

MOUTH

STOMACH

SMALL INTESTINE

LARGE INTESTINE

Saliva

- water
- mucus
- enzymes:
 - salivary amylase → carbs.
 - lingual lipase → fats
 - lysozyme

Mucus

Gastric juice:

- water
- HCl → pepsinogen
- enzymes:
 - gastric lipase → fat
 - pepsin → protein (HCl)

Hormones

- gastrin - enteroendocrine cells

Mucus

Brush-border enzymes:

- water
- enzymes:
 - enterokinase → trypsinogen
 - sucrase
 - maltase
 - lactase
 - dextrinase
 - aminopolypeptidase
 - dipeptidase → protein
 - phosphatase → DNA, RNA

Hormones

- cck
- Secretin

* Pancreatic Juice

- trypsin
- chymotrypsin
- elastase
- carboxypeptidase

* Bile

Absorption:

- water
- alcohol
- salt

Absorption:

- water & salt
- alcohol

Absorption

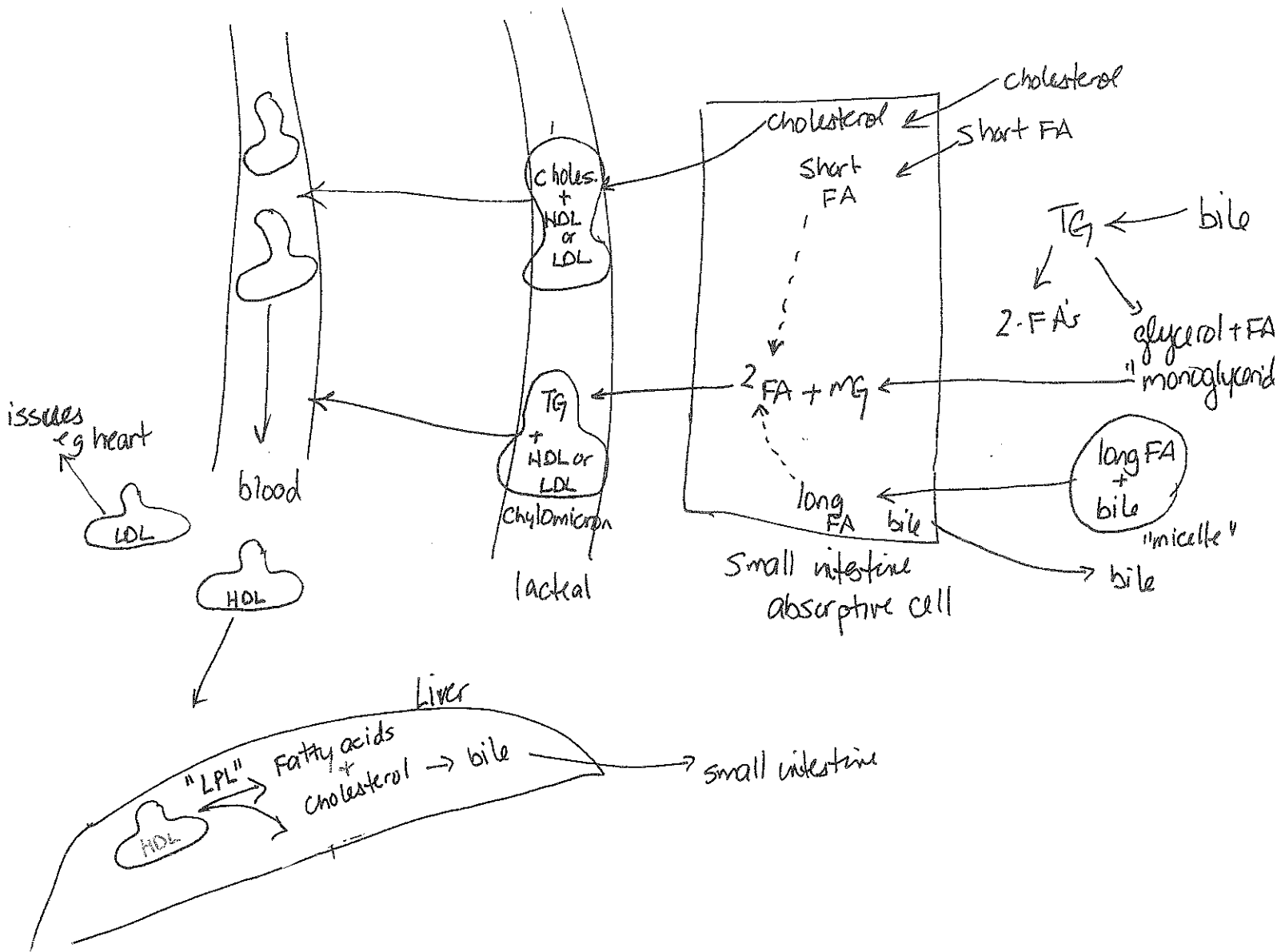
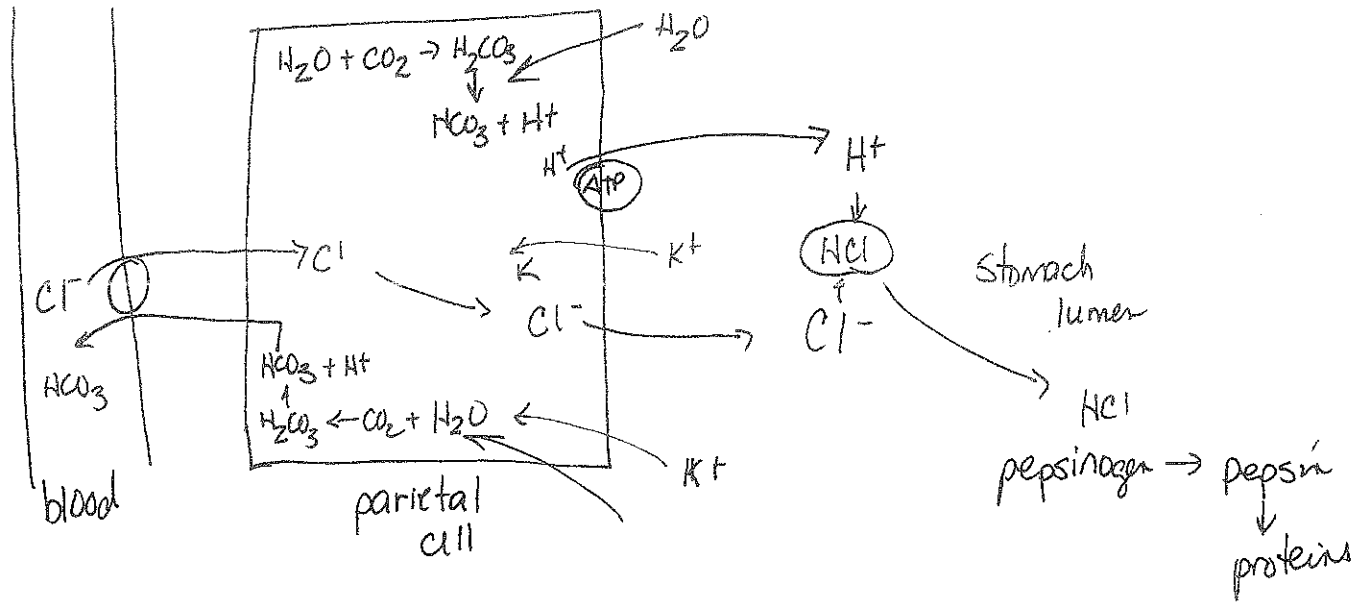
- water + salt
- alcohol
- amino acids
- saccharides
- triglycerides

Absorption:

- water + salt

Mucus

- NO enzymes
- NO hormones
- * Bacterial fermentation



| <i>Vitamin</i> | <i>Physiological Function in Humans</i> | <i>Symptoms of Deficiency</i> | <i>Food Source</i> |
|-------------------------------------|----------------------------------------------------------------------------|------------------------------------------------|---------------------------------|
| <i>Fat-Soluble Vitamins</i> | | | |
| Vitamin A | Part of visual pigments; maintains epithelia | Night blindness, infections | Vegetables, milk, eggs |
| Vitamin D | Absorption of calcium | Bone softness (rickets) | Liver oils, milk, eggs |
| Vitamin E | Not completely known; may protect cell membranes or aid electron transport | Sterility, muscular dystrophy, anemia | Green vegetables, seeds, oils |
| Vitamin K | Prothrombin synthesis during blood clotting | Hemorrhage (slow clotting) | Green vegetables, liver |
| <i>Water-Soluble Vitamins</i> | | | |
| Vitamin B ₁ (thiamine) | Decarboxylation in Krebs cycle | Beriberi (neurological disorder) | Whole grains, meats |
| Vitamin B ₂ (riboflavin) | Part of FAD ⁺ | Eye and skin lesions | Whole grains, eggs, milk |
| Vitamin B ₃ (niacin) | Part of NAD ⁺ | Pellagra (skin and mental disorders) | Whole grains, meats, legumes |
| Vitamin B ₆ (pyridoxine) | Amino acid metabolism | Nervous disorders, dermatitis | Whole grains, meats, vegetables |
| Pantothenic acid | Component of Coenzyme A | Nervous disorders, impaired antibody formation | Whole grains, meats, eggs |
| Vitamin B ₁₂ (cobalamin) | Nucleic acid metabolism | Anemia, nervous disorders | Eggs, milk, meats |
| Folic acid | Nucleic acid metabolism | Anemia (impaired red blood cell formation) | Whole grains, meats, vegetables |
| Biotin | Fat and amino acid metabolism | Dermatitis, muscle pains | Egg whites, meats, vegetables |
| Vitamin C (ascorbic acid) | Amino acid metabolism | Scurvy (breakdown of capillary walls) | Citrus fruits, fresh vegetables |

| <i>Mineral</i> | <i>Physiological Function in Humans</i> | <i>Symptoms of Deficiency</i> | <i>Food Source</i> |
|----------------|-----------------------------------------------|----------------------------------------|--------------------------------|
| Calcium | Muscle, nerve, and blood function | Softened bones, muscle tetanus | Milk, eggs, fish, legumes |
| Chlorine | Acid-base and osmotic balance | Muscle cramps | Most foods, table salt |
| Cobalt* | Synthesis of hemoglobin | Anemia | Meat |
| Copper* | Synthesis of hemoglobin | Anemia | Meat, liver |
| Fluorine* | Inhibits mouth bacteria | Tooth decay | Milk, many toothpastes |
| Iodine* | Part of thyronines (hormones) | Goiter and cretinism | Iodized salt, fish |
| Iron* | Part of hemoglobin and cytochromes | Anemia | Liver, eggs, raisins |
| Magnesium | Nerve and muscle function | Muscle tetanus | Meat, milk, green vegetables |
| Manganese* | Enzyme cofactor | Reduced cell respiration | Whole grains, leafy vegetables |
| Molybdenum* | Part of xanthine oxidase | Impaired nitrogen metabolism | Milk, grains, leafy vegetables |
| Phosphorus | Constituent of bone, lipids, and nucleotides | Mineral loss from bones | Meat, milk, grains |
| Potassium | Nerve and muscle function, membrane potential | Changes in nerve and muscle action | Most foods |
| Selenium* | Part of glutathione peroxidase | Oxidative damage to membranes(?) | |
| Sodium | Osmotic balance, membrane potential | Kidney failure, impaired muscle action | Most foods, table salt |
| Sulfur | Part of many proteins | Reduced growth | Meats, eggs, milk |
| Zinc* | In some enzymes and insulin | Skin disorders, testis failure | Most foods |

Dietary Fats

Many people are surprised to learn that dietary fat is vital to many bodily functions, and only when we consume it in excess do we increase our risk of some diseases.

Fats are classified as to their degree of saturation. Fats or fatty acids are considered organic acids, composed of long carbon chains with hydrogens attached. A fatty acid with a carbon chain containing all the hydrogens that it can hold is called a **saturated fat**. A fatty acid with a carbon chain that contains one double bond is called **monounsaturated**. A fatty acid that contains two or more double bonds is called **polyunsaturated**.

Fats and oils are mixtures of fatty acids. Each fat or oil is named a saturated fat, polyunsaturated fat, or monounsaturated fat based on the fatty acid(s) of predominance.

Saturated fatty acids are solid at room temperature and are among the most common fats found in the American diet. They are found in all animal products such as meat, fish, and poultry, full fat dairy products and in the tropical oils – palm and coconut. Saturated fat intake is linked to increased risk of heart disease, some cancers and stroke. Specifically, it is the fatty acids with 12 to 16 carbons that elevate total cholesterol and LDL-cholesterol. These fatty acids also elevate HDL-cholesterol to help compensate for the elevation in LDL-cholesterol.

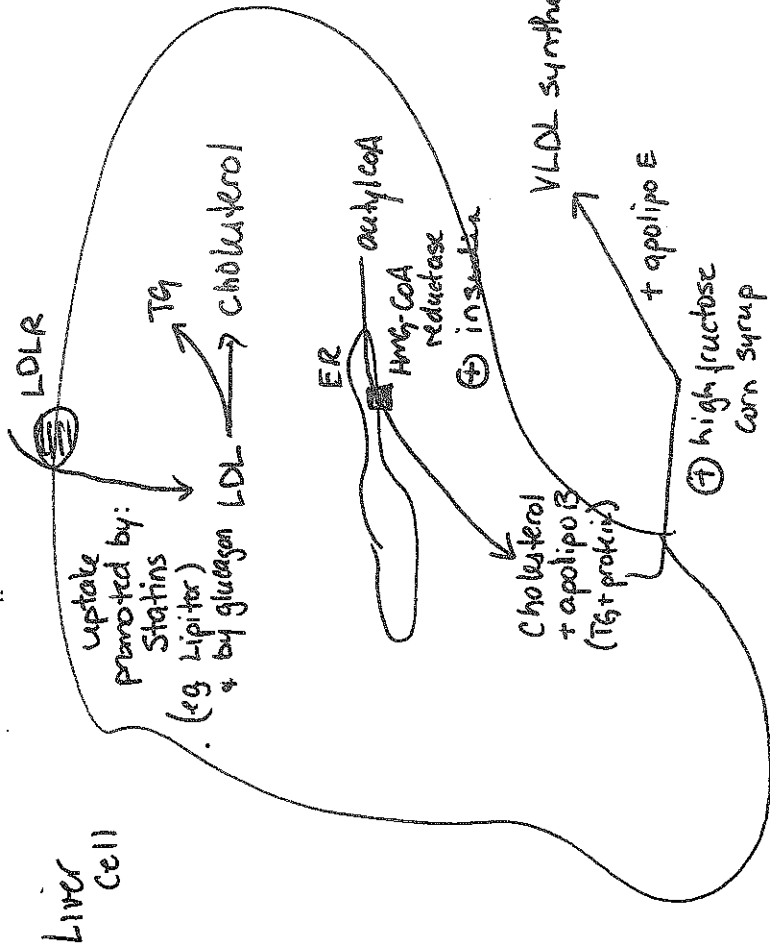
Myristic acid is a fourteen carbon fatty acid with no double bonds and is represented as 14:0. If myristic acid had one double bond, then the nomenclature would be 14:1. Myristic acid is the fatty acid that has the most pronounced effect on elevating total cholesterol and LDL-cholesterol. Stearic acid (18:0) is a saturated fat that does not elevate either total cholesterol or LDL-cholesterol. In fact, this saturated fatty acid has been shown to lower total cholesterol and LDL-cholesterol.

Monounsaturated fatty acids are liquid at room temperature but have been shown to begin to solidify in the refrigerator. Monounsaturated fats seem to have a different effect on the body when they are compared to saturated fats. Much research of late has been performed in the area of monounsaturated fat and their effect on health, especially heart disease. Recent epidemiological research has shown that when replacing saturated fat with monounsaturated fat in the diet, a neutral or hypocholesterolemic effect is observed.

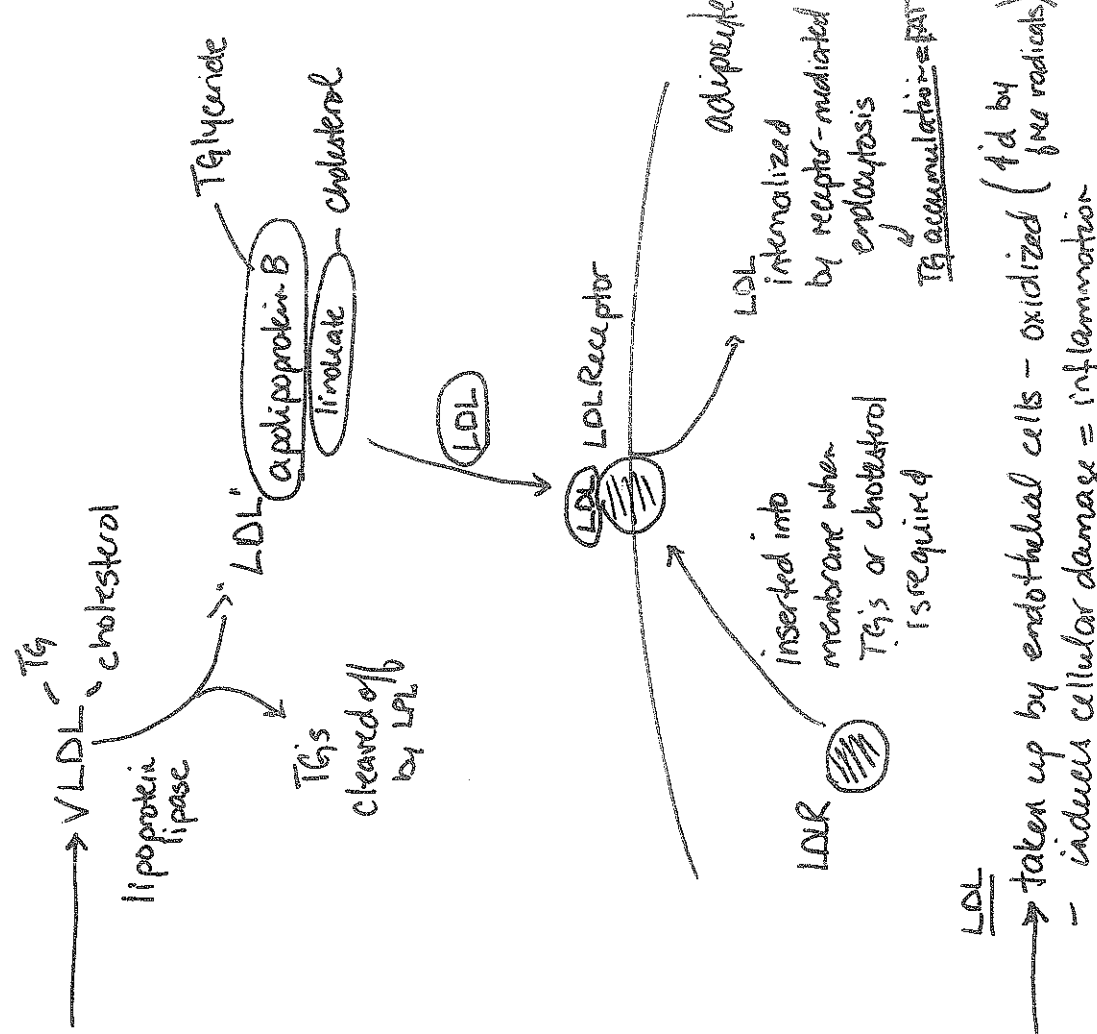
The main dietary sources of monounsaturated fat in the American diet are beef and dairy fats. Unfortunately, many of the food items are high in either saturated and/or *trans* fats. The major non-animal dietary sources of monounsaturated fats include: olive oil, canola oil, nuts, nut oils and avocados. Nuts and avocados are also an excellent source of dietary fiber. Metabolic studies have shown that when a high carbohydrate diet (>60%) is consumed, then an elevation in triglycerides and a reduction in HDL-cholesterol can occur.

Polyunsaturated fatty acids are liquid at all temperatures and have been shown to be hypocholesterolemic. The more double bonds a polyunsaturated fatty acid contains the greater the exposure to being oxidized (damage from oxygen) and then becoming rancid. A person who consumes a diet high in polyunsaturated fatty acids should have a higher intake of antioxidants to prevent oxidation (ie. Vitamin E).

In nature, most polyunsaturated fatty acids exist in the '*cis*' configuration. A fatty acid is in the '*trans*' configuration when the hydrogens are on opposite sides of the double bond. *Trans* fatty acids are created to increase the shelf life of a product and/or to create a more solid product.



- blocking HMG CoA reductase - by Lipitor - stimulates LDL uptake by LDLR (LDL "clearance")
 - ↳ rather than making LDL, you are taking it from the blood.
- insulin induces HMG CoA reductase - ↓ LDL "clearance" by liver
 - ↑ LDL synthesis
- high fructose corn syrup - ↑ VLDL synthesis which ↑ plasma TG levels
 - ↓ HDL
 - causes synthesis of smaller LDL particles



LDL oxidized by receptor-mediated endocytosis
 TG accumulation = fat
 taken up by endothelial cells - oxidized (Ad by free radicals)
 - induces cellular damage = inflammation