## **Force and Acceleration**

## Mission 1: Reaching and maintaining a constant speed.

In this mission, you will start with the block being at rest. Then, by applying forces to it with the joystick, try to get its speed to increase to 2 m/s and then stay at a constant value of 2 m/s afterwards.

a. First, predict how you would need to apply force to accomplish this mission. In particular, think about how the force might change with time, and how the presence or absence of friction might alter your answer.

b. Set the frictional coefficient to 0.5 and try to accomplish the mission. Once you have succeeded, write down how you did it.

c. Describe how you think the force will have to change if the frictional coefficient is set to 0.3 or 0.1. Then, try both new values for the coefficient and describe what you discover.

d. Set the frictional coefficient to be 0 (this represent frictionless motion). Predict how you would apply the force in this situation.

e. Now try it, and write down the succesful method. Compare your results to the situations in which there was friction.

## Mission 2: Applying and maintaining a constant force.

This time the goal is to apply a force which is constant in strength and direction. You will be asked to make observations about the motion of the block when it feels this constant force.

- a. Set the frictional coefficient to be 0, and the initial speed to 0. Apply a small, constant force (3-4 Newtons) and write down what you observe.
- b. Stop the block, set the frictional coefficient to be 0.1, and apply the same small force as before. Compare the block's motion with the motion from part a. Does it reach the same velocity? What is different?
- c. Set the frictional coefficient to be 1.0 and apply the same small force as before. Compare the block's motion with part a and part c.
- d. Bring the block to rest a few meters away from one end of the course and change the frictional coefficient back to 0.1. Apply a small force toward the end of the course and keep applying it, even when the block bounces back against it. Do this several times to make careful observations. Describe and explain what is happening. Does this sort of motion remind you of anything? (Try looking at it from different angles...)

Mission 3: Graphs which depict motion.

a. Here is a graph showing the amount of force applied to an object over a period of time. There is no friction. Try to sketch what a graph of the object's velocity might look like, and explain your reasoning.



b. Restart the simulation with the block at rest and the friction set to zero. Apply force to the block as in the graph given above and sketch the velocity graph that results. How does it compare to your prediction? If there are differences, try to explain why they are there.



c. Here is a graph showing the velocity of an object over a period of time. Try to sketch what a graph of the force applied to it might look like, and explain your reasoning.



d. Using the simulation, try to reproduce the velocity graph given above. When you have done so, explain how you applied the force in words and with a graph.

