



Curiosity Guide #507

Soccer Science

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

Nail Bed

Investigation #1

Description

Which is more likely to pop a balloon? One nail, or 100?

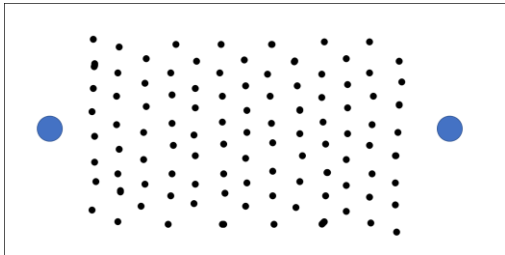
Materials

- Wood boards
- Saw
- Nails
- $\frac{1}{2}$ -inch wood dowels
- Drill
- Drill bits
- 100 nails
- Safety goggles
- Measuring tape
- 9-inch round balloon

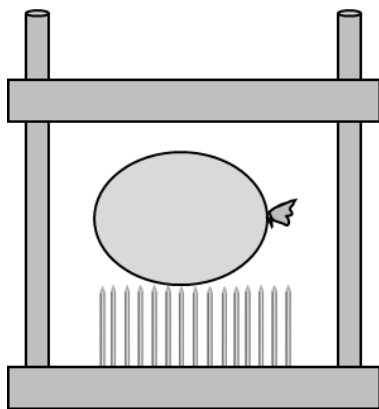
Procedure

- 1) Put on safety goggles.
- 2) Measure and cut two boards, 10 inches by 5 inches.
- 3) Measure and mark the midpoint of each short side. Drill a half-inch hole 1 inch in from the midpoint, on both ends of the board. On one board, drill the holes all the way through, but on the second board, leave a quarter-inch of material.

- 4) Drill 100 holes in the second board, spacing each hole one-half inch apart. Offset each row so that the holes of the second row are centered between the holes of the first. Use a drill bit that matches the shank of the selected nails.
- 5) Repeat the pattern for each row.



- 6) Slide each nail through the base of the second board until the nail heads seat against the board.
- 7) Cut two $\frac{1}{2}$ -inch dowels to 12 inches in length.
- 8) Fit the dowels into the two ends of the second board.
- 9) Blow up and tie the balloon closed.
- 10) Place the balloon on the nail bed and slide the first board over the two dowels.



- 11) Lay your hand on the top and press down onto the balloon.
- 12) What happened?
- 13) How can this connect to soccer?

My Results

Explanation

There is a relationship between surface area and pressure. If the balloon were pressed against a single nail, the balloon would pop without much pressure. However, when many nails are in contact with the surface of the balloon, a lot more pressure is required to get the balloon to pop. In fact, the nails can even protrude into the elastic of the balloon and still not pop it. How does this connect to soccer? If you were to kick a soccer ball with your toe, that is a small surface area contacting the ball, just like the single nail popping the balloon. If you connect with the ball on a larger surface area like the inside of your foot, the total energy is distributed and the contact hurts much less. An inside-of-the-foot kick may not be as forceful as a concentrated strike, but with practice will be much more accurate and far less painful.

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