NTR 306: Fundamentals of Nutrition

Chapter 5: Lipids

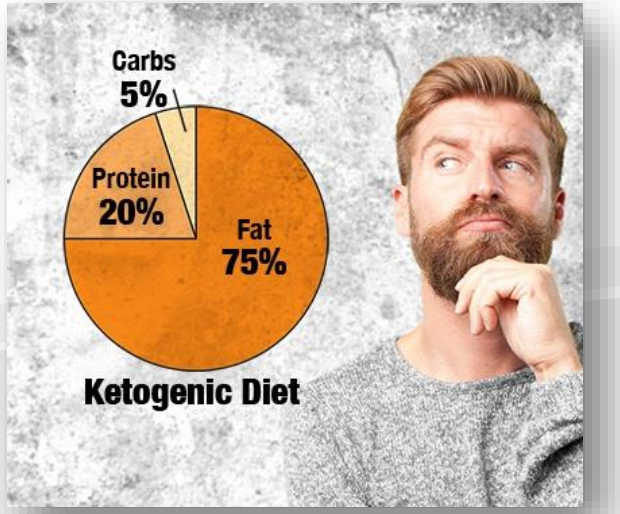
InstaPoll

What do you think about dietary fat?

- The body needs every type of fat in order to function.
- Only some fats are healthy.
- All types of fat are bad for the body.

Lipids: Friend or Foe

- Lipids: more than just 'bad fats'
  - Generically called *fats* but include many other things
    - ✓ Fats, Oils, Phospholipids, Sterols (i.e., cholesterol)
  - Sources of fats:
    - ✓ Plants: Oils, nuts, legumes
    - ✓ Animals: Fatty meats, full-fat dairy, seafood
  - "Fattening" – not necessarily!
- Energy-dense storage
  - Used by skeletal muscles, cardiac (heart) muscle, liver
- Emphasized in popular diets: Ketogenic Diets, Atkins, etc.



Fat's Bad Rap

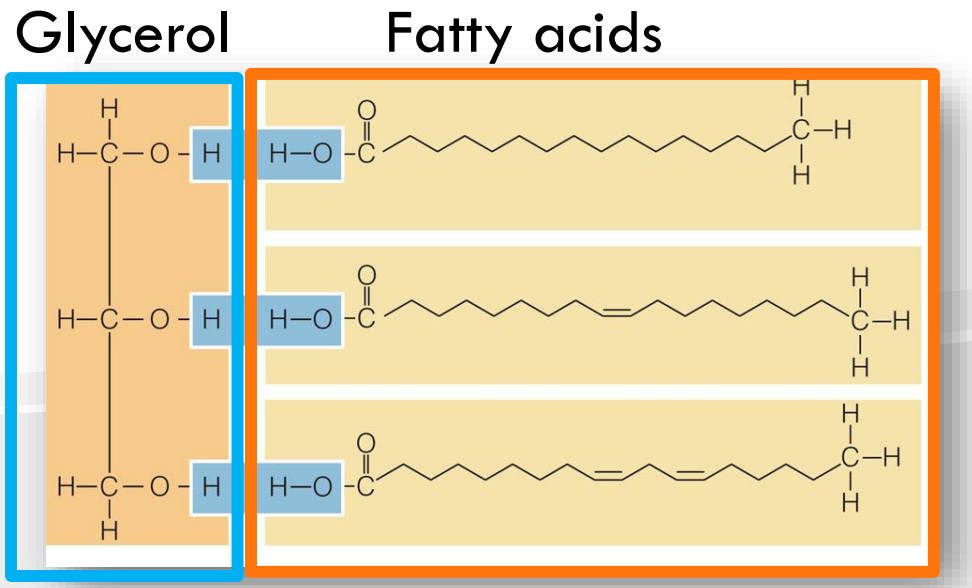
- Poor health can result from:
  - Too much fat
  - Too little fat
  - Too much of *some kinds of fat*

Chemist's View of Lipids

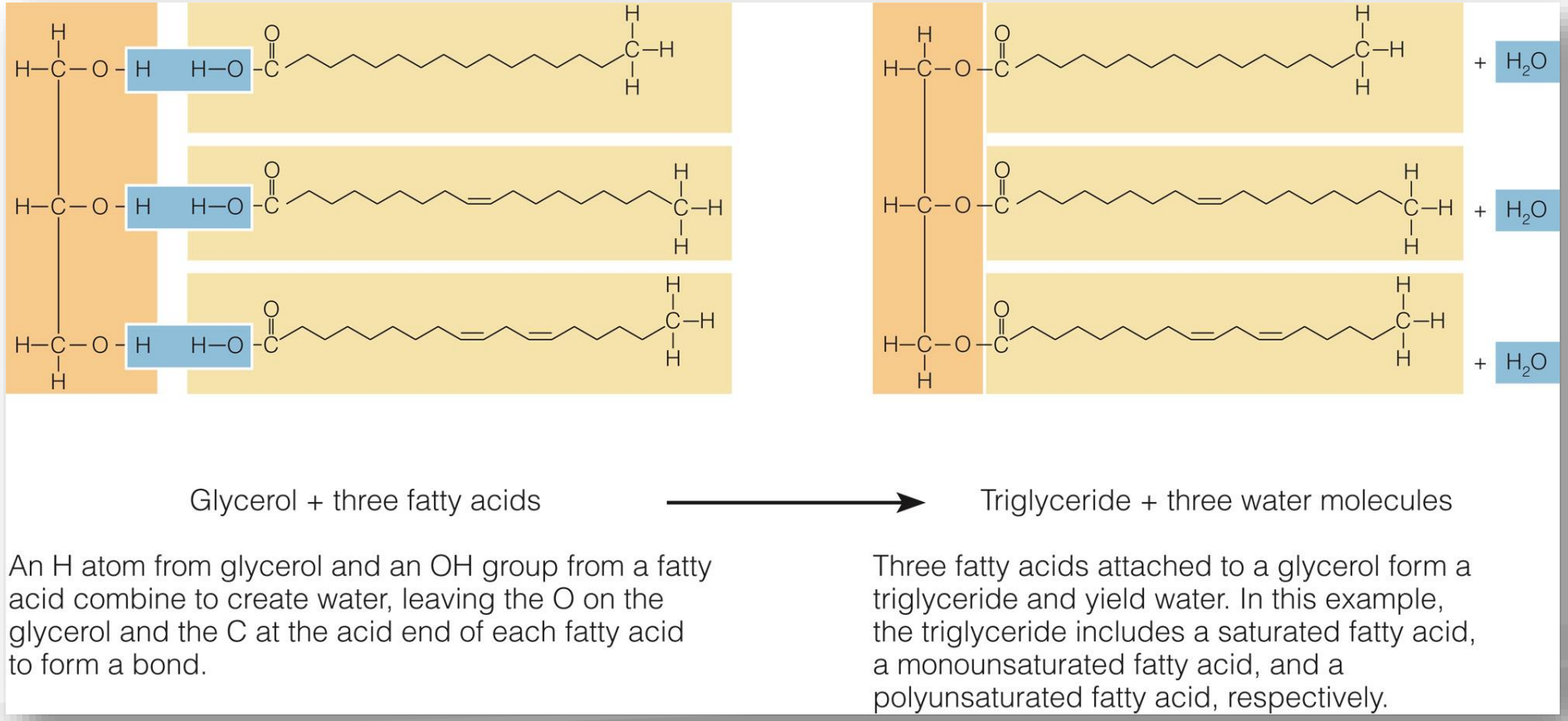
- *Lipids* include:
  - Triglycerides (TGs):
    - ✓ Commonly referred to as: fats
    - ✓ Most abundant in foods and the body
    - ✓ "fat" ≠ "lipid" (Lipid = TGs, phospholipids, and sterols vs. Fat = TGs)
  - Phospholipids
  - Sterols
- Composition = carbon (C), hydrogen (H), and oxygen (O)
  - More carbons and hydrogens than oxygens
  - More energy provided per gram (9 kcals/gram)

Chemist's View of Triglycerides

- Triglycerides (TGs)
  - 3 fatty acids (FAs)
    - ✓ Usually combination of different fatty acids
  - Glycerol backbone
  - Formed via condensation reactions
    - ✓ H from glycerol + OH from fatty acid = new bond and H_2O



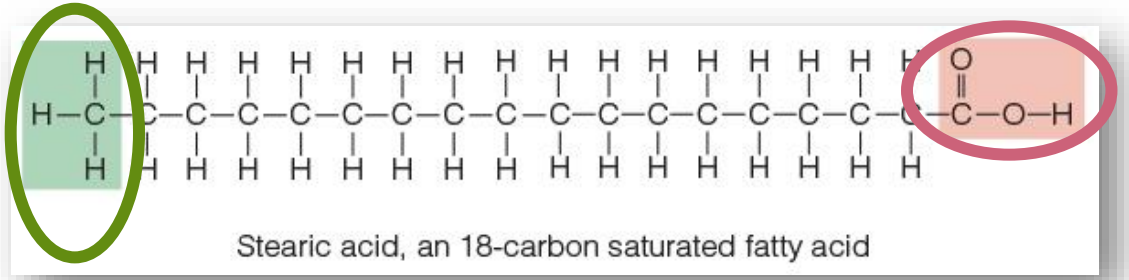
Chemist's View of TGs



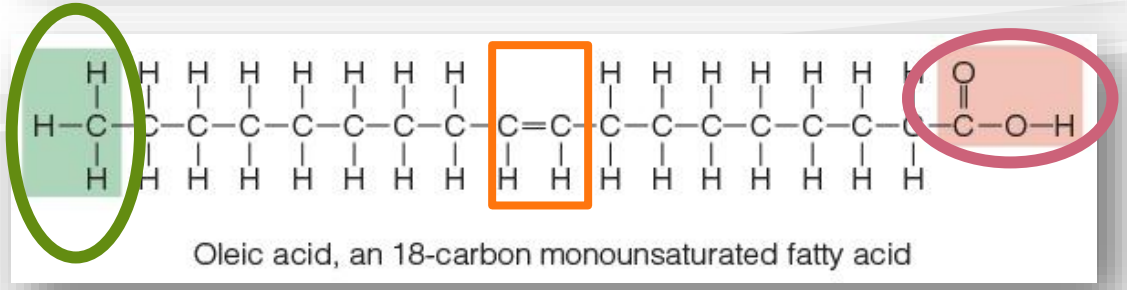
Whitney & Rolfes, Understanding Nutrition (15th ed.)

Chemist's View of Fatty Acids

- Fatty acids (FAs)
  - Organic acid
  - Methyl group at one end (CH_3); acid group at other end (COOH)
  - Identified by # of carbons (C) in chain (usually even number)
    - ✓ 18-carbon fatty acids abundant in food
    - ✓ Long-chain (>12 carbons)
    - ✓ Medium-chain (8-12 carbons)
    - ✓ Short-chain (<6 carbons)
  - Saturations
    - ✓ Saturated = full of hydrogens
    - ✓ Unsaturated = missing hydrogens
      - Double bonded C



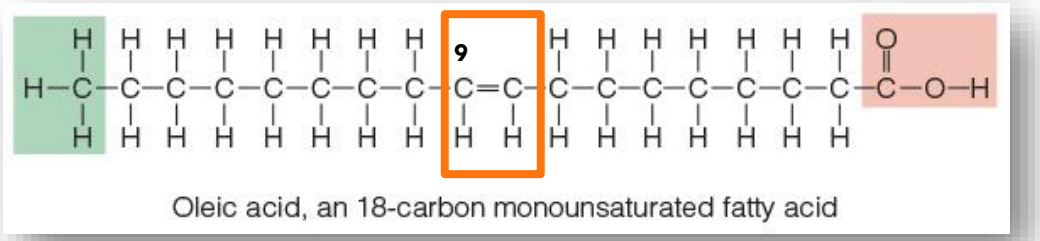
Stearic acid, an 18-carbon saturated fatty acid



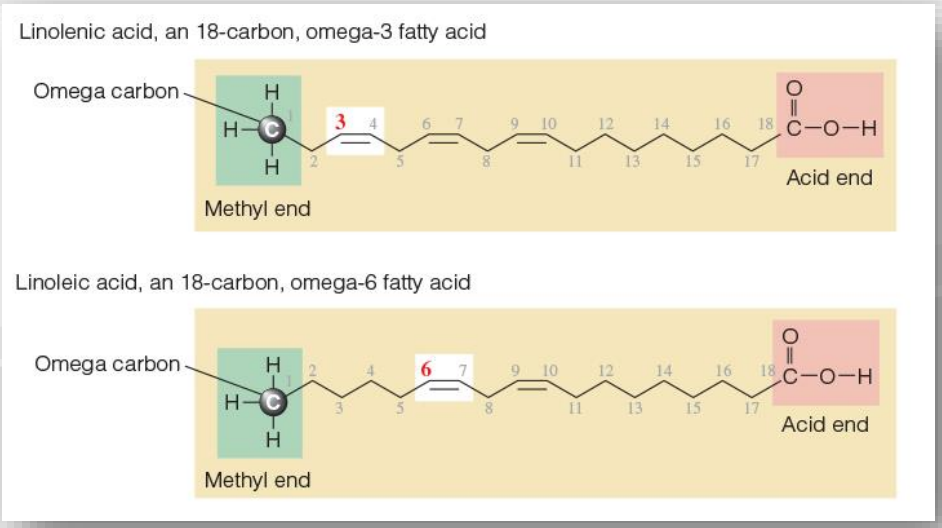
Oleic acid, an 18-carbon monounsaturated fatty acid

Chemist's View of FAs

- 2 main types of Unsaturated FAs
  - Classified by # of double bonds
  - Named based on position of double bonded C nearest methyl end (CH_3)
- Monounsaturated fatty acids (MUFA)
  - 1 double bonded C
  - 9 Cs away from CH_3 = omega 9: *Oleic acid*
- Polyunsaturated fatty acids (PUFA)
  - 2 or more double bonded Cs
  - 3 Cs away from CH_3= omega 3: *Linolenic acid*
  - 6 C away from CH_3= omega 6: *Linoleic acid*



Oleic acid, an 18-carbon monounsaturated fatty acid



Whitney & Rolfes, Understanding Nutrition (15th ed.)

Chemist's View of FAs

Omega-9

Omega-6

Omega-3

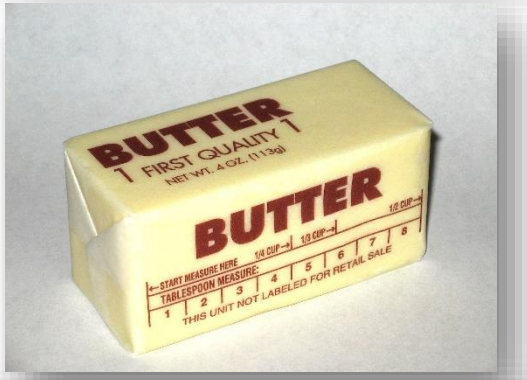
TABLE 5-1 18-Carbon Fatty Acids

Name	Number of Carbon Atoms	Number of Double Bonds	Saturation	Common Food Sources
Stearic acid	18	0	Saturated	Most animal fats
Oleic acid	18	1	Monounsaturated	Olive and canola oils
Linoleic acid	18	2	Polyunsaturated	Sunflower, safflower, corn, and soybean oils
Linolenic acid	18	3	Polyunsaturated	Soybean and canola oils, flaxseed, walnuts

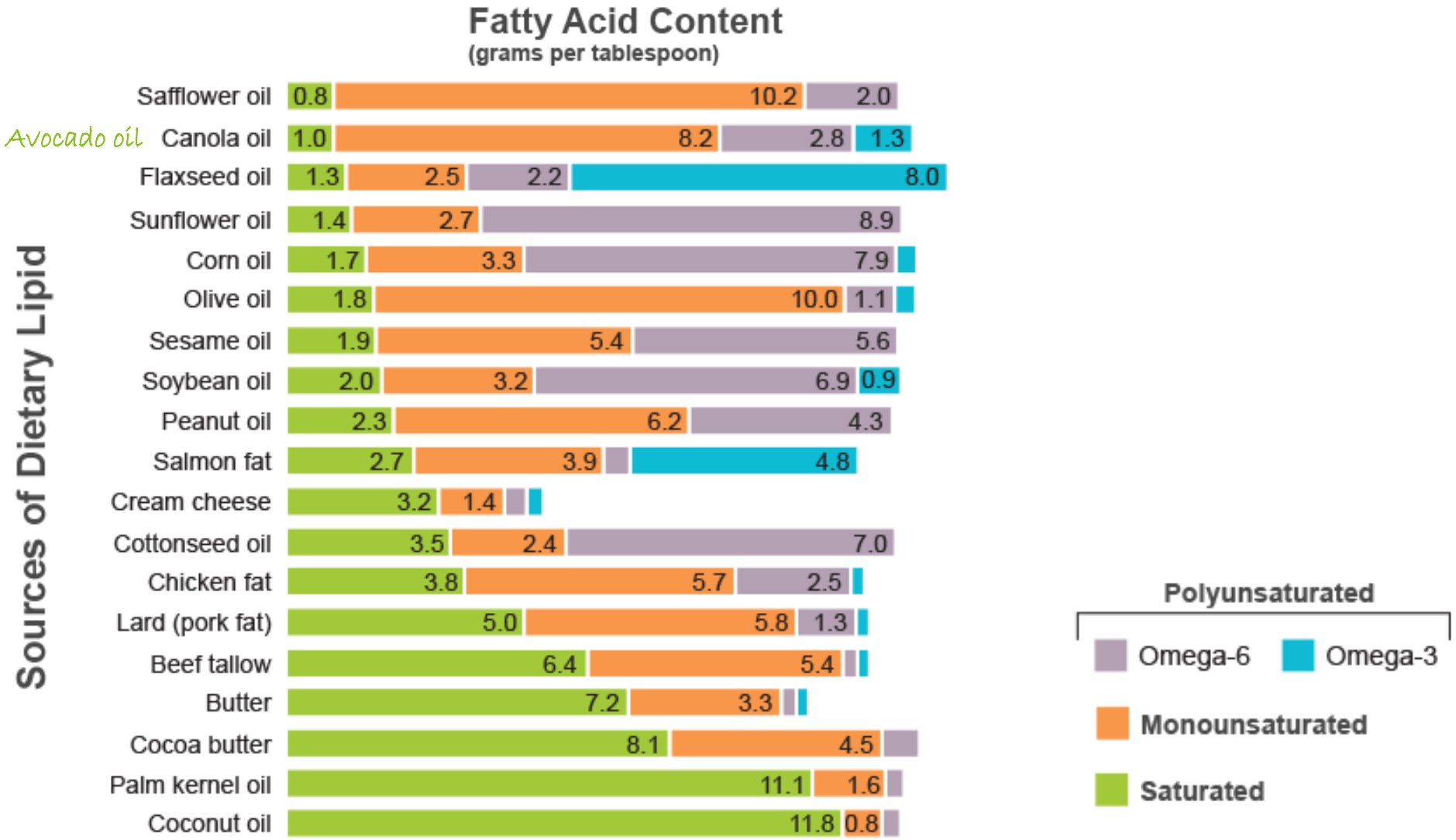
NOTE: Chemists use a shorthand notation to describe fatty acids. The first number indicates the number of carbon atoms; the second, the number of double bonds. For example, the notation for stearic acid is 18:0.

TGs (Fats & Oils) Characteristics

- Chemical composition of FAs within the TGs:
  - Existence, number, & location of double bonded Cs
  - Influences physical characteristics of fats and oils in foods
    - ✓ Structure = function
- Degree of FA (un)saturation: # of double bonded Cs
  - Firmness at room temperature
    - ✓ Mono & Polyunsaturated fats (most from vegetables) = liquid
    - ✓ Saturated fats (most from animals) = solid
    - ✓ Saturated fats (from plants) = solid (but softer than animal fats)



Fats & Oils

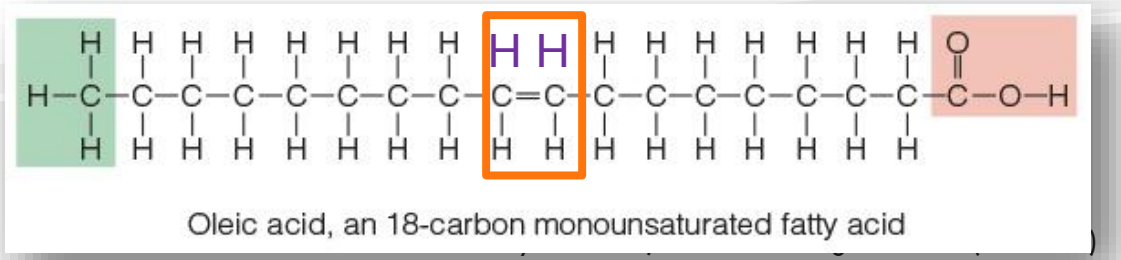

Fatty Acid Content
(grams per tablespoon)
Sources of Dietary Lipid
Safflower oil 0.8 10.2 2.0
Avocado oil
Canola oil 1.0 8.2 2.8 1.3
Flaxseed oil 1.3 2.5 2.2 8.0
Sunflower oil 1.4 2.7 8.9
Corn oil 1.7 3.3 7.9
Olive oil 1.8 10.0 1.1
Sesame oil 1.9 5.4 5.6
Soybean oil 2.0 3.2 6.9 0.9
Peanut oil 2.3 6.2 4.3
Salmon fat 2.7 3.9 4.8
Cream cheese 3.2 1.4
Cottonseed oil 3.5 2.4 7.0
Chicken fat 3.8 5.7 2.5
Lard (pork fat) 5.0 5.8 1.3
Beef tallow 6.4 5.4
Butter 7.2 3.3
Cocoa butter 8.1 4.5
Palm kernel oil 11.1 1.6
Coconut oil 11.8 0.8
Polyunsaturated
Omega-6
Omega-3
Monounsaturated
Saturated

TGs (Fats & Oils) Characteristics – continued

- Degree of unsaturation
  - Firmness at room temperature *-and-*
  - Stability
    - ✓ Oxidation → spoilage of fats (rancid smell and taste)
      - Polyunsaturated spoil quickly (many double bonded Cs = unstable)
      - Saturated keep longest (no double bonded Cs)

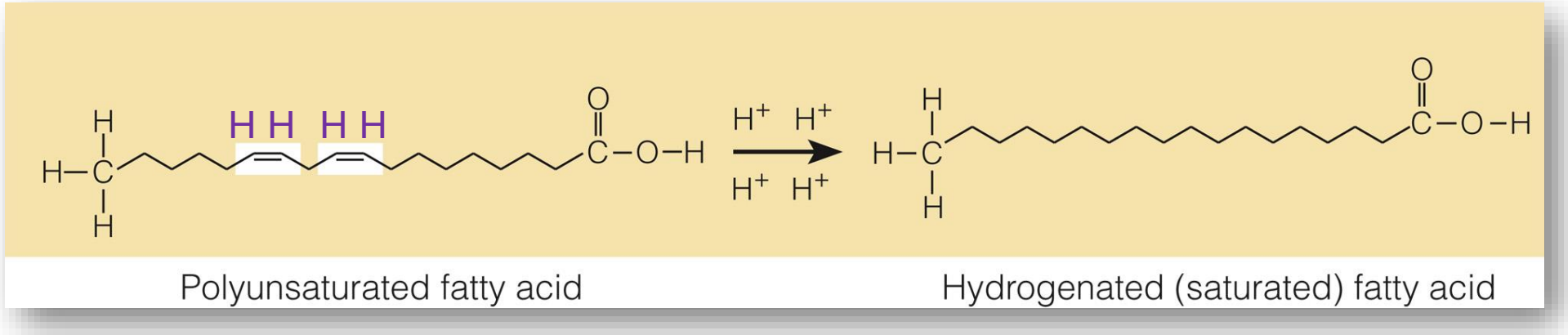
TGs (Fats & Oils) Characteristics

- Manufacturer options for protecting against oxidation:
  - Expensive storage (air-tight, non-metallic, cold, dark)
  - Addition of antioxidants
  - Hydrogenation
    - ✓ Hydrogen molecules added to points of unsaturation (becomes saturated)
    - ✓ Advantages: longer shelf life (less oxidation), alters texture of fats
    - ✓ Disadvantages: partially hydrogenated = some double bonds change from *cis* → *trans* configuration



Oleic acid, an 18-carbon monounsaturated fatty acid

TGs (Fats & Oils) Characteristics

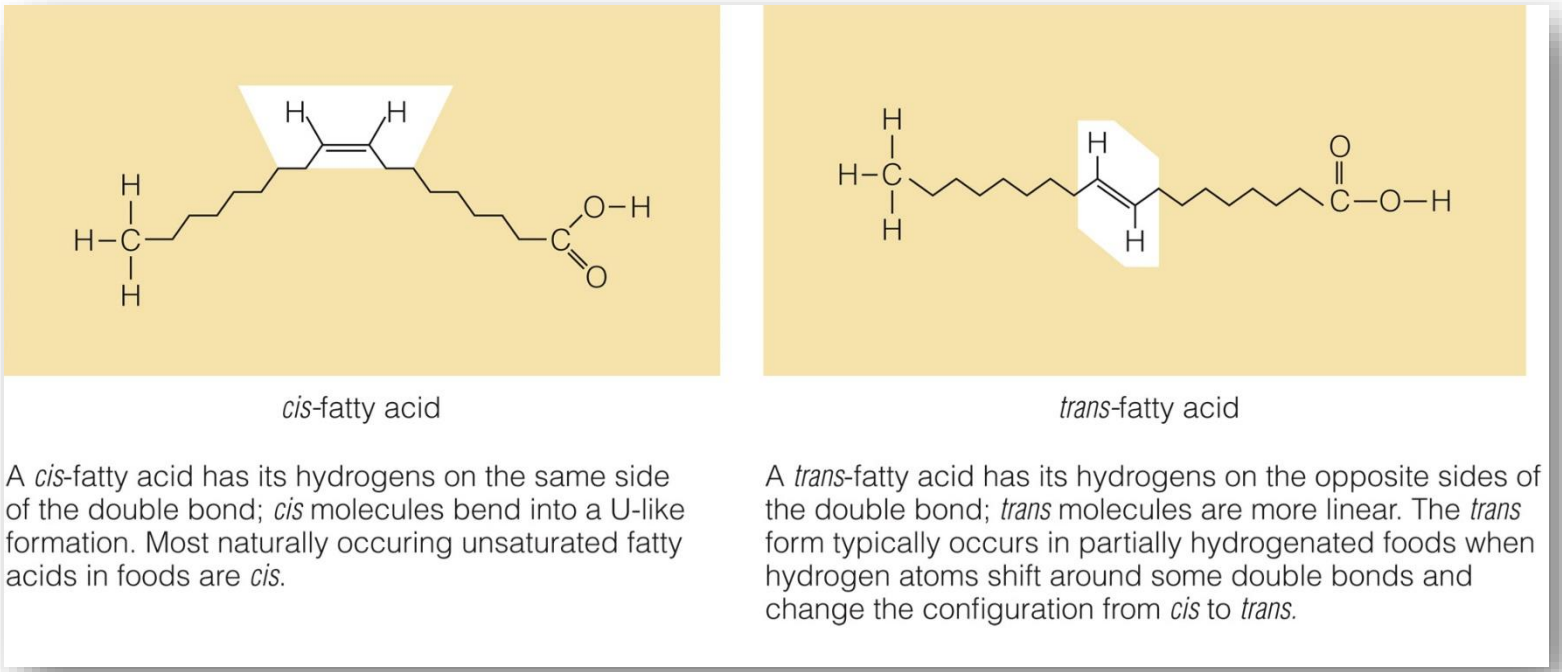


Total hydrogenation (rarely occurs in food processing)

- Trans-fatty acids
  - *Cis* = H next to double bonds on same side of carbon chain

TGs (Fats & Oils) Characteristics

- Trans-fatty acids
  - *Cis* = H next to double bonds on same side of carbon chain
  - *Trans* = H next to double bonds on opposite sides of carbon chain
  - Body processes *trans* fat like saturated fat
    - Increase blood cholesterol and heart disease risk



cis-fatty acid

A *cis*-fatty acid has its hydrogens on the same side of the double bond; *cis* molecules bend into a U-like formation. Most naturally occuring unsaturated fatty acids in foods are *cis*.

trans-fatty acid

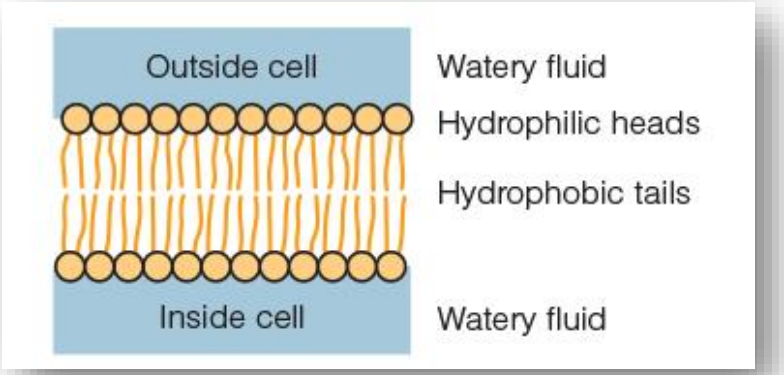
A *trans*-fatty acid has its hydrogens on the opposite sides of the double bond; *trans* molecules are more linear. The *trans* form typically occurs in partially hydrogenated foods when hydrogen atoms shift around some double bonds and change the configuration from *cis* to *trans*.

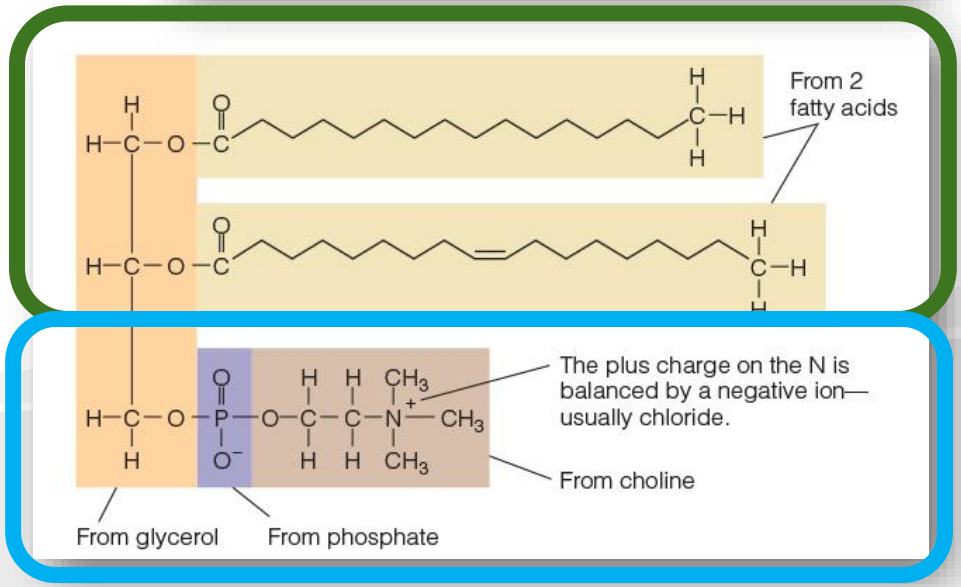
Partial hydrogenation

Whitney & Rolfes, Understanding Nutrition (15th ed.)

Chemist's View of Phospholipids

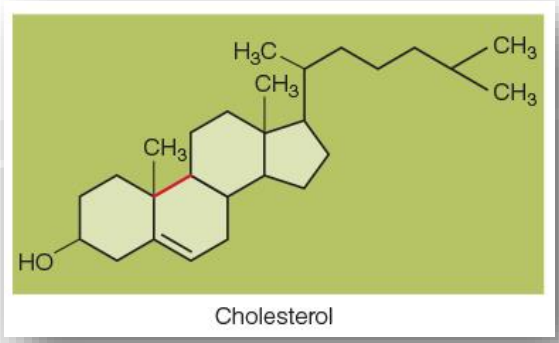
- Phospholipids and sterols ~5% of dietary lipids
- Phospholipids
  - Two fatty acids
    - ✓ Hydrophobic = **fat soluble**
  - AND phosphate group + N-containing compound
    - ✓ Phosphate group: hydrophilic = **water soluble**
  - Versatile: emulsifiers in food industry
  - Lecithin: best known phospholipid
    - ✓ Eggs, liver, soybeans, wheat germ, peanuts
  - Roles
    - ✓ Part of cell membranes
    - ✓ Vitamin and hormone transport in/out of cells
    - ✓ Emulsifier: keep fat suspended in blood





Chemist's View of Sterols

- Sterols
  - Multiple-ring structure
  - Food sources
    - ✓ Cholesterol: animal sources (meat, eggs, seafood, poultry, dairy)
    - ✓ Plant sterols: structurally similar to cholesterol but interfere with cholesterol absorption
  - Roles of sterols
    - ✓ Vital body compounds made from cholesterol: bile acids, sex & adrenal hormones, vitamin D
      - 90% of body cholesterol = in cells (≠ energy)
      - Cholesterol made in the body = endogenous (synthesized by liver)
      - Cholesterol made outside the body (foods) = exogenous
      - Accumulation in artery walls and plaque formation = harmful



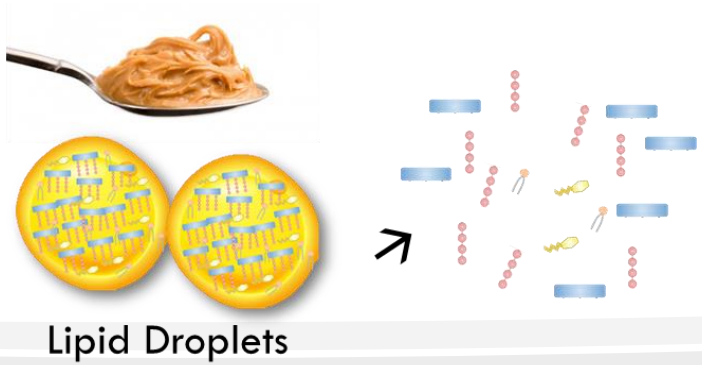
Cholesterol

Lipid Digestion

Ultimate goal: Break foods into smaller molecules for use by the body

Digestion:

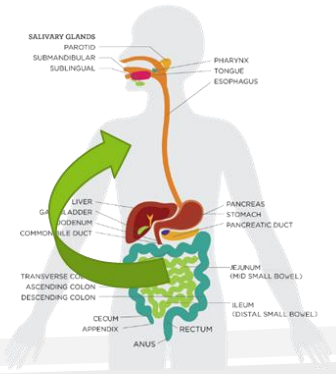
Lipids → Components



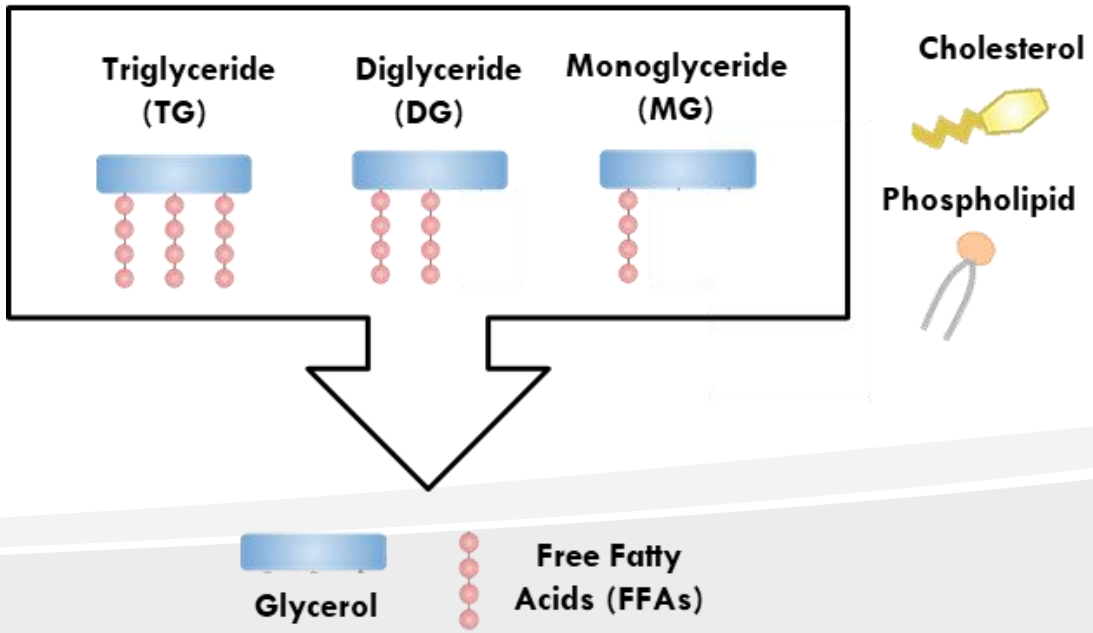
Lipid Droplets

Absorption:

→ Blood



Key Players

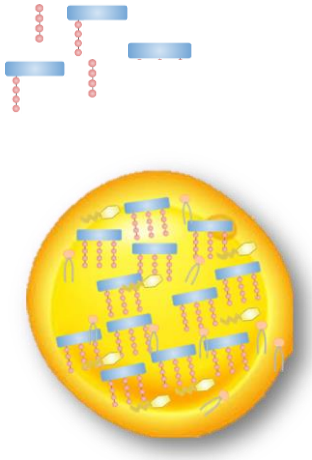


Lipid Digestion - Mouth

- Small amount of digestion (<5%)
  - Lingual (tongue) lipase

Lipid Droplet

Lipids		New Product
Triglycerides (TGs)	*Lipase* →	5% TGs: Monoglycerides, Free Fatty Acids, Glycerols 95% TGs
Phospholipids	→	Phospholipids
Sterols (cholesterol)	→	Sterols (cholesterol)

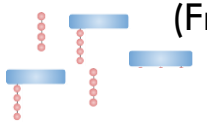


Lipid Digestion - Stomach

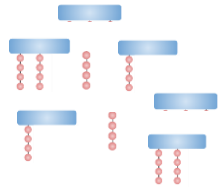
- Small amount of digestion (~5-25%)
  - Lingual Lipase (from mouth)
  - Gastric lipase (from stomach)

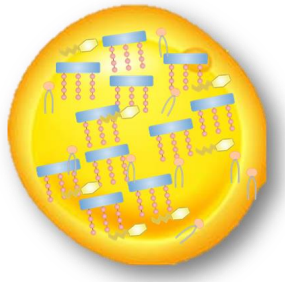
Lipid Droplet

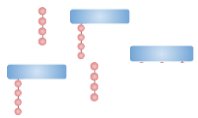
(From Mouth)



Lipids		New Product
Triglycerides (TGs)	*Lipase* →	5-25% TGs: Mono & Diglycerides Free Fatty Acids Glycerols
	→	75-95% TGs
Phospholipids	→	Phospholipids
Sterols (cholesterol)	→	Sterols (cholesterol)
Monoglycerides Free Fatty Acids Glycerols	→	Monoglycerides Free Fatty Acids Glycerols







Lipid Digestion – Small Intestine

- Emulsifying fats

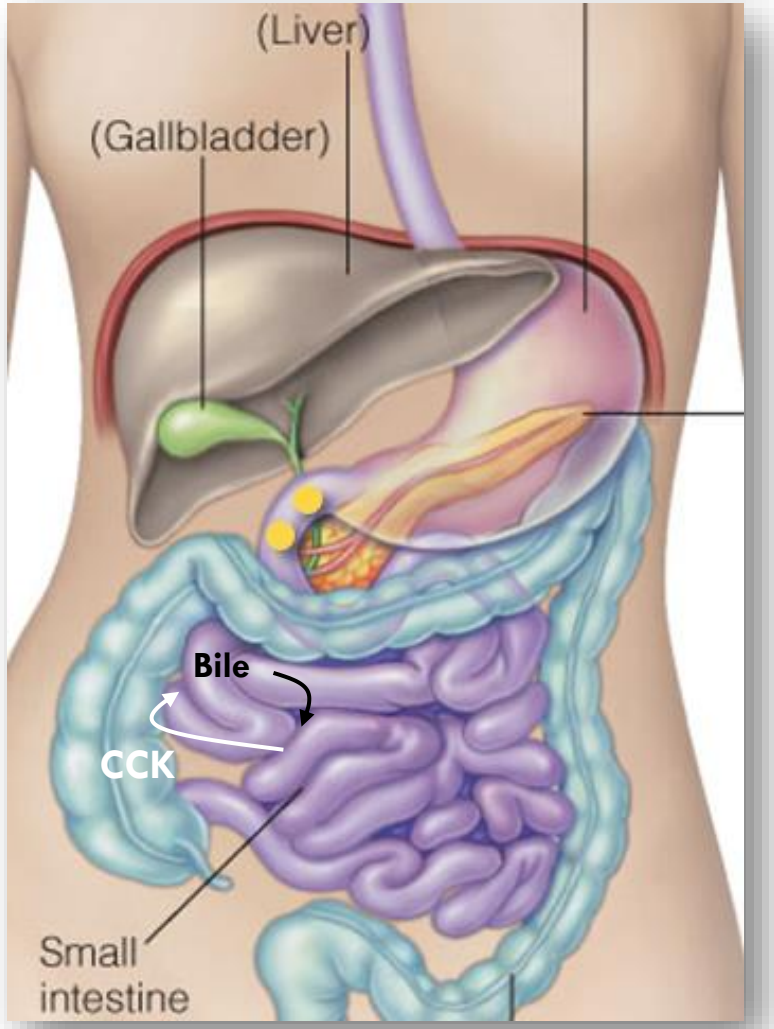
1) Fat stimulates CCK secretion (from small intestine)
2) CCK stimulates Bile secretion (from gall bladder)

Bile:
- *Made from cholesterol*
- *Made in the liver*
- *Stored in the gall bladder*
- *Acts as emulsifier*

hydrophobic end

hydrophilic end

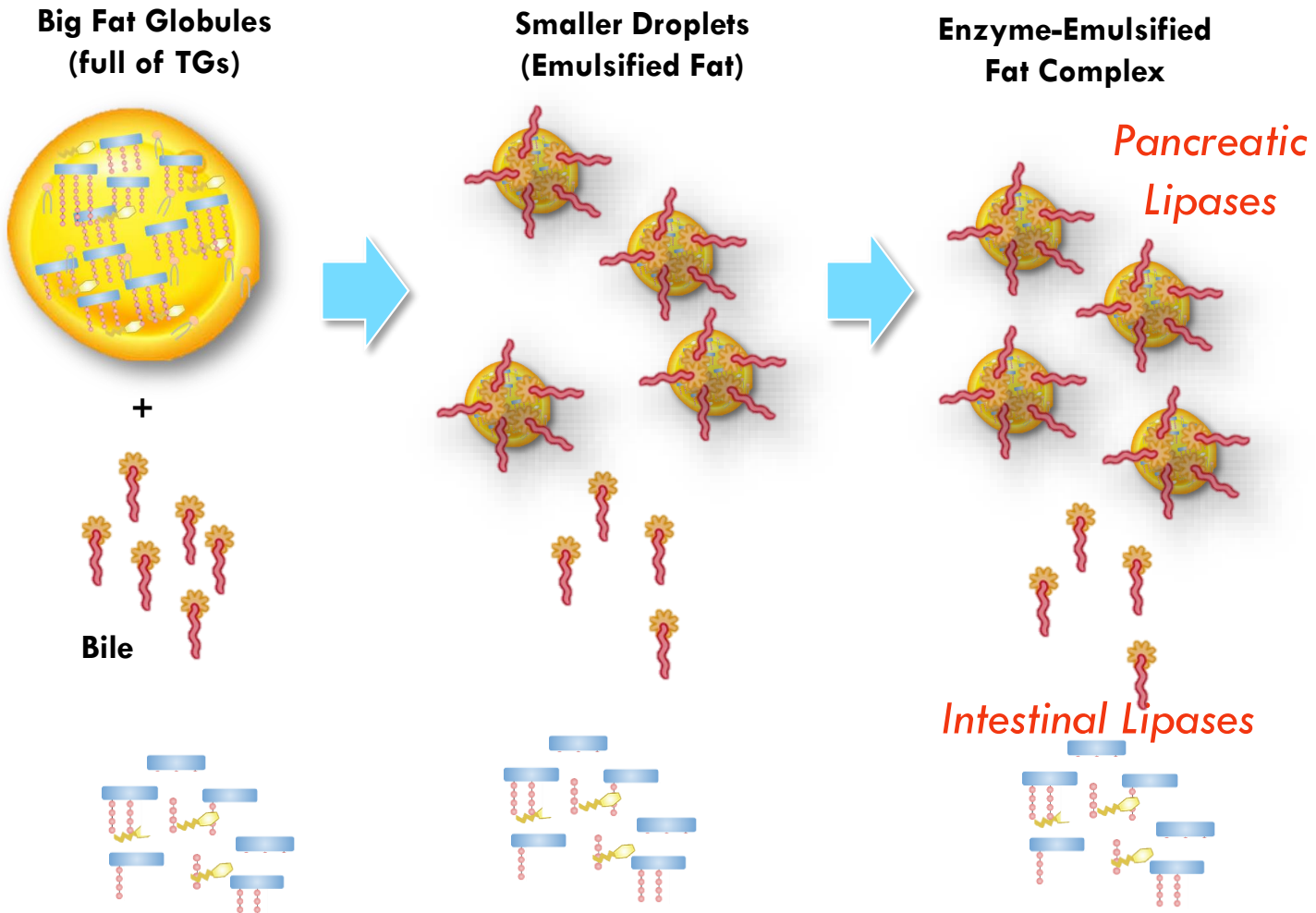
Emulsifier:
A substance that causes the mixing of two or more substances that would normally not mix (e.g., oil and water).



3) Bile stimulates breakdown of large fat globules into smaller droplets

Lipid Digestion – Small Intestine

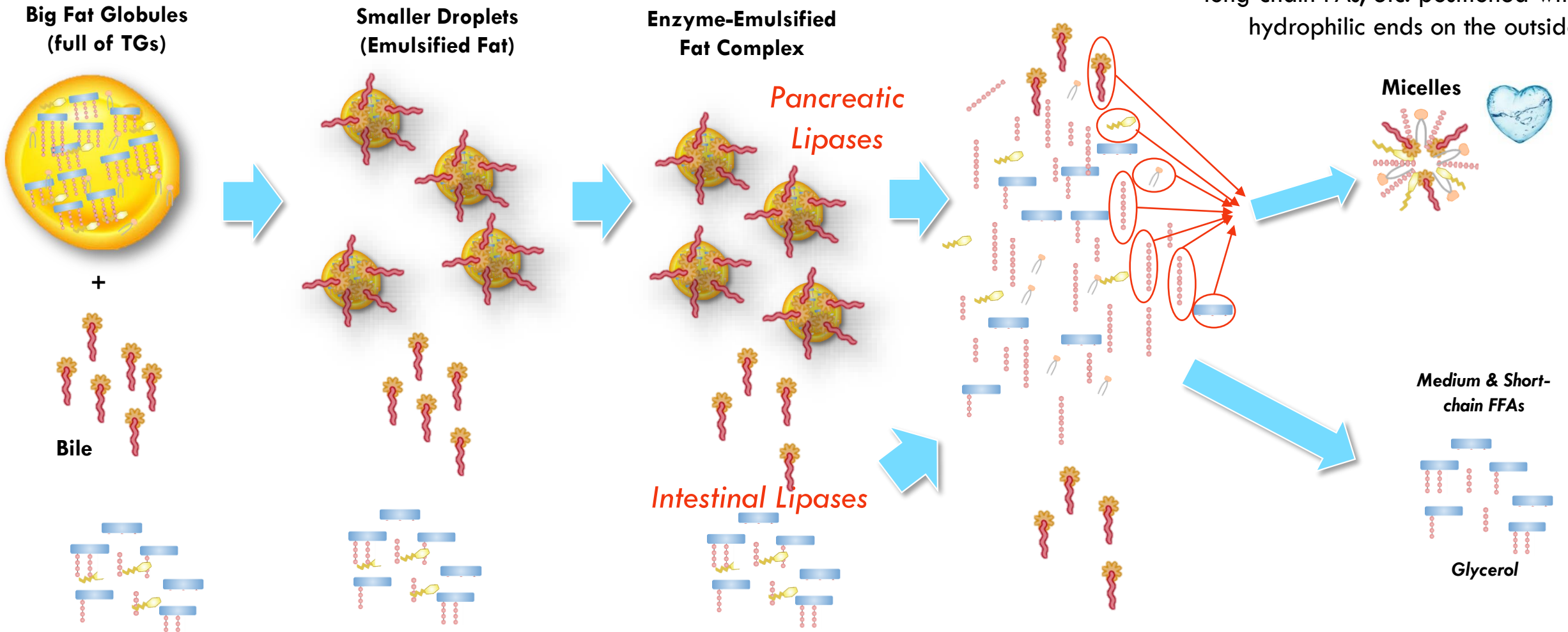
- Most digestion occurs here (~75%)



Lipid Digestion – Small Intestine

- Most digestion occurs here (~75%)

<u>Micelle</u> – lipid molecule that contains long-chain FAs, etc. positioned with hydrophilic ends on the outside



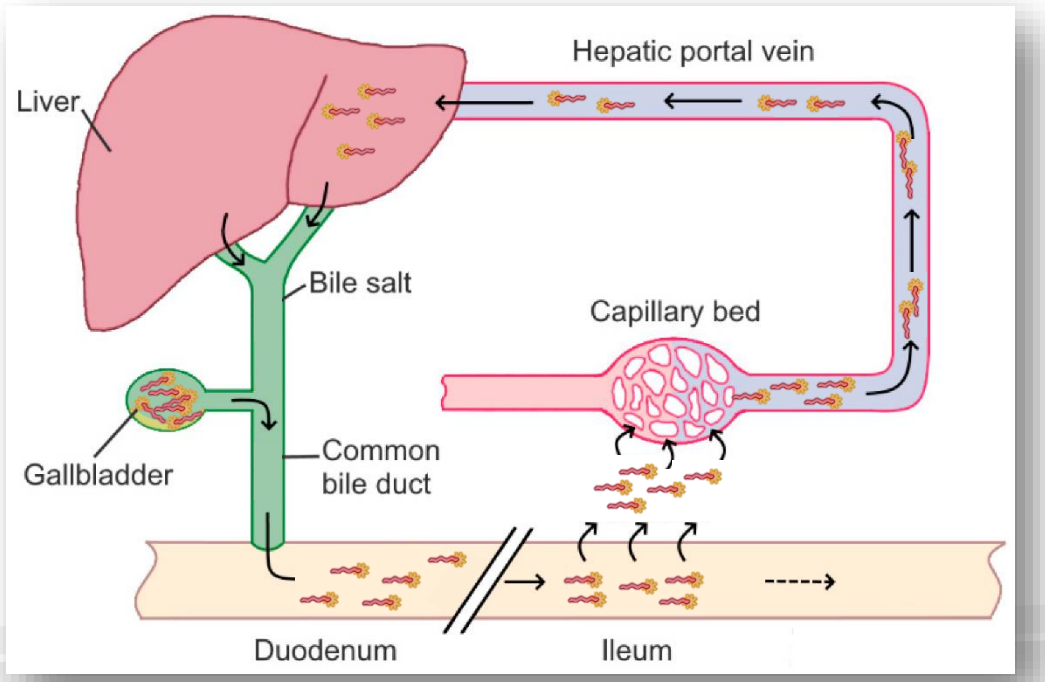
Lipid Digestion – Large Intestine

- None! (fats)
- Some important fat-related components (cholesterol) can be carried out of the body, but needs a ‘carrier’…

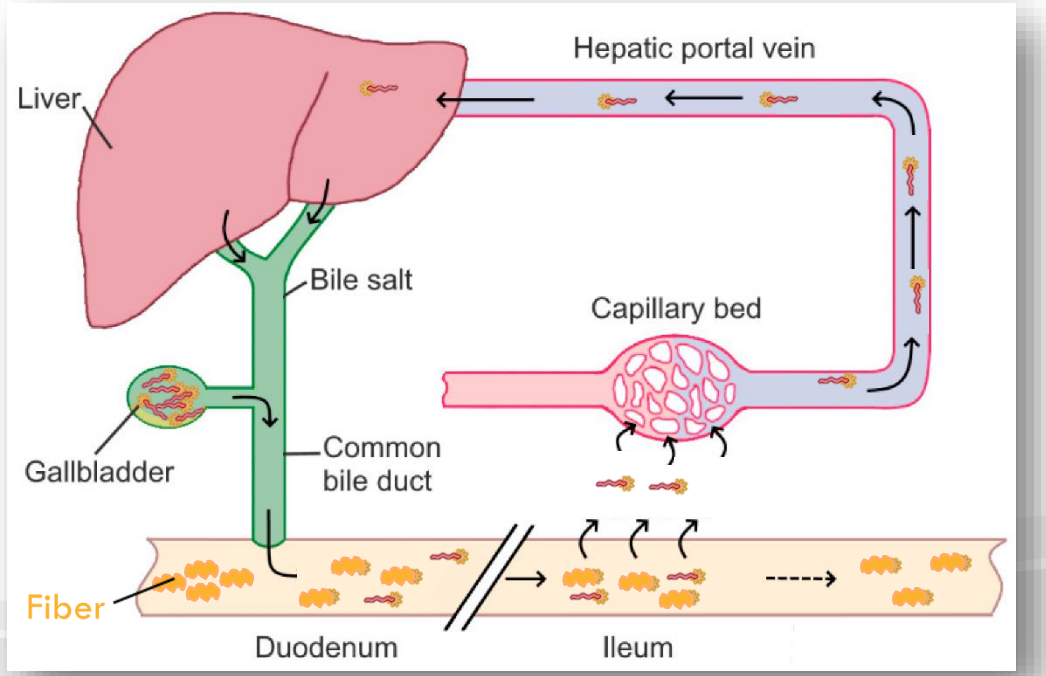
Role of Fiber

- Soluble Fiber - traps excess bile in the small intestine and carries it to the large intestine to be excreted

Before the Consumption of Fiber



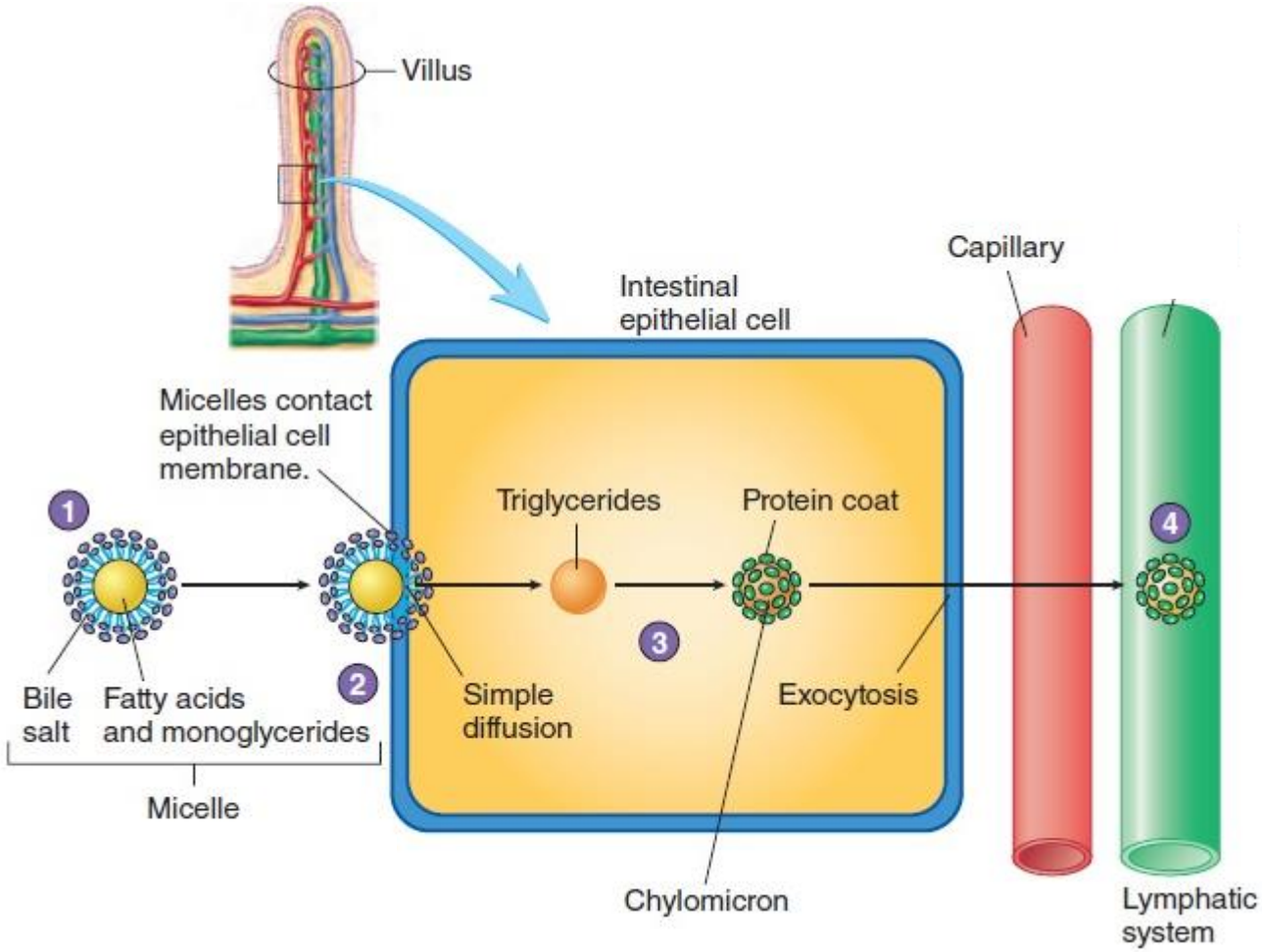
After the Consumption of Fiber



Lipid Absorption (Small Intestine)

Lipid transport:

1. Bile salts surround fatty acids and monoglycerides to form **micelles**
2. Micelles attach to the membrane and fatty acids + monoglycerides pass by simple diffusion into cell
3. Fatty acids + monoglycerides converted to triglycerides; proteins coat them to form **chylomicrons**. Chylomicrons move out of cell by **exocytosis**
4. Chylomicrons enter lymphatic system and eventually bloodstream

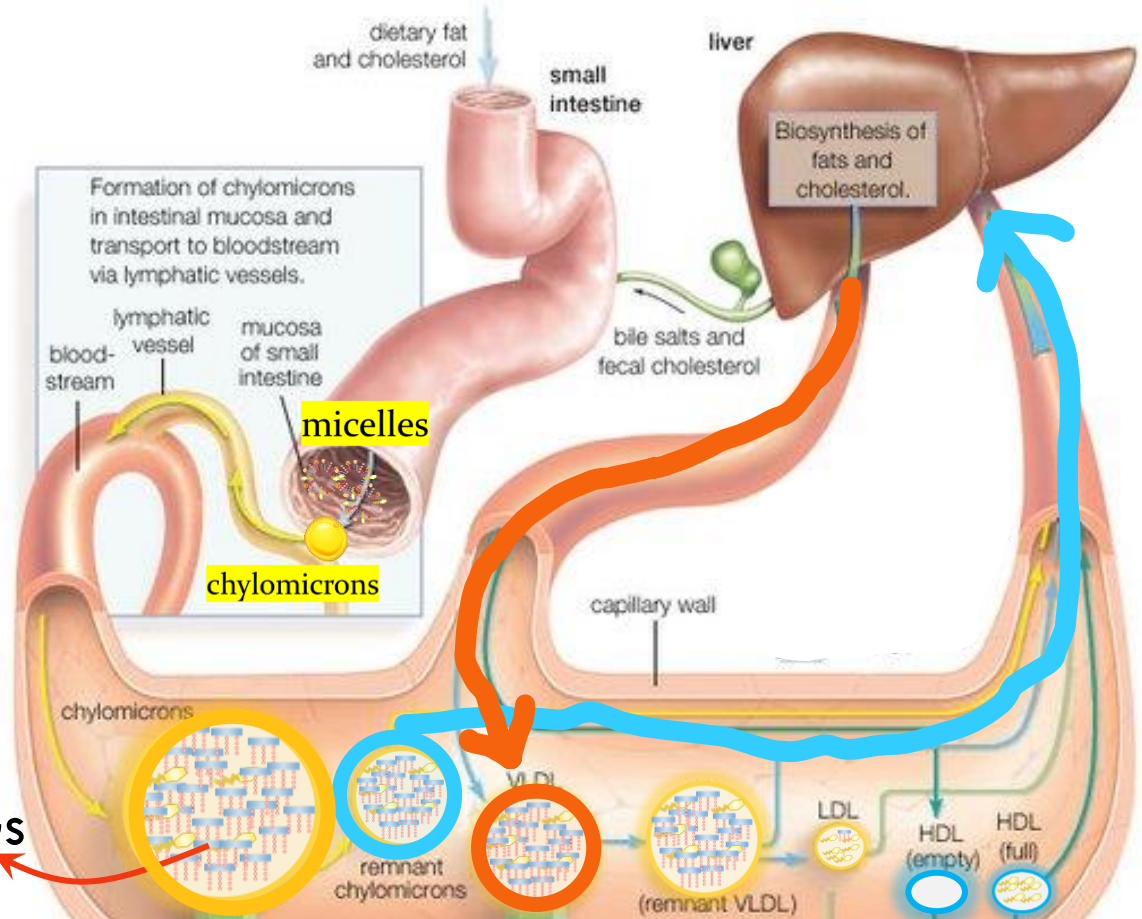


Lymphatic System: Part of the circulatory & immune system. It moves lymph (fluid) into the blood stream.

Lipid Transport in Circulation (blood)

Chylomicrons:

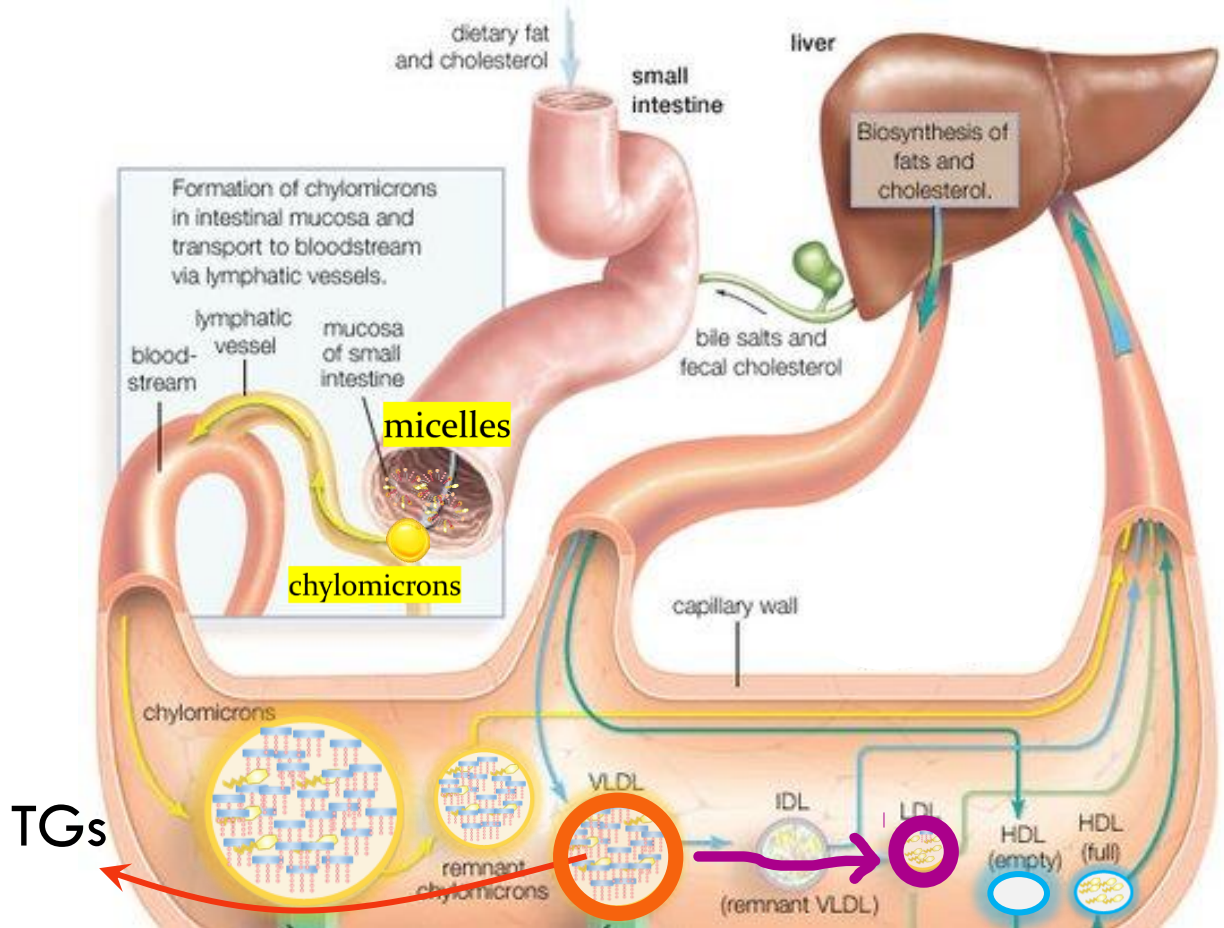
- **Lipoprotein**: "water taxi" for lipids
  - **Chylomicrons** = largest lipoproteins
- Chylomicrons transport TGs to peripheral tissues
  - Adipose Tissue
  - Muscle
  - Liver
- TGs get dumped off, chylomicrons get smaller
- Smaller versions go to liver and are repackaged into very low-density lipoproteins (**VLDLs**)



Lipid Transport in Circulation (blood)

Very Low Density Lipoproteins (VLDL):

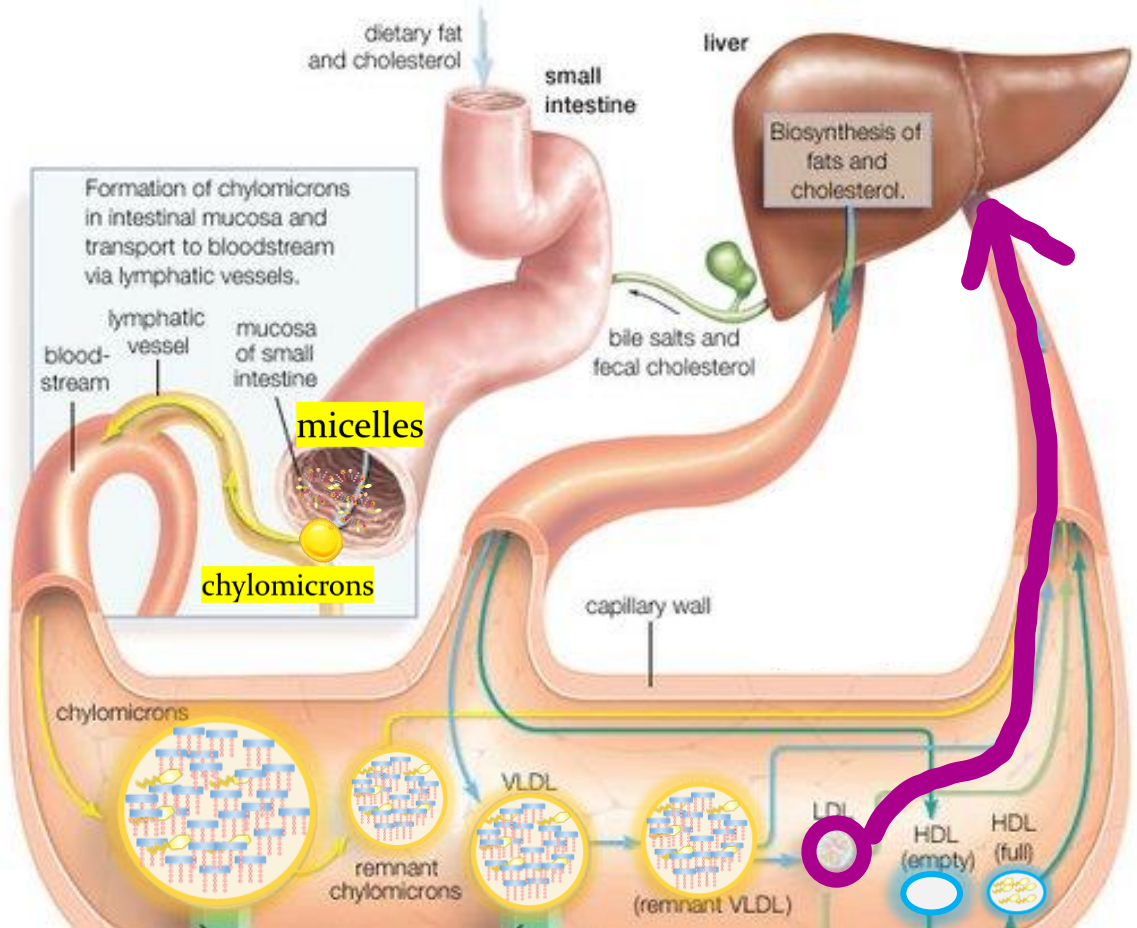
- Made in the Liver
- Full of TGs (but less than chylomicrons)
- Transport TGs to peripheral tissues
  - Adipose Tissue
  - Muscle
  - Liver
- TGs get dumped off, VLDLs get smaller
- Become Low Density Lipoproteins (LDL)



Lipid Transport in Circulation (blood)

Low Density Lipoproteins (LDL):

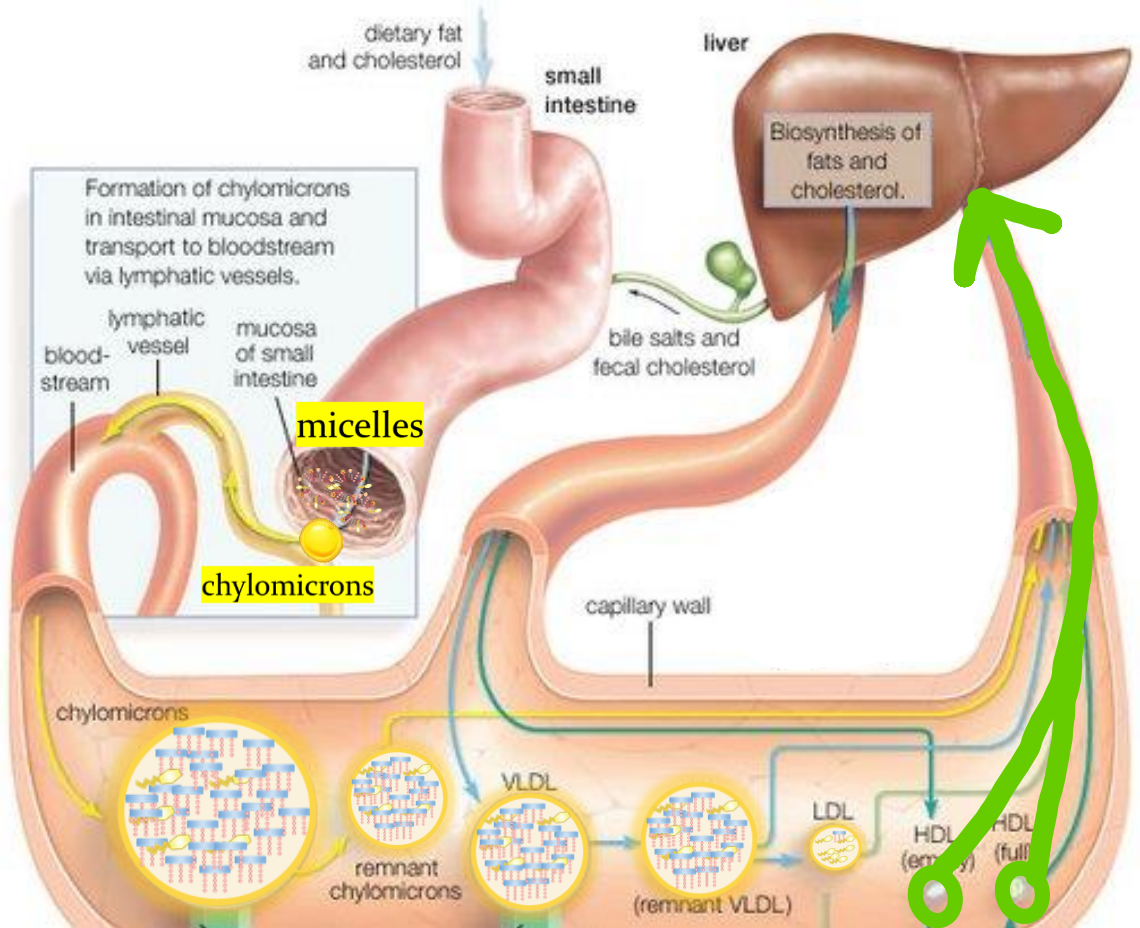
- Made from VLDL
- Fewer TGs than VLDL & Chylomicrons
- Contains mostly **cholesterol**
- Transports cholesterol to cells:
  - Make hormones
  - Used for bile
  - Build new cell membranes
- Liver removes some cholesterol from blood
- *Too much blood cholesterol = problematic…*



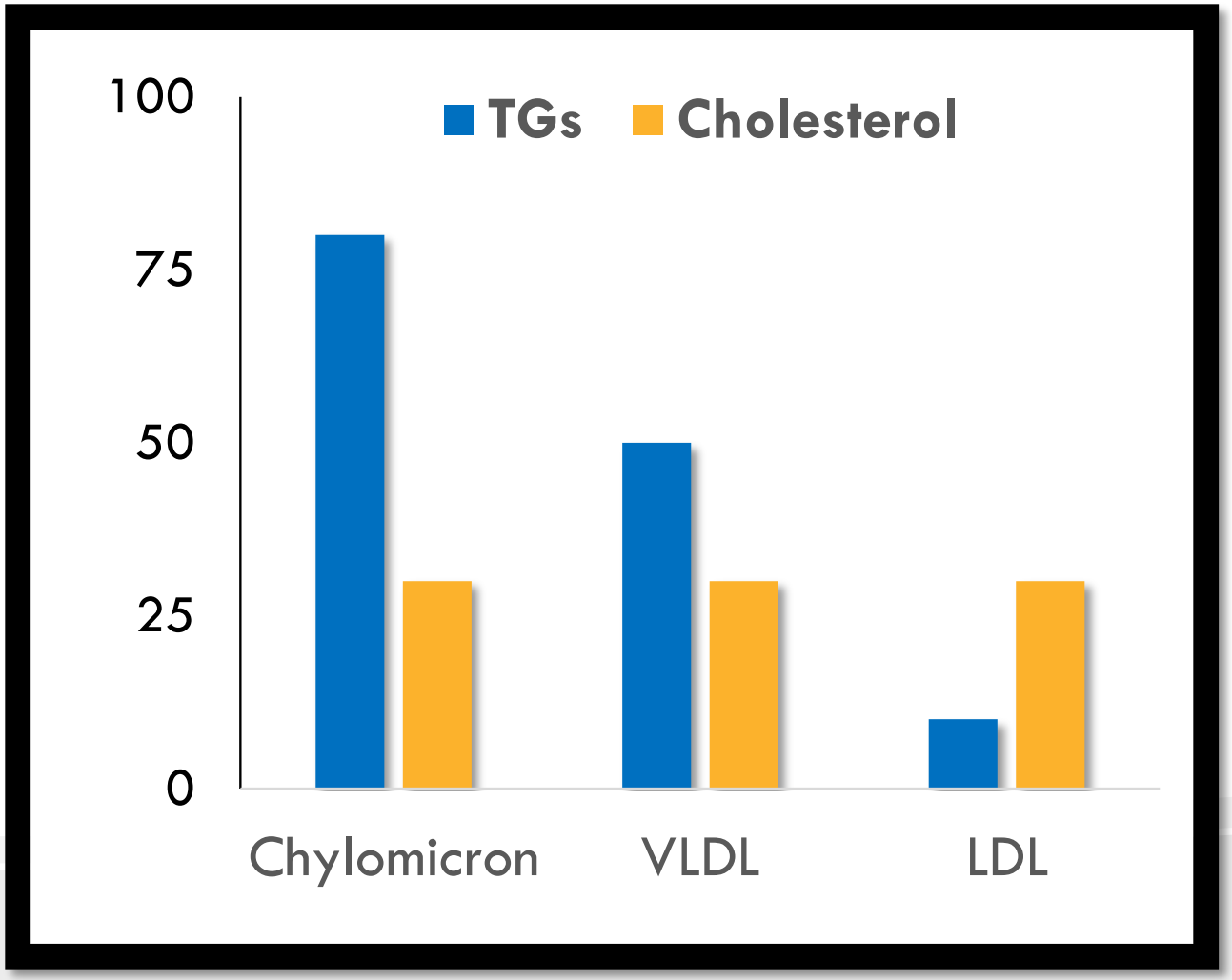
Lipid Transport in Circulation (blood)

High Density Lipoproteins (HDL):

- NOT Made from LDL
- Made by the Liver
- Removes cholesterol from cells
  - Carries cholesterol to liver and then gets recycled/disposed
- *Can be protective…*



Lipid Transport in Circulation (blood)



Triglyceride (TG) Metabolism

Fed State (abundance/surplus of TGs, e.g., after meals)

- Use it immediately – or – store energy for later use

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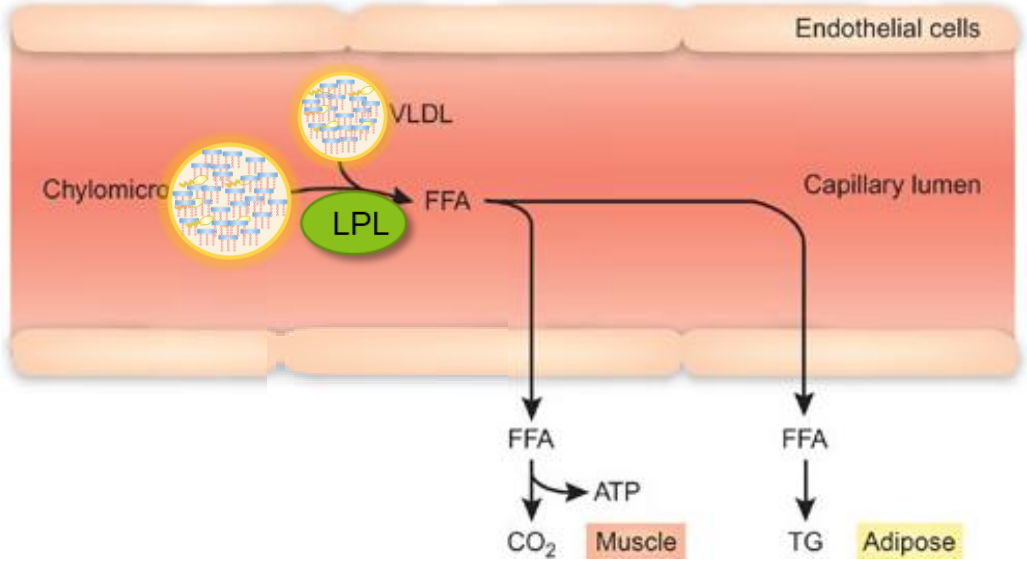
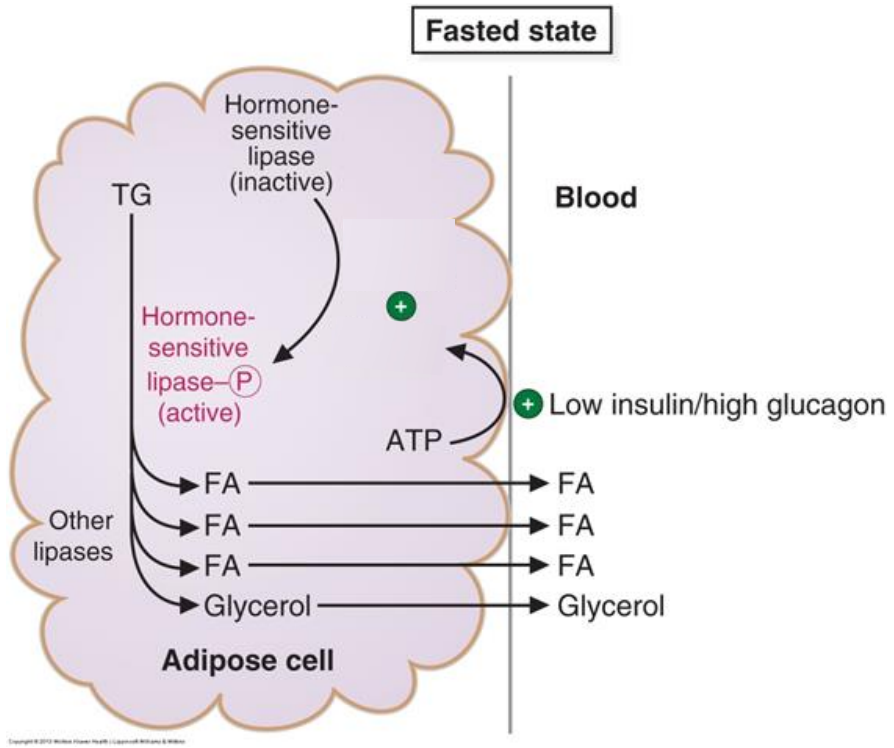
1) TGs (from Chylomicrons & VLDLs):
   - Broken down by Lipoprotein Lipase (LPL)
     - ✓ LPL secreted from adipose and muscle
   - Release FFAs + glycerol
2) FFAs enter the tissues
   - Muscle: FFAs used for energy
   - Adipose: FFAs get converted back to TGs
     - ✓ TGs = storage form of fats (energy)



Triglyceride Metabolism

- Fasted State (low energy availability, e.g., between meals/overnight)
  - ✓ Break down stored energy to fuel body tissues
  - ✓ Supplies 60% of energy (at rest)

1) Low blood glucose → low insulin/high glucagon
   - Activates Hormone Sensitive Lipase
   - Breaks TGs into FFAs + glycerol
2) FFAs + glycerol enter the circulation:
   - ✓ Used by liver and muscle for energy
   - ✓ Can be converted to Ketone Bodies
   - ✓ FFAs <u>cannot</u> be converted to glucose



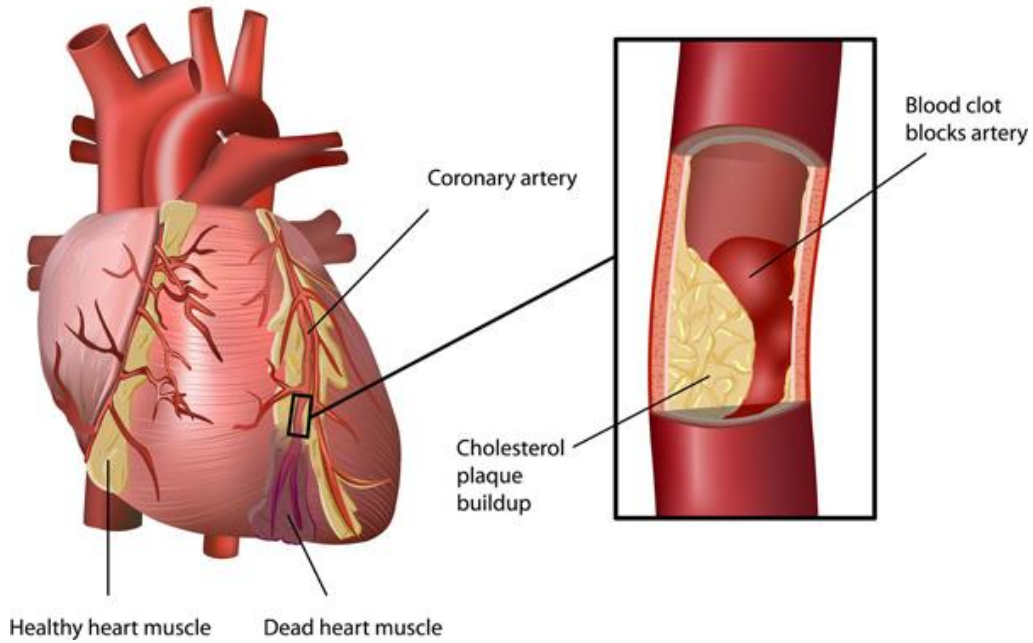
Main Roles of Body Lipids

- Long-term energy
- Help fat-soluble vitamins to be absorbed
- Protect organs (insulation)
- Component of cells
- Precursors to hormones
- Aids in digestion

Blood Lipids & Health Risks

- Blood lipid profile = lipids that are circulating in the blood
  - Triglycerides (TG), Total Cholesterol (LDL + HDL)

Cardiovascular (Heart) Disease



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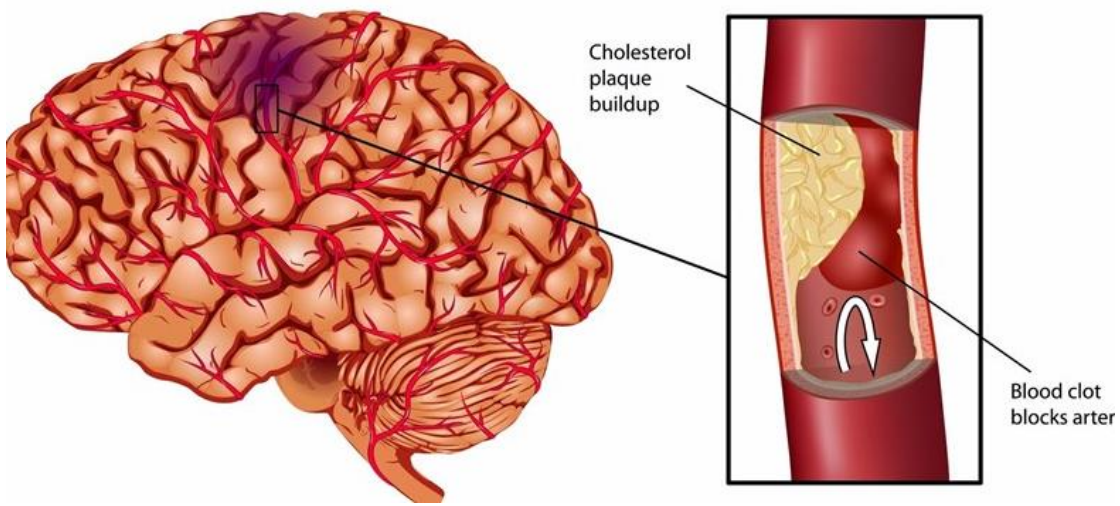

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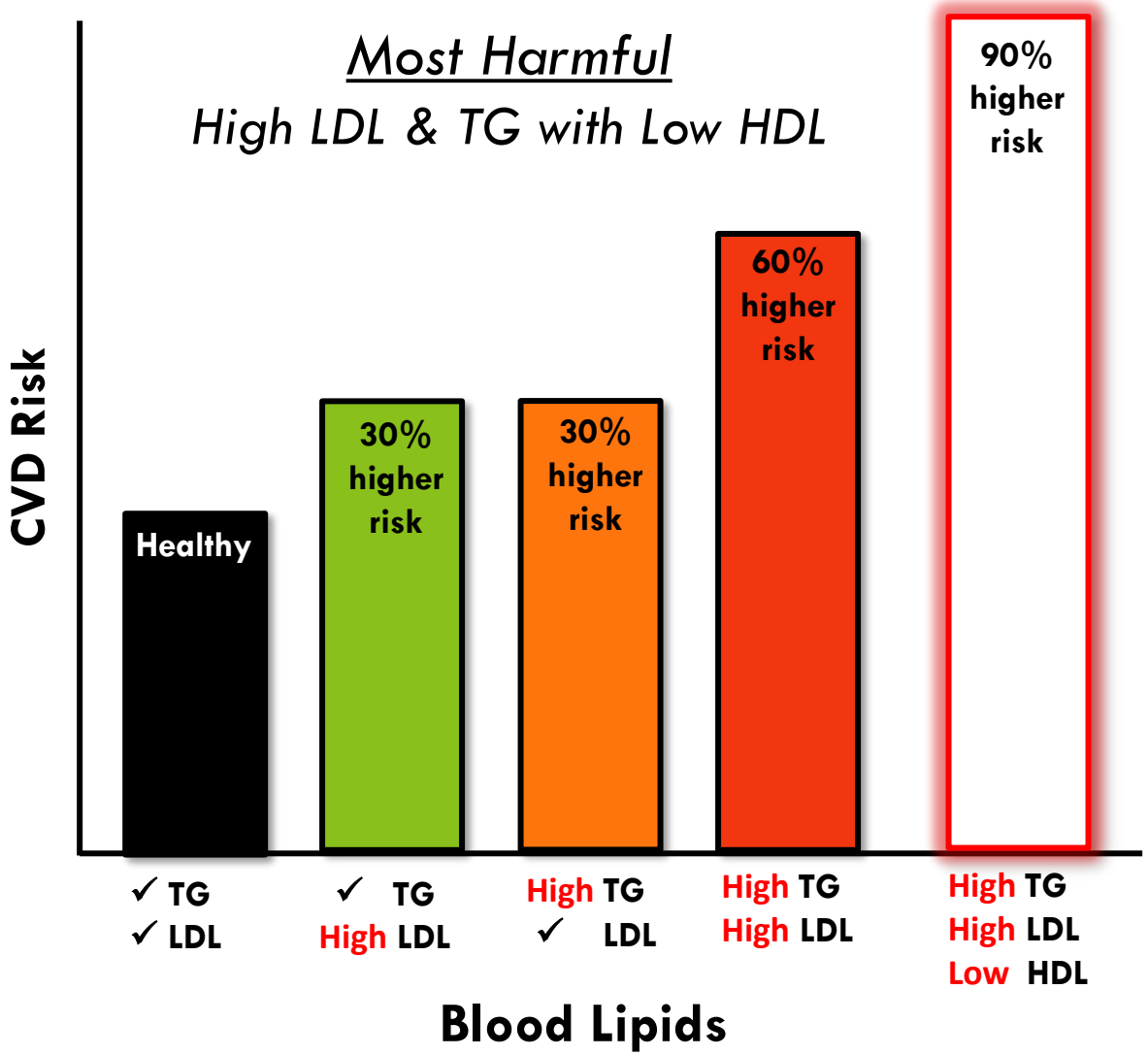
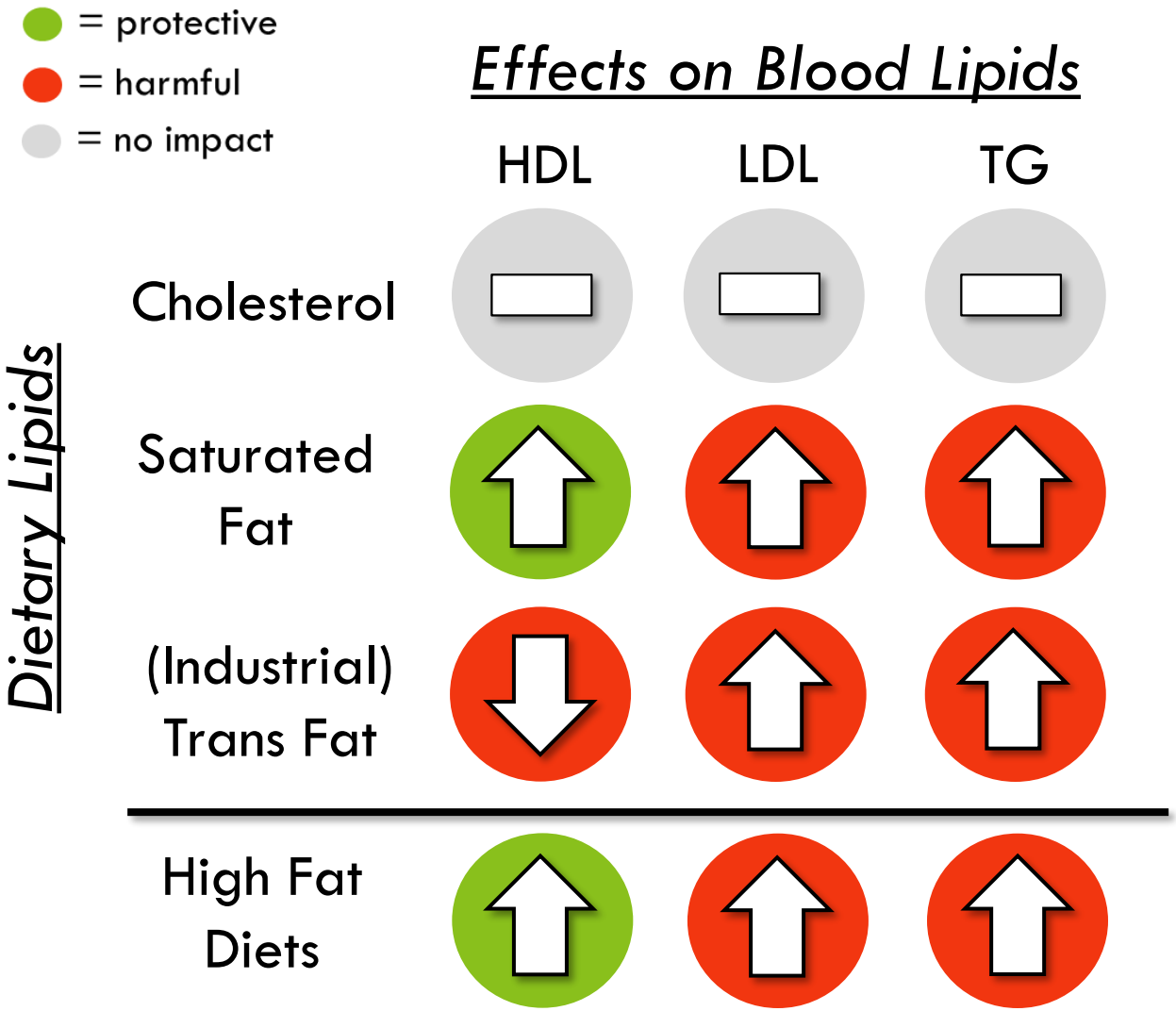
Blood Lipids & Health Risks



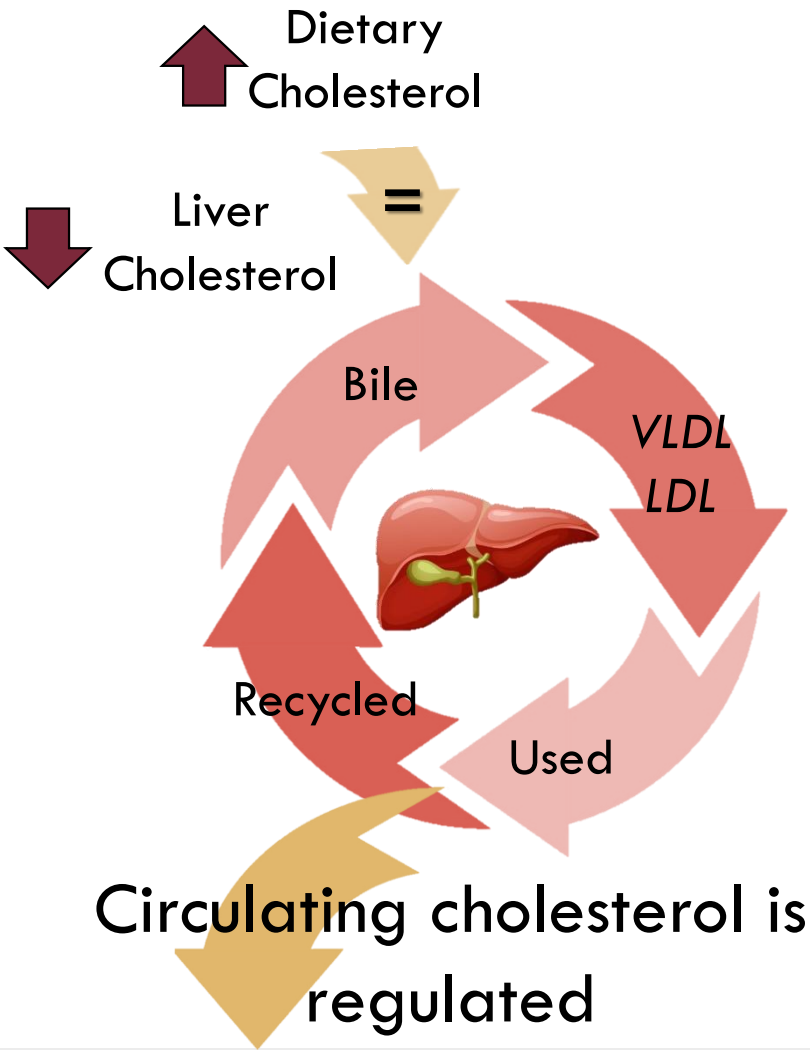
Recommended Blood Lipids	
Total Cholesterol	< 200 mg/dL
LDL Cholesterol	< 100 mg/dL
Triglycerides	< 150 mg/dL
HDL Cholesterol	> 60 mg/dL

Protective role of HDL…

Dietary Lipids & Health Risks: CVD



Impact of Diet



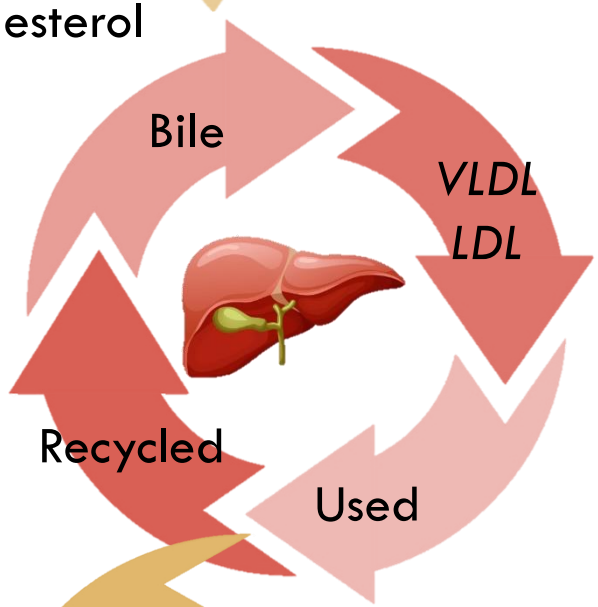
Circulating cholesterol is regulated

Impact of Diet

Dietary Cholesterol

Liver Cholesterol

=



Circulating cholesterol is regulated

High (Saturated) Fat Diet

Liver Cholesterol

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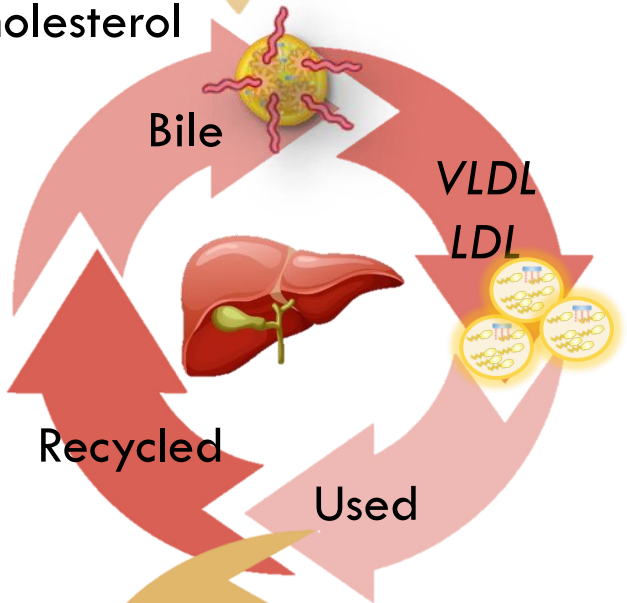


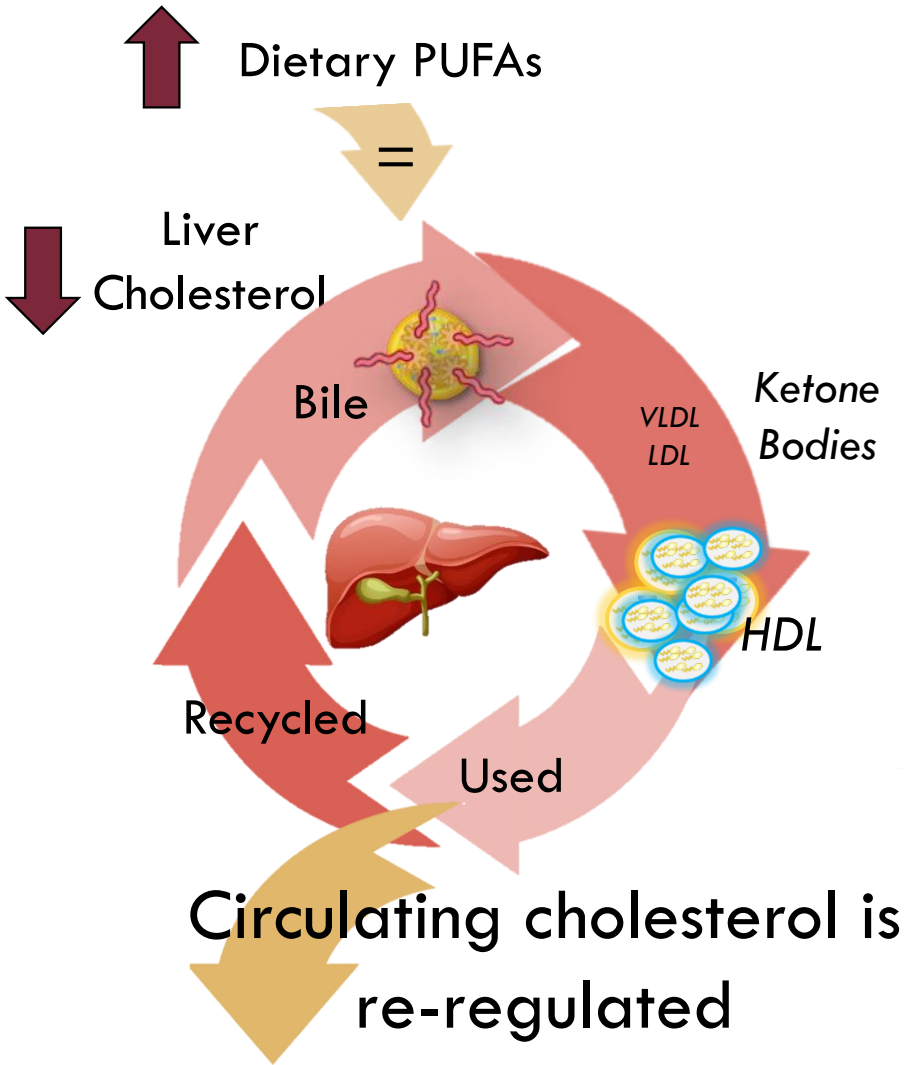
Circulating cholesterol is dysregulated

Impact of Diet

= protective
= harmful
= no impact

Effects on Blood Lipids

Dietary Lipids	HDL	LDL	TG
MUFAs	↑	↓	↓
PUFAs	↑	↓	↓



- PUFA (Omega-3): Immune function (anti-inflammatory)
- PUFA (Omega-6): Immune function (pro-inflammatory)

Circulating cholesterol is re-regulated

Fat – DRIs & Habitual Intake

Total FAT DRIs (19-30yo)		
RDA	AMDR	UL
N/A	20-35%	N/A

Habitual Intake (19-30yo)	
88 g/d	37%

- No RDA (or AI) for Total Fat: insufficient evidence
  - AMDR (lower range) set to for adequate consumption of:
    - ✓ Energy, essential FAs, and fat-soluble vitamins
- No UL → Fat isn't toxic but…
  - AMDR (upper range) set to prevent fat excess → obesity and CVD

Example **Fat** amounts within AMDR for a 2000 kcal diet:

2000 kcal x 0.20 (AMDR lower range) = 400 kcal/ 9 kcal/g = 44 g/d
2000 kcal x 0.35 (AMDR upper range) = 700 kcal/ 9 kcal/g = 78 g/d

- In the US, we do NOT meet Total Fat recommendations
- …what about ***quality***?

Fat – DRIs & Habitual Intake

- MUFAs – No RDA/AI or UL – not required
- PUFAs – Both Omega-6s & -3s have AI (but no UL)
  - Recommended Omega-6 : Omega-3 ratio
- In the US, we do NOT meet Omega-3 recommendations
  - Goal: increasing Omega-3s (not necessarily reducing Omega-6s)

	Habitual Intake		
	Omega-3 *(linolenic acid)*	Omega-6 *(linoleic acid)*	Omega 6 : 3
Males	1 g/d	22 g/d	20 : 1
Females	1 g/d	18 g/d	

	PUFA DRIs (19-30yo)				
	Omega-3 *(linolenic acid)*		Omega-6 *(linoleic acid)*		Omega 6 : 3
	AI	*UL*	*AI*	*UL*	*AI*
Males	1.6 g/d	N/A	17 g/d	N/A	4 : 1
Females	1.1 g/d	N/A	12 g/d	N/A	

Recommendations - DGAs

- **Goal:** Choose the right kinds of fat to promote health and reduce disease risk (**not** about eliminating all fat from diet)
- Fat provides taste and flavor!
- Reduce trans fat (ideally: 0%)
- Reduce saturated fat: **< 10% of daily calories**
- As little dietary cholesterol as possible (why?)
  - Most high cholesterol foods also contain saturated fats

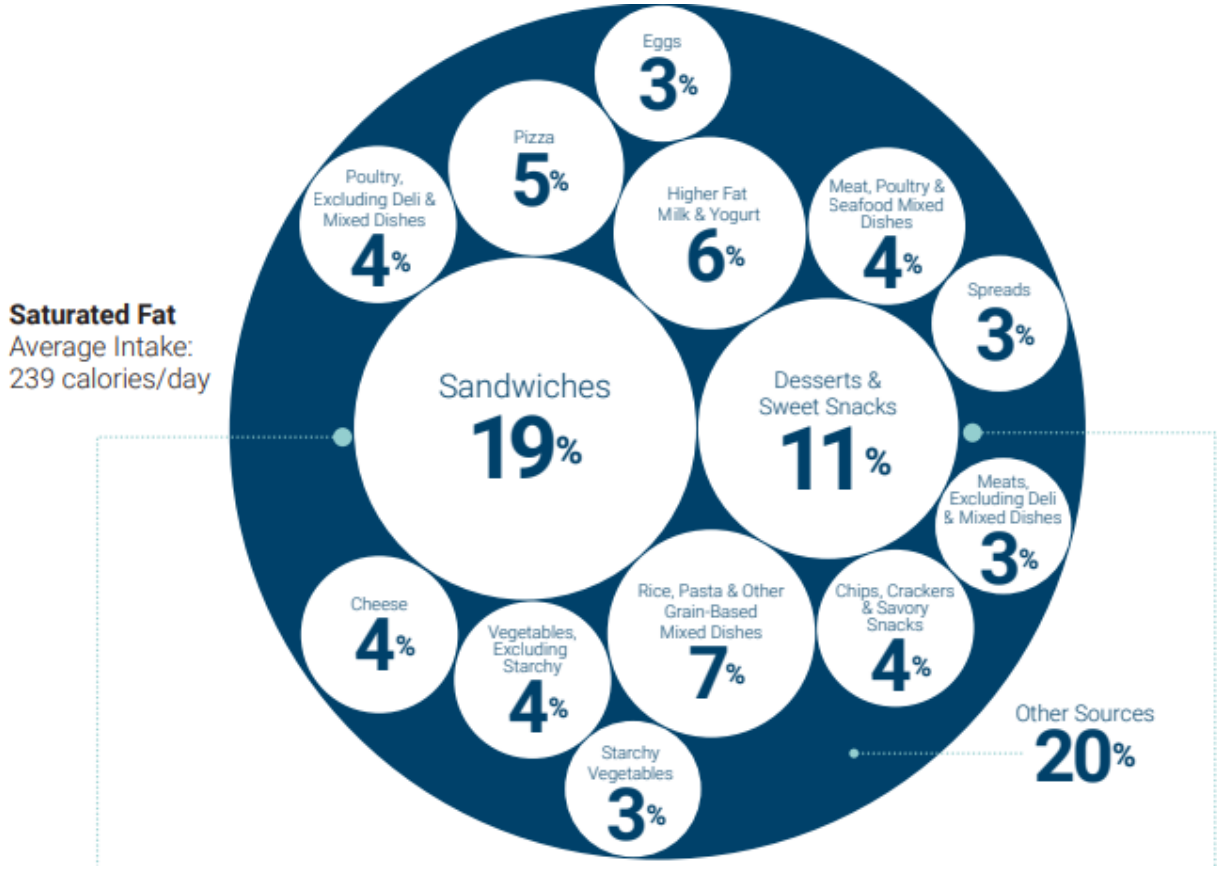
Saturated Fat: Fats that have a high proportion of saturated FAs & no double-bonded C

Saturated Fat – Habitual Intake

- In the US, we DO NOT meet saturated fat recommendations

12% daily intake (~240 kcal/d)

Top Sources of Saturated Fats:



Instapoll

- Which food label below represents the healthiest food option:

Nutrition Facts: A
Calories 100
Total Fat 11 g
Saturated Fat 4 g
Trans Fat 0 g
Polyunsaturated Fat 4 g
Monounsaturated Fat 3 g

Nutrition Facts: B
Calories 100
Total Fat 11 g
Saturated Fat 2 g
Trans Fat 3 g
Polyunsaturated Fat 1 g
Monounsaturated Fat 5 g

Nutrition Facts: C
Calories 100
Total Fat 11g
Saturated Fat 5 g
Trans Fat 2 g
Polyunsaturated Fat 3 g
Monounsaturated Fat 1 g

Answers:

A

B

C

All are the same

Fruit and Veggies - DGAs

Food Groups/Subgroups	CALORIE Level (within the Healthy US Dietary Pattern)											
	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Vegetables (cup eq/day)	1	1 ½	1 ½	2	2 ½	2 ½	3	3	3 ½	3 ½	4	4
Fruits (cup eq/day)	1	1	1 ½	1 ½	1 ½	2	2	2	2	2 ½	2 ½	2 ½

- Generally low in fat (with some exceptions)
  - ✓ Avocados and olives (higher-fat options)
- All are lower in saturated fat (and contain mainly MUFAs)
- Be mindful of cooking oils/fats
- Remember how many *other* nutrients these foods provide!

Dairy - DGAs

Food Groups/Subgroups	CALORIE Level (within the Healthy US Dietary Pattern)											
	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Dairy (cup eq/day)	2	2 ½	2 ½	3	3	3	3	3	3	3	3	3

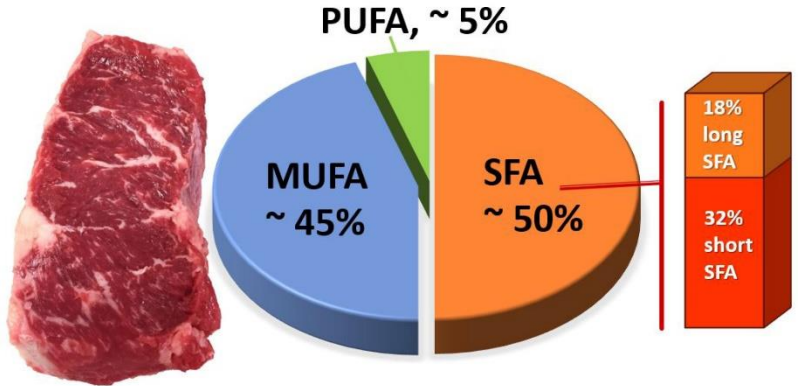
- Recommendations only include:
  - Low-fat (1%) or fat-free (skim)
  - Have no added sugar
- Foods/beverages include:
  - ✓ Milk (lactose-free/ultra-filtered)
  - ✓ Yogurt (Greek/American)
  - ✓ Cheese (including cottage cheese)
  - ✓ Soy alternatives (others not recommended)

'Milk' Per serving (1 cup)	Energy	Sat. Fat	MUFA	PUFA
Full-fat	150	4.6	1.7	0.3
Reduced-fat (2%)	125	2.9	1.4	0.2
Low-fat (1%)	100	1.5	0.7	0.1
Fat Free (Skim)/Soymilk	80	0	0	0

Protein Foods - DGAs

Food Groups/Subgroups	CALORIE Level (within the Healthy US Dietary Pattern)											
	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Protein Foods (oz eq/day)	2	3	4	5	5	5 ½	6	6 ½	6 ½	7	7	7

- Meats and poultry
  - Limit fatty, processed, and fried (higher in kcals and saturated fats: > 5g/serving)
  - Choose lean meats:
    - ✓ < 10g total fat
    - ✓ < 4.5g saturated fat
    - ✓ 90/10 (90% lean/10% fat) or higher
    - ✓ Many types of meat have a combination of saturated fat, MUFAs and PUFAs



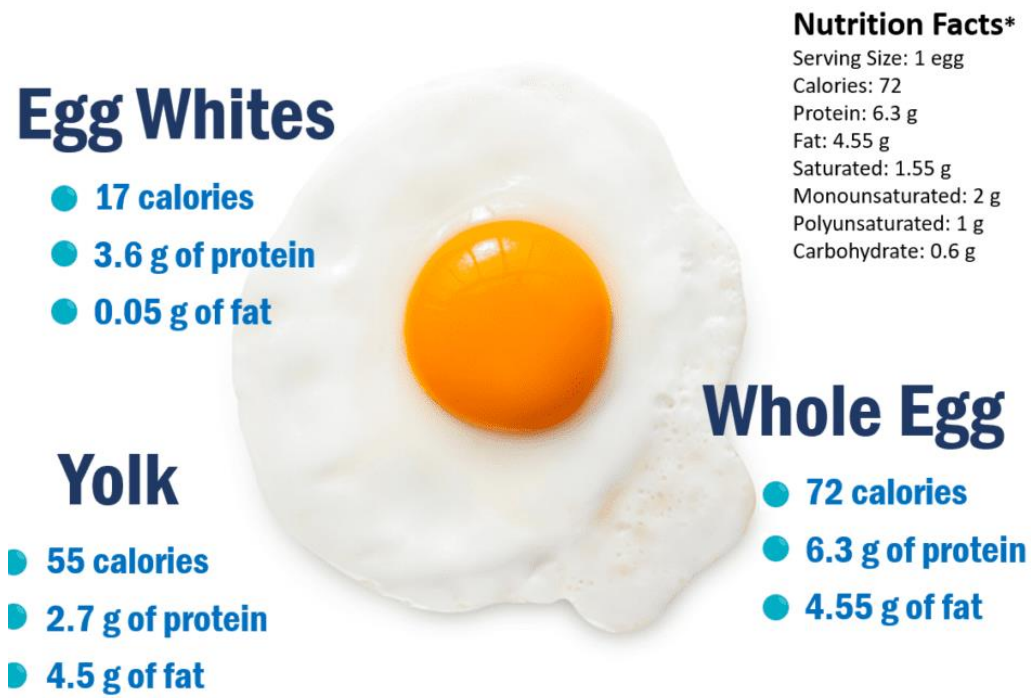
Protein Food Swaps

Saturated Fats	MUFAs	Omega-6 PUFAs	Omega-3 PUFAs
Fatty Meats Processed Meats	Lean Meat	Poultry	Mackerel Salmon Herring Sardines Tuna Eggs

Protein Foods - DGAs

Food Groups/Subgroups	CALORIE Level (within the Healthy US Dietary Pattern)											
	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Protein Foods (oz eq/day)	2	3	4	5	5	5 ½	6	6 ½	6 ½	7	7	7

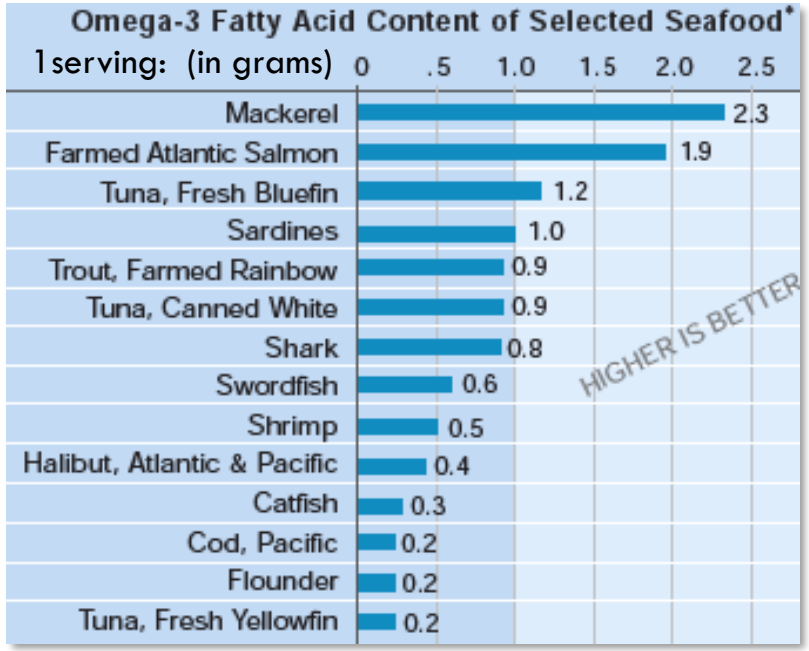
- Eggs
  - 1 egg = 1 serving



Protein Foods - DGAs

Food Groups/Subgroups	CALORIE Level (within the Healthy US Dietary Pattern)											
	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Protein Foods (oz eq/day)	2	3	4	5	5	5 ½	6	6 ½	6 ½	7	7	7

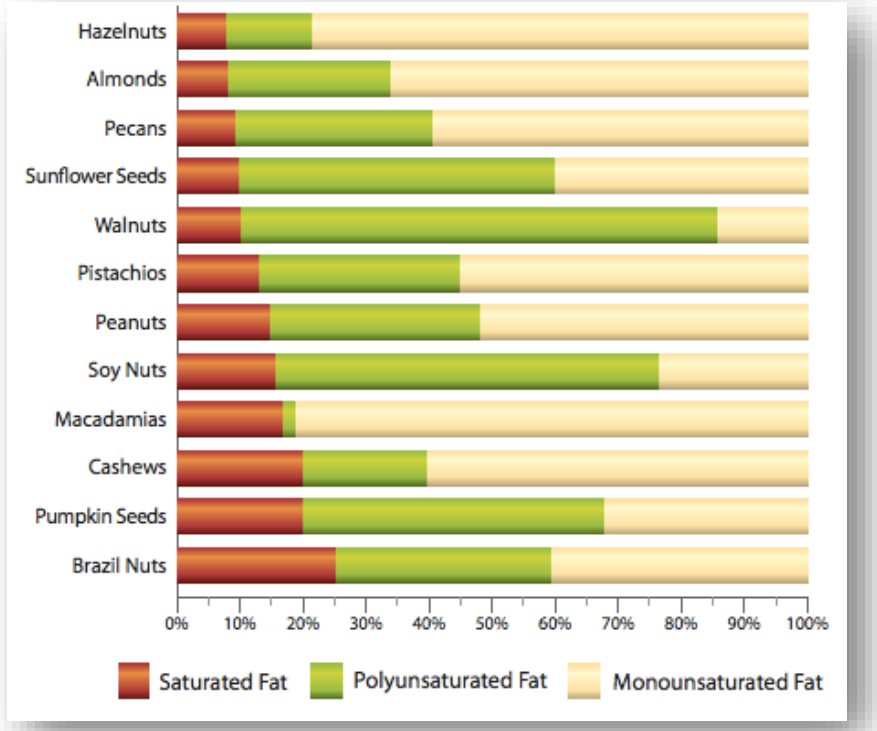
- Seafood
  - 2+ servings of cooked seafood/week
  - Be mindful of cooking oils/fats
  - Raw seafood at your own risk



Protein Foods - DGAs

Food Groups/Subgroups	CALORIE Level (within the Healthy US Dietary Pattern)											
	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Protein Foods (oz eq/day)	2	3	4	5	5	5 ½	6	6 ½	6 ½	7	7	7

- Nuts and Seeds
  - Composition: 80% kcals from fat
    - ✓ MUFA > PUFA > Saturated Fats
  - Beware of added sugars and sodium



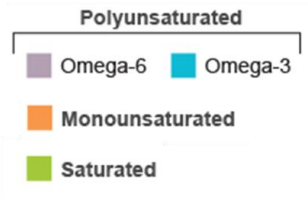
Snack Swaps

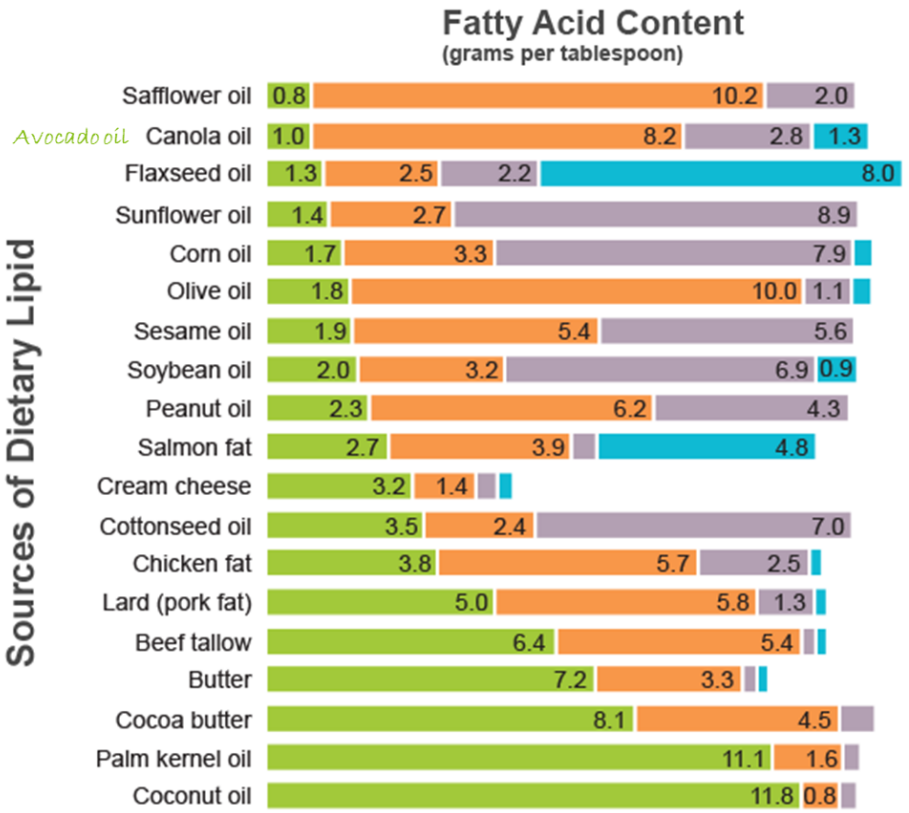
Saturated Fats	MUFAs	Omega-6 PUFAs	Omega-3 PUFAs
Chocolate Ice Cream Cakes Cookies Chips	Avocado Almonds Cashews Pistachios Olives Peanut Butter Sesame Seeds	Pine Nuts Pumpkin Seeds Sunflower Seeds	Flax seeds Chia seeds Walnuts

Oils - DGAs

Food Groups/Subgroups	CALORIE Level (within the Healthy US Dietary Pattern)											
	1000	1200	1400	1600	1800	2000	2200	2400	2600	2800	3000	3200
Oils (Tbsp/day)	1	1	1	1 ½	1 ½	2	2	2	2	2 ½	3	3 ½

- Oils
  - Plant-based oils are not equal!
  - Composition: 100% kcals from fat
    - ✓ 1 serving (1 Tbsp): 120 kcals = 14g Fat
    - ✓ Look for more PUFAs & MUFAs
      - Flaxseed Oil
      - Canola Oil





Fat/Lipid Swaps

Saturated Fats	MUFAs	Omega-6 PUFAs	Omega-3 PUFAs
Cream Shortening Sour Cream Coconut Oil Palm Oil Butter Cream Cheese Lard	Olive Oil Peanut Oil Sesame Oil	Margarine Mayonnaise Corn Oil Cottonseed Oil Safflower Oil Soybean Oil	Canola Oil Flaxseed Oil