DIRECTIONS—Design/Build

DO NOT BEGIN UNTIL INSTRUCTED TO DO SO

1. This packet contains instructions for the Design/Build portion of the competition and colored sketch paper to be used during the design phase.

2. Your team will have 10 minutes to brainstorm and sketch your design. You may not build during this portion of the competition.

3. All team members should contribute to the process of designing and building your solution.

4. Complete the SCHOOL/TEAMS INFORMATION at the top of data sheet provided.

   NOTE: Any sheets submitted without identifying school/team information will NOT be scored.

5. Teams are responsible to count the number of each item used: a signature verifying an accurate count is required.

6. A site volunteer will complete and sign the Design/Build Data Sheet that will be returned to TSA for scoring.

7. Data sheets are returned to the national TSA office for scoring.

Failure to adhere to directions may disqualify your team from competition.

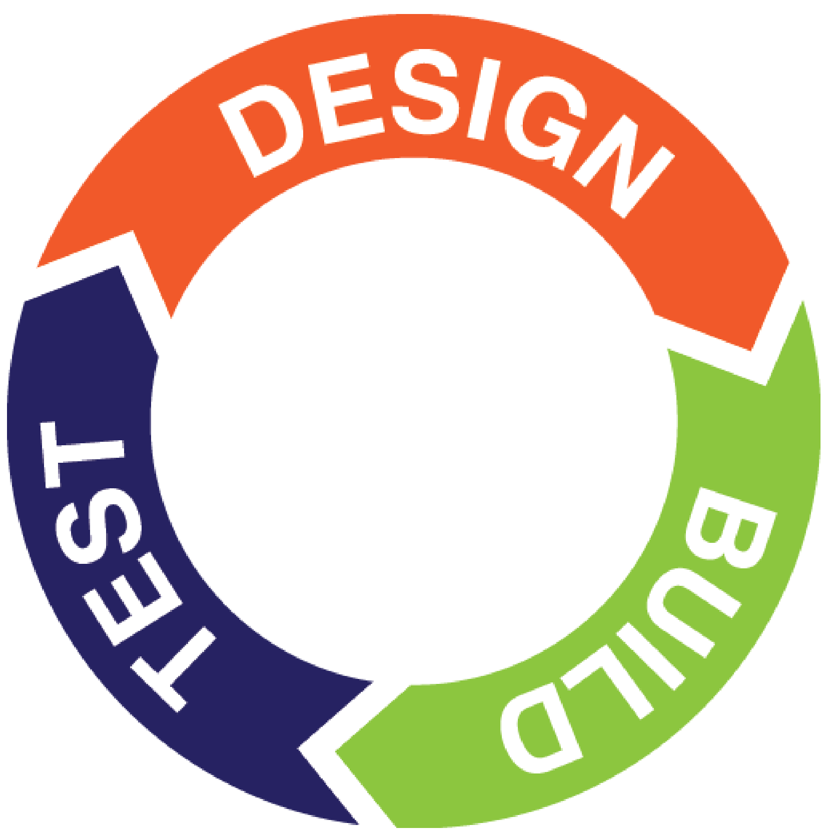
TEAMS Design/Build Challenge

Design and Build a Robot Arm

Inherent in engineering solutions to environmental issues is the responsibility to choose tools that will not adversely affect the end product or the environment. For example, imagine if engineers were working with nanotechnology and used tools that damaged the very devices they were creating, or if the tools used in medical research turned out to be hazardous to human health.

Engineers working in dangerous environments must protect themselves and the general public; this often means that engineers must design tools to interact with materials or systems that can be toxic, dangerous or fragile.

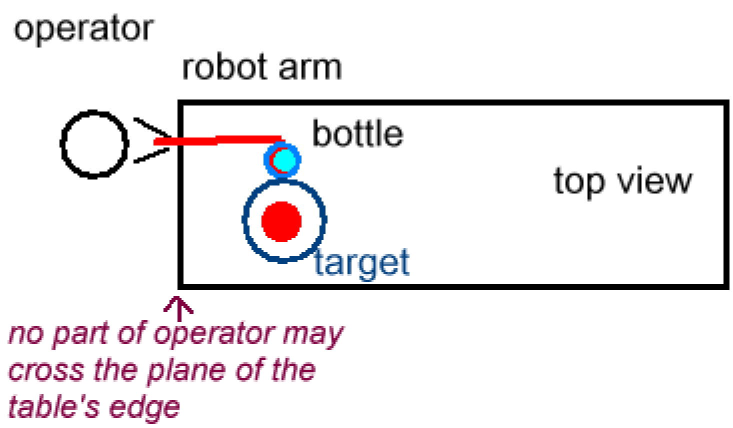
As the tools require more complexity, scientists and engineers will rely upon decision making frameworks to help inform their paths to discovery and to record their journey.



Challenge

Using only the materials on the TEAMS Design/Build Materials List, your team will design and build a “robot arm” to pick up a closed, full water bottle from a location 24” from the edge of a table, and place it upright on a new landing spot (designated by a target) also 24” from the edge of a table. The robot arm must completely disengage from the water bottle. No part of the robot operator (one of the members of the team) may cross the plane of the edge of the table.

Teams may only use the materials they have brought with them that are listed on the supply list.



In addition to designing and building your robot arm, your team will be challenged to understand how decision making frameworks inform the engineering design process. These decision making frameworks will be used as your team determines how it will use its available resources to meet the challenge.

Process

Each team will be allowed 10 minutes for brainstorming and sketching of design ideas. During this time, no building will be allowed.

The remaining 55 minutes is used to build and test your design. When time is called each team must stop and put down all materials. Each team’s robot arm will be tested and the data recorded and collected.

Evaluation Criteria

A design matrix (data sheet) will be used to evaluate your robot arm design process and performance. The data collected that will be used to judge the robot arm includes the following:

Cost: **Lower cost is better: 40% of your final score.**
The cost of production is always a factor when designing a product. Keeping your material cost low helps reduce production costs, therefore using only the materials needed to produce the most efficient design is best. Each item used in the design, the build or destroyed along the way adds to the total cost.

Fastest transfer: **Faster is better: 40% of your final score**
Each robot arm will be timed as it places the water bottle on the target and then disengages. A faster time is preferable. The total time from engagement to release is not to exceed 120 seconds.

Most accurate transfer: **More accurate is better: 20% of your final score**
Completed transfers of the water bottle are given a point value based on how close they come to the center of the target.

All data sheets will be returned to TSA. The data will be entered into a computerized scoring template to produce the score.

Calculating Cost:

You are realistically constrained to use only the allowable materials in your final robot arm. In addition, any materials damaged during the design or build 'count' toward the final cost of the arm: for example, bent paper clips or a piece of cardboard that is torn, but not used, would both count as used materials.

Each item has a specific cost, as shown in the table below.

When your arm is complete, your team is to list the number of each item used on the official scoresheet (note: enter the number of items used, NOT the total cost. For example, if you use 4 binder clips, enter

4	not	20	.

Cost per item used:

Pieces of corrugated cardboard *no more than 2.5" wide, no more than 24" long, no more than 3/16" thick*	5 pieces	*cost: 20 each*		
Binder clips	10 clips	*cost: 5 each*		
Wooden clothespins	12 clothespins	*cost: 5 each*		
4.5" craft sticks	16 sticks	*cost: 5 each*		
Paper clips	100 clips	*cost: 1-50=10* *51-100 = 20*		
Wooden pencil	8 pencils	*cost: 5 each*		
Rubber band	24 rubber bands	*cost: 5 to use 6 rubber bands*		
Wire hanger	2	*cost: 20 each*		
Twine: 4 feet total	Amount used (choose one)	None: cost: 0	some, but less than ½ cost: 10	1/2 to all cost: 20
String: 4 feet total	Amount used (choose one)	None: cost: 0	some, but less than ½ cost: 10	1/2 to all cost: 20
Duct tape: 4 feet total	Amount used (choose one)	None: cost: 0	some, but less than ½ cost: 20	1/2 to all cost: 40