Understanding Stereochemistry Outcomes of Reactions: Knowing Mechanisms + These Two Concepts = You Know EVERYTHING!

Organic chemistry features many reactions that end up creating tetrahedral carbons. New chiral centers are born when a carbon finishes as a tetrahedral with four different substituents.

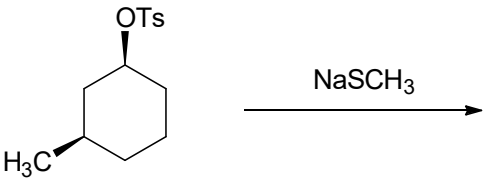
There are two mechanistic actions that give birth to new tetrahedral centers:

1. ***Attaching to an sp^2 carbon*** ***(a flat carbon)*** **goes from having 3 attachments to having 4.**
   - Mechanistically, the incoming fourth attachment has two faces it can attach to, and this can potentially lead to two stereoisomers.
   - ***You should be aware this action does not always lead to a racemic mix.*** You could end up with an achiral center, or you could end up making diastereomers instead of enantiomers.

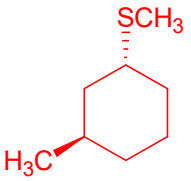
2. ***Attaching to an sp^3 carbon*** ***(already a tetrahedral carbon)*** **trades one group for another.**
   - Attaching to an sp^3 carbon means having only one way to attach to that carbon: the incoming nucleophile must attack from the backside of the outgoing leaving group (aka the S_N2 reaction).
   - The resulting product can only be one option of a stereoisomer, and it would be the inversion of configuration product only.

Applying the simplicity outlined above doesn't mean much if you don't understand the mechanisms of the reactions and you don't think of reactions mechanistically, so this is yet another example of why I am always touting the importance of having a clear understanding and command of mechanisms.

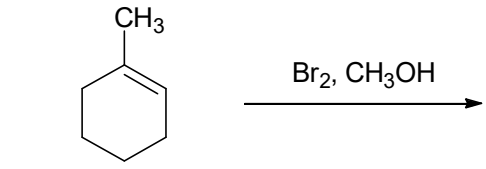
example 1



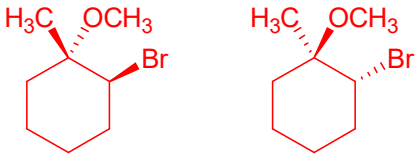
single stereoisomer via the S_N2 reaction (attach to sp^3)



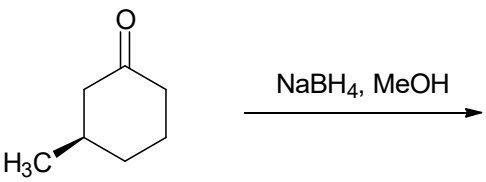
example 2



enantiomers via alkene addition (initially attaching to sp^2)



example 3



diastereomers via nucleophilic acyl addition (attaching to sp^2)