

The physics of the 3-point shot

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He may not see very many basketball players in his classroom, but Creighton University physics professor Gintaras Duda, Ph.D., says they are instinctual physicists because of what it takes to make the perfect shot on the court, particularly the 3-pointer.

What makes the perfect 3-pointer? Well, there is the angle the player takes on the 3-point line and the arc of the ball, which is the path the basketball flies from the time it leaves the shooter's hand until it arrives at the basket.

According to Duda and the research he has read, the lowest arc is 33 degrees for even a hope of making a 3-point shot, but with an arc of 45 degrees, a speed of just under 20 miles per hour and two revolutions per second of spin, at 20.9 feet from the basket, the player has the makings of the perfect 3-point shot.

While some people say gravity is the only thing affecting the ball once it is in the air, Duda is not so sure.

In the book *The Physics of Basketball*, the author, John Fantanella, explains the Magnus effect, the backspin which gives the ball a little bit of lift allowing for the slowest possible speed and a less

violent rebound if it hits the backboard or rim and may even allow the ball to go in the net.

"I've heard about it in baseball, you know the curve ball that pitchers throw to curve one way or the other over the plate, but I really didn't realize how important it is in basketball," said Duda. "On certain shots, like the free throw and the 3-pointer, you want a slower speed on the ball for that soft shot that has a better chance of landing in the basket than a faster ball with no spin."

In other words, avoiding the brick, that shot with the distinctive sound that lets you know the ball is not going in at all. It takes practice for the player to find that perfect shot. After all, consistency equals reliability, but by finding that perfect shot, the player has found the right speed, the right angle of approach, and the perfect arc of the [ball](#).

Creighton All-American Doug McDermott has that consistency. McDermott, who ranks among the top college scorers of all time, shot 45 percent from behind the arc. Teammate Ethan Wragge is the team's leading 3-point shooter, hitting 47.3 from 3-point.

Duda, the 2013 U.S. Professor of the Year, said he will be watching March Madness with renewed interest and understanding this weekend, and he's hoping the Bluejays get an A in physics for netting 3-point shots.

Provided by Creighton University

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