Classbox
by Betabox Learning

Activity Sheet: Centripetal Force
Name:

Instructions

Your goal is to use circular tracks to calculate the centripetal force using a scale to measure the mass of the car, a stopwatch, and measuring tape to find the radius of the circular track and the distance the car traveled.

Step 1: Background knowledge

Define centripetal force and come up with your own example.

Step 2: Form a hypothesis

What relationship do you expect between the mass of the car, the radius of orbit, and the car's speed, given the centripetal force formula?

Step 3: Set Up Experiment

1. Assemble a circular track using the image below as a guide. You will need several tracks and track connectors, the launcher at one of the ends, and two ramp supports.
   ⚠️ For best results, attach two ramp supports to the track and underneath the loop.
2. Before you bend the circular tracks, use a tape measure to record the length of your circle track. You will need this value later to determine the velocity of the moving car, which in turn will allow you to calculate the centripetal force.
   ⚠️ Make sure you are using centimeters (to convert cm to meters, multiply the given cm value by 0.01 m)
3. Find the radius of the circular track by measuring the diameter (the full length of the opposite sides of the circle) and divide it by 2.

Step 4: Test

1. Get your stopwatch and video camera ready, then place a toy car on the car launcher and push it down to set it in motion. Take down the time and it took for the car to circle the track. This value in seconds can be used to calculate velocity, as you did in previous lessons.
2. If you haven't already, weigh the mass of your car in grams.
3. You will need to convert all units to the metric system, so make sure you are using centimeters (to convert cm to meters, multiply the given cm value by 0.01 m).
4. You can experiment with different cars, masses, speeds, and radii to see how it affects the centripetal force. (If the car is moving with a low speed, it will simply go off the track or stop, while a high speed will hold the car in the path).

Step 5: Observations and Calculations

You can use the table to record the differences in your experimentation. The **control** and **experimental group** (changes #1 and #2) are compared against each other in an experiment.

For example, the control can be the average speed or velocity of your first track assembly and initial trials. For the experimental changes, you should change one variable only, such as the mass of the car or the radius of the track.

	Control	**Change #1**	**Change #2**
Trial 1			
Trial 2			
Trial 3			
Avg Speed or Velocity			
Centripetal Force (N)			

Calculations

Use the centripetal force formula. Centripetal force is easily calculated as long as you know the mass, m, of the object; its distance, r, from the center; and the tangential velocity, v. This equation is based on the metric system and the centripetal force, Fc, is measured in Newtons. One Newton is approximately 0.225 lb.

⚠️ Centripetal force is measured in Newtons and is calculated as the mass (in kg), multiplied by tangential velocity (in meters per second) squared, divided by the radius (in meters).

$$F_c = \frac{mv^2}{r}$$

F_c = centripetal force

m = mass

v = velocity

r = radius

Step 6: Conclusion

How does the centripetal force change when weight is added to the car? How does the centripetal force change when you change the radius of the circular track?