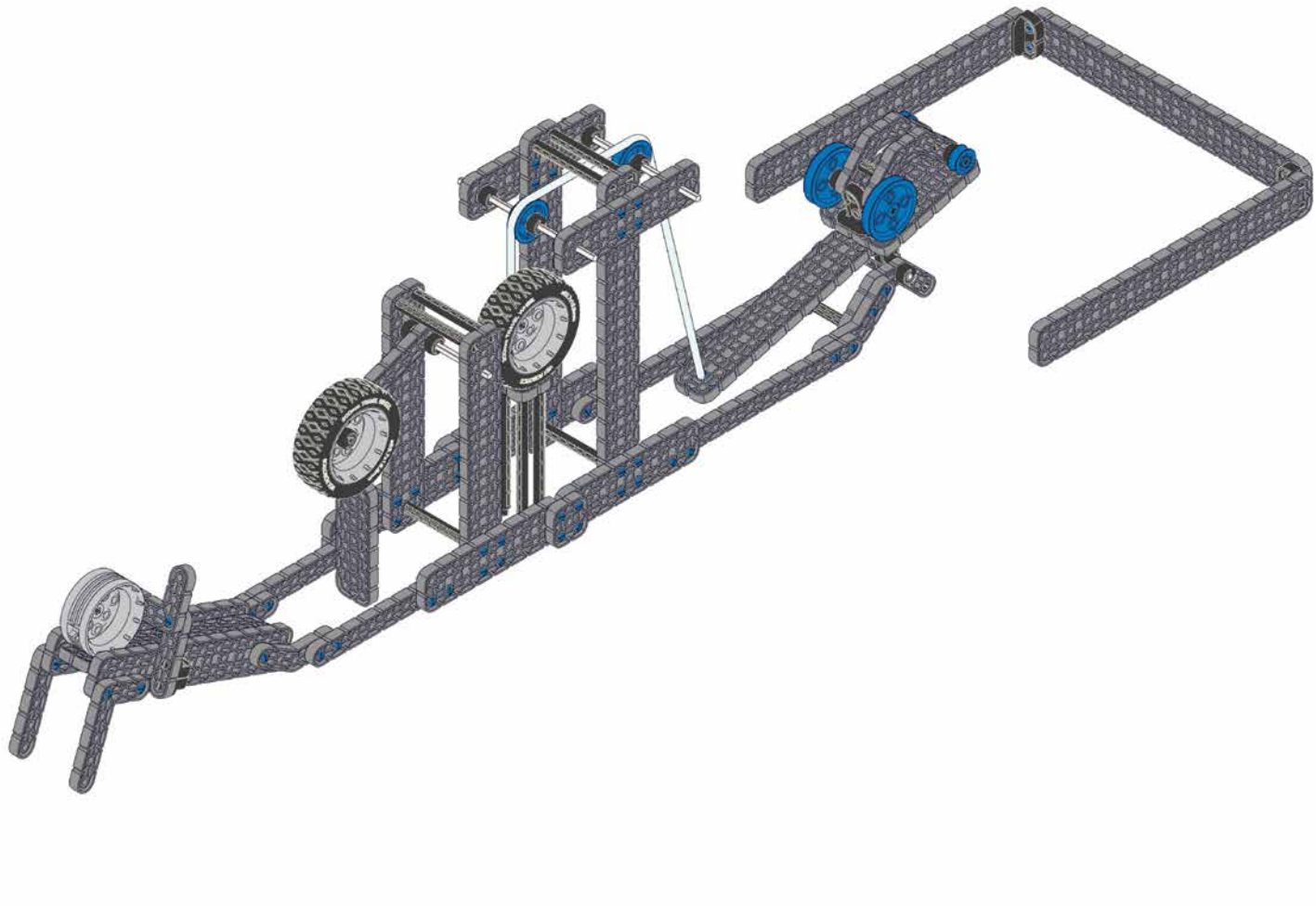
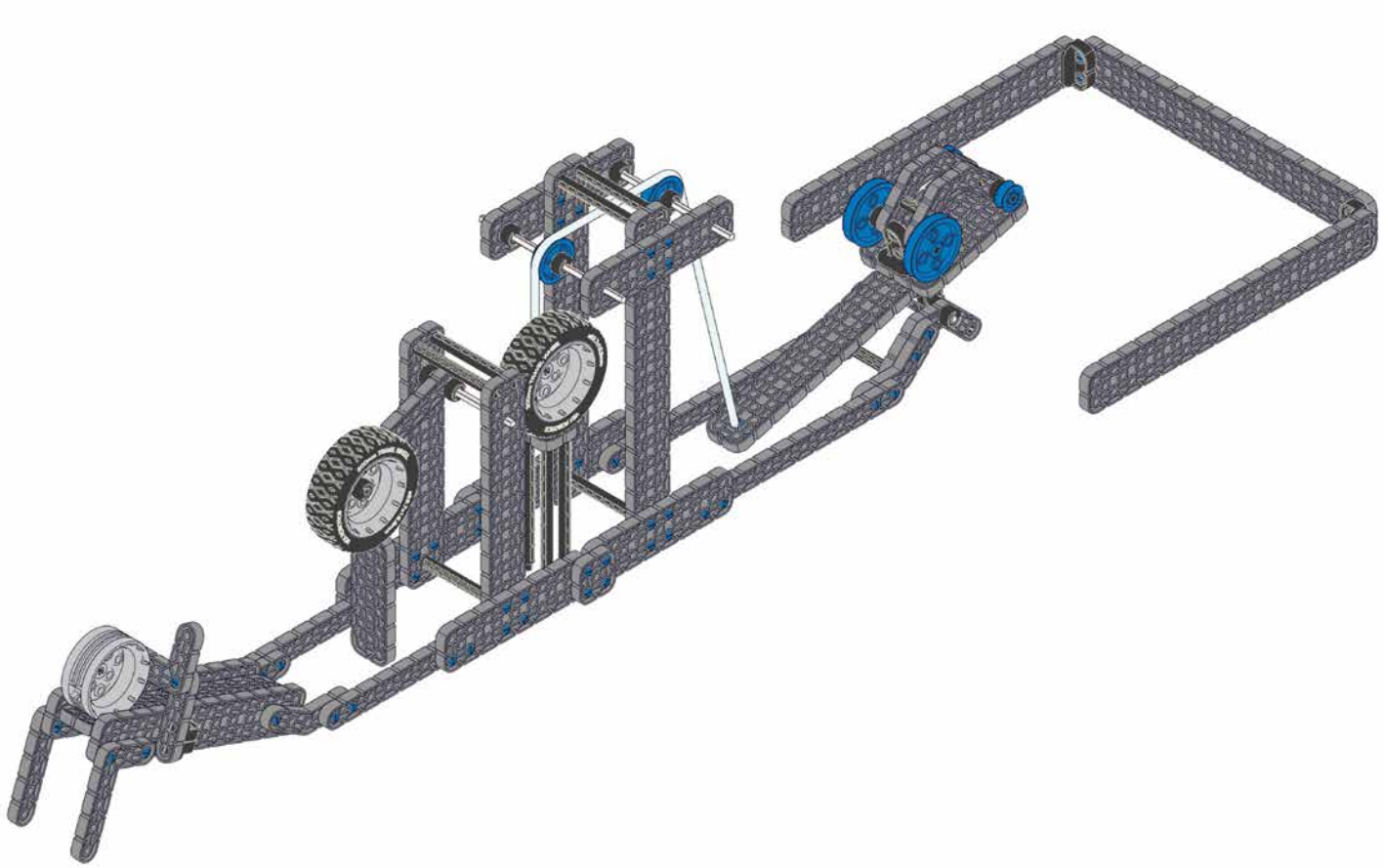
Chain Reaction Challenge





E.1

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:

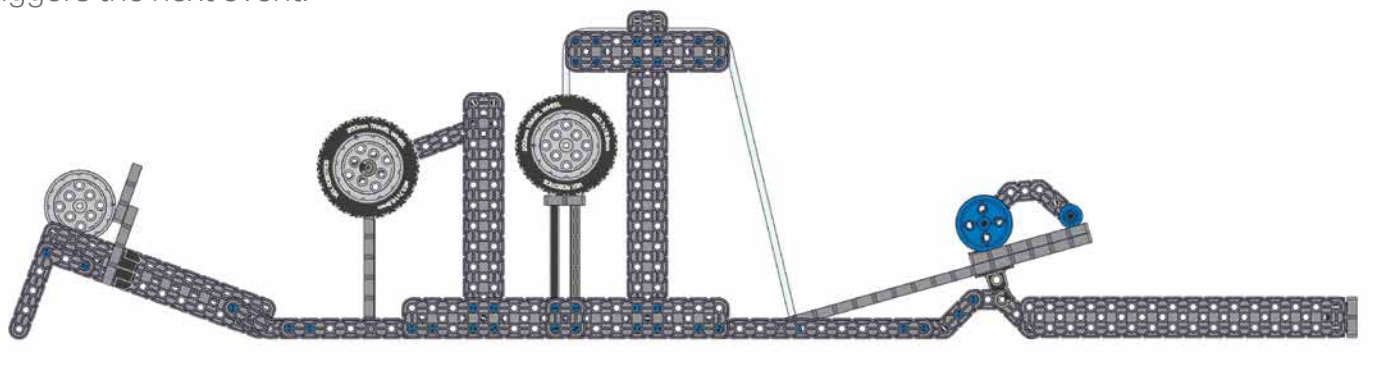
- Optional: Building The Sample Chain Reaction Device (see your teacher for details)
- Chain Reaction Challenge Device Build using Chain Reaction Device Rubric (unpowered, powered, or both – see your teacher for details)
- Completion of Idea Book Pages with device build and testing

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!

E.2

What is a Chain Reaction Device?

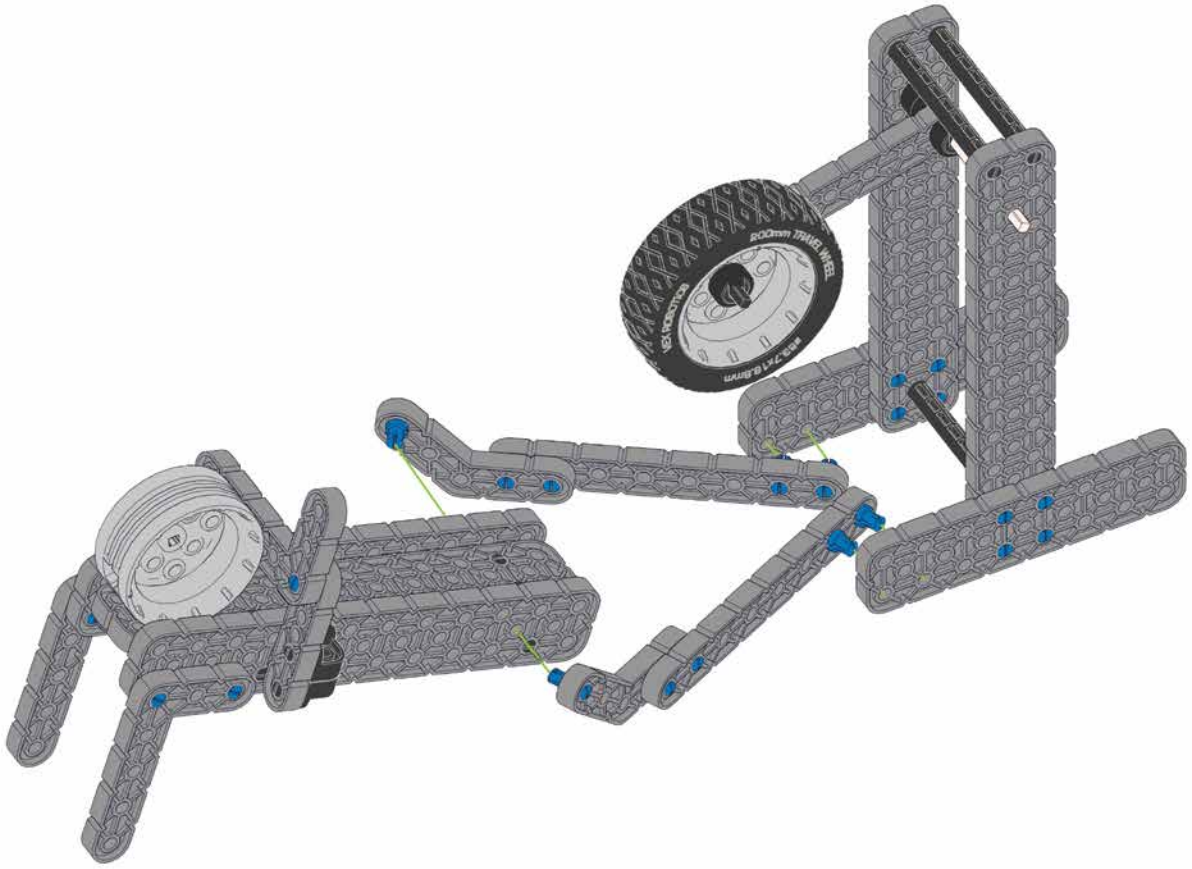
A Chain Reaction Device is a complex machine that performs a very simple task in a very complicated way. A Chain Reaction is a series of events so related to each other that each event triggers the next event.



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

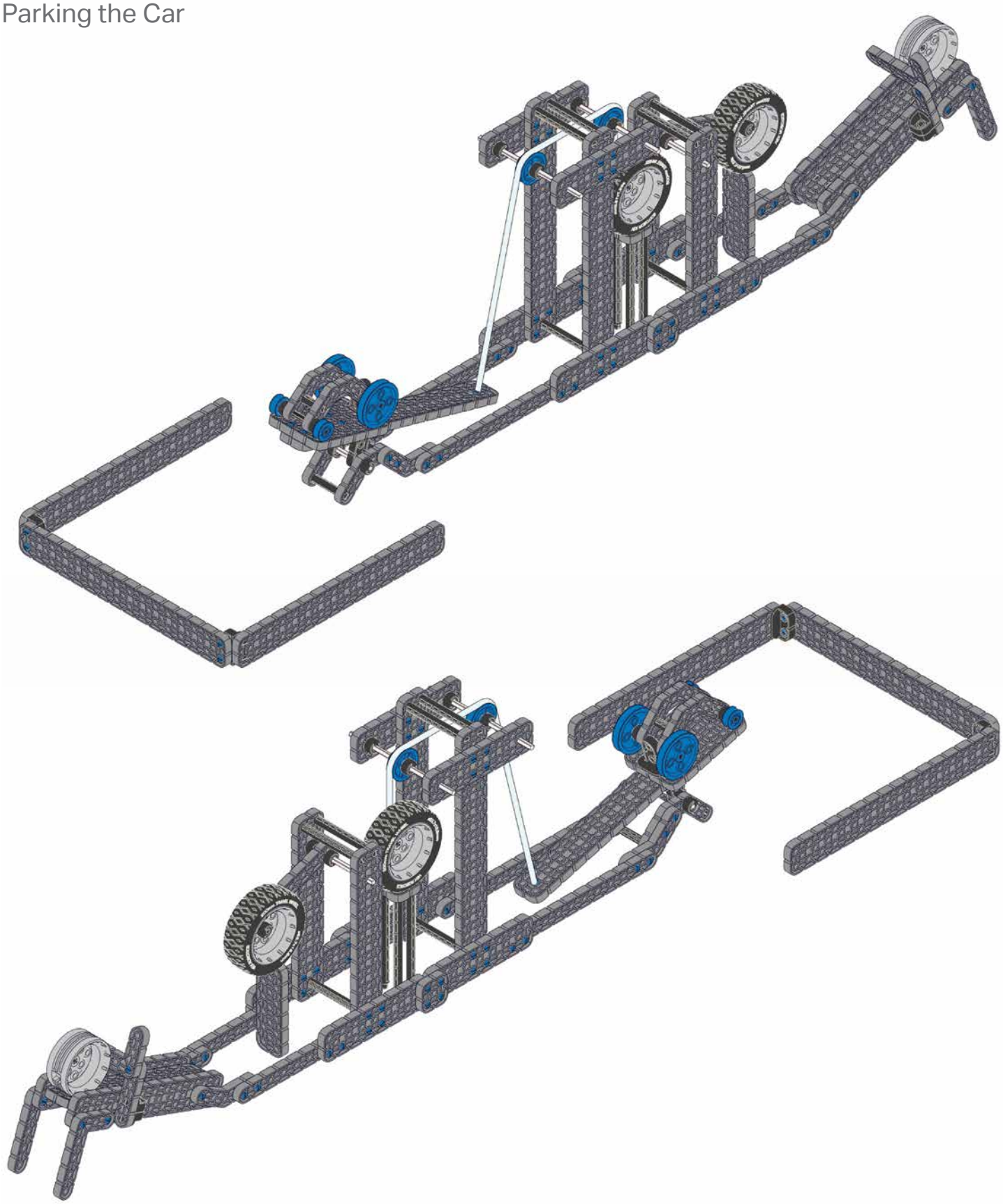
Your teacher may instruct you to assemble and test the sample unpowered Chain Reaction Device next.



E.3

Sample Chain Reaction Device Instructions

Parking the Car



E.3 cont.

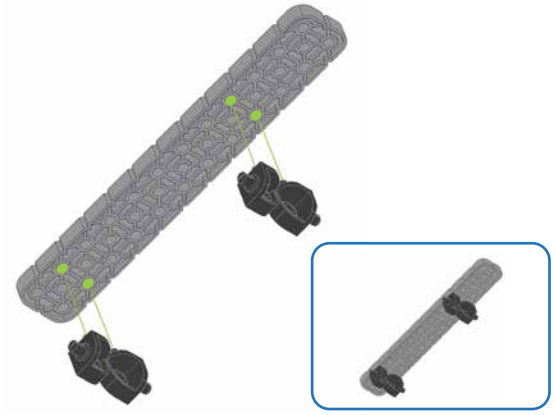
Inclined Plane Assembly

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.

1

1x 228-2500-026

4x 228-2500-127



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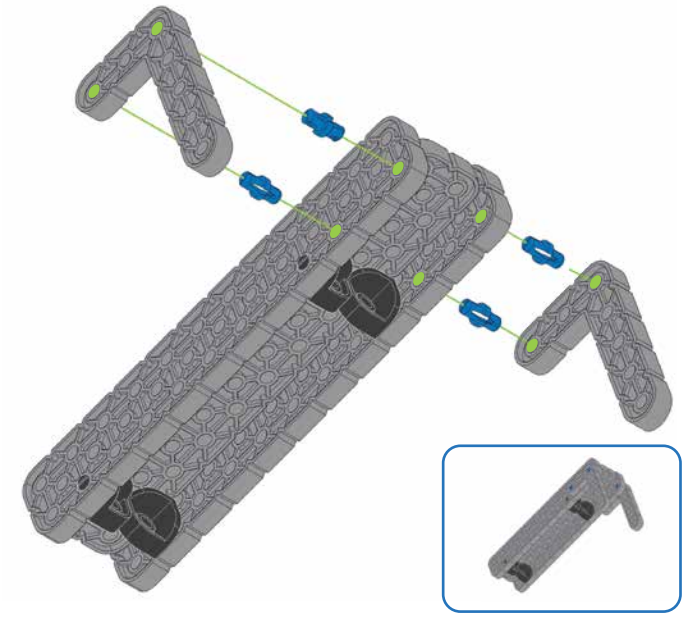
3

4x 228-2500-060

2x 228-2500-150



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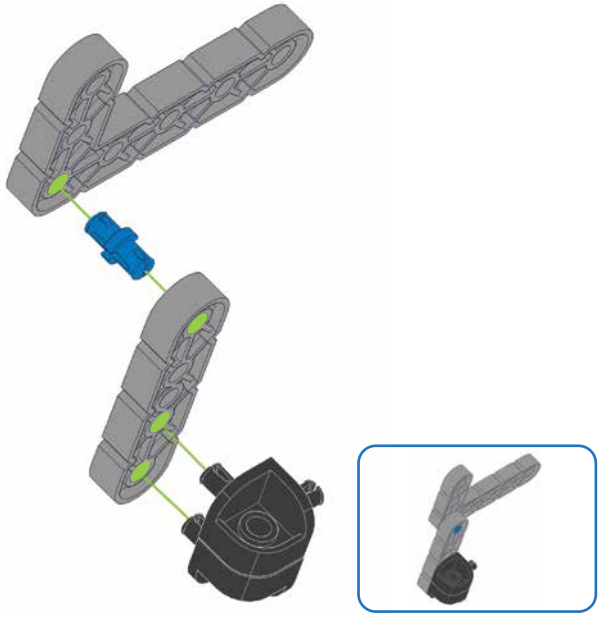
1x 228-2500-003

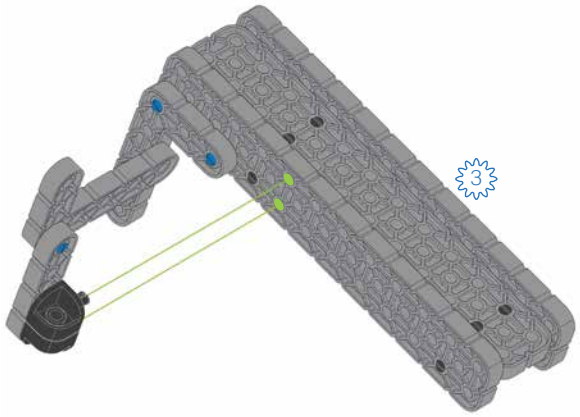
1x 228-2500-060

1x 228-2500-150



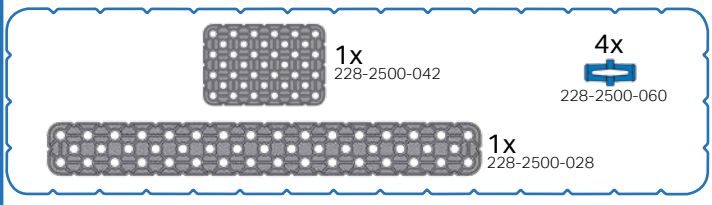
E.3 cont.

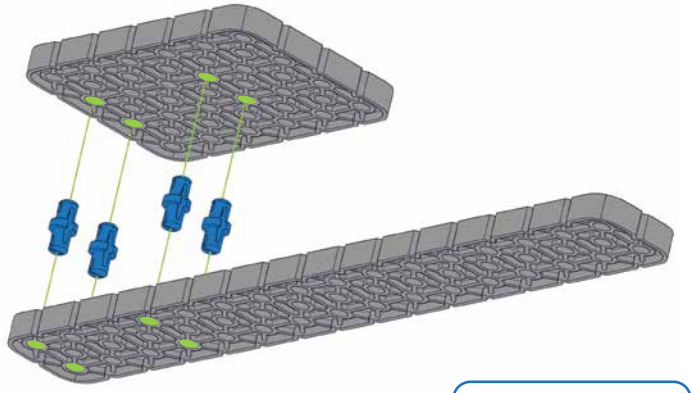
5

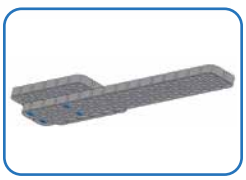


Lever Assembly

1







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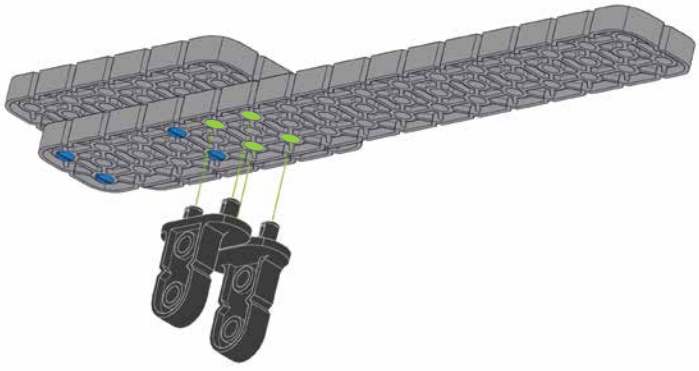


E.3 cont.

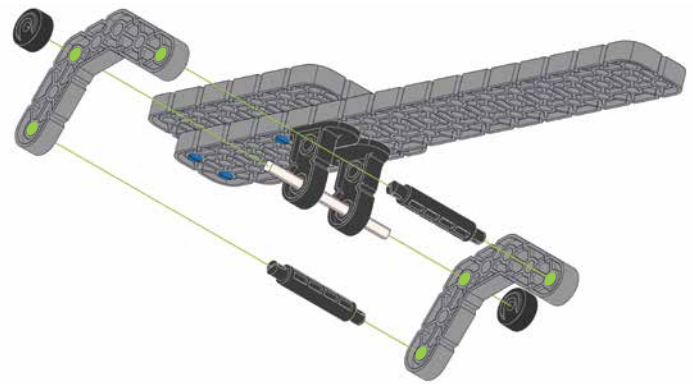
3

2x 228-2500-151

2x 228-2500-143

2x 228-2500-067

1x 228-2500-120



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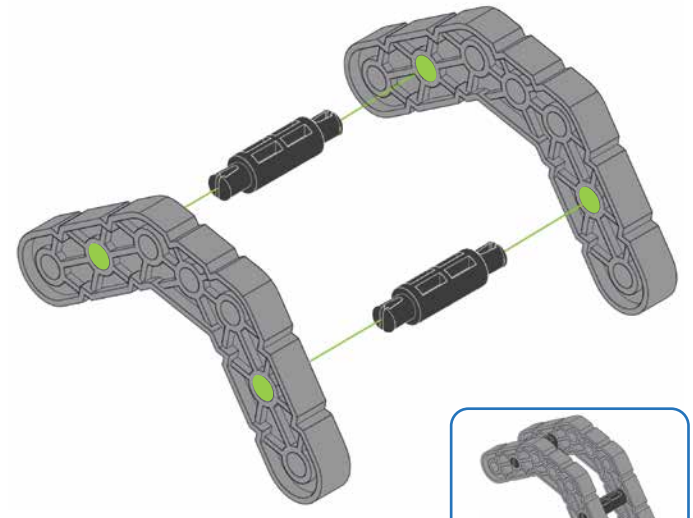
1x 228-2500-132

Car Assembly

1

2x 228-2500-151

2x 228-2500-065



2

2x 228-2500-120

1x 228-2500-163

1x 228-2500-165

2x 228-2500-143

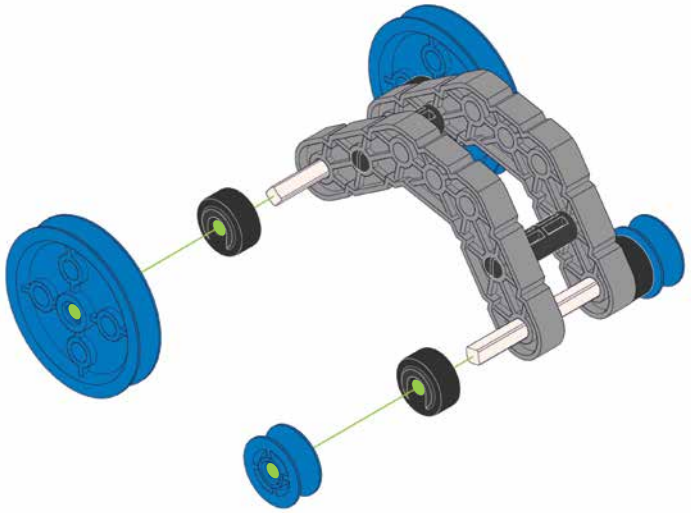
E.3 cont.

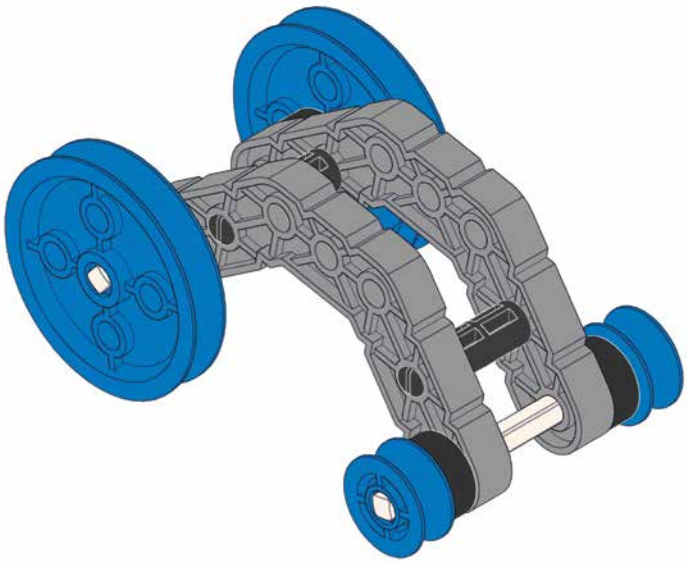
3

1x 228-2500-163

1x 228-2500-165

2x 228-2500-143





Garage Assembly

1

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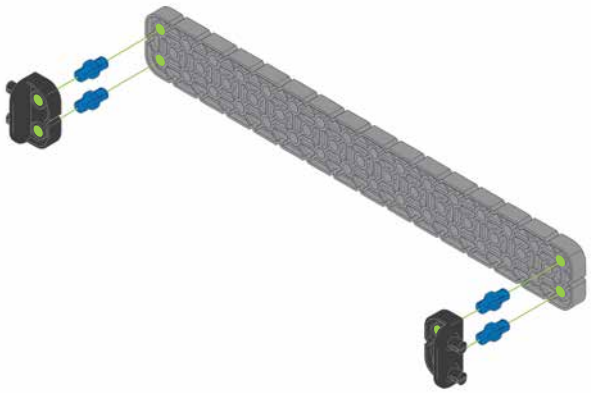
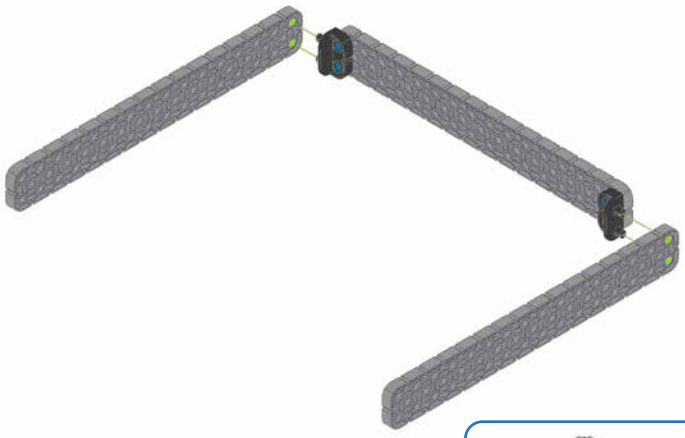
4x 228-2500-060

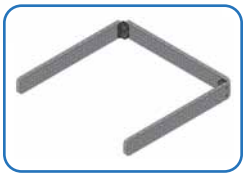
1x 228-2500-028



2

2x 228-2500-028





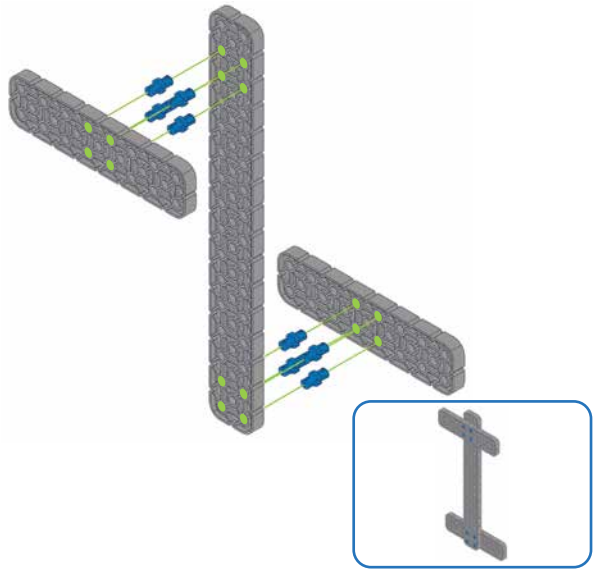
E.3 cont.
Pulley Assembly

1

2x 228-2500-023

8x 228-2500-060

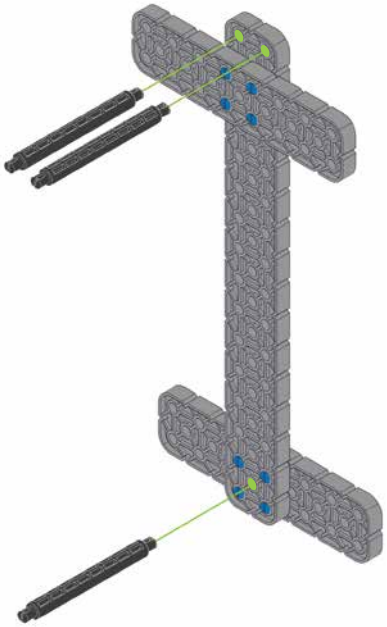
1x 228-2500-028



2

3x

228-2500-070



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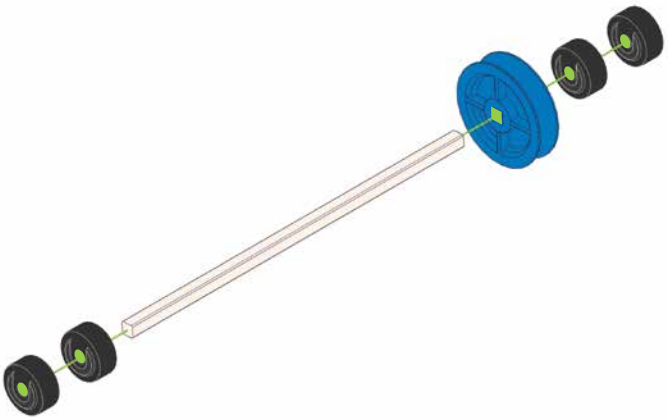
4x 228-2500-143

1x 228-2500-124

1x 228-2500-164

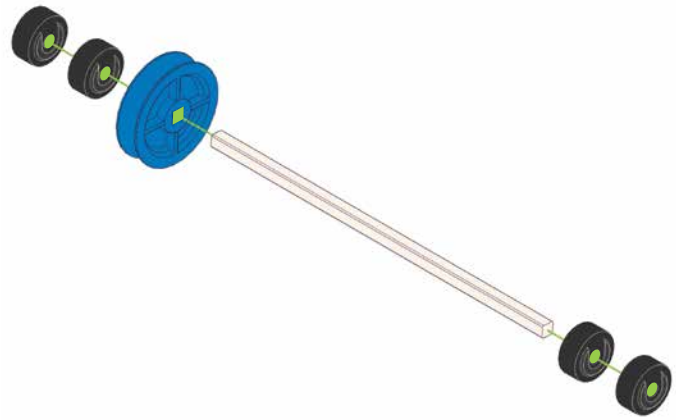


4

4x 228-2500-143

1x 228-2500-124

1x 228-2500-164



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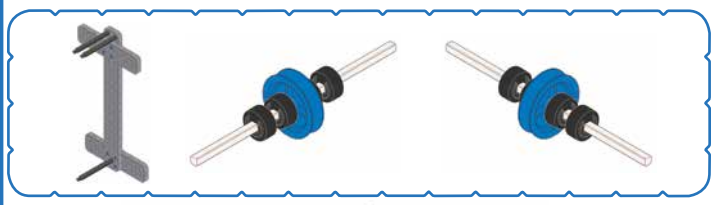

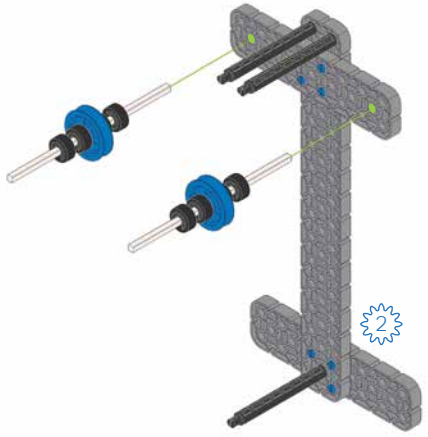

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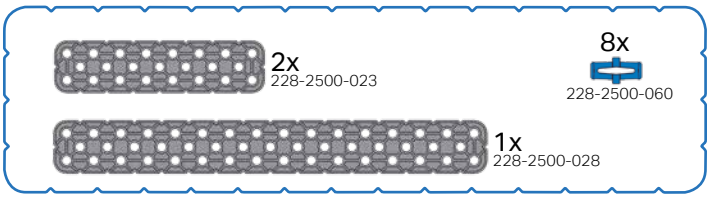

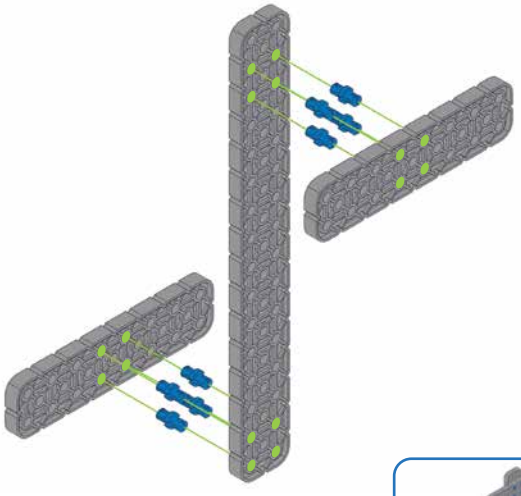

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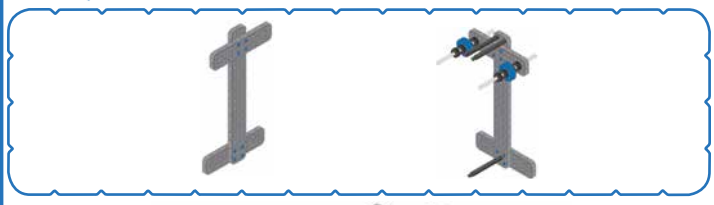

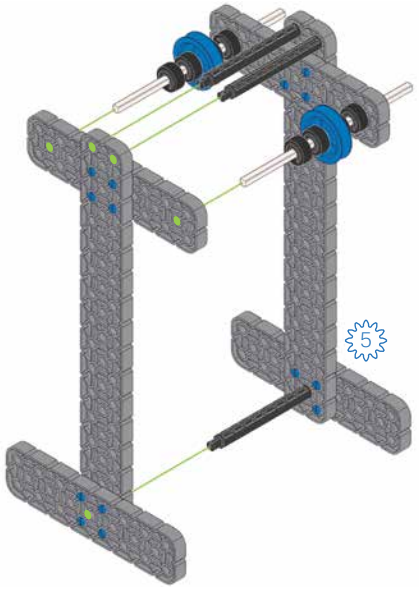

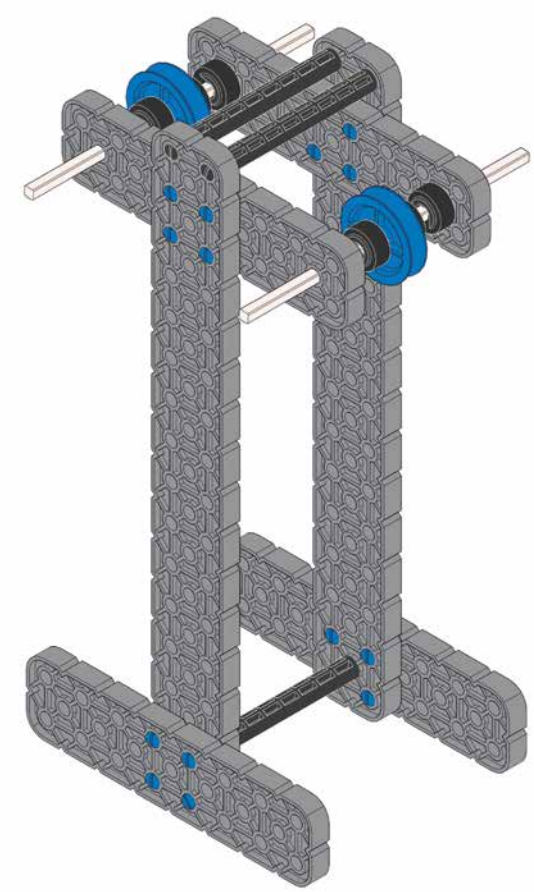

E.3 cont.

Pendulum Assembly

1

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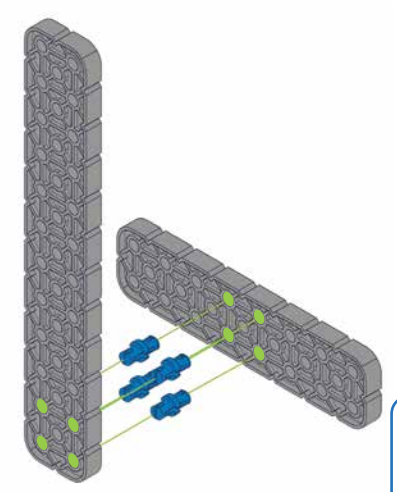
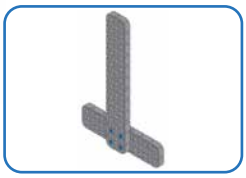
4x 228-2500-060

1x 228-2500-026

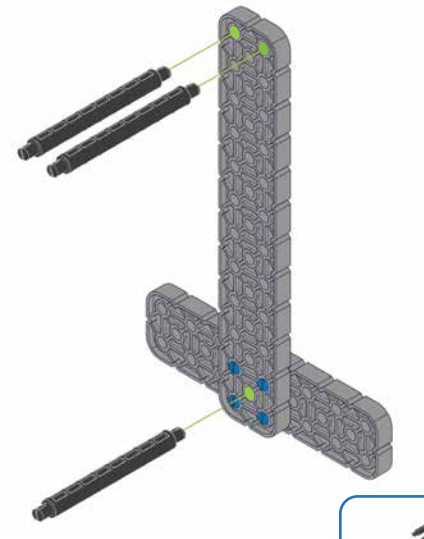




2

3x

228-2500-070



3

4x 228-2500-143

1x 228-2500-007

1x 228-2500-122

4

1x 228-2500-143

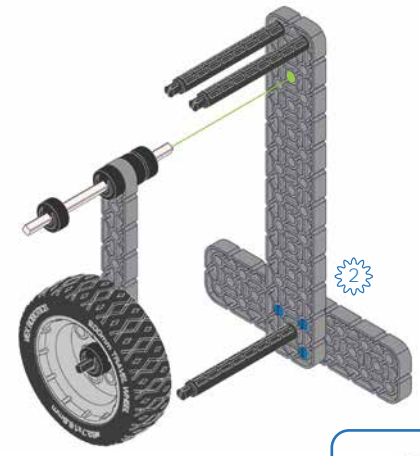
1x 228-2500-208

1x 228-2500-209

1x 228-2500-080

E.3 cont.

5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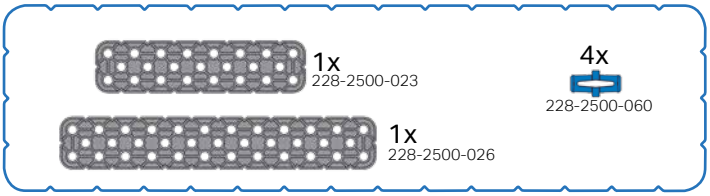
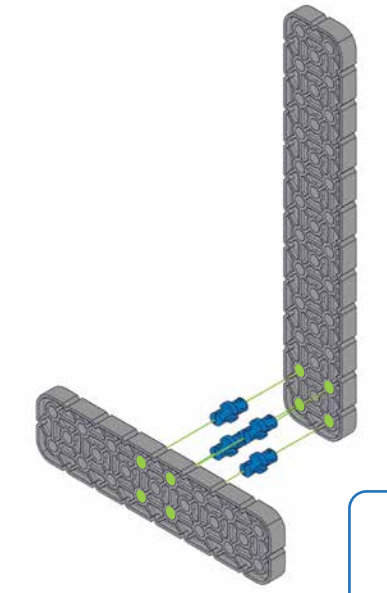
6


1x
228-2500-023
4x
228-2500-060
1x
228-2500-026



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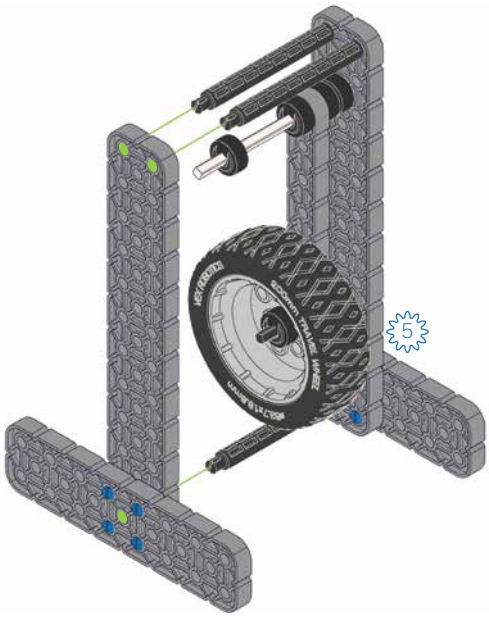
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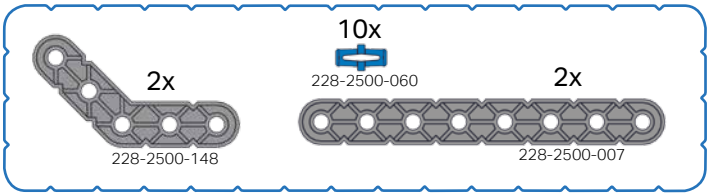
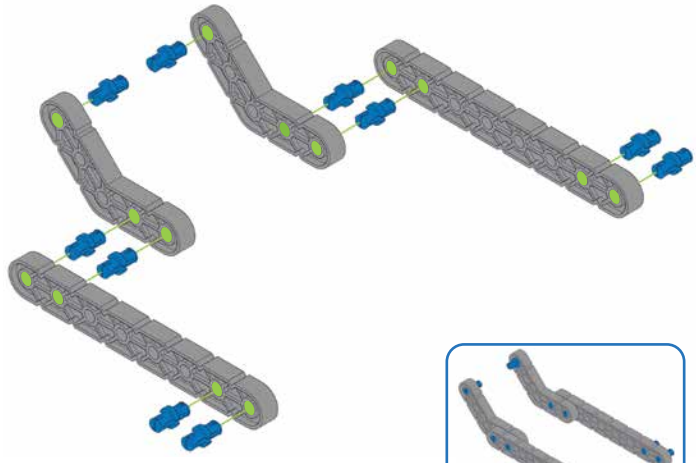
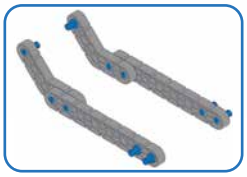
200mm TRAVEL WHEEL

E.3 cont.
Connecting Simple Machines & Pendulum Assembly

1







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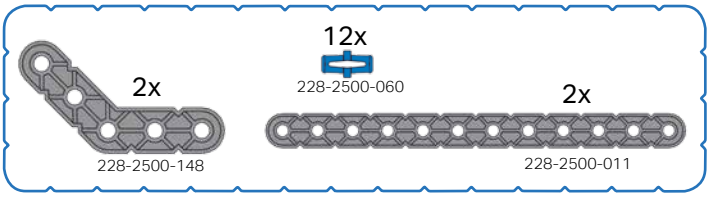

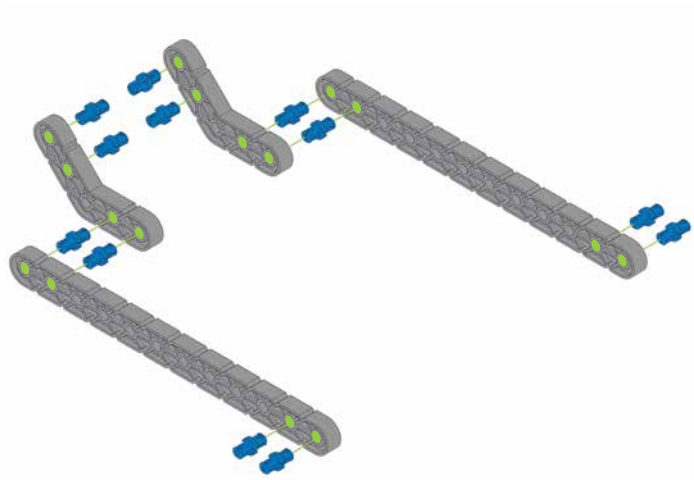

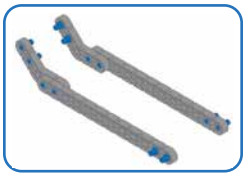

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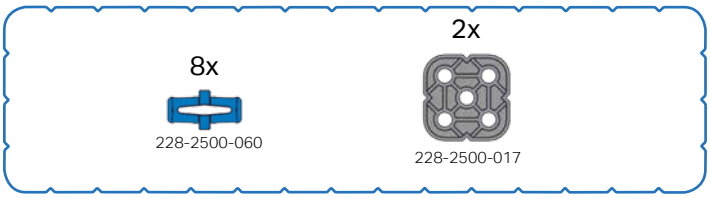

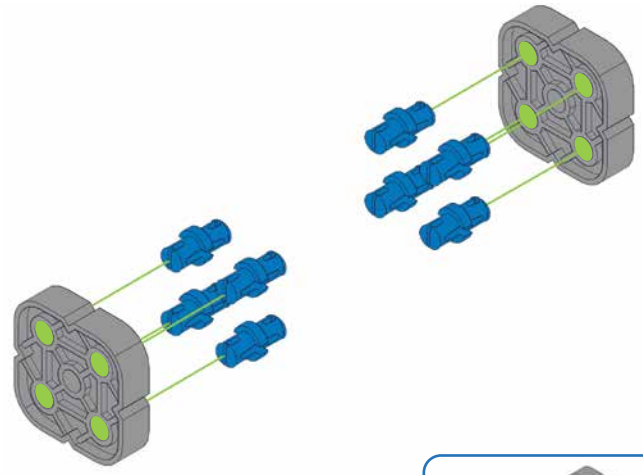

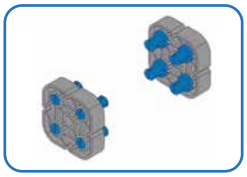

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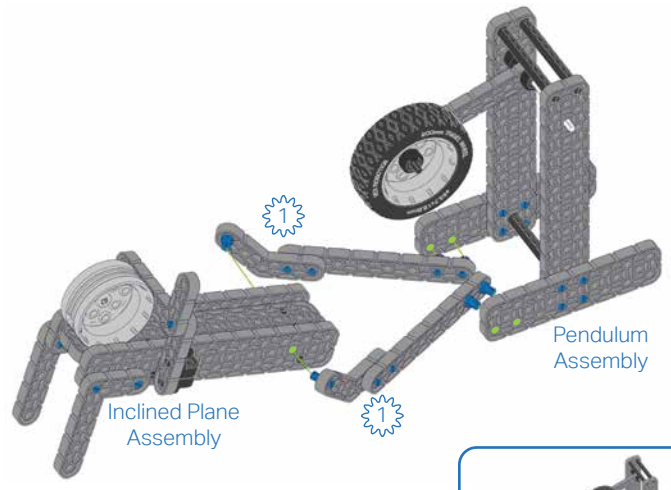
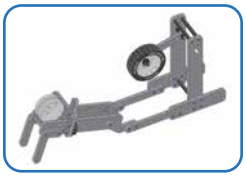
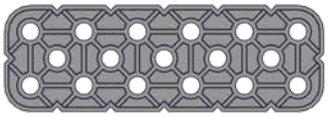




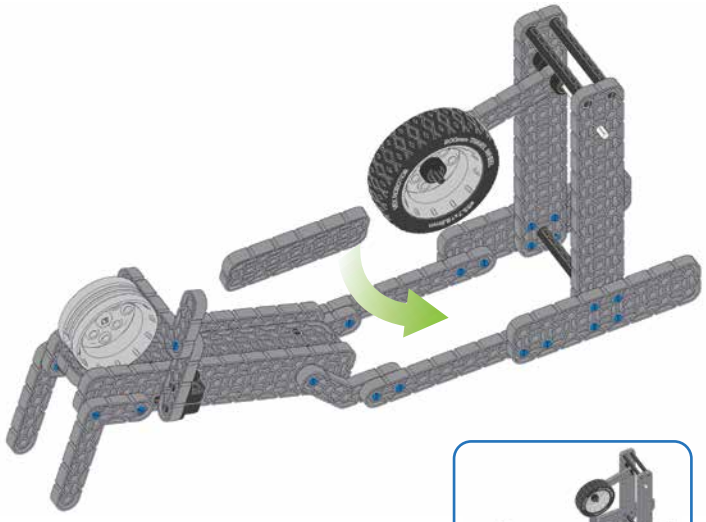
E.3 cont.

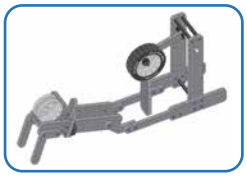
5

1x



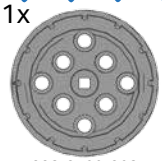
228-2500-021





6

1x

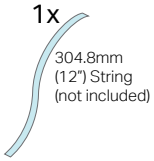


228-2500-208

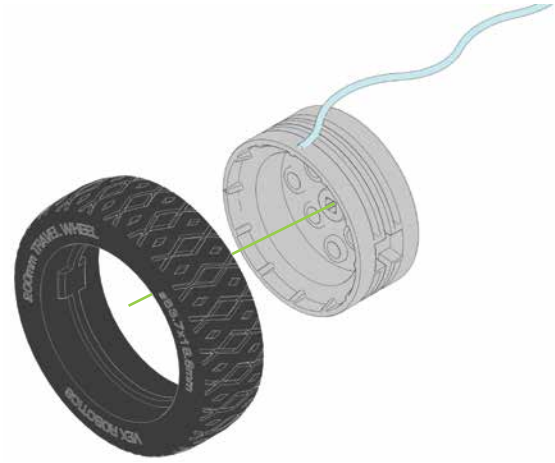
1x

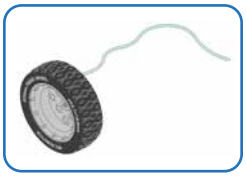
228-2500-209

1x



304.8mm
(12") String
(not included)





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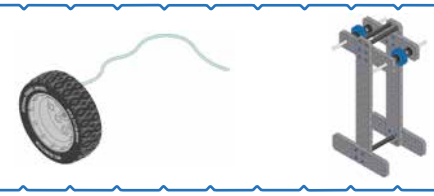
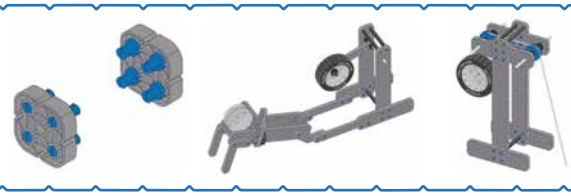
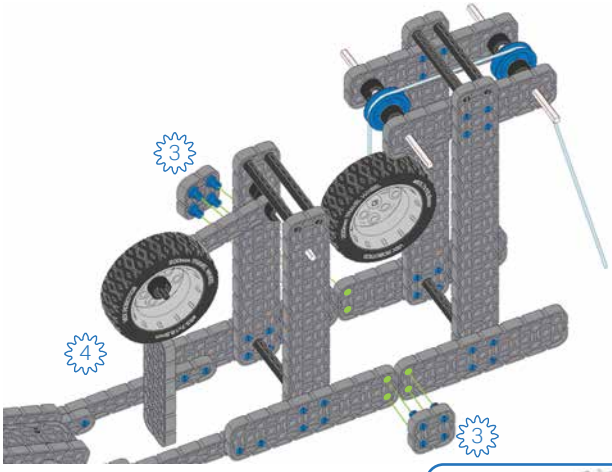


Pulley
Assembly

8





E.3 cont.

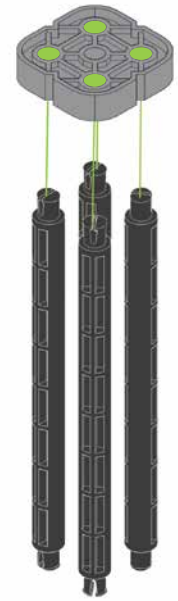
9

1x

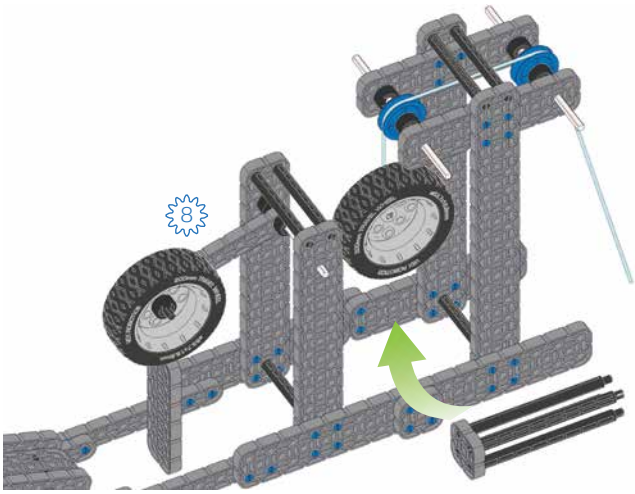
228-2500-017

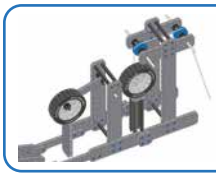
4x

228-2500-072



10

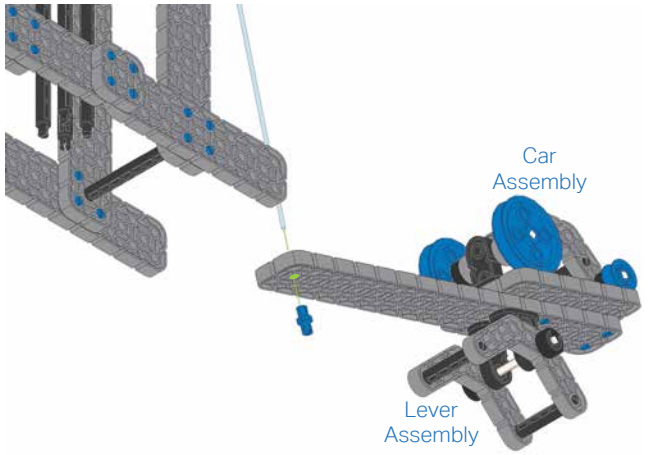


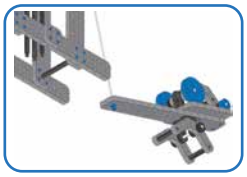


11

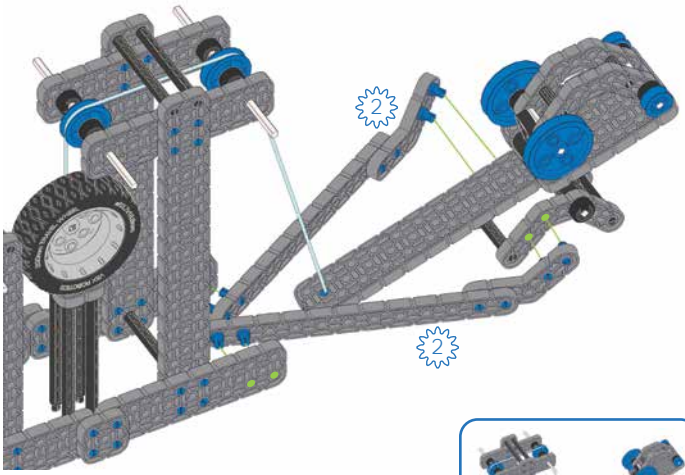
1x

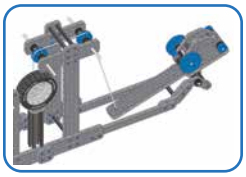
228-2500-060

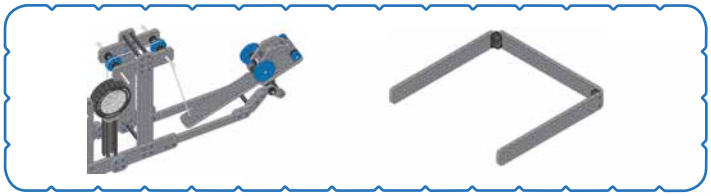


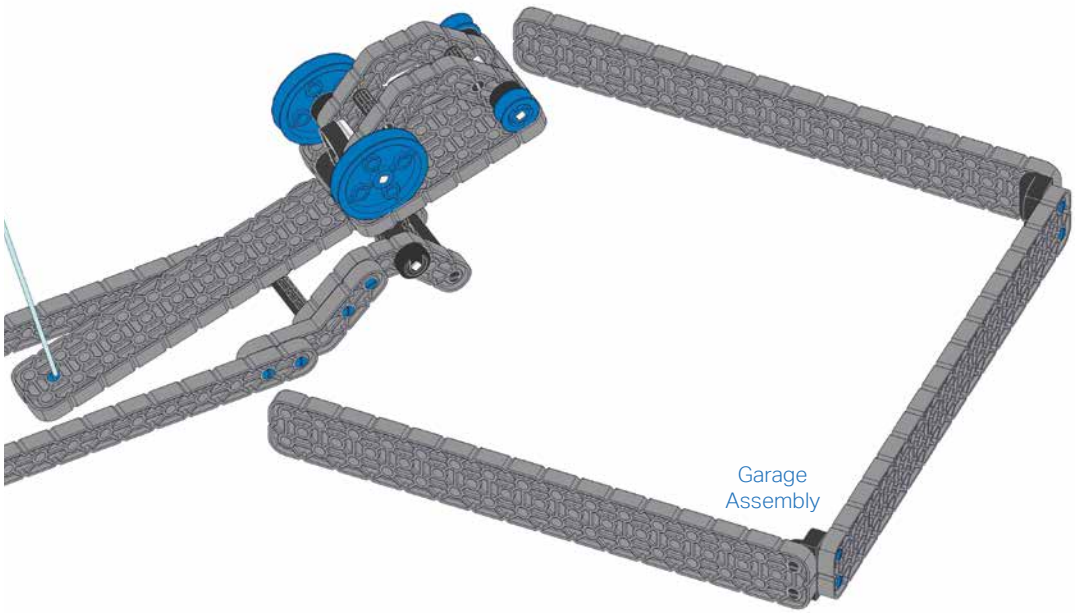


12





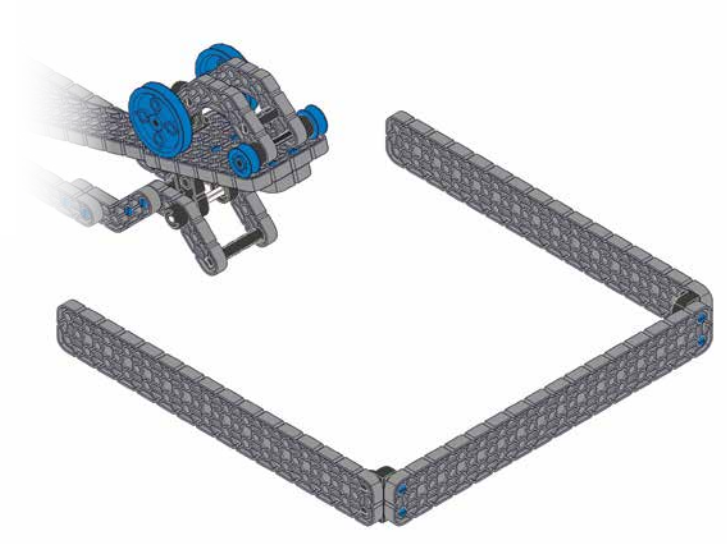



Garage
Assembly

E.4

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.

E.5

Rubric to Evaluate Unpowered Chain Reaction Device (grades 4-6)

Evaluation Criteria	Expert = 4	Proficient = 3	Emerging = 2	Novice = 1	Assessment	Comments
Design & Process Criteria						
Creating viable solutions to the given challenge: mechanism use	Four or more, well developed stages exist meeting all challenge rules	Three well developed stages exist meeting majority of challenge rules	Two or more partially developed stages are evident	A single stage that may or may not be developed is evident		
Simple machines and pendulum usage	Device uses three or more efficient simple machines/ pendulum	Device uses two functioning simple machines/ pendulum	One simple machine/ pendulum exists that functions	Attempt at using one simple machine/ pendulum		
Design Process (defined by the teacher, could be Idea Book use)	Design process utilized, documented & enhances product	Design process utilized and fully documented	Design process utilized consistently	Some evidence that design process was utilized		
Utilization of Resources (materials and parts, Information and instructions, people, and time)	Resources used fully within challenge rules and efficiency maximized	Resources utilized to maximize efficiency	Evidence that some resources utilized meeting challenge purpose	A few resources (e.g., tools & materials) partially utilized		
Technical Criteria						
Mechanical Systems (mechanisms & triggers)	Completely functional and consistent mechanical systems	Consistently functional mechanical systems	Functional, but inconsistent mechanical systems	Non-functional or incomplete/ unsafe mechanical systems		
Unifying Themes (This area emphasizes the Interaction of Science, Technology, & Human Endeavor)						
Communication (written, electronic and/or oral as defined by the teacher)	Sophisticated and highly efficient communication for stated audiences	Purposeful, consistent, effective communication	Purposeful, partially consistent communication	Communication very inconsistent and lacks purpose		
Teamwork	Teamwork that maximizes outcomes is evident	Team members define roles, goals, & work together	Team members partially define roles, goals, & work together	Participants function separately within a group		
Creativity	Device is unique, imaginative, and functional	Device is unique and/or imaginative in multiple ways	Device clearly shows a unique and/ or imaginative element	Unique and/ or imaginative element(s) unclear		

Rubric Adapted from Rubric and Evaluation Criteria for Standards-Based Robotics Competitions & Related Learning Experiences – TSA, 2005

E.6

Rubric to Evaluate Powered Chain Reaction Device (grades 4-8)

Evaluation Criteria	Expert = 4	Proficient = 3	Emerging = 2	Novice = 1	Assessment	Comments
Design & Process Criteria						
Creating viable solutions to the given challenge: mechanism use	Four or more, well developed stages exist meeting all challenge rules	Three well developed stages exist meeting majority of challenge rules	Two or more partially developed stages are evident	A single stage that may or may not be developed is evident		
Simple machines and pendulum usage	Device uses three or more efficient simple machines/ pendulum	Device uses two functioning simple machines/ pendulum	One simple machine/ pendulum exists that functions	Attempt at using one simple machine/ pendulum		
Design Process (defined by the teacher, could be Idea Book use)	Design process utilized, documented & enhances product	Design process utilized and fully documented	Design process utilized consistently	Some evidence that design process was utilized		
Utilization of Resources (materials and parts, information and instructions, people, and time)	Resources used fully within challenge rules and efficiency maximized	Resources utilized to maxi-mize efficiency	Evidence that some resources utilized meeting challenge purpose	A few resources (e.g., tools & materials) partially utilized		
Technical Criteria						
Mechanical Systems (mechanisms & triggers)	Completely functional and consistent mechanical systems	Consistently functional mechanical systems	Functional, but inconsistent mechanical systems	Non-functional or incomplete/ unsafe mechanical systems		
Electrical Systems	Battery charged. Wire routing safe, efficient, & completely functional	Battery charged. Wire routing safe & consistently functional	Functional, but inconsistent (battery or wiring issues)	Non-functional or incomplete (battery and wiring issues)		
Mechanical Systems (mechanisms & triggers)	Completely functional and consistent mechanical systems	Consistently functional mechanical systems	Functional, but inconsistent mechanical systems	Non-functional or incomplete/ unsafe mechanical systems		
Unifying Themes (This area emphasizes the Interaction of Science, Technology, & Human Endeavor)						
Communication (written, electronic and/or oral as defined by the teacher)	Sophisticated and highly efficient communication for stated audiences	Purposeful, consistent, effective communication	Purposeful, partially consistent communica-tion	Communica-tion very inconsistent and lacks purpose		
Teamwork	Teamwork that maximizes outcomes is evident	Team members define roles, goals, & work together	Team members partially define roles, goals, & work together	Participants function separately within a group		
Creativity	Device is unique, imaginative, and functional	Device is unique and/or imaginative in multiple ways	Device clearly shows a unique and/ or imaginative element	Unique and/ or imaginative element(s) unclear		

Rubric Adapted from Rubric and Evaluation Criteria for Standards-Based Robotics Competitions & Related Learning Experiences – TSA, 2005

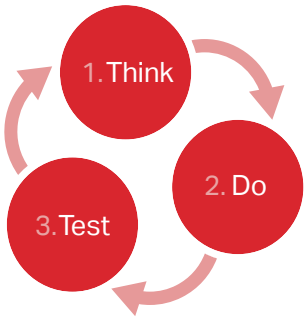
E.7

Chain Reaction Challenge Idea Book Page: Design Plan

Student Name(s): _____

Teacher/Class: _____ Date: _____ Page #: _____

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!

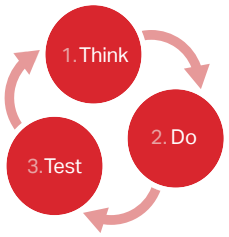
E.7 cont.

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!