



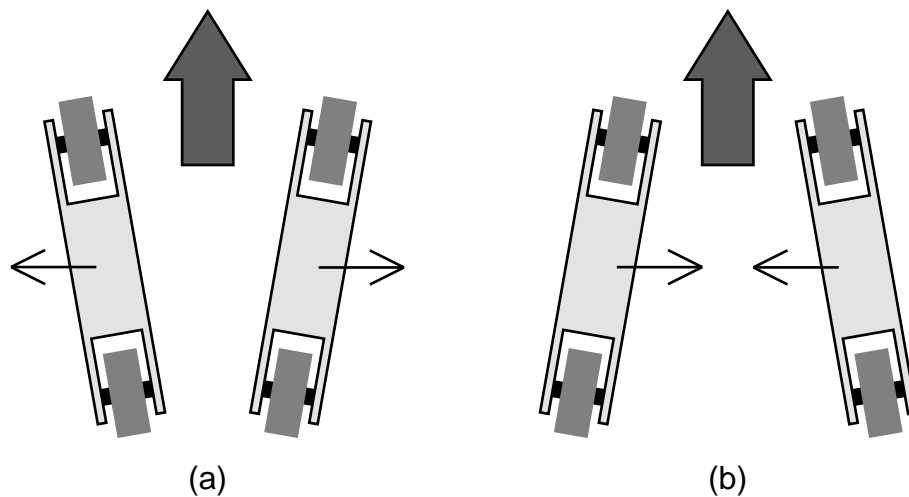
## **MODEL 3: WATER SKATER**

We usually propel a robot by rotating its tires or moving its legs. In this chapter we introduce a unique, unconventional method of propulsion.

The four tires in this robot can only coast because they are not con-

nected to the motor. Further, the axles attached to the angle connectors are not fixed and rotate as the motor turns the gear assembly. So how does this robot move? It skates.

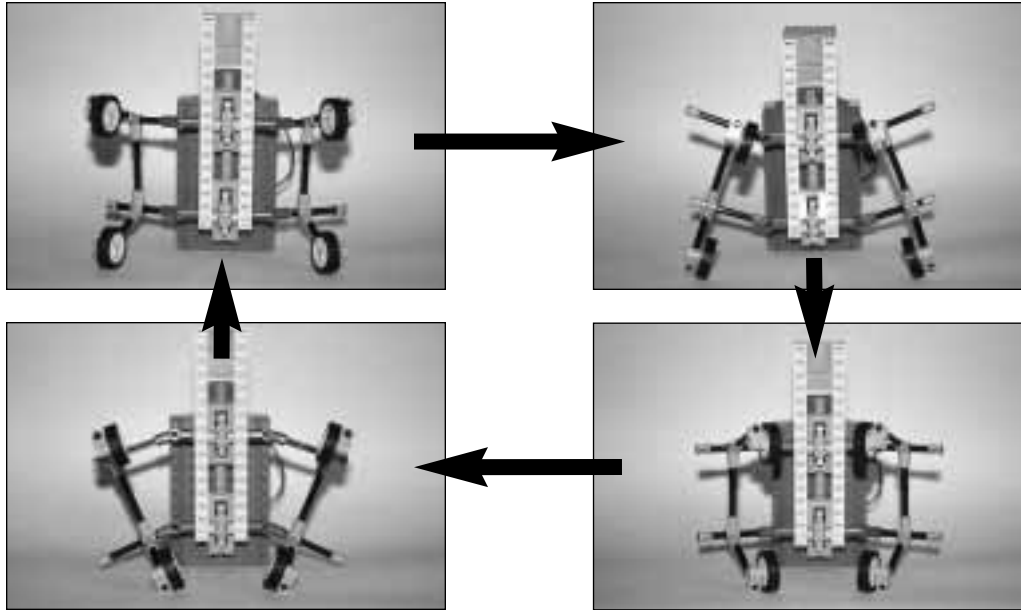
Think about how we move when ice skating, but not about sliding one foot at a time. While our robot will skate, it does so a bit differently than what we may be used to: It slowly moves forward by repeatedly forming a V shape with both feet, gradually letting its feet move farther apart, and then reversing the angle of both feet so that they come together again (see Figure 3-1).



**Figure 3-1:** How the Skater moves

Were you to try this movement on ice skates, you would need to repeatedly force your feet together, then apart, then together. However, because this robot is not moving on ice, it relies on coasting tires, which rotate forward or backward but not left or right. The feet diverge and converge using the unique method shown in the following photographs (Figure 3-2) of the Water Skater in action.

As you can see, this extremely simple structure produces a very complex kind of movement.



**Figure 3-2:** *The Water Skater in motion*

<b>PARTS LIST</b>		
<b>TYPE</b>	<b>SIZE</b>	<b>QUANTITY</b>
Beam	1x2	8
Beam	1x16	2
TECHNIC triangle		4
Gear	24-tooth	2
Worm gear		2
Cross axle	2	4
Cross axle	6	14
Axle joiner		1
Perpendicular axle joiner	1x2	8
Half bushing		5
Bushing		5
Angle connector	#3	4
Angle connector	#5	4
Motor		1
Connecting lead	Short	1
Wheel hub	Small	4
Rubber tire	Small	4

# ASSEMBLY PROCEDURE

## BUILD THE GEAR ASSEMBLY

1



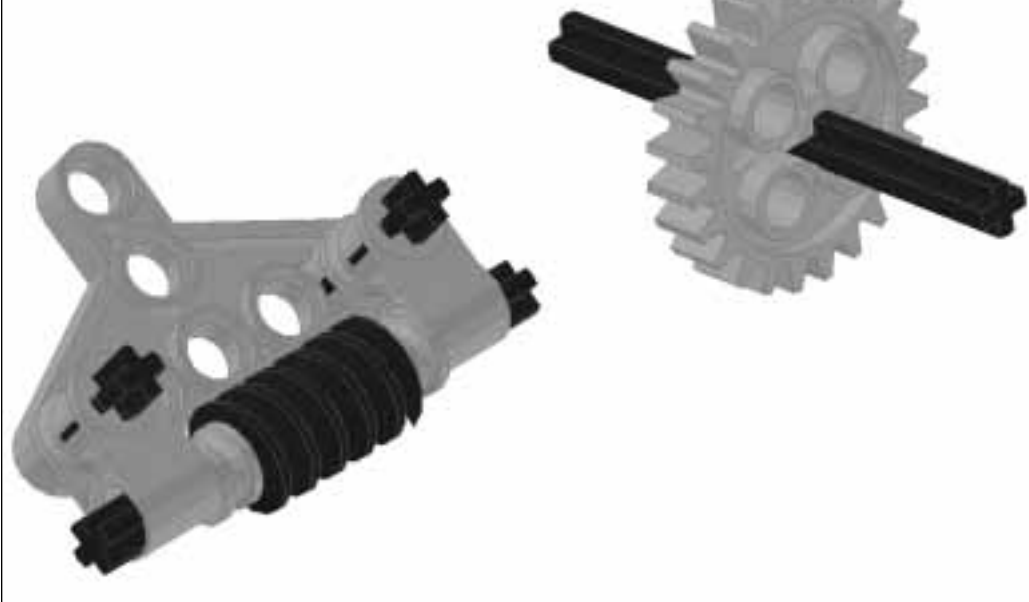
Since moving this robot requires a powerful torque (force for rotating the axle), we'll use a worm gear. The remaining pieces in the figure form the basis of the gear assembly.

2



Slide the worm gear onto an L6 cross axle and place half bushings at both ends to secure the gear as shown. Insert L2 cross axles into two perpendicular axle joiners, then collect the pieces for the next step.

**3**



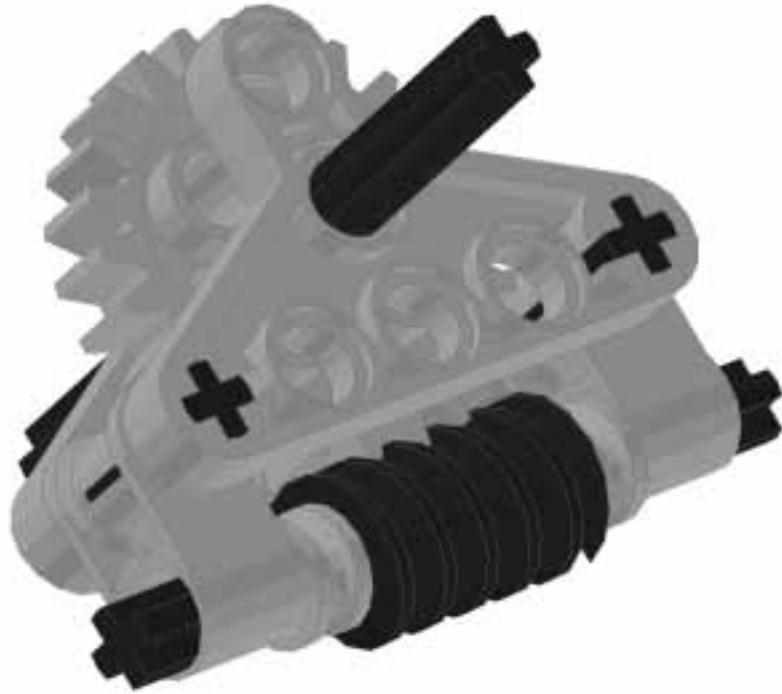
Pass the worm gear axle through the two perpendicular axle joiners, then attach the unit to a TECHNIC triangle. Pass a cross axle through the 24-tooth gear.

**4**



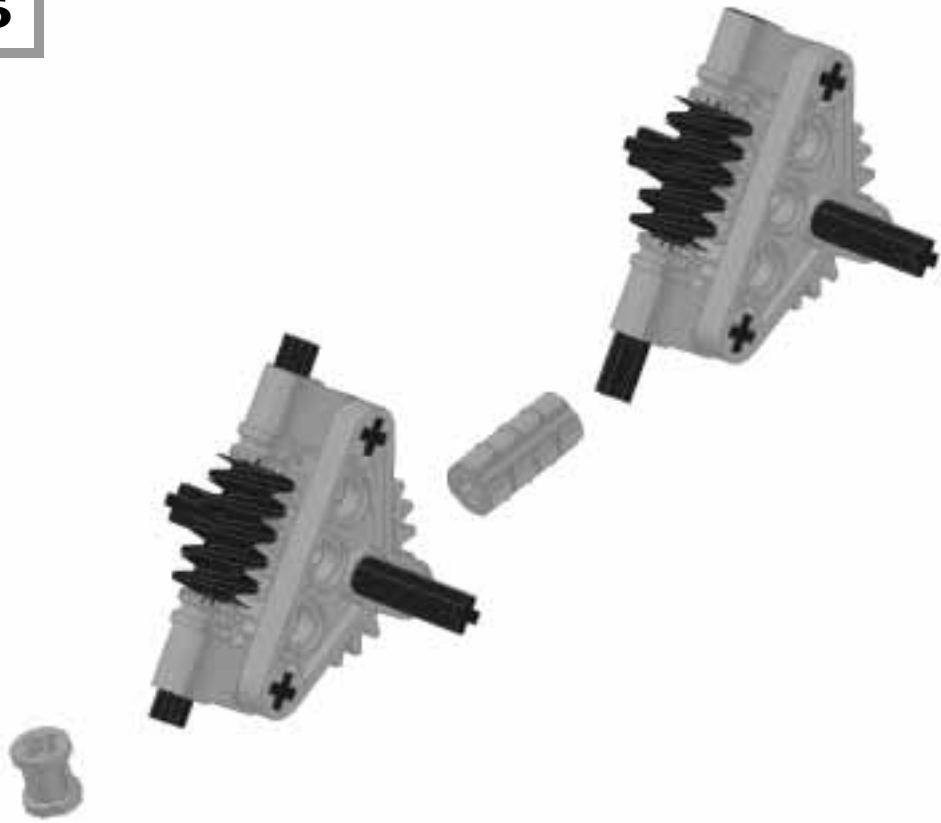
Mount the axle and gear onto the TECHNIC triangle so that the teeth align with the worm gear.

5



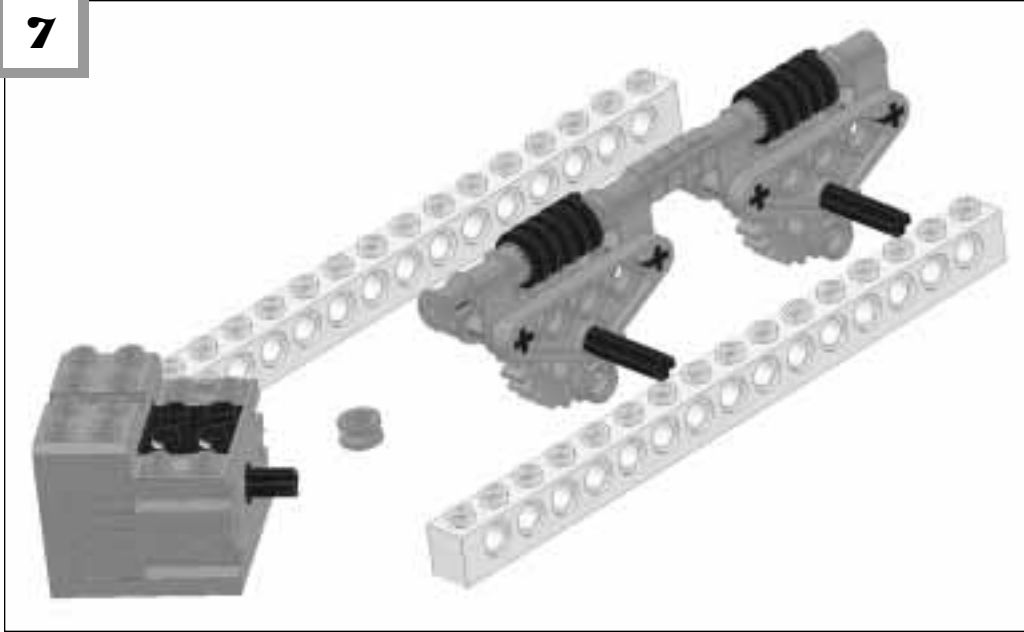
Fix the 24-tooth gear in place by attaching another TECHNIC triangle as shown.

6



Follow Steps 1 through 5 above to build a second, identical worm gear unit.

7



Use an axle joiner to connect the cross axles in the two worm gears. Align the cross axles so that their orientations match. When properly aligned, the axles' crosses should have the same orientation when viewed end-on (see NOTE below).

Attach a bushing to the end of the axle that will attach to the motor.

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**NOTE** *To see if axles are properly aligned look at them head-on and check that their crosses are pointed in the same direction. If we represent the axles' crosses as plus signs, then correctly aligned axles would look like this:*

+    +

*Incorrectly aligned axles would look like this:*

+    ×

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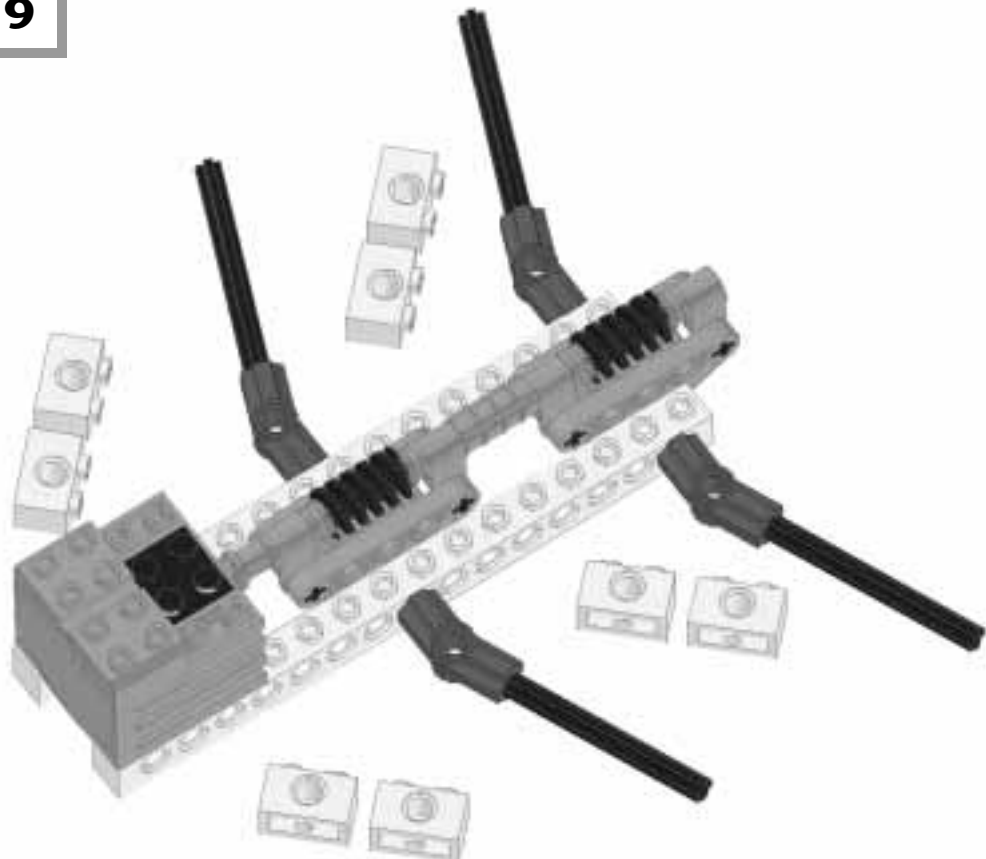
## BUILD THE BODY AND FEET

8



Slide two 1x16 beams onto the cross axles, then attach a half bushing as far as possible onto the motor shaft.

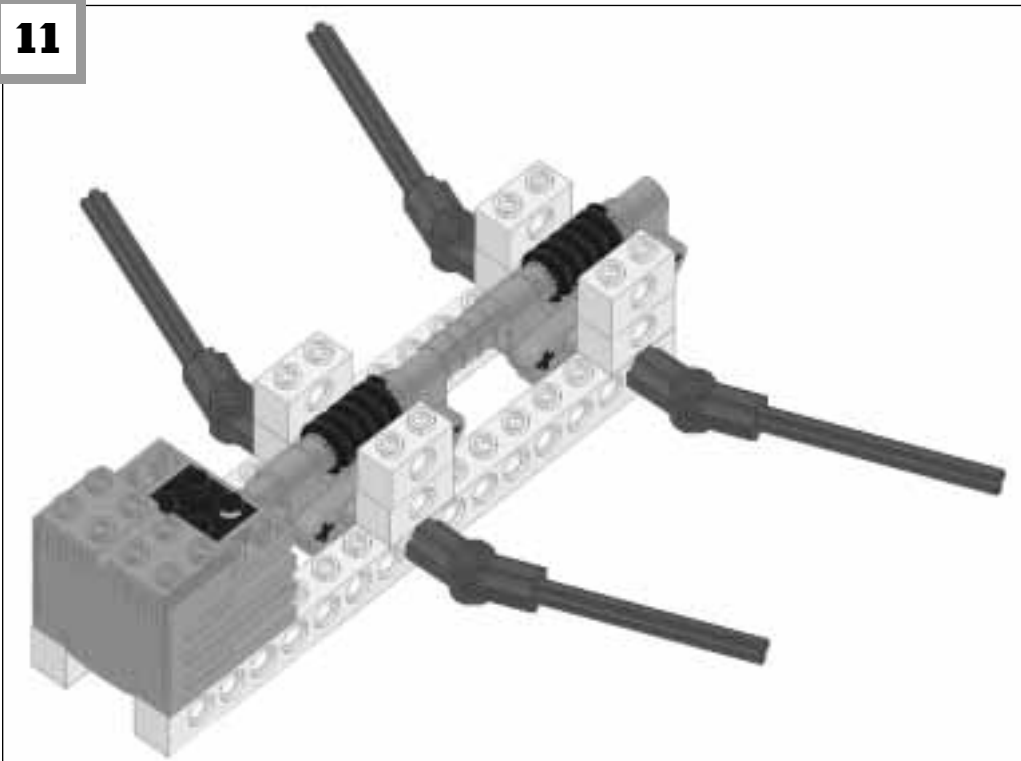
9



Snap the motor in place on top of the two 1x16 beams while inserting the motor shaft into the bushing, connecting it to the worm gear axle.

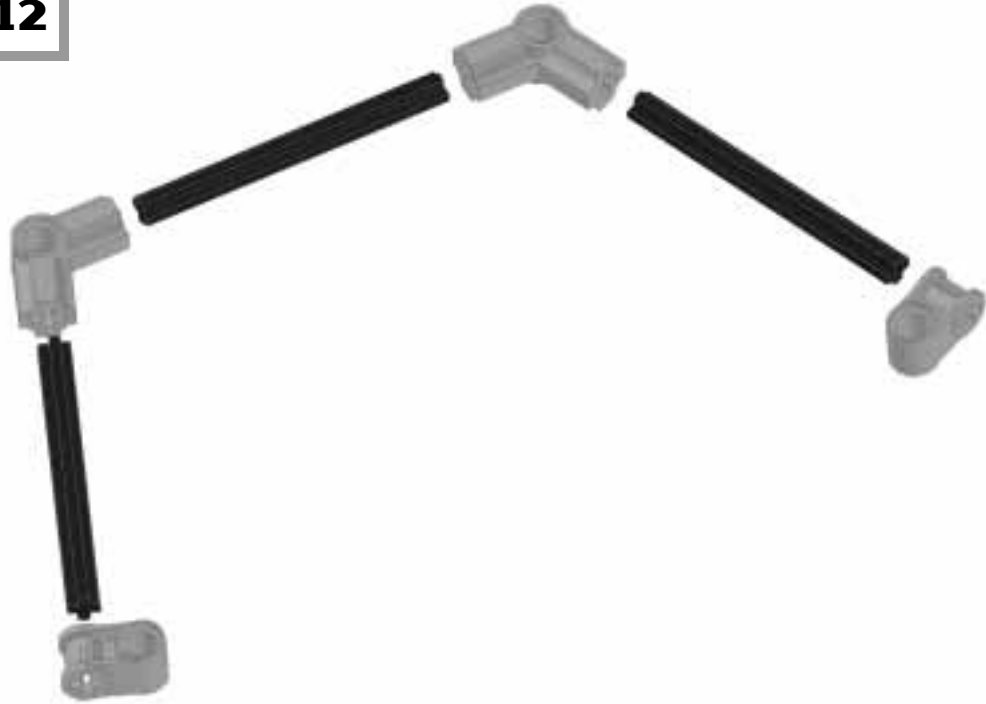
**10**

Extend L6 cross axles outward with #3 angle connectors, orienting all four connectors in the same direction. Next, assemble eight 1x2 beams (or bricks) as shown.

**11**

Attach the 1x2 beams (or bricks) as shown to form a base for mounting the RCX.

**12**



Align three L6 cross axles, two #5 angle connectors, and two perpendicular axle joiners as shown to build a foot.

**13**

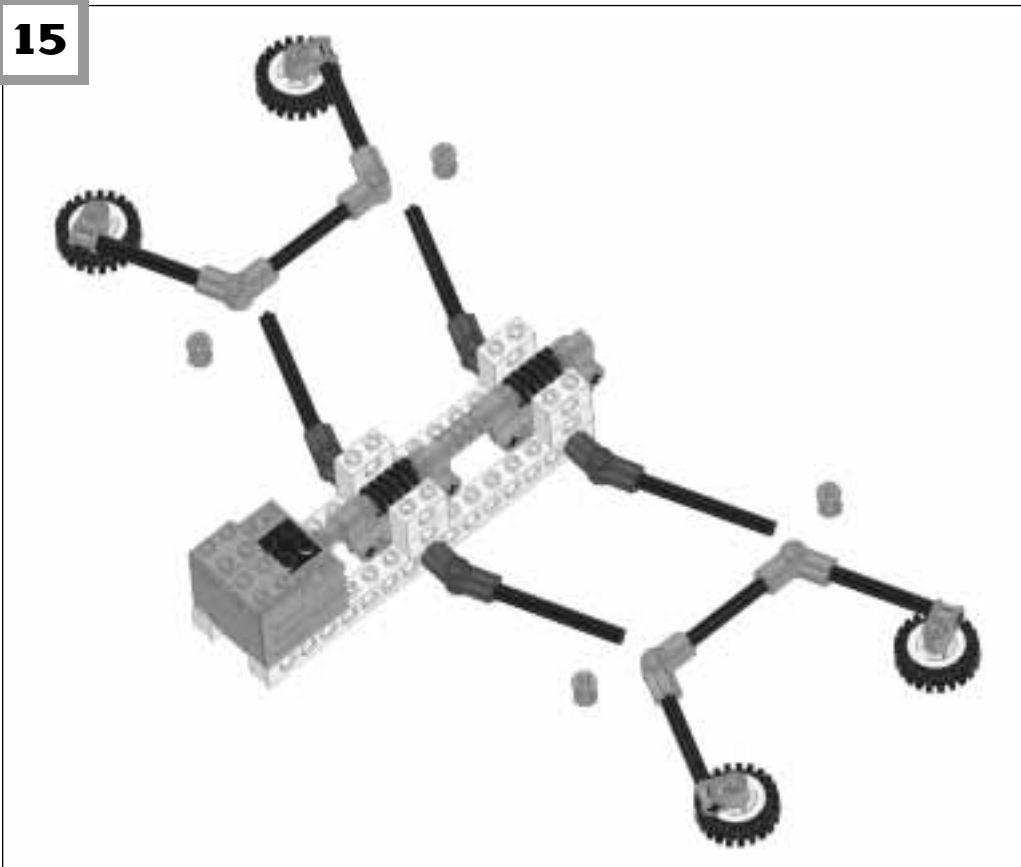


Begin building the foot by connecting the three cross axles with the #5 angle connectors as shown. Lay out tires, wheels, and gray TECH-NIC pins as shown.

**14**

Complete the foot by inserting the wheels into the tires and the gray TECHNIC pins into each axle so that the tires turn freely. Next, build one more identical foot, and assemble both feet as shown.

### ATTACH THE FEET AND RCX TO THE BODY

**15**

Slide the two feet onto the axles extending from the torso by sliding the axles through the angle connectors on each foot. When properly connected, the assembled wheels should be oriented as shown.

**16**



Snap bushings onto the ends of the axles extending from the torso to secure the feet.

**17**



Mount the RCX to the 1x2 beams (added in Step 11), then link the motor to output A of the RCX with a short connecting lead. Your Water Skater is now complete.

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**NOTE** *When the robot skates, the feet may press too hard against the #3 angle connectors and disconnect. If this is the case, try using longer axles to connect the feet to the torso in Step 10.*

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## **P R O G R A M**

This robot uses only output A and can move according to program 1, set by default in the RCX. Use the “Prog” button to select “1” and press the “Run” button to start the program.