Guiding Questions Activity 3

- **What is momentum?**

Purpose: To define momentum as a function of the mass and velocity of an object

Materials: Grooved ramp measuring 60 cm long, 30 cm wide, and rising 5 cm off the floor at the high end.
3 steel bearings of various weights, 1 small, 1 medium, 1 large (I use a 0.5 kg, a 0.2 kg, and a 14.17 gram steel bearing) Various sized marbles may also be used but it is important that they vary widely in size.
1 block of wood measuring about 2 cm thick, 9 cm wide, and 15 cm long
balance beam scale
stopwatch

Formula Used: Momentum=Mass X Velocity

Note: Momentum depends upon the mass of the object and the velocity with which it is traveling. All moving objects have momentum. The more momentum an object has the harder it is to stop. If either the object's mass or velocity is large then the object will have more momentum. Generally mass is measured in kilograms and velocity in m/sec (meters per second) so the unit for momentum is kg-m/sec (kilogram-meters/sec). Momentum is the same direction as the velocity.

Procedure:

1. **Begin by weighing each bearing on a balance beam scale. Record the weight of each bearing.**
   Bearing A._____
   Bearing B. _____
   Bearing C. _____
   Remember to use proper units when recording the weight of each bearing.
2. **Set up the ramp by placing a book under one end of the ramp to raise it off the floor about 5 cm.**

3. **Place a bearing at the top of the ramp. Use a ruler to hold the bearing in position. Raise the ruler allowing the bearing to proceed down the ramp.**
4 **Using a stopwatch begin timing the bearing once it hits the floor. Stop at one minute, mark, measure, and record the distance traveled in the data table during that minute.**
5. **Repeat steps 3 and 4 but change the time to 2 seconds and then to 3 seconds. Each time mark, measure, and record the distance traveled in the data table.**
6. **Repeat steps 3 and 4 for the second bearing and then the third bearing.**

Bearing	Time (sec)	1	2	3
	Distance			

7. **Copy the above data table on a separate sheet of paper. One table for each bearing. Fill in the data for each bearing.**
8. **Calculate the average velocity for each.**

Question:

1. **What is the average velocity of**
   Bearing A _____
   Bearing B_____
   Bearing C_____

2. **Using the formula for momentum, calculate the momentum of each bearing. Watch your units!**

   Bearing A. _____
   Bearing B. _____
   Bearing C. _____

INVESTIGATING THE EFFECT OF MOMENTUM

Purpose: To show the relationship between mass and velocity in determining momentum and the effect of that momentum on other objects.

Note: The total momentum of any group of objects remains the same unless outside forces act on the objects. Momentum is always conserved. One object may lose momentum but that momentum is gained by another object.

Procedure:

1. **Set up ramp as in earlier experiment.**
2. **Place wood block at the base of the ramp.**
3. **Place bearing A at the top of the ramp.**
4. **Release bearing A. Measure the distance the block is moved by bearing A. Record that distance in the data table.**
5. **Repeat steps 3 and 4 for bearing B and C. Remember to record the data in the data table.**

Bearing	Distance Block was moved

Conclusion: Explain how the mass and velocity affect the momentum of an object. What happened to the momentum of

the bearings after encountering the wood block? What was true of the momentum of the wood block after being struck by the bearing?