**Robotic Arm**

Name:

Name:

Name:

Date:

**Pneumatic / Hydraulic**

**Design Brief**

http://www.youtube.com/watch?v=sicZuYnMMuA

**Situation:**

You are part of a robotics engineering team at Carnegie Mellon University and have just been contacted by the Department of Home Land Security. A massive 8.9 earthquake just rocked eastern Maryland. The Calvert Cliffs Nuclear Power Plant on the western shore of the Chesapeake Bay is less than 35 miles from Washington D.C.! The immense earthquake and numerous aftershocks have caused a breach of the inner core of the nuclear reactor. Nuclear fuel rod pellets are now gushing deadly radioactive steam into the atmosphere. The fuel rod pellets need to be picked up, dunked into a chemical that will render them harmless and then placed into containment drums. If you fail at this task, nuclear contamination will spread to over a 300 miles radius. Rockwood will be obliterated with nuclear contamination and everyone will have to pack up and move. The people of the United States need your help!

**Lesson 3 Big Idea:** Knowledge gained from other fields of study has a direct effect on the development of technological products and systems.

**Challenge**

***Design a pneumatic or hydraulic robotic arm system for a specific task that will be timed.***

**Requirements**

1. The system must include a **minimum** of **three moving arm joints.**
2. The system must include an **end effector** . (*You’ll have to figure out what this is!!*)
3. The system components must be securely affixed to a 6”x6” wooden base.
4. The system must be able to pick up a regular marshmallow, submerge it in water,

and place it in a specific can.

1. The system must be reliable and be able to do the process repeatedly.

### Resources

The following parts and materials may be used to design and construct your active system:

* ¾” x 1” x 12” pine boards
* heavy duty string
* stainless steel pieces
* zip ties
* assorted gears
* other materials that you supply
* assorted nuts and bolts
* ¼” tubing
* 10cc syringes
* 35cc syringes
* Syringe mounts
* solid core wire
* coat hangers
* card stock
* variety of dowel rod sizes
* self tapping Phillips screws

**Procedure**

1. Form your design team and select the leader.
2. Design your solution using the ***Student Design Worksheet*** to document your work.
3. Present your design idea to another group and discuss if the design will work.
4. Gather the materials.

**WHAT YOUR ROBOTIC ARM**

**MUST DO**

**A.** Pick up a radioactive fuel pellet from square #1.

**B.** Dunk the radioactive fuel pellet in the dunk tank (Don’t drop it!)

**C.** Drop the neutralized fuel pellet in the #1 drum.

**D.** Return and pick up radioactive pellet #2 and do the whole process over.

1. Build the hydraulic or pneumatic robotic arm system.
2. Test and adjust the system as needed.
3. Present and demonstrate your solution to the class while being timed

###  Robotic Arm Testing Specifications

 (drawing is not to scale)



**RADIOACTIVE FUEL PELLETS**

**CONTAINMENT DRUMS**

**DUNK TANK**

#1

#2

#3

#4

10”

6”

6”

YOUR ROBOT PLATFORM

**“Radioactive Arm”**

Name:

Name:

Name:

Date:

**STUDENT DESIGN**

 **WORKSHEET**

**Identify the problem**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Criteria (What does your design *HAVE* to do?)**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**Constraints (What are your limits or limitations?**: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**RESEARCHING the FACTS**

**Go to my webpage. Open the Folder for our class. Open the Unit 3 folder and open the link to “How Stuff Works - Hydraulics”. Read the information from the webpage to answer the questions in complete sentences. You may also watch the video.**

1. What are two examples of hydraulic equipment? What work does the hydraulic on the equipment do?

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1. Explain the basic idea behind a hydraulic system.

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1. What fluid is commonly used in hydraulics? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. Click on the red arrow in the first diagram. Describe what happens to the piston on the right when the piston on the left is pushed down.

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1. Read the following statement then explain in detail why: When one piston is pushed down, the other piston is pushed up.

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1. What are the terms for one cylinder \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ that controls two or more other cylinders \_\_\_\_\_\_\_\_\_\_\_.
2. **Continue to read the article until you reach the quiz at the end. Take the quiz and *show* Mr. Kush your score.**
3. Use “Wikipedia” to research “pneumatics” What is the definition for pneumatics?

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 **Scroll down to the heading “Comparison to Hydraulics”.**

1. What do hydraulics and pneumatic have in common? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. What is a difference between hydraulics and pneumatics? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. For your robot arm, will you choose hydraulic or pneumatic power to move your arm? Explain your choice.

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**Brainstorming and Generating Ideas**:

1. Use the Internet to search for ideas. I recommend using image searches and YouTube searches.

LIMIT YOURSELF TO FIFTEEN MINUTES FOR ONLINE RESEARCH!!!!

1. **Each** group member must create a **brainstorm list** and then **sketch** the **solution ideas** in the Engineering Design Journal. The parts and materials of the sketch must be **labeled**. (If you prefer, sketches may be done on graph paper. Later, the brainstorming list and the sketches will be attached to this paper.)
2. Each group member must sketch two different designs on graph paper or in their engineering journal
3. Develop your ***best*** idea from your group of ideas.
4. **Present** your best solution to the group. The group will then select the **best** solution.
5. **Change** the design as necessary with **input** from the group.
6. **Sketch** the final design on graph paper and **label** all of the parts and materials.
7. Put **all** of the group names and the **date** on this paper.

**Exploring Possibilities**: Make a “+ and –” chart next to each of these “best ideas” and list advantages and disadvantages of the design.

**9. Selecting an Approach: Explain why your group picked this sketch over all of the other ideas. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

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**10. Testing and Evaluating:** Explain the testing that you did to your design. What worked? What did not work?

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# 11. Refining the Design: How did you solve problems?

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**12.** On a white piece of paper, draw a Universal Systems Model chart. Select one input into your robotic arm system and then complete the chart accordingly.

**13.** On a white piece of paper, draw and label a diagram of your hydraulic or pneumatic system.

**14.** What is one subsystem of your design? Create a Universal Systems Model chart for one of the subsystems that is different from answer #12.

**15.** Who was the true leader of your group? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**16.** Which member of the group contributed the most to the entire project? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**17.** CONFIDENTIAL: In your opinion, which member contributed the least to the group? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_