



Baseball Is A Numbers Game

Just An Average Day

In baseball, a hitter's **batting average** (BA) is defined by the number of hits (H) divided by at bats (AB). It is usually reported to three decimal places and read without the decimal. For example, a player with a **batting average** of .300 is "batting three-hundred."

BA: H/AB



In 2021, Brandon Lockridge had a strong season with 57 hits in 174 at bats. To figure out his batting average would be:

$$57 / 174 = .328$$

FIGURE OUT THE BATTING AVERAGE

Player	AVG	AB	H
Cabrera, O		437	112
Beltre, M		398	102
Castillo, D		334	93
Milone, T		174	48
Burt, M		162	39
Sands, D		194	49
Lopez, J		163	32
Garcia, D		385	81
Gilliam, I		328	77
Palensky, A		111	24
Breaux, J		100	24
Florial, E		35	8
Peraza, O		326	96

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You Get What You Earn

A pitcher's **Earned Run Average (ERA)** is the mean of earned runs (ER) given up by a pitcher per nine innings pitched (IP) - the normal regulation of a game. It is determined by dividing the number of earned runs allowed by the number of innings pitched and multiplying by nine (9). Innings pitched are broken into thirds to represent the number of outs that make up a half inning. Innings pitched are represented to one decimal place. For example, 6.0 would be "six innings pitched," 6.1 would be "six and a third innings pitched, and 6.2 would be "six and two thirds innings pitched." To figure out innings pitched, use .33 (1/3) for .1 and .67 (2/3) for .2 in the formula

FIGURE OUT THE EARNED RUN AVERAGE

Pitcher	IP	ER	ERA
Gomez, M	49.0	17	
Russ, A	33.0	7	
Gadea, K	36.1	12	
Greene, Z	39.1	16	
Marinaccio	39.2	8	
Junk, J	93.0	29	
Curtis, K	19.2	7	
Valdez, J	30.1	13	
Otto, G	65.1	23	
Medina, L	73.2	30	
Sears, J	50.2	23	
Semple, S	64.2	27	
Roe, N	49.0	27	
Teasley, R	96.1	45	

$$\text{ERA} = \text{ER} / \text{IP} \times 9$$



Ken Waldichuk was among the team leaders in pitching for the Patriots in 2021. He allowed 37 earned runs in 79.1 innings pitched. To figure out his ERA would be: $37 / 79.33 \times 9 = 4.20$

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The Science Of Baseball

Pitching Is Physics


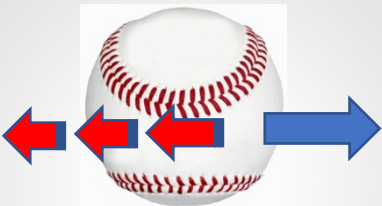

Physics (*pronounced fiziks*) is the natural science that studies matter and its motion and behavior through space and time. It studies the related entities of energy and force.

Energy is the quantitative property that must be transferred to an object in order to perform work on, or to heat, the object.

Force is an interaction that causes an affected object to be pushed or pulled in a certain direction.

A baseball thrown by a pitcher requires a lot of energy and force to make it from the pitcher's mound to home plate - a distance of 60 feet, 6 inches.

Three forces that affect a baseball are **Gravity**, **Drag**, and **Lift**.

GRAVITY	DRAG	LIFT
		
The natural force that causes objects to fall down towards the earth.	A force that works opposite of an object's motion.	An upward acting force that counters the pull of gravity on an object.

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Types Of Pitches And Why They Are Used With



4-SEAM FASTBALL

Hardest, straightest pitch with the most control.

Good ol' #1. Must be every pitcher's best friend to work hitters in and out. Typically used to get ahead in counts and relied on when behind. All pitchers work off the fastball.



2-SEAM FASTBALL

A little slower than a 4-Seam Fastball, but with more movement.

Also known as the sinker. It's used in and out to resemble a 4-seam fastball, except it won't be as firm. A good one will feature arm-side run and sink that will result in a lot of groundballs, foul balls, and swings and misses.



SLIDER

Tails laterally and down through the batter's hitting zone.

The power pitch of all the off-speed pitches. It features slight depth/ tilt with a tight spin on the ball. A 'chase' pitch thrown down and away in the zone or down and way out of the zone to get weak contact or swings and misses when ahead in the count late.



CURVEBALL

Forward spin on the ball causes it to dive as it approaches plate

A knee buckler by its sudden break from up to down. It has the biggest bend of all the pitches by creating deception to a hitter's eye. It can be used to steal a strike early or buried late in a count to get a hitter to chase.



CHANGEUP

Thrown to look like a fastball, but arrives slower to the plate.

The most effective pitch in baseball. The spin of the ball will mirror that of a 4-seam and 2-seam fastball to a hitter's eye, except for the drastic change in speed and the depth it creates right in front of the plate. It is designed to keep hitters off balance.

↑ This is how each pitch looks to a batter at the plate!

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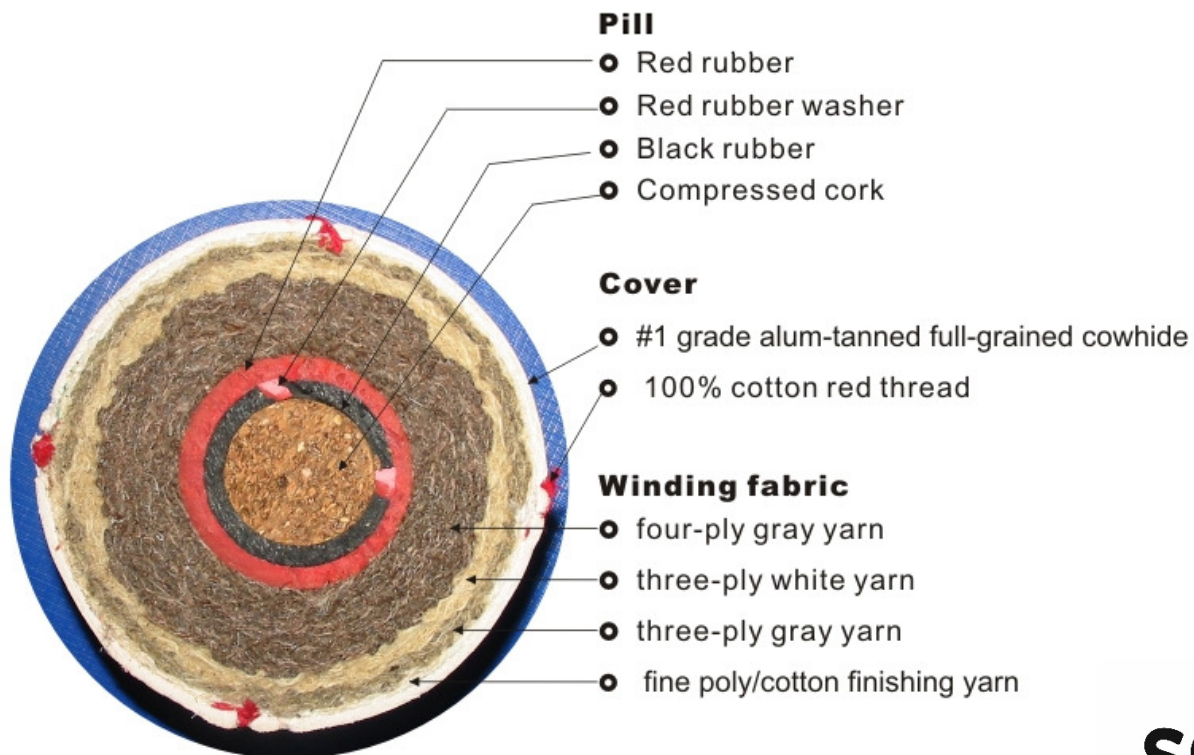
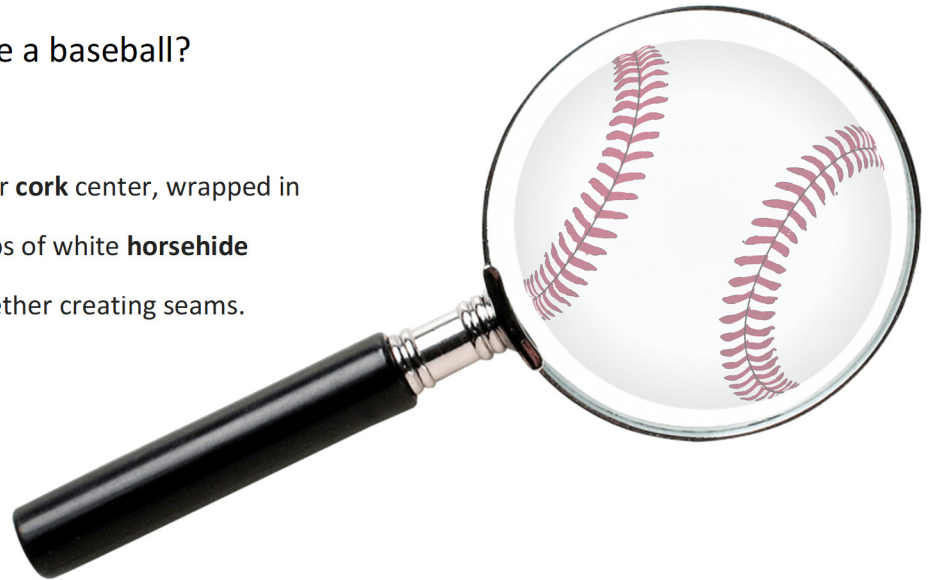


Engineering The Game

It's What's On The Inside That Counts

Ever wonder what's inside a baseball?

A baseball is made of a **rubber** or **cork** center, wrapped in **yarn**, and covered with two strips of white **horsehide** or **cowhide**, tightly stitched together creating seams.



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Batter Up... What Types Of Wood Are Used To Make Baseball Bats?

QUESTION?

Which type of baseball bat would you use as a baseball player and why?



Dermis Garcia broke a Patriots franchise record in 2021, smashing 31 home runs using a maple bat.



Maple: The strongest of the three kinds of wood. Maple is dense, which makes it more durable and adds more "pop."



Birch: Softer wood that provides more flexibility, which may create more whip and generate more bat speed.



Ash: Flexible wood that batters feel allows them to whip the barrel of the bat through the hitting zone to create more bat speed.

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How We Measure Up

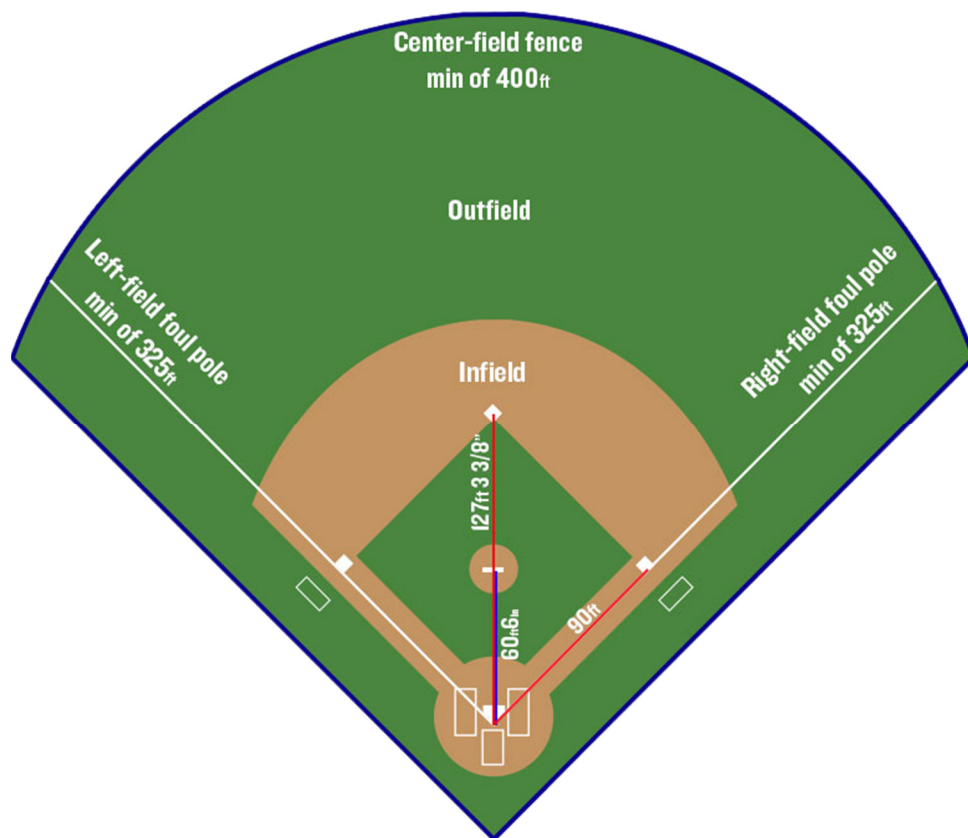
How a professional baseball field is designed comes down to several different measurements. From the distance between the pitcher's mound and home plate, to the number of feet between the bases, everything is engineered to create an approved and beautifully mastered playing field.

QUESTIONS?

1. The distance between each base is 90 feet. If a batter hits a home run, how far will he run?

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2. Which part of the field is the furthest from home plate?

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3. What is the shortest distance a home run can be to clear the outfield wall?
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Getting Technical



Baseball is a game of angles.

Where the ball hits the bat, at what speed the pitch is thrown, and how fast a bat is swung will all impact where the ball goes!

Hitters always try to hit the ball in the "Sweet Spot" of a bat because it makes the ball travel further!

Ain't It Sweet?

The Sweet Spot of a baseball bat can be defined either in terms of a vibration node or a center of percussion. It is where the impact forces on the hands are minimized.

To find the Sweet Spot on a baseball bat:

1. Hold a bat, hanging down, loosely between your thumb and index finger, just below the knob on the bat's handle.
2. Have a friend tap the bat gently with a hammer, starting at the fat end and moving up toward the handle.
3. You should feel a vibration in your fingers whenever the bat is struck, except when the *Sweet Spot* is hit.
4. You may also notice a slightly different sound when the Sweet Spot is struck.
5. When you find it, mark it off so you see the optimum place to connect with a baseball for the best results in hitting!



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