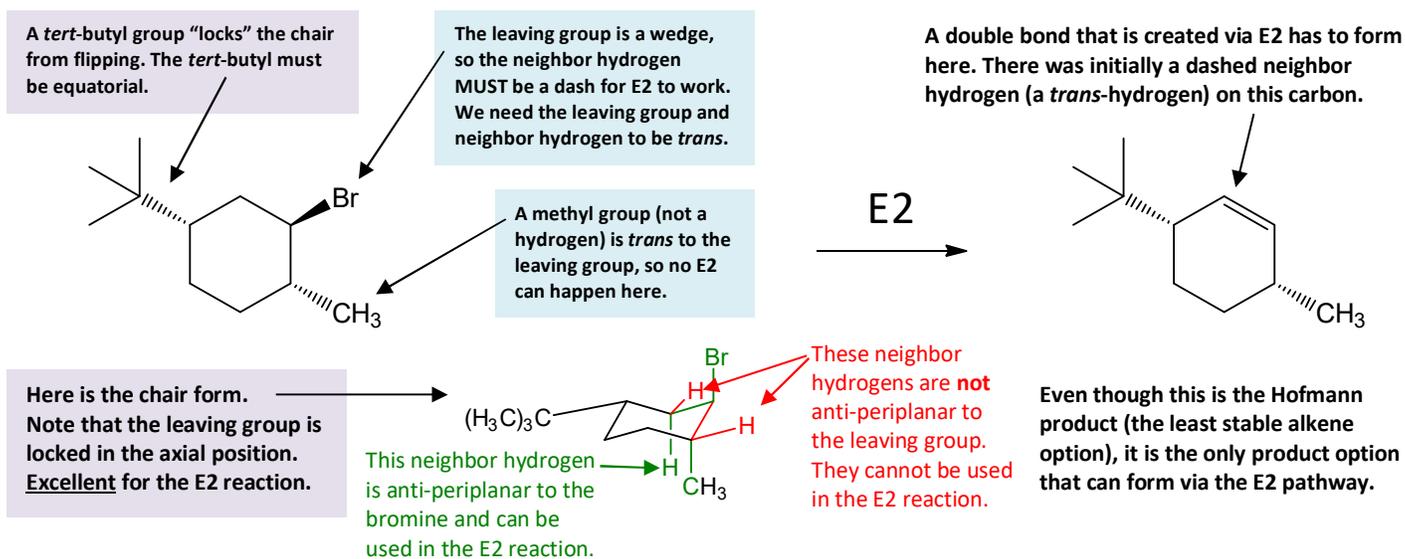


## E2 on cyclohexane (when the alkene forms between two ring carbons)

Two rules that can't be broken if the E2-created  $\pi$  bond is going to form **between two ring carbons**:

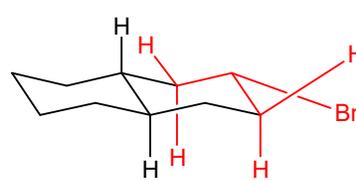
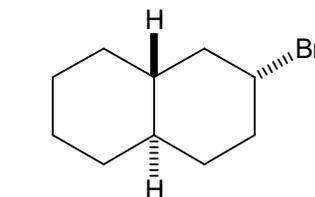
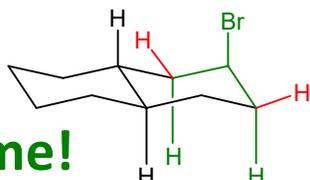
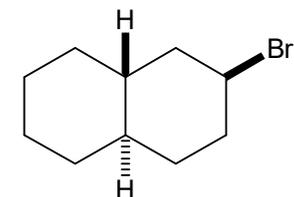
1. The leaving group and the next-door  $\beta$ -hydrogen attached to the ring **MUST be trans to each other**. This gives the needed anti-periplanar di-axial geometry. **If the leaving group is on the solid wedge, the  $\beta$ -hydrogen must be on the dashed line (and vice-versa)**. If you don't have that arrangement, you can't do an E2 between those ring carbons.
2. **The leaving group must be able to achieve the axial position**. Check if the cyclohexane can do flips; remember that if you have a *tert*-butyl substituent on the ring, the *t*-butyl will lock the chair into the conformation that has the *t*-butyl group equatorial. This will either lock the leaving group into the axial position (gives FAST E2!) or it will lock the leaving group into the equatorial position (gives no/slow E2). Another common structure we work with that prevents the chair flip is *trans*-decalin (shown below).

**Pattern Alert:** Leaving groups and  $\beta$ -hydrogens in the equatorial position will NOT participate in the E2 reaction to make an alkene between two ring carbons because equatorial substituents are anti-periplanar to ring carbons. If this concept is making you say "what?!", then build a model of a chair and see it for yourself.



**trans-Decalin** is another example of a cyclohexane that cannot do a ring flip. The bridgehead substituents (hydrogens in this example) are trapped in the axial position. You should be able to draw these correctly in chair conformation.

For this stereoisomer, the leaving group is "locked" axial which is excellent for E2. The chair conformation shows us there are two options for E2 because there are two hydrogens anti-periplanar. The green hydrogens could be removed in an E2 reaction, but the red hydrogens cannot be removed.



This stereoisomer has the leaving group "locked" equatorial. No E2 is possible because the leaving group is anti-periplanar to ring carbons. All four of the beta hydrogens are shown in red to make the point they can't help us for E2.



**E2 party time!**