

LECTURE OUTLINE Chapter 5 The Lipids: Fats, Oils, Phospholipids and Sterols***I The THREE types of LIPIDS*****A. Triglycerides (fats & oils)- the MAJOR type of lipid in food and humans.**

1. 2 parts of triglycerides-
 - a) one glycerol molecule which is a _____ carbon backbone to the triglyceride molecule
 - b) three fatty acid molecules (4-22 carbons) in each triglyceride

DRAW A TRIGLYCERIDE:

2. How Fatty Acids Differ
 - a) Chain _____ (chains 4 to 22 carbons long, always an **even #** of carbons)
 - b) Degree of SATURATION

Saturated Fatty Acids, SAFAs

- Carbons have all the hydrogen they can hold so no double bonds between the carbons.
- _____ at room temperature
- Can _____ risk of heart disease
- Food Sources: _____
- What impact do SAFAs acids have on blood cholesterol levels?

Monounsaturated Fatty Acids, MUFAs

- One point of unsaturation (one double bond)
- _____ at room temperature
- Can _____ risk of heart disease
- Food Sources: _____
- What impact do MUFAs have on blood cholesterol levels?

Polyunsaturated Fatty Acids, PUFAs

- Two or more points of unsaturation (2 or more double bonds)
- _____ at room temperature
- Can _____ risk of heart disease

- Can go rancid- oxygen attacks the _____ and produces fatty acid fragments that smell bad and are hard to digest
- Whether a PUFA is an Omega 3 or Omega 6 depends on the position of the _____
- Food Sources: _____
- What impact do PUFAs have on blood cholesterol levels?
- **Essential Fatty Acids, _____ (type of polyunsaturated fatty acid)**
 - Linoleic acid (omega 6) Food Sources: _____
 - Linolenic acid, ALA (omega 3) Food Sources: _____
 - Do you find ALA in fish?
- **Other Omega 3 PUFAs that are not _____**
 - EPA & DHA Food Sources: _____

Trans Fatty Acids

- Bi-product of _____
- Actually a monounsaturated fatty acid (*have one double bond*), but act MORE like a _____ fatty acid, due to the different configuration of hydrogen around the double bond.
- Can _____ risk of heart disease.
- What impact to trans fats have on blood cholesterol levels?

Food Labels and Trans Fat:

- A product can have zero trans fat, but still be high in _____ fat.
- To determine if a product has trans fat you need to look at the _____ list.

More about Hydrogenated Fats:

The fatty acids of a polyunsaturated oil are exposed to hydrogen gas at high temperatures and pressure, resulting in both _____ and _____ fatty acids.

Purpose: to make fats _____ (i.e. margarine and _____) and to _____ shelf life of baked goods.

B. **Phospholipids** (one example- lecithin)

1. 3 parts of lecithin (one kind of phospholipid)
 - a) one glycerol molecule
 - b) two fatty acid molecules
 - c) phosphorus group
 2. What is the difference between the structure of a triglyceride and the structure of a phospholipid like lecithin?
-

C. **Sterols (waxes)**. one kind is _____

1. How is the structure of cholesterol different than either of the other types of lipids?
2. Cholesterol can be made in the **liver** from _____ **fatty acids**.
3. Only _____ make cholesterol.

II Where do lipids come from?

- A. **Plants** make triglycerides and phospholipids from fragments of _____
Plants make sterols, but do NOT make cholesterol. Why?
- B. **Animals** make triglycerides from fragments of carbohydrates, _____ or _____ . Animals can make _____ from saturated fatty acids, and carbohydrates. Humans make all of the fatty acids they need except 2 called the **EFA**s. Can you remember which fatty acids are essential?

III Lipoproteins

- A. What do they do?
- Transport vehicles for _____ in _____ and _____
- B. What are they made of?
- Made by the body, composed of _____, _____, _____, _____
- A. Types:
1. **Chylomicrons**
 - Made in _____
 - Mostly composed of _____ which they carry from intestinal cells to cells in the body.

2. **Low Density Lipoproteins (LDLs)**

- Made in _____
- Mostly composed of _____
- Carry triglycerides and cholesterol from _____ to _____
- Can become oxidized and damage arterial walls which can lead to plaque buildup
- What effect do they have on heart disease risk?

3. **High Density Lipoproteins (HDLs)**

- Made in _____
- Mostly composed of _____
- Carry cholesterol from _____ to _____ for disposal
- Can remove cholesterol from plaque in arterial walls
- What effect do they have on heart disease risk?



Why are LDLs referred to as “bad” cholesterol and HDLs referred to as “good” cholesterol?

Do LDL and HDL carry different kinds of cholesterol?

Do you find LDL and HDL in foods?

Is there good and bad cholesterol in foods?

Can foods impact levels of LDL and HDL in the body?

IV Recommendations regarding lipids & heart health

1. Enjoy your food.
2. Eat plenty of whole grains, fruits & vegetables.
3. Dietary Guidelines 2010 Summary:

Keep total fat intake between _____ percent of Calories, mostly from WHOLE foods that provide unsaturated fats such as: _____

Keep saturated less than _____ of Calories, trans fat as _____ as possible and cholesterol less than _____ per day

_____ of seafood per week.

4. **Nutritional Disadvantages** of a lowfat diet:

- a. hard to get enough __FA
- b. hard to get enough vitamin ____
- c. may increase __DL and lower __ DL

	cholesterol, mg	saturated fat, g	total fat, g
egg, 1 large	274	1.5	5
hamburger, 3 oz.	86	8	18
chicken meat, 3 oz.	89	2	7
tofu, 1/2 cup	0	0.7	5

Which of the above foods would be most likely to raise your risk of heart disease? Why?

V Digestion and Absorption of _____

After eating foods with triglycerides, what needs to happen?

A. Separation & Isolation in the **stomach**

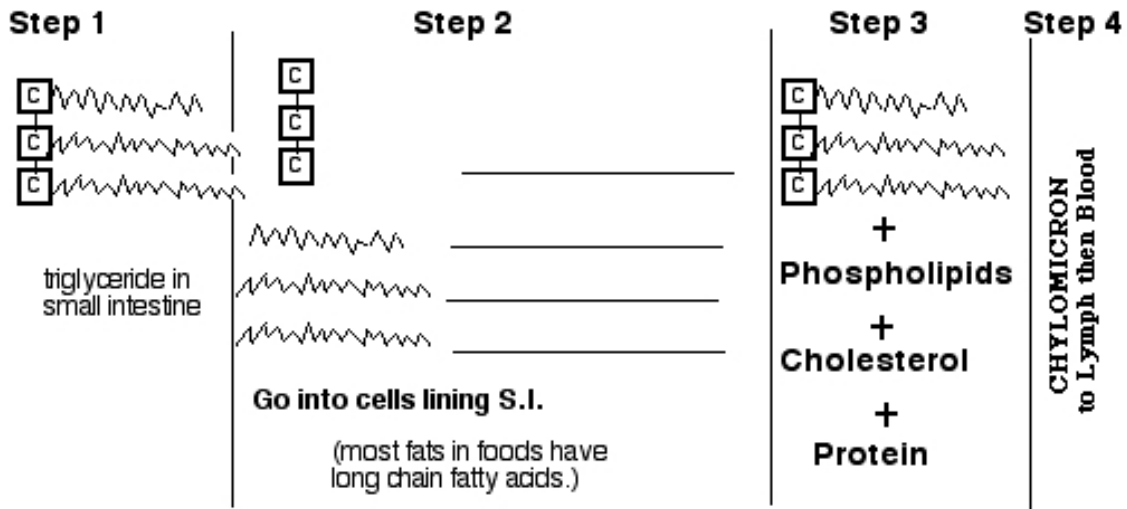
B. Addition of the emulsifier BILE into **small intestine**

1. Bile is an emulsifier made by the _____ and stored in the _____
2. Where does bile function as an emulsifier? _____ (an emulsifier helps oil & water stay mixed together)
3. Does bile function in the stomach? _____

C. Enzymatic digestion in the small intestine

1. Enzymes for lipids (lipases) made only by the pancreas and they function in the small intestine.
2. In the cream that's used to make butter, the main lipid that needs to be enzymatically digested is _____
3. After enzymatic digestion of the carbohydrates and lipids in whole milk, what is absorbed (after enzymatic digestion) into the cells lining SI?
The carbohydrate in the milk is _____ & it is enzymatically digested down to _____ and _____.
The lipid in the whole milk that needs to be enzymatically digested is _____ and it is enzymatically digested down to _____ & _____

So, what is absorbed into the cells lining SI after enzymatic digestion of the carbohydrates and lipids in whole milk?



D. ABSORPTION & TRANSPORT in the **lymph** to **blood** & then to **cells** all around the body.

TGs can NOT travel all by themselves in the watery blood.
Why?

In the layer of cells of the villi lining the wall of the small intestine, fatty acids and glycerol join together to make _____, which are made into a package that can travel in the watery lymph (then blood) because it has emulsifiers and protein.

The package is a combination of:

- a. TGs from food,
- b. Protein,
- c. Sterols and
- d. one more type of lipid to be the emulsifier. What is this type of lipid called that is an emulsifier? _____

The name of the package of protein and the 3 types of lipids (with the main one being TGs from food) is a _____

E. What happens once triglycerides have been delivered to the cells?

1. _____
2. _____
3. If the triglycerides contain EFAs, the EFAs are used to make:
 - a. _____
 - b. _____ (eico is Greek for _____)

VI Usefulness of Fats

A. Value of Fats in the **Body**

1. FUNCTION of **triglycerides** and **fatty acids** in human body

- a. cushion
- b. insulation layer
- c. energy reserve (Body's own oil well.)

(Why don't you need **fat** in the **diet** for these first 3 functions (cushion, insulation, energy) of fat in the **body**? _____)

- d. specific FAs, like
 - **Omega 6 EFA (linoleic)**- used in production of _____, including skin, nerve & brain cell membranes
 - **Omega 3 EFA (linolenic)** - used to make _____ compounds (called *eicosanoids*) that regulate blood pressure, blood clots, immune response
 - other important **FAs** like DHA & AA (NOT EFAs)- involved in visual acuity & brain development in infants.
DHA (docosahexaenoic acid) and **AA** (arachidonic acid)

Similac Advance Baby formula: Nonfat milk, lactose, high-oleic safflower oil, soy oil, coconut oil, whey protein concentrate plus small amounts of C. cohnii oil, M. alpina oil and about 30 added vitamins and minerals

Why does this formula have so many different kinds of oil?

2. FUNCTION of **cholesterol** in human body

- a. used to make _____ - an **emulsifier**
Definition of an emulsifier- a substance that allows fat droplets to stay dispersed in water.
- b. used to make vitamin D
- c. used to make reproductive hormones, like _____

Why don't you need **cholesterol** in the **diet** for these 3 functions?

3. FUNCTION of **phospholipids** in human body. Phospholipids are part of the **lipoproteins**. They are EMULSIFIERS in *cell membranes* as well as in the *blood*
- What are the **3 places** in the body where we've talked about emulsification taking place:

- a. _____
- b. _____
- c. _____

Why don't you need **phospholipids** in the **diet** for these functions?

B. Value of Fats in the **Diet**

- 1. fats & oils satisfy **appetite** (the *desire* to eat). Why?

- 2. fats & oils satisfy **hunger** (the *need* to eat). Why?

- 3. fats & oils carry the fat soluble vitamins: _____