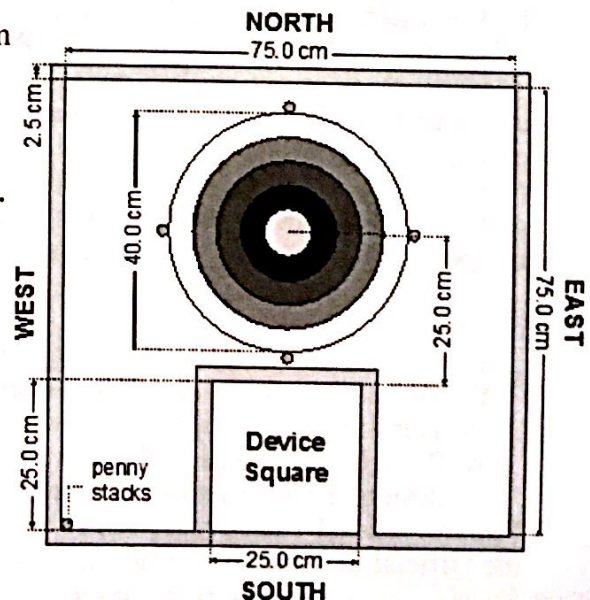


See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Prior to the competition, teams must design, build, document, and test one robotic device to move U.S. Lincoln cents (pennies).
A TEAM OF UP TO: 2
2. **EVENT PARAMETERS:** **IMPOUND:** No **EYE PROTECTION:** B **APPROX. TIME:** 10 min. Teams must provide one Device. Teams without proper eye protection must be immediately informed and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete and scored as a no-show. The Supervisor provides the Competition Area and pennies.
3. **CONSTRUCTION PARAMETERS:** The Device includes the Arm(s), remote control box(es) (e.g. wireless, hard-wired, etc.), their associated connections, and optional separate power supply.
 - a. The Arm(s) may be attached to a Base. In the ready-to-run position, all parts (except the control box(es), separate power supplies, and their connections) must fit inside an imaginary 25.0 cm x 25.0 cm force of gravity.
 - b. Commercial kits may be used, but each must have at least one functional modification, of which the lack of the modification will result in the Device working differently or not working.
 - c. While pneumatics are permitted, storage devices must not start with positive gauge pressure.
 - d. Only commercial batteries, not exceeding 14.4 volts as labeled, may be used to energize each of the Device's electrical circuits. Multiple batteries may be connected in series or parallel as long as the expected voltage output across any two points does not exceed 14.4 volts as calculated using their labeled voltage. Teams must be able to show the Event Supervisors (ES) the labeled voltage. All energy storage devices must be contained in the Device, power supply, or controller(s). **Lead-acid batteries are not allowed. Laptops/tablets not connected to a wall outlet may be used to control the Device and their internal voltage does not need to be checked.**
 - e. Competitors must go to www.soinc.org to check legal and permitted frequencies for radio-controlled equipment for surface devices.
 - f. Students must be able to answer questions regarding the design, construction, and operation of the Device per the Building Policy (see www.soinc.org) and Technical Documentation in 4.a.-c.
4. **TECHNICAL DOCUMENTATION** (must be submitted with the Device at check-in and include):
 - a. Illustration (photos, drawings, etc.) of the basic structure of the Device with labels (consistent with the Operating Description) that must show: i. All actuators; ii. All energy sources; iii. All controls used to interact with the Device.
 - b. Operating Description: i. Device reaction to each control input, ii. Tentative/proposed plan of movement (i.e., which pennies will be moved, how the Device plans to move the pennies).
 - c. Written Practice Log: Record at least 10 runs of at least 3 parameters including score and time.
5. **COMPETITION AREA:** The Competition Area is a 75.0 cm x 75.0 cm square marked using the inside edge of tape approx. 2.5 cm wide. The ES must designate each of the 4 sides as North, East, South, and West. The surface of the competition area may be any nominally flat board, floor surface, table, etc. See www.soinc.org for an expanded view of Competition Area.
 - a. The inside edge of tape is used to mark a 25.0 cm x 25.0 cm square (the "Device Square") inside of, centered on, and sharing the South edge of the Competition Area.
 - b. A standard 40 cm archery target following FITA standards (or a printout of it) is taped down on all sides or marked onto the Competition Area. The center of the target is 25 cm north of the Device Square's northern inside edge, centered between the west and east edges of the Competition Area. Concentric circles of radii 4.0 cm, 8.0 cm, 12.0 cm, 16.0 cm, and 20.0 cm separating the target into zones must be visible.
 - c. Five stacks of pennies, with 10 pennies each, heads side up, are placed such that one stack is tangent to, and outside of each of the west, north, east, and south edges of the 20.0 cm radius circle. One stack is also placed just inside the southwest corner of the Competition Area.





ROBOT ARM (CONT.)

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6. COMPETITION:

- a. At check-in, the ES will inspect and measure the Device, select 6 items from the Technical Documentation, and have the competitors point them out on their Device.
- b. **Teams will be given 3 minutes for each of two runs.**
- c. **Prior to the first run** teams will have 2 minutes of Preparation Time to set up and test their Device in the Competition Area. **There will be 2 minutes between the two runs to reset the robot and board.**
- d. Prior to **each** run, the Device must be in the Device Square in the ready to run configuration.
- e. Prior to **each** run, the ES must verify the timekeepers and competitors are ready. Three (3) Timers are suggested, recording the middle time as the Run Time. The ES will then count aloud "1, 2, 3, Go". Teams will have 3 minutes, starting from the word "Go", to complete the task of moving the pennies.
- f. **Pennies and Target** must not be damaged and must remain usable for other teams.
- g. The run must stop (and the time recorded to the precision of the Timers) when any of the following occurs (none of these actions will move the team to a lower tier):
 - i. 3 minutes **for each run** has elapsed from the word "Go"
 - ii. The competitors say "Science"
 - iii. The competitors contact the Competition Area a second time after being warned once
 - iv. The competitors impart energy directly into the Arm, Base, or pennies
 - v. Any end effectors are moved by anything besides stored energy in the Device
 - vi. Any part of the Device (except for end effectors and connections to control boxes) touching the Device Square surface in the ready to run configuration exits the Device Square
 - vii. **Any part detaches from the Device**
- h. All pennies must be scored based on where they are at the end of the run when time is stopped.
- i. Teams who wish to file an appeal must leave their Technical Documentation and Device with the ES.
- j. **The ES must verify with the team the correct recording of data on the team scoresheet.**

7. SCORING: High score wins. At the end of a run, points are awarded based on the pennies in the specified scoring areas and any Bonus. The total points for the best single run will be the Run Score.

- a. Teams must receive the following points for each penny lying completely flat, heads-up on the competition area at the end of the Competition Time by being in specific zones. These zones, as described in 5.b., are listed by their radius from the center of the target below. Any pennies in multiple zones and/or touching the line separating two zones as determined by the ES will receive points of the lesser point-value zone. Any penny under or over another penny or not visible to the ES must not receive any points.

	< 4.0cm	4.0cm-8.0cm	8.0cm-12.0cm	12.0cm-16.0cm	16.0cm-20.0cm	> 20.0cm
Regional	5	4	3	2	1	0
State	10	7	5	3	1	0
National	15	10	7	3	1	0

- b. Each penny satisfying 7.a. but tails up receives twice the point value listed in 7.a.
- c. **Bonus:** Teams receive 10 Bonus Points if all parts of the Arm(s) and optional Base are within the vertical space above the Device Square at the end of the run.
- d. **Final Score = Run Score x Penalty Multiplier(s)**
- e. For each item incorrectly identified in 6.a. a Penalty Multiplier of 0.98 will be assessed. (Max 6 times)
- f. For Incomplete Technical Documentation a Penalty Multiplier of 0.95 will be assessed.
- g. For no Technical Documentation a Penalty Multiplier of 0.80 will be assessed.
- h. Ties are broken by 1) Best non-scored run; 2) Shortest Run Time of best single run; 3) Shortest Run Time of non-scored run.
- i. Tiers:
 - i. Tier 1: Devices that meet all requirements.
 - ii. Tier 2: Devices with only Competition violations.
 - iii. Tier 3: Devices with any Construction violations or both Competition and Construction violations.
 - iv. Participation Points only: Devices that violate the frequency rules; that have no capability, by design or construction, to score points via moving pennies; or are unable to compete.

Recommended Resources: All resources including the Robot Arm DVD (RAD) are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>

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