

## Experiment M-13

# Pushing and Pulling a Car



### Objectives

- To investigate how pushing a toy can affects its motion.
- To compare different graphs of motion according to the force applied on the car.

### Modules and Sensors

- PANDA-1 Panda Multi-sensor 

### Materials

- A toy car
- String
- Masking tape or rubber band (may be needed depending on the type of car)

### Introduction

When you push a friend on a swing, you are using a force. Pushing moves something in a specific direction away from the pushing object. The harder the push (the more force that is applied), the further the item goes. A pull would be a force that brings the object in closer, rather than farther. An example of a pulling force is if a rope is attached to an object and a person uses that rope to bring the object closer to them.

In this experiment, you will place the Panda on a toy car, then pull and push the car and watch how the acceleration (change in velocity) of the car varies according to the type of motion and the amount of force.





## Procedure

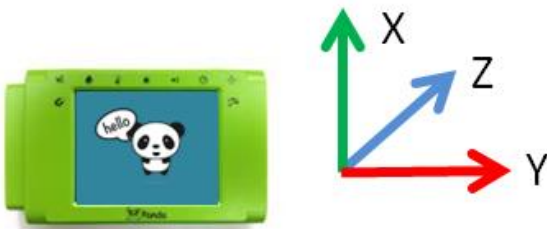
### Experiment setup




1. Place the Panda on the toy car in the best position according to the car. This position will affect the range you will choose in the next step.
2. If needed, tape the Panda to the car with masking tape (it may be best to do that after you program the Panda).




## Settings

3. Press on the **Sound sensor** icon  on the top left of the screen.
4. Use the arrows   to select the **Acceleration sensor**.
5. Press on the **m/s<sup>2</sup>** icon .



6. Change the range to according to the position of the Panda (for the sample experiment, we used the Y axis range). When the sensor is not in motion the reading should be close to zero, if it is around 9-10, it means the range you selected is not right for the Panda's position (for this experiment, the motion is horizontal and the gravity force should not affect the reading).
7. Press on the **Record** icon .
8. Set the duration of 5 seconds using the arrows  .

## Testing and measurements

9. While the Panda is on the cart in the right position, click on the **Record** icon  to start the measurement.
10. Immediately, push the car away from you.
11. Your graph should be similar to the following (the graph can look different between different types of cars and the friction with the floor):



We can see that the acceleration (the change in velocity) was rising when the car was pushed and gained speed. Then the acceleration decreased because we let go of the car and it started to slow down (still moving to the same direction). After that it reached zero again because the car stopped moving.

12. Draw your graph in the table in the next page.
13. Repeat this experiment but change the amount of force applied on the car while you push, for example, pushing harder than before. Draw the graph you got in the table in the next page.

14. Repeat the experiment but now pull the car by using a string. After that, repeat the measurement by pulling with a different amount of force. Draw your graphs in the table below.

	Push	Pull
Hard		
Soft		

- The graph can be below or above the 0. This depends on the direction of motion.

### Summary questions

1. What was the difference in the graphs when you pushed the car harder and softer? Explain.
2. What was the difference in the graphs when you pulled the car harder and softer? Explain.
3. Point out one example of pull and one of push from real life (a different example than what you did in this experiment).