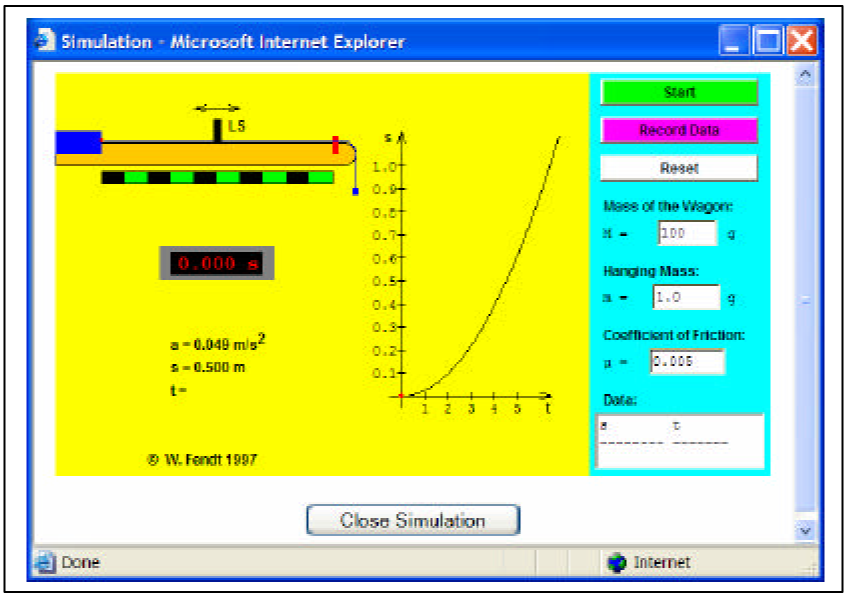
Newton's 2nd Law: Mass on Table System

A "Virtual" Exercise

- Go to the site http://webphysics.ph.msstate.edu/jc/library/4-7a/index.html .
- Click on "Start Simulation."
- You will open a window identical to the one shown below.
- Run the simulation while adjusting the mass of the wagon and the hanging mass in order to examine Newton's Second Law.



- According to Newton's 2nd Law, the acceleration of an object is inversely proportional to its total mass and directly proportional to the net force acting on it.

Part I:

For the first trials, you will keep a constant total mass of 200 g.
By "moving" mass from the wagon to the hanger, you will vary the net force.

1. Run the simulation using the masses shown in the data table and setting the friction coefficient to zero.
2. Record the acceleration shown in the simulation. How would you calculate these values if they were not given to you in the simulation?

3. Calculate the weight of the hanging mass. (Use g = 9.8 m/s/s when calculating this weight.)

4. Since there is “no friction,” the net force is equal to the weight of the hanging mass.
5. Make a graph of **Acceleration vs Net Force when Total Mass is Constant**.
6. Does the shape of your graph confirm the relationship between acceleration and net force that Newton’s 2nd Law predicts?

Experimental Results: Constant Mass

Mass, kg		Total Mass, kg	Net Force, N (Weight of the Hanging Mass)	Acceleration, m/s/s
Wagon	Hanging			
0.199	0.001	0.200		
0.175	0.025	0.200		
0.150	0.050	0.200		
0.125	0.075	0.200		
0.100	0.100	0.200		
0.075	0.125	0.200		
0.050	0.150	0.200		
0.025	0.175	0.200		
0.001	0.199	0.200		

Part II:

For these next trials, you will keep a constant net force of 0.49 N (by keeping a constant mass of 50 g on the hanger). By “adding” mass only to the wagon, you can maintain this same net force while varying the total mass.

1. Run the simulation using the masses shown in the data table, again setting the friction coefficient to zero.
2. Record the acceleration shown in the simulation. How would you calculate these values if they were not given to you in the simulation?
3. Calculate the weight of the hanging mass. (Use g = 9.8 m/s/s when calculating this weight.)
4. Since there is “no friction,” the net force is the weight of the hanging mass.
5. Make a graph of **Acceleration vs Total Mass when the Net Force is Constant**.
6. Does the shape of your graph confirm the relationship between acceleration and net force that Newton’s 2nd Law predicts?

Experimental Results: Constant Net Force

Mass, kg		Total Mass, kg	Net Force, N (Weight of the Hanging Mass)	Acceleration, m/s/s
Wagon	Hanging			
0.010	0.050			
0.030	0.050			
0.070	0.050			
0.100	0.050			
0.150	0.050			
0.250	0.050			
0.350	0.050			
0.500	0.050			
0.650	0.050			
0.800	0.050			
0.900	0.050			

Questions:

1. How would you calculate the acceleration of the system if friction were present?

2. Suppose there is no friction. In order for the wagon on the table to move, the weight hanging over the side of the table must be at least…

3. Suppose friction is present. In order for the wagon on the table to move, the weight hanging over the side of the table must be at least….

4. Is it possible to obtain an acceleration equal to the gravitational acceleration if friction is not present? Why or why not?