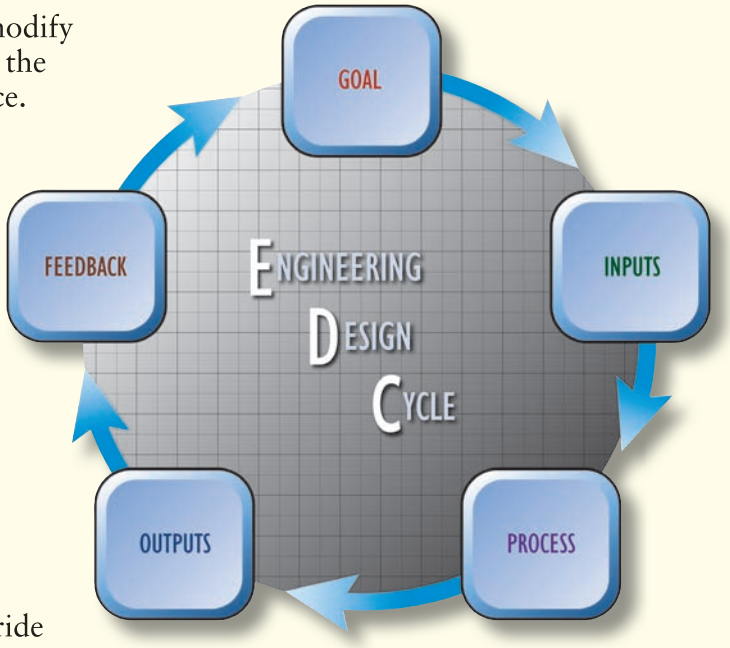
Chapter Mini-Challenge

Your challenge for this chapter is to modify the design of a roller coaster to create the optimum thrill for your target audience. You will have to give some careful consideration to each feature of the ride and decide how your audience would most likely enjoy it. Then, you will use the physics you've just learned to make it happen.



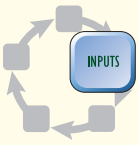
For your initial design you will need the following:

- A target audience — a particular group of riders with similar thrill tolerances
- A model of the design containing two hills, a vertical curve, and a horizontal curve
- Safety calculations at five points during the ride
- A calculation of the work required to start the ride
- A written poster or report

You still have more to learn before you can complete the challenge, but now is a good time to give the *Chapter Challenge* a first try. Your *Mini-Challenge* is to produce a thorough description of your target audience, a list of good ideas about which features of a ride will appeal to them, and to practice some calculations based on your ideas. You can describe what your target audience would like to experience in a roller-coaster ride, even if you are unsure of exactly how your coaster will deliver that type of movement. If your group is planning to make a poster, you might consider sketching the sections of the poster on print paper and taping them together to give the class an idea of how you will organize the information from your final design.

The physics you have learned so far will enable you to complete some of your safety calculations. If you assign a mass to each car on your coaster, you can begin to quantify how much potential energy there will be at the top of a hill and how much kinetic energy there should be at the bottom, too. You also know how to find the speed at the bottom of the hill using that same information.

Go back and quickly read the *Goal* at the start of the chapter. You will find all of the details for completing the entire challenge. At this point, you will focus on the portions you can complete with the physics you have learned so far. You can now complete a thorough description of your target audience, since you don't need any additional physics knowledge to describe their thrill-tolerance level.



In the *Engineering Design Cycle*, you are adding a critical *Input* by defining the target audience for your roller-coaster design. Additionally, you have your personal experience with roller coasters and the information you have learned in *Sections 1* to *5* to use as *Inputs*.

Your team should review the physics content from the first five sections to help you compose your roller-coaster design.

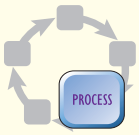
Section 1: You devised a method for drawing your roller-coaster model, a method for calculating velocities, and calculating accelerations. You also discovered that accelerations are more thrilling than high speeds.

Section 2: You investigated gravitational potential energy and its impact on velocity for objects going down a ramp. This should help you with your safety calculations of speed.

Section 3: You analyzed kinetic energy and the conservation of energy. Use this information to help decide how tall your hills can be and how fast you will be going.

Section 4: You investigated the force of gravity. You may wish to explain how your roller-coaster design would work on the Moon!

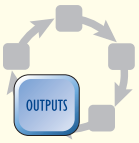
Section 5: You explored the weight of objects and how a spring scale works. What if you had a spring for a seat?



Brainstorm with your group to come up with potential target audiences. After you have a good list, pick two or three groups and make a list of ride characteristics that would be most appealing to each one: fast, lots of loops, big accelerations, gentle turns, and so on.

Next, have each member of your group rank each of the groups in the order they would most like to work on them—1, 2, 3, and so on (with 1 being the best). Add up the ranks for each group. The target audience with the lowest number should be the most popular one in your group.

At this point, you can do some very powerful analysis by calculating the potential and kinetic energy associated with each hill in your coaster design. Even if you change the height of the hill later, the calculation will be similar and simple to change to optimize your design. You will also be able to calculate the speed at any point for which you calculate the kinetic energy.



Presenting your information to the class is the *Output* for your design cycle. You should have a description of your target audience and a list of the features you will provide for them. You should present your *PE*, *KE*, and velocity calculations. Finally, you should present or describe the written portion of your final design presentation. This can be a sketched poster, brochure, or written paper.

Your classmates will give you *Feedback* on the accuracy and the overall appeal of your presentation based on the criteria of the design challenge. This feedback will become an *Input* for your final design in the *Chapter Challenge*.

Remember to correct any parts of your design that did not meet design constraints for speed for your target group. It will be harder to remember if you wait until the chapter is complete to go back and correct your mistakes. Then, store all of your information in a safe place so that it will be ready to use in the *Chapter Challenge*.