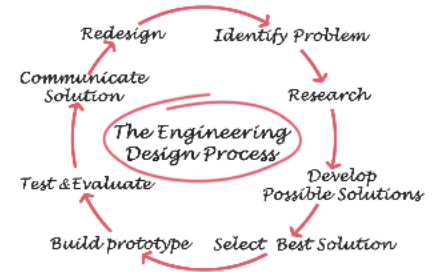




Design/Build Challenge Instructions

Engineers design solutions for problems that are large to small; from space travel, huge infrastructure projects, and desalination systems to convert ocean water to drinkable fresh water to innovative desk lamps, hot beverage makers and new animal transport devices. In every successful design, engineers follow a design process.

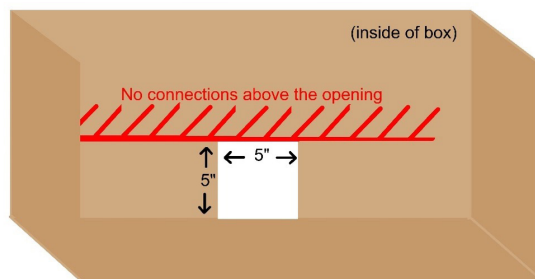


Challenge: Design a miniature prototype of a new and innovative luggage transport system

In this challenge, your team will design a miniature prototype of a new and innovative luggage transport system. This transport system will allow baggage personnel to load suitcases into an escape-proof pod which transports the luggage through to a designated exit. In your prototype, the luggage transport system must allow a suitcase (simulated by a ping pong ball) to enter the pod (simulated by a cardboard box) and allow it to exit out of the back of the unit, presumably to a baggage claim area in an airport.

Your prototype will have an entry door which must be opened through contact with the ping pong ball. Once the ball is inside the cardboard box, the door must automatically close (without intervention) to trap the ball in the box. The box must also have a back door where the ball must exit. The back door must be opened through contact with the ball (without intervention) and must automatically close.

Your task: Design and implement two doors or other mechanisms which completely secure the entrance and exit such that the ping pong ball cannot escape once it enters the box. Each mechanism must operate on its own: no human interaction is allowed. The mechanism must automatically and completely close the opening (entrance and exit) so that no gaps over $\frac{1}{4}$ " exist. The mechanism must close within 1 second. The mechanism may be attached to the box, but no part of the mechanism may be attached on the plane above the entrance or exit, whether inside or outside of the box.



Start: The ping pong ball will start at a designated spot of your choice, outside of the box. The ball must travel into the box; a door/mechanism must close off the entrance within one second and trap the ball inside.

In the box: The ball must remain in the box for a minimum of 5 seconds. During this time, both the entrance and exit must be closed, trapping the ball inside.

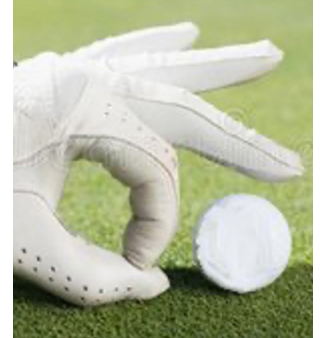
Finish: The ball then needs to exit out of the other opening. The box must not be picked up, tilted, or manipulated to cause the ball to move. Once the ball leaves the exit, the exit should be completely blocked (automatically, with no human intervention).



Design/Build Challenge Instructions

How can you move the ball?

- The ball may be 'flicked' through each opening: a finger may flick the ball forward. Note that this means one short contact, not grabbing or pushing the ball. Grabbing, holding, or pushing the ball will result in a significant penalty. You have no more than three tries to flick the ball through each opening.
- The ball may not be grabbed or held while moving.
- The ball may be tied or taped to a string and pulled, taped to a stick and pushed, etc. You may only use allowable materials and these materials count toward your total cost.
- Only one person may move the ball.
- The person moving the ball may reach into the box from the top if necessary.
- The shape of the ball may not be altered.



Scoring: Teams should film each attempt, as any successful attempt may be submitted as the entry for that team. Timing begins as soon as the ping pong ball is engaged. Timing ends when the last gate closes and the ball exits.

Only one video of a single attempt may be submitted; however, teams should film each attempt, as any successful attempt may be submitted as the entry for that team. Videos must be no longer than 45 seconds.

Preparation:

Prepare the box: Cut two 5" x 5" holes, one as the entrance and one as the exit to the box. The entrance and exit must be on opposite facing sides of the box. The holes can be cut on any part of the plane (i.e. bottom, top, side). A 5" x 5" template is provided on page 6. If the opening is not within 1/2" of 5" x 5", a penalty will be assessed. The top and/or bottom of the box may be removed. If both are removed, the shape of the box must be preserved. The box must be prepared during the "Design, build, test, iterate" period. **The cardboard removed from the box may not be used in the design.**

Hint: Work on your design before you cut these holes: once you cut the holes, they cannot be modified.

Timing:

15 minutes prior to start time: **Releasing the challenge:** Challenge released to student teams. Teams may begin sketching and brainstorming, but must not begin building.

120 minutes: **Design, build, test, iterate:** Team members will construct a prototype using only approved materials from the Materials List and iterate on their design. Teams must prepare their box (cut holes). All testing must be completed within this 120-minute block. Record a video each time your ball runs from start to finish through the box.

15 minutes: **Submit:** Teams complete the Datasheet and Honor Statement. Upload both forms and the video link using the instructions and submission link provided in your online coach account.

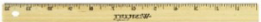
Design/Build Challenge Instructions

Materials: Your solution must be constructed out of the specified materials – no extra materials are allowed. The scissors, the ping pong ball, ruler, cardboard removed from the box, and the stopwatch may not be used in the design; they may only be used as tools.

REQUIRED MATERIALS

QUANTITY	SIZE	DESCRIPTION (Click link for Option to Purchase)	EXAMPLE
1	14-18" H, 14-18" W, 16-20" L	Cardboard Box, assembled	
10 Feet	Any Ply	Cotton Twine or String	
1 roll	1" x 60 yds. (max.)	Masking Tape, general purpose	
8	Standard, No.2	Non-Mechanical Pencils, unsharpened	
4	Any	Rubber Band	
1 box	100 count, standard size	Smooth Paper Clips	
20	8.5" L (max.) .20 - .25 dia.	Straws, unwrapped, non-flexible	
1	Standard, 40 mm Dia.	Table Tennis Ball	
1 roll	3/4" x 250" (max.)	Transparent Tape	
20	Standard	Wooden Craft Sticks	

REQUIRED TOOLS (not to be used as part of the final build)

1	Standard	Ruler	
1	Standard	Scissors	
1	Misc.	Writing Utensil	



Design/Build Challenge Instructions

Evaluation Criteria:

Your prototype will be evaluated based on the specific criteria, as given below. Your score is broken down into three parts: *required design elements, timing, and cost.*

Cost is per item used. **Using any part of an item, or damaging an item, counts toward the total cost.** For example, if a team uses a pencil, it counts as used. If a team breaks a pencil and uses half, it counts as a full pencil. Bend a paper clip to poke a hole? It was used, and counts as a paper clip.

Required design elements (40)	
Each door automatically closes	10 points*
No gaps in entrance or exit	10 points
No attachment overhead	10 points*
Ball moves legally	10 points
*penalty: manually closing doors, attaching device overhead, grabbing or holding the ball, altering the shape of the ball, opening not 5" x 5"	-10 points for each infraction
Timing (lower is better) (10)	
Timing: start to finish (includes 5 seconds in box). Timing starts as soon as the ping pong ball is engaged. Timing ends when the last gate closes and the ball exits.	10 points
Cost (lower is better) (30)	
DESCRIPTION	COST
Cotton Twine or String	5 for up to 5 feet, 10 for more than 5 feet
Wooden Craft Sticks	2 per craft stick
Masking Tape	5 for up to 5 feet, 10 for more than 5 feet
Transparent Tape	5 for up to 5 feet, 10 for more than 5 feet
Pencils	5 per pencil
Straws, unwrapped, non-flexible	2 per straw
Rubber Band	2 per rubber band
Smooth Paper Clips	1 per paper clip



Design/Build Challenge Instructions

Video Submission:

Select your best video. Only one video may be submitted. State your school name and participant ID at the beginning of the video. The submitted video must be continuous (not edited). Videos must be 45 seconds or less. Your video should show:

- A stopwatch timing the run from start to finish, clearly showing the total time. The stopwatch must not leave the frame of the video.
- The initial movement of the ball.
- The complete path taken by the ball.
- The ball exiting the box, with the stopwatch stopping the time.

Failure to display the stopwatch during the entire run will result in a zero score for timing.

Upload the video to a hosting platform (for example, YouTube or Vimeo). Submit the URL link using the provided submission link and instructions. The video link must be “unlisted” so it is viewable for judging. Video upload instructions are available in your online coach account.

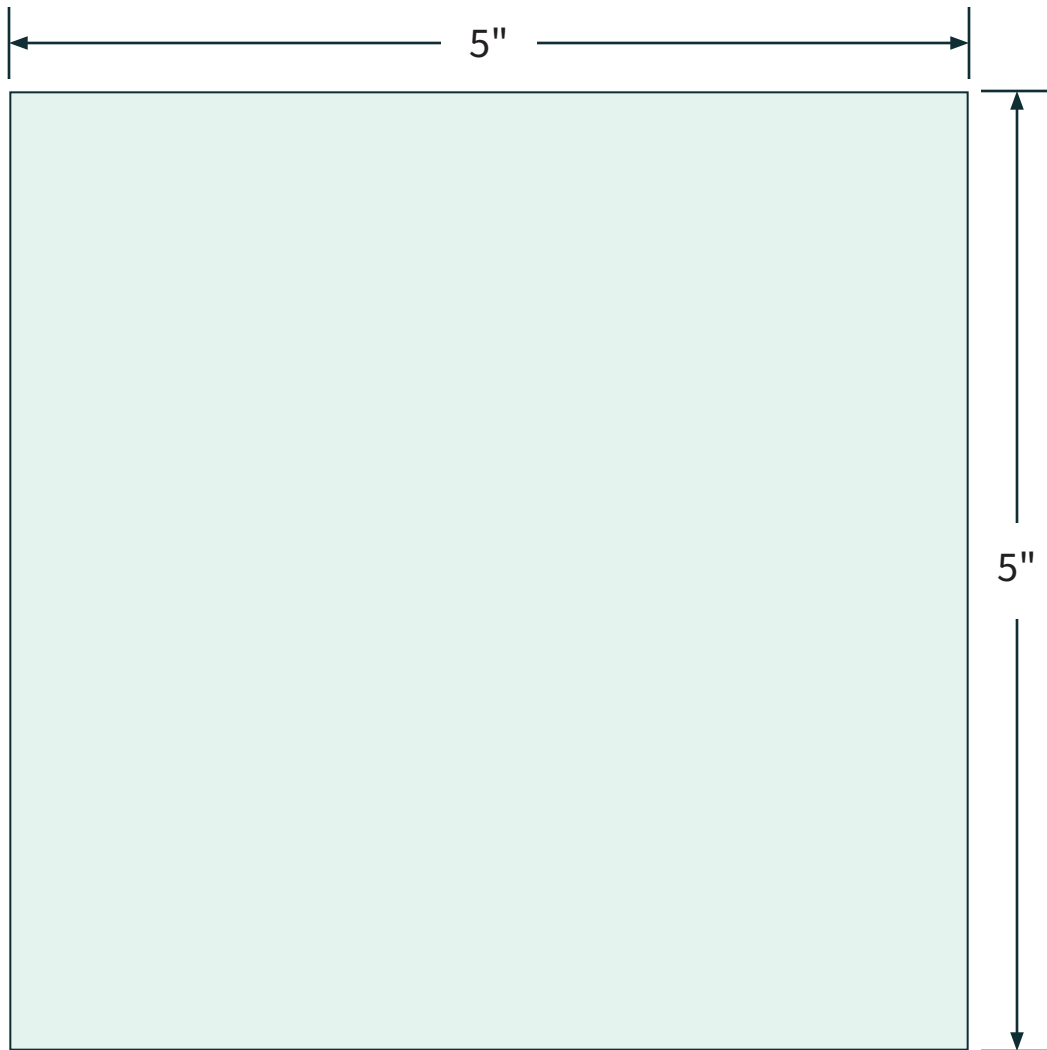
Videos that are not able to be viewed for judging will result in disqualification. Videos submitted via email will not be accepted.

Datasheet Submission:

Complete the Design/Build Challenge Datasheet and submit the completed form to your proctor. Verify the information is written clearly and accurately. Submit the form to TSA along with the video URL and Competitor Honor Statement using the instructions and submission link provided in your online coach account.

Design/Build Challenge Instructions

5" x 5" template





Design/Build Challenge Datasheet

Complete the information below and submit the completed form to your proctor. The total must be calculated. Verify the information is written clearly and accurately. One datasheet per team must be submitted to TSA along with the video URL and Competitor Honor Statement using the instructions and submission link provided in your online coach account.

Coach Name: _____

Coach's email address: _____

Participant ID number: _____

School: _____ State: _____

Total Cost: _____

Total testing time (seconds): _____ Total time, start to finish (seconds): _____

Required design elements (40)		Possible points		Points	
Each door automatically closes		10 points*			
No gaps in entrance or exit		10 points			
No attachment overhead		10 points*			
Ball moves legally		10 points			
*penalty: manually closing doors, attaching overhead, grabbing, holding the ball (failure to ‘flick’), altering shape of the ball, opening not 5" x 5”		-10 points for each infraction			
Timing (lower is better) (10)		Possible points		Time (sec)	
Timing: start to finish (includes 5 seconds in box)		10 points			
Cost (lower is better) (30)					
ITEM	COST	NUMBER/QTY		COST	
Cotton Twine or String	5 for up to 5 feet, 10 for more than 5 feet				
Wooden Craft Sticks	2 per craft stick				
Masking Tape	5 for up to 5 feet, 10 for more than 5 feet				
Transparent Tape	5 for up to 5 feet, 10 for more than 5 feet				
Pencils	5 per pencil				
Straws, unwrapped, non-flexible	2 per straw				
Rubber Band	2 per rubber band				
Smooth Paper Clips	1 per paper clip				
				TOTAL COST	