WATERCRAFT

DESIGN SQUAD™ PBS®

as built on TV™

pbs.org/designsquad

YOUR CHALLENGE

Design and build a boat out of straws and plastic wrap that can hold 25 pennies for at least ten seconds before sinking.

BRAINSTORM & DESIGN

Look at your materials and think about the questions below. Then sketch your ideas on a piece of paper or in your design notebook.

1. How will you make a boat that floats well enough to support a heavy load without sinking?
2. Should your boat be a platform (e.g., a raft or barge) or an open boat (e.g., a rowboat or canoe)?
3. What's the best way to make your boat waterproof?
4. How big do you need to make your boat to hold 25 pennies?

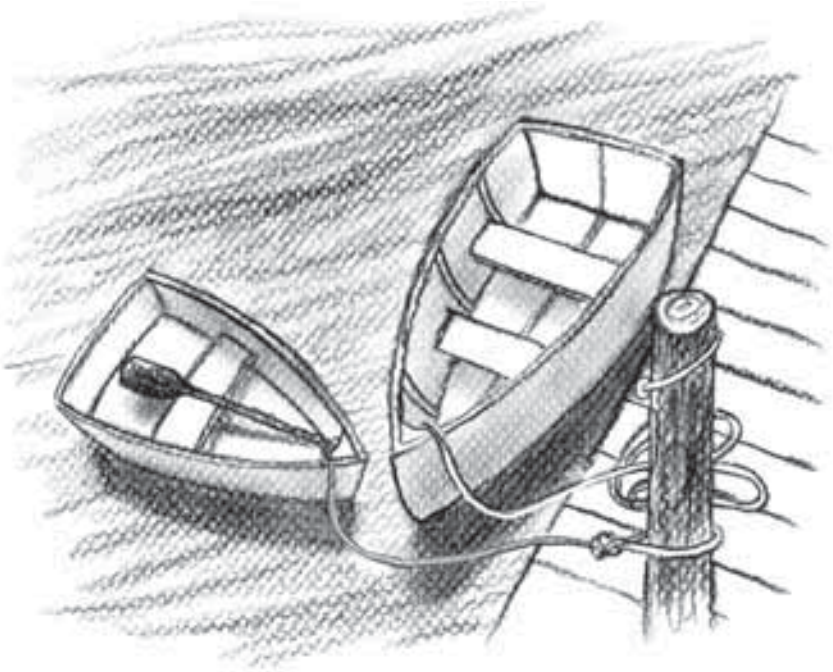
MATERIALS (per person)

- container filled with water (e.g., bucket, sink, plastic tub)
- duct tape
- paper cups (8-ounce or larger)
- 10-inch strip of plastic wrap
- 10 straws
- towels (paper or cloth)
- 25 pennies (or 15 standard, flat steel washers, at least 1 inch in diameter)

BUILD, TEST, EVALUATE & REDESIGN

Use the materials to build your boat. Then test it by floating it in a container of water and adding pennies, one at a time. When you test, your design may not work as planned. When engineers solve a problem, they try different ideas, learn from mistakes, and try again. The steps they use to arrive at a solution is called the ***design process.*** Study the problems and then redesign. For example, if the boat:

- sinks easily—*Increase its ability to float. When you set your boat in water, notice how it sinks down a bit, pushing aside some water. The water pushes right back, pressing on the boat's bottom and sides. The force from these pushes is called* ***buoyancy****. To change your boat's buoyancy, experiment with the boat's width and the height of its sides.*
- leaks a lot—*See if the straws are filling with water or if the plastic wrap is separating.*
- tips easily—*Check how near the weights are to each other. A boat can get tippy when one part is heavier than another.*



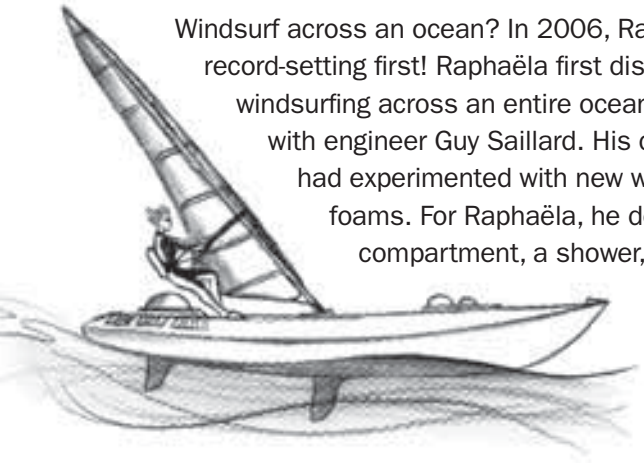
TAKE IT TO THE NEXT LEVEL

- Ready for some heavy lifting? Change your boat so it holds 50 pennies for at least ten seconds before sinking.
- Less is more! Build another boat that can hold 25 pennies, but use only half the amount of materials that you used for your first boat.

MAKE IT ONLINE

Underwater boat?
Build a self-propelled submarine out of 2 soda bottles, a rubber band, and 2 paper clips. See how on Make Magazine's project page at makezine.com/designsquad.

ENGINEERING IN ACTION



Windsurf across an ocean? In 2006, Raphaëla le Gouvello windsurfed 3,541 miles across the Indian Ocean—a record-setting first! Raphaëla first discovered windsurfing while on a family vacation. Soon, the idea of windsurfing across an entire ocean caught her imagination. To turn her dream into reality, she teamed up with engineer Guy Saillard. His challenge was to make her a sailboard she could live on. For years, Guy had experimented with new ways to use durable hi-tech materials such as epoxy resin, carbon fiber, and foams. For Raphaëla, he designed a strong, lightweight, 25-foot-long sailboard. It has a sleeping compartment, a shower, and its own satellite communication system—all the comforts of home. Or not! The cabin was only 8 feet long, 20 inches wide, and 31 inches high (slightly bigger than a coffin). If an engineer could build you the boat of your dreams, would you want to take a trip like Raphaëla's? Here's a snapshot:

- **Length of trip:** Two months.
- **Time sailed each day:** Seven hours.
- **Time spent sleeping:** Seven hours.
- **Weight of her first-aid kit:** 26 pounds.
- **Other things she did each day:** Send e-mail, check her course, get weather reports, talk to her support team by radio, relax, and make and eat meals.
- **Amount of water she used per shower:** A half gallon. The average shower in the US uses 18 gallons! Her boat only holds five gallons, but it has a solar-powered device that makes fresh water by taking the salt out of seawater.

DESIGN SQUAD PBS

Watch the DESIGN SQUAD PVC Kayak episode on PBS or online at pbs.org/designsquad.

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