DREAM IT BUILD IT:

ENGINEERING CLUB

THE EDGERTON EXPLORIT CENTER
www.edgerton.org

Dream It, Build It

Engineering camp for kids interested in learning to be an engineer!

Academic Curriculum

Engineering is more than just a job—it's an exciting world where creativity meets problem-solving through math and science! Engineers design and build everything from bridges and buildings to cutting-edge technology, impacting our daily lives. As one of the key STEM fields (science, technology, engineering, and math), engineering offers endless opportunities to innovate and create.

Additional Information

What is Engineering?

Engineering is a BIG category! There's so much involved in Engineering that it can be difficult to grasp the topic! Here is another video explaining engineering.

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What Is Engineering?

Engineering camp for kids interested in learning to be an engineer!

What Is Engineering?

Engineers love to figure out how things work and use their knowledge in practical ways; therefore, at their core, engineers are innovative problem solvers. While scientists and inventors create things, it's the engineer that figures out how the creation can be used to solve real-world complications. This can include building electronics, planning buildings or bridges, or even creating robots or spaceships to further human ingenuity.

Engineering has brought us some of the world's most incredible creations, from the majestic pyramids and the iconic Eiffel Tower to the ingenious Roman aqueducts and ancient road systems. Engineers apply math and science to solve problems and overcome challenges, answering the question, "What is an engineer?" in spectacular ways.

What's even more exciting is the variety within the field of engineering. Whether your child's interests lie in exploring space, designing cutting-edge electronics, or shaping the cities of the future, there's a place for them in engineering. No matter what sparks their curiosity, there's an engineering path waiting for them to discover!

What Do Engineers Do?

Engineers come with a wide range of interests, talents, and strengths. Some excel at planning and designing cities or structures, while others are passionate about technology, working on robots, or spacecraft. When it comes to answering the question, "What does an engineer do?" the possibilities are endless!

If you love to problem-solve, there's a place for you in the world of engineering, no matter where your kid's passions lie.

Types of Engineers →

In the world of engineering, there are many different types of work. Here are the most common types of engineers:

Civil Engineer	Civil engineers are those who help solve problems with infrastructure. That includes roads, bridges, tunnels, water or sewer systems, etc. They often work with cities, towns, or governments on projects.
Chemical Engineer	Solving challenges that involve food, medication, or chemicals is the role of a chemical engineer. They have a good understanding of various sciences like biology, chemistry, and physics. Chemical engineers apply their knowledge to make products safer and more effective. They often work in labs or offices.
Mechanical Engineer	The main role of a mechanical engineer is to design machines. This can include every type of machine from household appliances to jets. A mechanical engineer uses their abilities to solve problems for people and companies, from making life more comfortable to creating more environmentally friendly machines.
Electrical Engineer	Engineers that work with electrical components like computers and motors fall into the category of electrical engineers. Many industries hire electrical engineers from research facilities to manufacturing plants.
Agricultural Engineer	Food production has become a major industry and engineers also work in this area. Their role is to solve problems with regard to agriculture, which can include plants, animals, and machinery. For example, they can design farm equipment that makes harvesting more efficient.
Aerospace Engineer	For those who are excited about flight or space exploration, aerospace engineering would be an ideal fit. An aerospace engineer designs different parts of aircraft and spaceships. This can include every small component that is essential to making the machine work.
Biomedical Engineer	Making life better for patients and healthcare workers is the goal of a biomedical engineer. They use science and math to solve problems in healthcare. Some examples include pacemakers, artificial limbs, and surgical robots.
Nuclear Engineer	Engineers that develop and design safe ways to work with nuclear equipment are called nuclear engineers. Some of their tasks can include writing instructional materials for nuclear power plants or creating medical imaging devices for use in healthcare. They can also be called upon in emergencies such as a nuclear power plant shutdown.

Skills for Engineers →

Anyone with an interest in becoming an engineer will be successful. At Engineering For Kids, our programs are designed to help kids explore engineering and other STEM subjects. As we consider 'what is an engineer?', it's good to know what skills make this career choice a good fit.

Curiosity	Engineers have a natural wonder about the world around them and how things work. If you love to figure things out and see what makes them tick, engineering could be the right career for you.
Creativity	Those who like to think outside the box or come up with new uses for things could excel with an engineering career.
Detail - Oriented	In engineering, small things can make a big impact. If even one component is missing or not working properly, it can hinder the entire project. As an engineer, being detail-oriented and attentive to every aspect is crucial for success.
Problem - Solving	Does your child love puzzles? Are problems only opportunities to discover new solutions? At the heart of it, engineers are problem-solvers. They enjoy the challenge of wrestling with an issue until they can fix it.
Persistence	It can take time to figure out a solution to a problem. Engineers need to have patience and persistence to stick with a project and not give up too easily.
Communication	As with most careers, communication is a big part of what engineers need to do. It's one thing to have an idea for a solution, it's another to be able to express your child's idea to others. With engineering, they can share your plans either verbally or in writing. It's about helping others understand what the project goal is.

INTRODUCING EVERYONE

getting to know our class

HANDS UP FOR SCIENCE

An activity designed to get to know one another

Levels: K through 5th
Time: 20 to 25 minutes

OBJECTIVES

To help us learn more about the friends around you, we are creating a mural together that says,
“Hands Up for Science!” “Reach for the STARS!”
Each Student will be creating a one-of-a-kind hand that is designed by you and shows a little bit about who you are!

PREPARATION

It’s best to do this activity at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

ACTIVITY

1. Outline the hand and part of the arm with a pencil first (outline non-dominant hand) and then trace over the pencil with a Sharpie marker. Demonstrate how to do this.

2. Cut out the hand outline.

3. Use markers to decorate a one-of-a-kind hand.

4. The child needs to include their first name on the front of their hand.

5. Kids may design the hand how they want, include things about themselves, or simply decorate it.

6. When completed, kids may glue their hands to the mural. Add on stars.

7. Display in a prominent place in your classroom.

MATERIALS:

EACH STUDENT NEEDS:

- Mural Paper/Roll Paper with the words “Hands Up For Science” “Reach for the Stars” on it.
- Paper for kids to trace their hands and forearms on Or print use a preprinted handprint template (included below).
- Washable Markers
- Scissors
- Painter’s Tape to affix mural to the wall
- Glue sticks or Rubber Cement to attach hands to mural
- Star cut outs - write areas of science study on each star

REFLECTION

Things to do after the activity

Display mural in a prominent place for kids to enjoy.

Show a finished hand outline that you have designed and cut out. Talk about what things you like that you included on your hand, favorite colors you used, etc. Then brainstorm things the students could include on the hand outline....circles, stars, hearts, swirls, diamonds. Favorite sport, activity, food, season, etc.

WOULD YOU RATHER

A team-building activity designed to get to know each other

Levels: K through 5th
Time: 5 to 10 minutes

OBJECTIVES

Start a dialogue with the reminder that we are all different and that is what makes life and friends so fun and interesting! Today we are going to discover some fun things about our class—
We will discover we all have different interests and talents.
We will discover that we may like different things — and that is GREAT! It would be a boring world if everyone was the same and thought the same and liked the same things!!

MATERIALS:

EACH STUDENT NEEDS:

- Nothing! You don't need anything in order to play!

PREPARATION

Watch this video on why scientists need to be a good teammate:
The Power of Teamwork

Before you play, create a list of fun (and appropriate) would you rather questions. The more you come up with, the more you'll get to know your group!

REFLECTION:

1. How does getting to know your group/team/class make you a better scientist?
2. Share something you learned about another group member!

ACTIVITY

Have kids stand in a single file line facing the "question asker" who is standing at the front of the room.
When each question is asked, kids will step either right or left out of line to indicate their preference. Have them look around to see their peer's responses. All volunteers and helpers can be in the line as well indicating their preferences! preference for each question---have kids either step right or left out of the line. All volunteers and helpers need to be in the line too showing their preferences.

WOULD YOU RATHER QUESTIONS

- Would you rather ride an elephant or a camel?
- Would you rather be able to fly or breathe underwater?
- Would you rather swim with dolphins or swim with turtles?
- Would you rather be an amazing dancer or an amazing singer?
- Would you rather eat at McDonald's or eat at SpongeBob's restaurant?
- Would you rather be invisible or be able to fly?
- Would you rather own a horse or a bear?
- Would you rather be able to drive a car or fly a plane?

LEVEL ONE

A Beginners Guide to Engineering

PAPER CHAIN STEM CHALLENGE

Levels: K through 5th
Time: 20 to 40 minutes

OBJECTIVES

The objective of the Paper Chain STEM Challenge is to encourage students to apply their creativity, problem-solving skills, and understanding of basic engineering principles to design and build the longest possible paper chain using limited materials. Through this activity, students will explore concepts like measurement, structural stability, and efficient use of resources. The challenge also promotes teamwork and collaboration as students work together to plan, test, and refine their designs. Additionally, the activity fosters critical thinking as students analyze the effectiveness of different construction techniques and make adjustments to improve their results.

MATERIALS:

EACH STUDENT NEEDS:

- One piece of colored construction paper
- Scissors
- Masking Tape
- Measuring Tape

PREPARATION

Watch this video on how this activity is made:
Paper Chain STEM Challenge
STEM Paper Chain Challenge

It's best to do this experiment at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

ACTIVITY

One thing about this quick STEM activity is the setup time! The supplies are easy to grab at a moment's notice so that you can try this STEM project immediately. Everyone gets a sheet of paper, a pair of scissors, and tape.
But everyone gets only ONE sheet of paper, so make it count! Kids can do multiple trials–encourage learning!!

ACTIVITY

STEP 1: Give out supplies to each person.

STEP 2: Give a minute or two for a planning phase. Have them brainstorm and discuss what methods may produce the longest chain.

STEP 3: Set a time limit (15-20 minutes is ideal).

STEP 4: Once the time is up, have the kids lay out the chains on the table or floor to see which one is the longest.

Hint: Incorporate extra math in this step!
- Grab a measuring tape to measure and record each one.
- Count the links for the youngest kiddos.
- Round the measurement to the nearest whole number or include the fractions. (depending on the ages of your kids).
- Graph or record the results.
- Make comparisons between the paper chains using greater than, less than, or equal to symbols (< > =)
- Subtract the shortest from the longest.
- Add all of the lengths together.
- Estimate how many sheets of paper it would take to make a chain as long as the room using the type of chain you made. Bonus: try it!

STEP 5: If it works for you, have each kiddo share his/her thoughts on the challenge. A good engineer or scientist always shares his/her findings or results.

REFLECTION

Questions to ask after the activity

1. What factors contribute to one chain being longer than the other if they are each made out of the same size sheet of paper?

2. What was the most challenging thing about the STEM project?

3. What would you do differently if you had a chance to try it again?

4. What worked well and what didn't work well during the challenge?

FLOATING BALL HOVER ACTIVITY

Levels: K through 5th
Time: 20 to 30 minutes

OBJECTIVES

Have you seen those floating ball toys where you blow into one end and the ball "magically" floats above in place? Here's a way to create your own! You'll need a bendy straw, paper, scissors, a pen or pencil, tape, and a ping pong ball or ball made of foil.

PREPARATION

Watch these videos on the explanation of the science behind this activity and how this activity is made:
Balloon Hover Game

It's best to do this experiment at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

ACTIVITY

1. Kids trace lid/CD and cut out a circle from cardstock. Then cut a slit from the outside to the center.
2. Roll the circle into a cone shape and staple together.
3. Cut a small hole out of the point of the cone.
4. Decorate the catcher cone with eyes and teeth, etc.
5. Tape a bendy straw into the hole and seal completely with tape.
6. Put a cotton ball/foil ball into the cone. Use the straw to blow and make the cotton ball hover.

MATERIALS:

EACH STUDENT NEEDS:

- Cardstock to copy circles on
- 4 -5" Plastic lids/CDs to trace
- Bendy flexible straws
- Pencils
- Foil to make into balls
- Cotton balls or small balloons
- Scissors
- Scotch tape
- Markers and scrap paper to decorate hover catchers

HOW IT WORKS

the science behind this activity

The Floating Ping Pong Ball is a wonderful example of Bernoulli's Principle, the same principle that allows heavier-than-air objects, like airplanes, to fly.

Bernoulli, an 18th century Swiss mathematician, discovered something quite unusual about moving air. He found that the faster air flows over the surface of something, the less the air pushes on that surface. That means that the air pressure on the object is lower than average.

The air from the straw, as you blow through it, produces the levitating ball phenomenon using Bernoulli's Principle. The fast air moving that you are blowing around the sides of the ball is at a lower pressure than the surrounding, stationary air. If you look closely, you'll see that the ball wobbles while it is levitating in midair. The ball is attempting to leave the area of low pressure, but the higher air pressure surrounding it forces it back into the low pressure area.

STEM SKI CHALLENGE

A S.T.E.A.M. activity designed to explore the scientific method

Levels: K through 5th
Time: 35 to 45 minutes

OBJECTIVES

Create a skier that will get to the bottom of a hill on his/her skis. Share the following story with the students to make the challenge more motivating.

Perry is on a ski trip in the mountains called the Swiss Alps. Perry has a problem. When he got to the top of the hill, his skis broke! Perry just found out that there is a hot chocolate sale at the bottom of the mountain. (show the ramp = the mountain).

The kids need to help Perry get to the bottom of the hill by building him new skis so he can get his hot chocolate.

MATERIALS:

EACH STUDENT NEEDS:

- 1 12" x 12" sheet of foil
- Masking Tape
- Scissors
- Craft sticks
- A simple ramp made from cardboard or any flat surface the skier can run down.
- Optional-

hot chocolate, marshmallows in Styrofoam cups to serve kids at the conclusion of the activity.

PREPARATION

Watch these videos on the explanation on the scientific method:

Explaining the Scientific Method

It's best to do this experiment at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

ACTIVITY

1. Kids will need to decide if they are creating/engineering a skier, a sled, or a snowboarder. (Skiers and snowboarders need two craft sticks, sled will need three). Then demonstrate the following. Kids will create their own Perrys and ski equipment to try on the mountain.

2. Start by bending a piece of tin foil in the shape of an upside-down U. Then tape it down onto two craft sticks.

3. Bend the next piece of tin foil in the shape of a J. This will be our body. Hook the bottom of the j around the legs and make sure it's tight.

VOCABULARY

Words to know for this experiment

Prediction: the act of saying what might happen.

Trial and error: The process of experimenting with something to find the best option. Things may fail but try, try again!

ACTIVITY

4. With the next piece of tin foil, roll it up. This will be our arms. Place them on the middle of the body and crisscross the arms around the body.

5. With a small piece of tin foil, ball it up, then place it at the top of the body! Have kids create Perry's skis, sled or snowboard and use tape to connect Perry to it. (sleds and snowboards can be hooked together with tape).

6. Before you let Perry go down the hill, have the students predict how Perry will ski. Will it fall over or stay up straight? Will it go slow or fast? Once predictions are made Perry is finally ready to go down the hill! Find a flat slanted surface and take Perry to the top and let them go! This is also a perfect time to introduce trial and errort. At first, Perry may fall over, check to see if the skis are uneven? What if Perry is really slow? Try taping a penny to each ski and see if the weight will change the outcome.

At the end of the session, serve your students hot chocolate!!! With all the thinking and engineering- they've earned a sweet treat!

REFLECTION

Questions to ask after the experiment

1. What design did you choose for Perry (skier, sled, or snowboarder), and what influenced your decision?

2. How did your predictions about how Perry would move down the hill compare to the actual results? What surprised you?

3. What adjustments did you make to Perry's skis, sled, or snowboard to improve performance, and how did those changes affect the outcome?

4. What did you learn about trial and error during this activity, and how did it help you solve problems with Perry's design?

5. If you could build another Perry, what would you do differently to make Perry go faster or stay upright more easily?

LEVEL TWO

Deeping Our Understanding of Engineering

BALLOON SCULPTURES

A team-building activity used to explore methods of creative thinking and effective communication in groups.

Levels: K through 5th
Time: 30 to 40 minutes

OBJECTIVES

This is an informal lab that does not rely on technical knowledge or skills, so it works especially well when your group consists of participants of different job levels. It's a fun activity that allows the group to work together without thinking about their formal roles within the organization.
You may notice that participants may behave in ways contrary to their job levels or job roles (e.g. someone with lower authority in the office may step up and lead the team or someone who does a more technical job may turn out to be more creative).

MATERIALS:

EACH GROUP NEEDS:

- 25 balloons of varying colors and sizes
- Roll of Masking Tape
- Large cardstock for each team to build towers on.

OPTIONAL MATERIALS:

- a tape measurer
- sticky notes
- pen
- electric balloon inflator.

PREPARATION

Explore effective ways of communication within teams. Here's some ways teams can effectively work together:
How Teams Communicate
What Makes A Team Great?

It's best to read through this activity at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

CHALLENGE:

Can your team create the tallest free-standing balloon tower using 25 balloons and masking tape?

Freestanding means – without anyone holding it up or touching it and without the tower leaning against the wall.

How well can the teams work together? This activity tests communication and creative thinking between the participants. While participants are building their towers, observe strengths and weaknesses between the groups and talk about it afterward.

WHAT ARE WE LEARNING?

This lab is going to teach:

Communication: the process of sending and receiving information through verbal and non-verbal methods

Creative Thinking: the ability to develop new and different approaches to a problem or a concept. Essentially, creative thought involves processing existing information and experiences, adopting various perspectives, and figuring out new patterns

ACTIVITY

1. Put kids into 3 teams. (3-4 kids in each group)

2. Determine who can blow up/tie balloons in each group. Adult helpers help with this. Give each team about 10 minutes to blow up balloons. Using a portable electric balloon-inflating machine could help all teams out as well.
(Helpful Hint - have some balloons blown up ahead of time for each group)

3. On "Go" - The team has 10 minutes to build their towers using all 25 balloons and pieces of masking tape. Teams stop building after 10 minutes. (Allow extra time if needed...the process is more important than the time limit). Adult helpers become part of each team to help the process along.

4. Use the remaining time to measure each group's balloon tower and determine the tallest.

5. On a sticky note - Label each tower with height in inches so kids have a visual of each tower's height.

Take a photo of each group and their finished tower and celebrate teamwork.

QUESTIONS TO ASK:

1. What did you learn about your team members that you didn't know before?

2. What communication methods did your team use?

3. Did everyone agree with the idea for the balloon sculpture? If not, did you have to compromise?

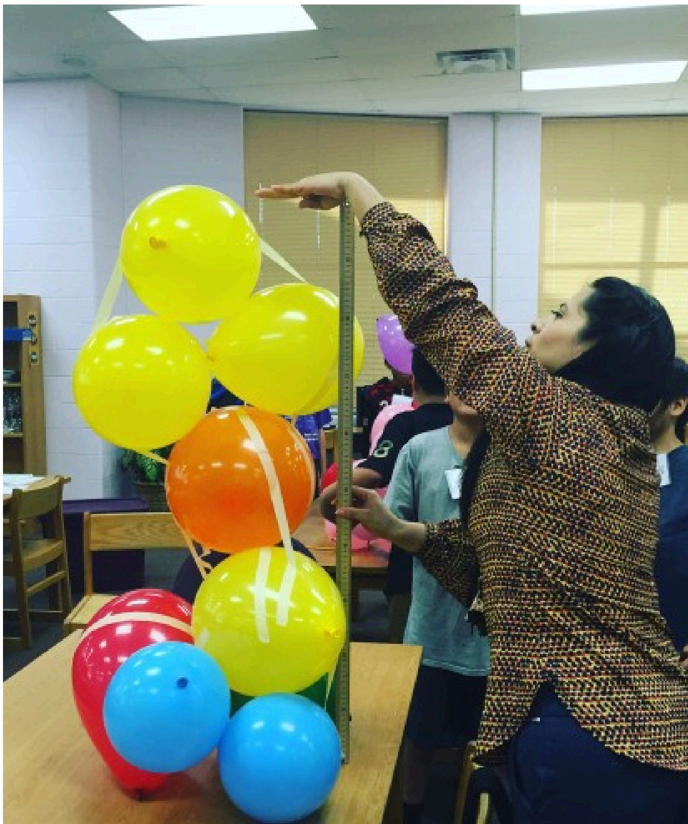
4. How well did you work as a team?

5. Did others in the team listen to your opinion? Did everyone have their input?

6. Did anyone emerge as a leader, and how did having a leader help?

SCIENTISTS & TEAMWORK

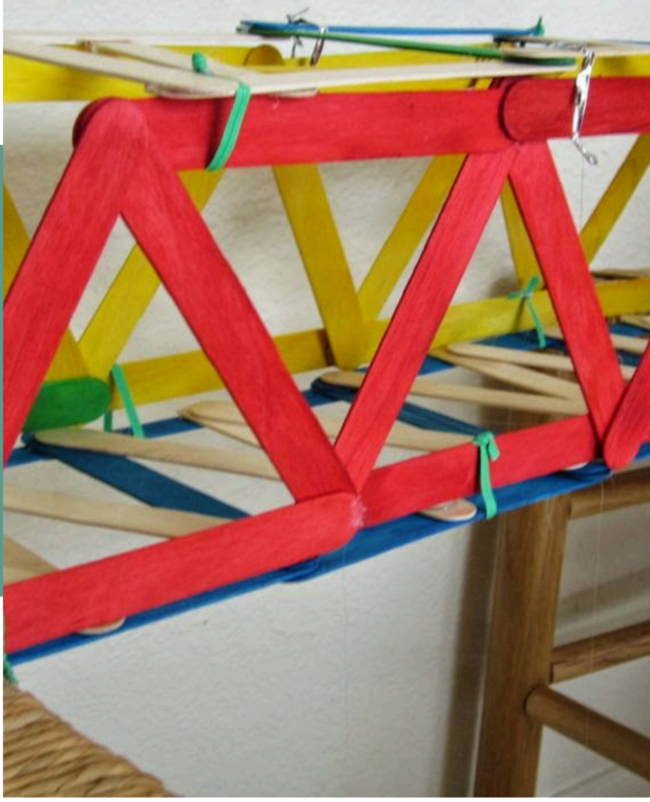
Scientists need to have effective teamwork because solving big problems often requires different skills and ideas. When scientists work together, they can share their knowledge, learn from each other, and come up with better solutions. Teamwork also helps them to complete projects faster and avoid mistakes by checking each other's work. By working as a team, scientists can make discoveries that help improve our world



BRIDGE BUILDING

A S.T.E.A.M. activity designed to explore the topics of engineering and bridge building

Levels: K through 5th
Time: 30 to 40 minutes



WHAT IS A BRIDGE?

It's something that helps us get from one place to another, like over a river or a road. And guess what? Learning about how bridges are made can teach us a lot about engineering!

1. What's Engineering?
Engineering is when we use our imagination and science to solve problems and build things. It's like being a super inventor!

2. Different Kinds of Bridges:
There are many types of bridges, just like there are many types of toys. Some are long and flat, some are big and strong, and some can even open up! Here are a few:

- Beam Bridge: Simple and flat, like a plank of wood across a stream.
- Arch Bridge: Curved and strong, like a rainbow made of stone.
- Suspension Bridge: Long and flexible, held up by cables, like a giant swing.

MATERIALS:

EACH STUDENT NEEDS:

- Painter's tape
- Popsicle sticks bundled into groups of 25
- Classroom desks or chairs

PREPARATION

Watch these videos on the explanation of engineering and bridge building: What makes Bridges so Strong?

It's best to do this experiment at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

ACTIVITY

Challenge– to make the strongest bridge across a 1 foot divide between the chairs/desks/tables.

Remember, there's no right or wrong way to learn. Have fun, be creative, and don't be afraid to try new ideas. Every time you build something, you're thinking like an engineer!

QUESTIONS TO ASK

Before, After, or During the Activity:

1. What are the different types of bridges you learned about? Can you name some examples and explain how they are different?
2. What materials did you use to build your bridge, and why did you choose them? How did the materials affect the strength and stability of your bridge?
3. How does the shape of a bridge affect its strength? What shapes did you use in your design, and why?
4. What did you learn about teamwork and collaboration during this activity? How did working with others help improve your design?

ACTIVITY

1. Divide the kids into groups of 2

2. Each pair of kids is given 2 small chairs to place 1 foot apart they will attach their bridge to. (kids can move their chairs to a location around the classroom or designate an area for each group of two)

3. Give each group 25 popsicle sticks and 3 feet of painter's tape.

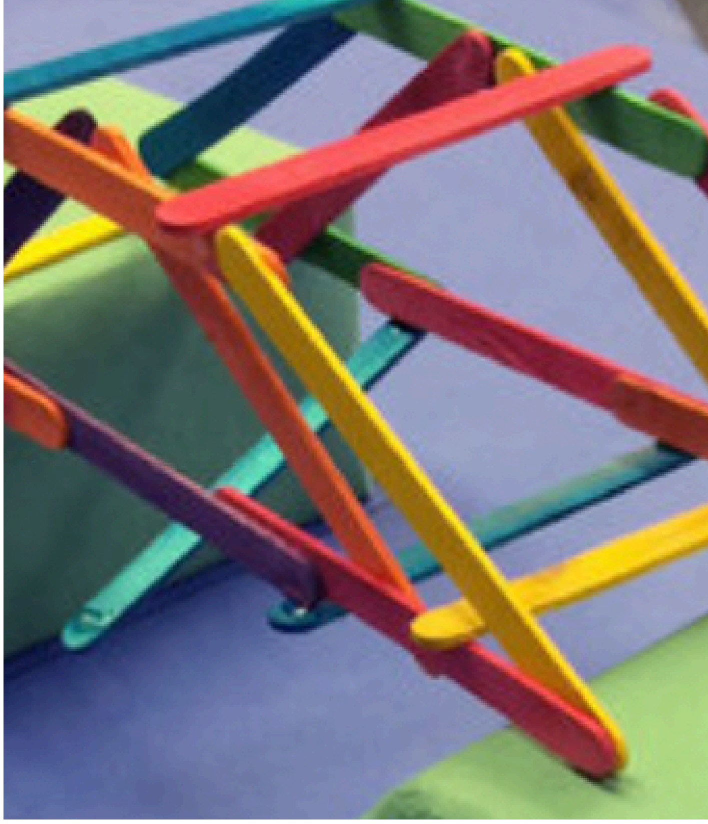
4. * Brainstorm as a group possible ways to make the bridge. Show pictures as examples. Teams must work together to create their bridge.

5. Kids have 15 minutes to build.

6. At the end of 15 minutes– Test the strength of each bridge. The teacher/helpers move from bridge to bridge and test the strength of each bridge using pennies on each structure to determine the bridge that is the strongest.

7. For young builders - partner them up with older students/volunteers.

8. Clean up – throw away tape. Rebundle craft sticks into groups of 25 for the next group to use, put chairs back to their original position.



ADD ON TO THIS CRAFT:

Extensions to continue this experiment:

Can you build a longer bridge?

1. Add more space between the chairs holding up the bridge. Can you make a strong bridge with 2 feet of space? Three feet?

LEGO ZIP LINE

Levels: K through 5th
Time: 35 to 45 minutes

OBJECTIVES

The STEM Challenge: to create the best zip-lining "cage" they can in 20 minutes so their Lego guy can make it safely to the bottom of the zipline.

PREPARATION

First – Show the video below giving the kids a glimpse into zip lining so they can see how a zip line works and so they can plan and design their zip lining cage:
Kids Ride GIANT ZIPLINE in HAWAII on Family Adventure!!

Watch this video on how this activity is made:
How to Make a Lego Zipline

It's best to do this experiment at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

MATERIALS:

EACH STUDENT NEEDS:

- Legos
- Lego People
- Cord, yarn or thick string
- Step stool

ACTIVITY

1. Build a Lego cage – this should be a structure that can hold the LEGO minifigure with a hole on the top where the zip line will go through.

2. Put the LEGO minifigure in the cage.

3. Tie one end of the string to a doorknob, back of a chair, or any place that is stationary and off the floor.

4. Thread the string through the hole in the Lego cage.

5. Pull the string so that it's taut and hold the loose end tightly and on a decline (Kids may use a step stool/chair to experiment with a greater slope).

DISCUSS THE FOLLOWING SCIENCE CONCEPTS AS EACH CAGE IS TESTED:

- speed up the lego man by increasing the angle of the slope
- slow down or stop the lego man by evening out the angle of the slope
- return the lego man by decreasing the angle of the slope
- gravity works to pull the LEGO man down the zip line but the angle of the slope can slow gravity
- tension on the cord is needed to maintain travel

ACTIVITY

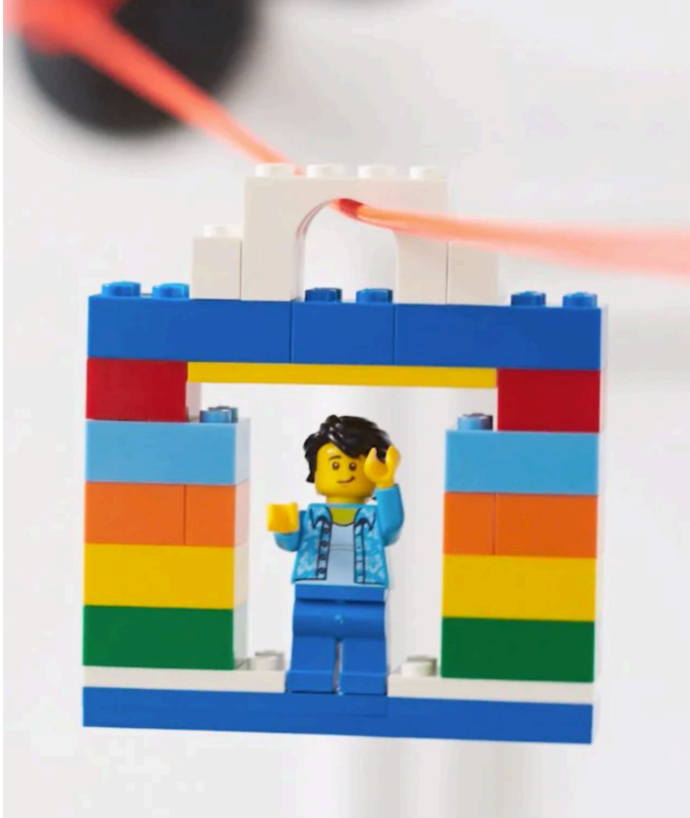
6. Push the cage all the way to the highest point of the string.

7. Before each experiment, ask kids to predict what their cage will do to develop critical thinking skills.

8. Let go of the cage and watch it slide down the zip line!

OPTIONAL - set up multiple zip lines with varying thicknesses of string/yarn for the kids to experiment with.

Kids can test their cage and then go back and redesign to make their cage better. Or start again and design a completely different cage. (trial and error)



TALK ABOUT THIS:

While the LEGO zip line may seem like just a simple, fun activity, there are so many science concepts that you can teach your kid. As the kids experiment with different designs, talk about:

Gravity: Why do the minifigure and the cage go downward on the zipline instead of sliding upward? Gravity is the force that pulls objects toward the center of the Earth. In this case, gravity is pulling the LEGO pieces to the ground.

Friction: Why do some cages slide down smoother than others? Friction occurs when one object rubs against another. Friction works against and acts in the opposite direction of motion.

Slope: How can you make the same cage design slide down the zipline faster or slower? The slope describes how steep a straight line is, and you can change the slope of the zipline by moving the end of the string that's touching the ground.

Speed: How fast does the cage move down the zip line? Speed is the measure of how fast something is moving or the distance that an object moves in a certain amount of time.

Weight: Do heavier cages slide down the zipline faster? Weight is the force gravity applies to an object and has an impact on the speed

LEVEL THREE

An Advanced Understanding of Engineering

ENGINEERING BALLOON POWERED CARS

Levels: K through 5th
Time: 35 to 45 minutes

OBJECTIVES

Challenge – to build a car with given materials that rolls and travels forward- hopefully in a straight line. Students have a paper plate and items to make the wheels and axles. They must also determine a way to attach the blown-up balloon. When the balloon is released the car will zoom forward.
The promise of races with other teams makes them work really hard!

PREPARATION

Watch these videos on the explanation of Newton's Law of Motion:
Crash Course: Newton's Law of Motion

Watch this video on what the activity should look like/do in the end:
Balloon Powered Cars

It's best to do this experiment at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

ACTIVITY

Start with a discussion about all the different ways that the vehicles we have can "move." Gas-powered, electric, solar, etc. Share that today the kids will be engineering a car that runs on AIR!

They may be as creative as they wish. Younger students will need assistance with gluing. Encourage kids to give their completed car a trial run and then have them make adjustments as needed.

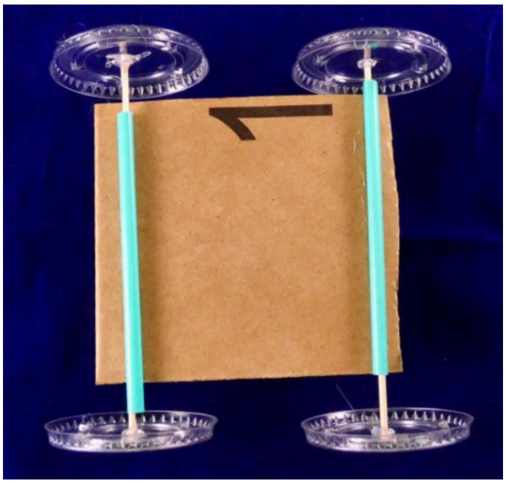
The emphasis of this activity is on design thinking, revising, and using science and
engineering practices.
Show kids your finished car and demonstrate how you made it. Share the materials they will be able to use to design their air-powered car. On a whiteboard, list the following parts their car will need:

MATERIALS:

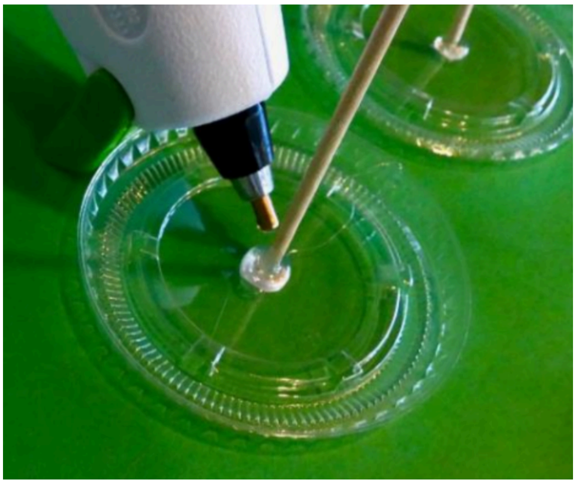
EACH STUDENT NEEDS:

- Cheap full-sized paper plates 1-2/student or a piece of pre-cut cardboard about 4" x 4"
- Scissors
- Balloons 1/student
- Bottle caps for wheels – 4/student (center hole pre- drilled in each cap) click link to view plastic caps here
- Bendy Straws 1/student
- Regular straws 2/student for axles.
- Rubber Bands to attach the balloon to the straw
- 2 skewers for axels for each student
- Hot glue guns to seal wheels onto the axle
- Masking Tape
- Markers to personalize cars
- Orange Cones for starting line and finish line
- A completed car you made ahead of time

Body (from a paper plate - it can be cone shaped, rolled like a hotdog, flat, etc.
4 wheels from plastic bottle caps with pre-drilled holes in the center for the axles



Axle made from a straw and a skewer through the middle. Attach the axle to the wheels with hot glue. Make sure the axles are glued in the center of each wheel.



Balloon attached to a straw with a rubber band that is then attached to their car to
make it GO!


ENGINEERING A ROBOT

Levels: K through 5th
Time: 45+ minutes

OBJECTIVES

Introduce the activity by having the kids brainstorm ways robots help us in our world. Read the book, "The Bot that Scott Built" to help the kids focus on what job Scott's robot had. (And enjoy the humor and unpredictability of the story!)
Challenge for the kids:
To create a one-of-a-kind robot using everyday items.

PREPARATION

Watch this video on how this activity is made:
How to Make a Robot out of Household Items
(Remember: the students can use their imagination!)

It's best to do this experiment at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

ACTIVITY

Two things their Robot must have when it is completed:
1. A name
2. A job/purpose

Share a completed robot that you have made with the kids.
Show them each of the supplies that you chose to you and they may use. They do not need to use all the supplies
Show them the glue, tape they have to work with.

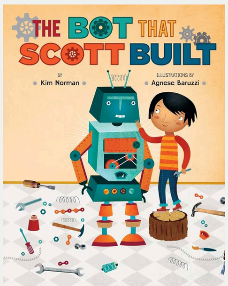
Brainstorm what they could use for the robot's body, arms, eyes, etc. The sky is definitely the limit on this open ended activity!
Set a time limit for them to work.

When they are finished with their robot, have them show you/others. Have them share the robot's name and purpose. Celebrate ALL creativity and cleverness!! The process is more important than the final product.

MATERIALS:

EACH STUDENT NEEDS:

- Pipe cleaners
- Styrofoam cups
- Craft sticks
- Scrap Paper
- Poms
- Foil
- Straws
- Wiggly eyes
- Cardboard tubes
- Beads
- Scissors
- Glue
- Glue guns
- Tape
- Literature Link - THE BOT THAT SCOTT BUILT by Kim
- Norman



ENGINEERING AIR-POWERED ROCKETS

Levels: K through 5th
Time: 35 to 45 minutes

OBJECTIVES

3...2...1...Get ready to blast off into a highflying and even higher excitement activity. Your students are going to design, build, and launch an air-powered rocket. This will be an exciting way for students to learn about aerospace engineering.

PREPARATION

Print out enough rockets for each student before they arrive

It's best to do this experiment at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

GUIDING QUESTIONS

As these questions after the activity:

- Which way of carrying the paper clips gave the rocket its farthest flight? Why do you think so?
- What would happen if you moved the position of the fins?
- What if you made your rocket out of something stiffer than paper, like a folder? What if it were made out of something lighter, like wrapping paper or newspaper?

MATERIALS:

EACH STUDENT NEEDS:

- Rocket templates

additional rocket templates at the end of the lesson.

- Scissors
- Tape
- 2 straws – one thinner than the other
- Markers
- Glue sticks

VOCABULARY

Newton's First Law – Objects at rest tend to stay at rest, and objects in motion tend to stay in motion at a constant speed in a straight line unless acted upon by an unbalanced force.

Newton's Second Law – The net force acting on an object in a given direction is equal to the mass of the object multiplied by the acceleration of the object in the same direction as the net force.

Newton's Third Law– The force of one object (object 1) acting on another object (object 2) is equal in magnitude and opposite in direction to the force of the second object acting upon the first.

Center of Gravity (CoM)- The point at which the entire weight of a body may be considered as concentrated so that if supported at this point the body would remain in equilibrium in any position. (0). Same location as center of mass. Center of

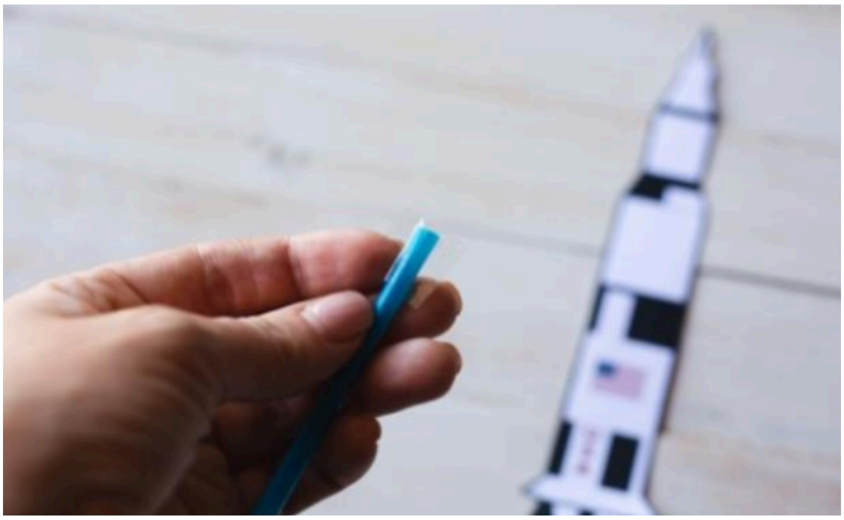
Pressure (CoP) - The point on a body where the sum of the total pressure acts. Pressure acting on a surface causes a force. The point at which the sum of these forces, from the various surfaces of the body is the CoP.

ACTIVITY

1. Cut out 2 of the same rockets, color, and design.

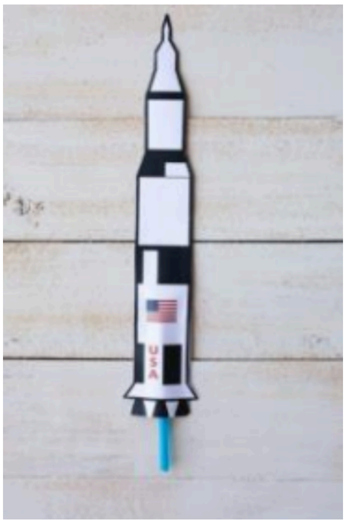
2. Have each student put their name on their rocket so it can be returned after it is launched.

3. Cut a thin straw down to 4 inches in length and tape the top of it shut.



4. Tape the thin straw to the wrong side of one rocket piece. Leave about 1.5 inches of straw sticking out of the bottom of the rocket, and stop the tape 1/2-inch from the edge of the rocket, as pictured.

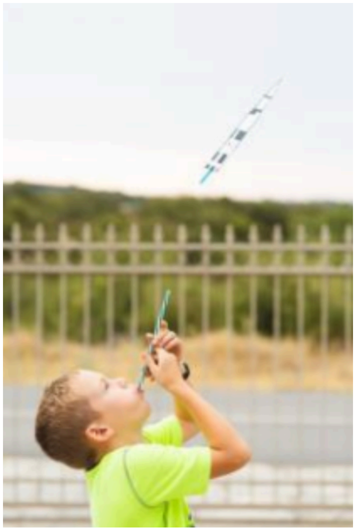
5. Tape or glue the edges of the rockets together, leaving the bottom edge open

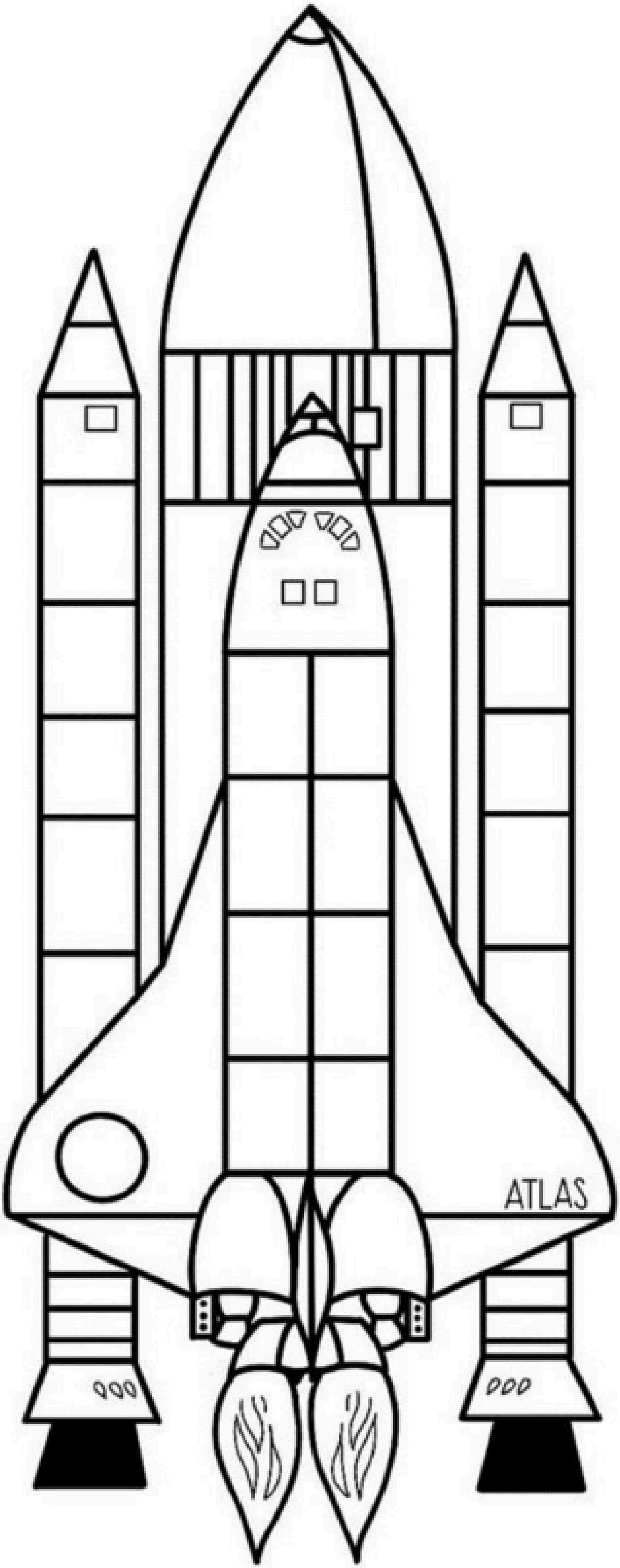


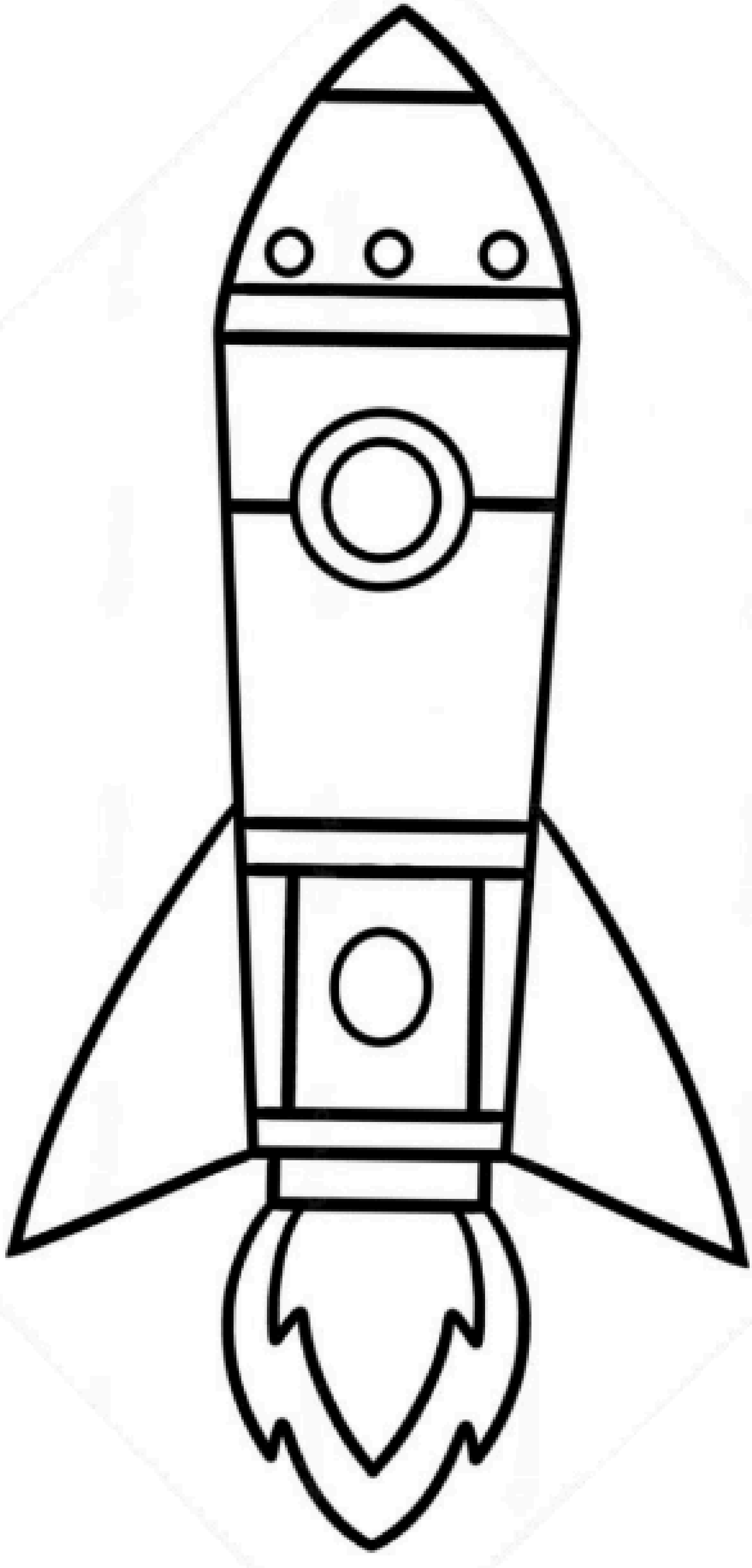
6. Slip the thicker straw over the thinner straw end that is sticking out of the rocket.

7. An outdoor, open space can be used for a rocket launching site. Count backwards from 10 and then have the kids use ‘air power’ to blow into their straw and “blast off” their rockets.
Retrieve and retest. Have fun!

Helpful Hint: There is a little trick to getting it go high -do not push the straw very hard into the rocket. Place it loosely on top. Then when you blow, give it one fast blow to make it fly sky high!




ATLAS



ENGINEERING POPSICLE STICK CATAPULTS

Levels: K through 5th
Time: 35 to 45 minutes

OBJECTIVES

It's one of the most iconic simple machine STEM projects for kids. Building the trusty catapult! It is an incredible STEM activity with a strong focus on engineering, but also math and physics all rolled into one amazing learning project. Today we tackled the iconic Popsicle Stick Catapult.

MATERIALS:

EACH STUDENT NEEDS:

- Craft sticks
- Spoons
- Rubber bands
- Foil (makes great ammo)

PREPARATION

Watch this video on how this activity is made:
How to Build a Popsicle Stick Catapult STEM Project

It's best to do this experiment at least once before teaching the students to 1) ensure you know how the experiment works, and 2) to have a few examples of what the project will look like.

VOCABULARY

Physics: the study of matter and its motion through space and time

Engineering: the process of designing, building, and testing machines, structures, and processes using science and math

Kinetic Energy: the energy of motion, or energy associated with the motion of objects, atoms, molecules, and more. All moving objects have kinetic energy, including trains, fans, and people kicking soccer balls.

Potential Energy: also known as stored energy, is energy that is held by an object due to its position relative to other objects

Projectile Motion: the motion of an object that's thrown or projected into the air and moves along a curved path due to gravity. The object is called a projectile, and its path is called a trajectory

GUIDING QUESTIONS

Ask these questions after the activity:

What happened to the ball? Did it fly? Did it go high or low? Where did it land?
What do you expect will happen when you push the cup farther down? Will this make it fly higher, farther, both higher and farther or take the same path but maybe faster?

ACTIVITY

1. Take 5 sticks and stack them, securing one end with a rubber band. You'll need to wrap the rubber band around several times to make it nice and secure.

2. Slide one more stick between the bottom stick and the rest of the stack.

3. Secure the other end with a rubber band.

4. Place the spoon on top, and attach the end of the spoon to the end of the single stick with the last rubber band

5. Crumpled balls of foil and small marshmallows make excellent projectiles for this style of catapult.

OPTIONS

- Add in an art component and have kids use markers to decorate their catapults.
- Set up targets (buckets, sheets of cardboard) and see if they can hit the target.
- See who's catapult can launch a projectile the farthest. Use a measuring tape to find out.

WHATS HAPPENING

When you bend your stick, you load your launching stick up with energy. When you let go, this energy is released and converted to energy of motion. Most of this energy transfers to the cotton ball, which shoots through the air.

Pushing the stick down farther takes more effort from you. Maybe you felt you needed to exert more force or work harder to bend the stick farther. Bending farther means more energy gets stored in the stick, and when you let go, all this stored energy is converted into energy of motion, so the cotton ball flies through the air at a higher speed. In the case of your catapult, the cotton ball probably flew higher and farther.

Moving the stack of six sticks closer to the launching cup makes the launching stick lie flatter. This results in a cotton ball aimed more upward than forward. Pushing your six sticks the other direction creates a greater angle between the launching stick and the base. This helps you aim the cotton ball forward.

REVIEW

what have we learned?

Review

What have we learned?

Review

Create a dialogue with the students about what they have learned. Ask questions about each activity and lab they have completed and discuss how each activity has helped them become better engineers. Let the students take turns and discuss with an open conversation

Questions

Let the students have an open discussion on what they have learned. If you feel as though you won't need questions to direct the conversation, don't use them! If you have other questions you would like to ask, ask them! This review is completely up to you and the students- let them take the lead on the discussion!

1. Go through each of the characteristics of a good engineer. What part of the project(s) helped build that skill?
2. Which skill were you naturally good at? Which skil did you need more work with? Did these activities help you build that skill? Are there any skills that you still need to work on?
3. What type of engineering seems the most interesting to you?
4. What other activities would you like to do in order to continue learning about engineering?

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www.edgerton.org

THE EDGERTON EDUCATION FOUNDATION
208 16TH STREET, A
URORA, NEBRASKA 68818

402-694-4032
EDGERTON.ORG
MARY@EDGERTON.ORG