Force Inquiry Lab

These activities will be discussed in depth in the following weeks. This is an opportunity for you to get experience with each situation and commit to your opinions. Answer each of the following questions using your experience and your group discussions. If you disagree with the group on any point, make sure that you write down your own ideas as well as the group's. **Do not erase anything unless it is a mathematical mistake**.

Free Body Diagrams (FBDs)- *These consist of only the object in question and the forces that act* ***on*** *that object. Forces are vectors so you need to indicate the direction by using arrowheads. There are very specific naming rules which we will discuss later.*

Station 1: Scales on Scales

Stand on each of the scales and read the numbers the scales give you.

a. What type of reading is the larger number?

b. What type of reading is the smaller number?

c. What is the physical meaning of the larger number?

d. What is the physical meaning of the smaller number?

e. What is wrong with measuring each of the quantities with the same device?

f. Describe one way you could demonstrate the difference in the readings.

Station 2: Shaken

Hold a 100 g mass in your hand. Move it quickly side to side. Now do the same for the 1000 g mass.

a. What differences did you notice when you shook each of the masses?

b. Draw a free body diagrams for each of the masses during the shaking.

c. Are the differences that you noted in part a caused by the difference in the weight of the objects? Explain your reasoning.

d. Now repeat the exercise vertically instead of horizontally. Are the differences that you notice related to weight in this case? Explain your reasoning.

e. Which is easier to stop, a bowling ball or a soccer ball, each traveling at the same speed? Explain your reasoning.

Station 3: Ball on Track

Look at the ball as it sits on the track.

a. Draw a free body diagram for the ball.

b. Now roll the ball along the level track. Bring it to a stop at the other end. Draw a free body diagram for the ball:

i. as the ball is being sped up.

ii. as the ball rolls along the track.

iii. as the ball is being brought the a rest.

i. ii. iii.

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c. Now roll the ball in the opposite direction. Identify the forces in the same positions as above.

iii. ii. i.

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d. What can you tell about an object's motion from a free body diagram?

Station 4: Fan Cart

******Caution: When operating the fan cart, take care to not get your fingers around the blade. Make sure that the fan cart is securely attached to the dynamics cart before turning on the fan.******

Use the stopwatch and meter sticks to measure the acceleration of the cart for the combinations listed below. Start the cart(s) from rest.

Fan Cart +	Time (s)	Distance _____	Acceleration _____
One Cart			
Two Carts			
Three Carts			
Four Carts			

a. Draw a free body diagram for the system of carts that are being accelerated (include the fan cart).

b. What happens to the force of the air on the system as you add mass to the system?

c. What happens to the acceleration of the system as you add mass?

d. What would happen to the accelerations if you used the high speed instead of the low?

Station 5: Tug-O-War

You will be using force probes that have a maximum reading of 50 N. Gradually increase your pull and be careful not to exceed the 50 N limit.

I. Have two group members stand stationary and gently pull in opposite directions on the force probes.

a. What is the meaning of the reading from each of the probes?

b. Have one of the members try to pull harder than the other while staying at rest. Describe your results.

c. Draw a free body diagram of each person.

II. We are going to simulate winning at Tug-o-War. One person (Winner) will move backward while pulling and the other person (Loser) will move forward while pulling back. Be careful to not exceed the 50 N reading on either scale.

a. Draw a free body diagram for the winner.

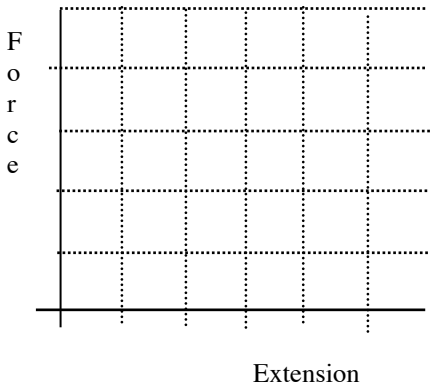
b. Draw a free body diagram for the loser.

c. Which person is pulling with the greater force?

Station 6: Springs

Hang the masses from the spring and measure the amount the spring extends. Fill in the chart below, then graph the results.

Mass (g)	Weight (N)	Extension(__)
20	0.20	
40	0.40	
60	0.60	
80	0.80	
100	1.0	



a. Draw a free body diagram for the hanging mass.

b. What does your graph tell you about the relationship between the force applied by a spring and the distance it is extended? Explain your reasoning.

c. How far would the spring have to be extended to provide a force of 0.50 N? Explain how you found your answer.

Station 7: Dropping Mass

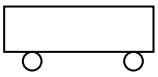
Attach a hanging mass to the string that is attached to the cart. Make sure that the string remains parallel to the track as you hang the mass over the pulley. Before you allow the system to move, check that the hanging mass will land on the padding provided.

a. Record the mass of the cart and the mass that is hanging from the string.

b. Use the photogate and picket fence to determine the acceleration of the cart. (Make sure that the gap spacing constant in the program corresponds to the band you are using.)

c. How does the acceleration of the cart compare to the acceleration of the hanging mass?

d. Draw a free body diagram for the cart.



e. Draw a free body diagram for the hanging mass.

f. For each pair of forces, identify which is the larger force:

i. Force of rope on cart, Force of rope on hanging mass

ii. Force of gravity on hanging mass, Force of rope on hanging mass

iii. Force of rope on cart, Force of gravity on the hanging mass

g. Explain briefly why each of the objects in the system accelerates.