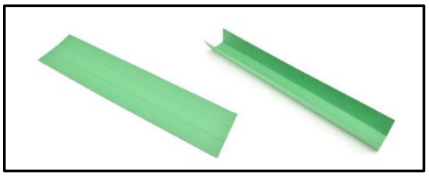
Wizards of Wright

Lesson: Group Work – Build a Roller Coaster

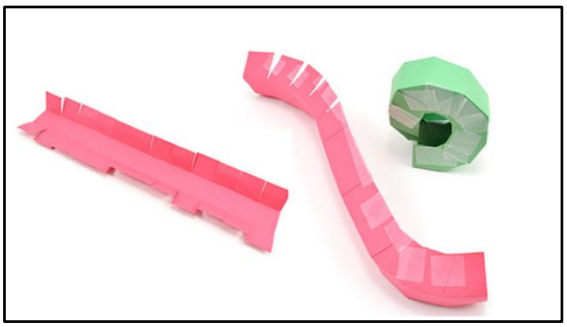
Use WOW! Lesson Intro to begin.

Background Info for Wizards:	There are several benefits for students to experience group work. - Group work creates more opportunities for critical thinking and can promote learning and achievement. - Students engaged in group work, or cooperative learning, show increased individual achievement compared to students working alone. - Student group work enhances communication and other professional development skills. - Group work can be an effective method to motivate students, encourage active learning, and develop key critical-thinking, communication, and decision-making skills. - Kids need to interact and problem solve sometimes apart from instruction and guided practice. This both assesses and develops high leveled thinking.
Materials:	9 oz cups ping pong balls and/or marbles construction paper small paper plates craft sticks masking tape paper for sketching ideas tape scissors rulers cardboard – They can use a piece of corrugated cardboard as a base, and assemble their track on it. (Tape the track segments together end-to-end to connect them.)
Lesson Time: 45-55 minutes	Introduction: 5 minutes Continued Introduction for Older Students: 5 minutes Guided Lesson: 5 minutes Student Activity: 30 minutes Wizard Demonstration: Do this during the Activity if needed. Conclusion: 5-10 minutes
Learning Targets:	Students will participate working in a group. - they will use critical thinking - they will participate in cooperative learning

	- they will have opportunities to communicate - this is an opportunity for active learning - they will practice decision-making skills and problem solving
Introduction for Students: 5 minutes	*The students must work in groups for this activity. The teacher should have created those groups already.* **Ask students**: Have you ever ridden a roller coaster? Have you ever wanted to design your own? There are some toys and video games you can buy that will let you build your own coasters—but today you'll make one out of the materials we have here. The first step of this project is to design a prototype of your roller coaster, and then you'll build a small version of it to test. Include whatever hills, twists, turns, and loops you think are necessary to make the most exciting and safe amusement park ride.
Continued Introduction for Older Students: 5 minutes	Roller coasters are a great way to discuss potential and kinetic energy. Here is a brief background: - As riders travel up the first hill, a motorized chain pulls their cart to the top (that's the click-click sound you hear at your feet). The first hill is usually the tallest and has the most potential energy, or the amount of energy stored, due to the object's height. - The amount of energy stored from falling down the first hill will be enough to carry riders all the way to the end of the ride! The taller the first hill, the farther that gravity can pull riders downward. - As riders scream while falling down the hill, gravity takes over. All the built-up potential (stored) energy now changes to moving or kinetic energy. The further down the hill, the faster you go! - As riders go up and down hills, the energy changes from potential to kinetic and back at each hill.
Guided Lesson: 5 minutes	<u>Explain the Mission:</u> Each team has the mission of designing a roller coaster that will carry their ping pong ball (or marble) at least the distance of 1 foot, and having it land in a cup at the end. I challenge you to see if you can increase the distance or use multiple turns as you plan and design. (A ping pong ball and a marble may give very different results... if there's time, they can test them both.) <u>Brainstorming</u>: Before brainstorming, show students the materials they will have available.

	Give them time to discuss things as a group. Give them paper to sketch out their ideas as they plan. It can always change as they build. As you walk around the room, ask them what materials they will use, and how they will manipulate that material.
Student Activity: 30 minutes	<u>Design and Build:</u> To begin with, don't share any ideas or show them any examples. Let their thoughts lead this. After enough brainstorming time, allow them to take materials from your table and begin building. Helpful hints during building: - Allow students to explore the materials and struggle with the initial design. - Keep challenging student teams to build taller rides with more twists. - Remind students to test out the track to make sure it's wide enough for the ping pong ball. - Does the ball fly off the track? Try adding a ledge to keep it on the track or decrease the slope of the track to slow it down. - Does the ball stop? Try increasing the slope of the track. *An optional design constraint is having a minimum-height requirement for the start of the track, such as 8 inches off the ground.* **Things to think about**: What happens? Does it make it the whole way through the track? If the ping-pong ball (or marble) made it the whole way to the end, try making your track longer by adding more pieces. If your ping-pong ball (or marble) didn't make it to the end, try to figure out why. - Is there a spot in your track where the ping-pong ball (or marble) got stuck? - Was the ping-pong ball (or marble) going too slow to make it through a loop? - If necessary, make changes to your design, like making the curves more gradual or the starting hill taller, and try again.
Wizard Demonstration: *Do this during the Activity if needed.*	If you see that students need help, here are a few design suggestions you can give them.  <u>To build a straight segment</u>: a. Cut a 3 inch (7.5 cm) wide strip of paper. b. Draw two parallel lines that divide it into three 2.5 cm-wide strips. c. Fold the two sides up 90 degrees along those lines to form walls.

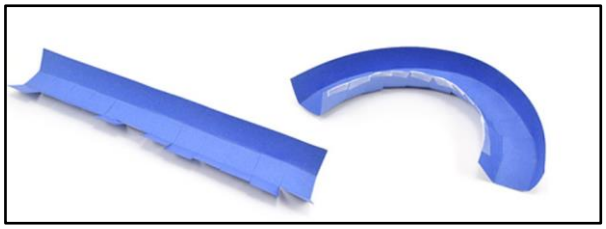
<u>To build a loop or a hill</u>:



a. Cut a 3 inch (7.5 cm) wide strip of paper.
b. Draw two parallel lines that divide it into three 2.5 cm-wide strips.
c. Make marks every 2.5 cm along the long edges of the paper.
d. Cut inward 2.5 cm from these marks to form tabs.
e. Fold the tabs up 90 degrees.
f. Bend the track into the shape you want, and tape the tabs together to hold it in place. This step is easier with two people, one to hold the track in place and one to do the taping.

<u>To build a curve</u>:

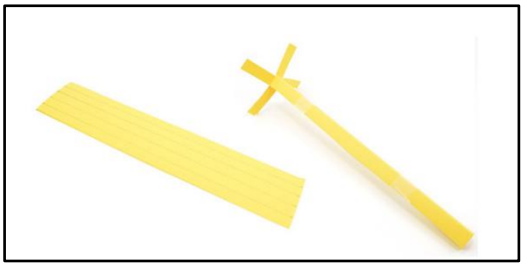
a. Cut a 3 inch (7.5 cm) wide strip of paper.
b. Draw two parallel lines that divide it into three 2.5 cm-wide strips.
c. Make marks every 2.5 cm along one long edge of the paper.
d. Cut inward 2 inches (5 cm) from these marks.
e. Fold up the uncut side of the paper 90 degrees to form a wall.



f. Fold up the tabs on the other side to form the other wall.
g. Since the bottom portion of the track is cut into segments, you can bend it horizontally to form a curve. Tape the tabs together to hold the curve in place.

<u>To build a support strut</u>:

a. Cut a 6.25 cm (2.5 inch) wide strip of paper.
b. Draw four parallel lines that divide it into five 1.25 cm (0.5 inch) wide strips.



c. Cut inward 2.5 cm along these lines from one edge.
d. Fold along the lines to form a square shape (so two of the segments overlap), and use tape to hold in place.
e. Fold the tabs you cut at the end outward. This will allow you to tape the tabs flat to a piece of cardboard, so your strut can stand upright.

Conclusion:
5-10 minutes

What Happened?

If you made your starting hill tall enough, and all the curves and loops of your roller coaster were gradual, your ping-pong ball (or marble) should have been able to get all the way to the end. However, if your coaster had any sharp turns or corners, your ping-pong ball (or marble) might have gotten stuck. If you tried to have your ping-pong ball (or marble) go up a hill or through a loop that was taller than the hill it started on, it wouldn't make it all the way through. Why not? It is all about energy!

Ask groups to briefly share their designs as you ask questions.

- What was a challenge you had in working in a team? (Do not let them blame or call out an individual)
- What did you learn about communication?
- What materials worked best for your design?

ideas and information credited to: https://teachingcenter.wustl.edu/resources/active-learning/group-work-in-class/benefits-of-group-work; https://uwaterloo.ca/centre-for-teaching-excellence/teaching-resources/teaching-tips/alternatives-lecturing/group-work/implementing-group-work-classroom; https://dynamitelessonplan.com/create-your-own-sport-a-small-groups-classroom-project/; /http://ajjuliani.com/design-thinking-activities/; https://www.vivifystem.com/blog/2019/10/24/thrilling-stem-activities-for-kids-roller-coaster-challenge; https://www.sciencebuddies.org/stem-activities/paper-roller-coaster