

# CHALLENGE 3 HARMLESS HOLDER



SHOW KIDS THE  
RELATED TV EPISODE



Photo: Parrish Kennington

To help out a group that runs an urban farm, the Design Squad teams compete to design the best compost lifter. Watch the "Green Machines" episode at [pbs.org/designsquad](http://pbs.org/designsquad).

Inventors and engineers work to make the world a better place.

## The invention challenge

Invent a holder for six cans that's animal-safe, sturdy, convenient, and easy to carry.

In this challenge, kids: (1) learn why discarded plastic rings can be a problem for wildlife; (2) examine plastic six-pack holders; (3) brainstorm animal-friendly ways to package six cans; and (4) follow the design process to invent a solution to the challenge.

### 1 Prepare ahead of time

- Read the leader notes and the challenge sheet.
- Get one or two plastic six-pack rings.
- Gather the materials (per team):
  - 6 full cans of soda, seltzer, or juice
  - duct tape
  - wax paper
  - cardboard (approx. 8.5x11 in.)
  - string
  - 4 paint stirrers
  - copier paper
  - 6 rubber bands
- Have sponges and towels on hand in case of spills.



### 2 Introduce the challenge (5 minutes)

To grab kids' attention, read the following story.

*It was getting all too common along the beach where she lived. Birds and turtles washing up on shore, tangled in the plastic rings used to hold drink cans together. Up ahead was just such a bird. Fortunately, it would live. With a snip of the girl's scissors, the plastic ring that was strangling the bird fell off. You know those plastic rings, the ones for carrying packs of soda cans. They may be strong, light, and easy to carry. But the trouble begins when they become trash.*

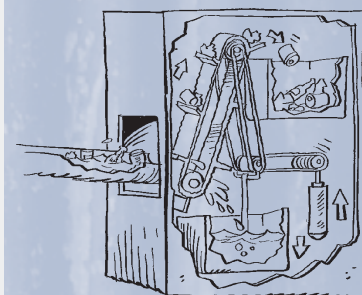


Birds, turtles, fish, and other sea creatures get tangled up in the rings of plastic beverage holders.

### 3 Warm up: Check out a plastic holder (10 minutes)

Pass around some six-pack holders and ask:

- How strong are the rings? How big? How stretchy? How easy to use?
- What are some advantages and disadvantages of plastic? (*Plastic is strong, waterproof, lightweight, easily molded, flexible, durable, and inexpensive. But when it's thrown in the trash, it never biodegrades, as paper, string, and wood do.*)
- Who would benefit from, or be interested in, having safe six-pack holders? (*Animals, of course, and manufacturers who want to offer a safe product, environmentalists, animal-rights groups, and consumers who buy "green" products*)

SHOW KIDS A RELATED  
INVENTEAM PROJECT

Storm water often contains debris, which can clog storm drains. More than an expensive problem, a clogged drain can be a health hazard. The Colfax High School InvenTeam invented a drain that separates out the debris and puts it into a trash can. Check out this project and others at [web.mit.edu/inventeams](http://web.mit.edu/inventeams).

Tell kids that animals get tangled in these plastic rings and can't get free. To have them experience this situation, have each kid slip a rubber band loosely onto his or her right wrist. Ask kids to try to remove it, using only their right hand. No fair using another body part, such as teeth or their left hand!



#### 4 Brainstorm design ideas (10 minutes)

To help kids brainstorm, show them the materials, discuss the questions below, and have them sketch some design ideas.

- The cans in a six-pack are all the same size and shape. Name some other containers that hold objects that are the same size and shape. (*Egg cartons, beverage trays, fruit cartons, a cash register drawer, tool racks, pencil holders, etc.*)
- You need to be able to carry the cans easily. What are some different kinds of handles used to pick up objects? (*Luggage handles, backpack straps, wheelbarrow handles, tops of milk cartons, etc.*)
- Do the cans have to sit in two neat rows of three? (*No. Kids can stack their cans or set them on their sides.*)
- How can you keep cans together? (*You can tie them together, loop them with rubber bands, stick them with tape, or set them on a tray made of cardboard or paint stirrers.*)
- How will you take one can out of your holder while still keeping the other five cans together? (*Leave an opening or make a way to pull the cans apart.*)
- Cans are heavy and will put a lot of force—pushes and pulls—on your holder. What are some ways a holder can resist such force? (*Using sturdy materials, reinforcing the joints where parts join together, and reinforcing the places where the cans put stress on the holder*)



During testing, we ended up with a variety of designs. These pictures show several possible solutions. But don't show them to kids—they're likely to copy the ideas they see.

## CHALLENGE THE STEREOTYPE

Tell kids that inventors and engineers work to make the world a better place. For example, point out that being “green” is important to people and that engineers and inventors look for ways to improve packaging systems to reduce litter and the need for raw materials as well as eliminate dangers to animals and the environment. Also show kids videos in which young engineers describe how engineering lets them lead interesting, exciting lives and do cool things. See them online at:

- [pbs.org/designsquad/profiles](https://pbs.org/designsquad/profiles)
- [web.mit.edu/inventteams/videos.html](https://web.mit.edu/inventteams/videos.html)

### 5 Build, test, and redesign (25 minutes)

To learn about a design’s strengths and weaknesses, inventors build a series of early designs called *prototypes*. During the building and testing of their prototypes, here are some problems your kids might face:

- **Six cans are too heavy for a design.** Even though a kid may have a good idea, it still may not support six full cans. Kids can strengthen their designs by reinforcing the sides or corners with cardboard, adding a layer of tape, or cutting slots and inserting materials into the slots.
- **The holder collapses when a can is removed.** Some designs use cans as part of the support system. When a can is removed, the holder caves in. Point out what’s happening and encourage kids to find ways to strengthen the holder so it doesn’t rely on cans.
- **A can opens.** We had spare cans for kids to use. We also had towels and sponges to wipe up any spills.
- **Kids want to drink the soda.** If you don’t want kids to drink, tell them you need the cans for another session or use cans of a drink they probably won’t like, such as tonic water or seltzer.

### 6 Discuss what happened (10 minutes)

Ask kids to present, compare, and discuss the prototypes they built today.

- Which features worked best for holding cans together? Picking them up? Carrying them?
- Which design is sturdiest? Lightest? Simplest? Uses the fewest materials?
- Your design had to withstand bending, twisting, and pushing. How well did your design resist these forces?
- What are some ways an improved holder could help the environment? (*An improved holder reduces litter, eliminates a danger to animals, and, if the design is reusable, reduces the need for raw materials.*)
- If an animal were to eat some of the materials you used today, it might still cause problems. How are these problems similar to or different from the problems caused by plastic six-pack holders?

## TINKER SOME MORE

As a follow-up or fun at-home project, ask kids to draw a design of a boat that skims trash off the surface of a river, lake, or ocean. Have them label the parts and give their invention a catchy name.

- What kind of vessel could do the job?
- What parts would it have?
- How would it move?
- How could it tell the difference between trash and other objects, such as animals and seaweed?
- How would it store and dump the trash?
- Could your machine double as a beach sweeper, sifting trash from sand? Explain.