Enantiomers: Mirror images, show same NMR, (unless in a chiral, optically active environ)
Diastereomers: have different NMR's.

\[
\begin{align*}
\text{H}_3C & \quad \text{H}_3C \\
\text{H} & \quad \text{H} \\
\text{b} & \quad \text{a}
\end{align*}
\]

\( \text{H}_b \text{ } \text{H}_c \) are diastereotopic

Substitution test

\[
\begin{align*}
\text{H}_3C & \quad \text{H}_3C \\
\text{H} & \quad \text{H} \\
\text{H} & \quad \text{Ar}
\end{align*}
\]

\( \text{H}_3C \text{ } \text{H}_3C \) are diastereomers

\( \text{H}_3C \text{ } \text{H}_3C \) are diastereotopic

Diastereomers

\[
\begin{align*}
\text{Br} & \quad \text{H} \\
\text{Br} & \quad \text{H}
\end{align*}
\]

NMR chemical shift trends

1) alkyl -CH\text{ } -CH\text{ } -CH

2) EWG

3) hybridization

\[
\begin{align*}
5p^3 & < 5p^2 < 5p^1 < 5s^2
\end{align*}
\]

\[
\begin{align*}
1-\text{H} & \quad \text{C} \text{=C} \text{H} \\
\text{5.1-6} & \quad \text{6.7-8.5} \\
\text{6.4-6.0} & \quad \text{6.2-6.5}
\end{align*}
\]

\( \text{IT systems (Double/tripl bonds) create magnetic anisotropy} \)
- Double Bonds deshield H's
- Triple Bonds deshield less than Double bonds
Submit a Single-sided Copy to the Office
DO NOT STAPLE

4 diff protons
- Methyl = Singlet (s) - δ 2.3
- Ortho H's = d
- Meta H's = t
- Para H's = e

- Inductive withdrawal is greater for ortho
  so ortho is most downfield

- NMR of aromatic H's are typically not first order.
- OK to draw first order on quiz/test.

- OH, acid, alcohol
- NH₂ amine
- Often singlet, no coupling, can be broad & variable chemical shift.
  δ depends on concentration which affects H-bonding
More Complex Spectra

1) second order effects - splitting
   Occurs when chemical shifts of H's get close together - peaks overlap
   \( \Delta V_{ab} \) is close to \( J_{ab} \)
   (first order... \( \Delta V_{ab} \gg J_{ab} \))

2) multiplicative splitting
   One set of H's coupled to 2 other sets w/ different coupling constants.

3 diff. H's on benzene

\[ J_{bc} = J_{cb} = 8 \text{ Hz} \]
\[ J_{ab} = J_{ba} = 16 \text{ Hz} \]
\[ J_{ab} \neq J_{bc} \]

Coupling tree for Hb
leaning is a 2nd order effect, when 2 H's are done
- Don't worry about why

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<th>H₀</th>
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ab quartet 2 doublets
leaning.

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singleton when Hₐ = Hₐ