



AMERICAN RIVER COLLEGE

# Electricity Basics

**Energy Instructor**

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# Lesson Plan

- System Components and Framing – Any Questions?
- NABCEP Learning Objectives Review: Electricity Basics
- Residential Wiring

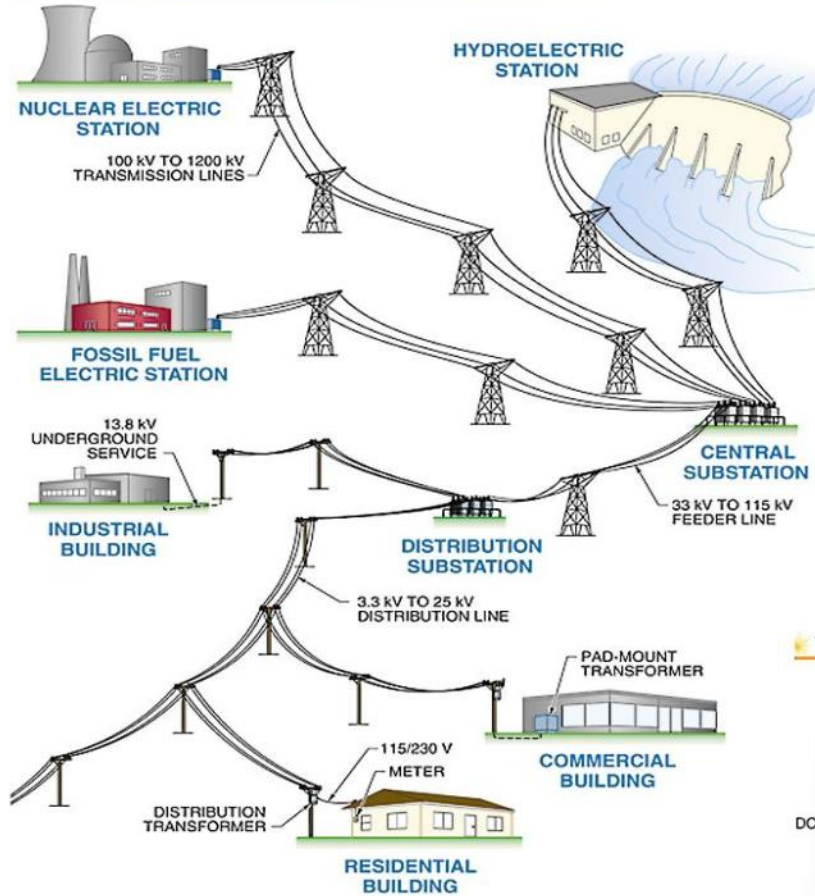
## NABCEP Learning Objectives

Category	Course Time By %	Exam Items	Level of Testing
1. PV Markets & Applications	5%	3	Comprehension
2. Safety Basics	5%	3	Comprehension Application
3. Electricity Basics	10%	6	Comprehension Problem Solving
4. Solar Energy Fundamentals	10%	6	Comprehension Application Problem Solving
5. PV Module Fundamentals	10%	6	Comprehension Application Problem Solving
6. System Components	15%	9	Comprehension Application Problem Solving
7. PV System Sizing Principles	10%	6	Application Problem Solving Design
8. PV System Electrical Design	15%	9	Application Problem Solving Design
9. PV System Mechanical Design	10%	6	Application Problem Solving Design
10. Performance Analysis, Maintenance and Troubleshooting	10%	6	Analysis Problem Solving
<b>Totals</b>	<b>100%</b>	<b>60</b>	

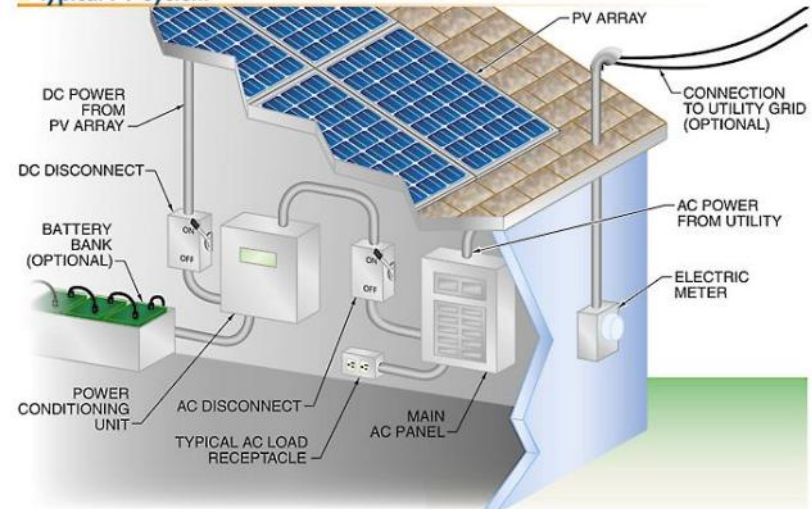
## NABCEP Learning Objectives

<b>3. Electrical Basics</b> <i>Suggested Percentage Time Allotment: 10%</i>	<b>Learning Priority</b>
3.1 Understand the meaning of basic electrical parameters including electrical charge, current, voltage, power and resistance, and relate these parameters to their hydraulic analogies (volume, flow, pressure, hydraulic power and friction).	Important
3.2 Explain the difference between electrical power (rate of work performed) and energy (total work performed).	Important
3.3 Describe the function and purpose of common electrical system components, including conductors, conduits/raceways and enclosures, overcurrent devices, diodes and rectifiers, switchgear, transformers, terminals and connectors, grounding equipment, resistors, inductors, capacitors, etc.	Useful
3.4 Identify basic electrical test equipment and its purpose, including voltmeters, ammeters, ohmmeters and watt-hour meters.	Useful
3.5 Demonstrate the ability to apply Ohm's Law in analyzing simple electrical circuits, and to calculate voltage, current, resistance or power given any other two parameters.	Important
3.6 Understand the fundamentals of electric utility system operations, including generation, transmission, distribution and typical electrical service supplies to buildings and facilities.	Important

## Centralized Electricity Distribution



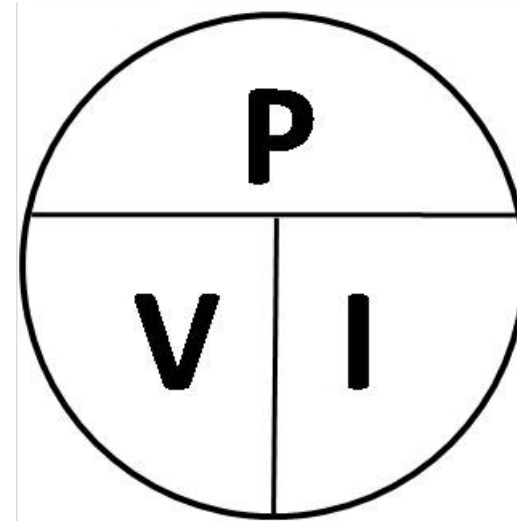
## Typical PV System



<u>Units</u>	Measure	Concept
• A		
• V		
• $\Omega$		
• W		
• KW		
• KWH		
• KVA		
• PF		
• HP		

<u>Units</u>	<u>Measure</u>	<u>Concept</u>
• A	Current	Electrical flow rate
• V	Voltage	Electrical pressure
• $\Omega$	Resistance	Electrical friction
• W	Electrical Power	Rate energy used/created
• KW	x 1000	Common convention
• KWH	Energy (useful)	Work available/performed
• KVA	Apparent Power	Real + reactive power
• PF	Power factor	KW/KVA
• HP	Mechanical Power	746 Watts

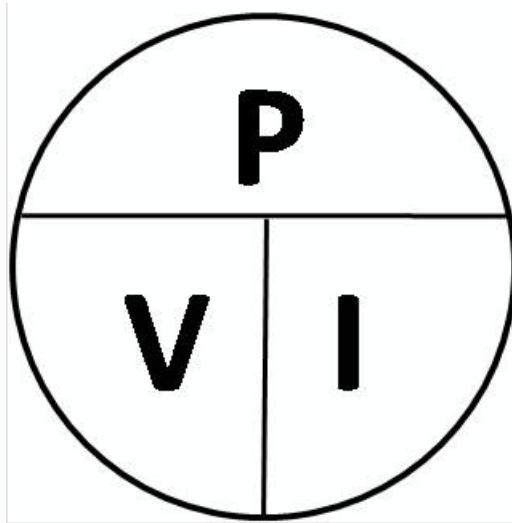
## Watt's Law



1. A toaster draws 7.5A. What is the power consumption of the toaster? (in the USA)
2. What is the amperage through a 100W light bulb? (n the USA)
3. A laptop computer operates with 65W and 3.25A. What is the DC voltage required?

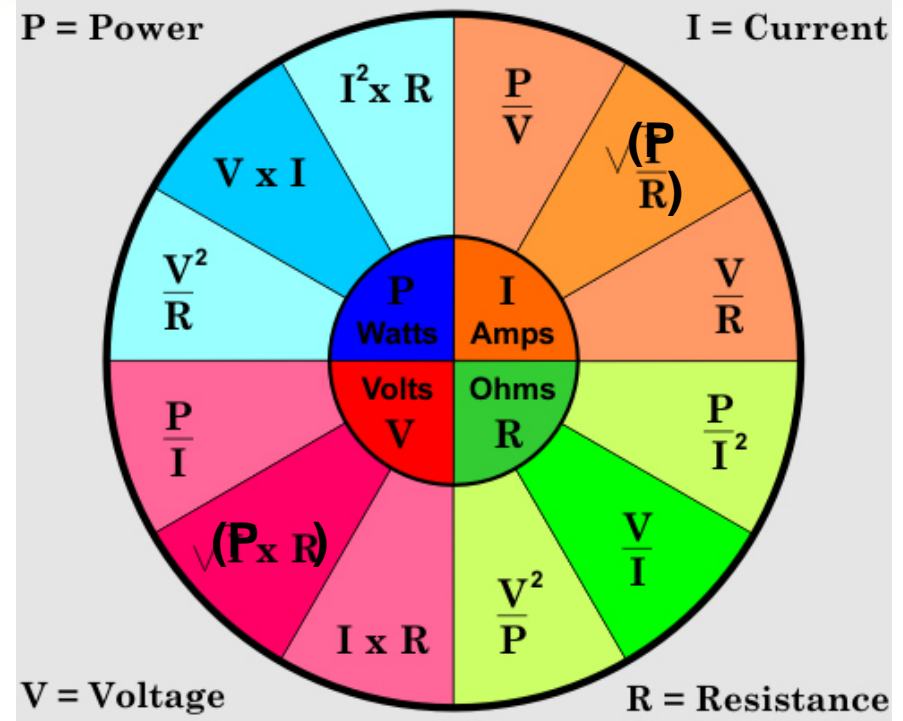
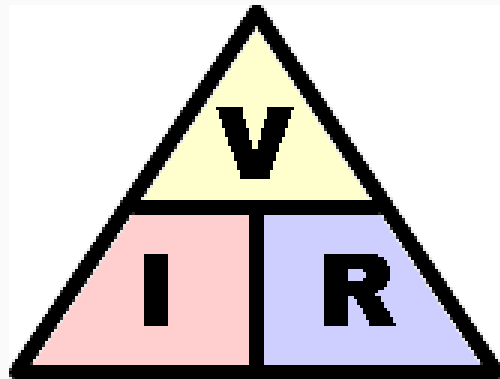


## Watt's Law .... Time and \$\$

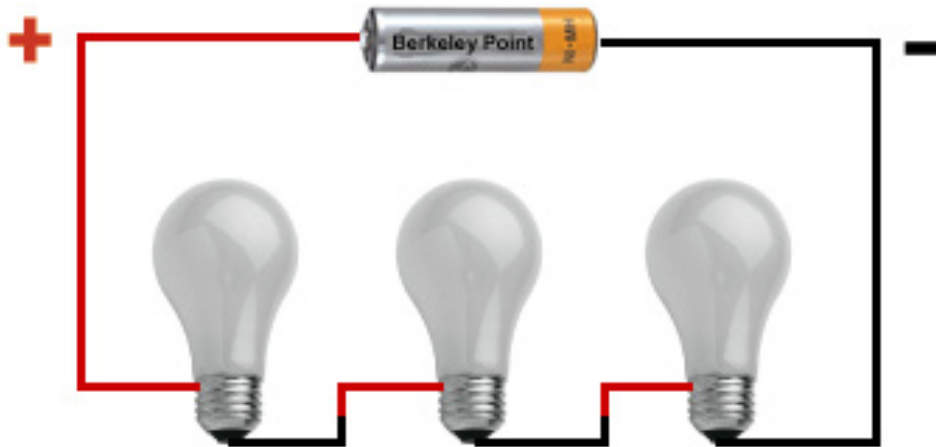


1. A 75W light is on a timer and comes on @ 8pm and goes off @ 7 am. How many watt hours does the light use per day? per 30 day month? per year?
2. If the power to operate the light costs \$0.15 per kWh, how much will it cost per day? Per month? Per year?

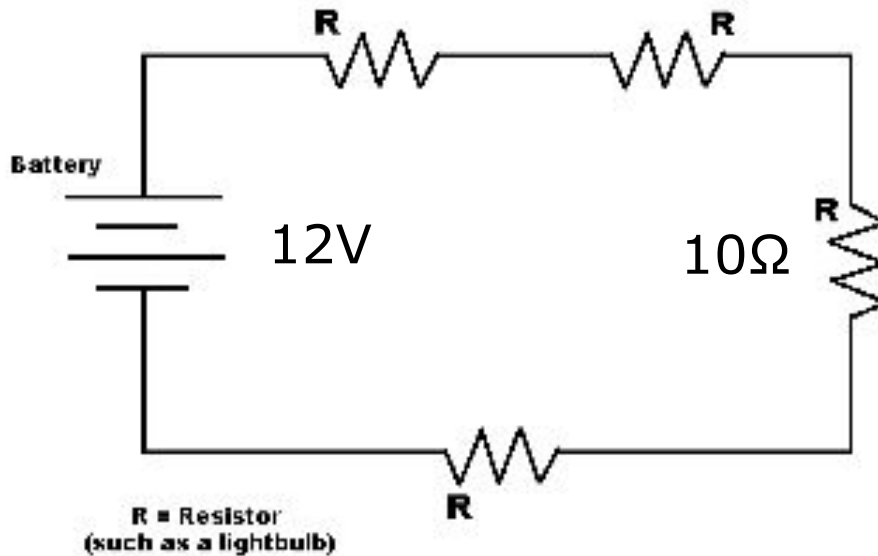
# Ohm's Law



1. A resistance of 30  $\Omega$  is placed across a 9V battery. What is the current flowing through the battery?
2. What is the overall resistance of a portable CD player if it is operated by a 6V battery and 0.75A flow through the circuit?
3. If there is 60V across a 120 $\Omega$  resistor. What is the power?



**Series Circuit**

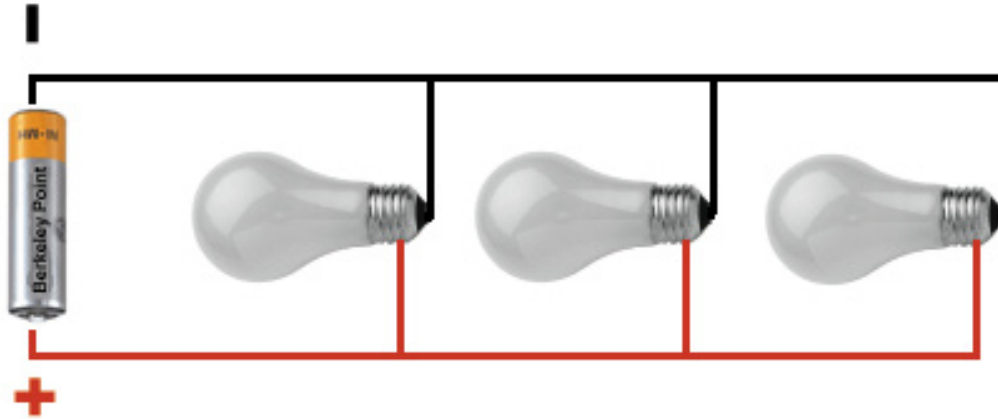


**Series:**  
**V increase**  
**A same**

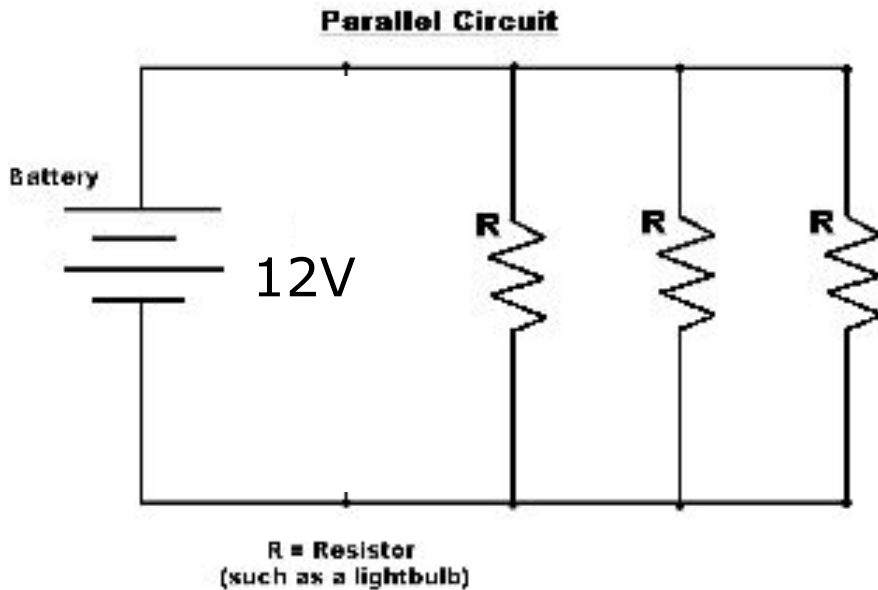
$$V_T = V_1 + V_2 + V_3 + \dots$$

$$I_1 = I_2 = I_3 = \text{Constant}$$

$$R_T = R_1 + R_2 + R_3 + \dots$$



**Parallel:**  
**V same**  
**A increase**



$$V_1 = V_2 = V_3 = \text{Constant}$$

$$I_T = I_1 + I_2 + I_3 + \dots$$

$$1/R_T = 1/R_1 + 1/R_2 + 1/R_3$$