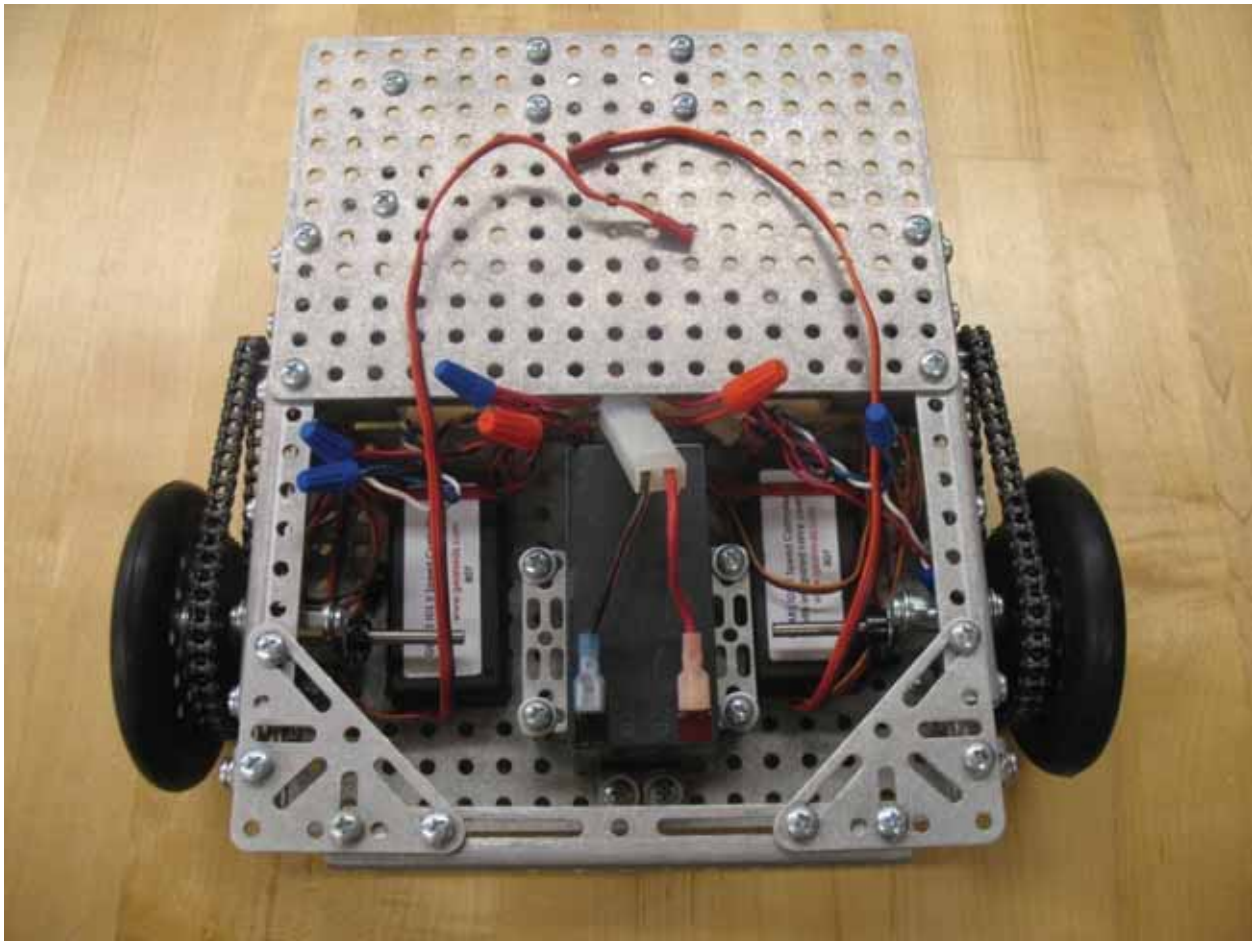
Gears
Educational Systems, LLC

Verminator

Construction Instructions



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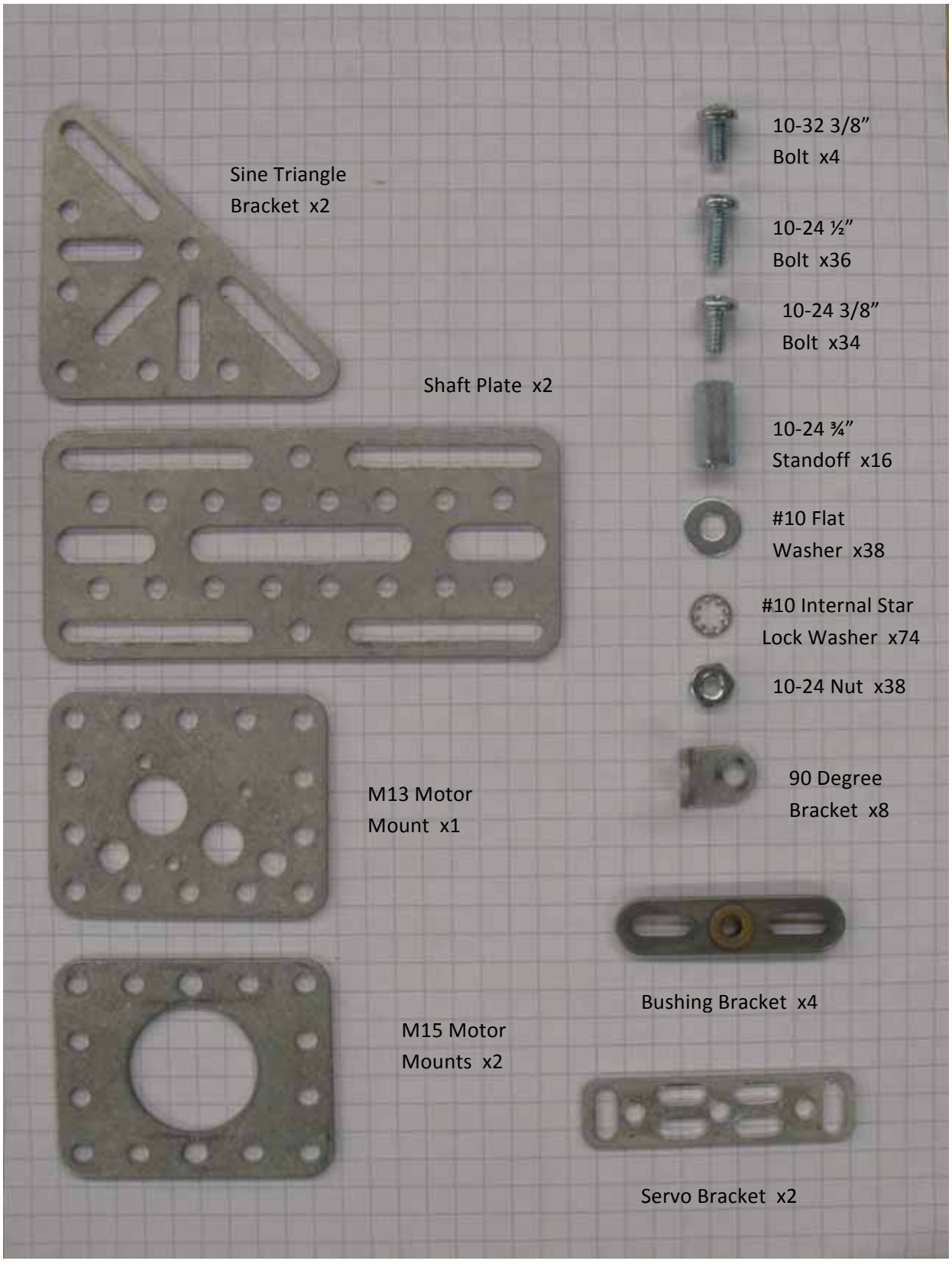
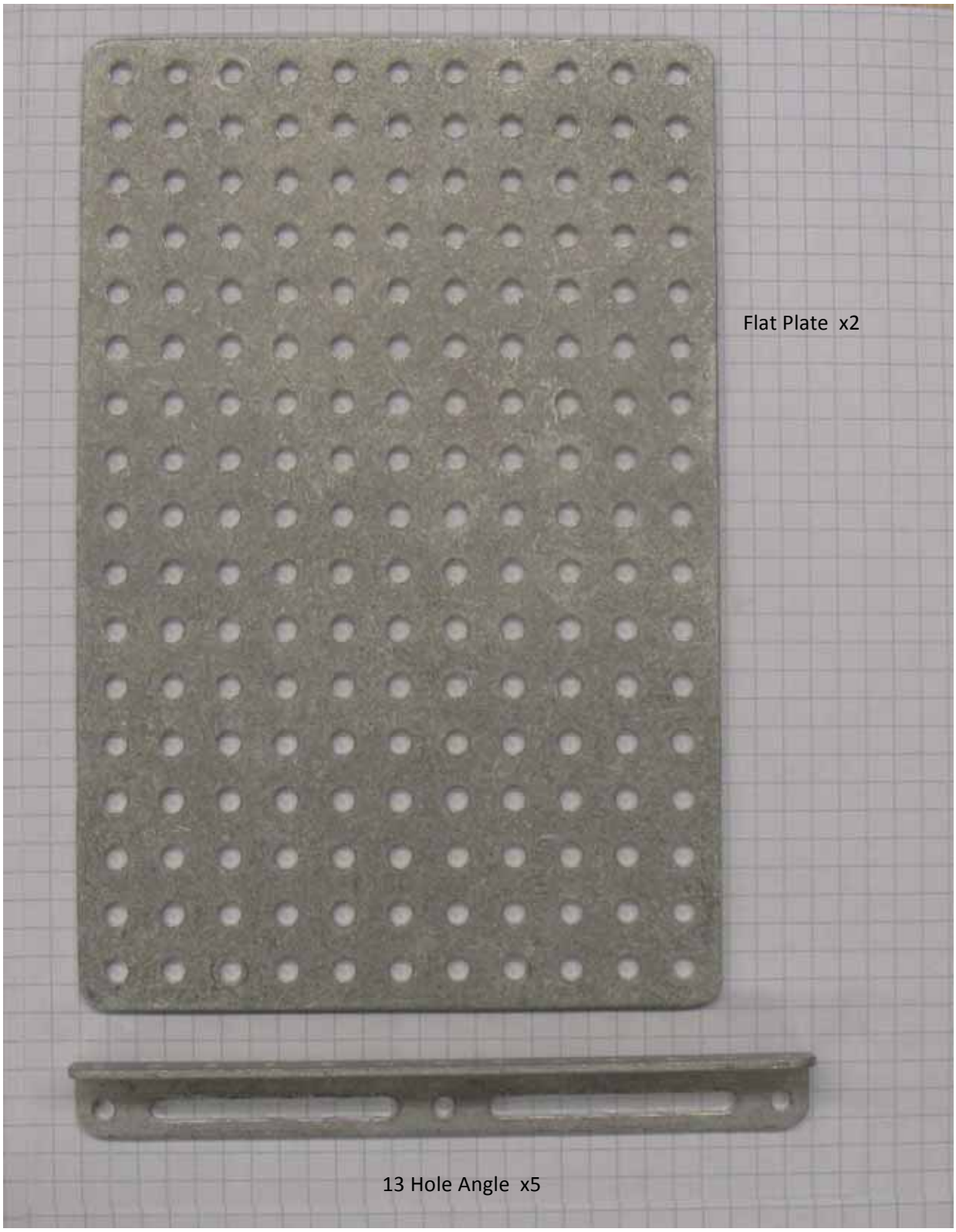
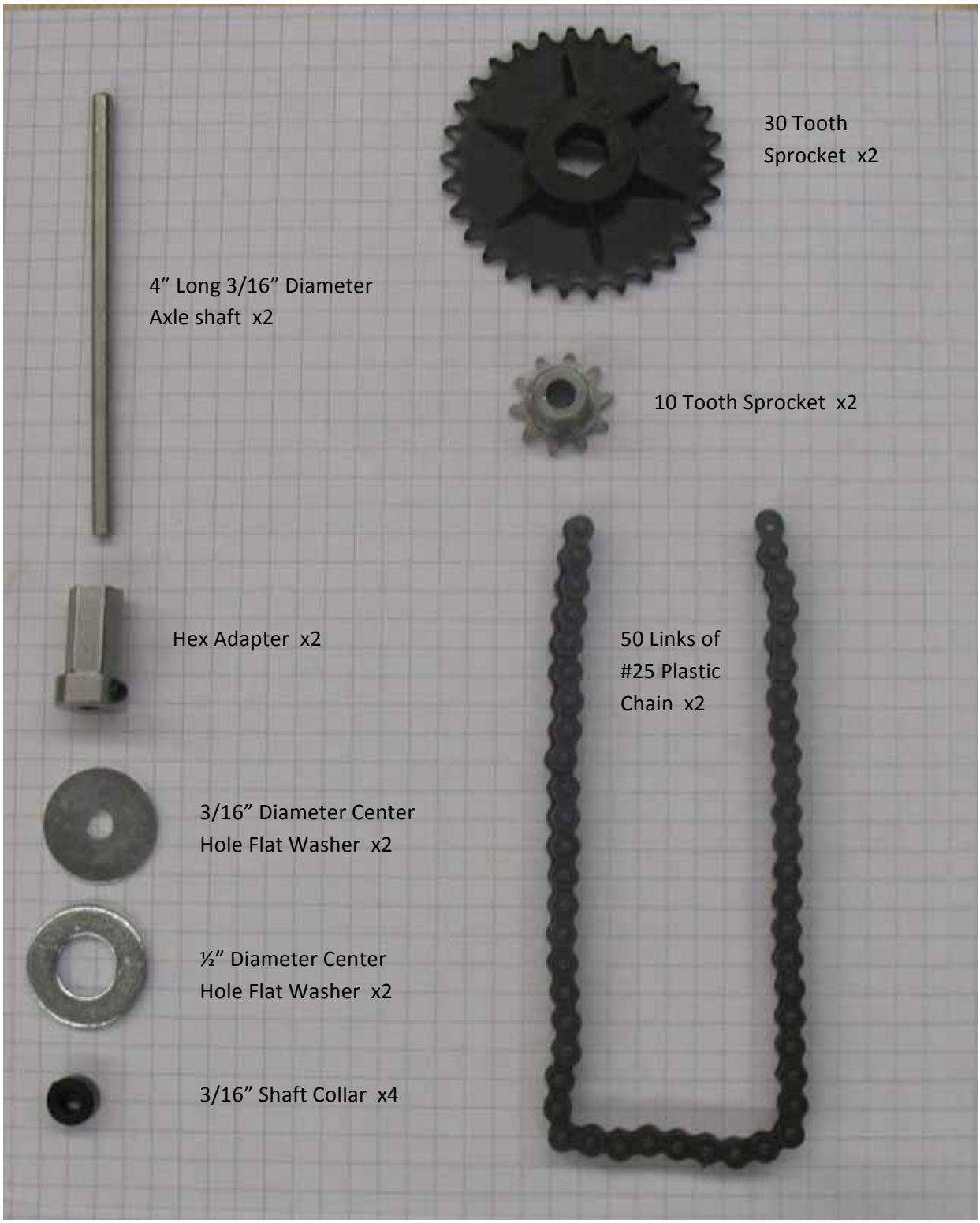
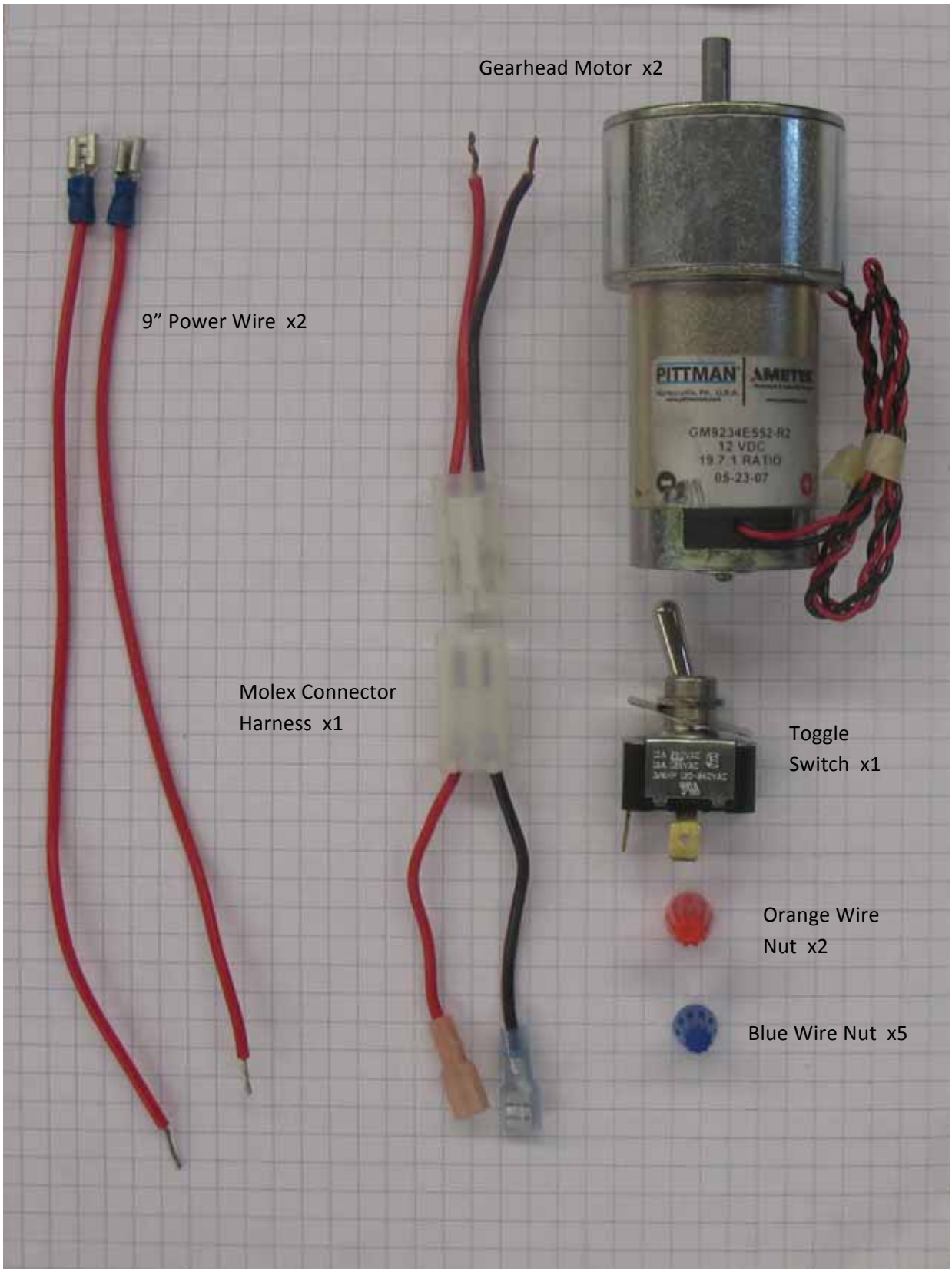
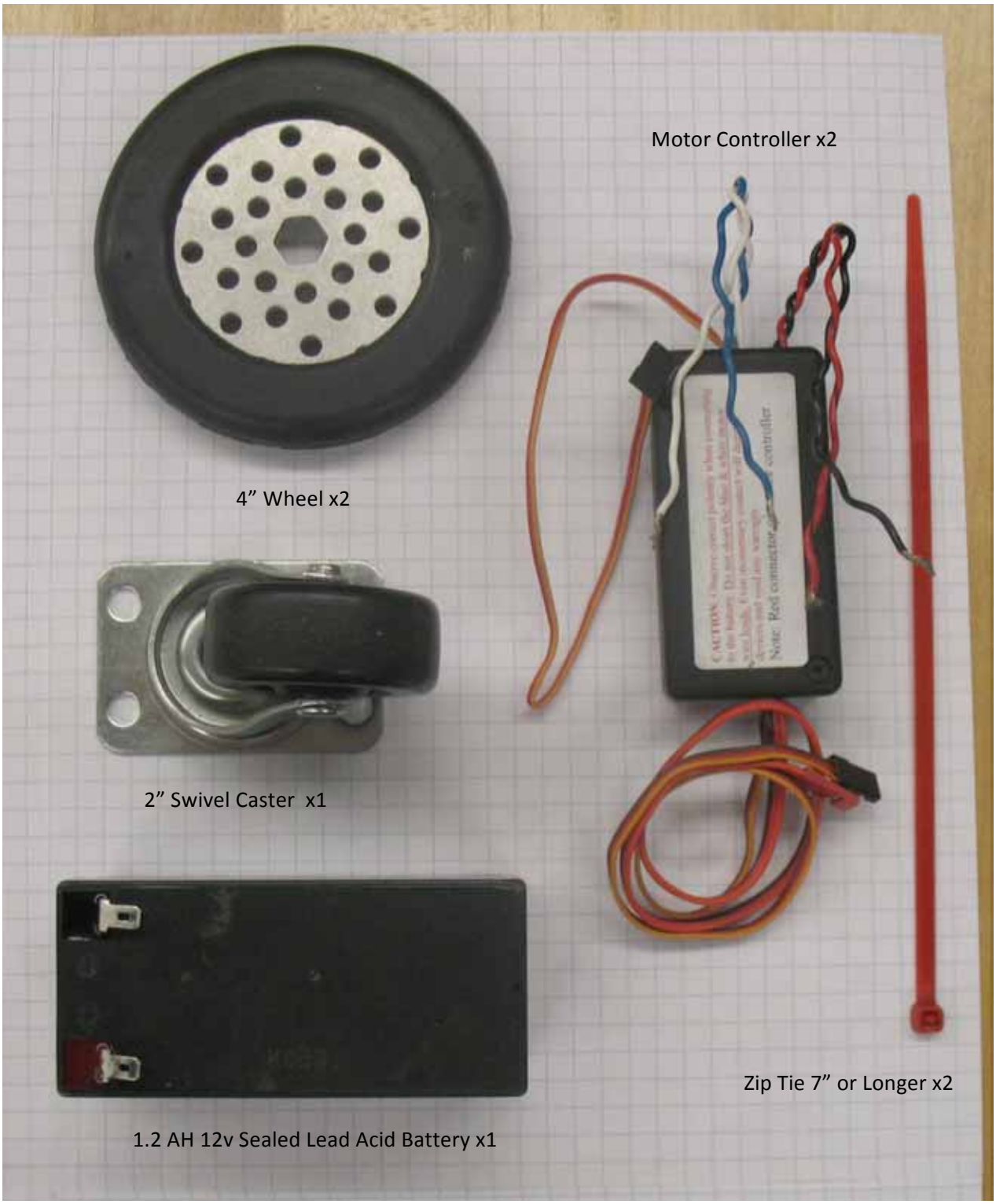
GEARS Educational Systems www.gearseds.com

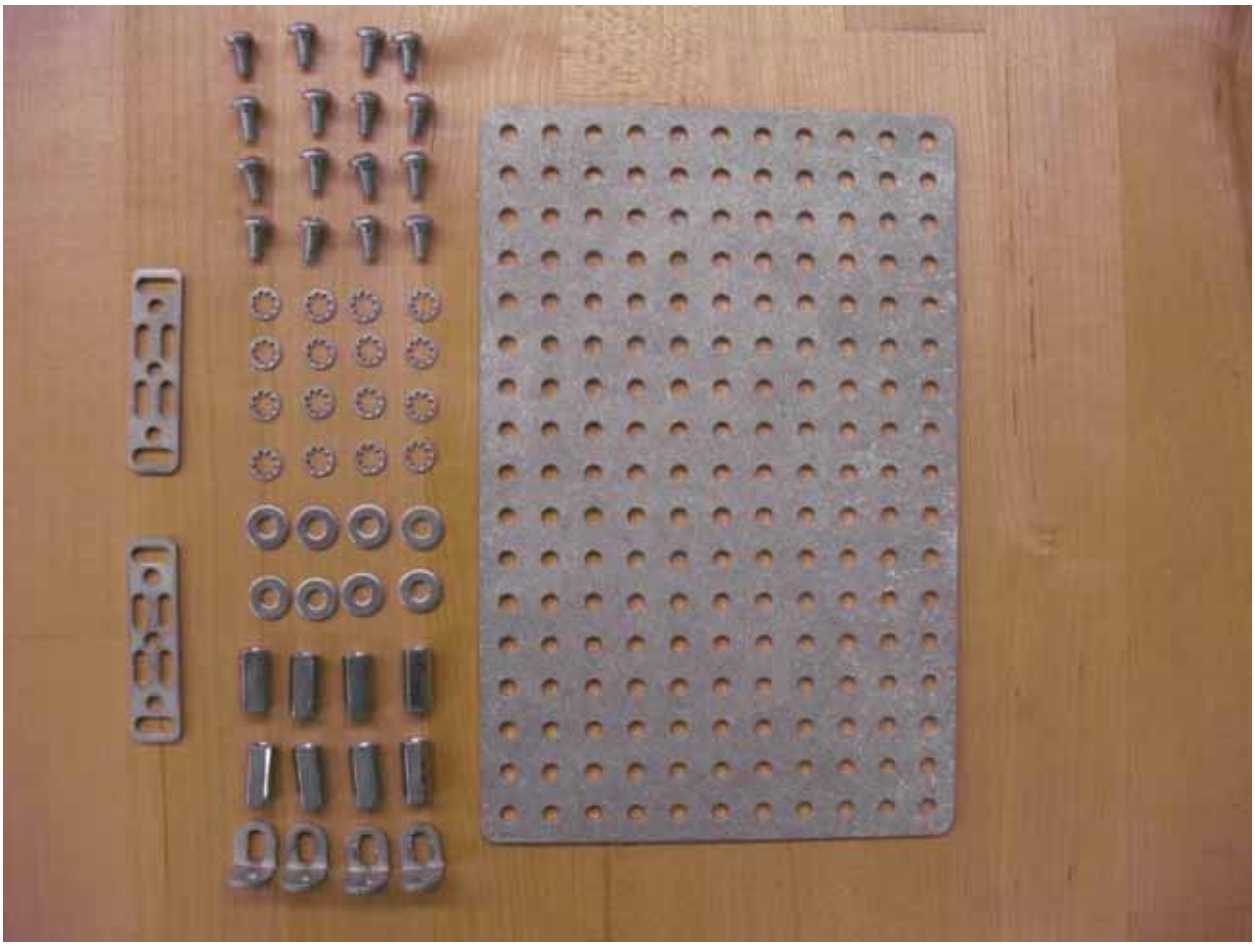

Sine Triangle
Bracket x2
10-32 3/8"
Bolt x4
10-24 ½"
Bolt x36
10-24 3/8"
Bolt x34
Shaft Plate x2
10-24 ¾"
Standoff x16
#10 Flat
Washer x38
#10 Internal Star
Lock Washer x74
10-24 Nut x38
90 Degree
Bracket x8
M13 Motor
Mount x1
Bushing Bracket x4
M15 Motor
Mounts x2
Servo Bracket x2


Flat Plate x2
13 Hole Angle x5


30 Tooth
Sprocket x2
4” Long 3/16” Diameter
Axle shaft x2
10 Tooth Sprocket x2
Hex Adapter x2
50 Links of
#25 Plastic
Chain x2
3/16” Diameter Center
Hole Flat Washer x2
½” Diameter Center
Hole Flat Washer x2
3/16” Shaft Collar x4


Gearhead Motor x2
9” Power Wire x2
PITTMAN
GM9234E552-R2
12 VDC
19.7:1 RATIO
05-23-07
Molex Connector
Harness x1
Toggle
Switch x1
Orange Wire
Nut x2
Blue Wire Nut x5


Motor Controller x2
4” Wheel x2
2” Swivel Caster x1
Zip Tie 7” or Longer x2
1.2 AH 12v Sealed Lead Acid Battery x1

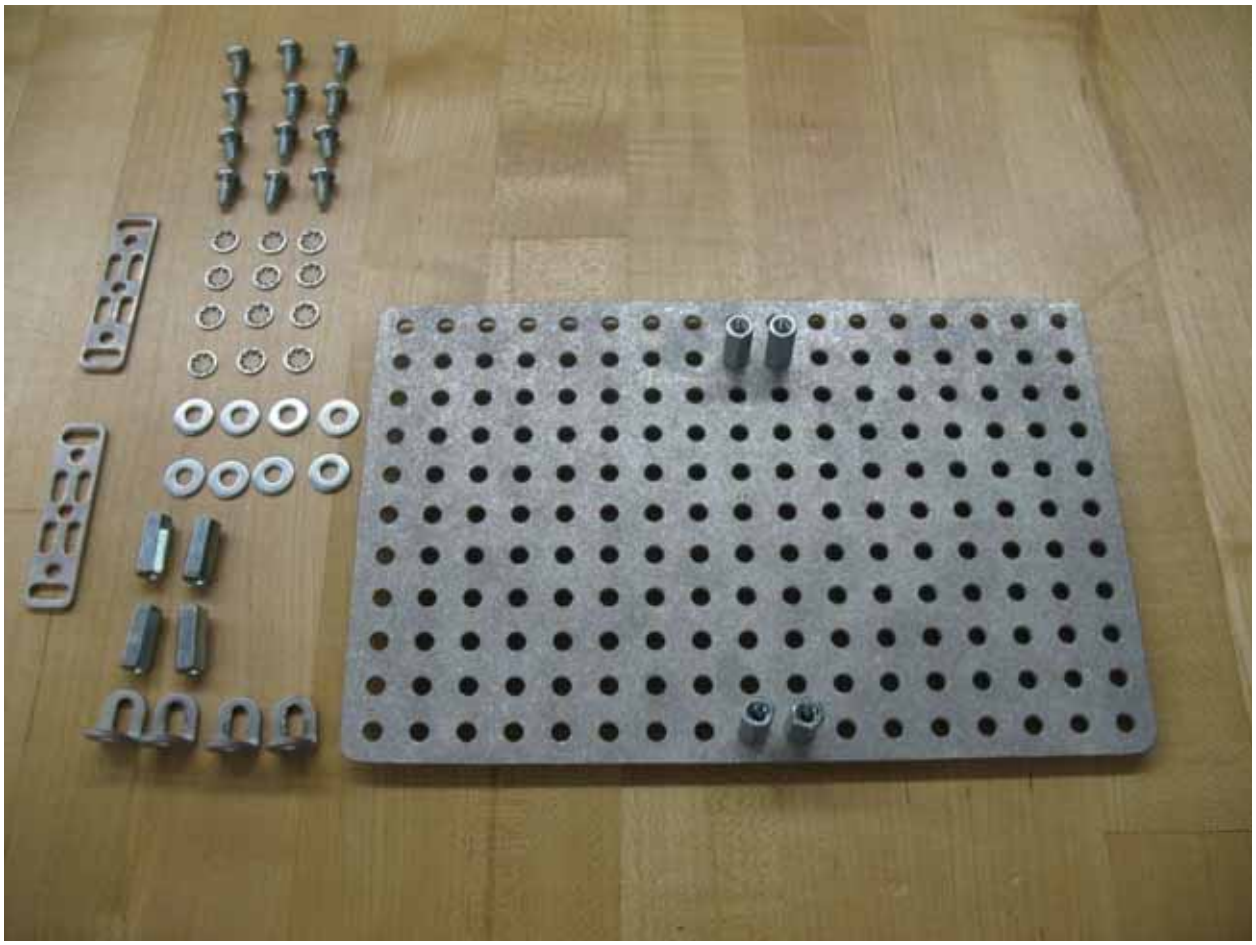


In this step you will install the battery holder on to the lower flat plate sub-assembly of the bot.

Parts Needed:

1	Flat Plate
2	Servo Brackets
4	90 Degree Brackets
8	10-24 Standoffs
8	#10 Flat Washers
16	3/8” 10-24 Bolts
16	#10 Internal Star Lock Washers

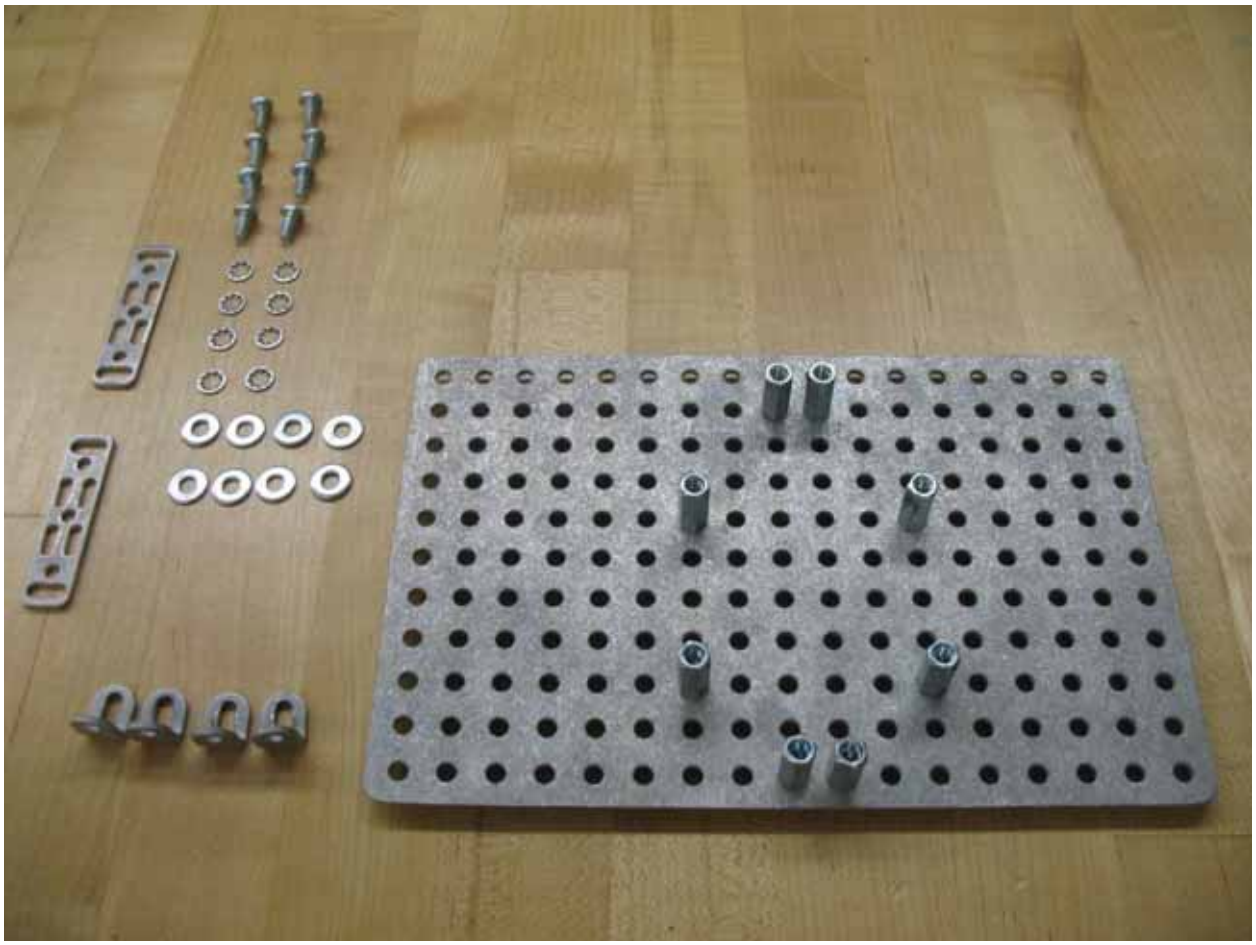
Finished battery holder:



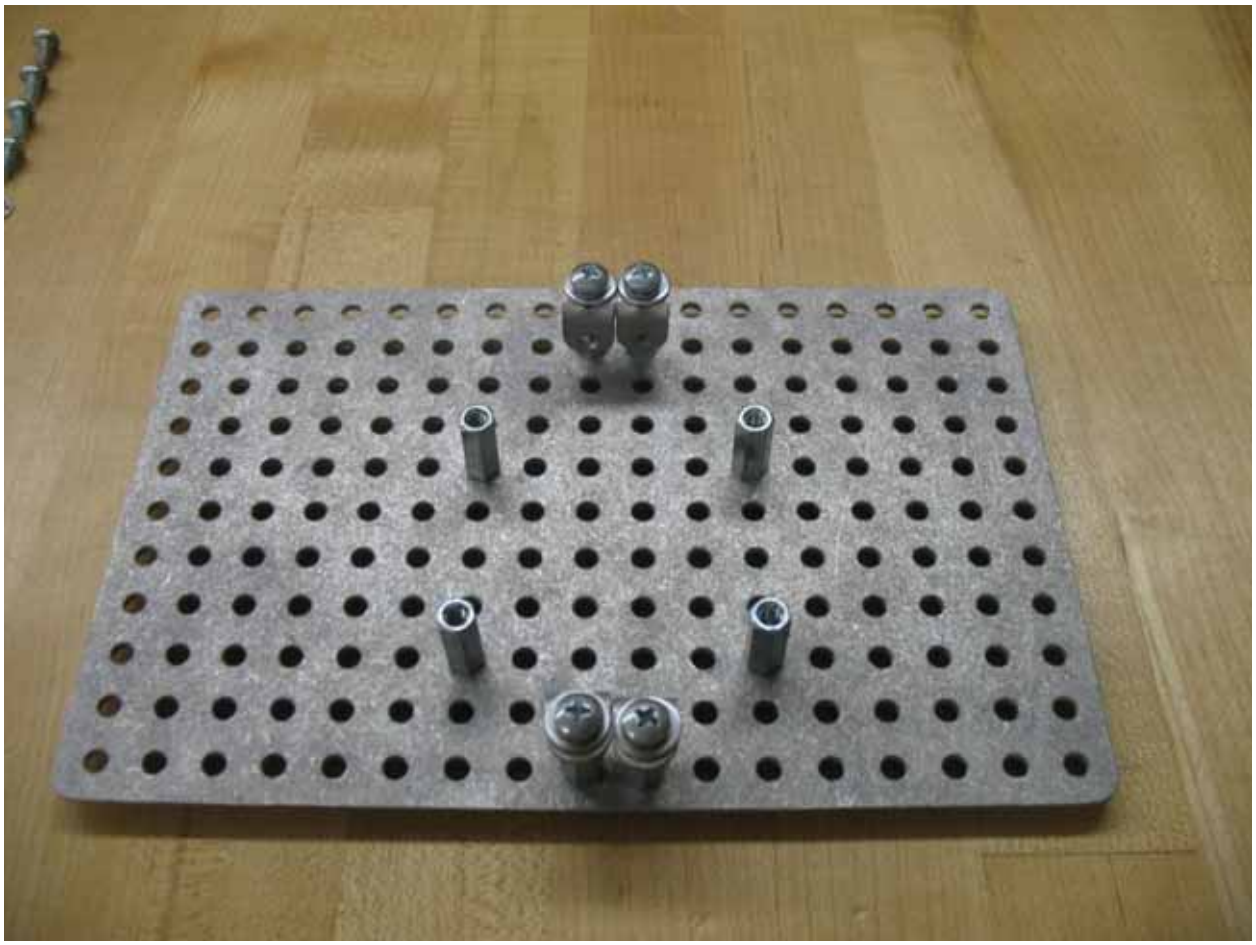
Lay the flat plate so the long edge is facing you (shown above). Install two 10-24 standoffs in the row of holes on the long edge closest to you using 3/8" 10-24 bolts and internal star lock washers. The right standoff should be in the 8th hole from the bottom right corner of the flat plate; this is the right corner that is closest to you. The left standoff should be placed in the next hole to the left of the standoff you just installed. With those standoffs in place install two more standoffs in the second to last row of holes on the flat plate on the long side that is far from you. Install the right standoff on the 8th hole over from the right side of the flat plate; install the left standoff in the next hole over in the same row. When finished the flat plate should look like the one pictured above.

Note: The internal star lock washers should not be used under the standoffs; the lock washers should be located directly under the head of the 10-24 bolts in this step.

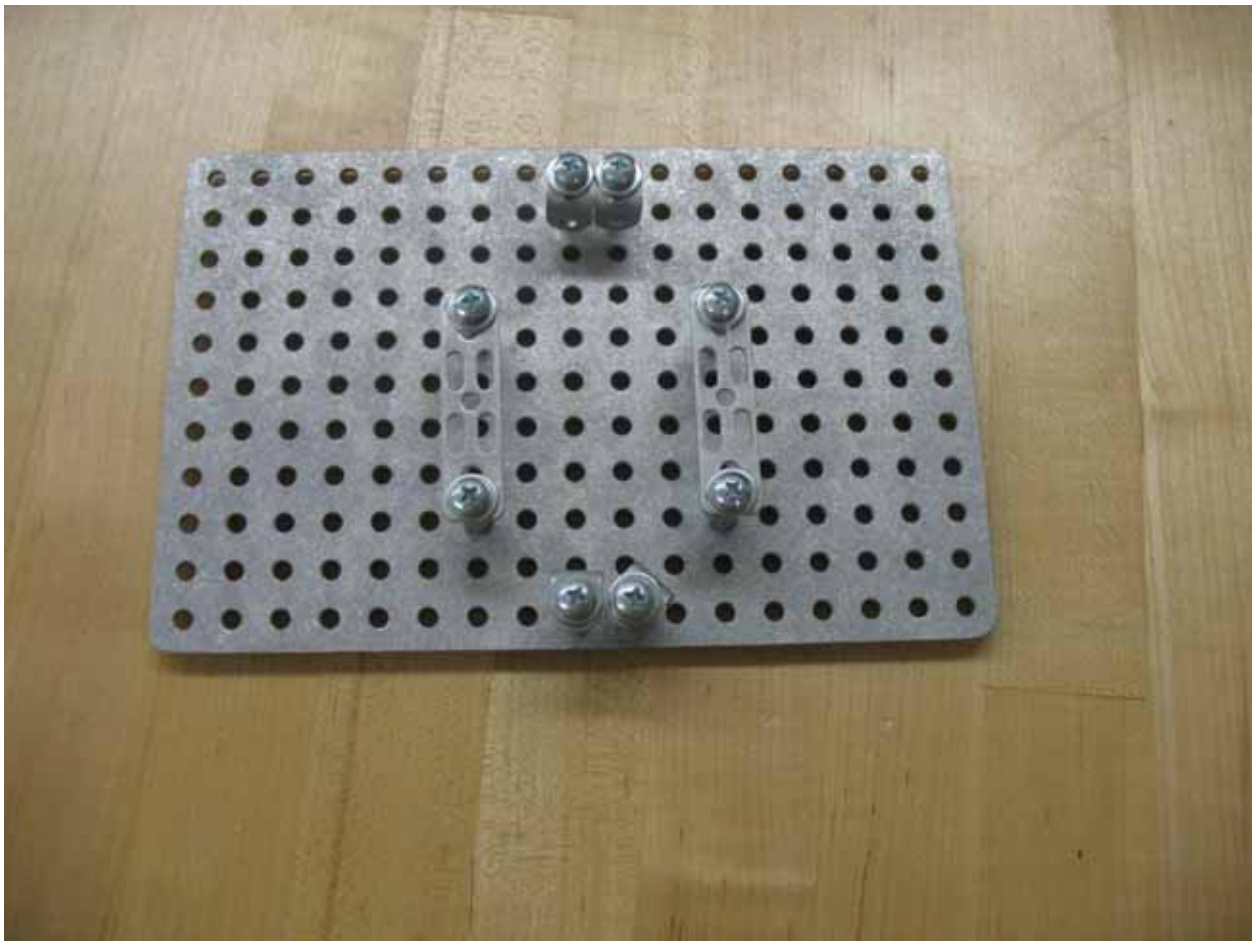
Note: The 3 hole flat bar shown in the picture represents the lower flat plate.



From the front right corner count 6 spaces to the left and 3 spaces away from you. Bolt a ¾" 10-24 standoff in this hole using a 3/8" 10-24 bolt and internal star lock washer. In the same row of holes count up four holes from the standoff you just installed and bolt another standoff in. From each of these standoffs count 5 spaces to your left and install two more 10-24 standoffs in the same way you installed the previous standoffs. When you are finished your flat plate will look like the one pictured above.

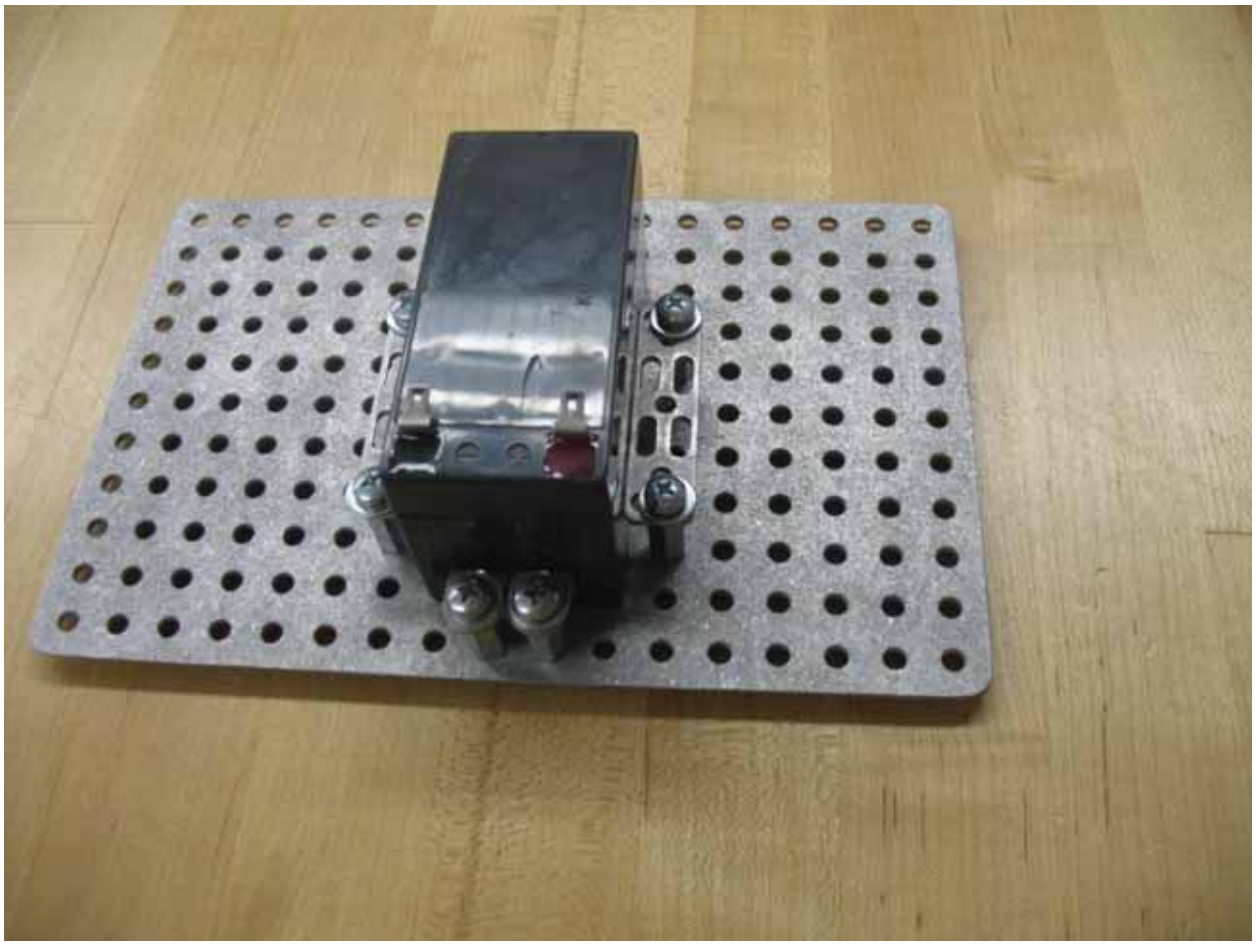


Bolt the four 90 degree brackets on the standoffs that are located along the long edges of the flat plate (pictured above). Pictured below is the order in which you are to use the hardware needed in this step. Place the 90 degree bracket on top of each standoff so the slotted end is laying on top of the standoff and the bend is facing down, on top of that place a #10 flat washer, and on top of the washer place an internal star lock washer. With all those in place use a 3/8" 10-24 bolt to secure all that down. Loosely tighten the bolt loosely it will need to be adjusted later.

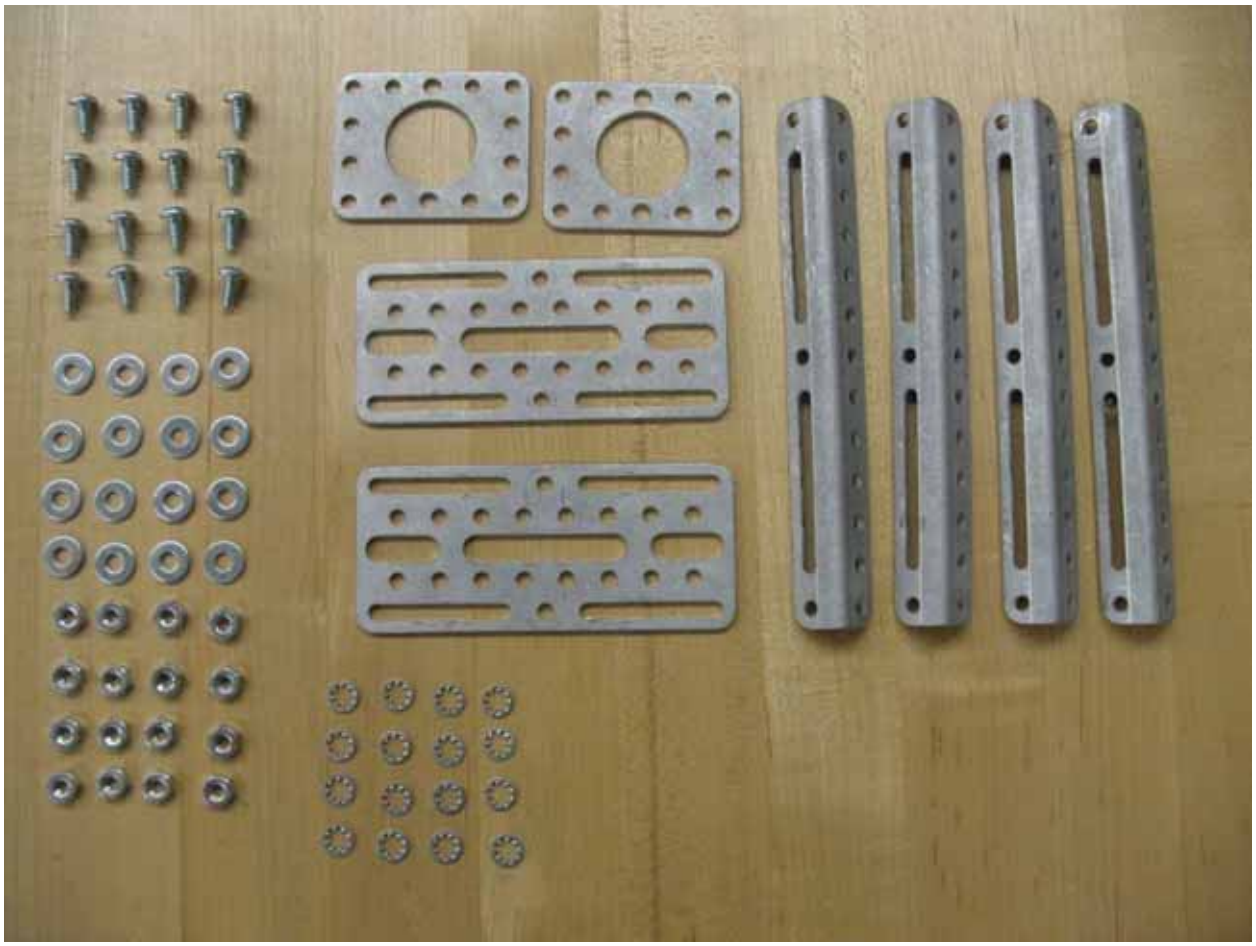


Set a servo bracket on top of the right set of standoffs. The outer most slots on each end of the servo bracket should line up with the bolt hole in each standoff on the right side. If this is not the case you will need to move one or both standoffs. With the servo bracket lined up on top of the standoffs, set a #10 flat washer over each standoff, and on top of that set an internal star lock washer. With all these pieces lined up over the standoffs insert a 3/8" 10-24 bolt through all those parts and thread the bolt into the standoffs. Be sure to only lightly tighten the bolts as the bracket will need to be adjusted later. Do the same procedure for installing the left side servo bracket. When you are finished installing both brackets the battery holder should look like the one pictured above.

This is the proper order for placing the servo bracket, washer, lock washer, and bolt on the standoffs.



Place the 1.2ah sealed lead acid battery in the battery holder you completed in the last step. It will fit rather loosely, this is okay. Adjust the brackets so they all touch the battery; be careful to not make them too tight against the battery. Once you have the brackets in a position that will hold the battery tighten the bolts down. With all the brackets tightened down the battery should not be free to slide around. If you cannot remove the battery you made the brackets too tight around the battery and you need to loosen them a little. The battery should be firmly held by the brackets, but be loose enough to be removed without having to loosen any of the bolts. Once you have the battery holder properly adjusted remove the battery to make the rest of the robot assembly easier.



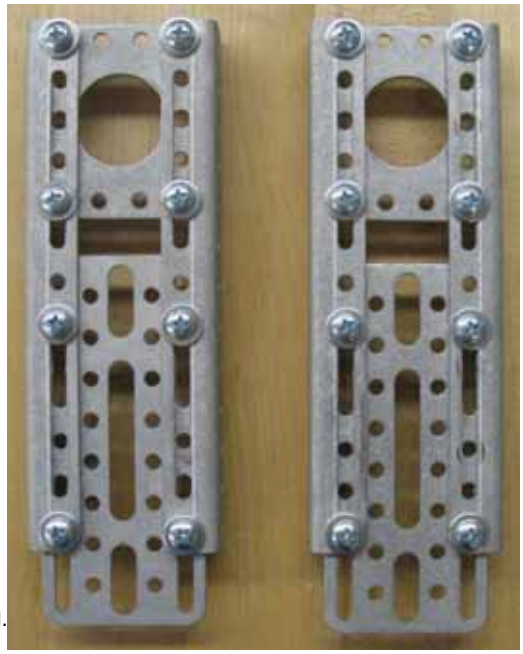
In this step you will construct the side rail sub-assemblies.

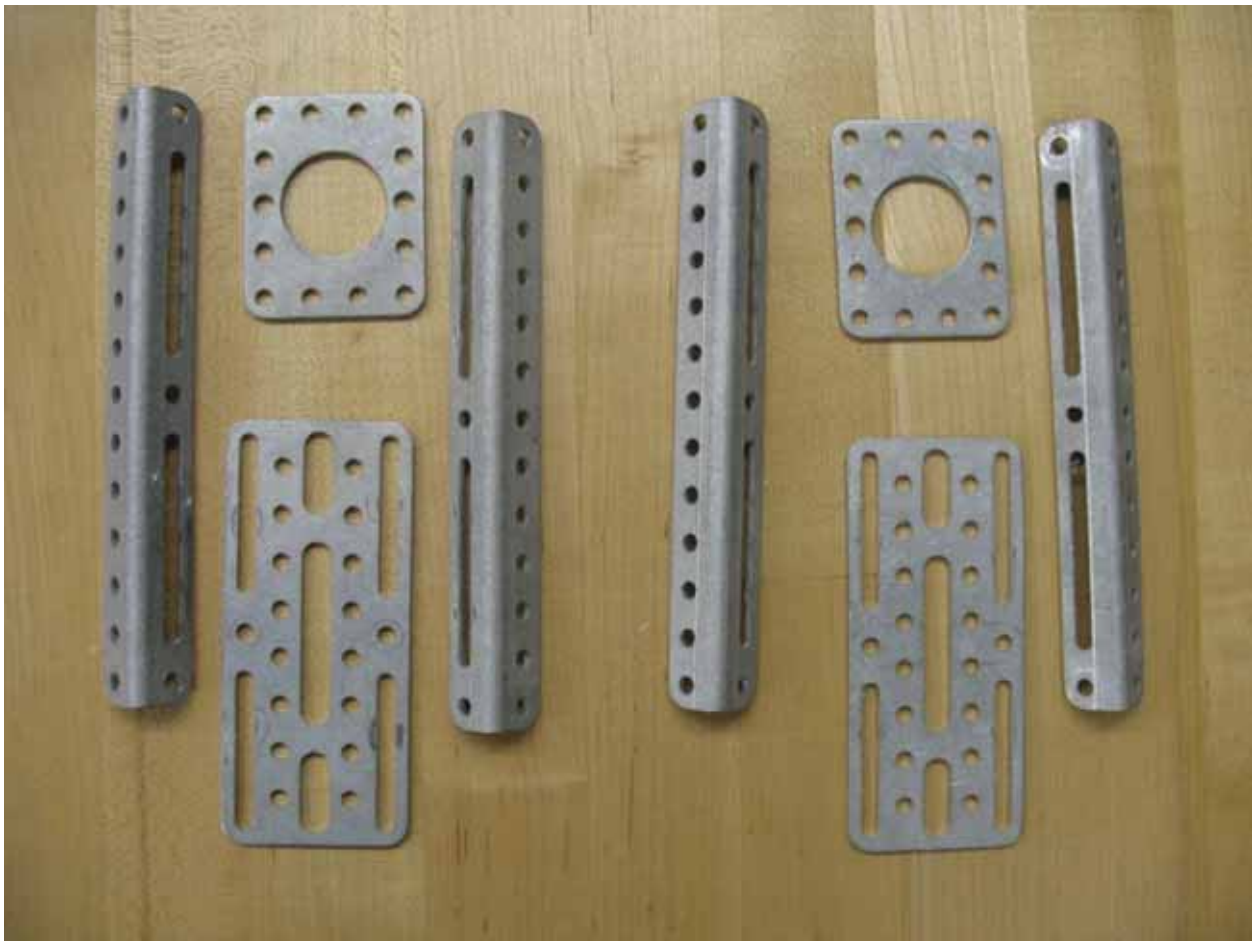
Parts Needed

4	13 Hole Angles
2	M15 Motor Mounts
2	Shaft Plates
16	1/2” 10-24 Bolts
16	#10 Flat Washers
16	#10 Internal Star Lock Washers*
16	10-24 Nuts*

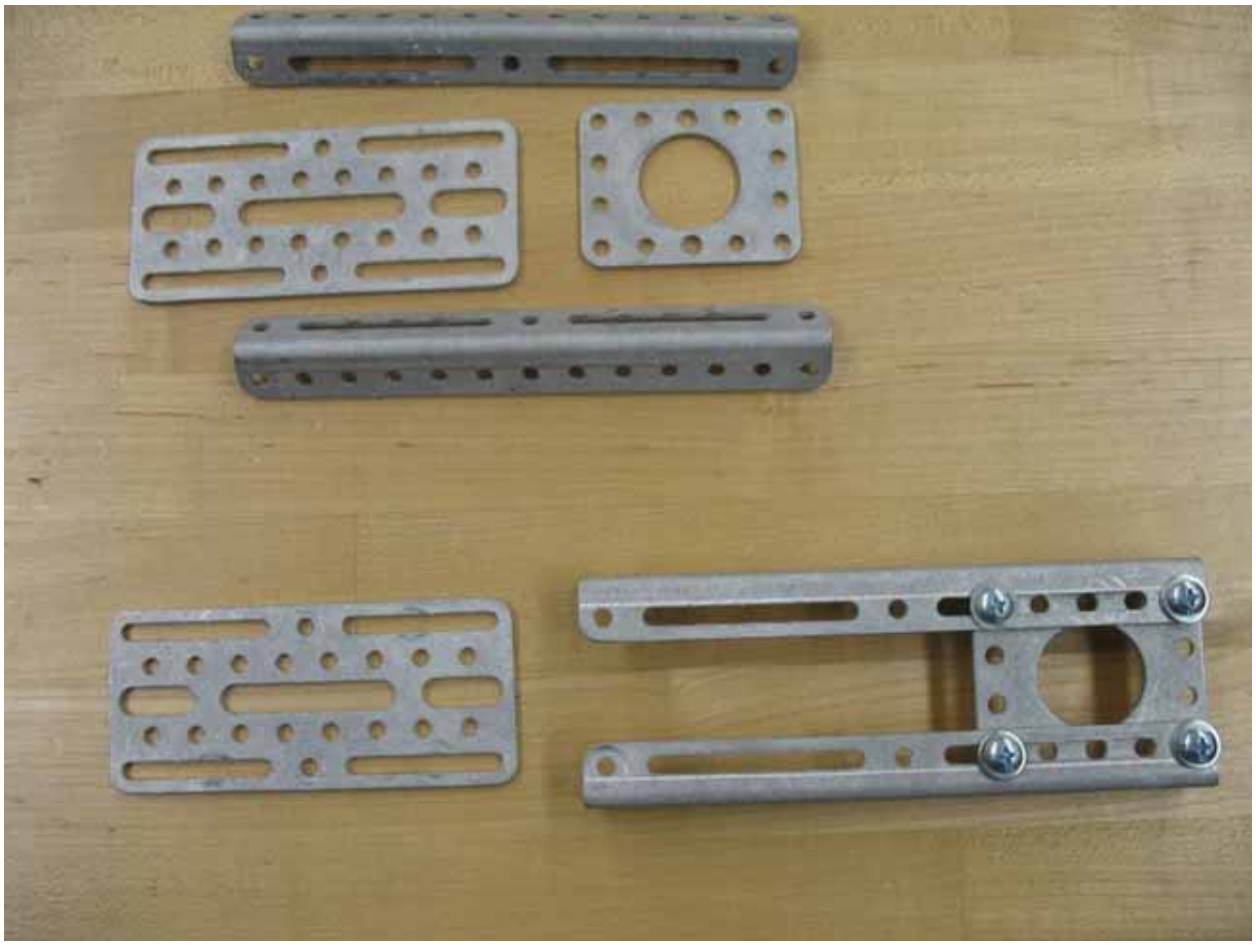
*NOTE: If Keps nuts are available you will not need the internal star washers.

Finished side rail sub-assemblies:



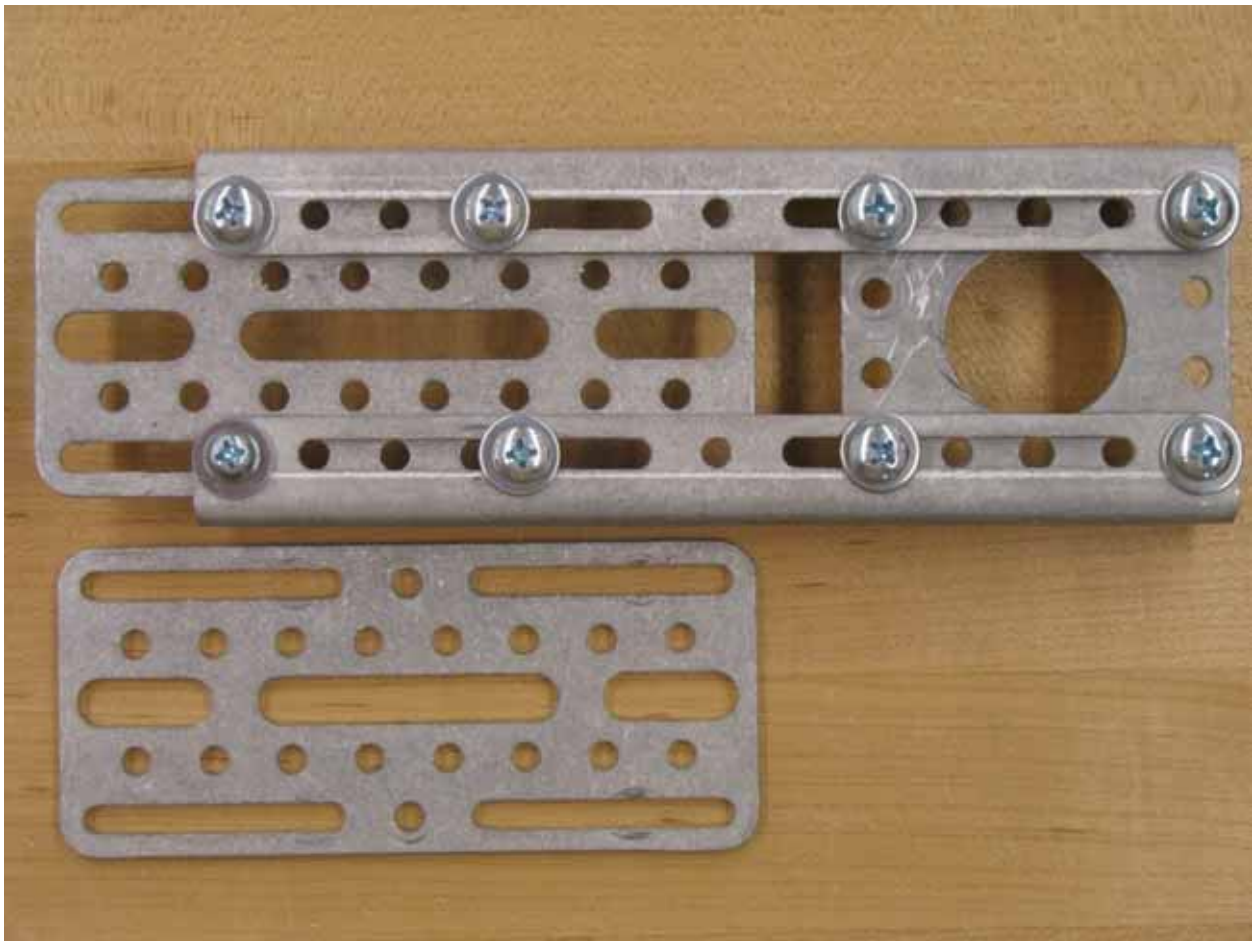


Take the 13 hole angles, the shaft plates, the M15 motor mounts, and line all the parts up as they are in the above picture. It is very important that you not only lay the parts out as in the above picture you need to build the side rail sub-assemblies so they are mirror images of each other. When the side rail sub-assemblies get mounted on the lower flat plate it is critical the parts line up from side to side.

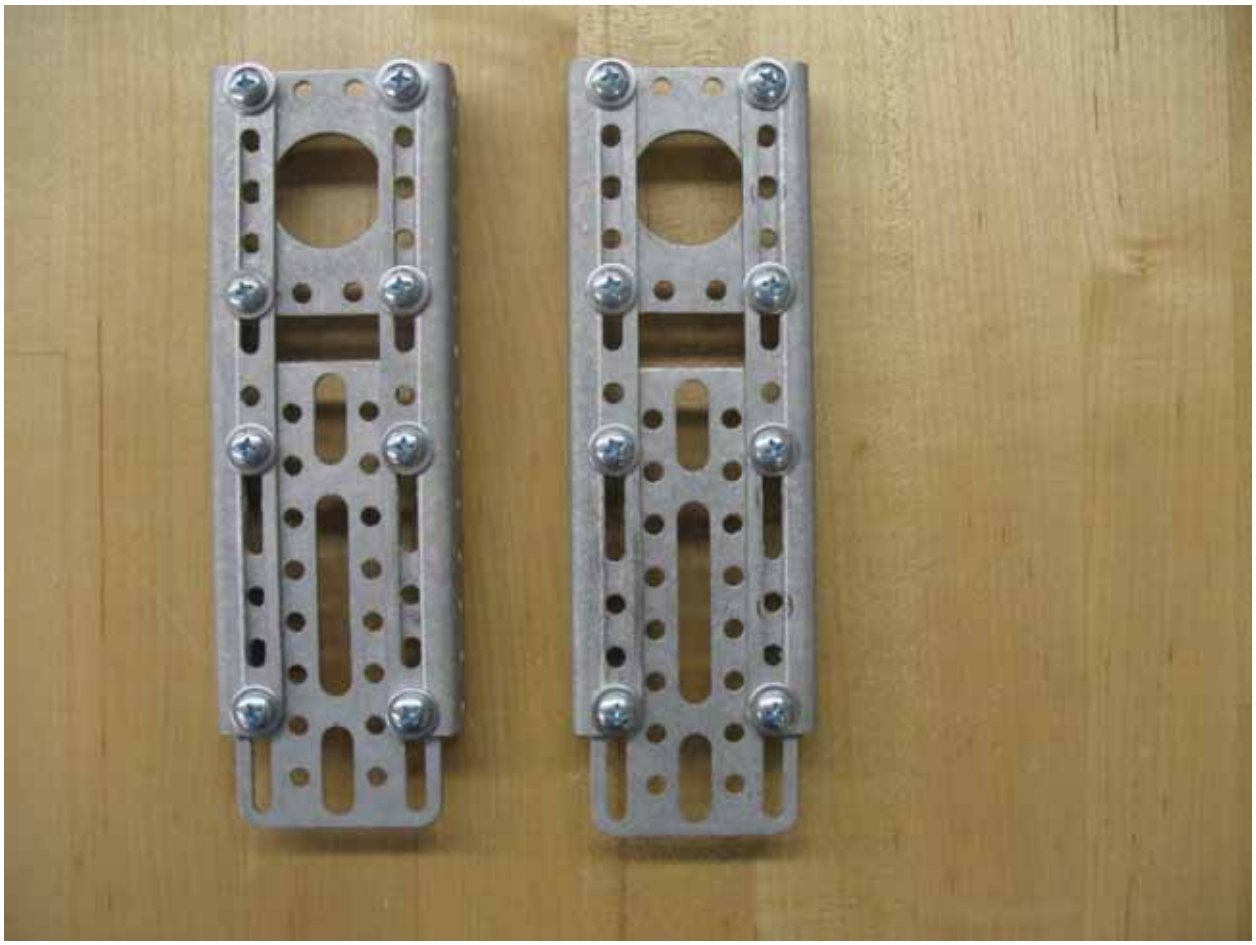


Start building the side rail sub-assemblies by taking the 13 hole angle and the M15 motor mount and bolting them together lightly as shown in the above picture. Be sure to keep the M15 motor mount to the inside of the 13 hole angles (shown above). When bolting these pieces together use a 3/8" 10-24 bolt, a flat washer, an internal star lock washer and a nut. Keep the flat washer by the head of the bolt, and the internal star lock washer by the nut on the end of the bolt. An illustration of this is shown in the picture below.

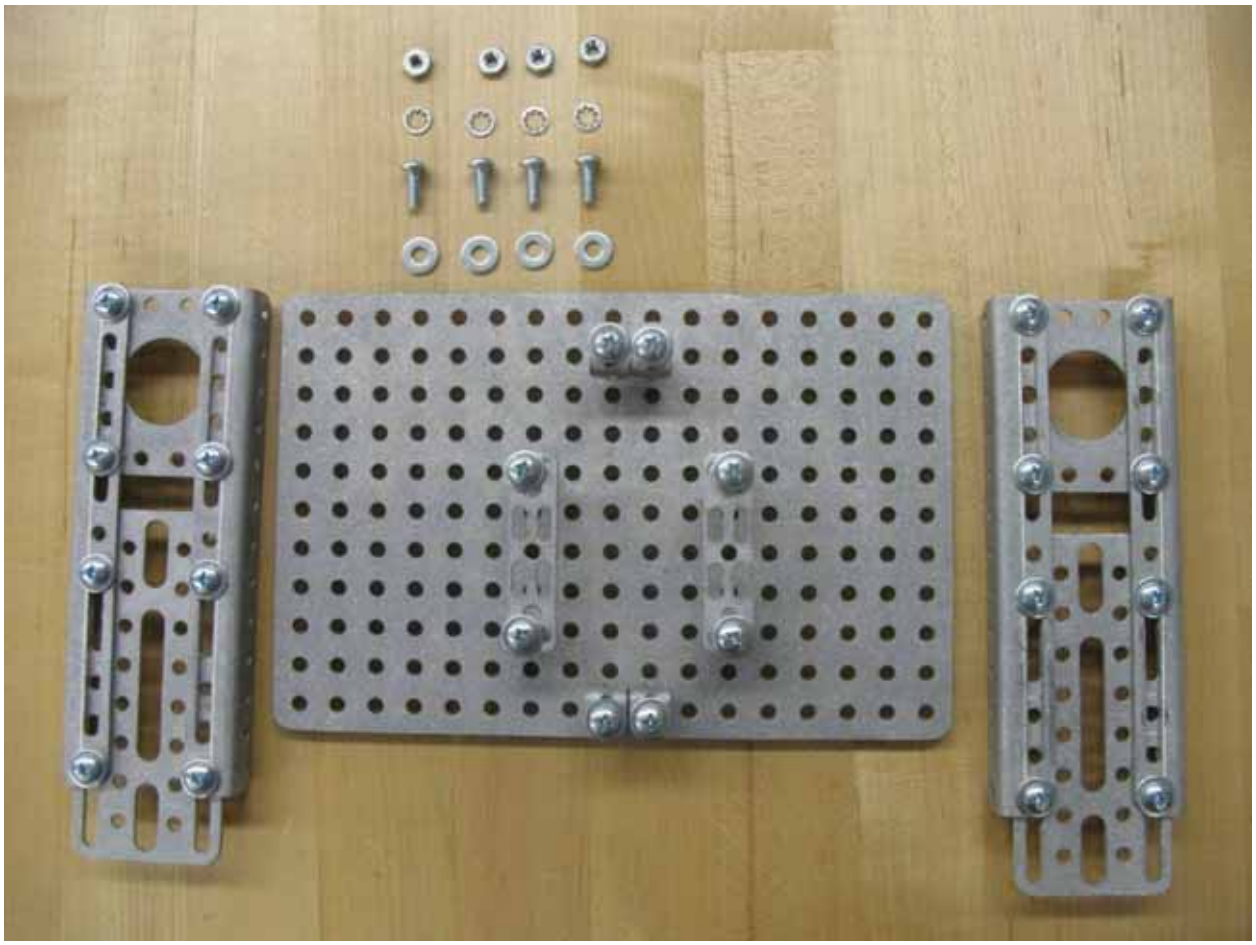
Note: The 3 hole flat bar represents the 13 hole angle and the M15 motor mount.



When attaching the shaft plate make sure the bolts going through the 13 hole angle go into the long openings on the top and bottom of the shaft plate. The shaft plate will be used to tension the drive chain on each side of the Verminator Bot later on in the assembly. So it is very important the shaft plate can slide forwards and backwards.



Once you have built one side rail sub-assembly build a second one that is the mirror image of the first one you built. After you have built the two side rail sub-assemblies, lay the assemblies next to each other with the motor mount ends facing away from you (shown above). Check the side rail sub-assemblies to make sure everything lines up between the two side rail sub-assemblies. Once you have everything lined up, tighten the bolts that hold the M15 motor mount plate to the 13 hole angles on each side rail sub-assembly. DO NOT tighten the bolts that hold the shaft plate to the 13 hole angles on the side rail sub-assemblies as you need to be able to move these plates to adjust the drive chain tension later in the build.



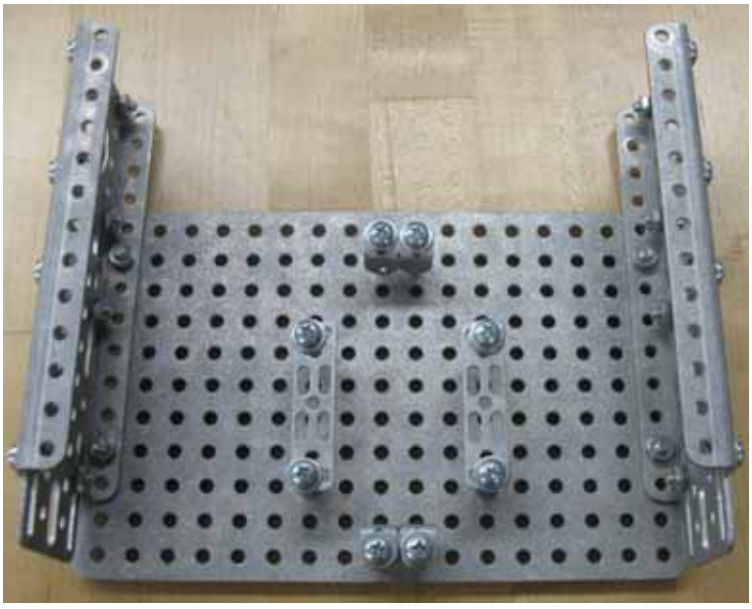
In this step you will build the lower chassis sub-assembly.

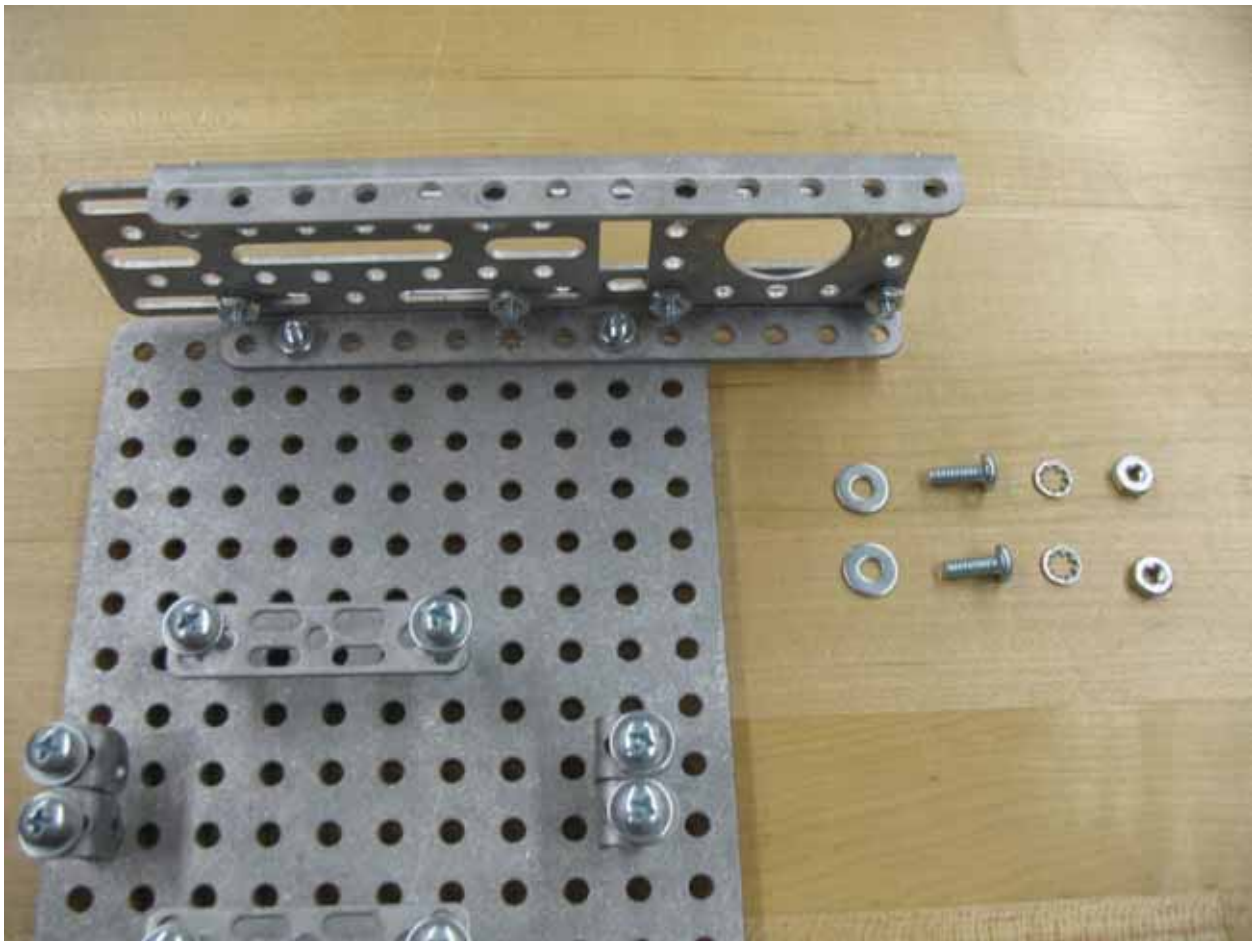
Parts Needed:

1	Lower Flat Plate Sub-assembly
2	Chassis Side Sub-assemblies
4	½" 10-24 bolts
4	# 10 Washers
4	#10 Internal Star Lock Washers*
4	10-24 nuts

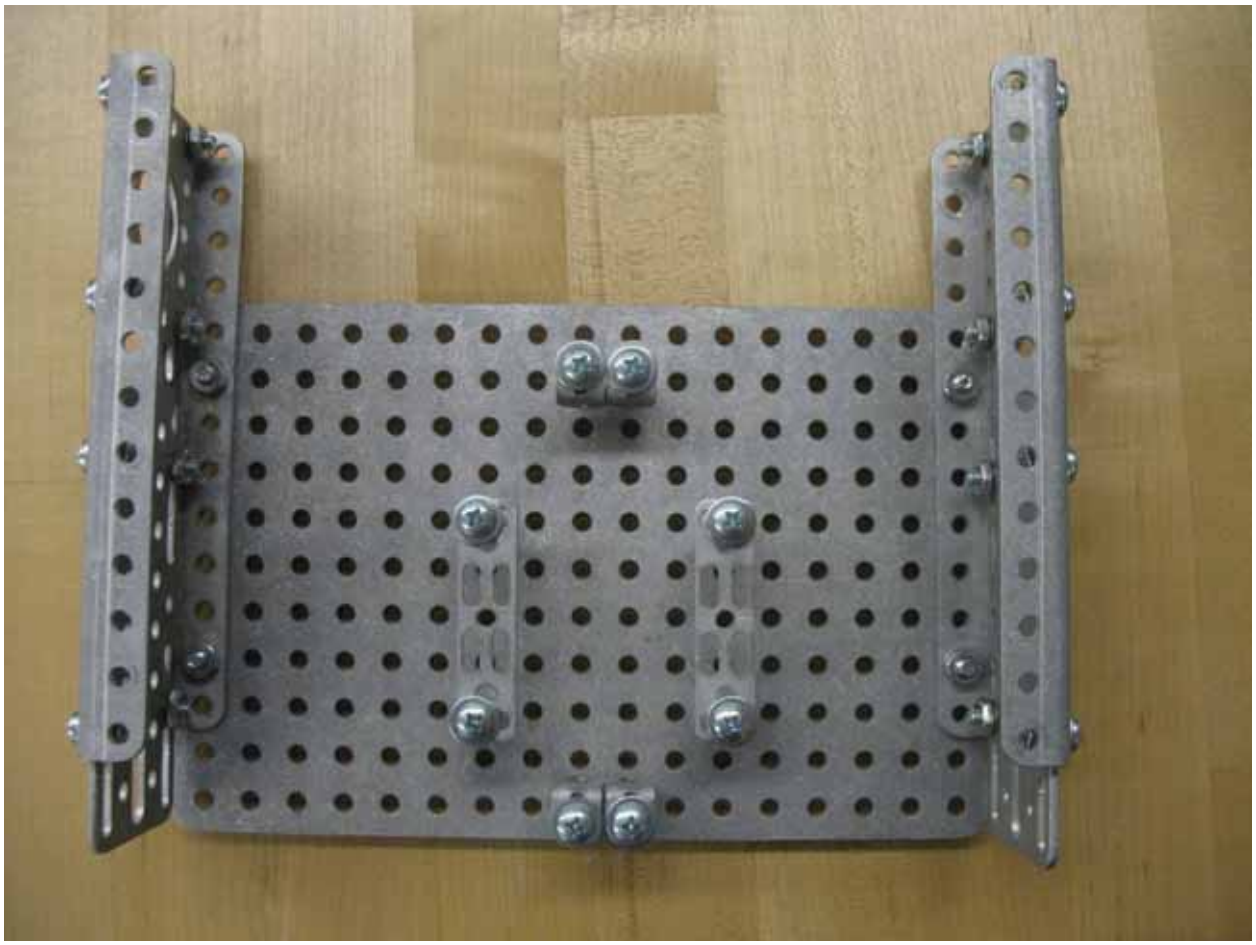
*Not needed if Keps nuts are available.

Finished lower chassis sub-assembly

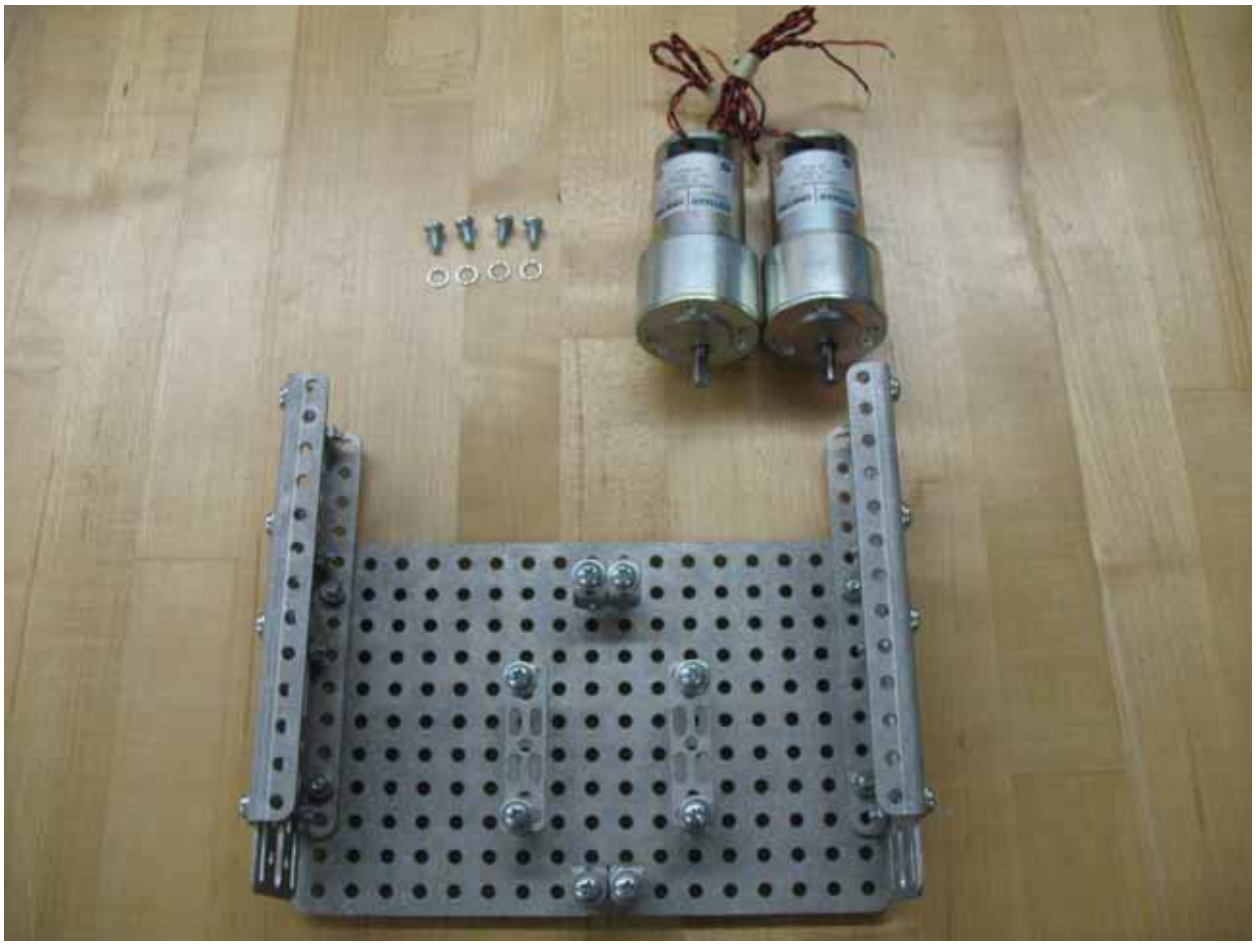




To attach the side rail sub-assemblies to the lower flat plate sub-assembly, lay the lower flat plate sub-assembly so that the long side with the extra row of holes is facing to the right (shown above). With the lower flat plate in position, align the side rail sub-assembly so the motor mount end is facing to the right and the angled part of the 13 hole angle is facing towards the inside of the robot. The motor mount end of the side rail sub-assembly should extend four holes past the front of the lower flat plate (shown above). Keeping everything lined up insert bolts with flat washers on from the under the lower flat plate sub-assembly of the robot through the 2nd hole in from the left on the side rail and the 8th hole in from the left on the same side rail sub-assembly. With the bolts in their proper locations place an internal star lock washer on the bolts and thread nuts onto the bolts. Be sure to attach the side rail sub assembly to the lower flat plate on the row of holes that is the furthest away from you.



Line the second side rail sub-assembly up with the side rail sub-assembly you just installed on the lower flat plate. Keep the motor mount ends facing the same direction and line everything up side to side. Once everything is aligned properly use two of each of these parts to attach the second side rail sub assembly: ½" 10-24 bolts, #10 washers, #10 internal star lock washers, and nuts. With all the bolts in place check the alignment, if everything is properly located tighten up the bolts that hold both of the side rail sub-assemblies to the lower flat plate. When you are finished your lower chassis sub assembly should look like the one pictured above, if it does not go back to the prior steps and look for where your chassis deviates from the directed way of building.



In this step you will be mounting two gear head motors into your Verminator Bot.

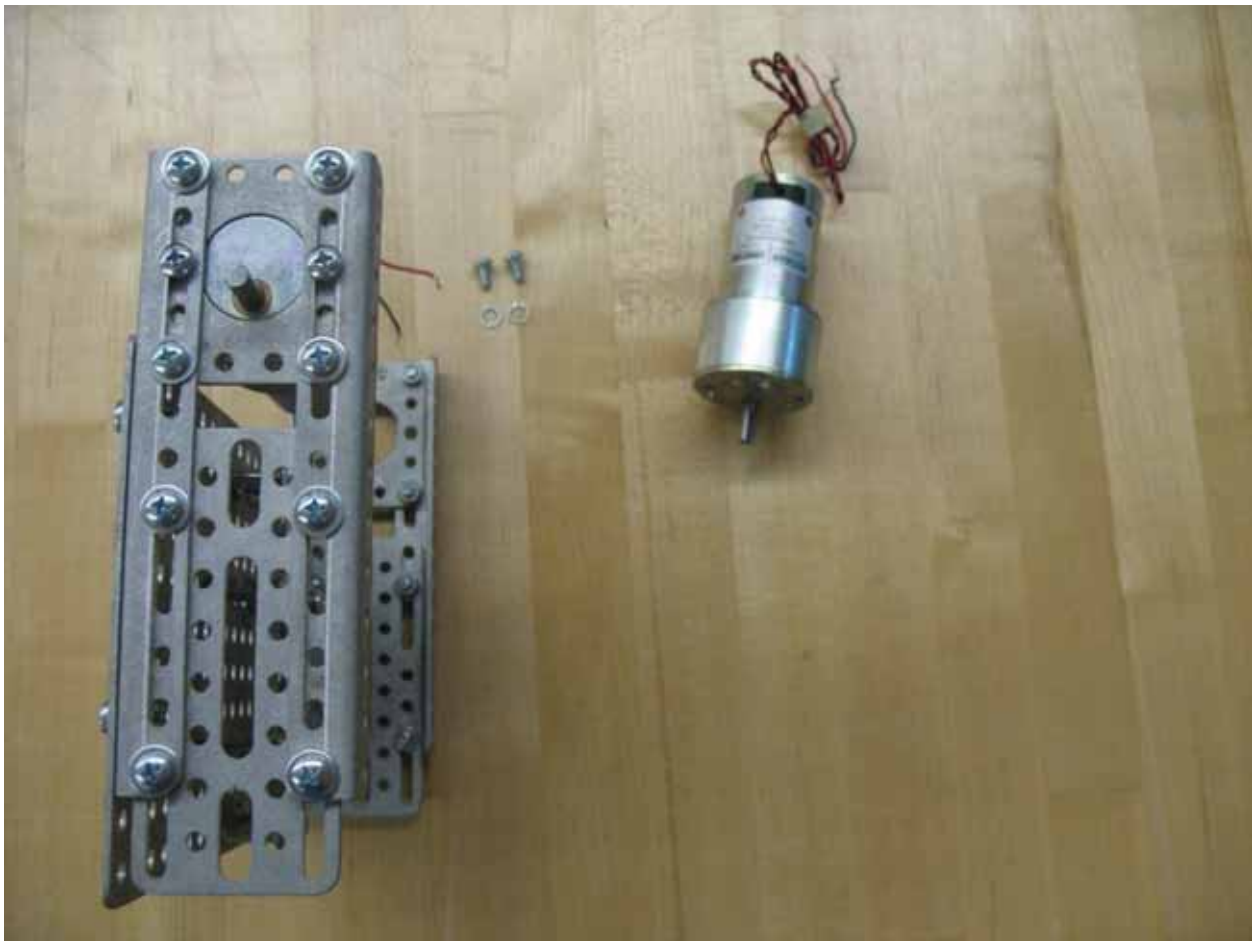
Parts Needed:

4 3/8” 10-32 Screws*

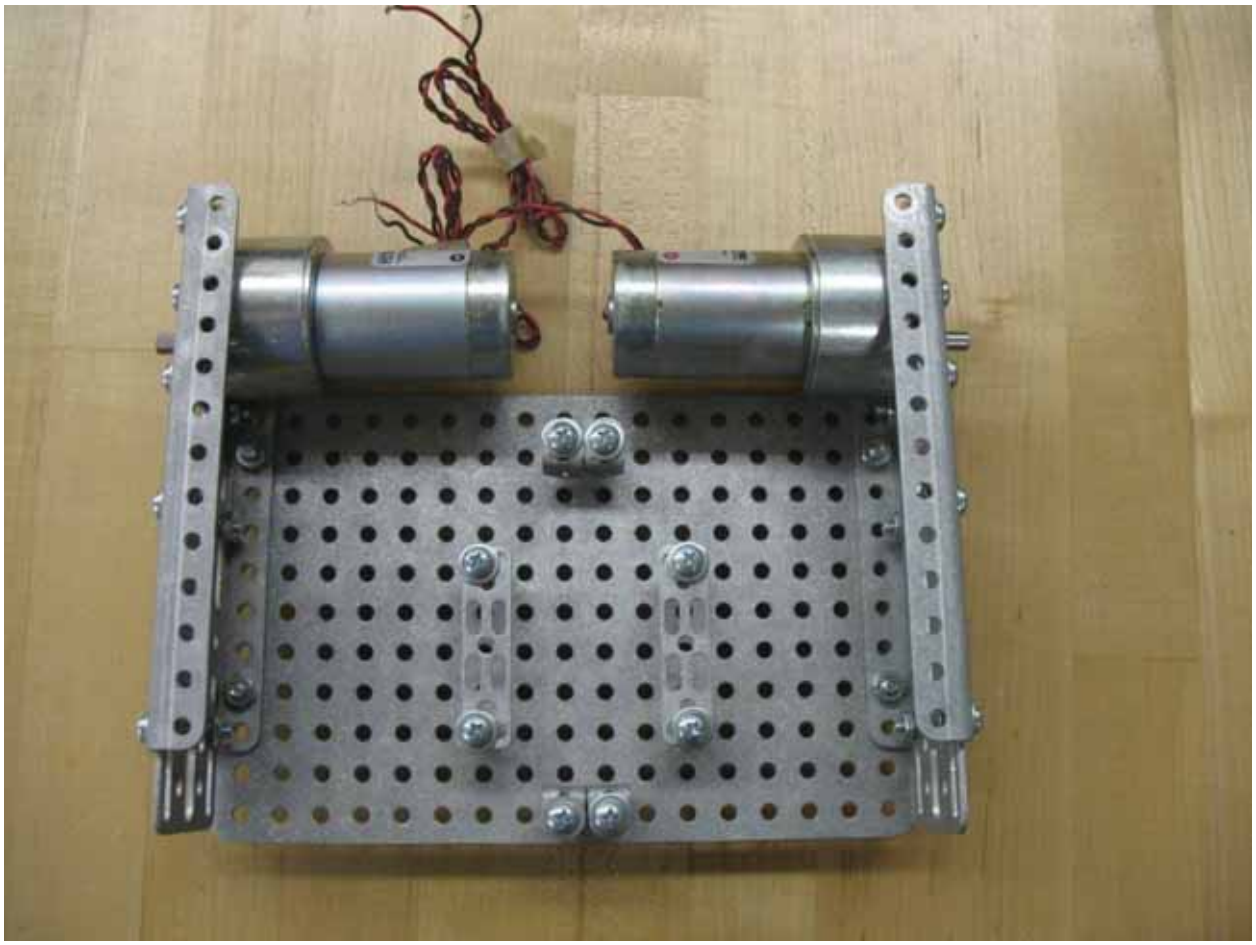
4 #10 Internal Star Lock Washers

2 Gearhead Motors

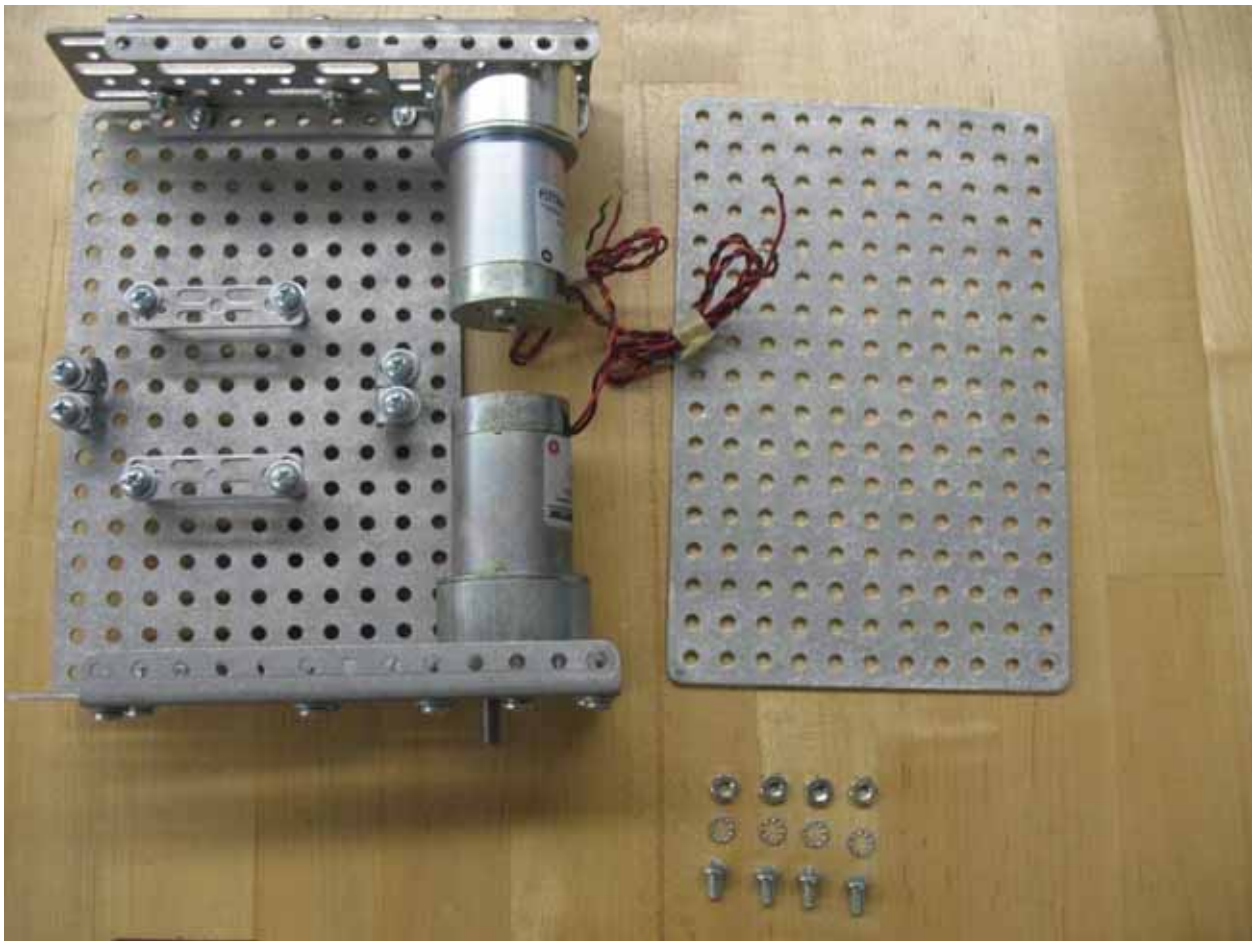
*DO NOT use 10-24 bolts in the motors you WILL damage the threads in the motor if you do. The threads on the 10-32 screws are much finer. You can tell the difference by looking at them as shown in the picture below.



When looking at the gearhead motor from the front you will notice the output shaft is not centered on the gearhead motor. It is not centered because as the name suggests there is actually a gear train located within the head of the motor. The output shaft of the motor is in the center of the motor which forces the gear box output shaft to be off center. Keeping the off center output shaft in mind orient the output shaft so it is close to the shaft plate (shown above). Using two 3/8" 10-32 bolts and #10 internal star lock washers secure the gearhead motor in place once it is properly located. Do this for each motor.



When both of your gearhead motors are mounted, their output shafts will line up from one side of the Verminator Bot to the other with the output shafts being oriented close to the shaft plates on the side of the bot. If they do not line up or are oriented so the output shafts are far from the shaft plates you need to remount one or both of the motors so they are oriented on the bot correctly.



In this step you will mount the upper flat plate to the lower chassis subassembly.

Parts Needed:

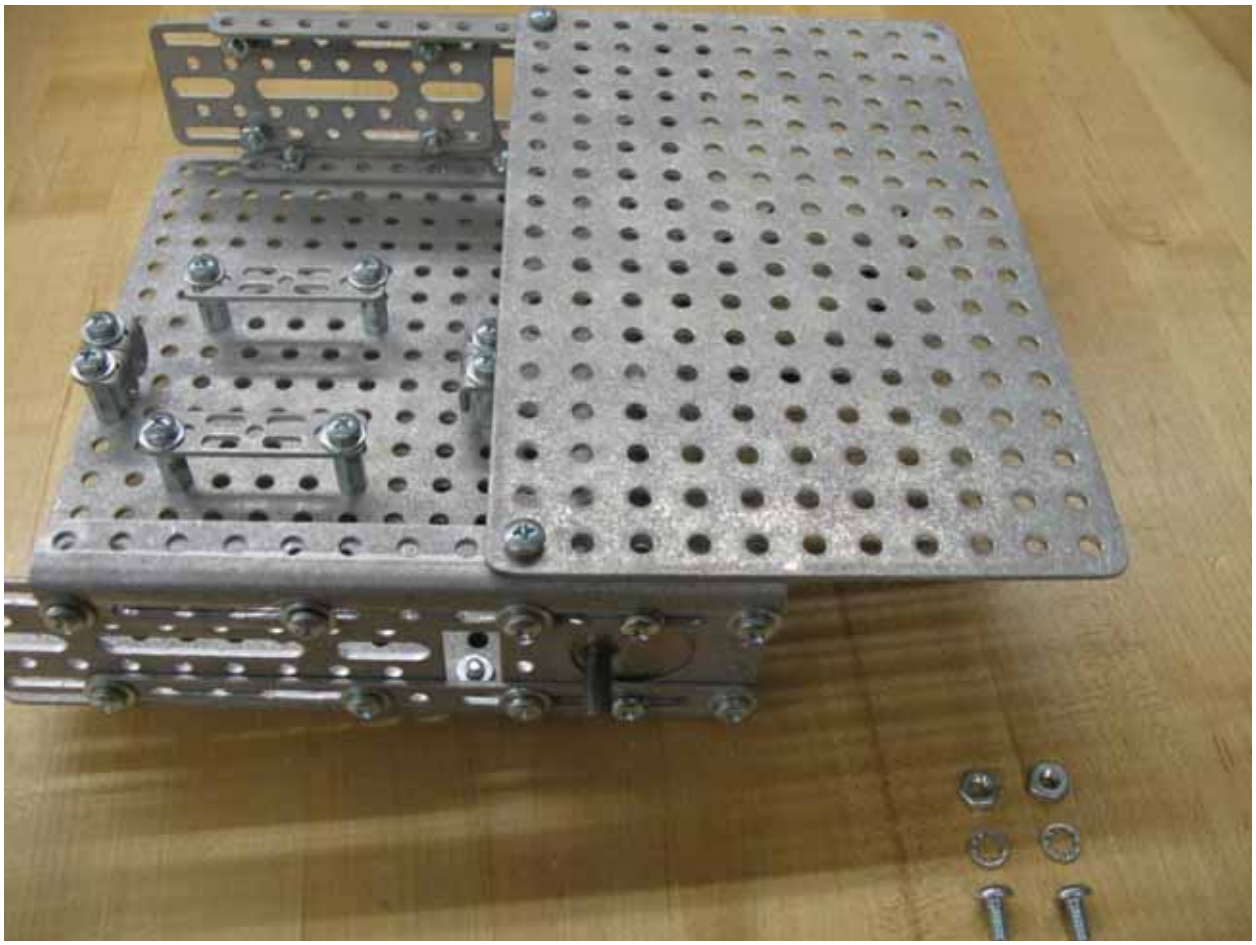
1 Flat Plate

4 3/8” 10-24 Bolts

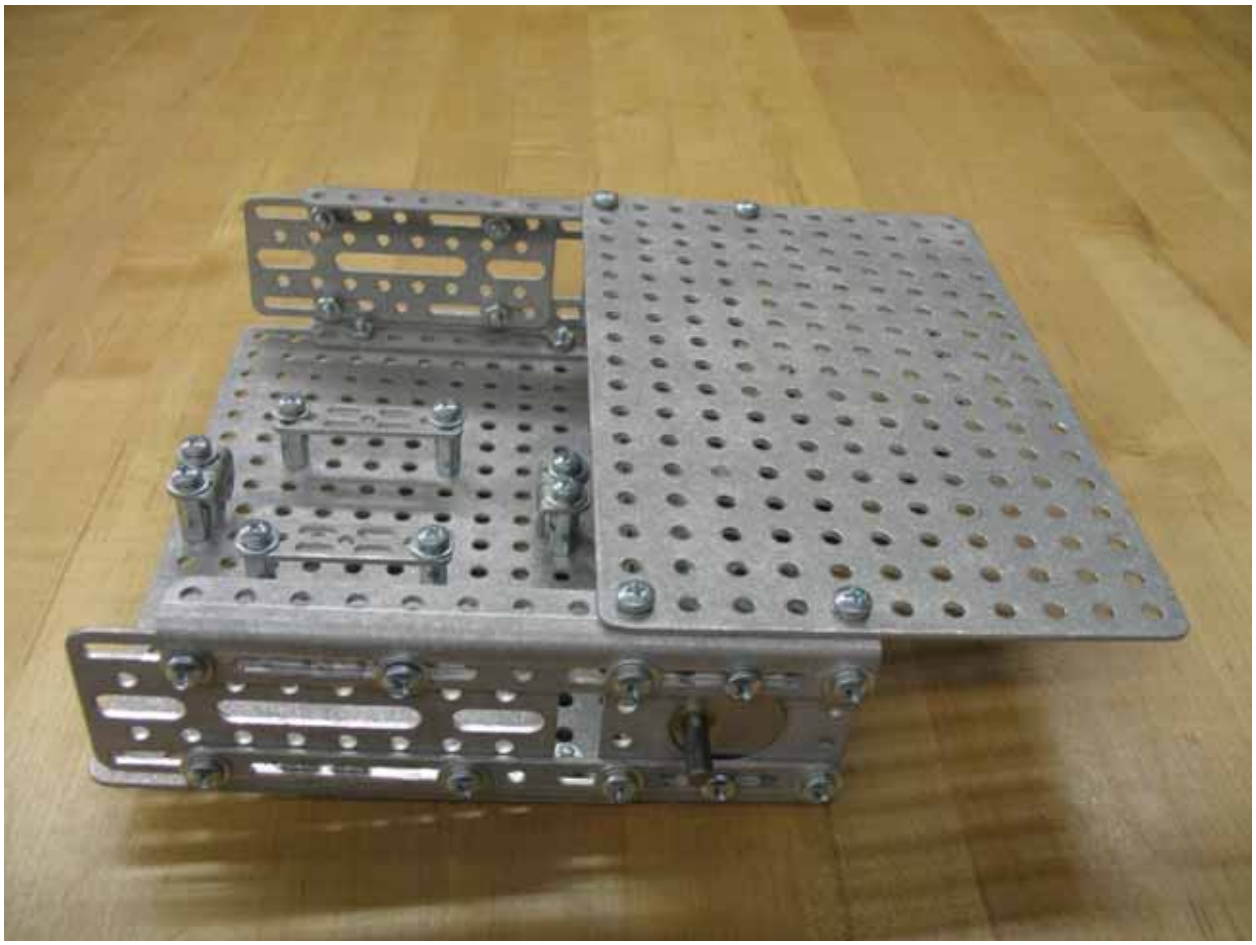
4 10-24 Nuts

4 #10 Internal Star Lock Washers

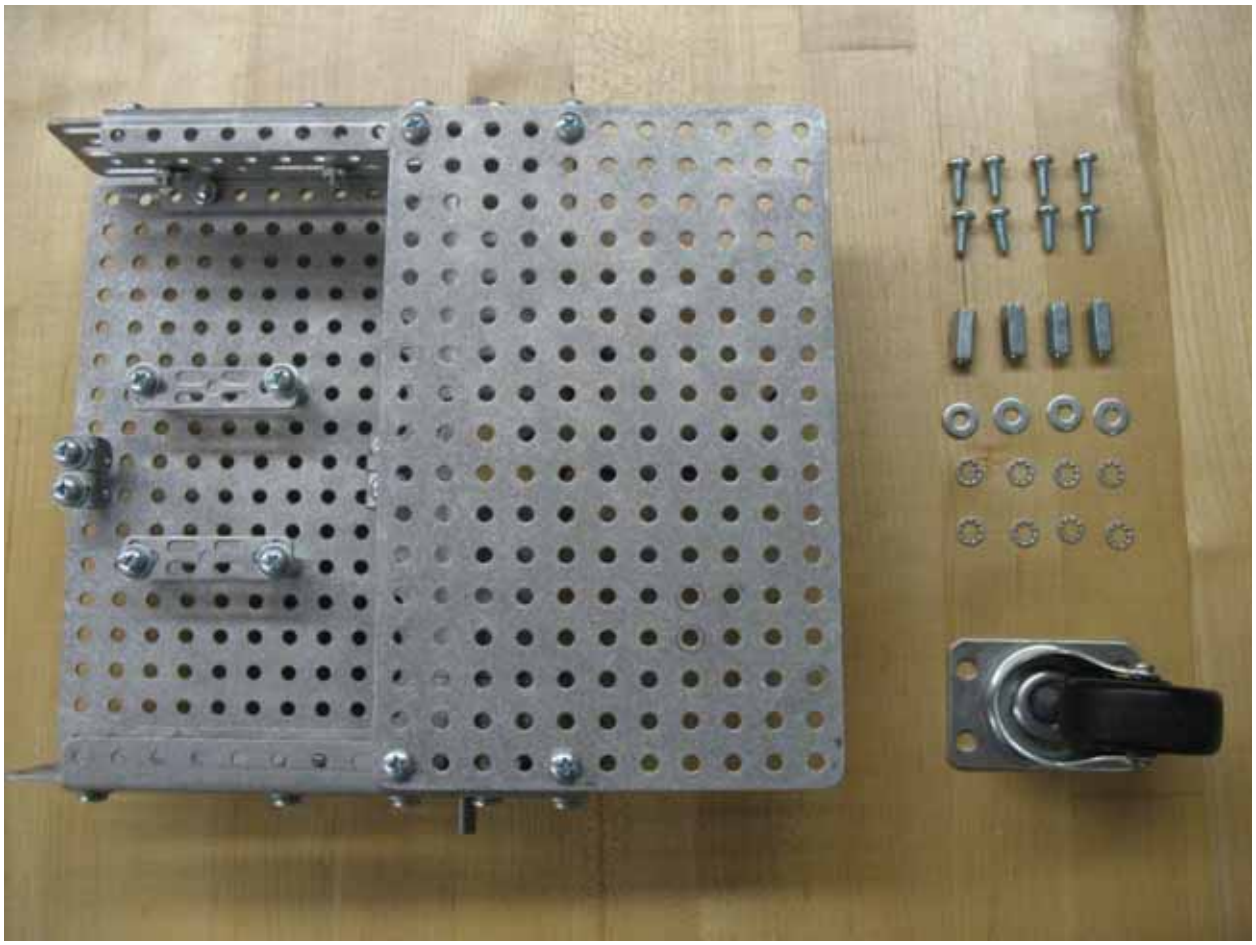
Finished:



On the upper flat plate insert a 3/8” 10-24 bolt with a #10 internal star lock washer through the corner holes on each end of the left side. Then count 5 holes in on the side rail and insert the bolts through those holes as well. This bolt should line up with the left bolt in the M15 motor mount plate. With the bolts going through the upper flat plate and the side rail in the proper locations (shown above) thread a nut on the end of each bolt and lightly tighten the bolts up.



Install another bolt and lock washer through each side of the upper flat plate and the side rail in line with the right bolt that holds the M15 motor mount in place on the side rail. With the bolts placed properly thread a nut on the bolt and lightly tighten it down. Compare your Verminator Bot to the one shown above to ensure the upper flat plat is installed correctly. The upper flat plate should only have 5 holes that are on top of the side rails and two of those holes should have bolts in them. If this is not the case revisit the last few steps to find where your bot deviated from the design and correct the problem.

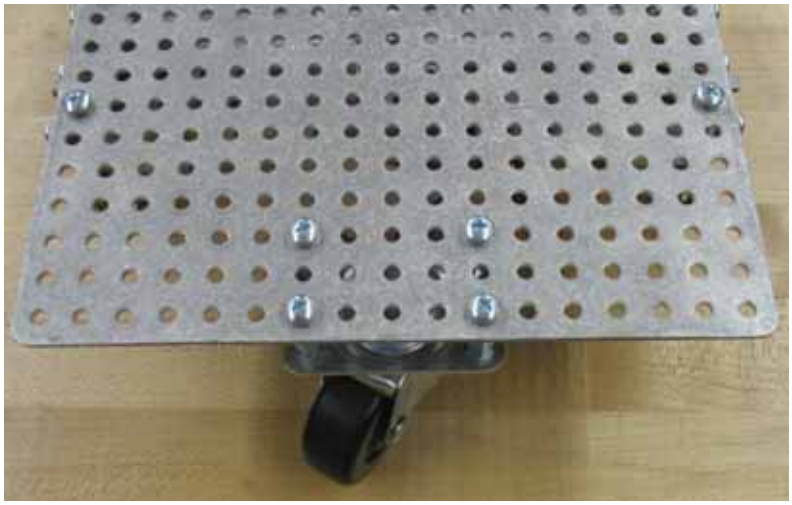


In this step you be installing the front wheel of the Verminator Bot.

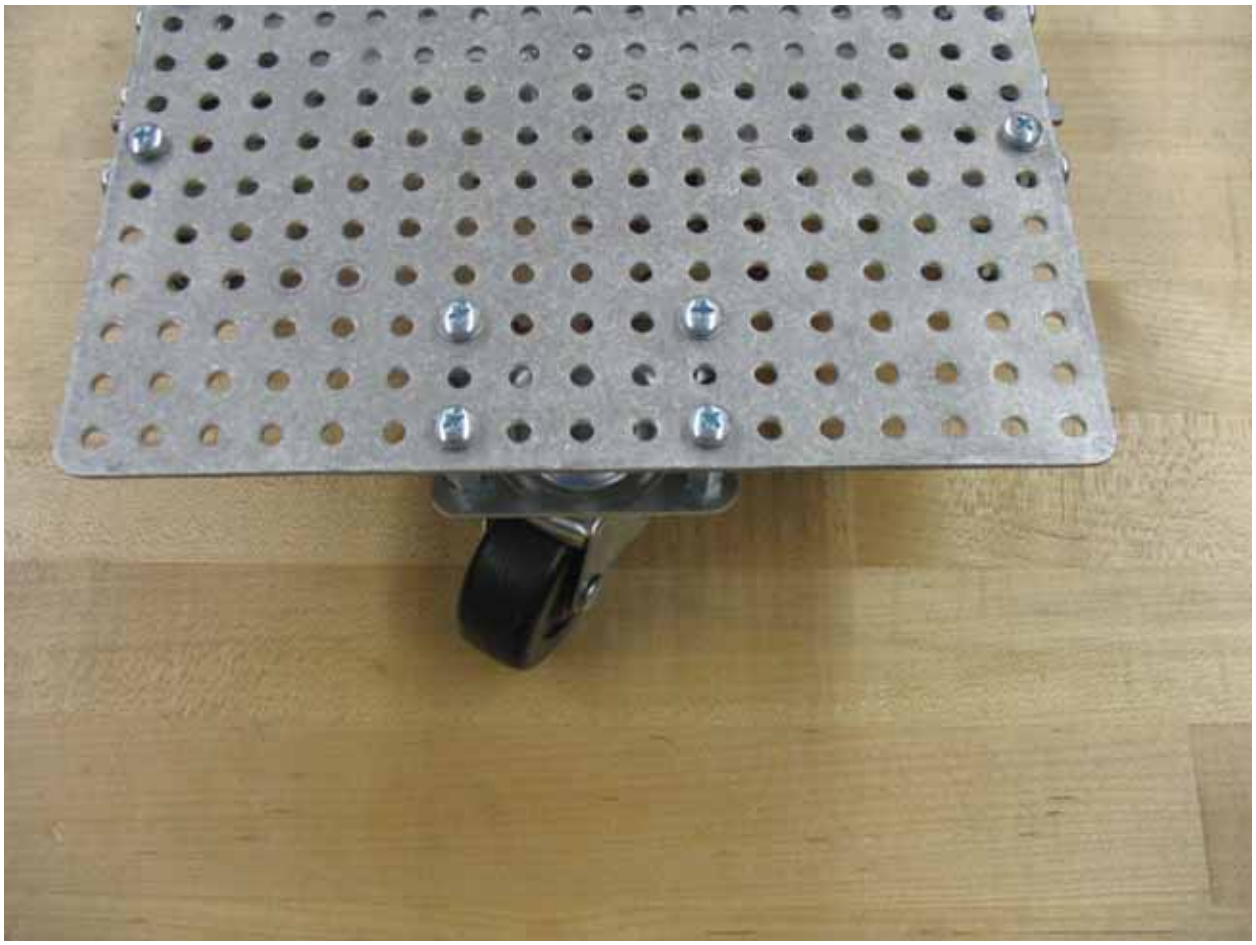
Parts needed:

1	2” Swivel Caster
4	¾” 10-24 Standoffs
4	#10 Flat Washers
8	#10 Internal Star Lock Washers
8	½” 10-24 Bolts

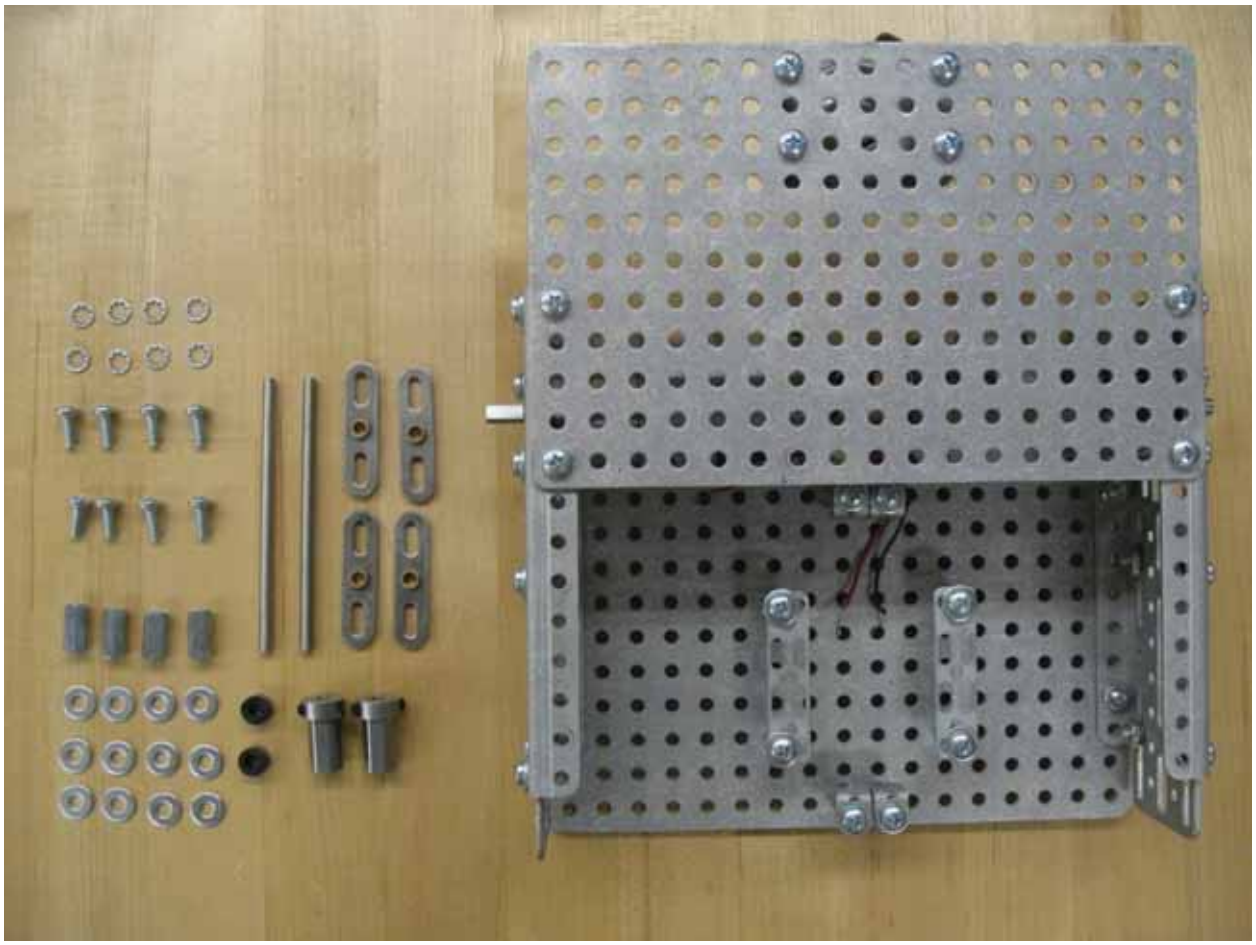
Finished:



Attach the ¾" 10-24 standoffs to the 2" swivel caster using ½" 10-24 bolts, #10 lock washers, and #10 washers. Below is a picture of the order in which you need to use the parts. The lock washer should be first on the bolt, the flat washer should be second and then the bolt should be inserted into a mount hole on the swivel caster. The standoff should then be threaded on to the bolt and lightly tightened. Do this for all 4 mounting holes. When you have installed all the standoffs the swivel caster should look like the one pictured above.



The swivel caster sub-assembly needs to be attached in the center of the robot with the long side of the caster assembly facing towards the front of the bot (shown above). The standoffs on the long side of the swivel caster need to be attached in the first row of holes on the front of the top flat plate. There should be 6 empty holes to either side of the standoffs on the swivel caster when it is centered on the front of the upper flat plate. Securing the swivel caster to the upper flat plate should be done with ½'' long 10-24 bolts and lock washers.

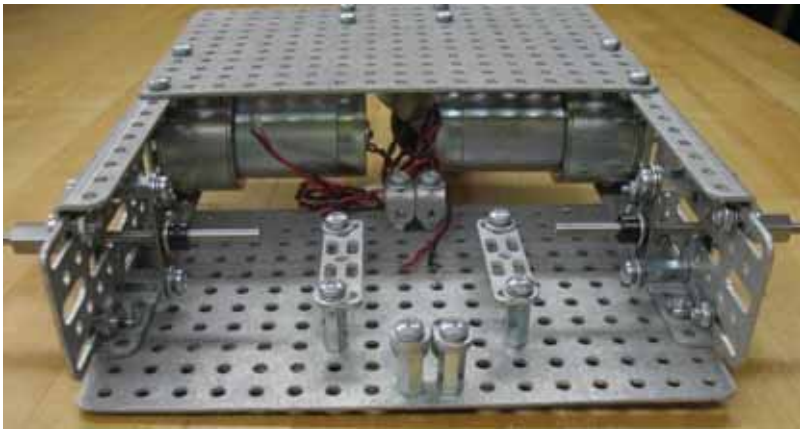


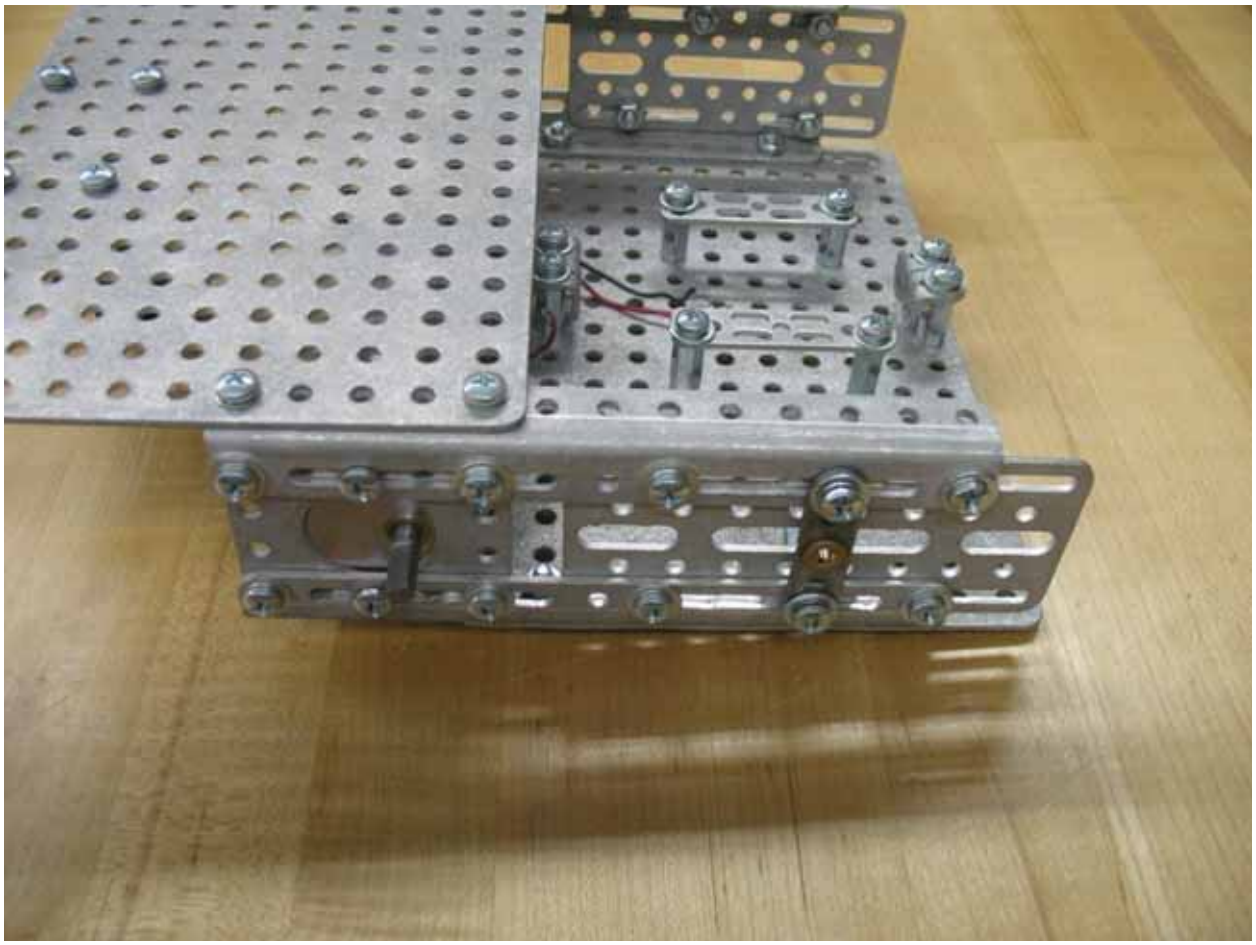
In this step you will be attaching the axles to the Verminator Bot chassis.

Parts Needed:

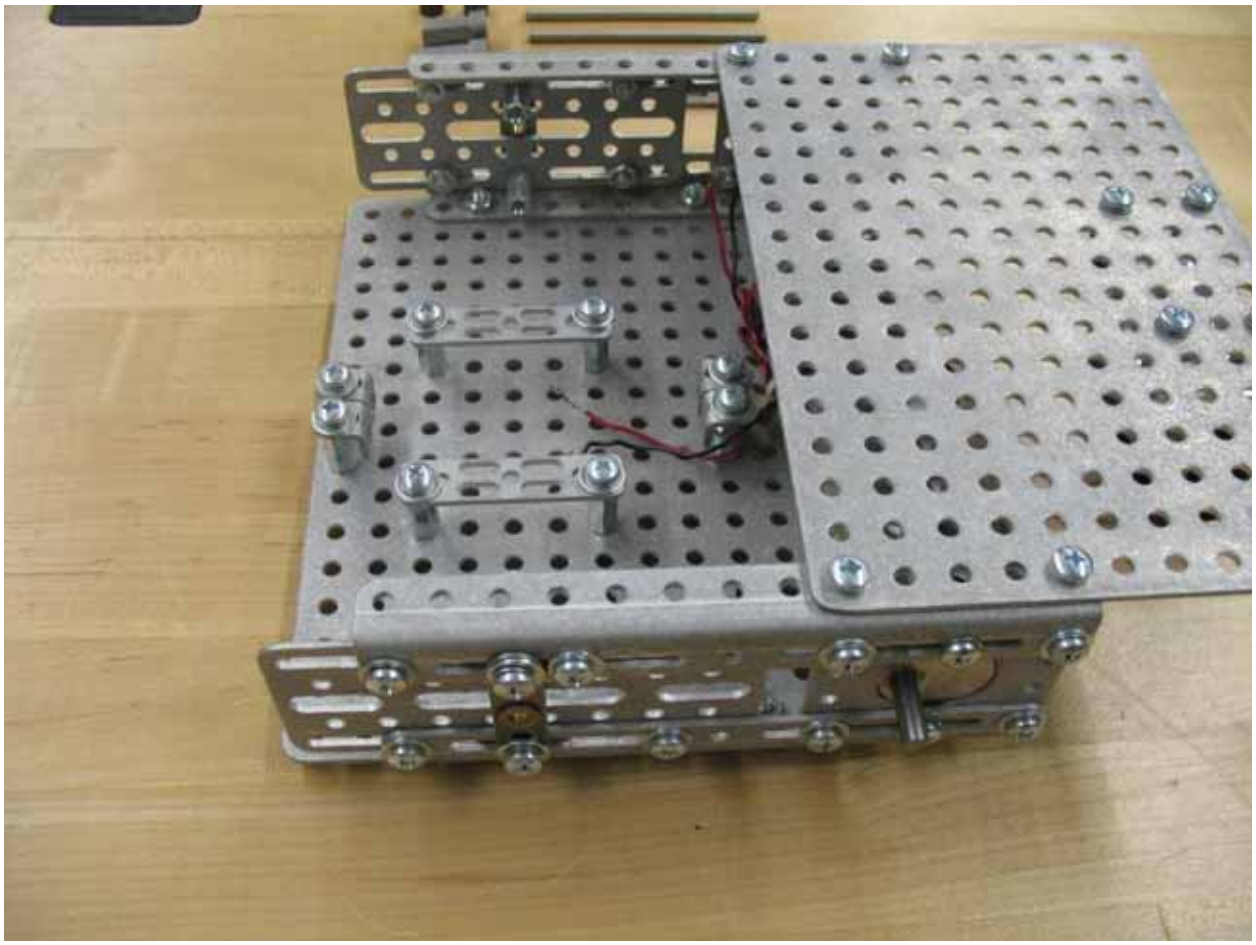
8	½” 10-24 Bolts
8	#10 Internal Star Lock Washers
4	¾” 10-24 Standoffs
12	#10 Flat Washers
2	4” 3/16” Axle Shafts
2	3/16” Shaft Collars
2	Hex Adapters
4	Bushing Brackets

Finished:

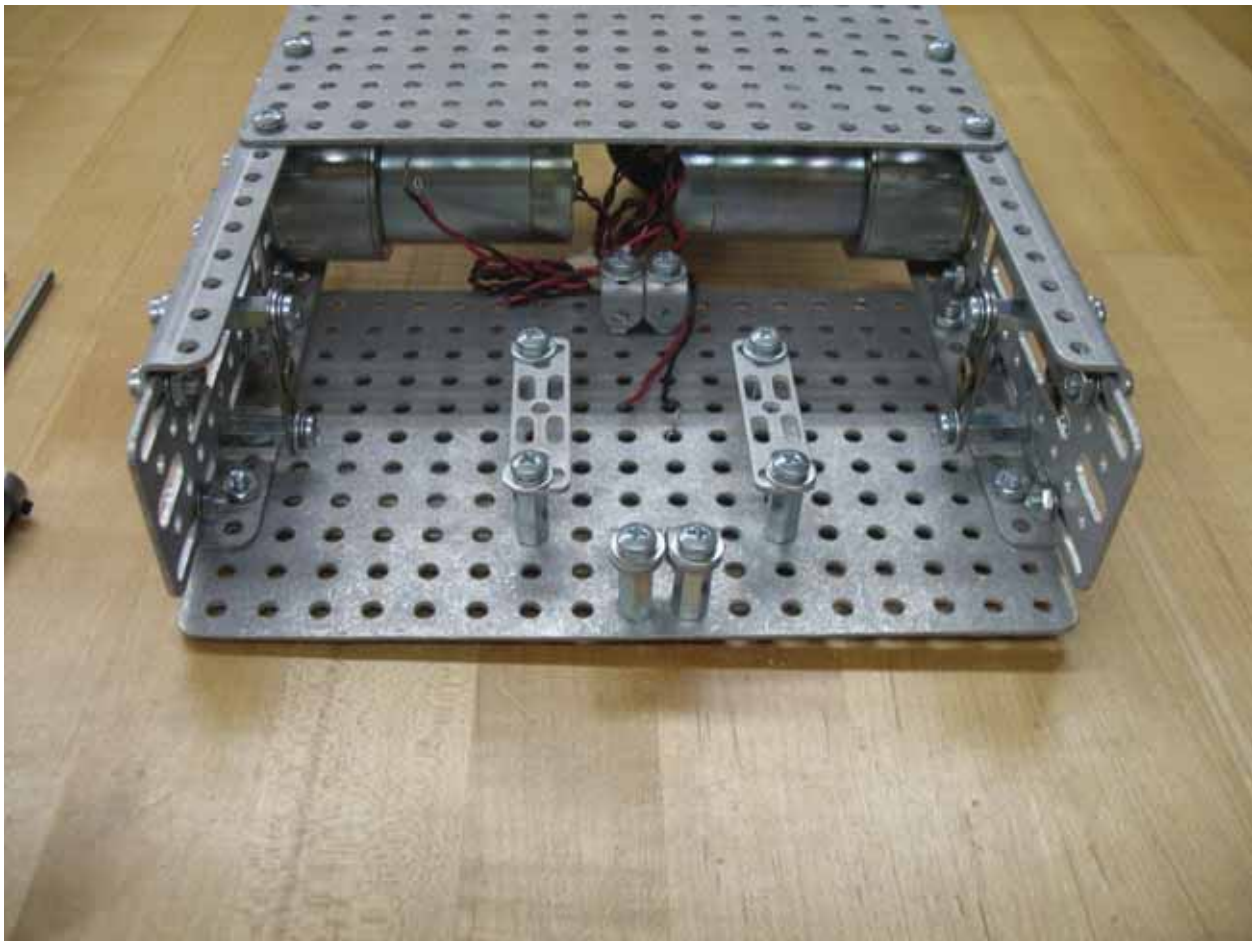




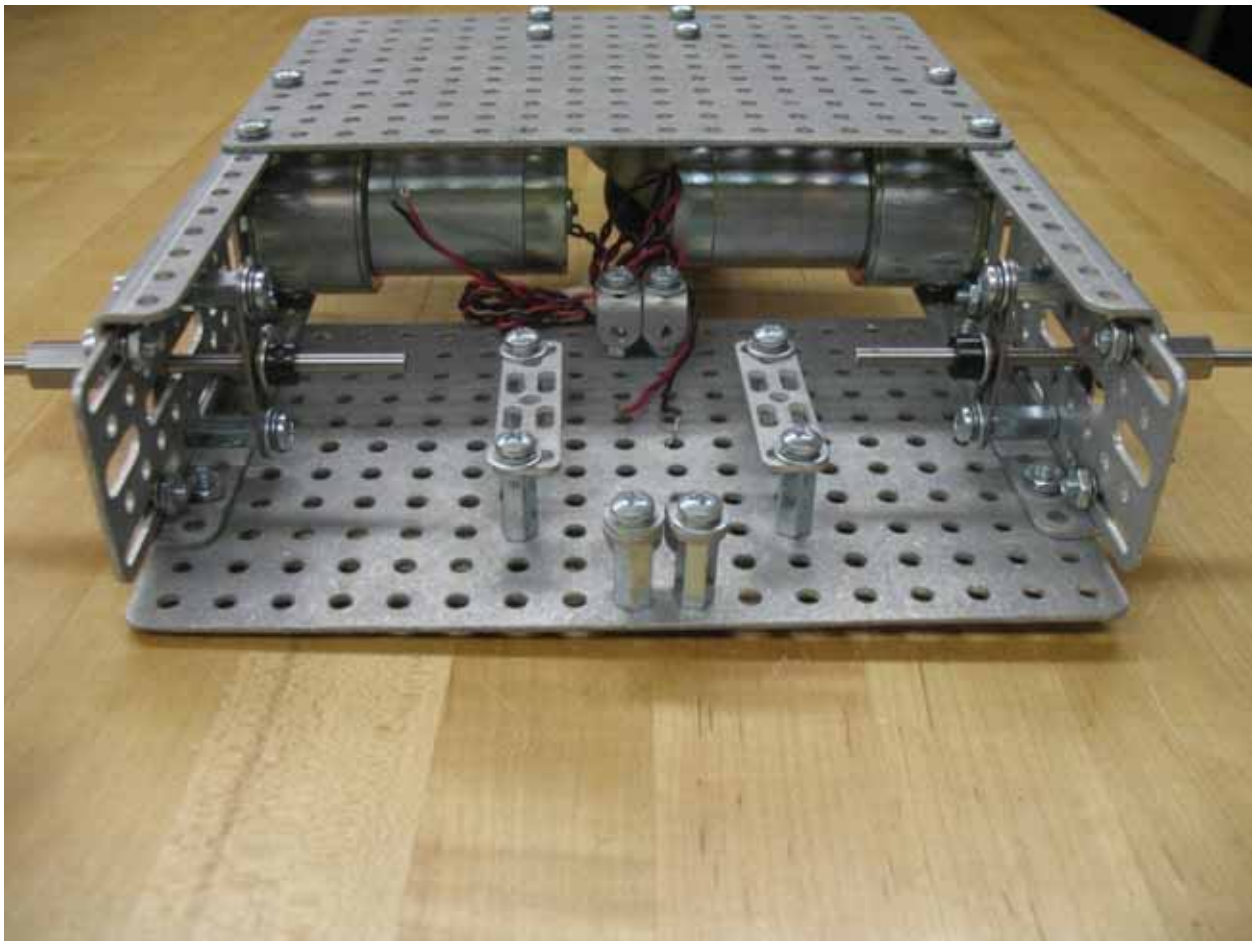
Bolt a bushing bracket on the outside of the left side rail of the chassis sub-assembly using two each: #10 flat washers, #10 lock washers, ½" 10-24 bolt, and ¾" 10-24 standoffs. Position the bushing bracket as it appears in the above picture. Slide a #10 lock washer and a #10 flat washer on a ½" 10-24 bolt and insert the bolt through the bushing bracket. Then slide the bolt through the upper slot on the side rail of the bot making sure the bolt goes through the hole on the shaft plate. On the shaft plate there are long slots on each side of a hole in the center of the plate along the top and bottom edges. This is the hole in the shaft plate you need to bolt the bushing bracket to on the top and bottom. With the bolt inserted in the correct hole thread a ¾" 10-24 standoff on to the back of the bolt. Do the same procedure for the bottom hole in the bushing bracket. Once you have the bushing bracket attached lightly tighten up the bolts.



On the right side rail bolt a bushing bracket on using the same procedure from the last step. Keep the bushing brackets only lightly tightened as you will need to adjust these mounts when you adjust the chain tension. When you have both of the outside brackets installed your bot will look like the one pictured above.

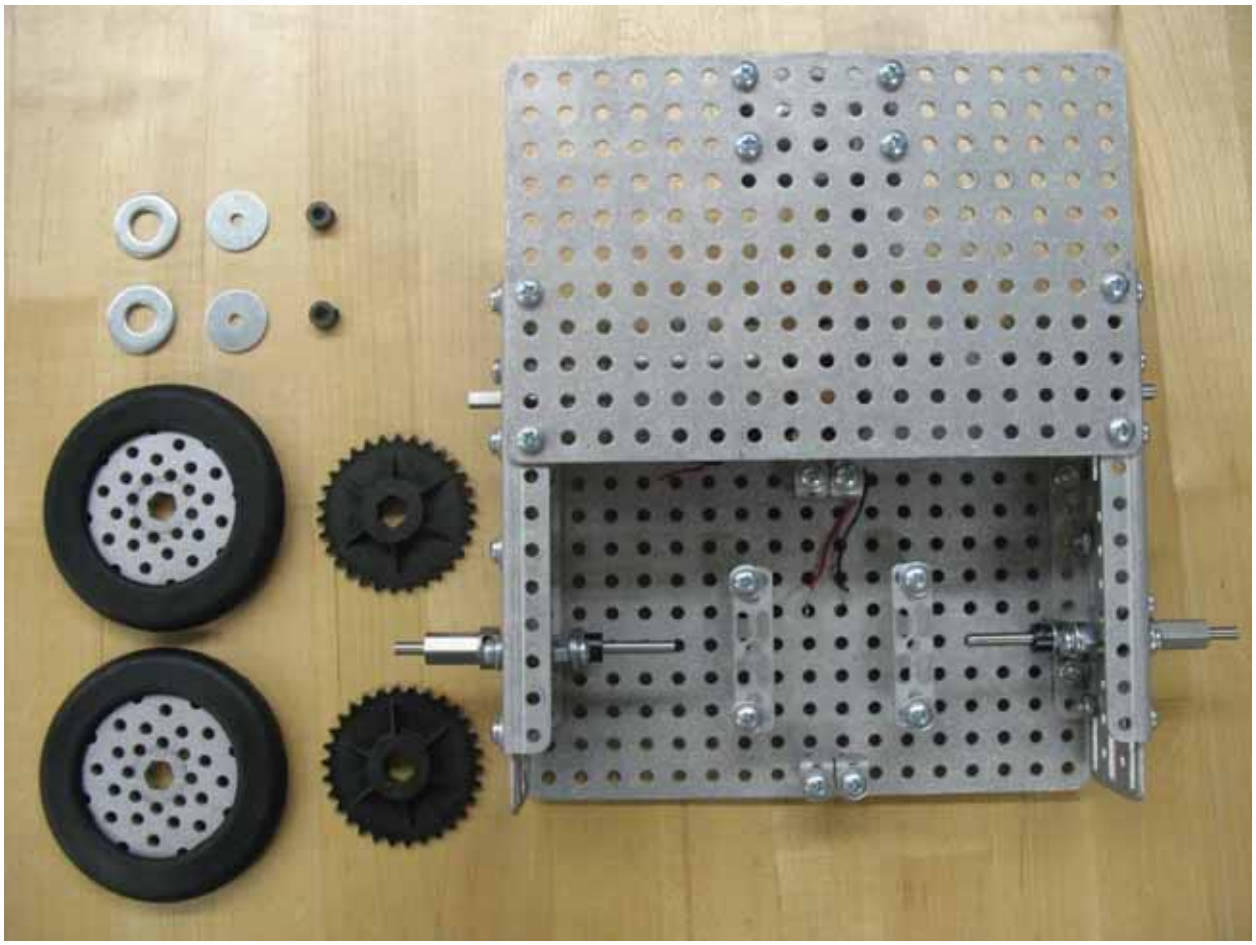


Install the inner bushing brackets by bolting them to the inner ends of the standoffs that are holding the outer bushing brackets on. Do this using ½" 10-24 bolts with #10 lock washers and flat washers. Put the lock washer by the head of the bolt and flat washer right behind the lock washer. Do this on all four bolts you use to install the inner bushing brackets. Lightly tighten these bolts as you did for the bolts that are holding the outer bushing brackets in place.



Slide a 4” long 3/16” axle shaft into each of the axle mounts you just made. On the axles slide a washer on the inside and the outside of the side rails. After you slide the flat washers on, slide a 3/16” shaft collar on the inside end of each axle (shown above). On the outside end of the axle slide the hex adapter. Below is a picture of how the axle should go together. On the outside of the side rail there needs to be a flat washer and a hex adapter on the axle. On the inside of the side rail there needs to be a flat washer and a shaft collar on the axle. Do not tighten the hex adapters or the shaft collars as they will be adjusted during a later step.

Note: Inspect the shaft for damage from previous assemblies, as set screw damage may hinder parts assembly. A metal file can be used to remove any high spots.



In this step you will be mounting the wheels on the axle shafts.

Parts Needed:

2 3/16” Shaft Collars

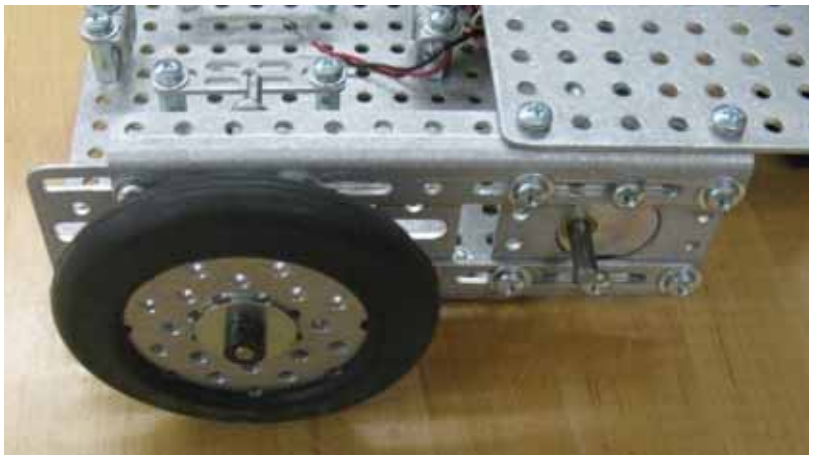
2 3/16” Diameter Center Hole Washers

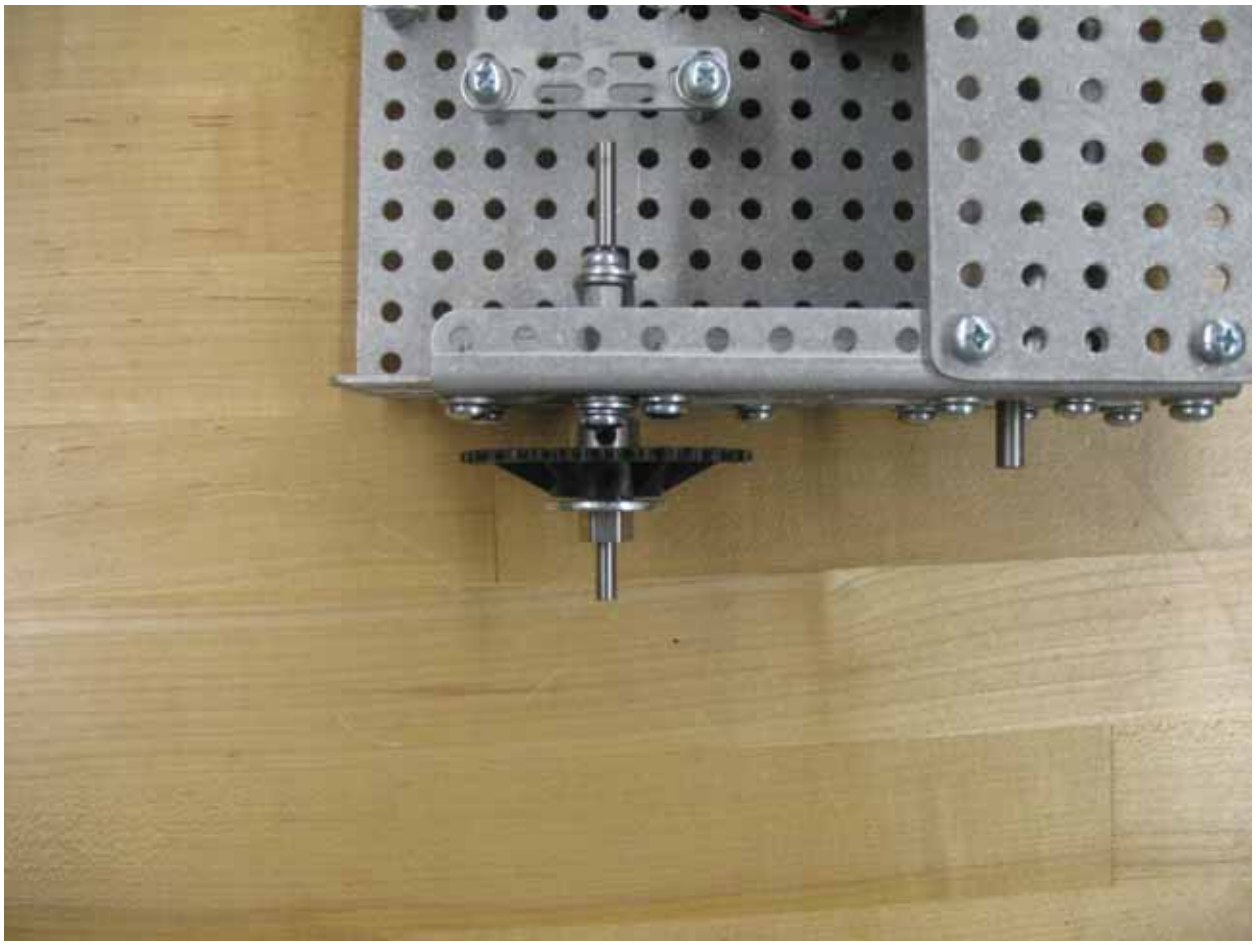
2 ½” Diameter Center Hole Flat Washers

2 4” Wheels

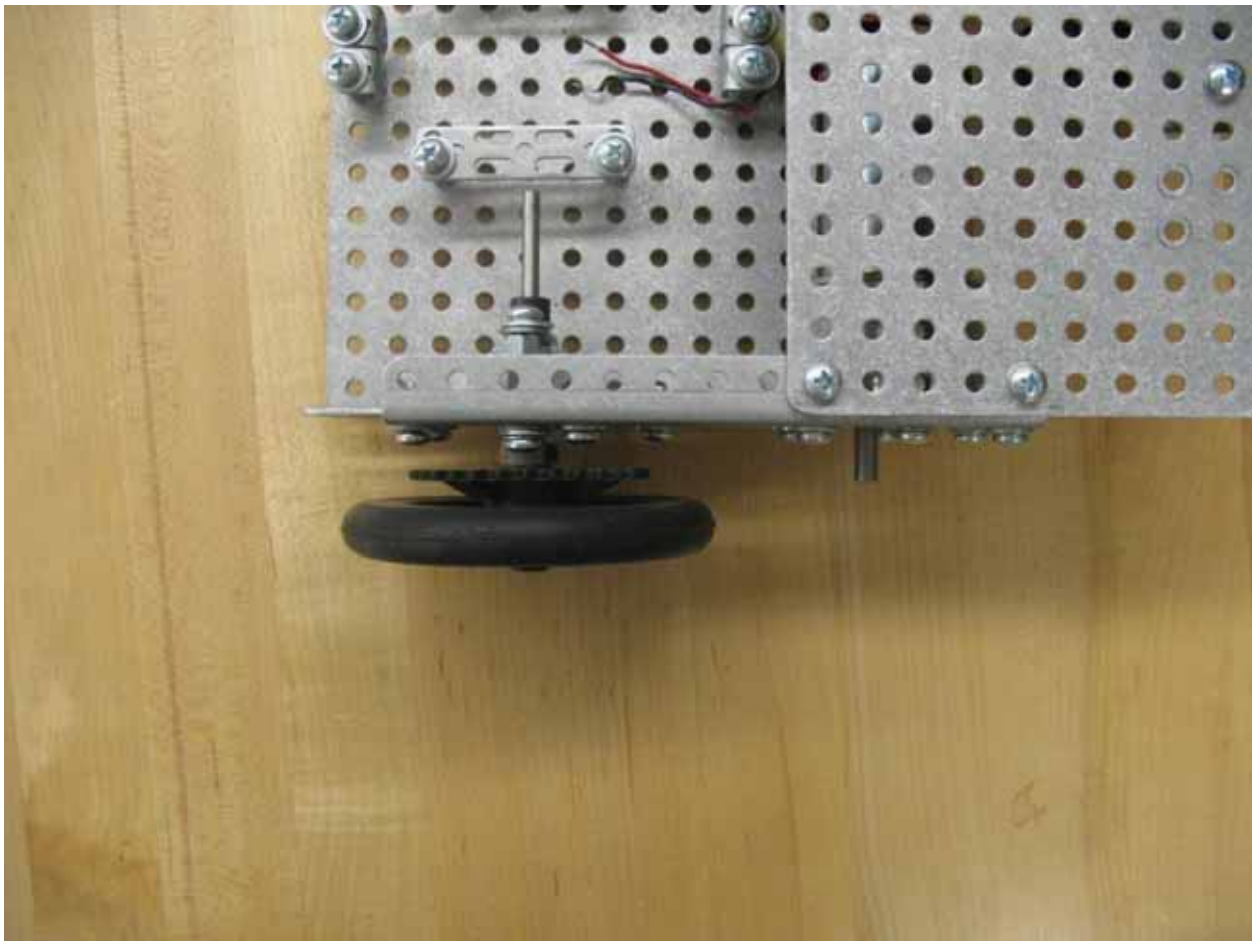
2 30 Tooth Sprockets

Finished:

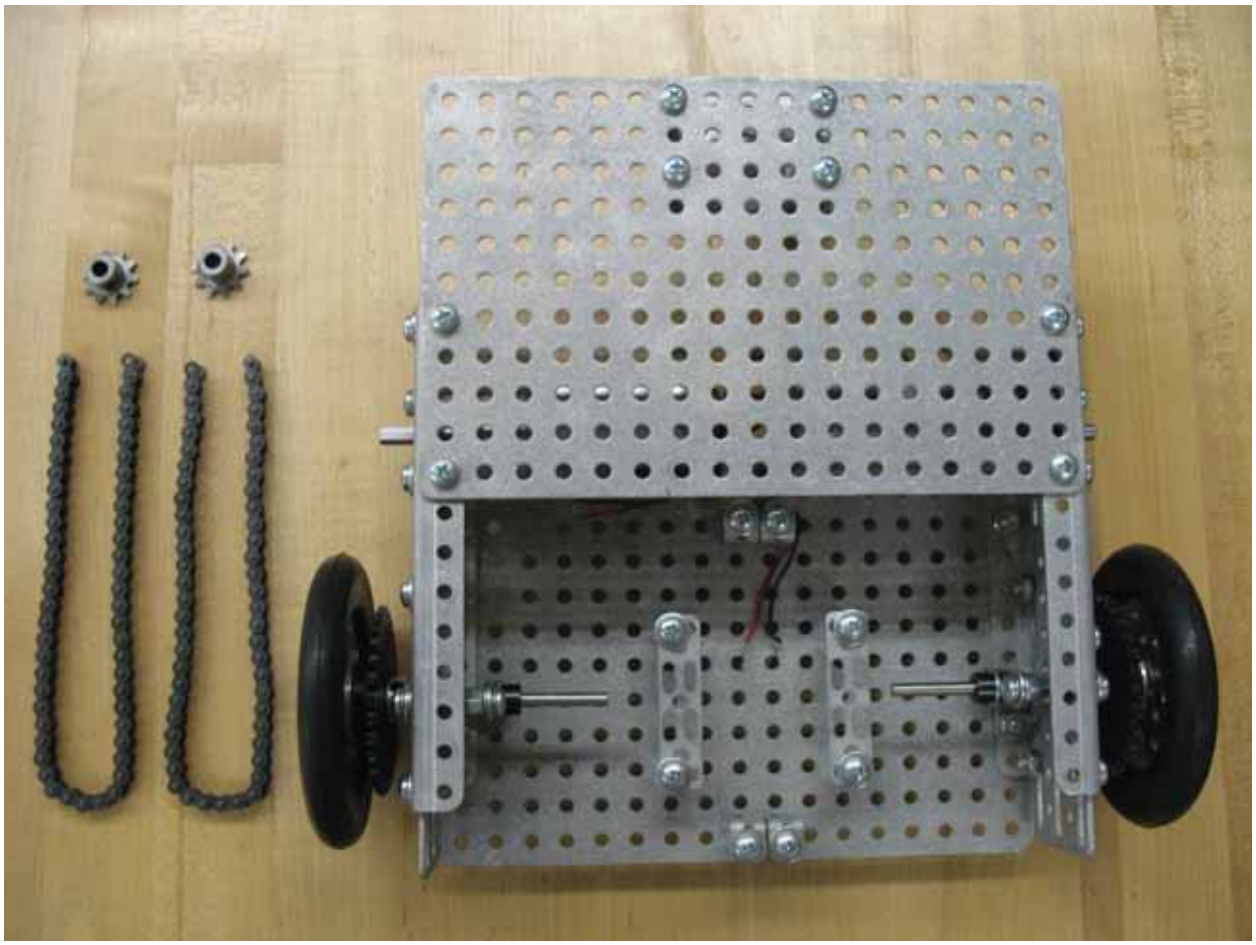




Slide the 30 tooth sprocket on to the hex adapter with the side that has the set screw in it facing out. Then slide a ½" center diameter flat washer on the hex adapter as well. Do this for both axles on the bot. Do not tighten the set screws at this stage.



Slide the 4” wheel onto the hex hub, and then slide the 3/16” diameter center hole washer onto the axle shaft. With both pieces in place slide a 3/16” shaft collar on the axle shaft. Line the outside edge of the collar up with the outer end of the axle shaft. Once you have the collar in the right place tighten it up. Push the axle with the collar on it in towards the bot until everything is tight. Then on the inner side of the axle slide the inner shaft collar until it is close to the inner bushing bracket. Make sure there is enough play that the axle can rotate freely and tighten the inner shaft collar down. The axle might not turn so well right now and that is due to the bushing brackets being loose, that is to be expected. You need to make sure the axle can slide side to side a little bit, but not too much. Too much side to side slop is a bad thing.



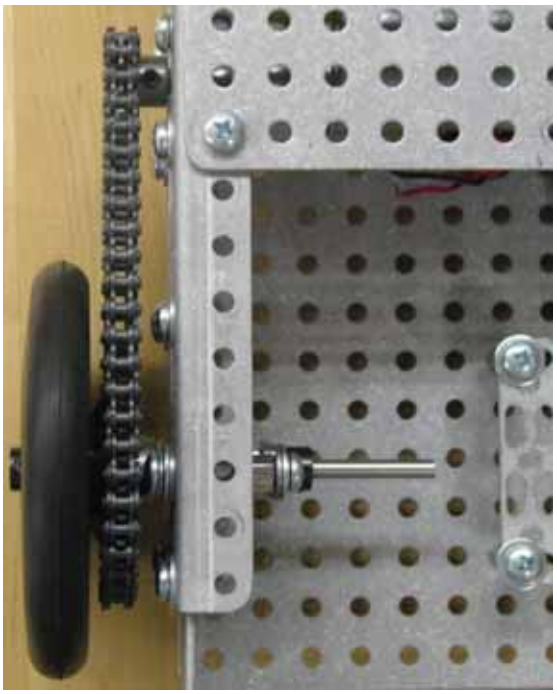
In this step you will be attaching the drive chains to the C.U.P. Bot.

Finished:

Parts needed:

2 10 Tooth Sprockets

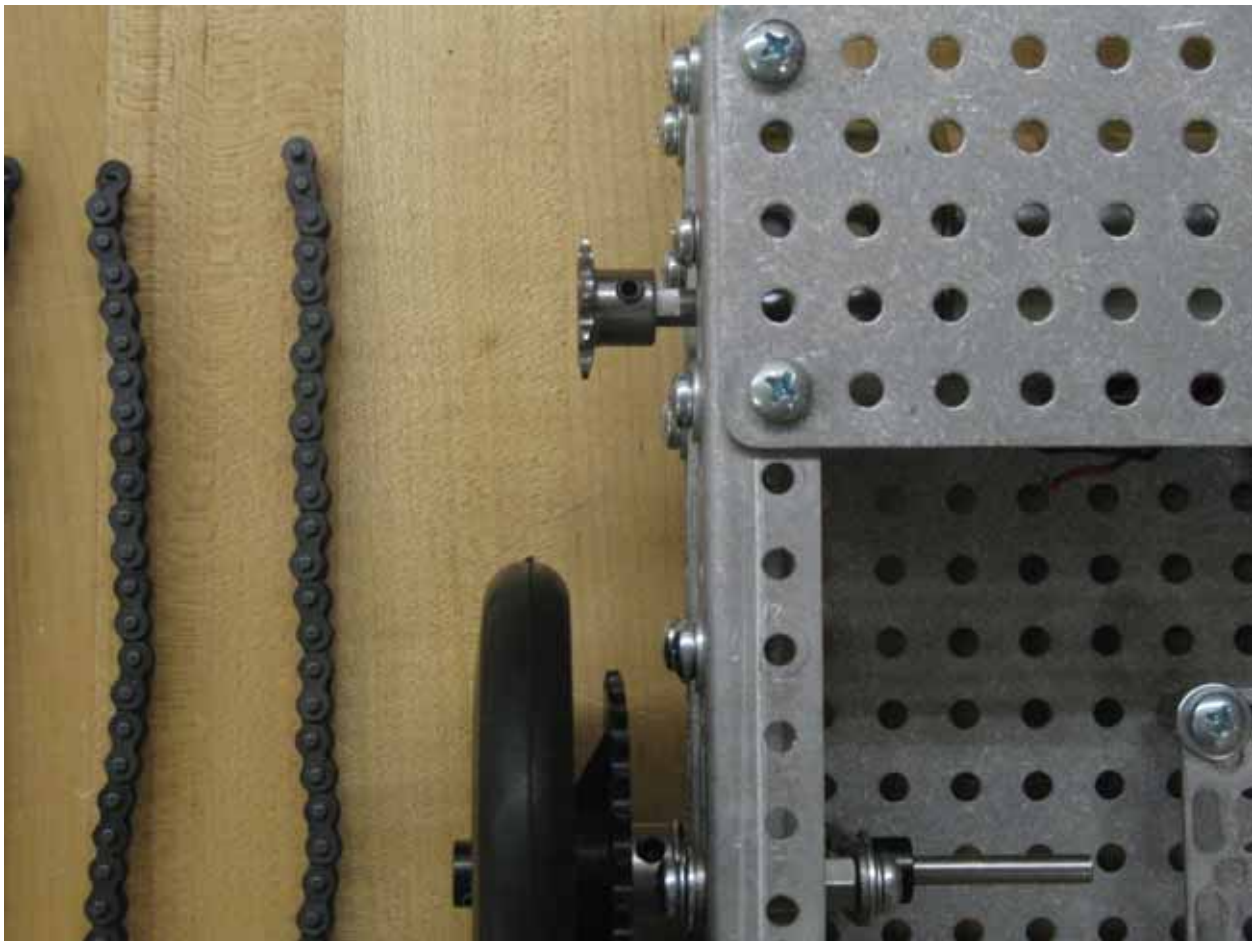
2 50 Links of #25 Chain*



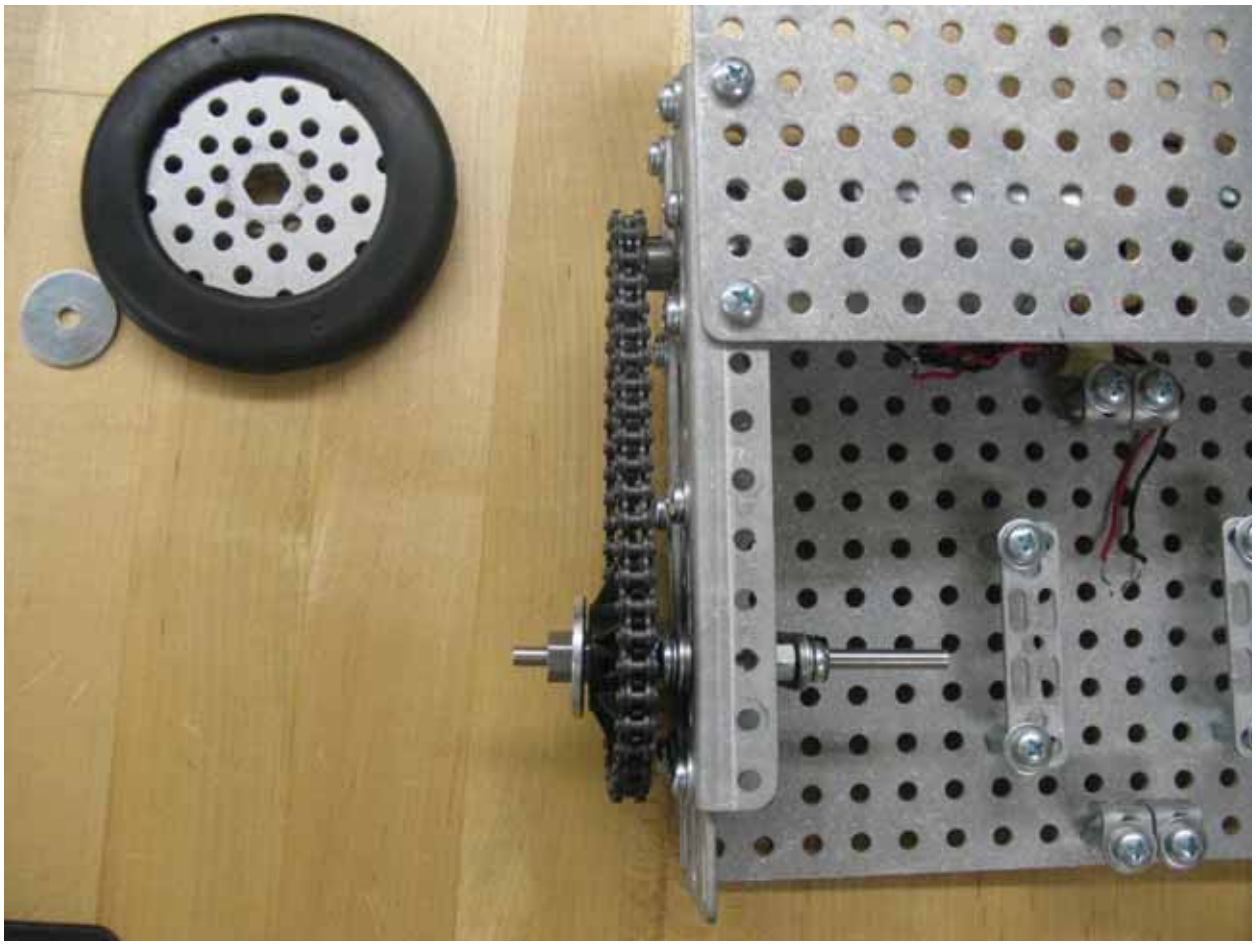
*A link is counted as shown below:

Count each numb sticking out

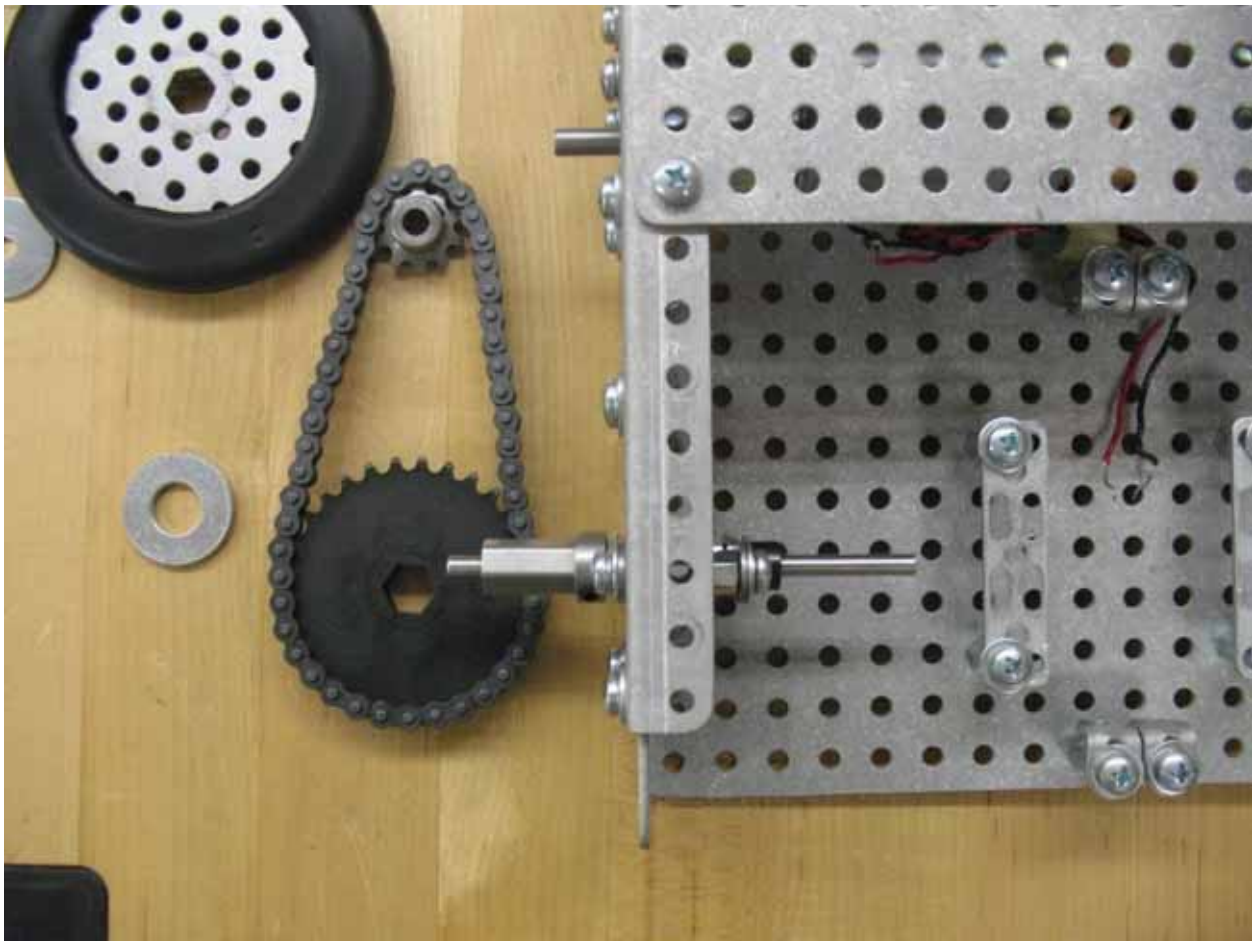
of the side of the chain as one link.



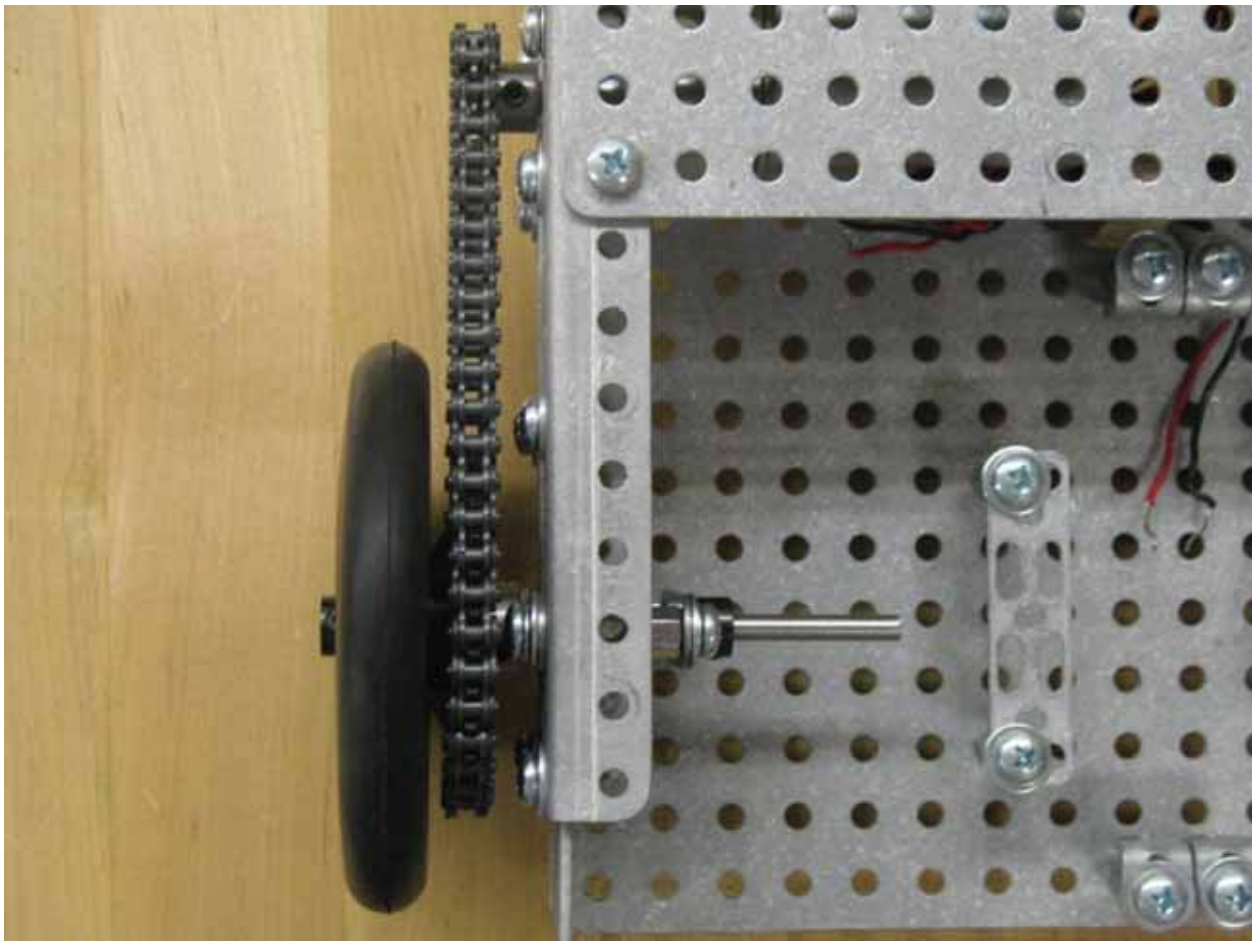
Slide the 10 tooth gear on to the shaft coming out of the gearhead motor. Make sure the 30 tooth gear on the wheel axle is tight against the wheel and the set screw is tightened up. With the 30 tooth sprocket in place line the 10 tooth sprocket up with the 30 tooth sprocket. Once the 10 tooth sprocket is lined up, tighten the set screw. Do this for both sides of the bot.



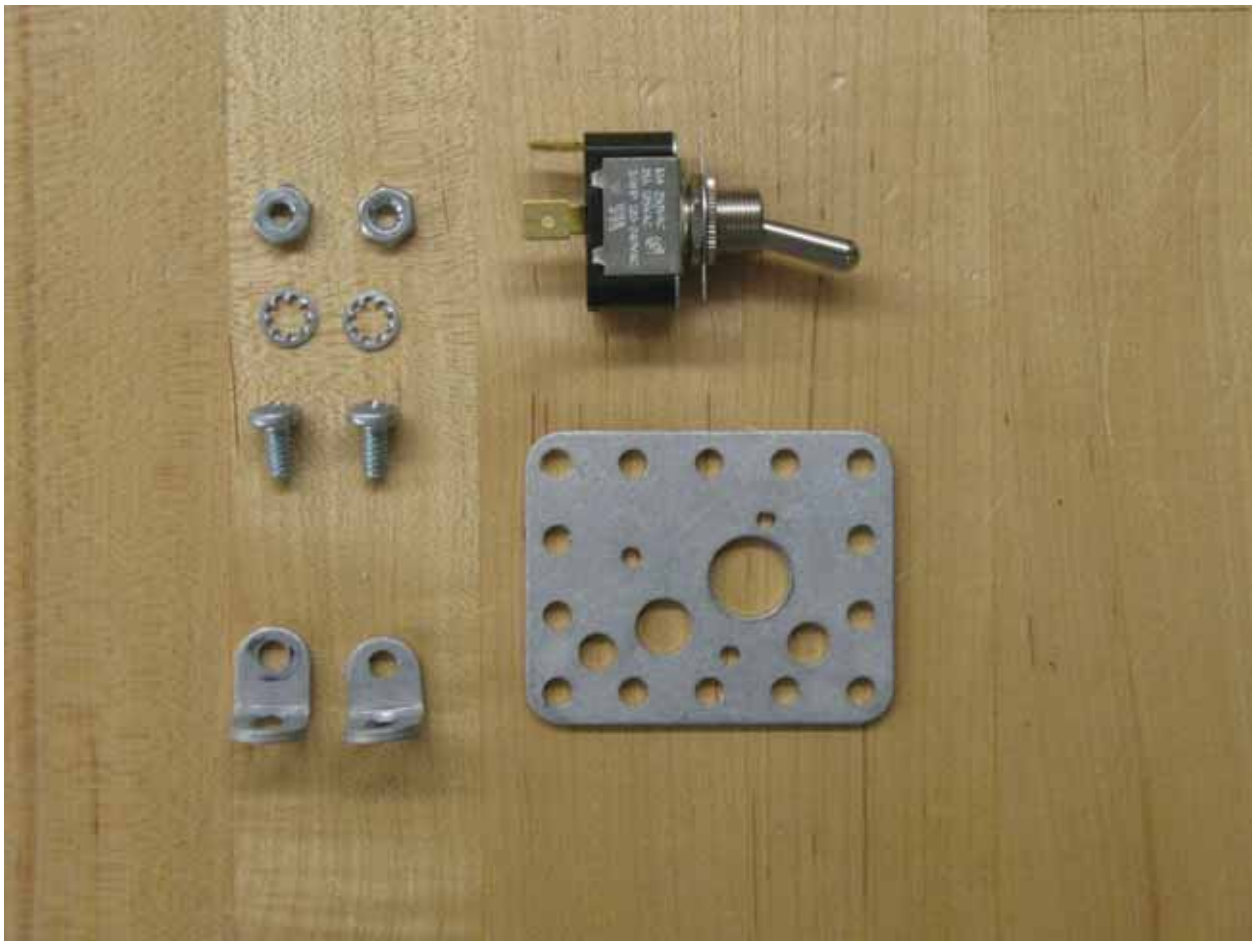
Run the chain around each gear, you may need to slide the axle shaft forward so the chain is long enough. Once you have the chain seated on the gears slide the shaft plate backwards to tension the chain. You need to moderate the tension, too loose and the chain may slip or bind, too tight and you will cause excessive friction and might bind the chain up. Once you have proper tension tighten the shaft plate down to the side rail. Make sure it is good and tight as you do not want it to loosen up. Do this for both sides of the bot.



Once you have the shaft plate tightened up you will need to remove the chain and sprockets to tighten up the bushing bracket bolts. Tighten these bolts up on the inside and the outside of the side rail. As you tighten these bolts check the axles to make sure you are not binding them up. If binding of the axle occurs loosen one of the bushing brackets and side it up or down, this should allow the axle to turn freely once again. Retighten the bushing bracket if you needed to adjust it. Do this for both sides of the bot. At this point, stop and check all bolts on the bot for tightness they should all be tighten down, no bolts should be loose.



Slide the sprockets and chain back on to the bot, keeping the 10 tooth sprocket on the motor shaft. With the sprockets and chains in place slide the washers, wheel, and collar back onto the bot. Be sure to keep the 30 tooth sprocket tight to the inner side of the wheel. Once the 30 tooth sprocket is in position line the 10 tooth sprocket up with the 30 tooth sprocket and tighten it down. Turn the wheel by hand to feel for binding of any kind and adjust accordingly.

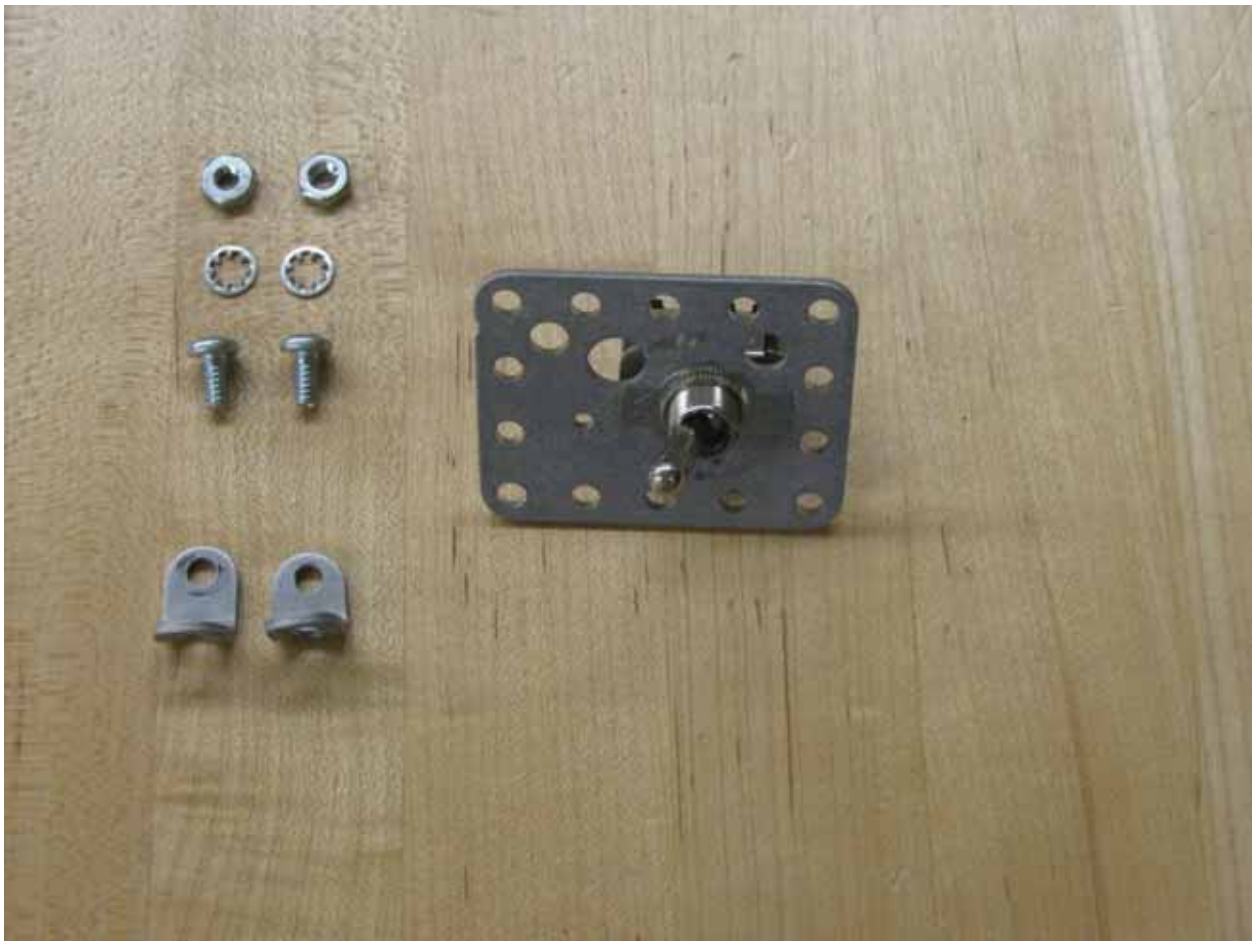


In this step you will build the switch mount sub-assembly.

Parts Needed:

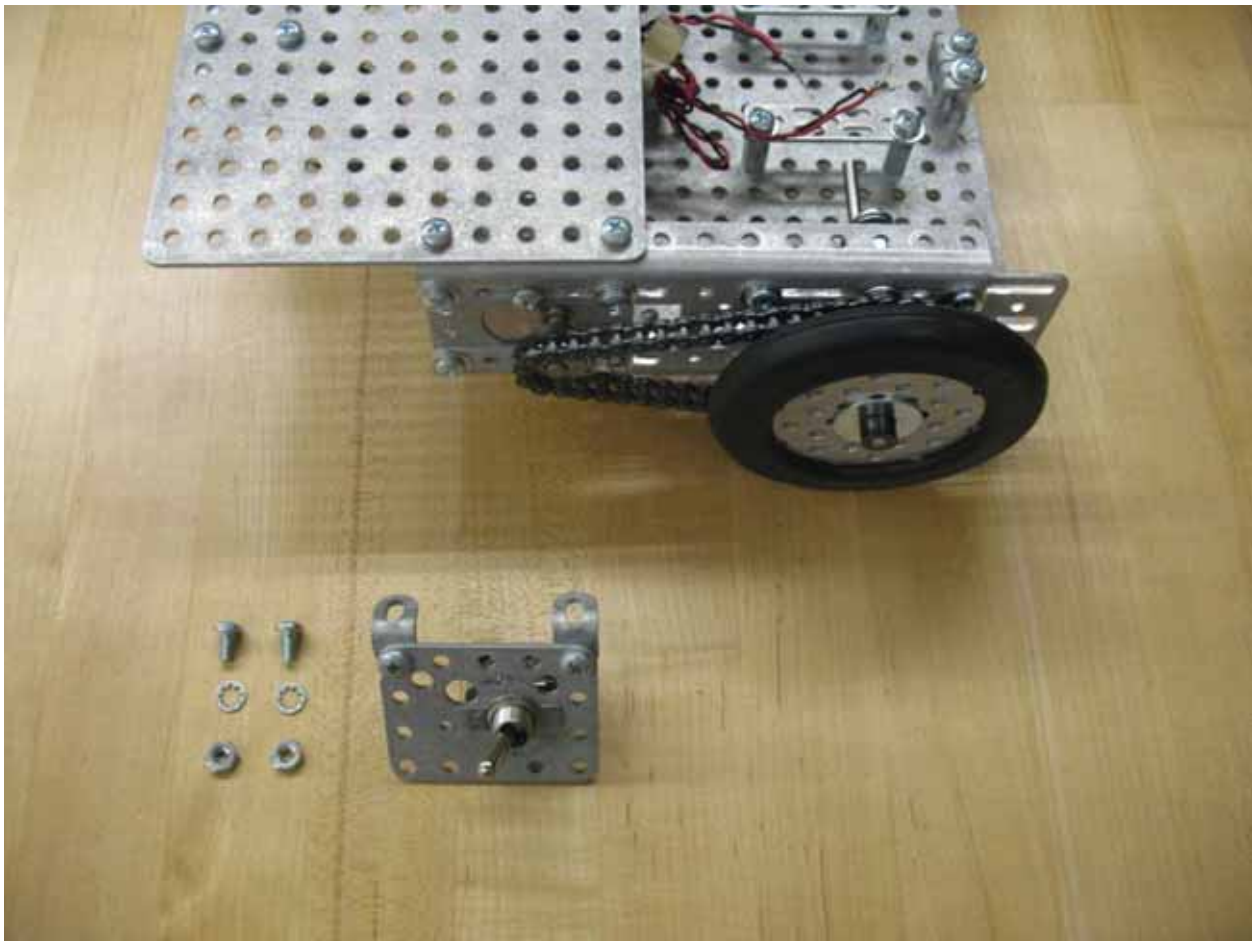
1	Toggle Switch
1	M13 Motor Mount
2	3/8” 10-24 Bolts
2	#10 Internal Star Lock Washers
2	10-24 Nuts
2	90 Degree Brackets

Finished:



Take the “ON-OFF” plate and the mounting ring the off of the switch and insert the switch through the largest hole on the M13 motor mount. Now slide the “ON-OFF” plate back on the switch and screw the mounting ring down the switch to mount the switch on the motor mount. On the motor mount plate orient the switch so that the ON-OFF is facing side to side along the long side of the plate as shown above; make sure the switch is secured tightly.

With the switch mount oriented as in the above picture install the 90 degree brackets with the slotted end facing away from the switch mounting bracket (shown above). Bolt the 90 degree brackets on the top row of holes on the switch bracket. Use the 3/8" 10-24 bolts, #10 internal star lock washers and 10-24 nuts to secure these 90 brackets. Only lightly tighten these as they may need adjusted to mount this sub-assembly to the bot.



In this step you will be installing the switch mount sub assembly to the Verminator Bot.

Parts Needed:

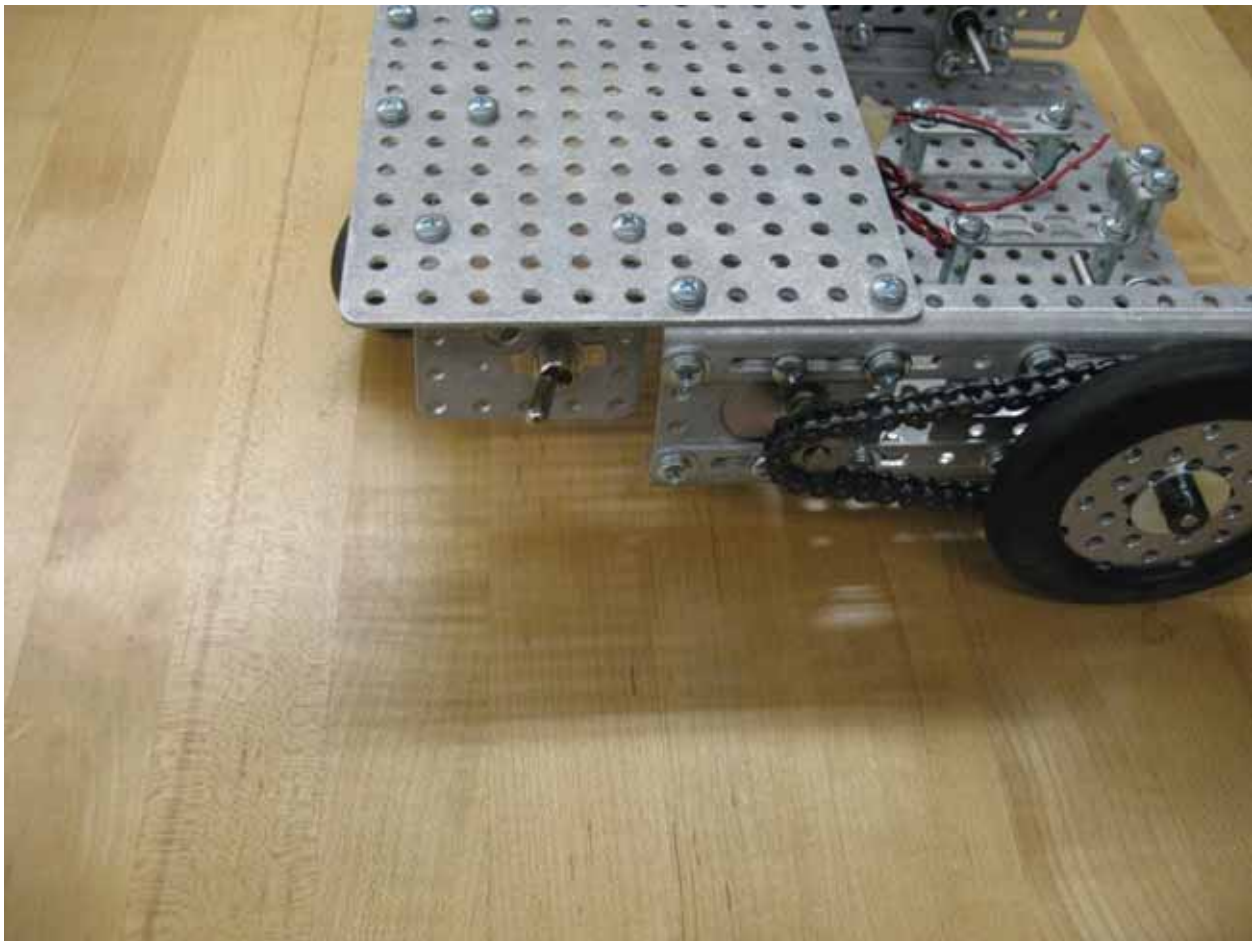
1 Switch Mount Sub-Assembly

2 3/8” 10-24 Bolts

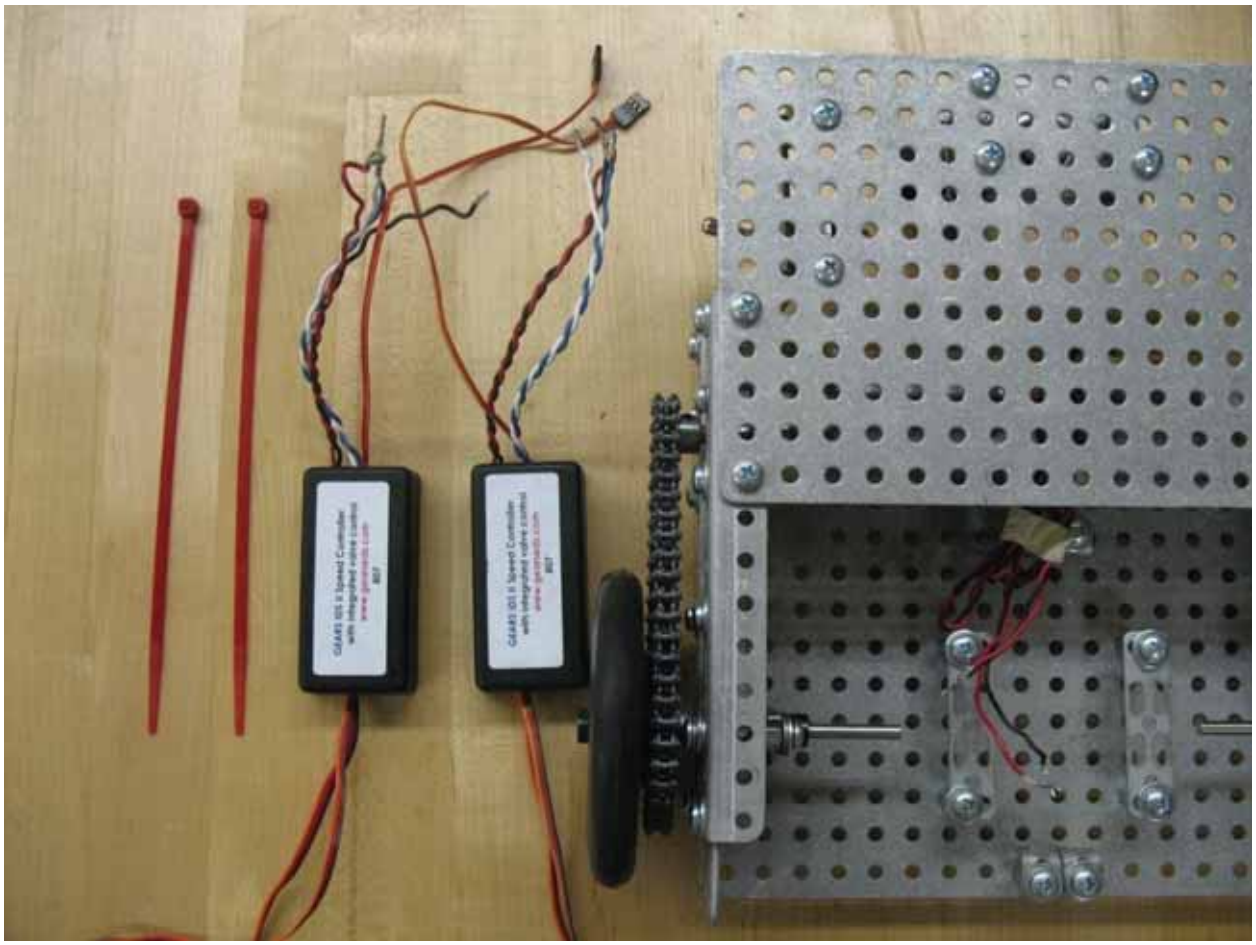
2 10-24 Nuts

2 #10 Internal Star Lock Washers

Finished:



On the left side of the bot (drivers side) count 2 holes back from the front and 3 holes in from the side of the upper flat plate, bolt the front 90 bracket of the switch mount sub-assembly to this hole. Have the switch facing out when you do this, the terminals should be facing the underside of the robot. From the bolt you just installed count four holes back towards the rear of the bot, use this hole to mount the rear 90 degree bracket onto the upper flat plate. When you are finished make sure your switch mount is installed like the one pictured above. With switch mounted make sure the swivel caster can turn 360 degrees freely, if it does tighten the bolts.



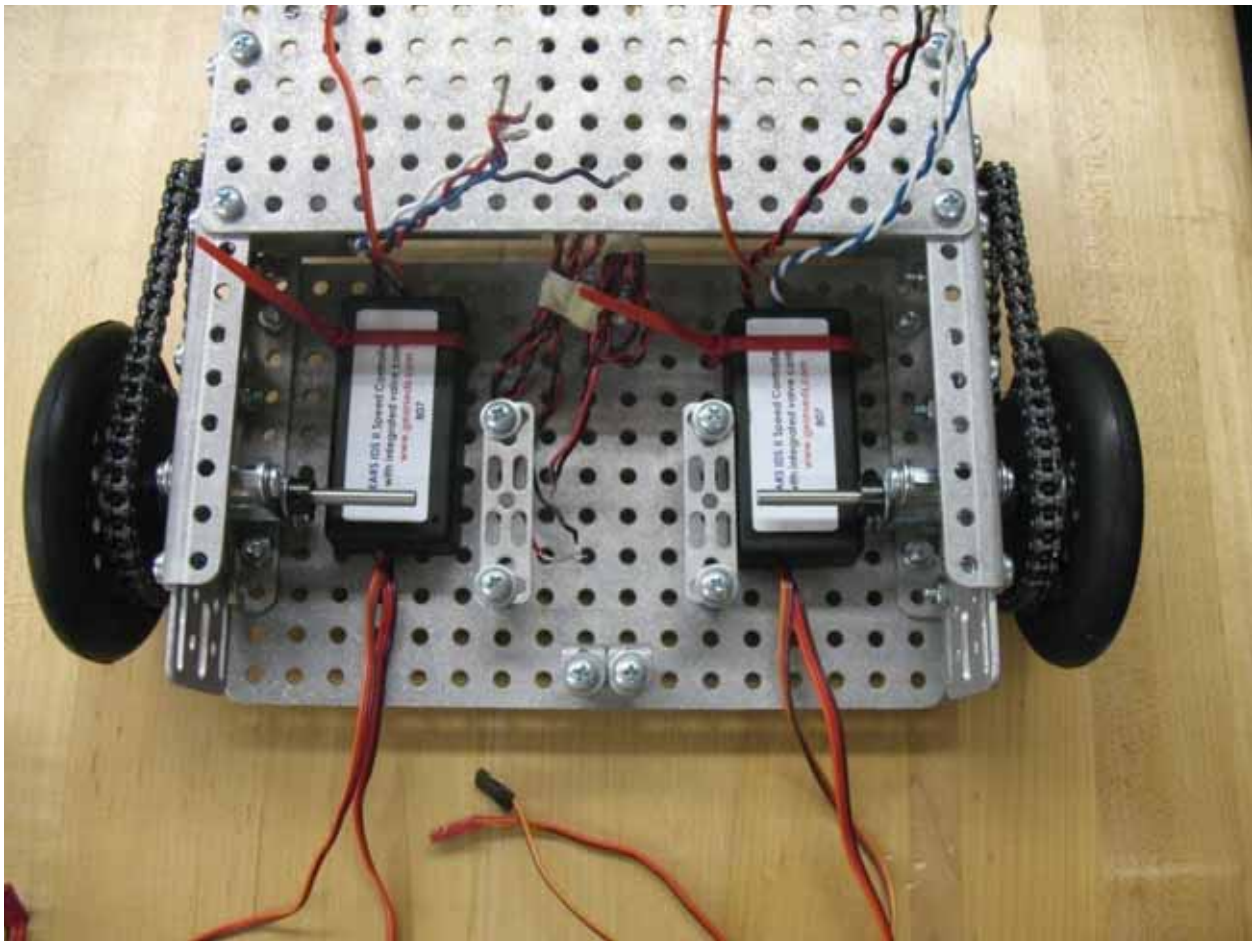
In this step you will mount the motor controllers.

Parts Needed:

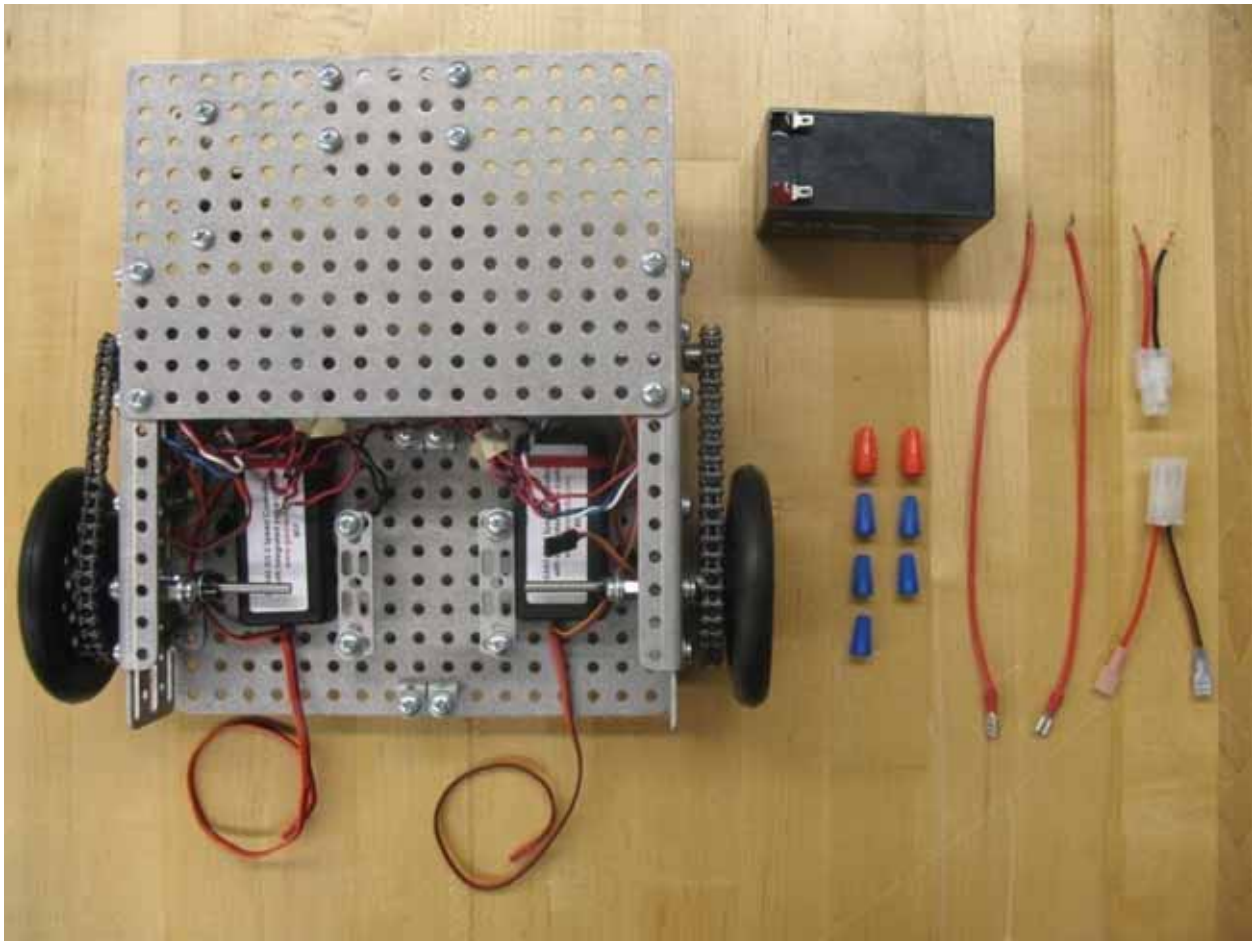
2 Motor Controllers*

2 Zip Ties seven inches or longer

*Your motor controllers may not look like the one pictured above. If the motor controllers are larger than the ones in these instructions you may need to mount them in a different location than what is going to be shown.



Using zip ties secure one motor controller on each side of the battery holder keeping the side with a LED on it facing up, and the end with the PWM cables facing out the back of the bot as shown in the above picture. PWM cables are the ones that have three separate wires going into a plastic connector end. On the motor controllers pictured there are two PWM cables on each controller. For this bot you will only need to use the one with the red connector end. Take the other one and tuck it in a place where it will not get in the way.

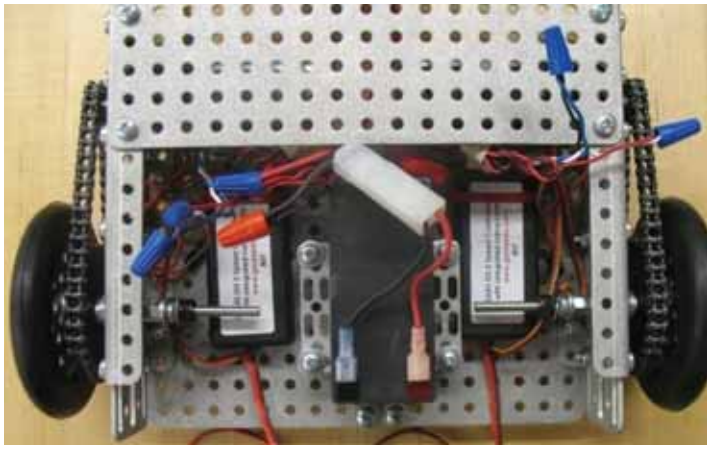


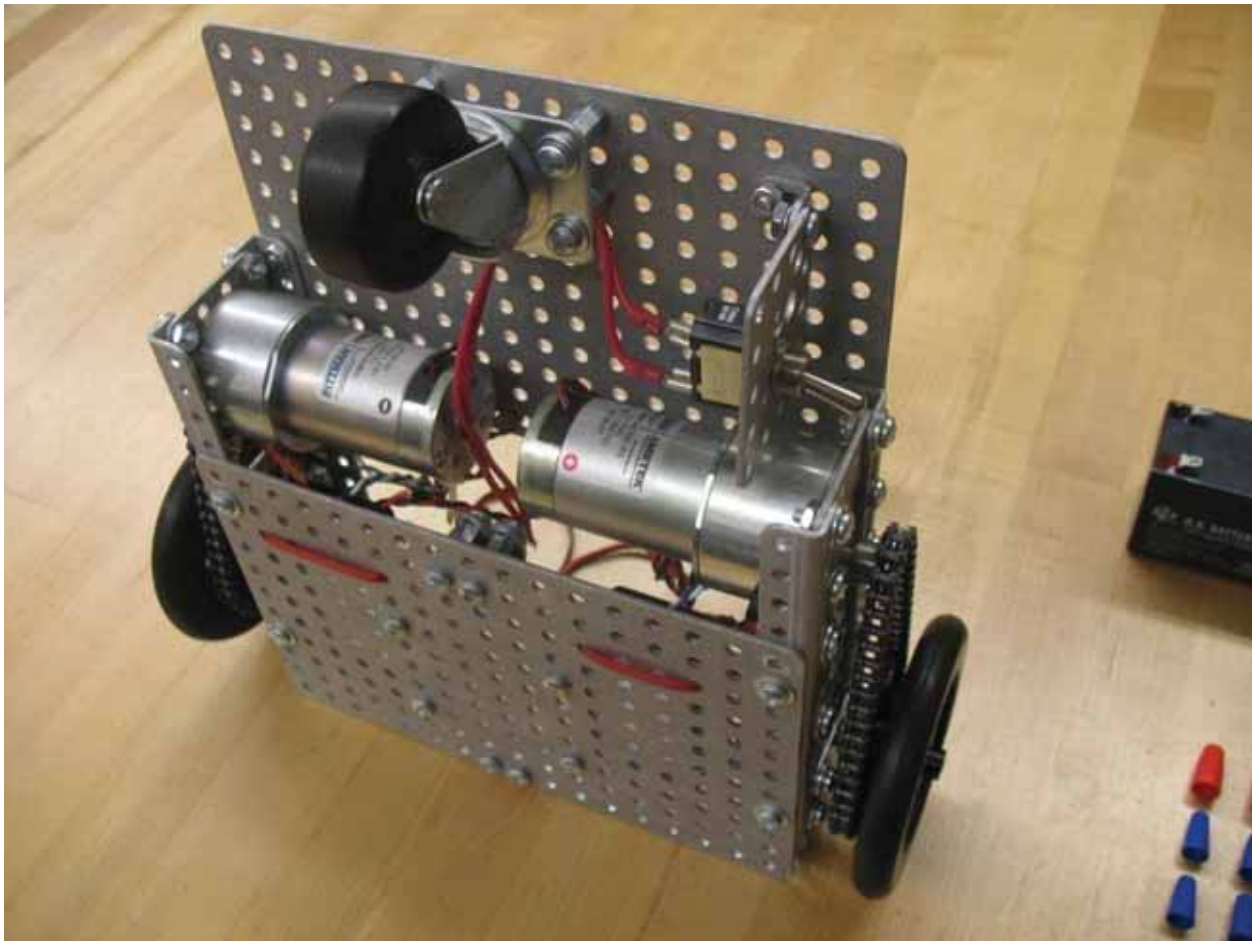
In this step you will be wiring the motor, motor controllers, main power switch, and battery together.

Parts Needed:

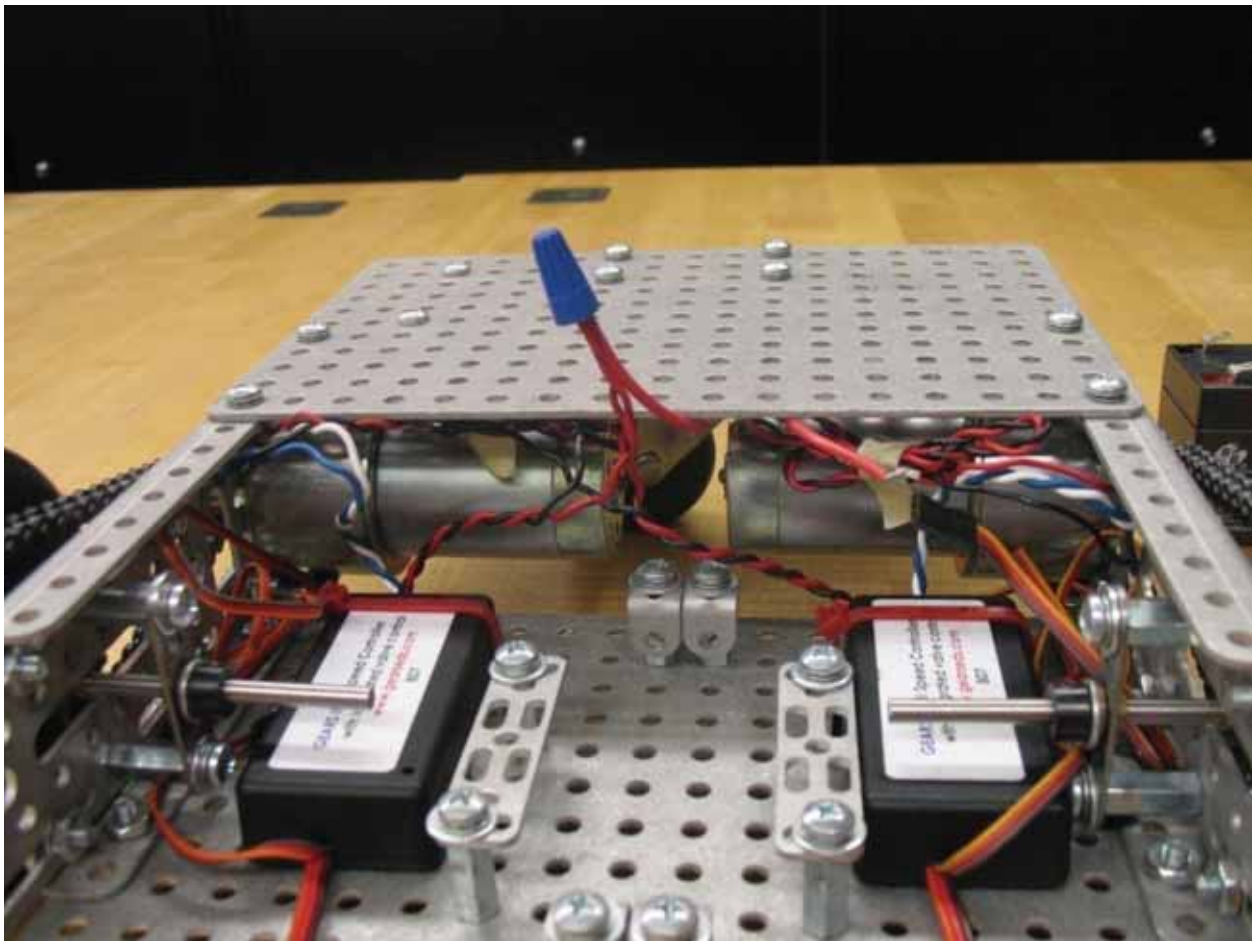
1	1.2ah 12v Sealed Lead Acid Battery
1	Set of Molex Connector Harnesses (one male and one female end)
2	Nine inch Power Wires (must have a female quick connector on one end of each wire)
2	Orange Wire Nuts
5	Blue Wire Nuts

Finished:



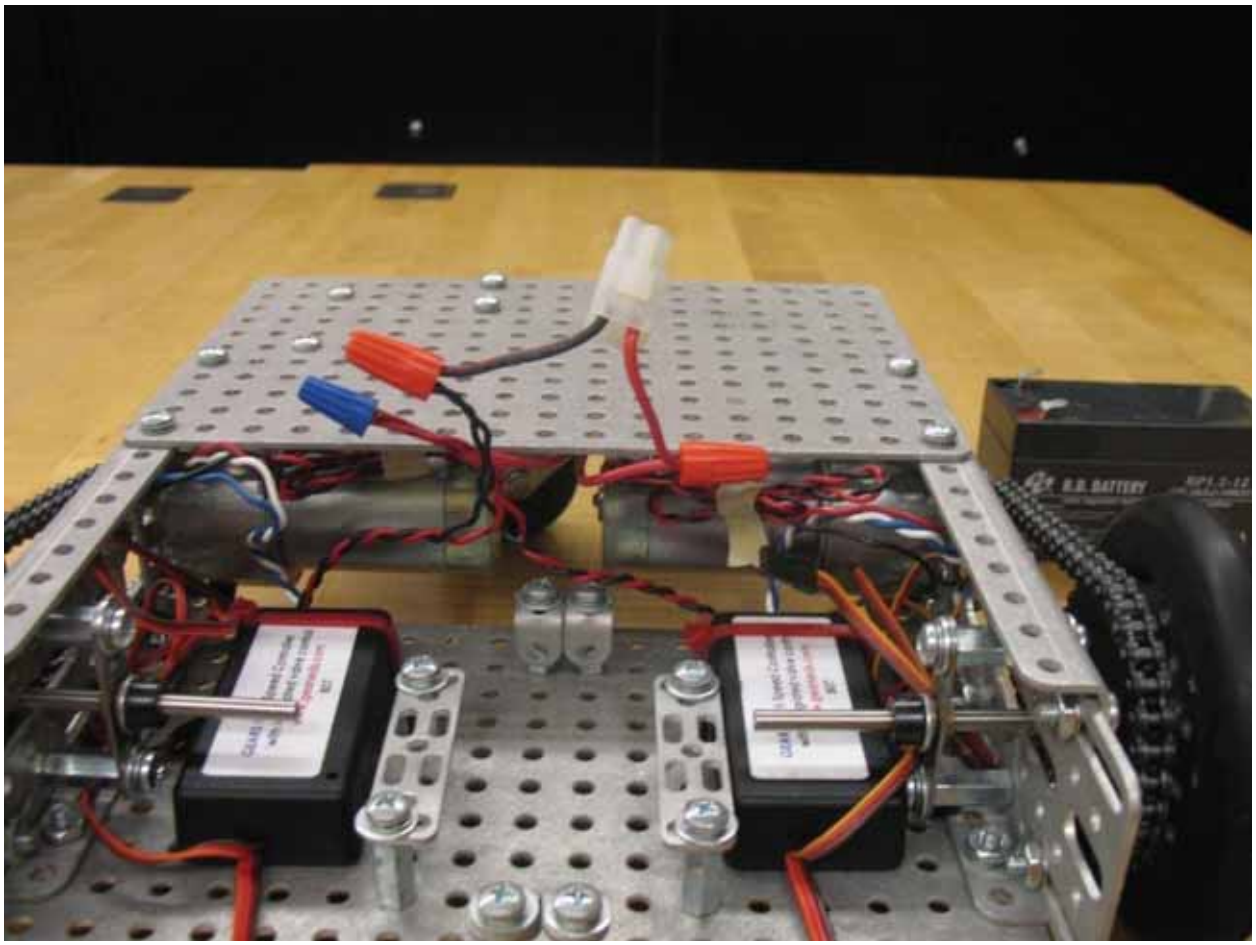


Take the two nine inch power wires and slide the female quick connector ends on to the male connector ends that are on the main power switch. Run the free ends of the wires around the standoffs that hold the swivel wheel on before running the wires to the back of the bot. This will help keep the power wires from interfering with the movement of the swivel caster.

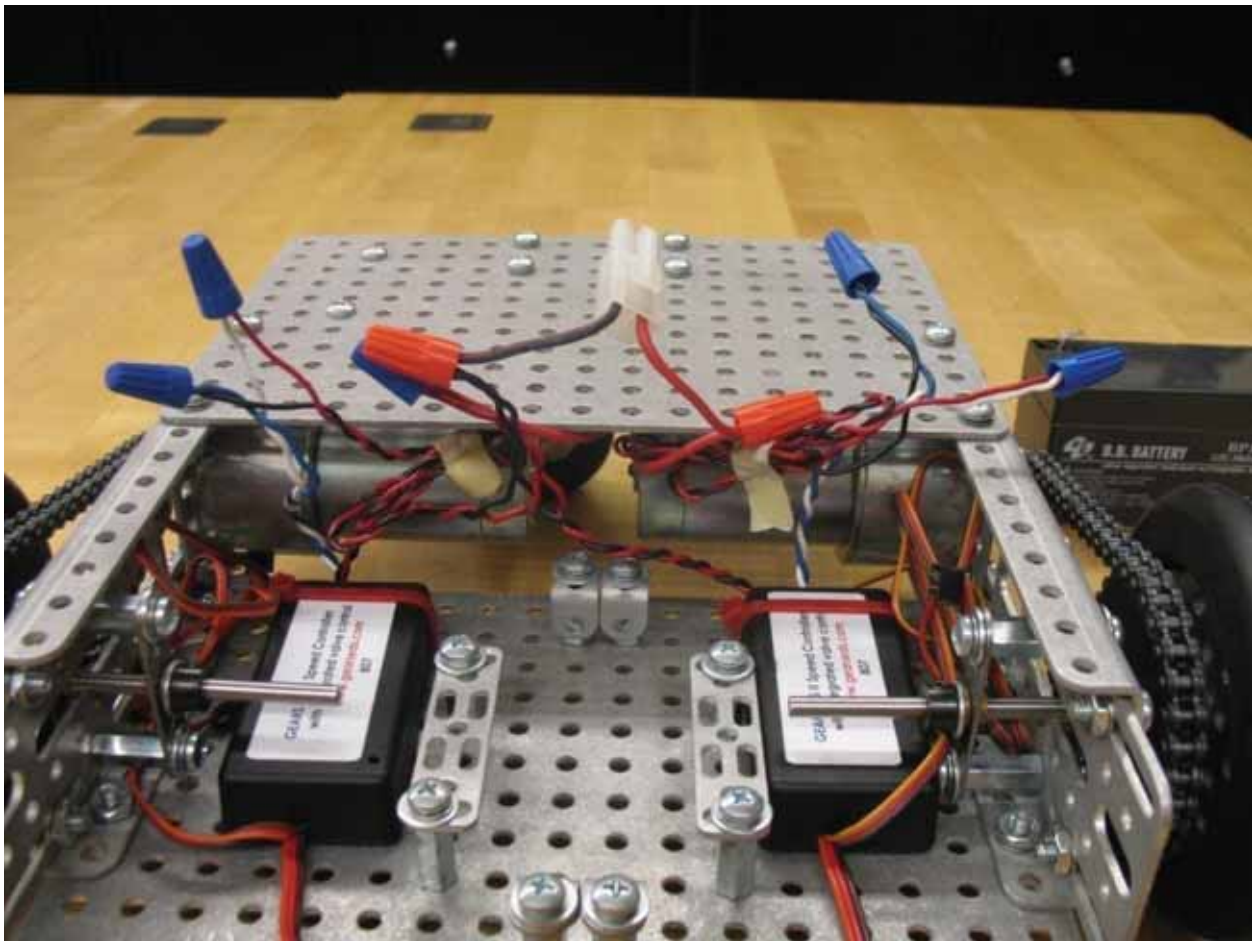


Take one of the nine inch power wires and twist the exposed end of the wire around the exposed ends of the red motor controller wires. When doing this check to make sure you are grabbing the red wires coming out of the motor controllers not the red wires coming out of the motors. Once you have twisted all three of the wires together twist a blue wire nut onto the wires to securely hold them together. After you have twisted the wire nut on the wires, give a good tug on the nut to see if it comes loose. If it does you need to redo the twisting of the wires and/or re-twist the wire nut on the wire ends.

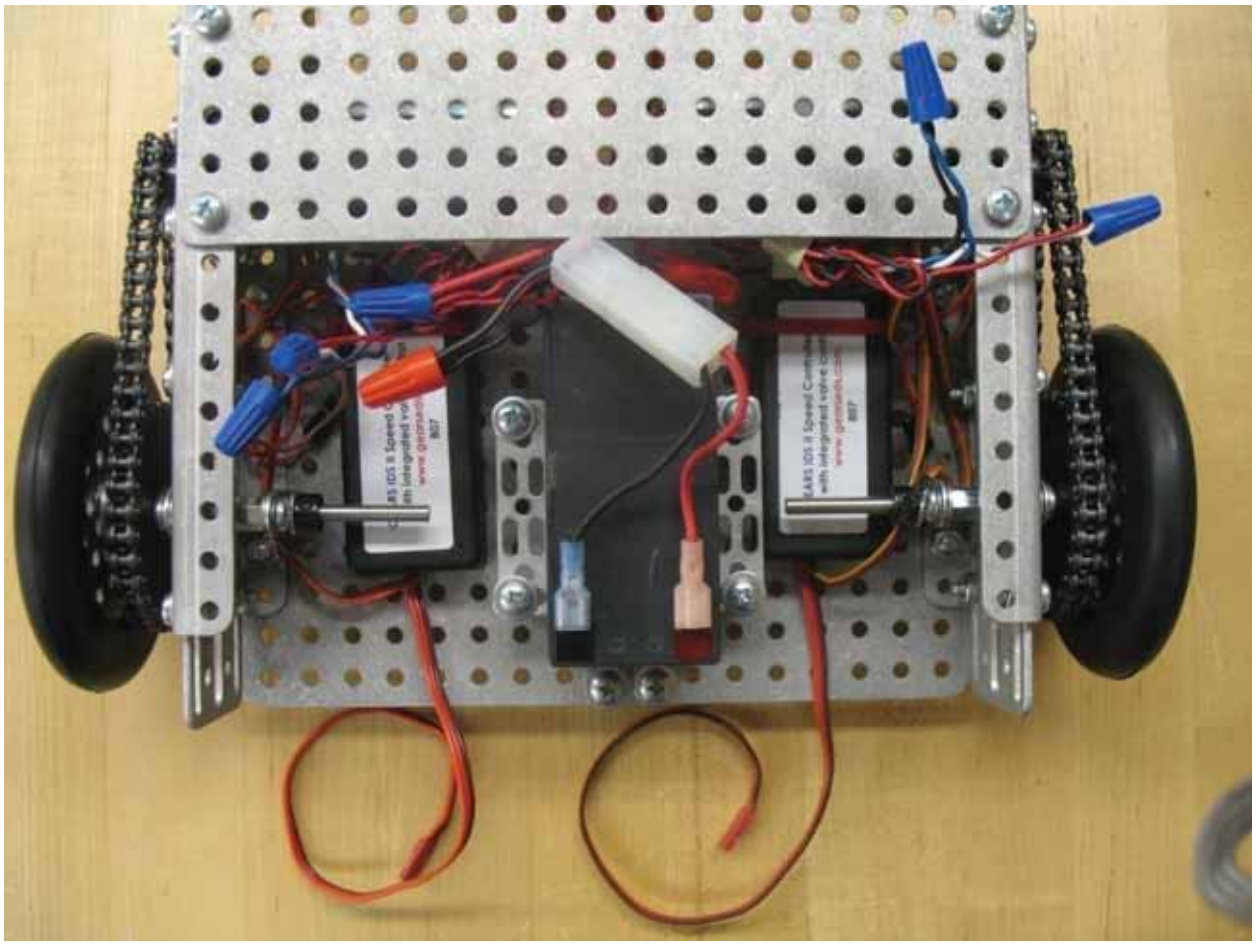
Note: When using wire nuts you want to twist the wires together in a clockwise fashion first to help hold the wires together before you twist the wire nut on. Also the wire nut twists on in a clockwise direction.



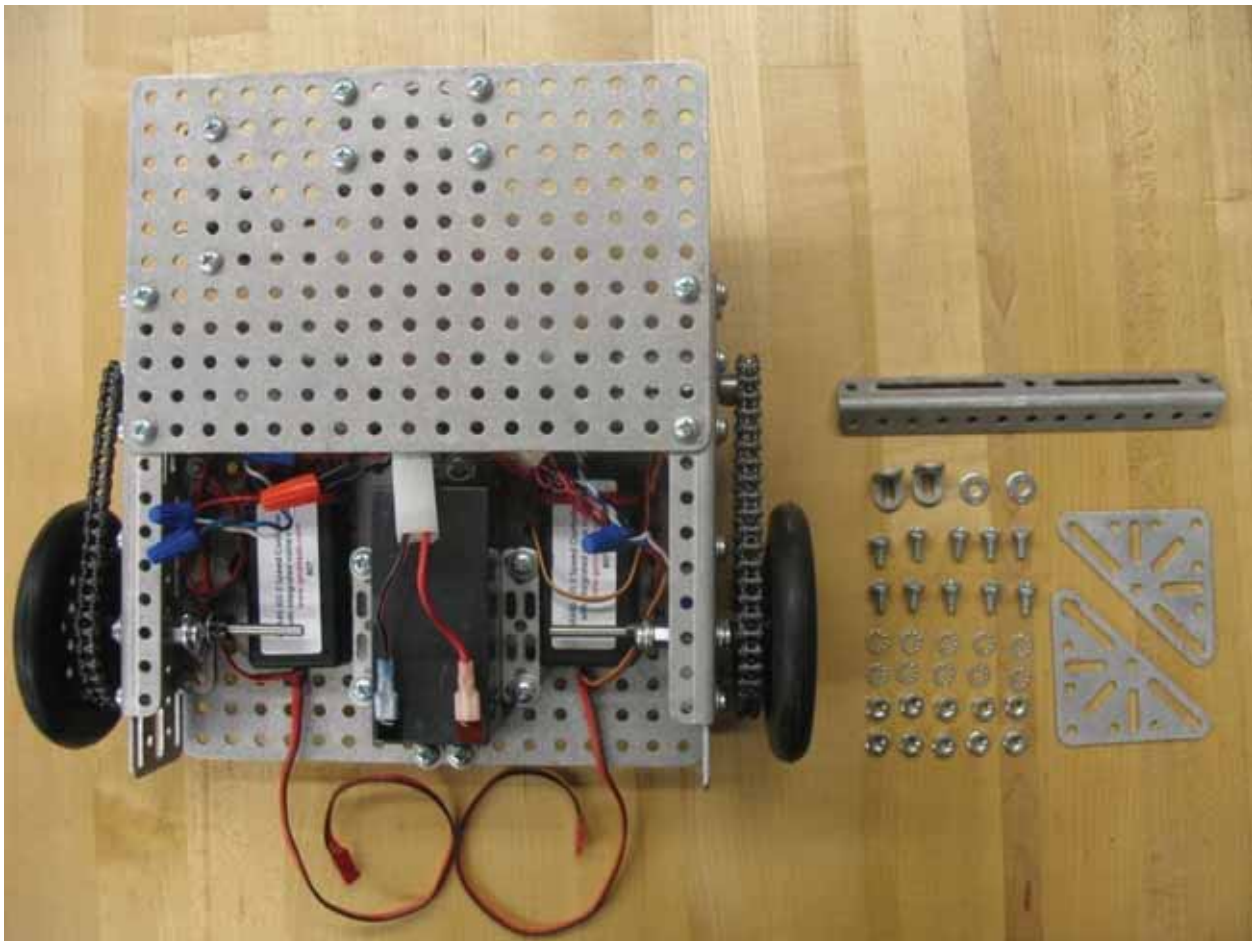
Take the red wire lead coming from the male end of the Molex harness to the other power wire coming from the main power switch. With these two wires twisted together you need to twist an orange wire nut on top of them. Grab the two black wires coming from the motor controllers (one from each controller) and twist their ends together along with the black wire lead coming from the male end of the Molex wire harness. Twist an orange wire nut on to the group of wires once you have the wires twisted together.



The blue wire coming from the left motor controller needs to be connected to the black wire coming from the left gearhead motor, do this by twisting the two wires together and twisting a wire nut on top of them. The white wire coming from the left motor controller needs to be connected to the red wire coming from the left gearhead motor, do this the same way you did the blue and black wires in the last step. Using the same procedures used above connect the wires together between the right motor controller and gearhead motor. Once all the wires are connected and have wire nuts on them, give each wire nut an easy tug to see if the wire nut is securely in place. Redo any connections that are loose.



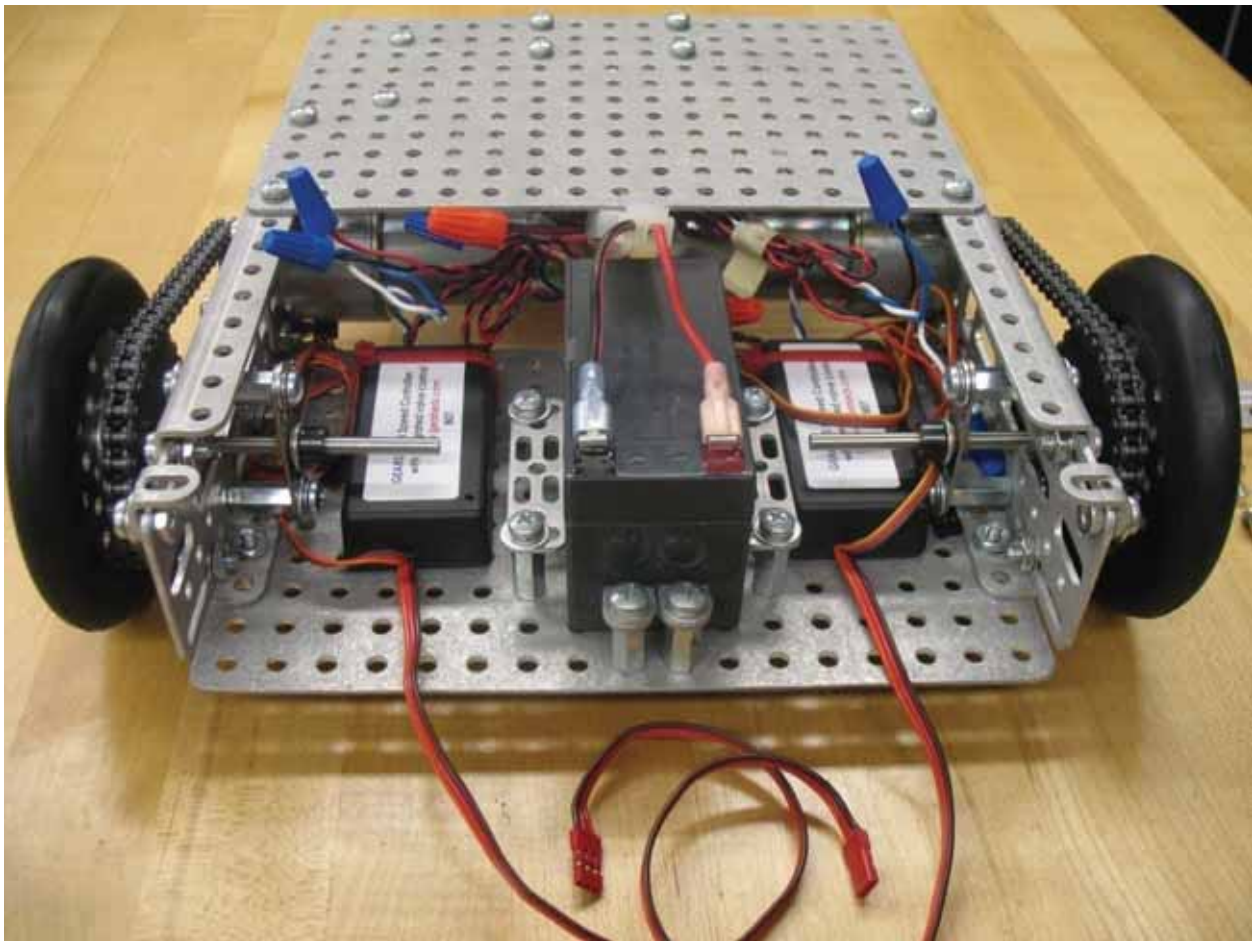
Connect the leads coming from the female end of the Molex wire harness to the corresponding terminals on the battery; black lead to the black terminal and the red lead to the red terminal. Then place the battery into the battery hold, with the battery in place you now can connect the male and female ends of the Molex wire harness together. With this done check all of your wiring connections for any wires that may be connected improperly and repair anything that looks incorrect or anything that may pose a safety threat. You do not want any power wires to come in contact with any metal part of the bot as sparking will occur. Sparking happens when a power wire is grounded out by touching the chassis of the bot, this can cause major damage to any electronics on the bot.



In this step you will be building the rear support bracket onto the Verminator Bot chassis.

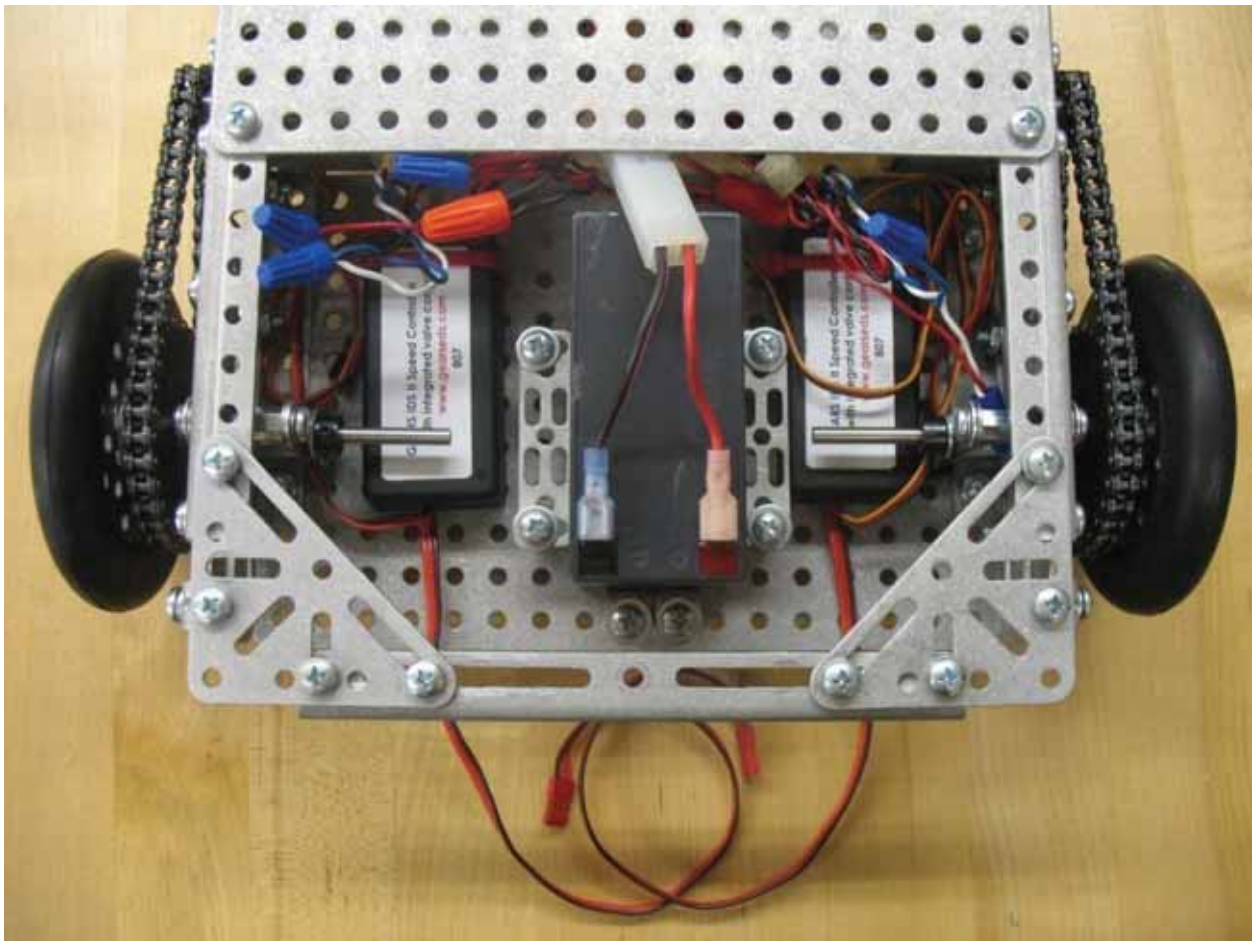
Parts Needed:

1	13 Hole Angle
2	90 Degree Angle Brackets
2	#10 Flat Washers
2	Sine Triangle Brackets
10	3/8” 10-24 Bolts
10	#10 Internal Star Lock Washers
10	10-24 Nuts

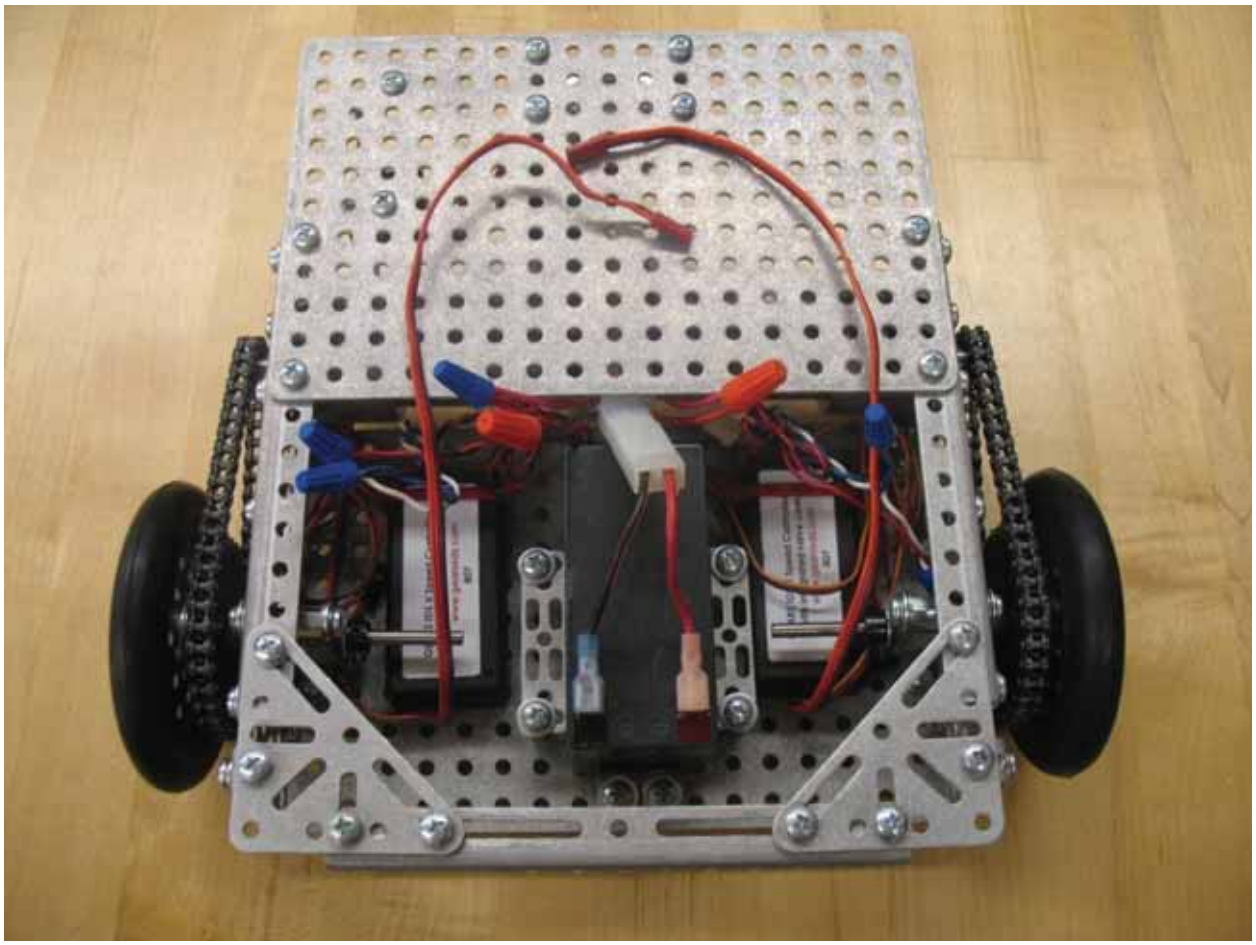


At the rear end of the shaft plate on the left side of the bot (driver's side) bolt the 90 degree angle bracket with the long slot facing towards the inside of the bot using a 3/8" 10-24 bolt, lock washer, flat washer, and nut. Also the 90 degree angle bracket should be bolted onto the outside of the shaft plate through the upper rear slot (pictured above). Use the same procedure for bolting a 90 degree angle bracket on the right side of the bot. Do not tighten up these bolts as they will need to be adjusted in an upcoming step.

Pictured to the right is the order in which the 3/8" 10-24 bolt, lock washer, flat washer, 90 degree bracket and nut should be used in bolting the 90 degree bracket on the Verminator Bot.



Bolt a sine triangle bracket on top of the left side chassis rail using two each of: 3/8" 10-24 bolts, lock washers, and nuts. From the rear end of the left side 13 hole angle count two holes forward and lay the point of a slotted end of the sine triangle on top of that 2nd hole. Be sure to have the triangle facing in towards the robot as shown in the above picture. With the triangle laying in the proper position insert a 3/8" bolt with a lock washer through the triangle into the 2nd hole in from the rear on the 13 hole angle. Lightly thread a nut on to the end of this bolt. Line up the 90 degree angle bracket with the second hole in from the corner on the left side of the sine triangle, and insert a 3/8" bolt and lock washer through the freshly lined up holes and lightly thread a nut up onto the bolt. Use this same procedure for attaching the sine triangle on the right side of the bot. Take a 13 hole angle and line the outer hole on the left side of it up with the perpendicular to the rear of the bot facing slot in the sine triangle (pictured on the left in the above picture). Be sure to keep the 13 hole angle on the bottom of the sine triangle. With both parts lined up insert a 3/8" bolt and lock washer through the slot and end hole. Thread a nut on the bottom of the bolt lightly. Do this same procedure on the right side of the bot, you may need to move the parts around so the holes line up, and this is common. Insert a 3/8" bolt and lock washer through the tip of the sine triangle that is directly over the 13 hole angle on both sides of the bot (shown above). At this point your bot should look identical to the one pictured above. If everything looks good tighten everything up good and tight.



Congratulations you have completed your Verminator Bot. You are now ready to mount the micro controller that is being used in class.