

Environmental Design Rules

Participants

- Each school may only have one team compete in the competition
- Each shall consist of a maximum of five members
- Each team member must be a registered participant of the 2017 ASCE Great Lakes Student Conference

Event Description

Each team must construct a liner to prevent leachate infiltration from their simulated landfill. Each team will be provided a box that simulates the landfill; to which they will apply and test their liner. Teams will be graded on the effectiveness and economy of their design.

Relevance

Leachate is a problem in landfills when the lining does not prevent the leachate (contaminated water) from escaping, which can lead to health problems for humans as well as the environment. Having a proper liner prevents the contamination of groundwater.

Required Materials

Teams should come prepared with their design and any tools from the following list:

- Cutting Implements
- Writing Implements
- Straight Edge

Guidelines

Construction:

Each team's liner will be constructed on a frame measuring 18 x 13 x 10 (L x W x H) inches.

Each team's liner shall be constructed using only materials from the following list:

- Pre Wetted Paper Stips (1" x 11")
- Pieces of Plastic Bags (3" x 5")
- Pre Wetted Fabrics (3" x 4")
- Popsicle Sticks (¼" x 4")
- Cotton Pads (2" Diameter)
- Drinking Straws (Bendy) (¼" x 9")
- Playing Cards (Standard Size)
- Pipe cleaners (12")

*All materials listed above are not guaranteed to all be exactly the same size

(see figure 2 below)

Testing:

- Each team will be given a wooden frame, constructed by the host school, covered in chicken wire, 18 x 13 x 10 (L x W x H) inches (see figure 1 below) that will serve as the base to build the liner. A Sterilite 16qt. Storage box, 16.75 x 11.88 x 7 in (L x W x H) from The Home Depot will be placed below the liner to collect any leachate that makes it through the liner.
- Each team will only have the first 10 minutes of the 30 minute construction time to purchase materials for their landfill liners. After the first 10 minutes you will no longer be able to purchase materials. A total of 30 minutes will be given to construct the liner.
- The liner must be laid flat along the chicken wire base, so that all leachate is held inside the liner; therefore, teams are not allowed to construct the liner in a manner that would allow for runoff of the leachate.
- Each material will be given a certain dollar amount; cost of the liner will be based on the materials that are purchased, not just materials used in construction of liner.

- ¼ gallon, approximately 2.085 lbs, of leachate, water with food coloring for effect, will be uniformly poured over the liner within 15 seconds from a watering can to see how much leaks through the liner.
- After the leachate has been poured over the liner, 15 seconds will be given to allow any leachate to soak through. The Sterilite box will be removed by the host school and then the judges will measure how much leachate was collected in the box, the less the better.

Scoring and Judging

Each liner will be judged based on how economical and effective the design is. The score will be weighted on a 60% for effectiveness and 40% for economy. The lowest cost and least amount of leachate will earn the maximum possible score of 100 points for that category; points thereafter will be directly proportional based off the top score in the category, please see figure 3 for examples. The final score will be a summation of the weighted values of the score in each category. This will be accomplished by giving each material which teams are permitted to use an assigned fictional dollar value listed in the table below:

Pre Wetted Strips of Paper	\$2 per Strip of Paper
Pieces of Plastic Bags	\$5 per Piece
Pre Wetted Fabric	\$5 per Sheet
Popsicle Sticks	\$1 per Stick
Pre Wetted Cotton Pads	\$2 per Piece
Bendy Straws	\$1 per Straw
Playing Cards	\$2 per Card
Pipe Cleaners	\$1 per Cleaner

The total cost of each liner will be calculated based on the sum of the costs of the materials purchased for each design. The lower the cost of a liner, the more economical it is; gaining it a higher score in this category.

Each liner will also be evaluated on how effective the design is. To do so, the leachate that was collected from below the liner will be measured based on weight in pounds. The lower the amount of leachate the liner allows to pass through, the more effective it is; gaining it a higher score in this category.

In the event of a tie, the team with the most effective landfill will be given the higher place.

Figures

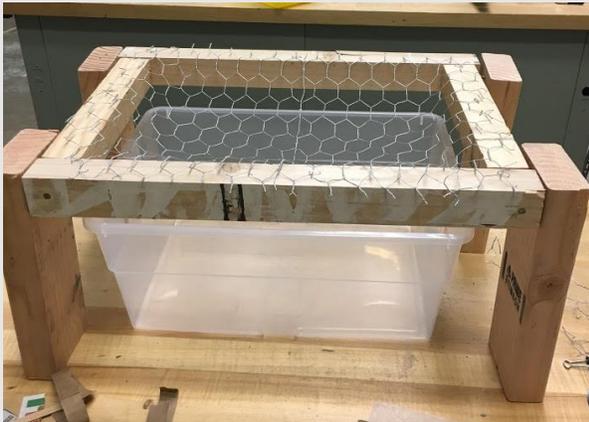


Figure 1: Liner frame example



Figure 2: Examples of each material (From left to right, top to bottom: Pipe Cleaners, Bendy Straws, Popsicle Sticks, Wetted Fabric, Cotton Pads, Playing Cards, Wetted Paper Strips, Plastic Bags)

Teams	Economy		Effectiveness		Total Score	Final Place
	Material Cost (\$)	Points in Category	Leachate (lbs)	Points in Category	$(0.4 * \text{Economy} + 0.6 * \text{Effectiveness})$	
A	\$ 25.00	100.00	1.00	100.00	100.00	First
B	\$ 45.00	55.56	2.00	50.00	52.22	Second
C	\$ 60.00	41.67	4.00	25.00	31.67	Third
D	\$ 75.00	33.33	7.00	14.29	21.90	Fourth
E	\$ 100.00	25.00	9.00	11.11	16.67	Fifth

Figure 3: Example of competition scoring.