

Electrical Wall Activity

Age level: K – 3rd grade

Time required: 1 hour

Adult supervision required: Yes, basic carpentry and electrical skills

Introduction

This activity is designed to introduce children to some fundamental tasks involved in wiring a house. It is essential that the participants understand the dangers of working with electricity and leave the activity knowing that they should not attempt this at home. The system will be powered with a 12-volt source and use standard sized A19 light bulbs that operate at 12 volts DC. Spend time at the beginning and end of the activity reminding the children of the dangers. Emphasize that they should always ensure that the power is disconnected and check with a test light.

Prefabricate a small, wood-framed wall and attach junction boxes in designated locations. Provide wire that is precut and stripped for the children to run between the boxes. Children will connect the wires to the electrical components and secure them in the boxes with screws. After connecting the system to the 12-volt power supply, the lights can be turned off and on. Figure 1 shows the completed project.

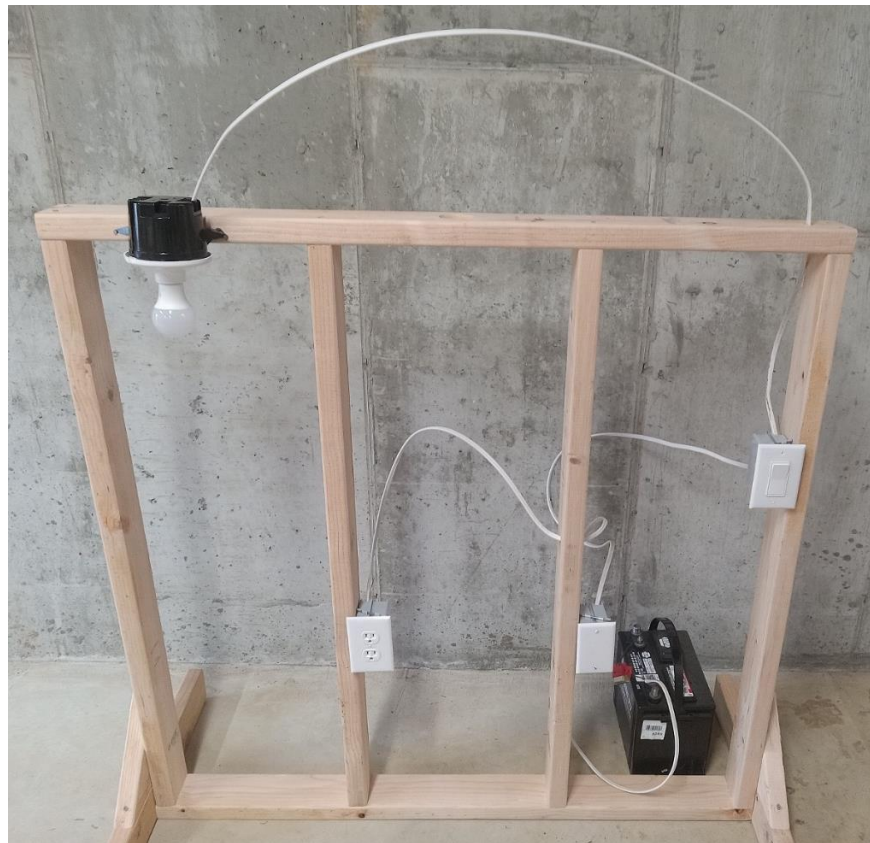


Figure 1. Completed Electrical Wall Activity

Material List

Prefabricated framed wall

2x4 x 8' studs	4 ea.
3" screws or 12d nails	26 ea.
Single gang junction boxes	3 ea.
Ceiling fixture box	1 ea.

Electrical components

14-gauge "Romex" wire	20 ft.
Wire nuts	5 ea.
Outlet	1 ea.
Outlet cover plate	1 ea.
Ceiling light fixture	1 ea.
Light switch	1 ea.
Switch cover plate	1 ea.
Junction box plate	1 ea.
Plug in lamp	1 ea.
12-volt, A19 light bulbs	2 ea.
12-volt power supply	1 ea.
12-volt circuit breaker	1 ea.

Tools

Wire cutters/strippers
Screwdrivers, flat head and Phillips
Needle nose pliers
Wrenches

Figure 2 shows the components used for this activity. Note that only an end of one of the 4 cables is shown.



Figure 2. Electrical components

Preassembly Wall Fabrication

The wall should be prefabricated and carried to the activity location. Construct a 4' x 4', 2x4 framed wall with 16" stud spacing. Attach stabilizers to the bottom to hold the wall upright. See Figure 3. The connections may be nailed or screwed. It will be easier to disassemble for storage if the stabilizers are screwed on. Attach junction boxes as shown in Figure 3. Remove punch outs from wire holes. Drill $\frac{3}{4}$ " holes through the framing, as required, to run wires (see Figure 1). The stabilizers are 30" long and installed 6" off-center so that the same wall can be used in the Plumbing Wall Activity.



Figure 3. Framed Wall with Junction Boxes

Preassembly Component Preparation

Before engaging the children, cut four pieces of 2-conductor, 14-gauge wire to make the electrical connections shown. The following lengths were used in the example:

- Power to Junction – 40"
- Junction to Outlet – 52"
- Junction to Switch – 55"
- Switch to Light – 72"

Remove the casing 3 inches from each end of the cable and strip $\frac{1}{2}$ " of insulation from the ends of each wire. More insulation may need to be removed for some connections, but the outlet and light switch used called for $\frac{1}{2}$ " to be stripped, and this is adequate for the wire nut connections. Label the ends.

Select a light switch and outlet that will be easy for children to make connections, ideally with either push in wires or screws with compression plates. Be sure that they are also easy to disassemble and reuse. The outlet shown in Figure 4 uses compression plates. The light switch has both compression plates and allows for push-in connections. The light fixture shown will require the ends of the wires to be bent in a hook. Strip $\frac{3}{4}$ " of insulation on these wires.

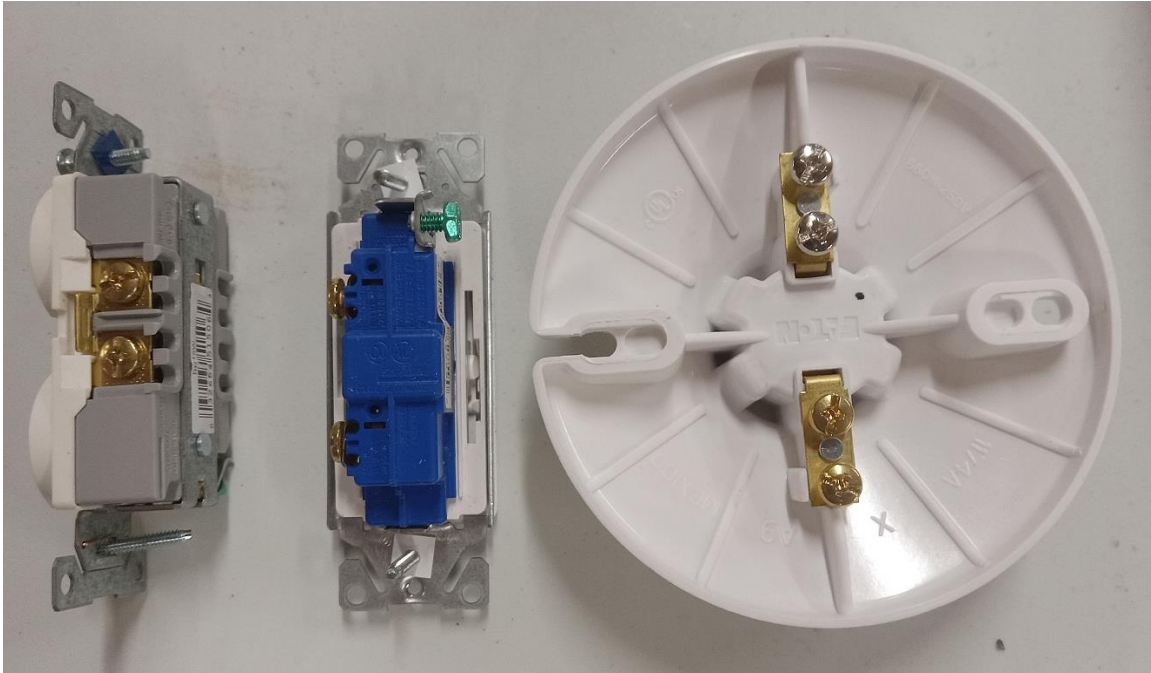


Figure 4. Outlet, switch, and light fixture

Activity Supervision

This activity should be conducted with 1 to 3 children. Discuss the dangers of working with electricity and ensure that they all know not to attempt to disassemble any electrical fixtures at home. Show them that the power supply is detached while working on the wiring. Explain that the 12-volt power used in the activity is relatively safe, but the 110-volt power at home is deadly.

Show the children Figure 1 and help them to identify the components in the completed system. Have them select the outlet, light switch and light fixture and place them near the appropriate junction box. Show them Figure 5 and instruct them to run the pre-cut pieces of wire that you provided as shown.

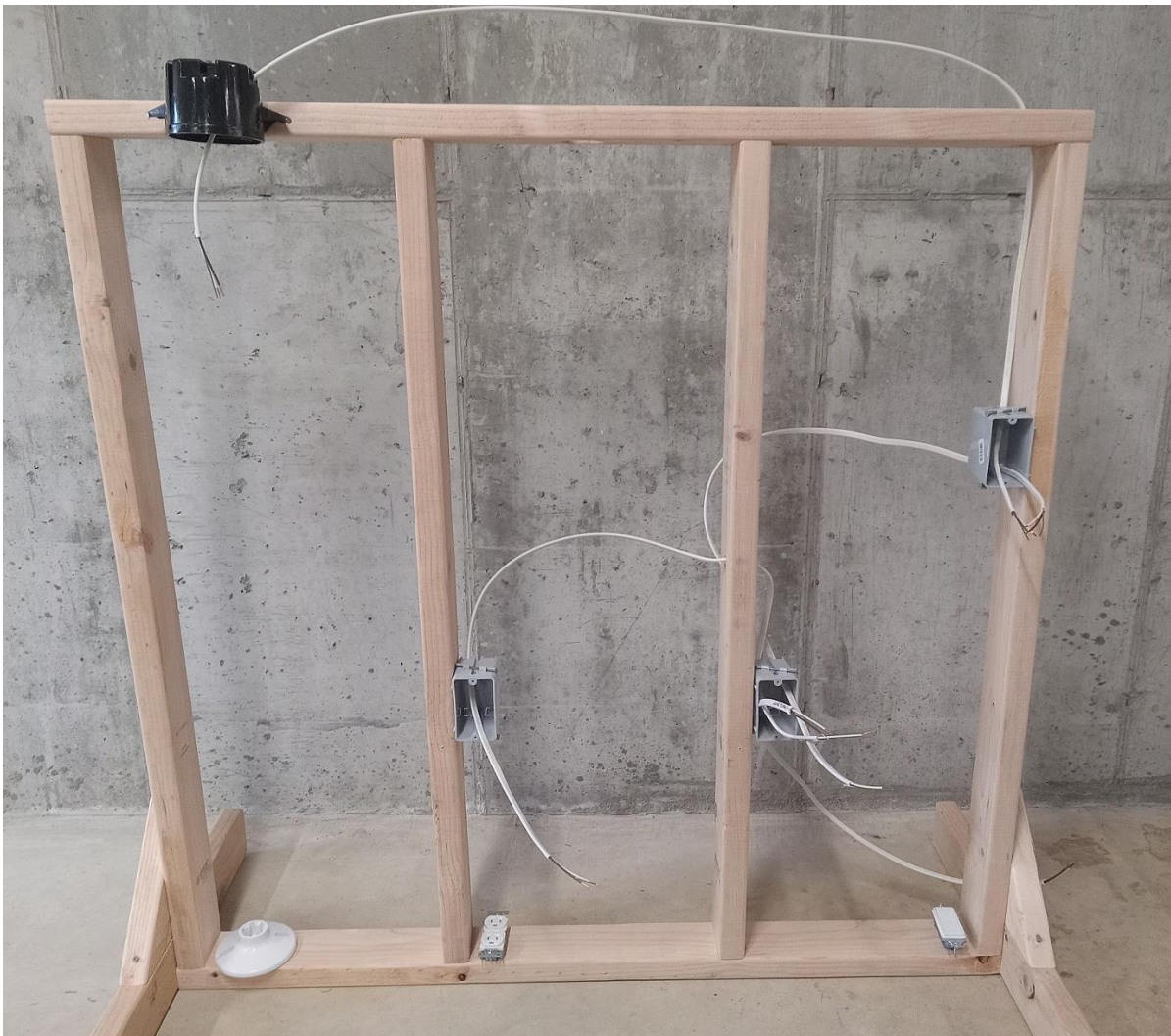


Figure 5. Wire Placement

Starting with the outlet, have the children attach the wires (Figure 6). Connect the black wire to the “HOT WIRE” side, as shown. Have the children simply insert the stripped end of the wire under the compression plate and tighten the screw. Note that the ground wire is bent out of the way. If there are multiple children in the group, they will probably all want to practice this so be prepared to remove the wires after each child.

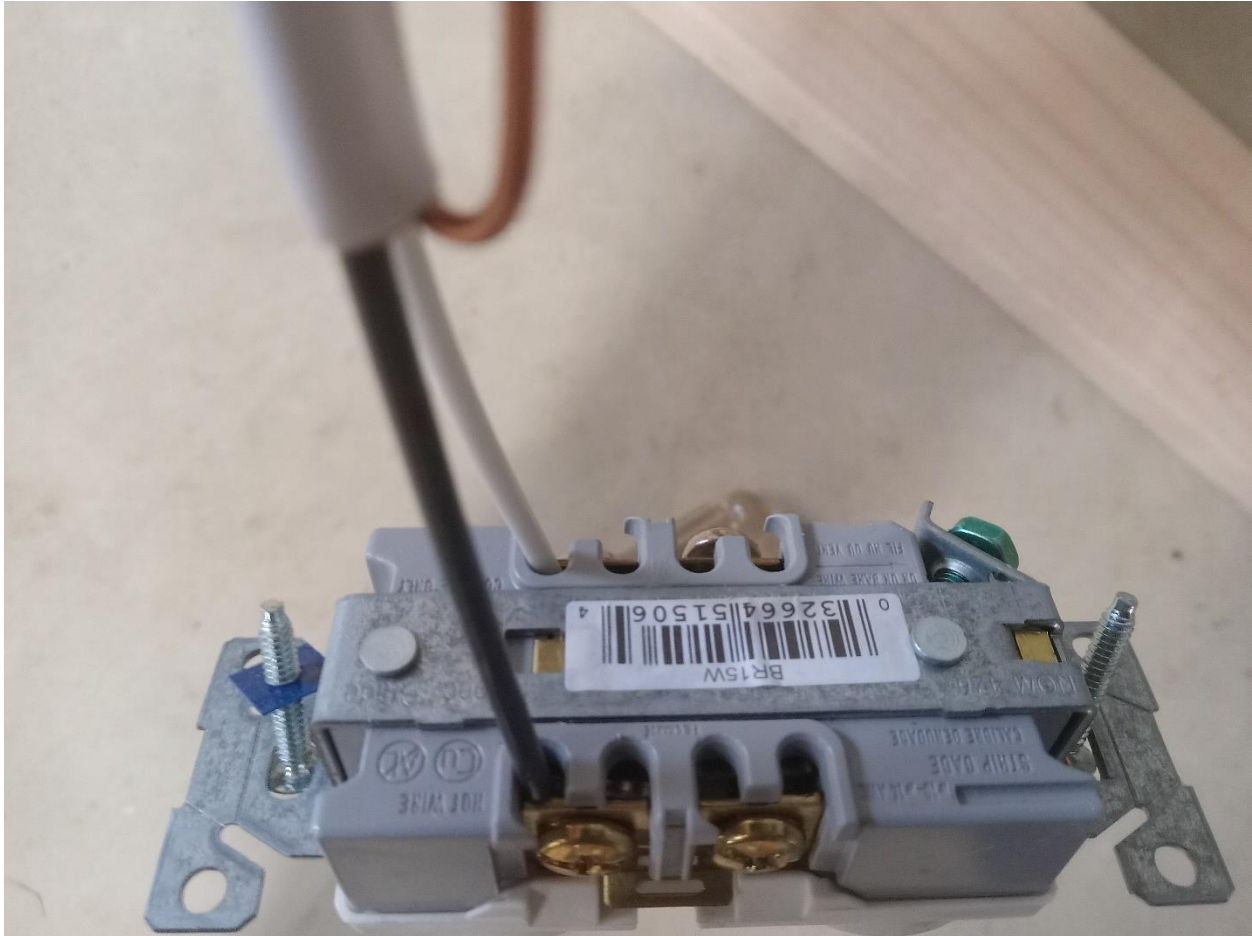


Figure 6. Connect the wiring to the outlet

Connecting the ground wire is optional. This may be too difficult and add unnecessary complication. Consider removing the ground wire from the Romex, or bend it so that it is out of the way and can't contact anything metal in the circuits. After connecting the outlet, secure the outlet in the junction box and attach a cover plate (Figure 7). The wires should not be stapled to the studs so they can be pulled through the holes in the junction box to align the outlet. Installing the screws may be difficult for some children depending on their age and dexterity. Encourage them to try and possibly provide an electric screw gun, if appropriate. It may be helpful to run a screw in and out of the plastic holes in the junction boxes a couple of times before beginning the activity to make it easier for the children to insert the screws. The adult supervisor may need to complete some parts of the installation.



Figure 7. Secure the outlet and cover plate

Move on to the ceiling light fixture. Strip a total of $\frac{3}{4}$ " insulation from the wires and help the children bend the wires into a hook, if this hasn't already been done. Attach the wires to the screw terminals. Secure the fixture in the junction box (Figure 8). Do not install the light bulb until all wiring is complete to minimize the risk of breaking it.



Figure 8. Install the light fixture

Connect the light switch. Have the children attach the two black wires to either side of the switch and connect the white wires using a wire nut (Figure 9). It is not necessary to twist the wires together before installing the wire nut. Attach the light switch to the junction box and secure the cover plate (Figure 10). Ensure that the end of the light switch marked "TOP" is on the top. Assist the children, if necessary.

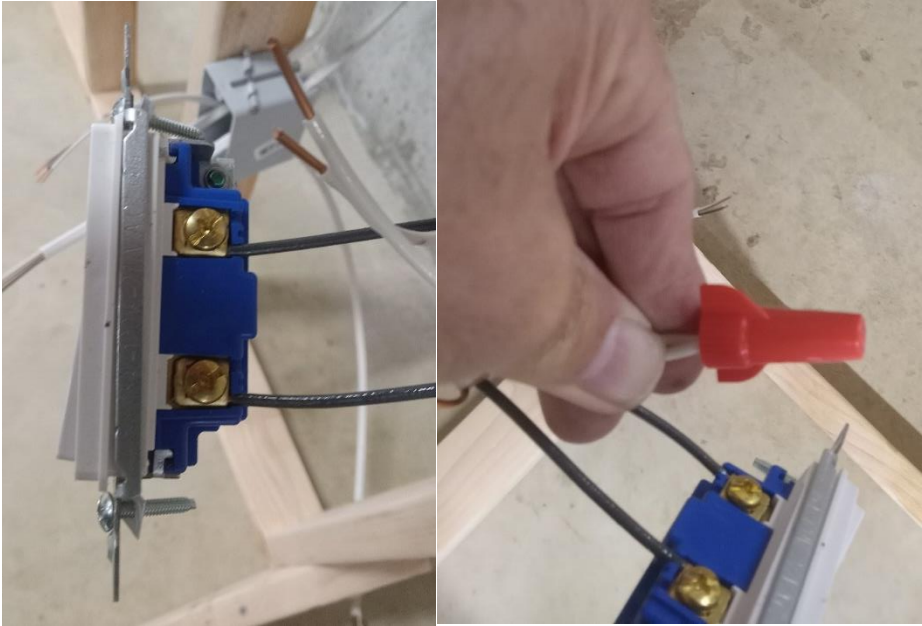


Figure 9. Connect the light switch



Figure 10. Secure the light switch and cover plate

Finally instruct the children to connect the three black wires, the three white wires and the ground wires in the junction box using three wire nuts (Figure 11). Fit these inside the junction box and attach a cover plate.



Figure 11. Connect the wires in the junction box

Connect the power supply to the system. If your power supply does not have a circuit breaker, install one in the circuit. The example uses a 12-volt, deep-cycle, lead-acid battery with screw terminals. Run a short, black wire from the positive terminal to a small 12-volt, RV circuit breaker then hook the 14-gauge wire around the negative terminal and circuit breaker terminal and tighten the nuts (Figure 12).

The example uses a lead-acid battery because it was readily available – it is far more powerful than required. The LED light bulbs require 6 watts so only 1 amp is required to power the system. Two general-purpose 6-volt batteries can be wired in series to power the system.

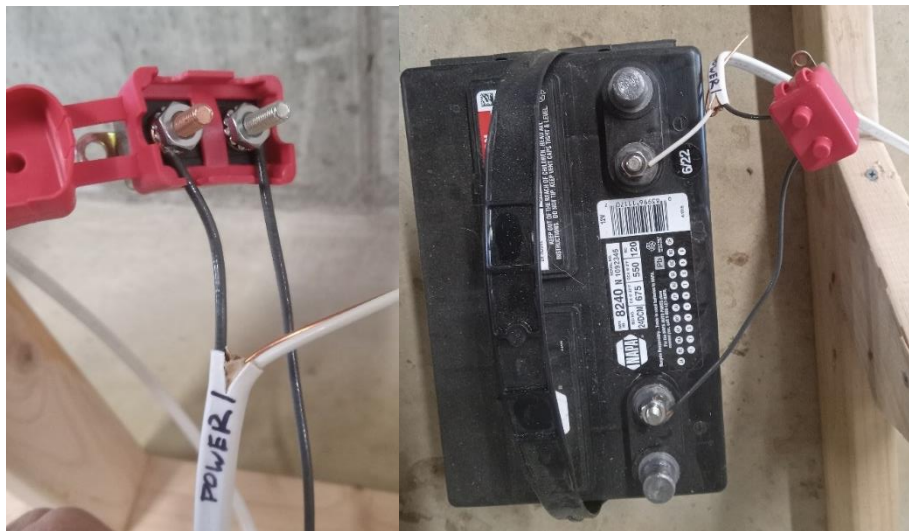


Figure 12. Connect the power supply with circuit breaker

Install the light bulb in the light fixture. Turn the light switch on. Plug in the lamp and operate it. Figure 13 shows the operating system.



Figure 13. Operational system