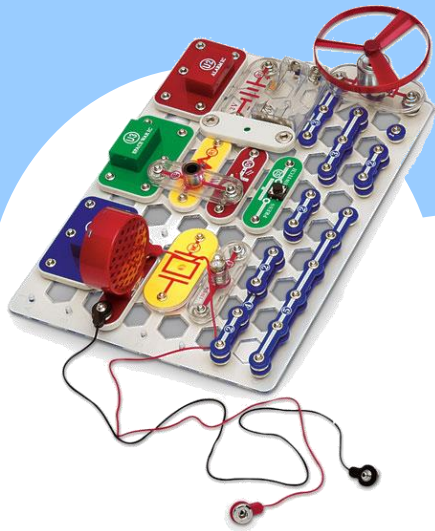


CIRCUITS & HARDWARE



STEM
WORKS
THINKit



Simple Circuits Activity

Grades
K-12

Career Pathways

Electrical Engineer
Civil Engineer
Contractor
Electrician

Academics

Math: Spatial Reasoning,
Measurement, Scale, Equations
Science: Circuits, Electricity, Systems

Professional Career Skills

Collaboration
Problem Solving
Organization
Perseverance

Materials

Snap Circuits Kit
Paper/Graph Paper
AA Batteries

Optional –

Conductive Connections Kit:
(Conductive Tape, Coin Batteries,
LEDs, Resistors)

Multimeter

Team Goal

Level 1

Build a circuit that turns a light on and off.

Level 2

Build both parallel and series circuits with switches that control lights or a fan. Use engineering symbols to draw circuits.

Level 3

Draft your own scale drawing of a floor plan and overlay an electrical engineering blueprint using appropriate symbols. Blueprints should contain both parallel and series circuits. Test your design by constructing the circuitry.

STEM
WORKS

Download Knowledge. Upload Service.

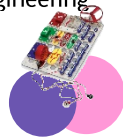
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Think like an Engineer with Circuits & Blueprints



Iterative Design

As you create your blueprint and circuitry, continue to think of new ideas and make improvements so it works and looks great! You do this by cycling through the engineering design process.



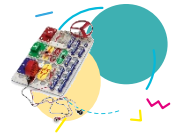
Product

When you decide to create or build a prototype or model, you are producing a product. Your circuit model and blueprint are products that can be shared with other people.



Fabrication & Manufacturing

When your floorplan is ready to be built into a real home or business, many people would help and be involved in creating your plan.



Precision

Engineers pay attention to the details in how components are put together. They need to be precise in measurements and make sure they sequence construction in a specific order.



Criteria

You will know your model or blueprint is successful by how well it works for your audience. Criteria for success may include: circuits that turn on and people who would want to live in your floorplan.



Constraint

All engineers are limited by resources or time. You may have a limited number of supplies or time create your blueprints. Engineers work with what they have to make the best product possible. It is very creative work!



Scheme, Blueprint or Diagram

A scheme, blueprint or diagram show a plan that other engineers can use. Draft your plan using the technical symbols. Blueprints also have labels, like measurements for scale so the size is accurate.



Prototype or Model

Before putting too many resources, like time or money into a final product, you should draw a blueprint and build a small model of your product first. You might make a few drafts before deciding on a final version.



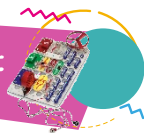
Troubleshoot

As you assemble a model of your blueprint, it may not work as well as you expected it would. Engineers always test, modify and refine their designs so they work!



Component

Your model has many parts that are needed to make the whole product work. For example, there are wires, batteries, LEDs, and resistors. The blueprint communicates a message about how these components fit together.



Modular

Many engineers design products that have components that can be fixed or replaced without having to throw away everything. Designing modular products is good for the environment and a future budget!



Assembly

You need to be precise when you put all the components together in your circuit. It is helpful to assemble a model in a certain order otherwise putting it together may be difficult or even impossible!

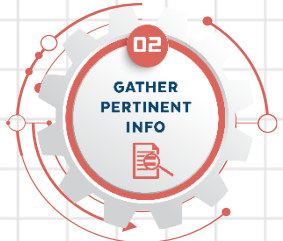


Engineering Design Process Directions:



Define the Problem

Choose a goal to tackle with your team!



Gather Pertinent Information

Explore how to build a circuit. Learn how to draw circuits using electrical symbols. Check out the [Electrical Engineering Tips](#). You will need Snap Circuits and paper. Snap Circuits come with guides, use these for research!



Generate Multiple Solutions

Explore the [Drafting Civil & Electrical Blueprints Tips](#). Think about how you might design a variety of electrical plans for a room. What does a room need? Brainstorm, build and draft possible circuits and/or floorplans.



Choose a Solution

Decide on a layout for circuits and/or floorplans that would work best. Draft your own scheme for electrical and/or civil engineering blueprints.



Design a Culturally Responsive Solution

As you create your solution, ask other people for feedback about your layout. Does your plan have enough light? Are the fans placed well for cooling? Are the switches easily accessible? Does the floorplan have enough space? Does the floorplan include fire exits?



Test and Optimize

Test your circuits. Do they turn on and off? Do they need more energy to run? Do you need to reverse your LEDs? Use what you learned to modify and improve your solution. Share your blueprint models and use the feedback. Are the models to scale? Are there any improvements to be made?



Share & Reflect

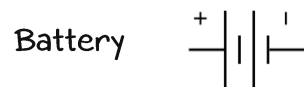
When and how did you use feedback to improve your solution?
How did you and your team collaborate and practice perseverance?
Talk to your team: What went well? What could have gone better?

Electrical Engineering Tips:

Electrical engineers create the electrical plan for a home. They use the home's floor plan as a guide. This way the wires from all of the circuits can be hidden in the walls. They draw their plan using electrical engineering symbols. The Snap Circuits sets have these symbols drawn on each piece!

Electrical engineers want the electricity to be well planned for each room. They plan out paths for electrons to flow through conductive material (like wires or copper tape). When you turn one switch off, do you want all the lights and appliances in the whole house to shut down? Probably not! Electrical engineers need to be creative to solve this problem. They draft a blueprint using different kinds of circuits so you can control the electricity in your home. Electrical Engineers use both series and parallel circuits and pay close attention to voltage, current and resistance. Remember voltage equals current times resistance ($V = IR$).

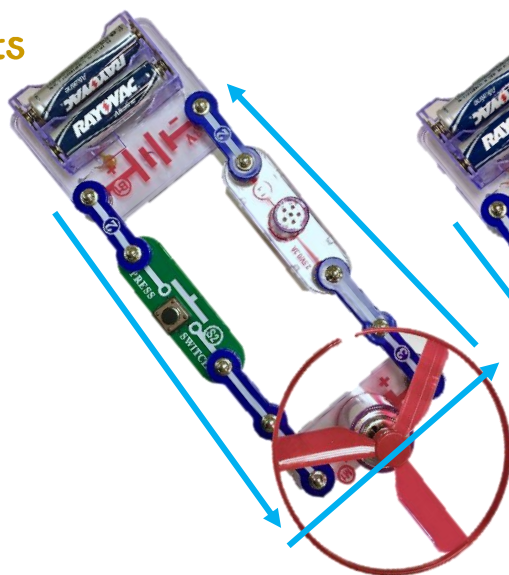
Common Electrical Symbols



Building Circuits

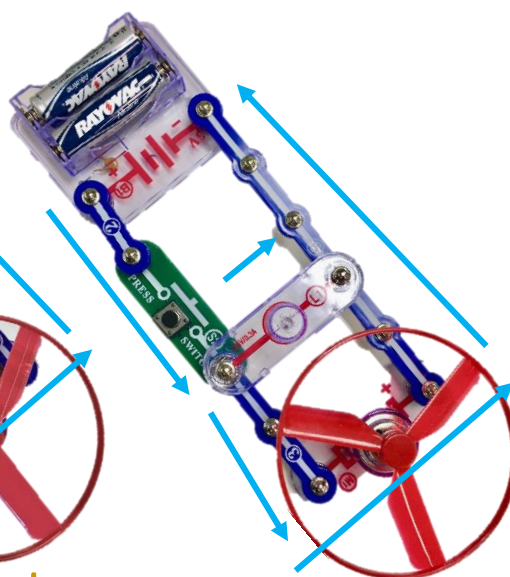
Series Circuit

Start at the battery and trace the circuit, there is only one path for electrons to flow all the way back to the battery.



Parallel Circuit

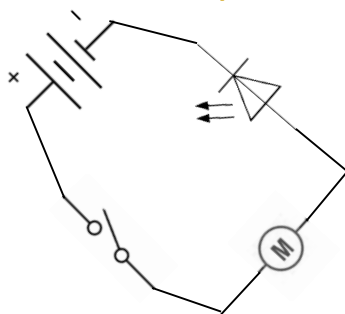
Start at the battery and trace the circuit, the path for electrons splits and you'll need more than one finger to follow all the wires back to the battery.



Drawing Circuits using Electrical Symbols

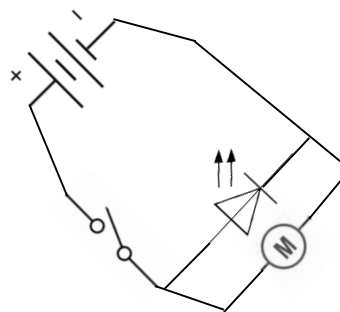
Series Circuit

This circuit has a switch. The motor (fan) and the LED are in series.



Parallel Circuit

This circuit has a switch. The motor (fan) and the LED are in parallel.



Voltage & Current

Voltage pushes the electrons to flow in a circuit. Batteries and solar panels can provide a source of voltage. The electric company supplies voltage to homes through electrical wires called "the grid."

$$\text{Voltage (V)} = \text{Current (I)} * \text{Resistance (R)}$$

Electrical current happens when electrons are flowing in a circuit. Lights, fans and other appliances need a flow of electrons to turn on. Sometimes the flow of current might be too strong for a device. Resistors are used to decrease the flow of current.

Drafting Civil & Electrical Blueprints Tips

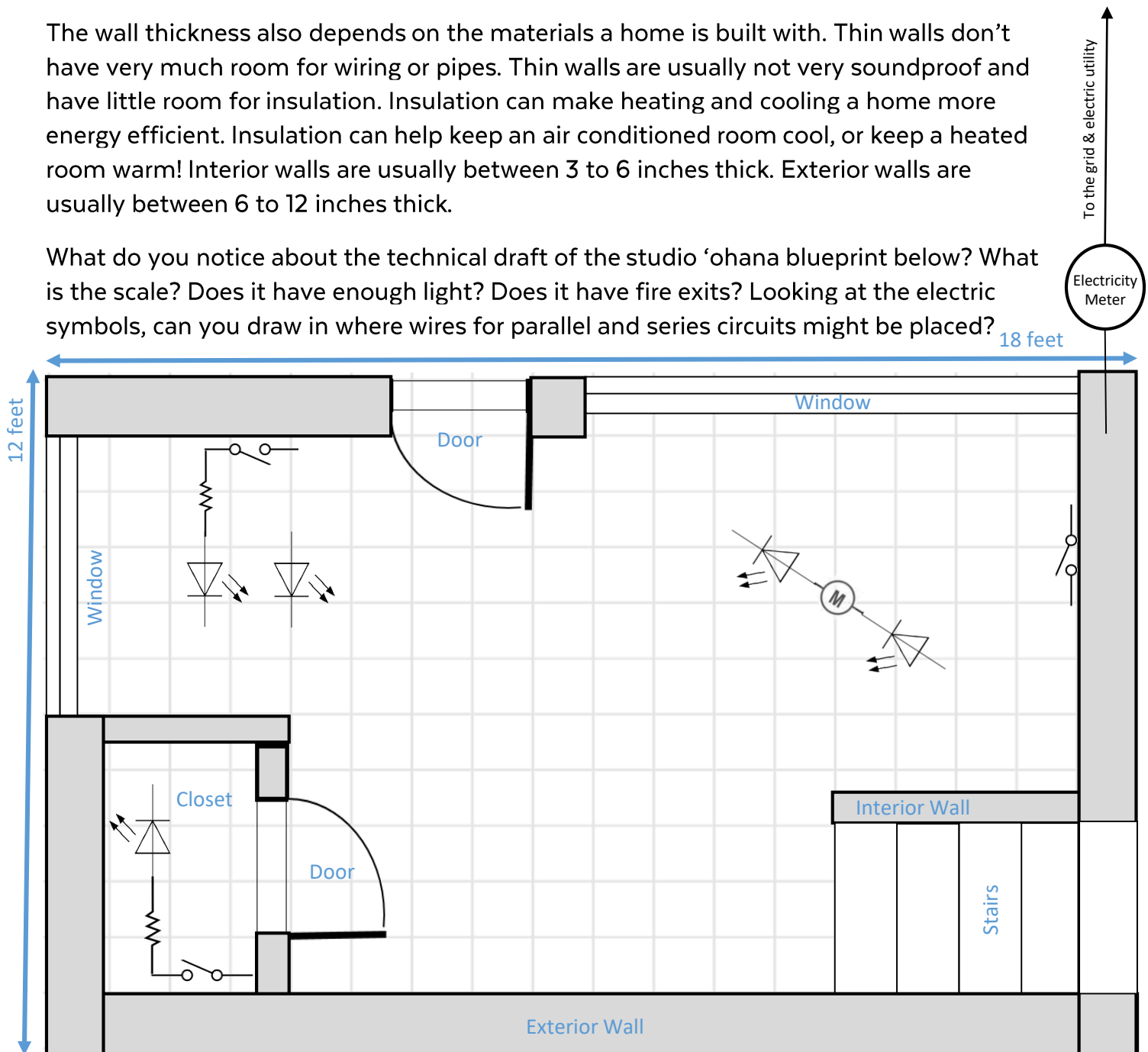
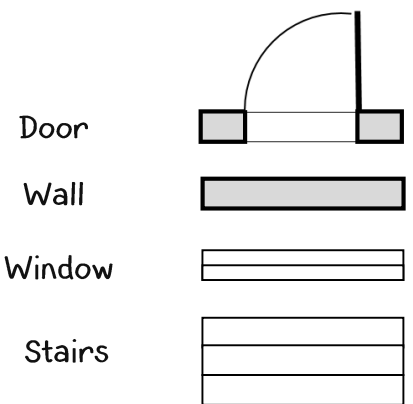
When civil engineers design structures, like homes and businesses, they draft blueprints. You can practice engineering skills by using common technical drafting symbols to design floor plans. Be sure to think about the scale of your blueprint! Will each square represent a square inch, foot, or even a square meter in real life?

A 2-dimensional floor plan is a “bird’s eye” view of a room. This means you are looking down into your design from above. There needs to be walls between rooms. Inside the wall are electrical circuits, pipes, beams and insulation. Electrical engineers will use the wall and the space between floors to layout their plans for circuits. The thickness of your walls matter!

The wall thickness also depends on the materials a home is built with. Thin walls don’t have very much room for wiring or pipes. Thin walls are usually not very soundproof and have little room for insulation. Insulation can make heating and cooling a home more energy efficient. Insulation can help keep an air conditioned room cool, or keep a heated room warm! Interior walls are usually between 3 to 6 inches thick. Exterior walls are usually between 6 to 12 inches thick.

What do you notice about the technical draft of the studio ‘ohana blueprint below? What is the scale? Does it have enough light? Does it have fire exits? Looking at the electric symbols, can you draw in where wires for parallel and series circuits might be placed?


Common Technical Drafting Symbols



Civil & Electrical Engineering Blueprints

1. Think about the space and electricity needs of a business or home.
Choose a scale for your model.
Build prototypes of your circuits to test if they work.
The battery can represent power from the grid.

Scale:

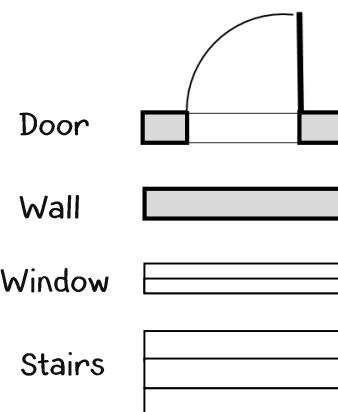
 = __ square feet

2. Draft your civil engineering blueprint of a floorplan for a room, a business, or a home.
3. Draft the electrical engineering blueprint for your circuitry.

Civil Engineering Blueprint



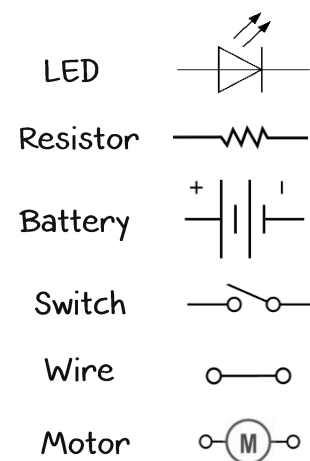
Common Technical Drafting Symbols



Electrical Engineering Blueprint




Common Electrical Symbols

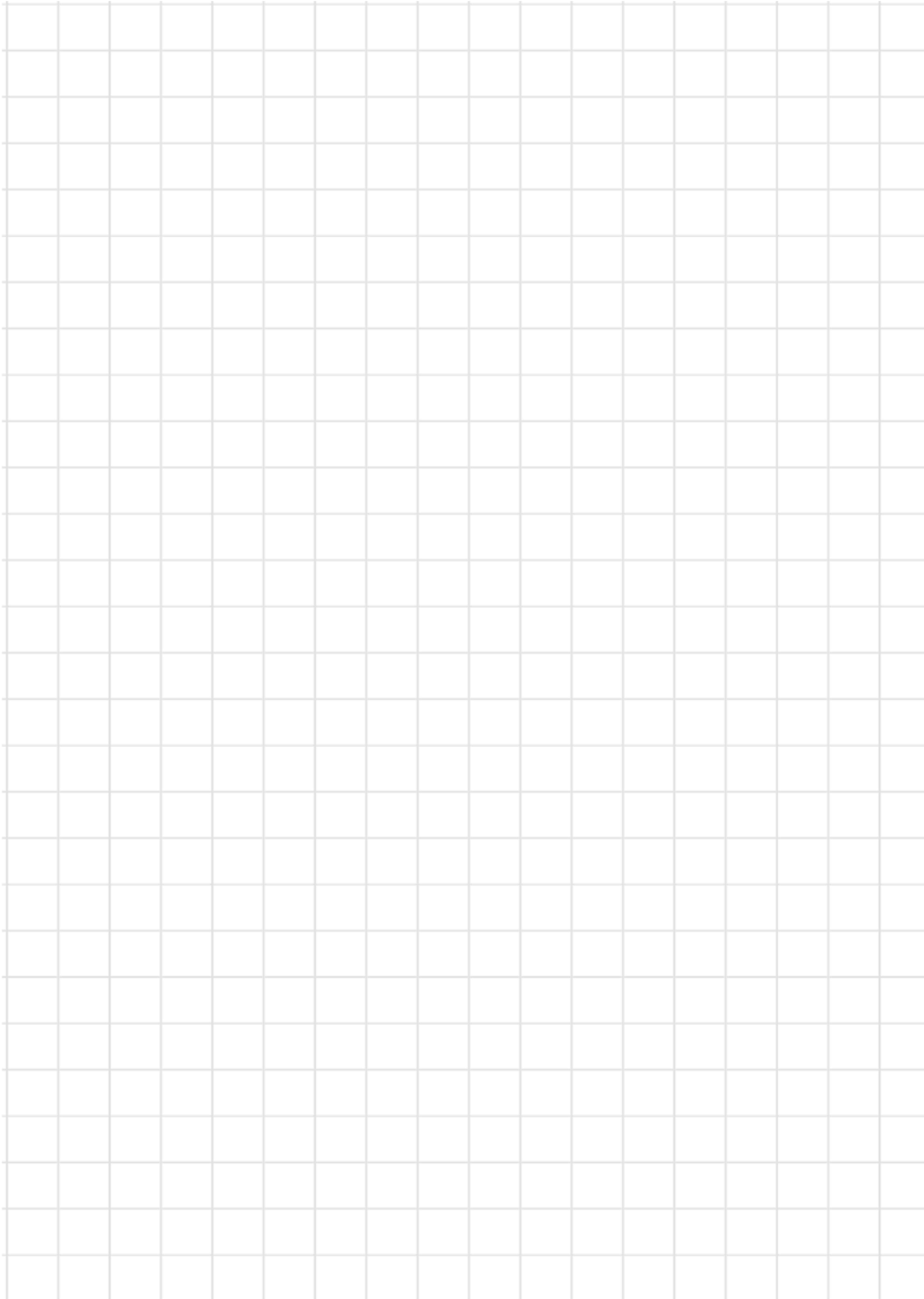


Overlap Engineering Blueprint Plans

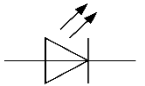
1. Think about the space and electricity needs of a business or home.
Choose a scale for your model.
Build prototypes of your circuits to test if they work.
The battery can represent power from the grid.
2. Draft your civil engineering blueprint of a floorplan for a business or home.
3. Decide where your circuitry belongs in the floorplan and draft electrical plans.


Scale:

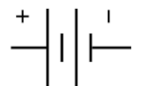
 = __ square feet

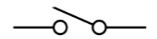


Electrical Engineering: Common Electrical Symbols

LED 

Resistor 

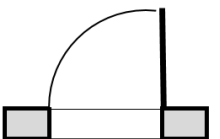
Battery 

Switch 

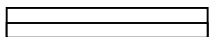
Wire 

Motor 

Civil Engineering: Common Technical Drafting Symbols

Door 

Wall 

Window 

Stairs 