



MAKEngineering Kit: Paper Roller Coaster

Inspired by *Curious George Roller Coaster* by H. A. Rey



This engineering kit would not have been possible without funding and support from the National Science Foundation.





ENGINEERING TASK

Read the book, *Curious George Roller Coaster*.

Curious George wants to ride a roller coaster with his friends. But he is not tall enough! He tried different ways to grow taller, but they did not work. How was his problem solved? Who do you think designs and builds roller coasters?

Your **engineering task** is to design a new roller coaster for a local museum that George and his friends could ride. You will build a prototype suitable for a marble to travel from the start to the finish.

WHAT IS A PROTOTYPE?



Prototype is a term we will use often, so what does it mean? One way to think of a prototype is as a simple model that lets you test your idea before sending it out to the world. Just imagine building a real-life roller-coaster and then finding out that it does not work! Building a prototype to test and improve new ideas saves time and money. And it is lots of fun!



DID YOU KNOW...?

Engineers design and work on a team to build theme park rides and attractions at Walt Disney World. If you want to learn more, check out these videos...

<https://youtu.be/Ny1zPqt8LVE>

<https://youtu.be/gXIVBiO633Q>

...and ask a few questions. What was the coolest thing you learned? How would you explain a theme park engineer to one of your friends? Would you want to be an engineer that designs roller coasters? Why?

MATERIALS IN KIT

- ♦ Multiple strips of Cardstock Paper
- ♦ Scissors
- ♦ Tape
- ♦ 2 Marbles
- ♦ Other Household Items
(e.g., cardboard, paper towel tubes)






STEP 1—RESEARCH

Did you know that most roller coasters have a theme—Space Mountain and the Incredible Hulk are two examples.

Explore this site that has the WORLD'S best roller coasters.

<https://familytraveller.com/holiday-destinations/travel-trends/worlds-best-rollercoasters/>

What did you notice? Which one was your favorite? Why? My favorite was ____ because ____.



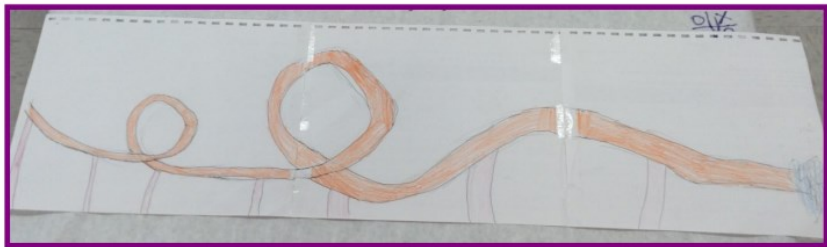
STEP 2—PLAN


Let's think through the following for your design. I will take notes for you so you can focus on thinking like an engineer.

1. What is the theme of your roller coaster? What artistic elements might you add?
2. How tall? How long?
3. How many turns and/or curves, if any? Where should they be in your design?
4. How will you support the structure?

STEP 2—PLAN

Now that we have some general design features, draw a sketch of your roller coaster.





STEP 3—Create

**CREATE roller coaster tracks and
BUILD on a flat surface!**

**USE RECYCLABLES AND SEE DIFFERENT
FOLDING TECHNIQUES ON THE FOLLOWING
PAGES.**

**Psst. To emphasize the testing and redesign stages of
the engineering design process (Step 4 here), we
suggest keeping the marble stored away until Step 4.**



STEP 3—SUPPORT

Optional questions to ask throughout this step:

- ◇ Show me where this track is in your sketch.
- ◇ It seems we need a taller support. What technique should we use to stack supports on top of one another? How can we make it stable?
- ◇ What if we _____ (e.g., added another track here)?
- ◇ I like the way you _____ (e.g., folded the track into three strips or thirds). Can you teach me?
- ◇ Can I show you how to _____ (e.g., cut the paper)?

Making Tracks



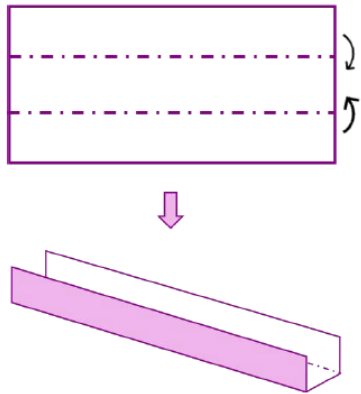
Roller coaster loops never
← make a circle. Uhm, so what
shape are loops?


Visitors ride the roller coaster "Big Loop" in Heide-Park in Soltau, Lower Saxony, Germany. Hauke-Christian Dittrich/
picture alliance via Getty Images

STEP 3—CREATE & BUILD

FOLDING TECHNIQUE—TRACK

Take 1 strip of paper and fold into thirds. To join tracks, overlap one end of a track to the end of another track. Use tape to attach the two tracks.





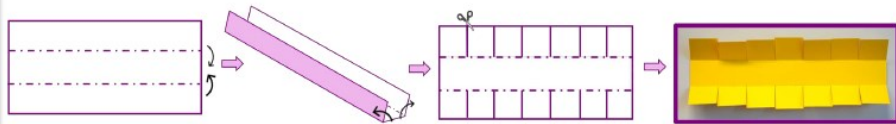
STEP 3—CREATE & BUILD

FOLDING TECHNIQUE—SINGLE LOOP, CURVE, HILL, AND MORE

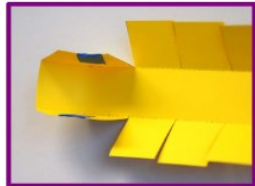
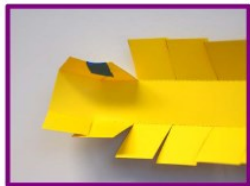
Take 1 strip of paper and fold into thirds. Cut slits of on both sides—not the track. The slits can be of any size, but should be similar or consistent. Fold as desired and use tape as needed.

STEP 3—CREATE & BUILD

FOLDING TECHNIQUE

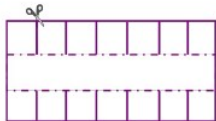


Cut along the solid lines

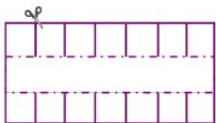


STEP 3—CREATE & BUILD

FOLDING TECHNIQUE



Single
loop



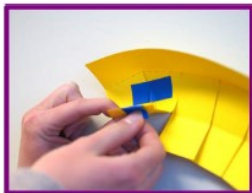
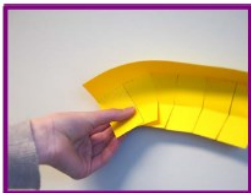
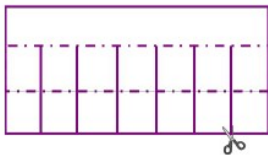
HILL



Vally

STEP 3—CREATE & BUILD

FOLDING TECHNIQUE



Creating Supports

This roller coaster was built in 1902 and it is still in operation! How old is this roller coaster? And it goes a whopping speed of 10 miles per hour. This is slower than riding a bicycle.

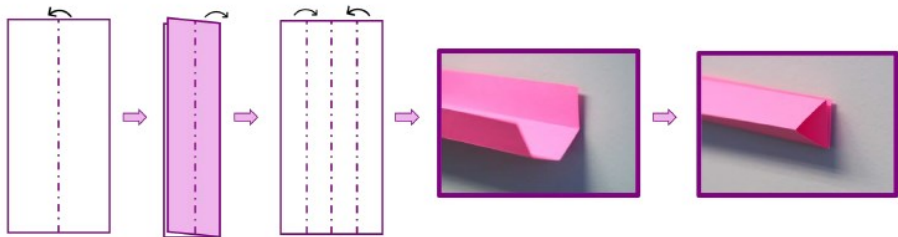


Leap-the-Dips Wikipedia

STEP 3—CREATE & BUILD

FOLDING TECHNIQUE—SUPPORT

Take 1 strip of paper and fold into fourths lengthwise. Make a triangular prism by overlapping two of the fourths.



STEP 3—CREATE & BUILD

FOLDING TECHNIQUE—SUPPORT

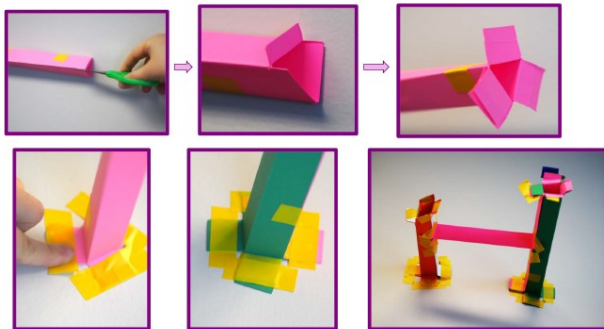
You can also make a rectangular prism using 2 strips of paper and folding both into fourths. Which support—triangular prism or rectangular prism—will provide more stability? Why?



STEP 3—CREATE & BUILD

FOLDING TECHNIQUE—SUPPORT

What do you notice about securing the supports to a base (e.g., table, cardboard)? Why is this an important step?





STEP 4—TEST & IMPROVE

PAUSE! Remember the goal is for the marble to travel from the top to the bottom. What you have noticed? What is working well?

What is not working so well?

What might you do about it?

What changes can you make?

What might George say about your roller coaster?

TEST!
IMPROVE!



COMMUNICATE

Imagine you are presenting to a local amusement park, how will you grab their attention and build excitement about your roller coaster?

1. Talk about your theme and what makes it unique. What features did you include for George to be able to ride?
2. Talk about changes you made when the marble did not travel from the beginning to the end.
3. Show how the roller coaster works.
4. End with something that will make you and your prototype unforgettable.



DID YOU KNOW...?

The first roller coaster in America opened at Coney Island in Brooklyn, New York on June 16, 1884. It traveled approximately six miles per hour and cost a nickel to ride.

Kingda Ka is one of the world's tallest (456 feet) and fastest (128 miles per hour) roller coasters. Yet, it may be one of the shortest at 50.6 seconds.

The longest roller coaster is the Steel Dragon 2000 at 8,000 feet long. The duration of the ride is 4:00 minutes.



IF YOU ARE INTERESTED...

Do more research about roller coasters around the world.

1. What rollercoaster has the most loops? How many?
What country is it located?
2. Are you more likely to get injured from falling off a bed or riding a roller coaster? Explain.
3. Where is the fastest rollercoaster in the world? How fast does it travel?
4. Why are there height restrictions on who can ride roller coasters?
5. True or False: Four men rode 74 rollercoasters in 10 theme parks in just one day.

SHARE THE FUN AND PASS IT ON!

Thank you for participating.

When you are done with this project, gift the book and the directions to your friend to make the idea of engineering roll like a marble traveling on a roller coaster.

