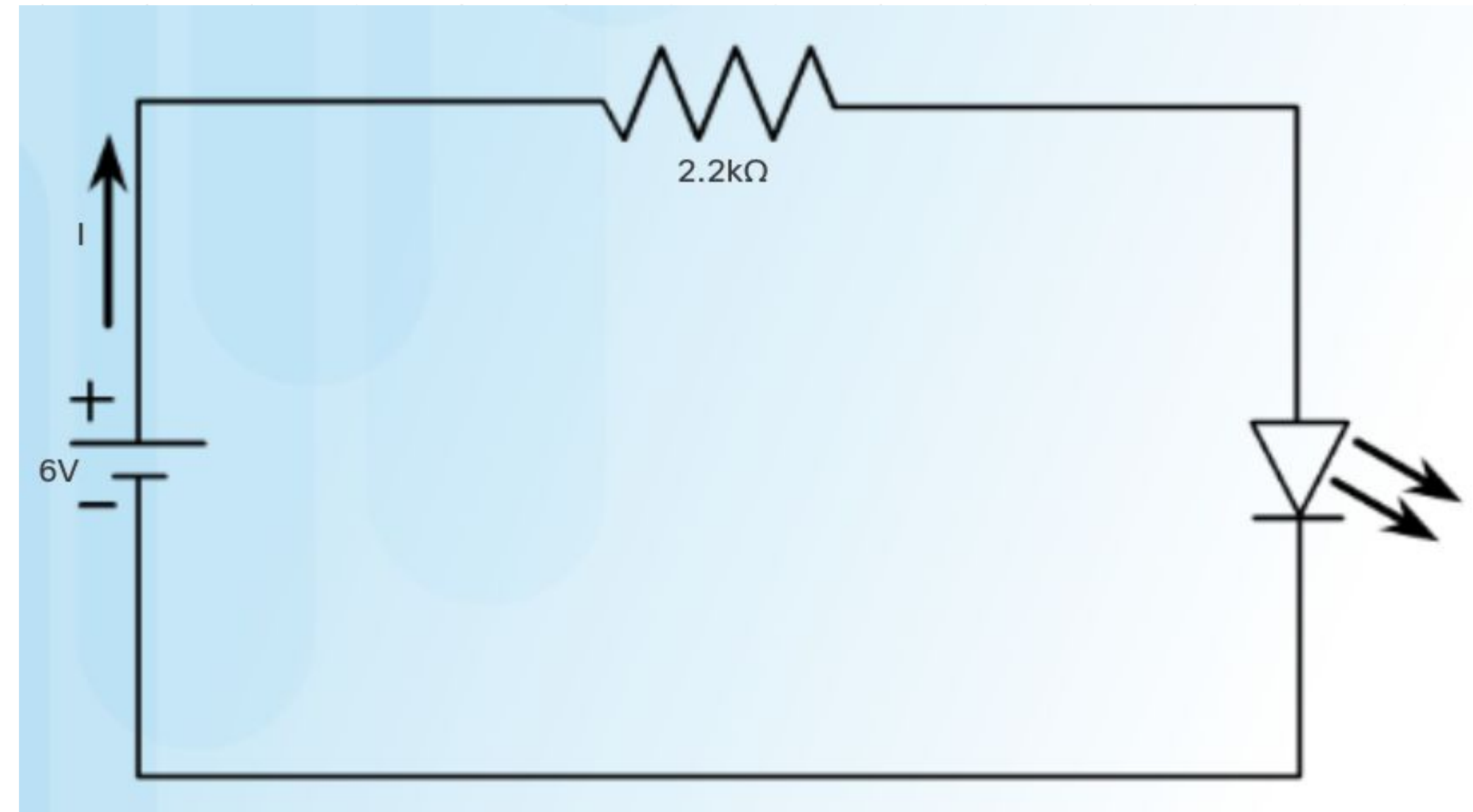Electronics

Basic Electrical Circuit

Circuit Diagram (schematic)

Conventional Current direction

- **Electronic devices** all share a fine level of control of **electrical energy**
  - This control happens through the **electronic circuit**

- To create an **electric current** the circuit also needs an **electrical energy** source
  - like a battery to start the flow of electricity

Circuits

- **Closed Circuit**
  - allows current to flow

- **Open Circuit**
  - has a break in the pathway which stops the current from flowing
  - can be created by placing an on/off switch along the circuit pathway

- **Short Circuit**
  - is usually not created by design
  - happens when unintended connection between 2 points bypass normal pathway

Short Circuit can Cause:

- too much current to overload components
  - Electrical current normally takes the path of least resistance

- overheating

- unsafe scenarios
  - melting wires
  - component failure
  - possibility of electrical fire

Electronic Components

Capacitor

Resistor

○ are usually made with **Leads**

○ **Leads** are protruding wires that

■ connect to the inside of the component

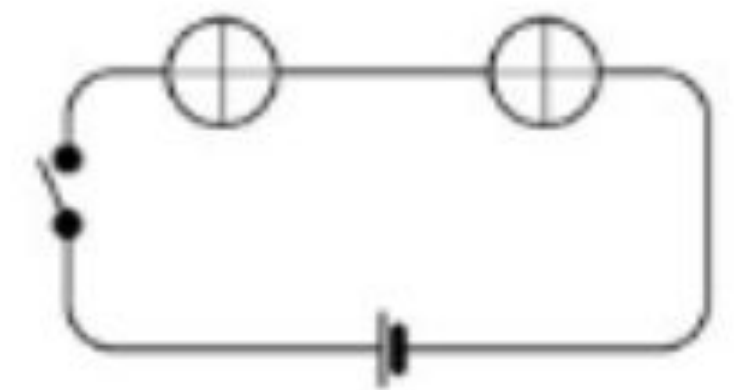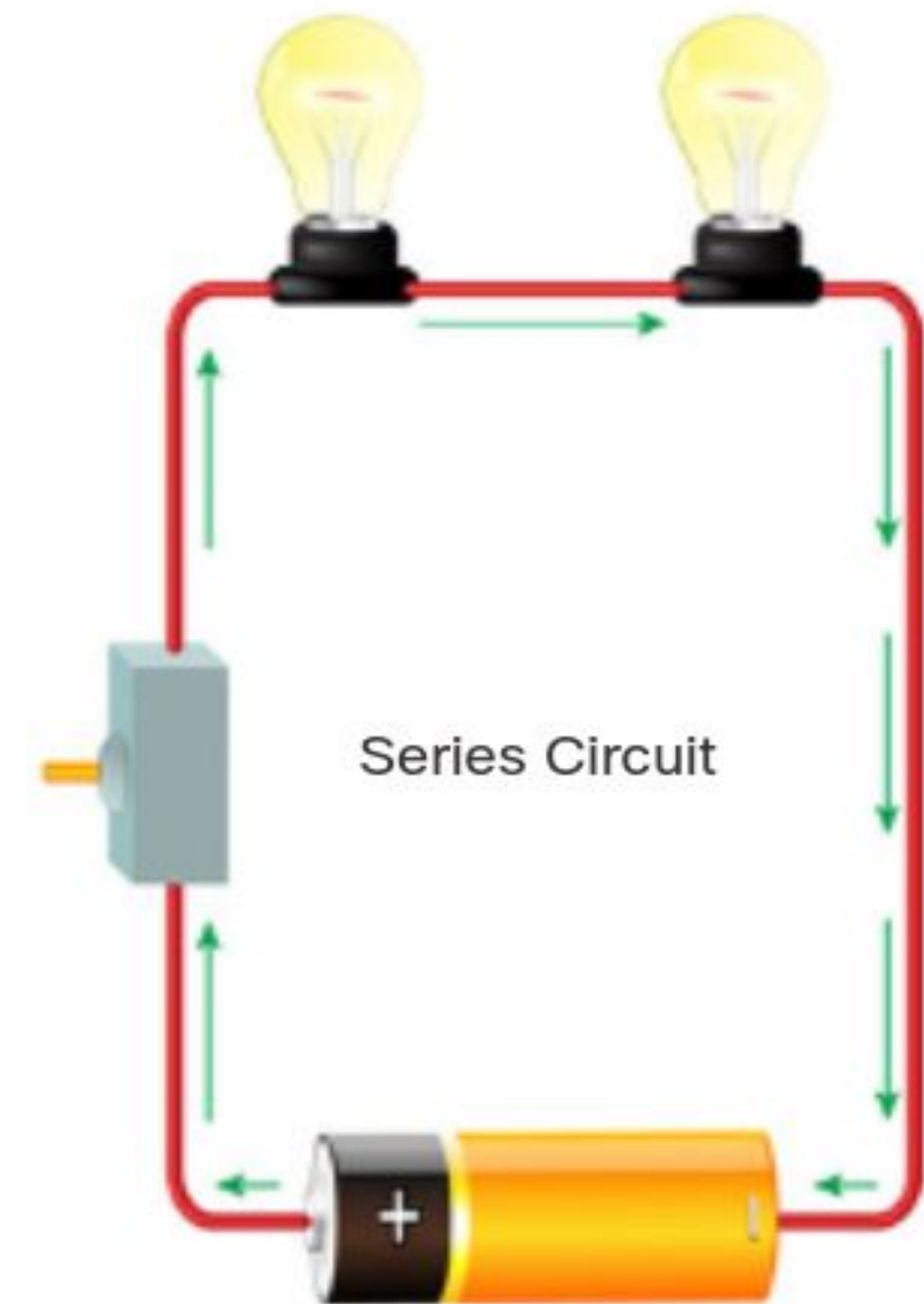■ provide the means to connect the component to other circuit elements
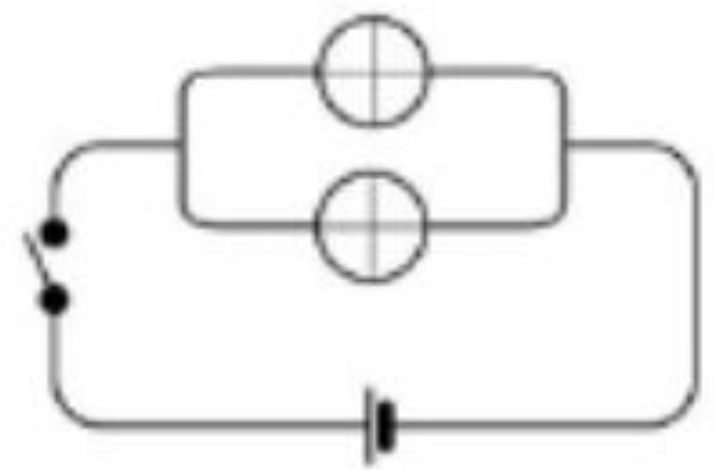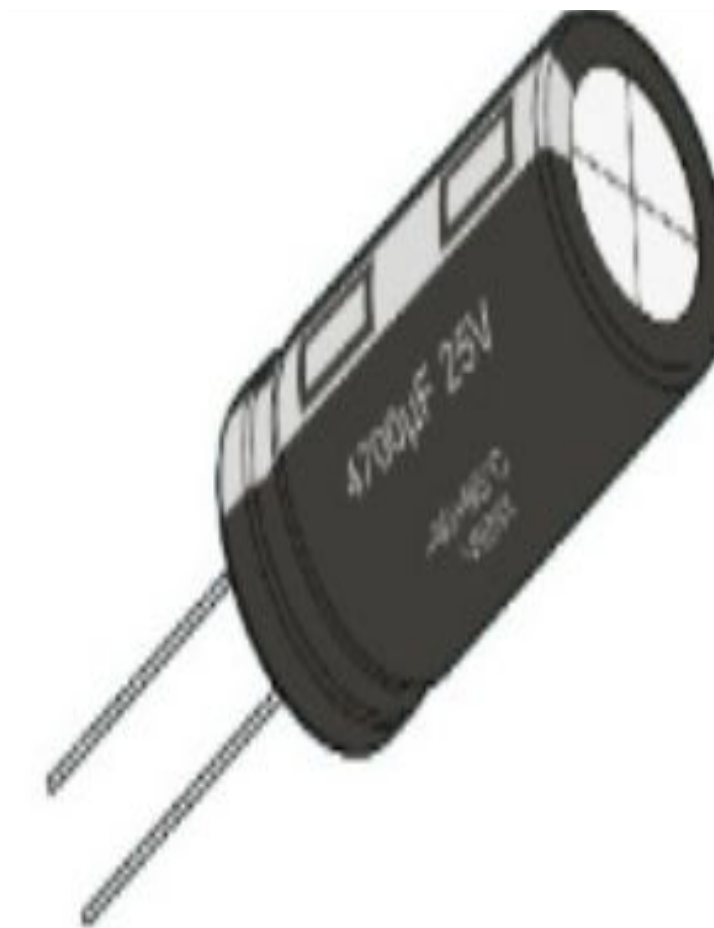
Series vs Parallel

Series Circuit

- ○ Components are interconnected one after another

- ○ **Current** travels through each component in a linear fashion

- ○ **Example:** string of decorative holiday lights
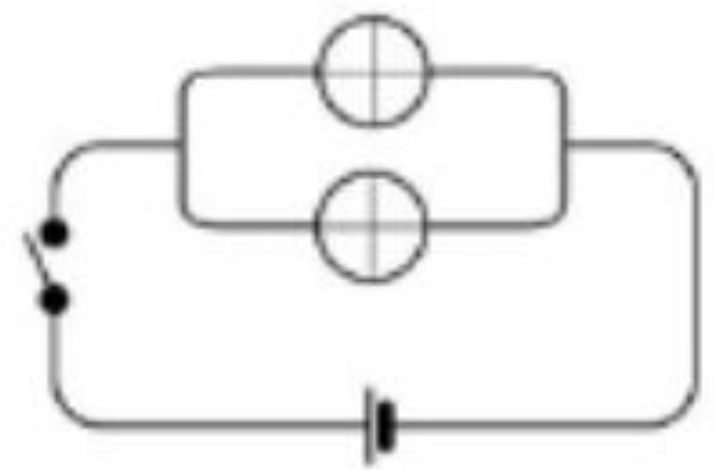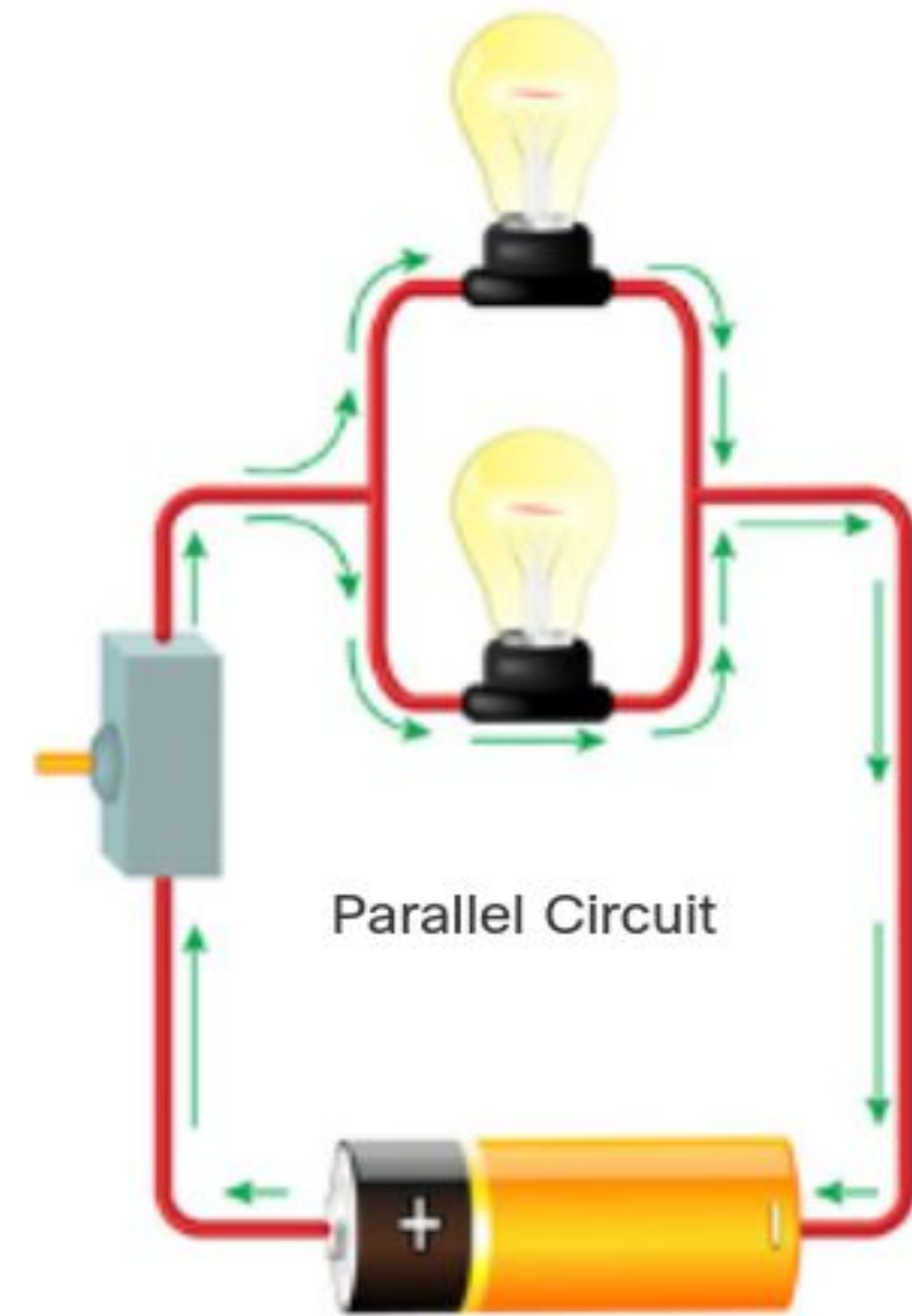
Series Circuit

Parallel Circuit (1/2)

○ Current splits at a **junction** which leads to parallel pathways

○ Components connected along each pathway

○ Solve the common problem of a holiday string of lights
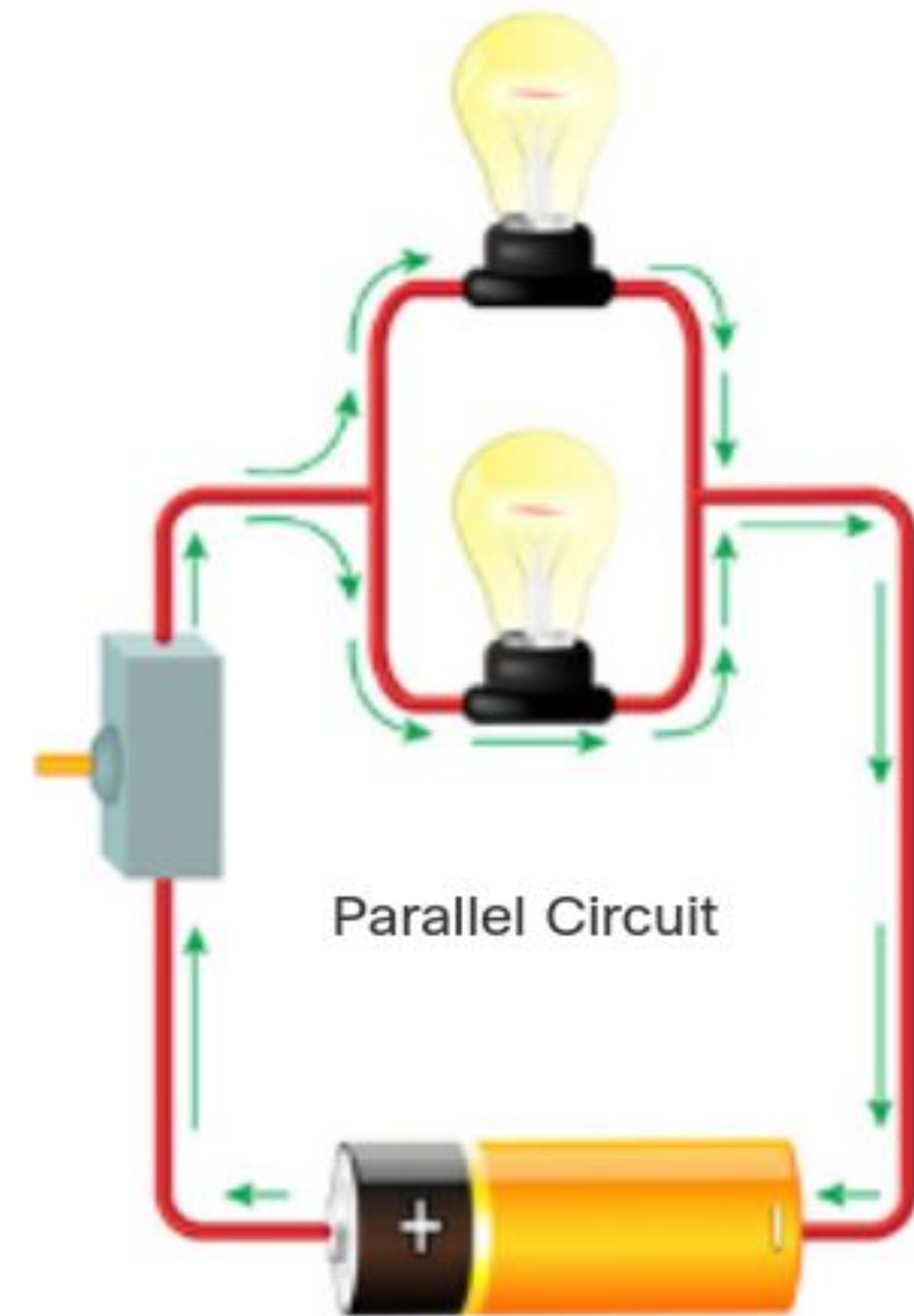
Parallel Circuit

Parallel Circuit (2/2)

○ You can power multiple components (like LEDs)

○ Each component gets its own supply of current

○ If any component were to fail, it would not stop the current from:

  ■ flowing to the other pathways

  ■ powering the other components

Parallel Circuit

Notes

Series or Parallel Circuits?

- decision depends on the application

Power Supply

- must be **powerful** enough to provide **power** to the entire circuit (series or parallel)

Electrical Device

- with switch creates circuit that can be closed or opened

Passive
vs Active

Passive Components

○ electronic components that **store energy** and create **linear circuits**

○ are incapable of controlling **electric current** by means of another ele

○ **cannot introduce energy** into a circuit

○ cannot rely on a source of power

■ except for what is available to them from the circuit they are connected to
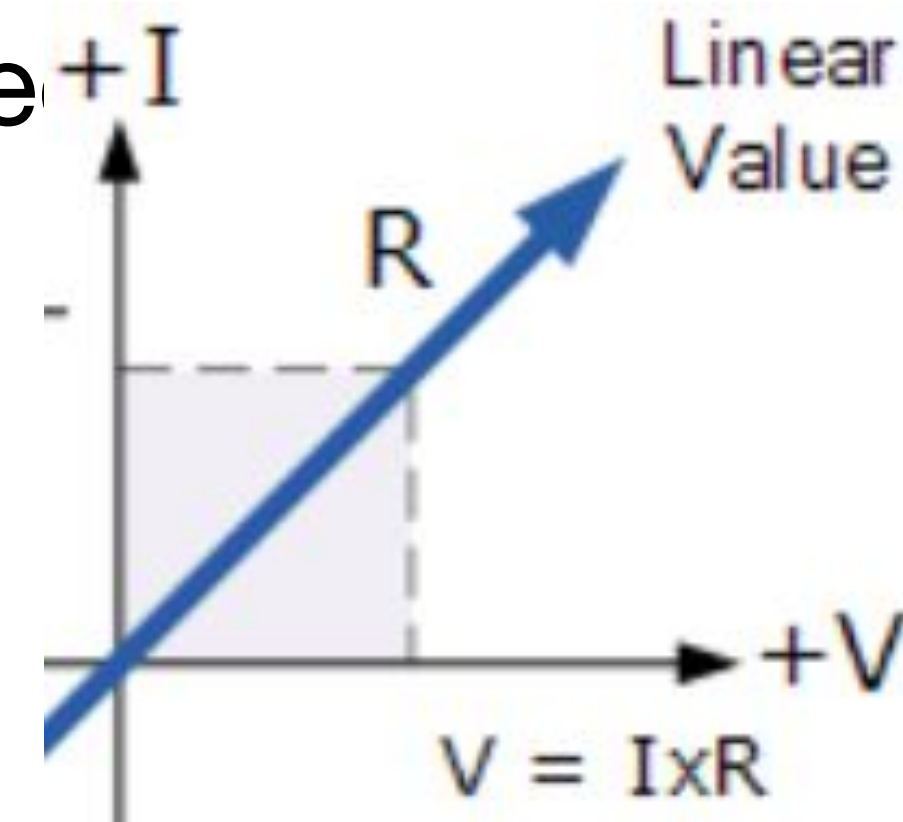
Passive Examples

Passive Component Examples

- ○ Resistors
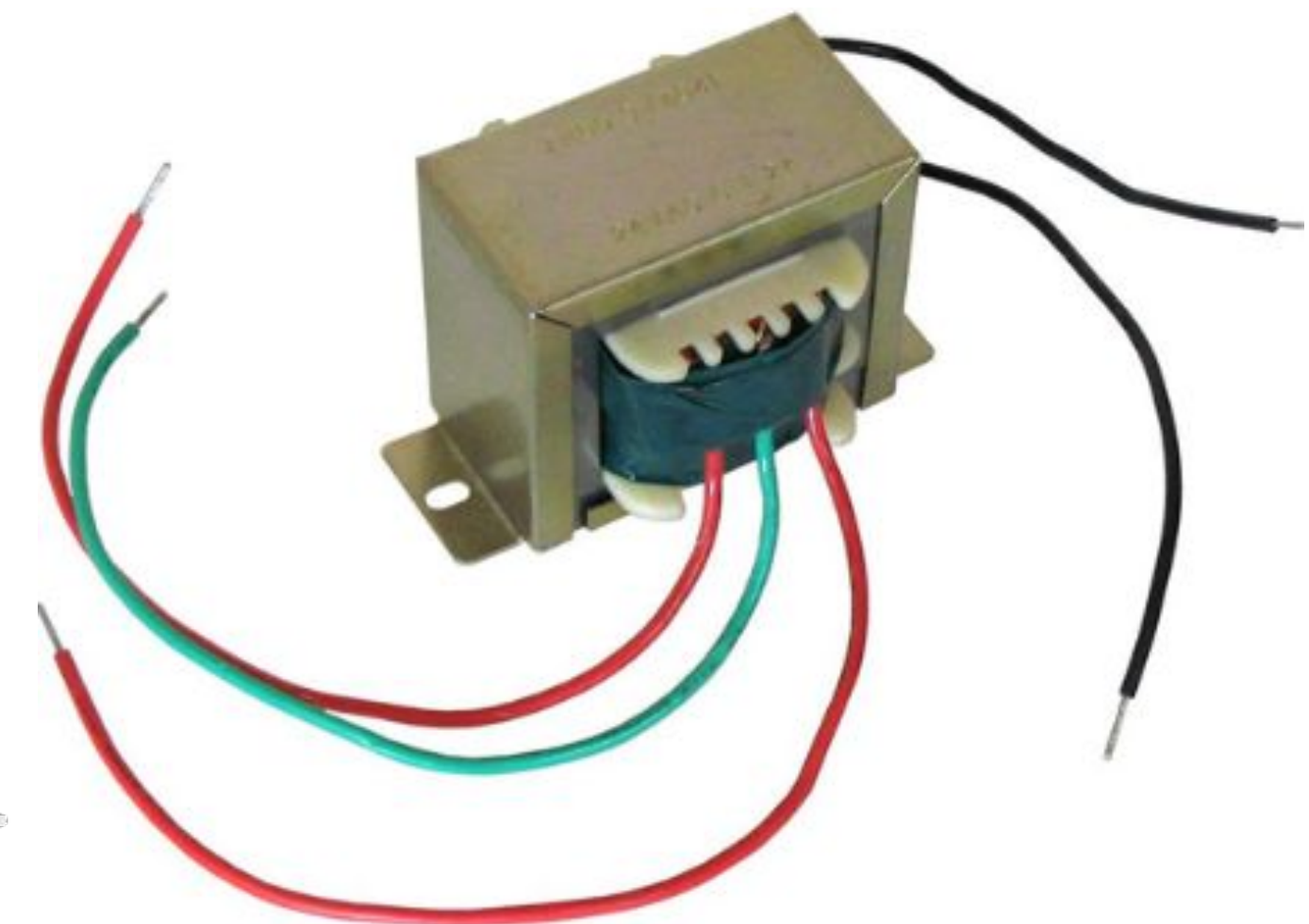- ○ Capacitors
- ○ Inductors
- ○ Transformers

Linear Circuits Examples

- ○ Amplifiers
- ○ Differentiators
- ○ Integrators
- ○ Linear Electronic Filters
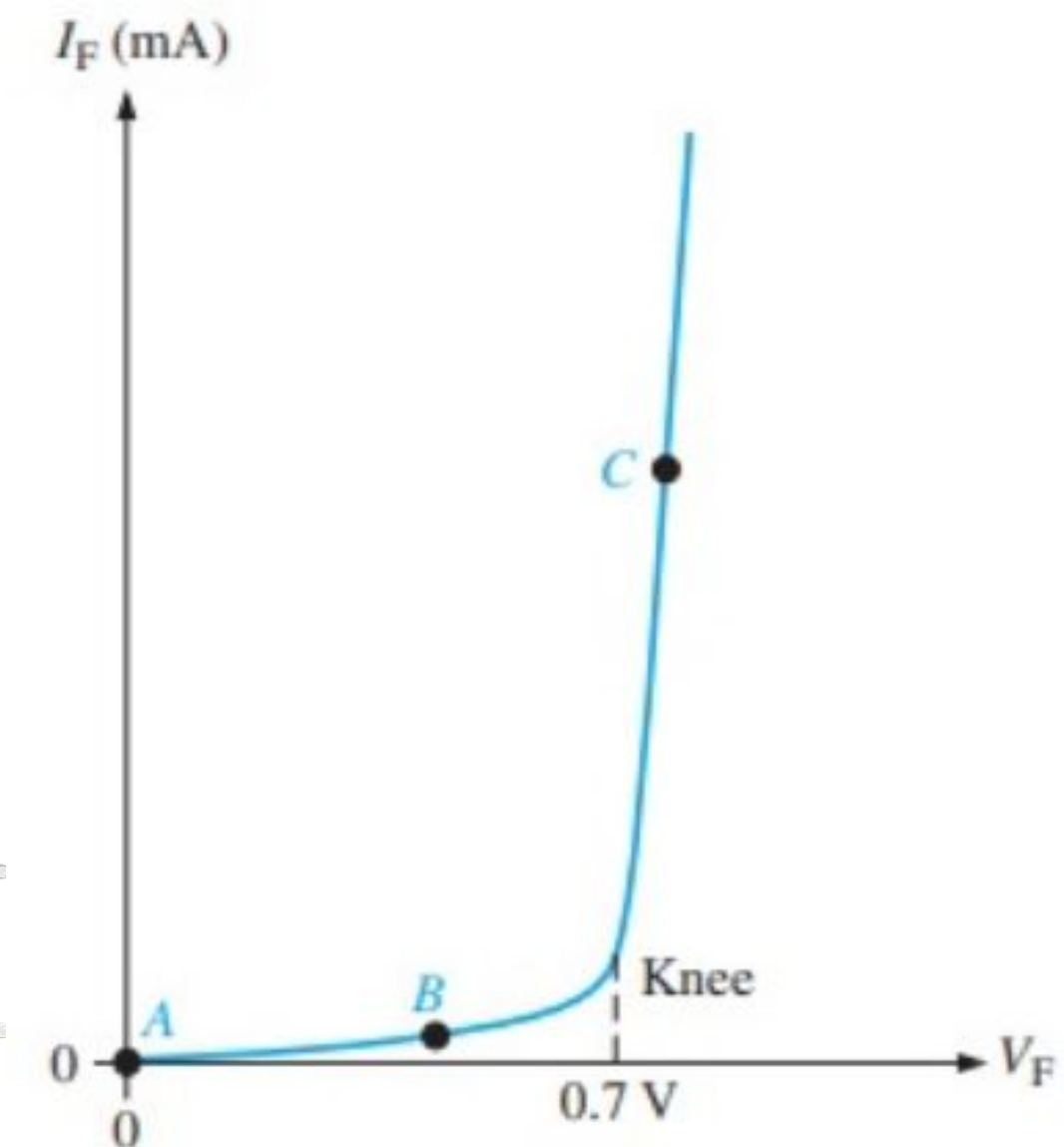
Resistor

Inductor

Capacitor

Linear Circuit

- has no **nonlinear components**

- in it, the values of the **electronic components** (resistors, capacitors, inductors ...)
  - do not change with the level of voltage or current in the circuit

- are important because
  - they can amplify and process electronic signals without distortion

- **Example** of electronic device that uses **linear circuits** is a sound system

Active Components

○ Electronic components that **produce energy** and create **nonlinear circuits**

○ can control **electric current** with an external source of energy

○ provide power gain or amplification that produces voltage signaling that is **discontinuous** (**nonlinear)**

Active Examples

Active Component Examples

- Diodes
- Transistors
- Silicon Controlled Rectifiers (SCRs)

Nonlinear Circuits Examples

- Mixers
- Modulators
- Digital Logic Circuits

Diode   Transistor   SCR

Circuits

- **Passive Circuit**
  - An electronic circuit consisting entirely of passive components

- **Active Circuit**
  - is a circuit with at least one **Active Component**

Analog vs Digital
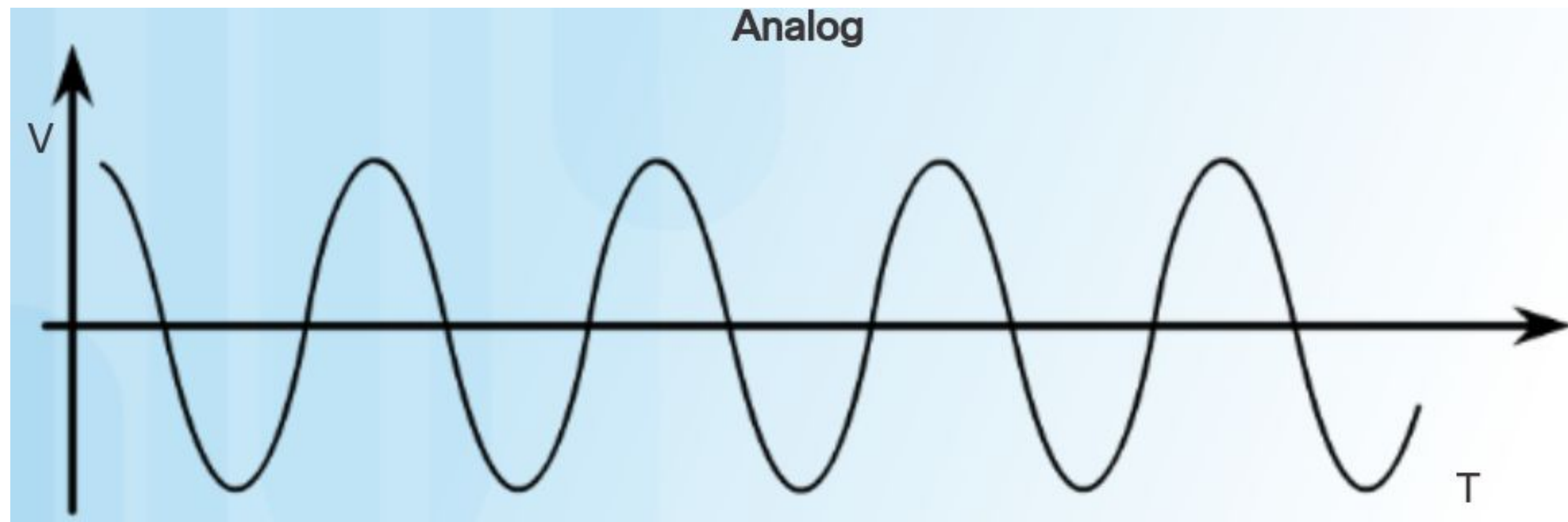
Circuits

- **Analog Circuits**
  - present a **contiguous signaling**
  - can assume any value between no power to full power

- **Digital Circuits**
  - present a **discrete signaling**
  - can assume either no power or full power (all or nothing) → no intermediate steps

Analog Circuits

○ in it, current or voltage may vary **continuously** with time to correspond to the information being represented

○ used in power management circuits, **sensors**, amplifiers, and filters

Digital Circuits (1/2)

- ○ have electric signals that
  - ■ take on two discrete **values** corresponding to the level of voltage

- ○ These **values** are binary and are represented as 1/0, on/off, or high/low
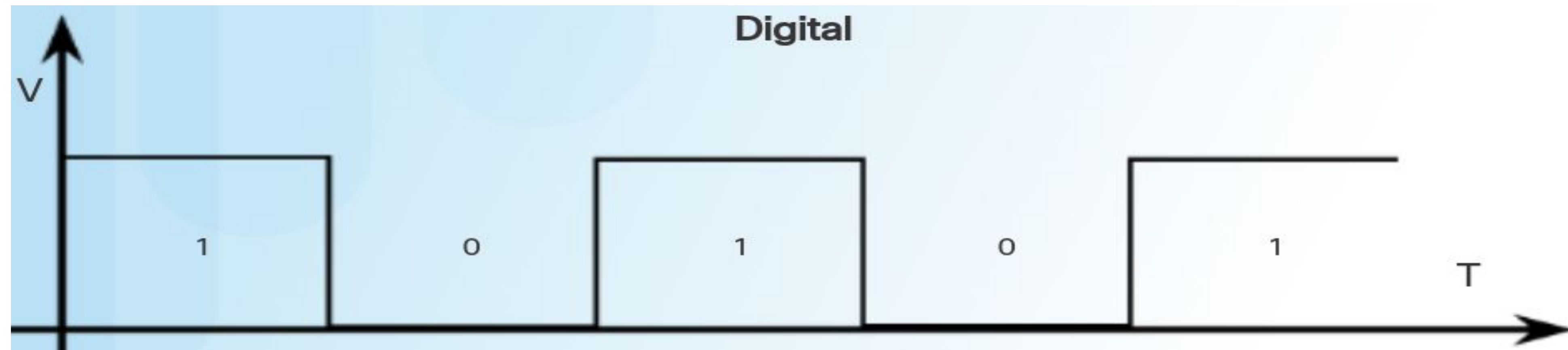
Digital Circuits (2/2)

○ In it, binary encoding is used:

■ one voltage represents a binary 1

■ another voltage represents a binary 0 (value near the ground potential or 0 volts)

○ can be designed to provide both logic and memory by:

■ interconnecting these binary signals,

■ enabling them to perform arbitrary computational functions
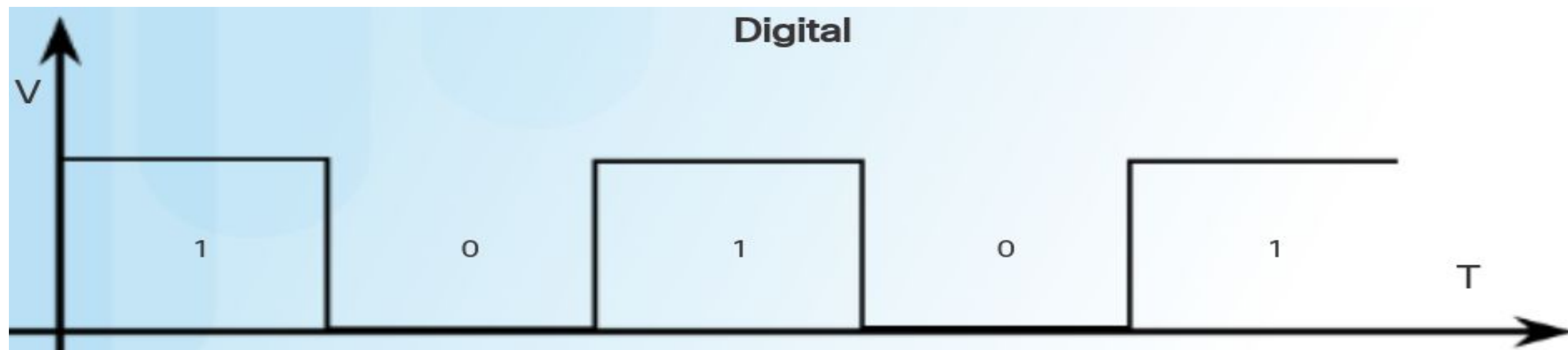
DC vs AC

Direct Current (DC)

○ Type of current in which the flow of electrons goes one way only

○ Produced by sources like batteries, power supplies, solar cells, or dynamos

○ Used to charge batteries and as power supply for electronic systems

○ can be obtained from **AC** by using a **Rectifier** to convert **AC** into **DC**

- **Rectifiers** force current to flow in one direction only

- **Rectifiers** are commonly found in an AC to DC power supply

Alternating Current (AC) (1/2)

- ○ its flow of electric current periodically reverses direction

- ○ is the form in which electric power is delivered to businesses and residences

- ○ its usual waveform of in most electric power circuits is sine wave
  - ■ Also, different waveforms are used like triangular or square waves
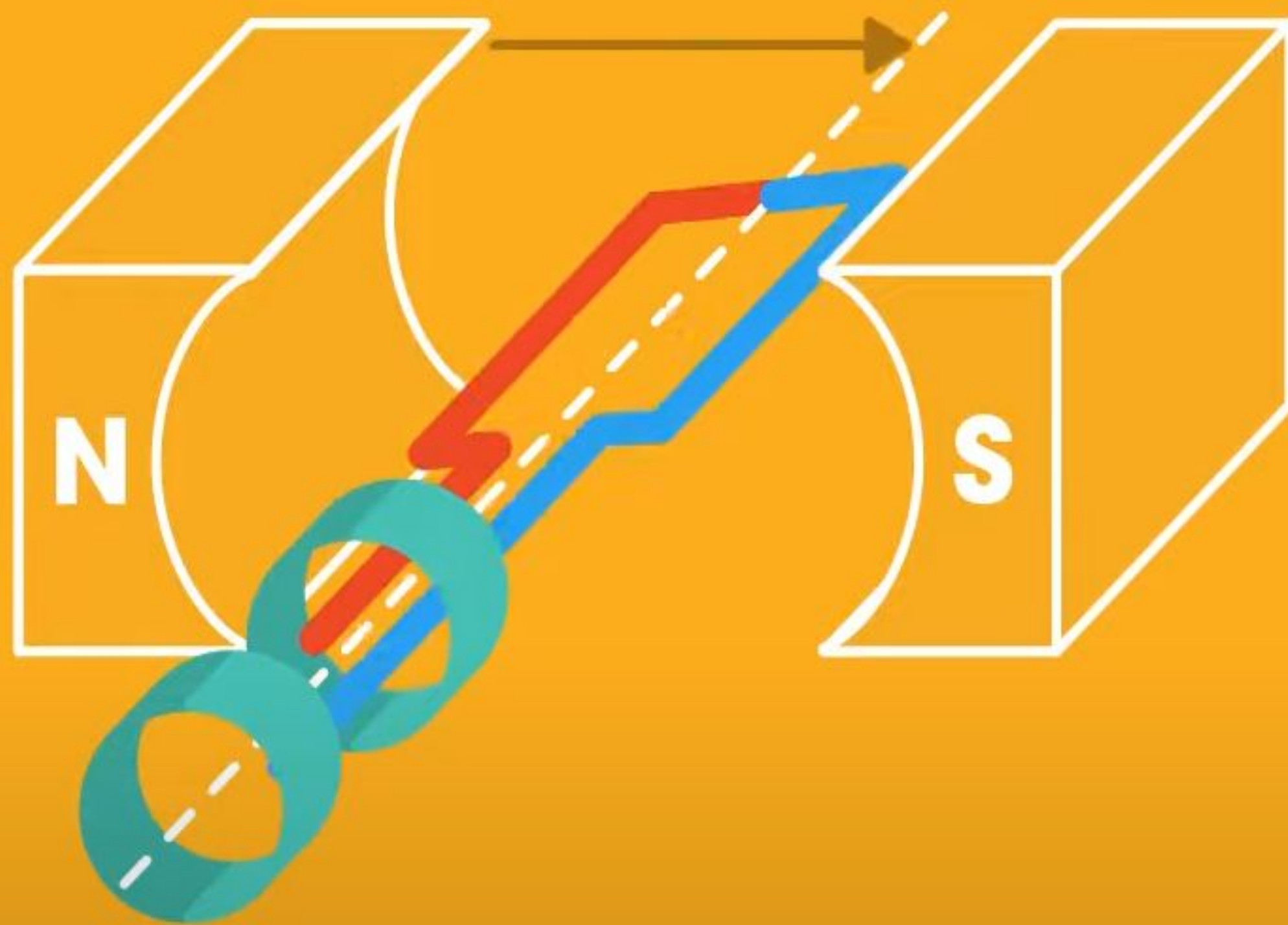
Alternating Current (AC) (2/2)
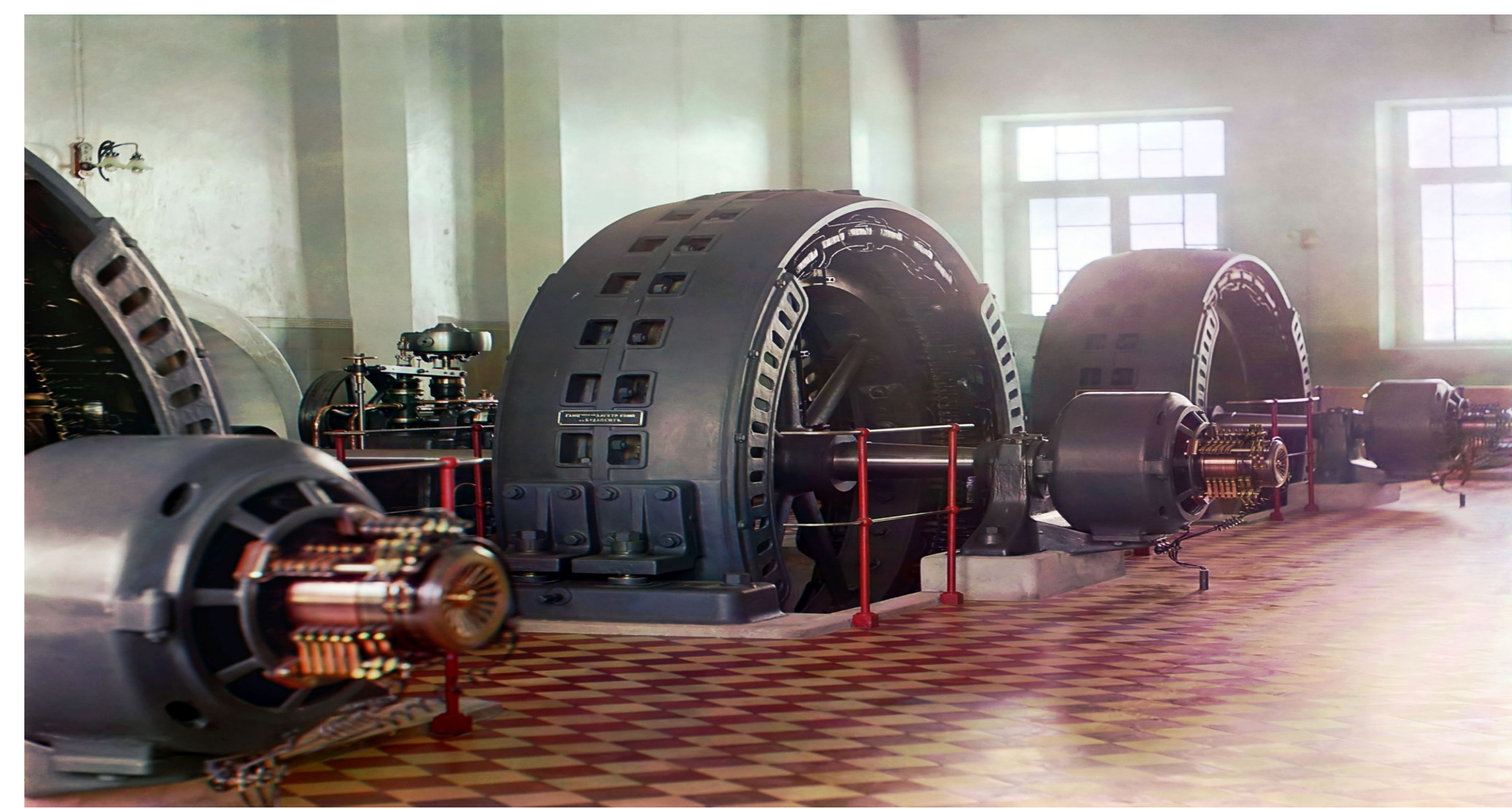
- ○ is produced in the electrical power plant by taking advantage of various forms of **mechanical energy** to move large scale **Alternators**
  - ■ **mechanical energy** like water flowing from a dam or the spin of a wind turbine
  - ■ **Alternators** then transform the mechanical energy into electricity

- ○ **DC** produced by a solar plant may be converted into **AC** with an **inverter** or a **motor-generator set**

Alternators vs Dynamos

Alternators vs Dynamos

Questions