

CHALLENGE 5

CONVENIENT CARRIER



SHOW KIDS THE
RELATED TV EPISODE



Photo: Helen Tsai

To help an aquatic dancer who's also an amputee, the Design Squad teams compete to design leg and hand prostheses for an underwater performance. Watch the "Water Dancing" episode online at pbs.org/designsquad.

Inventors are good at spotting problems and figuring out solutions.

The invention challenge

Invent a convenient way for someone using crutches or a wheelchair to carry small personal items.

In this challenge, kids: (1) experience some of the obstacles people on crutches face; (2) brainstorm ideas for carriers; (3) follow the design process to invent a solution to the challenge.

1 Prepare ahead of time

- Read the leader notes and the challenge sheet.
- Gather the materials (per session):
 - 1 armchair (represents a wheelchair)
 - crutches (at least one pair; more, if possible)
 - 4 cardboard sheets per team (approx. 8.5x11 in.)
 - 20 8-oz. paper cups
 - copier paper
 - rubber bands
 - string
 - duct tape
- To stand in for fragile personal items (e.g., a cell phone, remote control, glasses, and music player), collect items such as a book, pack of index cards, paper cup, CD case, soda can, deck of cards, and keys for kids to use.

2 Warm up: Do a "Life on Crutches" experience (10 minutes)

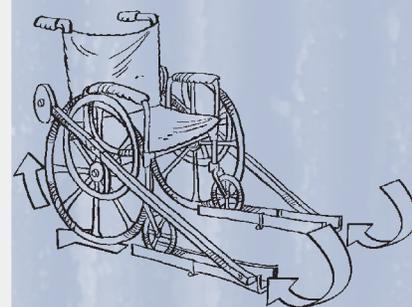
Have kids experience some of the obstacles people on crutches face. If possible, use actual crutches. But you can do the following to simulate using crutches. Give each kid two magazines, newspapers, or pieces of paper. Have them place the objects under their upper arms, holding them in place by pressing their upper arms to their body. Then ask kids to stand on one leg. This awkward posture simulates how much a pair of crutches affects one's movement. Next, hand each kid a lunch tray or flat sheet of cardboard. Place a paper cup on it. Have them pass the cups back and forth, keeping the crutches (or papers) in place. Ask them to take five steps (hops, really), holding the tray and not letting the cup fall. Collect the materials and have the kids sit down. Discuss what simple tasks would be hard or impossible to do on crutches? (*Talk on a cell phone, shake hands, drink a soda, tie shoes, carry objects, get onto a bus, go up stairs, etc.*)

3 Introduce the challenge (5 minutes)

To get kids focused on the need for devices to improve the lives of people living with disabilities, read the following news story.

One moment, teenager Carlana Stone was a gymnast and cheerleader. The next moment, she was destined for life in a wheelchair. After a car accident, both her legs were permanently paralyzed. Using only her upper body, she learned how to take showers, open doorways, and get in and out of cars and bed. Through her determination, Carlana learned to do far more difficult tasks. Even without the use of her legs, she became a skydiver, skier, scuba diver, and airplane pilot! Professionally, she landed a job as a TV reporter, broadcasting stories from all over Miami, Florida while sitting in a chair.

SHOW KIDS A RELATED
INVENTEAM PROJECT



The Americans with Disabilities Act requires all curbs to have cutouts for wheelchairs; however, many don't. To help, the Ardsley High School InvenTeam invented a device that attaches to a manual wheelchair and enables it to climb a curb. Check out this project and others at web.mit.edu/inventeams.

4 Brainstorm design ideas (10 minutes)

People who use crutches or wheelchairs have their hands occupied much of the time. This can make it difficult to carry lots of small personal items. Inventors like solving this kind of problem because it addresses a real need and has many interesting solutions. Tell kids that today's challenge is to invent a carrier for an assortment of personal items to be used by people in wheelchairs or on crutches. To help them brainstorm design ideas, ask the questions below.

- What kind of stuff do people carry with them in their daily lives? *(Cell phone, glasses, music player, sunglasses, keys, book, snack, drink, CDs, cup, purse, remote control, wallet, etc.)*
- What are some different types of holders? *(Pencil holders, backpacks, pockets, cup holders, purses, pouches, cans and bottles, drawers, etc.)*
- How could these holders be adapted for use by people in wheelchairs or on crutches?
- Look at the materials for today's challenge and sketch some different carrier designs.



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 think of creative ways to improve people's lives. For example, they develop carriers to help people using wheelchairs or crutches keep their personal items accessible and organized. 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
- web.mit.edu/inventteams/videos.html

5 Build, test, and redesign (25 minutes)

During testing, we encountered some problems that your kids might also face:

- **So many possibilities**—The number of options can overwhelm some kids. Should my carrier be for crutches or wheelchairs? Should it be specialized for particular items or used in general? Once we pointed out that each option would solve a problem and all were good ideas, they were able to choose a design and focus on building a prototype of it.
- **Carrier designs are all alike**—Carriers don't always have to attach to the wheelchair or crutch. In our testing, one kid designed a carrier that hangs around a person's neck.
- **Tray on the arm of a chair (or wheelchair) won't stay level**—A tray can sag or droop if it isn't firmly attached. To keep it level, have kids increase the amount of tray in contact with the chair's arm; position the tray so the chair's arm is closer to the middle; and use string, columns, or bracing to support the tray. Encourage kids to have the tray swing or lift out of the way to avoid making it hard to get in and out of the chair.

6 Discuss what happened (10 minutes)

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

- How did experiencing what it's like to be on crutches influence your design?
- How easy is it to attach and remove your carrier?
- Which carriers are easiest for putting in and taking out the items?
- If your carrier fell off easily or was unsteady, how did you redesign it? (*Increased the area of the base, centered the weight, used stronger or tighter fasteners, etc.*)

TINKER SOME MORE

(1) Brainstorm ideas for improving the usability of wheelchairs and crutches.

- How can you modify crutches so they'll work on a muddy field?
- How could a wheelchair climb stairs or over obstacles?
- How could a person in a wheelchair be at eye level with a person who's standing?
- Design crutches with heated handles that can be removed in the summer.
- Design crutches that collapse for storage or easy carrying.
- Design a wheelchair with a sunshade.

(2) Visit the following Web sites and show kids innovative assistive devices:

- **The Hampshire College Lemelson Center**
hampshire.edu/lemelson
- **Junior Engineering Technical Society**
jets.org/programs/nedc/index.cfm