

## **Forces and Motion: Basics Lab Practicum**

### **Gravity and orbits PhET Lab**

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##### **Forces and Motion lab:**

This simulation allows students to experiment with forces in a tug-of-war type simulation and pushing on different objects at different types of friction and force.

There are 2 parts to this lab simulation.

Part 1: Net force is tested with different size people figures that are either red or blue. The students are asked to make observations on their own before going to the step-by-step trials.

The student is asked if the object is being pulled or pushed in another direction, if the net force is creating a balanced or unbalanced situation. Then the student is asked if the cart is accelerating or not.

I have included a picture of the lab and the answers. I had my daughter, an eighth-grade student, complete the lab. I began writing the answers for her but then gave her the paper and let her go. She did great until the word acceleration came up. She looked up the meaning of acceleration and was quick to understand what that meant.

I feel like this lab was great in accomplishing what the students need to know about balanced and unbalanced forces in the eighth grade. Even after teaching the eighth grade multiple times, I find that the students understand the concepts, but when you throw in a term that is not typically used it trips them up a bit. If we said, "I am accelerating my bike to go faster than you." It would make sense, however that is just not how we talk in everyday life.

Part 2: Friction is tested with a 50 kg box and a 200kg refrigerator. I was concerned I was doing something wrong at first because my box did not move, once I got to enough force the box was able to move.

The directions were clearer on this because acceleration is given an explanation (slowing up, slowing down, changing direction). My daughter had left me to return to her hole in the house, and I was left to my own problem solving. As I went through the simulation I began to see that there was a

force that I would get the box to move, 200N or so. I had forgotten about the variable about friction.

When I began at the different size objects and how much force it took for each object to move, I began to really see that the friction force had to be lower than the net force for anything to really begin moving.

Then I was asked to move the friction from the highest setting to the lowest setting with the same size 50kg crate. This took a bit of observation on my part. It was not as much of a clear answer. At the lowest setting I could get the crate to move with just 5 N of force. When I added 40N of force, the box really began to move. However, I noticed that the longer the force was being put on the crate, the higher the speed was going. The speedometer maxed out at 40 m/s. I wanted to see how much force I had to put on the crate to get a stable speed, what I observed that even at 13N the box moved and the speed increased. The speed increased much slower than 40N, but it still eventually was able to make it up to 40m/s.

This lab, I wish I had started out my forces scope with. It covers what the students need to understand and also engages enough to ask questions and have conversations about the net force and friction.

**The following physics standards are addressed in the lab simulation.**

**8.PS2.4** Construct an explanation to describe why the position and motion of object(s) in a system, and the effects of forces on those objects, vary with respect to the observer.

**8.PS2.5** Plan and conduct an investigation to provide evidence that the change in an object's motion depends on the sum of the forces on the object and the mass of the object.

**8.PS2.6** Evaluate and interpret that for every force exerted on an object there is an equal force exerted in the opposite direction.