

# Environmental Design Competition Rules (V1.0)



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*Mid-American Ingenuity*

## Background

As a part of the 2023 ASCE Mid-America Student Symposium, the Kansas State ASCE Student Chapter intends to host an Environmental Design contest. The competition will closely mimic other environmental design contests hosted at other ASCE Student Symposia across the nation with a specific focus on water/wastewater infrastructure development/design.

## Objective

The American Society of Civil Engineers (ASCE) Environmental Design Competition encourages students to gain experience in designing and constructing low-tech, globally applicable water treatment systems. Participating students will learn about 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 targeted impurities. The goals of this competition are to inspire innovation, create an awareness of the water quality needs both inside and outside of the United States, and provide future water quality engineers with invaluable hands-on experience.

## Design Requirements

The objective of the competition is to remove harmful contaminants from polluted water, bringing it up to potable standards. 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/use their water filtration systems on-site. The following contaminants will be present in the following quantities.

**Table 1: Contaminant Quantities per Nine-Gallon Sample**

Contaminant	Quantity per nine-gallon sample
<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>Unknown water sample*</i>	20 mL

\*Sample could come from one of the following three sources (WWTP effluent, not essentially from Manhattan, KS; lake water; shallow groundwater well water)

## 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 or borrowed items used, the commercial value will need to be included in the value as well. These commercial values must be adapted from either Walmart.com 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.

## 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.

## Construction Rules

### *Site Constraints*

The teams will each be given a 10' x 10' area to construct their designs defined by tape on the ground. 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.

### *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.

### *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-heeled 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.

### *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 four operators (undergraduate students) to construct the treatment system and treat the provided contaminated water. Construction time will start once the chief operator (team captain) says "ready" and the judge starts the clock. Construction time will end once the chief operator says "stop" and the judge stops 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, 10 minutes to pour their water sample into the system, and 20 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.

## Scoring Criteria Breakdown

The total score is obtained for equal four criteria.

### *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 assessed a penalty.
3. Teams that fail to submit receipts with their report will be assessed a penalty.
4. Teams that submit design reports a missing section(s) will be assessed a penalty.

### *Water Quality – 100 points*

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

**Table 2: Water Quality Scoring**

<i>Parameters</i>	<i>Average Performance</i>		<i>Above Average Performance</i>	
	Level	Points	Level	Points
<i>Total P-PO<sub>4</sub><sup>3-</sup></i>	1 - 2 mg/L	8	≤ 1 mg/L	25
<i>Total N-NO<sub>3</sub><sup>-</sup></i>	10 - 20 mg/L	8	≤ 10 mg/L	25
<i>Turbidity</i>	1 - 5 NTU	8	≤ 1 NTU	25
<i>Odor</i>	N/A		PASS	25

### *Oral Presentation – 100 points*

An oral presentation (maximum of 10 minutes) 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, but not by other participating teams. An additional five-minute period is to be permitted for judges' questions immediately following the oral presentation. Questions are not to be permitted by any members in 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.

### *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>Average Performance</i>		<i>Above Average Performance</i>	
	Level	Points	Level	Points
<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, most of the constraints are pass/fail for receiving points. The volume constraint is the only one which offers points for an average performance.

## Participation Restrictions

Each student chapter participating in the ASCE Mid-America Student Symposium has one entry into the Environmental Design Competition. An Environmental design team shall consist of two to four students who shall be on-site for the competition. Faculty advice and input is encouraged, though a named faculty advisor is not required to participate.

## Overall Composite Scoring

The competition will be based on the performance of the team in four categories and each category will be assessed a fraction of the total score as:

- Design Report 100 points
- Water Quality 100 points
- Oral Presentation 100 points
- Final System Constraints 100 points
- **Total 400 points**