# FRISBEE PHYSICS

*How does physics play a role in Frisbee flying?*

- How does a Frisbee fly?
- Why is a Frisbee shaped the way it is?
- What would it be like to compete in a world championship Frisbee competition?
- How fast and how far can a Frisbee go?

David learns the many different ways that Frisbees fly and the mysteries of disc physics.

## Discussion

In the late 1940s Fred Morrison performed some experiments with flying discs. Some of the discs he experimented with were made out of metal while others were formed out of a new material called plastic. In 1955 the Wham-O Company purchased the rights and molds from Morrison. It wasn't until the early 1960s when Frisbees became the rage. Whamo-O's former General Manager Ed Headrick provided the organization and groundwork for the growth of the Frisbee craze. Today organized competitions take place each year around the world culminating in the World Frisbee Competition in California.

Two factors influence the flight of a Frisbee, gravity and air. Gravity acts on all objects the same way, accelerating their mass towards the center of the Earth at 10 meters/second. Once in the air, lift and angular momentum act on the Frisbee giving it a ballet-type performance. Lift is generated by the Frisbee's shaped surfaces as it passes through the air. Maintaining a positive angle of attack, the air moving over the top of the Frisbee flows faster than the air moving underneath it. Under the Bernoulli Principle, there is then a lower air pressure on top of the Frisbee than beneath it. The difference in pressure causes the Frisbee to rise or lift. This is the same principle that allows planes to take off, fly and land. Another significant factor in the Frisbee's lift is Newton's Third Law which states that for every action there is an equal and opposite reaction. The Frisbee forces air down (action) and the air forces the Frisbee upward (reaction). The air is deflected downward by the Frisbee's tilt, or angle of attack.

Spinning the Frisbee when it is thrown, or giving it angular momentum, provides it with stability. Angular momentum is a property of any spinning mass. Throwing a Frisbee without any spin allows it to tumble to the ground. The momentum of the spin also gives it orientational stability, allowing the Frisbee to receive a steady lift from the air as it passes through it. The faster the Frisbee spins, the greater its stability.

## Things to Talk About

1. Does the thick rim of the Frisbee affect its flight?
2. What happens when you throw a Frisbee straight up? How do you aim a Frisbee?
3. What other sports use spin for better performance?

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## Vocabulary

**Gravity**--The force that makes objects move or tend to move toward each other.

**Lift**--An upward force resulting from decreasing the pressure on the top of an object by increasing the velocity of the air flowing over the top of it.

**Angular Momentum**--A rotating body's resistance to change in its orientation and rate of rotation.

**Angle of Attack**--The angle formed by the tilt of the flying disk and the line parallel to the ground.

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### Resources


- Horowitz, Judy and Bloom, Billy. Frisbee, More Than Just A Game of Catch. Champagne, Illinois: Leisure Press, 1983.
- Johnson, Dr. Stancil E.D. Frisbee. A Practioners Manual and Definitive Treatise. New York: Workman Publishing Company, 1975.
- Tips, Charles. Frisbee by the Masters, Millbrae, CA: Celestial Arts, 1977


## Additional Sources of Information

- Wham-O Sports Promotion Department P.O. Box 4 San Gabriel, CA 91778-0004 (818) 287-9681
- International Frisbee Disc Association P.O. Box 970-P San Gabriel, CA 91776

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# Activity Page

**Flying on Paper!**

Discover the best conditions for Frisbee distance flying!

**Main Activity**

By graphing the results of various tosses you will be able to calculate the average distance you can make a Frisbee fly and discover the best conditions for distance flying.

Materials:

- Frisbee
- Tape measure
- Paper
- Pencil

1. Divide your class into equal teams. Take turns throwing the Frisbee.

2. Measure the distance from where you began to toss the Frisbee to where it hits the ground. Record your distances in a log.

3. After everyone has recorded the distances of a few tries, calculate the average distance of your team's throws.

4. Compare your average to the other teams. Record the averages in your log and create a graph to represent your data.

**Questions**

1. What caused the Frisbee to fly the farthest? The shortest?

2. What could be done to improve the flight of the Frisbee? Experiment with your ideas to see if you can make it fly farther.

3. What would the best weather conditions be for distance flying? How might strong winds affect the distance a Frisbee could fly? Why?


Learn more about the three axes of motion. Stand with your arms extended straight out from your sides like the wings of a plane. Bend over at the waist and then bend backwards to imitate pitch. Lean your body from side to side to simulate a roll. Now rotate or twist your body at the waist to do a yaw. What other moves can you imitate? Which ones are the hardest to do?


Find out about the similarities and differences between a Frisbee and an airplane. What makes heavier than air devices like helicopters, jets, single engine planes and rockets lift? Build a paper airplane and fly it. What physical forces affect its flight?


What would it be like if you were a Frisbee? Would you like to live on a Frisbee or travel around the world on one? Write a story about the kinds of experiences you might have. What would you do if there was a strong storm coming? How would you navigate?


Invite a couple friends to help you calculate the velocity and acceleration of a Frisbee toss. Take turns acting as the time keeper, data recorder and tosser. Use a stop watch to time how long the


Frisbee is in the air and a tape measure to determine the distance it travels. Record the data from each toss. Try calculating different kinds of throws like ones into the wind, with the wind and across the wind. Which direction works best? Does a fast flying Frisbee travel farther than a slower one?

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