

FUNDAMENTALS OF CHEMISTRY

CHAPTER 2



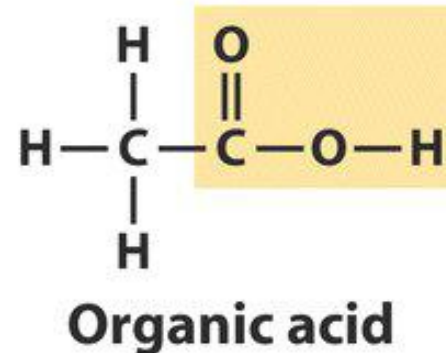
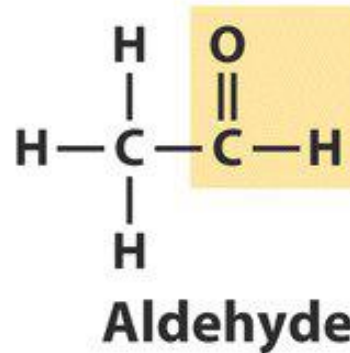
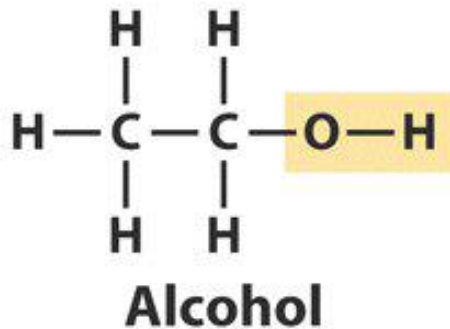
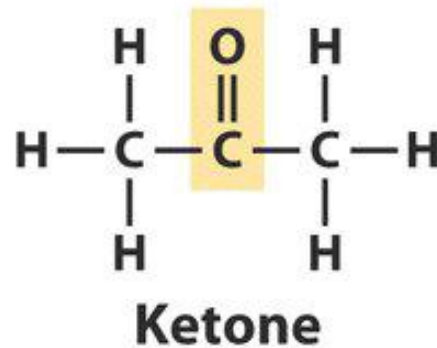
Stephen Saks Photography/Alamy

Begin with p. 37 Complex Organic Molecules

I realize that most of this material is review but I want to make sure that we all start on the same page with regard to information about organic molecules.

Biochemical Molecules

- Hydrocarbons
- Functional groups
- Organic monomers and polymers



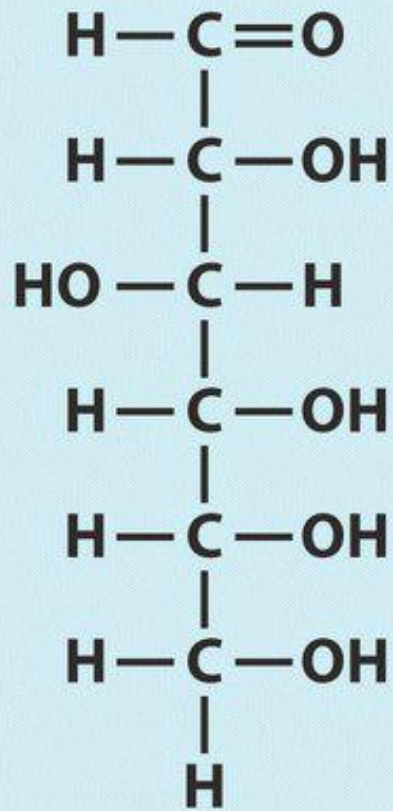
Reduced ←————→ **Oxidized**

Figure 2-8 Microbiology, 6/e
© 2005 John Wiley & Sons

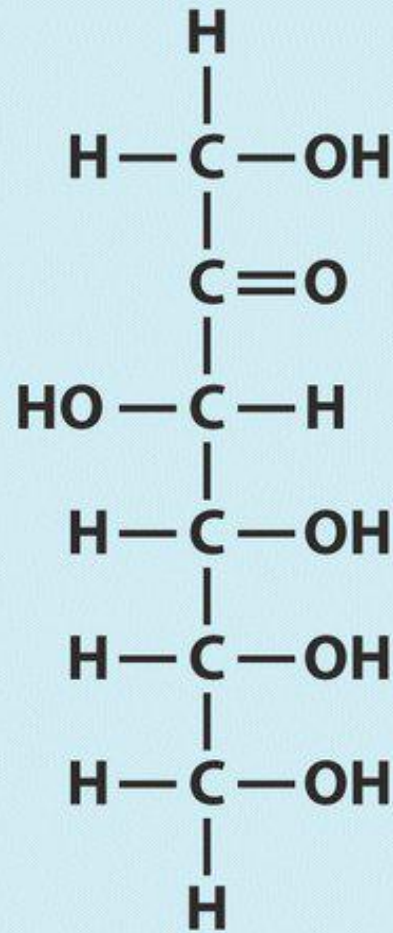
Oxidation= gain of oxygen or a loss of hydrogen

Reduction= loss of oxygen or gain of hydrogen

Fig. 2.8 Four Classes of organic compounds that contain oxygen



Glucose
(C₆H₁₂O₆)

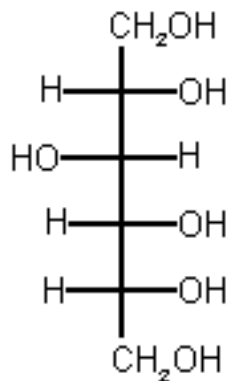


Fructose
(C₆H₁₂O₆)

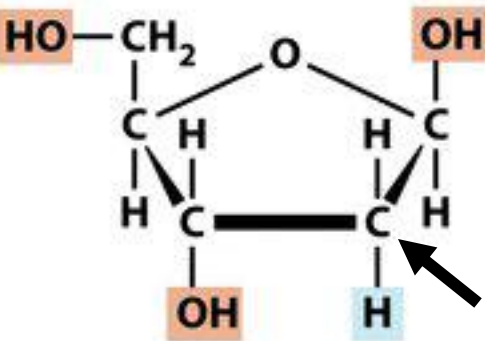
Figure 2-9 Microbiology, 6/e
 © 2005 John Wiley & Sons

Fig. 2.9 Isomers. Glucose and Fructose are isomers. They contain the same atoms, but differ in structure

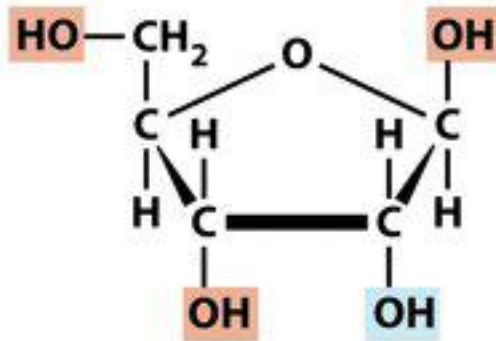
Sorbitol



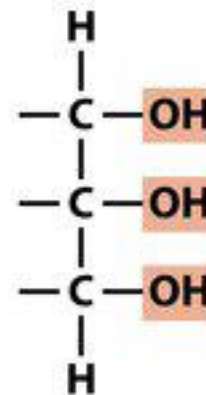
Sorbitol better than glucose (sucrose) for preventing dental carries because *Streptococcus mutans* cannot make a sticky plaque of dextran from sorbitol and it can from glucose.



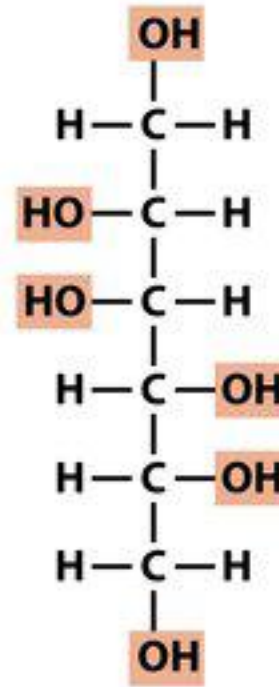
(a) Deoxyribose



(b) Ribose



(c) Glycerol

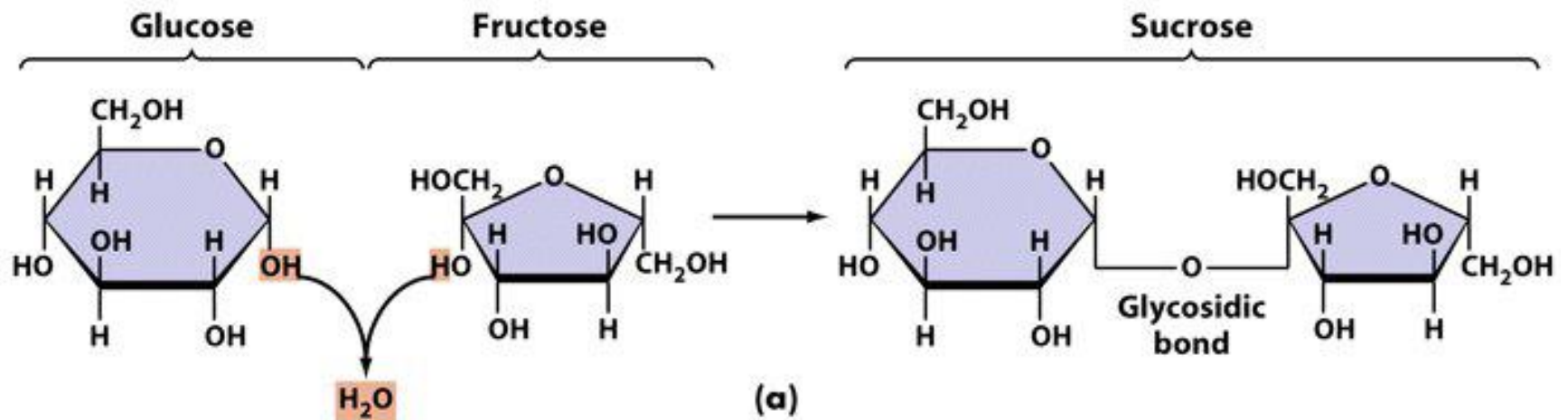


(d) Mannitol

Backbone for
Phospholipids and
Mono, di and triglycerides

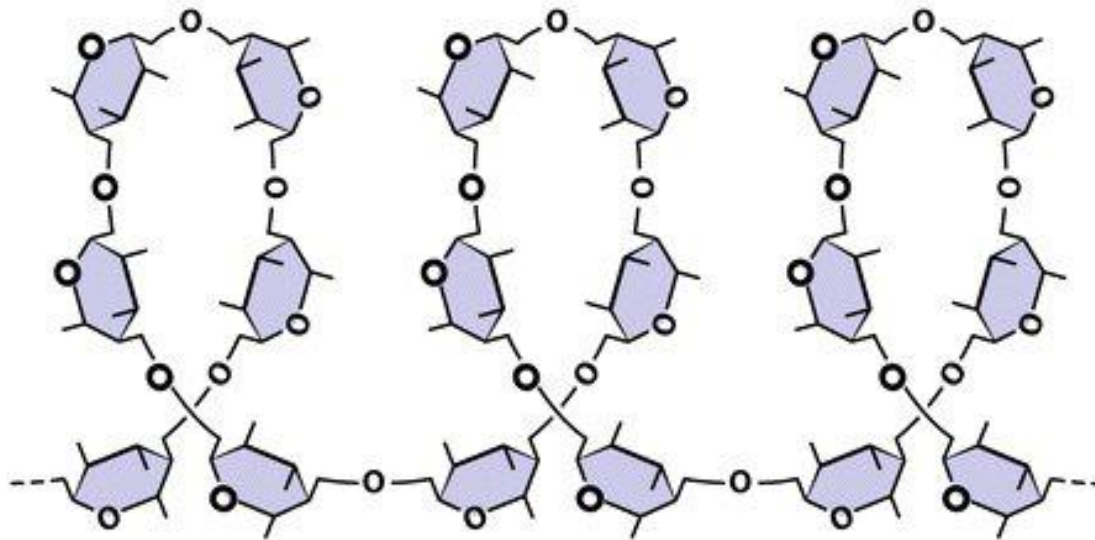
Mannitol
fermentation used
in diagnostic tests

Fig. 2.11 Deoxy sugars and sugar alcohols



Two monosaccharides

One disaccharide



(b) The polysaccharide starch

Figure 2-12 Microbiology, 6/e
© 2005 John Wiley & Sons

Fig. 2.12 Disaccharides and polysaccharides

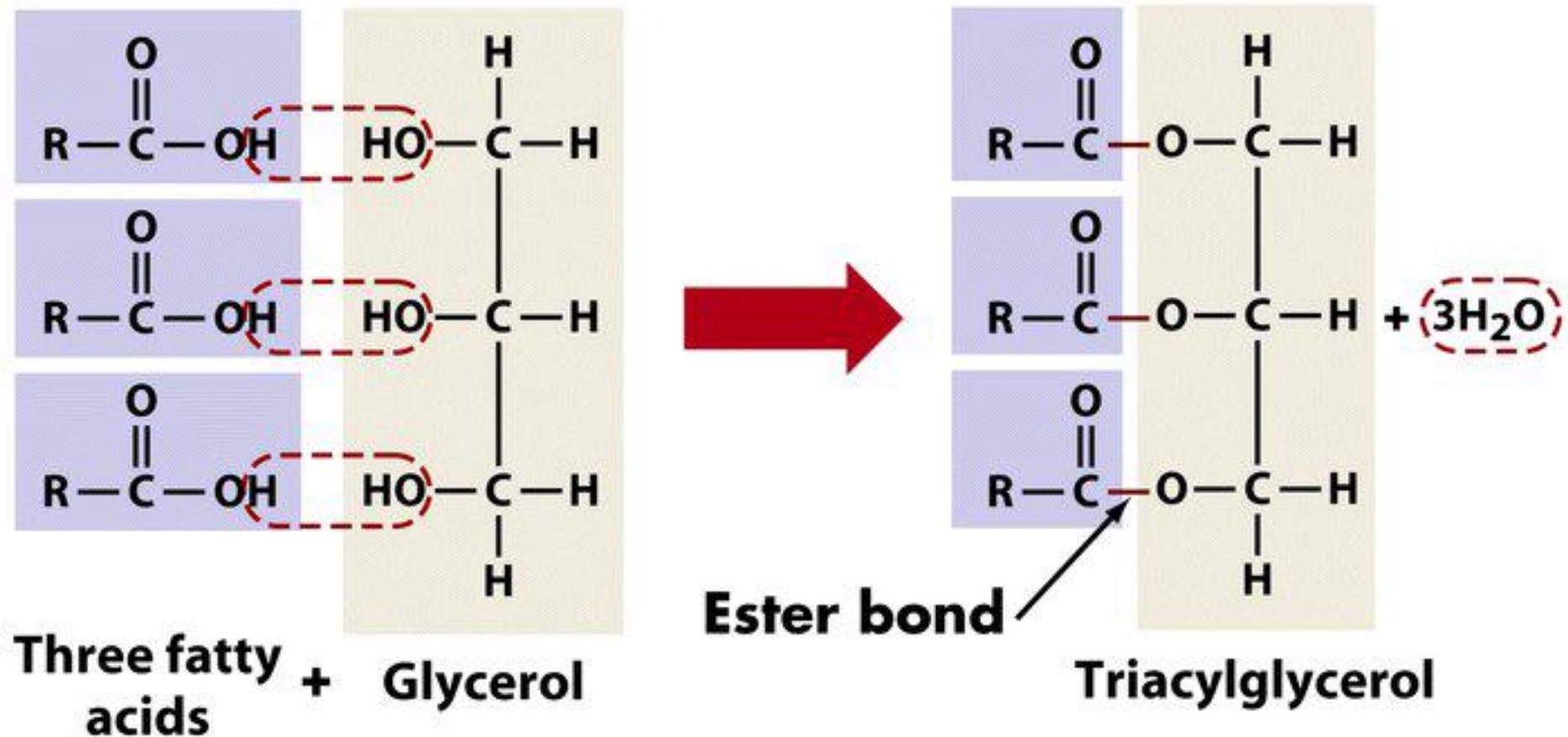
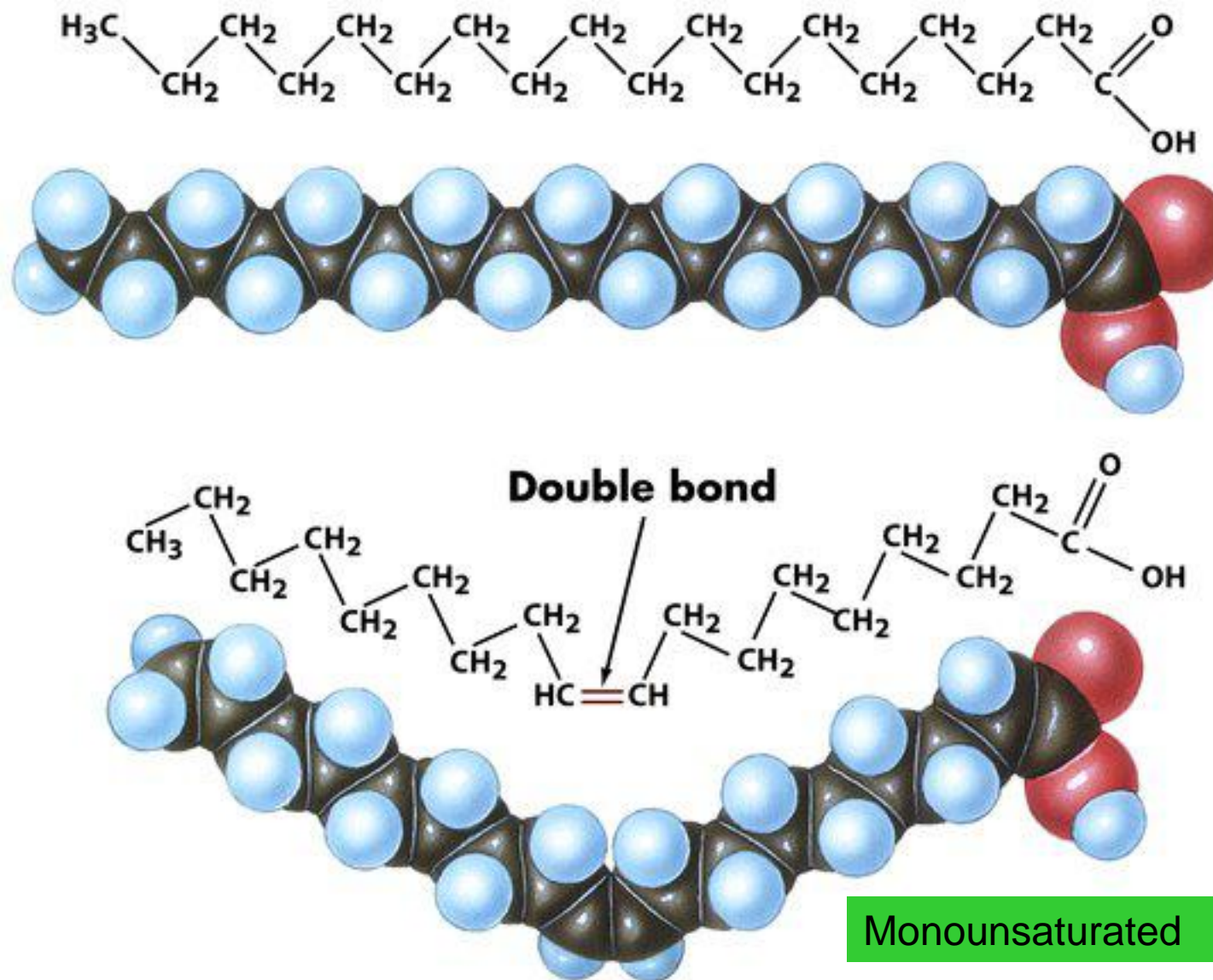


Figure 2-13a Microbiology
© 2005 John Wiley & Son: Dehydration reaction

Fig. 2-13a The structure of fats




Hydrogen (H)


Oxygen (O)


Carbon (C)

Figure 2-13b,c Microbiology, 6/e
© 2005 John Wiley & Sons

Fig. 213 b,c. Top saturated fatty acid (FA), bottom unsaturated FA

Scientists hunting for an AIDS vaccine may be getting close Since Robert Gallo and Luc Montagnier identified HIV — the virus that causes AIDS — in 1983, **only three vaccine trials have been completed**. The first failed to prevent or control infection. The second also failed, mysteriously increasing infection. The third, completed in 2009, provided protection to only about a **third** of the people receiving it — but how it did that is still unknown. The past few years have been a turning point,” said Gary Nabel, director of the Vaccine Research Center at the National Institute of Allergy and Infectious Diseases. “I’m more optimistic than I’ve probably ever been in my career.”

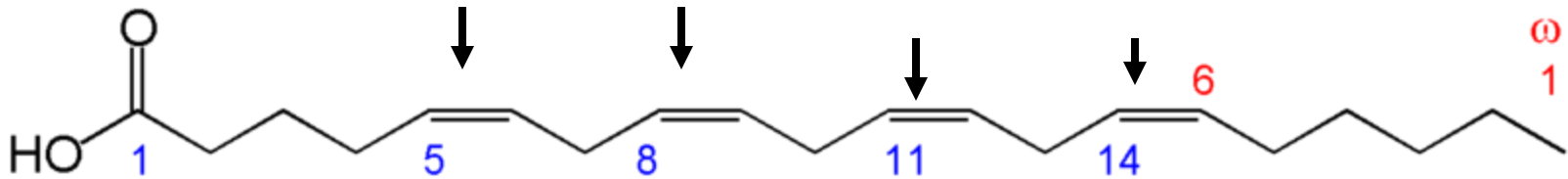
The optimism stems from recent strides in understanding antibodies — the first weapons the human immune system deploys to fight an infection. When a person is exposed to the AIDS virus, the immune system churns out millions of antibodies to fight it. HIV shakes off the vast majority of them, so researchers are focused on the remaining minority. **These “broadly neutralizing” antibodies bind powerfully to HIV’s outer shell and prevent the virus from invading cells.**

Until recently, scientists had been able to **identify only four such antibodies**. But in the past three years, they **have worked out the structures of nearly two dozen, and they have developed the technology to find more.**

If they can trigger these antibodies in healthy people, researchers suspect, they can create an effective **AIDS vaccine**.

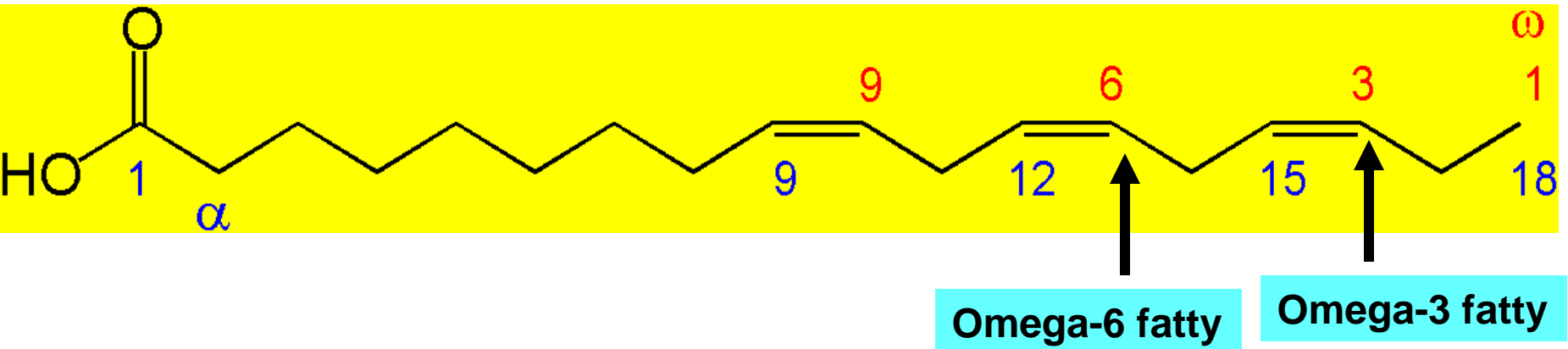
Salmonella Outbreak in 20 States Kills 2 and Sickens 141 An outbreak of salmonella infections across 20 states has resulted in two deaths and sickened 141 people in recent weeks, state and federal authorities said. The source of the outbreak appears to be **cantaloupes from a farm in southwestern Indiana**, the authorities said. They urged consumers who have purchased melons grown in that area to discard them. **The outbreak has been most severe in Kentucky, where 50 people have been infected and the two deaths occurred.** **People infected with salmonella develop diarrhea, fever and abdominal cramps within 12 to 72 hours after exposure,** according to a statement on Friday from the federal Food and Drug Administration's Coordinated Outbreak Response and Evaluation Network. Most people recover within a week. However, in some cases the diarrhea is severe and the infection can spread from the intestines to the blood stream and then to other parts of the body. If not treated quickly, it can lead to death. In Kentucky, health officials isolated a strain of salmonella from two cantaloupes taken from a local retail outlet and traced them back to a farm in Indiana. Last year, a multistate outbreak of listeriosis that killed 29 people was linked to cantaloupes from a farm in Colorado.

Polyunsaturated

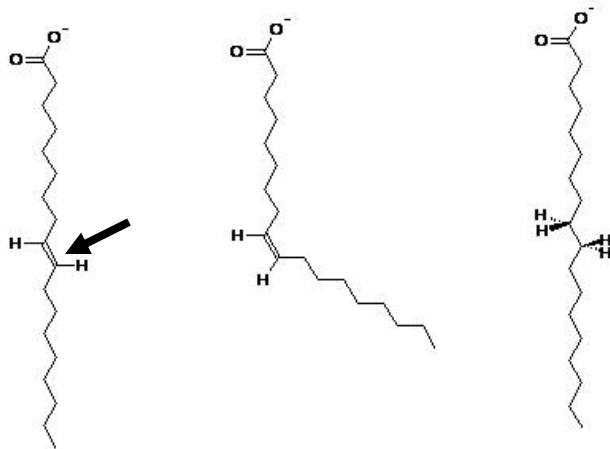
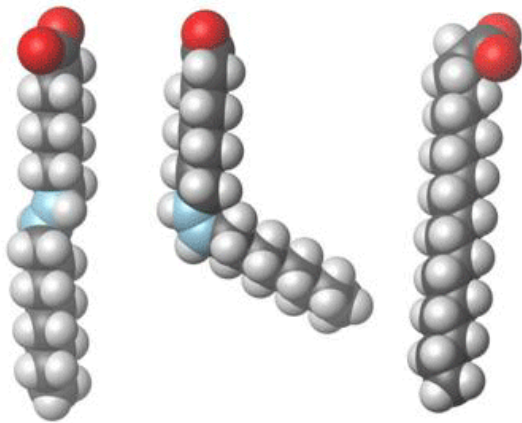


Arachidonic acid (ARA)– C20- fatty acid with 4 double bonds (eicosatetraenoic acid) - important as a precursor to prostaglandins and leukotrienes- which we will study in the immunology chapter. Involved in a host of different function including an important inflammatory mediator. The conversion of ARA to prostaglandins involves the enzyme cyclooxygenase (COX) which is inhibited by aspirin.

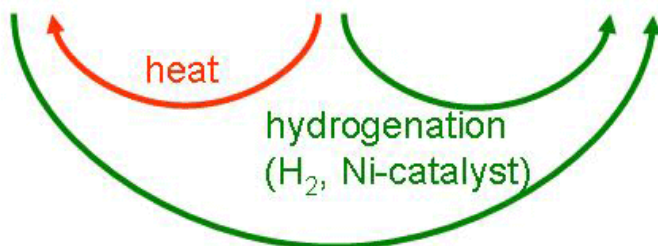
Another important family of fatty acids associated with health are the omega-3 fatty acids.



The ways that omega-3 fatty acids reduce cardiovascular disease risk are still being studied. However, research has shown that they (Fish omega 3 fatty acids) **decrease risk of arrhythmias**, which can lead to sudden cardiac death, **decrease triglyceride levels** **decrease growth rate of atherosclerotic plaque** **lower blood pressure (slightly)** Together, omega-3 and omega-6 fatty acids play a crucial role in brain function as well as normal growth and development.



elaidic acid (trans unsat.) oleic acid (cis unsat.) stearic acid (saturated)



Eating trans fat increases the risk of [coronary heart disease](#).^[2] For these reasons, health authorities worldwide recommend that consumption of trans fat be reduced to trace amounts. Trans fats from partially hydrogenated oils are generally considered to be more of a health risk than those occurring naturally.^[3]

A 2% increase in trans fatty acid intake increases the risk of coronary heart disease by approximately 25%. No amount of trans fatty acid is advisable.

Metabolic studies have shown that *trans* fats have adverse effects on blood lipid levels--**increasing LDL ("bad") cholesterol while decreasing HDL ("good") cholesterol.** This combined effect on the ratio of LDL to HDL cholesterol is double that of saturated fatty acids.³

Trans Fat Limits Show Benefits in New York The City of New York has dealt with legal challenges, and its mayor has endured some ridicule, but the new regulations on **trans fat** in restaurant foods appear to be having the intended effect.

The law, in full effect as of July 2008, restricts restaurants from using food that contains partially hydrogenated vegetable oil and has a total of 0.5 grams or more of trans fat per serving.

City health officials recorded about 7,000 purchases of food at 168 randomly selected fast-food restaurants in 2007 and again in 2009. Over all, average trans fat per purchase decreased by 2.4 grams over the two years, while saturated fat increased by 0.55 grams, for a net decrease of 1.9 grams of fat per purchase. (The researchers did not include intake of monounsaturated or polyunsaturated fats.) The study included restaurants from 13 chains, and results were the same in high- and low-income areas. The analysis, in Annals of Internal Medicine last week, also found that 59 percent of purchases in 2009 contained no trans fat at all, compared with 32 percent in 2007. "It's exciting news," said an author of the study, Christine J. Curtis, the director of nutrition strategy for the city's Department of Health and Mental Hygiene. "What's great about this is that people can walk in and order the same thing they've always ordered, and it just has less trans fat. The benefits accrued to everyone, in all neighborhoods."

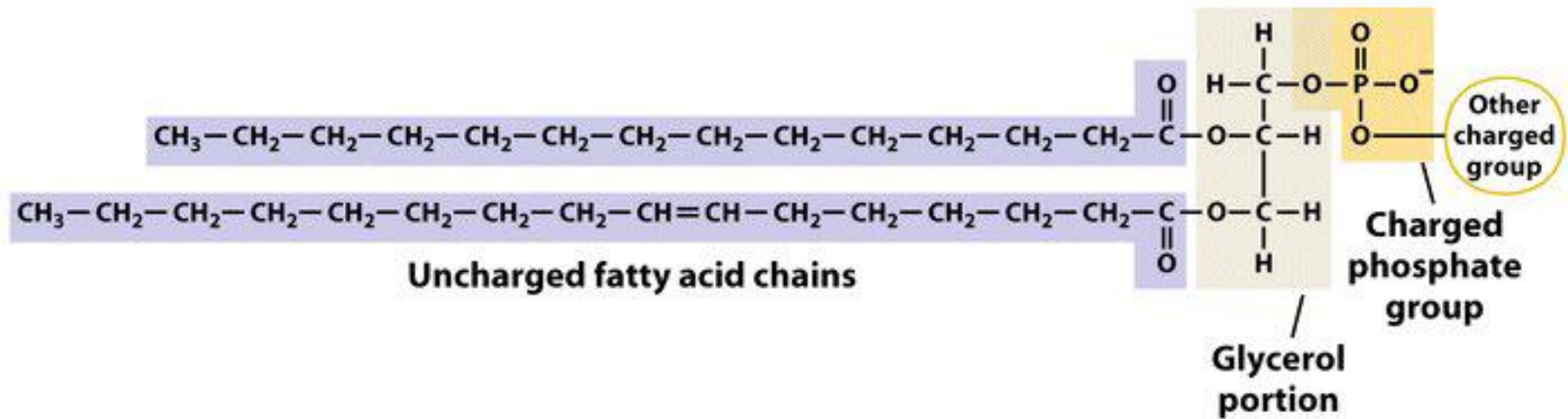


Figure 2-14a Microbiology, 6/e
© 2005 John Wiley & Sons

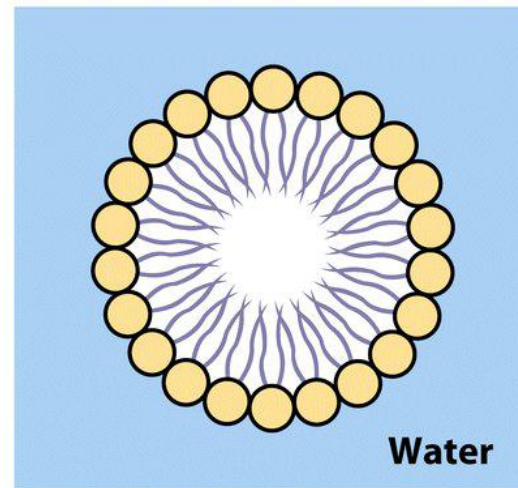
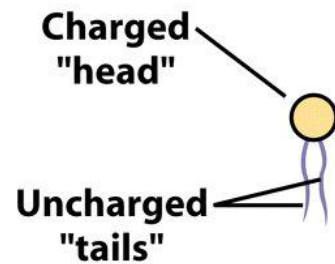
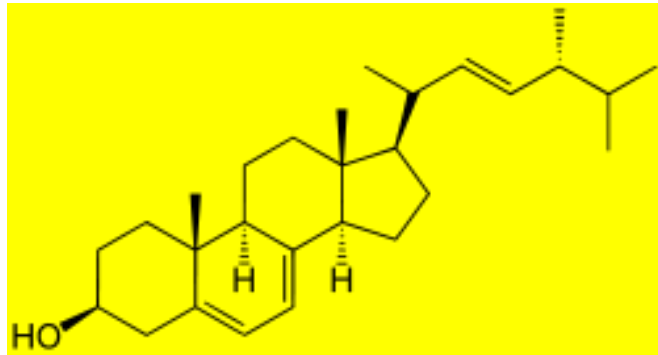


Figure 2-14b Microbiology, 6/e
© 2005 John Wiley & Sons

Fig. 2.14 Phospholipids



Ergosterol- found in fungi and an important target of Antifungal antibiotics

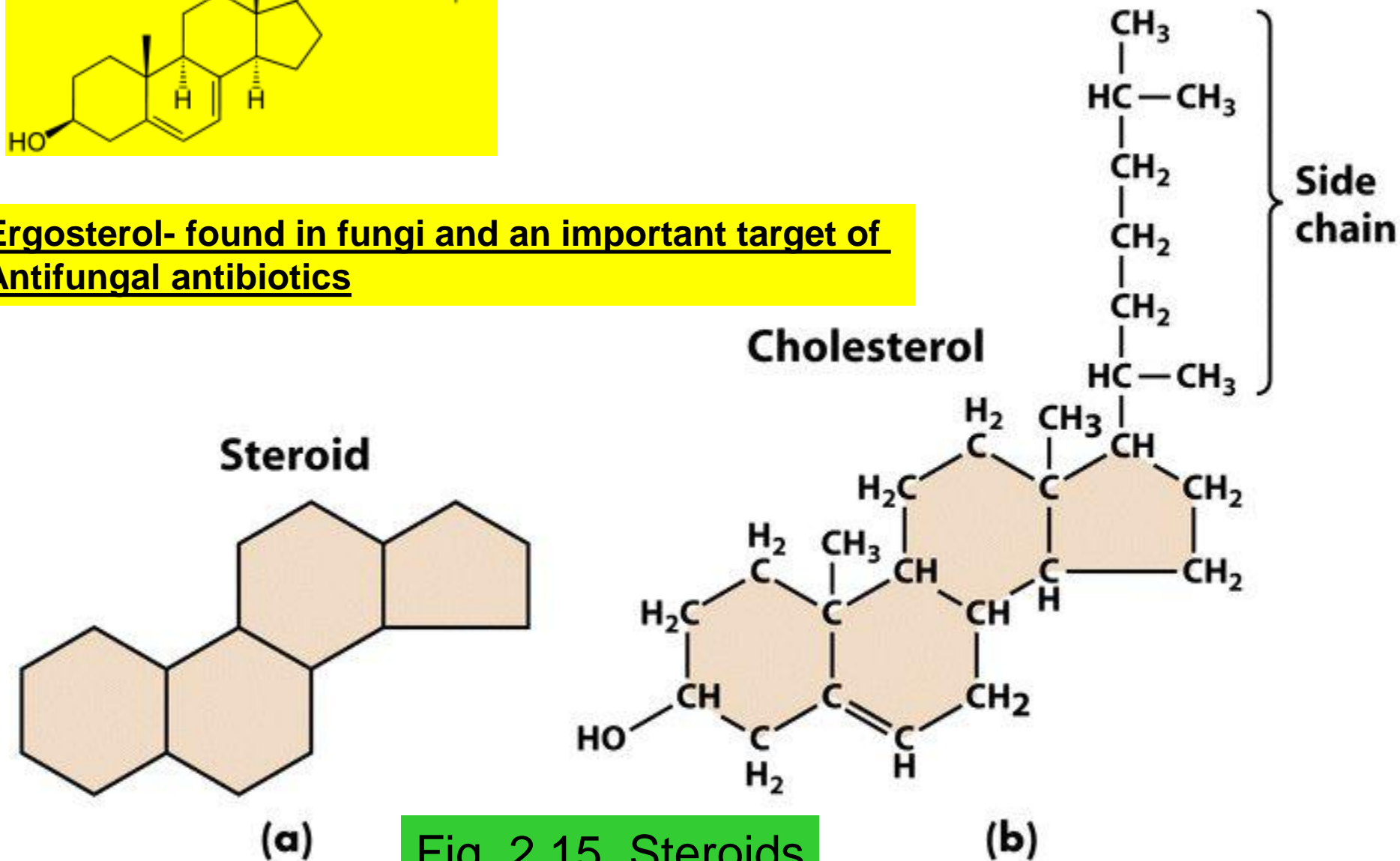
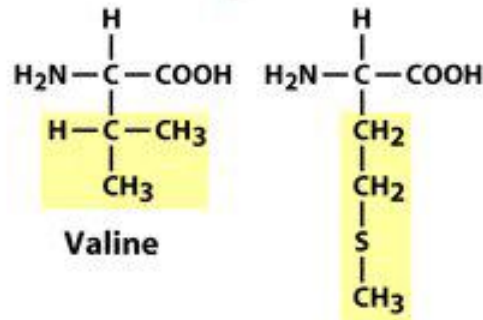


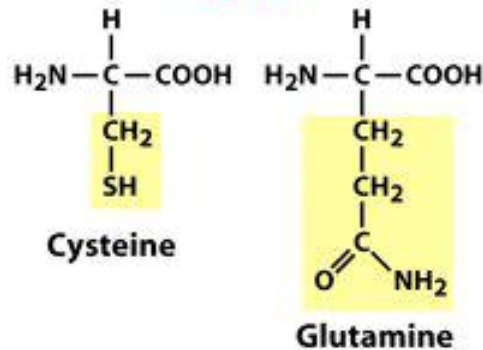
Fig. 2.15 Steroids

Nonpolar



Hydrophobic-

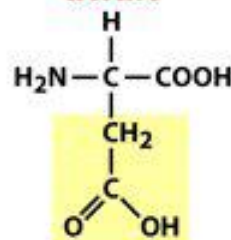
Polar



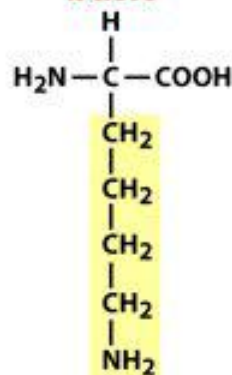
Hydrophilic

Know this slide

**Charged:
acidic**

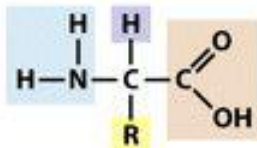


**Charged:
basic**



Also tend to be hydrophilic-but they have a charge which is potentially very important in their interaction with other molecules.

**Generalized
Amino acid**



(a)
Figure 2-16 Microbiology, 6/e
© 2005 John Wiley & Sons

(b)

Fig. 2.16 Amino Acids

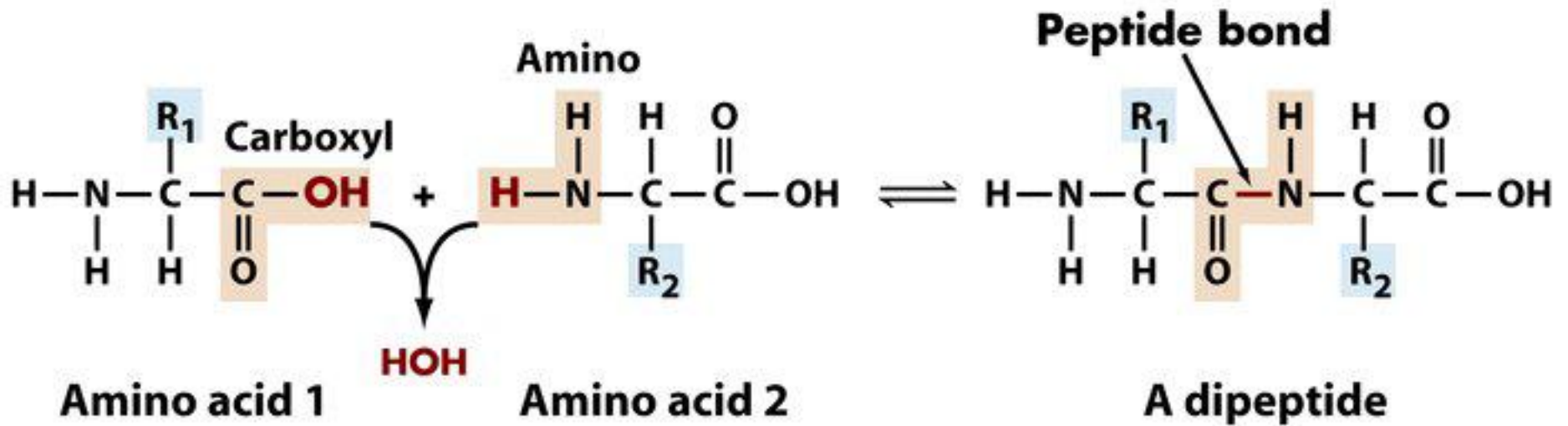


Figure 2-17 Microbiology, 6/e
© 2005 John Wiley & Sons

Fig. 2.17 Peptide linkage

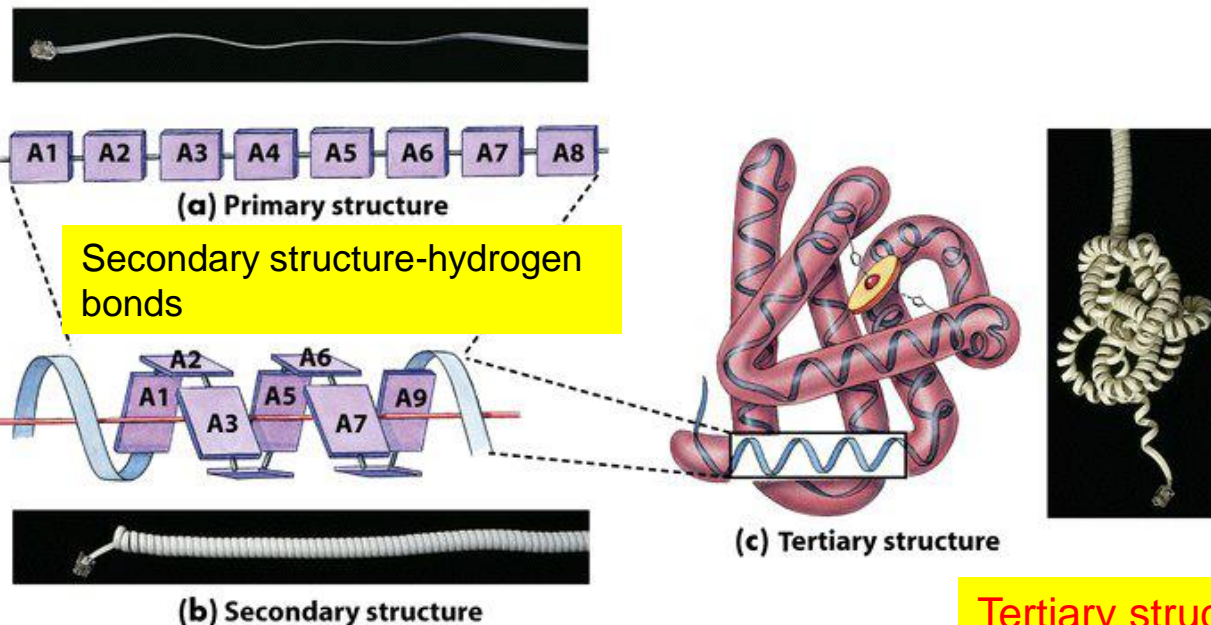
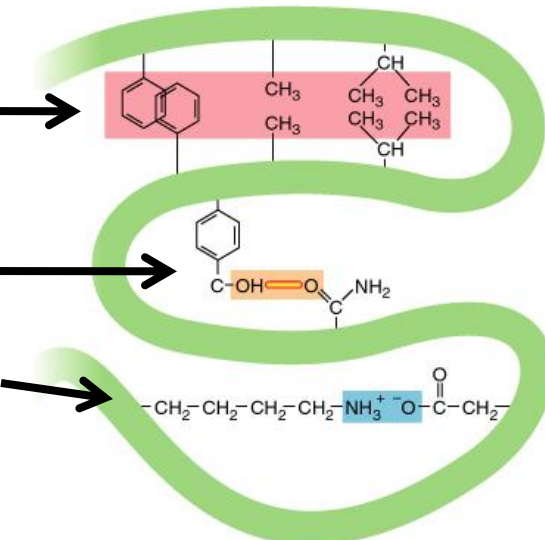


Figure 2-18 Microbiology, 6/e
© 2005 John Wiley & Sons

Tertiary structure:
hydrophobic interactions,
ionic interactions
and
hydrogen bonds.



Copyright 1999 John Wiley and Sons, Inc. All rights reserved.

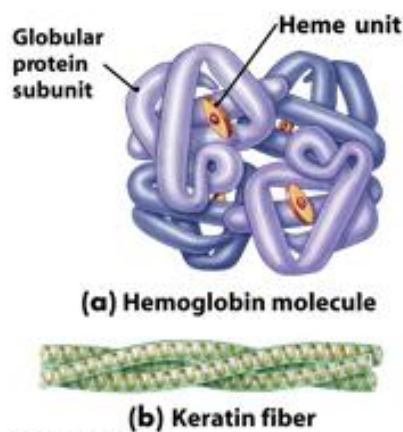


Fig. 2.19
Quaternary
Structure
S-S and hydrogen
bonds

Figure 2-19 Microbiology, 6/e
© 2005 John Wiley & Sons

Fig. 2.18 Three levels of protein structure

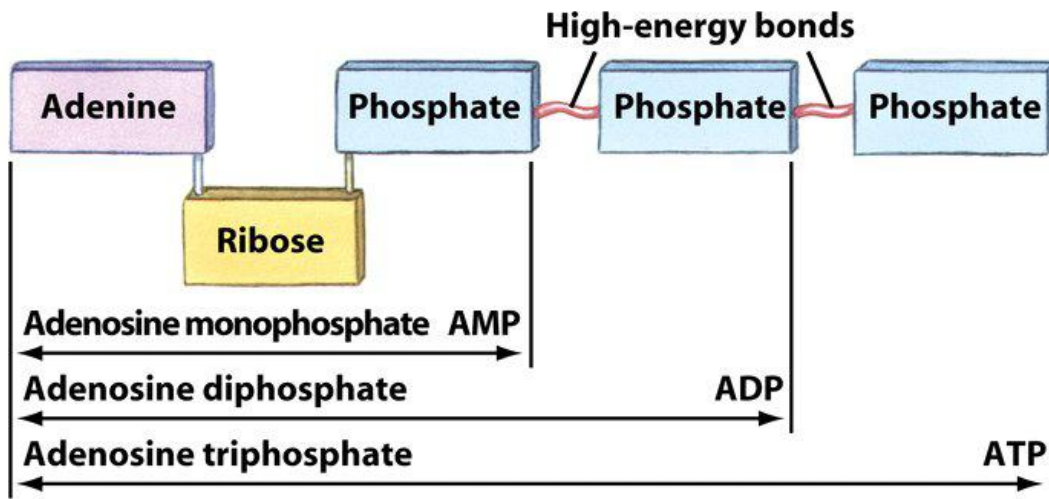


Figure 2-20a Microbiology, 6/e
© 2005 John Wiley & Sons

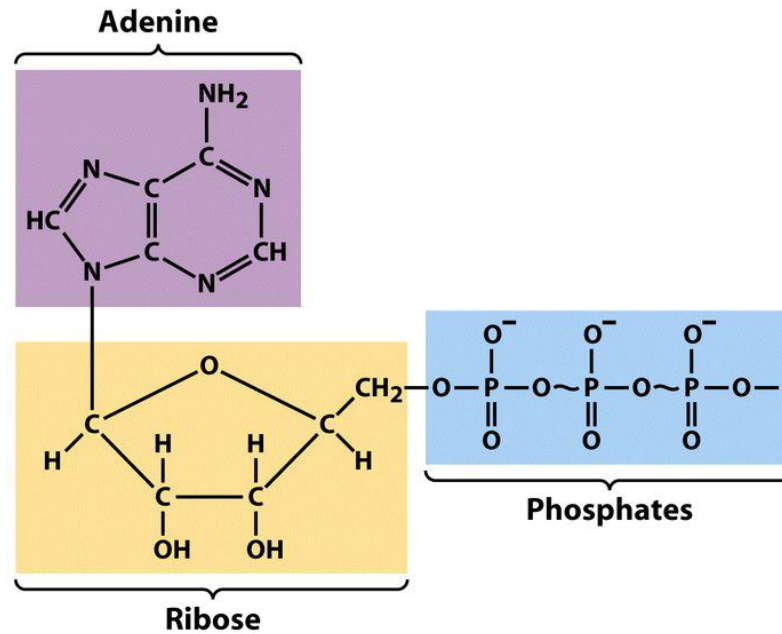
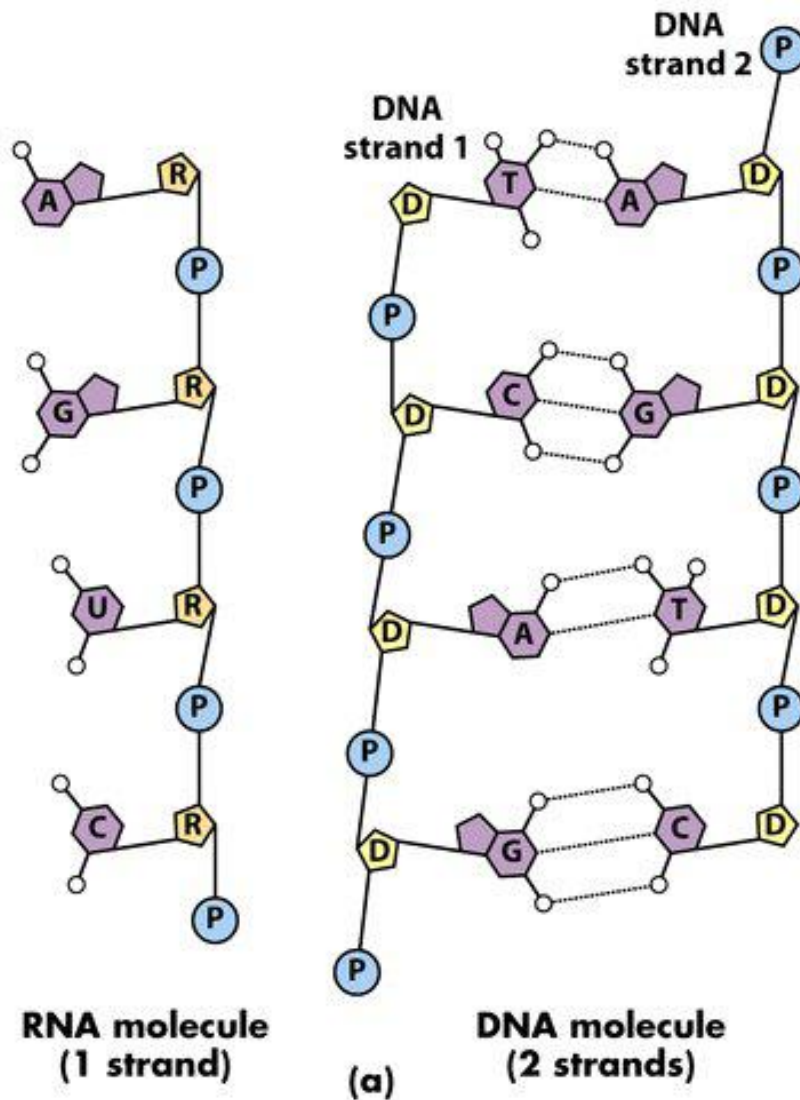
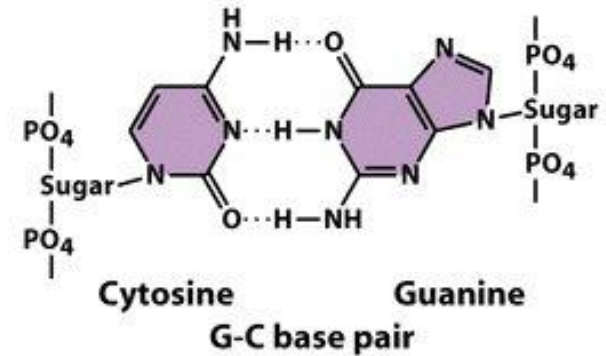
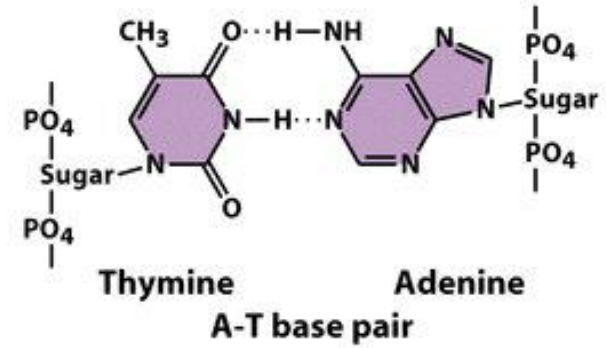


Figure 2-20c Microbiology, 6/e
© 2005 John Wiley & Sons

Fig. 2.20 Nucleotides



P = phosphate G = guanine C = cytosine
 R = ribose A = adenine T = thymine
 D = deoxyribose U = uracil

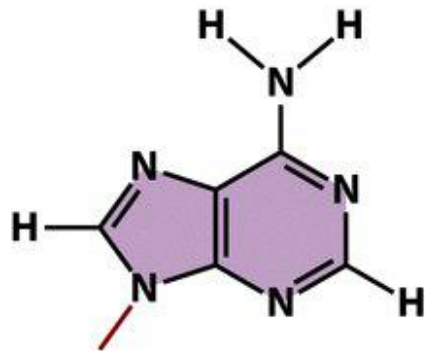


(b)

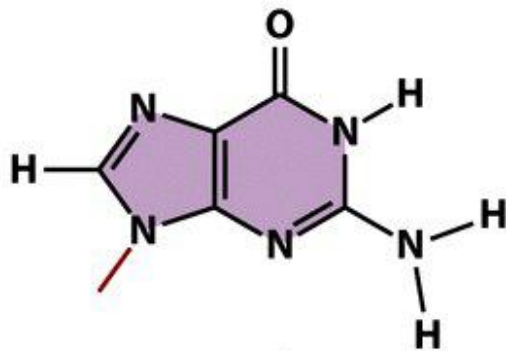
Figure 2-21 Microbiology, 6/e
 © 2005 John Wiley & Sons

Fig. 2.21 Nucleic acid structure

Purines

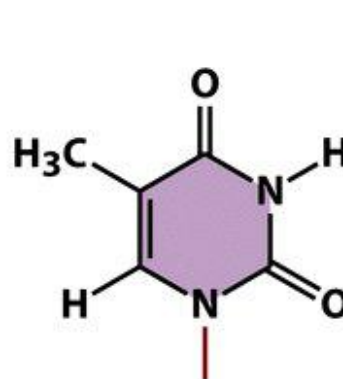


Adenine

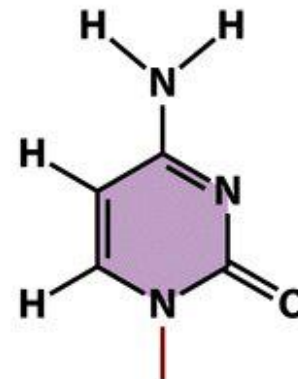


Guanine

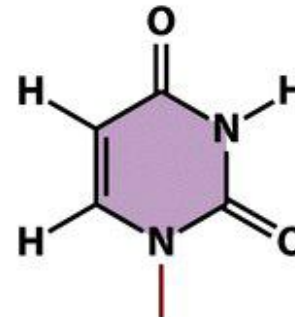
Pyrimidines



Thymine
(in DNA only)



Cytosine



Uracil (in RNA only)

Figure 2-22 Microbiology, 6/e
© 2005 John Wiley & Sons

You should be able to recognize these bases- I typically give one of these structures on an exam

Fig. 2.22 The five bases found in nucleic acids