Which Sports Ball Will Bounce The Highest?

Abstract

Many sports today use different types of balls. Which one would bounce the highest? We decided to figure this out. The bounce of a ball has tons of science behind it. Because of prior knowledge, we hypothesized that the racquetball would bounce the highest from a five foot drop. For our procedure, we set up a camera to record our experiment, and then set up a tape measure on a wall that that the camera could record. Then we set up a stool to drop the sports balls from a five foot drop. We recorded the dropping of each ball three times. After that, we reviewed the footage and found how high each ball bounced. Then we took the average for each ball. That is how we got our results, which showed that a racquetball and lacrosse ball both bounced the highest, at 130 centimeters each. That proved our hypothesis correct, partially. This experiment shows which ball is able to bounce the highest from a five foot drop.

Question

Question: Which sports' ball will bounce the highest from a 1.5 meter drop?

Hypothesis: The racquetball will bounce the highest.

Hypothesis

Background Research

The physics of how high a ball will bounce from a drop is a very interesting topic, yet not covered in much detail. It is a surprisingly complex process, as a ball that bounces without any outside forces will go through seven unique steps. The material of a ball could also determine how high it bounces. Another variable that could affect the bounce of the ball would be inflation. A ball that is less inflated might not bounce as high as a ball that is fully inflated. For our science fair, we decided to study this question: Which sports' ball will bounce the highest from a five foot drop?

When a ball bounces there are seven stages to the bounce (University of Illinois). The first step is called falling. This takes place when the potential energy (the amount of energy that is stored in an object based on its position, height, etc.) in an object turns into kinetic energy (When the potential energy in an object is released) with the force of gravity. The force of gravity on earth (the acceleration of an object taken by the force of gravity) accelerates objects at 9.8 meters per second. The second step is called initial contact. Initial contact when the ball first makes contact with the ground. The third step is when deceleration or negative acceleration occurs, deforming the ball, and pushing the direction acceleration off of the ground.

Continued

The fourth step is called maximum deformation. This is the lowest point on the bounce and the point where the maximum deformation on the ball occurs. The next step is called the initial rebound. This occurs when both velocity and acceleration on the ball, both point upward causing the ball to bounce up. The next step is called zero contact Rebound. This is when the ball is at its last point of ground contact. At this state there is no deformation of the ball. The last stage of a ball's bounce is called the full rebound. This is when the ball has left the ground and is in the air and being decelerated by air resistance and the force of gravity. This is the most simplified model of a bounce, with no external factors affecting the ball. There are also many other factors that could affect these seven stages of a bounce. Some factors include spin, friction and force of throw, the surface that the ball is bouncing on and the material the ball is (University of Illinois). In a bounce, there are two types of energy, potential and kinetic energy. Potential energy is the amount of energy that could be possible, like when a ball is about to be released from a cliff. Kinetic energy is when potential energy is transferred and becomes energy that is in effect, like the ball being released and starting to fall (University of Sydney).

Continued

One major factor that can change the bounce of the ball is the material. One example is ping pong balls because their plastic outside is hard and will not deform, yet they still bounce well. When the ball is made of a hard material which will not deform, it is important for the mass of the ball to be too great, because the extra weight will force down the ball and cause it to break or not bounce well. An example of this is a bowling ball. A ball that is inflated and is made of a material that will deform, like rubber, will bounce with the same success as a ping pong ball. This is because of the inflation of the ball.

Inflation matters when a ball that is made of a material that deforms, like rubber or silicone, because the air inside the ball plays a key role in the rebound of the ball (English). If the ball is inflated properly and to full capacity, the air inside the ball will squish when the material outside deforms. When the pressure of the air inside increases, it pushes back against the material that the ball is made of and pushes the ball back in the direction that it came from, creating a higher bounce (English).

The physics of a ball bouncing are very interesting. Many factors affect the bounce of a ball, like throw speed, spin, and friction of the surface that it bounces on. We learned a lot about bounce, kinetic and potential energy. Our hypothesis is that a racquetball will bounce the highest.

Materials and Procedure

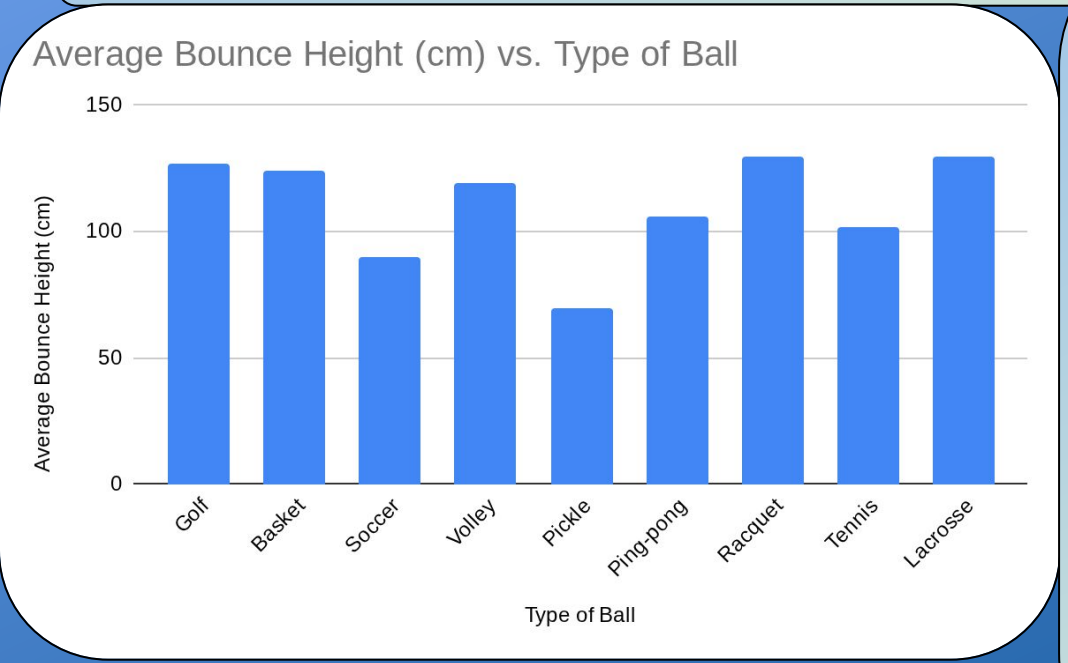
- 1 racquetball
- 1 basketball
- 1 soccer ball
- 1 tape measure that extends to at least 1.5 meters.
- 1 tennis ball
- 1 stool
- 1 wall
- 1 camera/slo-mo-video-recorder
- 1 Roll of Duct tape

1. Find 1.5 meters on the tape measure and lock the tape measure in that spot.
2. Lay the tape measure vertically against the wall and tape the tape measure at its highest point, with the heavier part at the bottom and the extended part at the top.
3. Set up the stool on the ground near the tape measure.
4. Set up the slo-mo-video-recorder in a spot where it may record the whole of any ball's bounce and push 'record' to start the recording.

Procedure continued

5. Stand up on the step stool with one of of the sport balls.
6. Hold the base of the ball at the 1.5 meter mark on the tape measure and drop the ball without throwing it down.
7. Repeat this step with all of the sports balls available.
8. Look at the slo-mo-videos and collect the data by looking at the tape-measure and measuring how far from the ground the bottom of the ball measured at the top of it's bounce.
9. Repeat steps 5 - 8, 3 times or more.

Data, Graphs, and Results



This table shows which type of sports ball we used for the trial on the x-axis, and the average bounce height of that type of ball on the y-axis. The types of balls we used were: golf, basket, soccer, volley, pickle, ping-pong, racquet, tennis, and lacrosse balls. We did three trials of each ball and then we averaged the bounce height for each ball on the y-axis. The results show a tie for highest bounce between the racquetball and the lacrosse ball. The ball that bounced the lowest was the pickle ball.

Conclusion

From our experiment, we found the average bounce height of a lot of different types of sports balls. We dropped each ball from a height of 1.5 meters, and recorded the average bounce height of each ball from three trials. The sports balls that we tested were: golf, basket, soccer, volley, pickle, ping-pong, racquet, tennis, and lacrosse balls. We found that the balls that bounced the highest were the lacrosse ball and the racquetball, as both averaged to 130 centimeters. Our hypothesis was that the racquetball was going to bounce the highest, so we were partially correct. The ball that bounced the lowest was the pickleball, at 70 centimeters. Our experimental procedure was to set up the tape measure and a camera, and then film each ball's three trials. After reviewing the data, we averaged the height of each bounce and then had our complete data set. In order to get more accurate results, we could have used a more accurate tape measure and maybe a more accurate camera. The camera angle was also a problem, because it was near the bottom of the tape measure, so if it had been closer to the top, there would be more accurate results. It was hard to estimate down to the fraction how high the balls bounced, and changing the camera angle would help with that. The sports balls we tested are not all of the sports balls that exist, but the data set could be expanded by testing different sports' balls such as a tchoukball, bowling ball, or maybe even a football.

References

References

University of Illinois. (2007, October 22). *Materials for Bouncy Balls.* University of Illinois. https://van.physics.illinois.edu/ask/listing/93

English, Trevor. (2023, June 28). *What are the Physics Behind Bouncing Balls.* Interesting Engineering. https://interestingengineering.com/science/what-are-the-physics-behind-bouncing-balls

Sydney University. (2014, June). *Physics of Bounce.* University of Sydney. https://www.physics.sydney.edu.au/~cross/BOUNCE.htm