

**Relative Strength Rules:**

1. A negative charge will always be a stronger nucleophile than its neutral counterpart.
2. The bulkier the base, the more basic and less nucleophilic it is.
3. Basicity and nucleophilicity have opposite size trends in polar protic solvents.

o **Periodic trend:**

The diagram illustrates periodic trends in nucleophilicity and basicity. On the left, a table shows electronegativity values: C (2.5), N (3.0), O (3.5), F (4.0), Cl (3.5), Br (3.7), and I (2.7). Arrows indicate that increasing electronegativity leads to increasing nucleophilicity in polar aprotic solvents and increasing basicity. A better leaving group is also indicated. On the right, two boxes compare nucleophilicity in aprotic and protic solvents. In aprotic solvents, nucleophilicity increases from F<sup>-</sup> to I<sup>-</sup>. In protic solvents, the order is reversed due to solvation, with I<sup>-</sup> being a stronger nucleophile than F<sup>-</sup>.

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1. For two nucleophiles with the same nucleophilic atom, the stronger base is the stronger nucleophile.  
The relative nucleophilicity of HO<sup>-</sup> and CH<sub>3</sub>COO<sup>-</sup> is determined by comparing the pK<sub>a</sub> values of their conjugate acids (H<sub>2</sub>O = 15.7, and CH<sub>3</sub>COOH = 4.8). HO<sup>-</sup> is a stronger base and stronger nucleophile than CH<sub>3</sub>COO<sup>-</sup>.
2. A negatively charged nucleophile is always a stronger nucleophile than its conjugate acid.  
HO<sup>-</sup> is a stronger base and stronger nucleophile than H<sub>2</sub>O.
3. Right-to-left across a row of the periodic table, nucleophilicity increases as basicity increases.

The diagram shows a row of anions: CH<sub>3</sub><sup>-</sup>, <sup>-</sup>NH<sub>2</sub>, <sup>-</sup>OH, and F<sup>-</sup>. An arrow points from right to left, labeled "Increasing basicity" and "Increasing nucleophilicity", indicating that as basicity increases from F<sup>-</sup> to CH<sub>3</sub><sup>-</sup>, nucleophilicity also increases.

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- o **Steric hindrance** is a decrease in reactivity resulting from the presence of bulky groups at the site of a reaction.
- o Steric hindrance decreases nucleophilicity but not basicity.
- o Sterically hindered bases that are poor nucleophiles are called nonnucleophilic bases.

The diagram compares ethoxide and tert-butoxide. Ethoxide is shown as a "stronger nucleophile" with a ball-and-stick model. tert-butoxide is shown as a "stronger base" with a ball-and-stick model, and a note states "Three CH<sub>3</sub> groups crowd the O, weaker nucleophile".

- **Smaller**, more electronegative anions are solvated more strongly, effectively shielding them from reaction.
- In **polar protic solvents**, nucleophilicity increases down a column of the periodic table as the size of the anion increases.
- This is the opposite of basicity.

The diagram shows a row of anions: F<sup>-</sup>, Cl<sup>-</sup>, Br<sup>-</sup>, and I<sup>-</sup>. An arrow points from left to right, labeled "Increasing nucleophilicity in polar protic solvents", indicating that nucleophilicity increases from F<sup>-</sup> to I<sup>-</sup> in these solvents.

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