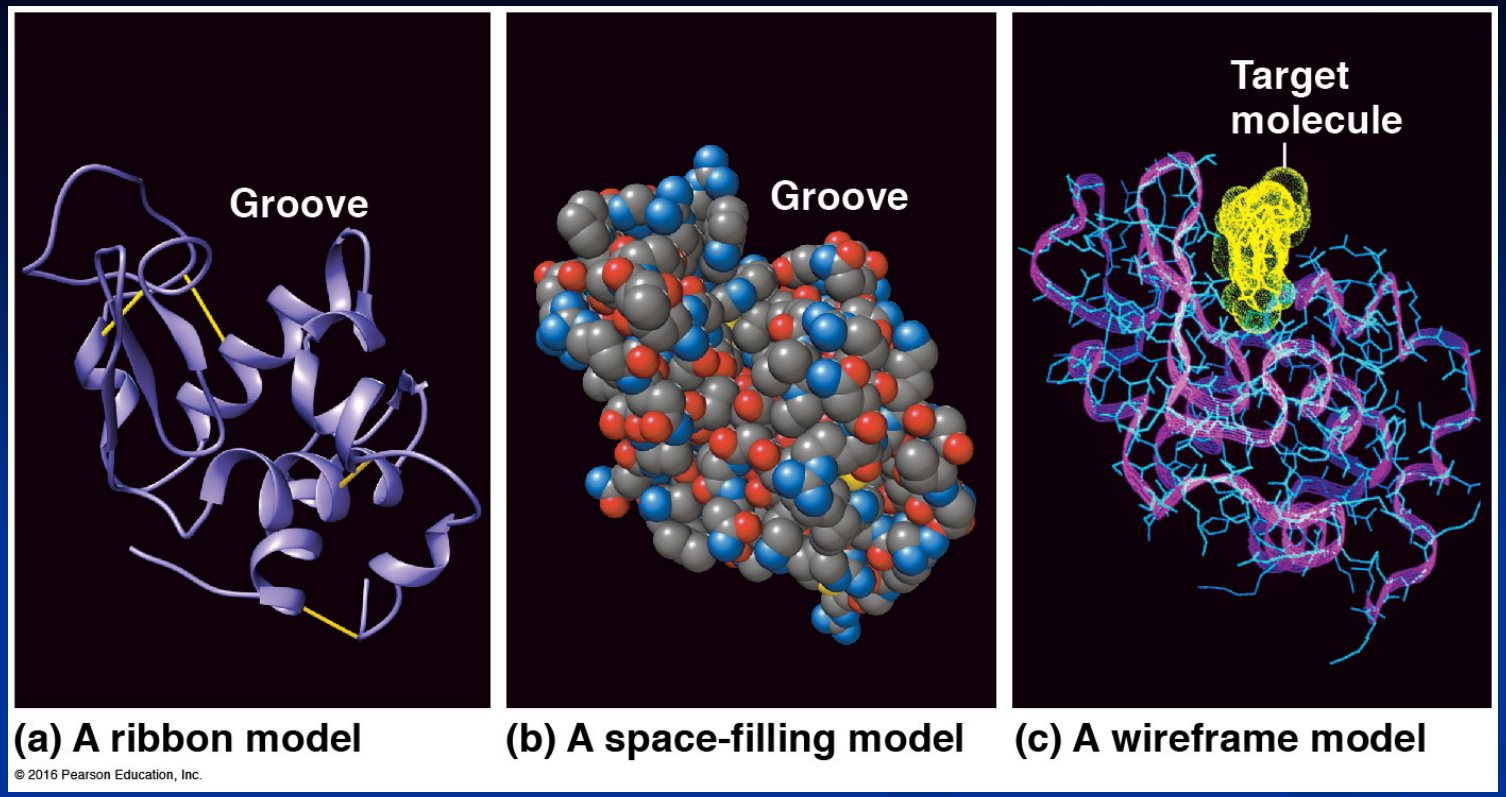
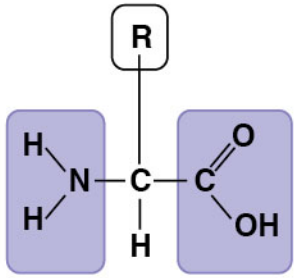


water causes protein folding.

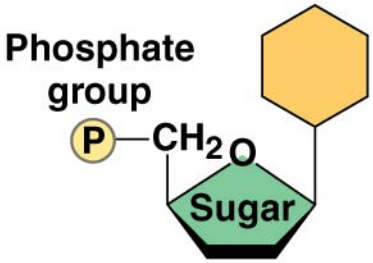
Ch. 3b: The Structure and Function of Macromolecules

Proteins → collection of amino acids

Components	Examples	Functions
 Amino acid monomer (20 types)	• Enzymes • Structural proteins • Storage proteins • Transport proteins • Hormones • Receptor proteins • Motor proteins • Defensive proteins	• Catalyze chemical reactions • Provide structural support • Store amino acids • Transport substances • Coordinate organismal responses • Receive signals from outside cell • Function in cell movement • Protect against disease

monomer

Nucleic Acids (DNA) Polynucleotides (polymer)

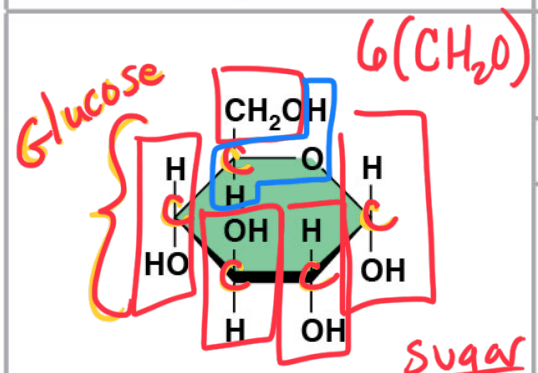
Components	Examples	Functions
Nitrogenous base  Nucleotide monomer	DNA:  • Sugar = deoxyribose • Nitrogenous bases = C, G, A, T • Usually double-stranded	Stores hereditary information
	RNA:  • Sugar = ribose • Nitrogenous bases = C, G, A, U • Usually single-stranded	Various functions in gene expression, including carrying instructions from DNA to ribosomes

Carbohydrate ⟷ sugar

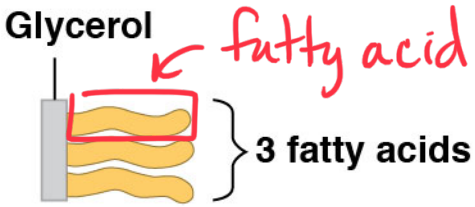
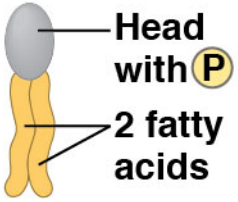
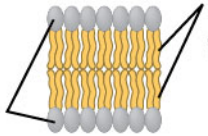
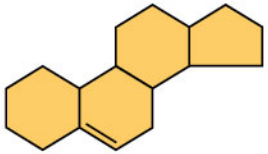
carbon "C" water H_2O

Polymer → polysaccharide

Monomer → monosaccharide

Components	Examples	Functions
 Monosaccharide monomer	Monosaccharides: glucose, fructose	Fuel; carbon sources that can be converted to other molecules or combined into polymers
	Disaccharides: lactose, sucrose	
	Polysaccharides: • Cellulose (plants) • Starch (plants) • Glycogen (animals) • Chitin (animals and fungi)	• Strengthens plant cell walls • Stores glucose for energy • Stores glucose for energy • Strengthens exoskeletons and fungal cell walls

Fatties Triacylglycerol → polymer
monomer → fatty acid

Components	Examples	Functions
	Triacylglycerols (fats or oils): glycerol + three fatty acids	Important energy source  
	Phospholipids: glycerol + phosphate group + two fatty acids	Lipid bilayers of membranes 
 Steroid backbone	Steroids: four fused rings with attached chemical groups	• Component of cell membranes (cholesterol) • Signaling molecules that travel through the body (hormones)

You Must Know

- The role of **dehydration synthesis** in the formation of organic compounds and **hydrolysis** in the digestion of organic compounds.
- How the sequence and subcomponents of the four groups of organic compounds determine their properties.
- The cellular functions of carbs, lipids, proteins, and nucleic acids.
- How changes in these organic molecules would affect their function.

You Must Know

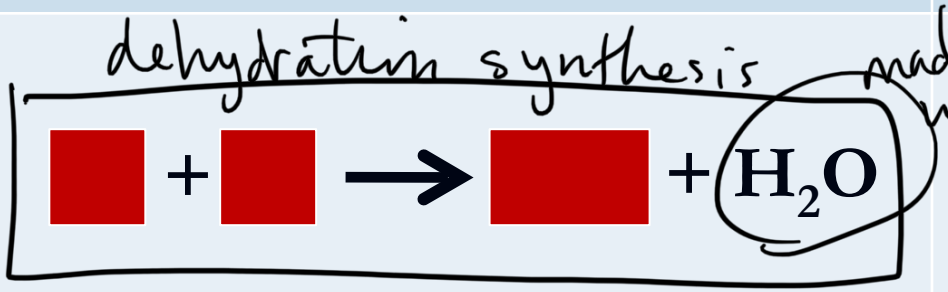
- The 4 structural levels of proteins and how changes at any levels can affect the activity of the protein.
- How proteins reach their final shape (**conformation**), the **denaturing** impact that heat and pH can have on protein structure, and how these changes may affect the organism.
- Directionality influences structure and function of polymers, such as nucleic acids (5' and 3' ends) and proteins (amino and carboxyl ends).

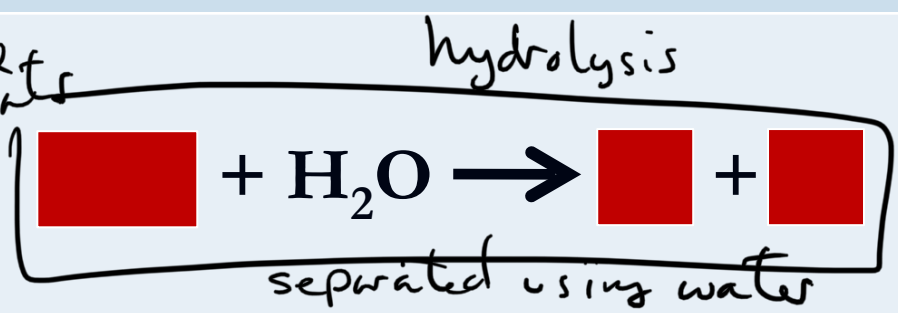
1 Monomers	Many Polymers train	Big Macromolecules
•Small organic boxcars •Used for building blocks of polymers •Connects with condensation reaction (dehydration synthesis) also called condensation	•Long molecules of monomers •With many identical or similar blocks linked by covalent bonds	•Giant molecules •2 or more polymers bonded together proteins carbohydrates (sugars) fats (lipids) polynucleotide (DNA)

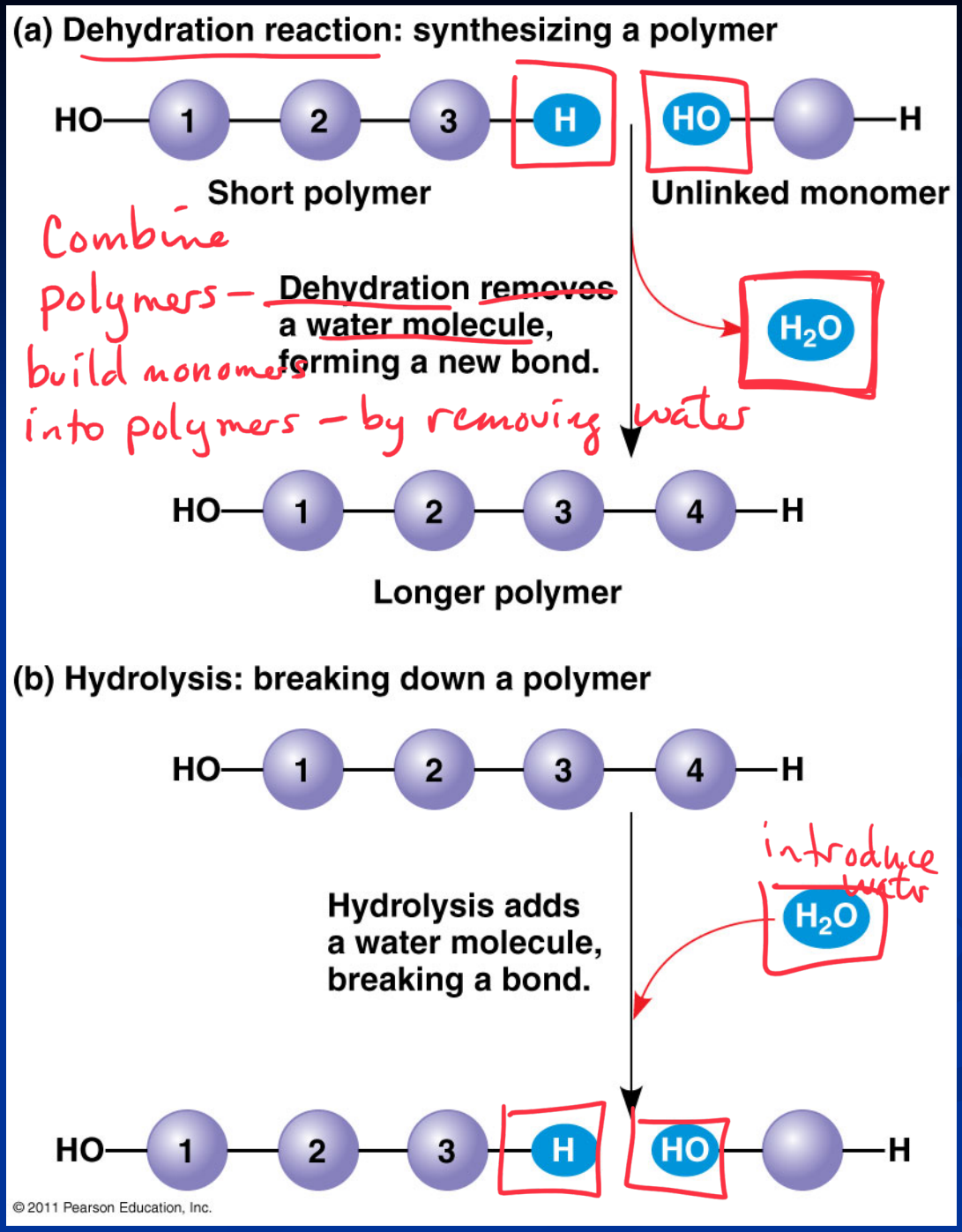
ie. amino acid → peptide → polypeptide → protein

smaller ⟶ **larger**

Dehydration Synthesis (Condensation Reaction)	Hydrolysis
Make polymers	Breakdown polymers
Monomers → Polymers	Polymers → Monomers
A + B → AB	AB → A + B






(a) Dehydration reaction: synthesizing a polymer
HO
1
2
3
H
HO
H
Short polymer
Unlinked monomer
Combine polymers –
build monomers into polymers – by removing water
Dehydration removes a water molecule, forming a new bond.
H_2O
HO
1
2
3
4
H
Longer polymer
(b) Hydrolysis: breaking down a polymer
HO
1
2
3
4
H
introduce water
Hydrolysis adds a water molecule, breaking a bond.
H_2O
HO
1
2
3
H
HO
H
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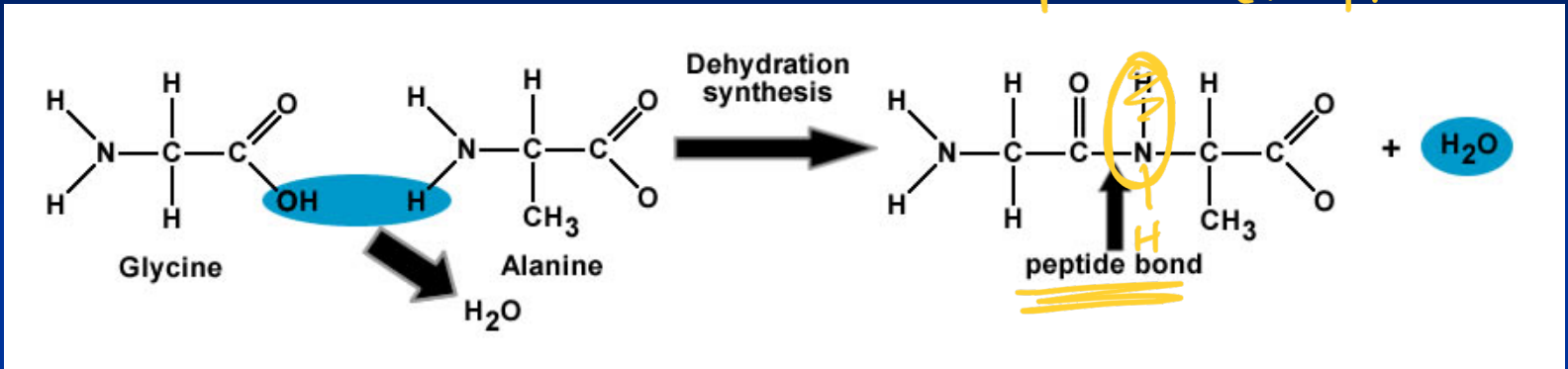
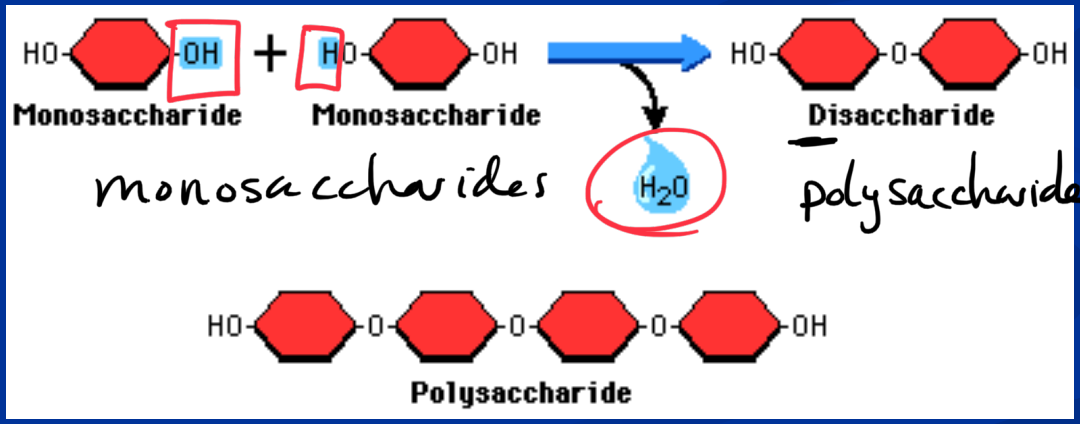
Dehydration Synthesis

monomer
amino acid

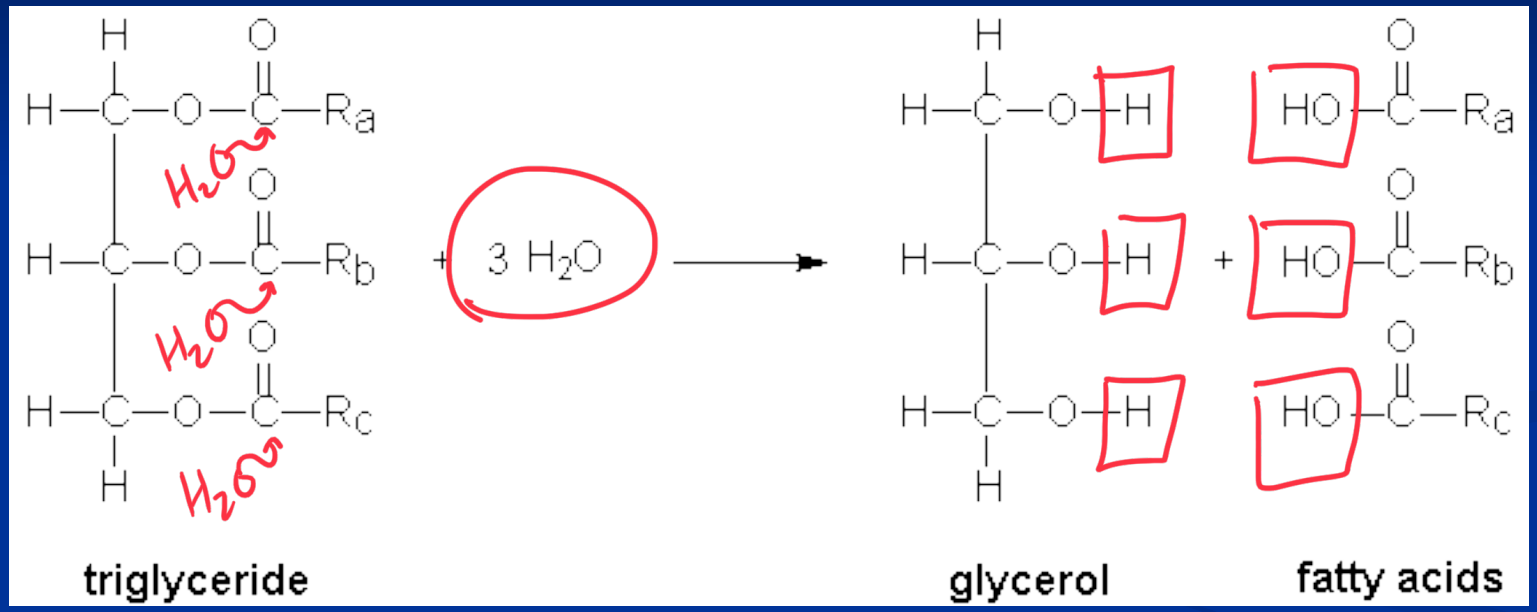
polymer
protein (polypeptide)





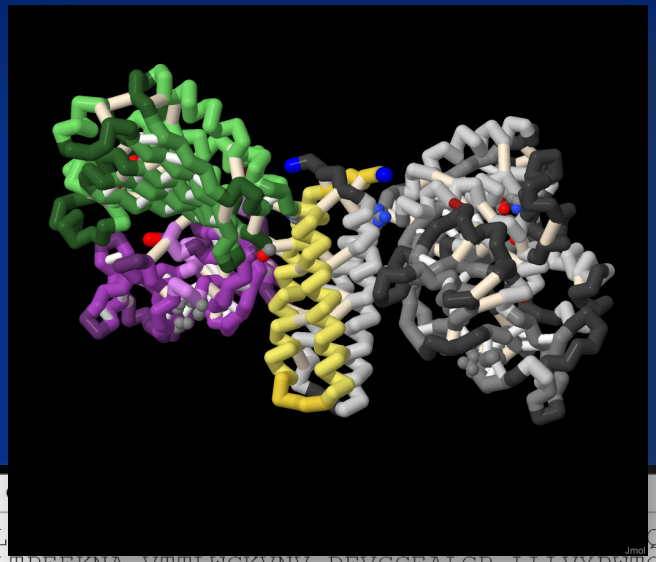
Hydrolysis

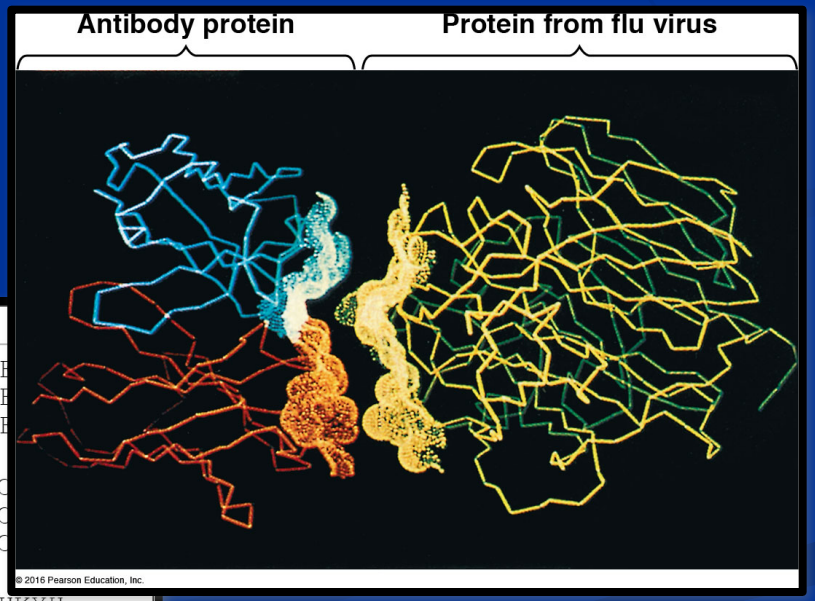
Triacylglycerol



Fat polymer breaks down into monomers

Proteomics: Analysis of proteins and sequences





Species	Alignment					
Human	1	VHL				QR FF
Monkey	1	VHLTPEEKNA	VTTLWGKVNV	DEVGGEALGR	LLVYPWTQR	FF
Gibbon	1	VHLTPEEKSA	VTALWGKVNV	DEVGGEALGR	LLVVYPWTQR	FF
Human	51	PDAVMGNPKV	KAHGKKVLGA	FSDGLAHLDN	LKGTFATLSE	LHC
Monkey	51	PDAVMGNPKV	KAHGKKVLGA	FSDGLNHLDN	LKGTFAQLSE	LHC
Gibbon	51	PDAVMGNPKV	KAHGKKVLGA	FSDGLAHLDN	LKGTFAQLSE	LHC
Human	101	ENFRLLGNVL	VCVLAHHFGK	EFTPPVQAAY	QKVVAGVANA	LAHKYH
Monkey	101	ENFKLLGNVL	VCVLAHHFGK	EFTPQVQAAY	QKVVAGVANA	LAHKYH
Gibbon	101	ENFRLLGNVL	VCVLAHHFGK	EFTPQVQAAY	QKVVAGVANA	LAHKYH

Data from Human: http://www.ncbi.nlm.nih.gov/protein/AAA21113.1; rhesus monkey: http://www.ncbi.nlm.nih.gov/ protein/122634; gibbon: http://www.ncbi.nlm.nih.gov/protein/122616