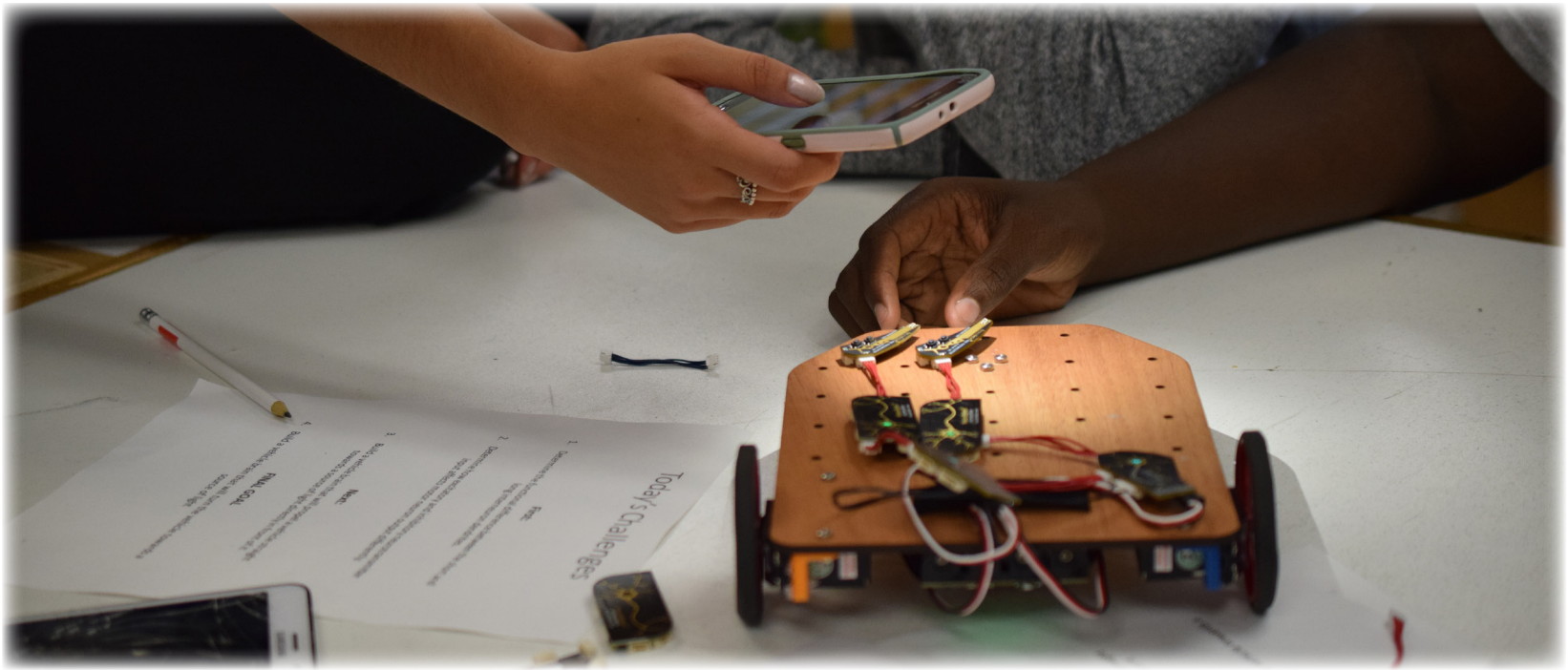
Your NeuroBuggy Kit

Valentino Braitenberg's *Vehicles*

In 1984, the cybernetician Valentino Braitenberg published *Vehicles: Experiments in Synthetic Psychology*. The book, which is still available from the MIT Press, explored a series of hypothetical robots that used simple neural circuits to respond to the environment in complex ways. In many cases, these circuits may only consist of one or two processing and sensing elements, and yet a casual observer would quickly assume the robot had real feelings: fear, aggression, timidity, etc.

For many students and casual readers, *Vehicles* served as a first introduction into the world of neuroscience and distributed systems. However, Braitenberg never intended the constructs from the book to be built in real life; he considered the robots to be thought experiments. With the NeuroBytes NeuroBuggy Kit, you can build many of the robots from *Vehicles*, and extend the basic circuits presented here to create fascinating robots that can solve complex problems using relatively simple designs.

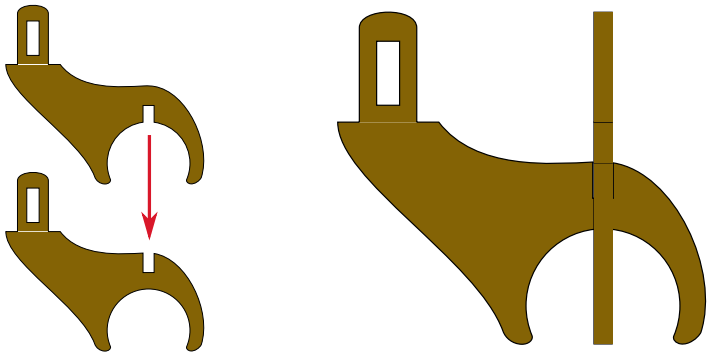


Your NeuroBuggy Kit

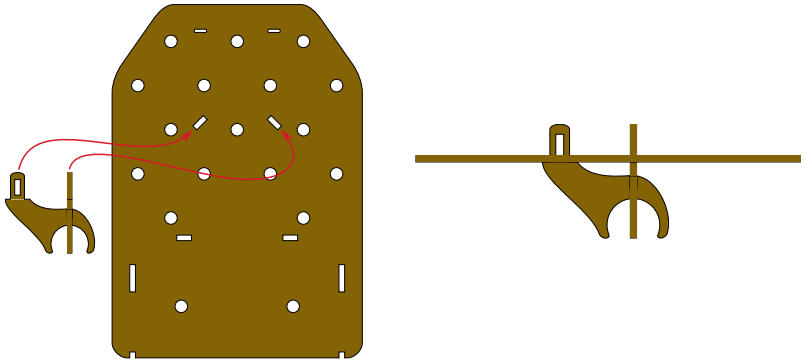
Building the Neurobuggy: Front Caster

Before building NeuroBytes circuits there are a few chassis elements you should assemble first. These wood parts can be installed in any order. Head here to see our instructional video: https://neurotinker.com/kits/neurobuggy

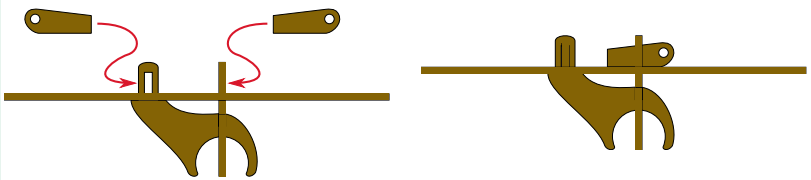
1 Slide the two caster mounts together.



2 Insert the caster mounts into the base plate.



3 Secure caster mounts using two wedges.v



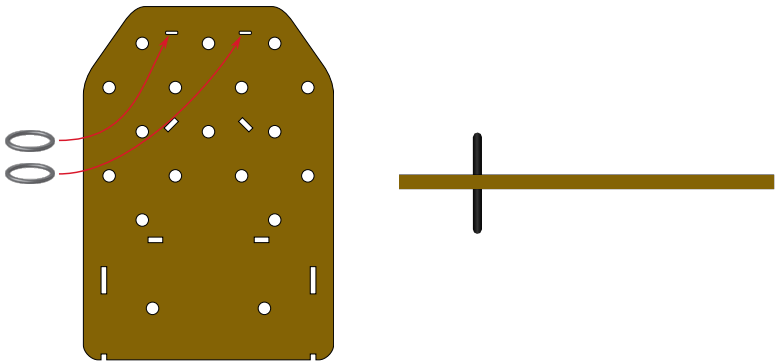
4 Snap ball into caster mounts.

Your NeuroBuggy Kit

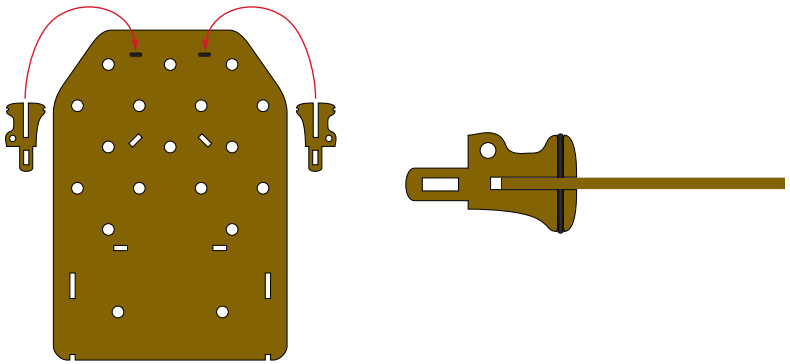
Building the Neurobuggy: Bumper Assembly

Before building NeuroBytes circuits there are a few chassis elements you should assemble first. These wood parts can be installed in any order. Head here to see our instructional video: https://neurotinker.com/kits/neurobuggy

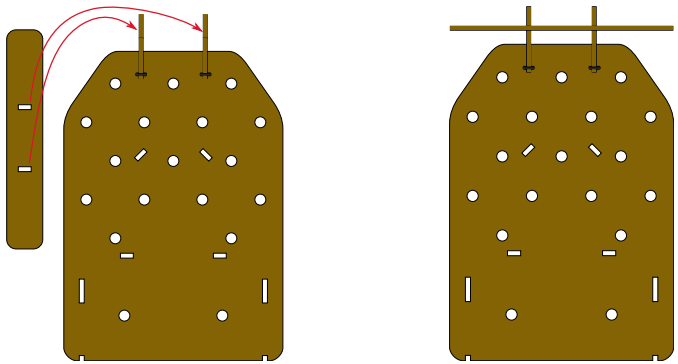
1 Insert two medium O-rings into slots near front of base plate.



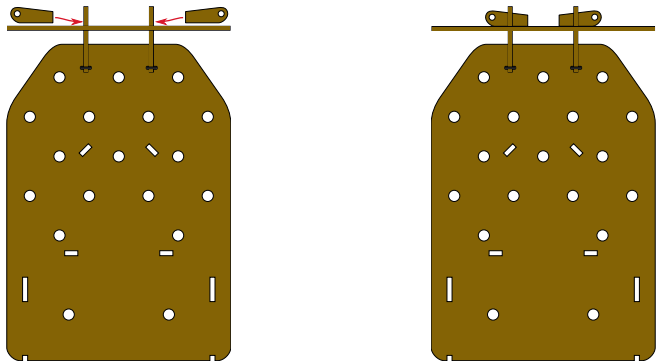
2 Slide the two bumper mounts onto the base plate with the O-rings resting in their grooves.



3 Slide bumper plate onto bumper mounts.



4 Secure bumper plate with two wedges.

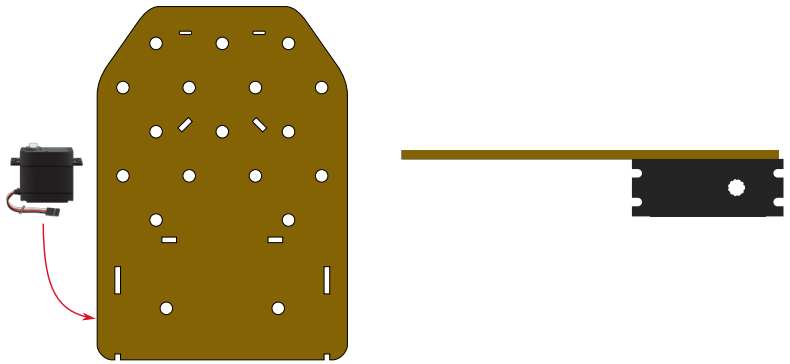


Your NeuroBuggy Kit

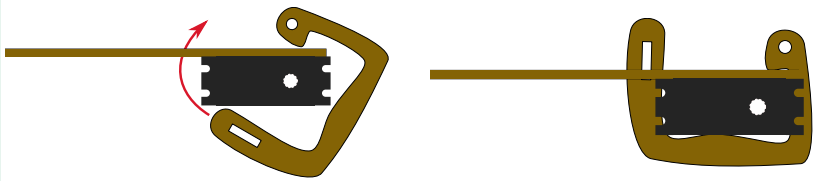
Building the Neurobuggy: Servo Installation

Before building NeuroBytes circuits there are a few chassis elements you should assemble first. These wood parts can be installed in any order. Head here to see our instructional video: https://neurotinker.com/kits/neurobuggy

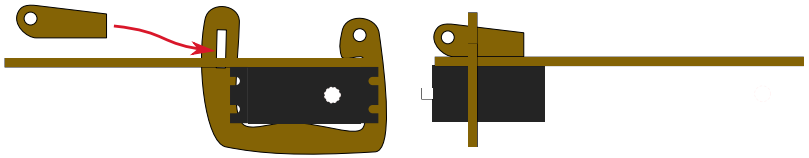
1 Position servo below base plate with white plastic gear near the back of the chassis.



2 Hook servo mount behind servo and rotate through base plate.



3 Secure servo mount with a wedge.



4 Repeat on the other side.

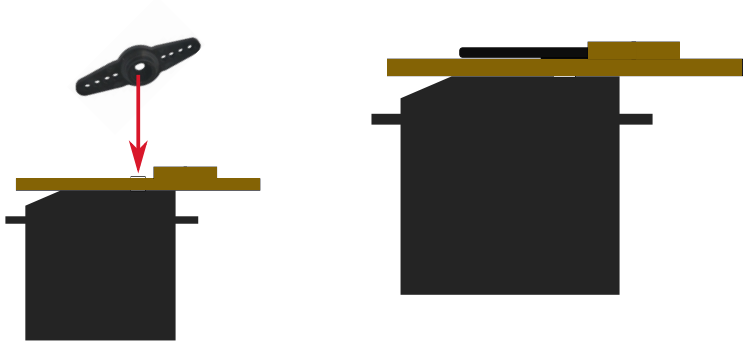
Your NeuroBuggy Kit

Building the Neurobuggy: Mounting the Wheels

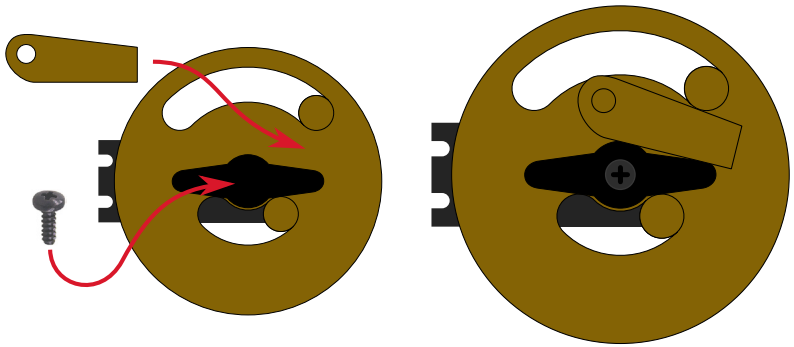
Before building NeuroBytes circuits there are a few chassis elements you should install first. These wood subassemblies can be addressed in any order. Head here to see our instructional video: https://neurotinker.com/kits/neurobuggy

1 Position wheel over servo gear with knobs facing out.

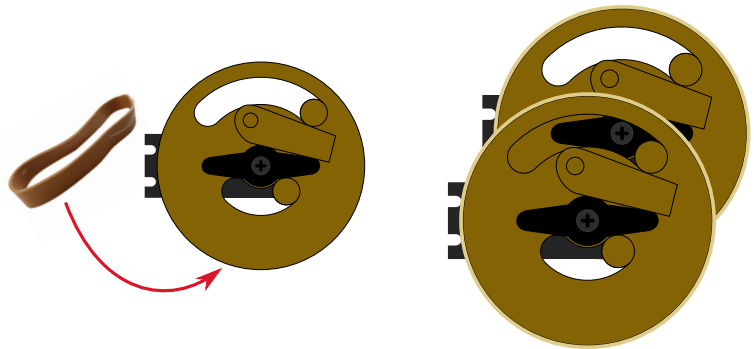
2 Push black servo horn onto gear through wheel. Horn and wheel should be snug but not tight.



3 Secure the wheel knobs to the servo horn using a wedge. Secure horn with screw to servo.



4 Stretch rubber band tire around wheel for traction. Repeat for second wheel.

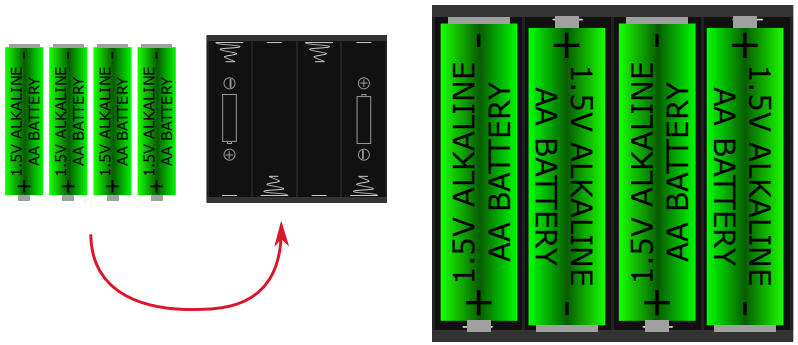


Your NeuroBuggy Kit

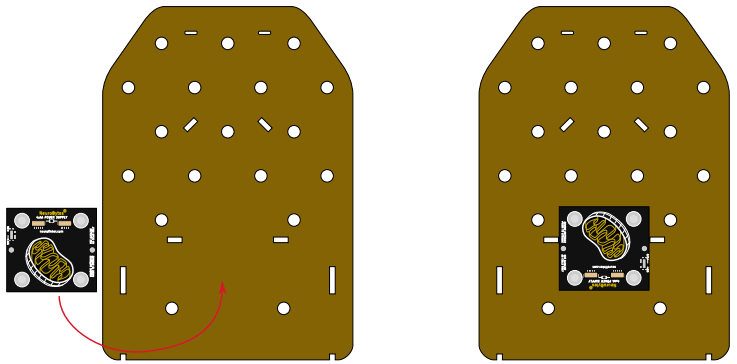
Building the Neurobuggy: Battery Pack

Before building NeuroBytes circuits there are a few chassis elements you should install first. These wood subassemblies can be addressed in any order. Head here to see our instructional video: https://neurotinker.com/kits/neurobuggy

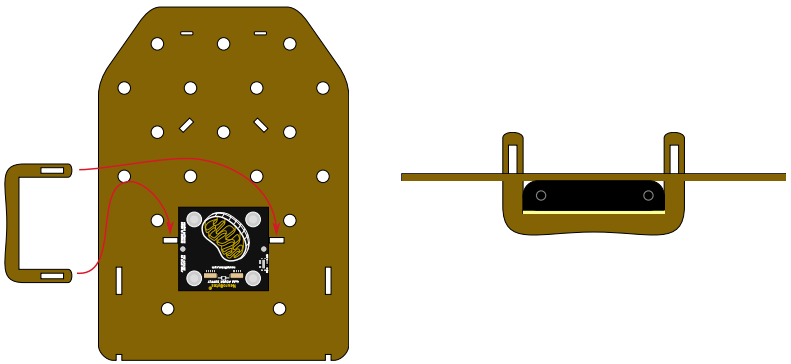
1 Install four fresh 1.5 V alkaline AA cells in the Battery Pack.



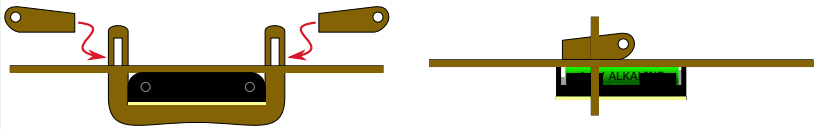
2 Position the Battery Pack under the base plate, batteries facing in. Note connector orientation.



3 Slide the battery pack clamp around the Battery Pack. Avoid components on board.



4 Secure battery pack clamp and Battery Pack with two wedges on the top of the base plate.

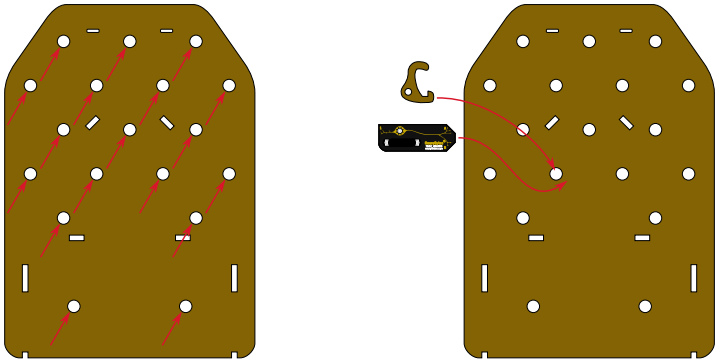


Your NeuroBuggy Kit

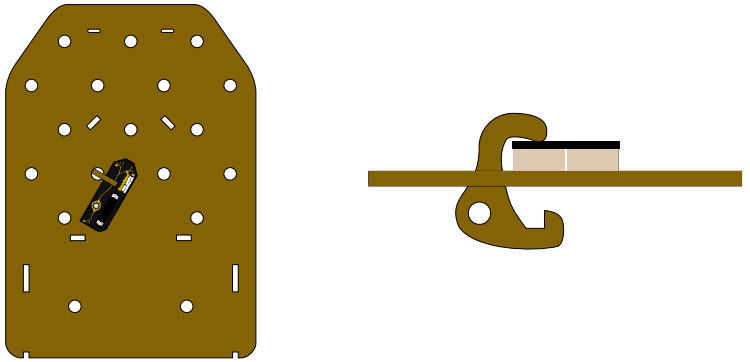
Building the Neurobuggy: Mounting NeuroBytes

Before building NeuroBytes circuits there are a few chassis elements you should install first. These wood subassemblies can be addressed in any order. Head here to see our instructional video: https://neurotinker.com/kits/neurobuggy

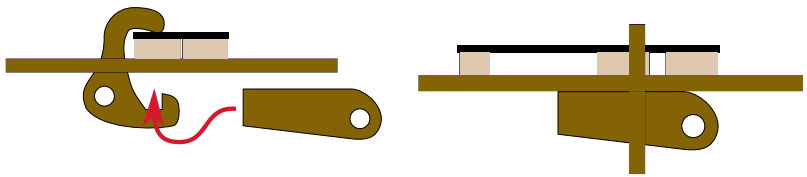
1 NeuroBytes can be mounted using any of the eighteen holes on the base plate and a clip.



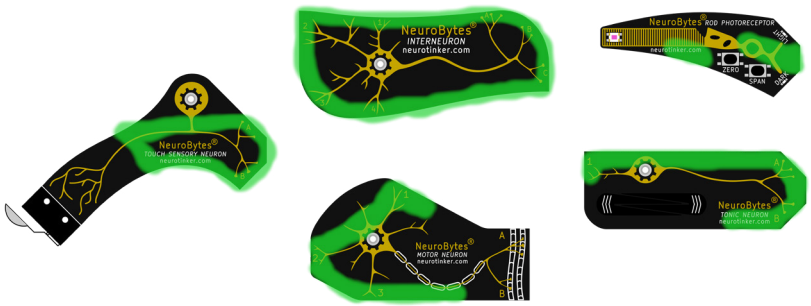
2 Position the NeuroBytes board near the hole. Slide clip up through hole from below.



3 Secure the clip and NeuroBytes board using a wedge.



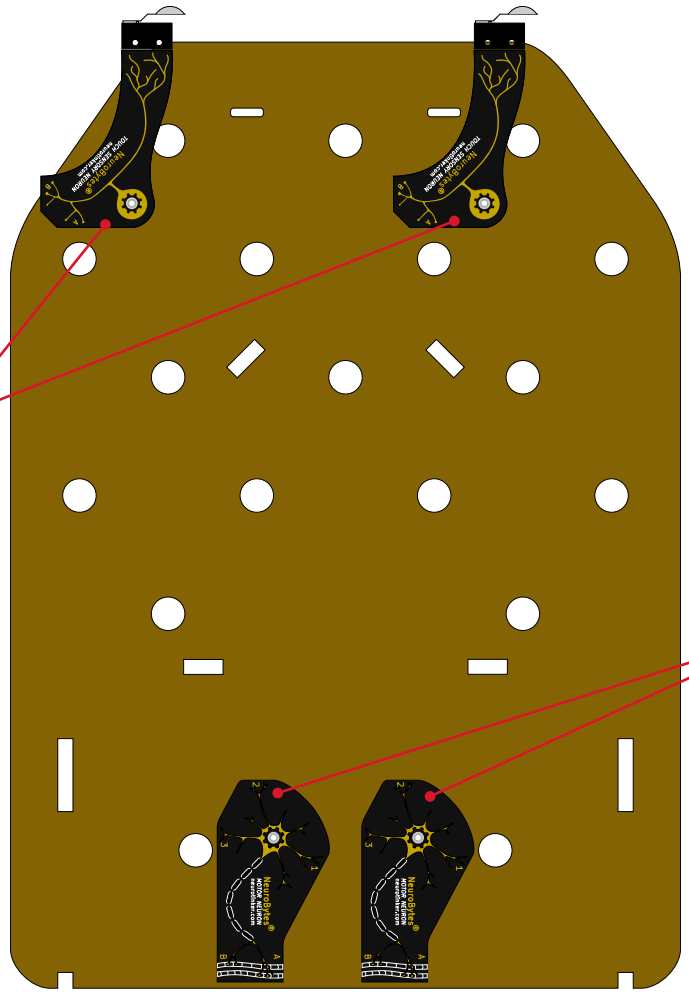
4 Most NeuroBytes can't be secured on all sides as the boards will tilt. Follow this guide.



Your NeuroBuggy Kit

Good Places to Mount NeuroBytes

NeuroBytes can be mounted using any of the eighteen round holes on the NeuroBuggy's chassis, but four are particularly well-suited for their locations as shown here.



Mounting a pair of Touch Sensory Neurons up front allows the bumper to actuate either one for an off-center hit, or both for a straight-on hit. You can also mount a single Touch Sensory Neuron in the middle if you don't need to sense direction.

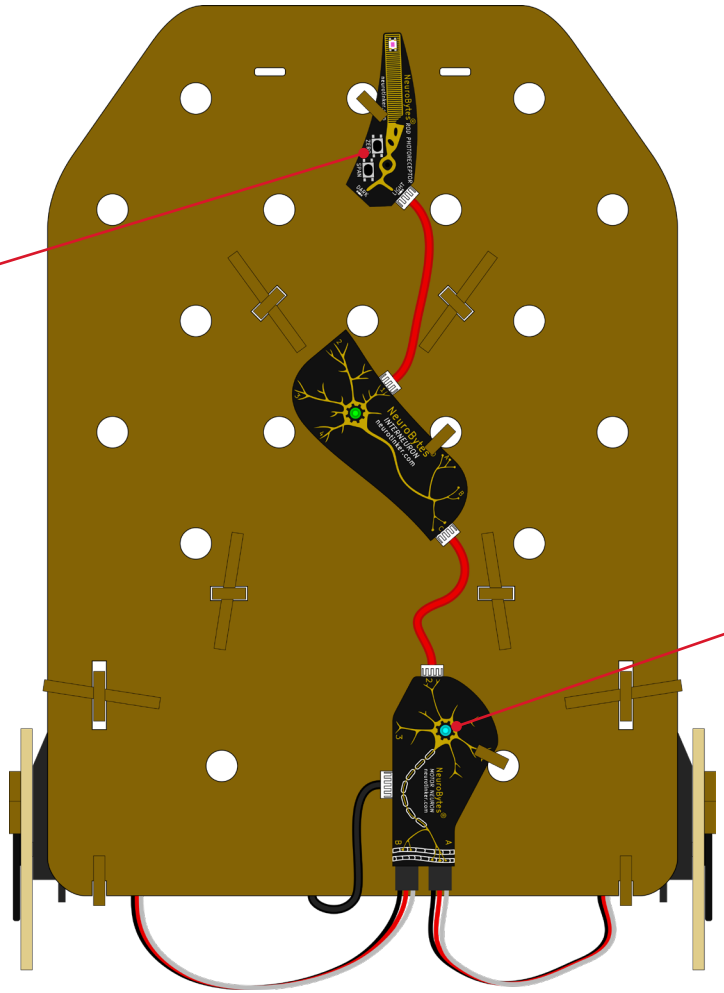
Mounting the two Motor Neurons at the back puts them near the servos and otherwise out of the way. This also encourages you to plug them directly into the battery pack which is best, as the servos can draw a good deal of current.

Your NeuroBuggy Kit

NeuroBuggy Circuit #1: Timid

Timid does not like the light. With one rod photoreceptor, it senses light and drives the wheels forward when it senses light. When the photoreceptor leaves the light, the NeuroBuggy stops.

Zero and span the Rod Photoreceptor for your ambient lighting conditions.



Don't forget to put the Motor Neuron into continuous rotation servo mode!

Your NeuroBuggy Kit

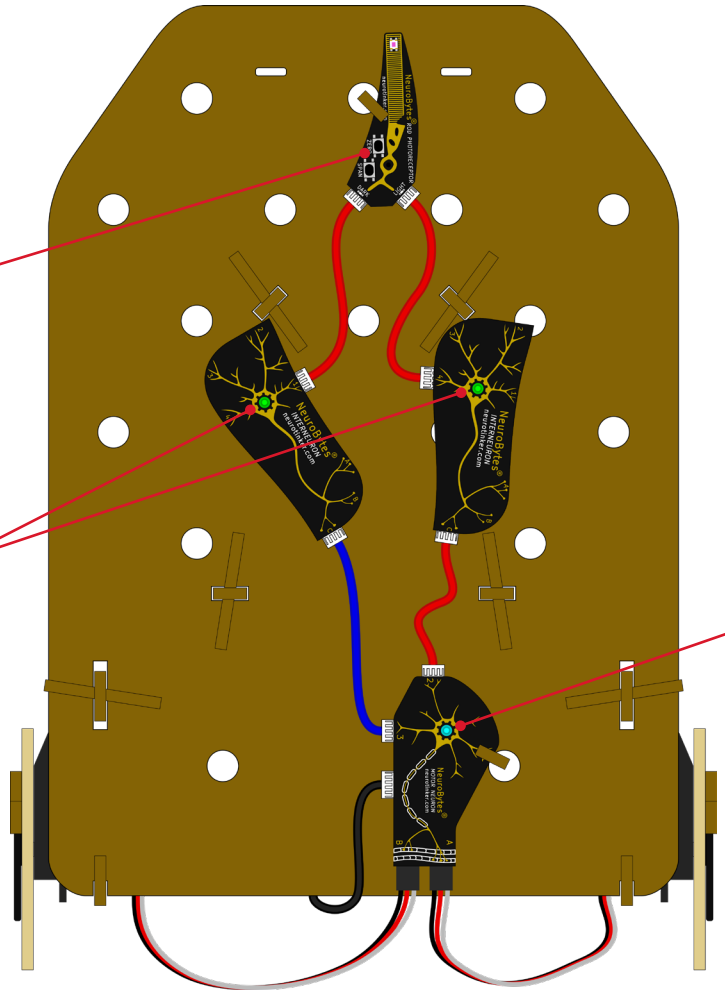
NeuroBuggy Circuit #2: Indecisive

The Indecisive NeuroBuggy can't make up its mind. When it's in the light, it will drive forward until it reaches a shadow. When it reaches a shadow, it will reverse and drive back into the light.

Zero and span the Rod Photoreceptor for your ambient lighting conditions.

You may not be able to fit clips on all NeuroBytes in a circuit. That's okay, the clips are just there to hold everything in place. These Interneurons will be fine.

Don't forget to put the Motor Neuron into continuous rotation servo mode!

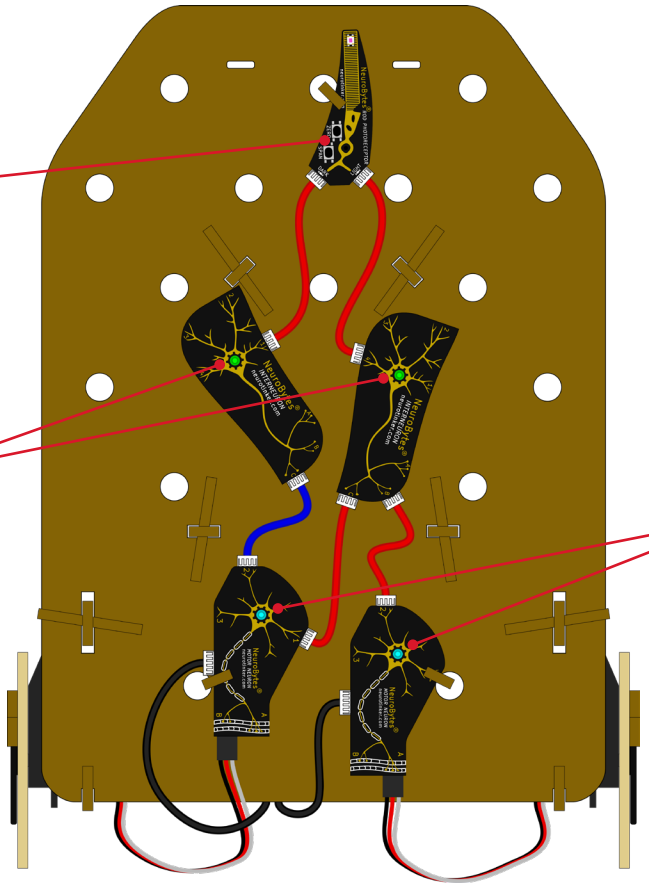


Your NeuroBuggy Kit

NeuroBuggy Circuit #3: Paranoid

Paranoid has one rod photoreceptor that it uses to navigate its environment. It uses two interneurons and two motor neurons to do so, but the two sides of the circuit are connected a bit differently. The "light" output on the rod drives both wheels forward, while the dark output drives just the left wheel backward. This results in a NeuroBuggy that follows the edge of a light halo.

Zero and span the Rod Photoreceptor for your ambient lighting conditions.



You may not be able to fit clips on all NeuroBytes in a circuit. That's okay, the clips are just there to hold everything in place. These Interneurons will be fine.

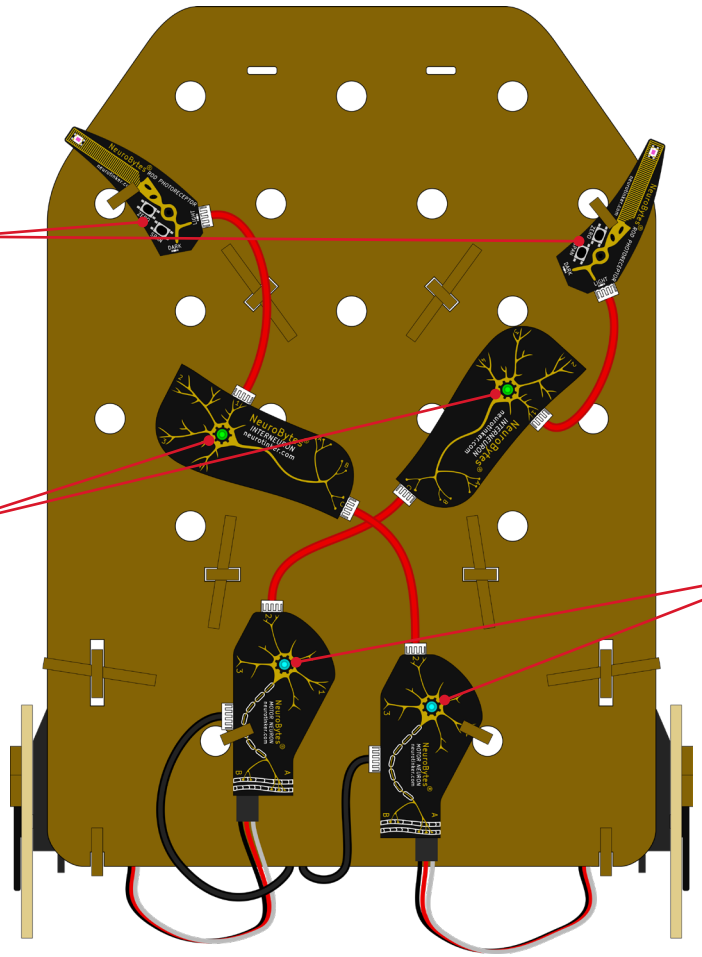
Don't forget to put the Motor Neurons into continuous rotation servo mode!

Your NeuroBuggy Kit

NeuroBuggy Circuit #4: Driven

Driven is a phototropic vehicle, meaning that it moves towards the light. The connections between Interneurons and Motor Neurons are crossed from right to left, so light shone into the left Rod Photoreceptor will cause the right Motor Neuron to drive the right wheel forward, and vice versa. Can you rewire this vehicle to make it photo*phobic*?

Zero and span the Rod Photoreceptors for your ambient lighting conditions.



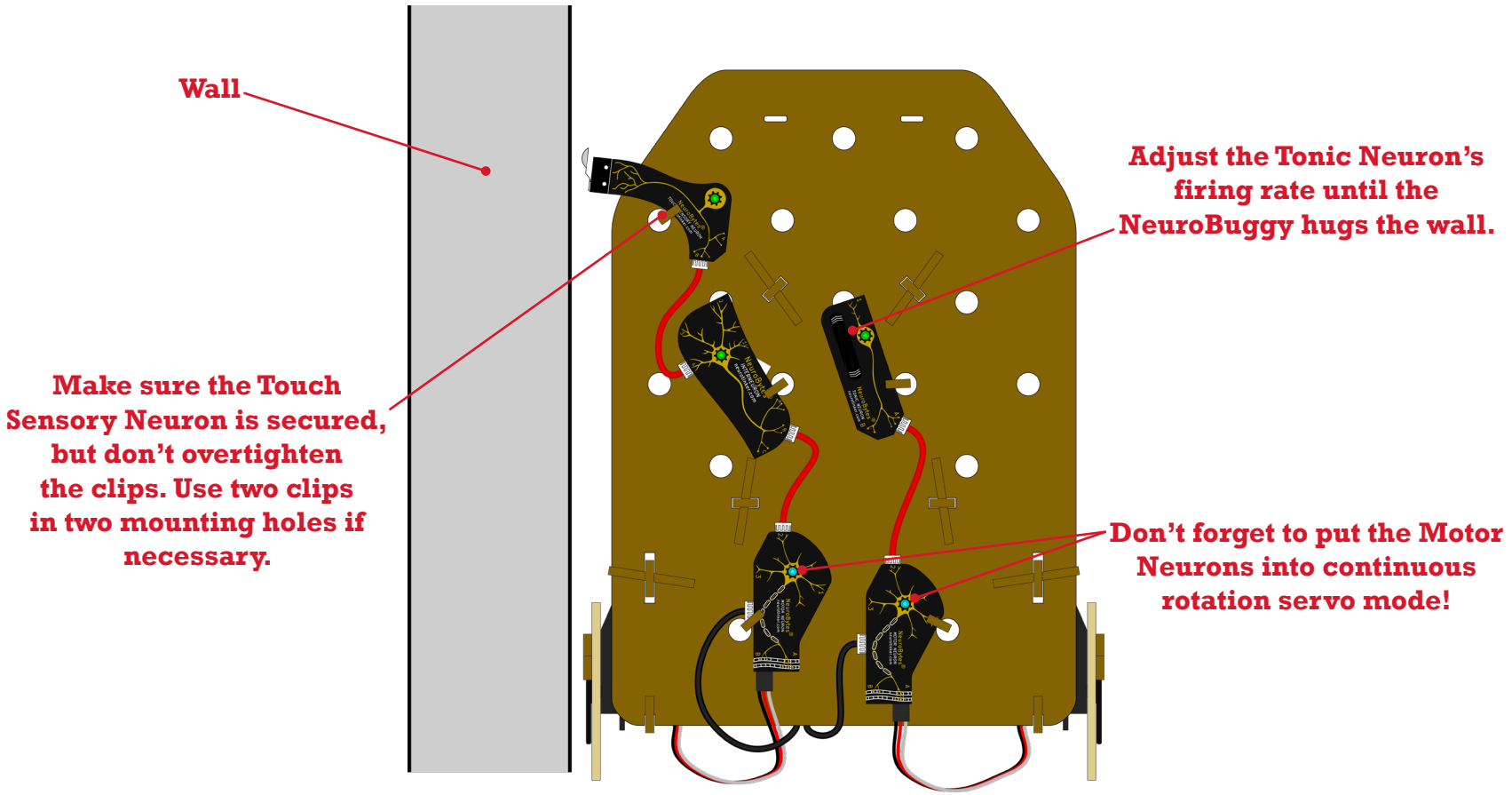
You may not be able to fit clips on all NeuroBytes in a circuit. That's okay, the clips are just there to hold everything in place. These Interneurons will be fine.

Don't forget to put the Motor Neurons into continuous rotation servo mode!

Your NeuroBuggy Kit

NeuroBuggy Circuit #5: Insecure

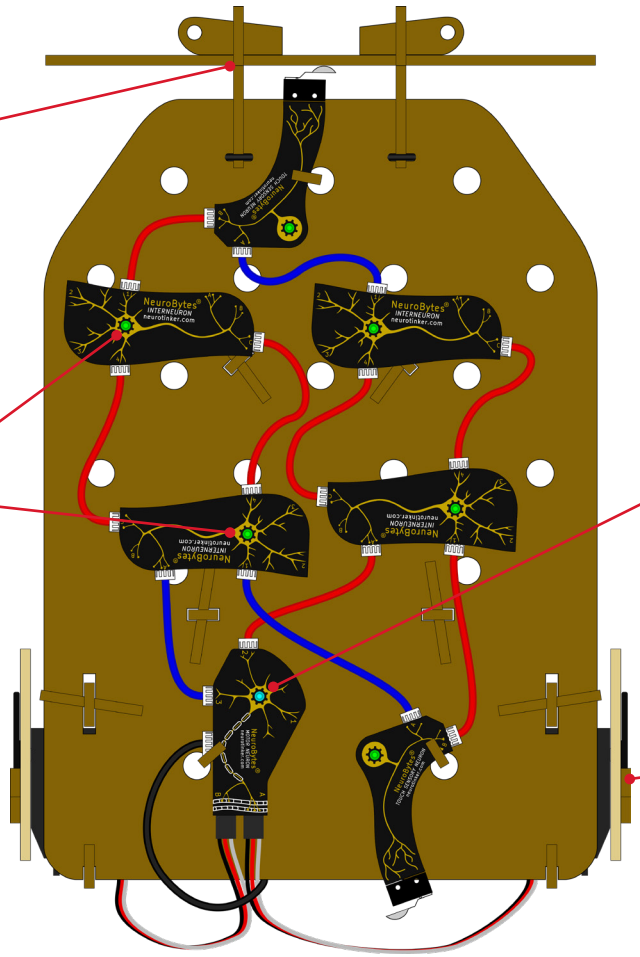
When Insecure is put down in an open area, the right wheel only will be moving forward, and the NeuroBuggy will be driving in counter-clockwise circles. If it is put down with a wall on its left however, the NeuroBuggy will move forward and left, bumping into the wall. This will activate the Touch Sensory Neuron on the left front of NeuroBuggy, which will activate the left Motor Neuron, and cause the left wheel to rotate forward. This will move the NeuroBuggy slightly away from the wall, deactivating the Touch Sensory Neuron, and the cycle begins again.



Your NeuroBuggy Kit

NeuroBuggy Circuit #6: Stubborn

Stubborn has paired two neuron oscillators on it. When the front touch sensory neuron is activated, the touch inhibits the "forward" oscillator and activates the "backwards" oscillator. When the rear touch sensory neuron is activated, the opposite happens. This circuit causes the NeuroBuggy to run back and forth between two objects.



Bumper time!

You may not be able to fit clips on all NeuroBytes in a circuit. That's okay, the clips are just there to hold everything in place. These Interneurons will be fine.

Don't forget to put the Motor Neuron into continuous rotation servo mode!

Try mounting the servos backwards to give the rear Touch Sensory Neuron more clearance.

Your NeuroBuggy Kit

NeuroBuggy Circuit #7, #8, #9…

Your NeuroBuggy kit comes with a ton of NeuroBytes, and you can even use boards from other kits on your NeuroBuggy too! See if you can incorporate all of the concepts shown before: touch and light input, independent wheel control, a Tonic Neuron heartbeat, etc. Share your projects with us, and don't forget to name the circuit!