

# ROBOT ARM

presented  
1/12/12

## SCIENCE OLYMPIAD

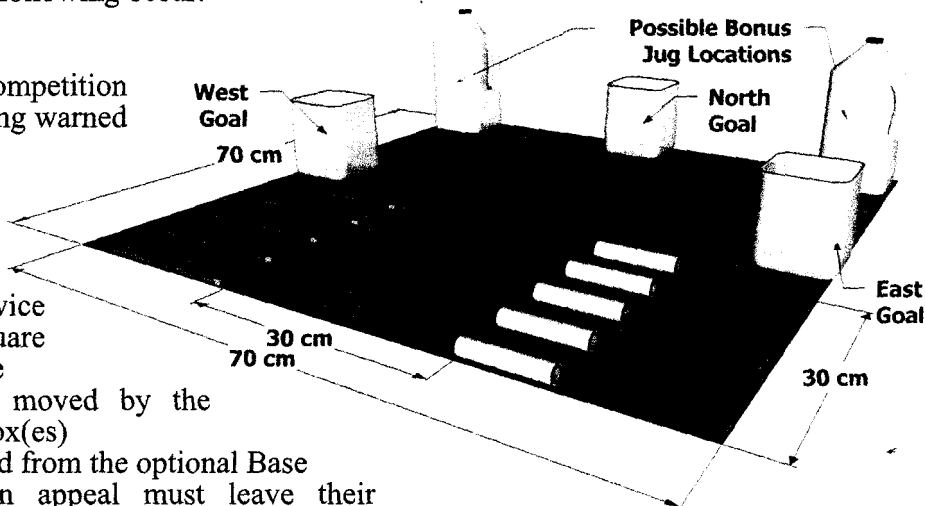
Read the General Rules in the manuals and on [www.soinc.org](http://www.soinc.org) as they apply to every event.

1. **DESCRIPTION:** Prior to the competition teams must design, build, document and test one robotic device to move scoreable items.  
**A TEAM OF UP TO: 2** **IMPOUND:** No **EYE PROTECTION:** #5 **APPROX. TIME:** 10 min.
2. **EVENT PARAMETERS:** Teams must provide one Device. Teams without proper eye protection must be immediately informed of that and given a chance to obtain eye protection if time allows, otherwise not be allowed to compete and are scored as a no-show. The Supervisor provides the Competition Area and items.
3. **CONSTRUCTION PARAMETERS:** The Device includes the Arm(s), an optional permanently attached Base, remote control box(es) (e.g. radio control, infrared, connections (i.e., wires, tubes, hoses, etc.)).
  - a. The Arm(s) may be attached to a Base. All parts (except the control box(es)/connections) in the ready to run position must fit inside a 30.0 cm x 30.0 cm square with no height restriction. The Arm(s) is not restricted to these dimensions during the run and must be attached to the floor only by the force of gravity.
  - b. The Device may use modified kit parts and have any number of arms and joints.
  - c. Competitors must not impart energy directly onto the Arm(s) (i.e., all end effector movements must be powered by stored energy in the device components).
  - d. 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 points does not exceed 14.4 volts as calculated using their labeled voltage.
  - e. Arm functions may have independent circuits, sources of electrical energy and/or control mechanisms.
  - f. Radio control equipment used for this event must operate on frequencies designated by the FCC for surface devices. The frequency must be marked by the manufacturer on the transmitter. Allowable frequencies are: 75 MHz band (75.41 - 75.99 MHz), 27 MHz band (26.995 - 27.255 MHz), 49 MHz band (49.8302 - 49.890 MHz) or 2.4 GHz. Devices using other frequencies must not be allowed to compete.
4. **DOCUMENTS:** In addition to the Device, teams must develop and submit at check-in (or as announced by the tournament director) the following three technical documents-examples available at <http://www.soinc.org>
  - a. Engineering Drawings (hand-drawings are acceptable), either as 3-views or projected views, of the basic structure of the Device that must show:
    - i. All motors and/or actuators on the Arm(s)
    - ii. All energy sources
    - iii. All Arm(s) end effectors (parts that interact with the items on the Competition Area)
    - iv. Controls the competitors are using to interact with the Arm(s)
  - b. Individual Component List for every component of the Arm(s), except fasteners, with the following information. A preassembled component (one not assembled by the team) counts as one component:
    - i. Name of each component
    - ii. Location/vendor from which the component can be obtained
    - iii. Two or more key properties of the component (e.g., weight, dimensions, voltage rating, etc.)
    - iv. Energy source of the component (n/a is an acceptable entry if the component is a voltage/current source or if the component is not energized)
  - c. Operating Description
    - i. Device reaction to each control input
    - ii. Tentative/Proposed plan of movement (i.e., which items in the Competition Area will be moved; how the Device will move each item)
5. **COMPETITION AREA:** The Competition Area is a taped 70.0 cm x 70.0 cm square using the inside edge of tape to mark the area. The Supervisor must designate each of the 4 sides as North, East, South, and West.
  - a. A taped 30.0 cm x 30.0 cm square (the "Arm Square") is marked inside of, centered on, and touching the South edge of the Competition Area. The outside tape edge is used to mark the Arm Square.
  - b. Goal Boxes are labeled W, N, & E and placed inside the Competition Area centered on the West, North, and East sides, touching the edges of the Competition Area. Goal boxes must be a bottom portion of a half-gallon milk jug, cut to a height between 9.5 and 10.5 cm with the opening facing up. They must not be secured to the surface. The Device may move them anywhere after Competition Time begins.
  - c. The Competition Area is divided into North and South Zones along a 35.0 cm Center Line that is defined by the northern edge of a piece of tape running from the East to West edges of the Competition Area.
  - d. At the beginning of each Competition Time, 5 "½ inch nominal size" PVC pipes (9.5 – 10.5 cm long), 5 ferromagnetic nails (9.5 – 10.5 cm long), and 5 unsharpened #2 pencils are spaced 7.5 cm apart and placed perpendicular to the edges of the Arm Square in a row. The head of each nail, the eraser end of each pencil, and an end of each pipe touches the edges of the Arm Square, and points away from it.
  - e. The pencils are placed along the West edge, the nails along the North edge and the pipes along the East edge. 4 upright D batteries are centered between each pair of nails with the positive terminal (nub) up.

# ROBOT ARM (CONT.)

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- f. One unmodified half-gallon jug with the cap removed (the "Bonus Box") is placed at one of the two North corners of the Competition Area by the Event Supervisor. Placement is the same for all teams. It must not be secured to the ground. The Device may move it anywhere after Competition Time begins.
6. **COMPETITION:** At check in, the Event Supervisor inspects and measures the device, selects 4 items from the technical documentation, and has the competitors point them out on their device.
- Teams have 5 minutes of Prep Time to set up and test their Device in the Competition Area.
  - Teams have 3 minutes of Competition Time to complete the task of moving the scoreable items, which begins once the team notifies the Supervisor they are ready and initiate movement of the Device.
  - The run must stop if any of the following occur:
    - 3 minutes has elapsed
    - The team says "Stop"
    - The team steps onto the Competition Area a second time after being warned once
    - Any end effectors are moved by anything besides stored energy in the Device
    - Any part of the Device touching the Arm Square surface exits the Arm Square
    - The Device is physically moved by the connections to the control box(es)
    - The Arm(s) become detached from the optional Base
  - Teams who wish to file an appeal must leave their documentation and Device with the Supervisor.



7. **SCORING:** High score wins.
- If the team or control box(es) connections move any of the scoreable items (pencils, nails, pipes, batteries), or if any scoreable item touches the surface outside of the Competition Area, even if it is under the control of the Arm(s), that item is out of play and must not be used to attain any points. The Goal and Bonus Boxes may touch the surface outside the Competition Area.
  - Teams receive points for items completely supported by Goal Boxes at the end of the Competition Time as listed below. Points attributed to an item in the Goal Box must only be counted if that item was placed while the box was upright.
 

	West Goal Box	North Goal Box	East Goal Box
Pencil	3	2	2
Nail	2	3	2
PVC	2	2	3
  - Teams receive 4 points for each Goal Box that completely supports one or more batteries. (12 points max.)
  - At the end of the run, any item that is completely within the North Zone and not completely supported by one of the Goal or Bonus Boxes receives 1 point.
  - 10 points for each item type (except batteries) completely in the Bonus Box. (30 points max.)
  - If at least one item is fully in the North Zone or supported by a Goal Box when time is stopped 5 points are awarded for each Goal Box that did not lie completely sideways at any time. (15 points max.)
  - The maximum number of points possible is 94.
  - Teams with complete technical documents receive their full score. For each complete document missing (4a-c), teams receive a 10% penalty off of their final score (up to 30%). For each incomplete document (e.g., the Drawings do not include a motor on the device) teams receive a 5% penalty (up to 15%).
    - 1 point is subtracted for each missing or incorrectly identified item during the check-in inspection.
  - Ties are broken by:
    - Least number of electrical, hydraulic or pneumatic motors used.
    - Quality of technical documentation.
  - Tiers:
    - Tier 1: Devices that meet all requirements are ranked by highest score
    - Tier 2: Devices that fail to meet a spec. under "Construction Parameter" are ranked by highest score.
    - Tier 3: Devices with Competition violations are ranked by highest score.
    - Participation Points only: Devices that violate the frequency rules; that have no capability, by design or construction, to score points via moving objects; or are unable to compete.

**Recommended Resources:** All reference, sample documents and training resources including the Robot Arm DVD are available on the Official Science Olympiad Store or Website at <http://www.soinc.org>

## Annie Cunial

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**From:** Annie Cunial  
**Sent:** Wednesday, January 11, 2012 2:33 PM  
**To:** 'Pati Demartinis -SOS'; 'Alan England--Audubon Society'; 'Alison Howard-Kimball'; Amber Baranowski; 'Ann Leale'; 'Ann Niendorf-- East Union'; 'Ara Tekerlek'; 'Araceli Ramirez - McNair'; 'Ben Theiss -McParland'; 'Ben Theiss -McParland'; 'Bill Ries-Knight -Ben Holt'; Bob Perkins; Brenda Hopson; 'Carolyn Huang -Sierra Middle School'; 'Casey Avalos -Franklin Middle-B'; Cassandra de Wood; 'Charalee Cunningham -Christa McAuliffe'; 'Christine Fink -- Mousetrap EM'; 'Christyn Simpkins--Madison'; 'Craig Wedegaertner'; 'Cyndy Green --McNair'; 'Damien Lawrence'; 'Dan Fetterman--Delta Valley Modelers EM'; Daniel Hadsall; 'Dave.Stephania Uhlich -EM Towers'; 'David Bussey -Hot Air EM'; 'Dawn Arbogast- Monte Vista Middle School'; 'Derek Sato --Williams Middle School'; 'Diana Solaegui--Tracy Learning Center'; 'Dick Filson -Remote Sensing/Road Scholar EM'; 'Don Voortman'; 'Doug Perry'; 'Doug Stelzer-Edison'; 'Dr. Lisa Wrischnik - UOP'; 'Dr. Michele Korb --Protein Modeling EM'; 'Dr. Robert Knudsen--Delta College.Microbe Mission EM'; 'Eric Merlo --Franklin'; 'Garret Quindimil--Ben Holt -EM'; 'Gurleen Kaur --George Kelly'; 'James Rexroth -Oak Grove Park EM'; 'Janwyn Funamura -SOS'; 'Jeff Baker'; Jim Bock; 'Jim Carr'; 'John Vaughn --Sounds of Music EM'; 'Joseph Van Steyn'; 'Julia Merlo--Peyton'; 'Julie Doughty'; 'Julie Porta'; 'Katie Burns -Nightingale'; 'Kay Nicholas'; 'Ken Wedel -Tracy High'; 'Khushwinder Gill- Geroge Kelly Principal'; 'Laurel Taylor --Kimball'; 'Leigh Kielhold'; 'Lissa Gilmore -Jefferson'; 'Maralee Thorburn --Art Frieler'; 'Maria Castanon'; 'Marie Ciano'; Mark McKay; 'Martin Wong'; 'Mary Cortez--'; 'Melissa Turner'; 'Michael Heberle -EM Disease Dectives'; 'Michelle Sopoliga-- East Union'; 'Nima Thananjeyan'; Pamela Carson; 'Patrick Chan -Ben Holt'; 'Patty Wong'; 'Paul Neidhamer --Reach for the Stars EM'; 'Rich Ozminkowski'; 'Rich Ozminkowski, Jr.'; 'Richard Prima --Awesome Aquifers EM'; 'Rita Canepa'; 'Rita Canepa--St. George'; 'Russ Reiber -- Bottle Rocket EM'; 'Ruth Anderson'; 'Ruth Byrd -St. George'; 'Ryan Sedillo--Franklin'; 'Sañdy Witbeck --Bear Creek'; 'Sarah Solari-- McNair'; 'Shawn McLaughlin'; 'Shayne Zurilgen -August Knodt'; 'Shelley Collier'; 'Sherri Ries-Knight--Ben Holt'; 'Shryl Thomas'; 'Stan Oshita'; 'Steve Meredith'; 'Sue Macfarlane --Tokay'; 'Susan Heberle --Dynamic Planet EM'; 'Susan Wong - SOS'; 'Tam Bui --McNair'; 'Terry Chukwuneke'; 'Thoeun Bun'; Thomas Lee; 'Thomas Lee-- Wicklund.Lammersville'; 'Tim Cassidy Delta Valley Modelers-EM'; 'Todd Degrandmont -Lodi EM Gravity Vehicle'; 'Tony Moles'; 'Trisha Doyle'; Victoria Sawyer; 'Warren Snell --Compute This EM'; 'Wes Huffman --Williams Middle School'; 'Yoed Nehoran -West High'

**Subject:** FW: Robot Arm-clarification  
**Attachments:** Robot Arm

Hello C Coaches,

Below is some clarification on building a Robot Arm. Robot Arm will be presented at tomorrow's meeting—so bring your questions ☺

See you then-

### **Do we need to spend \$700 on a Robot Arm----**

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**From:** Nickerson, Cameron [mailto:cnickerson@oakdale.k12.ca.us]

**Sent:** Tuesday, January 10, 2012 3:54 PM

**To:** Little, Barbara

**Subject:** RE: Robot Arm

I don't think so. It would be easy to spend \$700 to buy a Vex kit and the other stuff from Vex and start from there. We are spending some money on it to upgrade our existing Vex kit with some new stuff trying to eliminate motors, which adds points. For us it is turning out to be expensive, but I don't think it has to be that way.

In my opinion, the main trick will be to come up with motors or alternatives that have the power to grasp the objects and move quickly to get them deposited in the containers, and then to practice with the machine until you can do the task in your sleep.

The arm does not require wireless remote, which always adds expense. Wired remote can be as simple as you can imagine, one circuit per function, cheap switches or rheostats. I can even imagine a hydraulic thing powered by syringes and tubing that might be made to work, with something like a wooden frame. That should be fairly cheap and would probably be legal. One could reuse found motors, ask the school staff etc. for donations. Frame it with wood, or erector sets... The rules for the device are fairly liberal.

So, I think it could be done fairly cheaply if you are a bit of a packrat and were willing to show up with something that looks "homemade". A person who practices with such a device would, I think, be very competitive with one who shows up with the more expensive Vex or whatever. In fact, I'm fairly convinced that our investment in Vex was a mistake. The motors are not very good for these kinds of events and we have burned up several trying to get them to work.

Take that advice for whatever it's worth. If our second team gets into this they are not using a kit, they will be building from scratch and we will get to test the theory, but so far that hasn't come up.

Cameron

no limit on weight  
tie breaker → # of motors  
2nd tie breaker → quality

Thurs afternoons — to get ideas  
jbock@sjcoe.net

containers may be moved during competition  
if robot stalls during competition —  
yes — can touch robot arm — can touch  
but can't fix — difference ?