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# Designing an Active Learning Assignment for the Inductive Effect

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## Designing an active learning assignment for the Inductive Effect

## Organic Chemistry I

This activity will take place for 1.5 hours of a 2 hour lecture.

Students need to be able to manipulate the following concepts; Bronsted-Lowry Acid-Base Theory,  $K_a$ ,  $pK_a$ , and the relationship between  $pK_a$  values and relative stabilities of conjugate acids and conjugate bases.

The inductive effect is introduced in a previous lecture, for this class a short 10 minute review will take place reminding students of how electronegative atoms can stabilize negative charges or destabilize positive charges within the same molecule.

For the first 15 minutes students will work alone and analyze Table 1 identifying differences among the given compounds based on structure and distance of electronegative atoms. The idea is for them to draw parallels to similar differences among structures reasoning out the observed  $pK_a$  trend.

Then students will be placed in groups of 3 or 4 where they will discuss and come to a group consensus with respect to determining the relationship between structure and  $pK_a$  trend. Total time 20 minutes.

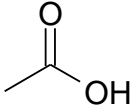
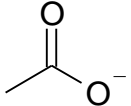
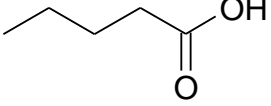
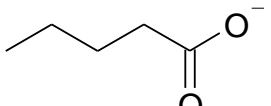
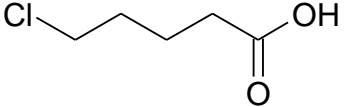
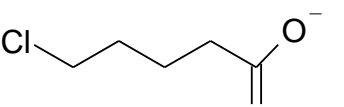
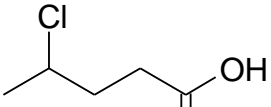
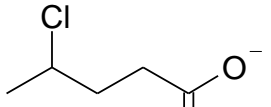
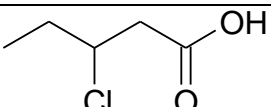
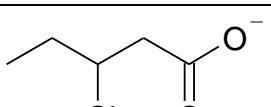
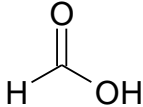
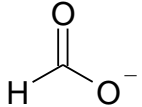
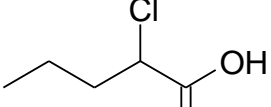
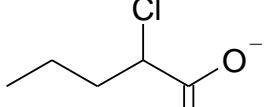
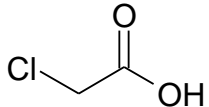
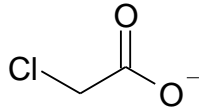
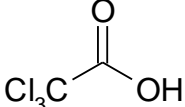
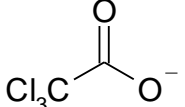
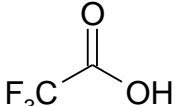
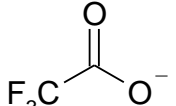
Tables 2 through 4 give students experience in isolating structure variables and drawing analogies on the basis of these variables in order to decide on the relative stabilities of acids or bases. This activity is done within the group and will take 30 minutes to work through as many tables as possible within the time frame.

The last 15 minutes are reserved for whiteboard discussion to facilitate student group determination between structure, stability and  $pK_a$ .

I don't expect the students to finish this exercise in class. They can continue at home or in study groups, which I always encourage.

## Exploration of the inductive effect

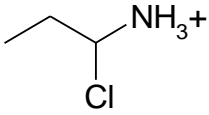
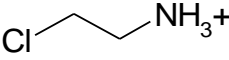
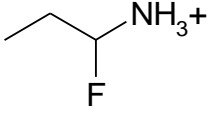
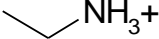
Table 1. Identifying pKa trends for acids and their conjugate bases

Acid	Conjugate Base	pKa
		<b>4.8</b>
		<b>4.8</b>
		<b>4.7</b>
		<b>4.5</b>
		<b>4.1</b>
		<b>3.7</b>
		<b>2.8</b>
		<b>2.8</b>
		<b>0.9</b>
		<b>0.0</b>

Inductive Effect (this exercise is to determine if the student learned)

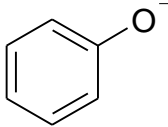
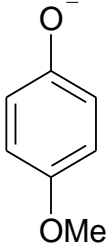
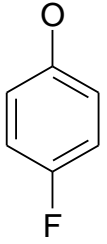
Answer the following questions based on your interpretation of the data on Table 1. List the following compounds in order of decreasing acidities. 4 = most acidic and 1= least acidic and **EXPLAIN** how you determined the order.

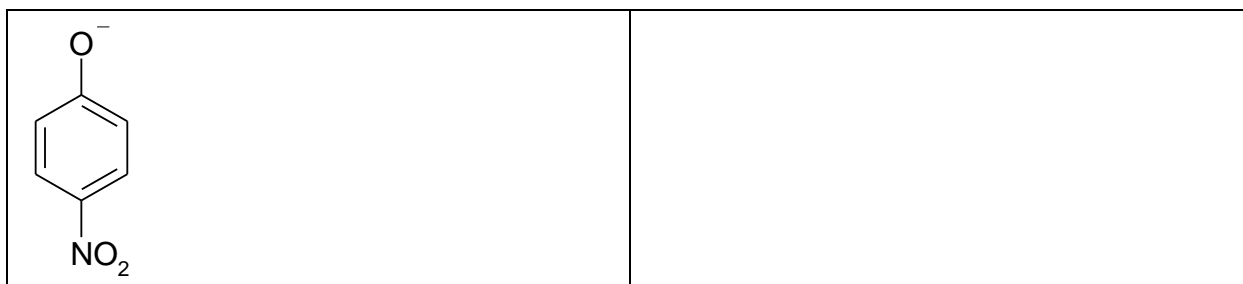
**Table 2.** Conjugate Acid Stability

List the following anions in order of decreasing stability and **EXPLAIN** how you determined the order. 1= most stable and 4 = least stable. Suggest structural explanations for the effects

**Table 3.** Conjugate Base Stability



For each compound circle the most acidic proton. 1= most acidic and 4 = least acidic

**Table 4.** Determination of Acidic Protons

