

**ARE YOU
ON
THE LEVEL?**



**SMALL BOAT
STABILITY**

This booklet is intended for you the boater who are just beginning to enjoy recreational boating. The facts in this booklet are selected to suggest ways for dealing with loading and operating small boats.

Here is what you will find inside:

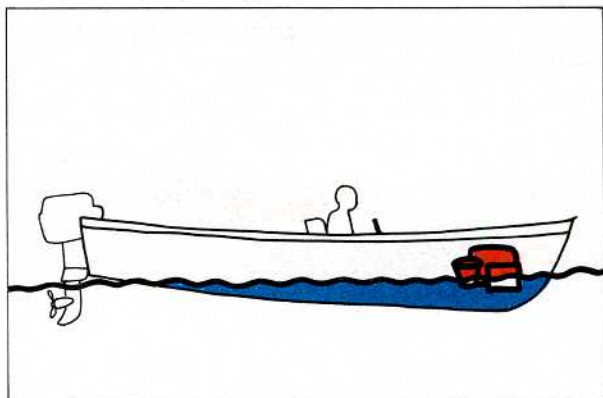
- why your boat is stable or not stable;
- what factors affect "rolling" or a boat;
- what are some tricks for loading your boat so that it is as seaworthy as possible;
- how to determine "freeboard" of your boat and how freeboard is affected by load and water conditions;
- some things to consider about stability while operating your boat.

You may find it more convenient to begin by reading through a list of words and their definitions at the back of this booklet. These words are used all through the booklet and may have their own meanings when used in boating.

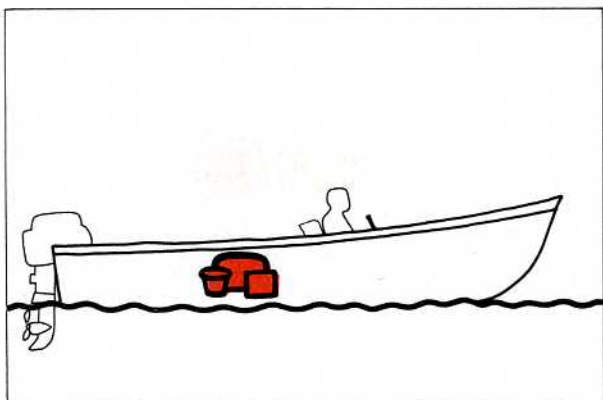
A boat's stability is equated with balance. It is affected by boat size and type of hull, by the distribution of load the boat will carry, by trim and motion of the boat, and by movement of persons within the boat. Some of the movements which will affect your boat's stability are standing, casting while fishing, and moving from one position to another in the boat. While you can move fairly freely on large boats, movement around small boats must involve thinking on everyone's part. Many small boats will capsize (turn over) without adequate warning.

All movements by persons should be made slowly with the intent of keeping the boat in balance. It is important to keep the boat in balance fore and aft as well as side to side to maintain the most stability possible.

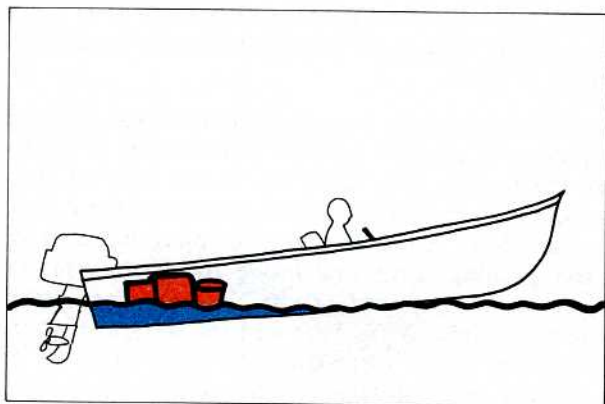
Here is how the small boat is affected by loading of equipment or persons.



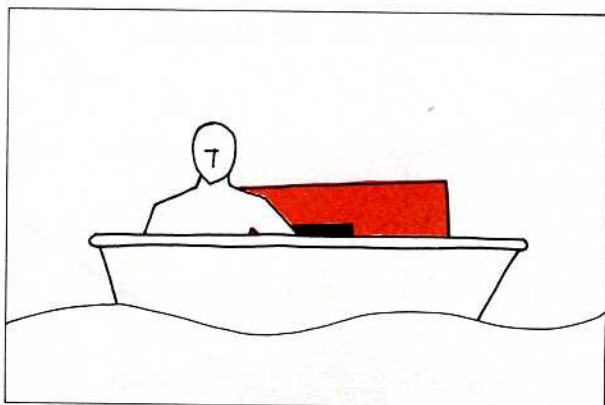
This boat is "down by the bow," and is more easily capsized when the operator turns either left or right.



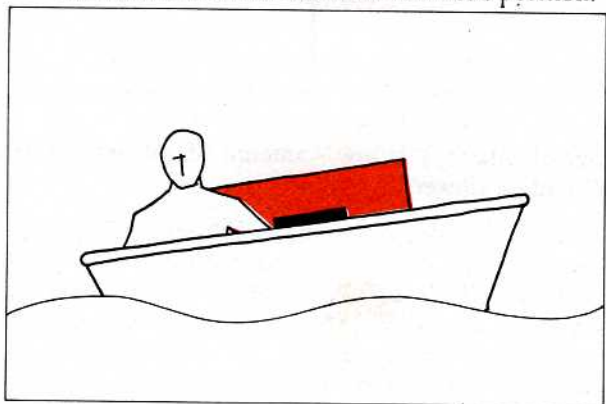
This boat is trimmed and in a balanced position.



This boat is "down by the stern." Water can more easily enter from the stern and swamp (flood) the boat. Operator visibility is lowered.



This boat is trimmed and in a balanced position.

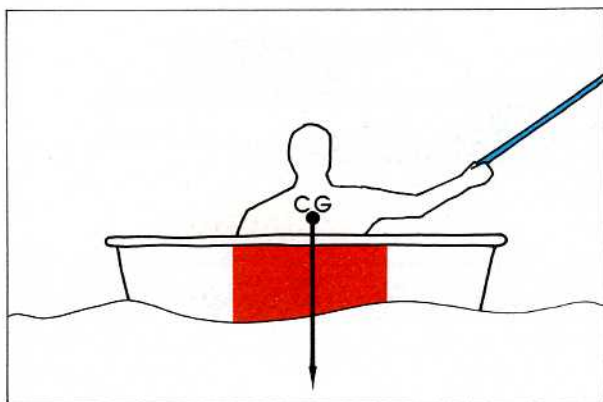


This boat is off balance "heeled to starboard."

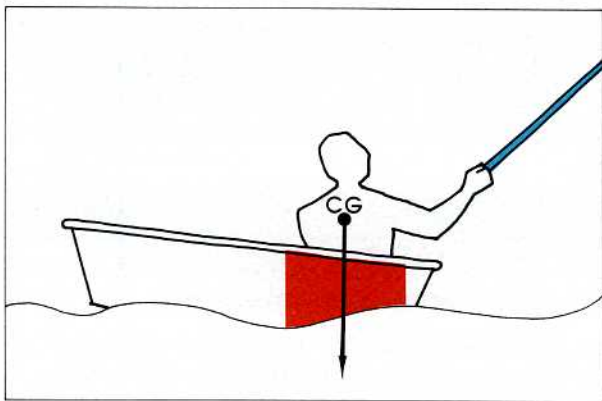
Roll is one of several natural motions of a boat. It is the side to side rotation of the boat in the water, and varies considerably for different types of hulls.

The rolling of a boat results from two natural forces acting on the boat - buoyancy and gravity. It is the combination of these forces that causes the boat to roll. Buoyancy is the upward force that allows the boat to float. Gravity is the downward force that keeps the boat in the water. A boat can be made more stable by keeping the load and persons down low inside the boat. This has the effect of lowering the center of gravity. The center of gravity is a point where the weight of the boat and the weight of everything on board could be placed to produce the same effect on stability as if the weight were distributed throughout the boat. Both horizontal and vertical distribution of weight in the boat help establish the center of gravity.

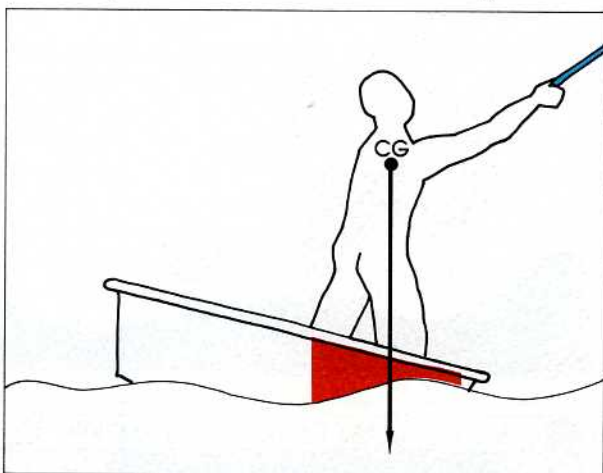
Roll stability is greatly affected by the height of the center of gravity so it is important to know where this is with respect to the boat, water conditions, load, and passengers.



CG (Center of Gravity) is low - amount of roll will be less and rate of roll will be slower.



Weight unevenly distributed horizontally.
(CG too far to one side of center)



Weight distributed too high vertically.
(CG too high above boat - rate of roll
will be faster and less controlled)

Placing weight to one side of the center line of a boat (or shifting the weight horizontally) will make the boat roll to one side. Increasing the height of the center of gravity such as standing (or shifting the weight vertically) will also cause the boat to roll and become less stable. Any movement can affect your boat's stability, so move about slowly and carefully in the boat.

Loading and capacity primarily refer to the weight of persons, fuel, gear, etc., that can be carried safely. The number of seats in a boat is *not* an indication of the number of persons it can carry safely. The number of people a boat can safely carry depends on such characteristics as the hull volume, and the size of the boat. Normally, seating is designed to provide a variety of seating positions.

Overloading beyond hull capacity will cause the boat to sit lower in the water which will have an effect of unpredictability on stability. The boat low in the water also increases the danger of even small waves and wakes coming in over the sides or over the stern.

Boats under 20 feet in length with a few exceptions must now display a U.S. Coast Guard capacity plate which states the total weight and weight of persons that can be safely carried on board.



U. S. COAST GUARD CAPACITY INFORMATION

MAXIMUM PERSONS CAPACITY (POUNDS) **1200**

MAXIMUM WEIGHT CAPACITY
(PERSONS & GEAR) (POUNDS) **1495**

THIS BOAT COMPLIES WITH U. S. COAST GUARD SAFETY
STANDARDS IN EFFECT ON THE DATE OF CERTIFICATION

MANUFACTURER:


MODEL:

**DESIGN COMPLIANCE WITH THE FOLLOWING
BIA CERTIFICATION REQUIREMENTS IS VERIFIED**

LOAD CAPACITY • BASIC FLOTATION
NAVIGATION LIGHTS • STEERING SYSTEM
COMPARTMENT VENTILATION • FUEL SYSTEM
ENGINE AND DRIVE NOT TO EXCEED 1105 LBS.

 **BOATING INDUSTRY ASSOCIATIONS**

Capacity plate for inboards, etc.

U. S. COAST GUARD CAPACITY INFORMATION	
MAXIMUM HORSEPOWER	7.5
MAXIMUM PERSONS CAPACITY (POUNDS)	360
MAXIMUM WEIGHT CAPACITY (PERSONS, MOTOR & GEAR) (POUNDS)	500
THIS BOAT COMPLIES WITH U. S. COAST GUARD SAFETY STANDARDS IN EFFECT ON THE DATE OF CERTIFICATION	
MANUFACTURER:	<input type="text"/>
MODEL:	<input type="text"/>
COMPLIANCE WITH THE FOLLOWING U.S. COAST GUARD REQUIREMENTS AND/OR BIA RECOMMENDATIONS IS VERIFIED	
LOAD AND H.P. CAPACITY • BASIC FLOTATION	
COMPARTMENT VENTILATION	
	BOATING INDUSTRY ASSOCIATIONS

Capacity plate for outboards.

If a capacity plate is not displayed in your boat, a rough estimate for determining the number of persons you can safely carry in good weather conditions is obtained by multiplying the overall length of the boat (L) by the maximum width of the boat (W) and dividing by 15. If the answer is a whole number and a fraction, round it down to the nearest whole number. For example if your boat is 18 feet long and five-and-a-half feet wide, in good weather and water conditions, you could safely carry six people weighing an average of 150 pounds each.

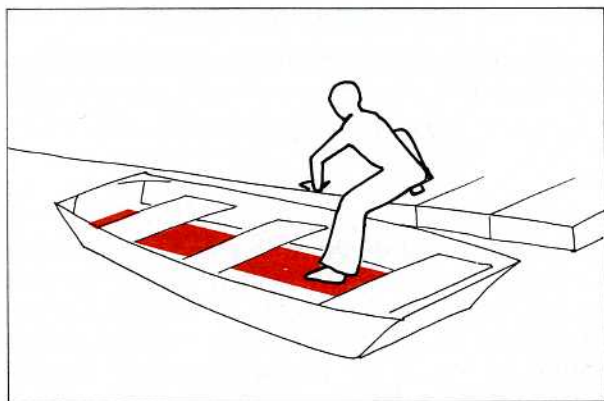
$$\frac{L \times W}{15} = \frac{18 \times 5.5}{15} = 6.6 = 6 \text{ persons}$$

Remember, this number is determined assuming that the engine is of the recommended size, that there is a normal amount of fuel aboard, and normal amounts of equipment and supplies on board. For rough weather conditions, it is important to carry considerably less than the maximum allowable weight.

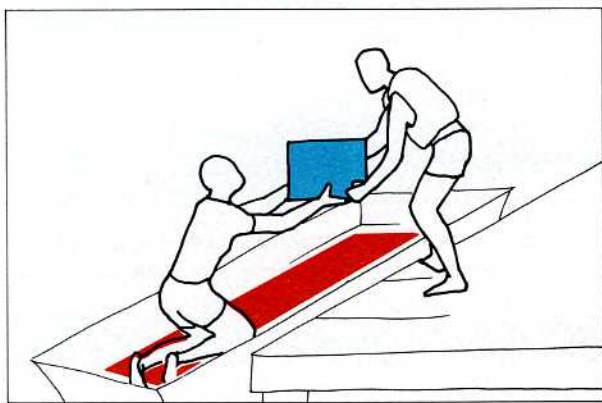
When actually loading your boat, there are several things to keep in mind. First when arranging the equipment and gear within the boat, try to keep an aisle clear down the center so that you won't have to step near the sides of the boat when moving from one position to another. Be sure that the equipment which

is not needed for the moment is stowed out of the way to make as much clear space as possible. Remember to keep PFDs (Personal Flotation Devices) and a fire extinguisher readily accessible. Also, fasten down your gear in order to prevent it from moving about during the ride. Many boats have been capsized when loose gear shifted and changed the center of gravity in the boat.

When getting in, remember to step as close to the center of a small boat as possible. Stay low in the boat and have someone on the dock hand gear to you to load after you are already in.



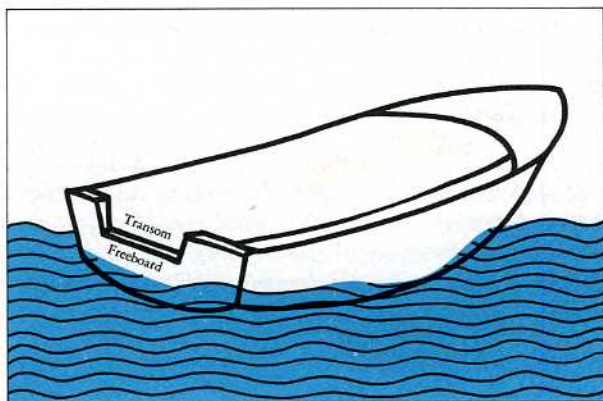
Stay low and step into the center of the boat.



Have someone on the dock hand you your gear.

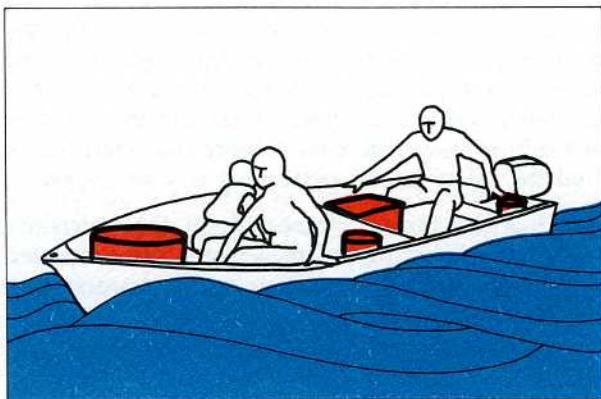
When all supplies and equipment have been loaded and secured, your passengers may board. Hold the boat steady for them and make sure they sit so that the boat is stable and balanced. You might remind your passengers to remain seated. They should move only when you reduce your speed or stop. The forward motion of the boat does change its stability characteristics. Careful loading and the safety of the passengers is *your* responsibility.

Freeboard is the vertical distance from the waterline to the boat's lowest edge above the water where water can enter inside the boat. This is usually the position on the transom where the outboard motor is mounted.



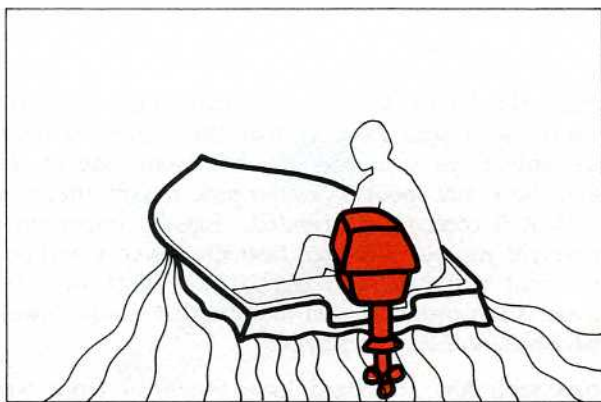
To maintain the boat's stability and maximum freeboard, you should always load your boat so that the weight is distributed evenly not only from fore and aft, but from side to side. In loading your boat, you should consider how weight affects stability even though it is correctly distributed. Equally important is that the more weight you put into your boat the lower it will be in the water (the boat will have less freeboard.) That is, with more weight, there is less distance from the waterline to the lowest edge of the boat which will let water inside.

Many boats with low freeboard have swamped from waves or wakes and from persons suddenly moving to the back of the boat.



Overloading your boat will reduce its freeboard.

It is up to you to decide whether or not you should carry the full amount of recommended weight depending upon the weather and water conditions, etc. Make sure you do not exceed the recommended size of outboard motor since too large a motor will reduce the freeboard and will create serious operating problems at high speed.



Too large a motor will reduce your freeboard.

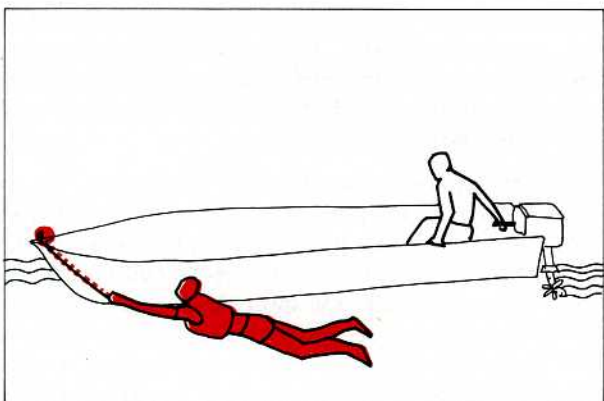
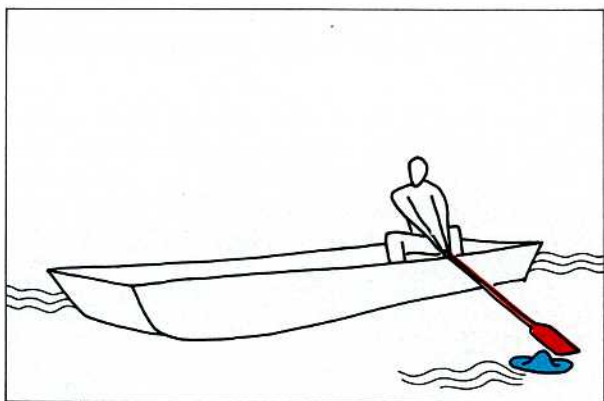
You can see that low freeboard coupled with unfavorable weather and water conditions or wakes from passing boats could produce flooding of the boat.

After you have loaded your boat and all your passengers are aboard, a good practice is to check on your freeboard. You should consider any necessary passenger or cargo movements since these, too, will affect your freeboard. Take a look at the weather and water conditions and then make your own judgement as to whether or not you think you have adequate freeboard. A boat with low freeboard is more easily swamped than a boat with higher freeboard.

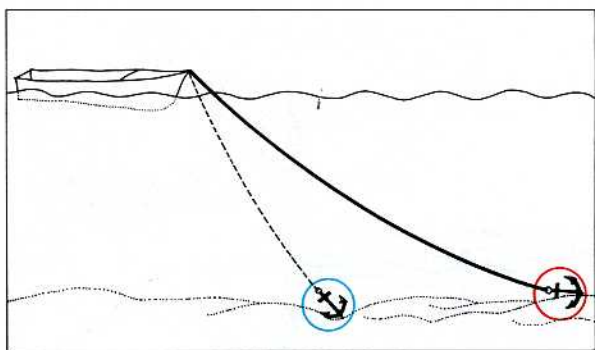
Virtually any type of activity or movement in a boat, and particularly a small boat, will to some extent affect its stability. These movements include such things as moving from one position to another within the boat, fishing and hunting activities, anchoring activities, making adjustments to the outboard motor or emergency repairs, getting in and out of the boat, and recovering objects or persons from the water.

To recover any object from the water, bring the boat as close to the object as possible. Avoid leaning over the edge of the boat since this reduces its stability the same as unbalanced loading. If your weight is extended over the edge, your chances of going overboard as the boat rolls are likely.

If you need to recover a person from the water, be especially careful considering the lowering of the freeboard and the balance of the boat. Freeboard may be less affected by pulling the victim in over the bow. Pulling a victim in over the side can easily swamp or capsize the boat. Usually the most stable place for a victim to get aboard is the stern. But the stern also has the least freeboard and already bears the weight of an outboard motor. It is a matter of your judgement here. You may find it safer for all persons concerned to leave the person in the water, especially if you are close to shore. Secure them to the forward part of the boat, and slowly tow them to shallow water. Always watch out for the propeller when a person is in the water near the boat.



When anchoring, here are some things to consider. First, make certain that your anchor line is long enough to make the anchor fast (secure). If the line is too short, the anchor's holding power will be insufficient and the boat will drift. This is especially hazardous when anchoring overnight where no one is awake to watch if the anchor begins to drag. Another very important aspect of line length is that when the limit of a short line is reached, the boat could suddenly capsize. This is especially important in rivers where the current is constantly exerting force on the anchor line.

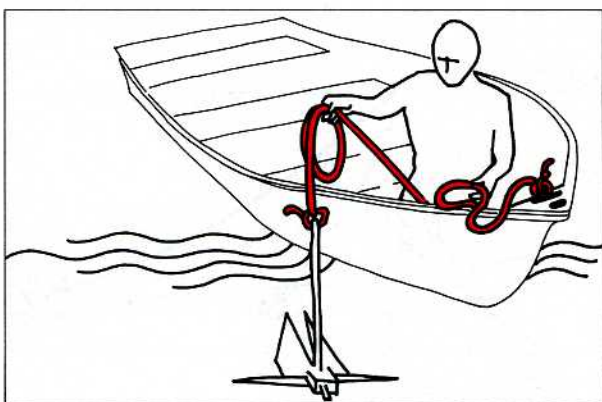


The safe ratio of anchor line-to-water depth, or scope, is seven-to-one. For example, if the water depth is 20 feet, then your line should be 140 feet. Remember, any weight or downward tug on the anchor can pull the boat down further into the water. A ratio of five-to-one may be adequate, but a ratio of three-to-one can be dangerous.

To anchor your boat, secure the line to some part of the boat at the forward end. Then, guide your boat slowly to the spot where you wish to anchor and, from the bow, carefully lower the anchor until it hits the bottom. Never throw or heave the anchor out of the boat.

Make sure the anchor digs in or sets. The line can then be played out with the boat running slowly in reverse until the length of line is about seven times the depth of the water. Recheck to see that the line is secure and shut off the motor. Be prepared to cut the line in an emergency. Floating or submerged objects in the current can strike the anchor line and pull the bow lower in the water.

When recovering the anchor, the same hazards hold and you should exercise just as much caution. To free the anchor, always "run up" over it with the motor or oars. Never pull the boat up to the anchor using the anchor line. The anchor should be pulled up slowly from the bottom.



Always lower the anchor from the bow.

This pamphlet has discussed a few of the questions you or your passengers may have had about boating. If you have other questions about the operation of your boat, contact a local United States Coast Guard Auxiliary flotilla or United States Power Squadron unit. They offer classes and they can make a lot of information available to you.

Remember, when you go out in a boat, your passengers and other boats are assuming that you're a boater. And that implies that you know things like rules of the road, what distress signals mean, and many other things not commonly found on land.

Because if you're a boater,
you're obligated to know, you know.

Definitions

AFT - the rear area or stern of a boat. The transom of the boat (where the outboard motor is mounted) is usually the farthest aft part of the boat.

BOW - the forward end or front of a boat.

CAPACITY PLATE - a plate or label in a boat giving maximum weight capacity and maximum horsepower rating.

CAPSIZING - a turning over of the boat, resulting from a rolling motion.

CENTER OF GRAVITY (CG) - the hypothetical point where the total weight of the craft and everything aboard could be centered to produce the same effect on the hull as if the weight were evenly distributed.

FORE (or forward) - the front area of a boat. The bow is the foremost part of the boat.

FREEBOARD - the vertical distance from the water to the lowest part of the boat where water can enter inside the boat.

HULL - the main body of a boat. Some hull designs often used in small boats include flat bottom, round bottom, and semi-V hulls.

LOADING - the placement and arrangement of supplies, people, and gear aboard a boat.

ROLL STABILITY - a balancing of side to side rotational motion of the boat in the water.

SCOPE - the length of anchor line. Seven-to-one scope means that the length of the anchor line from the boat to the anchor is seven times the water depth.

STERN - the after end or back of a boat.

SWAMPING - flooding of the boat with water.

TRANSOM - the part of the stern of a small square-ended boat where the outboard motor is mounted.

WAKE - the turbulent water left behind a boat when moving across the water.



COAST GUARD