

Non-Metallic Cable Wiring Electrical Project

Name: _____

Date: _____

Description:

Students are to connect four electrical boxes that are nailed onto a 2x4 board together using non-metallic cable. The first box is to have a duplex receptacle. The second box is to have a light switch on it. The third and fourth box are to have light bulb fixtures. The project will be tested by plugging it into an extension cord. Once the project is plugged in, the light switch will be turned on to see if both light bulbs turn on. The project will not be accepted until both light bulbs light up.

Materials:

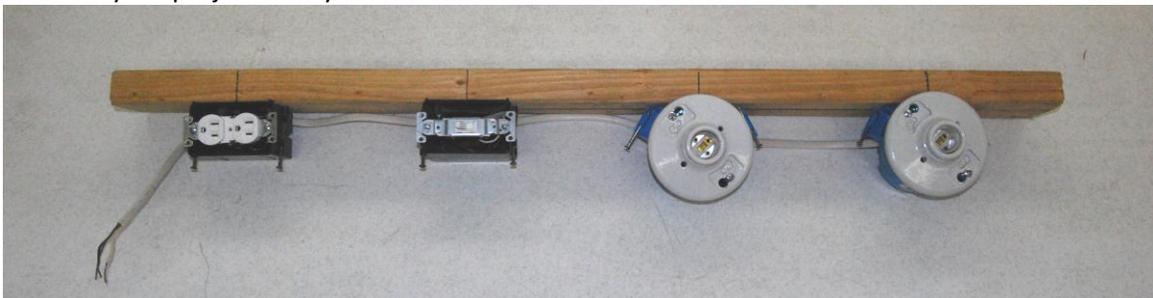
- 2x4 fir lumber
- 14/2 Non-metallic cable (6' / project)
- Non-metallic cable staples
- Wire nuts
- Light fixture (lamp holder)
- On/Off switch
- Duplex Receptacle
- 4 electrical boxes

Tools:

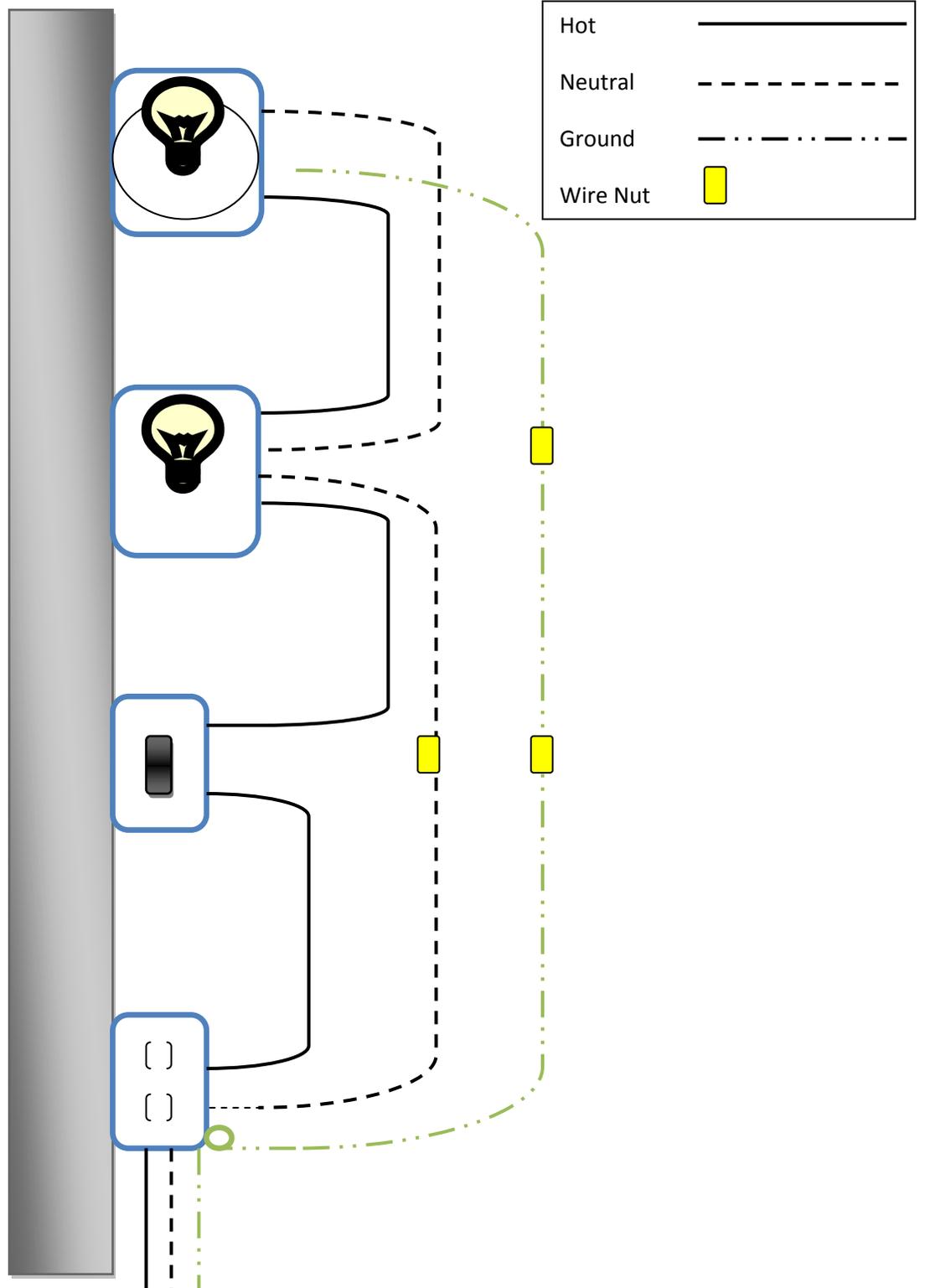
- Wire strippers
- Hammer
- Tape measure
- Phillips and Flat Head screwdrivers
- Power Miter Saw or Circular Saw
- 2 light bulbs for testing
- Cord cap with a short cord to connect projects to power source.

Procedure:

1. Cut a 2x4 42 inches long
2. Nail on the 4 electrical boxes on one side of the board placed 8 inches apart.
3. Pull wire between each box. Be sure to include a length of wire as a power source.
4. Wire the ground wires first and tuck into the bottom of the boxes.
5. Install a duplex receptacle outlet in the first box.
6. Install the switch in the second box wire to control both of the lights.
7. Install in the third box one light fixture (lamp holder)
8. Install in the last box another light fixture.
9. Review your wiring. Does it meet "code"? Is the circuit correct?
10. Install two lamps and the cord cap (plug).
11. Test your project with your teacher.



Drawing:



Electrical Wiring Worksheet

Name: _____

Date: _____

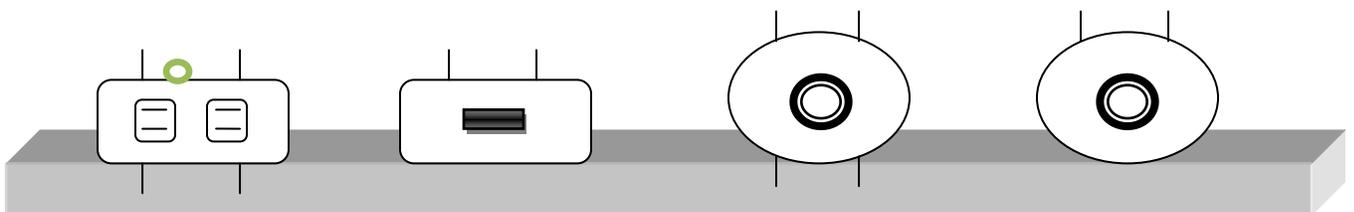
1. What does each of the following wire colors indicate (hot, neutral, ground)?
 - a. Black: _____
 - b. Green: _____
 - c. White: _____
 - d. Red: _____
2. How many inches of wire should be sticking out of the electrical box for wiring?

3. What wires do you connect to the following screws (hot, neutral, ground)?
 - a. Brass: _____
 - b. Silver: _____
 - c. Green: _____

4. When nailing on electrical boxes how far must the box stick out from the 2x4?

5. What safety precautions must be done before working with electricity?

6. Complete the circuit diagram below. Draw in wire connections with a line and label the wire color. (5 points)



Grading Rubric:

Criteria	Possible	Actual
Proper Box Location	5	
Wire Nuts	5	
Properly Grounded	5	
Wires Stripped to Right Length	5	
Correct Circuit (Light Bulb turns on)	5	
Workmanship (looks neat, no extra wire)	5	
Total	30	

Electric Project Teachers Notes:

Note that the project can be done outside a shop. Store the supplies in tubs and wire in a class or lab room. This is particularly easy as the boards have the boxes pre-mounted.

Agricultural Standards Met:

- 6.0 Health and Safety. Students understand health and safety policies, procedures, regulations, and practices, including the use of equipment and handling of hazardous materials:
- 6.1 Know policies, procedures, and regulations regarding health and safety in the workplace, including employers' and employees' responsibilities.
 - 6.2 Understand critical elements of health and safety practices related to storing, cleaning, and maintaining tools, equipment, and supplies.
 - 6.4 Maintain safe and healthful working conditions.
 - 6.5 Use tools and machines safely and appropriately.
 - 6.6 Know how to both prevent and respond to accidents in the agricultural industry.
- B1.0 Students understand personal and group safety:
- B1.1 Practice the rules for personal and group safety while working in an agricultural mechanics environment.
 - B1.2 Know the relationship between accepted shop management procedures and a safe working environment.
- B3.0 Students understand the basic electricity principles and wiring practices commonly used in agriculture:
- B3.1 Understand the relationship between voltage, amperage, resistance, and power in single-phase alternating current (AC) circuits.
 - B3.2 Know how to use proper electrical test equipment for AC and direct current (DC).
 - B3.3 Analyze and correct basic circuit problems (e.g., open circuits, short circuits, incorrect grounding).
 - B3.4 Understand proper basic electrical circuit and wiring techniques with nonmetallic cable and conduit as defined by the National Electric Code.
 - B3.5 Interpret basic agricultural electrical plans.

Objectives:

By properly completing this project, students will be able to:

- Understand proper basic electrical circuit and wiring techniques
- Connect 4 electric boxes using Non-metallic cable using basic agriculture electric plans
- Understand the relationship between volts, amps, resistance, AC currents

Alternative Tools/Methods/Materials:

Other circuits can be developed using the same set of boxes with different devices.

Safety Review:

- All power is turned off or disconnected
- Disconnect power source if burning smell is noticed or if wires get hot.
- Check switches, outlets, fixtures or extension cords for damage before using
- Do not use wire that has exposed parts

- Do not touch electrical wire while you have wet hands
- Working with electricity can be dangerous. However, electricity can be safe if properly worked with and respected.
- Double check before testing it!

Project Time:

Demonstration:	20 minutes
Build:	1 hour

Demonstration Notes

1. Review electrical section of an Ag Mechanics text.
2. Review the terms, types of wire and names of items and tools being used.
3. Cover the basic rules of wiring and discuss the National Electric Code:
 - I. Color coding of wire and terminals
 - II. 6" of free conductor – reason: allows replacement of devices without having to replace the wire.
 - III. Use of wire nuts: tight and no bare wire showing.
 - IV. Grounding: boxes and devices.
4. Proper connection to a screw terminal: Clockwise, loop $\frac{3}{4}$ around, no insulation under the screw, no bare wire past the device.
5. Go over what a "pig tail" is and how to make one to connect devices to multiple wires.
6. Cover basic circuits. Tip: show students a complete circuit and have them trace it.
7. How to make a proper eye for terminals (bend back 90° first). Practice this and look like a pro!
8. When testing finished product use a tester made with a GFCI and short cord. This will protect the circuit and prevent tripping the shop circuit breaker.
9. Before testing finished project visually check it to make sure things look properly installed. You can plug in an improper circuit as long as you have a circuit tester plugged as well.
10. If their project does not work ask the student to troubleshoot. Sometimes they learn more this way!

Bill of Materials:

Note: Lumber, boxes, and devices are reusable and need not be purchased for every class.

Projects:		24				
Size	Description	Units	Qty/Project	Cost/Unit	Order	Amount
14/3	Non-metallic wire	250 ft	0.024	\$74.20	1	\$ 74.20
2x4 x 12'	Std grade fir	each	0.33333333	\$4.05	8	\$ 32.40
	Yellow wire nut	225	0.01333333	\$14.85	1	\$ 14.85
15 amp	Duplex Receptical	10	0.1	\$ 4.58	3	\$ 13.74
15 amp	Light Switch	10	0.1	\$ 4.66	3	\$ 13.98
250 volt	Light Fixture	1	2	\$ 1.47	48	\$ 70.56
20 Cu In	Electical Light Box	1	2	\$ 0.98	48	\$ 47.04
18 Cu In	Electrical Box	1	2	\$ 0.28	48	\$ 13.44
					TOTAL	\$ 280.21