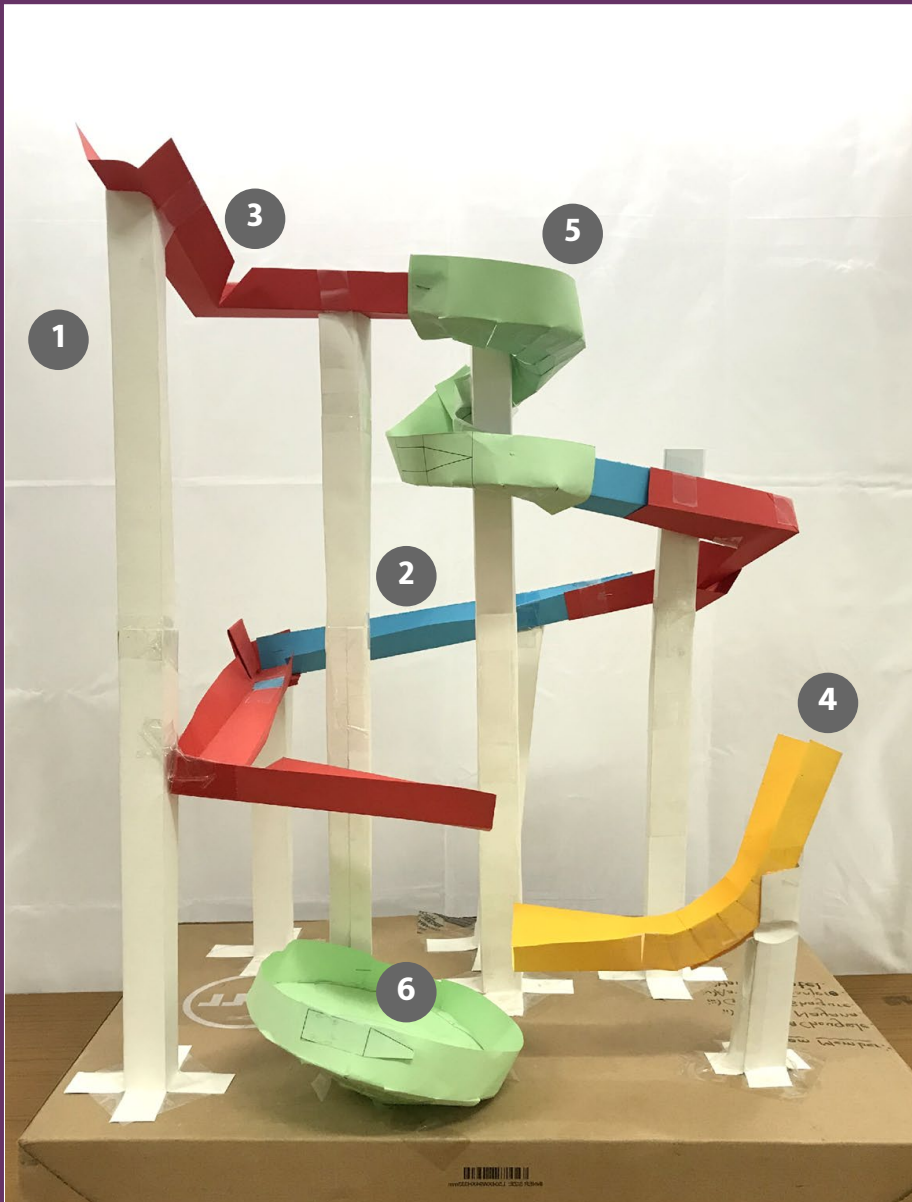


Designing Paper Roller Coasters



To design a paper Roller Coaster (RC), we need to prepare a set of parts which will be assembled together to make the model. There are six parts (as seen in the image): pillars, straight track, L-shaped track, curved track or loop (U-shaped), a wide loop and a funnel.

1. The **pillars** form the foundation on which the weight of the RC model rests.
2. A **straight track** is the basic track which makes most of the path.
3. An **L-shaped track** gives the marble the ability to turn from one track to the other.
4. A **curved track/loop** is arch shaped and is useful for turns and drops.
5. A **wide loop** makes the marble go from one level to the other in a S-shaped path.
6. A **funnel** aids in increasing the time a marble spends on the RC.

Let us now learn how to make these parts and design a paper roller coaster. Try designing one yourself with your friends.

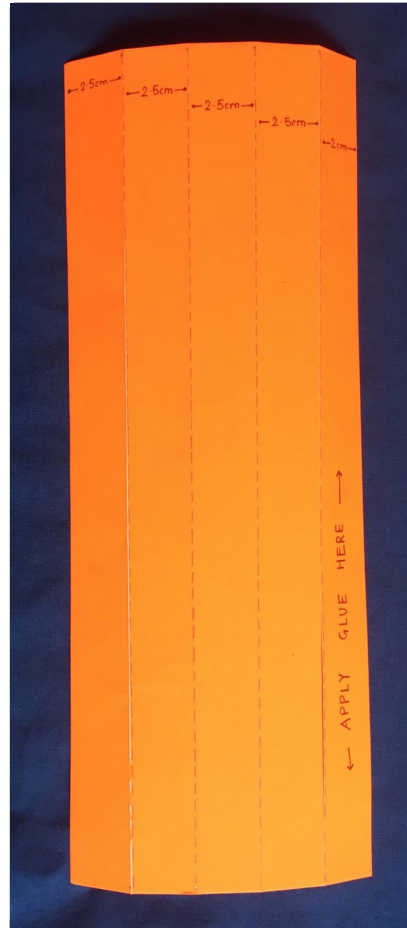
Material required:

Thick white A3 sheet (nos. 5), A4 coloured sheets of paper (nos. 8-10), pencil, scale, eraser, cutter, scissors, cellotape, double-sided tape, stapler (optional), scotch tape, glue and a marble.

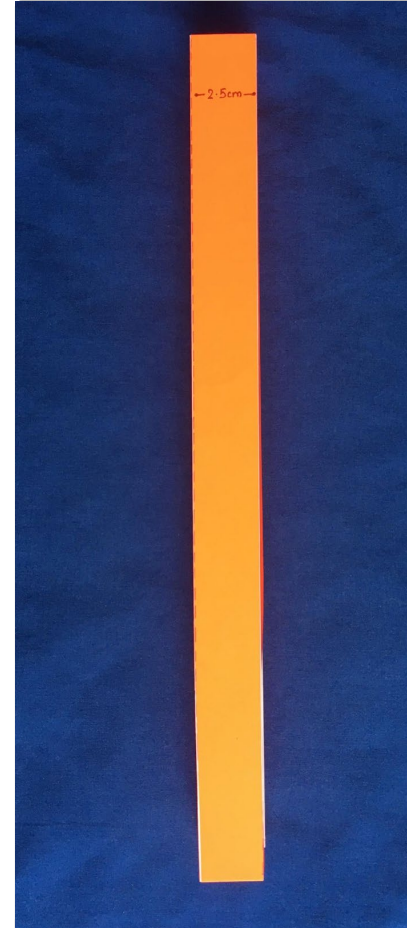
Paper Roller Coasters- Pillar



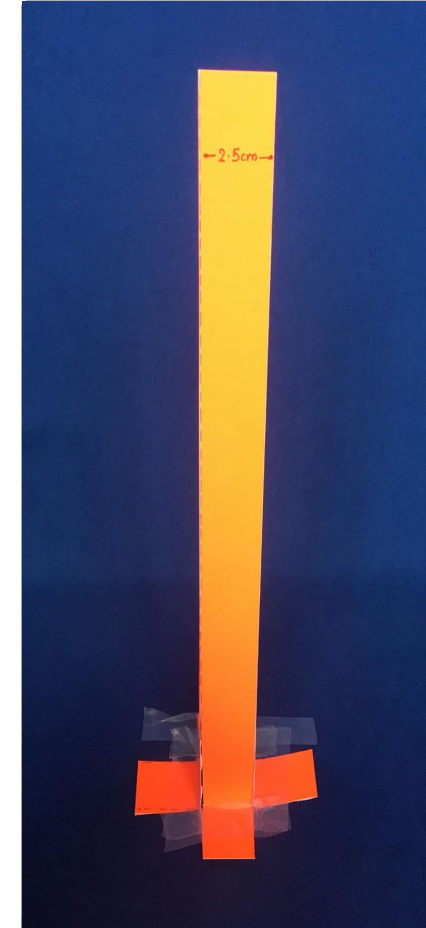
Step 1: Take a thick A3 size paper and cut a rectangle of 12 cm width. Make four columns of 2.5cm each and one of 2cm as shown above.



Step 2: Carefully make vertical creases on the paper as shown in the above image. Then, apply glue on the last (2cm) column.

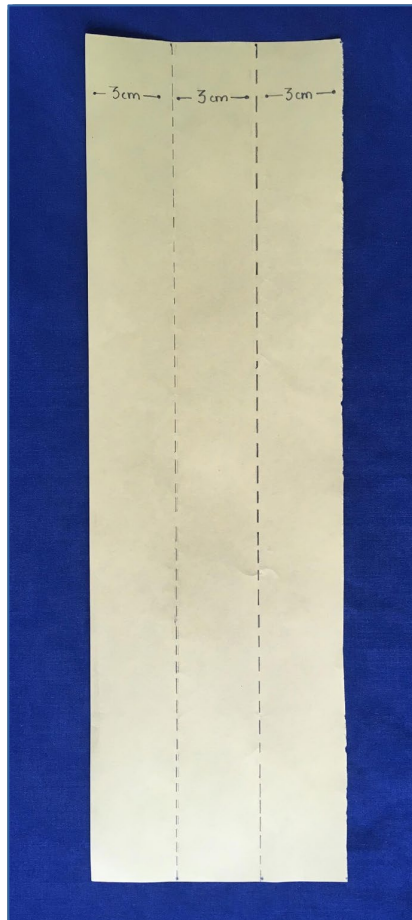


Step 3: Overlap the 5th column on the 4th column and stick it. Allow it to dry.

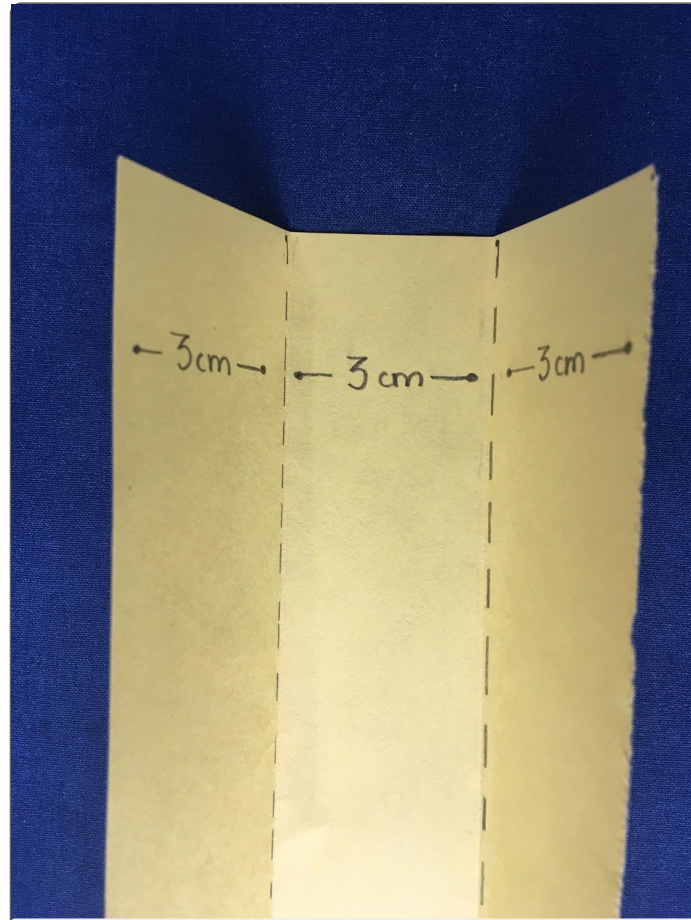


Step 4: Now, make 4 small cuts on the lower side of the pillar and fold it outwards. With help of tape make the pillar stand upright.

Paper Roller Coasters- Straight Track



Step 1: On a thick A4 size paper make 3 columns with 3 cm markings as shown in the image above.

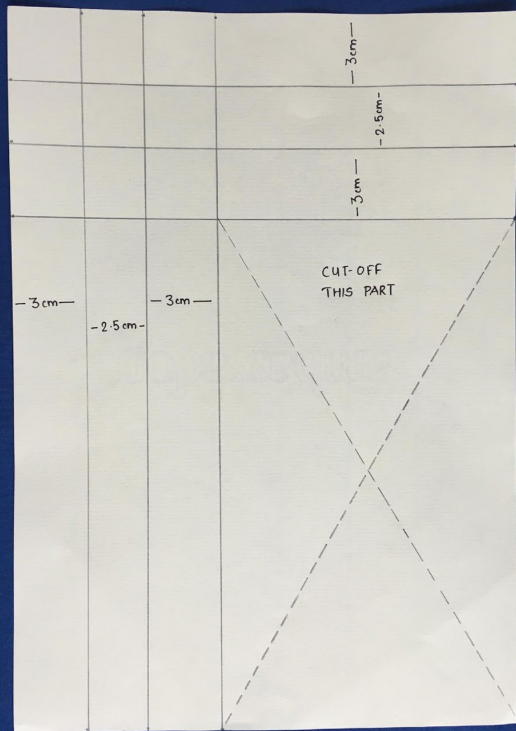


Step 2: Make creases on the column line markings. The two side columns become the walls to secure the marble from falling and the middle one is the path.

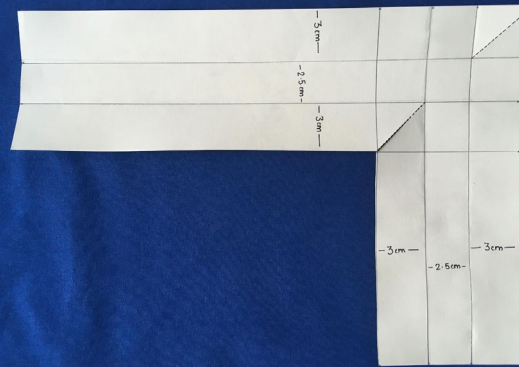


Step 3: The straight track is ready for use. This track serves as the base track to make other types of tracks and loops.

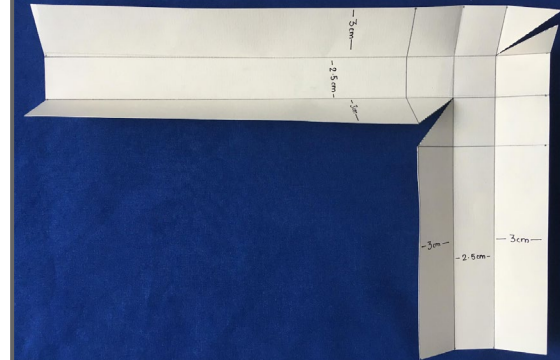
Paper Roller Coasters- L-Track



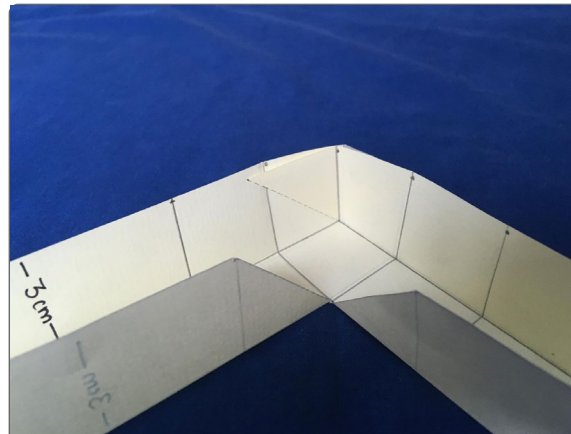
Step 1: On a thick A4 sheet, make the markings as shown in the image both vertically (3cm-2.5cm-3cm) and horizontally (3cm-2.5cm-3cm). Cut the remaining part of the paper. You will get an L-shaped cut out.



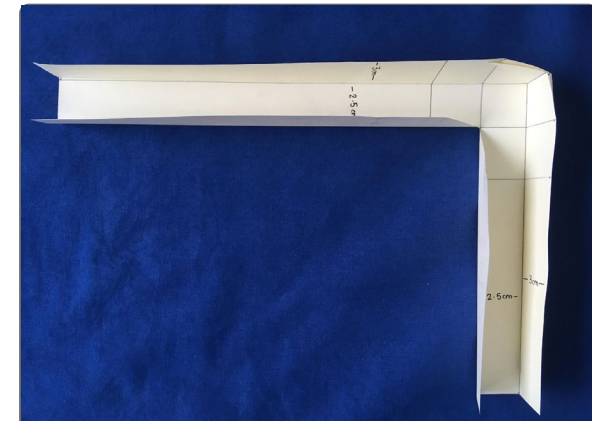
Step 2: Cut two diagonal slits, one on the top left corner square and the other on the right corner square as shown.



Step 3: Press all the column markings to make creases. The central column becomes the path and others become the walls.

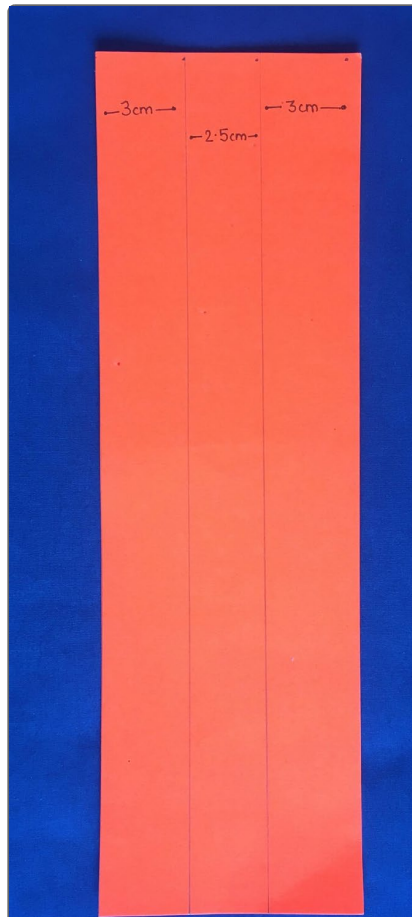


Step 4: Now, carefully overlap the two sides at the top corner and fold the other columns as shown in the image.

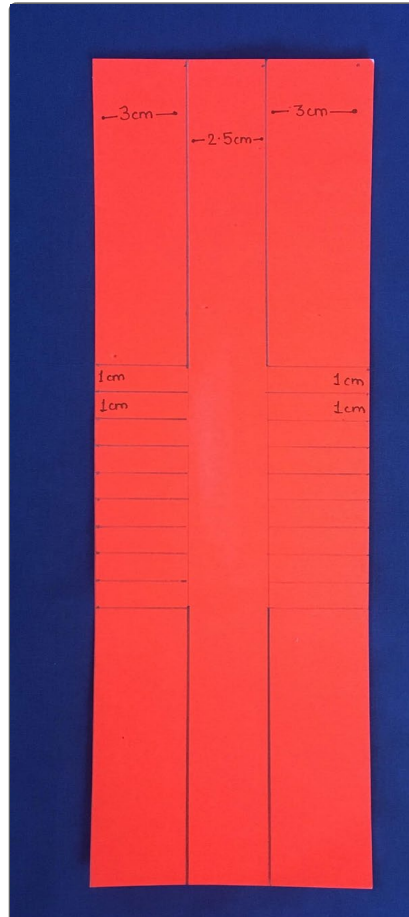


Step 5: Make sure the folds are stiff. The L-shaped track is ready.

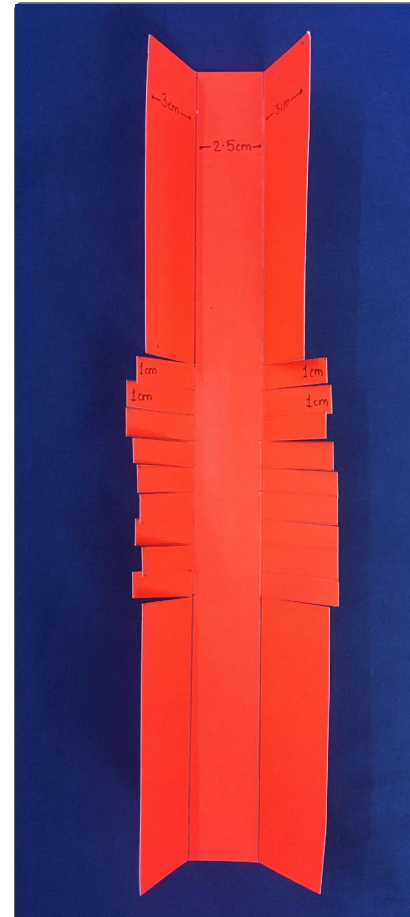
Paper Roller Coasters- Curved Track



Step 1: On an A4 sheet make a rectangle of 8.5cm width and in that make 3 columns (3cm x 2.5cm x 3 cm).



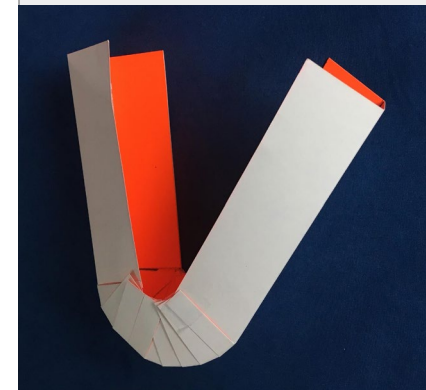
Step 2: Make a few lines of 1 cm each in the middle of the 1st and 3rd column. Fold the 1st and 3rd columns to make creases for the path.



Step 3: Cut the 1 cm marks as shown in the above image. Make sure you do not cut or cross the second column while cutting these lines.

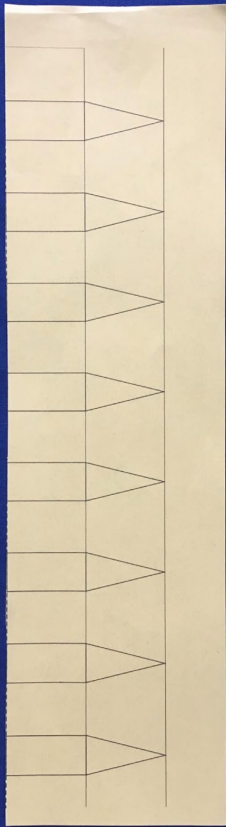


Step 4: With the cuts facing outward, your inverted U-shaped track should look like the image above. Stick the cuts together using a tape.

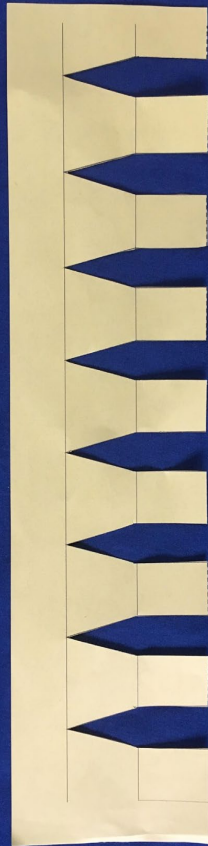


Step 5: For an inward loop, fold the track as shown. Stick the cuts together using a tape to make the final form.

Paper Roller Coasters- Wide Loop



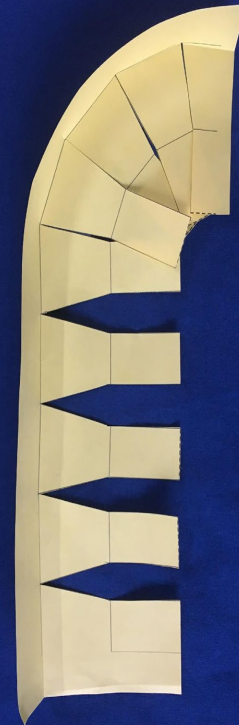
Step 1: On a thick rectangle paper, make equidistant markings as shown.
** The template is available at the end of this resource.*



Step 2: As shown in the image, cut the pencil like shapes on the rectangle.

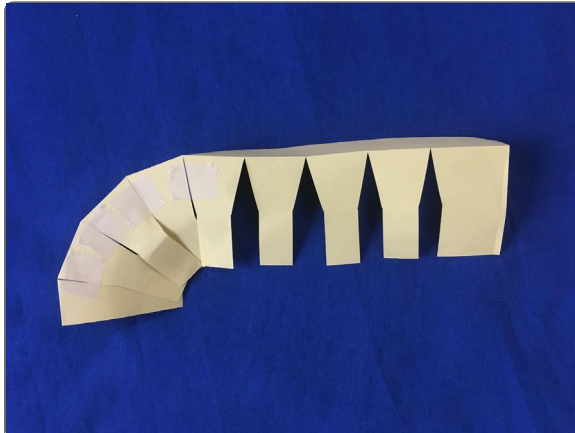


Step 3: Fold the first column upright. Fold the third column and open it to make a crease.

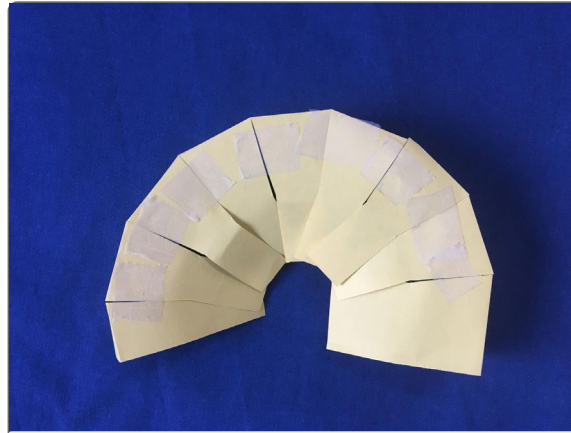


Step 4: Now, starting from the corner start bringing the cuts together by overlapping first on the next cut.

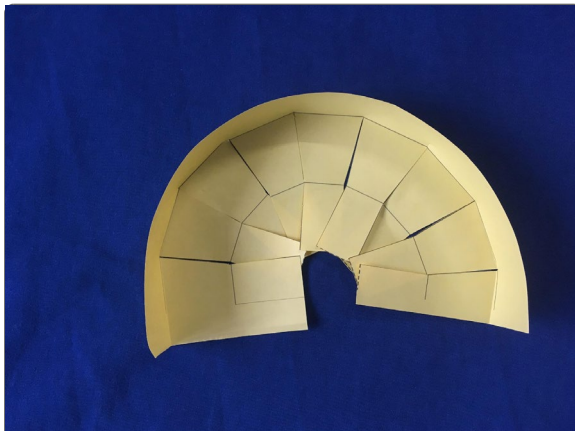
Paper Roller Coasters- Wide Loop



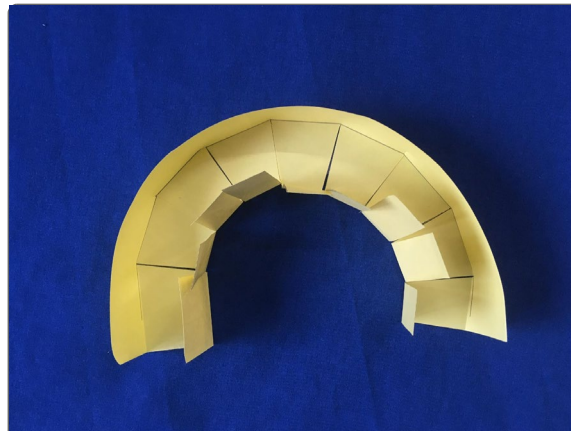
Step 5: (Back view) You can start sticking the 2nd column cuts together using a tape. Take few at a time.



Step 6: As you go ahead sticking the cuts, paper will take the form of a curve as seen in the image above.



Step 7: Now, turn the curve and fold the 3rd column cuts carefully to make them stand upright.

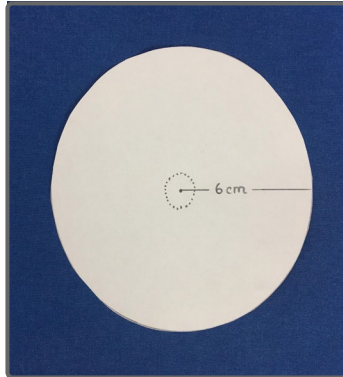


Step 8: After all the cuts are folded stick them with help of a tape (few at a time). It's ok to have a few overlaps.

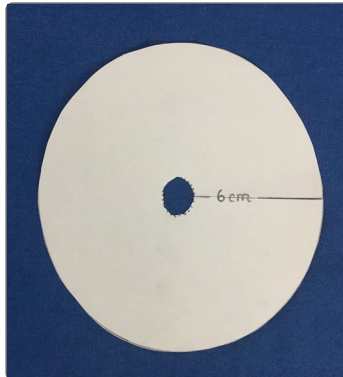


Step 9: The wide loop is ready. The 2nd column is the path and the 1st and 3rd columns are the walls to secure the marble from falling down.

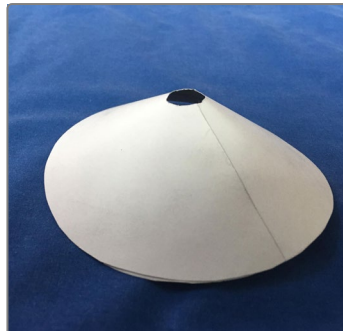
Paper Roller Coasters- Funnel



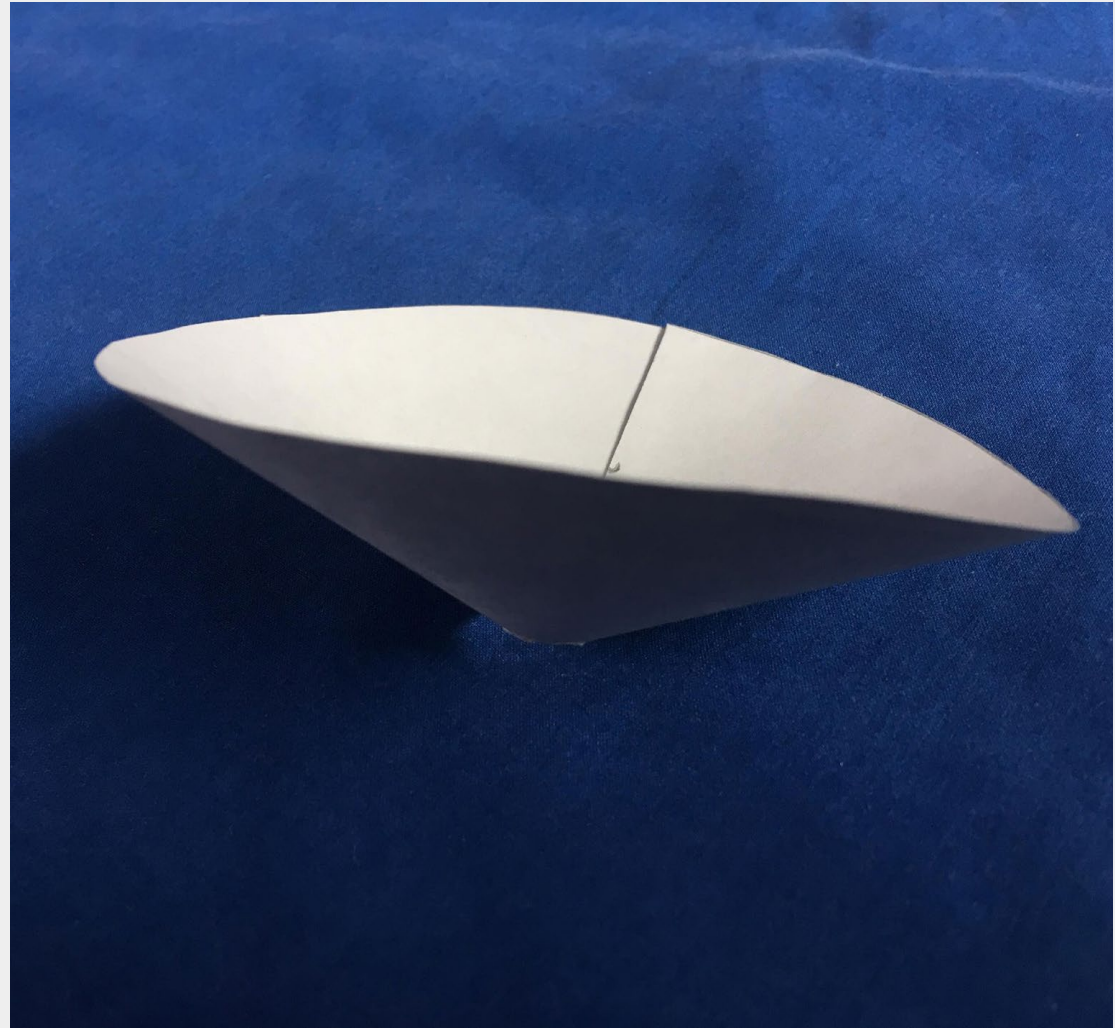
Step 1: Cut a circle of 6 to 8cm radius. Also, draw a small circle (through which the marble will drop) inside the bigger circle as shown in the image on the left.



Step 2: Cut a straight line from the bigger circle till the smaller one. Also, cut the smaller circle as shown in the image.



Step 3: Folding in the form of a funnel, now stick one end of the slit on the other thus overlapping the two with help of glue.



Designing Paper Roller Coasters

Background

Hands-on model making and material exploration helps in mastering fundamental design and engineering skills such as measurement, precision, estimation and approximation (Choksi, Chunawala & Natarajan, 2006). Research studies performed with practising designers have shown frequent use of mock-up models and rapid prototyping aids in discovering opportunities, conceptual design and comparing design solutions (Hess & Summers, 2013; Deininger et al., 2017). There have also been studies to suggest that co-working on building models helps in verbalising ideas and developing non-verbal modes of communication like sketching and gesturing (Härkki et al., 2018).

Amongst children, the process of model-making has been reported to aid in externalising and verbalising ideas that might otherwise be difficult to imagine, explicate and communicate (Yrjönsuuri, 2019). Non-template based paper roller coasters have the potential to provide students opportunities of hands-on experience of designing, open-ended thinking, exploration and modelling (Dalvi et al., 2020).

References:

Choksi, B., Chunawala, S., & Natarajan, C. (2006). Technology as a school subject in the Indian context. In K. Volk (Ed.), *Articulating technology education in a global community: Proceedings of the International Conference on Technology Education in the Asia Pacific Region* (pp. 374-384). Hong Kong: Hong Kong Technology Education Association and The Hong Kong Polytechnic University.

Dalvi, A., Muralidhar, A., Dolas, A., Shinde, R., & Chunawala, S. (2020). Designing and making roller coasters by Indian middle school students. In K.K. Mashood, T. Sengupta, C. Ursekar, H. Raval and S. Dutta (Eds.), *Proceedings of epiSTEME8: Eighth international conference to review research on Science, Technology and Mathematics Education, HBCSE* (pp. 199-201). India: HBCSE/Gaurang Publishing Globalize Pvt. Ltd.

Deininger, M. Daly, S., Sienko, K., & Lee, J. (2017). Novice designers' use of prototypes in engineering design. *Design Studies*, 51, 25–65.

Härkki, T., Hakkarainen, K., & Seitamaa-Hakkarainen, P. (2018). Line by line, part by part—collaborative sketching for designing. *International Journal of Technology and Design Education*, 28(2), 471-494.

Hess, T., & Summers, J. D. (2013). Case study: Evidence of prototyping roles in conceptual design. In *DS 75-1: Proceedings of the 19th International Conference on Engineering Design (ICED13), Design for Harmonies, Vol. 1: Design Processes* (pp. 249-258). Seoul, South Korea.

Yrjönsuuri, V., Kangas, K., Hakkarainen, K. & Seitamaa-Hakkarainen, P. (2019). The roles of material prototyping in collaborative design process at an elementary school. *Design and Technology Education*, 24(2), 141-162.

