

Pearson R G. Hard and soft acids and bases. *J. Amer. Chem. Soc.* **85**:3533-9, 1963.
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Lewis acids and bases are classified as being either 'hard' (non-polarizable) or 'soft' (polarizable). The HSAB principle is proposed: hard acids prefer to bind to hard bases, and soft acids prefer to bind to soft bases. [The *SCF*[®] indicates that this paper has been cited over 865 times since 1963.]

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"I first developed a strong interest in generalized acidbase behavior in 1961, when John Edwards, Brown University, spent a sabbatical leave at Northwestern University. I found Edwards to be very stimulating and together we wrote a paper on nucleophilic reactivity which turned out to be of considerable interest and utility. In it we showed that electrophiles could be divided into categories, depending on whether they were sensitive to the proton basicity or to the polarizability of various nucleophiles.

"The following year, I decided to do the same thing for equilibrium data that Edwards and I had done for rate data. That is, I would categorize Lewis acids in terms of whether they were sensitive to the proton basicity or the polarizability of the base. The criterion was to be the stability of the acid-base complex formed. By using the Lewis definitions, it was obvious that all organic and inorganic compounds could be considered as acid-base complexes.

"I had already put many Lewis acids and bases into one of two categories and, in fact, I originally thought to call them class (a) or class (b) acids and bases. However, I often felt the need to use comparative terms, implying a gradual transition rather than a sharp demarcation between classes. I had also spent much time trying to decide on the

fundamental properties which led to class (a) or (b) behavior. At this point, I decided to call my categories hard and soft. These labels were simple and descriptive, seemed to fit the properties of the various acids and bases, and allowed for the easy use of both the comparative and superlative.

"What is HSAB? It is supposed to be a unifying concept which makes easier the remembering of a vast body of chemical facts and which enables predictions of a limited nature to be made. The essence is contained in the Principle of Hard and Soft Acids and Bases, which states that hard acids prefer to combine with hard bases and soft acids prefer to combine with soft bases (hard and soft being defined in a qualitative way).

"The principle is supposed to be a concise statement of fact, something in the nature of a law of chemistry. Yet, it would be presumptuous to call it a law because it is very imprecise.

"My belief is that the HSAB concept, with all its imperfections, is still very useful. I believe that it should be introduced first in high school chemistry. In college it should be used in the general chemistry course and in the first organic course as well. It is in these descriptive courses, assuming that they still contain some descriptive material, that such a simple concept is most helpful. It becomes a device for organizing quantities of material which, to the student at least, are vast. The use of the HSAB approach also has the advantage of making familiar to the student the generalized acidbase concept. Unfortunately, at the present time the important ideas of Lewis are barely mentioned in most elementary texts.

"At the research level, it seems to be true that many chemists have found the HSAB principle to be a useful first approximation. This is particularly so for those chemists who actually run reactions and try to isolate products. Scientists who are interested in precise measurements are not likely to find HSAB useful, or even acceptable."