# N-10
# Introduction to Electrons

**Target:** I can describe the locations of electrons in an atom.

**Link to YouTube Presentation:** https://youtu.be/3SzbSLV3eO8

*Don't need to write*

# N-10 Introduction to Electrons

The electron is a theory we use; it is so useful in understanding the way nature works that we can almost call it real.

...will you understand what I'm going to tell you?...No, you're not gong to be able to understand it...I don't understand it. Nobody does.

– Richard P. Feynman

*Don't need to write*

# The Bohr Model of the Atom

Neils Bohr

I pictured electrons orbiting the nucleus much like planets orbiting the sun.

But I was wrong! They're more like bees around a hive.

*Don't need to write*

# Quantum Mechanical Model of the Atom

**Mathematical laws can identify the regions outside of the nucleus where electrons are most likely to be found.**

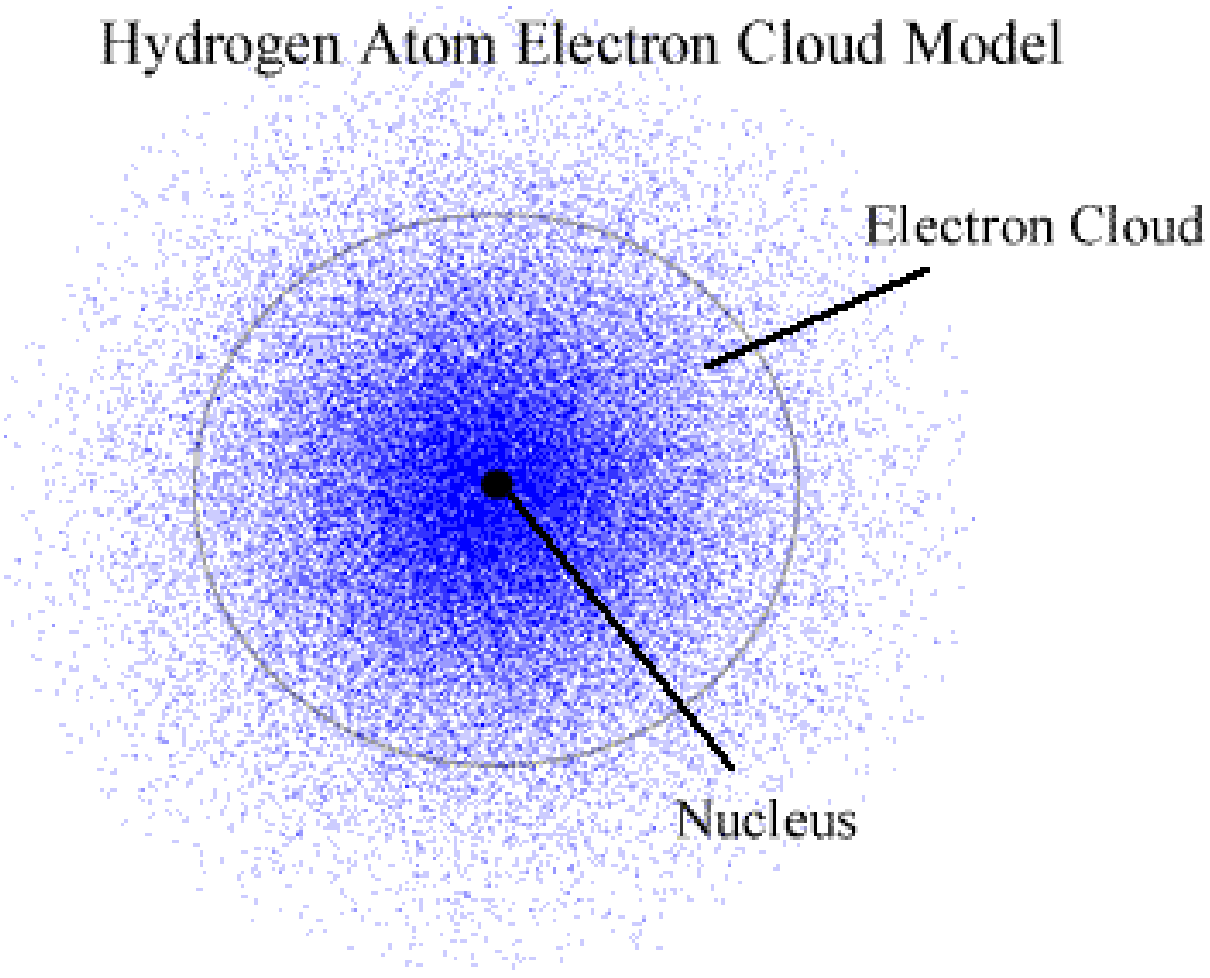
**The math is beyond the scope of this class…**

# Atomic Orbitals

**"An area where an electron is most likely to be found."**

**"A probability cloud"**

- *A region where there is a high probability of finding an electron. A mathematical function…*
- *Orbital shapes are defined as the surface that contains 90% of the total electron probability.*




**ORBITALS ARE NOT TANGIBLE OBJECTS!**
**JUST A MAP OF WHERE YOU MIGHT FIND THE ELECTRONS!**

# How do we describe orbitals?

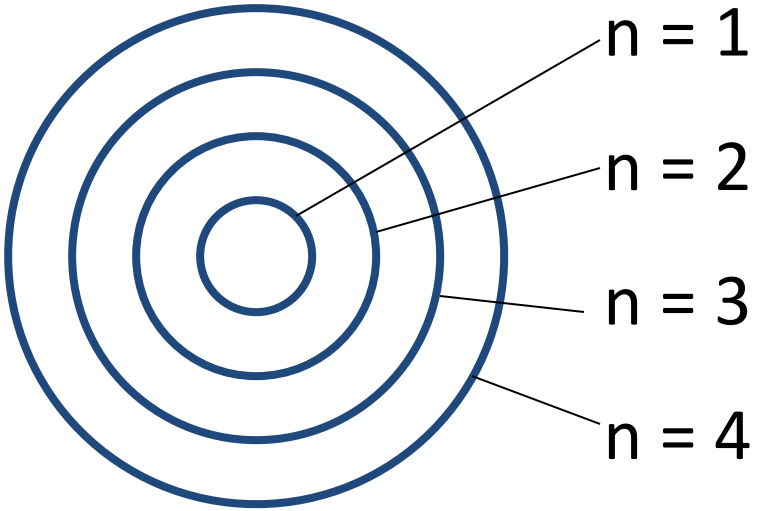
1) Energy level
2) Shape
3) Orientation
4) How many electrons are in each orbital

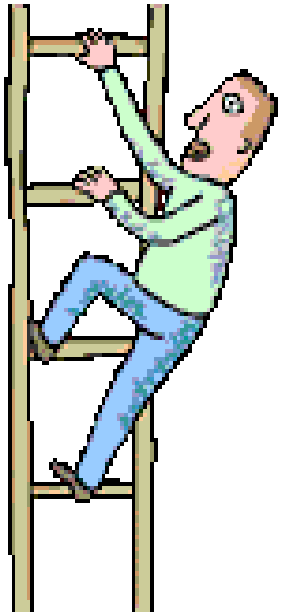
# Energy Levels

**Different orbitals are in different energy levels**

**n = 1, 2, 3, 4, 5, 6, 7.**

*1 = lowest energy, closest to the nucleus*



# Orbital Shape

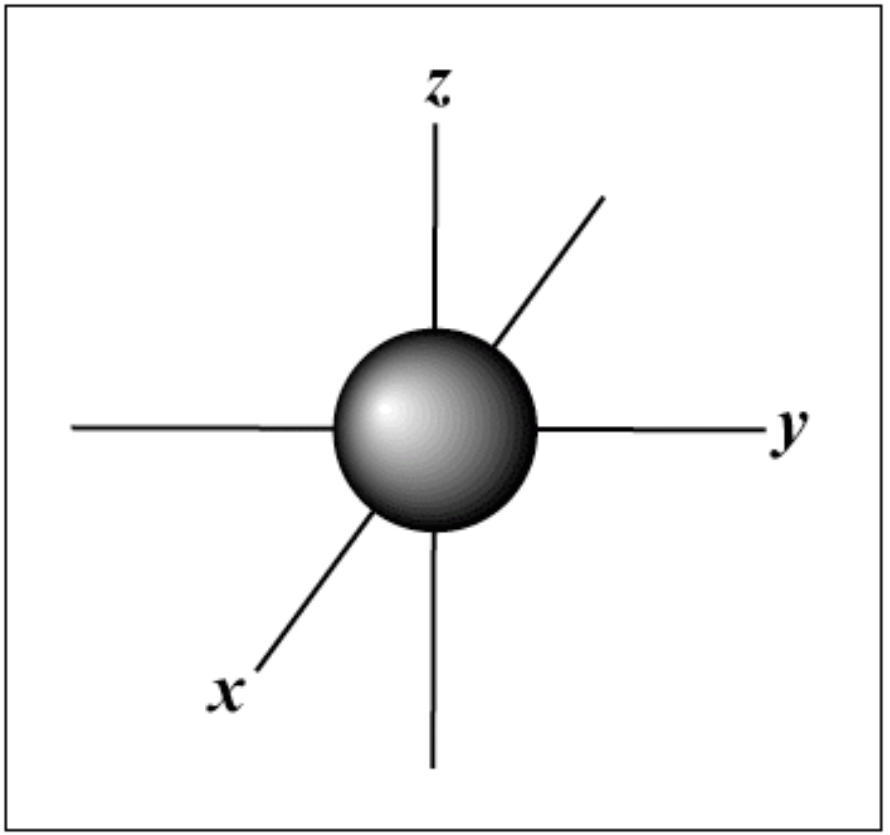
**Different orbitals have different shapes**

s, p, d, f

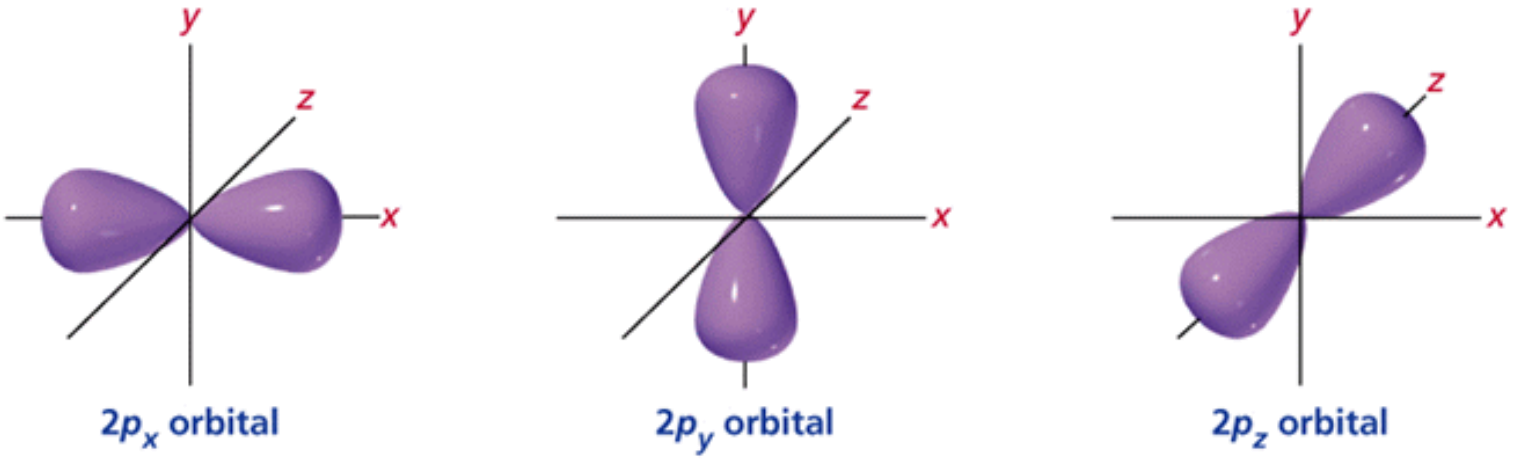
**The shapes have funny names!**
**They are just letters**

# *s* Orbital Shape

**The "s orbital" has a spherical shape centered around the origin of the three axes in space.**



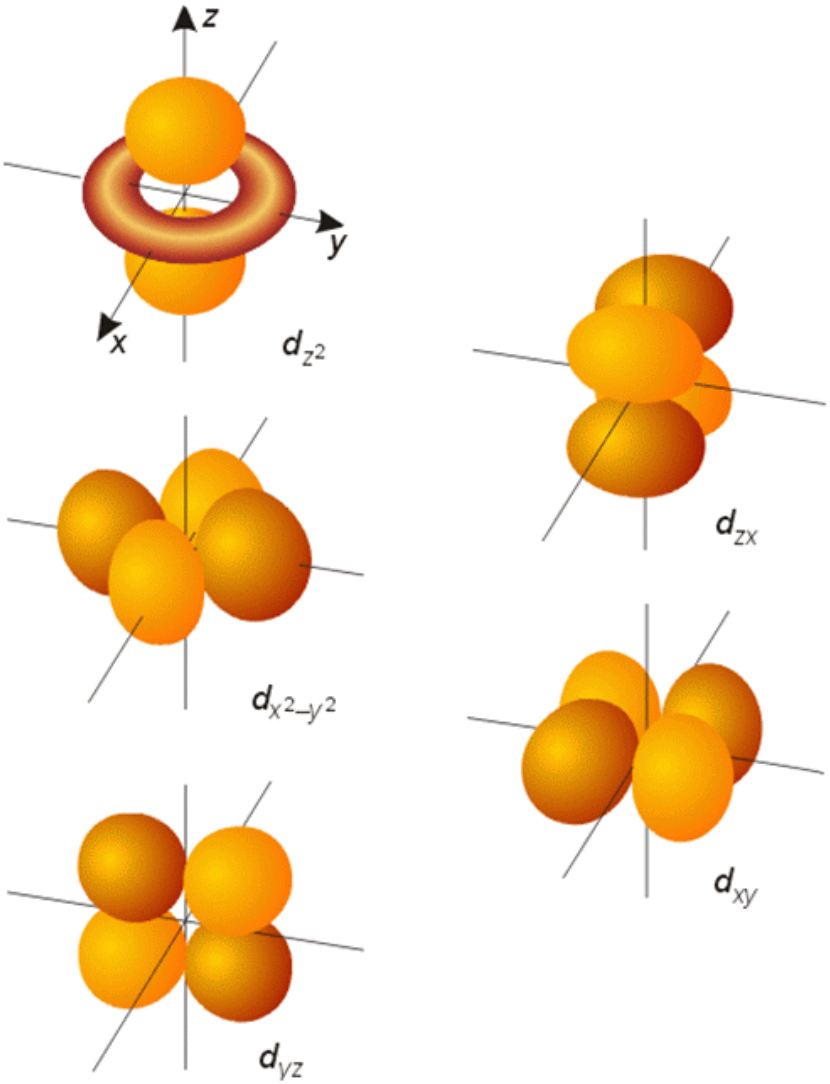
# *p* Orbital Shapes




**There are three or double-lobed *p* orbitals in each energy level above n = 1, each assigned to its own axis (x, y and z) in space.**

**Petal shaped, peanut shaped, (dumbbell shaped)**

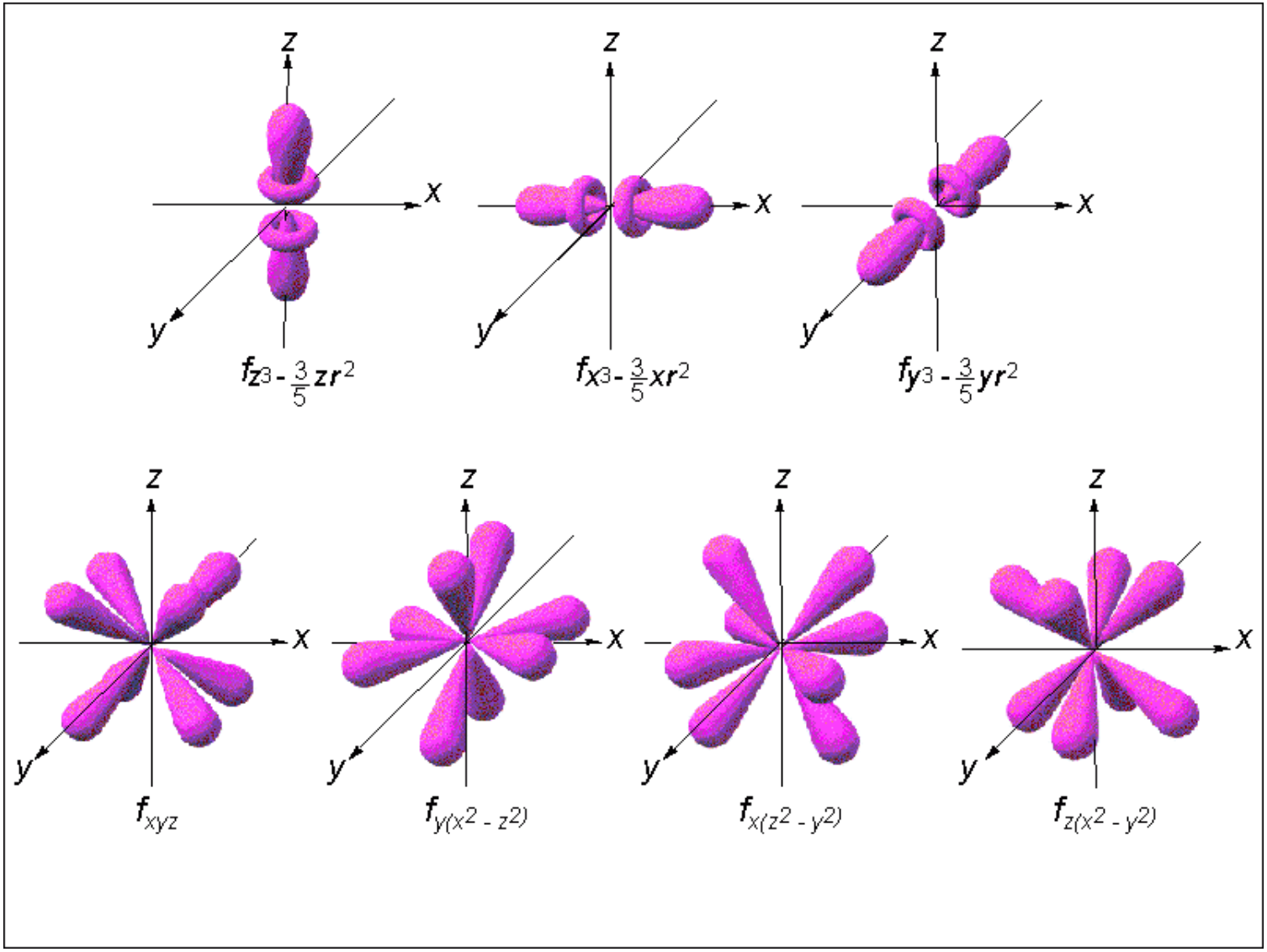
# *d* Orbital Shapes




- **d orbitals are weird!**
- **Five *d* orbitals that are found in the *d* sublevels beginning with n = 3.**
- **"double dumbbells" or "dumbbell with a donut"!**

# *f* Orbital Shapes

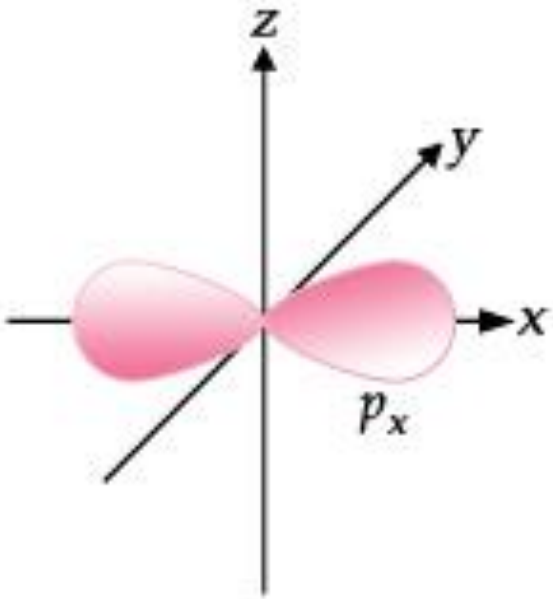
## "funky" shaped!



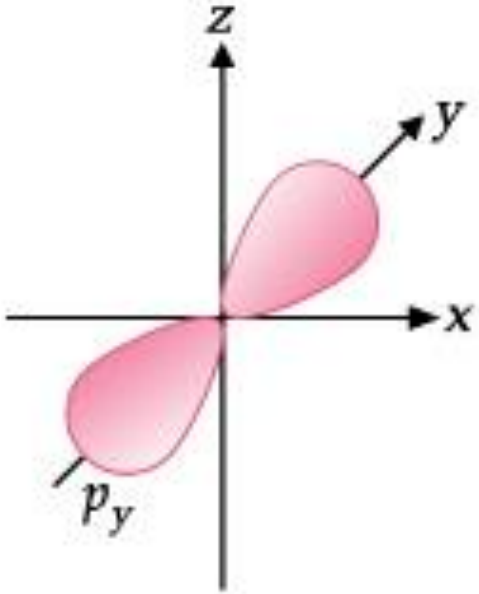
# Orbital Orientation

## Different orbitals have different orientations

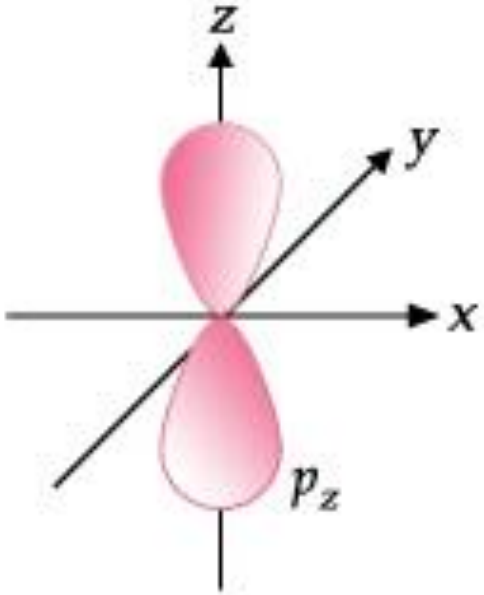
x, y, z (axis)




$p_x$ orbital



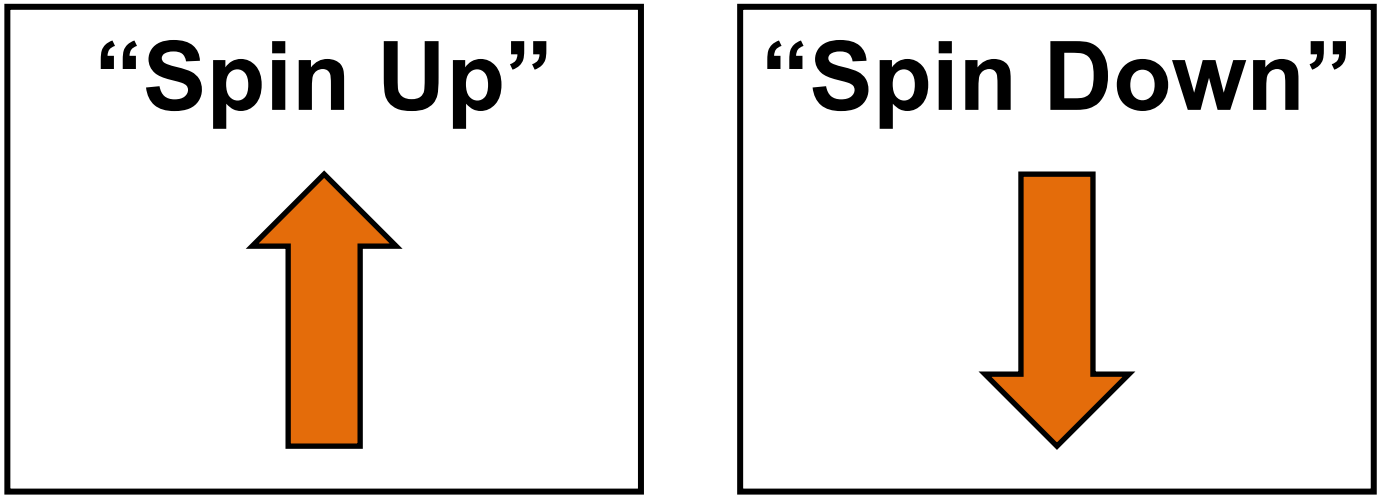

$p_y$ orbital



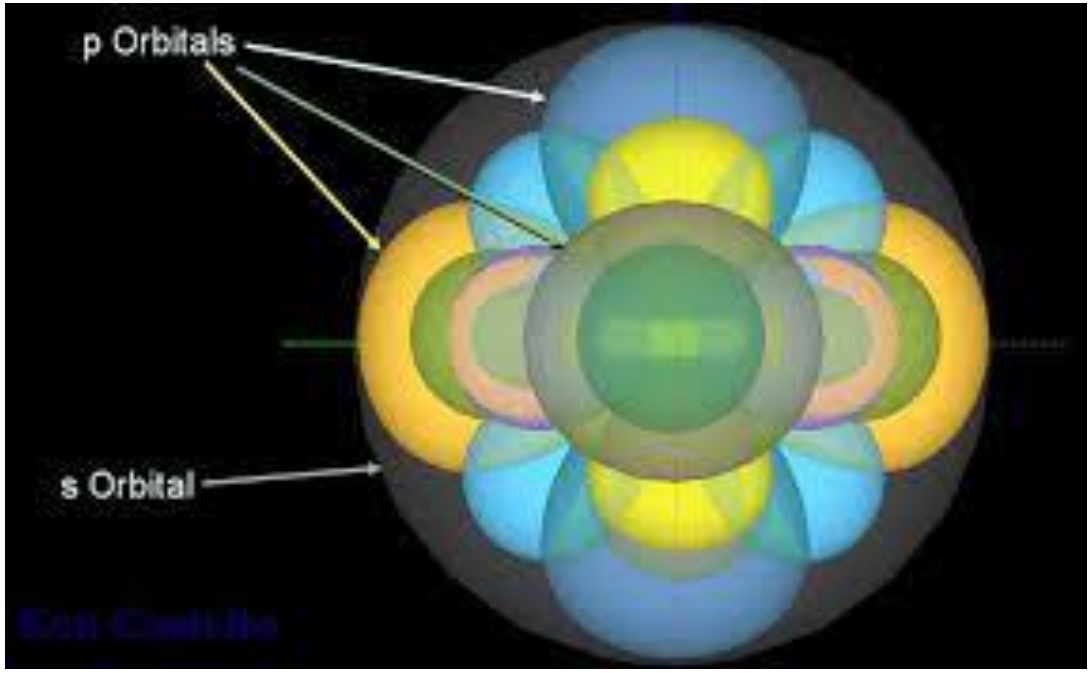

$p_z$ orbital

# Electrons in an orbital

**Each orbital is only allowed to have TWO $e^-$s**



# Orbitals all exist together




http://www.johnmacneill.com/Atom_Table.html

# So how do I tell someone exactly where an electron is???

# Think about where you live…

| | |
|---|---|
| California | State |
| Pleasanton | City |
| Ferdinand Avenue | Street |
| #2345 | House # |

**You can write an ADDRESS for where you live**

**So couldn't you write an ADDRESS for where the electrons are in an atom???**

# Where do e- live?
# What is the address for one?

| | | |
|---|---|---|
| State | ⇢ | Energy Level |
| City | ⇢ | Type/Shape of Orbital |
| Street | ⇢ | Orientation |
| House # | ⇢ | Spin up or Spin down |

# Electron Configuration is an address!

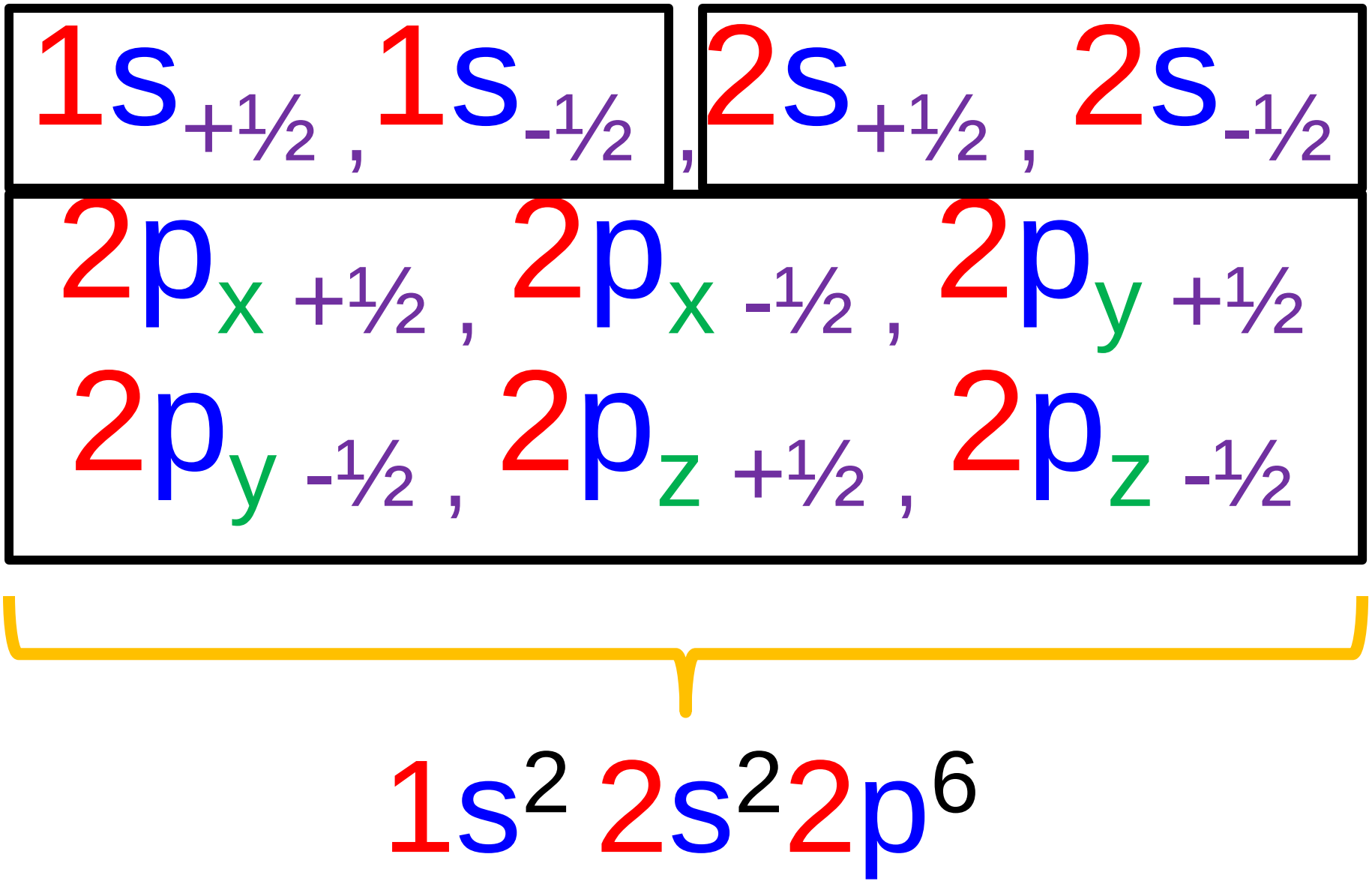
$2p_x +½$

**Energy Level**

**Type/Shape of Orbital**

**Orientation**

**Spin up or Spin down** **+ ½ , - ½**


1s+½ , 1s-½ , 2s+½ , 2s-½
2px +½ , 2px -½ , 2py +½
2py -½ , 2pz +½ , 2pz -½
1s2 2s2 2p6

# Want to describe where ALL the e$^-$s in an atom were?

**Shrink it down and only list the basics!**

***Energy levels***

***Shapes of Orbitals***

***Number of electrons in each orbital***

$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^4$

$= 2+2+6+2+4 = 16\ e^-$ Sulfur!

# Steps to finding all the electrons

**1)** Pick an **atom**

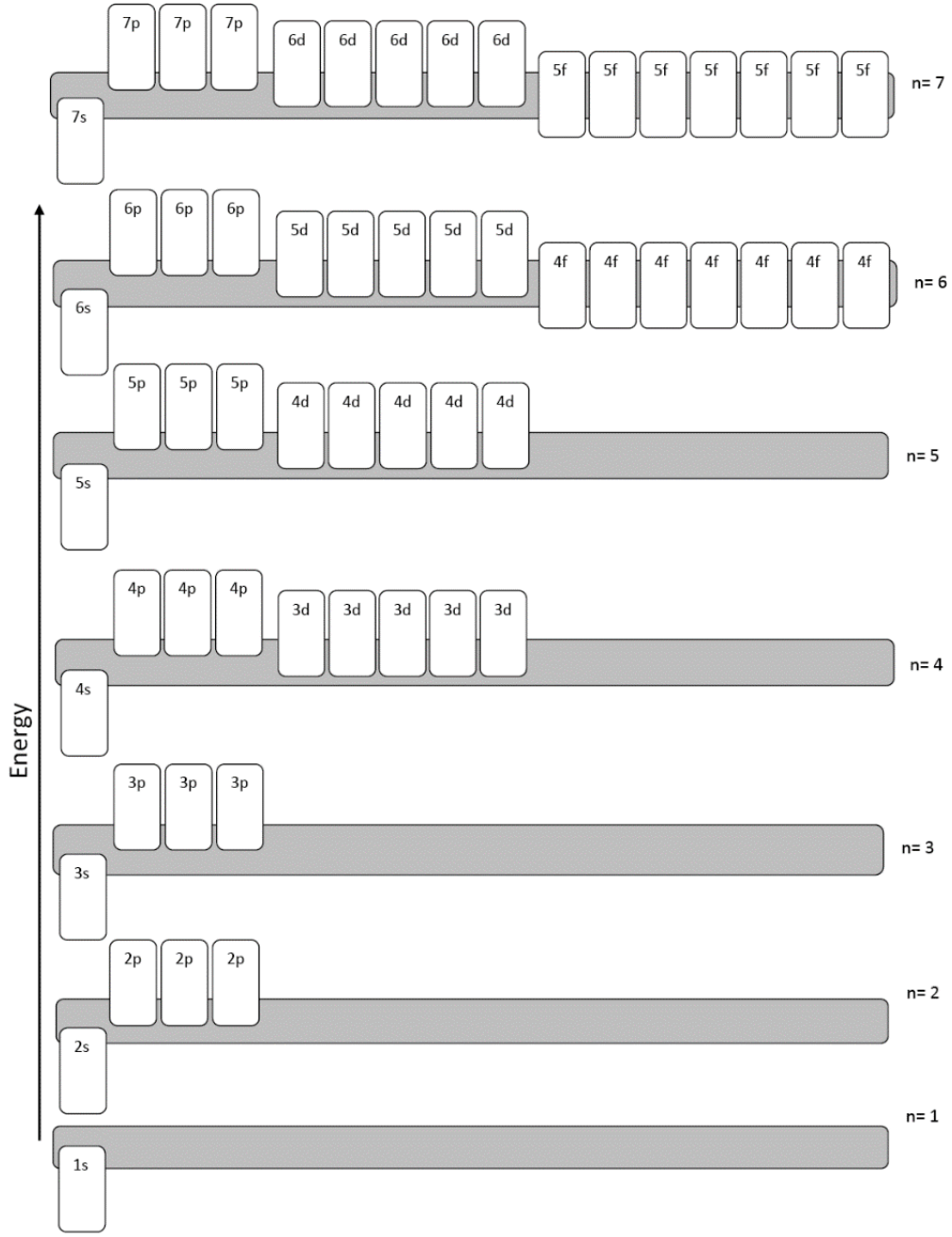
**2)** Find the number of **electrons it has**

**3)** Start putting electrons into the **orbitals**
Use an **ORBITAL CHART/DIAGRAM**

**4)** List which **orbitals** you used and **how many** electrons in each one

# Orbital Diagram

A chart that shows you the order that the orbitals go in.



# Rules for putting e⁻s in orbital diagrams

## Aufbau Principle

An electron occupies the lowest energy orbital that it can.

**Means:** **Fill from the bottom up**

***Electrons are lazy!***

# Rules for putting e$^-$s in orbital diagrams

## Pauli Exclusion Principle

No two electrons in the same atom can have the same set of 4 quantum numbers

**Means:** **If there are two e$^-$s in one orbital, one must be spin up, one spin down.**

***They can't have exactly the same "address"***

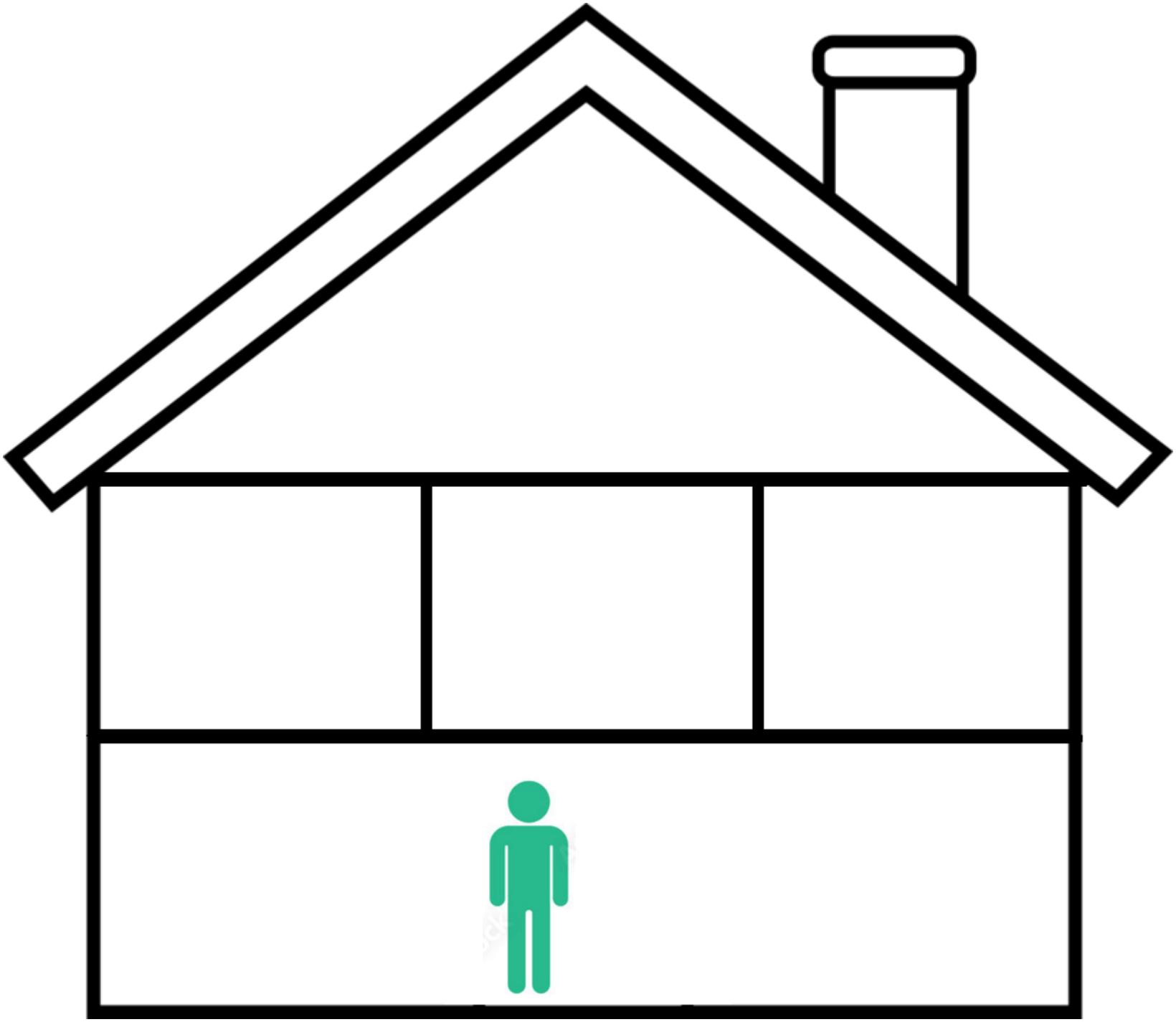
# Rules for putting e⁻s in orbital diagrams

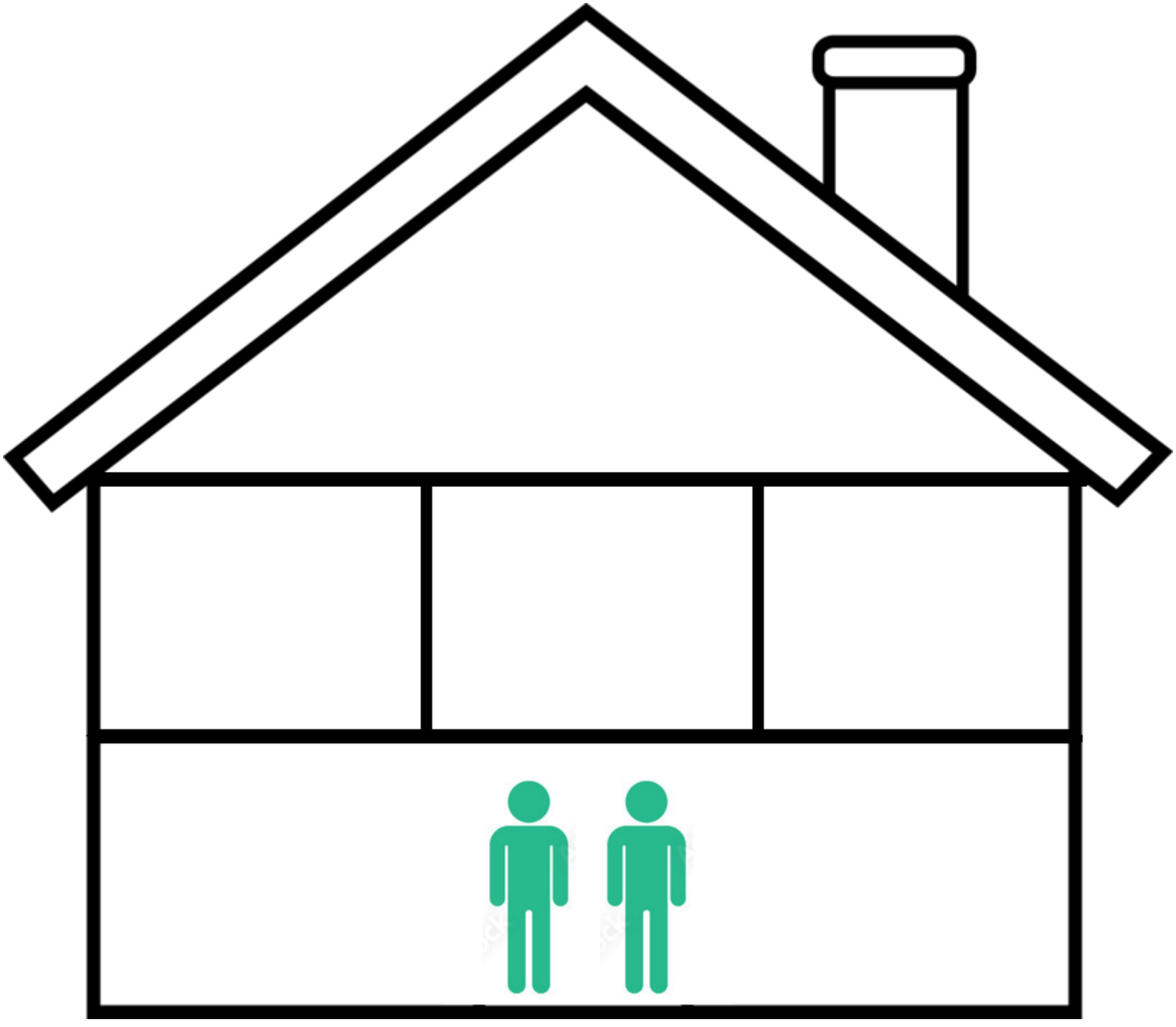
## Hund's Rule

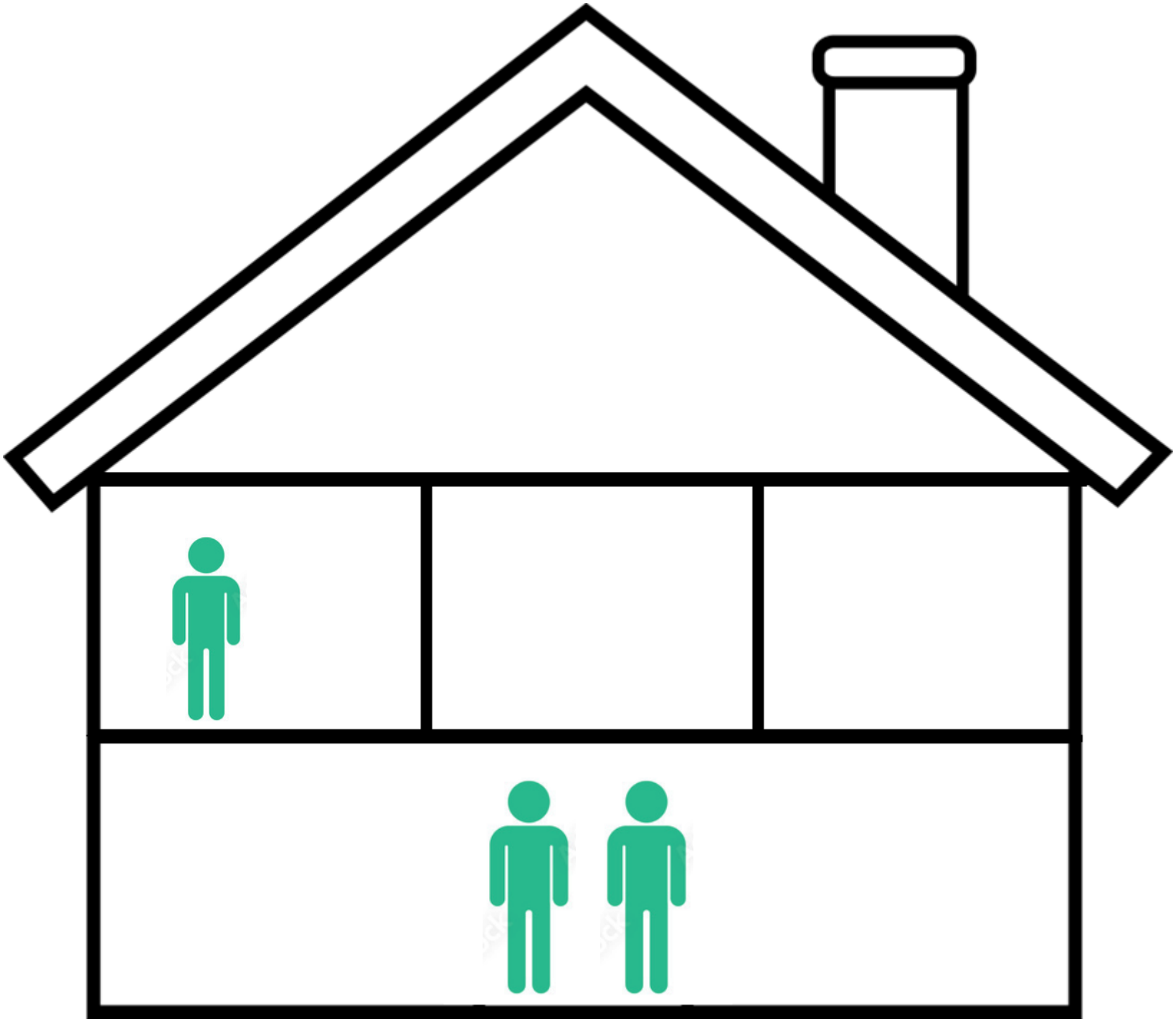
Orbitals of equal energy are each occupied by one electron before any orbital is occupied by a second electron.

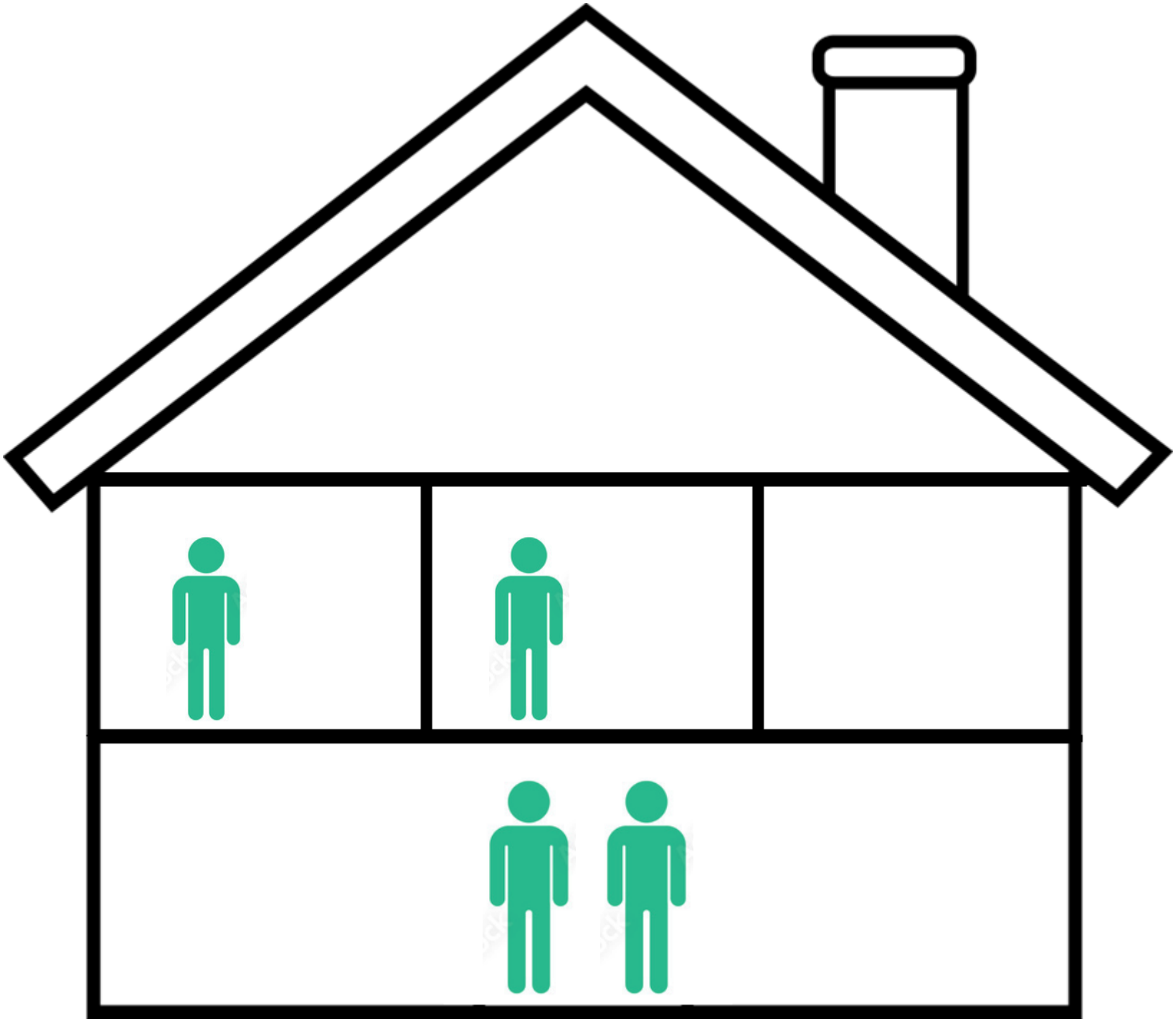
**Means:** **If there are more than one orbital at the same energy, put one electron into each orbital before pairing up**

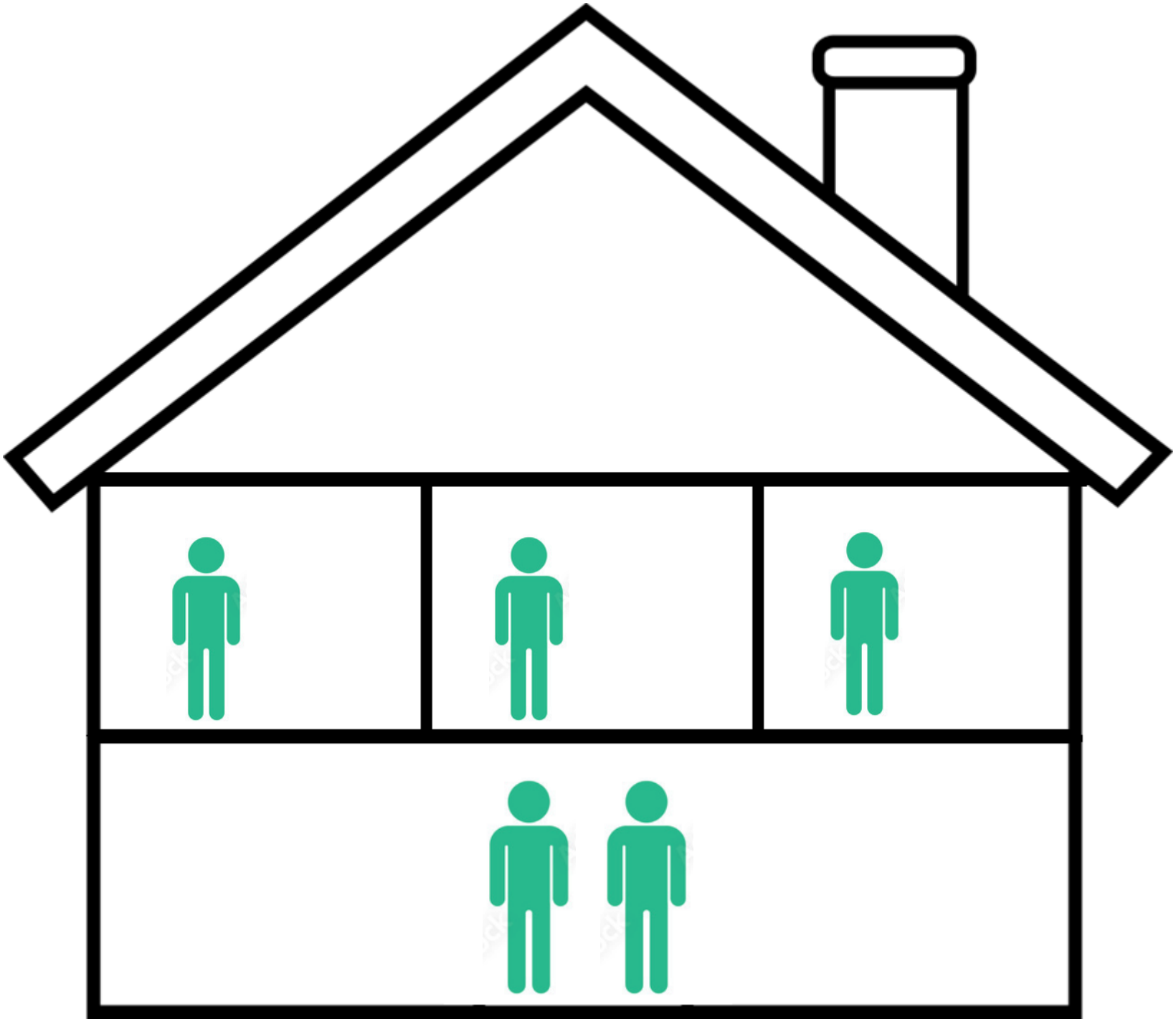
**Don't share a bedroom unless you have to!**

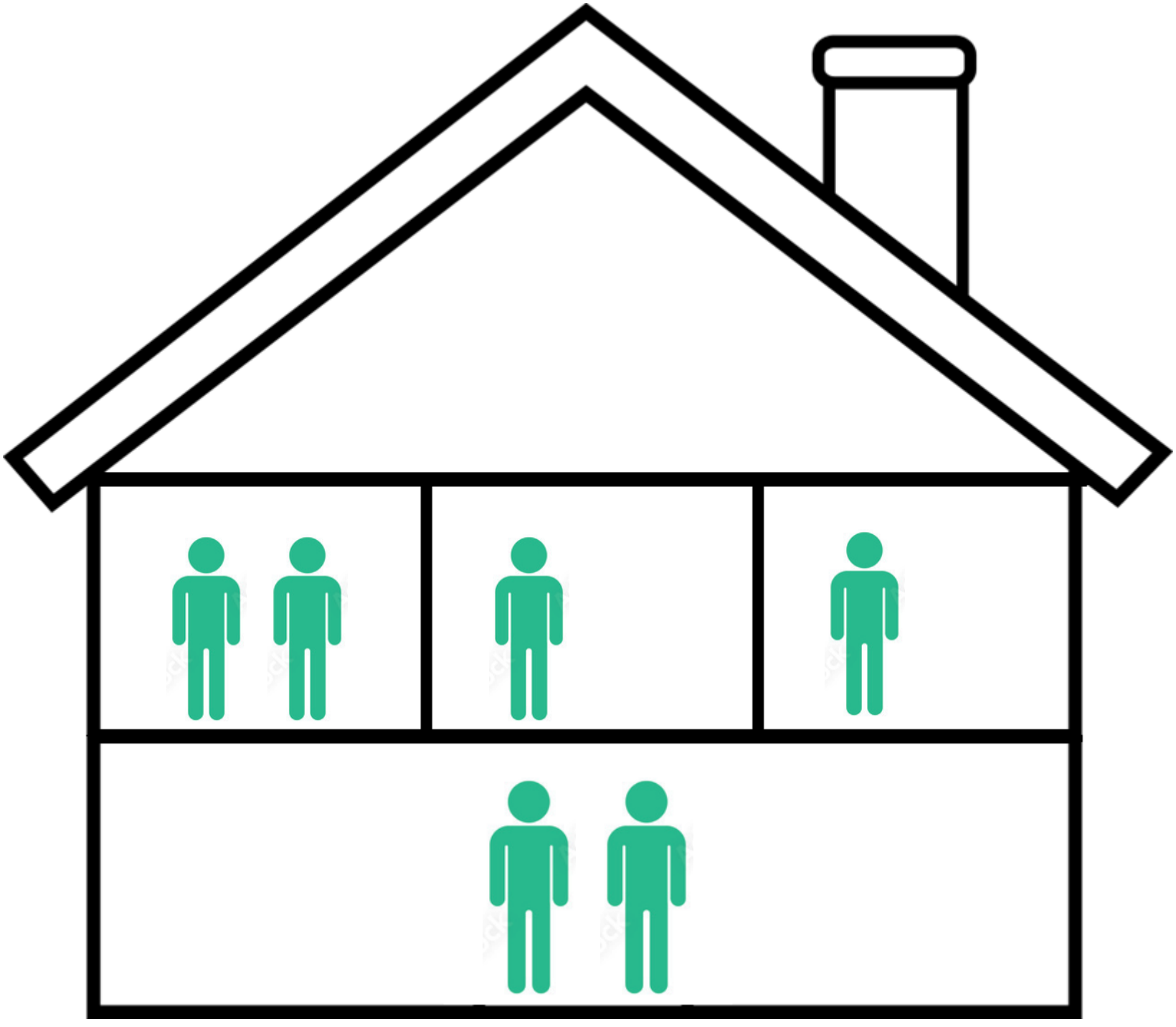


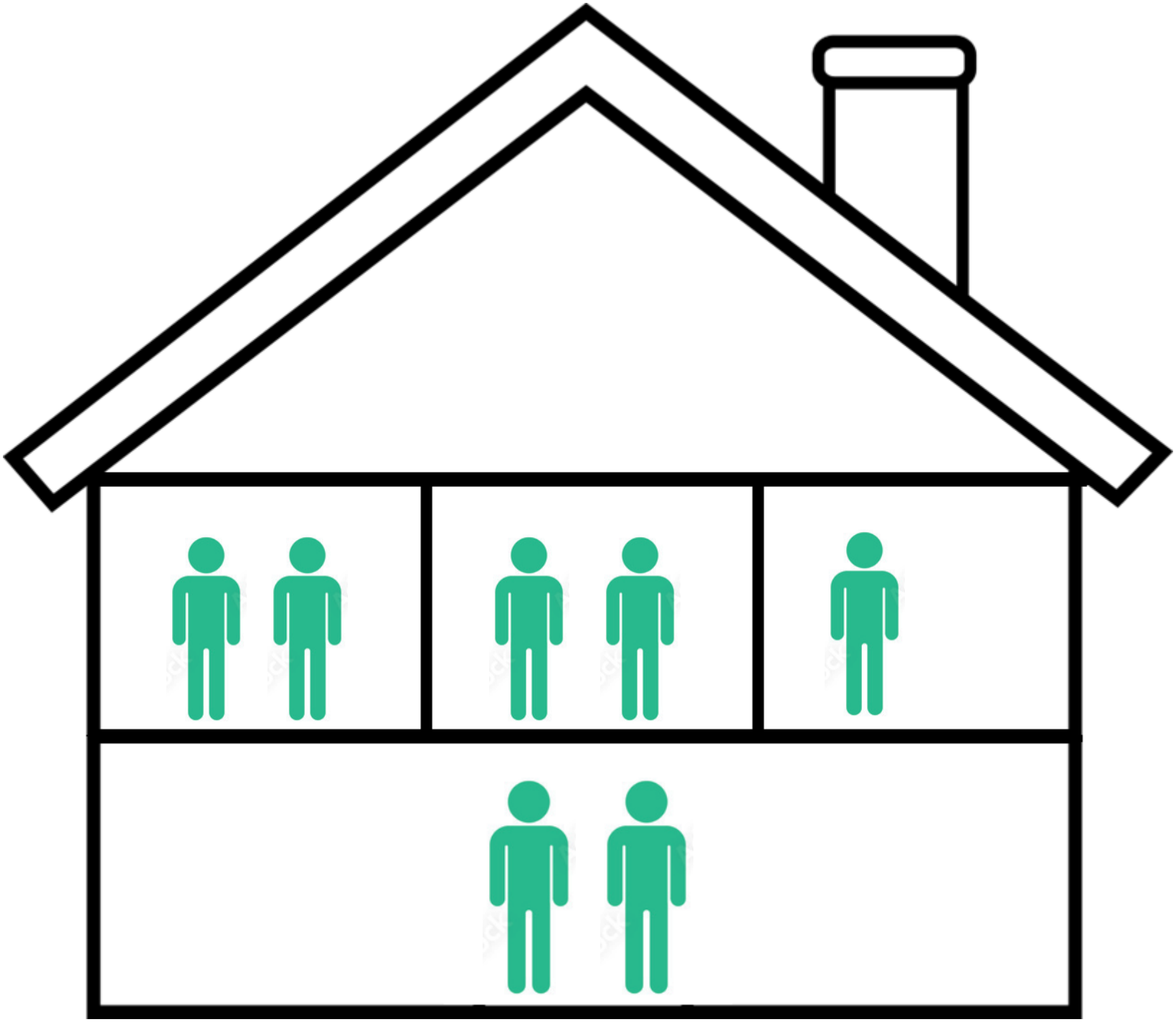


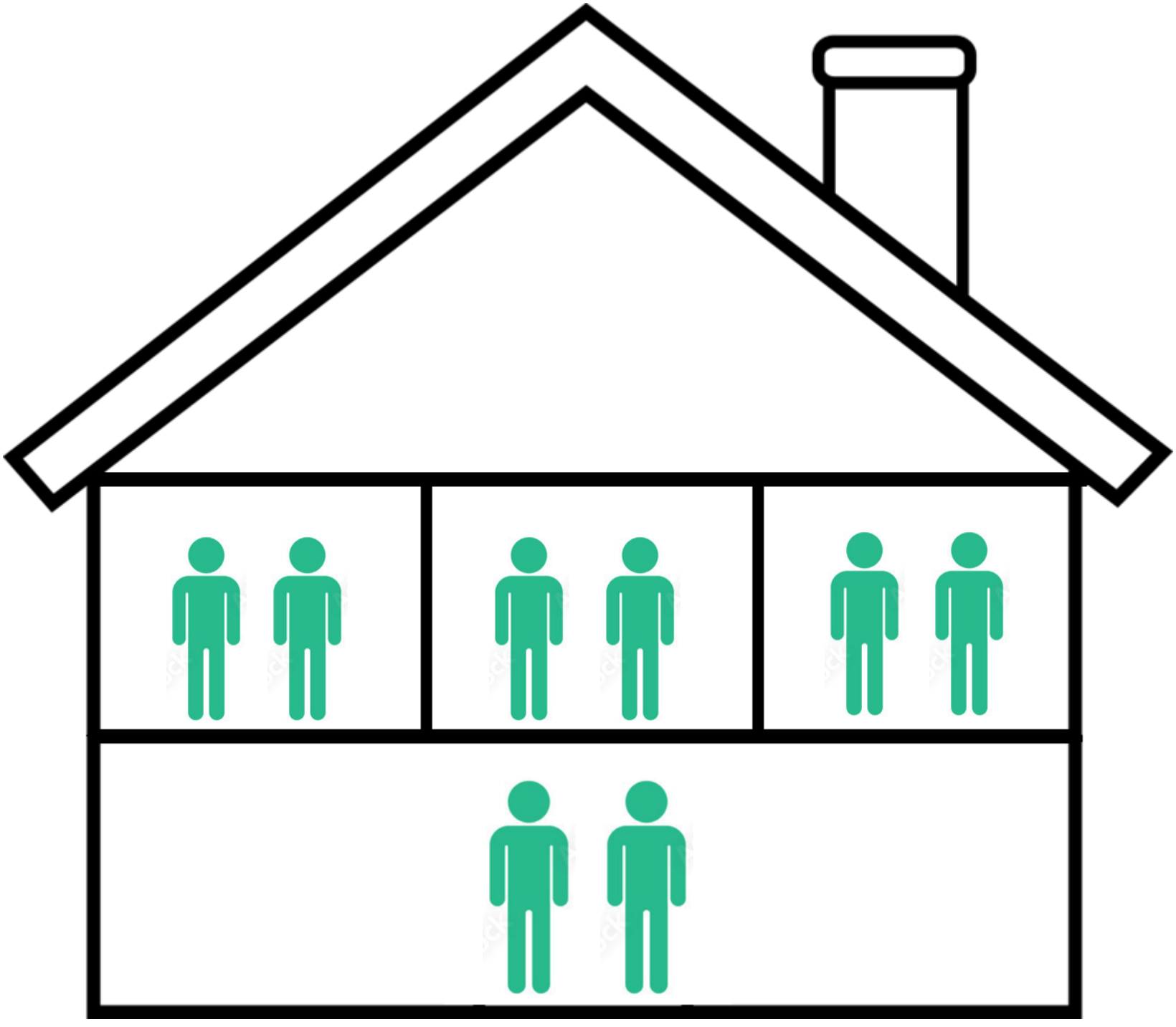


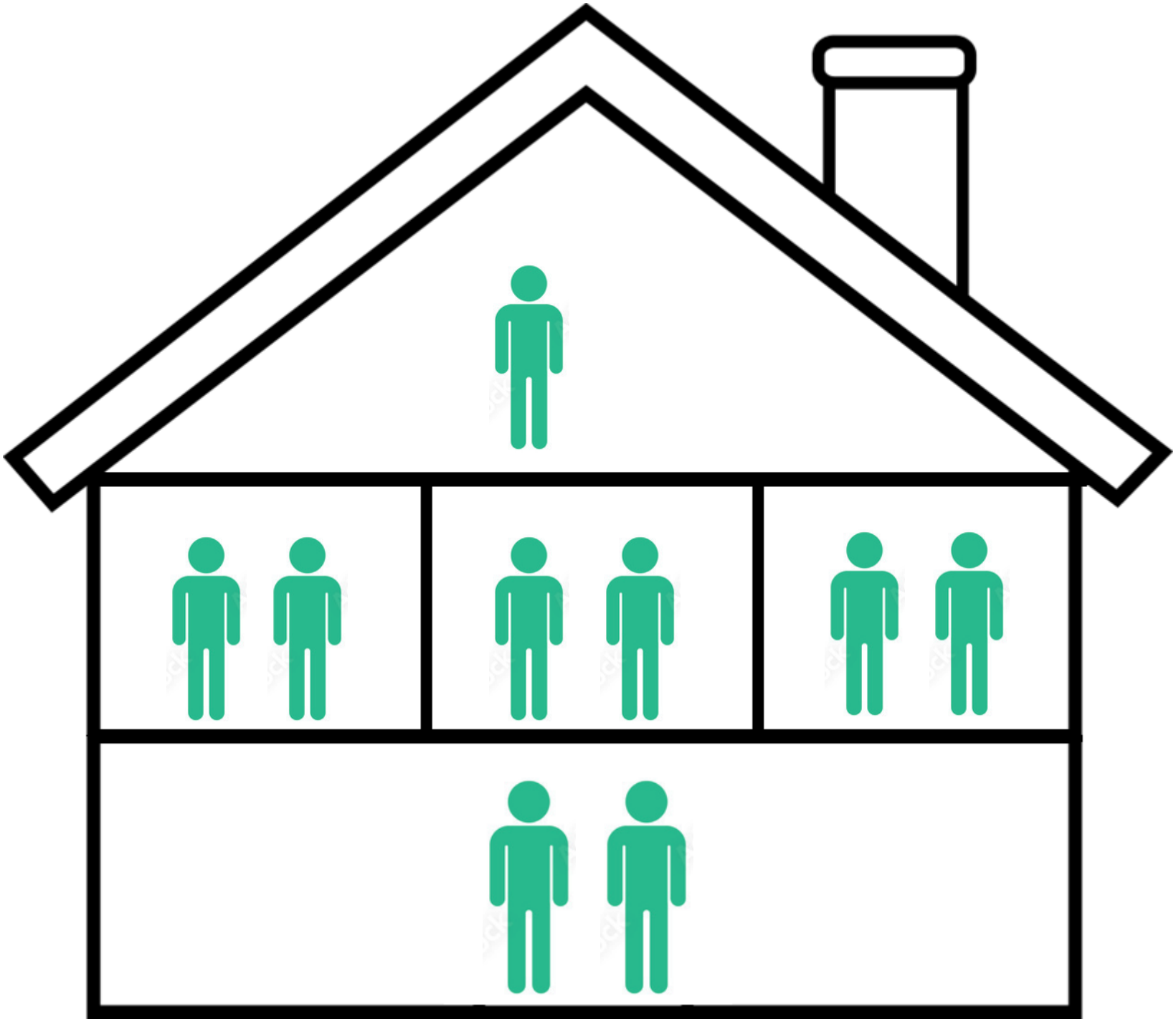


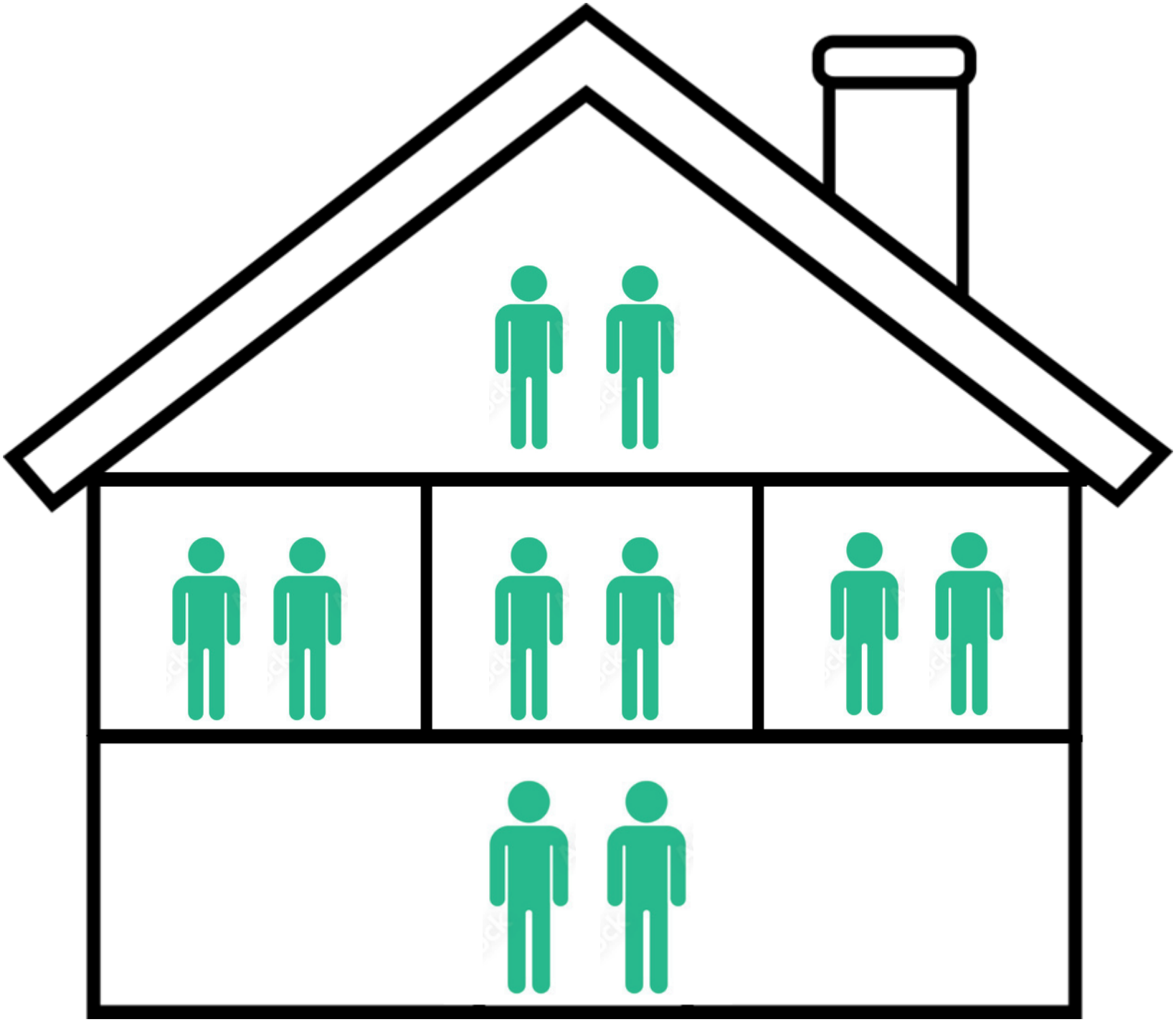


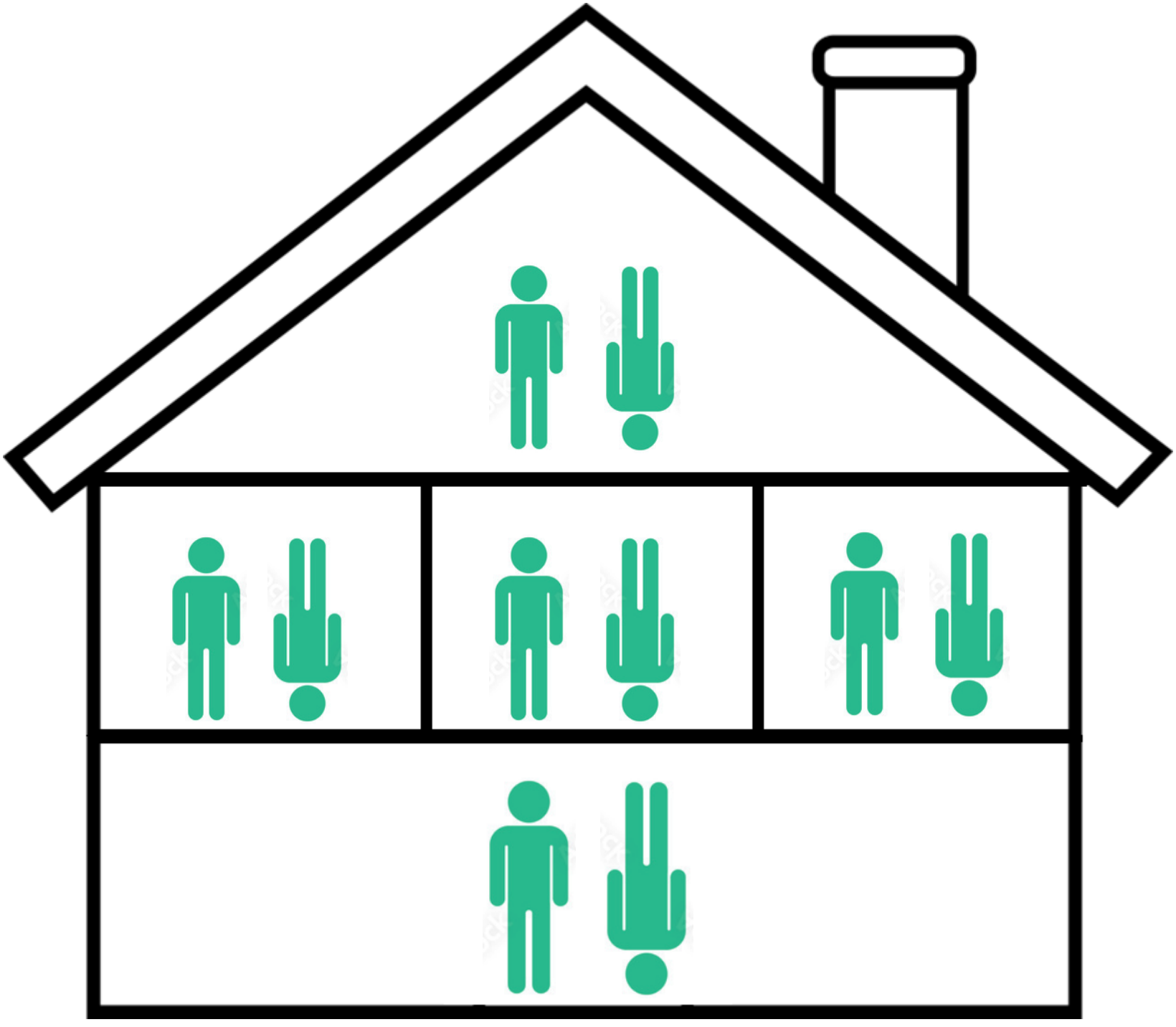




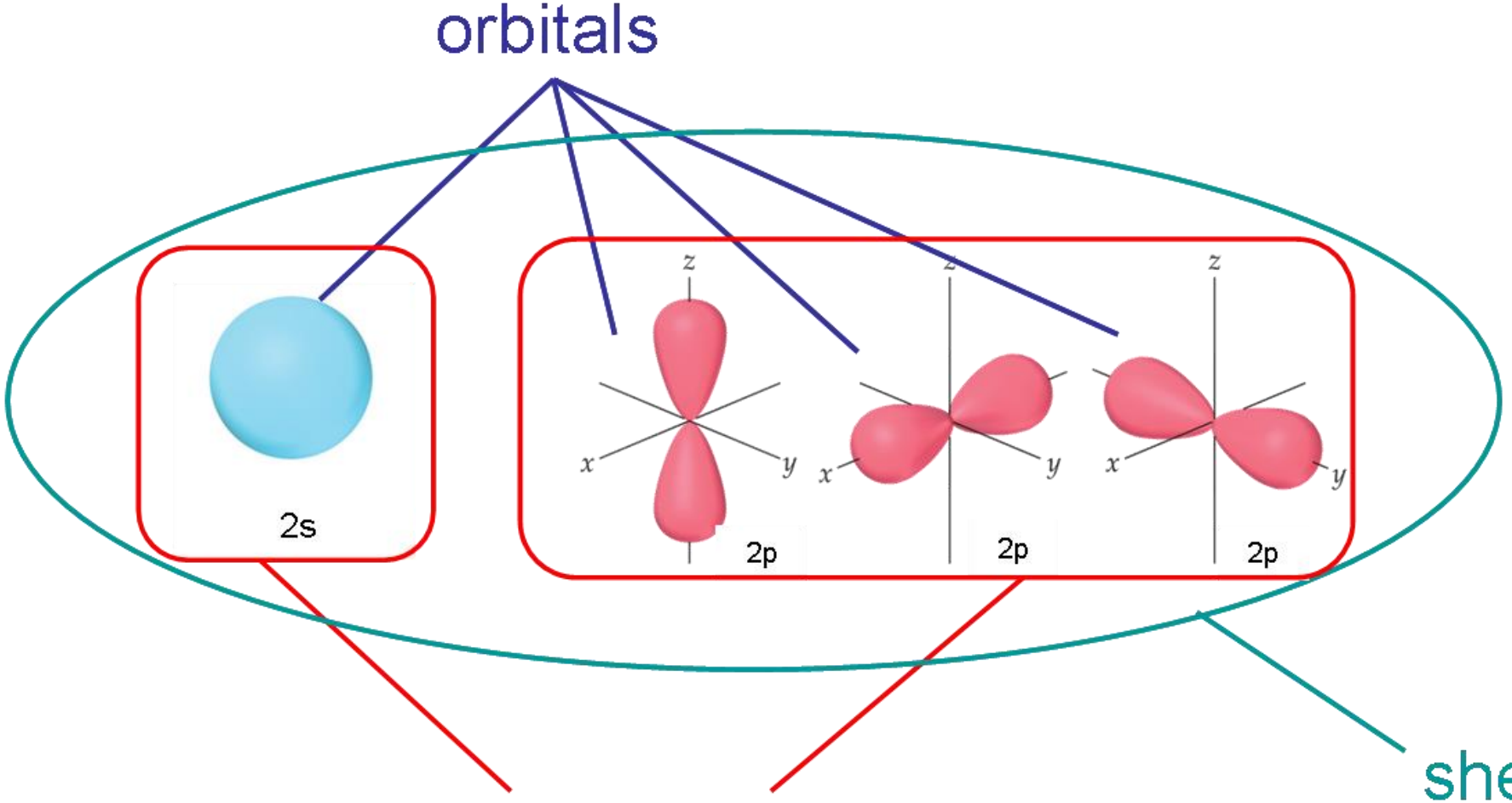








# Some terms you may hear



# YouTube link to presentation

- https://youtu.be/3SzbSLV3eO8