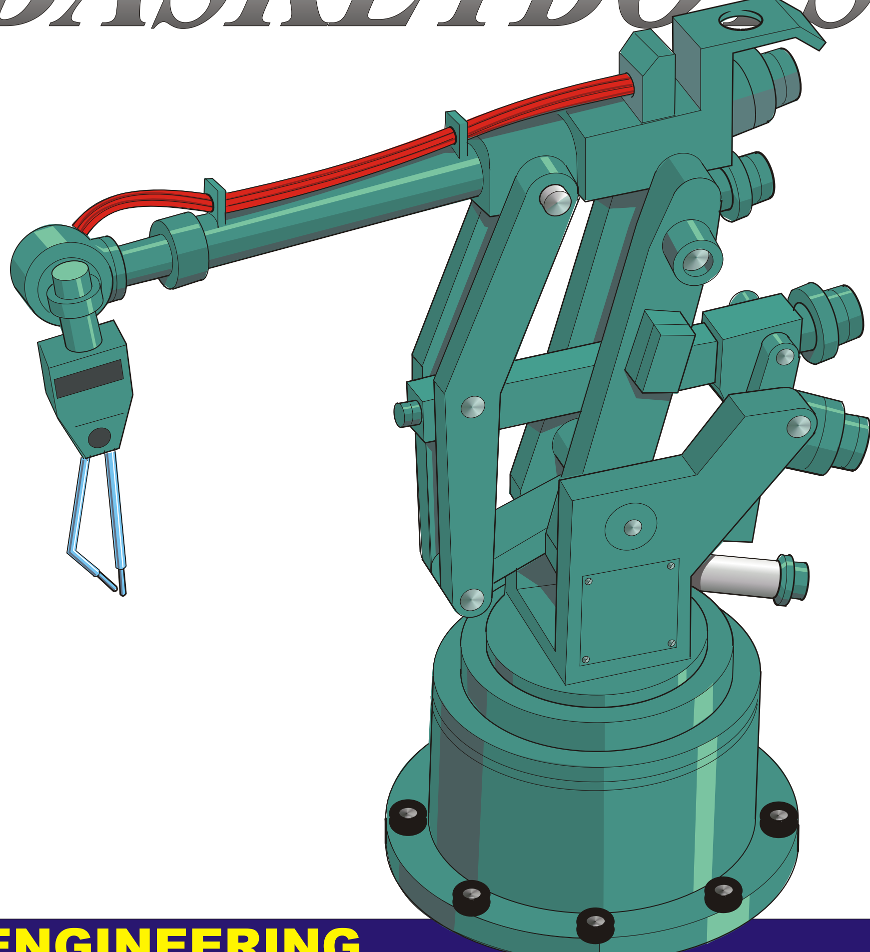
Engineering Technology

BASKETBOTS



BIOENGINEERING

BIGELOW

TECHNOLOGY EDUCATION

MIDDLE SCHOOL
Newton, MA

9-10-11

PROBLEM GUIDELINES

Your challenge is to design a robotic arm that will lift a ping pong ball from a storage area to a basket located 12" off the ground. In addition to the materials provided, you will be able to gather and use any "other" materials you feel will work in the construction of your robot. Each member of your group needs to participate in each step of the process. Points will be awarded each time a team correctly completes a stage in the process. If a team fails to correctly complete a step, they must redo that step.

1. The robotic arm can stand no taller than 24" before it is in its extended position
2. No more than 8 syringes may be used in the construction of the robotic arm (unless approved)
3. Your robotic arm must be able to rotate at least 90˚ from its original position
4. The size of the base of the robotic arm must not be altered in any way (supplied by teacher)
5. Any materials you can gather can be used in the construction of the robot
6. Each group must submit a completed design packet before they can participate in the final competition

When you meet as a team you should:

- Review the problem.
- Review the specifications.
- Each team member should draw at least two thumbnail sketches of possible robot arm designs.
- Meet as a group and review all of the thumbnail drawings from each of your team members
- Select one final design and each team member needs to draw that design on the final design sheet. (The final design may be a combination of many designs)

- **HINT:** Keep the design simple! Sometimes the best solution is the simplest one.

tools

band saw	**coping saw**	**try square**
drill press	**hack saw**	**compass**
file	**X-acto knife**	**wire cutterss**
sand paper	**rulers**	**sander**

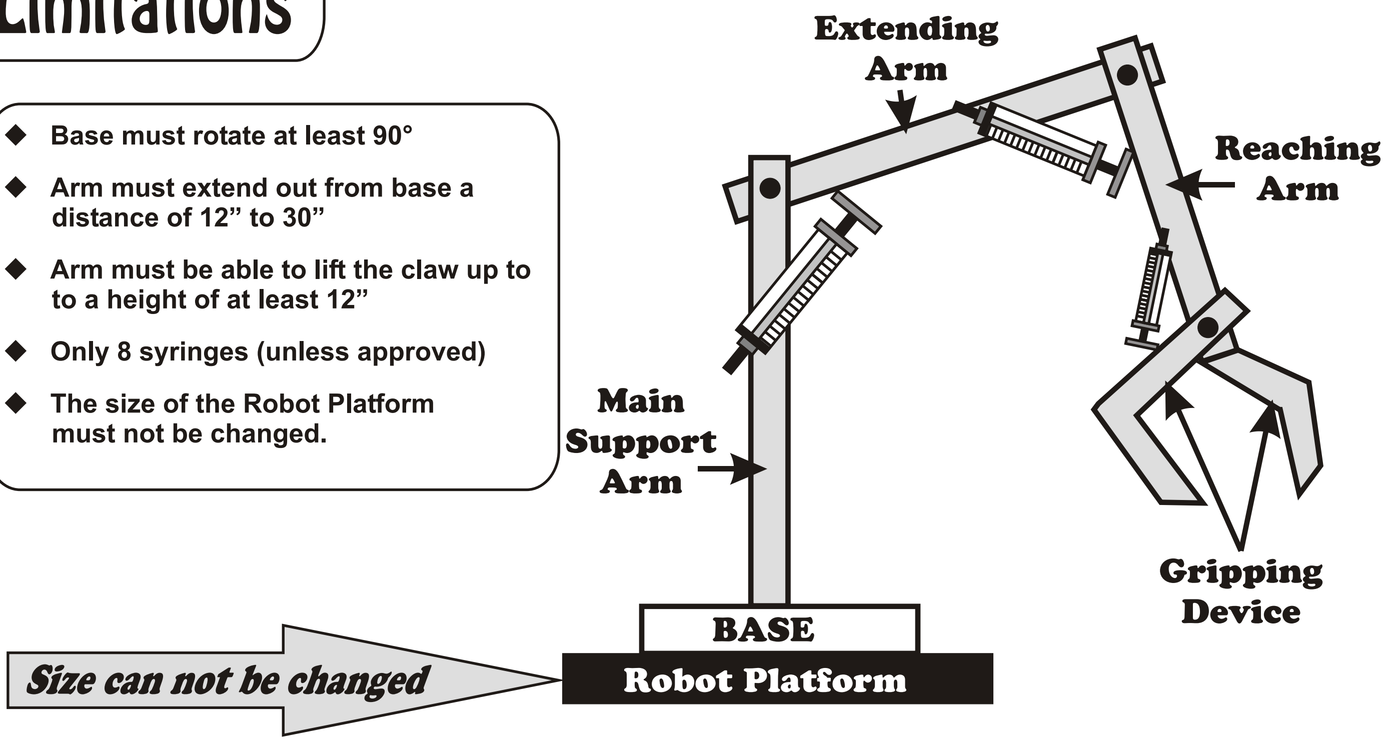
materials

rigid insulation	**wood**	**nuts / bolts**
dowels	**syringes**	**zip ties**
tape	**1/8" tubing**	**hinges**
glue	**cardboard**	**plastic**
rubber bands	**pins**	**Ping Pong balls**

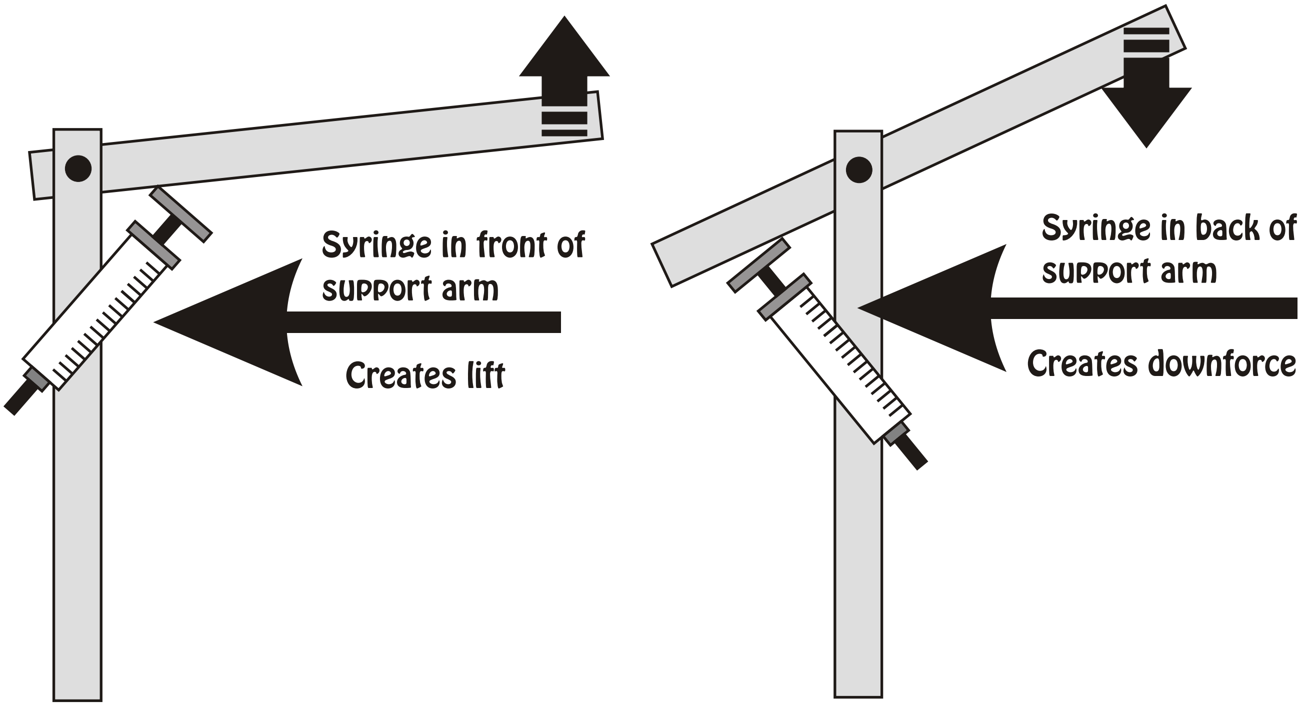
DESIGN SPECIFICATIONS

Limitations

- Base must rotate at least 90°
- Arm must extend out from base a distance of 12” to 30”
- Arm must be able to lift the claw up to to a height of at least 12”
- Only 8 syringes (unless approved)
- The size of the Robot Platform must not be changed.



Strategies



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DESIGN RESEARCH

Design Criteria

The first phase in designing a robot involves collecting data from a series of questions. Initially, the questions should address the productivity of the robot in relation to a human; the type of robot needed to meet the job specifications; the robots working environment (the Basketball Court size and dimensions).

Design Questions

What does the robot have to do? ____

____

____

What are the dimensions of the object to be moved (Ping pong ball)? ______________________

How far (max) will the robot have to reach?____

What is the minimum reach of the robot? ____

How long are the pieces of wood?____

____

What are the 3 sizes of syringes available to use? ________cc ________cc ________cc

How many axises will the robot have? ____

How many degrees will the robot have to rotate?____

How high will the robot have to lift the ping pong ball?____

What is the diameter of the "basketball hoop" (PVC tube)?____

Observe the robot examples around the room. List 3 features that you feel could be improved______________

____

____

____

____

____

List 3 features that you feel are good ideas and might help in the design of your robot____________________

____

____.

____.

____.

____.

NAME: ______________________ **CLASS:** __________.

DESIGN SHEET

Team Members: ______________________

Step 1 Identify the need or the problem

What do we have to do?

____

____

____

____

Standards we must meet:

Maximum height:

Maximum # of syringes::

Minimum rotation angle:

What can not be altered?

Step 2 Research the need or problem

Use the back side of this worksheet to do your research

Step 3 Develop possible solutions

Draw at least **2** possible solutions (thumbnail drawings)

sketch 1	sketch 2

NAME: ______________________ CLASS: ____________.

FINAL DESIGN

Step 4: Select the best possible solution

Include dimensions and the materials you plan to use.

final design

Step 5: Construct a prototype of your solution

List the steps you took to build your robotic arm (Also write down any idea changes you have while you build)

Step 6: Test and evaluate your solution

Test your arm on the playing field (what is wrong?)

List how you intend to fix the problems

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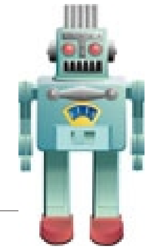
DETAIL of the GRIPPER



Use the space below to draw a close-up detail of the gripper you plan to use. Use the ball to gauge the size of gripper you will need. Include dimensions and the materials you plan to use.

gripper detail

materials

____

____

____

NAME: ______________________ **CLASS:** __________.

RE-DESIGN & EVALUATE

Step 7: Communicate the solution

Test your arm with all four members of your group. List any needed changes or adjustments.

Observations	List any changes or adjustments
______.	______.
______.	______.
______.	______.
______.	______.
______.	______.

Step 8: Redesign and / or rebuild

List any and all changes that you made to your robotic arm

______.
______.
______.
______.

Step 9: Evaluation

What was the best improvement that you made to your robotic arm?

______.
______.

What was your worst design idea? Explain why?

______.
______.

If there were a "next time" what design changes would you make?

______.
______.

Explain how teamwork was essential to controlling the robotic arm?

______.
______.

How did your team use mechanical advantage to accomplish a task with your robot?

______.
______.

List the 9 steps of the design process

1. ______.
2. ______.
3. ______.
4. ______.
5. ______.
6. ______.
7. ______.
8. ______.
9. ______.

NAME: ______________________________ CLASS: ____________.

SUMMARY SHEET

Answer the following questions as completely as you can

1. How are robotic arms utilized in Bioengineering?____.
____.

2. Why was water used instead of air for our robotic arms?___________________________________.
____.

3. List the 4 parts of your robot that each syringe controlled.________________________________.
____.
____.

4. List 2 ways that robots are able to move.
   1. ____.
   2. ____.

5. What is hydraulics?____.
____.

6. List 2 ways that hydraulics are used in our world.
   1. ____.
   2. ____.

7. What is pneumatics?____.
____.

8. List 2 ways that pneumatics are used in our world.
   1. ____.
   2. ____.

9. How would using different sized syringes allow you to gain mechanical advantage?______________.
____.

10. How far would a 60 mL syringe extend if it were controlled by a full 10 mL syringe?
    a. 1/6 b. 1/4 c. 1/2 b. all the way

11. What is the problem with having air bubbles present in the tubing?_____________________________.
____.

12. Why is group communication so important when trying to control your robot arm?________________.
____.

13. How is your brain similar to your whole group when controlling your robot?____________________.
____.

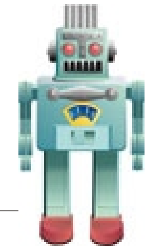
14. Match the parts of the robots with simalar parts of the human body.

______dowel	1.	hand/fingers
______Long support shafts	2.	nerves
______tubing	3.	brain
______syringes	4.	joints
______Control Panel (group)	5.	muscles
______“Pinchers” or “grippers”	6.	arm

15. List 2 problems your group encountered during the competition.
____.
____.

NAME: ______________________ **CLASS:** ____________.

DESIGN RESEARCH



Team Members: ______________________

Step 2 Research the need or problem

What is Bioengineering?______________________.
______________________.
______________________.

List 3 practical applications of Bioengineering______________________.
______________________.
______________________.

Who works with Bioengineering?______________________.
______________________.
______________________.

What is a Robot?______________________.
______________________.
______________________.

How do robots relate to Bioengineering?______________________.
______________________.
______________________.
______________________.

List 3 ways robots are used______________________.
______________________.
______________________.

What is Hydraulics?______________________.
______________________.
______________________.
______________________.

List 3 ways hydraulics is used in our everyday lives______________________.
______________________.
______________________.
______________________.

What is Pneumatics?______________________.
______________________.
______________________.
______________________.

List 3 ways pneumatics is used in our everyday lives______________________.
______________________.
______________________.