



# Science: It's a Family Affair

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A Guide for Parents

Brought to you by:

**techbridge**  
Inspire a girl to change the world



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# Introduction

Children are naturally curious and eager to make sense of their world. While exploring in the park or playing with toys, kids discover new things, make observations, and come to you with their questions.

What's the best way to explore a career in engineering with my child?

What science and engineering activities are available to families?

How can I support my child's interest in science?

This guide is meant to help support your child's sense of wonder, to encourage you to explore scientific questions together as a family, and to plant the seeds for future interest—possibly even a career—in science or engineering.

- You don't need to be an expert to provide your child with the confidence to learn about and enjoy these topics.
- It's never too early to begin to help your child think about and plan for the future.
- Making time to support your child's interests and providing opportunities to explore different careers can set your child on a path to discovering a lifelong passion for science or engineering.

In this guide we share ideas for projects that you can try at home to explore science and engineering with your child. Additional resources can be found on the Techbridge website at [techbridgegirls.org](http://techbridgegirls.org).





# Parents Make a Difference!

You don't need a degree in science or engineering to play a crucial role in shaping your child's learning. When you approach the world with curiosity and a willingness to explore, whether you're helping your child solve a problem or build a tower out of blocks, you can spark an interest in science, technology, engineering, and math.



Check out these tips to encourage learning and family fun through science and engineering

## Encourage your child to ask questions in school.

Each morning, challenge your child to ask a question in school and check back at the end of the day to see if he or she did it. Just asking questions has been shown to make kids more interested in their learning in school.

## Share in your child's discoveries.

Ask your child to share one idea or lesson he or she learned in school. Here are questions to start the conversation:

- ▶ Can you tell me about something new you learned today?
- ▶ What questions did you ask in science class?
- ▶ What new idea did you think about today?

*Approach the world with curiosity, and you will help spark an interest in science.*



When choosing TV shows to watch with the family, find programs that highlight positive role models. Most of the time scientists and engineers on TV shows are depicted as nerdy or uncool. Research shows that there are very few female scientists or engineers portrayed on TV. Show your family that both men and women engage in science and are interesting people with fun lives.

## While watching TV, ask your child:

- ✓ What science and engineering careers do you see?
- ✓ What kinds of problems or issues do scientists and engineers address?
- ✓ Do scientists work alone or in teams?
- ✓ What hobbies or interests do you think engineers and scientists have outside their work?

### Take time to explain the science behind the objects and activities around you.

Here are questions that can start a conversation and support learning:

- How do the gears on your bike work?
- What makes popcorn pop?
- Why do you get dizzy when you spin really fast?
- Don't worry if you don't know the answers—you can have fun looking them up as a family. The Internet, a smart phone, or your local library can be excellent resources.

### Collect data like a real scientist.

Help analyze deep-sea videos from your computer or collect light pollution data using your smart phone. Citizen Science projects rely on the field work of people like you and your child—find a project near you at [www.scienceforcitizens.net](http://www.scienceforcitizens.net). Or develop your own simple experiments by looking around your house. For example:

- What detergent makes the biggest bubbles?
- Do all round things bounce the same?
- Do you sleep later if it's cloudy outside?

### Spend a day playing board games.

Games such as jigsaw puzzles, checkers, chess,

and tangrams promote problem-solving and spatial skills. Here are some conversation starters when playing:

- You put a lot of thought into this game. What was your strategy?
- How could we change the game to make it more fun or more challenging?
- How do game designers test their ideas?
- What game would you like to invent?

### Introduce your child to stimulating environments.

Visit beaches, wetlands, parks, and other nature areas. Not only is there a lot to learn about science and engineering on these outings, but they can inspire a new career interest. While you're there, stop and read the signs telling visitors about points of interest. Ask questions to get your child to think about the environment. For example:

- Why is it important that we take care of our parks?
- How do bees help our environment?
- What would happen if there were no insects?

### Experience science at home.

Many activities and explorations can be done in your kitchen with simple materials you have



on hand. If you're short on ideas, the Science Buddies website ([www.sciencebuddies.org](http://www.sciencebuddies.org)) lists more than 1,000 science projects, ranging from physical and earth science to engineering and math. Most projects require materials that are easily accessible at home.

### Support your child's interests.

Your child's interests may become talents. Note what topics your child discusses and activities he or she chooses to do. You can help your child find resources, such as books or camps, to learn more.



## ..... a growth ..... MINDSET

Research shows that intelligence can be developed with effort. As a parent, you can teach your child that the brain is like a muscle that gets stronger and works better the more it is exercised. By supporting this kind of growth mindset, you will encourage your child to want to learn new and challenging things. In the face of challenges, children with a growth mindset are more likely to be persistent and successful.

### Here are some tips for reinforcing this mindset:

- ✓ Highlight the importance of learning from mistakes by sharing your own experiences.
- ✓ Appreciate practice and persistence when your child is learning a new skill, such as playing a new instrument or working on advanced math problems.
- ✓ Offer positive reinforcement when your child stretches beyond his or her comfort zone and takes on challenges rather than plays it safe.
- ✓ When you see your child struggling with a task, remind your child of when he or she accomplished something with additional effort.
- ✓ Highlight the fun of challenges with statements such as, "Wow, it's fun to work that hard, right?"

Source: Carol S. Dweck, *Mindset: The New Psychology of Success*.



# Girls Can!

Today's challenges call for creative solutions and diverse perspectives, but when it comes to science and engineering careers, women are underrepresented. Girls and boys perform the same in these fields in elementary school, but by middle school many girls begin to lose both confidence and interest.

As a parent, you make a difference in your daughter's future. By providing positive science and engineering experiences from an early age, you can help maintain your daughter's confidence and increase her interest.

Here are  
some  
ideas

## **Make time to tinker.**

Some girls may not have the same opportunities as boys to play with games and toys that develop spatial skills. GoldieBlox, Roominate, and K'NEX are great toys for girls.

## **Explain your next home or car repair project to your daughter.**

Studies have shown that parents are more likely to explain how things work to boys than to girls during science activities.

## **Remember to connect technology products to how people use them or how they can help people.**

Girls often express interest in how technology will be used and how it can make the world a better place.

## **Expose girls to role models in the media.**

SciGirls is a PBS TV series that features girls ages 11–14 as scientists and engineers. Find out more at [www.pbskids.org/scigirls](http://www.pbskids.org/scigirls).

## **Read about inspirational women.**

The **Women's Adventures in Science** series features notable women in science and engineering. These books can be purchased online or you can ask your local library to carry them.

## **Explore science and engineering careers with your daughter.**

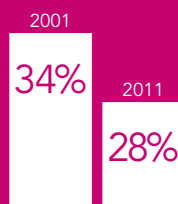
A few of our favorite sites are [engineergirl.org](http://engineergirl.org), [engineeryourlife.org](http://engineeryourlife.org), and [FabFems.org](http://FabFems.org).

*These are the experiences that build interest and give our girls the confidence to pursue careers in engineering in the future.*

**DID  
YOU  
KNOW?**

Only **18%** of  
graduating engineers  
are women

The number  
of women  
graduating in  
computer science  
has decreased



Only **25%**  
of professional  
astronomers are female

Fewer  
than **50%**  
of high school girls know  
a woman in a STEM career



# Discover the Science Near You

An afternoon at a science museum makes discovery fun and can foster a lifelong love of science. It's a great way to spend quality time with your family without the distractions of computers and TV. Buy a family membership to your favorite museum. In just a few visits, the membership will pay for itself.



Here are some tips for making your family's museum visit fun and meaningful from start to finish

## Create a custom tour.

Check out the museum's website and plan your visit around the exhibits that interest your family.

## Investigate together.

Spend time reading the information at your favorite exhibits. Ask your child, "What could we do to learn more?" Asking questions and seeking answers is a powerful way to model how new discoveries are made.

## Connect to school.

Let your child be the expert and explain to you the most fascinating concept that he or she learned during the visit to the museum. Ask your child, "How would you explain to your class what you learned today?" By asking reflective questions, you help your child better understand and retain new information.

## Follow up on interests.

After a fun day at a museum, continue to explore the topics that interest your child. Go online or visit your public library to find books, activities, or articles that expand on what you saw. Look for TV shows that relate to your experiences at the museum. Check out PBS, The Discovery Channel, and Animal Planet for family-friendly science shows.

## Support summer learning.

It's important to provide your child with opportunities to learn throughout the year. Many museums provide summer camps and resources to explore science and engineering.

*With their hands-on activities and expert staff, science and technology centers are a great source for family fun.*

## ..... summer ..... SCIENCE FUN

Summer is a time for fun and learning! Research reveals that kids can lose as much as two months of math skills over the summer. Here are some strategies to help prevent summer learning loss:

✓ **Books:** Reading is an excellent tool for keeping a child's mind engaged and for maintaining your child's readiness for school in the fall.

✓ **Help with home tasks:** Simple chores can be turned into fun lessons. For example, invite your child to follow a recipe or help calculate a grocery bill.

✓ **Summer camps:** Science, technology, and engineering camps are a great way for kids to continue their learning and enrich their summer experience.

✓ **Hands-on science activities:** Take advantage of the museums and science and engineering programs for kids in your community.

# Exploring Careers in STEM

Who is creating a model human heart using a 3D printer? Who is designing a laptop that kids in villages around the world can use? As a biomedical engineer or a computer scientist, your child could work on these innovative projects.

Scientists and engineers dream up creative solutions for problems faced by people and communities. By asking questions to better understand the problem and searching for answers, scientists and engineers help make the world a better place. As a scientist or engineer, your son or daughter could develop products and systems that save lives, reduce poverty, and prevent diseases.

Here are some tips for exposing your child to the wonders of science and engineering

## Sign up your child for summer science and engineering programs in your community.

Job shadows and office tours give older kids a chance to "test the waters" and discover new careers.

## Introduce a role model.

Find someone whom your child can talk with to learn more about studying science or engineering in college or pursuing a career in the field. Speak with a teacher or school counselor if you need help finding this person.

## Include college campuses in your travel plans.

College tours can help your child begin to think about the future. Many colleges have community outreach days, during which tours and workshops are offered to families.

**Help your child discover his or her dream job.** Visit Try Science ([www.tryscience.org/parents/se\\_6.html](http://www.tryscience.org/parents/se_6.html)) for more information on careers in science, technology, and engineering.

*The role models made me see where science can take you—other than a job and white lab coat. A job can be creative, fun, and full of teamwork.*



## DID YOU KNOW?

The demand for scientists and engineers is expected to grow by

**44%**  
— IN —  
**10 Years**



Engineers earn some of the highest salaries in science, technology, and engineering.

The starting salary for those holding a bachelor's degree in computer science is

**\$60,000**

IT jobs will be among the fastest growing and highest paying over the next decade.

**43%**

of kids said that role models would increase their interest in learning about science, technology, and engineering.



# Super Cuffs

Has your child ever seen a superhero movie or read a superhero comic? Superheroes have extraordinary powers and dedicate their lives to protecting humankind. Yet, even with all their super powers, superheroes still need protection.



**In this activity,** your child will take on the role of a structural engineer. Structural engineers use shapes to add strength and stability to buildings, roads, and a variety of products. Your child's mission is to create a powerful wrist cuff by using a repeating pattern of shapes. The cuffs have to be strong enough to support the weight of a stack of books.

## MATERIALS

- ✓ Straws
- ✓ Scissors
- ✓ Tape, hot glue, or other bonding material
- ✓ Soup can
- ✓ 4 heavy books

## CHALLENGE

Construct a wrist cuff (using only straws and tape) that:

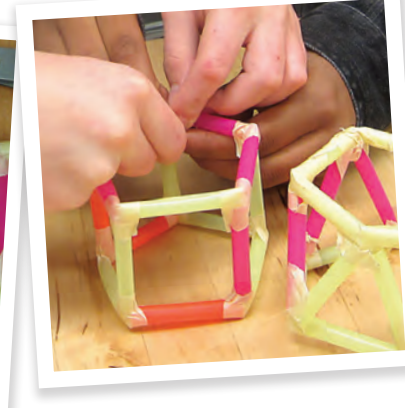
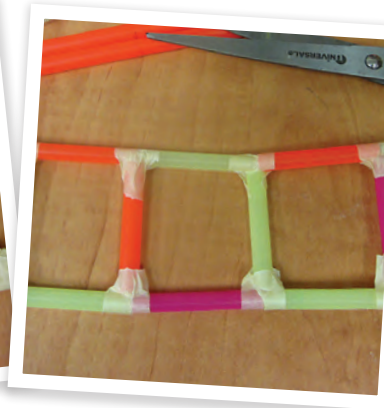
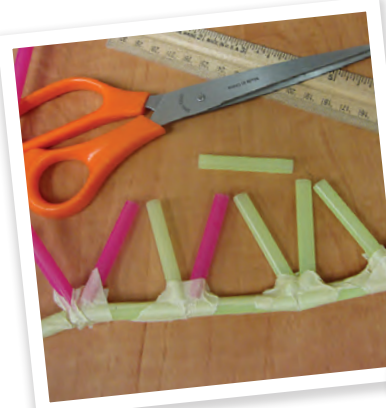
- ✓ Can withstand the weight of four heavy books
- ✓ Fits around your wrist

# PROJECT #1

## DIRECTIONS

- 1 **Look over the materials and ask your child:**
  - ✓ Where can you see shapes that support a lot of weight?
  - ✓ Which shapes (such as squares or triangles) do you think are the strongest? Why?

- 2 **Cut straws into two-inch pieces.**



- 3 **Create two wrist cuffs**, one out of squares and one out of triangles, by using straws to make the patterns shown above. Use a soup can as a template for creating the cuff shape, wrapping the cuff around the can as you build it.

- 4 **Test the strength of the cuffs** by placing a book directly on top of each, adding one book at a time. Examine your cuffs after you add each book.

- 5 **Assess the strength of each cuff:**
  - ✓ How much weight did each cuff support?
  - ✓ Were there weak points in your cuff?
  - ✓ Which shape was stronger?
  - ✓ What could you do to make your next set of cuffs stronger?
  - ✓ Why would it be important for superheroes to have strong cuffs?
  - ✓ Where else might you see "strong" shapes?

- 6 **Redesign a new, stronger cuff** using what you learned from your previous two designs.

MORE ABOUT  
**Structural Engineering**

Starting Salary:  
**\$55,000**

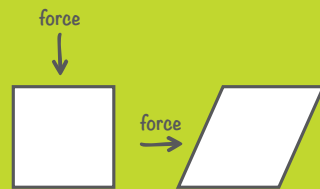
Structural engineers design load-bearing structures for buildings, bridges, and roadways. They are responsible for making sure that structures are strong and can withstand earthquakes and other natural disasters.

# SCIENCE

## BACKGROUND

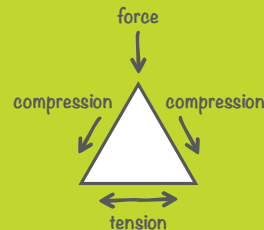
Force is a push or a pull on an object. For example, when you push on a door to close it, you are exerting force on it.

A structure's shape determines its strength. For example:



### Squares:

When force is placed on one side of a square, that force may shift the corners (angles) of the square. This changes the shape of the square, making it unstable.



### Triangles:

When force is placed on top of a triangle, that force is equally distributed to both sides (compression) and pushes on the bottom side (tension). This distribution of force is what gives triangles their strength.

## OUT —AND— ABOUT

Go on a shape scavenger hunt!

When you're out in your community, see if you can find shapes in larger structures, such as houses, bridges, and playgrounds. Which shapes do you see? What roles do they play in structures?

### FOR YOUNGER KIDS

- » Provide a template of each structure for your child to follow.



### FOR OLDER KIDS

- » Experiment with using different shapes, such as rectangles, hexagons, or octagons.
- » Try creating cuffs with multiple layers.

### ADDITIONAL RESOURCES

- » Check out PBS's Building Big: Shapes lab to find out more about how shapes are used to strengthen structures [pbs.org/wgbh/buildingbig/lab/shapes.html](https://pbs.org/wgbh/buildingbig/lab/shapes.html)
- » Want to try another activity to test the strength of different shapes? Head over to Zoom! [pbskids.org/zoom/activities/sci/strongestshape.html](https://pbskids.org/zoom/activities/sci/strongestshape.html)
- » Put squares and triangles to the test in this Strong Shapes activity [thinkingfountain.org/s/strongshapes/strongshapes.html](https://thinkingfountain.org/s/strongshapes/strongshapes.html)



# Crash Test Piñata

The piñata was originally a Chinese invention that made its way to Mexico in the 16<sup>th</sup> century. Today, piñatas filled with candy are a tradition at birthday parties and special events. They take a lot of abuse from children trying to get the candy out.



In this activity, your child will design a piñata using an empty cereal box and other materials. Like a safety engineer designing a car to withstand a crash, your child will use engineering skills to make a piñata that can withstand the impact of 10 hits and safely contain one cup of candy.

## MATERIALS

- ✓ Cereal box (or other food packaging box)
- ✓ Small pieces of cardboard
- ✓ Newspaper
- ✓ Styrofoam peanuts
- ✓ Two feet of tape
- ✓ Two feet of string
- ✓ Scissors
- ✓ One cup of candy
- ✓ Decorating materials
- ✓ Rope
- ✓ Wooden broomstick

## CHALLENGE

Use the materials to construct a piñata that:

- ✓ Can withstand the impact of 10 hits
- ✓ Has enough storage space for one cup of candy
- ✓ Has a hole for inserting the candy
- ✓ Uses no more than two feet of tape and two feet of string
- ✓ Can be attached to a rope

## DIRECTIONS

## 1 Look over the materials and ask your child:

- ✓ How strong is a cereal box?
- ✓ What are the weak points in a cereal box?
- ✓ How could you change the box to make it stronger?
- ✓ Can you incorporate a crumple zone and a safety cell into your design?

■ **Note:** Crumple zones and safety cells are used in cars to protect passengers during a crash. A crumple zone acts like a cushion that can absorb some of the energy during an impact, while the safety cell is a reinforced area that protects the objects inside.

- ✓ Can you incorporate triangles into your design?

■ **Note:** Triangles are extremely stable and do not change under pressure, which means that they can be useful in safety cell designs.

2 Design and build the piñata.  
Encourage your child to be creative and experiment with different piñata shapes and designs. During the design process ask your child:

- ✓ How can we better protect our candy?
- ✓ Are there additional materials we could use to make the piñata stronger?



## 3 Test the piñata. Hang it from a tree branch and have your child hit it with the broomstick. Be careful not to hit other objects or people. Start with one hit and review the damage. Continue this process until you get all 10 hits in or the piñata breaks. Have your child assess the damage:

- ✓ How well did your piñata do?
- ✓ Was any of the candy damaged?
- ✓ What additional steps can you take to make your next design stronger?

## 4 Redesign the piñata using the information you gathered from testing your original design.

## MORE ABOUT

Safety  
Engineering

Starting Salary:

\$51,500

Safety engineers develop, improve, and test automotive safety systems, including airbags, seatbelts, and crumple zones. Engineers use various tools to test cars and ensure that they meet safety standards.

# SCIENCE

## BACKGROUND

Isaac Newton was an influential scientist who wrote about three laws of motion that describe how objects behave. Newton's Second Law of Motion plays an important role in the design of crumple zones.

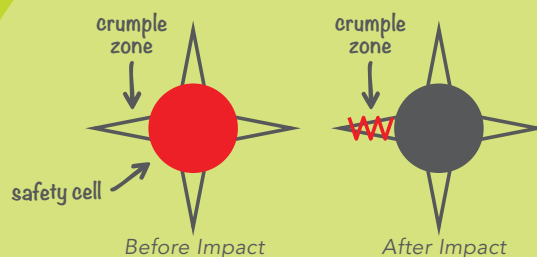
The Second Law says that the more mass an object has, the more force is needed to quickly speed up (accelerate) or slow down (decelerate) its motion.

The more quickly the piñata starts moving when it is hit by a stick, the more force is applied to the candy inside. Too much force and the candy will break. Crumple zones increase the time it takes for the piñata to accelerate (speed up) after it is hit by the stick.

A crumple zone is designed to be crushed and to absorb some of the force of a crash, distributing the force around the safety cell.

- ✓ The crumple zone is also designed to increase the time it takes for the car to stop after a crash (thus reducing the force).
- ✓ In cars, crumple zones are often at the front, where most accidents occur. Where could you put a crumple zone on a piñata?

### Safety Cell On a Piñata



## OUT — AND — ABOUT

**Visit a car dealership and look at all the car safety features:**

- ✓ How have car safety features changed over the years?
- ✓ How can you incorporate what you see into the design of your piñata?

**Watch YouTube videos on crash tests:**

- ✓ Watch the crumple zones in action.
- ✓ Compare the injuries of a test dummy who wears a seatbelt to a test dummy who doesn't.

### FOR YOUNGER KIDS

- » Provide a stronger box, such as a shoe box or a cardboard box.

### FOR OLDER KIDS

- » Have your child construct a piñata using five sheets of newspaper rather than cardboard.

### ADDITIONAL RESOURCES


» **Engineering websites for kids:**

[www.sciencekids.co.nz/engineering.html](http://www.sciencekids.co.nz/engineering.html)  
[pbskids.org/designsquad/parentseducators/index.html](http://pbskids.org/designsquad/parentseducators/index.html)

» **Engineering books:**

Janice Vancleave. *Engineering for Kids*.





We hope that you have been inspired to explore the world of science at home, in the community, and at school. Share the excitement of wonder and discovery with your children, and you will be amazed at the difference you can make.

We would like to hear about your experiences using this resource guide, and we welcome your comments and questions. Please contact us at [info@techbridgegirls.org](mailto:info@techbridgegirls.org), or visit [techbridgegirls.org](http://techbridgegirls.org).

## About Techbridge

Founded in 2000 at Chabot Space & Science Center with support from the National Science Foundation, Techbridge is helping to address the shortage of women and underrepresented minorities in science, technology, and engineering. Based in the San Francisco Bay Area, Techbridge serves girls in grades 5–12, providing after-school and summer programs that offer hands-on projects and career exploration. Techbridge reaches thousands more girls each year through our partnership with Girl Scout councils nationwide. Recognizing the importance of building a strong network of adult support for girls, Techbridge provides resources and training for teachers, parents, and role models as well as organizations across the country working to increase youth engagement in science, technology, engineering, and math.

## Special Thanks to Chevron

Chevron has been a generous and valued partner of Techbridge since 2007 and plays a leadership role in helping to promote STEM education. Their partnership ensures that students and families in our community and beyond have the opportunities and resources they need to follow their dreams and succeed. Chevron's commitment to education and investment in developing a skilled 21st century workforce will enable today's youth to become tomorrow's leaders and innovators.





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