Easy Tesla Coil!

by DrewPaulDesigns

Wireless electricity is here! From wirelessly powered lighting to wireless chargers and even wireless smart homes, wireless transmission of power is an emerging technology with innumerable applications.

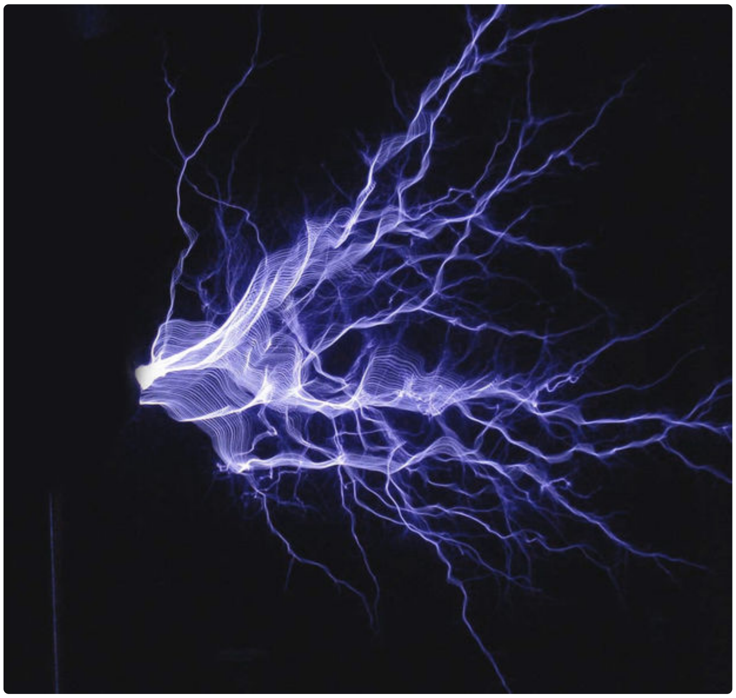
A light bulb powered with no wires? A cell phone charger that doesn't need to be plugged in? A home with no plugs, no wires and everything just 'works'? It's not magic, it's no mystery, it's science!

The invention of wireless power transmission is typically attributed to 20th century inventor Nikola Tesla, though the technology may have been in use much earlier. Since then, however, improved designs and modern components make this an easy DIY project anyone can do with just a few simple parts!

Let's get started!

FUN FACT: A Tesla Coil can even create mini lightning bolts that spark from the surface!

CAUTION: Do not use near persons with pacemakers, sensitive electronics or flammable materials.



Step 1: Here's How It Works

Electricity needs to travel through wires, right? Well, not anymore!

This simple device shows how electricity can be transmitted wirelessly to power all types of electrical devices for convenience, necessity or just plain awesomeness!

Here's how it works. We are creating a system that converts a low voltage to a high voltage and simultaneously turns itself on and off very quickly. That's all it takes to transmit wireless electricity. A few volts of electricity are passed to one side of a coil of wire and to a grounded capacitor connected to the negative side of the power supply. The other side of the coil is connected to the collector of a transistor, a device that can turn off the flow of current based on an input signal, and then to ground as well. This causes two things to happen. The capacitor begins to charge while the coil (based on this) begins to radiate an electromagnetic field. This coil is then placed around a second coil with many more windings of a smaller gauge wire which creates a transformer, converting a low input voltage to a very high voltage in the second coil. This secondary coil is then connected to both a resistor connected to the power source and the base of the transistor which then shuts off the flow of current to the first primary coil.

This circuit configuration creates a feedback loop which automatically turns on and off the secondary coil hundreds of times per second which creates a high voltage, high frequency electric field capable of transmitting wireless electricity!

Simple enough, right?

FUN FACT: A transistor is what makes the processors in computers work, so, in essence, we are building a super simple computer to control our Tesla Coil!

Step 2: What You'll Need

The coolest thing about this project is its simplicity! This is the world's simplest and easiest Tesla Coil circuit design! With just a few simple parts you'll be creating your own mini lightning bolts and powering things wirelessly in no time!

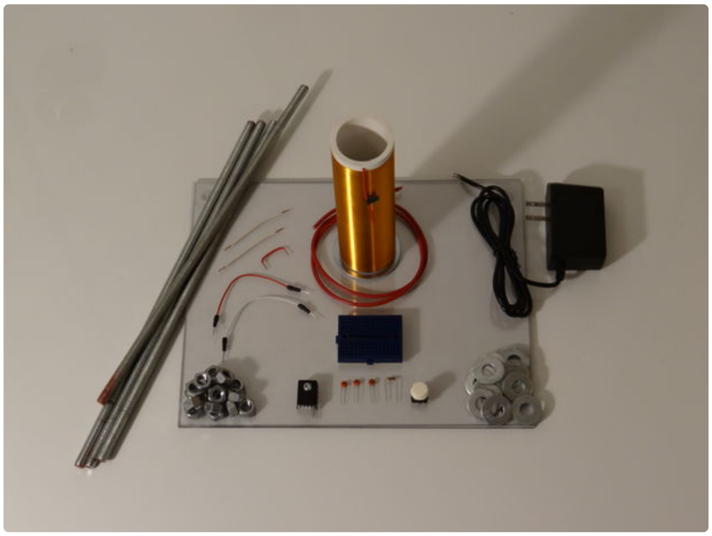
Here are the parts you'll need:

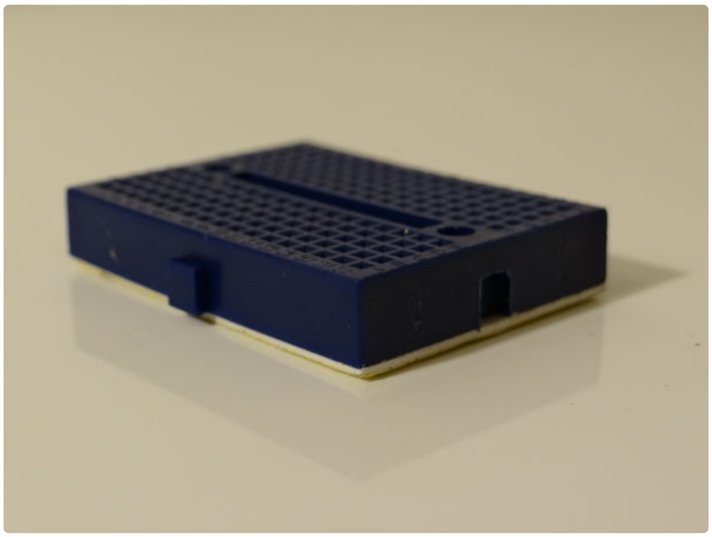
(1) Breadboard Circuit (A-J/1-17)
(1) MJE3055T Transistor with Heat Sink
(3) 104 .1uF Ceramic Capacitors
(1) 1K Resistor
(1) Solid Core 16 ga. Insulated Copper Wire, ~1.5ft.
(1) PVC Pipe 2" x 2.5" diam.
(1) AWG 27 Insulated Magnet Wire
(1) PVC Pipe 7" x 2" diam.
(1) 3" Steel Washer
(5) Jumper Wires
(1) 12v/1A Power Supply
(2) 8" x 10" Plexiglass Sheets
(4) 5/15" Threaded Rod
(16) 5/16" Nuts
(16) 5/16" Washers
(8) 5/16" Rubber End Caps

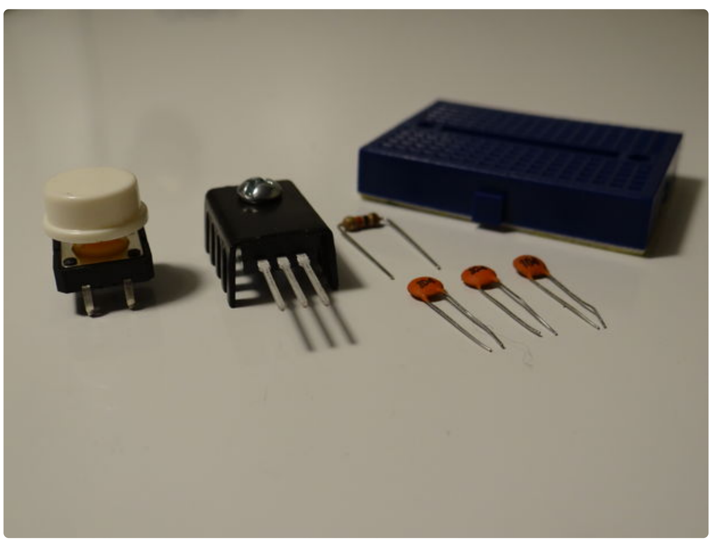
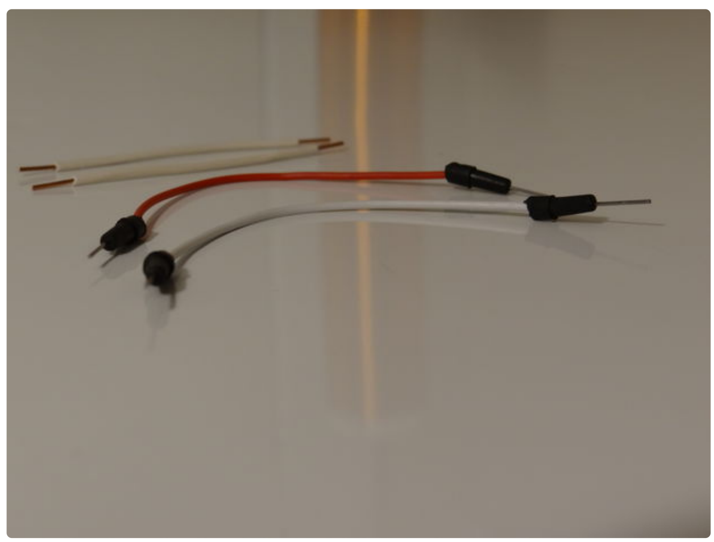
GET THE FULL KIT

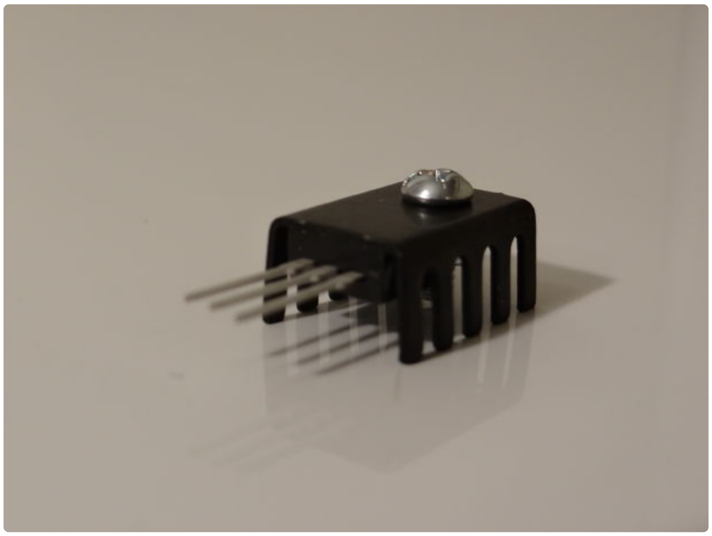
Also, get the circuit diagram here.

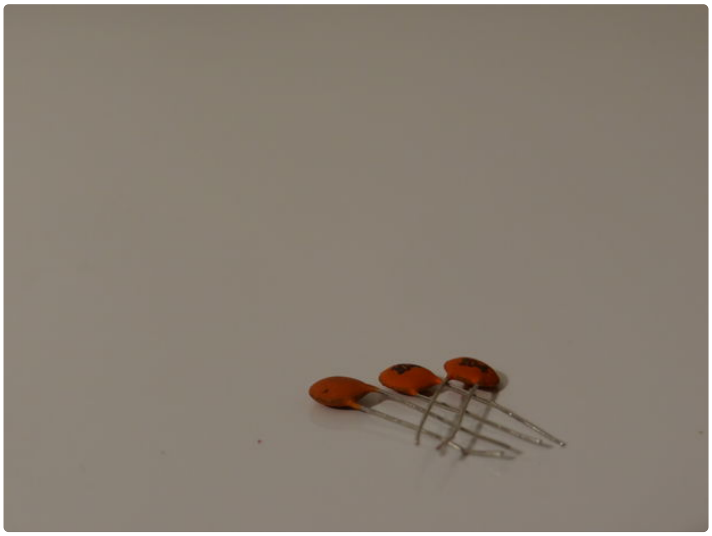
FUN FACT: Tesla used a high voltage spark gap to control his circuit; we'll be using something a bit more modern and reliable, an MJE3055T transistor.

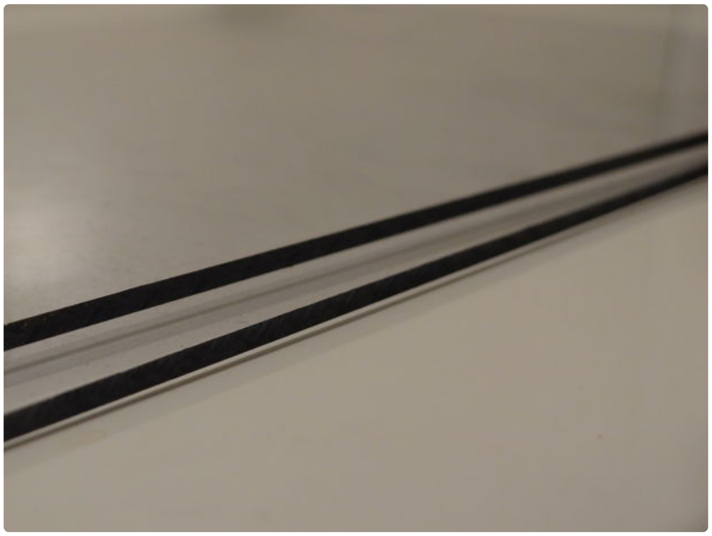










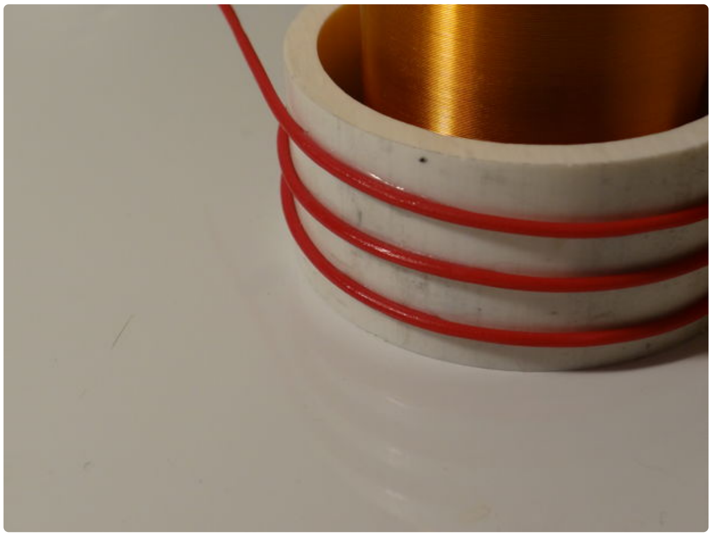
Step 3: Wind Your Coils

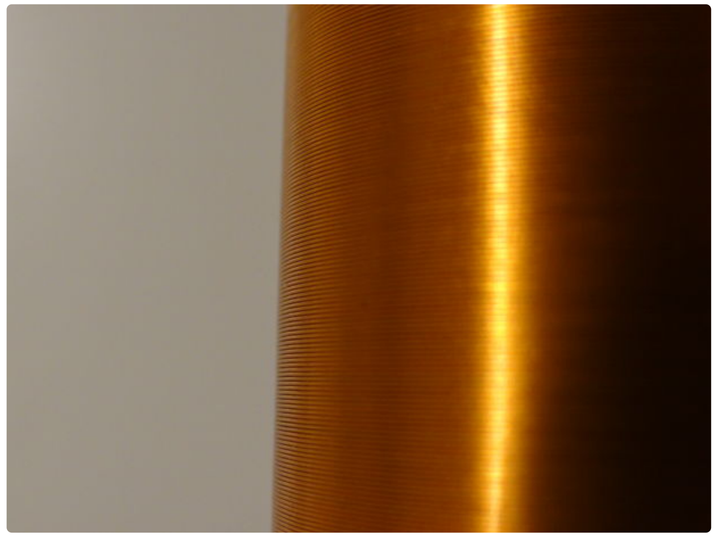
To begin, we'll need to wind out coils. To do this, we'll need to be precise and accurate otherwise our coils won't function properly.

Get pre-wound coils and full parts kit here

First, we will make our primary coil. We will wrap our short 2.5" PVC pipe with the 16 ga. Insulated Copper Wire making three rotations evenly spaced about 1/4" apart and secure with tape. Then strip the ends.

Next, we will take our 2" PVC and line up the magnet wire across about 1/4" from the bottom and secure it with tape leaving several inches extra on the end. Now comes the tedious part so get comfortable. We will now wrap the magnet wire around several hundred times until we reach around 1/4" from the top. Be sure to wrap tightly, straight and without gaps between windings. Also, be sure to add a piece of tape every inch or so to keep everything secure. Once you reach the top, leave a couple inches of additional wire, cut and strip both ends by lightly sanding the ends of the wire. Then you can secure your winding by wrapping with tape from top to bottom. Lastly, press the stripped wire end between the top of the PVC and your 3" washer and secure with glue. This will act as your secondary coil and transmitter cap.





Step 4: Build Your Circuit

There are only a few parts, so building your circuit is simple. Just make sure to have the circuit diagram handy while following along.

First we will install the three legs of the Transistor in breadboard slots E1, E2 and E3 with the heat sink and front of the transistor facing back toward slot F.

Next we will insert the three capacitors into slots H14/H17, I14/I17 and J14/J17 respectively so that they are in parallel.

Now, lets connect the first leg of the transistor to one side of our capacitors with a jumper wire. Connect one end of a jumper wire to slot D1 and the other to F14.

Next, we'll connect a jumper wire from the other side of our capacitors back to where our ground will be. Connect one end of a jumper wire to slot F17 and the other end to slot D5.

Insert one end of your resister on the same column, slot C5, and the connect the other end of the resistor to the base of the transistor by inserting it in slot C3.

Next, connect one last jumper wire to slot A5 and the other end to slot B11. This will allow us to connect to our primary coil.

We will now insert our secondary coil into our primary coil keeping it centered.

The bottom wire of your primary coil can be inserted into slot A11. The top wire from your primary can be connected to slot A2. Connect your secondary coil by inserting the bottom wire into slot A3, and the base of your transistor.

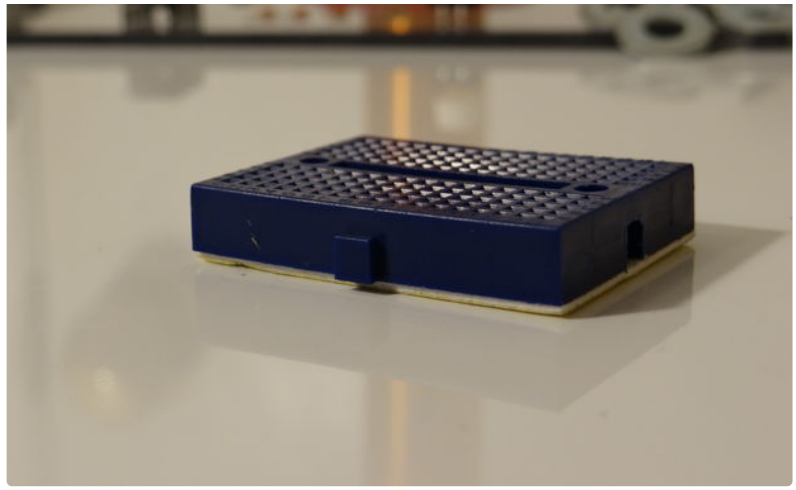
Check all connections before proceeding.

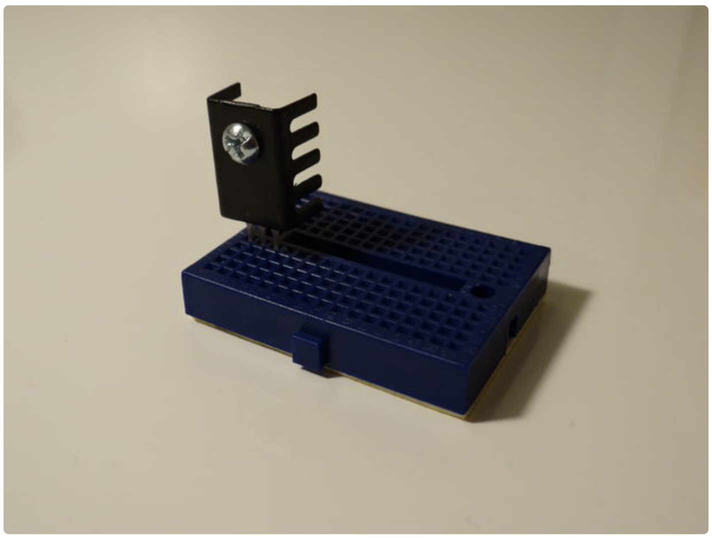
Lastly, connect the positive from your power supply (+) to slot B5, and connect the negative from your power supply (-) to slot B1.

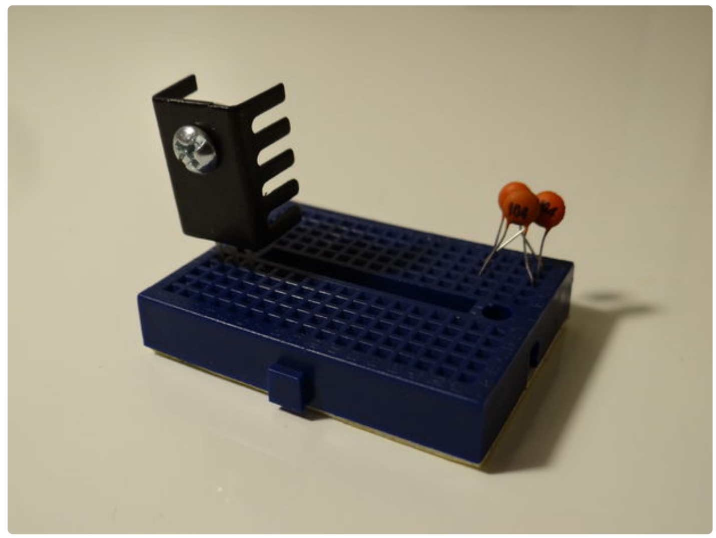
You may now carefully test your circuit by plugging it in momentarily.

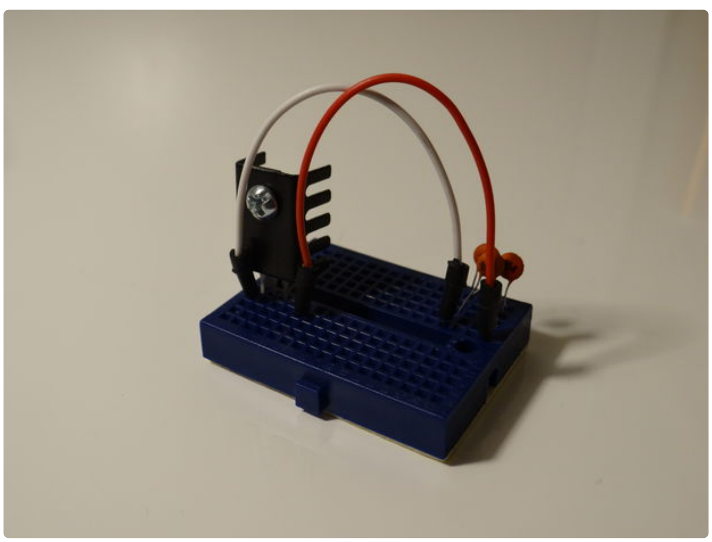
NOTE: To avoid overheating, only power your Tesla Coil for short durations of no more than 20 seconds or less.

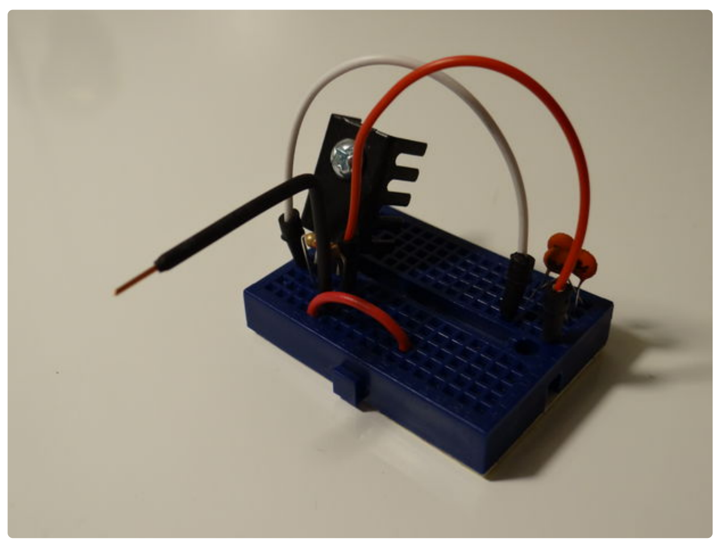
Picture of Build Your Circuit

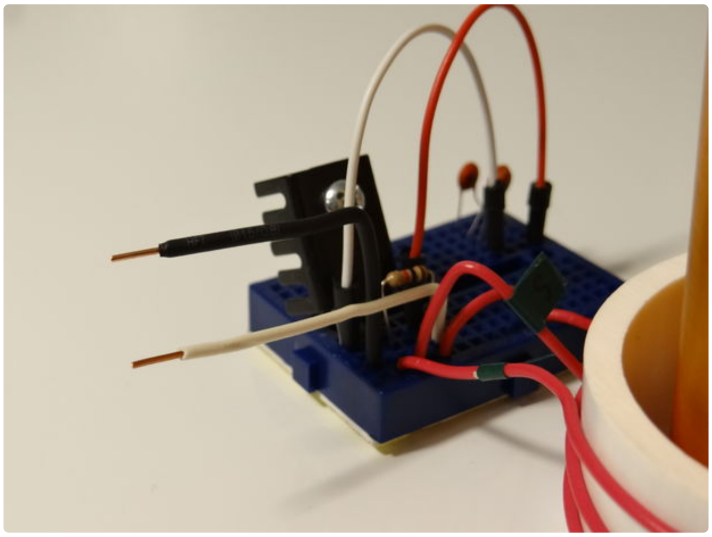
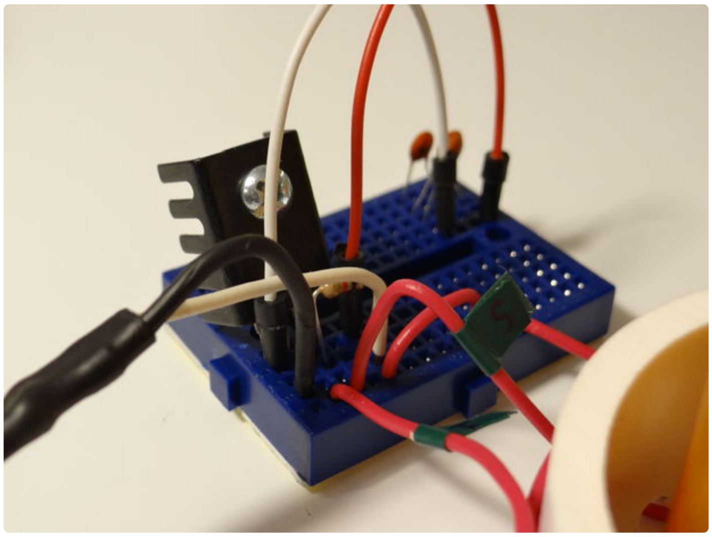










Step 5: Construct the Enclosure

Now we will build an enclosure to display our Tesla Coil. This enclosure is also important in order to isolate the coil from flammable materials and sensitive electronics as well as to keep the coil upright and to provide a platform for experimentation.

First we will place a washer, nut and end cap on each of our threaded rods. Then we can drill a 5/16" hole in each corner of our plexiglass sheets.

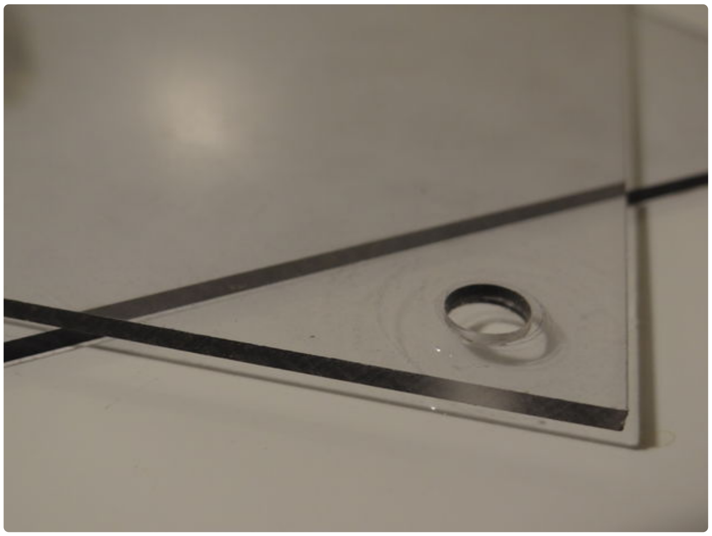
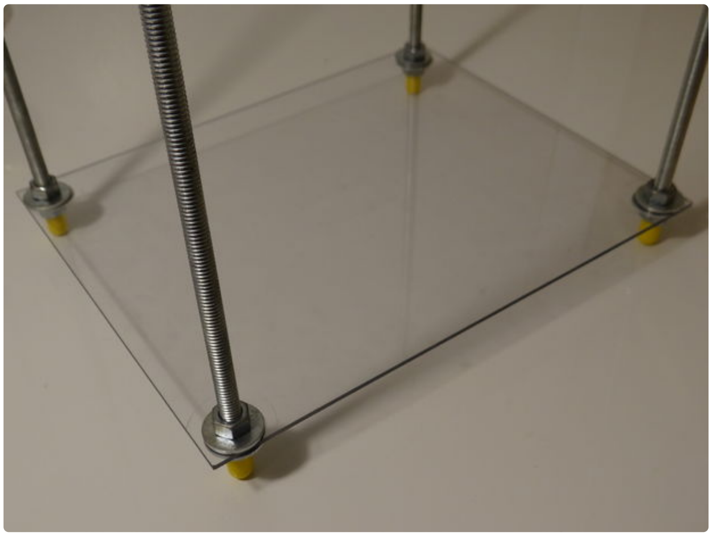
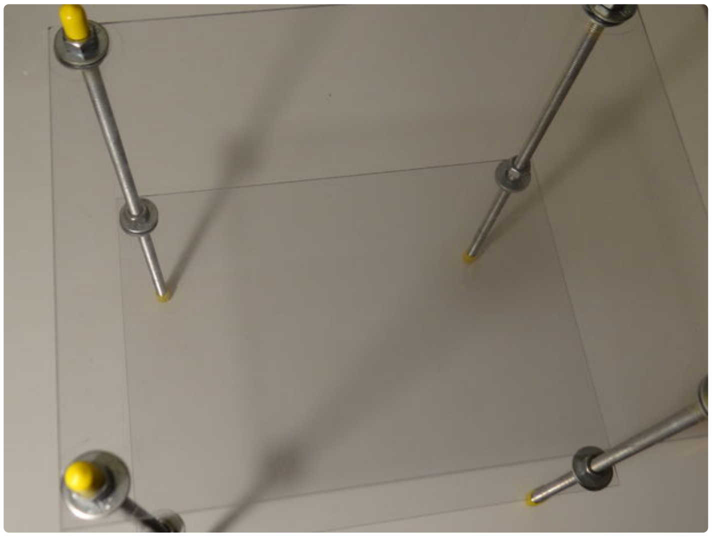
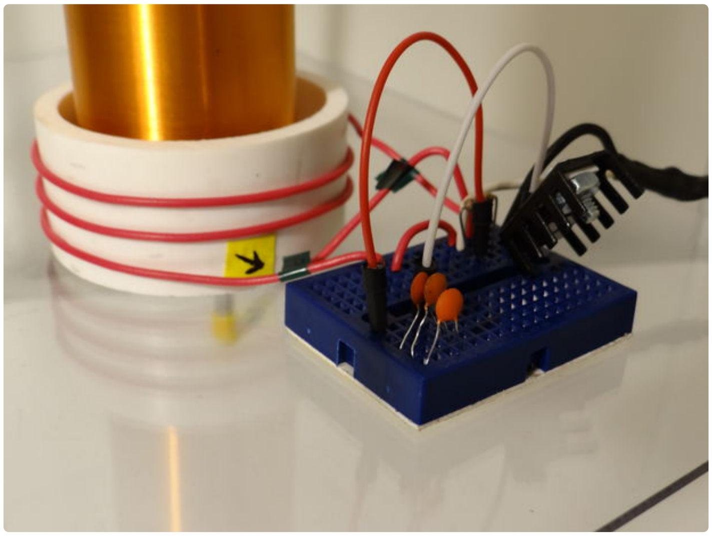
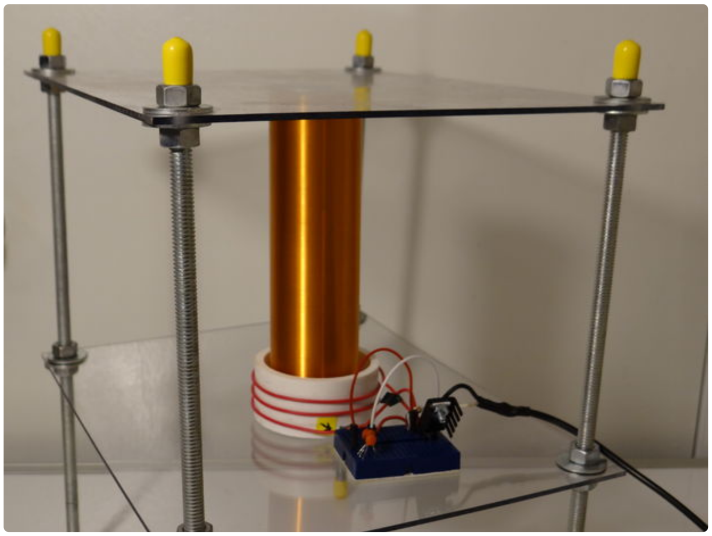
Then insert the four rods into the holes in one of your plexiglass sheets and add a washer and nut to secure, creating the base of the enclosure.

Next, place your circuit and coil on top of the sheet, making sure it is centered, and remove the adhesive backing from the breadboard in order to affix it to the platform.

Lastly, add a nut and washer to each of the rods, place the second plexiglass sheet on top and adjust in order to tightly hold the coil in place. Once secure, add an additional washer and nut to each rod, tighten and add an end cap to each.

Your enclosure is now complete and your Tesla Coil is now ready to use!



Step 6: Experiment, Observation and Operation

Now that your Tesla Coil is complete you can begin your experimentation.

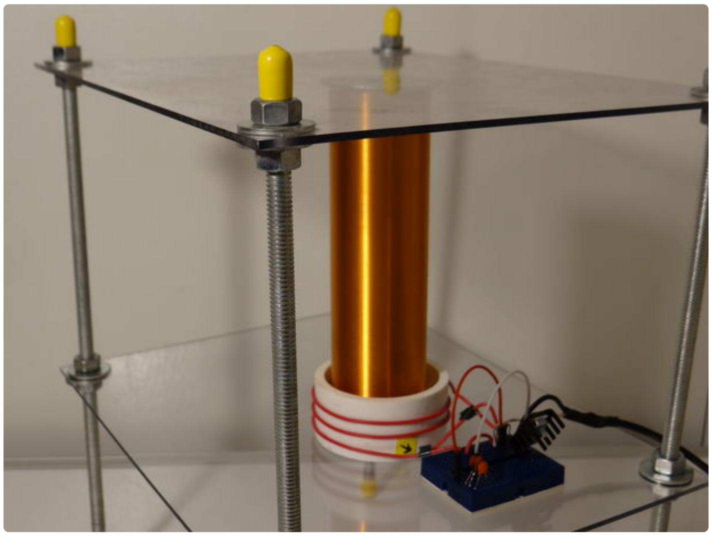
You can now connect the power and watch as florescent bulbs light up like magic once placed near the coil. Watch as sparks fly when metallic objects are place near the coil (take caution) or use a digital multi-meter to observe the high voltage field at varied distances from your coil.You can even tune your coil by lifting or lowering the primary coil to see the effects of different positioning.

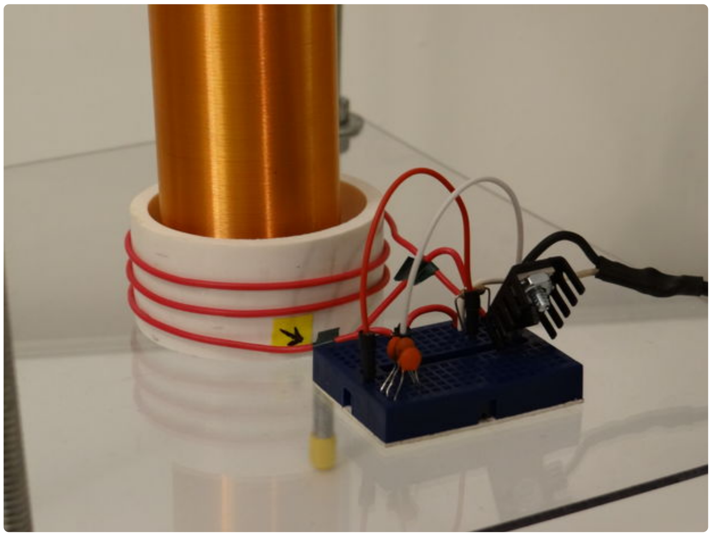
Want to take it a step further? Add a resistor to an LED to to create your own wirelessly powered light bulb. You can even experiment with wireless charging coils to create your own wireless charger for mobile devices. The possibilities are endless!

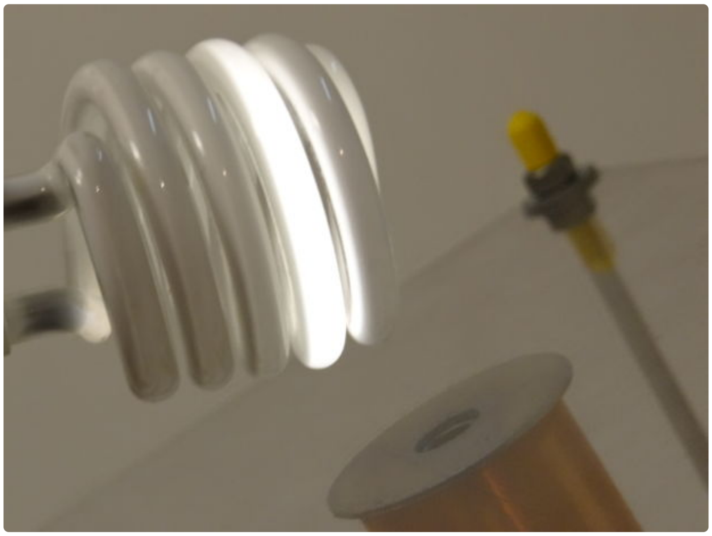
What real world applications does this technology have? How can this technology be used in the future? What will you do with your Easy Tesla Coil?

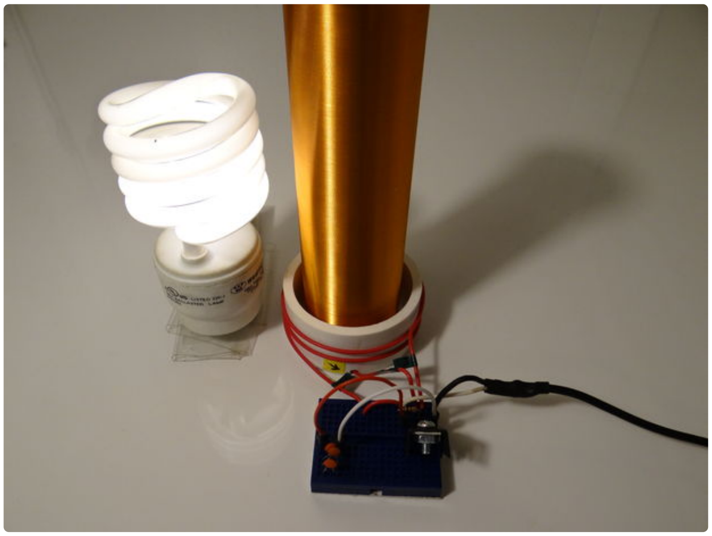
Give this project a try and let us know how yours comes out by posting pictures, comments and questions in the comment section below!

Learn more at: http://DrewPaulDesigns.com
Get the Kit: http://drewpauldesigns.com/easy-tesla-coil-kit/









Thanks everyone for checking out my project! Wireless electricity is the technology of the future and I am so glad to see so many people taking interest in this project! If you have any questions, need help or just want to chat about the incredible inventions of Nikola Tesla, feel free to get in touch!

I posted this in the wrong place so am reposting it here.
It seems this is the new "darling" technology. But what everyone ALWAYS fails to mention is that, while it works, it isnt an efficient way to move power. Wires are much more efficient and in a world where wasting power requires oil resources,I would think the greenies would be against ti. Its like filling a glass with water from 10 feet away with a garden sprinkler. It takes a lot of water to fill that glass. Cute and a parlor trick but it wasnt useful when Tesla did it and it still isnt useful. Saying things like, "wireless transmission of power is an emerging technology with innumerable applications" is grossly misleading. $200 for a toy is expensive.

The thing that makes this such a 'darling' technology is that it is currently being adopted by the U.S. Military. The modern soldier is loaded with electronics from GPS to night vision, smart rifles and cameras to H.U.D. in the helmet, and they are all wirelessly networked. That requires a lot of constantly available power, which can be (is) broadcast over a battlefield to keep everyones batteries constantly charged. The important part is that it has progressed out of the research/experimental realm and has reached the stage of semi-practicality, at the least. While the military may not be above spending far too much for seemingly little return, one thing they are is efficient so they will waste no time in perfecting the science. Now we can see what exactly the chemtrails that used to be a conspiracy theory are really all about: For the past decade and a half they have been dumping ionizing particles into the atmosphere to make it more conductive....

Your last sentence is "tongue in cheek" right?

I see you chose the blue pill....

"Using the 3.6-megawatt high-frequency (HF) HAARP transmitter, the plasma clouds, or balls of plasma, are being studied for use as artificial mirrors at altitudes 50 kilometers below the natural ionosphere and are to be used for reflection of HF radar and communications signals.

"Past attempts to produce electron density enhancements have yielded densities of 4 x 105 electrons per cubic centimeter (cm3) using HF radio transmissions near the second, third, and fourth harmonics of the electron cyclotron frequency. This frequency near 1.44 MHz is the rate that electrons gyrate around the Earth's magnetic field.
"The NRL group succeeded in producing artificial plasma clouds with densities exceeding 9 x 105 electrons cm3 using HAARP transmission at the sixth harmonic of the electron cyclotron frequency."
https://www.nrl.navy.mil/media/news-releases/2013/nrl-scientists-produce-densest-artificial-ionospheric-plasma-clouds-using-haarp

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Whoa, cool!

I think what makes this seem inefficient is the fact that energy is propagated radially, out in all directions. So, at any given point, the energy transfer may seem inefficient. This circuit runs very efficiently and with minimal heat output. The challenge is to capture all the energy radiated from the coil.

I did some tests and an article can be found here if you're interested in reading more: WIRELESS ELECTRICITY, EFFICIENCY AND IMPLICATIONS http://drewpauldesigns.com/2016/04/wireless-electricity/

Since its radiating in all directions it would take a full enclosure sphere to capture it all and then where are you....back at the start with the power supply contained within the receiver and no "wireless transmission" at all !!

That is funny, good point! But, consider that in some applications connecting devices with no wires is beneficial even if it is a bit less efficient.

Wireless electricity is beneficial for convenience, for example. Wireless mobile chargers are convenient because they allow you to toss your cell phone on a pad instead of dealing with plugging in wires, even if it takes a few extra minutes to charge.

Can you think of any other applications where wireless electricity could be used?

Wireless

I'm confused. If it has "minimal heat output" then why do you have to warn people to run it for only 20 SECONDS at a time so it doesn't OVERHEAT? Also, what's the point of having a bunch of these to power lights and stuff, if you can just connect the lights directly with short pieces of wire? Plus, if you did have one for lights all over the house, how would you turn lights on and off individually?

No, I'm afraid these things will never be anything more than fascinating science demonstrations.

I see how it can be a bit confusing, but the inefficiency is in the transistor not in the circuit and coil.

Thanks for finding my article fascinating! Stay tuned for more projects!

I can understand that you are offering a kit of parts to make building the project more convenient, but for those that would like to provide their own materials it would be nice if your parts list was more complete. After all, this site is called Instructables and the intent is to show readers how to make something. The information provided isn't complete enough for someone to replicate your work without buying what you're selling.

The wire gauge and estimated length for the secondary coil isn't provided.
The estimated length of wire needed for the secondary coil isn't provided.
The voltage rating of the .1uF disk capacitors isn't specified. Why not use a single 0.33uF capacitor?
The heat sink used isn't specified along with the fasteners used.
The threaded rod used isn't specified along with the nuts, washers, and plastic caps.
The plexiglass top and bottom plates aren't specified.
The 1K resistor power dissipation or tolerance value isn't specified.
The current rating of the 12V power supply isn't specified.

The above also isn't covered on the your web site. So I'm not sure what a customer would actually get if they ordered a kit. The Instructable mentions "pre-wound coils" but the web site doesn't. It says you get a roll of magnet wire. So it's not clear whether the buyer has to roll their own secondary or not. Certainly it looks like the primary coil has to be wound because the web site just shows a pile of #16 wire.

I estimate you have maybe $25 to $35 in parts for this project, but your web site is asking for $200 plus shipping which frankly I think is unreasonable.

I think this is an attractive project, but it needed more attention to detail. Especially if offering a kit for sale. I wouldn't purchase a kit based on the information provided on the web site.

NetZener

Ummmm.... The parts list specifies AWG 27 Insulated Magnet Wire, which is .0142" in diameter, giving us about 70 rows/inch. We need 6.5 inches (7" - (1/4" * 2)) means 457 turns. Circumference = pi * diameter, or 6.28" per turn, gives us 2,875" or so, leaving 2" at each end. It works out to roughly 240'.
There are pictures of the capacitors, and we all know 3 .1uF caps in parallel is no different than a single .3uF.
As for the heat sink, the photo should help you a little, and as far as a bolt size, I think anything that fits will work.
I could go on, but my point should be readily apparent.
Instructables are for Makers. By definition we improvise, tinker and find ways to make things work. We do not need safe spaces, step-by-step instructions, or anyone to think for us. Unfortunately, our liberal, left-wing saturated education system is hell-bent on teaching what to think rather than how to think nowadays. So far Gen-X, Gen-Next and the Millennials have all failed to out-perform their preceeding generation. Did Western civilization reach it's zenith with the baby-boomers, or is there hope for Gen-Z, despite their parents? And when did they stop teaching basic math?

A nephew of mine came over to the shop one day and said, "Can you show me how to make a bird house? I want to make a bird house". I said, "Sure! I think I have some stuff that will work". We spend the rest of the day working on it and his dad put it up in his back yard. I used a plan recommended by a community of folks that knew a lot more about bluebird houses than I did. We went step-by-step. I described the materials we used, how the tools worked, taught him a little about shop safety practices (I admit it was mostly warnings not to touch this without me present), even told some exaggerated stories about birds during the tedious bits. With just a little instruction from me, he painted it himself and was very proud of the work. He held it up to his mother and said, "Mom! I made a bird house. I made it!"

I consider my nephew a Maker. And as a Maker myself, I got to show him how to do it in a safe place in a step-by-step way. We could have just bought a bird house from a store and painted it. It would have been much cheaper and easier. But building it together was a great way for us to connect socially and for me to share some of my experience.

Sure he's a Millennial and I'm a "boomer". I didn't stab him or his parents in the back over it with claims my generation is superior to theirs. Or call his teachers up and yell at them for not teaching kids how to build a properly leaning birdhouse. Or blame people that don't share the same political views I do for my nephew not being able to think his way into building a bird house on his own.

My nephew and I, we took full advantage of the knowledge someone else took the time to publish and we had a great experience together. I'm not embarrassed by that in the least. That's what Makers do. As a Maker, I've written no less than six Instructables since I joined this site in June 2015 to pay back this community for knowledge others have shared with me. And I'm just getting started. If someone takes that work and makes it their own and has a good time with it, I don't care how old they are or which country they are from, or whether they are conservative or liberal. But I'll commit to you this: be they expert or beginner, there will be enough information present to replicate the work and learn from it. That, in a larger context, is what Makers do.

Netzener, you are the best!

Thank you so much for the valuable feedback. Sometimes I miss a thing or two so I really appreciate you pointing that out form me. I have added the missing part specifications which I used. This is the simplest and easiest Tesla Coil circuit design I have ever built and it works great! As you pointed out, some of the parts can are interchangeable so feel free to make any adjustments as you see fit.

You take the time to answer him; but I also notice you never mentioned if the kit came with pre wound coils or not. You maybe have a reason to not answer?

Oh, sorry, yea it does. The kit comes with a pre-wound primary and secondary coil if you don't feel like winding them yourself.

Agreed... this "instructable" is dangerously close to spam -- still trying to decide if I should flag it or not.

There is certainly a lot of "spam" articles on this site. Mostly from people associated with JLCPCB in the Technology category.

But I think Drew is sincere. He's just left a few things out which would help readers replicate the project without buying a kit. If you read the comments section on any of my projects, you'll see that occasionally I miss a thing or two and have to make corrections. But that just makes the project better. Making addition and corrections to this article will also help folks that buy the kit. The the kit web site has no assembly instructions. Instructables is the only source for information on how to build the project.

There are a lot of Tesla coil projects on this site. Most of them are high school science projects that contain a lot of errors and omissions. These are young people learning physics and trying to figure things out. We've all been there. Drew is at a different level, however, which is why I think maybe he was running low on time and couldn't polish the article to a professional shine.

What I was really concerned about was the cost of the kit. Drew presents himself as both artist and alternative energy activist. If someone wants a professional like Drew to wind a coil for them by hand (very tedious) to a very high aesthetic standard (which is very hard), then $200 is the price and delivery is 4 to 6 weeks. No argument from me.

But the web site you order the kit from doesn't say that the buyer will receive a pre-wound coil. It shows a picture of one already wound. But the kit description says the buyer will receive a spool of magnet wire. Much of the hardware in the photos along with the transparent base and top are missing from the parts list as well. If I make the assumption that only what is written under "The kit includes the following" is all that is promised for delivery, I wouldn't consider the kit good value.

I was hoping that Drew would clear that up which is why I spent the time to write a comment about it.

NetZener

You use a 12 volt DC power supply so the common is not -12 volts

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The -12V should probably be labeled as Ground.

Correct. Thanks for pointing this out. The schematic has been updated.

Look on eBay and you will find the exact same set of components for $12.00 including shipping. Some of the kits are much better than others. Some have a Printed Circuit board and a very large heatsink for $12.00 and some have a box. A box is not necessary and there is no reasoning why the turns have to be accurately aligned. A slight amount of jumble winding will not make any difference. If you look at the end of the plastic tube you will see it has been "parted" and thus I am inferring the items have come from a kit.

That's actually a good point. I did search on ebay as you suggested, and although I didn't find the exact same parts I did find several that were pretty close (MJE3055 instead of TIP30C for example). But the coil does look very similar. At $19.50, the one I saw on ebay was a good deal.

And I agree with you on the windings. The secondary coil is a resonant circuit using the winding inductance and inter-winding capacitance for L and C. So it doesn't have to be perfect. For appearance sake I personally would wind it as accurately as I could.

I guess the best advice is that the buyer needs to look around, see whats available, and decide where the price is right. Because, yeah, there's a huge difference.

I would sell the electronics for a kit like this for about $15.00. I would also provide a printed circuit board and sheets of clear mylar to make the former. Any gauge of wire can be used (0.25mm or 0.5mm) and three turns of hook-up flex.
Colin Mitchell Talking Electronics.com

The TIP41C, caps and resistor and jumper wires are pretty inexpensive, yes, but the parts for the case, breadboard and coils start to add up a bit, not to mention winding the coils can be very tedious. It important though to have a perfectly wound coil because any gaps in windings or even the slightest overlap will cause the coil to malfunction. I also found that by adding a case it allows the circuit to be isolated from sensitive electronics and flammable materials and it also adds a nice platform for experimentation. Thanks for reading the article. Give this project a try, its a lot of fun!

There's quite a leap between transmitting milliamps over short distances (to charge a phone or a toothbrush) and "A home with no plugs, no wires and everything just 'works'?" I believe in telling the truth in science. Would you enlighten us by telling us how the power transmitted is a function of distance and other factors? What would it take, say, to power a 100W lightbulb from across a 20 foot room?

This is a great question! But powering devices in a home wirelessly does not necessarily mean transmitting power over long distances. Check out how these MIT students approached the challenge: https://www.ted.com/talks/eric_giler_demos_wireless_electricity