity, and right angles.

Before you begin the activity, decide on how many groups you will have and who will be in each group. We recommend that each group be composed of 3 or 4 students. Consider each of your students' strengths and weaknesses as you form groups. The dynamic within each group can dictate whether or not they are successful. This lesson has been written to allow the students to choose from a variety of materials that will be offered. Teachers can choose to make the problem more challenging by limiting the number or amount of materials available. Students can also be provided a budget with a corresponding price list for supplies. Upper grade students could also be challenged to compute the cost of their track.

Introduce the Design Process

Pass out a copy of the Get Caught Engineering Design Process so the students can refer to it throughout the activity. Tell the students that the Engineering Design Process gives engineers a framework to help them solve problems. Although the process looks like a continuous circle, most times, engineers do not make it all the way to the test step without many times going back to earlier steps.

It is suggested that this is a good time to address that the solution will not come easily and it is expected that several designs will have to be created in order to be successful. Engineers expect to fail during the process and perceive failure as merely a step that leads them to the solution.

"I am not discouraged, because every wrong attempt discarded is another step forward" Thomas Edison

Ask

Before engineers can plan and design a solution to a problem, they first need to totally understand the problem and know what all of the constraints are.

Define the word constraint and have the students compile a list of constraints for this activity. Write the list on a large piece of paper or on the Smart Board. This list should be kept posted in an area that the students can continually refer.

Encourage the students to ask questions about the requirements of the solution to the problem. In some cases, you may need to model a question that might be asked.

Ask the students what they know about force, motion, gravity, and right angles.

Show the students the materials that will be available for their use during this activity.

Plan

Have individual students write and sketch their ideas and solutions. Drawings should be detailed and labeled.

Once every student has several ideas, assign students to their groups. Each member should have an opportunity to share their ideas while the others consider the pros and cons of each idea. It is important for the teacher to set this expectation at the beginning of the first meeting of the groups.

The group should decide upon a design and create a detailed, labeled drawing.

Create

Once the group has produced a detailed plan and drawing they can gather their materials and proceed.

As the students create, circulate among the groups to evaluate how they are progressing.

As they build, the students will face and need to overcome many problems. It can be frustrating for students to have repeated failures; therefore it is recommended to end the first "creating" session with a shared discussion of each group's progress. Reiterate to the students that engineers fail many times before they succeed and just like real engineers, they are continually learning while they are failing.

As you walk around you may need to help students focus on what specific parts of their design are working and what specifically is not working. In our experience some groups continually start over rather than pinpoint the flaw in their design.

Encourage group members that are having great difficulty coming up with a plan that works. Invite them to walk around the room and look at others' designs. You may have to have a discussion with the class that this is not cheating, rather a communication of ideas.

Test

As students feel that they are ready, they can test their marble on the track.

Redesign or Improve

If a group is successful, ask them to discuss and plan with their group members how the track can be improved.

If the vehicle is unsuccessful, encourage the team to focus on the part that isn't working. Ask them if it is a problem with how they built the track or is the problem with the design? Have the group go back and either work on the track or begin to redesign their track.

Reflection

It is helpful for the students to reflect on their experience once the activity is over. They should reflect upon not only their solution but also to the workings of their group. Questions to ask are:

What went well?

What didn't work? Include not only design but group interaction

What would you do differently next time?

Engineering Energizers!

Quick Classroom Lessons to Activate the Design Process

What Goes Up, Must Come Down

Engineering a Parachute to Protect an Egg

Why Engineering?

Engineering for children? Really?

Exciting activities that combine math, science, reading and writing?

Lessons that promote planning and problem solving?

Strategies that develop perseverance and patience?

Teacher friendly instruction that easily integrates into one's units?

Get Caught Engineering does all that and more, providing a unique application for the learning benchmarks.

Get Caught Engineering was created to inspire elementary students to explore the world of engineering and apply the design process to problem solving. After investigating what is already available in this area, we found there are some great materials but they are either dedicated to gifted and talented classes, for after school programs, or are lengthy units that are too expensive or too time consuming. **Get Caught Engineering** has been developed to introduce all children to engineering concepts in a teacher friendly approach that easily integrates into subject areas. Simple low cost materials, lesson templates, and teacher tips all add up to user friendly activities that will inspire children to consider engineering as a cool career choice, and a reason to pursue math and science classes during their school years.

The engineering profession is concerned within ten years there will not be enough engineers to meet America's needs. Studies show that the time to inspire students' interest in these fields is at the elementary level. Through introductory engineering lessons, elementary level teachers can plant the seeds of inspiration for future engineers for our country.

Please visit our blog and Facebook page for more ideas

- http://www.getcaughtengineering.com
- https://www.facebook.com/GetCaughtEngineering

And to be notified when we add more lessons be sure to follow us at:

- http://www.teacherspayteachers.com/Store/Get-Caught-Engineering-Stem-For-Kids

Teacher Notes and Materials List

Time: One hour to design and build the parachute. All parachutes will be dropped at the same time.

Suggested Materials:

Eggs, trash bags, cardboard, coffee filters, construction paper, tissue paper, saran wrap, string or yarn, pieces of fabric, newspaper, cotton balls, rubber bands, tape, hole punch, scissors

Teacher Notes:

Students should work collaboratively in groups of 4. The above materials list can be altered to fit the availability of materials at your school. The larger the variety of materials, however, the more varied the solutions to the problem will be. The height from which the egg is dropped can also be changed.

What Goes Up Must Come Down

Engineering a Parachute to Protect an Egg

- Engineer a container and parachute that will protect an egg from being dropped from a 6 foot ladder.
- The container must hold the egg securely during the descent and touchdown.
- No testing will be performed until all parachutes are completed and tested at the same time.
- An unbroken egg signals a successful design.

Think...Create...Think...

...Think...Create...Think

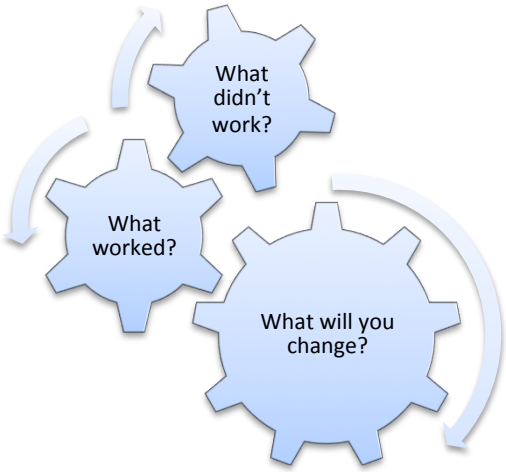
My Design

WHAT I ENGINEERED!

Was the egg unbroken after it landed?

If not, what needs to be changed?

If yes, how would you improve your design?



STEM YOUR NEST
with
Materials and Structure Engineering

Engineering Energizers!

Quick Classroom Lessons to Activate the Design Process

Teacher Notes and Materials Lists

Time: 60 minutes

Materials: Tray or hard surface for each group to contain materials
Scissors
String, twine, or yarn
Twigs, sticks, leaves and other natural materials found in the school yard (if no available foliage, check with a local florist and ask them to donate their older stems, leaves and foliage
4 marbles or pebbles to represent bird eggs

In groups of one to four, students will use the materials on the tray to create a bird nest that will hold 4 round objects when lifted from the tray.

Teacher Hints: Take the students outside to gather materials that they think a bird might use to build a nest. Discuss what might work and what might cause a problem. If available view real bird nests to analyze their structure or look online for examples to show the students.

STEM YOUR NEST

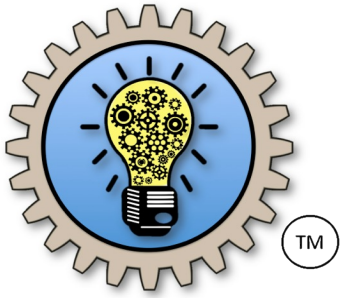
Or

(Are you a better engineer then a bird?)

Birds are amazing engineers. Each spring, they build nests from materials they find in their habitat.

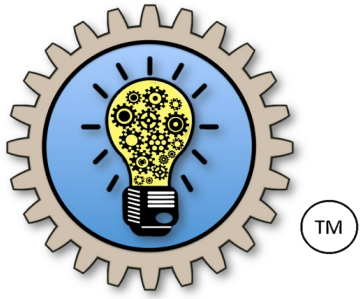
Now it is your turn. Using natural materials and string or twine, engineer a nest that will hold four round marbles or pebbles when lifted off the tray

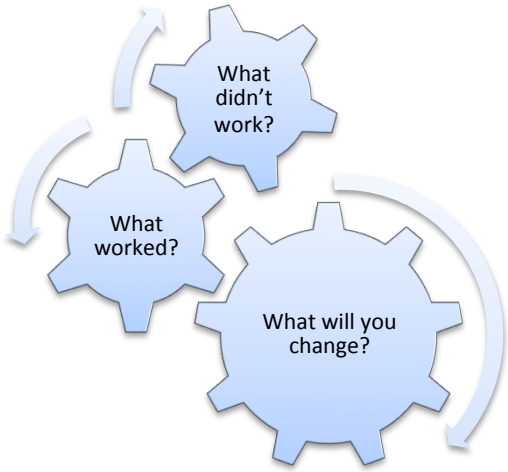
Think...Create...Think...



...Think...Create...Think

My Design



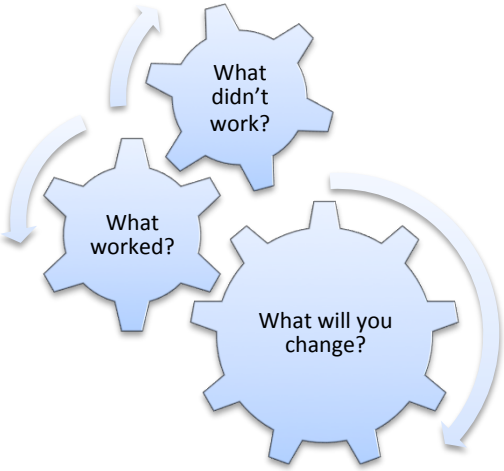


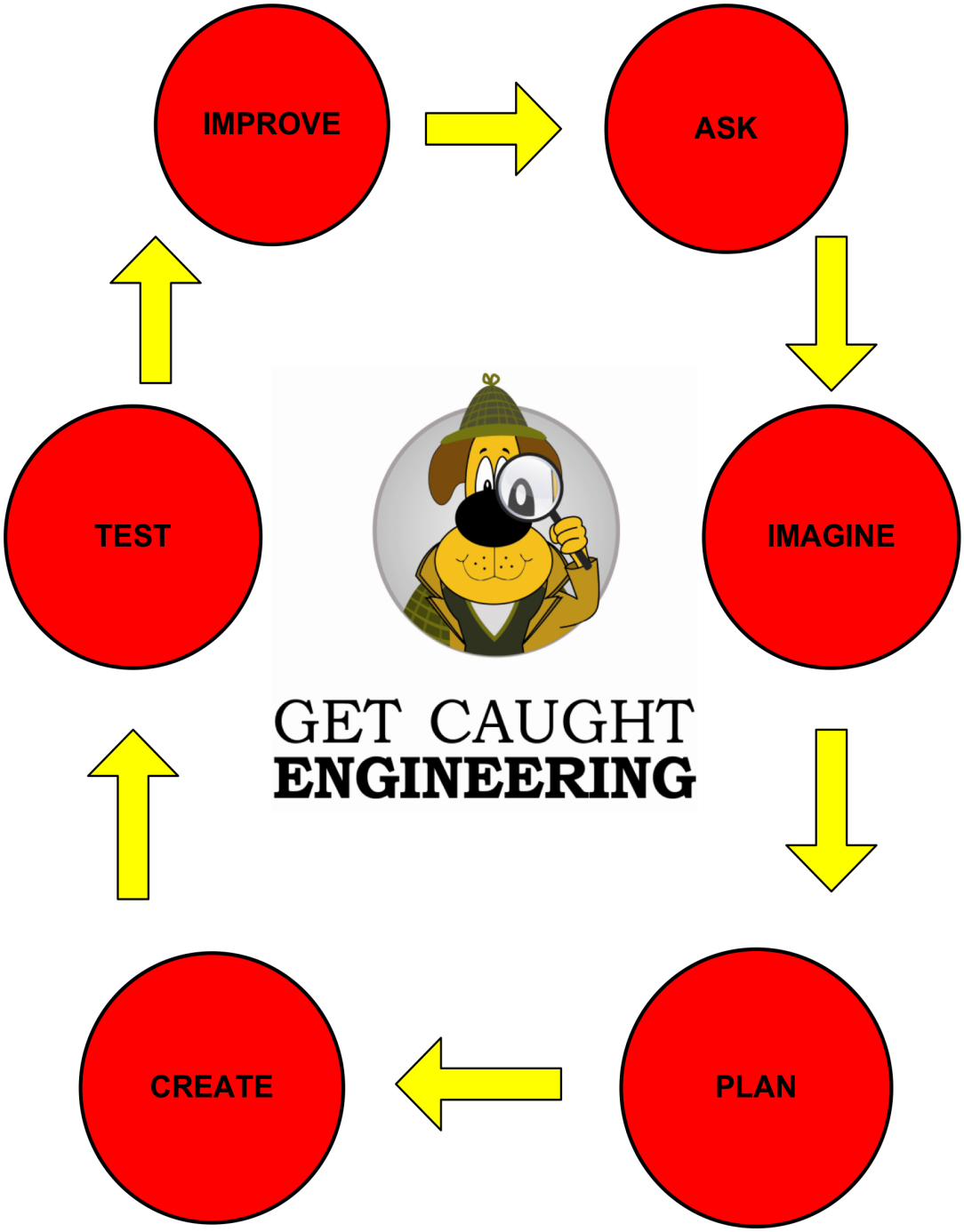
WHAT I ENGINEERED!

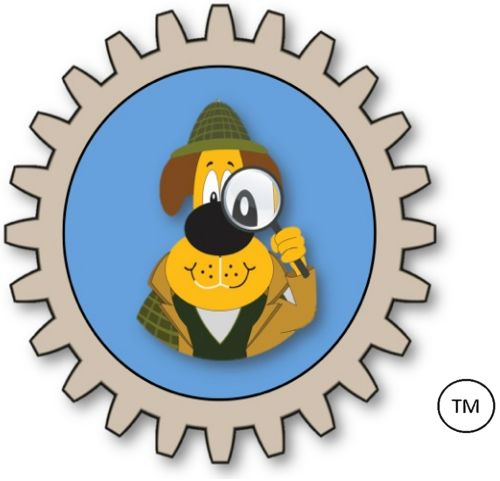
Did your nest hold the objects?

Look at your classmates nests. What appears to have been some good methods to use?

If you did this again, what would you do differently?







Engineering Energizers!

Quick Classroom Lessons to Activate the Design Process

Marshmallow and Pasta Tower
"Squish and Stick Structural Engineering"

Teacher Notes and Materials List

Time: 30 minutes

Materials: 15 spaghetti noodles
10 small marshmallows
12 inches of string
1 large marshmallow
1 sheet of paper with a 5"by 5" square drawn on it
Yardstick or Meter Stick

Group size: 1-4 students

Problem: students are to build the tallest tower possible out of spaghetti and small marshmallows to support a large marshmallow. The free standing tower will be built on a paper with the 5"by 5" square drawn on it. The large marshmallow should rest on top of the structure and not be impaled by the spaghetti. The groups will have 20 minutes to build once the materials have been distributed.

To increase the rigor, a dollar value can be added to the marshmallows and pasta so students can " buy" more materials if needed, as well as provide an extra points incentive if they use less and come in under budget for their tower.

"Organized Chaos" Strategy: Prepare kits of bagged materials for each group before the lesson for easy distribution and clean up.

Squish and Stick Marshmallow and Pasta Tower Directions

Your challenge is to build the tallest tower possible out of spaghetti and small marshmallows to support a large marshmallow. The free standing tower will be built on a 5" by 5" square. The large marshmallow should rest at the top of the tower and cannot be impaled by the pasta. You will have twenty minutes to complete this task.

Think...Create...Think...

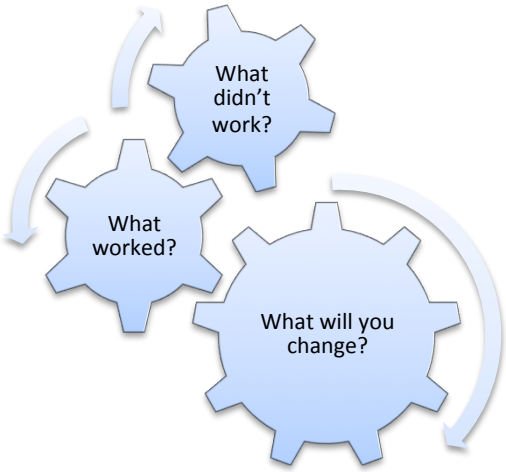
...Think...Create...Think

My Design

WHAT I ENGINEERED!

How high was your tower?

What shapes provided the strongest framework?



Engineering Energizers!

Quick Classroom Lessons to Activate the Design Process

"Read All About it!! A Newspaper Tower!!"

with

Materials and Structure Engineering

Teacher Notes and Materials Lists

Time: 40 minutes (student building time 20 minutes)

Materials: Two pieces of newspaper

Scissors

12 inches of masking tape

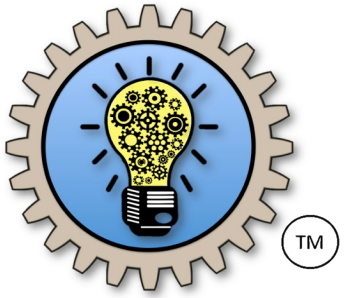
In groups of one to four, students will fold, twist or cut the newspaper to build the tallest structure possible.

Teacher Hints: Cut and measure the tape ahead of time. Discuss properties of materials prior to the activity. After they have tried once and shared ideas, let them try again. You could also try a different type of paper to reinforce the impact of material choices.

Read All About It!!! A Newspaper Tower!!!

Engineer the tallest tower possible with two pieces of newspaper. You can fold, twist, or cut the paper. You may also use up to 12 inches of tape and you may use scissors. You will have twenty minutes to reach your goal.

Think...Create...Think...



...Think...Create...Think

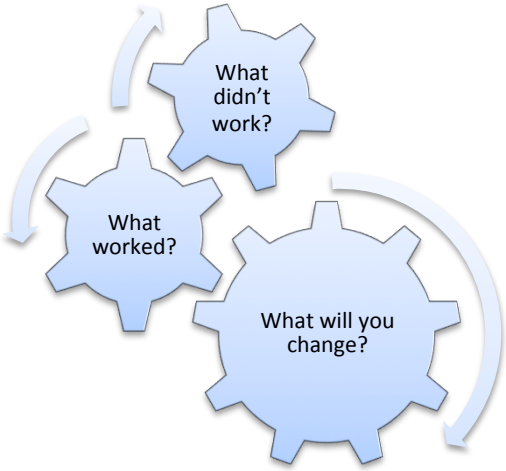
My Design

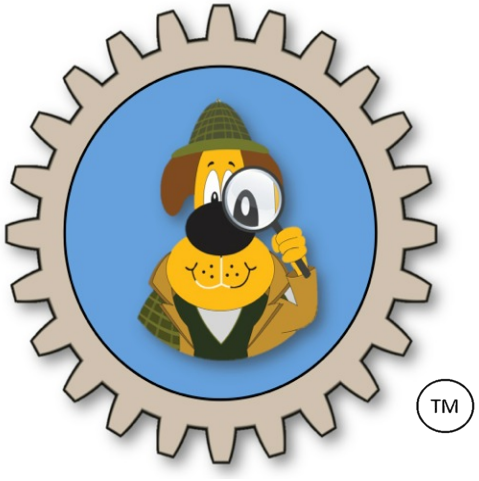
WHAT I ENGINEERED!

How high was your tower?

Look at your classmates towers. What appears to have been some good methods to use?

If you did this again, what would you do differently?





Engineering Energizers!

Quick Classroom Lessons to Activate the Design Process

Row, Row, Row the Foil Boat
With
Marine Engineering

Teacher Notes and Materials List

Time: One Hour

Materials: 5” by 6” aluminum foil
small tub of water
scissors
20 pennies

Directions: Prepare bag of materials for each student or group.

Students will fold foil to create a vessel that will float and hold pennies. Challenge them to create a vessel that will hold the most pennies.

Suggestion: access prior knowledge of surface area by discussing how they shape their body when they float on water.

Row, Row, Row the Foil Boat

- Fold a 5 by 6 inch piece of foil into the shape of a boat.
- It must float and hold a cargo of pennies.
- Place the boat in a tub of water.
- Begin adding pennies for the ship's cargo.
- See how many pennies it will hold before it sinks.

Think...Create...Think...

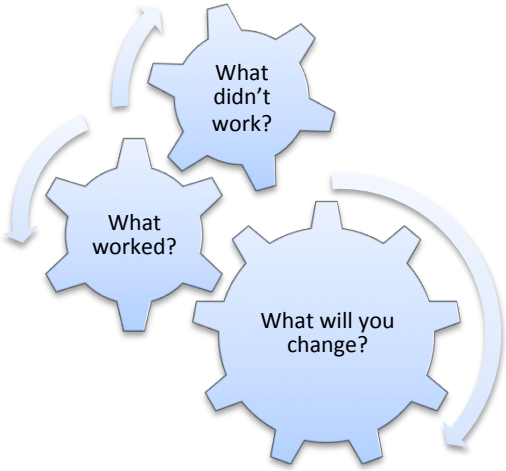
...Think...Create...Think

My Design

WHAT I ENGINEERED!

How many pennies did your boat hold?____

What would you like to change on your boat in order to hold more pennies?



Engineer Like an Ancient Greek!
Structural Engineering with Columns

Calling all P.I.s …PROBLEM INVESTIGATORS!

The town of STEM-a-lot wants to build a museum about ancient Greece in their town. They want the museum to have columns to support the roof instead of walls. They know that as an engineer, you have the skills to build a prototype for this structure. They are counting on your skills with the five P's: **problem solving, planning, perseverance, patience,** and **presentation** as you **engineer** an answer!

Here's the problem:

We need you to develop a prototype for the museum. Use what you know about measurement, geometry and mathematical shapes to build a museum model that has columns instead of walls. The prototype must fit on a cardboard or foam core base that is no larger than 30 cm by 30 cm. The columns must all be the same height and must have a paper roof that will then support a textbook. Placement of the columns will be crucial to the successful support of the roof and weight of the textbook.

Your materials:

- **10 sheets of 8 ½ by 11 inch standard copy paper**
- **Masking tape**
- **30 cm by 30 cm cardboard or foam core base**
- **30 cm by 30 cm piece of construction paper for roof**
- **Ruler**
- **scissors**

Ask:

What do you know about the Parthenon building in Ancient Greece?

Imagine:

What are some ideas you can try as you design your building? How does that information help you design the museum prototype?

Plan:

Sketch your team's design

Create:

Build the prototype following your design

Test

Check your building

Does it have columns? Yes No If yes? How many?_____

How tall are the columns? _____cm

Does it support the text book? Yes No

Will it support more than one text book? Yes No

Improve

If your building will not meet your criteria, what will you change?

_____

_____

_____

Patience (Keep Trying) ™

Check your building again.

Does it have columns? Yes No/ If yes….how many?_____

How tall are the columns? _____cm

Does it support the text book? Yes No

Will it support more than one text book? Yes No

Improve

If your building will not meet your criteria, what will you change?

_____

_____

_____

Presentation ™

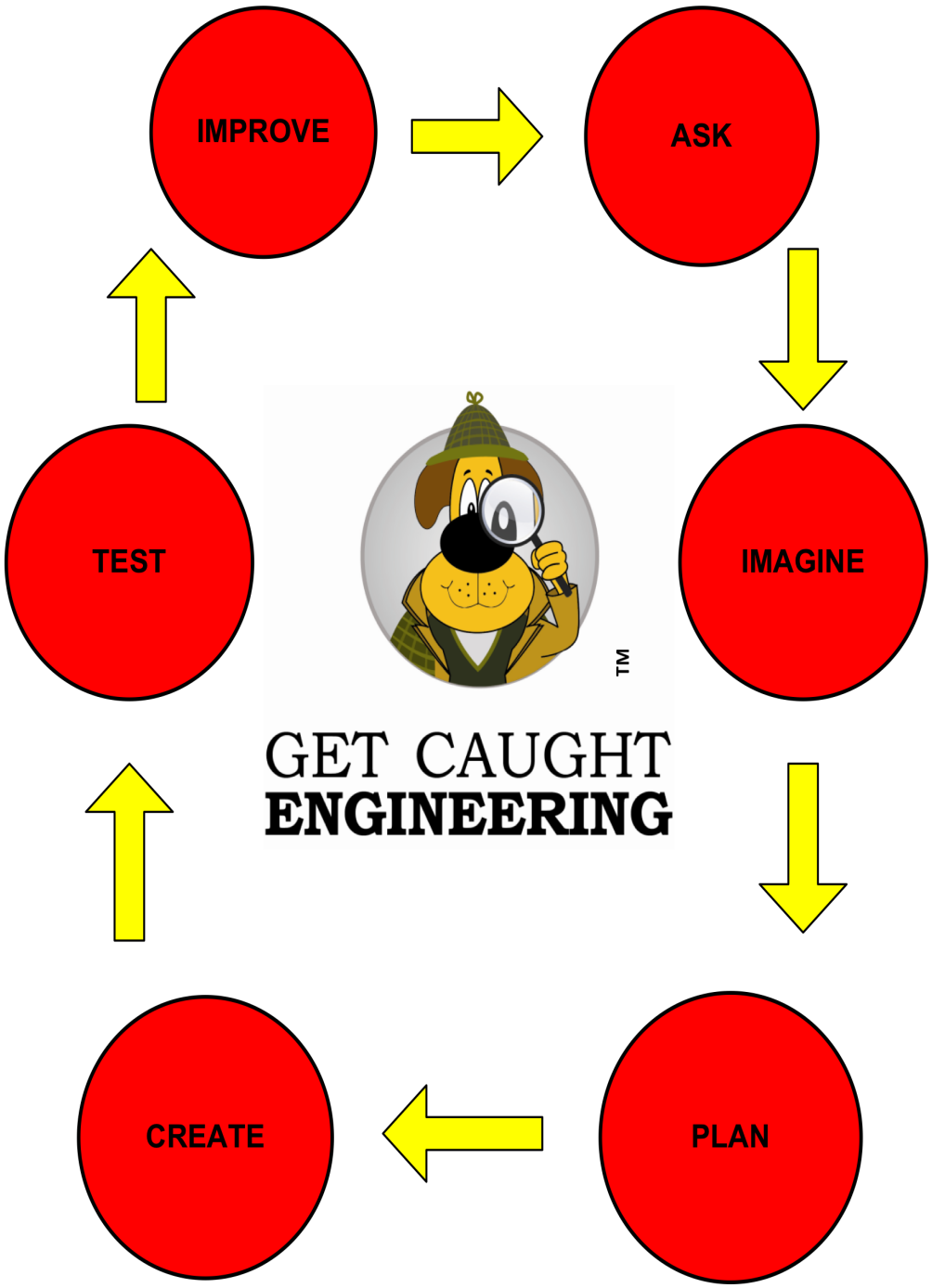
Prepare a presentation that:

Explains your plan and why you designed your pyramid the way you did

Shows how you solved problems

Shares how you persevered

Gives examples of your team's patience



Get Caught Engineering™

RUBRIC				
	No Evidence	Some Understanding	Good Understanding	Excellent Understanding
Brainstormed ideas				
Created and labeled a sketch to use a blueprint				
Evaluated how to make it better				
Completed Presentation				

Teacher Notes

This activity is designed to allow students to apply what they know about geometry and shapes as they engineer a building with columns. It provides an opportunity for STEM integration into an Ancient Greece history or a math measurement lesson.

Before you begin the activity, decide on how many groups you will have and who will be in each group. We recommend that each group be composed of 3 or 4 students. Consider each of your students' strengths and weaknesses as you form groups. The dynamic within each group can dictate whether or not they are successful. This lesson has been written to allow the students to choose from a variety of materials that will be offered. Teachers can choose to make the problem more challenging by limiting the number or amount of materials available. Students can also be provided a budget with a corresponding price list for supplies. Upper students could also be challenged to compute the cost of their building.

Introduce the Design Process

Pass out a copy of the Get Caught Engineering Design Process so the students can refer to it throughout the activity. Tell the students that the Engineering Design Process gives engineers a framework to help them solve problems. Although the process looks like a continuous circle, most times, engineers do not make it all the way to the test step without many times going back to earlier steps.

It is suggested that this is a good time to address that the solution will not come easily and it is expected that several designs will have to be created in order to be successful. Engineers expect to fail during the process and perceive failure as merely a step that leads them to the solution.

"I am not discouraged, because every wrong attempt discarded is another step forward" Thomas Edison

Ask

Before engineers can plan and design a solution to a problem, they first need to totally understand the problem and know what all of the constraints are.

Define the word constraint and have the students compile a list of constraints for this activity. Write the list on a large piece of paper or on the Smart Board. This list should be kept posted in an area that the students can continually refer to it.

Encourage the students to ask questions about the requirements of the solution to the problem. In some cases, you may need to model a question that might be asked.

Ask the students what they know about buildings in ancient Greece, shapes, and geometry. Have them complete the information on the design brief.

Show the students the materials that will be available for their use during this activity.

Plan

Have individual students write and sketch their ideas and solutions. Drawings should be detailed and labeled.

Once every student has several ideas, assign students to their groups. Each member should have an opportunity to share their ideas while the others consider the pros and cons of each idea. It is important for the teacher to set this expectation at the beginning of the first meeting of the groups.

The group should decide upon a design and create a detailed, labeled drawing.

Create

Once the group has produced a detailed plan and drawing they can gather their materials and proceed.

As the students create, circulate among the groups to evaluate how they are progressing.

As they build, the students will face and need to overcome many problems. It can be frustrating for students to have repeated failures; therefore it is recommended to end the first "creating" session with a discussion of how things are going. Reiterate to the students that engineers fail many times before they succeed and just like real engineers, they are continually learning while they are failing.

As you walk around you may need to help students focus on what specific parts of their design are working and what specifically is not working. In our experience some groups continually start over rather than pinpoint the flaw in their design

Encourage group members that are having great difficulty coming up with a plan that works. Invite them to walk around the room and look at others' designs. You may have to have a discussion with the class that this is not cheating, rather a communication of ideas.

Test

As students feel that they are ready, they can assess their columns and building using the questions provided in the Design Brief.

Redesign or Improve

If a group is successful in meeting all of the requirements, ask them to discuss and plan with their group members how the building can be improved. They can be challenged to find ways to increase the building's ability to hold more weight.

If the building fails to meet the requirements, encourage the team to focus on the part that isn't working. Ask them if it is a problem with how they built their structure or is the problem with the design? Have the group go back and either work on the structure or begin to redesign their building. . Note that placement of the columns is just as crucial as the height and width of the columns.

Reflection

It is helpful for the students to reflect on their experience once the activity is over. They should reflect upon not only their solution but also to the workings of their group. Questions to ask are:

- What went well?
- What didn't work? Include not only design but group interaction
- What would you do differently next time?

Get Caught Engineering
Presents
Enchanted Engineering

Beauty and the Beast
Engineer a Celebration!

Beauty and the Beast is one of the most beloved fairy tales of all time. Everyone loves the ending when Beauty sees past the Beast's outward appearance, falls in love with him, and breaks the spell that turned him into a beast. The other occupants of the castle, as well as the villagers, rejoice that their prince has been restored to his handsome self.

Although the story ends at this point, you know that Beauty and the Prince will live happily ever after. However, before they settle down to their wonderful life, there needs to be an extravagant wedding followed by a huge celebration. Obviously the celebration will include a parade through the streets, cheering crowds and…… confetti! Engineers would be needed to design confetti launchers along the parade route to launch clouds of confetti into the air as the happy couple passes by.

Here's the problem:

Organizers of Beauty and Beast's celebration need you to develop a prototype for a machine that will launch confetti high into the air. Use what you know about force and motion to design and build a confetti launcher that will throw confetti at least 3 feet into the air.

Materials:

- 1 tsp paper confetti
- wooden spool
- 4 rubber bands
- 1 straw
- Duct tape
- String
- 2 sheets of cardboard (about copy paper size)
- Plastic tablecloth or tarp with an large tape X in the middle

- 4 paint stirrers
- 4 oz. paper cup
- 2 8 oz. paper cups
- 1 Cardboard tube

Problem Solving

™

Ask:

- What are some ways that confetti could be launched into the air?

_____

_____

_____

- What do you know about levers, force and motion that could help you accomplish your task?

_____

_____

_____

Imagine:

- Describe what your confetti launcher will look like. How will it work?

_____

_____

_____

_____

Plan:

Sketch your team's design

Create:

Build the prototype following your design

™

Test:

- Does your machine launch confetti 3 feet into the air?

Yes No

Improve:

If your launcher is not successful, what will you change? If it is successful, how can you improve it?

™

Patience (Keep Trying):

- Does your machine launch confetti 3 feet into the air?

Yes No

If your launcher still does not meet your minimum criteria, what additional changes can you make to meet the criteria?

_____

_____

_____

Test one more time. Keep working until your launcher is successful.

™

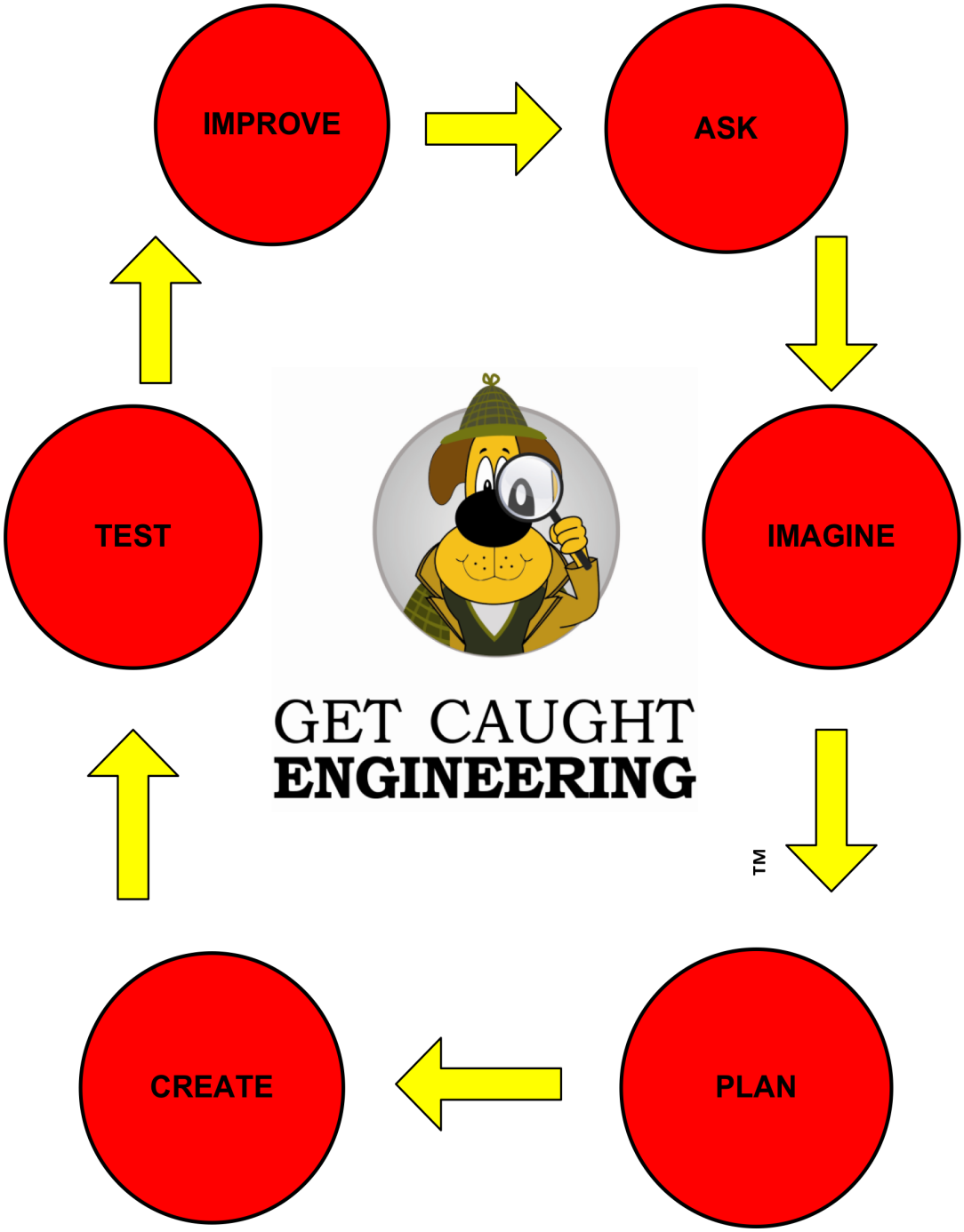
Prepare a presentation that:

Explains your plan and your design

Shows how you solved problems

Shares how you persevered

Gives examples of your team's patience



™

RUBRIC				
	No Evidence	Some Understanding	Good Understanding	Excellent Understanding
Brainstormed ideas				
Created and labeled a sketch to use a blueprint				
Evaluated how to make it better				
Completed Presentation				

Teacher Notes

One way to incorporate engineering into a fairy tale is to ask students to think about what will happen after the story ends. You could actually brainstorm a list of ideas, choose which ones can incorporate engineering and let the students decide what they would like to build. This lesson, however, presents a specific scenario and engineering problem to the students

In this lesson, students are asked to build a machine that will launch confetti into the air. As you guide your students through the design process, the criteria and constraints will challenge your students to apply math and science concepts. However, as with any of our lessons, individual constraints can be eliminated or modified to fit the needs of your students. For example, you may want to eliminate the height requirement for younger students.

The activity should begin with a class discussion of all of the requirements and constraints of the problem. Guiding questions have been provided in the design brief to make sure important concepts are emphasized. Misconceptions, constraints, and important details can be discussed.

You may want to begin the lesson with a discussion of times and occasions they have seen confetti explode into the air. Lead the discussion to the conclusion that for it to be exciting, the confetti needs to be launched as high as possible so it can rain down upon the crowd. Ask for possible ideas of machines that could be used. Common designs are slingshots, catapults and simple levers that work like a seesaw. This is also a good time to make sure the students understand that some sort of force is needed to launch the confetti. For older students, concepts such as potential and kinetic energy, and force and motion can be reinforced.

Before the students begin to design their confetti launcher, all materials should be shown. For younger students, a short discussion of how the different items can be used might prove helpful to many of the students. Remind the students that all materials can be modified by cutting and twisting.

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Although a wide variety of materials will be available, teachers can create a more challenging situation for their engineering teams by limiting the number or amount of supplies or by placing prices on the materials and requiring students keep within a budget. Doing so, imitates the real world of engineering. Point out that real engineers are always bound by the amount of money they can spend on their project and the materials that are available to them.

The children will be eager to begin building and the teacher will need to emphasize the importance of planning. Student drawings should identify all requisite structures and shapes. We have learned that reviewing each group's drawing to make sure they are meeting the criteria prior to distributing supplies is prudent. Younger children, especially will need to be encouraged not to rush through the planning step. Also, you should monitor that the students are taking only the amount of each material that their drawing indicates that they need. It is frustrating for the children if all of one of the cups are used up because a group did not plan carefully on their usage.

Because this activity can create quite a mess, it is important to have an identified launch area. A plastic tablecloth or two works well. Use tape to mark an X in the middle. This is where the student must stand. It is also a good idea to have a small dustpan and broom. Each team can sweep up their confetti and actually reuse it as they test their design.

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Questions? Need an engineering lesson to fit your curriculum? Want some ideas for engineering resources?
Please contact Wendy Goldfein and Cheryl Nelson at Getcaughtengineering@gmail.com