Objective:

Find the relationship between the mass of the cart and the acceleration of the cart.

Hypothesis:

The relationship between the cart's mass and its acceleration will be linear. The slope of the graph of mass vs. acceleration will equal the total force (in Newtons) of the fan.

Procedure/Strategy

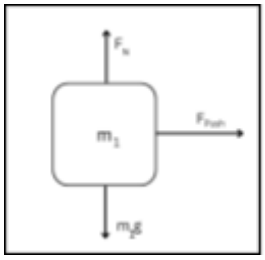
1. **Setup:**
   - Place the fan securely onto the cart on the track.
   - Make sure the track is on a level surface.
   - Put the track on one end
2. **Baseline**
   - Measure the mass of the cart and the weights
   - Turn the fan in the direction of the track
   - Turn on the fan to level 4
   - Record and measure the acceleration without added mass
   - Find the force of the fan by connecting the cart to the force sensor
3. **Data Collection:**
   - Repeat the above process, but increase the mass of the cart by 126g (1 block) every time
   - Record all data in the table

Data

Starting Cart mass (with fan): 433.5g
Force of the fan: 0.243N

	Total Mass (g)	Acceleration Trial 1	Acceleration Trial 2	Acceleration Trial 3	Average Acceleration
No Added Mass	433.5	0.526	0.536	0.537	0.533
+126g	559.5	0.409	0.392	0.408	0.403
+251.7g	685.2	0.326	0.320	0.320	0.322
+377.5g	811	0.273	0.261	0.259	0.264
+504g	937.55	0.219	0.22 5	0.228	0.224

Analysis



The free body diagram in Figure 1 show the forces affecting the cart in our experiment.

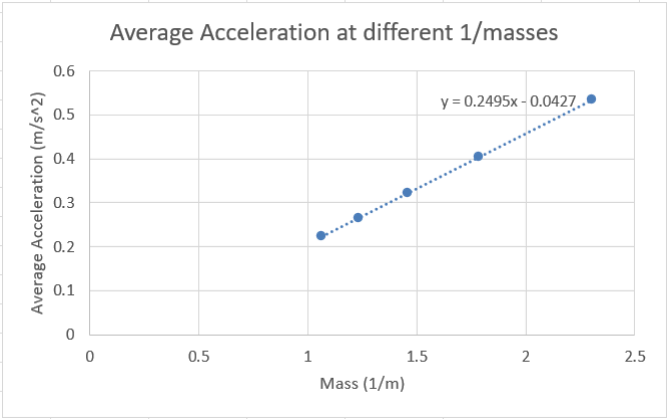
Figure 1: Free Body Diagrams

This equation to calculate the total force is based on the free-body diagram. Positive motion is to the right:

$$F_{Fan} = m_1 a \mid a = F_{Fan}/m_1 \mid a = (F_{Fan})\ (1/m_1)$$

These equations indicate that the relationship between the acceleration and mass will be inversely proportional. Since F is constant, if we graph acceleration as the Y and 1/m as the X then the slope of the line should be F, which is the Newtons of the fan.

A graph of acceleration and 1/mass does show that the slope of the graph is ~0.25 (meters * mass/s^2). This is equal to 0.25 Newtons, which is close to the force of the fan measured at level 4.



Note that grams are converted to kilograms for the mass because Newtons are measured with relation to kilograms.

The actual force of the fan was 0.243N, which means the force found from the graph is 2.8% larger than expected. The fact that it is too large indicates that the measured acceleration could have been too high. This could be due to a non-level surface because if the surface was facing downwards then gravity would become another force adding acceleration. Another reason could be a fan that doesn't have constant acceleration. An inconsistent fan could lead to scattered data, slightly altering the slope. According to our experiment, the higher the mass, the lower the acceleration, and the lower the mass, the higher the acceleration.