TOPIC # 6
ELECTROMAGNETIC RADIATION
&
THE ELECTROMAGNETIC SPECTRUM

An important KEY to unlocking the topics of: The GREENHOUSE EFFECT, GLOBAL WARMING & OZONE DEPLETION!

Class Notes: pp 29-30

Objectives for today's class:

1) To understand some key aspects of **ELECTROMAGNETIC RADIATION** that most directly relate to GLOBAL CHANGE!

2) To learn how principles of **MATTER** & **ENERGY** tie into this . . . .

3) . . . and relate to one Global Climate Change solution: **SOLAR POWER**

Two radiating bodies!

Salt River Project activates Arizona's largest solar array

Arizona Daily Star Arizona Daily Star | Posted: Wednesday, September 7, 2011 12:00 am | Comments

The Salt River Project has switched on Arizona's largest solar-energy array, a 144-acre, 20-megawatt installation in Florence.

The Copper Crossing Solar Ranch, on the west side of Florence, will initially provide power to more than 100 schools in 11 Phoenix-area school districts. The schools are participating in SRP's EarthWise Community Solar program, which allows customers to essentially buy power from utility-scale solar installations.

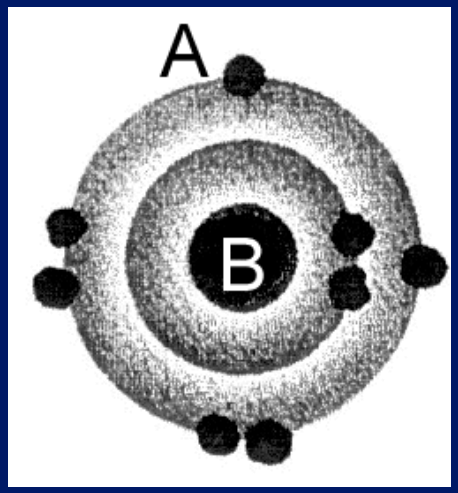
SRP is a quasi-governmental water and power authority that serves about 940,000 electric customers in the Phoenix area.

Copper Crossing, which provides enough power for about 3,700 SRP customer homes, is the largest of rdrola Renewables in the United States.

hotovoltaic panels manufactured by SunPower Corp.,

watts of solar energy from the plant for a fixed price for issions by an estimated 575,000 metric tons over the

But first, a quick review & wrap-up of last Friday:



Dot diagram of an OXYGEN ATOM:

A = ELECTRON

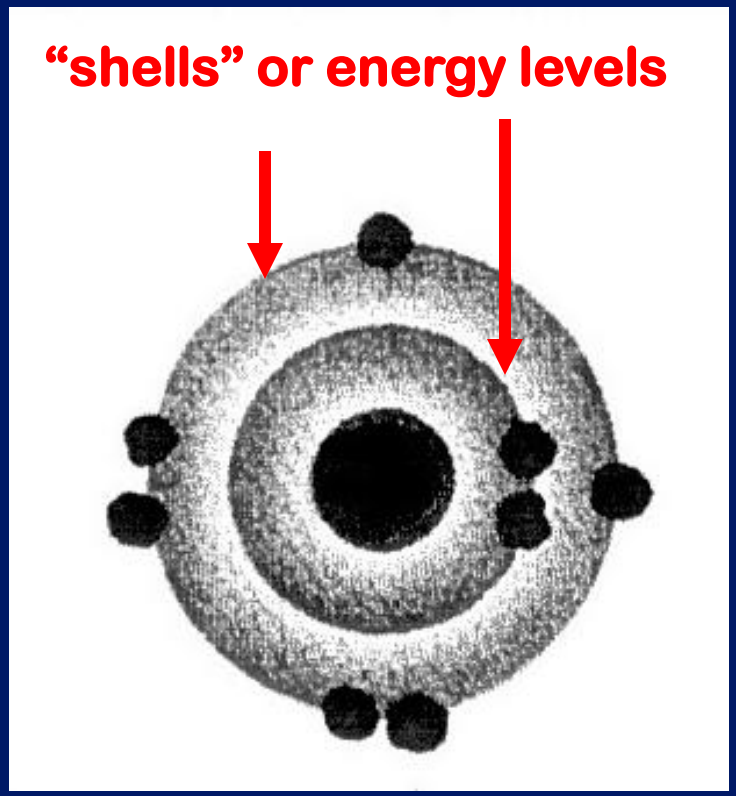
B = NUCLEUS

 # electrons = 8

 # protons = 8

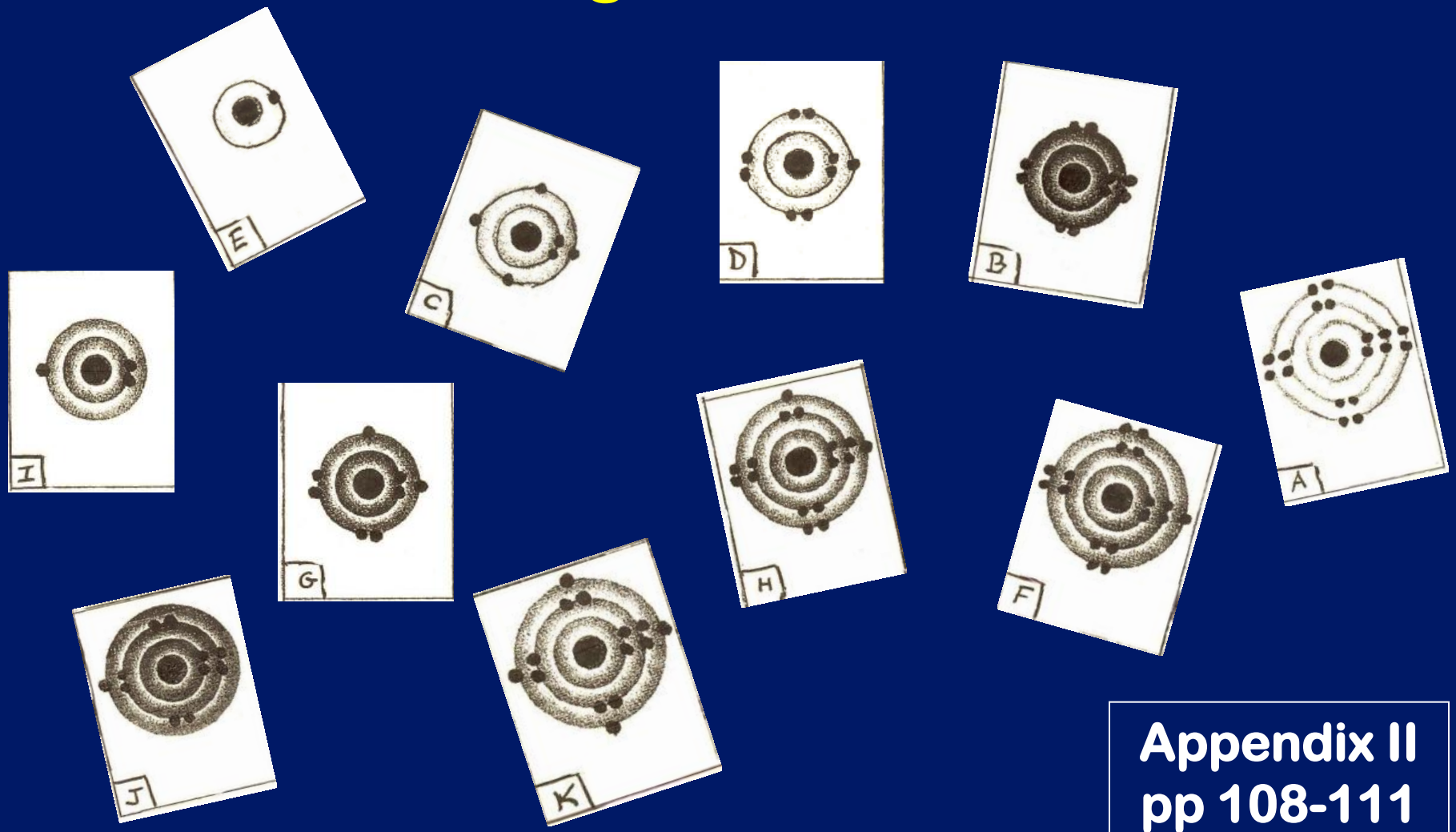
 # neutrons = 8

atomic # = 8



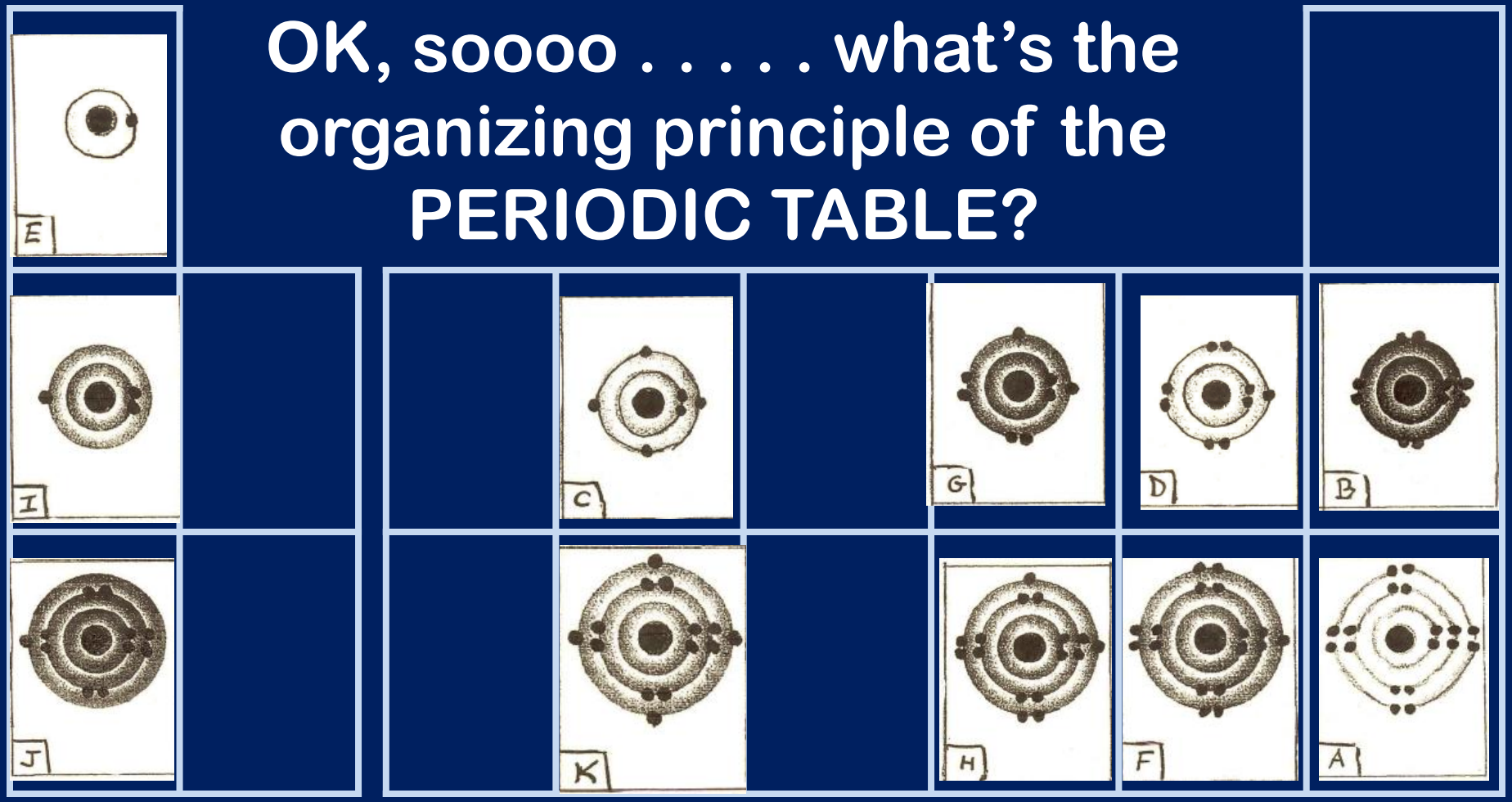
Review p 23

How is the PERIODIC TABLE OF THE ELEMENTS organized?



Appendix II
pp 108-111

Which elements go in which row + column?



[Table is on p 109 of Class Notes Appendix]

How is the PERIODIC TABLE organized?

1 electron in outer shell in this column

The Periodic Table is organized by:

# of shells (rows)

# of electrons in the <u>outer</u> shell (columns)

2 electrons

4 electrons in outer shell in this column

6 electrons in outer shell in this column

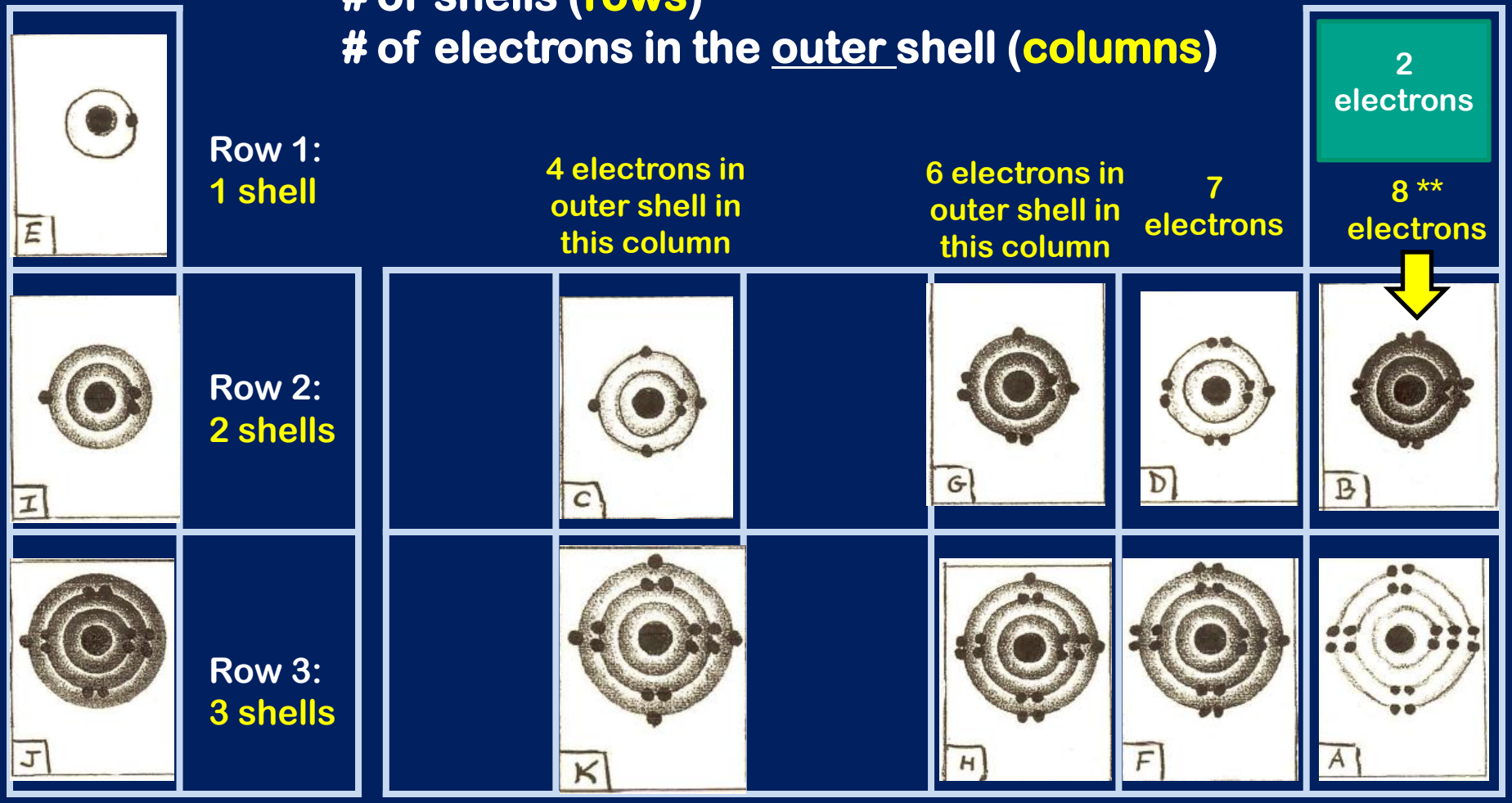
7 electrons

8 ** electrons

Row 1: 1 shell

Row 2: 2 shells

Row 3: 3 shells

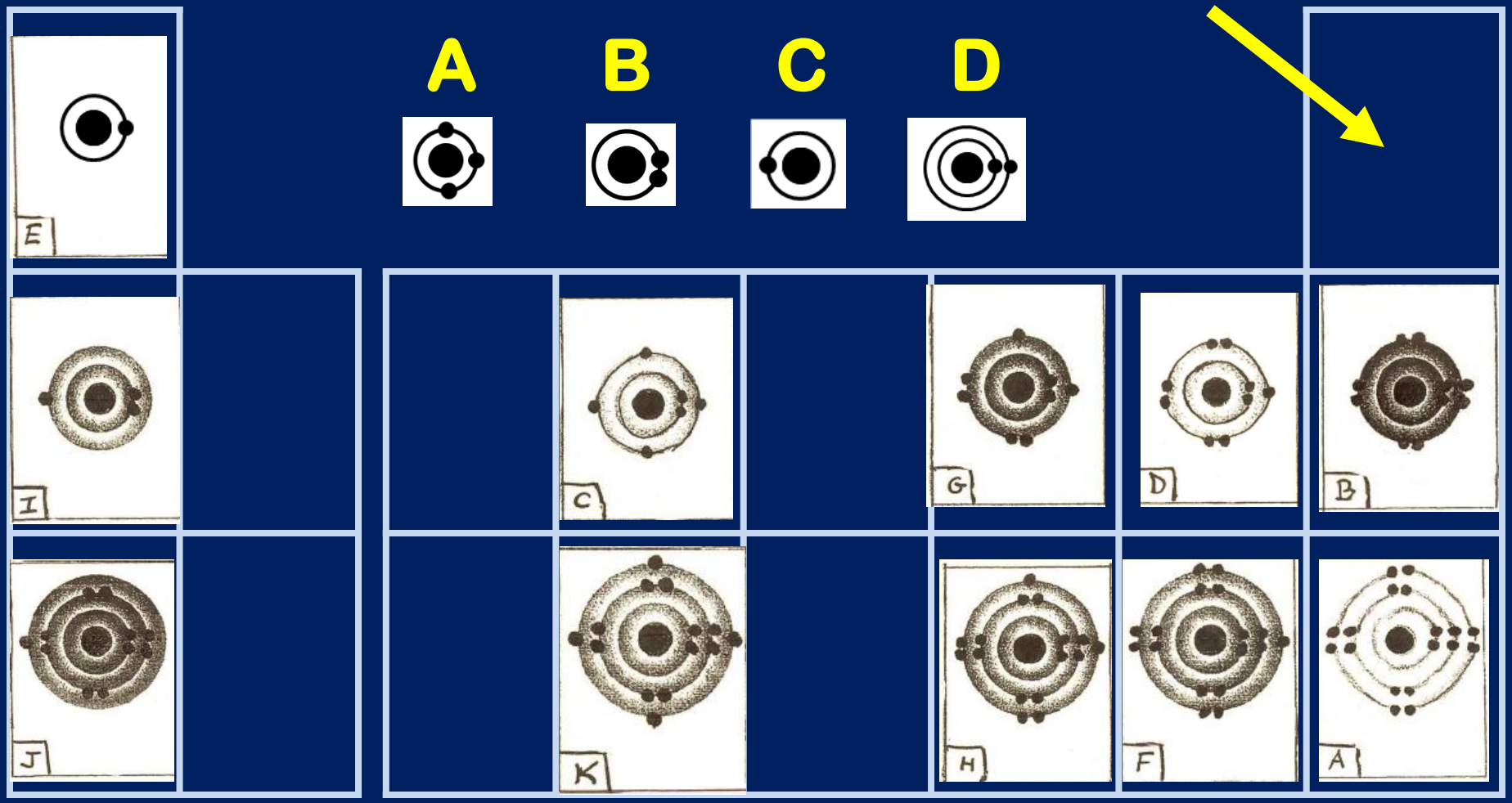


In Row 1 the outer shell is "full" with only 2 electrons in last column **

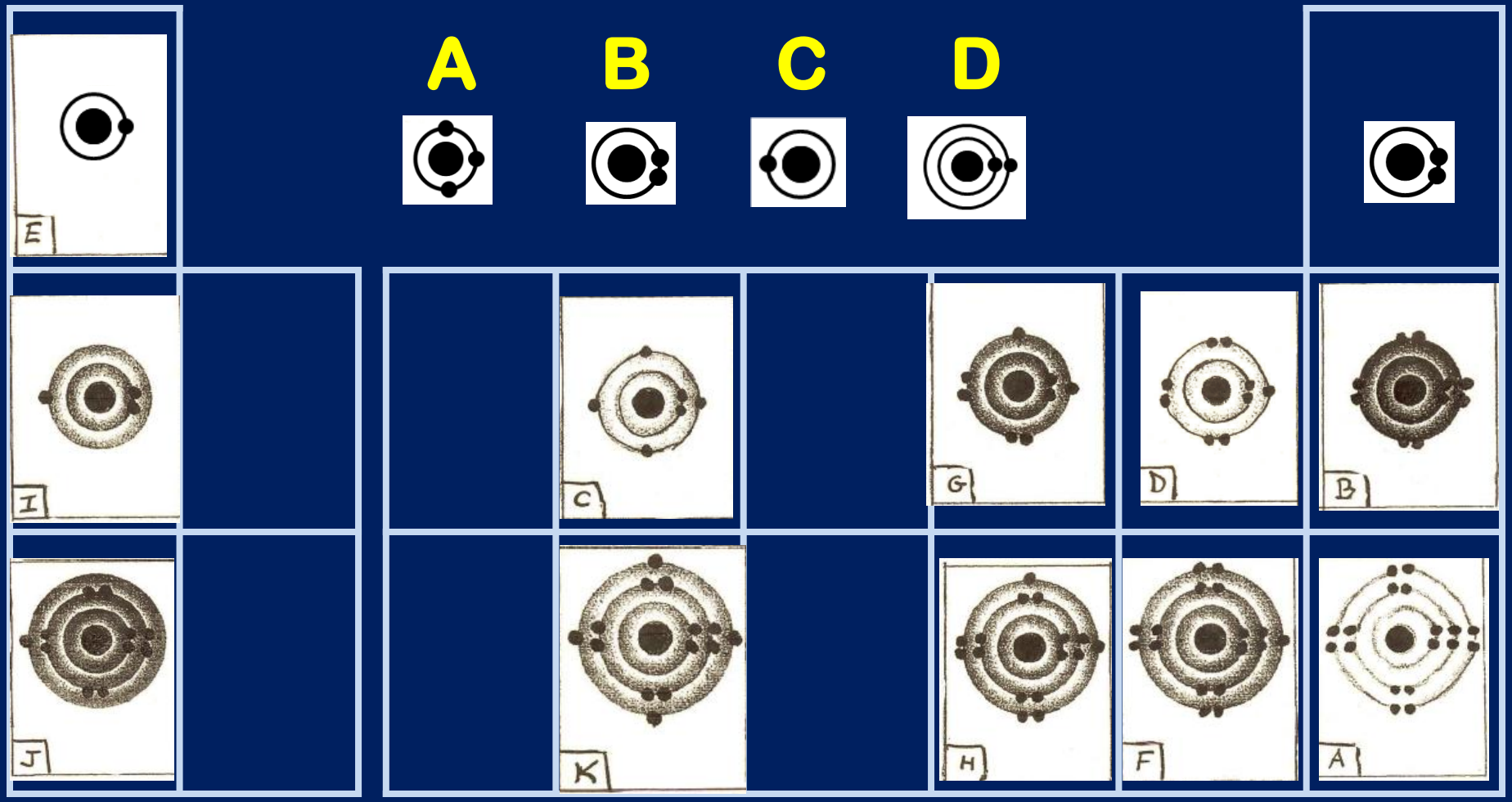
In Row 2 the outer shell is "full" with 8 electrons in last column

In Row 3 the outer shell is "full" with 8 electrons . . . and so forth

Q1. Which of these is the proper dot diagram for the element in this position?



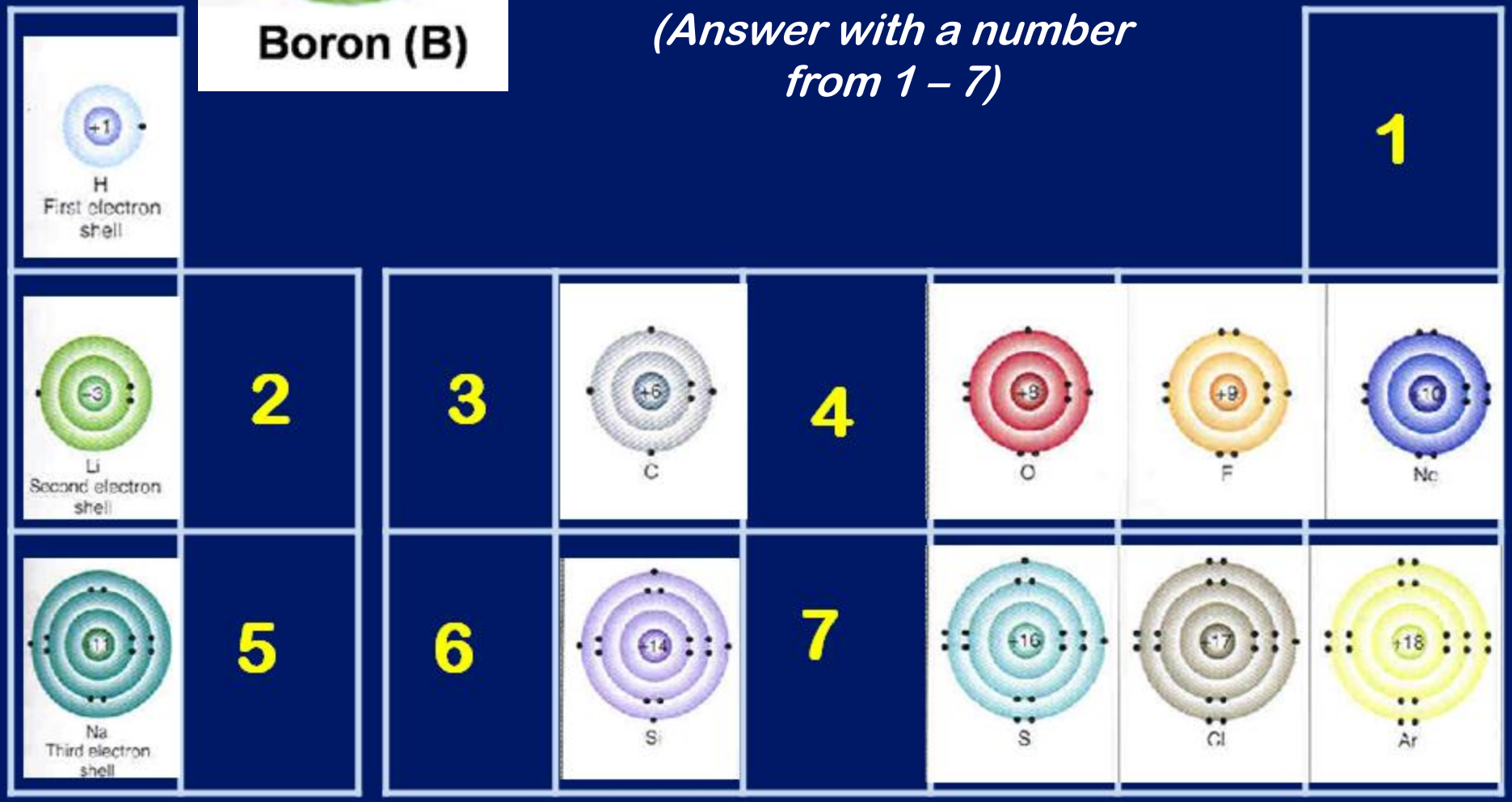
Q1. Which of these is the proper dot diagram for the element in this position?



B is correct! The element is Helium (He)

Q2. Where does Boron fit in the Table?

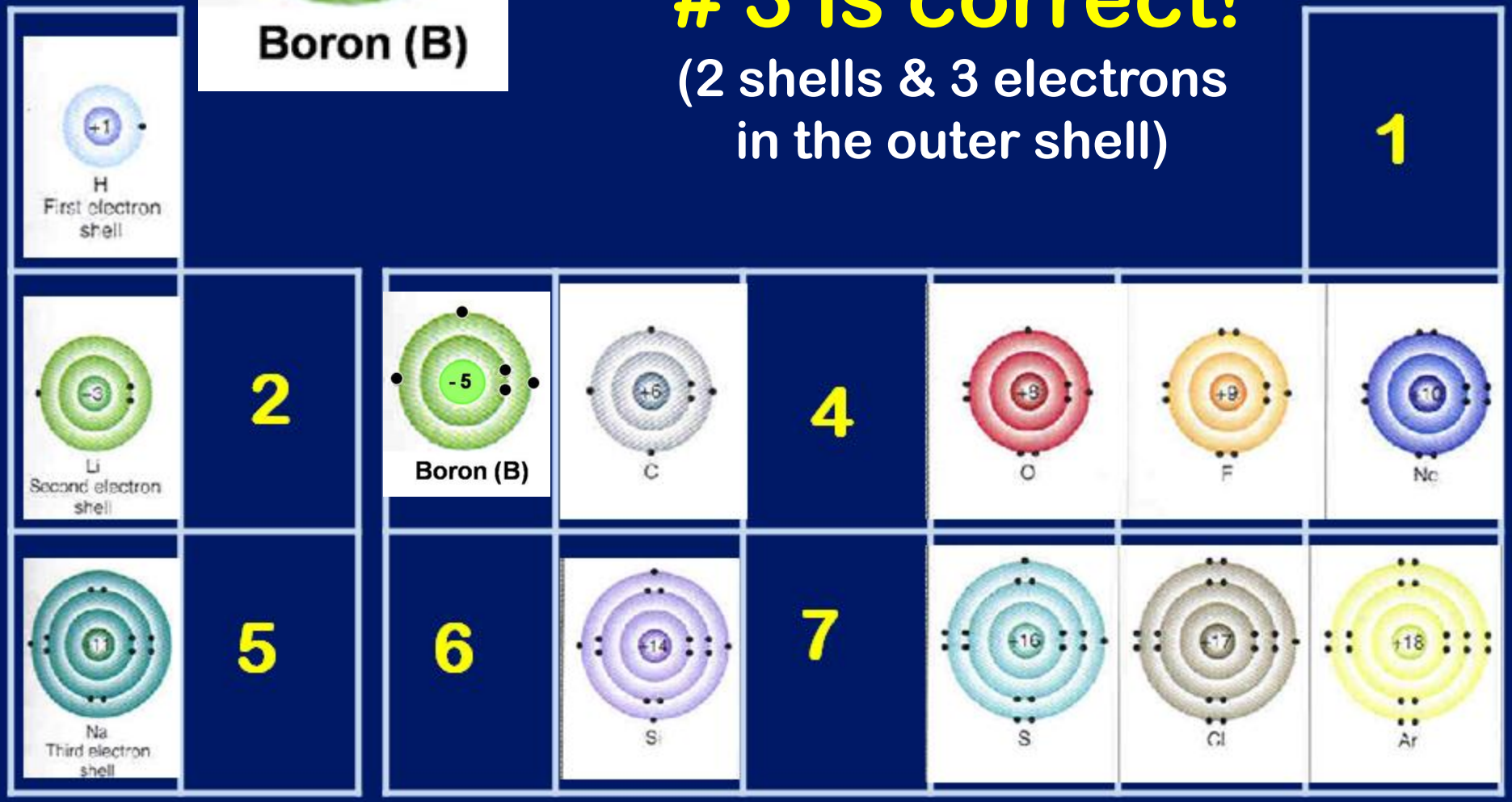
(Answer with a number from 1 – 7)

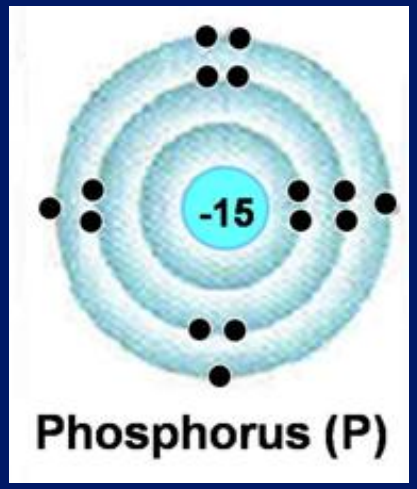


Q2. Where does Boron fit in the Table?

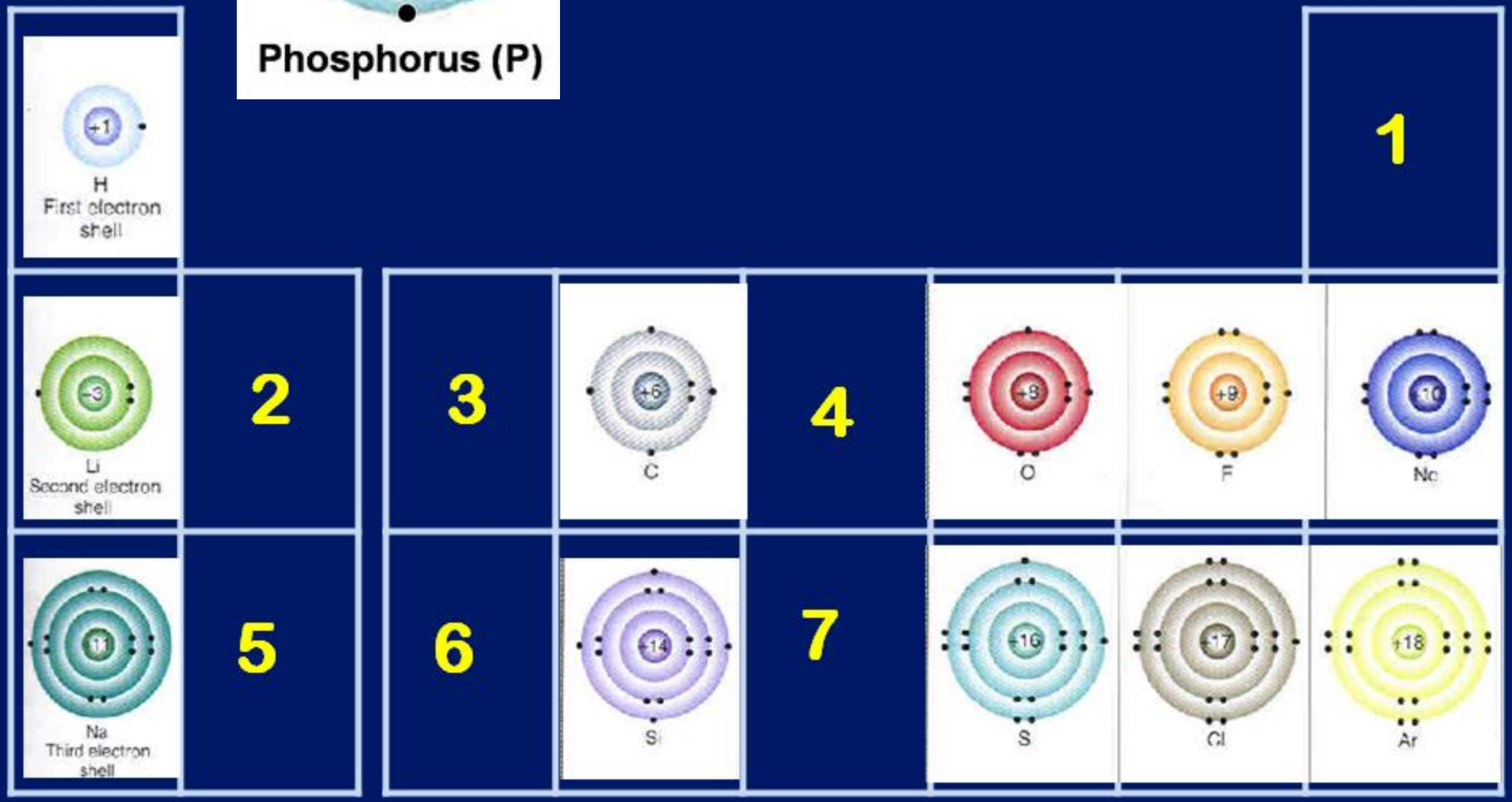
3 is correct!

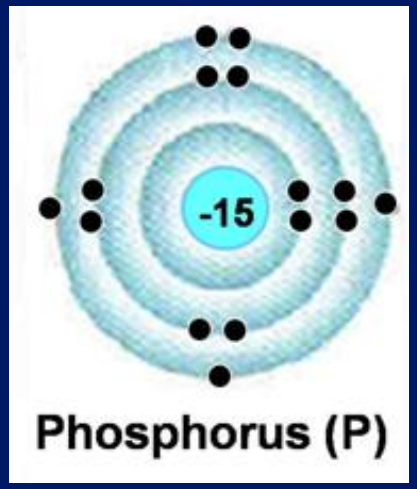
(2 shells & 3 electrons in the outer shell)





Q3. Where does Phosphorus fit in the Table?

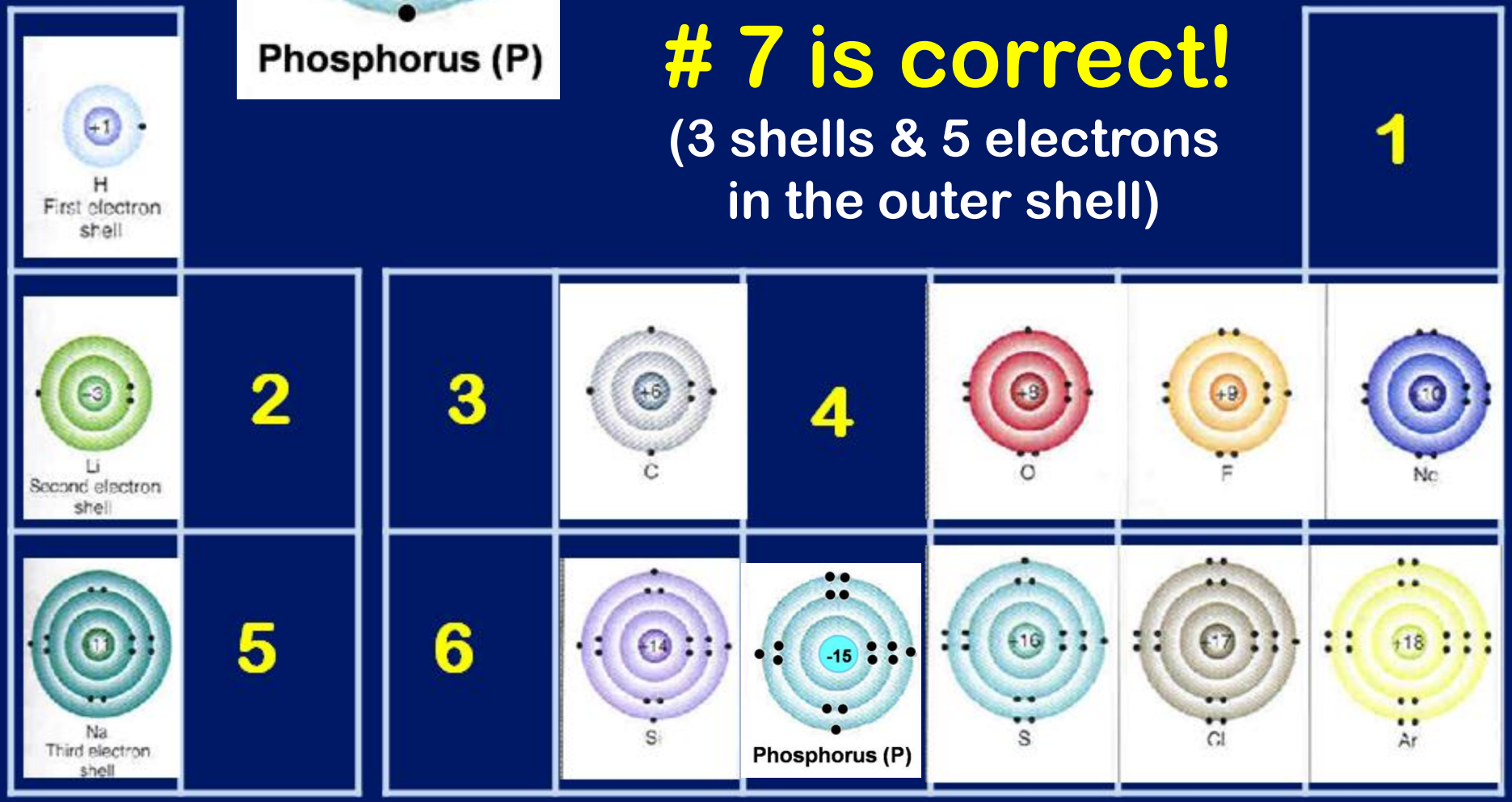




Q3. Where does Phosphorus fit in the Table?

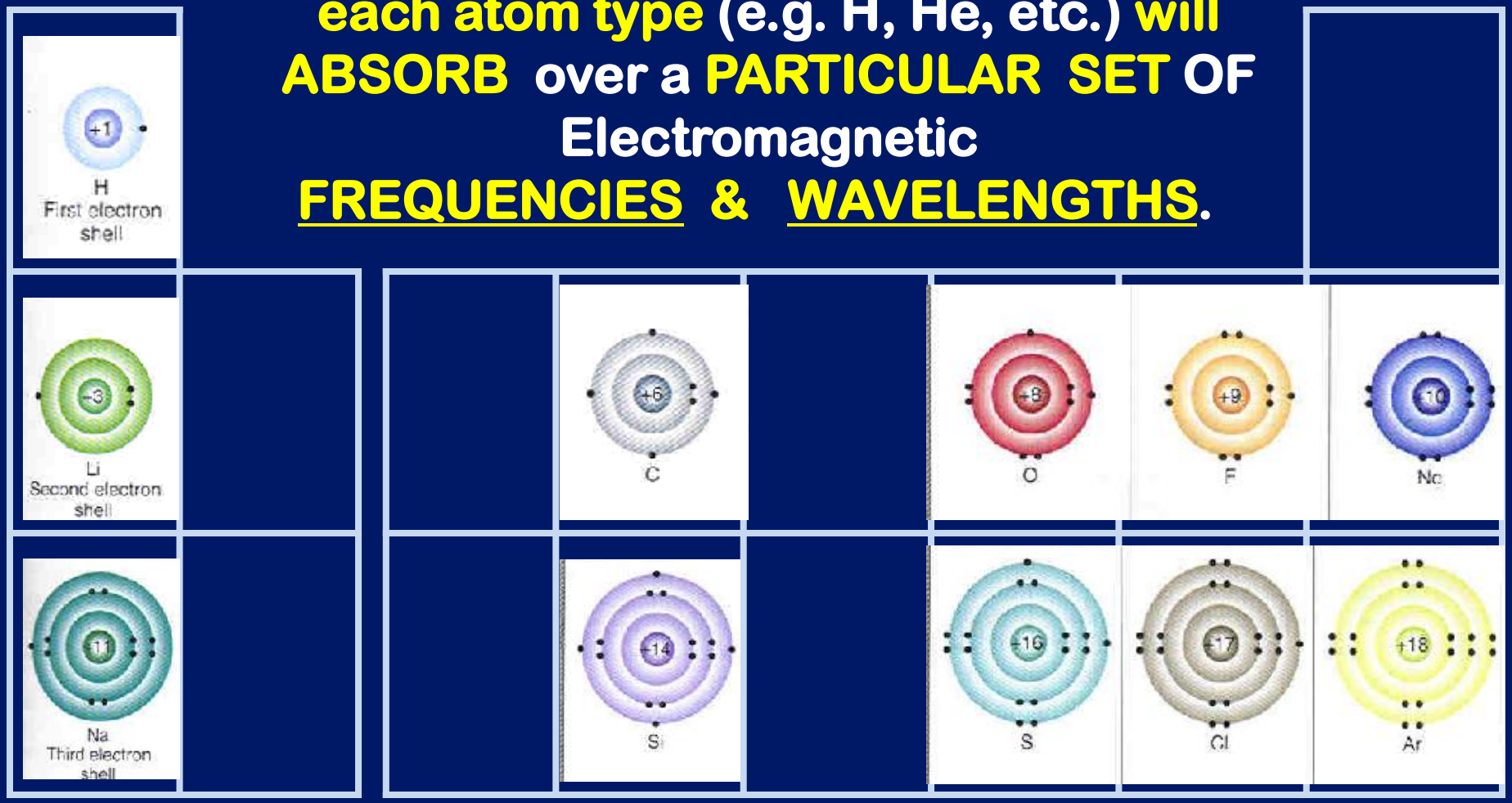
7 is correct!

(3 shells & 5 electrons in the outer shell)



A KEY POINT → Because each atom type (element) has a unique set of energy levels,

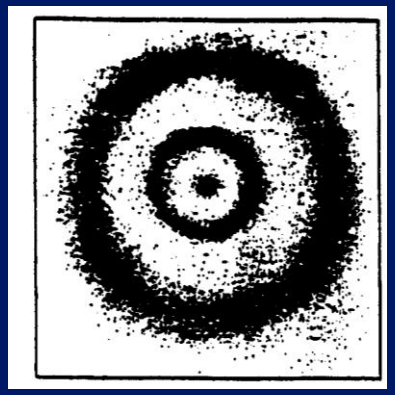
each atom type (e.g. H, He, etc.) **will ABSORB** over a **PARTICULAR SET** OF Electromagnetic **FREQUENCIES & WAVELENGTHS**.



Note -taking suggested ➡

Review of last Friday:

The Bohr Model of the Atom:



The quantum model of the atom states that:

electrons can exist only in <u>discrete allowed places within shells</u> (orbits or energy levels) and not in between.

. . . but how do they get from one level to another? And what does it have to do with Global Change

Review pp 24-25

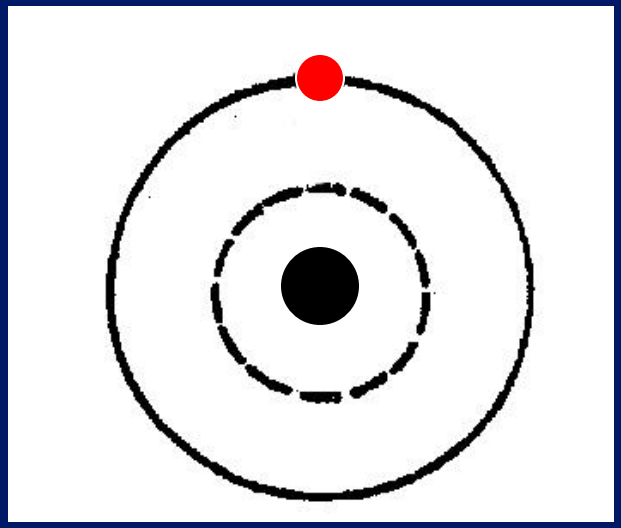
TOPIC #5 – Part I
ELECTROMAGNETIC RADIATION

Not only is the universe stranger than we imagine, it is stranger than we can imagine.
~Arthur Eddington

RECAP: An electron moves between energy levels by "quantum leaps,"

i.e., it disappears from one energy level and reappears in another without ever traversing any of the positions in between!

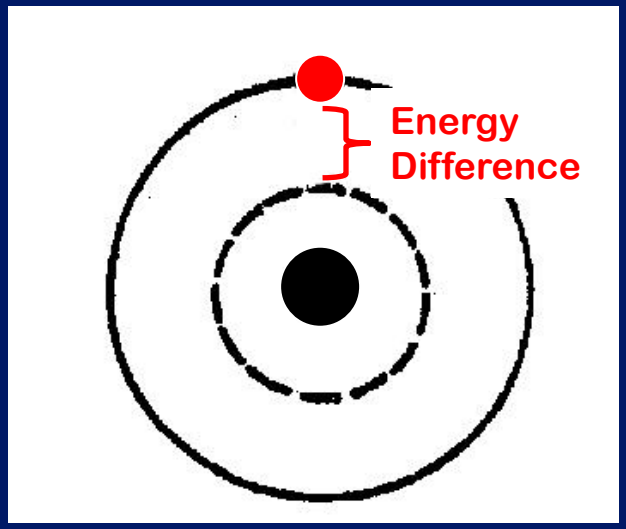
What causes the "leap" ?



☺

Electrons make transitions (leaps) between the orbits (or energy levels) by:

absorbing or emitting energy



BUT: the energy absorbed or emitted has to be equivalent to <u>exactly the energy difference</u> between the orbits for that atom!

The energy involved in the electron leaps is called

ELECTROMAGNETIC ENERGY

It can be viewed either as:

pulses of energy traveling in **WAVES**
(of a specified wavelength and speed)
OR
as bundles of particle-like energy
called **PHOTONS**

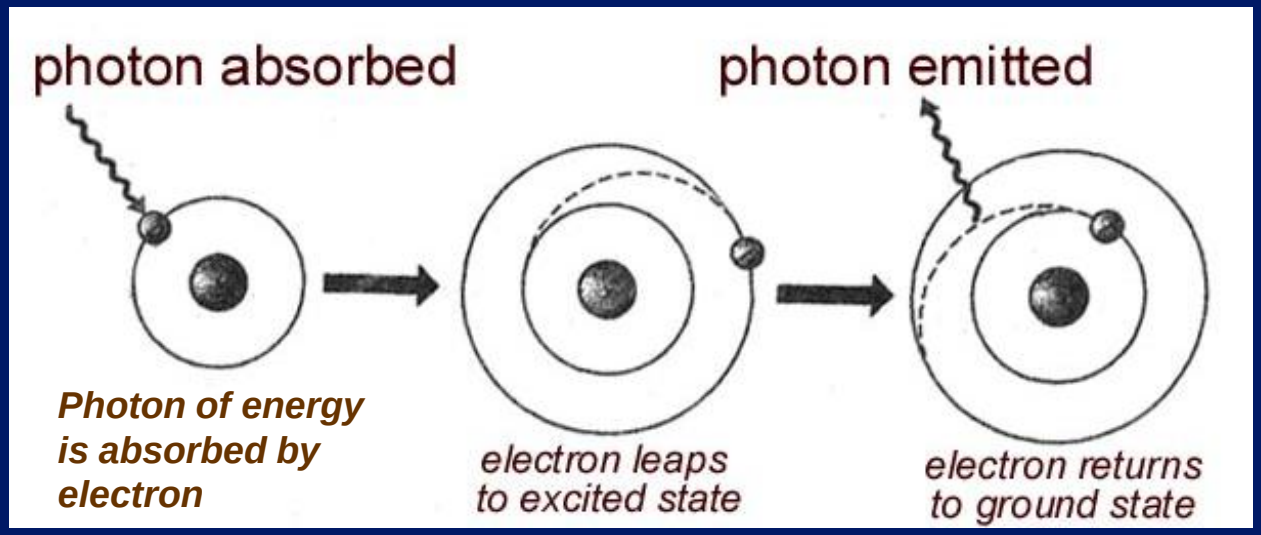
PHOTON =

A particle-like unit of electromagnetic energy (light), emitted or absorbed by an atom when an electrically charged electron changes state.

[can also be described as the form in which a single packet of ELECTROMAGNETIC ENERGY travels]

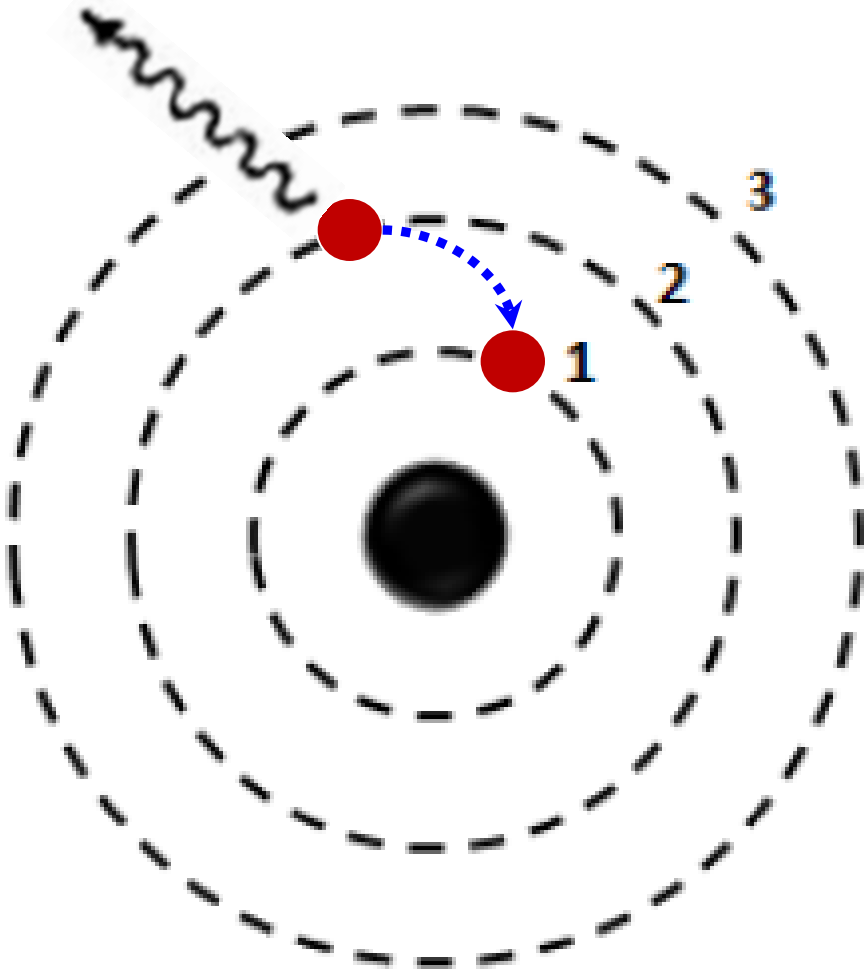
Photons, NOT protons!

The Quantum Behavior of Electrons in Atoms produces Electromagnetic Energy

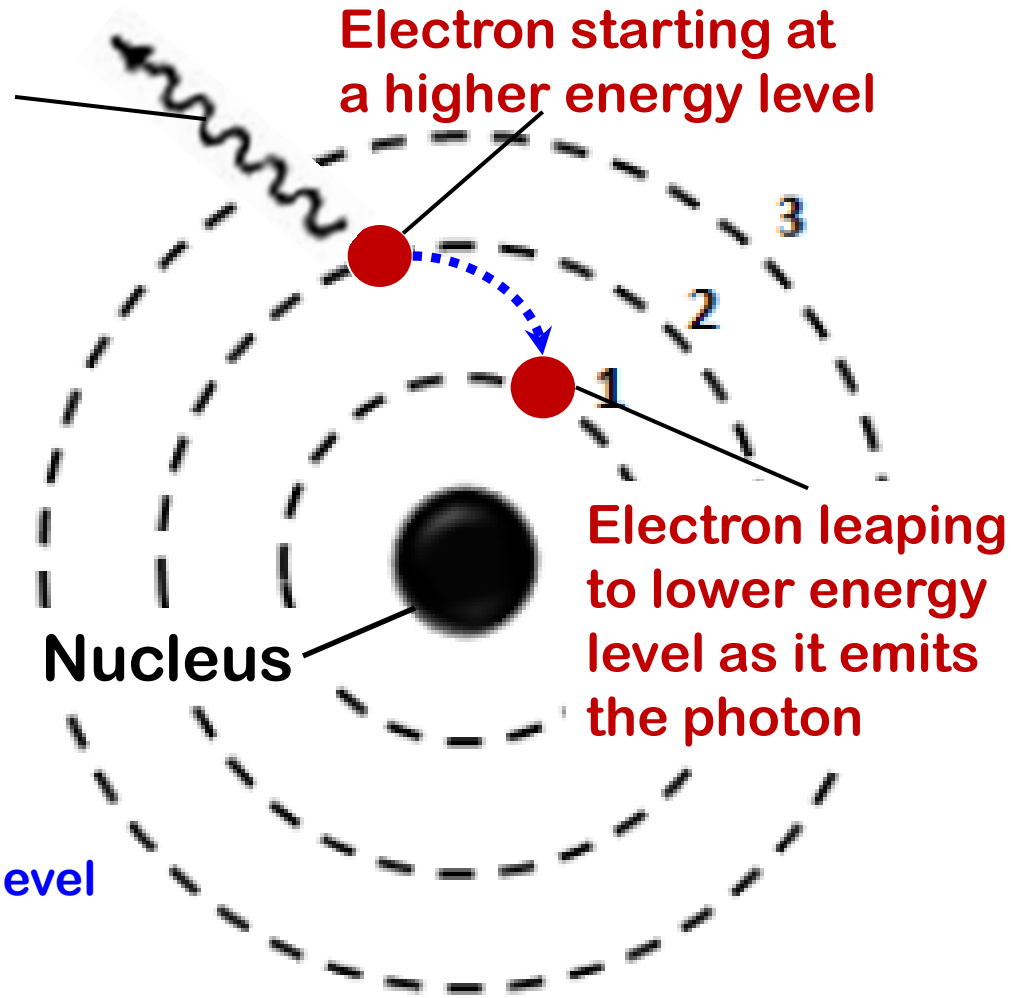


Illustrate the **photon behavior** and **electron behavior** that takes place when a photon is ***emitted*** (given off) by an electron:

Try it yourself on page 30:



Illustrate the **photon behavior** and **electron behavior** that takes place **when a photon is *emitted*** (given off) **by an electron**:



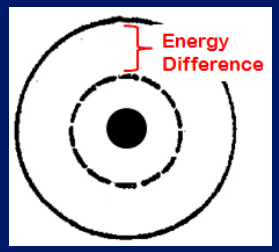
LABEL your sketch:

- Identify the names of the features in your diagram
- Explain what is happening to them:
  - being absorbed
  - being emitted
  - leaping to a lower/higher level

Could you do the sketch for a photon being absorbed by an electron?

RECAP: QUANTUM MECHANICS at the SUBATOMIC SCALE

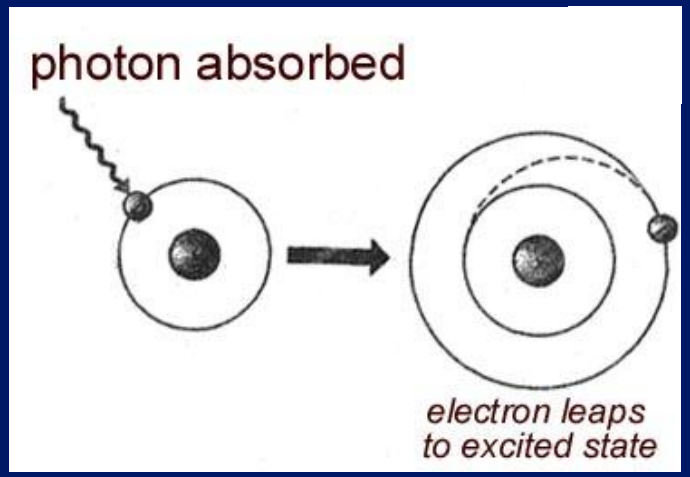
- If a photon of electromagnetic energy strikes an atom,
- and if the **FREQUENCY** of the electromagnetic radiation is such that it is equal to: the *difference* in the energy of the ground level & the first excited level,



- the electron **ABSORBS** the photon energy and . . .
- the electron makes a "quantum leap" to Level 2

Hydrogen atom:

with electron in ground state (Level 1 shell)



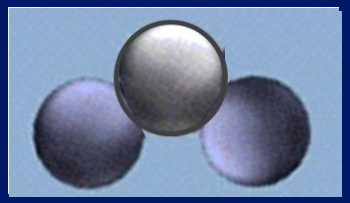
☺

But what happens if PHOTONS of electromagnetic energy strike an entire MOLECULE ?

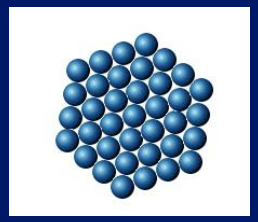
(not just a single atom)

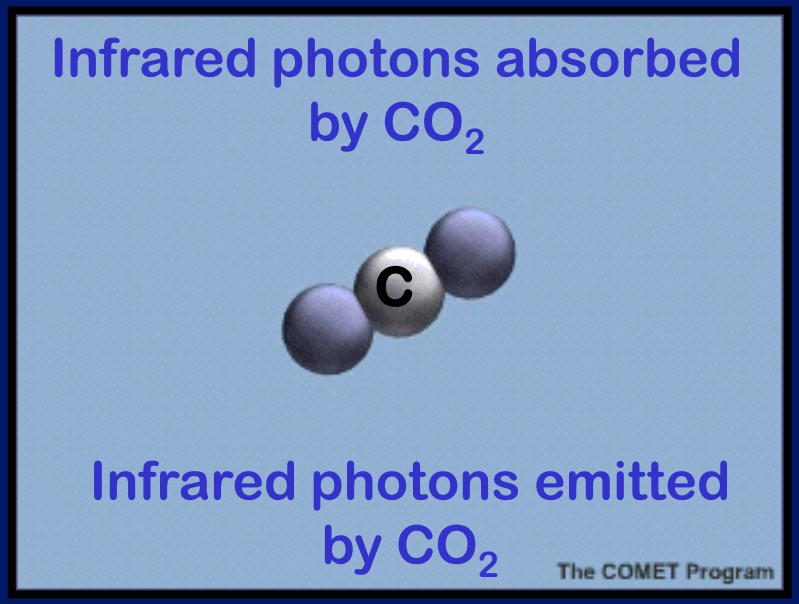
Quantum theory <u>also</u> involves the ***behavior of molecules***:

as seen in their molecular-scale motions:

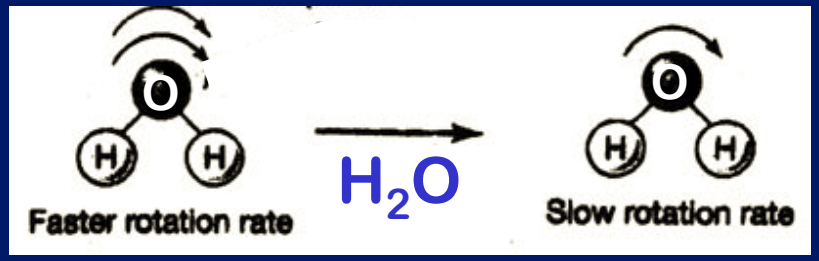


rotation
bending
vibration





Infrared photon is emitted ➔



LINK TO GLOBAL CHANGE:

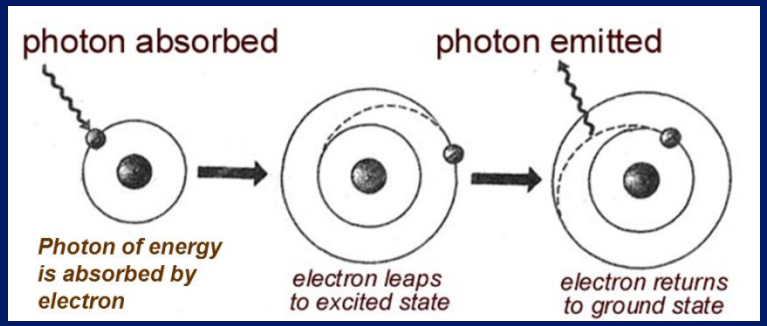
The type and frequency of molecular motions in gases like CARBON DIOXIDE and WATER VAPOR explain why <u>THEY</u> contribute to The Greenhouse Effect while other gases (O_2, N_2 . . .) do not!!

(more on this later . . .)

Recap of Key Concept:

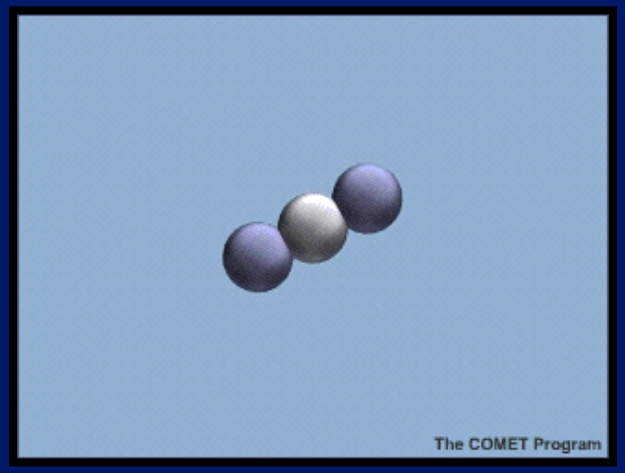
ENERGY & MATTER INTERACT !!!

within atoms



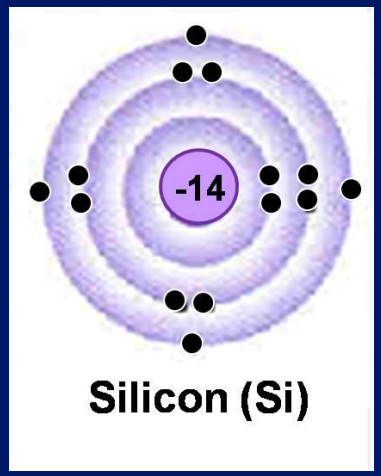
&

within molecules



PRESENTING . . . . A New Feature: The SUSTAINABILITY SEGMENT!!!

Staring:
The SUN
&



http://www.pbs.org/wgbh/nova/solar/