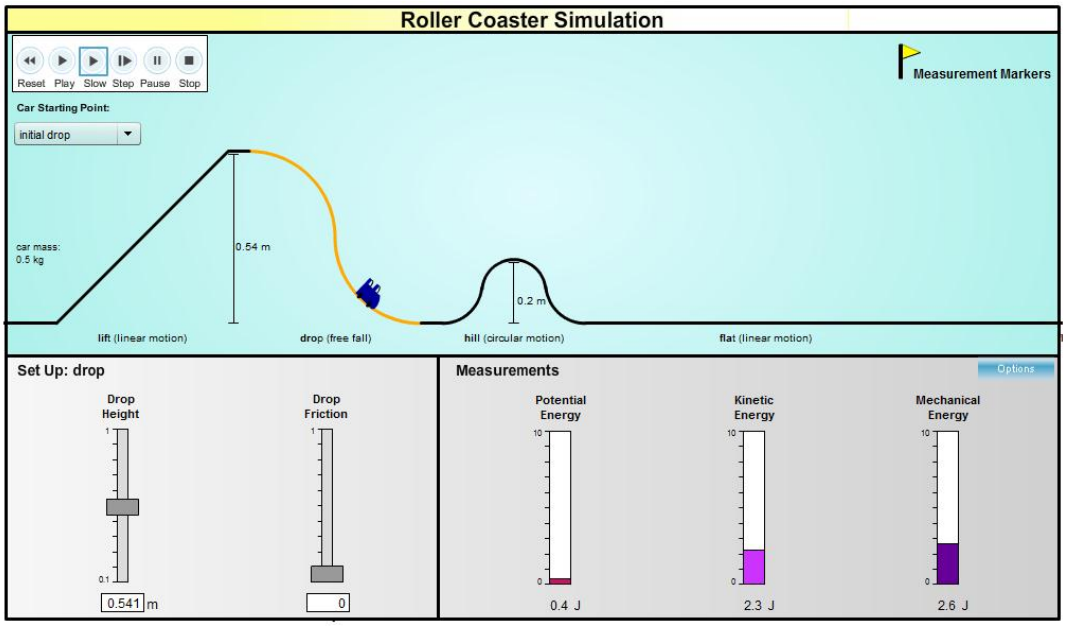
CoMPASS Roller Coaster Simulation Manual



How to get to the roller coaster simulation

You can open the roller coaster simulation by logging onto compass (www.compassproject.net) and then clicking the "roller coaster simulation" link. Or you can go directly there by typing this URL in your browser: www.compassproject.net/sims/roller_coaster_sim.html

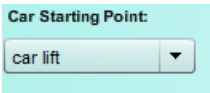
How to use the roller coaster simulation

Animation Controls:

These buttons control how the simulation runs. By default, the simulation is stopped. You have to press ***Play*** to run the simulation. Press ***Reset*** to re-run the simulation. You can also click the ***slow*** button to run the simulation in slow motion. You can also pause the simulation at any time with the ***Pause*** button and can move the simulation forward one step at a time with the ***Step*** button. The ***Stop*** button can be used to stop the simulation entirely.

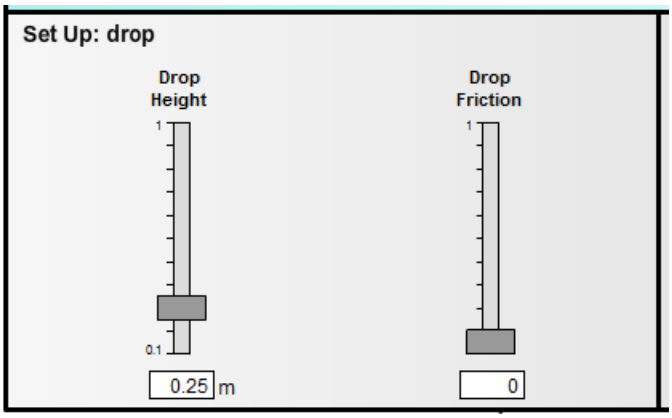
Tip: If the roller coaster car disappears or you encounter any other problem with the simulation, clicking the ***reset*** button often fixes the problem. If that doesn't fix the problem, restart the simulation by clicking the "refresh" button in your web browser.

Car Starting Point:

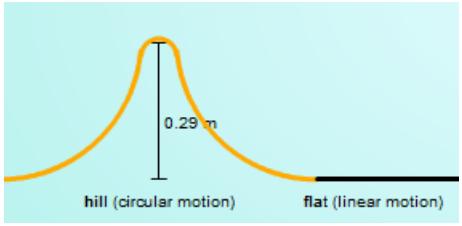


Use this dropdown to control where your roller coaster car starts. The car can start at one of two places: either at the beginning of the car lift or the beginning of the initial drop. Note: If the car starts at the beginning of the car lift, it will stop at the top of the car lift. To get the car to go through the rest of the roller coaster, you need to start the car at the top of the initial drop.

Changing Values:

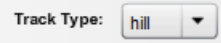


The roller coaster track is split up into different sections. By default, section 1 is a car lift, section 2 is a drop, and the remaining are flat sections. Each track section is labeled below the track with the type of track section (lift, drop, hill or flat) and the type of motion that applies to that section of track (circular motion, linear motion or free fall).



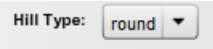
To change properties of a track section, first ***click on the track section or the label below the track***. The track will then be highlighted orange. The sliders that appear in the ***Set Up*** section of the screen will control that section of the track. For example, if you click the drop section of the track, you will see sliders for "Drop Height" and "Drop Friction". Changing these properties adjusts the height and friction of the drop. You can change any of the properties of the different track sections this way. Similarly, to change the mass of the car, you first click on the car, and then use the "car mass" slider to change the mass of the car. To use the sliders, just click on the dark grey rectangle and drag it up or down. To get more exact values, click in the box below the slider and type in the value you want. The value of that section of track (or the car) will be updated automatically.

Changing Track Sections:



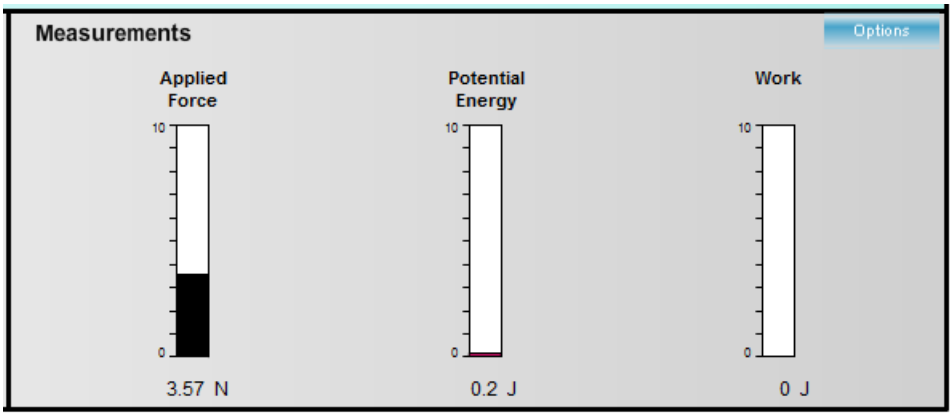
For track sections after the drop, you can change the type of track. You can change the type of track to a hill or back to a flat section. To add a hill, click on a flat part of the track. It should now be highlighted orange. You can then change the ***Track Type*** dropdown to “hill”.

Changing Hill Type:

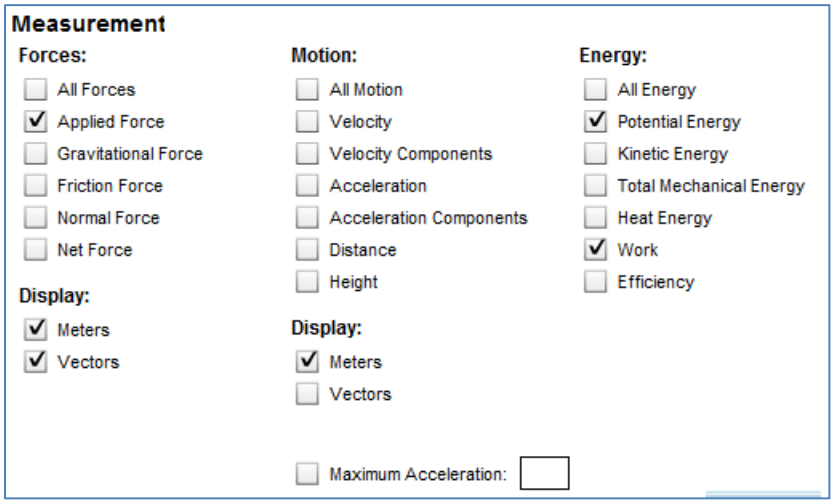


If you’ve made a hill, you can click on the hill and then change the ***Hill Type*** dropdown to change the type of hill. There are three different hill shapes that you can select and explore: gradual, round and steep.

Measurements:

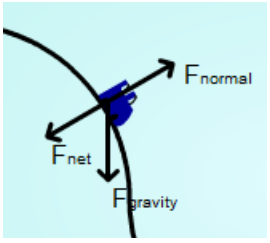


You can measure lots of different physics variables with this simulation, and the values appear as "meters" on the bottom right of the screen. To change what variables are recorded, click the ***Options*** button:



Then you can select which variables to display by checking the checkbox for that variable. (Note: The simulation will only show meters for six variables at a time.)

For some variables (forces, velocity and acceleration), you can also display the values as vectors on the car:

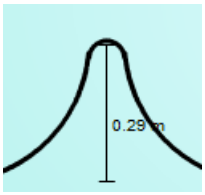


Vectors will show you not only the size of the variable, but its direction as well. To display vectors for a variable, check the ***Vectors*** checkbox for that type of variable (forces or motion).

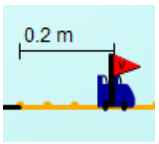
Clicking the ***Options*** button again will hide the options screen.

Additionally, some other values are shown in other places on the screen. The mass of the car appears on the left side of the screen, above the track:

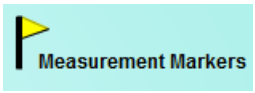
For hills, lifts and drops, the height of the track section (in meters) appears below the track:



When adding braking friction to a flat section of track, the stopping distance of the car will be shown:

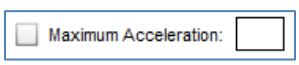


Measurement Markers:

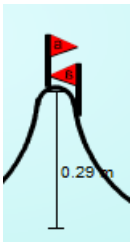


You can add ***Measurement Markers*** to record values at specific places. To use them, drag the little yellow flags from the top-right corner of the simulation onto the track where you want to take a measurement. After running a trial, you can then click on a flag to place the car there to see what the values were at that point during the trial.

Maximum Acceleration Flags:



You can also have the simulation flag places where the car's acceleration is more than a maximum value that you set. (This is on the ***options*** form.) When the car exceeds the maximum acceleration, a red flag will be placed on the track. When the car goes back under the maximum acceleration, another red flag (pointing backwards) will be placed on that point in the track.



To see what is happening between those two points, click on the first red flag. The meters in the "measurement" section will now show you what was happening to the car at this point on the track. You can now use the ***step*** button to step the roller coaster car to the next flag and see what is happening between the two flags. (You will use this feature in the "adding hills" exploration).

Minimum Velocity Flags:

The simulation will automatically warn you when the velocity of the car has reached zero by placing a red flag with a "v" on it where the velocity was zero. In some cases, you might be stopping the car on purpose and you don't mind that the velocity has reached zero. Other times, this means that the car won't make it over the hill and your roller coaster doesn't work. Click on the flag and to place the car there and see what the values were at that point.