Lesson 1: Basic Chassis Overview

In this lesson, users will learn how to use the elements of the TETRIX® system that will be involved in building the basic chassis of the Ranger Bot without using any motors or wires. Safe building practice will be introduced, as well as proper usage of required hand-tools.

Estimated Time: 60 minutes

Preparation:

- Clean the workstation.
- Organize the TETRIX set.

Materials:

- TETRIX Education Base Set (739143)
- Hex Key 4-Pack

Resources:

- Engineering Journal Worksheet
- Lesson 1: Basic Chassis Overview
- Lesson 1: Basic Chassis Building Guide
- Lesson 1: Basic Chassis Reference Guide
- Safety Guide
- Hand-Tools Guide
- *TETRIX Endless Possibilities* video
- Basic Chassis 3-D Model

Building Objectives:

- Learn how to build with the TETRIX system.
- Learn how to use hand-tools.

Programming Objectives:

- This activity focuses on building.

Best Practices:

Be sure to review the General Best Practices Guide in the Introduction section of the TETRIX Getting Started Guide.

Building

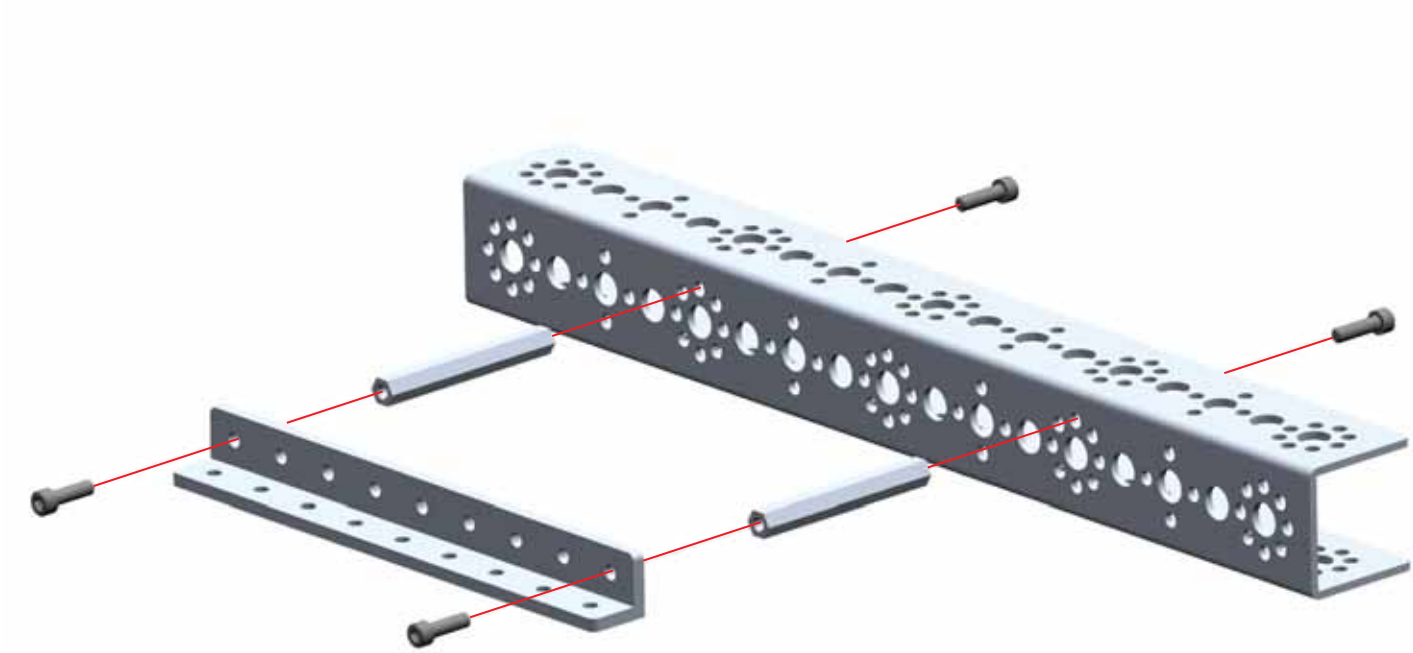
- It is important to orient the screws and channels carefully. Orient the screws as directed in the building guide so that they can be tightened or removed easily.

Lesson 1: Basic Chassis Building Guide

Step 1

Parts Needed

1x 288 mm Channel | 2x 2-Inch Stand-Off Post | 4x 1/2" SHCS | 1x 144 mm Angle



Tips

- There is only one size of screw to use while building this model: the 1/2" SHCS.
- To maintain accurate angle orientation, tighten all screws a little at a time, alternating between turns, until all screws are tightened completely.
- Use the correct size of hex key when tightening screws to prevent screws from stripping. Use the 7/64" hex key for these screws.

Lesson 1: Basic Chassis Building Guide

Step 2

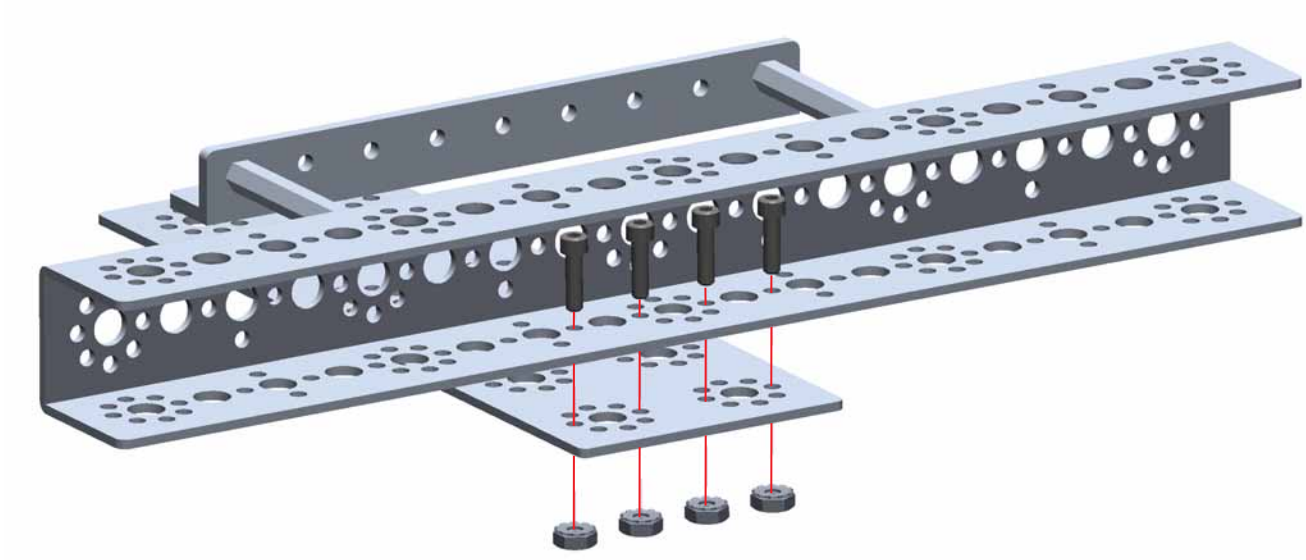
Parts Needed

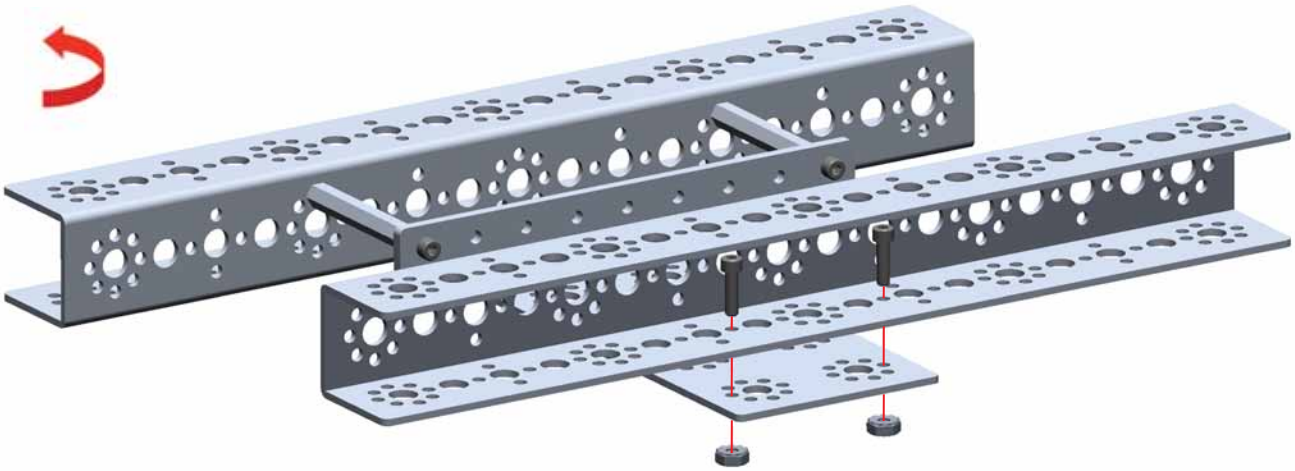

1x 288 mm Channel


1x Flat Building Plate


6x 1/2" SHCS


6x Kep Nut





Tips

- The easiest way to tighten the screws is to insert the hex key through the holes above them.
- Do not tighten all of the screws fully until the plate is attached.

Lesson 1: Basic Chassis Building Guide

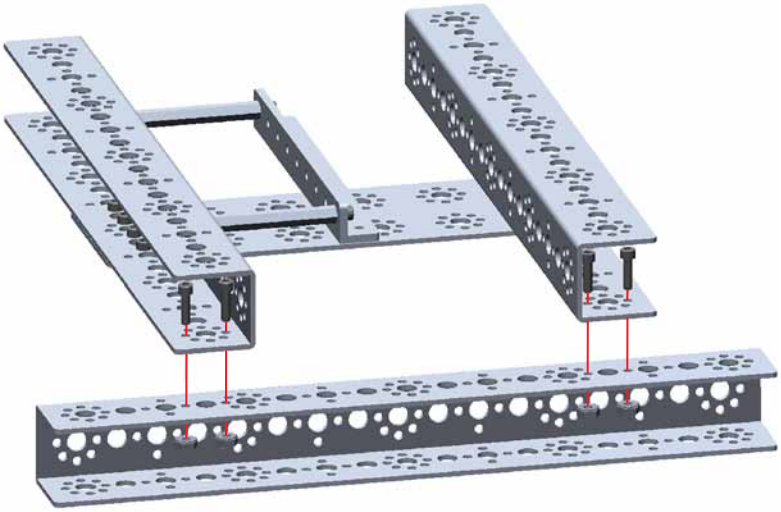
Step 3

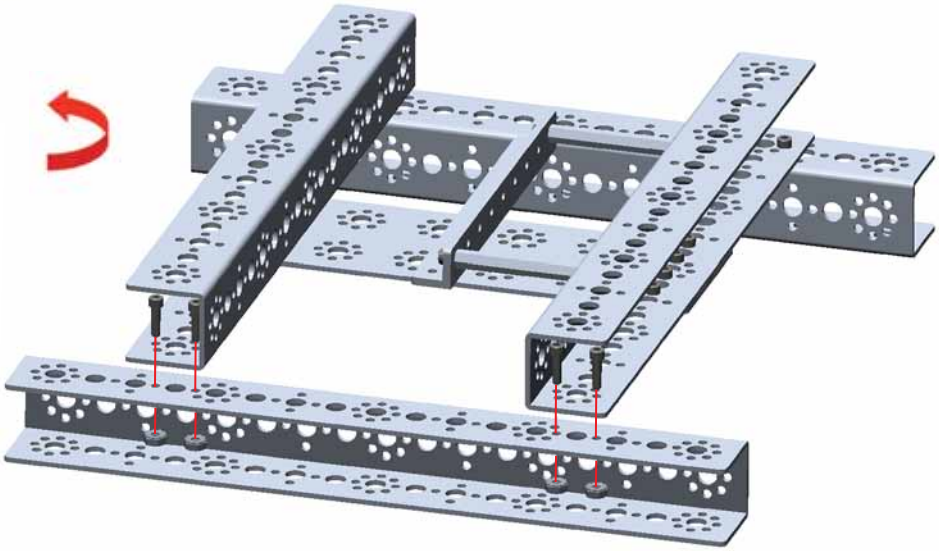
Parts Needed

2x 288 mm Channel

8x 1/2" SHCS

8x Kep Nut





Tips

- Ensure that the teeth of the nut face the head of the screw.
- For easier access, face the inside angle of the channel away from the center of the model.
- Remember: The easiest way to tighten the screws is to insert the hex key through the holes above them.
- The head of each screw should face the top of the chassis.
- Attach the top channels to the lower channels by aligning to the fourth large hole, counting from the ends of the lower channels, as shown.

Lesson 1: Basic Chassis Building Guide

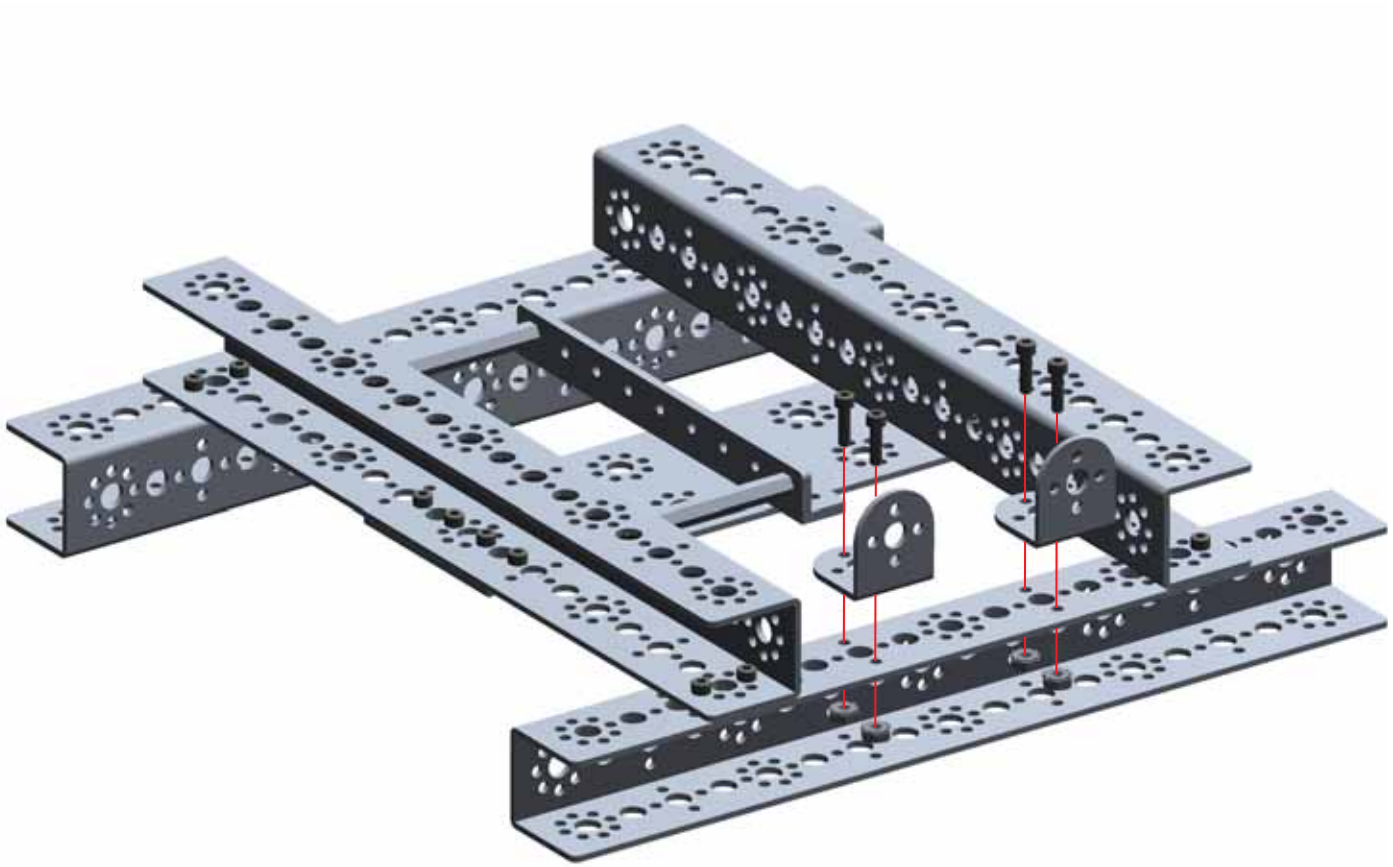
Step 4

Parts Needed

2x L Bracket

4x 1/2" SHCS

4x Kep Nut



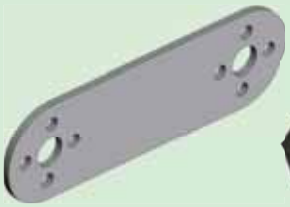
Tip

- Reminder: Ensure that the teeth of the nut face the head of the screw.

Lesson 1: Basic Chassis Building Guide

Step 5

Parts Needed



1x Flat Bracket

2x 1-inch Stand-Off Post

2x 1/2" SHCS

Tips

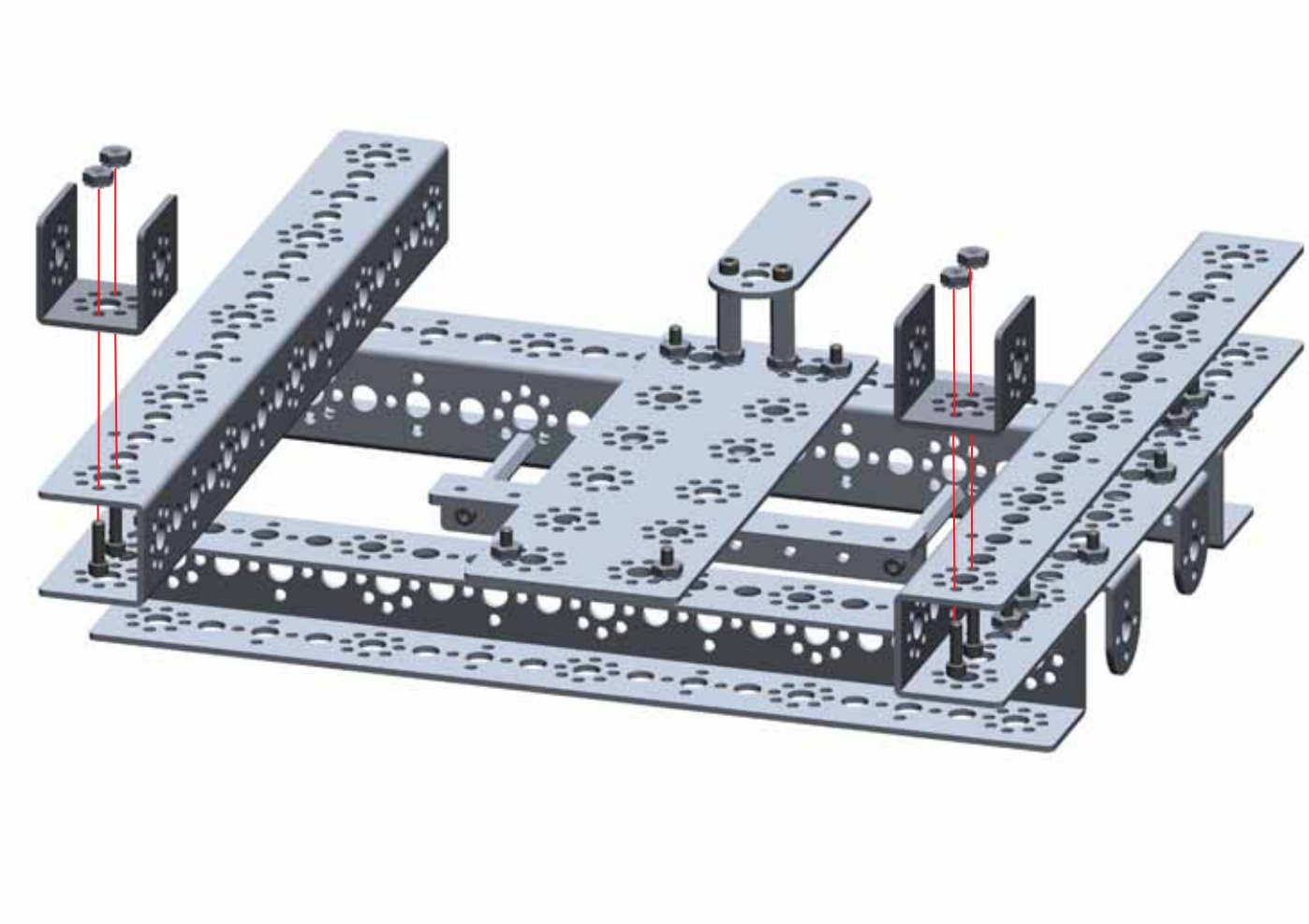
- Attach the stand-off post to the chassis first. The screws that are attached to the channel are held in with a nut and cannot be turned.
- To keep the flat bracket oriented properly, tighten the bottom two screws bit by bit, alternating between them.

Lesson 1: Basic Chassis Building Guide

Step 6

Parts Needed

2x 32 mm Channel | 4x 1/2" SHCS | 4x Kep Nut

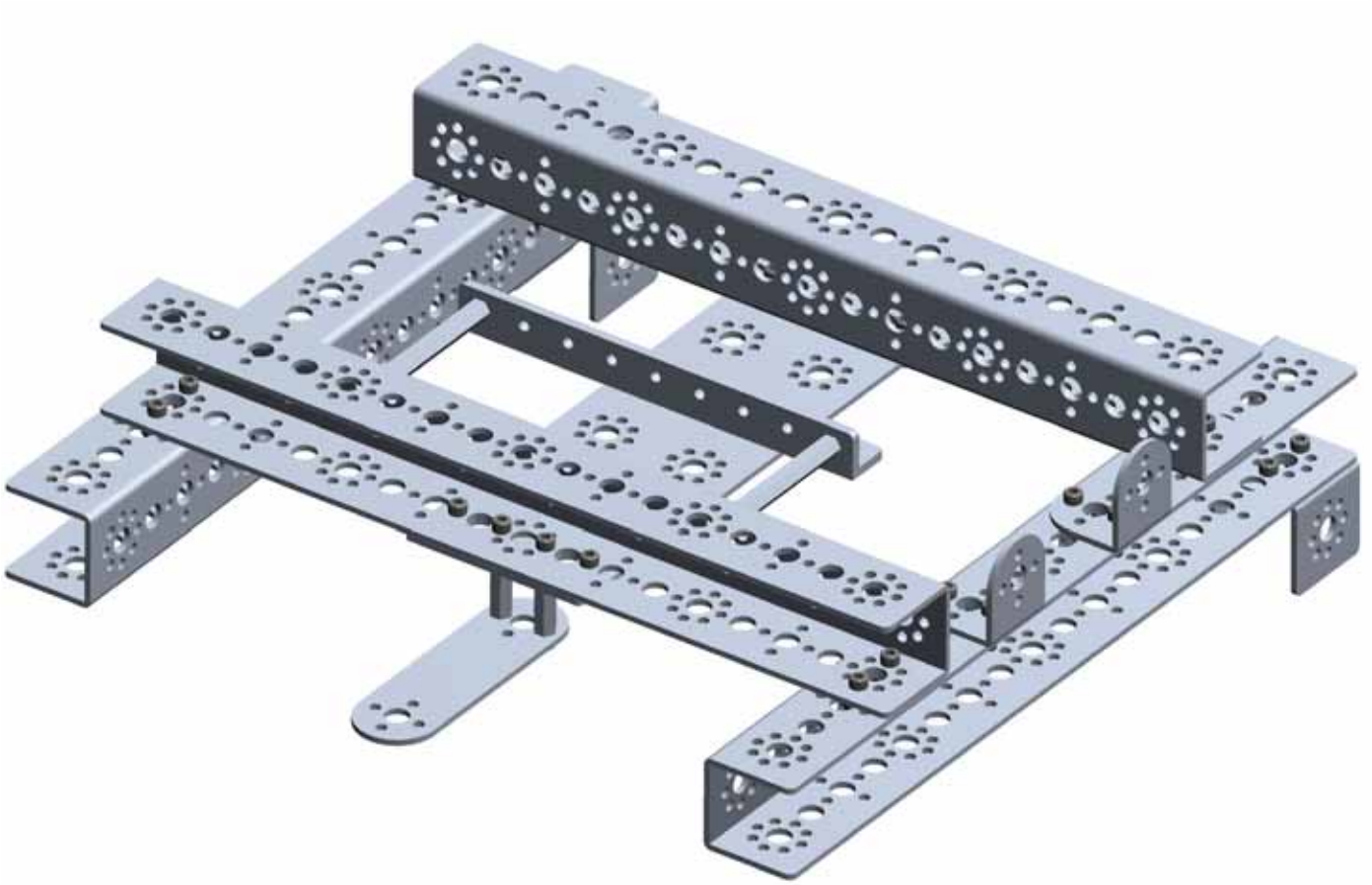


Tip

- Reminder: Ensure that the teeth of the nut face the head of the screw.

Lesson 1: Basic Chassis Building Guide

Final View



Lesson 1: Basic Chassis Reference Guide

Expectations	
Technology: • Develop an understanding of the characteristics and scope of technology. • Develop and produce a product or system using a design process. • Develop an understanding of the attributes of design. • Develop an understanding of engineering design. • Develop an understanding of the core concepts of technology.	**Mathematics:** • Understand patterns, relations, and functions. • Analyze characteristics and properties of two- and three-dimensional shapes. • Develop mathematical arguments about geometric relationships. • Understand measurable attributes of objects and the units, systems, and processes of measurement. • Formulate questions that can be addressed with data and collect, organize, and display relevant data.
Science: • Implement a proposed solution. • Communicate the problem, process, and solution.	**Engineering:** • Identify a need or problem. • Sketch a two-dimensional model. • Sketch a three-dimensional model. • Test and evaluate. • Redesign what has been created. • Meet design constraints.

Classroom Organization and Setup

1. Open the TETRIX® sets and sort the elements into the compartments of the plastic tray.
2. Set up a projector with a computer to show the *TETRIX Endless Possibilities* video.
3. Organize the class into groups of two or three students. These groups will work together for the first three lessons in the TETRIX Getting Started Guide activities.
4. Provide each student with a copy of the Engineering Journal worksheet.
5. Provide each group of students with a copy of the Lesson 1: Basic Chassis Building Guide.

Lesson Progression

1. Become familiar with the TETRIX set and the resources provided with it.

   Take out and examine:
   a. The metal and electronic elements within the TETRIX set, starting with the elements in the "Start Here" box.
   b. The tools that will be used when assembling the elements in the TETRIX set.

2. Watch the *TETRIX Endless Possibilities* video that is provided on the TETRIX Getting Started Guide DVD.
3. Highlight one or two interesting building or programming goals from the video. Record these goals in a notebook or as part of an engineering journal entry.
4. Identify and inventory each element within the TETRIX set using the Elements Inventory or the Parts Card.
5. Sort the elements into the tray provided and think critically about why this is a necessary step. For example, it allows users to identify any missing parts. It also creates an organizational system so that parts can be easily found when needed.
6. Follow the Lesson 1: Basic Chassis Building Guide to complete the basic chassis.

Lesson 1: Basic Chassis Reference Guide

Frequently Asked Questions

Q: What are the benefits of using metal pieces to construct the basic chassis?

A: Metal pieces make the structure of the basic chassis much sturdier than one made with plastic materials. Using metal pieces means that the basic chassis will be able to accomplish tasks that require greater strength.

Q: Which tool would be most effective in assembling the basic chassis? Why?

A: The 7/64" hex key provided in the TETRIX® Base Set is required to assemble the basic chassis because it is the only tool that will fit the head of the socket head cap screw.

Q: What features make the base stable?

A: The basic chassis is stable because it has a square base and because its center of mass is very low to the ground and near the center of the robot.

Q: Why is it important to pay attention to the orientation of the screws while assembling the basic chassis?

A: It is important to orient the screws so that they can be easily accessed in future lessons as additional elements are added to the model.

Q: Why should the inside angle of the channel face away from the center of the basic chassis when assembling the basic chassis?

A: Orienting the channels so that the inside angle of the channel faces away from the center of the basic chassis ensures easy access and a clear visual line to elements that may be attached in future lessons. For an illustrated example, see the General Best Practices Guide in the printed TETRIX Getting Started Guide.

Q: What could be the result of using an incorrectly sized screwdriver or hex key?

A: It is easy to accidentally strip the screws and even damage the hand-tools when the wrong-sized tool is used.

Q: What is the proper way to orient the nuts when assembling the basic chassis?

A: The teeth of the nut should face the head of the screw.

Q: Why should screws be tightened fully only after the entire subassembly has been completed?

A: Tightening screws before an entire subassembly is complete can make it difficult to accurately line up the holes in the channels. All screws in a subassembly should be fastened loosely before any are completely tightened to ensure that the elements have been aligned properly.

Innovation and Inspiration

Suggestion #1: "What could be built from this?"

- Using the basic chassis as a starting point, brainstorm what could be built with the remaining TETRIX and MINDSTORMS® elements.
- This new model can be a real or imaginary product, such as a frame for a new musical instrument.
- Create a sketch of the plan and add elements to the base.
- Share developed ideas with others and outline additional uses for the model.
- Various constraints can be imposed on the design, such as cost, size, or weight.
- These constraints can be gathered from other students in the class, acting as potential customers, depending on what they want to do with the product.
- The data that is collected can be graphed to anticipate what the demand of the class is, as well as which design might have the best sales.
- Give the product a name and a monetary value. Discuss who might be interested in buying it.

Lesson 1: Basic Chassis Reference Guide

Suggestion #2: "Find the perimeter and area of the TETRIX® Channels."

- Place a five-hole TETRIX channel on a blank piece of paper and trace its outer edge.
- Measure the perimeter and calculate the approximate area of the traced image.
- Estimate the perimeter and area of the nine-hole TETRIX channel.
- Place the nine-hole TETRIX channel on a blank piece of paper and trace its outer edge.
- Measure the perimeter and calculate the approximate area of the traced image.
- Calculate the area of the traced image.
- Create a table containing the perimeters and areas of both the five-hole and nine-hole TETRIX channels.
  For example:

	Perimeter	**Approximate Area**
Five-Hole TETRIX Channel		
Nine-Hole TETRIX Channel Estimation		
Nine-Hole TETRIX Channel		

- How accurate was the estimate?
- Calculate the difference between the measured nine-hole TETRIX channel perimeter or area and the estimated values.
- Consider the relationship between the perimeter of the TETRIX channels and the number of holes in them.
- Also consider the relationship between the area of the TETRIX channels and the number of holes.
- Create another table containing the calculated values for the perimeter per number of holes in the TETRIX channels and the area per number of holes in the TETRIX channels.
  For example:

	Perimeter/# of Holes	**Area/# of Holes**
Five-Hole TETRIX Channel		
Nine-Hole TETRIX Channel		

- Is the area per number of holes approximately constant for the five- and nine-hole TETRIX channels? Is the perimeter constant? Explain why or why not.
- Does this rule apply to other sizes of TETRIX channels?

Lesson 2: Ranger Bot Movement Overview

In this lesson, DC motors, a DC Motor Controller, the NXT brick, wires, and wheels will be attached to the basic chassis that was created in Lesson 1. The Ranger Bot will be observed completing basic movements. Movement can be implemented using a keyboard in LabVIEW for LEGO MINDSTORMS, or by running the provided ROBOTC sample code in ROBOTC. Optionally, if a joystick is available, it can be used in either LabVIEW for LEGO MINDSTORMS or in ROBOTC.

Estimated Time: 90 minutes

Preparation:

- Clear the workstation.
- Organize the TETRIX® and MINDSTORMS® sets.
- Charge the TETRIX and NXT batteries.
- Download the latest firmware onto the NXT Brick.

Note: See the Quick-Start Guide in the Introduction section of the TETRIX Getting Started Guide.

Materials:

- Completed Basic Chassis from Lesson 1
- TETRIX Education Base Set (739143)
- LEGO® MINDSTORMS Education NXT Base Set (W979797)
- Programming Software (ROBOTC® or LabVIEW™ for LEGO MINDSTORMS) installed on each computer

Note: A joystick is not included in the TETRIX Education Base Set (739143)

Resources:

- Engineering Journal worksheet
- Lesson 2: Ranger Bot Movement Overview
- Lesson 2: Ranger Bot Movement Building Guide
- Lesson 2: Ranger Bot Movement Programming Guide or (Optional) Joystick Programming Guide
- Lesson 2: Ranger Bot Movement Reference Guide
- Lesson 2 Sample Program
- *Lesson 2: Ranger Bot Movement Tutorial* video (optional)
- Lesson 2: (Optional) Joystick Driving
- *Lesson 2: Ranger Bot Movement – How It Should Work* video
- Ranger Bot Movement 3-D Model

Building Objectives:

- Wire and attach a TETRIX DC motor and a DC motor controller.
- Attach an NXT Brick to a MINDSTORMS with TETRIX robot.

Programming Objectives:

- Make the Ranger Bot move using either a sample program or remote control from either the computer or a joystick.
- Configure the robot motor controller (with LabVIEW for LEGO MINDSTORMS or ROBOTC).
- Control the Ranger Bot:
  - Using a keyboard with LabVIEW for LEGO MINDSTORMS.
  - By deploy a basic movement program in ROBOTC.
  - (Optional) By controlling the Ranger Bot using a joystick with LabVIEW for LEGO MINDSTORMS or ROBOTC.

Best Practices:

Be sure to review the General Best Practices Guide in the Introduction section of the TETRIX Getting Started Guide.

Building

- To balance the weight of the robot and provide weight on the front wheels for better traction, mount the battery toward the front of the Ranger Bot.
- MINDSTORMS elements can be attached to TETRIX with hard point connectors. Turn the screws only until the hard point connectors are securely attached to the TETRIX channels.
- Motor controllers are attached using screws and hex keys different from those used in Lesson 1: Basic Chassis. Keep this in mind when choosing which hand-tools to use.
- Complete all wiring before attaching the battery.
- Use the 4-in-1 screwdriver to tighten the screws that secure the wires into the motor controllers.

Programming

- Ensure that all NXT Bricks are given unique names.

Lesson 2: Ranger Bot Movement Building Guide

Step 1

Parts Needed

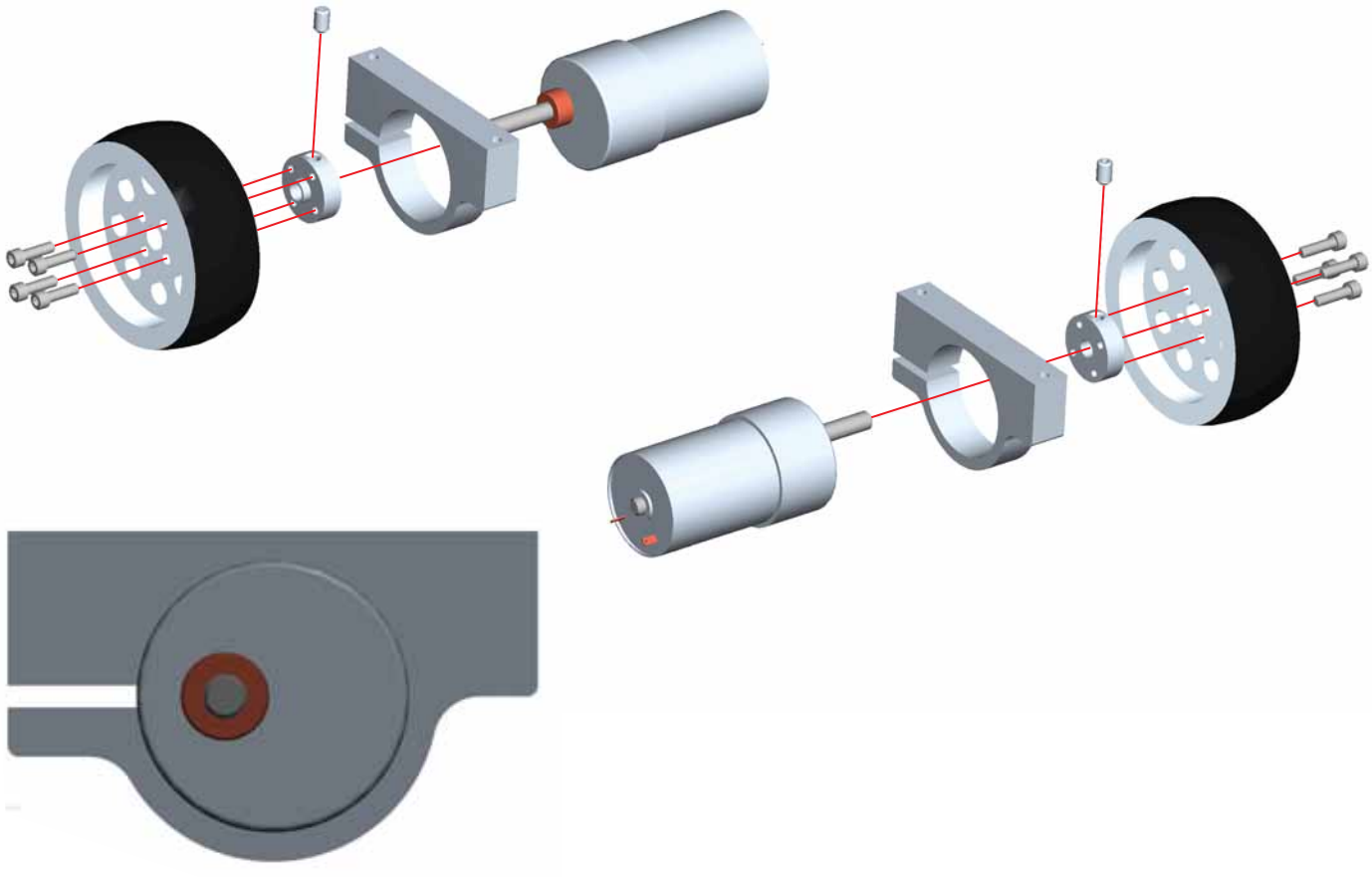

2x DC Drive Motor


2x Motor Mount


2x 3" Wheel


2x Motor Shaft Hub


8x 1/2" SHCS



Tips

- The 7/64", 3/32", 5/64" hex keys will be needed to build this model. Some sets may also require a 1/16" hex key.
- Use the motor shaft hub. The axle hub is too small.
- The set screw should connect to the D-flat side of the motor shaft.
- Make sure that the gaps in the motor mounts are facing as shown.
- Note that the shaft of the DC motor is not centered. Ensure that the motor is rotated in the mount so that the shaft is positioned closest to the gap, as shown in the bottom picture.

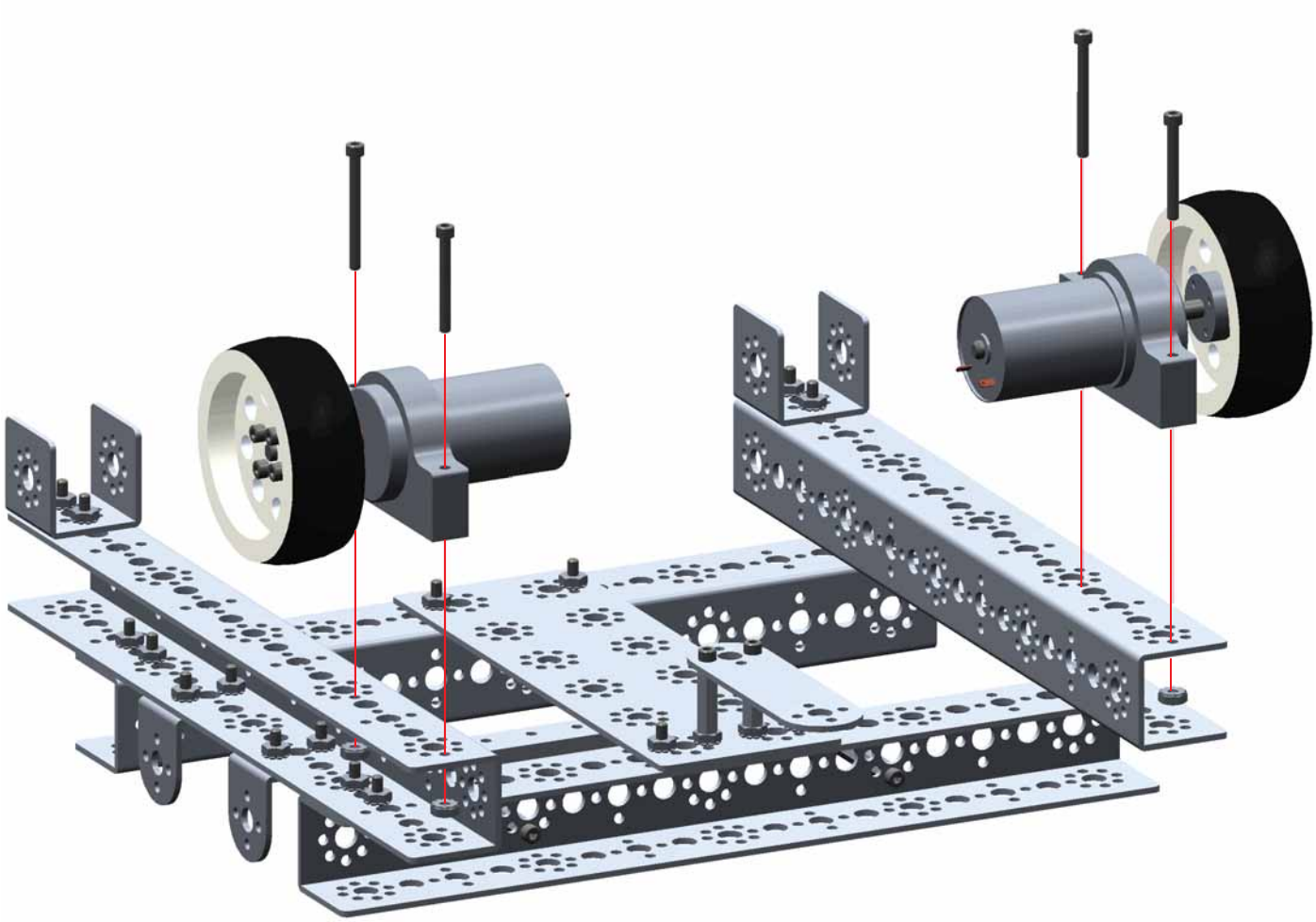
Lesson 2: Ranger Bot Movement Building Guide

Step 2

Parts Needed

4x 1.5" SHCS

4x Kep Nut



Tip

- Ensure that the teeth on the nuts face the head of the screw.

Lesson 2: Ranger Bot Movement Building Guide

Step 3

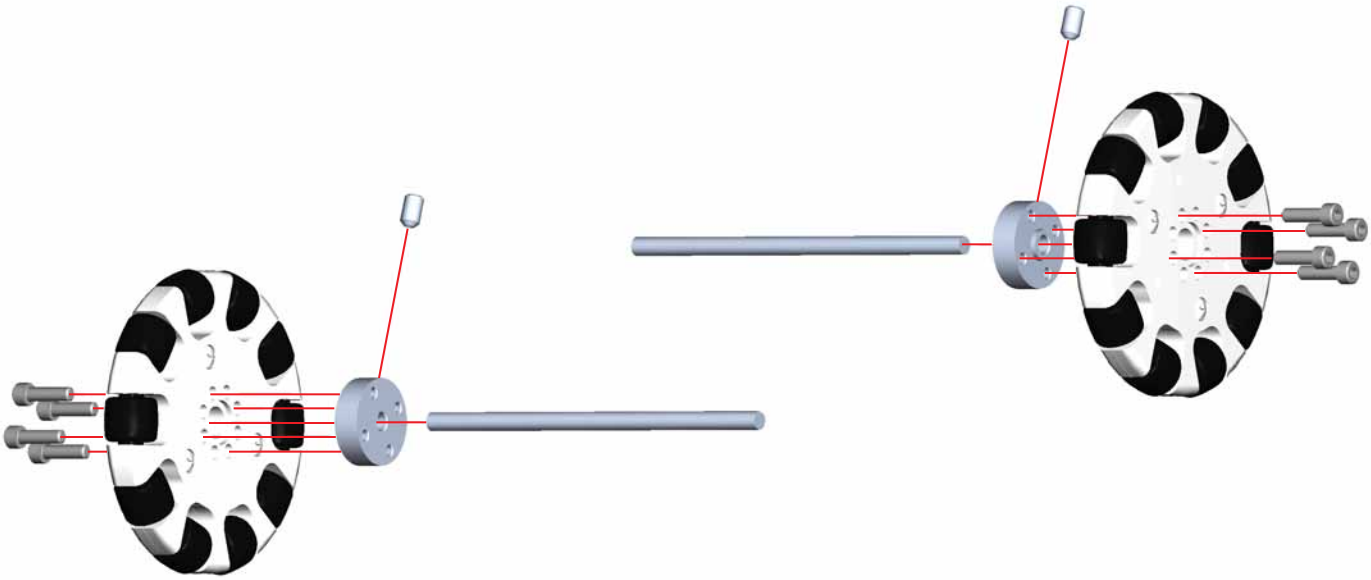
Parts Needed


2x Omni Wheel


2x Axle Hub


2x 100 mm Shaft


8x 1/2" SHCS



Tips

- Make sure to use the appropriate hub. The axle hub is smaller than the motor shaft hub.
- Use the 3/32" hex key for the axle hub.

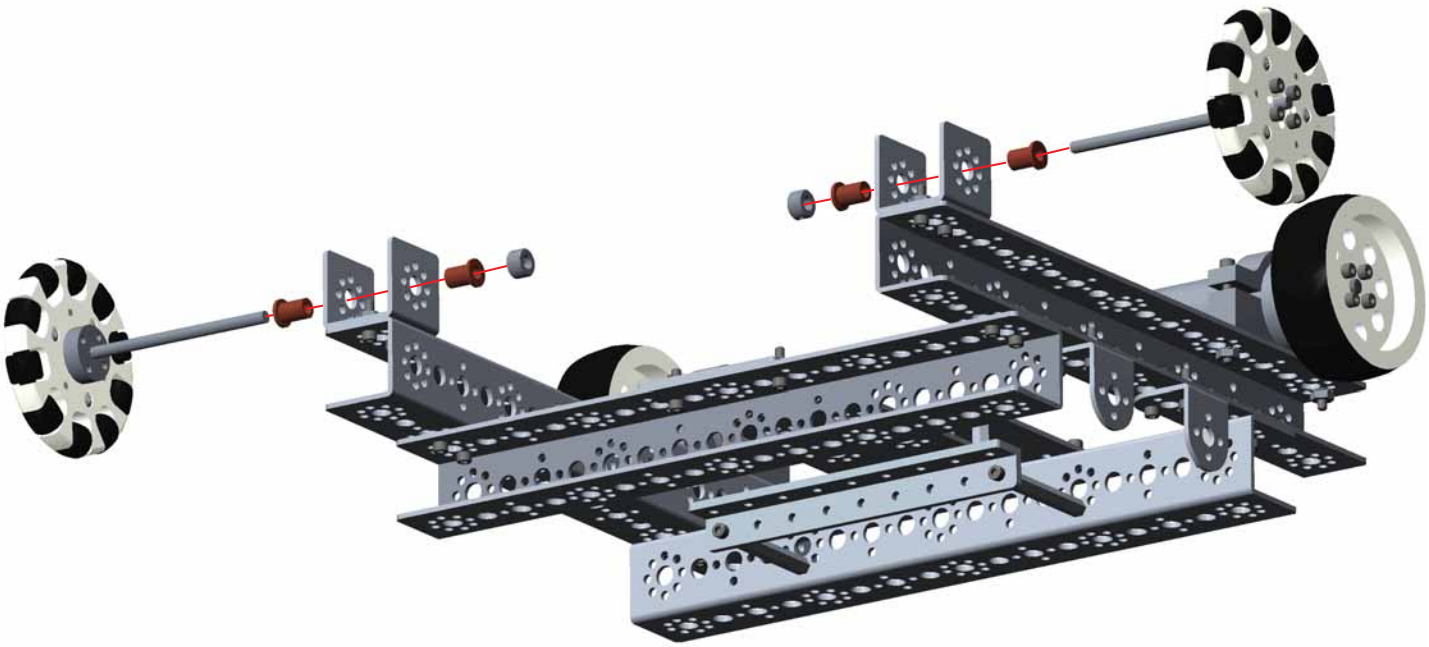
Lesson 2: Ranger Bot Movement Building Guide

Step 4

Parts Needed

4x Bronze Bushing

2x Shaft Collar



Tip

- Depending on the TETRIX® set, use either the 1/16" or 5/64" hex key for the shaft collar set screw.

Lesson 2: Ranger Bot Movement Building Guide

Step 5

Parts Needed


1x NXT Rechargeable Battery

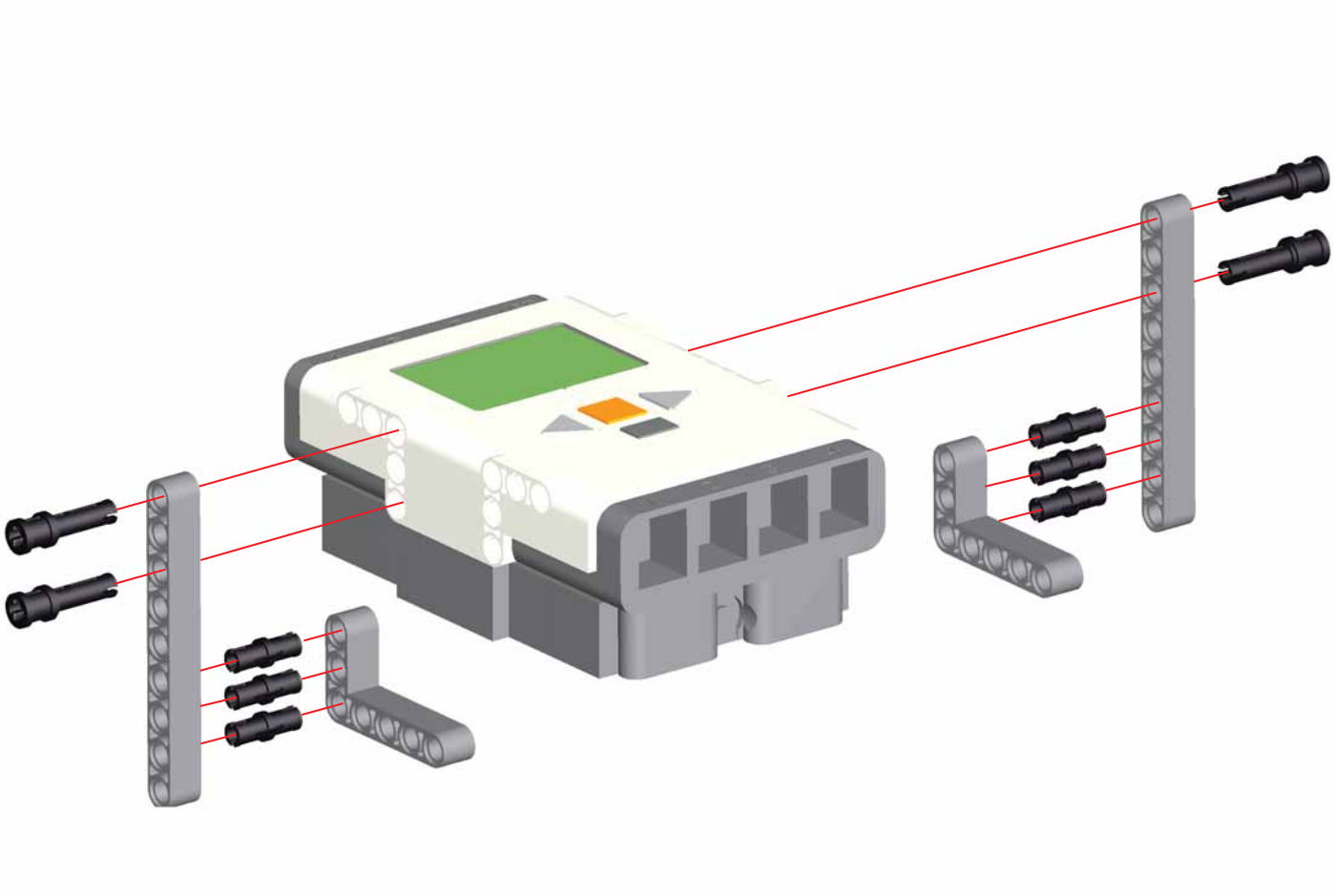

1x NXT


2x 3 x 5-Module Angular Beam


2x 9-Module Beam


4x Connector Peg with Bushing


6x Connector Peg with Friction



Tip

- Make sure that the NXT rechargeable battery has been attached to the NXT brick.

Lesson 2: Ranger Bot Movement Building Guide

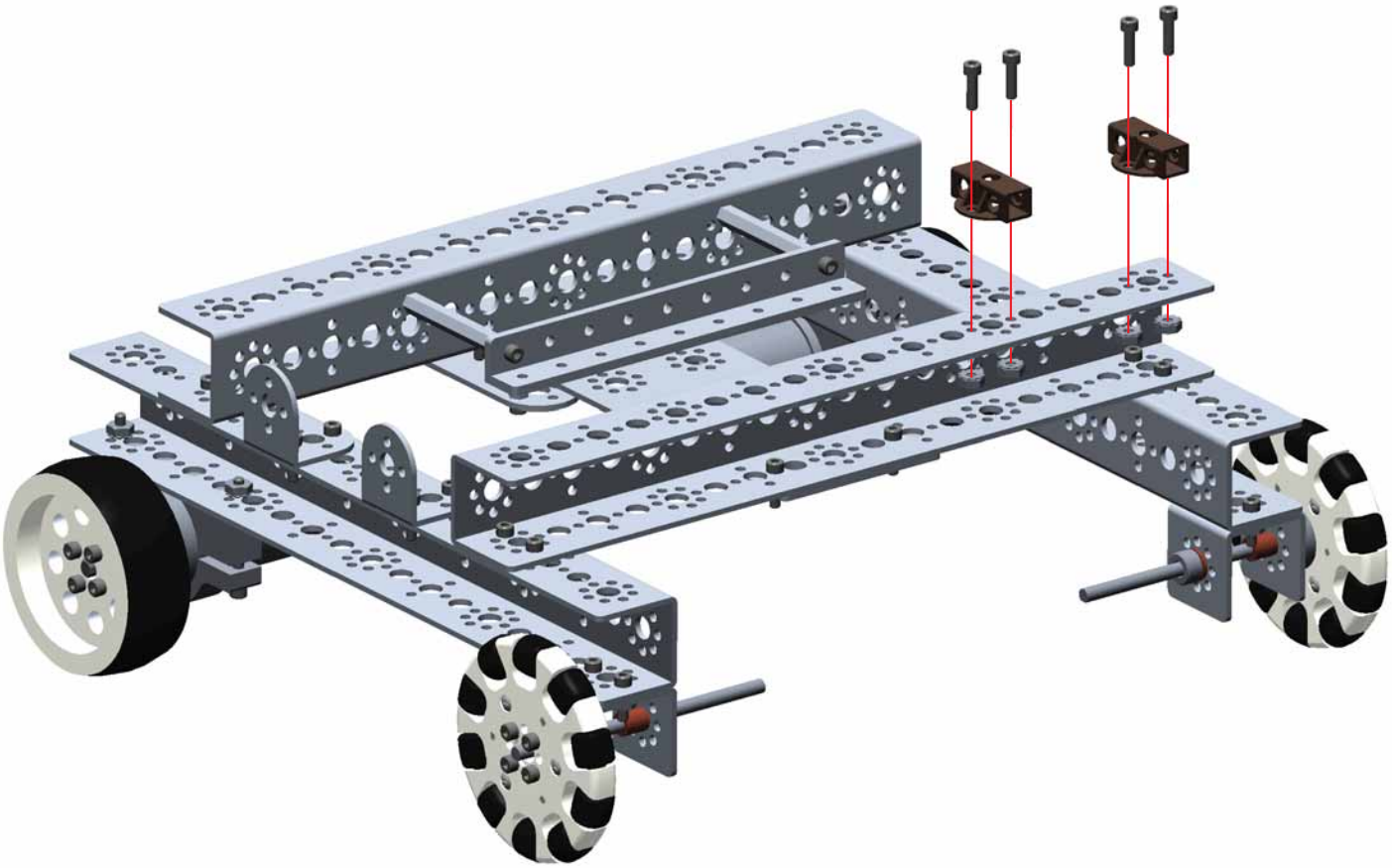
Step 6

Parts Needed

2X TETRIX® Hard Point Connector

4x 5/16" SHCS

4x Kep Nut



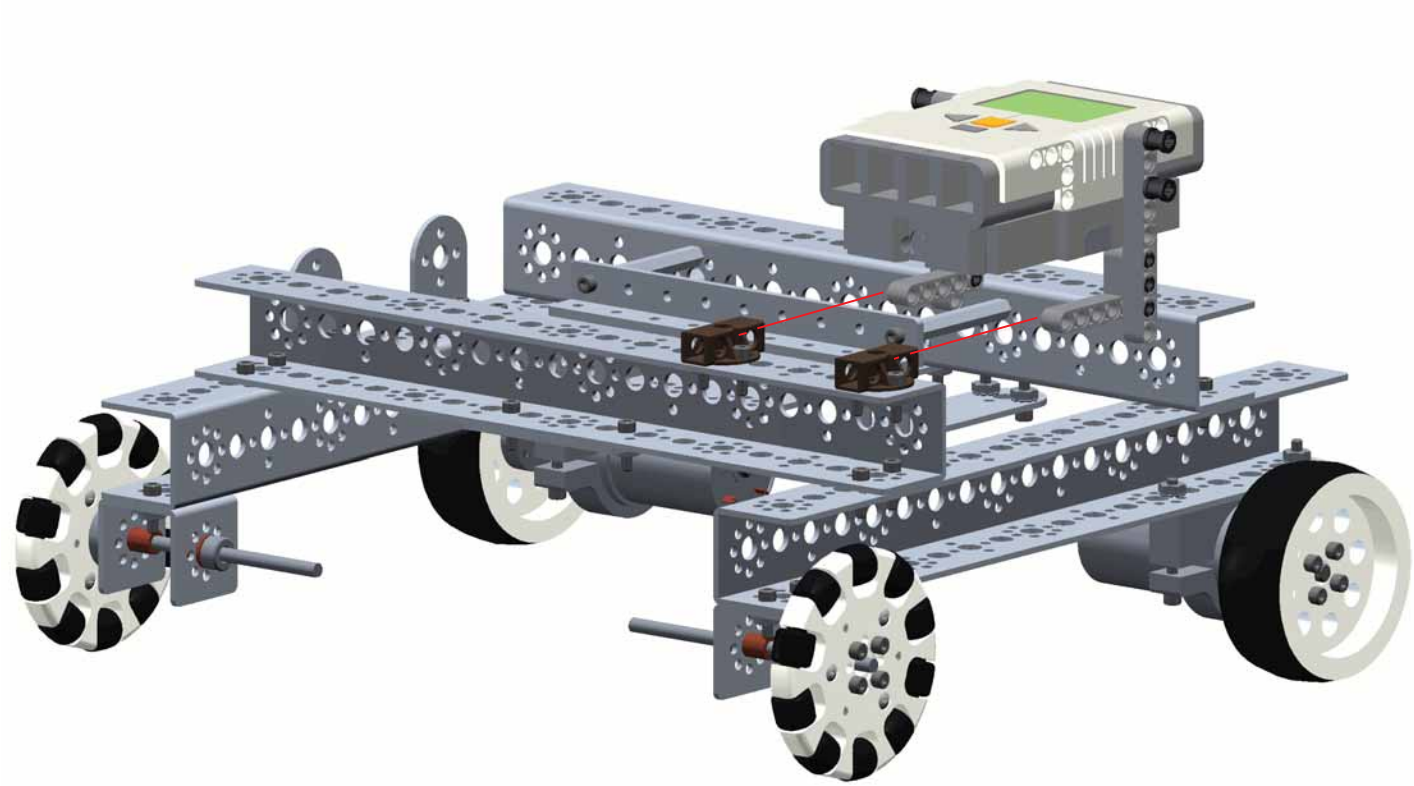
Tips

⚠ Turn the screws only until the hard point connectors are securely attached to the TETRIX channels.

- Remember: Ensure that the teeth of the nut face the head of the screw.

Lesson 2: Ranger Bot Movement Building Guide

Step 7

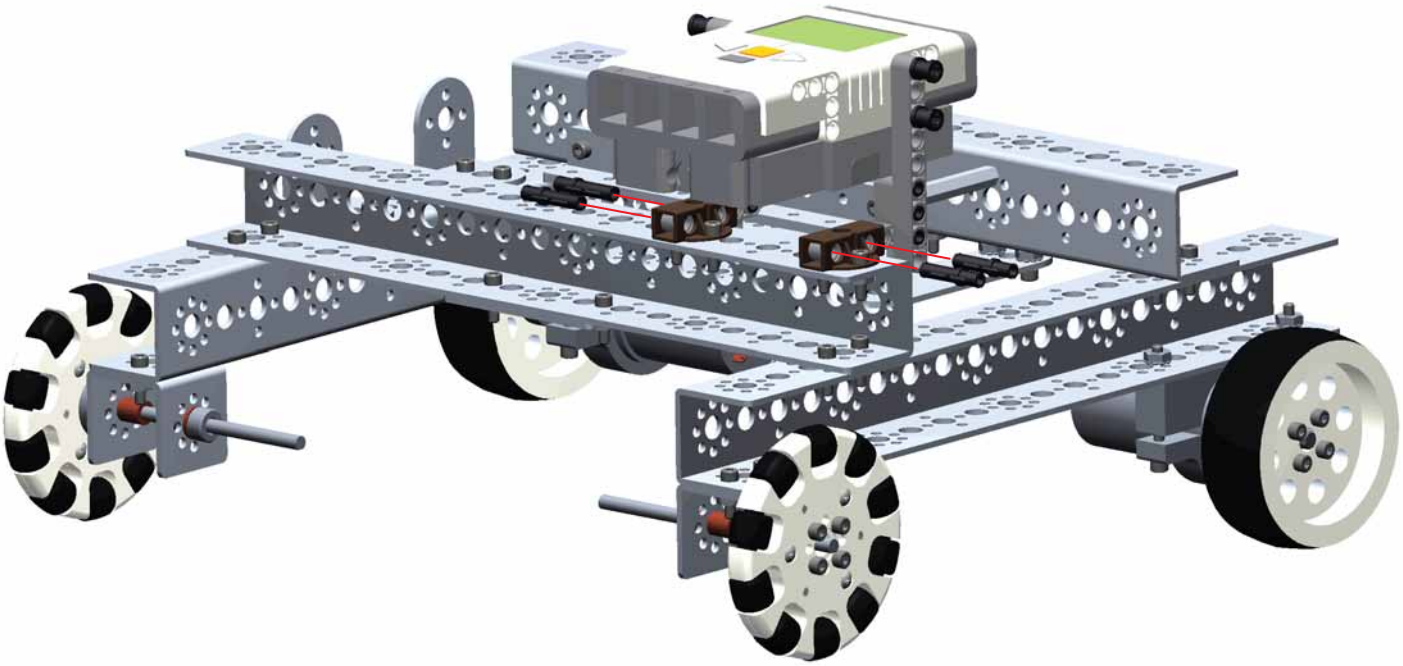


Lesson 2: Ranger Bot Movement Building Guide

Step 8

Parts Needed

4x 3-Module Connector Peg
with Friction



Lesson 2: Ranger Bot Movement Building Guide

Step 9

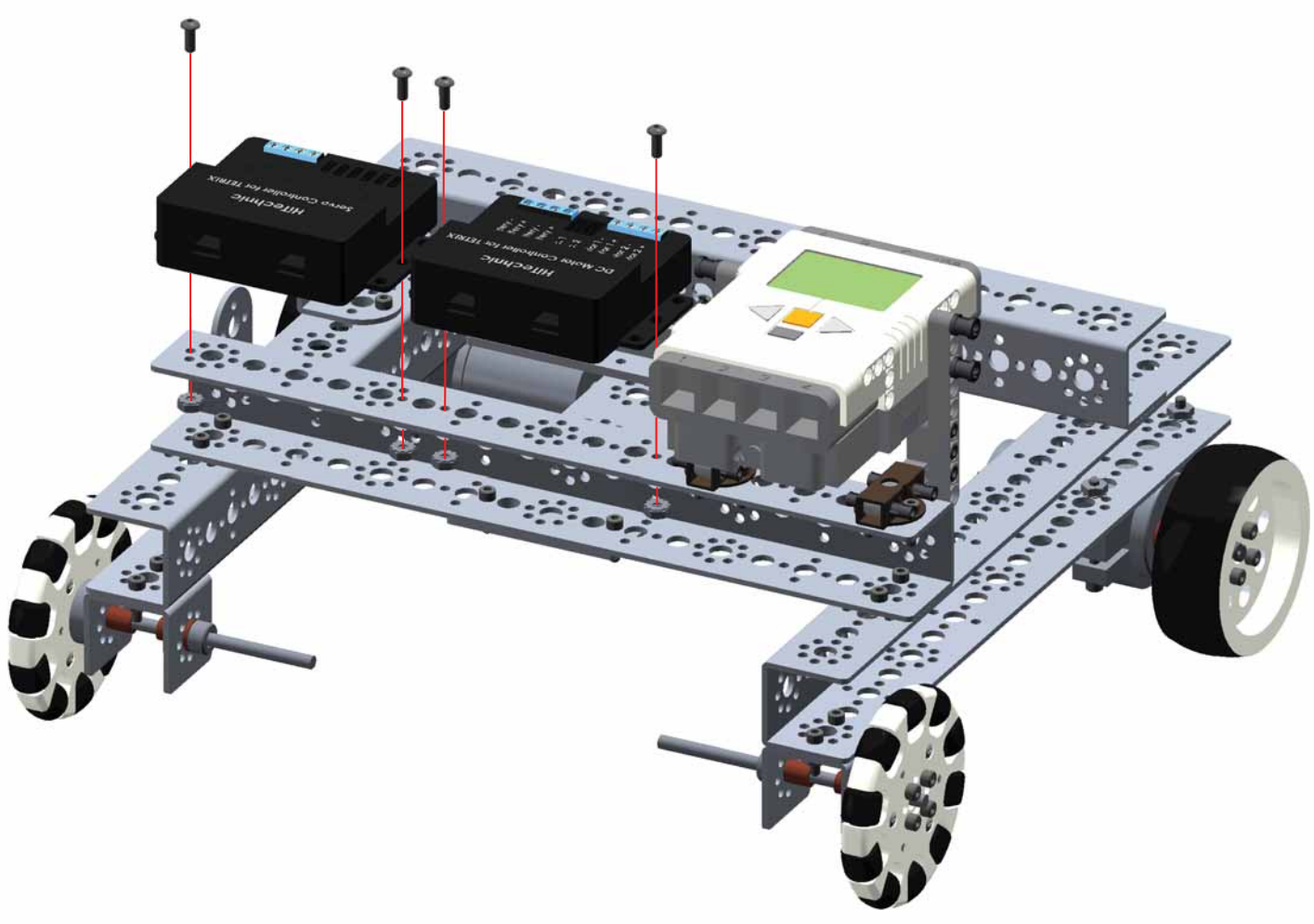
Parts Needed

1x HiTechnic DC Motor Control

1x HiTechnic Servo Controller

4x 3/8" BHCS

4x Kep Nut



Tips

- The motor controllers are attached using the button head cap screws. Use the 5/64" hex key for these screws.
- Tighten the screws only until the controllers are securely attached.
- Ensure that the teeth of the nut face the head of the screw.

Lesson 2: Ranger Bot Movement Building Guide

Step 10

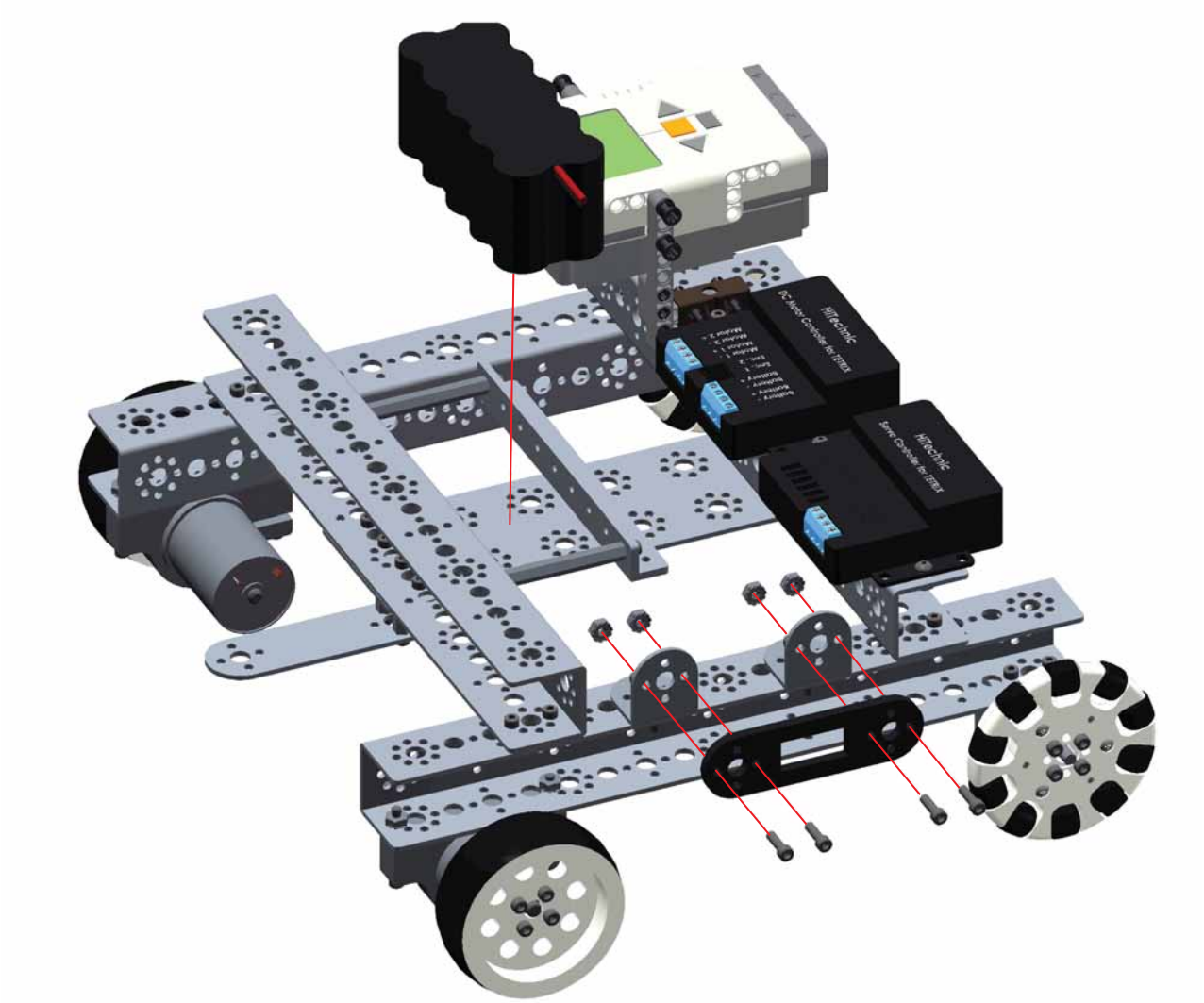
Parts Needed


1x 12V Rechargeable Battery Pack


1x Bracket Switch Mount


4x 1/2" SHCS


4x Kep Nut



Tip

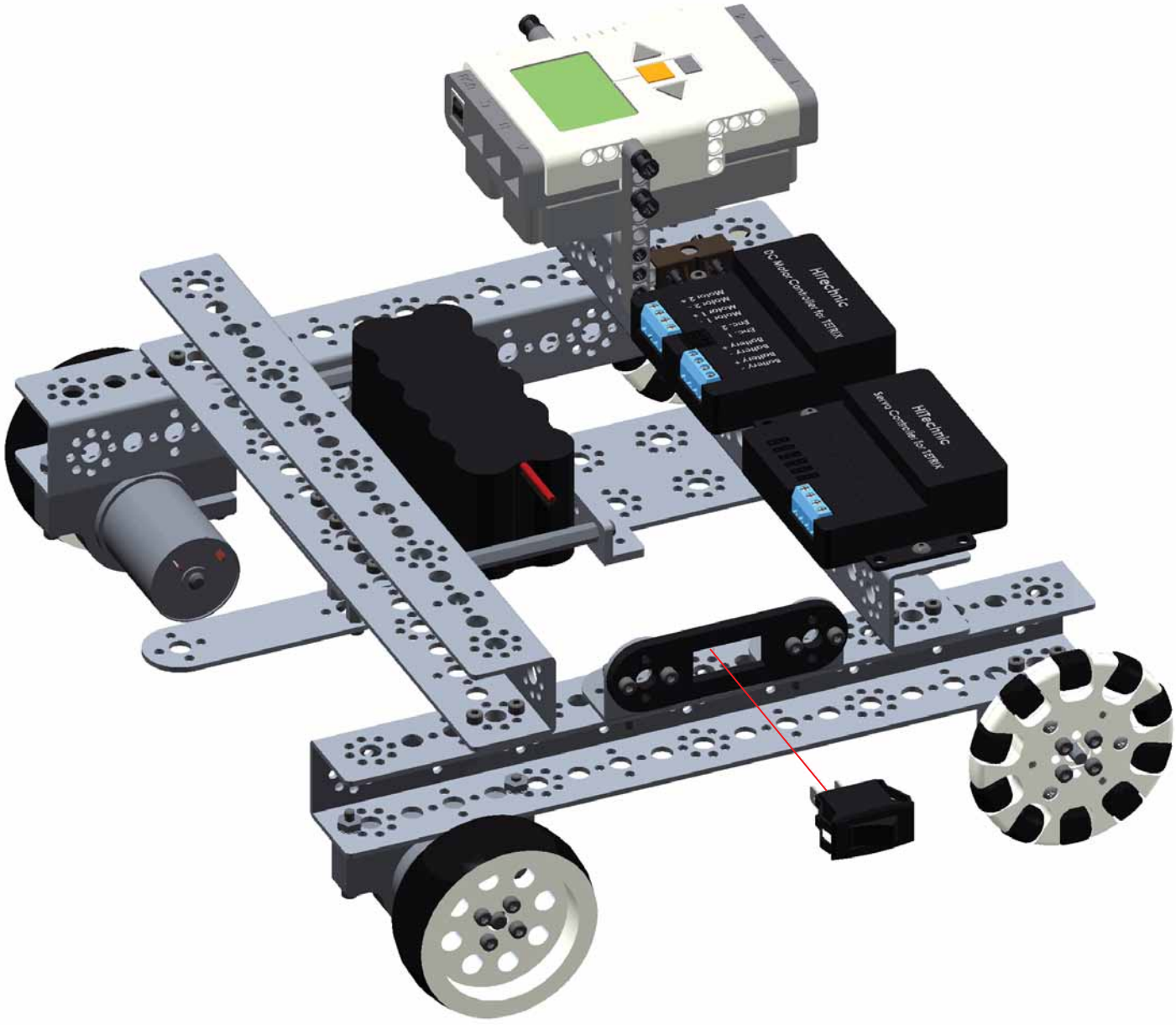
- Ensure that the teeth of the nut face the head of the screw.

Lesson 2: Ranger Bot Movement Building Guide

Step 11

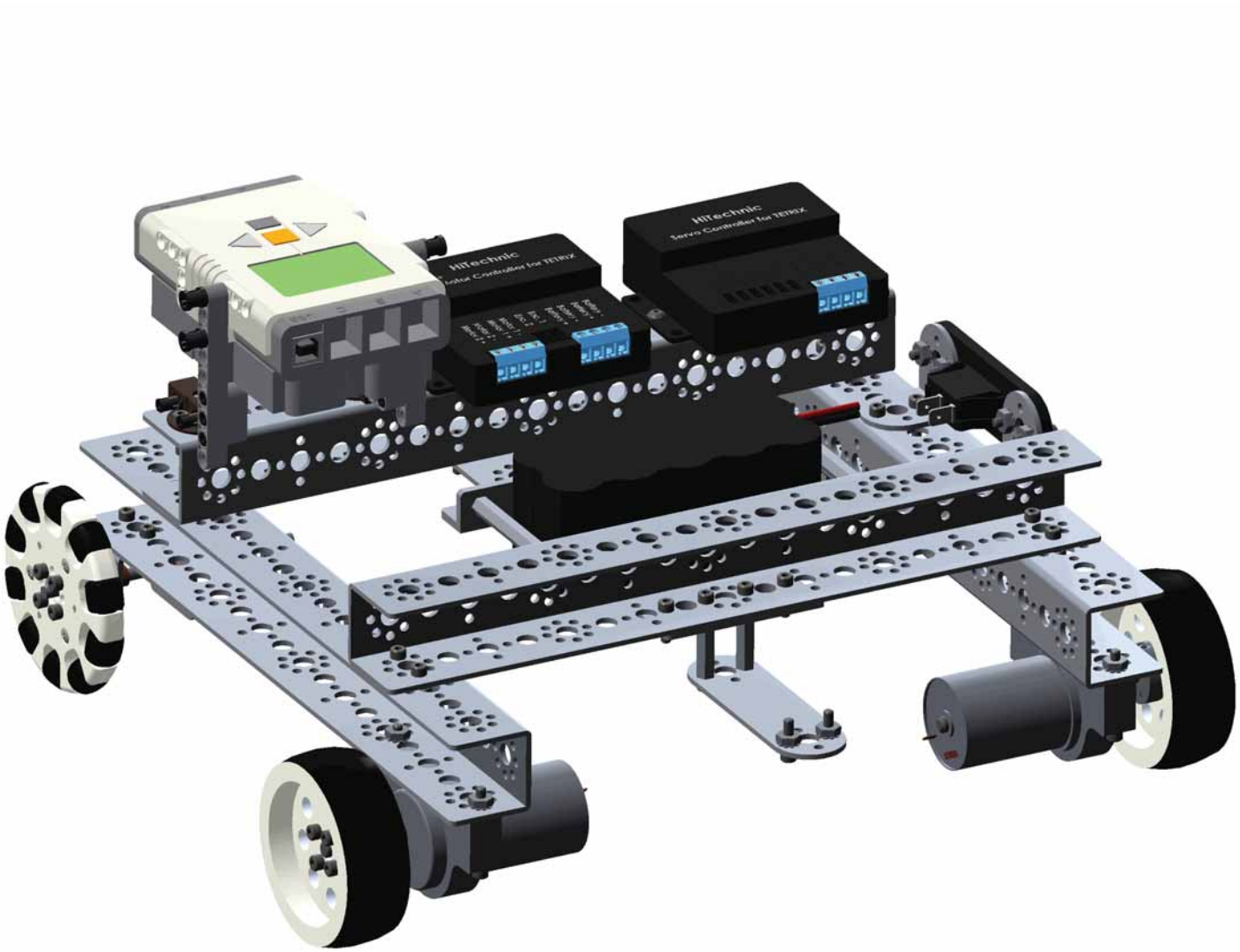
Parts Needed

1x On/Off Switch



Lesson 2: Ranger Bot Movement Building Guide

Final View



Lesson 3: Ranger Bot Sensors Building Guide

Step 1

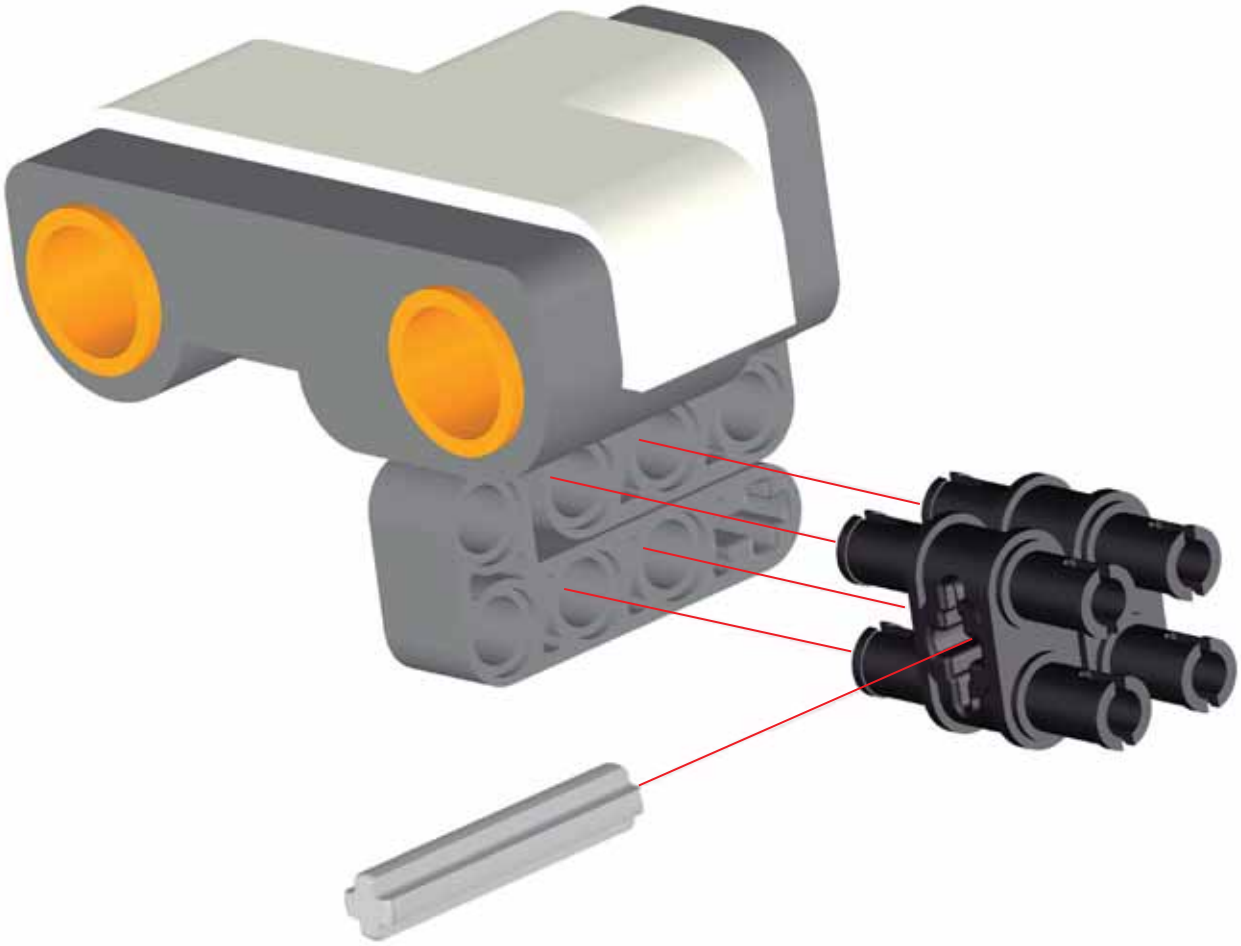
Parts Needed

1x NXT Ultrasonic Sensor

1x 4 x 2-Module Angular Beam

2x 2-Module Double Connector Peg

1x 3-Module Axle



Tip

- Only the 7/64" hex key is necessary while building this model.

Lesson 3: Ranger Bot Sensors Building Guide

Step 2

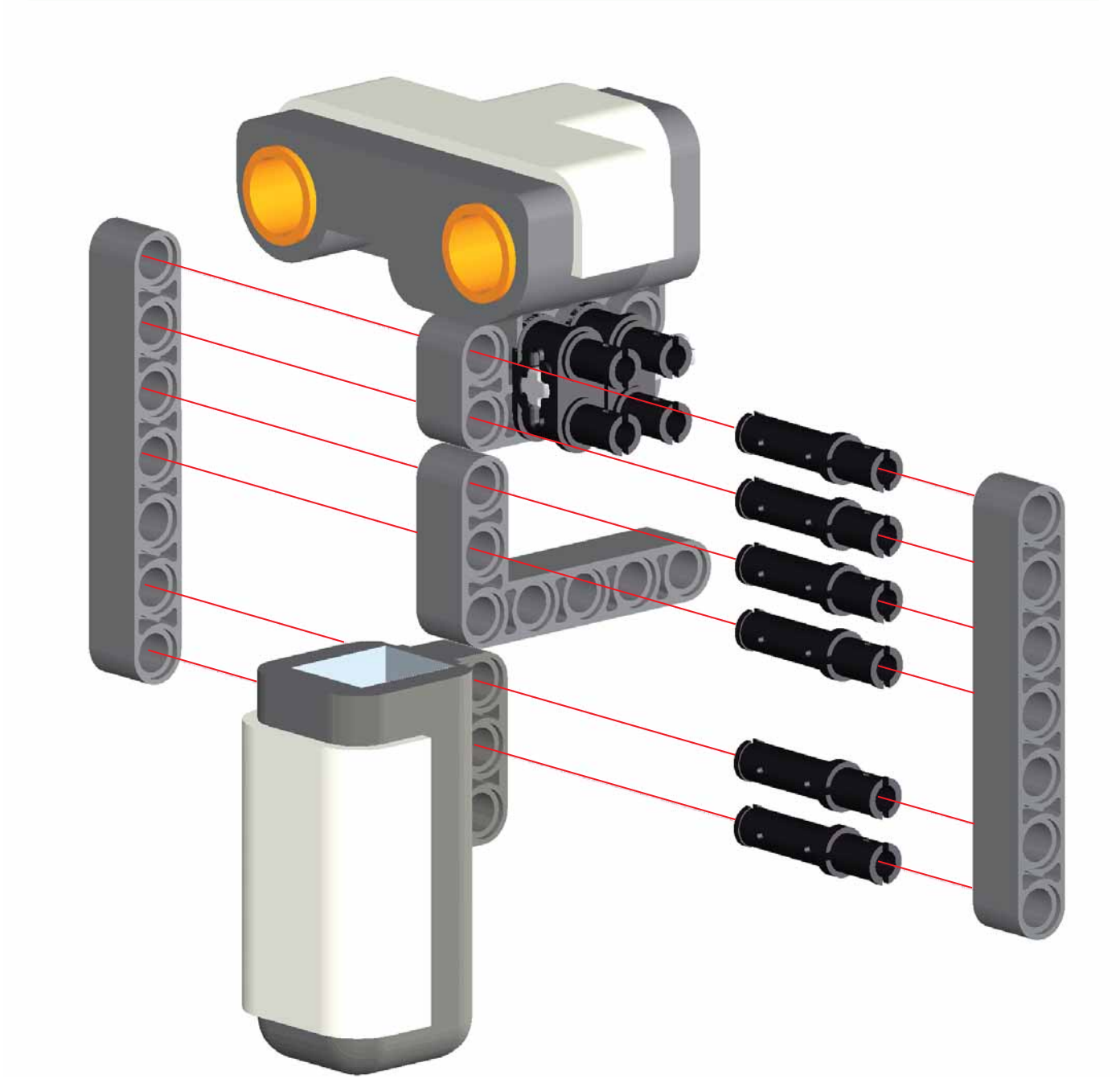
Parts Needed


1x NXT Light Sensor


1x 3 x 5-Module Angular Beam


6x 3-Module Connector Peg with Friction


2x 7-Module Beam



Lesson 3: Ranger Bot Sensors Building Guide

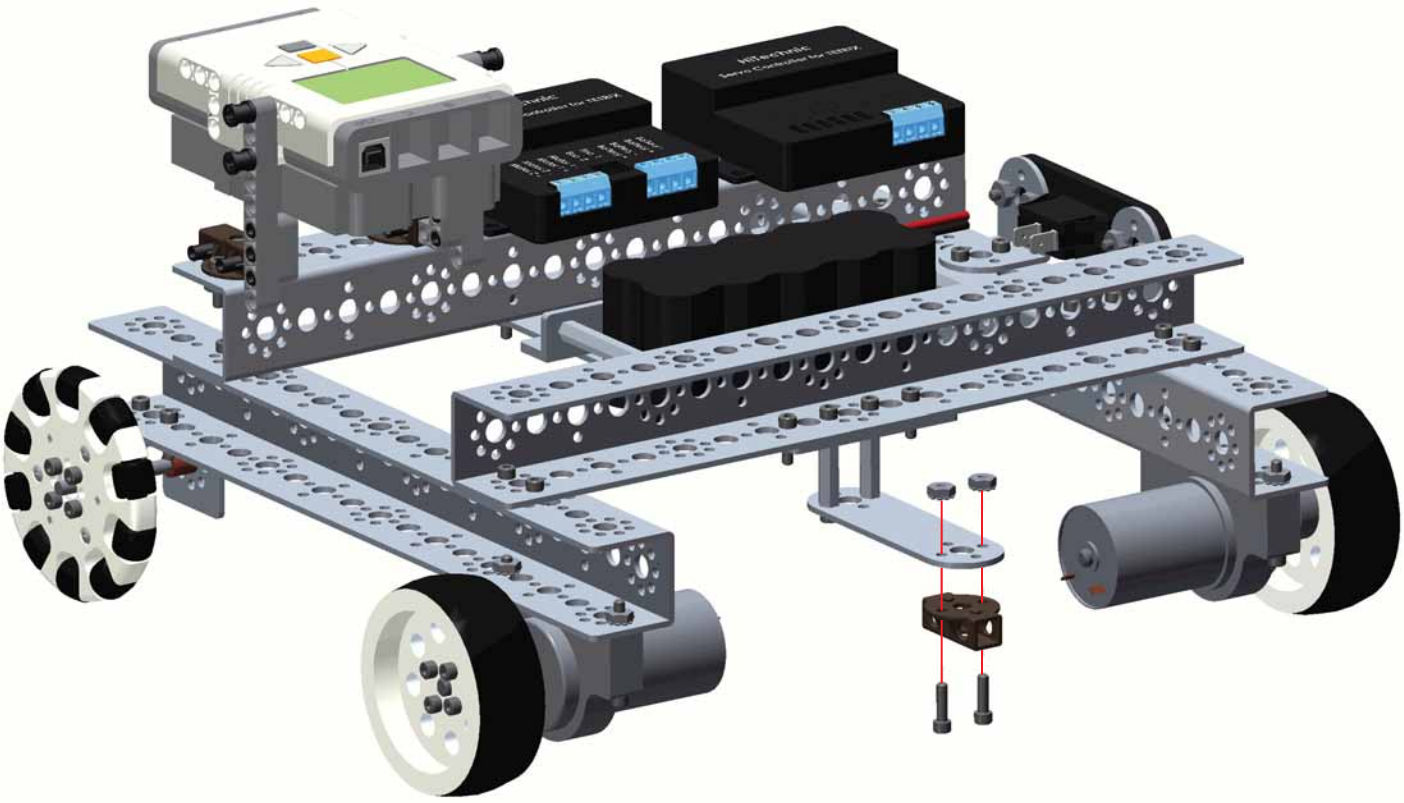
Step 3

Parts Needed

1x TETRIX® Hard Point Connector

2x 5/16" SHCS

2x Kep Nut

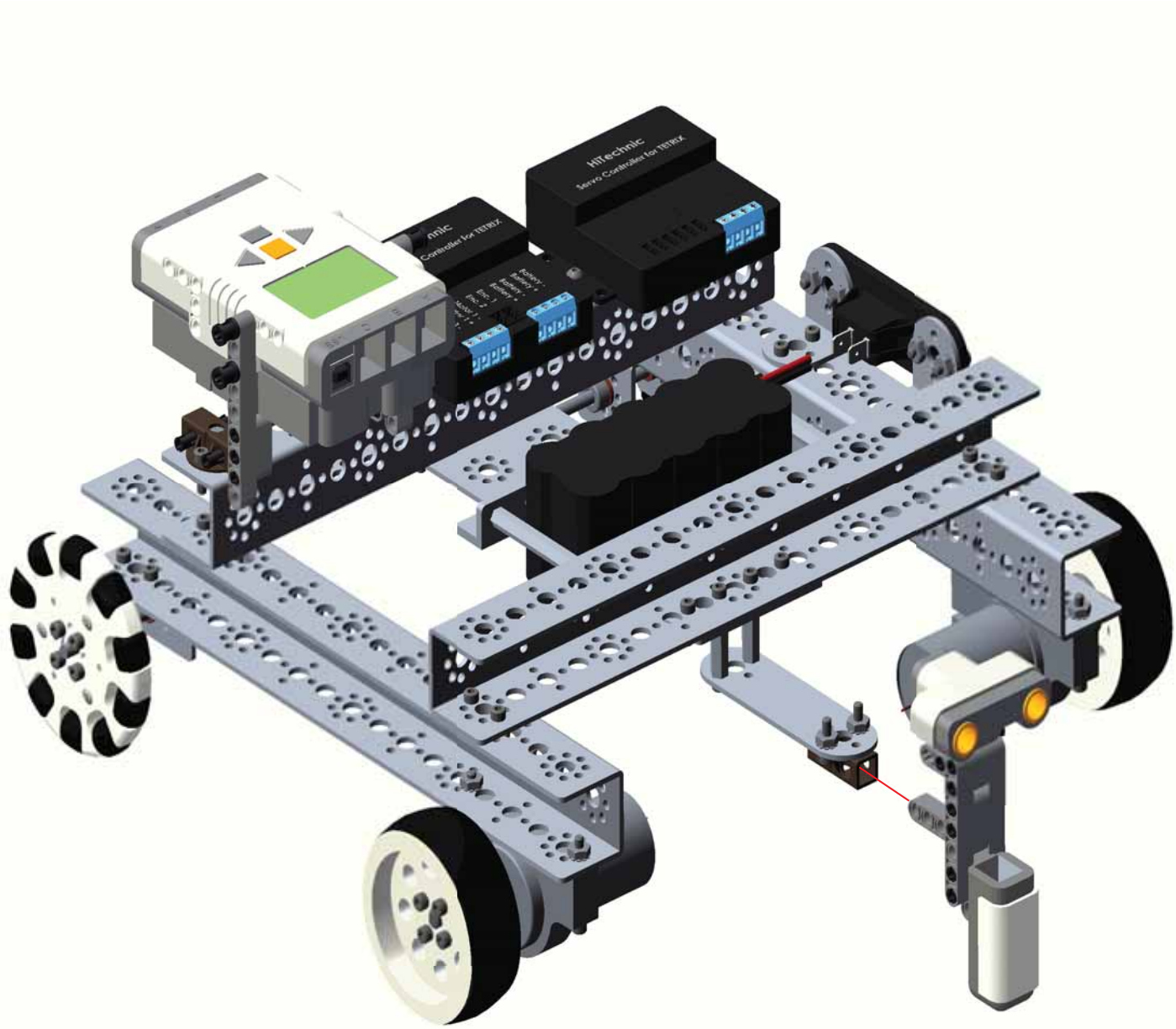


Tip

⚠ Turn the screws only until the hard point connector is securely attached to the TETRIX channels.

Lesson 3: Ranger Bot Sensors Building Guide

Step 4

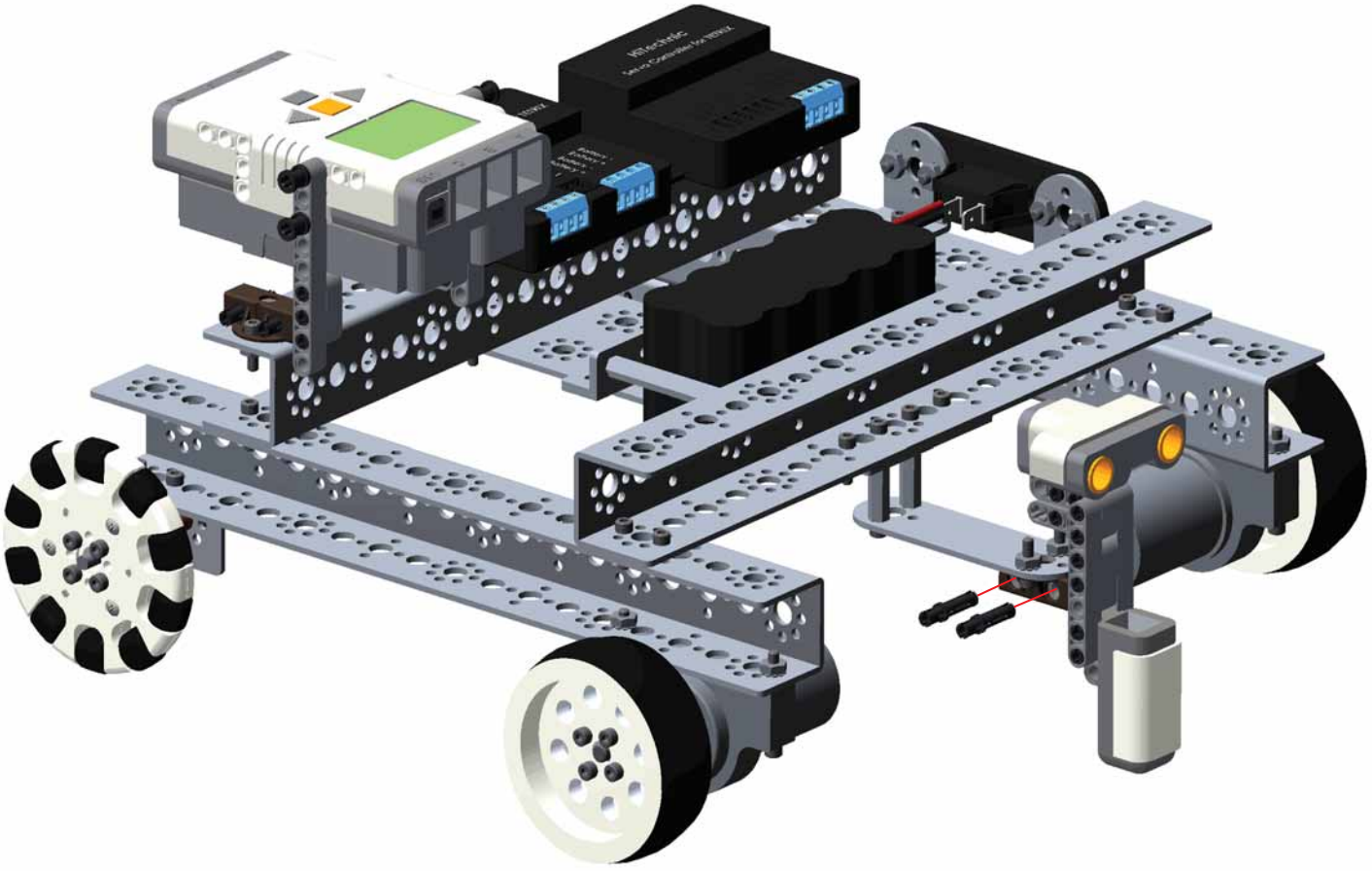


Lesson 3: Ranger Bot Sensors Building Guide

Step 5

Parts Needed

2x 3-Module Connector
Peg with Friction



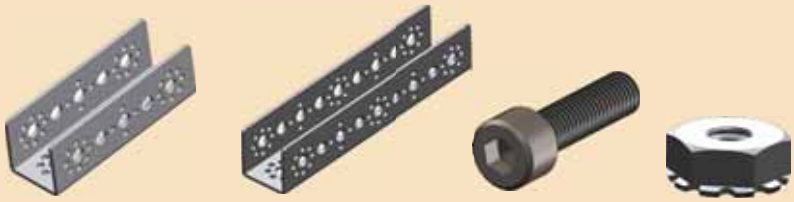
Lesson 3: Ranger Bot Sensors Building Guide

Final View

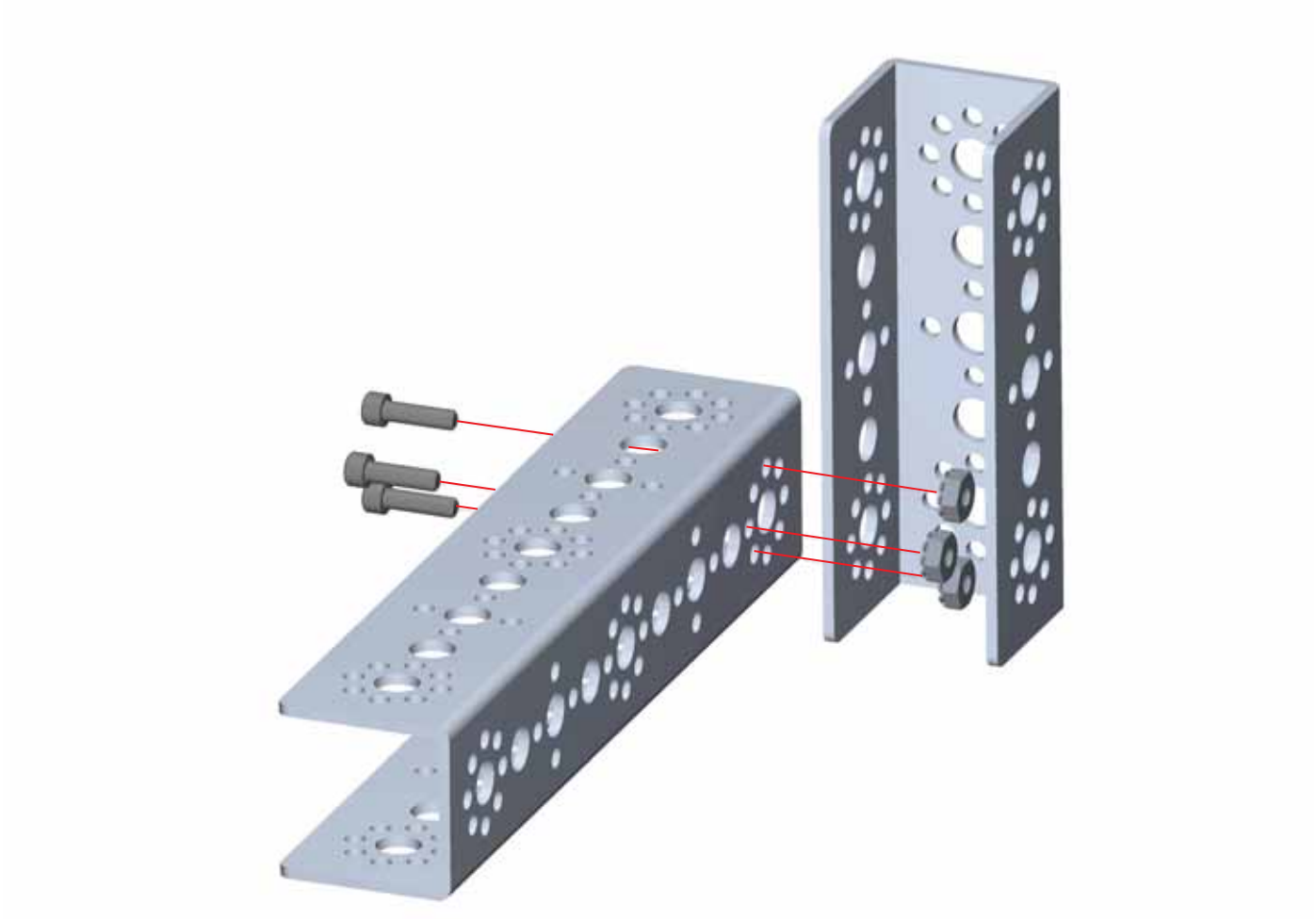
Arm and Gripper Building Guide

Step 1

Parts Needed



1x 96 mm Channel | 1x 160 mm Channel | 3x 1/2" SHCS | 3x Kep Nut



Tips

- Make sure all the internal screws are very secure, as they will be hard to retighten later.
- The 7/64", 5/64" and 3/32" hex keys will be needed to build this model.
- Use the 7/64" hex key for these screws throughout the model.
- Ensure that the teeth of the nut face the head of the screw.

Arm and Gripper Building Guide

Step 2

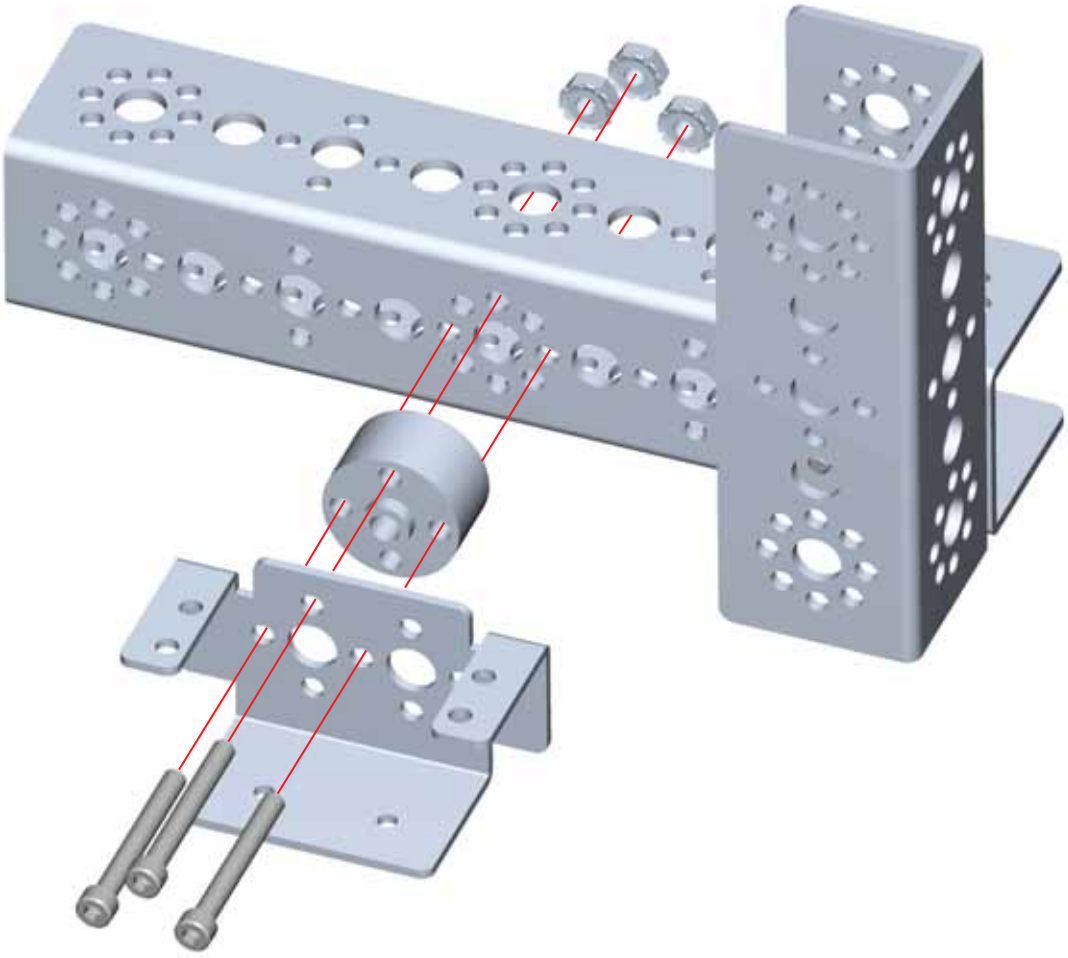
Parts Needed


1x Single-Servo Motor Bracket


1x Gear Hub Spacer


3x Kep Nut


3x 1.5" SHCS



Tips

- Ensure that all screws are tightly secured at this point, as they will not be easily accessible later.
- Reminder: Ensure that the teeth of the nut face the head of the screw.

Arm and Gripper Building Guide

Step 3

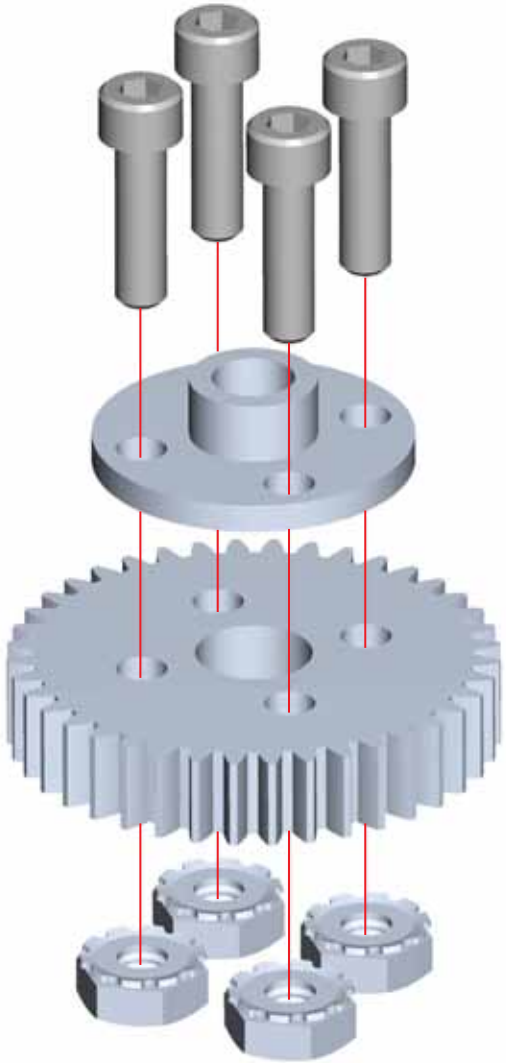
Parts Needed


1x 40-Tooth Gear


1x Servo Horn


4x 1/2" SHCS


4x Kep Nut



Tip

- Ensure that the teeth of the nuts are facing the gear.

Arm and Gripper Building Guide

Step 4

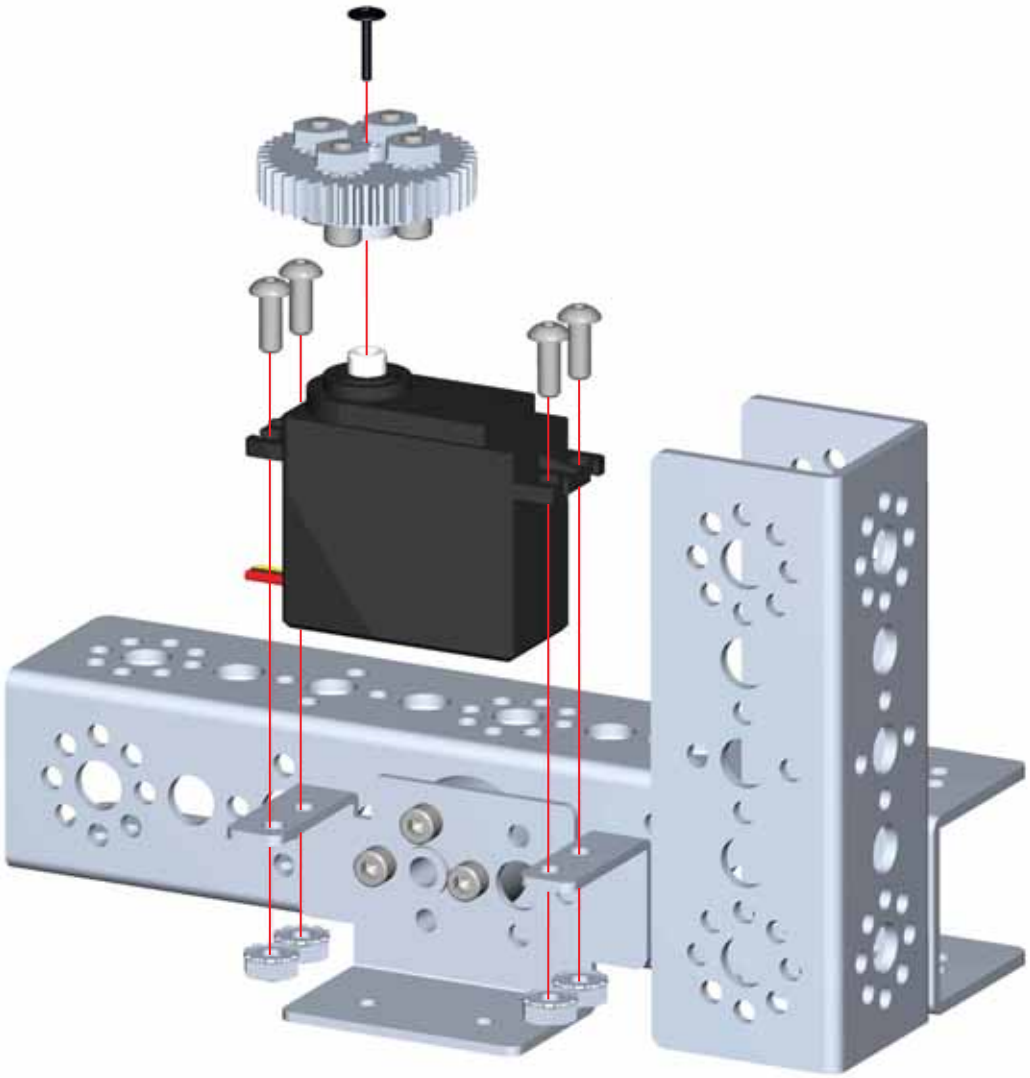
Parts Needed


1x 180° Servo Motor


4x 3/8" BHCS


4x Kep Nut


1x Servo Screw



Tips

- Use the Phillips head on the 4-in-1 screwdriver to tighten the servo screw. This will keep the servo horn attached to the servo motor.
- Use the 5/64" hex key for the BHCS.

Arm and Gripper Building Guide

Step 5

Parts Needed


1x 80-Tooth Gear

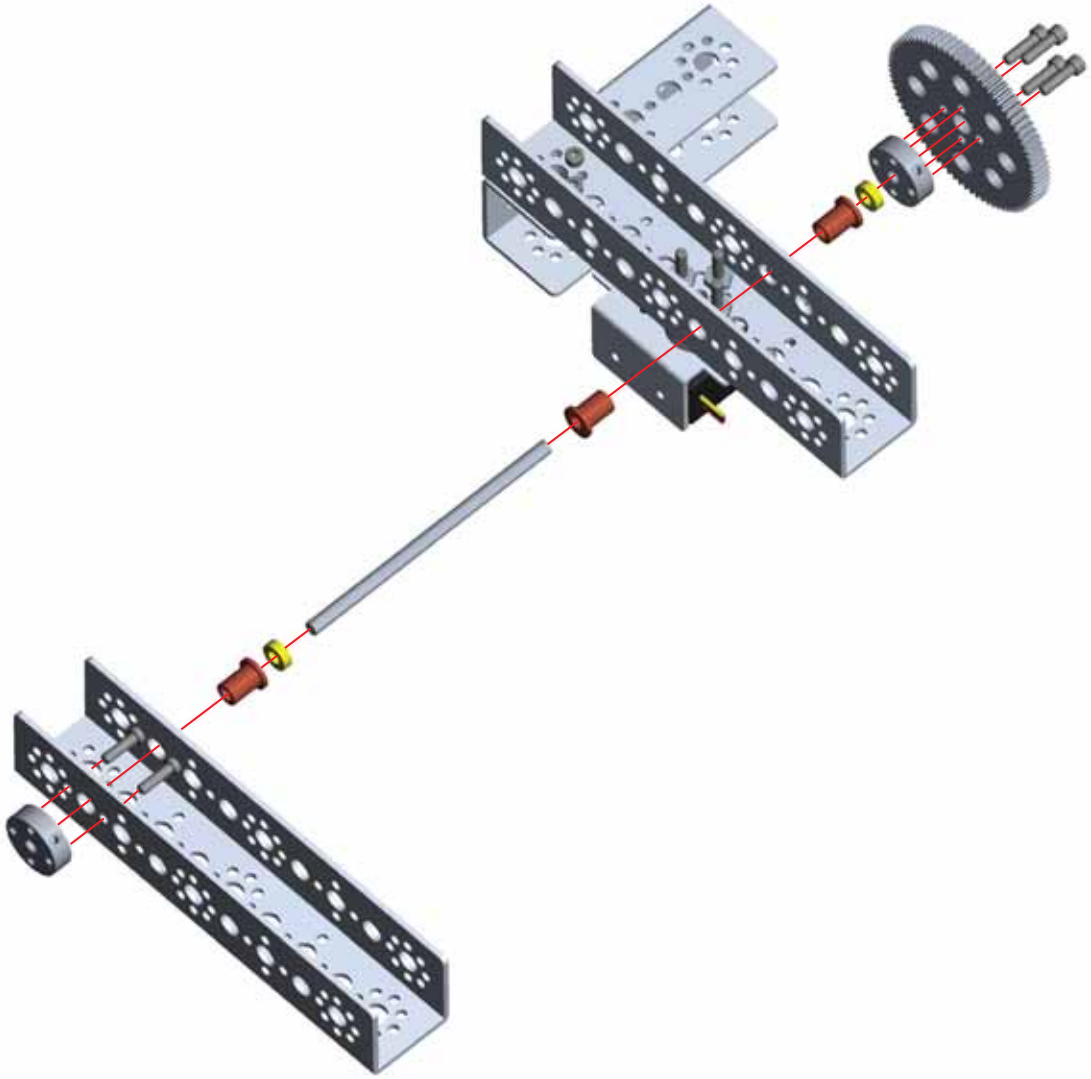

1x 100 mm Axle


2x Axle Hub


3x Bronze Bushing


2x 1/8" Axle Spacer


6x 1/2" SHCS



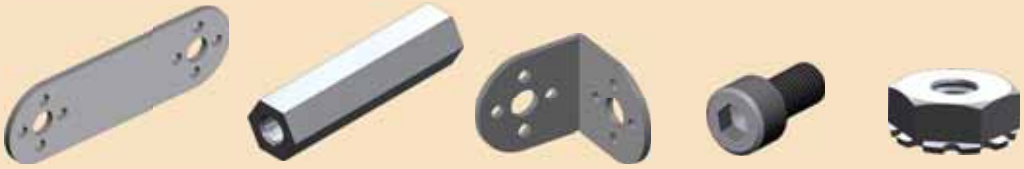
Tip

- The 3/32" hex key is used on the axle hubs.

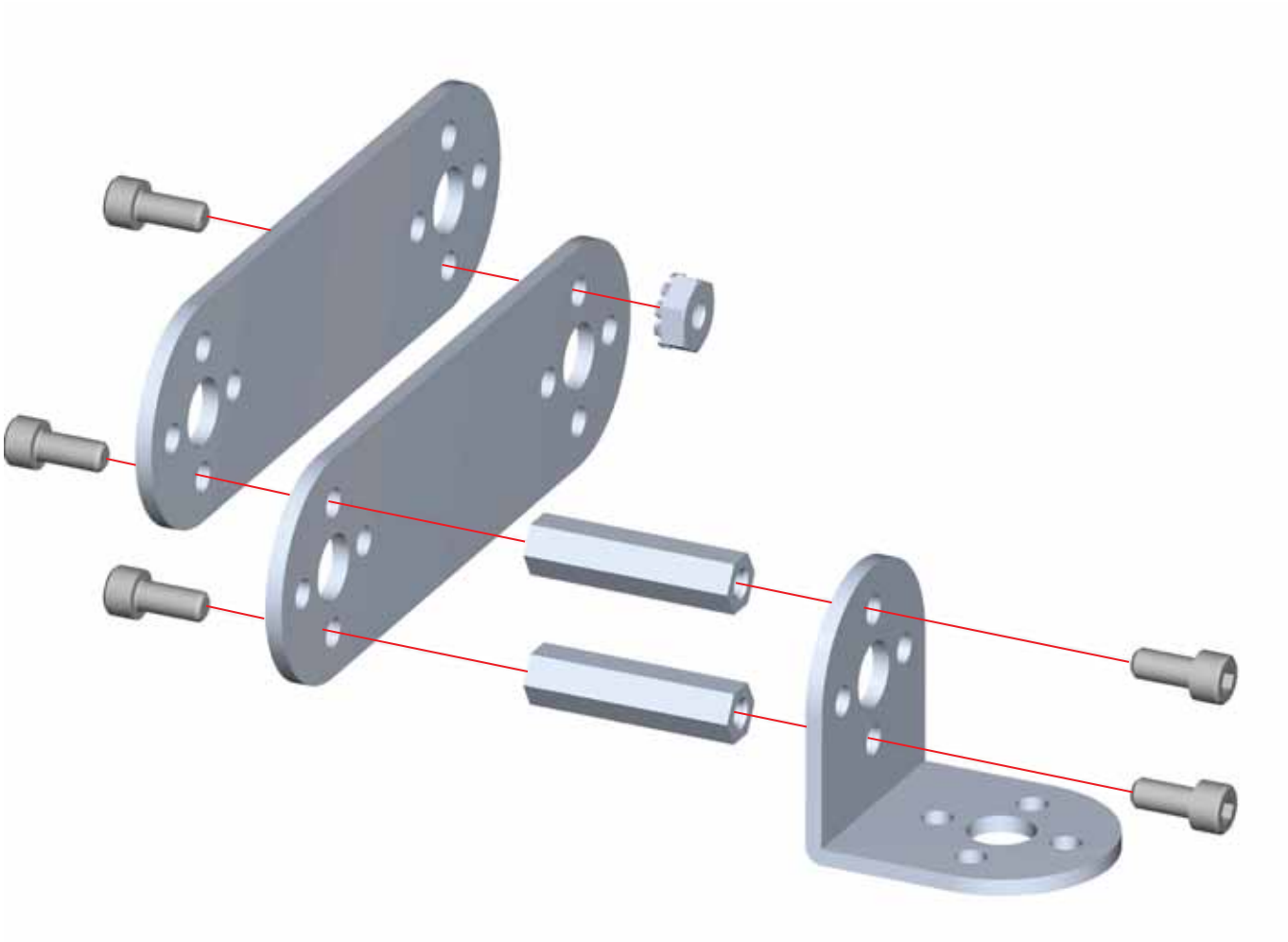
Arm and Gripper Building Guide

Step 6

Parts Needed



2x Flat Bracket | 2x 1" Stand-Off Post | 1x L Bracket | 5x 5/16" SHCS | 1x Kep Nut



Tip

- Reminder: Ensure that the teeth of the nut face the head of the screw.

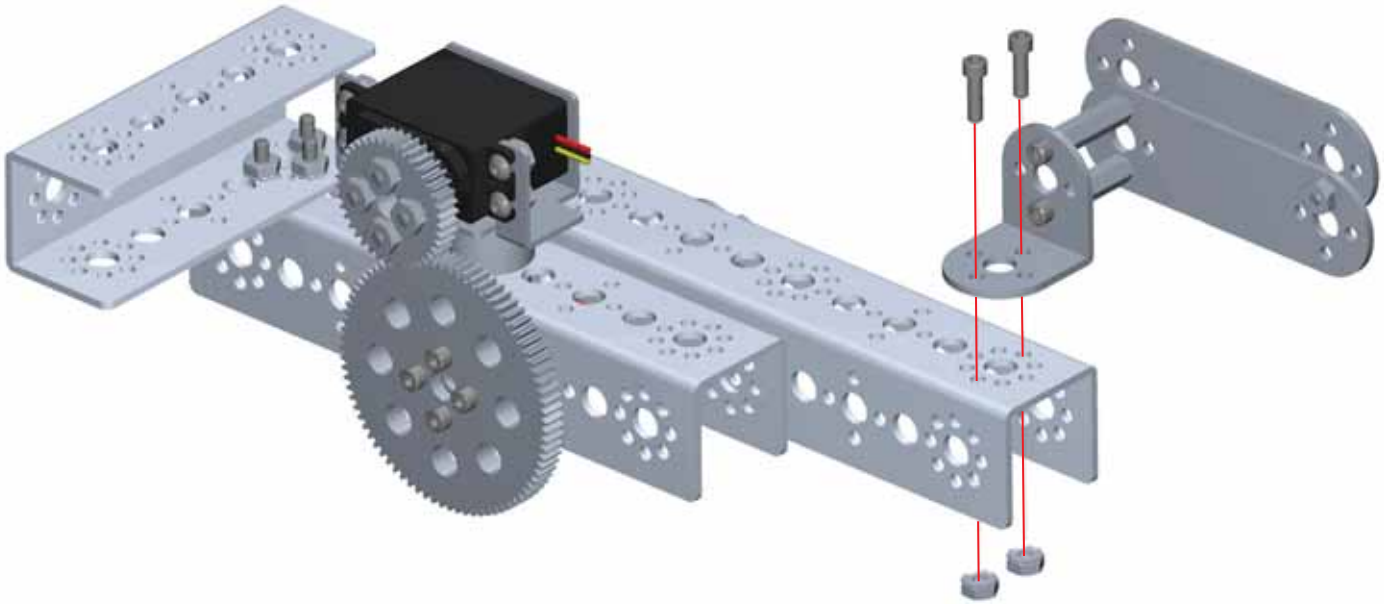
Arm and Gripper Building Guide

Step 7

Parts Needed

2x 1/2" SHCS

2x Kep Nut



Tip

- Reminder: Ensure that the teeth of the nut face the head of the screw.

Arm and Gripper Building Guide

Step 8

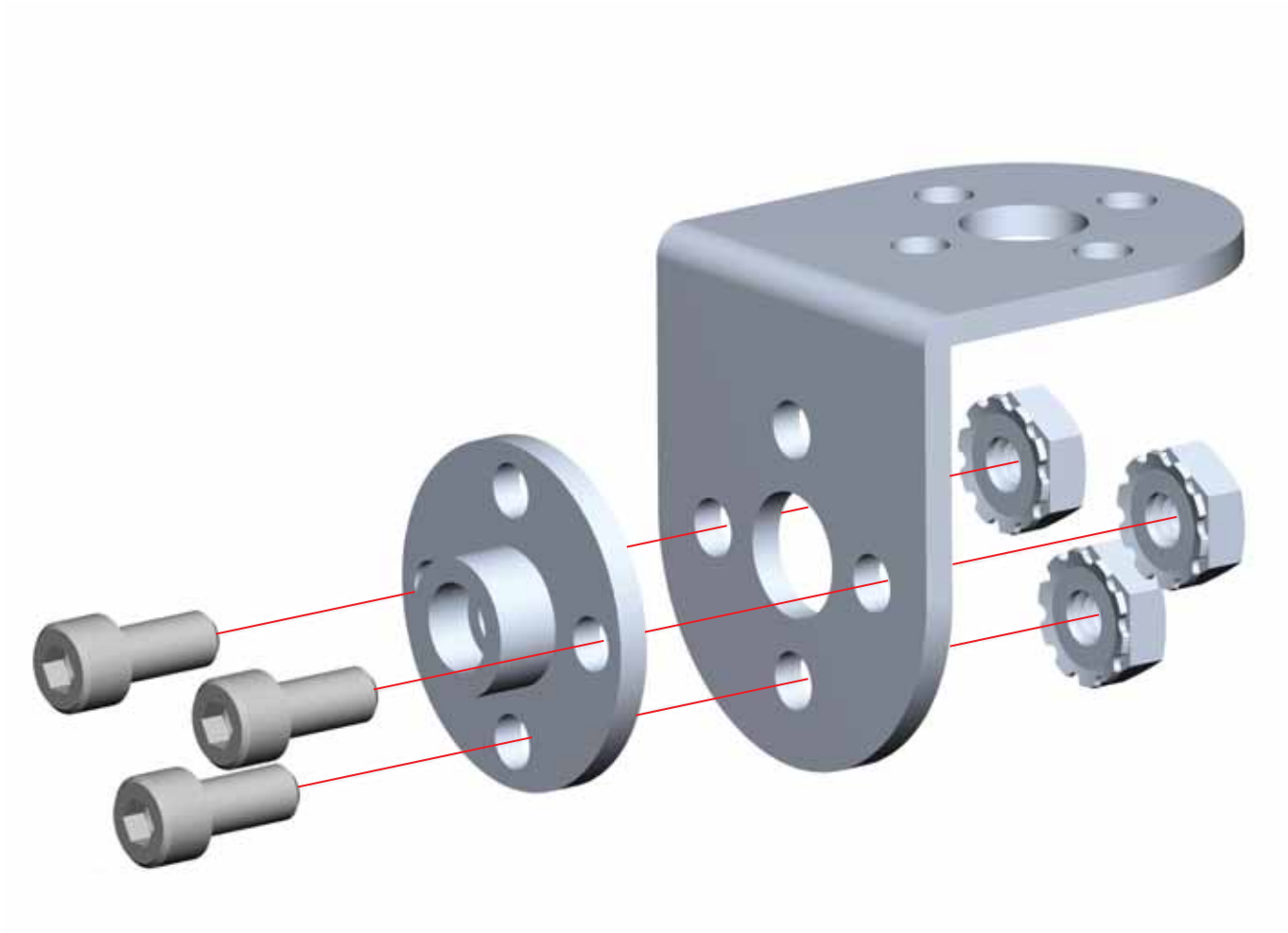
Parts Needed


1x L Bracket


1x Servo Horn


3x 5/16" SHCS


3x Kep Nut



Tip

- Reminder: Ensure that the teeth of the nut face the head of the screw.

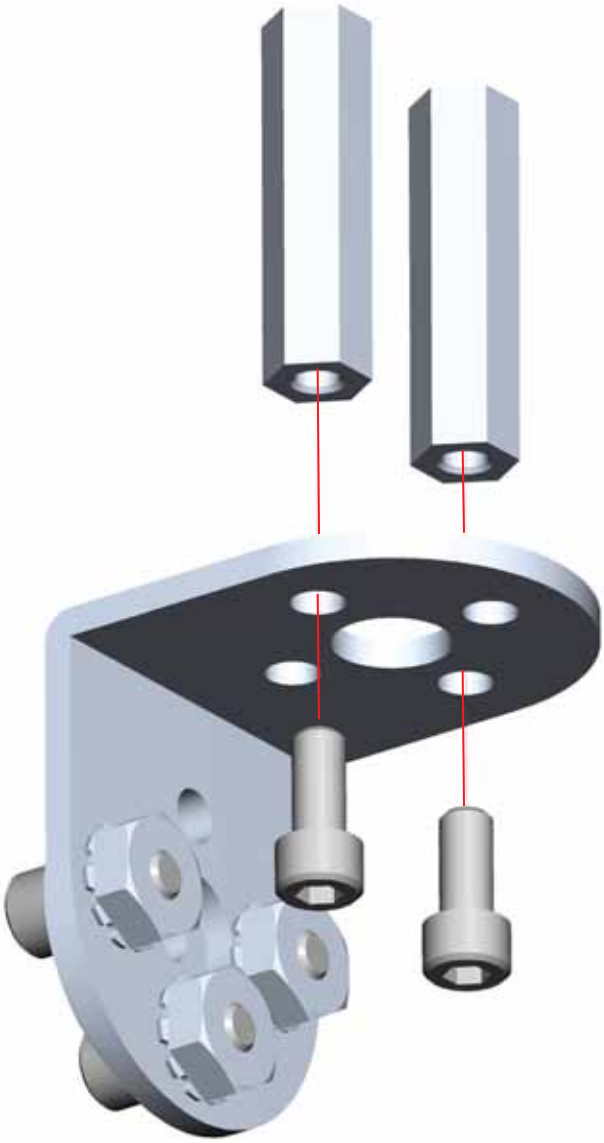
Arm and Gripper Building Guide

Step 9

Parts Needed

2x 1" Stand-Off Post

2x 5/16" SHCS

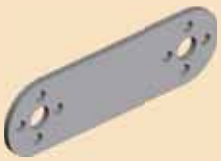


Arm and Gripper Building Guide

Step 10

Parts Needed

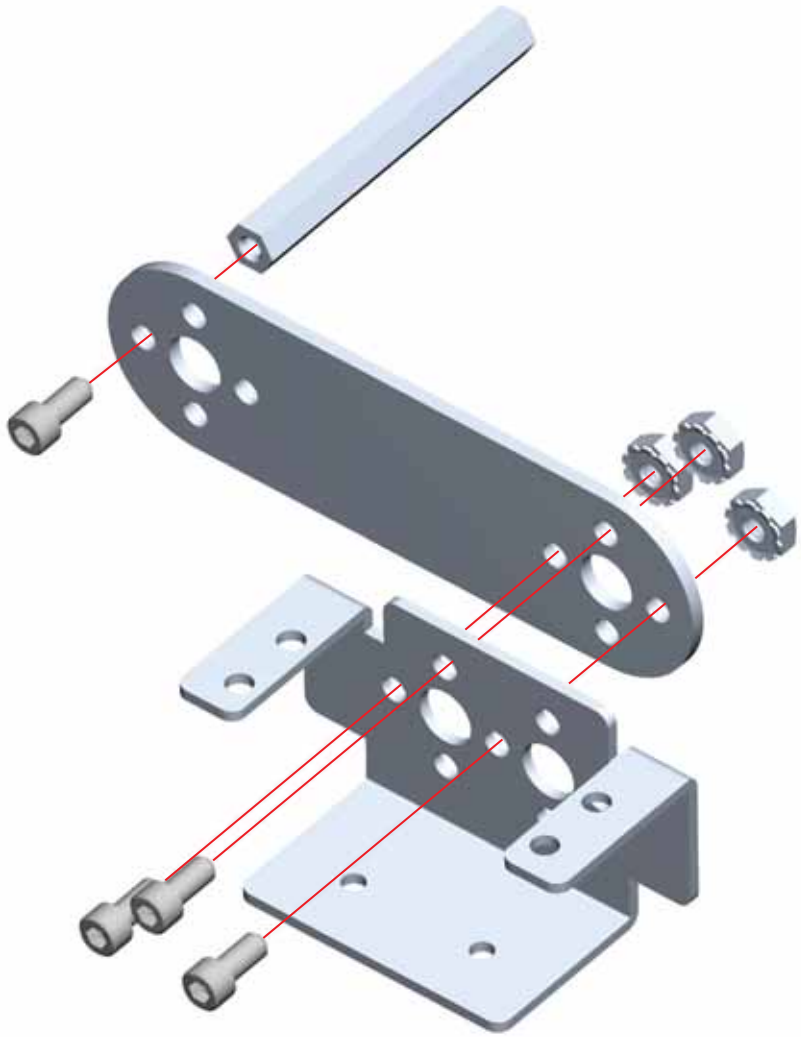

1x Single-Servo Motor Bracket


1x Flat Bracket


1x 2" Stand-Off Post


4x 5/16" SHCS


3x Kep Nut



Tip

- Reminder: Ensure that the teeth of the nut face the head of the screw.

Arm and Gripper Building Guide

Step 11

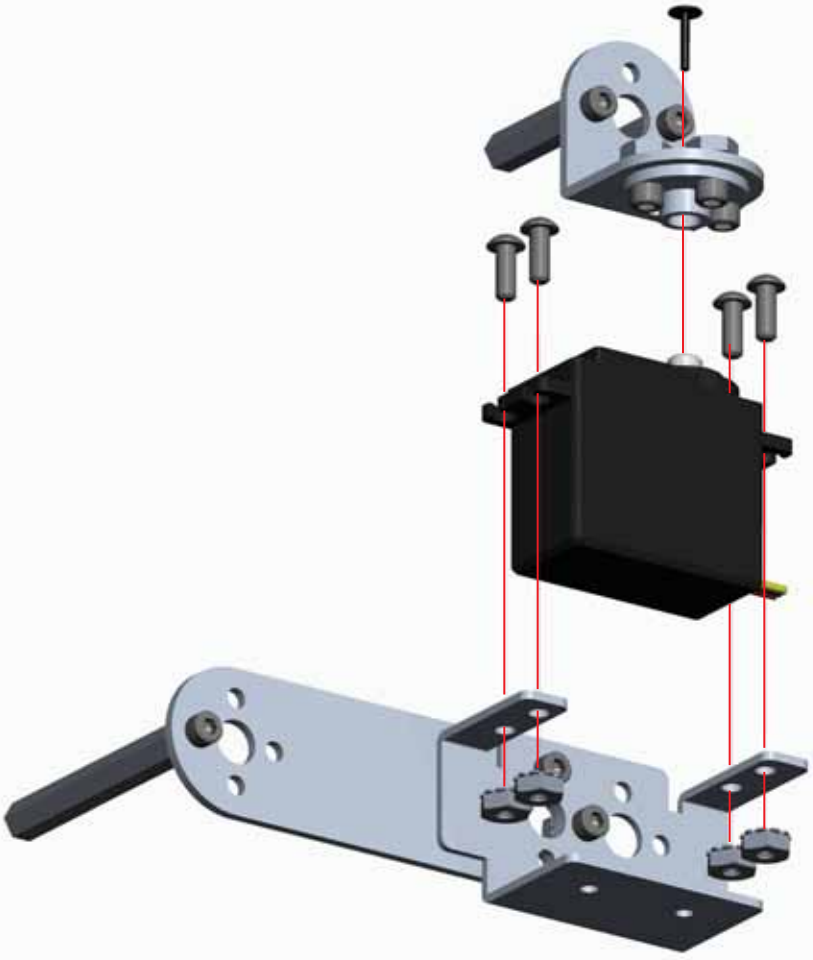
Parts Needed


1x 180° Servo Motor


4x 3/8" BHCS


4x Kep Nut


1x Servo Screw



Tip

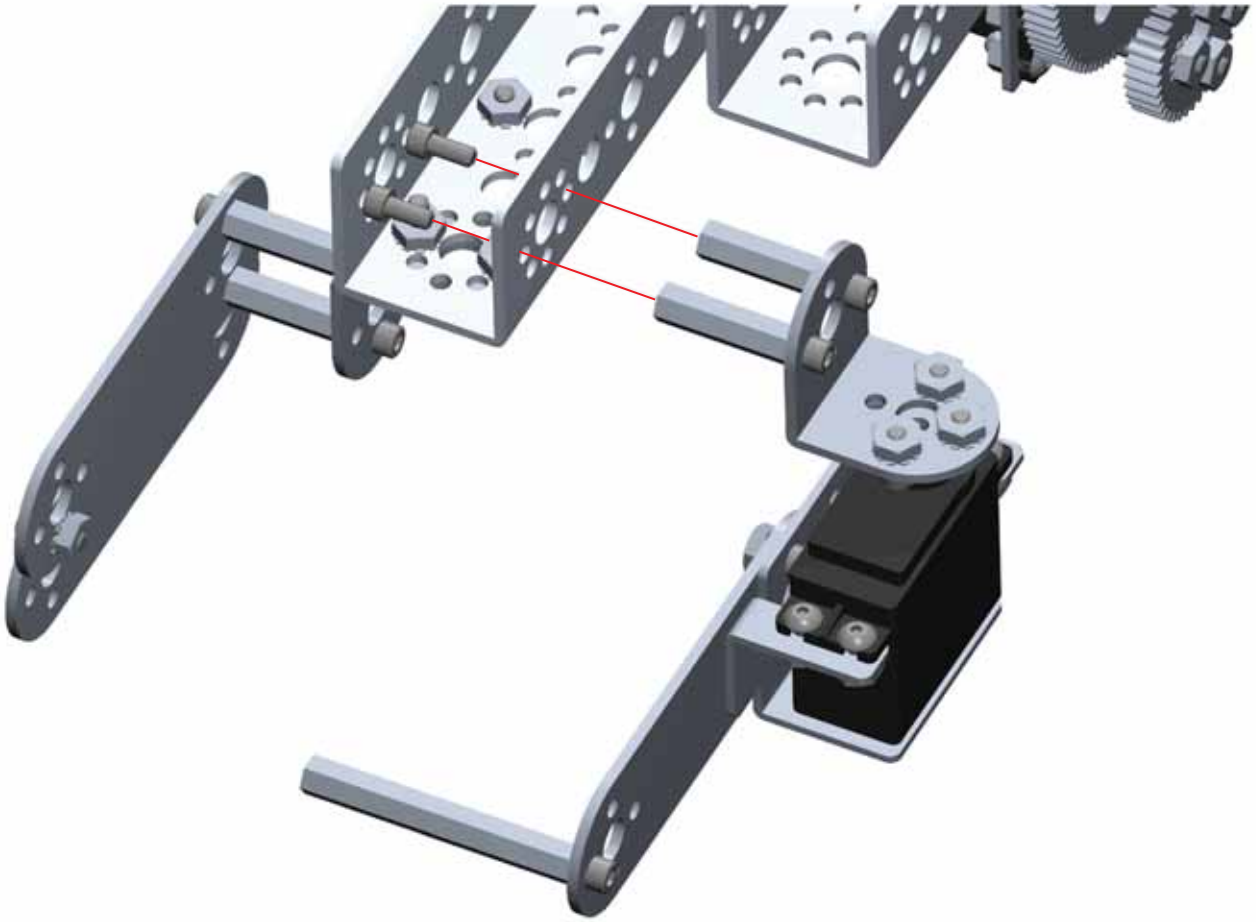
- Use the Phillips head on the 4-in-1 screwdriver to tighten the servo screw. This will keep the servo horn attached to the servo motor.

Arm and Gripper Building Guide

Step 12

Parts Needed

2x 5/16" SHCS



Tip

- To keep the arm oriented properly, tighten the screws bit by bit, alternating between them.

Arm and Gripper Building Guide

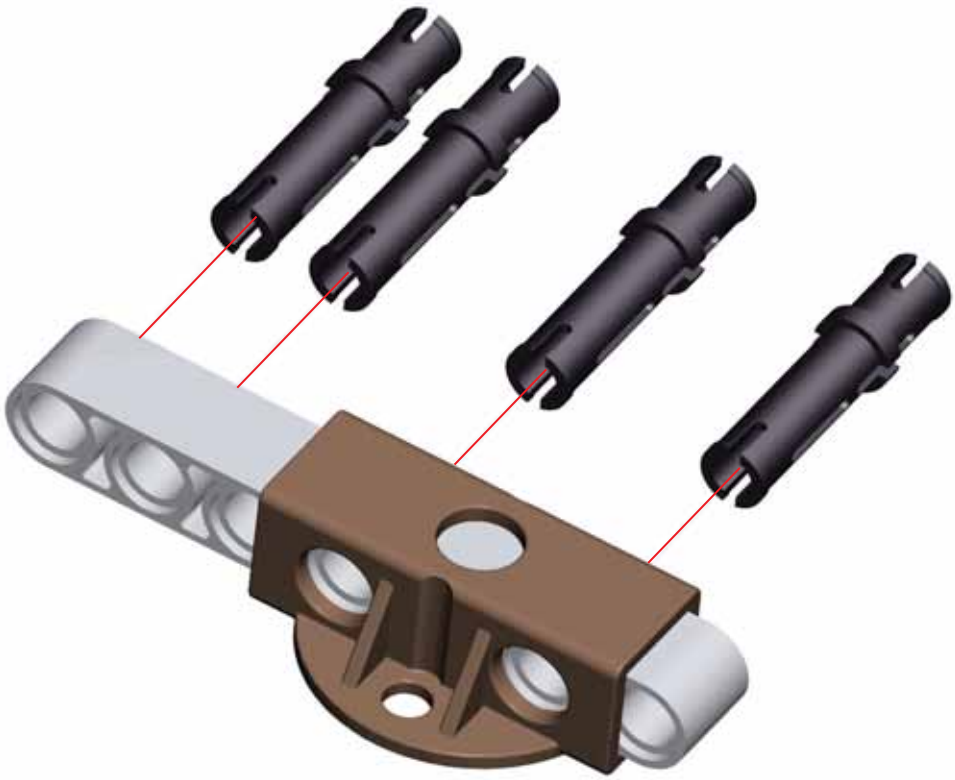
Step 13

Parts Needed

1x TETRIX® Hard Point Connector

1x 7-Module Beam

4x 3-Module Connector Peg with Friction

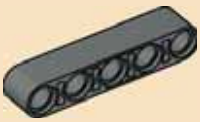


Arm and Gripper Building Guide

Step 14

Parts Needed

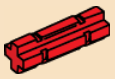
2x 3-Module Connector Peg with Friction



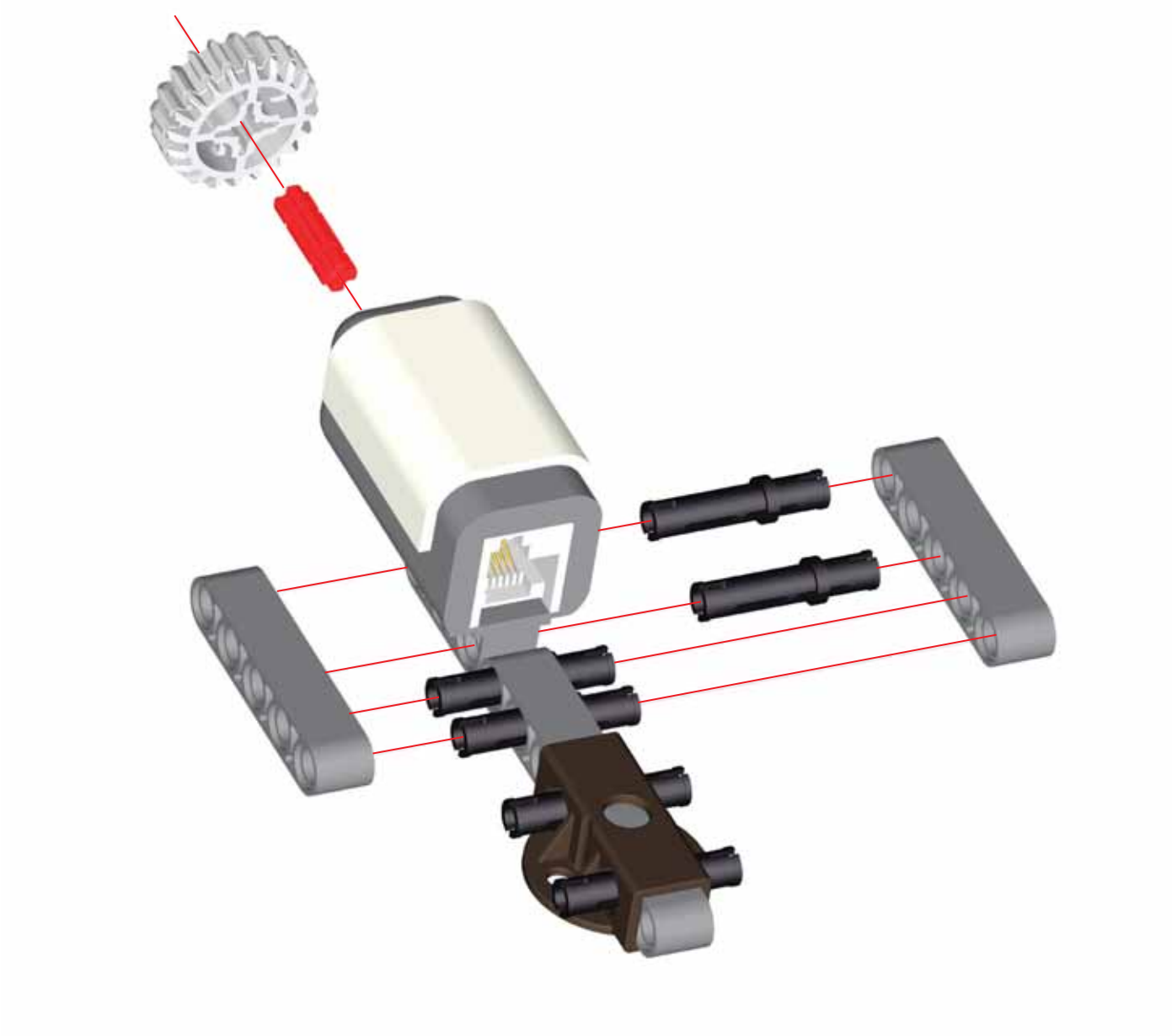
2x 5-Module Beam

1x NXT Touch Sensor

1x 20-Tooth Gear



1x 2-Module Axle



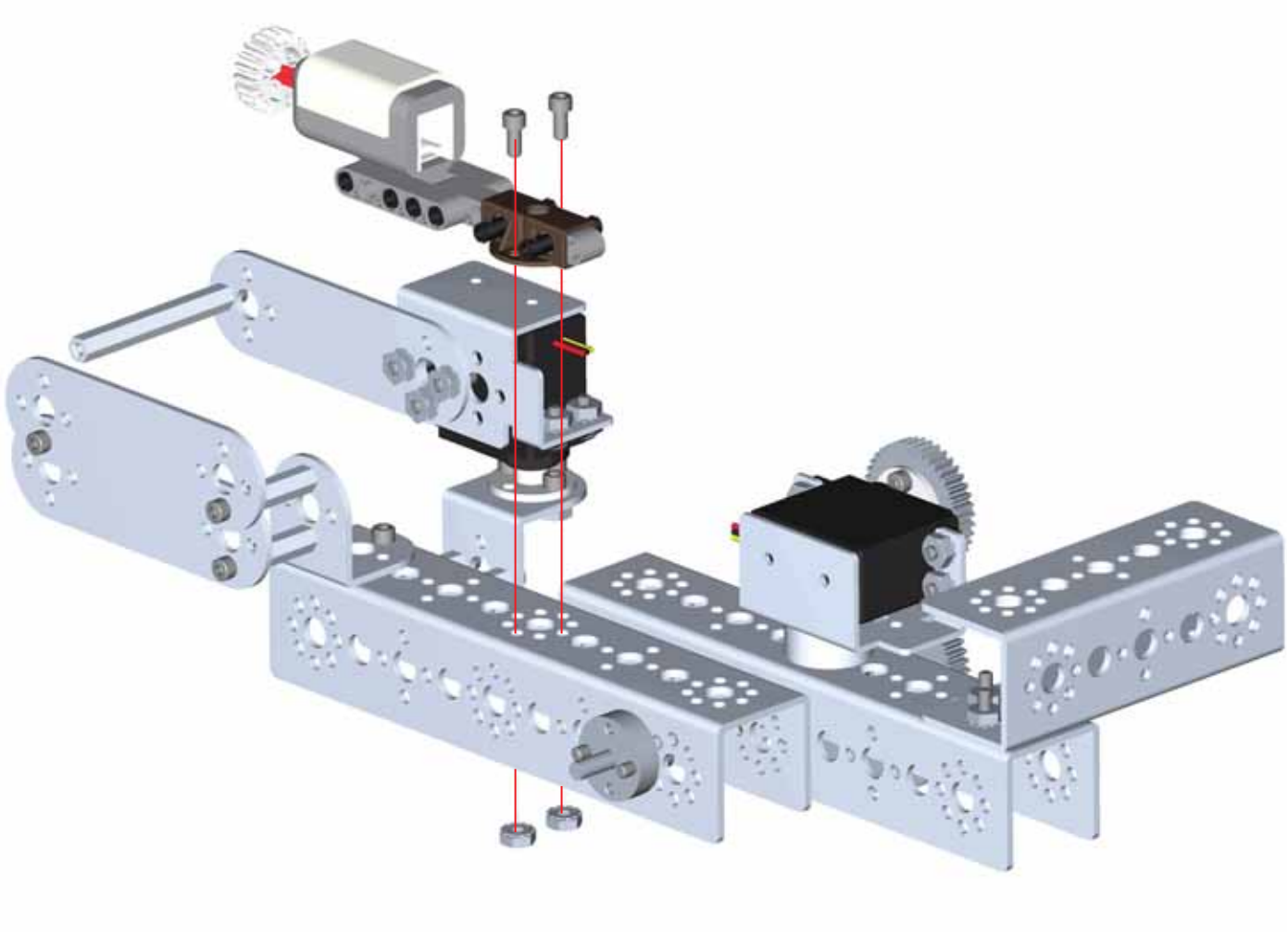
Arm and Gripper Building Guide

Step 15

Parts Needed

2x 5/16" SHCS

2x Kep Nut



Tip

- Turn the screws only until the hard point connector is securely attached to the TETRIX® channel.

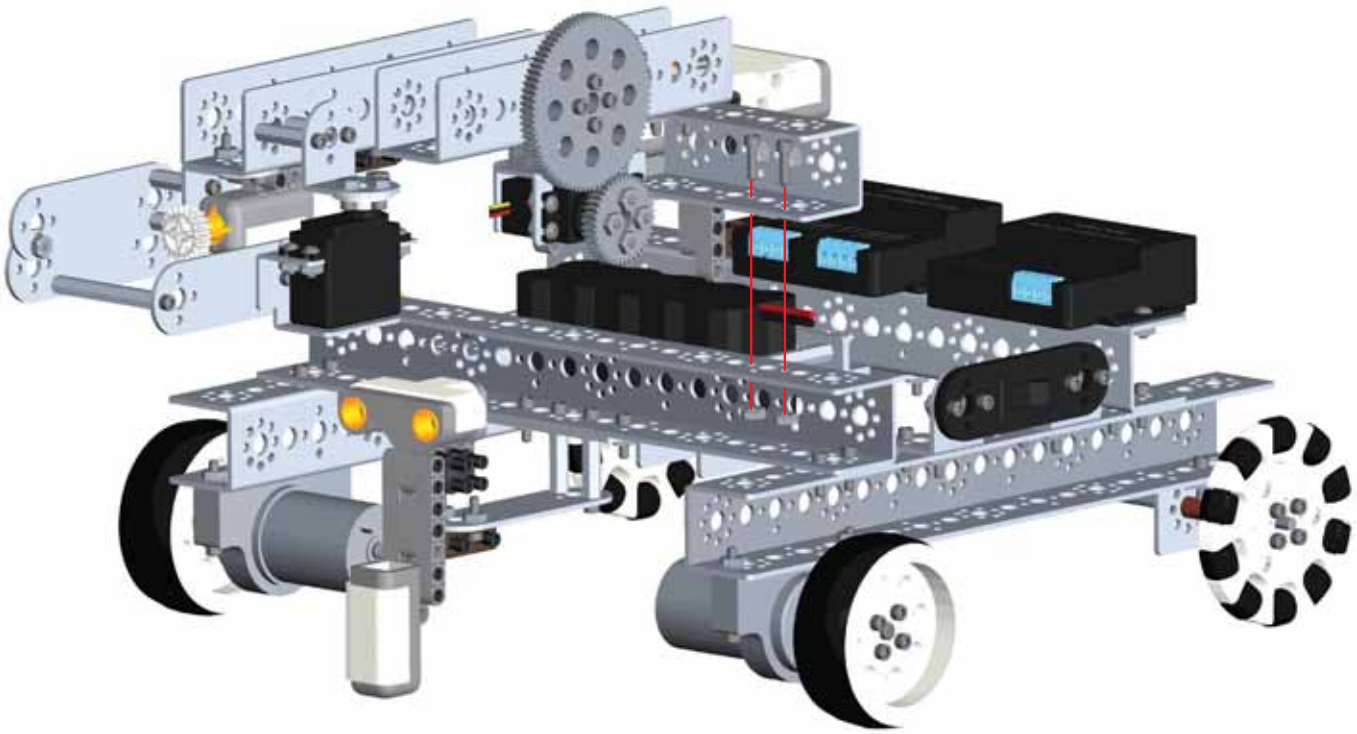
Arm and Gripper Building Guide

Step 16

Parts Needed

2x 1/2" SHCS

2x Kep Nut



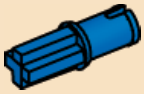
Harvester and Transporter Building Guide

Step 1

Parts Needed


2x 3-Module Connector Peg with Friction


1x Connector Peg with Friction

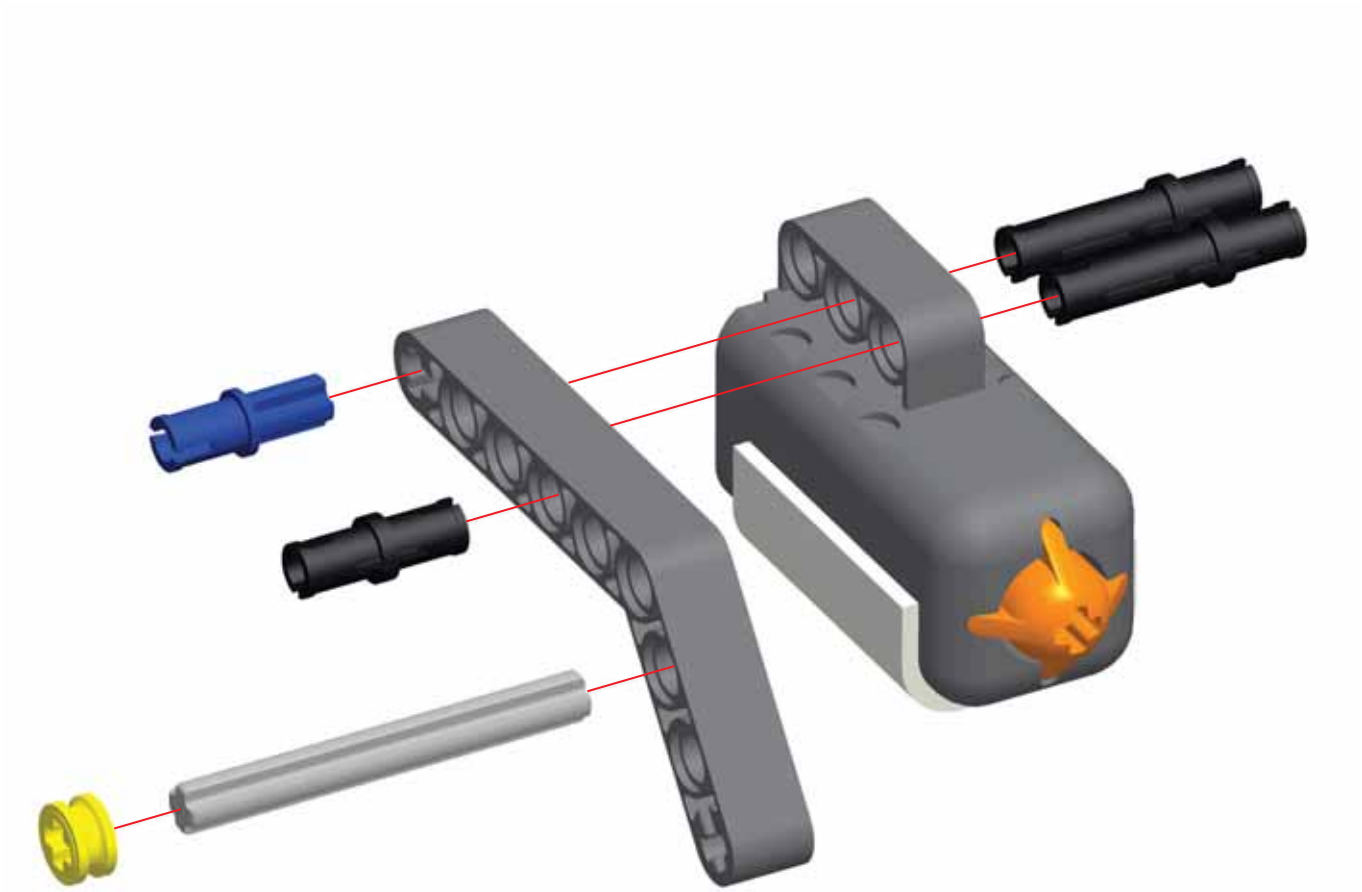

1x Connector Peg with Friction/Axle


1x 4 x 6-Module Angular Beam


1x Half-Module Bushing


1x 5-Module Axle


1x NXT Touch Sensor



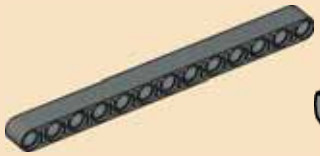
Tips

- Use the 7/64" and 5/64" hex keys in this model.
- Make sure that the connector pegs on the same side are inserted facing the same direction.

Harvester and Transporter Building Guide

Step 2

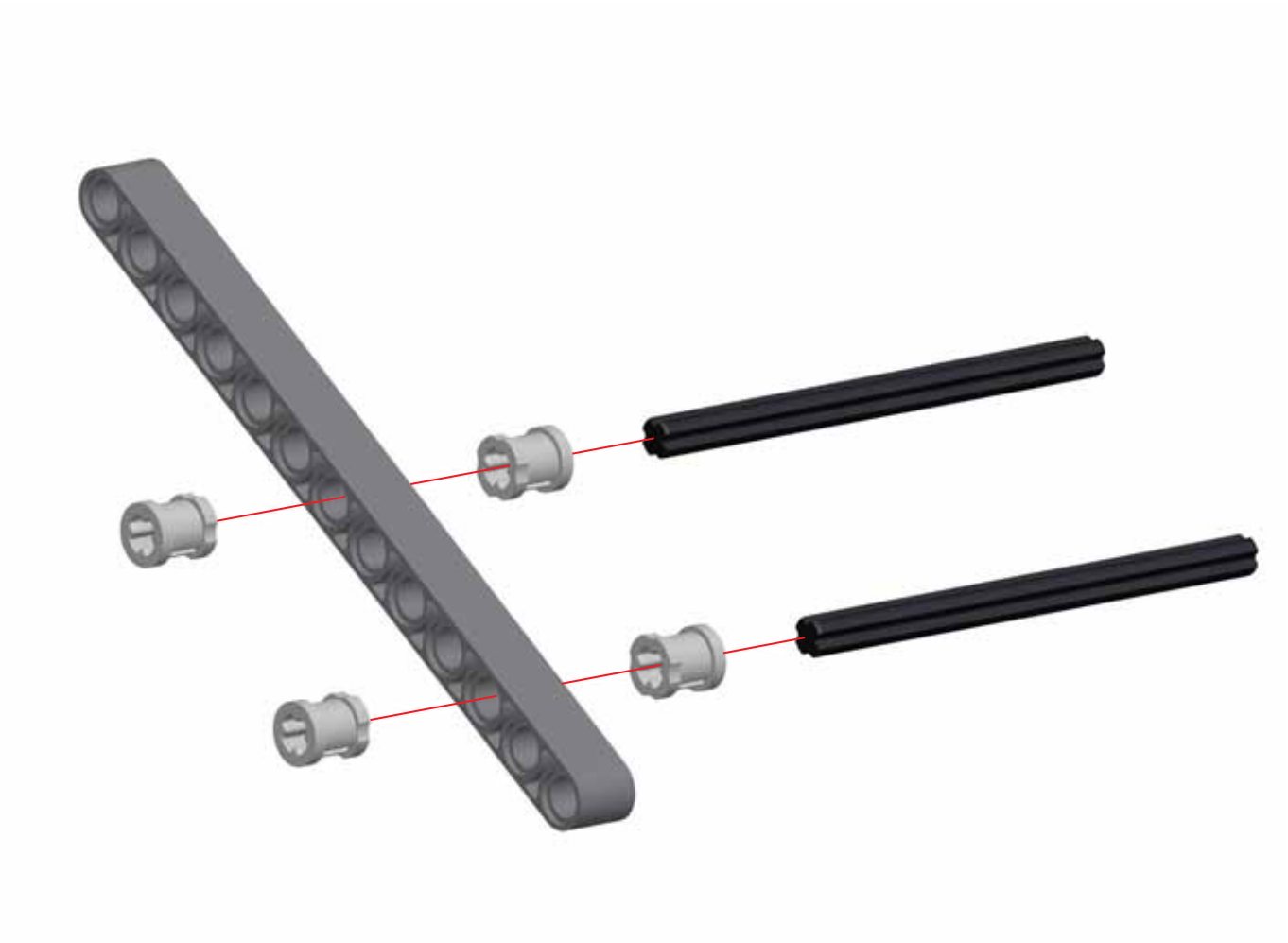
Parts Needed



1x 13-Module Beam

4x Gray Bushing

2x 8-Module Axle



Tip

- Ensure that the bushings are firmly in place against the beam.

Harvester and Transporter Building Guide

Step 3

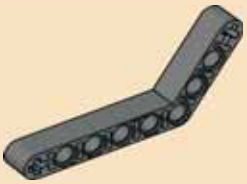
Tips

- Ensure that the axles on the assembly from Step 2 are pointed away from the angular beam from Step 1.

Harvester and Transporter Building Guide

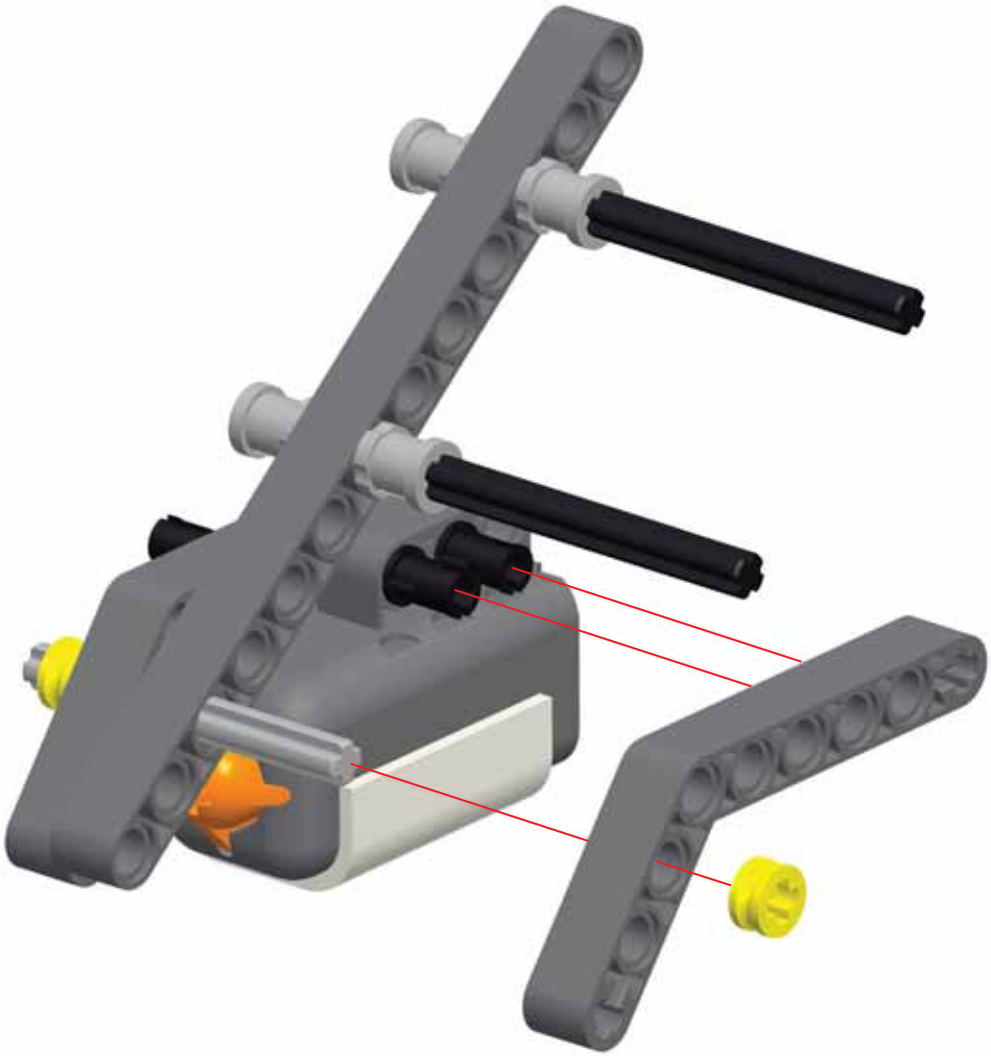
Step 4

Parts Needed



1x 4 x 6-Module Angular Beam

1x Half-Module Bushing



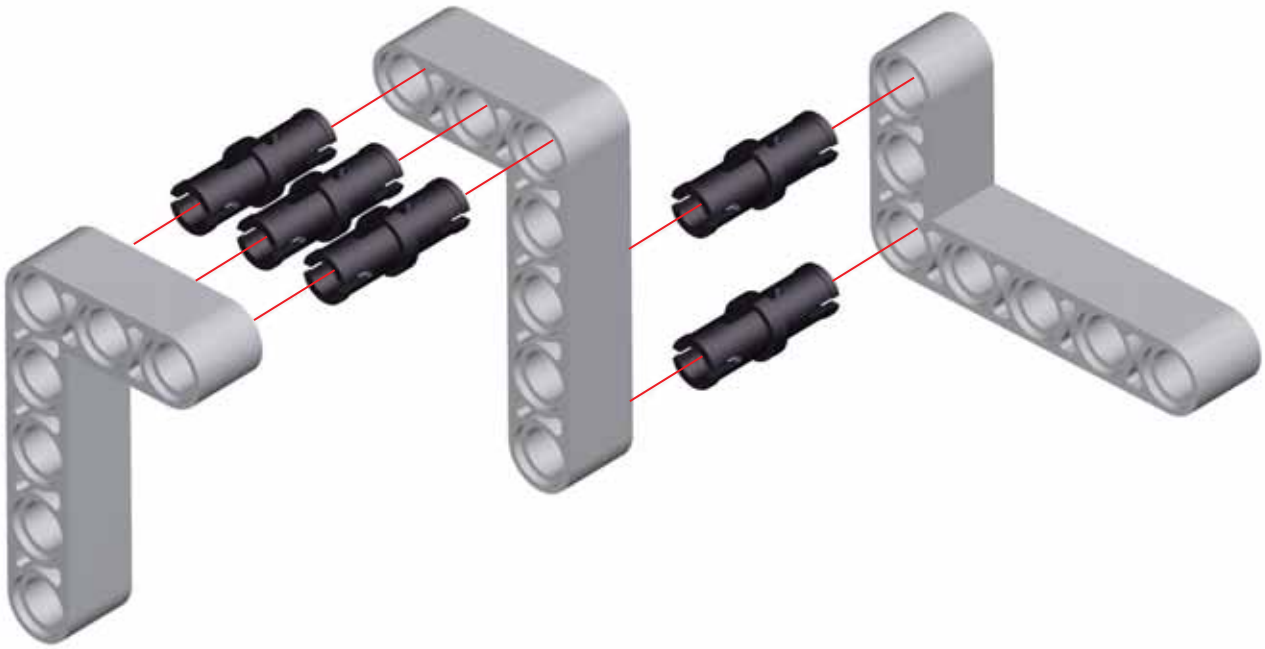
Harvester and Transporter Building Guide

Step 5

Parts Needed

3x 3 x 5-Module Angular Beam

5x Connector Peg with Friction



Harvester and Transporter Building Guide

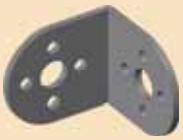
Step 6

Parts Needed

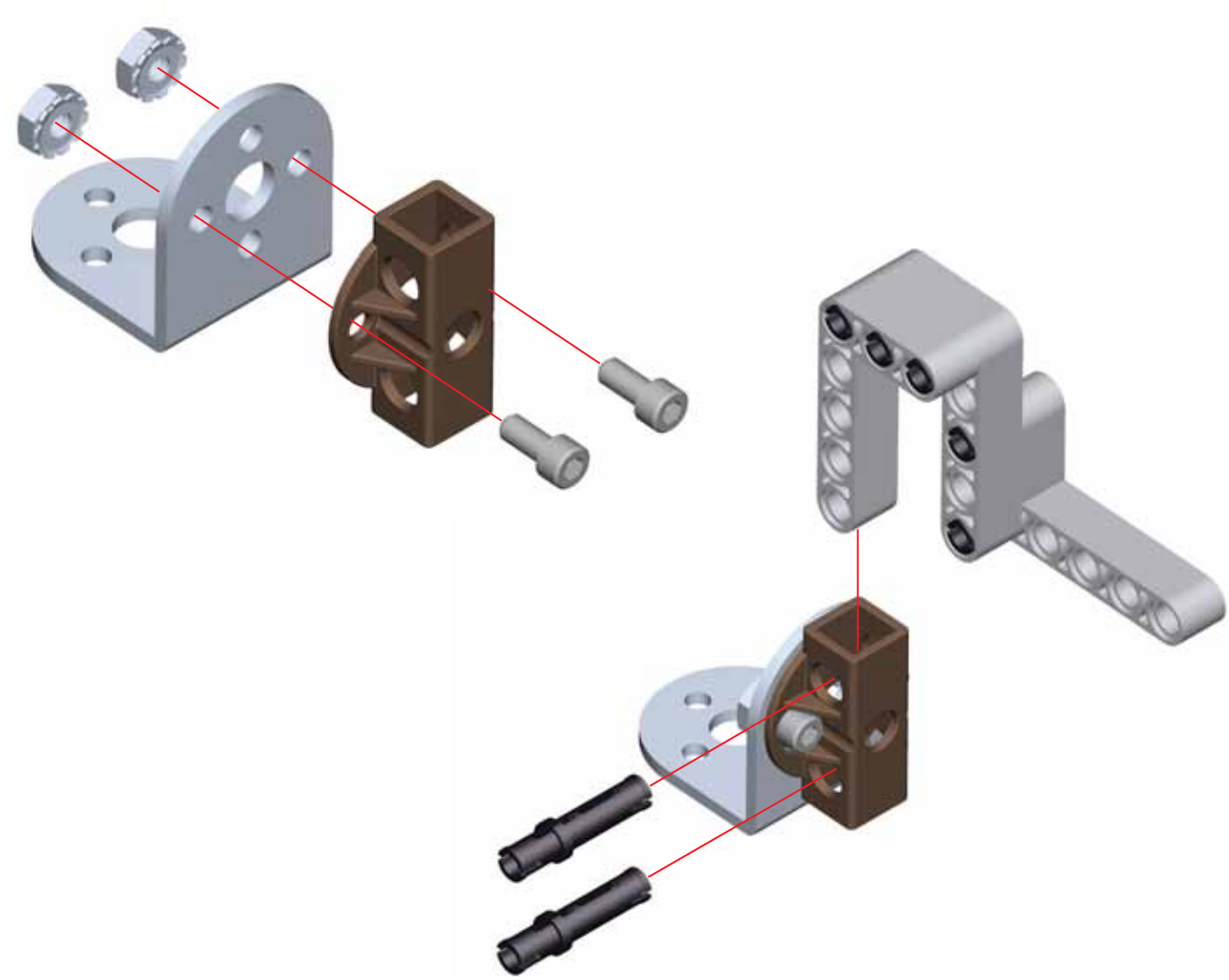

2x 3-Module Connector Peg with Friction


2x 5/16" SHCS


2x Kep Nut


1x L Bracket


1x TETRIX® Hard Point Connector



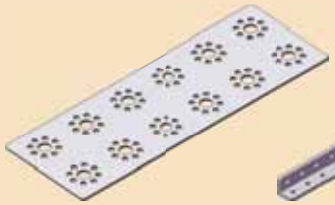
Tips

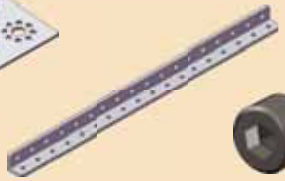
- Make sure the screw heads are on the same side as the connector pegs.
- Reminder: Ensure that the teeth of the nut face the head of the screw.

Harvester and Transporter Building Guide

Step 7

Parts Needed

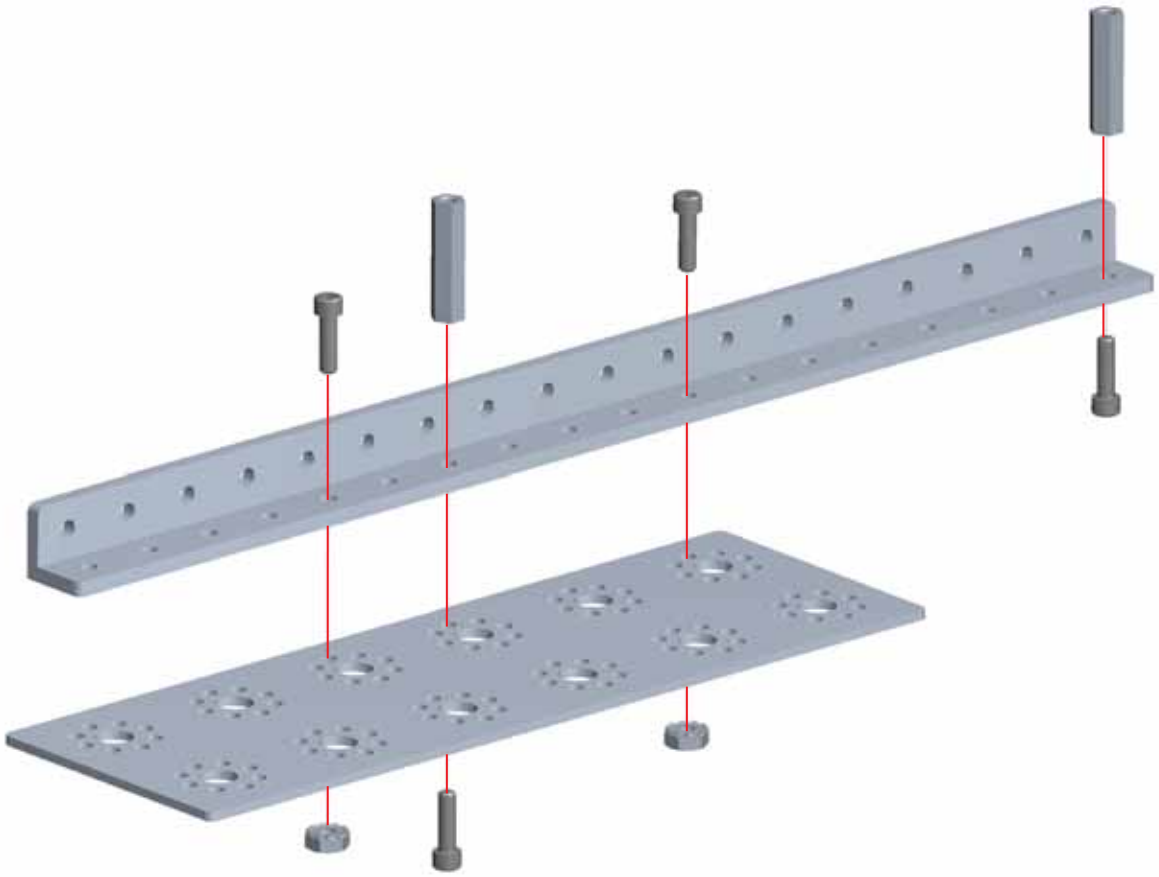

1x Flat Building Plate


1x 288 mm Angle


4x 1/2" SHCS


2x 1" Stand-Off Post


2x Kep Nut



Tips

- Make sure that the nuts are on the opposite side of the angle.
- Make sure that the stand-off posts are in the first hole and the 12th hole counting from the end (without the flat building plate).
- Reminder: Ensure that the teeth of the nut face the head of the screw.

Harvester and Transporter Building Guide

Step 8

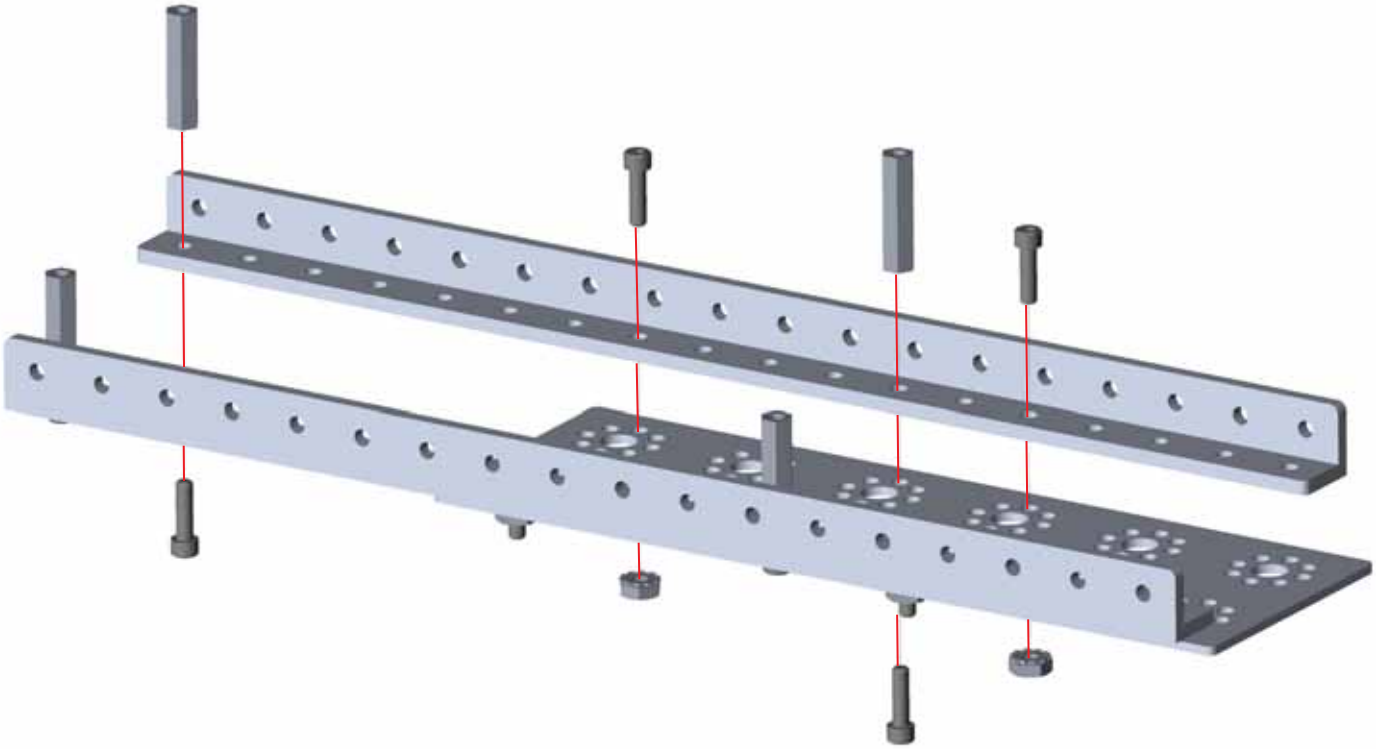
Parts Needed

1x 288 mm Angle

4x 1/2" SHCS

2x 1" Stand-Off Post

2x Kep Nut



Tips

- Ensure that both sides are symmetrical.
- Reminder: Ensure that the teeth of the nut face the head of the screw.

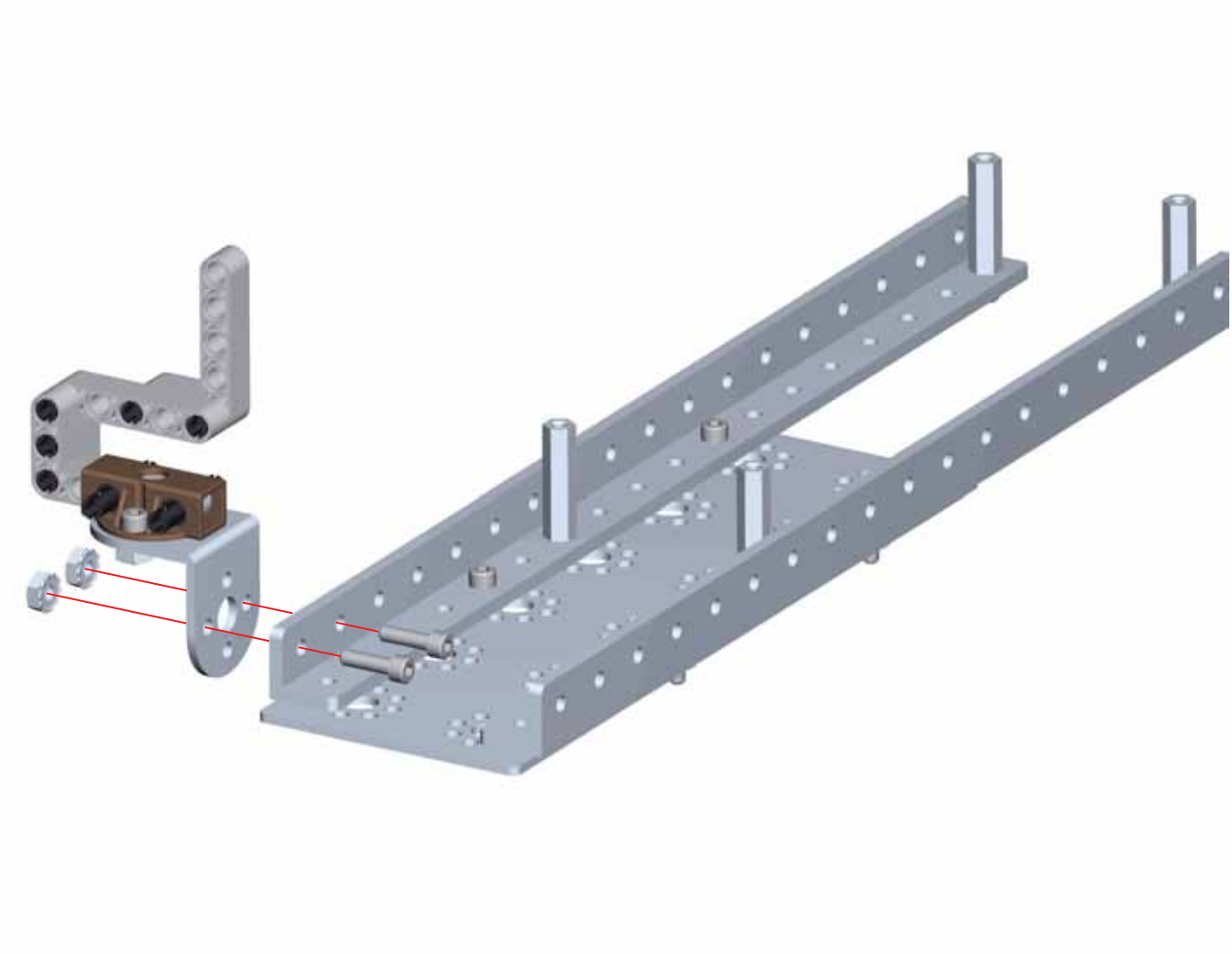
Harvester and Transporter Building Guide

Step 9

Parts Needed

2x 1/2" SHCS

2x Kep Nut

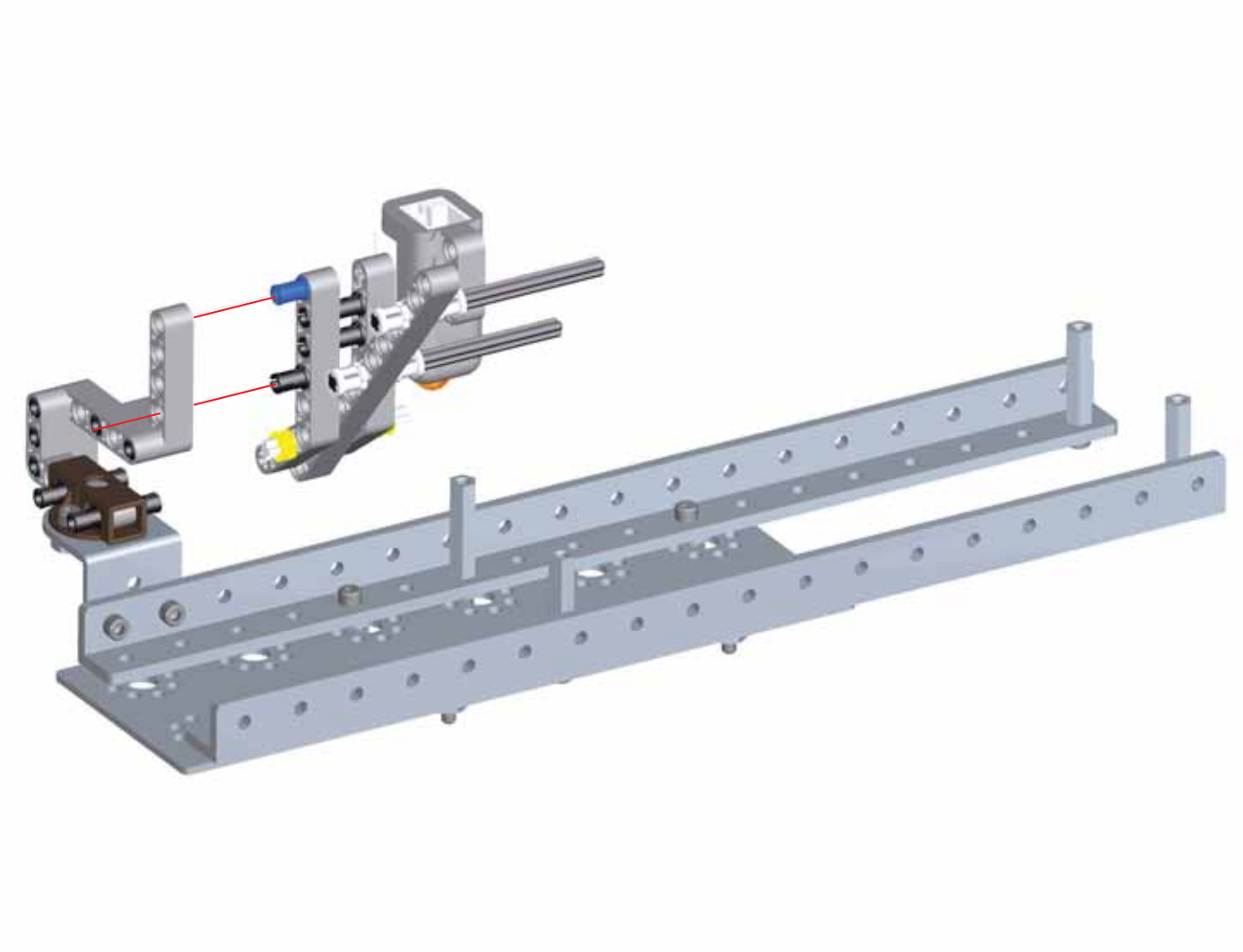


Tip

- Reminder: Ensure that the teeth of the nut face the head of the screw.

Harvester and Transporter Building Guide

Step 10



Tip

- Make sure that the protruding axles on the subassembly are pointing towards the far end of the angles.

Harvester and Transporter Building Guide

Step 11

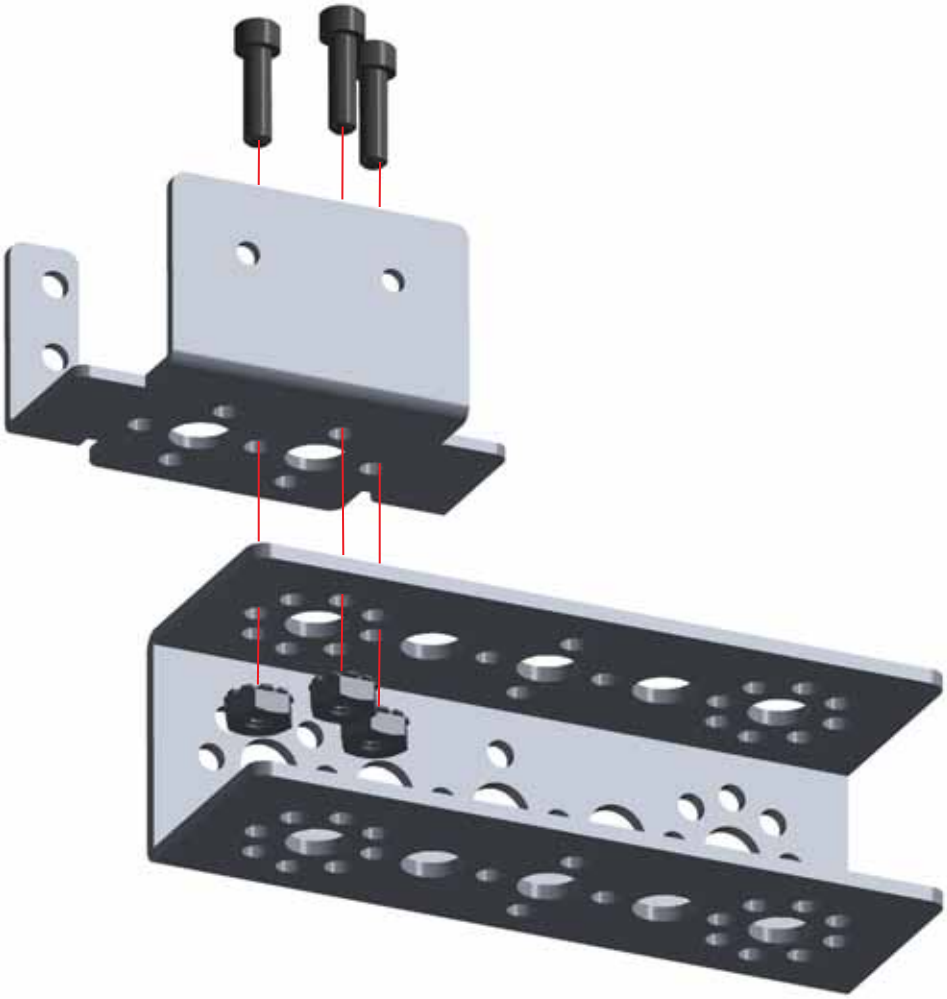
Parts Needed


1x Single-Servo Motor Bracket


1x 96 mm Channel


3x 1/2" SHCS


3x Kep Nut



Tips

- Ensure that the screw heads are on the inside of the bracket.
- Reminder: Ensure that the teeth of the nut face the head of the screw.

Harvester and Transporter Building Guide

Step 12

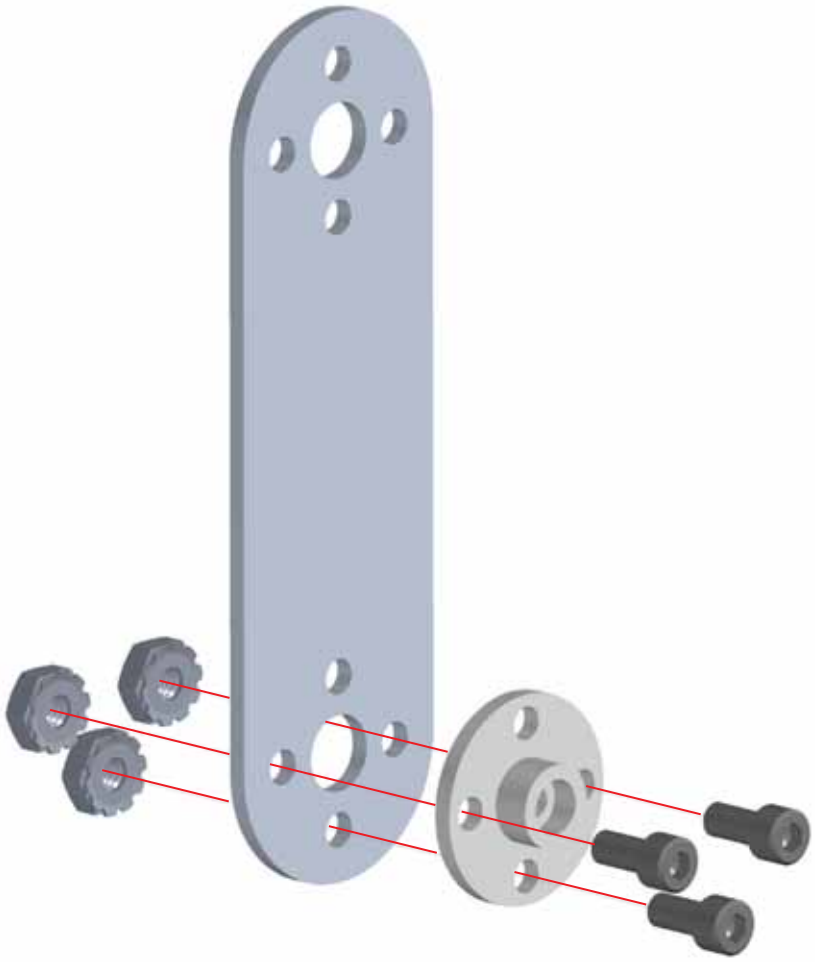
Parts Needed


1x Servo Horn


1x Flat Bracket


3x 5/16" SHCS


3x Kep Nut



Tip

- Reminder: Ensure that the teeth of the nut face the head of the screw.

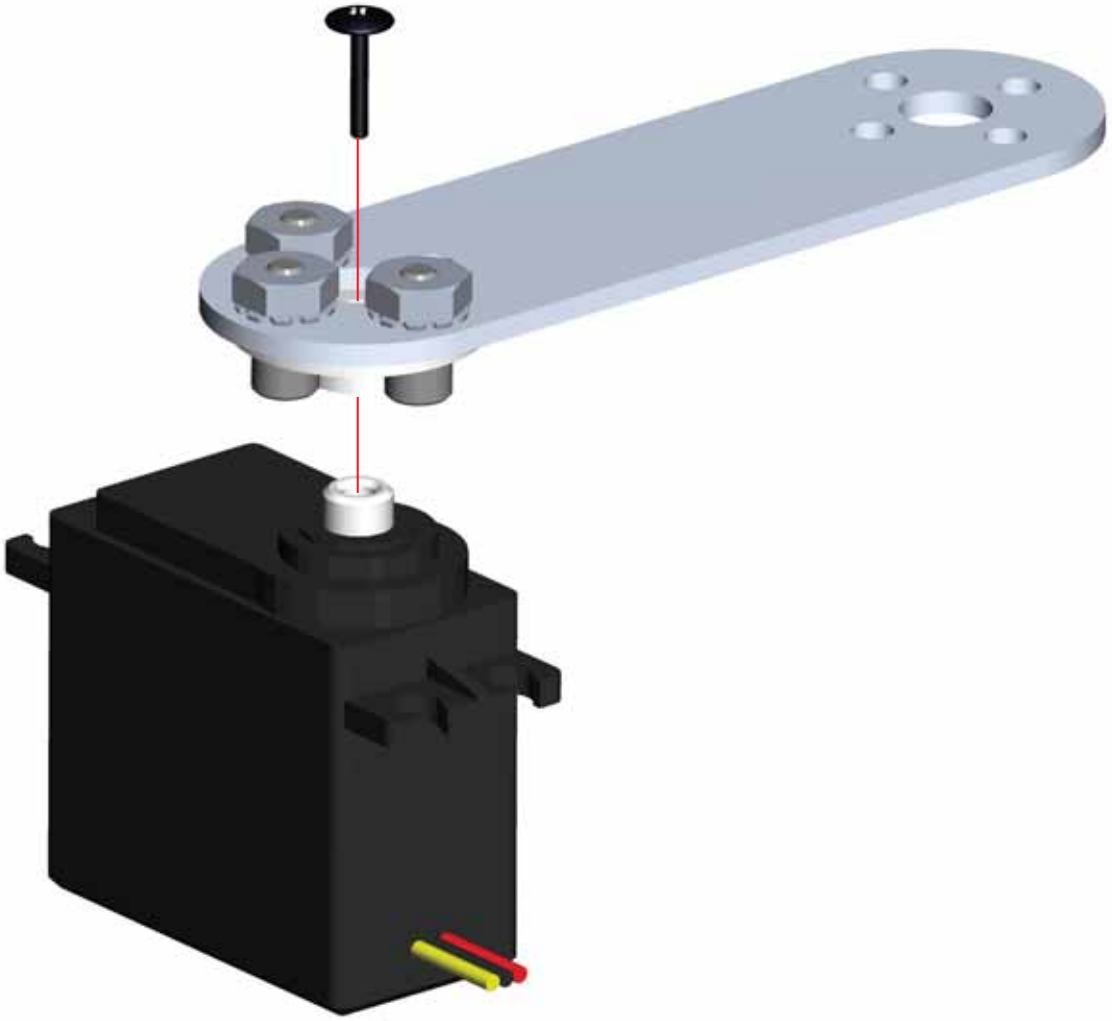
Harvester and Transporter Building Guide

Step 13

Parts Needed

1x 180° Servo Motor with Horn

1x Servo Screw



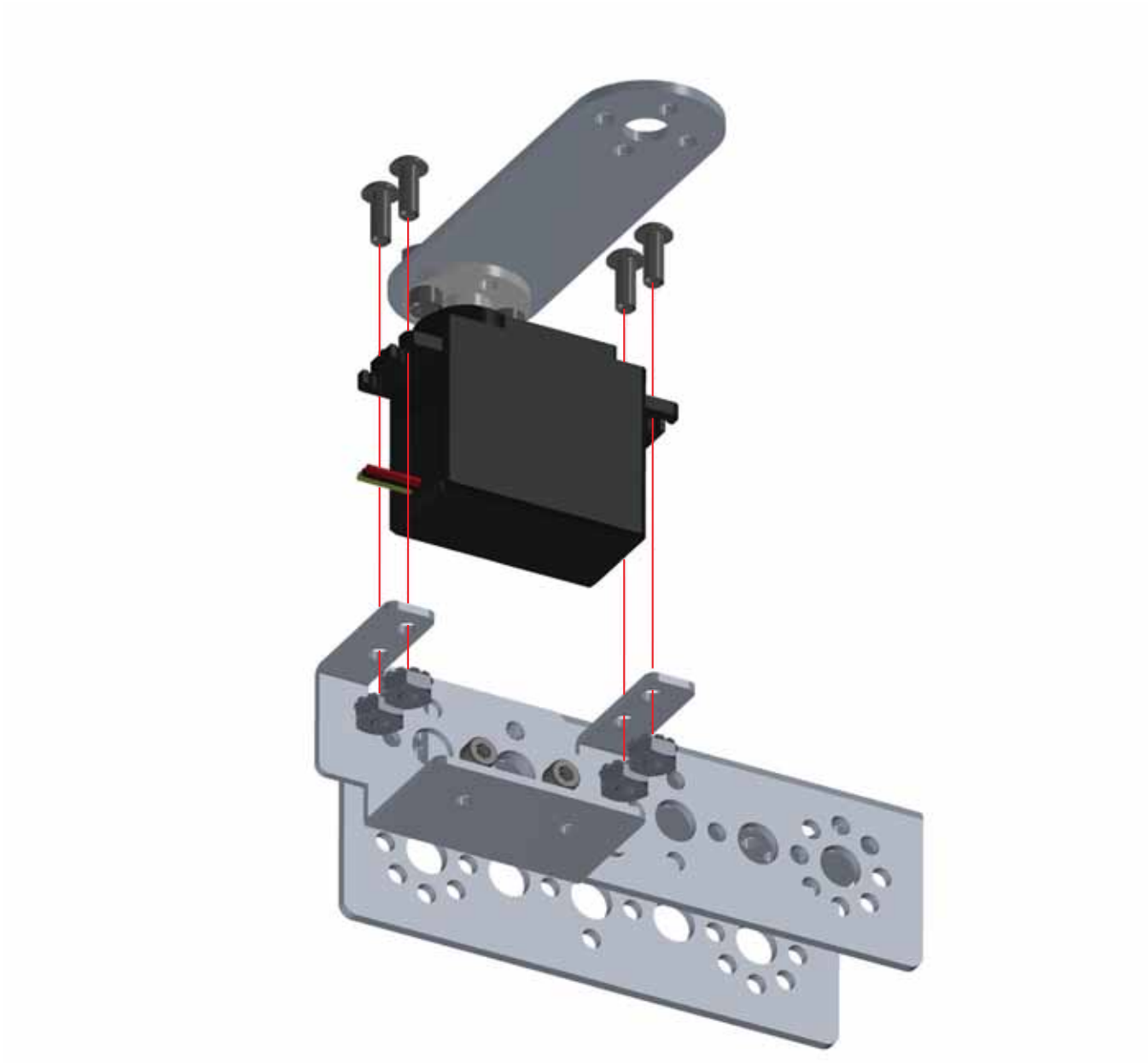
Harvester and Transporter Building Guide

Step 14

Parts Needed

4x 5/16" BHCS

4x Kep Nut

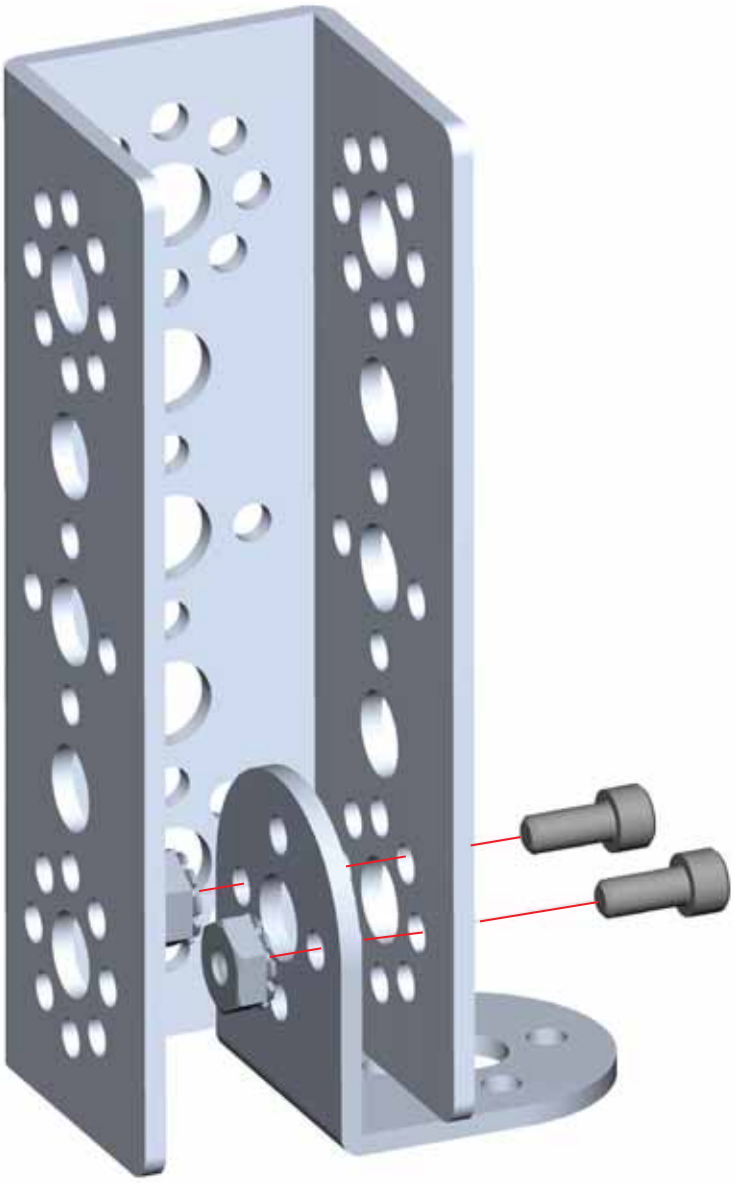


Harvester and Transporter Building Guide

Step 15

Parts Needed

1x L Bracket | 2x 5/16" SHCS | 2x Kep Nut



Harvester and Transporter Building Guide

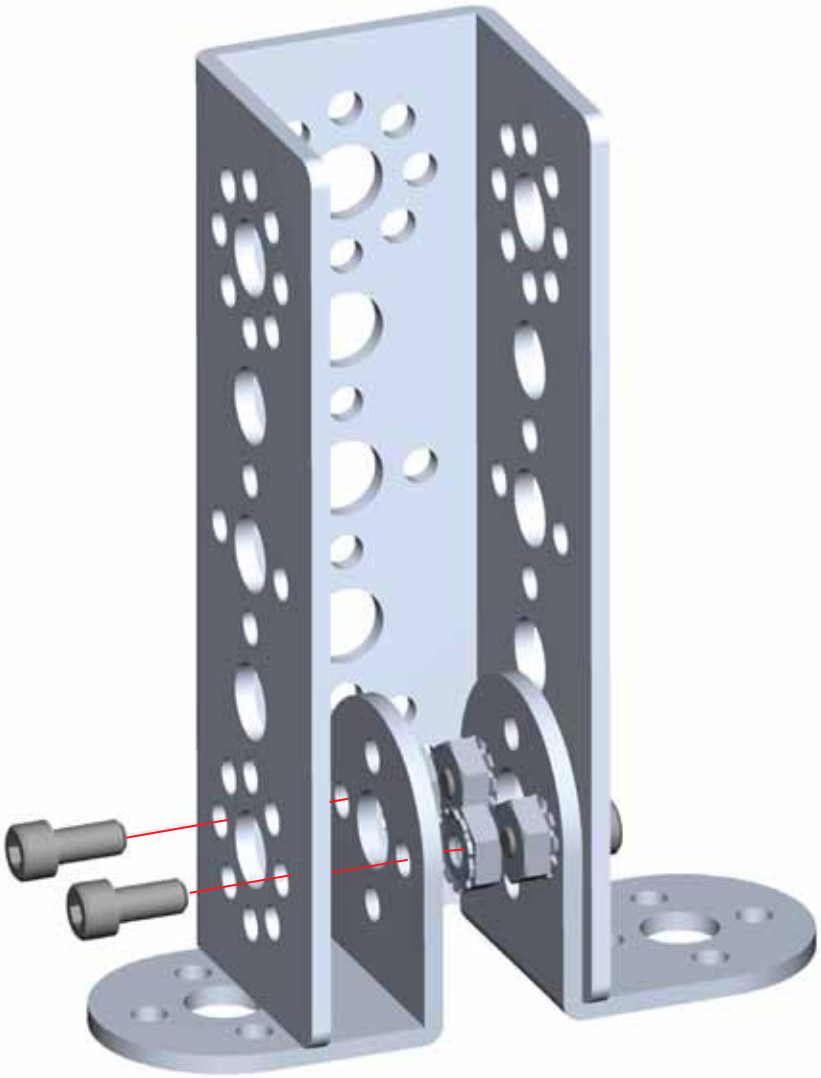
Step 16

Parts Needed

1x L Bracket

2x 5/16" SHCS

2x Kep Nut



Harvester and Transporter Building Guide

Step 17

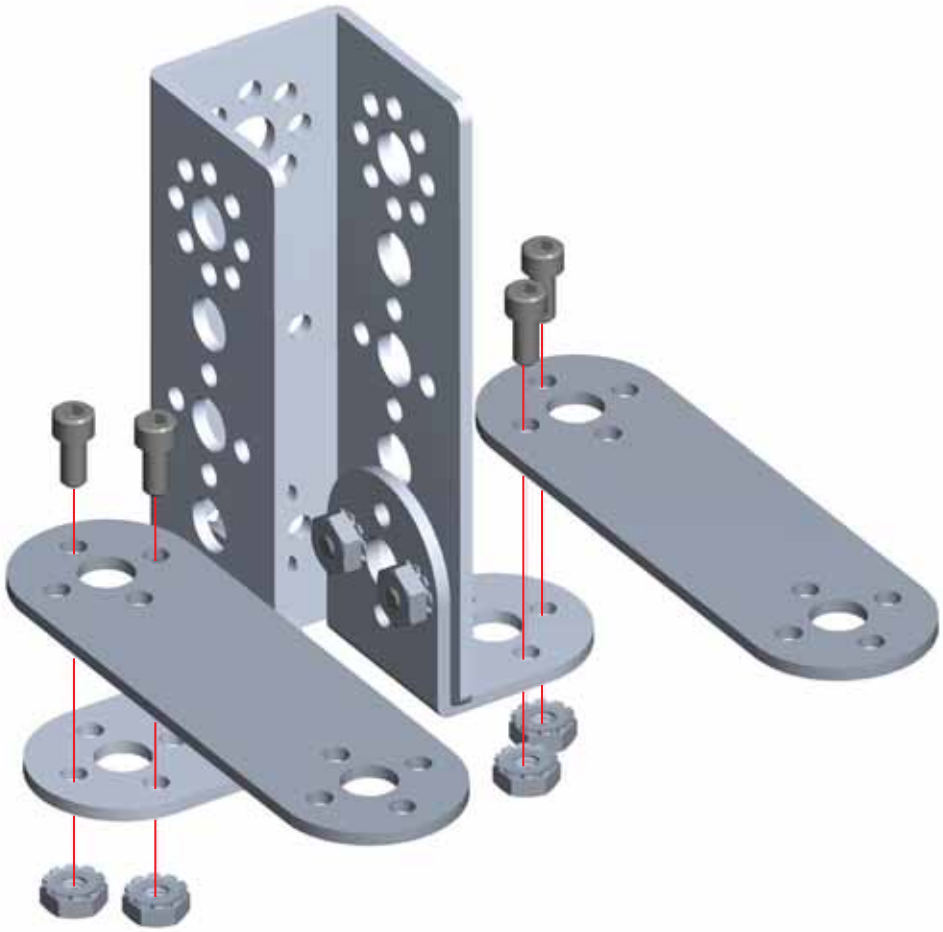
Parts Needed


2x Flat Bracket


1x 96 mm Channel


4x 5/16" SHCS


4x Kep Nut



Tips

- Make sure that the open side of the channel is on the same side as the flat brackets.
- Reminder: Ensure that the teeth of the nut face the head of the screw.

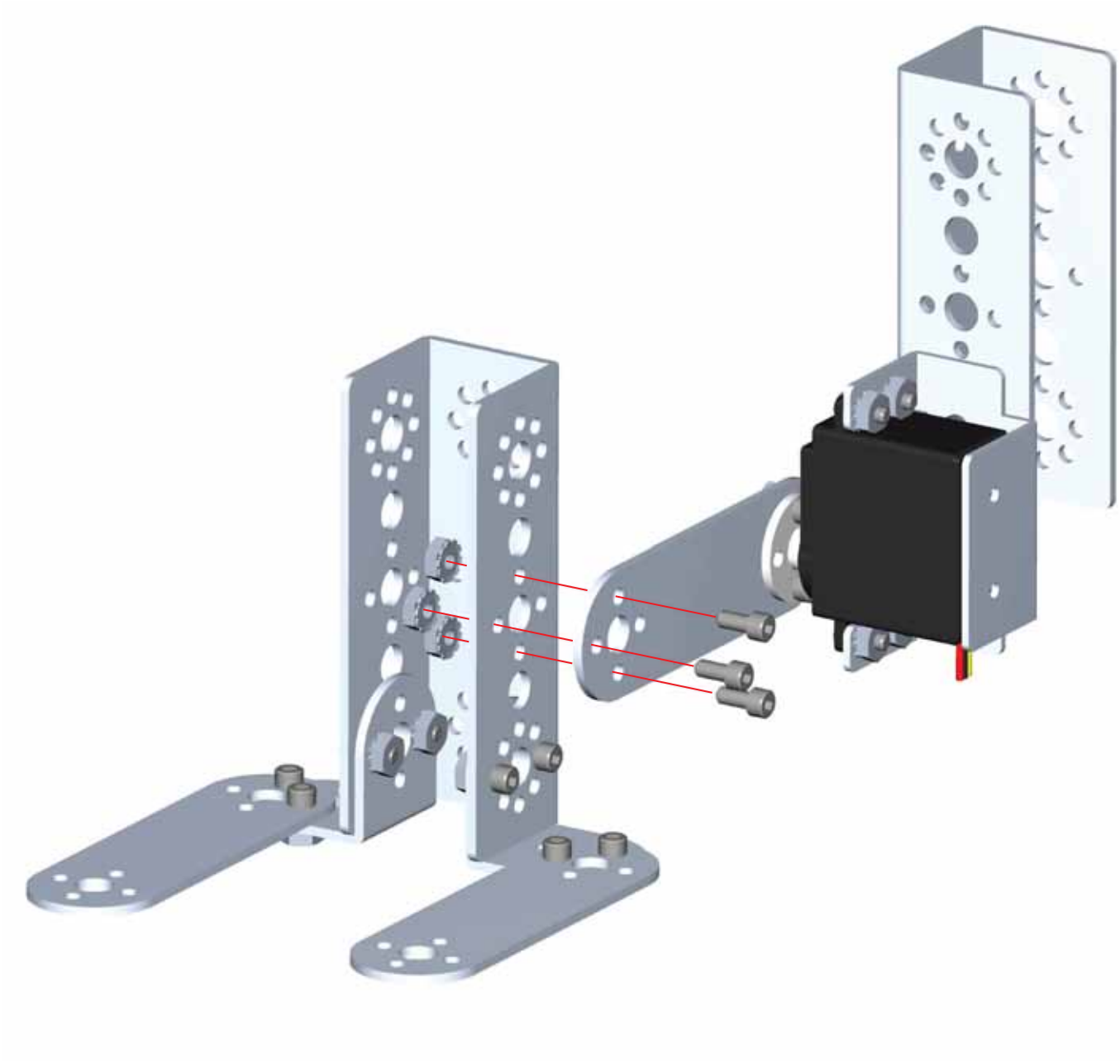
Harvester and Transporter Building Guide

Step 18

Parts Needed

3x 5/16" SHCS

3x Kep Nut



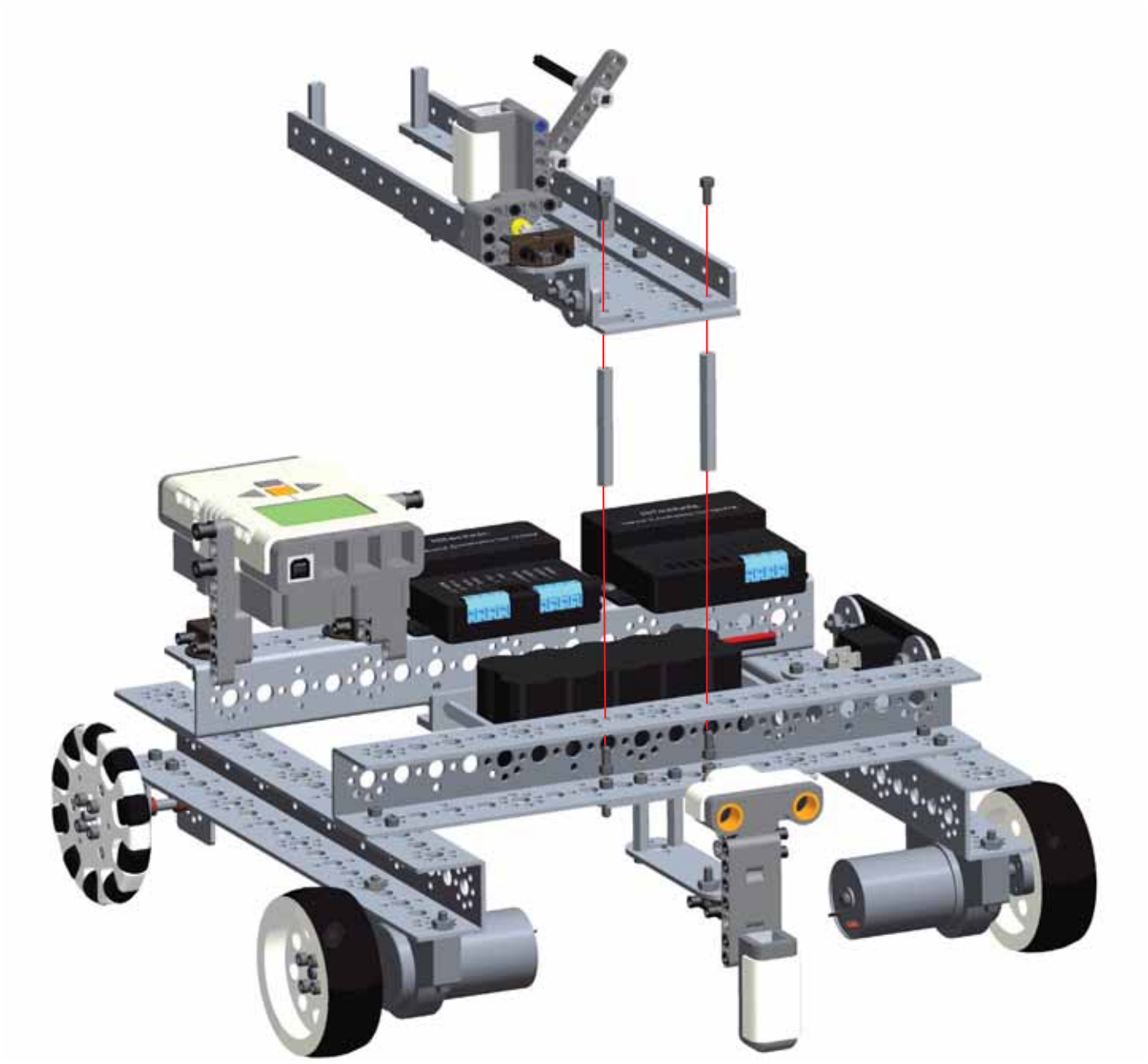
Harvester and Transporter Building Guide

Step 19

Parts Needed

4x 1/2" SHCS

2x 2" Stand-Off Post



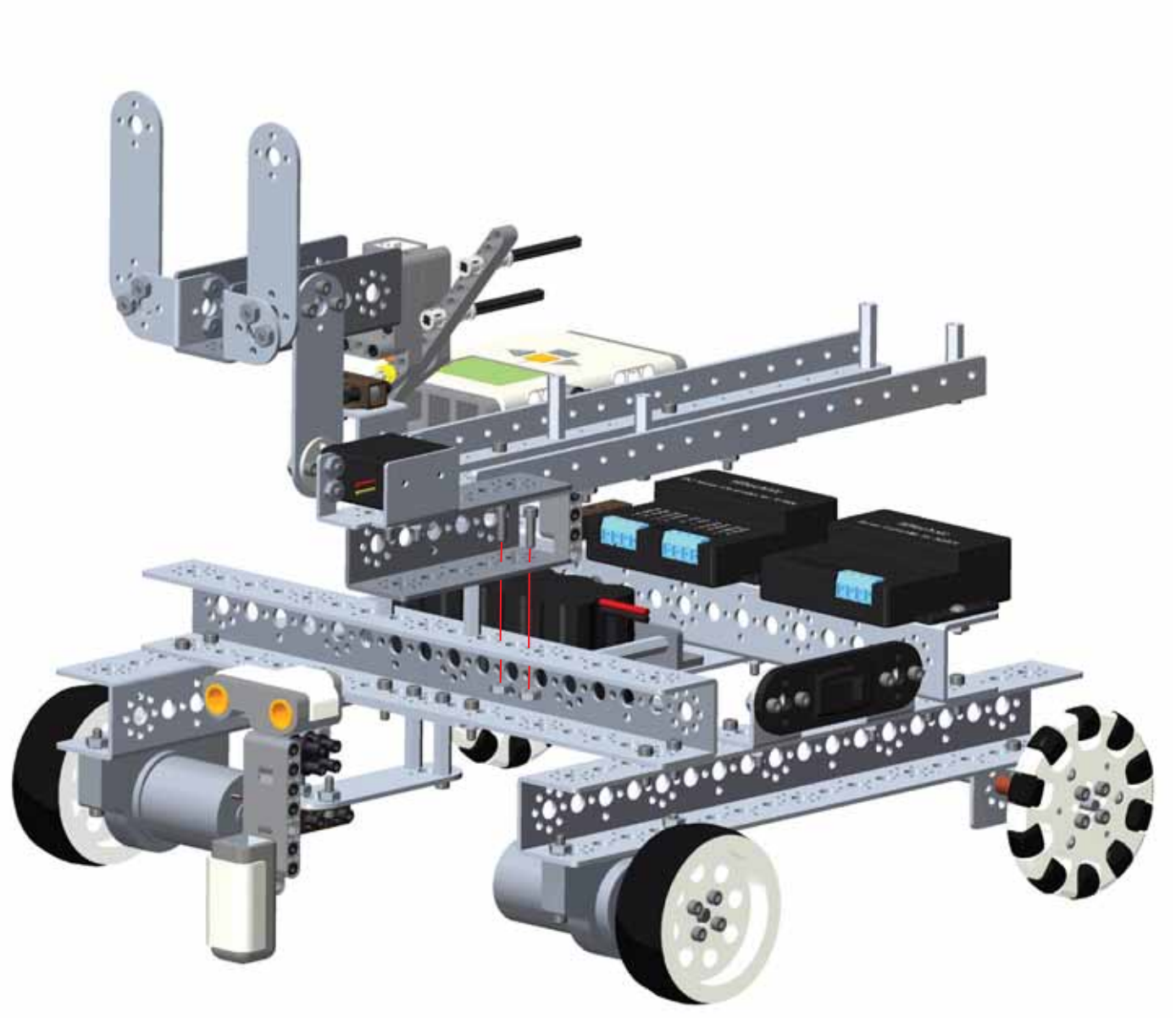
Harvester and Transporter Building Guide

Step 20

Parts Needed

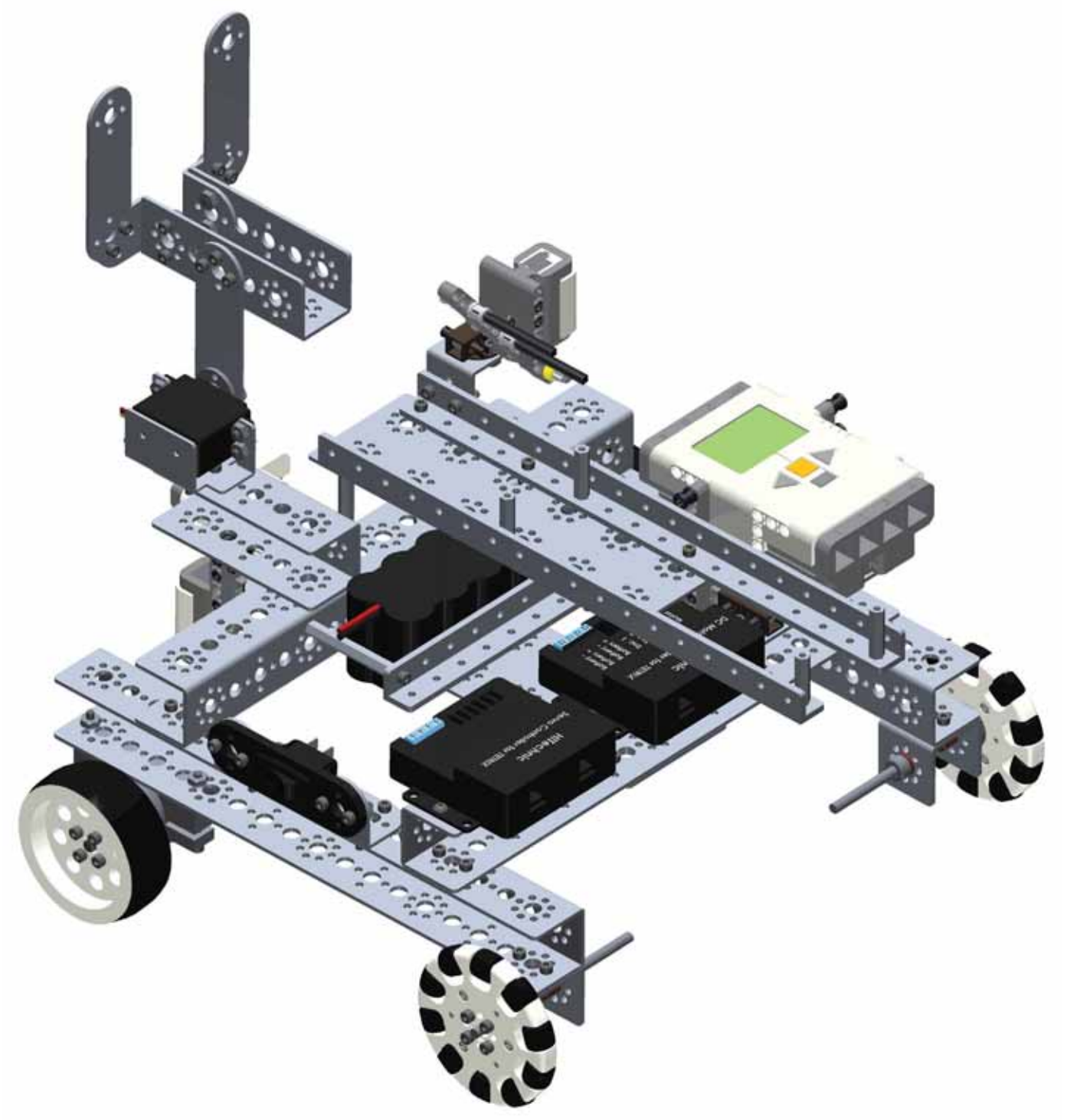
2x 1/2" SHCS

2x Kep Nut



Harvester and Transporter Building Guide

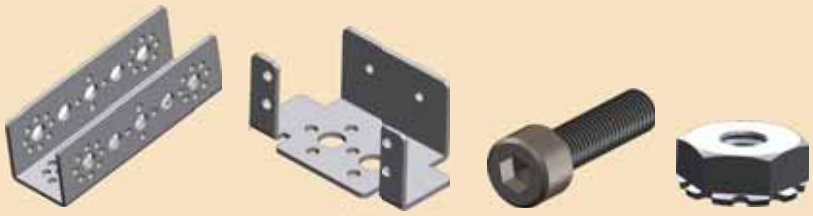
Final Version



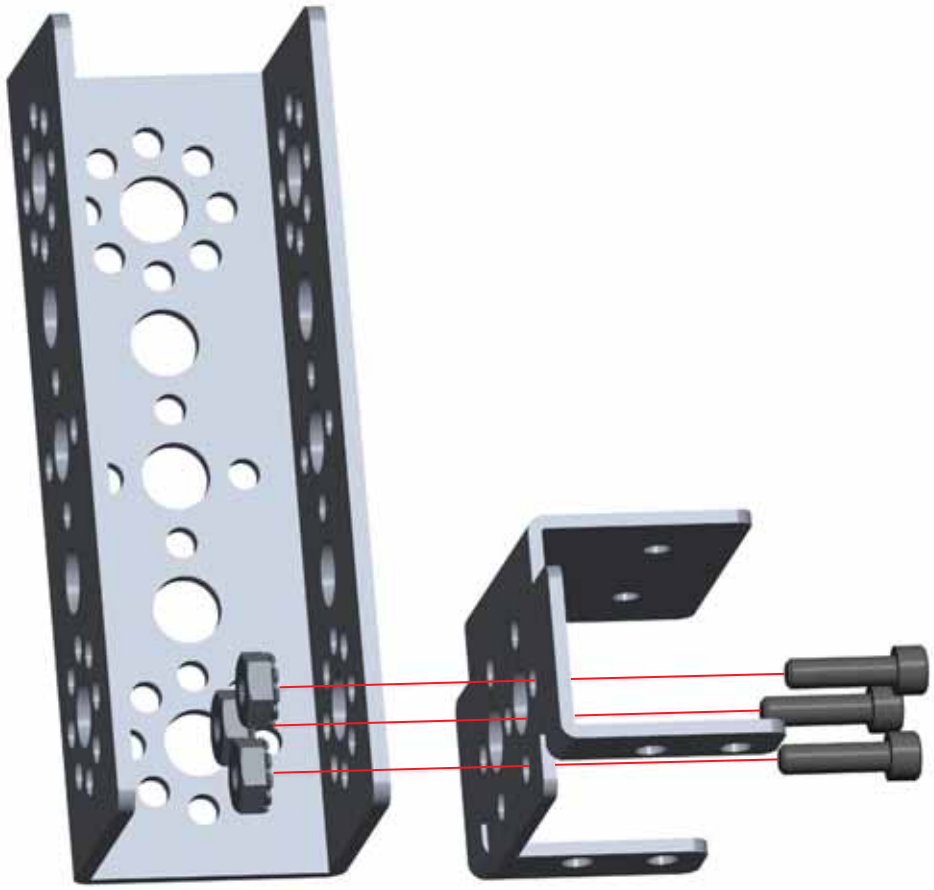
Dispenser Building Guide

Step 1

Parts Needed



1x 96 mm Channel | 1x Single-Servo Motor Bracket | 3x 1/2" SHCS | 3x Kep Nut



Tip

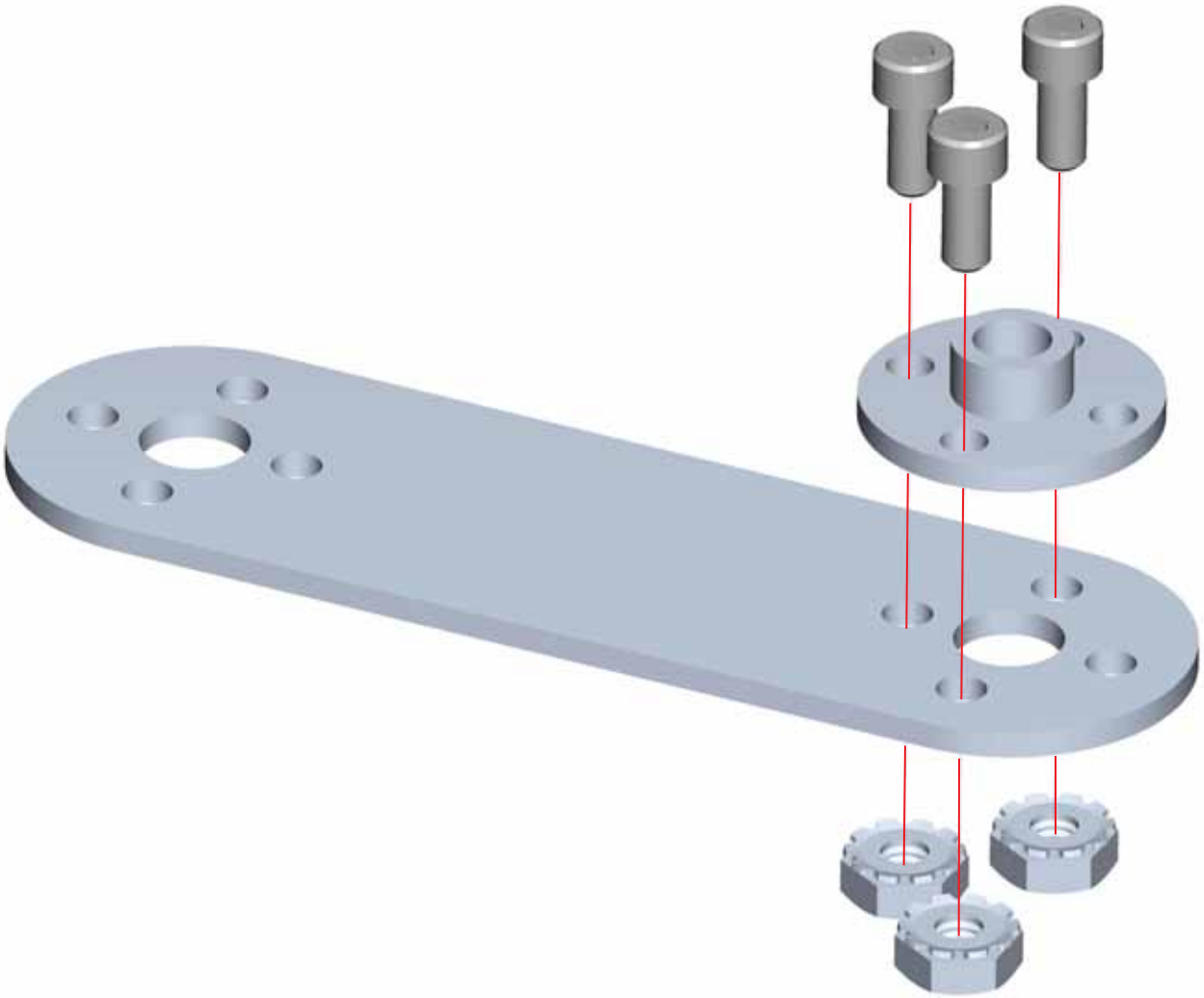
- Ensure that the teeth of the nut face the head of the screw.

Dispenser Building Guide

Step 2

Parts Needed

1x Servo Horn | 1x Flat Bracket | 3x 5/16" SHCS | 3x Kep Nut



Tip

- Reminder: Ensure that the teeth of the nut face the head of the screw.

Dispenser Building Guide

Step 3

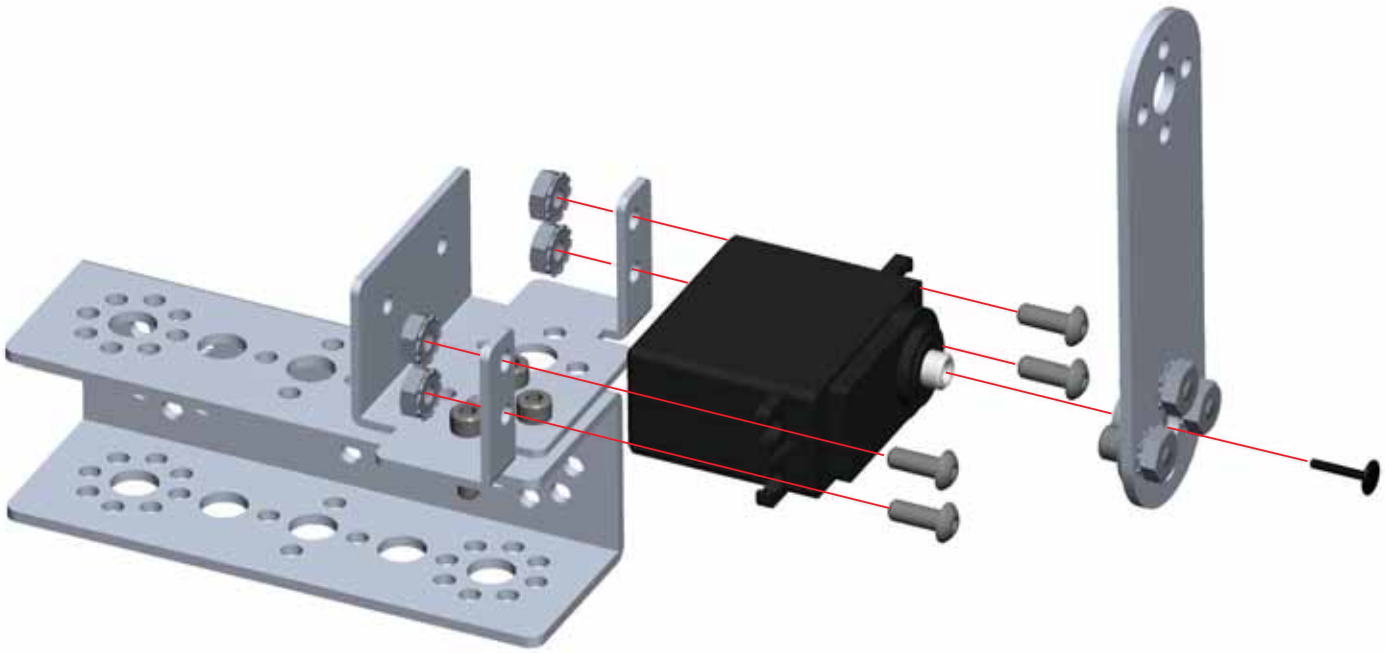
Parts Needed


1x 180° Servo Motor with Horn


1x Servo Screw


4x 3/8" BHCS


4x Kep Nut



Tips

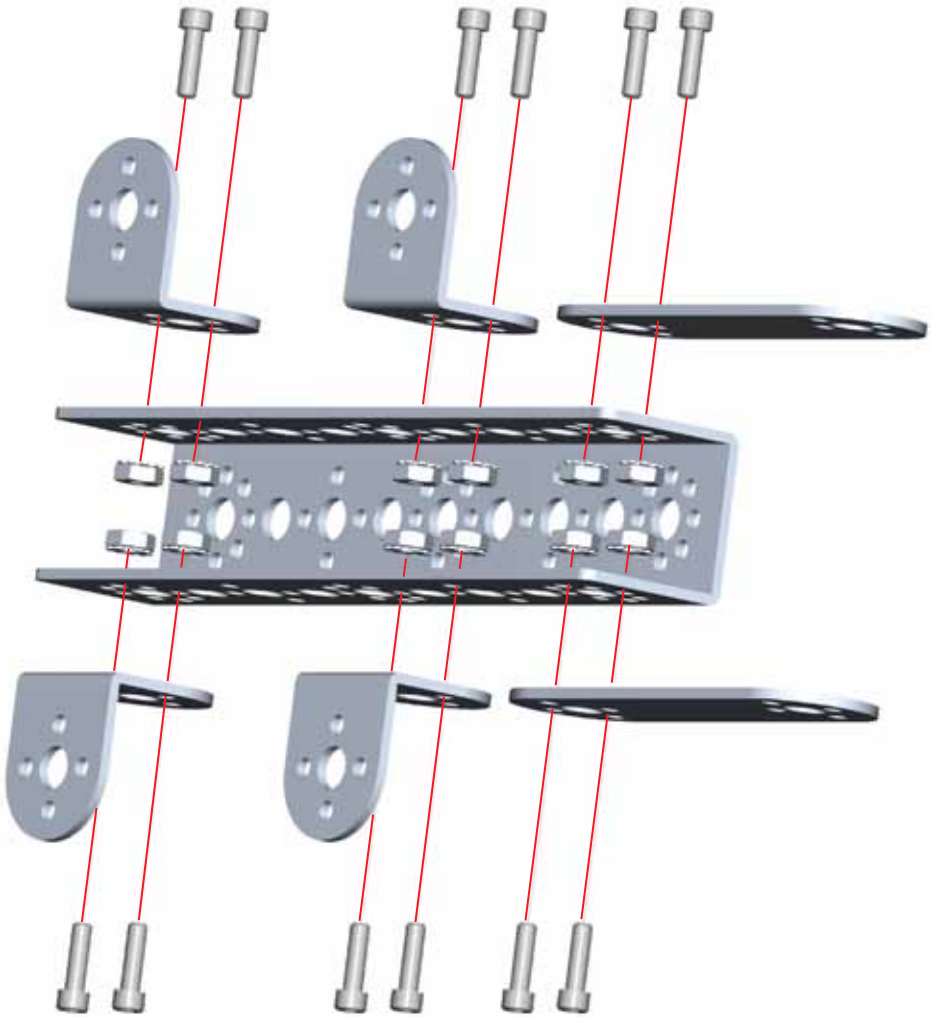
- Use the Phillips head on the 4-in-1 screwdriver to tighten the servo screw. This will keep the servo horn attached to the servo motor.
- Use the 5/64" hex key for the BHCS.

Dispenser Building Guide

Step 4

Parts Needed

2x Flat Bracket | 4x L Bracket | 1x 160 mm Channel | 12x 1/2" SHCS | 12x Kep Nut



Tips

- Ensure that the screw heads are on the outside of the channel.
- Reminder: Ensure that the teeth of the nut face the head of the screw.

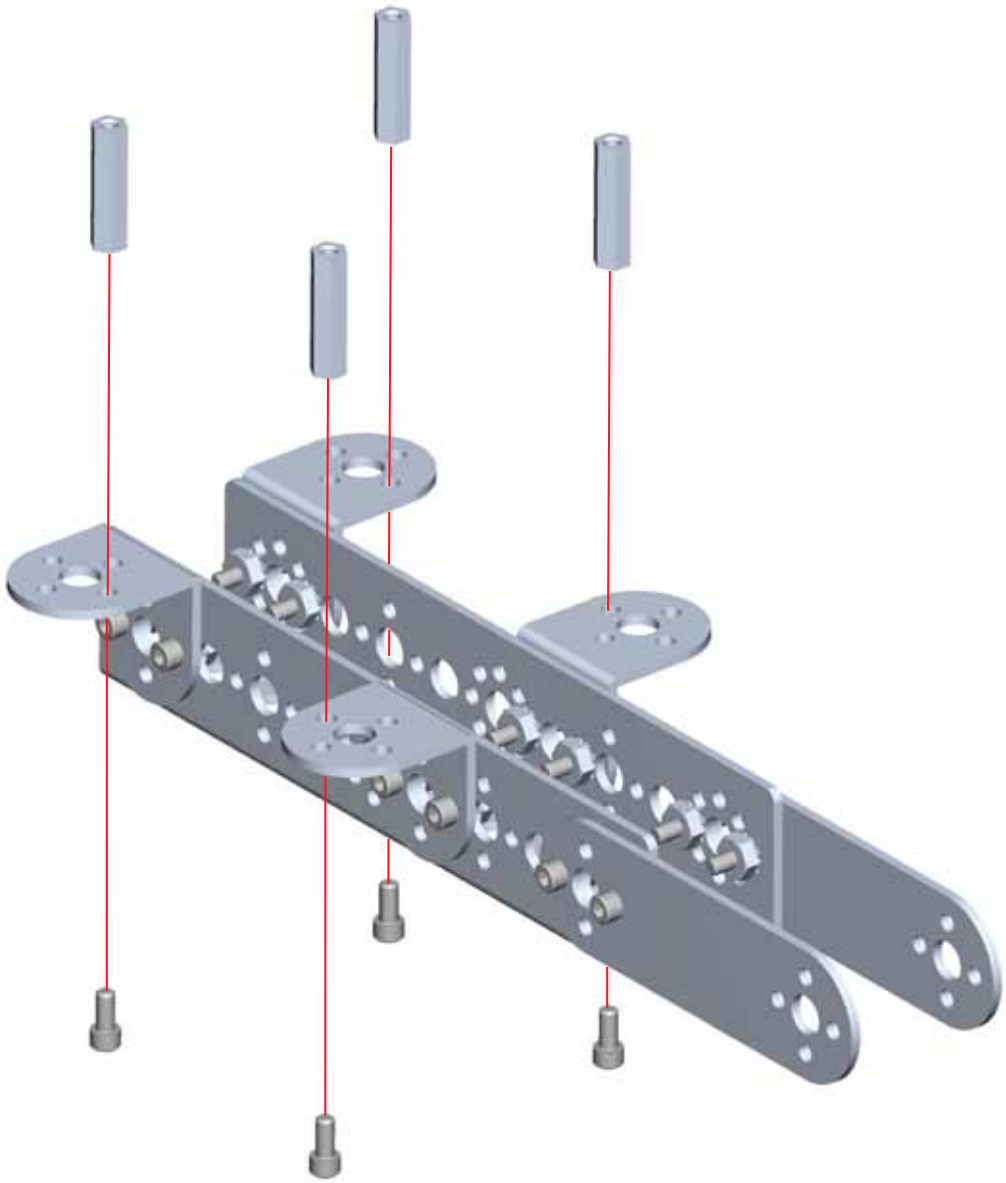
Dispenser Building Guide

Step 5

Parts Needed

4x 1" Stand-Off Post

4x 5/16" SHCS



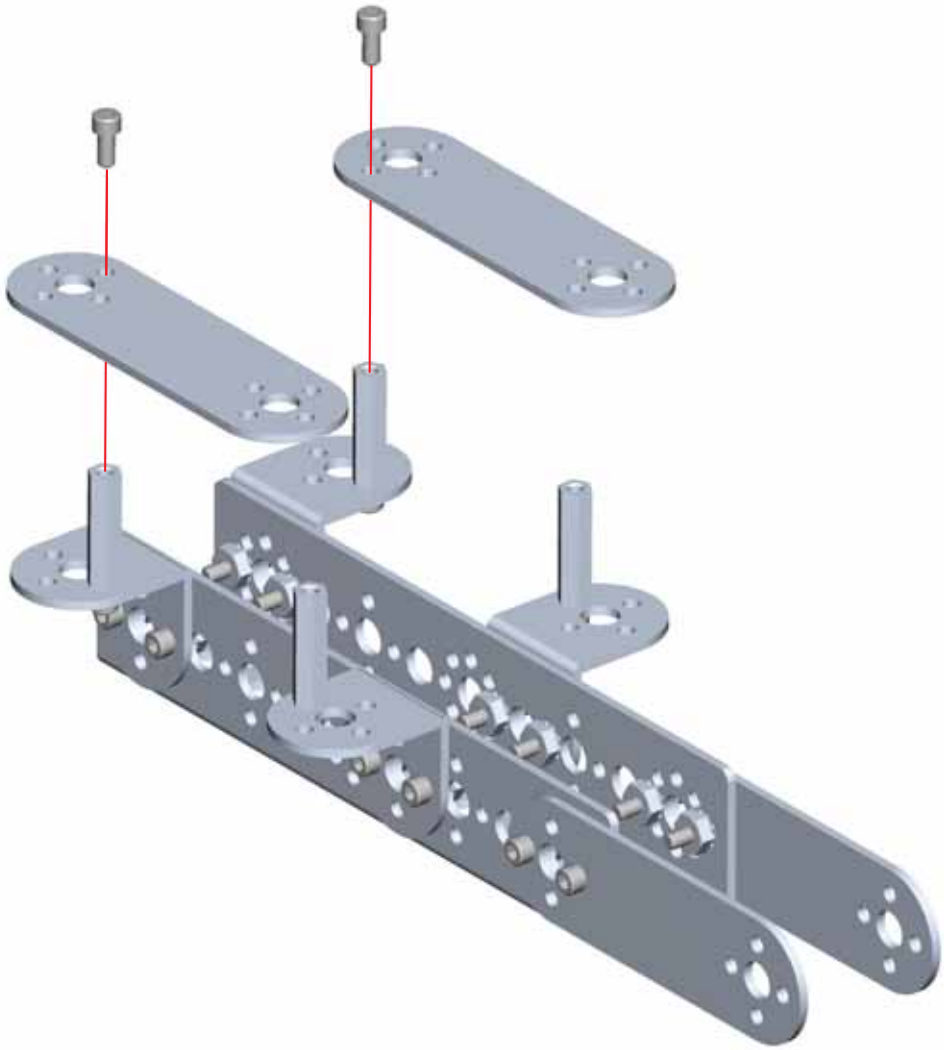
Dispenser Building Guide

Step 6

Parts Needed

2x Flat Bracket

2x 5/16" SHCS



Tips

- Remember not to put the screws on the two front-most stand-off posts; the hard point connectors will go there in Step 12.
- Do not tighten all of the screws fully until Step 12.

Dispenser Building Guide

Step 7

Parts Needed

2x 3-Module Connector Peg with Friction

1x NXT Touch Sensor

Dispenser Building Guide

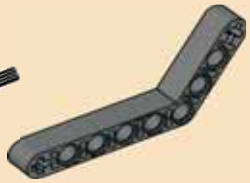
Step 8

Parts Needed


1x 11-Module Beam


2x Half-Module Bushing


2x 12-Module Axle

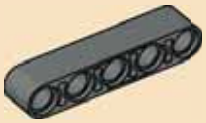

2x 4 x 6-Module Angular Beam


1x 5-Module Axle

Dispenser Building Guide

Step 9

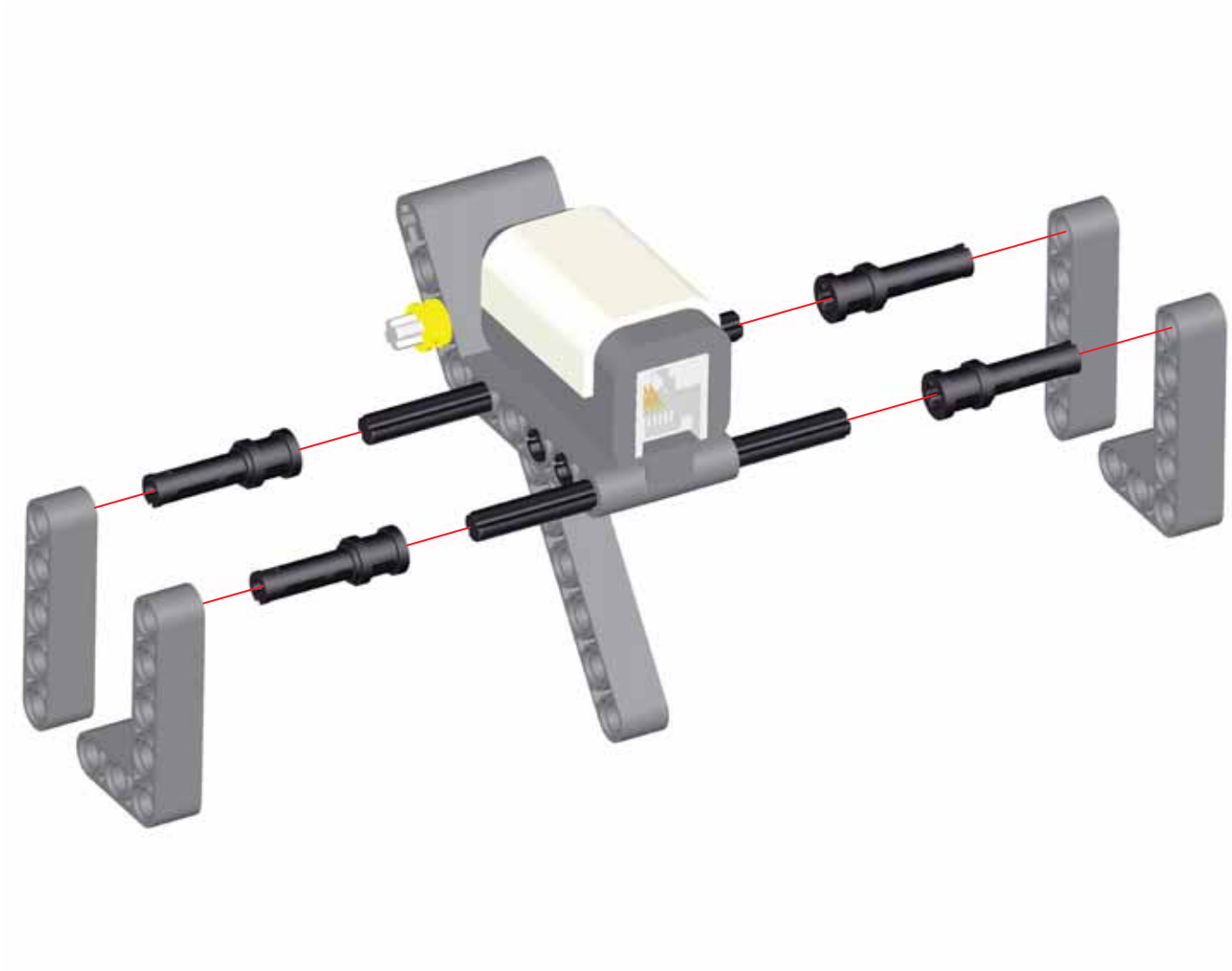
Parts Needed



1x 5-Module Beam

2x 3 x 5-Module Angular Beam

4x Connector Peg with Bushing



Dispenser Building Guide

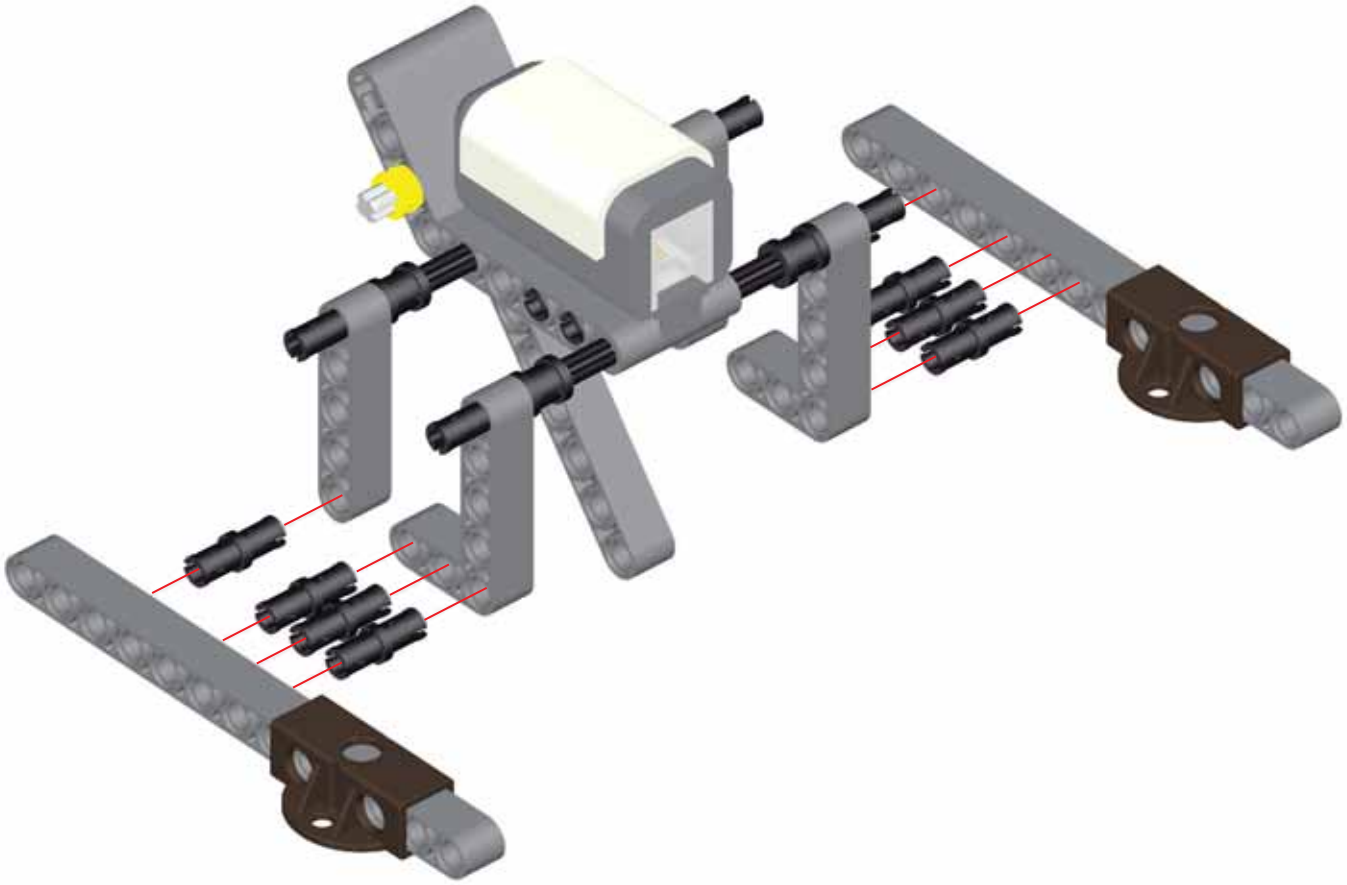
Step 10

Parts Needed

2x TETRIX® Hard Point Connector

2x 13-Module Beam

8x Connector Peg with Friction

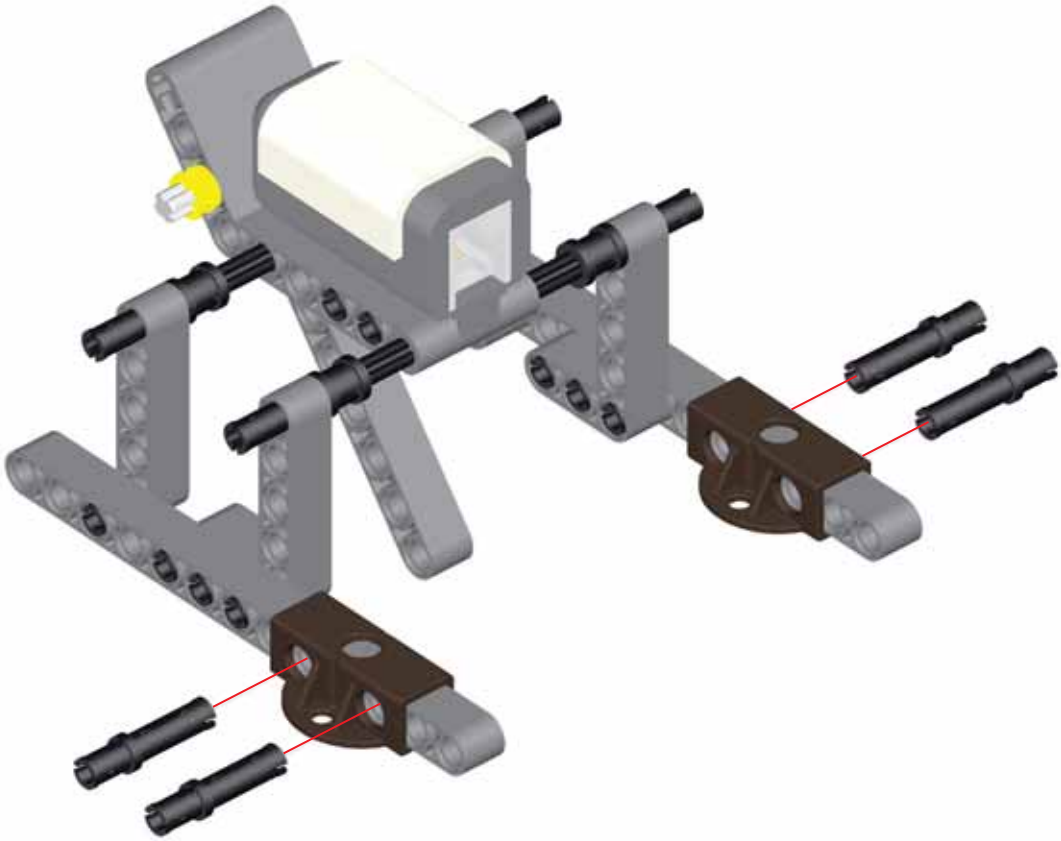


Dispenser Building Guide

Step 11

Parts Needed

4x 3-Module
Connector Peg with
Friction



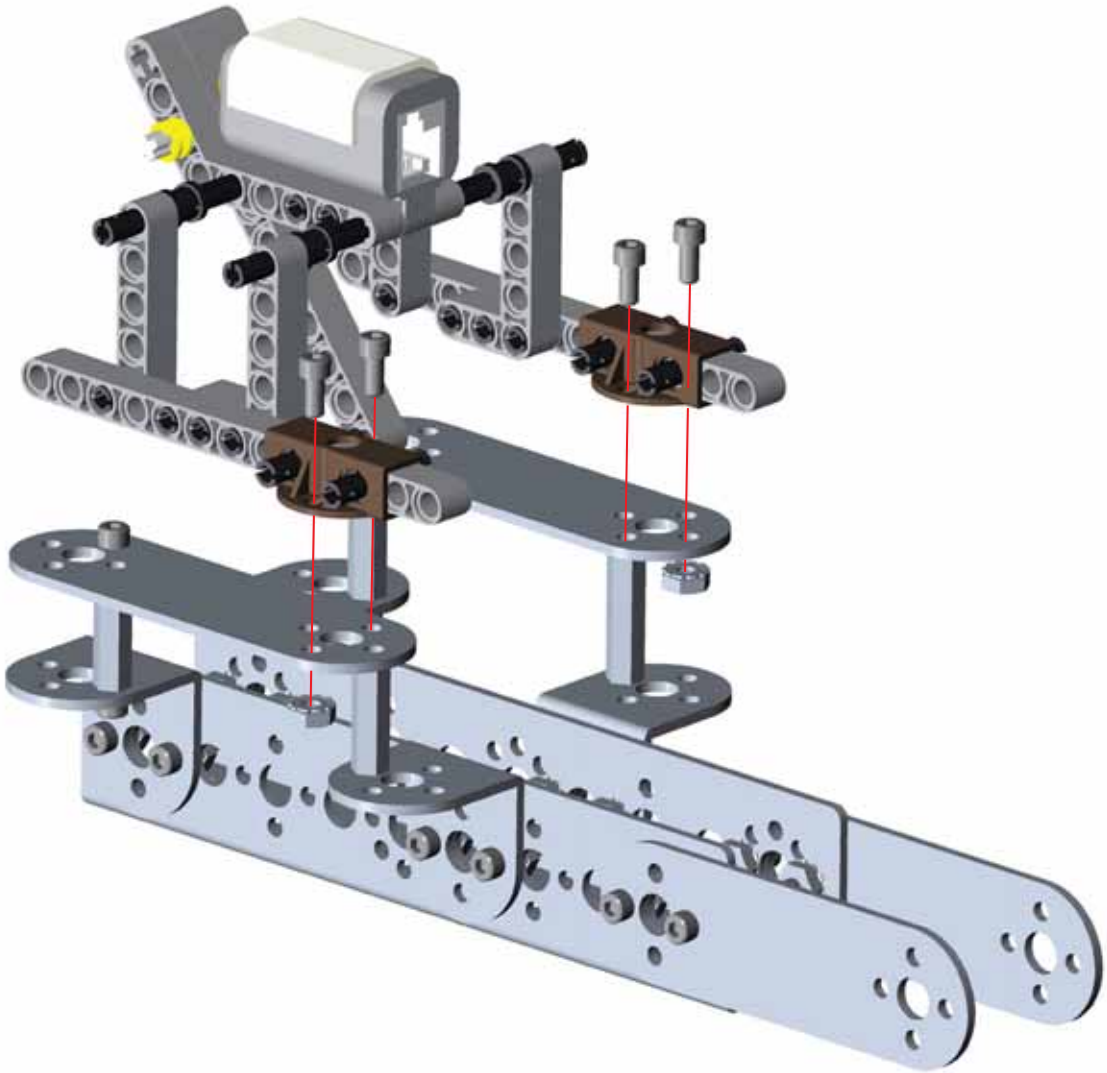
Dispenser Building Guide

Step 12

Parts Needed

4x 5/16" SHCS

2x Kep Nut



Tip

- Turn the screws only until the hard point connector is securely attached to the TETRIX® channel.

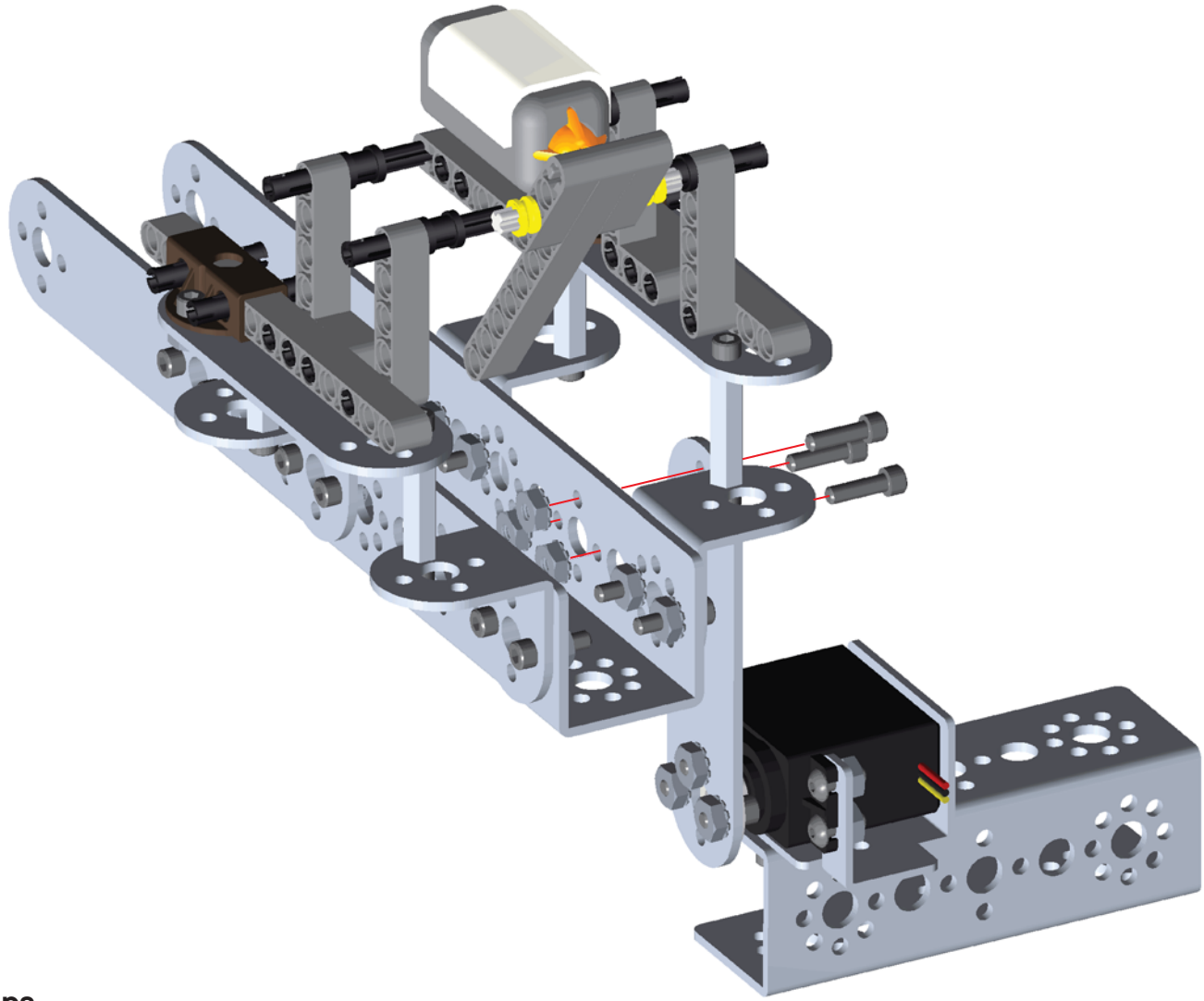
Dispenser Building Guide

Step 13

Parts Needed

3x 1/2" SHCS

3x Kep Nut



Tips

- Ensure that the screws are oriented so that the heads are on the outside of the channel.
- Reminder: Ensure that the teeth of the nut face the head of the screw.

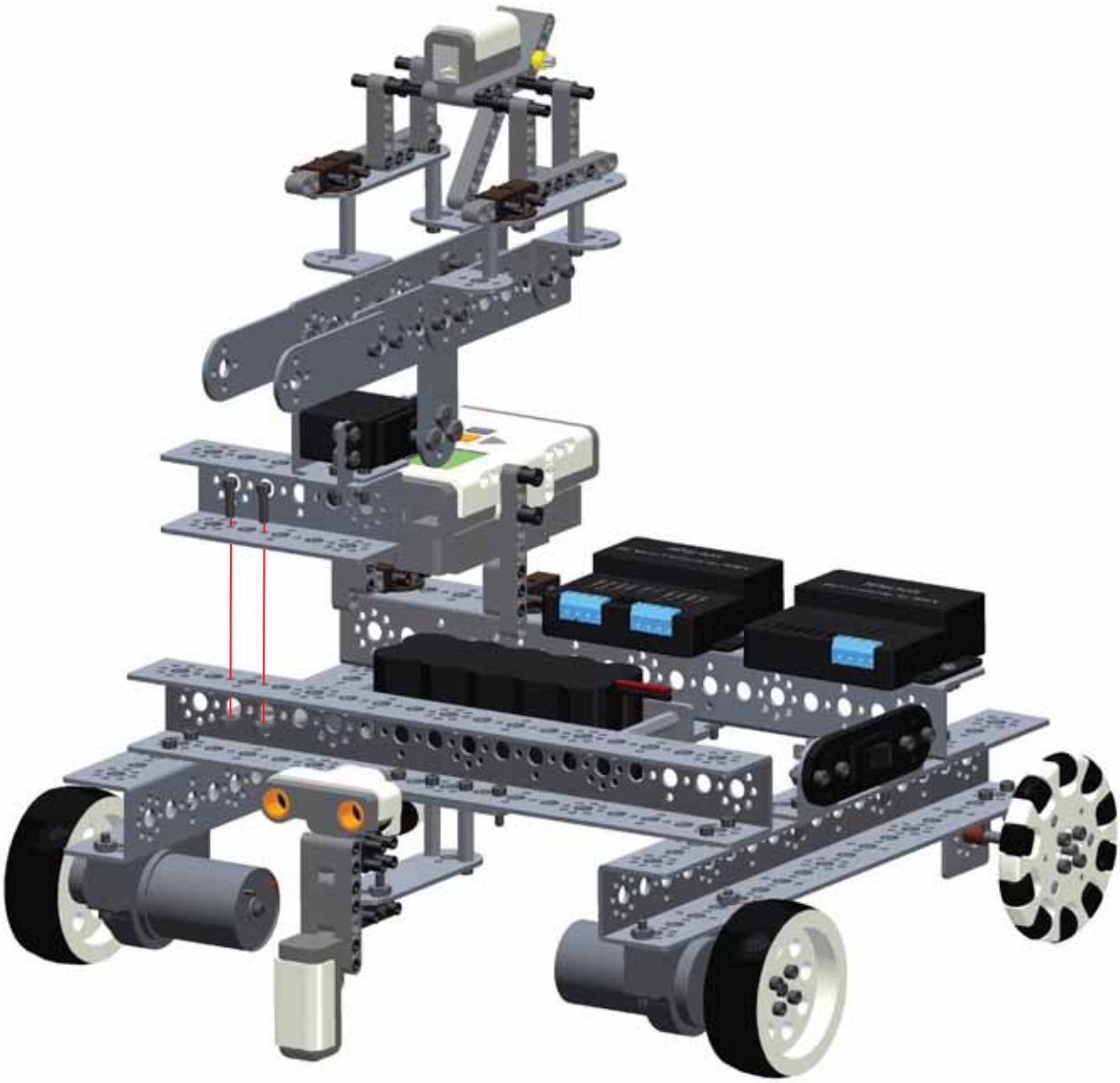
Dispenser Building Guide

Step 14

Parts Needed

2x 1/2" SHCS

2x Kep Nut



Dispenser Building Guide

Final View