



Curiosity Guide #507

Soccer Science

Accompanies Curious Crew, Season 5, Episode 7 (#507)

Zigzagging Balls

Investigation #2

Description

How do you kick a knuckleball? Science can help!

Materials

- Steel balls
- Round plastic beads
- Marbles of assorted weights
- Aquarium tank
- Water
- Glass olive jar, one with a narrow neck
- Fish net

Procedure

- 1) Place the glass jar in the center of the bottom of the tank.
- 2) Fill the tank with water.
- 3) Hold one of the balls over the glass jar above the water. Drop the ball in.
- 4) Did the ball go into the glass jar?
- 5) What did you notice?
- 6) Try the same thing with an assortment of steel balls, plastic beads, and marbles of various weights.
- 7) How do the different balls behave in the water?

My Results

Explanation

Did you notice that the lighter balls zigzag more when moving through the fluid water? This is especially true when there is little or no spin on the balls. The lighter balls experience more deflection because they are not moving with as much velocity as the heavier steel balls, but even heavier balls will experience some deflection.

Something similar happens in soccer when the kicker kicks a knuckleball. A "knuckleball" in soccer refers to a ball kicked at very low spin, which results in a zigzag trajectory. As the ball moves through the air with hardly any spin, it experiences different amounts of lift and resistance, deflecting the ball in unpredictable ways and making the ball difficult to block. The air flow around the ball goes from a fluid, laminar flow to a turbulent flow. This change in air flow causes the ball to shift one way or the other in a path change that is nearly the diameter of the ball.

To kick a knuckleball: If you kick with your right foot, first set the ball down. Back up four steps. Then take two steps to the left. Run up straight to the ball. Strike the ball just under the ball's center, but not too low, to get an underspin. Try to contact the ball with the top 3 left eyelets of your shoelaces. Slightly lean your upper body over the ball during contact and limit the contact with the ball so there is not much follow-through. With a lot of practice, you can perfect the knuckleball kick.

If you kick with your left foot, after backing up four steps, take two steps to the right. Try to contact the ball with the top 3 left eyelets of your shoelaces.

Investigate further: Soccer is a wonderful sport, but there is also a lot of science involved in the game. Imagine placing a soccer ball down on the grass. Newton's first law of motion says that an object will stay at rest until a force is applied to the object. That force happens when we kick the ball. The ball immediately starts to move. But why doesn't the ball just keep going? First, gravity continues to pull the ball toward the earth. Second, the ball also slows down from all of the friction against the grass or turf. You might have noticed this when playing soccer in tall grass. The ball sure does slow down quickly! So close!

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