**Objective**: In this activity you will observe the conservation of momentum in a closed system.

Follow the directions below carefully and answer the accompanying questions. You may ask your group members for help; HOWEVER, every student in a group must collect their own data. Also, SHOW YOUR WORK!

1. On PhET’s “My Solar System Simulation, set the initial settings to the following:



1. Click the green “Start” button on the top right corner of the screen. What do you see?
2. Click the red “Stop” button. When you hover your mouse pointer either sphere, you should see data pop-up at the bottom right hand corner of the screen. (See figure 2 for an example.) Copy the mass and velocity of both spheres in *Table Initial* below.

Figure 2



mass=100

vx=$v\_{x}$=4.3

vy=$v\_{y}$=-7.5

velocity=$\vec{v}$=(4.3,-7.5,0)

|  |
| --- |
| *Table Initial* |
| Body 1 | Body 2 |
| Body 1 mass=$m\_{1}$ |  | Body 2 mass=$m\_{2}$ |  |
| Body 1 x-velocity=$v\_{x,1}$ |  | Body 2 x-velocity=$v\_{x,2}$ |  |
| Body 1 y-velocity=$v\_{y,1}$ |  | Body 2 y-velocity=$v\_{y,2}$ |  |
| Body 1 velocity=$\vec{v}\_{y,1}$ |  | Body 2 velocity=$\vec{v}\_{y,2}$ |  |

1. The total momentum of a system is the sum of the momenta of the system’s *N* number of particles.

$$\vec{p}\_{Total}=\vec{p}\_{1}+\vec{p}\_{2}+...+\vec{p}\_{N}$$

(Remember, we use the following equation to calculate the momentum: $\vec{p}=m\vec{v}$.)

In the case of our little solar system, the total momentum is equal to

$$\vec{p}\_{Total}=\vec{p}\_{Body 1}+\vec{p}\_{Body 2}$$

For example, the total momentum of the system partially depicted in figure 2 is

$$\vec{p}\_{Total}=100\left(4.3, -7.5, 0\right)+ \vec{p}\_{Body 2}=\left(430, -750, 0\right)+ \vec{p}\_{Body 2}$$

**Calculate the total momentum of the system with the data you recorded in *Table Initial*.**

1. Click the “Start” button again. Run the program for a couple of seconds and then click the stop button. Hover your mouse clicker over the bodies and collect the same set of data. A table is provided.

|  |
| --- |
| *Table Final* |
| Body 1 | Body 2 |
| Body 1 mass=$m\_{1}$ |  | Body 2 mass=$m\_{2}$ |  |
| Body 1 x-velocity=$v\_{x,1}$ |  | Body 2 x-velocity=$v\_{x,2}$ |  |
| Body 1 y-velocity=$v\_{y,1}$ |  | Body 2 y-velocity=$v\_{y,2}$ |  |
| Body 1 velocity=$\vec{v}\_{y,1}$ |  | Body 2 velocity=$\vec{v}\_{y,2}$ |  |

1. **Calculate the total momentum of the system with the data you collected in *Table Final*.**
2. In the table below, write down the *initial total momentum* you calculated in step 4 and the *final momentum* you calculated in step 5. Also, write down the values your group members calculated.

|  |  |  |
| --- | --- | --- |
|  | Initial Momentum | Final Momentum |
| Your recordings |  |  |
| Group Member \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |
| Group Member \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |
| Group Member \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |
| Group Member \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |  |  |

1. Are any of the planets in your solar system simulation influenced by external interactions?
2. According to your answer for number 8, should the total momentum of the solar system simulation remain constant?