

# Physics of Sports

## Lesson 3: Kinematic Variables Teacher's Guide

### Connections:

Previous Lesson	Current Lesson	Next Lesson
Quality Assurance and Physics	Kinematic Variables	Energy measurements

Objectives:	<ul style="list-style-type: none"> <li>To use simple measurement devices to measure or estimate physical quantities known as kinematic variables.</li> <li>To compare them to the real speeds in an actual sport and compare values.</li> </ul>
Resources required:	<ul style="list-style-type: none"> <li>A table-tennis ball and table or a writing desk</li> <li>A ruler</li> <li>A pencil or marker</li> <li>Student's Worksheet Lesson 3</li> </ul>
Useful data:	<ul style="list-style-type: none"> <li>Rotational speed of the ball, <math>v = 1.0</math> m/s (average),</li> <li>Linear speed of the ball <math>v = 12</math> m/s (linear, at tracking limit or the maximum speed at which you can still see it moving)</li> </ul>
Video(s):	Start by showing a short video clip where the game is played at a high speed: <a href="https://www.youtube.com/watch?v=46OahVA7GNc">https://www.youtube.com/watch?v=46OahVA7GNc</a>
Physics Review:	Five equations describe the five parameters in one-dimensional motion of objects: $x = \bar{v}t$ $x = vt$ or $\bar{v} = x / t$
Discussion Questions	<p>The activity starts with some questions:</p> <ol style="list-style-type: none"> <li>Do you have any idea of the speed of the ball in a real ping-pong game (12 m/s)?</li> <li>The video shows the ball moving from one place to another. What kind of motion does this represent? (linear) Do you think that the ball is moving in any other way? (rotational motion). How can you tell? Does it matter?</li> <li>In 2001 the ITTF regulations were changed to increase the ball diameter from 38 mm to 40 mm. How might this relatively small change have impacted the game? Think from the point of view of player and observer. [Slower game for players, easier for spectators to watch the ball!]</li> </ol> <p>Extension:</p> <ol style="list-style-type: none"> <li>Notice that it takes less than a second to the ball to go from one side of the table to the other. That is also the time the other player has to 'see' the ball, judge its future path, rotation direction, and to decide how best to play. What allows players to make these choices so quickly?</li> <li>Estimate the percentage change in the cross-sectional area of the ball which faces air resistance while going from 38mm to 40 mm in diameter.</li> </ol>
Fun fact	Ping-pong balls have been used to salvage sunken boats (with some success)! See: <a href="https://www.youtube.com/watch?v=IKKu0DA5lvM">https://www.youtube.com/watch?v=IKKu0DA5lvM</a>