

Playing the Angles

What is this about?

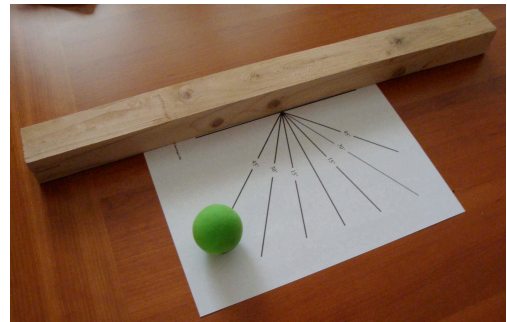
Being able to hit the ball well to all fields is a matter of strength and timing. Compared to a well hit ball up the middle, a right handed batter must swing just a bit later to hit it toward right field and a bit earlier to hit it to left. There is some very basic physics behind this timing that you will explore.

What do I need?

You will need a ping-pong ball or any ball of the same size, a piece of wooden 2x2 or 2x4 at least a foot long, a protractor, and printed copies of the last two pages of this file.

What will I be doing?

You will roll the ball toward the 2x2 at different angles and measure the angle that the ball bounces off. Then you will “pitch” the ball toward the 2x2 and find the angles needed to hit the ball along the right or left field line.



What do I think will happen?

Take a minute and write down a description of what you think will happen and why you think it. How do you think the outgoing angle will compare to the incoming angle?

What really happened?


1. Print out the last two pages of this file.
2. Use the sheet marked with angles as shown in the photo. Roll the ball at the 2x2 along each of the marked angles. Try to minimize the side-spin on the ball. Measure the rebound angle for the ball.
3. Now use the second page. Place the 2x2 “bat” at home plate and “pitch” the ball toward the bat. Adjust the bat angle until the pitch is hit along the left field line.
4. Measure this angle then find the angle to hit the ball along the right field line.

Write a description of your results. Compare the incoming angle to the outgoing angle.


What did I learn?


You likely found that the incoming angle is the same as the outgoing angle. Physicists call this the “Law of Reflection” and it turns out to be related to the Law of Conservation of Momentum that you may have heard of in earlier activities.

The angle between the pitcher and the field lines is 45° . Since the incoming angle must equal the outgoing angle, the bat must be at 22.5° or less to hit a fair ball. Baseball is not just a “game of inches,” it is also a “game of degrees!”

 What else should I think about?

Now we can use physics to understand why a right handed batter can generally hit the ball harder to left field than to right field. Think about the fact that the batter speeds up the bat as he swings it around. When the bat is 22.5° open toward right field, the bat is moving slower than it will be when it reaches the point where it will hit the ball up the middle. The bat is moving even faster then it has reached the point where it will hit the ball toward the left field line.

 Catch it in the Web!

 <http://baseball.physics.illinois.edu/video/softballswing.wmv>

Alan Nathan's web site has this great video of a batter hitting a pitch from a viewpoint directly above home plate. Note that the ball is hit directly up the middle due to the bat angle at the moment of collision.

 <http://www.hardballtimes.com/why-flies-go-one-way-and-grounders-go-the-other/>

Did you ever wonder why groundballs are almost always hit to the pull side and why many more flies are hit to the opposite field than to the pull field? This article by Matt Lentzner has an interesting answer.

