### Stage 1 Desired Results

#### ESTABLISHED GOALS

- **HS-ETS4-1(MA).** Research and describe various ways that humans use energy and power systems to harness resources to accomplish tasks effectively and efficiently. *Clarification Statement: Examples of energy and power systems can include fluid systems such as hydraulics and pneumatics, thermal systems such as heating and cooling, and electrical systems such as electronic devices and residential wiring.*

- **HS-ETS4-2(MA).** Use a model to explain differences between open fluid systems and closed fluid systems. Determine when it is more or less appropriate to use one type of system instead of the other.

- **HS-ETS4-3(MA).** Explain how differences and similarities between hydraulic and pneumatic systems lead to different applications of each in technologies.

#### Transfer

- **Students will be able to independently use their learning to...**
  - Build simple robots that are powered by hydraulic, pneumatic, or both systems.
  - Demonstrate understanding of hydraulic and pneumatic systems.
  - Determine how they will approach building their robot.

#### Meaning

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### UNDERSTANDINGS

**Students will understand that...**

- That there are a variety of different robots with different purposes.
- Why you would use one system over the other, or both for the same bot.
- Why pneumatic/hydraulic controls are used in robots.

### ESSENTIAL QUESTIONS

- What is a robot? What are they for?
- What are the advantages/disadvantages of using hydraulic and/or pneumatic systems?
- How are hydraulic/pneumatic area/pressure, speed, and power related?
- Should the purpose of the robot be factored into the design of a pneumatic system?

#### Acquisition

**Students will know...**

- The difference between hydraulic and pneumatic powered systems.
- Why hydraulic/pneumatic systems are used in robots.
- What components comprise a pneumatic system (air pressure generator, regulator, reservoir,

**Students will be skilled at...**

- Identify the parts of a robot and what they can do.
- Will design, build, test, and evaluate a variety of robots that use hydraulic, pneumatic, or both systems for power.
- Safely use tools/machines and other resources to design, build, test, and evaluate hydraulic and pneumatic systems.
The process and procedures for safely using pneumatic systems.

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### Stage 2 - Evidence

<table>
<thead>
<tr>
<th>Evaluative Criteria</th>
<th>Assessment Evidence</th>
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<tbody>
<tr>
<td>Rubric</td>
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<tr>
<td>-Rubric for ThingLink</td>
<td>PERFORMANCE TASK(S):</td>
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<tr>
<td>-Rubric for group discussions: whether or not students mention specific key ideas/concepts. Demonstration of individual understandings.</td>
<td>Pneumatic Magic Box*</td>
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<td>Extending Grabber</td>
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<td>CARDBOARD Robotic Hydraulic Arm</td>
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<td>Robot Arm</td>
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<td>Hydraulic Fighting Robots*</td>
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<td>*optional</td>
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<table>
<thead>
<tr>
<th>Answer Key</th>
<th>OTHER EVIDENCE:</th>
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<tr>
<td></td>
<td>-Group discussion</td>
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<td>-Engineering Notebook</td>
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<td>-ThingLink explanation of one of the bots, how it works, etc.</td>
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### Stage 3 – Learning Plan

*Summary of Key Learning Events and Instruction*

**Day 1:**
Introduction to Robotics

- Introduction to hydraulic and pneumatic systems. Teacher leads discussion on hydraulic/pneumatic components and theory of operation. Demonstrates how to calculate pressure, volume, and speed in basic circuits.

- Students will be introduced to the first type of simple bot (Extending Grabber) they will build using hydraulic and pneumatic systems.

Day 2:

- Students will build and continue working on Extending Grabber.

Day 3:

- Students are introduced to the next bot they will build; the Cardboard Robotic Hydraulic Arm (Instructables.com). Students will collect materials, build their base and parts.

Day 4:

- Students will continue working on their robot arm.

Day 5:

- Group discussion on how the cardboard robot arm works, pros and cons. What changes would students make? How could it be improved?

- Introduction to third bot lab, Robot Arm made with sturdier materials (Rubber Band Engineer book). Students begin build.

Day 6:

- Students continue building their Robot Arm.

- When build and testing are complete, students should discuss the differences between the Robot Arm and the first Cardboard Arm. Pros and cons, etc.

Day 7+:

- Continue with additional simple bots as needed.

- Have students create a ThingLink explaining their bot and how it works. Explanations should include specifics on hydraulic and pneumatic systems involved in their controlling their bot.