Do the Math

Gallon of water = 8.3 pounds (You don’t really need to know this unless you’re making your boat out of half-gallon paper ice cream cartons. Fifty of them glued together will float 208 pounds...very temporarily.)

Cubic foot of water = 62.4 pounds
Cubic foot = 1728 cubic inches
Volume of a rectangular solid = width x height x length
Volume of a triangular solid = (½ base x height) x length
Volume of a cylinder = (Pi x radius-squared) x length

What will it take to float you?

If you and your fellow paddler weigh a total of 250 pounds, your boat must displace 250 pounds of water. 250 pounds divided by 62.4 pounds per cubic foot = 3.9 cubic feet. Let’s call it 4 cubic feet for what we’re doing.

If you design a basic boxy boat 4 feet long x 2 feet wide x 1 foot high you have 8 cubic feet, enough to float 500 pounds or twice the paddlers’ weight. That means your boat will sit 6 inches deep and you’ll have 6 inches above the water to keep the water from splashing in. Of course two people won’t fit in a boat that small, so you’ll have to make it a bit longer, floating even more pounds. So don’t worry, you won’t sink unless the boat gets wet and falls apart.

If you build a totally triangular vee bottom boat, use the formula for a triangular solid. If it’s 2 feet wide at the top and 1 foot deep and 8 feet long, then you displace (½ x 2 x 1) x 8, or 8 cubic feet, 500 pounds worth of water. Calculating the amount of the boat’s sides above and below the waterline is not hard, but we’re not going into that here. (Hint...it’s not 6 inches)

If you build a raft with carpet tubes that are, for example, 6 inches in diameter and 8 feet long, your displacement per tube is (3.14 x 3-squared = 28.3 square inches) x 96 inches long, or 2717 cubic inches. A cubic foot is 1728 cu. in., so each tube is 1.6 cubic feet (2717 divided by 1728) and will float about 100 pounds. So you’ll need 3 tubes to float your 250 pounds with 50 pounds leftover to keep you and your first mate above water.

What should my boat look like?

Flat bottom boats (your basic box) aren’t as stable as you think, are hard to paddle in a straight line because they have no keel, and they’re not very fast. They’re not very rigid, fall apart easily and have a lot of drag.

A truly triangular boat is streamlined and is very fast, and (theoretically) easy to paddle in a straight line but will tip over instantly unless you heavily ballast (weight) the bottom of the vee. (We’re not going into determining center of mass of an irregular object and offsetting it with a calculated amount of ballast at a calculated depth.)

Rafts made from carpet tubes are easy to make but are really slow and hard to paddle as they’re not at all streamlined, have no keel, and create plenty of drag. However, if you can put a sloped prow on the front and a keel underneath, you can improve your speed and handling.

Your boat must be rigid! If the boat flexes, then the paint cracks, the cardboard gets wet, and you won’t make it to the second turn before your boat becomes a soggy submarine. A wide flat “barge"
won’t get very far...a painted refrigerator box just doesn’t have enough rigidity to not fall apart. You can start with one, but you have to reinforce it. A lot.

The triangle: physics’ perfect shape. The three sides of a triangle are generally exerting equal forces of compression and tension, keeping each other in check. A triangular “pipe” is very rigid and very easy to build. By itself it won’t make much of a boat, but using it to reinforce the sides of a boxy boat gives great rigidity. That’s the principal of Kees’ ladybug boat.

A combination of a box with triangular sides and a keel works fine for what we’re doing. Build the basic ladybug according to Kees’ design and add a triangular keel down the center of the underside. That gives you rigid strength, stability, straight paddling and lots of displacement.

You can get creative and try different designs. Many will work fine. This is just the basics.

**Things to remember when building**

Be careful with the knife! Don’t hurt yourself.

When bending/folding cardboard, use a board as a straight edge. If folding in the same direction as the corrugation, do not crease the cardboard or you’ll probably tear it. If folding at an angle to the corrugation, gently crease the cardboard using a roller. Don’t overdo it and tear the cardboard.

If using multiple layers of cardboard, try to run the corrugation in the layers at right angles to one another. This adds strength.

Use contact cement in a well ventilated area for gluing large surfaces together. Use liquid nails for seams, joints and smaller surfaces. Use clamps to hold things in place while the glue sets. Avoid glues like Emler's white glue. Even yellow carpenters glue must be rated waterproof to hold well.

Duct tape doesn’t work as well as you’d think on a cardboard boat. (But keep some handy on race day in case you poke a small hole in your painted surface. It works fine as a patch as long as the cardboard hasn’t gotten too wet.)

Glue the cardboard before you paint it. Otherwise it doesn’t hold very well at all. Paint everything after gluing is finished.

Paint it several times if possible. If you can afford it, use Kilz first as it is made to soak in deeply and harden. Then paint over the Kilz. Don’t leave any cardboard unpainted! Paint the inside too as you will get water inside your boat. Inside or out, unpainted surfaces will soak up water like a sponge and cause your boat to fall apart fast.

Don’t wait until the last minute to build and paint your boat. It can take a while for the glue and paint to dry, especially if the weather is rainy.

**Other**

Learn to paddle! A lot of good boats lose the race for lack of an experienced crew. Kayak paddles, with a blade on each end, work best if your boat is narrow enough to paddle on both sides. That keeps you from leaning over too far and taking on water over the sides, which is not good for the boat.

Make your boat as narrow as possible. A long skinny boat is faster than a short wide boat and a lot easier to paddle.