



# *Environmental Competition*

Pacific Southwest Conference 2018

## **1.0 Objective**

The American Society of Civil Engineers (ASCE) Environmental Design Competition encourages students to gain experience in designing and constructing low-tech, unconventional water treatment systems. Participating students will learn of the necessary procedure to remove contaminants from drinking water without the technology or budget of a full water treatment facility. By conducting research, testing alternatives, and finalizing a water treatment design, each team will be prepared to demonstrate the simplicity of constructing their model and its efficacy to remove harmful contaminants. The goals of this competition are to inspire innovation, create an awareness of the water quality needs outside of the United States, and provide future water quality engineers with invaluable hands-on experience.

## **2.0 Participant Rules**

- Each university may enter only one team
- Teams must consist of a minimum of 4 members and a maximum of 6 with two identified alternates
- Everyone on the team must be a registered participant of ASCE and PSWC 2018
- The team must have at least one underclassman
- The team must have at least one female

## **3.0 Event Description**

Although there are several noticeable exceptions, the United States is generally successful at providing clean drinking water to its citizens. Meanwhile, millions of individuals living in developing countries still do not have access to a protected water source, and even those sources protected against contamination may not be safe to drink. The major challenge that these countries face primarily stems from a lack of funding. Until every nation reaches an equality in terms of safe drinking water, a temporary solution needs to exist in order to save those who still remain unassisted. It has been requested that water quality engineers in privileged countries help end this condition by designing a reusable, low-cost household water treatment system that is low maintenance and simple to construct.

Each team will design a transportable water treatment system utilizing readily available and affordable materials. In addition to the analysis, design, construction and testing of the system; teams will be required to submit a final design report, provide a process flow diagram during

construction, present a technical presentation, and construct/test their water filtration systems on-site.

#### 4.0 Contaminated Water Constituents

The objective of the competition is to remove harmful contaminants from polluted water, bringing it up to potable standards. The following contaminants will be present in the following quantities.

*Table 1: Contaminant quantities per nine gallon sample*

<i>Contaminant</i>	<i>Quantity per nine gallon sample</i>
<i>Miracle Gro All Purpose Plant Food</i>	1000 g
<i>Bulk Apothecary Kaolin Clay</i>	1000 g
<i>Star Kay White Pure Lavender Extract</i>	30 mL
<i>Wastewater Treatment Plant (WWTP) effluent</i>	20 mL

The contaminants listed in Table 1 will be added to each nine gallon water sample in the following order: Miracle Gro All Purpose Plant Food, Bulk Apothecary Kaolin Clay, Star Kay White Pure Lavender Extract, and WWTP effluent. The contaminants will be split evenly between two five gallon buckets, each containing four and half gallons of water. Utilizing a yardstick, the mixture will be stirred thoroughly for one minute after all of the contaminants are added. It will be mixed again for one minute immediately before the start of the treatment process.

#### 5.0 Budget

Budgets must not exceed \$500. This includes all materials and equipment found inside the 10' x 10' space during the construction portion of the competition (e.g. water collection bin, nails, sand, etc.). Tools used to pre-mark the materials before the competition are not included in expenses unless they were utilized during the 30 minute construction time (e.g. permanent markers, power drill, etc). The flow diagram is not included within the \$500 budget. For donated items used, the commercial value will need to be included in the value as well. These commercial values must be adapted from either Walmart or HomeDepot.com and placed within a table before the receipts in the Appendix. This also includes any item that was reclaimed from a recycling plant or landfill. Each team must provide scanned images of receipts used to complete the design within the Appendix of the submitted design report.

## 6.0 Design Report

Each team is required to submit a design report detailing the overall project and must include a description of the design process, final design, treatment principles utilized, environmental impacts, cost analysis, and tables of material and operational costs.

### 6.1 General Requirements

The body and appendices of the Design Report must be presented on white 8 ½" x 11" pages in portrait orientation. No background images or watermarks are permitted behind the body or appendices of the paper. An Appendix Table of Contents is permitted, but is not required. No blank pages are to be inserted into the report.

Body text must be in English and use 12-point, Times New Roman, and be single spaced. Section headings and subheadings may be of greater than 10-point font. The following items must be numbered: headings in the "Body of Work" section outlined below, body pages, and appendices (e.g. Appendix 1, A-1, etc.).

Photographs, tables, line drawings, graphs, headers and footers are permitted. Captions used are to be no less than 10 point, normal width font.

Items such as page numbers, logos, designs, section headings, etc. may be incorporated into the header and footer of the pages and are not subject to the font requirements of the body text. The header and footer may be located within the margin itself (i.e., outside of the body text limits).

### 6.2 Format

Each technical report must include the following items and/or sections:

1. Memo formatted page
  - a. Followed by brief description of contents
2. Professional Cover Page
  - a. University name
  - b. Competition name
  - c. Participant names, majors, and years
  - d. Date submitted
3. Executive Summary:
  - a. Basic information about the team including the name and location of the school
  - b. Overview and highlights of final design and filtration results
  - c. Total cost of the system
4. Professional Table of Contents
  - a. Must have all sections and subsections titles listed with page numbers

- b. Must include tables for figures, charts, equations, abbreviations, etc.
- 5. Body of Work
  - a. Methodology
    - i. Identify the methods utilized to conduct the analysis
    - ii. Include the following: formulas, equations, software, references, field work
  - b. Results of analysis
    - i. Description of results
    - ii. Use tables, graphs, diagrams, etc
  - c. Discussion
    - i. Evaluation of results
    - ii. Discussion of legitimacy
    - iii. Discussion of challenges that may have affected the results
  - d. Conclusion
  - e. References
    - i. Must be cited in IEEE
    - ii. References utilized should only be from credible sources; websites ending in .com/.org are not credible sources
- 6. Appendices
  - a. Receipts
  - b. Visuals larger than half a page

\*Please submit an electronic version of your report (in PDF format) via email to [pswc2018@gmail.com](mailto:pswc2018@gmail.com) by no later than midnight on March 12, 2018 (11:59 PM). Hardcopy submissions will not be accepted.

## **7.0 Construction Rules**

### **7.1 Site Constraints**

The teams will each be given a 10' x 10' area to construct their designs defined by tape on the floor. The site limits will be measured from the inside of the boundary marker. Neither operators nor materials may exceed the boundaries of the area. All sites will be located on a mostly level (slope not to exceed 2%) paved surface.

### **7.2 Time Constraints**

Teams will be timed on the construction of their systems. Each team will be limited to a total of thirty minutes to construct the treatment systems. Teams will then be allotted ten minutes to pour the nine gallon sample into their system. At the end of the ten minutes, teams must exit the 10' x 10' area. Twenty minutes will be allowed for the system to treat the water. The collection basin must be removed from the treatment system immediately following the treatment phase.

### ***7.3 Personal Protection Equipment (PPE)***

To ensure the safety of all those involved, each team member inside the given 10' x 10' space during the construction and treatment phase must be wearing the following PPE: closed-heel and closed-toed shoes, long pants, long-sleeved shirt, gloves, OSHA approved protective eyewear, and OSHA approved hard hats. To protect against contact with the specified contaminants, lab coats will be required. Longer hair and loose clothing items must also be tied back or secured. Note these items are not included in the final budget.

### ***7.4 Construction Specifics***

Teams will place all their unassembled raw materials and tools in the 10' x 10' competition area prior to beginning the construction phase. Judges will compare the provided materials list in the team's technical report to the materials present at the competition. All materials may be brought to conference pre-tampered with (e.g. marked, cut, drilled) but they must not be pre-built. Store-bought water filters (e.g. Brita filters) cannot be used within the design. Treatment systems must include a collection basin capable of holding nine gallons of water; collection basins will not be provided.

Power saws and power blades are not permitted. Battery-powered tools are permitted, with the exception being the items listed in the above detail. Corded power tools of any kind are not permitted.

Teams may use up to 4 operators to construct, load, and treat the team's system. Construction time will start once the chief operator says "ready" and the judge will start the clock. Construction time will end once the chief operator says "stop" and the judge will stop the clock. Once the chief operator says "stop," teams may not re-enter the construction region, until the filter loading phase. Teams will be given a maximum of 30 minutes for the construction of the system, ten minutes to pour their water sample into the system, and twenty minutes for their water to filtrate through the system. During the twenty minute treatment phase, team members will not be allowed inside their 10' x 10' construction site.

## **8.0 Scoring**

### ***8.1 Design Report - 100 points***

Professionalism must be taken seriously in order to be credible as future engineers. Teams that submit a logical, cohesive technical report with all required sections and content with zero grammatical or spelling errors will be awarded the full 100 points. Teams that fail to do so will be penalized as follows:

1. Spelling and/or grammatical errors will be deducted 5 points for each error.
2. Teams that fail to submit a design report on time will be disqualified.
3. Teams that fail to submit receipts with their report will be disqualified.
4. Teams that submit design reports with one missing section or more will be disqualified.

## 8.2 Water Quality - 100 points

The following table outlines the parameters that will be tested for after the treatment phase and the respective scoring procedure that will be followed for each parameter.

Table 2: Water Quality Scoring

Parameters	Average Performance		Above Average Performance	
	Level	Points	Level	Points
Total P-PO <sub>4</sub> <sup>3-</sup>	1 - 2 mg/L	8	≤ 1 mg/L	20
Total N-NO <sub>3</sub> <sup>-</sup>	10 - 20 mg/L	8	≤ 10 mg/L	20
Turbidity	1 - 5 NTU	8	≤ 1 NTU	15
Chlorine	N/A		4 ± 1 ppm	15
Total coliforms	N/A		≤ 5%	15
Odor	N/A		PASS	15

Chlorine, total coliforms, and odor will be scored on a pass or fail basis. If the above average performance level is not met, zero points will be awarded for that parameter.

## 8.3 Oral and Process Flow Diagram Presentation - 100 points

### 8.3.1 Process Flow Diagram

The process flow diagram is to be presented on a poster. Posters may not be larger than the standard poster size of 24" x 36" and does not need to be included in the overall budget. Each process flow diagram must contain a visual depiction of the design, a materials list with respective costs for each item, and proper references. Poster stands will not be provided at the competition.

### 8.3.2 Technical Oral Presentation

An oral presentation (maximum of 5 minutes, 5 seconds) is required for each participating school. All technical presentations must be conducted in a professional manner. Oral presentations must be presented in English. Presentation order will be randomly selected before the competition begins and will be provided no later than the time of on-site registration. The oral presentations will be open to the public for viewing. An additional five minute period is to be permitted for judges' questions immediately following the oral presentation. Questions are not to be permitted by members of the audience. The time required to set up equipment must not exceed four additional minutes for each school, and the time required to take down must not exceed four minutes for each school.

### *Equipment*

The host school will provide two power plugs, two projection screens, and a computer projection unit for general use during the oral presentation. The host school will provide a stage diagram two weeks prior to the competition. Access to the staging area may be limited. The ability to use props may be limited by this restricted access. The individual school making a presentation must furnish any additional equipment necessary.

### *Presenters*

Presenters may be any of the registered participants of the environmental team who officially sign-in at registration. Presenters include those with speaking parts and individuals operating the computer or overhead projectors during the course of the presentation. A minimum of two people must speak during the live presentation. The use of videos will not be permitted. Teams must not prerecord any speaking parts. No handouts or other materials are to be given to the judges as part of the oral presentation. All team members participating in the presentation must be on stage and available for judge's questions.

### *Deductions*

Deductions will be assessed for infringements of the specifications, including but not limited to, exceeding the official time limit of 5 minutes 5 seconds and not following the live presentation format.

## *8.4 Final System Constraints - 100 points*

This section will include the parameters required for the final system. Each parameter has a required parameter goal. Listed below in Table 3 are each of the scoring ranges.

*Table 3: Final System Constraints*

<i>Constraints</i>	<i>Average Performance</i>		<i>Above Average Performance</i>	
	<i>Level</i>	<i>Points</i>	<i>Level</i>	<i>Points</i>
<i>Volume</i>	5 - 8 gal	5	8 - 9 gal	10
<i>Weight</i>	N/A		≤ 200 lbs	15
<i>Construction Time</i>	N/A		≤ 30 min.	15
<i>Budget</i>	N/A		≤ \$500	20
<i>Filter Time</i>	N/A		≤ 30 min.	20
<i>Process Flow Diagram</i>	N/A		PASS	20



As seen in Table 3, the majority of the constraints are pass/fail for receiving points. The volume constraint is the only one which offers points for an average performance.

### 8.5 Summary of Competition Scoring

The following table displays the Environmental Design Competition's distributed scoring system. The competition is composed of four categories: design report, water quality, oral presentation, and final system constraints. Each category contains various sub-categories outlined in Table 4. Points are evenly distributed throughout each of the four main categories, and it is under the judge's discretion to score teams in a professional manner.

*Table 4: Scoring Summary*

Category	Sub-Category	Maximum Points
Design Report	<i>Subtotal</i>	100
Water Quality	Total P-PO <sub>4</sub> <sup>3-</sup>	20
	Total N-NO <sub>3</sub> <sup>-</sup>	20
	Turbidity	15
	Chlorine	15
	Total coliforms	15
	Odor	15
	<i>Subtotal</i>	100
Oral Presentation	Technical Content	40
	Response to Questions	30
	Visuals	20
	Time	10
	<i>Subtotal</i>	100
Final System Constraints	Volume	10
	Weight	15
	Construction Time	15
	Budget	20
	Filter Time	20
	Process Flow Diagram	20
	<i>Subtotal</i>	100
	<i>Total</i>	400