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Wind Tunnel

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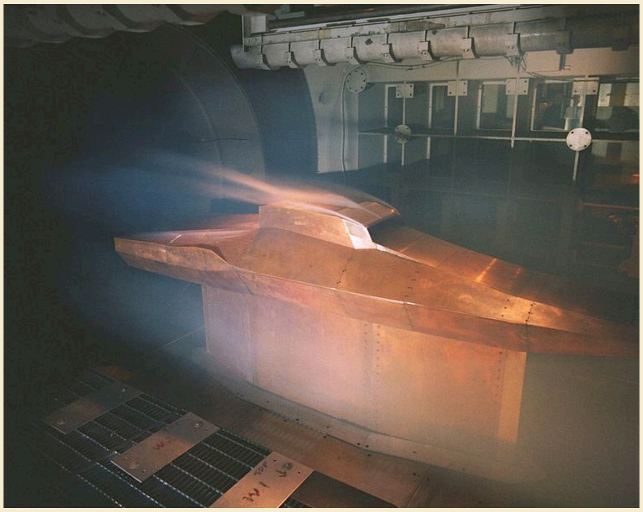
Do you need an idea for a scientific study?
Try out one of our ideas or make one of your own.

Start learning right now about how the shape of an object affects air resistance. Take the following brief quiz to see how much you already know about drag. See the bottom of page 4 to check your answers.

1. How fast can winds be simulated in the world's fastest wind tunnel?
   a. 250 miles per hour
   b. 2,500 miles per hour
   c. 25,000 miles per hour
   d. 250,000 miles per hour

2. When the world's fastest wind tunnel operates, about how much energy does the tunnel require?
   a. enough to drive a car at 100 miles per hour
   b. enough to fly an airplane at 300 miles per hour
   c. enough to drive ten cars at 100 miles per hour
   d. enough to launch a Saturn rocket from Earth

3. About how hot does the gas in the world's fastest wind tunnel have to be heated for the tunnel to operate properly?
   a. 100 °F
   b. 1,000 °F
   c. 10,000 °F
   d. 100,000 °F



4. What is the density of sea level air at 15 °F?
   a. 0.001 g/cm^3
   b. 0.100 g/cm^3
   c. 1.000 g/cm^3
   d. 10.000 g/cm^3

5. Drag or air resistance exists between:
   a. a moving solid and a stationary fluid.
   b. two moving solids.
   c. a stationary solid and a stationary gas.
   d. none of these

Kind of a Drag

Drag is another name for air resistance. Drag is caused when a solid object such as a car moves through a fluid, such as air. The friction created as the object moves against and collides with the air causes the object to slow down. Objects dropped from a height are accelerated due to the force of gravity, which pulls the object downward. Air resistance opposes this motion and an upward resistance force is produced. When the drag and gravitational forces are equal, the object falls at a constant speed called terminal velocity. A number of factors affect the terminal velocity of a falling object. You'll investigate some of these drag factors in this simple experiment. Don't drop the ball as you study air resistance…wait, you might actually have to drop things.

Materials

paper cupcake holders (8)
small 2-speed electric fan
paper coffee filters (5)
stop watch

Procedure

Part I: The Big Drop (corresponds with questions 1-3)

1. Place one cupcake holder in your right hand, stand up, and extend your right arm as high as possible. Hold the stop watch in your left hand.
2. As you release the cupcake holder, start the stop watch to measure how long the holder takes to fall to the ground. Record the holder's falling time on a separate piece of paper.
3. Repeat the process, only release the cupcake holder from different orientations (sideways, bottom first, top first, and so on). Make sure to record your data.
4. Stack two cupcake holders together and repeat the process. Continue stacking more holders together until the stack contains all holders.
5. Repeat steps 1 – 4 with the coffee filters.

Part II: The Big Blow (corresponds with question 4)

1. Hold one coffee filter sideways about 18 inches in front of an electric fan. Make sure the fan blade guard is properly positioned and secured. Turn the fan on low and note the motion of the filter. Turn the fan off.
2. Repeat step 1, only with the fan on the high speed setting.

Questions

1. How did the orientation of the cupcake holders affect their falling time?

2. How did the stack size affect falling time? Propose a reason for their different falling times.

3. How did the falling time of the cupcake holders compare to that of the coffee filters? Propose a reason for their different falling times.

4. How did the motion of the coffee filter change when the fan was on the low speed as compared to the high speed? Provide a reason for the change in motion of the filter.

Wind Tunnel

Tunnel Vision

Some clever entrepreneurs have turned wind tunnels on their side to create "reverse skydiving" experiences for thrill-seekers. Instead of a sky diver free-falling out of an airplane, the wind tunnel's blast of air holds the sky diver in a stationary position a few feet above the propeller blades with the force of gravity pulling the diver downward being cancelled out by the upward force of the air lifting the diver upward.

Scientists and engineers test many different products in wind tunnels to improve product performance. Most people know that automobiles are wind tunnel tested; however a number of other products must face the rigors of high wind speeds. Rocket ships, missiles, roofing materials, and bridge models are commonly tested products that must hold up under wind speeds that exceed 100 miles per hour. In fact, missiles and rocket ships must be tested at speeds up to Mach 30, which is 30 times faster than the speed of sound (about 767 miles per hour).

A variety of wind tunnel types offers engineers multiple platforms for testing the drag associated with high winds or fast object speeds. Although modern tunnels are very different from the earlier versions, scientists have been using wind tunnels since the early 1700's to measure drag forces on moving objects. The NASA Ames Research Center, with its 80 by 120 foot-long tunnel currently holds the record for the world's largest wind tunnel.

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Answers: Page 2 Answers: 1) c, 2) d, 3) b, 4) a, 5) a. **Page 3 Answers:** Kind of a Drag – 1) Answers will vary. 2) Answers will vary. 3) The coffee filter should take longer to fall because of its larger surface area to mass ratio. 4) The coffee filter should have a greater change in moving at the high speed setting since drag is directly proportional to speed.

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