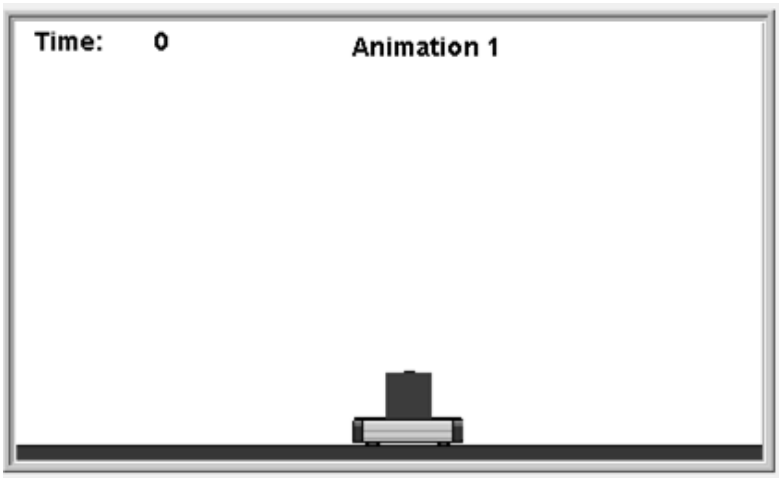
On first glance it may seem like Newton's first law (an object at rest remains at rest and an object in motion remains in motion unless acted on by a net force) is contained within Newton's second law. This is actually not the case. The first law is also a statement regarding reference frames. This is the information NOT contained in the second law. Sometimes the first law is also called the law of inertia. It defines a certain set of reference frames in which the first law holds, and these reference frames are therefore called inertial frames of reference.

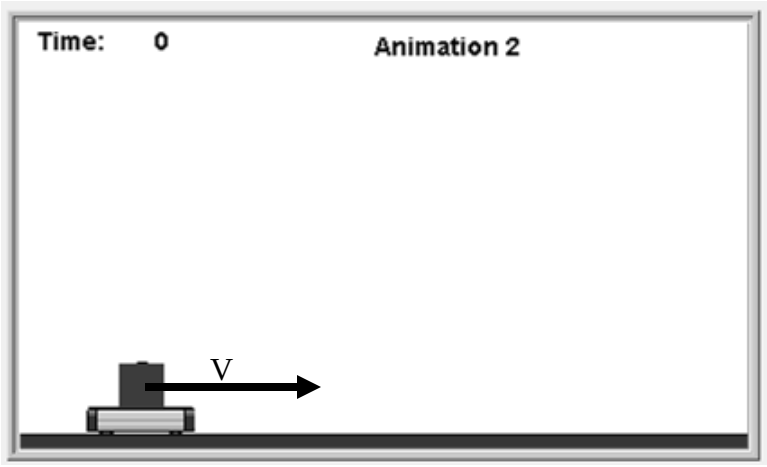
A ball popper on a cart **(position is given in meters and time is given in seconds)**. In each animation the ball is ejected straight up by the popper mechanism at t = 1 s.



In this animation the cart is stationary. But is it really? We know that we cannot tell if we are stationary or moving at a constant velocity (in other words in an inertial reference frame).

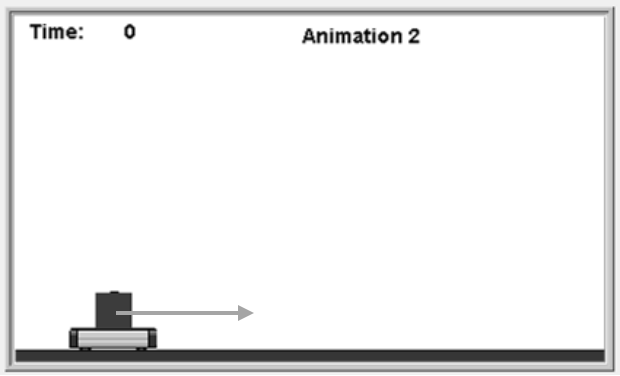
---------- Demonstration----------

In this demonstration we will shift our frame of reference so that the cart will be observed moving to the right at a constant velocity.



---------- Predictions ----------

Draw what you think the path of the ball will be during this demonstration.



Where will the ball land? Why?

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_____

_____

_____

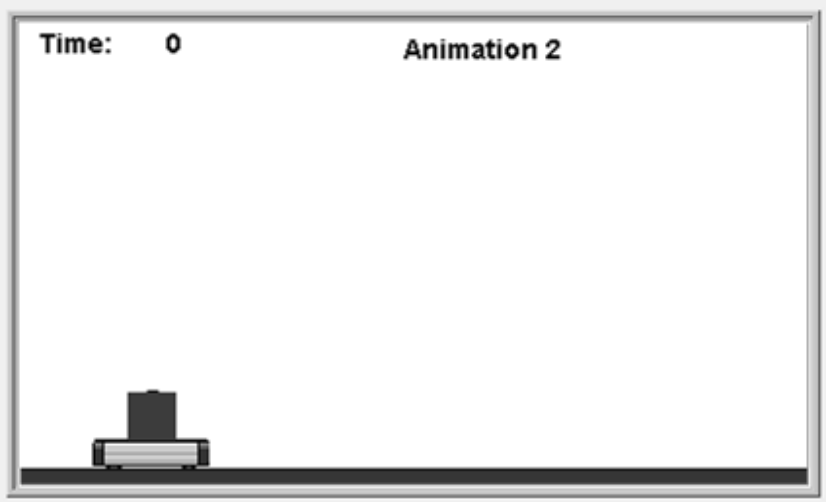
---------- Partner Discussion----------

---------- Class Discussion ----------

---------- Physics Speaks ----------

---------- Results ----------

Draw the path of the ball will be during this demonstration.



Where did the ball land? Why?

What was the change in the ball's motion horizontally? What caused this change?

What was the change in the ball's motion vertically? What caused this change?

---------- Extend ----------

Watch the demonstration up front and predict what is going to happen.