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5.111 Principles of Chemical Science  
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## Periodic Trends (or Organization of the Periodic Table)

See lectures 9 and 10 for an introduction to periodic trends.

Elements within the same group of the periodic table have related valence electron configurations and many similar properties. For example:

Figure by MIT OpenCourseWare

- Li, Na, and K (group 1A) all have one valence electron and are all soft, reactive metals.
- He, Ne, and Ar (group 8A) all have filled valence shells and are inert.

In the late 1800s, the similar chemical properties of related atoms were believed to an extreme.

Today, in contrast, we understand that the differences between elements within a given group (many of which may be predicted by periodic trends) are as significant as the similarities.

### Example from Lecture 9 (not included in notes): Alkali earth metals in the body: Na and K versus Li

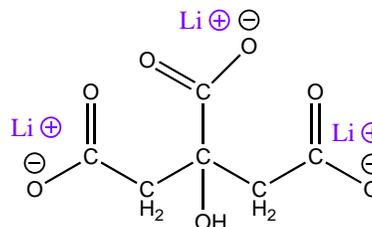
Consider sodium, potassium, and lithium ions, all from group 1 of the periodic table.

- $\text{Na}^+$  and  $\text{K}^+$  are both found in high concentrations in the body and are essential for diverse biological processes. For instance,  $\text{Na}^+$ , the most abundant cation in blood plasma, and potassium, the most common cation inside cells, are both involved in heart function regulation and in signal transduction in neurons. (For an example of the body's ability to differentiate between sodium and potassium ions, see the ion channel example in lecture 10.)
- $\text{Li}^+$ , on the other hand, has no known natural biological function.

**Sodium** citrate and **potassium** citrate are both found as soda additives. In the early 1920's a new lime soda, 7up, instead included **lithium** citrate and advertised many benefits of "lithiated soda". Lithium has a molecular weight of 7 g/mol, which may have led to the name 7up.



Lithium citrate



7up advertisements claimed that the lithiated soda was “Slenderizing” and “Dispels hangovers...takes the ‘ouch’ out of grouch.”

The Food and Drug Administration (FDA) banned the lithium component in 1950, shortly after the introduction of lithium carbonate as a possible psychiatric drug and the discovery of dangerous or deadly effects from lithium overdose. Lithium drugs are still used today to treat biopolar disorder and manic depressive illnesses in some patients.

Lithium treatments are administered as lithium salts, typically lithium citrate (as in 7up above!) or lithium carbonate, with the lithium ion as the active component.