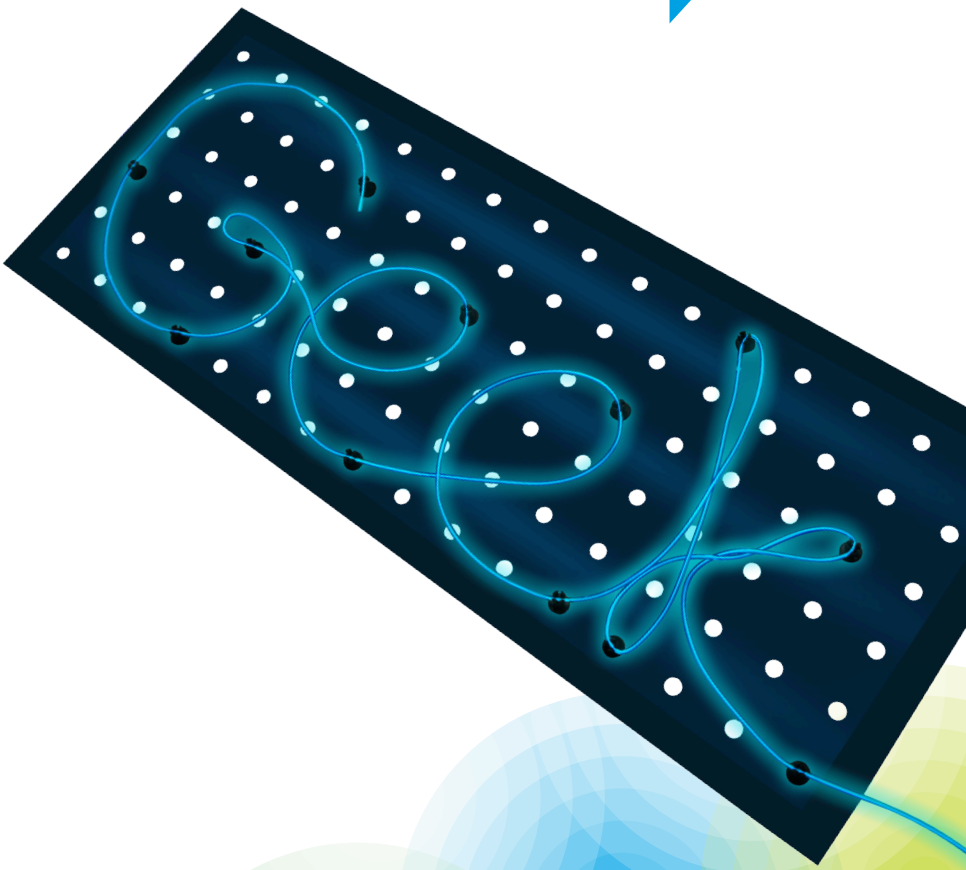
GEEK & CO. SCIENCE!

PROJECT KIT

Ages 8+

NeON LiGHT WRITER



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Safety information

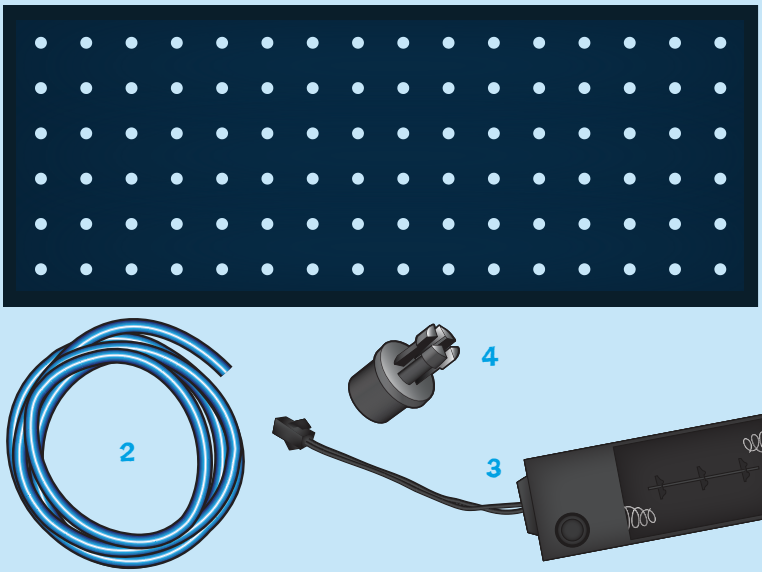
WARNING.
Not suitable for children under 3 years. Choking hazard — small parts may be swallowed or inhaled. Strangulation hazard — long wires may become wrapped around the neck.
Keep the packaging and instructions as they contain important information.
Read the notes about the electrical components on the inside back cover.
Do not run the inverter without the electroluminescent wire attached. You could damage it. Turn it off when you are done using it.

Notes on experimenting with batteries

Warning. Only for use by children aged 8 years and older. Instructions for parents or other supervising adults are included and have to be observed. Keep the packaging and instructions as they contain important information.
The wires are not to be inserted into socket-outlets. Never perform experiments using household current! The high voltage can be extremely dangerous or fatal!
Two AA batteries (1.5-volt/LR6) are required, which could not be included in the kit due to their limited shelf life.
Different types of batteries or new and used batteries are not to be mixed.
Do not mix old and new batteries.
Do not mix alkaline, standard (carbon-zinc), or rechargeable (nickel-cadmium) batteries.
Always insert batteries in the right polarity orientation, pressing them gently into the battery compartment.
Non-rechargeable batteries are not to be recharged. They could explode!
Rechargeable batteries are only to be charged under adult supervision.
Rechargeable batteries are to be removed from the toy before being charged.
Exhausted batteries are to be removed from the toy.
The supply terminals are not to be short-circuited. A short circuit can cause the wires to overheat and the batteries to explode.
Dispose of used batteries in accordance with environmental provisions.
Be sure not to bring batteries into contact with coins, keys, or other metal objects.
Avoid deforming the batteries.
Have an adult check the assembly before you use it so you can be sure it was assembled properly!

NOTE! The additionally required items are highlighted in italic script in the individual experiments. Before starting the experiments, carefully read through everything that will be required and make sure to have all the materials ready.

KIT CONTENTS



1 | Cardboard peg board
2 | Electroluminescent wire (EL wire), 2 meters
3 | Battery holder and inverter
4 | Pegs (25)

YOU WILL ALSO NEED: *Two AA batteries (1.5-volt, type AA/LR6), two sheets of white paper, tape, markers, nails or thumbtacks*

Hey Neon Geekers!

Ready to put your name in lights? In this kit, you will use a cool lighting technology called electroluminescent wire (EL wire) to make a kind of neon sign. You can write your name or any word you want! This manual will teach you how and will also explain how EL wire works. Wiley the Geeker will be your guide!

PART 1

PREPPING YOUR SIGN STUDIO

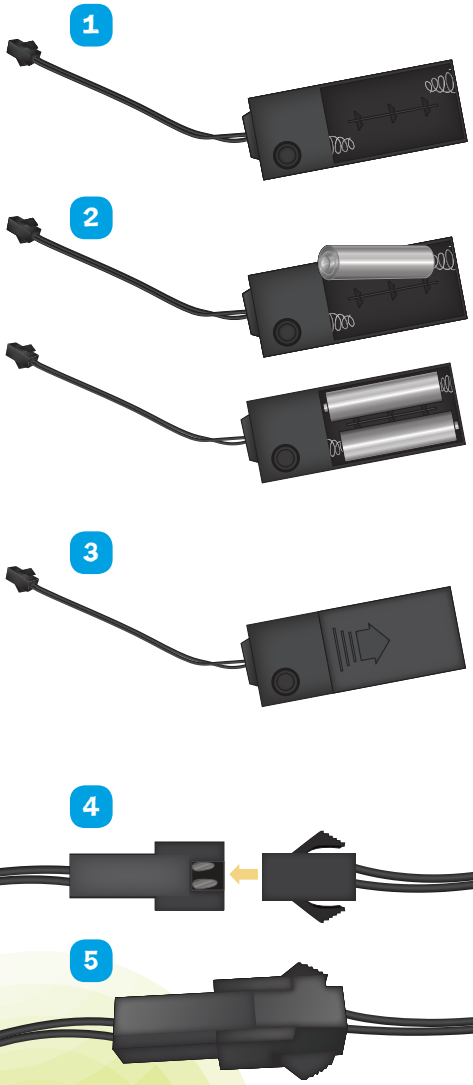
Getting your materials set up

You will need:

Battery holder, *two AA batteries*

Here's how:

1. Remove the lid from the battery holder compartment on the inverter by sliding it off.
2. Insert two AA batteries (1.5-volt, type AA/LR6) into the battery holder. Make sure you insert them according to the correct polarity, in the correct direction.
3. Close the battery compartment by sliding it back on.
4. To attach the EL wire to the inverter, line up the plug and socket, and slide them together until they click.
5. To disconnect the EL wire from the inverter, press the two tabs inward to release the lock and slide apart. You can leave the inverter disconnected while you wire your sign.



How to shape the EL wire on the sign

Once you learn the basic method for attaching the EL wire to the sign, it's pretty easy to make any letters or numbers you want to write!

You will need:

Peg board, EL wire, battery holder, pegs, *two AA batteries, black tape*

Here's how:

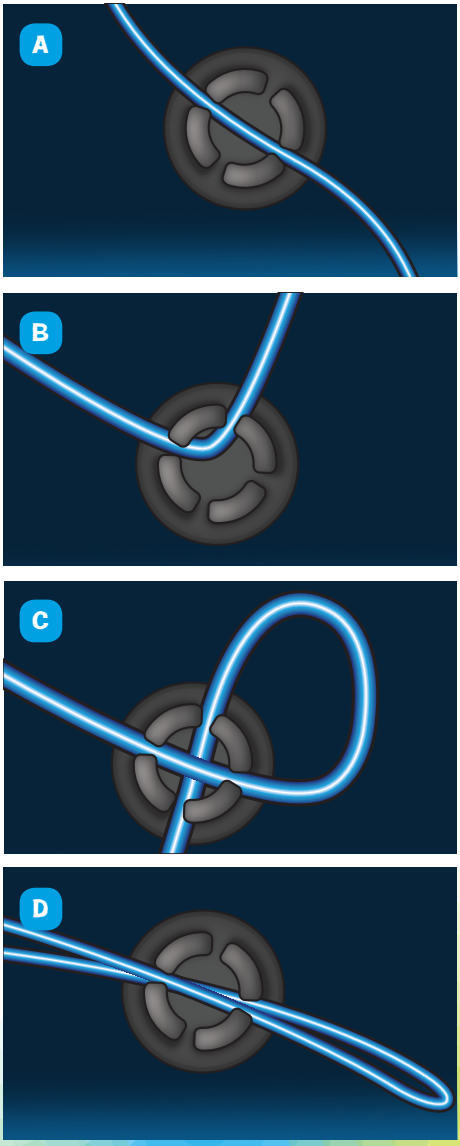
1. Unfold the peg board.
2. Insert a peg into a hole in the peg board.
3. There are a few ways to connect the EL wire to the peg board.

A **Straight across:** Simply press the EL wire into two of the peg's grooves straight across from each other.

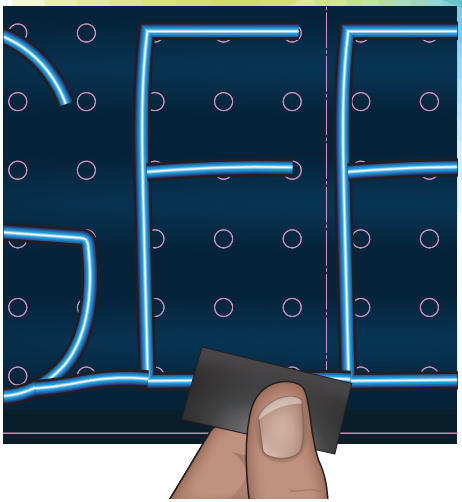
B **Corner:** Press the EL wire into one groove, bend it 90 degrees, and press it into the second groove.

C **Loop:** You can make loops of differing sizes by pressing the EL wire first straight across, then looping it around and pressing it through the other two grooves perpendicular to the first two grooves.

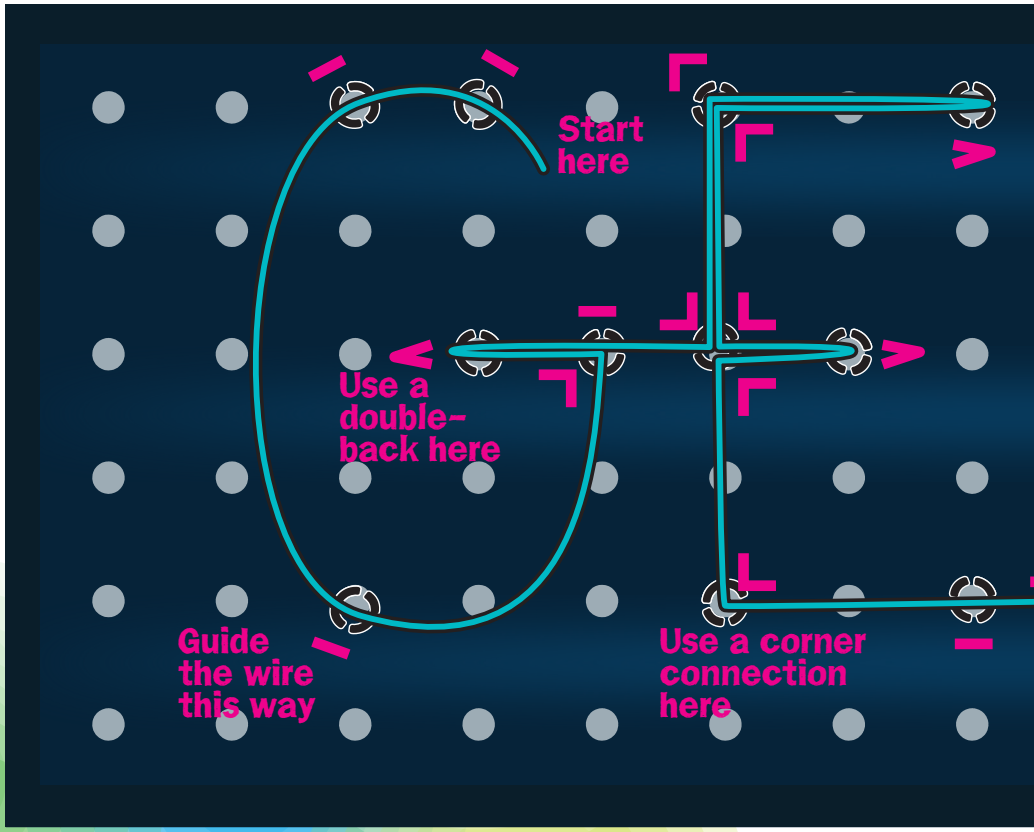
D **Double-back:** You can make a straight line where the EL wire exits the same way it enters the peg. Do this by pressing the EL wire first straight across, bending it 180 degrees back, and pressing it again through the same two grooves.



4 If there are any parts of the EL wire that you don't want to show up, you can cover them up with a little black electrical tape or black paper taped over the parts you want to mask out.



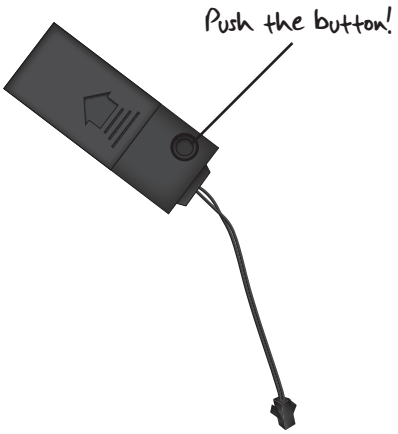
5 Now that you know how to connect the EL wire to the pegs, try your first word! Below is a guide to help you write the word "GEEK." It's a good place to start if you aren't sure yet how to do another word. Or you can look at the following pages for examples of other words, how to write your name, and individual characters.

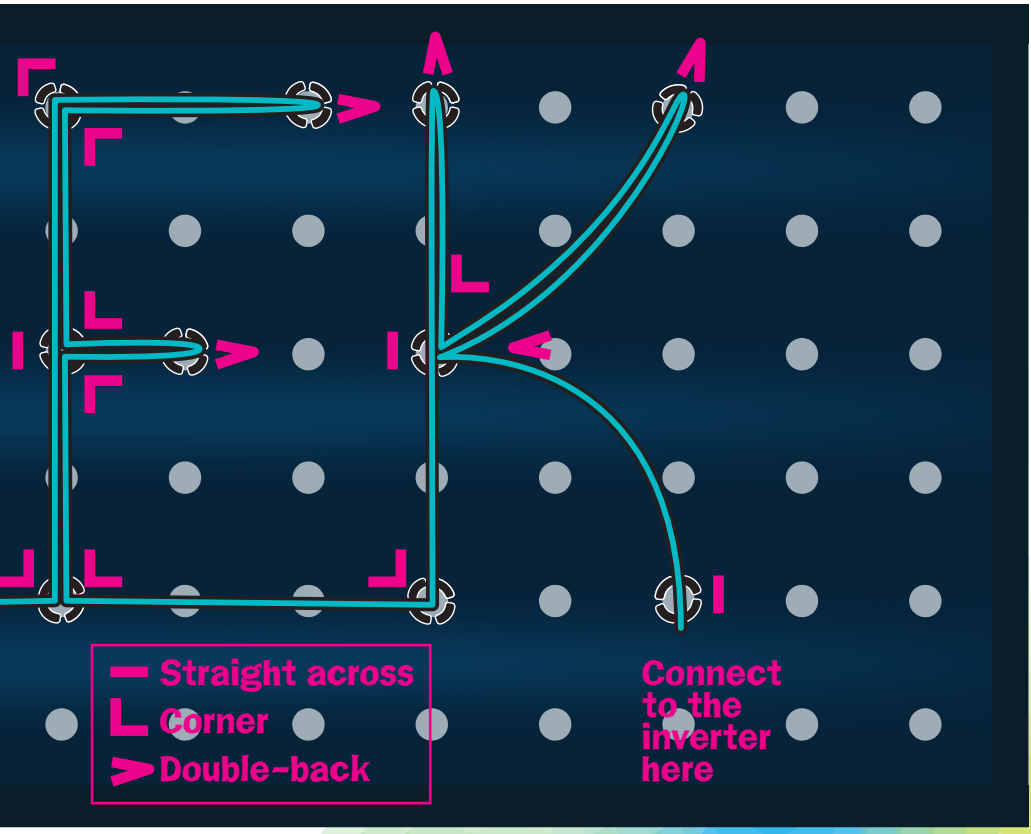


6 When you are happy with your EL wire sign, connect the inverter and press the button to turn it on. The inverter has four modes:

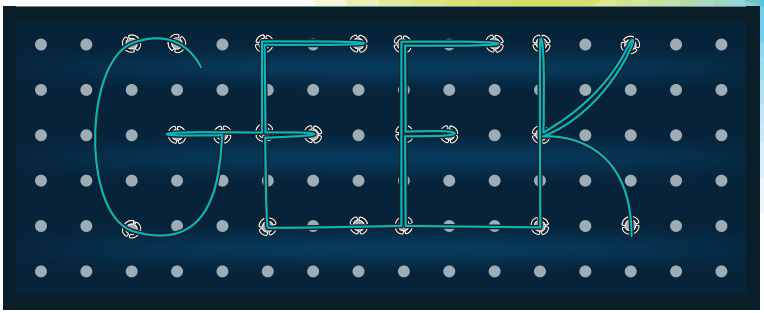
Constant on
Blinking slow
Blinking fast
Off

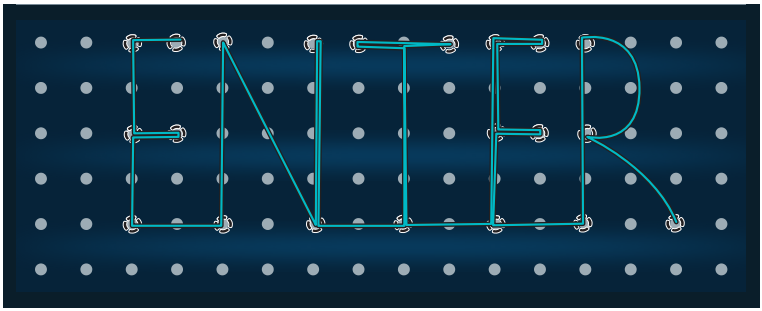
Press the button to cycle through the four modes over and over.

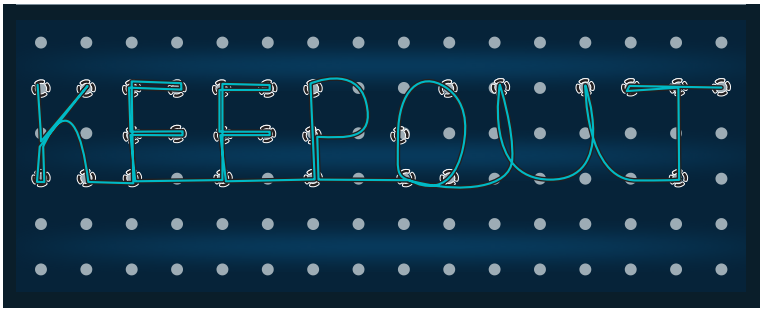


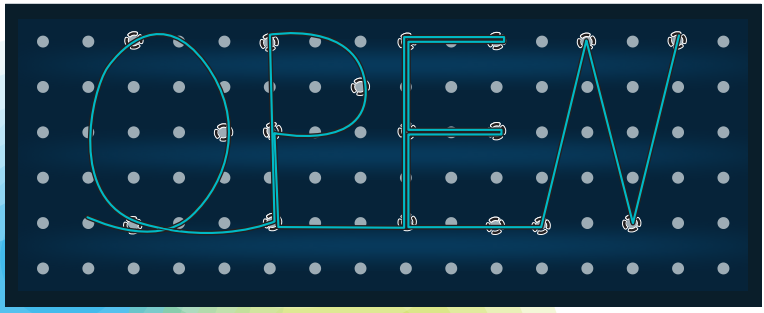


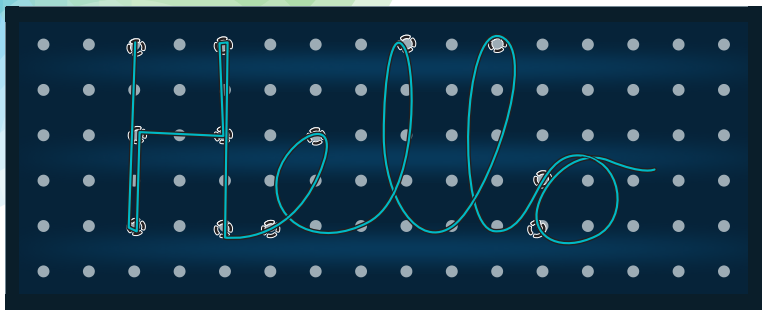
On these two pages, there are guides for making eight popular words.

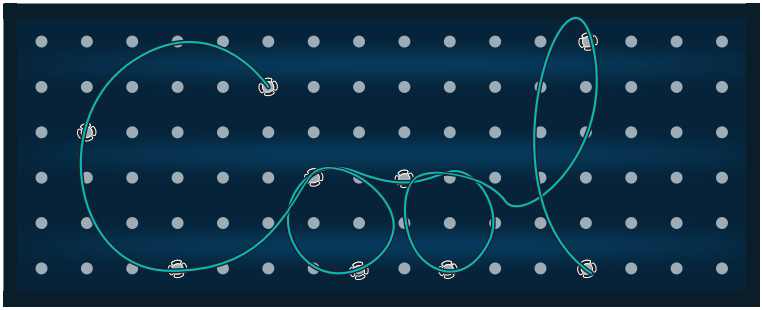


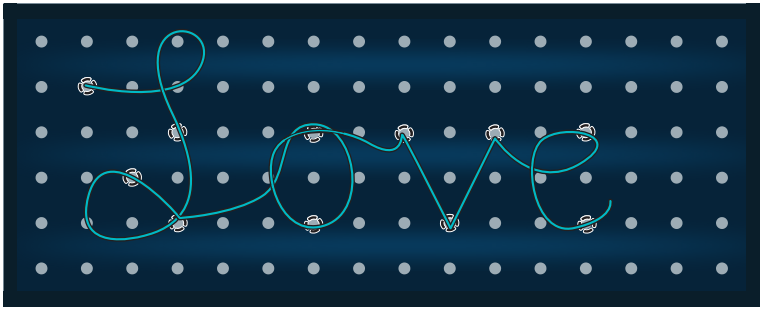


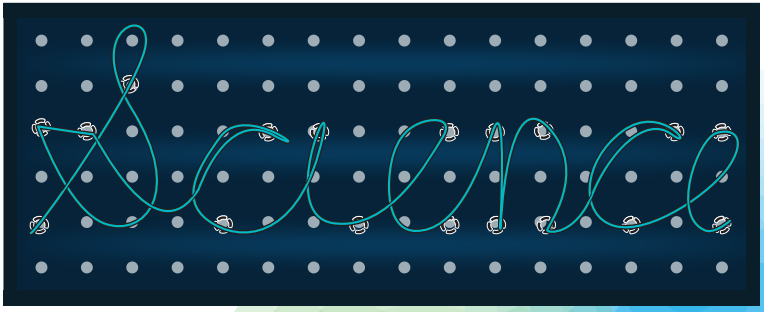




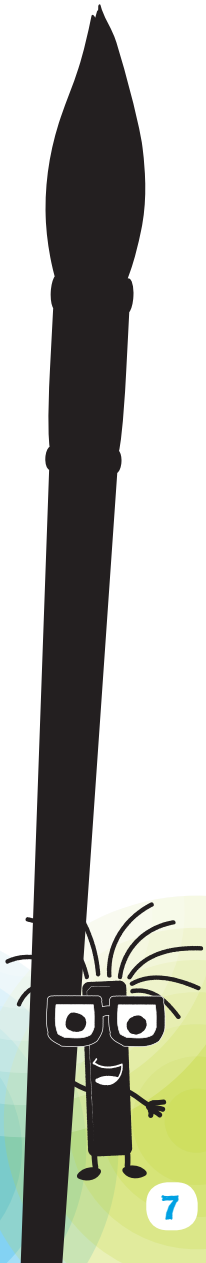




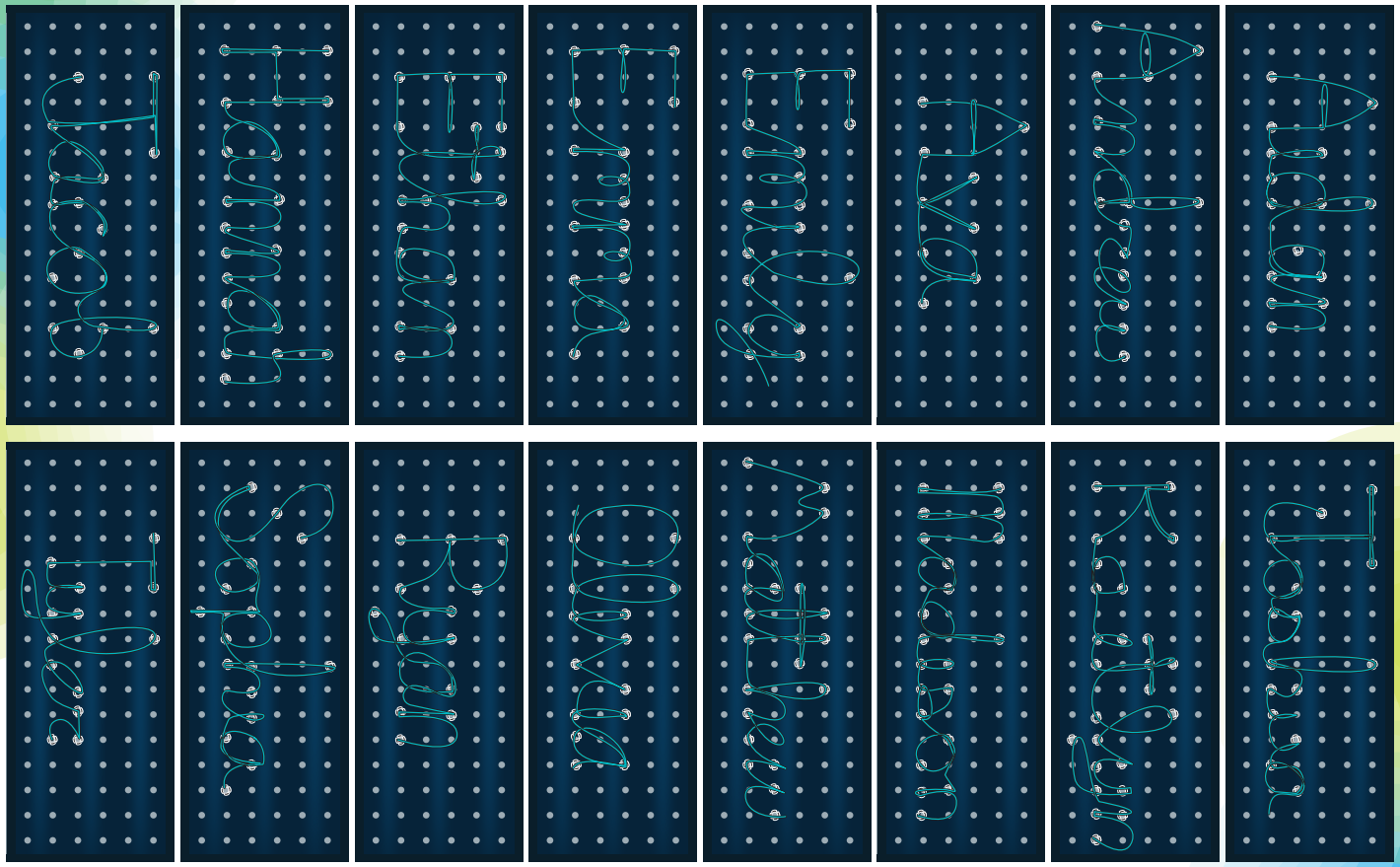




Notice how you can use a block letter style or a cursive style script.



On this page are some of the top names for babies over the past decade.



PART 2

MAKING IT YOUR OWN

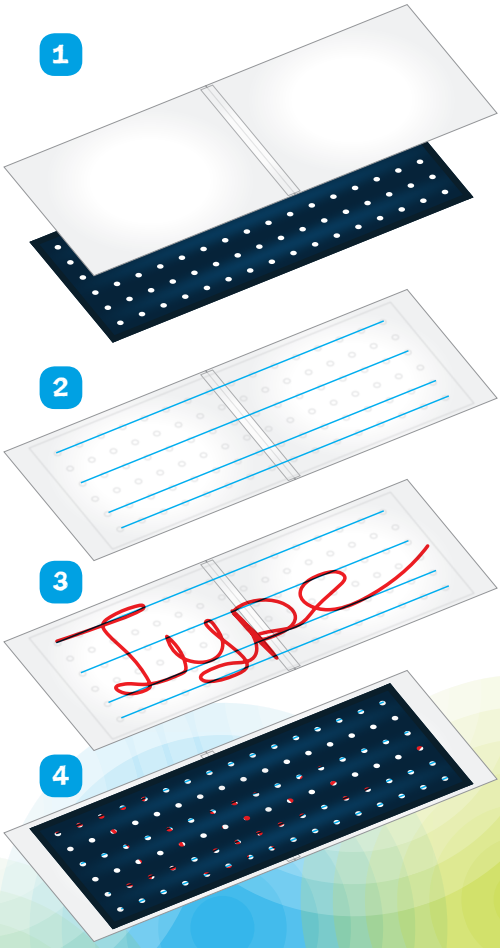
Designing your sign

You will need:

Peg board, EL wire, battery holder, pegs, *two sheets of white paper, tape, markers*

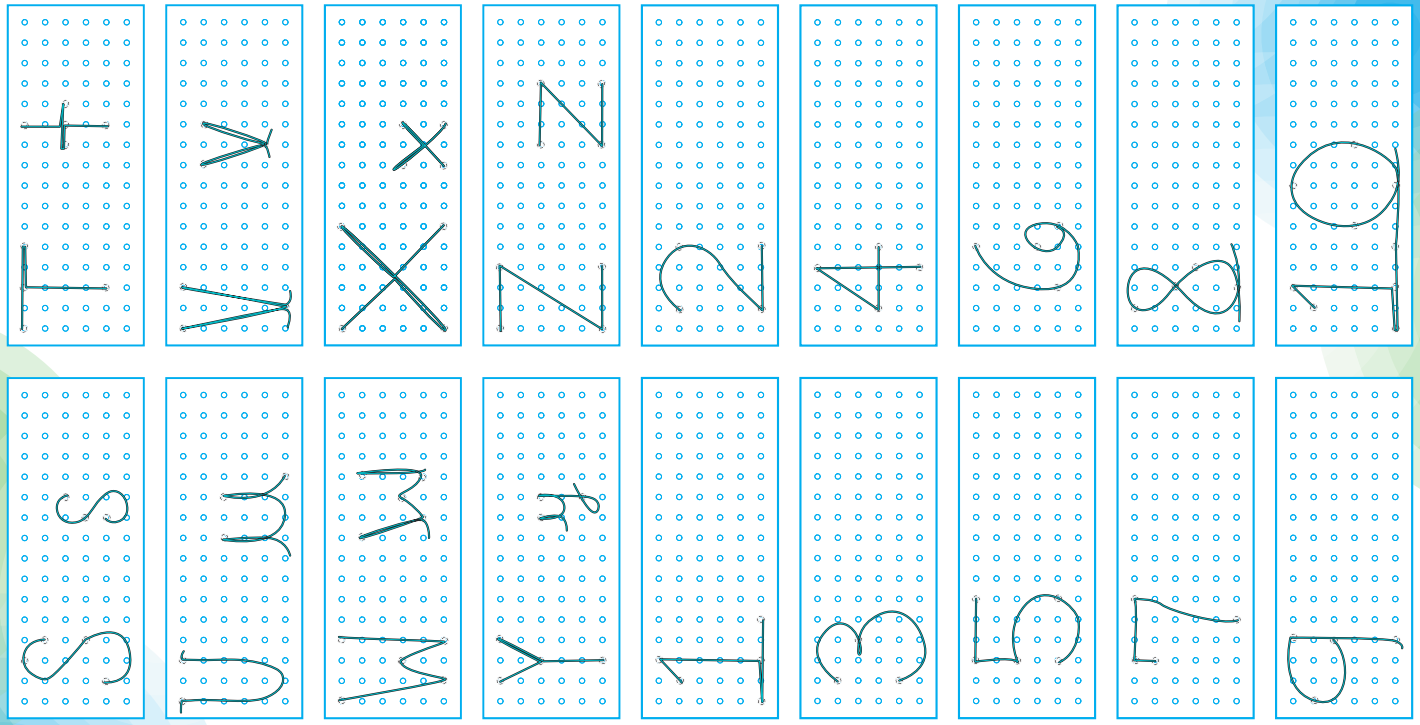
Here's how:

1. Tape two sheets of white paper together so they cover the entire peg board.
2. Draw horizontal guidelines on the paper by feeling where the holes are beneath the paper.
3. Draw your word in print or cursive, or however you like. Keep in mind the limited length of your EL wire.
4. Put the paper underneath the peg board. Through the holes, you can see where your pegs should go. Put some pegs into the holes.
5. Now you can guide the EL wire through the pegs. Use the drawing as a guide.
6. If you aren't sure how to make a specific letter or number, use the guides on the next page to help you.



Use these guides to help you make all of the upper case and lower case letters, and all of the numbers.

EL Wire Alphabet



PART 3

THE BIG UNVEILING

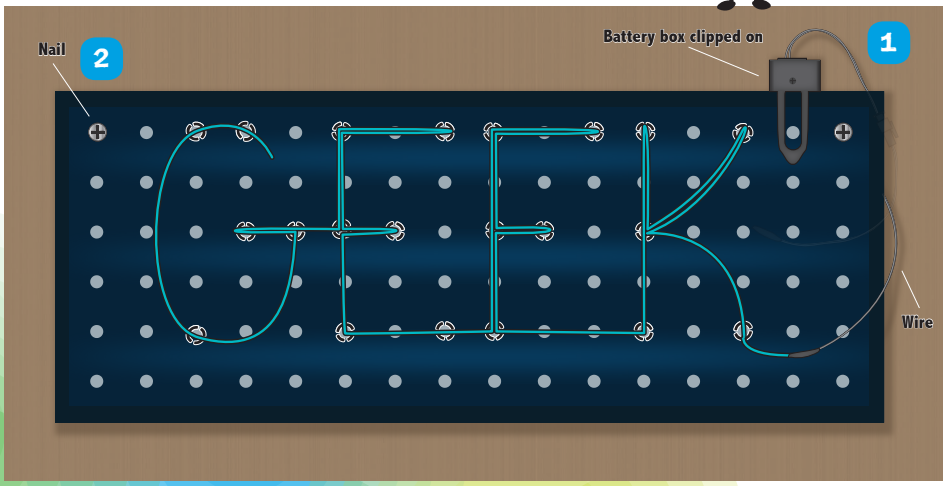
Hanging your sign

You will need:

Assembled sign, *tape, nails or thumbtacks*

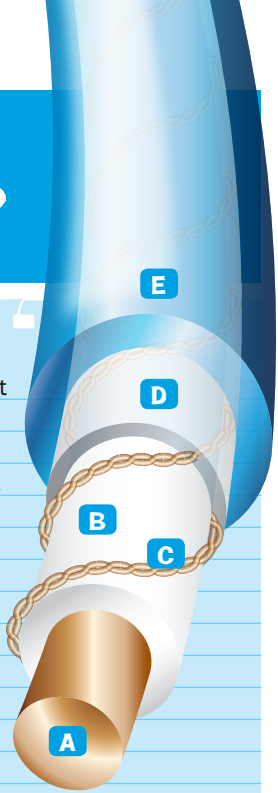
Here's how:

1. Clip the battery holder to the top of the sign. You can secure it with some tape if you like.
2. With nails or thumbtacks, attach the sign to the wall or door. Make sure you ask your parents for permission before you put holes in walls or doors.
3. Turn on your sign and let it glow!



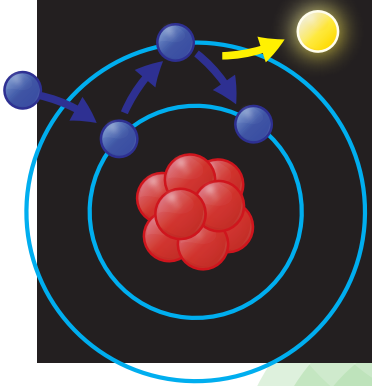
GEEK OUT!

HOW DOES EL WIRE WORK?



Electroluminescent materials are simply materials that light up (luminesce) when electric current flows through them. Invented in 1936 by **Georges Destraiu**, a French scientist, the earliest electroluminescent wires were not flexible or bendy. They were made of glass and rigid materials. When the glass was replaced by plastic years later, it became more flexible, waterproof, and less expensive. EL wire is made of the following components:

- **A** **Copper core:** coated with a phosphor layer
- **B** **Phosphor layer:** a solid substance that lights up when exposed to energy, like light or electricity. Phosphor can be **phosphorescent**, which stays glowing after the energy source is removed, or **fluorescent**, which only glows while the energy is present and for a brief moment after. Glow sticks and glow-in-the-dark stars are made of phosphor.
- **C** **Twisted copper wire:** wrapped around the phosphor layer
- **D** **Inner PVC plastic sleeve:** protects the inner contents and keeps them together
- **E** **Colored outer PVC plastic sleeve:** provides many different colors and a final layer of protection
- **F** **AC power source:** provides electric current that flows through the wires and provides the energy needed to make the phosphor layer glow



WHY DOES THE PHOSPHOR LIGHT UP?

Electricity excites **electrons** in the atoms in the phosphor layer causing them to jump up to another energy level. When they fall back down, they release light energy, or **photons**. The back-and-forth alternating current provides a continuous cycle of energy to excite the electrons and make the phosphor layer glow steadily. The current switches direction at a high frequency, many times per second. This high frequency is what gives the EL wire its subtle high-pitched sound.

GEEK OUT!

HOW DOES THE CIRCUIT WORK?

The **EL wire circuit** is pretty simple. It just needs a power source, an inverter, the EL wire itself, and connecting wires.

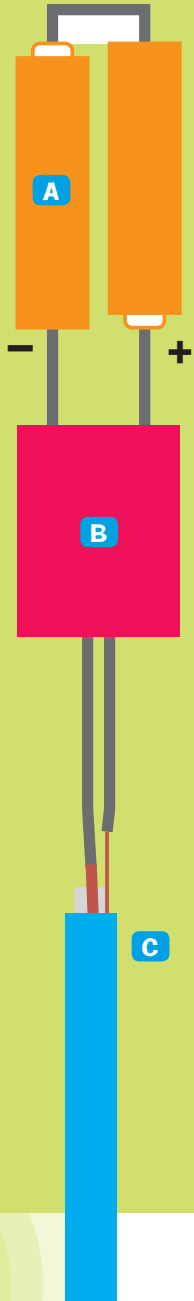
The **power source** A usually starts out as direct current, just like the electrical current supplied by the two AA batteries in the power source in this kit. Typically the batteries supply a direct current of 3 volts.

The electricity then runs through the **inverter** B. Inside the inverter, there are some electronic components. The most important of these are a transformer, a transistor, and a switch. The **transformer** consists of two windings of wire that are both wound around a common core. The transformer converts electrical charge in one circuit (the battery side) to electrical charge in a other circuit (the EL wire side) through electromagnetic induction. The transistor is what allows the current to switch directions back and forth over and over again. The switch allows you to turn the device on and off. The inverter produces a high voltage of perhaps 100 volts but at a very low current.

The DC to AC inverter is absolutely required because the very fast back-and-forth electrical charge is what makes the glowing effect continuous.

Finally the inverter is connected to the **EL wire** C. One wire from the inverter is connected to the thin copper wire and the other is connected to the thicker copper wire core.

Each meter of EL wire draws about 15 mA of current, or 1.5 Watts per meter. Two AA batteries provide up to 9 Watt-hours of power, so you can run two meters of EL wire for three continuous hours on two AA batteries.



GEEK OUT!

LIGHTING TECHNOLOGIES

There are so many different ways to generate light! Visible light is electromagnetic radiation that travels in very tiny bundles called **photons**, which are sort of like energy waves and sort of like particles. Here are some different lightning technologies.

Incandescent light is emitted by thermally hot objects. Have you ever seen a blacksmith's metal glow red hot or even white hot? That is incandescent light. Most incandescent light bulbs work by heating a metal filament by running an electric current through it. Conventional light bulbs and halogen light bulbs are examples of incandescent light.

Luminescent light is emitted without heat, and is also known as cold light. There are many types of luminescence. Chemiluminescence is light emitted by a chemical reaction, like glow sticks and glowing diatoms in the ocean.

Electroluminescence is light emitted from electricity flowing through a substance. Sound familiar? EL Wire, LEDs (light-emitting diodes), and back-lit liquid crystal displays are examples of electroluminescent lights.

Photoluminescence is light that is emitted as a result of other light that is absorbed. Examples of this are fluorescence, like tonic water or laundry detergent glowing under a UV black light, and phosphorescence, like glow-in-the-dark paint and glow-in-the-dark stickers that glow for a period of time after other light sources are turned off.

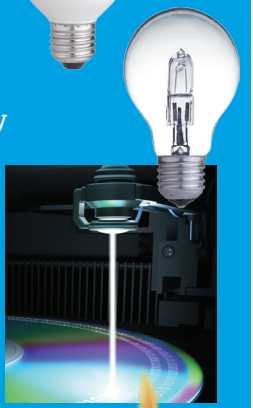
There is even light caused by mechanical action, such as when the bonds between materials are broken causing the release of energy as photons. A classic example of this is the spark of light you can sometimes see when someone bites a wintergreen candy in the dark.

Light can also be produced by crystallization, radiation, and sound waves!

GEEK OUT!

LIGHTING TECHNOLOGIES

Continued!



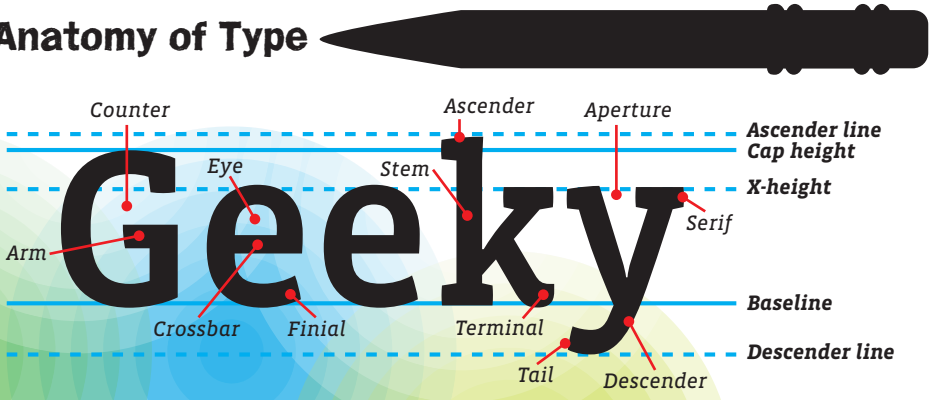
Gas discharge lamps generate light by sending an electric current through ionized gas, which forms a plasma. Examples include neon signs, plasma balls, black lights, and compact fluorescents.

High-intensity discharge lamps produce light from an arc of electricity jumping between metal electrodes inside a glass tube filled with special gases. The gases include mercury vapor, metal halide vapor, sodium vapor, and xenon. These lights are high-energy and very bright and are often used for indoor greenhouses.

Lasers are another type of lighting technology. The word "laser" stands for "light amplification by stimulated emission of radiation." Lasers use optics to focus electromagnetic radiation into highly focused beams of light. Examples of lasers are found in DVD players, laser printers, barcode scanners, and laser cutters.

Combustion-based light is another large category of light technologies. Combustion is a chemical reaction that releases heat and usually light. The best example of combustion is simply fire. Combustion is used in many light technologies, including candles, gas lanterns, kerosene lamps, oil lamps, fireworks, flares and even the torches cavemen are imagined to have carried around!

Anatomy of Type



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Notes on disposal of electrical components

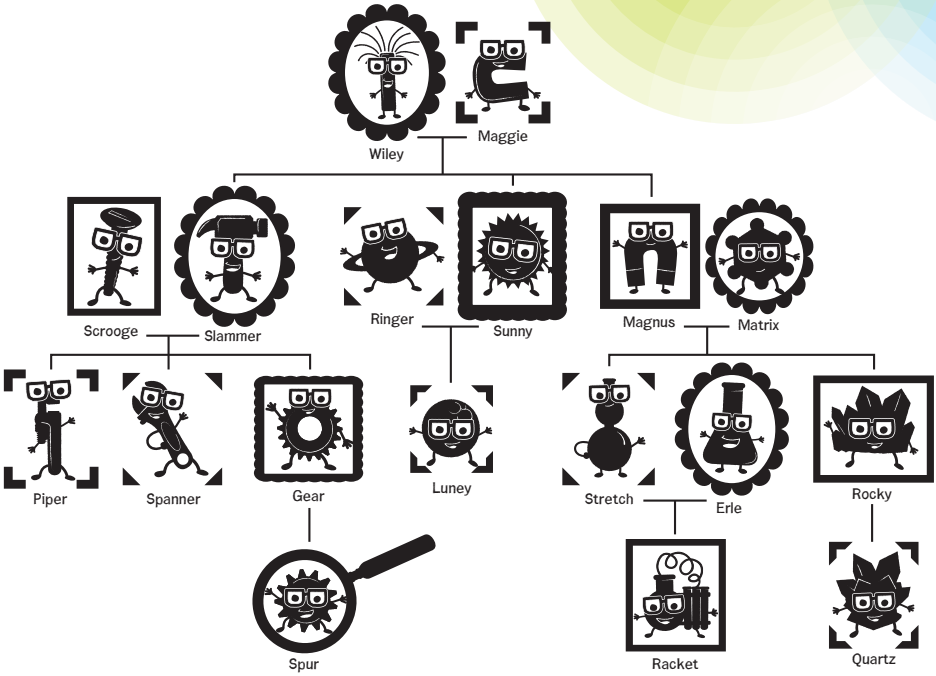
None of the electrical or electronic components in this kit should be disposed of in the regular household trash when you have finished using them. Instead, they must be delivered to a collection location for the recycling of electrical and electronic devices. The symbol on the product, instructions for use, or packaging will indicate this. The materials are reusable in accordance with their designation. By reusing or recycling used devices, you are making an important contribution to the protection of the environment. Please consult your local authorities for the appropriate disposal location.

Information to users

FCC Part 15 Subpart B Verification

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.
Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.
NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, maybe cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:
- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different form that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

MEET THE GEEKERS!



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