

ZIP LINE



YOUR CHALLENGE

Design and build something that can carry a small object from the top of a zip line string to the bottom in four seconds (or less!).

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. Using these materials, what can you design that can carry a small object down a zip line?
2. How will your payload carrier stay on the zip line as it goes from the top to the bottom?
3. What kinds of materials should be in contact with the zip line so that the carrier slides quickly?

BUILD, TEST, EVALUATE & REDESIGN

Use the materials to build your carrier. Then make a zip line. Run the line between the back of a chair and a stack of books. Make sure the high end is about two feet above the low end. Test the carrier by putting it on the line. When you test, your design may not work as planned. The design process is all about “if at first you don’t succeed, then try, try again.” On *Design Squad*, we say, “Fail fast—succeed sooner!” Study the problems and then redesign. For example, if your carrier:

- keeps dropping the object—*Check that it has a big enough place to hold the ball.*
- stops partway down—*Make sure there’s nothing blocking your carrier where it touches the line.*
- doesn’t balance well—*Adjust the weights. Add weights or move them so they are farther below the zip line. Doing this changes the carrier’s **center of gravity**, the point within an object where all parts are in balance with one another. See how changing the numbers and positions of washers affects the carrier’s balance.*
- takes longer than four seconds to travel the zip line—*Find ways to reduce friction. Yes, there’s **friction**—the force that resists motion—even when you’re dealing with something as smooth as fishing line. You’ll find friction anytime things rub together. Experiment with different materials to see if you can reduce friction and speed up the carrier.*

as built on TV™
pbs.org/designsquad

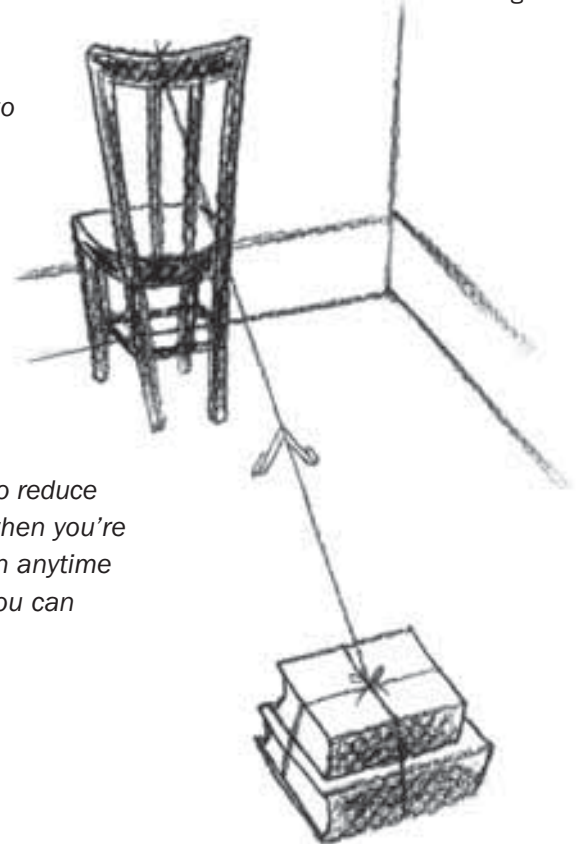
MATERIALS (per person)

Included in the kit

- Small plastic cups
- Plastic straws (either in the bag or from the straw tower activity)
- Scissors (misc bag)
- Smooth fishing line
- Cotton string
- Tape (straw tower bag)

Optional additional materials you might find at home

- Cardboard (from a cereal box or back of a notepad)
- Object to serve as payload (could be a ping pong ball, a small plastic figure, a small ball, etc.)
- Pennies to use as weights



TAKE IT TO THE NEXT LEVEL

- Slow down! Build a carrier that takes ten seconds to travel the length of the zip line.
- Piggyback time. Make a carrier that can hold several objects at the same time.
- Blast off! Find a way to turn out the object being carried when the carrier gets to the end of the zip line.
- On your mark. Get set. Go! Set up two zip lines and race different ball carriers.

MAKE IT ONLINE

Travel by blimp, anyone?

Build a jet-propelled blimp that can travel across a large room. Make it out of 2 balloons, 2 straws, and some clay and tape. See how on Make Magazine's project page at makezine.com/designsquad.



ENGINEERING IN ACTION

Ever want to zip up the side of a building like Batman or Spiderman? Now this superpower can be yours, thanks to engineer Nate Ball, host of *Design Squad*, and his friends. For a contest, they designed and built a climbing device that could carry a person 50 feet up the side of a building in less than five seconds. After months of work, the team tested their climber by lifting a 150-pound load of tires. Nate recalls, "After a few seconds, there was an awful sound. The gearbox exploded. The tires smashed to the ground with a huge crash." After analyzing the ruined climber, they made lots of changes and ended up winning third prize in the contest. Ultimately, they patented the climber and started a company to sell it. Today, soldiers, firefighters, and rescue workers around the world use the team's climber to fly up buildings. Now, those are *real* superheroes.



Watch the **DESIGN SQUAD Backyard Thrill Ride** episode on PBS or online at pbs.org/designsquad.



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