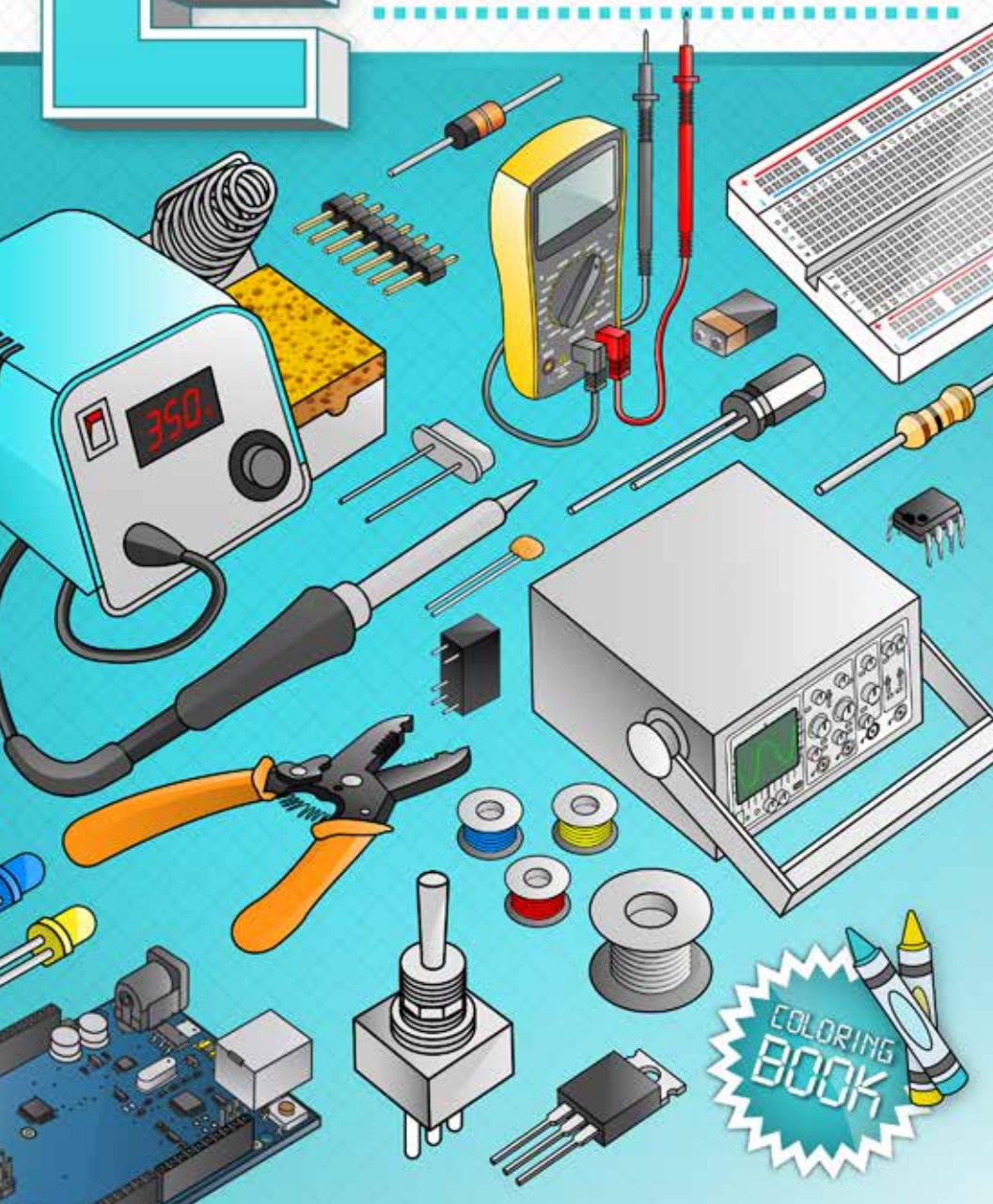


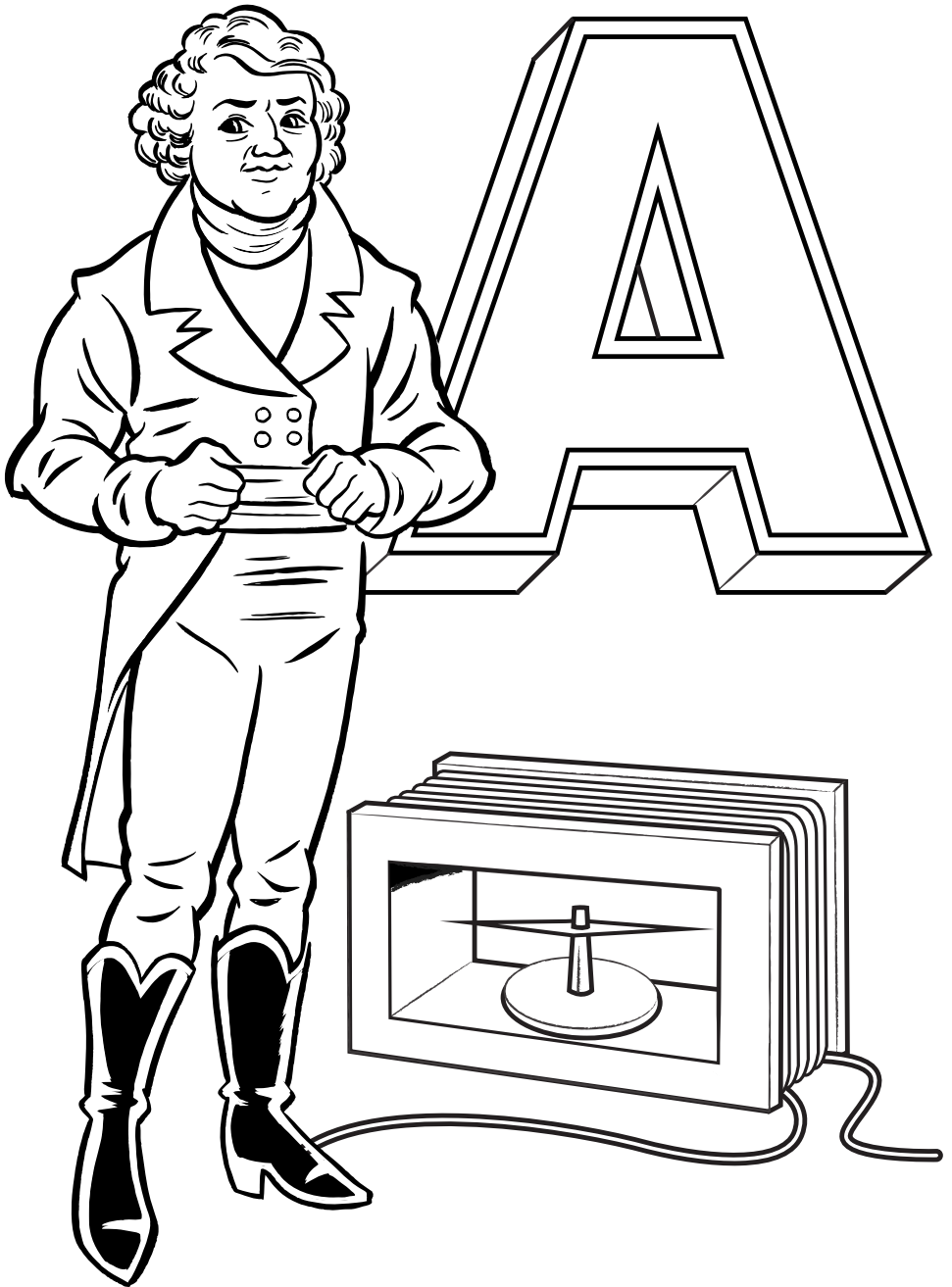
LadyAda's

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E

IS FOR ELECTRONICS.

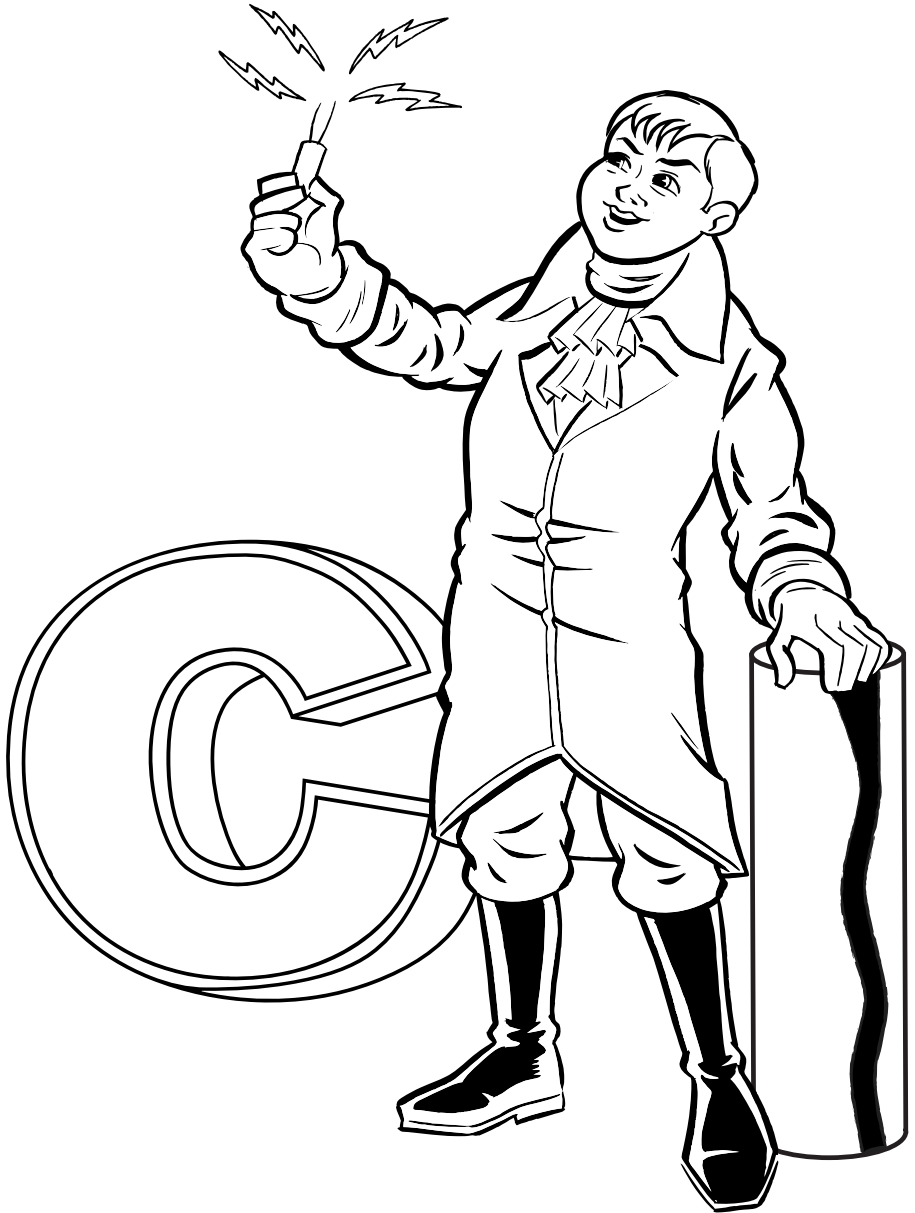




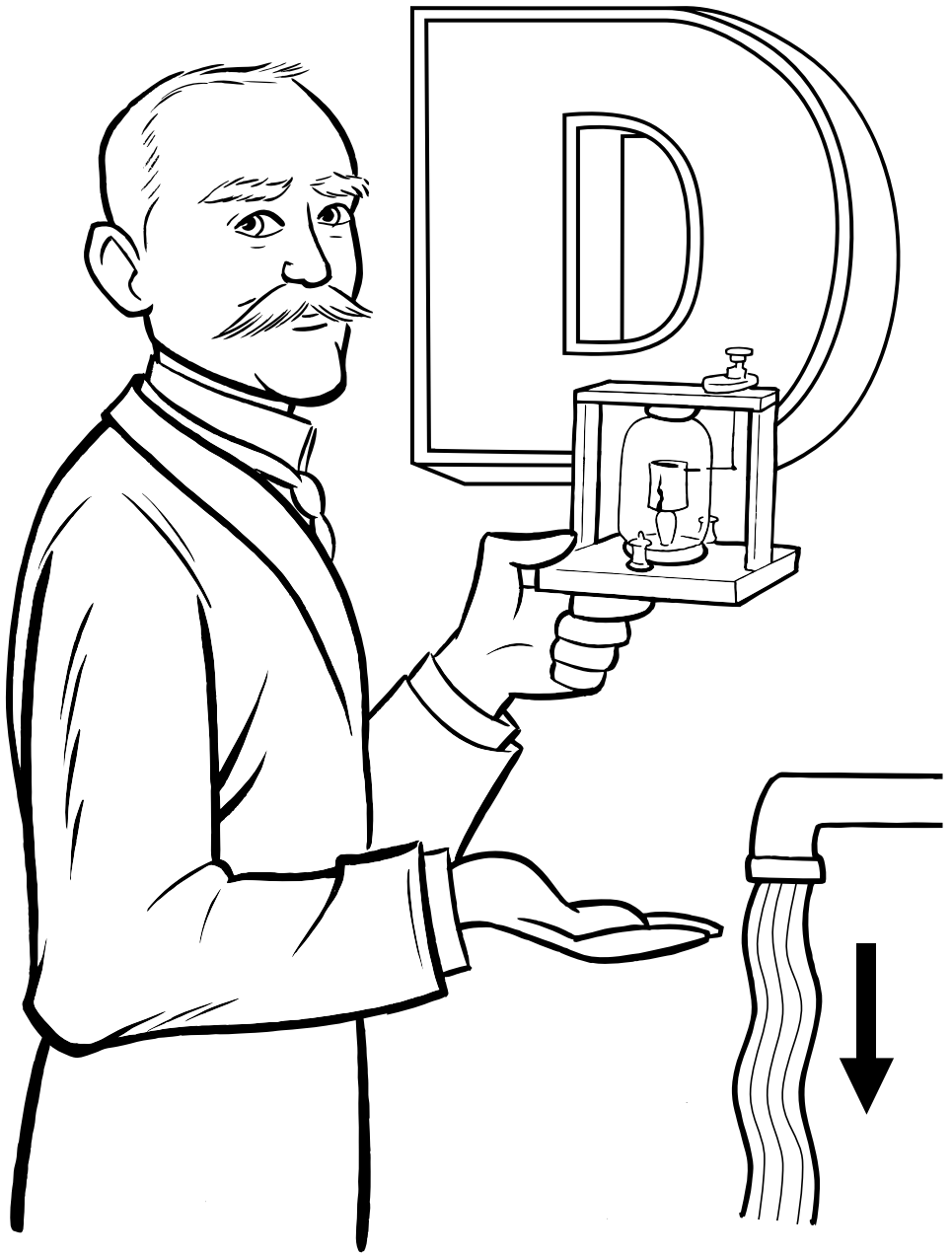
Ampere describes the number of electrons that flow through a circuit in one second. It is named after **Andre-Marie Ampere**, who was one of the first people to use math to describe electricity.



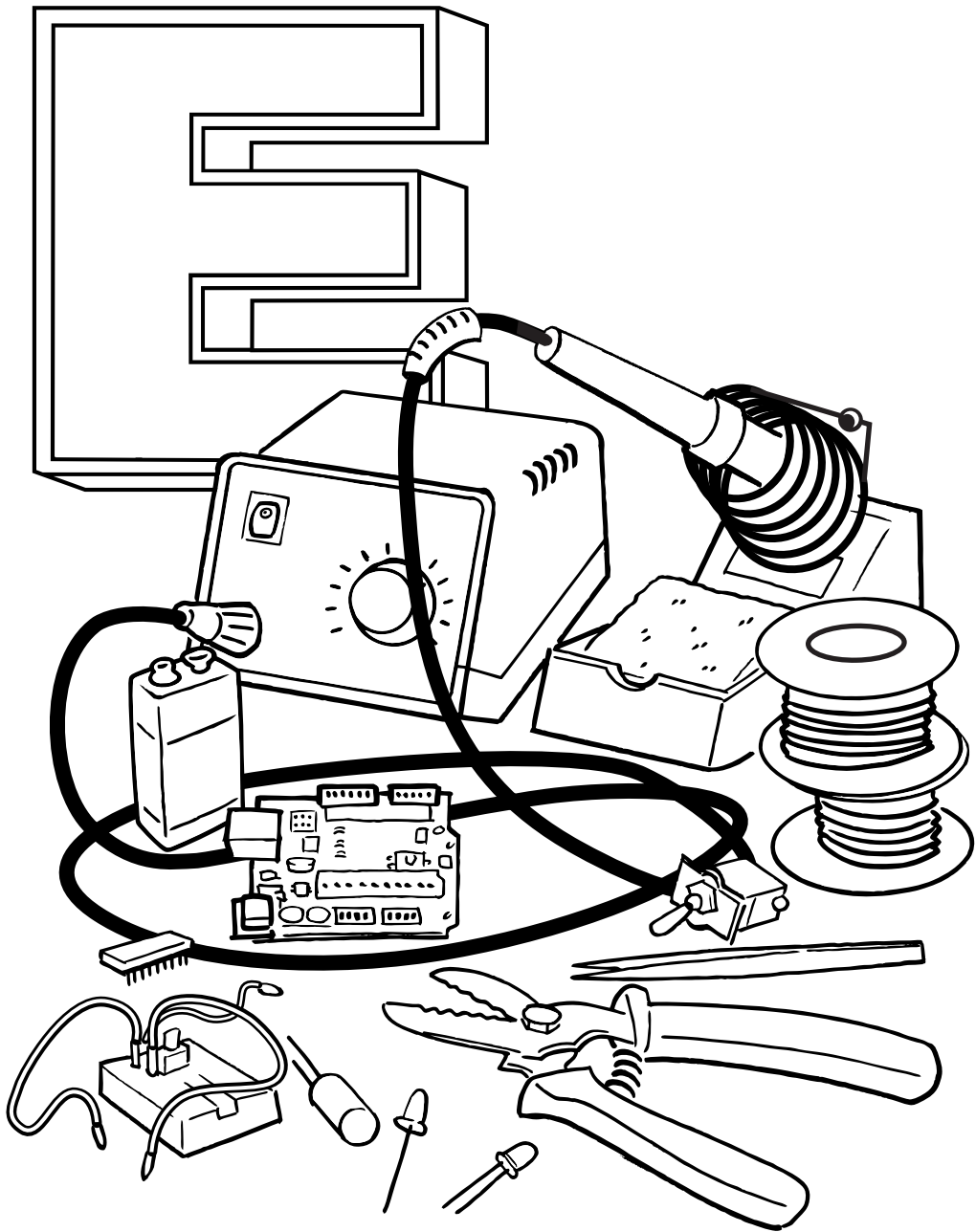
A **battery** stores electrons so that they can be used to power electronics. **Batteries** come in lots of fun shapes and sizes, so that they can be used with all kinds of different devices. A **breadboard** can be used to test out or practice building electronic circuits.



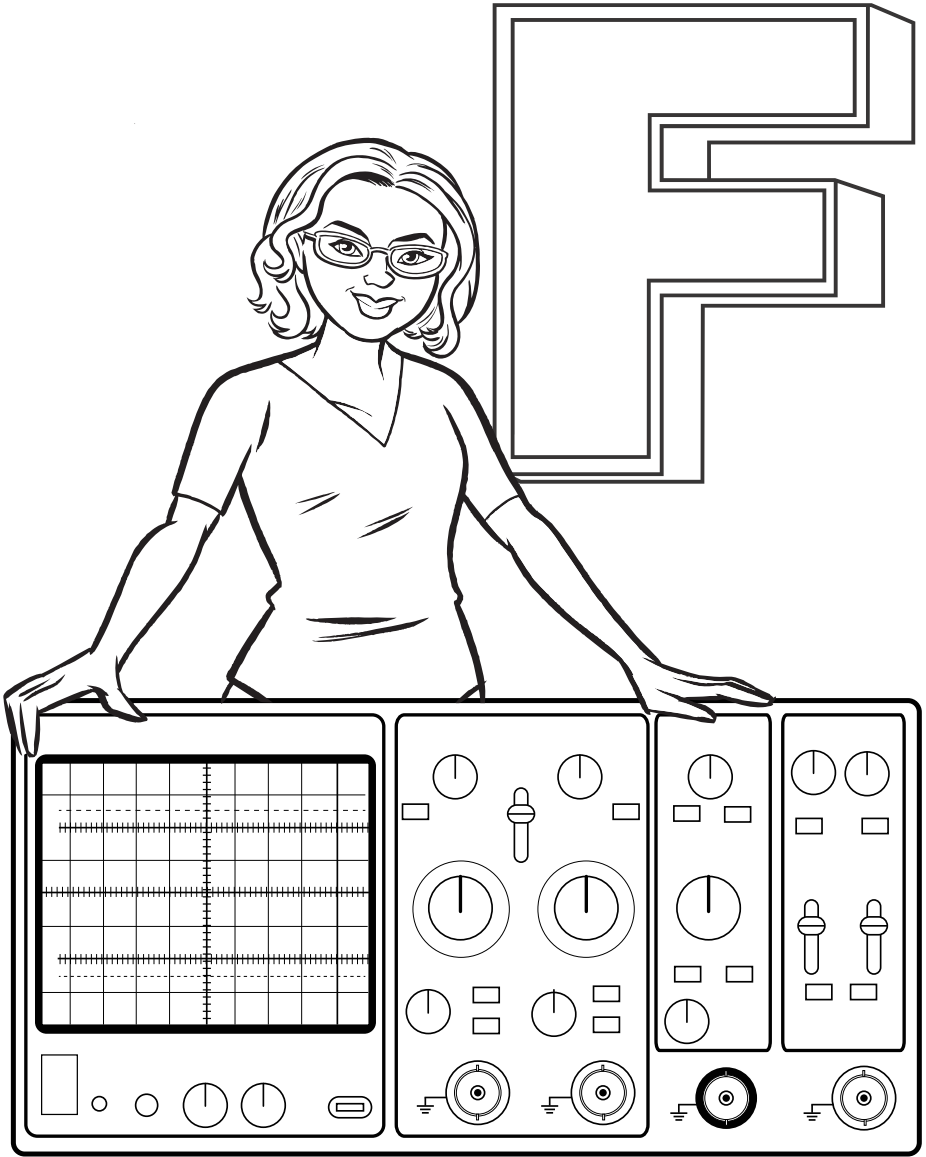
A **capacitor** stores electrons using an electric field. The **capacitor** has two separated plates, where electrons are held. A voltage placed across the **capacitor** makes the electrons want to move from one plate to the other, but a 'dielectric' between the plates is there to make sure that they don't. The electrons can be stored on the plates until they are needed to make a circuit. **Ewald Georg von Kleist** made one of the first capacitors.



A **diode** lets electrons flow in only one direction. It works like a switch: when current is flowing one way, the switch is on, but when current tries to flow the other way, the switch turns off. **Sir John Ambrose Fleming** is best known for inventing the **diode**, originally called the kenotron.



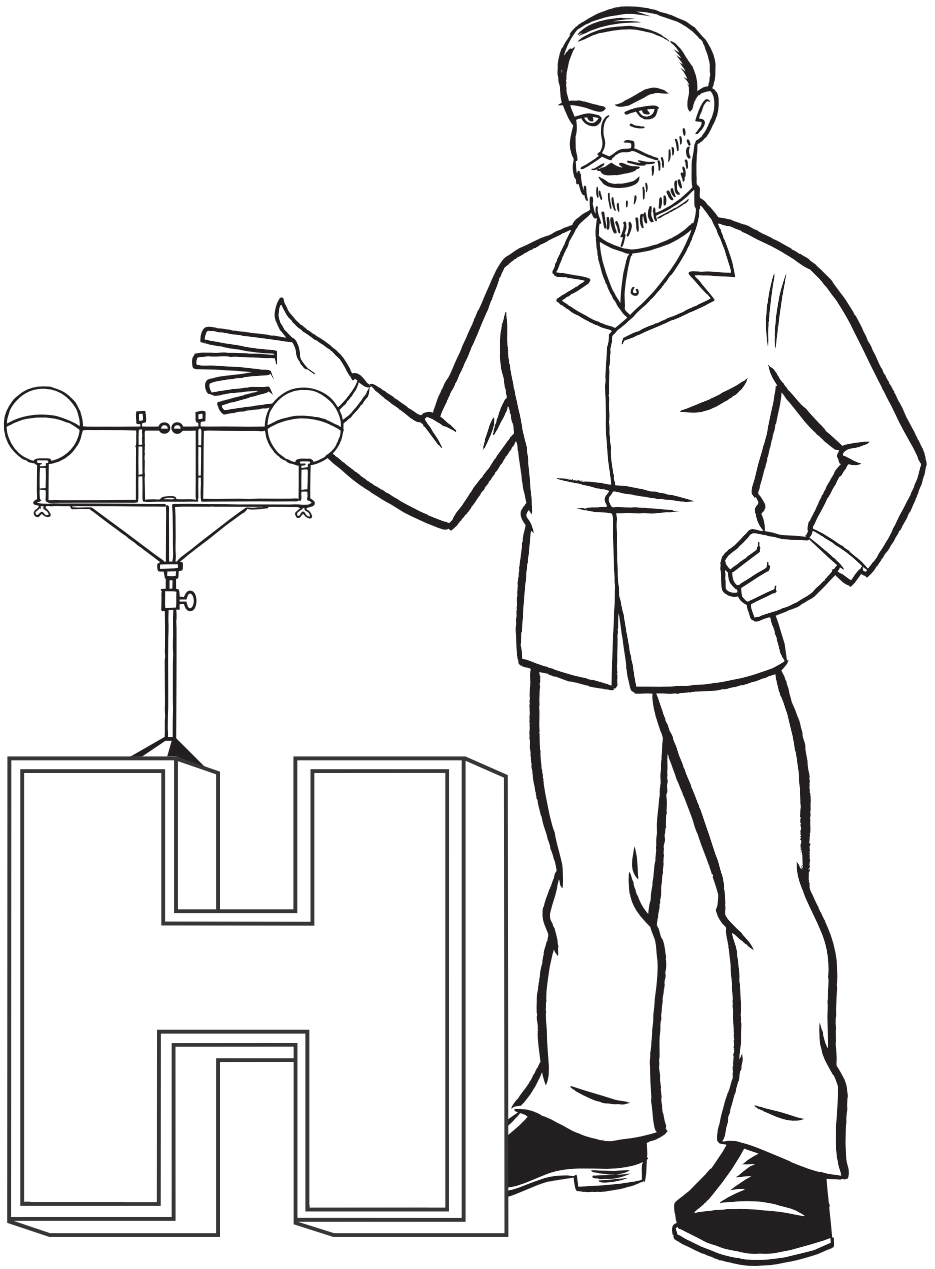
Electronic devices work by moving **electrons** around to light up video games and power cell phones. **Electrical engineers** like Ladyada design **electronics** using batteries, capacitors, diodes, LEDs, transistors, and integrated circuits. By combining all these parts in new and clever ways, **engineers** can make the wonderful new devices you use every day.



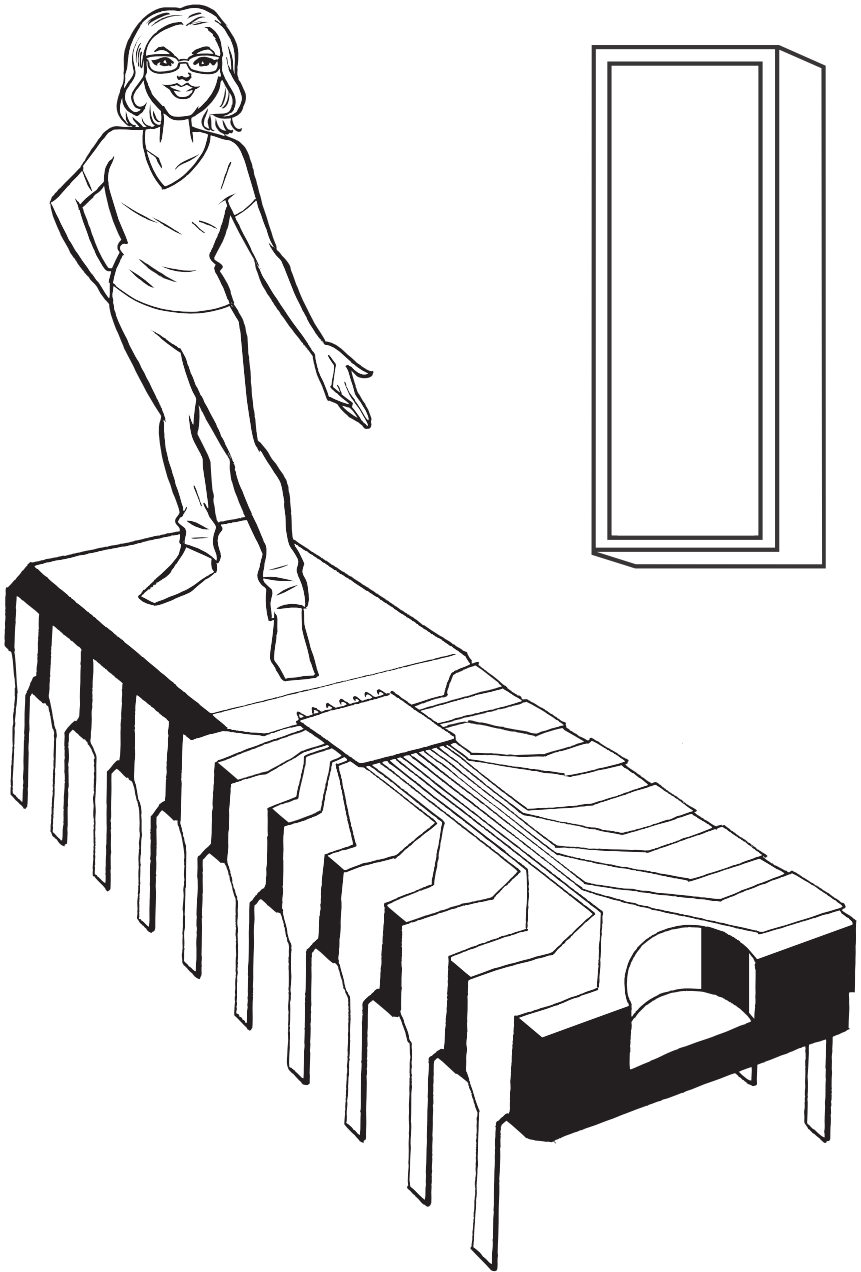
Frequency is the measurement of how often something happens. **Frequency** is measured in Hertz. If something happens once every second, it has a **frequency** of 1 Hertz. Likewise, something that happens 10 times every second has a **frequency** of 10 Hertz. Draw in your favorite wave!



Ground is the name for a special point in an electrical circuit that is used as a reference for making measurements. When you want to know how tall somebody is, you measure them from their feet (which are on the **ground**) to the top of their head. Voltages in circuits are measured the same way.



Hertz is a unit that describes how often something happens. An event that happens once every second has a frequency of 1 **Hertz**. **Hertz** is named after **Heinrich Hertz**, who first proved that electromagnetic waves exist.



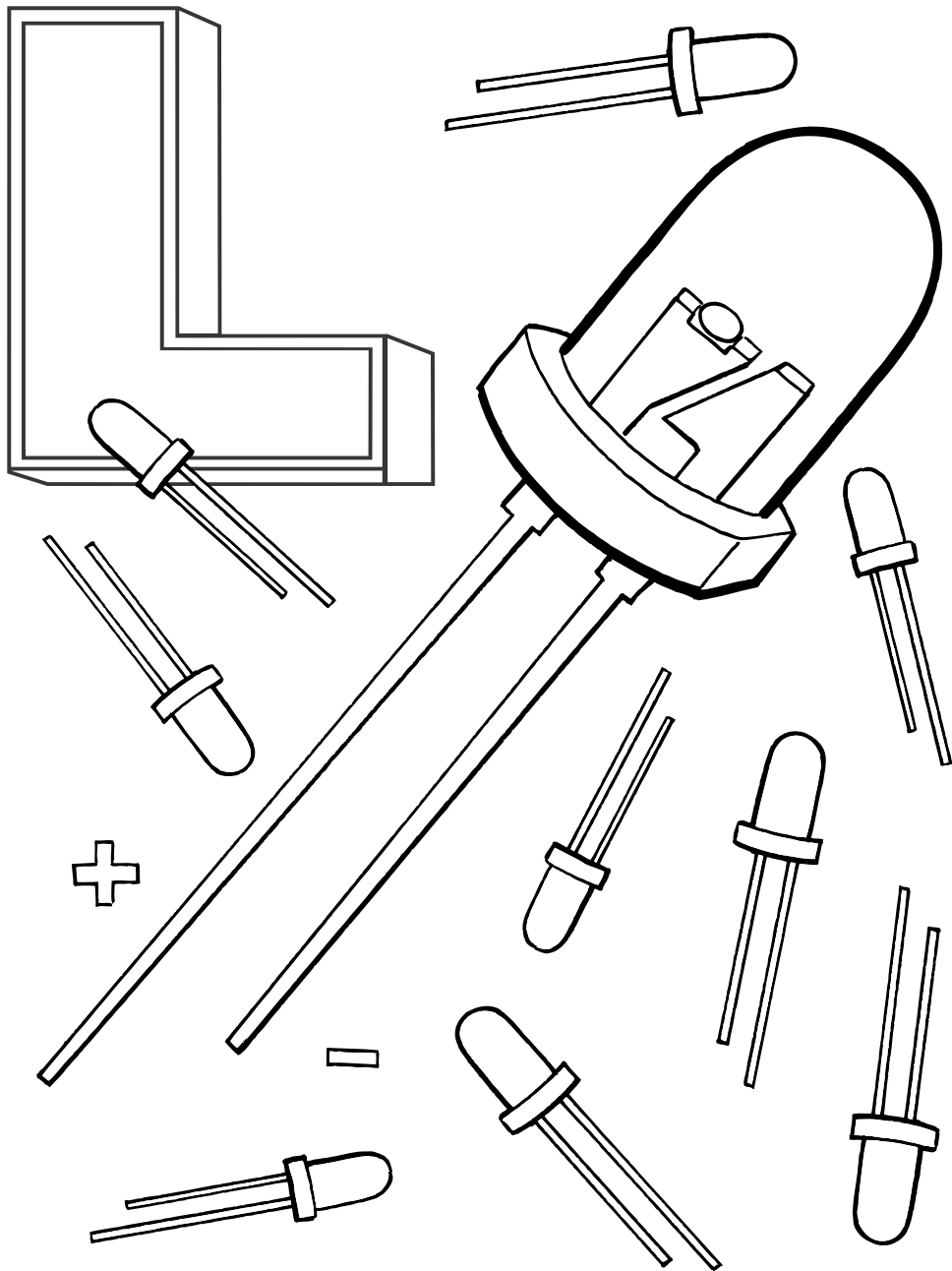
"**I**" is used as the symbol for electric current. We use "**I**" because current can also be thought of as the **intensity** of the flow of electrons through a circuit. "**I**" also stands for **integrated circuit**, usually called an "**IC**" or "chip".



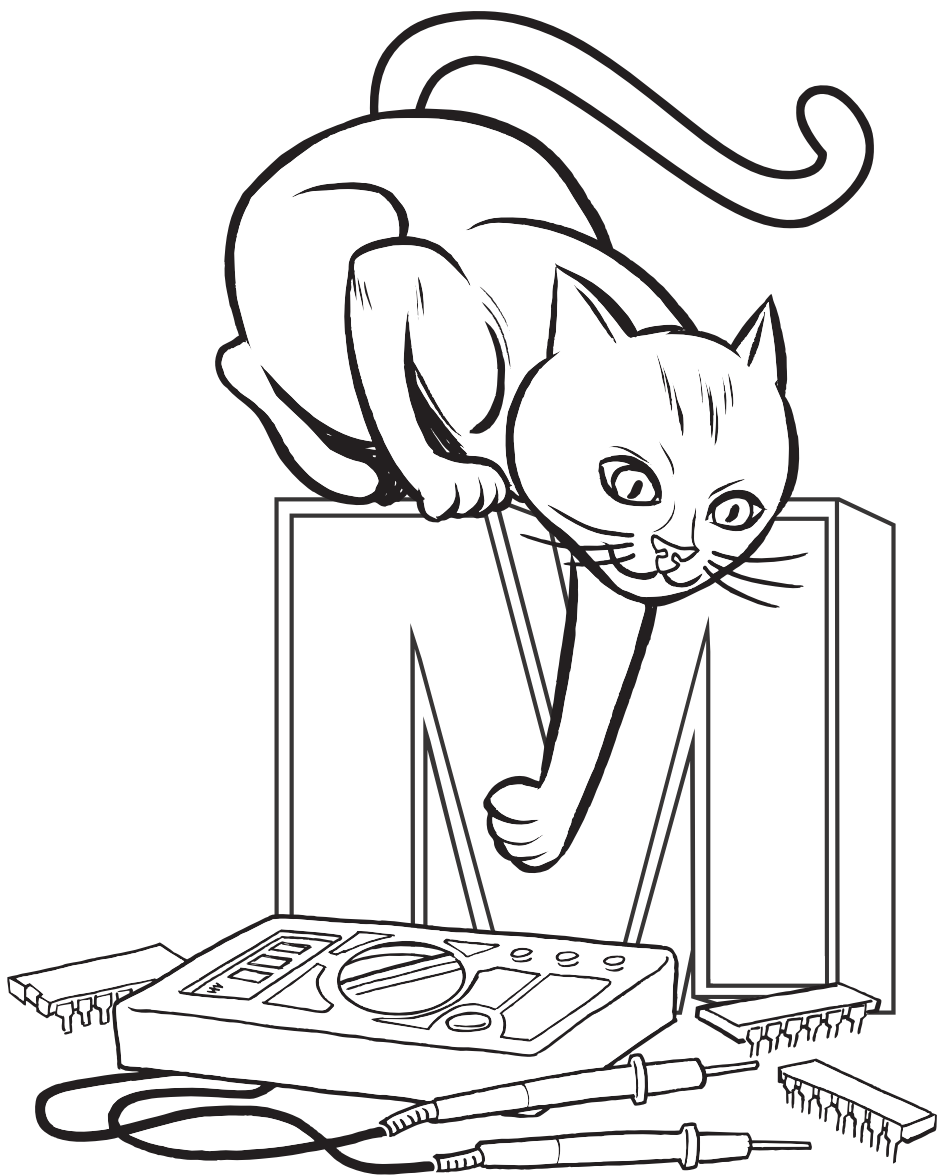
A **Joule** is a unit of energy with the symbol "**J**". It can also be thought of as a unit of work. The **Joule** is named after English scientist **James Prescott Joule**, who studied the nature of heat and how it was related to work and energy.



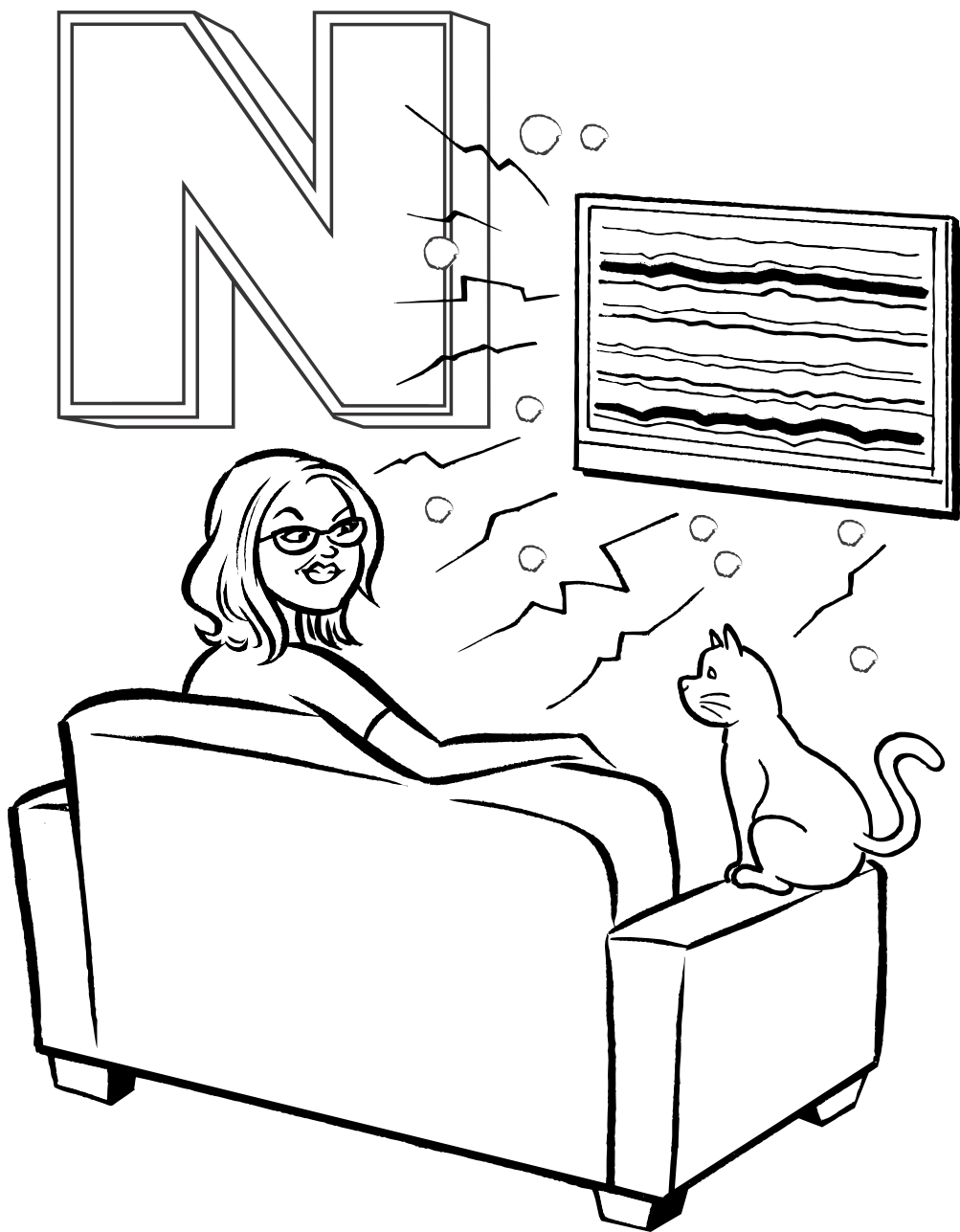
Ladyada makes electronics **kits** to help makers of all ages learn electronics. **Kits** are circuit boards and parts that you assemble, solder, and put together by following the directions from the **kit** maker, Ladyada! Her favorite **kit** is the MintyBoost. Once you build the **kit** you can use it to recharge your phone, camera, or anything else that needs power!



An **LED (light-emitting diode)** is a special kind of diode that emits light when a current flows through it. The **LED** has two terminals, an anode and a cathode. Because it is a diode, electrons can only flow in one direction. When the electrons cross the barrier between the anode and the cathode, they release a photon, which produces light.



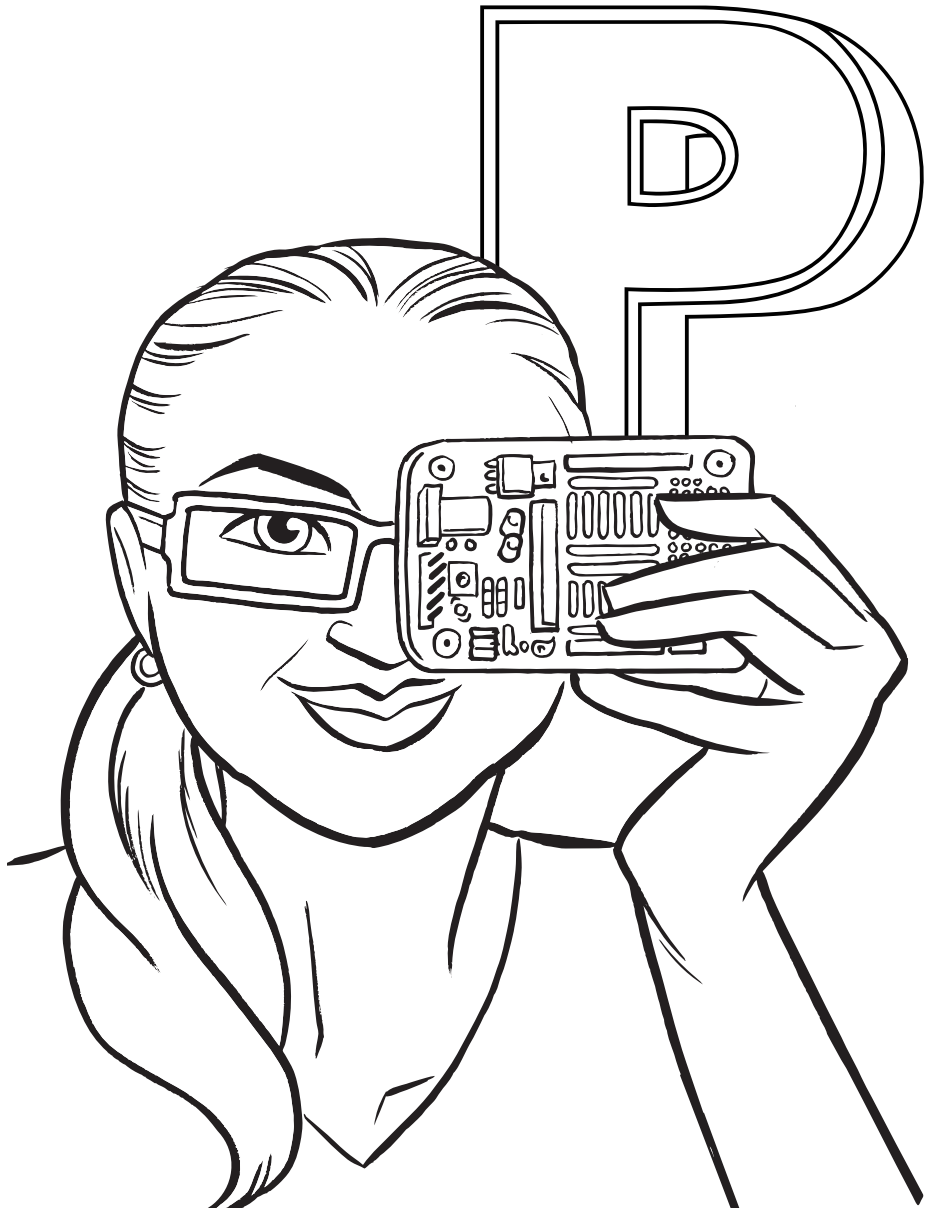
Every great engineer needs a great assistant. Ladyada's assistant is **Mosfet** the cat! **Mosfet** helps keep the lab clean and inspects all the electronics, like the multimeter!



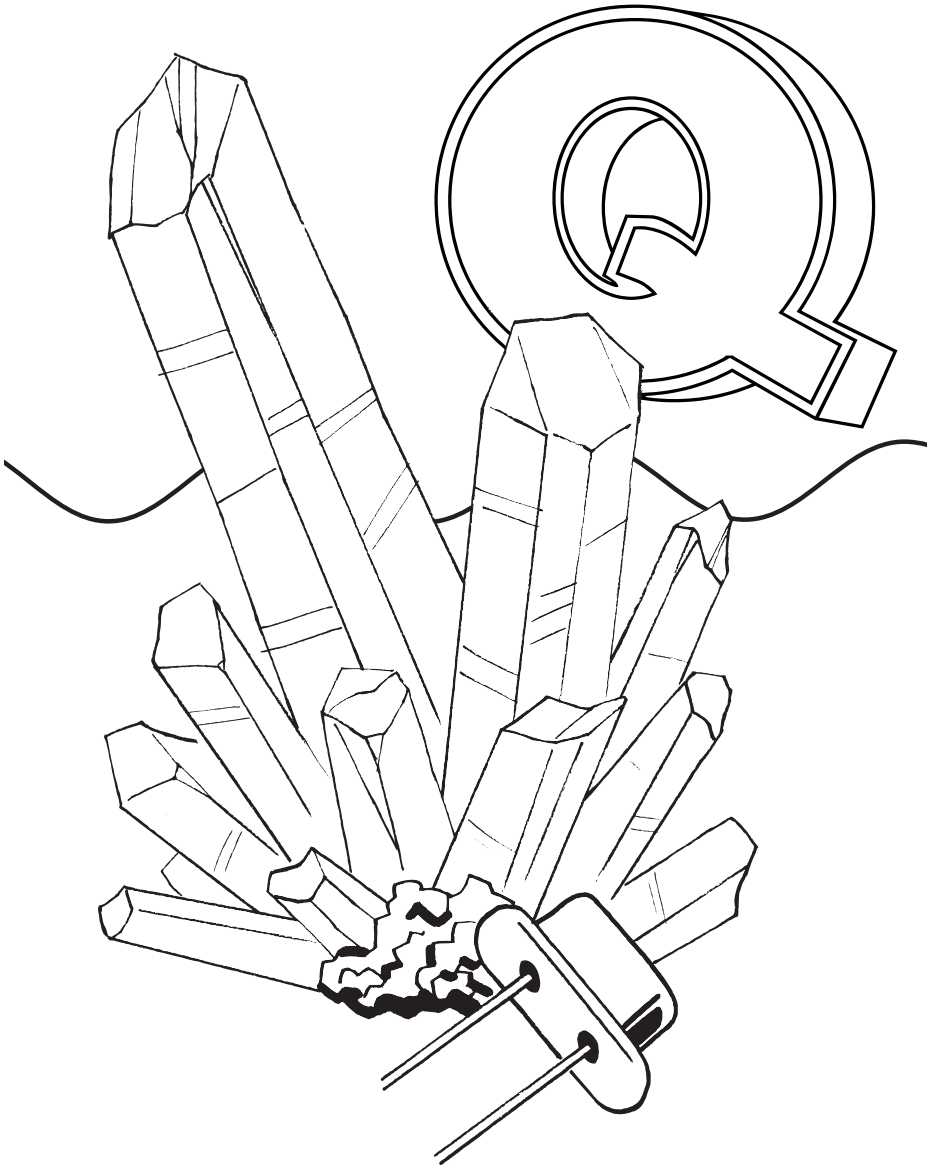
Noise is an unwanted, random signal that can cause a device to behave in an unexpected way. One of the goals of a good engineer is to build things that can work properly even when there's lots of **noise**.



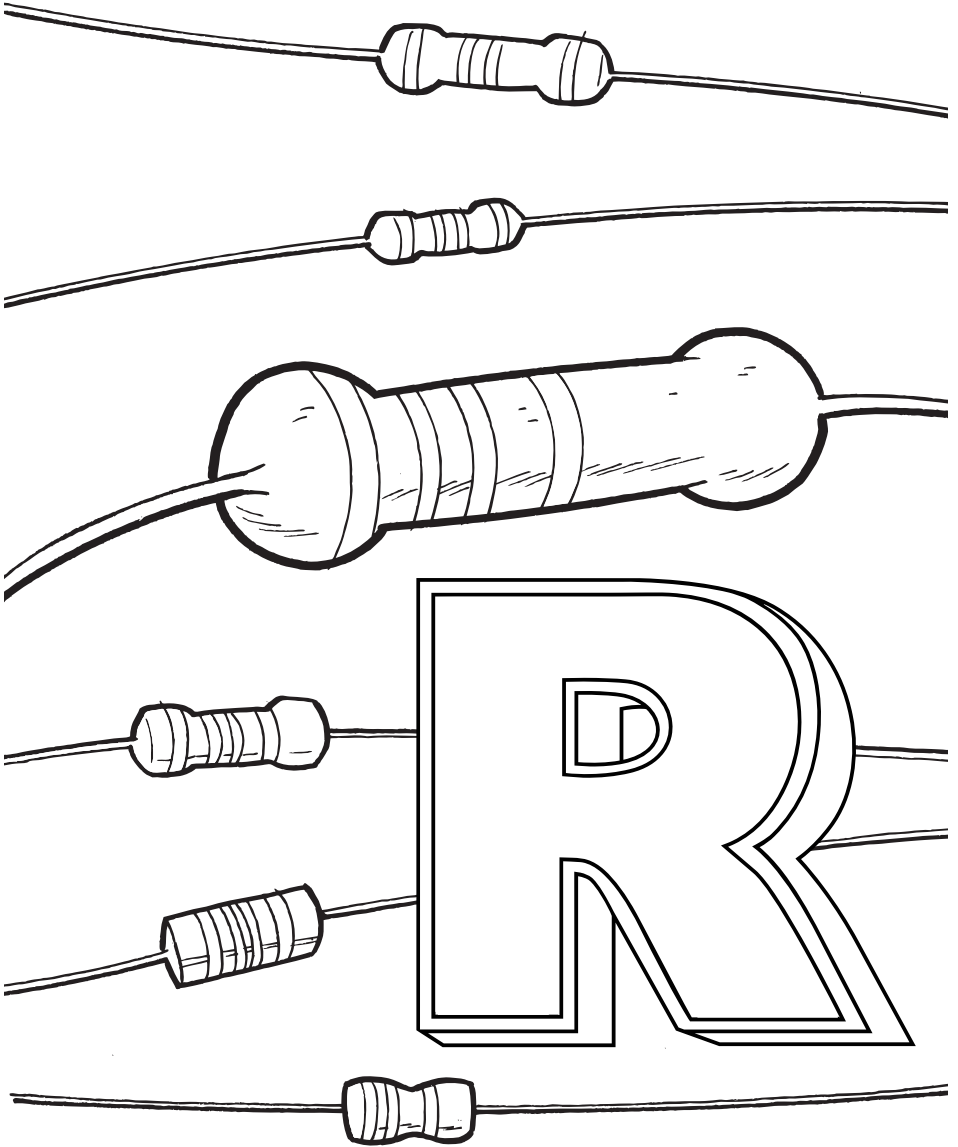
An **Ohm** is a unit of resistance. When you place a voltage of 1 Volt across a resistance of 1 **Ohm**, 1 Ampere of current will flow through it. The **Ohm** is named after German scientist **Georg Simon Ohm**. Using an equation we now call **Ohm's law**, he discovered that voltage and current are related to each other by their resistance.



A **PCB** is a '**Printed Circuit Board**'. It is a special board coated on one or both sides with thin copper plate. A design is then printed onto the copper plate, and special chemicals are used to dissolve the copper, leaving behind copper traces. Holes are drilled into the board so that components can be connected. Finally, the components are soldered to the board using a soldering iron that melts the metal.



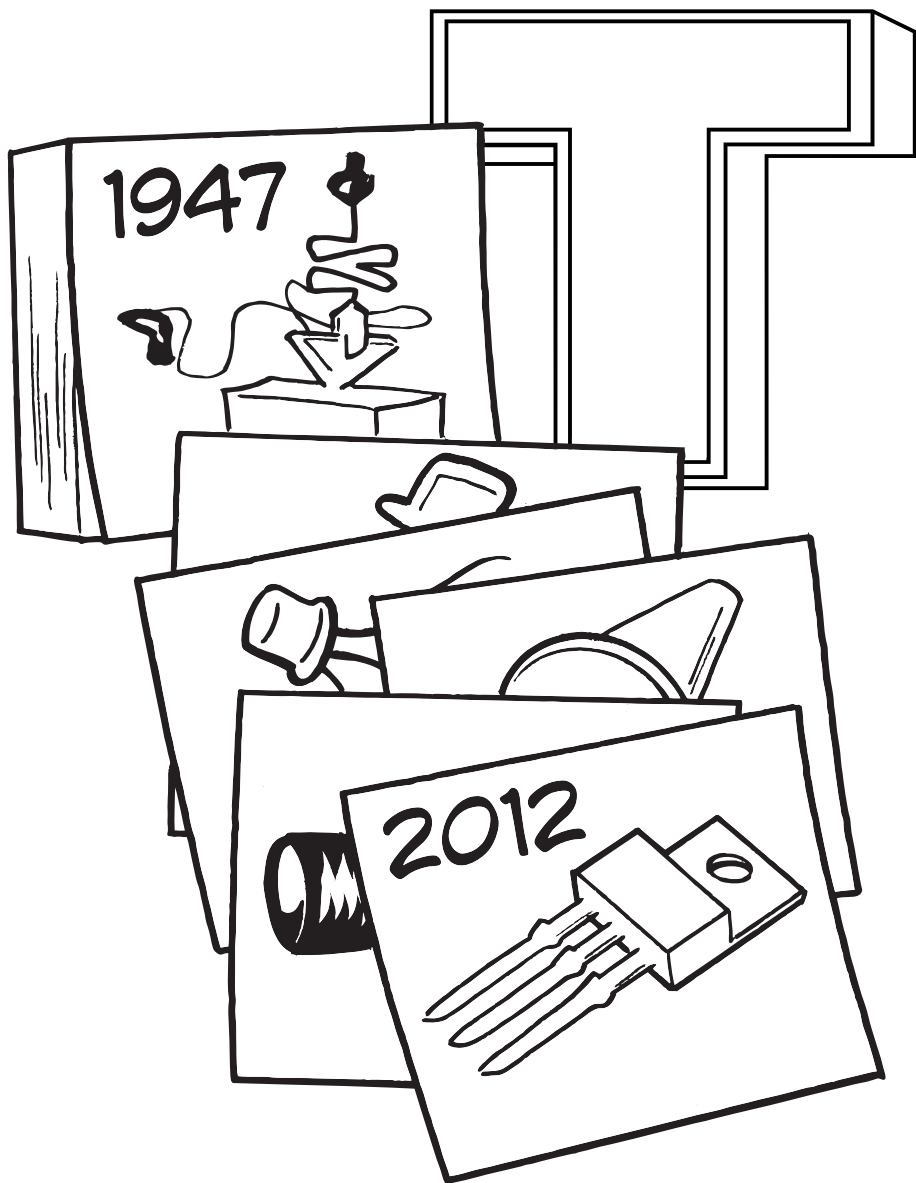
Quartz is a type of crystal with a very unique property called piezoelectricity. If you squeeze a **quartz** crystal, it will generate a small voltage. If you apply voltage to the **crystal**, it will expand or contract. This rapid expansion and contraction of the crystal is known as resonance. Resonance can be tuned to a particular frequency. A carefully made **quartz** crystal can provide a very accurate electronic clock signal.



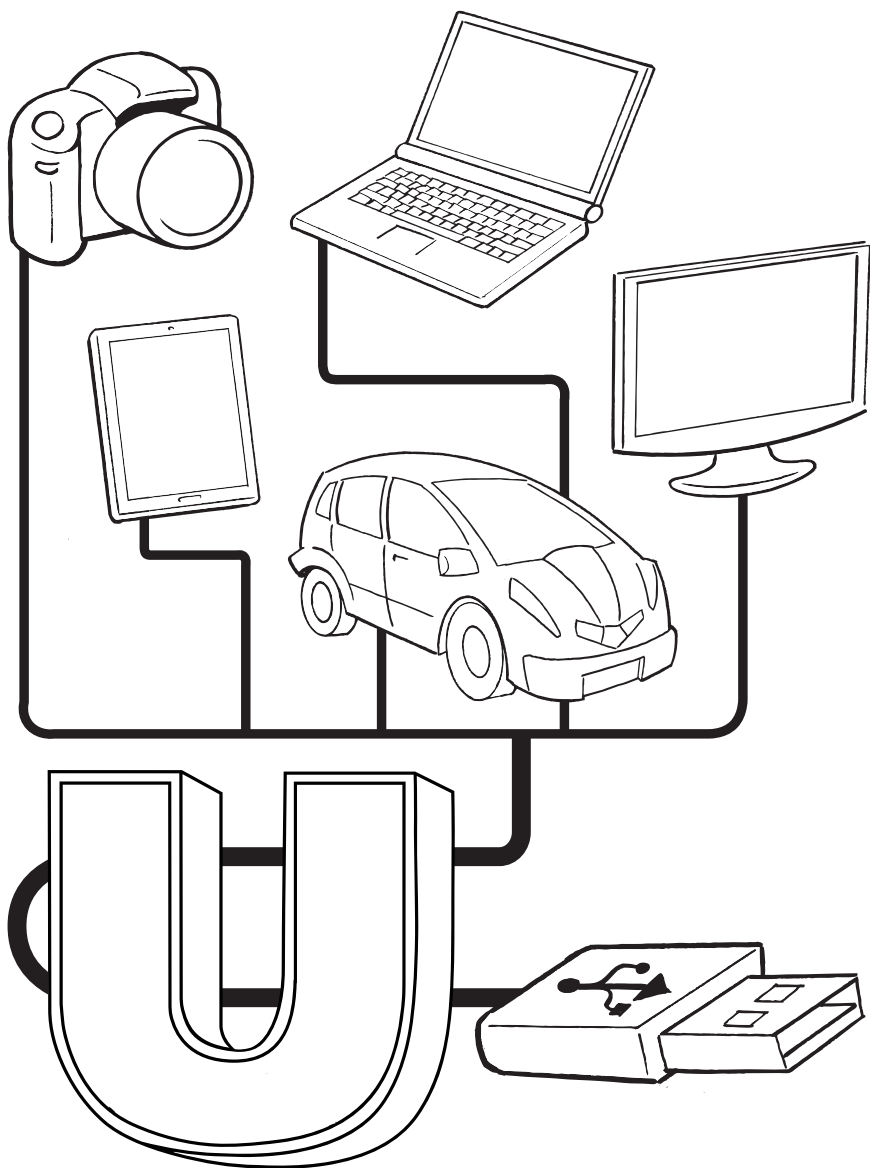
A **resistor** controls the flow of electrons through a circuit by letting only a certain number of electrons go through the circuit per second. Any extra electrons that try to get through must wait in line. The colored stripes let you know how many electrons can go through the **resistor** at the same time.



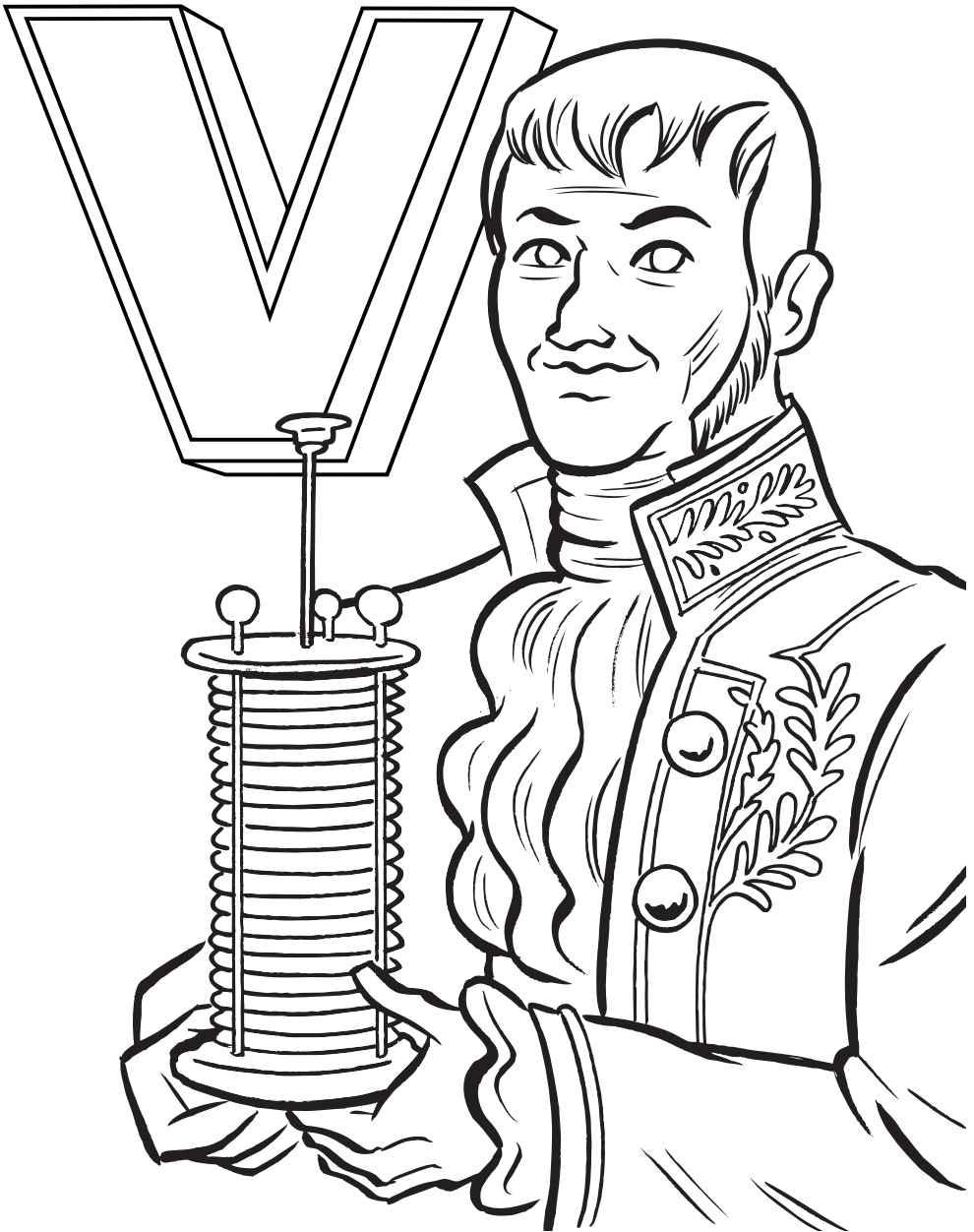
A **soldering iron** is like a hot glue gun for electronics, except instead of glue, it melts metals like silver, tin and lead. Using metals to build electronic devices is important because metal conducts electricity. When the metal cools and hardens, it fixes the components in place, connects them electrically, and keeps them from moving around.



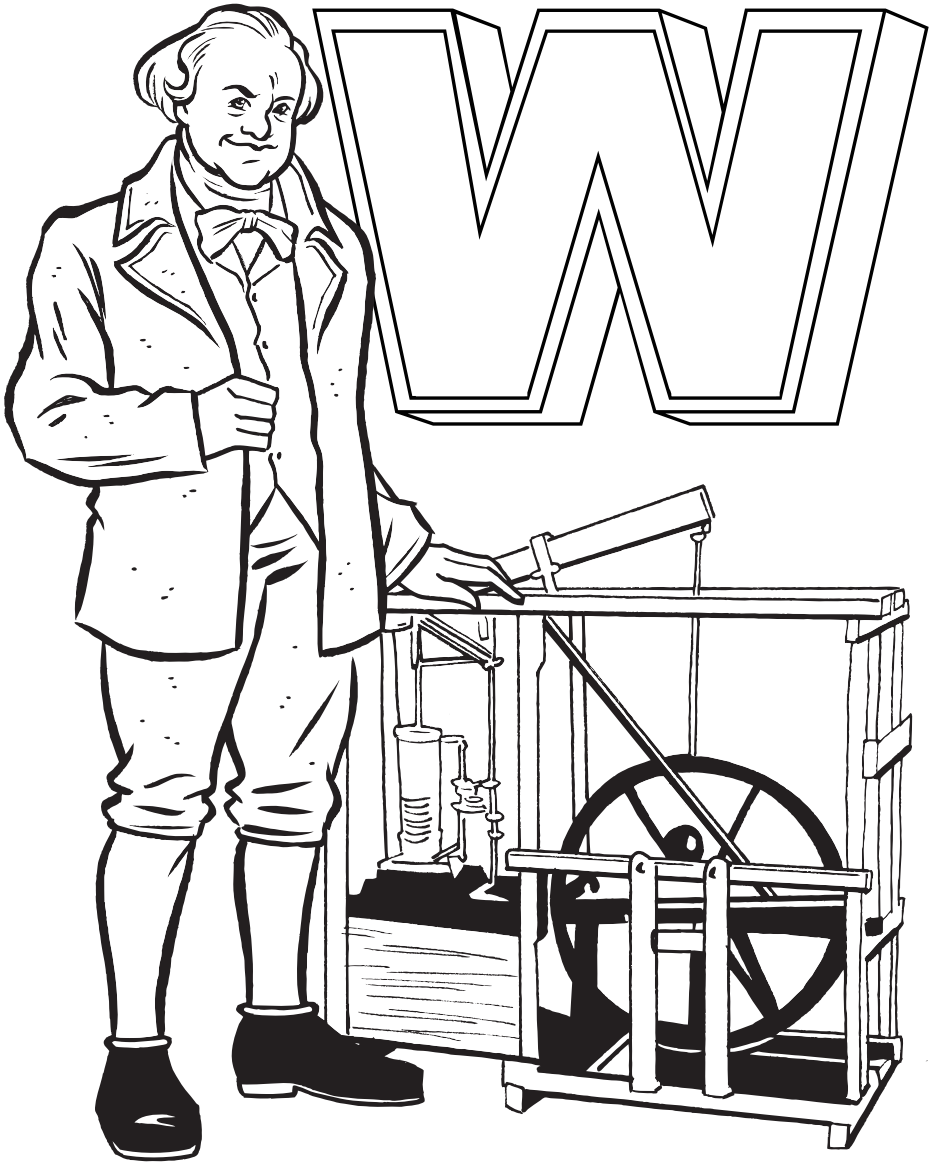
A **transistor** allows one circuit to control another circuit. One of these circuits is usually much bigger than the other, so a **transistor** acts like a lever where a small current can control a much bigger current. There are all sorts of **transistors**, but the two most common ones are bipolar junction transistors (BJT) and field-effect **transistors** (FET). **Transistors** are used in everything, everywhere: including computers, radios, TVs, and cameras.



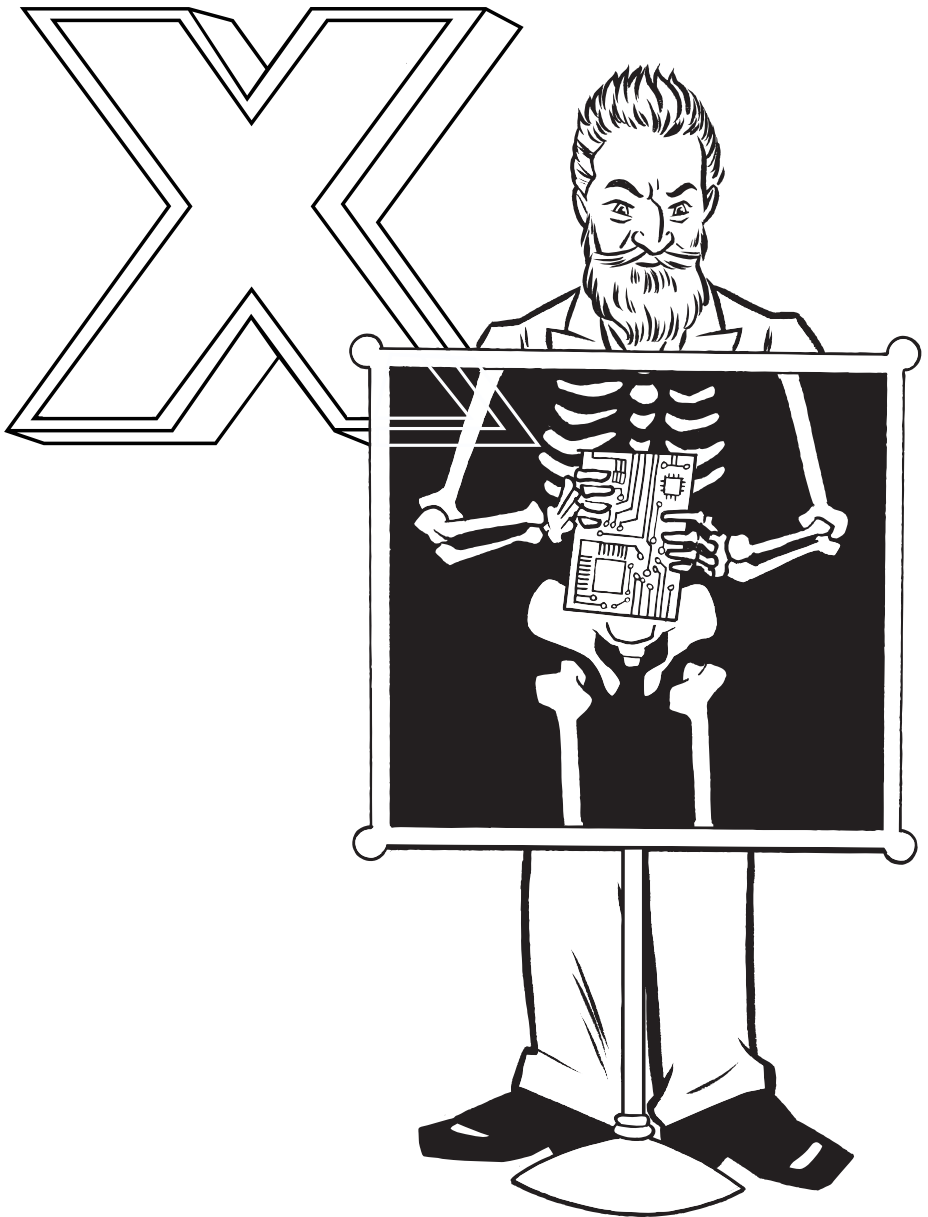
USB means 'Universal Serial Bus.' It is a type of connection that is used to allow computers to talk to other devices like printers, mice, and keyboards, cameras, phones, and disk drives.



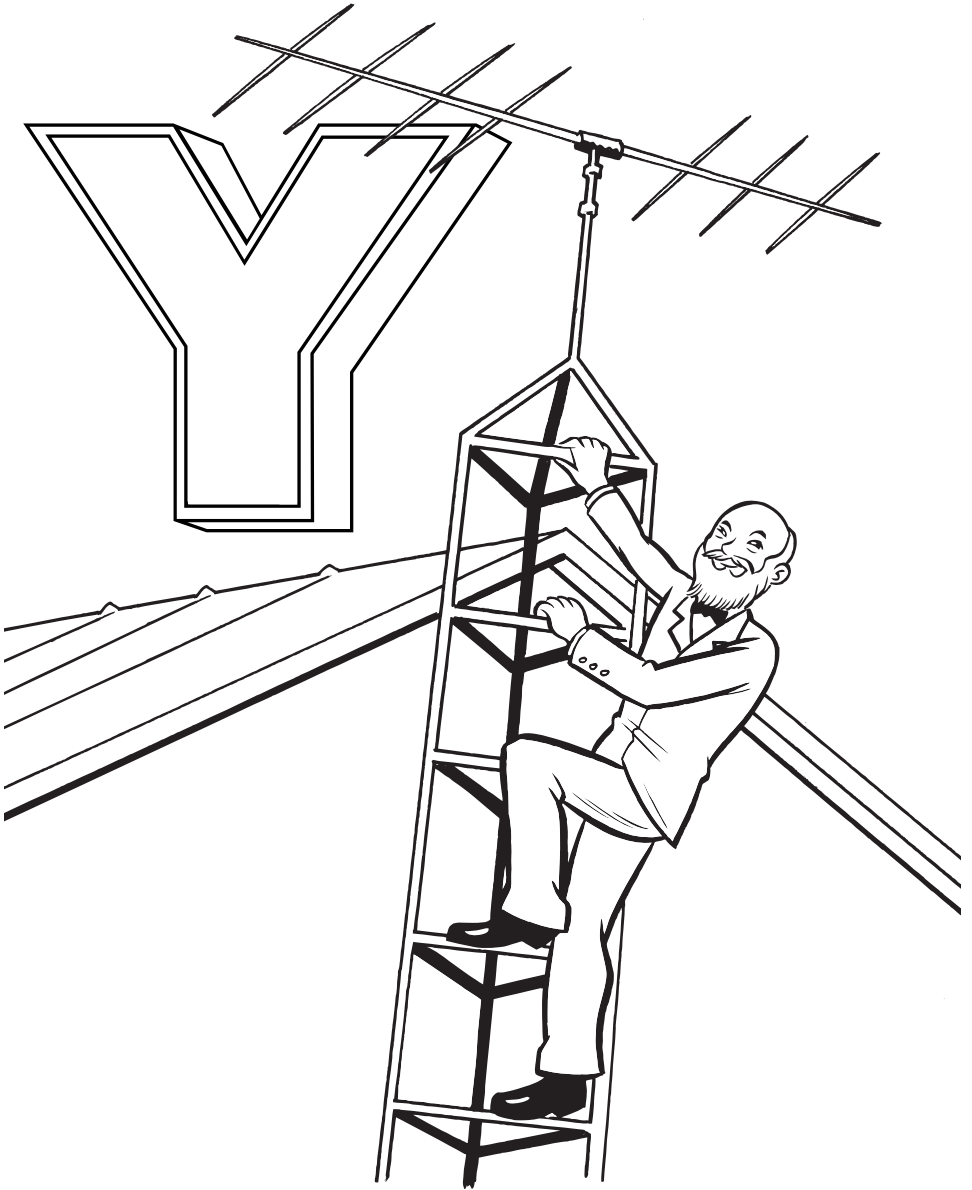
Voltage, measured in **Volts**, is the potential electric energy, per unit charge, between two points. **Voltage** is like air or water pressure: the higher the **voltage**, the more it can push electrons through a circuit. The **Volt** is named after **Alessandro Volta**, who invented the voltaic pile, one of the first batteries.



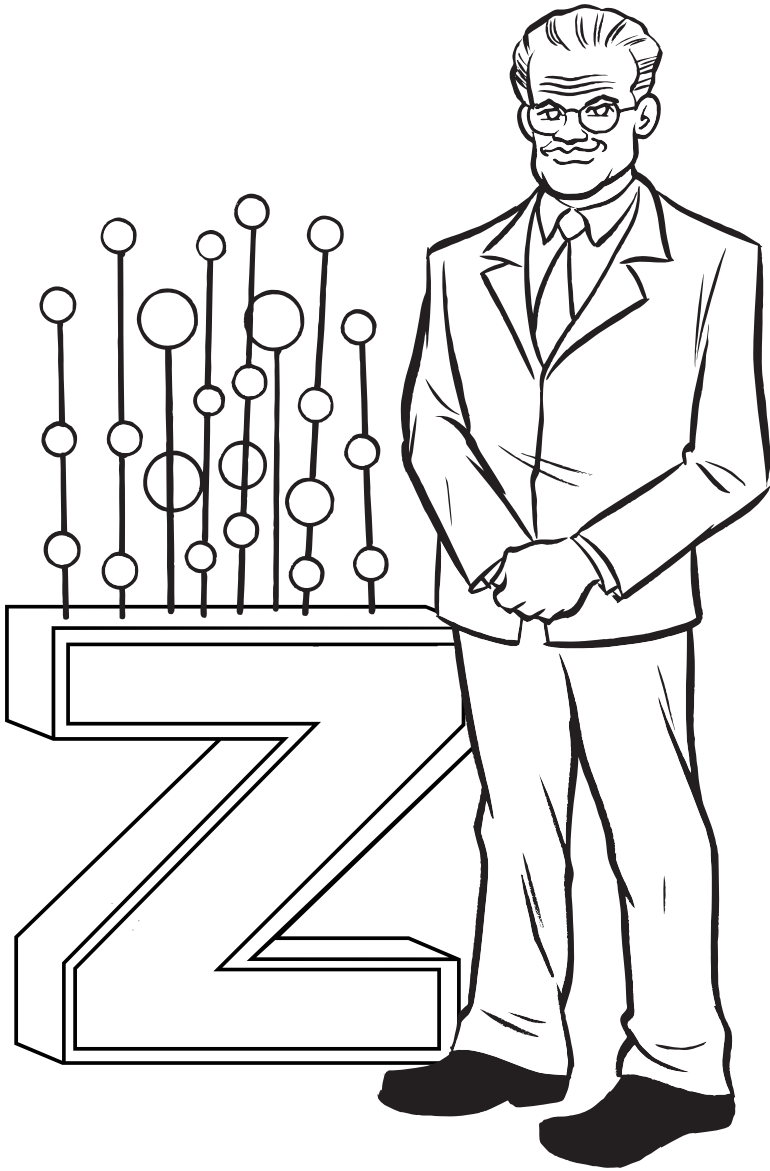
In electronics, a **wire** is a long, thin piece of metal, usually copper, that is used to conduct electricity from one point to another in a circuit. A **wire** typically has some plastic or rubber, called the jacket or insulator, around the outside of the copper. A **Watt** is a unit of power. One **Watt** is the amount of power required to perform one Joule of work per second. It's also the amount of power required to make one Ampere of current flow across 1 Ohm of resistance. The **Watt** is named after Scottish engineer **James Watt** who designed the first reliable steam engine.



An **X-ray** is a type of electromagnetic radiation. **X-rays** have a frequency higher than that of visible light, so we cannot see them with our eyes. However, we can use a special photographic film that responds to **X-rays** to see what they look like. **X-ray** inspection is used to look inside many electronics devices, just like doctors use **X-rays** to look inside people. **Wilhelm Conrad Röntgen** was the first person to make and detect **X-rays**.



A **Yagi antenna**, also called a Yagi-Uda antenna, is a kind of antenna for radio frequencies that uses multiple pieces to direct and strengthen a signal. By sending energy as radio waves antennae allow devices to communicate without using wires. The **Yagi antenna** was invented by **Shintaro Uda** and **Hidetsugu Yagi**.



A **Zener diode** is a special kind of diode. As we learned before, most diodes will only allow current to flow in one direction. Like a regular diode, a **Zener diode** will always allow current to flow from the anode to the cathode. But a zener diode will also let current flow in the opposite direction if the voltage applied to it is above a certain level. The **Zener diode** is named for American physicist **Clarence Zener**, who studied the properties in which various materials breakdown.

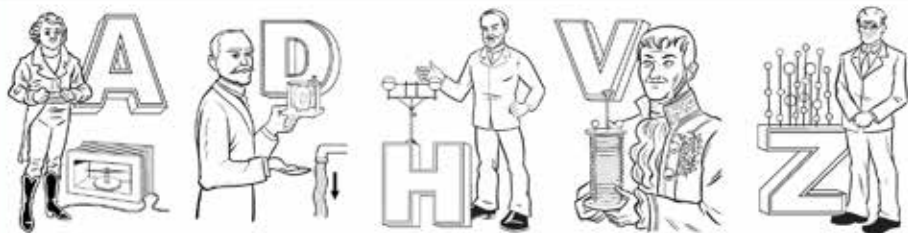
LadyAda's

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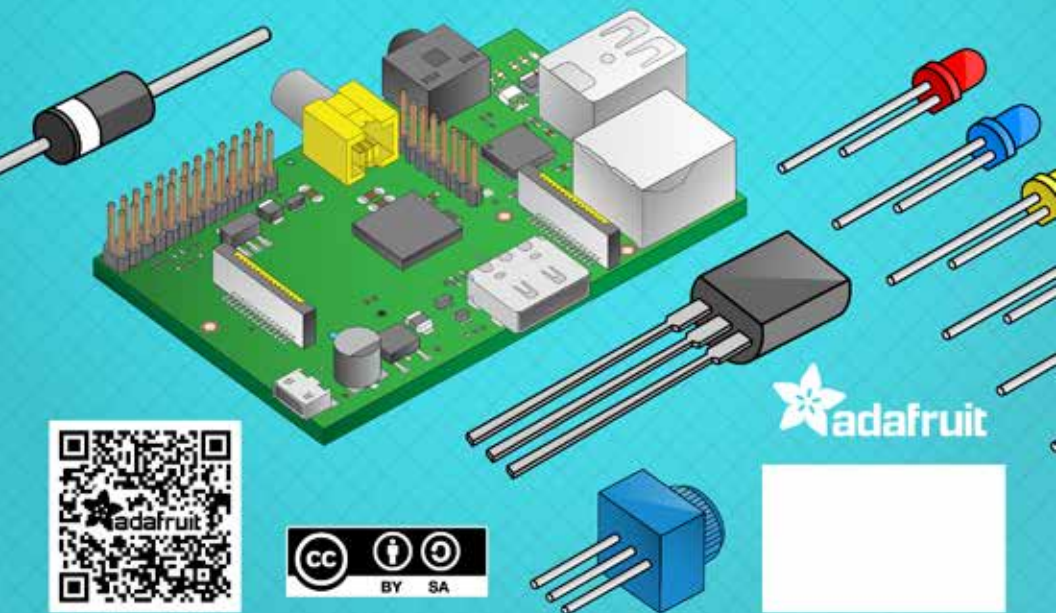
Ladyada's "E is for Electronics" is a coloring book adventure with electronic components and their inventors.

Makers of all ages can learn, color and share common parts and historical figures throughout history.



Explore the world of electronics with Ladyada as your guide.

CREDITS: Designed by: Ladyada & pt, Illustrations: Robert Ullman, Cover & Layout: David Stadler, Writing: John DeCristofaro



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