Over and Over Again

What can a marshmallow launcher show us about free throw shooting technique?

In the NBA, on average about 75% of free throws attempted will be made. If you want to be a good free throw shooter, you will want to make more than 75% of your free throw attempts. How do these elite athletes become so efficient at the foul line? Let's do some activities to find out.

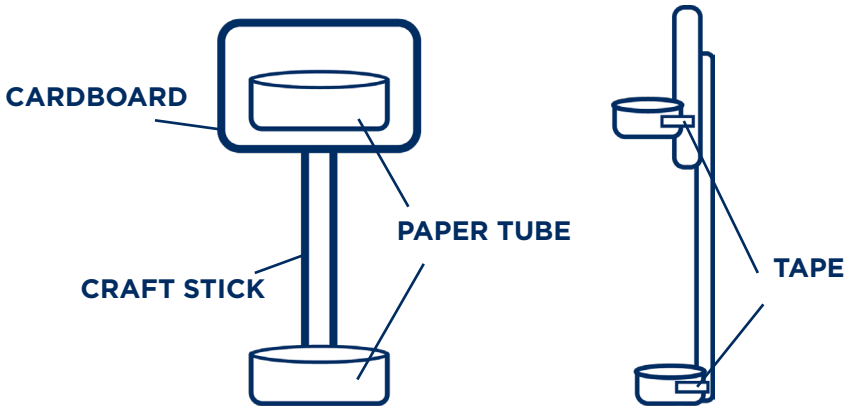
HERE'S WHAT YOU'LL NEED:

- Toilet paper or paper towel tubes
- Balloons
- Tape
- Craft sticks
- Scrap cardboard or index cards
- Scissors
- Small marshmallows
- Ruler
- Journal
- A pencil

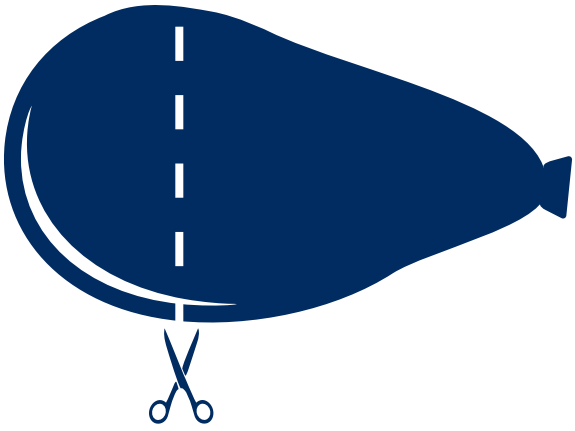
WARMUPS

To make a table top basketball goal for this activity, you will need a craft stick, an index card folded in half, two equal-size rings cut from a paper towel or toilet paper roll and some tape.

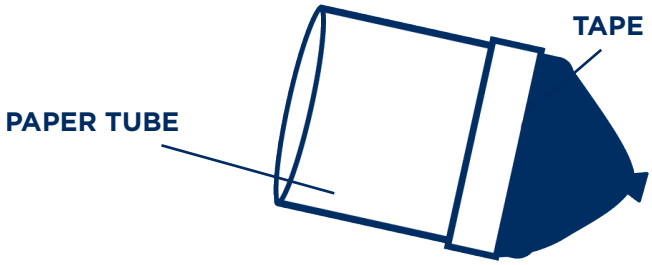
Create the rim and backboard for your goal by taping one of the rings to the index card. Tape the finished piece to one end of the stick. Attach the remaining ring to the other end of the stick to form a base. The completed goal should look something like this:



Assemble a "ball" launcher out of another cardboard tube and a balloon. Without inflating the balloon, tie a knot in the end and then cut off less than half of the rounded part of the bottom of the balloon.



Slide the open end of the balloon onto one end of the cardboard tube and secure it in place with tape. It should look something like this.



Use marshmallows as balls and try out your launcher and hoop. Load a marshmallow into the launcher. See if you can aim the launcher, pull back on the tied end of the balloon, let go and shoot the marshmallow through the hoop. It may take several tries. Can you make a shot from far away? Do you need to angle the launcher a certain way?

GAME TIME

Now that you have the basic components needed to practice making a shot, you'll need a free throw line. The line should be 30 cm in front of the pole of your basketball goal. Use a ruler to measure the distance and tape to mark the foul line.

Using your marshmallow launcher, shoot 10 baskets from behind the free throw line. Record your misses and makes in your journal.

Take a moment to think about each of your shots. There were likely many **variables,** or factors, that changed with each attempt. Did you alter the angle or direction you held the launcher? How far back did you pull the balloon before you let it go? Was there a specific combination and order of factors that were the most effective? List those steps in your journal so that you can refer back to them.

With those steps in mind, use your engineering skills to create a device that will hold your launcher steady and at the best angle to allow you to shoot the marshmallow into the hoop repeatedly.

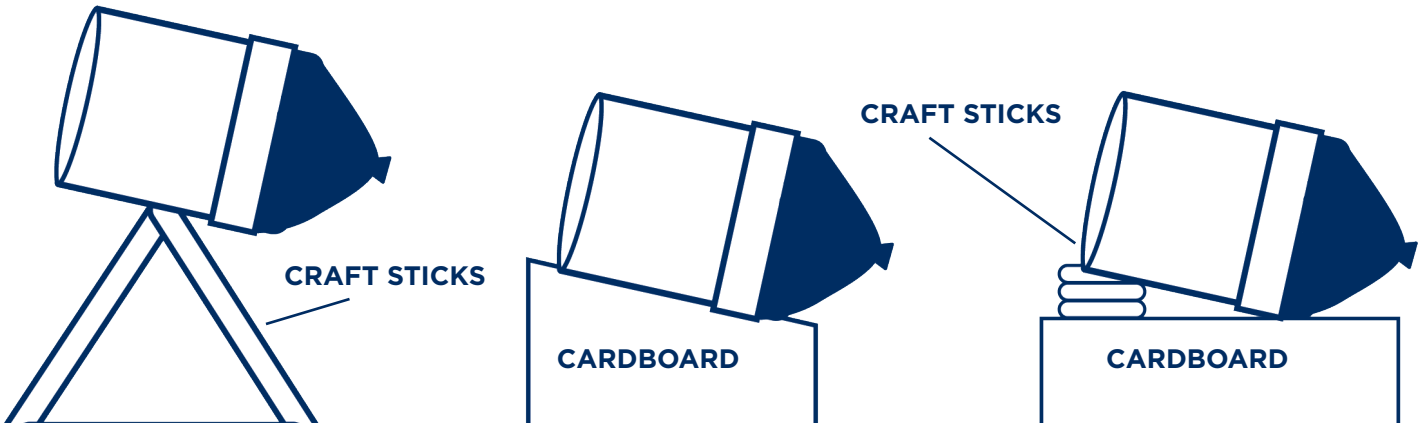
TAKE IT A STEP FURTHER AND TRY YOUR HAND AT STATS

Each time you take a shot, you are making a Free Throw Attempt, or FTA. Each free throw attempt that scores is a Free Throw Made, of FTM.

You can calculate your initial Free Throw Percentage, or FT%, by dividing the number of free throw attempts by the number of free throws made.

You can record this in your journal and use it as a baseline to compare to in future shot groups.

This challenge will require that you **prototype,** or make test models of a device that you think will hold the marshmallow launcher in place and at the chosen angle. You can use scrap cardboard or any other readily available materials you have on hand. Remember, it is important to test and modify your design often while you build it. There are many different designs that may be effective, so you may wish to make some sketches in your journal and keep notes about what works and what doesn't.



Once you are satisfied with your prototype and your step-by-step set up, attempt ten more shots. Were your shots more consistent than your initial 10 shots? Did the marshmallow consistently hit around the same area even when you missed your attempt?

ANALYZE THE REPLAY

What happened?

Thinking back on the process, did it appear that creating a device that would keep the marshmallow launcher in the right place or developing repeatable steps lead to more improvement? Were they equally important? Are there any additional adjustments that you would like to make to the contraption or the routine to improve the consistency of your shot?

If you had more time to practice, do you think your free throw percentage would increase?

OVERTIME

Let's take it further

Let's take it a step further. There are many stories and news articles discussing that NBA players generally make a greater percentage of their free throw shots in a practice than they do in a game. In addition to having good mechanics and a routine, it helps to be relaxed and able to concentrate on the goal.

A game time situation can be much different. The crowd noise and the other players can be distracting. The stress of knowing that your team needs the point from the free shot can add a lot of stress, too.

For this activity, you can set up a challenge and compete with your friends. To create a situation of cheering and high stakes, get your entire class involved. Half of the class will be on one team. The other half of the class will be on the other team. Each person in class gets 10 shots. Only one person shoots their marshmallow launcher free throw at a time. Then a member of the other team will shoot. Someone will need to record how many shots of the attempted ten, each student makes. Non-shooting members of the class can cheer for their teammate or even try to distract a member of the other team.

COACH'S CORNER

Additional information and explanations for parents and educators

Recreating the repetitive motion of a successful foul shot was the goal of this engineering challenge. A marshmallow launcher took the place of a basketball player. The design challenge allowed students to consider the variables of shot angle and applied force and how they affected the outcome of shot. Prototyping encouraged both testing and modification and created a situation where failure became a starting rather than stopping point.

With the marshmallow launcher students had the opportunity to experience how a change in the amount of force applied to the balloon launcher affected the effectiveness of a shot. When students pulled back on their balloon, they provided it with potential energy. When it was released, that **potential energy** became **kinetic energy** and launched the marshmallow through the air. The amount of energy, or the amount of work it takes to pull back the balloon, will be equal to the amount of energy the balloon uses to launch the balloon when released. This is part of the activity was an example of **Newton's Third Law** which states that for every action in nature there is an equal and opposite reaction.

When shooting free throws a player applies energy to the ball with their body. Using one fluid motion that uses their entire body including knees, elbows, wrist, and fingers, the player provides kinetic energy to the ball.
The device designed in the engineering challenge helped reduce variables to the shot and provides a stable platform to help direct that energy release. In the game, the player aligns their toes, elbows and entire body, this helps limit variables.

As the marshmallow travels through the air, you can see an example of **Newton's Second Law,** which informs us that the velocity of an object changes when it is subjected to another force. In this case air resistance slows the marshmallow down and gravity pulls it to the center of the Earth. You can witness Newton's Second Law when you watch a basketball leave a player's hands on the way to the basket.

DO YOU WANT TO LEARN MORE?

Research: Applied Force, Kinetic Energy, Newton's Laws, Momentum, Potential Energy, Trajectory, Variables

STANDARD	4TH GRADE	5TH GRADE	6th Grade
MATH			
N.1.1 - Numbers and Operations	●		
N.1.2 - Numbers and Operations	●		
N.1.5 - Numbers and Operations	●		
N.2.5 - Numbers and Operations	●		
N.2.6 - Numbers and Operations	●		
SCIENCE			
PS2-1 - Motion and Stability			
PS3-2 - Energy	●		
PS3-3 - Energy	●		
PS3-4 - Energy			
MS-PS3-1			●
MS-PS3-2			●