TAKING IT TO THE BANK

Comparing direct arc shots to bank shots

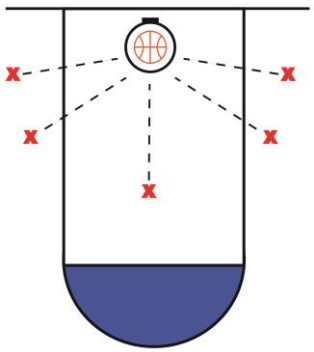
There are many different types of shots that can be made in basketball. Let's take a scientific look at two and discover the benefits of both!

HERE IS WHAT YOU WILL NEED:

- Basketball
- Basketball goal
- Three or more volunteers
- Measuring tape
- Masking tape
- Notebook
- Pencil

WARM-UPS

Start with one person standing stationary directly under the basketball goal holding one end of the measuring tape. Using the diagram as a guide, have another person measure out 4 meters and mark five spots on the ground with masking tape around the goal.



In your notebook draw a diagram of the court and label each location.

For this activity, have each participant shoot three baskets from each spot without using the backboard. Repeating the shot multiple times is important. Scientists use multiple data points to ensure the accuracy or their test results.

Design a table to record baskets made or missed at each location. A shot that goes in, but touches the backboard, is considered a miss.

Your chart might look like this:

Volunteer Name	Location	Shot 1	Shot 2	Shot 3	Percent Made
Adam	A	X			
Adam	B	O			
Adam	C	X			
Adam	D	X			
Adam	E	O			
Becca	A	O			
Becca	B	O			
Becca	C	X			
Becca	D	X			
Becca	E	O			

Use this data to calculate the percentage of shots made from each location. See formula.

Calculate the percentage of shots made at each location:

$$\text{Percentage } (\%) = \frac{\text{shots made}}{\text{total shots attempted}} \times 100$$

GAME TIME

Let's investigate if a banked shot affects the likelihood of making a basket.

In this trial, we will change the type of shot used and compare results.

Repeat the warm-up activity procedure, but this time each person should try to make each shot by using the backboard. Bank shot is a term used to describe hitting the basketball off of the backboard before making a basket. When repeating the trials this time, if the ball does not touch the backboard, it is considered a miss.

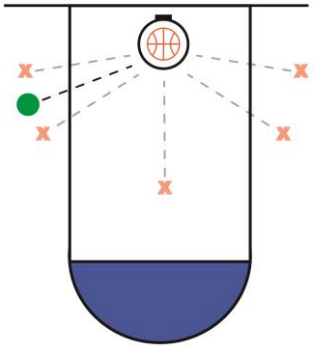
Create another chart to record this new data.

ANALYZE THE REPLAY
What happened?

Review all of the information you have collected through your trials and observations.

- Look at the chart and analyze the results. Do you see any patterns?
- Which locations have the best results for bank shots? What about the best locations for the direct arc shots?
- What other games or sports benefit from the use of banking objects off another surface?
- From what you have discovered so far, what type of shot would be best to use from the location shown by the green dot:

Use the evidence found in your data to support your answer.



OVERTIME
Let's take it a step further

Investigate other factors that affect the probability of a shot resulting in a basket.

Keep the angle to the goal the same and change something new. Remember to record your results! Possible variables to try:

- Distance to goal
- Rotation of the ball, backspin, no spin, topspin
- Speed of ball
- Size or inflation of ball

For more ideas watch Jai and Jonathan on PBS Kids compare different shooting positions:
http://pbskids.org/dragonflytv/show/basketball.html

DO YOU WANT TO LEARN MORE?
Research:
Trajectory, Arc, Projectile Motion, Newton's Third Law

You can also challenge yourself and use your knowledge about physical science and angles to play video games. The Angry Birds™ series of games is a great example of this, but there are also many fun and educational games that can be found online.

CHECK OUT THESE WEBSITES FOR DIFFERENT CHALLENGES

Use angles and velocity to shoot virtual basketball set shots:
http://www.fearofphysics.com/Proj/proj.html

Play *Gorilla!* to use force and angles to throw bananas on skyscrapers:
http://www.hqprimary.co.uk/gorilla/

Move objects to bounce adorable blobs into a bucket using velocity and angles in *Blobs Hunter*:
http://www.physicsgames.com/projectile-games_blobs-hunter/

COACH'S CORNER

Additional information and explanations for parents and educators

When a basketball game is on the line and the clock is ticking to zero, star players will often rise to the occasion with a clutch shot. The question arises 'what kind of shot is better, a bank shot or an arc shot direct to the hoop?'

Research conducted by North Carolina State University indicated that from many areas on the court, the likelihood of making a bank shot exceeded that of a direct shot[1]. The study went on show that bank shots were more effective from the "wing" areas between the three-point line and the sides of the free-throw line.

Researchers simulated one million shots through use of a computer. They discovered that a bank shot was up to 20 percent more effective when shot from many angles up to about 12 feet from the basket. Bank shots from the baseline area by the goal were least likely to be successful.

The trajectory of the ball also affects how likely it will go into the hoop. If the ball doesn't have enough of an arc, it will approach the hoop at a shallow angle with only a small target area that can limit its chance of success. Using different angles off of a backboard provides many paths to successful shots. It is widely accepted that when players are at a 30- to 60 degree angle from the hoop, they should use the corner of the square on the backboard for a bank shot. Thunder players spend years honing their skills perfecting these types of shots.

When an object banks off a surface, we observe Newton's Third Law of Motion. When one object applies a force to another object, the second object applies an equal and opposite force on the first object. This is of particular importance when using a backboard in basketball. At the correct angle, the opposing forces of the backboard and basketball combine for a successful shot. This reaction can be fun use. It can also be observed in real world games such as miniature golf, billiards, air hockey, and more.

[1] North Carolina State University. "Basketball: Optimal aim points for bank shots." ScienceDaily. www.sciencedaily.com/releases/2011/03/110310151224.htm

OKLAHOMA STANDARDS			
Mathematics		4th grade	5th grade
N 1.2	Numbers & Operations	●	
N 2.1	Numbers & Operations		●
N 2.6	Numbers & Operations		●
N 2.8	Pattern Relationship	●	●
A 1.1	Algebraic Reasoning & Algebra		●
GM 2.4	Geometry & Measurements	●	
GM 3.2	Geometry & Measurements		●
GM 3.4	Geometry & Measurements		●
D 1.1	Data Analysis		●
D 1.2	Data Analysis		●
Science			
PS 3.3	Energy	●	
PS 2.1	Motion & Stability		●