

Haley Hensley

Course: Survey of Ag / Electricity I

Unit Title: Introduction to electricity

Materials: Wiring materials, one way switches, stripping tools [a potato for each student or group, pennies, copper wires, zinc-plated nails

**I. Lesson Title**

- a. Electricity!

**II. Situation**

- a. Students have been through the theory of electricity as well as the basic terminology and wiring colors. Students will be 9<sup>th</sup> -12<sup>th</sup> grade. Students may have some to little knowledge of the area.

**III. Teachers Objectives**

- a. Select appropriate circuit wiring materials and supplies through application with 100% accuracy.
- b. Differentiate among the various types of switches, receptacles, and connectors through application with 90% accuracy.
- c. Perform the methods of wiring a single switch through application with 90% accuracy.

**IV. Teaching procedures**

- a. Interest approach
  - i. How to make a potato powered light bulb!
    - 1. Instructions:
      - a. Cut the potato in half then cut a small slit into each half big enough to slide a penny inside.
      - b. Wrap one copper wire around each penny a few times, leaving loose ends on both
      - c. Stick the pennies in the slits you cut with the loose ends sticking out.
      - d. Wrap the third copper wire around one zinc-plated nail, leaving a loose end, and stick the nail into one of the potato halves.
      - e. Take the loose end of the wire connected to the penny in the potato half with the nail and wrap some of it around the second nail. Stick the second nail into the other potato half.
      - f. Connect the two loose ends of the copper wires to the light bulb or led light and it will light up.

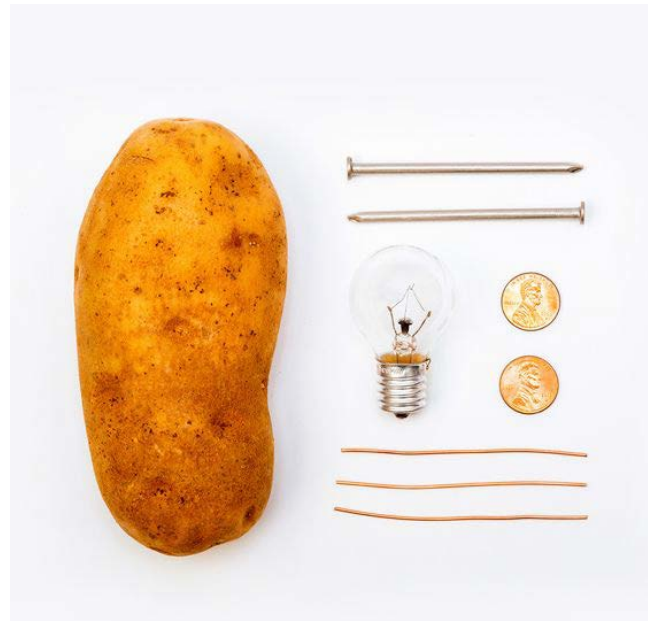


Image found at: <https://www.pinterest.com/pin/449937819008289725/>

**b. Reasons to learn**

- i. Why should we understand the correct way to wire receptacles and switches?
- ii. Why do we have to strip the insulation off the wires?

**c. Questions to answer**

- i. What are the purposes of switches and receptacles?
- ii. What is the correct way to wire and single switch?

**d. Answers to questions**

- i. Electrical Devices
  1. Electrical devices used in common circuits can be classified as loads, switches, and receptacles.
  2. Loads convert energy to do work
  3. Switches provide a way to break the current flow, thus controlling the electric power delivered to a load
  4. Receptacles provide a means of conveniently connecting to or disconnecting a load from a circuit.
  5. Two common examples of receptacles are light sockets and convenience outlets

ii. Receptacles

1. These vary in structure and configuration based on the amperage they are designed to deliver.
  - a. Light socket receptacles (closets and garages) are porcelain or plastic structures into which a lightbulb is screwed into place.
  - b. The most common receptacle is the standard duty 15A, 120V duplex receptacle into which the plug from a power cord is inserted.
2. Duplex receptacles
  - a. These are two outlets that are combined into one receptacle. There are 4 screw terminals for connecting conductor wires and a fifth green terminal that is reserved for the ground wire.



b.

Image found at: [http://ace.imageg.net/graphics/product\\_images/pACE3-17510843enh-z7.jpg](http://ace.imageg.net/graphics/product_images/pACE3-17510843enh-z7.jpg)

3. GFCI receptacles

- a. These are required for circuits that are near to, or may be exposed to, moisture be protected through a GFCI. (these would be used in your bathrooms)



b.

Image found at:

[https://fthmb.tqn.com/tTy9NNGOUVjC6YUcfiUPB3cLd0=/2537x3800/filters:no\\_upscale\(\):fill\(tranparent,1\)/Leviton\\_Dual\\_Function\\_AFCI\\_GFCI\\_Receptacle-5841e9a75f9b5851e56d9cf0.jpg](https://fthmb.tqn.com/tTy9NNGOUVjC6YUcfiUPB3cLd0=/2537x3800/filters:no_upscale():fill(tranparent,1)/Leviton_Dual_Function_AFCI_GFCI_Receptacle-5841e9a75f9b5851e56d9cf0.jpg)

4. Heavy-Duty Receptacles

- a. Equipment and appliances that operate at increased amperage requirements must be plugged into circuits equipped with receptacles capable of delivering higher amperages. (these would be for your washer and dryer)



Found image at: [https://images.homedepot-static.com/productImages/c76f4856-bad5-441f-8441-8cafebcec65e/svn/white-leviton-outlets-receptacles-5461-w-64\\_1000.jpg](https://images.homedepot-static.com/productImages/c76f4856-bad5-441f-8441-8cafebcec65e/svn/white-leviton-outlets-receptacles-5461-w-64_1000.jpg)

b.

5. These are the different types of plug/receptacle configurations for different amperages.



Image found at: Hancock, J. P., Edgar, D. W., Pate, M. L., Dyer, L. A., & Hoover, W. B. (2017). *Agricultural mechanics and technology systems*. Tinley, Park, IL: Goodheart-Willcox Company.

### iii. Switches

1. When you think of a switch, it is easiest to visualize a single-pole which the switch is either off or on.
2. The job of the switch is to break the circuit before electricity reaches the load.
3. The two screw terminals are bronze, signifying that they should be connected to a hot (black) conductor. The neutral (white wire) conductor should always be connected to the silver screw.

### iv. Connecting wires

1. Electrical connections must always be tight and secure. The effectiveness of the connection depends on having adequate surface-to-surface contact between conductors so that moving electrons can make the transition without arcing (the current jumping a gap in the circuit).
2. Splices: are connections from wire to wire when one section is not long enough.
  - a. Its best to avoid having to make splices by planning ahead.

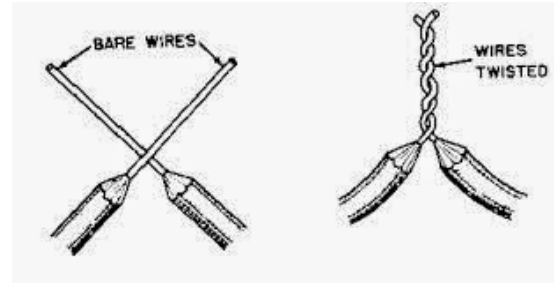
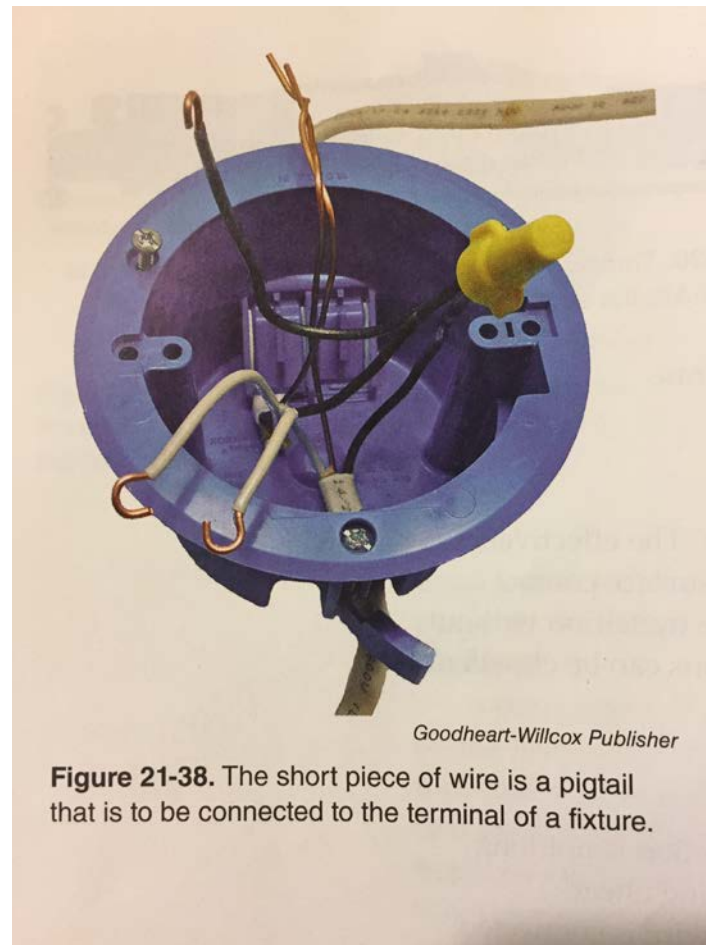


Image found at: [http://electriciantraining.tpub.com/14176/img/14176\\_47\\_1.jpg](http://electriciantraining.tpub.com/14176/img/14176_47_1.jpg)

3. Tap: is another type of wire-to-wire connection. One wire is connected along the length of another in order to create a branch in another direction.
  - a. These are common in AC circuits.
  - b. A short piece of wire tapped into another and leading to a device in the same enclosure is known as a pigtail.

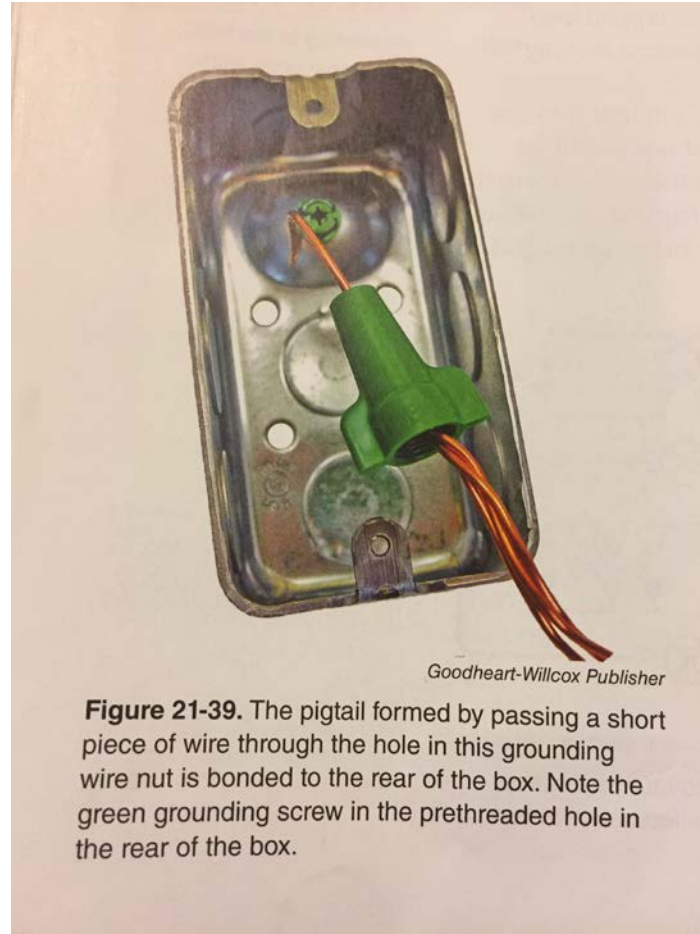


c.

Image found at: Hancock, J. P., Edgar, D. W., Pate, M. L., Dyer, L. A., & Hoover, W. B. (2017). *Agricultural mechanics and technology systems*. Tinley, Park, IL: Goodheart-Willcox Company.

4. Wire nut: this is the most common methods of connecting wires in AC circuits, where you use a solderless twist-on connector.
  - a. A wire nut is a plastic or ceramic cone with a tapered, spiral metal insert that grips the ends of wires to make a connection.

- b. When a wire nut is twisted onto the stripped and twisted-together ends of the wires, the conductors are drawn into the metal spiral and compressed together inside.



*Goodheart-Willcox Publisher*  
**Figure 21-39.** The pigtail formed by passing a short piece of wire through the hole in this grounding wire nut is bonded to the rear of the box. Note the green grounding screw in the prethreaded hole in the rear of the box.

Image found at: Hancock, J. P., Edgar, D. W., Pate, M. L., Dyer, L. A., & Hoover, W. B. (2017). *Agricultural mechanics and technology systems*. Tinley, Park, IL: Goodheart-Willcox Company.

v. Terminal connections

1. Terminal connections are points at which wire conductors terminate and are connected to electrical devices.
2. Every wire in a service panel is attached at a terminal connection.

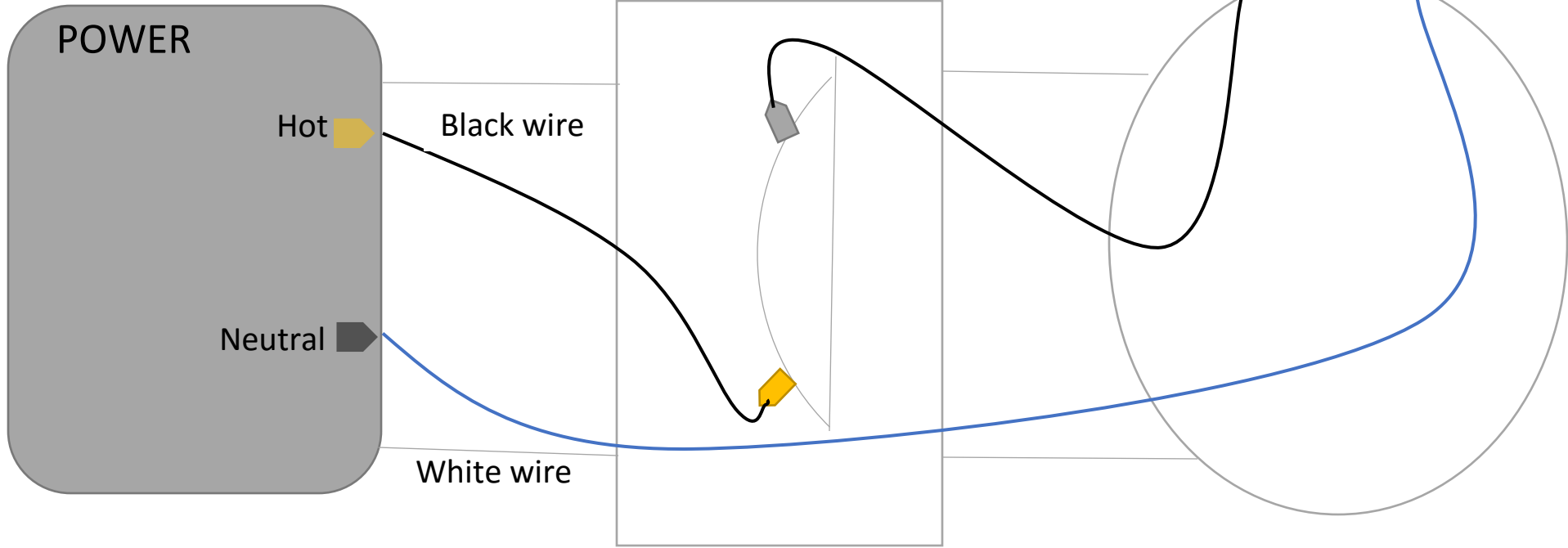
3. Switches, receptacles, and other devices are connected to circuits using terminal connections.
  4. Solid, single wire conductors are easily bent into a hook shape and secured under the heads of common screw terminals.
- vi. Stripping insulation
1. Before electrical connections can be made, the insulation must be removed from the ends of the conductor.
  2. The best and safest way to remove the outer sheathing is with a tool called a cable ripper.
    - a. A cable ripper cuts the outside sheath for removal while minimizing damage to the insulation on the conductors inside.
  3. You then to remove a little bit of the insulation from the ends of the conductor wires. The goal is to strip enough to make a good connection and not leave any bare conductor exposed past the connection.
  4. A wire stripper is a tool that resembles a pair of pliers with a series of openings fitted to different gauges of wire. Most stripping tools include a cutter, and sections of the jaws may be configured for crimping attachments.
  5. Use a wire stripper to cut the insulation at the proper length indicated by the strip gauge and use the jaws of the stripper to pull the wire.
- vii. Basic rules for wiring:

### **Single Switch**

1. Neutral wire from power source to silver screw of the light.
2. Black (hot) wire from brass screw of light to screw on  $S_1$ .
3. From source, hot (black) to remaining screws on switch.



Light bulb image found at:  
[https://upload.wikimedia.org/wikipedia/commons/thumb/b/b4/Gluehlampe\\_01\\_KMJ.png/170px-Gluehlampe\\_01\\_KMJ.png](https://upload.wikimedia.org/wikipedia/commons/thumb/b/b4/Gluehlampe_01_KMJ.png/170px-Gluehlampe_01_KMJ.png)



**V. Testing Solution Through Application**

- a. Students will need to draw a replication of the above single switch wiring and make sure to understand the rules and process of wiring the single switch.
- b. Students will practice wiring a single switch. Teacher will monitor students and make sure that the correct procedures are taken.

**VI. Closure**

- a. What are the purposes of switches and receptacles?
  - i. Receptacles: is an electric device that provides a means of conveniently connecting to or disconnecting a load from a circuit.
  - ii. Switches: any device that is used to interrupt the flow of electrons in a circuit, stopping or redirecting the flow of electricity.
- b. What is the correct way to wire and single switch?
  - i. Neutral wire from power source to silver screw of the light.
  - ii. Black (hot) wire from brass screw of light to screw on  $S_1$ .
  - iii. From source, hot (black) to remaining screws on switch.
  - iv. *Allow time for discussion for any students that have questions.*