PITSCO

TETRIX® PRIME

R/C Builder's Guide

PITSCO EDUCATION

44367

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Check Pitsco.com/TETRIX-PRIME-RC-Robotics-Set#resources for PDF updates of this guide.

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Contents

Preface

Set Components

Setup/Construction Tips

Build Instructions

Preface

Pitsco Education is pleased to bring you this *TETRIX® PRIME R/C Builder's Guide*. This resource has been created to:

- Help introduce new users to the TETRIX PRIME building system.
- Demonstrate how the building system can be used to create original, remote-controlled robot designs and give inspiration for expanding beyond the provided builds.
- Provide step-by-step instructions that progressively guide users with little or no previous experience to a comfortable level working within a real-world, scalable building system.
- Build confidence and generate enthusiasm for the fields of engineering and robotics.

Expected Outcomes:

This builder's guide has been developed to provide students with positive experiences in robotics engineering. With the assistance of this guide, students will learn to use the TETRIX PRIME parts to design and construct three different robots. After using this guide, students should be able to use the TETRIX PRIME parts to construct a robot of their own design.

Using This Guide:

The activities in this guide build upon each other. The activities should be completed in the order in which they are presented. Concepts explored in one activity might not be repeated in later activities, but students could be required to understand the concepts in order to be most successful. When students are completing the activities, they should work in teams of two to three as the interaction and problem-solving among peers enhances and encourages the learning process.

Grade-Level Appropriateness:

The activities used in this guide are targeted toward middle school students. With some additional instruction, upper elementary students should be able to successfully complete the activities. Additionally, secondary teachers could use these parts to provide an exploratory experience in engineering.

Time Expectations:

The TETRIX PRIME R/C Robotics Set contains all the essential tools and hardware needed to enable users to build all the robots shown in the builder's guide one at a time. The models in this guide are meant to progress in complexity in order to foster the growth of technical building skills for the new or inexperienced user. Please keep that in mind when planning for build time. Depending on user experience and skill level, each model should be able to be completed in one or two, 45- to 50-minute class periods. Specific time expectations for each model are given in the model overview and are unique to that model.

Safety Information

Mechanical

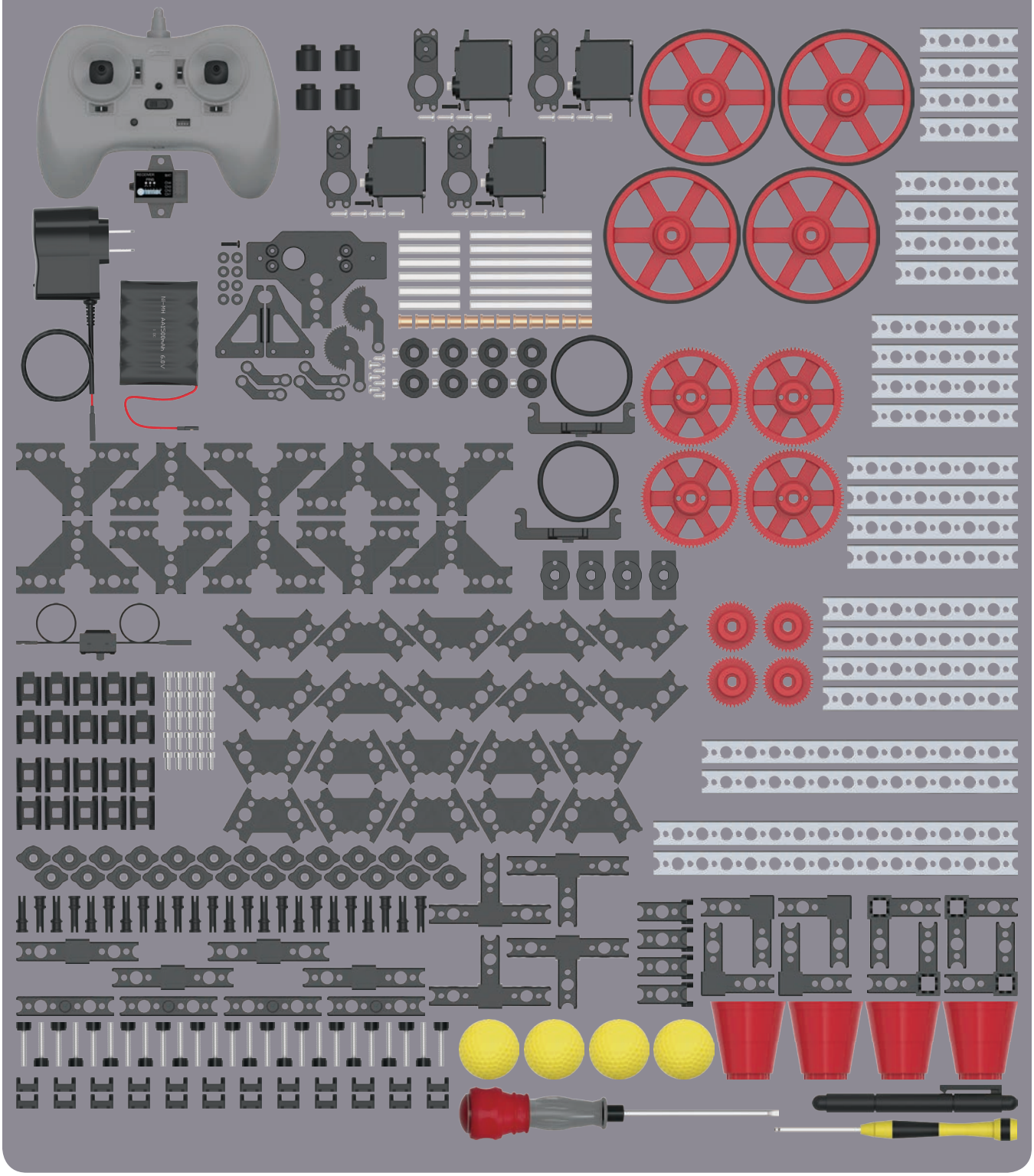
- Keep fingers, hair, and loose articles of clothing clear of gears and moving parts.
- Never pick up the robot while it is moving or the servo motors are running.
- Remove any burrs caused by cutting the metal beams.

Electrical

- Make sure the power is turned off when the robot is not in operation.
- Do not operate the robot in a wet environment.
- Always power down the robot before making any changes.
- Use caution when working with bare wires to avoid creating a short circuit situation.
- Route wires carefully and secure them if necessary to avoid damage to the wire or its insulation.
- Mount the battery pack and all electronic components securely.

R/C Robotics Set

Note: In order to complete the three builds shown in this book, you must have the TETRIX PRIME R/C Robotics Set.



TETRIX PRIME R/C Robotics Set Parts Index

Beams

Part No.	Part Name	Quantity
40201	TETRIX PRIME 4-Hole Square Beam	4
40202	TETRIX PRIME 5-Hole Square Beam	4
40203	TETRIX PRIME 6-Hole Square Beam	4
40204	TETRIX PRIME 7-Hole Square Beam	4
40205	TETRIX PRIME 8-Hole Square Beam	4
40206	TETRIX PRIME 13-Hole Square Beam	2
40207	TETRIX PRIME 15-Hole Square Beam	2

Internal Connectors

Part No.	Part Name	Quantity
40212	TETRIX PRIME 3-Way Beam Connector	4
40213	TETRIX PRIME Tee Beam Connector	4
40211	TETRIX PRIME 90-Degree Beam Connector	4
40214	TETRIX PRIME Beam End Connector	4
40322	TETRIX PRIME Beam Extension Connector	4
40215	TETRIX PRIME Beam Straight Connector	4

External Connectors

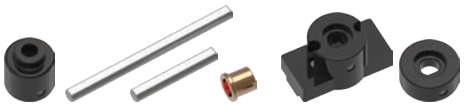
Part No.	Part Name	Quantity
40208	TETRIX PRIME 90-Degree Beam Bracket	10
40209	TETRIX PRIME 60-Degree Beam Bracket	10
40210	TETRIX PRIME Tee Beam Bracket	10
40216	TETRIX PRIME Straight Block Beam Connector	10
40217	TETRIX PRIME 90-Degree Cross Block Connector	10

Connecting Hardware

Part No.	Part Name	Quantity
40219	TETRIX PRIME Quick Rivet Connector	15
40220	TETRIX PRIME Quick Rivet Peg	24
40221	TETRIX PRIME Wing Nut	24
40323	TETRIX PRIME Thumbscrew	24
40516	Socket Head Cap Screw	25

Wheels, Gears, & Servos

Part No.	Part Name	Quantity
40222	TETRIX PRIME Wheel with Tire	4
40223	TETRIX PRIME 40-Tooth Plastic Gear	4
40224	TETRIX PRIME 80-Tooth Plastic Gear	4
40538	TETRIX Standard-Scale Servo Motor	2
40379	TETRIX Continuous Rotation Servo Motor	2
40232	TETRIX PRIME Servo Mounting Bracket	4



Wheel, Gear, & Servo Hardware

Part No.	Part Name	Quantity
40230	TETRIX PRIME Shaft Servo Hub	4
40225	TETRIX PRIME 80 mm Steel Axle	6
40226	TETRIX PRIME 40 mm Steel Axle	6
40227	TETRIX PRIME 8 mm x 6 mm Bronze Bushing	12
40228	TETRIX PRIME Beam Attachment Hub	4
40229	TETRIX PRIME D-Shaft Set Collar	8

Gripper Assembly & Controllers

Part No.	Part Name	Quantity
40234	TETRIX PRIME Gripper Kit	1
40239	TETRIX Wireless Joystick Gamepad System with Receiver	1

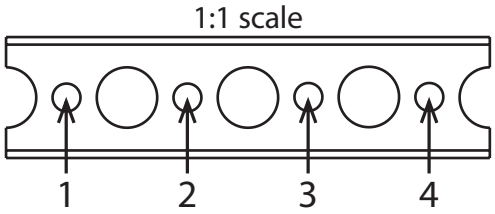
Batteries & Hardware

Part No.	Part Name	Quantity
40236	TETRIX PRIME Battery Mount Bracket	2
40235	TETRIX PRIME 6 V NiMH Battery Pack	1
40457	TETRIX PRIME Battery Pack On/Off Switch	1
40378	TETRIX PRIME 5-Cell NiMH Battery Pack Charger	1
36404	4-in-1 Screwdriver	1
40341	Miniature Ball-Point Hex Driver	1
42991	2-in-1 Screwdriver	1
41769	Plastic 2 oz Cups	4
14041	Practice Golf Balls	4
44367	TETRIX PRIME Builder's Guide	1

TETRIX PRIME Hardware Components

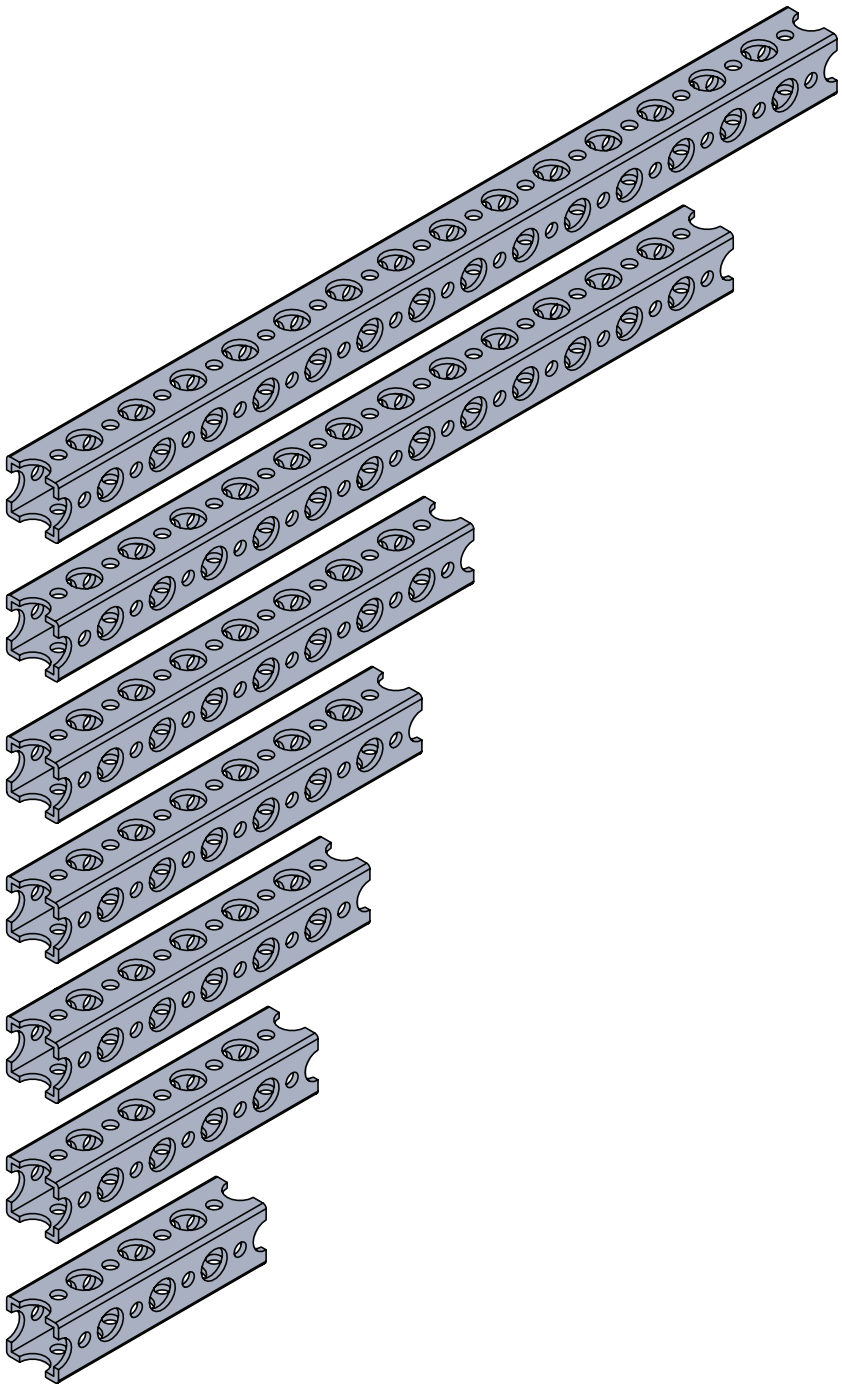
Beams

The beams are named by the number of small holes on one side of the beam. Do not select beams by counting the larger holes (see right).



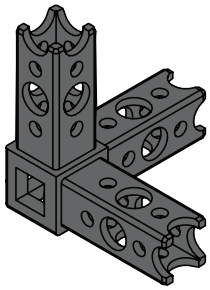
To identify TETRIX PRIME Square Beams, count the small holes. The example above is a 4-hole square beam.

Structural Elements

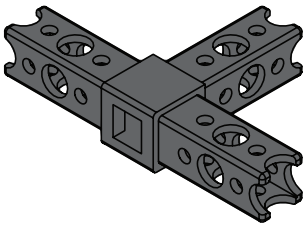


Structural Elements

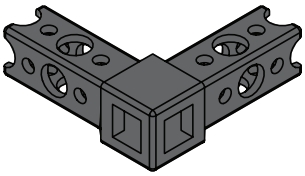
3-Way Beam Connector 40212



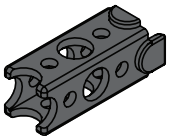
Tee Beam Connector 40213



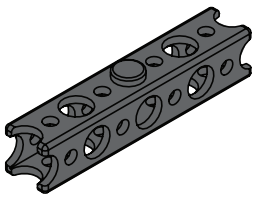
90-Degree Beam Connector 40211



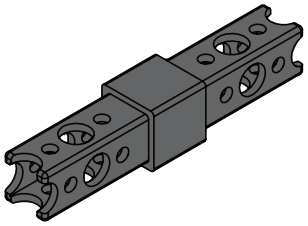
Beam End Connector 40214



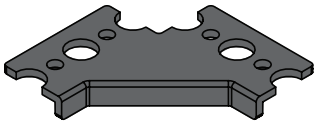
Beam Extension Connector 40322

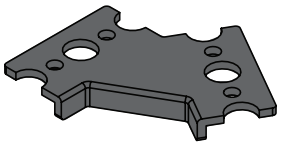


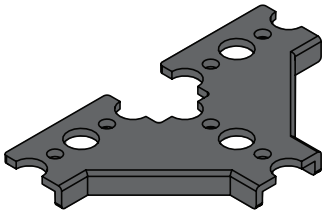
Beam Straight Connector 40215



Structural Elements

90-Degree Beam Bracket 40208 

60-Degree Beam Bracket 40209 

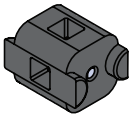
Tee Beam Bracket 40210 

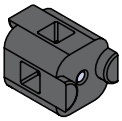
Quick Rivet Connector 40219 

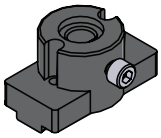
Quick Rivet Peg 40220 

Wing Nut 40221 

Thumbscrew 40323 

Straight Block Beam Connector 40216 

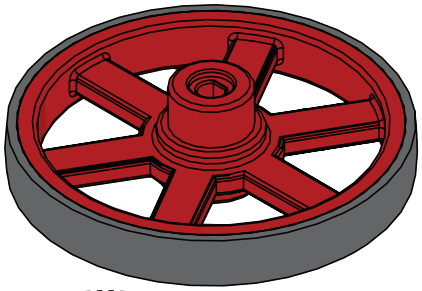
90-Degree Cross Block Connector 40217 

Beam Attachment Hub 40228 

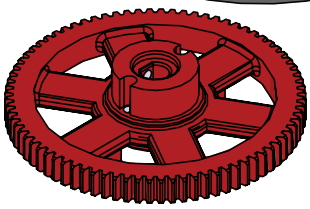
Tip: These two parts, the straight block beam connector and the 90-degree cross block connector, are very close in appearance and can be easily confused. Please double-check that you are using the one the directions call for.

Motion Elements

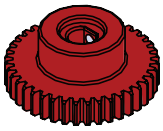
Wheel with Tire 40222



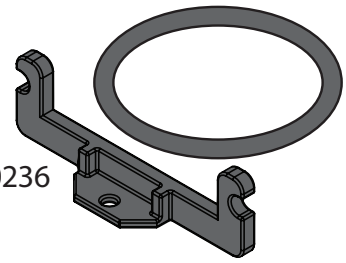
80-Tooth Plastic Gear 40224



40-Tooth Plastic Gear 40223



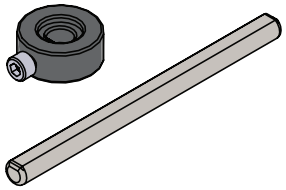
Battery Mount Bracket 40236



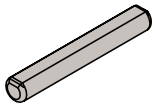
8 mm x 6 mm Bronze Bushing 40227

D-Shaft Set Collar 40229

80 mm Steel Axle 40225

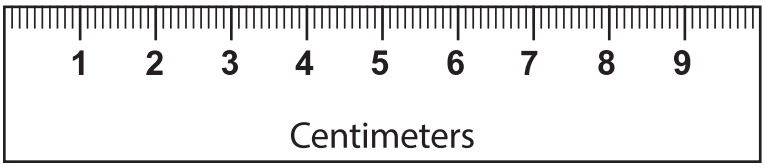


40 mm Steel Axle 40226



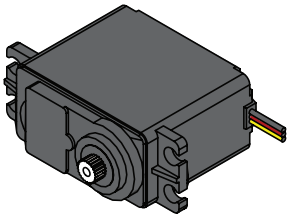
Socket Head Cap Screw 40516

Measure 80 mm and 40 mm steel axles here.

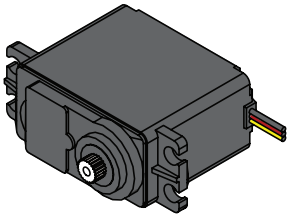


Motion Elements

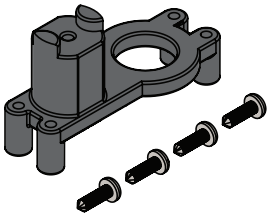
Standard-Scale Servo Motor 40538



Continuous Rotation Servo Motor 40379

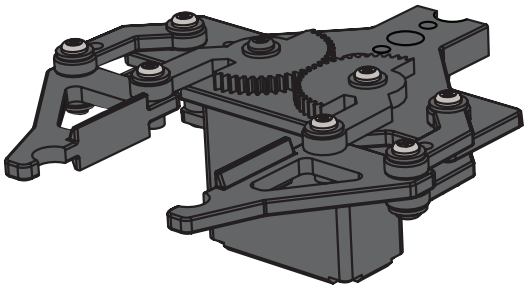


Servo Mounting Bracket 40232



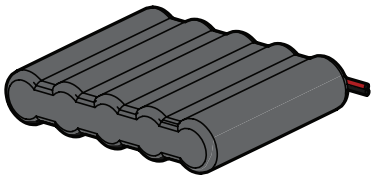
Shaft Servo Hub 40230

Gripper Kit 40234

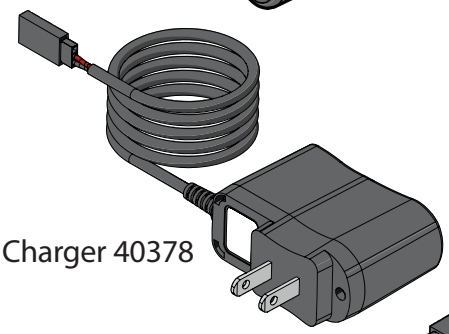


Power, Tools, and Accessories Elements

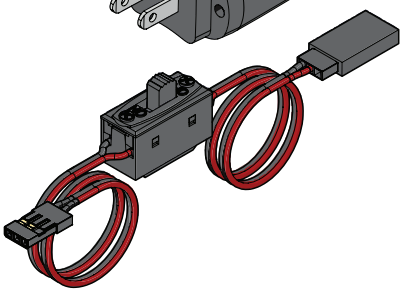
6 V NiMH Battery Pack 40235



5-Cell NiMH Battery Pack Charger 40378

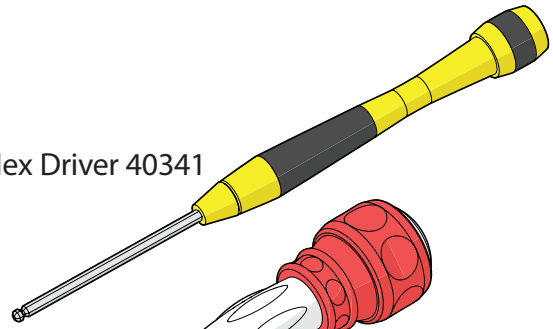


Battery Pack On/Off Switch 40457

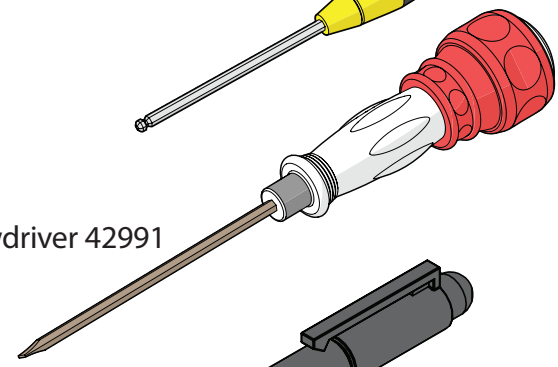


Power, Tools, and Accessories Elements

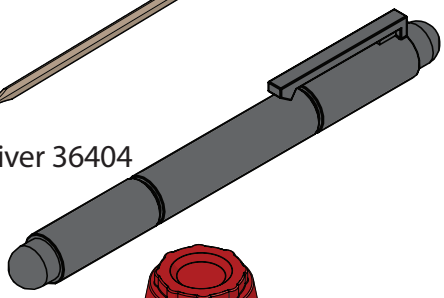
Miniature Ball-Point Hex Driver 40341



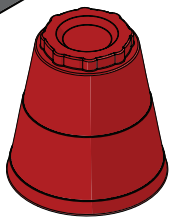
2-in-1 Screwdriver 42991



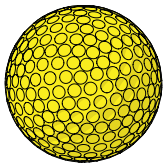
4-in-1 Screwdriver 36404



Plastic 2 oz Cups 41769

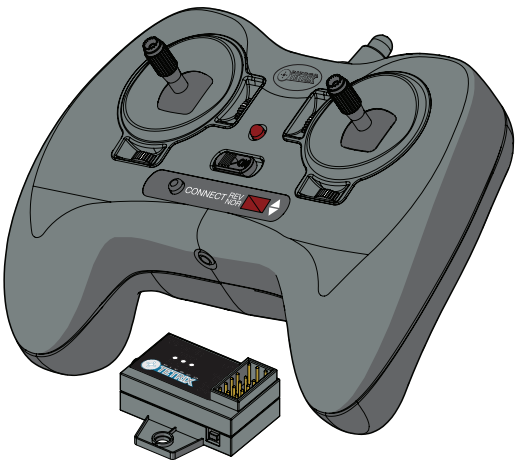


Practice Golf Balls 14041



Control Elements

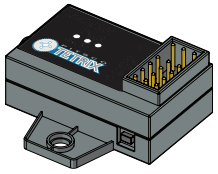
Wireless Joystick Gamepad System with Receiver 40239



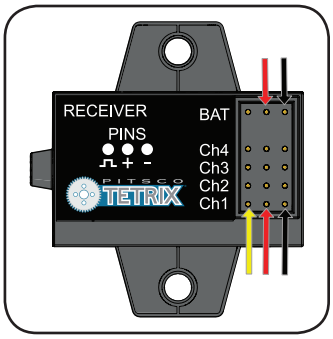
Remote Control Setup

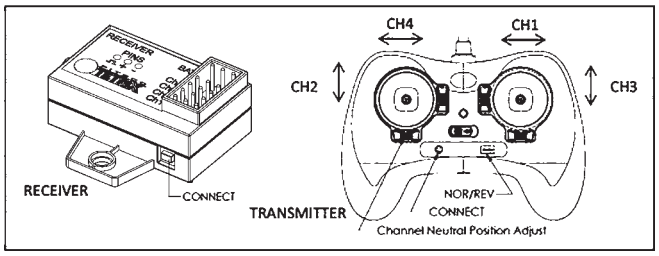
Your TETRIX PRIME robot is controlled by a standard 2.4 GHz remote control and an accompanying receiver mounted to the robot. Transmitters are connected to specific receivers, allowing multiple transceiver combinations to be used in the same area.

Wireless Joystick Gamepad System 40239



4-Channel Wireless Receiver from Wireless Joystick Gamepad System 40239





Transmitter and Receiver Connection Procedure:

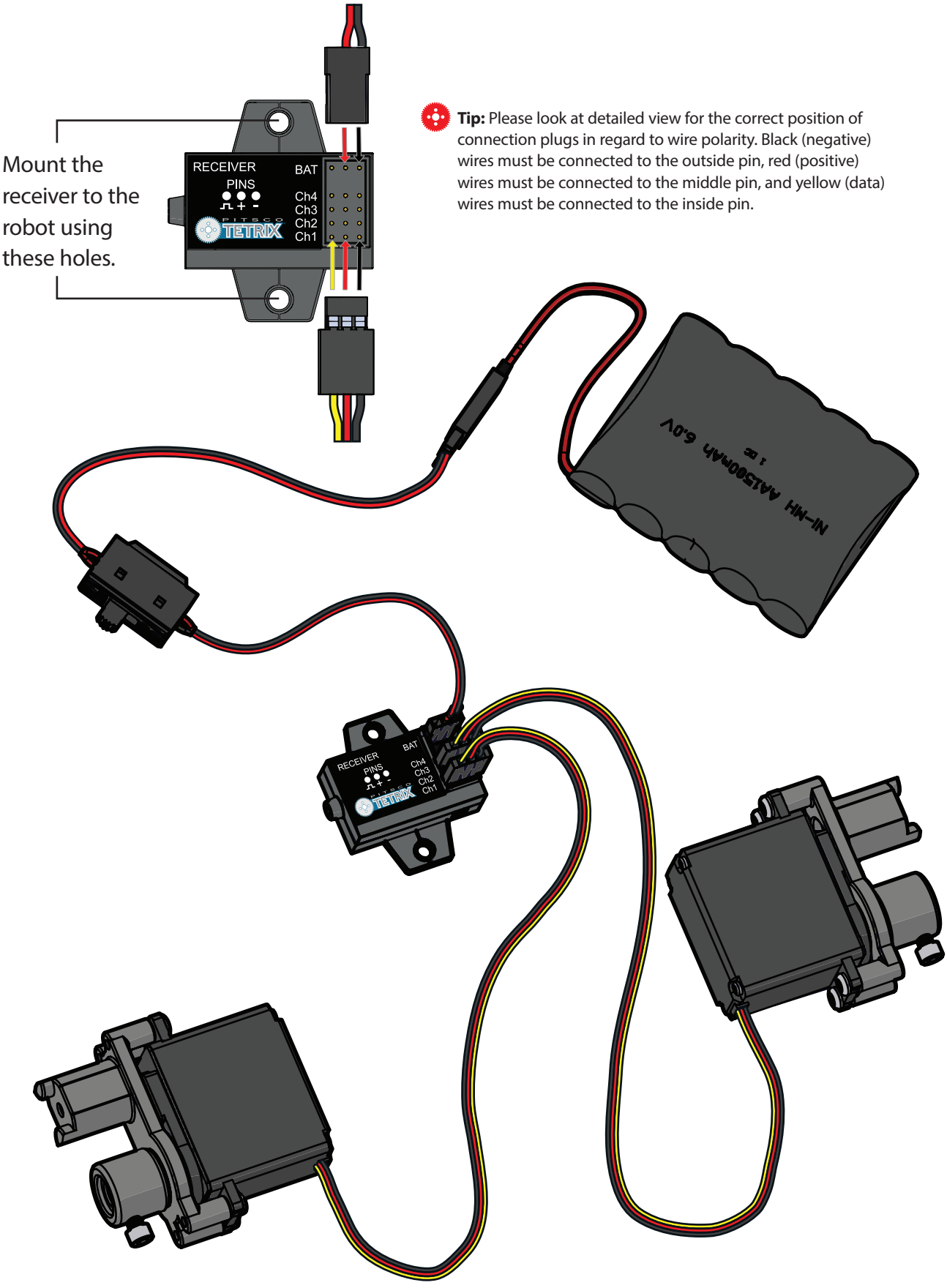
The wireless gamepad transmitter must be linked to the receiver with a unique ID code in order to function properly. To do this, follow these steps:

1. Make sure the transmitter is switched OFF.
2. Install four AA batteries in the transmitter. Connect the battery pack to the receiver; the red LED will be flashing.
3. Press the CONNECT button on the side of the receiver. The red LED will change to a rapid flashing rate.
4. Switch the power slide switch on the transmitter ON.
5. Press and hold down the transmitter's CONNECT push button.
6. The red LED on the receiver will stop flashing. Release the transmitter's CONNECT button.
7. The transmitter and receiver are now connected and ready for operation.

The transmitter might require periodic adjustment. Located next to each joystick are trimmer wheels used to adjust the neutral position of each channel. Trim each channel by moving the wheel until no movement of the servo occurs when the joystick is in the neutral position.

The direction of movement for servos might change due to servo positioning. To change the direction of movement, use a small screwdriver to change the position of the NOR/REV switches on the transmitter. **Caution:** Do not use a pencil to adjust the NOR/REV switch position. The material used for pencil lead conducts electricity and could damage your controller.

TETRIX PRIME Wiring Illustration

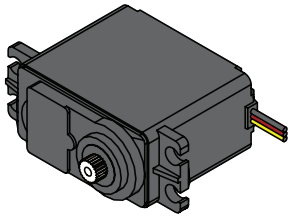


Tip: Please look at detailed view for the correct position of connection plugs in regard to wire polarity. Black (negative) wires must be connected to the outside pin, red (positive) wires must be connected to the middle pin, and yellow (data) wires must be connected to the inside pin.

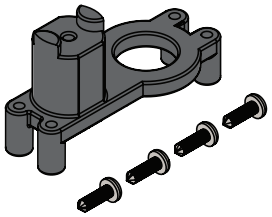
Standard Servo Assembly

You will need the standard-scale servo motor with screw, the servo mounting bracket with screws, a shaft servo hub, and a socket head cap screw. You will also need the 4-in-1 screwdriver and the miniature ball-point hex driver. Remove the white plastic servo horn attached to the servo. Retain the screw for future use, but discard the white plastic servo horn. Attach the Standard Servo label to the servo. Assemble one of the standard servos as indicated in the illustrations. The other standard servo will be used for the gripper assembly.

Standard servo motors are used for proportional rotation and for grippers, steering, and positioning.



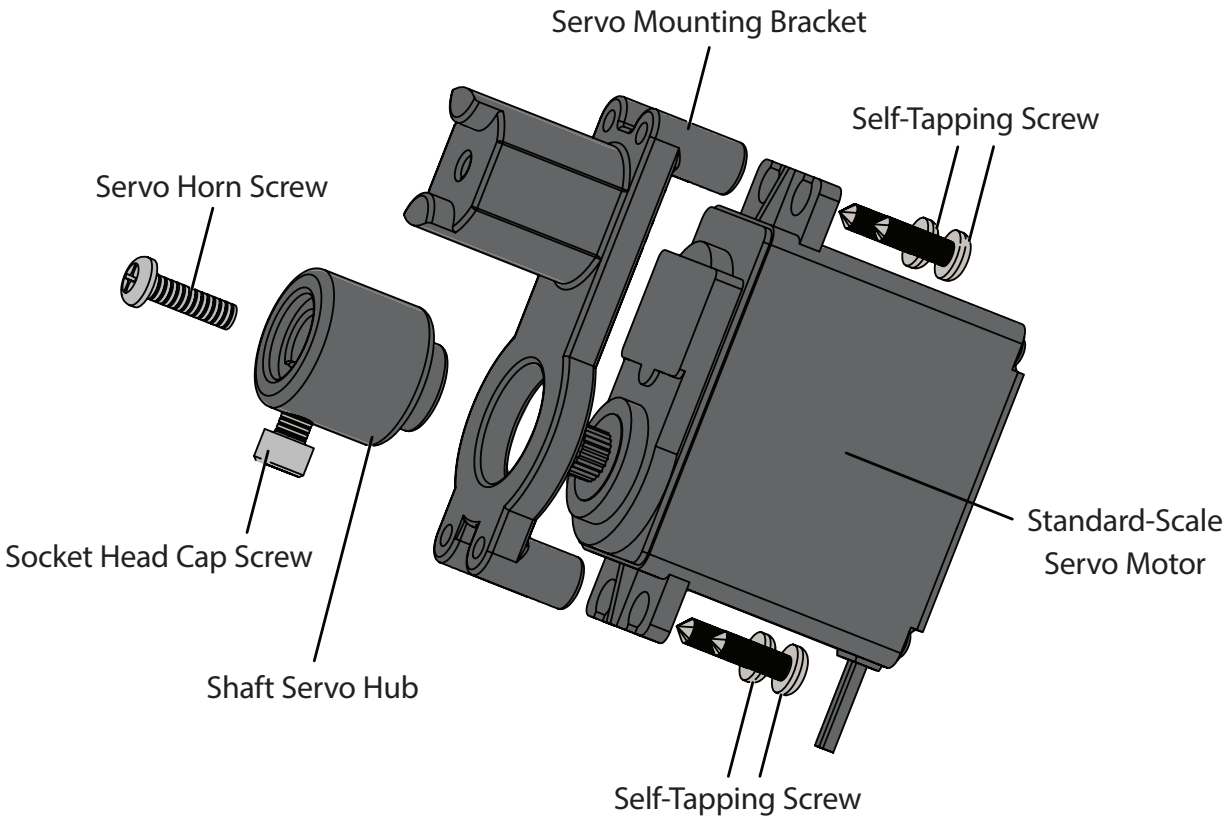
1x
Standard-Scale
Servo Motor 40538



1x
Servo Mounting
Bracket 40232

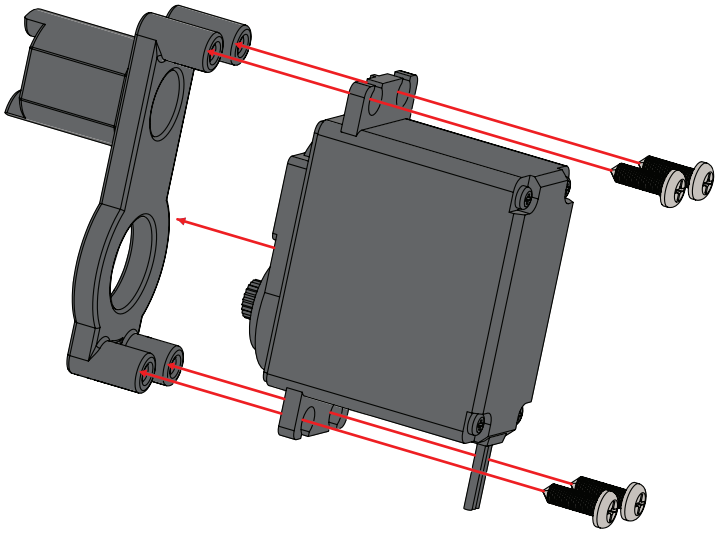
1x
Shaft Servo Hub
40230

1x
Socket Head Cap
Screw 40516

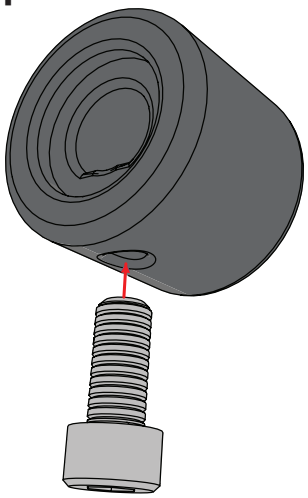


Tip: Keep in mind that the continuous rotation servo mounts in the servo mounting bracket the same way as the standard servo, but there is no need to center the servo horn.

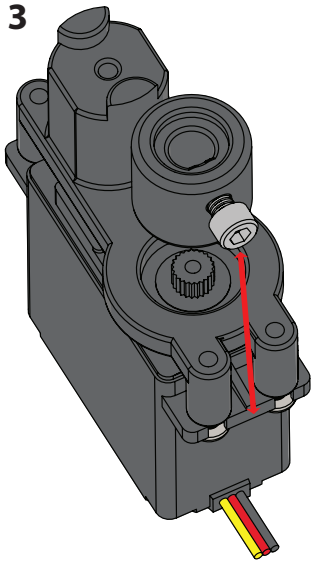
Step 1



Step 2

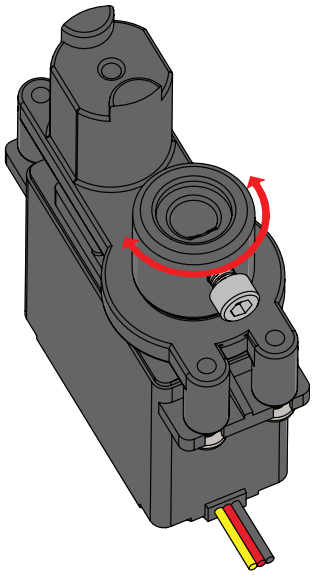


Step 3

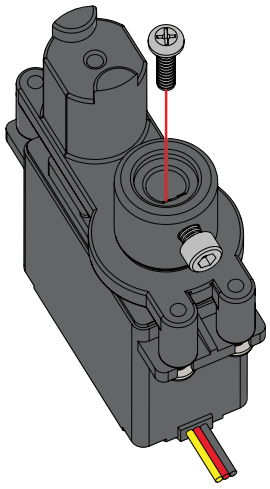


Step 4

Before attaching the servo hub, you must make sure the server is in the neutral position. To do this, connect both the servo and the battery to the receiver and turn on the power to the remote transmitter. Make sure both joysticks and trimmers are in the center, or neutral, position. The servo motor will move to its neutral position.



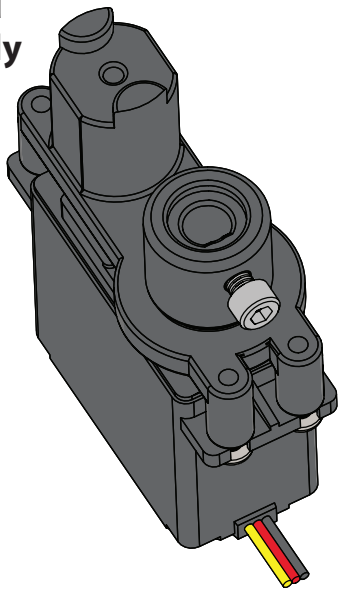
Step 5



Line up the splines on the hub with the splines on the servo and press the two parts together. The set screw should line up as close as possible with the center of the servo case. Tighten the screw holding the hub in place.

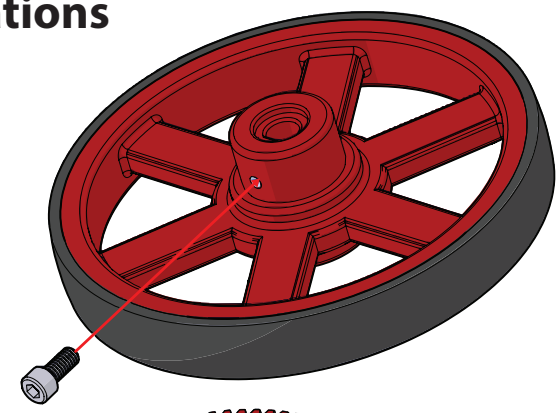
Using the remote transmitter, verify the operation of the servo. If the servo operates properly, disconnect the battery from the receiver and the servo. Your servos are ready for use.

Finished Assembly

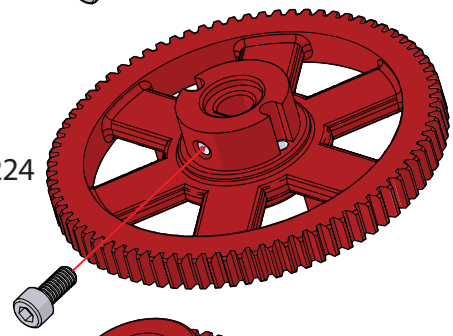


Set Screw Applications

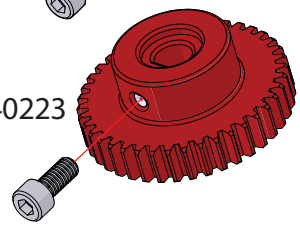
Wheel with Tire 40222



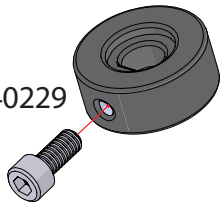
80-Tooth Plastic Gear 40224



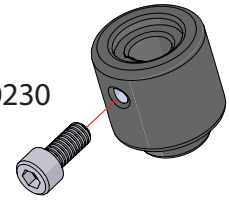
40-Tooth Plastic Gear 40223



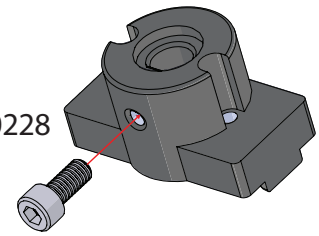
D-Shaft Set Collar 40229



Shaft Servo Hub 40230



Beam Attachment Hub 40228



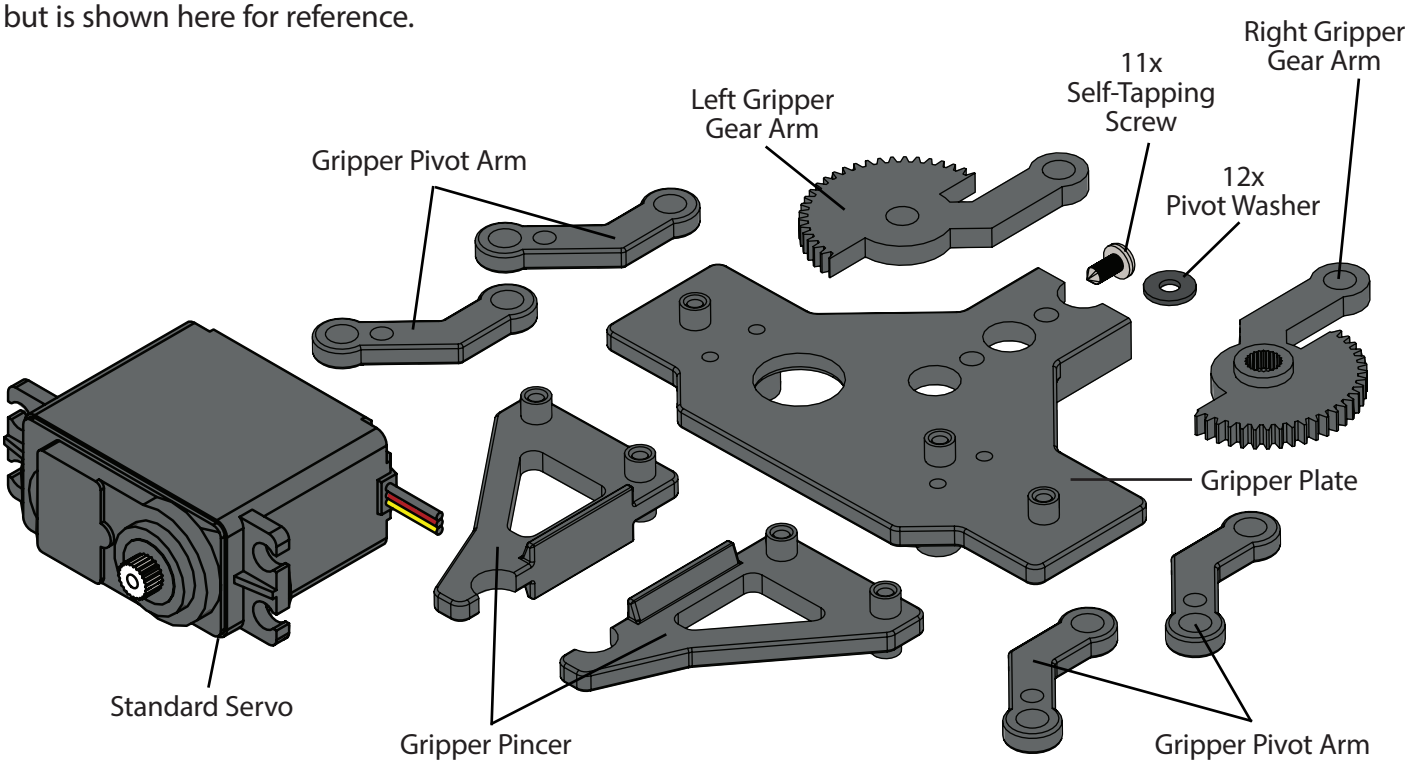
Tip: Please keep in mind that if your parts already have socket head cap screws installed and the directions call for that operation, you can skip to the next step.

Tip: Directions will show these types of parts in proper position. After the parts are in place, don't forget to tighten the socket head cap screws before moving on to the next step.

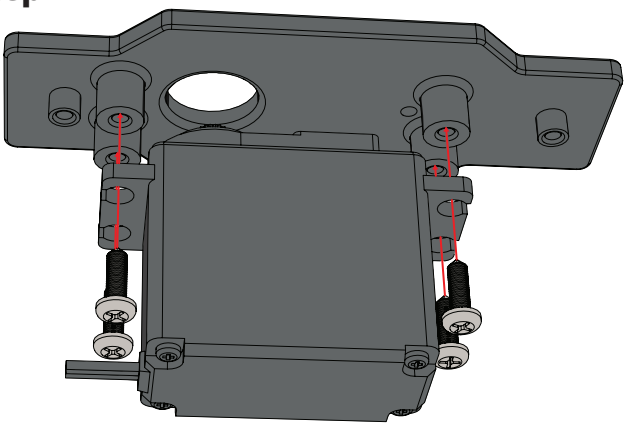
Tip: Socket head cap screws should be snug but not overtightened. Overtightening socket head cap screws can damage components.

Gripper Assembly

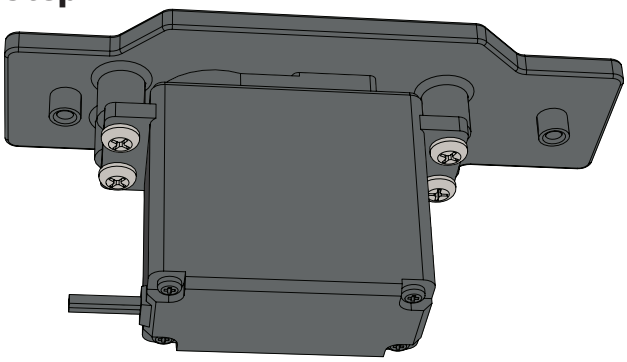
The gripper kit is included with the TETRIX PRIME R/C Robotics Set but is shown here for reference.



Step 1

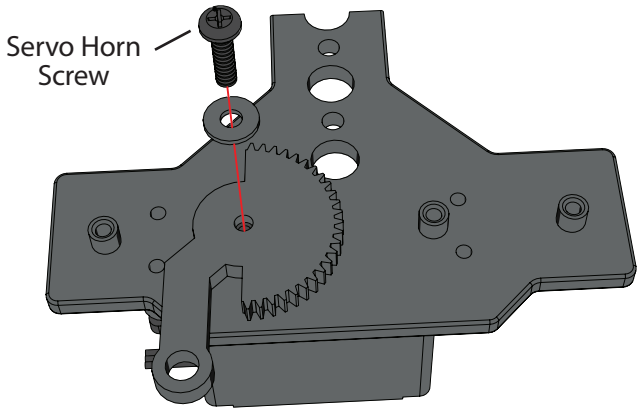


Step 2

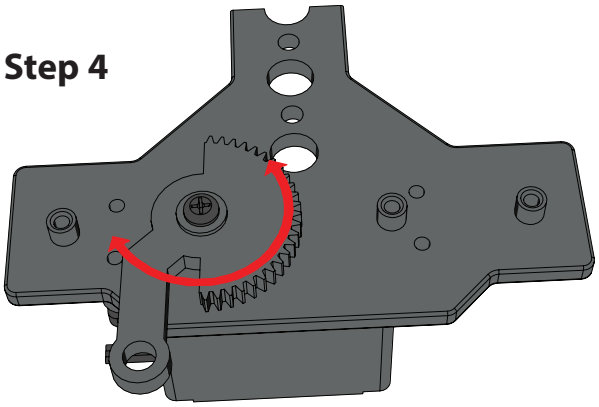


IMPORTANT: Before attaching the right gripper gear arm to the standard servo, attach the standard servo to the gripper plate. Then, connect the standard servo to the wireless joystick gamepad system and position the servo motor to the neutral position (center joystick) for proper gear position alignment as shown in the following steps. Instructions on assembly of TETRIX PRIME parts can also be found at Pitsco.com/TETRIX.

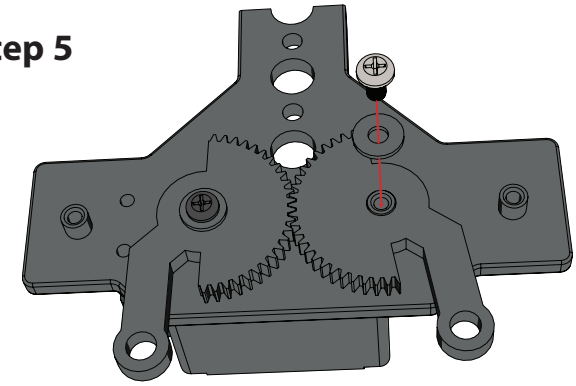
Step 3



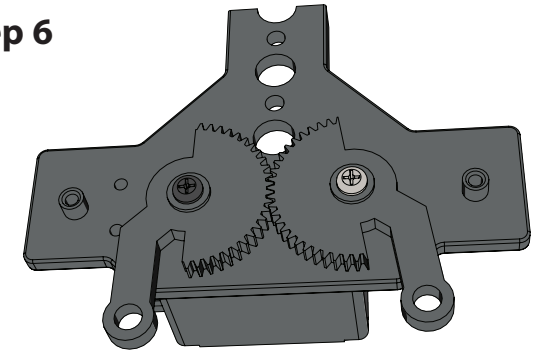
Step 4



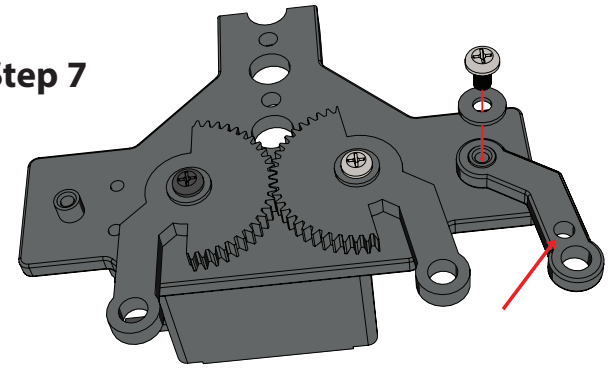
Step 5



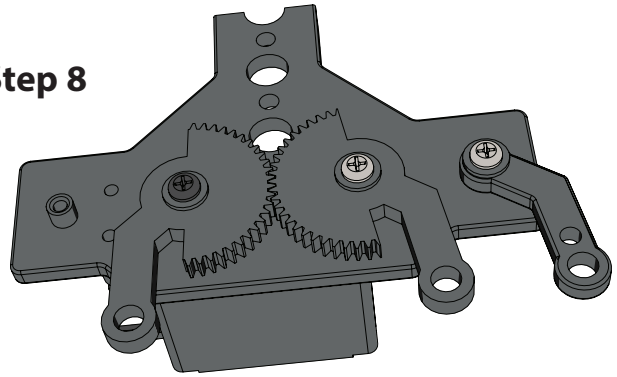
Step 6



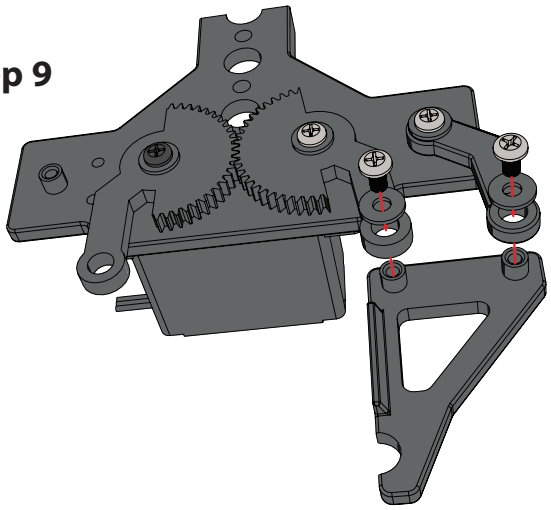
Step 7



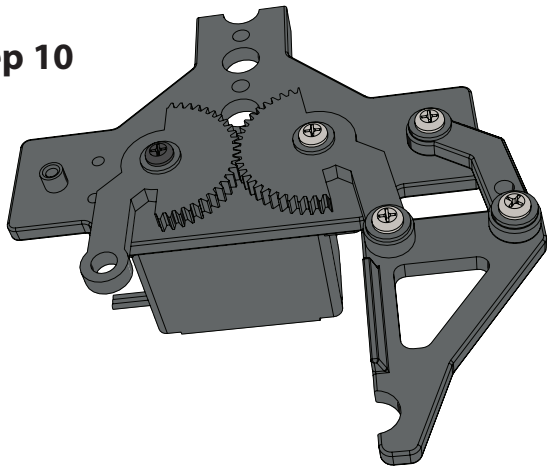
Step 8



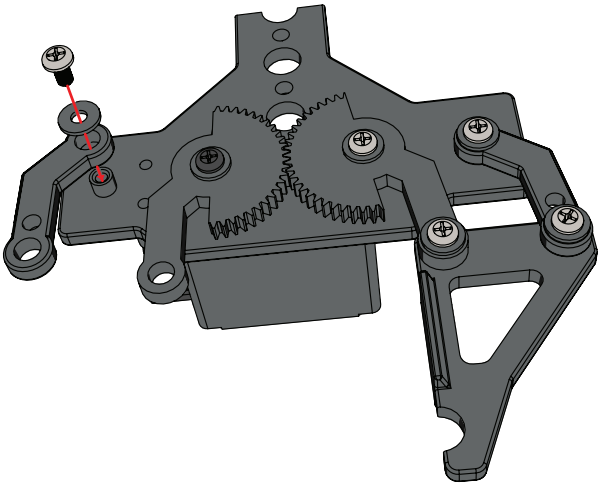
Step 9



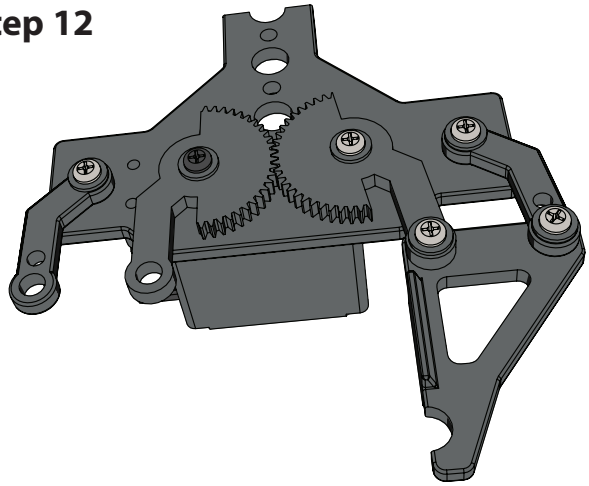
Step 10



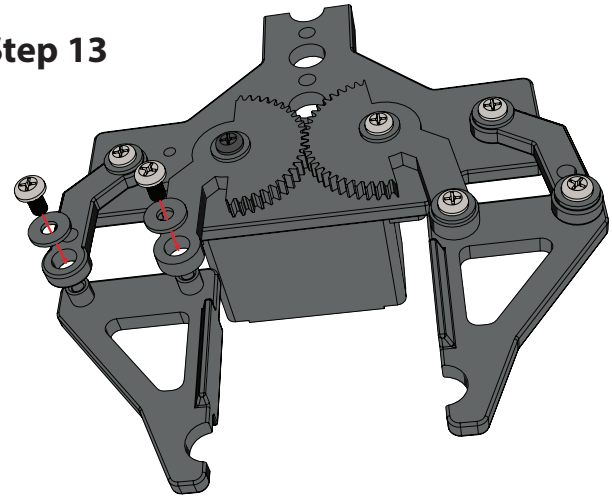
Step 11



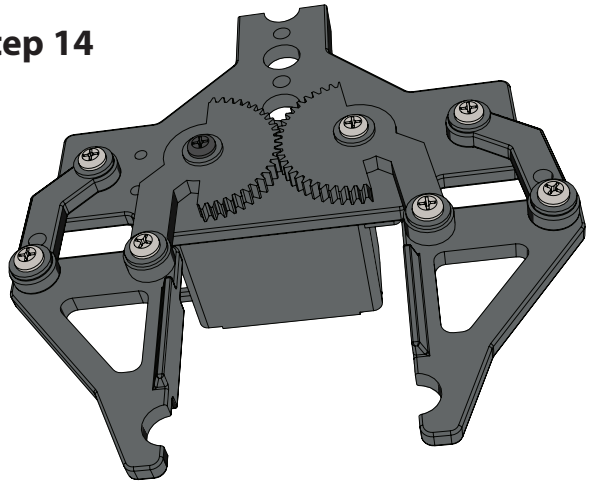
Step 12



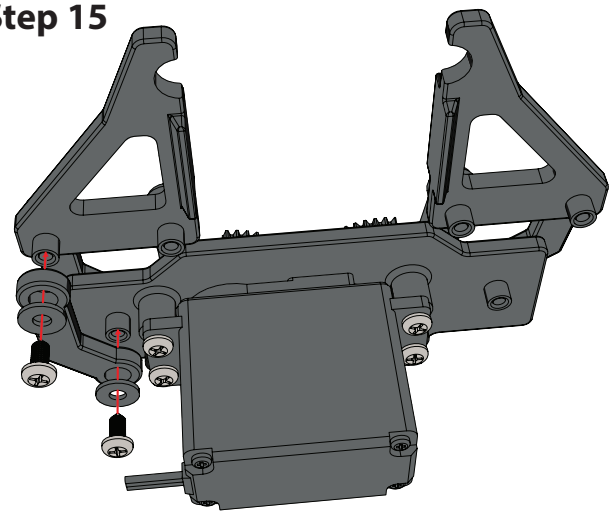
Step 13



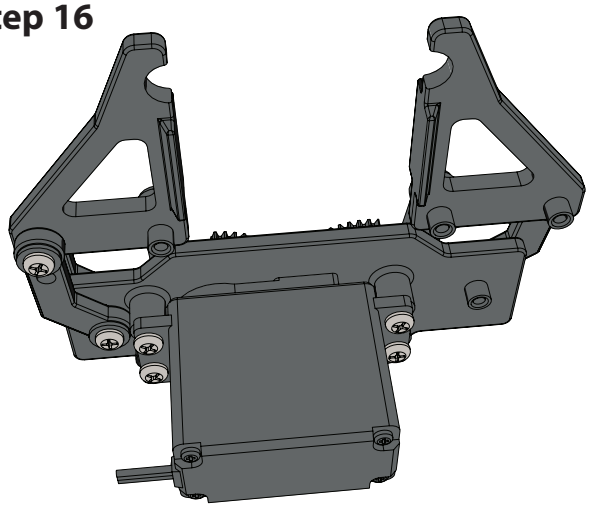
Step 14



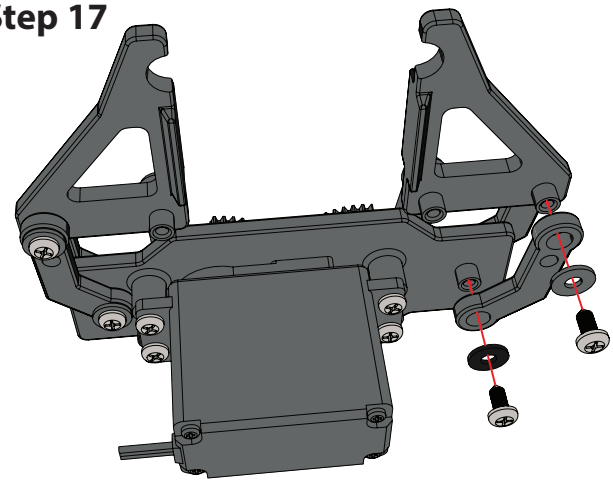
Step 15



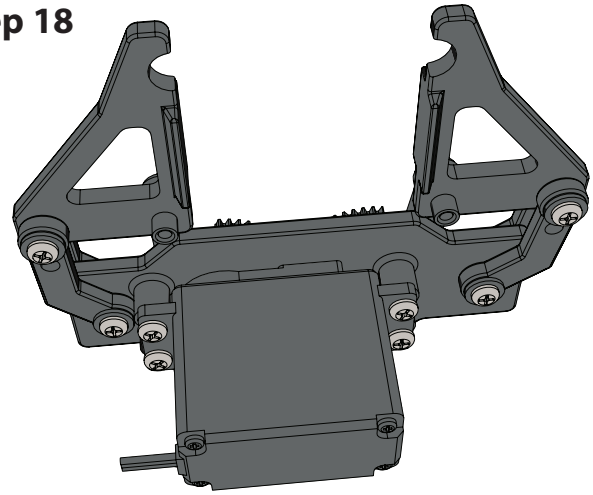
Step 16



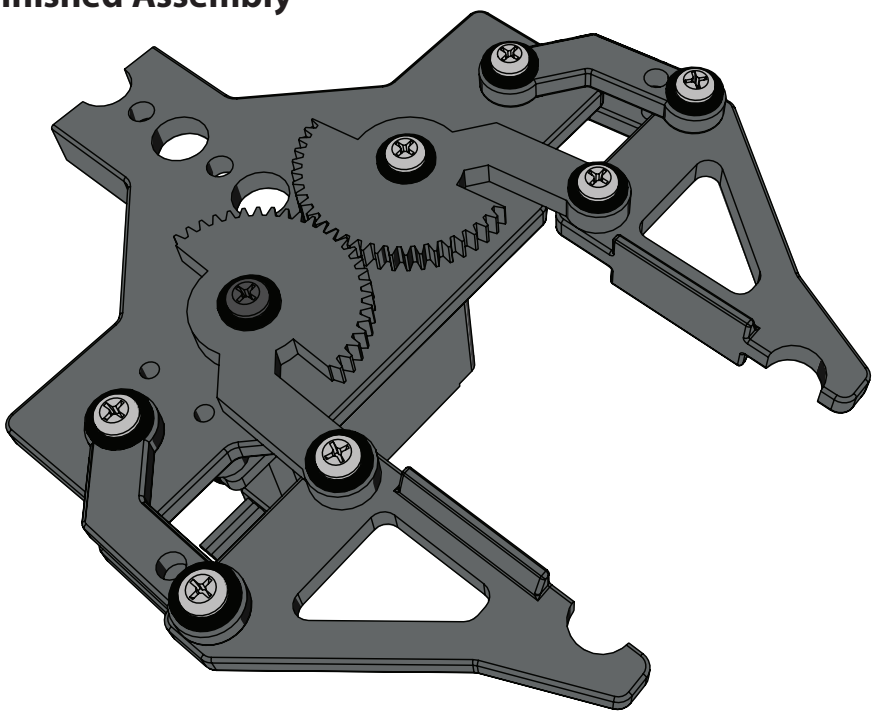
Step 17



Step 18

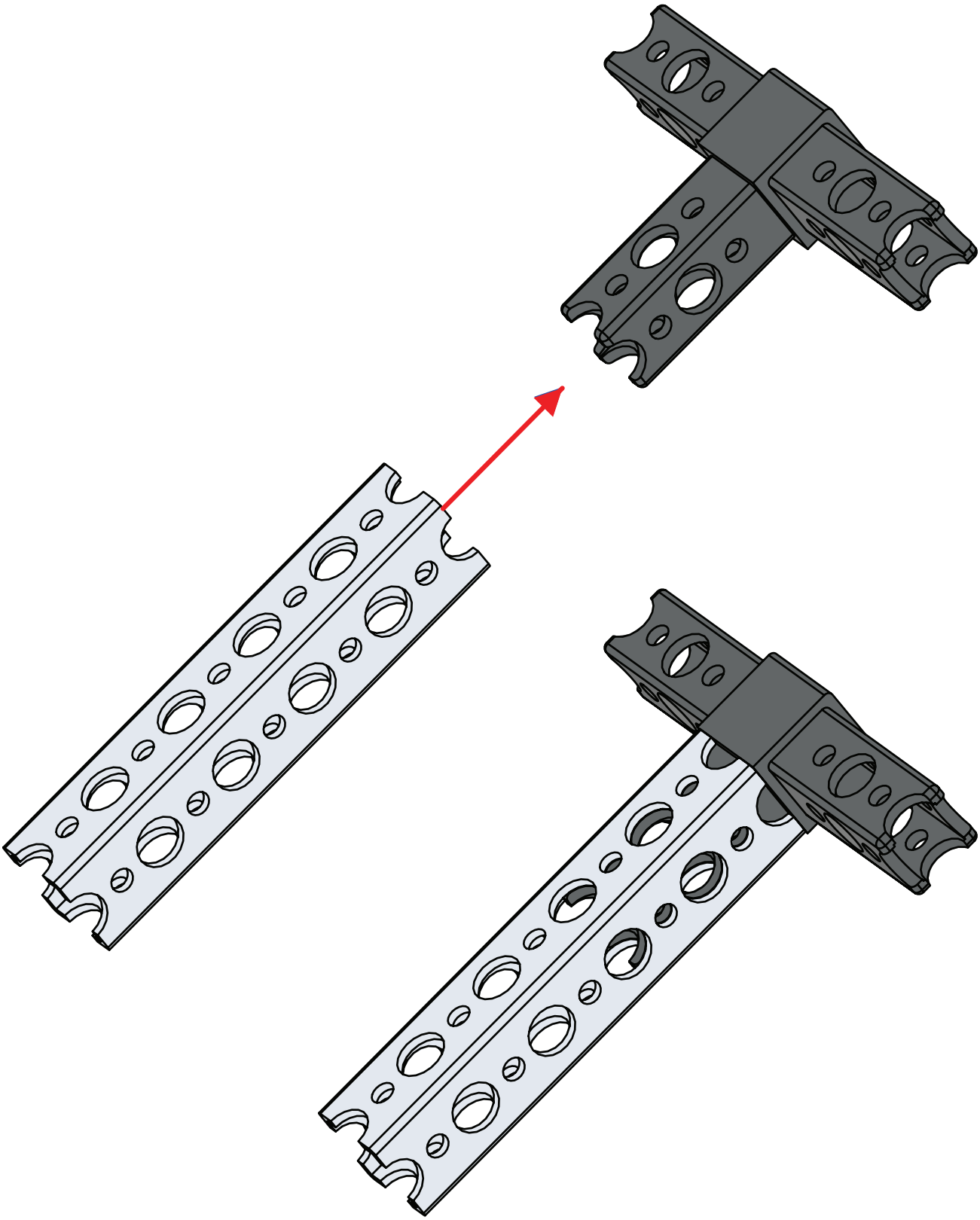


Finished Assembly

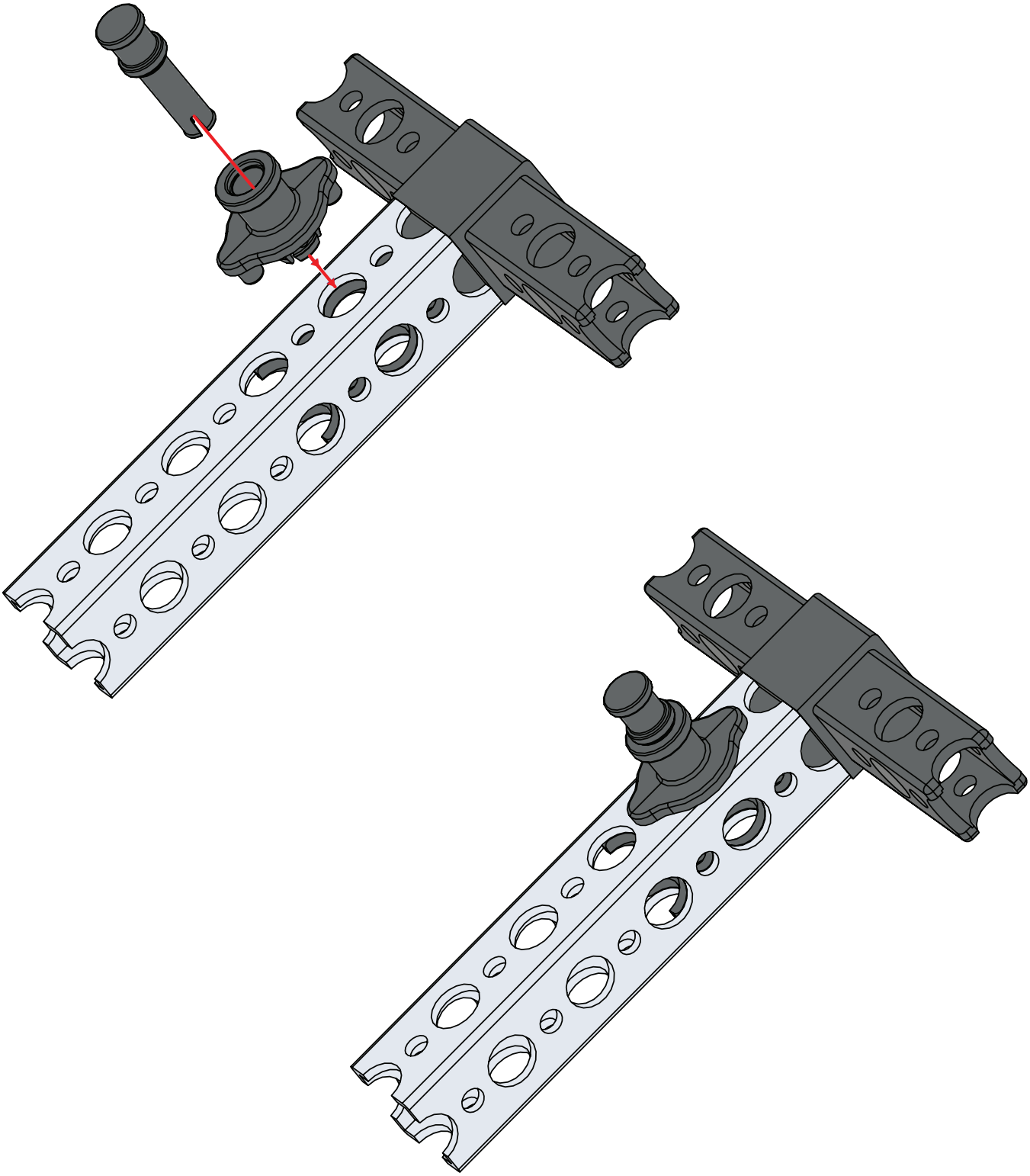


Construction Tips

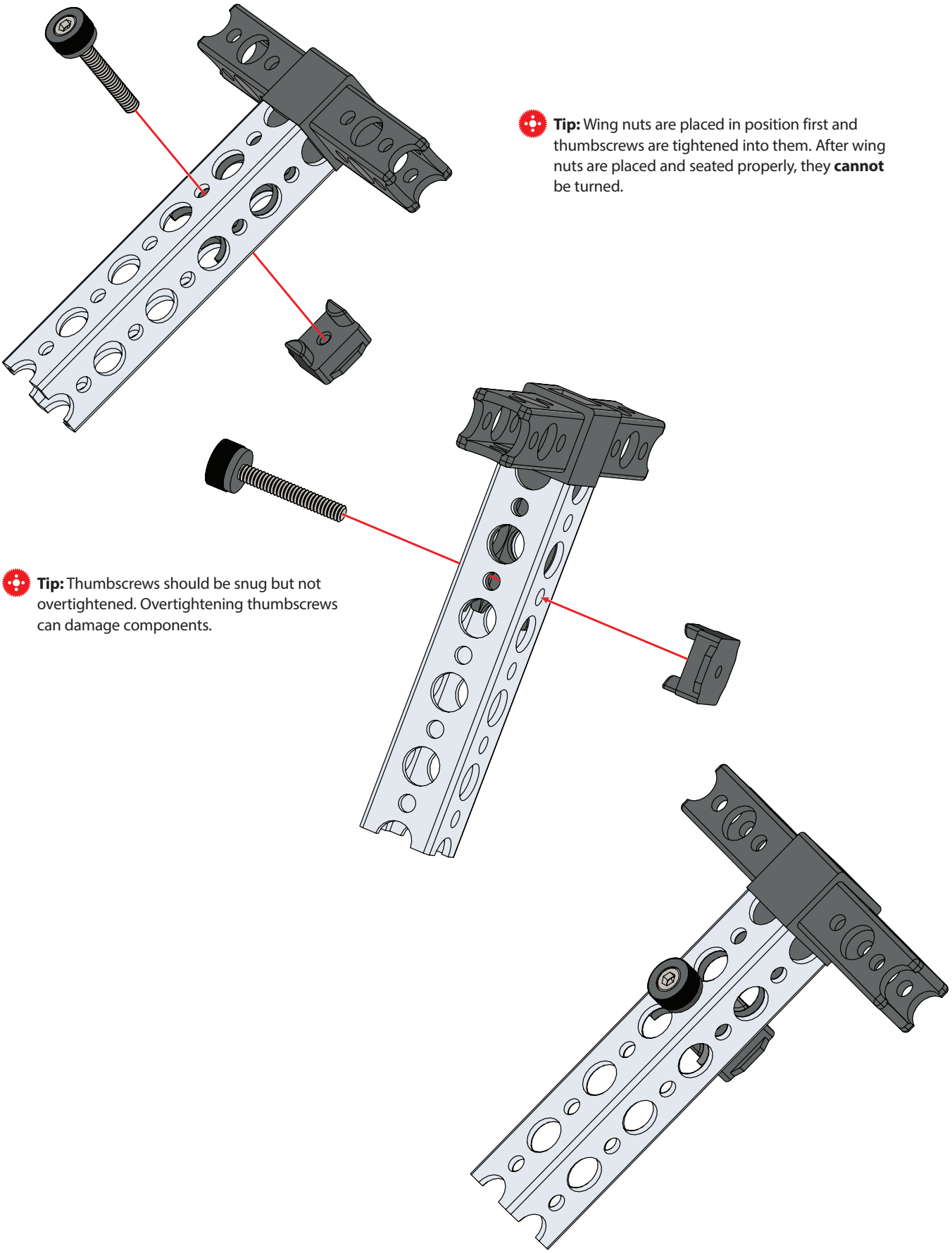
Connectors fit inside beams and come in 3-way, tee, 90-degree, end, extension, and straight beam connector designs.



Quick rivet connectors and pegs are a quick option for securing connectors. Press the rivet in place on the beam and use the peg to spread the rivet to secure the connection. Using rivets on two sides of the connection will make it more stable.



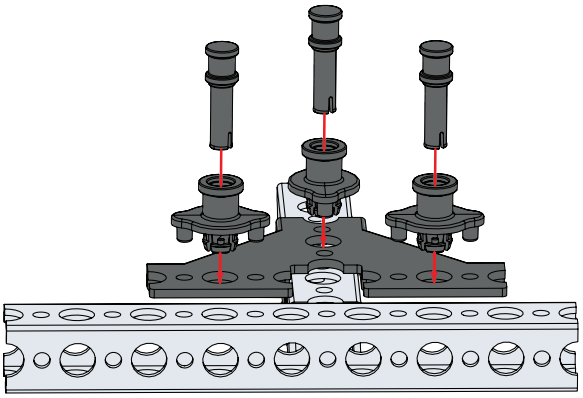
Joints can be made more permanent by using a thumbscrew and wing nut to secure the beams and connectors.

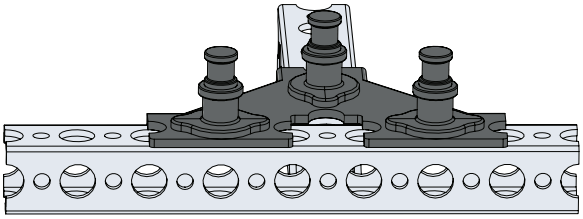


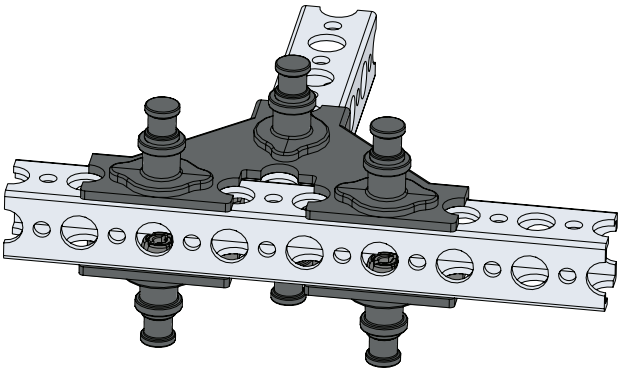
Tip: Wing nuts are placed in position first and thumbscrews are tightened into them. After wing nuts are placed and seated properly, they **cannot** be turned.

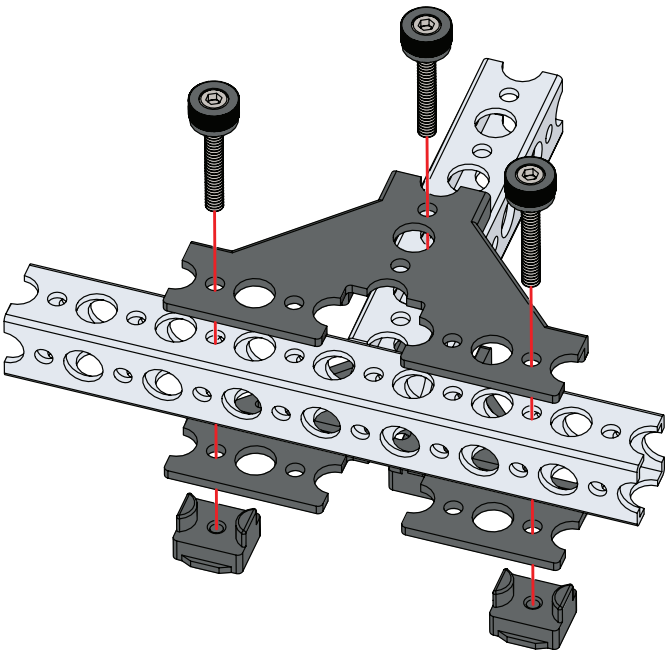
Tip: Thumbscrews should be snug but not overtightened. Overtightening thumbscrews can damage components.

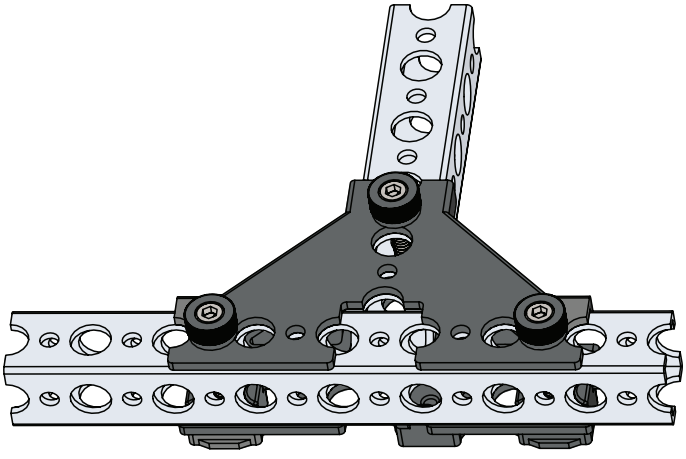
Brackets can also be used to connect beams. Brackets are available for a tee connection, 60-degree connection, or 90-degree connection. Brackets should be used in pairs, with two brackets on opposite sides of a beam. Brackets are secured using quick rivets and pegs or thumbscrews and wing nuts.



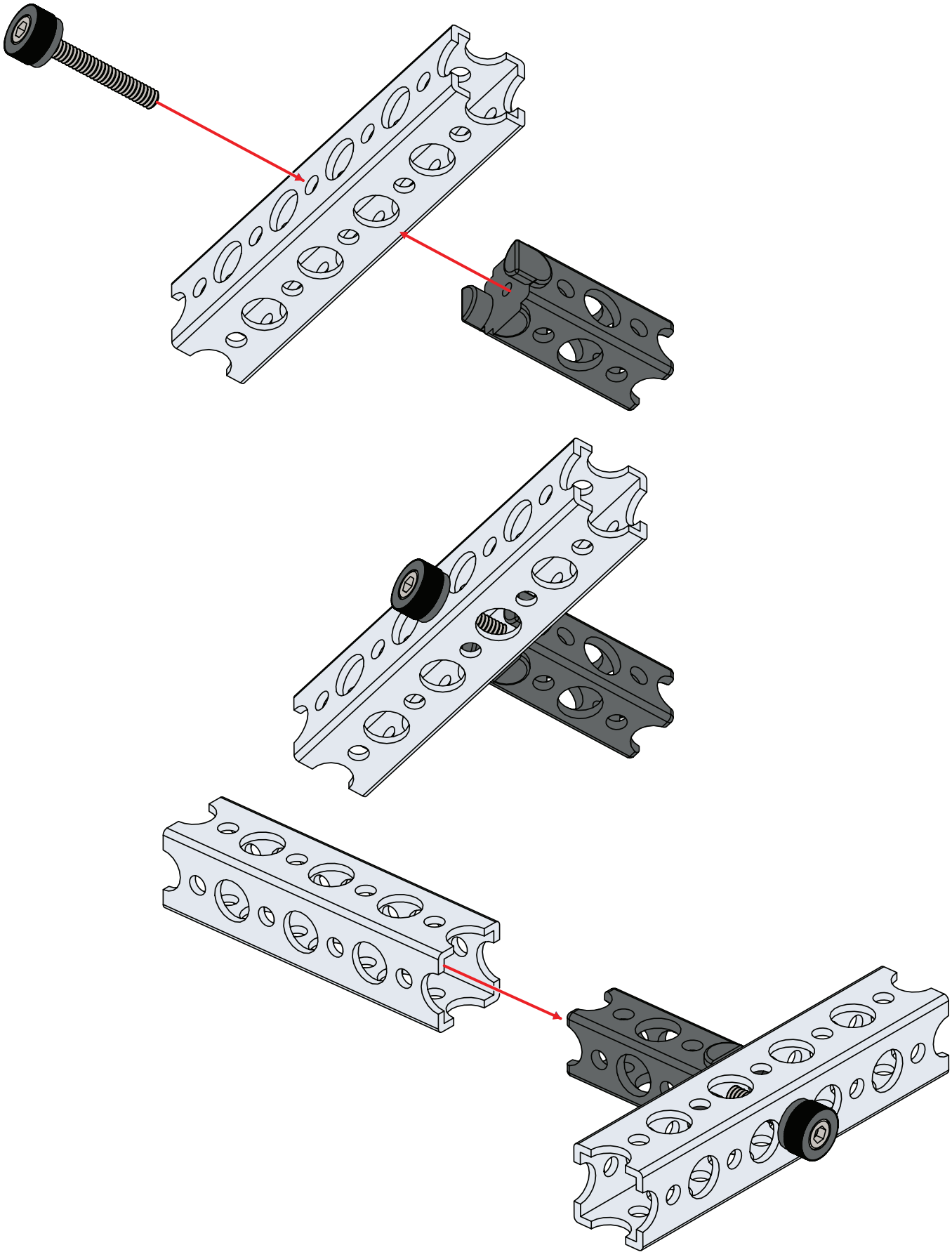




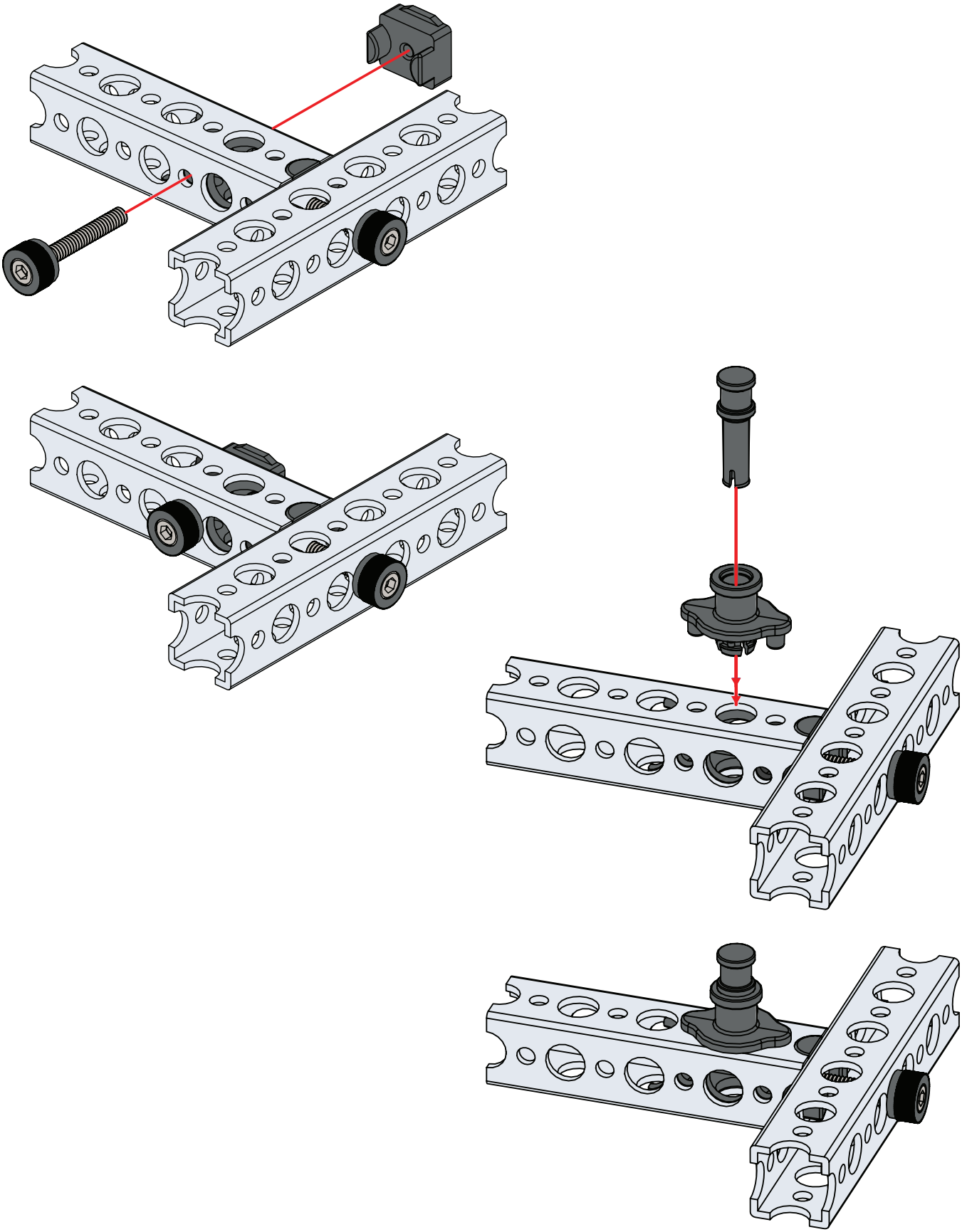




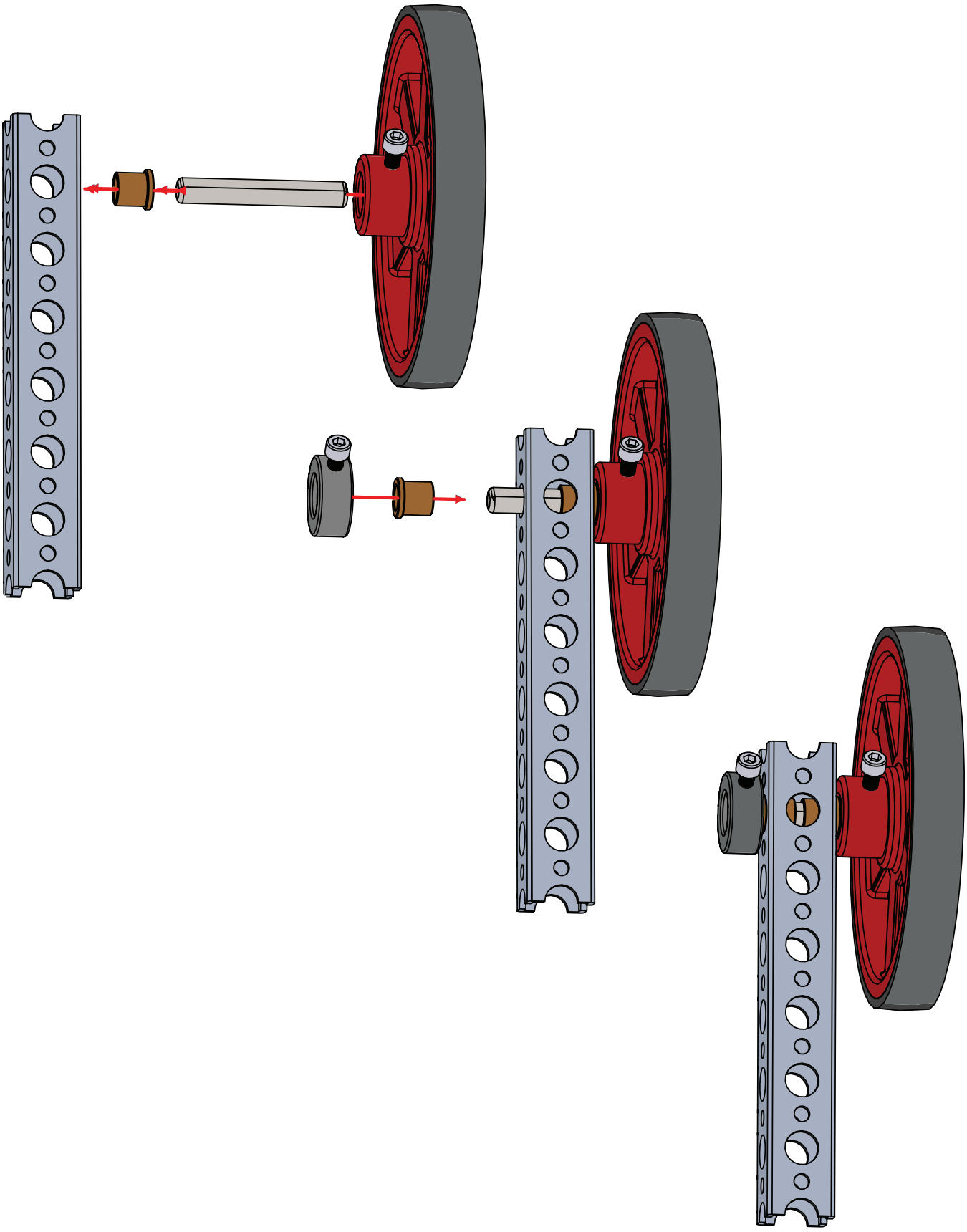
Beam end connectors, straight block beam connectors, and 90-degree cross block connectors are secured using a thumbscrew through the beam and into the connector.



After the thumbscrew is used to secure the end of the connector, a quick rivet and peg or a thumbscrew and wing nut are used to secure the intersecting beam.



Anytime an axle is used, it should be supported at two points. Place a bronze bushing on opposite sides of a beam and place the axle through the bushings. Secure the axle to a D-shaft set collar, wheel, gear, or hub.



TETRIX PRIME Wheelee Bot Assembly

Overview:

The TETRIX PRIME Wheelee Bot is an excellent starting point for building your first working robot from the PRIME R/C Robotics Set. The Wheelee Bot is a basic three-wheeled robot that is quick and easy to build and offers a good introduction to the inner workings of the PRIME structural and motion elements.

How It Works:

The TETRIX PRIME Wheelee Bot uses one continuous rotation servo as the drive motor and one standard servo for steering in its tri-bot design. As an extension option, the TETRIX PRIME Gripper along with another standard servo motor can be added to the model for picking up objects.

Getting Started:

- Refer to pages 30-50 for instructions on how to build the complete Wheelee Bot.
- See page 51 for suggested sample activities.

Time Expectations:

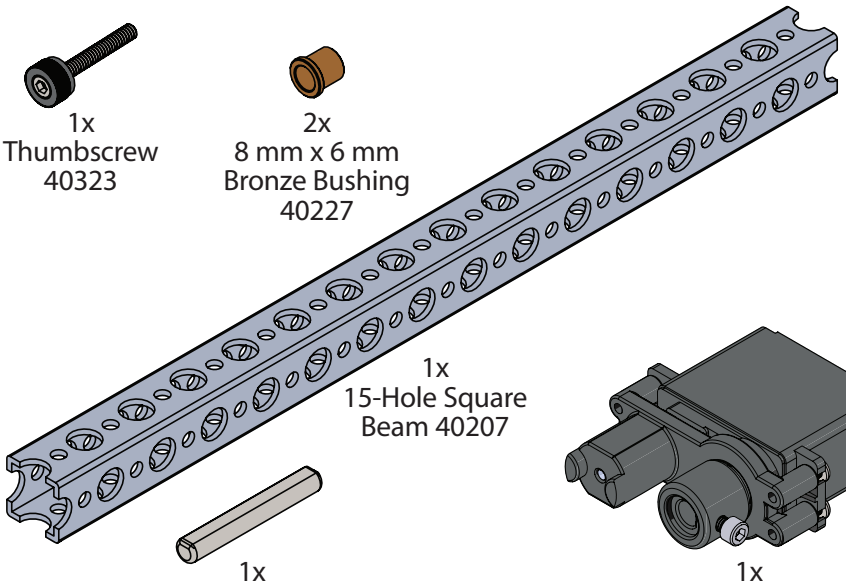
30-50 minutes

Note: Many factors can affect building time, including set organization and whether builders use a partner. The above time is an estimate only and based on a single builder of average experience who is comfortable with the product and has access to well-organized sets. Actual time might vary.

You can also build the Wheelee Bot following our step-by-step video tutorial. To view it, visit **video.pitsco.com/TETRIX**.

Step 1

Parts Needed



1x
Thumbscrew
40323

2x
8 mm x 6 mm
Bronze Bushing
40227

1x
15-Hole Square
Beam 40207

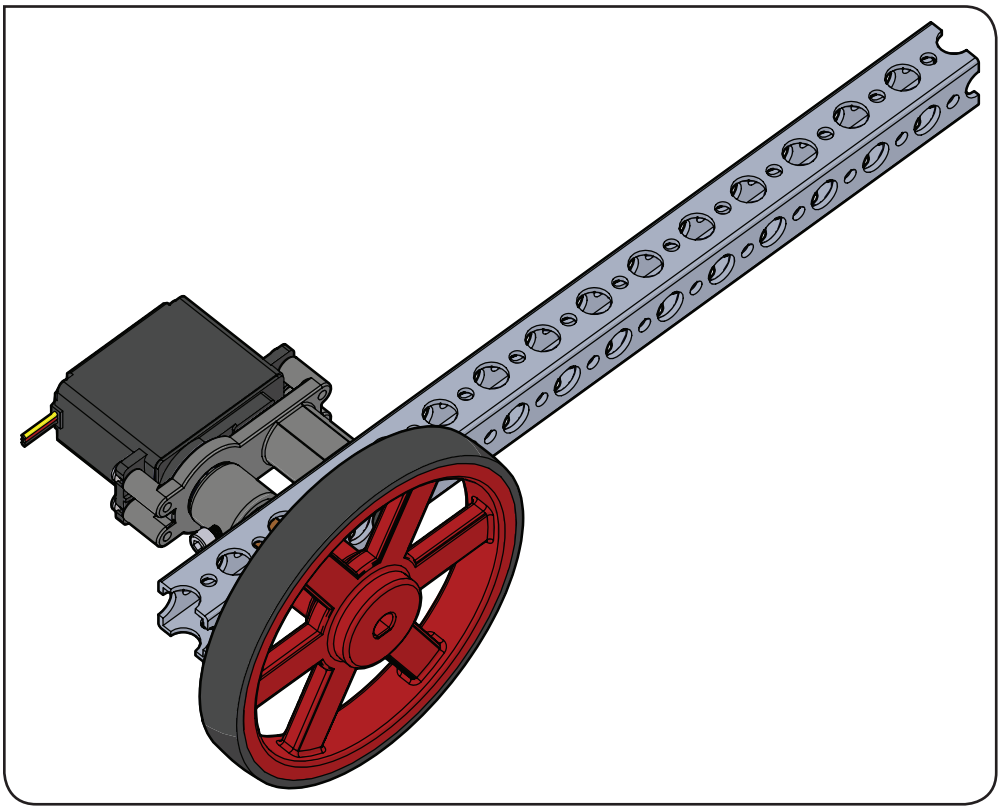
1x
Wheel with Tire 40222

1x
40 mm Steel Axle
40226

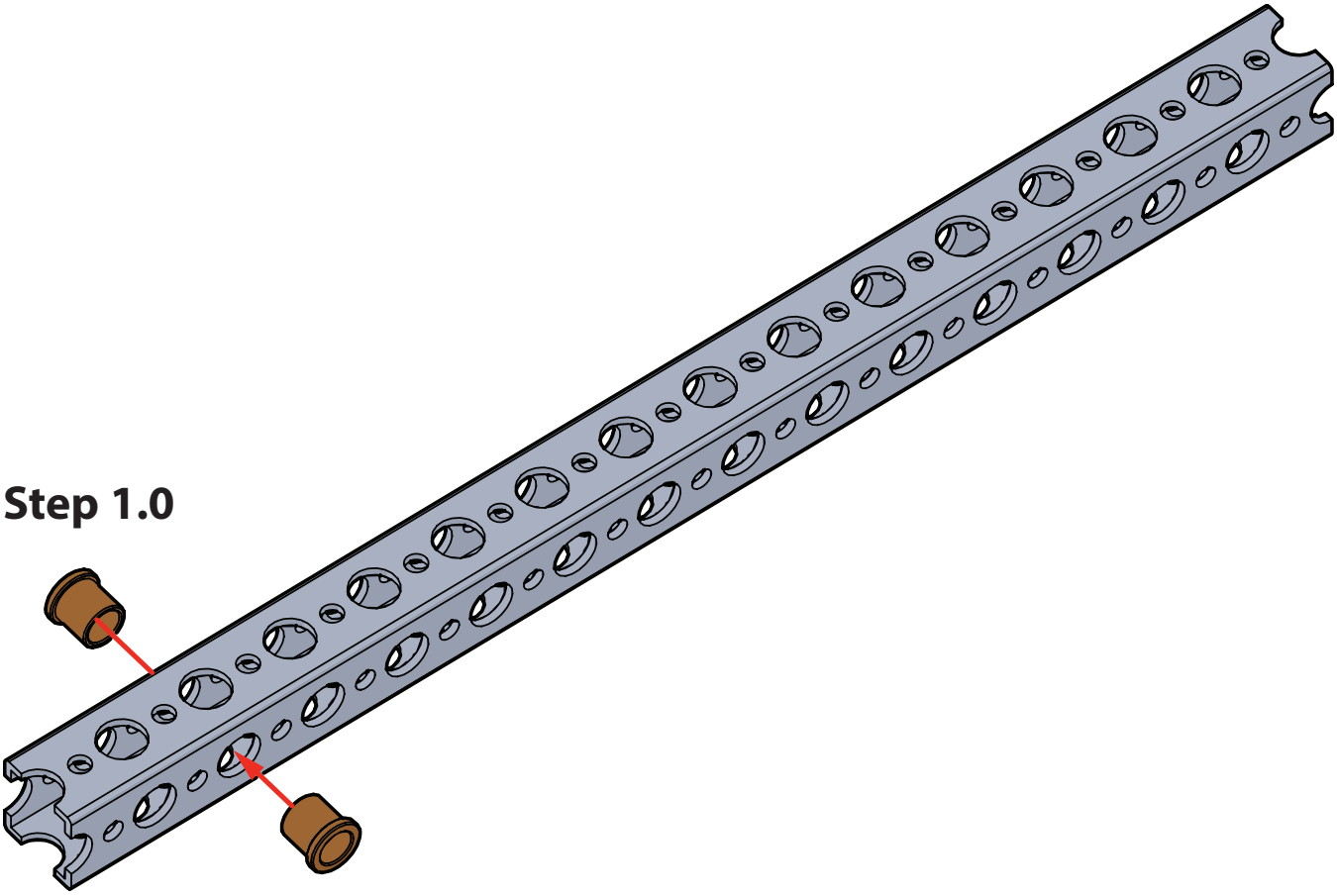
1x
Continuous Rotation Servo Motor 40379
with Servo Mounting Bracket 40232
(Assembly instructions on pages 14-15.)

Tip: Some elements require the use of Socket Head Cap Screws (40516) as set screws.

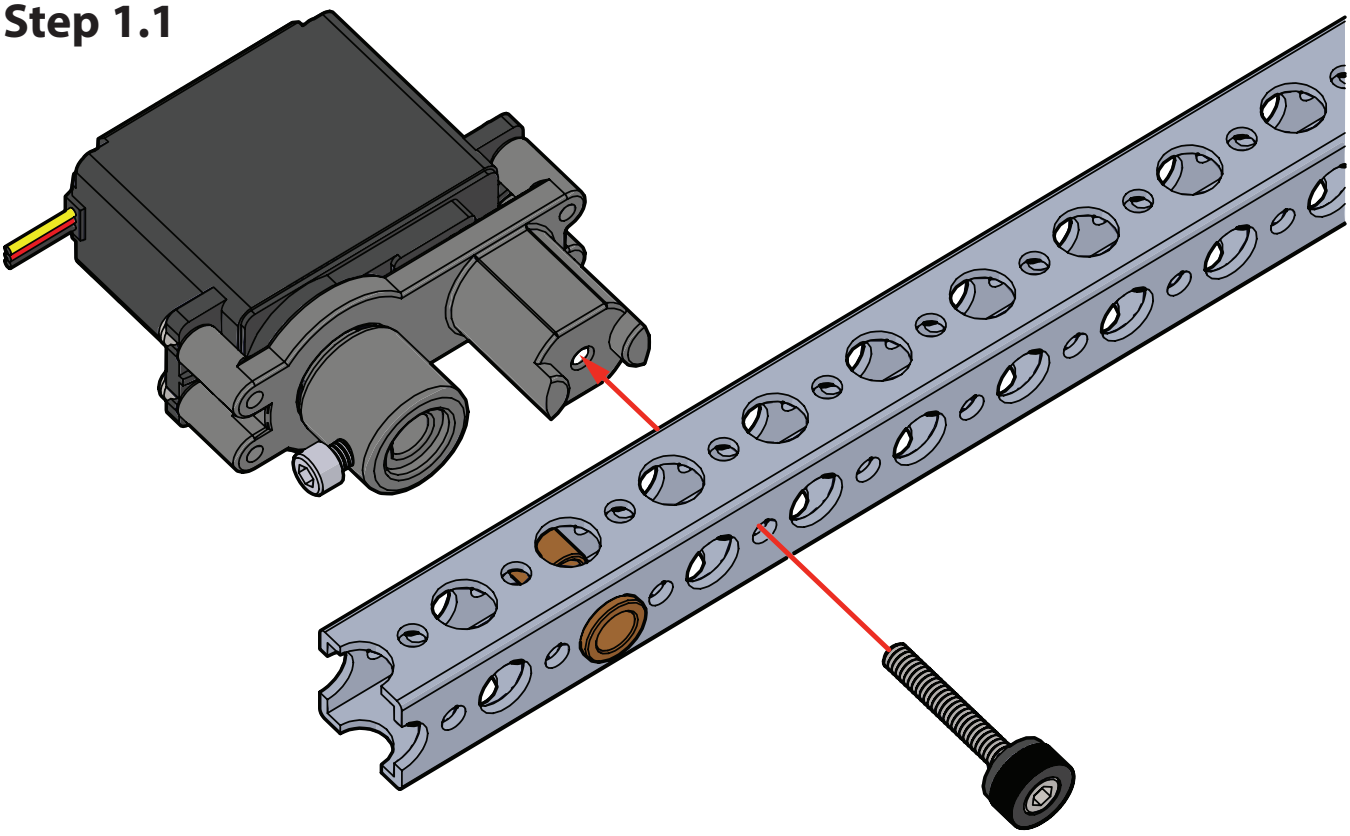
Partial assembly should look like this.



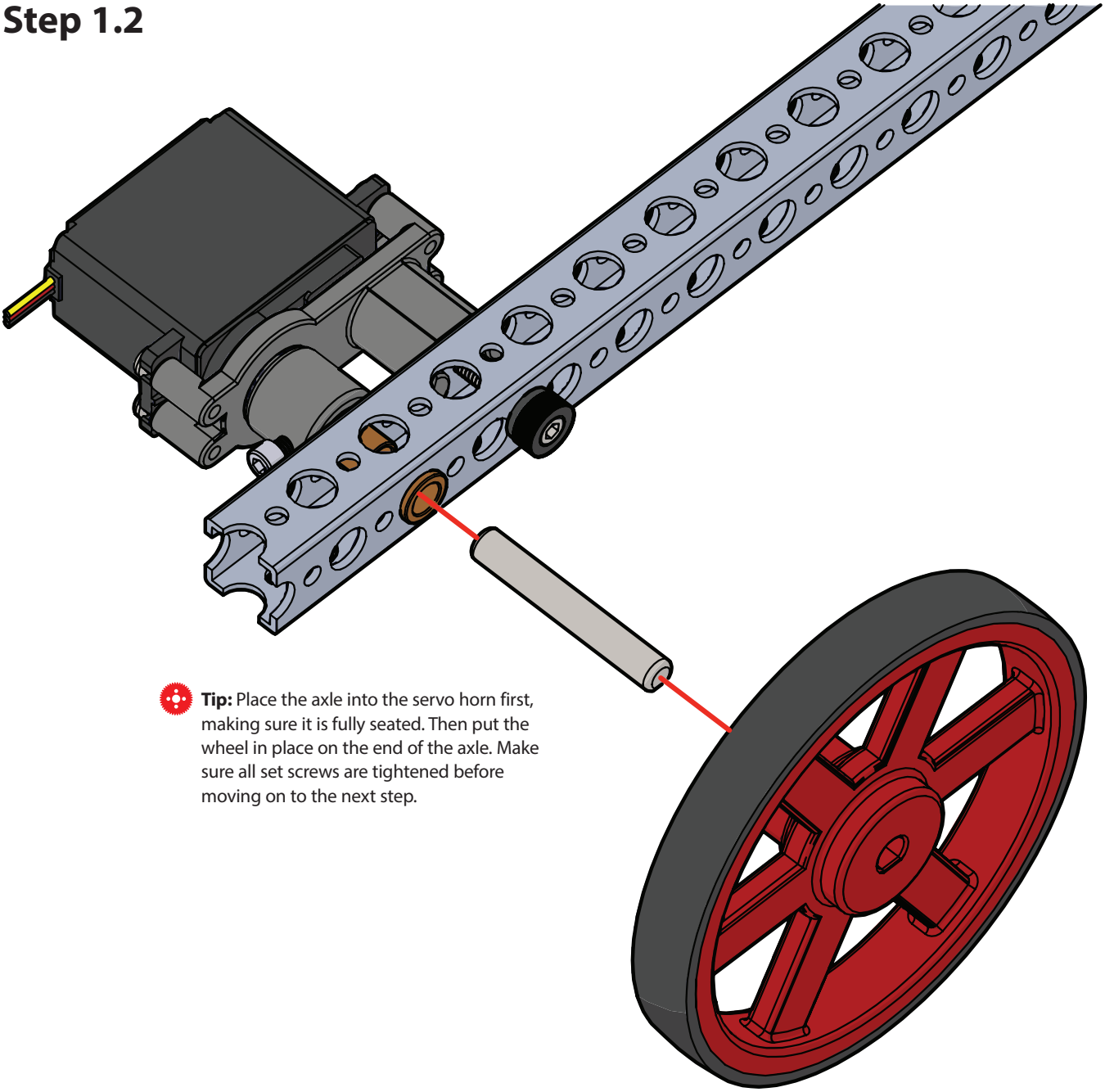
Step 1.0



Step 1.1



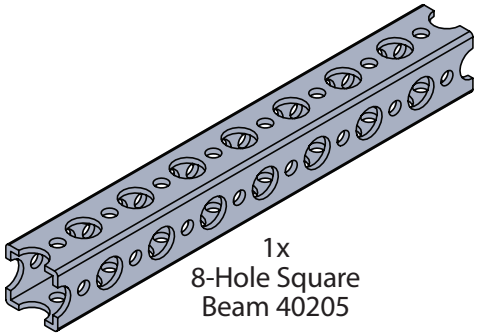
Step 1.2



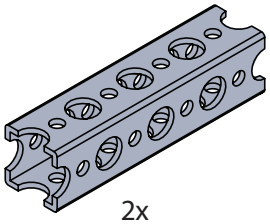
Tip: Place the axle into the servo horn first, making sure it is fully seated. Then put the wheel in place on the end of the axle. Make sure all set screws are tightened before moving on to the next step.

Step 2

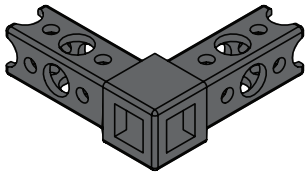
Parts Needed



1x
8-Hole Square
Beam 40205



2x
4-Hole Square Beam 40201

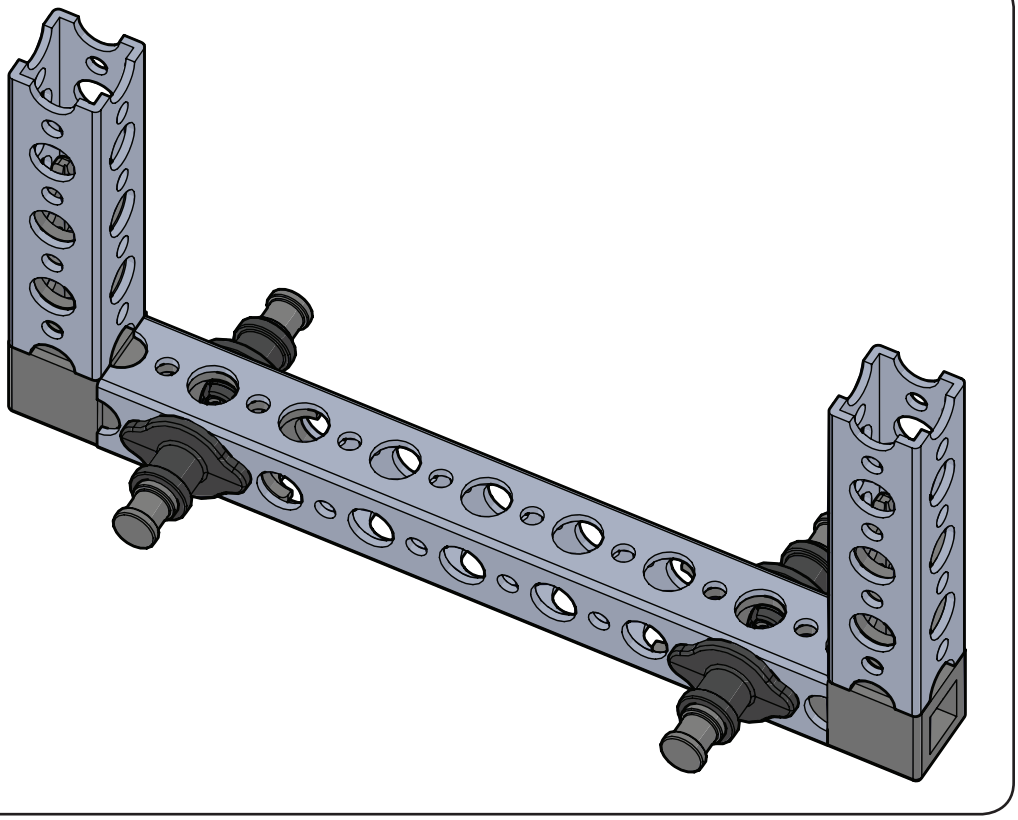


2x
90-Degree Beam Connector 40211

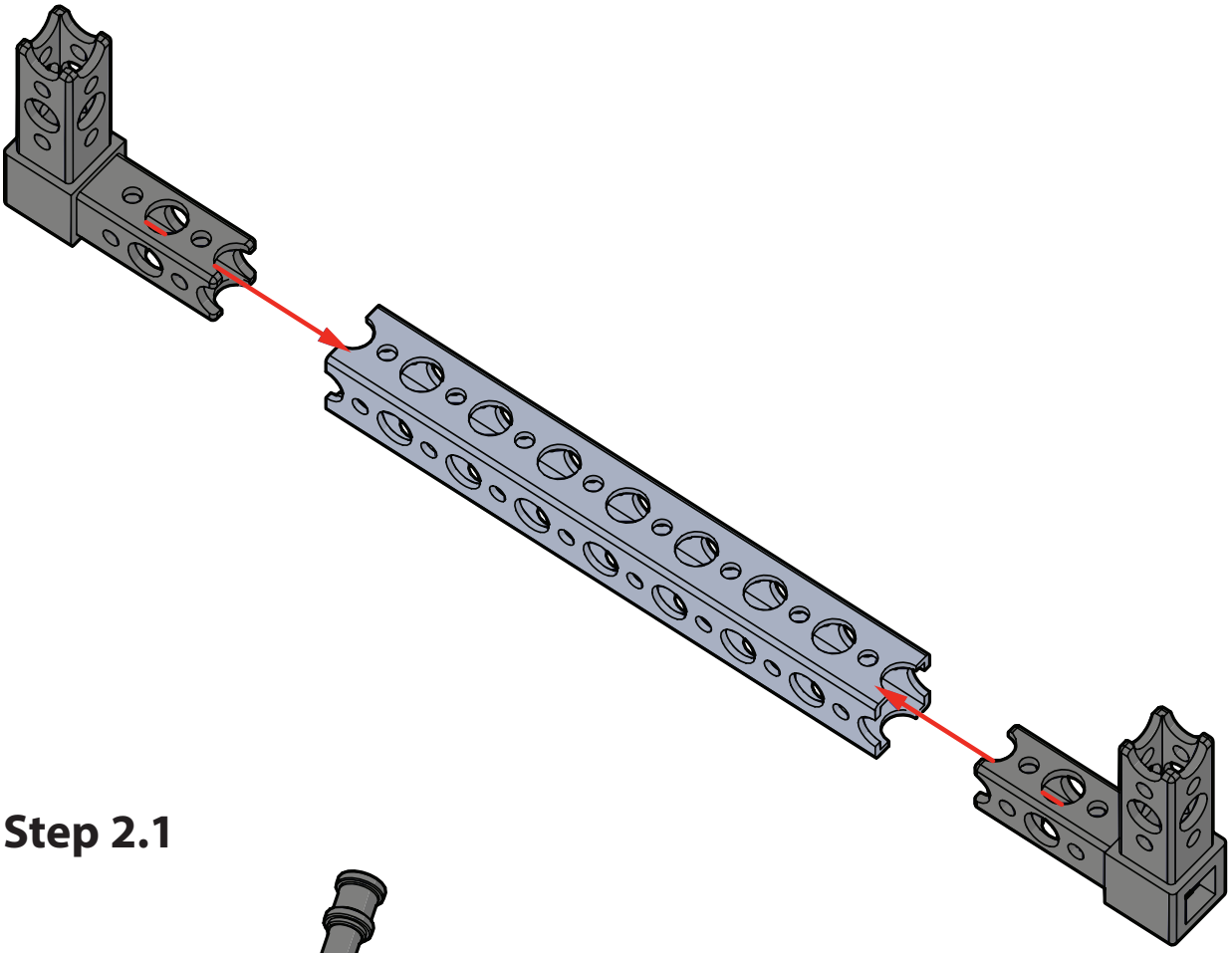
4x
Quick Rivet Peg 40220

4x
Quick Rivet Connector 40219

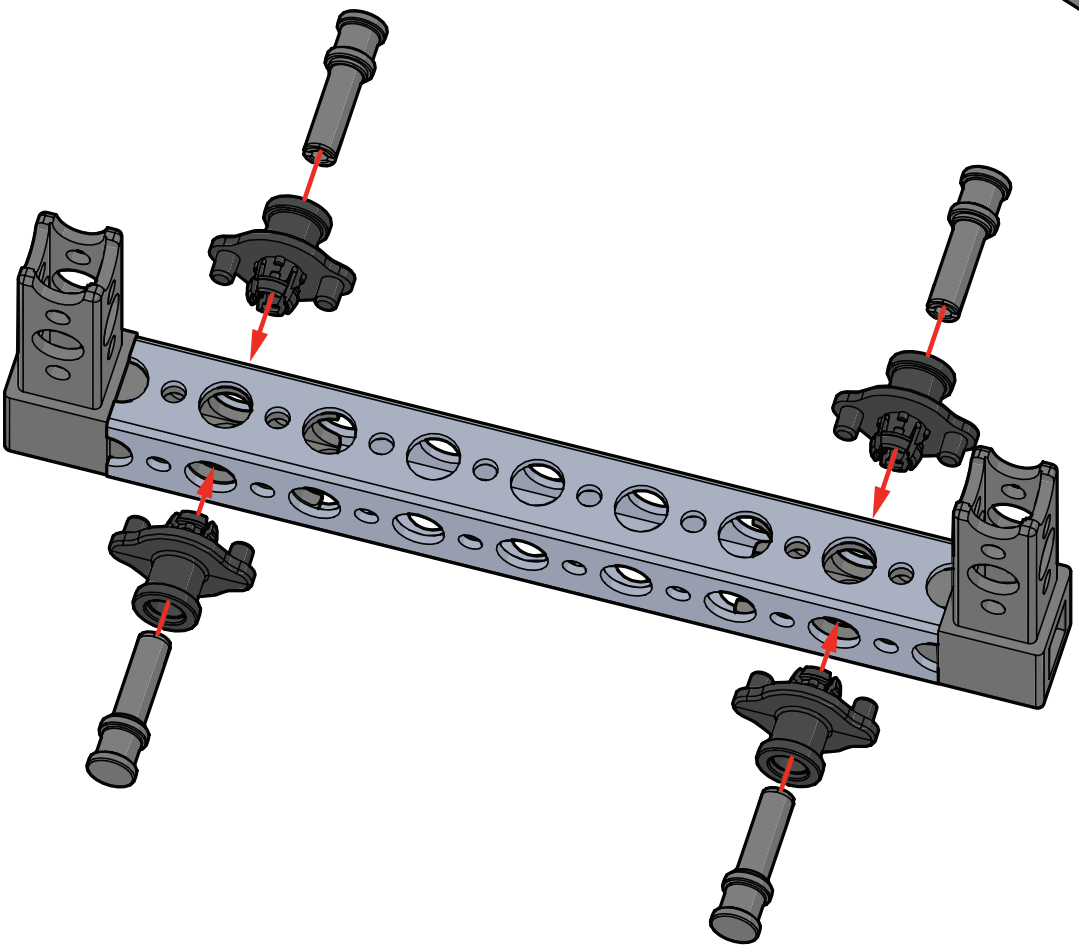
Partial assembly should look like this.



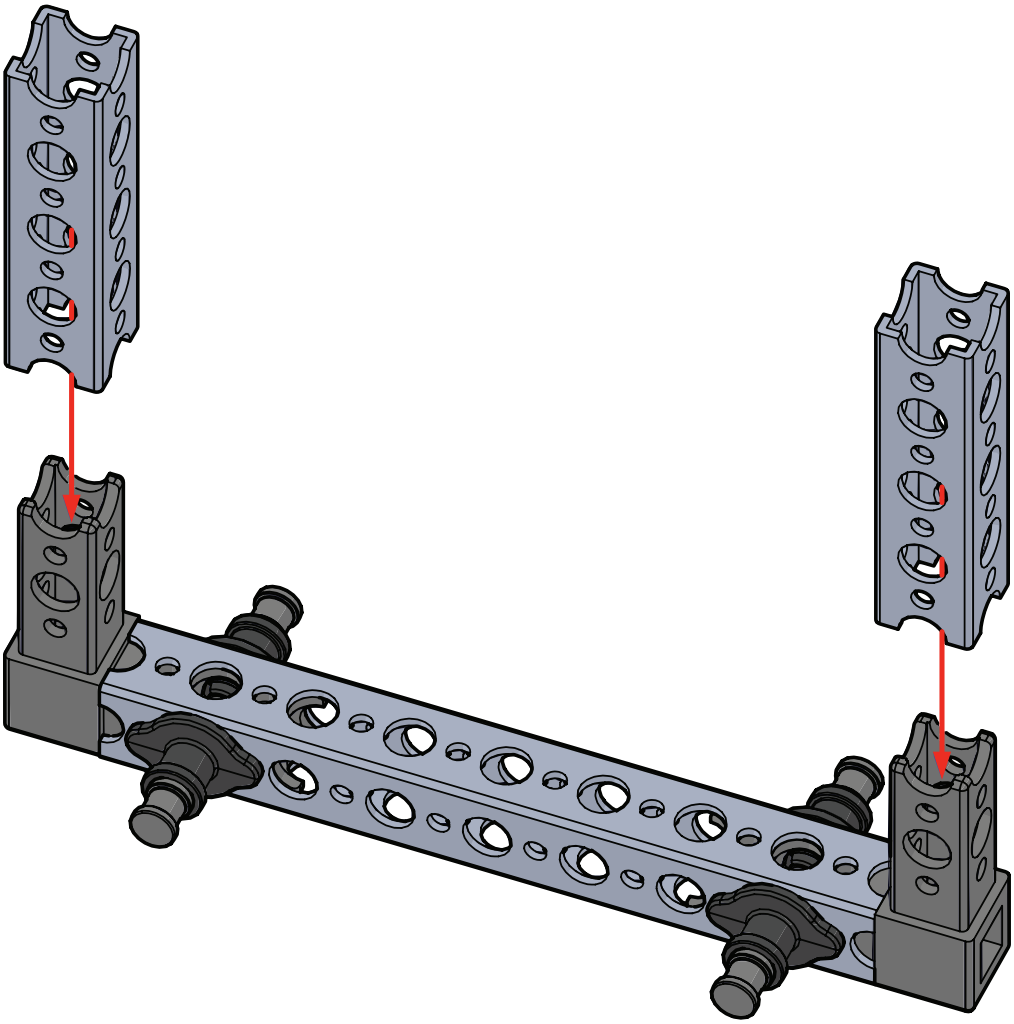
Step 2.0



Step 2.1

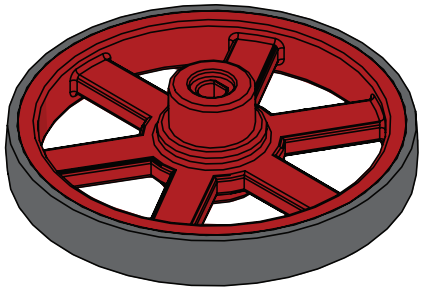


Step 2.2



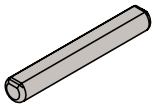
Step 3

Parts Needed

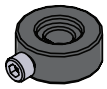


2x
Wheel with Tire 40222

4x
8 mm x 6 mm
Bronze Bushing
40227

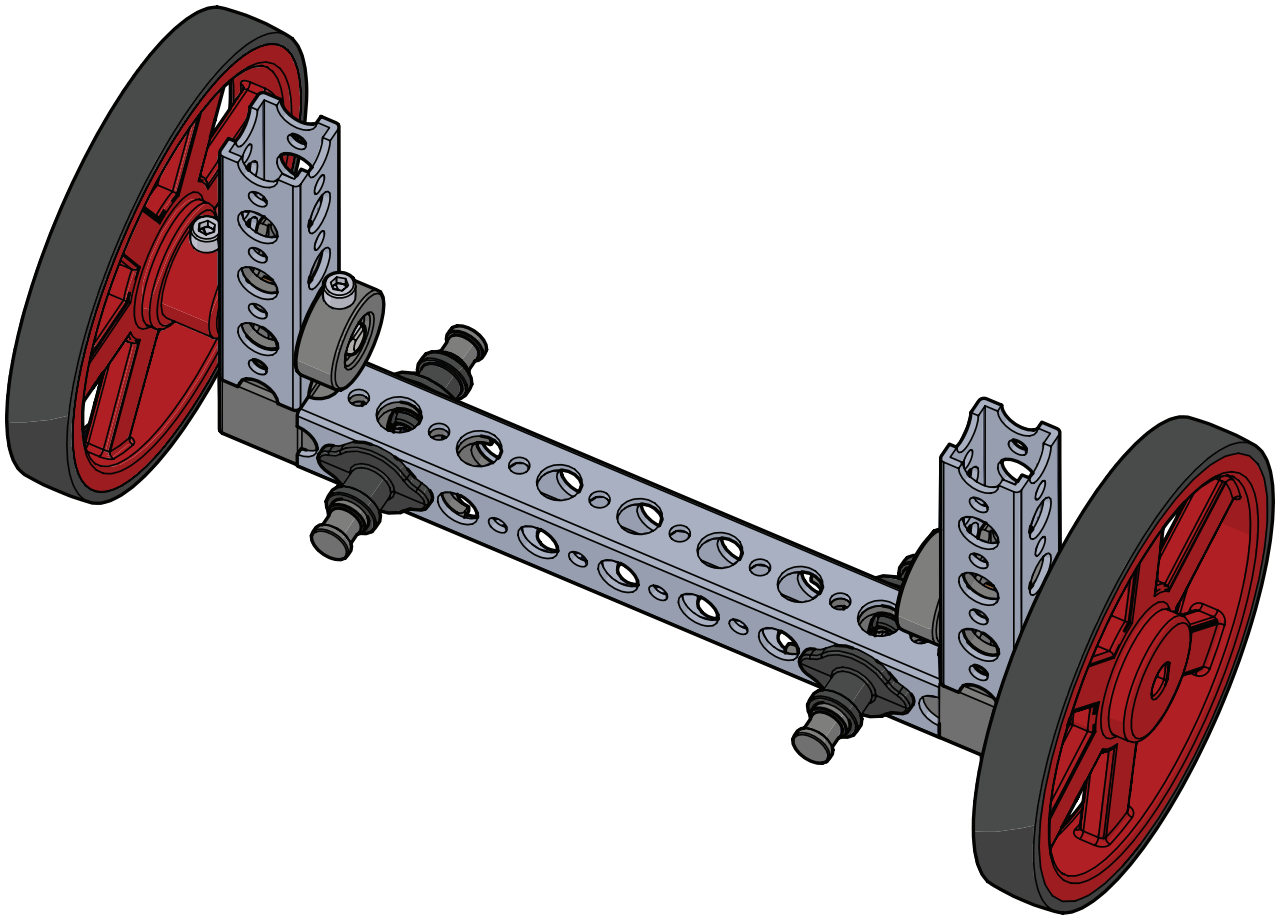


2x
40 mm Steel Axle
40226

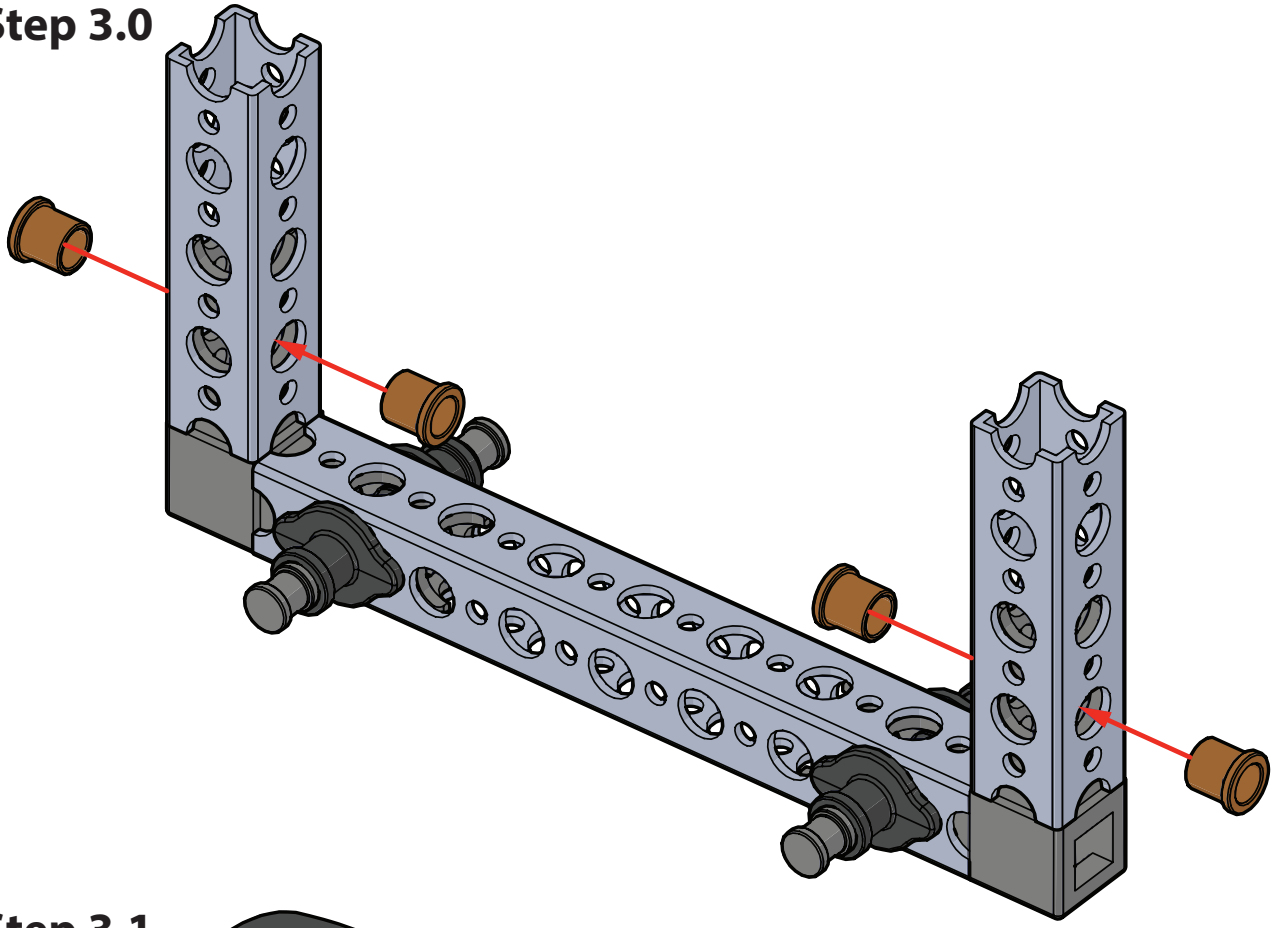


2x
D-Shaft Set Collar
40229

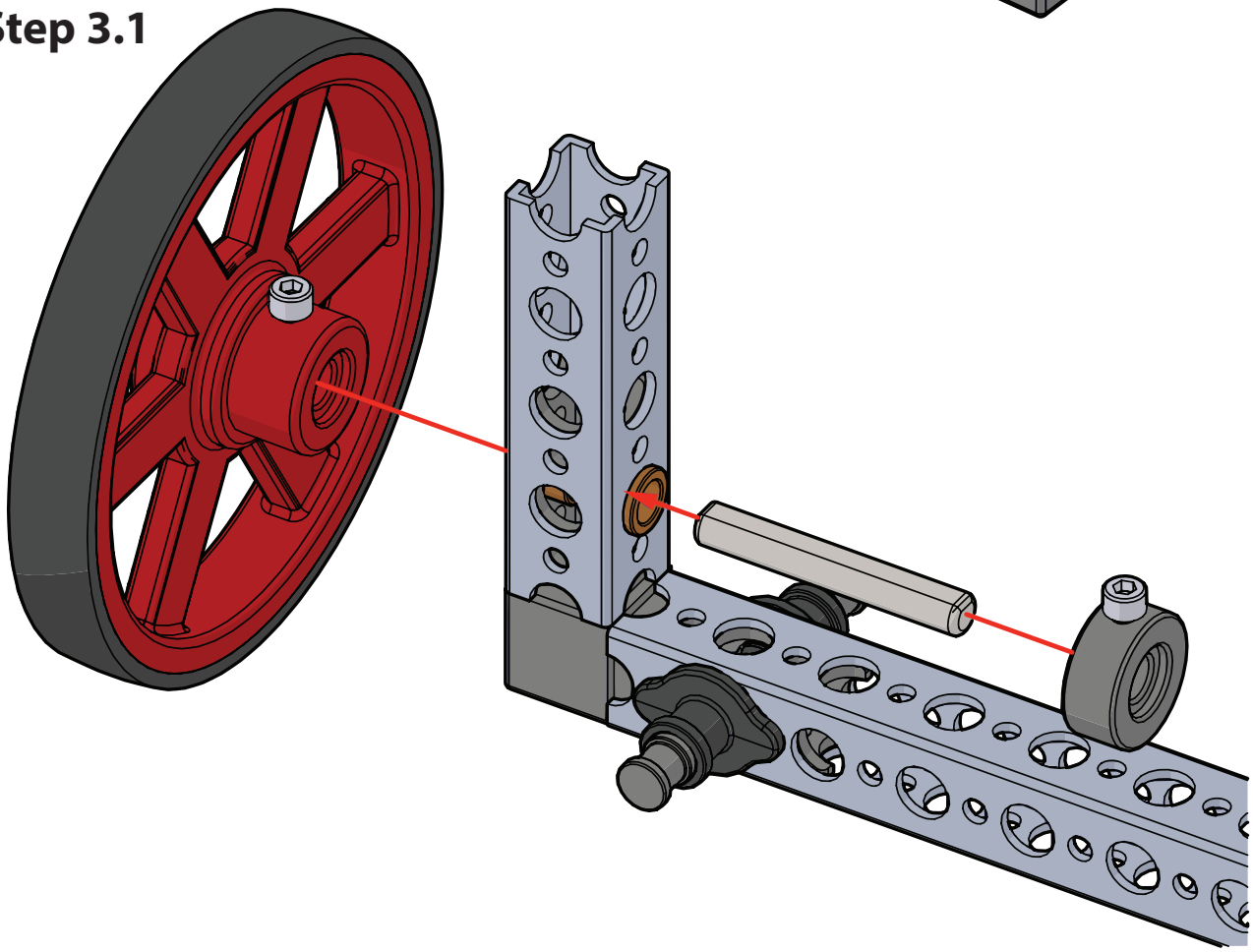
Partial assembly should look like this.



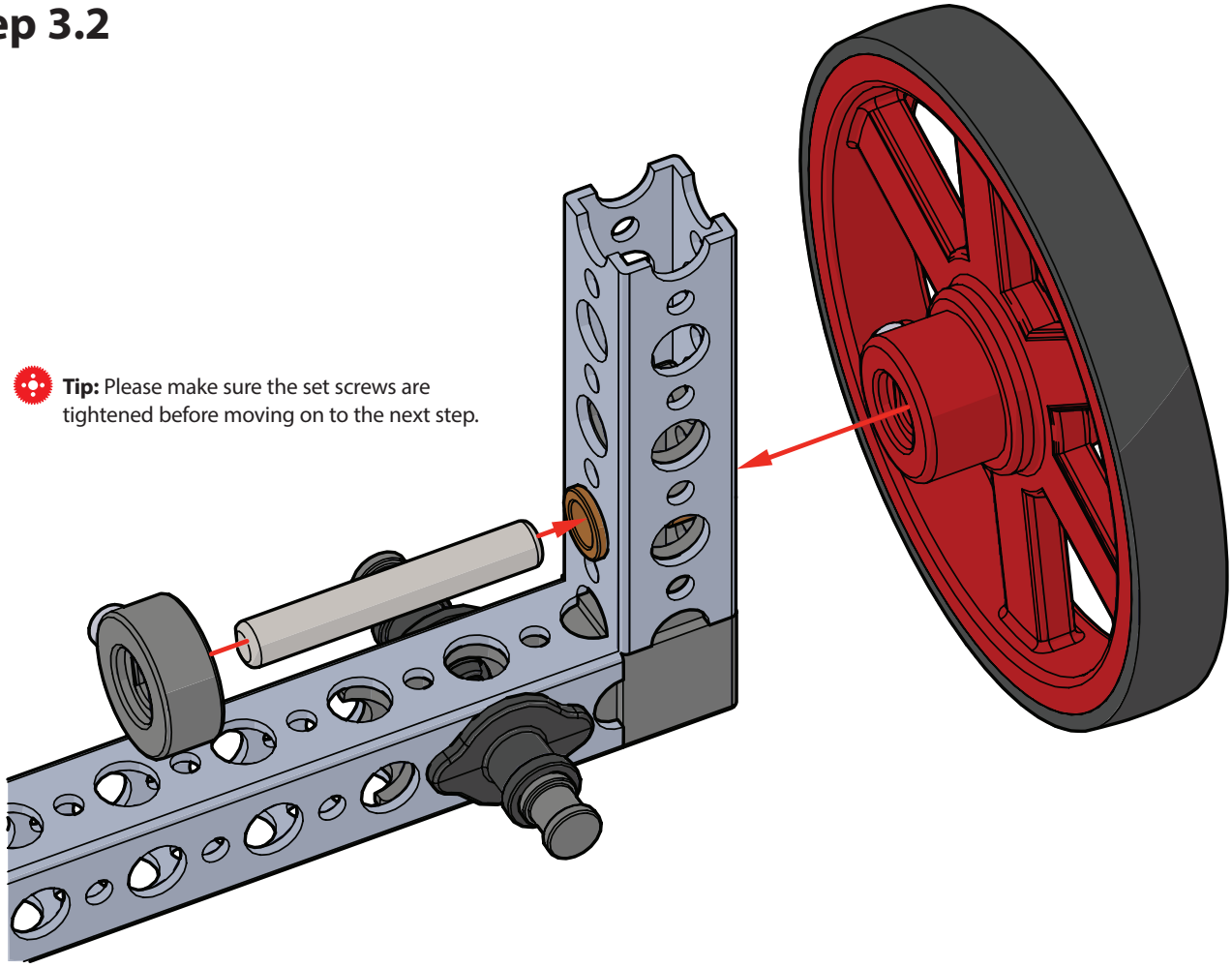
Step 3.0



Step 3.1



Step 3.2



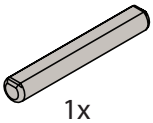
Tip: Please make sure the set screws are tightened before moving on to the next step.

Step 4

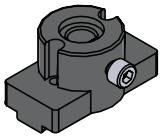
Parts Needed

2x
Thumbscrew 40323

1x
8 mm x 6 mm Bronze Bushing 40227

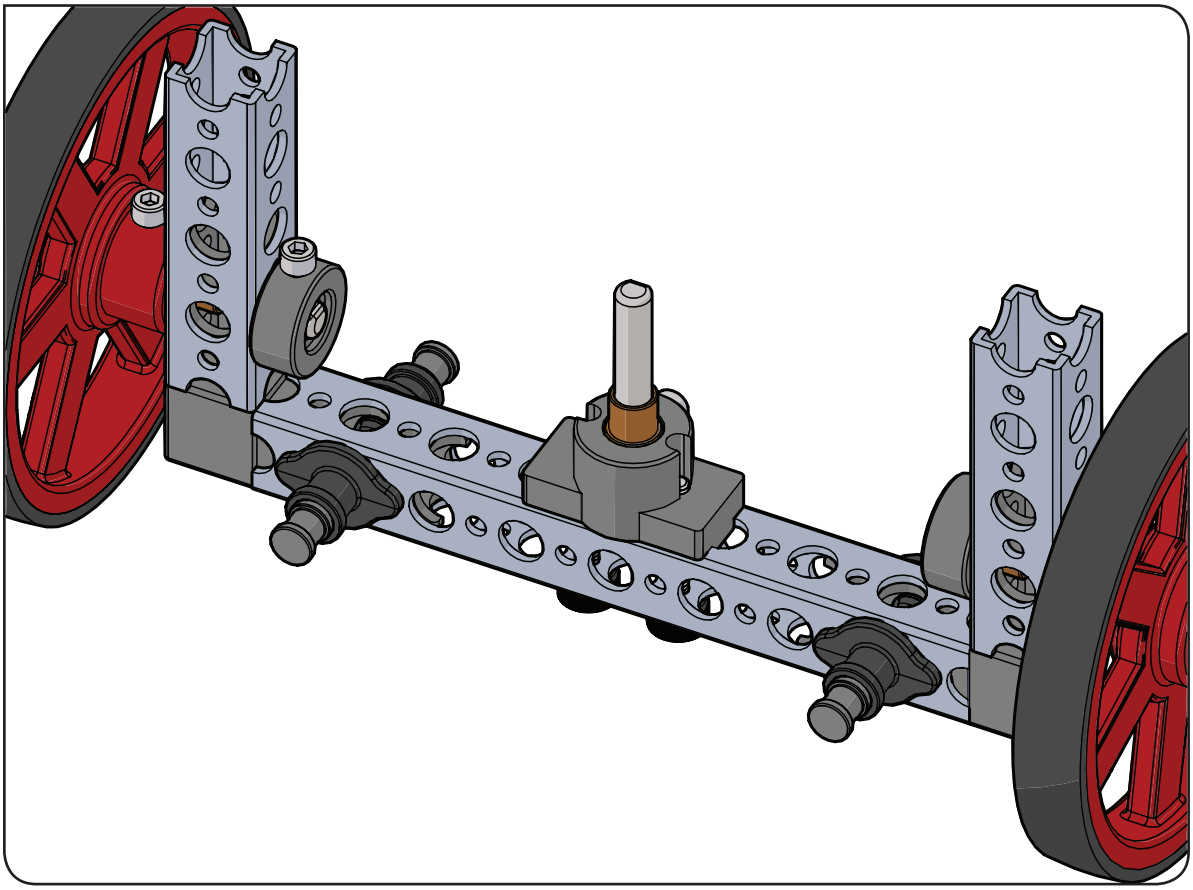


1x
40 mm Steel Axle 40226

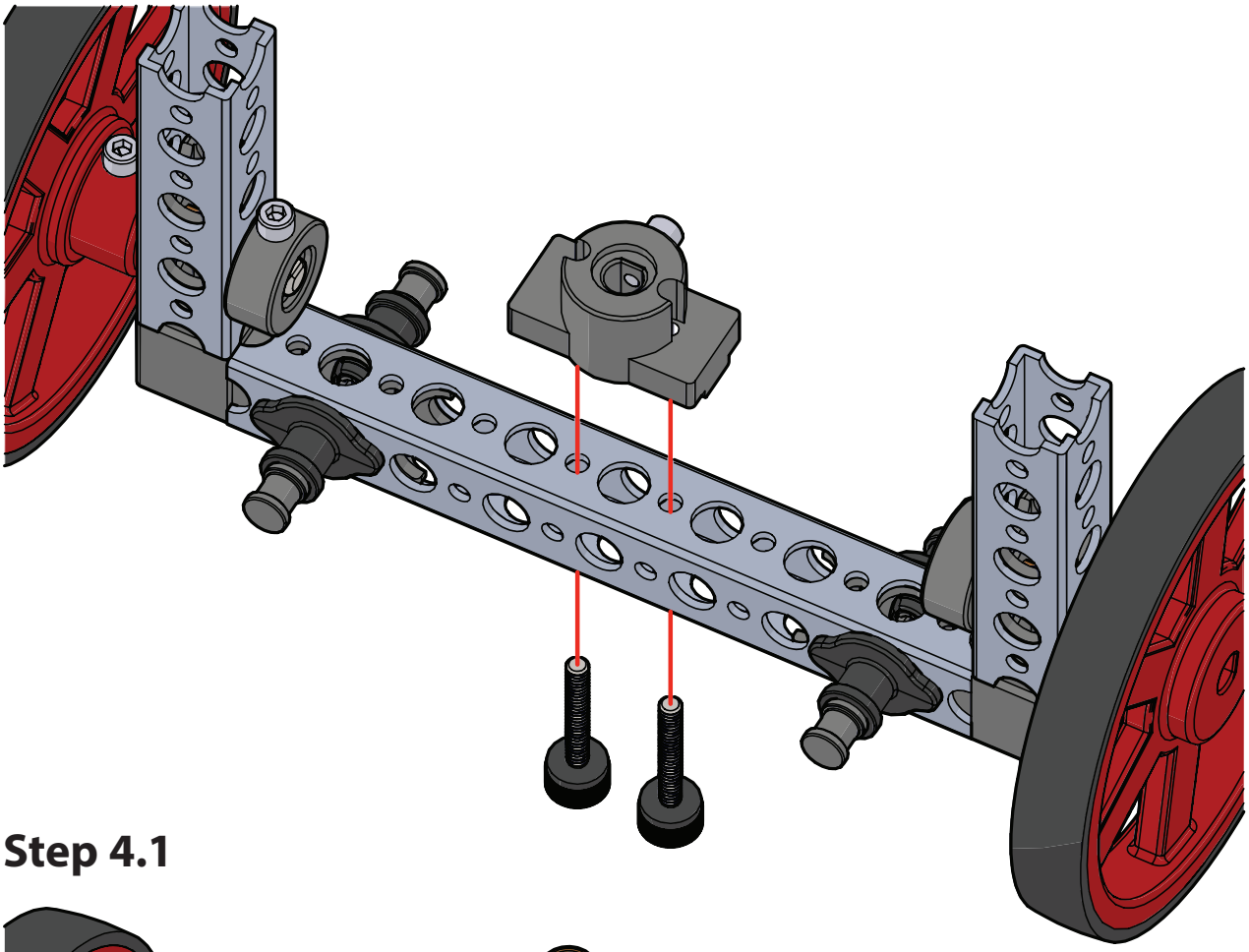


1x
Beam Attachment Hub 40228

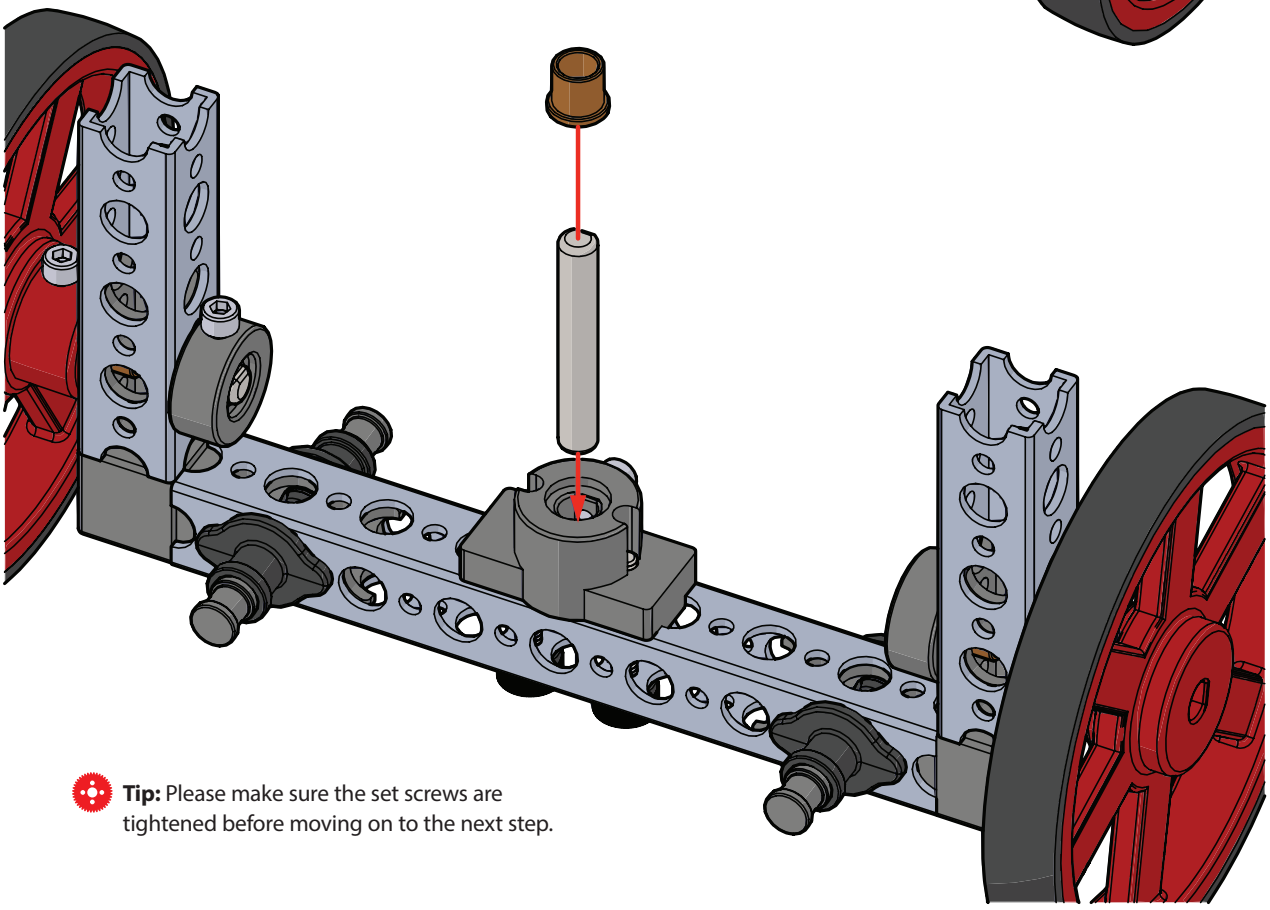
Partial assembly should look like this.



Step 4.0



Step 4.1



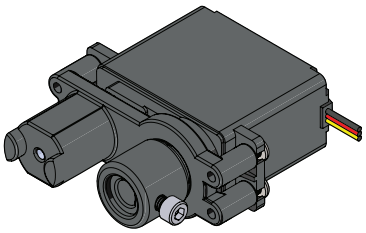
Tip: Please make sure the set screws are tightened before moving on to the next step.

Step 5

Parts Needed

1x
8 mm x 6 mm Bronze Bushing
40227

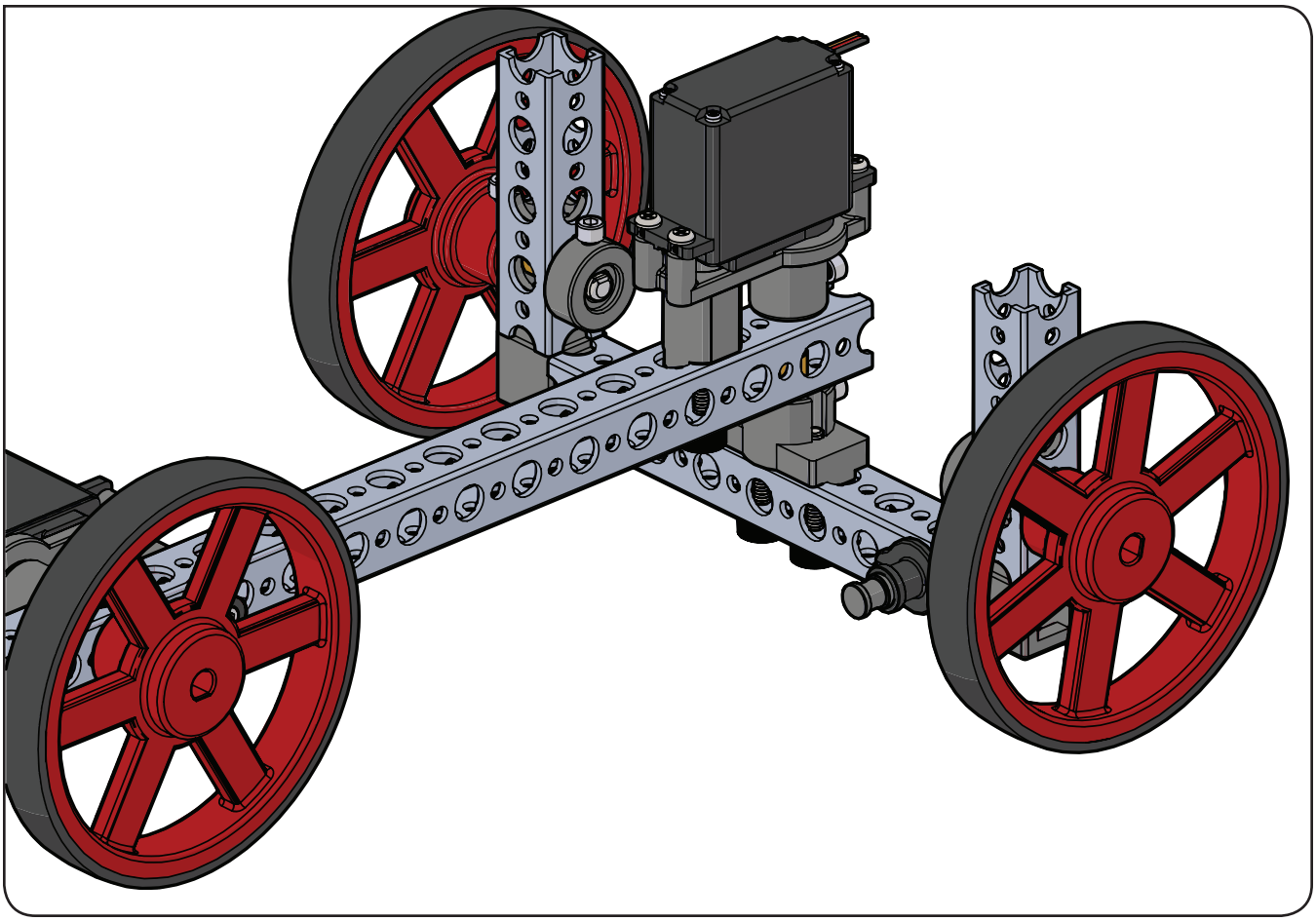
1x
Thumbscrew 40323



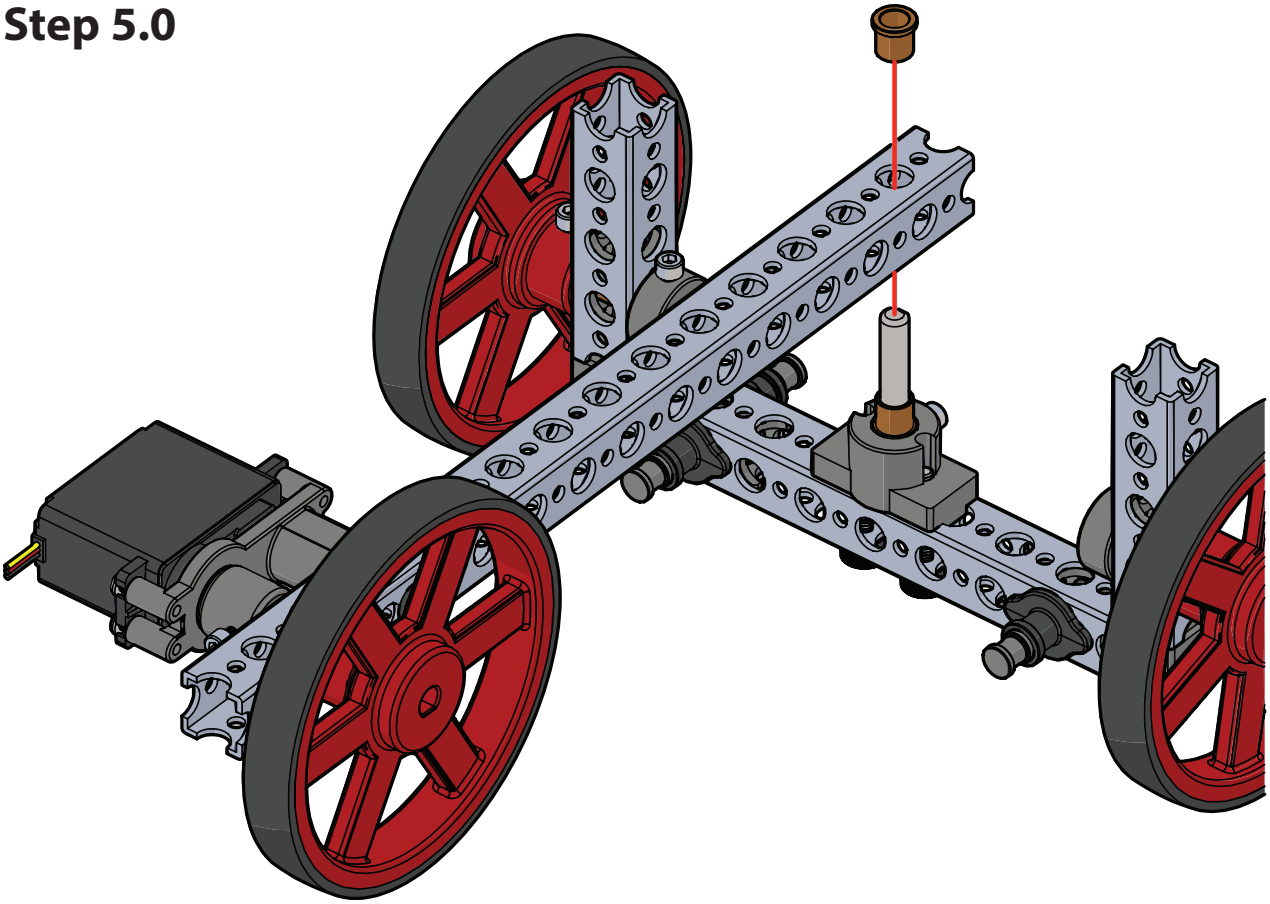
1x
Standard-Scale Servo Motor 40538 with Servo Mounting Bracket 40232 (Assembly instructions on pages 14-15.)

Tip: You also need the beam and wheel assembly created in Step 1.

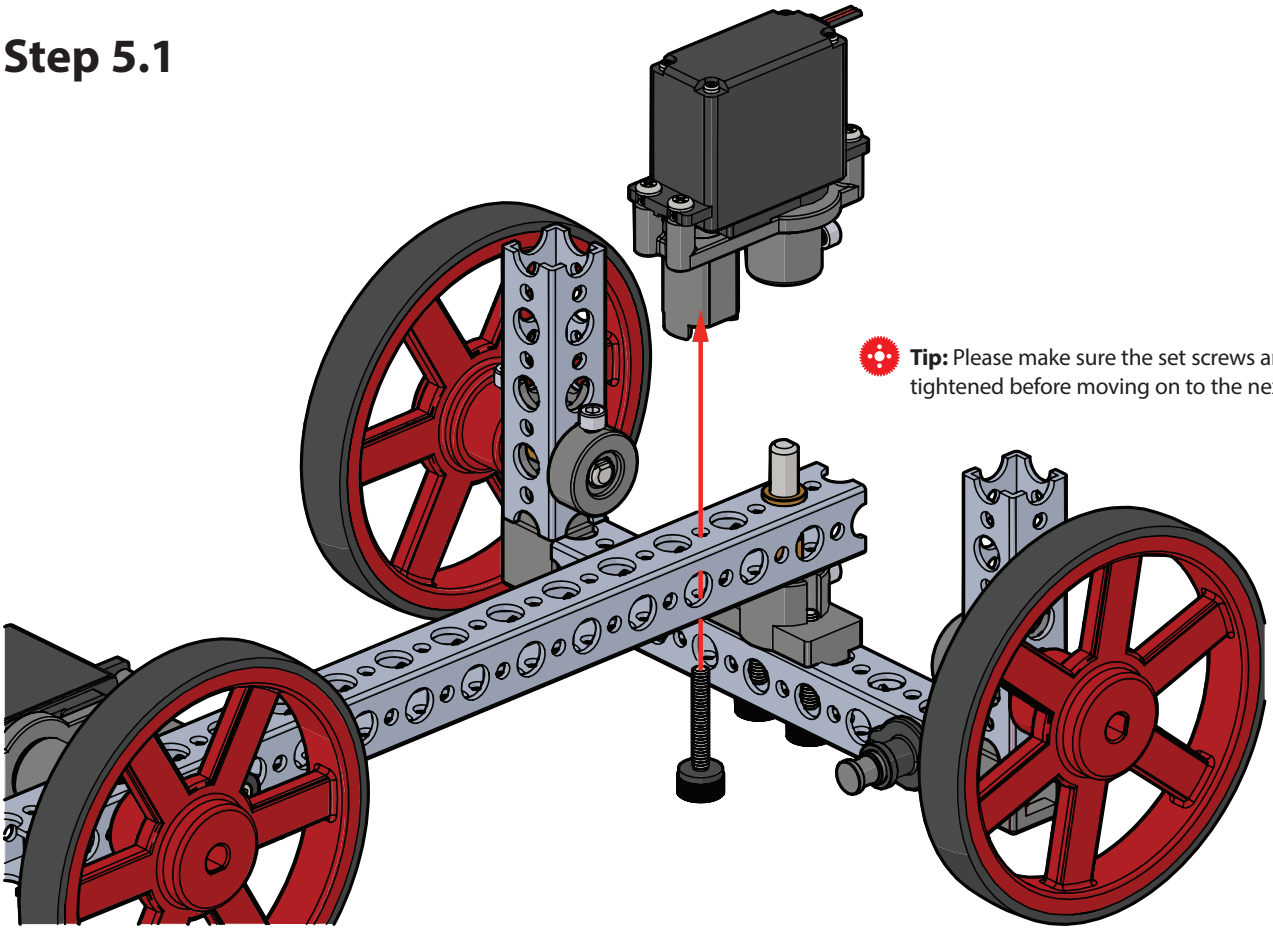
Partial assembly should look like this.



Step 5.0



Step 5.1



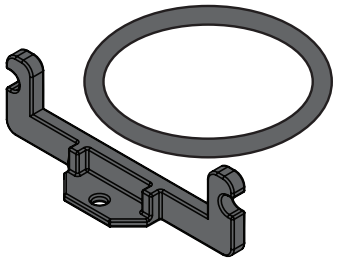
Tip: Please make sure the set screws are tightened before moving on to the next step.

Step 6

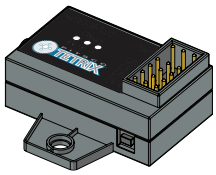
Parts Needed

4x
Wing Nut 40221

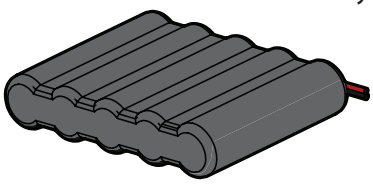
4x
Thumbscrew 40323



2x
Battery Mount Bracket 40236

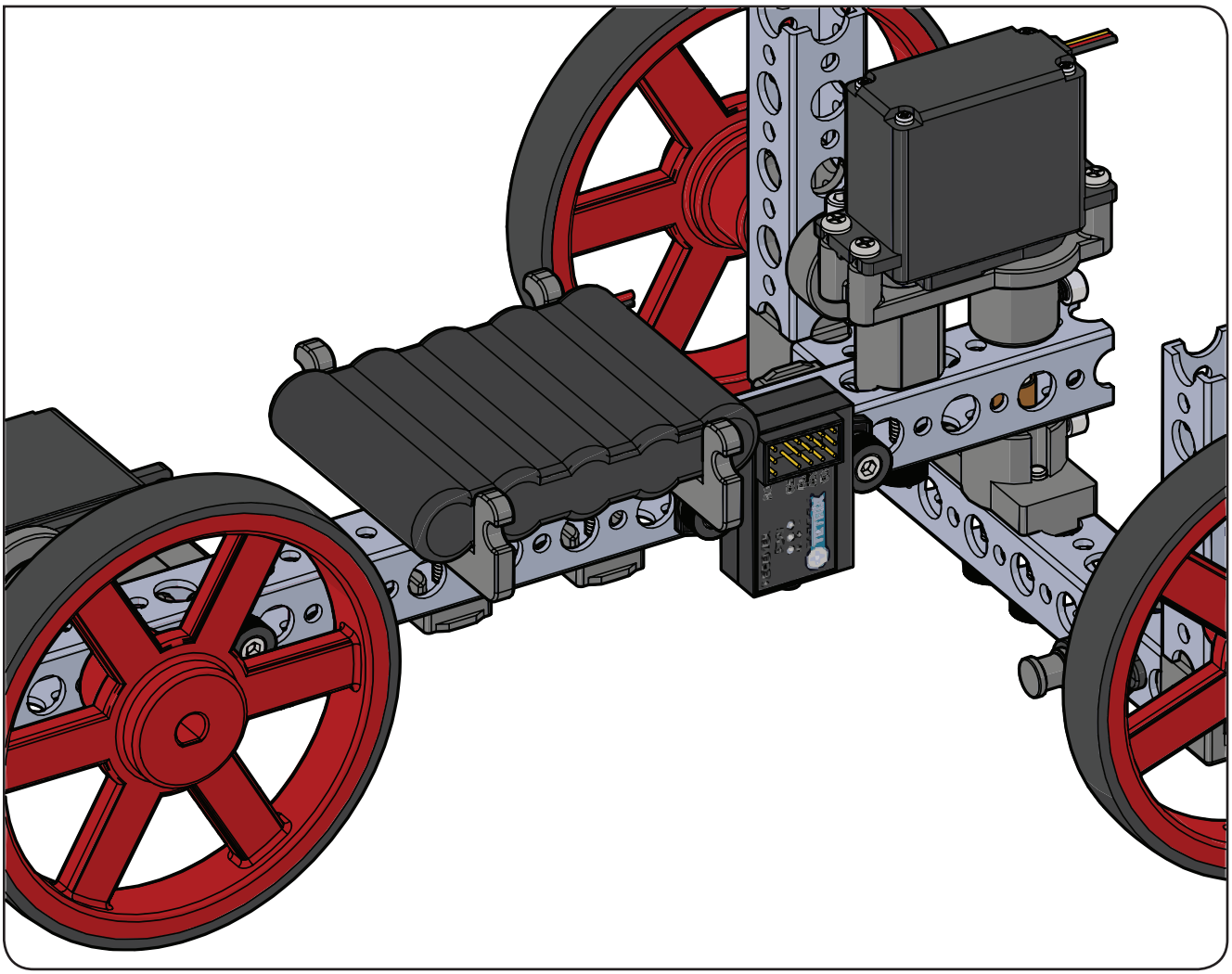


1x
4-Channel Wireless Receiver
from Wireless Joystick Gamepad
System 40239

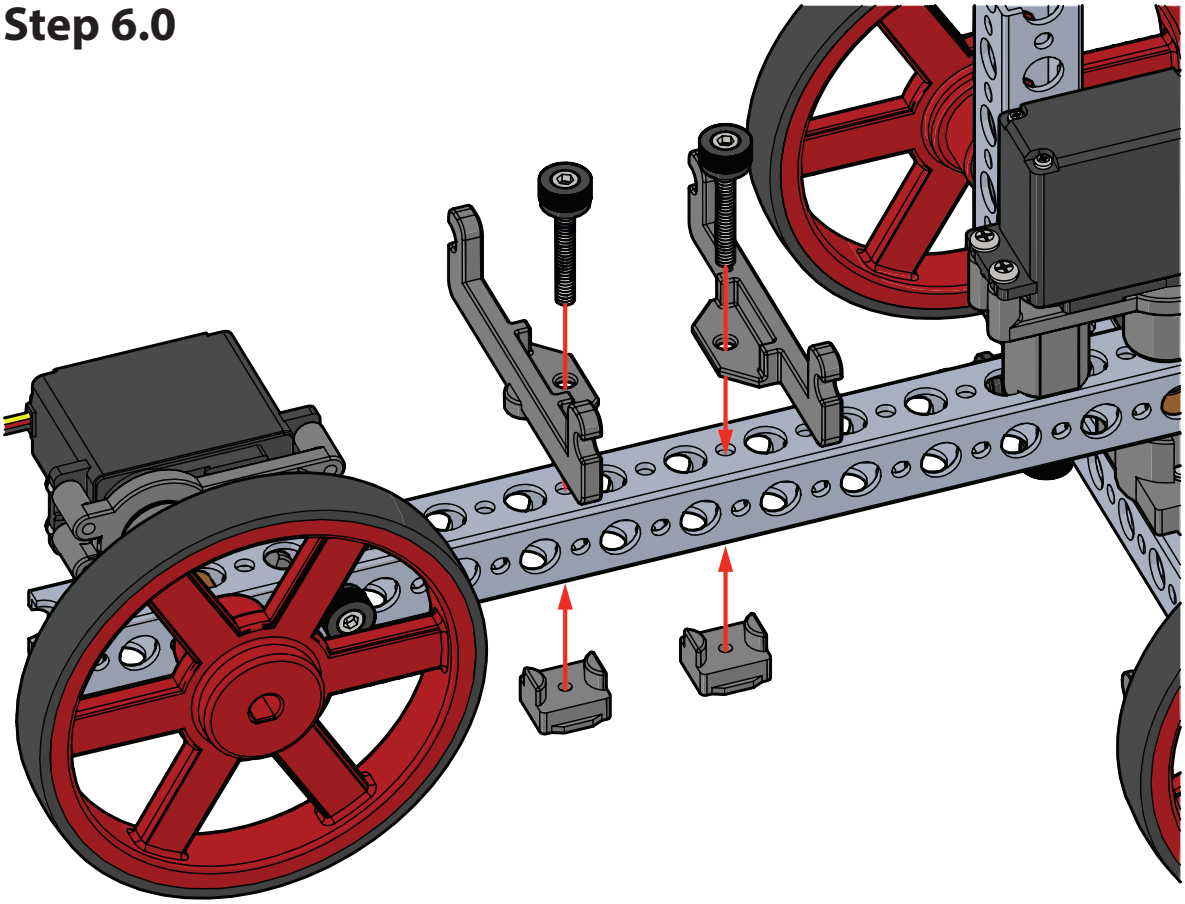


1x
6 V NiMH Battery Pack 40235

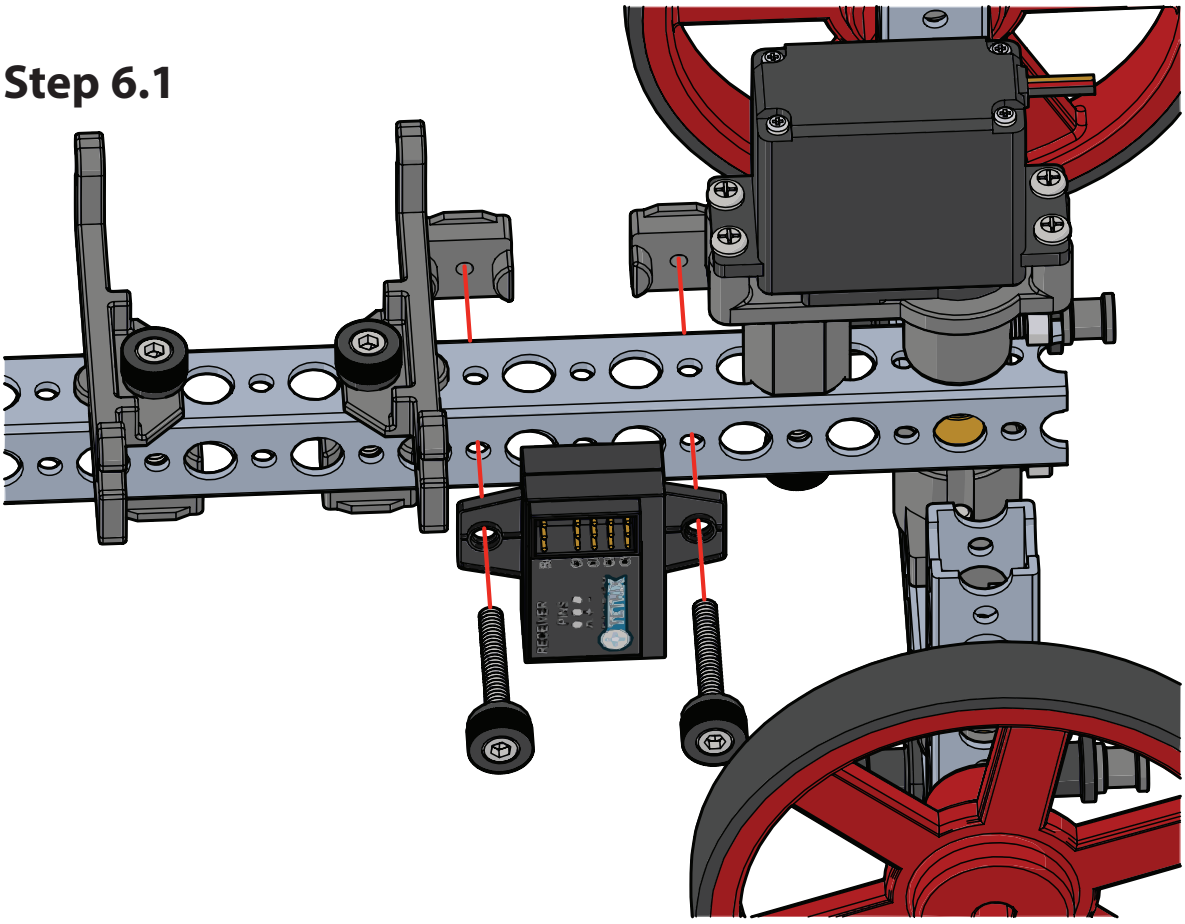
Partial assembly should look like this.



Step 6.0

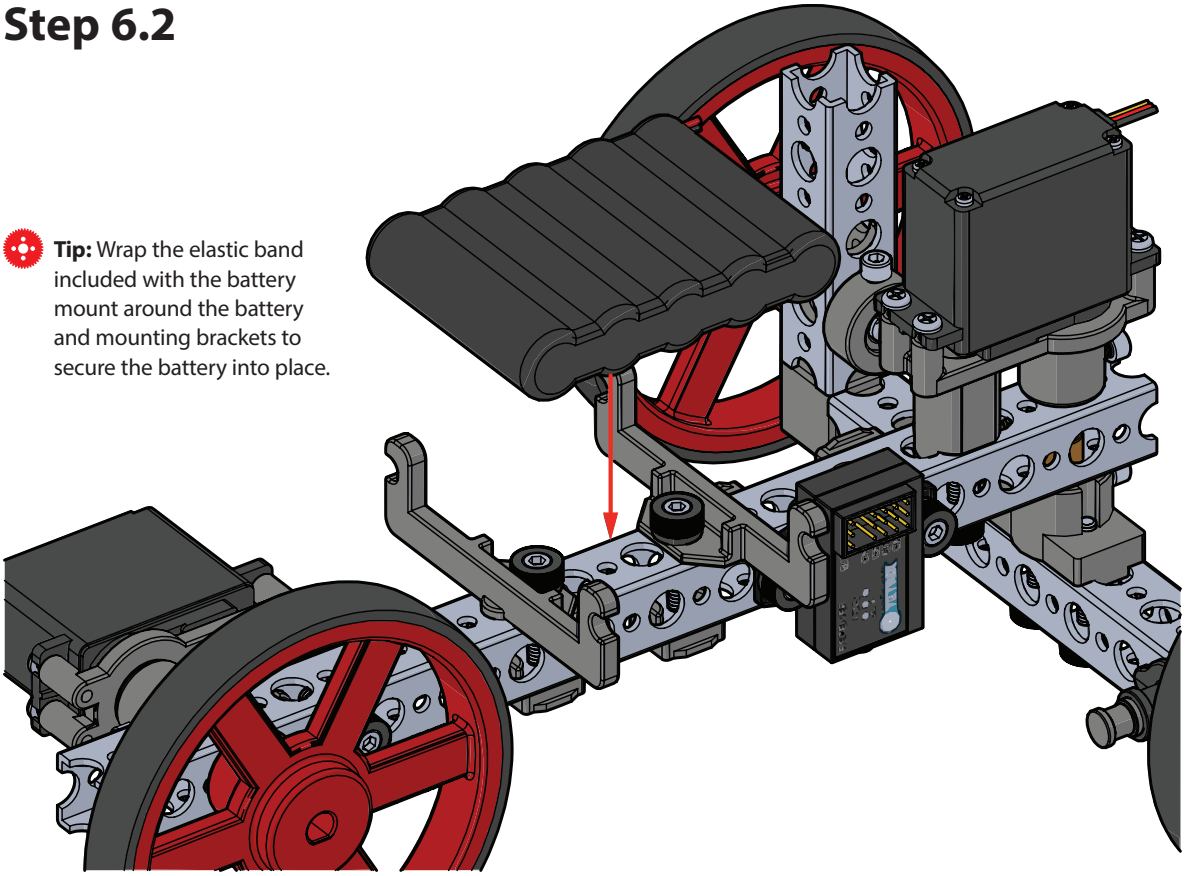


Step 6.1

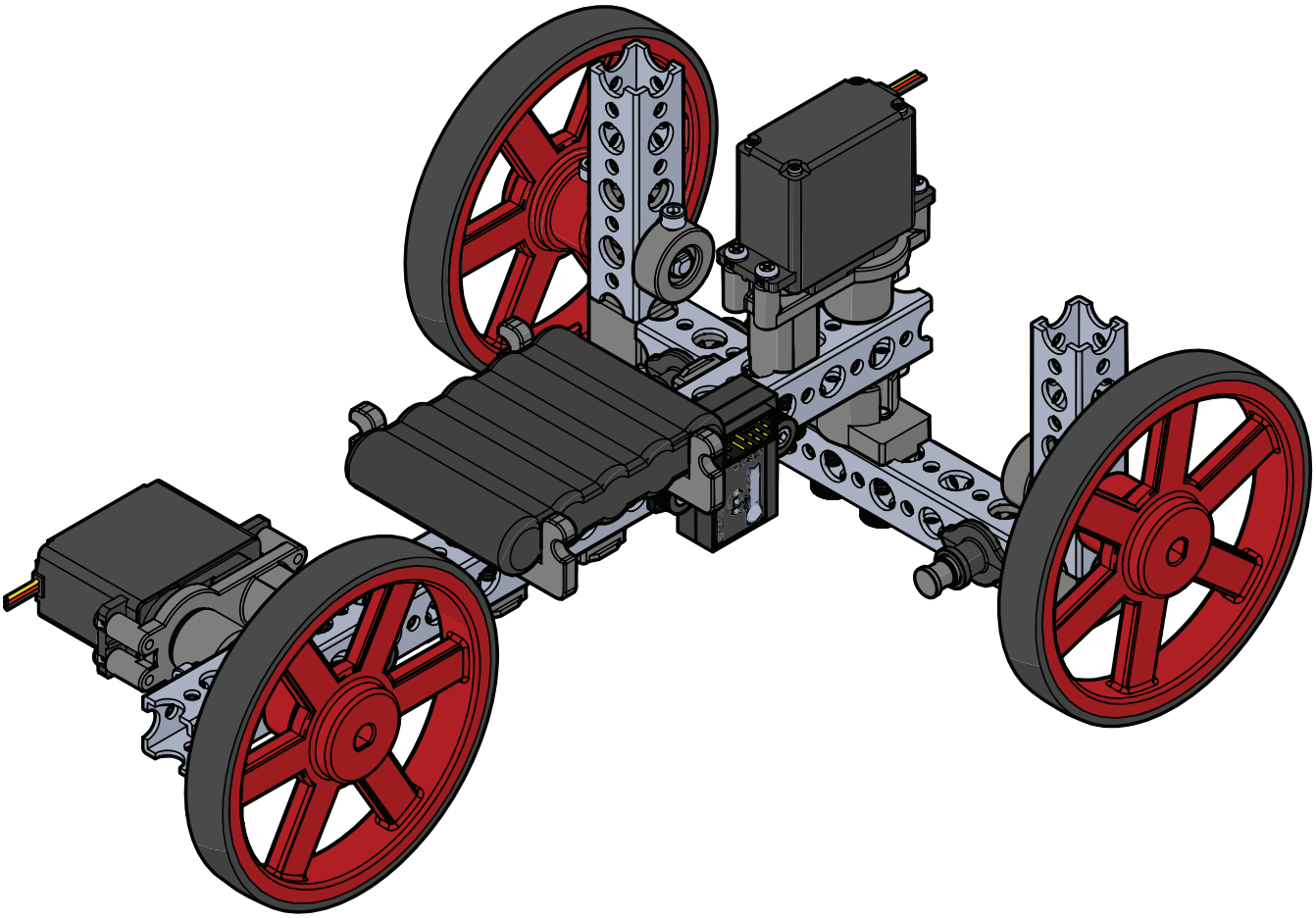


Step 6.2

Tip: Wrap the elastic band included with the battery mount around the battery and mounting brackets to secure the battery into place.



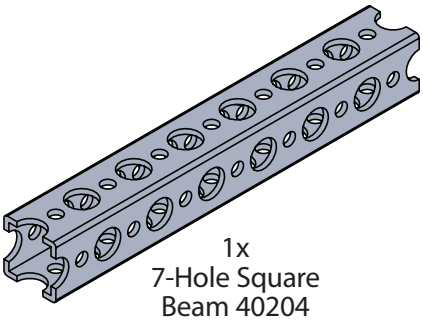
Finished assembly without gripper.



Optional – Wheelee Bot with Gripper Assembly

Step 7

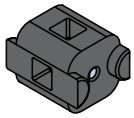
Parts Needed



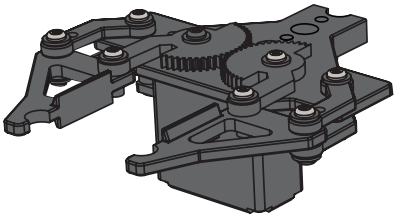
1x
7-Hole Square
Beam 40204

1x
Wing Nut 40221

5x
Thumbscrew 40323

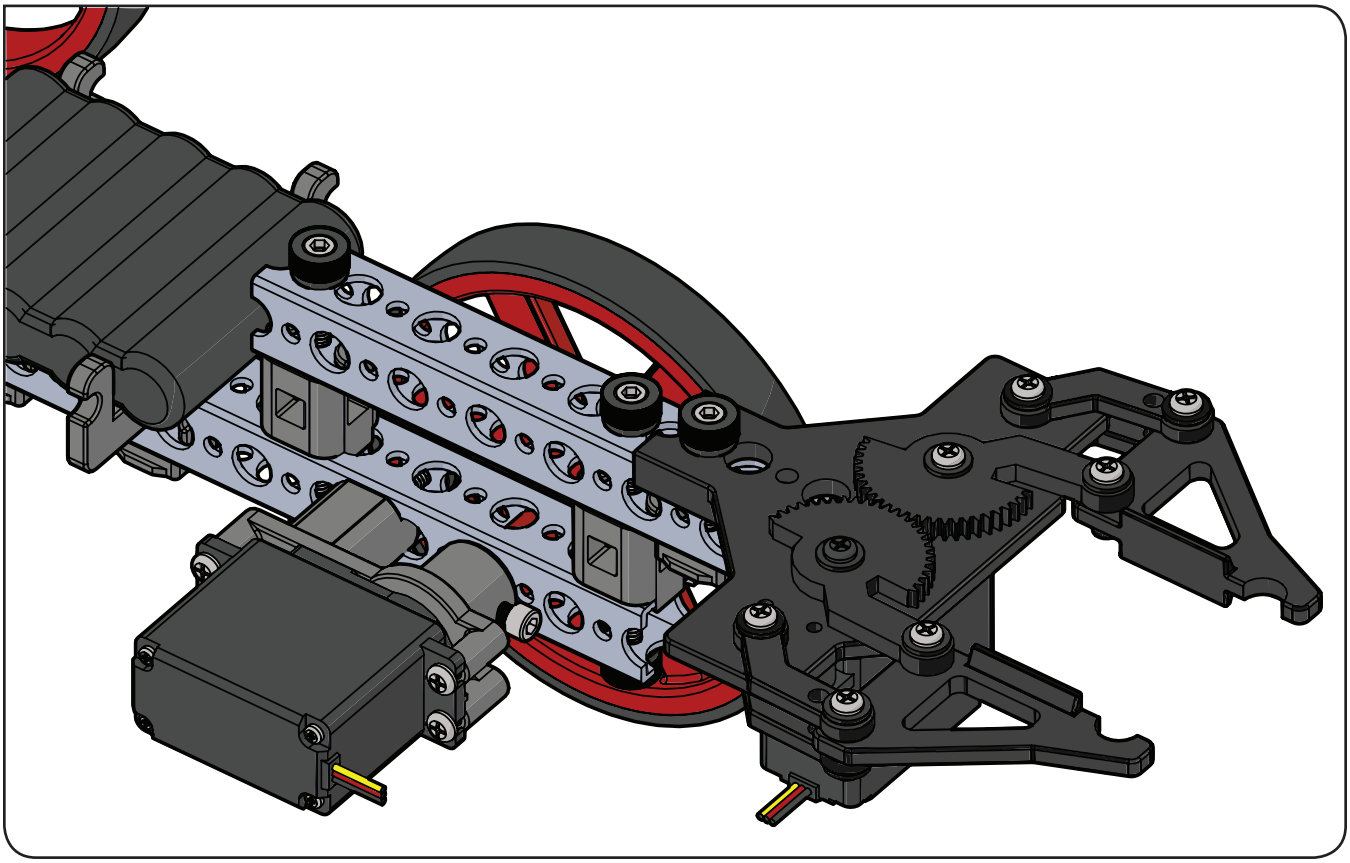


2x
Straight Block Beam Connector
40216

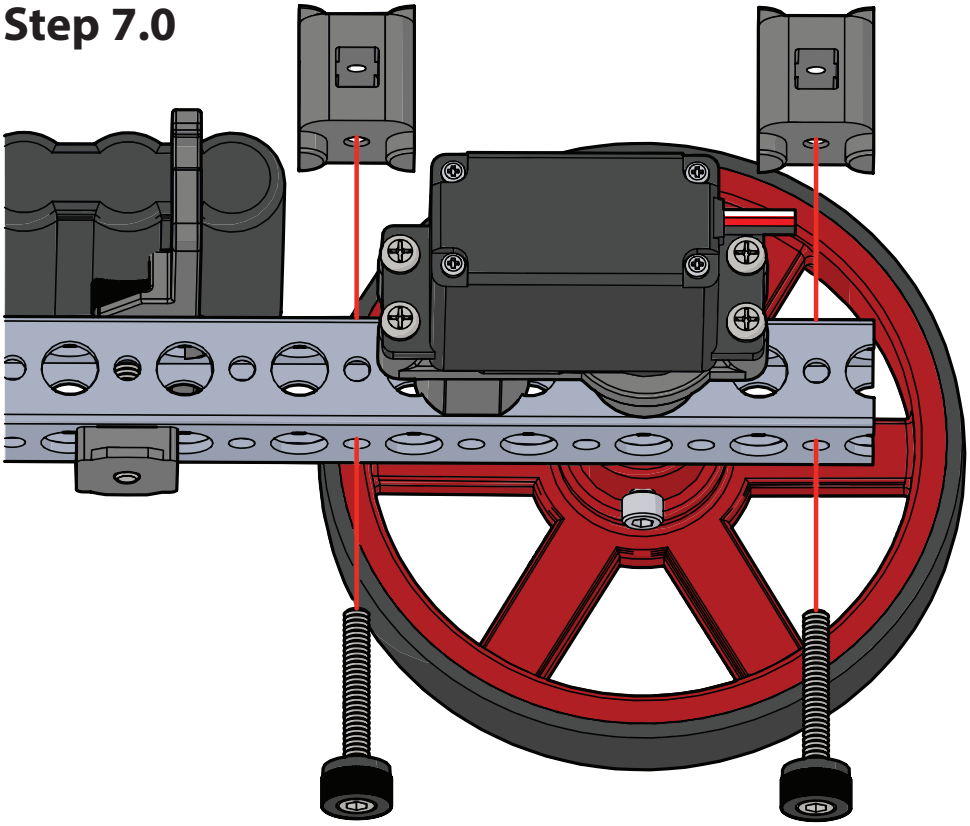


1x
Gripper Kit 40234

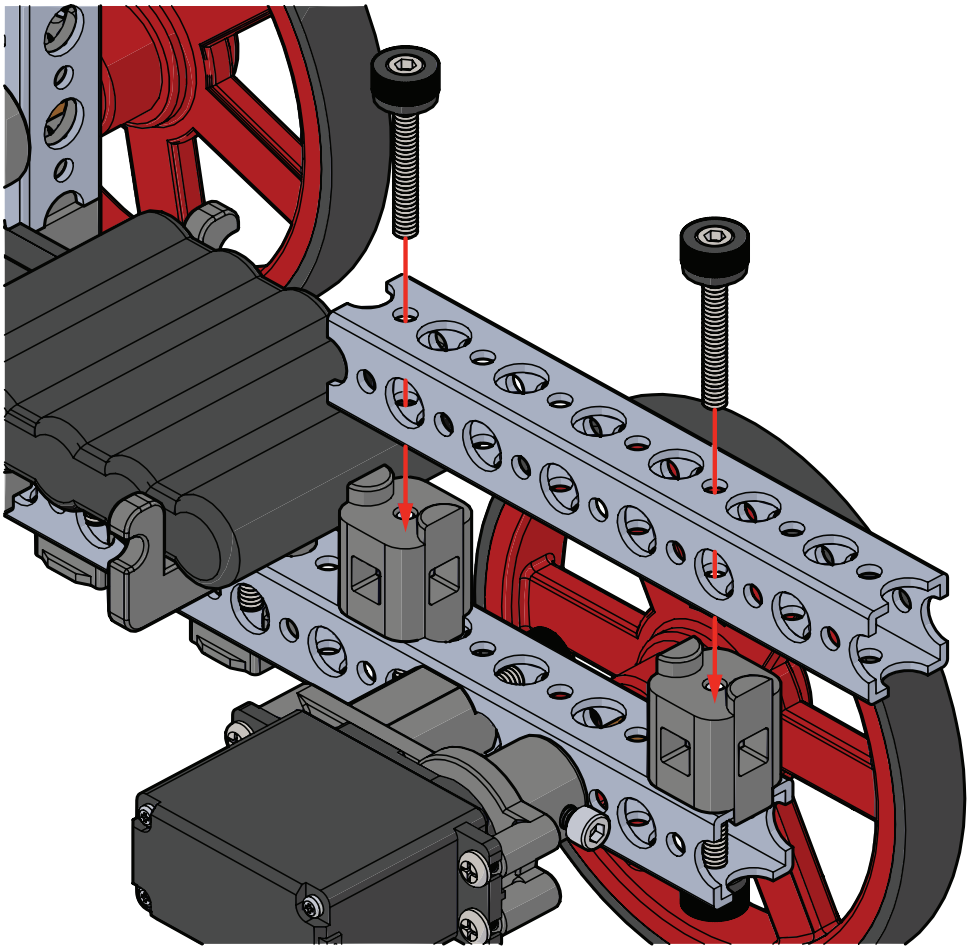
Partial assembly should look like this.



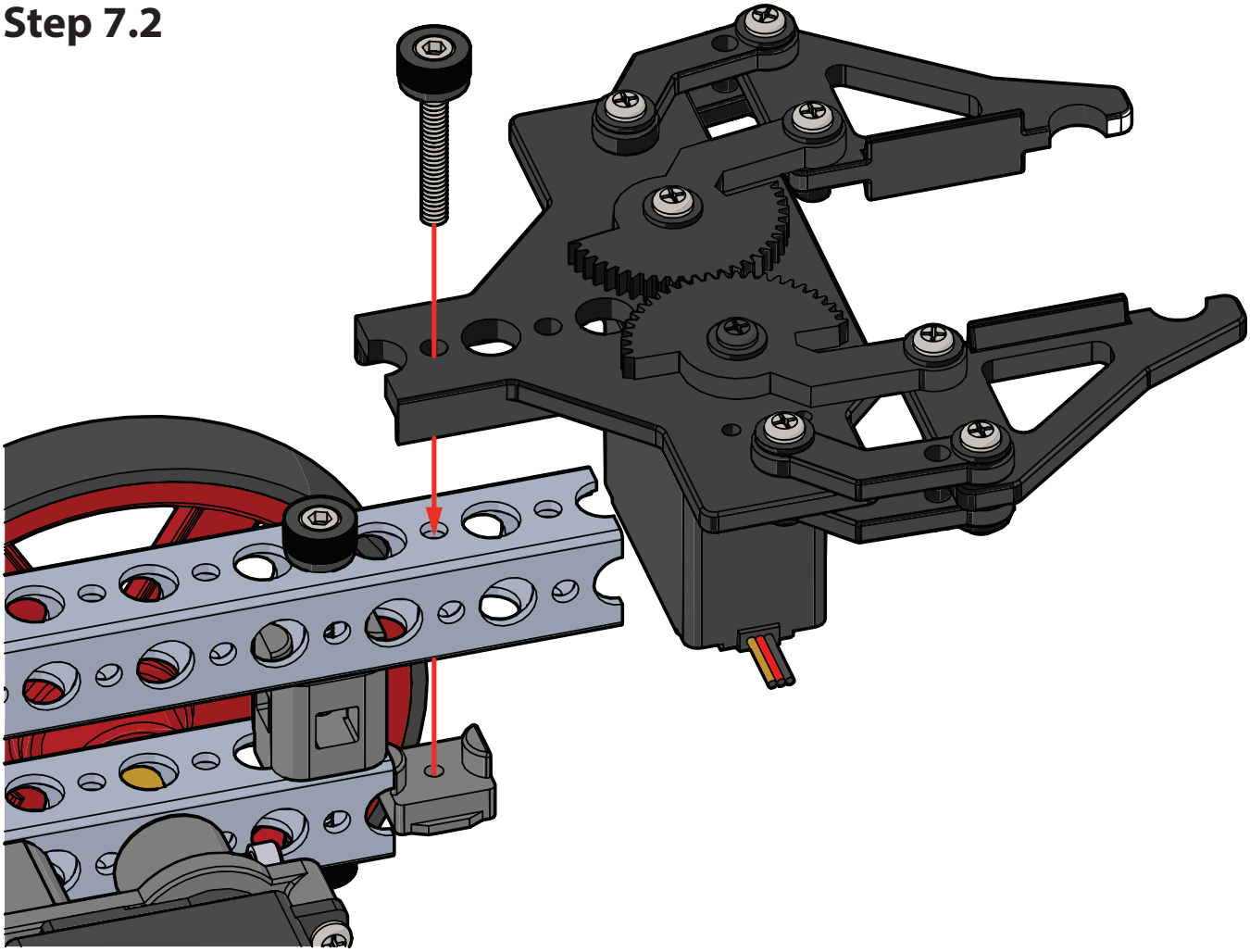
Step 7.0



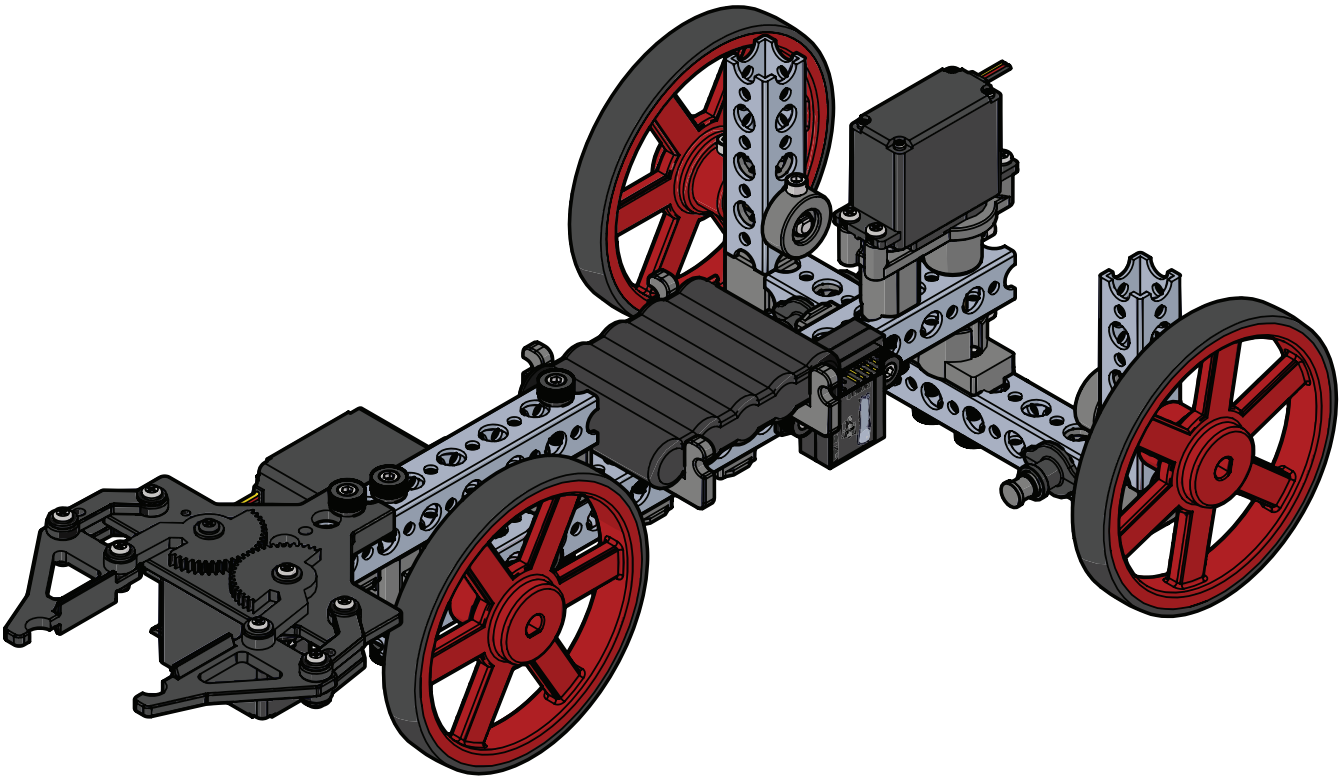
Step 7.1



Step 7.2



Finished assembly with gripper.



TETRIX PRIME Wheelee Bot Activities

Final Connections:

After you've installed the battery with the battery mount bracket, you are ready to connect the servo motors to the wireless receiver. Remember to reference page 13, which shows a typical wiring diagram for connecting the battery, switch, and wireless receiver.

Connect the battery to the BAT connection on the receiver. Connect the continuous rotation servo to Channel 3 of the wireless receiver. Connect the standard servo to Channel 1. Secure the wires so they do not become entangled in any moving parts. Turn on the wireless joystick gamepad system and test the operation of the Wheelee Bot. If the motion does not correspond with the joystick movement, use a screwdriver to change the position of the NOR/REV switches for the appropriate channel. If necessary, use the trimmer controls to adjust servo movement or position when the joysticks are in the neutral position.

Don't forget to reference page 12 for complete instructions on setting up the wireless joystick gamepad system and configuring input to personal preferences.

Sample Activities:

After you complete the construction of the Wheelee Bot, it is time to have some fun. Practice driving the Wheelee Bot to familiarize yourself with the way it works.

Activity 1

- Place a piece of masking tape on the floor and set cups upside down to resemble cones. Place the cones in a straight line beginning 24 inches from the tape with 24 inches between each cone. Put another piece of tape on the floor 24 inches past the last cone. Place your Wheelee Bot on the side of the tape opposite the cones. Drive the Wheelee Bot through the cones in a slalom pattern. Use a stopwatch to time how long it takes to drive Wheelee Bot through the slalom course to the tape at the other end of the cones. Try to complete the slalom faster than your partner without hitting the cones.

Activity 2

- After completing the build of the Wheelee Bot, you can add the optional Gripper Assembly. Refer to the instructions on pages 47-50 for attaching the gripper. Assemble the Ball Rack. Refer to pages 117-119 for instructions on how to assemble the Ball Rack. Place four balls on the crossbar of the Ball Rack. Place four small cups about four feet from the Ball Rack. Use the remote control to maneuver the Wheelee Bot into position and pick up a ball using the gripper. Drive the robot to one of the cups and place the ball into the cup. Harvest the remaining balls from the rack and place them in the other cups. Make it a competition by timing how long it takes to move all four balls from the rack to the cups.

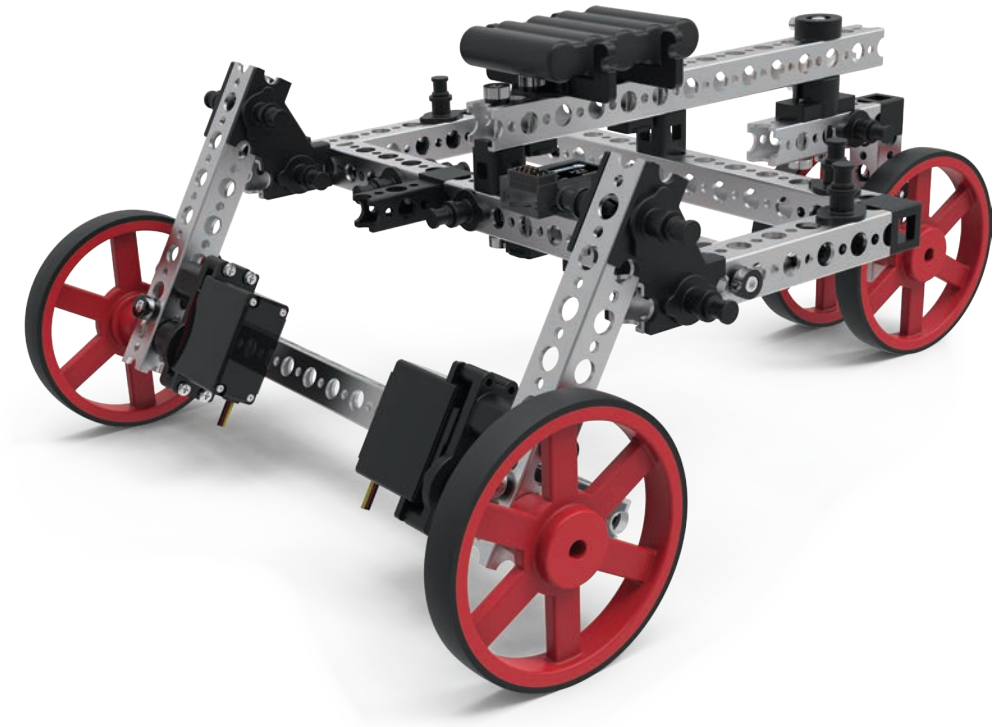
Activity 3

- With permission from your instructor, make modifications to improve the performance of the Wheelee Bot. Some improvement ideas include reducing the turning radius, improving the stability, or improving the steering response.

Don't forget to document your efforts and remember the engineering design process.

You can also build the Wheelee Bot following our step-by-step video tutorial. To view it, visit **video.pitsco.com/TETRIX**.

TETRIX PRIME Buggee Bot Assembly



Overview:

The TETRIX PRIME Buggee Bot is a basic rover-type robot.

How It Works:

The TETRIX PRIME Buggee Bot uses two continuous rotation servos for both propulsion and steering and can be driven in tank mode or arcade mode. As an extension option, the TETRIX PRIME Gripper along with two standard servo motors can be added to the model for picking up objects from differing heights.

Getting Started:

- Refer to pages 54-88 for instructions on how to build the complete Buggee Bot.
- See page 89-90 for suggested sample activities.

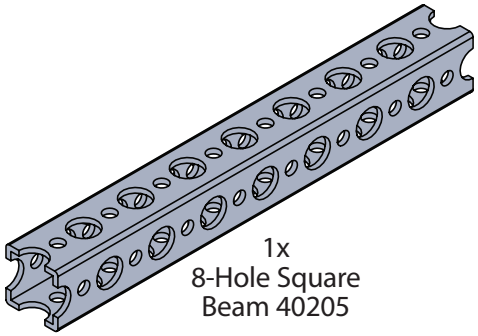
Time Expectations:

30-50 minutes

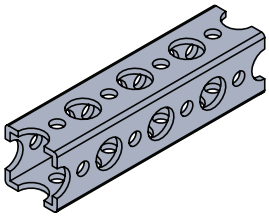
Note: Many factors can affect building time, including set organization and whether builders use a partner. The above time is an estimate only and based on a single builder of average experience who is comfortable with the product and has access to well-organized sets. Actual time might vary.

Step 1

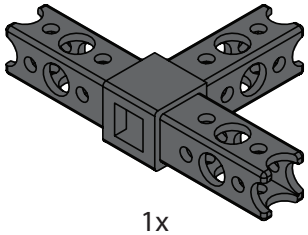
Parts Needed



1x
8-Hole Square
Beam 40205



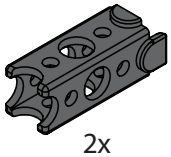
1x
4-Hole Square Beam 40201



1x
Tee Beam Connector 40213

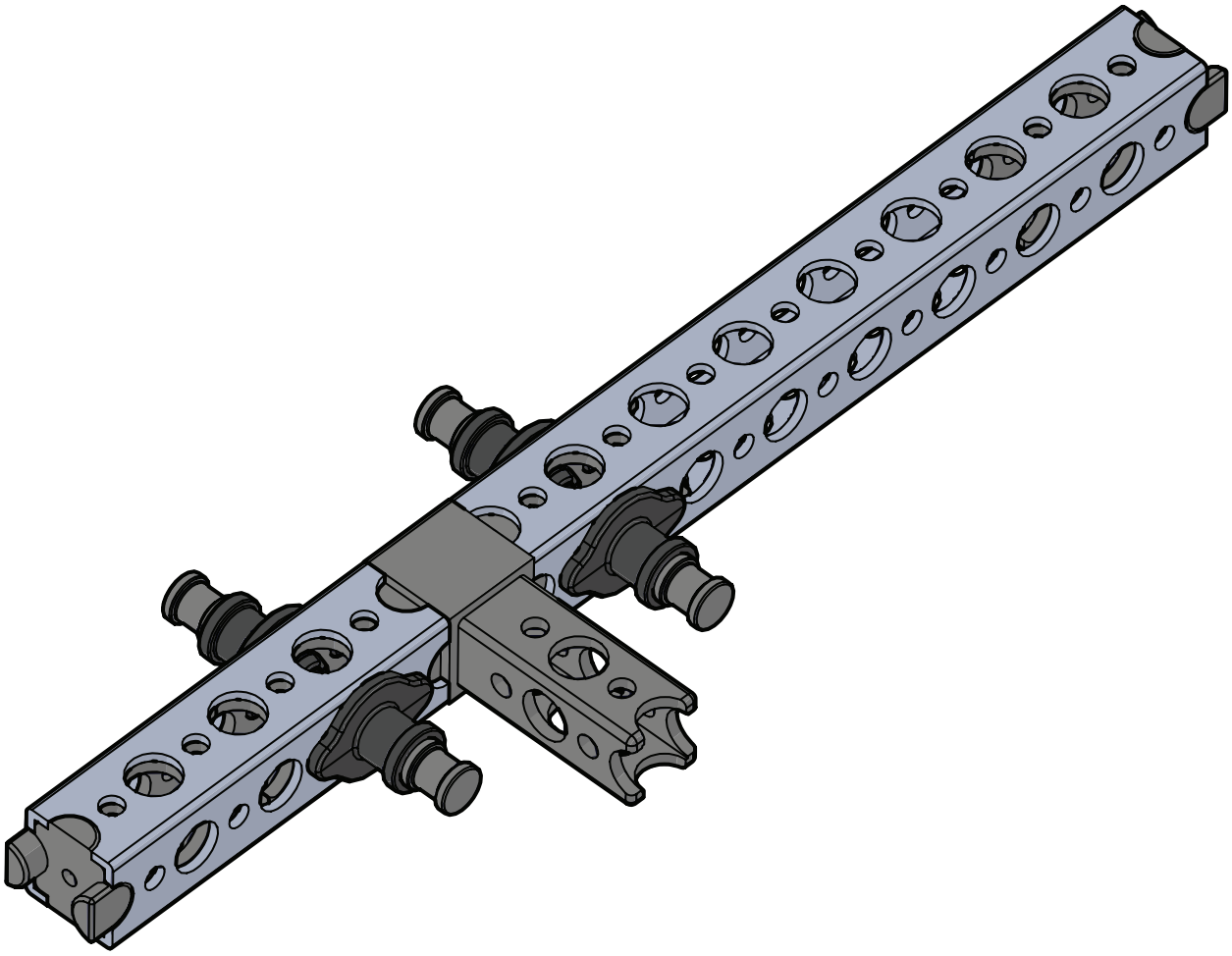
4x
Quick Rivet Connector 40219

4x
Quick Rivet Peg 40220

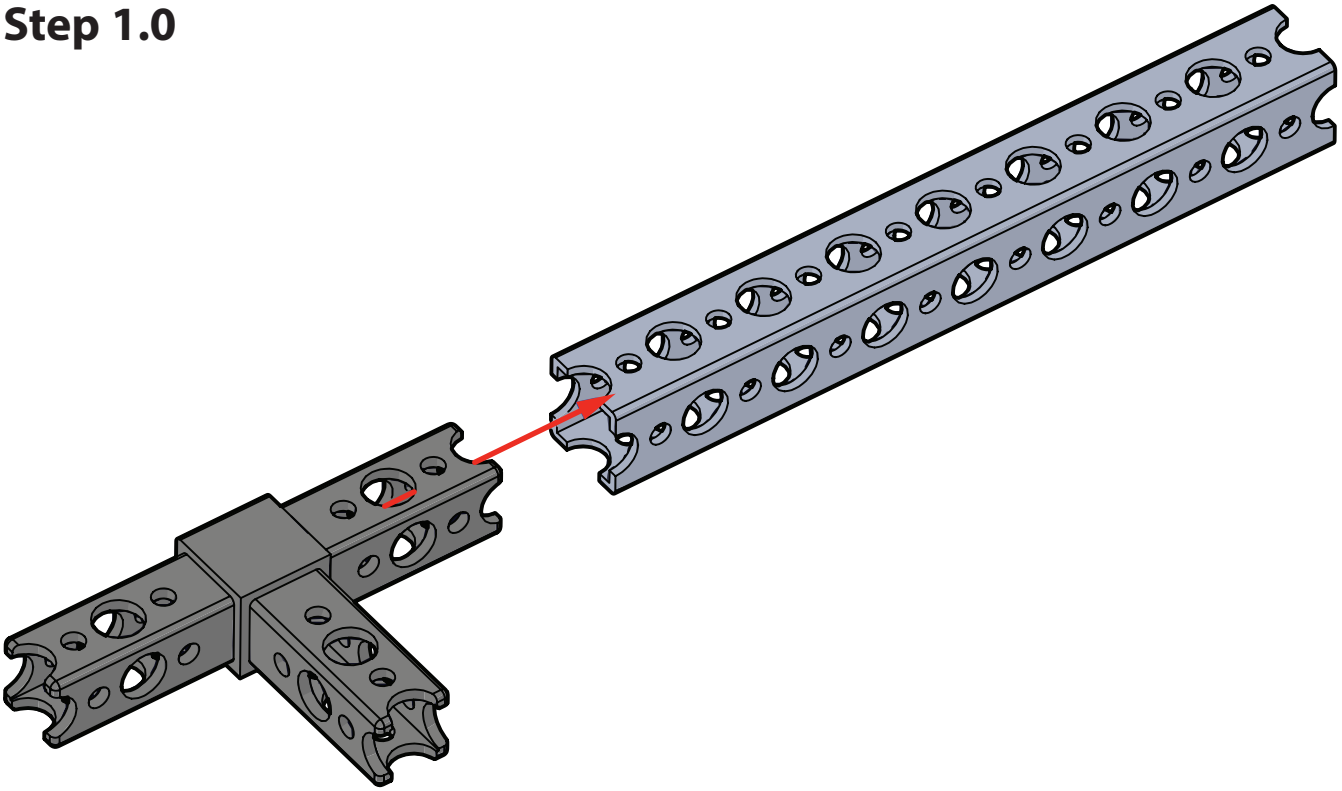


2x
Beam End Connector 40214

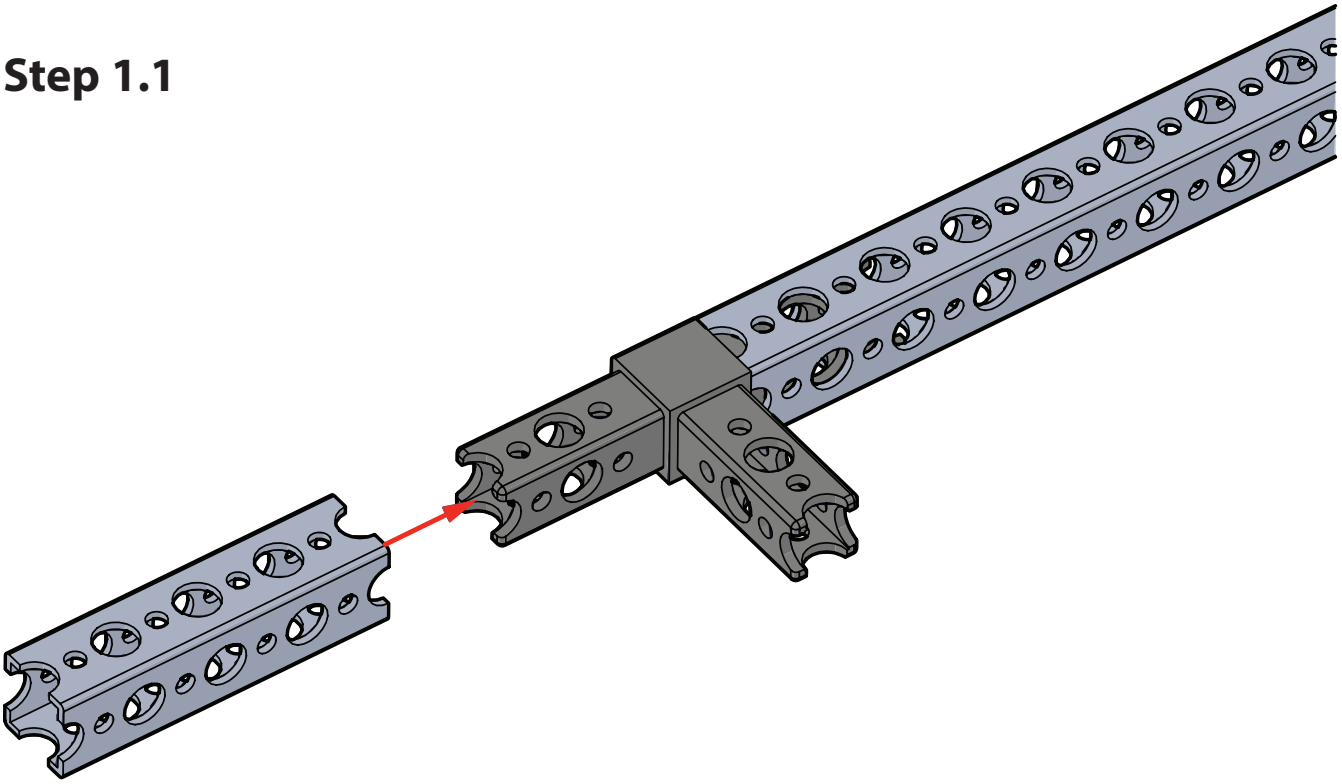
Partial assembly should look like this.



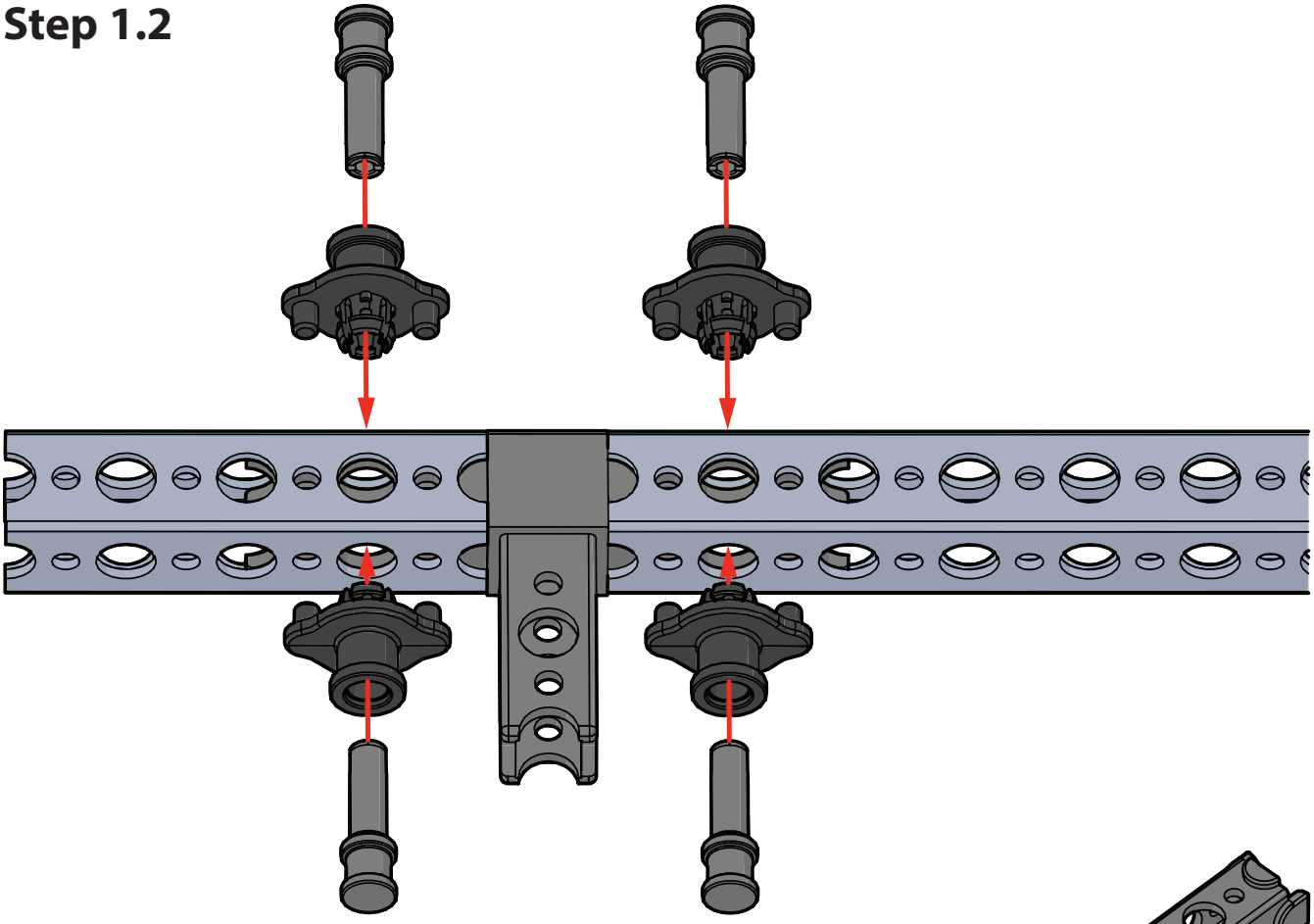
Step 1.0



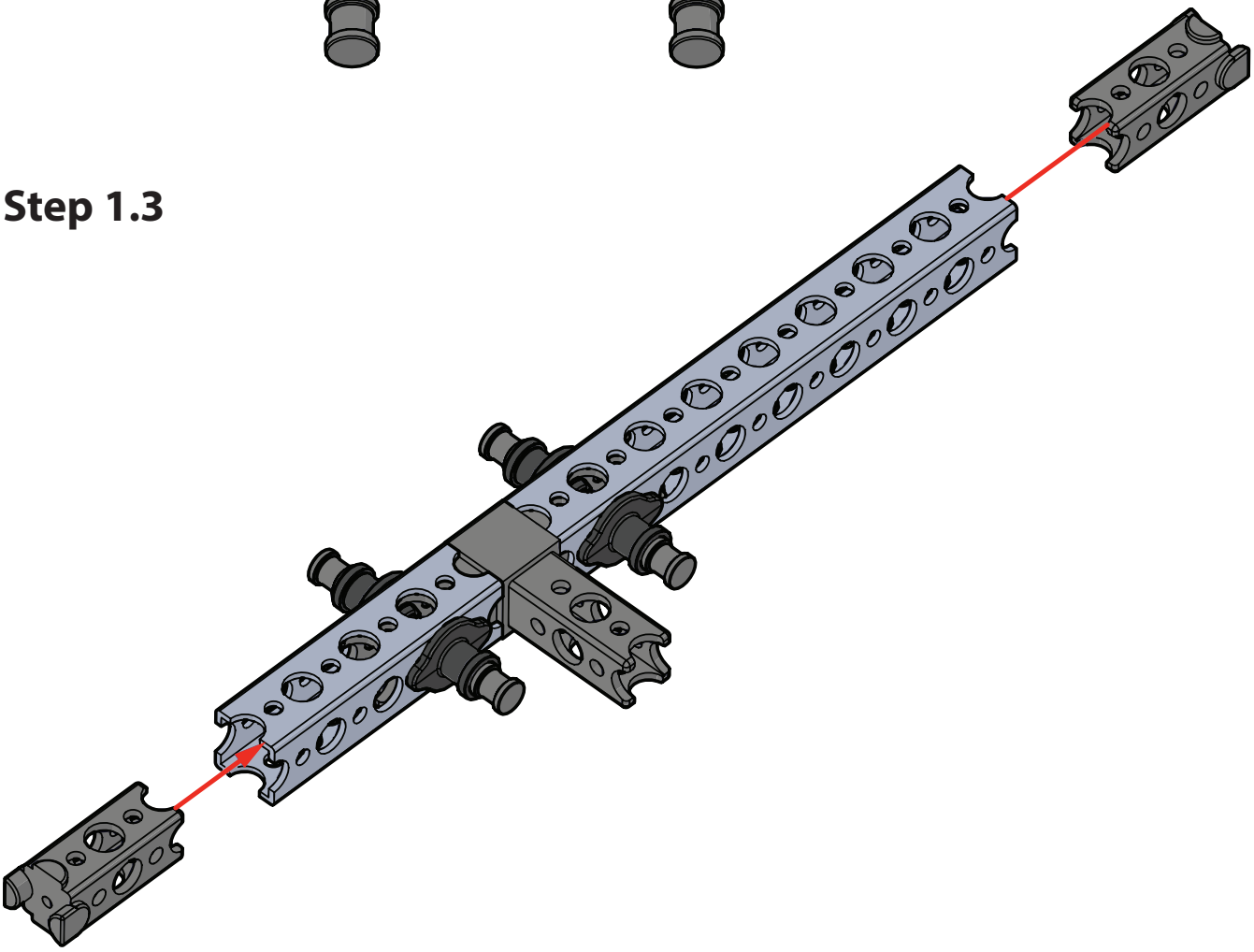
Step 1.1



Step 1.2

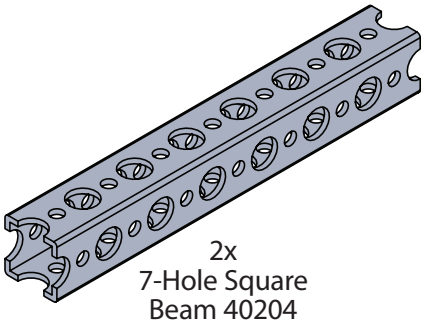


Step 1.3



Step 2

Parts Needed

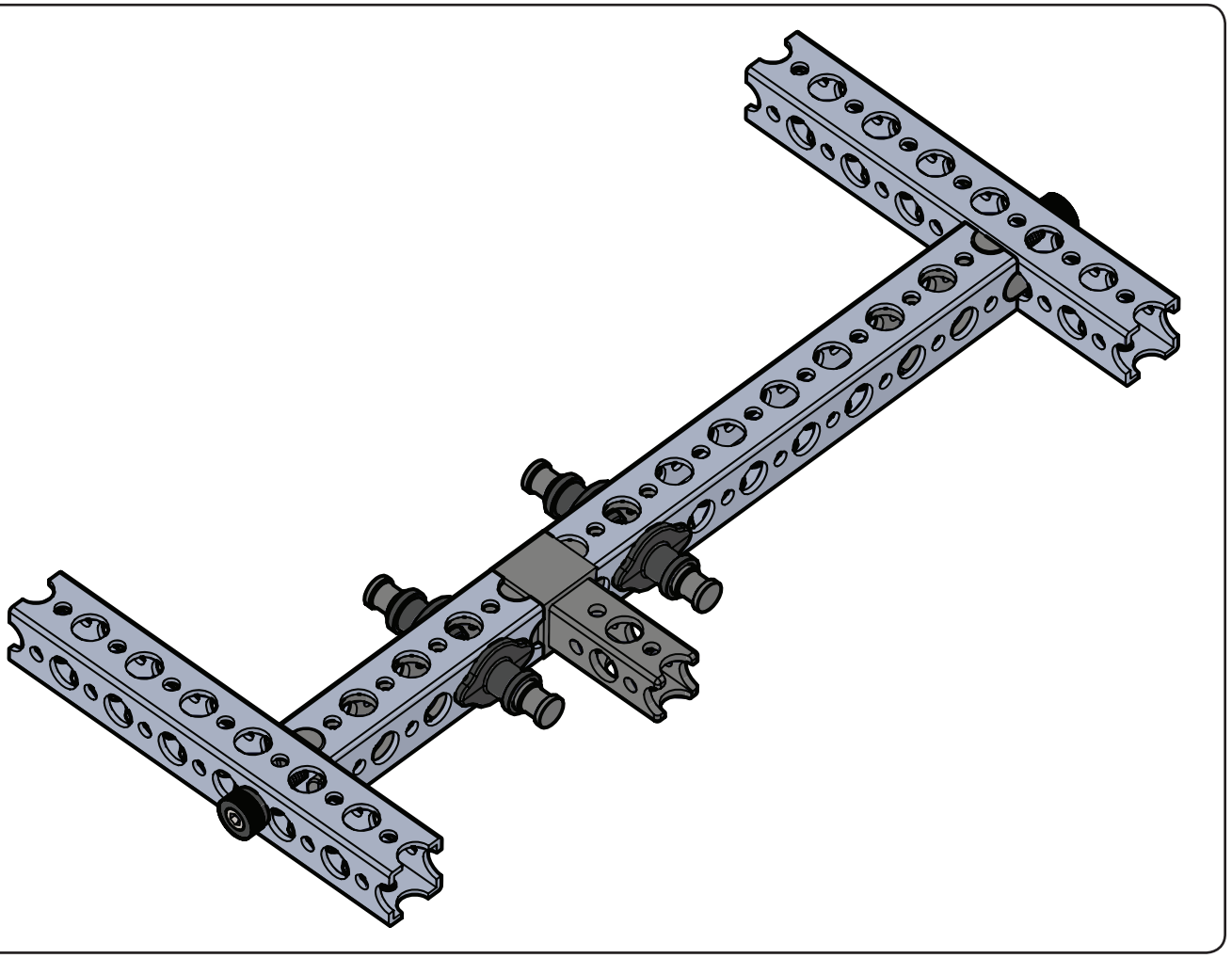


2x
7-Hole Square
Beam 40204

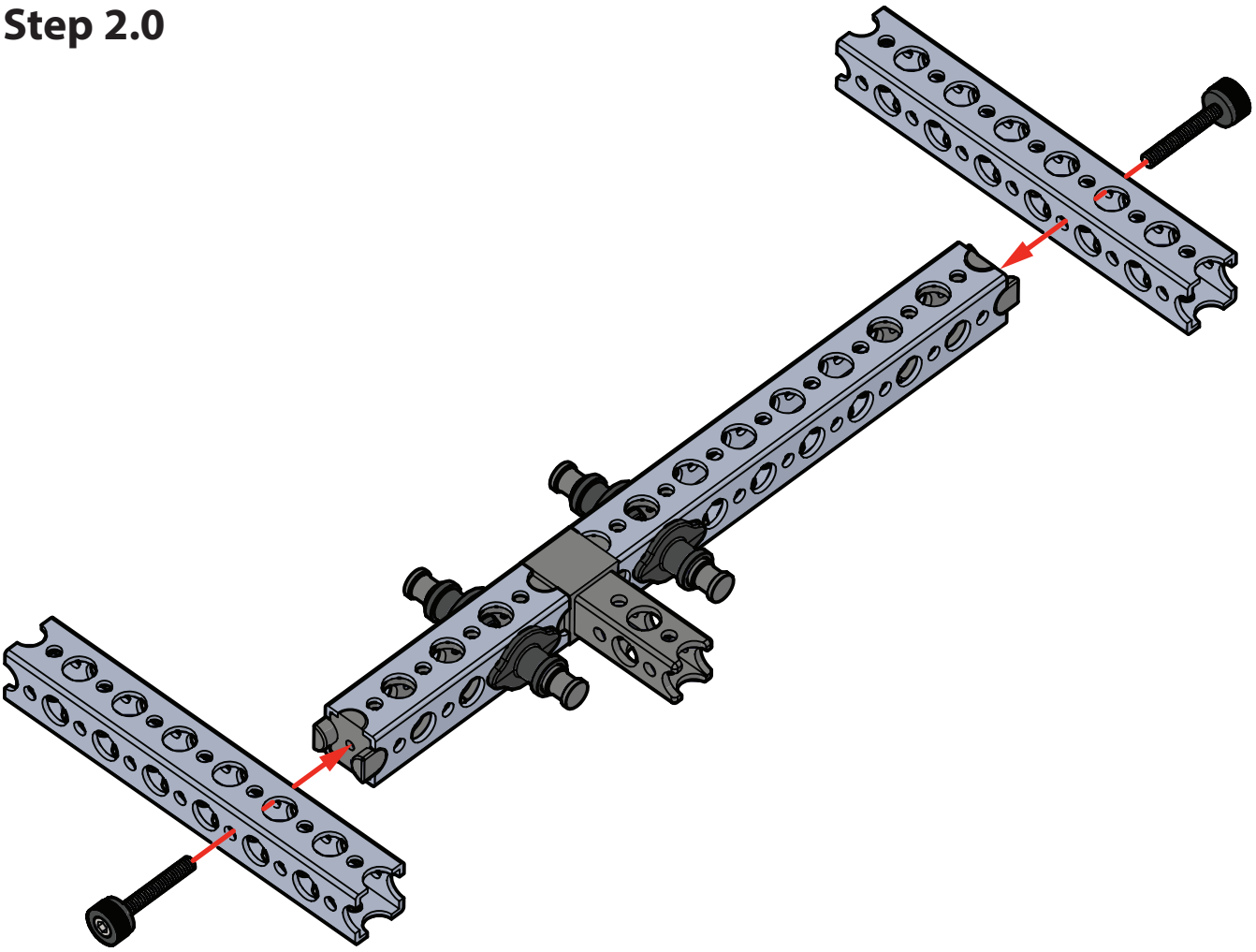
2x
Wing Nut 40221

2x
Thumbscrew 40323

Partial assembly should look like this.

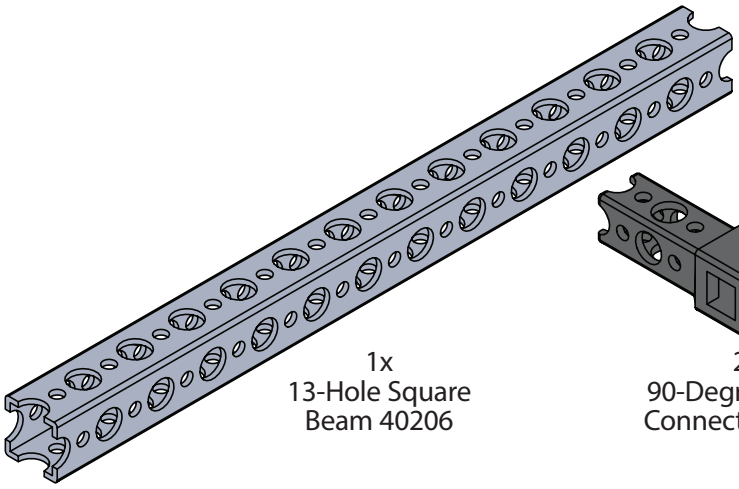


Step 2.0

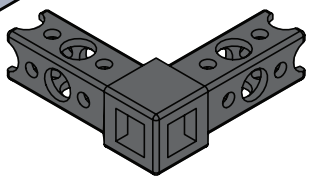


Step 3

Parts Needed



1x
13-Hole Square
Beam 40206

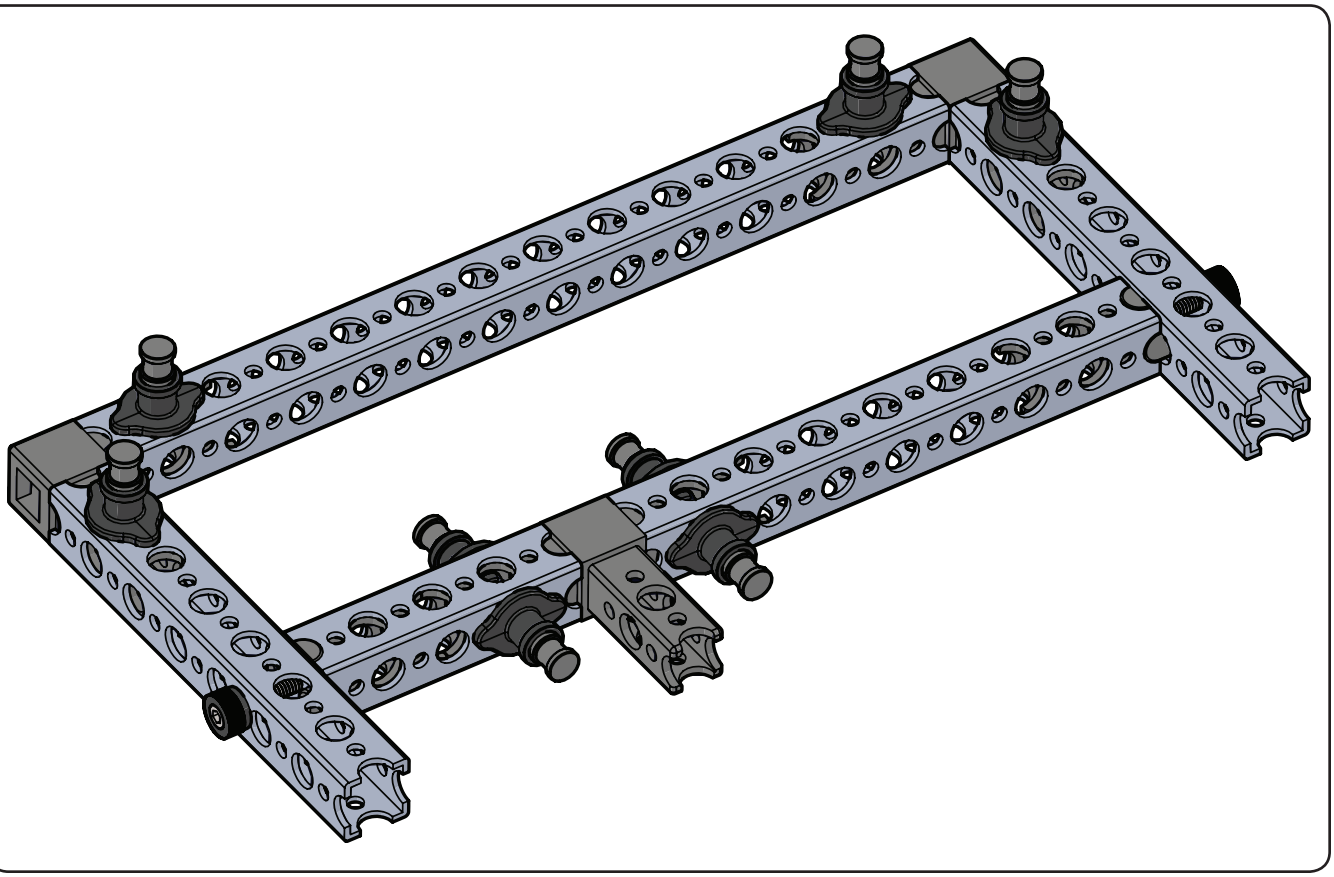


2x
90-Degree Beam
Connector 40211

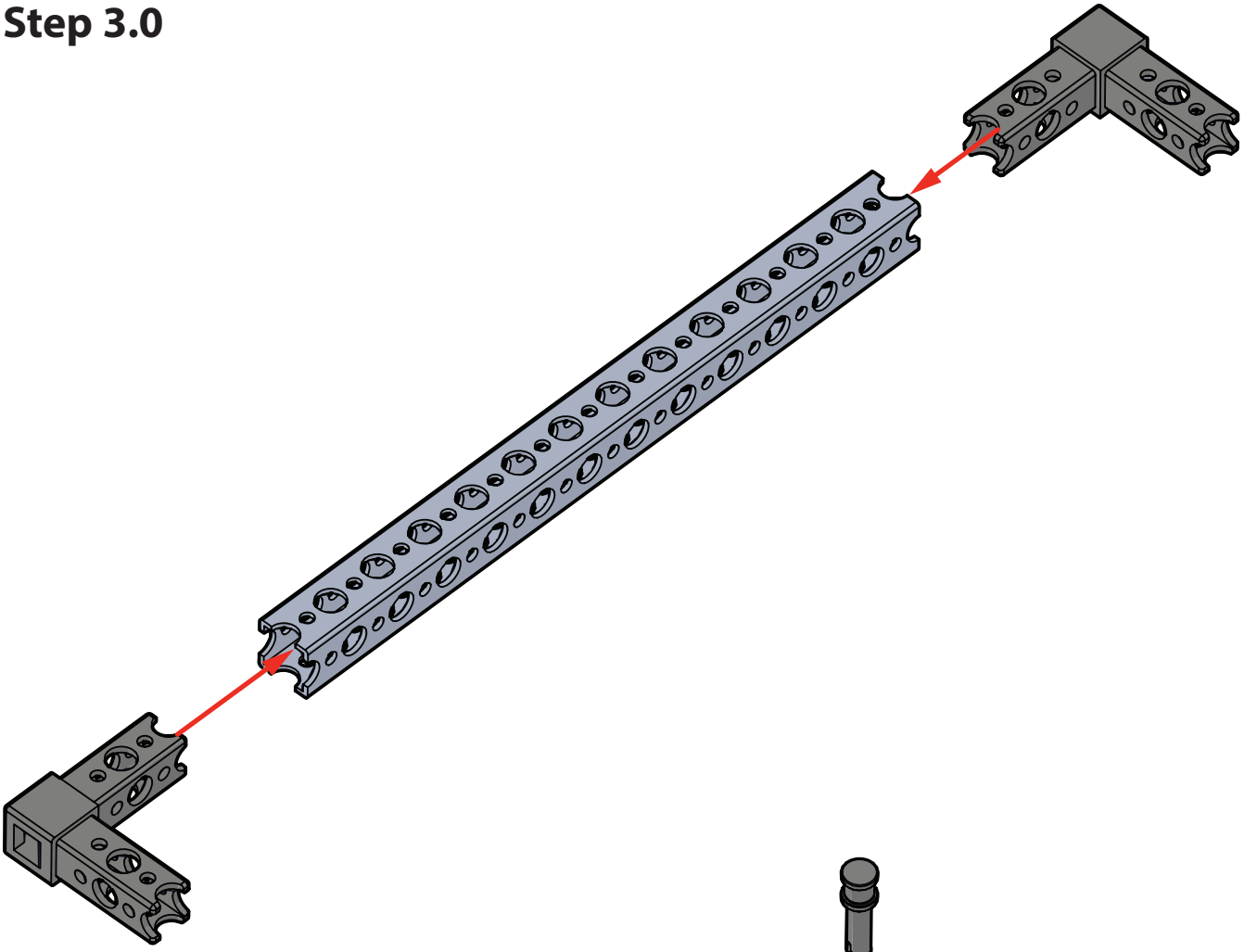
4x
Quick Rivet Peg 40220

4x
Quick Rivet Connector 40219

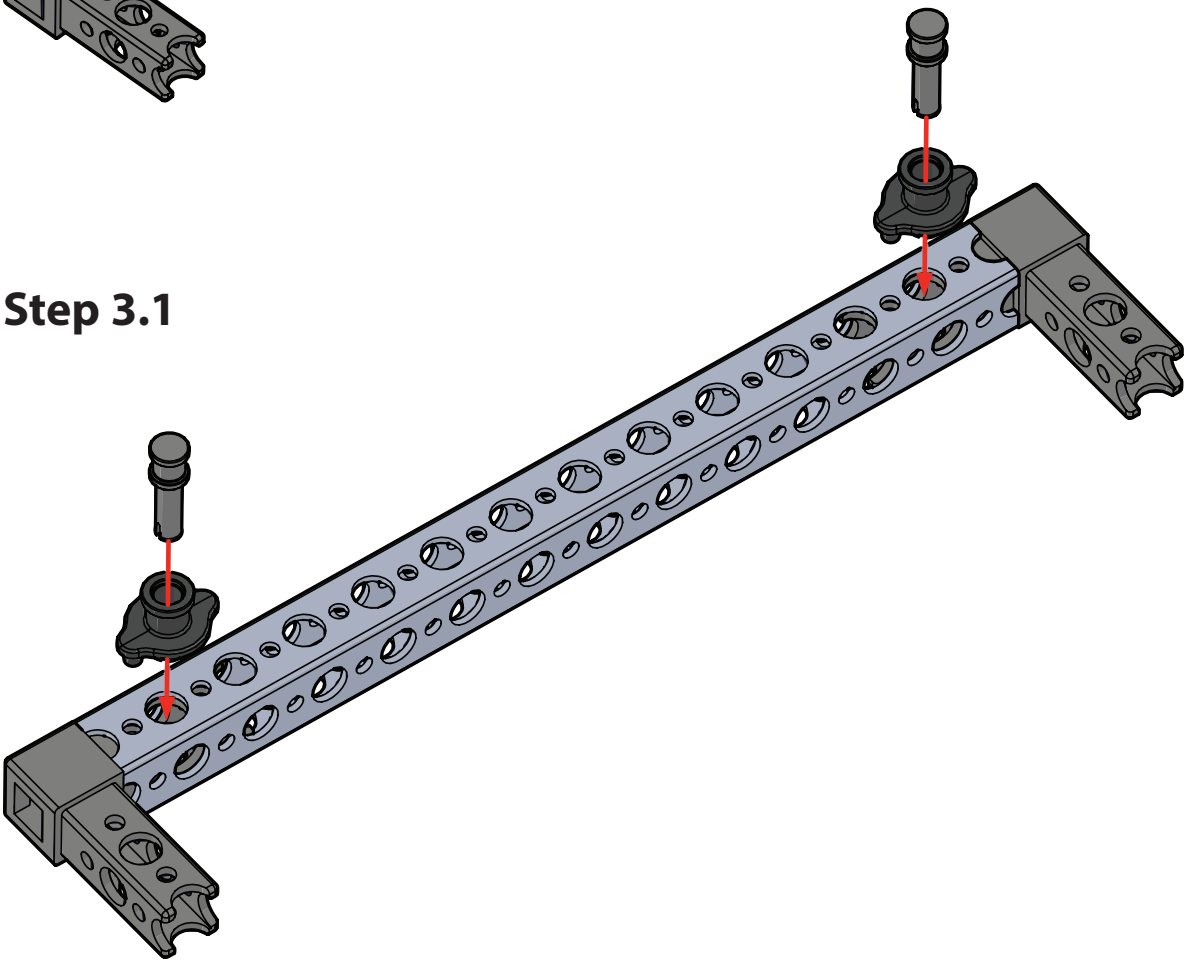
Partial assembly should look like this.



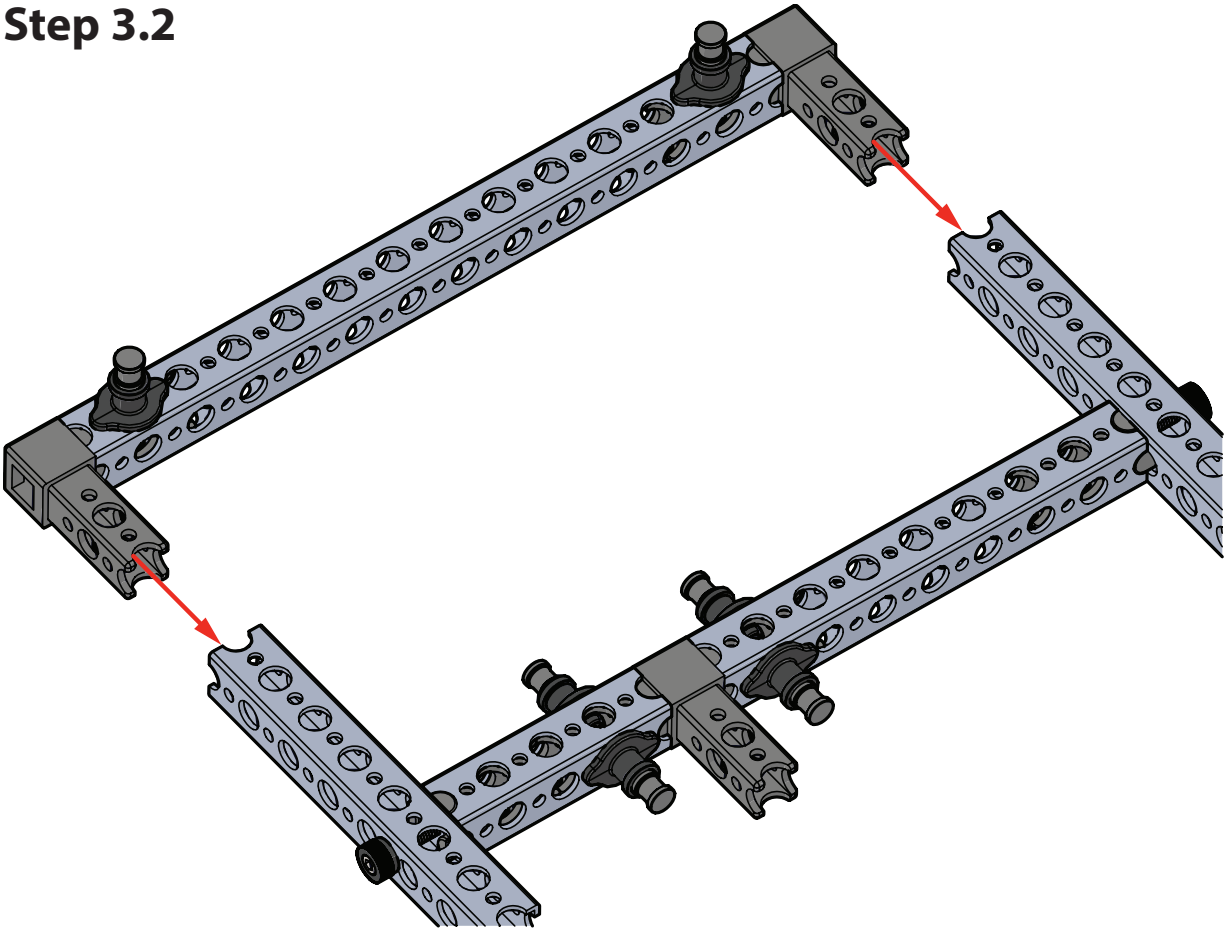
Step 3.0



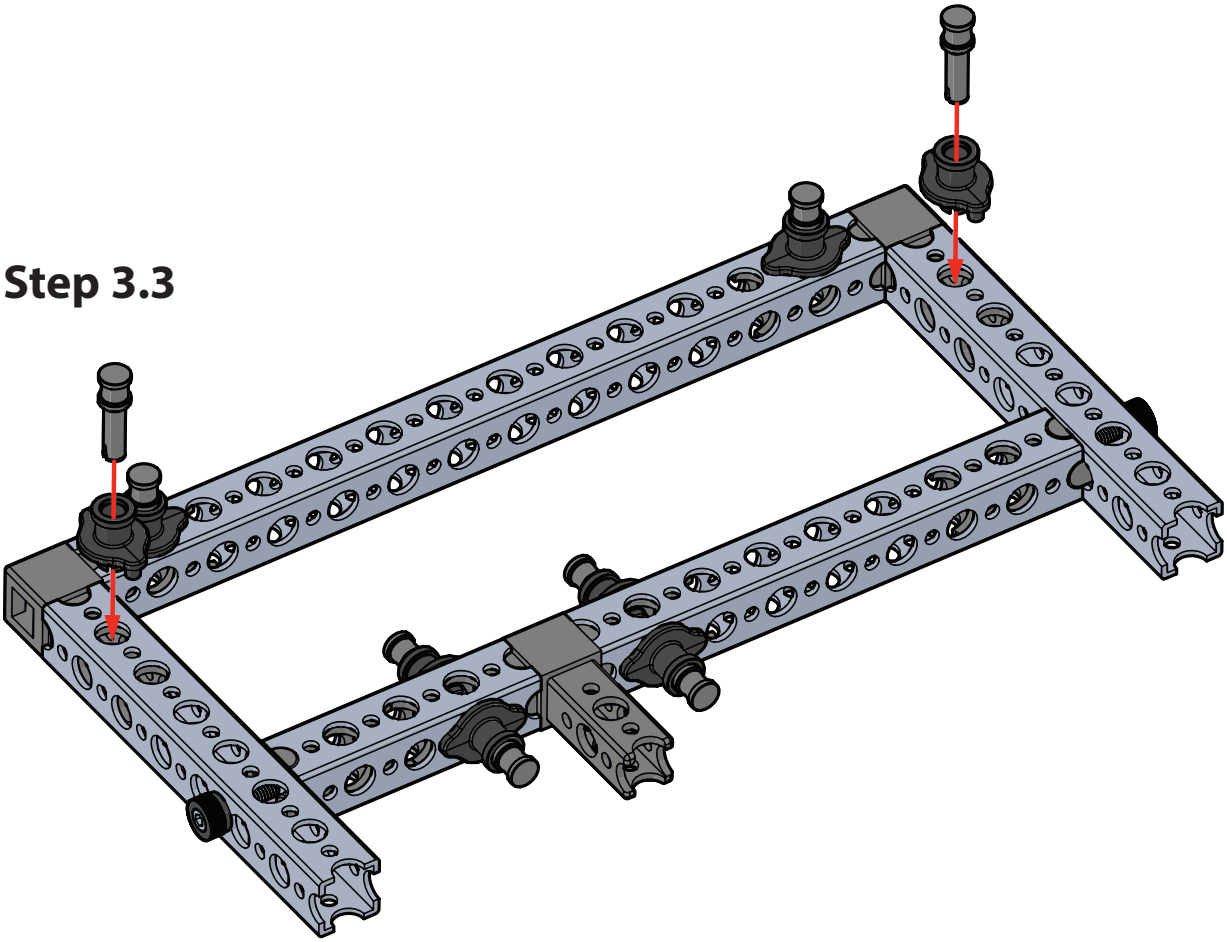
Step 3.1



Step 3.2

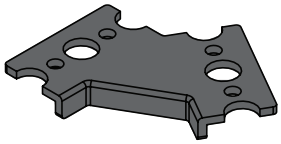


Step 3.3



Step 4

Parts Needed

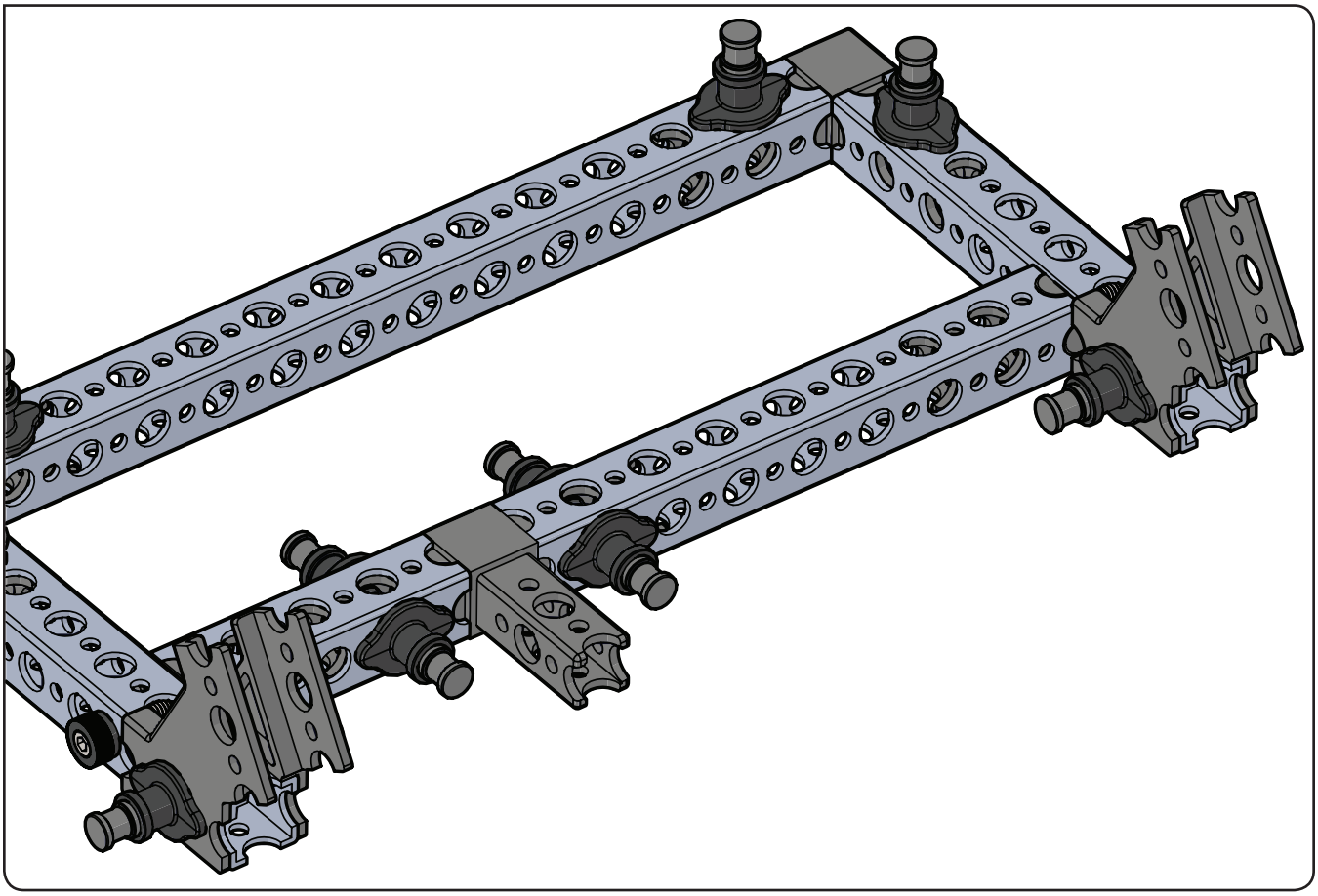


4x
60-Degree Beam Bracket 40209

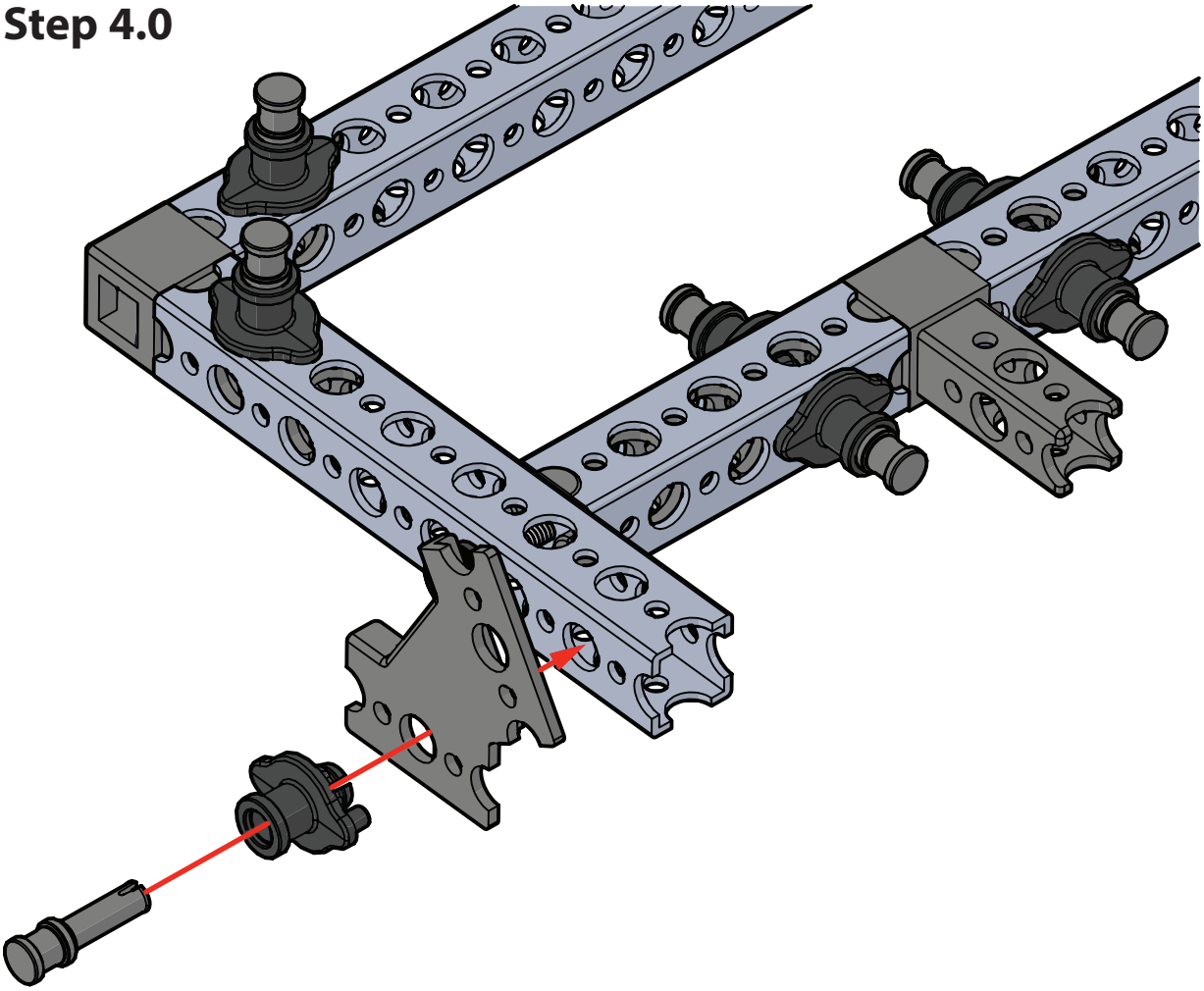
4x
Quick Rivet Connector 40219

4x
Quick Rivet Peg 40220

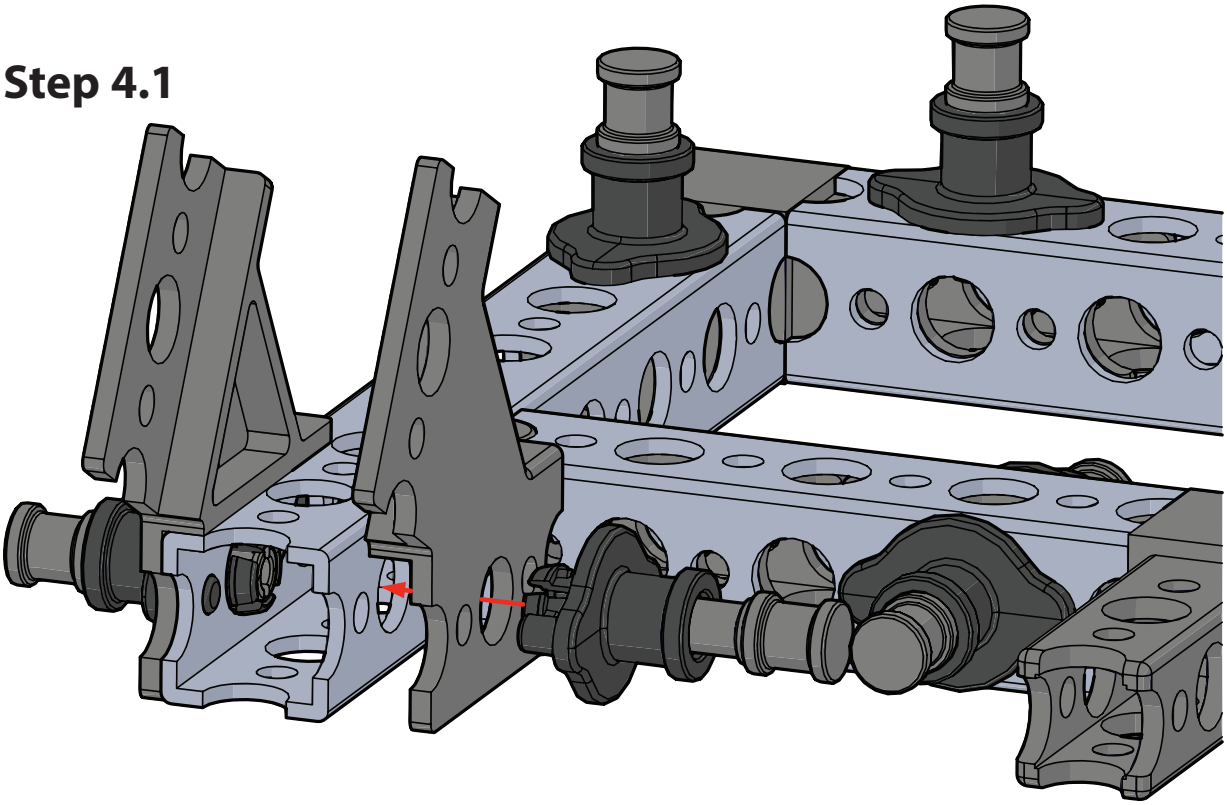
Partial assembly should look like this.



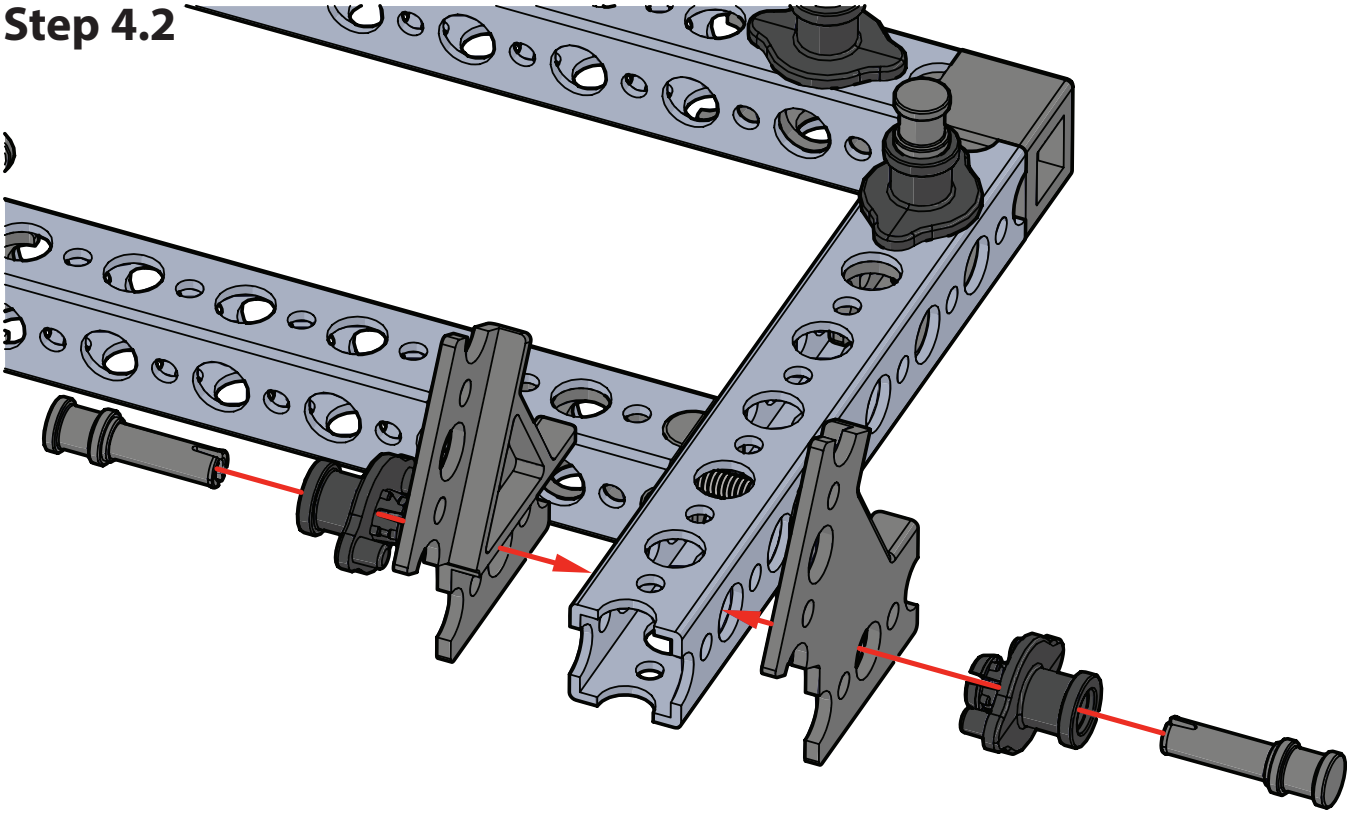
Step 4.0



Step 4.1

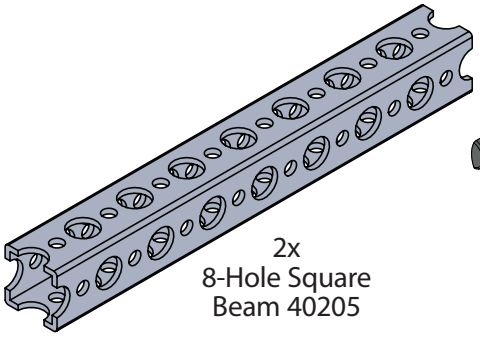


Step 4.2

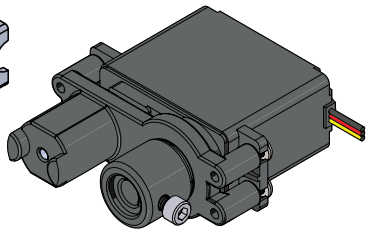


Step 5

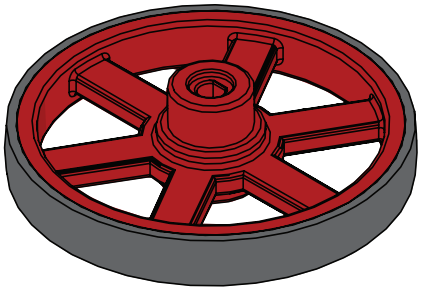
Parts Needed



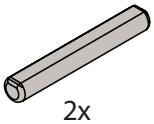
2x
8-Hole Square
Beam 40205



2x
Continuous Rotation Servo
Motor 40379 with Servo
Mounting Bracket 40232
(Assembly instructions on
pages 14-15.)



2x
Wheel with Tire 40222



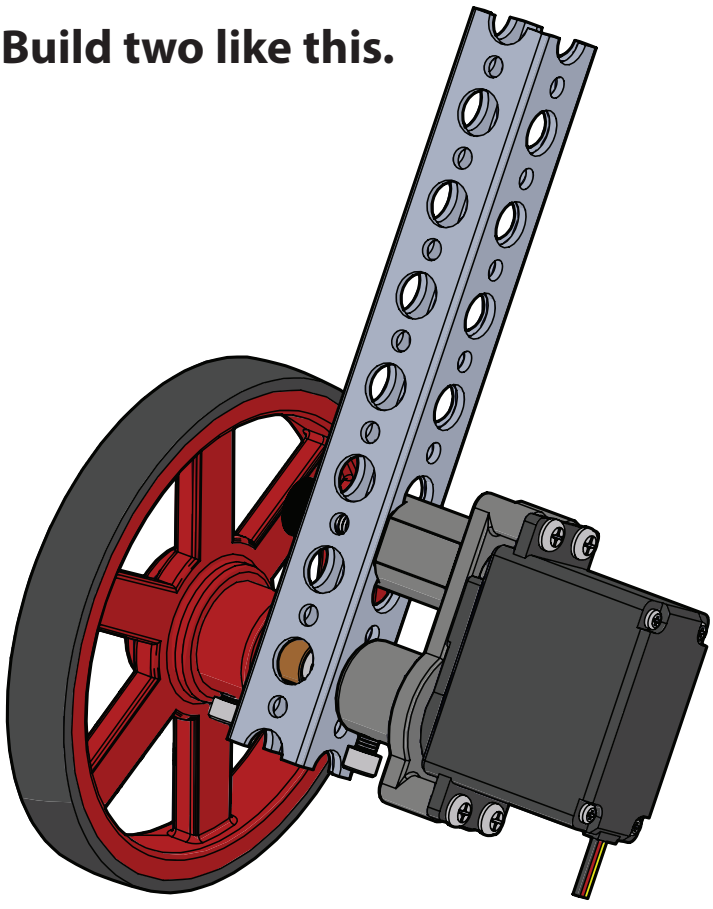
2x
40 mm Steel Axle
40226

4x
8 mm x 6 mm Bronze Bushing
40227

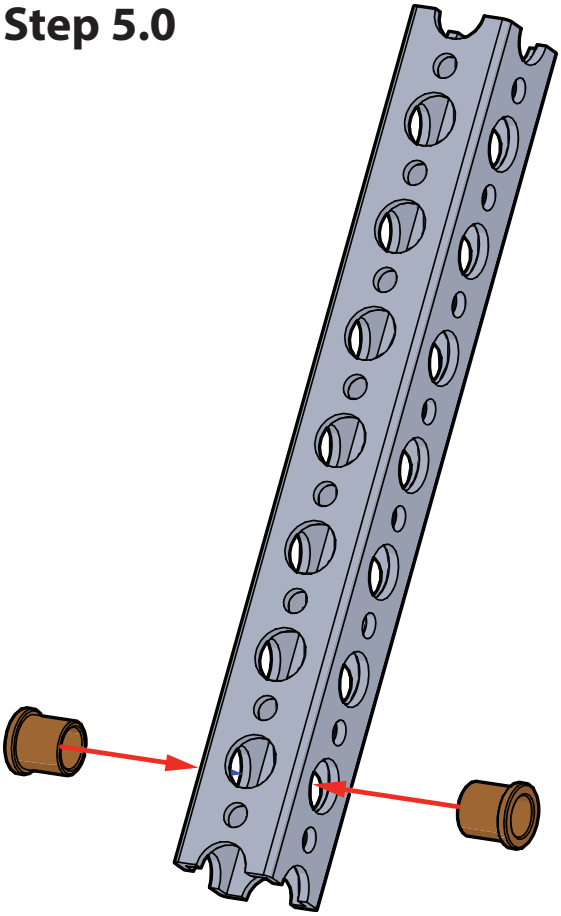
2x
Thumbscrew 40323

Partial assembly should look like this.

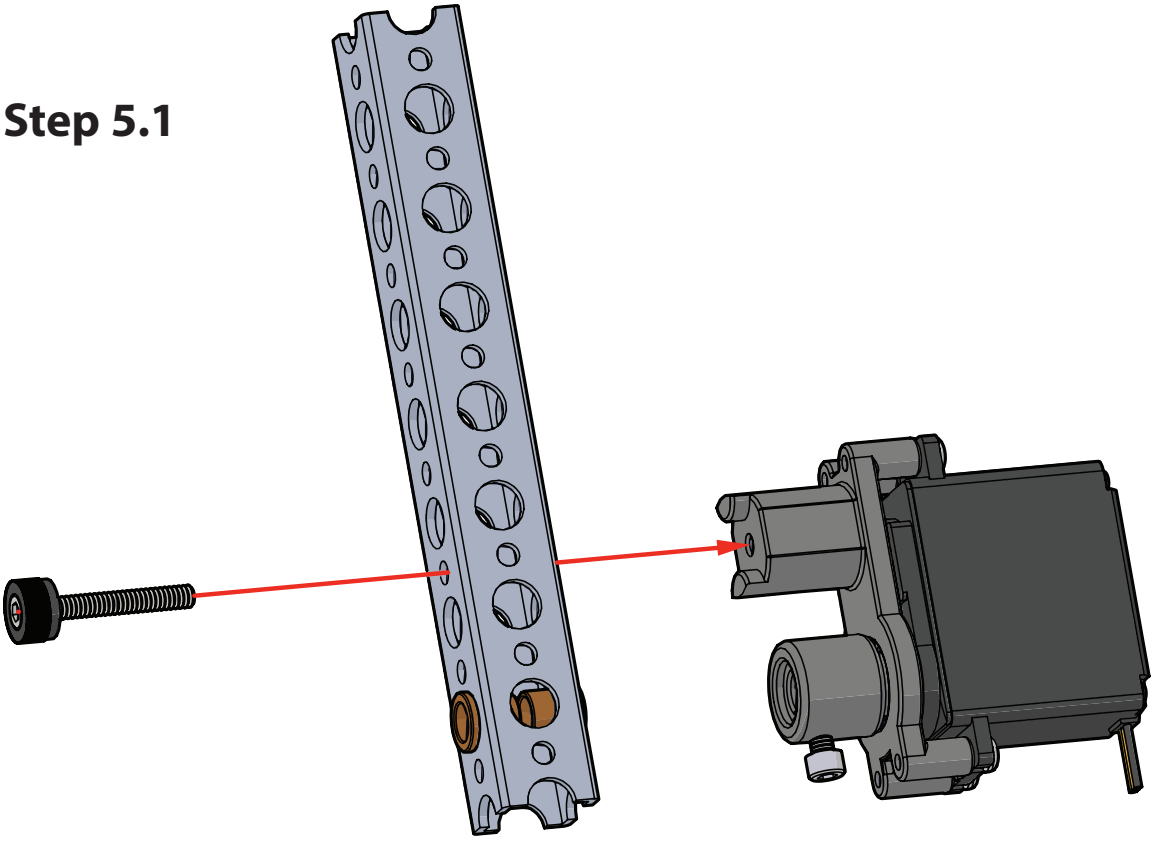
Build two like this.



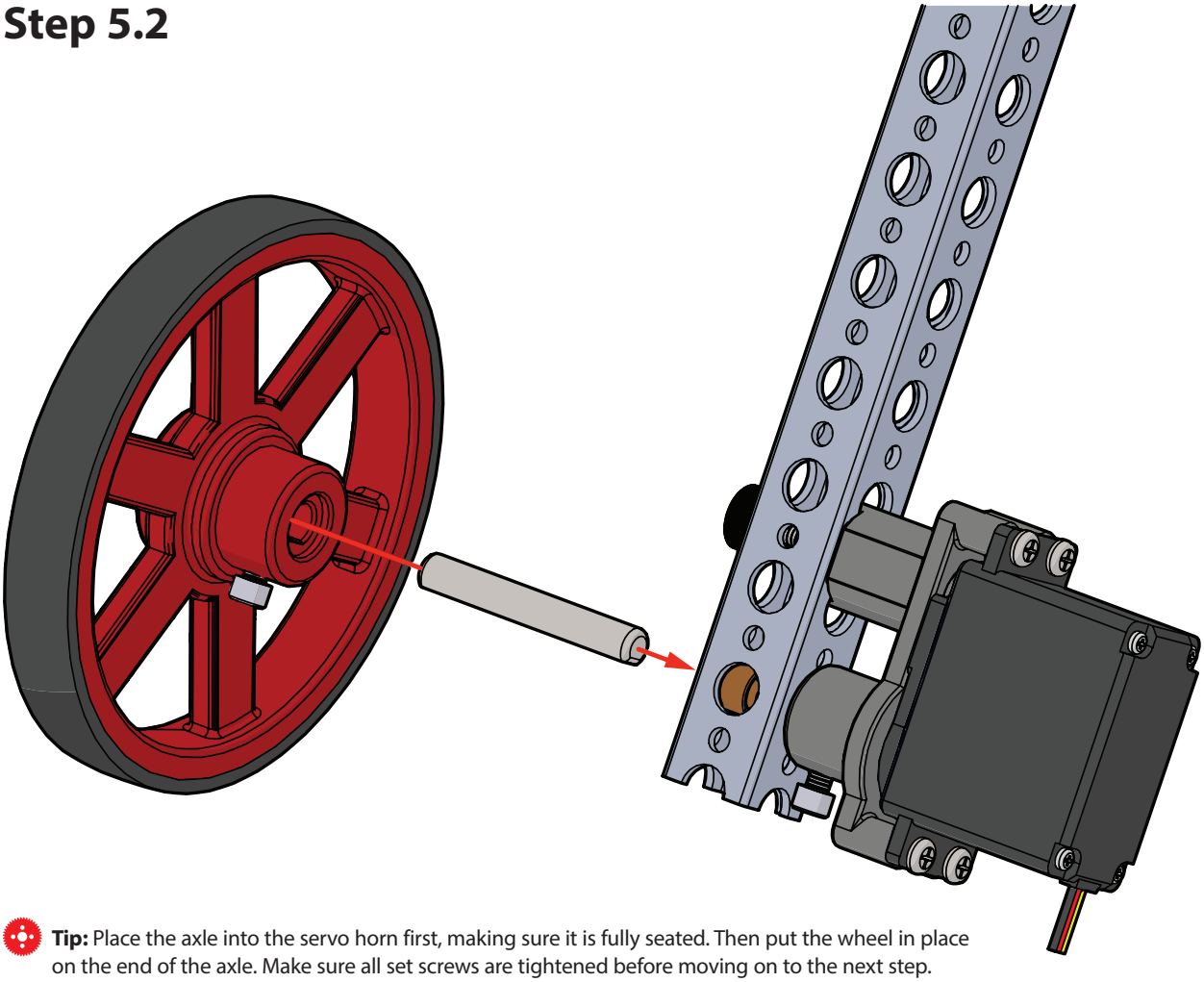
Step 5.0



Step 5.1



Step 5.2



Tip: Place the axle into the servo horn first, making sure it is fully seated. Then put the wheel in place on the end of the axle. Make sure all set screws are tightened before moving on to the next step.

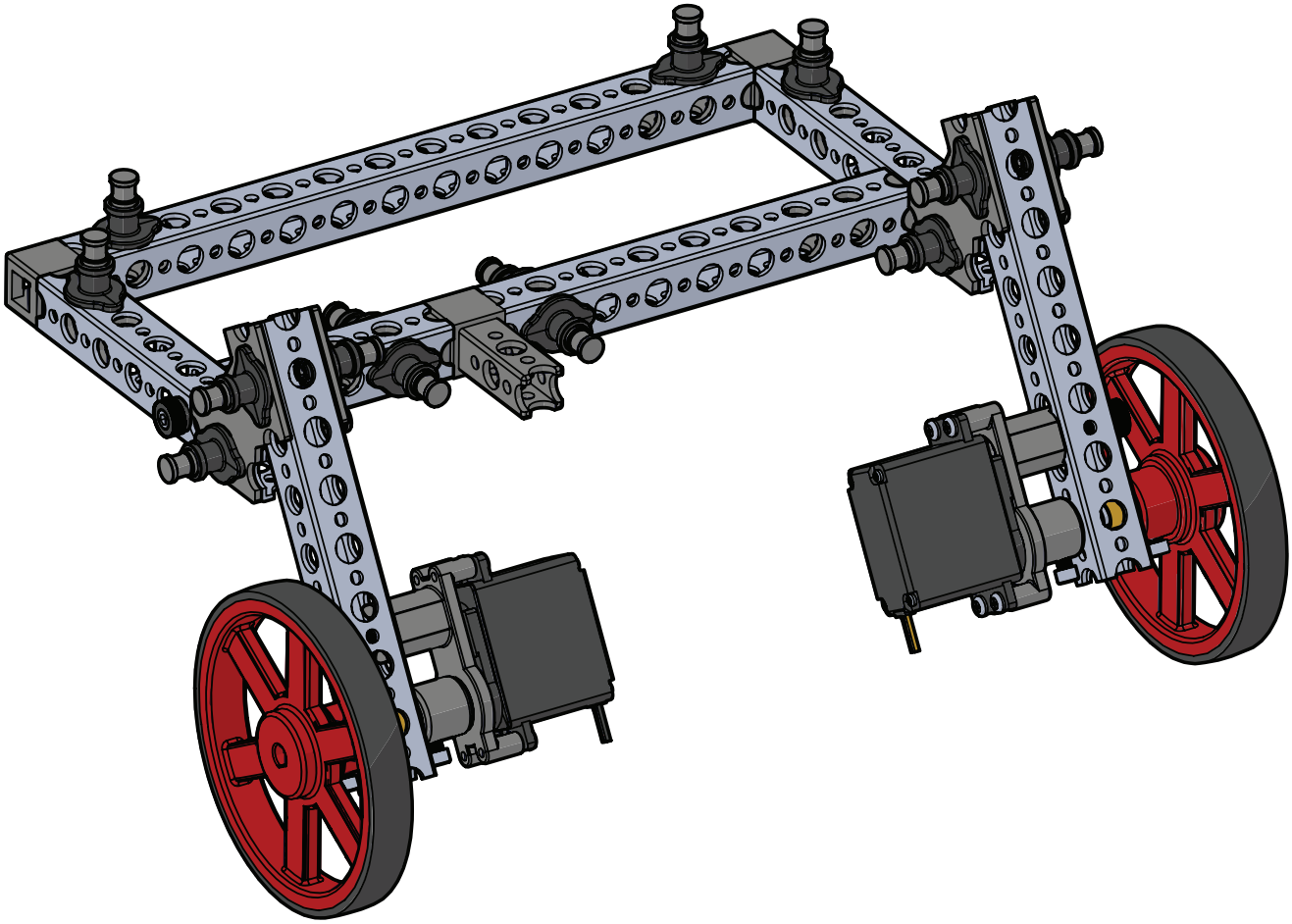
Step 6

Parts Needed

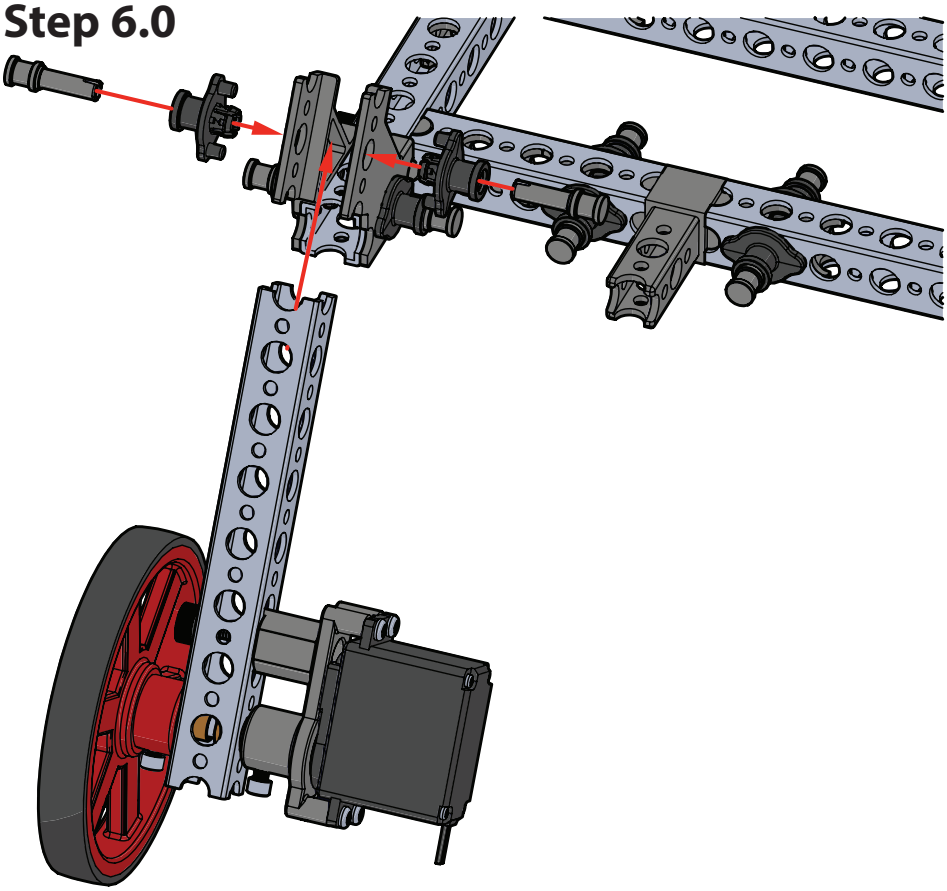
4x
Quick Rivet Peg 40220

4x
Quick Rivet Connector 40219

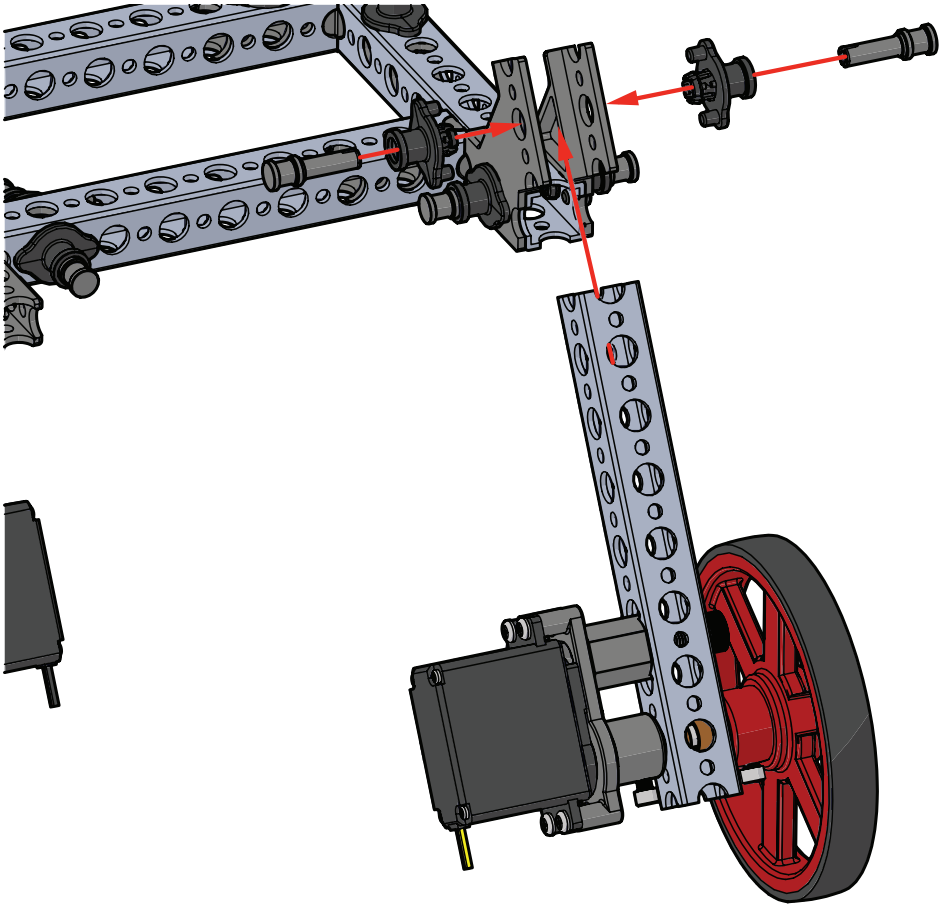
Partial assembly should look like this.



Step 6.0

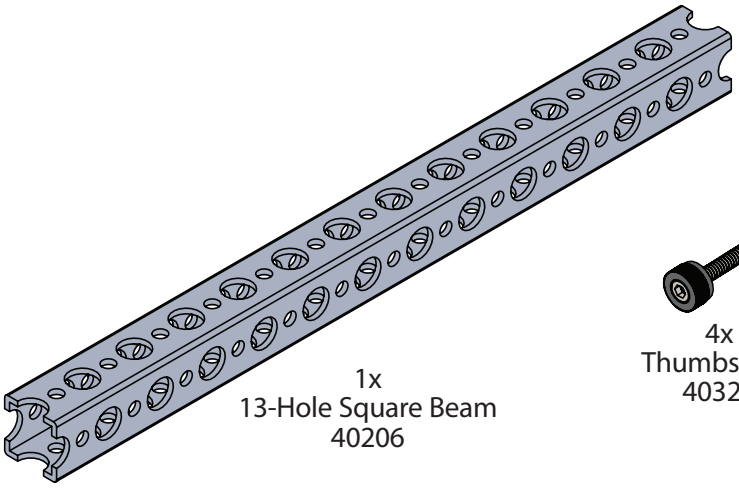


Step 6.1



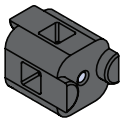
Step 7

Parts Needed



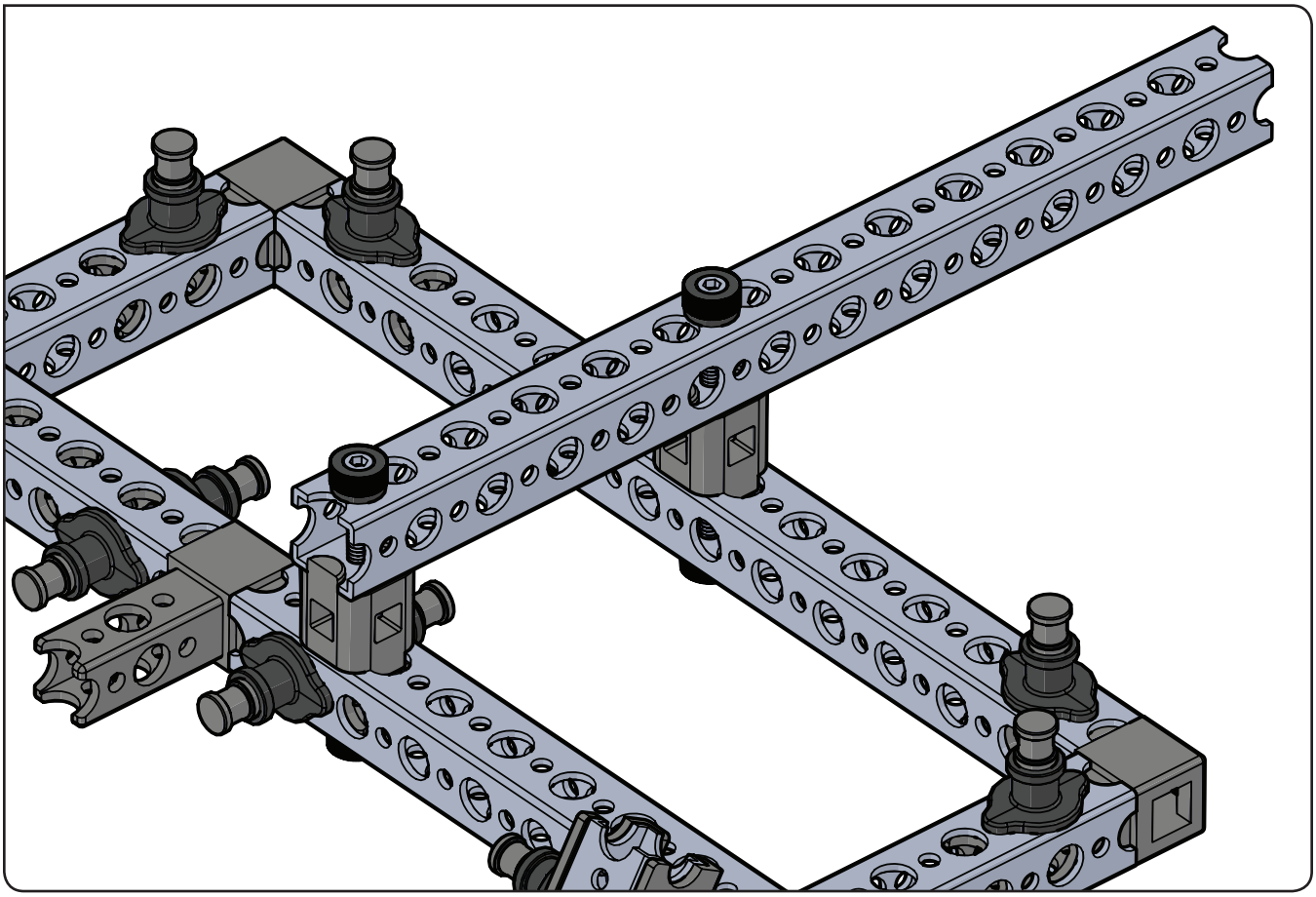
1x
13-Hole Square Beam
40206

4x
Thumbscrew
40323

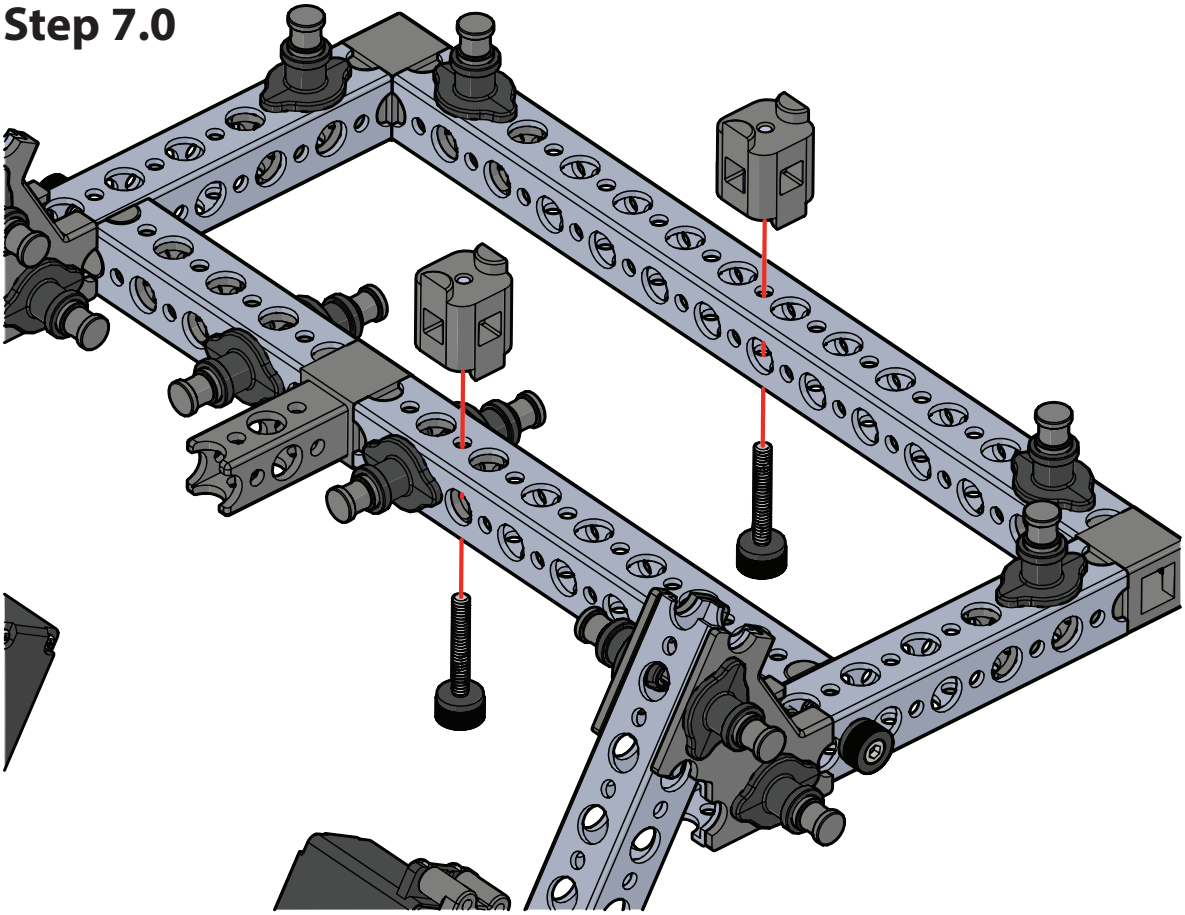


2x
90-Degree Cross Block
Connector 40217

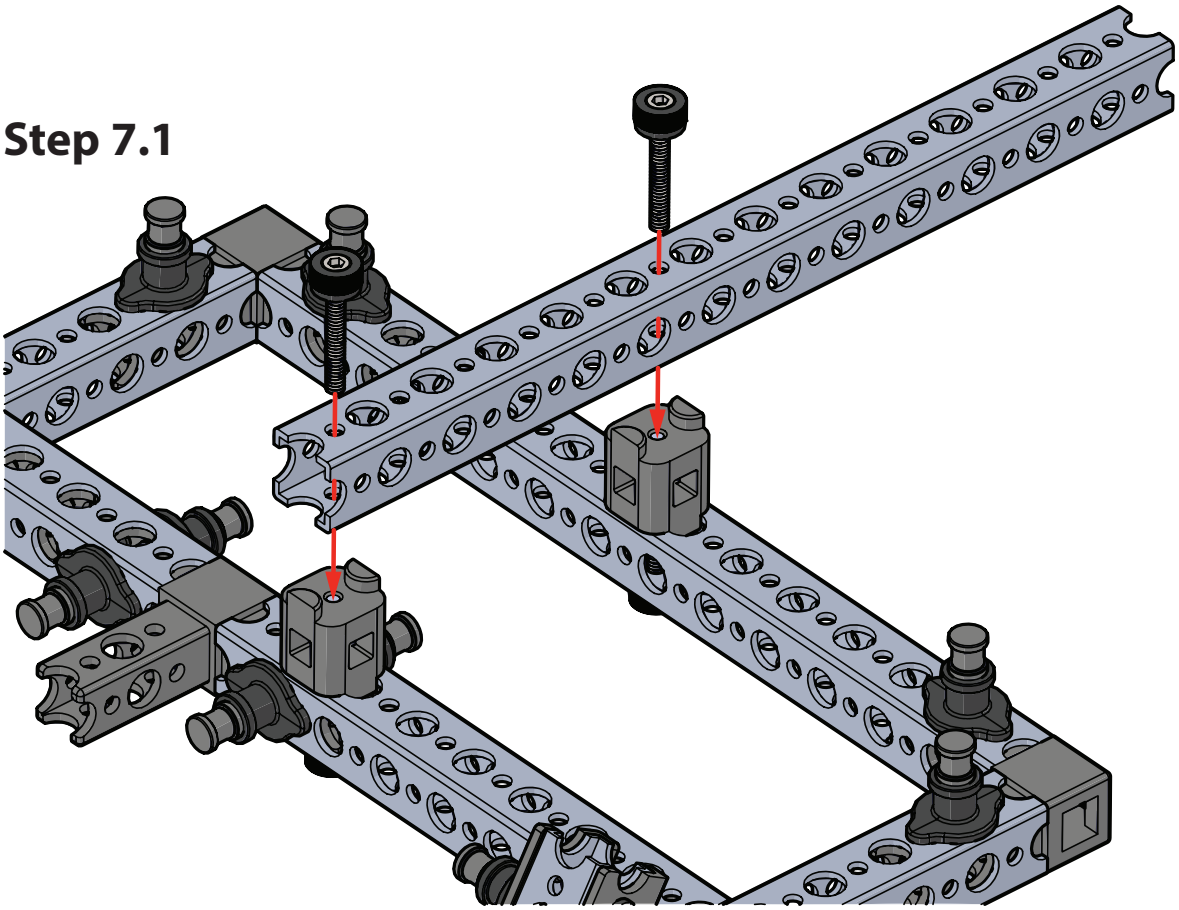
Partial assembly should look like this.



Step 7.0

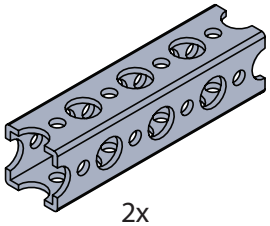


Step 7.1

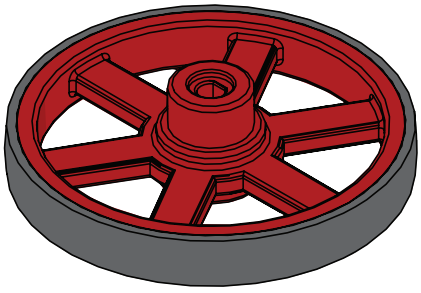


Step 8

Parts Needed



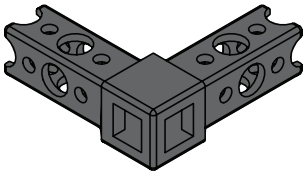
2x
4-Hole Square Beam 40201



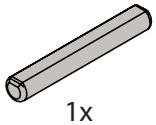
2x
Wheel with Tire 40222

2x
Quick Rivet
Connector 40219

1x
Thumbscrew
40323



1x
90-Degree Beam
Connector 40211



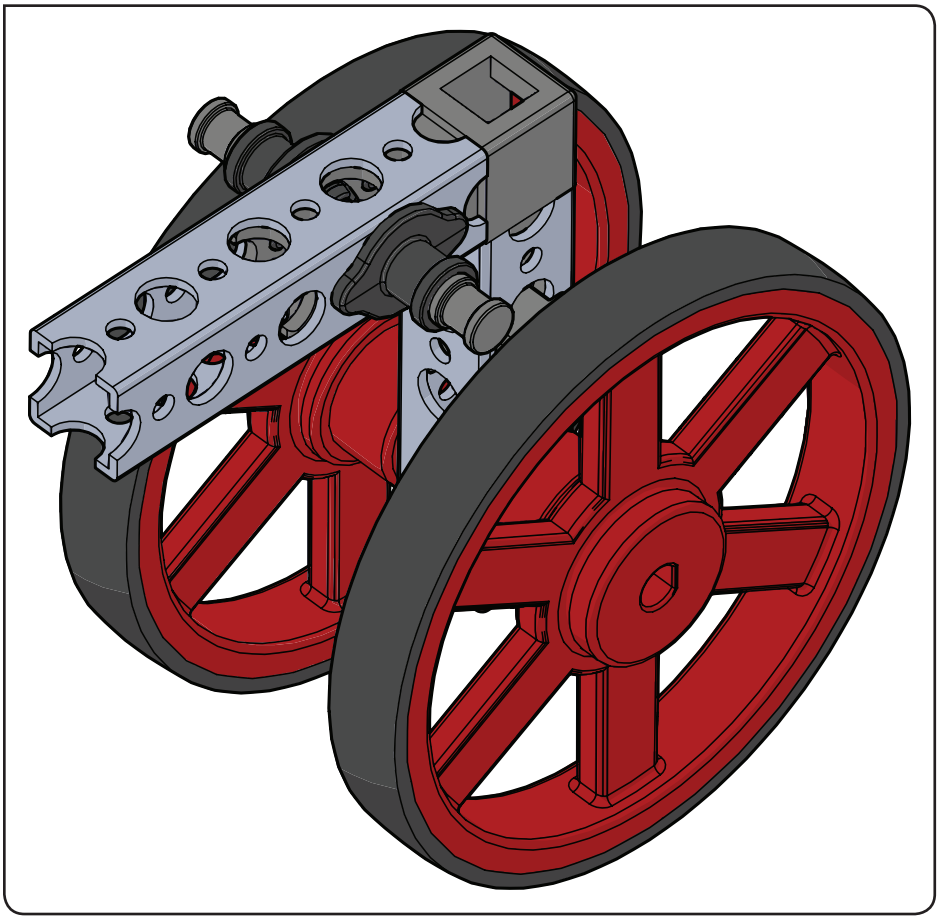
1x
40 mm Steel Axle
40226

2x
Quick Rivet Peg
40220

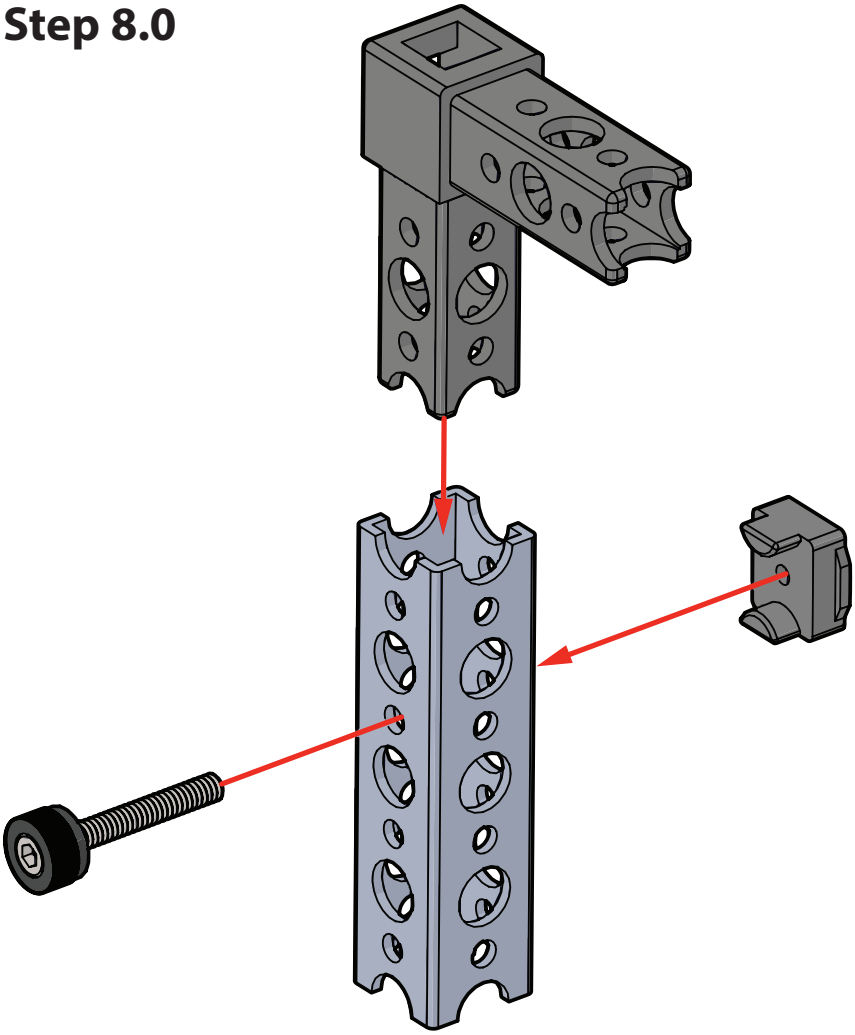
1x
Wing Nut
40221

2x
8 mm x 6 mm
Bronze Bushing
40227

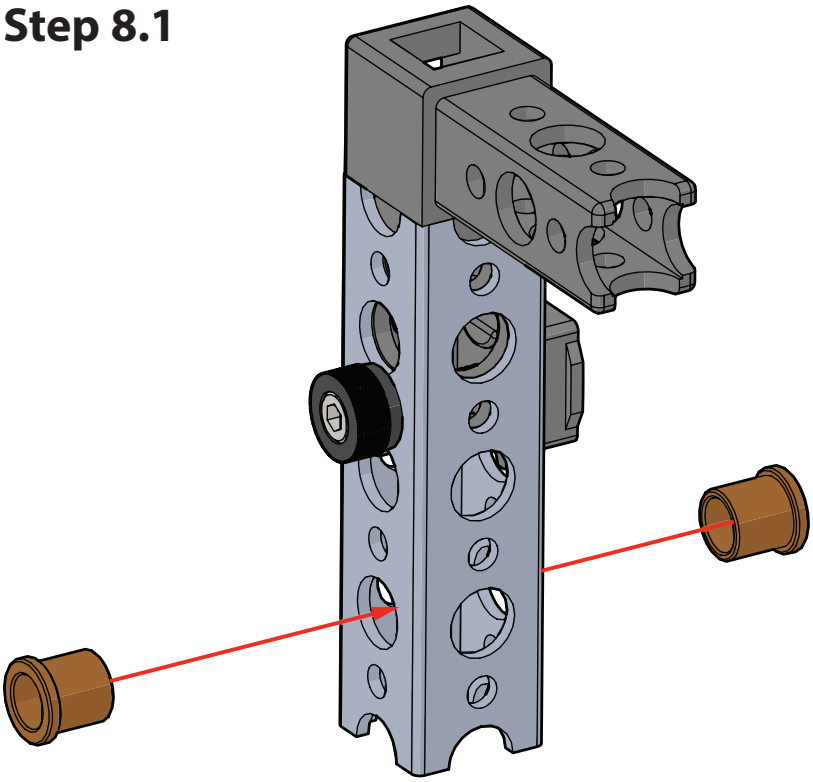
Partial assembly should look like this.



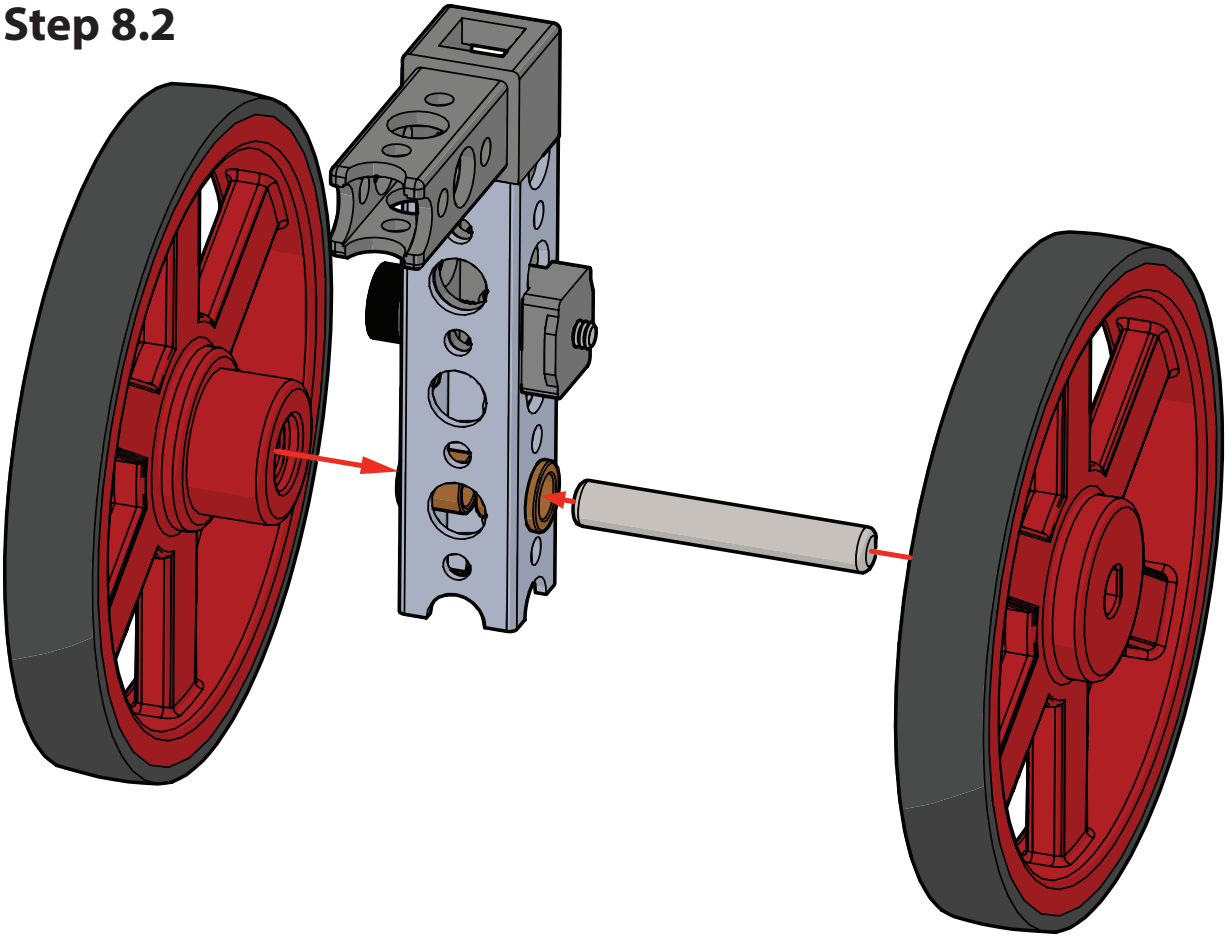
Step 8.0



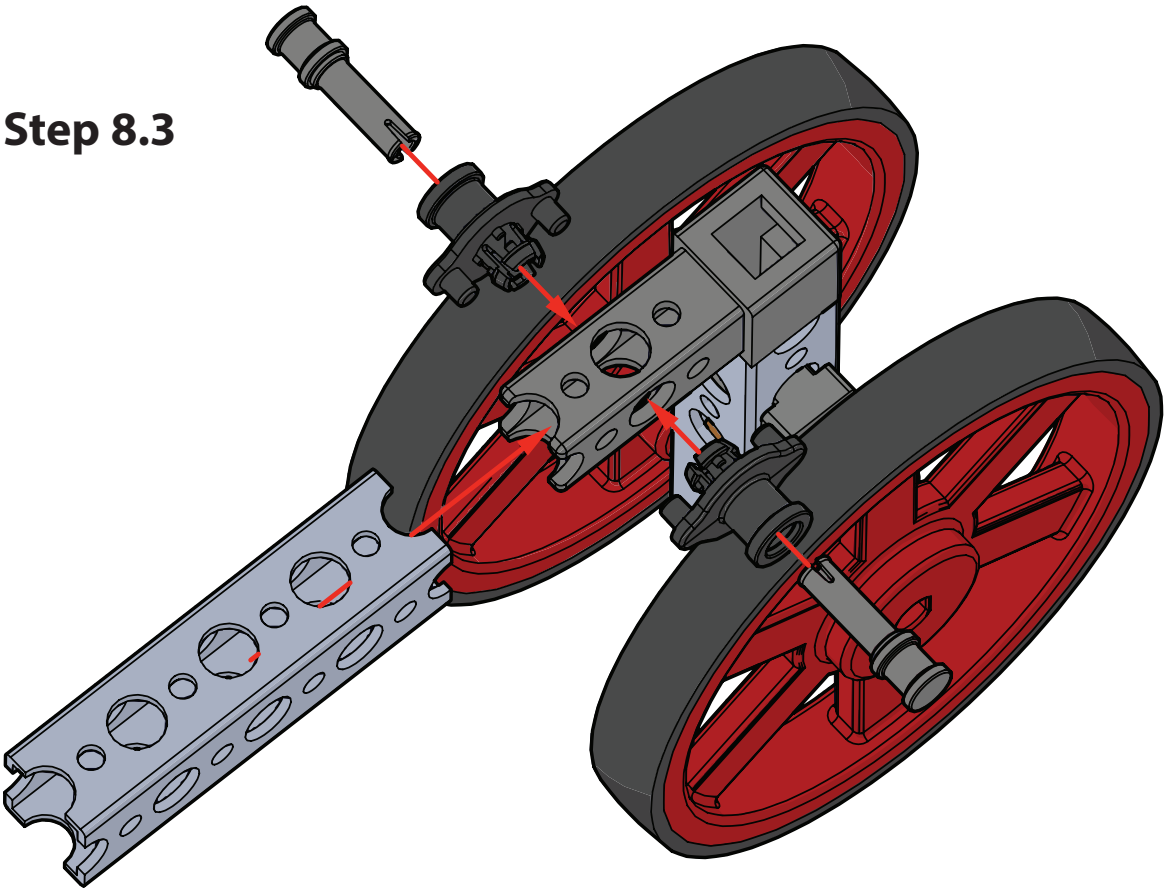
Step 8.1



Step 8.2

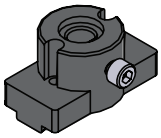


Step 8.3

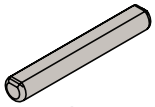


Step 9

Parts Needed



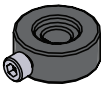
1x
Beam Attachment Hub 40228



1x
40 mm Steel Axle 40226

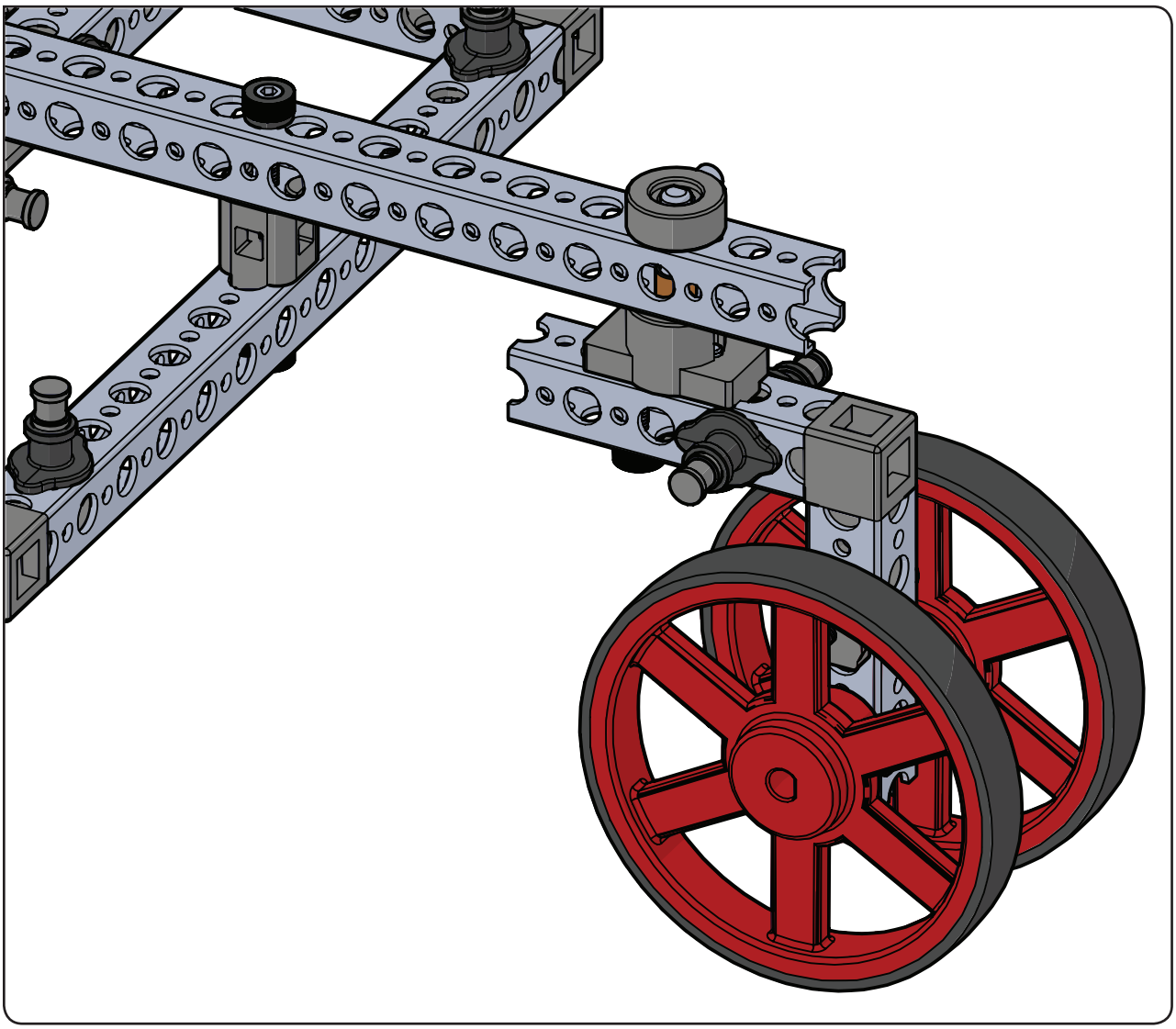
2x
Thumbscrew 40323

2x
8 mm x 6 mm Bronze Bushing
40227

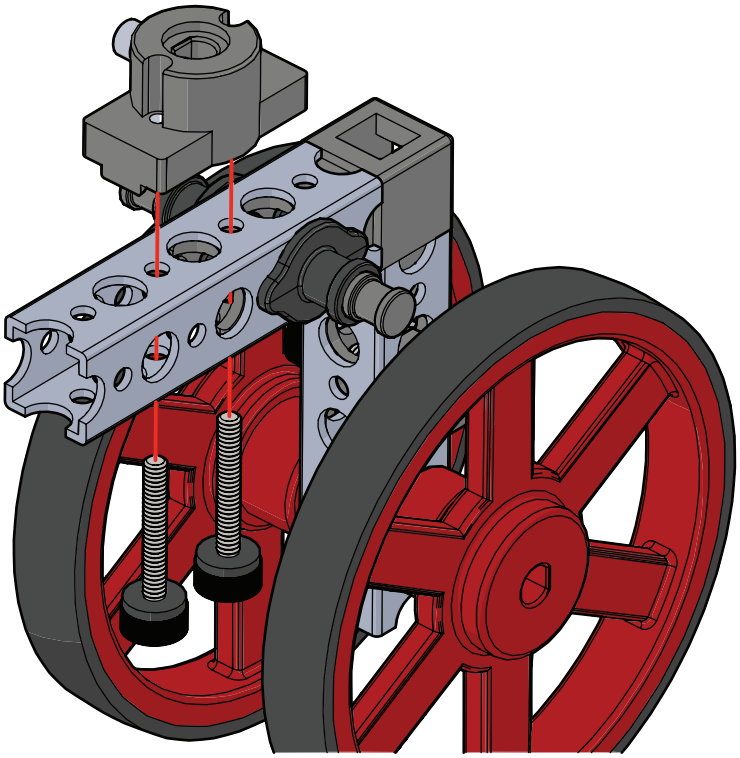


1x
D-Shaft Set Collar 40229

Partial assembly should look like this.

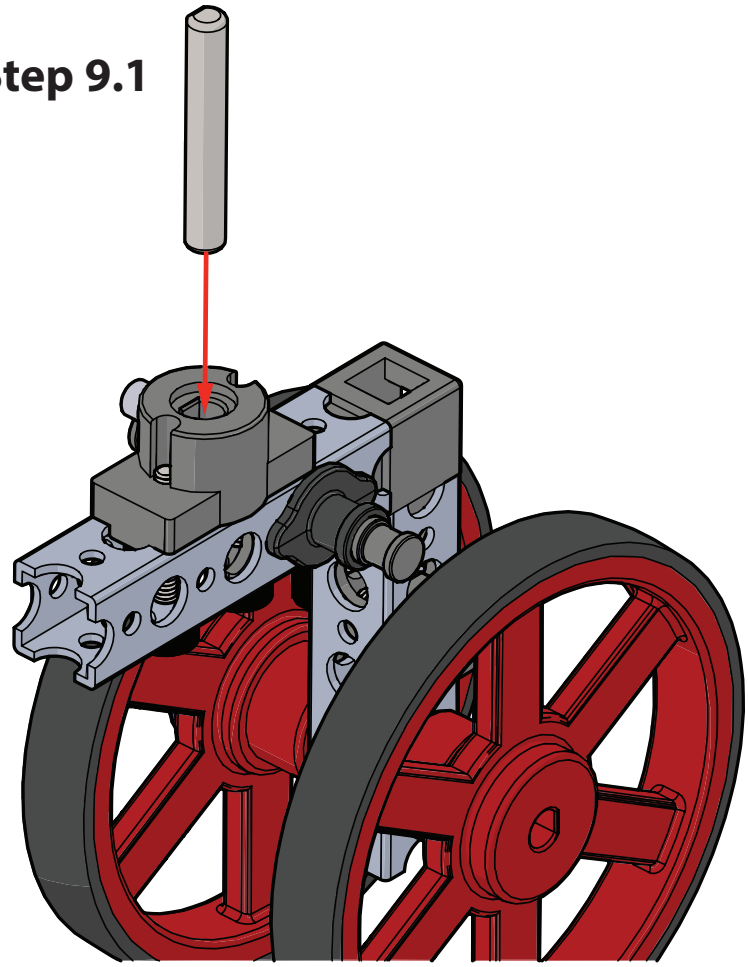


Step 9.0

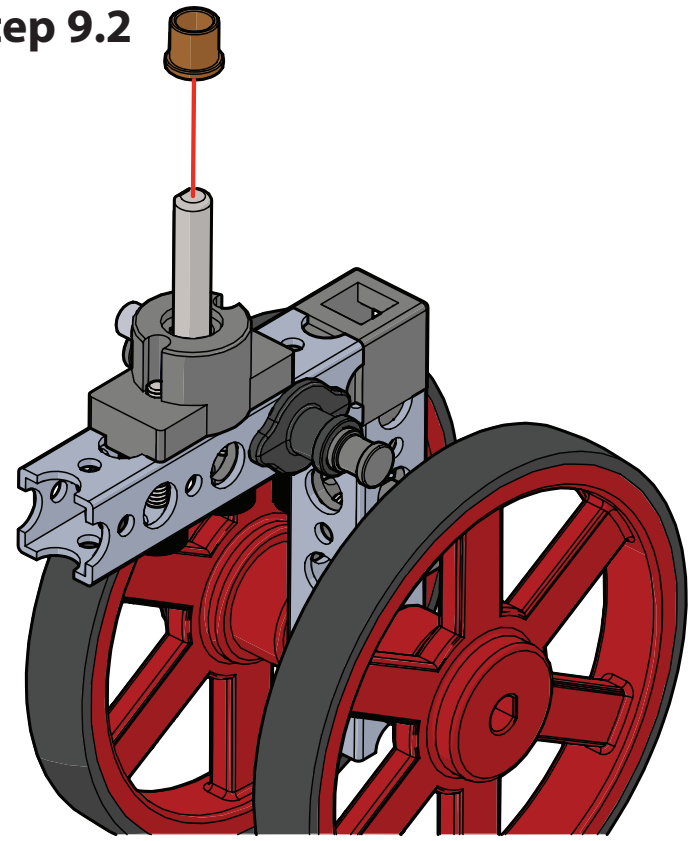


Tip: Please make sure the set screws are tightened before moving on to the next step.

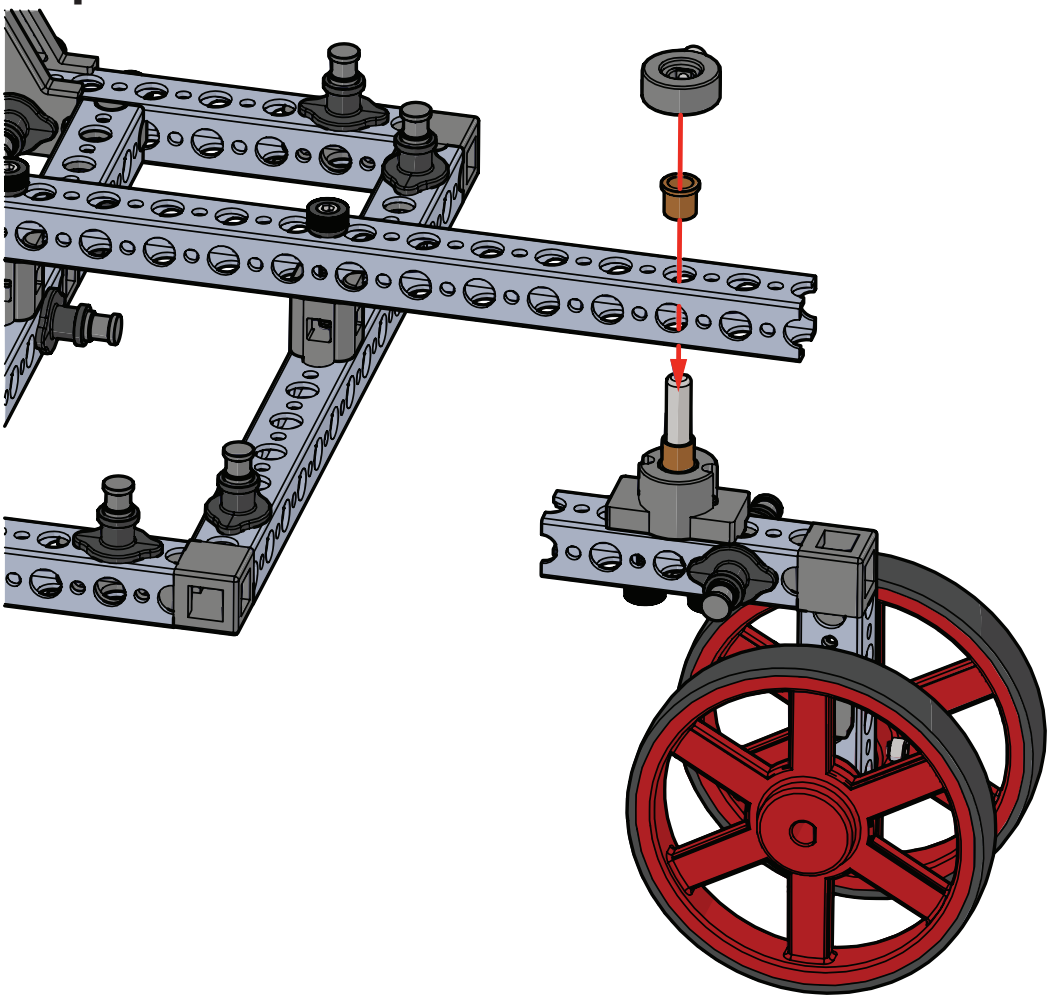
Step 9.1



Step 9.2



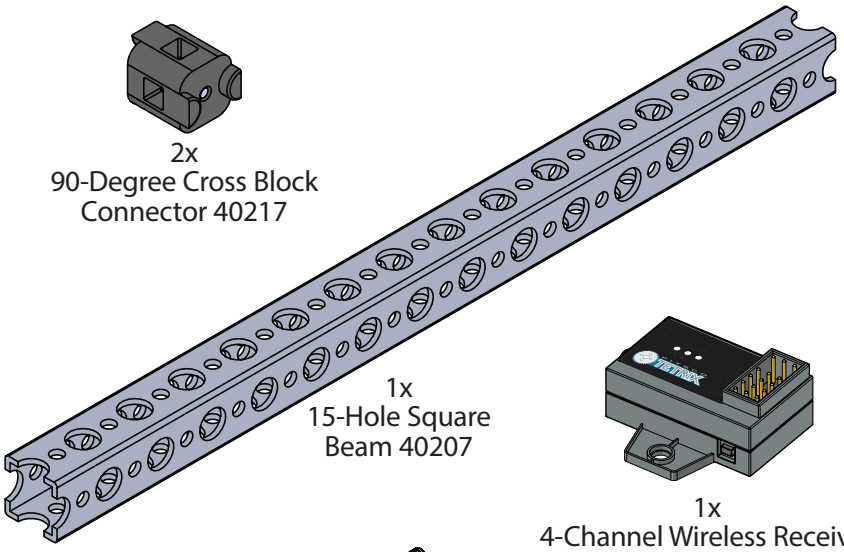
Step 9.3



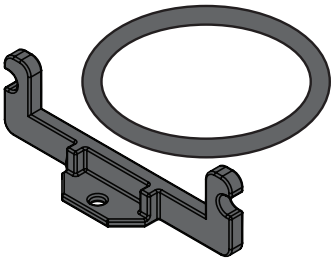
Step 10

Parts Needed

2x
90-Degree Cross Block Connector 40217

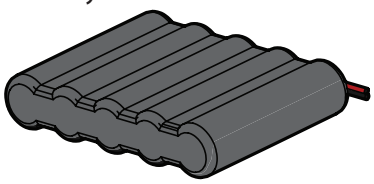


1x
15-Hole Square Beam 40207



2x
Battery Mount Bracket 40236

1x
4-Channel Wireless Receiver from Wireless Joystick Gamepad System 40239

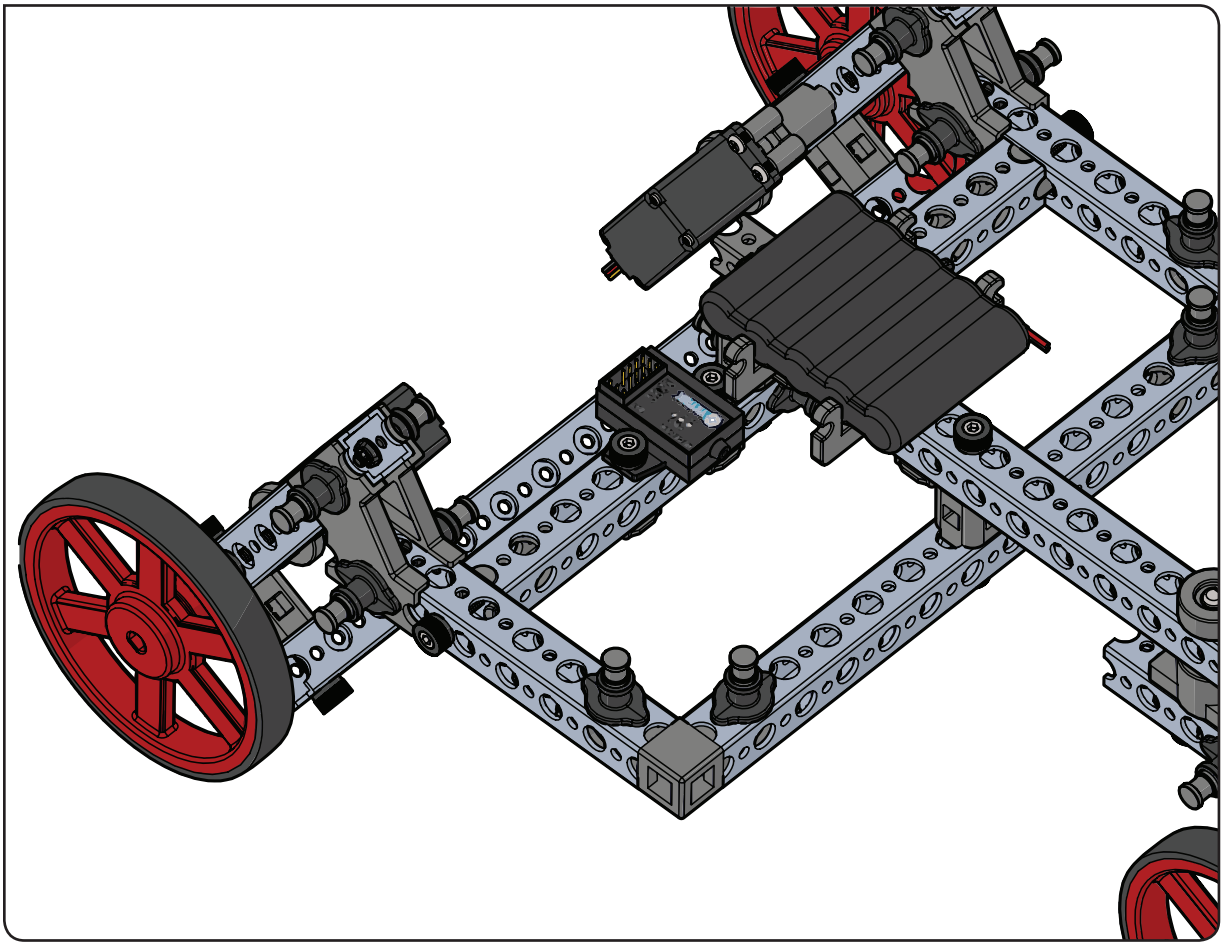


1x
6 V NiMH Battery Pack 40235

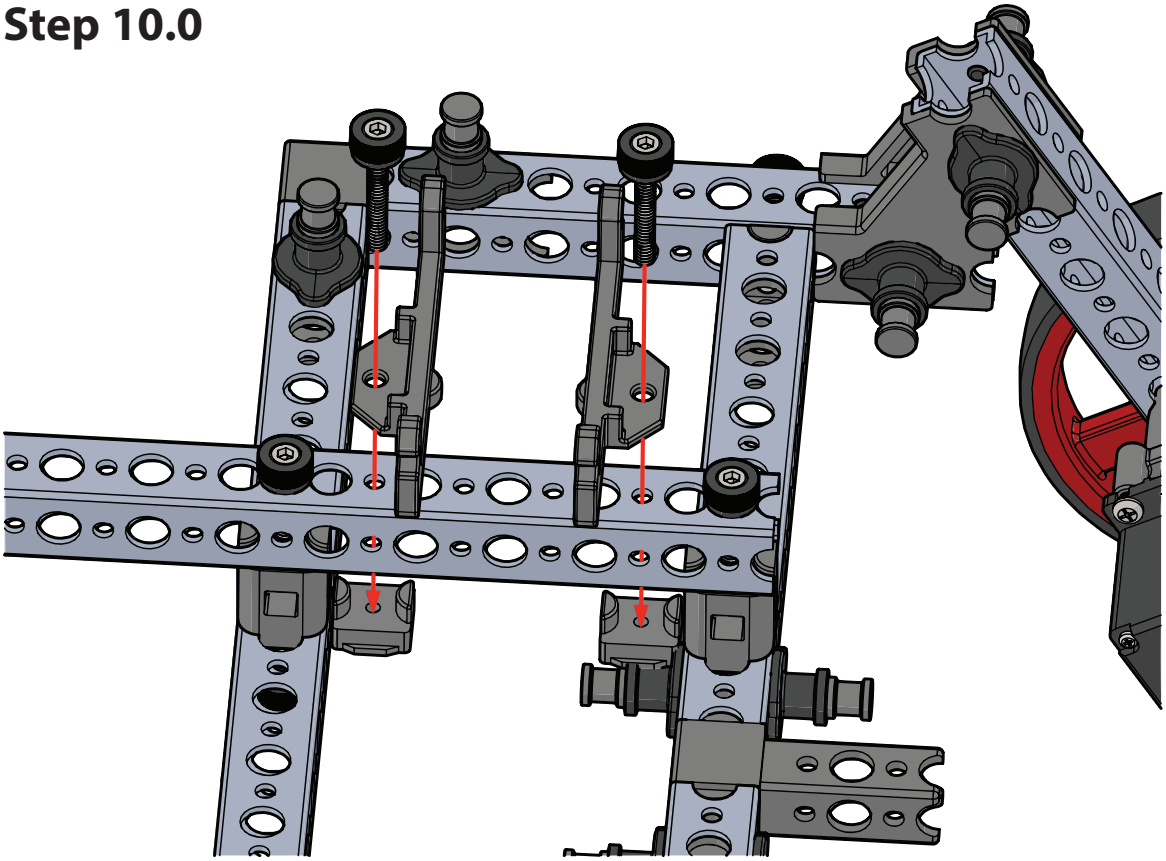
4x
Wing Nut 40221

8x
Thumbscrew 40323

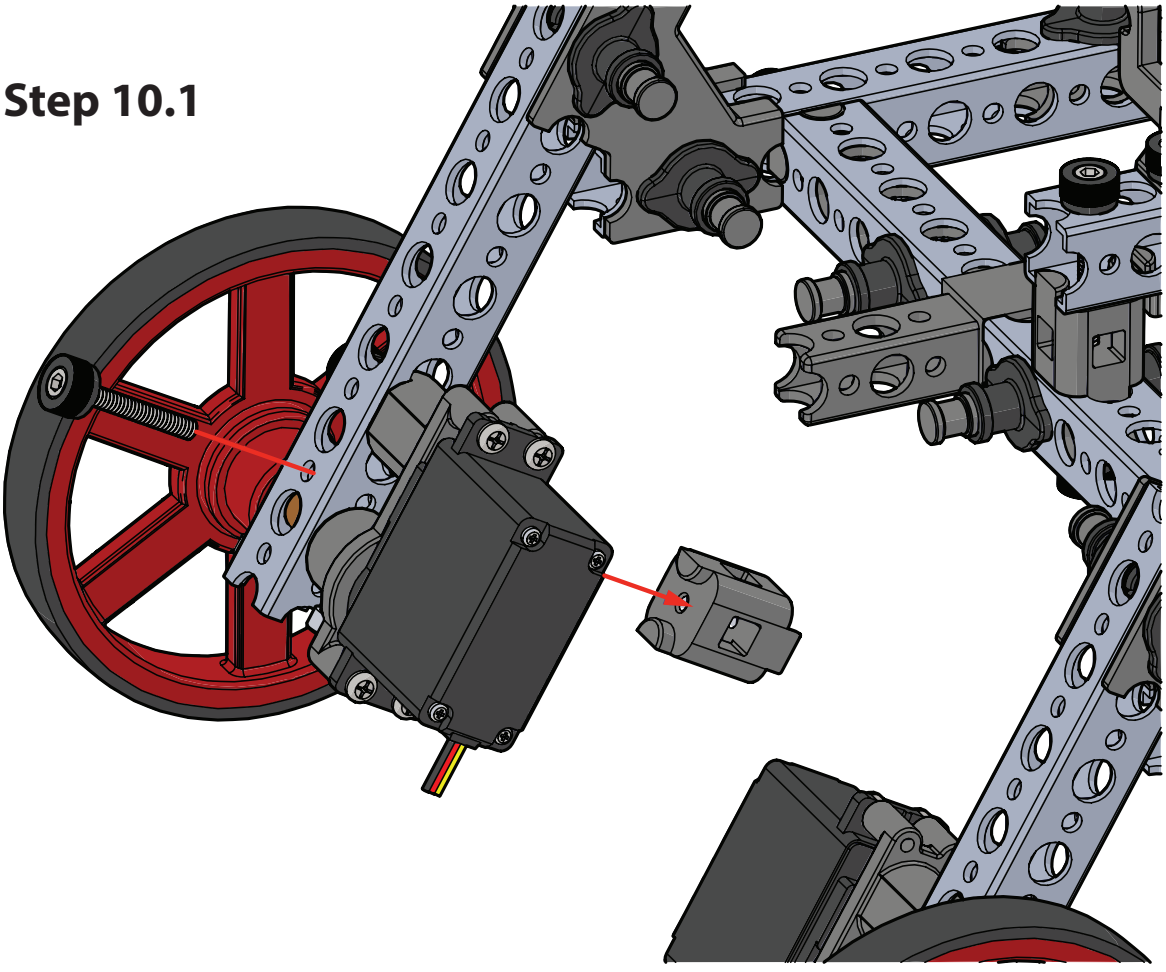
Partial assembly should look like this.



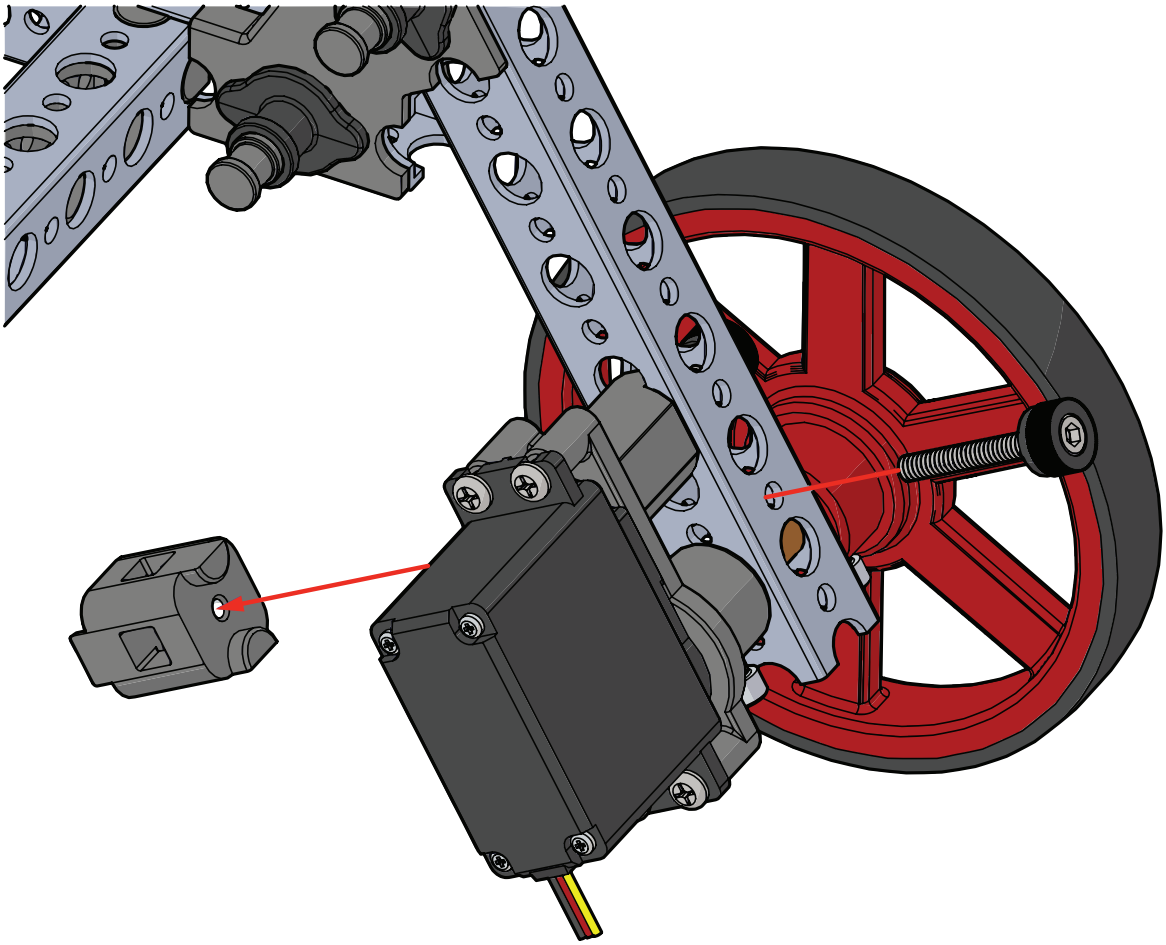
Step 10.0



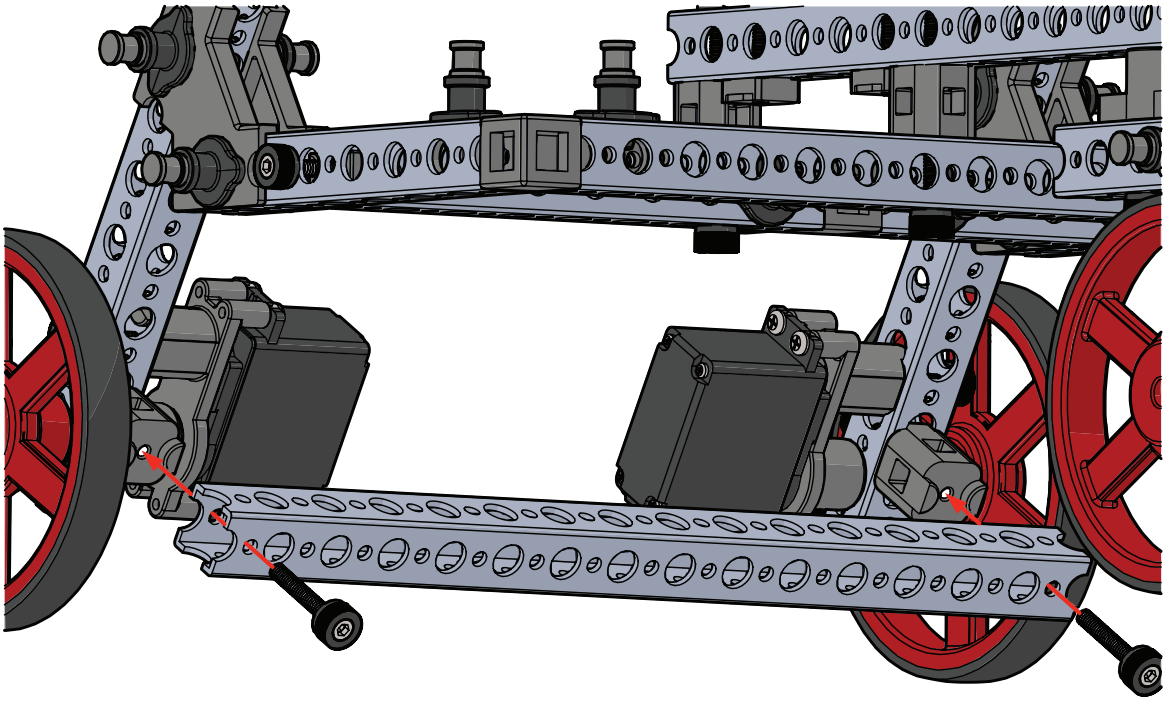
Step 10.1



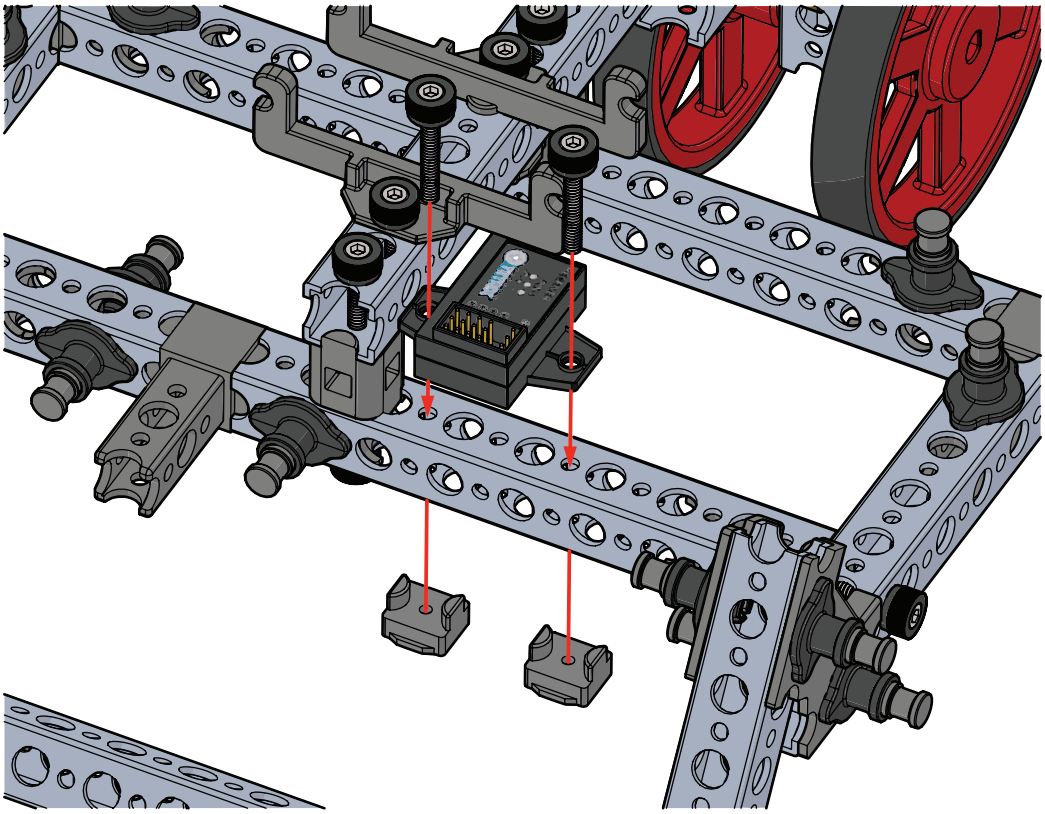
Step 10.2



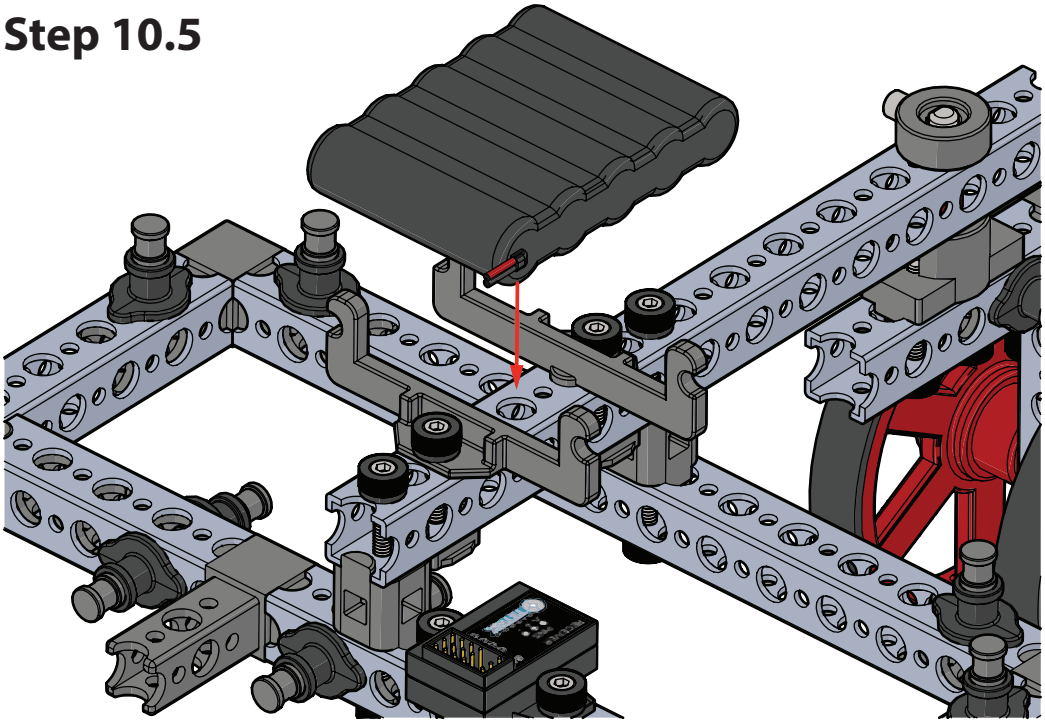
Step 10.3



Step 10.4

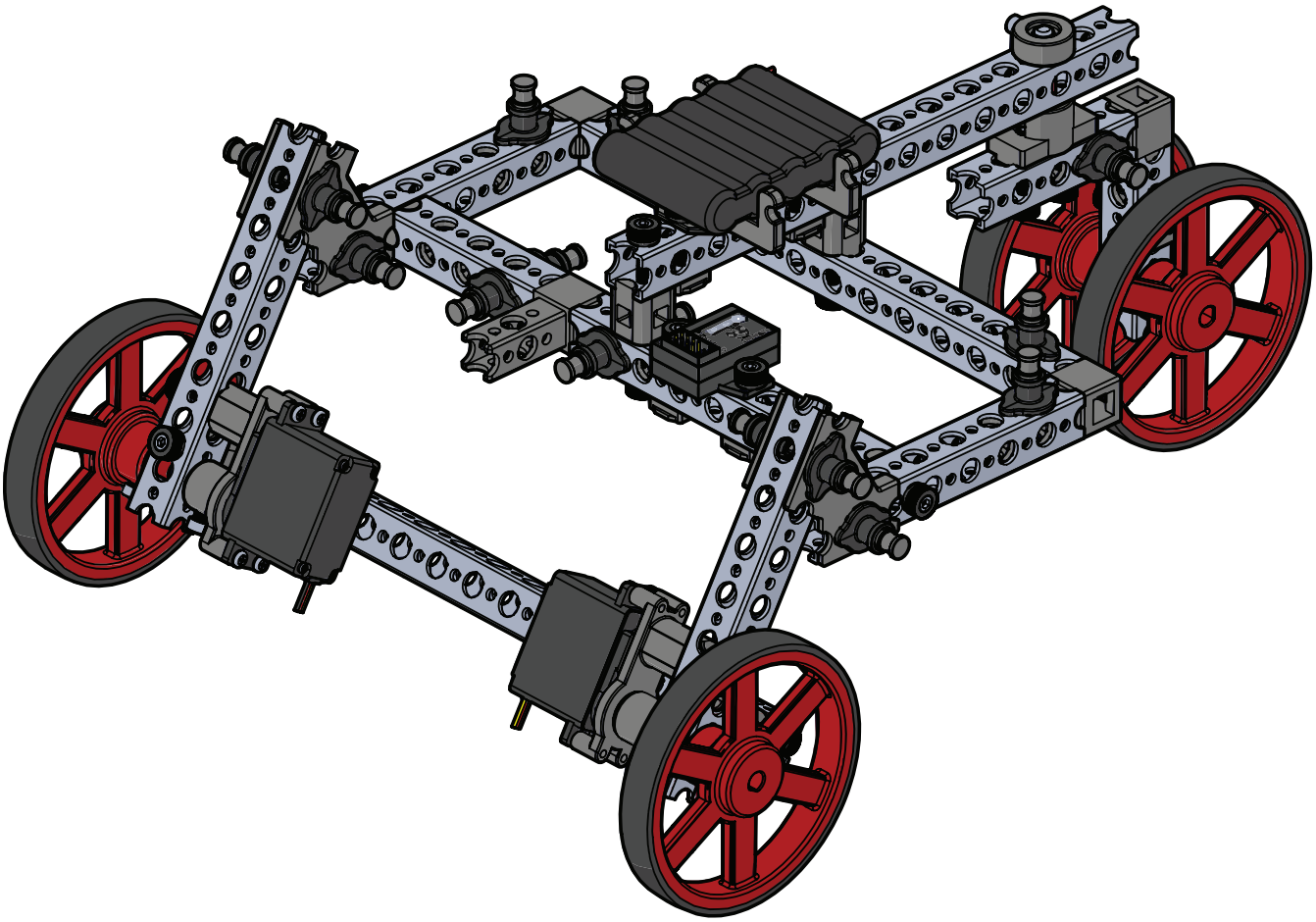


Step 10.5



Tip: Wrap the elastic band included with the battery mount around the battery and mounting brackets to secure the battery into place.

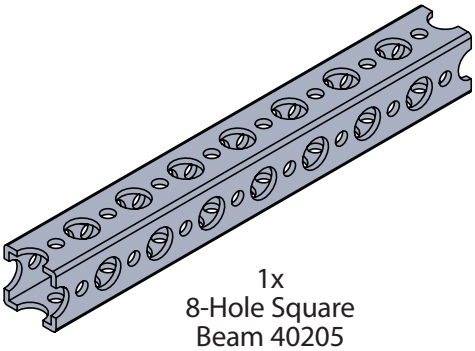
Finished assembly without gripper.



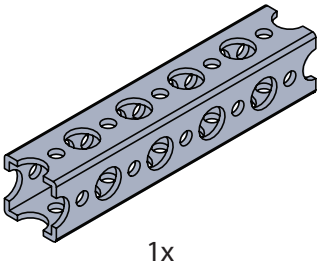
Buggee Bot Gripper Assembly

Step 11

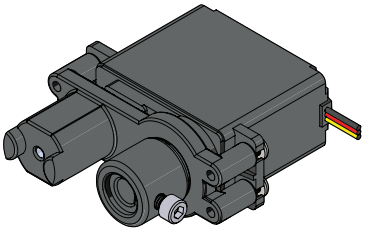
Parts Needed



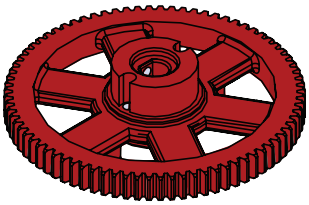
1x
8-Hole Square
Beam 40205



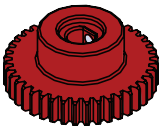
1x
5-Hole Square Beam 40202



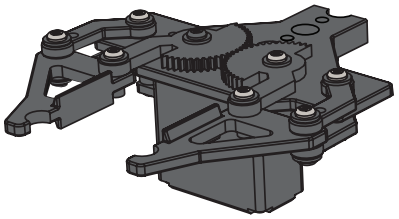
1x
Standard-Scale Servo Motor 40538
with Servo Mounting Bracket 40232
(Assembly instructions on pages 14-15.)



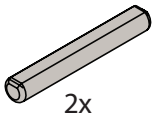
1x
80-Tooth Plastic Gear 40224



1x
40-Tooth Plastic Gear
40223

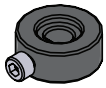


1x
Gripper Kit 40234



2x
40 mm Steel Axle
40226

4x
8 mm x 6 mm
Bronze Bushing
40227

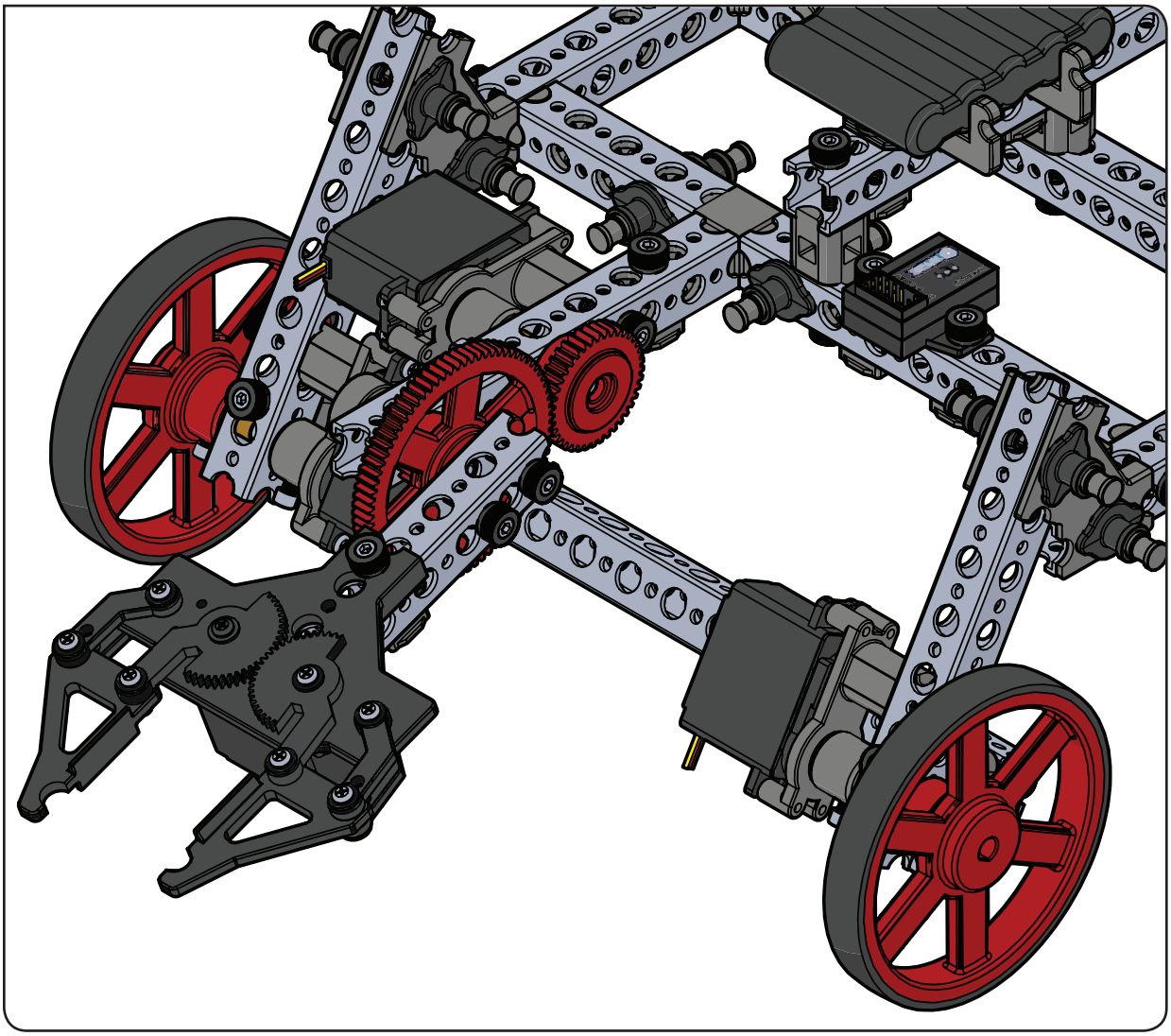


1x
D-Shaft Set Collar
40229

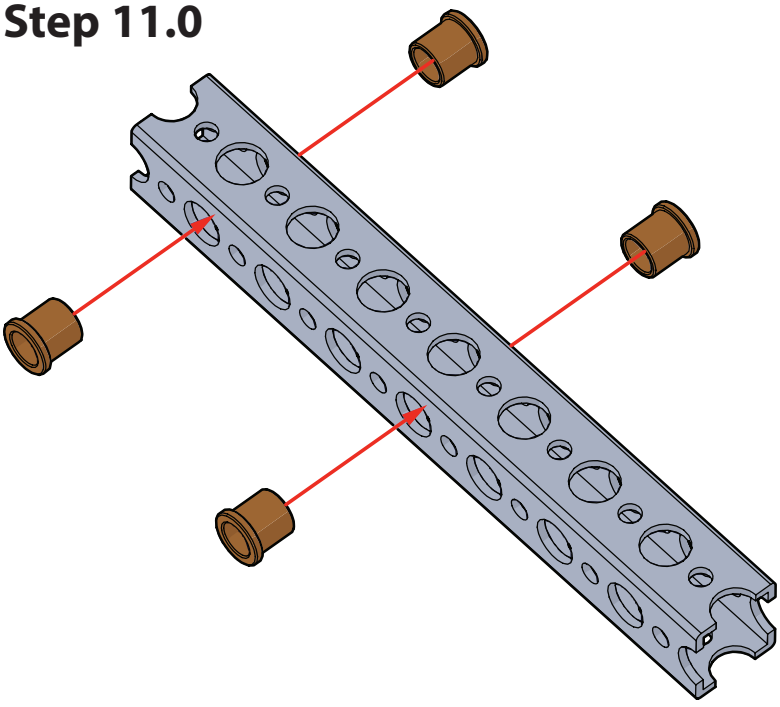
5x
Thumbscrew
40323

2x
Wing Nut 40221

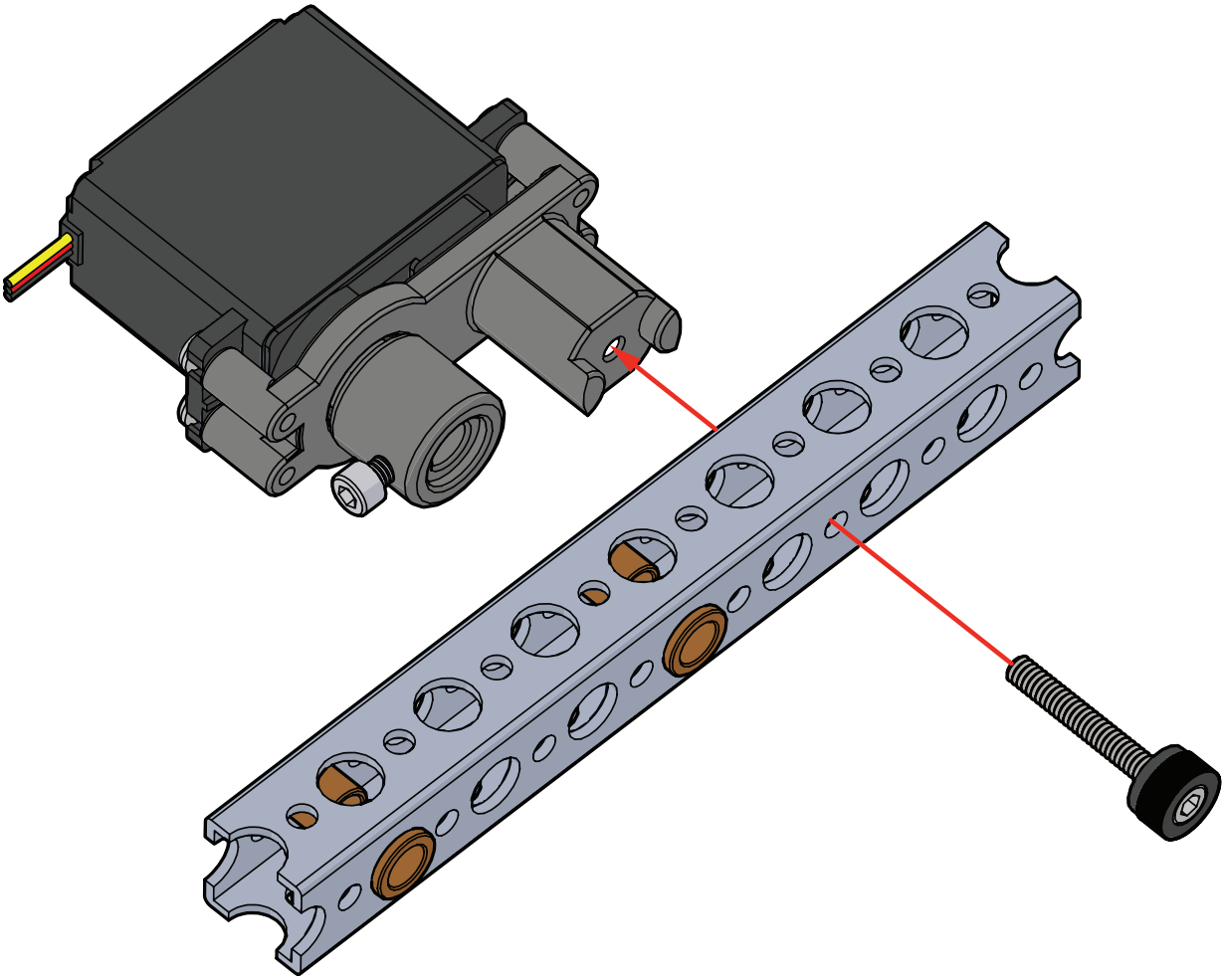
Partial assembly should look like this.



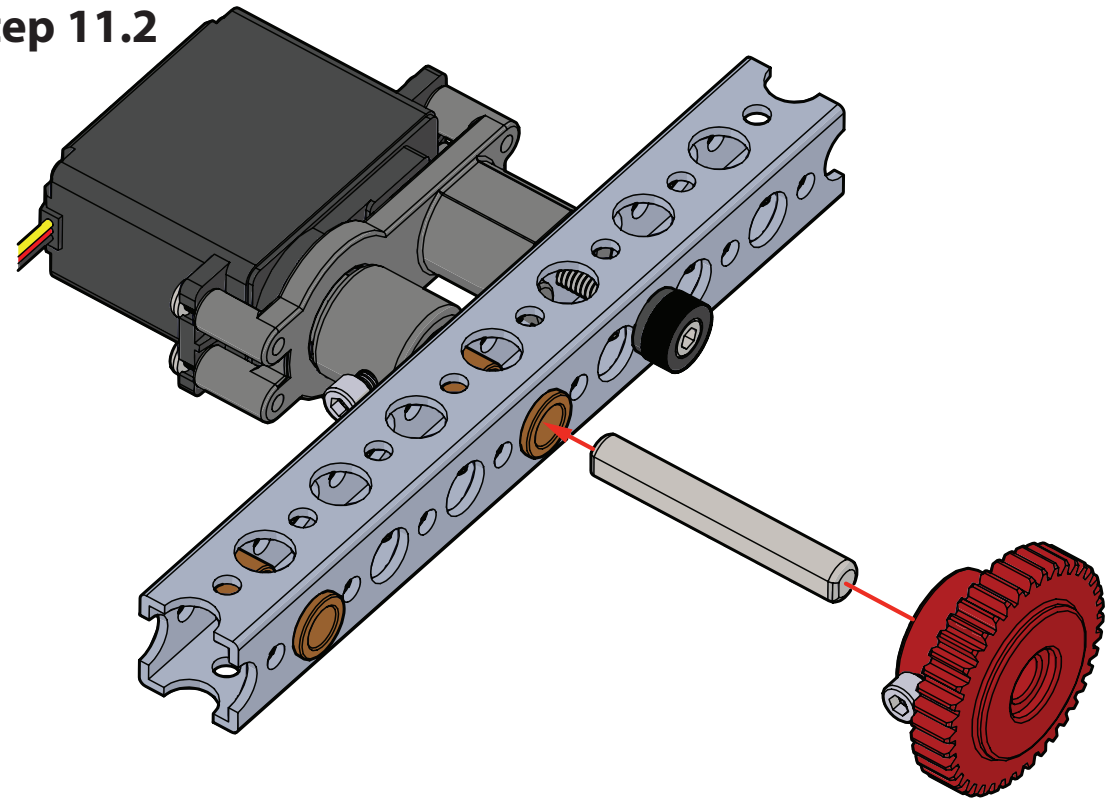
Step 11.0



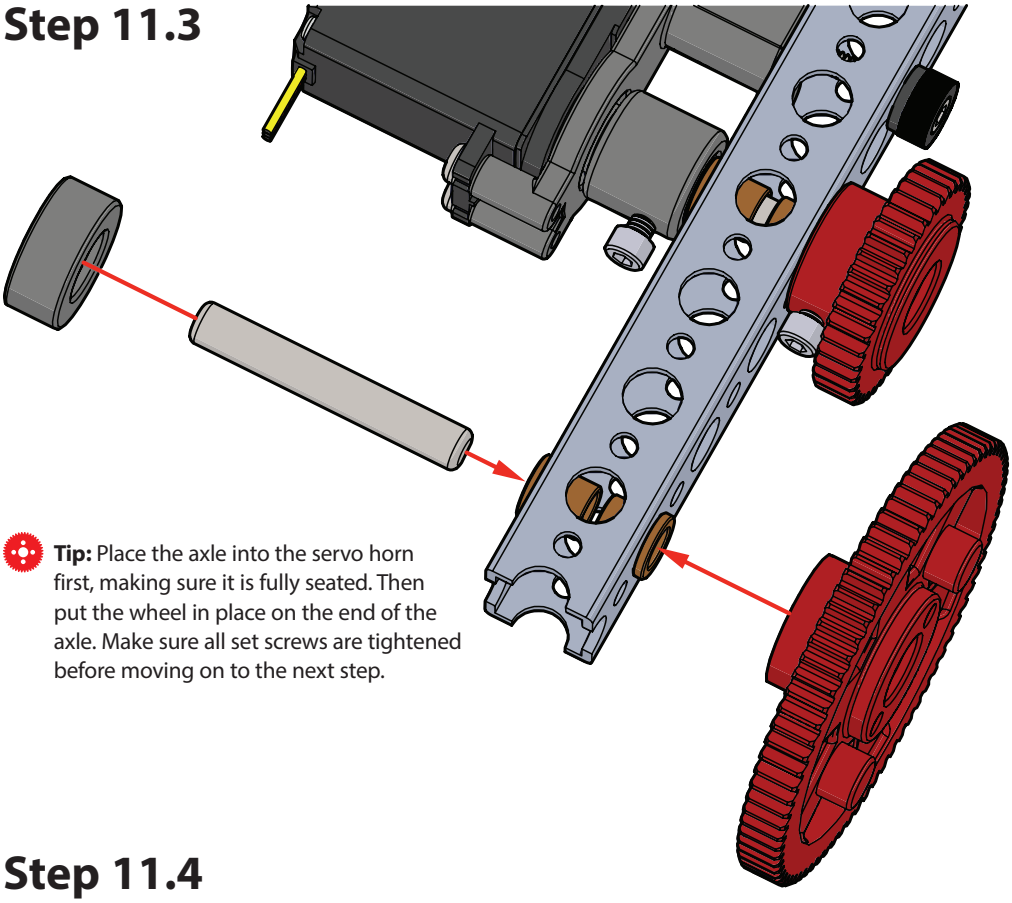
Step 11.1



Step 11.2

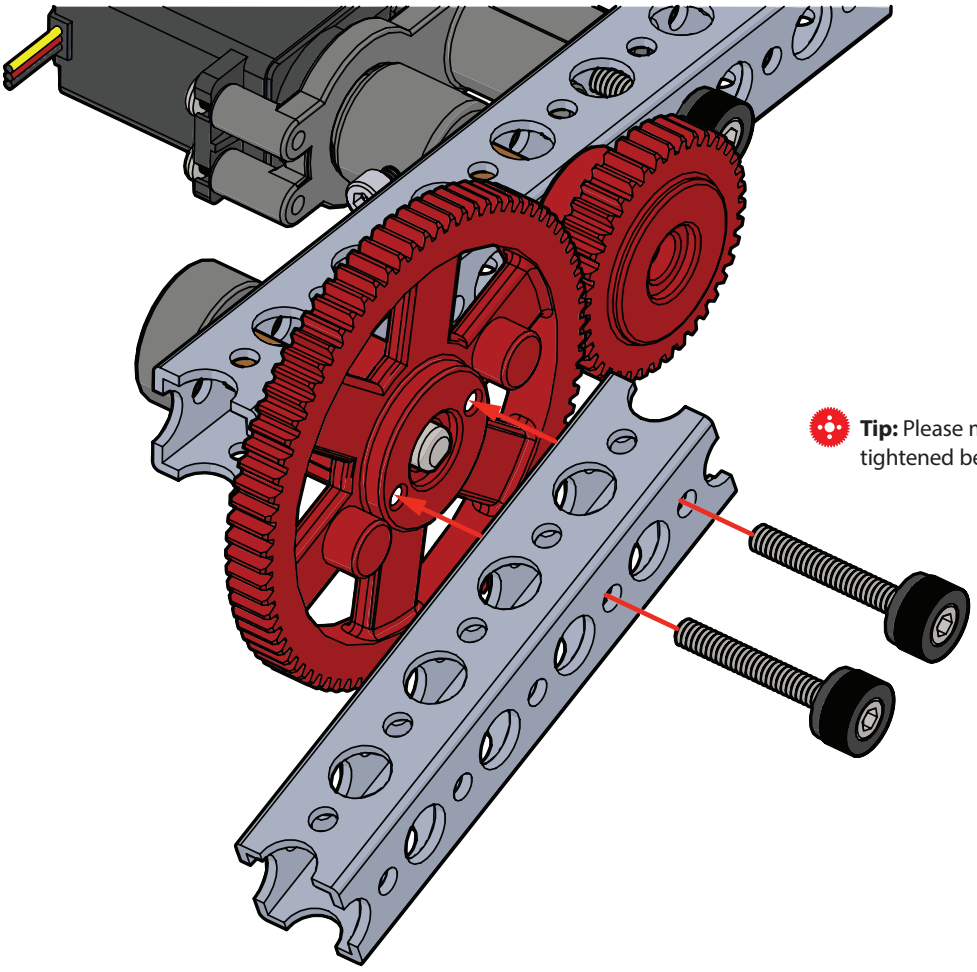


Step 11.3



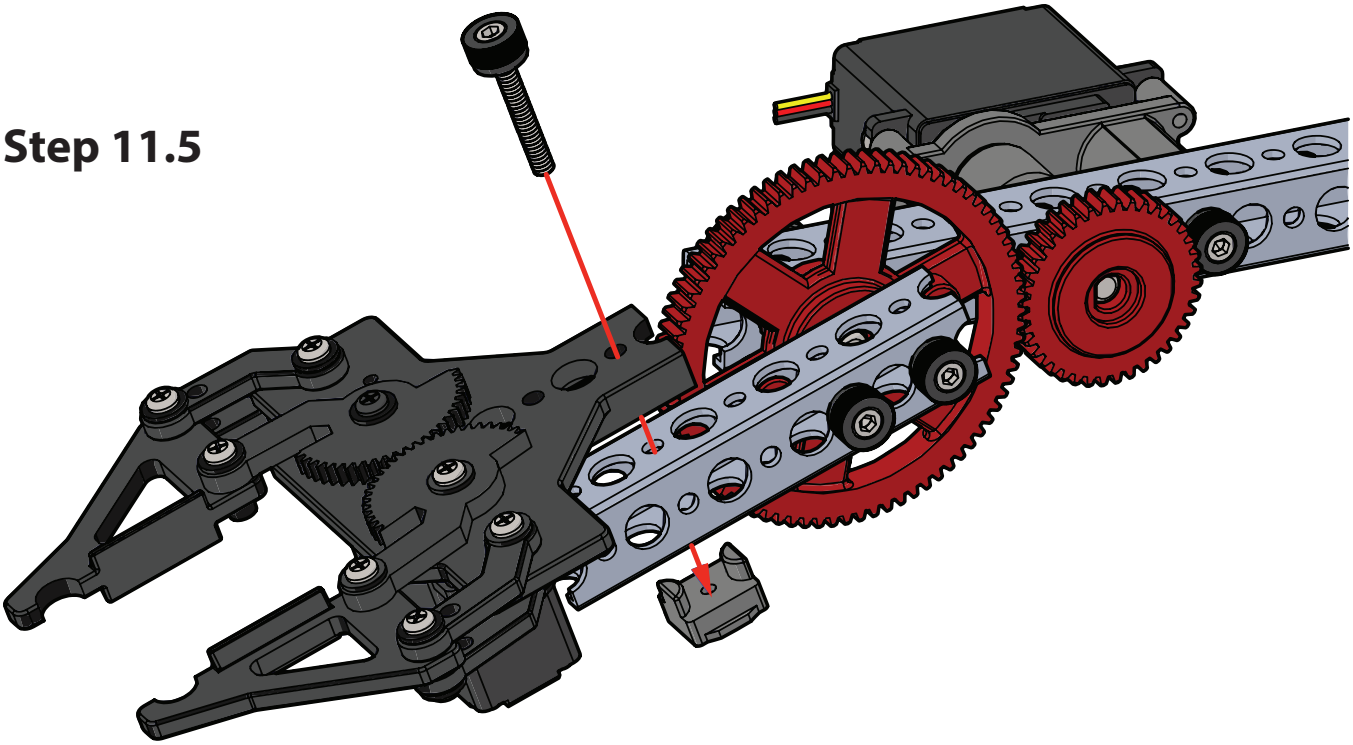
Tip: Place the axle into the servo horn first, making sure it is fully seated. Then put the wheel in place on the end of the axle. Make sure all set screws are tightened before moving on to the next step.

Step 11.4

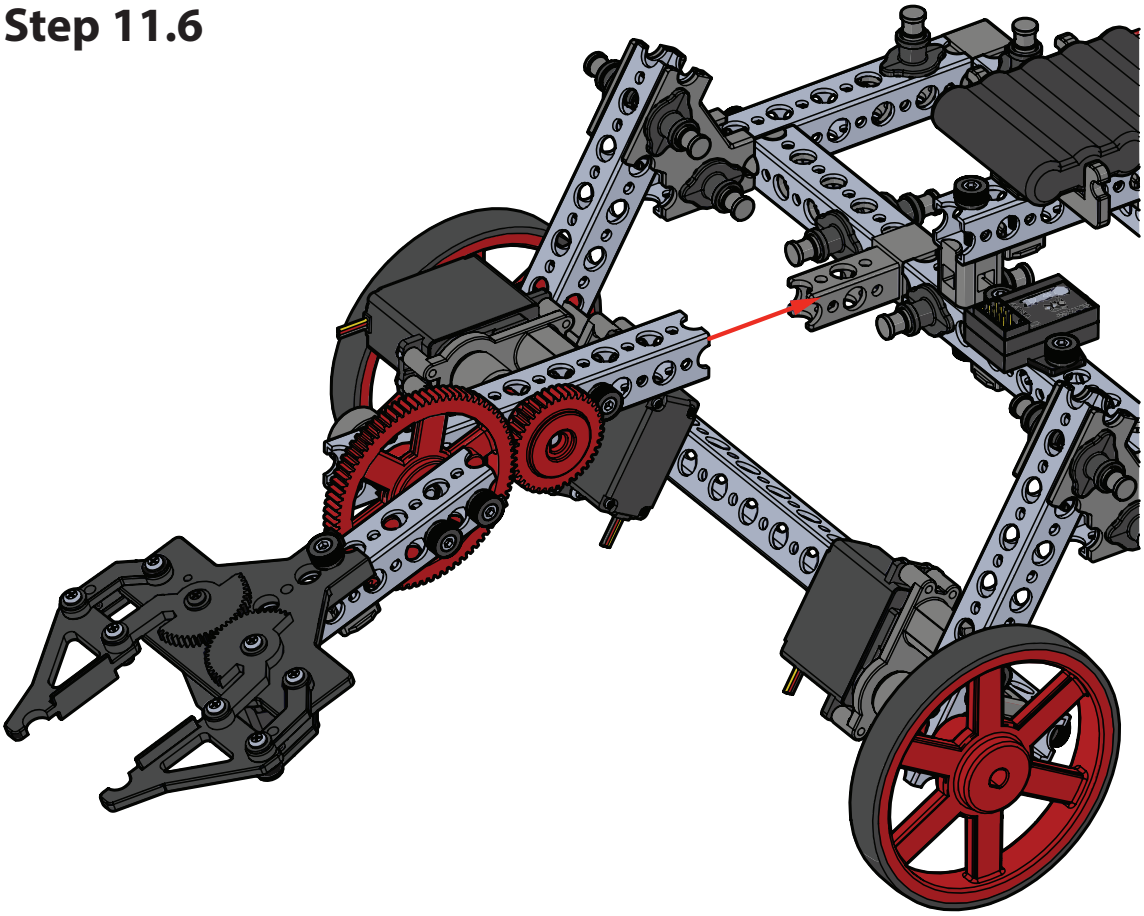


Tip: Please make sure the set screws are tightened before moving on to the next step.

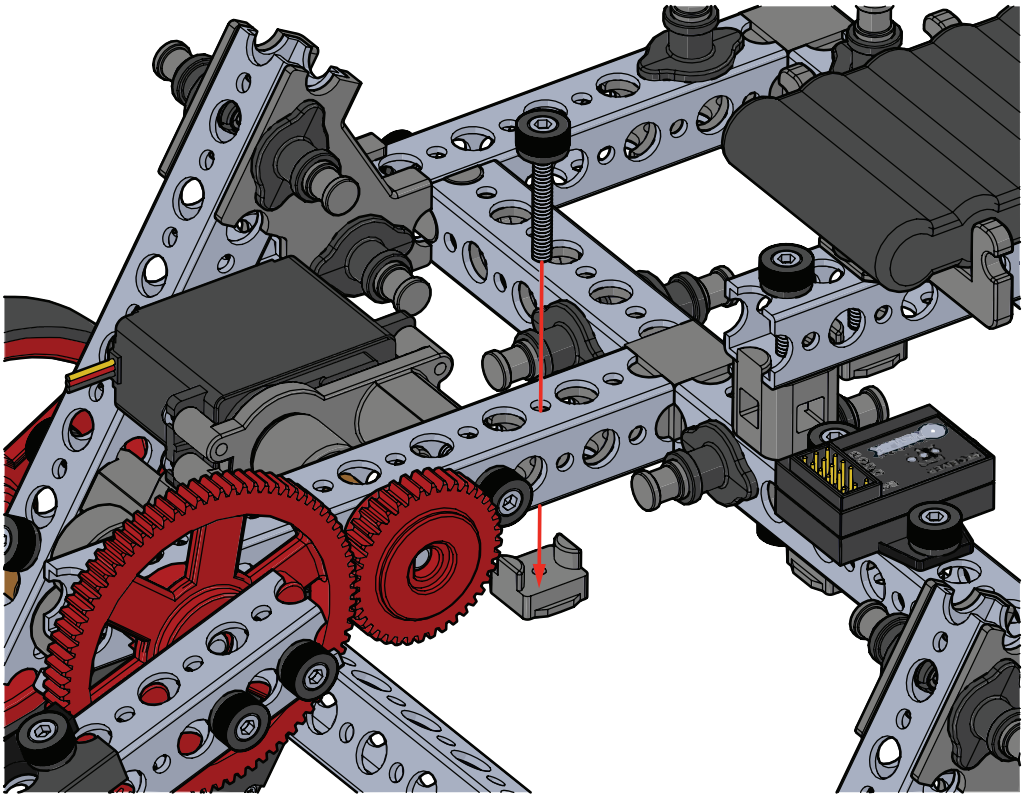
Step 11.5



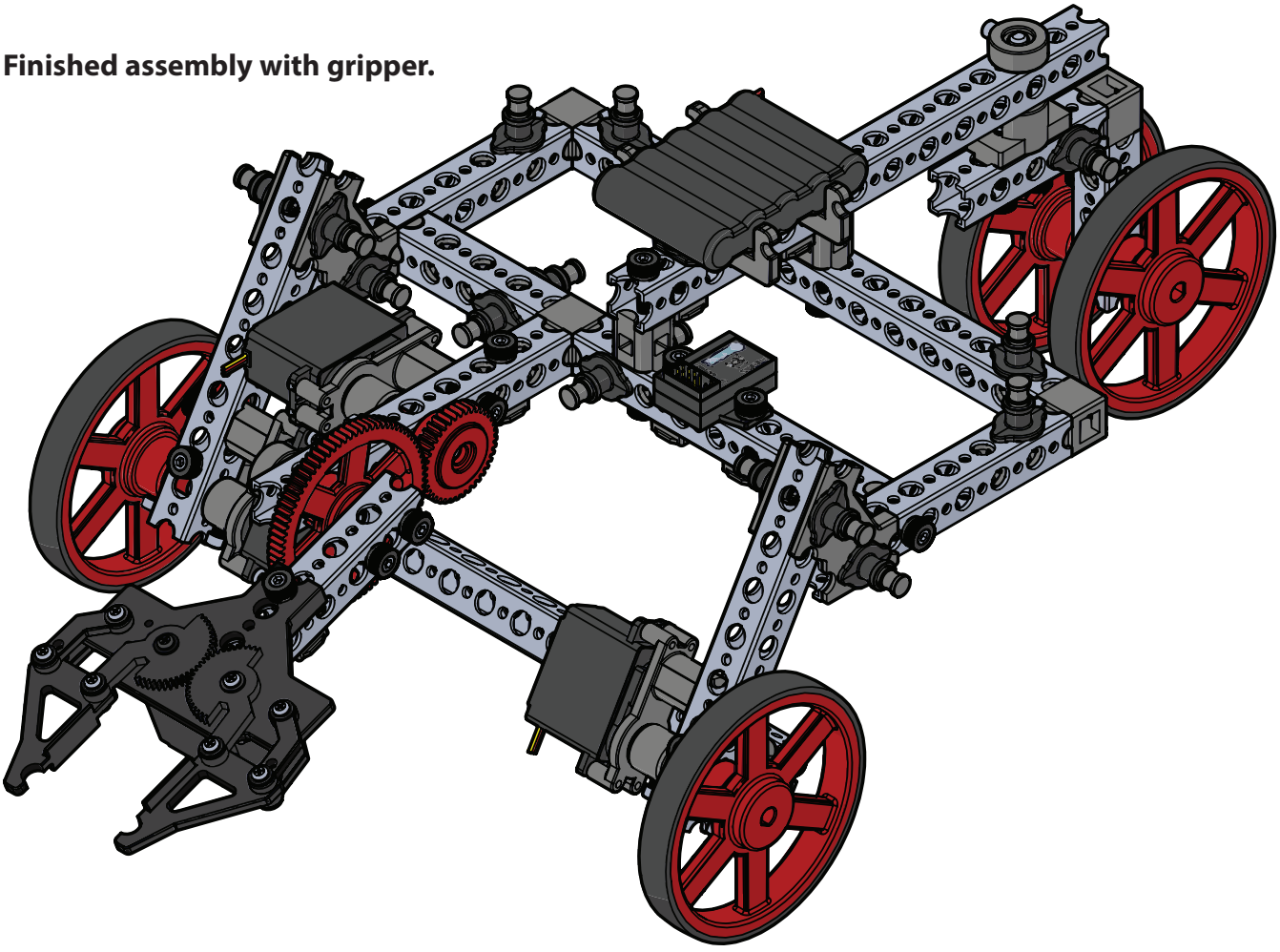
Step 11.6



Step 11.7



Finished assembly with gripper.



TETRIX PRIME Buggee Bot Activities

Final Connections:

After you've installed the battery with the battery mount bracket, you are ready to connect the servo motors to the wireless receiver. Remember to reference page 13, which shows a typical wiring diagram for connecting the battery, switch, and wireless receiver.

Connect the battery to the BAT connection on the receiver. Set up the robot to operate in tank mode by connecting the left continuous rotation servo to Channel 2 and the right continuous rotation servo to Channel 3. In this mode, the left joystick will control the left motor and the right joystick will control the right motor. Secure the wires so they do not become entangled in any moving parts. Turn on the wireless joystick gamepad system and test the operation of the Buggee Bot. If the motion does not correspond with the joystick movement, use a screwdriver to change the position of the DIP switches. If necessary, use the trimmer controls to adjust servo movement or position when the joysticks are in the neutral position.

Don't forget to reference page 12 for complete instructions on setting up the wireless joystick gamepad system and configuring input to personal preferences.

Sample Activities:

After you complete the construction of the Buggee Bot, it is time to have some fun. Practice driving the Buggee Bot to familiarize yourself with the way it works.

Activity 1

- Set the controller to operate in tank mode. In tank mode, the left joystick controls the left motor and the right joystick controls the right motor. Place four cups upside down to resemble cones. Place the cones in a square pattern with 18-inch sides. Place your Buggee Bot in the center of the cones. Drive the Buggee Bot around the cones in a figure eight pattern. Use a stopwatch to time how long it takes to drive the Buggee Bot through the pattern and back to the center of the cones. Try to complete the figure eight faster than your partner without hitting the cones.

Activity 2

- Set the controller to operate in arcade mode. To set the robot to operate in arcade mode, plug the left continuous rotation servo into Channel 1. Leave the right continuous rotation servo plugged into Channel 3. In this mode, the right joystick will control both the left and right motors. Driving in a straight line is accomplished by moving the joystick in a diagonal motion. Place four cups upside down to resemble cones. Place the cones in a square pattern with 18-inch sides. Place your Buggee Bot in the center of the cones. Drive the Buggee Bot around the cones in a figure eight pattern. Use a stopwatch to time how long it takes to drive the Buggee Bot through the pattern and back to the center of the cones. Try to complete the figure eight faster than your partner without hitting the cones. Compare the time required to complete the figure eight in each driving mode. Which operating mode enabled you to complete the task faster?

Activity 3

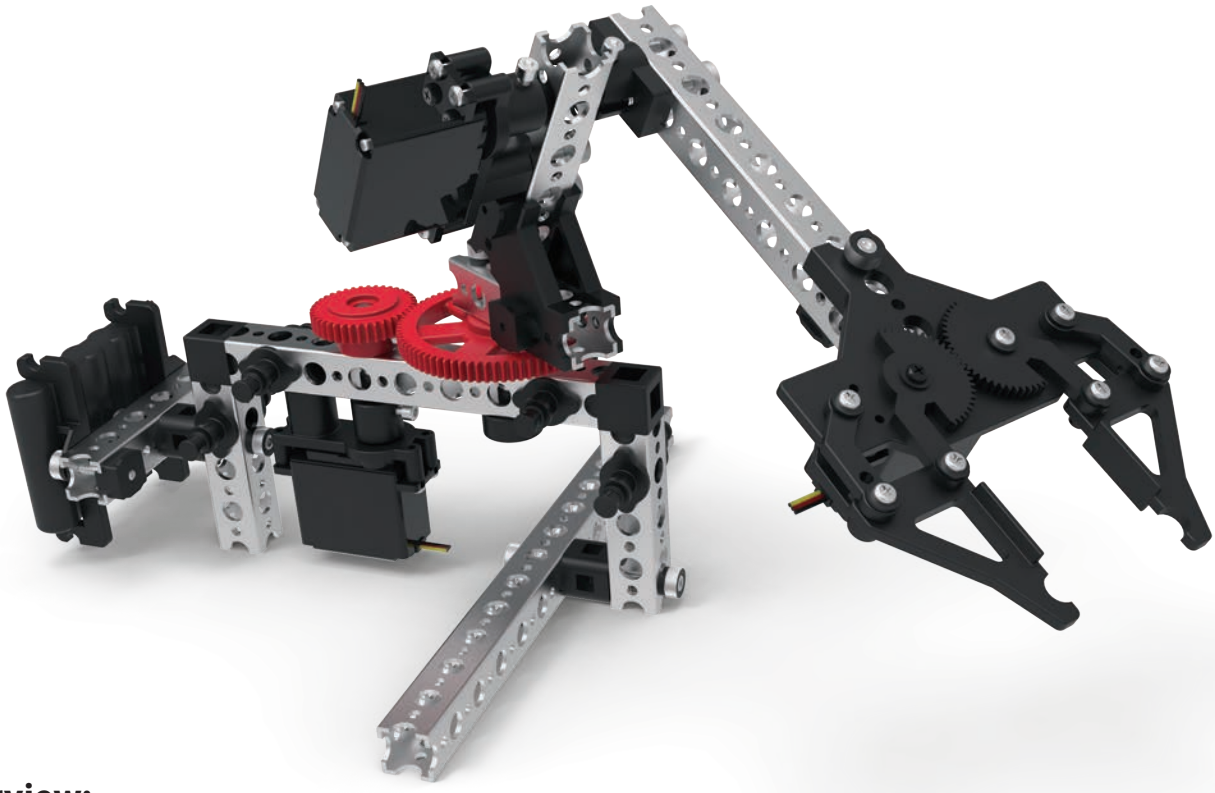
- After completing the build of the Buggee Bot, you can add the optional Gripper Assembly. Refer to the instructions on pages 83-88 to assemble and attach the gripper. Attach the servo that opens and closes the gripper to Channel 4. Attach the servo that raises and lowers the gripper to Channel 2. Invert two small cups to serve as ball supports. Place two small cups about four feet from the two inverted cups. Use the remote control to maneuver the Buggee Bot into position and pick up a ball using the gripper. Drive the robot to one of the cups and place the ball into the cup. Harvest the remaining ball from the support and place it in the other cup. Make it a competition by timing how long it takes to move both balls from the support and place them in the cups.

Activity 4

- With permission from your instructor, make modifications to improve the performance of the Buggee Bot. Some improvement ideas include reducing the turning radius, improving the stability, or improving the steering response.

Don't forget to document your efforts and remember the engineering design process.

TETRIX PRIME Pickee Bot Assembly



Overview:

The TETRIX PRIME Pickee Bot is a nonmobile pick-and-place robot, similar to an industrial robot that might be used in a manufacturing plant.

How It Works:

The TETRIX PRIME Pickee Bot uses two standard servos to operate and elevate the gripper and one continuous rotation servo to pivot the gripper.

Getting Started:

- Refer to pages 92-115 for instructions on how to build the complete Pickee Bot.
- See page 116 for suggested sample activities.

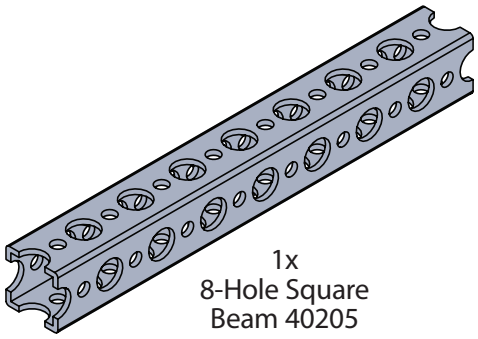
Time Expectations:

30-50 minutes

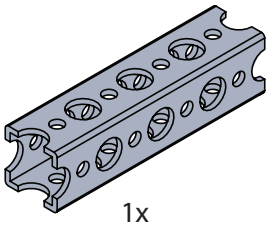
Note: Many factors can affect building time, including set organization and whether builders use a partner. The above time is an estimate only and based on a single builder of average experience who is comfortable with the product and has access to well-organized sets. Actual time might vary.

Step 1

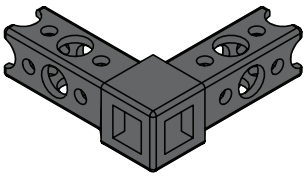
Parts Needed



1x
8-Hole Square
Beam 40205



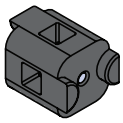
1x
4-Hole Square Beam 40201



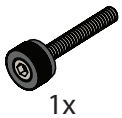
1x
90-Degree Beam
Connector 40211

2x
Quick Rivet
Connector 40219

2x
Quick Rivet Peg
40220

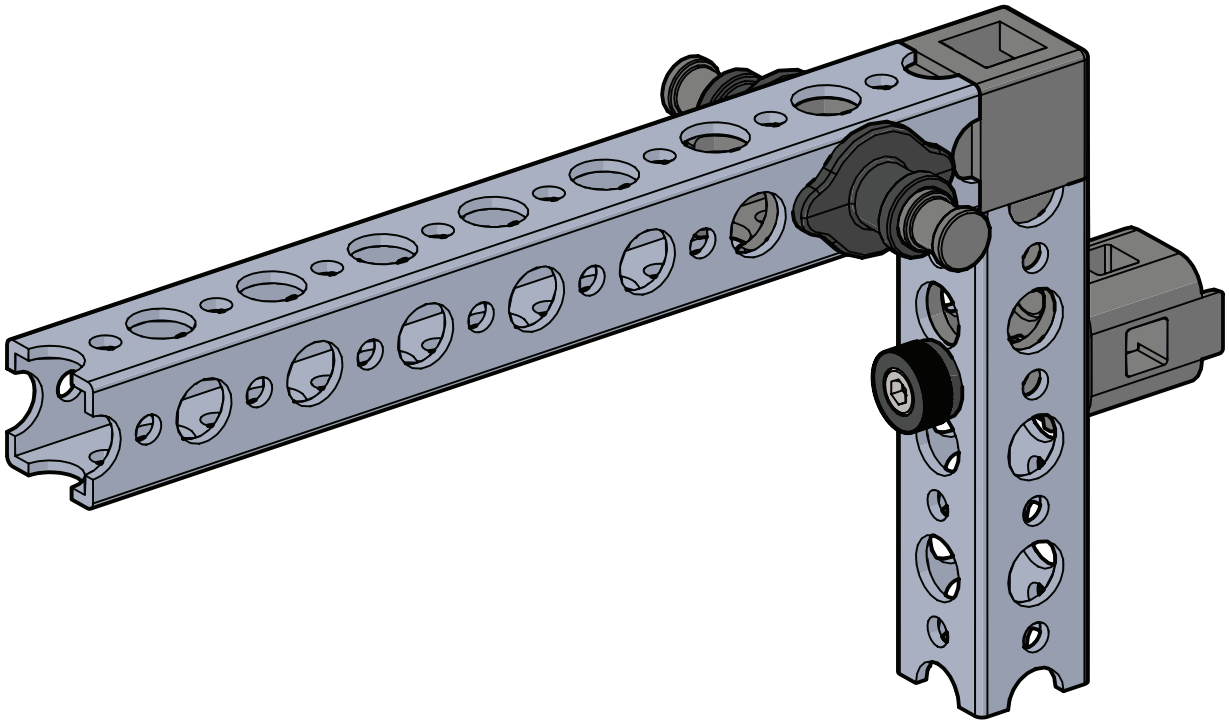


1x
90-Degree Cross Block
Connector 40217

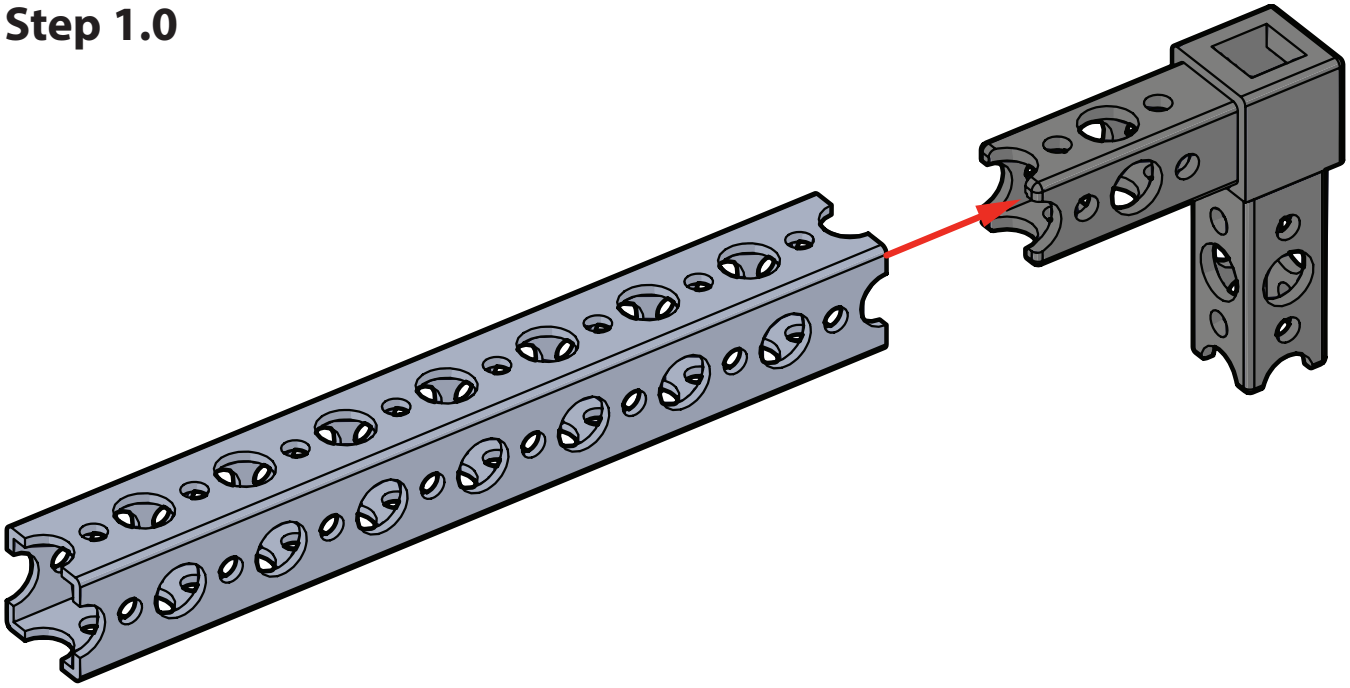


1x
Thumbscrew
40323

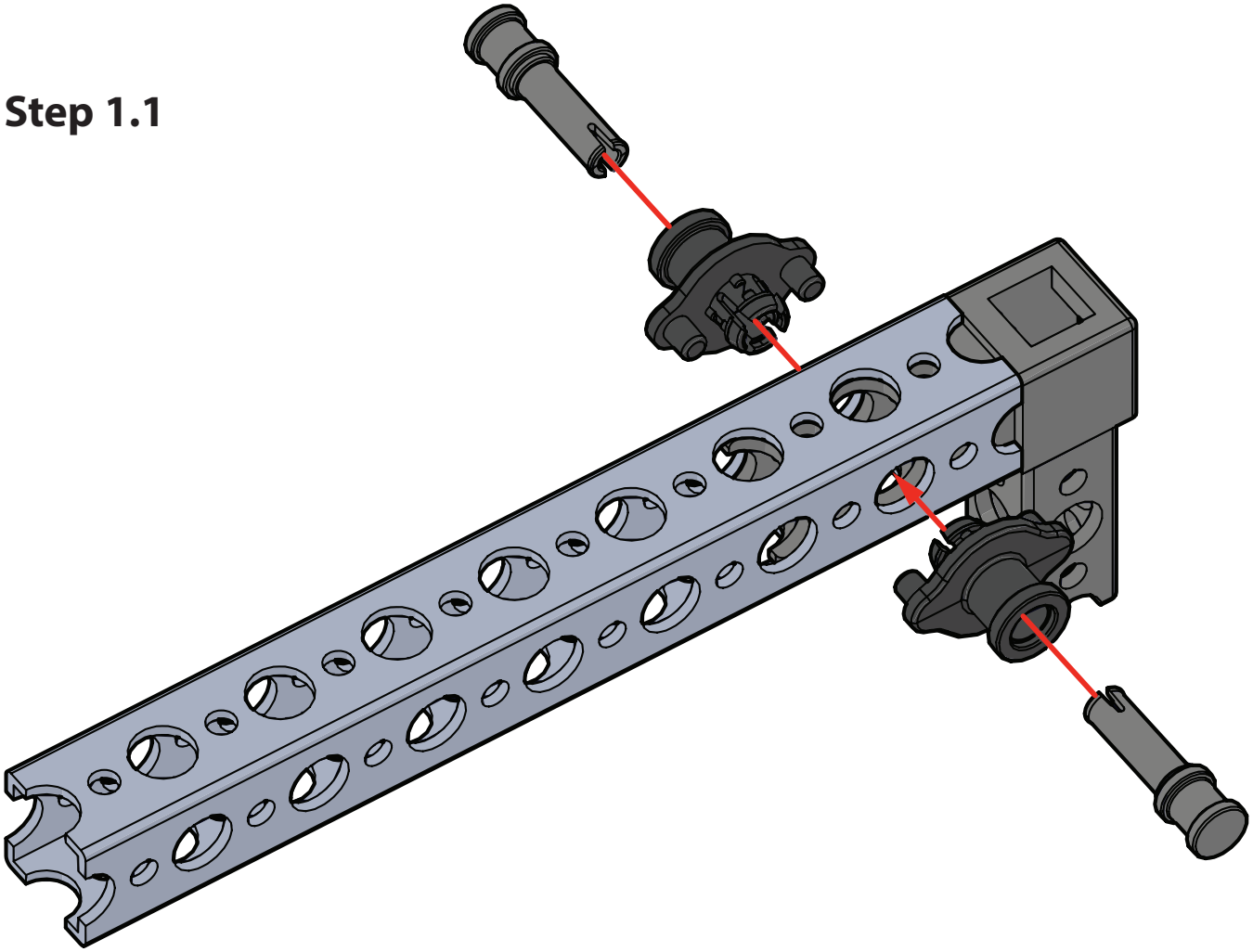
Partial assembly should look like this.



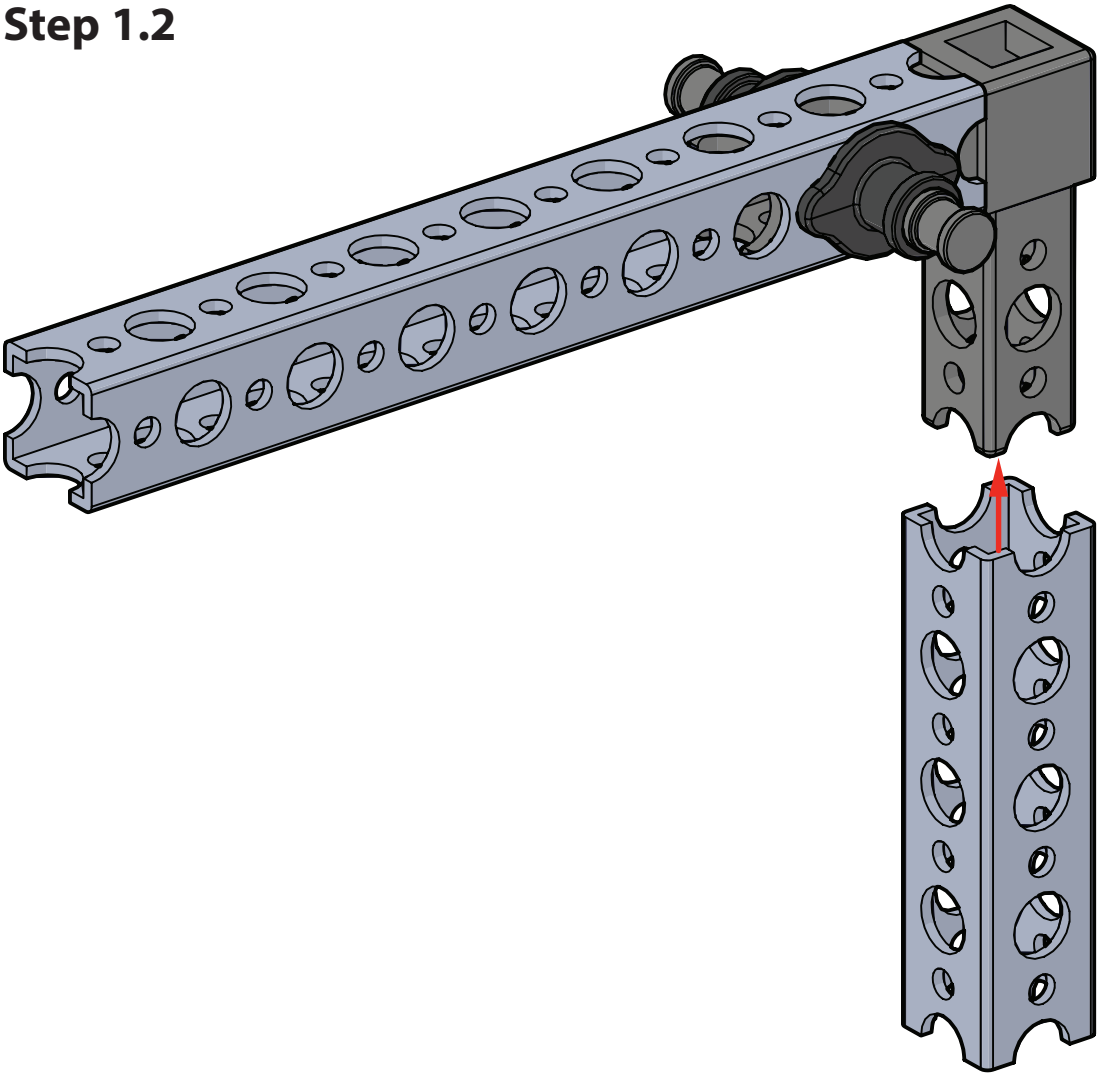
Step 1.0



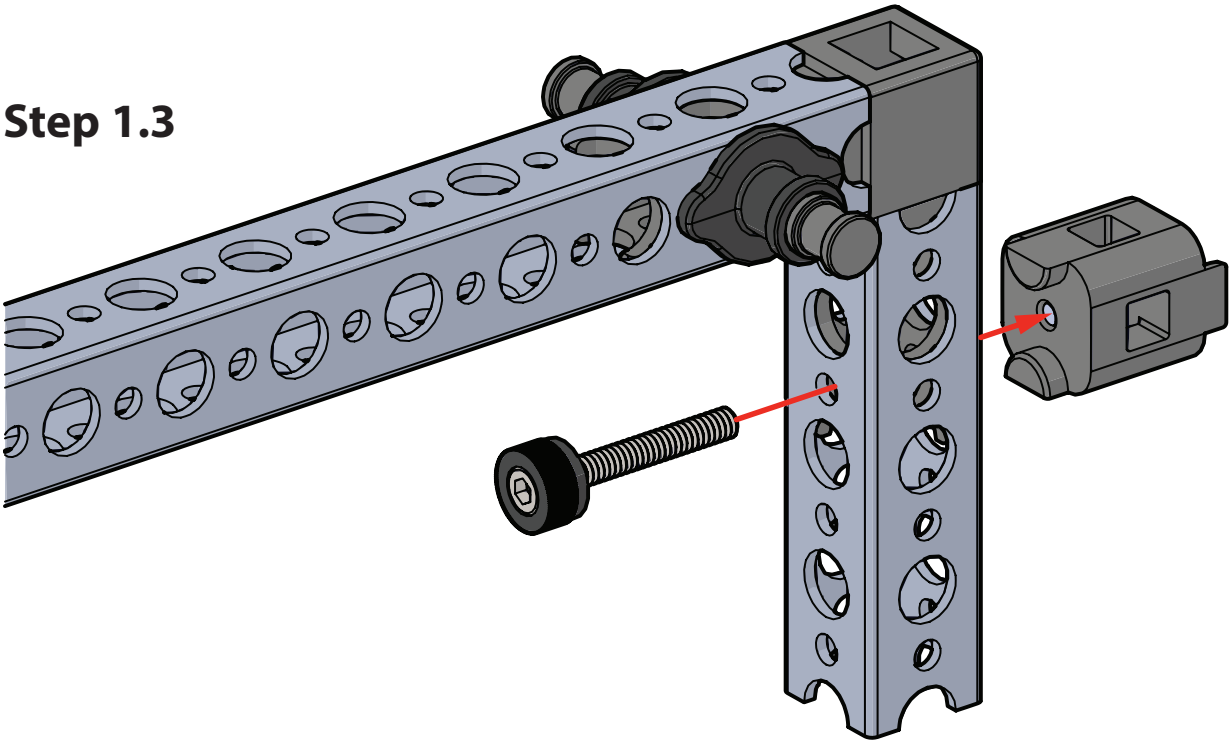
Step 1.1



Step 1.2

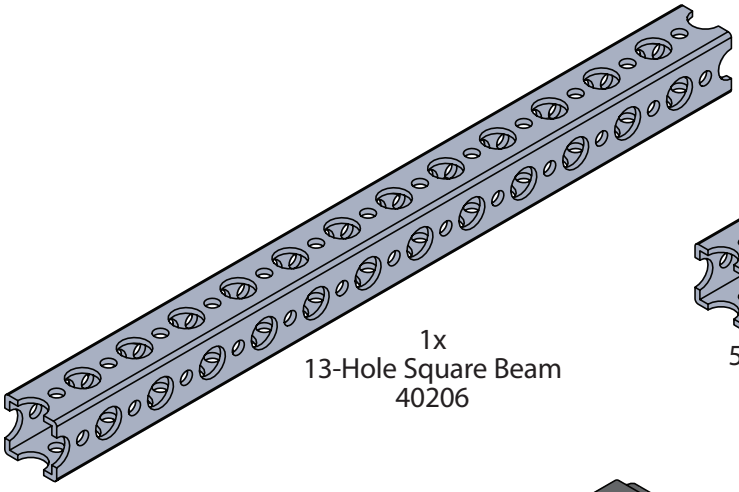


Step 1.3

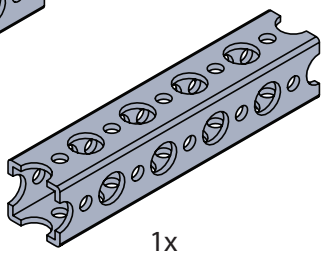


Step 2

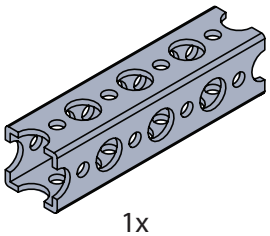
Parts Needed



1x
13-Hole Square Beam
40206



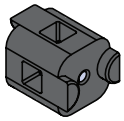
1x
5-Hole Square Beam
40202



1x
4-Hole Square Beam
40201

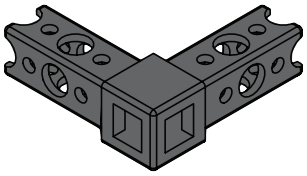
4x
Quick Rivet
Connector 40219

4x
Quick Rivet Peg
40220



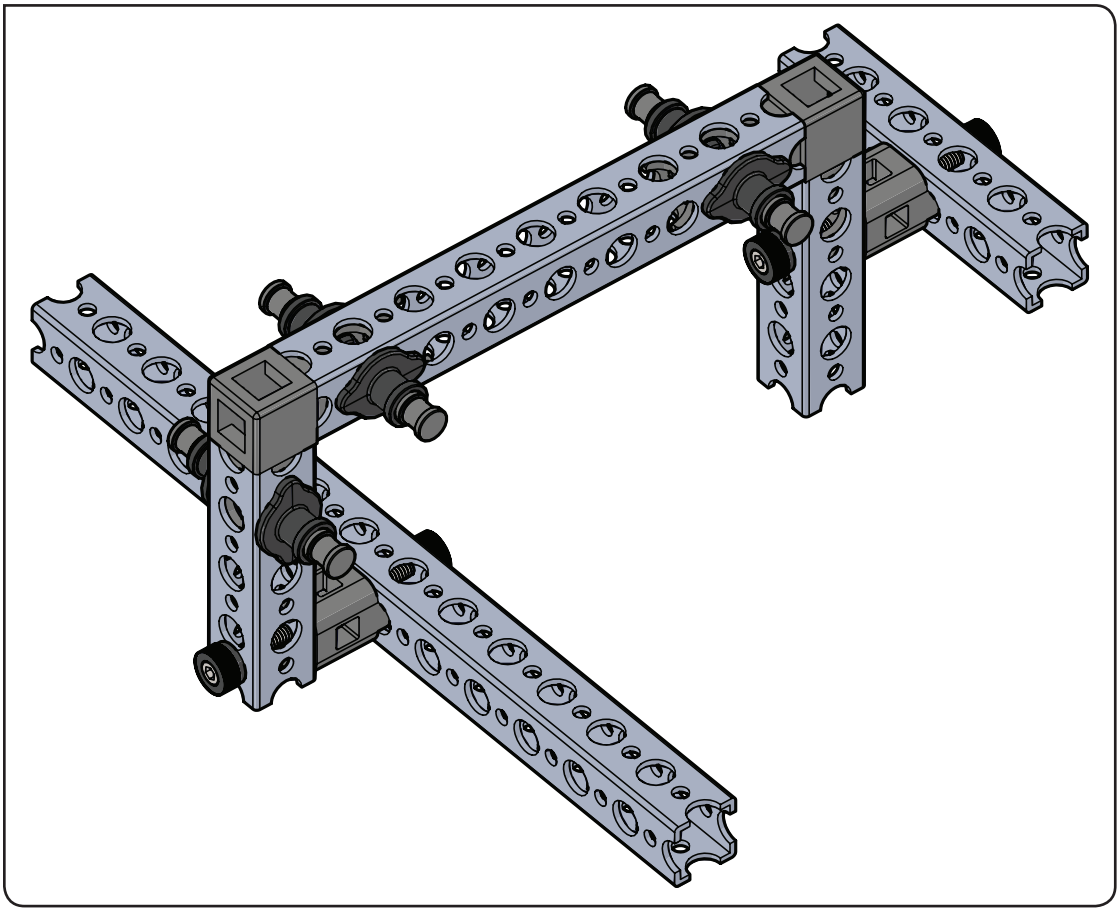
1x
90-Degree Cross
Block Connector
40217

3x
Thumbscrew 40323

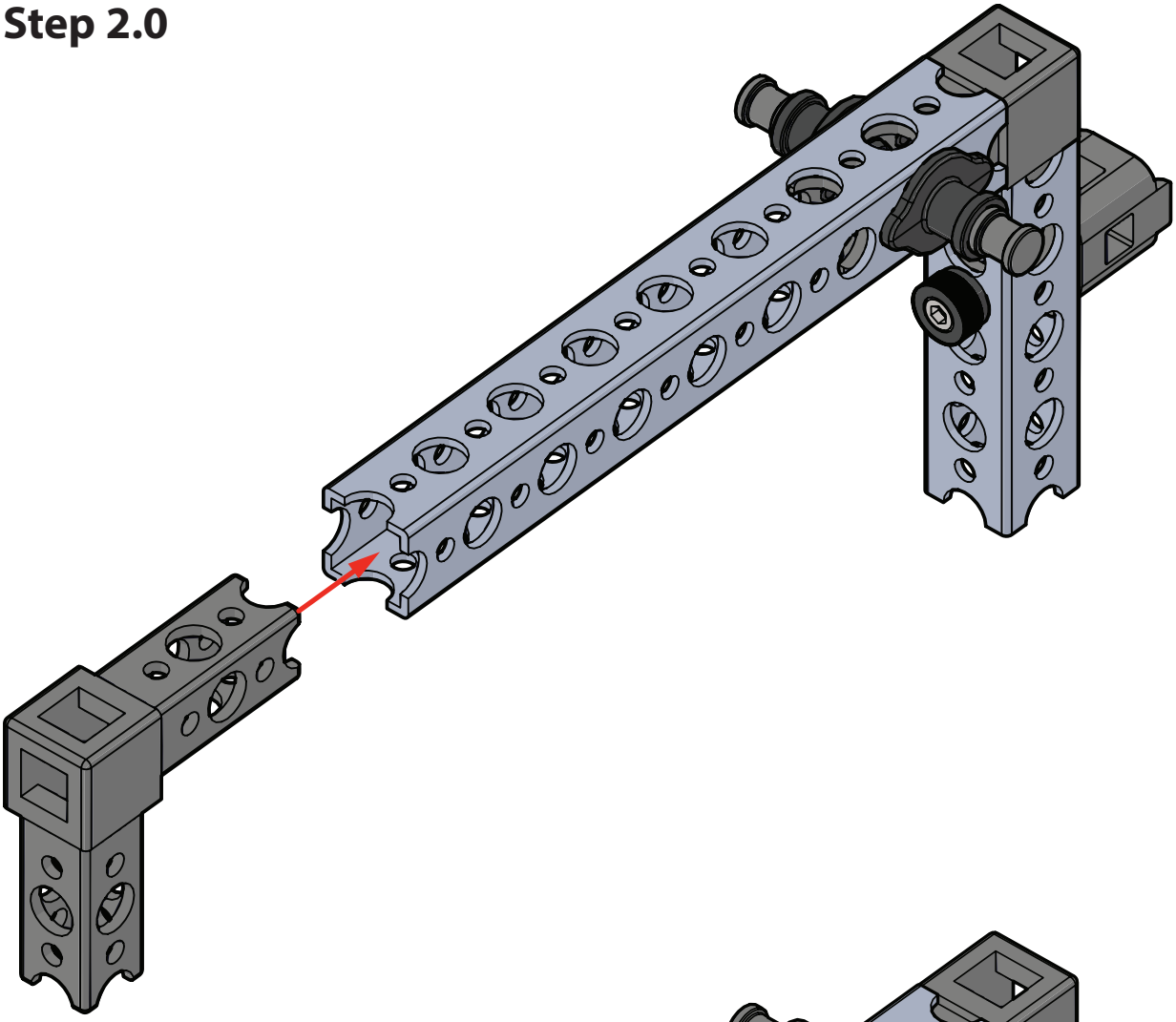


1x
90-Degree Beam
Connector 40211

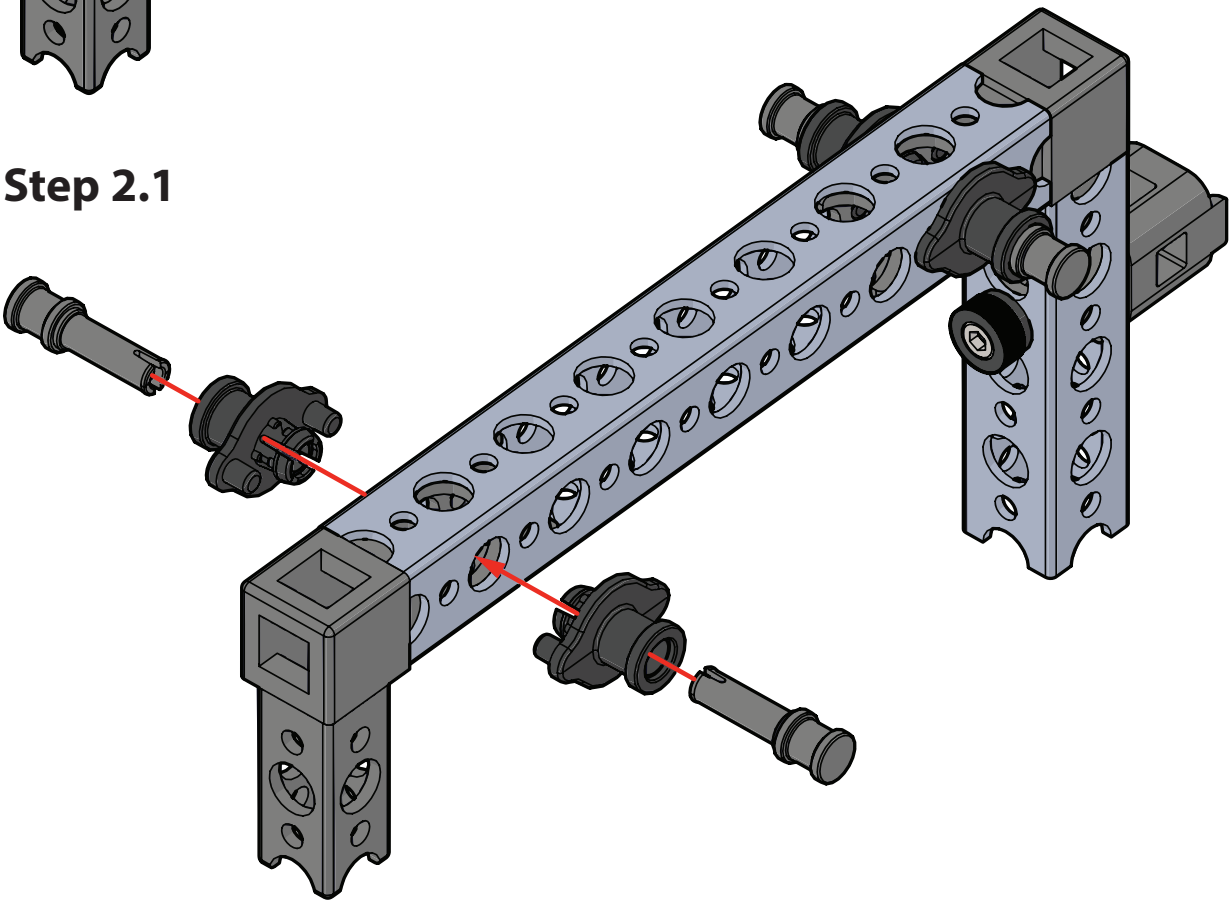
Partial assembly should look like this.



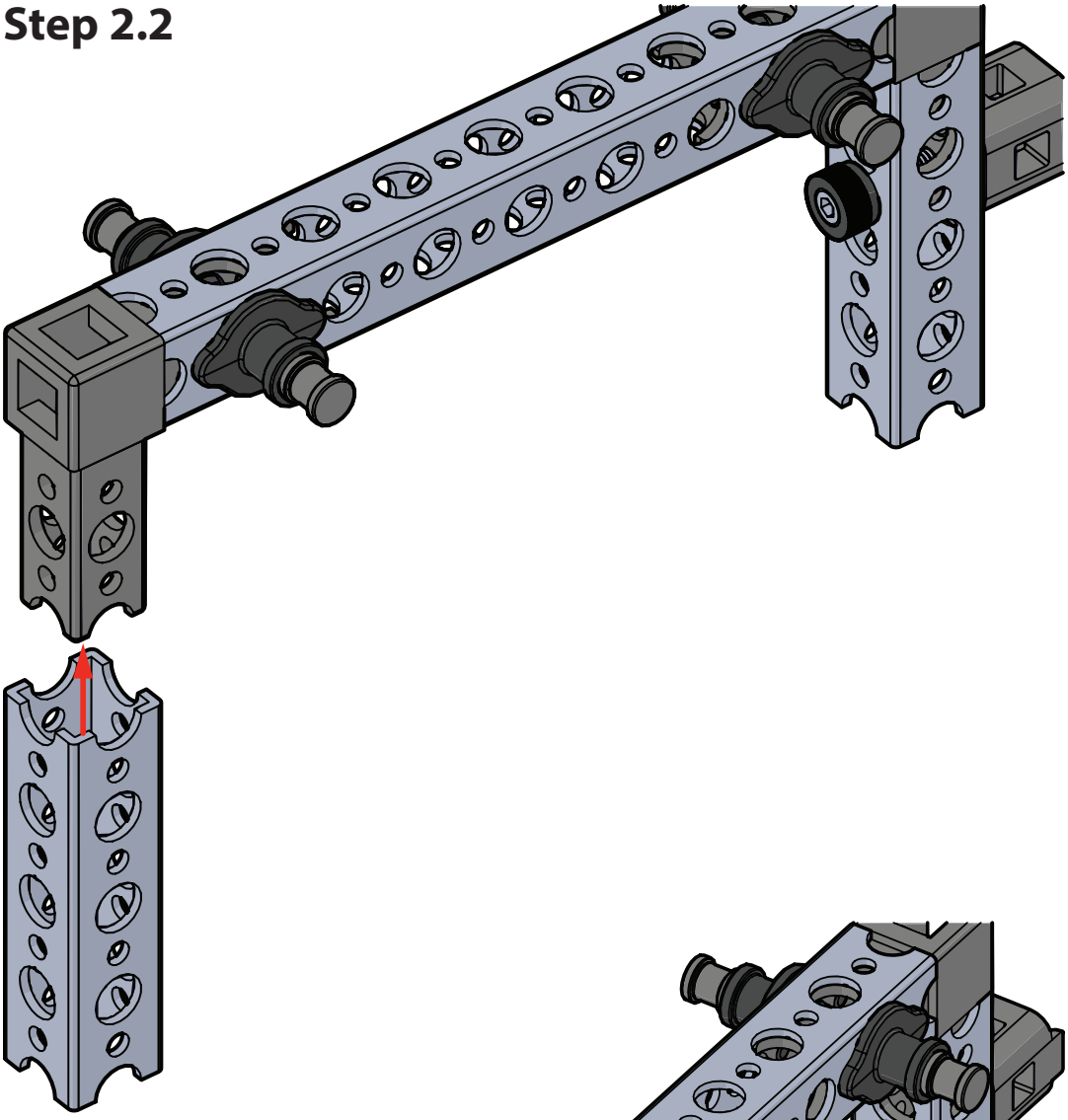
Step 2.0



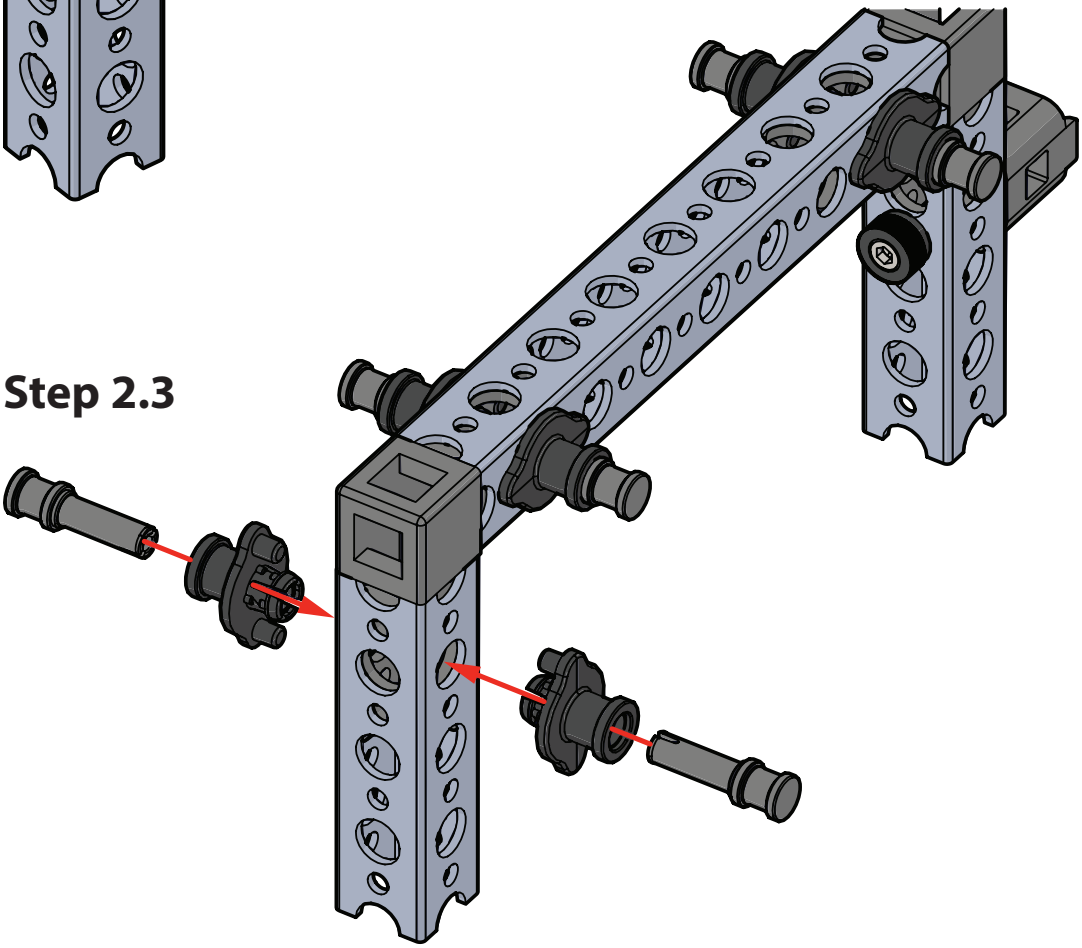
Step 2.1



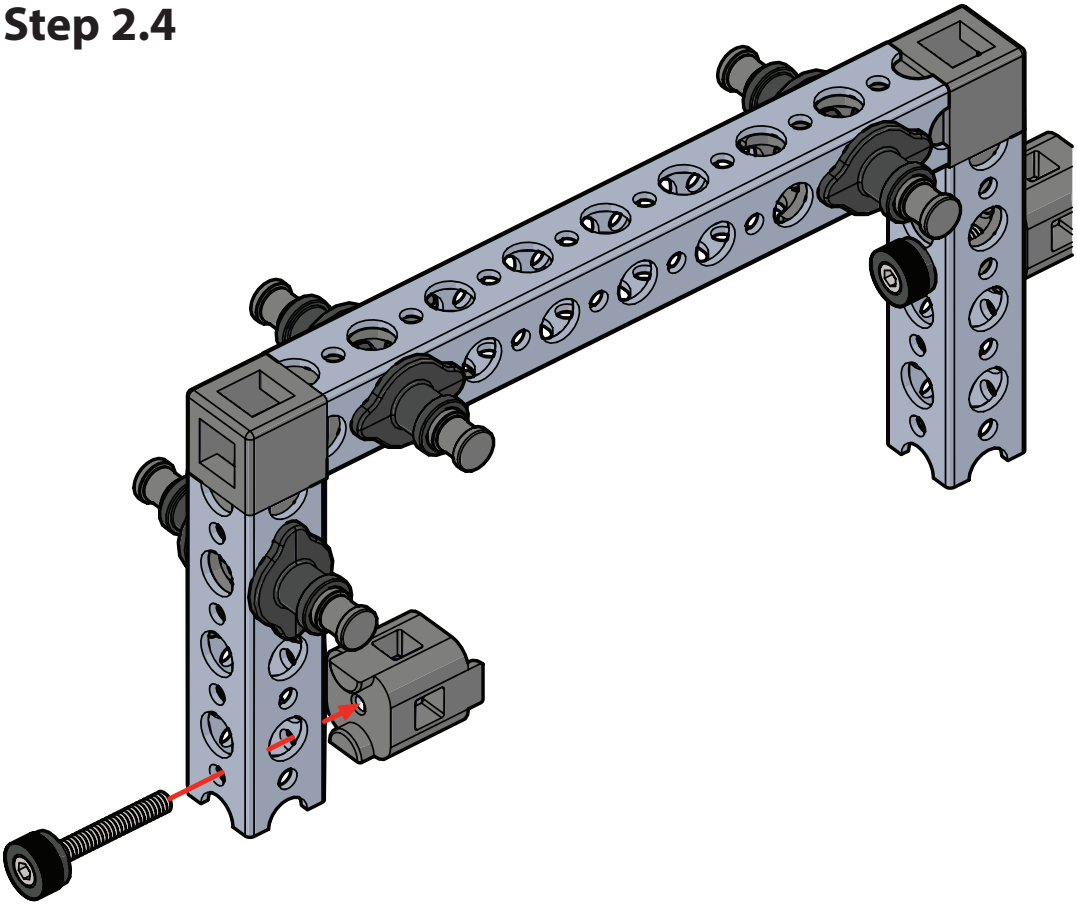
Step 2.2



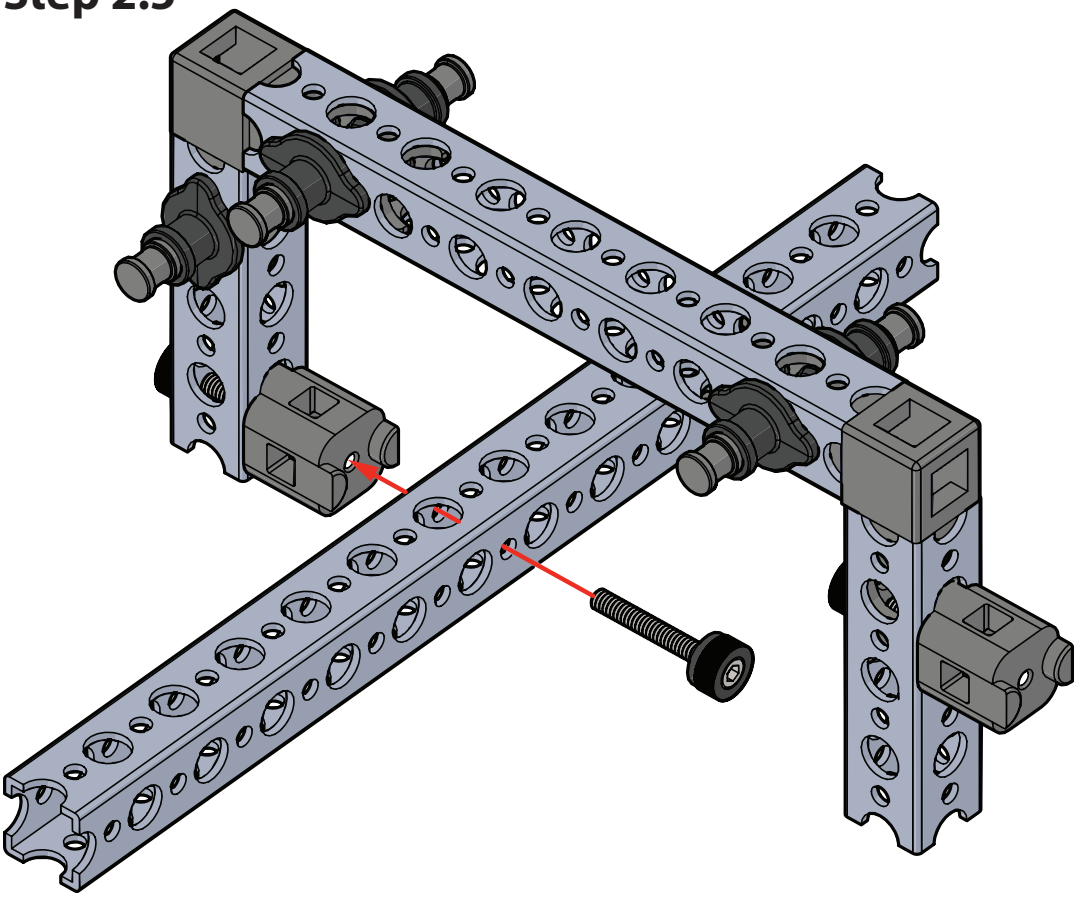
Step 2.3



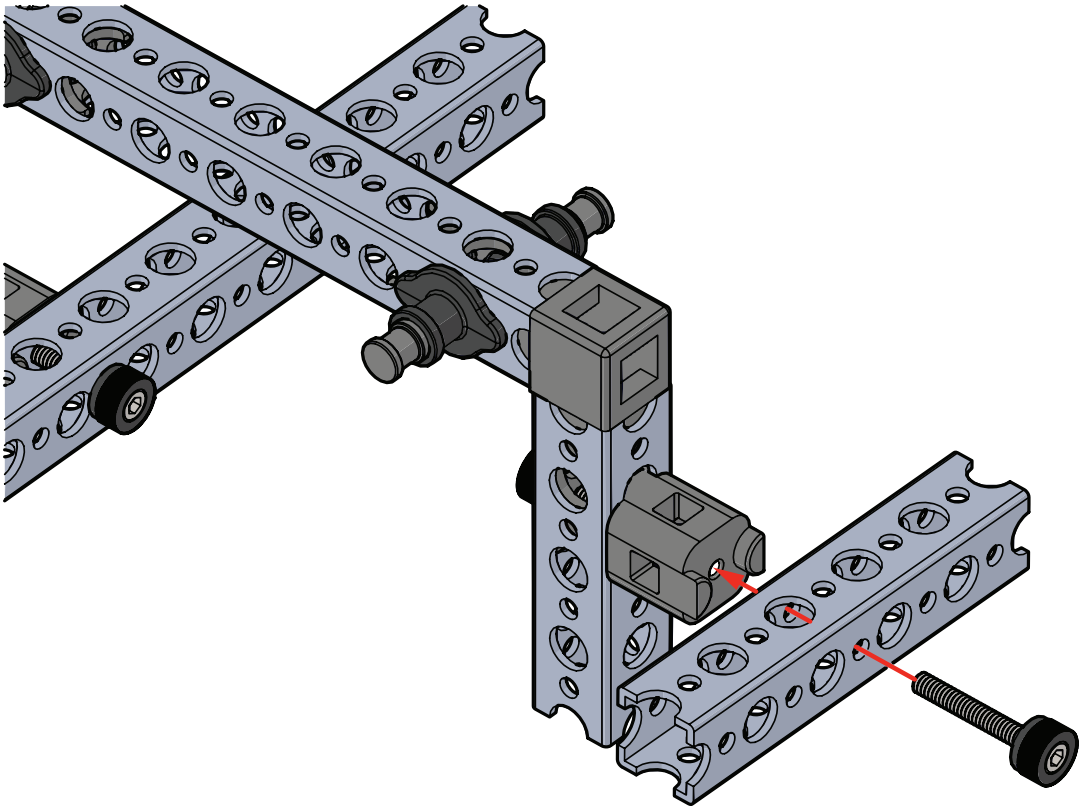
Step 2.4



Step 2.5

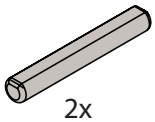


Step 2.6



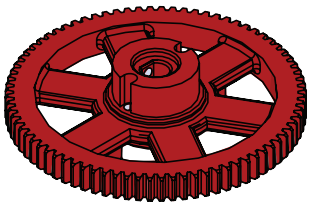
Step 3

Parts Needed



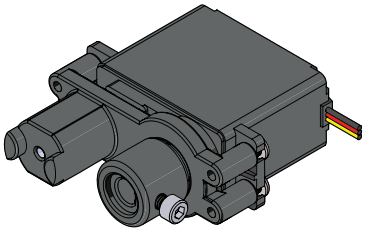
2x
40 mm Steel Axle 40226

4x
8 mm x 6 mm Bronze Bushing 40227

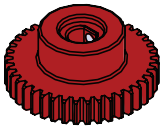


1x
80-Tooth Plastic Gear 40224

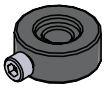
1x
Thumbscrew 40323



1x
Continuous Rotation Servo Motor 40379 with Servo Mounting Bracket 40232 (Assembly instructions on pages 14-15.)

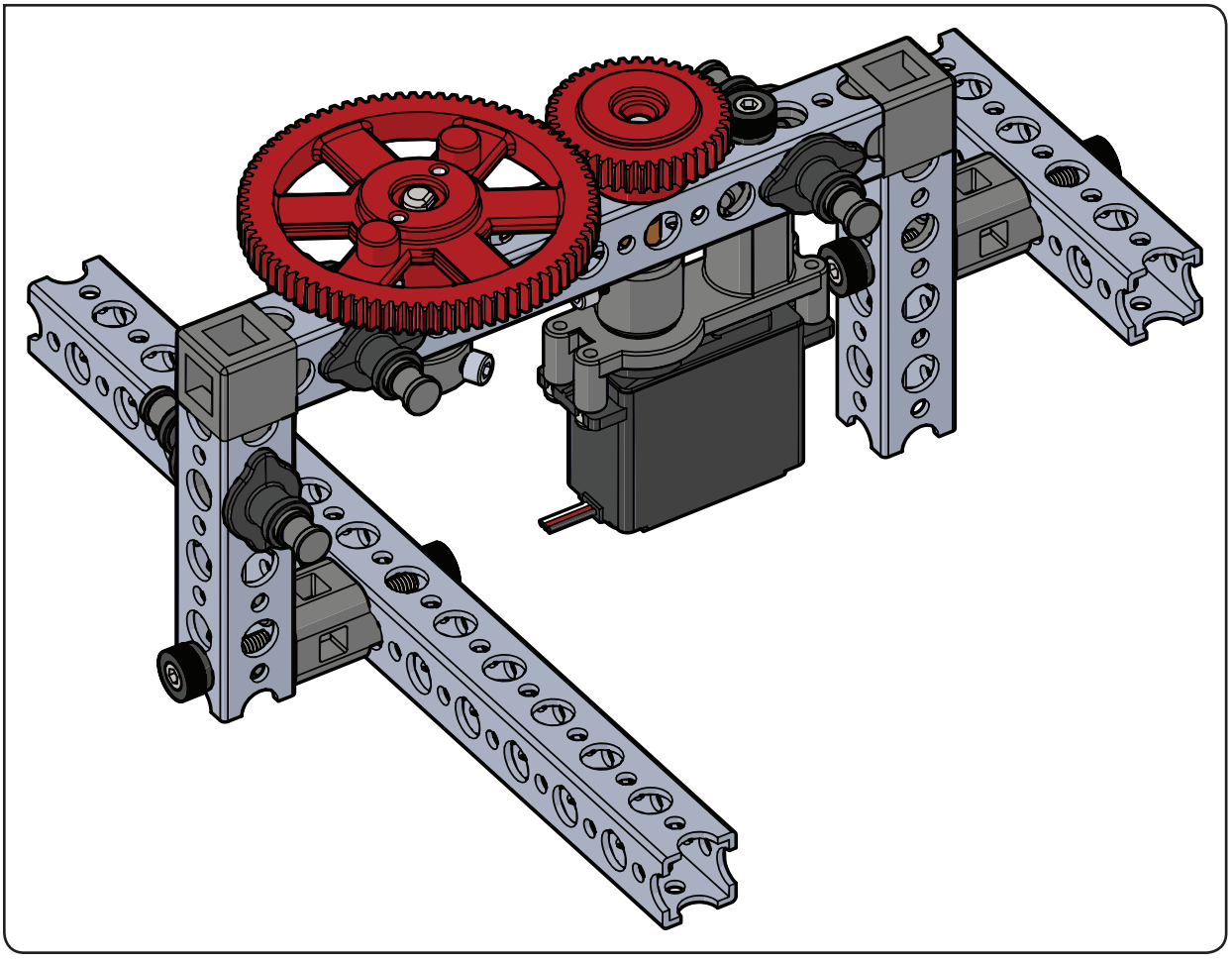


1x
40-Tooth Plastic Gear 40223

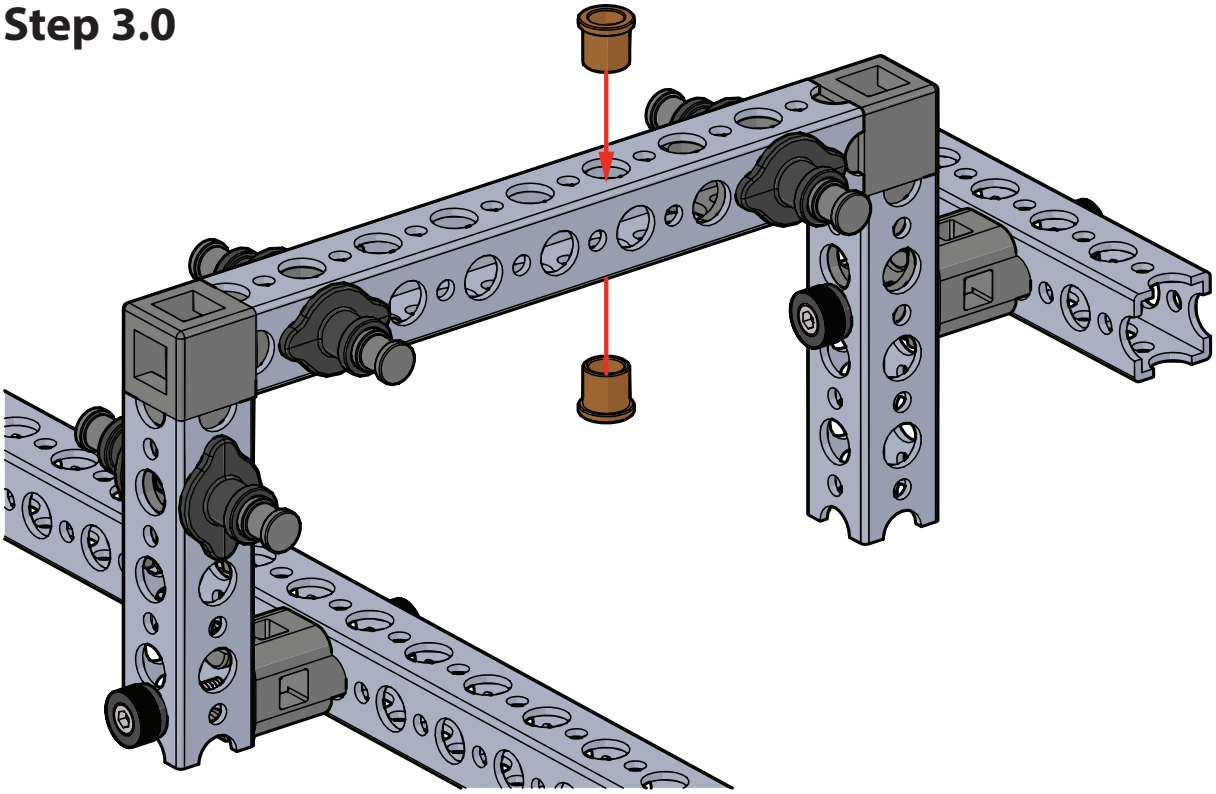


1x
D-Shaft Set Collar 40229

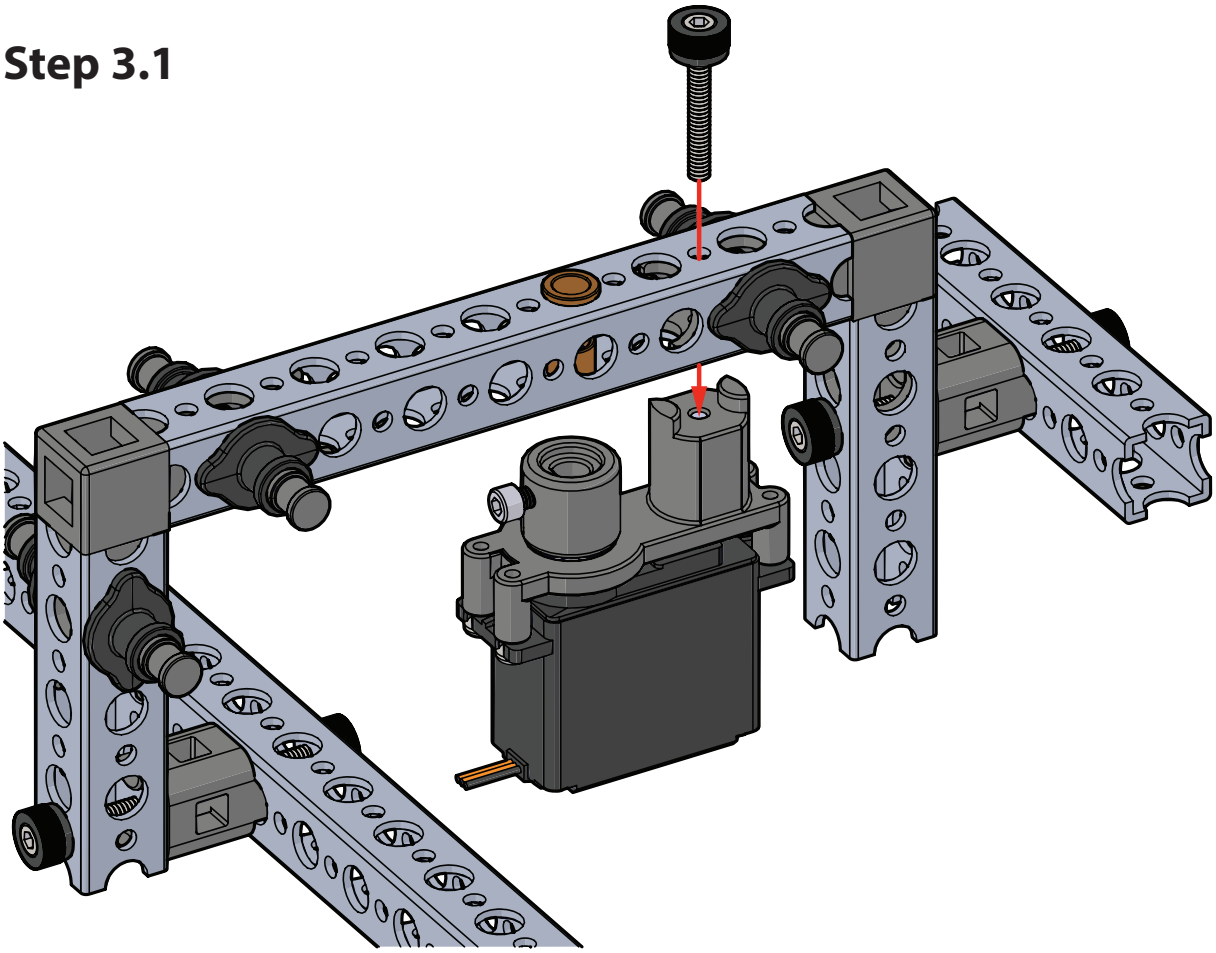
Partial assembly should look like this.



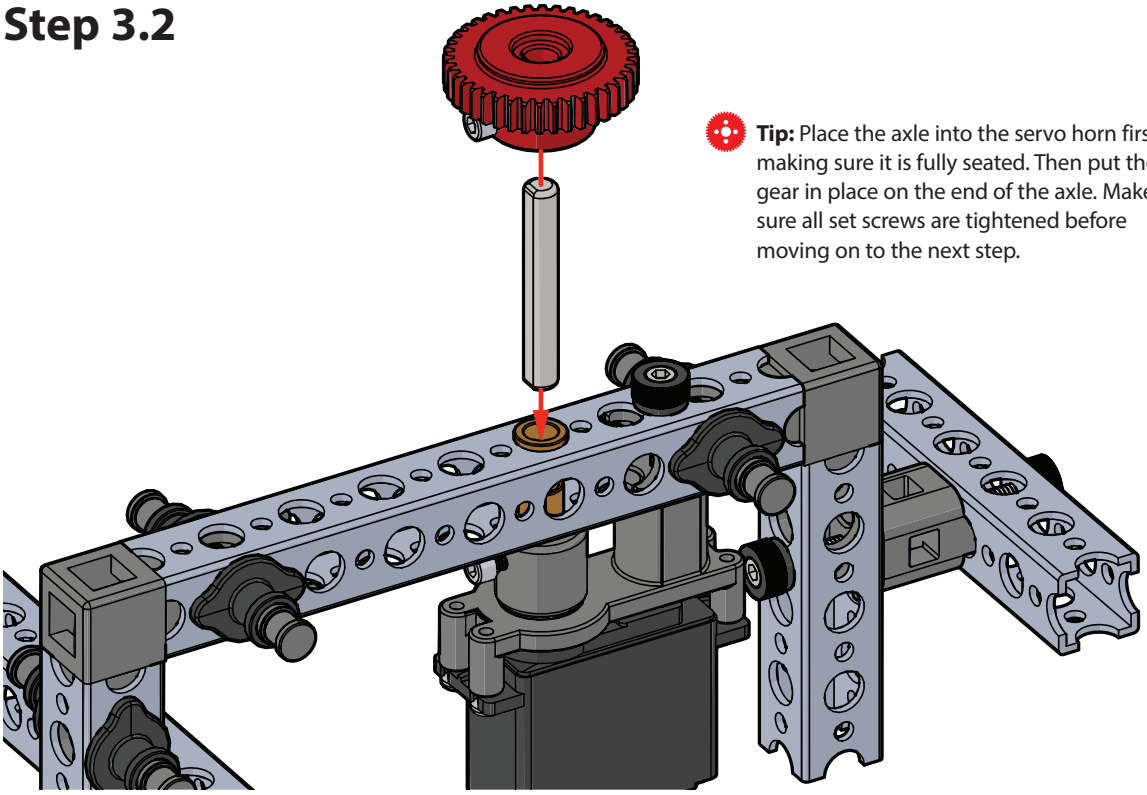
Step 3.0



Step 3.1

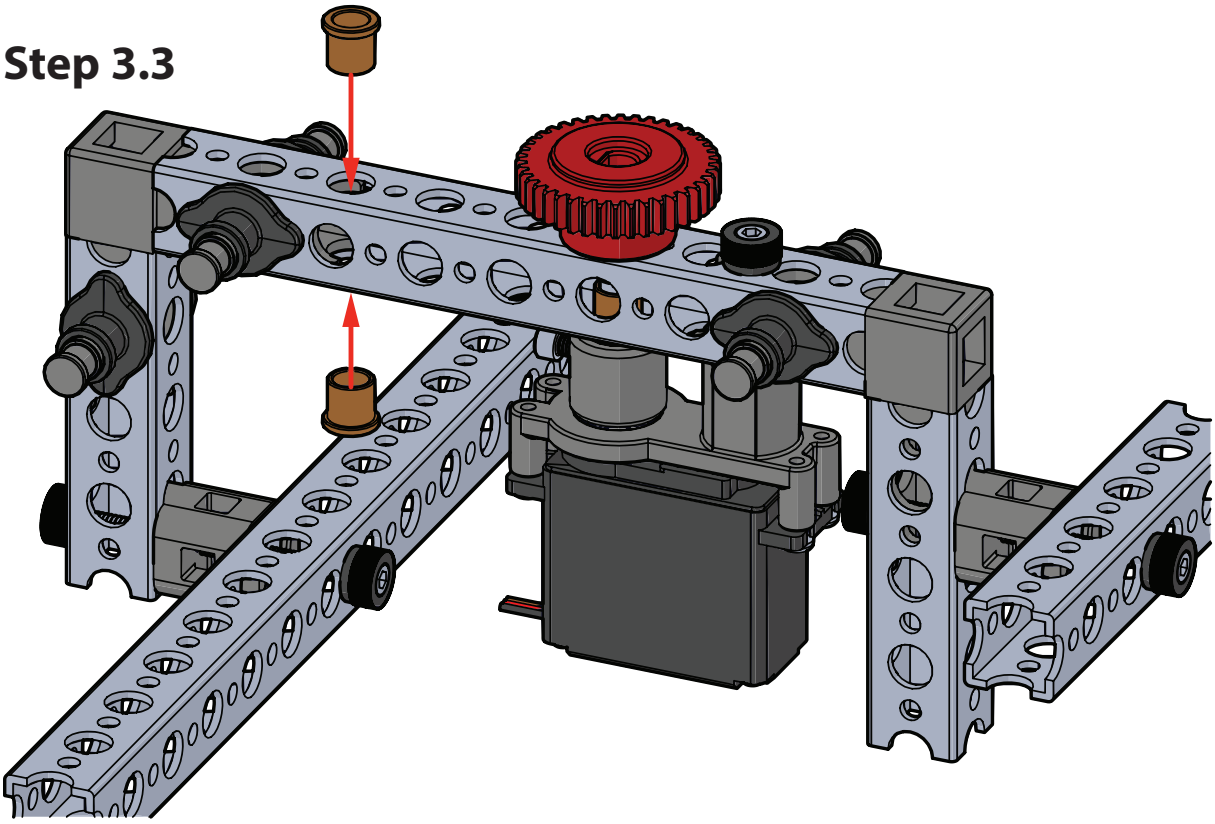


Step 3.2

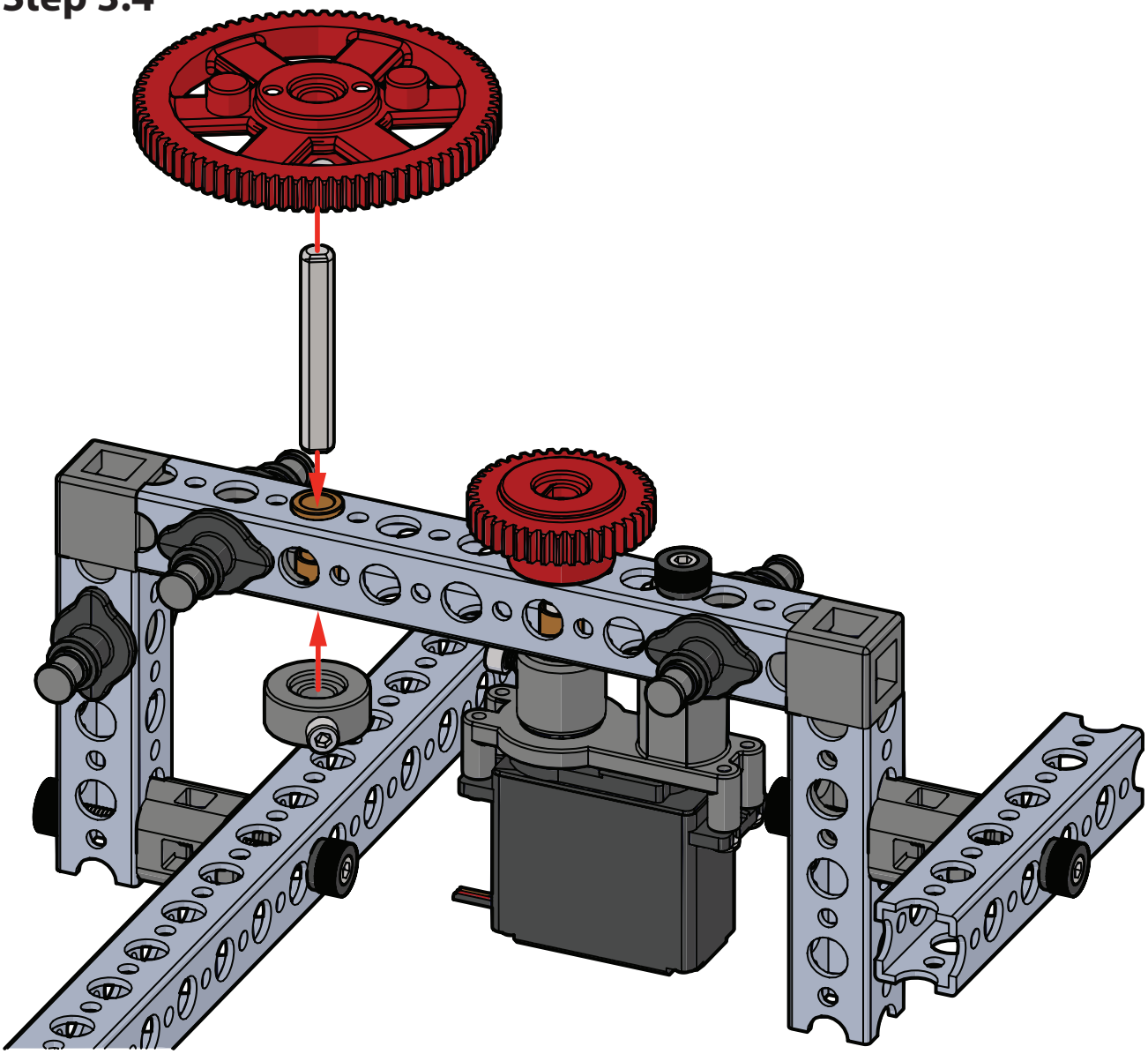


Tip: Place the axle into the servo horn first, making sure it is fully seated. Then put the gear in place on the end of the axle. Make sure all set screws are tightened before moving on to the next step.

Step 3.3

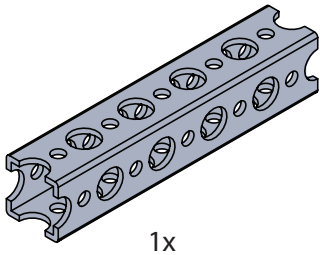


Step 3.4

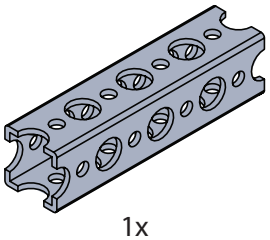


Step 4

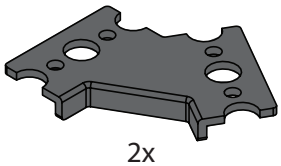
Parts Needed



1x
5-Hole Square Beam
40202



1x
4-Hole Square Beam
40201

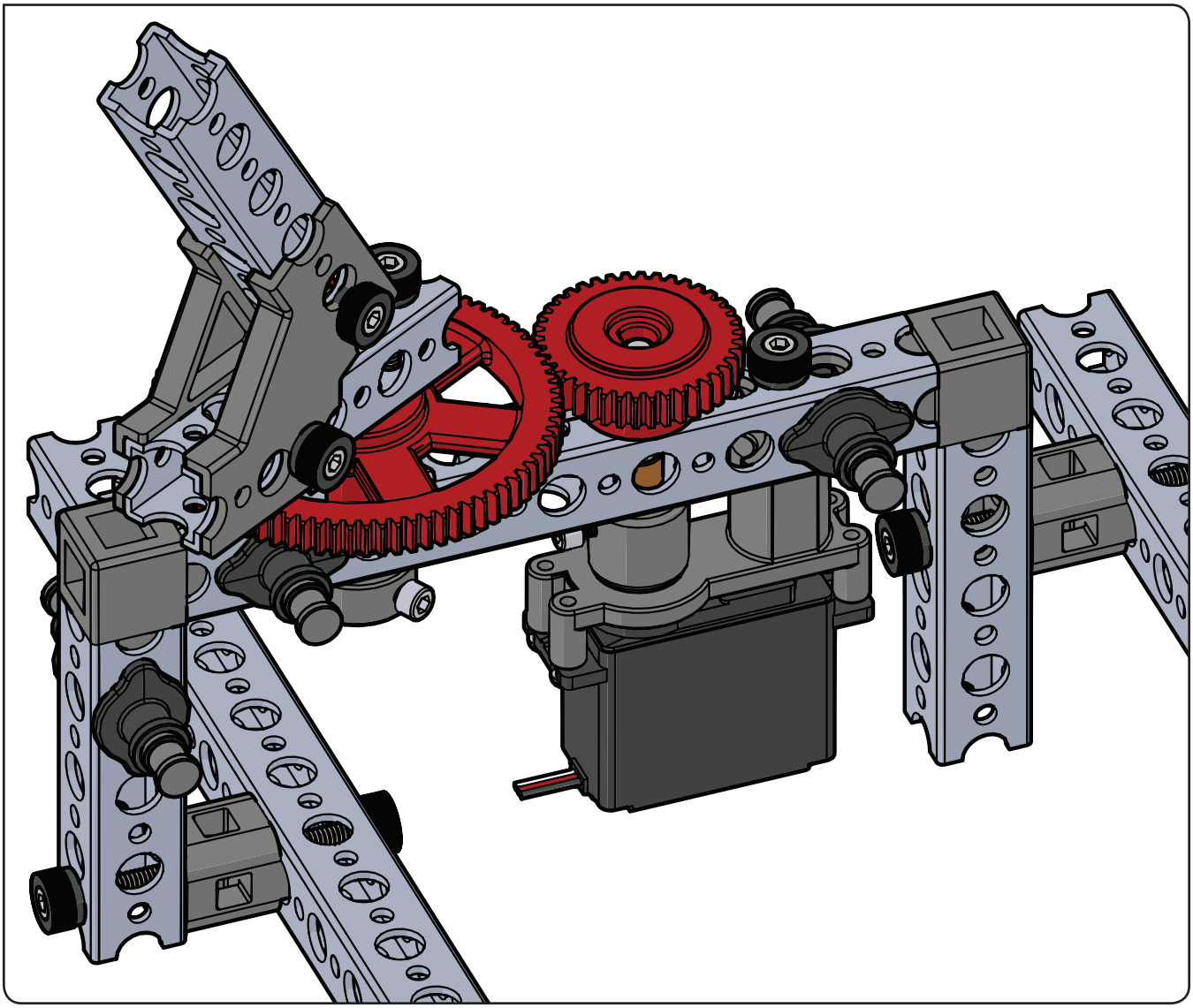


2x
60-Degree Beam Bracket
40209

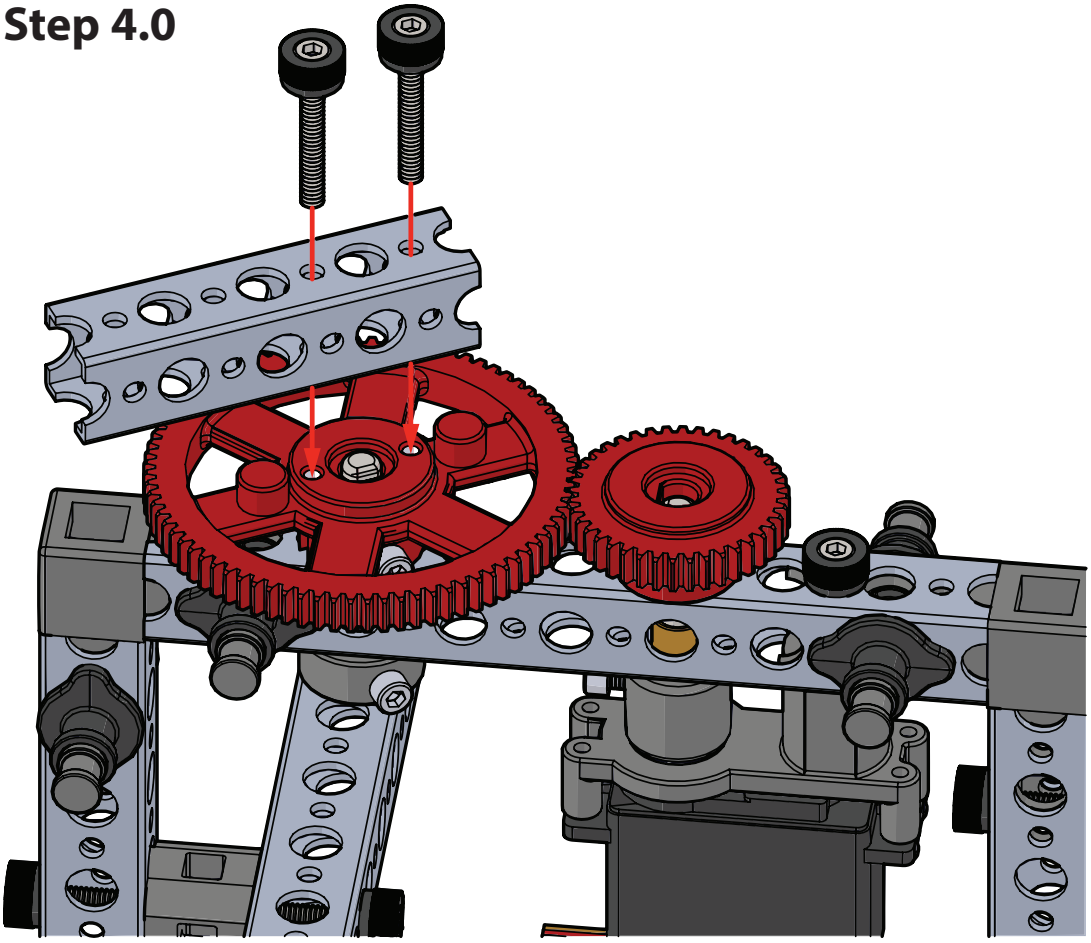
2x
Wing Nut 40221

4x
Thumbscrew 40323

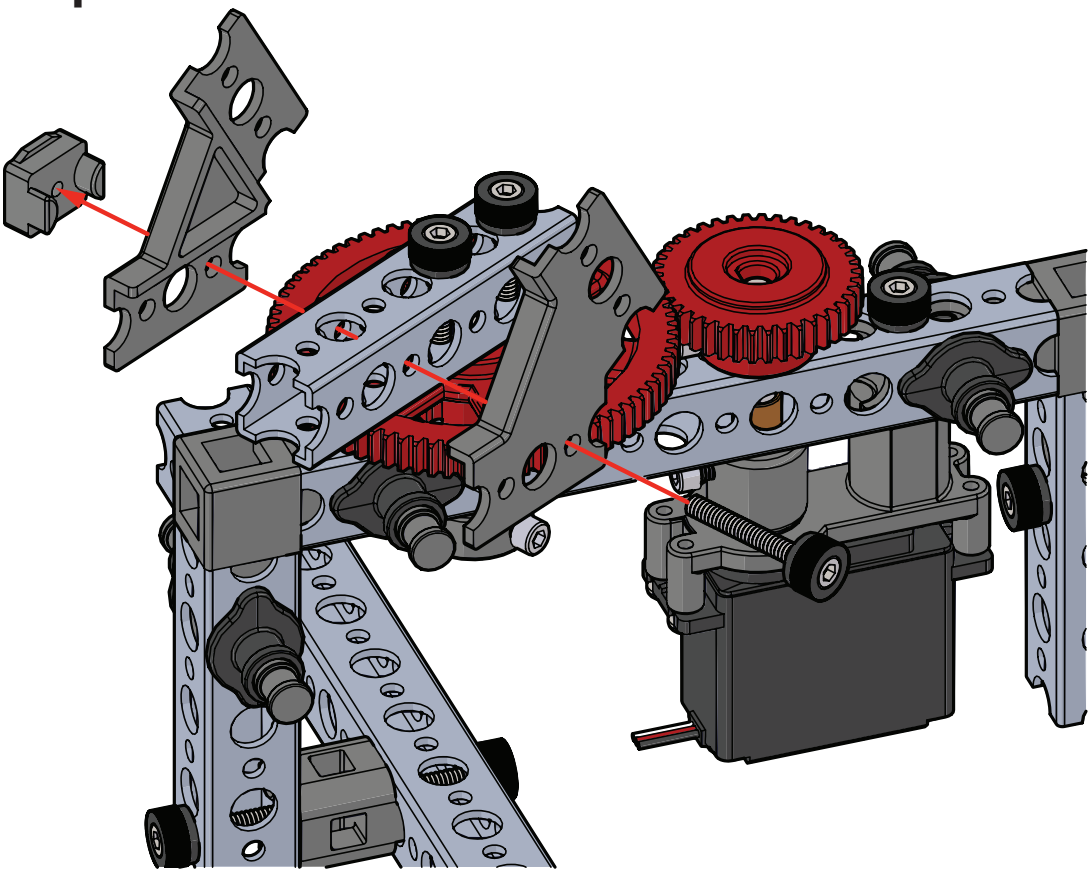
Partial assembly should look like this.



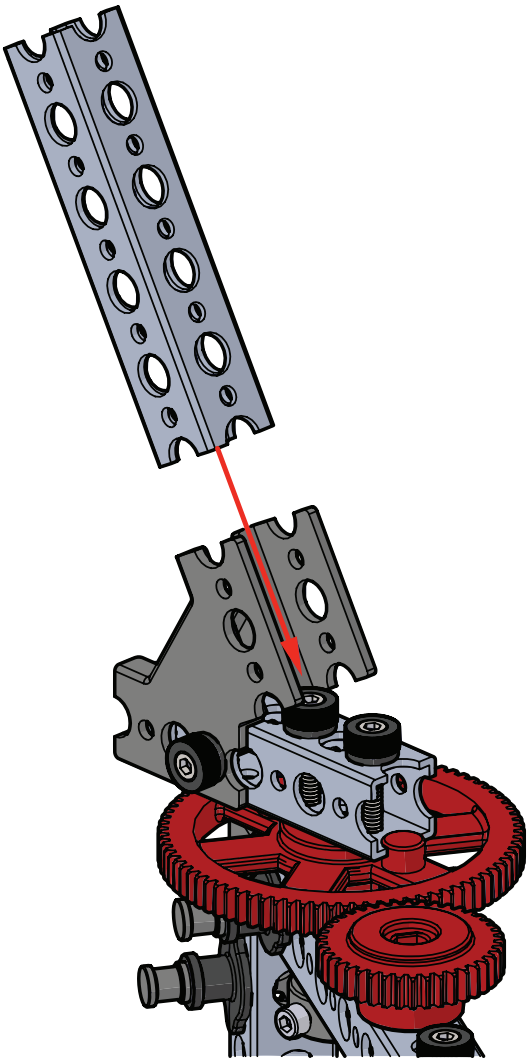
Step 4.0



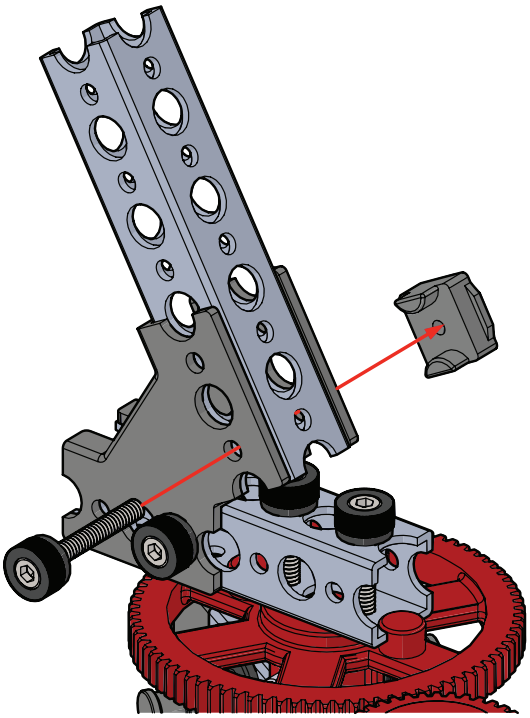
Step 4.1



Step 4.2

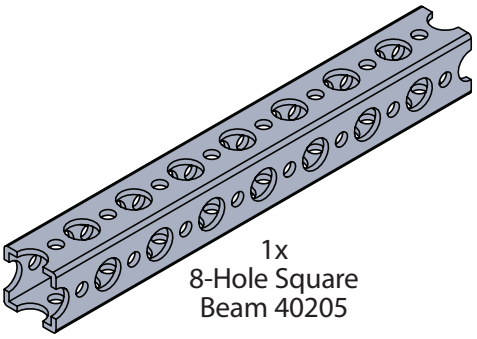


Step 4.3

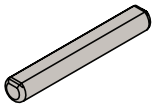


Step 5

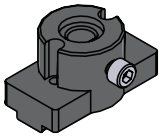
Parts Needed



1x
8-Hole Square
Beam 40205



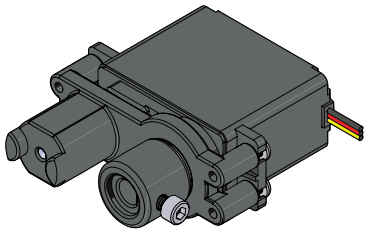
1x
40 mm Steel Axle
40226



1x
Beam Attachment Hub
40228

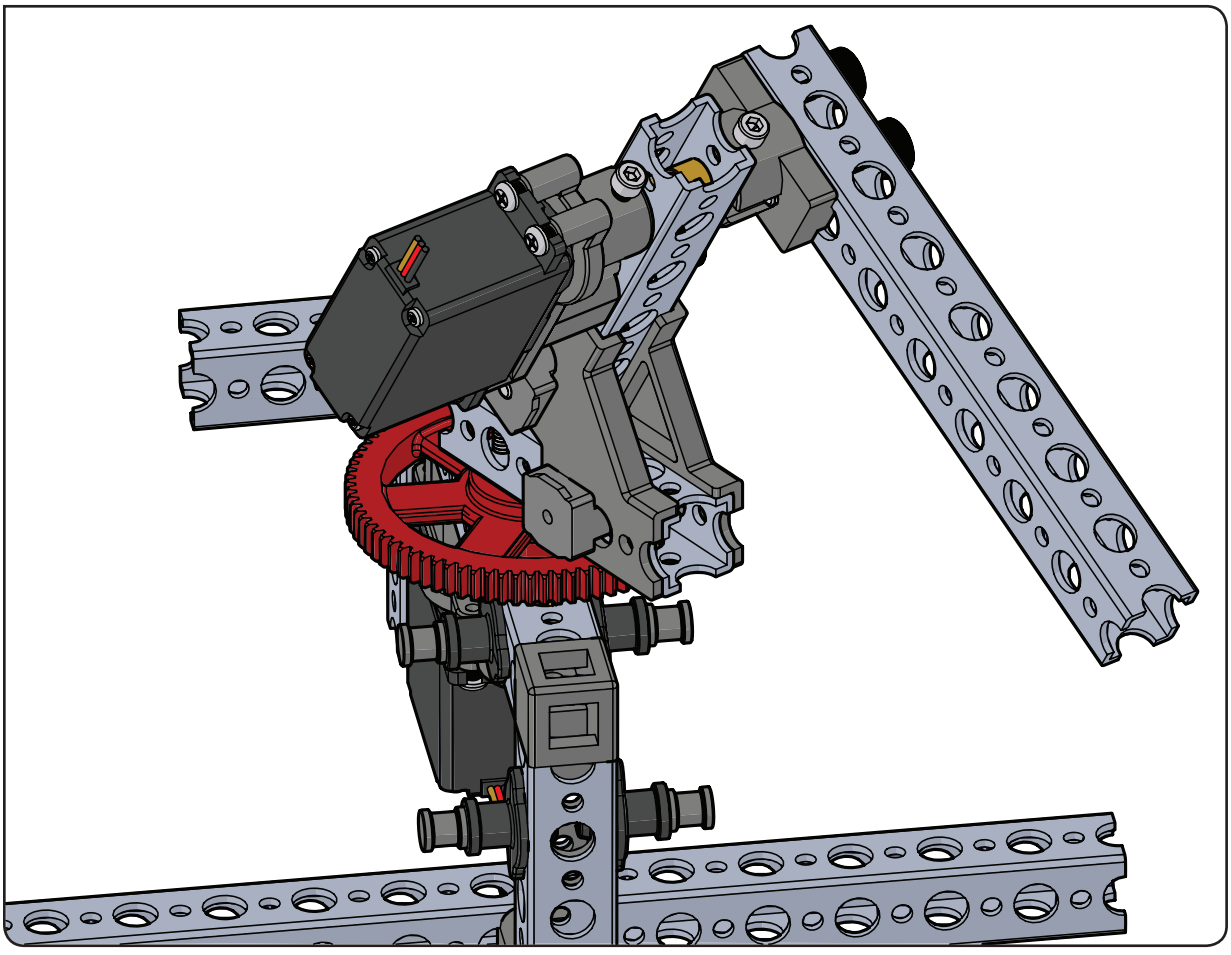
2x
8 mm x 6 mm Bronze Bushing
40227

3x
Thumbscrew 40323

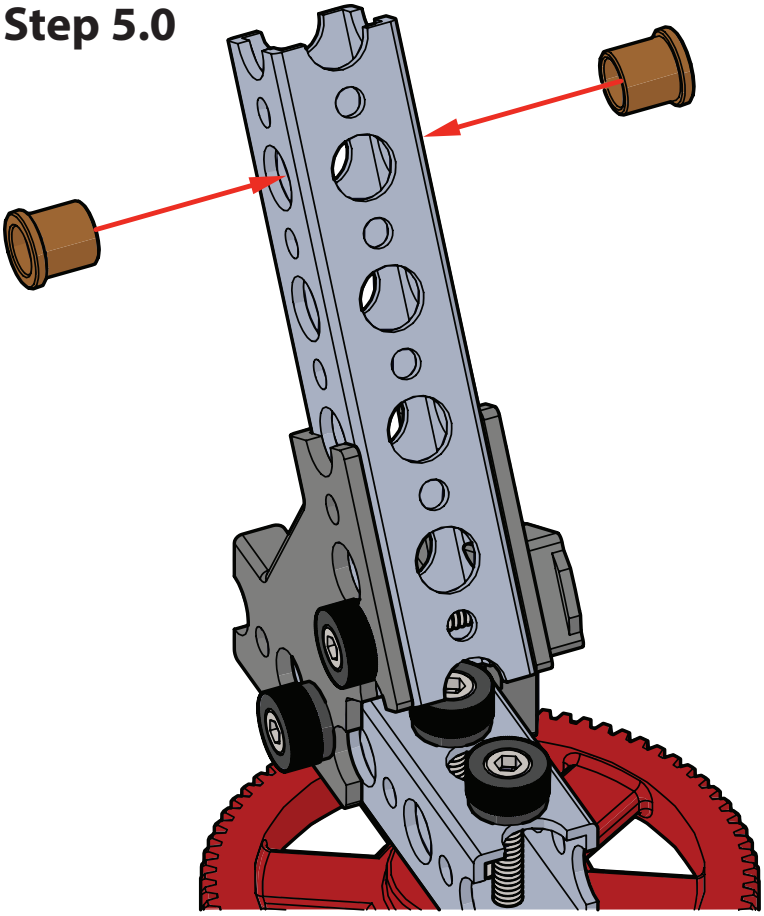


1x
Continuous Rotation Servo Motor 40379 with
Servo Mounting Bracket 40232 (Assembly
instructions on pages 14-15.)

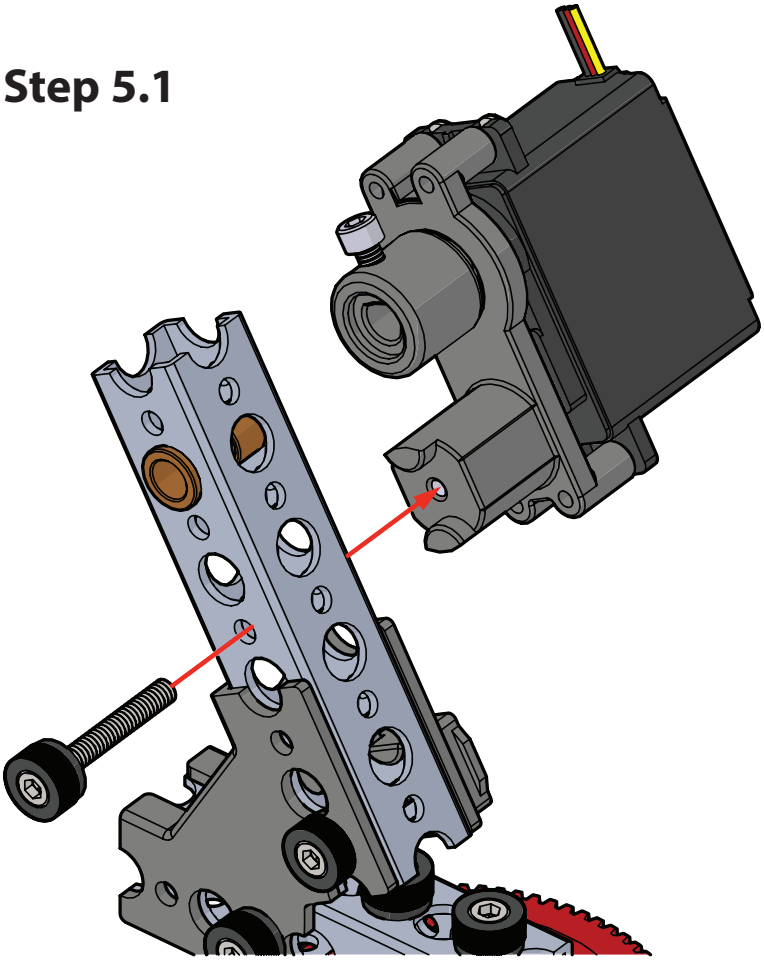
Partial assembly should look like this.



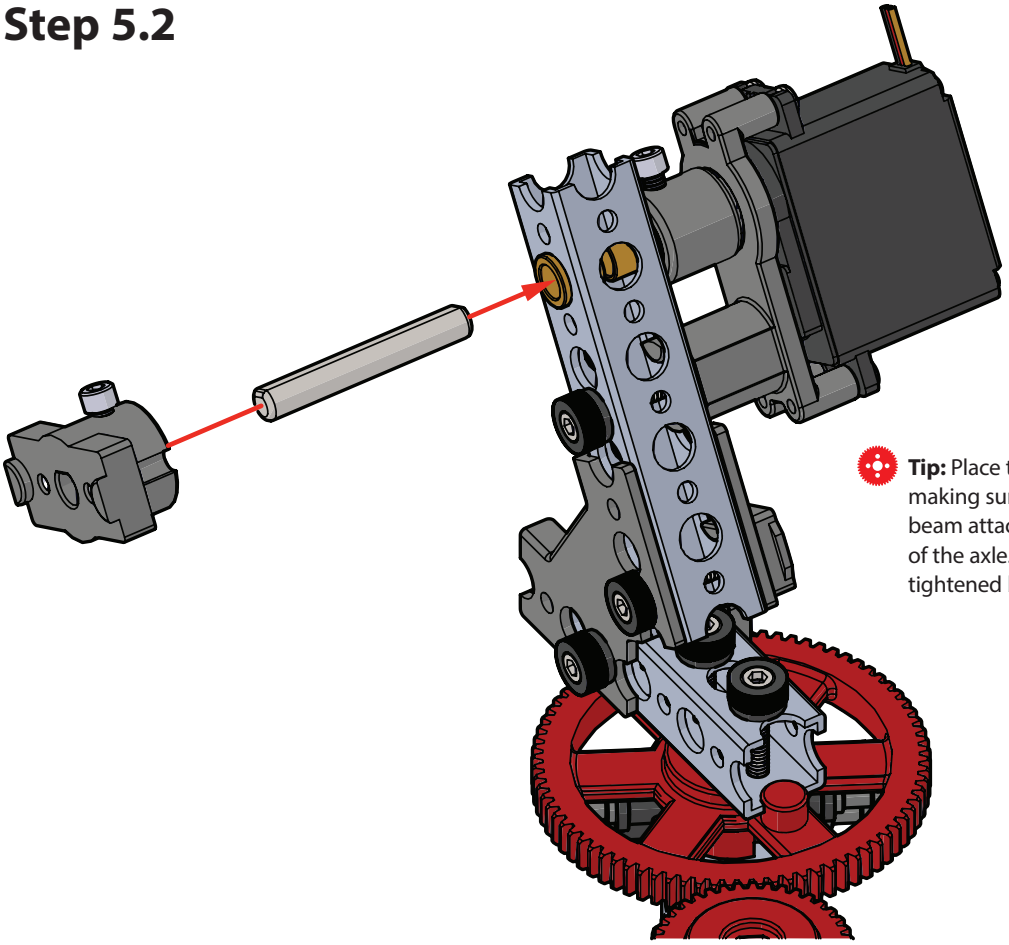
Step 5.0



Step 5.1

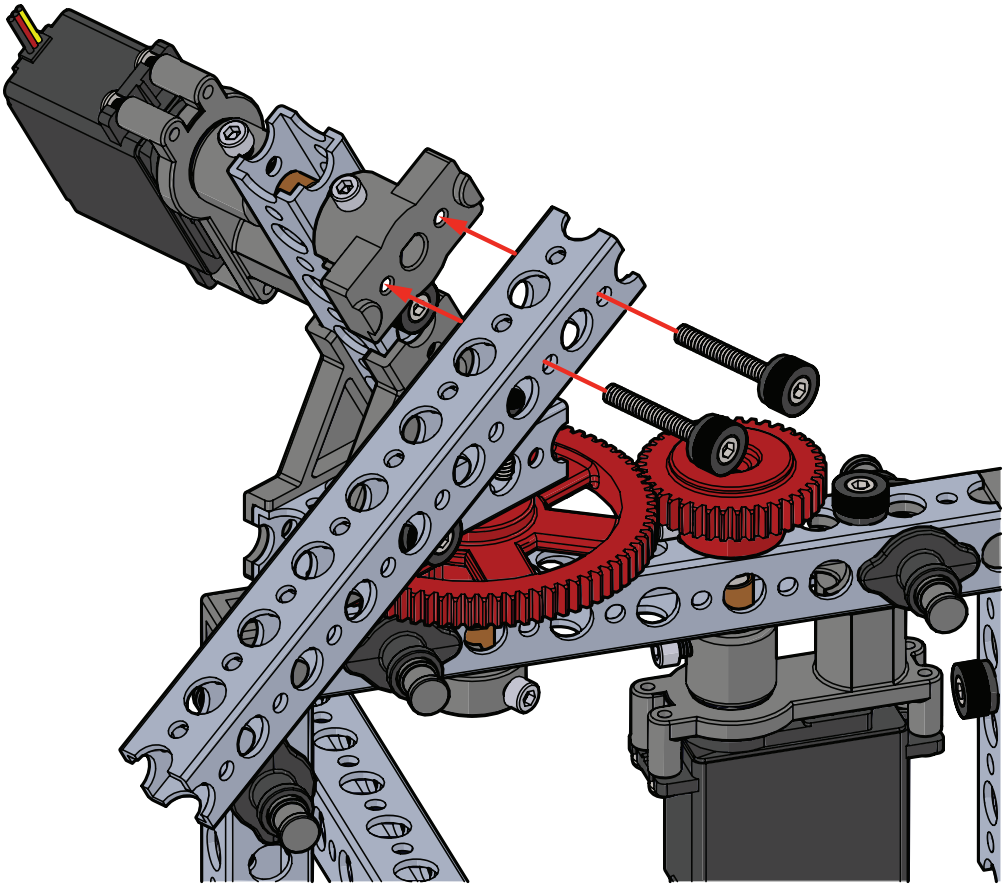


Step 5.2



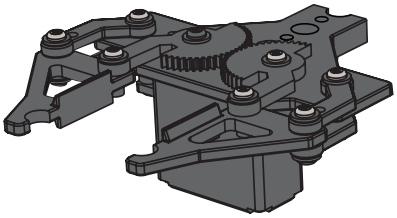
Tip: Place the axle into the servo horn first, making sure it is fully seated. Then put the beam attachment hub in place on the end of the axle. Make sure all set screws are tightened before moving on to the next step.

Step 5.3



Step 6

Parts Needed

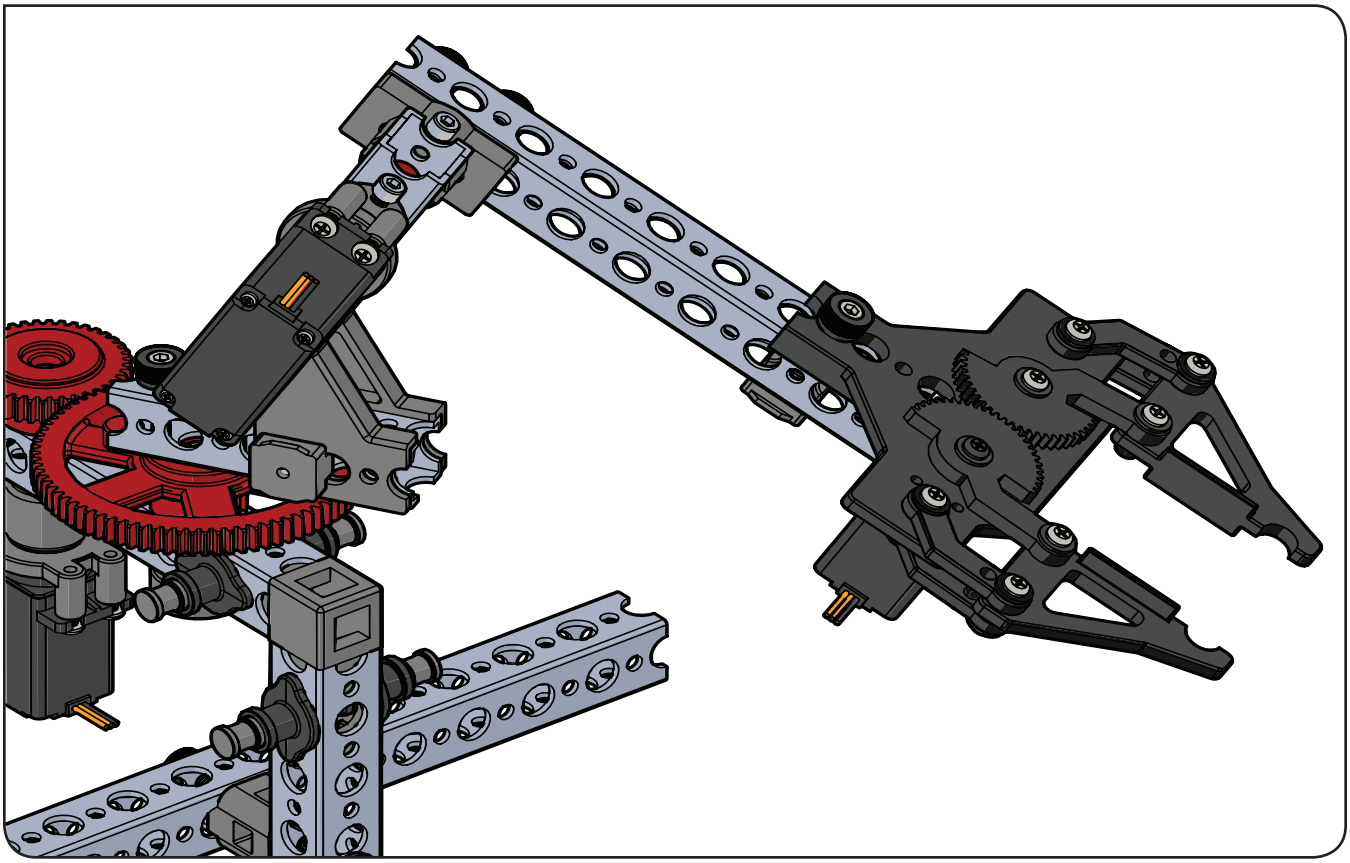


1x
Gripper Kit 40234

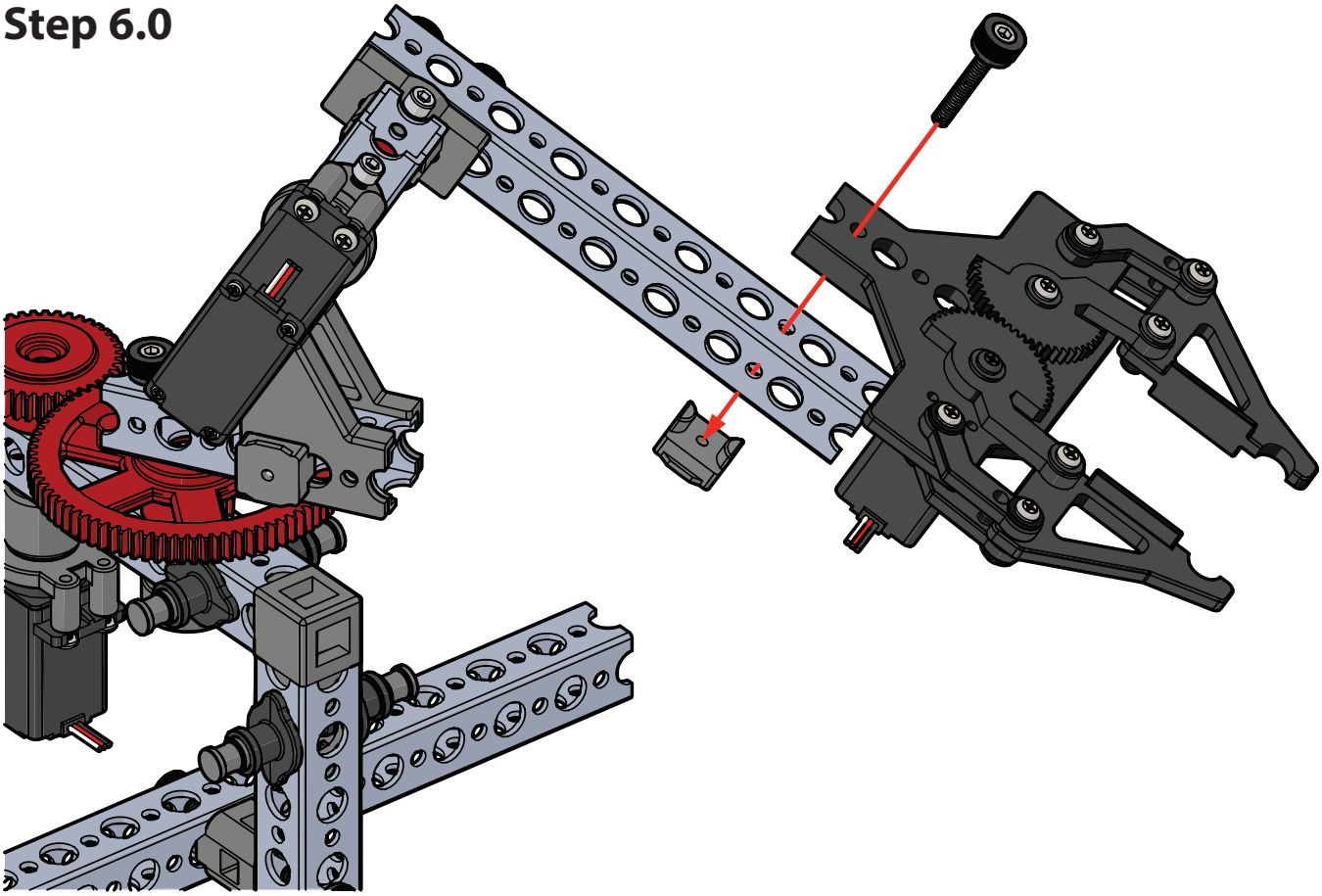
1x
Wing Nut 40221

1x
Thumbscrew 40323

Partial assembly should look like this.

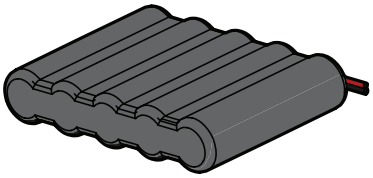


Step 6.0

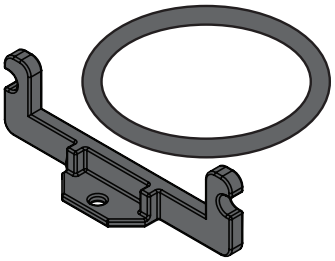


Step 7

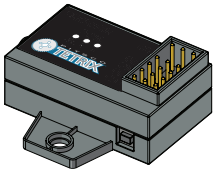
Parts Needed



1x
6 V NiMH Battery Pack 40235



2x
Battery Mount Bracket 40236

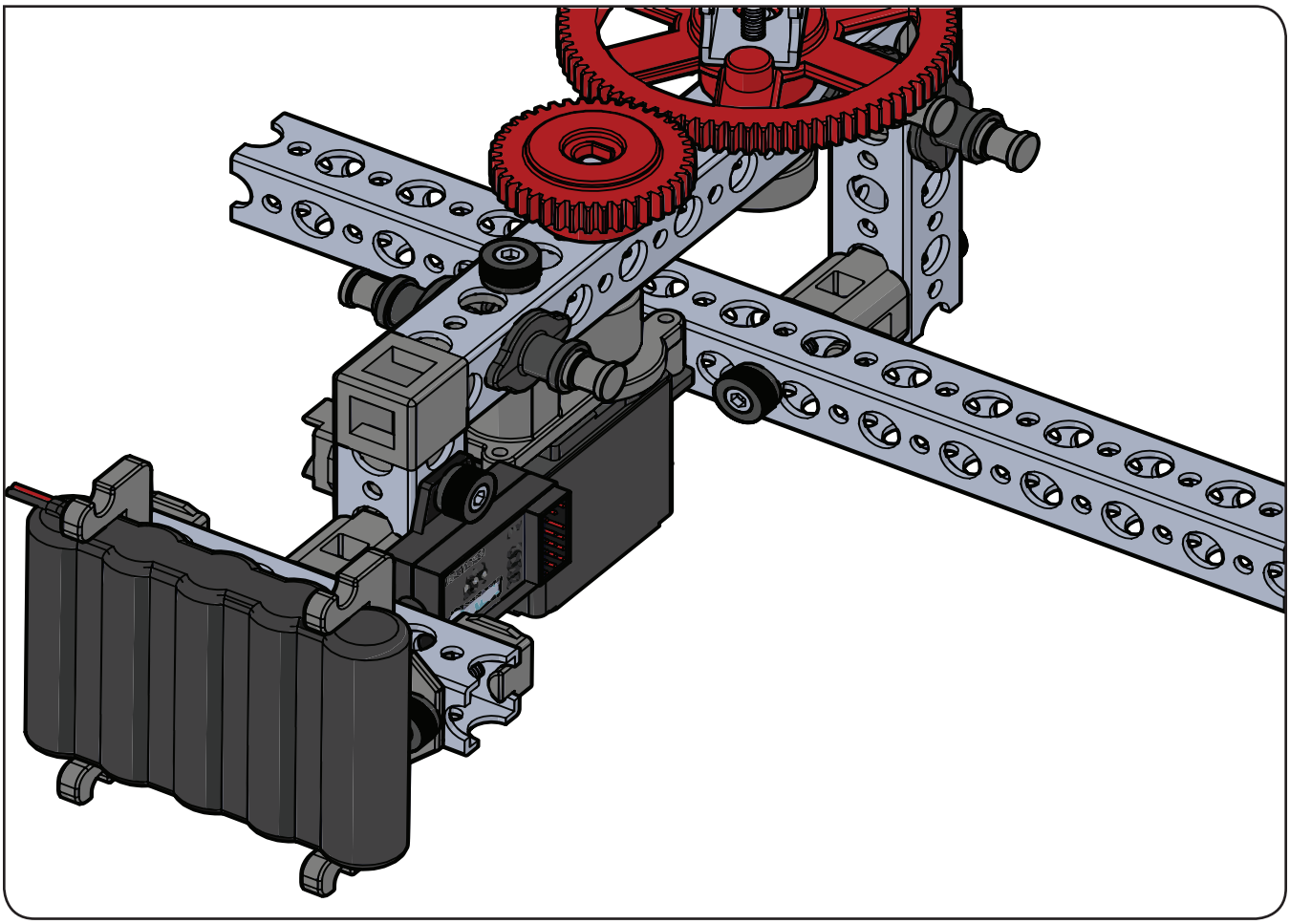


1x
4-Channel Wireless Receiver
from Wireless Joystick Gamepad
System 40239

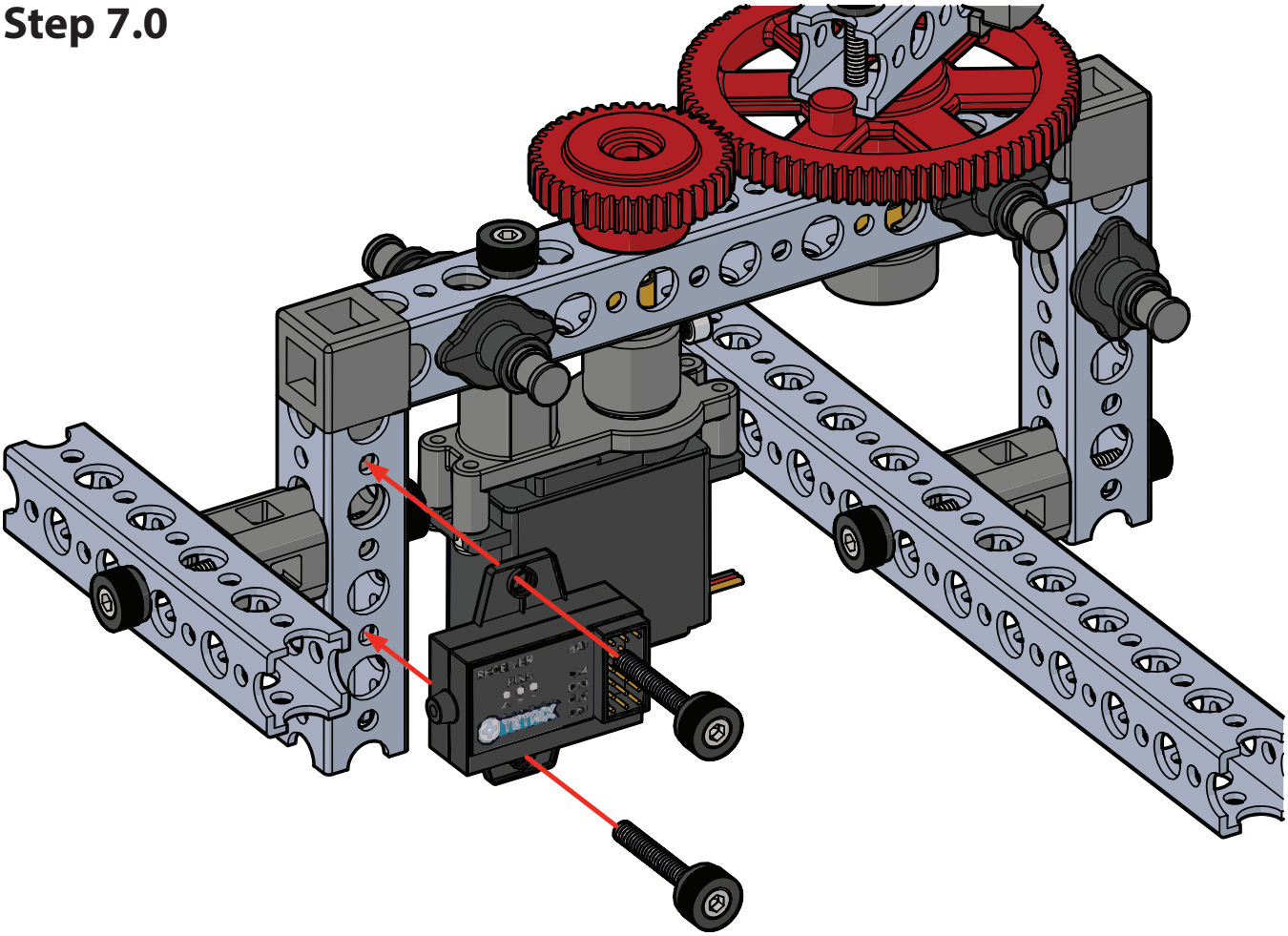
4x
Wing Nut 40221

4x
Thumbscrew 40323

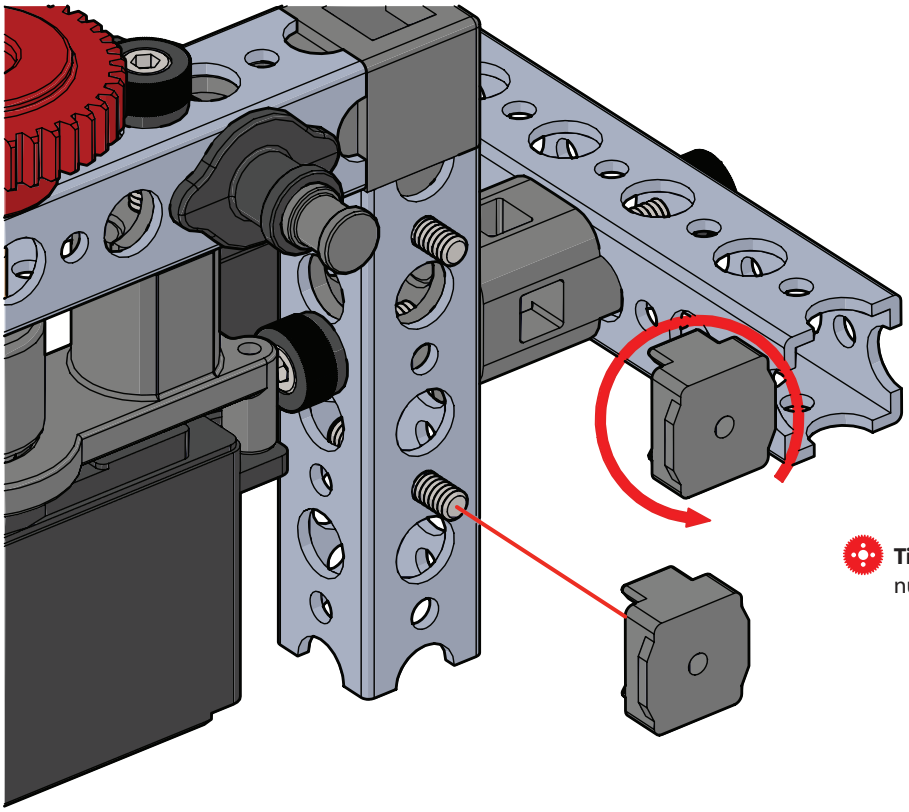
Partial assembly should look like this.



Step 7.0

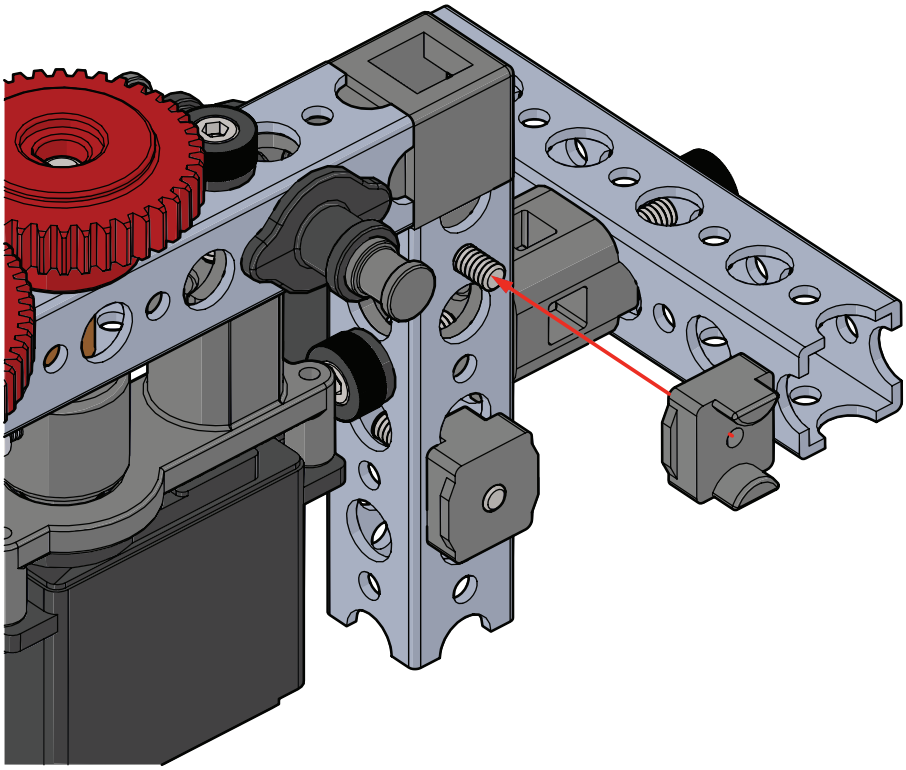


Step 7.1

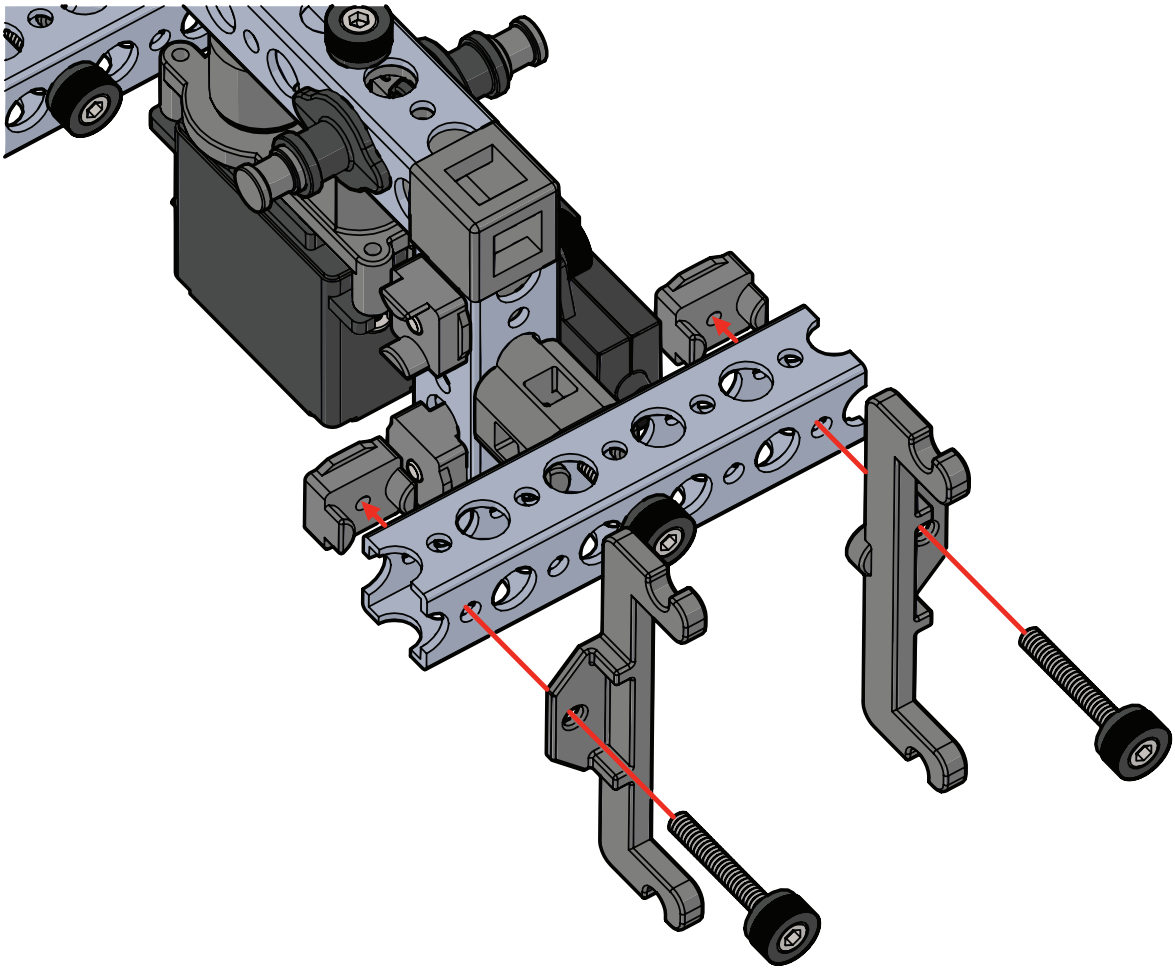


Tip: Notice the different orientation of the wing nut to properly tighten the top thumbscrew.

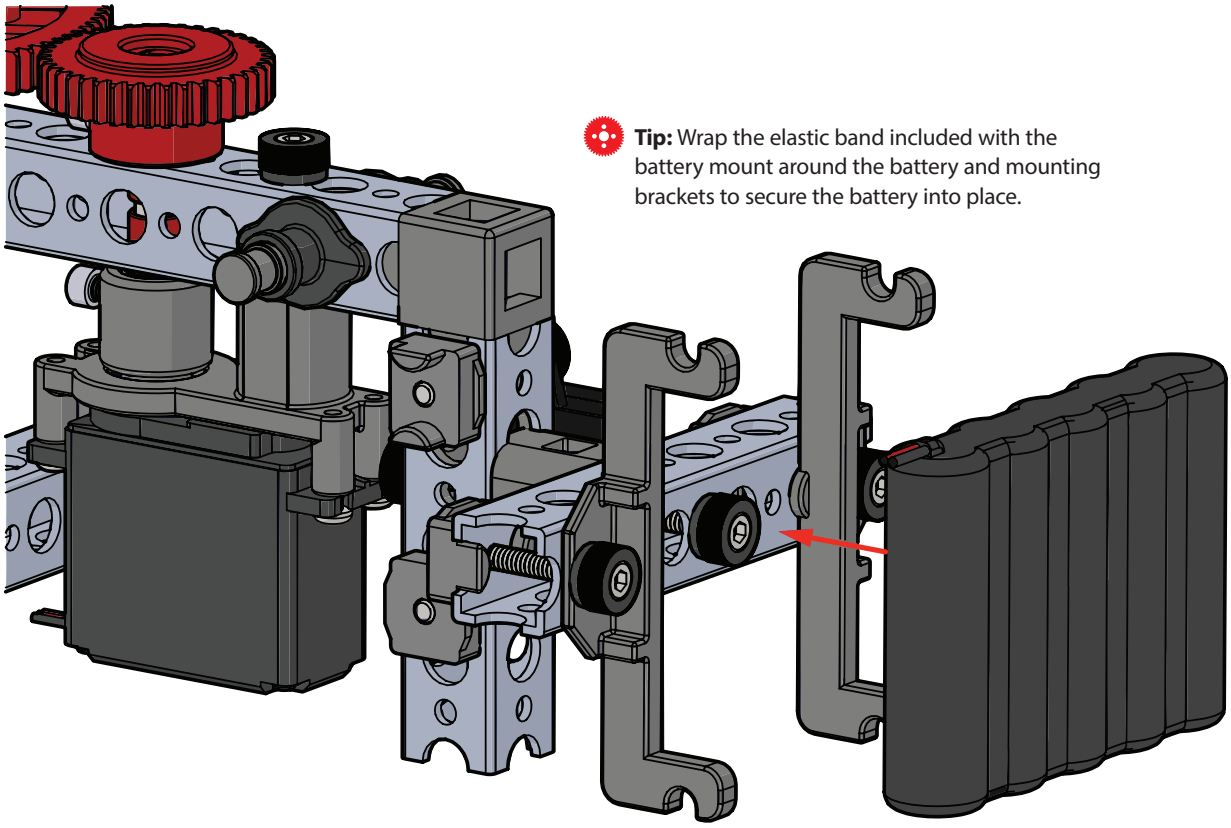
Step 7.2



Step 7.3

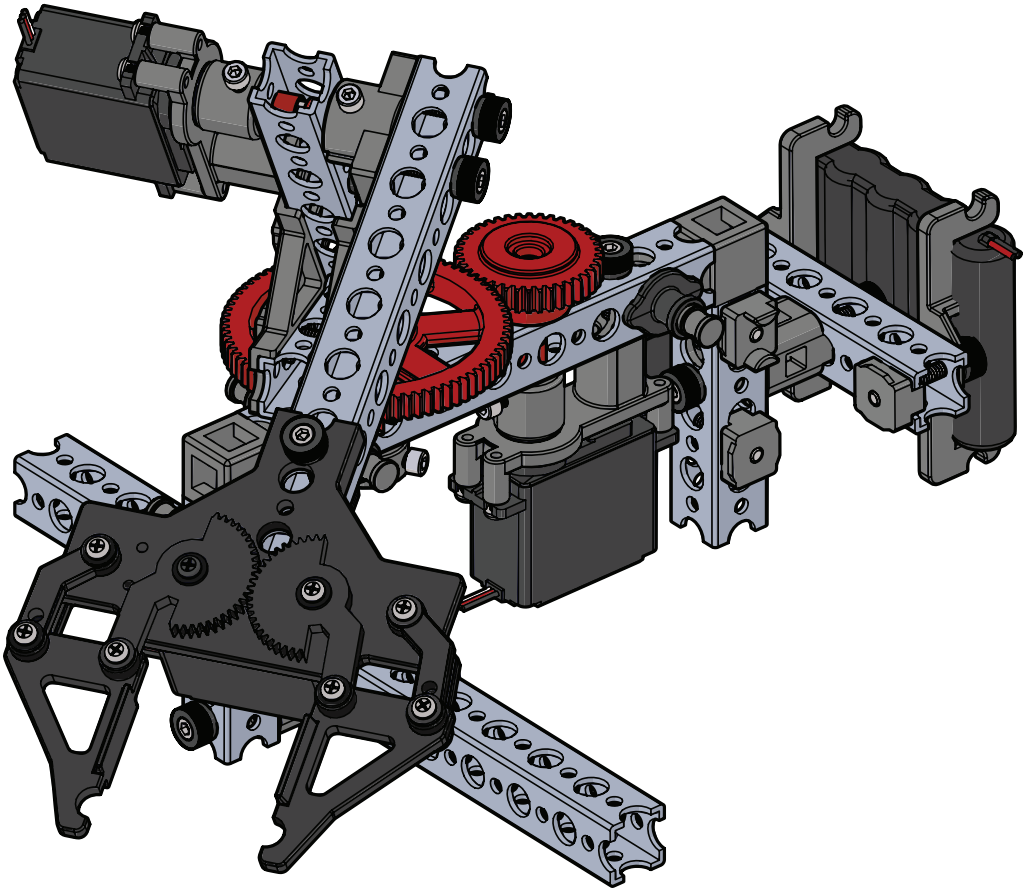


Step 7.4



Tip: Wrap the elastic band included with the battery mount around the battery and mounting brackets to secure the battery into place.

Finished assembly.



TETRIX PRIME Pickee Bot Activities

Final Connections:

After you've installed the battery with the battery mount bracket, you are ready to connect the servo motors to the wireless receiver. Remember to reference page 13, which shows a typical wiring diagram for connecting the battery, switch, and wireless receiver.

Connect the battery to the BAT connection on the receiver. Connect the continuous rotation servos to Channel 1 and Channel 2. Connect the standard servo motor to Channel 4. Secure the wires so they do not become entangled in any moving parts. Turn on the wireless joystick gamepad system and test the operation of the Pickee Bot. If the motion does not correspond with the joystick movement, use a screwdriver to change the position of the DIP switches. If necessary, use the trimmer controls to stop all movement of the servos when the joystick is in the neutral position.

Don't forget to reference page 12 for complete instructions on setting up the wireless joystick gamepad system and configuring input to personal preferences.

Sample Activities:

After you complete the construction of the Pickee Bot, it is time to have some fun. Practice moving the Pickee Bot and operating the gripper to familiarize yourself with the way it operates. Use caution not to entangle the wires when rotating the gripper boom. Reverse your motion to avoid damaging the wires.

Activity 1

- Assemble the Ball Rack. Refer to pages 117-119 for instructions on how to assemble the Ball Rack. Place the Ball Rack in a position so that the Pickee's gripper is able to reach both ends and the middle holes. Place one cup to the right side of the Pickee Bot, one to the left side of the Pickee Bot, and one behind the Pickee Bot so that the Pickee's gripper is able to reach each of the cups. Place a ball on each end of the Ball Rack and one in the middle. Maneuver the Pickee's gripper to pick up a ball and place it in one of the cups. Make it a competition to see which partner is able to complete the task in the shortest amount of time.

Activity 2

- Place an inverted cup in position in front of the Pickee Bot so that the Pickee's gripper is able to reach a ball placed on the cup. Place one cup to the right side of the Pickee Bot and one to the left side of the Pickee Bot so that the Pickee's gripper is able to reach each of the cups. Place a ball on the inverted cup. Maneuver the Pickee gripper to pick up the ball and place it in one of the cups. Place another ball on the support and maneuver the Pickee to place this ball in the other cup. Make it a competition to see which partner is able to complete the task in the shortest amount of time.

Activity 3

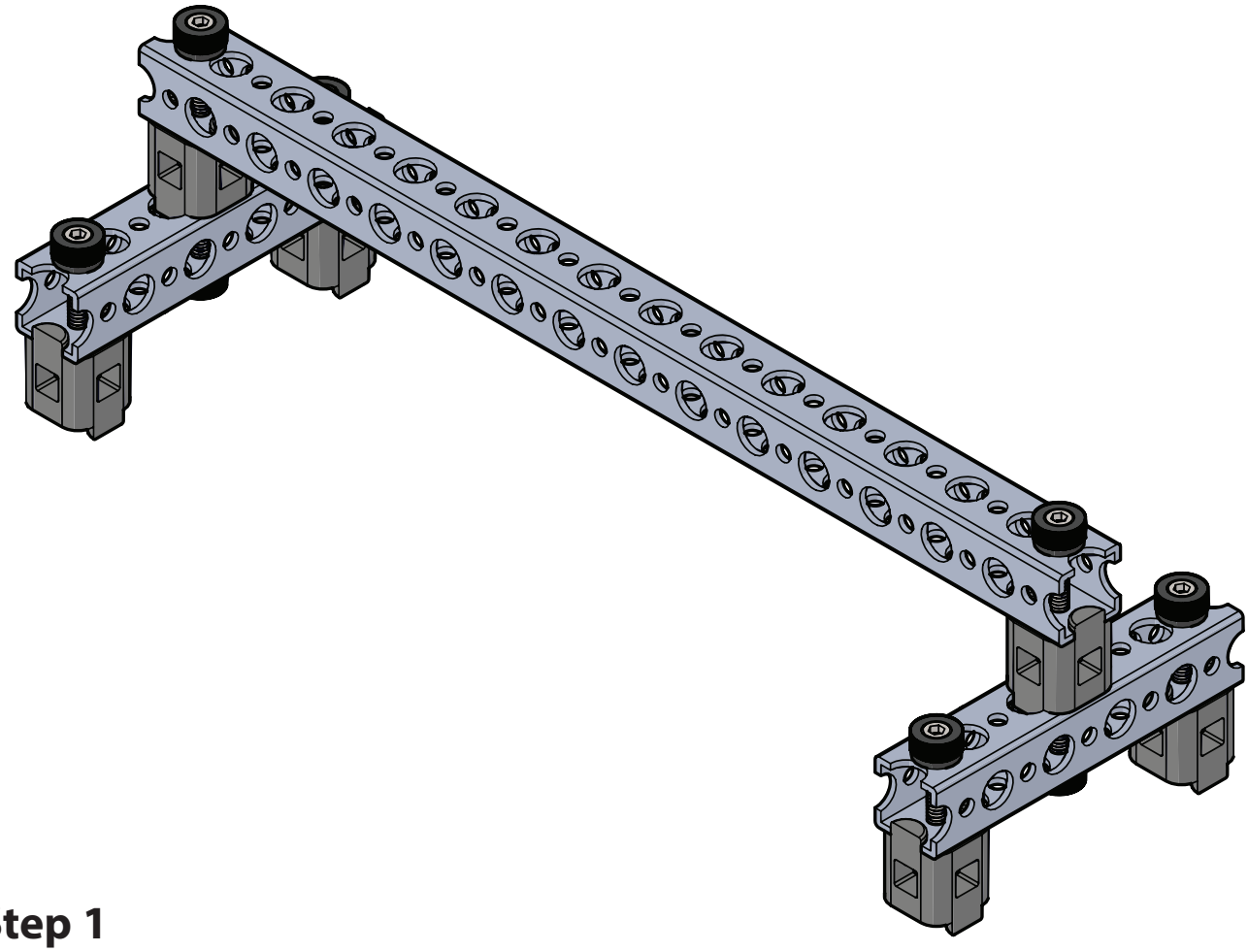
- With permission from your instructor, make modifications to improve the performance of the Pickee Bot. Some improvement ideas include eliminating the chance of wire entanglement, increasing the gripper reach distance, improving the stability, or increasing the lifting power.

Don't forget to document your efforts and remember the engineering design process.

Ball Rack Assembly

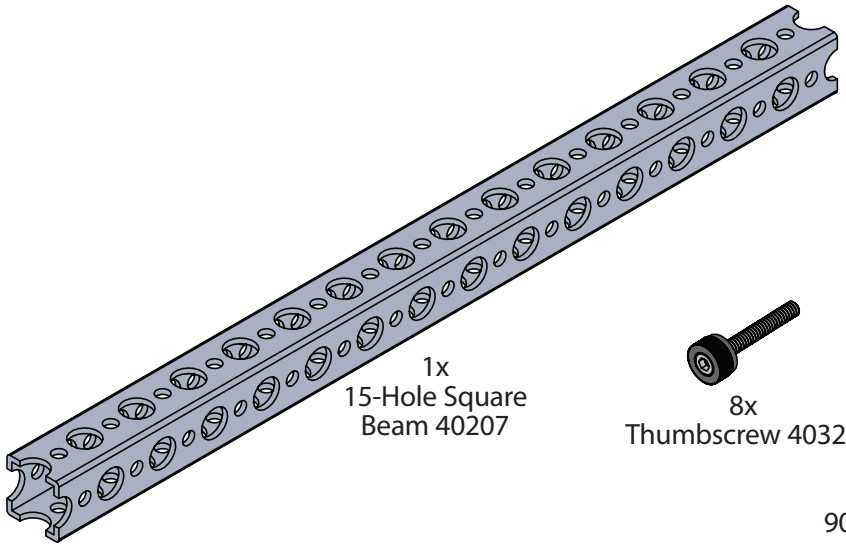
Overview:

Using this guide, create this Ball Rack for use with the Wheelee Bot and Pickee Bot.

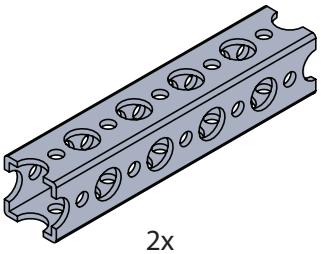


Step 1

Parts Needed

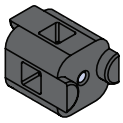


1x
15-Hole Square
Beam 40207



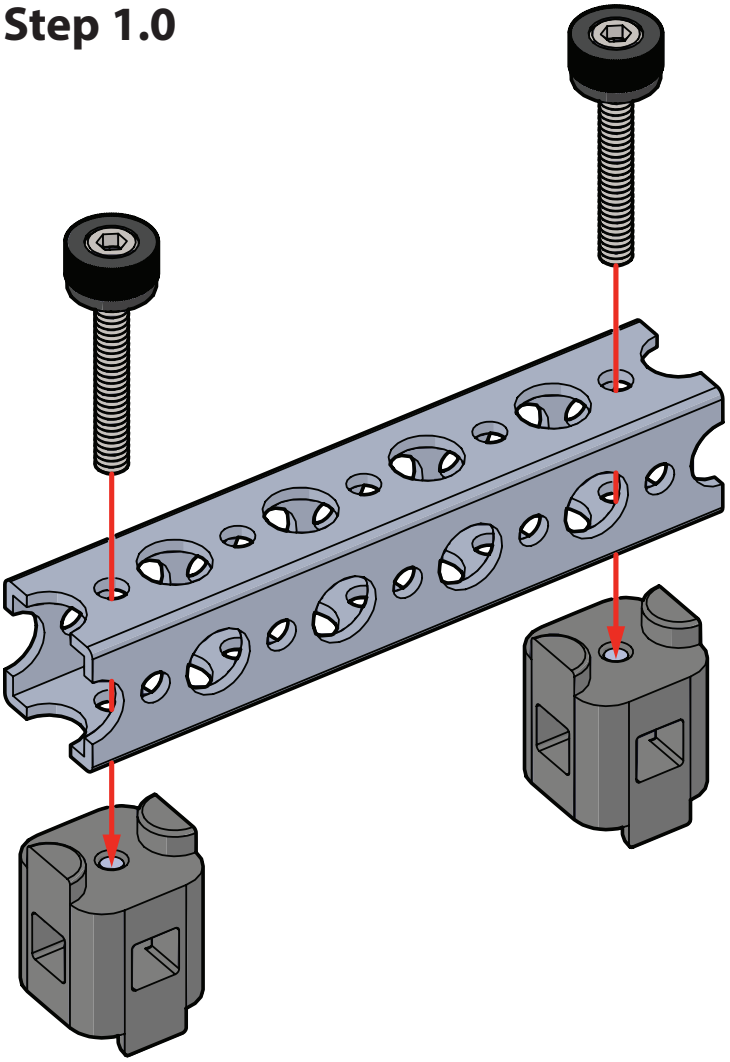
2x
5-Hole Square Beam 40202

8x
Thumbscrew 40323

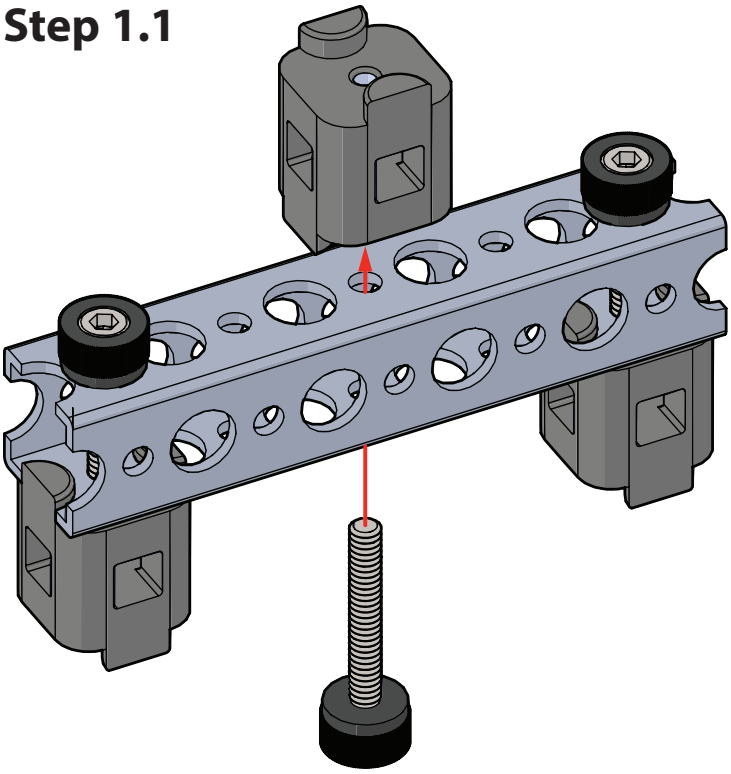


6x
90-Degree Cross Block Connector 40217

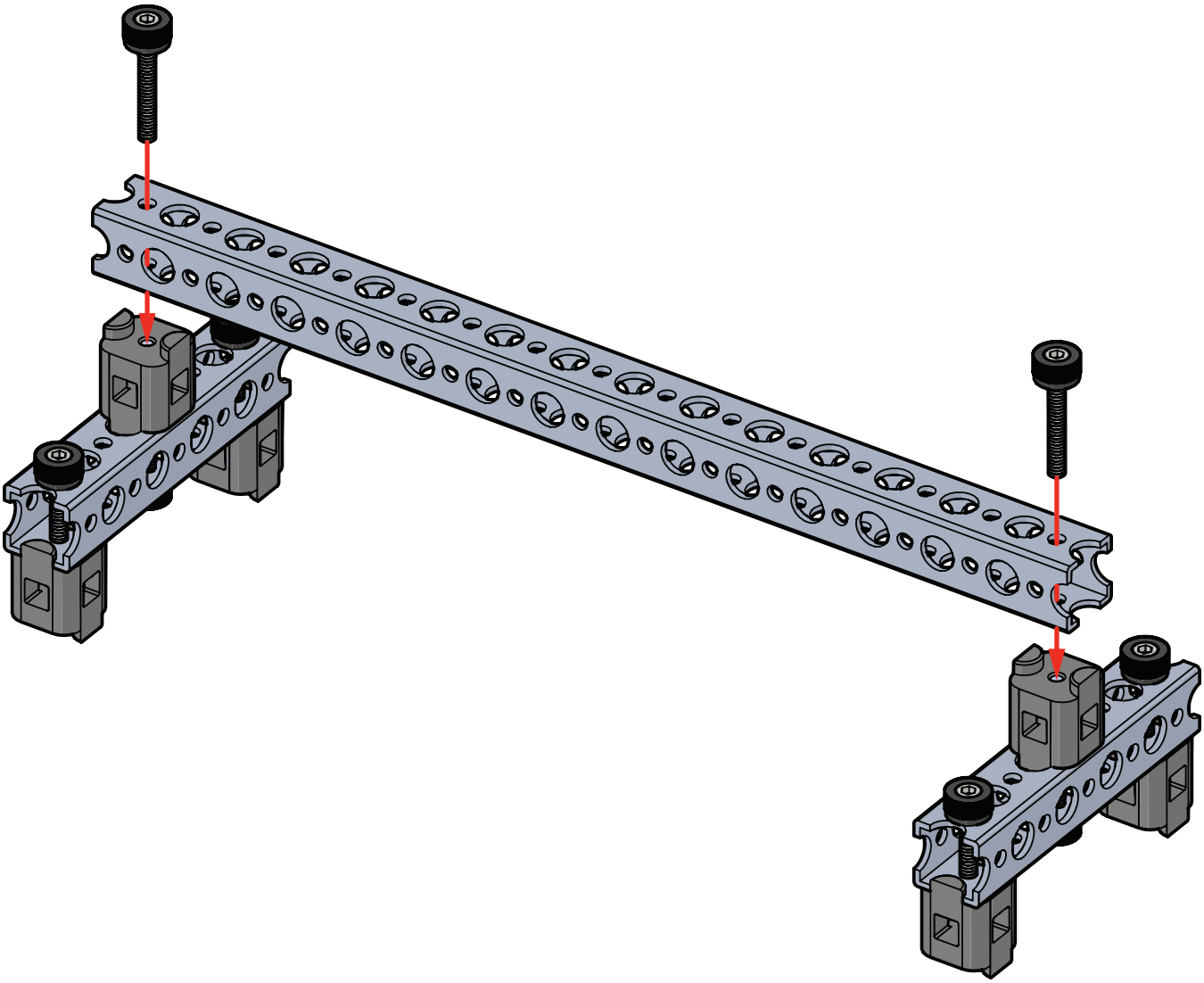
Step 1.0



Step 1.1



Step 1.2



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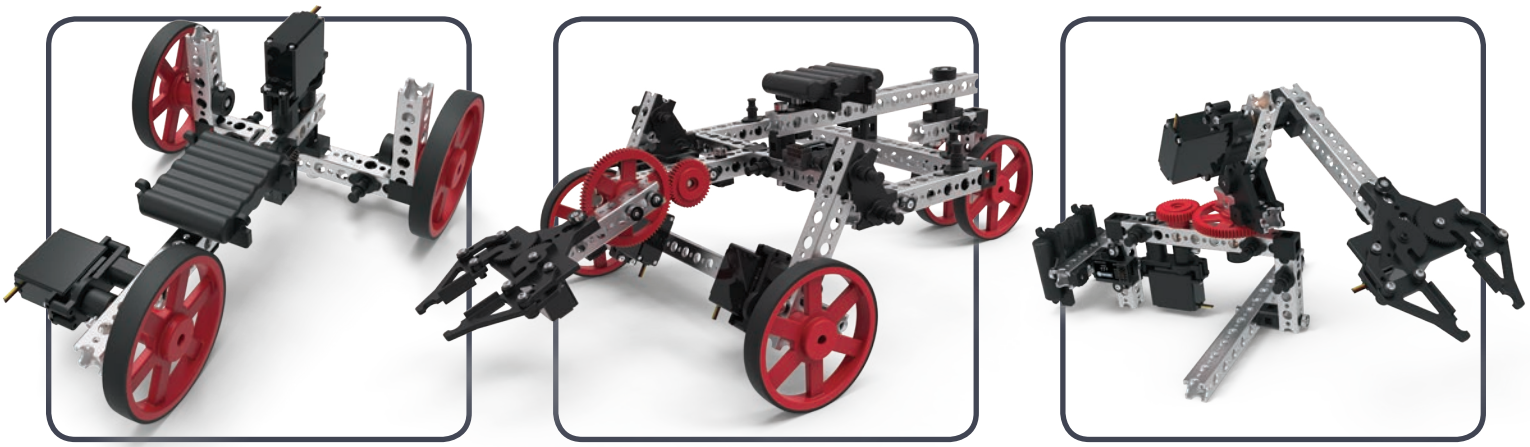

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