

Build An LED Clipboard

These LED clipboards provide light for reading and writing during audience participation planetarium shows. The purpose of this article is to provide building instructions for anyone wishing to replicate this simple, useful design.

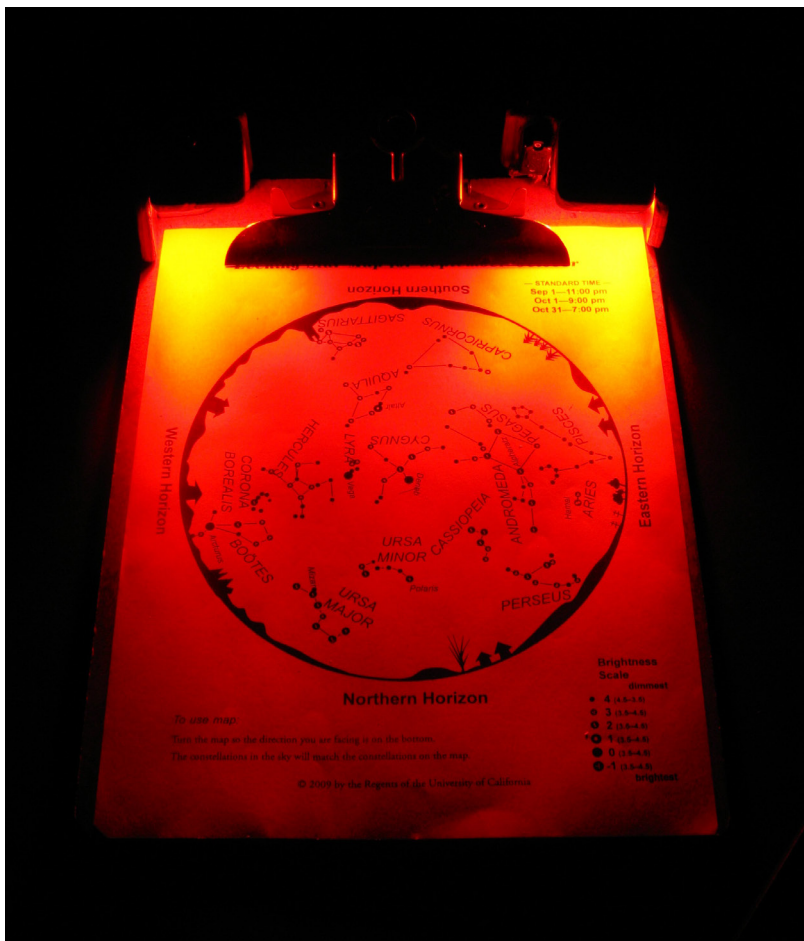


Figure 1: LED clipboard in the dark, illuminating star map for use in *Constellations Tonight* planetarium program

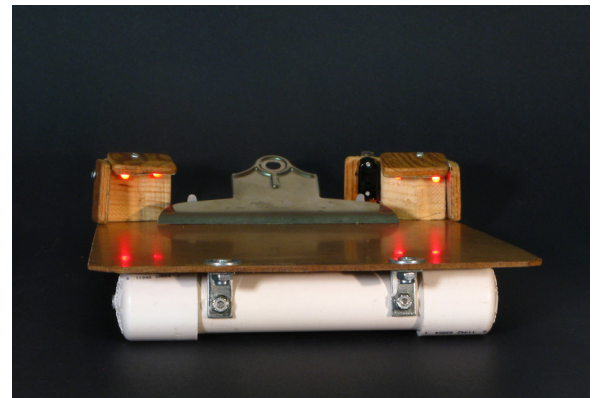


Figure 1b: LED clipboard bottom view

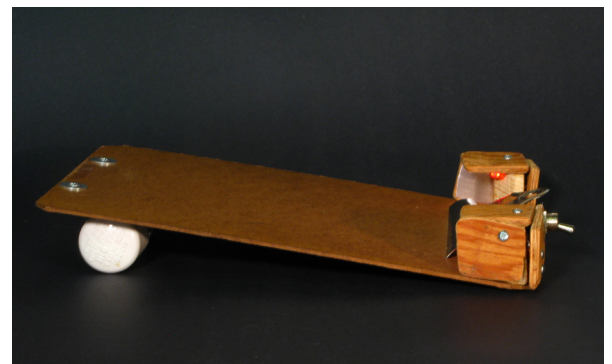


Figure 1c: LED clipboard side view



Figure 1d: LED clipboard top view

Materials List (for one LED clipboard) (Figure 2)

LED mount

- four (4) orange diffused LEDs
- one (1) 10-Ohm resistor
- 1 toggle switch
- two (2) wooden wedges to hold LEDs (1.5" x 1.75" x 3/4") (figure 3)
- two (2) plywood side covers (1.5" x 1.75" x 1/4")
- two (2) plywood top covers (1.75" x 1.75" x 1/4")
- two (2) plywood back covers (1.5" x 1.75" x 1/4") and (1.5" x 2.75" x 1/4")
- two (2) top (1.5" x 1.75") and two (2) side (1.5" x 1.75") silver cardboard reflectors
- ~65" of ~30 gauge enameled wire
- eight (8) 3/4" 8-32 wood screws for clipboard and back cover
- four (4) 1/2" 8-32 wood screws for side and top cover

Battery Pack:

- three (3) C-cell batteries
- 1" diameter x 6 1/4" PVC pipe
- 2 PVC end caps
- 20 inches galvanized wire for spring
- one (1) 1 1/2" 8-32 bolt for positive terminal
- one (1) 8-32 nut for positive terminal
- two (2) 1" L-brackets
- two (2) 1/2" 8-32 flat head bolts
- two (2) 8-32 lock nuts
- two (2) 1/4" #4 round head screws for end caps

Clipboard:

- one (1) standard clipboard, 9" x 12"
- 3 coffee straws
- two (2) pieces (11" x 3") and (9" x 3") black cardboard paper to cover wire
- four (4) 10-32 lock nuts for bottom L-brackets and top securing bolts
- two (2) 1/2" 10-32 flat head bolts for bottom L-brackets
- two (2) 1/4" diameter washers for bottom L-brackets
- two (2) 2 1/2" size 8-32 securing bolts for childproofing
- four (4) 10-32 nuts for securing bolts

- Tools: handsaw, sandpaper, screwdrivers, pliers, adjustable crescent wrench, power drill, drill bits, vice/clamp, hammer, chisel, solder, soldering iron, white glue, hot glue

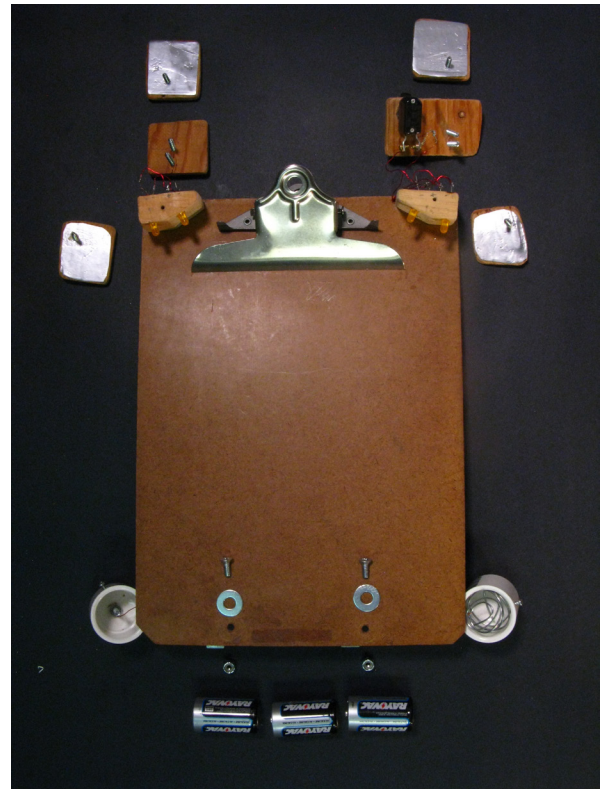


Figure 2: semi-exploded view, screws in place

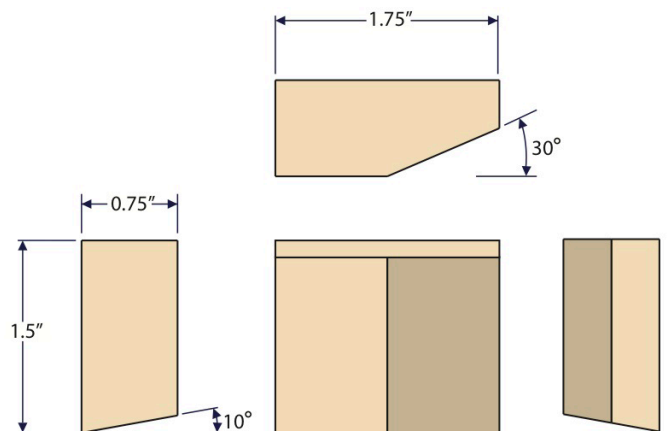


Figure 3: wooden wedge, LED mount

Battery Pack Assembly

1. Cut a length of 6¼ inches of 1" diameter PVC pipe.
2. Measure, mark, and drill all holes in the PVC pipe and endcaps, as shown (Figure 4).
3. Sand all holes, edges, and ends of the PVC pipe for child safety. Sand inside surface of end caps to make it more easily removable.
4. Insert flat-head bolts into each countersunk hole. Attach L-brackets and lock nuts, and tighten.
5. Sand about 1/2" off the ends of two ~30" pieces of enameled wires, exposing conductive material. Thread these two lengths of wire through the small hole in the PVC pipe, and out the ends.
6. Insert long bolt into endcap. Connect one of the sanded enameled wires by wrapping it around this bolt clockwise and clamping it down with the nut (Figure 5).
7. Bend about 20 inches of flexible galvanized steel wire into a tapered spiral for a battery spring, with base circle about 1" in diameter (Figure 6). Place spring into one of the PVC caps for the negative terminal. Connect the end of the other enameled wire to this spring.
8. Insert batteries in series, with the negative side touching the spring.
9. Affix caps and make sure the spring and the bolt have good connections by testing the far end of the wires with a voltmeter.
10. Insert small ¼" #4 round head screws into endcaps and tighten to attach to pipe.

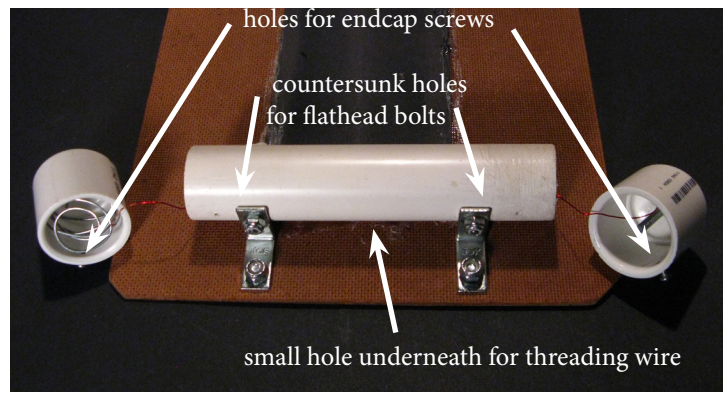


Figure 4: battery pack



Figure 5: positive battery terminal



Figure 6: battery spring

Clipboard Assembly

- Measure, mark and drill holes into the clipboard, as shown (Figure 7).
- Attach the battery pack with two L-brackets, two bolts, two washers, and two lock nuts (Figure 8).
- Thread enameled wires from battery pack through coffee straws and up through the two small holes in top of board (Figure 7). Be careful not to strain the delicate enameled wire.
- Attach the enameled wire to the switch.

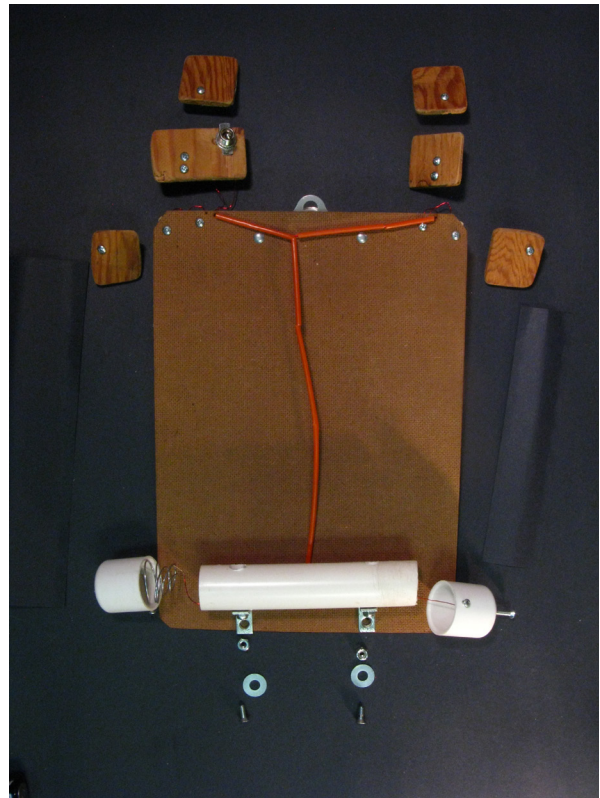


Figure 7: semi-exploded diagram, back view
This picture shows the locations of the 8 holes needed in the clipboard: two for the battery pack, two for the wires, and four for the wedges.



Figure 8: attach battery pack

LED lights and mount assembly

1. Cut wooden wedges and top, side, and back cover pieces to the correct dimensions (Figures 3, 9).
2. Measure, mark, and drill holes in the appropriate places in the wedge for the LED leads, and the screws to attach the clipboard, top, side and back covers (Figures 2, 10, 11).
3. Sand all corners to a fillet to avoid splinters.
4. Attach the wedges to the clipboard with wood screws.
5. Insert orange LEDs into the wedge and bend leads down (Figure 10, 11).
6. Connect the LEDs in parallel, with the resistor in series with the power source, as shown in the circuit diagram and pictures (Figures 10, 11, 12). Sand wire and solder connections (Figure 13). Trim wire as necessary.
7. Run wire from one side of the circuit through the small holes and back through the same coffee straw to the other side of the clipboard to complete the circuit. Sand wire and solder connections (Figures 10, 11).
8. Insert the toggle switch through the hole of back cover, tighten with pliers, and connect to circuit (Figure 11).
9. Now, flip the switch on to test the circuit. If the lights do not turn on, check that all connections are correct and secure, and test with a voltmeter.
10. Cut silver cardboard reflector pieces.
11. Paste reflectors on top and side pieces with white glue.
12. Use white glue and one screw to attach each side piece to the wedge (Figure 14).
13. Attach top covers with wood screws. Attach back covers with wood screws.
14. Tuck away any excess enameled wire.



Figure 9: cut wood in clamp

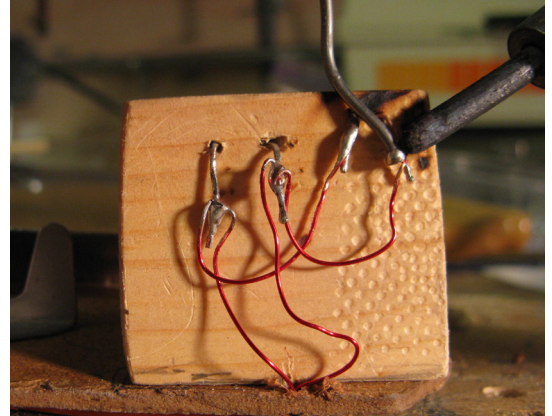


Figure 10: LED connections

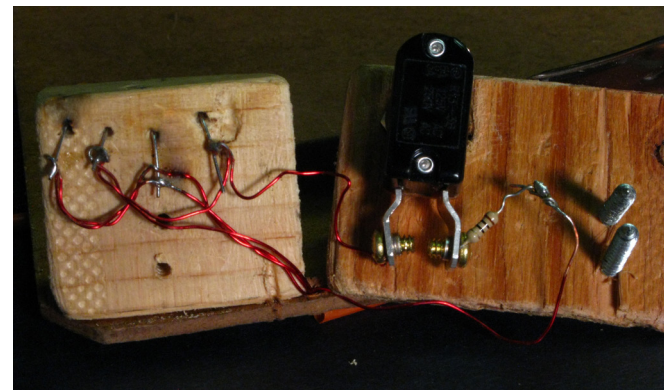


Figure 11: LED, resistor, and switch connections

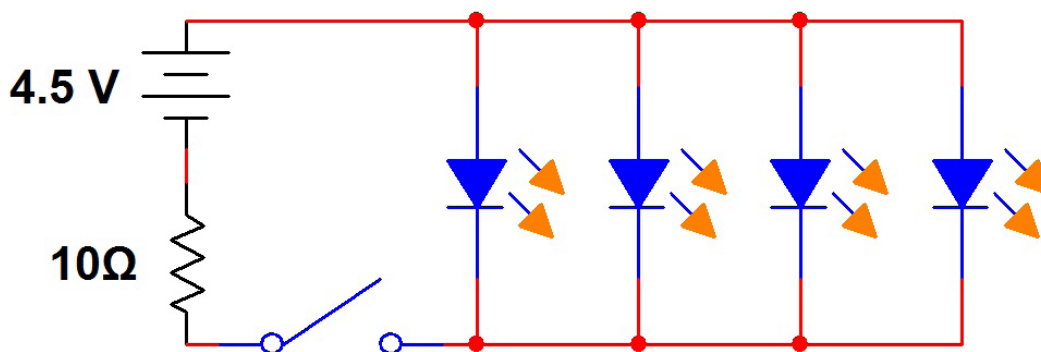


Figure 12: circuit diagram

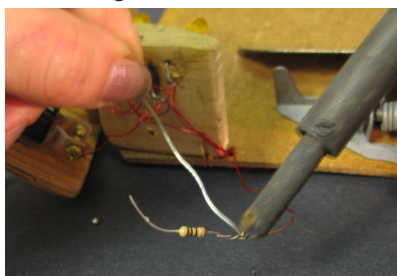


Figure 13: solder resistor to wire



Figure 14: glue side cover

15. Cut black cardboard paper to correct dimensions (Figure 15).
16. With hot glue, paste the black cardboard over the straws to child-proof the wires (figure 15).
17. Re-tighten all nuts and bolts.
18. Test in a dark place.
19. Bend the LEDs to spread light across the entire clipboard.

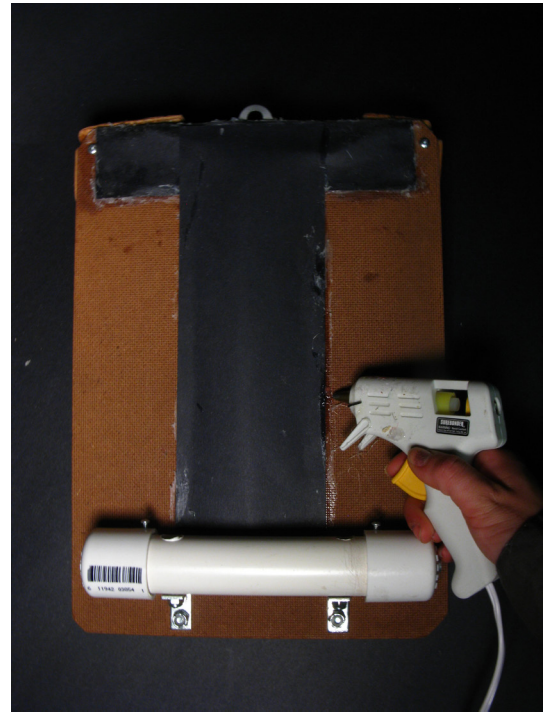


Figure 15: paper wire cover

Congratulations, you have made an LED clipboard!



Figure 16: LED clipboard front view

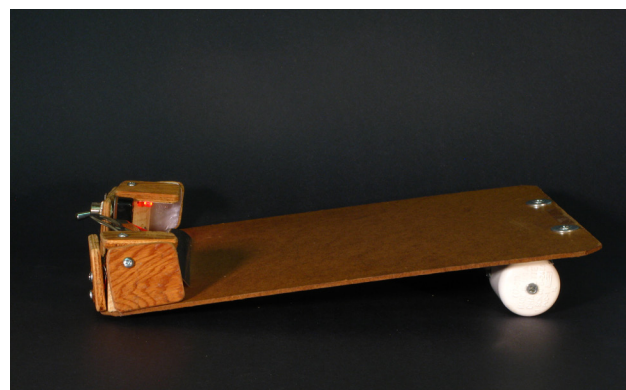


Figure 17: LED clipboard side view