The syringe robotics competition

STUDENT PACKET

SPRING VALLEY TECH ED
INNOVATION IN ACTION

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WHAT IS A ROBOT?

ADVANTAGES

DISADVANTAGES

TYPES OF ROBOTS (5)

PARTS OF A ROBOT ARM

ROBOT MOTION CAUSED BY:

HYDRAULICS
PASCAL’S LAW

Pascal’s Law- Any force applied to an enclosed fluid is transmitted in all directions to all walls (surfaces) of the container. Pressure is discussed in PSI or pounds per square inch.

Multiplying force with fluid power
MECHANICAL MOTION (4) TYPES

SIX TYPES OF SIMPLE MACHINES

LINKAGES AND LEVERS

THE WORK CELL

WORK CELL PROGRAMS
SPRING VALLEY TECHNOLOGY EDUCATION

Syringe Robot Arm Competition

Team Members:

Planning and Design Phase Requirements: Worth 70 points

Just as in all Technology Education and industry related projects, you will be required to go through the planning phases of this project as a team. It is very important that you measure the work areas your robot must operate in before planning, since it is in this setting you will complete the required tasks. Your robot has some minimum requirements that you must meet and keep as a priority during the planning and building phases.

It is important that your project plans include the following:

- List of team members including a team captain
- Project notebook for keeping the teams meeting notes, ideas, sketches etc.
- Measurements noted on a drawing of the work cell areas
- Scrounging list of materials necessary to complete the project
- Minimum of 4 sketches showing several different design features
- Parts of each robot listed on each sketch and possible materials listed to build each part
- Dated meeting notes for each meeting listing ideas mentioned by each team member
  - It is very important to not throw out any team members ideas. You never know when you may need additional ideas and some of those may help out.

Grading the planning stage:

1. Complete list of team members-captain clearly labeled _____/10
2. Project notebook for team all members listed on cover for keeping notes, drawings etc. _____/10
3. Drawings of work cell with measurements included and potential difficulties labeled _____/10
4. Scrounging list of materials included _____/10
5. Minimum of 4 sketches, clearly labeled design features _____/10
6. Robot main parts listed and noted on each drawing with materials to build listed _____/10
7. Dated meeting notes, carefully taken, team members mentioned with ideas _____/10

TOTAL _____/70

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Syringe Robot Arm Competition

Description:
This competition provides an opportunity for students to demonstrate and apply knowledge obtained through research, lecture, and discussion covering simple machines, robotics, fluid power systems and their applications. Students empowered with these concepts will build and operate robotic arms to perform the tasks outlined below in the given work cells.

General Competition Rules: (may be changed or amended by instructor as needed)
1. Competition entries may be by individual students or teams of no more than 2 students.
2. Robotic arms may only be operated by the builders.
3. Base area of the robot is not to exceed 16"x 16". The arm may reach beyond the base area to accomplish its task. Base can be clamped to table top to prevent tipping during work cycles.
4. Arm must start from a home, or totally closed position to begin each task and return to that position at the completion of the task.
5. Power sources must include a combination of at least hydraulic and pneumatic power with electrical power as an added option. (12volt or less only !)
6. Robotic arms may be constructed from any materials provided by the student team or Mr. Gilles.
7. End effector (gripper) may be padded, if necessary, for competition.
8. Team must use the designated work cell area provided by the instructor.
9. Machine must prominently display a name for the machine, the school name, and tasteful, school appropriate decoration.
10. Judge (ME 😊) may disqualify any team or machine that does not follow rules and guidelines!

TASK ONE: This is a timed competition!
1. Using the robotic arm and the task table provided and pictured below, the first task is to pick up blocks from work space A and transfer the blocks to storage area B in the order written on the blocks beginning with number “1”, then number “2” and so on in described on the task area. In storage area B the blocks must be stacked on the rod, in order, to maximize stacking space and prevent load shifting.
2. A work cell program, typed by the student, must reflect the order of operations and the stacking of all of the blocks.
3. At no time can the team use anything but the robotic arm to complete the task.
4. Team members may work together to operate the arm during the task.
5. Clock starts when robot first moves from home position and stops when last task is complete and arm returns to home position.

Criteria for Judging Task One:
1. Team members work together to accomplish tasks
2. Arm begins from and ends in the home position as described above.
3. Blocks are picked in order from work area A in the work cell.
4. Blocks are not dropped during the pick and place task.
5. Blocks are stacked in order on the post in storage area B of the work cell.
6. Written work cell program reflects necessary steps to accomplish the task.
7. Teams should try to use the least amount of tries to accomplish the task in the least amount of time. Fewer attempts and less time will be worth more points.
8. Only the robotic arm is used to complete the task, NO human intervention is used.

Top view of work cell:
## Grading Rubric for Robotic Arm and Task One

**Grading Rubric for Robotic Arm and Task One** *(10 PTS PER LINE ITEM)*

<table>
<thead>
<tr>
<th>Line Item</th>
<th>Points</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Robotic arm appears complete, no loose parts, good joinery, consideration for quality workmanship</td>
<td>10</td>
<td>Arm appears complete and well built, Arm seems to hold together, little concern for quality and workmanship</td>
</tr>
<tr>
<td>2. Team Robot base does not exceed 16” x 16”</td>
<td>10</td>
<td>Base is within the size limit, Base is outside of limitations</td>
</tr>
<tr>
<td>3. Arm is stored in and starts in a “home” or closed, stored position</td>
<td>10</td>
<td>Arm is stored and begins at “home”, Arm starts at home but not totally closed, difficulty with closed &amp; home</td>
</tr>
<tr>
<td>4. Robot is designed to fit in and work within the parameters of the designated work cell area provided</td>
<td>10</td>
<td>Robot fits well within parameters of work cell area, some measurement issues, Robot out of spec</td>
</tr>
<tr>
<td>5. Robot has prominently displayed machine name and school name-nicely decorated</td>
<td>10</td>
<td>BOTH displayed and decorated, only one or the other, No names</td>
</tr>
<tr>
<td>6. Robot picks blocks from work space A and stacks them in storage area B in proper order as designated</td>
<td>10</td>
<td>Easily picks and manipulates blocks, some difficulty with task, Lots of difficulty, not able to pick and place</td>
</tr>
<tr>
<td>7. Blocks are not dropped during the pick and place operation</td>
<td>10</td>
<td>No blocks dropped, one or two drops, several drops, All dropped</td>
</tr>
<tr>
<td>8. Work cell program is neatly typed and reflects the order of operations for the robot arm</td>
<td>10</td>
<td>Neat, easy to read, carefully describes order, some explanation, neatness less than desirable, could use work</td>
</tr>
<tr>
<td>9. No other human intervention is used to stack the blocks, other than those completed by the robot as manipulated by team</td>
<td>10</td>
<td>No intervention, Needs a little help, Needs lots of help, Pretty much a cripple</td>
</tr>
<tr>
<td>10. Team members work together in support of the team to accomplish the tasks using the team robot</td>
<td>10</td>
<td>Excellent teamwork/support for the cause, could work together better, Come on, try to be a team</td>
</tr>
</tbody>
</table>

**Due Date**

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**Time required from start, through stacking operation, and return to home position**

**Penalties for dropped blocks during the operation**

**Penalties for human intervention**

**Total Time**

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TASK TWO: Simulated manufacturing or sorting robot

- Using the robotic arm, the second task is to pick up in order (begin with #1) the 4 items (marshmallow, Oreo cookie, apple slice and grape) from the holder in work space A and transfer the items to the dunking station B and the place them in order on the waxed paper in drying area C.
- In dunking area B the marshmallows must be completely submerged to be counted.
- In drying area C the marshmallows must be placed, in order, (beginning with #1) on the numbered spots on the waxed paper for drying.
- Typewritten work cell program must reflect the order of operations for picking, dunking, and placing the items.
- The team will be allowed 3 tries to complete the task in the least amount of time. Teams will be ranked as the top three shortest times for completing the task.
- At no time can the team use anything but the robotic arm to complete the task.
- Penalties are given for items dropped between picking, dunking and placing.

Criteria for Judging Task Two:
1. (4) Items are picked from work area A in the work cell (in order beginning with #1).
2. (4) Items are completely submerged in dunking station B.
3. (4) Items are placed in drying area C completely on the waxed paper, (in order beginning with #1) to dry.
4. Written work cell program reflects necessary steps to accomplish the task.
5. Team uses least amount of tries to accomplish the task in the least amount of time. Fewer attempts and less time will be worth more points.
6. Only the robotic arm is used to complete the task, NO human intervention is used.

TOP VIEW OF THE WORK CELL

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**Grading Rubric for Robotic Arm Task Two**

(10 PTS PER LINE ITEM)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Possible Points</th>
<th>Score</th>
</tr>
</thead>
</table>
| 1. Robotic arm appears complete, no loose parts, good joinery, consideration for quality workmanship | Arm appears complete and well built  
Arm seems to hold together  
little concern for quality and workmanship | 10  8  6  4  2  0 |       |
| 2. Team Robot base does not exceed 16” x 16” | Base is within the size limit  
Base is outside of limitations | 10  0 |       |
| 3. Arm is stored in and starts in a “home” or closed, stored position | Arm is stored and begins at “home”  
Arm starts at home but not totally closed  
difficulty with closed & home | 10  8  6  4  2  0 |       |
| 4. Robot is designed to fit in and work within the parameters of the designated work cell area provided | Robot fits well within parameters of work cell area  
some measurement issues  
Robot out of spec | 10  8  6  4  2  0-REBUILD TO SPEC |       |
| 5. Robot picks up each item in work cell A without dropping it (5 sec penalty for each drop) | EASILY handles each item  
some difficulty picking holding etc.  
Lots of troubles | 10  8  6  4  2  0 |       |
| 6. Robot completely dunk each item in dunking area B (must be completely submerged to count) | Each item completely dunked  
some difficulty dunking  
can’t seem to get the job done | 10  8  6  4  2  0 |       |
| 7. Robot places items in coordinating space on drying area C in proper order | Items placed in proper places and in order  
some difficulty with placement  
really missing the mark, hard to control | 10  8  6  4  2  0 |       |
| 8. Work cell program is neatly typed and reflects the order of operations for the robot arm | Neat, easy to read, carefully describes order  
some explanation, could be neater  
needs help | 10  8  6  4  2  0 |       |
| 9. No other human intervention is used to accomplish tasks other than those completed by the robot operated by team | No intervention needs a little help  
needs a lot of help  
pretty much a cripple  
5 SECOND PENALTY FOR EACH INTERVENTION | 10  8  6  4  2  0 |       |
| 10. Team members work together in support of the team to accomplish the tasks using the team robot | Excellent teamwork/support for the cause  
could work together better  
Come on, try to be a team | 10  8  6  4  2  0 |       |

Time required from start, through stacking operation, and return to home position ____________ min/sec
Penalties for dropped blocks during the operation ____________ drops x 5 sec= ____________ penalty seconds
Penalties for human intervention ____________ X 5 seconds per intervention = ____________ penalty seconds

___________ Total Time

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Summarizing Your Robot Project: 80 POINTS POSSIBLE

As in industry and business, designers, builders and employees quite often are required to develop a presentation that shows the boss of the company, members of the board, other workers, and the general public what you have been working on and how well it worked to justify the expense or to go forward with a project. Often this presentation includes pictures, drawings, video clips, and resources for your information.

You are going to be required to make such a presentation summarizing all of the work your group did on this project. Your presentation should include at least the following minimum items combined to produce a professional looking, and appealing presentation. Try to imagine that you are building this robot and trying to sell your ideas and equipment to a company looking for a sorting, stacking and warehousing style of robot. See Mr. Gilles to check out a camera or video equipment for developing this project as you go along. Remember to take many photos during the construction phases of the project to use in this presentation!

Your Powerpoint should include at the following:

- An attention getting cover slide including the name of your robotics company and the team members involved
- A minimum of 12 well done slides
- At least 8 topic related pictures to go along with the slides
- At least one video clip of your robotic arm in operation
- At least one slide with a close up photo of the robotic arm with the features clearly labeled
- At least one slide clearly displaying the name on your robot and its decorations
- At least one slide summarizing what you accomplished in the project
- At least one slide that gives contact info for your pseudo “robot building company”

GRADING THE PRESENTATION:

1. Attractive, attention getting cover slide with company and team member names _____/10
2. At least 12 well done slides _____/10
3. At least 8 high quality, topic related photos or pictures _____/10
4. At least one video clip of the team robot in operation _____/10
5. At least one slide with close up photo of robot with major parts clearly labeled _____/10
6. At least one slide with a picture clearly displaying the robot name and decoration _____/10
7. At least one summary slide _____/10
8. At least one slide that gives pseudo robot company contact info _____/10

TOTAL _____/80

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Pictures of Work Cells