Science: Physics

Featured Activity:
Rollercoaster!

- Create a rollercoaster out of paper
- Find out how fast a marble needs to go to get through an upside down loop!

About the Book...

Roller Coaster Marla Fraze
Twelve People set aside their fears and ride a roller coaster, including one who has never done so before.
Call Number: JE
Copies: 31

What You Need:

- Pencil/pen
- Tape
- Marbles
- Cardstock paper
- Scissors
- Ruler
- Some books (for varying heights)

How You Are Helping...

This activity fosters:

- **Vocabulary**
- **Print Motivation**

Children will learn:

- **Basic laws of physics**
- **To find the minimum height necessary to make it around the loop without falling out.**
- **Engineering skills**

Before the Activity:

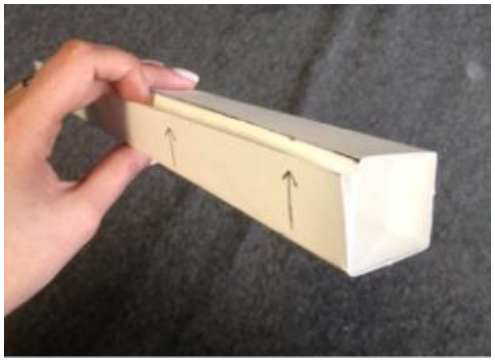
- In advance, ask the Children's Librarian for permission to display the children's finished work in the library.
- Find as many books as you can about roller coasters and physics. Place them on the table for the children to access.
- Prepare the materials on the table in advance to encourage the children to participate.
- Marbles and other small pieces can be choking hazards to young children. Please supervise small children when working with marbles and scissors.

Directions:

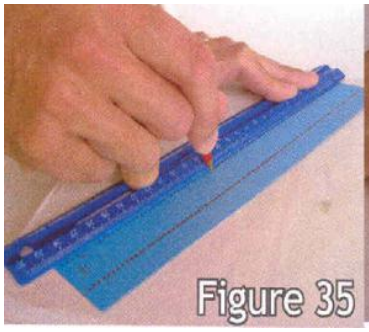
Before you share the featured book with the children, ask them if they have ever felt scared before trying something for the first time. Ask them what they tried and if they would ever do it again, while sharing the featured book.

1. **Creating two straight tracks for your roller coaster (Closed or Open Tracks)**:

    - Cut your 8.5'' x 11'' cardstock paper in half lengthwise. Then fold each side over four times (Closed-Straight Track) or three times (Open-Straight Track) lengthwise in folds of at least 1.25'' in width. Exact measurements are not important. Crease all folds.
    - Cut through the last fold.
    - For the Closed-Straight Track, Overlap the last column over the first and tape along the edge.

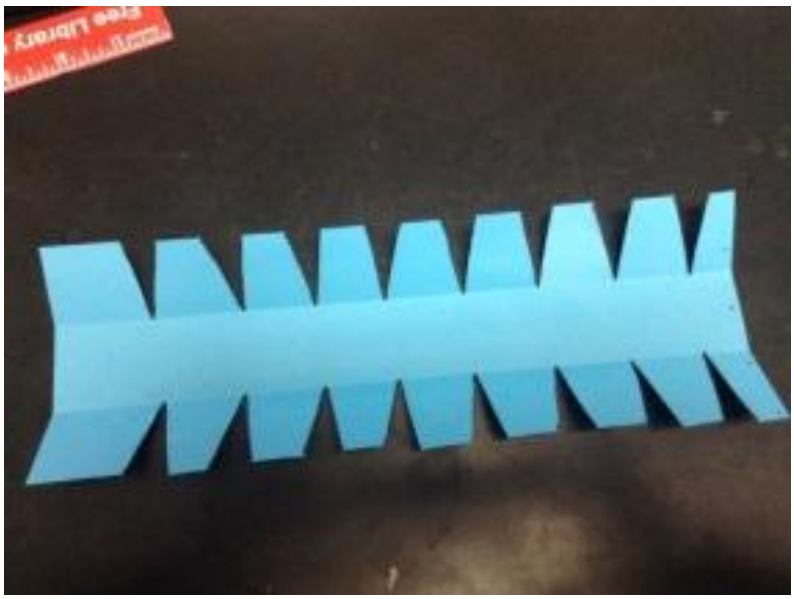


- For the **Open-Straight Track,** draw or fold over four lines at least 1.25'' apart on construction paper. Once this is complete fold in the outer columns in to create an open track. Be sure to crease all folds.



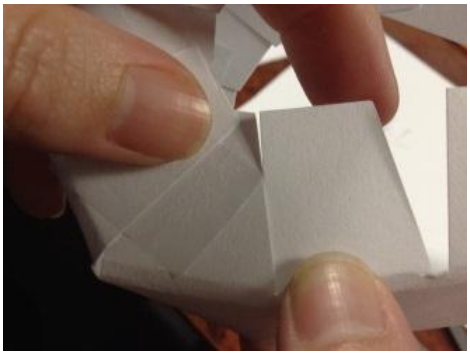
2. Making the Loop(s):

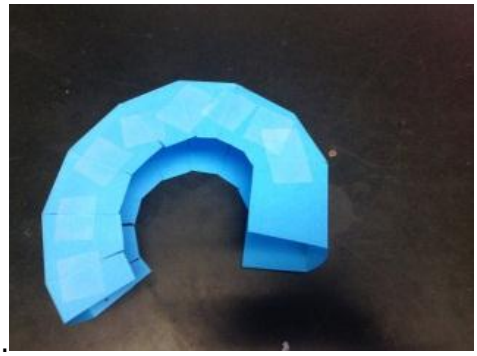
- Following the template on p. 15, trace the cut out shape onto cardstock paper. Alternatively, you can make four folds, cut though the fourth fold and make several equidistant outward facing triangles or V's of your own on the outer folds. Exact measurements are not important.



- Tape the flaps together on both sides forming a loop.

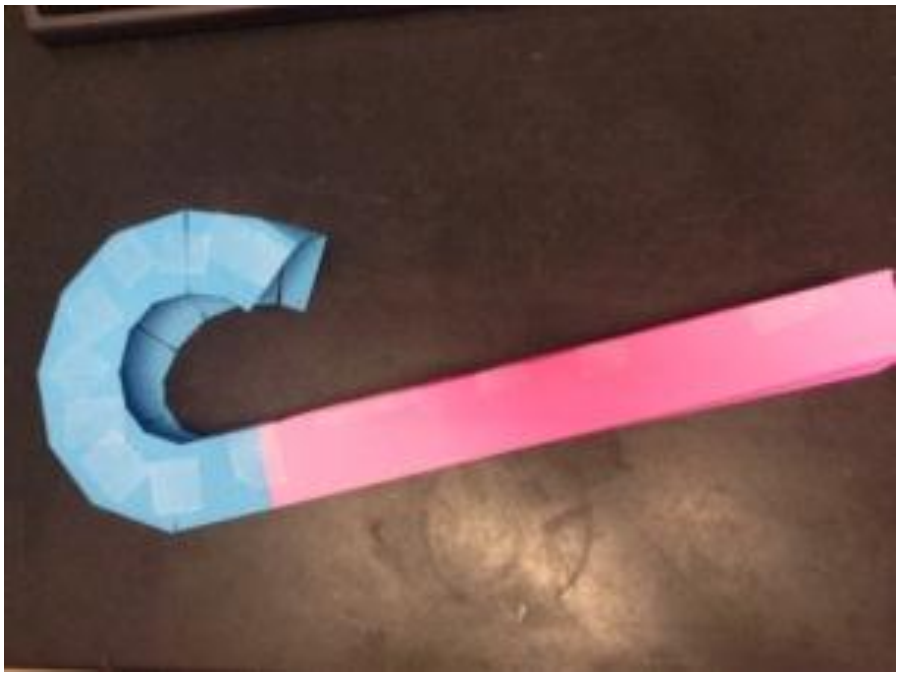
➡ **Tip:** You will use a lot of tape, try to prepare small pieces of tape before connecting the flaps to avoid using too much tape.





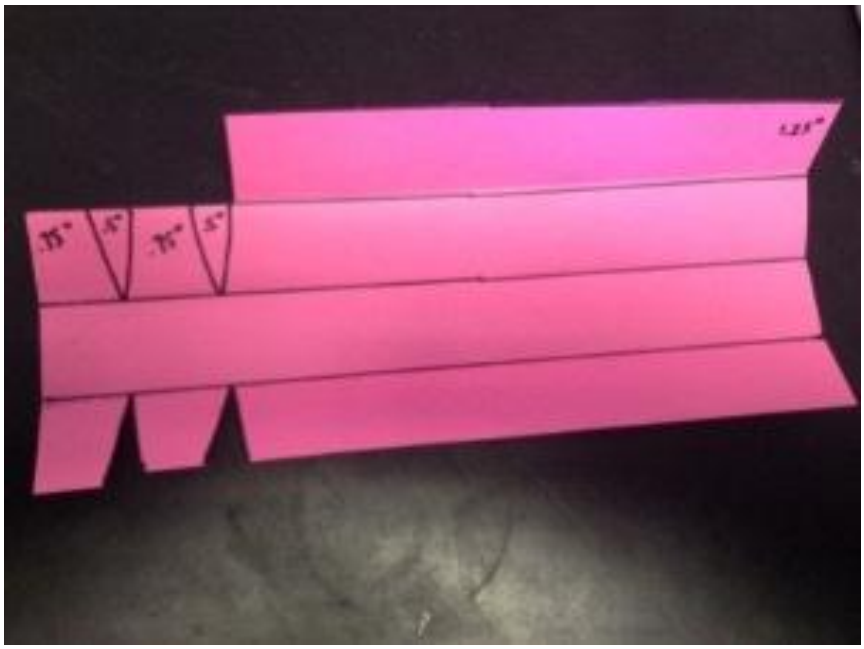
Once this this complete, you are ready to merge the straight track to loop.

3. **Making a Merge**
   - Tape together the loop to the straight track (as shown below).

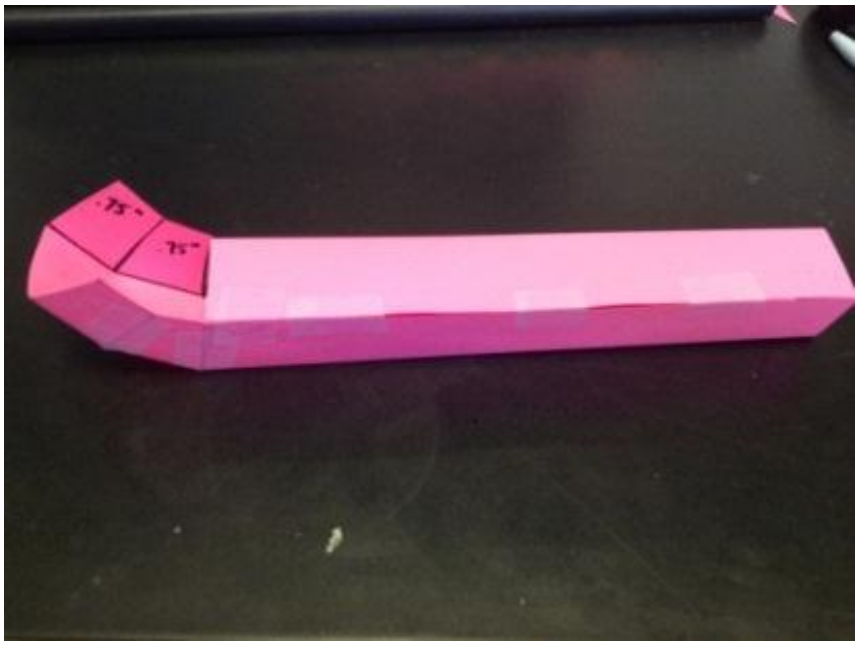


4. **Making an Extension Loop**: You may need to build an additional or extension loop if your loop is not complete
   - Folding a 11” long paper five times leaving at least 1.25” between folds. Draw outward facing triangles on the 3rd row from the bottom using equidistant spacing for the loop for as long as necessary. Try to keep the size of the triangles consistent.

- You will then cut off the row above the triangles that you drew (shown below).

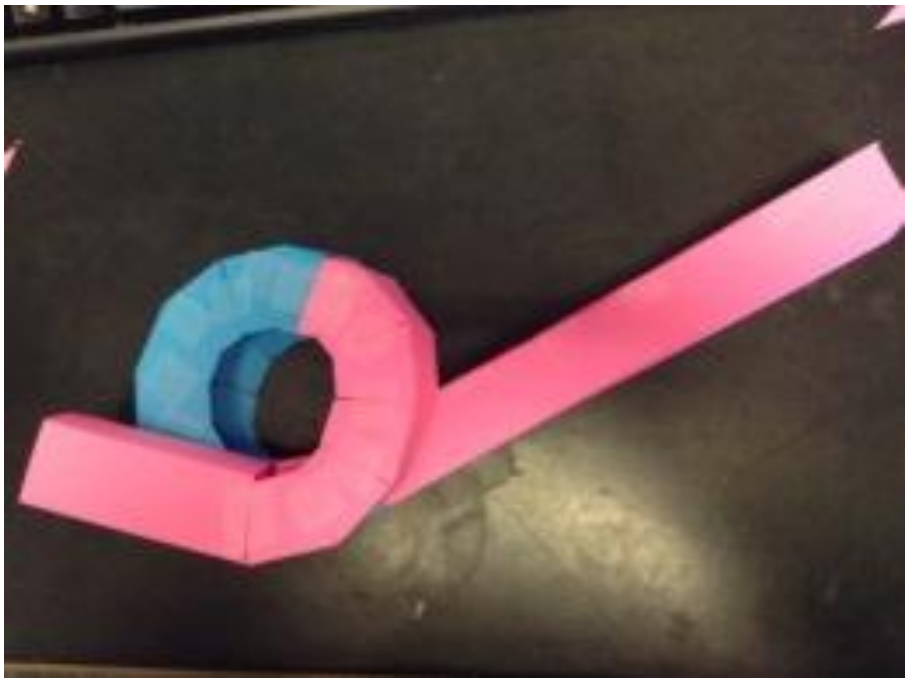


- Join the flaps together with tape as done with the loop and overlap the last column over the first and tape along the edge.



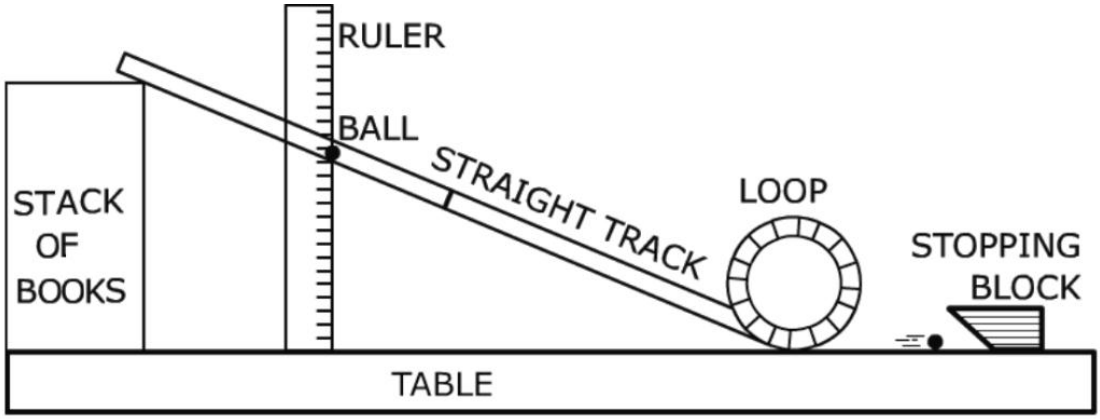
- More triangles may need to be cut out for a larger loop

- Connect you extension loop. You may need to tape the loop together at the bottom of the circle.



5. Experimenting with Marbles

- Now that you have connected an upside-down loop and a straight track you will need to lean the straight track on a stack of books

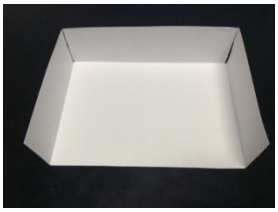


- Adjust the height of the straight track, or elongate the track using extension straight tracks or loops.

Have the children record the height of where the marble was released and whether or not it was successful.

6. Stopping Block for your Roller Coaster

- You will need a sheet of paper, scissors and tape.
- Fold the corners of 3 sides of a sheet of paper. Cut out two boxes in the folds.
- Next, tape the cuts together without overlap. You should have a "goal" shaped stopping block for your roller coaster now.



Keep in Mind...

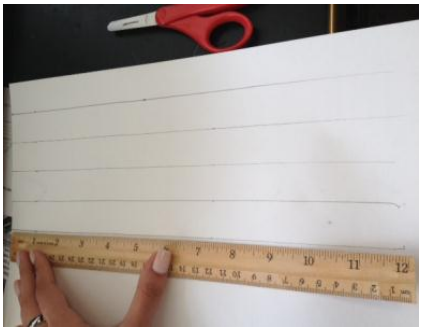
- Encourage **older children** to be creative with their roller coaster and make variations on the original paper roller coaster design with extra loops and longer straight tracks.

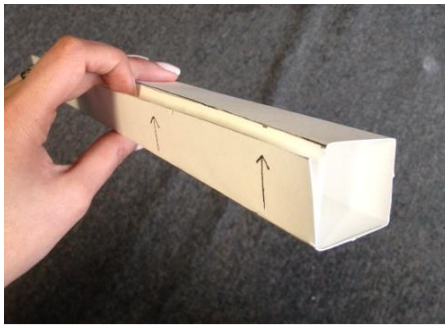
- Encourage **younger children** to experiment with different size marbles and heights. Have them record whether or not it was successful.

More Activity Ideas:

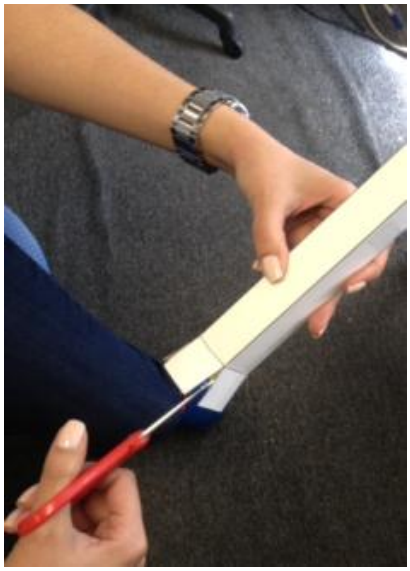
Building a structure for your roller coaster:

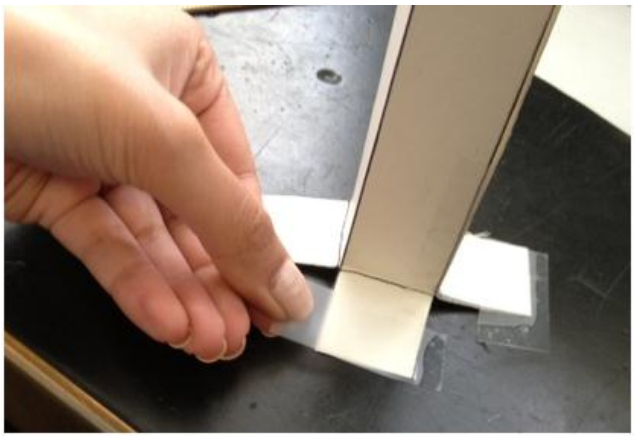
- By measuring 12” by 1” columns, draw five vertical lines and fold along the lines you have just created.



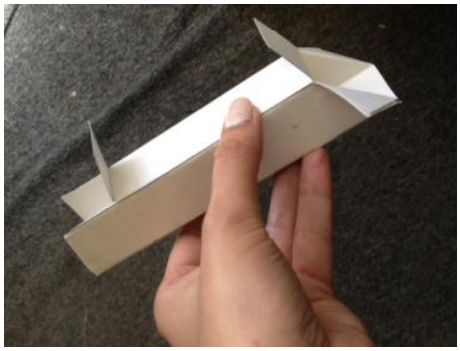


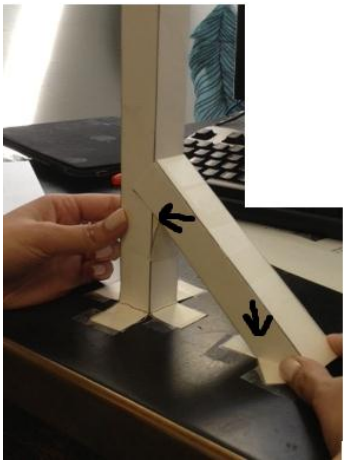
- Overlap the last column over the first and tape along the edge.



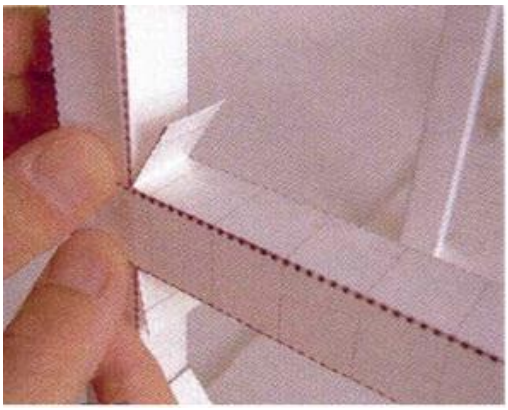


- To secure the columns, you can add support to the bottom by attaching smaller columns with only two 1” cuts. Then attach the side flaps folded out on an angle at the ends to secure to the floor.

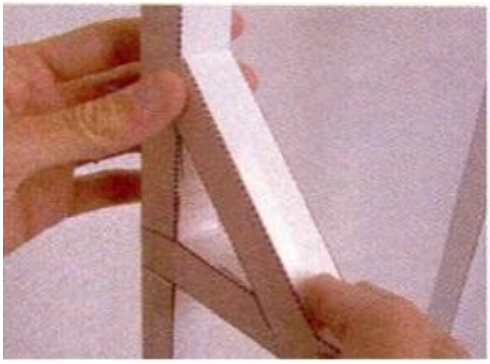




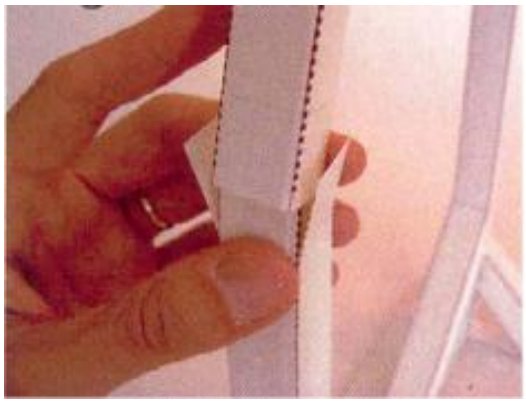
- Making beams to attach between the columns is a very similar process to making columns. However, in this instance you will be making one inch cuts on both sides to secure and tape on each column. Depending on how far apart your columns are placed, the beams must be measured out accordingly.



If the structure doesn't feel secure; "diagonal support" can be put in for the beams.



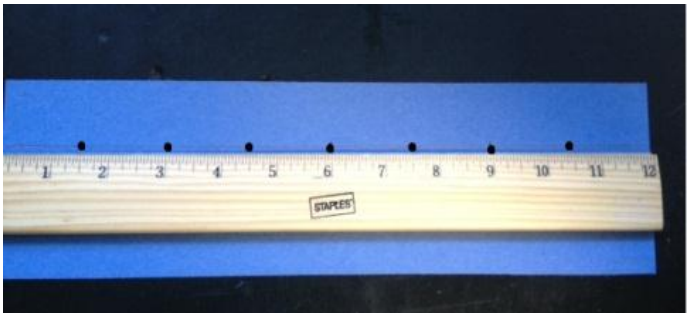
- **Extending columns or beams**- this can be done by inserting two flaps in the next beam/column and taping the outer flaps to that beam/column.

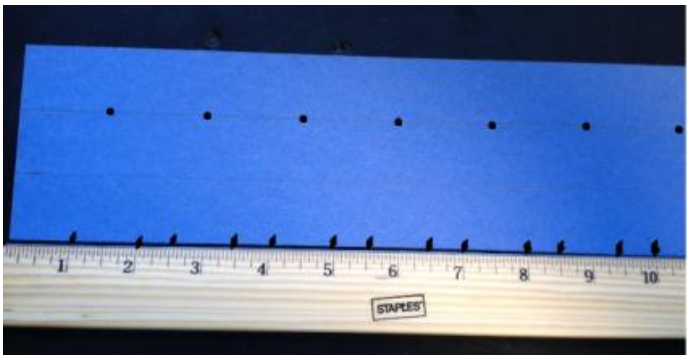


Creating side loops for your roller coaster:

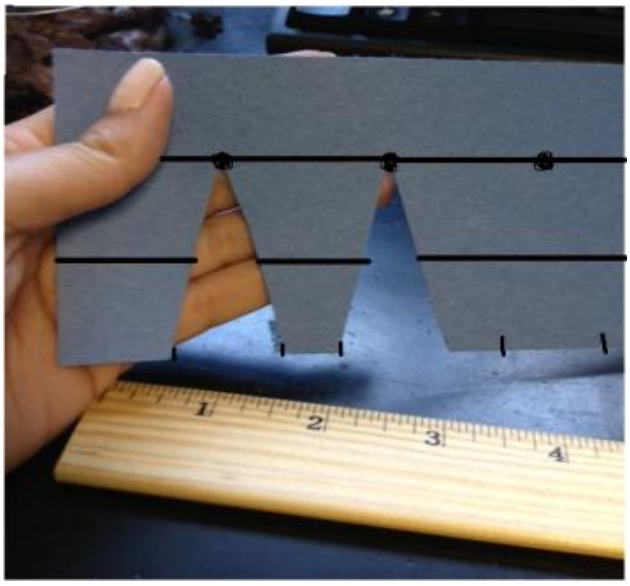
You can now use different colored construction paper or poster board to create the various tracks and features on your roller coaster.

- **Making a curve:** depending on how long you cut your curve for this part; you can get creative and turn it into a few different types of features for you roller coaster. If you use longer paper you can make more loops to create a spiral.

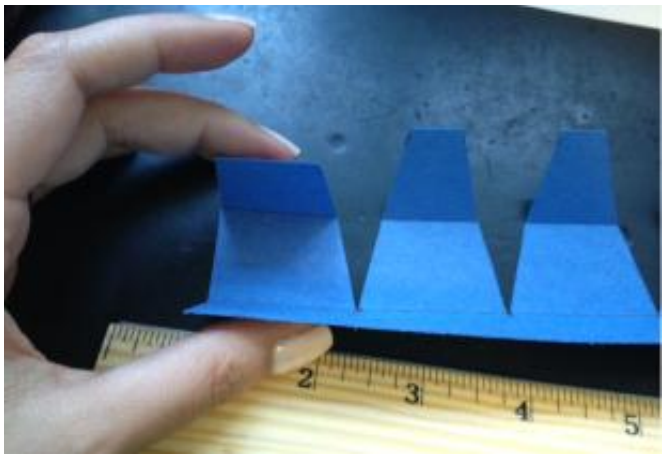




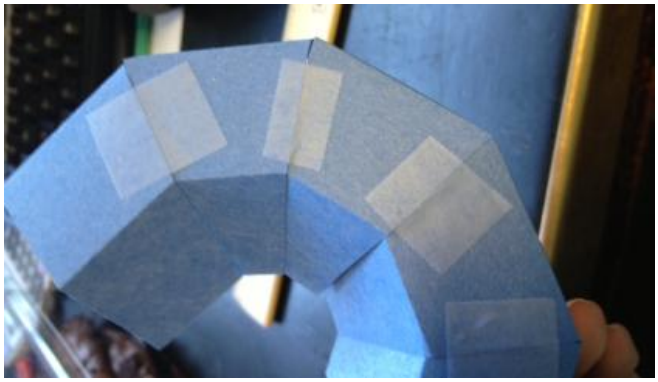
Start out by drawing four vertical lines one inch apart the same way you would for making a track. However, this time you will make a dot every 1.5 inches apart on the 3rd line up from the bottom. On the first line on the bottom you will make a dot every inch and then skip half an inch and so on (this is indicated in the pictures above).



Cut out the triangles you have created between the inches on the bottom line to the dot on the 3rd line. Then continue to fold the small flaps over until you are left with something like this:



- Turn the curve feature over and begin taping the flaps together.



- Once that is complete, you can turn it back over and begin to tape the smaller flaps together on the inside of the curve.
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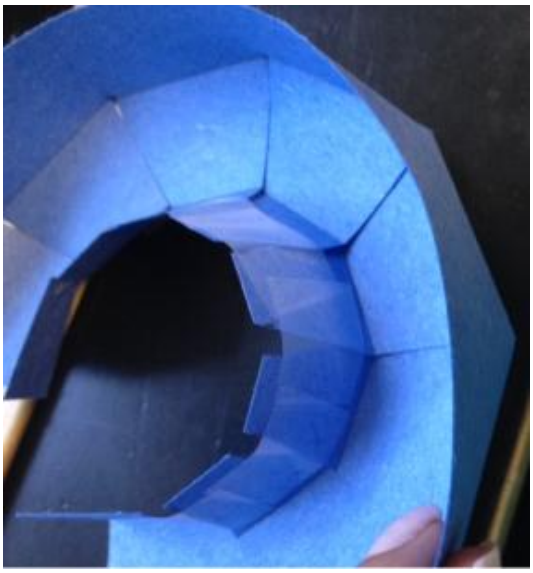


- Connect this to a straight track and keep designing!

Thrills not Spills experiment:

- Share the featured book with the children.
- You will need: dried peas, plastic cups, pieces of string, tape, plastic straws and scissors.
- Fill the cup a quarter – halfway to the top.
- Tape a piece of string to the cup to form a handle.
- Push the strings through the plastic straw. You may use clay to hold it in place.
- Hold the string on the other side of the straw and swing in an upwards circle. The peas do not fall out even if the cup turns upside down!

Note: You may want to ask the children why the peas can stay in place. Inertia helps roller coaster riders to stay seated as roller coaster cars turn completely upside down.

Keeping Track of Your Roller Coaster

Name of Roller Coaster: _____

# of Tries	Size of Marble	Height	Length of Straight Track	# of Loops	Success? Y/N
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					

Loop Template

Tips and Roller Coaster Troubleshooting:

1. Avoid making straight cuts instead of V's or triangles. It will be more difficult to form a sturdy loop. Taping will also become more challenging.

2. If you cut inward facing V's or triangles, you may end up with something that looks like *teeth*. You will need to start again.

3. If your curve is too long you can try to tighten your flaps or tape the two loop shoots together.

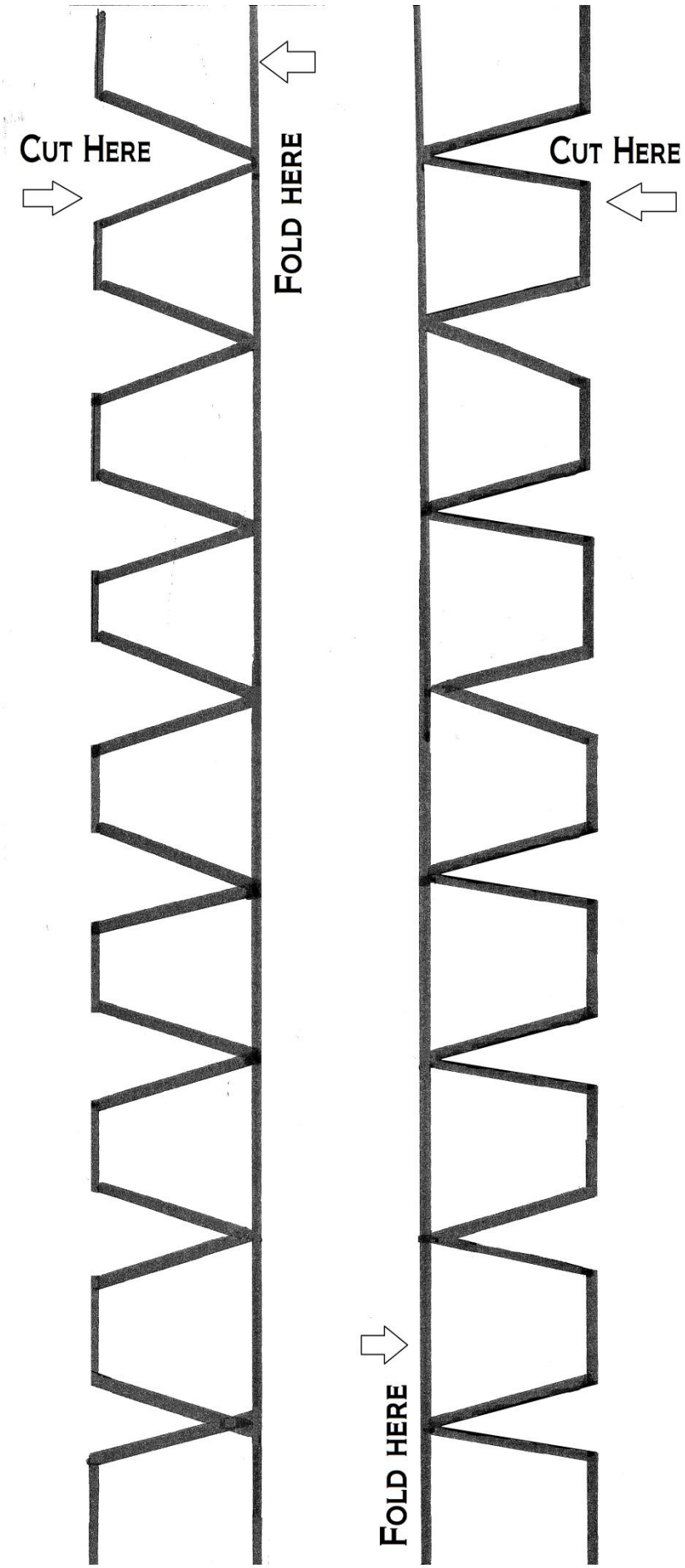
4. The number of triangles you have is not as important as keeping it consistent.

5. If you have finished your paper roller coaster, you might consider joining it with someone else's roller coaster and experiment with the outcomes.

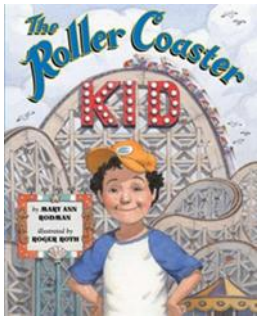
6. If your marble is not getting through the loop, it could be that the loops are not supported enough. You can hold them with your hand or build support for each loop.

7. Experiment with marbles of all sizes and textures. Make sure to record which marble you used.

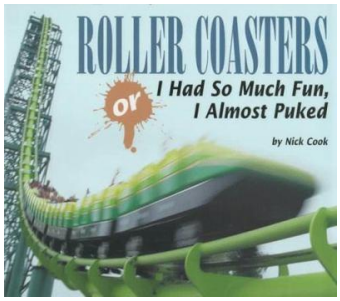
8. Create your own stop for your paper roller coaster to catch runaway marbles!



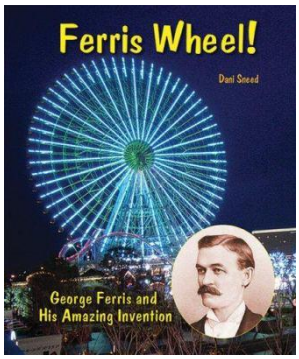
Recommended Additional Books



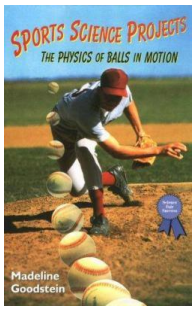
The Roller Coaster Kid by Mary Ann Rodman
Even though Zach finds roller coasters scary, he rides one with Grandpa in an attempt to make him happy again after Grandma's death.
Call Number: JE
Copies: 7



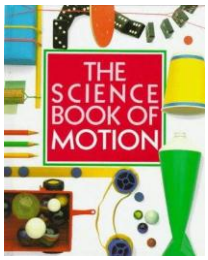
Roller Coasters, or, I Had So Much Fun, I Almost Puked by Nick Cook
Discusses the history, physics, parts, and design of roller coasters and examines some modern examples.
Call Number: J791.0687
Copies: 13



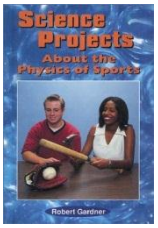
Ferris Wheel: George Ferris and His Amazing Invention by Dani Sneed
Tells the story of George Ferris and his amazing invention, the ferris wheel.
Call Number: J624.092 F417S
Copies: 50



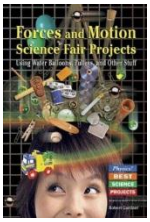
Sports science projects : the physics of balls in motion by Madeline Goodstein
Presents experiments and science fair projects that demonstrate the differences between kinds of sports balls and the relationship between their design and performance.
Call Number: J530.078 G629S
Copies: 4



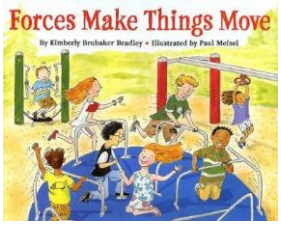
The science book of motion by Neil Ardley
By following simple steps of each experiment, you can learn basic principles of motion and apply them to the world around you.
Call Number: J531.11 AR28S
Copies: 16



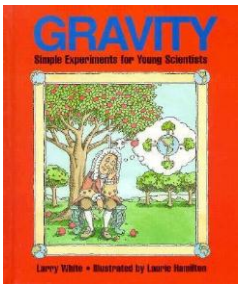
Science projects about the physics of sports by Robert Gardner
Call Number: 530.078 G1776S
Copies: 7



Forces and motion science fair projects: using water balloons, pulleys, and other stuff by Robert Gardner
Call Number: 531.6078 G1776F
Copies: 9



Forces make things move by Paul Meisel
Simple language and humorous illustrations show how forces make things move, prevent them from starting to move, and stop them from moving. There are forces at work whenever you throw a ball, run up the stairs, or push your big brother off the couch.
Call Number: 531.6078 G1776F
Copies: 25



Gravity: simple experiments for young scientists by Lawrence White
Call Number: J531.1407 W584G
Copies: 13

Please ask the Children's Librarian at your library for more suggestions!