Chemistry 1010

The Chemistry of Food:

Fats and Oils

For the rest of this unit, we will be talking about the chemistry of food.




From a scientific point of view, what are the chemicals in food useful for?

providing energy

raw material for building and repairing tissues

participate in chemical reactions

What's in food?

macronutrients – major components of food

- carbohydrates
- fats and oils
- protein
- water

micronutrients – components of food found in smaller amounts

- vitamins
- minerals

non-nutrients – other things added to food

- artificial sweeteners, preservatives, etc

Fats and Oils

Today we will continue our discussion of macronutrients by looking at the chemistry of fats and oils.

What are fats and oils primarily useful for?

they provide energy





How do fats compare with carbohydrates at providing energy?

carbohydrates: 4 calories per gram

fats: 9 calories per gram

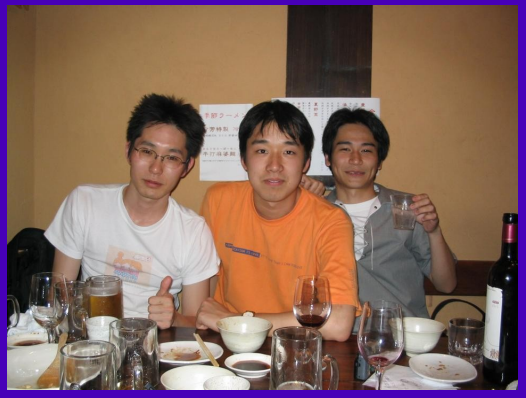
What percentage of calories are recommended to come from fat?

30%

What are some other things fats are useful for?

carry flavor

create a feeling of fullness



energy storage

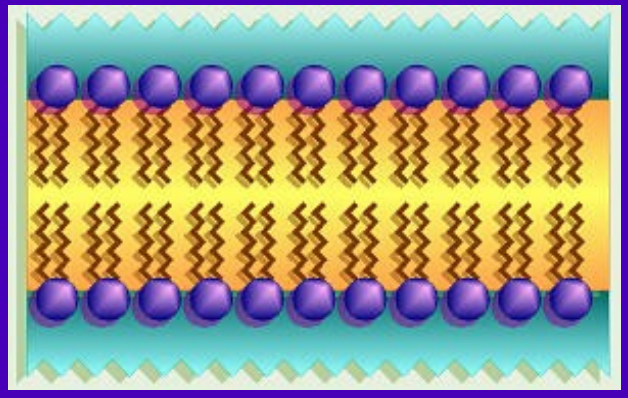



store fat-soluble vitamins


cushion organs

provide insulation

form cell membranes



protect nerves (myelin sheath)

Of course, too much stored fat can be a health hazard.

Obesity is connected to higher risks of:

- Hypertension
- Type 2 diabetes
- Coronary heart disease
- Stroke
- Gallbladder disease
- Osteoarthritis
- Sleep apnea and respiratory problems
- Some cancers (endometrial, breast, and colon)

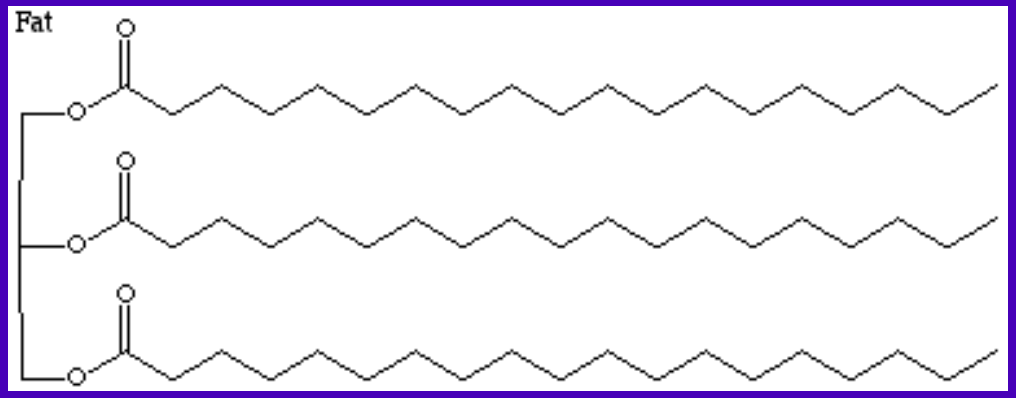
Most Americans have difficulty with...

- too much fat
- the wrong kinds of fats

...in their diet.

Structure of Fats and Oils

So, what do fat molecules look like?



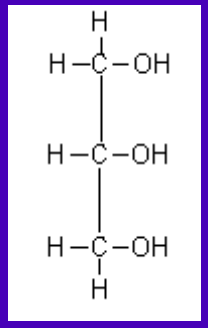
3 ester groups

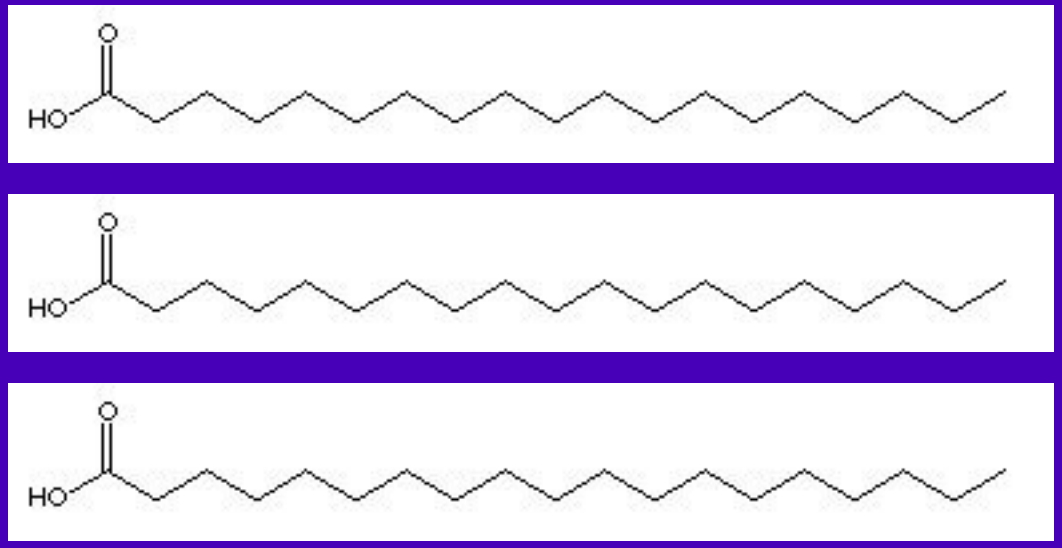
3 long carbon chains

During digestion, fats are broken down into

three fatty acids

glycerol



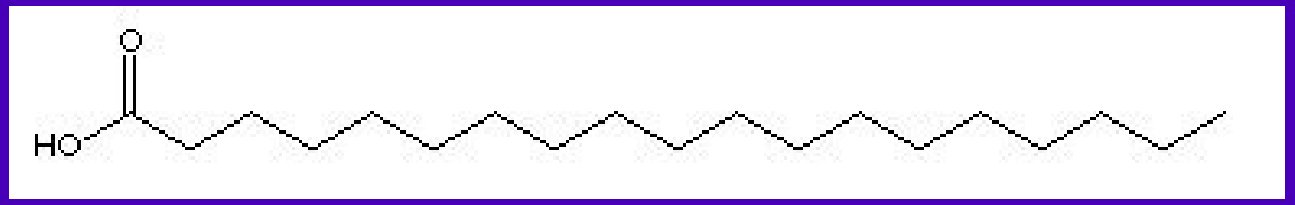


Types of Fats

There are two main kinds of fats.

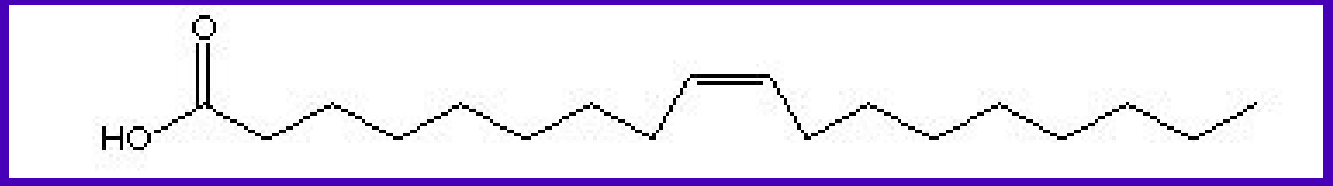
Saturated fats are made from fatty acids that have:

only C-C single bonds in their chains



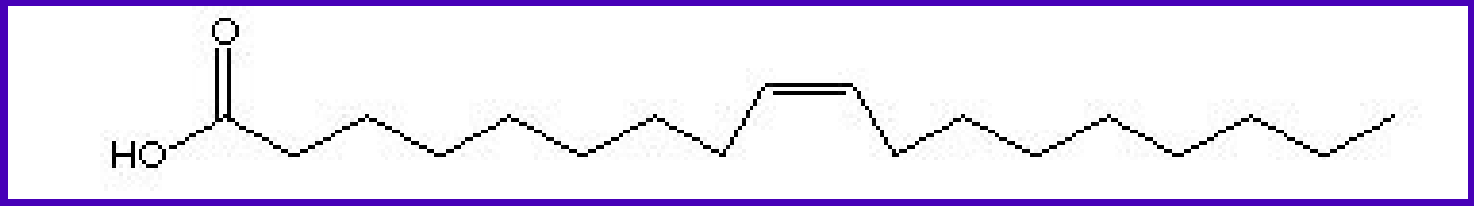
Unsaturated fats are made from fatty acids that have:

one or more C=C in their chain



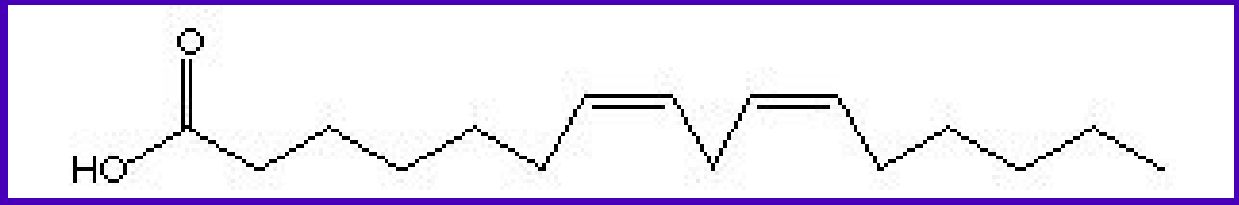
Unsaturated fats may contain monounsaturated or polyunsaturated fatty acids:

monounsaturated



one C=C

polyunsaturated



2 or more C=C

Saturated fats usually come from: **animal sources**

chicken, beef, pork, milk, butter, etc



exception: **fish usually have unsaturated fats**


Unsaturated fats usually come from: **plant sources**

corn oil, olive oil, canola oil, avacados, nuts

exceptions: **tropical oils**

coconut oil, palm kernel oil

Physically, saturated fats are usually:

solid

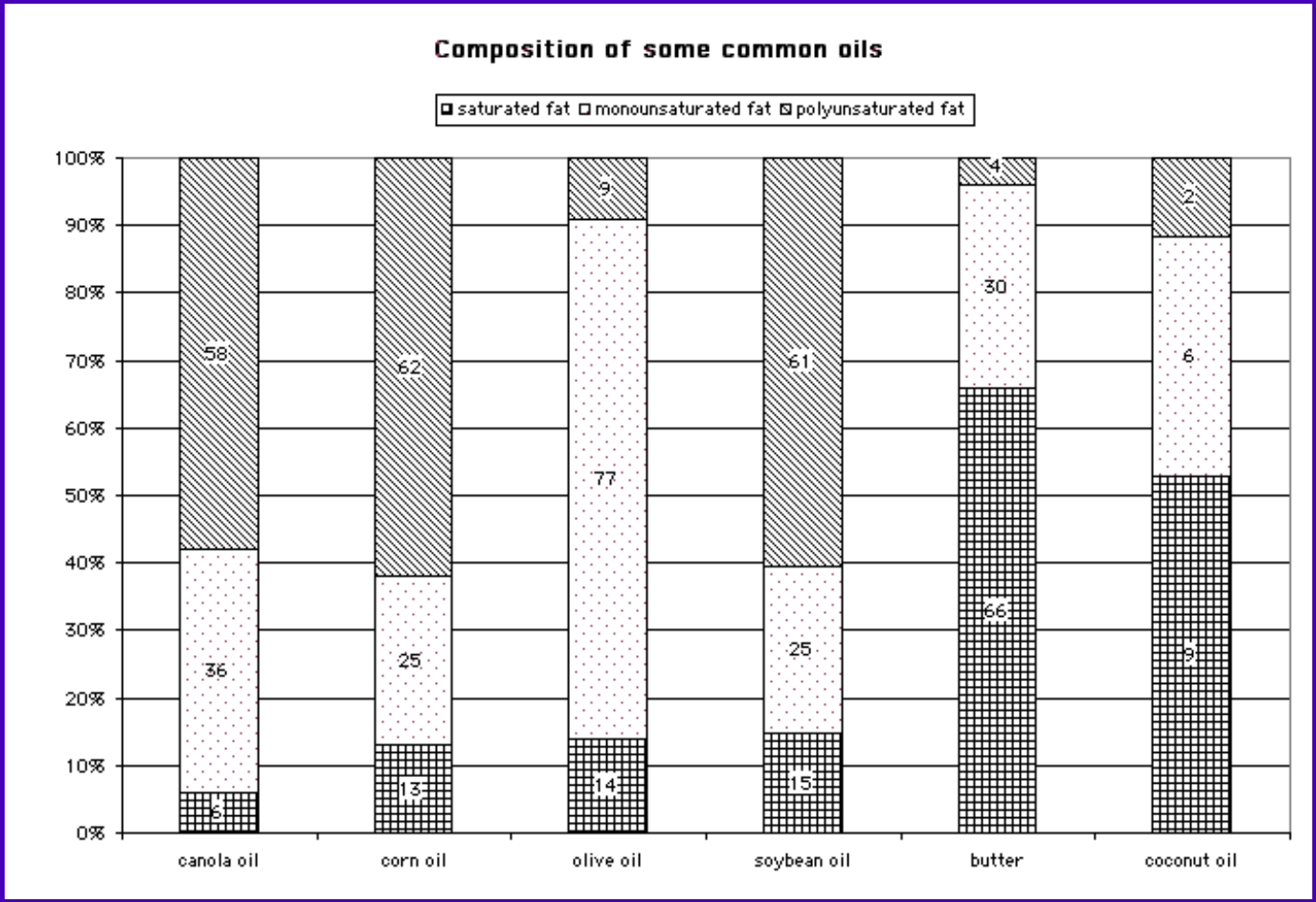
while unsaturated fats are usually:

liquid

Also, unsaturated fats often spoil easily,

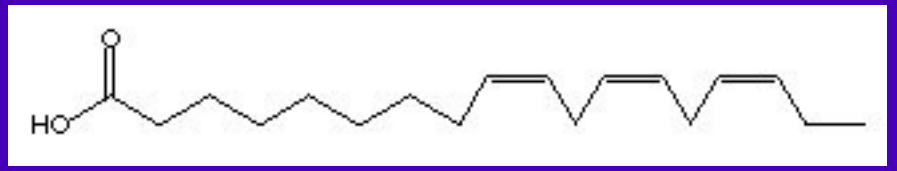
while saturated fats usually have a longer shelf life.

Of course, foods don't actually have just one kind of fat.



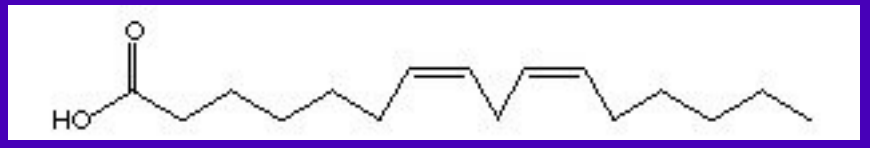
It has also been recently discovered that there are two important categories of unsaturated fats.

omega-3 fatty acids



found in: flax seeds, salmon, walnuts

omega-6 fatty acids



found in: corn oil, sunflower oil, safflower oil, soybean oil

The concern is that most people get plenty of omega-6 fatty acids, but not enough omega-3 fatty acids.

omega-6: doubled from 1940 levels

omega-3: 1/6 of 1850 levels

Processed Fats

Unsaturated fats can be chemically changed to saturated fats by a process called hydrogenation.

unsaturated fats + H_2 ⟶ saturated fats

Why would we want to do this?

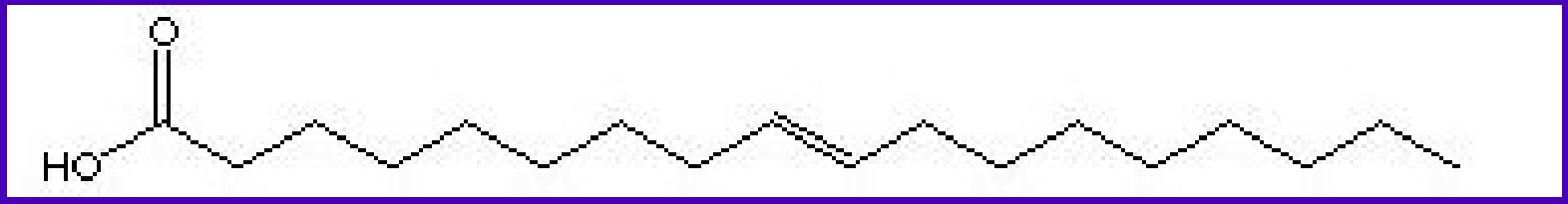
- **gives the oils a longer shelf-life**
- **makes them easier to spread!**
- **keeps oils from separating**
- **plant-based oils are cheaper**

Most processed foods contain partially hydrogenated oils.

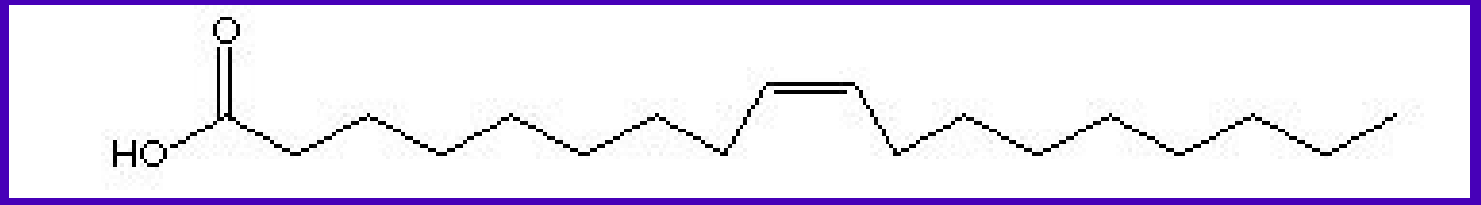
some of the unsaturated fats are changed, some not

Unfortunately, the process of partial hydrogenation has a side effect:

it produces trans fatty acids



Natural fatty acids have a U-shaped C=C.



Trans fats were considered an advantage by the food industry:

long shelf life, but listed as unsaturated fat

Unfortunately, they have been linked to:

heart disease, breast cancer

It is estimated that at least **30,000 deaths** due to coronary disease could be prevented by eliminating trans fats.

Rather than banning trans fats outright, a law was passed requiring the amount of trans fat to be listed on the nutritional label.

Nutrition Facts

Serving Size 1 cup (228g)
Servings Per Container 2

Amount Per Serving	
Calories 260	Calories from Fat 120
	% Daily Value*
Total Fat 13g	**20%**
Saturated Fat 5g	**25%**
Trans Fat 2g	
Cholesterol 30mg	**10%**
Sodium 660mg	**28%**
Total Carbohydrate 31g	**10%**
Dietary Fiber 0g	**0%**
Sugars 5g	
Protein 5g	

Vitamin A 4%	•	Vitamin C 2%	
Calcium 15%	•	Iron 4%	

* Percent Daily Values are based on a 2,000 calorie diet. Your Daily Values may be higher or lower depending on your calorie needs:

	Calories:	2,000	2,500
Total Fat	Less than	65g	80g
Sat Fat	Less than	20g	25g
Cholesterol	Less than	300mg	300mg
Sodium	Less than	2,400mg	2,400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

Calories per gram:
Fat 9 • Carbohydrate 4 • Protein 4

How will this make a difference?

consumers will choose products that don't have trans fats

Kraft has voluntarily eliminated partially hydrogenated oils from their products.

However, if it is under 0.5 g, it can be listed as 0 g. Look for partially hydrogenated oils on the label!

Health effects of fats

Which fats are good for you?

- **monounsaturated fats**
- **polyunsaturated fats (especially omega-3 fats)**

Which fats are bad for you?

- **saturated fats**
- **trans fats**