



Student Worksheets

Ultimate Thrill Ride

Wonderville.ca Science Challenges
Grade 7: Structures and Forces

TEAM WORK SHEET 1: BACKGROUND INFORMATION

The 6 Quarks Theme Park on Wonderville is expanding and looking for a brand new ride to thrill our guests! We need the help of some great creative thinkers to build something that no other theme park has. We have heard that you might be that group to design this ride. Are you up for it? Then let's get started!

The new ride in Wonderville has some VERY specific requirements that need to be followed very closely. The most important of all these is that the passengers have to be safe! The ride must be strong enough so it doesn't fall down or let the passenger fall out. We know that you will be able to design using your knowledge of structures and forces to build a strong, stable and safe ride.

The 6 Quarks Theme Park would like you to design and build a prototype ride so that we can compare all the designs. For the prototype you can use a marble to represent the passenger.

Your New Ride must:

1. Fit inside a 50cm x 50cm box that can be as high as you can build it.
2. Allow the marble to travel a distance of at least 55cm during the ride (longer distances will score higher);
3. Give the marble at least 5 second ride;
4. Keep the marble at least 10cm off the surface from start to finish;
5. Use gravity as the only energy source for the ride;
6. Be a free standing structure (rides cannot be built on solid platforms to which pieces are attached);
7. Not use Lego, Mechano, K'Nex or other commercial construction sets.

Once you have designed and built the prototype ride you will need to submit a picture, a description of your ride, a scientific drawing, and finally a Video presentation to the Science Challenges website. On the website you will find a Tips and Tricks video that will help you with your video presentation.

For all your help, we have some cash prizes for the top rides in each of the following categories: Best Ride, Most Creative Ride, Best Presentation, Longest Distance, Longest Time.

Thanks again! We can't wait to see what exciting new ideas you come up with!

TEAM WORK SHEET 2: BRAINSTORMING

Think about all the amusement park rides you've ever been on. As a group, list the team's four favorite rides:

Some rides spin quickly, others have loop-de-loop or have vertical drops. What does the team find most exciting about their favorite rides?

TEAM WORK SHEET 3: STRUCTURE AND FORCES – PRELIMINARY DRAWING

Before drawing consider the questions below. Once these questions have been answered, sketch an amusement park ride, on a blank piece of paper that has two of the team's favorite features listed from the team's brainstorming.

What features from the class brainstorming does the team like? Prioritize them.

What **structural factors** does the team need to consider in designing the team's ride (beam, joints, bearing, cantilever)?

What **forces and motions** does the team need to consider when designing the team's ride (tension, compression, shearing, torsion, bending) ?

What other important points do the team need to consider? (Research on Internet or in books/textbooks)

TEAM WORK SHEET 4: MATERIALS

What materials will be required to build the ride your team has designed? Your team will need materials that:

- Act as a support or base for the ride
- Guide the marble as it moves through the ride
- Prevent the marble from falling on the ground or flying off the sides of the ride
- Keep the marble at least 10 cm off the table
- Stop the marble at the end of the ride (it must not be below 10cm)

Look around your classroom. Below is a list of some materials the team can consider. Are there other materials that can be incorporated into the ride?

Elastic Bands, Cardboard, Books, Milk Cartons, Milk Jugs, Paper Clips, Plastic Bags, Straws, Scissors, Glue, Funnels, Foam, Pipe cleaners, Wires, Newspaper, Hoses / tubes, Retort Stands, Toothpicks, Pop bottles, Cardboard tubes, Flexible plastic sheets, Tape, String, Netting, Nylons, Boxes, Rulers, Wood

Looking at your team's diagram from the previous section decide what materials can be used for each section or part of the ride and make a list of what your team will need to find.

Ask each member of the team to bring in various materials.

List who will bring what material on this sheet and each team member should put the items in their agenda. Decide what day the materials are to be brought to the class.

Name	Material

TEAM WORK SHEET 5A: BUILDING THE RIDE

Below is your checklist to make sure you remember the rules of the challenge. Building the ride could take 2 or 3 days. Your teacher will let you know how many class days your team will have to build the ride or if it will be done outside of class time.

Your team must:

1. Design an amusement park ride that will fulfill the following requirements:
 - a. All structural elements must fit inside a 50cm x 50cm x Unlimited height box;
 - b. Allow the marble to travel a distance of at least 55cm during the ride (longer distances will score higher);
 - c. A ride time for the marble of at least 5 seconds;
 - d. Keep the marble at least 10cm off the surface from start to finish;
 - e. Use gravity as the only energy source for the ride;
 - f. Have a free standing structure (rides cannot be built on solid platforms to which pieces are attached);
 - g. Does not use Lego, Mechano, K'Nex or other commercial construction sets.
2. Be able to discuss the following points during the Team's presentation
 - a. What type of structure(s) did the team use to make sure it was stable, strong and able to withstand the movement of the marble (load)?
 - b. Where are the tension, compression, shearing forces and the torsion and bending motions within the structure? (What types of force did the marble put on the structure as it traveled through the ride?)
 - c. What materials did your team use, why did your team use them and how did your team join the different materials together?
 - d. Identify points in the ride where flexible or fixed joints are required, and discuss why those different types of joints were used for the ride.

Later on the team will need to:

- **Time** how long the ride takes
- **Measure the distance** the marble travels in the ride

TEAM WORKSHEET 5B: BUILDING THE RIDE

Steps to take before and during building

- Check to see that the team has the preliminary drawing
- Check to see the team has all materials to get started
- Measure out a **50cm X 50 cm area**. A piece of paper cut to these dimensions is a good idea (can not have anything outside this area)
- Let each team member choose a section of the project to build
- Reevaluate as the team goes
- Does it meet the criteria of the challenge?
- Is it stable?
- Do test runs.
- Trouble shoot and modify the design if the project does not meet the requirements or is not stable
- Once the team is satisfied with the project, make final touches and improvements to make the run longer and/or take more time.
- Add special touches to the project – consider appearance, creativity and drawing interest to your ride.

TEAM WORK SHEET 6A: SCIENTIFIC DRAWING

The communication of ideas is an important part of our everyday lives. One of the ways that scientists communicate is to use drawings. It is important to make a scientific drawing clear, neat, and accurate so that someone else can replicate and test your design.

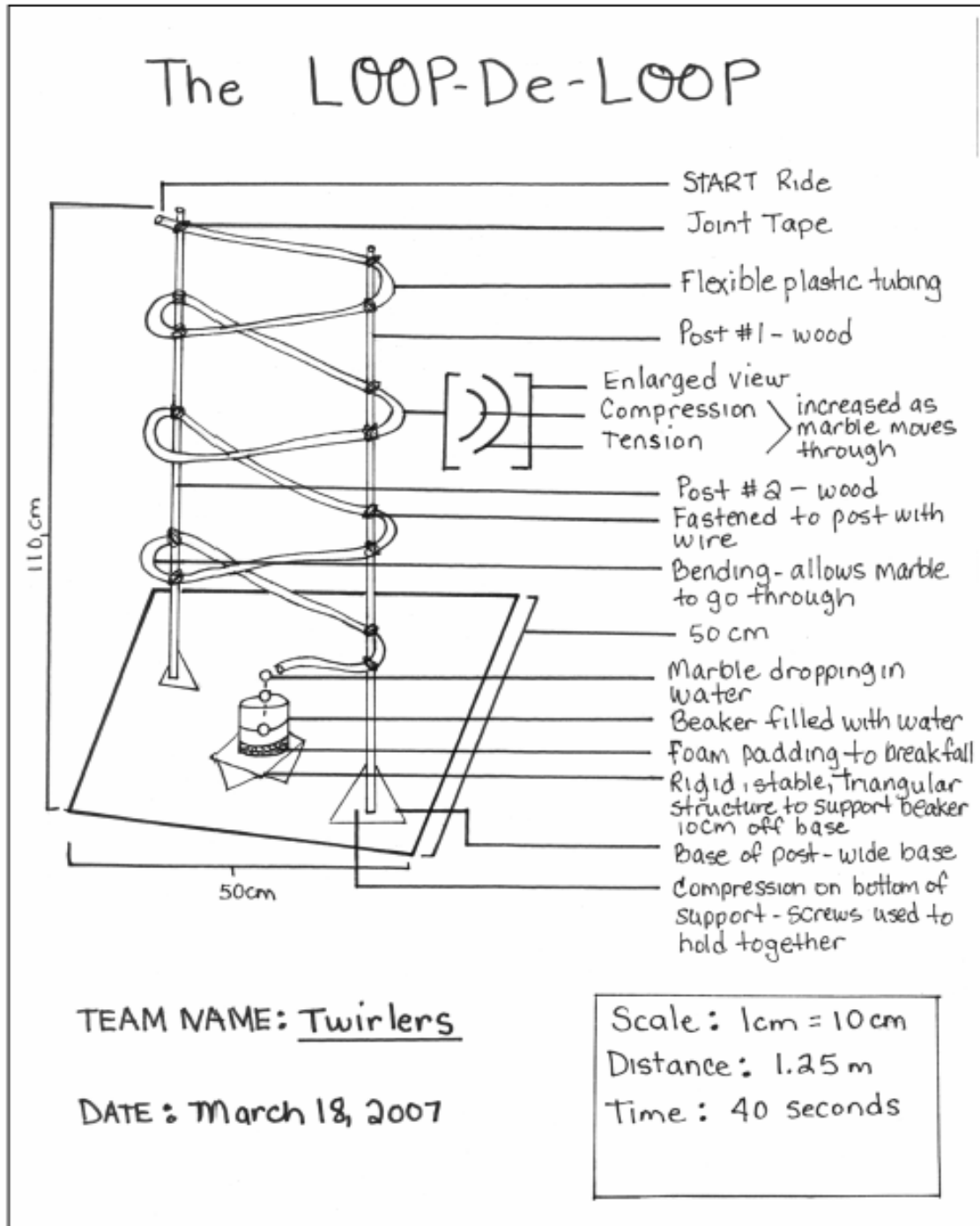
What to Do

- Decide who will make the Scientific Drawing
- Use unlined paper and a sharp pencil. Your team will also need a ruler and make sure you use a good quality eraser to make your corrections.
- Draw a side profile of your ride.
- Give yourself plenty of space. Your diagram should be at least 1/2 page in size. You need the space to add labels and captions to your drawing.
- Neatly label the details of the drawing. Using a ruler, draw lines from the detail you are naming to the margins of the paper. Make sure the line clearly touches the part of the drawing you are labeling.
- Labels identify the parts of the object you are drawing. Place labels on the right your drawing unless putting them all on the one side would make your drawing cluttered. Use your ruler to draw lines to the different structures. Make sure none of your label lines cross. Remember – neatness, clarity and accuracy are what count in a scientific diagram!
- Draw only what you see and keep your drawing simple.
- Shading or colouring is not usually found on scientific drawings. If you want to indicate a darker area, you can use stippling (a series of dots).
- Label the following: Title (name of ride), Date, Team Name, Tension, Compression, Shearing, Bending, and Torsion, Structure (arch, cable etc.), Joints, Materials.
- You must also include a scale of your drawing – the person looking at your diagram needs to know the approximate size of the structure.

Travel Distance: _____cm

Time from start to finish: _____seconds.

TEAM WORK SHEET 6B: SAMPLE SCIENTIFIC DRAWING



TEAM WORK SHEETS 7 – PRESENTATION

Clearly communicating your ideas to others is a very important part of any job. As part of the challenge, your team must make a 1- 2 minute video about your ride. Each person on your team must participate in the video. There is a suggested outline below.

- Plan for the presentation – it is a critical component of the Challenge
- Decide who will do each section of the presentation.
- Brainstorm ideas to include in each section
- Each team member should prepare one part of the presentation.
Remember you have a MAXIMUM of 2 minutes to present all your information.
- Practice your presentation to be sure you have included all of the required information.
- Judges will be awarding points for presentations.

SPEAKER 1: Introduce the team and the ride. Explain why your team built this type of ride and how you came up with the concept and design. What structures contributed to its strength and stability?

SPEAKER 2: Demonstrate how the ride works. Discuss the materials used to build the ride, and how the materials were joined together. Explain the safety features.

SPEAKER 3: Discuss the forces in and on the structure exerted by the marble. Point out the places where the forces of tension, compression, shearing, bending, and torsion are found as the marble moves through the ride.

SPEAKER 4: Which parts of the ride structure worked well? What would your team change if they could do the challenge again?
