# Construction Rules (Equal Opportunity)

- The ENTIRE BOAT must be built of CARDBOARD
  - Only exceptions are the paddles & decorations
  - Use Cardboard boxes, “blocks”, carpet tubes
  - NO pre-treated cardboard allowed
    - No SONA-TUBES, or waxed or ‘treated’ cardboard
  - NO wood, plastic or fiberglass
  - NO caulking compounds or two-part/mixed adhesives.
  - NO wrapping in duct tape, plastic or fiberglass

# Construction Rules (continued)

- Waterproof the boat with Varnish, Paint or Polyurethane (1-part, paint-like substance)
- Decorations are allowed - as long as they don't effect structural strength or buoyancy
- The crew compartment can NOT be ENCLOSED so as to interfere with escape
- Every crew member must wear a life jacket

# Construction Materials

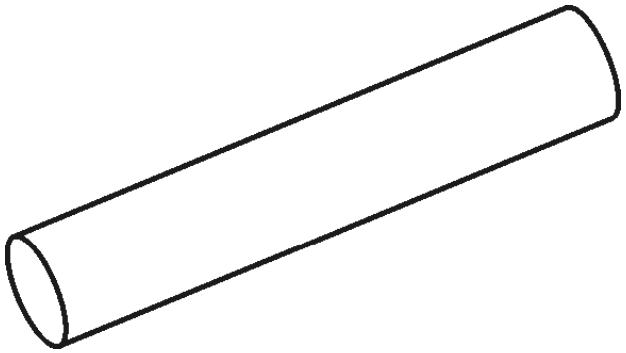
## Permissible Materials

- Corrugated Cardboard
  - Appliance or Grocery Stores
- Cardboard "blocks"
  - Furniture stores
- Cardboard Tubes
  - Carpet/Linoleum stores
- Fastening material
  - Duct or masking tape
  - Liquid nails adhesive
  - Latex Paint, Varnish

## Materials NOT Allowed

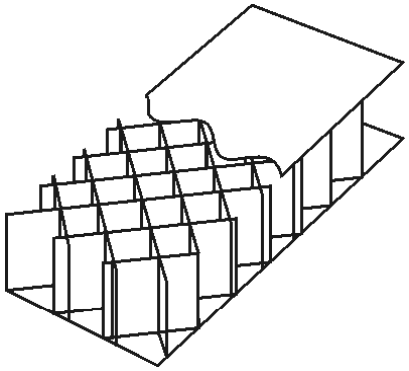
- Wood, Styrofoam
- Plastic sheathing
- Fiberglass
- Sona-Tubes, coated cardboard
- Silicon, Wax, Tar
- Caulking compounds
- Metal
- Staples, clamps, screws
  - * Judges decide on the interpretation of the rules

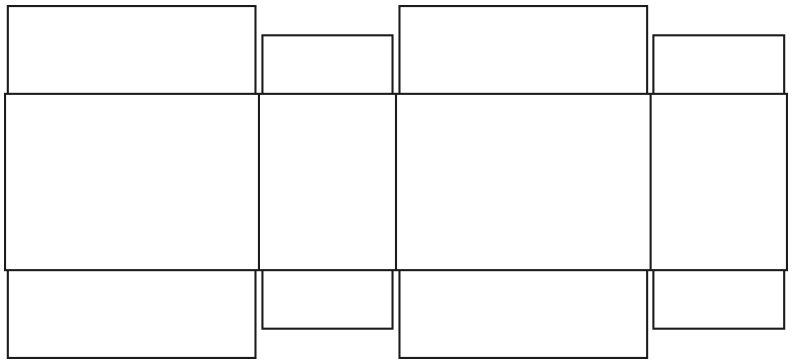
# Construction Materials (continued)



Carpet Tube
(about 4 ½” dia.)

Cardboard
Block
(2-3” thick)





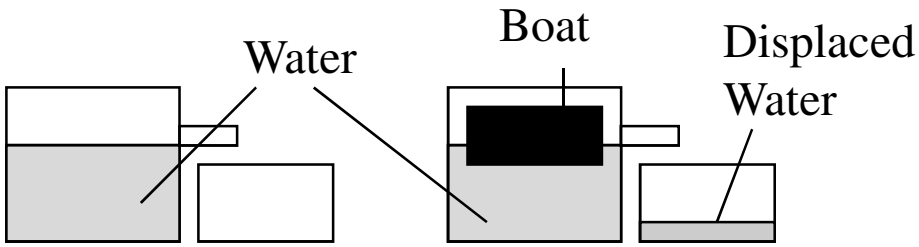
Cardboard Box - cut open

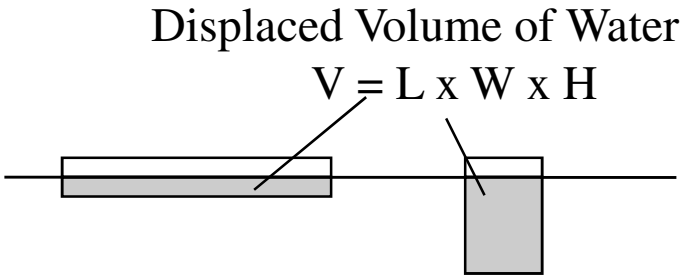
# Cardboard Boat Design

- Consider its Size - building & transporting
  - Big enough to hold crew, small enough to carry
  - Wider is better, but still be able to paddle
    - no surfboard style designs are allowed
    - Rafts ARE allowed
  - Consider total weight of all materials when wet
  - EVERYTHING must be removed from the lake
- Boat decorations & crew costumes are encouraged - use your imagination

# Cardboard Boat 'Physics'

- "How much will you sink? - Displacement




Weight of Water =
62.4 pounds/cubic-foot

$$\text{Water Displaced}(ft^3) = \frac{\text{Weight-of-boat-\&-people-lbs}}{62.4\ lbs/ft^3\text{-H20}}$$

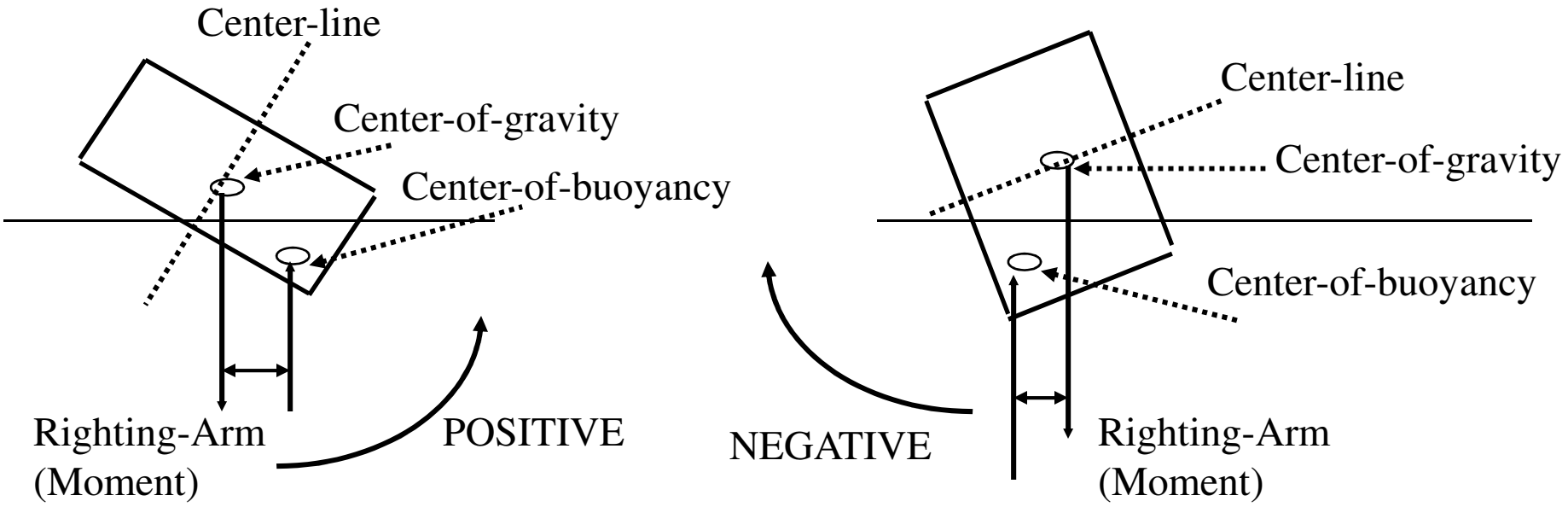
$$\text{Depth(ft) boat sinks} = \frac{\text{Water Displaced}(ft^3)}{\text{Length X Width of boat}\ (ft^2)}$$

**Example:**

Box boat, 3 ft X 6 ft, 1ft tall (high)
Boat volume = 3' X 6' X 1' = 18 $ft^3$
Boat displacement = 18 $ft^3$ X 62.4 $lbs/ft^3$ = 1123.2 lbs
Which equates to 93.6 lbs per inch of boat height

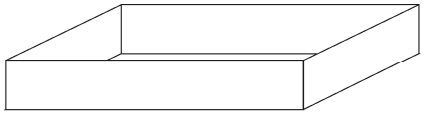
# Cardboard Boat 'Physics'

- "Wider is Better" - Center of Buoyancy

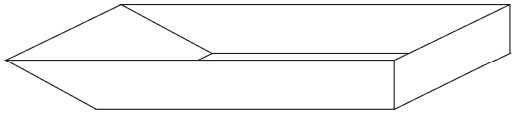


# Cardboard Boat 'Physics'

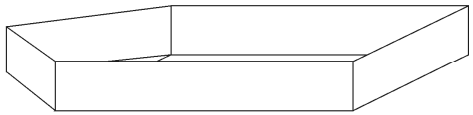
- Movement Through the Water



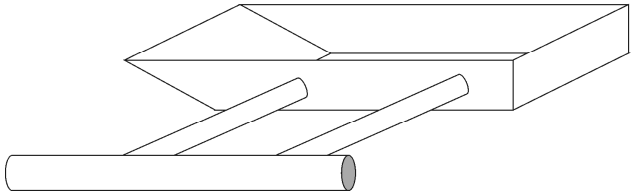
Simple
Box



Slanted
Box

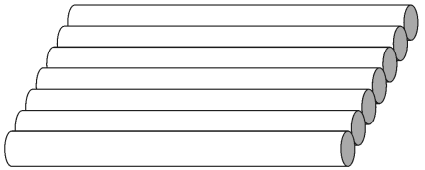


V-Shaped
Bow



Outrigger
Design

Pontoon
Design



Raft
Design

# Cardboard Boat Design Suggestions

- Set the Design Goal:  FUN, Speed or looks
- Sketch out your design
  - build a scale model from manila paper:
    - estimate materials or plan how to use what you have
    - plan out what construction techniques will be used
- 1'x1'x3' box:  will float 187 lbs.
  - if it'll hold you, it's big enough to float
- Flat bottoms, sit-to-paddle  - are the best/easiest
- Rudders help keep you straight but make turning difficult and adds complexity to your design.

# Cardboard Boat Suggestions (cont'd)

- Long boats go fast - but are harder to turn
- Short boats (<10') - are difficult to keep straight
- Best Length: 8-12 feet
- Best Height: 18 inches
  - allows room to sit/kneel & still paddle over the edge
- Best Width:
  - 18"-30"(max) for 1 person
  - 48" wide for 2 people side by side
- Kneeling is a "power" position but sitting is more comfortable

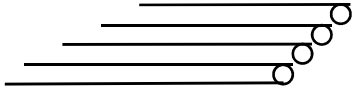
# Construction Tips & Techniques

- Cover edges of cardboard - acts like siphon
- Cardboard Tubes make great frames
  - Cutting for joining & bending
  - Fastening tubes together
- Cardboard Hull
  - 1-2 layers, fasten & cover the seams
  - With 2 layers, overlap the seams
  - Decorate, paint & varnish
- Reinforce the area where you sit, kneel or stand

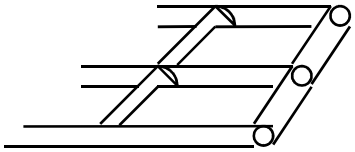
# Construction Tips & Techniques

- Carpenter's glue works well, liquid nails
  - hot-melt glues melts in the sun
- Duct tape only non-painted surfaces (tubes or frame that will be covered)
  - Duct tape shrinks when painted
  - Duct tape can be covered with masking tape if you need to paint it.
  - No Clear tape - it melts when painted
  - Masking tape for glued edges & seams
  - Kraft paper with spray adhesive also

# Construction Tips & Techniques



Solid Tube
Frame

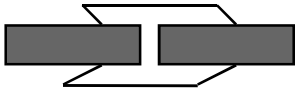


Center/Cross
Beam
Frame

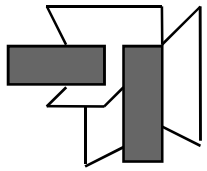
**FRAMES**

**CONNECTING TUBES**

Cardboard
Wrapper for Tubes
End-to-End

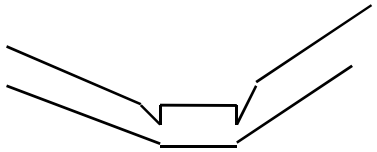


Cardboard
Wrapper for Tubes
At Right-Angles

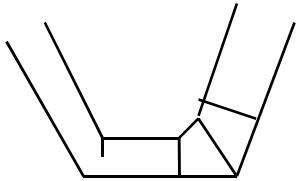


# Construction Tips & Techniques

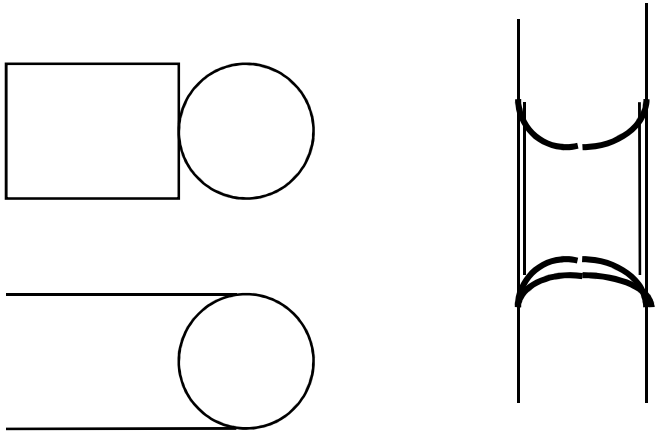
**FRAME ANGLES**



V-Shaped Cuts

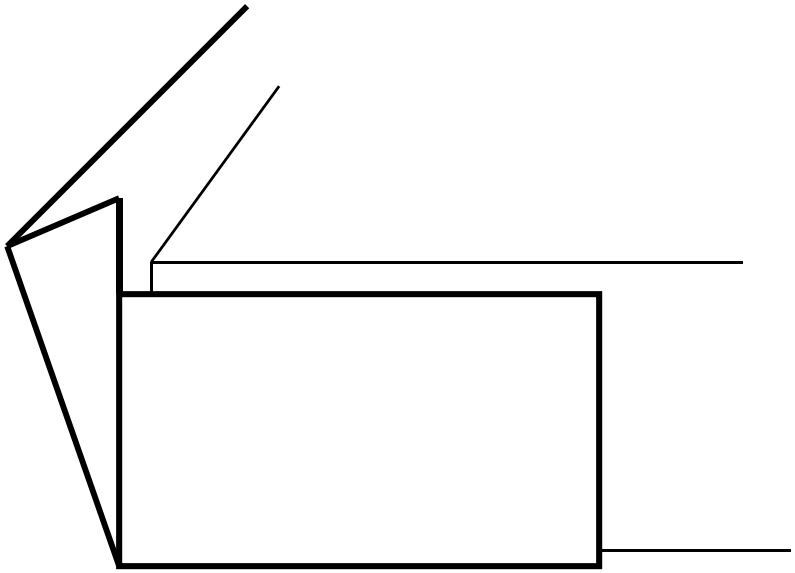


Multiple Cuts
for Sharper Angles



**TUBE CUTTING TEMPLATE**

# Construction Tips & Techniques

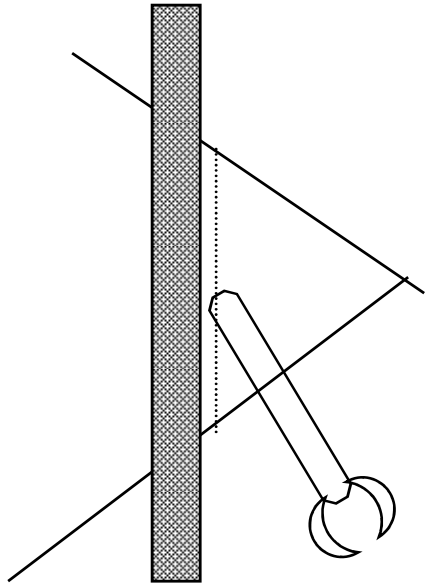


**FOLD & OVERLAP**
**CARDBOARD**
**AROUND CORNERS**

# Construction Tips & Techniques

**Crease/Score a line for a nice**

**STRAIGHT FOLD**

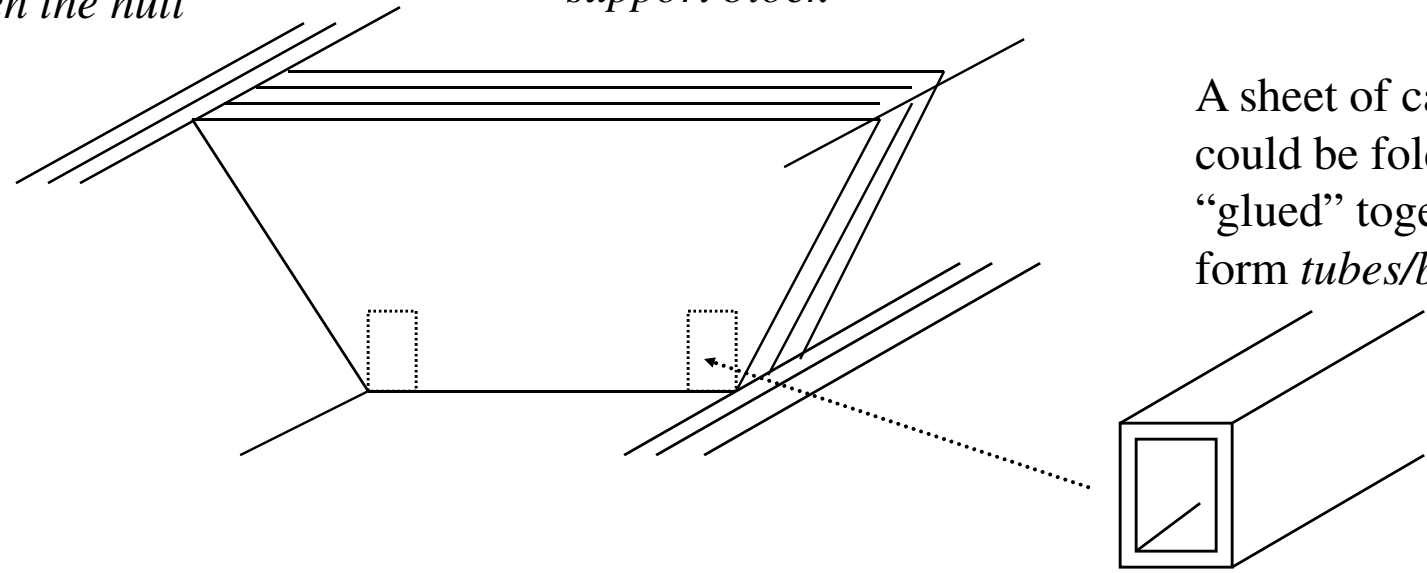


# Construction Tips & Techniques

Multiple cardboard layers
"glued" together on the sides
*strengthen the hull*

Multiple trapezoid-shaped pieces
"glued" together to form a
"*support block*"

A sheet of cardboard
could be folded &
"glued" together to
form *tubes/beams*



BOAT LENGTH + WIDTH: 8ft. by 2ft.

Length: 14 ft 4 inches
Width: 7ft 4 inches
} Pattern Length + Width

Load Capacity: 748 pounds

Cut on heavy Black Line

Fold on thin Black Line.