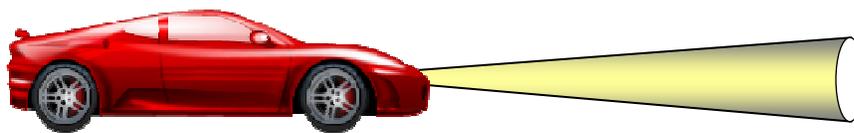




Make Your Car Shine...

Instruction Manual



PinewoodLights.com

Important Safety Information:

Warning: Choke Hazard, Contains small parts and plastic bags, not for children less than 5 years old.

Sharp Edges: Plastic circuit board edges and copper foil edges are sharp

Pointed Wires: Electrical wires, screws and rivets are pointed and can cause puncture wounds.

Lithium Battery: Do not swallow or disassemble battery. Contact poison control if swallowed. Follow local regulations for disposal. Do not place in water.

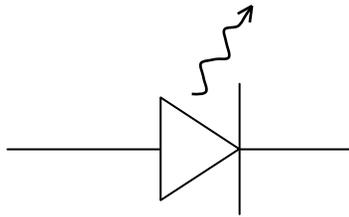
Bright Lights: Do not stare directly into lights for long periods of time.

Parts List:

- 1 Plastic Circuit Board
- 1 Switch (small rectangular plastic board)
- 2 Red tail Lights
- 2 White (Clear) headlights
- 12" Copper Tape with release liner on back
- 1 Small Plastic Rivet
- 4 Small Screws and one spare
- 1 Coin Battery
- 2 PinewoodLights Stickers
- Instructions (this document)

Electrical Circuits:

Circuit is the Greek word for circle and is used in electronics because the electricity goes in a circle. An electrical circuit must have a power source (battery) receiver (LED light) and conductors (wires) connecting them together.



L.E.D.
(Light Emitting Diode)



Figure 1.

Light Emitting Diodes are special devices that conduct electricity in only **one** direction and emit light (indicated by wavy arrow). Therefore LED's **MUST** be wired correctly or they will not light up. The red wires must be connected to the positive side of the battery. Test your lights by pressing the red wire to the top (+) terminal on the battery and the blue to the bottom (-) terminal. See what happens when you reverse the wires.

If by chance your LED is wired backwards (blue wire to + and red to - lights up) mark the light and remember to install it with the wires reversed when you connect the lights.

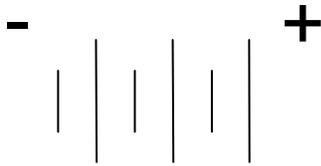


Resistor



Figure 2.

A resistor “resists” and thus controls the flow of electricity through a circuit like a little valve. The resistors of your kit are already connected to the LEDs. See if you can find them.

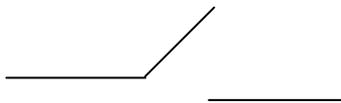


Battery



Figure 3.

Batteries store electricity and release it into a circuit when the switch is on. If the positive (+) and negative (-) terminals of the battery are directly connected (with no LED or Resistor) there is no resistance to electrical flow and your lights will not come on. The battery will run down in minutes. This is called a short circuit, because the electricity takes a “**short cut**” from positive to negative and does not go through the lights. Your battery must be placed on the board with the + side up as shown in the Figure 3.



Switch

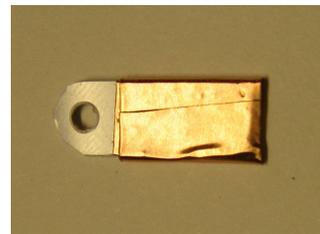


Figure 4.

A switch starts and stops the flow of electricity into a circuit. When the switch is closed (on) electricity can flow through the switch. When it is open (off) it cannot flow. Your kit uses the switch shown above to form a conductive bridge across a gap made of two conductive pieces of tape.

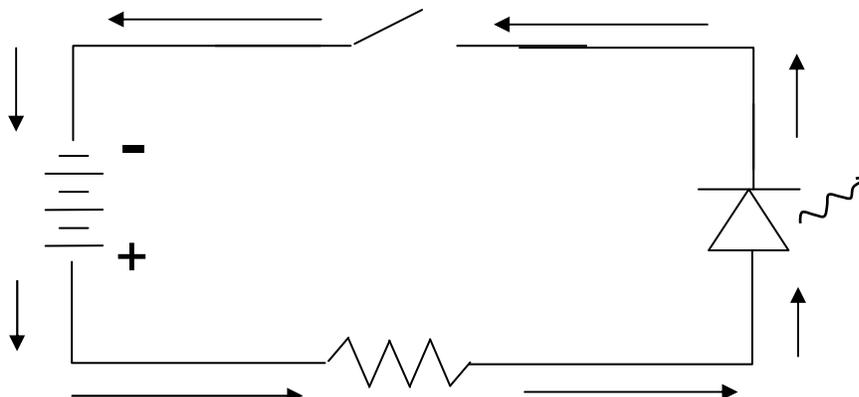


Figure 5.

A simple circuit showing all of these parts connected is shown in Figure 5. Straight arrows show electricity flow and the wavy arrow indicates light.

Your PinewoodLights circuit is a little more complex. There are 4 LED's and 4 resistors (Figure 6.). The resistors cause the electricity to divide evenly between the diodes. After you have built your kit, return to this diagram and see how it matches what you've built.

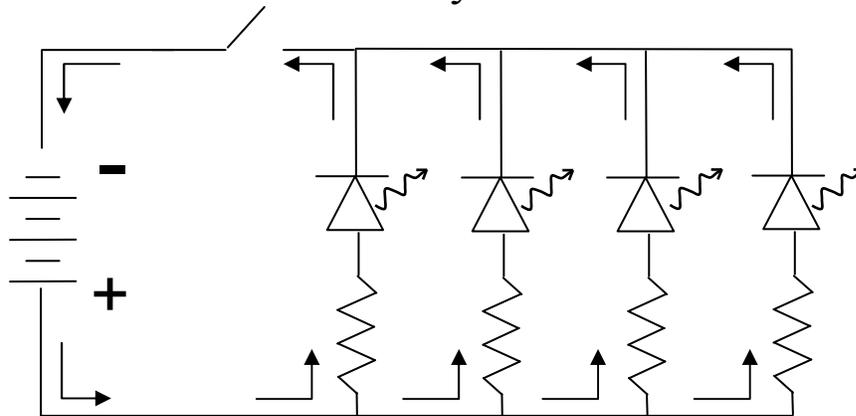


Figure 6.

Circuit Board Construction:

Before you install the light kit you must construct the circuit board that has the battery, on/off switch, and electrical connections. You will then build the Pinewood Derby car, install the lights and connect the lights. Be sure to read everything in this section before beginning. Examine the pictures carefully and check the website www.PinewoodLights.com for more pictures and information.

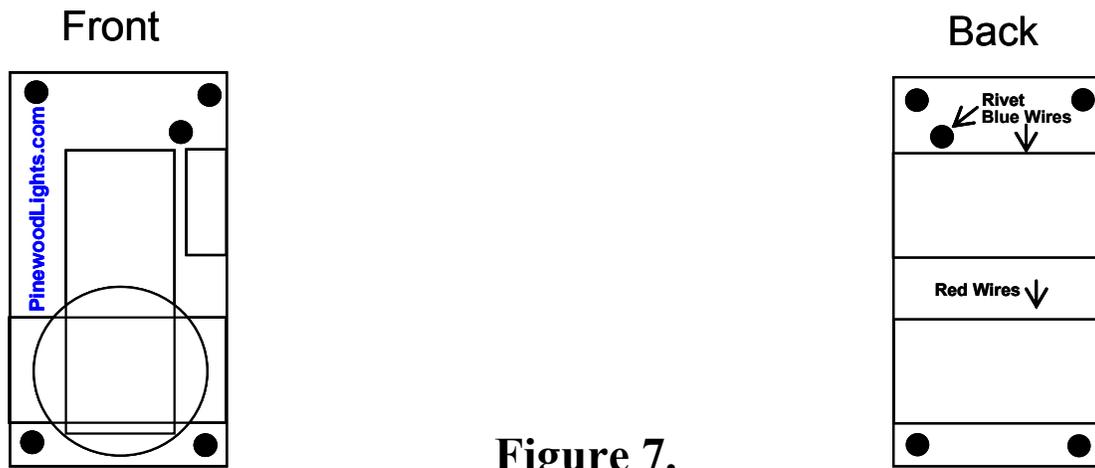


Figure 7.

Pictures of the plain circuit board are shown in Figure 7. Instead of using wires on the circuit board you will use electrically conducting copper tape.

There is more than enough tape to build the kit but not enough to do it twice.

You should trim any sharp corners on the circuit board with a pair of scissors or fingernail clippers but don't remove the corner mounting holes.

Step 1: With scissors cut a piece of copper tape 1 1/4 inches long (see the back page for tape lengths). Try to cut it straight across. Carefully remove the backing and place the tape in the center on the front of the board (Figure 8). Start at the top right corner nearest the gap and carefully follow the line downward because the gap is important for proper switch operation.

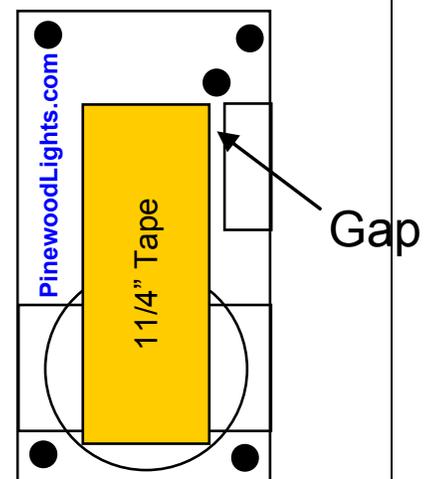


Figure 8.

Step 2: Cut a second piece of copper tape 1 1/4" long, remove the backing and place it as shown in Figure 9. Start at the top left corner of the tape on the front side near the gap and carefully wrap the tape around onto the back of the circuit board following the lines on the back as well.

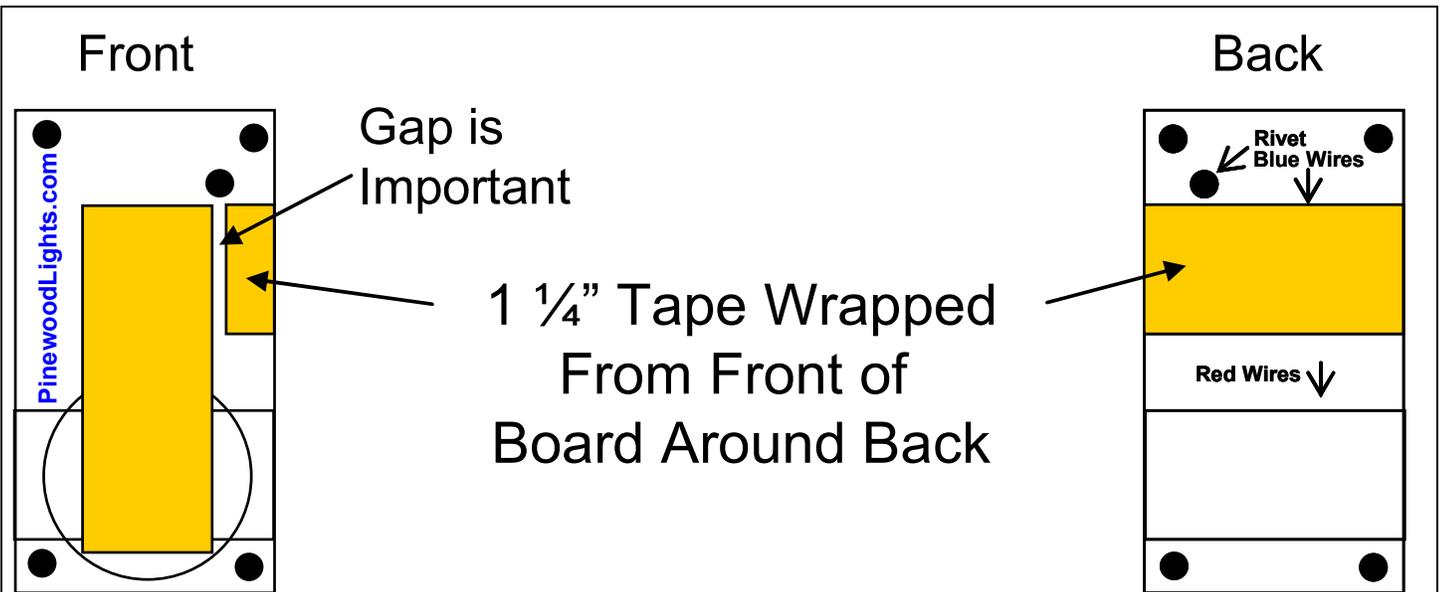


Figure 9.

Try to make the gap exactly the same width as shown on the circuit board. Use the edge of a coin or the switch to smooth both tapes until they are securely stuck down flat especially along the edges of the gap. Any wrinkles in the tape around the gap should be completely flat and none of the tape edges should stick up.

Step 3: Cut a third piece of tape 2 1/2" long. Place the + side of the battery against the center of the sticky side and tape the battery to the

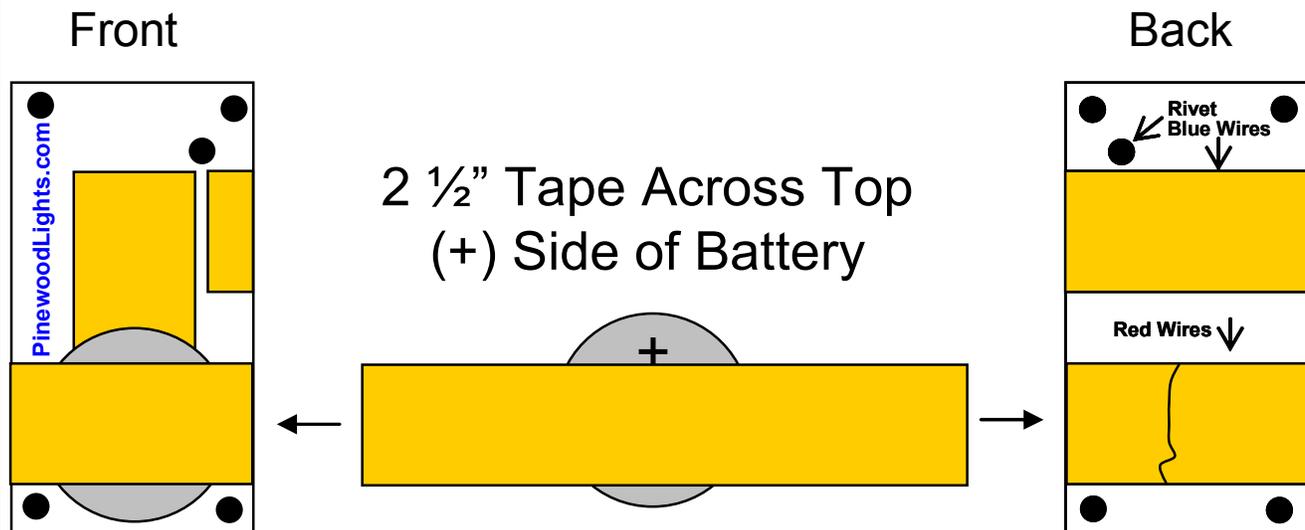


Figure 10.

circle on the board (Figure 10). Wrap the tape around the board. It will overlap on the back. It is **VERY IMPORTANT** that the + side of the

battery is up on the front of the circuit board and that the battery be held down tightly.

Do not let this battery tape touch the second tape from step 2 on the back side of the board as this will create a short. Although you want the battery to be securely fastened to the board, you must also avoid the situation in Figure 11 where the battery is shown from the side.

Side View of Battery and Third Tape



Figure 11.

The battery tape must not touch the negative side (bottom part) of the battery since this too will cause a short circuit and the battery will run down quickly. If it does touch the negative side, immediately peel it up and put it back down as indicated “OK” above.

Step 4 - Switch: Using scissors or fingernail clippers round off any square edges of the switch on the end with the hole. The switch will not work without rounding off this end. Cut a fourth piece of tape 1 1/2” long, Remove the backing and carefully wrap it around

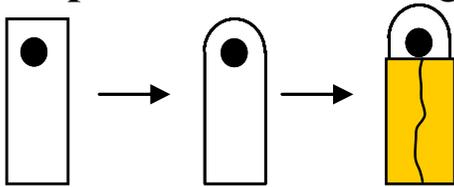


Figure 12.

the bottom half inch of the square (no hole) end of the switch. Make 2-3 layers and smooth it out. Where the tape ends and forms a seam will designate the top side of the switch.

Step 5 - Rivet: The plastic rivet must be installed from the back of the circuit board in the hole closest to the gap marked “Rivet” (Figure 13). Place the rivet with the flat head down on a table or hard surface. Put the circuit board face up over the rivet post and push down hard around the

rivet hole. It should “snap” into place. Be careful not to put your finger over the hole or you will get poked when it comes through.

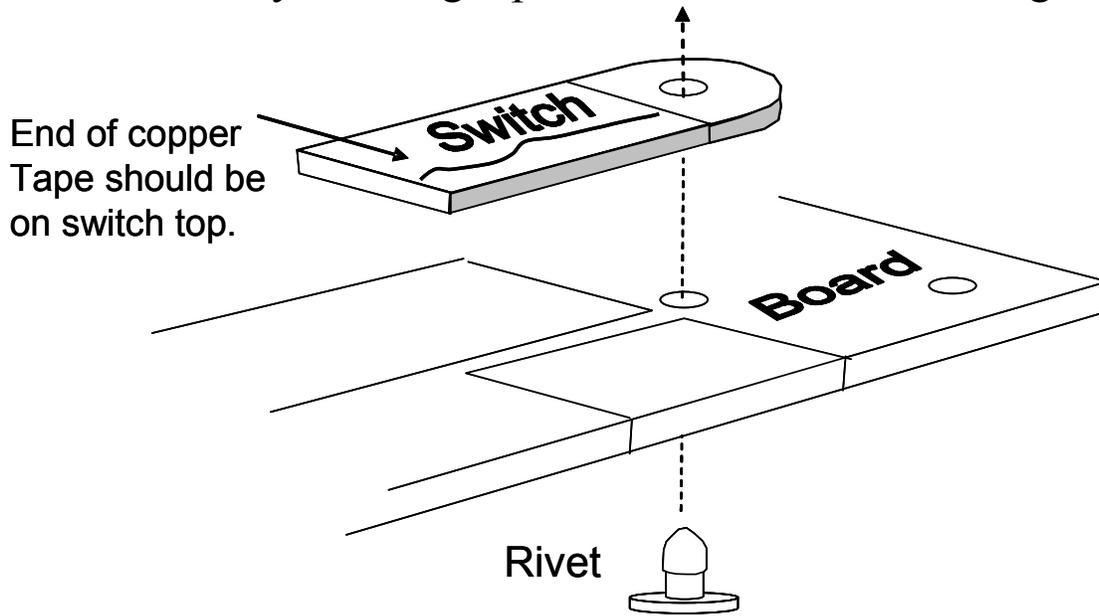


Figure 13.

Next, place the hole in the switch over the top of the rivet with the copper tape seam facing up (this assures a smooth operating switch). Push down very hard on the switch around the rivet. It should snap into place and hold the switch down securely. Place the jaws of an adjustable wrench on each side of the rivet hole in the switch and push down hard if your fingers aren't strong enough.

If the rivet is damaged or ruined it may be replaced with a spare screw when installing the board in the Pinewood car. Just fasten the switch to the circuit board by driving a screw down into the car through the rivet hole.

Rotate the switch to cover the gap; this is the “on” position. Rotate it to uncover the gap to turn the circuit “off”. Make sure the end of the switch does not touch the battery. If it does it will create a short just trim off a little bit from the end of the battery (tape and all) or shift the battery down the board a little.

A PinewoodLights sticker can be placed on the battery and elsewhere on the car as if it were sponsored by PinewoodLights.

The basic circuit board is now assembled and should look like Figure 14. Put the circuit board alone in a plastic bag or envelope until after you have installed the lights on your Pinewood car and are ready to connect the lights.

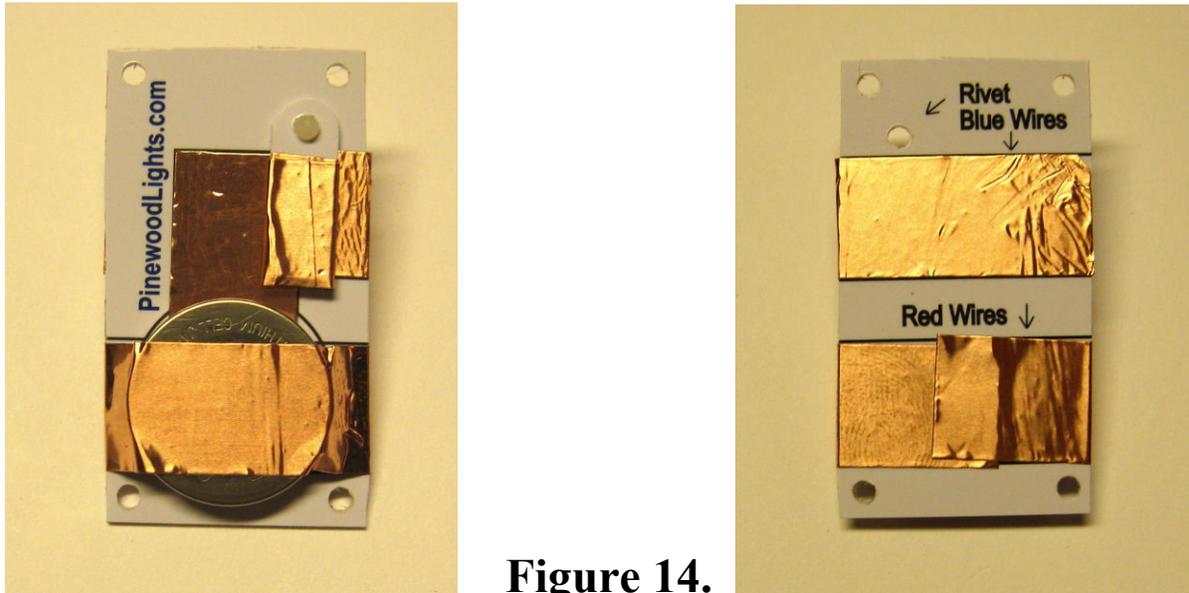


Figure 14.

Save the remaining copper tape, you will need it to connect light wires or to replace the battery. Do not save both the circuit board and tape or metal parts in the same place since a short may form and run down the battery.

Installation:

Installation will follow these basic steps:

1. Carve a cavity to mount the circuit board.
2. Shape the Pinewood Derby car
3. Drill holes for mounting the lights,
4. Sand and paint the car
5. Install the lights.

The recommended installation method is described here but this will be unique to every car. The circuit board can be hidden in a cavity in the

wood, under plastic or left exposed depending on your design. Similarly the wires may be hidden internally or run along the bottom or sides of the Pinewood car. *Use your imagination!*

The first step to install the lights is to plan where to mount the lights and circuit board and where to run the wires. Derby rules require that the Pinewood car be only 7" long and weigh less than 5 ounces. If the lights extend beyond the front or back you may need to trim about 1/8" off one end of the block. Since the entire light kit with the basic car kit is less than 5 ounces weight should not be an issue.

The Derby track has a raised portion in the center between the wheels so if you mount the circuit board underneath the car it **MUST** be recessed into a cavity. There is enough track clearance for the wires to run along the bottom of the car.

1. Carve the Cavity

In this example a location near the center of the car on the bottom is chosen to mount the board (Figure 15). The first step is to carve out a cavity for the board 1 1/8" wide by 2" long by 1/4" deep. This is slightly larger than the board to allow some room to work and slightly deeper to allow room underneath for the extra wire. Mark the size of the hole by tracing around the board on the bottom of the car block and cut outside the line. It's easiest to carve the cavity before shaping the car.

Next remove the wood to a depth (adult supervision required) of 1/4" with either a chisel or a drill.

With a chisel, hammer it straight down about 1/16" all around the opening that you have marked. Be careful near the sides of the car so that you don't split the wood. Then using the chisel at an angle and working with the grain of the wood, remove the wood in the center. Repeat this process 3 more times until the opening is uniformly 1/4" deep.

Alternatively, use a drill with a forstner bit, spade bit, or even a normal $\frac{1}{4}$ " drill bit. Wrap tape around the drill bit $\frac{1}{4}$ " above the end to mark the depth. If using a spade bit make sure the tip doesn't go through to the top of the Pinewood car. Drill out all of the wood in the cavity to a depth of $\frac{1}{4}$ ". A small chisel or a utility knife (adult supervision) can be used to clean up the cavity.

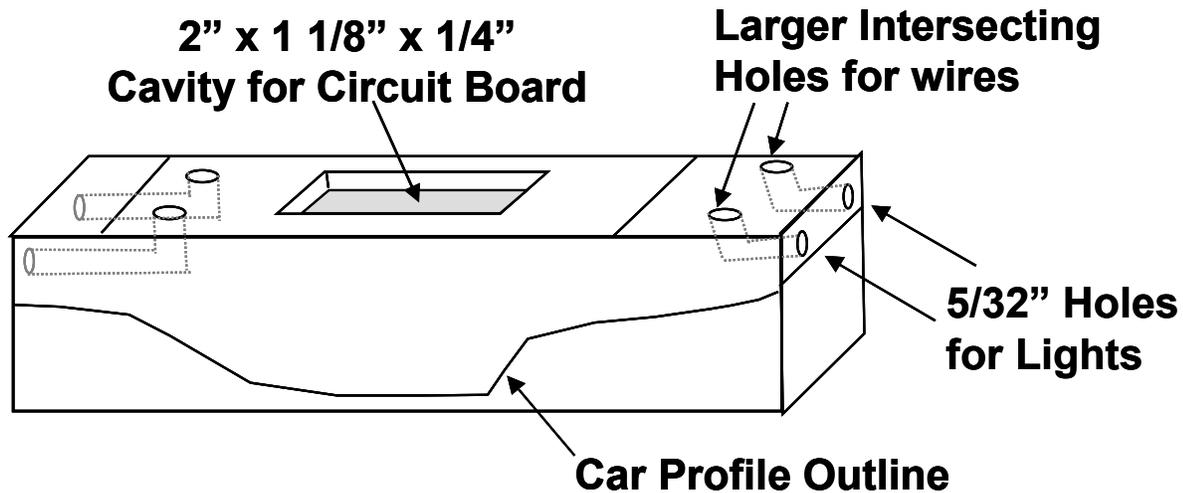


Figure 15.

2. Cut, shape and rough sand your Pinewood car.

3. Drill for the light wires. Using a drill with a $\frac{5}{32}$ " bit, drill holes 1-2" deep to place the lights in. A $\frac{1}{8}$ " bit will work but you will need to enlarge the entrance a just little to hold the base of the lights. From the bottom of the car, drill larger holes to intersect the first holes so that you can run the wires from the lights through to the bottom of the car and eventually connect them to the circuit board. Avoid drilling through the axle grooves so you don't interfere with the wheel installation.

4. Finish final sanding and painting.

5. Install the lights

Push (don't pull) the light wires from the ends of the car through to the intersecting holes and out the bottom of the car. It can help to pre-bend

the wires to go up the intersecting holes. Tweezers or small needle nosed pliers are helpful for grabbing the wires in the intersecting holes. Mount the lights in place using wood glue or hot melt glue (some solvent based glues may damage the LED light plastic). They may be tight enough already.

Turn the Pinewood car upside down and place the circuit board over the cavity with the battery side facing down. Sort and separate the red wire ends and the blue wires ends so that they are near each other. Collect the red wires together. Align the bare red wire ends between your fingers as shown in the Figure 16 and twist all of the wires around each other all the way to the end of the bare portion. Then bend the wires into a hook shape. Collect the ends of all four blue wires together in the same way and twist them together, forming a second hook.

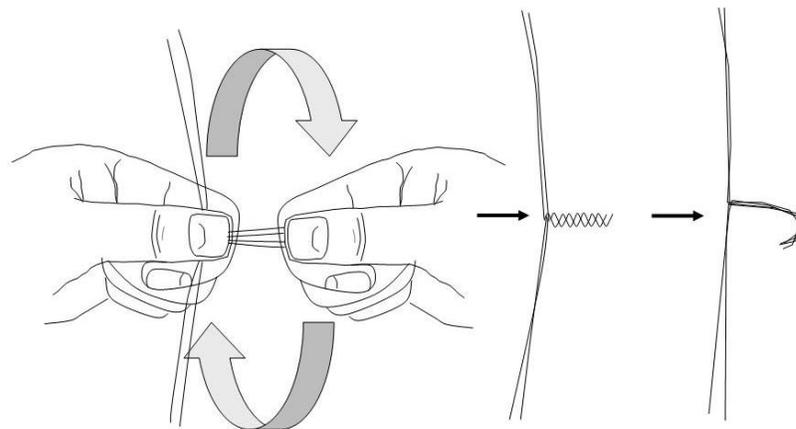


Figure 16.

Now, cut a piece of copper tape 1” long and tape the red wires to the bottom strip on the back of the board marked “red wires” (Figure 17). Cut another 1” piece of copper tape and tape the blue wires to the top strip on the back of the board marked “blue wires”.

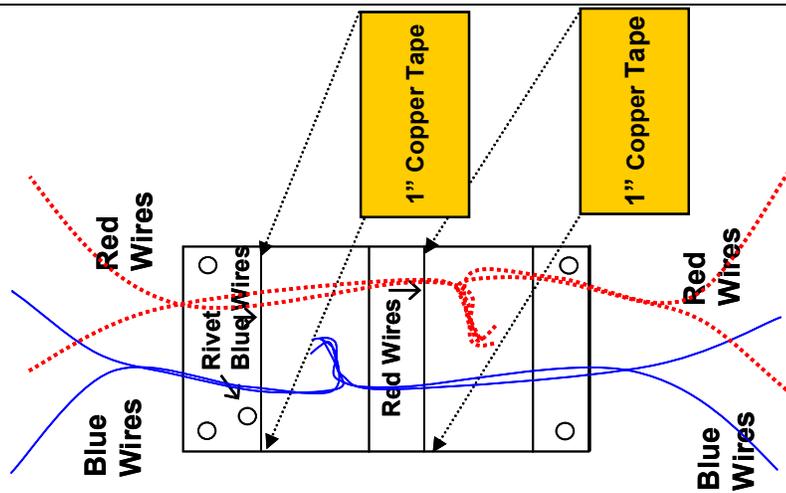


Figure 17.

Press down hard on the tape all around the wires to get a good solid connection. Test the switch to be sure the lights operate correctly (see troubleshooting).

6. Mount the Circuit Board

Gently turn the board over (battery side up) while holding the two strips of tape in place. Take any extra wire and carefully coil and twist it to fit into the cavity under the board. Make sure the copper tape still holds the hooked wire ends securely in place on their respective strips. Use the switch and turn the lights on. If they don't all light up see the troubleshooting section.

Keep the lights on and use the small screws (two in the board bottom and two at the top) to secure the board. **Do not** screw through any wires and keep the board as flat as possible by tightening each screw a little at a time. If the lights go off during this process the board has become warped because a screw is too tight and it is interfering with proper operation of the switch. Loosen one or more screws and retighten them evenly. When done, turn the lights off. If the rivet was damaged during the switch assembly step just use one of the screws to hold it down to the circuit board by screwing through the switch and circuit board in the rivet hole.

Press the wires flat and use scotch tape to secure the wires in place along the bottom of the car. You want clearance for the raised portion of the track.

Troubleshooting:

No Lights: Make sure battery is installed + side up. Switch may not be working. Press down to flex it or add tape to the underside of the switch. Be sure the blue wires are connected to the top strip in the back and the red wires to the bottom strip. A short is another common cause. Check to see that there are no bits of tape or wire causing a short. Make sure the battery tape is not touching the bottom of the battery (Figure 11). Battery may be dead. Replace it.

Lights Always On: Switch is not working correctly. Check for flecks of copper foil bridging the gap especially around the rivet hole.

Switch only works when pressing down on it: The board may be warped so that the switch doesn't lie flat and does not properly bridge the gap. Loosen the screws and push the board flat. Flex the switch so it presses down harder against the board. Screw the board down evenly. Replace the switch rivet with a screw if the rivet is damaged.

Only 1-3 Lights on: Poor connection between copper tape and twisted wires on back of board. Press down harder on tape around the wires or gently remove, twist wires tighter and re-tape.

All Flickering Lights: Probably caused by a bad switch (see above) or the battery tape not holding the battery tightly down (adjust) or a poor connection between the twisted wires and the board (press flat/re-twist).

Broken Wire: Occasionally the stripped end of a wire may break off during twisting. You can fix this with wire strippers or a pair of finger

nail clippers and carefully cutting into the insulation while pulling on the wire. Rotate it slowly as you work to strip the insulation from the wire.

Replacing Battery: The battery will give 20-30 hours of service which is more than enough for a Derby Race. To replace the battery, carefully cut along the side of the battery tape and peel it back from the battery. Place the new battery + side up in the circle and put the tape over the battery (Figure 10). Use part of the leftover copper tape to repair the cut battery tape.

Hint for race day:

Since Pinewood cars are usually impounded after the weigh-in you should turn on the lights beforehand. If the weigh-in is the day before the race you should ask one of the leaders to turn on the lights for you just before the race.

Good Luck!

You may not win but you do have a cool car!

1" Tape

Tape lengths are shown here to simplify cutting the copper tape.

1 1/4" Tape

If you downloaded and printed this document you should measure the rectangle marked 1" Tape since different printers may scale differently.

1 1/2" Tape

If it is not exactly 1" use a ruler to mark the tape, not these images.

2 1/2" Tape