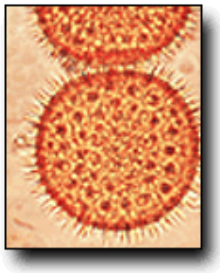
Wrap Up of: "PROXY" DATA or NATURAL ARCHIVES of CLIMATE

Corals

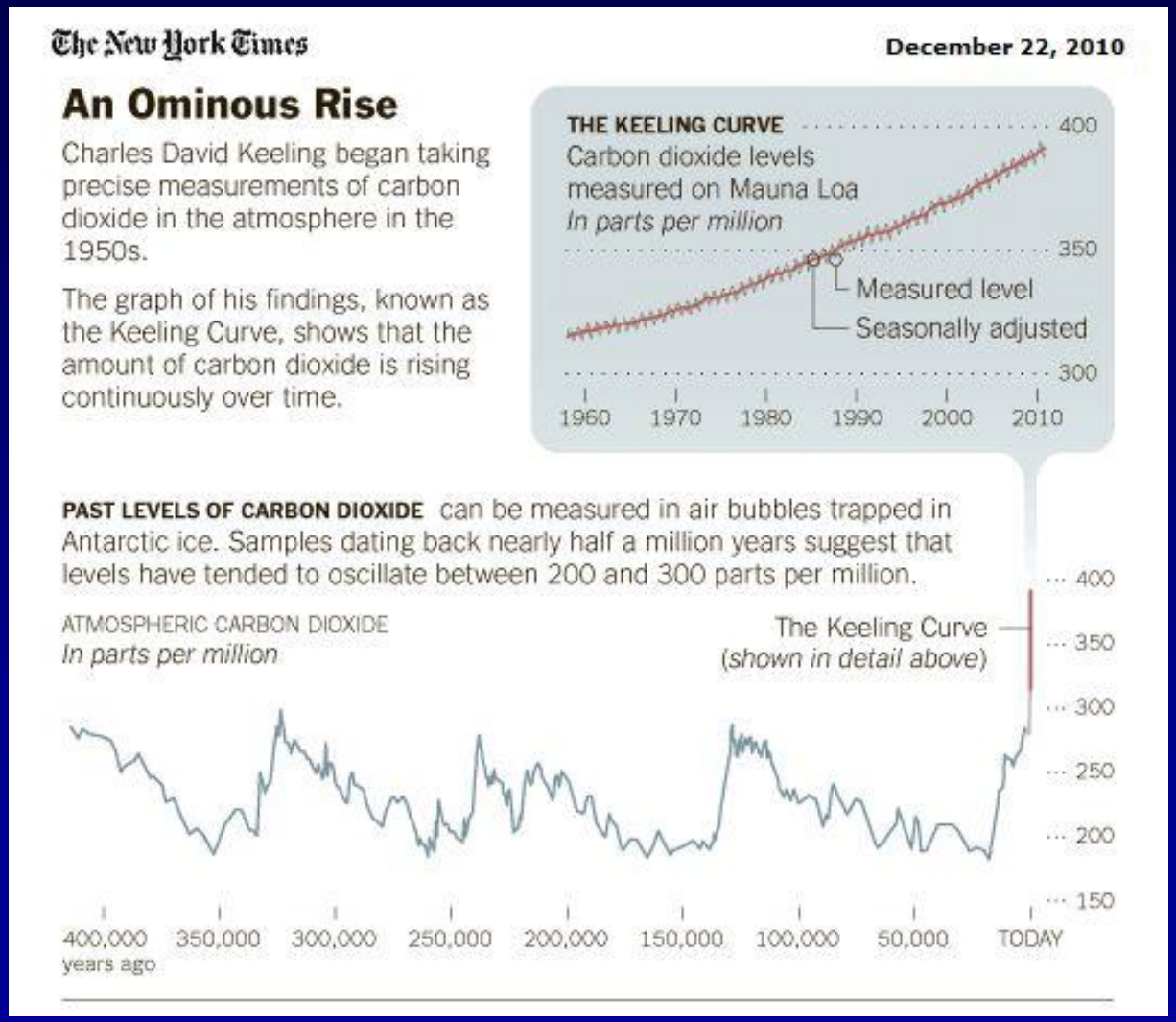
Ice cores

Lake, bog & ocean sediments



Pollen

How does the KEELING CURVE compare to the ANCIENT CO_2 RECORD FROM ICE CORES?



http://www.youtube.com/watch?v=SXHDwdd7Tf8&lr=1

Topic #3
ENERGY & MATTER
OVERVIEW (continued)

OBJECTIVES:

To review basic physical concepts of energy and matter and some key ways in which they interact.

Class Notes page # ➔

LAST CLASS:

We reviewed the basics of MATTER

Now let’s review the atoms themselves and their internal structure . . .

ATOMIC STRUCTURE:

Electron
Nucleus
Proton
Neutron

ELECTRON: tiny, - charged, very low mass

circles in orbits around a positively charged nucleus of an atom

NUCLEUS: small & massive
(contains protons, neutrons . . .)

central part of an atom;
made up of elementary particles
that are even smaller ➔

PROTON: + charged, in nucleus
(mass > an electron)

NEUTRON: neutral charge, in nucleus,
(approximately equal in mass to a proton).

The # of neutrons can vary → **ISOTOPES** . . . .

ISOTOPE:

atoms of a given element that have different numbers of **neutrons** in their nuclei (hence slightly different masses)

e.g. **carbon-12** (^{12}C) & **carbon-13** (^{13}C)

ATOMIC NUMBER = # of protons in nucleus

Atom is neutral (no charge) when:

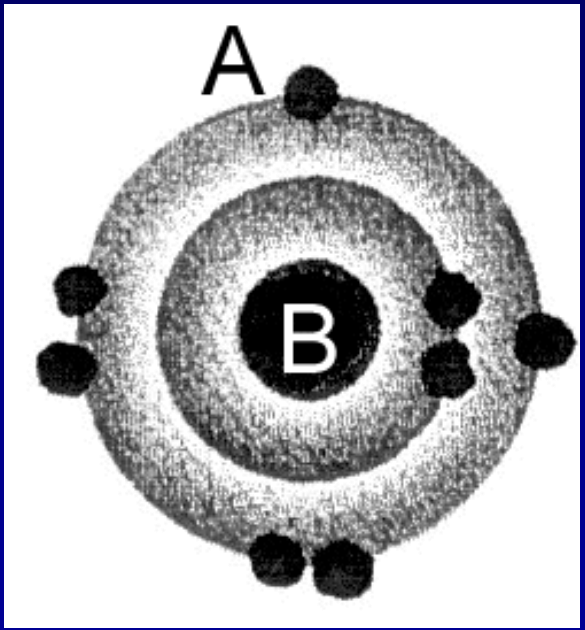
protons (+) = # of electrons (-)

ION: if the atom has a charge (+ or -) it is an **ION**

protons (+) ≠ # neutrons (-)

MASS NUMBER = # protons + # neutrons in the nucleus

Schematic “dot” diagram of an oxygen atom



What is A? _____

What is B? _____

 # electrons = _____

 # protons = _____

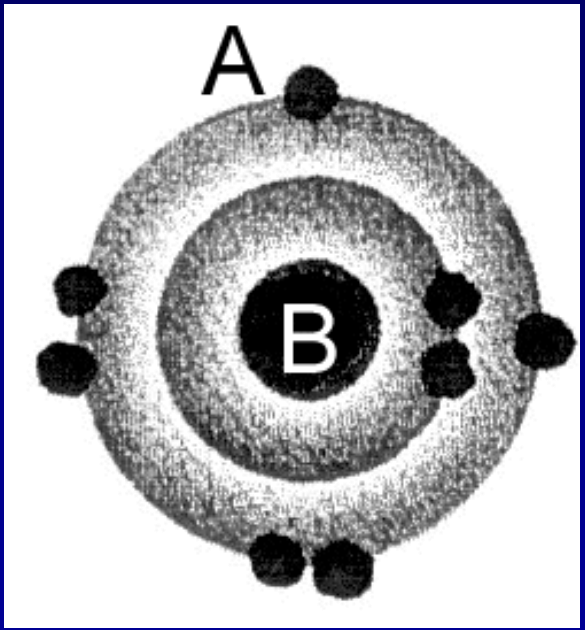
 # neutrons = _____

atomic # = _____

mass # = _____

Is ^{18}O [lighter or heavier] than ^{16}O?

Schematic “dot” diagram of an oxygen atom



What is A? electron

What is B? nucleus

 # electrons = 8

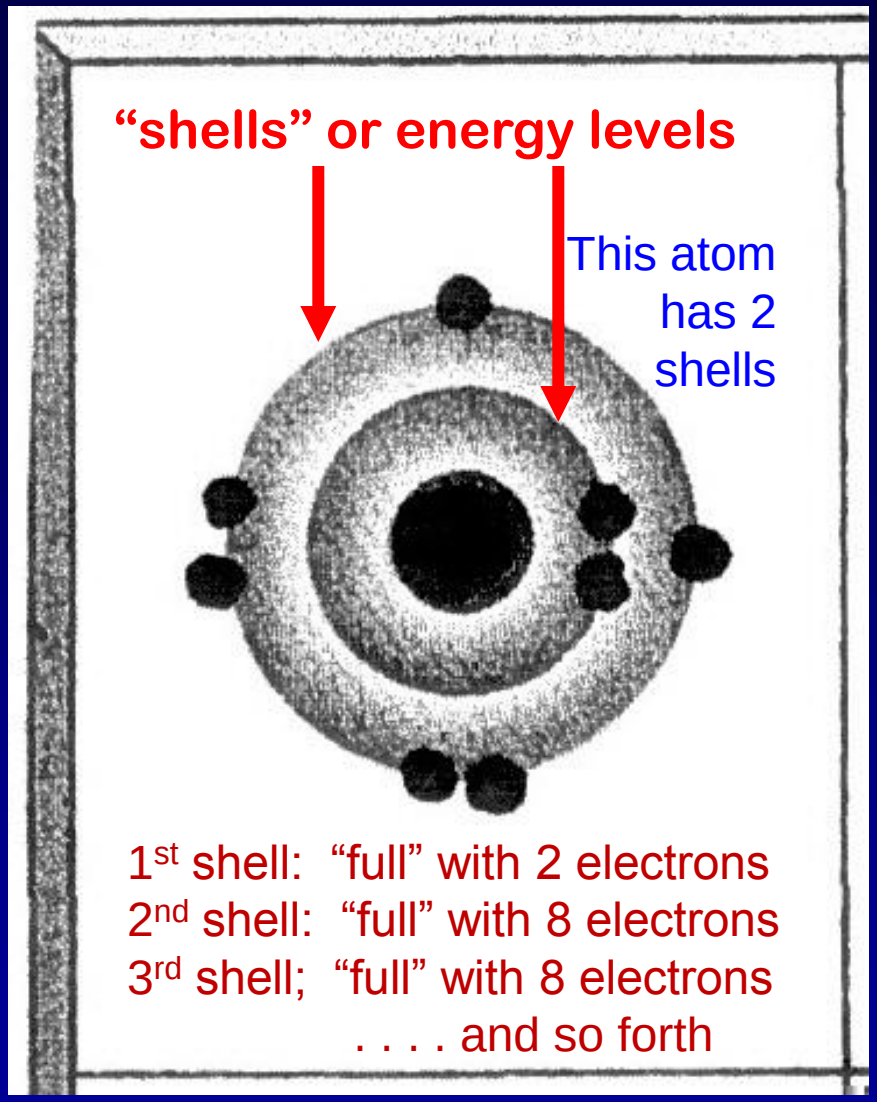
 # protons = 8

 # neutrons = 8

atomic # = 8

mass # = 16

Is ^{18}O [lighter / heavier] than ^{16}O?

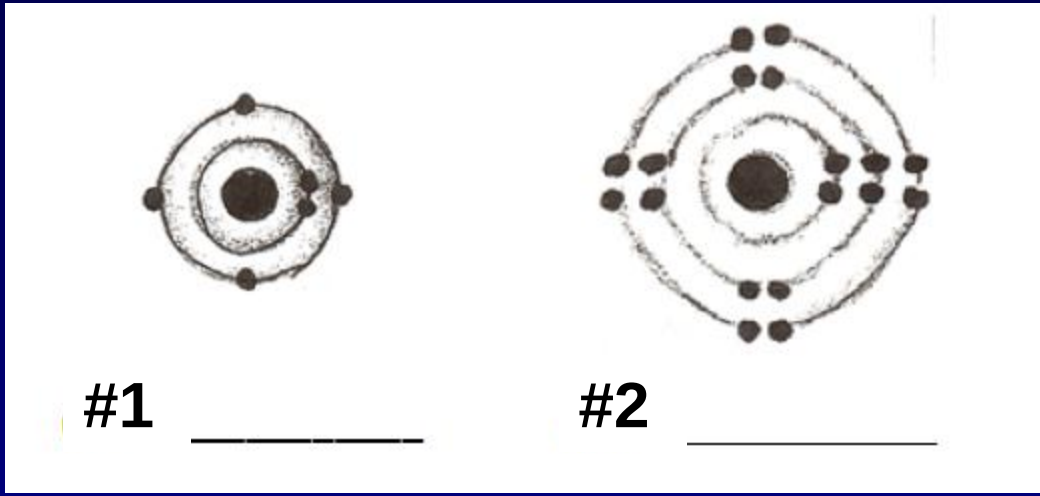


Electron Configuration in Shells
(for Elements 1 to 18)

Atomic #	*Element & Symbol*	Number of Electrons in Each Shell			*Total # of Elec-trons*
		1st	2nd	3rd	
1	*Hydrogen, H*	1			*1*
2	*Helium, He*	2 (Full)			*2*
3	*Lithium, Li*	2	1		*3*
4	*Beryllium, Be*	2	2		*4*
5	*Boron, B*	2	3		*5*
6	*Carbon, C*	2	4		*6*
7	*Nitrogen, N*	2	5		*7*
8	*Oxygen, O*	2	6		*8*
9	*Fluorine, F*	2	7		*9*
10	*Neon, Ne*	2	8 (Full)		*10*
11	*Sodium, Na*	2	8	1	*11*
12	*Magnesium Mg*	2	8	2	*12*
13	*Aluminum, Al*	2	8	3	*13*
14	*Silicon, Si*	2	8	4	*14*
15	*Phosphorus, P*	2	8	5	*15*
16	*Sulfur, S*	2	8	6	*16*
17	*Chlorine, Cl*	2	8	7	*17*
18	*Argon, Ar*	2	8	8 (Full)	*18*

A CLICKER QUESTION . . .

Q1. Using the Table on p 18, figure out which elements these dot diagrams represent:



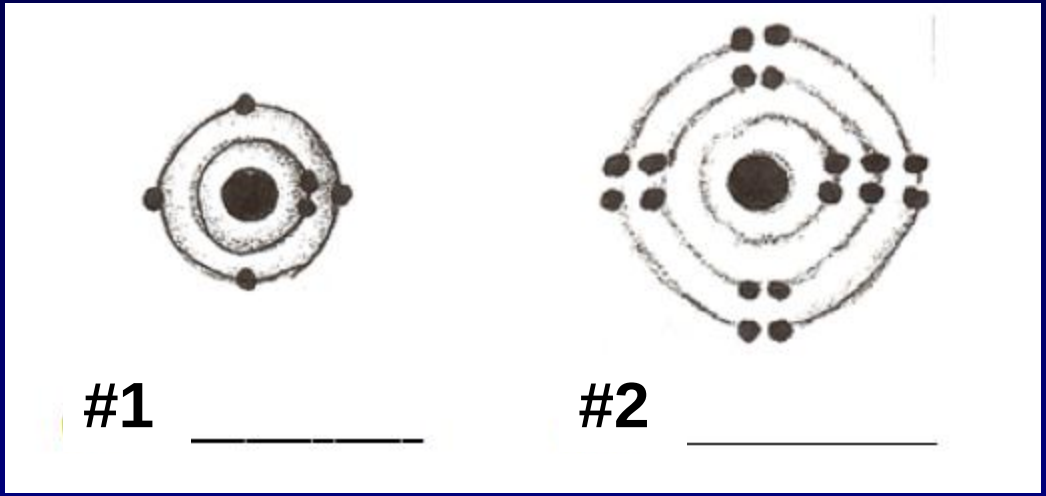
A) 1 = Beryllium and 2 = Neon

B) 1 = Oxygen and 2 = Sulfur

C) 1 = Neon and 2 = Silicon

D) 1 = Carbon and 2 = Argon

Q1. Using the Table on p 20, figure out which elements these dot diagrams represent:



A) 1 = Beryllium and 2 = Neon

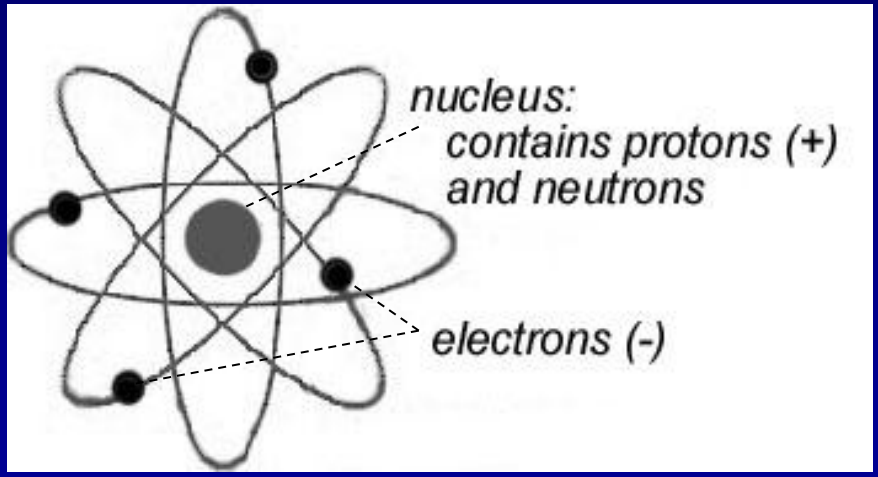
B) 1 = Oxygen and 2 = Sulfur

C) 1 = Neon and 2 = Silicon

D) 1 = Carbon and 2 = Argon

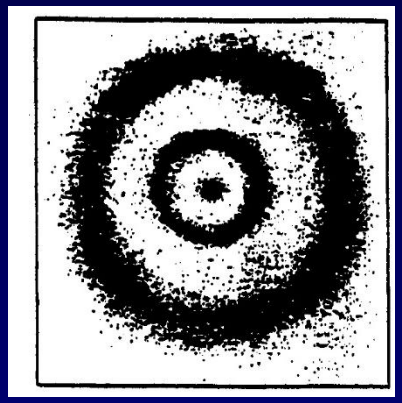
THE EARLY PLANETARY MODEL OF THE ATOM . . . .

Electrons "orbiting" the nucleus



VS. . . . .

The BOHR MODEL OF THE ATOM:



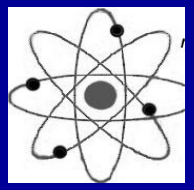
According to Neils Bohr's model of the atom,

electrons circling the nucleus cannot maintain their orbits at just *any* distance from the center of the atom (the early model). . . .

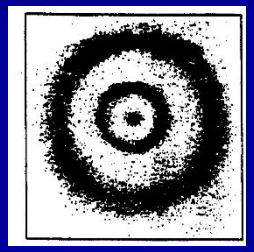
. . . .there are only certain "allowed orbits"

- in which an electron can exist for long periods of time without giving off radiation (energy).

- As long as the electron remains at one of these distances, its energy is fixed.

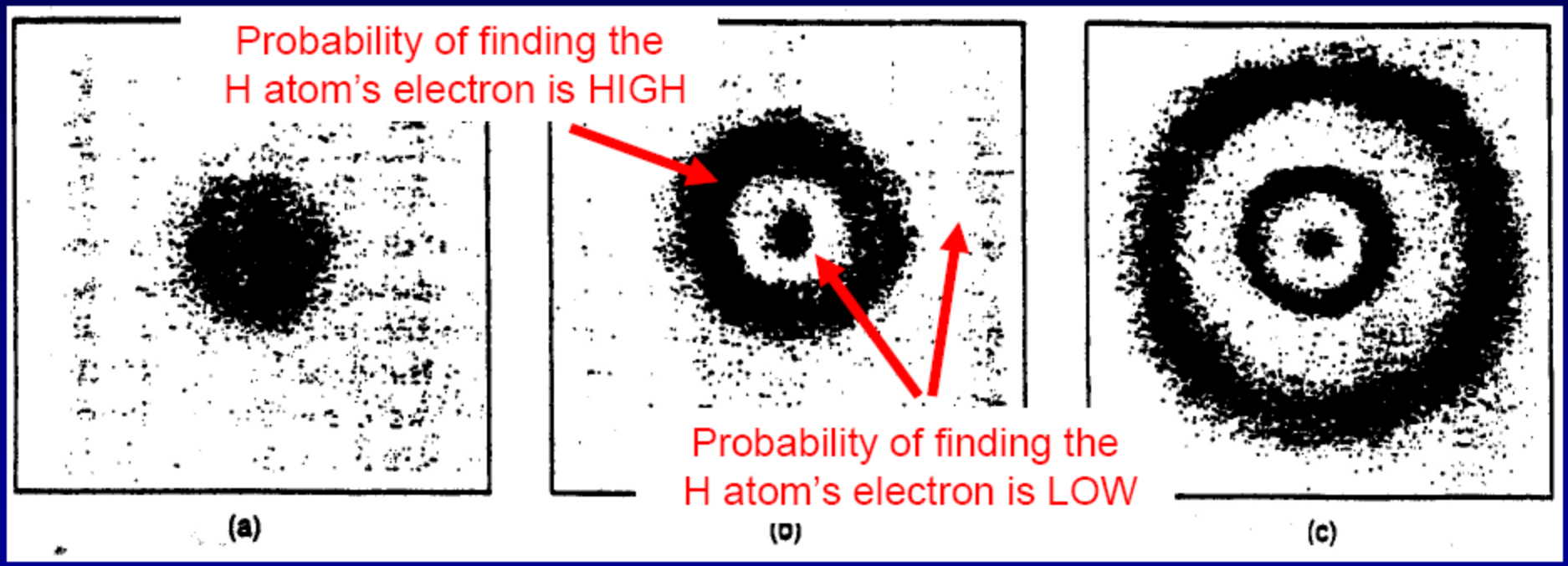


vs.



Schematic Diagrams representing ELECTRON ENERGY STATES (Shells) for Hydrogen H in the Bohr model :

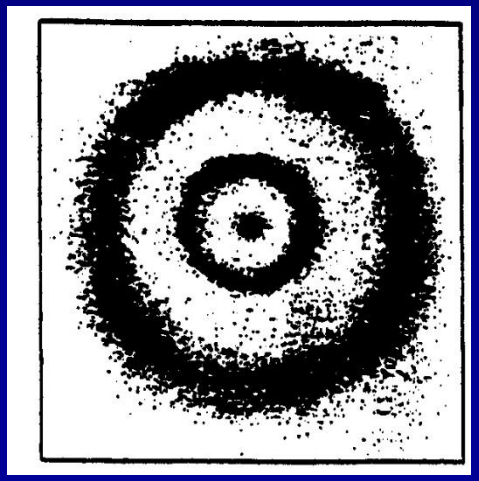
REMEMBER: HYDROGEN has only ONE electron!

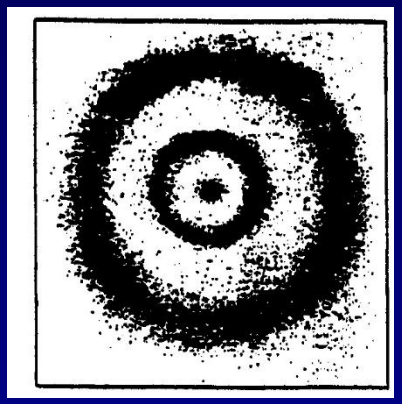


GROUND State **Excited State 1** **Excited State 2**

The quantum model of the atom states that:

electrons can exist only in
discrete allowed places within shells
(or energy levels)
and not in between.





-- The “empty” spaces represent areas with *little likelihood* of finding an electron

-- Dark areas represent places (or energy levels) where electrons are “allowed” to be

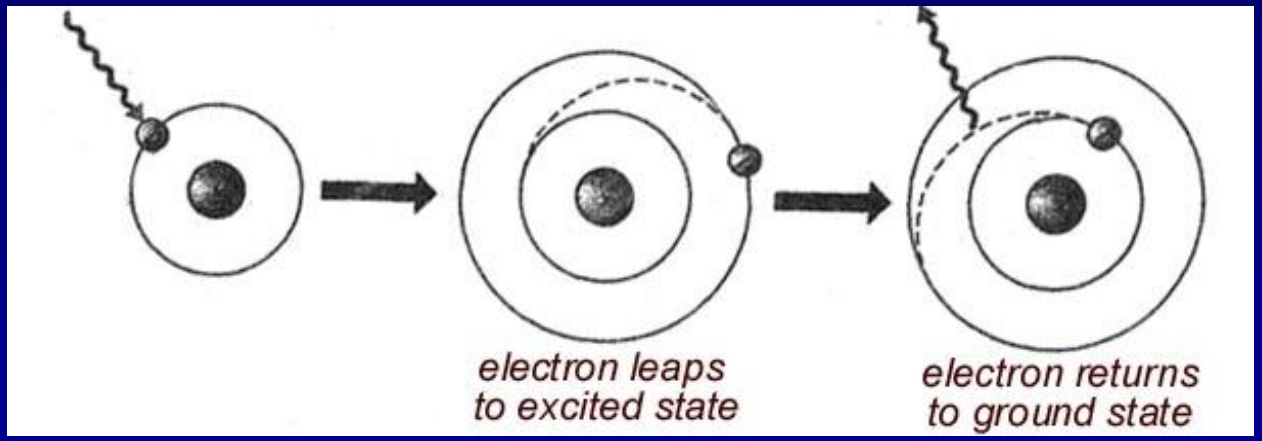
. . . BUT HOW DO THEY GET FROM ONE ENERGY LEVEL TO ANOTHER???

The electrons move -- NOT according to Newtonian laws of motion

-- but according to

quantum mechanics.

Energy Absorbed → Energy Released

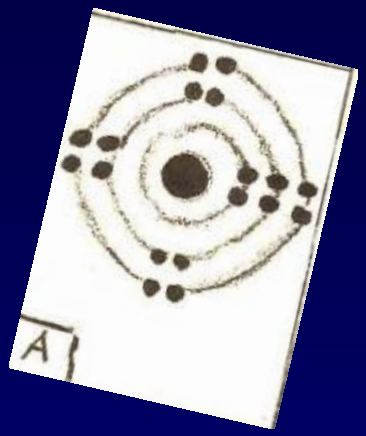


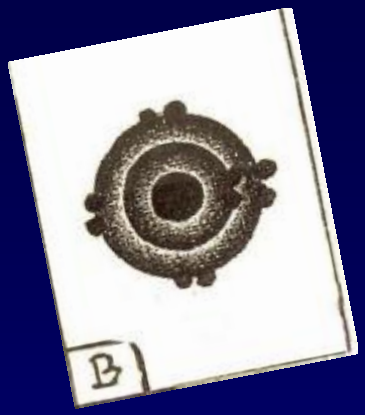
MORE on how this happens and what it has to do with GLOBAL CLIMATE CHANGE in upcoming lectures!!

A little rusty on atoms, elements, shells, and the Periodic Table?

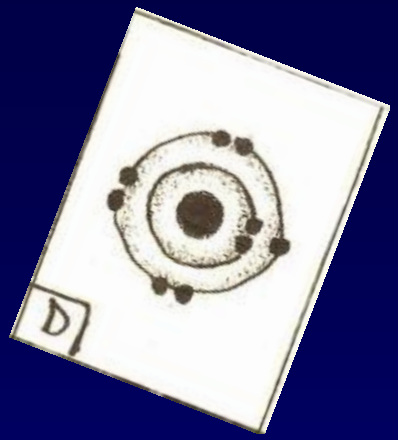
“HANDS ON”
LEARNING ACTIVITY

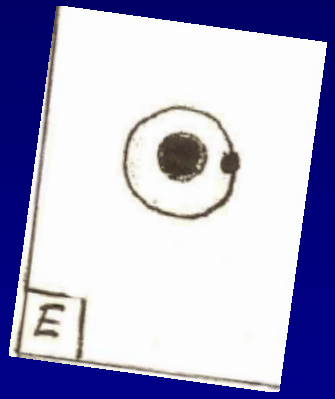
Go to the Class Notes Appendix pp 110 - 113

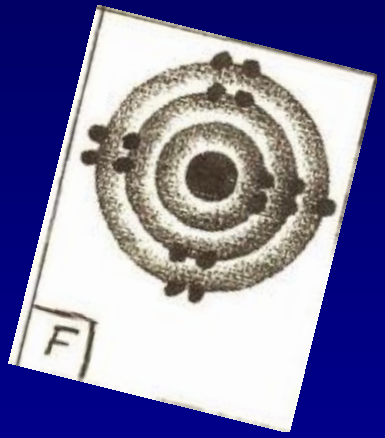

A

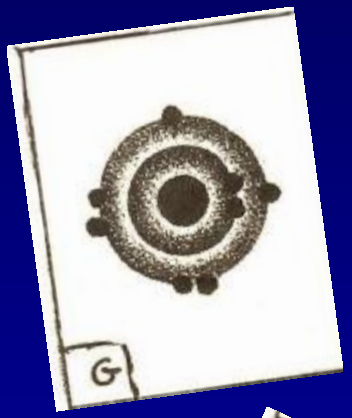

B


C

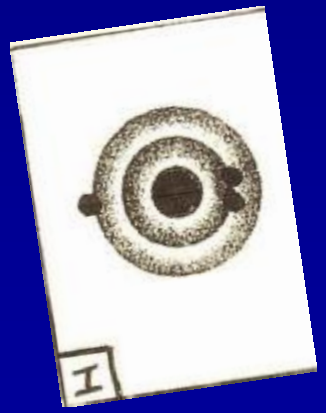

D


E

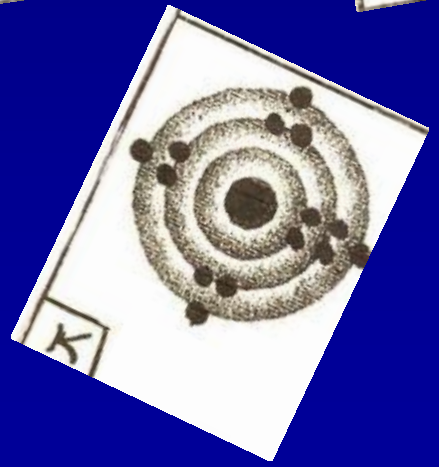

F


G


H


I


J


K

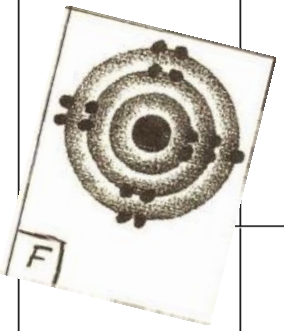
PLACE THE ATOMS ON THE BLANK PERIODIC TABLE in the right location,

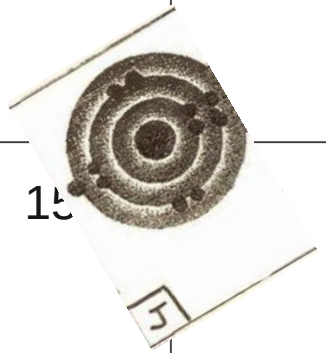
then answer the rest of the questions on p 109

GAP

1							2
3	4	5	6	7	8	9	10
11	12		14	15		17	18

Pair up with one or two classmates & arrange your atoms!



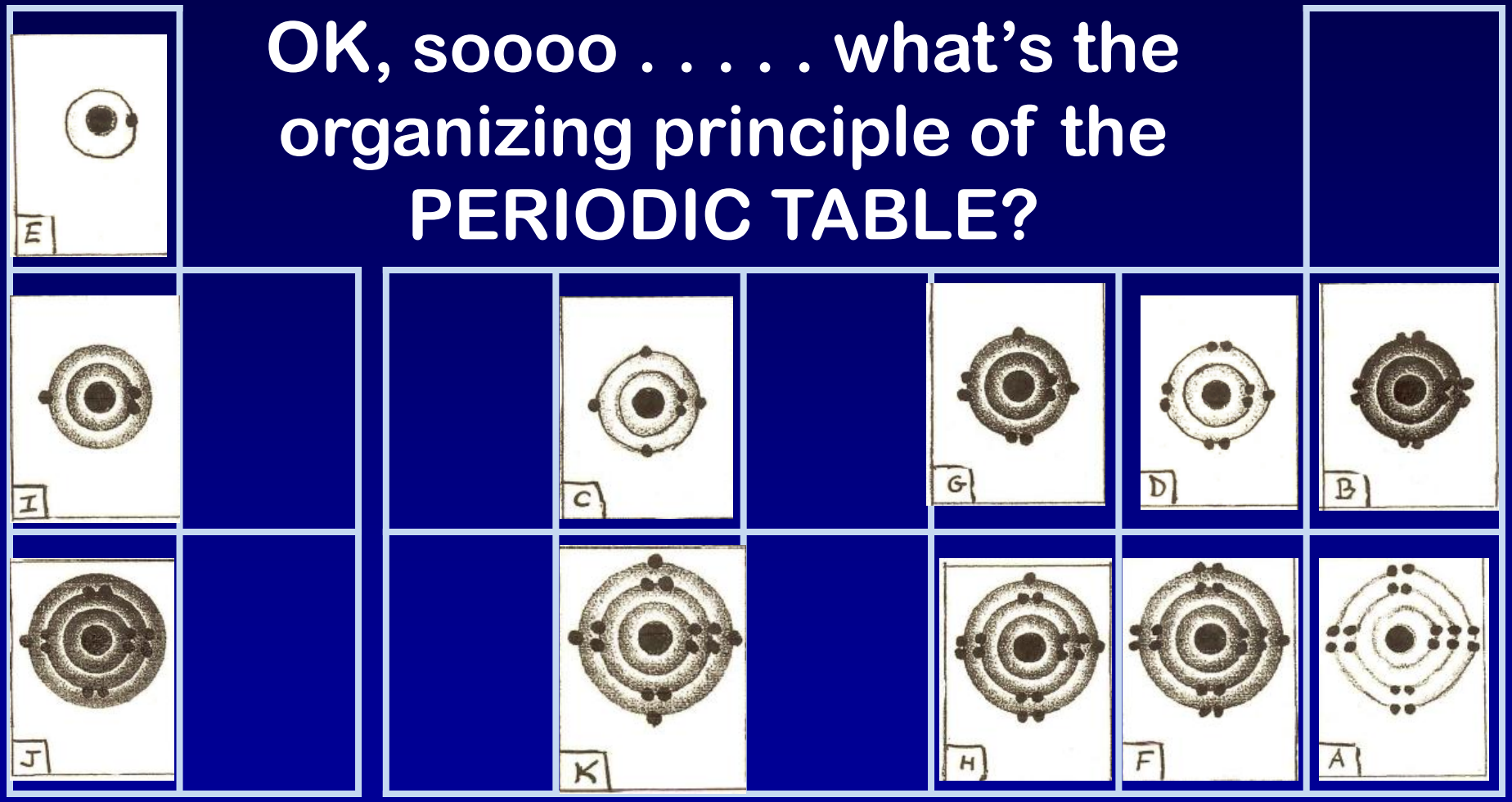


Page 157

p 113

Which elements go in which row + column?

OK, soooo . . . . . what's the organizing principle of the PERIODIC TABLE?



[Table is on p 111 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 outer shell (columns)

2 electrons

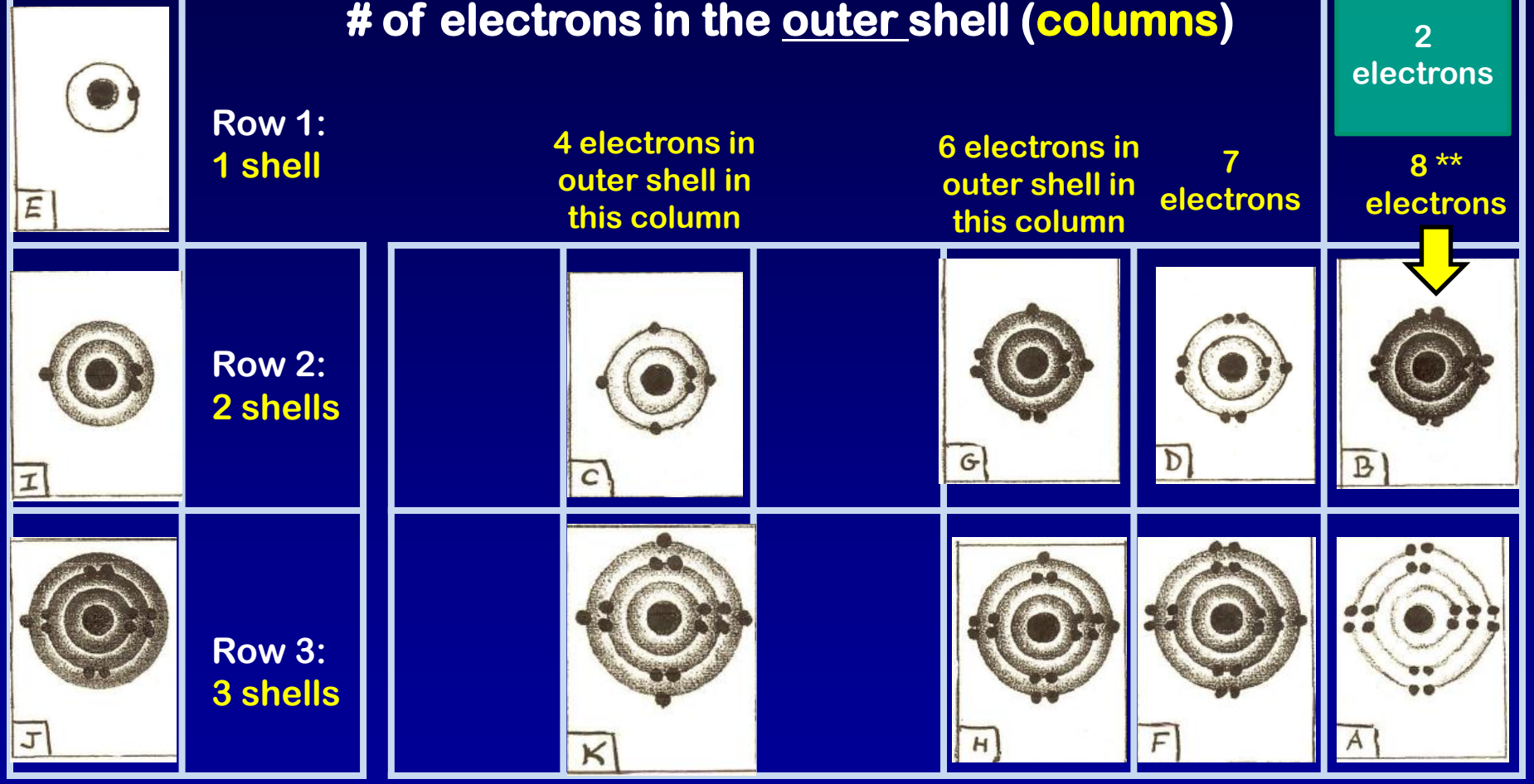
Row 1: 1 shell

4 electrons in outer shell in this column

6 electrons in outer shell in this column

7 electrons

8 ** electrons



Row 2: 2 shells

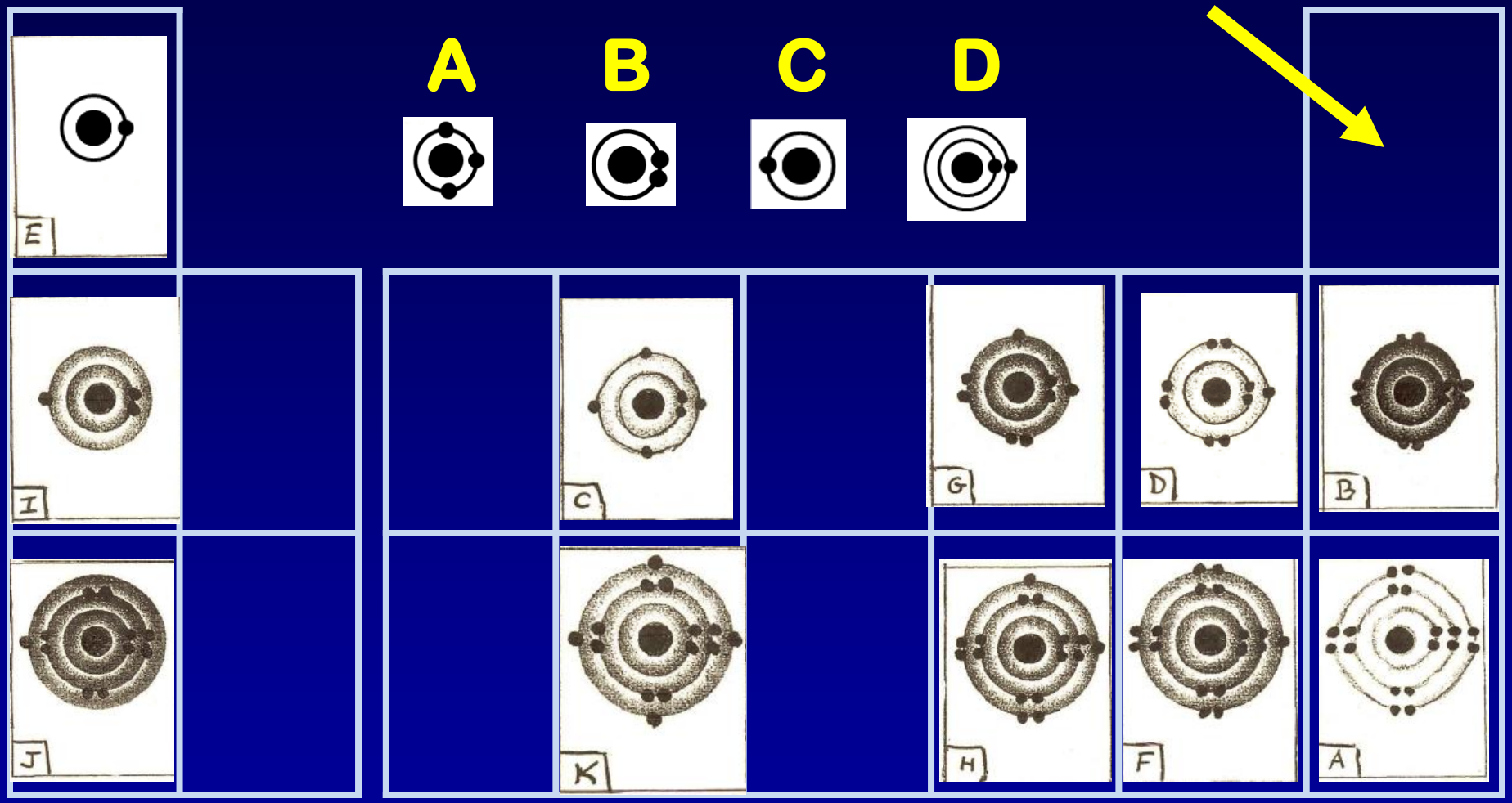
Row 3: 3 shells

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

Q2. Which of these is the proper dot diagram for the element in this position?



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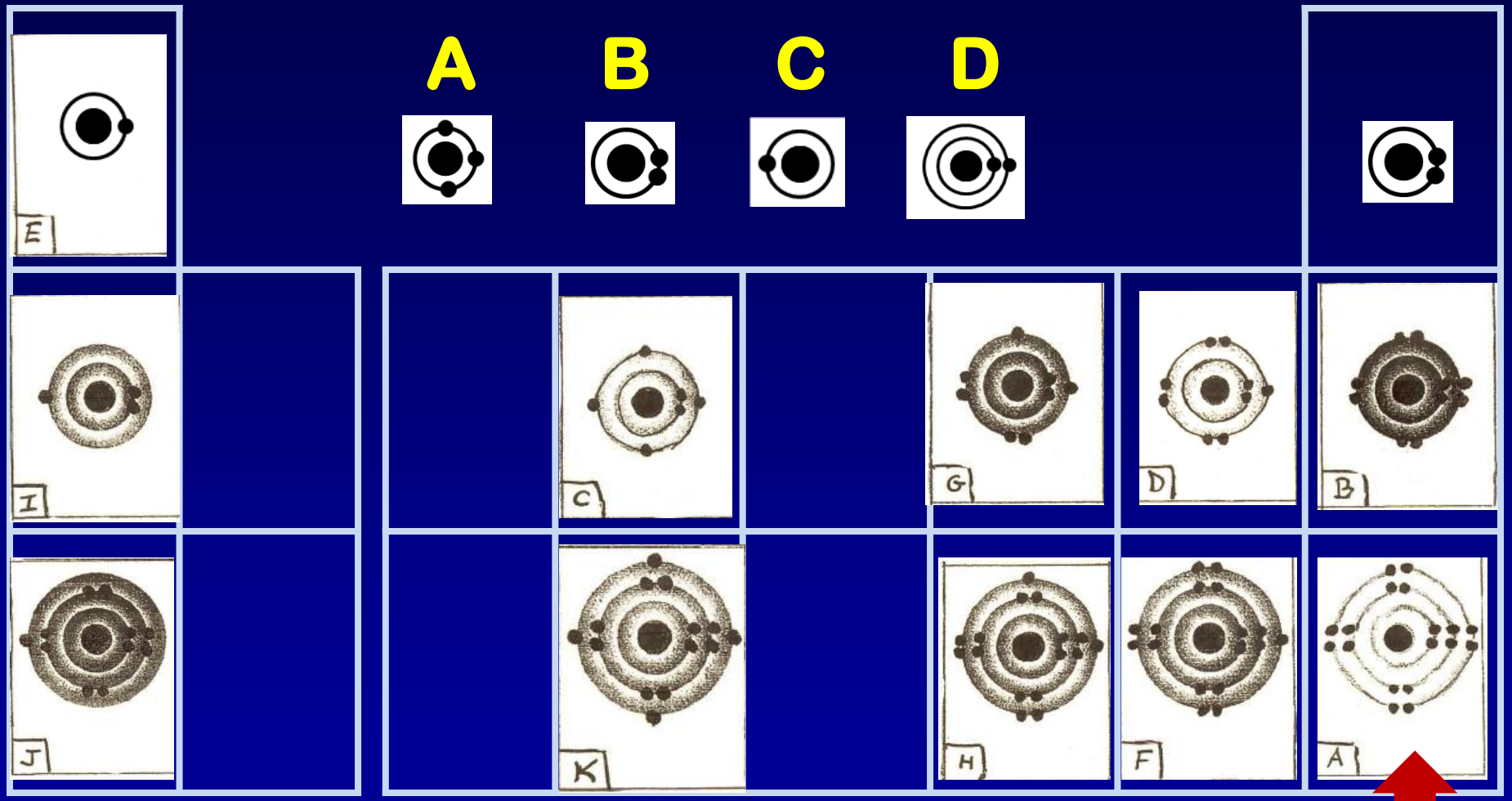


B is correct! Helium (He)

Noble Gases (stable)

QUICK
ENERGY REVIEW

Energy Terms & Units

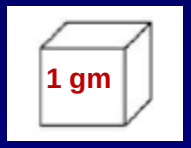
Energy (def) = the quality of an object that enables it to do “work;” the ability to do work.

Force (def) - A push or pull that, acting alone, causes a change in acceleration of the object on which it acts.

Energy Unit Review

Joule (or J) is the physical measurement for work.

Calorie (def) = the amount of **heat** required to raise 1 gram of room-temperature water 1 degree Celsius in temperature



~ 1 cubic centimeter H_2O

1 calorie = 4.186 joules
1 calorie per second = 4.186 watts

HUGE AMOUNTS OF ENERGY ARE IN A HURRICANE!!!

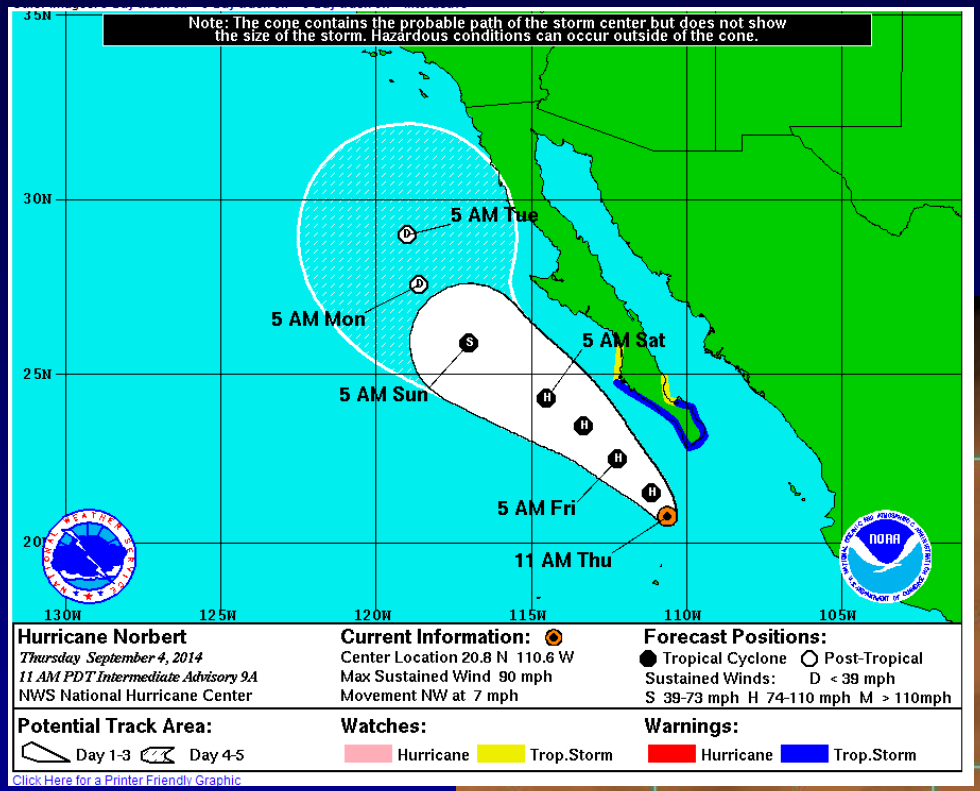
http://www.aoml.noaa.gov/hrd/tcfaq/D7.html

1.3×10^{17} Joules / day

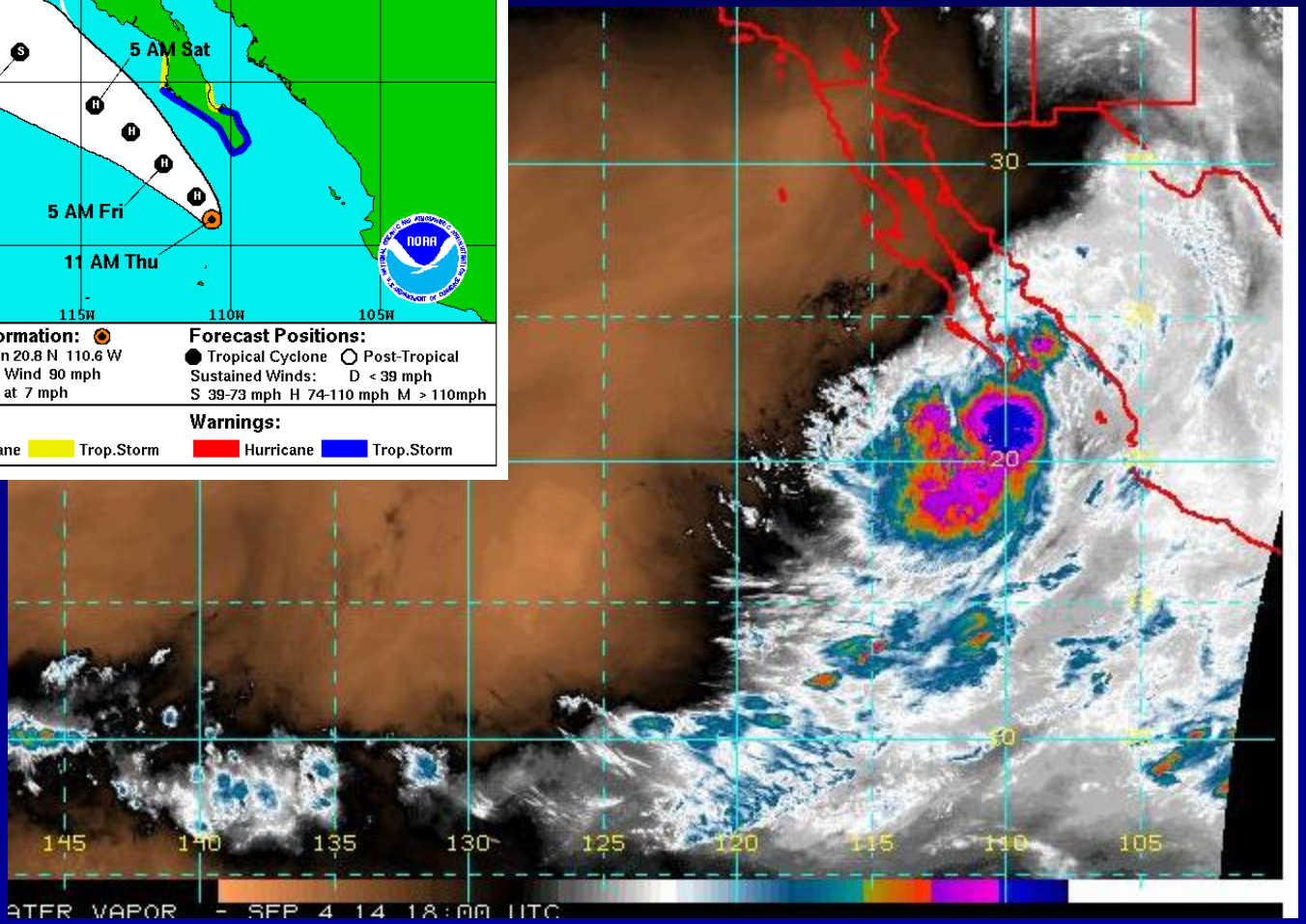

TODAY!
30
25
20
15
10
135
130
125
120
115
110
105

http://www.nhc.noaa.gov/refresh/graphics_ep4+shtml/090205.shtml?5-daynl

HURRICANE NORBERT!



Water vapor imagery:

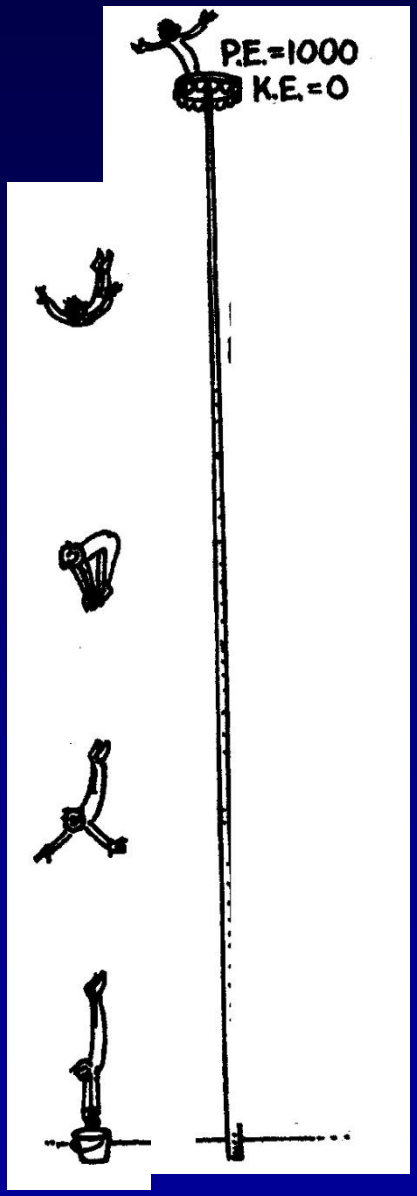


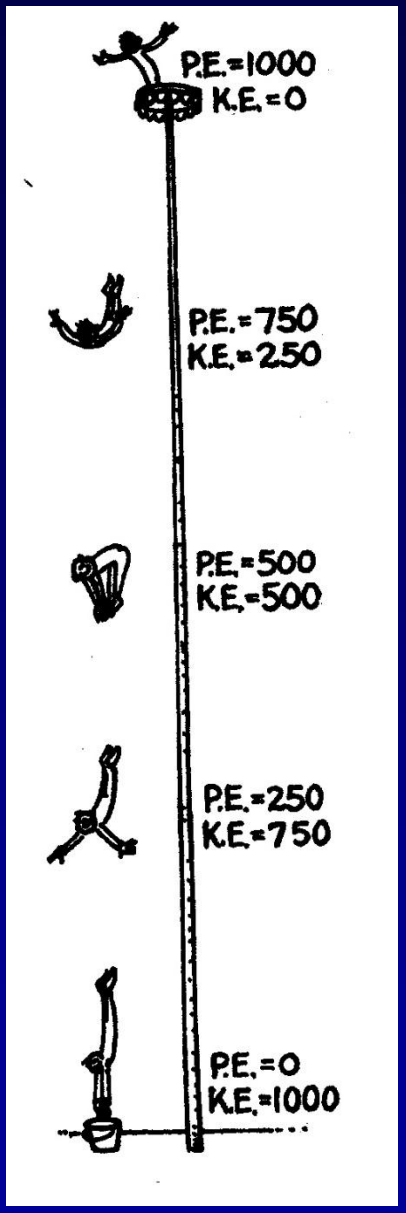
Different Forms of Energy

- **Kinetic** (KE or KinE) = energy of *motion*; the ability of a mass to do work.

  KE = ½ (mass x velocity^2) or KinE = (1/2) ms ^{2}

- **Potential** (PE) = energy a system possess if it is capable of doing work, but is *not* doing work now


P.E.=1000
K.E.=0


P.E.=1000
K.E.=0
P.E.=750
K.E.=250
P.E.=500
K.E.=500
P.E.=250
K.E.=750
P.E.=0
K.E.=1000

POTENTIAL ENERGY (PE) – The energy a system possesses if it is capable of doing work, but is not doing work now.

Quick summary of different forms of potential energy:

Gravitational - Energy associated with the position of a mass in a gravitational field; *energy stored by virtue of its position*.

Elastic - Energy stored in a flexed muscle, a coiled spring, a stretched rubber band, etc.

Chemical - Energy stored in the electrical bonds that bind together the molecules or atoms of a substance. In any process in which atoms rearrange to form different molecules, a chemical reaction occurs, during which energy is absorbed or released by matter.

Electrical - Energy associated with the position of a charge in an electric field; an electric charge is an excess or deficit of electrons on an object. .

Magnetic - Energy stored in a magnetic field. Magnetic fields can be created by the motion of electrical charges.

Different forms of POTENTIAL ENERGY

Review these definitions on your own . . .

Especially important for THIS class are:

ELECTROMAGNETIC & THERMAL ENERGY

Especially important for THIS class are . . .

2 Important forms of POTENTIAL ENERGY that are keys to Global Change Issues:

Electromagnetic Energy

(Topics #4 & 5)

&

Thermal energy

(Topic #7)

Related to Topic #8:

Energy Transformations & Conservation of Energy:

"Everything that happens can be described as energy transformation."

ENERGY IS CONSERVED!

The Law of Conservation of Energy:

Energy cannot be created or destroyed.

It can be transformed
from one form to another . . . . but

THE TOTAL AMOUNT OF ENERGY NEVER CHANGES.

Same as : 1st Law of Thermodynamics
(Topic 7)

➔ ***Link to GREEN TECHNOLOGIES & SOLUTIONS for addressing climate change:***

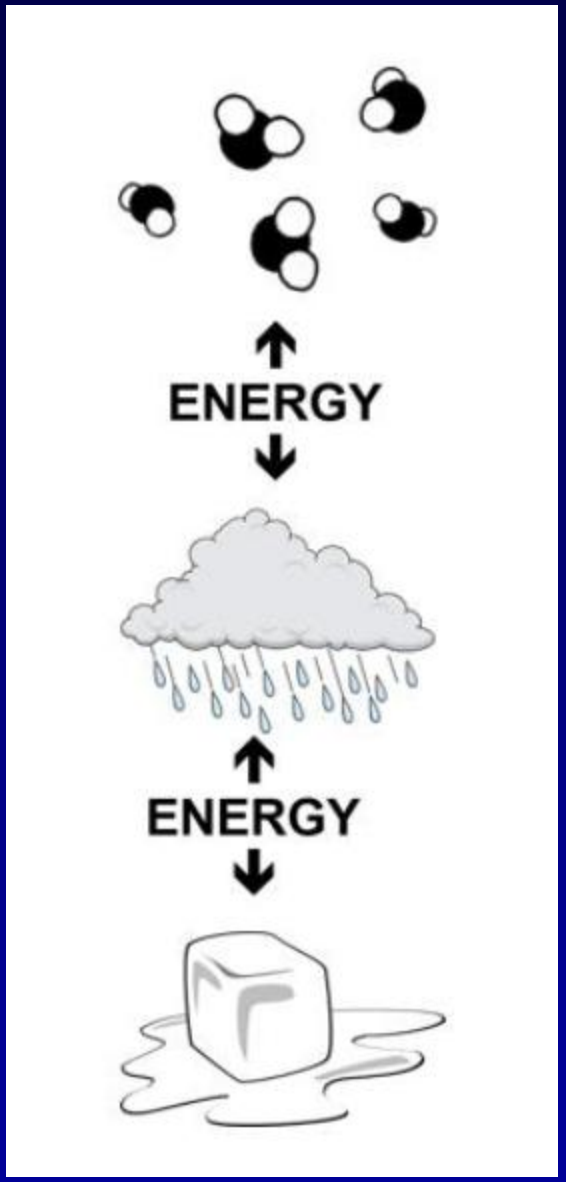
Although energy may not be destroyed, it can become **INEFFICIENT**

i.e., is not easily used or available to do work!

Efficiency = work done / energy used

Also coming up under Topic #7:

ENERGY & MATTER INTERACT IN PHASE CHANGES



Recap of ANNOUNCEMENTS:

- **RQ-2 is due one week from today – the SELF TEST & RQ will be posted tonight.**

- **INDIVIDUAL ASSIGNMENT #1 will be due in next Tuesday Sep 9th in the DROPBOX by 11:59 pm (details in class today)**

- **Dr H's official OFFICE HOUR: Thursdays 2:15 – 3:15 pm OR by EMAIL APPOINTMENT**

Here for the FIRST TIME today?
Please pick up a **Course Info Sheet & Background Form** from the table in the front of the room and **see a TA .**

Have a great weekend!