

# Hydraulic Equipment Engineer: Building a Warehouse Robot



## Adventure Description:

In this adventure, students will think like a hydraulic equipment engineer and design a robot to sort, scan, and package items in a warehouse.

## Activity

Teacher Note: This activity is long. We recommend splitting this lesson over 2 days. On Day 1, complete Steps 1-3. On Day 2, complete Steps 4-6.

### Step One: Background Information on Hydraulic Equipment Engineers, Hydraulic Devices, and Robots in Warehouses (10-15 minutes)

- Explain to students that hydraulic equipment engineers specialize in building hydraulic devices. Hydraulic devices use fluid, like oil or water, to create pressure to perform work. Show [Handout: How Hydraulic Devices Work](#). Have students brainstorm what industries could use hydraulic devices (e.g., construction, manufacturing).
- Discuss how hydraulic systems can be used in many different kinds of devices, including robots! Show [Handout: Hydraulics and Robotics](#). Discuss how robots can be created with hydraulic joints, arms, and tracks.
- Next, have students brainstorm why people and companies use robots. Examples include:
  - Performing tasks that are too dangerous for humans to do: Robots have been developed that can dive deep underwater. This is dangerous for humans because deep water can cause pressure sickness.
  - Performing repetitive tasks that take up time. Robots have been developed that offer autonomous (automatic) driving of farm machinery, like sprayers and tractors, which frees up time for farmers to perform other necessary tasks.
  - Reducing human errors that cause mistakes. Robots could completely eliminate human error, because they can be programmed to do the same job repeatedly, in the same way, without error.
- Introduce the idea that warehouses have begun using robots to automate tasks. Show [Video: Amazon Robots](#). Discuss how robots have been created to help automate processes in Amazon warehouses.
- Explain to students that robots were created in the Amazon warehouse to help optimize the packaging and shipping process in a warehouse. Amazon chose to optimize the process because there are many processes that must occur before a package is ready to ship to the customer. One mistake along the process can cause a delay or error in the packaging or shipping process. Show [Handout: Optimizing Warehouse Flow](#).

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- Discuss the flow of items through a warehouse. Ask students to speculate about where errors could occur during the process.
- Discuss the human error and costs that are often associated with employing large numbers of workers.
- Discuss how robots could improve efficiency at large warehouses by eliminating the need for thousands of human workers. Human workers can cause errors during shipping, such as adding the wrong item to a package, printing the wrong shipping label, or not properly counting inventory.
- Extra Time? Discuss downsides to automating the packaging and shipping of items at warehouses. (e.g., automating the flow of packages in a warehouse takes jobs away from workers).

## Step Two: Creating a Hydraulic Syringe System (10 minutes)

- Explain to students that they will think like a hydraulics engineer and create a robot that can count inventory, print shipping labels, and increase the efficiency of packaging items in a warehouse.
- To build a robot, students will first create the basic hydraulic syringe system for their robots. This is the system that will create pressure to transfer force, causing the different components within the robot to move. Provide students with **Handout: Creating a Warehouse Robot**.
- Provide students with the following materials:
  - 6 syringes
  - 3 pieces of tubing that are 8" in length
  - 1 container with water (optional: add a drop of food color to better see flow of water)
- Have students complete Step 1 on the handout.

## Step Three: Creating Hydraulic Arm (30-35 minutes)

- Explain to students that they will now create a hydraulic arm for their warehouse robot. This will enable the robot to have arms that can move to scan bar codes or pick up boxes.
- Provide students with the following materials:
  - 8 tongue depressors
  - Drill with 1/16" bit
  - 2 - 3/4" pieces of 22 gauge wire
  - 1 - 4" piece of 22 gauge wire
  - 1 roll of masking tape
- Have students complete Step 2 on the handout.

## Step Four: Creating Hydraulic Rotating Base (20-25 minutes)

- Explain to students that they will now create a hydraulic base for their warehouse robot. This will enable the base of the robot to rotate, which will allow it to move in different directions to track inventory in different locations in a warehouse.

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- Provide students with the following materials:
  - 12 tongue depressors
  - Extra syringe
  - 1 - 4" piece of 22 gauge wire
- Have students complete Step 3 on the handout.

## **Step Five: Creating a Hydraulic Lift (20-25 minutes)**

- Explain to students that they will now create a hydraulic lift for their warehouse robot. This will enable the robot to move in a vertical direction to count inventory, scan bar codes, or move boxes.
- Provide students with the following materials:
  - 7 tongue depressors
  - 8 3/4" pieces of 22 gauge wire
  - 4 toothpicks, pointy on both ends
- Have students complete Step 4 on the handout.

## **Step Six: Attaching the Hydraulic Components (15+ minutes)**

- Explain to students that they will now assemble the pieces of their robot together.
- Provide students with strong glue, such as superglue.
- Have students complete Step 5 on the handout.

## **Extra Time? Design a Shelf System (20 minutes) (HOMEWORK OPPORTUNITY)**

- Explain to students that they will now create a shelving system that would be sold with the robot and would hold inventory. The goal of the shelving system is to allow the robot to access all of the inventory stored on the shelves quickly and easily.
- Provide students with [Handout: Designing a Shelving System](#).
- Have students design the shelf system. Remind students that their robot is designed to optimize the efficiency in a warehouse. Their shelving system should enable the robot to perform its job quickly.

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## Materials List

### Provided online:

- Handout: How Hydraulic Devices Work
- Handout: Hydraulics and Robotics
- Video: Amazon Robots
- Handout: Optimizing Warehouse Flow
- Handout: Creating a Warehouse Robot
- Handout: Designing a Shelving System

### Not provided (Each group needs):

- 11 syringes
- 5 8" pieces of tubing
- 1 container with water
- 30 tongue depressors
- 10 - 3/4" pieces of 22 gauge wire
- 2 - 4" piece of 22 gauge wire
- 4 toothpicks
- Drill with 1/16" bit
- Masking tape
- Strong glue, such as E-6000
- Art supplies and building materials

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