Chain Reaction Challenge
Chain Reaction Challenge

Unit Overview:
In this unit you will use your knowledge of simple machines to learn about, build, and test Chain Reaction Devices.

Unit Content:
- What is a Chain Reaction Device?
- Sample Chain Reaction Device Assembly Instructions
- Chain Reaction Challenge Rules

Unit Activities:
- ⚪ Optional: Building The Sample Chain Reaction Device (see your teacher for details)
- ⚫ Chain Reaction Challenge Device Build using Chain Reaction Device Rubric (unpowered, powered, or both – see your teacher for details)
- 🍃 Completion of Idea Book Pages with device build and testing

Note: Separate copies and/or printouts of activities may be used for student work. Please see your teacher BEFORE writing in this guide. Visit www.vexiq.com/curriculum to download and print PDFs of all exercises!
What is a Chain Reaction Device?

A Chain Reaction Device is a complex machine that performs a very simple task in a very complicated way. A Chain Reaction is a series of events so related to each other that each event triggers the next event.

In this unit you will use a series of simple machine and/or pendulum assemblies to create Chain Reaction Devices. Each individual simple machine/pendulum assembly is known as a Stage of the overall device. Students will also build and/or design at least one Trigger Mechanism to activate the operation/chain reaction of their device(s) in this unit.

Assembling the Sample Chain Reaction Device

Your teacher may instruct you to assemble and test the sample unpowered Chain Reaction Device next.
Sample Chain Reaction Device Instructions
Parking the Car
Note for Teachers: This sample Chain Reaction Device is built using the Inclined Plane, Pulley, and Pendulum from the Simple Machines & Motion Sample Assemblies. The Lever in this sample Chain Reaction Device has its own assembly instructions, however this lever can also be created by modifying the lever that is part of the Simple Machines & Motion Sample Assemblies.
Lever Assembly

1. 1x 228-2500-042
   4x 228-2500-060
   1x 228-2500-028

2. 2x 228-2500-132
Car Assembly

1

2

3

4

cont.
Garage Assembly

1. 2x 228-2500-128
   4x 228-2500-060
   1x 228-2500-028

2. 2x 228-2500-028
Pulley Assembly

1. 2x 228-2500-023
   8x 228-2500-060
   1x 228-2500-028

2. 3x 228-2500-070

3. 4x 228-2500-143
   1x 228-2500-124
   1x 228-2500-164

4. 4x 228-2500-143
   1x 228-2500-124
   1x 228-2500-164

cont.
E.3 cont. Pendulum Assembly

1. 1x 228-2500-023
   1x 228-2500-026

2. 3x 228-2500-070

3. 4x 228-2500-143
   1x 228-2500-007
   1x 228-2500-122

4. 1x 228-2500-143
   1x 228-2500-208
   1x 228-2500-209

Connecting Simple Machines & Pendulum Assembly

1. 2x 228-2500-148
    10x 228-2500-060
    2x 228-2500-007

2. 12x 228-2500-060
    2x 228-2500-011

3. 8x 228-2500-060
    2x 228-2500-017

4. Inclined Plane Assembly
   Pendulum Assembly
The Chain Reaction Challenge Rules: Parking the Car

Challenge Goal & Overview: The goal is to build a Chain Reaction Device that successfully parks the car in the garage. Your teacher will provide you with (or ask you to build) the car and garage models to be used in this challenge. In most cases you will be asked to work together in teams, but you may be asked to work alone.

Challenge Rules for Unpowered Chain Reaction Device (grades 4-6):
1. Build a four-stage Chain Reaction Device that parks the car in the garage.
2. Your Chain Reaction Device will be unpowered - no Smart Motors, Robot Brain, or Controller.
3. Use three or more of the following to construct your stages: Wheel & Axle, Inclined Plane, Wedge, Lever, Pulley, Screw, or Pendulum. You may use a type of simple machine or pendulum more than once if you wish.
4. Please see the Rubric to Evaluate Unpowered Chain Reaction Device for all of the details on how you will be evaluated.
5. Idea Book Pages can be used for planning and troubleshooting. Your teacher will provide further instructions on using the Idea Book Pages.

Challenge Rules for Powered Chain Reaction Device (grades 4-8):
1. Build a four-stage Chain Reaction Device that parks the car in the garage.
2. Your Chain Reaction Device will be powered using three or more Smart Motors, a Robot Brain, and a Controller. You will be expected to teleoperate your device with the Controller.
3. Use three or more of the following to construct your stages: Wheel & Axle, Inclined Plane, Wedge, Lever, Pulley, Screw, or Pendulum. You may use a type of simple machine or pendulum more than once if you wish.
4. NO sensors will be used and NO programming is required for this challenge.
5. Please see the Rubric to Evaluate Powered Chain Reaction Device for all of the details on how you will be evaluated.
6. Idea Book Pages can be used for planning and troubleshooting. Your teacher will provide further instructions on using the Idea Book Pages.
### Rubric to Evaluate Unpowered Chain Reaction Device (grades 4-6)

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Expert = 4</th>
<th>Proficient = 3</th>
<th>Emerging = 2</th>
<th>Novice = 1</th>
<th>Assessment</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design &amp; Process Criteria</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creating viable solutions to the given challenge: mechanism use</td>
<td>Four or more, well developed stages exist meeting all challenge rules</td>
<td>Three well developed stages exist meeting majority of challenge rules</td>
<td>Two or more partially developed stages are evident</td>
<td>A single stage that may or may not be developed is evident</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple machines and pendulum usage</td>
<td>Device uses three or more efficient simple machines/pendulum</td>
<td>Device uses two functioning simple machines/pendulum</td>
<td>One simple machine/pendulum exists that functions</td>
<td>Attempt at using one simple machine/pendulum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design Process (defined by the teacher, could be Idea Book use)</td>
<td>Design process utilized, documented &amp; enhances product</td>
<td>Design process utilized and fully documented</td>
<td>Design process utilized consistently</td>
<td>Some evidence that design process was utilized</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Utilization of Resources (materials and parts, Information and instructions, people, and time)</td>
<td>Resources used fully within challenge rules and efficiency maximized</td>
<td>Resources utilized to maximize efficiency</td>
<td>Evidence that some resources utilized meeting challenge purpose</td>
<td>A few resources (e.g., tools &amp; materials) partially utilized</td>
<td></td>
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<tr>
<td><strong>Technical Criteria</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Mechanical Systems (mechanisms &amp; triggers)</td>
<td>Completely functional and consistent mechanical systems</td>
<td>Consistently functional mechanical systems</td>
<td>Functional, but inconsistent mechanical systems</td>
<td>Non-functional or incomplete/unsafe mechanical systems</td>
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<td>Sophisticated and highly efficient communication for stated audiences</td>
<td>Purposeful, consistent, effective communication</td>
<td>Purposeful, partially consistent communication</td>
<td>Communication very inconsistent and lacks purpose</td>
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<td></td>
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<tr>
<td>Teamwork</td>
<td>Teamwork that maximizes outcomes is evident</td>
<td>Team members define roles, goals, &amp; work together</td>
<td>Team members partially define roles, goals, &amp; work together</td>
<td>Participants function separately within a group</td>
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<td></td>
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<tr>
<td>Creativity</td>
<td>Device is unique, imaginative, and functional</td>
<td>Device is unique and/or imaginative in multiple ways</td>
<td>Device clearly shows a unique and/or imaginative element</td>
<td>Unique and/or imaginative element(s) unclear</td>
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Rubric Adapted from Rubric and Evaluation Criteria for Standards-Based Robotics Competitions & Related Learning Experiences – TSA, 2005
## Rubric to Evaluate Powered Chain Reaction Device (grades 4-8)

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<td>Battery charged. Wire routing safe, efficient, &amp; completely functional</td>
<td></td>
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<tr>
<td>Electric Systems</td>
<td>Battery charged. Wire routing safe &amp; consistently functional</td>
<td>Functional, but inconsistent (battery or wiring issues)</td>
<td>Non-functional or incomplete (battery and wiring issues)</td>
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### Unifying Themes (This area emphasizes the Interaction of Science, Technology, & Human Endeavor)

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Plan and design a Four-Stage Chain Reaction Device that meets challenge and rubric criteria on pages 1 and 2 below.

Sketch/Describe Stage 1 of your Device, Including Trigger Mechanism Here:

Machine Type (One of the Simple Machines or Pendulum):

Sketch/Describe Stage 2 of your Device Here:

Machine Type (One of the Simple Machines or Pendulum):

Sketch/Describe Stage 3 of your Device Here:

Machine Type (One of the Simple Machines or Pendulum):

Remember: Problems ARE NOT failures, they are an expected part of the design process!
Sketch/Describe Stage 4 of your Device Here:

Machine Type (One of the Simple Machines or Pendulum):

Plans for Connecting Each Device Stage:

Follow through with your design plan and BUILD your device, then TEST and OBSERVE.

Testing Observations:

Does your Device function like you expected? YES NO

If you answered “YES” - Congratulations! You will score well on the Challenge Rubric. You may now move on to other lessons.

If you answered “NO” - Use your observations above and the Rubric to determine what problem needs troubleshooting, then use a copy of the Troubleshooting Idea Book Page to help solve that problem. Keep repeating this “THINK - DO - TEST” process with the troubleshooting pages, until your device functions correctly.

Remember: Problems ARE NOT failures, they are an expected part of the design process!
Chain Reaction Challenge Idea Book Page: Troubleshooting

Student Name(s): ____________________________________________
Teacher/Class: ________________ Date: ________ Page #: ______

Use a copy of this Idea Book Page for each device problem you have to troubleshoot.

Sketch/Describe Your Device Problem Here:

Sketch/Describe Your Solution to the Problem Here:

Follow through with your solution and MAKE PLANNED CHANGES to your device, then TEST and OBSERVE.

Testing Observations:

_____________________________________________________________________________________________________
_____________________________________________________________________________________________________
_____________________________________________________________________________________________________

Does your Device function like you expected? YES NO

If you answered “YES” - Congratulations! You will score well on the Challenge Rubric. You may now move on to other lessons.

If you answered “NO” - Use your observations above and the Rubric to determine what problem needs troubleshooting next, then use another copy of this Idea Book Page to help solve that problem. Keep repeating this “THINK - DO - TEST” process with troubleshooting pages, until your device functions correctly.

Remember: Problems ARE NOT failures, they are an expected part of the design process!