

### **Solution to the reference frame dilemma in the Mythbusters video**

From the perspective of the truck (i.e., the truck as the reference frame) the ball accelerates backward due to the force from the cannon. If you were a rider on the truck, you would say that the ball was stationary with you in the truck, and then it accelerated away from you. This makes the point of view of the truck an inertial reference frame. The horizontal force caused the ball to accelerate horizontally, changing the ball's velocity relative to the truck. Vertically, from the point of view of the truck, gravitational force also causes acceleration, as the ball will appear to you to accelerate downward, so both vertically and horizontally the truck reference frame is inertial.

From the perspective of a bystander on the ground the reference frame is also inertial vertically and horizontally. Vertically the force of gravity causes the ball to accelerate downward, as it does from the truck's reference frame, so vertically the bystander's point of view is an inertial reference frame. Horizontally the force from the cannon on the truck causes the ball to accelerate by changing its forward motion. The ball was initially moving at a steady pace to the side. Then it stopped moving horizontally. The force from the cannon caused this change in velocity (acceleration), so the horizontal reference frame is also inertial.

Even though the description of the ball's motion varies depending on the reference frame, we see the effects of the forces acting on the ball regardless of our perspective. Therefore both reference frames are inertial. Can you think of any way we could view this interaction as non-inertial? We will investigate such a question as we begin to look at internal forces acting within systems.

*Bonus concept: Notice that in this case it might make sense to call the left direction positive from the bystander on the ground's point of view, since that is the forward direction of the truck. Additionally a person on the truck could call the direction of ball's motion positive, because that is the direction the cannon is pointing. The person on the truck might also call the motion of the ball negative because it is backward relative to the direction the truck is moving. The choice belongs to the scientist. 😊*