**WATER ROCKET**

**THE CHALLENGE:** Teams (of 2) will design, build and test a water rocket designed to stay aloft for the greatest amount of time.

**THE COMPETITION REQUIREMENTS:**

1. **The rocket’s “Pressure Vessel”:**
   a. The “pressure vessel” is the part of the rocket that connects to the launcher and is filled with water and pressurized air.
   b. The pressure vessel must be made out of a single 2-liter plastic carbonated bottle (a soda bottle).
   c. Label may be removed, but must save it for the competition at the safety inspection.
   d. Only TAPE may be used on the pressure vessel; glue may be used in other parts of the rocket assembly, just not on the pressure vessel.
   e. No alterations may be made to the pressure vessel.

2. **The Rocket’s Nose:**
   a. The nose must be blunt (flat) or rounded; nothing sharp or pointed!
   b. The width of the nose must be at least 2.5cm (radius of 1.25 cm)

3. **The Rocket’s Fins:**
   a. The fins must be at least 5 cm from the mouth of the pressure vessel: this is the “No Fin Zone”.
   b. The fins may be any shape.
   c. Only tape may be used to attach fins to the pressure vessel.

4. **Recovery System:**
   a. Any recovery system is allowed.

5. **Safety Requirement:**
   a. Participants must wear eye protection when launching the rocket!

~ Research Questions: Go to TinyURL.com/WDSTEM ~

1. What kind of engineer designs and builds flying crafts such as planes, rockets, and satellites? ________________

2. What is Newton’s Third Law of Motion?

[Diagram of a water rocket with specifications for nose and fins, along with a QR code for additional resources.]
HOT TO CONSTRUCT A WATER ROCKET

I. Mark Fin Location.
   a. Select how many fins: 3 FINS or 4 FINS
   b. Cut out the Fin Location Strips for your # of fins.
   c. Wrap around Pressure Vessel and mark both sides.
   d. Draw a long line through the marks along the bottle.

II. Make Fins.

OPTION A: Fold-over Fin with Tabs
(Plastic pocket folder or Cereal Box)

1. Select Fin template and cut out around the Tab.
2. Trace template onto Fin material ***Be sure the Leading Edge is next to a Folded side!
3. Cut out Fins.
4. Mark and fold the Tabs out: 1.5 cm Tabs.
5. Fold and hot glue the two sides of each fin together in the middle. **You can add extra material in the middle for added stability.
6. Center each fin to the marked lines on the Pressure Vessel.
7. Tape the tab of the fins to the vessel. *Be sure it is 5 cm from the opening of the bottle!

OPTION B: Thick Fin Glued to a Tab
(Plastic CD, Chipboard, Cardboard, Corrugated Plastic)

1. Select Fin template and cut out without the Tab.
2. Trace template onto Fin material.
3. Cut out Fins.
4. Cut out a rectangular Tab about 1 inch wide to attach along the bottom of the fin. (Use scrap plastic bottle or scrap plastic pocket folder)
5. Hot glue each fin to a Tab. **Be sure it is straight!
6. Center each fin to the marked lines on the Pressure Vessel.
7. Tape the tab of the fins to the vessel. *Be sure it is 5 cm from the opening of the bottle!

III. Nose Cone (Padded)
   a. Cut the base off of a second 2 Liter bottle.
   b. Leave the cap on it.
   c. Hot glue a Foam Donut around the cap to the bottle.
   d. Slide the Nose Cone bottle onto the Pressure Vessel.

IV. CG: Center of Gravity (Balance Test)
   a. **The “Center of Gravity” must be above the fins on the pressure vessel, but not past the top of the pressure vessel.
   b. Add mass to nose cone or on top of the pressure vessel until the CG (center of gravity) is “just right”.
   c. To find the Center of Gravity, balance the rocket on a string.
   d. Mark the Center of Gravity with

V. Go Fly! Fill Pressure Vessel ¼ to 1/3 full with water.
**FIN LOCATION STRIPS**

1. Cut out the strips for your selected # of fins.
2. Tape together.
3. Wrap around pressure vessel.
5. Then connect the marks to make a loooooooong line.
Cut around tab. This tab is what you tape to the pressure vessel.

No Fin Zone
5 cm from opening.
FIN: "DOLPHIN"
(a.k.a. Clipped Delta)

14 cm

LEADING EDGE

3 FIN
11.3 cm

4 FIN
8.5 cm

DOLPHIN 50°
DOLPHIN 40°
DOLPHIN 30°
DOLPHIN 20°

NO FIN ZONE
5 cm from opening

TAB
Cut around tab. This tab is what you tape to the Pressure Vessel.

Fold line

Cut slits
Fin: "MARLIN" (a.k.a. Stretched Delta)

- 16 cm

3 Fin: 11.3 cm
- 1 Fin: 8.5 cm

MARLIN 45°  MARLIN 35°  MARLIN 25°  MARLIN 16°

FOLD LINE

- TAB - Cut around tab. This tab is what you tape to the pressure vessel.
- Cut slits

No Fin Zone
5 cm from opening
BLANK FIN → 2 Liter Bottle

Cut around tab. This tab is what you tape to the pressure vessel.

Fold Line 5

Tab

Cut slits

3 Fin

8.5 cm

11.3 cm

NO FIN ZONE

5 cm from opening
DORSAL FIN: Trapezoid (12 x 11 x 10 cm)

Fold Line: 12 cm

Tab: 11 cm

Fold Line: 10 cm

Tab: 8.5 cm

Bockslider Recovery System

17 cm

2 FINS

4 FINS
Wing

DORSAL FIN: 18 x 12 Trapezoid

[BACKSLIDER RECOVERY]

17 cm

2 FINS

8.5 cm

4 FINS

12 cm

11 cm