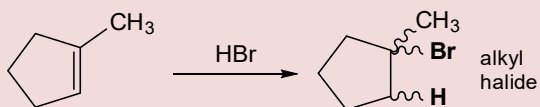
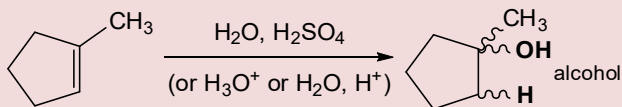
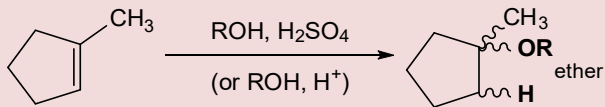
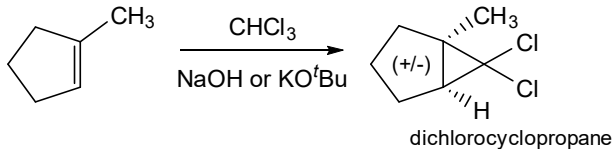
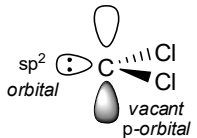
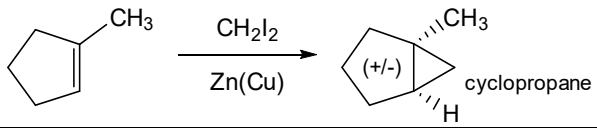
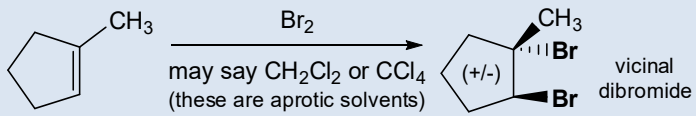
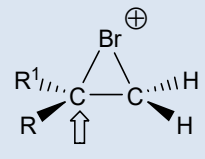
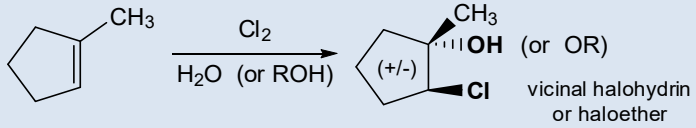
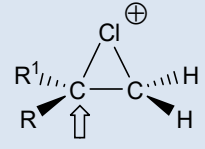
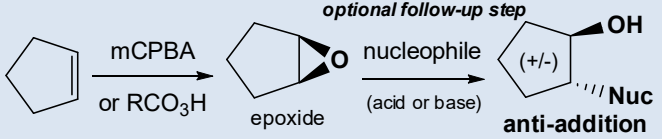
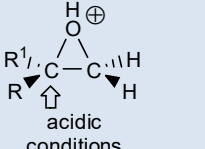
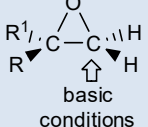
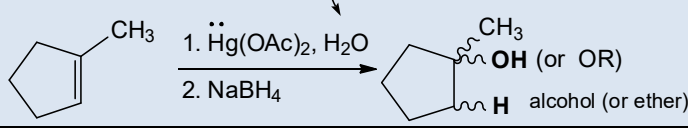
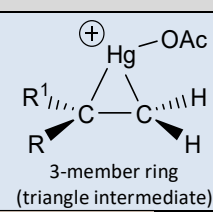
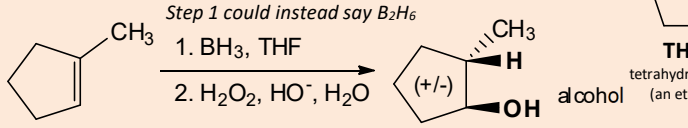
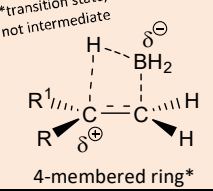
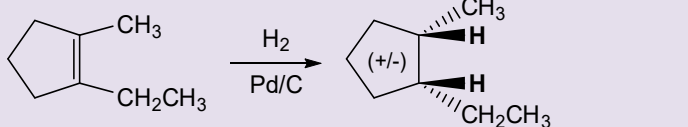
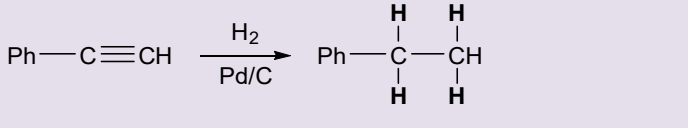
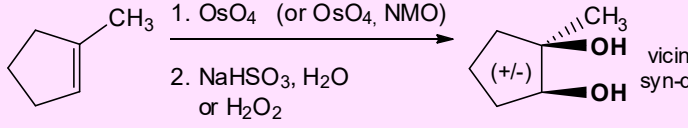
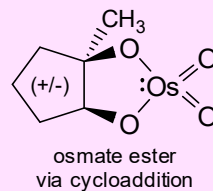

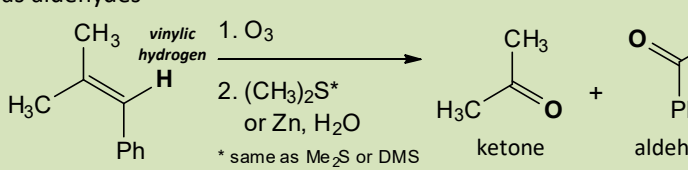
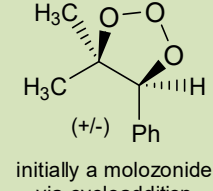
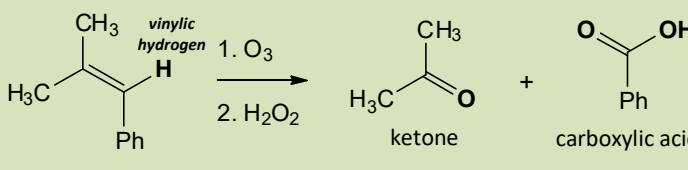
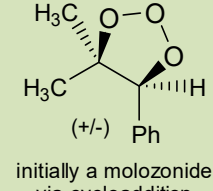
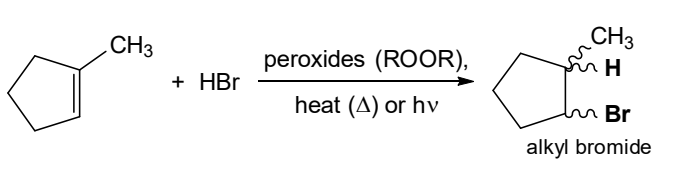
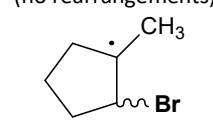


## Electrophilic Addition to Alkenes

Reaction	Mechanistic Intermediate	Stereo-chemistry The groups add:	Regiochemistry (regioselectivity)
<b>HX (X = I, Br, Cl) addition of hydrohalic acid</b> 	carbocation (rearrangement possible)	syn & anti (scrambled)	Markovnikov
<b>H<sub>2</sub>O with acid</b> acid catalyzed hydration 	carbocation (rearrangement possible)	syn & anti (scrambled)	Markovnikov
<b>alcohol with acid</b> acid catalyzed alkoxylation 	carbocation (rearrangement possible)	syn & anti (scrambled)	Markovnikov
<b>chloroform with base</b> forms dichlorocyclopropane 	carbene (:CCl <sub>2</sub> ) (an unfilled octet) 	syn	
<b>Simmons–Smith</b> CH <sub>2</sub> I <sub>2</sub> with a Zn & Cu couple forms cyclopropane 	organozinc carbenoid (I-CH <sub>2</sub> -Zn)	syn	
<b>X<sub>2</sub> (either Br<sub>2</sub> or Cl<sub>2</sub>, makes vicinal dihalides)</b> 		anti (meso possible)	The ring-opening nucleophile adds to the carbon that would have been the best carbocation.
<b>X<sub>2</sub> / H<sub>2</sub>O or X<sub>2</sub> / ROH (makes vicinal halohydrins or haloethers)</b>  <p><i>Other nucleophiles such as carboxylic acid or thiol can open the ring.</i></p>		anti	The ring-opening nucleophile adds to the carbon that would have been the best carbocation.
<b>mCPBA to make an epoxide</b> (can then do a follow-up S <sub>N</sub> 2 reaction on the epoxide with many different nucleophiles. Using water in either acid or base conditions is a way to make a vicinal anti-diol.) 	 <p>acidic conditions</p> <p>Reaction conditions dictate where epoxide-opening nucleophile will add.</p>  <p>basic conditions</p>	anti (meso possible for diol)	The ring-opening nucleophile adds:  acid - <b>more</b> subbed side  base - <b>less</b> subbed side

Reaction	Mechanistic Intermediate	Stereo-chemistry The groups add:	Regiochemistry (regioselectivity)
<b>Hg(OAc)<sub>2</sub>, H<sub>2</sub>O</b> (using alcohol in step 1 instead of H <sub>2</sub> O makes ether) oxymercuration-demercuration  <p>(Hg has a lone pair, so form a triangle)</p>	 <p>3-member ring (triangle intermediate)</p>	syn & anti (scrambled)  Initially anti after first step, but becomes scrambled in the second step.	Markovnikov  <b>(no rearrangements)</b>
<b>BH<sub>3</sub></b> (also shown as BH <sub>3</sub> , THF -or- BH <sub>3</sub> •THF -or- B <sub>2</sub> H <sub>6</sub> ) hydroboration  <p>Step 1 could instead say B<sub>2</sub>H<sub>6</sub></p> <p>THF tetrahydrofuran (an ether)</p>	 <p>*transition state, not intermediate 4-membered ring*</p>	syn	anti-Markovnikov  <b>(no rearrangements)</b>
<b>H<sub>2</sub> with Pd/C, Pd, Pt, or Ni</b> with alkene (hydrogenation) 	no intermediate	syn (meso possible)	
<b>H<sub>2</sub> with Pd/C, Pd, Pt, or Ni</b> with alkyne (hydrogenation) 	no intermediate		
<b>OsO<sub>4</sub></b> osmium tetroxide does dihydroxylation to make syn-diol  <p>vicinal syn-diol</p> <p>alternate reagent: cold KMnO<sub>4</sub> in dilute base conditions</p>	 <p>osmate ester via cycloaddition</p>	syn (meso possible)	NMO (or NMMO)   N-methylmorpholine N-oxide
<b>O<sub>3</sub></b> ozonolysis + reducing agent in step 2: vinylic hydrogens survive as aldehydes  <p>vinyl hydrogen</p> <p>ketone + aldehyde</p> <p>* same as Me<sub>2</sub>S or DMS</p>	 <p>initially a molozonide via cycloaddition</p>	<div style="border: 1px solid black; padding: 5px;"> <b>IMPORTANT:</b> ozonolysis BREAKS a carbon-carbon bond.             This is one of the few reactions we learn in the class for SHORTENING a carbon chain.         </div>	
<b>O<sub>3</sub></b> ozonolysis + oxidizing agent in step 2: vinylic hydrogens become an "OH" group and yields carboxylic acid  <p>vinyl hydrogen</p> <p>ketone + carboxylic acid</p> <p>alternate reagents: hot, conc. KMnO<sub>4</sub> in acidic conditions -or- Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> -or- K<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub></p>	 <p>initially a molozonide via cycloaddition</p>		
<b>HBr + peroxides with heat or hv</b> this only works with HBr, not HCl or HI  <p>alkyl bromide</p>	radical (no rearrangements)  	syn & anti (scrambled)	anti-Markovnikov  <b>(no rearrangements)</b>