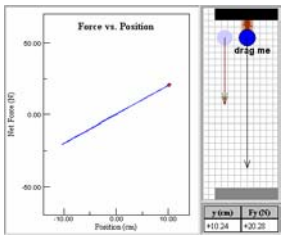
Worksheet for Exploration 5.3: Spring Force



The spring-ball system shown in the animation can be stretched by click-dragging the dark blue ball **(position is given in meters and time is given in seconds)**. The black arrow attached to the ball shows the net, i.e., total, force on the ball. The pale blue ball on the left is the *free-body diagram* for the dark blue ball. The red and green arrows attached to the pale blue ball show the spring and gravitational forces, respectively. The acceleration due to gravity is 9.8 m/s^2 in this animation. Restart.

a. Find the mechanical equilibrium for this system when the spring constant is 1.0 N/m, 2.0 N/m, 3.0 N/m, and 4.0 N/m.

i. To do this set the appropriate spring constant, hit the "set values and play" button, and then drag the object to the appropriate position.

Equilibrium Position (k=1.0N/m)=_____

Equilibrium Position (k=2.0N/m)= _____

Equilibrium Position (k=3.0N/m)=_____

Equilibrium Position (k=4.0N/m)= _____

ii. At the equilibrium position for one of the conditions above sketch the free body diagram. Use appropriate labels for the magnitude of each force (F_g and F_{sp}). To the side of your diagram indicate what the net force and acceleration are.

b. Use your equilibrium measurements to find the mass of the ball. Hint: What forces act on the ball?

i. Predict where center of the blue ball should be located to have the spring at rest length.

ii. Measure and confirm your prediction using the animation. Describe how to do this.

c. Use your equilibrium measurements to find the natural length of the spring, that is, the length of the spring without an attached mass.

i. Is the net force on the ball constant?

ii. Is the spring force on the ball constant?

iii. Is the gravitational force on the ball constant?

iv. Where is the MAGNITUDE of each force the largest and smallest, and what is the magnitude of the force at each location?

	Position(s) max	Magnitude of Force max	Position(s) min	Magnitude of Force min
$\|F_g\|$				
$\|F_{sp}\|$				
$\|F_{net}\|$				

v. What are the locations where the ball is moving fastest? Slowest?