

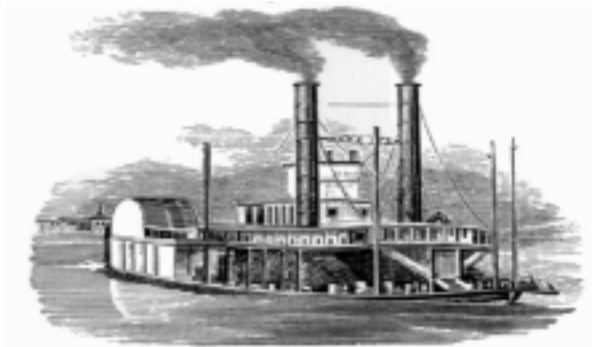
Hull Design

by

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Buoyancy:	The upward force a liquid exerts on an object less dense than itself.
Hull:	The frame or body of a ship.
Draft:	The depth of a boat's hull below the water line.

Webster's Dictionary



Context:

One of the earliest forms of transportation to be developed was **marine or water transportation**. The first boats were probably made out of logs either lashed together to form rafts or dug out logs to form primitive boats. As technology improved new boats and forms of power were discovered. The science of mechanics and fluids (how boats move) is called **hydrodynamics**. This science has made it possible for ships to carry larger cargos, travel farther, and travel faster than ever before.

A boat's ability to float is called **buoyancy**. As a boat is on the water it creates a force that pushes down because of gravity. Water also creates a force that pushes up on the boat. If the force of the water pushing up on the boat is greater than the force of the boat pushing down, then the boat will float.

In order for a boat to transport cargo, it also needs to be able to remain stable in the water. **Stability** is the ability of a boat to remain upright in the water. If the boat does not stay upright in the water, then the cargo on the boat will fall off. **Hulls** are designed to keep a boat floating and upright. There are two main types of hulls. **Flat/Planing hulls** are used to transport cargo in shallow waters and ride higher on the surface of the water. **Displacement hulls** include rounded hulls or v-shaped hulls. These hulls displace the water allowing the boat to float and ride lower in the water.

Objectives:

By the end of this activity you should be able to:

- Explain what factors influence a boat's buoyancy/draft
- Work in a group to design a functional boat that will carry an identified cargo
- Test and record your data from the boat (hull) activity



Challenge:

Your challenge is to design and fabricate a boat out of Styrofoam that will carry a provided cargo (a film canister filled with sand) the length of a water tank without tipping.



Figure 1. Waterway with a towing system

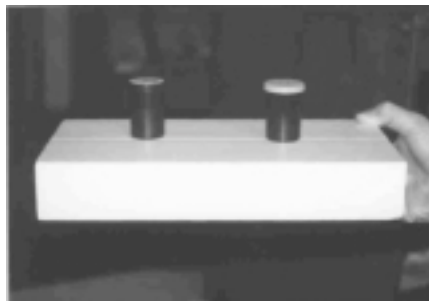


Figure 2. Sample Cargo

Materials / Equipment

List:

Styrofoam Stock
Scissors / Knife
Glue
Pencil
Ruler
Styrofoam Hot Wire
Cutter
Abrasive Paper
Water Tank

Procedure:

1. The teacher will divide the class into teams of three.
2. Brainstorm and draw at least 5 rough sketches for your boat(hull).
3. Select a design to use for your project and make a final sketch.
4. Receive approval on the design from the instructor.
5. Build your boat.
6. Test your boat in the water tank with the eye-hook the instructor provides.

7. Finalize your boat design.

8. If any changes are made, record them in your daily log with other data.

9. Race and record your boat's performance in the waterway.

10. Remember to write in your log at the completion of each day.

Evaluation:

See attached rubric

References:

McLaughlin, C. (1998). Hull design activity. Muncie, Indiana: Ball State University.

Johnson, S. R. and Farrar-Hunter P. A., (1993), Exploring transportation. South Holland, Illinois: Goodheart-Willcox.

About the Authors

Mr. Phelps is a Technology Education major and Mr. Robinson is an Elementary Education Major with an emphasis in Technology Education. Both are students at Ball State University. This article is based on an activity that was originally developed in a methods class at Ball State. The material for this article was further developed in coordination with Mr. Mike Fitzgerald of Driver Middle School.

Four Examples of Hull Designs

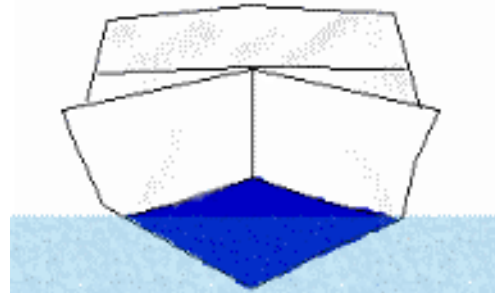
http://sites.state.pa.us/PA_Exec/Fish_Boat/julaug99/boathull.htm



Flat-bottom boats

The one thing you can say about flat-bottom boats is that with their large bottom area, the boat is very stable in calm weather. Characteristically, however, the flat, broad bow area creates a rough ride. These boats are usually limited to low horsepower motors because they don't handle well at high speed. Flat-bottom boats are greatly suited for fishing in skinny water from the Susquehanna River to the Florida Keys, where a very shallow draft is a must.

Early in our nautical history, boats were powered by wind or by hand-stroked oars. Early boat designers found that boats went faster, and were easier to steer, if the bow was pointed. They also soon discovered that by lowering the center of gravity, the high sail masts had better balance, and usually kept the boat upright even in bad weather.



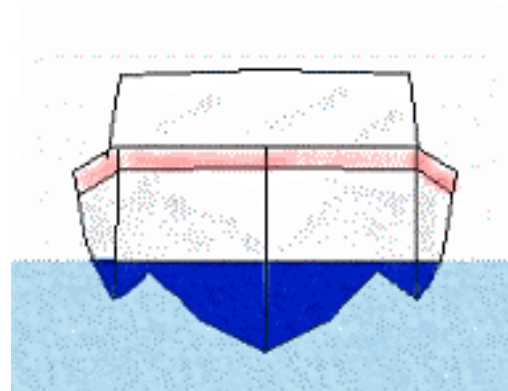
“V” – Bottom boats

The “V”-bottom boat is probably the most common hull design. Most manufacturers of boats built today use modifications of this design. This design offers a good ride in rough water as the pointed bow slices forward and the “V”-shaped bottom softens the up-and-down movement of the boat. The degree of the angle of the “V” is called “deadrise.” As the “V” shape extends to the back of the boat, it usually flattens out until it all but disappears at the transom. Some “V”-bottom boats have a flat surface at the very bottom called a “pad.” This pad allows a little more planing surface and at the sacrifice of a little softness in the ride, but this addition increases top speed.



Rounded Bottom Boats

The round-bottom boat has mostly a displacement hull and is usually used for dinghies, tenders, and some car-top boats. This boat style is usually easier to maneuver at slow speeds than the flat-bottom boat.



Tri – Hull Bottom Boats

There are many boats that have a distinct modification of the “V”-bottom. They are called tri-hulls and cathedral hulls. The tri-hull boat is the traditional “V” hull with additional outside hulls. This design is more stable than the “V”-bottom at rest, but it gives a rougher ride in choppy water because of the increased surface at the bow.

Hull Design Worksheet Templates

These pages are designed to be enlarged to 8.5" x 11"

Directions: Each team must complete a minimum of 5 sketches.
 Names: _____ Date: _____

Rough Sketches

Daily Log Sheet

Groups will record what they accomplished each day
 Minimum of 3 complete sentences per day of recorded data.

Monday	
Tuesday	
Wednesday	
Thursday	
Friday	

Directions: Each team must have one final design presented in the box below.
 Make sure your drawing is clean, neat, in pencil, and closely resembles the boat that will be tested.
 Names: _____ Date: _____

Final Design

Hull Design

Evaluation Sheet

Names: _____ Date: _____
 _____ Group #: _____

1. Rough Sketches (minimum of five designs) (5pts) _____
2. Final Drawing (10pts) _____
 Is it clean, neat, and in pencil
 Resembles the boat that was tested
3. Creativity / Originality (5pts) _____
4. Daily Log Sheet (completed every day) (5 pts) _____
5. Vehicle Completed Run Without Tipping (10pts) _____

Additional Bonus Points as Voted by the Class

1. Most Creative = 3 pts
2. Best Built = 3 pts
3. Fastest = 3 pts

The best time from two runs will be used.

Boat Run #1 Time: _____
 Boat Run #2 Time: _____