Purpose:

The goals of this lab are threefold:

I. To verify Newton's 2nd Law, $a = F_{net} / m$. When a constant force is applied to an object, how does an increase in mass affect the object's acceleration?
II. To verify that when the fan is turned by an angle θ° the force along the direction of motion is reduced by cos(θ) since the force component along the direction of motion is reduced.
III. To learn to write a detailed, coherent, sensible, grade-level appropriate scientific lab report.

Procedure:

- *Step 1:* Measure the weight of the fan cart using the force probe and use the weight to determine the cart's mass. Record the value of the cart's mass.
- *Step 2*: The fan can generate two constant forces, designated "LOW" or "HIGH." Choose "HIGH" and measure the force from the fan using the force probe. Be careful that your environment is controlled – for instance, that the fan cart is not on an inclined surface. Record the value of the force produced by the fan. Each fan cart likely produces a different force, so don't switch fan carts halfway through your experiment. Fan carts with fresh batteries typically produce between 0.1 and 0.5 N of force.
- *Step 3:* Place the fan cart on a track **on the ground** and place obstacles (i.e. books) at each end of the track to prevent the fan cart from driving off. Also, please **DO NOT** put anything into the fan like a pencil or your finger. The wooden blades and motors are quite delicate, so treat these carts with care. Set up a range finder at one end of the track to measure the cart's acceleration.
- *Step 4*: Before making any measurements, predict the value for the cart's acceleration using Newton's 2nd Law. Record this predicted value – we will compare the prediction to theory later.
- *Step 5*: Turn the fan cart on the HIGH setting, and use the range finder and Logger Pro software to measure the acceleration of the fan car. Record this value; be sure to save (as a screen shot) and print out any relevant graphs you made on Logger Pro.
- *Step 6*: Increase the mass of the fan cart system by placing known brass weights on the top.
- *Step 7:* Repeat steps 4 – 6 using the new mass. Repeat again with a new mass. The more data points you take here, the better.
- *Step 8:* Calculate the percent difference between your predicted values and your observed values and record them. Remember that the % difference between two numbers (also called the % discrepancy) is the difference between the two numbers divided by their average, expressed as a percentage.
- *Step 9:* Rotate the fan so that it points at a 60° angle away from straight. Measure the force again using the force probe and by verifying a decrease in measured acceleration. Work with other angles as well – the more you have, the more accurate your experiment will be.
- *Step 10*: Write up this set of experiments in a formal lab report. Each student will turn in an individual lab report, even if the data is common among your group members. Read the attached rubric and checklist *very carefully* – we will use it to grade your work. In your lab, limit your discussion to the theory (as presented in class) and the experiments based only on your results. Be sure to discuss whether your results did or did not verify Newton's 2nd law and use concepts from our unit (i.e. inertia, net force) in your discussion. Also, discuss whether your results did or did not verify the idea that the net force decreases when the fan is rotated. Read carefully the admonition in the rubric that experimental error *not* be treated as an afterthought. You must know the accuracy of your experiment very well if you are going to comment on the discrepancy between theory & experiment.