

Build a Boat Challenge - Elementary School Level

Reasoning: This activity challenges kids to build a weight bearing boat. Part of the design of many ships or submarines is being able to carry people. Kids will be given a variety of materials and must use their problem-solving skills to build a boat that can float and then once it floats it must be able to bear weight.



Materials per team:

- | | |
|-----------------------------|--|
| -Straws (10) | -Pencil |
| -Cups (4) | -Duct Tape (Optional) |
| -Saran Wrap (1 ft) | -Storage bin with water or body of water |
| -Scissors | -Weights or Pennies |
| -Paper (for sketching only) | -Scale (Optional) |
| -Masking Tape (1 yd) | |

Procedure:

1. Put kids into teams of 2 or 3.
2. Have them draw out a plan of what they want their boat to look like.
3. Review and check proposed design.
4. Give them materials to build their boats.
5. Announce time limit for construction (Recommended: 15 minutes)
 - a. Observe progress: if more time is needed add 5 minutes.
6. Have them put their boats in the water to see if they float.
7. If the boats float add weights/pennies and see whose boats can hold the most pennies.
 - a. Optional: Use scale to measure exact weight carried by each boat.
8. Optional: Give time for students to redesign and test based on feedback.
9. Hold discussion about successes and areas for improvement.

Troubleshooting/Guide:

Some kids may struggle to think of how to make something that will float. To help them you can show pictures of other versions of the activity or ask questions about what you think is important to make the boat function. Consider bringing the materials over to the water and allowing them to interact with the water and the materials so they can see how that works.



Discussion Questions (to be asked after or throughout):

Why do you think boats need to hold weight?

What do you think is important to keep the boats floating?

If their boat doesn't work: Do you think there's a different way you can try this to make it work?



Build a Boat Challenge - Middle School Level

Reasoning: This activity challenges kids to build a weight bearing boat and introduces them to build cost and planning. Part of the design of many ships or submarines is being able to carry people. Kids will be given a variety of materials with assigned cost and must use their problem-solving skills to build a boat that can float and bear weight.

Materials - see Bill of Materials (BOM) for cost:

- | | |
|-----------------------------|--|
| -Straws | -Plastic Bag |
| -Cups | -Pencils |
| -Saran Wrap | -Popsicle Sticks |
| -Wax Paper | -Duct Tape (Optional) |
| -Scissors | -Storage bin with water or body of water |
| -Paper (for sketching only) | -Weights or Pennies |
| -Masking Tape | -Scale (Optional) |
| -Rubber Bands | |

Procedure:

1. Put students into teams of 2 or 3.
2. Pass out BOM cost and order sheets.
 - a. Set a cost limit of at least \$45 or no limit.
3. Have them draw out a plan of what they want their boat to look like and fill out their BOM.
4. Fulfill their “purchase” to build their boats.
5. Announce time limit for construction (Recommended: 15 minutes)
 - a. Observe progress: if more time is needed add 5 minutes.
6. Have them put their boats in the water to see if they float.
7. If the boats float add weights/pennies and see whose boats can hold the most pennies.
 - a. Optional: Use scale to measure exact weight carried by each boat.
8. Optional: Give time for students to redesign and test based on feedback.
9. Hold discussion about successes and areas for improvement.

Discussion Questions (to be asked after or throughout):

- What do boat designs need to be effective?
- What do you think is important to keep the boats floating?
- What materials do you need vs. want?
 - How is this material going to make your design better?
- If their boat doesn't work-do you think there's a different way you can try this to make it work?

Cost Sheet - Middle School

Unit Cost	Build Material
\$0.75	Straw (3 pcs)
\$1.00	Cardboard
\$0.25	Plastic Bag
\$1.00/yard	Wax Paper
\$1.00	Plastic Cups (2 pcs)
\$2.50	Popsicle Sticks (7 pcs)
\$2.00/yard	Plastic Wrap

Unit Cost	Fastening Material
\$0.25	Rubber Bands
\$2.00/yard	Plastic Wrap
\$2.50/yard	Duct Tape
\$1.25/yard	Masking Tape



Bill of Materials - Order

Max Cost: \$

Team Name: _____

Part Name	Quantity	Cost	Total Cost
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
Total Build Cost			\$
Amount Under Budget			\$

Build a Boat Challenge - High School Level

Reasoning: This activity challenges students to build a boat and start understanding concepts such as cost benefit analysis. Students will be provided with the “cost” of various materials and put into groups where they will design their vessel and put together a bill of materials. After the ships have been built, a barrier will be erected to simulate decreased visibility in the ocean and students will act as sonar with the goal of targeting the opposing teams ship.

Materials - see Bill of Materials (BOM) for cost:

-Straws	-Paper	-Cardboard	-Nerf Gun 1 & 2
-Cups	-Pencil	-Hot Glue	-Slingshot
-Balloon	-Plastic Bag	-Duct Tape (Optional)	-Ping pong balls
-Saran Wrap	-Popsicle Sticks	-Weights or Pennies	-Storage bin with water or body of water
-Scissors	-Wax Paper	-Rubber Bands	-Scale (Optional)

Pre-prep

1. Set up a sonar grid in an open area using masking tape or chalk.
2. Plug in hot glue guns to heat.

Procedure:

1. Put students into teams of 3-4.
2. Pass out BOM cost and order sheets.
3. Have them draw out a plan of what they want their boat to look like and fill out their BOM.
4. Fulfill their “purchase” to build their boats.
5. Announce time limit for construction (Recommended: 20 minutes).
 - a. Observe progress: if more time is needed add 5 minutes.
6. Have them put their boats in the water and add weights to simulate passengers on the boat.
7. Erect barrier, explain basic sonar concept, and have teams position their boat.
8. Facilitate “battleship”
 - a. Have each team assign a sonar person and a projectile “shooter”.
 - b. The sonar person is allowed one statement to describe the position of the target and the shooter is allowed one opportunity to shoot.
 - c. Have each team switch off, first to 3 hits wins.
 - d. Depending on time limitation, first to hit within XX minutes may be more effective.
9. Discuss various STEM aspects of the activity.
 - a. For example: Projectile motion, Newton's laws, etc.
10. Hold discussion about successes and failures

Discussion Questions (to be asked after or throughout):

- What physics concepts do you think were most relevant to this activity?
- Do you think you should consider what your competitors are doing when you are developing your own product?
- What makes a projectile and attack successful?

Cost Sheet - High School

Unit Cost	Build Material
\$0.75	Straw (3 pcs)
\$1.00	Cardboard
\$1.00	Balloon
\$0.25	Plastic Bag
\$1.00/yard	Wax Paper
\$1.00	Plastic Cups (2 pcs)
\$2.50	Popsicle Sticks (7 pcs)
\$2.00/yard	Plastic Wrap
\$1.00	Ping Pong Balls (3 pcs)

Unit Cost	Fastening Material
\$0.25	Rubber Bands
\$2.00/yard	Plastic Wrap
\$2.50/yard	Duct Tape
\$1.25/yard	Masking Tape
\$2/minute	Hot Glue Gun

Unit Cost	Projectile
\$25.00	Nerf Gun 1
\$30.00	Nerf Gun 2
\$15.00	Slingshot
\$8.00	Ping Pong Balls



Bill of Materials - Order

Max Cost: \$

Team Name: _____

Part Name	Quantity	Cost	Total Cost
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
		\$	\$
Total Build Cost			\$
Amount Under Budget			\$