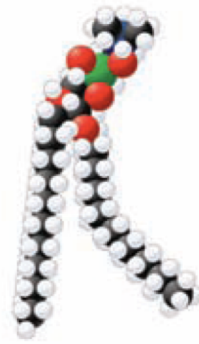
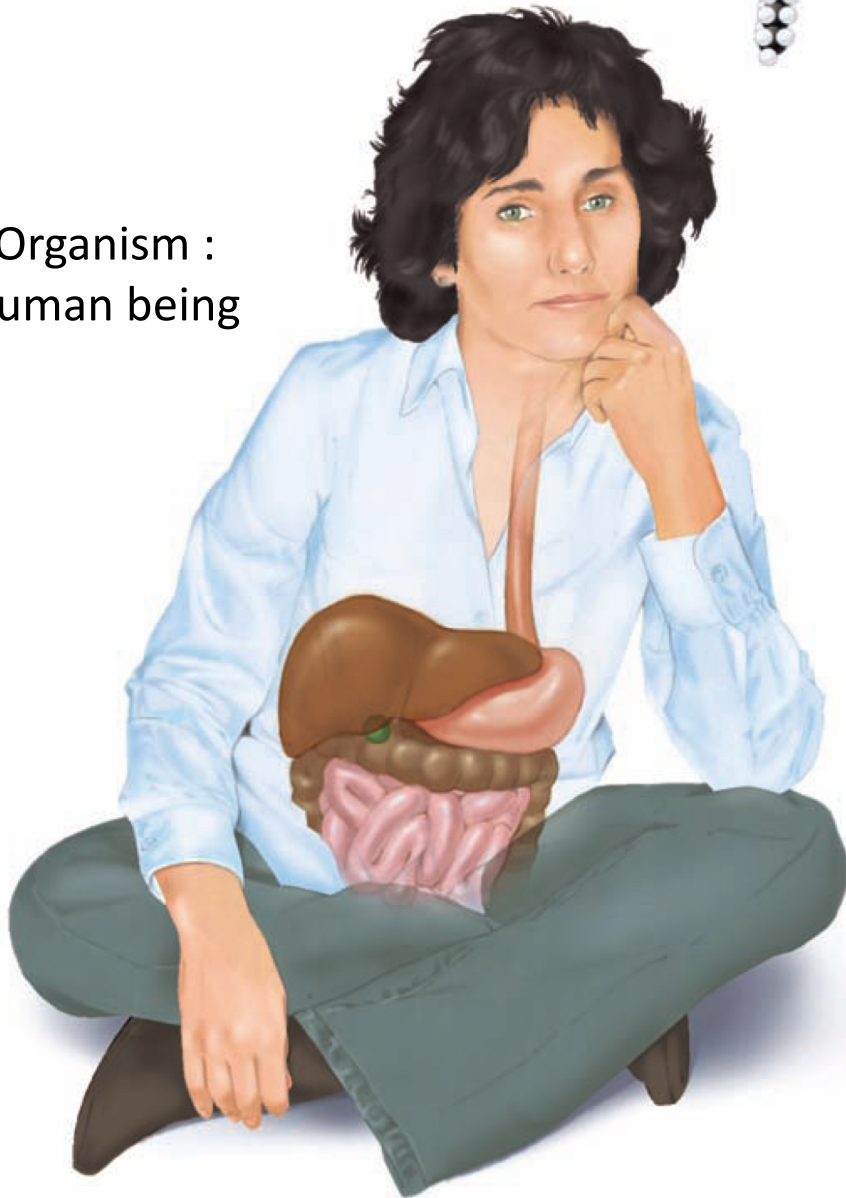
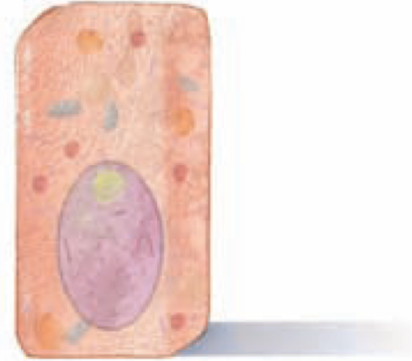


Hierarchical organization

Organism :
human being



Molecular level
(biochemistry)

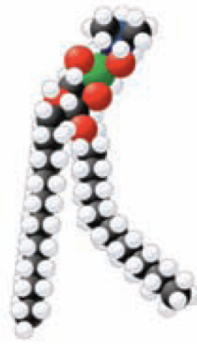
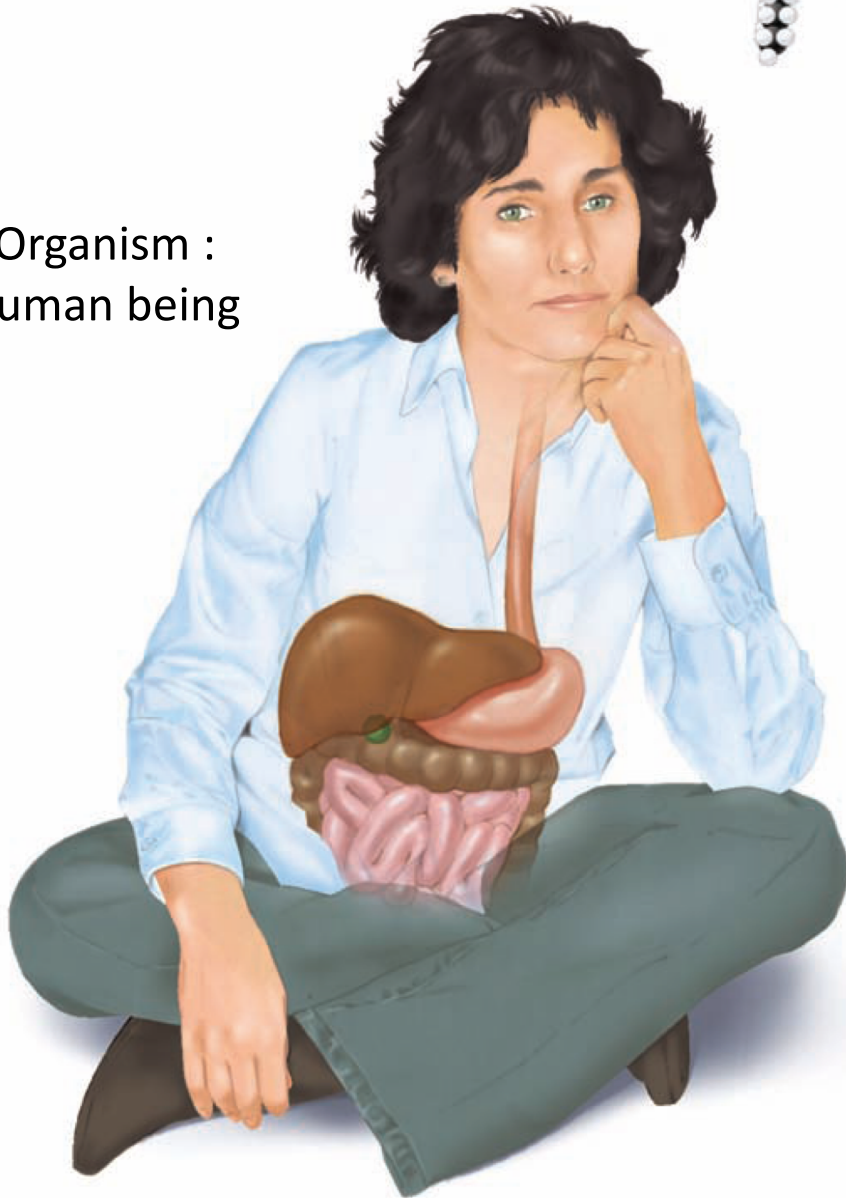


Cellular level

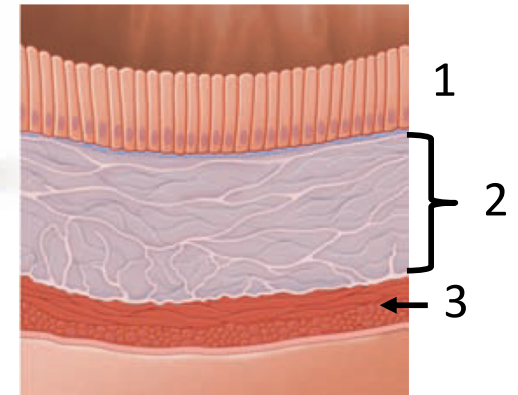
The molecule shown is a phospholipid,
a component of the cell membrane.

Hierarchical organization

Organism :
human being



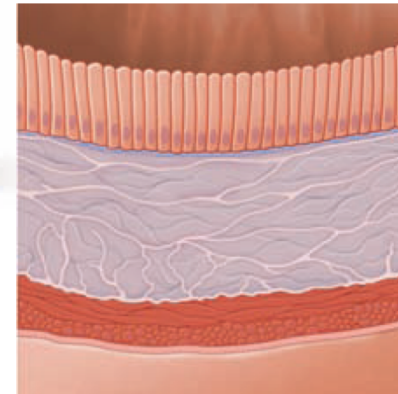
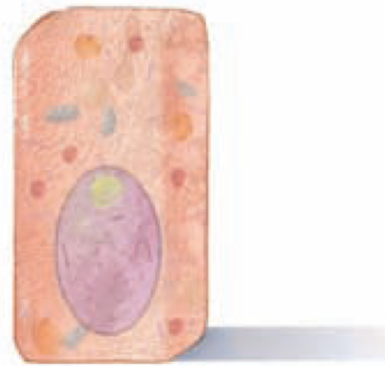
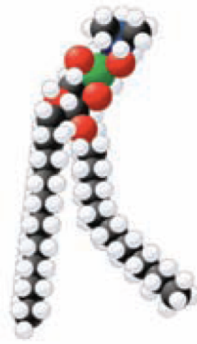
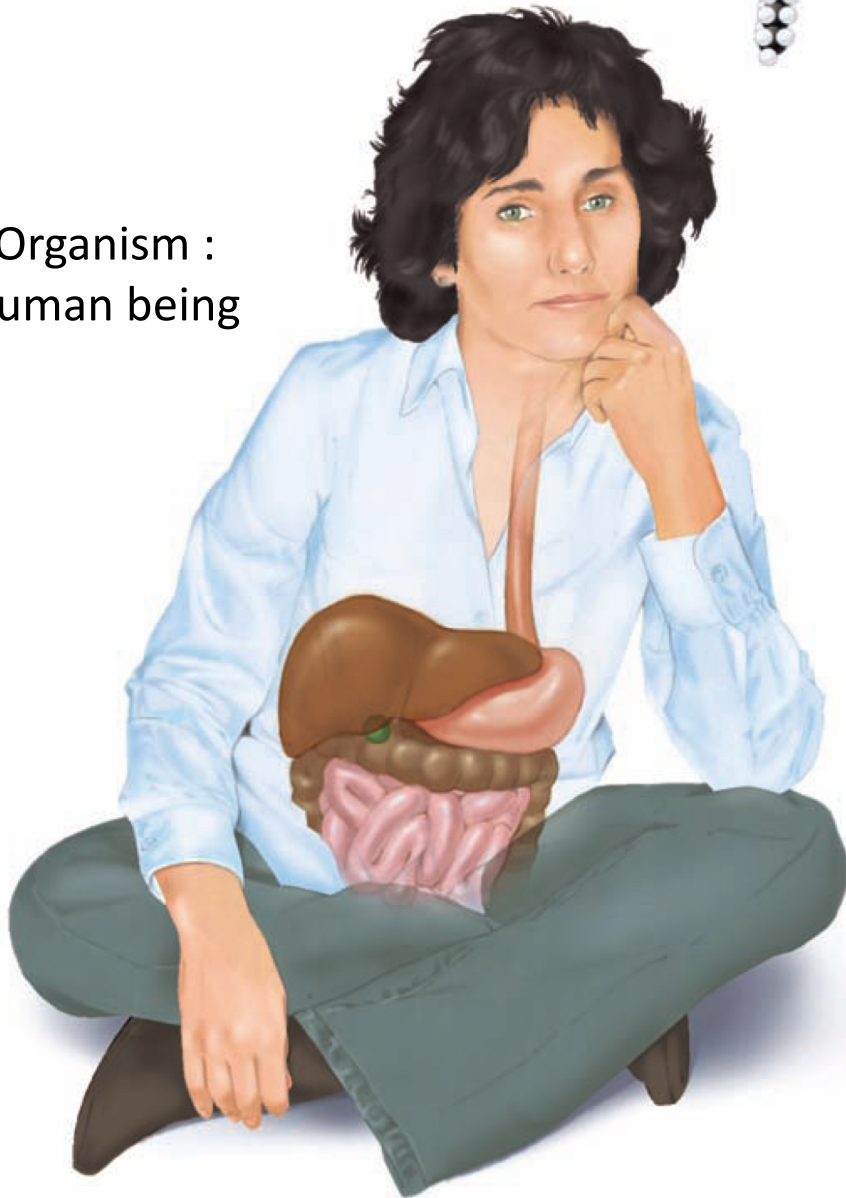
Tissues level :



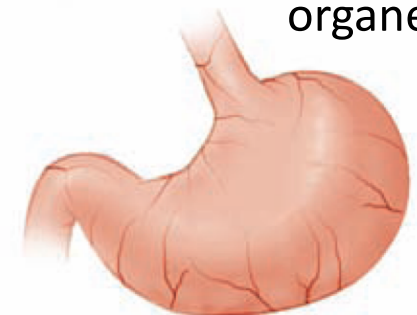
1 = epithelium
2 = connective tissue
3 = smooth muscle

Hierarchical organization

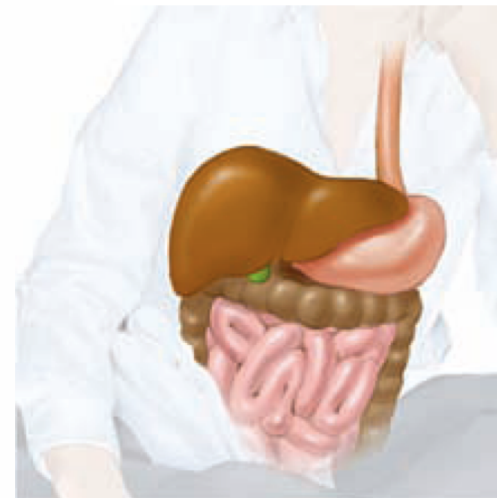
Organism :
human being



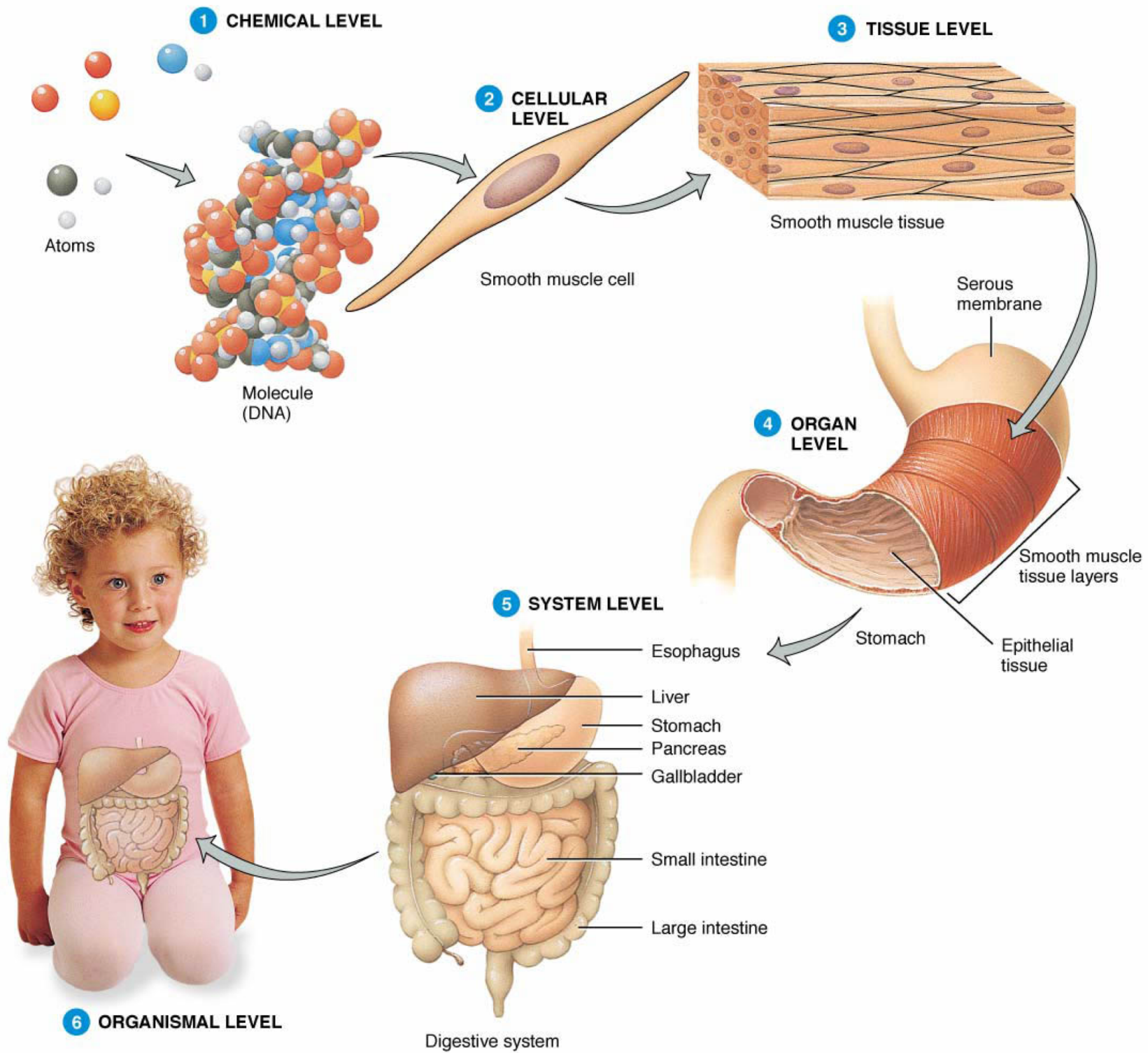
organe



stomach

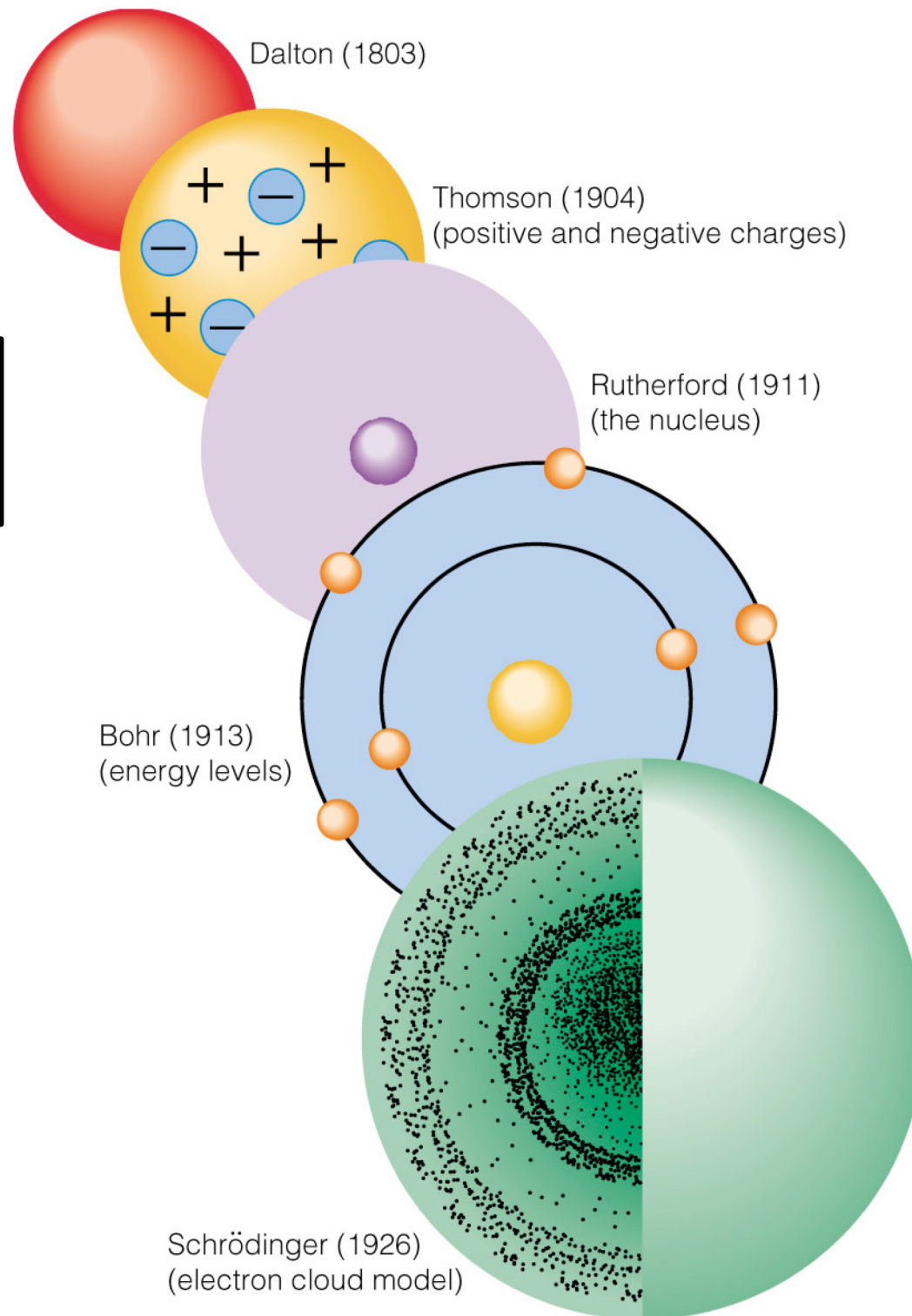


Digestive
system



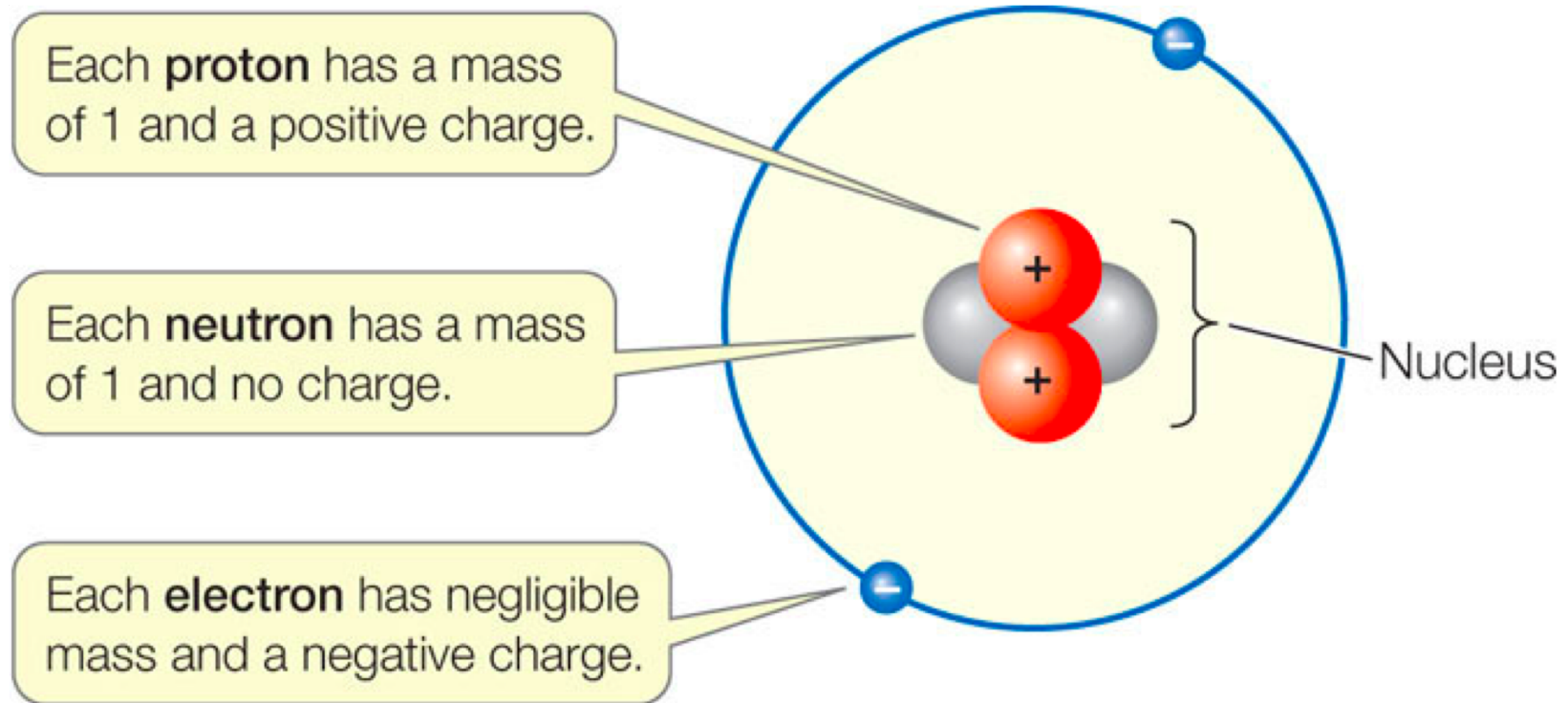
Hierarchical organization

1. atom level



Hierarchical organization

1. atom level

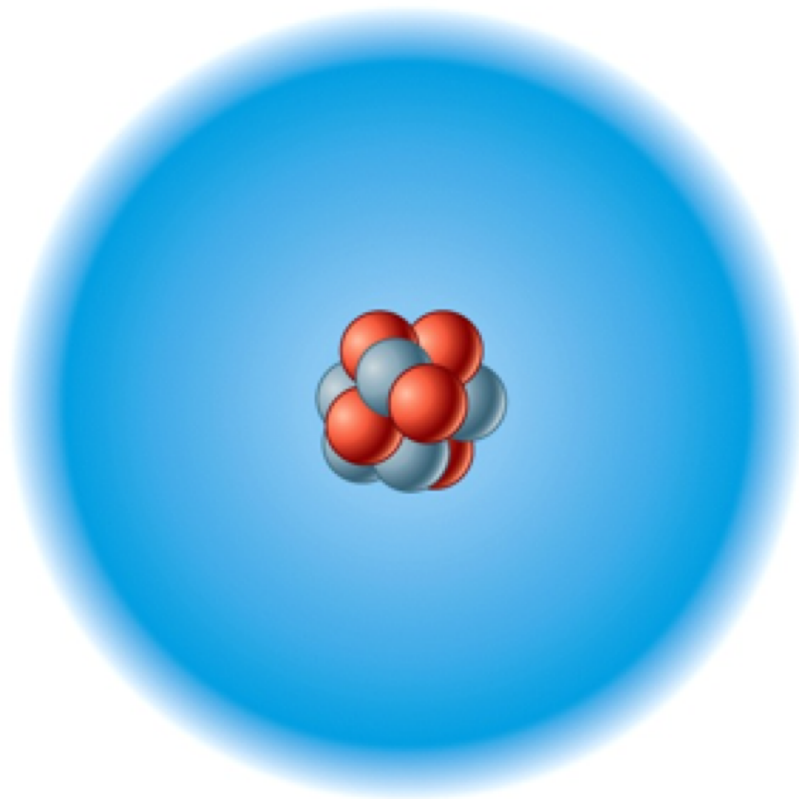


Protons and neutrons have a mass 2000 time higher than electrons.

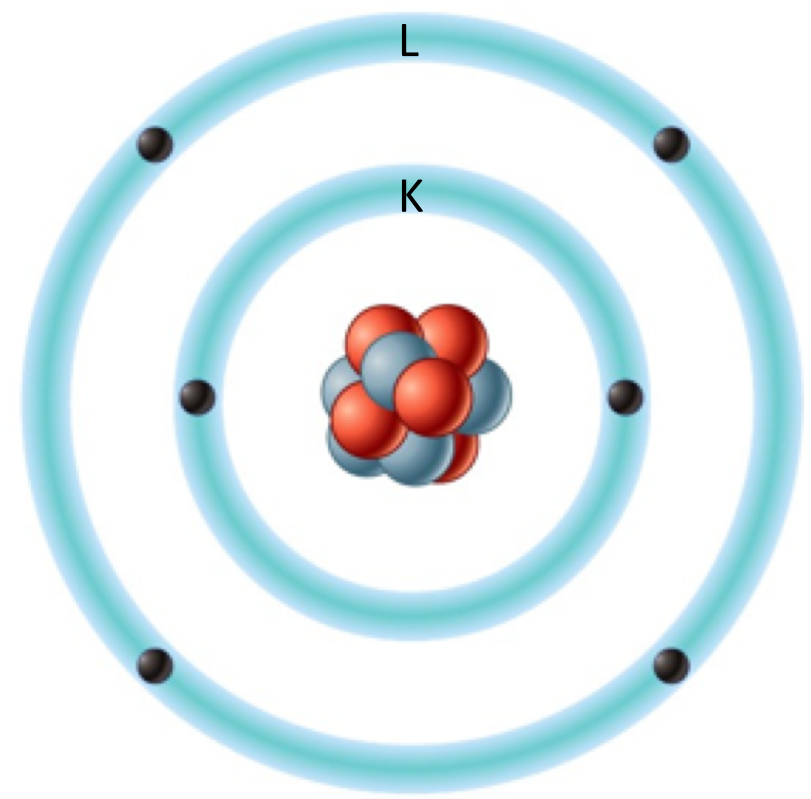
Atomic number : number of protons

- Protons (p^+)
 - Neutrons (n^0)
 - Electrons (e^-)
- Nucleus

K shell can contain 2 electrons
L shell can contain 8 electrons



(a) Electron cloud model



(b) Electron shell model

Shells are divided in subshells

Watch the tutorial for more explanations

	K	L	M	N
Shell number:	1	2	3	4
Subshell designation:	s	s , p	s , p , d	s , p , d , f

Subshell label	ℓ	Max electrons	Shells containing it	Historical name
s	0	2	Every shell	sharp
p	1	6	2nd shell and higher	principal
d	2	10	3rd shell and higher	diffuse
f	3	14	4th shell and higher	fundamental
g	4	18	5th shell and higher (theoretically)	(next in alphabet after f, excluding i) ^[5]

↑
comes from spectroscopy

Periodic Table of the Elements

Horizontal
rows are
periods

The atomic number defines the element

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Period 1

Period 2

Key

1

H

atomic number

chemical symbol

1 H																	2 He	
3 Li	4 Be																	10 Ne
11 Na	12 Mg																	18 Ar
19 K	20 Ca	21 Sc	22 Ti	23 V	24 Cr	25 Mn	26 Fe	27 Co	28 Ni	29 Cu	30 Zn	31 Ga	32 Ge	33 As	34 Se	35 Br	36 Kr	
37 Rb	38 Sr	39 Y	40 Zr	41 Nb	42 Mo	43 Tc	44 Ru	45 Rh	46 Pd	47 Ag	48 Cd	49 In	50 Sn	51 Sb	52 Te	53 I	54 Xe	
55 Cs	56 Ba	57 La	72 Hf	73 Ta	74 W	75 Re	76 Os	77 Ir	78 Pt	79 Au	80 Hg	81 Tl	82 Pb	83 Bi	84 Po	85 At	86 Rn	
87 Fr	88 Ra	89 Ac	104 Rf	105 Ob	106 Sg	107 Bh	108 Hs	109 Mt	110 Ds	111 Uuu	112 Uub	113 Uut	114 Uuq	115 Uup	116 Uuh			
(Lanthanide series)			58 Ce	59 Pr	60 Nd	61 Pm	62 Sm	63 Eu	64 Gd	65 Tb	66 Dy	67 Ho	68 Er	69 Tm	70 Yb	71 Lu		
(Actinide series)			90 Th	91 Pa	92 U	93 Np	94 Pu	95 Am	96 Cm	97 Bk	98 Cf	99 Es	100 Fm	101 Md	102 No	103 Lr		

a.

Green color : elements present in living organisms

Periodic Table of the Elements

Periodic table of the Elements

Atomic number
(number of protons)

Element symbol

Mass number
(number of protons plus neutrons)

Period 1	H																	He		
Period 2	Li	Be													B	C	N	O	F	Ne
	Na	Mg													Al	Si	P	S	Cl	Ar
	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe		
	Cs	Ba	La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn		
	Fr	Ra	Ac	Rf	Db	Sg	Bh	Hs	Mt	Uun	Uuu	Uub		Uuq		Uuh		Uuo		
			Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu				
			Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr				

From Essential Biology chapter 2

Hierarchical organization

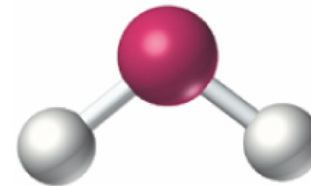
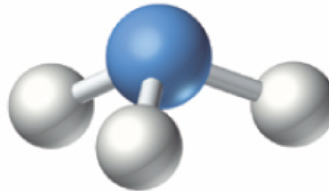
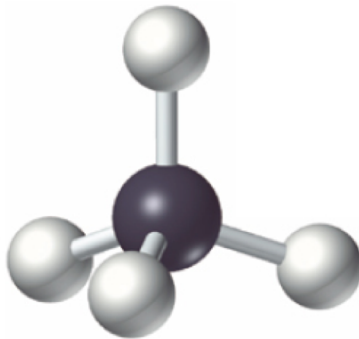
2. Molecular level

Covalent bonds

Space-
filling



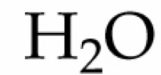
Ball-and-
stick



methane



ammoniac



water



Hydrohloric acid

Periodic table : horizontal rows are periods.

Carbon 4 vacancies	Nitrogen 3 vacancies	Oxygen 2 vacancies	Fluorine 1 vacancy	Neon 0 vacancy
-----------------------	-------------------------	-----------------------	-----------------------	-------------------

Number of electrons
in the L shell :

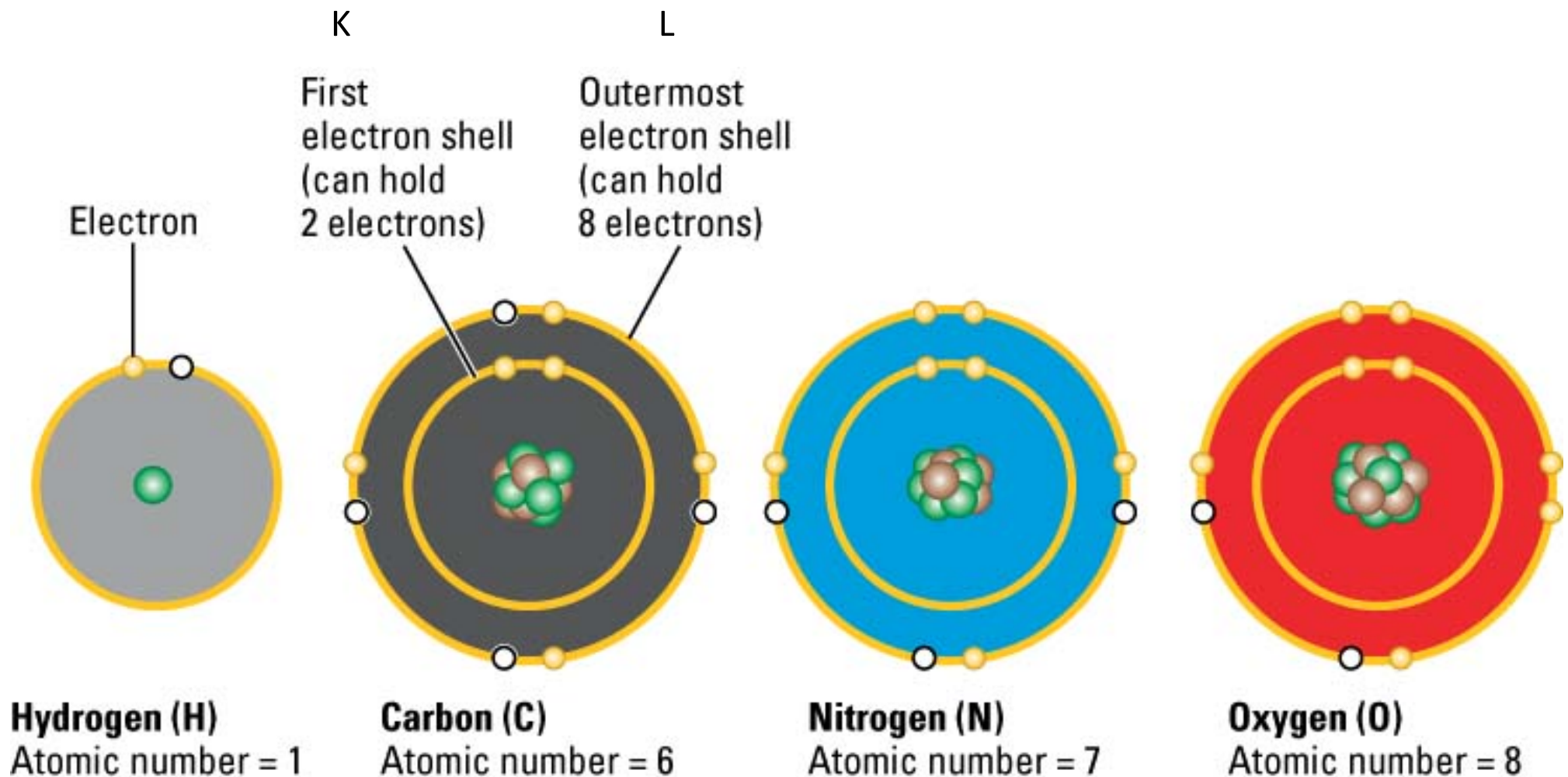
Period 2	Li	Be	B	C	N	O	F	Ne
	1	2	3	4	5	6	7	8
Period 3	Na	Mg	Al	Si	P	S	Cl	Ar
Period 4	K	Ca	Ga	Ge	As	Se	Br	Kr

L shell is full: 8 electrons

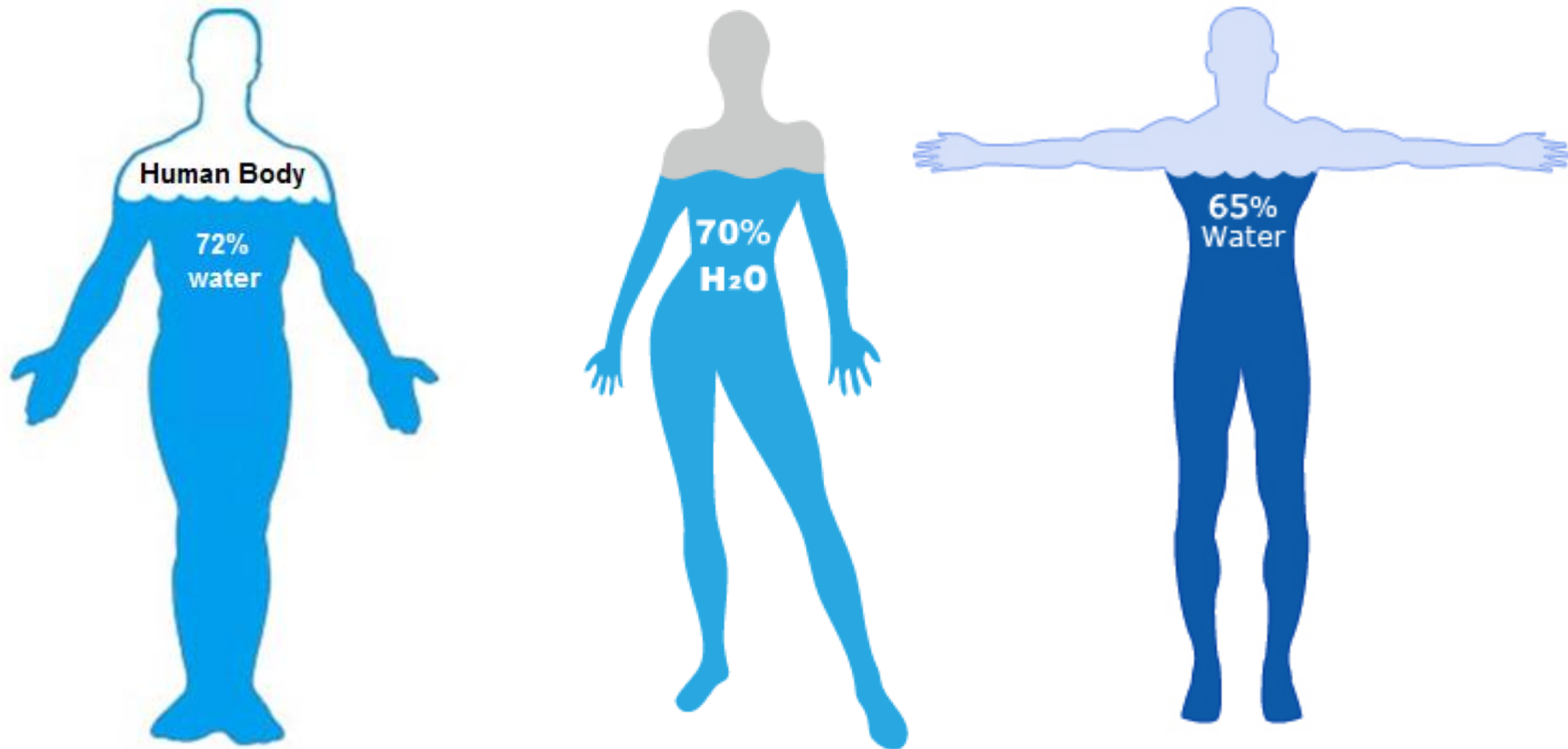
Vacancies :

4 3 2 1 0

Electron Arrangement and the Chemical Properties of Atoms

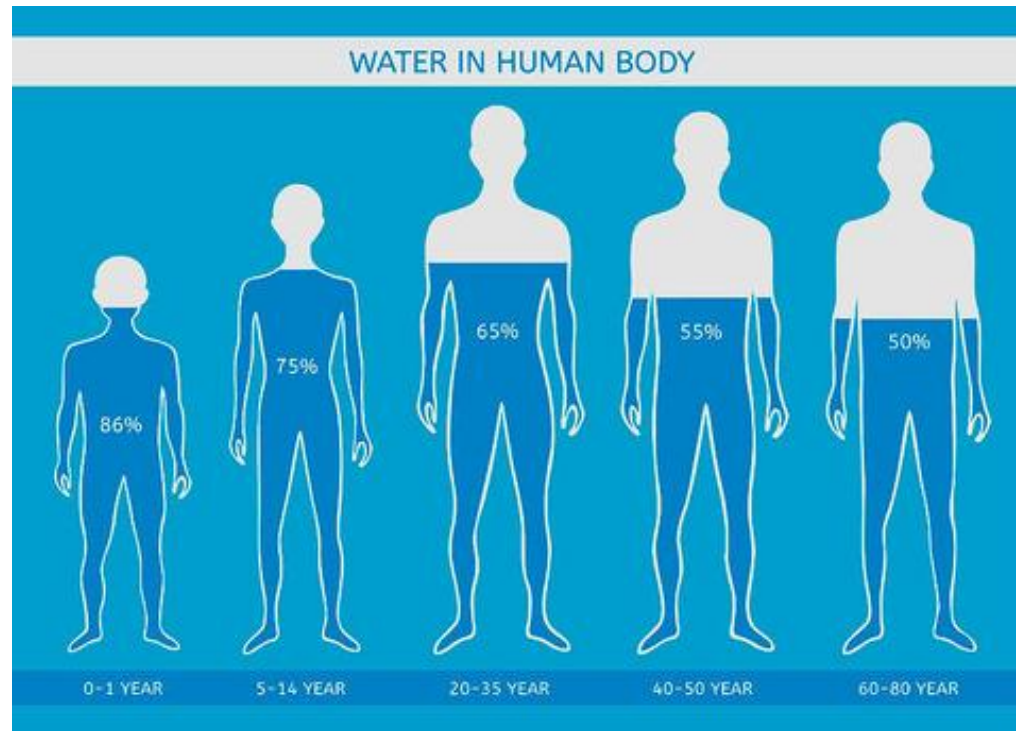


How much water in the human body ?



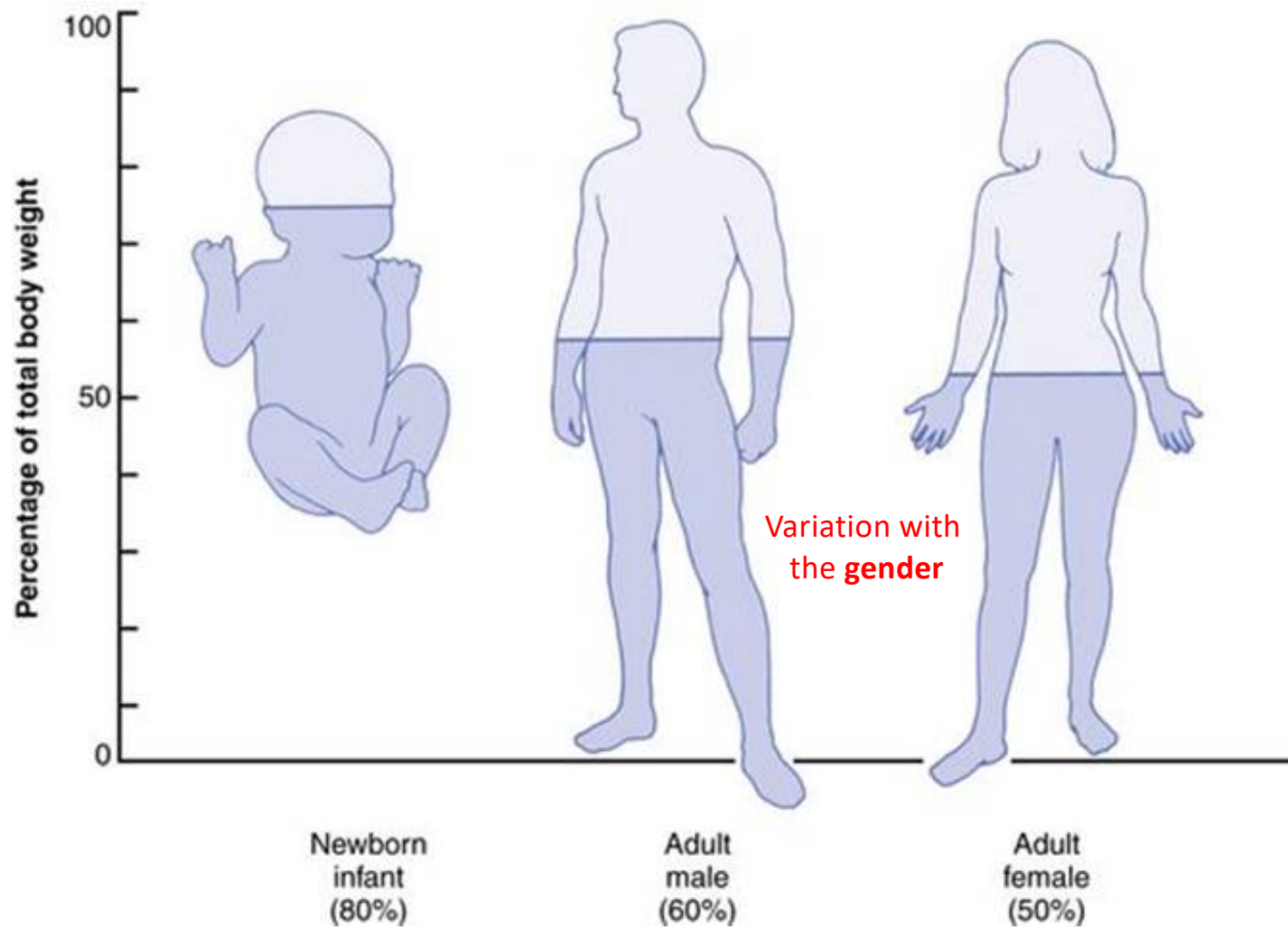
Discrepancies should not bother you !

The water content of the human body varies with age.

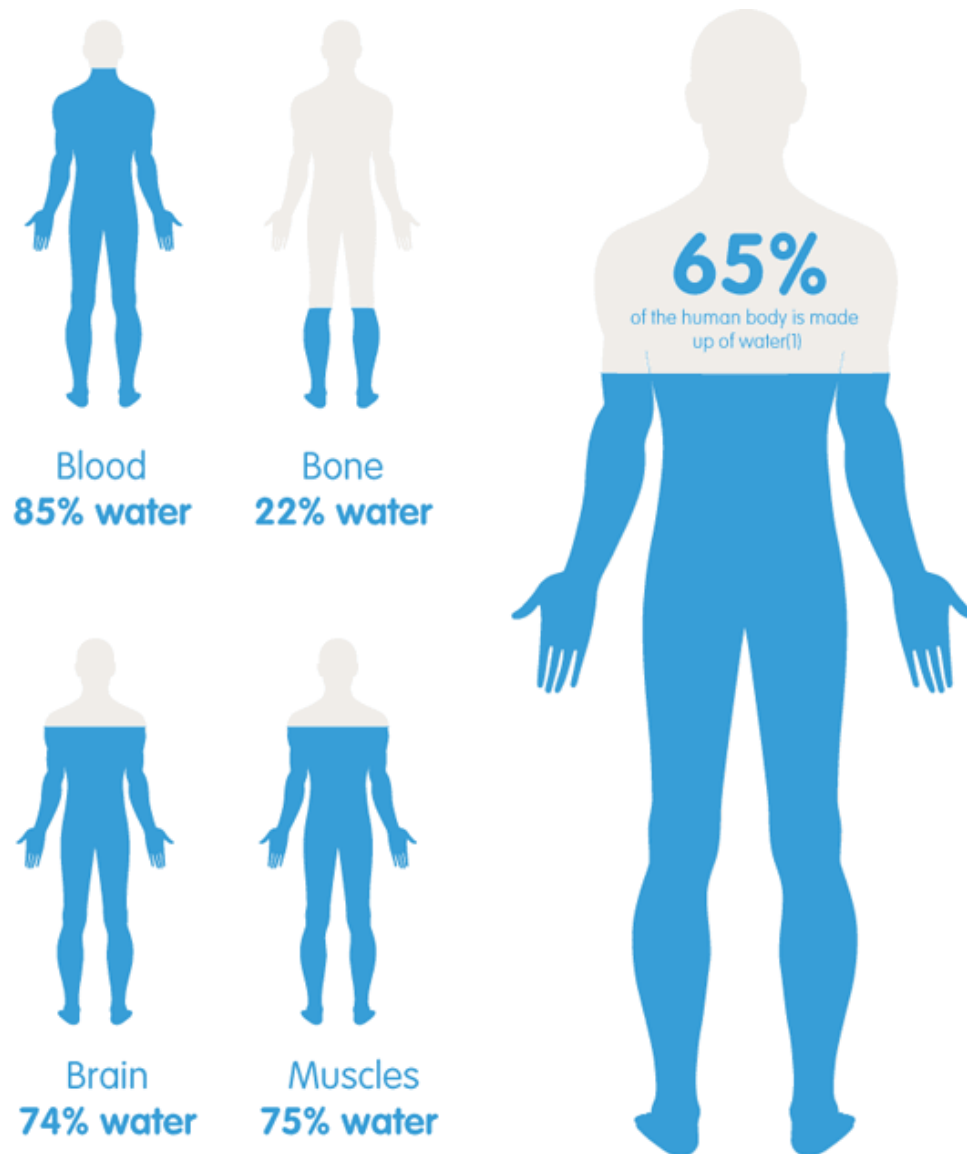


<https://www.socratica.com/lesson/hydrogen-bonding-in-water>

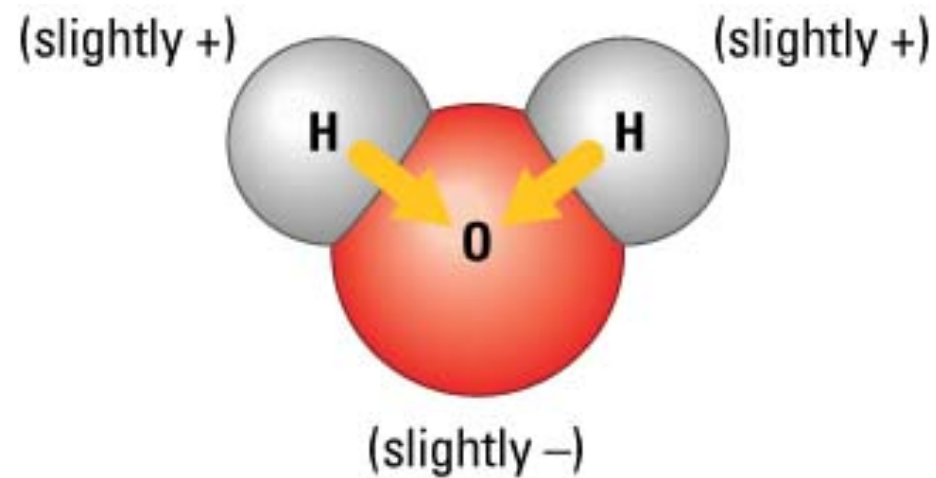
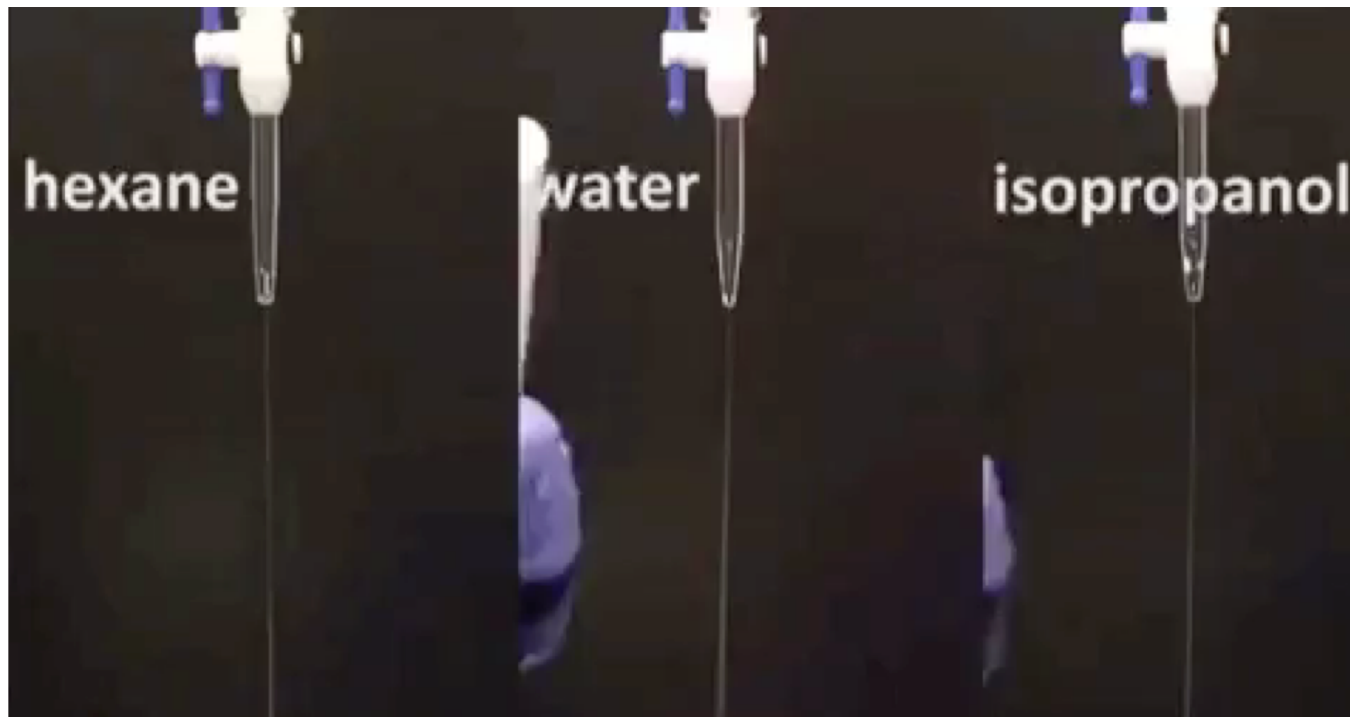
How much water in the human body ?



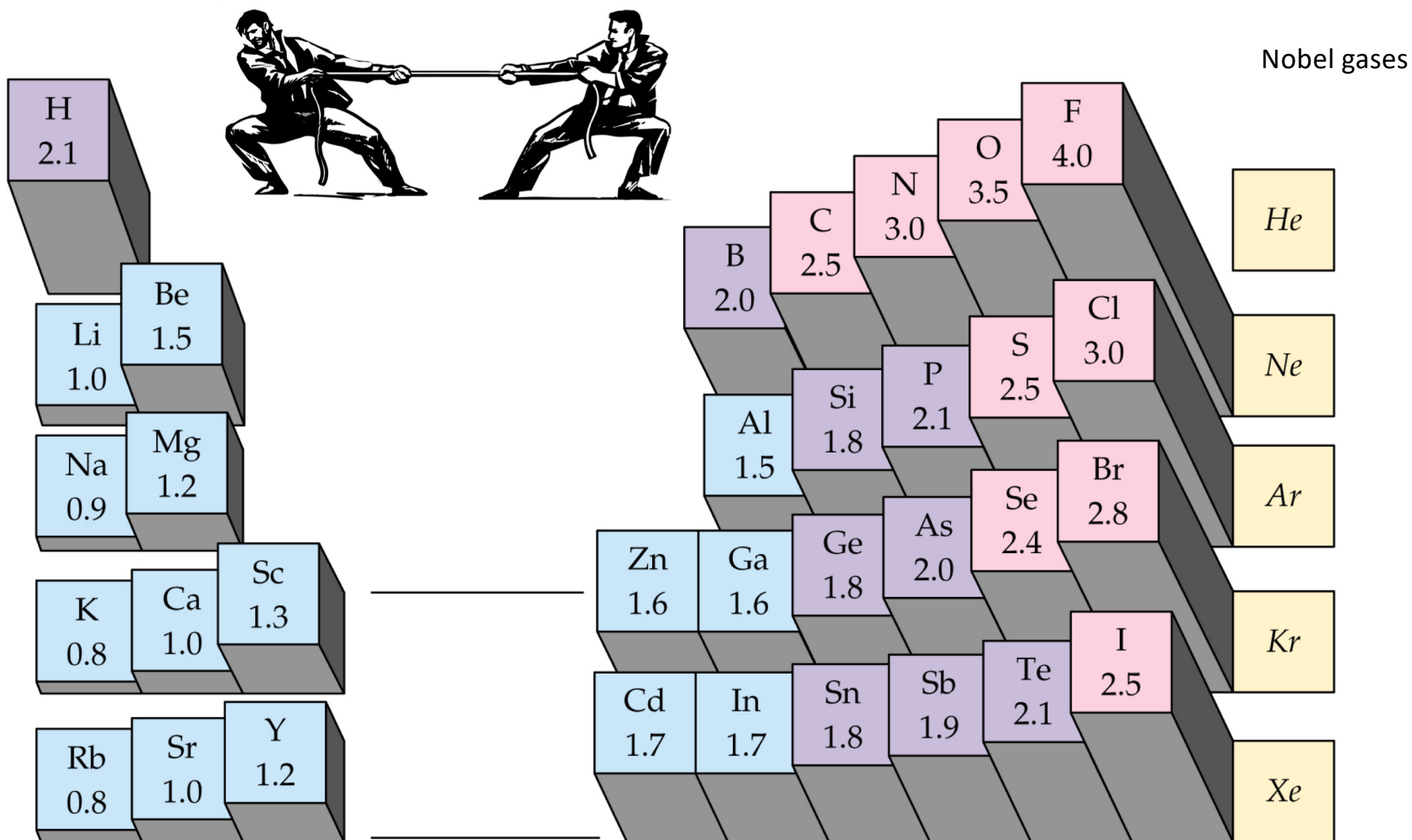
Variation in organs



Water is a polar molecule



Electronegativity

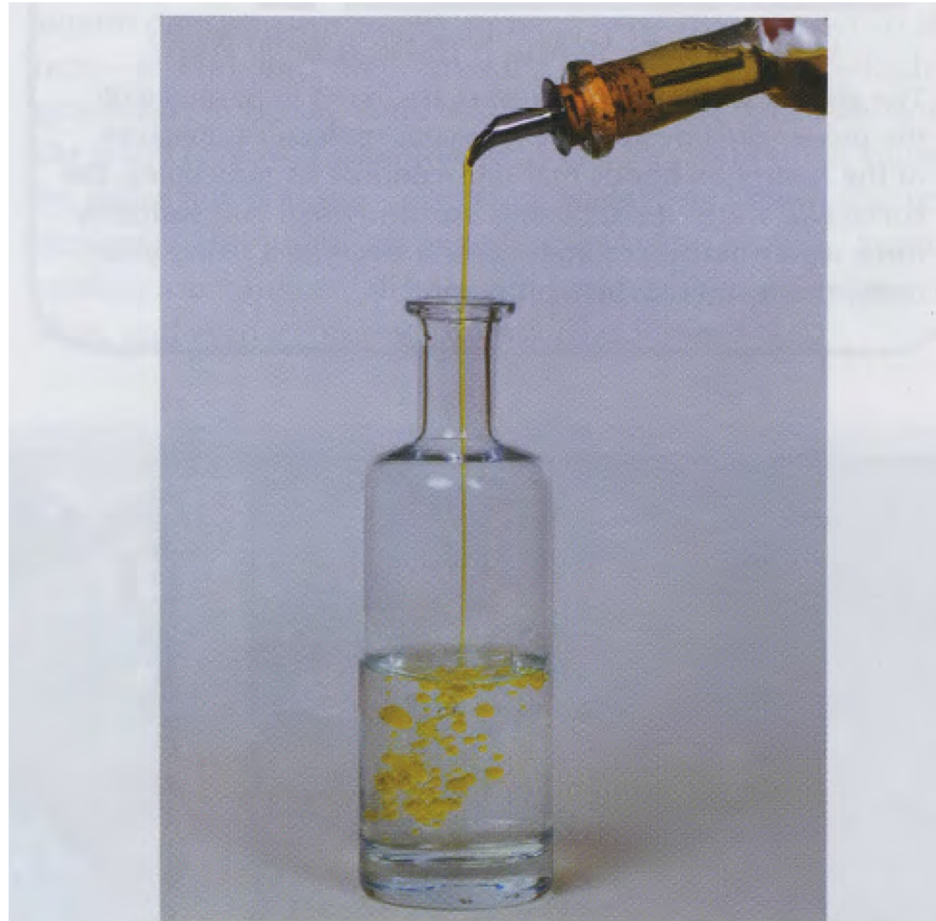


Electronegativity difference : $3.5 - 2.1 = 1.4$

Polarity and solubility

Water :

- polar
- hydrophilic



▲ **FIGURE 2-10 Oil and water don't mix** Yellow oil has just been poured into this bottle of water and is rising to the surface. Oil floats because it is less dense than water, and it forms droplets in water because it is a hydrophobic, nonpolar molecule that is not attracted to water's polar molecules.

Oil :

lipid

nonpolar

hydrophobic