Types of Energy: Doodle Coaster

Suitable Ages:

Suitable for ages 14+

Skill Level:

Intermediate

Materials Required:

- 1 3Doodler pen and power pack per student
- 15-20 Doodle strands per group of 4 students (PLA suggested)
- 1 piece of cardboard per group of 4 students
- 1 glass marble per group of 4 students

Duration:

~90 minutes (can be split up into 2 class periods: Construction & Testing)

Contents

Objective

This lesson will guide students through the process of creating a track for a marble to roll down using the 3Doodler. After completion, students will be able to explain how the concepts of potential and kinetic energy apply to the marble.

Classroom Setup

Students will be divided into groups of four and provided with a piece cardboard as a base to work on, 15-20 Doodle strands, and a glass marble. Each student will be provided with a 3Doodler pen. Students will work together to construct a roller coaster for their marble to travel along.

Warm-up

Using the provided handout, discuss mechanical, potential, and kinetic energy and how they relate to the marble on the roller coaster track.

Activity

Students in groups of four will plan out a roller coaster track. Using the included stencils, students will construct the components of their roller coaster.

Sequence & Pacing

1. Using the handout on page 8, review the types of energy covered in this lesson.
2. Arrange students into groups of four and distribute supplies.
3. Students must plan and design their Doodle Coaster track.
4. Using the provided stencils, create the components of the coaster.
5. Test the Doodle Coasters and record results. Ask the students to review and reflect.

Striving Students

Paying close attention to these students will ensure safe use as well as readily available assistance. Grouping striving students with accelerated students can provide additional support. Encourage use of stencils.

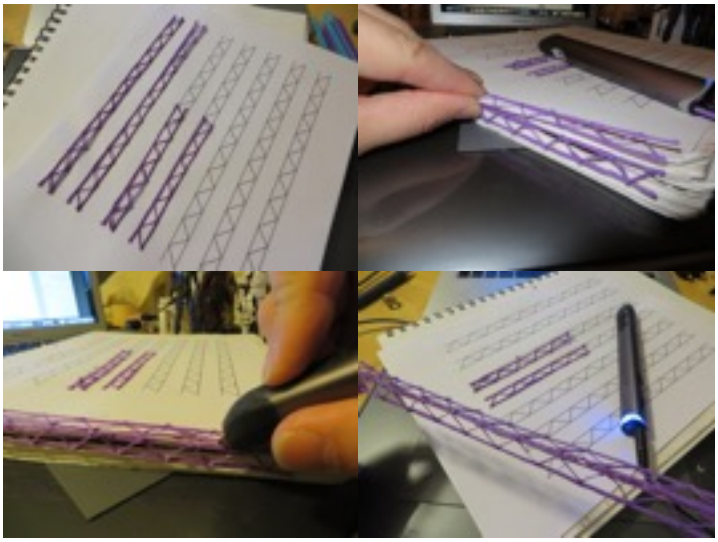
Accelerated Students

Grouping these students with striving students will give them an opportunity to provide assistance and encouragement to their fellow classmates, reinforcing the lesson for both parties. Encourage these students to use the stencils as a jumping-off point.

Evaluation Strategies

Students will be graded according to a rubric on their attentiveness and participation as well as the completion of the **Doodle Coaster**. Cooperation will be key in completing a functional rollercoaster. If the marble can't make it to the end of the track, students must be able to describe why in terms of potential and kinetic energy. The handout will be collected at the end of class and corrected for use as reference material for future lessons.

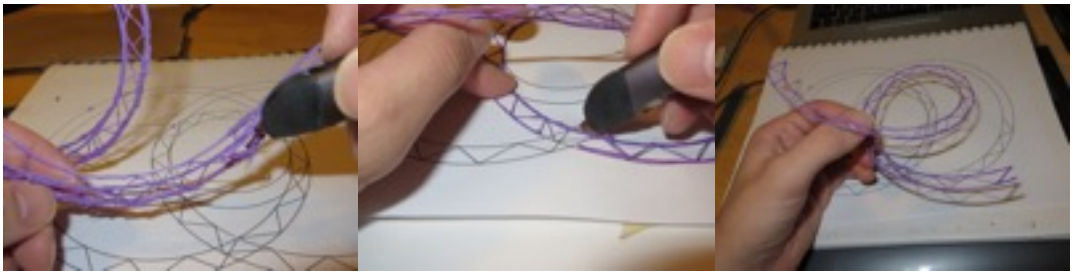
Doodle Coaster Construction



Students will use the 3Doodler and the provided stencils to create the components of their roller coaster. **For each straight section** of track, two lengths will need to be traced and then joined together at a right angle. This method will also be used to create supports for the track.

To create curves, use the circular stencil and trace as much as you want around the edge, then create a straight piece. Join them at the ends at a right angle, and slowly bend the straight section around the curved edge while connecting them with more plastic.

For the loop-the-loop, trace the section that has the triangular supports, but leave a gap when you come around and continue it on the other side. Peel up the connected section and Doodle underneath it to connect the part where a gap was left. Repeat to create the other side of the track.



Connect the two halves of your loop-the-loop track starting at one end and working your way around the center edge. Use straight sections to support and anchor the track securely to the cardboard.

Evaluation Rubric

	4	3	2	1
Participation	Students raise their hands to ask and answer pertinent questions. Follow directions. Stay on task. Fill out the handout completely.	Students raise their hands to ask and answer pertinent questions. Follow directions.	Students answer when called upon. Follow directions.	Students fail to engage in classroom discussion. Failure to follow directions/stay on task.
Attentiveness	Students are following along and paying close attention at all times.	Students are following along with the lesson.	Students need to be reminded of instruction due to lack of attention.	Students are not following along/ paying attention.
Utilizing Stencils	Proper completion of stencils that results in a successful rollercoaster.	Proper use of stencils even if connections aren't smooth.	Successful completion of stencils, unassembled.	Failure to complete any stencil pieces.
Teamwork	Team divides work efficiently, works well together.	Multiple members working on different stencils at once.	Difficulty dividing workload.	Failure to work well together.

Handout: Mechanical Energy

Definitions:

Mechanical Energy - Energy of an object due to position or motion.

Potential Energy - Energy possessed by an object in regard to its position in relation to other objects.

Kinetic Energy - Energy possessed by an object in motion.

Discussion Points:

- Explain how the marble has Potential Energy in relationship with the roller coaster, when it is at the top and when it is at the bottom.

- How would one go about increasing the Potential Energy of the marble?

- What needs to happen to transfer the Potential Energy into Kinetic Energy?

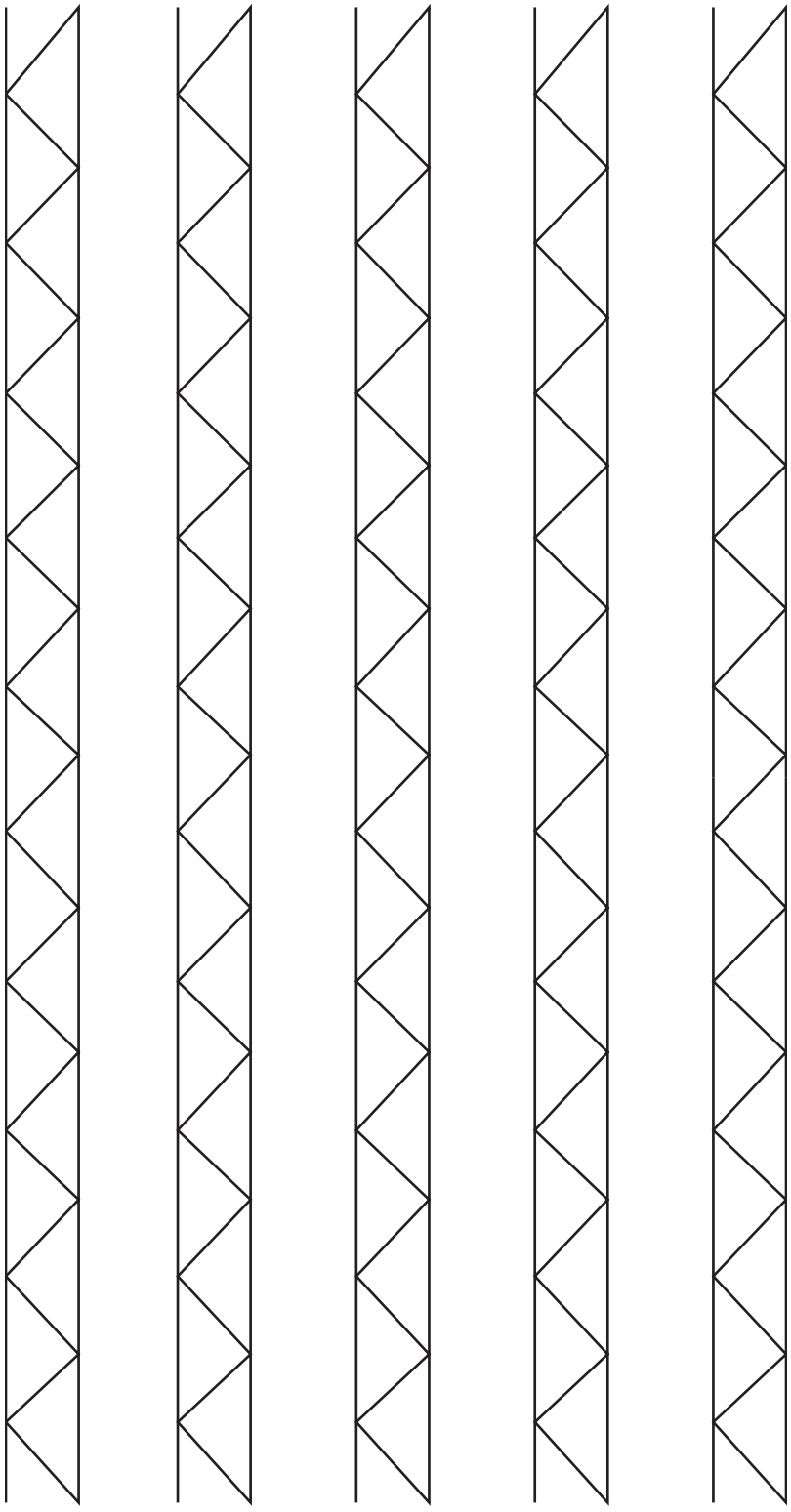
- Explain the forms of energy the marble goes through on its way from the top to the bottom of the roller coaster.

- What could potentially prevent the marble from having enough energy to complete the course?

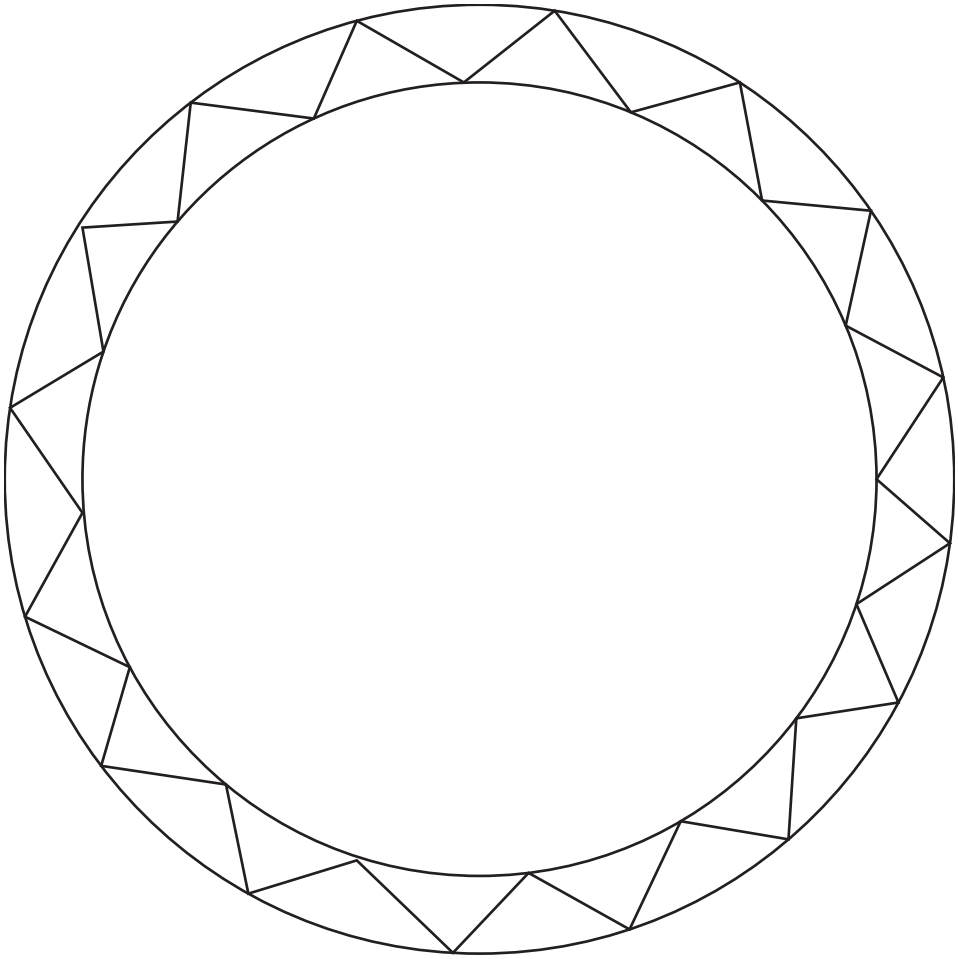
Review and Reflect:

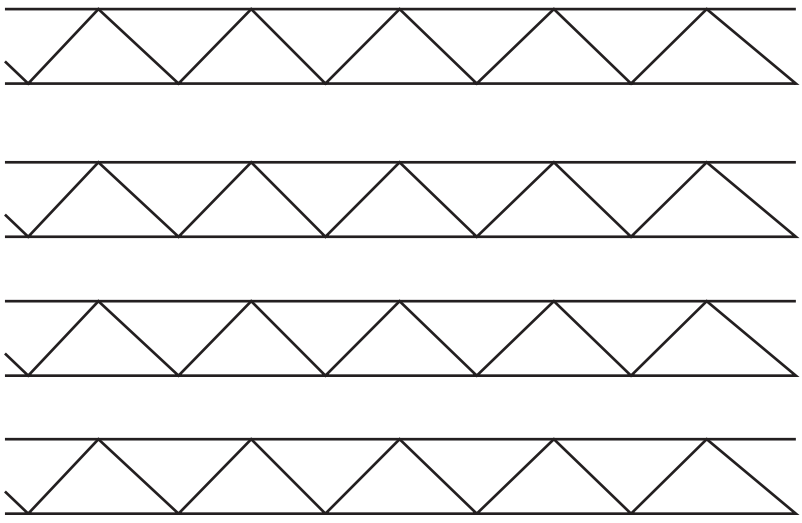
- Was your rollercoaster successful? What would you have changed to make it work even better?

Track Stencil: Straights

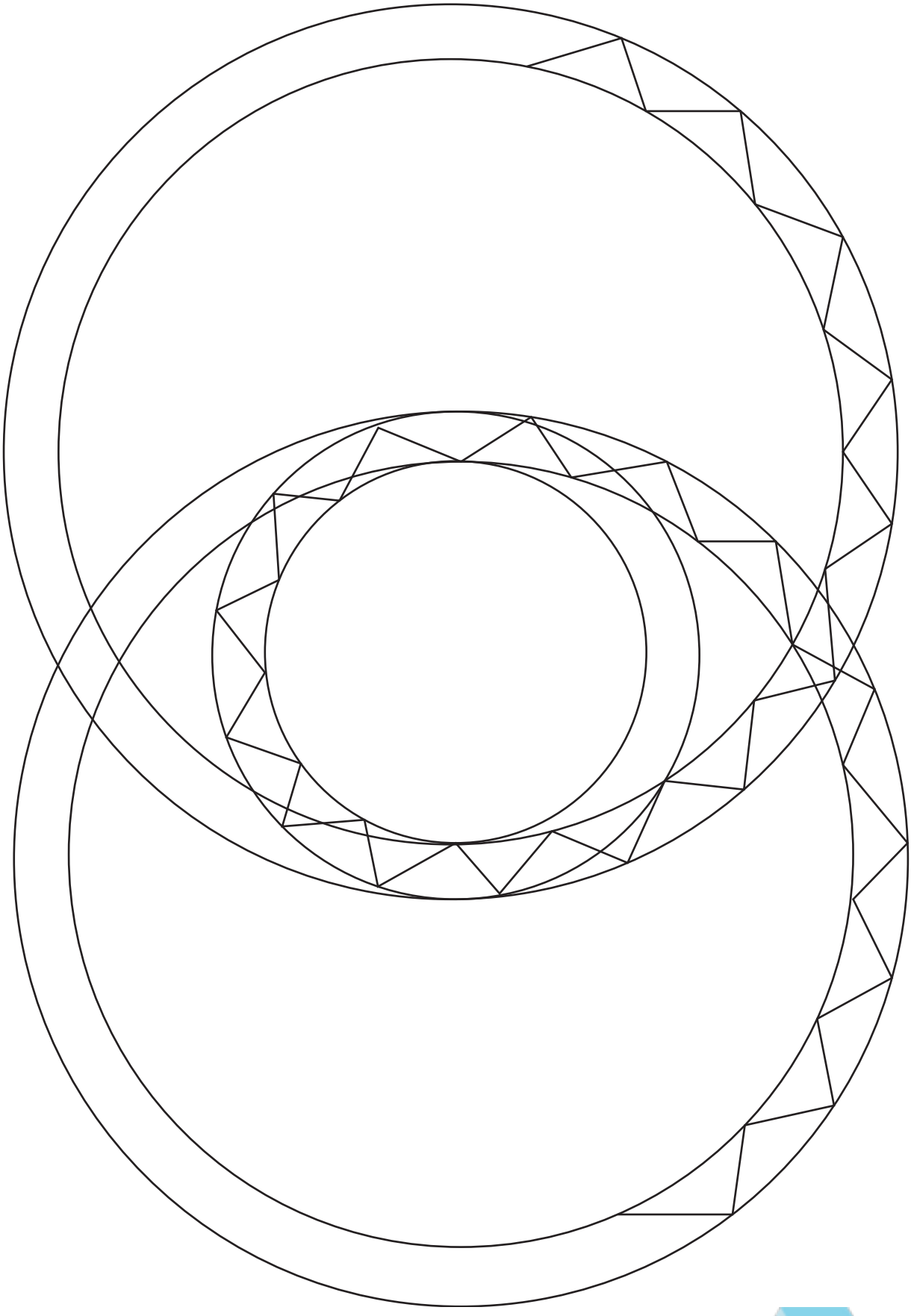


Track Stencil: Curves





Track Stencil: Loop-the-loop



Additional Resources

Tutorial Videos

Please visit the3Doodler.com/videos/#started to find videos demonstrating the skills required for this activity. Individual videos that will be useful include:

- Inserting Plastic:
  - YouTube: https://www.youtube.com/watch?v=ZSmdhZEnMDE
  - Dropbox: https://www.dropbox.com/s/3jnmafuve2saqu4/Inserting%20Plastic.mp4?dl=0
- The Buttons:
  - YouTube: https://www.youtube.com/watch?v=mos2SBukObo
  - Dropbox: https://www.dropbox.com/s/cqkozrmhktr3u38/Buttons.mp4?dl=0
- Reversing Plastic:
  - YouTube: https://www.youtube.com/watch?v=aD84E55mgac
  - Dropbox: https://www.dropbox.com/s/mpzxcrky9f5aq41/Reversing%20Plastic.mp4?dl=0

Additional Inspiration

For additional inspiration and ideas about other simple projects that can be accomplished at this level, check out the following links:

- Stencils and Projects: the3Doodler.com/community/
- Doodles by You: the3Doodler.com/doodles/
- Videos: the3Doodler.com/videos/
  - Getting Started: the3Doodler.com/videos/#started
  - Tips & Tricks: the3Doodler.com/videos/#tips

3Doodler EDU

More curricular materials are available at the3Doodler.com/EDU/.

At 3Doodler, we are committed to supporting educators with learning content to inspire and make it easy to create. The materials hosted on this page are designed to introduce the 3Doodler into classrooms, libraries, museums, and maker spaces. All materials are freely available and downloadable. Educators should feel free to adapt, hack or modify the suggested activities, lesson plans and units to meet their needs and those of their students.

If you have additional ideas for classroom activities or lessons, feel free to reach out to us at education@the3Doodler.com or share with the 3Doodler EDU community on social media using the hashtag #3DoodlerEDU.