**Circuit Concepts (Residential)**

**Description**

This Activity Plan will allow students to understand how electrical circuits work in a home. Students will also gain knowledge of service panel installation and understanding of how the Canadian Electrical Code (CEC) applies to residential electrical wiring.

According to residential wiring requirements, to safely wire a home electricians must understand the concepts of branch circuit wiring. Many new apprentices spend time wiring homes in order to gain experience. The time spent learning how to rough in a home will help them to understand how to wire a home and learn about the CEC requirements for residential wiring. Residential house wiring also teaches new apprentices about:

* Electrical equipment
* How to read electrical drawings
* Understanding electrical symbols
* Using practical measurement and layout
* Distribution of electrical circuits
* Applying CEC rules to electrical installations

Wiring a home is a small-scale electrical job, but it incorporates many of the skills needed to move on to more complex electrical jobs. The basic skills learned during residential wiring are really the foundational skills needed to advance in the electrical trade.

## Lesson Outcomes

The student will be able to:

* Understand how electrical power enters a home and is distributed to branch circuits
* Know some of the CEC requirements for BC
* Learn about safety issues regarding electrical services

## Assumptions

The student:

* Has little or no knowledge of residential wiring
* Has knowledge of a basic electrical circuit
* Understands electrical hazards and safety
* Knows what role the Canadian Electrical Code plays in determining standards for electrical installations



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## Terminology

**Branch circuit**: the portion of wiring from the final circuit breaker to the outlet.

**Drywall**: gypsum wallboard used to cover the interior walls of most homes.

**Electrical bonding**: the permanent joining together of metal parts to form an electrically conductive path that has the capacity to conduct safely any fault current likely to be imposed on it.

**Electrical equipment**: equipment such as receptacles (outlets), light fixtures, switches, conductors (wires), circuit breakers, electrical panels, conduit, etc.

**Electrical layout**: taking information from a blueprint or electrical drawing and transferring it to the actual locations in a room to denote where devices will be installed (e.g., lights, switches, receptacles).

**Electrical meter**: a device that measures the amount of electrical energy consumed by a residence, business, or electrically powered device.

**Grounding**: the process of connecting equipment to a common ground, or “earth.” This is done as a safety mechanism in order to avoid the unsafe energizing of equipment.

**Main electrical panel**: a metal electrical service box that accepts the main power to the home and distributes electrical current and voltage (power) to the various circuits within the home.

The various circuits are protected from over current by the use of circuit breakers or fuses. The electrical panel is also known as a *service panel*, *breaker panel*, and *fuse box* (archaic).

**Overload**: an overcurrent that exceeds the normal full load current of a circuit. This type of overcurrent characteristically does not leave the normal current-carrying path of the circuit. It flows from the source, through the conductors, through the load, back through the conductors, to the source again.

**Rough in**: work performed on a building’s electrical system before the interior walls are insulated and finished with drywall.

## Estimated Time

1–2 hours

## Recommended Number of Students

20, based on *BC Technology Educators’ Best Practice Guide*

## Facilities

Computer lab, classroom, or shop

## Tools

Pencils, pens

**Materials**

* Class copies of or enough for pairs: *Electrical Code Simplified, House Wiring Guide*. P.S. Knight. ISBN number 978-0-920312-48-3. Available at most home improvement stores.
* Projector and screen
* Computer with Internet access and sound
* Photocopied handouts or overhead projector with transparencies

## Optional

This would be a good opportunity for a field trip to a residential construction site to show the electrical system being built. This could also serve as an opportunity to show the carpentry and plumbing trades performing their jobs.

## Resources

### Understanding Wiring

Video providing information on the electrical panel. <http://www.youtube.com/watch?v=Qgtx6Eckovg>

### Basics of Your Home's Electrical System - The Home Depot

https://[www.youtube.com/watch?v=nZVeOgusxqk](http://www.youtube.com/watch?v=nZVeOgusxqk)

***Electrical Code Simplified, House Wiring Guide***, ***BC Book 1***, published by P.S. Knight. Available at most home improvement stores.

# Activity

* 1. As a class, watch the “Understanding Wiring” video (see the Resources section). This video is from the United States, but it gives a good overview of an electrical panel and concepts of branch circuit wiring. It also covers some important safety issues related to house wiring.
  2. Watch the “Panel Upgrade” video to show students how power comes into an electrical service from the power authority. It will also show and explain to students how a panel is upgraded from a smaller service to a larger service. The electrical portion of this 23:44 video is the first 16:05.
  3. Discuss these videos as a class and help students understand that electrical wiring in homes is done very similarly across North America, although different areas have different code requirements for electrical work. The teacher should preview these videos and generate some discussion topics and questions to check for student understanding.
  4. Have students pair up or work individually on the questions on the next page, based on

*Electrical Code Simplified, House Wiring Guide, BC Book 1*.

## Evaluation Guidelines

The student:

* + - Participates in discussions about the videos
    - Displays knowledge and understanding of branch circuits through discussion and questioning
    - Demonstrates understanding of some of the safety issues around electrical services and branch circuit wiring
    - Displays knowledge and understanding of the main service of the home through discussion and questioning
    - Answers questions on code requirements correctly

## Extension Activity

If there are enough copies of *Electrical Code Simplified*, students in small groups could draw up a few questions from specific chapters in the book, then trade questions with another group to find the answers from the book. This activity will help students become more familiar with code rules as well as how to find them in the simplified code book.

# Electrical Code Questions

All questions are generated of pages 52–53 of *Electrical Code Simplified, House Wiring Guide*. The images on pages 52–53 lead to a page in the book that has the answer. Provide the code rule as well as the answer to the questions. Wire sizes and ampacities are:

* #14 wire—15 amps
* #12 wire—20 amps
* #10 wire—30 amps
* #8 wire—45 amps
* All wire is NMD90 copper Answer key on the next page.

1. What is the maximum amperage and wire size that may be used for a washing machine in a laundry room? What type of receptacle is it?
2. What is the maximum size of circuit breaker to be used for an electric water heater?
3. How many conductors and what size of wire should be used to supply an electric dryer? What size of circuit breaker should be used?
4. In British Columbia is it mandatory for outdoor plug outlets to be controlled by a switch inside the house?
5. What is the minimum wire size and ampacity used to supply a fridge? How many conductors should be used? What other load may be supplied by a fridge circuit?
6. Is it allowable to install an outlet box behind a baseboard heater?
7. How many conductors and what size of wire should be used to supply an electric range outlet? What should the plug receptacle rating be? Is it acceptable to fasten a range receptacle outlet box on one side only?
8. What types of receptacles are required in a bedroom? What is their purpose?

## Answers

* 1. Rules 26–710 (e) (i), 26–720 (b): 20 amp #12 copper, 20 amp T slot receptacle 2. 26–750 (4): 20 amps

3. 26–744 (2) & (3): 3 wire #10 copper, 30 amp

1. 26–717 (a): No, but recommended by CSA
2. 26–720 (a): #14 wire 15 amps, two conductors, clock outlet 6. 12–506, 12–3002 (6): Yes, but not preferred

7. 8–300, 26–744, 26–746: 3 wire #8 copper, 45 amp receptacle rating, 12–3012 (3): No, supported on two or more sides

8. 26–722 (f) & (g): AFCI type, arc fault circuit interrupters, to trip quickly to avoid fire hazards