

We have seen some indications that maybe the direction of the net force on an object matches the direction of the velocity of the object, and we have seen some indications that maybe the direction of the net force matches the direction of the change in velocity of the object. Let's explore to see if one of these ideas is better supported by evidence.

Using folded note cards, two people in your group will push in opposite directions against a pool ball. Notice that the harder you push, the more bent the note card is. We can use this as a rough way to observe relative amounts of forces—if one card is more bent than the other, then that card must be pushing harder than the other.

Please draw one interaction diagram that shows all six scenarios.

Description	Motion Map	Direction of Velocity	Change in Velocity (0, $\rightarrow$, or $\leftarrow$)	Force Diagram	Direction of Net Force (0, $\rightarrow$, or $\leftarrow$)
A and B both push but pool ball does not move		0			
A pushes a bit harder than B as the ball rolls toward B		$\rightarrow$			
A pushes a bit harder than B as the ball rolls toward A		$\leftarrow$			
A and B both push while ball is rolling toward B at a steady speed		$\rightarrow$			
B pushes a bit harder than A as the ball rolls toward A		$\leftarrow$			
B pushes a bit harder than A as the ball rolls toward B		$\rightarrow$			

Two students, Andre and Barbara, are discussing their ideas. Andre thinks that the direction of net force determines the direction of the velocity of a moving thing. Barbara thinks that the direction of net force determines how the velocity changes.

1. Are there any circumstances where Andre's idea matches your observations? If so, what do they all have in common?

2. Are there any circumstances where Andre's idea does not match your observations? If so, what do they all have in common?

3. Are there any circumstances where Barbara's idea matches your observations? If so, what do they all have in common?

4. Are there any circumstances where Barbara's idea does not match your observations? If so, what do they all have in common?

5. Both of these ideas have circumstances where they appear to be valid. Are these ideas equally valid, or is one ("force determines velocity" *versus* "force determines change in velocity") better than the other? Why would you say so, based on the above results?