

BUILD A BOAT

Volunteer Instructions • Girl Scout STEM Workshop • K–12

Workshop goal: Participants design and build a small boat from simple materials, then test how well it floats and how much weight it can carry. The emphasis is on **design, testing, iteration, and teamwork**—not on making a perfect boat.

MATERIALS & SUPPLIES — KEEP IT SIMPLE

For each small team	Suggested amount
Aluminum foil	2–3 sheets, about 12 × 12 in each
Drinking straws	4–8
Craft sticks / popsicle sticks	8–12
Masking tape or painter's tape	1–2 ft
Paper cups or small plastic cups	1–2 for measuring/testing water
Pennies, plastic counters, or large washers	10–30 per team for cargo
Tub, basin, or large plastic container	1 testing station
Water	Enough to fill testing container
Paper towels	For spills
Pencils + worksheets	1 per participant

Optional substitutions: index cards or cardstock for craft sticks; string for straws; plastic tubs or clean food containers for the test tank. You do not need every material listed—the challenge works with just foil + tape + cargo + water.

BEFORE THE TROOP ARRIVES

- **Set up one testing station** with a shallow tub or basin of water. Place it where spills are easy to clean.
- **Prepare material stations** rather than giving each participant a large pile. This encourages teams to make design choices.
- **Choose a cargo item.** Pennies are convenient, but plastic counters or large washers are reusable. For K–2, use larger items when possible and supervise small objects closely.
- **Decide the challenge level.** Younger groups can focus on “Will it float?” Older groups can measure cargo capacity, stability, or efficiency.
- **Print one worksheet per participant** (or one per team for very young participants).

THE CHALLENGE

Mission: Design and build a boat that floats and carries as much cargo as possible. You will have a limited amount of material, so you must make choices about shape, size, strength, and balance.

SUGGESTED 45–60 MINUTE FLOW

Time	Activity	Volunteer focus
5 min	Introduce the challenge	Ask: What makes a boat float? What makes one tip over?
5–10 min	Plan	Have teams sketch or describe their idea before building.
15–20 min	Build	Let teams experiment. Resist fixing designs for them.
10–15 min	Test	Place boats gently in water, then add cargo one piece at a time.
5–10 min	Improve + retest	Ask teams to change one thing and test again.
5 min	Share	Celebrate different solutions and discuss what the tests showed.

HOW TO RUN THE BUILD

1. Introduce the problem

Explain that engineers often build, test, discover a problem, and improve their design. There is no single correct boat shape.

2. Plan first

Have participants draw a quick design. Ask what part will touch the water, where cargo will go, and how the boat will stay balanced.

3. Build

Give teams their materials and a clear build time. Encourage them to use only the materials provided.

4. Test gently

Place each boat on the water. Add cargo slowly, preferably one item at a time, until the boat becomes unstable or sinks.

5. Record results

Have participants record the number of cargo items their first design carried.

6. Improve

Challenge them to change one feature—such as the bottom shape, width, sides, or cargo placement—then test again.

7. Compare

Ask what changed and whether the result improved. A failed design is useful information if the team learned something from it.

VOLUNTEER GUIDE: FACILITATING THE ENGINEERING

GOOD QUESTIONS TO ASK

- What do you notice about boats that stay upright?
- Where do you think the weight should go?
- What could make your boat wider or more stable?
- What happens when you add cargo in one spot instead of spreading it out?
- What is one thing you could change without rebuilding the entire boat?
- What did your test teach you?
- How is your second design different from your first?

KEY IDEAS TO EXPLAIN — ADJUST FOR AGE

Age range	Keep the explanation focused on...
K–2	Floating and balance: A boat needs to displace water and stay balanced. Try different shapes and see what happens.
3–5	Shape and stability: Wider bottoms and spreading weight can help a boat stay upright. Testing gives evidence about which design works better.
6–8	Forces and variables: The boat experiences an upward buoyant force and downward weight. Changing hull shape, mass, and cargo placement changes performance.
9–12	Engineering optimization: Discuss buoyancy, displacement, stability, constraints, variables, tradeoffs, and iterative design. Consider cargo capacity relative to material used.

TESTING RULES

- Use the same cargo item for all teams if you are comparing results.
- Add cargo gradually and consistently. Count the last successful load before the boat sinks or becomes too unstable to continue.
- If a boat absorbs water or falls apart, record what happened rather than treating it as simply “wrong.”
- For a fair competition, give teams the same amount and type of building material and the same test conditions.
- If time is short, skip the competition and focus on one build → test → improve cycle.

SAFETY & CLEANUP

- Wipe up water promptly to reduce slipping hazards.
- Supervise the water-testing station, especially with younger children.
- Small cargo pieces such as pennies are choking hazards; keep them supervised and use larger alternatives with very young participants.
- Do not require participants to put materials or water in their mouths.
- Dry and store reusable materials after the workshop.

OPTIONAL EXTENSIONS

- **Capacity challenge:** Which design carries the most cargo?
- **Efficiency challenge:** Which design carries the most cargo using the least material?

- **Stability challenge:** Which design stays upright when cargo is moved from side to side?
- **Fair-test challenge:** Change only one feature between tests and explain why that makes the comparison more useful.
- **Real-world connection:** Discuss how engineers design boats, ships, floating platforms, and other structures under constraints.

Volunteer reminder: The goal is not the “best-looking” boat. The goal is for participants to practice asking questions, making predictions, testing ideas, learning from results, and improving a design.