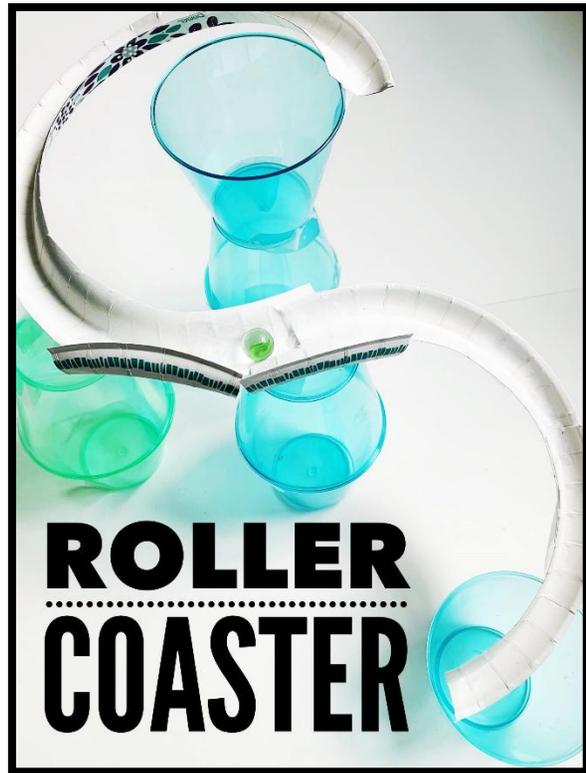


End of the Year

STEM



Roller coaster challenge

← **CREATED BY BROOKE BROWN**

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Optional Google Slides Notebook

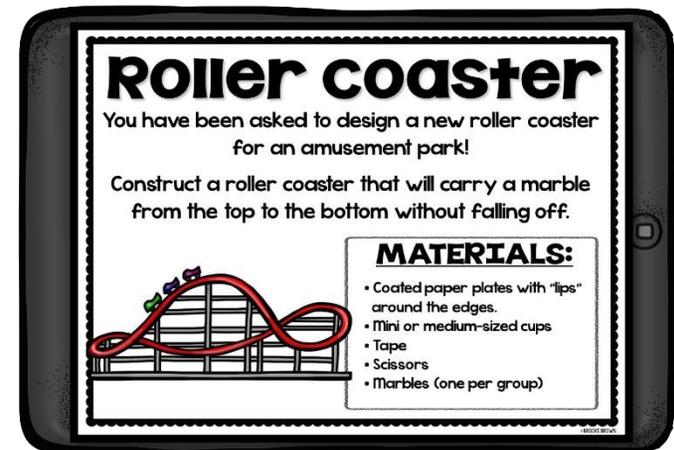
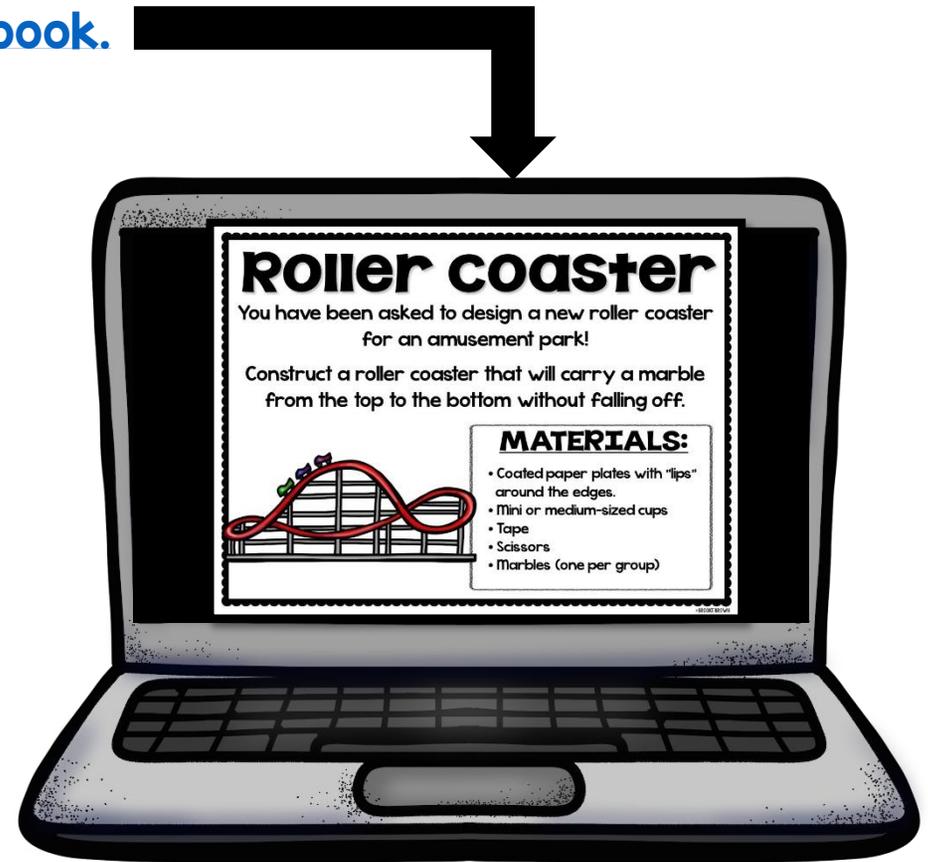
1. Download [Link for the Google Slides Notebook](#).
2. Sign into your Google Account.
3. **MAKE A COPY** of the notebook.

Each student will need their own Google account if they will be working on their own Digital Interactive notebook using Google Slides. If your students will be using iPads, they will also need to download the **Free Google Slides App** for the digital notebook to work properly.



Before you and your students begin editing/filling in your digital notebook, it is **VERY** important to first save a copy of the file on your own Google Drive, and then edit the copy. Your students will follow these same steps when you share the file with them.

YOU DO NOT WANT YOUR STUDENTS TO EDIT THE ORIGINAL FILE.



ASK



IMAGINE



**THE
ENGINEERING
DESIGN
PROCESS**

PLAN



CREATE



**TEST &
IMPROVE**



**REFLECT &
PRESENT**

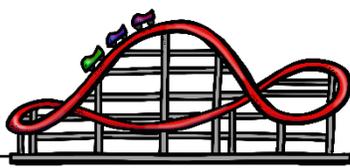


SUPPLIES CHECKLIST

STEM CHALLENGE	ITEM	NUMBER PER GROUP	I HAVE IT
Roller Coaster	cups (mini or medium-sized work best)	12	
	coated paper plates with "lips" around the edges	6	
	tape	1 roll	
	scissors	2	
	marble	1	
	9" x 12" sheet of construction paper	1-2	

STANDARDS ALIGNMENT

CHALLENGE	ENGINEERING	SCIENCE	MATH
Roller Coaster	<p>K-2-ETSI Engineering Design: K-2-ETSI-1, 3-5 ETSI-2, 3-5 ETSI-3</p> <p>3-5-ETSI Engineering Design: 3-5-ETSI-1, 3-5 ETSI-2, 3-5 ETSI-3</p>	<p>K-PS2 Motion and Stability: Forces and interactions</p> <p>3-PS2 Motion and Stability: Forces and Interactions</p> <p>4-PS3 Energy</p> <p>5-PS2 Motion and Stability: Forces and Interactions</p>	<p>MPI: Make sense of problems and persevere in solving them</p> <p>MP.2: Reason abstractly and quantitatively.</p> <p>MP.4: Model with mathematics</p> <p>MP.5: Use appropriate tools strategically</p>



STEM CHALLENGE: Roller coaster

OVERVIEW: This challenge is perfect for the end of the year. It requires perseverance as well as constant testing and improvements, and is sure to bring cheers of success at the end! For best results, purchase coated paper plates with prominent “lips” around the outer edges that are not too thick for students to cut (not Styrofoam). Students will cut off the outer lips of the plates and crease them along the middle to make “tracks” for the marbles. They may also cut the tracks into different sizes so that they can turn their track different directions. The tracks should be taped to the top of mini or medium-sized plastic (cocktail) cups. The cups can be taped together in towers so that students can gradually reduce the height of the tracks from beginning to end.

HELPFUL TIPS:

- 1) Test each piece of the track before extending it to add another piece.
- 2) Tape the cup towers down to the construction paper to stabilize the roller coaster.
- 3) If any drops in the roller coaster are too steep, the marble may fall out. Tape small pieces of paper plate to the tracks to act as “bumpers” to block the marble from falling out.

After students achieve a successful roller coaster design, encourage them to give it an exciting name and decorate their poster with signs and details.

KEY SKILLS: Engineering roller coasters, Potential and Kinetic Energy, Acceleration and Momentum, Gravity

SUGGESTED READ ALOUDS: [Roller Coaster by Marla Frazee](#), [Roller Coasters \(How it Works\) by Precious Mckenzie](#), [The Pigeon Will Ride the Roller Coaster! by Mo Willems](#)

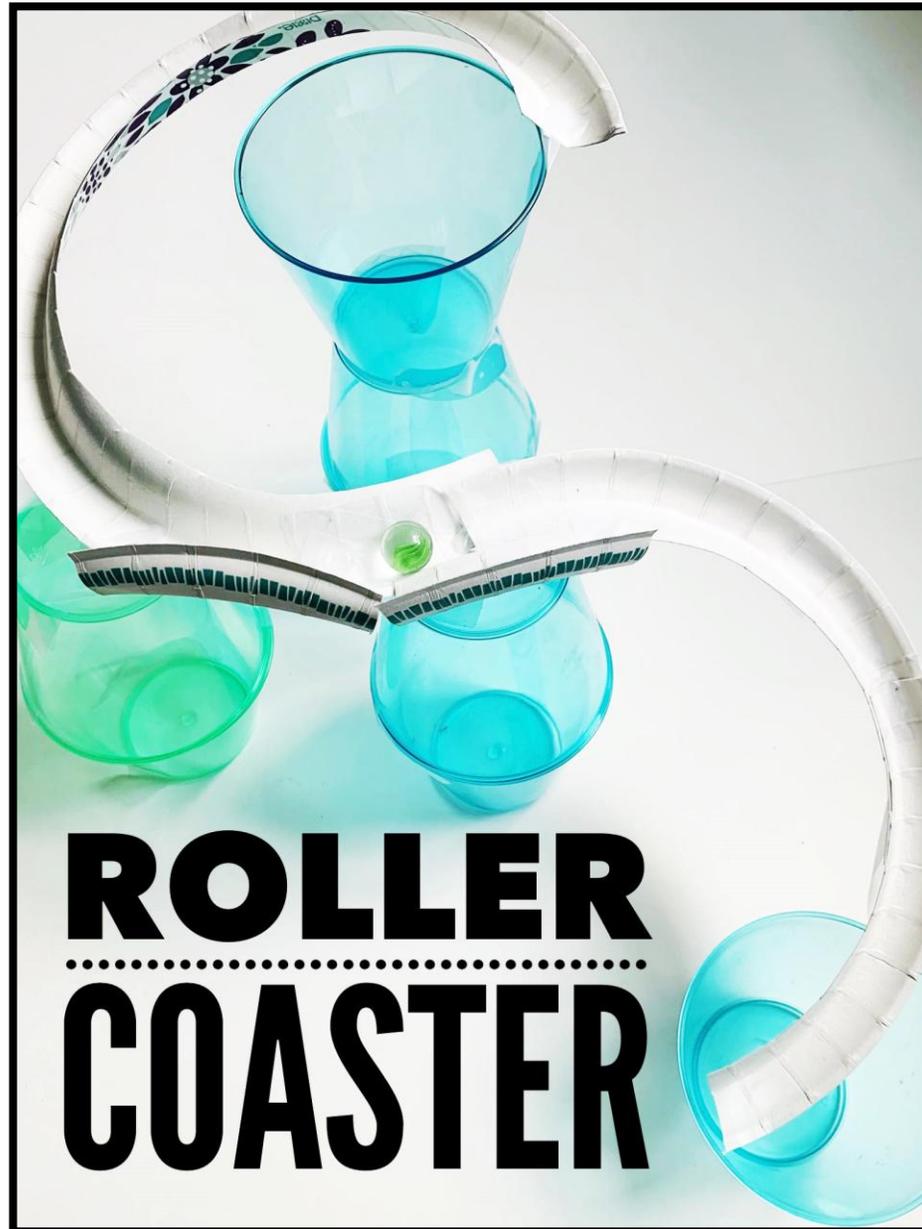
MATERIALS PER GROUP: marble, 12 mini or medium-sized cups, 6 coated paper plates with “lips” around the edges, 1-2 sheets of 9” x 12” construction paper, scissors, 1 roll of tape

LESSON PLAN

1. Activate students' prior knowledge by asking them to share what they already know about roller coasters and the forces at work during a roller coaster ride.
2. Share and discuss the videos on “Explore Roller Coasters.”
3. Hold a class discussion, using the teacher chart and real world examples to guide student thinking. (You can project the chart on an interactive whiteboard or document camera.) Record their ideas on the teacher chart.
4. Introduce the STEM challenge and permitted materials.
5. Introduce and discuss key vocabulary cards related to the challenge.
6. Have students sketch blueprints of their designs on their recording sheets.
7. Distribute materials and allow students 60-90 minutes to construct their roller coasters and test them with marbles.
8. Hold a whole class closing discussion and reflection, allowing students to share, compare, and contrast their roller coaster designs. Use the “Let’s Reflect” poster to guide the discussion.

Roller coaster

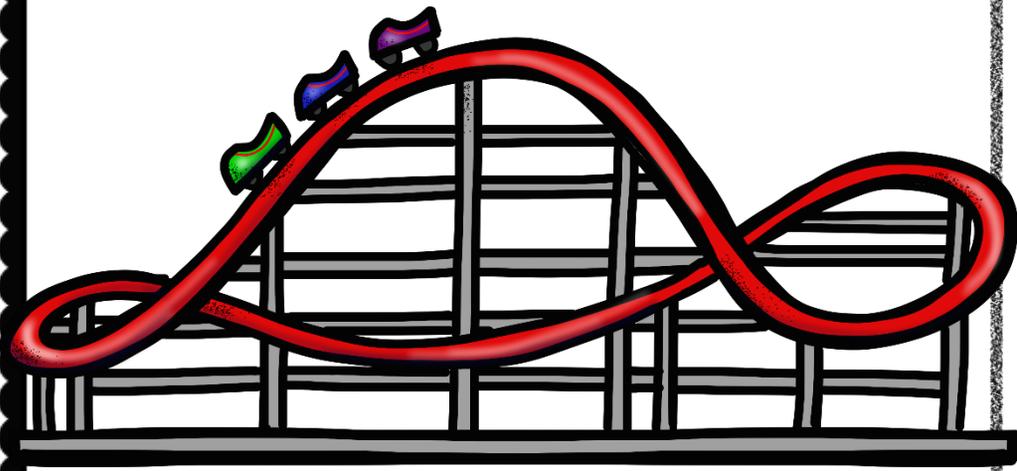
POSSIBLE PRODUCT
(for teacher reference only)



Roller coaster

You have been asked to design a new roller coaster for an amusement park!

Construct a roller coaster that will carry a marble from the top to the bottom without falling off.



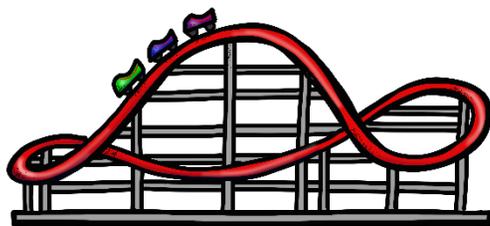
MATERIALS:

- * Coated paper plates with “lips” around the edges.
- * Mini or medium-sized cups
- * Tape
- * Scissors
- * Marbles (one per group)

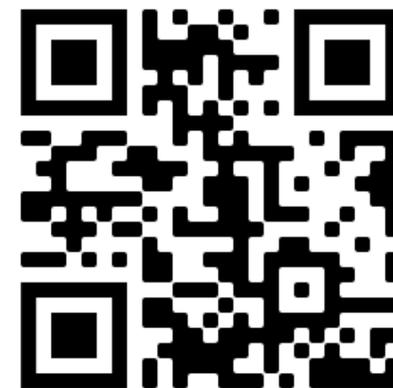
EXPLORE

ROLLER COASTERS

ROLLER COASTERS



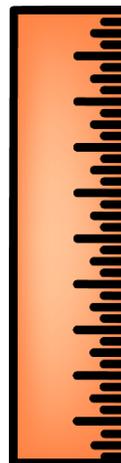
ROLLER COASTER PHYSICS



ROLLER COASTER FORCES



WORLD'S TALLEST ROLLER COASTERS



Roller coaster

REAL WORLD EXAMPLES



What is similar? What is different?

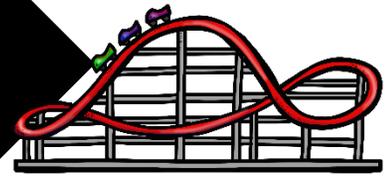
Forces at Work in Roller Coasters

Important Features
of Roller Coasters

Our Design Ideas



WORDS TO KNOW



gravity

force of attraction of objects to the center of the Earth



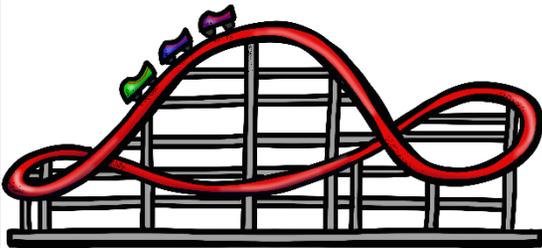
friction

surface resistance to motion



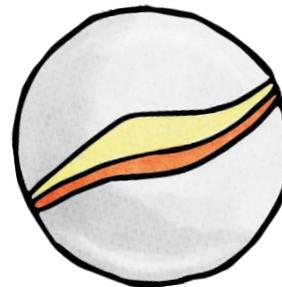
acceleration

an object's capacity to increase in speed

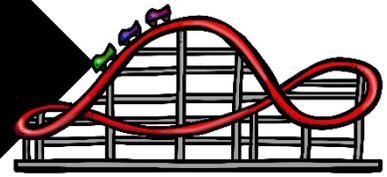


momentum

the amount of motion in a moving object



LET'S REFLECT!



- What was most difficult about this challenge?
- What features in your design were necessary for the marble to roll all the way to the end?
- What improvements were necessary as you constructed your roller coaster?
- What force pulled your marble to the end of the track?
- How are potential and kinetic energy used in a roller coaster?
- How did friction affect your marble?
- How is your roller coaster design similar to and different from a real roller coaster?
- If we completed this challenge again, what would you do differently next time?

STEM Challenge Assessment Rubric

Challenge: _____

Date: _____

Student Name: _____

3	2	1
Student followed all instructions for challenge.	Student followed some instructions for challenge.	Student did not follow instructions for challenge.
Student used best effort and perseverance on challenge.	Student used some effort and perseverance on challenge.	Student did not show effort or perseverance on challenge.
Student completed assigned blueprint and reflection sheet.	Student partially completed assigned blueprint and reflection sheet.	Student did not complete assigned blueprint and recording sheet.
Student showed accuracy in testing, calculating, and measuring.	Student showed some accuracy in testing, calculating, and measuring.	Student did not show accuracy in testing, calculating, or measuring.
Student fully cooperated with group members and contributed fairly.	Student partially cooperated with group members and contributed fairly.	Student struggled to cooperate with group members and/or failed to contribute.
Student fully participated in class discussions.	Student somewhat participated in class discussions.	Student did not participate in class discussions.

TOTAL POINTS: _____ /18

Comments: _____

STEM Challenge Assessment Rubric

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Date: _____

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3	2	1
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Student fully participated in class discussions.	Student somewhat participated in class discussions.	Student did not participate in class discussions.

TOTAL POINTS: _____ /18

Comments: _____

STEAM Challenge Assessment Rubric

Challenge: _____

Date: _____

Student Name: _____

3	2	1
Student followed all instructions for challenge.	Student followed some instructions for challenge.	Student did not follow instructions for challenge.
Student used best effort and perseverance on challenge.	Student used some effort and perseverance on challenge.	Student did not show effort or perseverance on challenge.
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TOTAL POINTS: _____ /18

Comments: _____

STEAM Challenge Assessment Rubric

Challenge: _____

Date: _____

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TOTAL POINTS: _____ /18

Comments: _____



We Need **STEM** Supplies!

Dear Families,

We are learning all about Science, Technology, Engineering, and Math through STEM lessons, and we need your help! If you are able to donate any of the following supplies for our STEM Challenges, please detach and return the form below and send back to school with your child. We greatly appreciate your support and generosity!

We are in need of the following items by _____.

Thank you so much for helping to make our STEM lessons possible!
Please contact me at _____ with any questions.

Sincerely,

If you are able to donate, please detach and return the form below:

Parent Name(s): _____

Child's Name: _____

I am able to donate: _____



We Need

STEAM Supplies!



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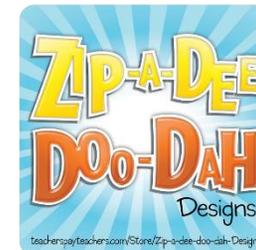
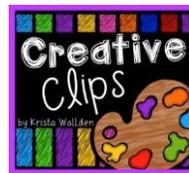
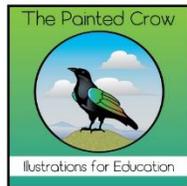
Child's Name: _____

I am able to donate: _____

credits

created by Brooke Brown

Thank you for your purchase!



<http://www.teacherspayteachers.com/Store/Zip-a-dee-doo-dah-Designs>