

Integrate
Data Science
Investigate
Roller
Coasters



Do you find roller coasters exciting or intimidating? Roller coasters like the one above are made from steel and are carefully engineered to safely deliver a rush of adrenaline. With sharp turns, loops, steep lifts, and sudden drops, riders are in for an exhilarating ride! What design features make roller coasters so thrilling — or terrifying?

Roller Coaster Statistics



Maximum Height

150 feet tall



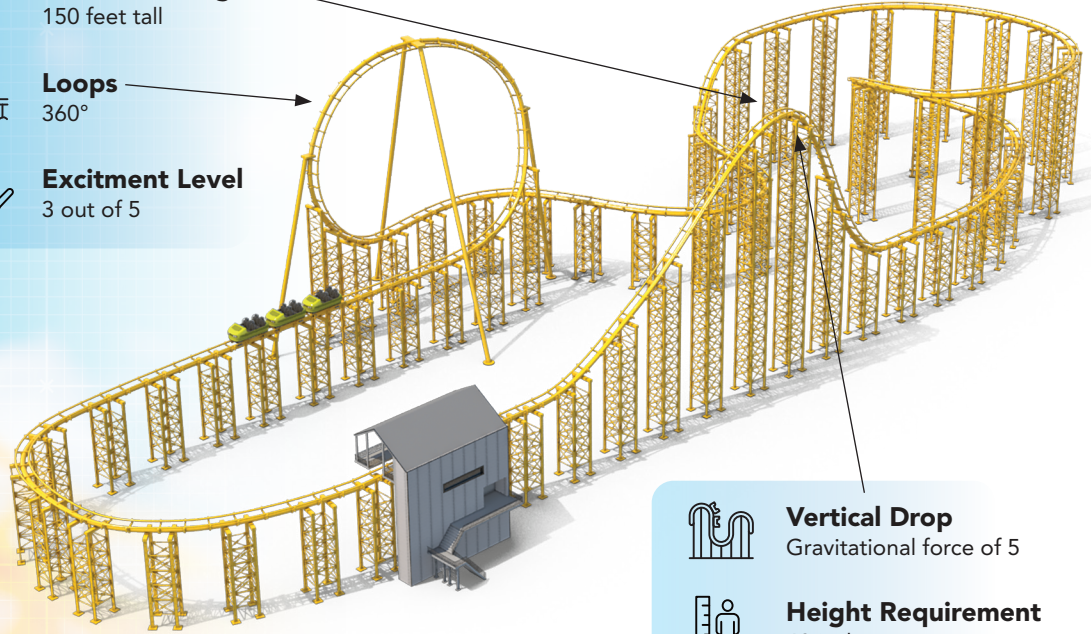
Loops

360°



Excitement Level

3 out of 5



Vertical Drop

Gravitational force of 5



Height Requirement

48 inches



Ride Length

3,900 feet



Ride Duration

160 seconds



Maximum speed

60 miles per hour

What do you notice?

What do you wonder?

If you make a claim based on your observations, where can you find the evidence to support it?

SOME ROLLERCOASTERS REACH SPEEDS FASTER THAN MOST CARS ON HIGHWAYS.

Mathematical modeling plays a crucial role in roller coaster design, ensuring the structure is safe, functional, and thrilling. Engineers use mathematical functions to represent the shape and motion of the tracks, taking into account factors such as speed, acceleration, and gravity.

X2 Roller coaster
Six Flags Magic Mountain
California



- 1 What function types do you see in the shape of the roller coaster?
- 2 The quadratic equation $f(x) = -0.01x^2 + 1.34x + 2.11$ models the shape of the hill on the X2 roller coaster at Six Flags Magic Mountain. In this model, x represents the horizontal distance and y represents the vertical distance from the start of the hill. How could you use the model to find the maximum height of the hill? What units make sense?
- 3 Many roller coasters start with a climb followed by a drop. Why might this be an important design feature?
- 4 How are the height of a roller coaster and its top speed related? What other relationships between the variables could you explore?

Coaster	State	Top Speed (mph)	Max Height (ft)	Duration (sec)
Batman The Ride TM	TX	38	120	120
Hangtime TM	CA	57	150	75
Kingda Ka TM	NJ	128	456	50
Raging Bull TM	IL	73	202	150
Son Of Beast TM	OH	78	218	140
Titan TM	TX	85	245	210
X2 TM	CA	76	175	120
Zonga TM	CA	62	115	120

What else do you wonder about other variables related to roller coasters?

DRIVE YOUR INVESTIGATION

Choose another roller coaster that you are interested in researching more. To drive your investigation, search for data about the roller coaster on official websites.

1. **Make Sense of the World** Investigate roller coasters in your state or in an area of interest to you. Create a mathematical model to represent the roller coaster(s) you investigated, or design your own.
2. **Predict** How can you use your model to make predictions about the roller coaster?
3. **Make an Impact** When designing roller coasters, what factors do you think engineers need to consider? How could the materials and design be used to minimize environmental impact?

REFLECT ON MATH PRACTICES AND PROCESSES

Choose two of the following questions to reflect on how you engaged the math practices and processes during the investigation.

1. **Model with Mathematics** How did you use mathematical models to represent the roller coaster?
2. **Use Appropriate Tools** What tools use in your investigation? How did your choice of tools help you answer the questions?
3. **Reason** How does your mathematical model represent the physical and design features of the roller coaster?
4. **Look for Relationships** What patterns did you notice in the roller coaster data? How did these patterns help you to create your model?

EXTENSION

Investigate innovative amusement park designs that are better for the environment.

- What measures are in place to help amusement parks minimize environmental impact?
- Given your research, suggest ways a local amusement park could make their roller coasters more environmentally friendly.
- How could you support your recommendations using data?