

Force Play

What is this about?

You now understand that three forces determine the motion of baseball in flight. Gravity always is the same size and points directly downward regardless of the motion of the ball. Air drag always acts opposite to the motion of the ball. Finally, the Magnus force is exerted perpendicular to the plane defined by the axis of spin and the axis of the velocity of the airflow over the ball.

What do I need?

You need a copy of the worksheet on the next page.

What will I be doing?

This exercise will help you be sure you understand the way forces act on the motion of a ball by asking you to sketch the forces on balls in different situations.

What really happened?

1. For each ball shown on the worksheet the speed of the ball and the direction it is moving is indicated by the thin straight arrows. A longer arrow means faster speed. Also, the direction of the ball's spin and the rate of spin are indicated by the bent arrows. Again, a longer arrow means greater spin.
2. Draw the arrows to represent each of the three forces on the ball, gravity, drag, and Magnus. Make sure the force arrows are in the proper direction and their length represents the strength of the force.
3. Compare your answers with the ones on the last page.

What did I learn?

Did you get most of them right? Note that gravity is always the same size and the same direction because the Earth always pulls straight down on the ball regardless of its motion. The air drag is always opposite the velocity of the ball. It grows with the speed. Finally, the Magnus force is always perpendicular to the axis of the spin and the velocity. It grows with the speed and the spin.

What else should I think about?

If you can work through the PitchFX activity you will discover that major league pitchers can spin a ball fast enough and give it sufficient velocity that the total force caused by the air (both Magnus and drag combined) is about the same as the force of gravity on the ball.



Catch it in the Web!



Forces on a Baseball

(<http://www.grc.nasa.gov/WWW/K-12/airplane/ballforce.html>)

While NASA is known for rocket science and airplanes, they love to solve more down-to-earth problems too. Many researchers are big fans of America's pastime too!

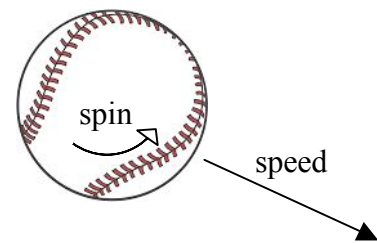
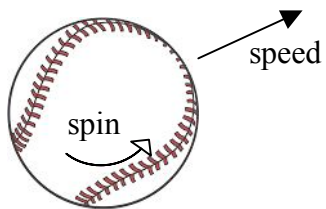
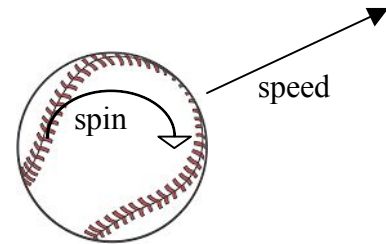
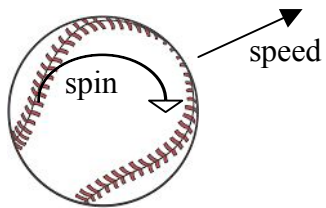
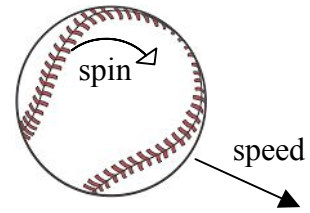
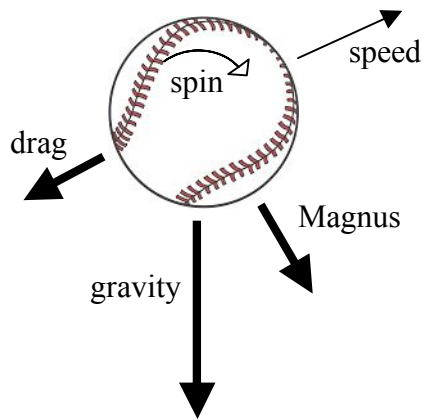


108 Stitches: The Physics in Baseball

(<http://www.pbs4549.org/baseball/baseball4.htm>)

“The Flight” takes into consideration perfect projectile motion, launch angle, air drag, turbulence, temperature, air density and, of course, the Magnus force — all the factors that go into sending a baseball from home plate over the fence more than 350 feet away.

Example:



Answers:

