

## TCIPG presents

# Minecraft World of Power

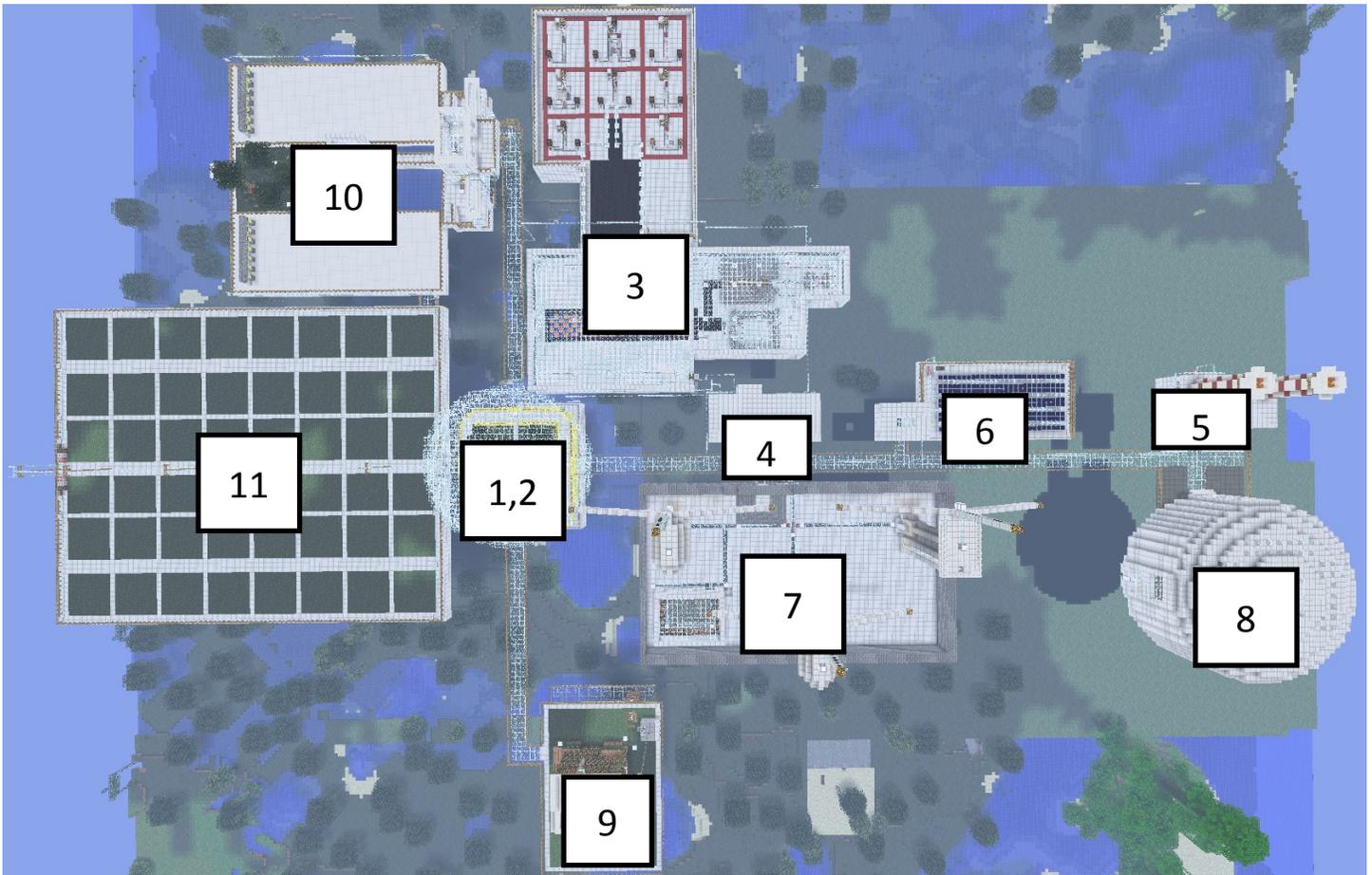


Explore electricity generation and delivery in this Minecraft scenario. Navigate an environment that includes a wind farm, a solar farm, and coal and nuclear power plants, as well as sensors, substations, and other buildings. Learn about energy generation and build and power your own town. Experiment with passive house design as you explore a house that is not connected to the power grid. Password protect substations and home management systems and develop a cyber secure power world.

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These materials were developed by TCIPG Education, a joint project of the Office for Mathematics, Science, and Technology Education and the Information Trust Institute at the University of Illinois at Urbana-Champaign.

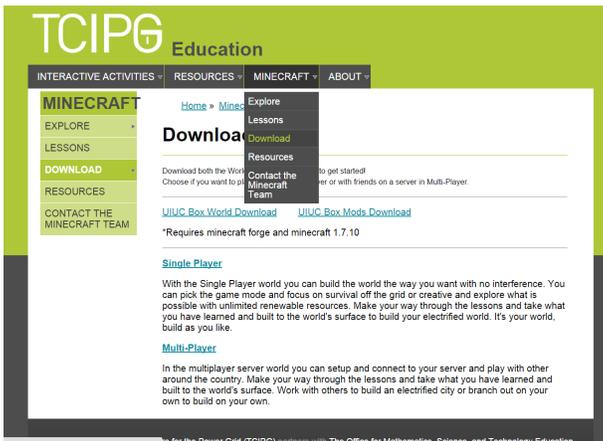
## Minecraft World of Power



### Map Legend

- |                                 |                       |                              |
|---------------------------------|-----------------------|------------------------------|
| 1—Training Ground (Lower Level) | 5—Peaker Plant        | 9—Passive House              |
| 2—Orb                           | 6—Solar Farm          | 10—Password Protection House |
| 3—Circuitry Lab                 | 7—Wind Farm           | 11—Building Area             |
| 4—Substation                    | 8—Nuclear Power Plant |                              |

# Minecraft World of Power



To download the World of Power, visit [TCIPG.MSTE.Illinois.Edu](http://TCIPG.MSTE.Illinois.Edu). Under the Minecraft drop down menu, click on “Download”.

Click on the “UIUC Box World Download” link. Download the WoP\_14.11.07 file, and save it to a location you will remember. Once downloaded, revisit the Downloads page on the TCIPG Education website. Click on the “UIUC Box Mods Download”. Download each of the .jar and .zip files individually and save to a location you will remember. Do not unzip these files.

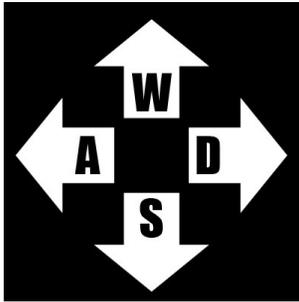
For PC Users:

Access your .Minecraft folder. The easiest way to do this is to open up your “Run” program, type in “%AppData%”, and click enter. In your .Minecraft folder, drop the WoP\_14.11.07 folder into your saves folder. Drop your .jar and .zip mods into the Mods folder.

Note that you need to be running Forge 1.7.10. To install Forge 1.7.10, view this [short video guide](#).

## Getting Started

### Movement



Walk toward blocks on the ground to pick them up.

### Left Click

Attack/Destroy/Dig

### Right Click

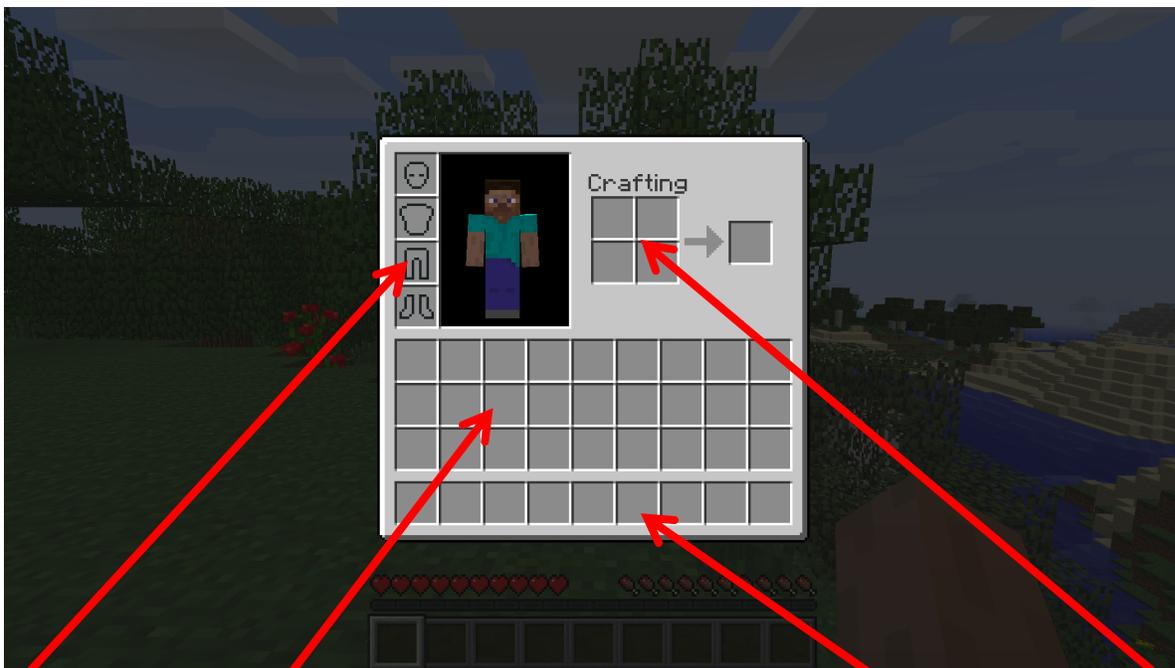
Use Item/Place/Talk

Moving the mouse controls the third person camera view.

### Hotkeys:

E: Opens and Closes Inventory

- Add Armor to Character
- Basic Crafting Table
- Inventory Slots
- Quick-bar Slots (Select using 1-9 keys or by scrolling using Mouse Wheel)



Character Armor

Inventory

Quick-bar Slots

Basic Crafting Table

# Training Ground



Spawn Point

- Follow the yellow path through the Training Ground.
- Read the guide signs.
- Explore.
- Learn to build and create.
- Talk to Tutorial Tom.

## Build a House

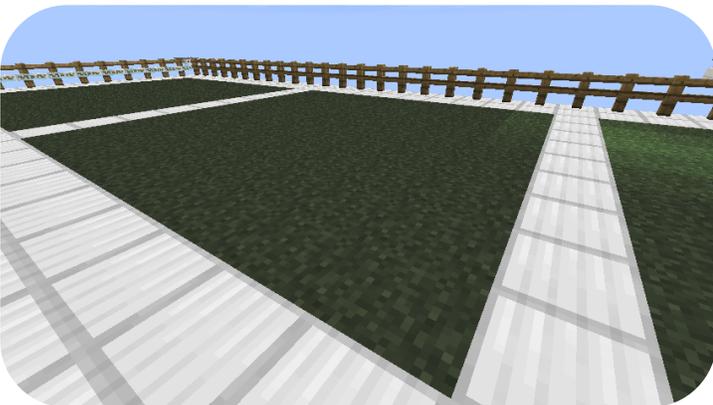
1. Go to the Building Area and find the chest.



2. Open the chest and choose the items you need. Left click on a cell to take everything or right click to take just one at a time.



3. Find an open area to build.



4. Use Wood Planks to build a bottom layer. Jump on top to build the next layers. Add windows and a door.



5. Furnish and decorate your house.



## Logic Gates

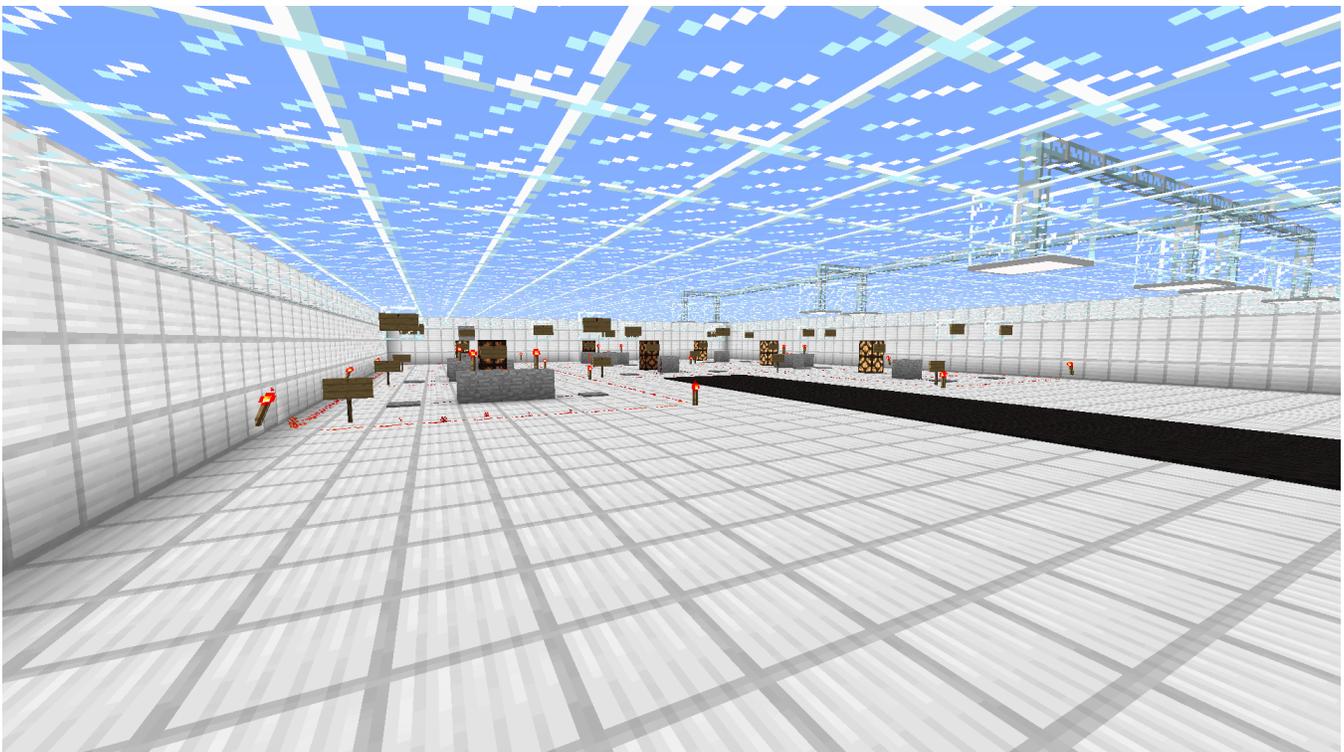
We can use truth tables to show the functions of basic logic gates. A closed switch in a circuit is represented by an input value of **1** and a **0** input represents an open switch. The truth table output shows **1** when the load (light, motor, buzzer) is **on** and **0** when the load is **off**.

IN	IN	OUT
1	0	0
0	1	0
0	0	0
1	1	1

Explore logic gates as you use copper tape, a battery and LEDs to build the circuits on pages 6-9.

Then head over to the Circuitry Lab and talk to Circuit Cersei to learn a little more about Redstone and circuits.

This truth table shows that the load is **on** only *when both switches are closed*.



## LOGIC GATES

Sometimes electric circuits use switches to make decisions. These are called *logic gates*. The gate receives one or more inputs and produces one output. Each input and each output is either **off** or **on** (**0** or **1**, **low voltage** or **high voltage**).

Different types of logic gates perform different logical functions. Often, we use truth tables to help us interpret logic gates.

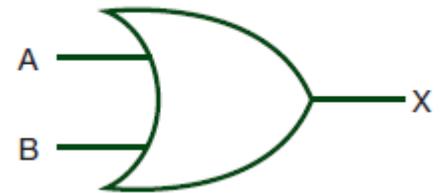
**OR gates** and **AND gates** are examples of common basic logic gates.

### OR gate

Use copper tape, a battery, and an LED to build the circuit below.

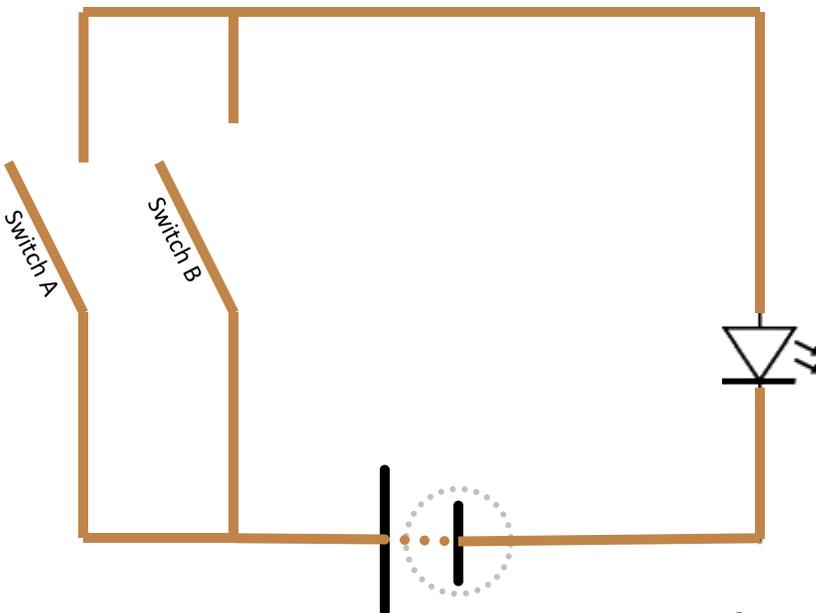
Open and close switches A and B and observe the LED to complete the truth table.

When does this gate output an **on** decision? Test the combinations of switches that cause the LED to light. Mark **0** in the table when the LED is off and **1** when the LED is on.



OR gate symbol

A lamp in a room that can be controlled by two separate switches uses an OR gate.

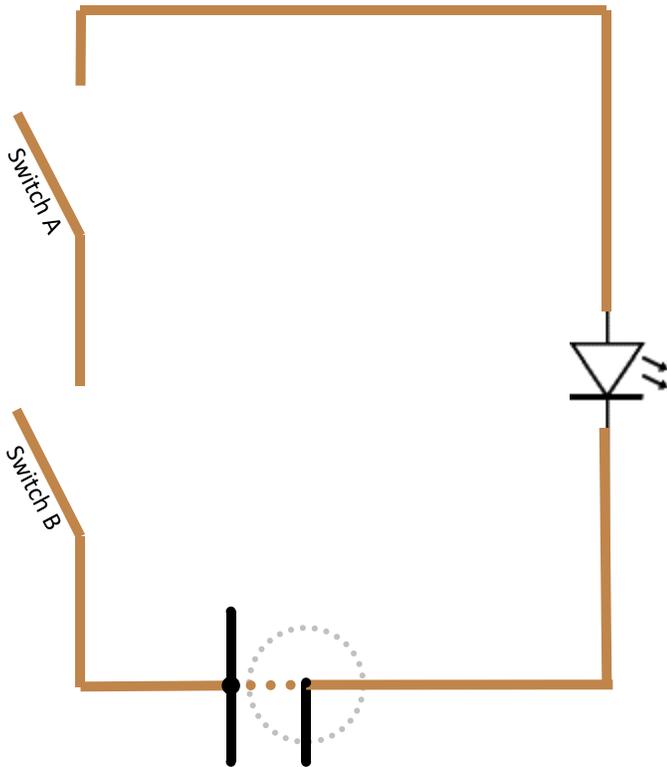
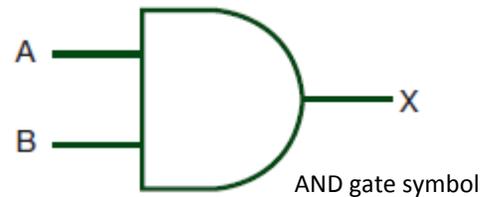


	Switch A IN	Switch B IN	LED OUT
Both switches A and B off	0	0	
Switches A on, B off	1	0	
Switches A off, B on	0	1	
Both switches A and B on	1	1	

## AND gate

Use copper tape, a battery, and an LED to build the circuit below. Open and close switches A and B and observe the LED to complete the truth table.

When does this gate output an *on* decision? Test the combinations of switches that cause the LED to light. Mark **0** in the table when the LED is off and **1** when the LED is on.

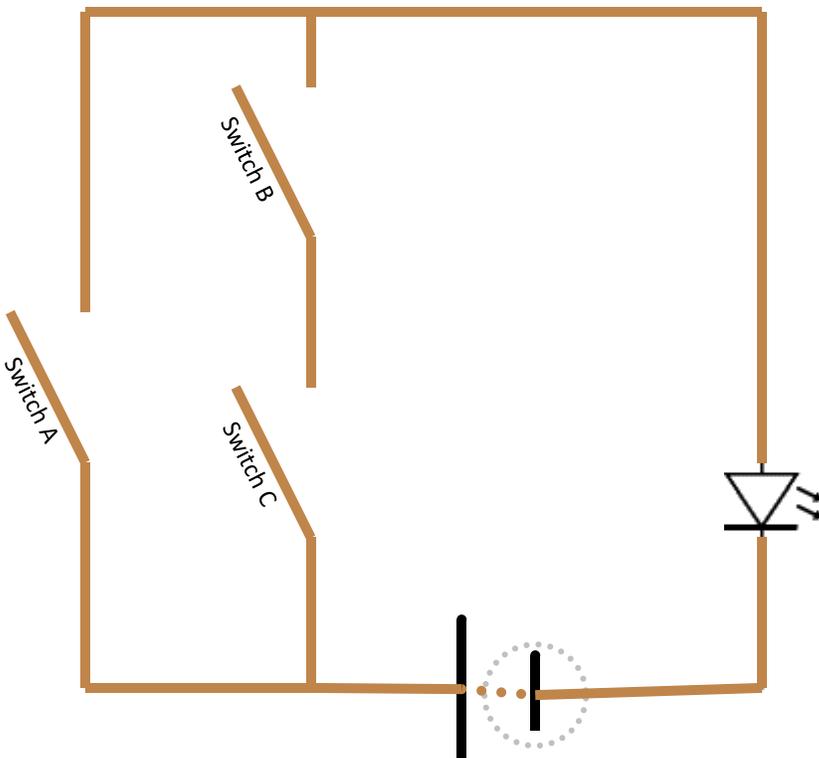
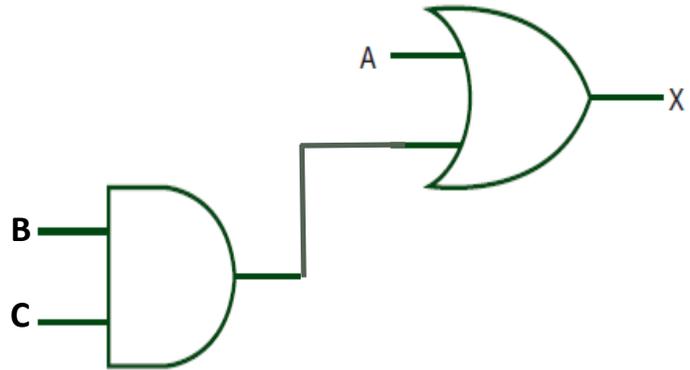


	Switch A IN	Switch B IN	LED OUT
Both switches A and B off	0	0	
Switches A on, B off	1	0	
Switches A off, B on	0	1	
Both switches A and B on	1	1	

Logic gates can be combined together to produce more **complex logic circuits or networks**. This network has three inputs and eight possible outputs.

Use copper tape, a battery, and an LED to build the circuit below. Open and close switches A and B and observe the LED to complete the truth table.

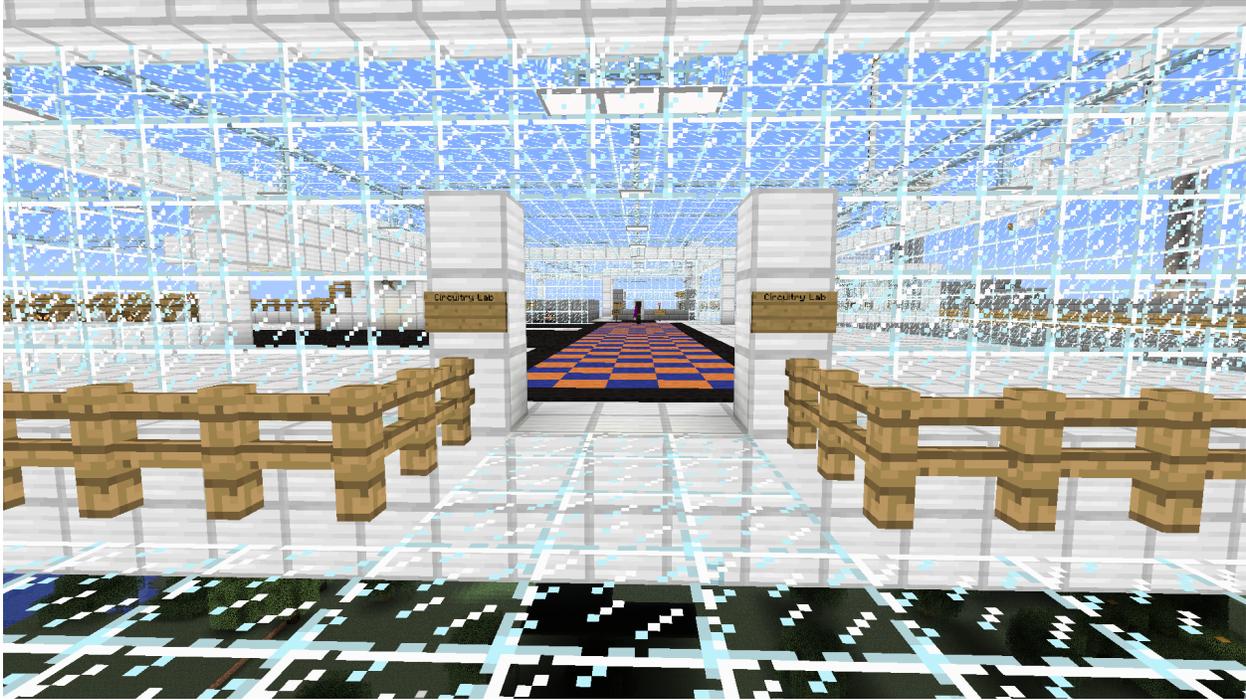
When does this gate output an **on** decision? Test the combinations of switches that cause the LED to light. Mark **0** in the table when the LED is off and **1** when the LED is on. When might this type of logic circuit be used?



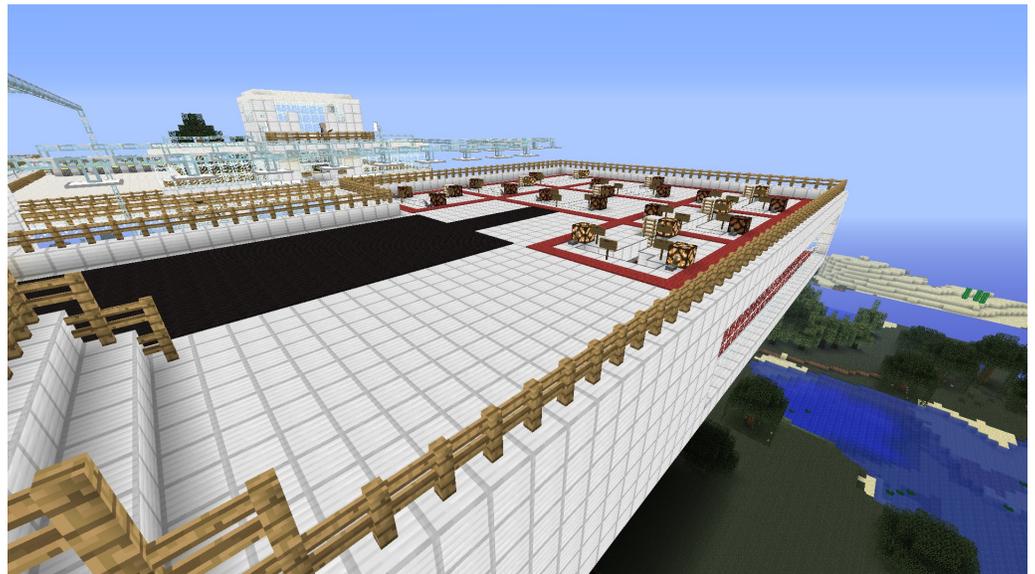
	Switch A IN	Switch B IN	Switch C IN	LED OUT
All switches A, B, and C off	0	0	0	
Switches A on, B and C off	1	0	0	
Switches A off, B and C on	0	1	1	
Switches A and B on, C off	1	1	0	
Switches A and C on, B off	1	0	1	
Switches B on, A and C off	0	1	0	
Switches C on, A and B off	0	0	1	
All switches A, B, and C on	1	1	1	



## Circuitry Lab



Head over to the Circuitry Lab and talk to **Circuit Cersei**. When you're done talking to her, try to match the Redstone circuits to the basic logic gates on the following sheets of paper. Each circuit is numbered with a sign—the answers are given in the notes section on page 50.



Logic Gates Area

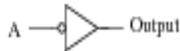
## Redstone Logic Gates

Logic gates can take one or more Redstone inputs and perform a logical operation producing a single logical output.

Match the Logic Gates inside the Circuit Lab to their names below using the logic tables and symbol.

NOT Gate—The output is the inverted A input.

NOT	
IN	OUT
A	X
1	0
0	1



Number

OR Gate—The output is on if A or B inputs are on.

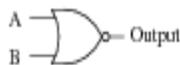
OR	
IN	OUT
AB	X
00	0
01	1
10	1
11	1



Number

NOR Gate—The output is on if both A and B inputs are off.

NOR	
IN	OUT
AB	X
00	1
01	0
10	0
11	0



Number

AND Gate—The output is on if both A and B inputs are on.

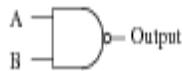
AND	
IN	OUT
AB	X
00	0
01	0
10	0
11	1



Number

**NAND Gate**—The output is on if either A or B inputs are off.

NAND	
IN	OUT
AB	X
00	1
01	1
10	1
11	0



Number

**XOR Gate**—The output is on if the A and B inputs are different.

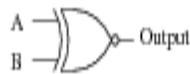
XOR	
IN	OUT
AB	X
00	0
01	1
10	1
11	0



Number

**XNOR Gate**—The output is on if the A and B inputs are the same.

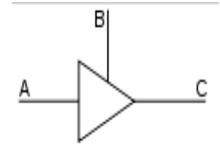
XNOR	
IN	OUT
AB	X
00	1
01	0
10	0
11	1



Number

**IMPLIES Gate**—The output mimics B input if A input is on; otherwise always on.

IMPLIES	
IN	OUT
AB	X
00	1
01	1
10	0
11	1



Number

## Redstone Logic Gates

Combine three of the simple logic gates to build your own complex logic circuit in the building area. Make two simple logic gates output to a third logic gate. Use symbols to draw what you build and complete the truth table to show the results of your network.

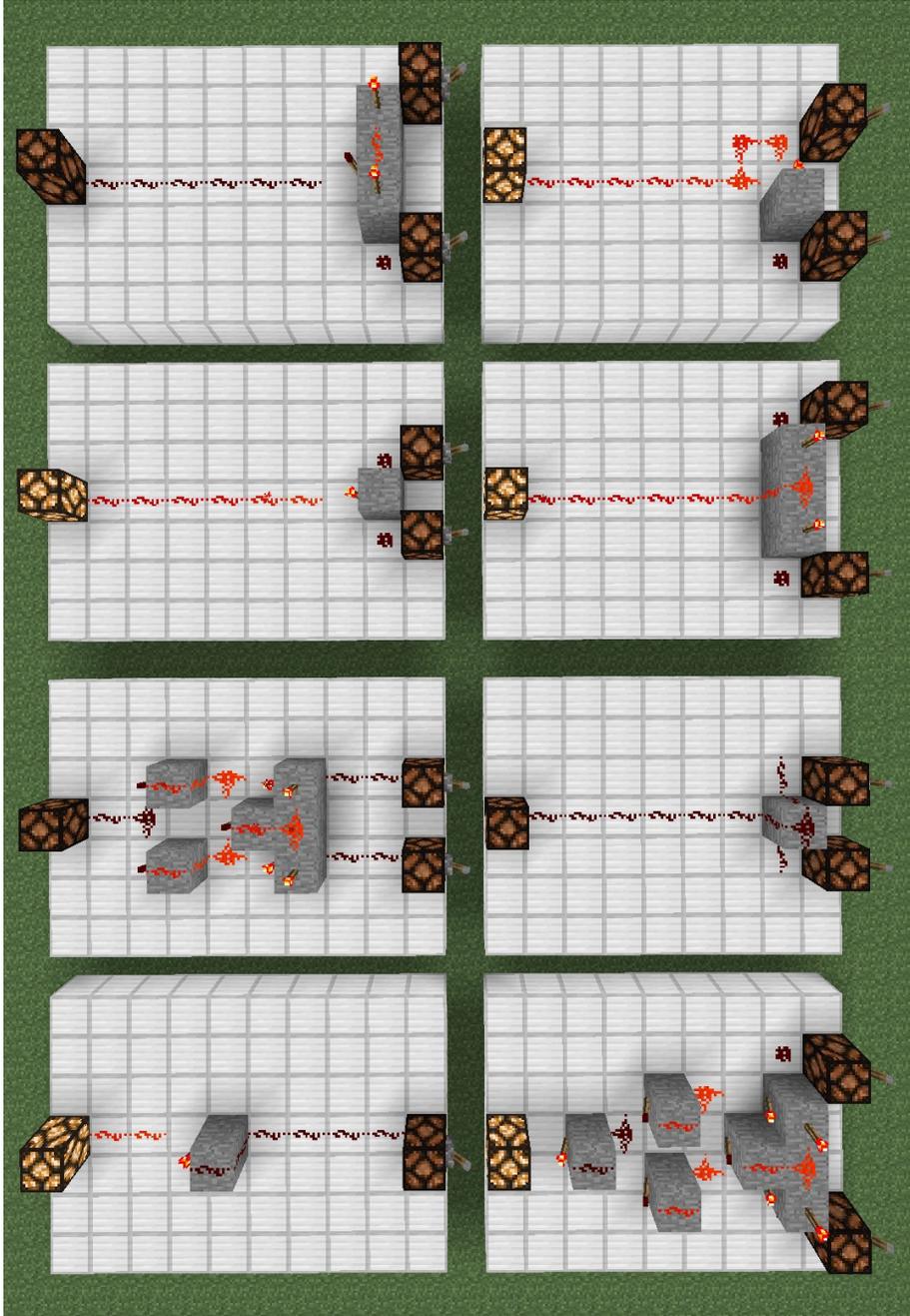
Which two logic gates are you using to act as inputs?

IN	OUT
ABCD	X
0000	
0001	
0010	
0100	
1000	
0011	
0110	
1100	
1001	
0111	
1110	
1101	
1011	
1111	

Which logic gate is receiving the output of the first two logic gates?

Draw your logic gate schematic below.

## Minecraft Logic Gates



NOT	XOR	NOR	AND
XNOR	OR	NAND	IMPLIES

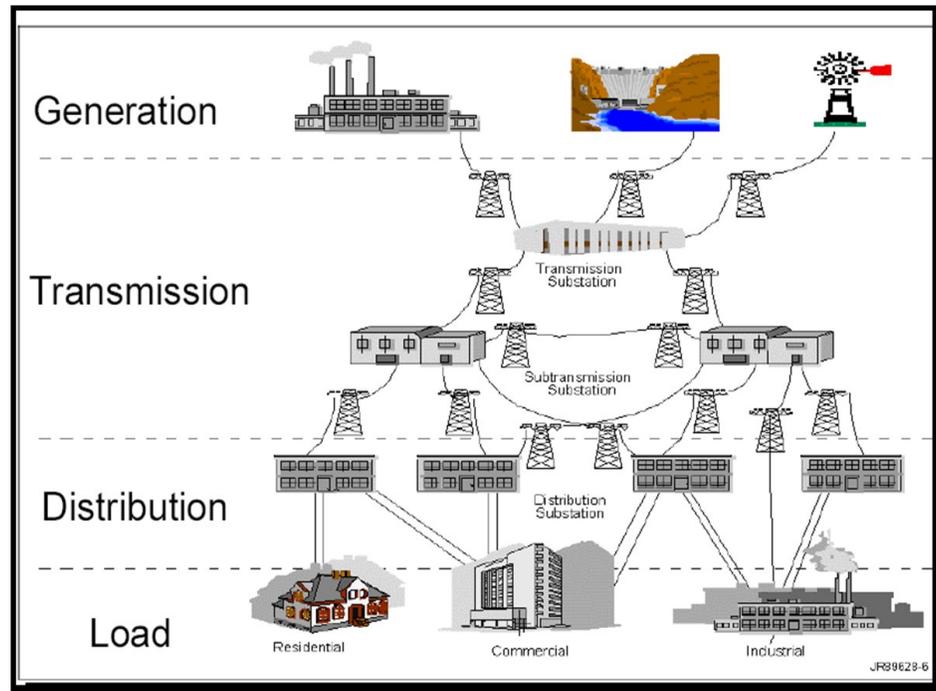
# Logic Gates Activity Answers

Redstone Circuit Number	Gate
Circuit 1	NOT
Circuit 2	XOR
Circuit 3	NOR
Circuit 4	XNOR
Circuit 5	OR
Circuit 6	NAND
Circuit 7	AND
Circuit 8	IMPLIES

## The Power Grid

⇒ Voltage Increased, or Stepped Up after Generation for Transmission

⇒ Voltage Decreased, or Stepped Down for Distribution



Simple Power Grid Schematic

### What is it?

Electric-power transmission is the bulk transfer of electrical energy from generating power plants to electrical substations that are located near demand centers.

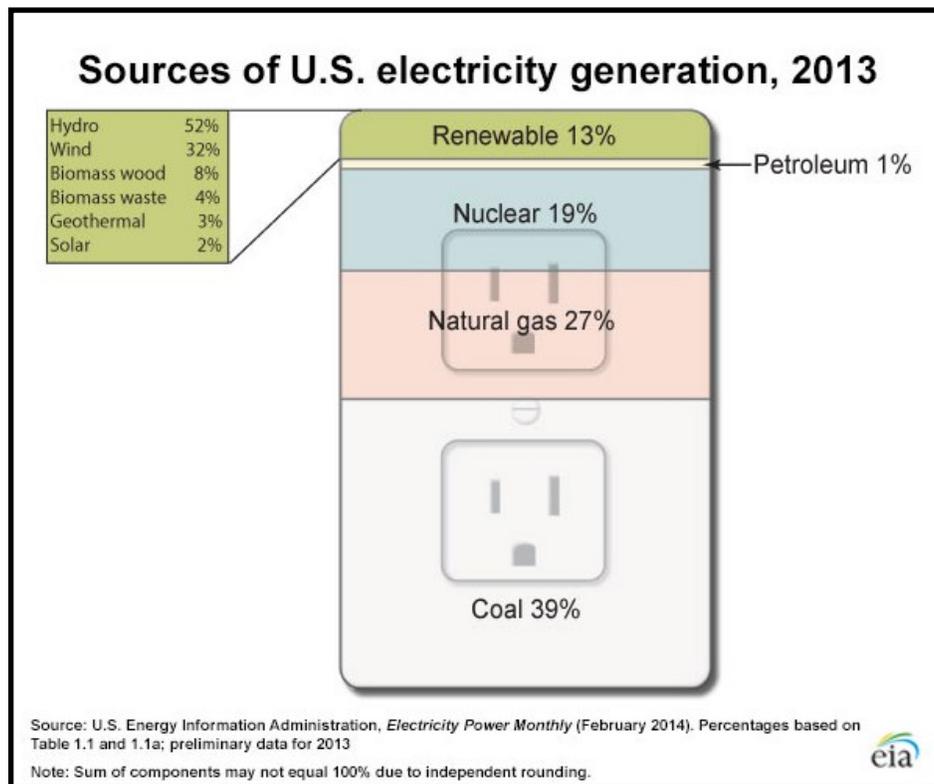
Ideally, a local power system would generate exactly as much power as is being used at the exact moment, but because power demand is constantly changing, this is often not possible. There is no easy or economical way to store large amounts of electricity, so any “extra” power is sent to other users. These generation systems are interconnected to allow electricity to travel. This interconnected system is the **Power Grid!**

Everything that is plugged into the wall, or anything that is hooked up to the power grid that uses energy creates a small demand for power generation at a power plant. This includes plugging a computer into the wall, or turning on a TV, or microwaving food in your house!

## The Power Grid

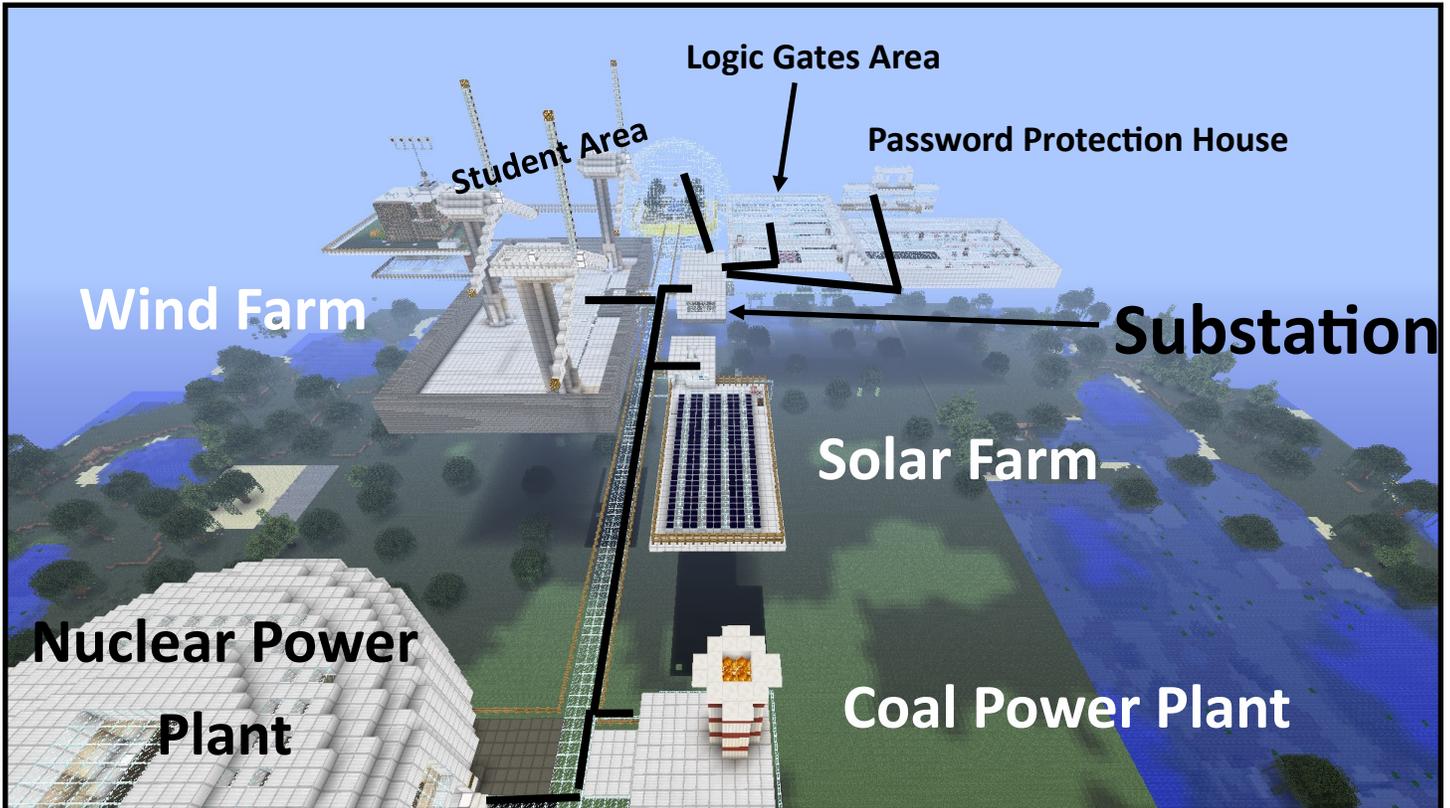
### How does it work?

- First, power is generated using renewable energies, nuclear energy, natural gas, or coal.
- Next, the power is stepped up to a very high voltage so it can be transmitted to a substation over long distances with little power loss.
- Once it gets to a substation, the voltage is stepped down again so that the power can be distributed a short distance for residential or commercial use.
- Power is consumed by the customer at a home or office.



US Electricity Generation

## Minecraft Power Grid



Minecraft Power Grid Labeled

*The TCIPG Minecraft World has a few key differences from the **Power Grid**:*

- The main energy is called an **EU (Energy Unit)**. This is similar to the SI unit **Joule**.
- Instead of the SI unit for power, **Watt (or Joule/second)**, we use **EU/t (Energy Unit/tick)** in the Industrial Craft 2 modification. A tick is a time interval in Minecraft—typically, there are 20 ticks in Minecraft for every second in the real world.
- There are no losses in the wires in Minecraft due to an update in Industrial Craft 2.
- The energy is sent through **MFSU's**, which output a high EU/t that needs to be **stepped down** to a low enough EU/t that can be used for lighting. This is similar to stepping down voltage for household use from the high voltage wires that run through neighborhoods.
- The MFSU's **store energy** and output the energy when a load is applied, like a battery pack. Thus, the grid is not supplying **instantaneous power** as it does in the the real world **Power Grid**.

# Energy Storage

The TCIPG Minecraft World relies on the storage of energy in MFSU's and the distribution of that stored energy to keep the world with power supplied at all times. The MFSU's act as a perfectly lossless rechargeable battery —something the real world Power Grid does not have access to! In fact, one of the largest growing problems with the Power Grid right now is finding a way to store the energy captured from renewables, such as wind and solar power, to be redistributed when the power is most needed.

A problem with large renewable energy systems such as solar power and wind power is that the energy they produce is not consistent. With coal and nuclear power plants, the power output can be controlled—however we do not have control over when the wind blows and when the sun shines.

As a result, large renewable energy systems, or operating on solely renewable energies right now is not feasible. However, there are some examples of people pushing for the storage of renewable energies to more efficiently use these energies is in the works.

Recently, Hawaii has been having problems handling the amount of renewable energies being used to generate electricity on their grid because their grid is small enough that the renewable energies are causing noticeable fluctuations in the amount of energy available for use on their grid. Because of this, they applied in May of 2014 for a large scale storing system that can store 60 to 200 Megawatts for up to 30 minutes to help manage the solar and wind power.

For more information on the energy storage methods they have to choose from, visit the [Hawaiian Electric web page](#).

# Minecraft Substation



Substation

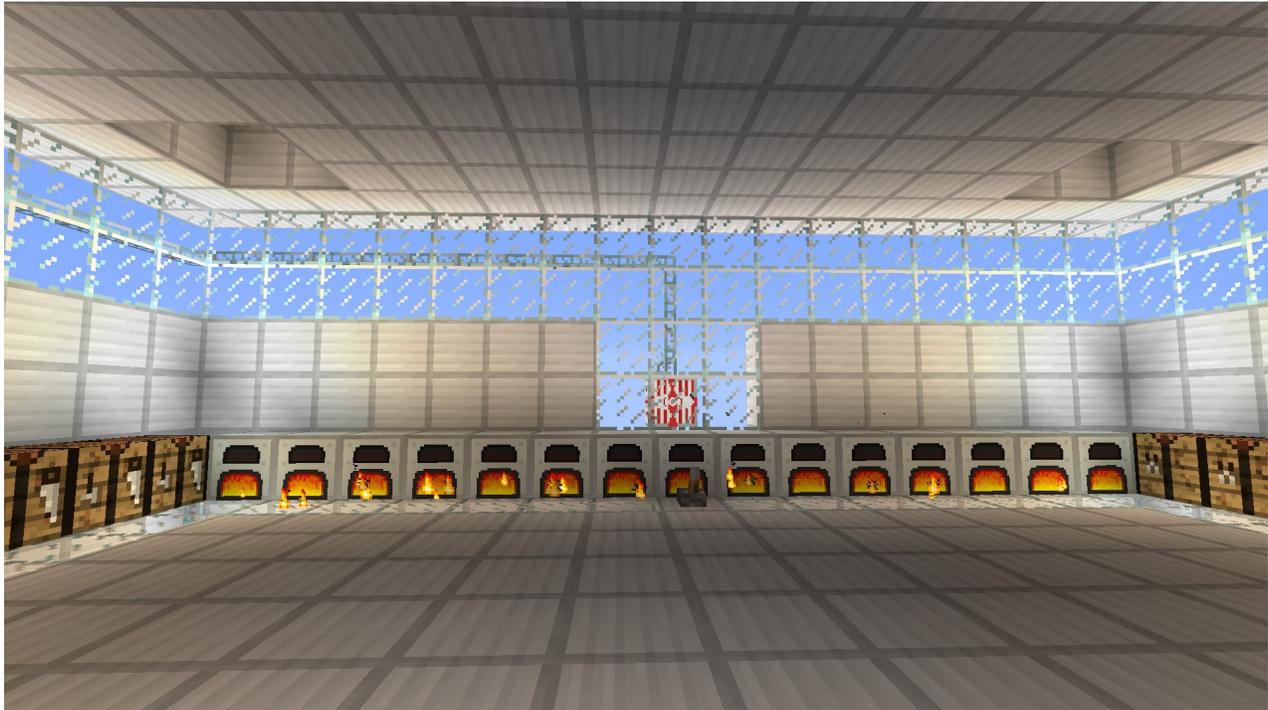
Just as a normal substation would, the substation in Minecraft allows the user to shut off power to different areas of the map. This allows you to control the power flow to certain areas if the load is too great for the power being supplied.

There are also switches that turn on and off power around certain buildings—keep your eyes open as you explore so you can turn on and off certain lights in buildings using switches!



Switches to turn off power to certain areas of the map.

# Peaker Plant



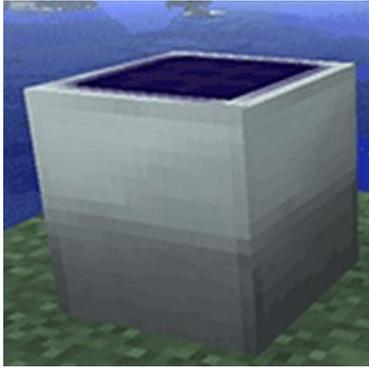
Peaker Plant running to meet the power demand

In the Minecraft world we have included a Power Plant that consumes non-renewable energy. This plant exists to supply power to the grid when there is **high demand** for electricity—that is when the demand for power is greater than the baseline power can supply. At times where the energy consumption is **peaking**, a **Peaker Plant** is used so that the grid can meet the demand for power!

Generally, peaker plants in real life are natural gas power plants. They are usually very expensive to run, which is why they are used as a last resort. A peaker plant can operate many hours a day, or only a few hours a year.

In the TCIPG Minecraft World, the Peaker Plant is a coal power plant because that is the main non-renewable energy that exists in Minecraft.

## Using Solar Power



Solar Panel

Adding solar panels to your home in the TCIPG Minecraft World will reduce the amount of power your house needs from the power grid. The solar panels transmit at 1 EU/t while the sun is shining.

You can go to the solar farm and get solar panels, glass fibre cables, and Redstone daylight sensors in the chests in the building next to the solar farm.



Solar Farm

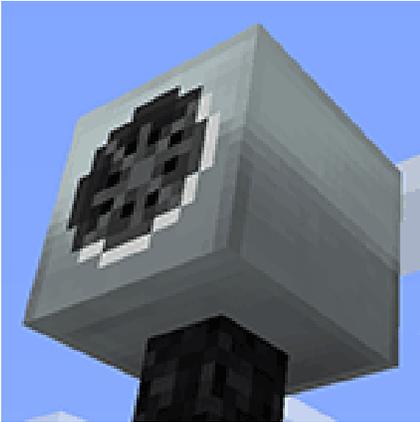
By adding an EU Splitter and a Daylight Sensor you can make your lights turn on only at night.

The sensor outputs Redstone at night and the splitter connects electrical wire if Redstone is applied.

The daylight sensor forms a NOT gate using Redstone current.



## Using Wind Power



Wind Mill

Adding wind mills to your home will reduce the amount of power your house needs from the power grid.

You can go to the building in the wind farm area and find wind mills and transmission cables in the chest.



You can travel up to the top of one of the wind turbines and view the transmission cables.



Wind Farm

# Using Nuclear Power



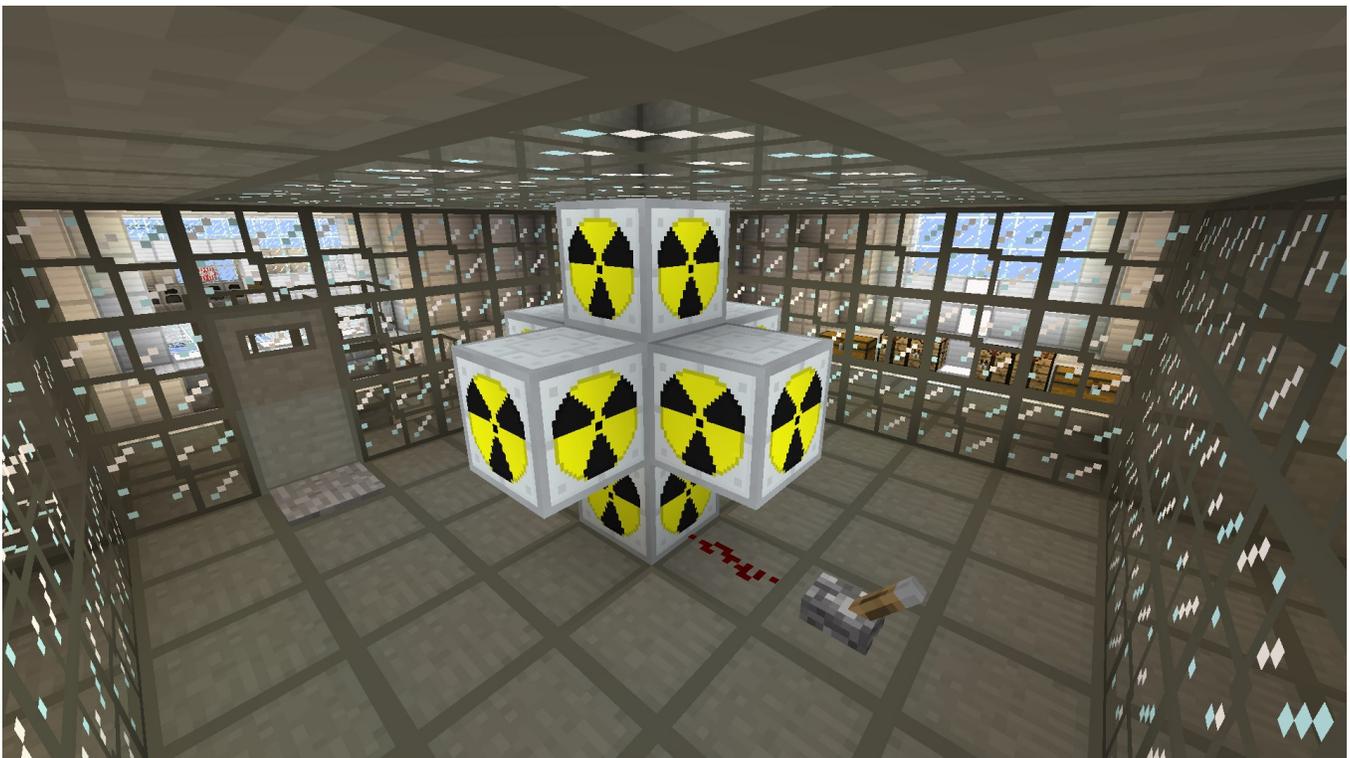
Nuclear Reactor

Nuclear reactors have the potential to create a lot of energy—but in Minecraft, these also have the potential to destroy large areas if used improperly.

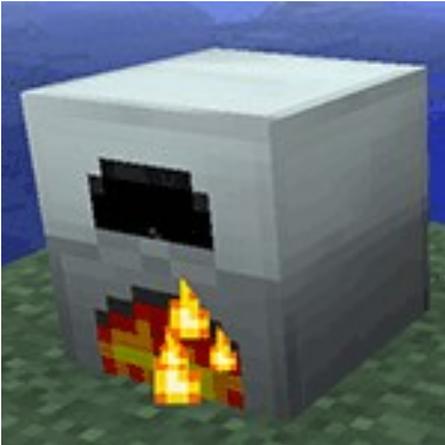
Before attempting to use a Nuclear reactor, visit the [Nuclear Reactor page on the IC2 wiki](#).

Note that you need Redstone to power the nuclear reactor.

Make sure to visit the IC2 java applet linked on the Resources page to test out your reactor type safely before implementation.



# Using Coal Power



You can use generators by burning coal to get 4000 EU per piece of coal at a rate of 10 EU/t.

Head over to the Coal Plant to get Generators and Coal.

Generator



Coal Power Plant

# Passive House Design

## What does the term Passive House mean?

“...Passive house is a generic term referring to a set of design and construction principles, as well as a quantifiable energy performance standard that has evolved to be applicable to any type of building” (Katrin Klingenberg, “Putting Passive House in Order”).

There are a growing number of PHIUS (Passive House Institute US) certified projects in the US. We will use some of these principles to model a Passive House in Minecraft.



Passive House Designed in Minecraft

### Design Principles:

- Superinsulation—Highly rated insulation in the walls.
- Airtightness—A lot of energy is lost due to cracks and poor sealing in buildings.
- High Performance Windows—Highly insulated windows.
- Energy Recovery Ventilation—Exchanging heat energy between the air being exhausted from building and the incoming ventilation air from outside the building.
- Solar Gain Management—Increasing temperature inside of a building using solar radiation (the sun!).

### Activity:

- Go to the Passive House and explore.
- Use some of the information discussed in this activity and around the house to design your own Passive House in the design area.
- Note that your building can be a commercial or residential building.

# Off-Grid Homes

A home that is off of the grid is a home that is not hooked up to the power grid—specifically, it receives no energy from the power grid. Almost all homes in the US are on the grid, which means they are hooked up to and receive energy from the power grid.

## What are the benefits of living off the grid?

The main benefit of living off of the power grid is that you do not have to pay an electric bill! This can save a lot of money. However, if you would like to live off the grid and have electrical appliances or items, you will need to have your own power generation devices, such as solar panels, and an energy storage system., such as a battery bank.

In the TCIPG Minecraft world, living off the grid is easy. You can use solar panels and/or wind turbines to generate energy, and an MFSU to store and distribute all of the energy to your home.

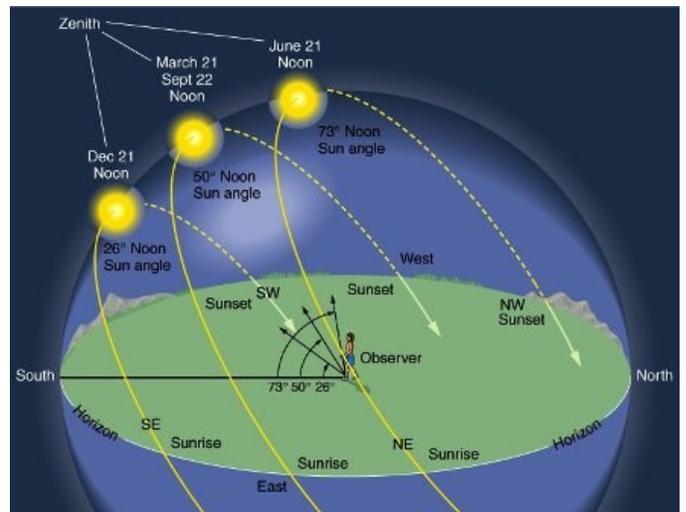
## Why don't more people live off the grid?

The reason more people don't live off the grid is because it is much more reliable and economical at this point to use personal solar PV systems and wind turbines to sell power back to the grid than it is to store your own generated energy and use it. Also, there are lots of issues with maintenance, generating enough power, as well as losing some of the power you generate due to battery inefficiency.

To learn more about the advantages and disadvantages of living off the grid, read this [homepower article](#) written by Ian Woofenden, who has lived off the grid for more than 25 years.

## More information:

- In the northern hemisphere, south facing windows receive the most sunlight throughout the day! The reason is because of the path of the sun through the sky—everybody knows the sun rises in the east and sets in the west. However, the angle of the sun compared to the earth varies during the seasons, as shown in the picture below. (Think about this: Which side of a building would receive the most sunlight in the southern hemisphere?)
- Note that these same sun angle considerations are taken when designing solar PV arrays.
- Vernacular Architecture is based on local needs and construction materials, and reflecting local traditions. Similarly, the Passive House was designed with the type of geographically available materials in the Minecraft world. It is often best to think about the materials being used when creating an environmentally friendly design, as the materials themselves have a carbon footprint.
- Trombe Walls are a high heat capacity material that is built in such a way that it will receive direct winter sunlight so it can slowly heat up throughout the day and at night release that heat into the house. In the design of the house in the game, the wall, but generally the wall would have a layer of glass on the outside, an air gap, and then the trombe wall inside of the building.
- If the eaves and trombe wall of a building are built correctly, the trombe wall will NOT heat up a building in the summer.



Sun Path in Northern Hemisphere

Image Credit: David Epstein at Boston.com



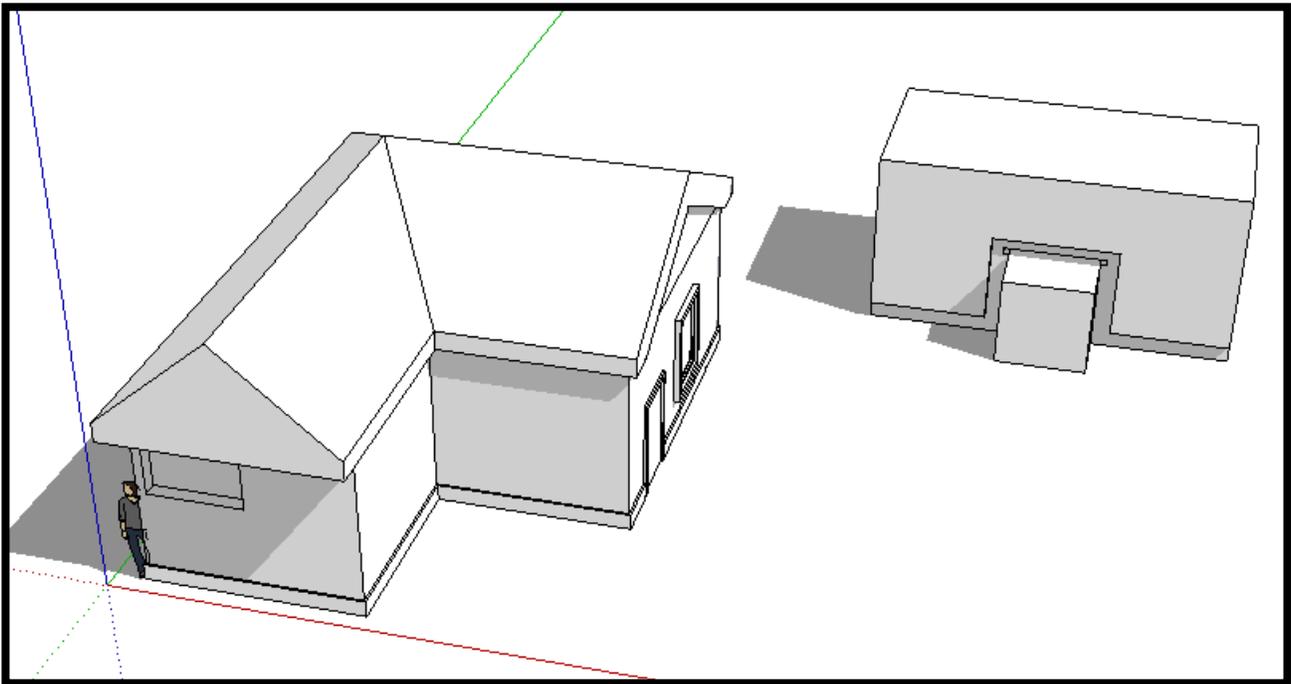
Passive House in the Evening

## Going Above and Beyond

*After you've built your building in Minecraft using the Passive House design principles, you can try to recreate it in a free, widely used 3D modeling program.*

- Go online and [download Sketch Up Make for free!](#)
- Once the program is downloaded it, visit the [Sketch Up tutorials website.](#)
- Once you feel comfortable with the program, start building! Make it as complex as you want.
- Sketch Up has been used for projects such as the [Element House](#), the 2007 Solar Decathlon house by University of Illinois students!

Once the house is built, adjust some of your dimensions based on shading, which can be toggled using the *view > toolbars > shadows* option.



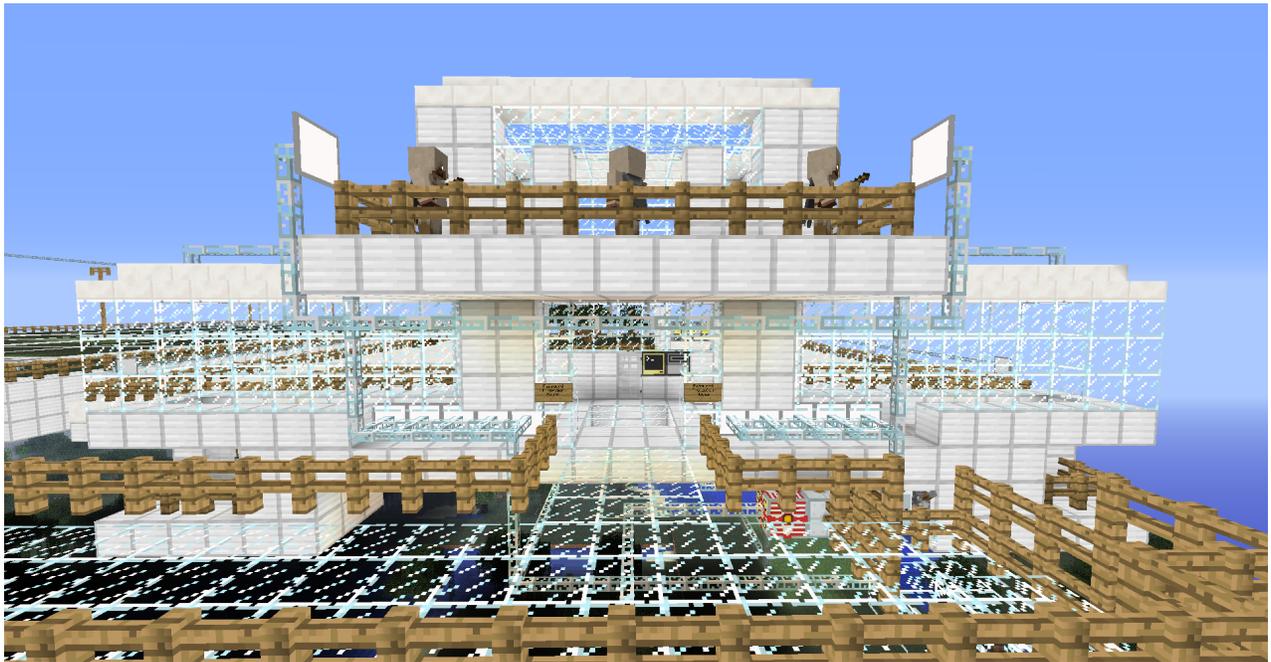
Showing off some of the shadowing effects in Sketch Up Make

# Password Protection Activity

**Using ComputerCraft, a popular modification to Minecraft, we will create a password protected door.**

*In this activity, we will write code in the Lua programming language to create a Redstone output from a Computer, and, ultimately, a password protected door in Minecraft.*

Head over to the Password Protection House to begin the activity.

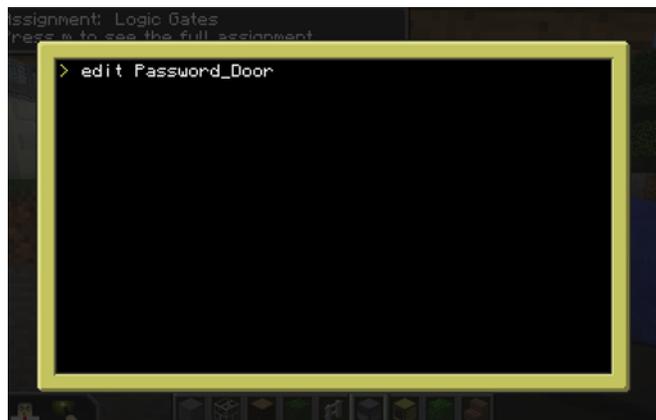


Password Protection House

- First, talk to the **Password Wizard** by climbing the ladders up to the second level of the house and right-click on one of the characters. Once you feel confident enough to guess the password for the doors in the treehouse, go ahead and guess.
- Next, access the Classroom building area.
- Once you are in one of the building areas, right click on a computer screen and you will see a blank terminal.

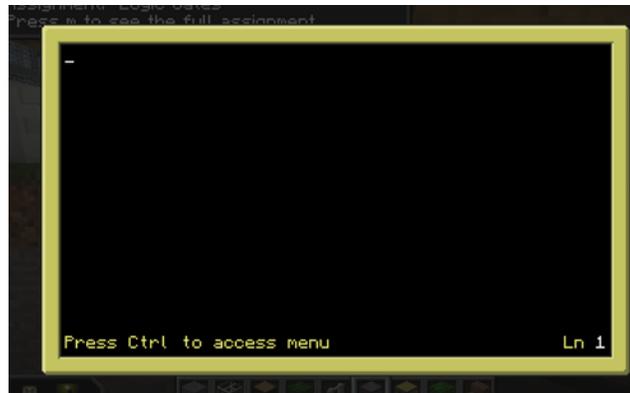


- Choose a name for your program.
- Type in “edit” + (spacebar) and your program name. As an example, I’ve named my program “Password\_Door”.



- Now press **Enter**.

- Now you are on a screen where you can write your password protection program for your password protected door. It should look like this:



- Write the code on the following page. Make your password unique! After you've written it all carefully (every word is case sensitive unless it has " " around it), press **Ctrl** then use the arrow keys to save your code. You can then exit back into the terminal.



- Now, simply type in the name of your program to run your password protection program! If you receive an error, you can go back to editing your code. (**Hint:** If your code has an error, make sure you proofread your work)

Please write the following code in your program, **changing only the bolded portions of the code**. Anything in **green** is a comment explaining the code and does not need to be written.

```
while true do --Creates an infinite loop, saying do the following code until I specify when it ends
term.clear() --Clears the screen
term.setCursorPos(1,1) --Fixes the cursor position
print("Password:") --Prints 'Please Enter Password:' onto the screen
input=read("*") --Reads any keys typed as '*'
if input=="12345" then --Checks if the user inputted the correct password (if you enter '12345' then the computer will execute the following lines)
redstone.setOutput("side", true) --Outputs a redstone current to the side specified (e.g. 'left', 'right', 'bottom', 'top', 'front', 'back')
sleep(number of seconds) --the current will remain outputted for specified number of seconds (e.g. '5')
end
end
```

Once you have practiced writing a program, you can take some computers, disk drives, disks, and Redstone doors available in the chests to make password protected doors in your home in the Building Area.

For more information on Computercraft uses, visit the [ComputerCraft Wiki](#).

# Resources

We highly recommend using the following resources along with this document to get the most out of your TCIPG Minecraft World experience.

- [Minecraft Wiki](#)
- [Redstone Section of Minecraft Wiki](#)
- [Hawaiian Electric web page](#)
- [Industrial Craft 2 Wiki](#)
- [Nuclear Reactor Section of Industrial Craft 2 Wiki](#)
- [Industrial Craft 2 Reactor Planner Java Applet](#)
- [Off-Grid Homepower Article](#)
- [Sketch Up Make Free Download](#)
- [Sketch Up Make Tutorials Website](#)
- [Element House - University of Illinois at Urbana-Champaign Solar Decathlon House \(Designed Using Sketch Up\)](#)
- [Computercraft Wiki](#)

If you are using the TCIPG MinecraftEdu Server:

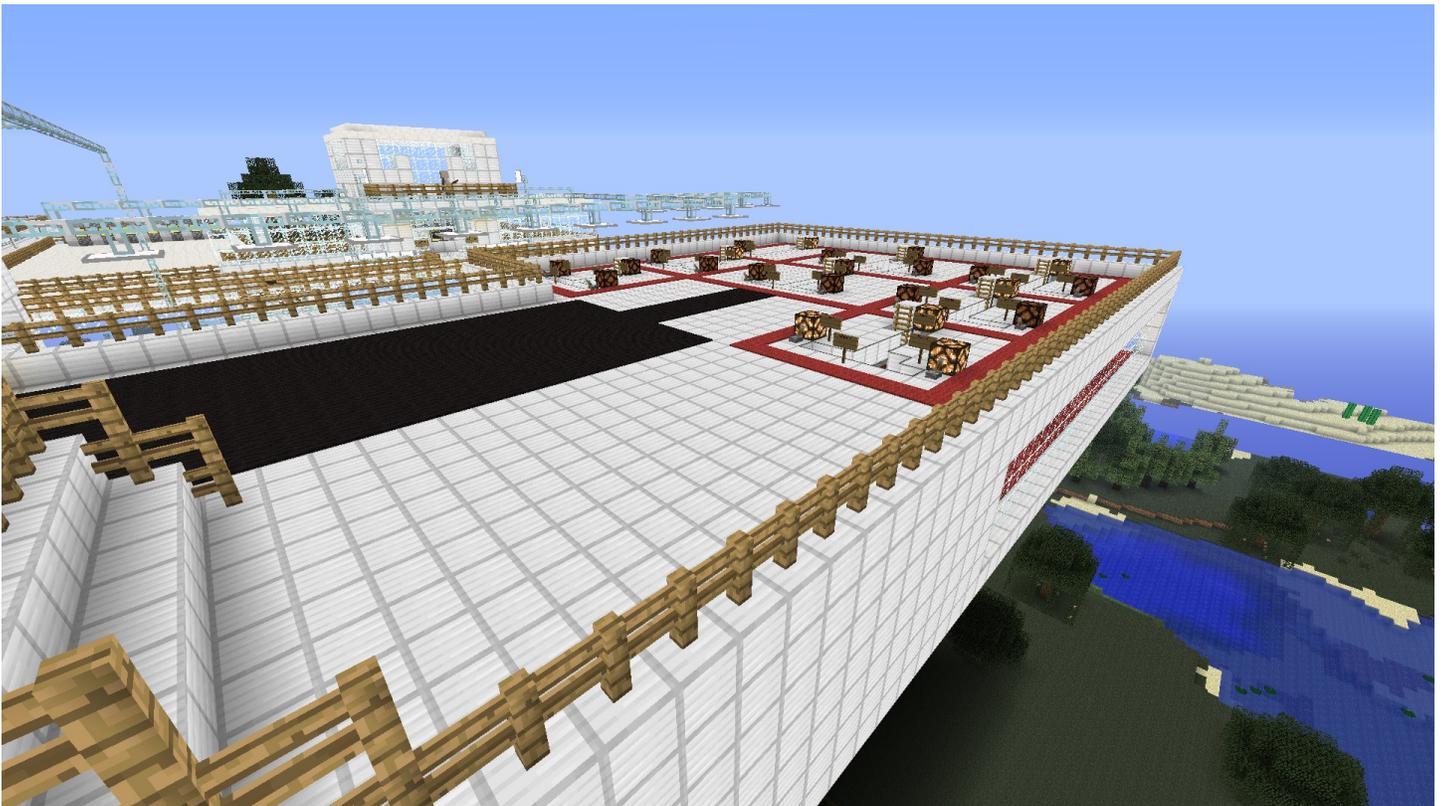
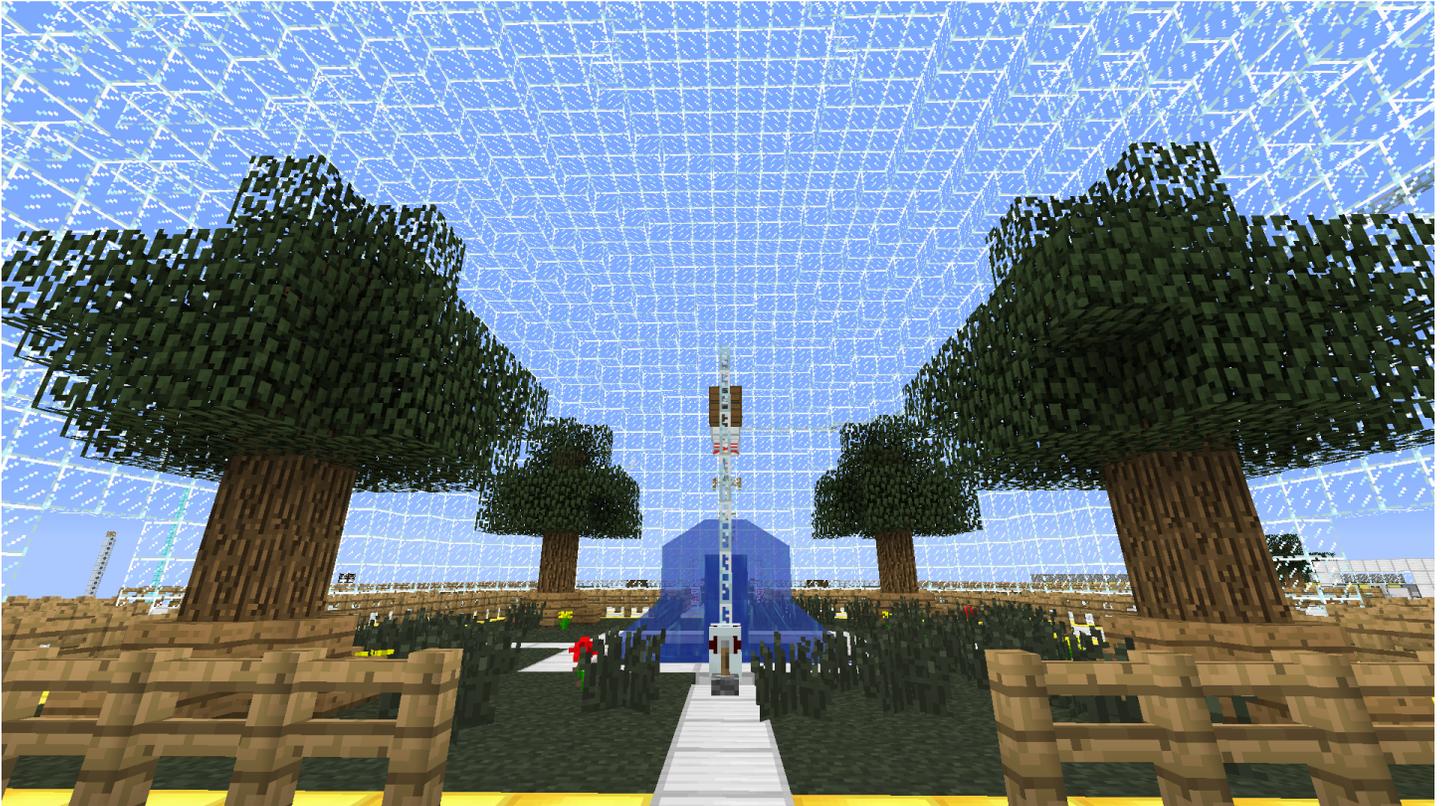
- [MinecraftEdu Wiki](#)

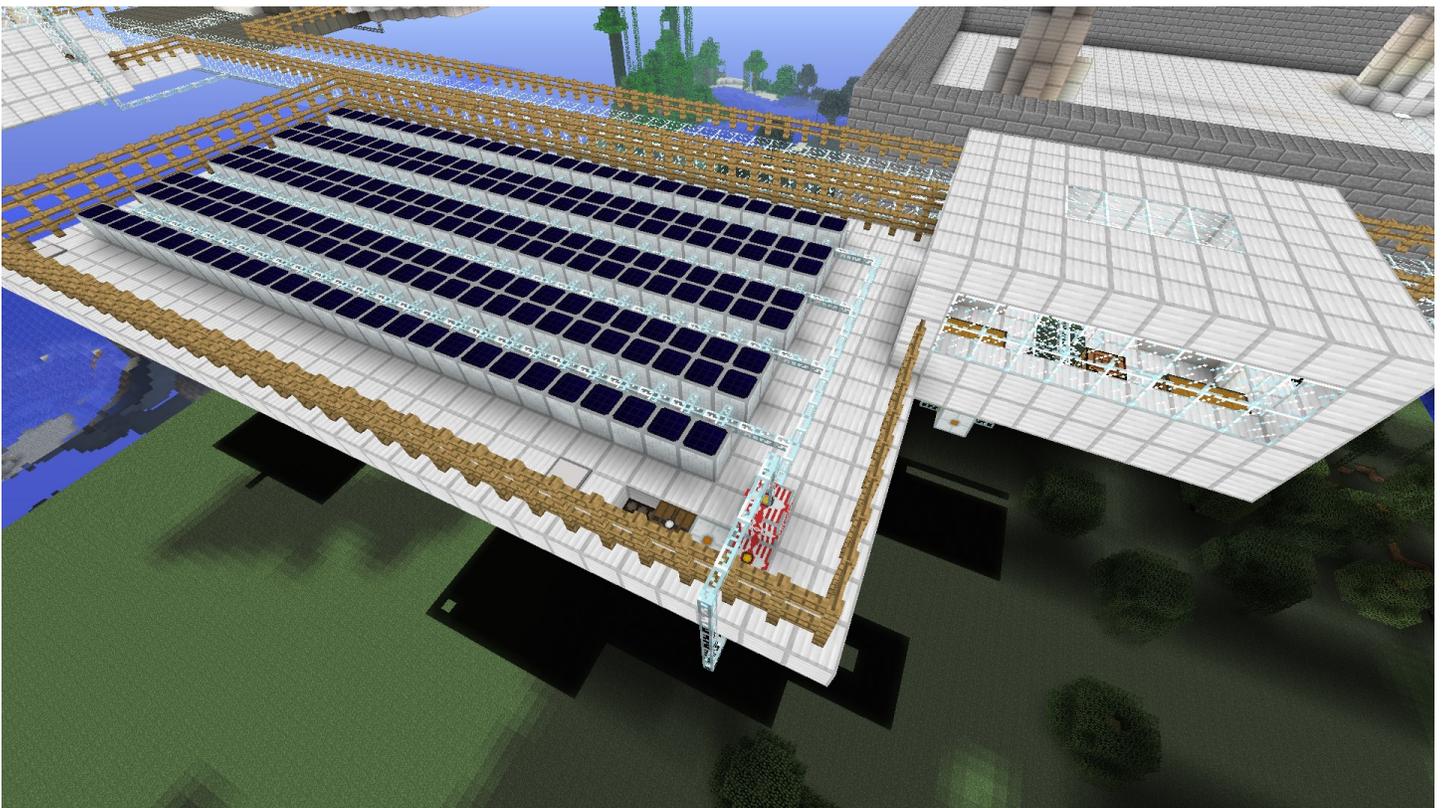
# **TCIPG World Photos**

# TCIPG

TRUSTWORTHY CYBER INFRASTRUCTURE FOR THE POWER GRID









# TCIPG

TRUSTWORTHY CYBER INFRASTRUCTURE FOR THE POWER GRID



# TCIPG

TRUSTWORTHY CYBER INFRASTRUCTURE FOR THE POWER GRID



# TCIPG

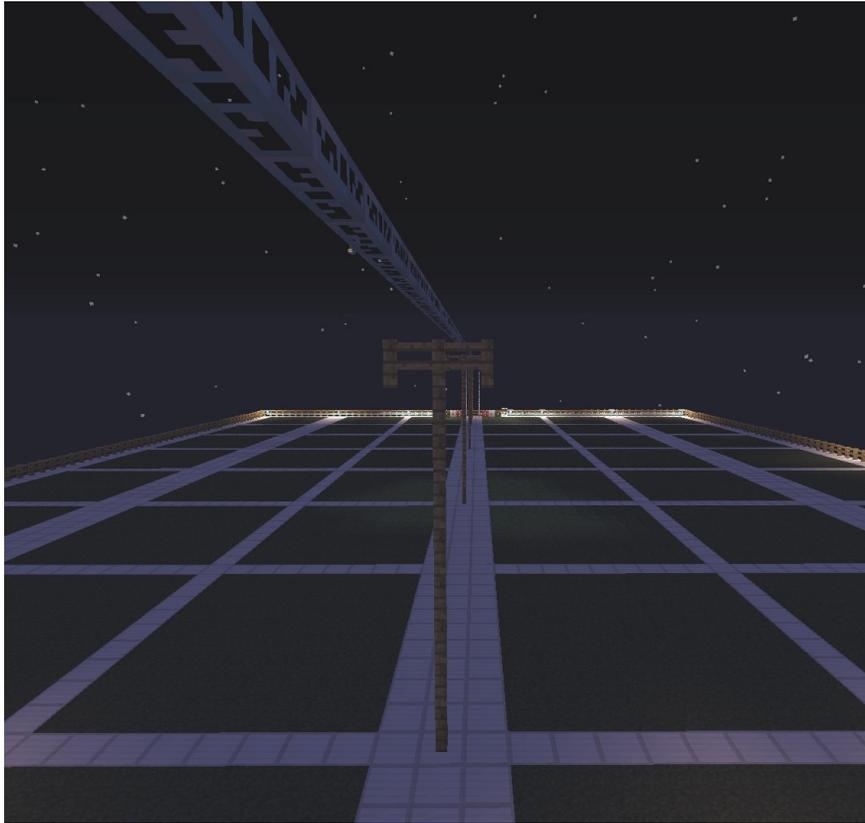
TRUSTWORTHY CYBER INFRASTRUCTURE FOR THE POWER GRID





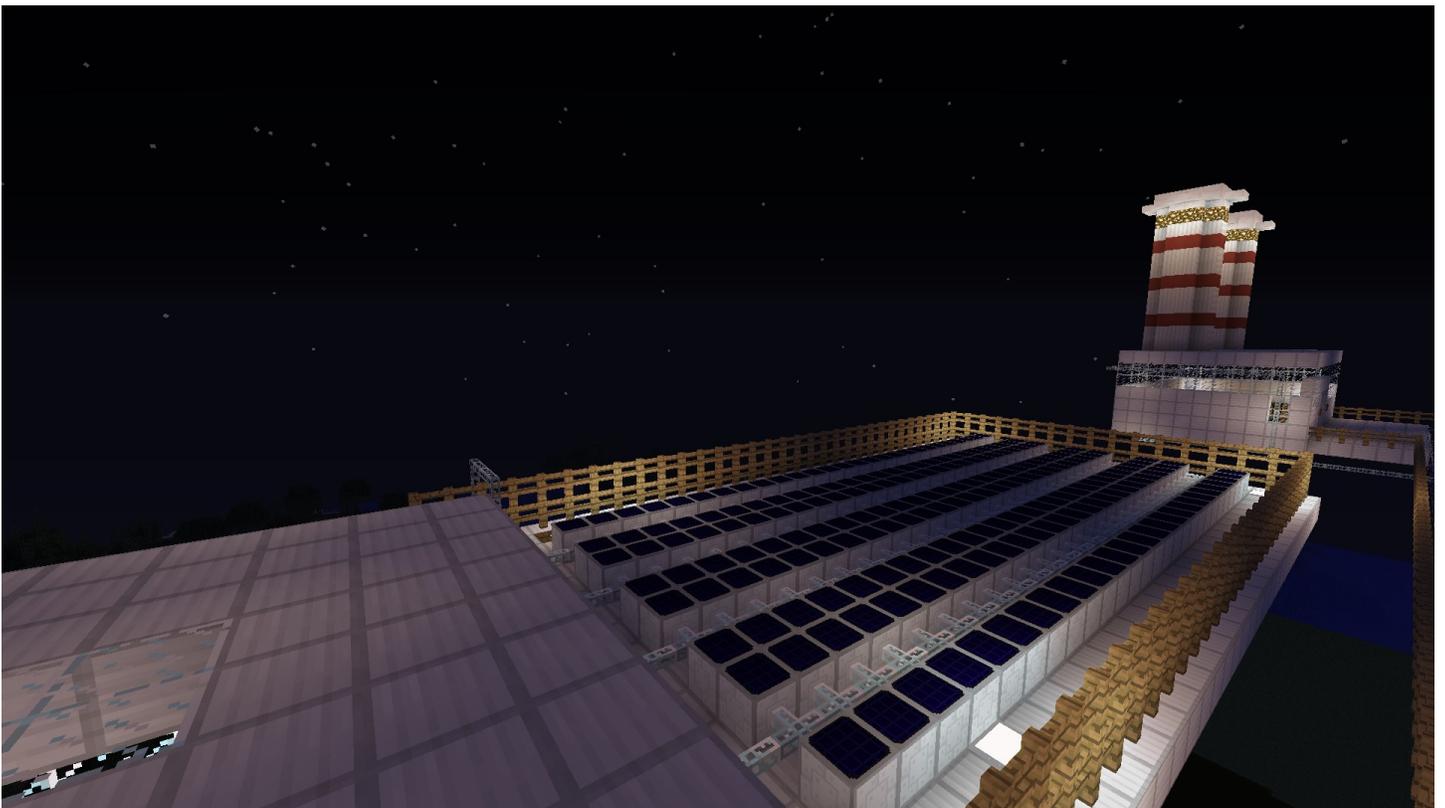
# TCIPG

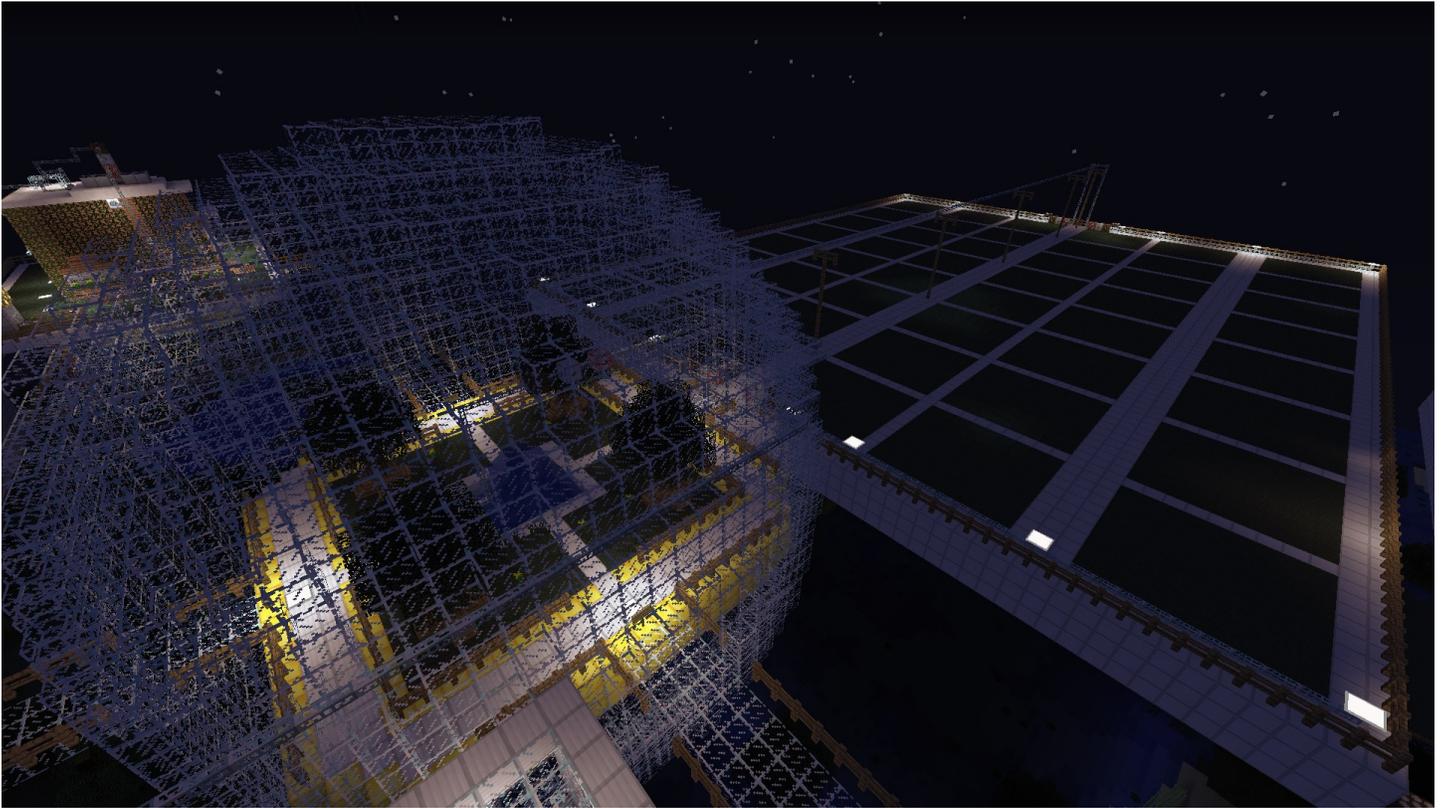
TRUSTWORTHY CYBER INFRASTRUCTURE FOR THE POWER GRID



# TCIPG

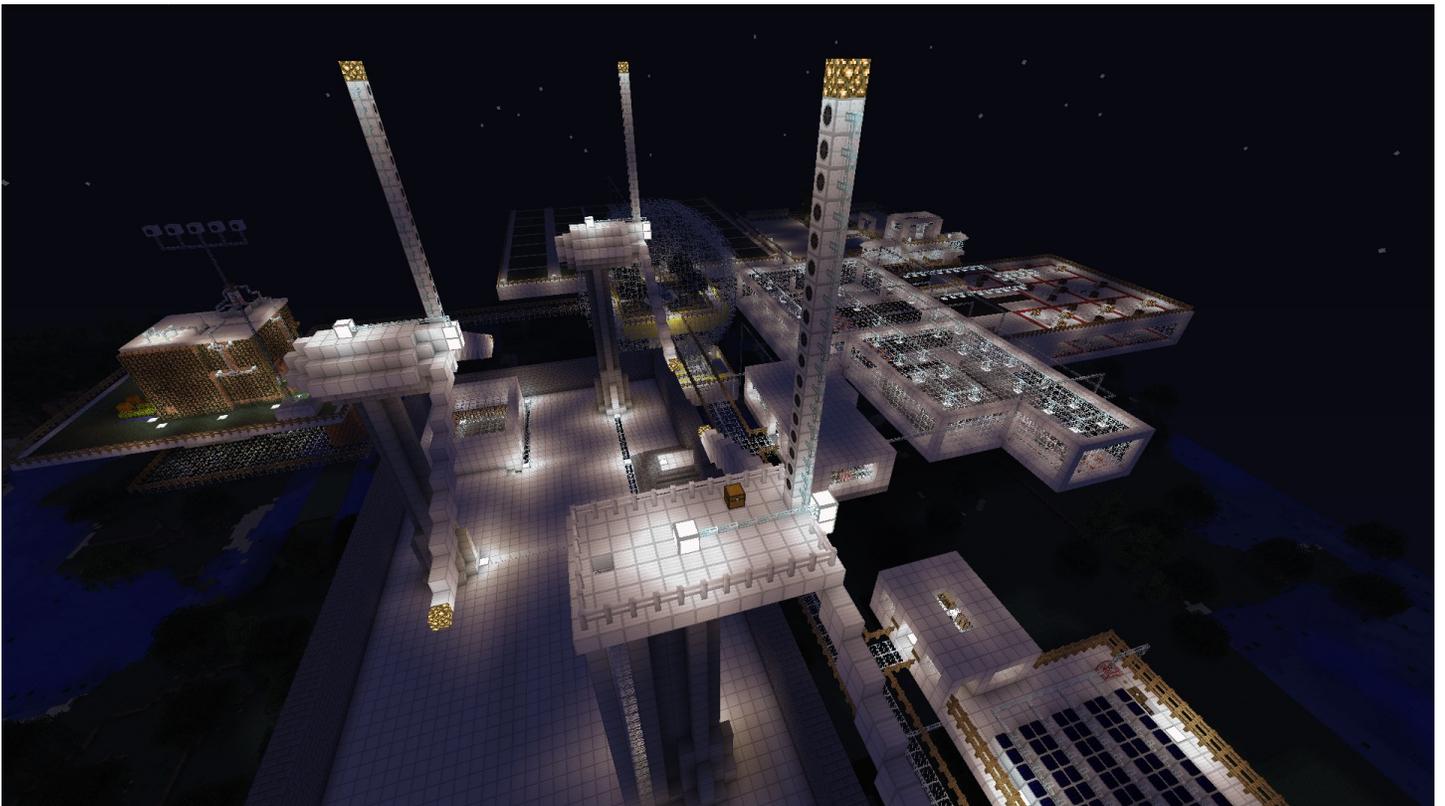
TRUSTWORTHY CYBER INFRASTRUCTURE FOR THE POWER GRID





# TCIPG

TRUSTWORTHY CYBER INFRASTRUCTURE FOR THE POWER GRID

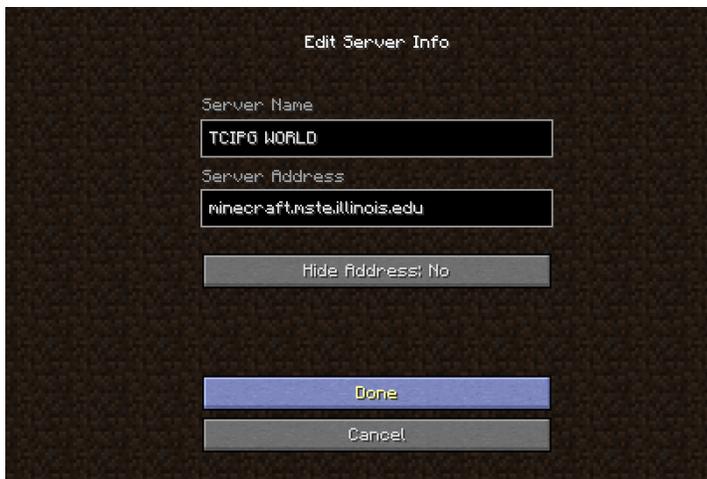


# **For MinecraftEdu Users**

## Student Log in to TCIPG MinecraftEDU Server

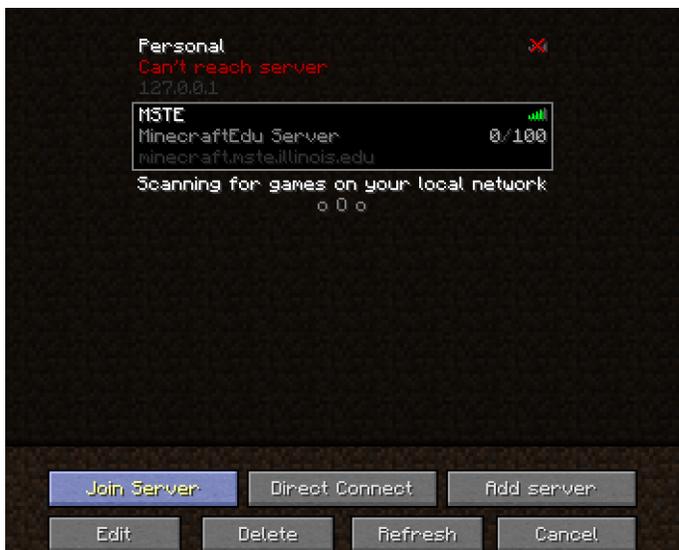


1. Double Click the MinecraftEDU icon
2. Select "Start MinecraftEdu"
3. Select "Launch"
4. Enter your name and select your gender
5. Select "Multiplayer"



*This part is only done the first time and can be skipped in the future.*

- 
6. Select "Add Server"
  7. Enter "TCIPG World" in the Server Name
  8. Enter "minecraft.mste.illinois.edu" in Server Address
  9. Select Done
- 



10. Select the "TCIPG World" and click "Join Server"
11. Select "I am a Student"
12. Choose your player and click Select

# Student Controls

## For MinecraftEdu:

**T:** Opens Text Box

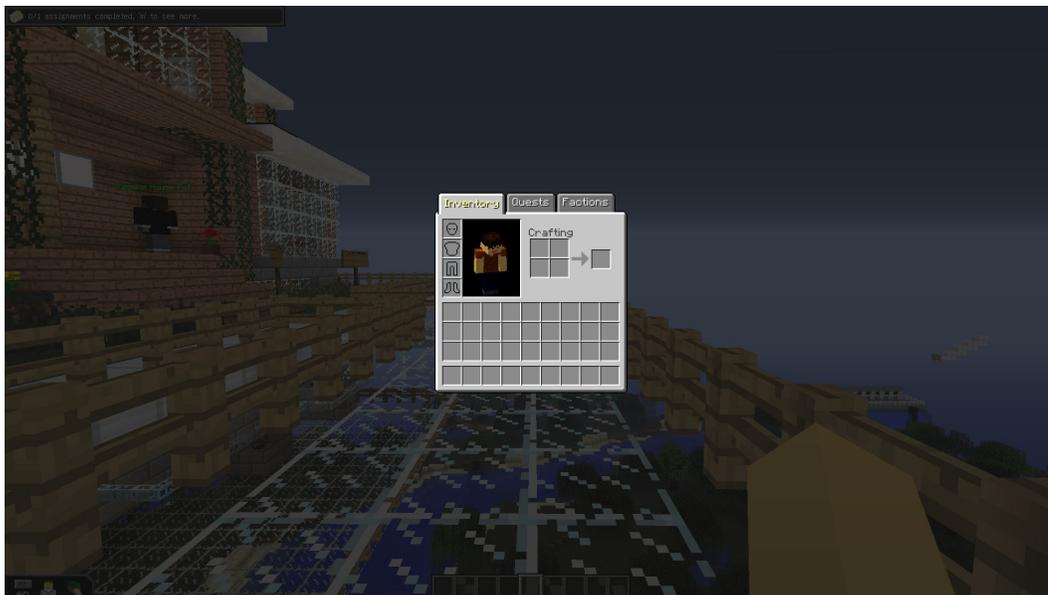
**L:** Opens Quests Log

**Z:** Zoom Minimap

**X:** Fullscreen Minimap

**M:** Opens Assignment Window

- Check Daily Assignment
- Teleport to Spawn
- Teleport to Surface



# Teacher Controls

## Hotkey for Teachers:

**P:** Opens Teacher Menu

- Can Manage Students, build, teleport, and much more!
- For more MinecraftEdu Teacher help, visit the [MinecraftEdu Wiki](#)



# Logic Gates

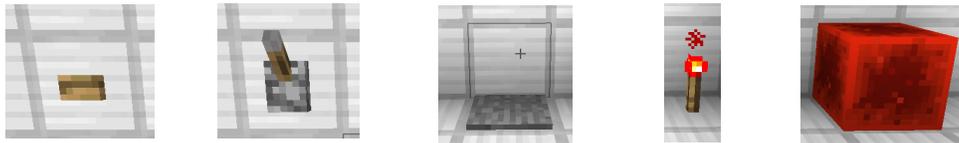
## Background

Logic gates are gates that take in one or more electrical signals from a circuit and send an output signal based on that input. The way these gates are placed can determine how data is physically processed in a computer.

In this lab you will learn how to create and utilize Redstone logic gates. To learn more about Redstone, visit the [Redstone section of the Minecraft Wikipedia](#).

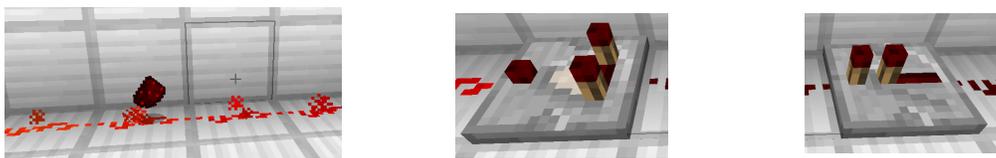
## Redstone Basics

**Power Components** – Redstone items that provide power to a Redstone circuit.



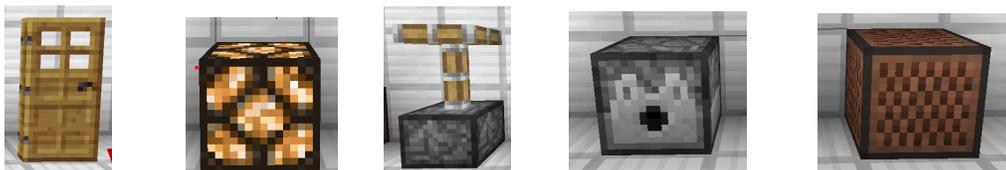
*Button, Lever, Pressure Plate, Redstone Torch, Redstone Block*

**Transmission Components** – Redstone items that transmit power through a circuit.



*Redstone Dust, Redstone Comparator, Redstone Repeater*

**Mechanism Components** – Receives Redstone input and performs a function.



*Redstone Door, Lamp, Piston, Dispenser, Note Block*