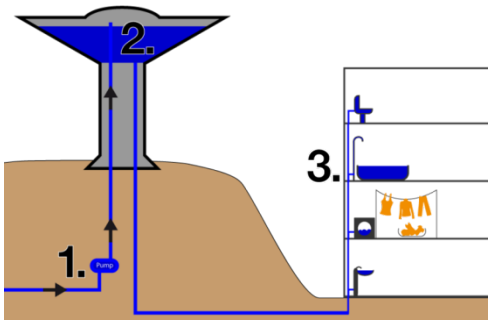
Water Tower Model



A **water tower** is an elevated structure supporting a water tank constructed at a height sufficient to pressurize a water supply system for the distribution of potable water.

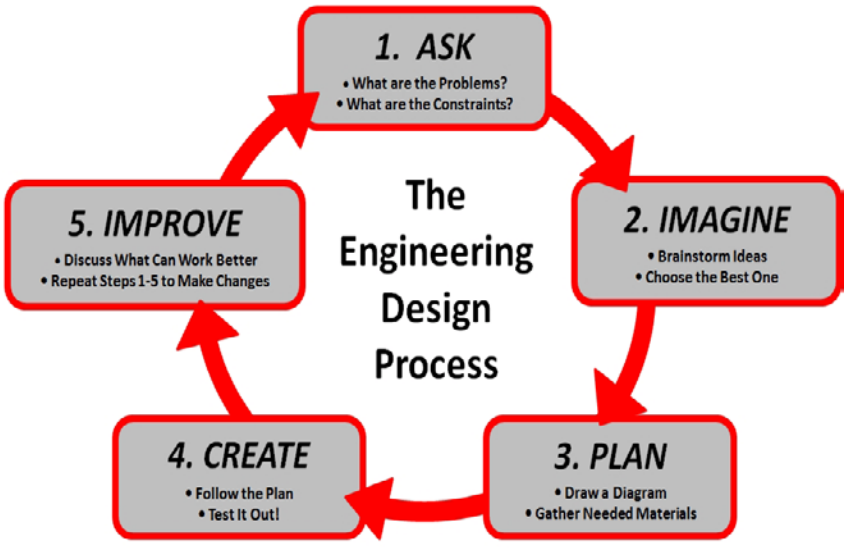
Pressurization occurs through the hydrostatic pressure of the elevation of water; for every 10.20 centimeters (4.016 in) of elevation, it produces 1 kilopascal (0.145 psi) of pressure. 30 m (98.43 ft) of elevation produces roughly 300 kPa (43.511 psi), which is enough pressure to operate and provide for most domestic water pressure and distribution system requirements.

Many water towers were constructed during the Industrial Revolution; some are now considered architectural landmarks and monuments, and may not be demolished. Some are converted to apartments or exclusive penthouses.

In certain areas, such as New York City in the United States, smaller water towers are constructed for individual buildings. In California and some other states, domestic water towers enclosed by siding (tank houses) were once built (1850s-1930s) to supply individual homes; windmills pumped water from hand-dug wells up into the tank.

We Challenge You To…

…design and build a scaled model of a working water tower using the design process and parameters found below.



Date	Deadline
June	Think about Water Tower
July	Think about Water Tower
August	Think about Water Tower/Possible Construction
September	Think about Water Tower/Begin Construction
October	School Competition and Regional's

Gannt Chart	June	July	Aug	Sept	Oct
Idea					
Construction					
School Comp and Regional's					

Objective

The objective of the competition is to make participants aware of the importance of **reliable drinking water** and the rewarding opportunities available in the **water profession**. The competition meets this objective by having students develop an idea into a functioning water tower, just like what water professionals do in the real world.

The top teams will go on to represent Buchanan at the Regional's Competition.

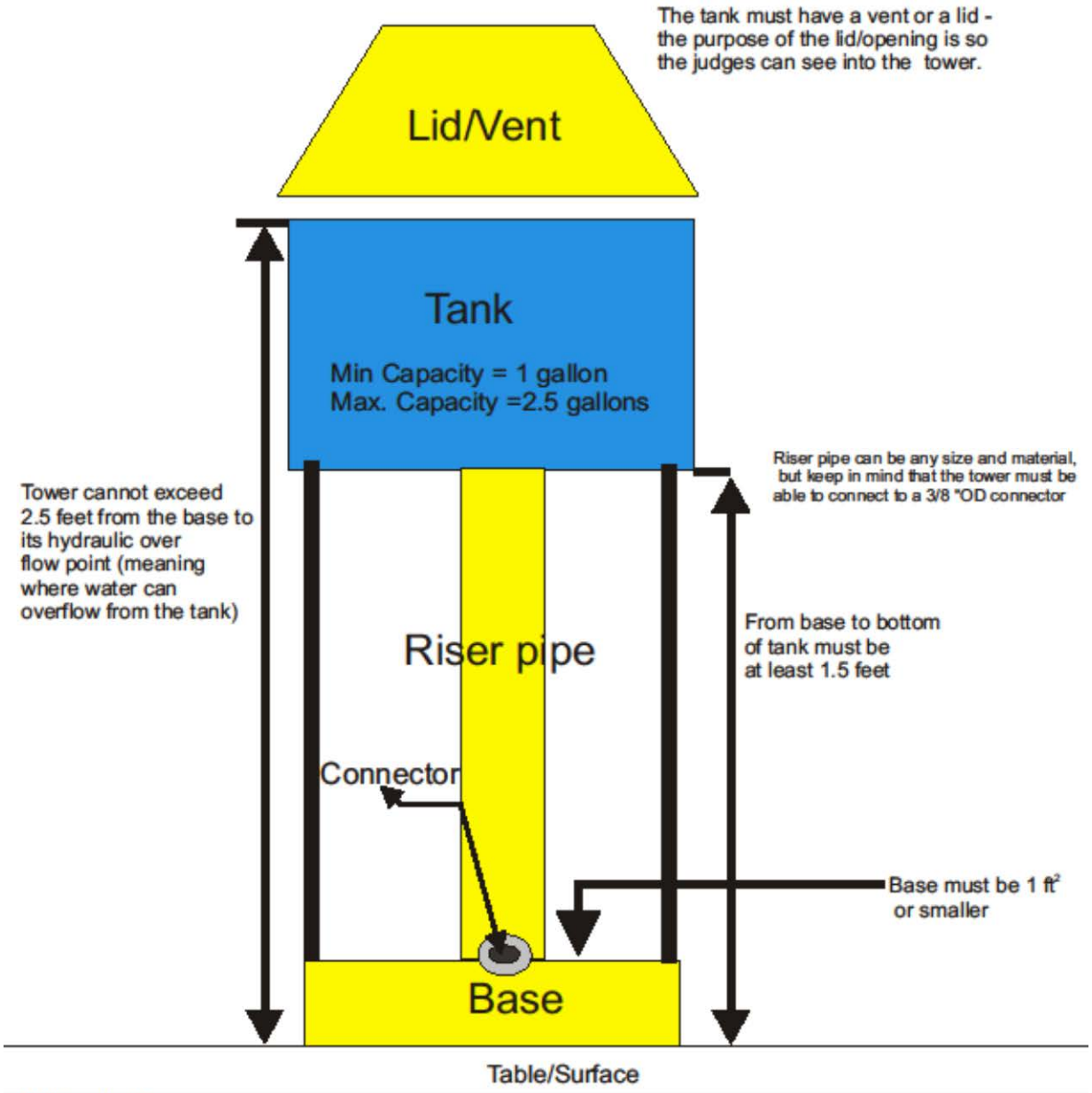
Constraints

Keep to the following standards when designing and constructing your model:

- Footprint: The base of the model must fit in a square **1 foot on each side**. If not, a **2 point penalty** will be assessed.
- Tank Height: The tank must be **between 1.5 and 2.5 feet high (See Drawing)**. If not, a **2 point penalty** will be assessed.
- Tank Volume: When full, the tank must **hold between 1 and 2.5 gallons** of water. Hint: test your model to make sure the tower can hold the weight of the water! If not, a **2 point penalty** will be assessed.
- Leaks: The tank **should not leak**. If any part of the tower leaks (e.g. tank, piping, connector), then a **2 point penalty** will be assessed.
- Vent/Lid: The tank must have a **vent or removable lid** so the judges can tell when it is full. Uncovered towers or non-vented towers will result in a **penalty of 1 point**.
- 3/8 Inch Connector: The model must use the **3/8 inch connector** as supplied by the FSAWWA Region IV MWTC Chair. **The 3/8 inch connector will be mailed to the teacher or advisor of the Team upon receipt of the registration forms**. If the tower does not have this 3/8 inch connector, then a **1 point penalty** will be assessed.
- Receipts: **Bring receipts** for all materials purchased for your model. A one point penalty will be assessed for each item not having a receipt (**Maximum of 3 penalty points**).
- Materials' List: **Bring your materials' list to the competition.** If the materials' list is not provided at the competition, a **3 point penalty** will be assessed.
- Structural Stability: The tower should be structural stable throughout any part of the competition. If the tower exhibits structural instability (e.g. tower has to be supported by a person during filling of water or during any part of the testing), then a **2 point penalty** will be assessed.

Penalties will be assessed for not following the standards described above and these penalties will be directly added to the tower's score. These standards are demonstrated in the diagram attached to this handout.

MWTC Requirements



Additional notes:
Your Model must be an elevated tank design including a riser pipe, a tank, a supporting structure to hold the tank and a base.

The Maximum and minimum volume requirements INCLUDE the storage in your riser pipe.

The maximum 2.5 feet height refers to the length from the base to the hydraulic height (ie the overflow height).

3/8" OD connector will be supplied by the MWTC Chair (registration required) and is the only allowable 3/8" OD connector that can be used on competition day.

Structural Score

Structural efficiency is the maximum mass that a structure can hold divided by the mass of the structure. Therefore, the model tower's structural efficiency is the weight (in pounds) of the maximum amount of water that the tower can hold divided by the weight (in pounds) of the tower.

This is shown with the following formula:

$$Structural\ Efficiency = \frac{Maximum\ weight\ (pounds)\ of\ water\ that\ tower\ can\ hold}{Weight\ (pounds)\ of\ tower\ when\ empty}$$

A higher number indicates a more structurally efficient tower. This criterion is similar to what engineers use in the real world. Remember, the tank should be between 1.5 feet and 2.5 feet high (See Drawing Provided) and hold at least 1 gallon of water but no more than 2.5 gallons!

A tower's structural score will be calculated utilizing the following formula:

$$Structural\ Score = \frac{1}{Structural\ Efficiency}$$

A more structurally efficient tower will have a better structural score. Remember, the towers with the lowest total scores win.

Hydraulic Efficiency

Hydraulic efficiency is the amount of **time it takes** the judges to fill and drain the model with one (1) gallon of water. The judges will fill the tank by pumping water through the 3/8 inch connector. The tank will be drained by letting the water flow out of the tank **by gravity only**. The less time it takes to fill and drain the tank through the connector the better. **The tank must have a vent or a cover so the judge can see into the tower. Coverless towers will not be considered vented.** Each tank will be tested (filled and drained) twice and the **average** of the two fill and drain times (in minutes) will equal the hydraulic efficiency score. The hydraulic efficiency formula is as follows:

$$Hydraulic\ Efficiency\ (time in \min) = \frac{First\ Test\ (fill\ and\ drain) + Second\ Test\ (fill\ and\ drain)}{2}$$

Cost Efficiency

Cost efficiency measures your ability to save money while building your model. **Bring receipts** for all items purchased for your model. Points will be assigned as follows (the lower the score the better):

$ 0.00 -$ 5.00	1 point
$ 5.01-$ 10.00	2 point
$ 10.01-$ 15.00	3 point
$ 15.01-$ 20.00	4 point
More than $ 20.00	5 point

List all items used in your model and their costs on the **Materials List Form (**form on next page). This form is required on the day of the event. Where recycled items are used, put the letter "R" in the cost column. You may use as many recycled materials as you wish. A penalty of 1 point will be given for each missing receipt for items purchased new specifically for tower construction. A 3 point penalty will be added to the student's score if the Materials list form is missing. No receipt is necessary for recycled items; however, the items must be accounted for on the materials list form. The cost of glue, nails, screws, general adhesives, and items used to decorate the tower should not be counted towards the tower's total cost. The cost of the tower should **not** include tax.

Materials List Form

Team Name: _____

Participants: _____

Complete and bring this form and all receipts on the day of the contest. List the materials and costs used to construct your model water tower. Put an 'R' in the cost column where recycled materials are used.

MATERIAL	**COST**
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
TOTAL	_____

* Use additional sheets if necessary to list all materials. A penalty will be given for not bringing this form or receipts.

Design Ingenuity

Ingenuity **(in · ge · nu · i · ty)** is how much **imagination and skill** were used in your model. Water professional must often use ingenuity; they use skill and imagination to solve difficult problems. The judges will look at several items:

- Craftsmanship (is the model sturdy, do the parts fit together nicely)?
- Imagination (are the design and materials unique)?
- Artistic merit (does the model have creative ideas, colors or themes)?