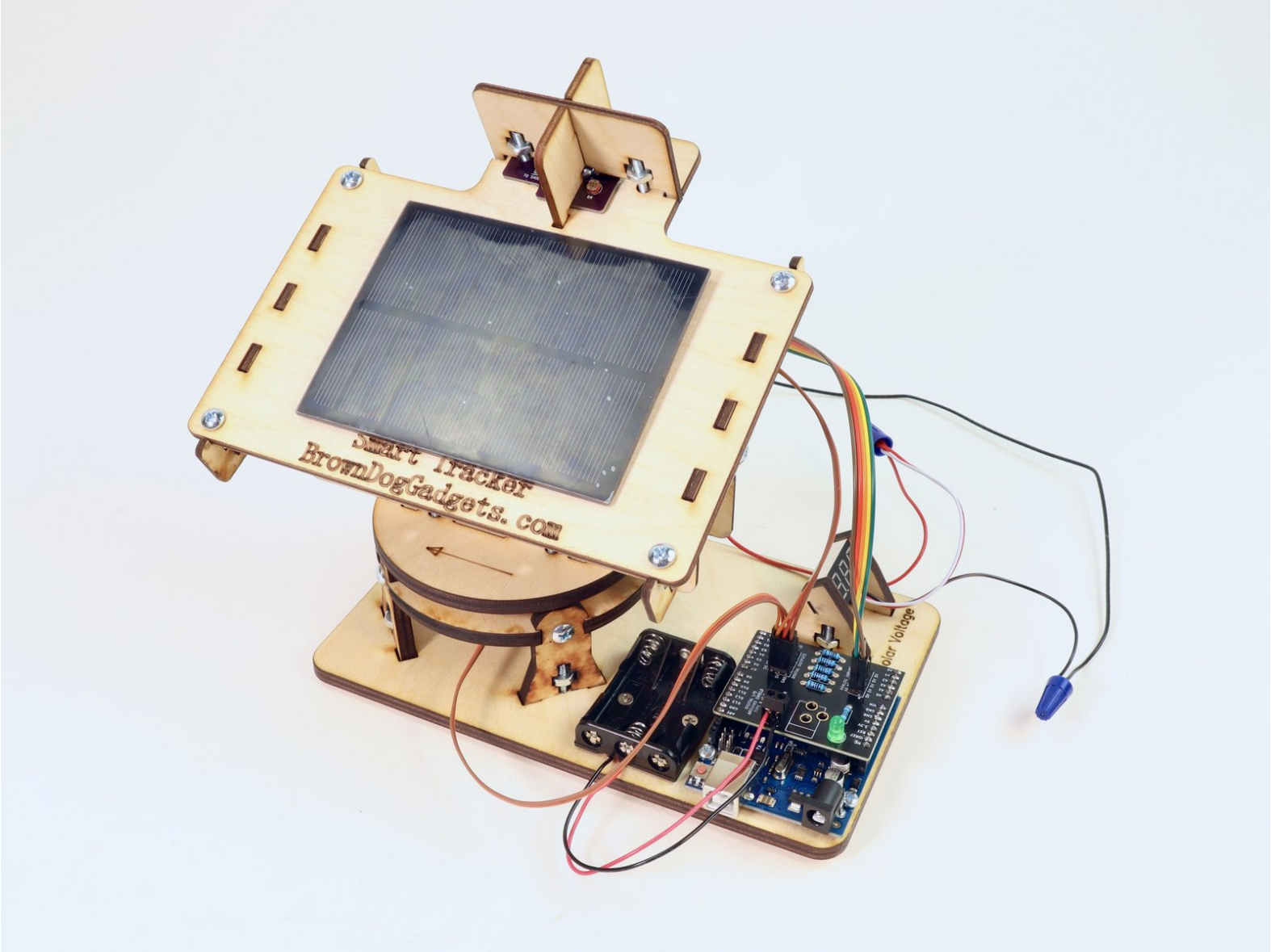
Dual Axis Solar Tracker 3.0

A physical assembly guide for our third iteration of the Dual Axis Solar Tracker including a 3AAA battery holder for use in powering servos directly.

Written By: Andy Wallus



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INTRODUCTION

The Dual Axis Smart Tracker 3.0 is a project designed to teach engineering and programing. The project uses a custom Arduino shield and sensor holder, a custom lasercut body, and code. The kit includes everything you need to build the project.

If you'd like to build your own from scratch, or customize part of this project on your own, you can find our Open Source resource files here.

Our Open Source files include:

- Laser Cut Files
- PCB Design Files
- Code

TOOLS:

- Phillips Screwdriver (1)
- Small Slotted Screwdriver (Flat Head) (1)
- Wire Strippers (1)
- Computer (1)

PARTS:

- Dual Axis Tracker 3.0 Kit (1)

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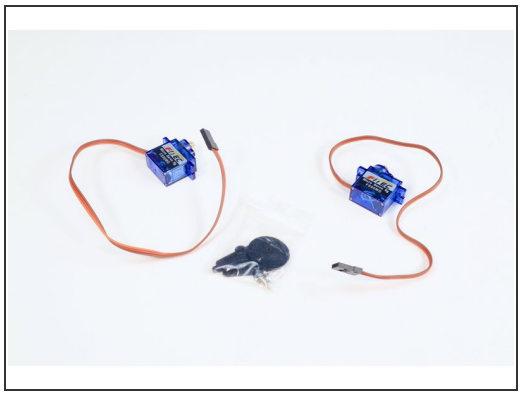
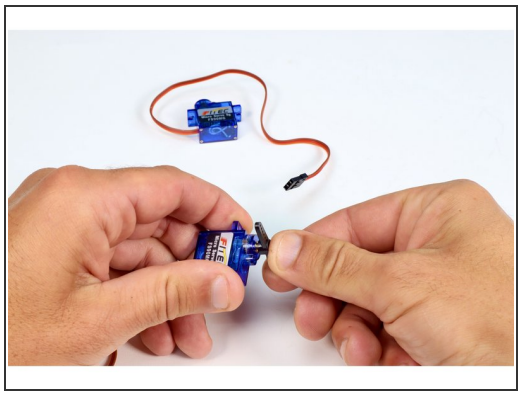
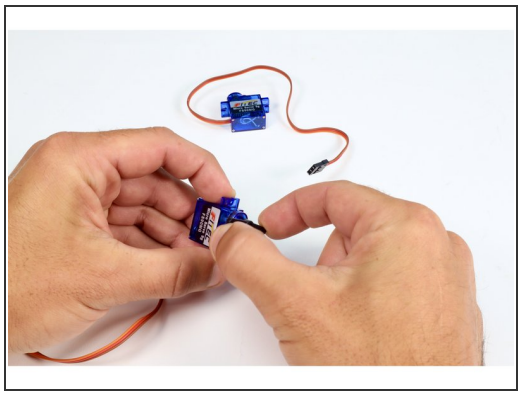
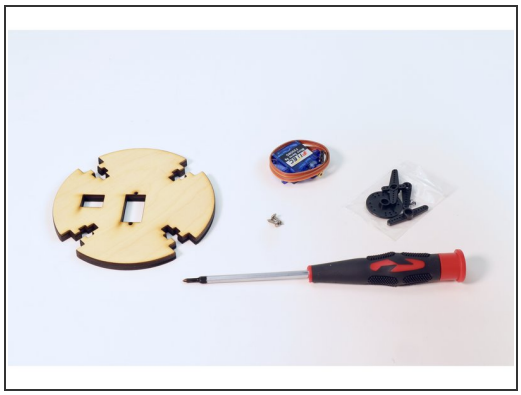
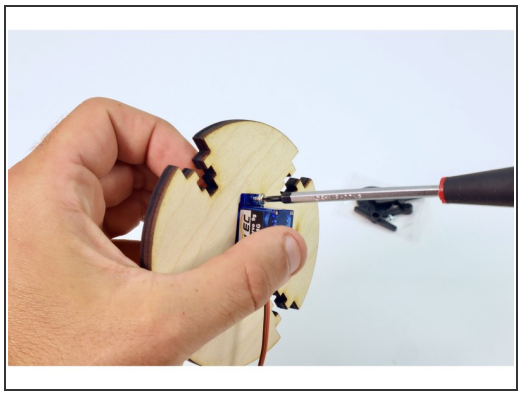
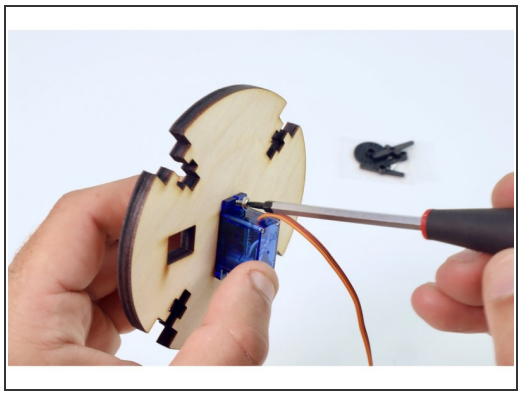
Step 1 — BEFORE YOU BEGIN: Zero your servos.

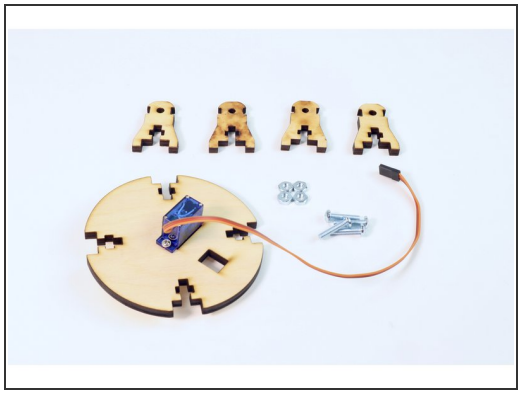
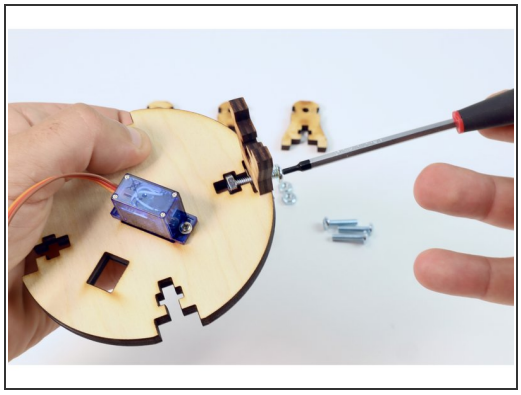
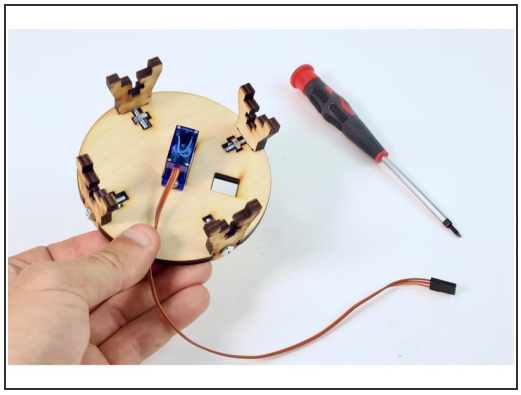
- The movement instructions within the code that you'll upload from your computer after building the Tracker are going to cause movement at servos in reference to a starting point within their 180 degree range. **For the code to accurately instruct a certain degree of motion "from zero" we first need to assure that the servos start from zero.**
- Find the two servos and remove them from their bags. **Take any of the plastic servo horns also included in the bags and push onto the servo axle of one of your servos.**
- Using the servo horn, **hand turn the servo axle clockwise until you cannot turn it any further.** This is the zero position of that servo.
- Remove the servo horn and **use the same process to turn the second servo axle to its zero position.**
- **Your servos axles are now at their zero positions** and, when the Tracker is fully built and receiving instructions from the Arduino, the servos will execute all movement commands from the correct starting point.

Step 2 — The Solar Tracker Build

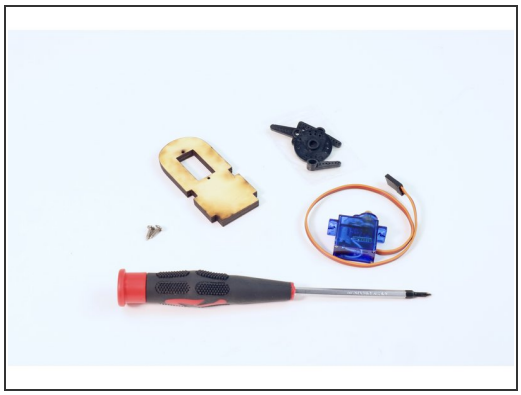
- Using two of the **matching screws** (found in each servo bag) and a small Phillips head screwdriver, **mount one of the servos** as shown onto the circular Solar Tracker platform.

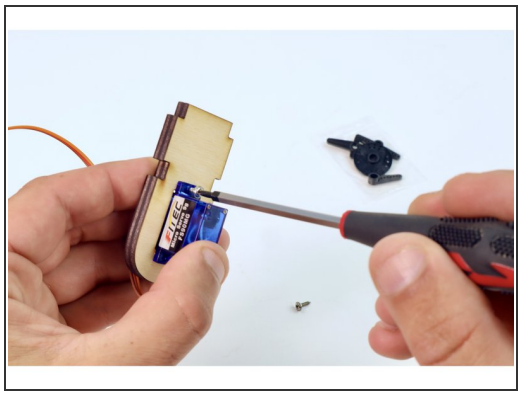
Step 3

- Find the **circular platform** you just attached the servo to, four **platform legs**, four (8-32-3/4”) **screws** and four (8-32) **nuts**.
- **Bracing it from behind with a finger from one hand,** seat a single nut in the slot **of one leg position.**
- Next, **seat a single wooden leg** as shown.
- **Thread a single screw** through the hole in the wooden leg and hand tighten to the nut behind it.
- Use your screwdriver to **fully tighten**, cinching the leg in place.
- **Repeat this process** for the remaining three legs so the entire assembly looks like the final photo.

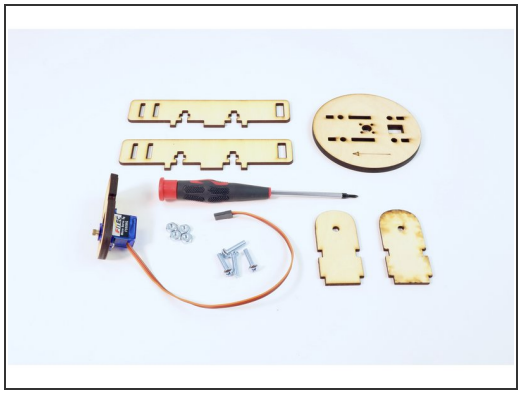
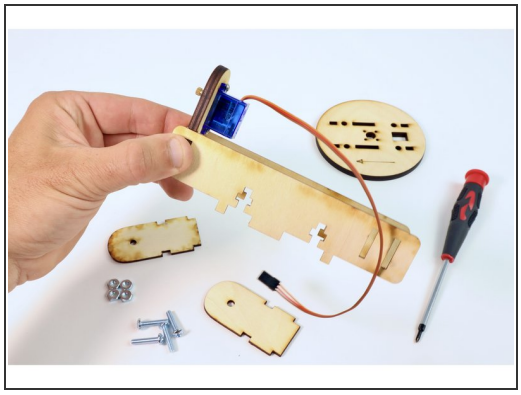
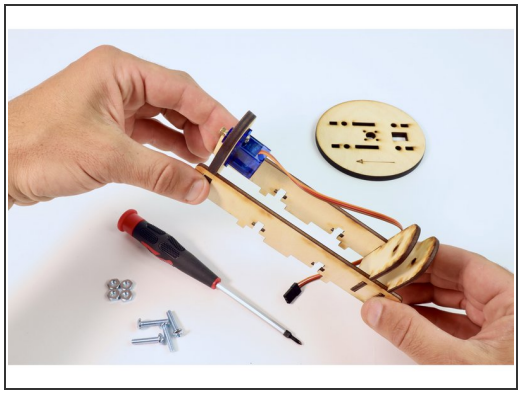
Step 4





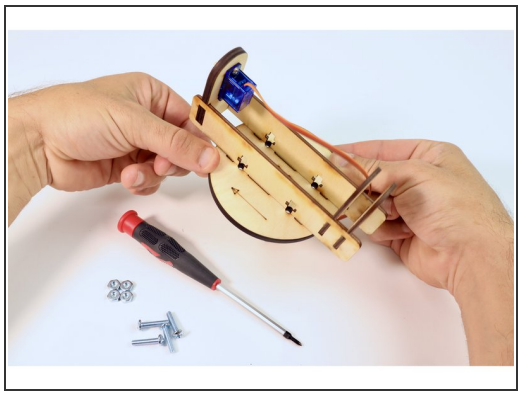
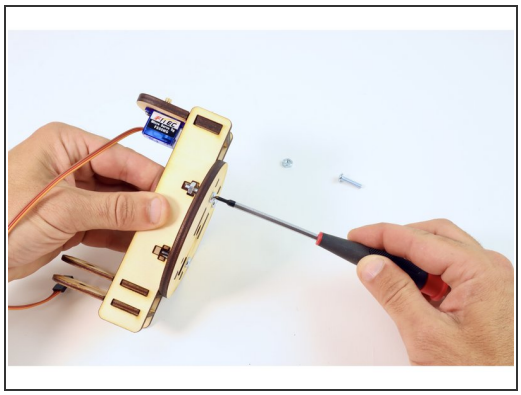
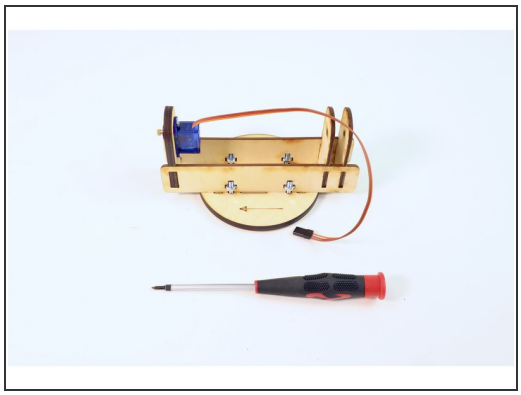
- Using the **wooden servo plate** shown, and the **two matching small screws** found in the last servo bag, **mount the remaining servo** using your Phillips head screwdriver.

Step 5

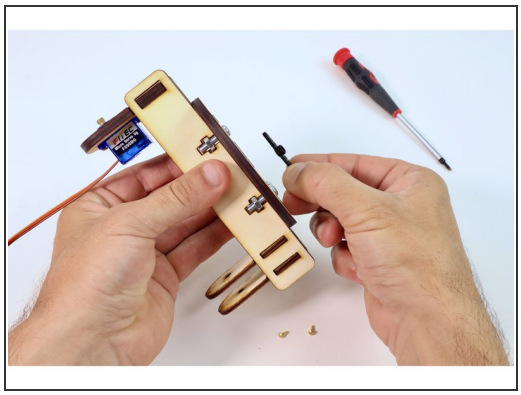
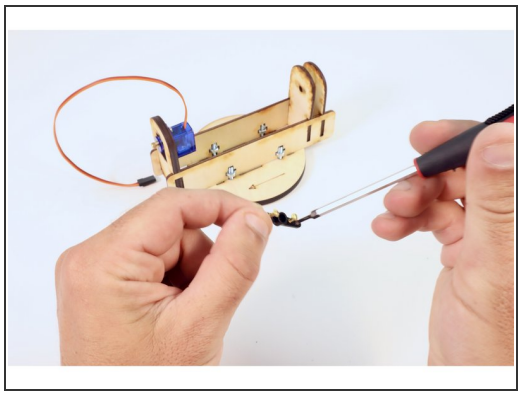
- Gather the **wooden parts** shown and **four (8-32-3/4”) screws/nuts**.
- **Seat the tabs of the servo mount** in the single slots of the two long wooden pieces as shown. **Pinch and hold** them in place making sure the servo axle is facing outward as shown with the servo itself on the opposite side of the nut/screw slots of those long wooden pieces.
- Insert the remaining **two matched wooden pieces** into the slots at the opposite end of the longer pieces. **Make sure** their curved ends match the orientation of the curved end of the servo plate. **Pinch and hold** together.

Step 6

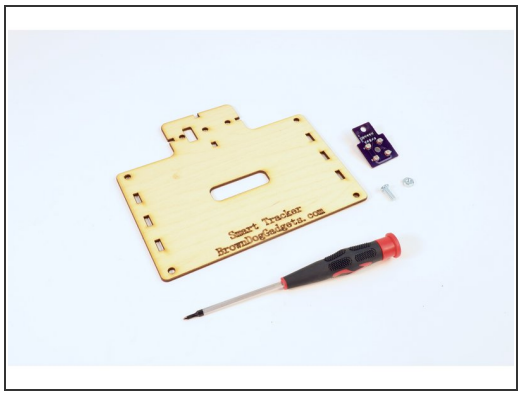
- **Fit the assembly** from the previous guide step **into the slots** on the circular piece making sure that the etched arrow side is oriented as shown.
- **Seat** a single (8-32) nut into one of the slots, bracing it from behind with a finger from one hand.
- **Thread a single screw through the corresponding hole** on the other side of the circular piece and **tighten it** to the nut with the small Phillips head screwdriver.
- **Repeat this process** for the remaining three nuts/screws until the entire assembly looks like the final photo.

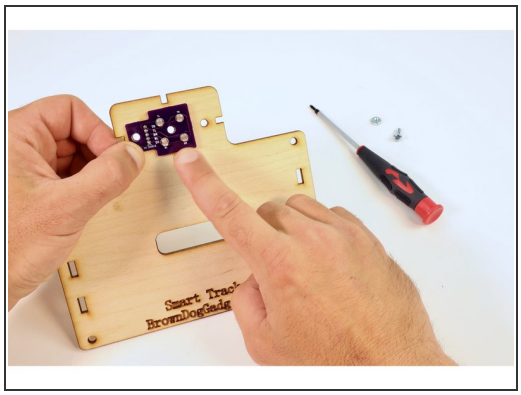
Step 7

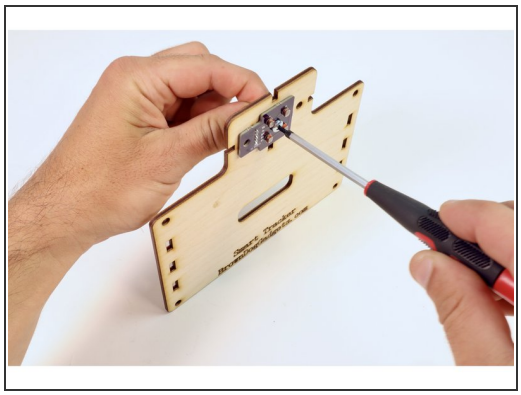



- **Select the black plastic servo horn pictured** from a servo bag and note the first photo indicating the eventual orientation of it . The raised, circular part will need to face in the **same direction as the screw heads**.
- **Find two of the four gold screws** included in your kit. On a flat surface away from the wooden assembly, **screw** one into the hole **second from the center** of the servo horn and the other into the **third hole from center on the opposite side of the center** .
- **Turn each** of these two screws so that their **tips just barely poke out** the back of the servo horn (this will help you keep this part aligned while screwing it to the wooden assembly).
- **Place the servo horn** in the center of the non-etched side of the circular piece so that the screw tips are aligned with the pre-made holes.
- Use the screwdriver to **tighten the servo horn** in place against the wood plate.

Step 8

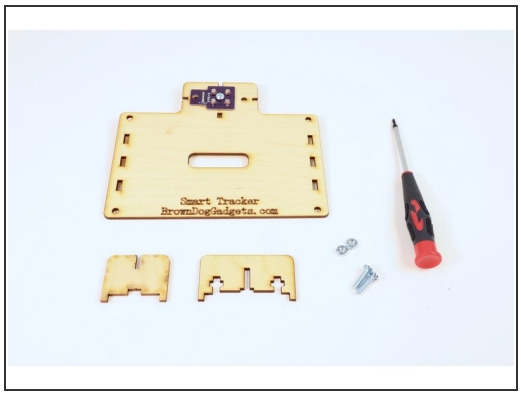


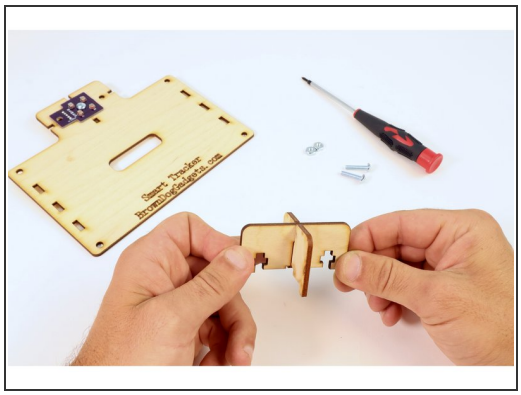


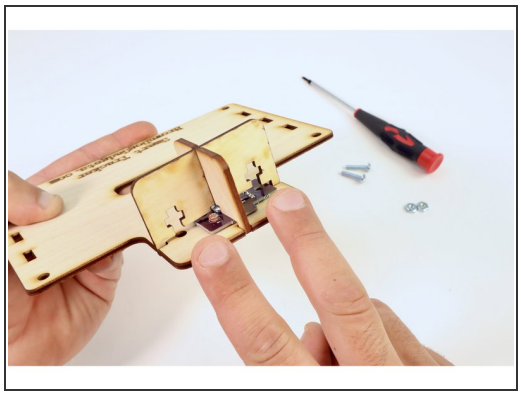


- **Gather** the solar panel mounting plate, the single (8-32 1/2") screw, a single (8-32) nut and the small circuit board with four photoresistors on it.
- **Position** the circuit board as pictured so that the metal pins on the back drop through the rectangular hole on the wooden piece. This should allow the circuit board to lay flush against the wooden plate.
- **Thread the 1/2" screw** through the hole between the four photoresistors and, using the nut and the screwdriver, tighten to secure the circuit board to the wooden plate.

Step 9

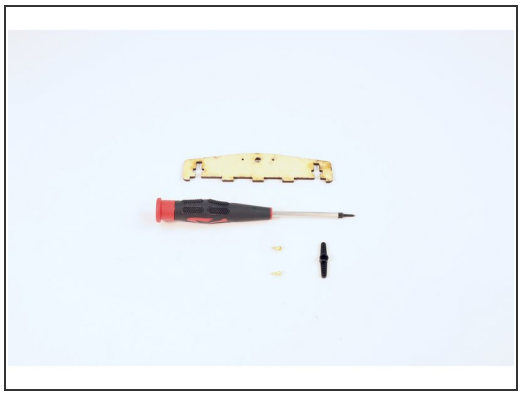


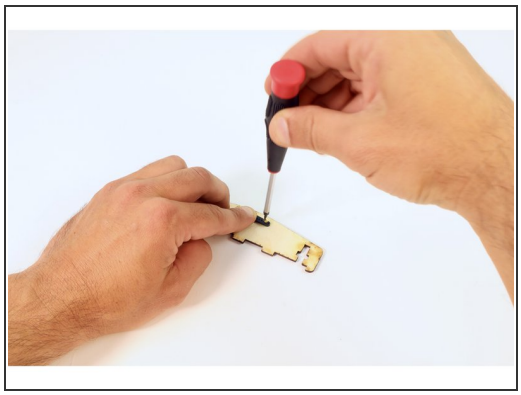




- **Gather** the assembly from the previous step, two (8-32 3/4") screws, two (8-32) nuts, and the two slotted wooden pieces shown.
- **Fit the two small wood pieces together** as shown by sliding the larger of the two pieces atop the smaller via slots.
- **Press the crossed divider assembly in place** atop the circuit board so that the pegs fit into the holes on the larger plate.
- **Use the two screws and nuts** as you have in previous steps to join the crossed divider assembly to the larger plate.

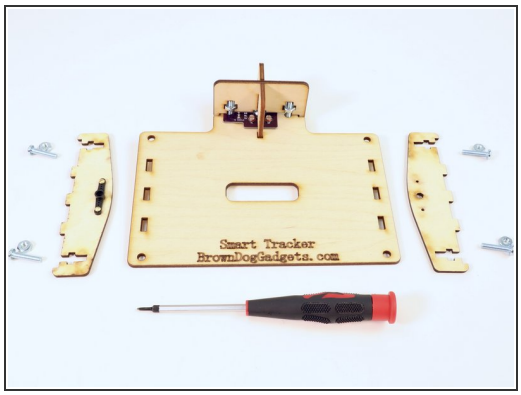
Step 10

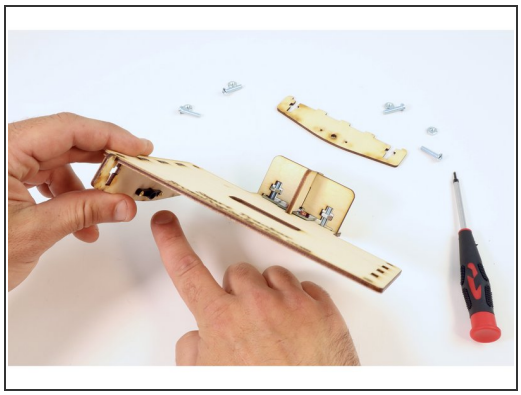
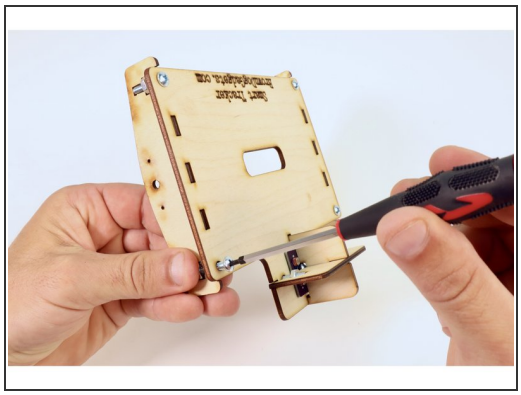




- **Gather** the **wooden side brace** pictured, another **servo horn** from a servo bag and the remaining **two small gold screws**.
- **Note the eventual orientation** of the raised circular side of the servo horn in photo 2.
- On a flat surface away from the wooden side brace, **start one** screw in the **second hole from the edge** on one side of the servo horn. Then, **start the other** screw in the second hole from the edge of the on opposite side. **Turn the screws** so their tips are just barely poking out of the back.
- Use the barely showing screw tips to guide placement of the servo horn where shown in the final photo. **Tighten screws in place** to secure horn to wood.

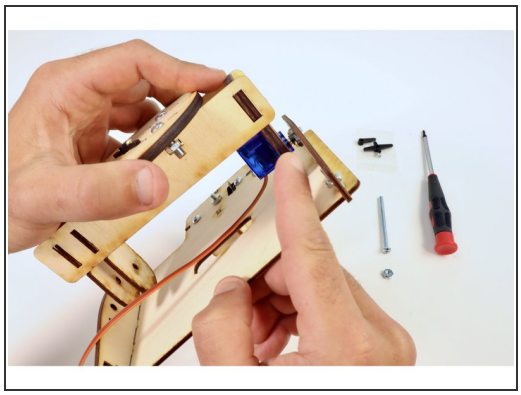
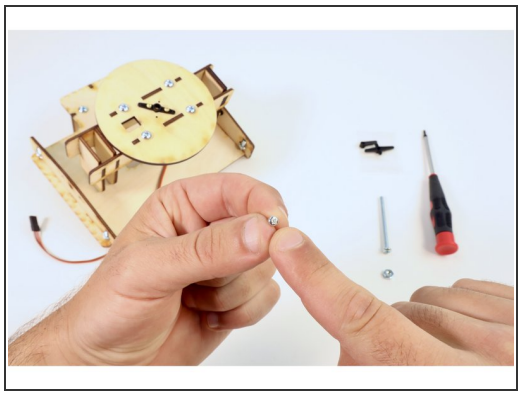
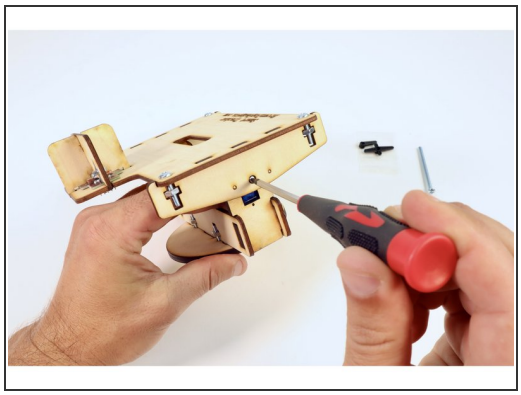
Step 11



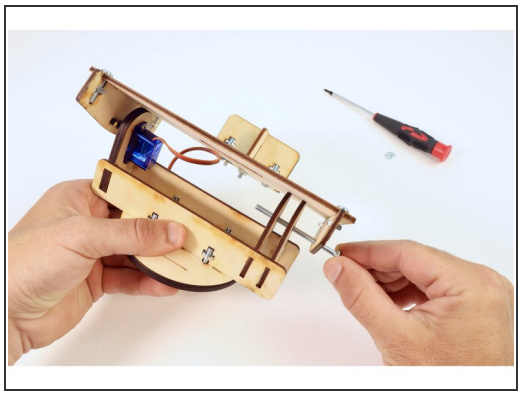
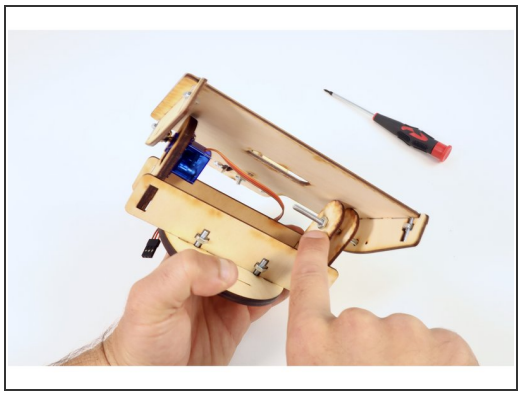
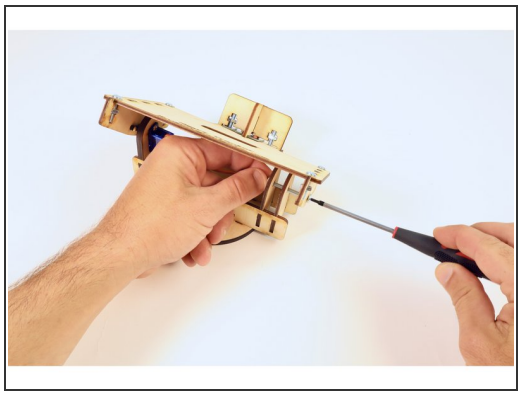
- **Gather** the two **side braces** (one has a servo horn attached now), the etched **solar panel plate with divided photoresistors**, four (8-32 3/4") **screws** and four (8-32) **nuts**.
- **Fit the "servo horn" side brace into the lefthand slots** on the side of the panel plate that is opposite the engraving so that the horn itself is oriented inward as shown in photo 2. **Secure** in place using two screws/nuts and your screwdriver.
- **Fit the remaining side brace** into the slots on the righthand side of the panel plate with the same orientation as the other. Use the remaining two screws and nuts to **cinch that brace** to the underside of the plate.

Step 12

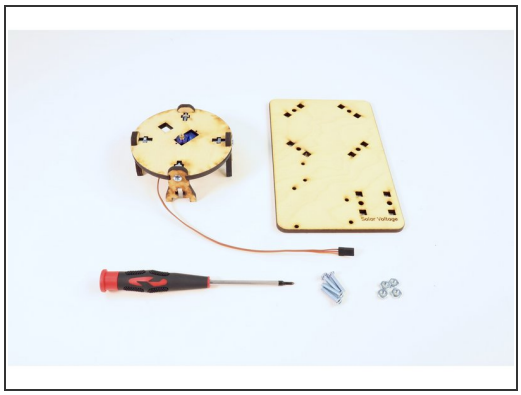
- **Connect the two completed subassemblies** by first inserting the servo axle into the servo horn as shown in the first photo.
- **Locate** one of the remaining **small screws** from the servo bags and **thread it** through the hole on the left solar panel side brace.
- **Use the screwdriver to tighten** that small screw to the servo axle that you inserted into the horn. This single screw will join this side of these two subassemblies.

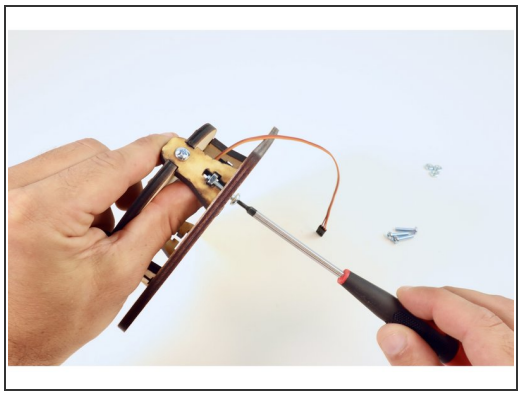
Step 13

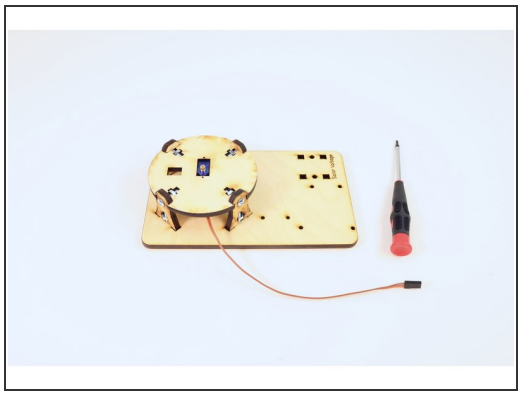




- **Locate the longest screw** in your kit and **thread it through all three holes** in the wooden pieces on the opposite side of the servo connection you just made.
- **Use one (8-32) nut** and your screwdriver to solidify this connection. **Don't over tighten!** This screw functions mostly as an axle that allows the plate above to swivel.

Step 14

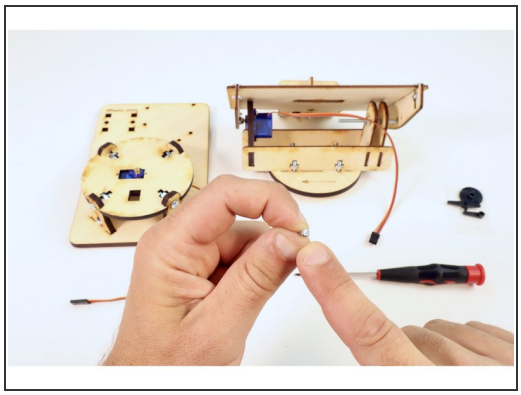
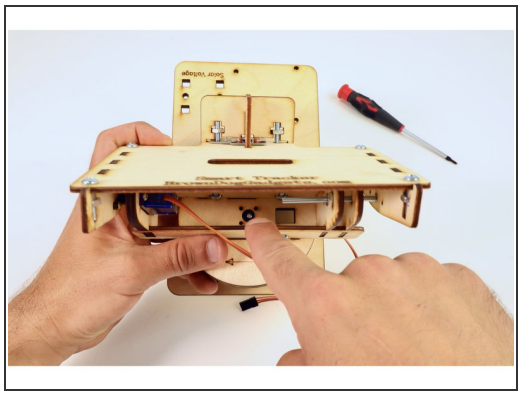
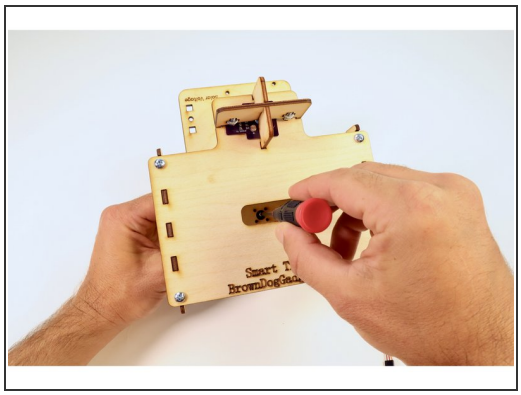






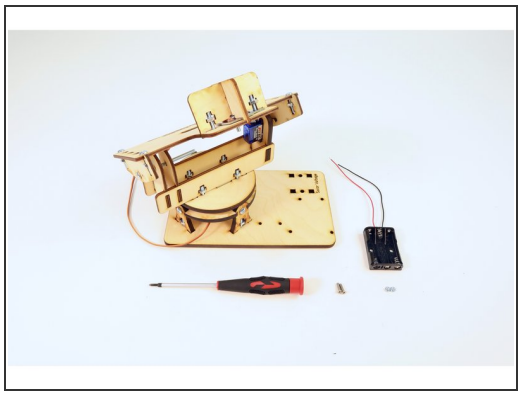
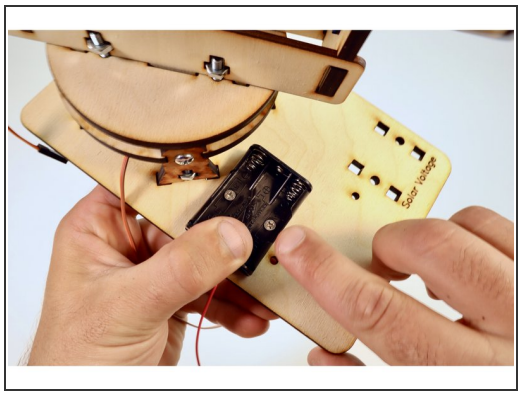
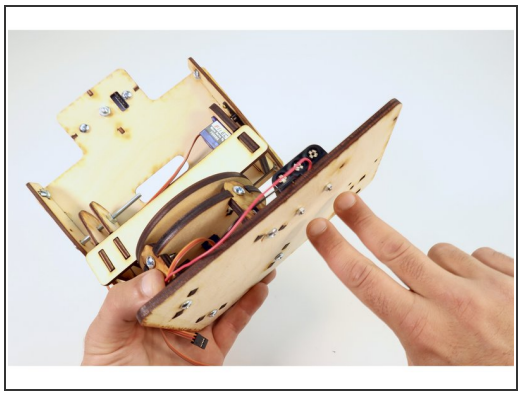
- **Gather** the large **engraved base plate** and the **circular assembly** from earlier as well as **four (8-32 3/4") screws** and **four (8-32) nuts**.
- **Fit** the legs of the circular assembly into the slots of the engraved side of the base plate as shown.
- **Use the four screws/nuts** and your screwdriver to **join the circular assembly to the plate**.

Step 15

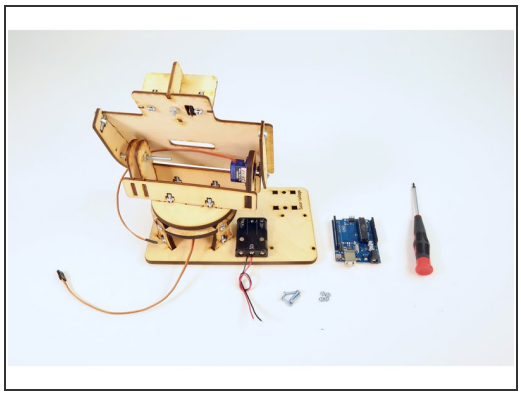
- To join the pictured assemblies, first **locate the last small screw** from the servo bags.
- **Press the servo horn** of the photoresistor array assembly on top of the servo axle from the assembly you just finished and **thread the small screw through the hole** above the servo axle as shown.
- Use your hand to **reposition the solar panel plate angle** so that the hole in the center allows easy screwdriver access to the small screw. Then **tighten to secure** these two assemblies together.

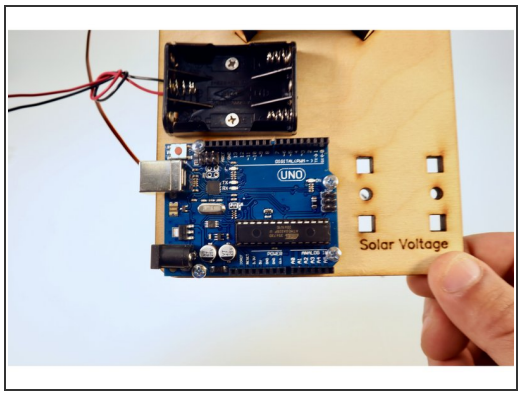
Step 16

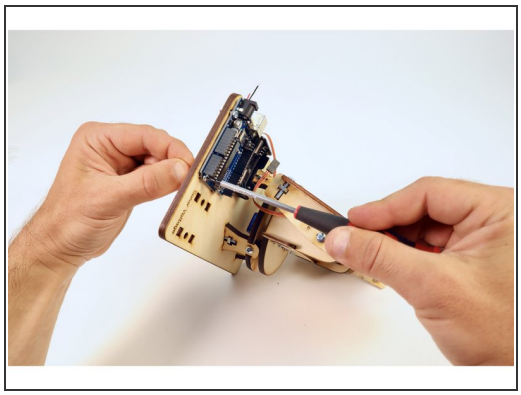




- **Gather** the 3AAA **battery pack**, two (12mm M3) flathead **screws**, two (M3) **nuts** and the final assembly from the previous step.
- **Position the battery pack** as pictured and **thread the two screws through the two holes** as well as the wooden plate below.
- Secure the battery pack by **tightening the two M3 nuts** to the screws with your screwdriver.
- **A note about the battery pack:** While your Arduino is powered by USB and must be plugged in if the Arduino is to work, the battery pack is a **separate power supply**, giving reliable power to the servos and MUST have batteries installed.

Step 17

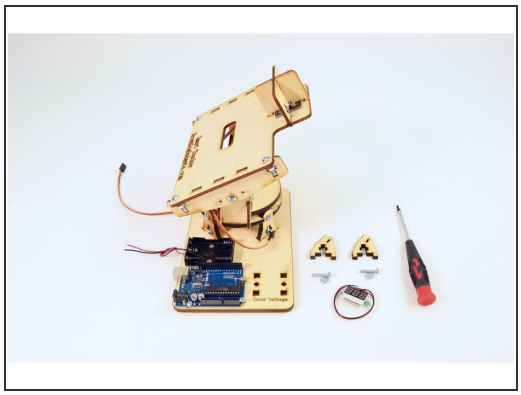
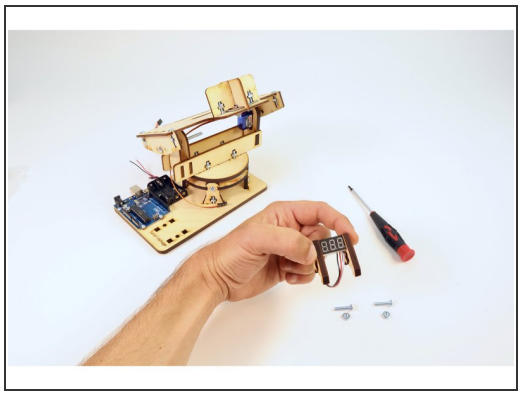
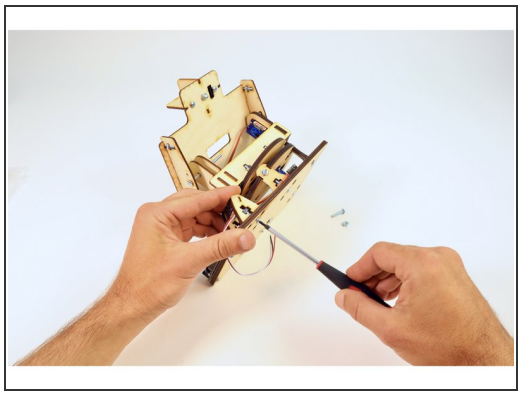






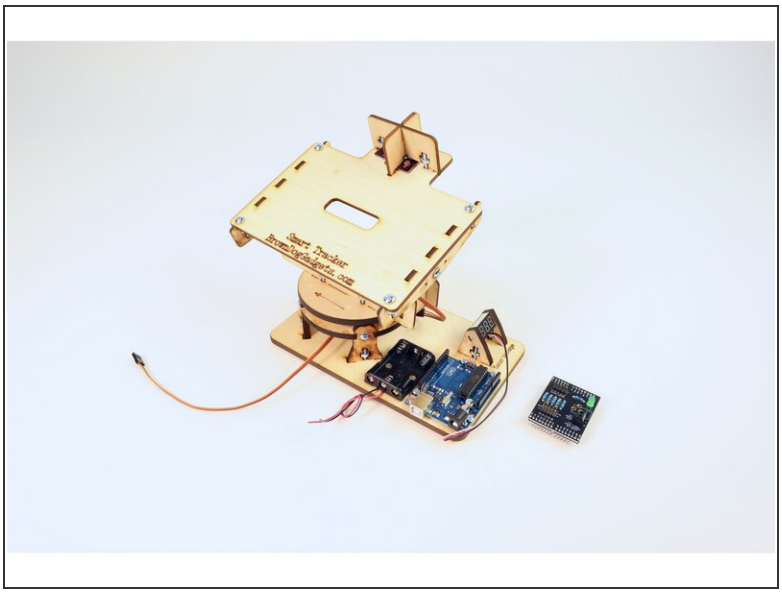
- **Gather** the **Arduino**, four (8-32 3/4") **screws**, four (8-32) **nuts** and the assembly from the previous step.
- **Position the Arduino** over the holes next to the battery pack with the USB port orientation as pictured.
- Secure the Arduino to the Solar Tracker assembly by **tightening the four screws to the four nuts** with your screwdriver.

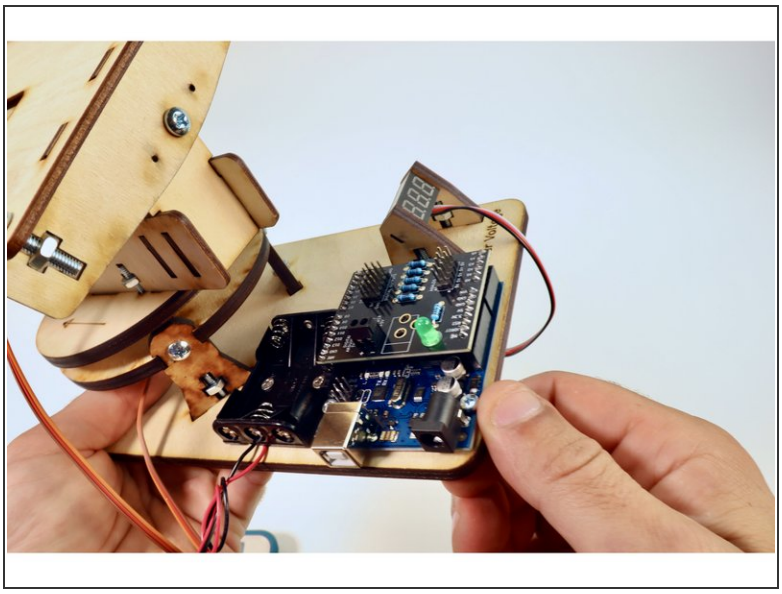
Step 18

- **Gather** the two **wooden brackets** pictured, two (8-32 3/4") **screws**, two (8-32) **nuts**, the wired **voltmeter** and the Solar Tracker assembly from the previous step.
- Fit the **side tabs** of the voltmeter **into the slots** on the wooden brackets and **pinch together** as shown in the second photo.
- **Insert** this assembly into the remaining holes on the Solar Tracker base as pictured **and secure** by tightening the screws and nuts with your screwdriver as done in previous steps.

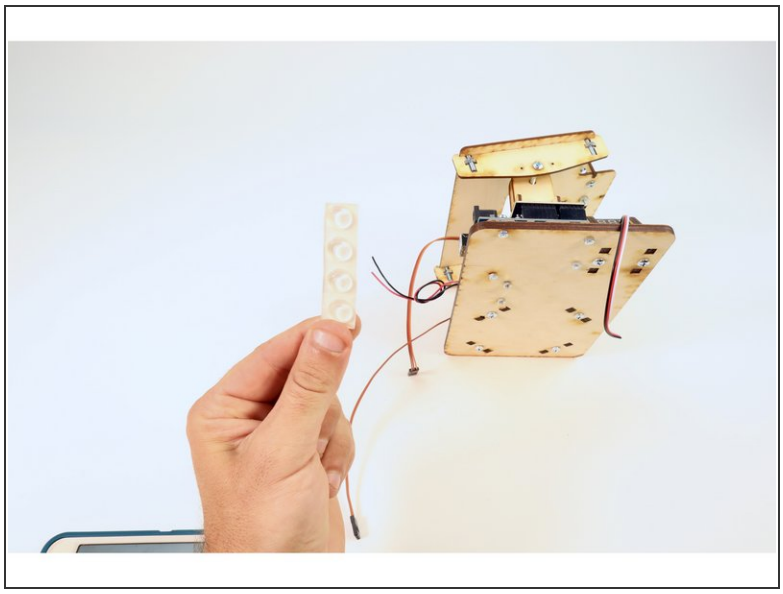
Step 19





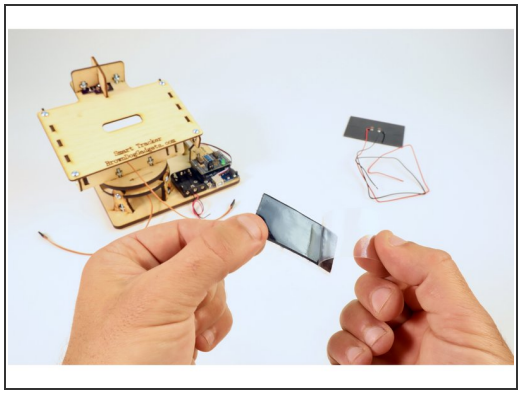
- **Find the Arduino shield** and **orient it to match the second photo**.
- Take care to **line up all the pins** from the underside of the Arduino shield **with the holes** on the Arduino.
- **Firmly press the shield downward** to seat the pins in their respective holes and connect these two boards.

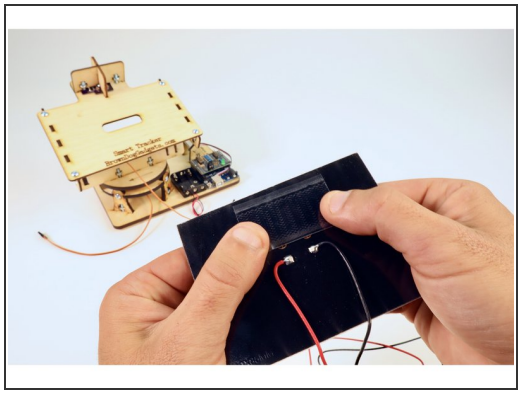
Step 20

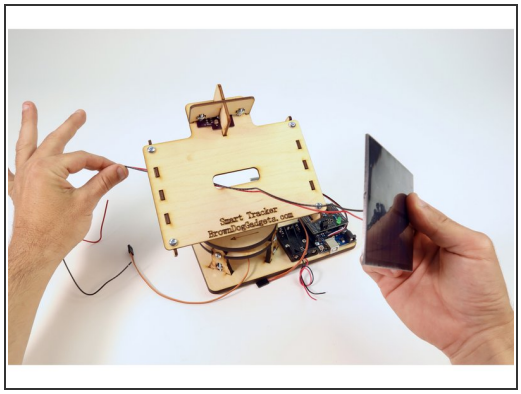


- **Find the strip of four rubber feet,**
- **Peel and stick** them in the corners on the underside of the Solar Tracker base plate.

Step 21

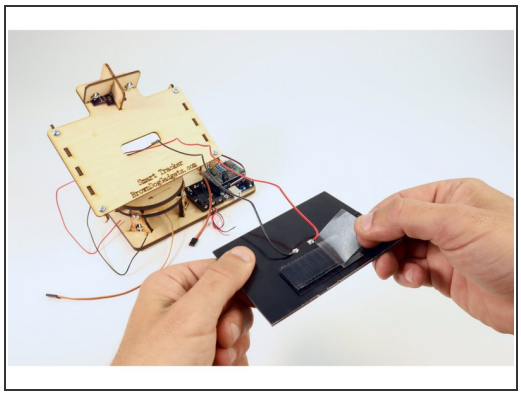
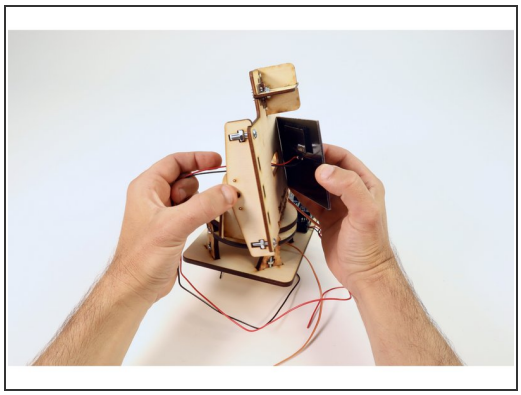
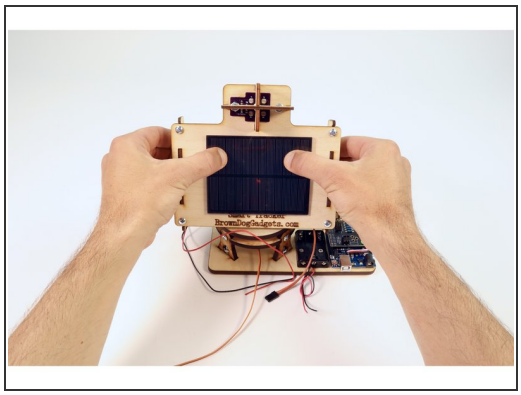






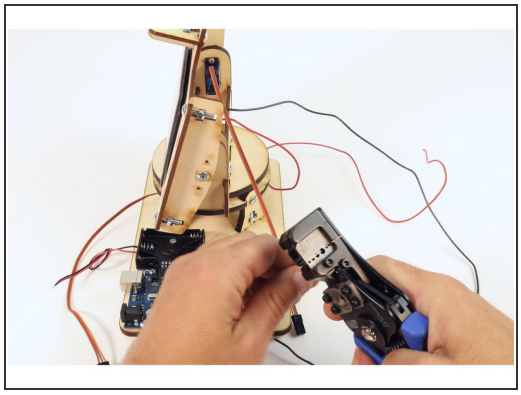
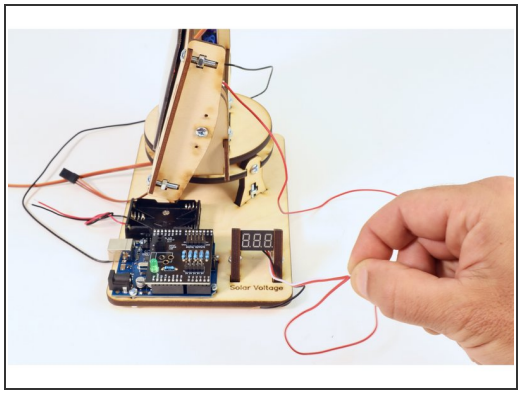
- **Find the Solar Panel and velcro strip** in your kit and **peel one side** of the velcro backing off to reveal its sticky side.
- Leaving the opposite side backing intact, **press the velcro in place** as shown on the back side of the solar panel.
- **Thread the long wires** through the hole on the wooden mounting plate.

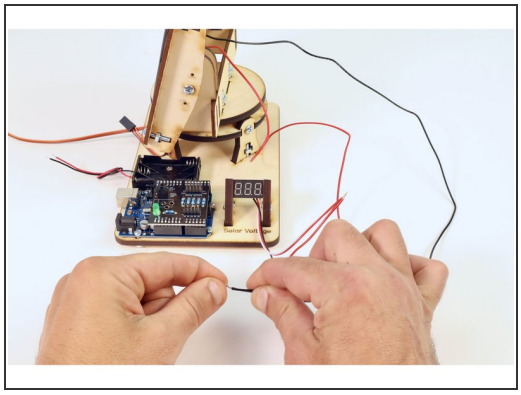
Step 22

- **Peel the remaining backing** from the velcro (now attached to the solar panel).
- **Pull the wires** the rest of the way through and **press the Solar Panel in place** atop the mounting plate as shown.

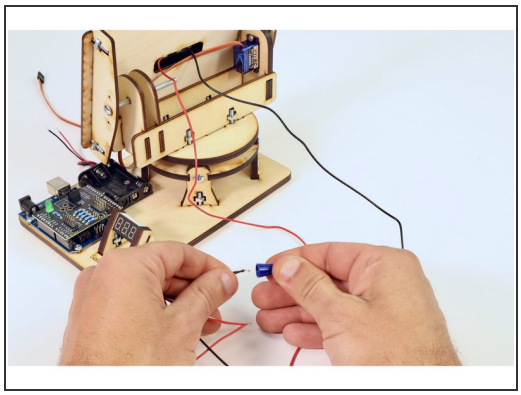
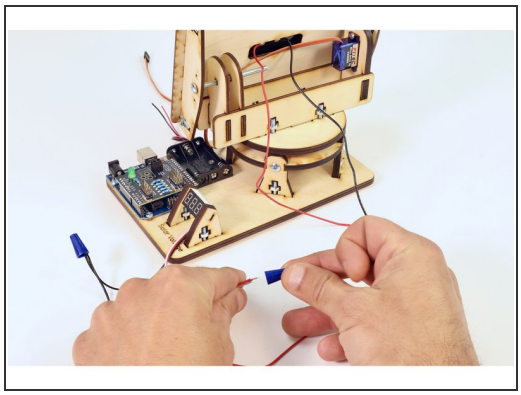
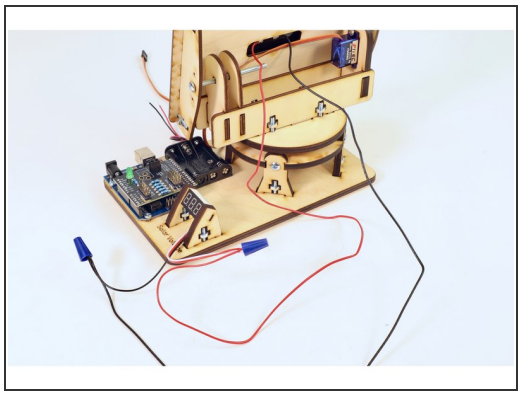
Step 23 — Wiring the electronics.



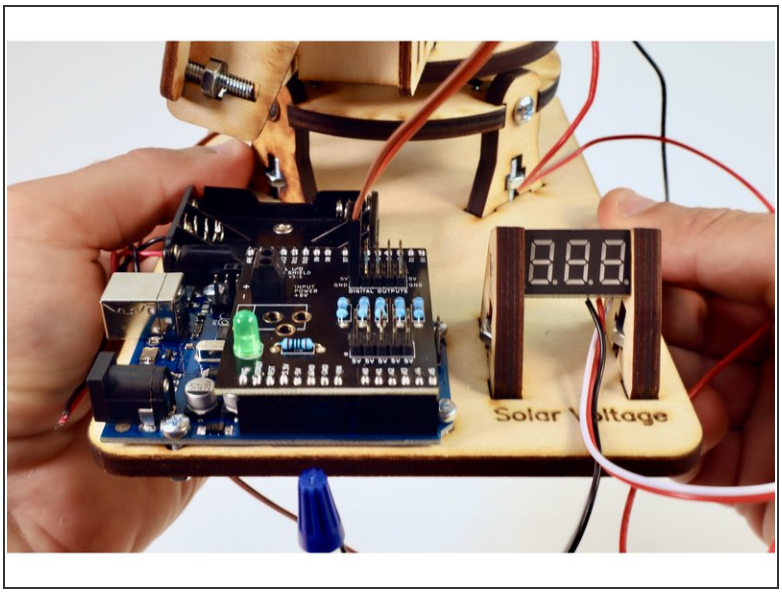
- Using a wire stripper, **remove about 1/4" of insulation** from each of the three wires that are connected to the voltmeter.
- **Twist** the copper strands from the red wire of the solar panel to the strands from both the red and white wires of the voltmeter.
- **Twist** the copper strands from the black wire of the solar panel to those of the black wire of the voltmeter.

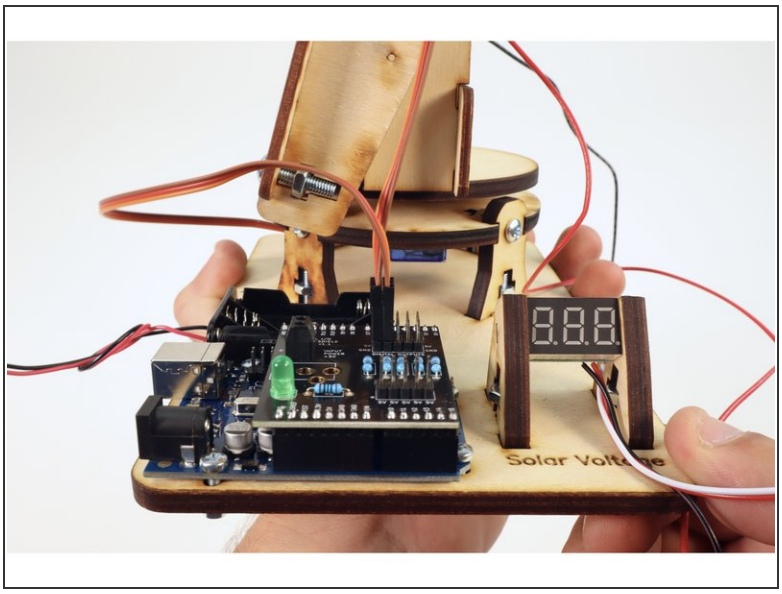
Step 24

- **Gather** the two blue **wire nuts** from your kit.
- **Twist** one wire nut onto the **black** wire bundle.
- **Twist** the other wire nut onto the **red/white** wire bundle.

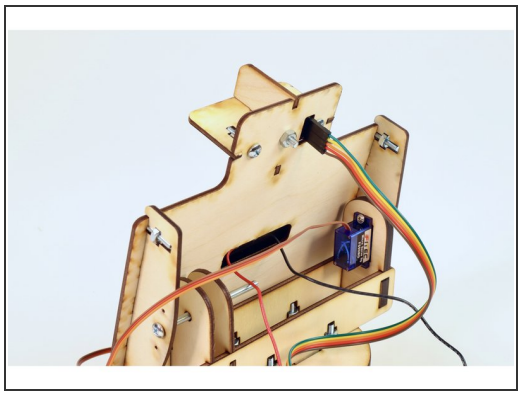
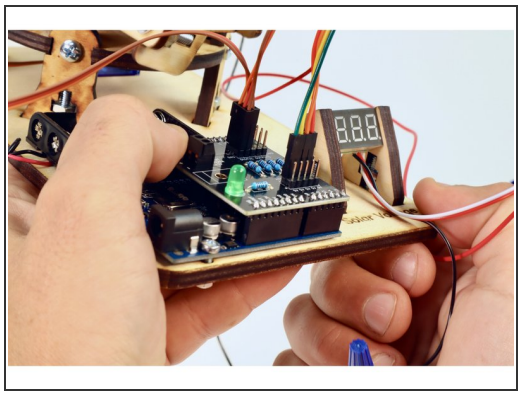
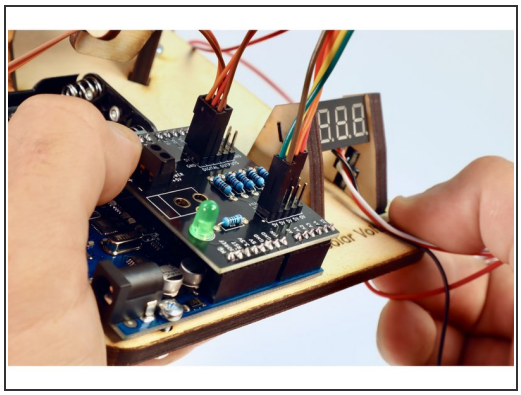
Step 25





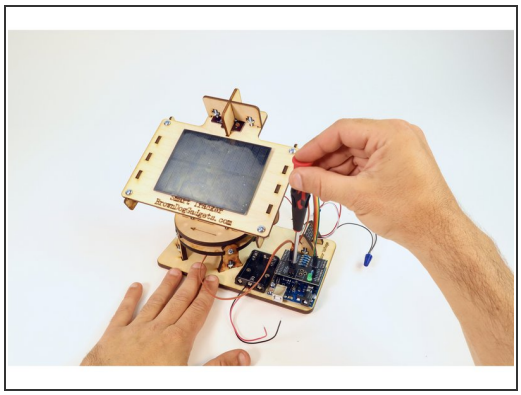
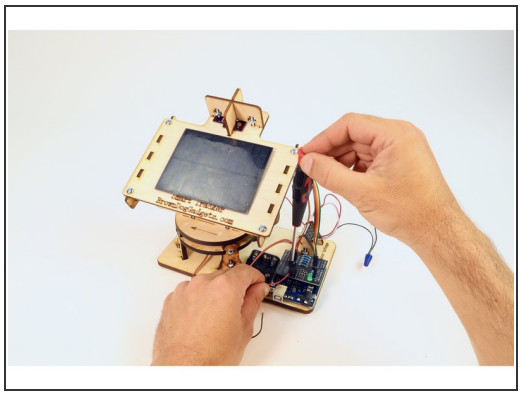
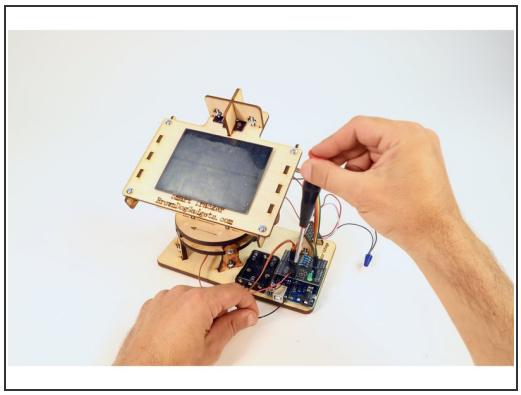
- Take the **wires from the uppermost servo** and **plug** them **into** the row of pins labeled **D6** as shown in photo one. **Orient** the plug **so** that the **brown wire connects to** the column of pins labeled **"GND"**.
- Take the **wires from the lower servo** and **plug** them **into** the row of pins labeled **D5** as shown in photo two. Again, **orient** them **so** that the **brown wire connects to** the column of pins labeled **"GND"**.

Step 26

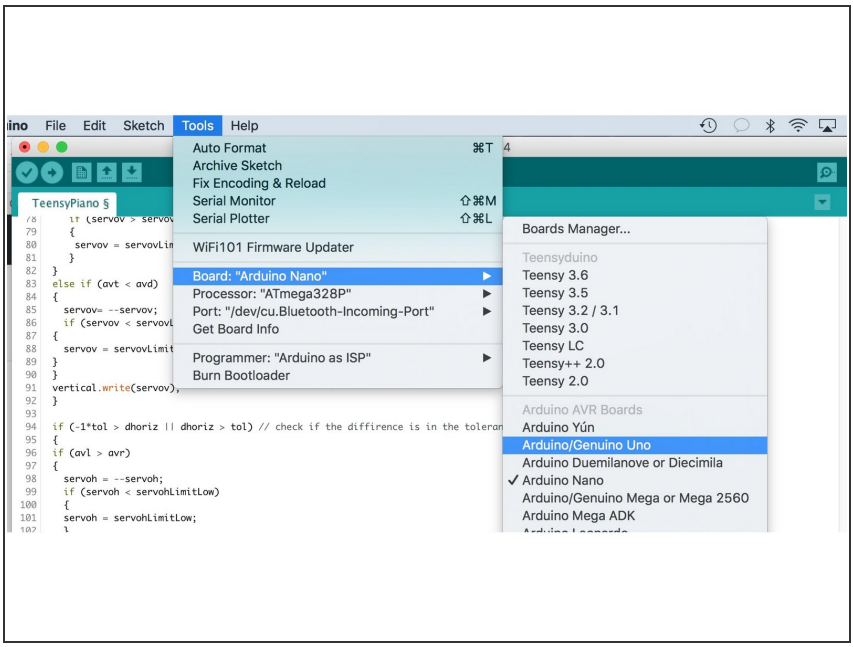
- **NOTE: The following instructions reference these wires' position from "top to bottom".** However, **if you prefer to reference the designators** (names) for these pins (found on the front side of the photo resistor circuit board) or just need a different visual, **use the downloadable wiring guide found at the top of this guide.**
- **Note the color of the topmost wire** already plugged in (green in our photo...but yours may be a different color). **Find the opposite end** of that wire and **plug it into the analog pin labeled A0** on the Arduino shield.
- **Note the color of the wire that is already plugged in and second from the top** (yellow in our photo...but yours may be a different color). **Find the opposite end** of that wire and **plug it into the analog pin labeled A1** on the Arduino shield.
- **Note the color of the wire that is already plugged in and third from the top** (orange in our photo...but yours may be a different color). **Find the opposite end** of that wire and **plug it into the analog pin labeled A2** on the Arduino shield.
- **Note the color of the wire that is already plugged in and fourth from the top** (red in our photo...but yours may be a different color). **Find the opposite end** of that wire and **plug it into the analog pin labeled A3** on the Arduino shield.
- **Note the color of the bottommost wire already plugged in** (brown in our photo...but yours may be a different color). **Find the opposite end** of that wire and **plug it into the first 5V pin** on the Arduino shield. This should be the only available pin immediately adjacent to the first wire. **See photo three.**

Step 27

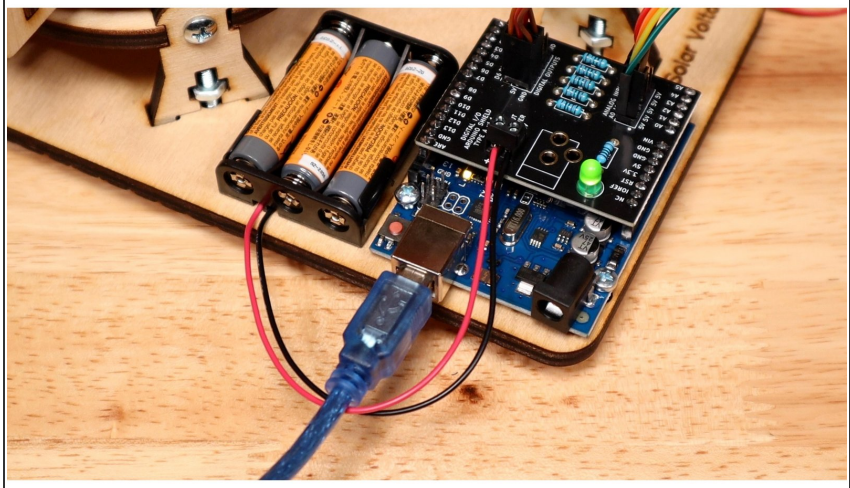
- Using a small slotted (flat head) screwdriver, **partially unscrew the two tiny set screws** within the screw terminal on the Arduino shield.
- **Insert the red wire** from the battery holder **into the screw terminal hole designated as POSITIVE**. Use the screwdriver to **tighten the set screw** atop that red wire.
- **Insert the black wire** from the battery holder **into the screw terminal hole designated as NEGATIVE**. Use the screwdriver to **tighten the set screw** atop that black wire.

Step 28 — Uploading the code that controls the Solar Tracker



- You first need to **download the Arduino programming software to your computer** and **connect the Arduino on your Solar Tracker** to your computer via USB.
- **From the TOOLS drop down menu**, make sure "Arduino Uno" is selected as the board and that the correct port (not bluetooth) is selected.
- **Open up a new project window** by selecting "new" from the FILES drop down menu.
- **Copy**/**Paste** the V3 code found here into the project window you just opened up within the Arduino software.
- **Click the teal checkmark** at the top left of the project window to verify. **Then click the arrow** to upload.

Step 29 — Running the Code



⚠ **Note:** You must power the Arduino via USB and power the shield with the 3 AAA Battery Pack with fresh batteries.