University of South Alabama
Civil Engineering Department

Rules and Regulations

For

Water Filtration

Presented by the Student Chapter of the American Society of Civil Engineers at the University of South Alabama
for the USA-ASCE High School Competition

Updated October 2026

Build and Test a Sand Filter for Treating Water

Requirements

In *thirty minutes*, use your engineering judgment to construct a sand filter to treat (purify) pond water. Assessment parameters are based on water turbidity (NTU), time (seconds), and cost ($$$).

Design Your Own Sand Filter

Design and engineer a sand filter to optimize the turbidity (cloudiness of water), time, and cost of treatment. Turbidity will be measured in nephelometric turbidity units (NTU) by a spectrophotometer. A box of materials will be distributed to your school with all components needed to build the sand filter inside. You may use any combination of the provided materials to build your filter. Once the box is opened, you have thirty minutes to construct your filter at the University of South Alabama's campus in the testing and construction location. A cost per unit of materials is provided in **Table 1** below. An Initial NTU value will be provided by the judges.

Table 1: Specification for Sand Filter per Item

Materials	Unit	Price Per Unit ($)	Water Percolation	Filtration
Gravel	1 - inch	100	High	Low
Lab Grade Sand	1 - inch	300	Moderate	Moderately High
Activated Charcoal	1 - inch	500	Moderate	Moderate
Cotton Ball	1 - inch	1000	Low	High

**1-inch units will be judges' discretion – only whole and half unit areas will be permitted*

Building a Model Sand Filter

1. Empty the bottle of water issued.
2. Cut off the bottom of the bottle (be careful!).
3. Turn the bottle upside down so the top is now the bottom.
4. Unscrew the cap from the bottom.
5. Use a rubber band to hold the mesh to "cap the bottom."
6. With the mesh bottom, fill the bottom layer with gravel to form a flat base to start building your filter. The gravel used to form the flat base is your engineered decision!! The beginning of this flat base will be the start of the judges' measurement of materials.
7. With the flat base, start the build of your filter! Use any amount of gravel, sand, charcoal, and cotton balls provided in your kit. Alteration of material is allowed (ex. Pulling apart cotton balls, crushing gravel, etc.). Just know that each unit of material has a price per unit and will affect your score.
8. After construction, flush the built sand filter with 1000 mL of clean water. This will get rid of any preexisting contaminants.
9. Get ready for testing and acquire 500 mL of pond water.

10. Bring the filter and collected pond water to the judge. Make note of the time.
11. In front of the judges, pour and collect the pond water through your filter. Time how long it takes to collect and treat 50 mL with the provided stopwatch and graduated cylinder. The 50 mL of treated pond water will be used to determine the filter's effectiveness with the NTU measurement. Make sure not to dump it out.
12. Report the construction and filtering/treatment time to the judge.
13. Leave the filter with the judge to calculate the cost per material. All rulings made by the judges are final.
14. Collect the filter after judging to keep or dispose of in appropriate disposal locations.

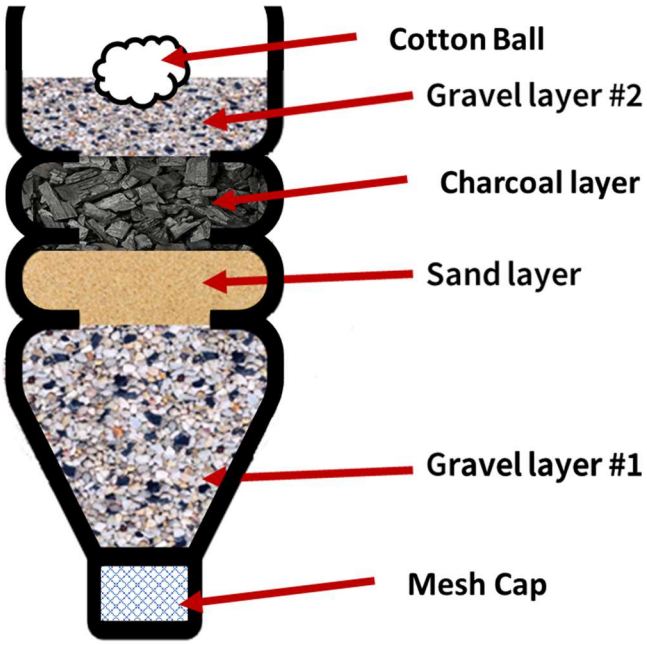


Figure 1: Example Filtration System

Building Specifications

1. Participants must complete the project within thirty minutes at the construction/testing site.
2. Construction will be monitored by the judges and participants visually or using video. The video will then be shared with the judges for verification of the allotted time.
3. Projects that surpass the *thirty minute* limit will not be judged.

Rubric

School Name: _____ Group Name/Number: _____

Category	Requirements	Points
Largest difference in influent NTU and effluent NTU	- First Place (50 points) - Second Place (40 points) - Third Place (30 points) - Nth Place (50-7(N-1) points)	
Lowest Cost	- First Place (30 points) - Second Place (25 points) - Third Place (20 points) - Nth Place (30-4(N-1) points)	
Fastest Time	- First Place (20 points) - Second Place (18 points) - Third Place (16 points) - Nth Place (20-2(N-1) points)	
Point Deductions	-Use of excess materials not included in the box (-20 points)	

Influent NTU: _____

Effluent NTU: _____

Time: _____

Total:_____

Cost Breakdown of Materials

Materials	Unit	Price Per Unit ($)	# of Units Used	Total
Gravel	1 - inch	100		
Lab Grade Sand	1 - inch	300		
Activated Charcoal	1 - inch	500		
Cotton Ball	1 - inch	1000		

Total Cost ($$):_____