CHAPTER 1

Introduction: Biology Today

PowerPoint® Lectures for
Essential Biology, Third Edition
– Neil Campbell, Jane Reece, and Eric Simon
Essential Biology with Physiology, Second Edition
– Neil Campbell, Jane Reece, and Eric Simon

Lectures by Chris C. Romero

Lecture Notes 1

Bio 10 Dr. Schmidt

Introduction: Biology Today

The Nature of Science

A fundamental principle of science that sets it apart from other systems of proof (such as art, religion, philosophy, etc.) is that it limits itself, and its explanations, to the natural world of the physical universe.

1. What is Science?
2. What is Biology?
3. What is Life?
4. Scientific Methodology

Observations are the raw materials of science.
Hypothesis & Theories.
How is science done today?
Science and the public.
Anecdotal evidence.

WHAT IS LIFE?

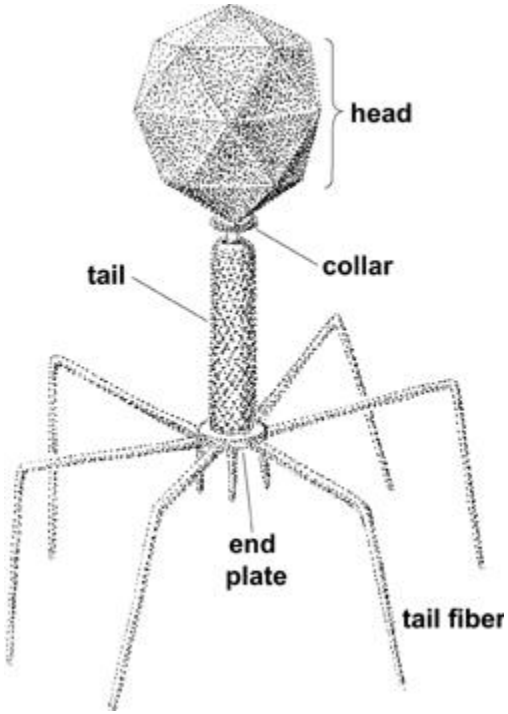
The Physical Aspect of the Living Cell

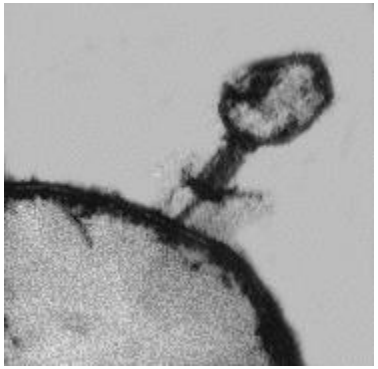
BY

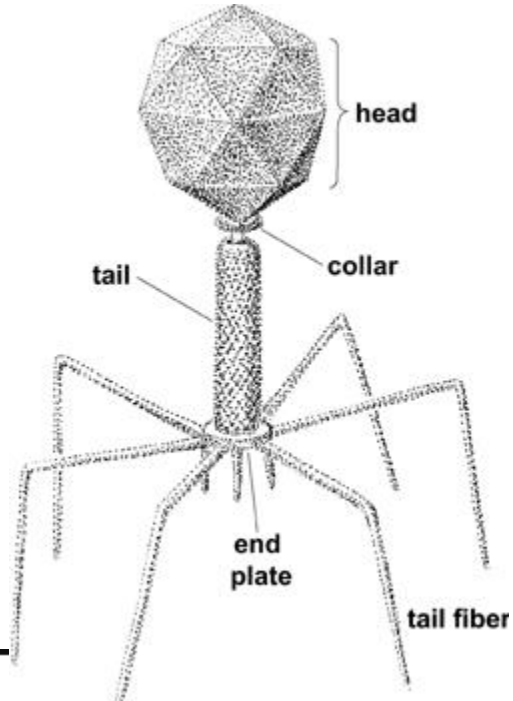
ERWIN SCHRÖDINGER

SENIOR PROFESSOR AT THE DUBLIN INSTITUTE FOR ADVANCED STUDIES

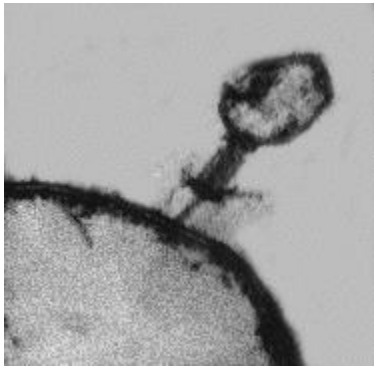
Virus

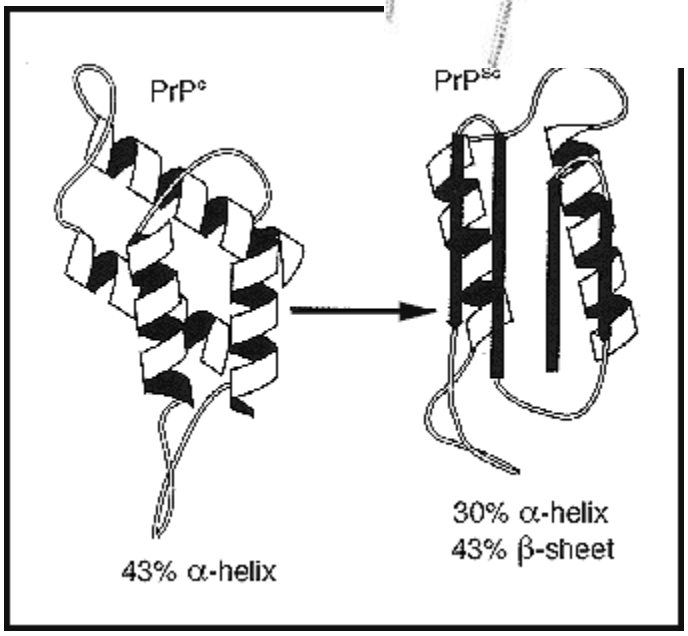




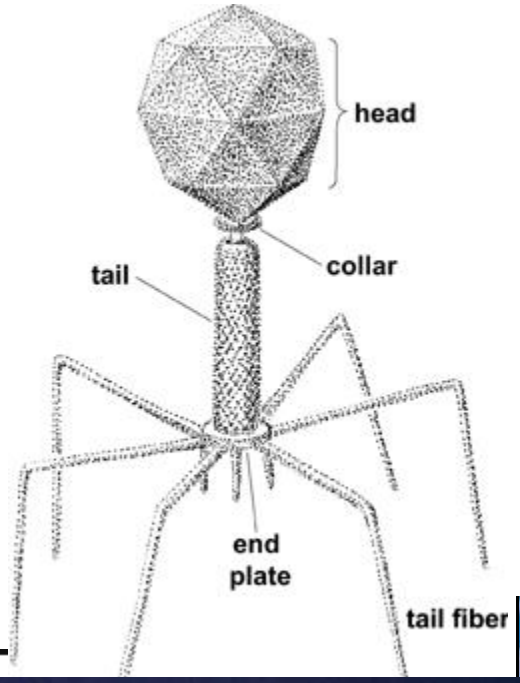

head
collar
tail
end
plate
tail fiber

Virus

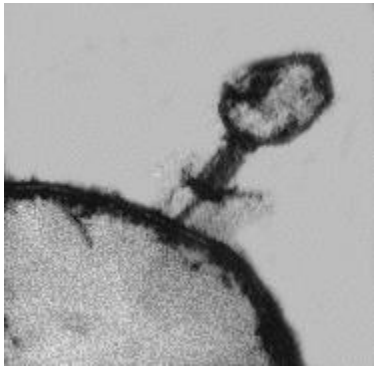


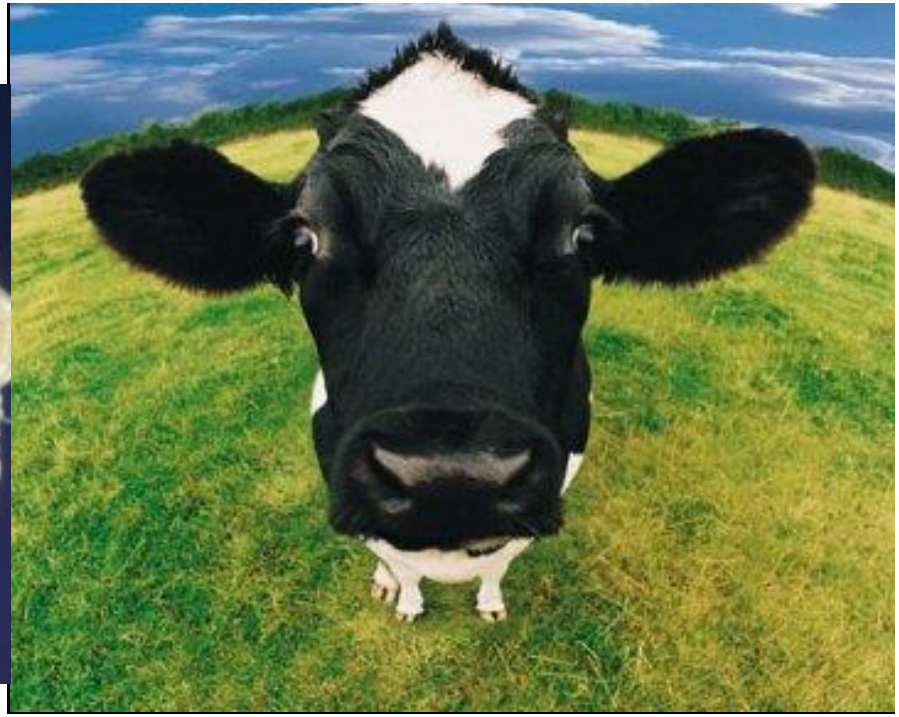

PrP^c
PrP^Sc
43% α-helix
30% α-helix
43% β-sheet

Prion



Virus





Mad Cow Disease

Lecture Notes 1

Bio 10 Dr. Schmidt

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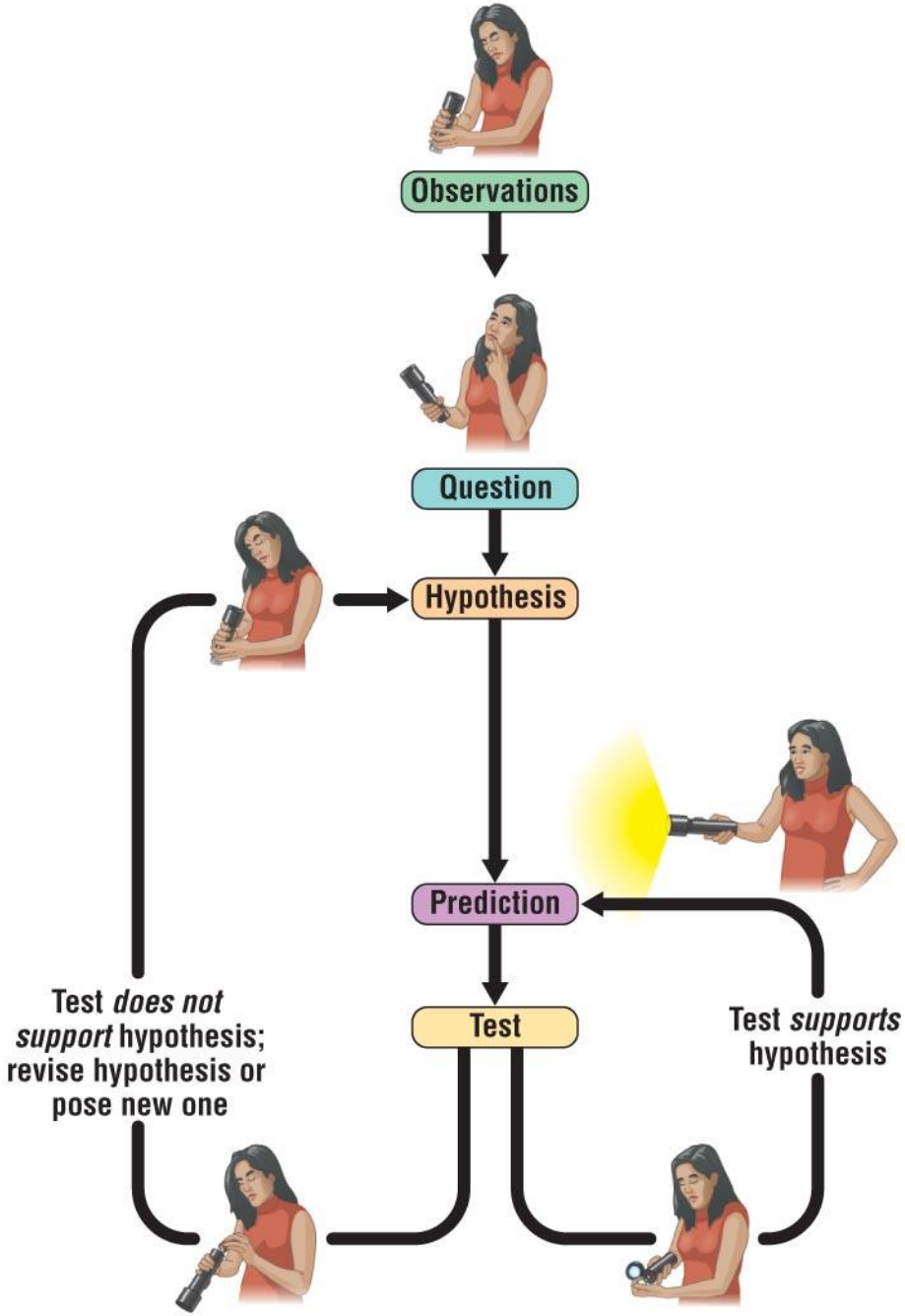
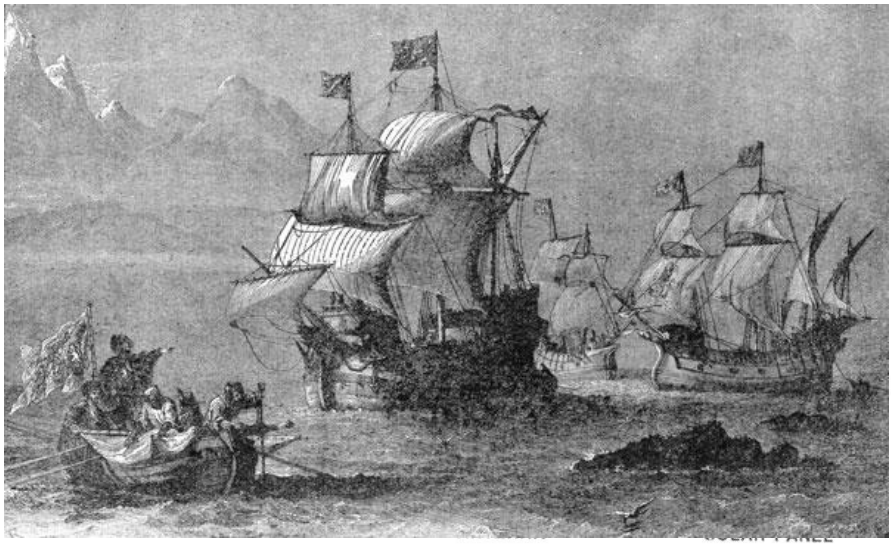
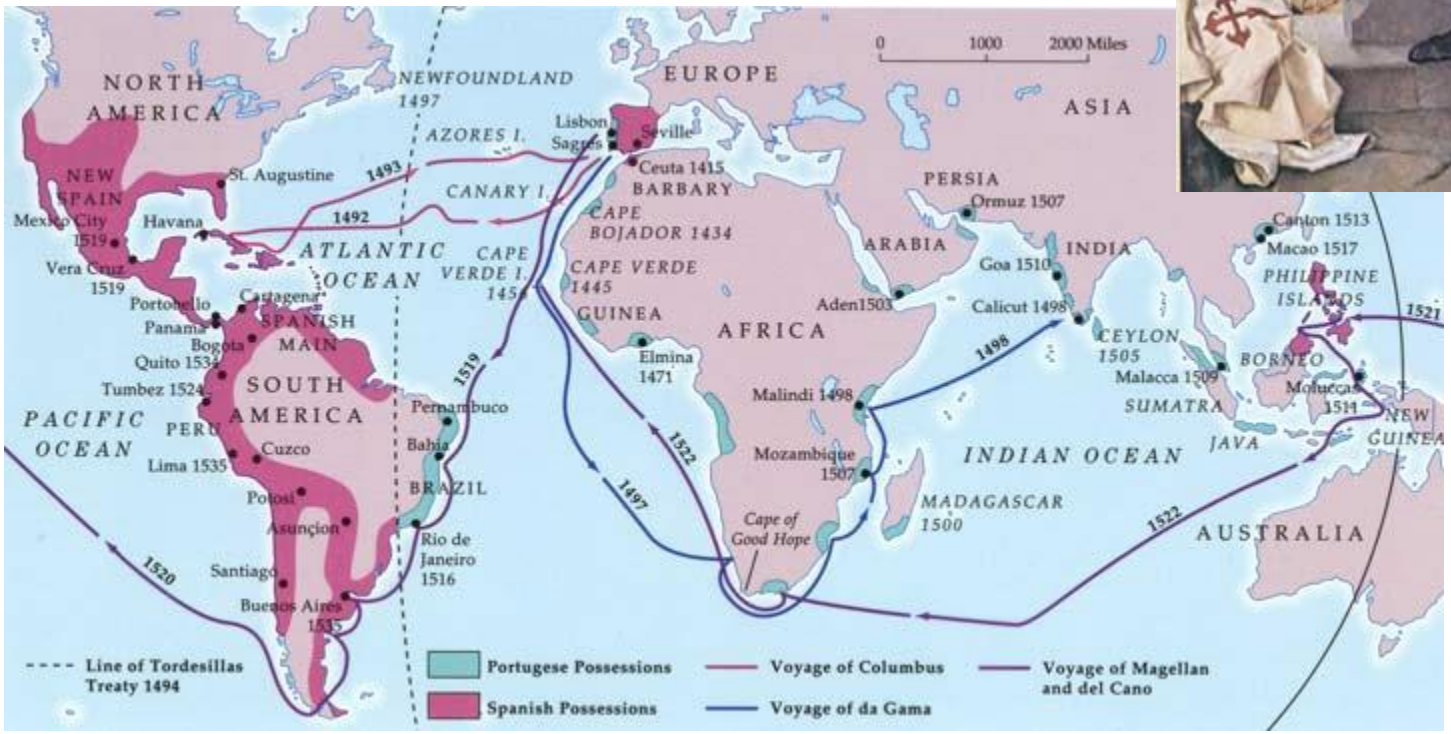




Magellan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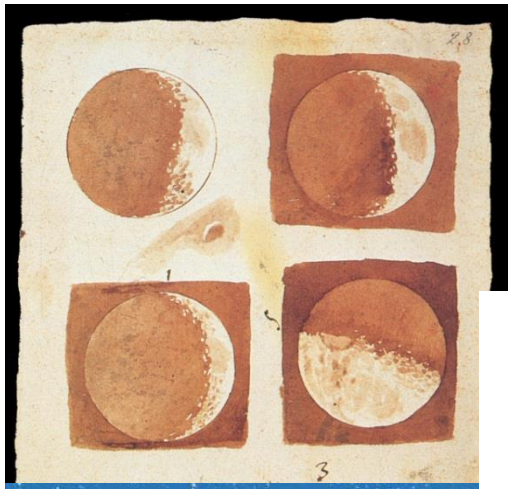
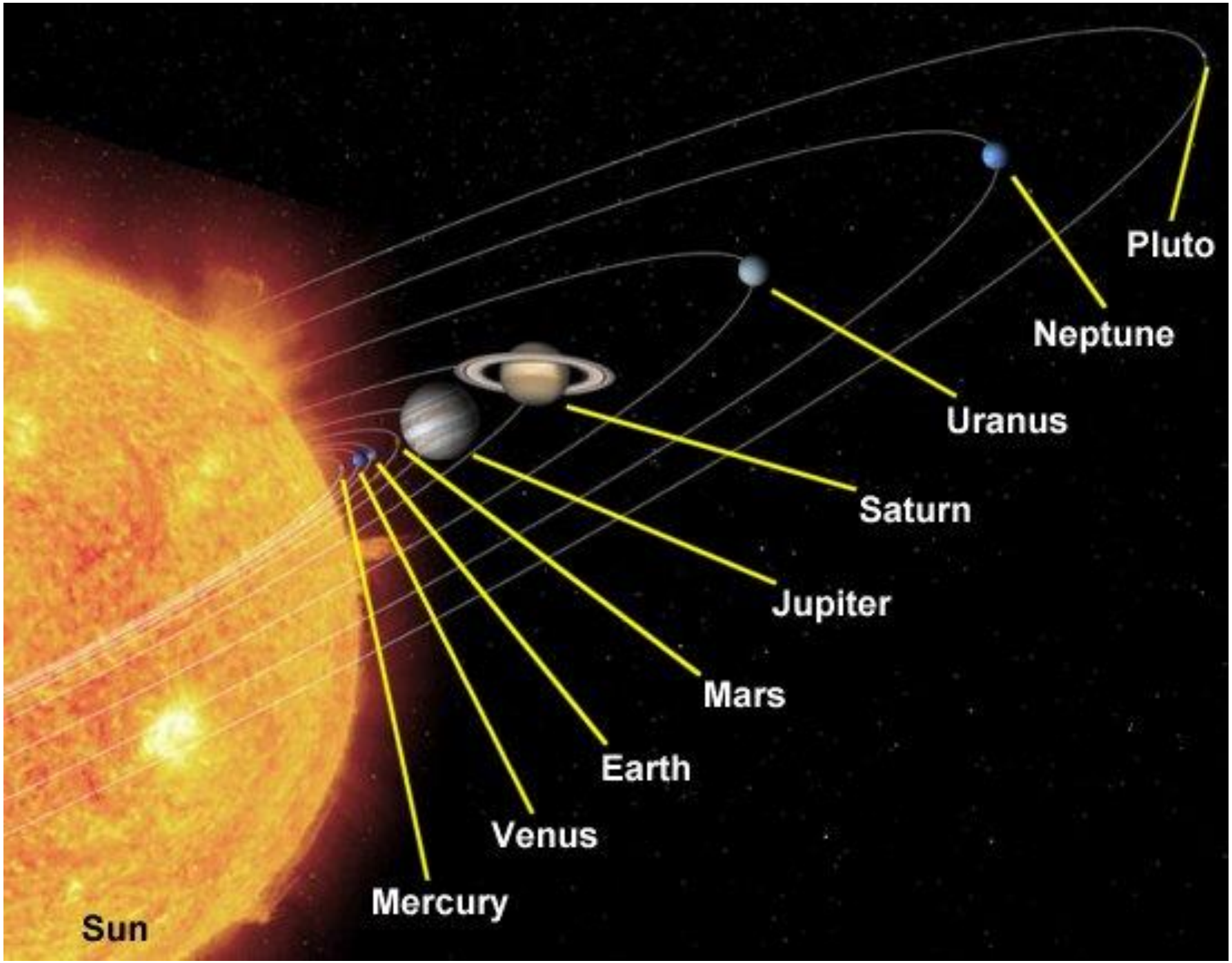
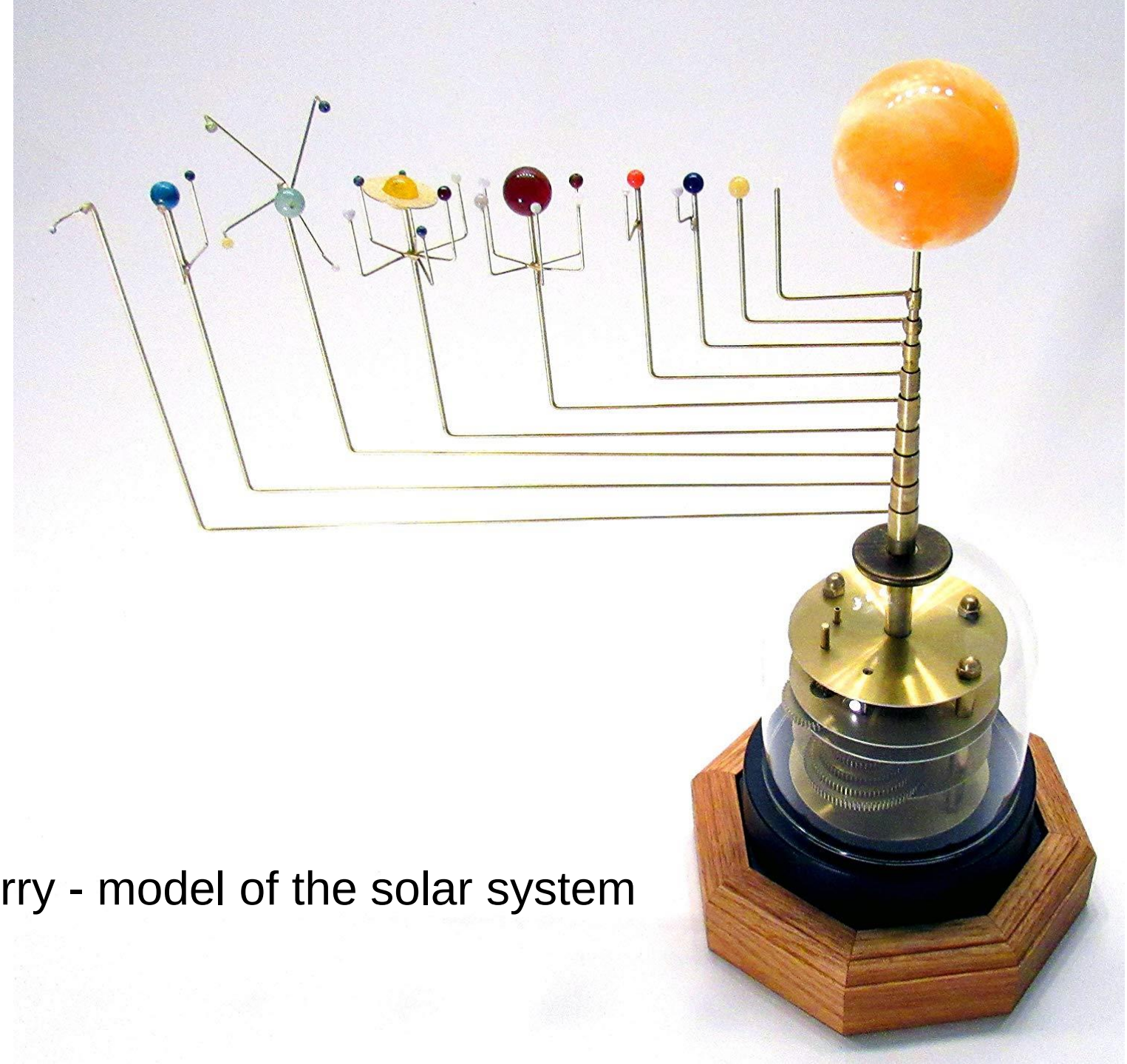
NEWFOUNDLAND 1497
EUROPE
ASIA
0 1000 2000 Miles
AZORES I.
Lisbon
Seville
Sagres
Ceuta 1415
BARBARY
CANARY I.
1493
1492
NEW SPAIN
St. Augustine
Mexico City 1519
Havana
Vera Cruz 1519
ATLANTIC OCEAN
CAPE BOJADOR 1434
CAPE VERDE I. 1456
CAPE VERDE 1445
GUINEA
AFRICA
PERSIA
Ormuz 1507
ARABIA
INDIA
Goa 1510
Aden1503
Calicut 1498
Canton 1513
Macao 1517
PHILIPPINE ISLANDS
1521
CEYLON 1505
Malacca 1509
BORNEO
Moluccas 1511
SUMATRA
JAVA
NEW GUINEA
Portobello
Cartagena
Panama
Bogota
Quito 1534
Tumbez 1524
SPANISH MAIN
SOUTH AMERICA
PERU
PACIFIC OCEAN
Cuzco
Lima 1535
Potosi
Asunçion
Santiago
Buenos Aires 1535
Pernambuco
Bahia
BRAZIL
Rio de Janeiro 1516
1519
1520
1522
1497
1498
Elmina 1471
Malindi 1498
Mozambique 1507
Cape of Good Hope
MADAGASCAR 1500
INDIAN OCEAN
AUSTRALIA
Line of Tordesillas Treaty 1494
Portugese Possessions
Spanish Possessions
Voyage of Columbus
Voyage of da Gama
Voyage of Magellan and del Cano

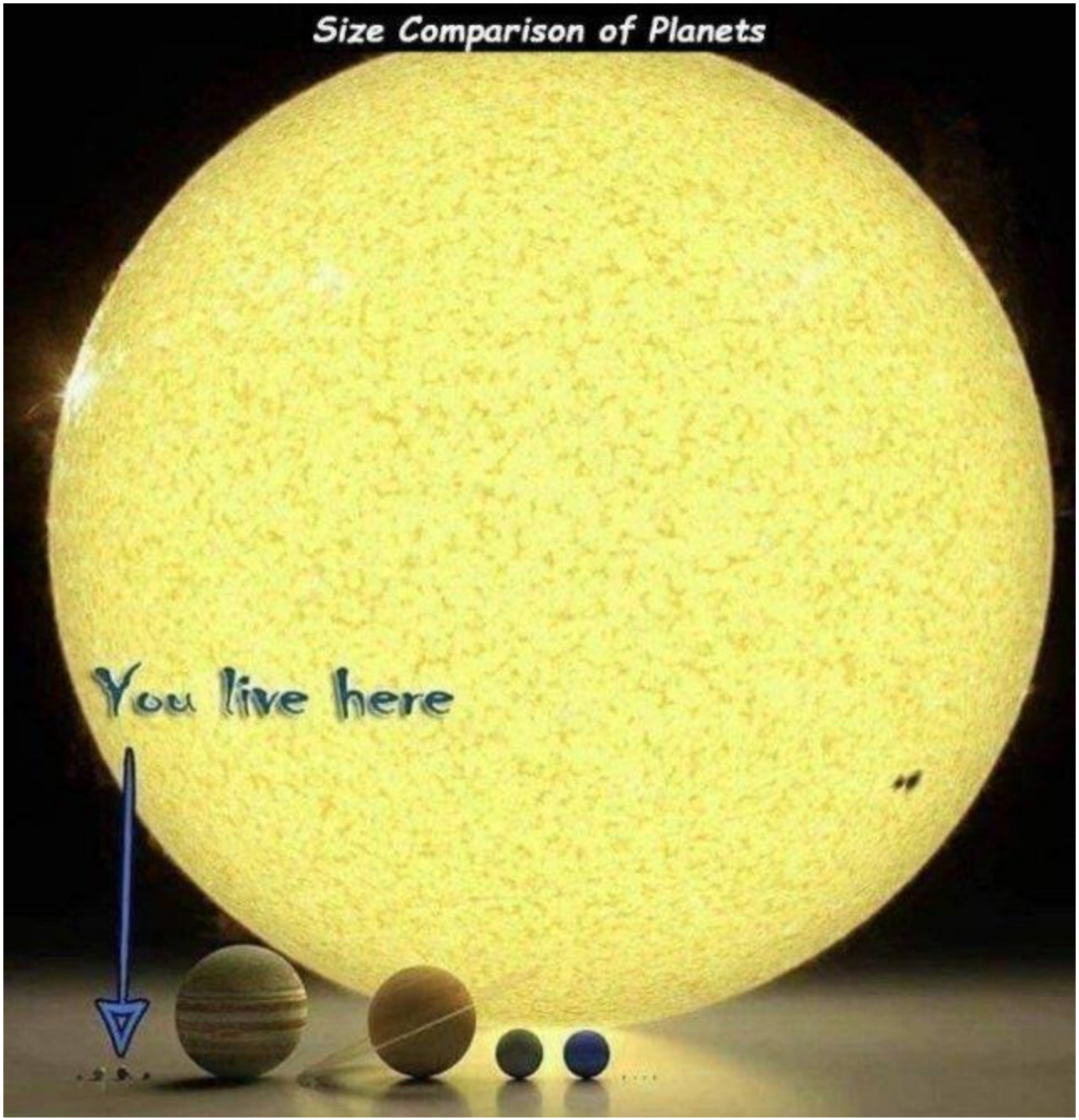
Galileo



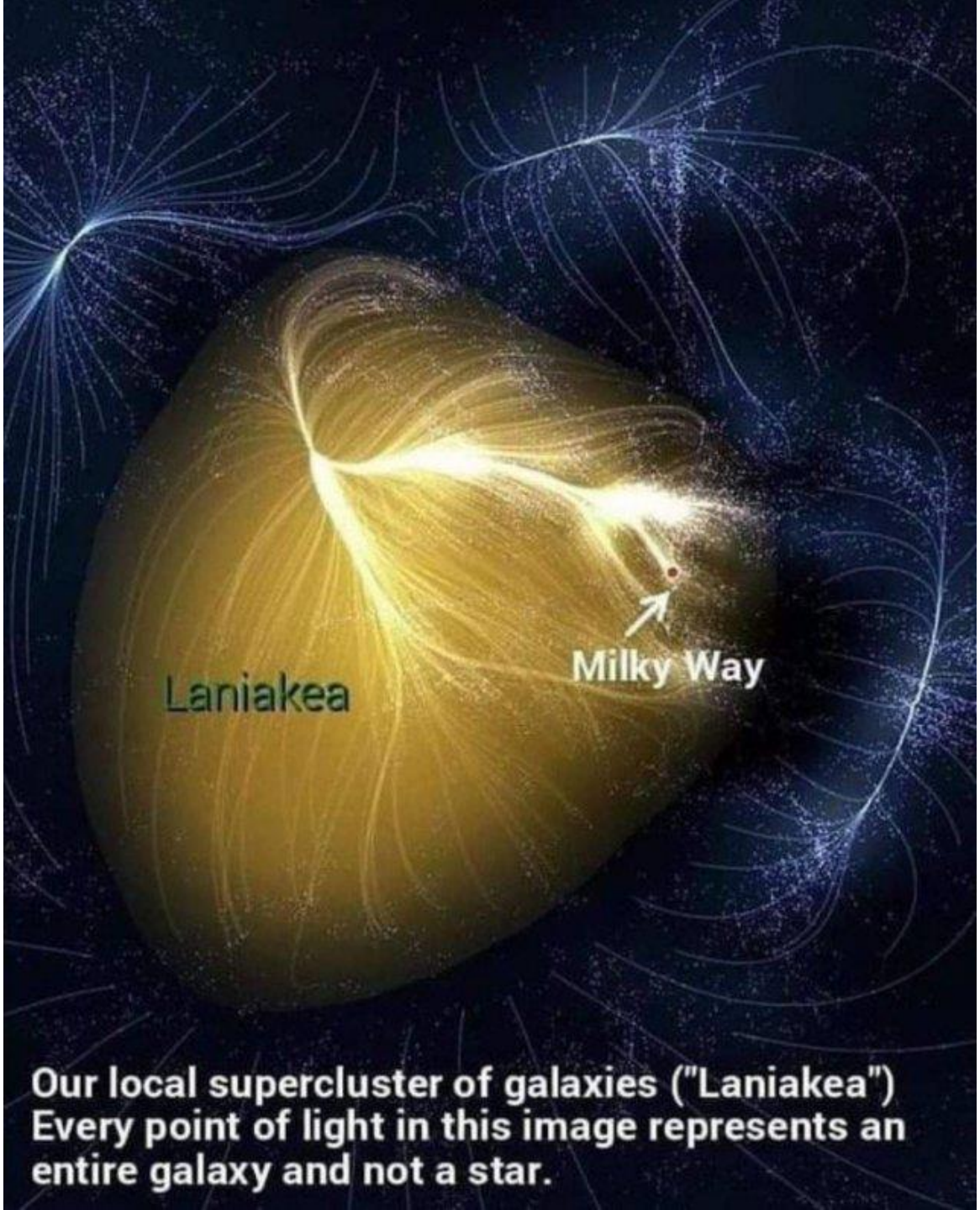

Pluto
Neptune
Uranus
Saturn
Jupiter
Mars
Earth
Venus
Mercury
Sun



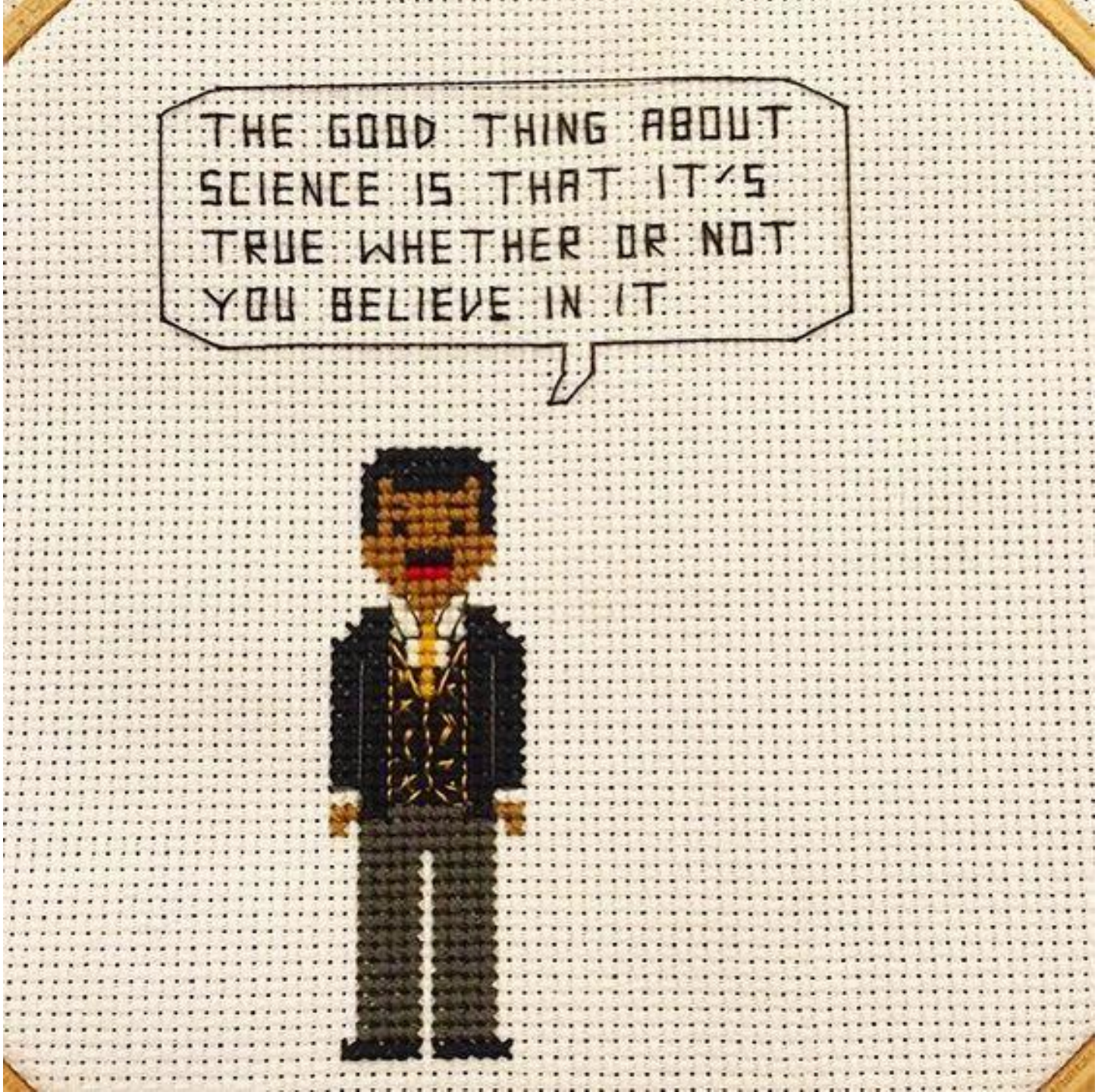
Orerry - model of the solar system


Size Comparison of Planets
You live here

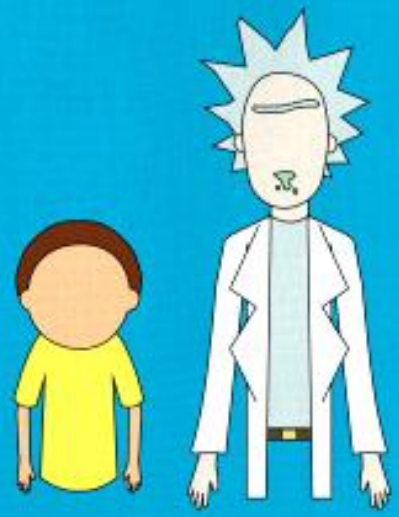

All the stars you see
at night are just part
of this yellow circle.



Our local supercluster of galaxies ("Laniakea")
Every point of light in this image represents an entire galaxy and not a star.


THE GOOD THING ABOUT
SCIENCE IS THAT IT'S
TRUE WHETHER OR NOT
YOU BELIEVE IN IT

NOBODY EXISTS ON PURPOSE.
NOBODY BELONGS ANYWHERE.
EVERYBODY'S GONNA DIE



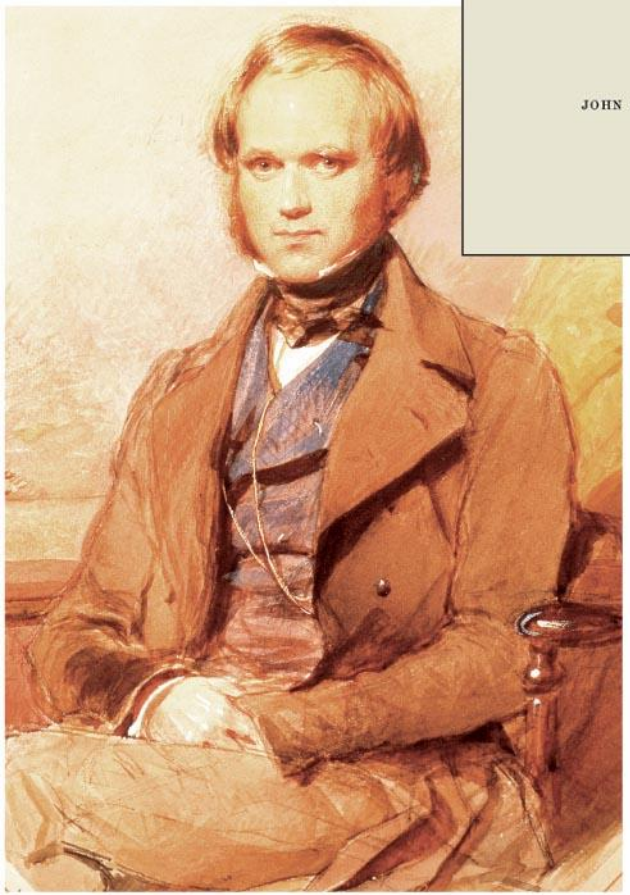
COME WATCH TV?

The Theory of Evolution

1. Charles Darwin
   - Darwin was the first to propose a valid mechanism for evolution.
   - Charles Lyell, geologist, greatly influenced Darwin: “The Earth is Ancient”.
   - HMS *Beagle*, 1832, five year trip, around the world, collecting, observing.
   - Darwin was greatly impressed by the constantly changing variety of organisms.
   - Thomas Malthus, essay described how food supply holds populations in check.

2. Published *On the Origin of Species* in 1859.
   - Darwin’s writings developed the idea of natural selection to account for different rates of survival and reproduction in the evolution of species.
   - Alfred Russell Wallace proposed a similar theory to account for evolution.
   - (Darwin-Wallace theory)

3. Natural vs. Artificial Selection
   - Inherited traits
   - Selection pressure
   - Survival of the "fittest"



ON

THE ORIGIN OF SPECIES

BY MEANS OF NATURAL SELECTION,

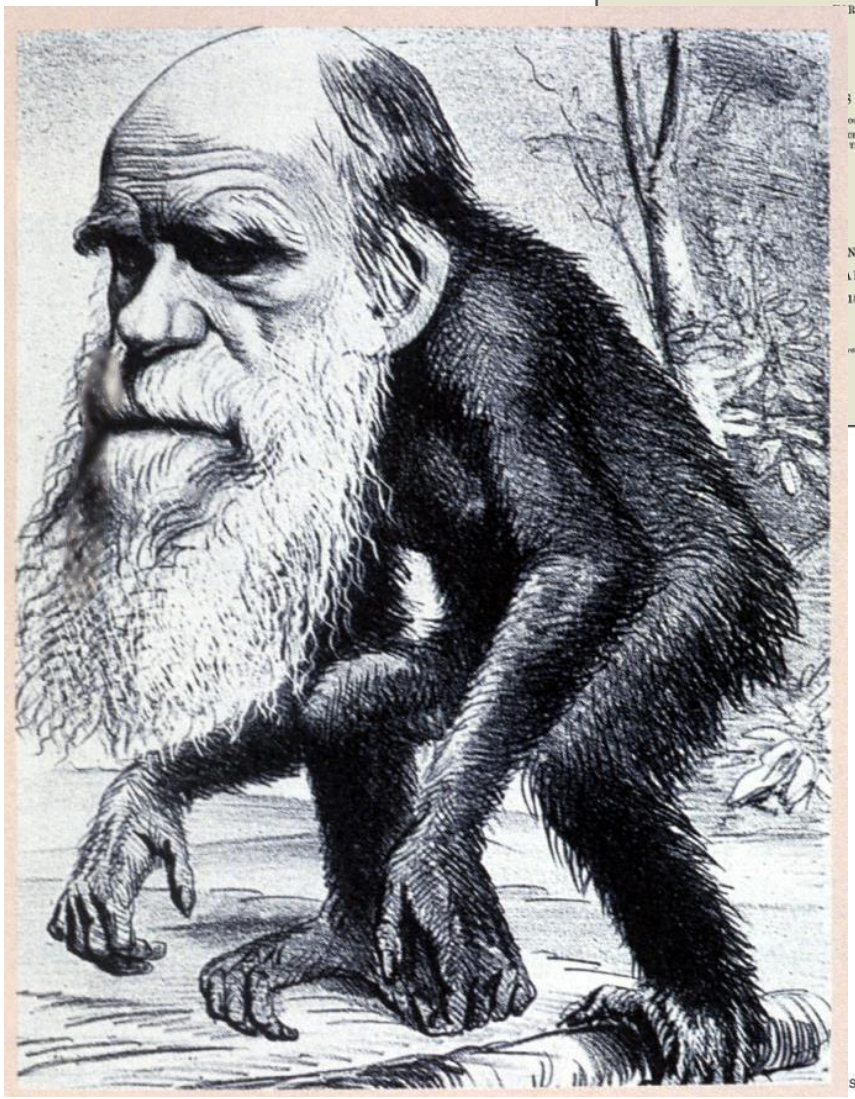
OR THE

PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE.

By CHARLES DARWIN, M.A.,

FELLOW OF THE ROYAL, GEOLOGICAL, LINNEAN, ETC., SOCIETIES;
AUTHOR OF 'JOURNAL OF RESEARCHES DURING H. M. S. BEAGLE'S VOYAGE ROUND THE WORLD.'

LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1859.



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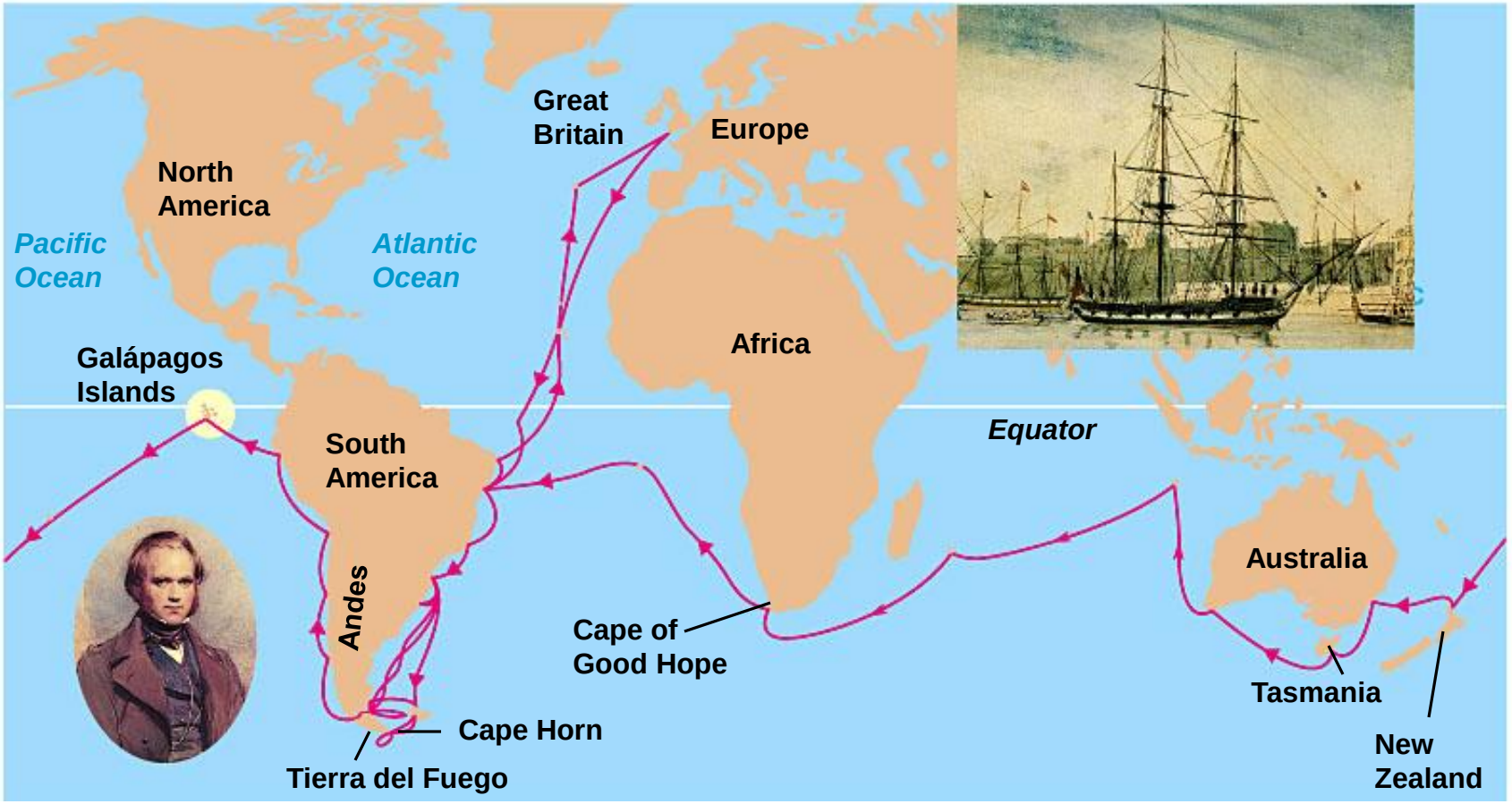
The Voyage of the *Beagle*



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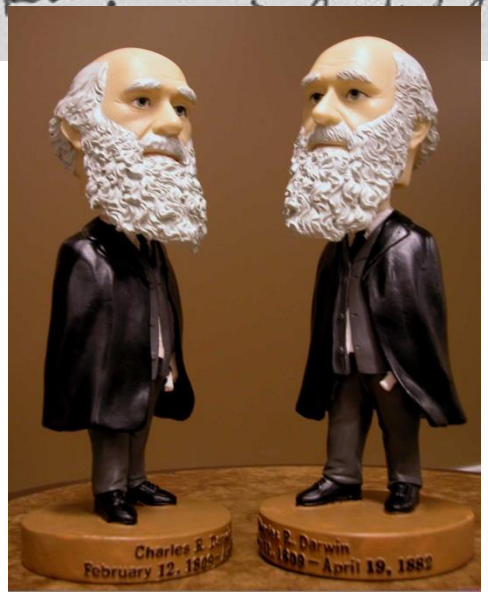
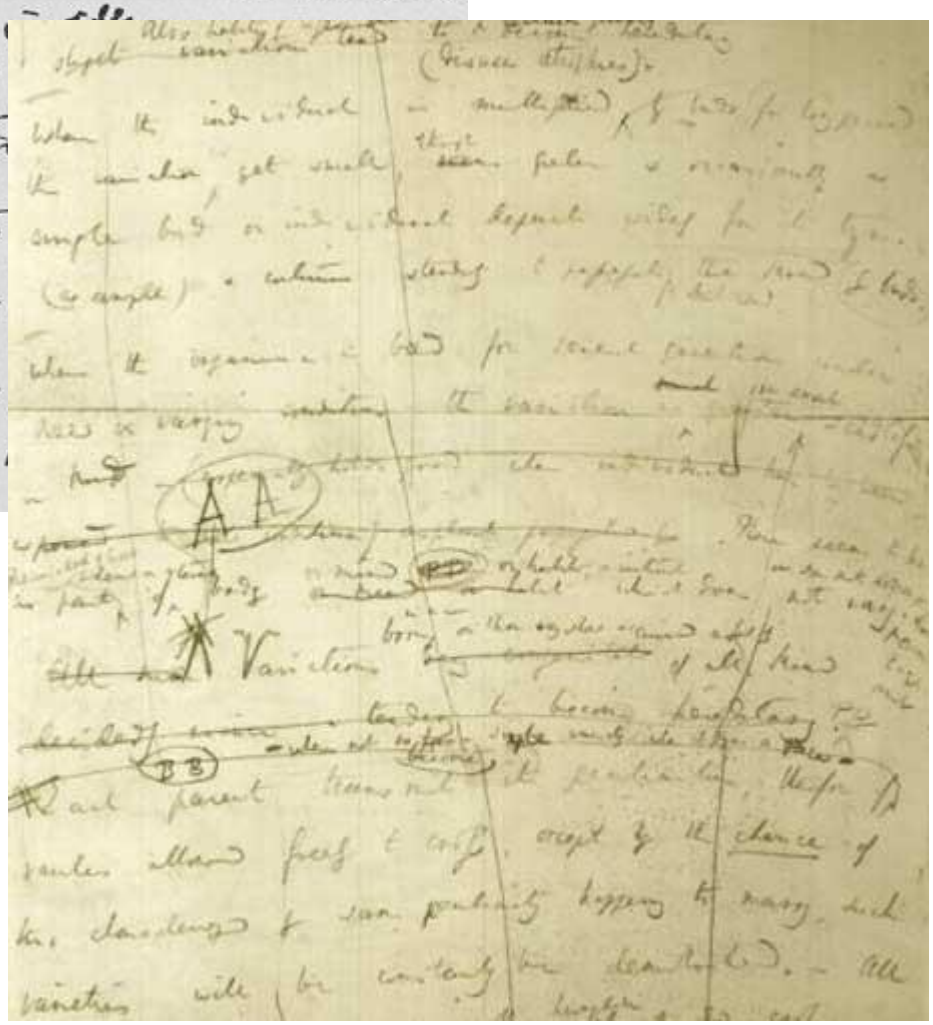
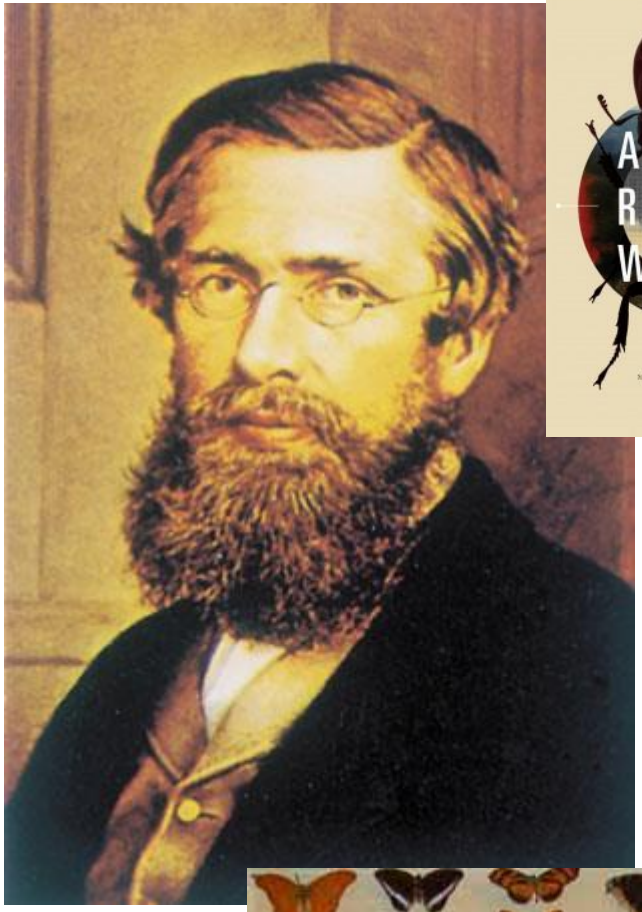
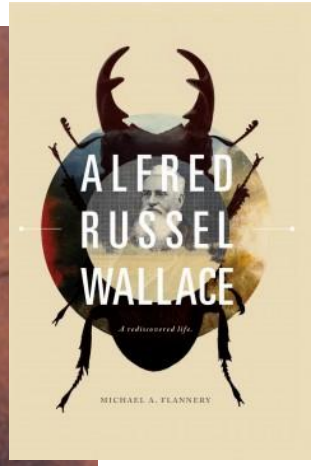
– lead to comprehend two affinities. By theory
would give rise to Comparative Anatomy; it
would lead to study of instincts. Hereditary & mixed hereditary,
whole metaphysics. → It would lead to distinct examination
of hybridisation, causes of change
how come from or to what we ten
to what circumstances favour crossing & what
this & direct purposes of
might lead to laws of change
species.

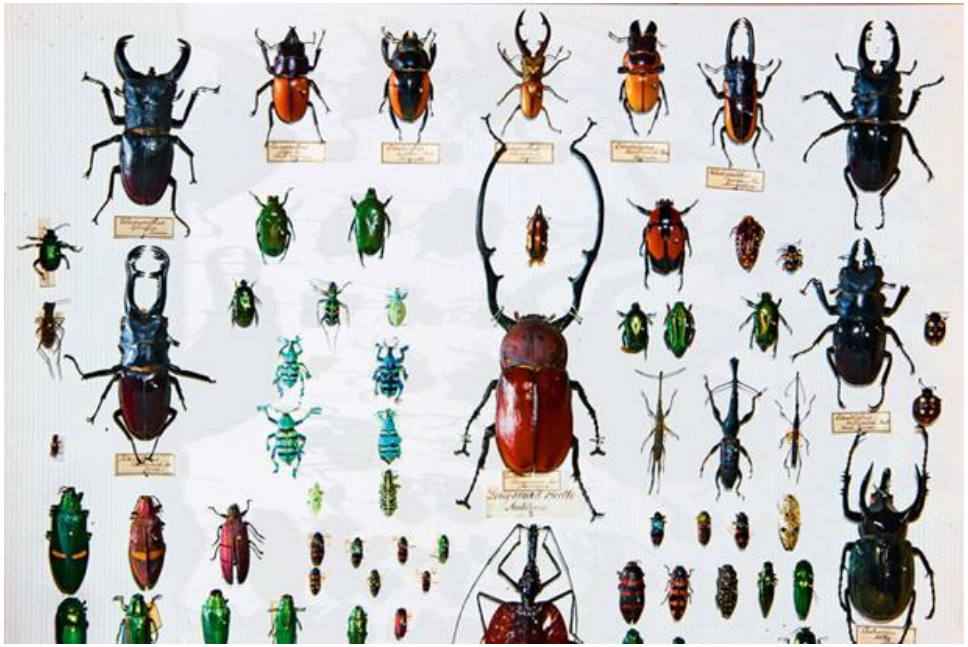


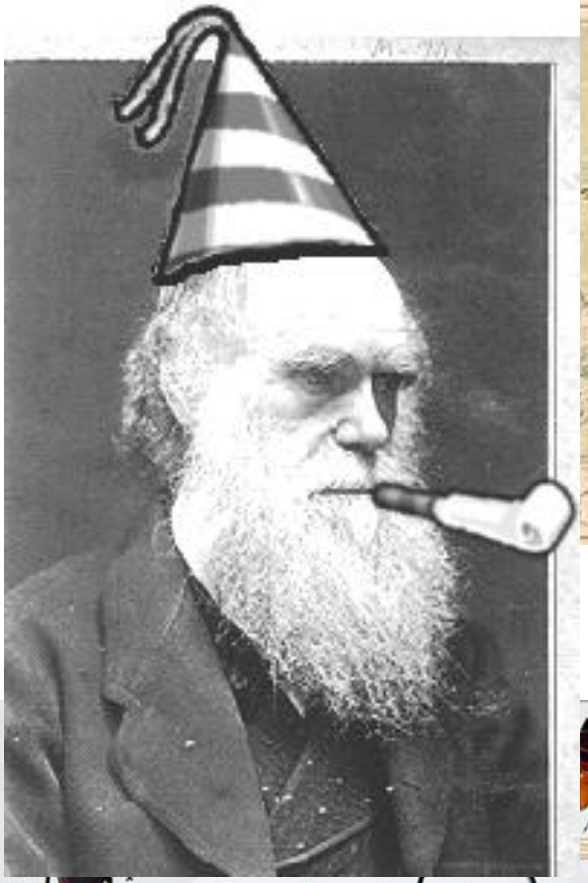



INSULINDE




ALFRED
RUSSEL
WALLACE
A rediscovered life.
MICHAEL A. FLANNERY



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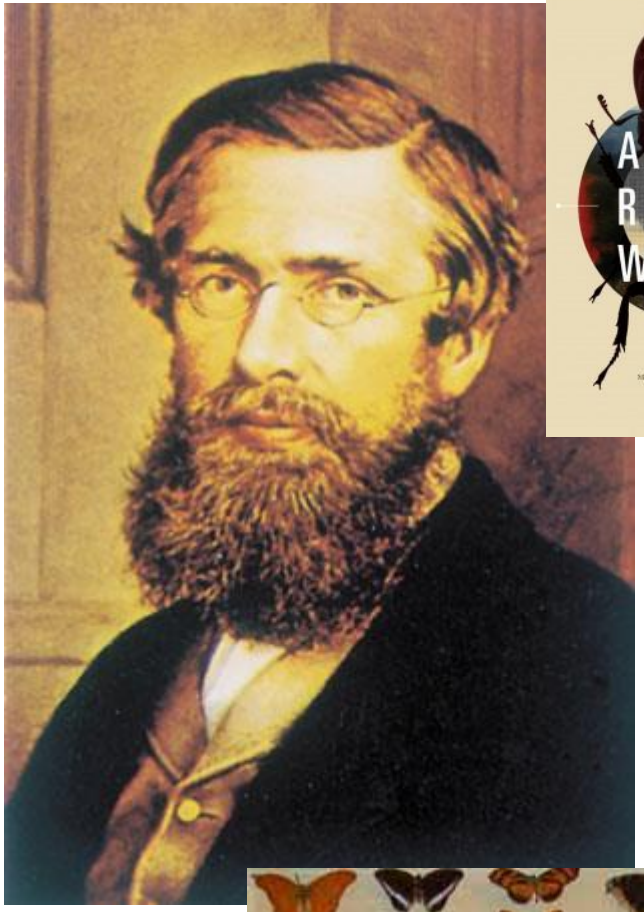

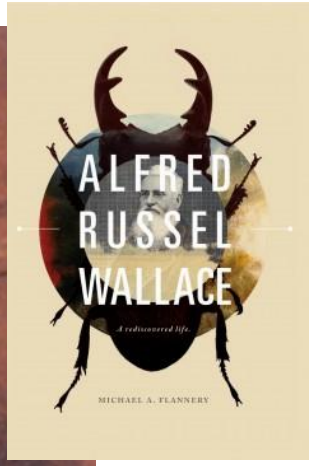
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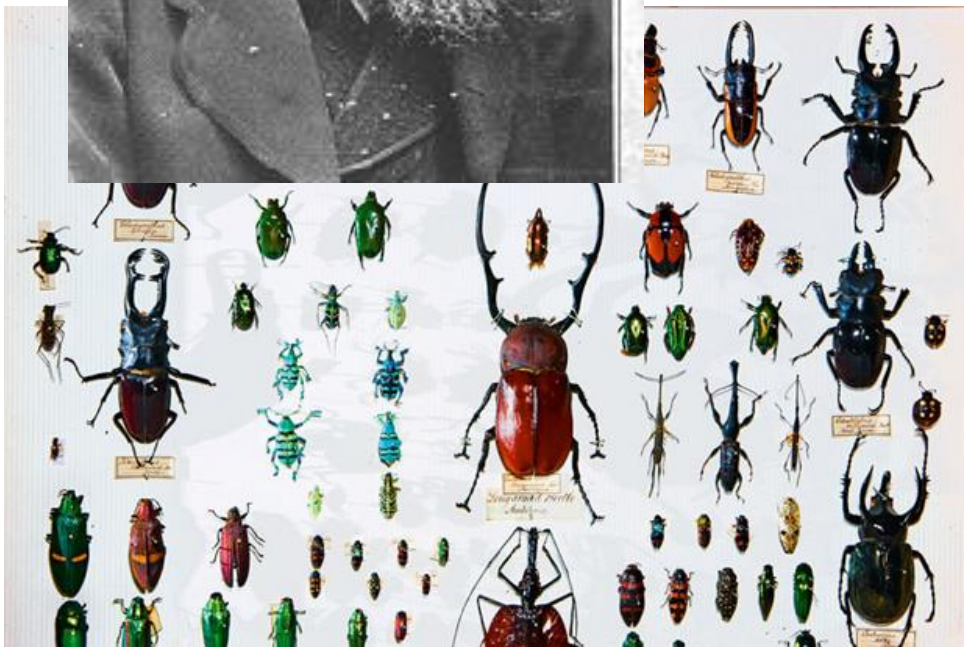
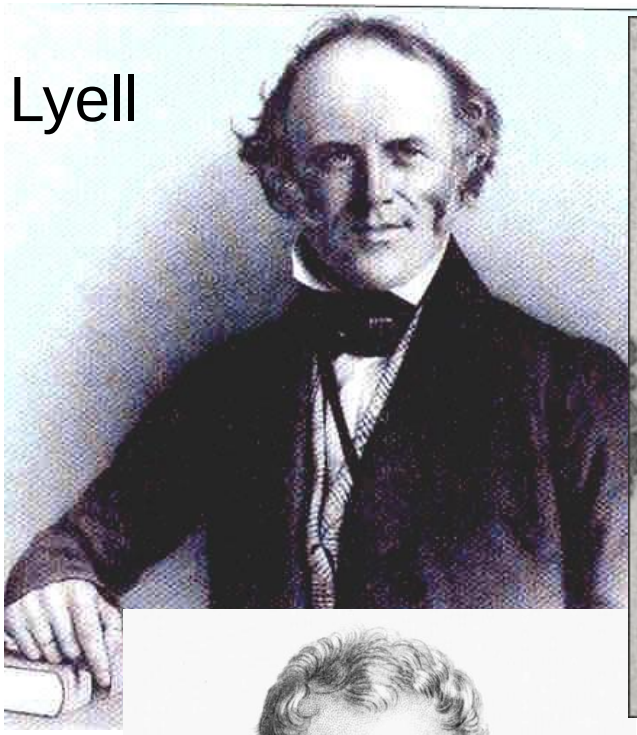
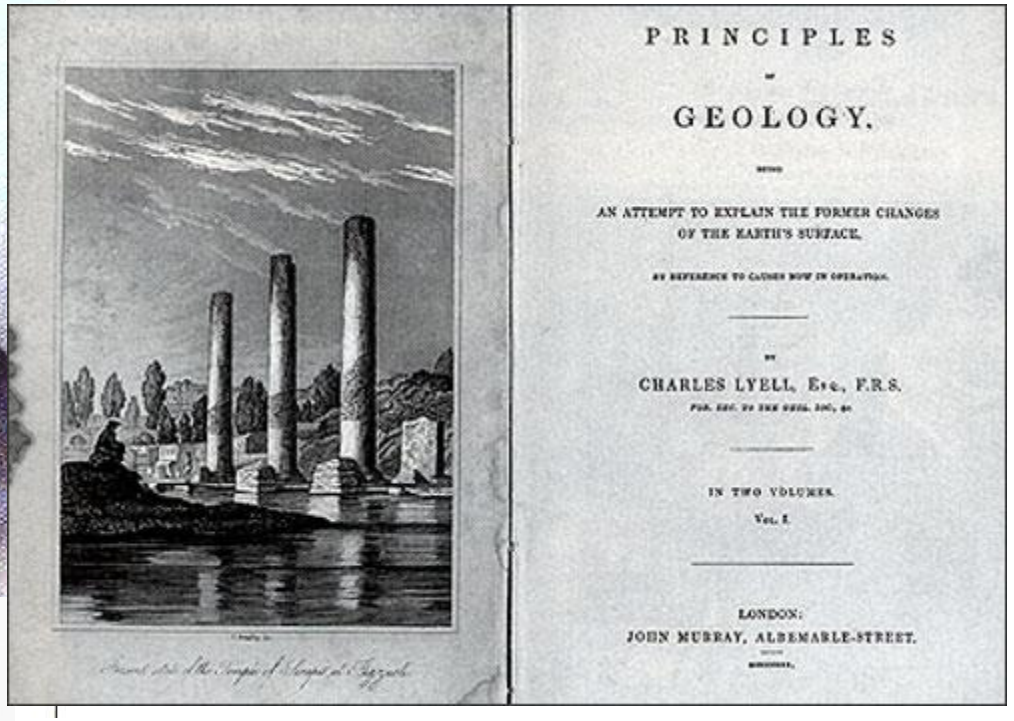


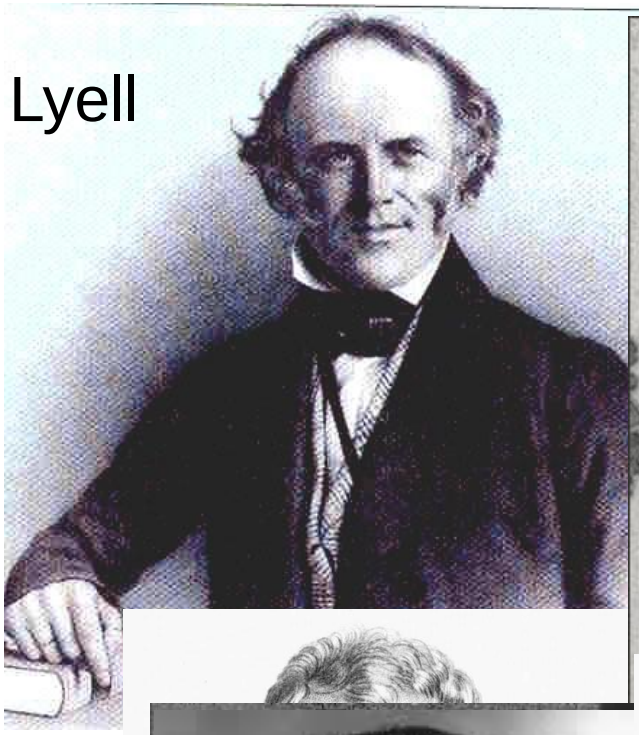
Lyell

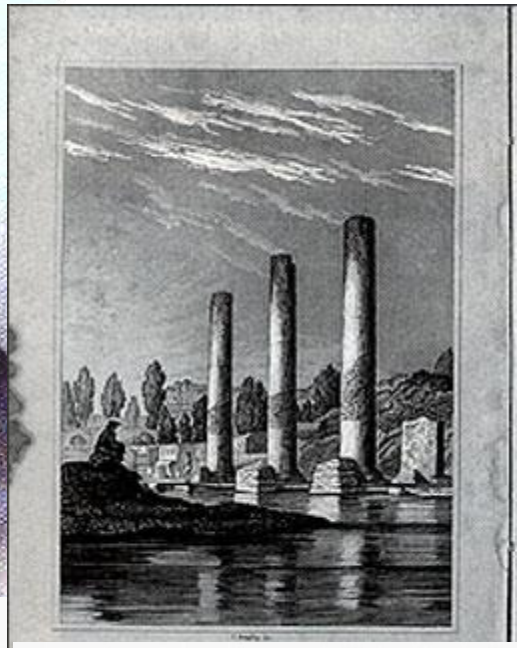


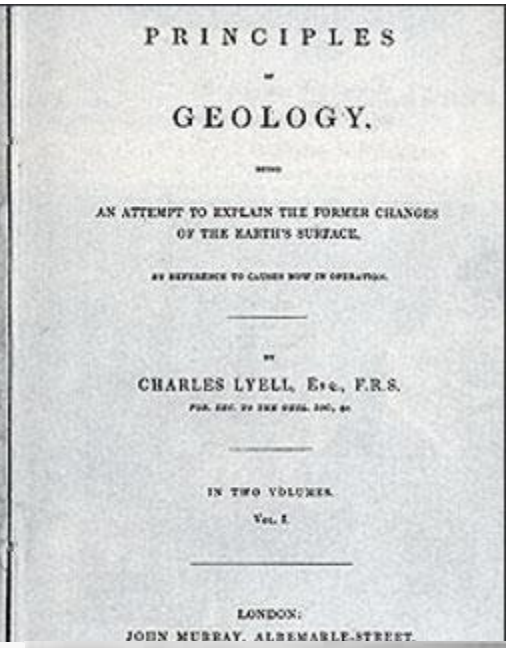


Malthus

Lyell

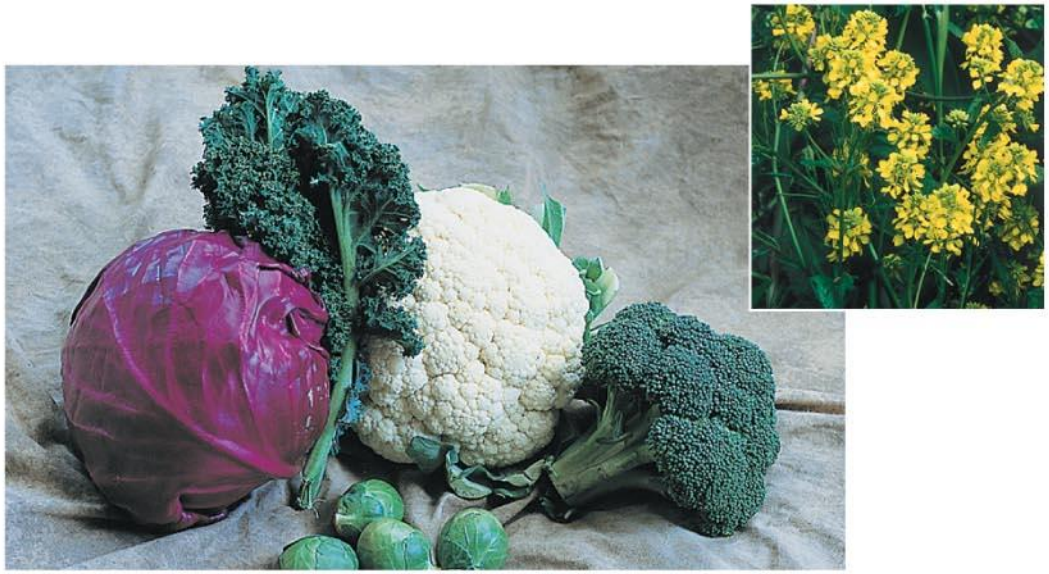






Malthus

(a)



(b)

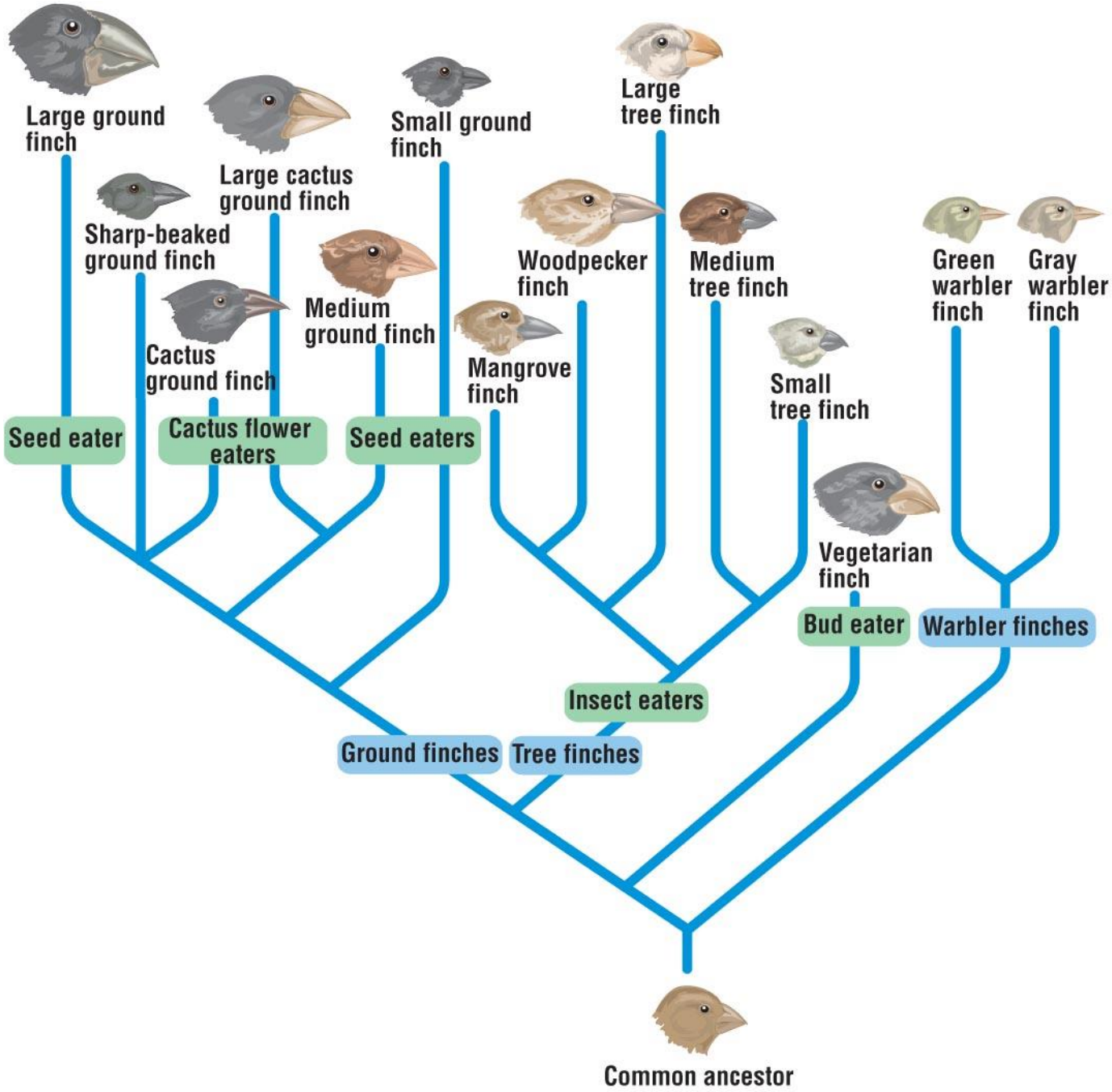
(a) Eastern coral snake (poisonous)

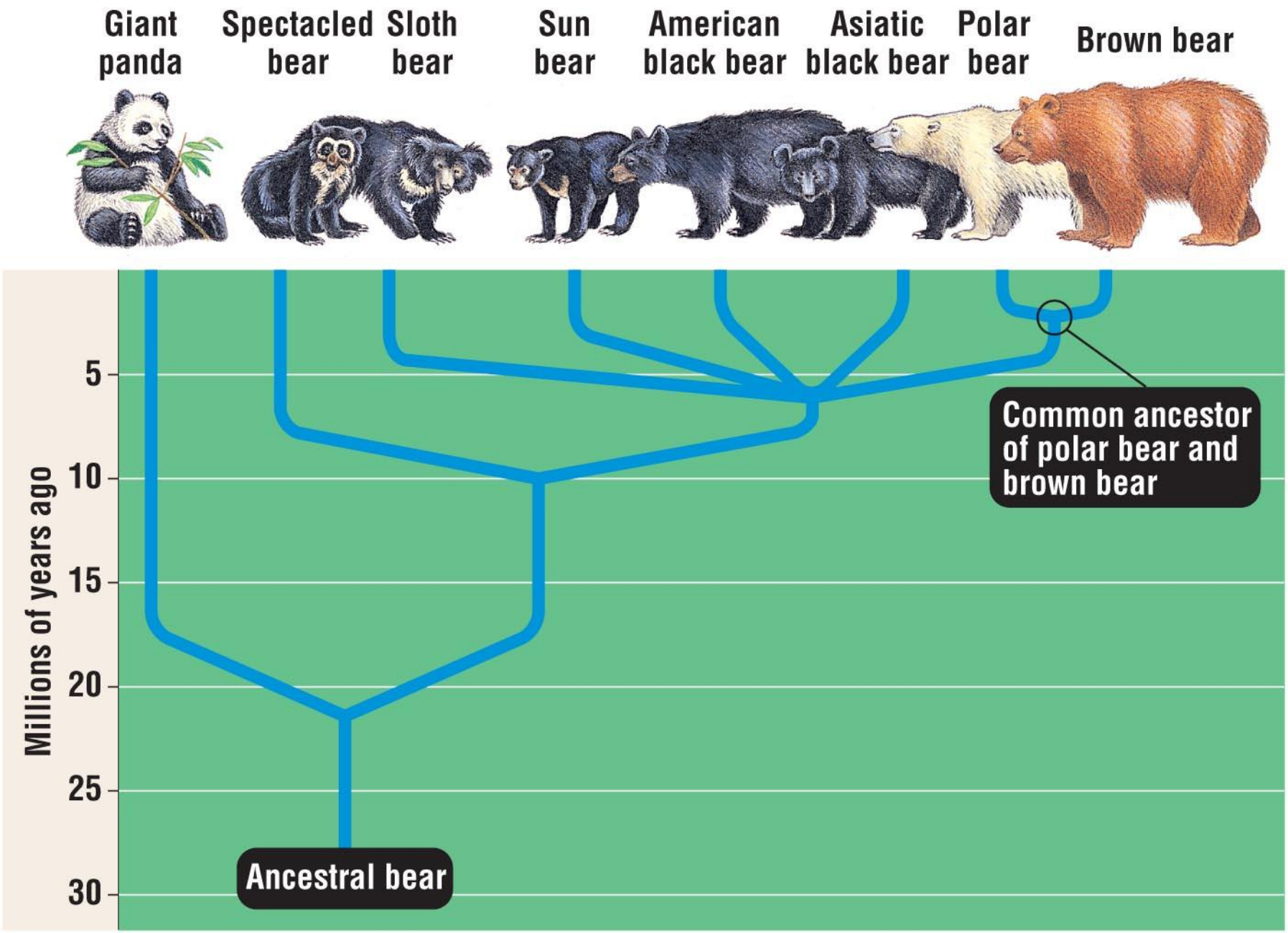
(b) Scarlet king snake (nonpoisonous)


TOAD
SNAKE


Not a leaf


TO FIGHT
LAST TO LEAVE





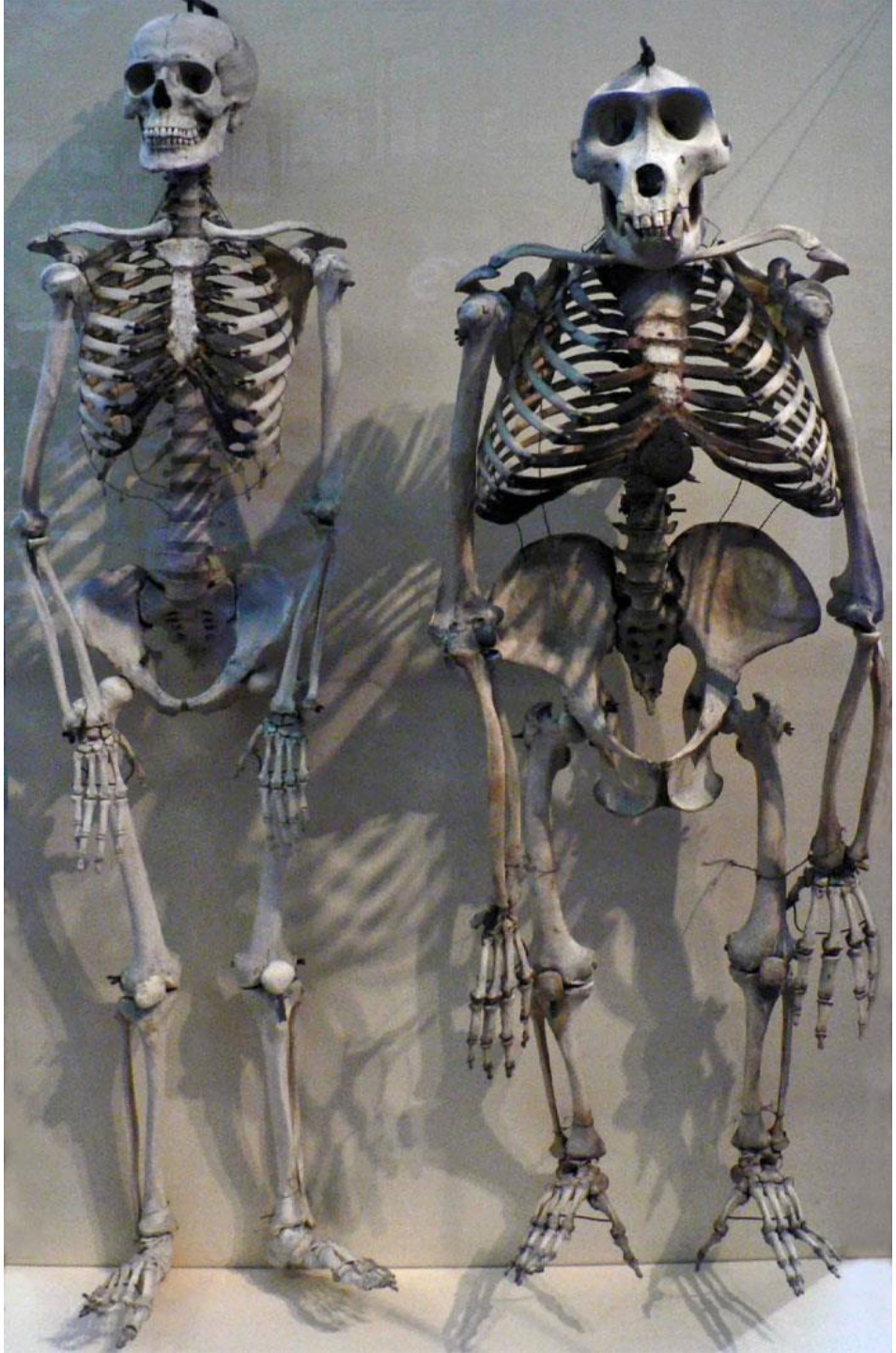
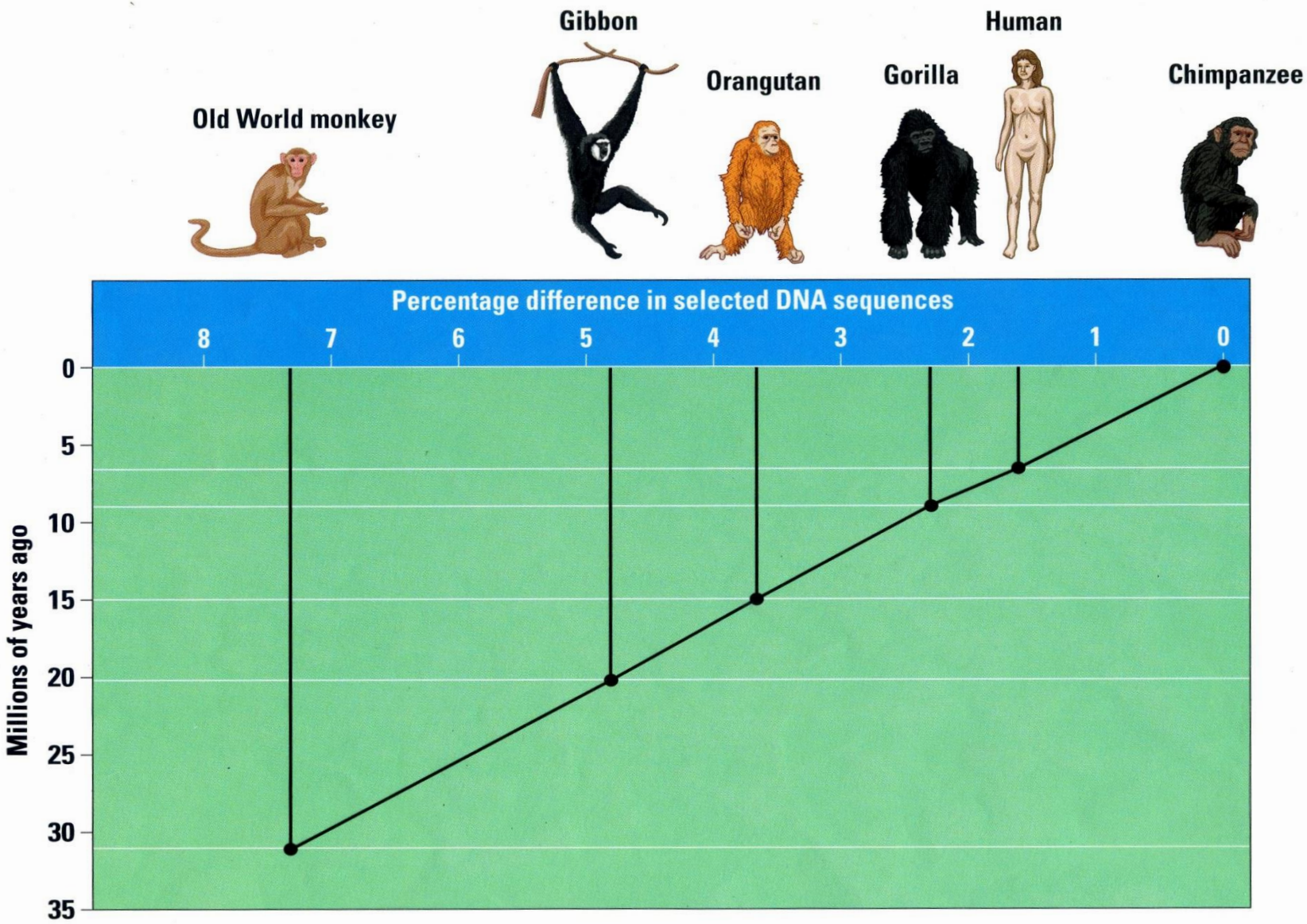
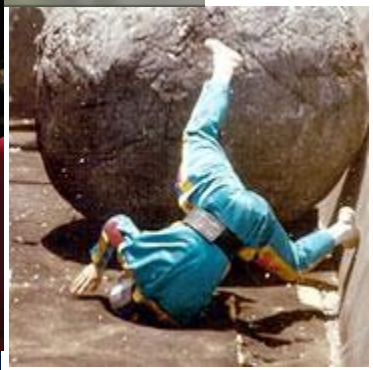


Figure 13.12 Genetic relationships among some primates



Bonobo

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CHAPTER 2

Essential Chemistry for Biology

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– Neil Campbell, Jane Reece, and Eric Simon
Essential Biology with Physiology, Second Edition
– Neil Campbell, Jane Reece, and Eric Simon

Lectures by Chris C. Romero

Chapter 2
Atoms and Molecules

The “Big Bang”

1. 10 to 20 billion years ago
2. Transition of the universe from energy to matter
3. Formation of subatomic particles and atoms

Atoms: The fundamental building blocks of everything.

1. The periodic table – elements can’t be broken down
   - 92 naturally occurring elements
   - All those other elements
2. The nucleus
   - Protons - positive charge, atomic number
   - Neutrons - neutral
   - Isotopes
     - extra neutrons
     - chemically the same

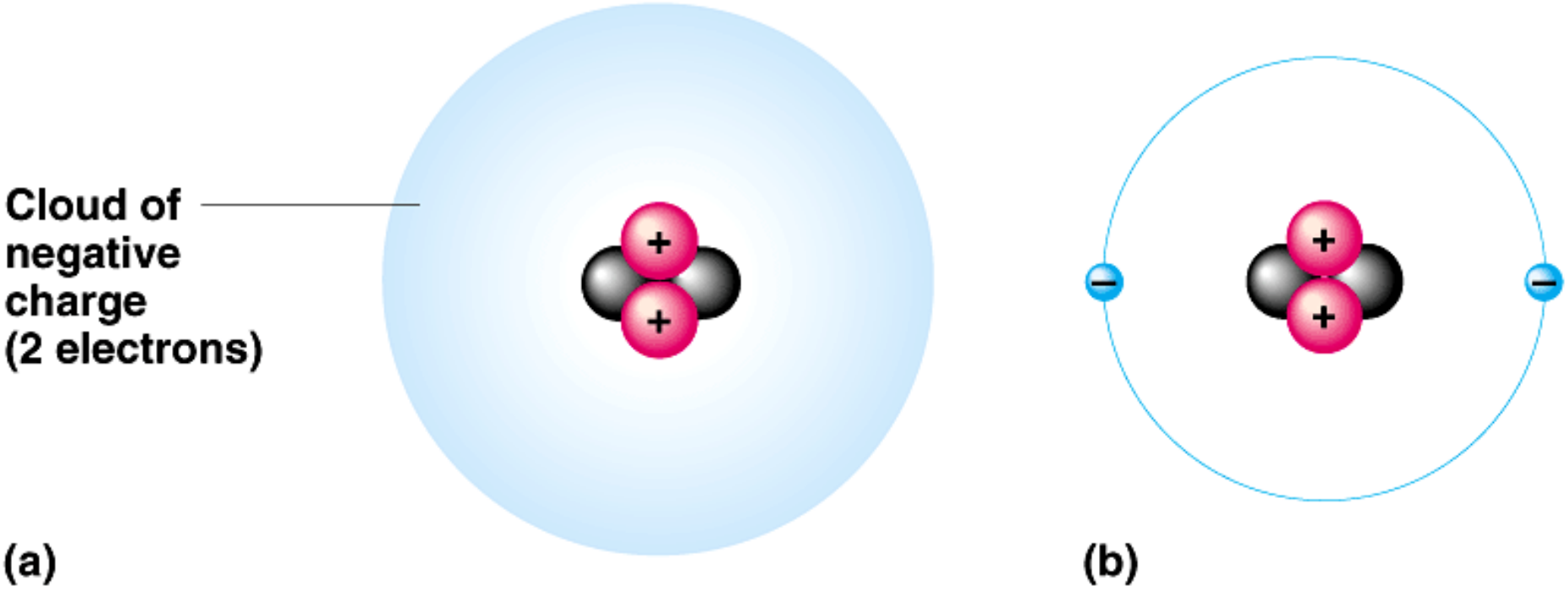

Heavy Quark Physics
THE BIG BANG
THEORY
WWW.ENTERTAINMENTWALLPAPER.COM

Periodic Table of the Elements

1 IA	2 IIA	3	4	5	6	7	8	9	10	11	12	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (97.9)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac~ (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Uuu (272)	112 Uub (277)	113 Uut	114 Uuq	115 Uup	116 Uuh		

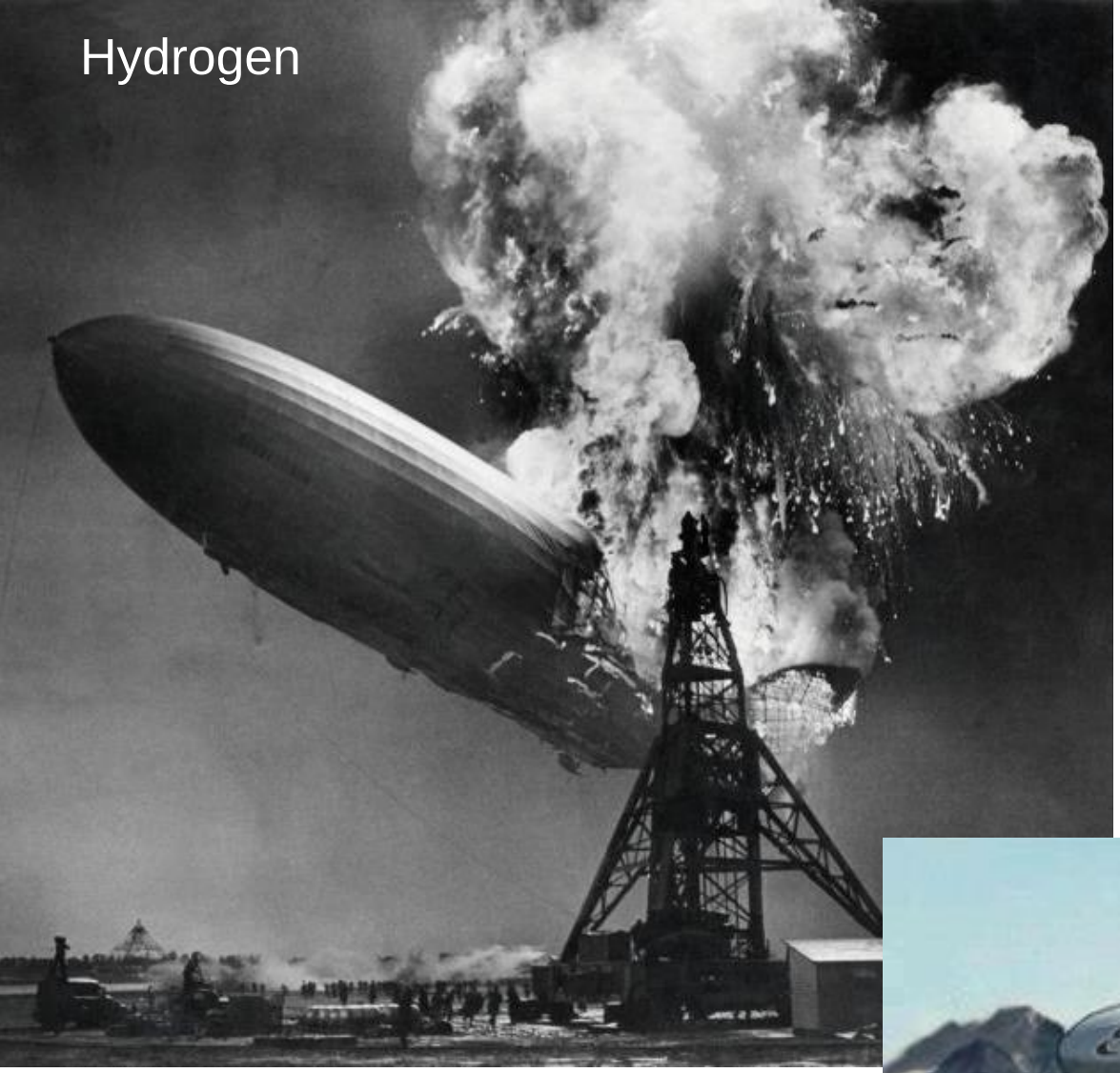
*Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
~Actinides	90 Th 232.0	91 Pa (231)	92 U (238)	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

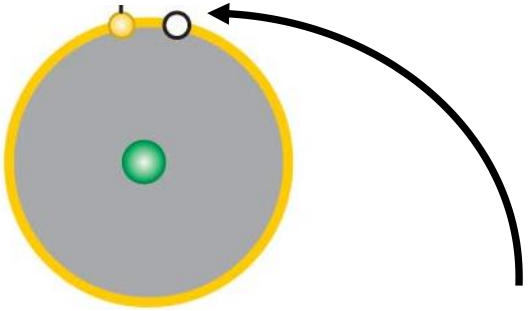
Figure 2.5 Two simplified models of a helium (He) atom



2 Protons (positive charge)
2 Neutrons (neutral charge)
} Nucleus

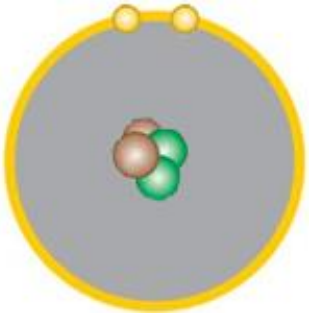
2 Electrons (negative charge)





Hydrogen (H) = 1

There's your problem right there



Helium (He) = 2

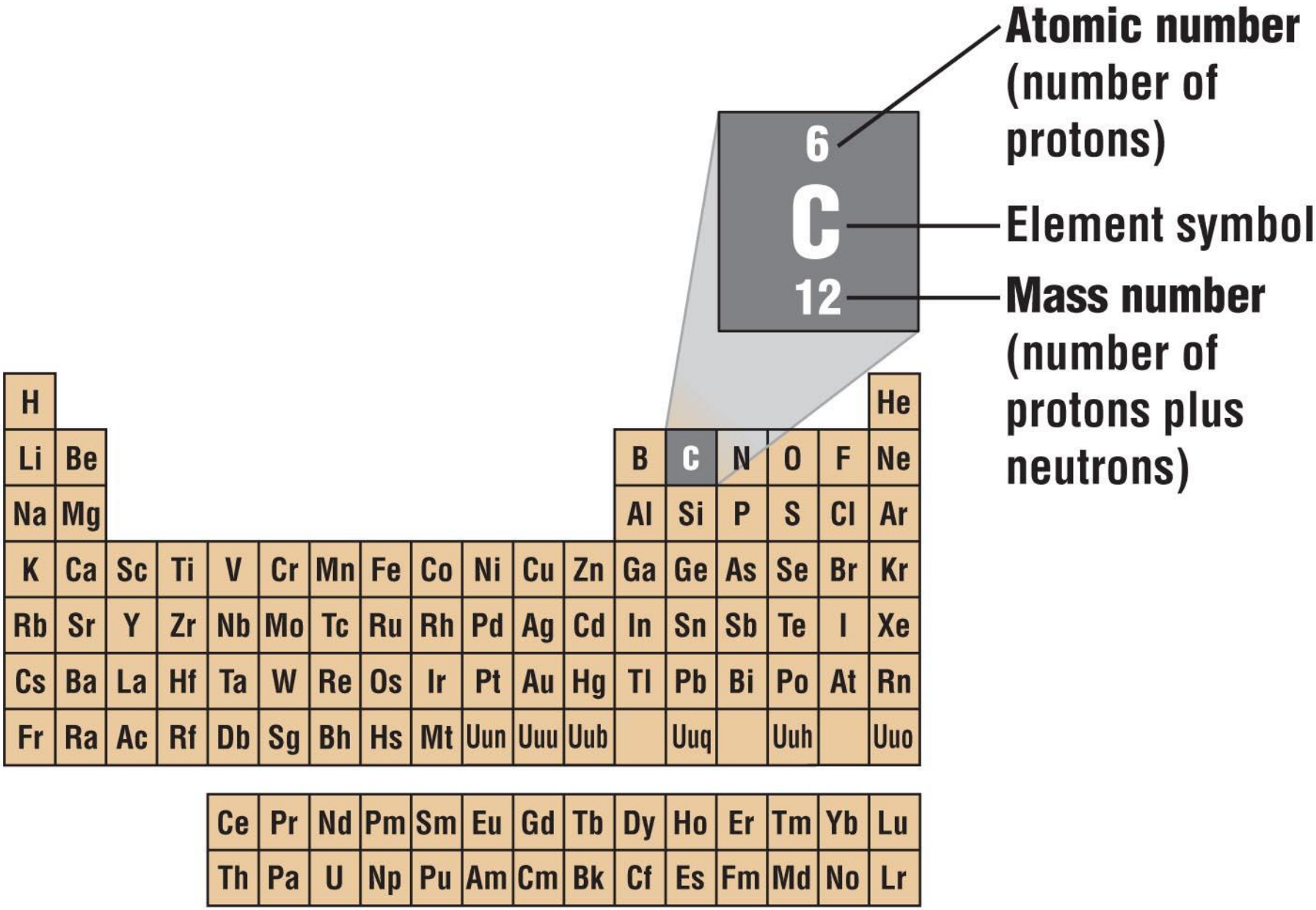


Figure 2.2

Periodic Table of the Elements

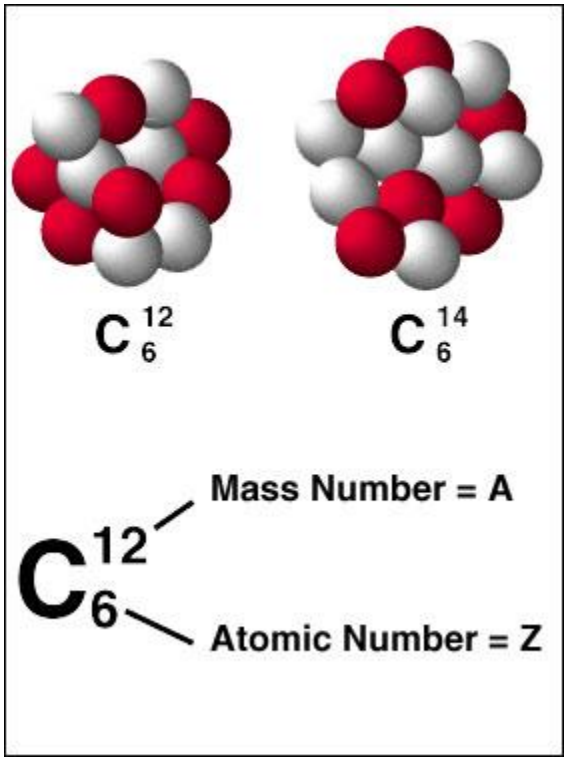
1 IA	2 IIA	3	4	5	6	7	8	9	10	11	12	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (97.9)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra (226)	89 Ac~ (227)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (277)	109 Mt (268)	110 Ds (271)	111 Uuu (272)	112 Uub (277)	113 Uut	114 Uuq	115 Uup	116 Uuh		

*Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
~Actinides	90 Th 232.0	91 Pa (231)	92 U (238)	93 Np (237)	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)	103 Lr (262)

Table 2.1 Isotopes of Carbon

	Carbon-12	Carbon-13	Carbon-14
Protons	6 (mass number)	6 (mass number)	6 (mass number)
Neutrons	6 (mass number 12)	7 (mass number 13)	8 (mass number 14)
Electrons	6	6	6

Carbon 14



Cobalt 60

Chapter 2
Atoms and Molecules

Electrons: Charged particles moving at the speed of light. Lots of empty space.

1. Potential energy
2. The arrangement of electrons
   - Determines how atoms will react chemically
   - The different energy levels electrons occupy

Molecules: two or more atoms bonded together

Periodic Table of the Elements

1 IA	2 IIA	3	4	5	6	7	8	9	10	11	12	13 IIIA	14 IVA	15 VA	16 VIA	17 VIIA	18 VIIIA
1 H 1.008																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.01	7 N 14.01	8 O 16.00	9 F 19.00	10 Ne 20.18
11 Na 22.99	12 Mg 24.31											13 Al 26.98	14 Si 28.09	15 P 30.97	16 S 32.07	17 Cl 35.45	18 Ar 39.95
19 K 39.10	20 Ca 40.08	21 Sc 44.96	22 Ti 47.87	23 V 50.94	24 Cr 52.00	25 Mn 54.94	26 Fe 55.85	27 Co 58.93	28 Ni 58.69	29 Cu 63.55	30 Zn 65.41	31 Ga 69.72	32 Ge 72.64	33 As 74.92	34 Se 78.96	35 Br 79.90	36 Kr 83.80
37 Rb 85.47	38 Sr 87.62	39 Y 88.91	40 Zr 91.22	41 Nb 92.91	42 Mo 95.94	43 Tc (97.9)	44 Ru 101.1	45 Rh 102.9	46 Pd 106.4	47 Ag 107.9	48 Cd 112.4	49 In 114.8	50 Sn 118.7	51 Sb 121.8	52 Te 127.6	53 I 126.9	54 Xe 131.3
55 Cs 132.9	56 Ba 137.3	57 La* 138.9	72 Hf 178.5	73 Ta 180.9	74 W 183.8	75 Re 186.2	76 Os 190.2	77 Ir 192.2	78 Pt 195.1	79 Au 197.0	80 Hg 200.6	81 Tl 204.4	82 Pb 207.2	83 Bi 209.0	84 Po (209)	85 At (210)	86 Rn (222)
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*Lanthanides	58 Ce 140.1	59 Pr 140.9	60 Nd 144.2	61 Pm (145)	62 Sm 150.4	63 Eu 152.0	64 Gd 157.3	65 Tb 158.9	66 Dy 162.5	67 Ho 164.9	68 Er 167.3	69 Tm 168.9	70 Yb 173.0	71 Lu 175.0
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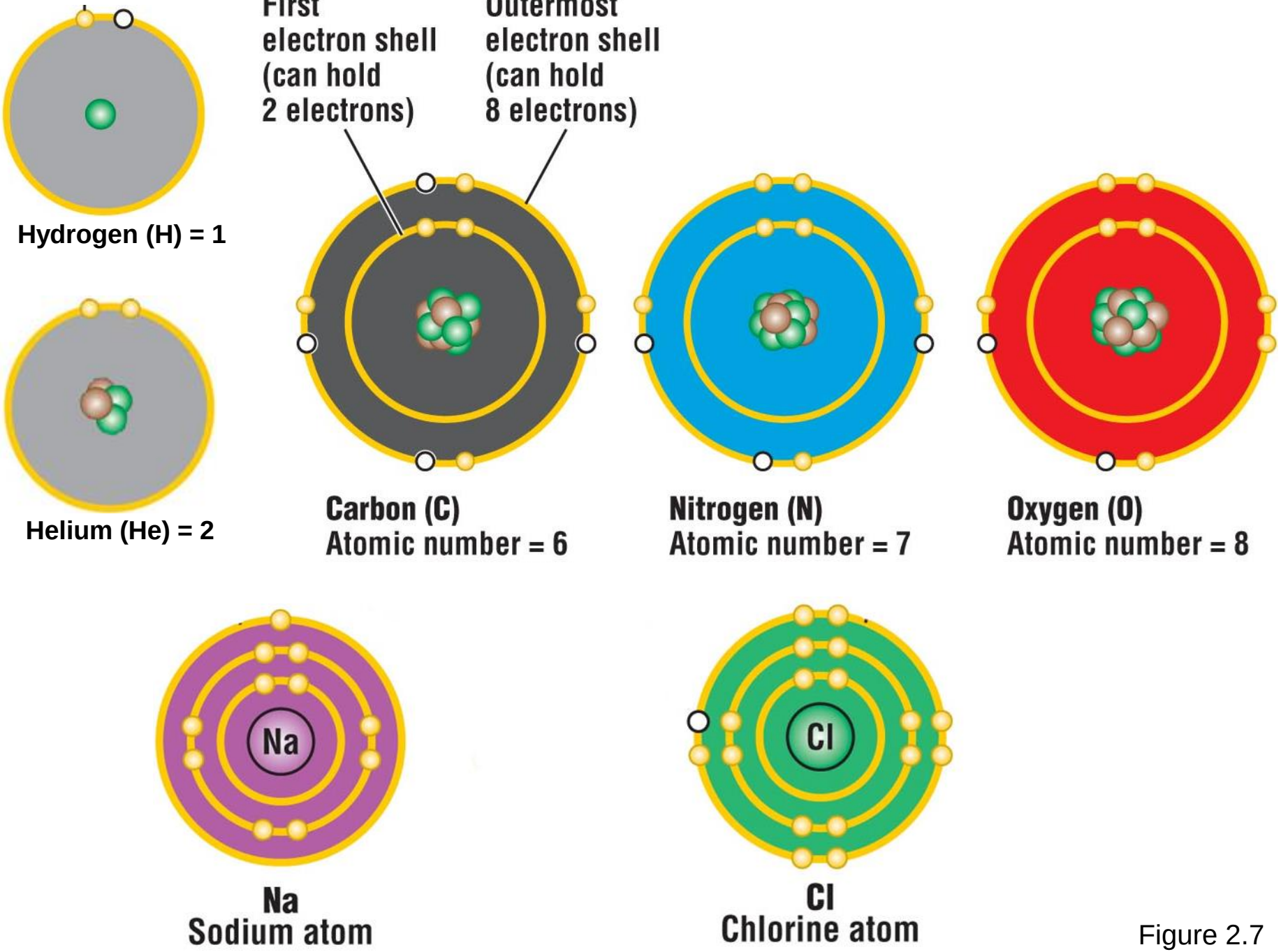
First electron shell (can hold 2 electrons)
Outermost electron shell (can hold 8 electrons)
Hydrogen (H) = 1
Helium (He) = 2
Carbon (C)
Atomic number = 6
Nitrogen (N)
Atomic number = 7
Oxygen (O)
Atomic number = 8
Na
Na
Sodium atom
Cl
Cl
Chlorine atom

Figure 2.7

Chapter 2
Atoms and Molecules

1. Types of Chemical Bonds – compounds trade or share electrons
    - Ionic bonds
        - Exchange of electrons
        - Tend to come apart in water
        - Can be quite strong though: salt crystals
    - Covalent bonds
        - Sharing of electrons
        - Single and double bonds
        - Polar and nonpolar compounds

2. Chemical Reactions:
    - Formation of chemical compounds
    - All organic molecules composed of atoms of C, H, N, O, P, S

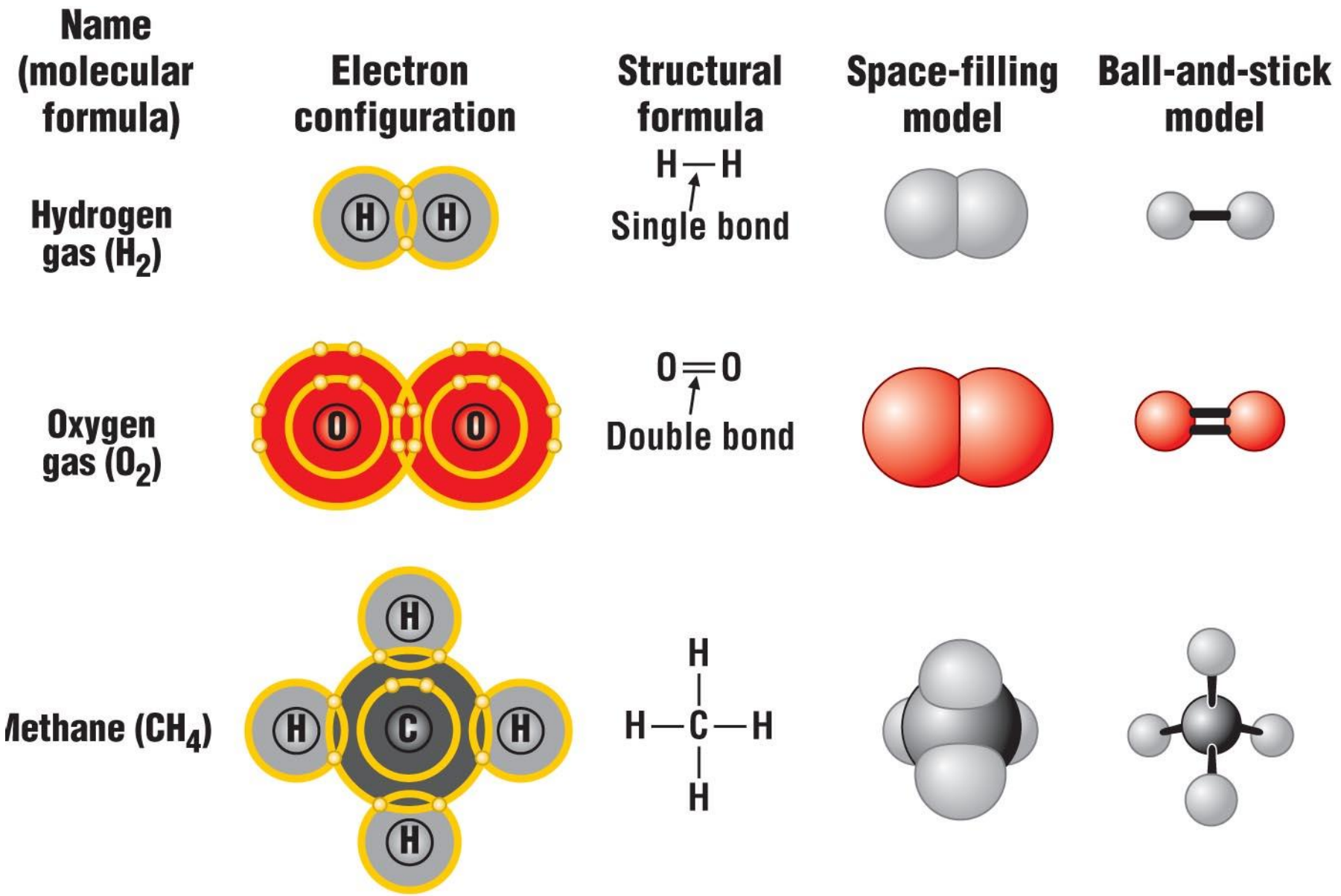
Name (molecular formula)
Electron configuration
Structural formula
Space-filling model
Ball-and-stick model
Hydrogen gas (H_2)
H—H
Single bond
Oxygen gas (O_2)
O=O
Double bond
Methane (CH_4)
H
C
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Figure 2.9

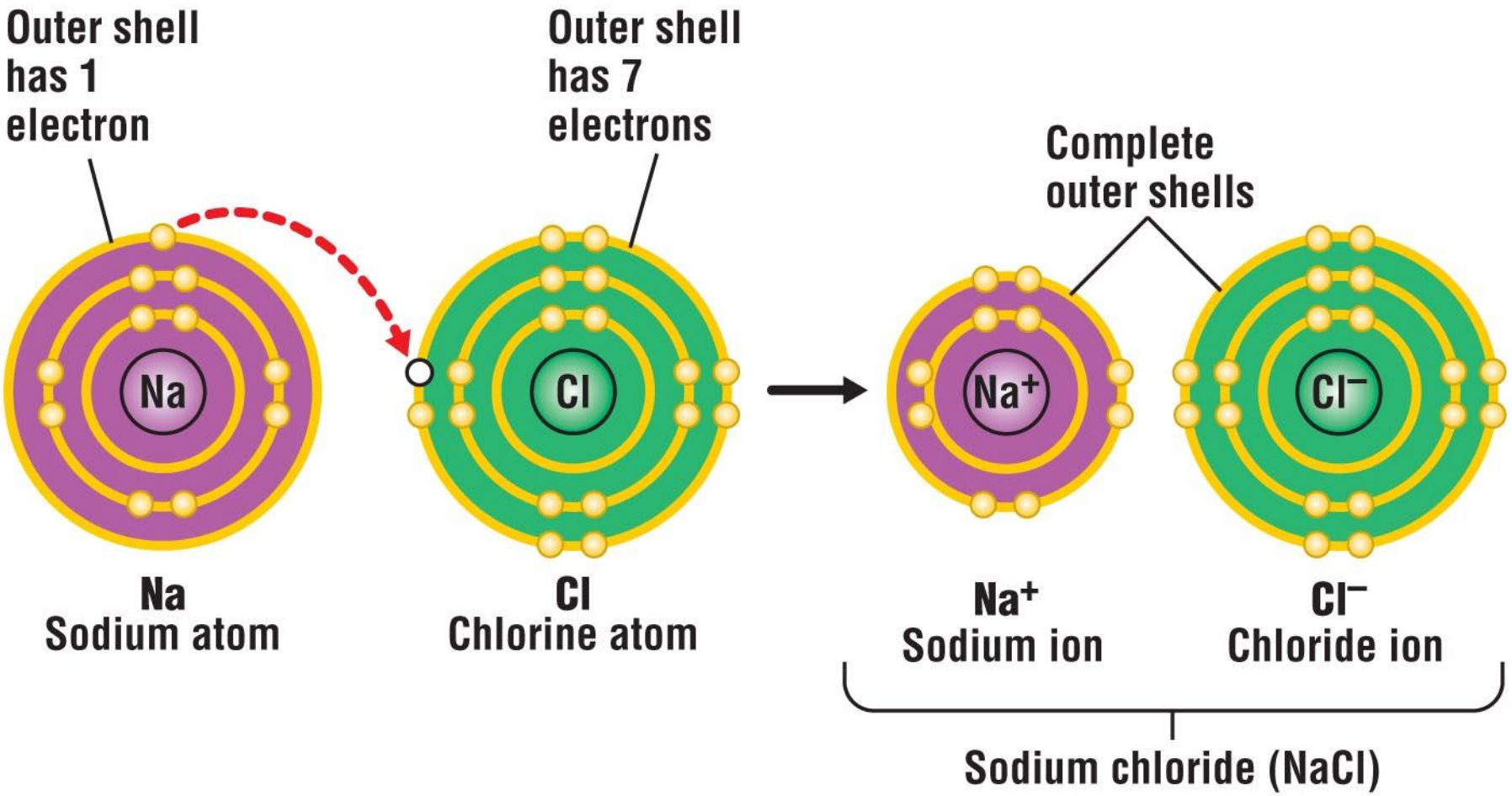


Figure 2.8

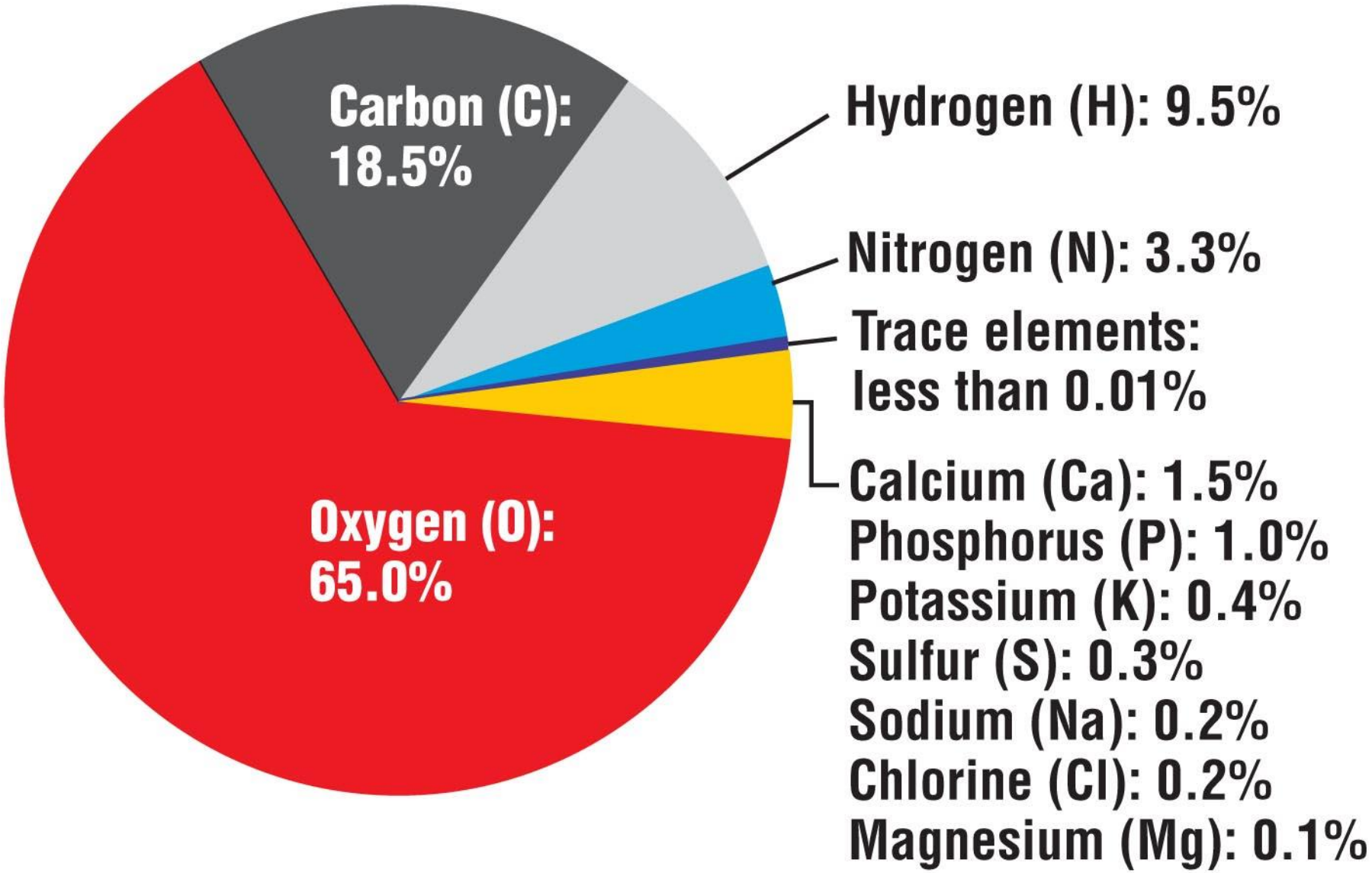


Figure 2.3

(a) (b)

Figure 2.4

CHAPTER 2

Essential Chemistry for Biology

PowerPoint® Lectures for
Essential Biology, Third Edition
– Neil Campbell, Jane Reece, and Eric Simon
Essential Biology with Physiology, Second Edition
– Neil Campbell, Jane Reece, and Eric Simon

Lectures by Chris C. Romero

Figure 2.11

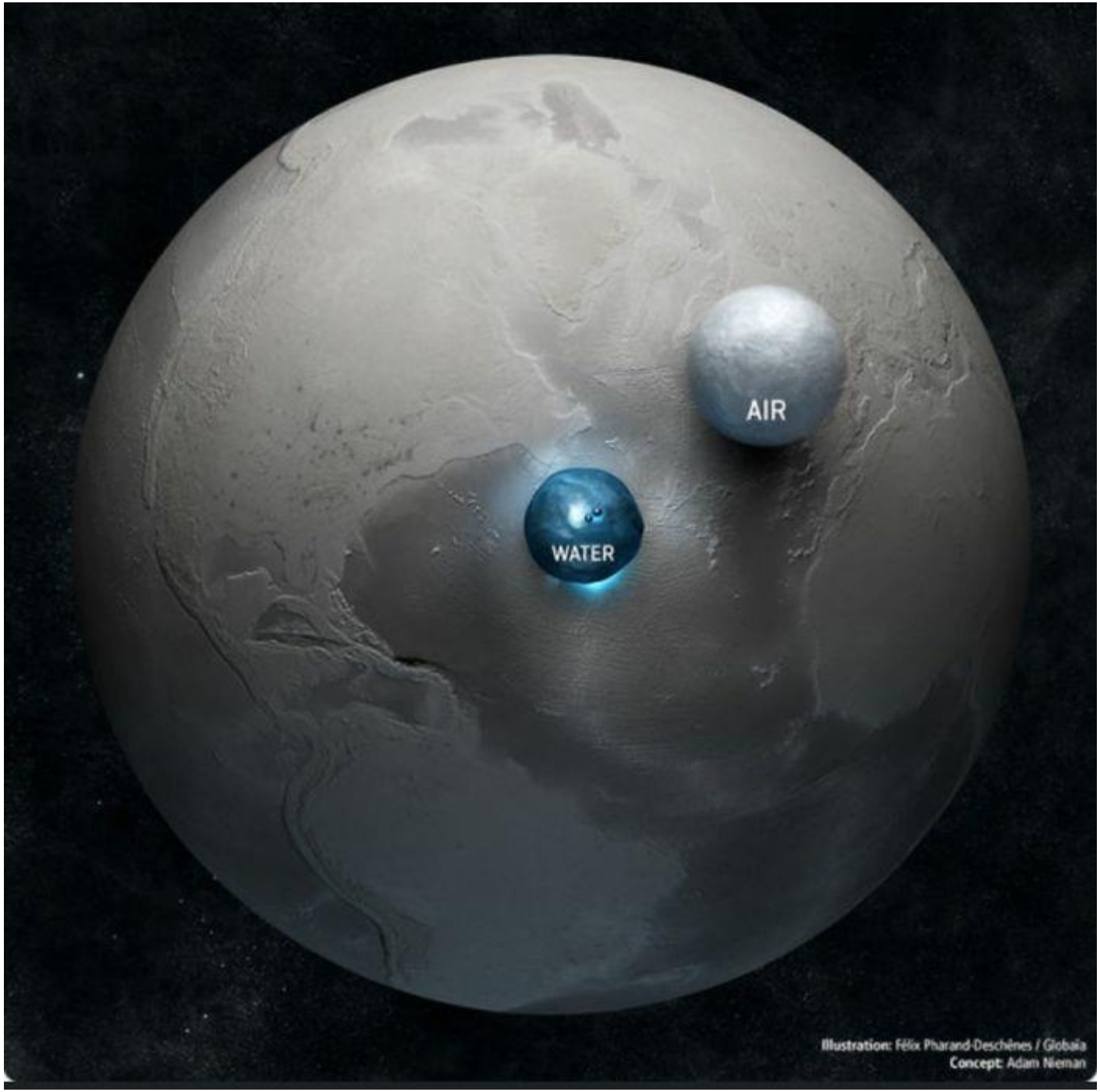
Chapter 2
HOH

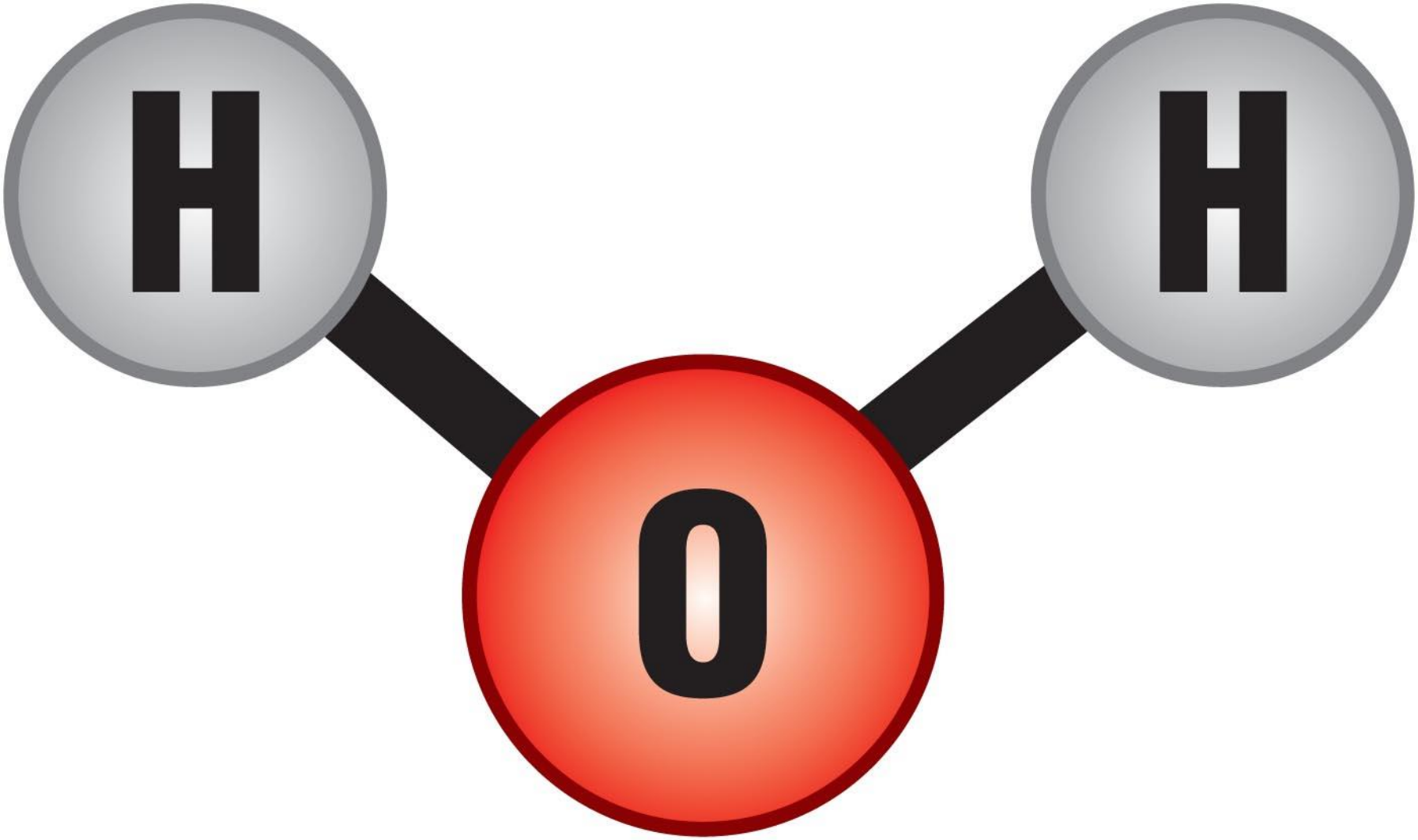
The structure of water

1. Hydrogen bond
   - formed in other large molecules
   - provides structural stability
   - weak and short lived bond

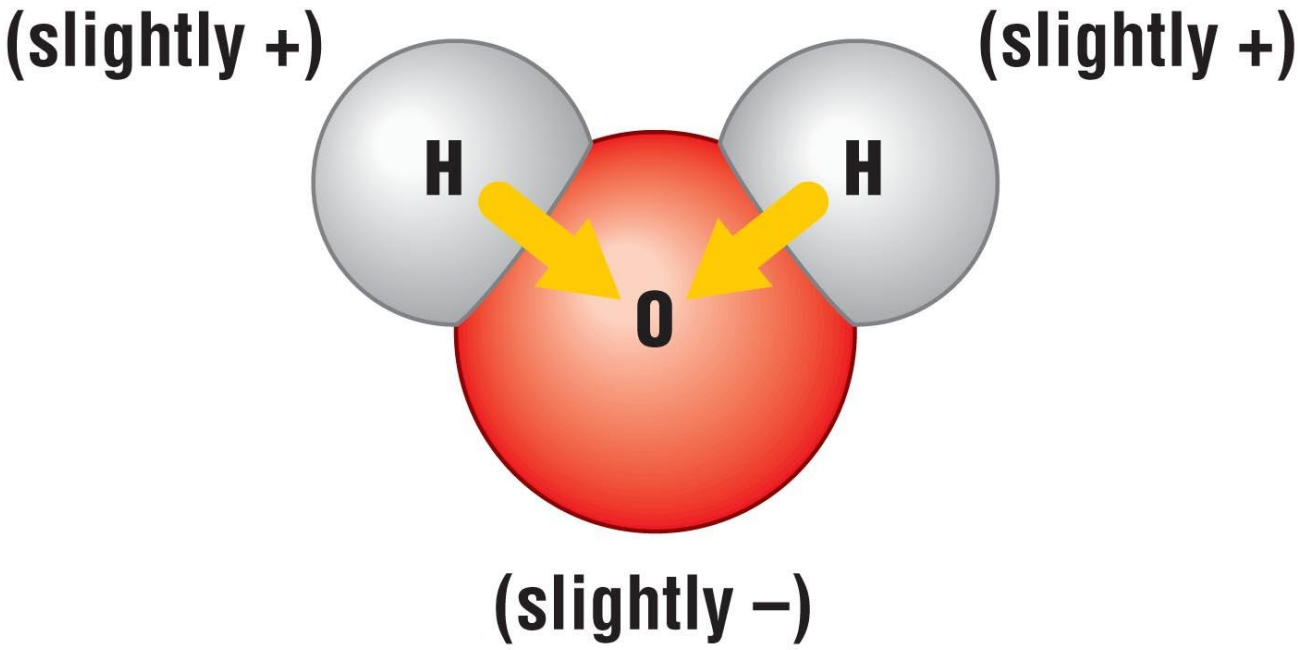
2. Surface tension and cohesion
   - forms “skin” on surface,
   - holding together of like molecules

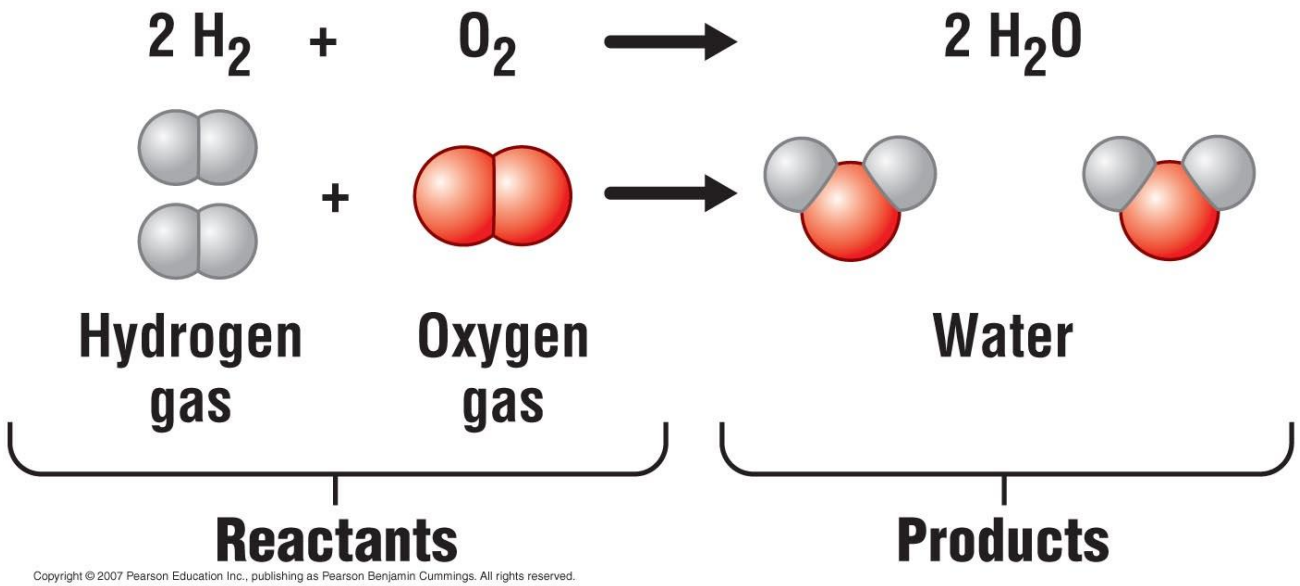
3. Capillary action cohesion and adhesion.
   - holding together of non-alike molecules


AIR
WATER
Illustration: Félix Pharand-Deschênes / Globaia
Concept: Adam Nieman



Unnumbered Figure, p. 26





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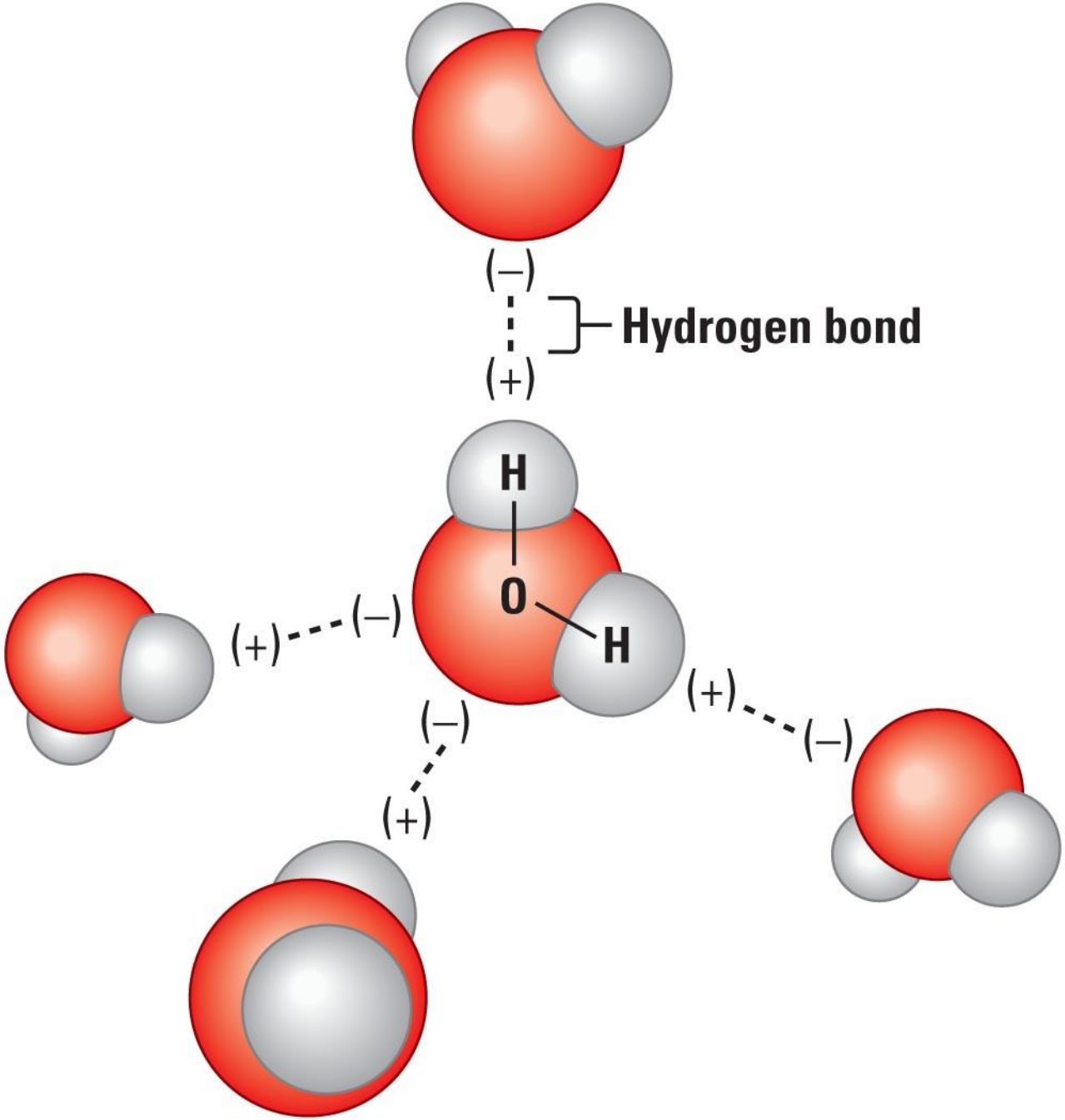


Figure 2.10

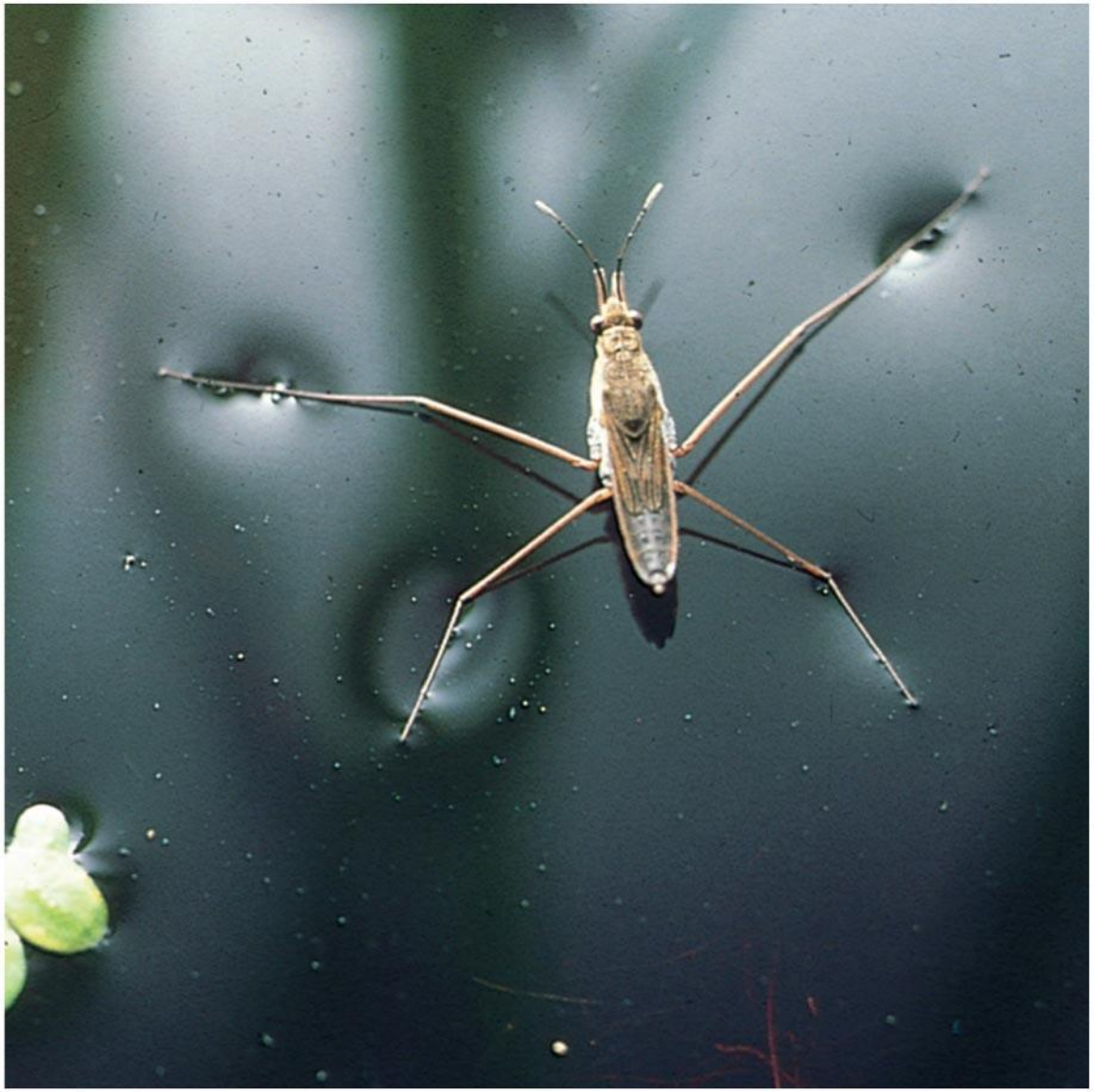


Figure 2.13

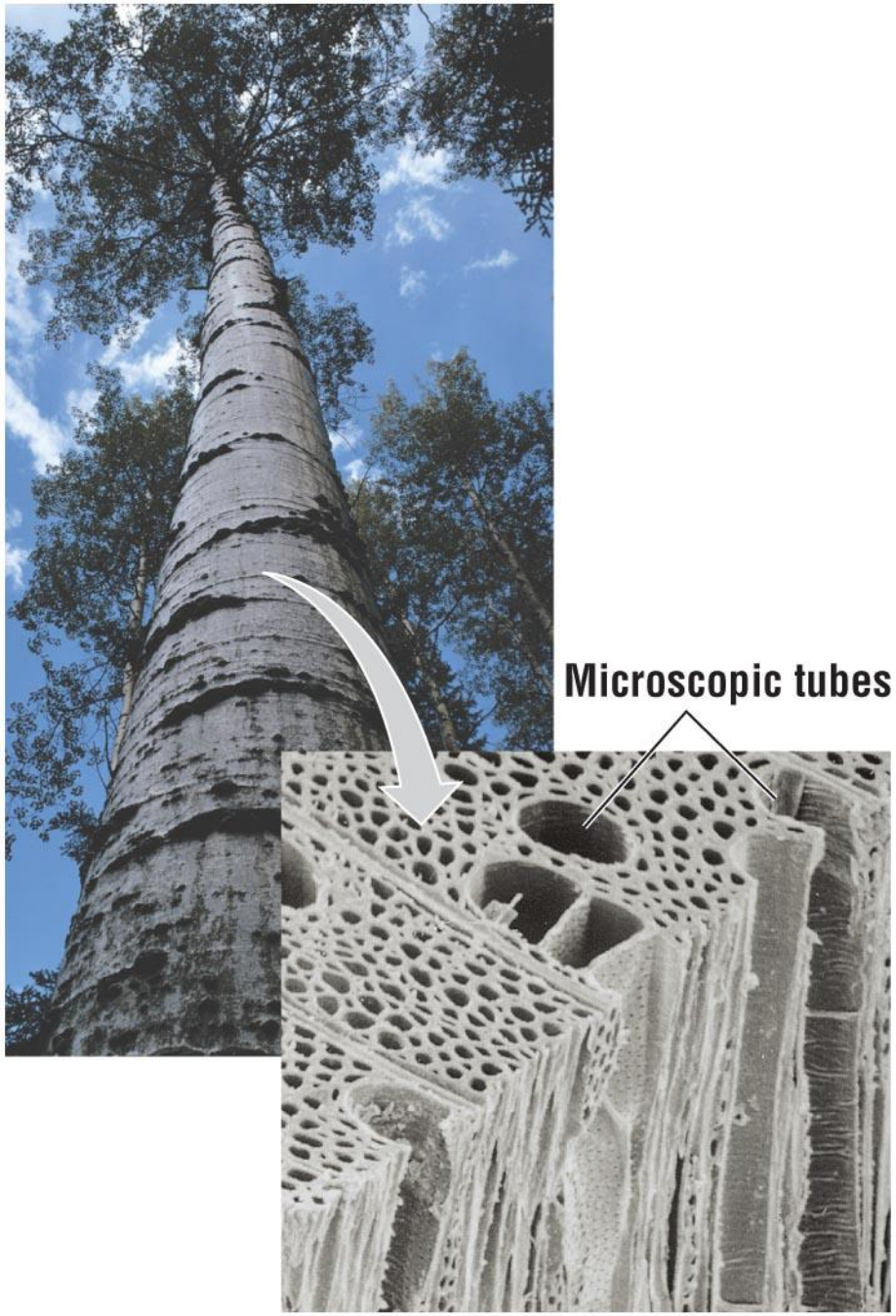


Figure 2.12

Chapter 2
HOH

The amazing hydrogen bond

1. Specific heat – Water is hard to heat up
    - amount of heat required to change temperature
    - high specific heat due to hydrogen bonds
    - mediates temperature changes in organisms
2. Heat of vaporization – Water is hard to boil
    - amount of heat required to vaporize (boil)
    - boiling breaks hydrogen bonds of HOH
3. Freezing, density, and the formation of ice.
    - density normally increases as temperature drops
    - at 4ºC HOH expands due to hydrogen bonds
    - (ice floats)

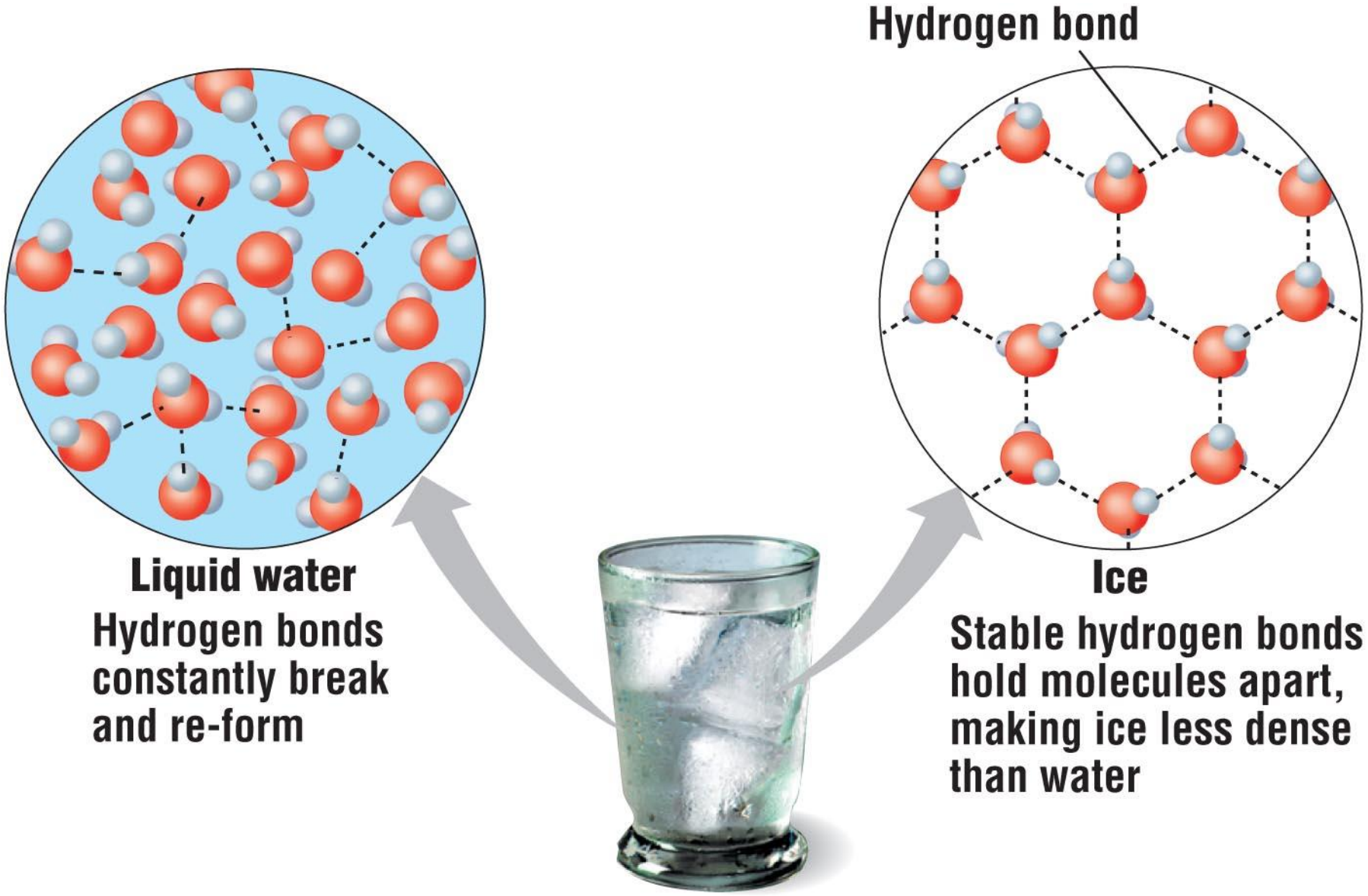


Figure 2.15


AL GORE


RICHARD NIXON

Chapter 2
HOH

Water as the universal solvent

1. Solutions – uniform mixture of 2 or more substances (salt water)

2. Solvents – substance of greatest amount (usually liquid)

3. Solutes – substances of lesser amount

4. Polarity of solvents
    - Hydrophobic substances – water “fearing”
    - Hydrophilic substances – water “loving”

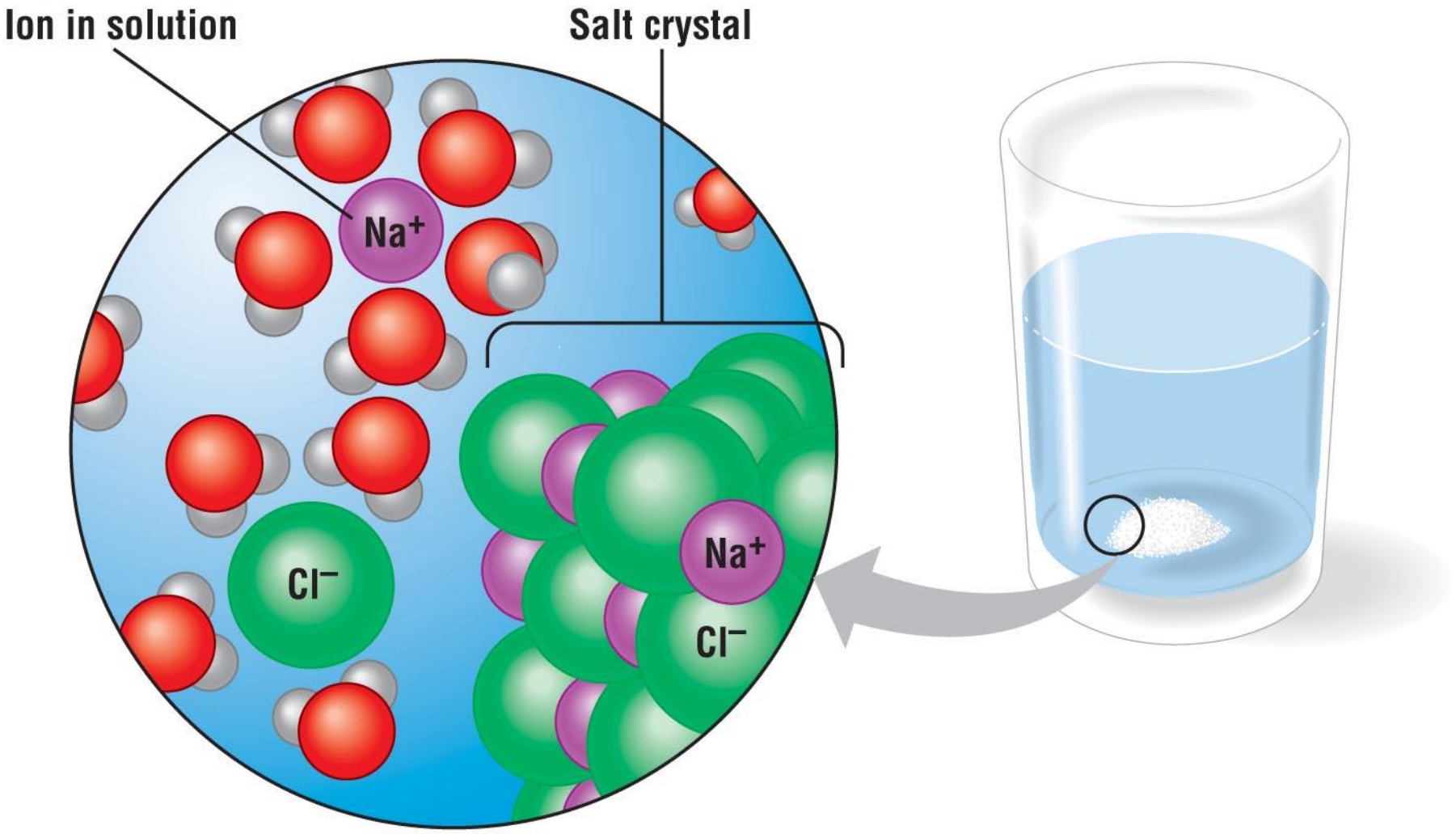


Figure 2.16

Chapter 2
HOH

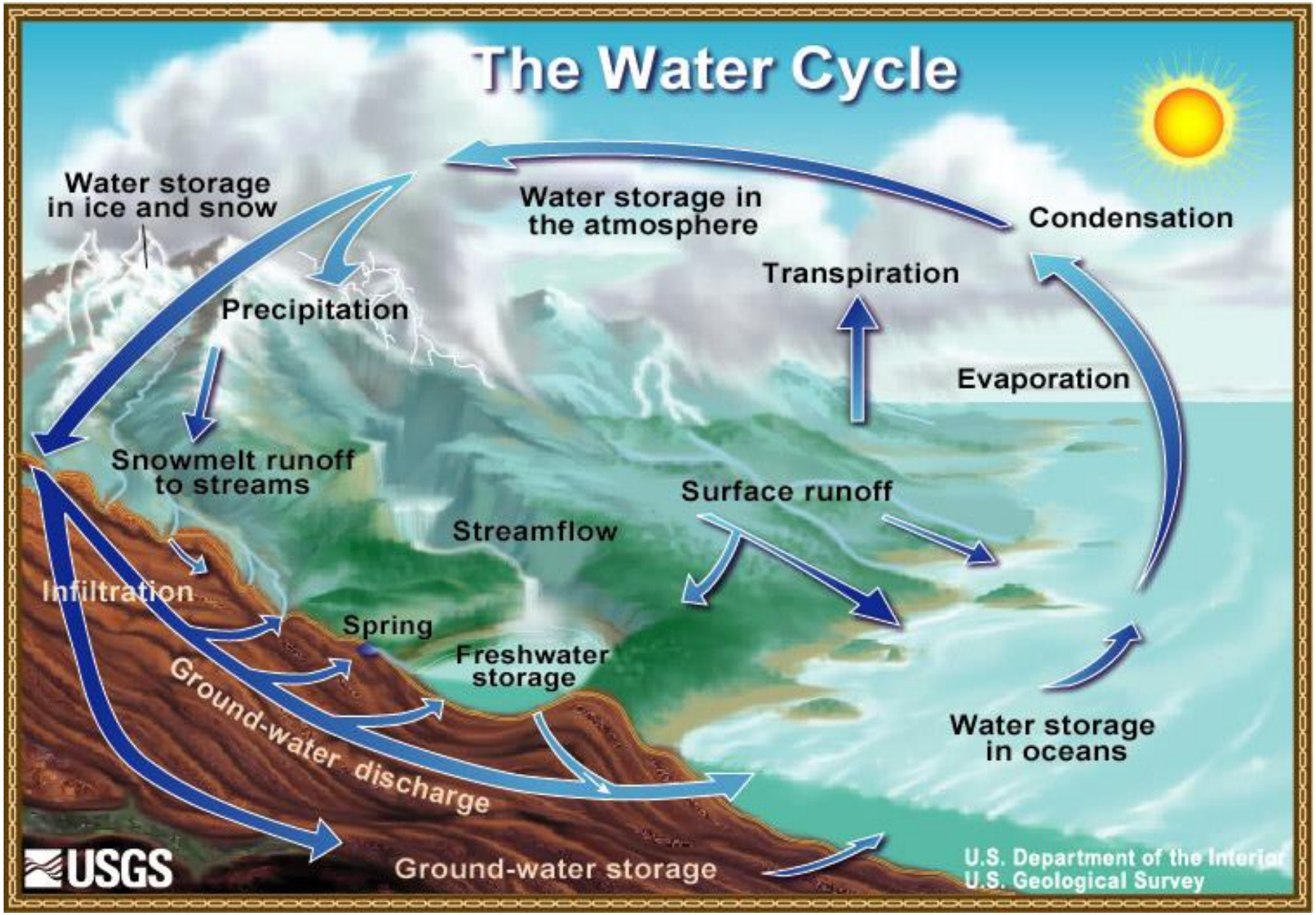
All the water on the planet.

1. Water is the most common liquid on earth

2. 3/4 of the planet is covered with water, only 2% of it is ice

3. 50 - 95% of the weight of living organisms is water

4. The cycling of water through the atmosphere is powered by solar energy


The Water Cycle
Water storage in ice and snow
Water storage in the atmosphere
Condensation
Transpiration
Precipitation
Evaporation
Snowmelt runoff to streams
Surface runoff
Streamflow
Infiltration
Spring
Freshwater storage
Water storage in oceans
Ground-water discharge
Ground-water storage
USGS
U.S. Department of the Interior
U.S. Geological Survey

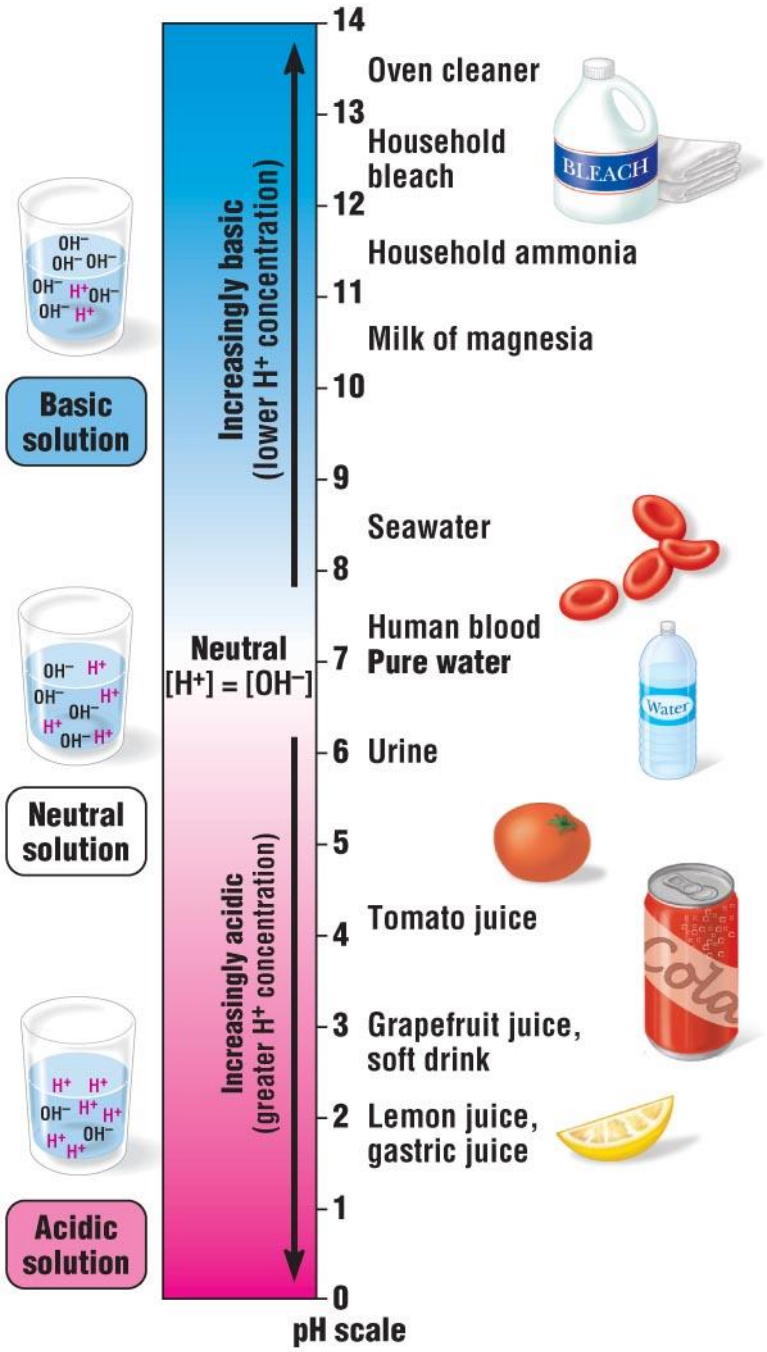


Figure 2.17

CHAPTER 3

The Molecules of Life

PowerPoint® Lectures for

Essential Biology, Third Edition

– Neil Campbell, Jane Reece, and Eric Simon

Essential Biology with Physiology, Second Edition

– Neil Campbell, Jane Reece, and Eric Simon

Lectures by Chris C. Romero

Chapter 3
Organic Molecules

Carbon

1. Central to all organic molecules

2. Carbon chains as building blocks

3. Hydrocarbons – contain only C, H

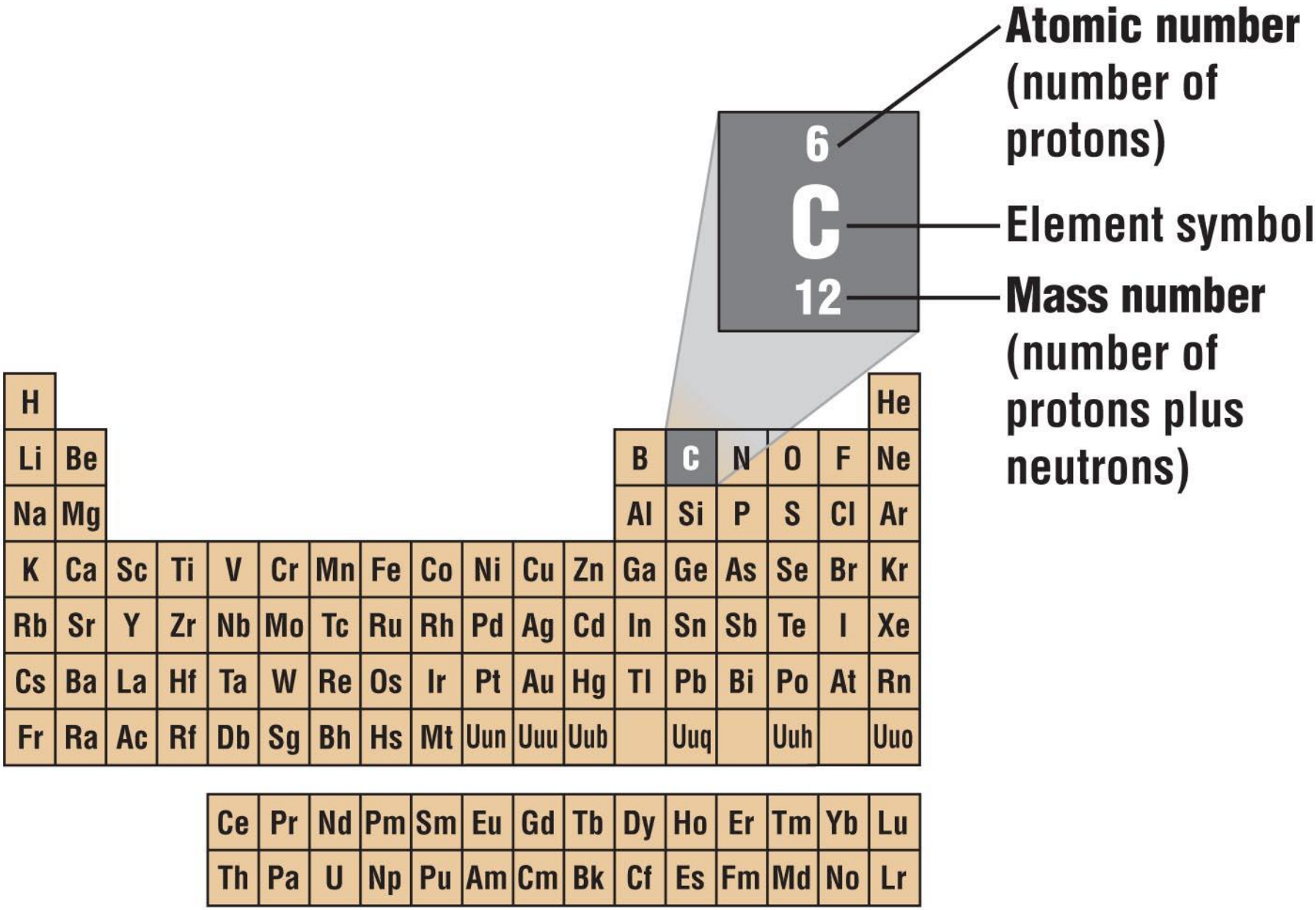
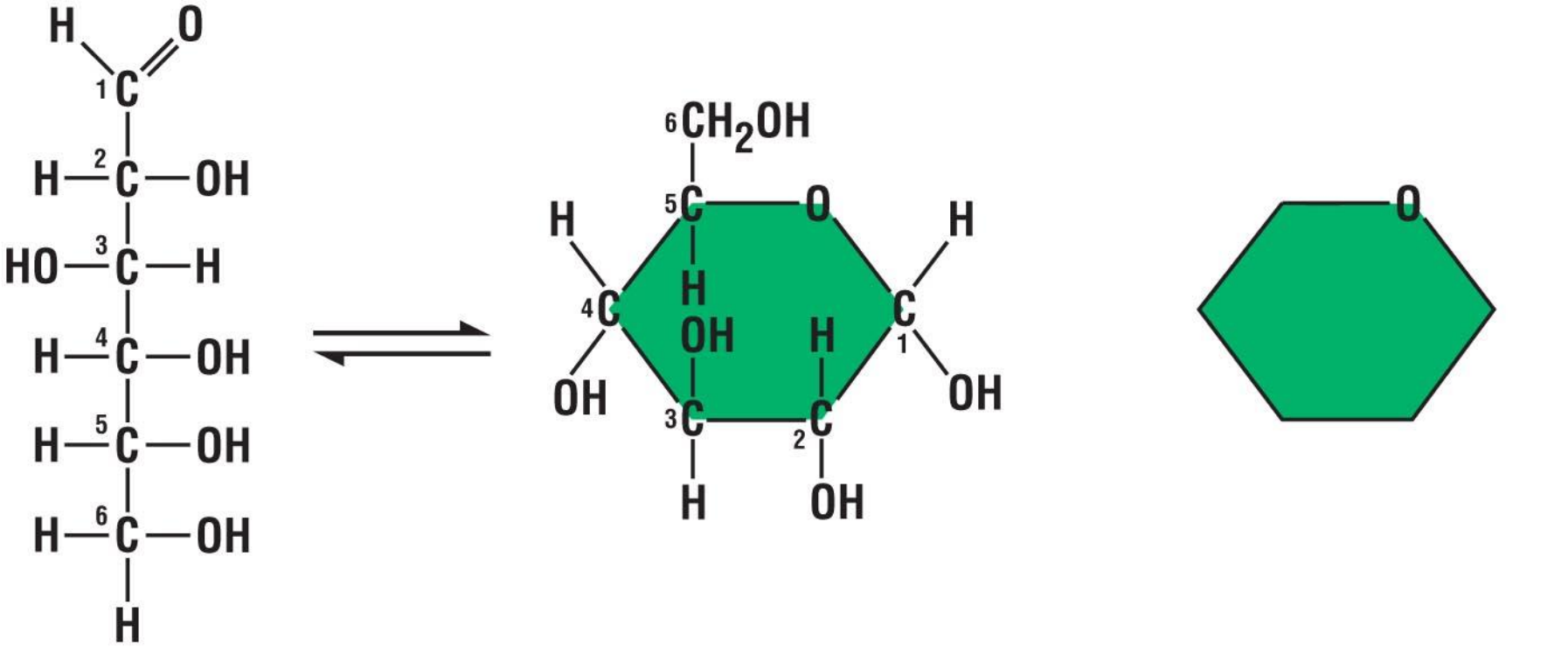


Figure 2.2

Chapter 3
Organic Molecules

1. Monosaccharides – single sugars
    - Energy source for living systems – stored in covalent bonds of sugars
    - Building blocks of larger molecules
    - Form rings in HOH
    - Release energy when broken down (oxidized)
    - Structural forms - Monomers & Polymers
    - Glucose is the main energy source in some cells
2. Disaccharides – double sugars
    - Transport form of sugar in living systems
        - Sucrose - transport sugar in plants (glucose & fructose)
        - Trehalose - transport sugar in insects (glucose & glucose)
        - Glucose - transport sugar in mammals
    - Hydrolysis - breakdown into monosaccharides
3. Polysaccharides – long chains of monosaccharides
    - Storage forms of sugar in living systems
    - Starch - storage polysaccharide in plants
    - Glycogen - storage polysaccharide in animals, fungi, etc.
    - Structural forms in plants and animals
    - Cellulose - structural polysaccharide in plants
    - Chitin - structural polysaccharide in insects
    - Polysaccharides hydrolysed to disaccharides before used as energy sources
        - Plants have high carbohydrate storage capacity – potato starch
        - Animals have limited carbohydrate storage capacity

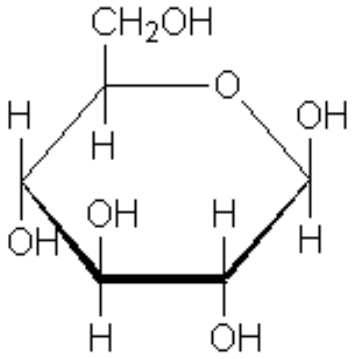
Glucose

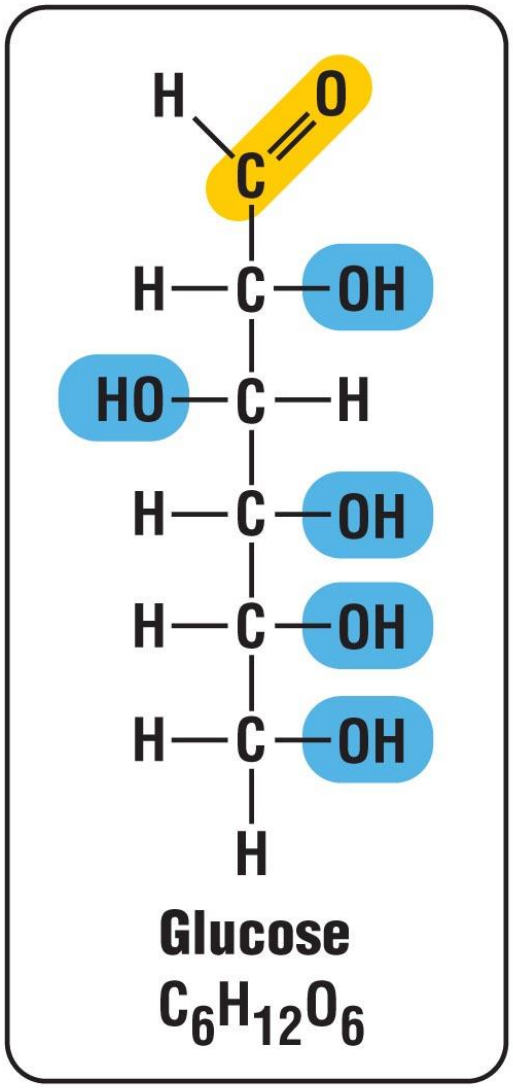


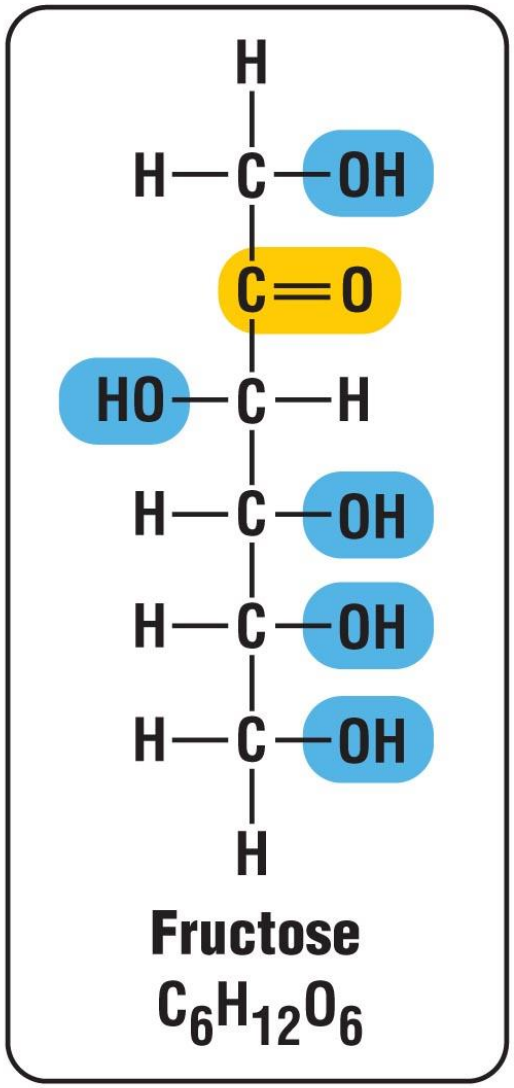
(a) Linear and ring structures

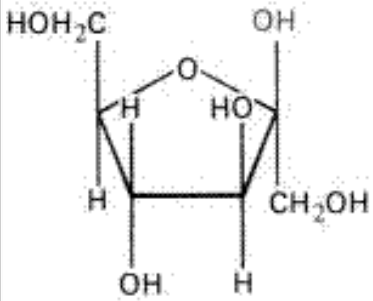
(b) Abbreviated ring structure

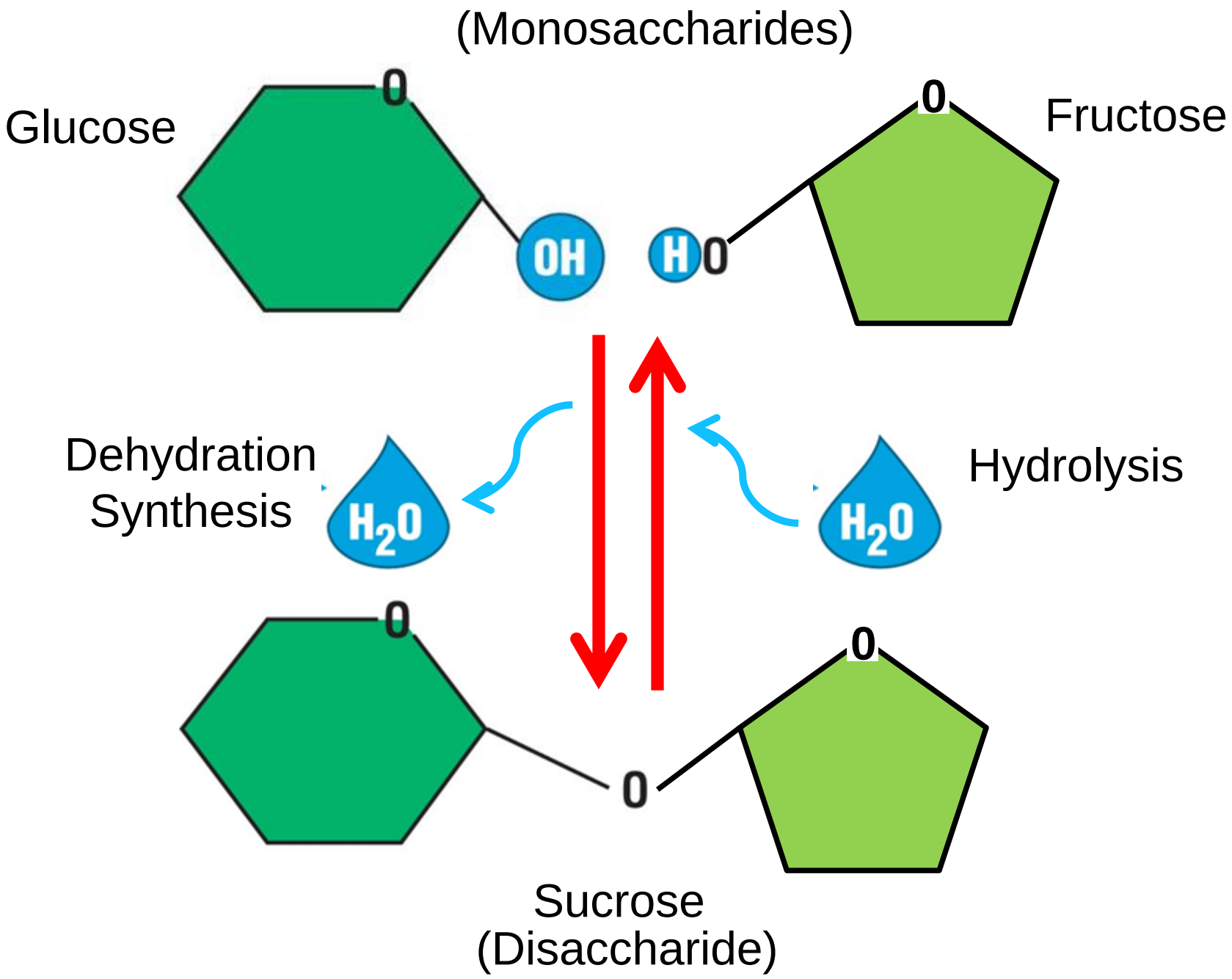
Figure 3.9










(Monosaccharides)
Glucose
Fructose
O
O
OH
H
O
Dehydration
Synthesis
Hydrolysis
H_2O
H_2O
O
O
O
Sucrose
(Disaccharide)

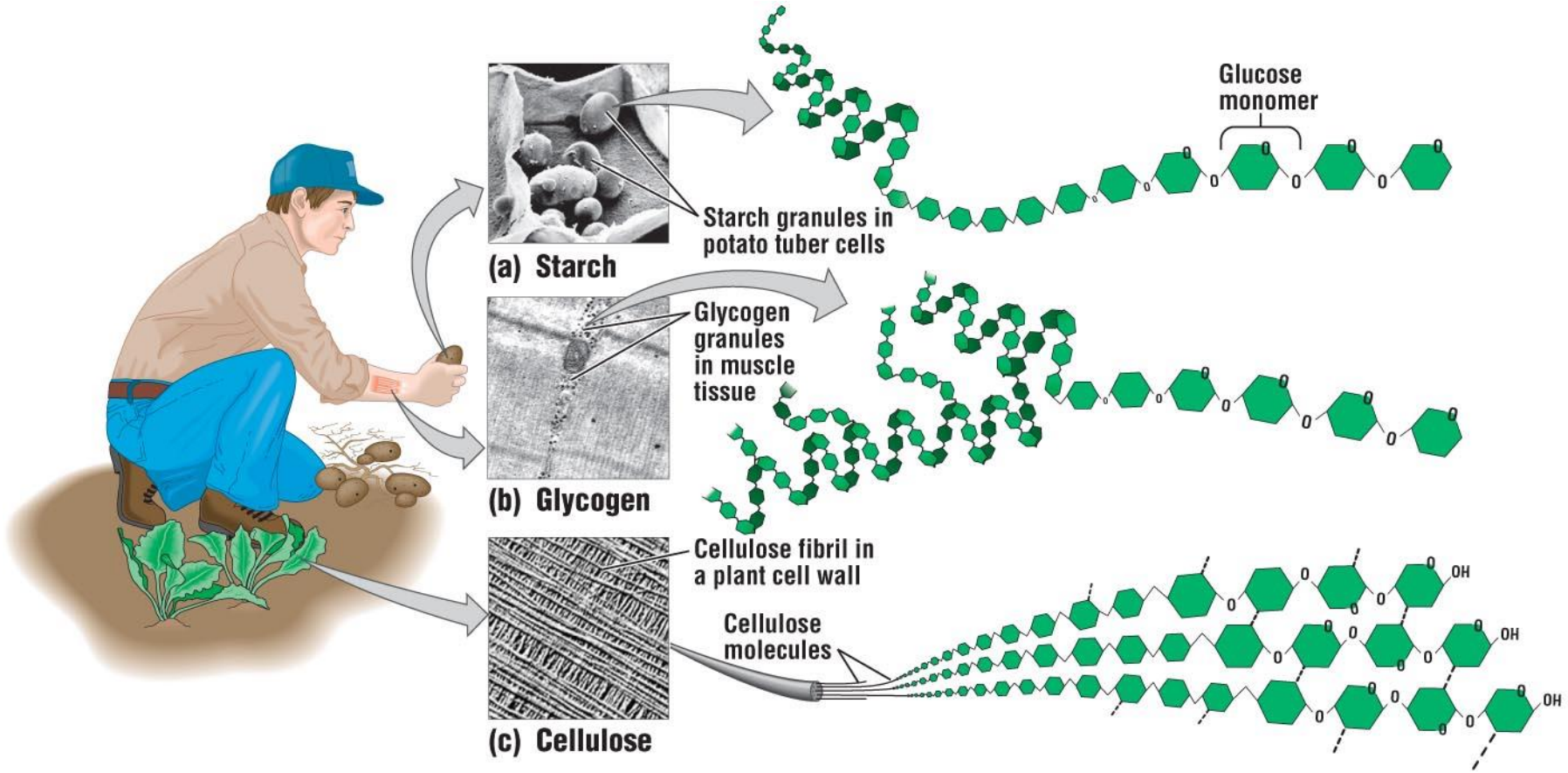


Figure 3.13

Chapter 3
Organic Molecules

Lipids, etc.

1. Fats & Oils

Energy storage - contain more chemical energy than carbohydrates

Excess glycogen in animals is stored as fat

Fat molecule = 1 glycerol & 3 fatty acid molecules

Saturated & unsaturated fatty acids

2. Phospholipids.

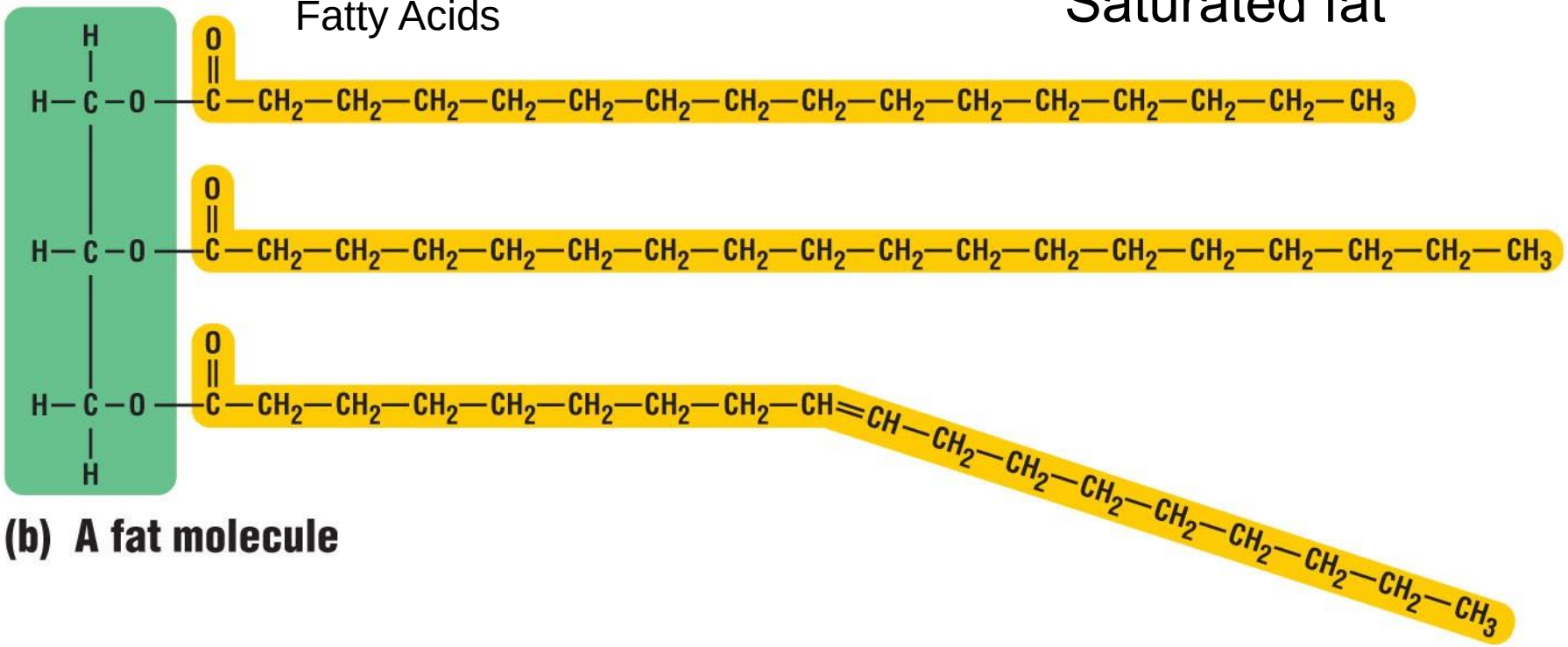
Important structural components of cell membranes

Polar and nonpolar ends of a long chain molecule

Glycerol Molecule

Fatty Acids

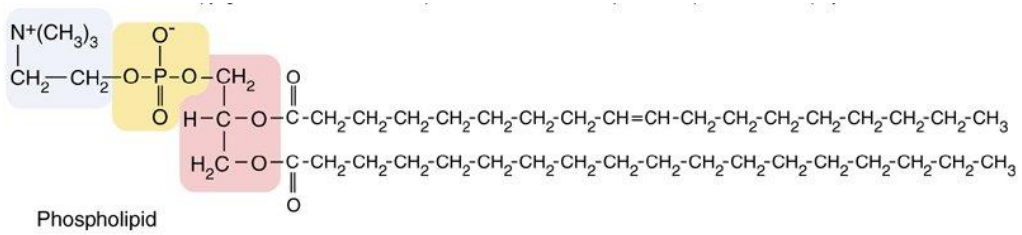
“Saturated fat”

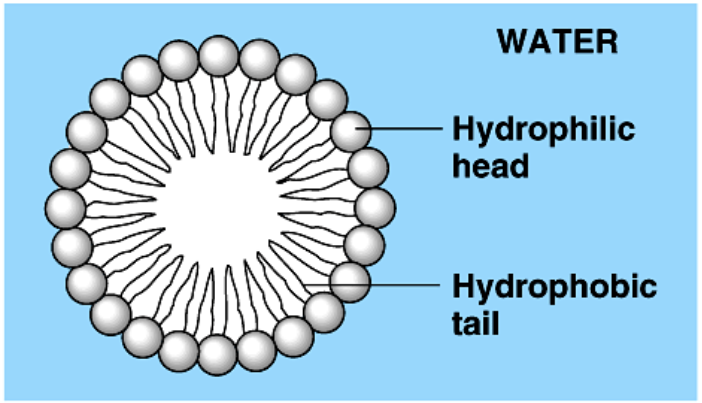


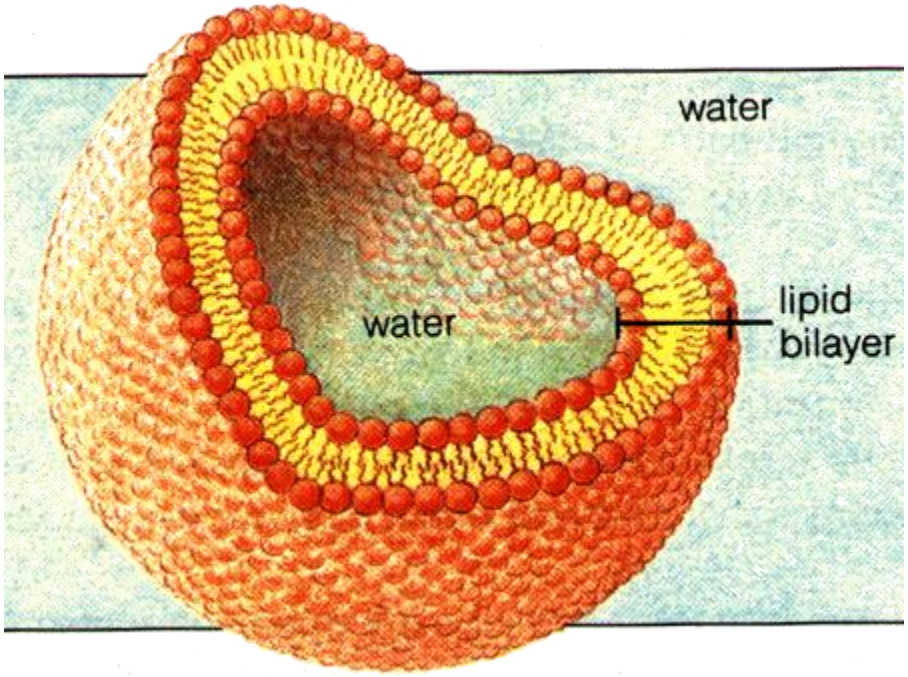
(b) A fat molecule

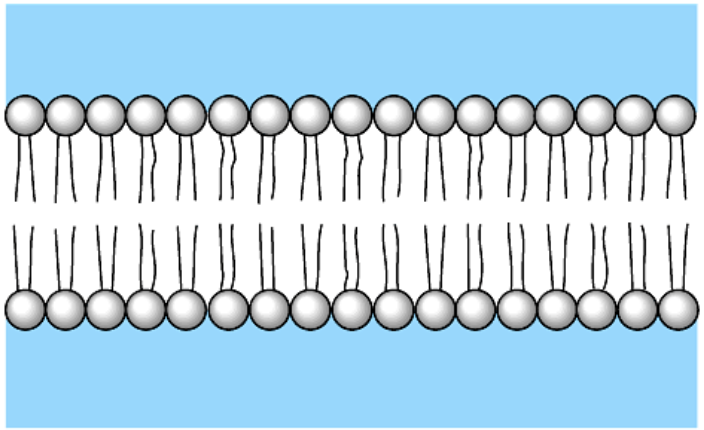
“Unsaturated fat”

Phospholipids









Chapter 3
Organic Molecules

Proteins

1. Diverse functions – Muscles, Enzymes, etc.
2. Composed of polymers of amino acids, the building blocks of proteins
    - Peptide bonds
    - Polypeptides
3. Structural levels
    - Primary structure – linear sequence of amino acids
    - Secondary structure
        - Formation of helixes – held together by hydrogen bonds
        - Pleated sheets
        - Fibrous proteins
    - Tertiary structure .
        - Disulphide bridges - cysteine
    - Quaternary structure
        - Composed of more than one polypeptide chain
        - Enzymes and antibodies

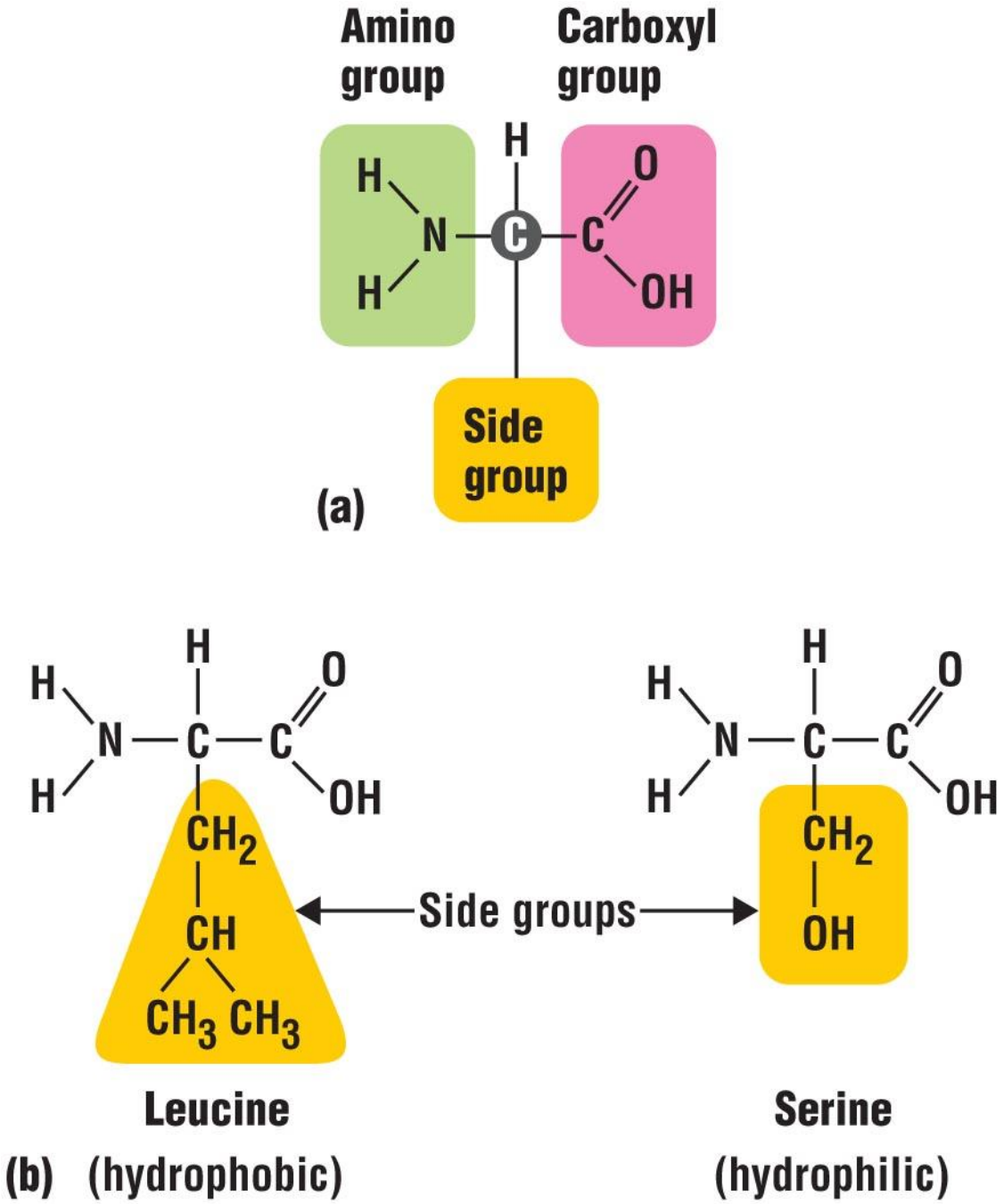


Figure 3.20

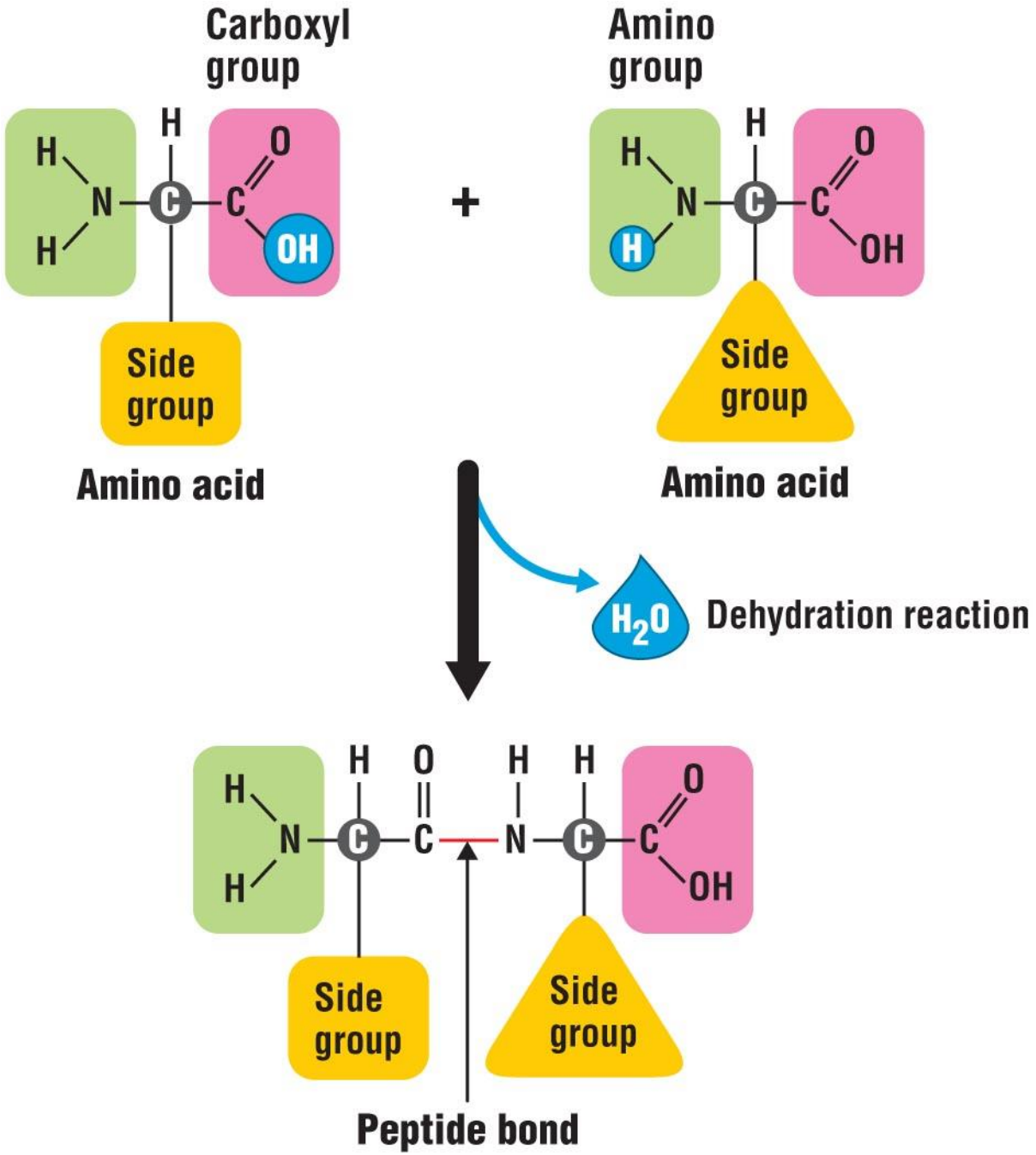
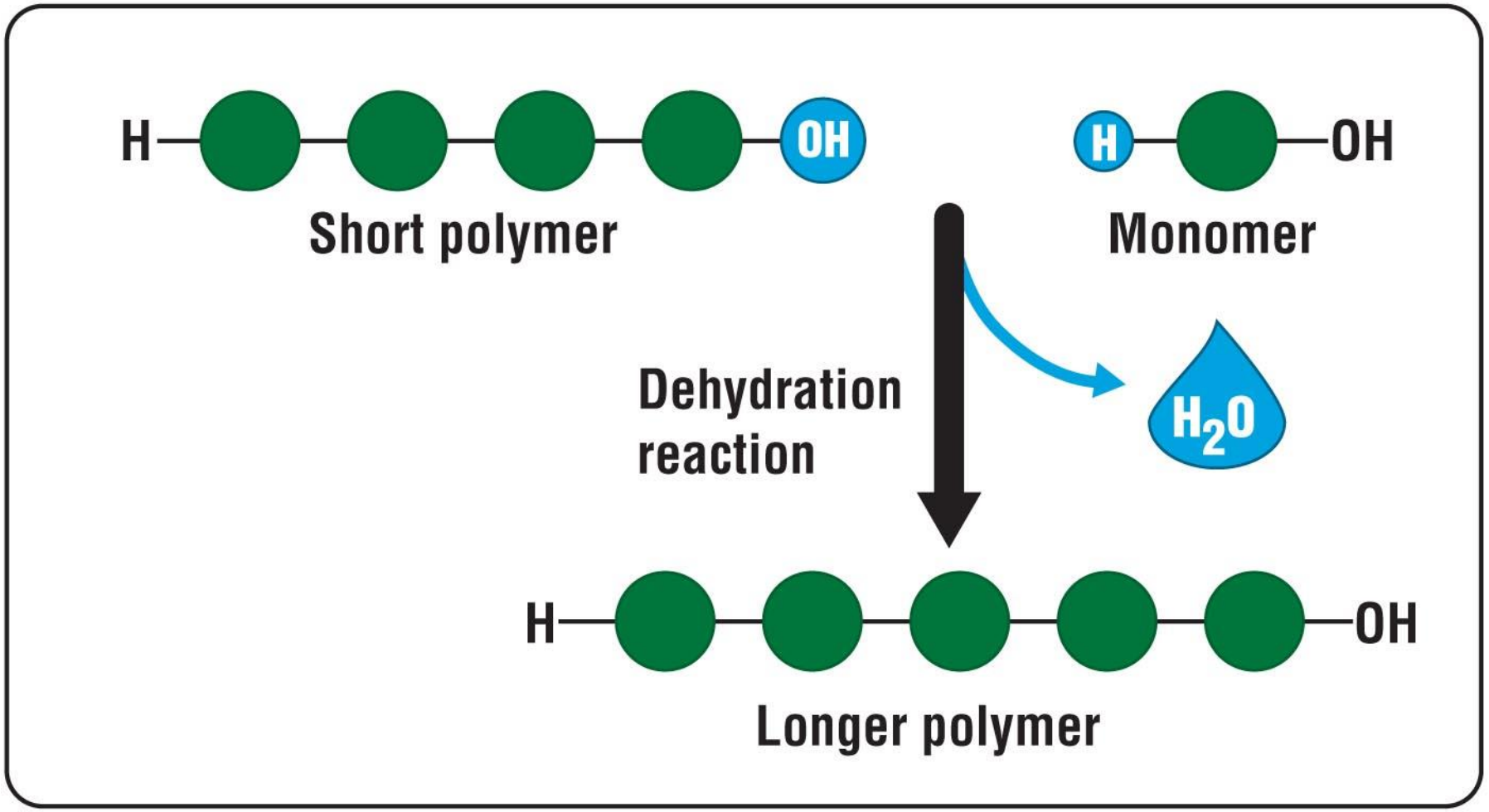
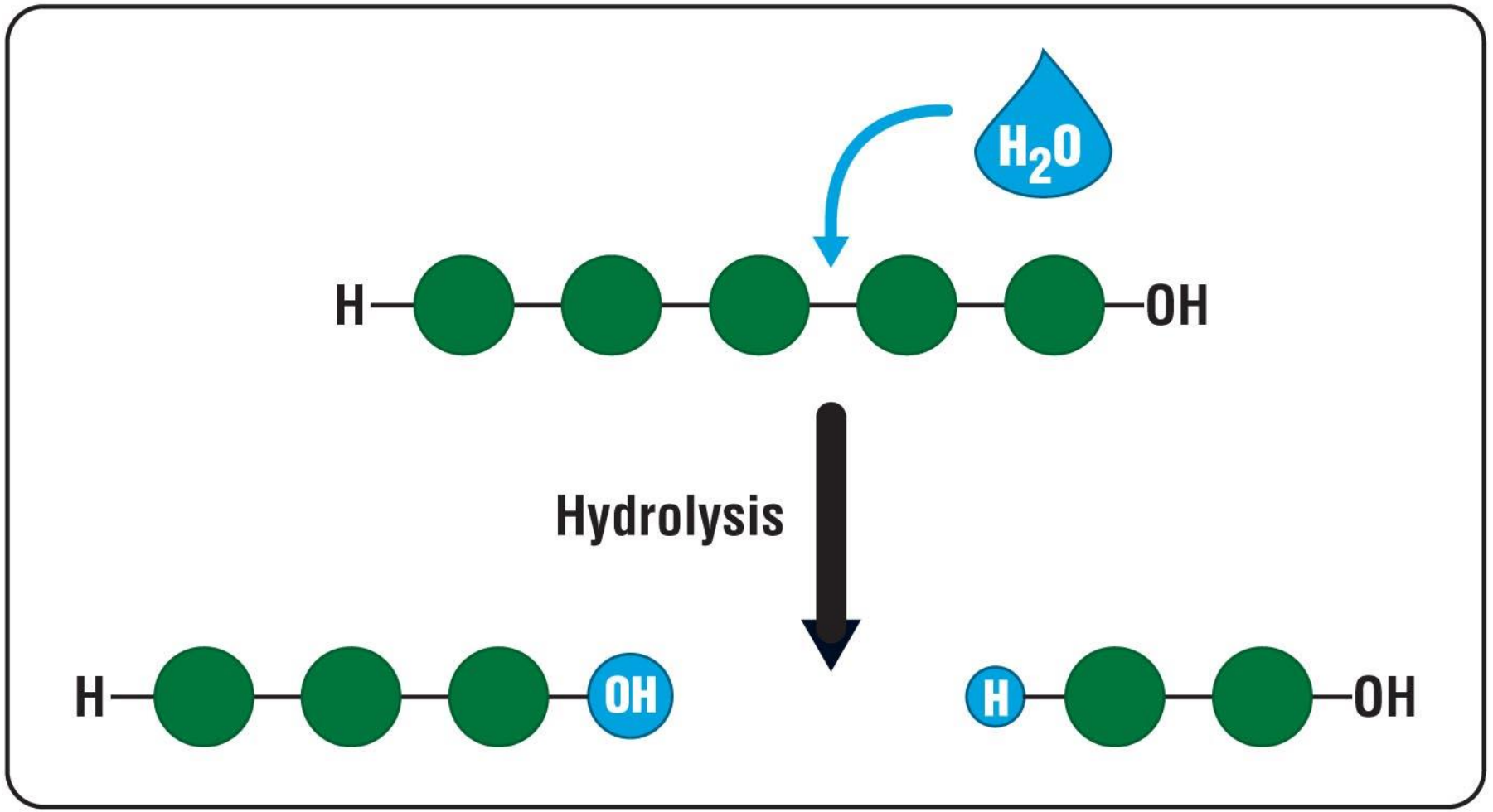


Figure 3.21



(a) Building a polymer chain

Figure 3.6a



(b) Breaking a polymer chain

Figure 3.6b

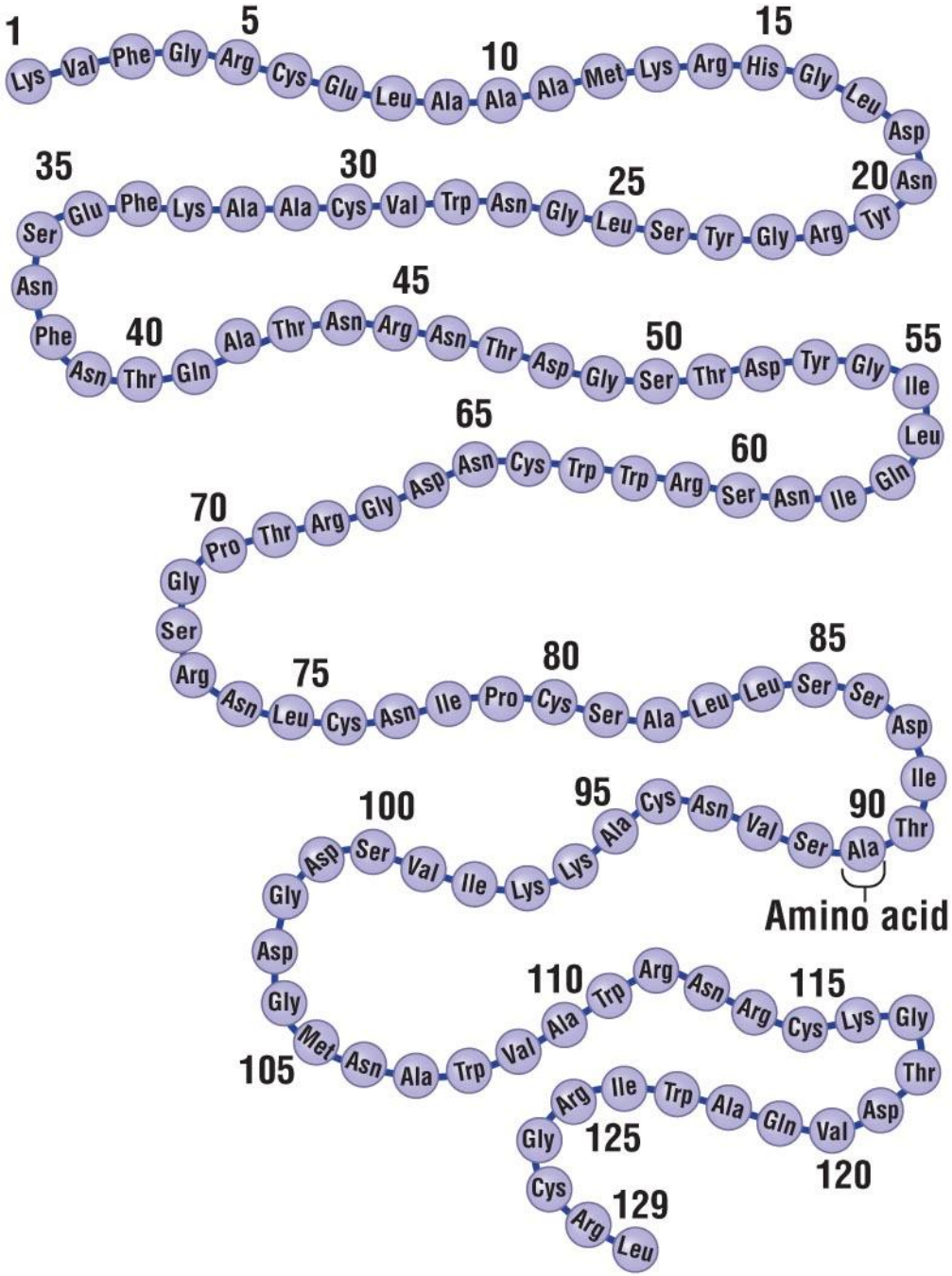


Figure 3.22

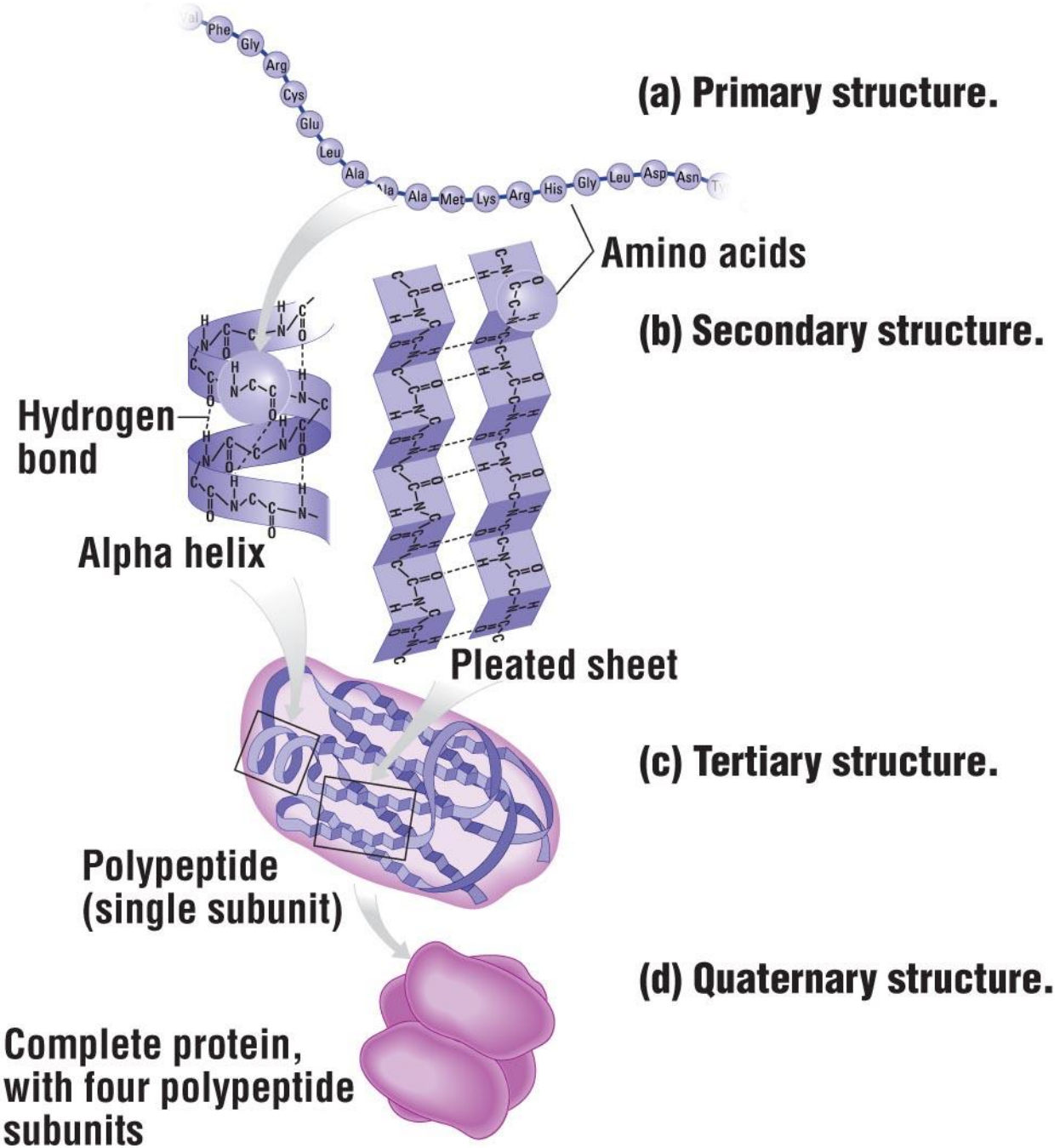


Figure 3.24

1-21. Quaternary Structure: Geometry

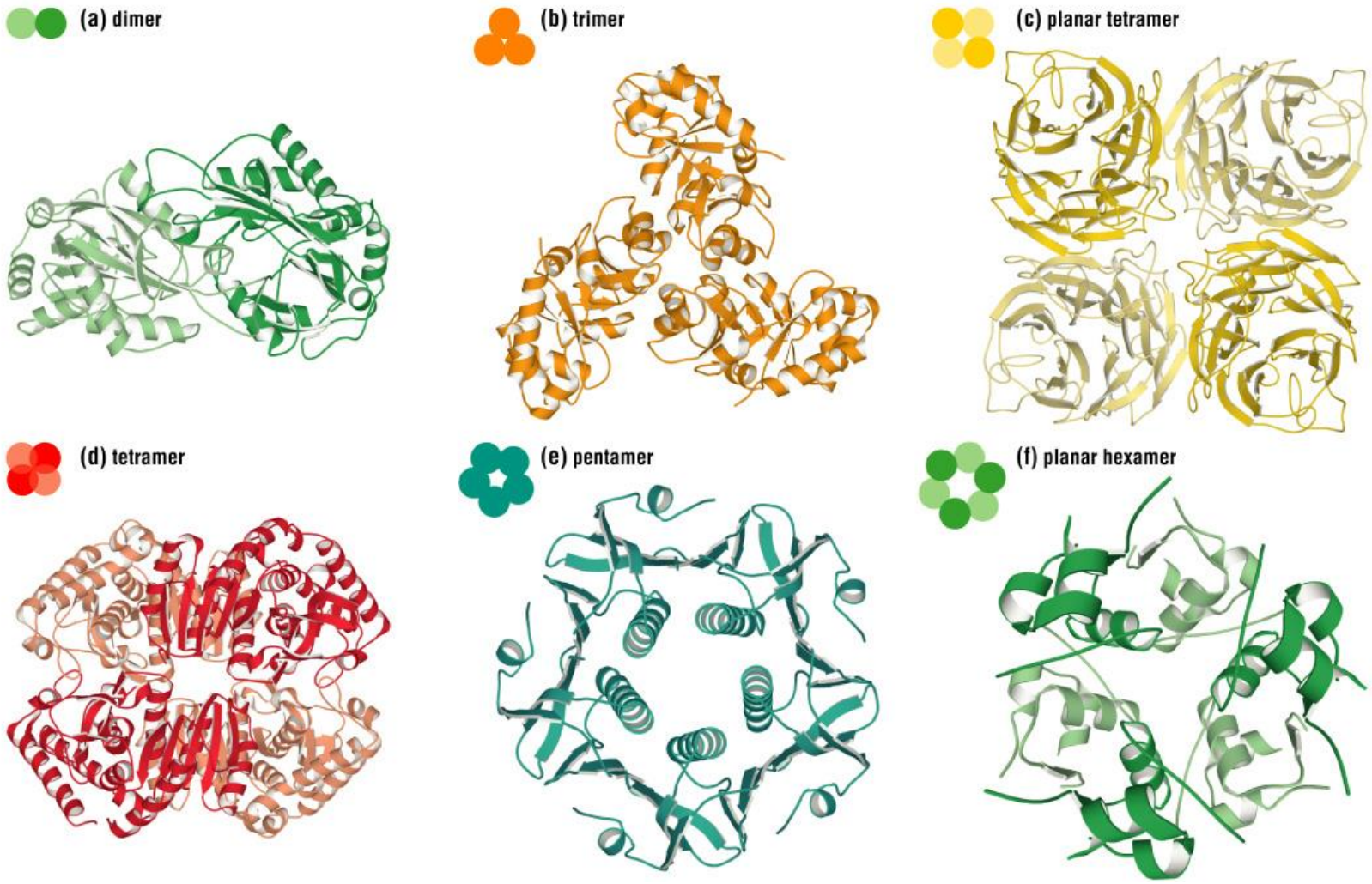


Figure 1-74. Examples of quaternary arrangements observed for oligomeric proteins

1-21. Quaternary Structure: Geometry

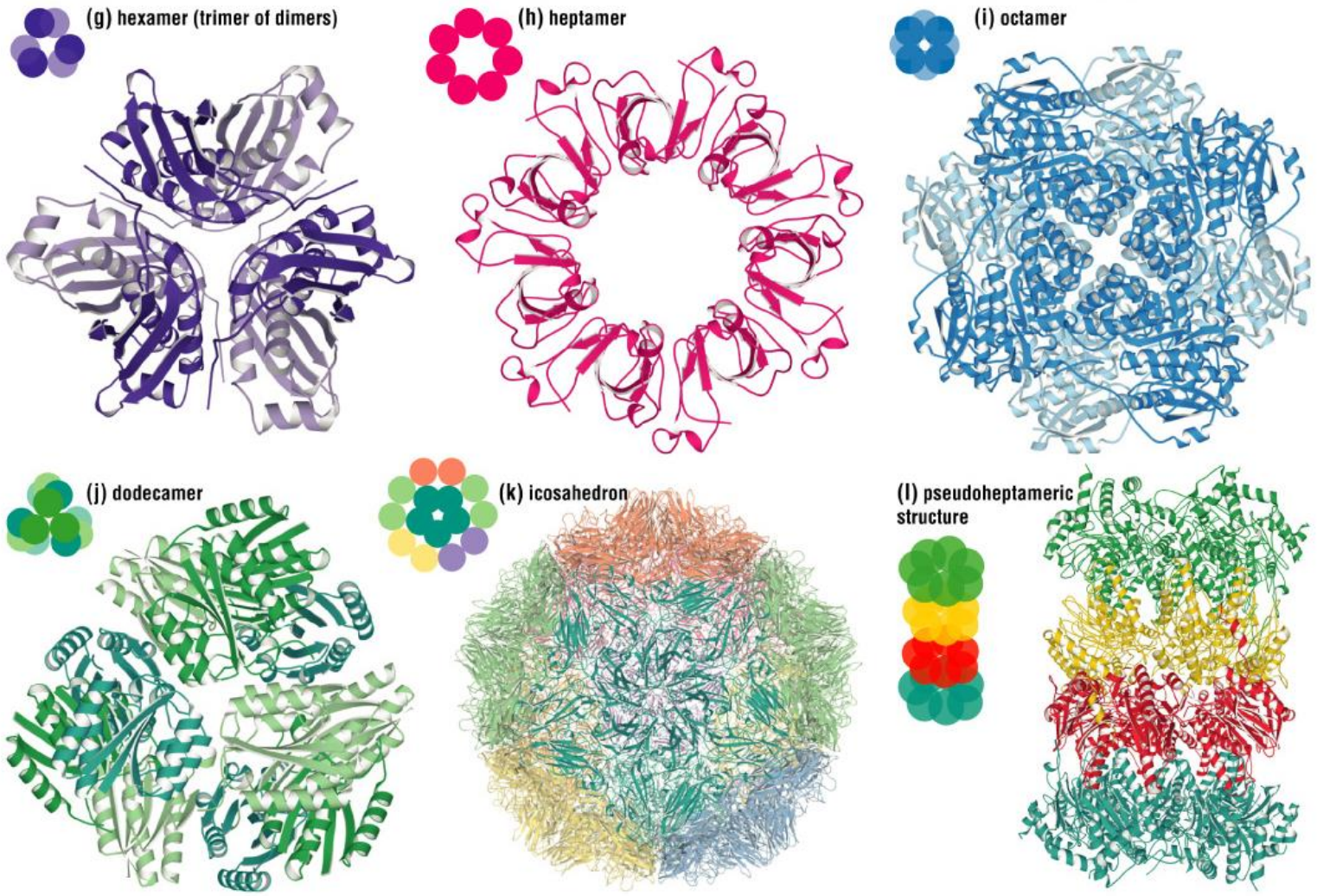
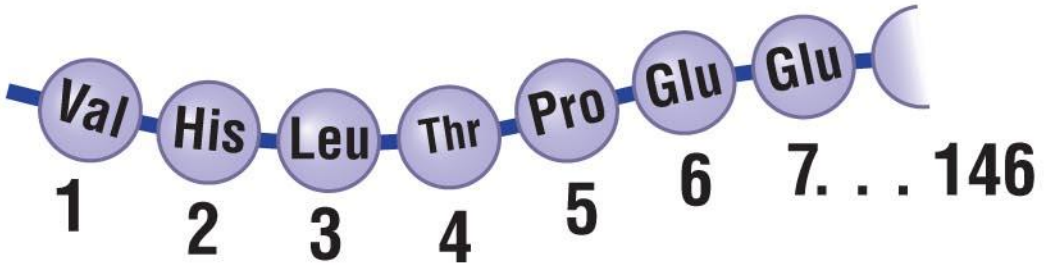


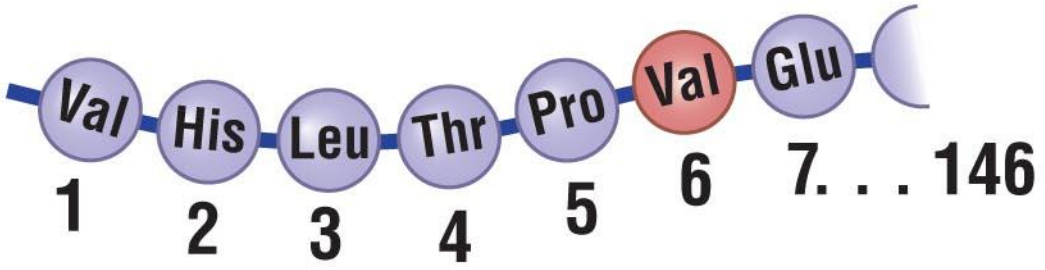
Figure 1-74. Examples of quaternary arrangements observed for oligomeric proteins



Normal red blood cell

Normal hemoglobin

(a)



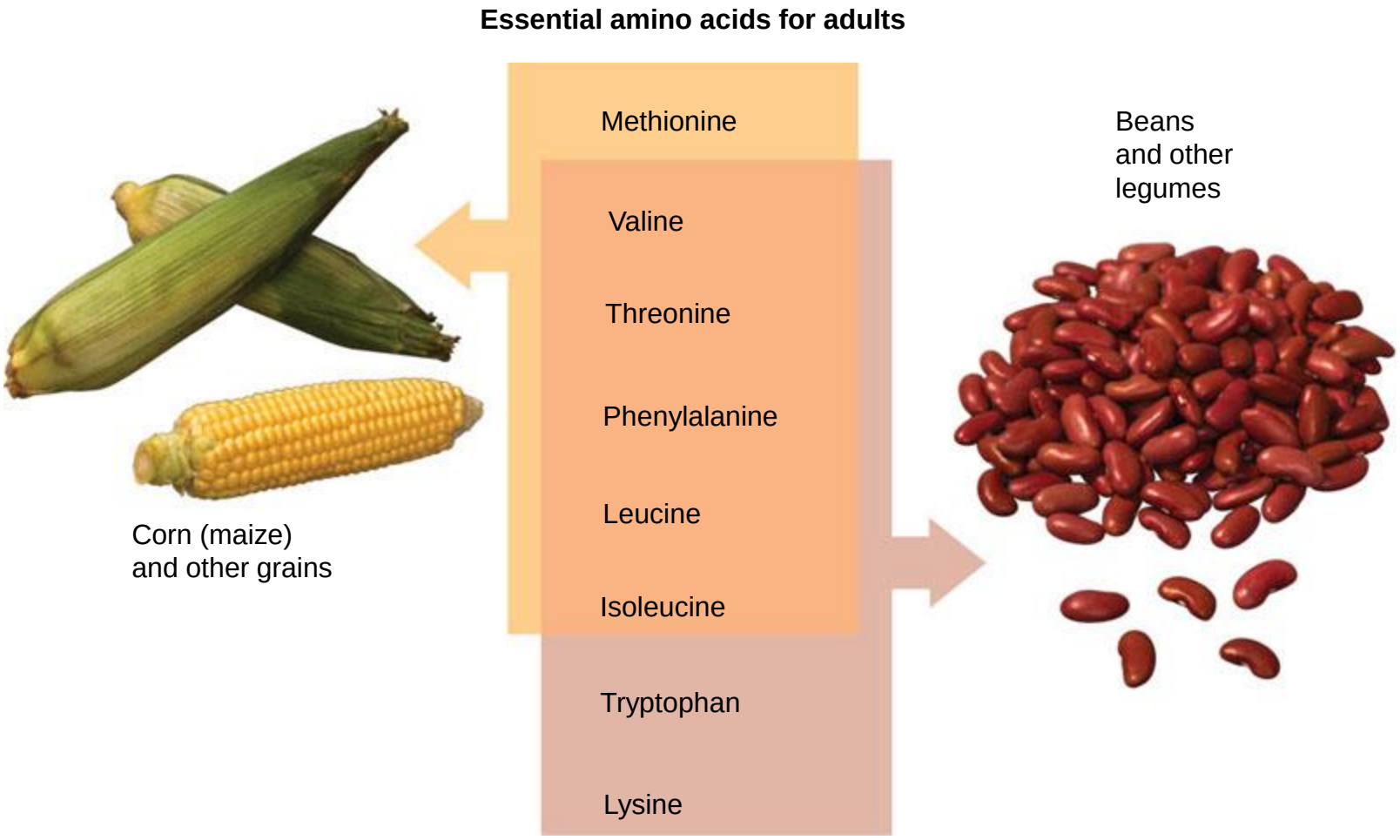
Sickled red blood cell

Sickle-cell hemoglobin

(b)

Figure 3.23

Figure 41.10 Essential amino acids from a vegetarian diet



Chapter 3
Organic Molecules

Nucleic Acids – long chains of nucleotides

1. Information carrying structures
2. Nucleotides
    - Building blocks of nucleic acids
    - Energy carrying molecules
        - ATP – adenosine triphosphate
        - ADP – adenosine diphosphate
3. Nucleic acids
    - DNA – genetic carrier - genes
    - RNA – transcript for protein synthesis

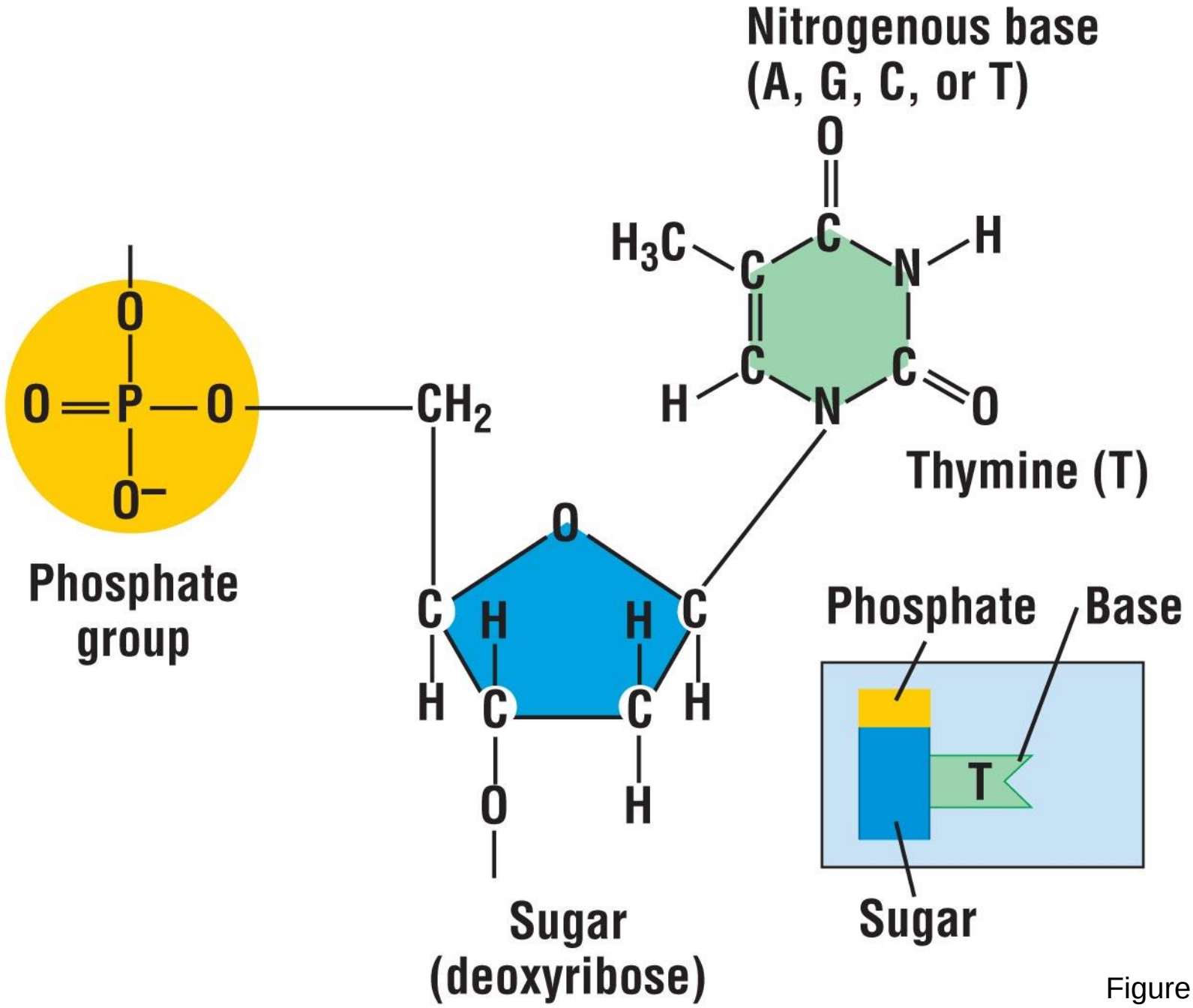
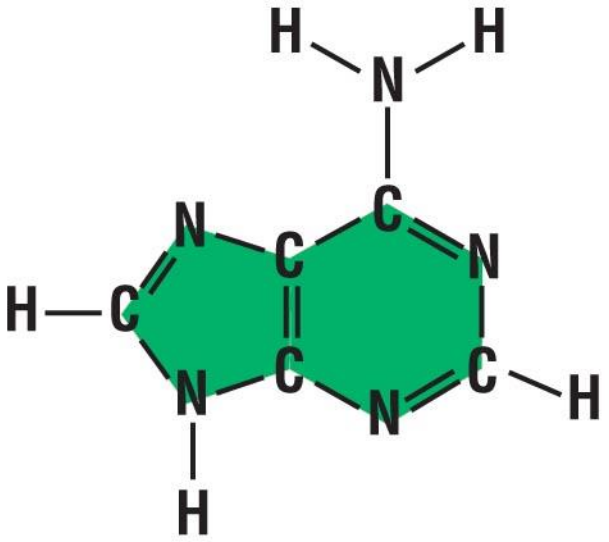
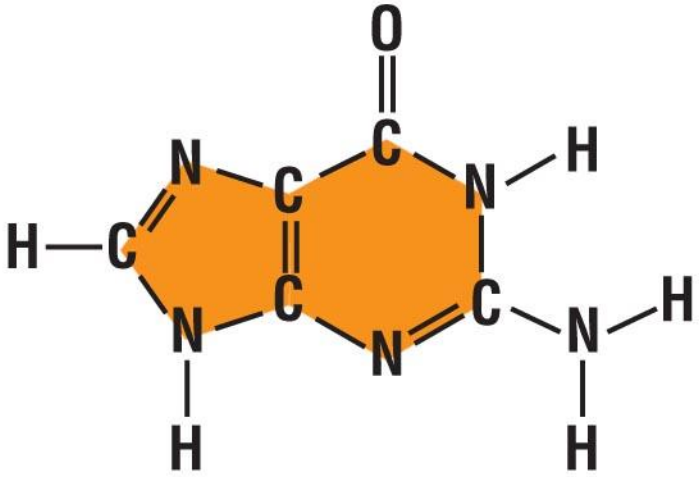


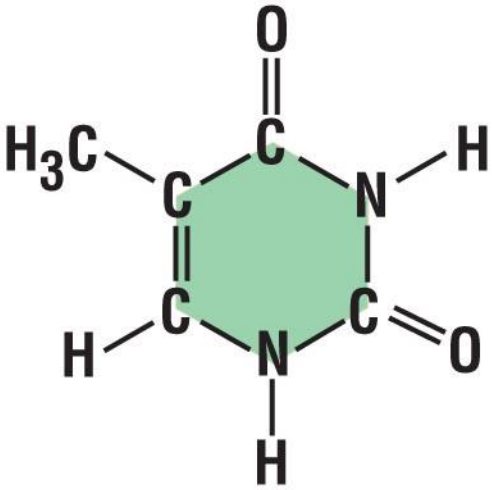
Figure 3.26



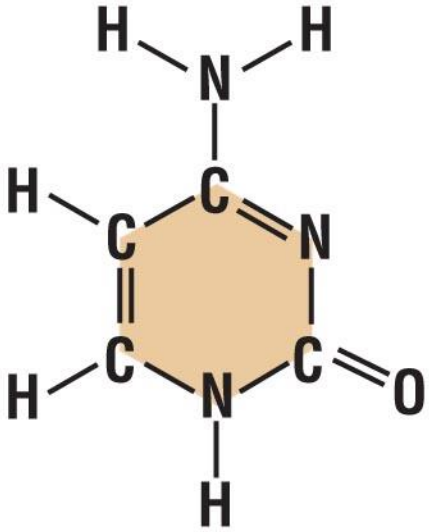
Adenine (A)



Guanine (G)



Thymine (T)



Cytosine (C)

Figure 3.27

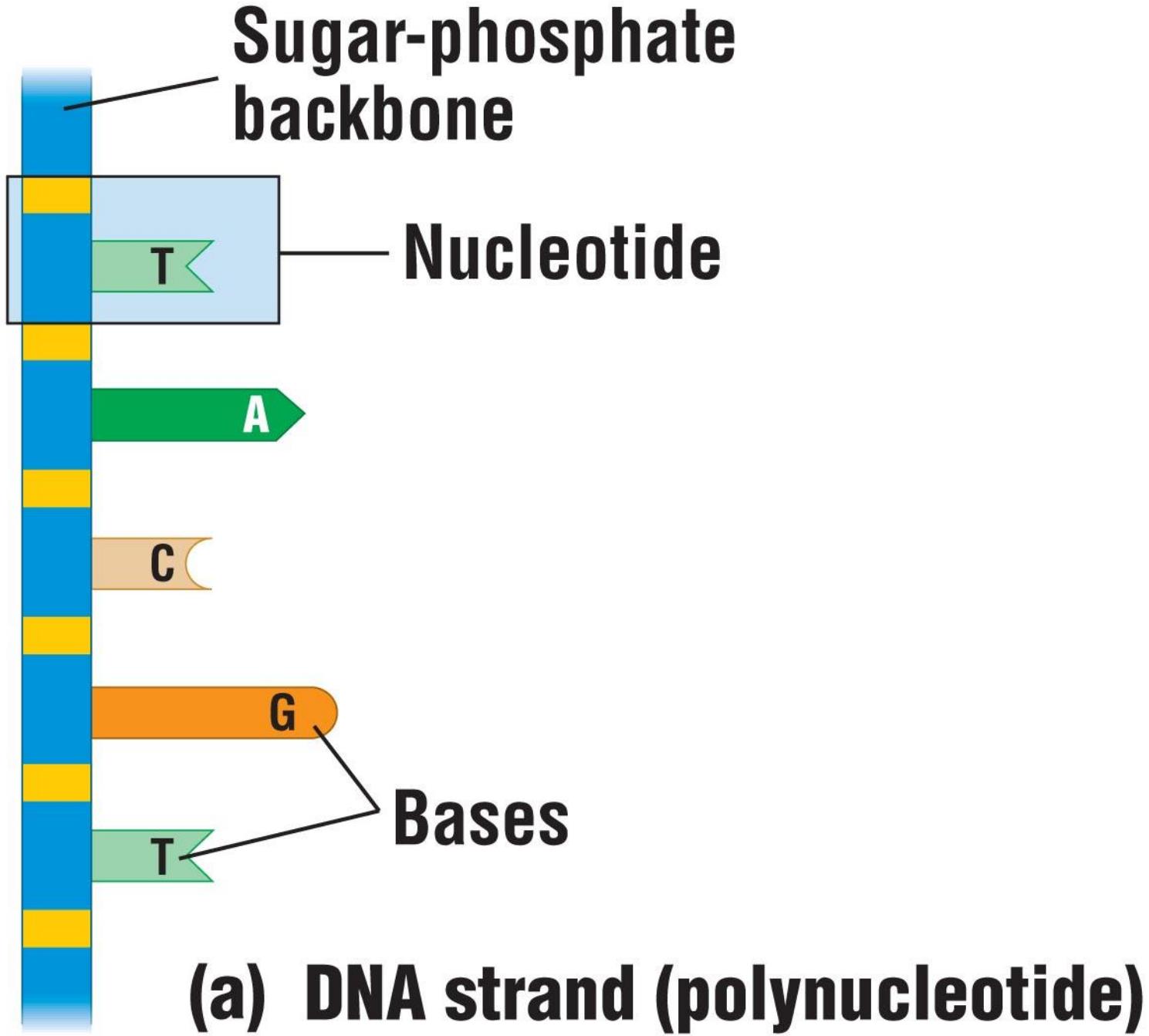
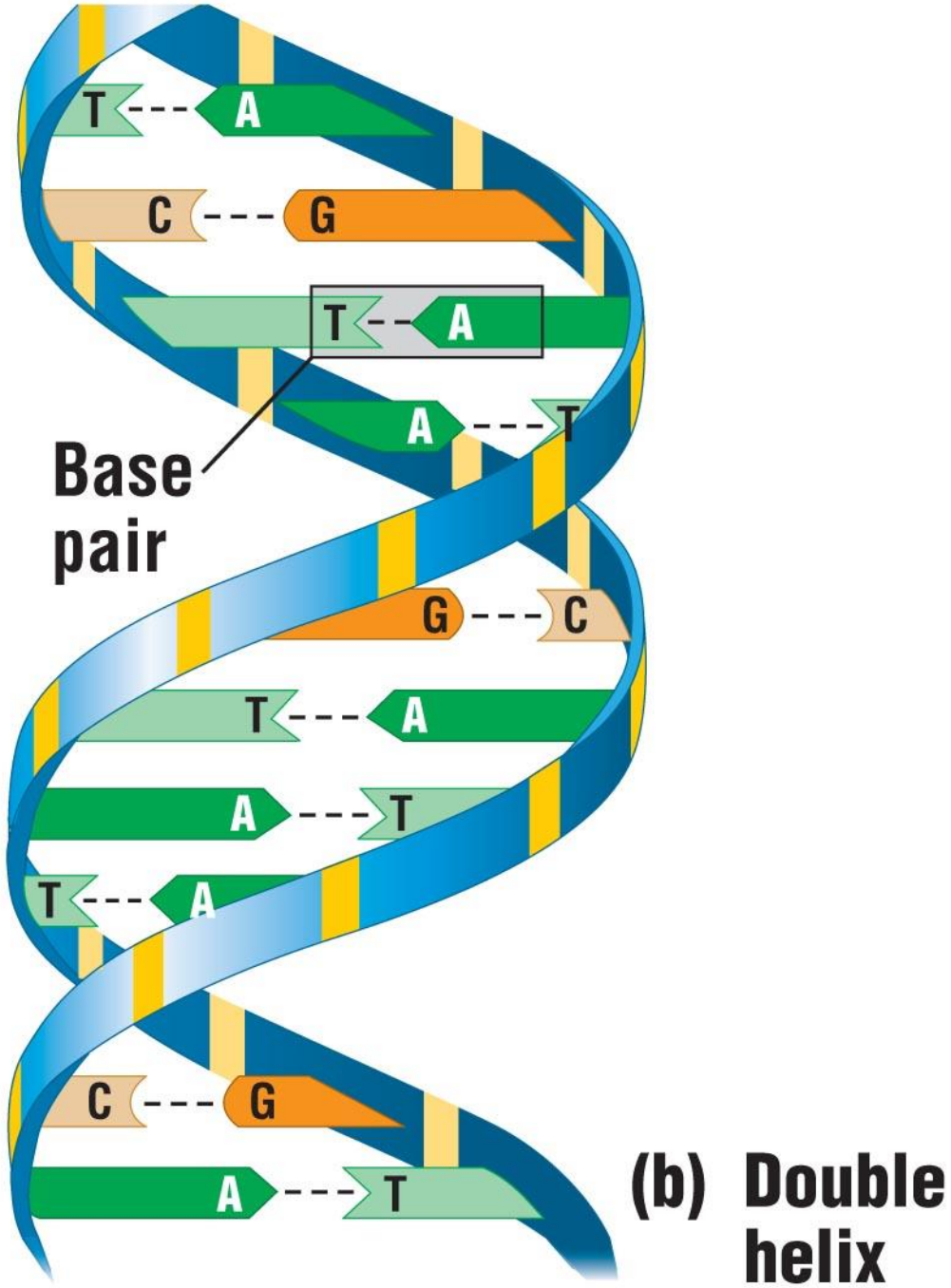


Figure 3.28a



(b) Double helix

Figure 3.28b

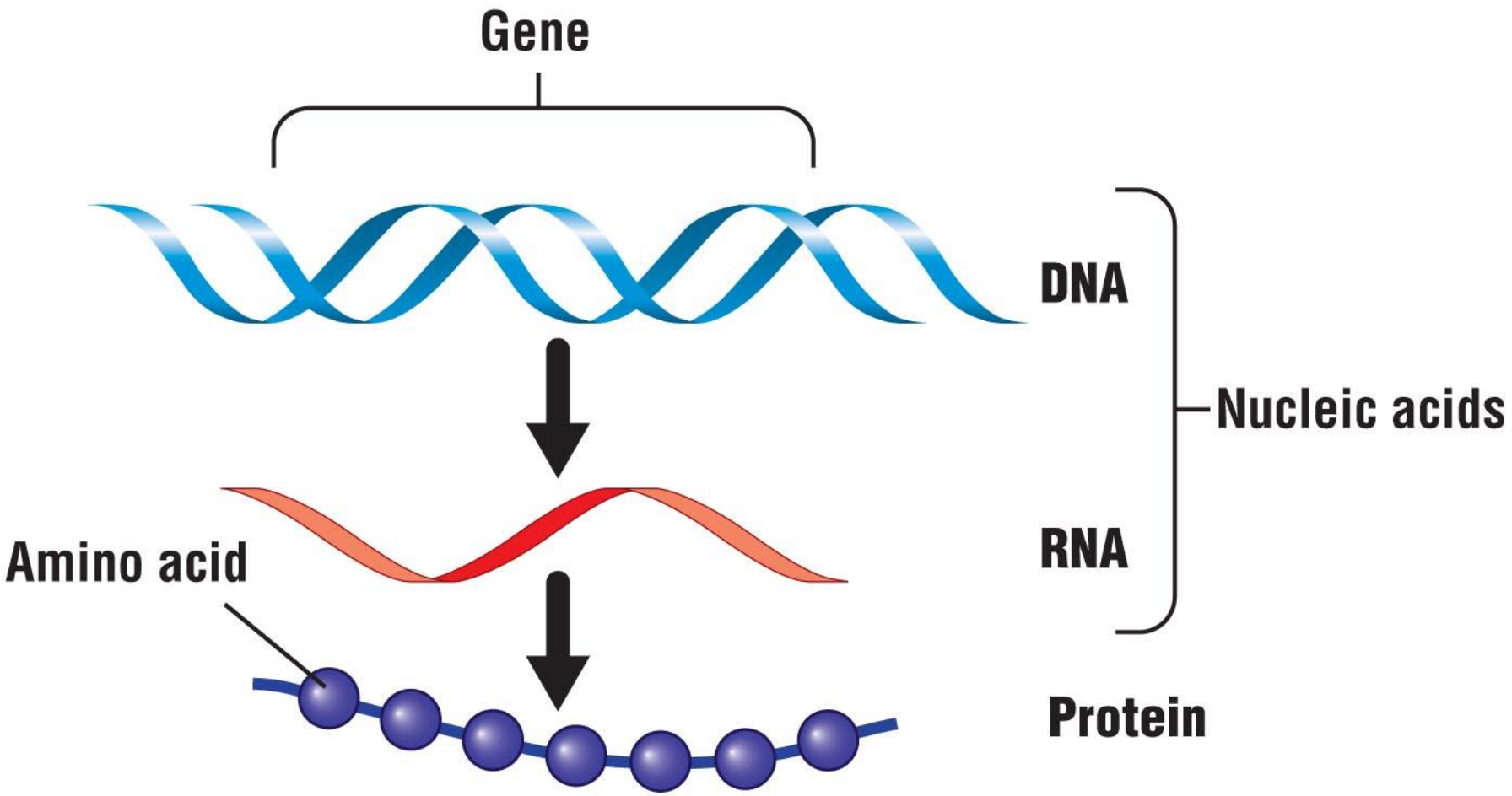


Figure 3.25

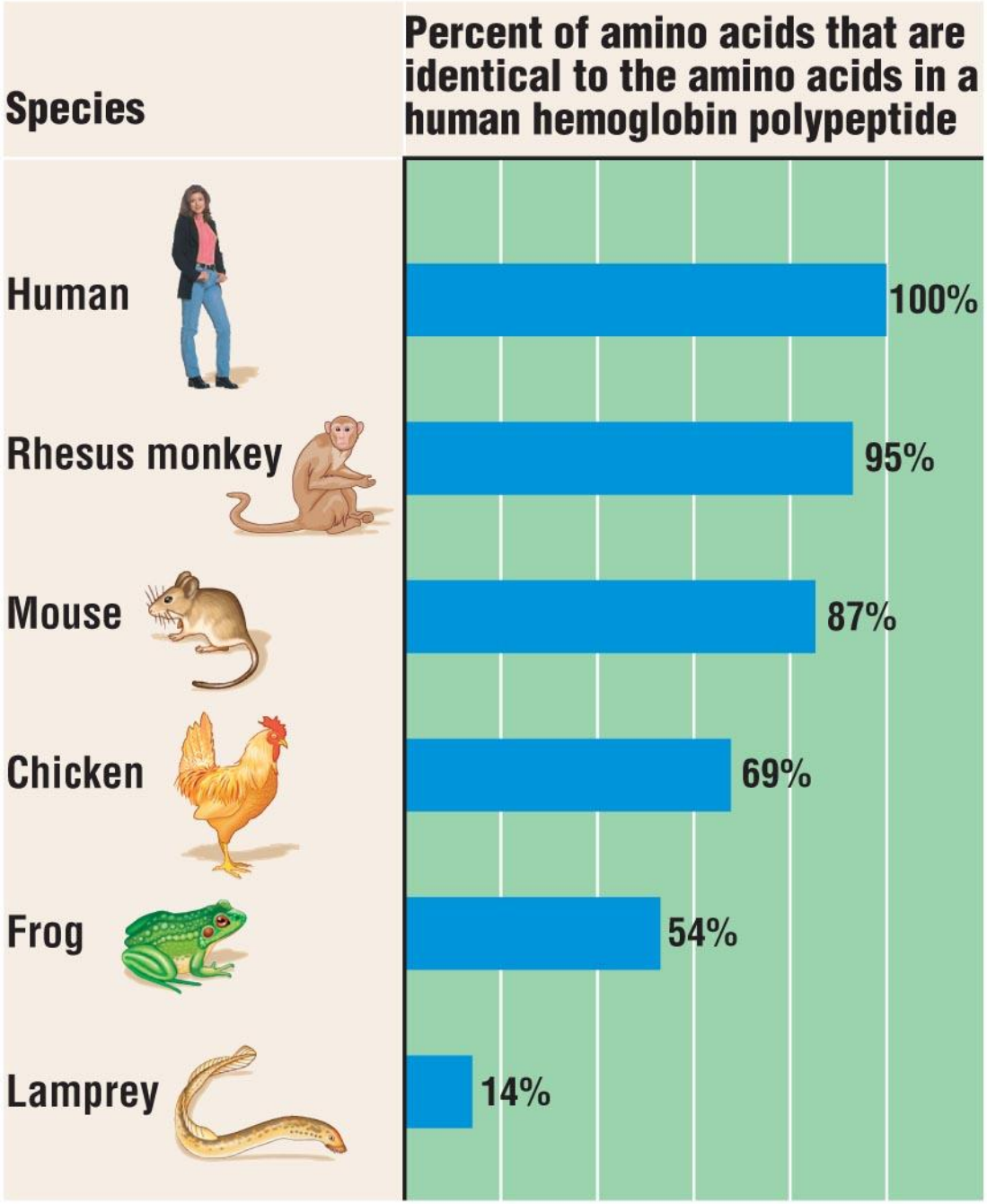
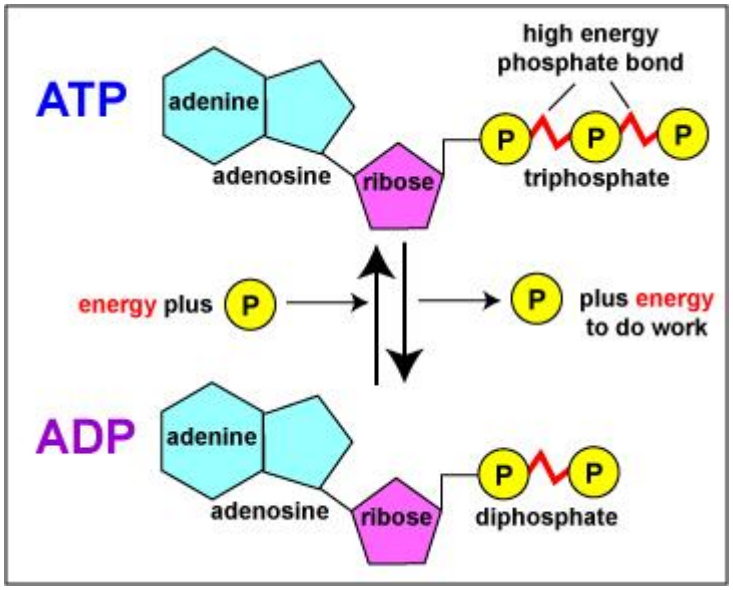
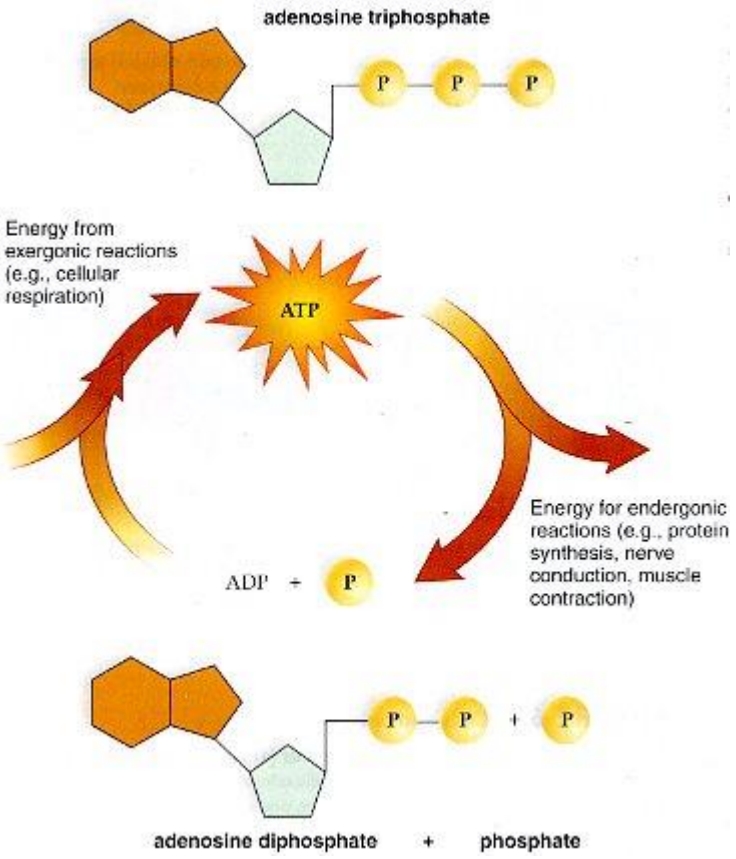


Figure 3.30


ATP
adenine
adenosine
ribose
high energy
phosphate bond
P
P
P
triphosphate
energy plus
P
P
plus energy
to do work
ADP
adenine
adenosine
ribose
P
P
diphosphate


adenosine triphosphate
P
P
P
Energy from
exergonic reactions
(e.g., cellular
respiration)
ATP
Energy for endergonic
reactions (e.g., protein
synthesis, nerve
conduction, muscle
contraction)
ADP
+
P
P
P
+
P
adenosine diphosphate
+
phosphate