

# N-14 Atomic Absorption & Emission, Line Spectra and the Chemical Composition of Stars

**Target:** I can explain how we can use movement of electrons to determine the identity of unknown substances.

Link to YouTube Presentation: [https://youtu.be/cq12jS\\_ZA1I](https://youtu.be/cq12jS_ZA1I)





**Where did the  
elements come from?**



# THE BIG BANG THEORY

*Time begins*

*One Second*

*Present Day*

Time	$10^{-43}$ sec.	$10^{-32}$ sec.	$10^{-6}$ sec.	3 mln.	300,000 yrs.	1 billion yrs.	15 billion yrs.
Temperature		$10^{27}^{\circ}\text{C}$	$10^{13}^{\circ}\text{C}$	$10^8^{\circ}\text{C}$	$10,000^{\circ}\text{C}$	$-200^{\circ}\text{C}$	$-270^{\circ}\text{C}$

1 Cosmos goes through super fast inflation

2 Universe is a hot soup of electrons, quarks, other particles

3 Rapid cooling, lets quarks clump together to make protons and neutrons

4 Still too hot to form atoms, no light can travel, super hot fog

5 Electrons combine with protons and neutrons to make atoms – H and He. Light can finally shine!

6 Gravity makes H and He condense to form clouds of galaxies and stars

7 Galaxies cluster together, stars die and spew heavy elements into space to make new stars and planets

# The Great Explosion (The Big Bang)



13.7 billion  
years ago



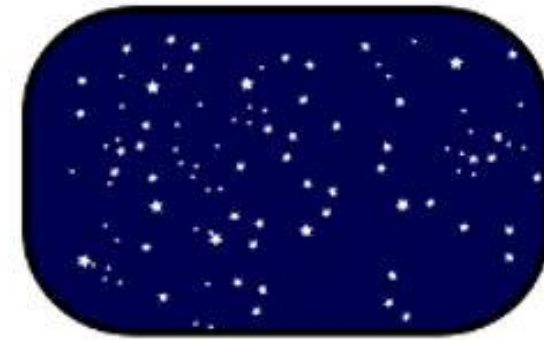
# Hydrogen Atoms and Molecules Appear



370,000 years  
later



# Stars Appear



100 million years  
later

Nuclear Fusion



Blue and Yellow  
Stars:  
Conversion from  
Hydrogen to  
Helium

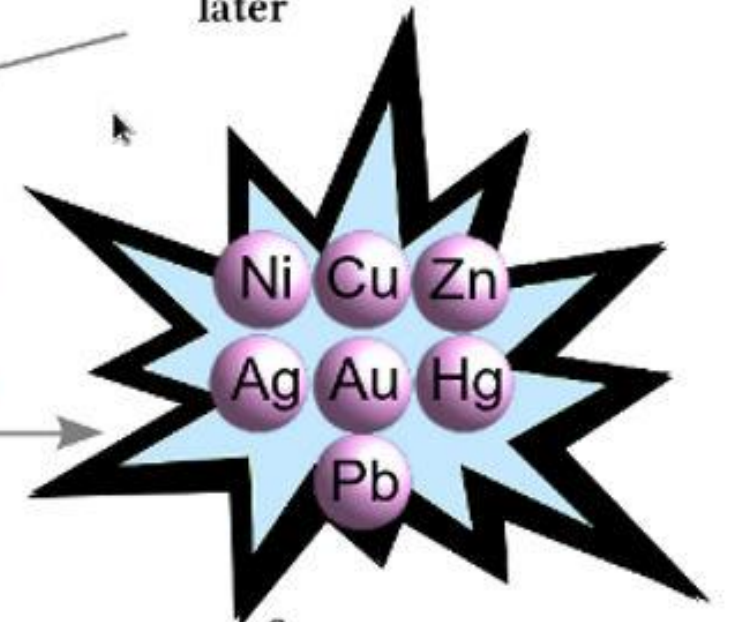


Red and Red-Giant Stars,  
Blue-White Stars:  
Conversion from Helium  
to Carbon, Nitrogen,  
and Oxygen

+

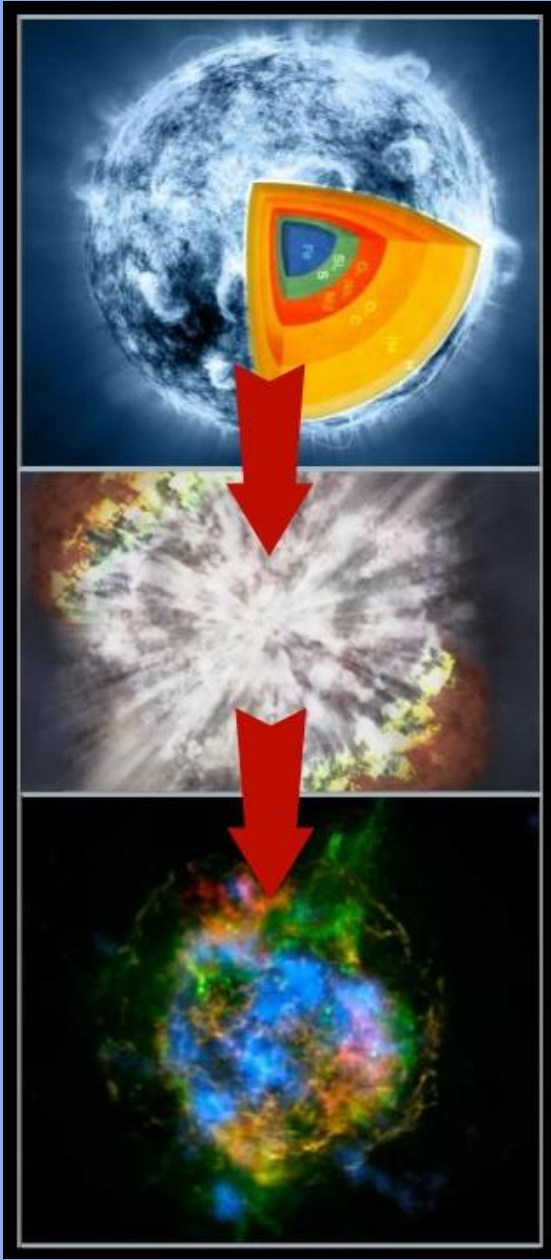
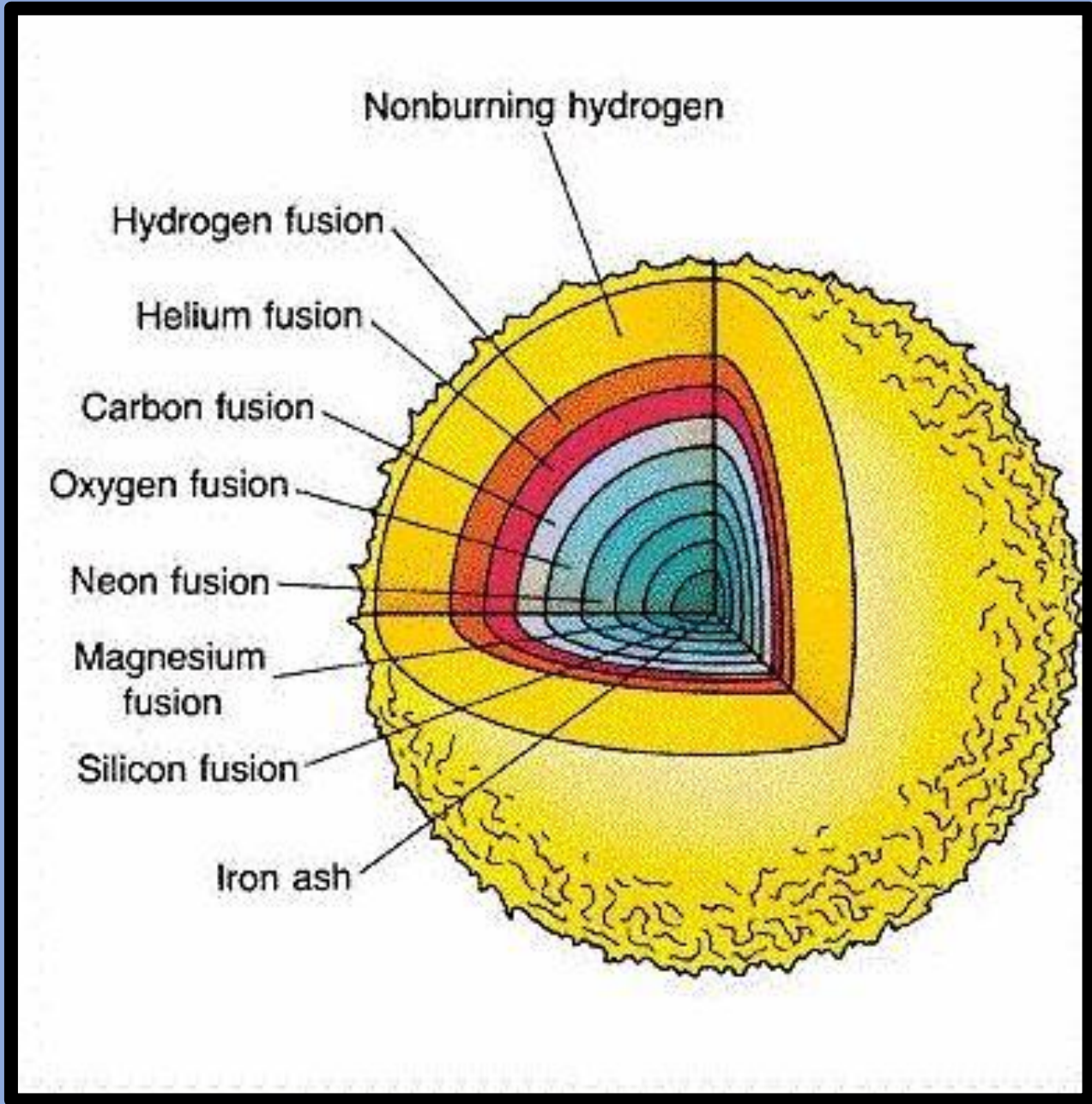


Blue-White  
Stars



Supernova





**Out of fuel**

**Implosion**

**Forms  
nebula of  
elements**









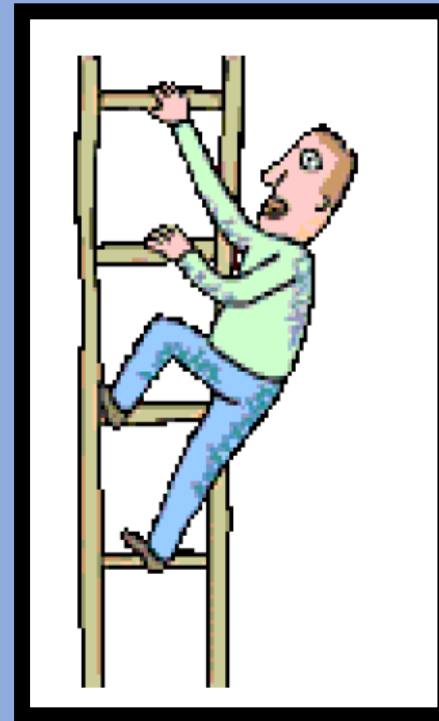
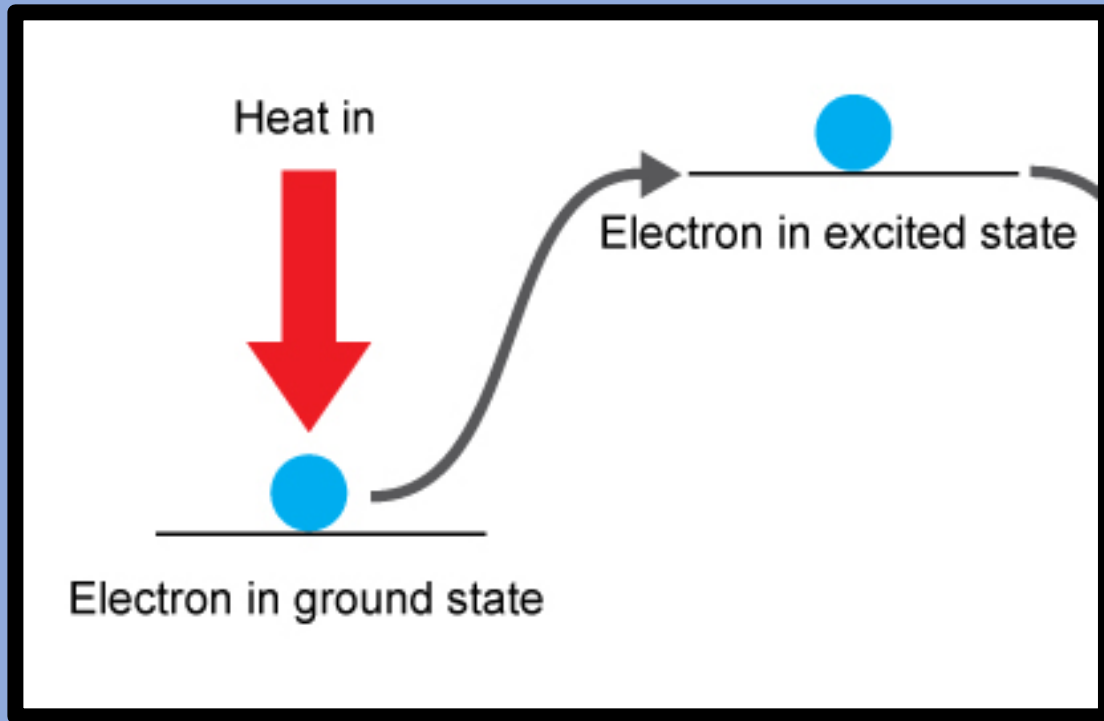
**How do we know which stars have which elements?**

**We can analyze the  
wavelengths of light  
that are absorbed or  
released by the stars**



# ABSORPTION

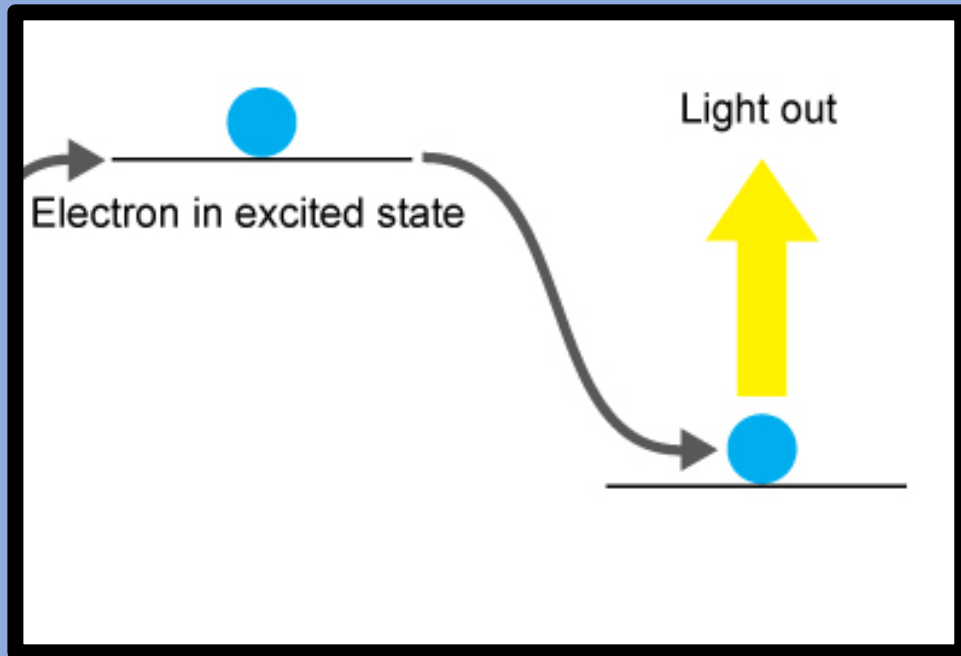
If you give an atom energy, the electron can be pushed up to a higher energy level





# EMISSION

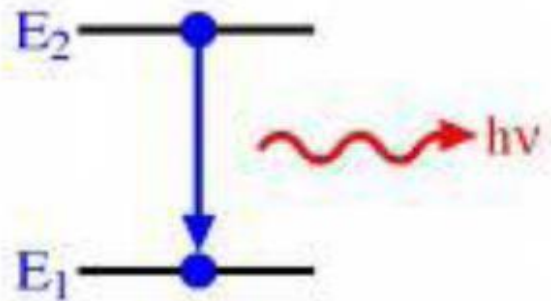
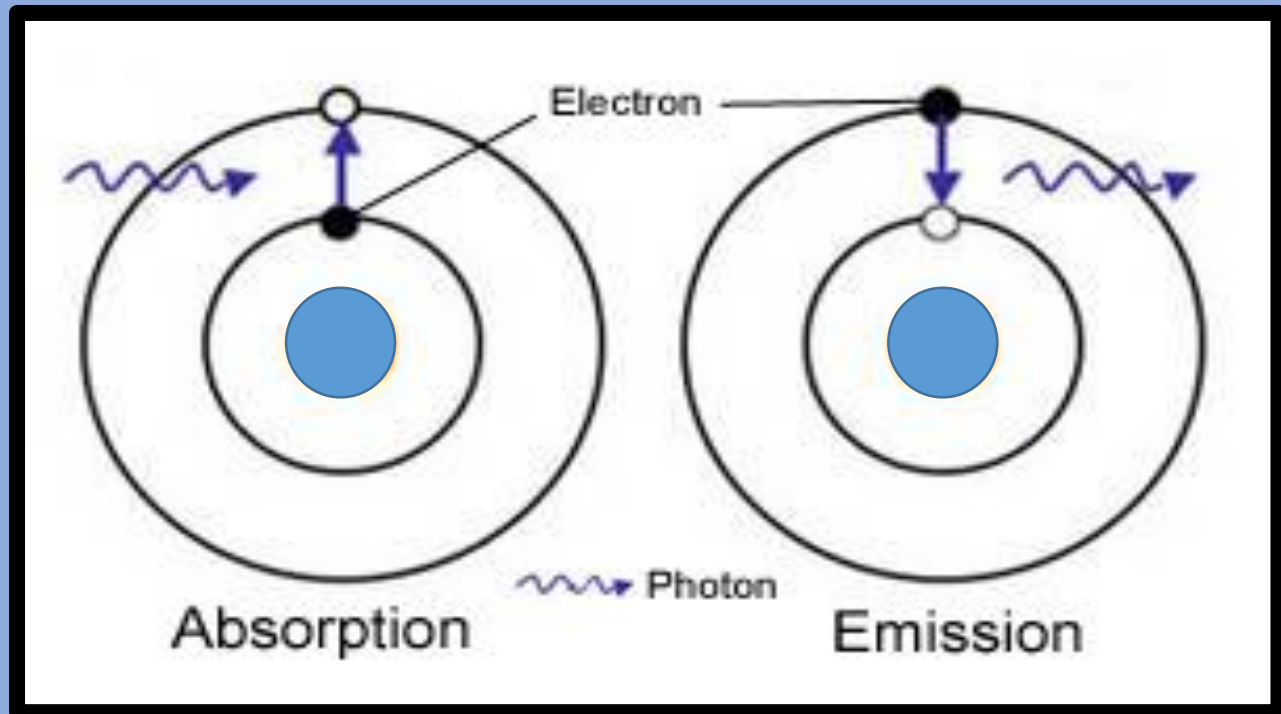
The electron does not want to stay at that higher level (Aufbau Principle!) so it will fall back down.



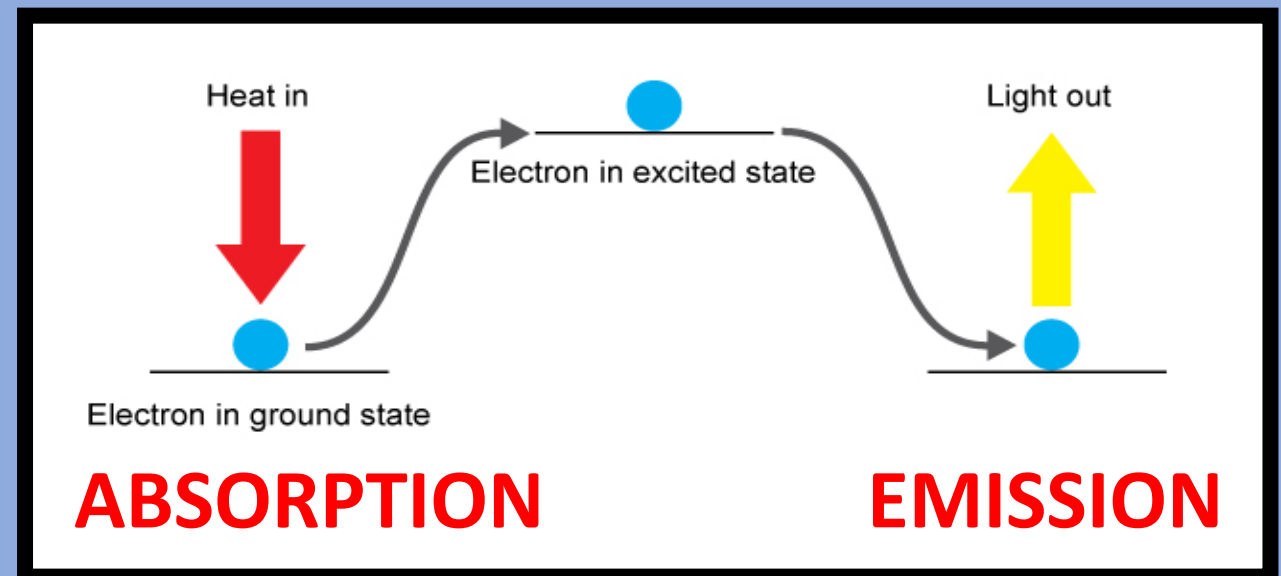


# LOTS OF WAYS TO DRAW THIS

Make sure to show if energy is coming in or out, and which direction the electron is moving.



$(h\nu = \text{energy})$

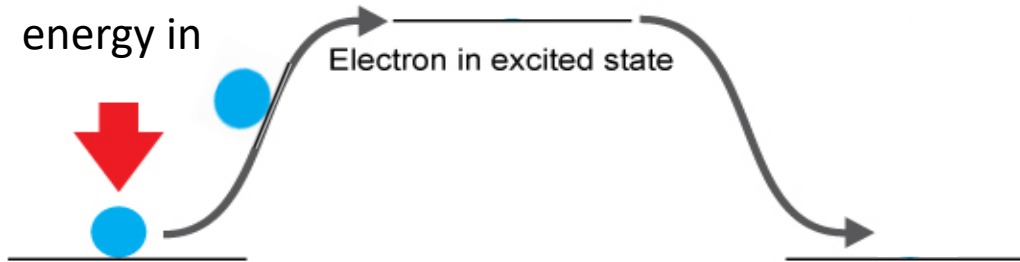




# NEED THE RIGHT AMOUNT OF ENERGY!

If you don't give the atom enough energy to get to the higher orbital, then nothing happens!

Small amount of  
energy in



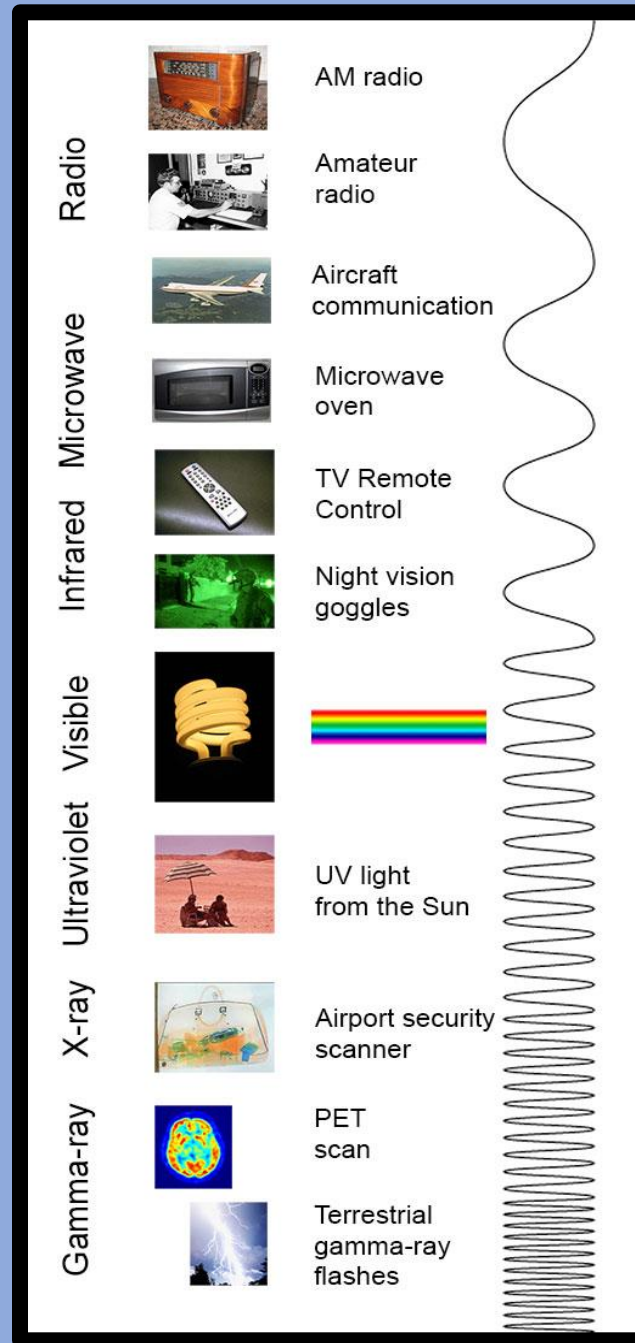
Electron in ground state

**ABSORPTION**

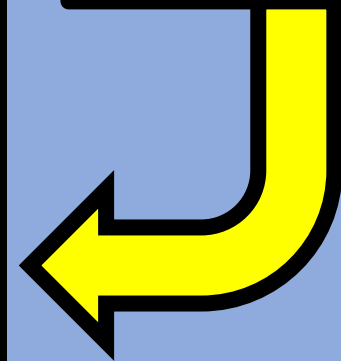
**NO Light  
released!**

# ENERGY RELEASED DURING EMISSION

*Sometimes* the released energy can be seen as **LIGHT!** The amount of energy given off depends on which energy levels the electron is falling from.



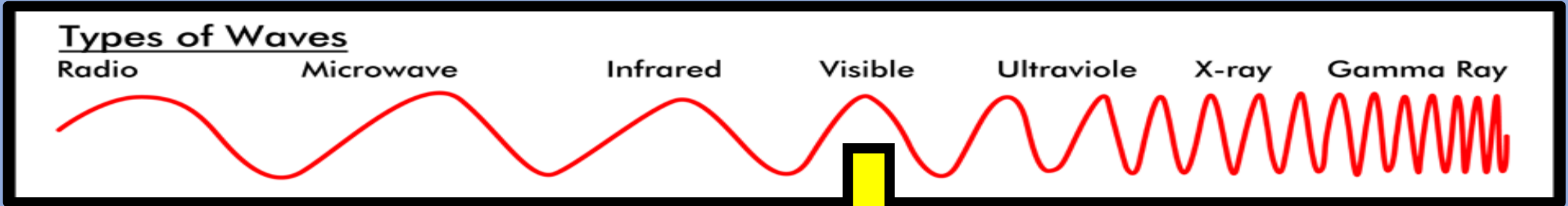
We can only see this little range here





# ENERGY SPECTRUM

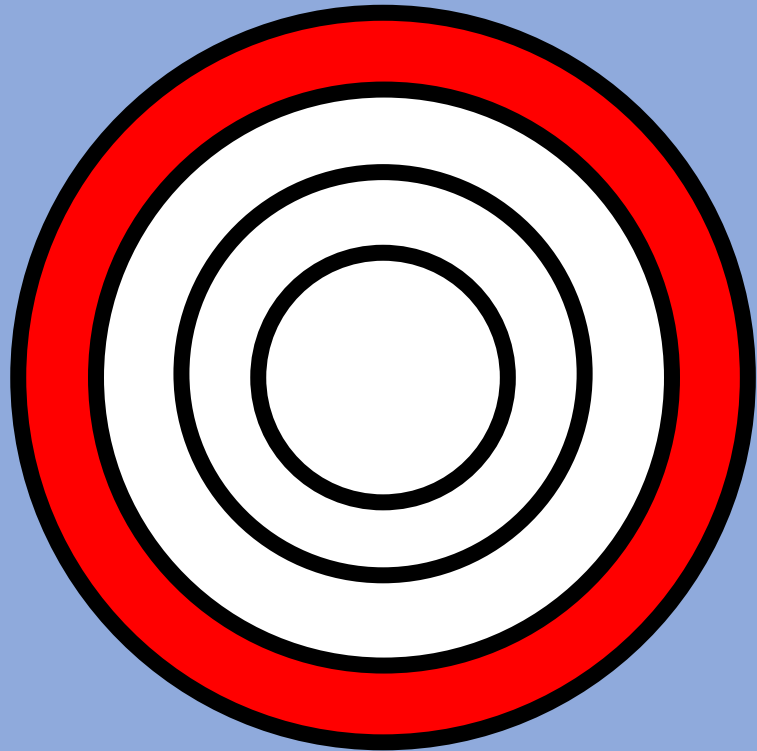
You can measure the exact wavelength and it can tell you how big the energy gap was that the e- fell from



<b>Red</b>	<b>Orange</b>	<b>Yellow</b>	<b>Green</b>	<b>Blue</b>	<b>Purple</b>
<b>LOW</b>					<b>HIGH</b>
<b>energy</b>					<b>energy</b>

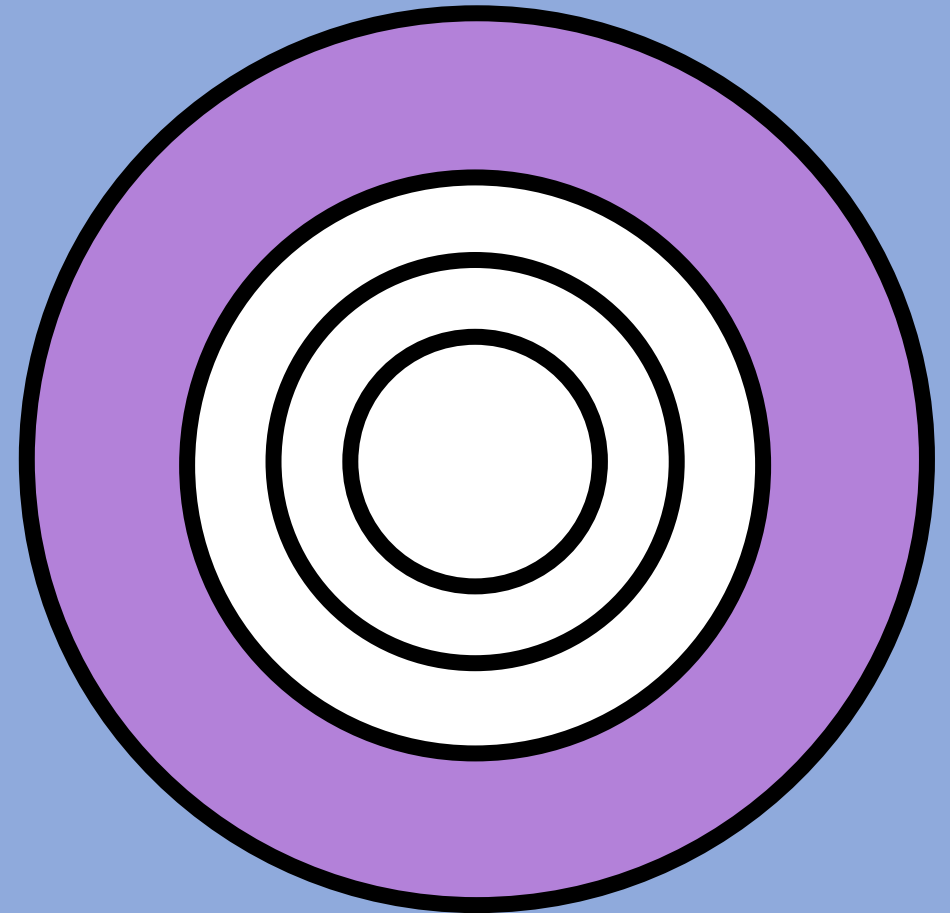
# Not all energy levels are equally spaced!

Changes the wavelength of energy absorbed/released



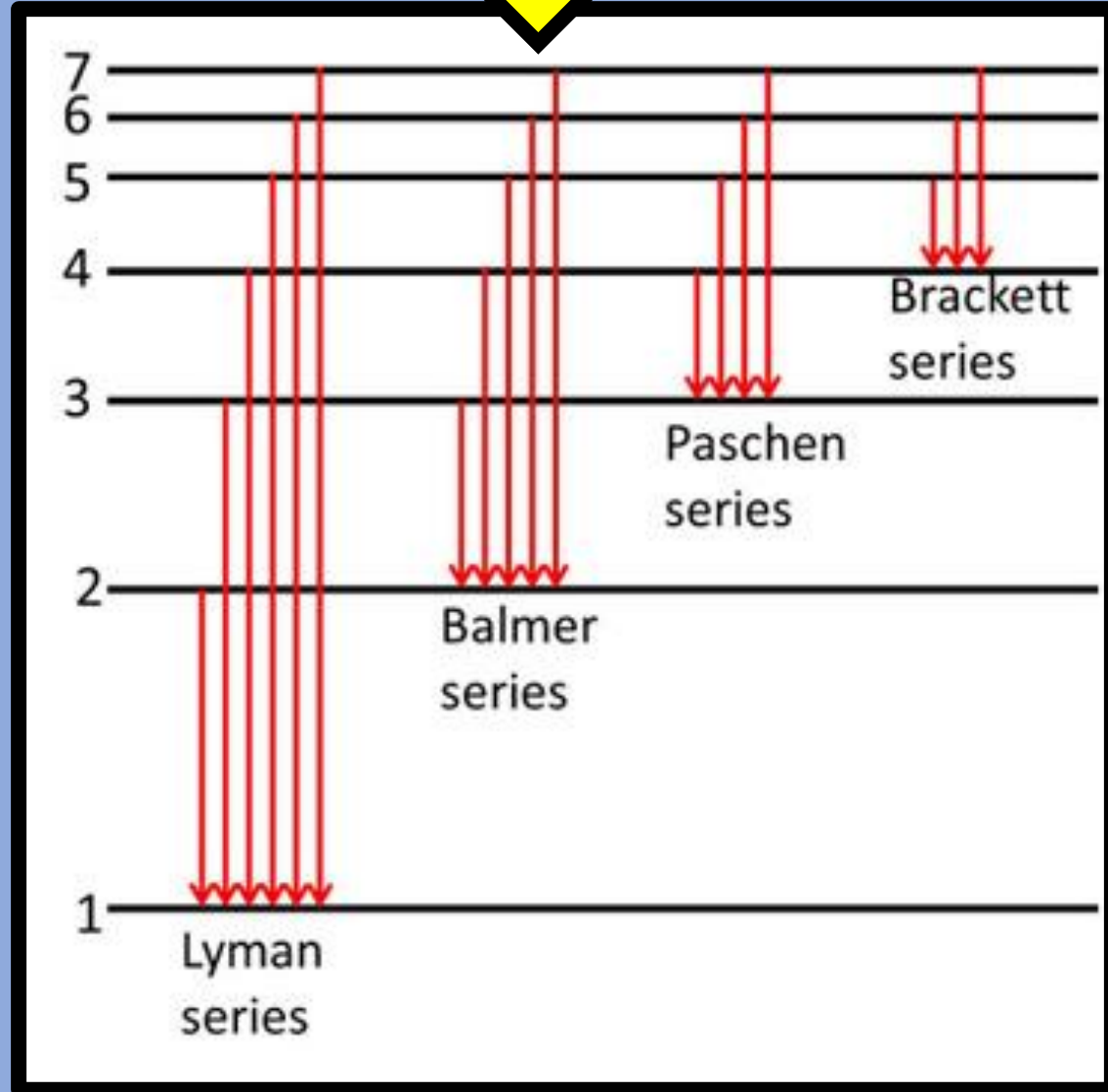
Smaller gap  
= less energy  
= lower color

Bigger gap  
= more energy  
= higher color





**The Balmer Series of emissions are in the range we can see**

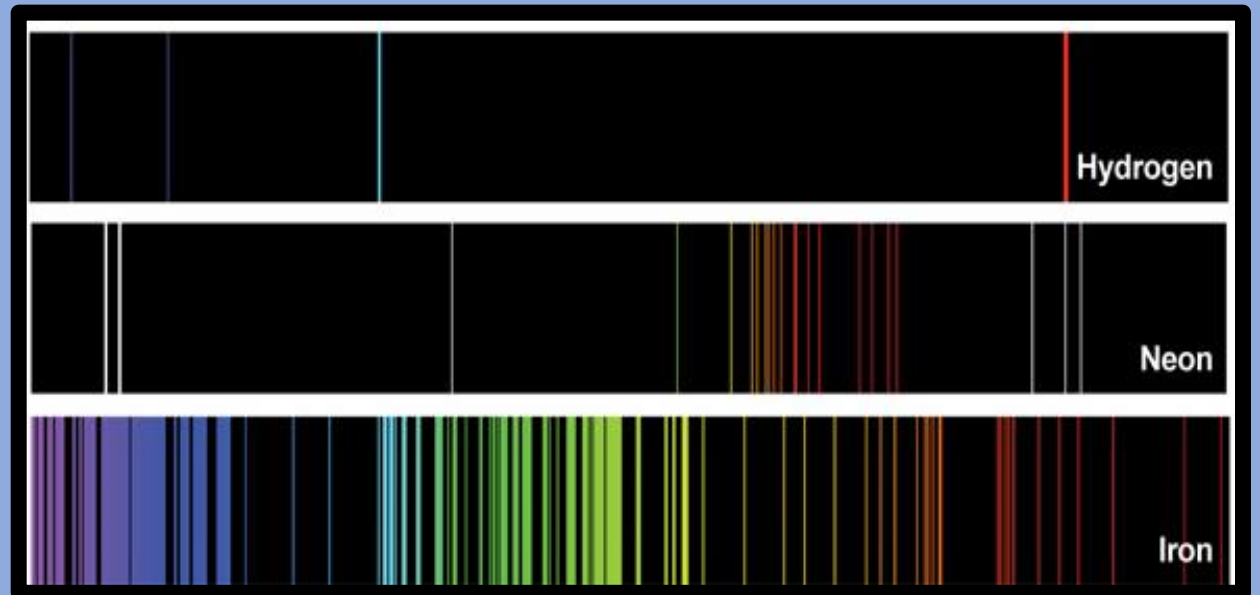


**The energy and color of light will change based on which element it is.**

**The amount of energy is different because the difference between energy levels is not the same for every element or every level**

# UNIQUE LIKE A FINGERPRINT

So just like people have unique finger prints, atoms have unique wavelengths they release (or absorb)

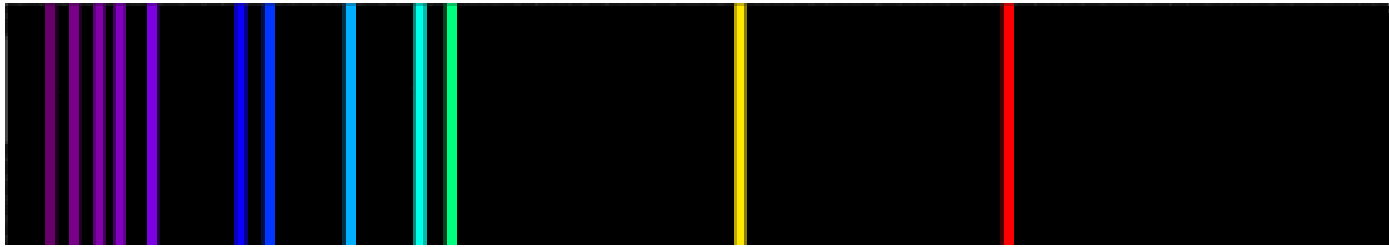




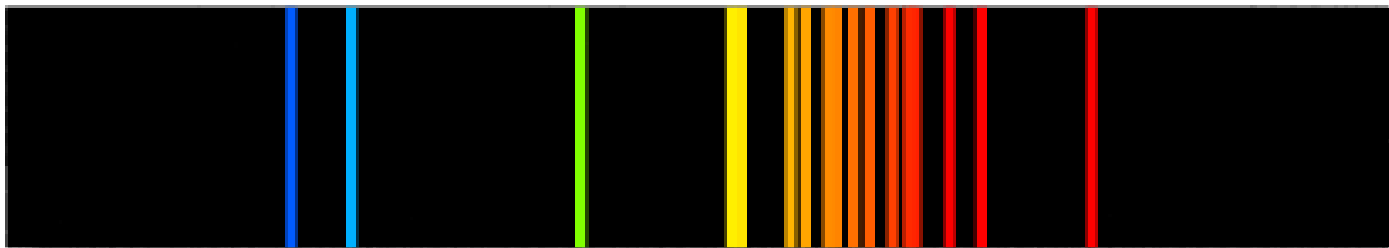
Hydrogen



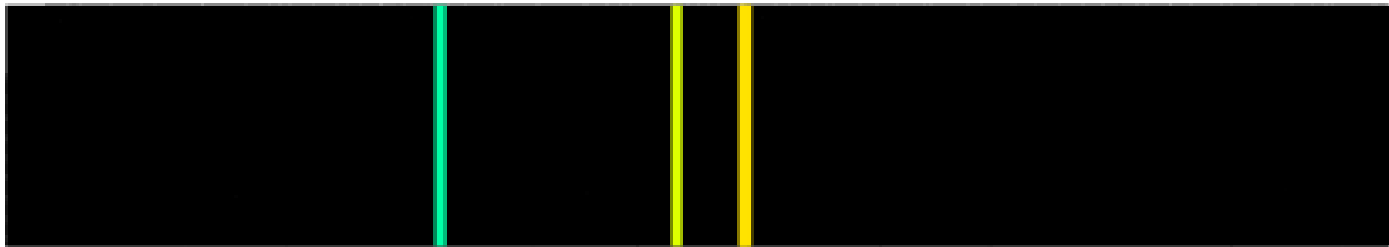
Helium



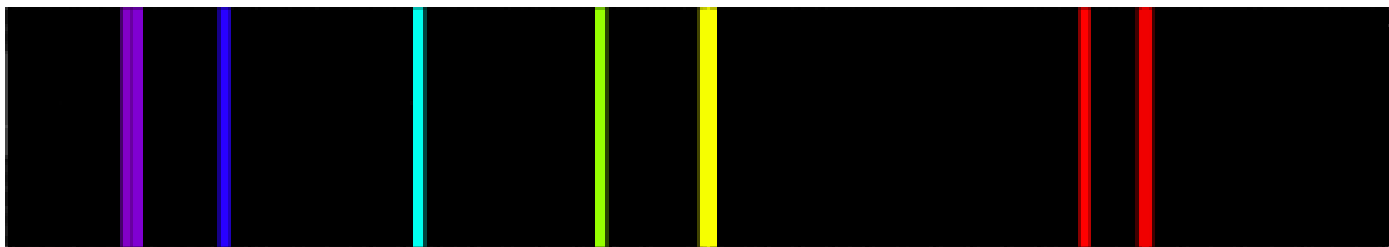
Neon



Sodium

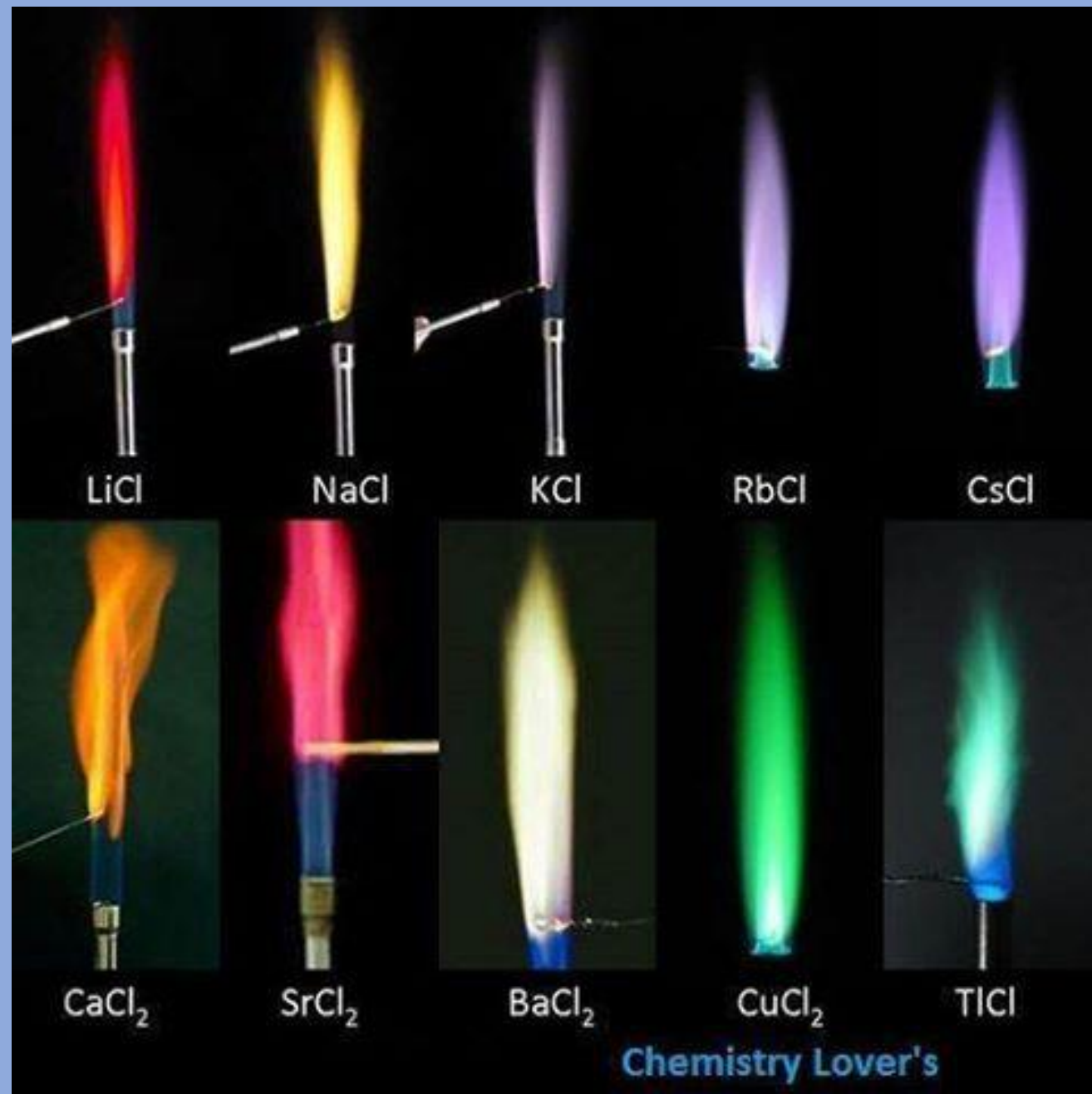


Mercury



# FLAME TESTS IN THE LAB

Compounds containing certain ions can be recognized by burning the compound and observing the colors produced



**White**



**aluminum or magnesium**

**Silver**



**aluminum, magnesium or titanium powder**

**Blue**



**copper chloride or copper compounds**

**Red**



**strontium salts or lithium salts**

**Green**



**barium chloride**

**Yellow**



**sodium nitrate**

**Purple**

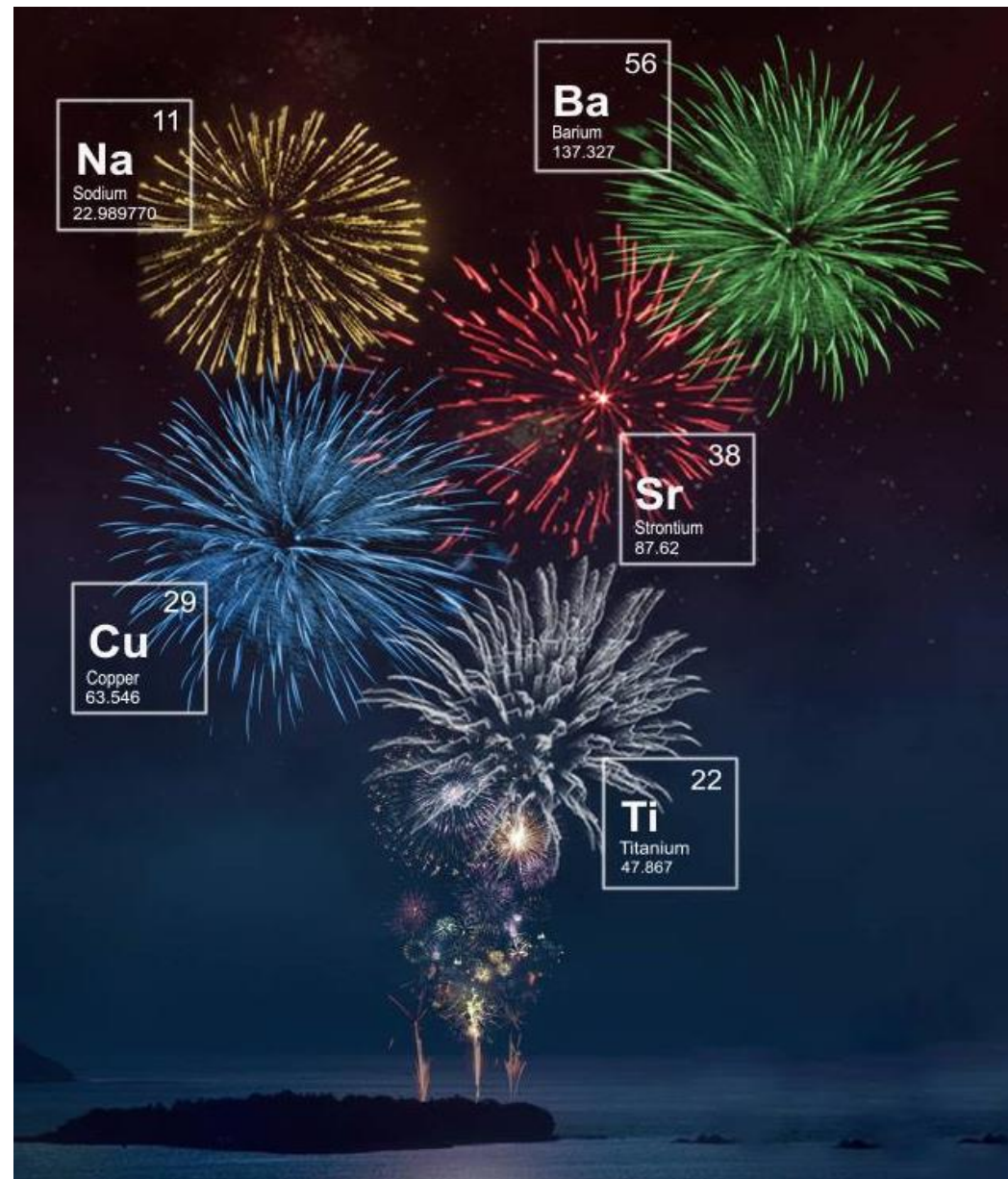


**mix of strontium and copper compounds**

**Orange**



**calcium chloride**



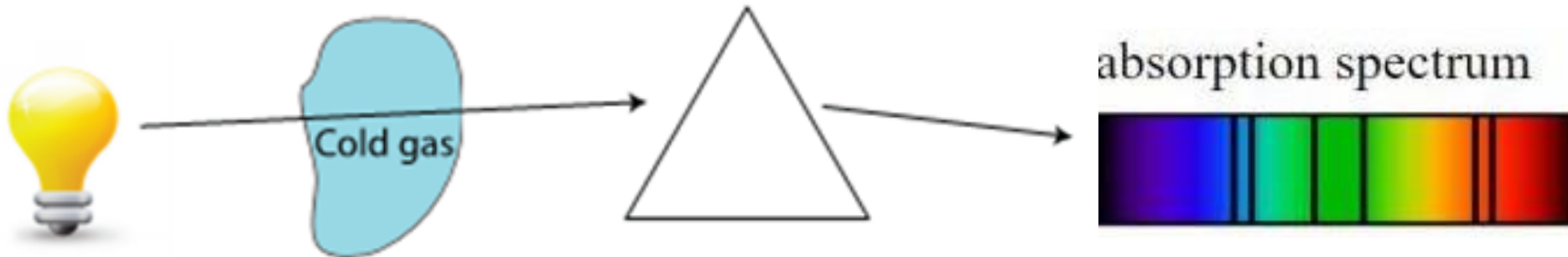


**Emission** – seeing wavelengths of energy **RELEASED** as excited electrons fall down to lower levels



IN LAB  
HEAT  
ATOMS

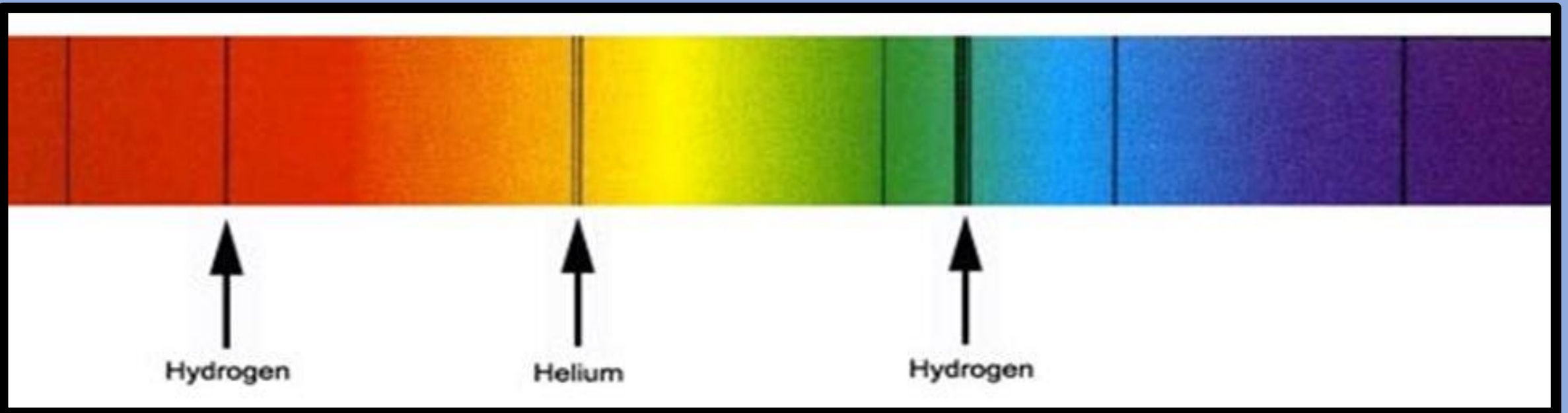
**Absorption** – seeing **MISSING** bands of energy being **ABSORBED** by a cold gas



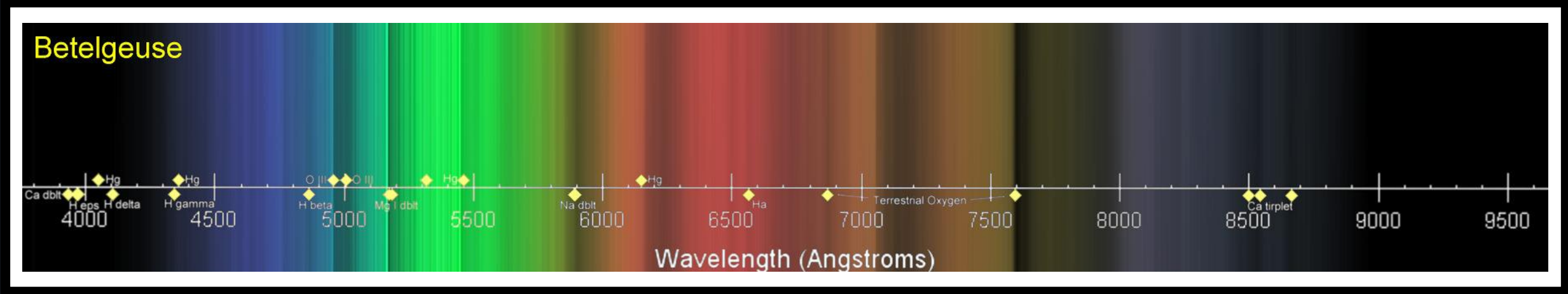
IN THE  
STARS

# ABSORPTION LINES FOR STARS

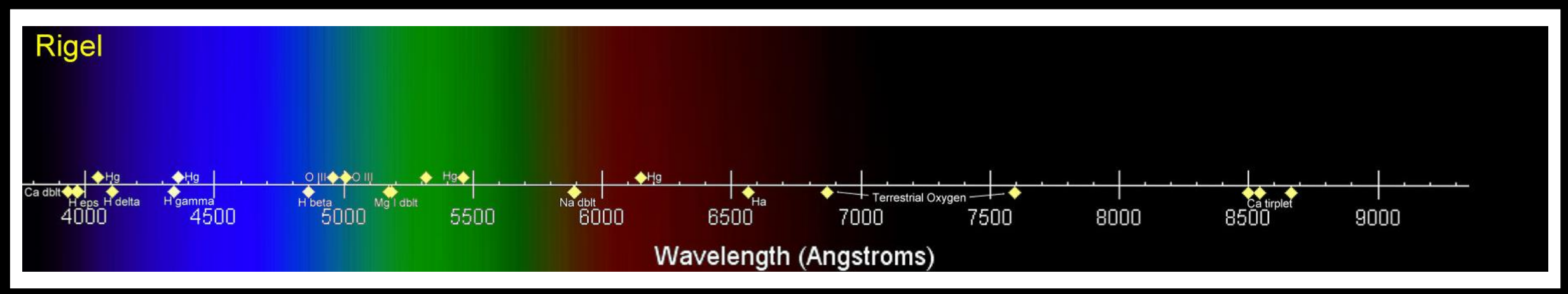
The “colder” outer layers of the stars absorb the emission energy from the hotter inside of the star, so what we can see are absorption lines



**Betelgeuse – Old star, lots of absorption lines because lots of elements have been made**



**Rigel – Young star, few absorption lines because not many elements have been made yet**





# YouTube Link to Presentation:

[https://youtu.be/cq12jS\\_ZA1I](https://youtu.be/cq12jS_ZA1I)