

Land on the Moon!

What Is *IT!*

How does a whirligig work?

Think of a pinwheel or a kinetic garden wind ornament. A whirligig is a device that either spins or turns, usually by the force of moving air. Also known as pinwheels or spinners, they can have many uses. They can either entertain us with the spinning of their beautifully colored parts, serve as a toy that floats in the air, or through the simple rotation of the whirligig, transmit sounds and vibrations into the ground that ward off pesky rodents from our yards. Understanding air resistance, lift, and gravity is the secret to successfully designing a whirligig. The phenomena work together to cause a whirligig to move.

Think About *IT!*

Why does a whirligig fly and fall??

When a whirligig takes flight, it has three forces at play: air resistance, lift, and gravitational force. An upward force of air pushes on the blades in opposite directions causing them to spin. However, the gravitational pull is greater than the resistance of air pushing up. Therefore, when the whirligig is dropped, it will gently twirl to the ground.

Extend *IT!*

What questions do you have? Whirligigs move by the spinning of a propeller-like apparatus. Do you think the shape, size, and weight of the propeller would make a difference? Think of the possible variables that could be manipulated to get different results.

- How does the shape and size of the rotors affect its flight?
- What factors influence the lift?
- How does the material used to make the whirligig influence its flight?



Materials List:

- Small paper or plastic cup (3oz.)
- Small paper clips
- String
- Paper
- Meter stick
- Whirligig Lunar Lander template

Dare to Change *IT!*

How can your understanding of a whirligig help design a Lunar Lander model?

Scenario: NASA is looking for a simpler form of a Lunar Lander. They have called together a group of engineers, mathematicians, and scientists to design the next Lunar Lander to improve landing accuracy. Using limited materials and a simple design, you and your team members must construct and demonstrate a model of the Lunar Lander.

Challenge: Using the limited materials, design, build, and test a simple whirligig Lunar Lander. What criteria would you use to define success? Present your findings to the group.

Suggested Resources and Articles:

"How Things Fly" Sponsored by the Smithsonian National Air and Space Museum

"How to Make a Paper Helicopter" YouTube video, published April 24, 2014.

"Whirligig Lollapalooza: Exploring Science and Engineering Practices." National Math + Science Initiative, Dallas, Texas.

"Inspired by a whirligig toy, Stanford bioengineers develop a 20-cent, hand-powered blood centrifuge." *Stanford News Service*, January 10, 2017.

"An Ancient Toy Could Improve Health Care in the Developing World" by Ed Yong. *The Atlantic*, January 10, 2017.

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Whirligig Template

