Model Water Tower

Mecklenburg Tournament TRIAL Event

1. **DESCRIPTION**: The challenge is to build a structurally efficient model water tower that holds water that can be filled and drained quickly, while also being aesthetically pleasing.

2. **ESSENTIAL STANDARDS ALIGNMENT**: 1.L.1, 1.L.2, 1.E.2, 3.E.2, 4.L.1 5.L.2.3.P.1, 5.P.1, Science as Inquiry

3. **TEAM OF UP TO**: 2

4. **MAXIMUM TIME**: 60 min.

5. **TEAMS**: Must bring built water tower, materials list, receipts, pencil.

6. **EVENT LEADERS**: Leaders will provide a hands-on event with all necessary materials including meter scale, buckets with water, calculators, Tape measure, Scales, funnels, 3/8" OD shut Off Valves with quick connect and 3/8" OD tubing, Pump, tubing, Scissors, and Drill.

7. **SAFETY REQUIREMENTS**: Safety goggles.

8. **IMPOUND**: Yes

9. **EVENT DETAILS**: This event will run in a station format with 2 parts.

Part 1: There will be a testing station with questions about water and water treatment. The testing questions may include any or all of the following topics.

a. Hydrologic cycle
   - Identify the different parts and what state the water is in (gas, solid, liquid)
   - Natural
   - Human Impact

b. Rainfall
   - Average amount Mecklenburg County receives seasonally/annually
   - How and where is rainfall collected and measured
   - Microbursts

c. Water Treatment
   - Screening & Straining
   - Sedimentation
   - Disinfection
   - Filtration
   - Distribution

d. Flooding
   - Causes and prevention
   - Safety tips to prevent injury
   - Role of stream buffers
   - Role of floodplains
   - Impervious & Pervious surfaces

e. Extreme weather events
   - Water conservation tips
   - Impacts to the water table

Part 2: There will be stations to test the structural, hydraulic, cost and design components of your built water tower.

Construction Parameters: 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 does this by having students develop an idea into a functioning water tower, just like water professionals do in the real world! Keep to the following standards when designing and constructing your model:

a. Tank Requirements:
   i. The base of the tower **should be 1.5 feet from** the bottom of the tank.
   ii. The base of the tower **should be 2.5 feet from** the top of the hydraulic height (the point where the tower cannot hold any more water, i.e. top or overflow point); see attached figure 1 for explanation, and
   iii. The base of the model should fit within one square foot area
   iv. The tank must have a **vent or removable lid** so the judges can tell when it is full.

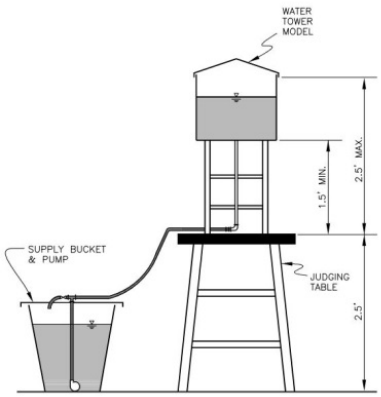

Figure 1: Overall Model Water Tower

b. When full, the tank must **hold between 1 and 2.5 gallons** of water and it **should not leak**. Hint: test your model to make sure.
c. The model must use the **3/8 inch connector** specified. See Figure 2. The proper 3/8" diameter push-on connector must be used by all registered contestants. Connectors must be 3/8" O.D. on the pump connection side. Watts 3/8" OD by 3/8" OD quick connect union elbows (Model No. PL-3022) are available at both Lowes and Home Depot for approximately $3.50. The cost of the connector will be deducted from the total cost to construct so it will not affect your "Cost Efficiency" score. You must use the connector specified to avoid a penalty.
d. **Bring receipts** for all materials purchased for your model. A one point penalty will be given for each item not having a receipt. (Reminder: recycled items have no cost associated with them and do not require a receipt.)
e. **Electricity will not be supplied to your tower.**

Figure 2: 3/8" Connecter

Penalties will be assessed for not following the above standards. These standards are demonstrated in the Figure 1 above.

10. **SCORING**

Judging will be based on four criteria – structural efficiency, hydraulic efficiency, cost efficiency and design ingenuity. Understand and achieve these criteria to do well! They are explained below.

a. **Structural Efficiency:** Structural efficiency is calculated by dividing the weight of the model when it is empty by the average height of the tank times the amount of water it holds. The lower this number the better. This is shown with the following formula:

$$Structural\ Efficiency = \frac{Weight\ of\ the\ tower\ when\ empty\ (pounds)}{Average\ tank\ height(ft) \times Amount\ of\ water\ the\ model\ holds\ (gal)}$$

This criterion is similar to what engineer's use in the real world! Remember, the tank should be between 1.5 feet and 2.5 feet high.

b. **Hydraulic Efficiency:** Hydraulic efficiency is the amount of time it takes the judges to fill the model with 1 gallon of water and drain it back out again. The judges will fill the tank through the 3/8 inch connector. The less time it takes to fill and drain the tank through the connector the better. The time measurement will be taken twice to take an average.

c. **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 pt
$ 5.01-$ 10.00 = 2 pt
$ 10.01-$ 15.00 = 3 pt
$ 15.01-$ 20.00 = 4 pt
More than $ 20.00 = 5 pt

List all items used in your model and their costs on the Materials List Form. 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 pt will be given for each missing receipt for items purchased new. No receipt is necessary for recycled items.

d. **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 or materials unique), and **Artistic merit** (does the model have creative ideas, colors or themes). For each of the above category, model will be assigned points in the range 1 (best score) to 6 (poorest score).

e. **Test:** Points will be awarded for the accuracy of responses. Ties will be broken by the accuracy or quality of responses to pre-selected questions chosen by the event leader

PENALTIES:

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

a. The base of the model must fit in a 1 square foot area.
b. The base of the tower should be 1.5 feet from the bottom of the tank.
c. The base of the tower should be 2.5 feet from the top of the hydraulic height.
d. When full, the tank must hold between 1 and 2.5 gallons of water and it should not leak. Hint: test your model to make sure.
e. The model must use the 3/8 inch connector specified.
f. Bring receipts for all materials purchased for your model. A one point penalty will be given for each item not having a receipt. (Reminder: recycled items & adhesives have no cost associated with them and do not require a receipt.)
g. Electricity will not be supplied to your tower.

11. **EVENT RESOURCES**:

See the Event Resources tab on our website at www.sciencenc.com for instructions, videos and more.

http://sciencenetlinks.com/lessons/the-water-cycle/
http://www.education.noaa.gov/Freshwater/Water_Cycle.html
http://www.scholastic.com/teachers/activity/water-cycle-studyjams-activity
https://www.youtube.com/watch?v=i3NeMVBcXXU
https://www.ncsafewater.org/page/ModelWaterTower
http://www.ncsafewater.org/event/MWT_Charlotte_2015
http://people.howstuffworks.com/water.htm
http://mentalfloss.com/article/64577/how-do-water-towers-work
http://wonderopolis.org/wonder/how-do-water-towers-work/
http://tryengineering.org/lessons/watertower.pdf

Materials List Form *(bring with day of Tournament)*

Team Name: _____

Participants: _____

Complete this form and bring with it you along with 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 and required receipts.**

Figure 1: Overall Model Water Tower

MODEL TESTING