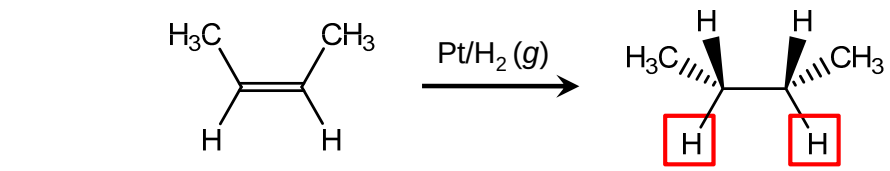
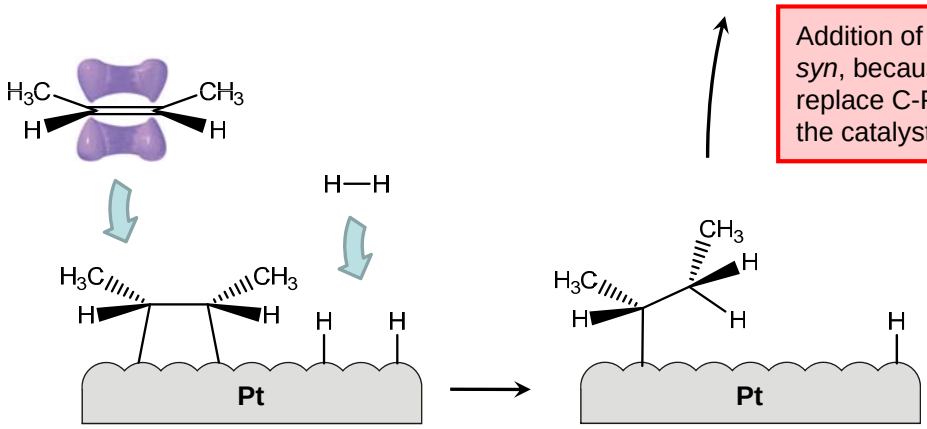
Catalytic Hydrogenation of Alkenes

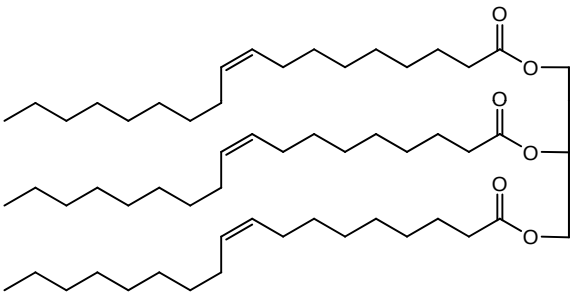
Adds two H atoms to the same face of an alkene (to yield an alkane).





Addition of 2 H's is *syn*, because they replace C-Pt bonds at the catalyst surface.

Alkenes in Unsaturated Fats

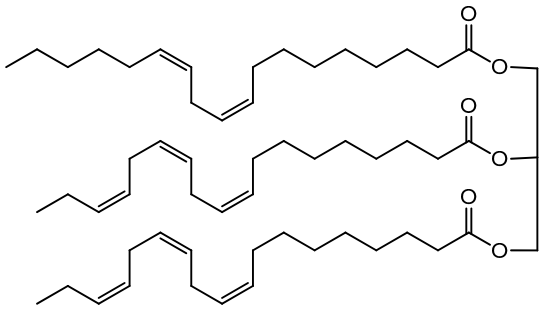


*an **unsaturated** fat/triglyceride*

Critical for cell membrane fluidity.

ester of linoleic acid (***omega-6***)

esters of linolenic acid (***omega-3***)

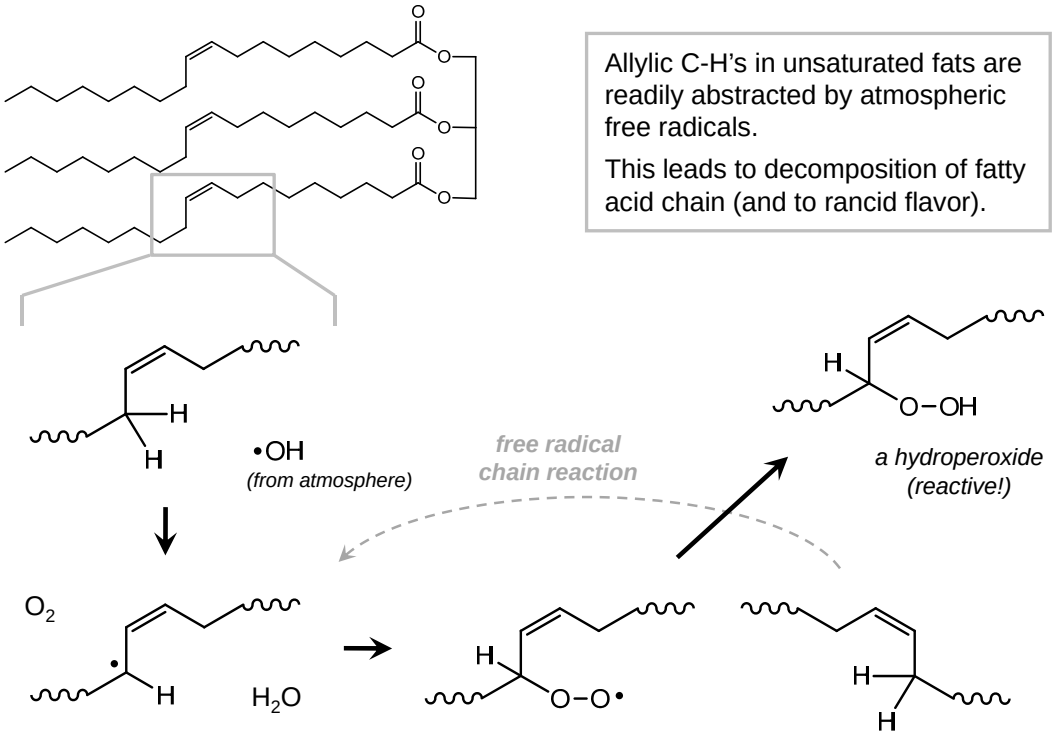


*a **polyunsaturated** fat/triglyceride*

Associated with heart health.

"*Essential*"—we need them, but our bodies don't make them.

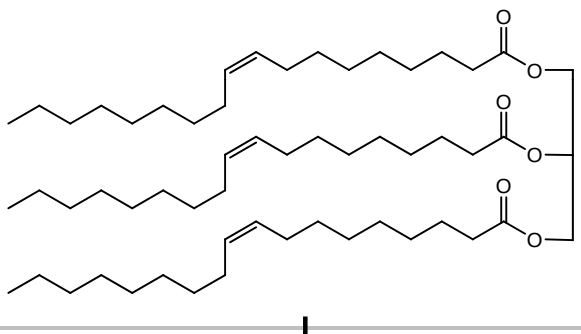
Rancidity in Unsaturated Fats



Allylic C-H's in unsaturated fats are readily abstracted by atmospheric free radicals.

This leads to decomposition of fatty acid chain (and to rancid flavor).

In Theory, Hydrogenation of Unsaturated Fats Yields Fully Saturated Fats



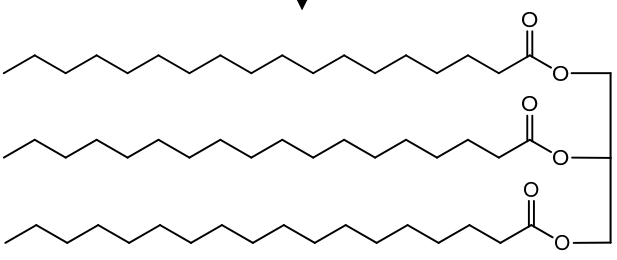
triolein
*(an **unsaturated** fat/triglyceride)*

***liquid**, mp = -4 °C*

Ni/H_2 (*g*) | 150 °C, 2000 psi

Hydrogenation of unsaturated, liquid soybean oil leads to solid, saturated fat—less rancid, easier to process.

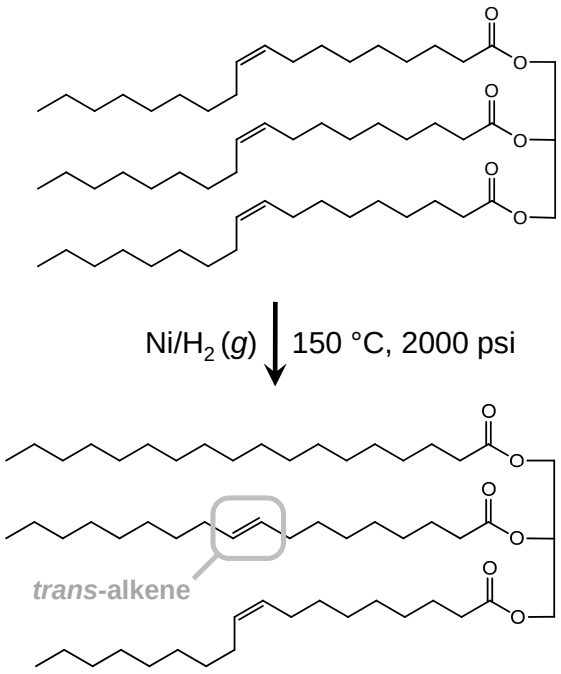
Nickel typically used instead of platinum to lower cost. Requires heat, pressure.



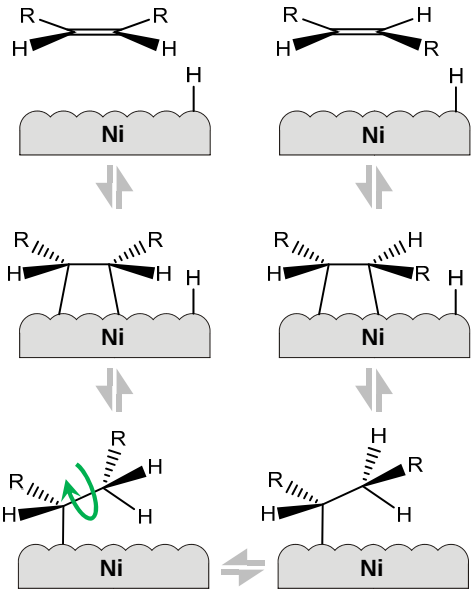
tristearin
*(a **saturated** fat/triglyceride)*

***solid**, mp = 72 °C*

In Practice, Partial Hydrogenation Can Yield *trans*-Fats



At high temperatures, reactions between Ni catalyst and alkene are reversible.



Reducing *trans*-Fats

trans-*fat-containing food products*

a hydrogenation plant

The problem:

Omega-3/6 fats are essential, and both saturated fats and *cis*-fats are used in the body, but *trans*-fats are not.

New York City restaurant poster

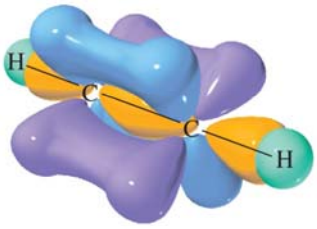
Chapter 8 Material Not Covered in Lecture:

Addition of Carbenes to Alkenes: Wade, Chap. 8.11. Not important.

Polymerization of Alkenes: Wade, Chap. 8.16. Covered in CHEM 2302.

But do read "Problem-Solving Strategy: Organic Synthesis," pp. 367-369.

Alkynes: Structure and Acidity



Reminder: Alkynes have *sp*-hybridized carbons, linear (180°) geometry.

$H_3C-C\equiv C-CH_3$	$H_3C-CH_2-C\equiv C-H$
an *internal* alkyne	a *terminal* alkyne

The terminal proton of alkynes is slightly acidic.

$$R-C\equiv C-H \quad + \quad Na^{\oplus}\ NH_2^{\ominus} \quad \rightleftharpoons \quad R-C\equiv C^{\ominus}\ Na^{\oplus} \quad + \quad NH_3$$

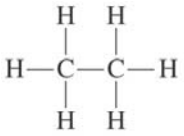
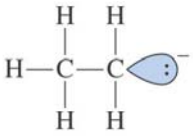
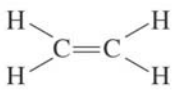
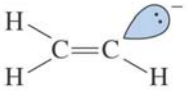
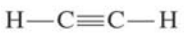
$R-C\equiv C-H$: $pK_a = 25$

$R-C\equiv C^{\ominus}\ Na^{\oplus}$: *an alkynyl anion*

NH_3: $pK_a = 35$

So, strong bases deprotonate terminal alkynes.

Alkynes: Structure and Acidity

Acid	Conjugate base	Hybridization	*s* character	pK_a
		sp^3	25%	50
		sp^2	33%	44
$:NH_3$	$:\ddot{N}H_2^-$	(ammonia)		35
		*sp*	50%	25
R—OH	R—$\ddot{O}:^-$	(alcohols)		16–18

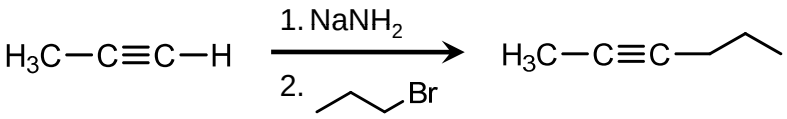
weakest acid

stronger acid

More *s* character = Electrons more closely held to nucleus
= Anion better compensated by nuclear charge

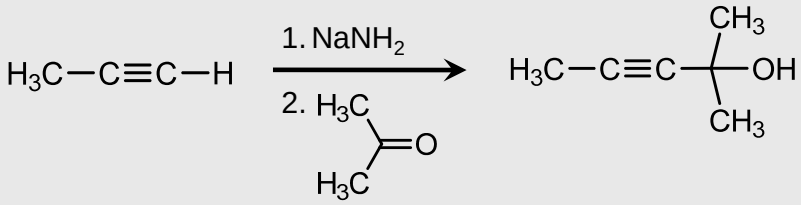
Synthesis with Alkynyl Anions

S_N2 on 1° halides:



Alkynyl anions are also strong bases, so S_N2 doesn't work well on 2° or 3° halides. (E2 interferes.)

Wade says:



Don't worry about this yet (we'll discuss w/ Ch. 10).