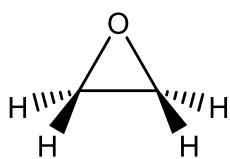


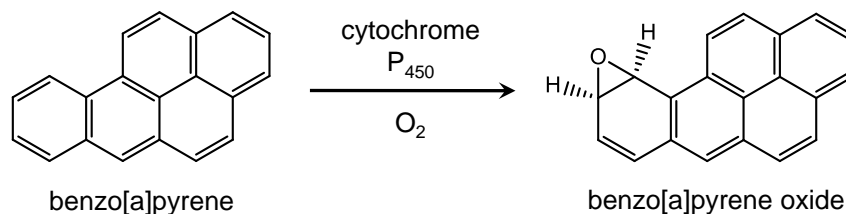
Epoxides



Epoxide: A three-membered ring made of two carbons and one oxygen.

Very reactive towards nucleophiles.

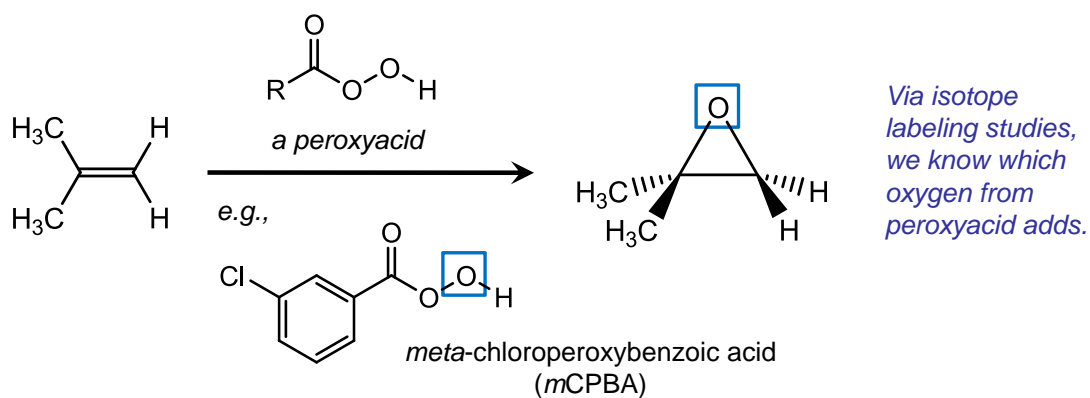
Example from biology:



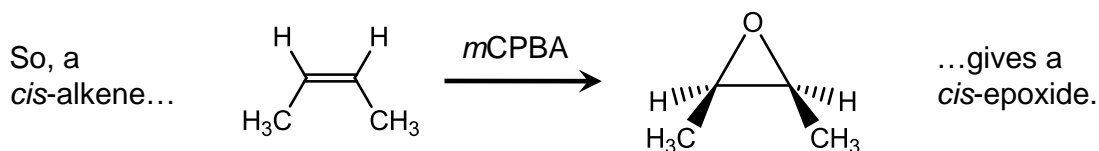
a polyaromatic hydrocarbon (PAH)
byproduct of burning tobacco, charring meat

reacts with nucleophiles in DNA to generate DNA "lesions", which can produce cancer-causing mutations

Synthesis of Epoxides

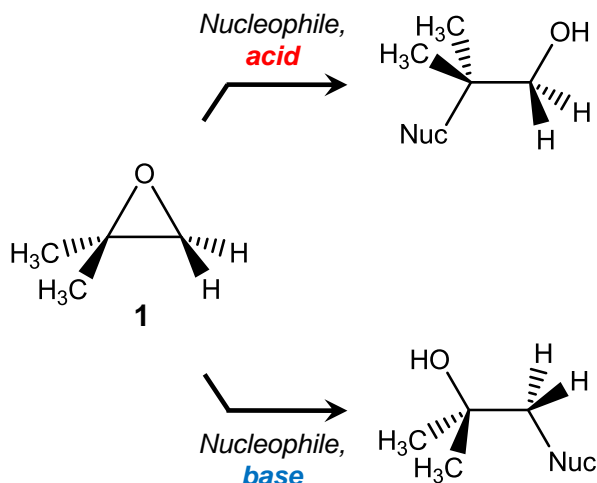


Stereochemistry of alkene starting material is retained in epoxide product.



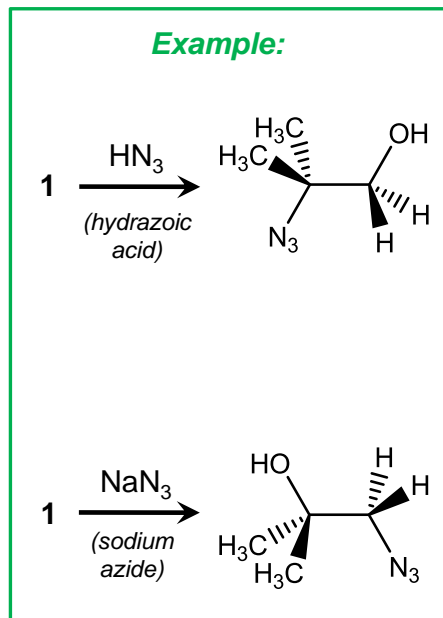
Ring-Opening Reactions of Epoxides

In acid, nucleophile adds to site of most stable carbocation.



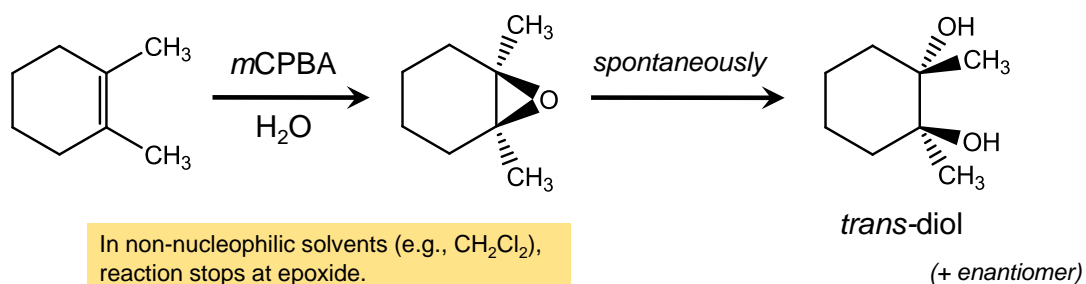
In base, nucleophile adds to least hindered carbon.

Example:

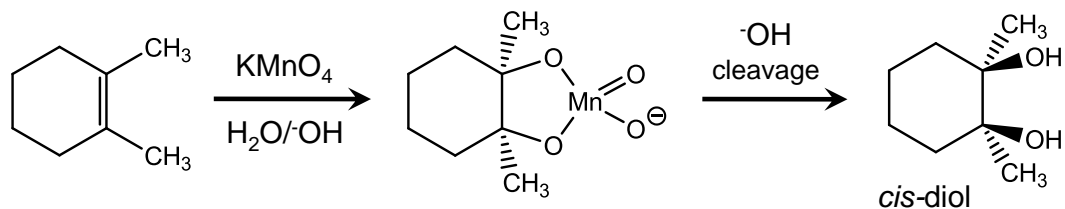


Dihydroxylation of Alkenes

anti-Dihydroxylation via epoxides:

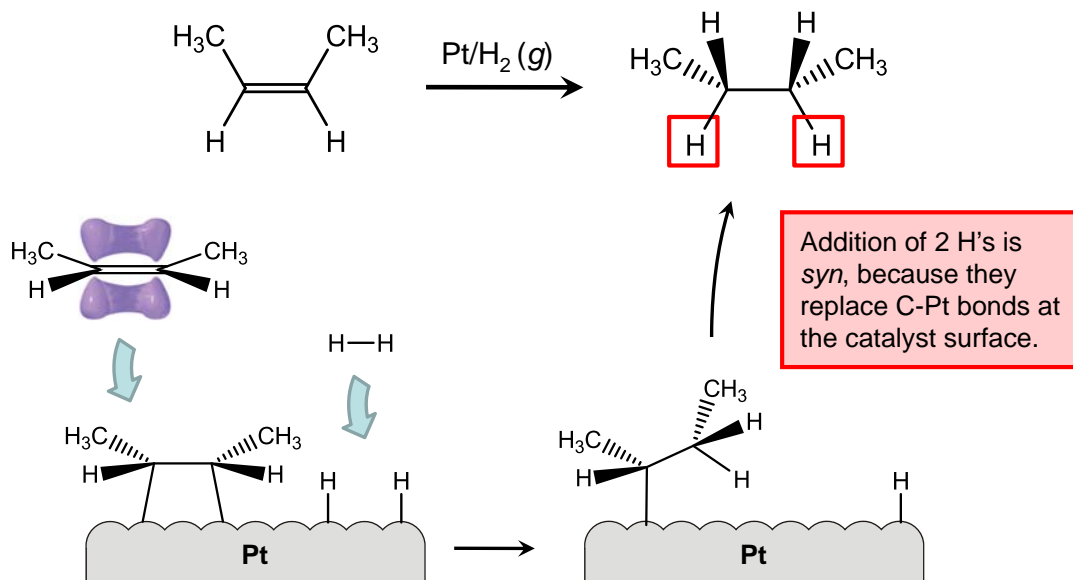


syn-Dihydroxylation with permanganate:

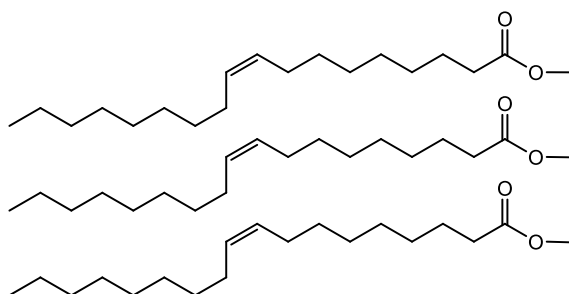


Catalytic Reduction (Hydrogenation) of Alkenes

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

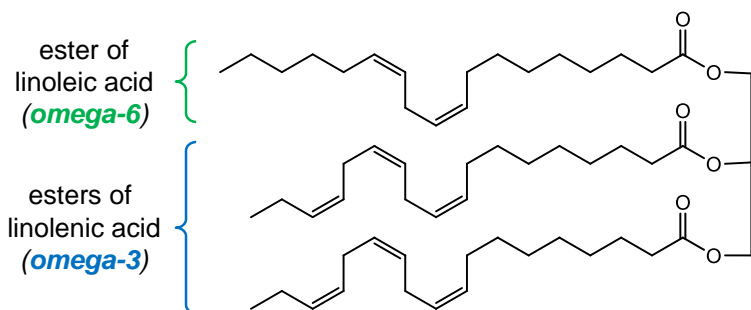


Alkenes in Unsaturated Fats



an unsaturated fat/triglyceride

Critical for cell membrane fluidity.

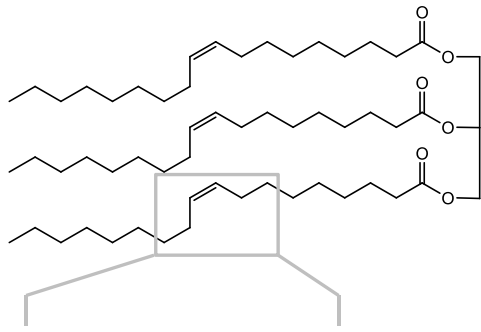


a polyunsaturated fat/triglyceride

Associated with heart health.

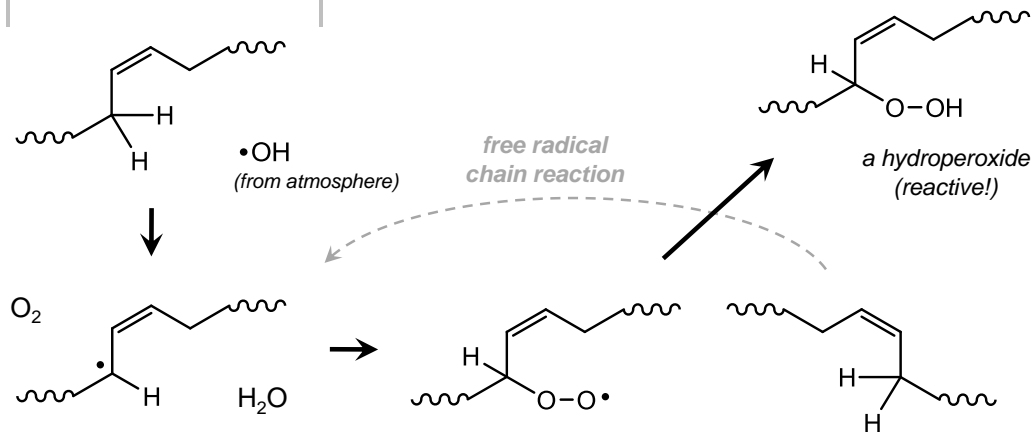
"Essential"—we need them, but our bodies don't make them.

Rancidity in Unsaturated Fats

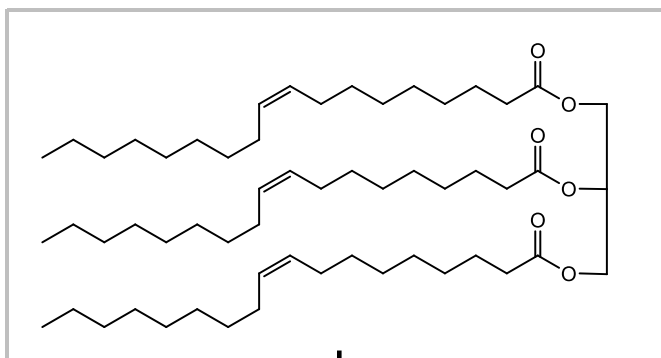


Allylic C-H's in unsaturated fats are readily abstracted by atmospheric free radicals.

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



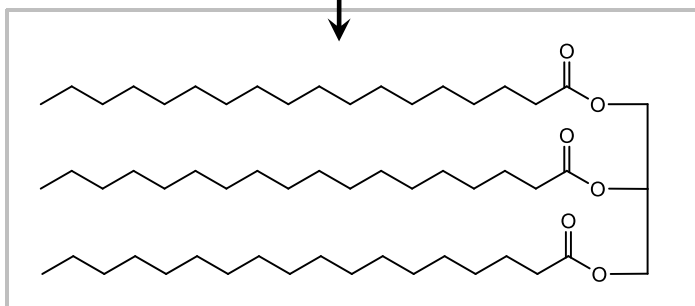
In Theory, Hydrogenation of Unsaturated Fats Yields Fully Saturated Fats



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

liquid, mp = -4 °C

Ni/H_2 (g) 150 °C, 2000 psi



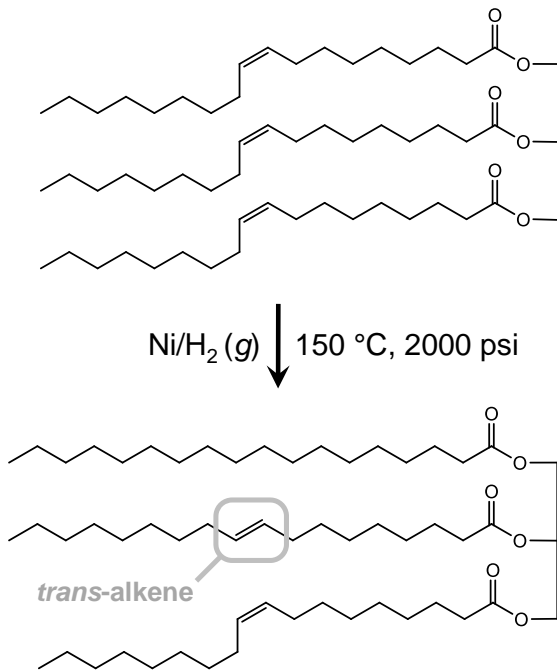
tristearin
(a **saturated** fat/triglyceride)

solid, mp = 72 °C

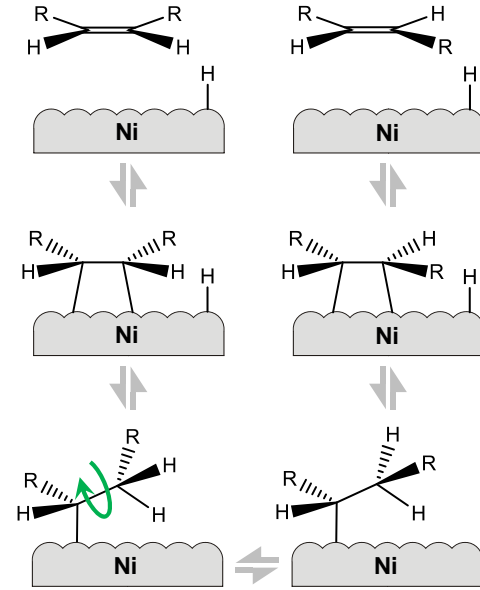
Hydrogenation of unsaturated, liquid soybean oil leads to solid, saturated fat—less rancid, easier to process.

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

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

