FATS:
SATURATED AND UNSATURATED

Fats on the label

On a nutrition label, total fat includes saturated, polyunsaturated and monounsaturated fats.

Nutrition Facts

Serving Size 16 crackers (34g)

Amount Per Serving

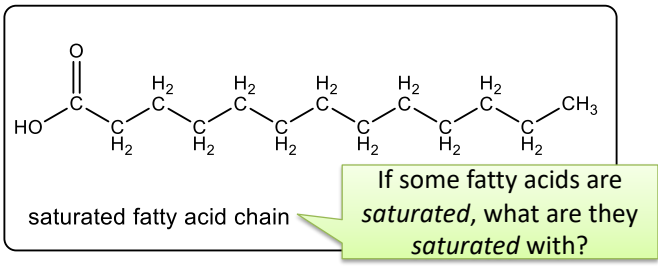
Calories 155	Calories from Fat 50
	% Daily Values*
Total Fat 6g	**9%**
Saturated Fat 1g	**5%**
Trans Fat 0g	
Polyunsaturated Fat 3g	
Monounsaturated Fat 1g	
Cholesterol 0mg	**0%**
Potassium 96mg	**3%**
Sodium 238mg	**10%**
Total Carbohydrate 24g	**8%**
Dietary Fiber 2g	**8%**
Sugars 5g	
Protein 3g	**6%**

Calcium 3% • Iron 5%

*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	2400mg	2400mg
Total Carbohydrate		300g	375g
Dietary Fiber		25g	30g

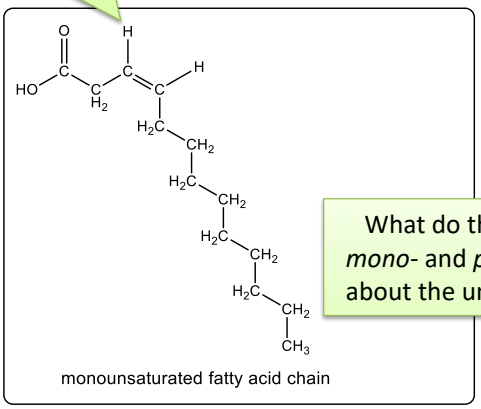
Fats come in different forms



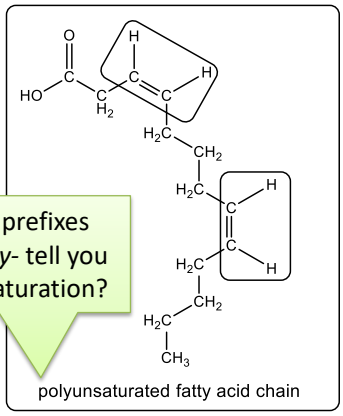
If some fatty acids are *saturated*, what are they *saturated* with?

A C=C double bond:
chemists call this a unit of unstaturation

Saturated, ***monounsaturated*** and ***polyunsaturated*** fatty acids can all be used to make triglycerides. A single triglyceride can be made of fatty acid chains of all of one type (e.g. all saturated) or a mixture of types

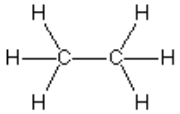


What do the prefixes *mono-* and *poly-* tell you about the unsaturation?

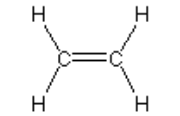


Unsaturations

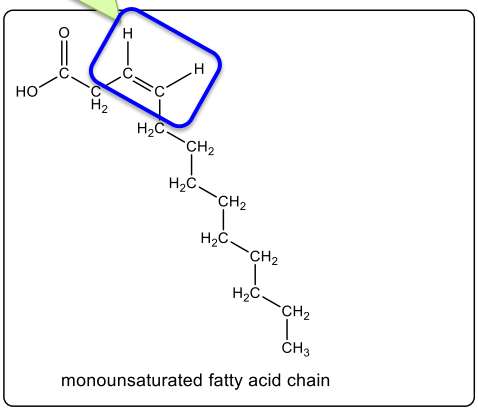
Making a C=C double bond here, required removing two H atoms.



saturated with H



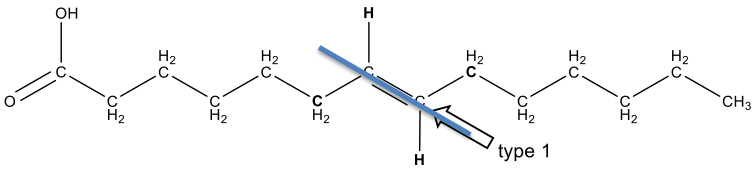
unsaturated wrt H

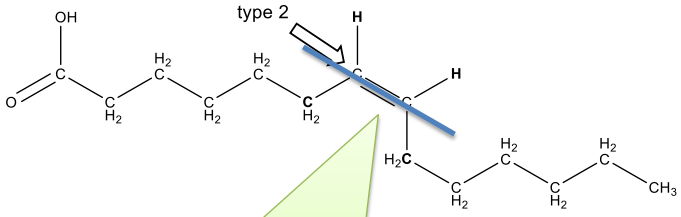


Double bonds come in different types

Fatty acids can have double bonds between carbon atoms. Double bonds come in two main types.

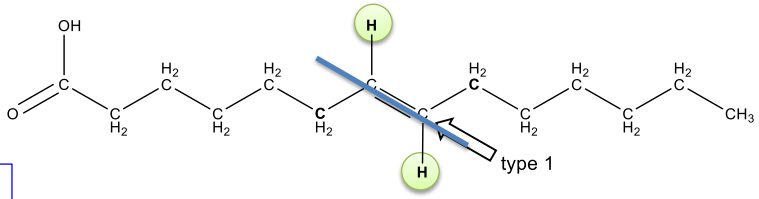
The double bond between the carbons *fixes* all the atoms in place – in effect, the 4 atoms attached to the doubly bonded carbons are *stuck there*. This is in contrast to singly bonded atoms, which are able to rotate freely.



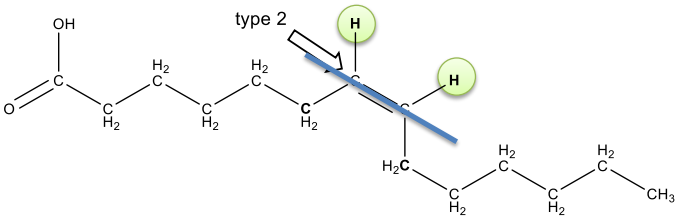


Since these atoms are fixed in space, we can think of the double bond as having two "sides".

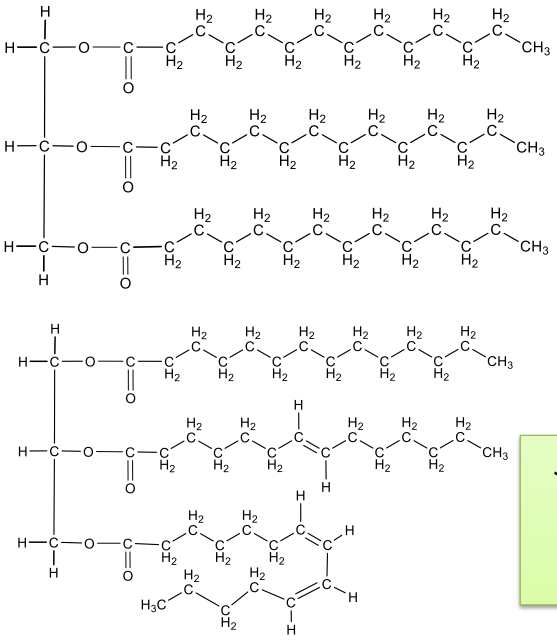
What is the difference between the two types of double bonds?



Chemists refer to these two types of double bonds as *cis* and *trans*.



Fats on the label



Saturated fat is referring to the *composition of the fatty acid chains* that make up the triglycerides.

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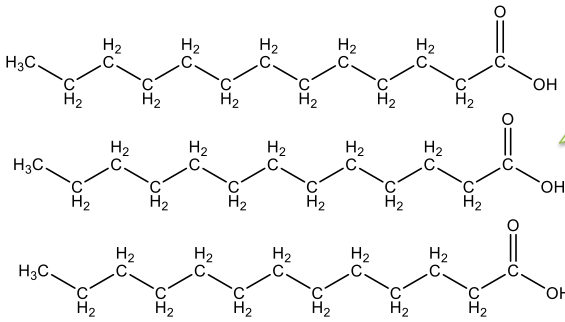
Triglycerides from different food sources

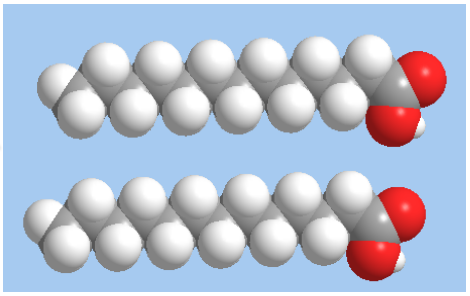
Source	Fatty acids in triglycerides are…	Physical appearance
Animal triglycerides (e.g. butter, lard, tallow from cow, pig etc)	50% Saturated, 50% unsaturated (1-5% of the unsaturated is trans)	Solid (fat)
some Fish triglycerides (e.g. fish oil)	Cis unsaturated and polyunsaturated (contain omega-3 fatty acids)	Liquid (oil)
Plant triglycerides (e.g. peanut oil, olive oil, corn oil)	85% Cis unsaturated and polyunsaturated, 15% saturated	Liquid (oil)

Liquid fat vs. Solid fat



Three saturated fatty acid chains could make a fully saturated triglyceride (when combined with glycerol).

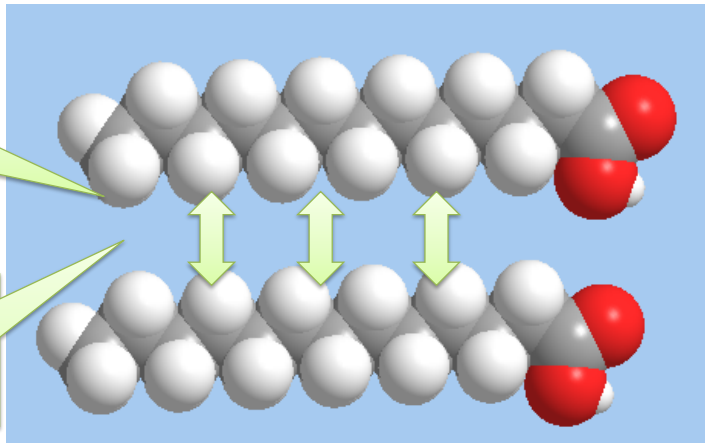
long tube-shaped fatty acids can stack closely together in a triglyceride



Three saturated fatty acid chains shown in a *space filling model*. This representation shows how much space the actual atoms would take up. The straight tube-like structure of the saturated fatty acid means it can stack closely with another saturated fatty acid in a triglyceride.

Van Der Waals (VDW) attractions

Hydrophobic interactions between molecules – the principle of mutual dislike



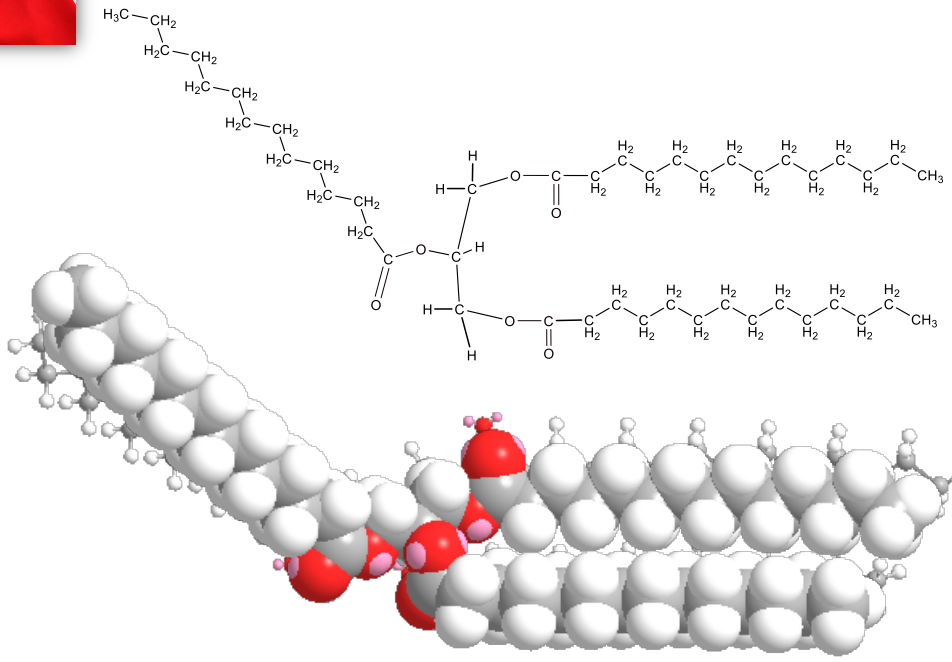
C-C and C-H bonds

Attractions between **non-polar** regions

In order to form a solid from a liquid, the molecules have to slow down and stable interactions must form between them (same goes for a gas to a liquid).

Q. What kinds of intermolecular attractions can form between molecules that have mostly non-polar covalent bonds?
A. VDW attractions (hydrophobic attractions)

A saturated Triglyceride



Saturated Triglycerides can make many VDW contacts

The ability to stack closely means that saturated triglycerides have many intermolecular attractions