

CONSTRUCTION

HANDS-ON WORKSTATIONS

ZONE



Residential Wiring



Residential Wiring

This Construction Zone workstation will teach you the basic fundamentals of residential wiring, as you acquire skills by performing hands-on activities. No prior knowledge of the trade is required, as the Construction Zone curriculum will introduce you to professional tools and provide step by step instructions to use them in skills practice.

Before working on the activities, you will learn:

- Four important life skills that this course may help you develop
- The requirements for becoming a journeyman electrician and master electrician
- What the National Electrical Code is
- The fundamentals of electricity

After you have learned about how electricity works and about the wires and cables that carry current into a building, you will run cable and wire various electrical devices found in a home.

WORKSTATION OVERVIEW

You will complete the following tasks:

- Cut, strip and run cable
- Install switches, light fixtures, and outlets
- Make electrical connections
- Create a pigtail wire to extend a circuit
- Wire a three-way circuit
- Wire a doorbell circuit
- Connect and install circuit breakers
- Test and troubleshoot circuits
- Install cover plates
- Disassemble the Residential Wiring workstation

RESIDENTIAL WIRING SKILLS OBJECTIVES

Activity Day 1

- List four important life skills
- Explain why maintaining a home's good condition is important
- Define the terms journeyman electrician and master electrician
- Define the National Electrical Code

Activity Day 2

- Draw and label a diagram of an atom
- Define the terms current, voltage, power and resistance, and describe the water analogy associated with each
- Define the terms conductor and insulator
- Define the term circuit and describe how current flows in a circuit
- Define the term ground and describe the purpose of a ground wire
- Explain the conditions necessary for electric shock to happen
- Define the term transformer
- Describe the function of hot, neutral and ground wires
- Explain why the size of wire is important
- Define the term cable

Activity Day 3

- Name and locate the various tools in the Residential Wiring workstation
- Identify two different types of screwdrivers
- Identify the different parts of a tape measure
- Identify the different parts of a cable/wire stripper
- Safely use a cable/wire stripper to cut and strip cable
- Locate the cable clamps and knockouts in an electrical box
- Run cable to and from electrical boxes

Activity Day 4

- Safely use the cable/wire strippers to strip #14 wire
- Identify the different parts of needle nose pliers
- List the safety considerations when using needle nose pliers
- Distinguish clockwise rotation from counter-clockwise
- Make wire end loops
- Identify the different parts of lineman's pliers
- Define the term wire nut
- Locate the two types of terminals and other important components on switches and receptacles
- Using hand tools, safely wire a light switch and receptacle outlet
- Explain the term single pole

Activity Day 5

- Using an electrician's hand tools, safely make wire connections for a circuit breaker and circuit breaker box
- Troubleshoot a circuit that is not functioning correctly
- Safely use a 12 volt test lamp to troubleshoot an electrical problem
- Install cover plates

Activity Day 6

- Identify the different parts of a swivel cable stripper
- Safely use a swivel cable stripper to strip 3-way cable
- Run cable to and from electrical boxes

Activity Day 7

- State the formula for total amperes in a circuit
- Define the term pigtail
- Make and install a pigtail
- Safely use a cable/wire stripper to cut and strip cable and strip wires
- Make wire connections for a switch and a receptacle outlet
- List items to check when troubleshooting a switch, receptacle outlet, and circuit breaker box

Activity Day 8

- Locate the two types of terminals and other important components on a 3-way switch
- Explain how 3-way switches control one electrical device from two different locations
- Using an electrician's hand tools, safely wire a light fixture, two 3-way switches, and a circuit breaker box
- Troubleshoot a circuit that is not functioning correctly
- Install cover plates

Activity Day 9

- Define the term wire stripper
- List the correct gauge wire for doorbell installations
- State the function of the chime assembly
- Explain why doorbells require a low voltage transformer

Activity Day 10

- Safely use a screwdriver to disconnect the cover plates and electrical devices
- Disconnect all wires from one another and from electrical boxes
- Safely use a screwdriver to loosen cable clamps
- Pull out all cable and wire runs
- Use a cable/wire stripper to cut wire
- Review general safety precautions

Activity Day 4

Installing Electrical Devices: Single Pole Switch, Light Fixture, Receptacle Outlet, & Junction Box

Residential Wiring Skills Objectives

1. Safely use the cable/wire strippers to strip #14 wire
2. Identify the different parts of needle nose pliers
3. List the safety considerations when using needle nose pliers
4. Distinguish clockwise rotation from counter-clockwise
5. Make wire end loops
6. Identify the different parts of lineman's pliers
7. Define the term wire nut
8. Locate the two types of terminals and other important components on switches and receptacles
9. Using hand tools, safely wire a light switch and receptacle outlet
10. Explain the term single pole

Day 4 Activities

1. Read the section *Activity Introduction*.
2. Read the sections *To strip wire insulation*, *Using the Needle Nose Pliers*, *Directional Symbols*, *To make wire end loops*, *Using Lineman's Pliers*, *Splicing Wires with Wire Nuts*, and *The Single Pole Switch*.
3. Complete the step-by-step directions to install a light switch.
4. Complete the step-by-step directions to wire a light fixture.
5. Read the section *The Receptacle*, then complete the step-by-step directions to wire a receptacle.
6. Complete the step-by-step directions to wire a junction box.
7. Complete the Activity Day 4 workbook questions.



Activity Introduction

Your task is to wire various electrical devices, including a single pole switch, a light fixture, a receptacle, and a junction box. Before you begin, you will learn how to properly and safely use needle nose pliers and lineman's pliers.

You will learn how to identify the various components of a switch and a receptacle.

Shut power off using the circuit breakers before you begin your activities.



Wiring a Light Switch



Put on your safety glasses and wear them until you finish all jobs.

To install a single pole switch, a light fixture, a receptacle, and a junction box, you'll need the tools and materials pictured below. Each is labeled in the tool drawer of the workstation.

When you have finished using a tool, return it to the labeled tool holder.

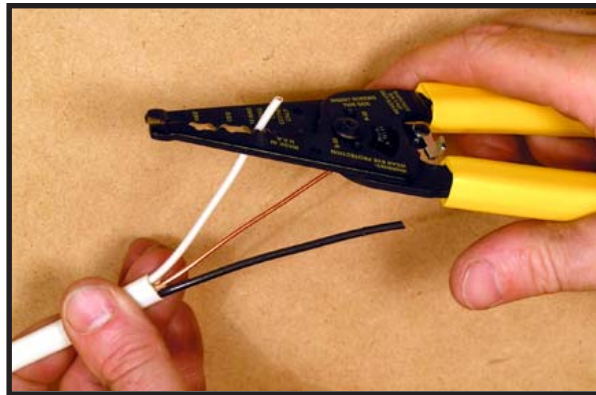
Activity Day 4 Tools & Materials	
 <i>Safety Glasses</i>	
 <i>Cable/Wire Stripper</i>	 <i>Needle Nose Pliers</i>
 <i>Slotted Screwdriver</i>	 <i>#2 Phillips Screwdriver</i>
 <i>Wire Nuts</i>	 <i>Lineman's Pliers</i>

Step-By-Step Instructions

To strip wire insulation:

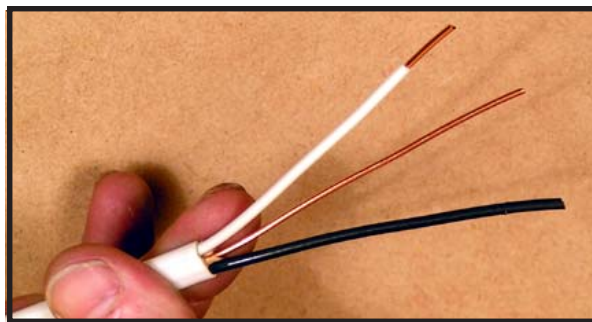
1. Read the writing that is embossed on the wires inside the cable. You are using 14 gauge wire.

Place each insulated wire in the stripping hole labeled 14 AWG (the top hole). The end of the wire should extend one inch from the wire stripper.



Stripping Wire

2. Firmly squeeze the handles of the cable/wire stripper and pull off the insulation. This action will cut through the wire insulation only, and will not cut or nick the current carrying wire.

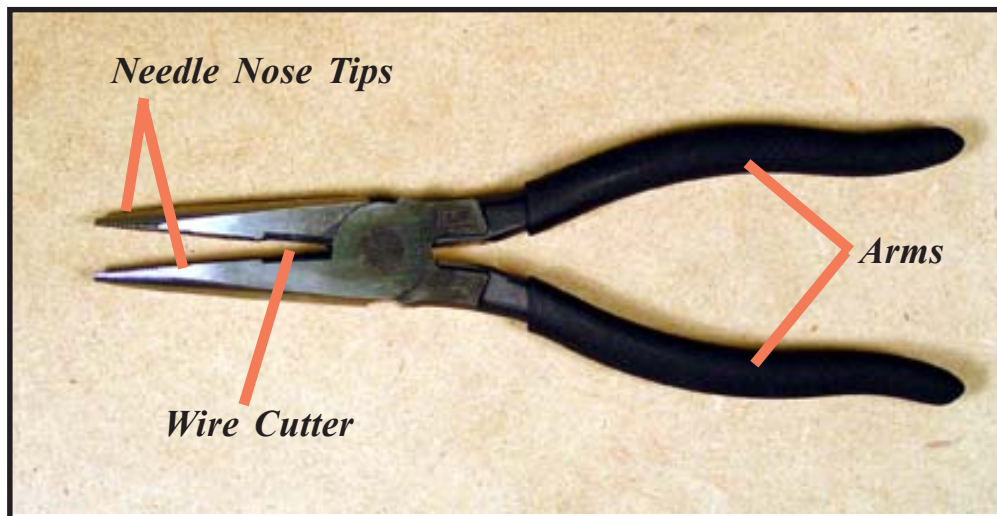


Stripped Wire



Using the Needle Nose Pliers

The parts of a pair of needle nose pliers are called out in the photo below.



Needle Nose Pliers

Needle nose pliers are gripping tools with two hinged arms that are commonly used for holding small or delicate objects, reaching into tiny spaces, and for working with wire. Needle nose pliers have built in cutters for snipping small wires.

Read and follow these safety tips when using needle nose pliers:

- √ Do not use needle nose pliers to loosen nuts or bolts. A wrench will do the job better and with less risk of damage to the fastener.
- √ Do not force the pliers beyond their ability to grip
- √ Always cut wire at right angles. Never rock from side to side or bend the wire back and forth against the cutting edges.
- √ Needle nose pliers can be damaged by using the tips to bend too large a wire. Use a sturdier tool.
- √ Never use pliers as a hammer nor hammer on the handles. They may crack or break, or edges may be nicked by such abuse.
- √ Safety glasses should be worn when cutting wire to protect your eyes

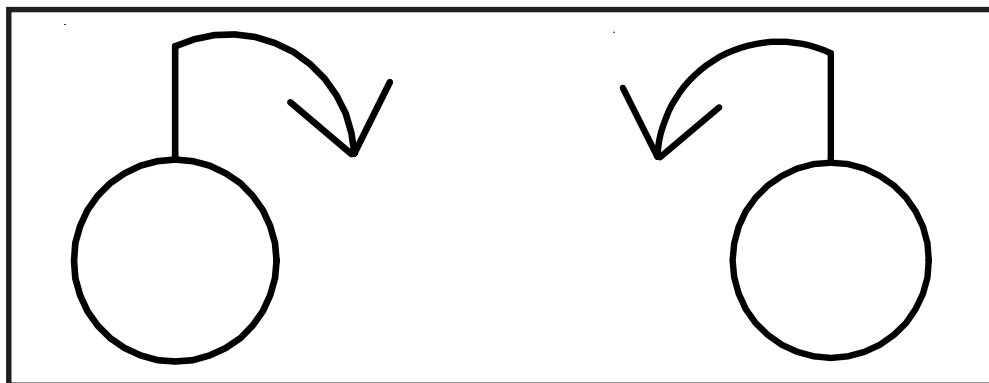


Directional Symbols

You are now ready to use some of the tools used by professional electricians in their daily work.

These tools and their application (work) will require you to apply them in two directions: clockwise and counter-clockwise.

Think about the way the hands of a clock turn--that is the clockwise direction. Counter-clockwise is the opposite direction--the hands of a clock turning backwards. The symbols for these two directions are below.



Clockwise

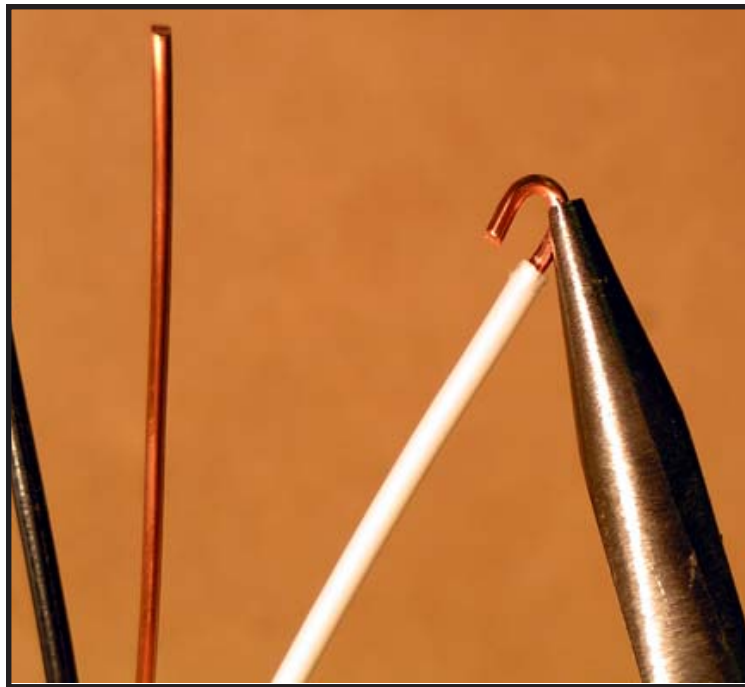
Counter-clockwise

You will see these symbols in the workbook instructions whenever turning in a specific direction is required.


Step-By-Step Instructions

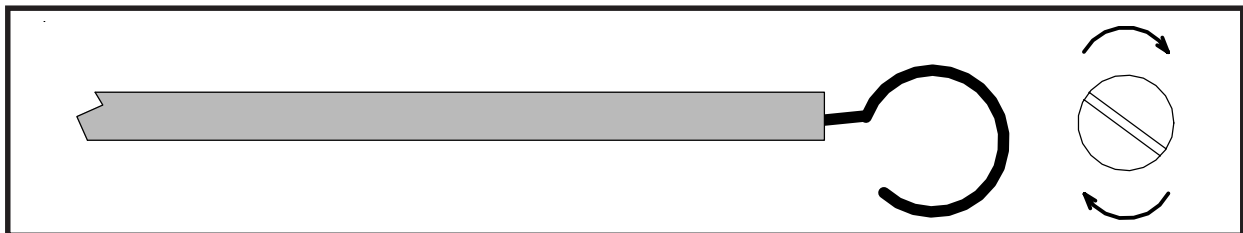
To make wire end loops:

1. Some electrical devices, like receptacles and light fixtures, have screw terminals (attachments). Wire end loops are required for this type of attachment.
2. Use the needlenose pliers to bend the wire ends into loops to fit around terminal screws.



Wire End Loop

Be sure to attach the loop in the direction in which the binding screw turns (clockwise ) when tightening to terminal.

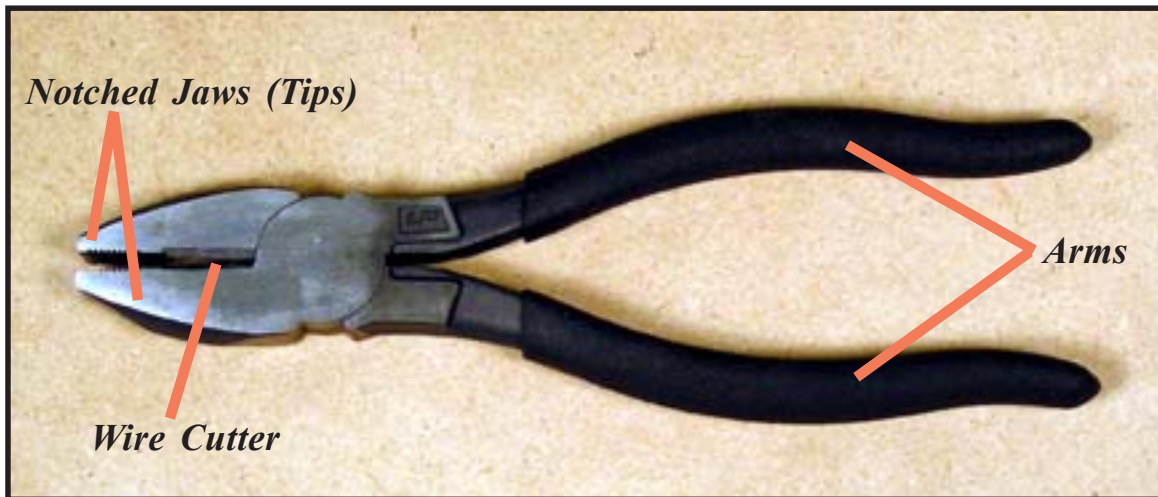


Direction to Attach Wire End Loop



Using Lineman's Pliers

The parts of a pair of lineman's pliers are called out in the photo below.



Lineman's Pliers

Lineman's pliers are hand tools designed to hold, turn, and cut wire or other objects. These pliers have strong cutting and gripping power and are good for pulling and twisting wires. They have a blunt, tapered nose and notched jaw tips for firm gripping. Lineman's pliers have built in side wire cutters for cutting all types of regular wire.

Read and follow these safety tips when using lineman's pliers:

- √ To avoid slippage or scraped knuckles, make sure the jaws of the pliers are snug in position before you manipulate the handle
- √ Do not use pliers to loosen nuts or bolts. A wrench will do the job better and with less risk of damage to the fastener.
- √ Do not force the pliers beyond their ability to grip
- √ Always cut wire at right angles. Never rock from side to side or bend the wire back and forth against the cutting edges.
- √ Never use pliers as a hammer nor hammer on the handles. They may crack or break, or edges may be nicked by such abuse.
- √ Safety glasses should be worn when cutting wire to protect your eyes

Name: _____ Date: _____

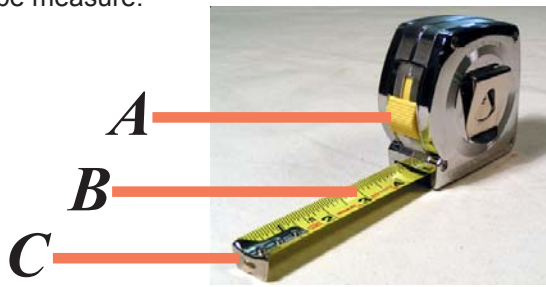
Residential Wiring- Activity Day 3 Workbook Questions

Match the phrases on the right with the tools on the left.

- | | | | | |
|----|---|-------|----|-------------------------|
| 1. | Phillips Screwdriver | _____ | A. | Has a wedge-shaped tip |
| 2. | Slotted Screwdriver | _____ | B. | Can take greater torque |
| 3. | List one safety tip to consider when using a screwdriver. | | | |
-
-

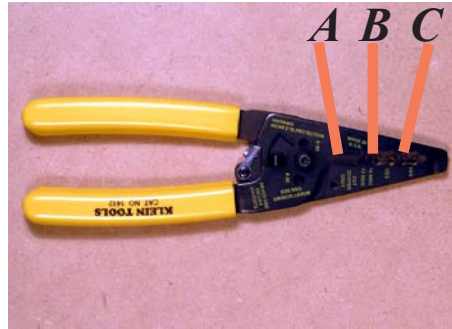
Match the terms on the left with the parts of a tape measure.

- | | | |
|----|-------------|-------|
| 4. | Button Lock | _____ |
| 5. | Tape | _____ |
| 6. | Hook | _____ |



Match the terms on the left with the parts of a cable/wire cutter.

- | | | |
|----|---------------------|-------|
| 7. | 14-2 Cable Stripper | _____ |
| 8. | #14 Wire Stripper | _____ |
| 9. | Cable/Wire Cutter | _____ |



10. What type of cable did you use for this project? _____

WORKSHEET – RESIDENTIAL WIRING

Definitions

Current: _____
Voltage: _____
Power: _____
Resistance: _____

Cable Runs

Enter the length of each cable run.

Breaker Box to Box A = _____ inches Box E to Box I = _____ inches
Box A to Box B = _____ inches Box E to Box F = _____ inches
Box A to Box D = _____ inches Box F to Box G = _____ inches
Box B to Box C = _____ inches Box G to Box H = _____ inches
Breaker Box to Box E = _____ inches

Electrical Boxes

How many hot wires are in **Box A**? _____
The black wires in **Box B** are connected to _____.
In **Box C**, the copper wire is connected to _____.
The neutral wire in **Box D** connects to a _____ terminal screw.
How many neutral wires are in **Box E**? _____
The copper wires in **Box F** are _____ together, then made into a _____.
How are the two red wires connected in **Box G**? _____
What color wire is connected to the common terminal in **Box H**? _____
Connect the white wire in **Box I** to a _____ terminal screw.