

# COURT CONNECTIONS

*Let's investigate how different surfaces affect the bounce of a basketball.*

## HERE'S WHAT YOU'LL NEED:

- Basketball
- Basketballs with different covers, like leather or rubber
- Another type of ball
- Pillow
- Meter stick or tape measure
- Masking or painter's tape
- A variety of floor surfaces to test (*at least 3*)
- Notebook and pencil or tablet

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## WARMUPS

- Choose a surface to test that is relatively flat and near a wall. Write a brief description of the test area in your notebook.
- Secure your tape measure or meter stick to the wall with masking tape.
- Stand near the wall and hold the basketball so that the bottom of ball is one meter above the ground.
- Choose either the top or the bottom of the ball to always watch. Release the ball and pay attention to the highest point the ball reaches, based on your choice. Record this height in your notebook.
- Scientists always double check test results, so repeat the one meter drop at least three more times and record those results in your notebook.

Did the basketball bounce back to its original height? Based on your observations, give an explanation for what you think is happening.

- Place a pillow on the floor and then repeat the experiment by dropping the basketball onto to the pillow and recording the ball's bounce height.
- Make a table to organize your data of the observed bounce heights and use the data to find the average height of the bounce.

How does the bounce height on the pillow compare with original test surface?



## GAME TIME

Based on what you've discovered so far, do you think the flooring in a basketball court makes a difference in how well a player is able to dribble the ball?

Does a basketball bounce differently when you play inside in the gym or out on the playground? Would the ball behave the same way if you tried to dribble on a football or soccer field?

- Plan and conduct your own experiment to compare the basketball's bounce height on a several different playing surfaces. Write your procedures in your notebook.

## Items to consider as you plan your experiment:

- Remember that it is important to only change only one variable at a time in an experiment. Since you are testing different types of court surfaces, keep all the other variables and steps in your investigation the same.
- Don't forget to conduct multiple trials and record the data.
- Once you've finished testing, create a graph or table with the data you have collected to help you look for patterns and analyze your results.



## ANALYZE THE REPLAY

What happened?

Once you've finished testing, take time to review all of the information you have collected through your tests and observations.

Did your experiments have the outcomes you expected?

Which surface did the basketball bounce the highest on? Describe the characteristics of your best surface. (Was it hard or soft, rigid or flexible?)

## OVERTIME

Let's take it further

- Basketballs come in different sizes with different types of covers, like leather or rubber. Try testing several different types of basketballs to see which surface they bounce the best on.
- Try dropping the basketball on a variety of surfaces and record the number of bounces it makes before it completely stops.
- Try testing one other type of ball to see how they bounce on different surfaces. How do they compare your basketball data? **Examples:** volleyball, soccer ball, beach ball

Compare your description for the best surface to the test surface with the worst results. How are they similar? How are they different?

What do you think happens to all the energy the ball had when it was dropped? Draw a diagram of a ball bounce on your worst performing surface, using arrows to illustrate where you think the energy goes.

Make sure to include labels to show what is happening.

Why do you think that the ball bounced better on some surfaces than on others? Think about what you have discovered and use your data to help you write a scientific explanation for your results.



## COACH'S CORNER

Additional information and explanations for parents and educators

It doesn't take a lot of effort to lift a basketball off the ground, but work is still being done. The energy from your muscles is transferred to the ball as it is being lifted; giving it something called potential energy. As the ball is released, gravity pulls the ball downwards and transforms that potential energy into kinetic energy, the energy of motion.

Inside the basketball, the air molecules are in constant motion, colliding with each other and into the wall of the ball. When the ball hits the ground, the ground pushes back causing the sphere of the basketball to flatten and indent. As the ball's shape compresses, the moving air particles inside are forced into a smaller area. The result is like pushing down on the coils of a spring. As the ball leaves the ground, it returns to its original shape, the compressed air rapidly expands air propelling the ball up into the air. But, not all of the ball's original energy is left to go into the rebound. During the collision, some of its kinetic energy is converted into sound waves, creating the "thump" of the ball hitting the ground. Friction between the ball and the ground converts a little more of it into thermal energy, or heat, leaving both the ball and the spot it hit slightly warmer.

Additional energy is also absorbed by the surface the ball is bounced upon. How much, depends on what material the court it is made of. Some surfaces, like grass, carpet or sand, are springy and actually compress a bit when the ball hits; absorbing some of the ball's energy. The more energy that is transferred to the ground, the less energy is available to bounce it back up. This energy transfer can make dribbling more difficult because players have to work harder and expend more of their own energy to keep the ball bouncing. On the other hand, surfaces that are more rigid, like concrete or hardwood, absorb less of the ball's energy and allow it to bounce higher. If a player were to bounce a ball once and walk away, the bounces of the ball would decrease proportionally each and every time until the ball eventually stopped bouncing. To keep a ball bouncing, the player has to exert enough force on it to allow the ball to maintain its energy level. The less "give" a surface has, the smaller the amount of additional energy required from the player.

All NBA courts are shiny and smooth and constructed from dense hardwoods like maple. Maple is strong and durable. The tightly packed grain of the wood gives it a smooth finish that helps keep dirt out. The stiffness of the grain provides good shock resistance, meaning it can take thousands of hours of heavy use on a court floor without suffering damage.

A common measurement of wood hardness is the Janka hardness test. The test measures the amount of force required to embed an 11.28mm/.444" diameter steel ball halfway into the wood. Hard maple or Sugar Maple has a rating of 1450. Compare that figure with the woods listed in the table below.

The harder the court surface is the more energy a dropped ball retains and the higher it rebounds. A basketball bounces pretty well on hardwood, but even better on concrete. But, if the floor is too hard, it can lead to serious player injuries. Most hardwood courts have a layer of rubber or a fiberglass-foam composite installed underneath. The padding allows the floor to give a little and absorb some of the excess energy from falls or running feet. A player has to expend a little more energy to dribble effectively, but the court causes less wear and tear on the player's body.

### Janka Hardness Scale

Wood Type	Pound-Force
Red Mahogany	2697
Hard Maple, Sugar Maple	1450
White Oak	1320
White Ash	1320
Eastern White Pine	380
Balsa	100

### DO YOU WANT TO LEARN MORE?

Research: Kinetic Energy, Potential Energy, Conservation of Energy, Collisions, Newton's Third Law

#### OKLAHOMA ACADEMIC STANDARDS: MATHEMATICS

STANDARD	4 <sup>TH</sup> GRADE	5 <sup>th</sup> Grade	6 <sup>th</sup> Grade
PS3-2 Energy	●		
PS3-3 Energy	●		
PS2-1 Motion and Stability		●	
PS3-2 Energy			●

#### CHECK OUT THESE WEBSITES FOR MORE INFORMATION

##### Physics of the Bounce

<http://leenaphysicsbasketball.weebly.com/dribbling.html>

##### Different Types of Basketballs and Court Surfaces

[http://basketball91.com/information/different-types-of-basketballs-and-court-surfaces/#.Vgw\\_tvIViko](http://basketball91.com/information/different-types-of-basketballs-and-court-surfaces/#.Vgw_tvIViko)

##### What Are the Different Types of Basketball Court Surfaces?

<http://www.livestrong.com/article/430186-what-are-the-different-types-of-basketball-court-surfaces/>

##### Janka Hardness Scale

<http://sizes.com/units/janka.htm>

##### Tread Lightly - A complete guide to selecting the right sports surface

[http://www.recmanagement.com/feature\\_print.php?fid=200305fe00](http://www.recmanagement.com/feature_print.php?fid=200305fe00)