HIGH FLYERS

Stacked Basketball Drop

How high a basketball bounces affects a player's ability to dribble and to control rebounds.

HERE'S WHAT YOU'LL NEED:

- Basketball
- Tennis ball
- Assorted balls of various sizes and weights
- An outdoor area or gym with tall ceilings as a testing site
- Meter stick

WARM-UPS

Let's find out how high balls bounce when dropped.

Start by holding a basketball exactly one meter above the ground. Let go and watch closely to see how high it bounces. It is always important to double check your results, so repeat the drop from the same height at least two more times. Make a data table to record the estimated bounce heights. Are they about the same?

Repeat the same test using a tennis ball. With the data you have recorded, make a graph that compares the bounce heights of the two balls. Does either ball bounce higher than the height from which you dropped them?

Based on your results so far, make a prediction of how high you think other types of balls will bounce. Test to find out.

GAME TIME

What would happen if you teamed up the balls and dropped them together? Do you think their bounce heights will improve or fall flat?

Hold the basketball one meter above the ground. Using your other hand, center the tennis ball on top of the basketball. Drop both balls at the same time.

What happens to the basketball? Does the tennis ball behave the same way? Describe the result, how would you explain what is going on?

OVERTIME

Let's take it a step further

Switch positions and try dropping the balls with the basketball balanced on top of the tennis ball.

Try adding a third or fourth ball to the stack.

Try different ball combinations.

ANALYZE THE REPLAY

What happened?

Draw a model of the ball arrangement you think performs best.

What data do you have to support your claim?

Looking back at your warm-up exercises and "ball team" tests, what scientific explanation can you give to support the evidence you've collected?

Do you want to learn more?

Research Kinetic Energy, Potential Energy, Conservation of Energy

COACH'S CORNER

Additional information and explanations for parents and educators

When you lift a ball up from the ground, you transfer energy from your muscles to the ball. Because of its new position, the ball now has potential energy. When you release the ball, gravity pulls it towards the ground and transforms that energy into kinetic energy or energy of motion.

Potential energy (PE) is energy stored in an object as a result of gravity pulling downwards. The amount of potential energy an object has depends on both its weight and how high it is from the ground. The higher it is the more potential energy it has.

An object's weight is based on its mass (the amount of matter it contains) multiplied by the effects of gravity. Mass doesn't change with location but weight does because it depends on gravity. You weigh less on the moon than on Earth. On Earth the gravitational pull is about 9.8 m/s^2, but on the moon it is only 1.6 m/s^2.

You can calculate how much potential energy an object has by multiplying its weight by the height it is dropped from.

$$PE_{grav} = \text{weight} \bullet \text{height}$$

As the ball hits the ground, the outside squashes a bit and compresses the air inside it. Some of the ball's energy is released as sound and heat. The ground pushes back and the ball bounces back up and into its original shape. But, because it has lost some of its energy, it doesn't rebound to its original height.

By measuring the rebound height, you can calculate the total amount of energy transferred in the collision.

(original drop height • weight) $PE_{initial}$ **−** (rebound height • weight) $PE_{rebound}$ **=** energy lost or transferred to heat and sound

When two balls are stacked and dropped together, they each have energy as they fall towards the ground. The basketball hits first and rebounds into the path of the falling tennis ball, transferring some of its remaining energy into the smaller ball as the two collide. The energy transfer gives the tennis ball an extra push, sending it higher into the air.
The basketball, having lost even more energy to the tennis ball, doesn't bounce as high as it did when it was dropped by itself.

Oklahoma Academic Standards for Science	
GRADE	STANDARD
4th	PS3-2
	PS3-3
5th	PS2-1
6th	PS3-2

REAL WORLD EXAMPLES OF ENERGY TRANSFER DURING COLLISIONS

Car Collisions

When a car is hit from behind by another vehicle, energy from the moving vehicle is transferred to the rear-ended vehicle, sending the vehicle forward. Multi-car accidents are usually the result of this type of collision. Car 1 hits Car 2 propelling it forward. Car 2 then hits Car 3 and so on. Usually most damage occurs to the first car and depending on the distance in between each vehicle, as energy is transferred, the other cars can also sustain varying amounts of damage.

Billiards

A cue ball is shot into a pack of tightly racked balls, transferring most of its energy to the ball it collides with pushing forward and into the other balls causing the pack to scatter in multiple directions. The direction each on rolls depends on the point of impact and amount of energy that is transferred.

Baseball

Compare the energy transfer of a player who swings a bat at a fast ball to a player who bunts. When the player swings the bat, some of the bat's energy is transferred into the moving ball and the ball rebounds past the pitcher. When the player holds the bat stationary in a bunt, the collision causes the ball to lose energy (as sound and heat) and the ball's rebound fall short.

Soccer

Player jumps up and hits the ball with his head transferring the energy from the player into the rebound of the ball.

Trampoline

Double bouncing is similar to the stacked ball drop.

One person jumps onto a trampoline, pushing the surface downward. Before the trampoline's surface can rebound upward, a second person lands onto an already downwards displaced trampoline, displacing it further downwards. As the trampoline returns back upwards, it is pushing both people back up, but the second person experiences more of the force and for a longer period of time, so ends up bouncing higher.
Reference https://www.physicsforums.com/threads/double-bounce-of-two-balls-on-a-trampoline.406926/