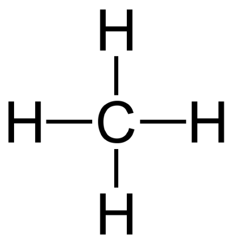
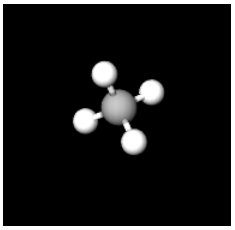
4.6: Implications of Periodicity for Atomic Theory

The concept of valence implies that atoms of each element have a characteristic number of sites by which they can be connected to atoms of other elements. Carbon, as seen below, has 4 'connection' or valence sites. Here Carbon is connected to 4 Hydrogen atoms, forming CH_4, better known as methane. Note that the symbolic and 3D representations below both depict the same molecule, but the symbolic representation clearly shows the valence sites, while the 3D representation accurately shows how those valence sites are arranged in 3D space.



A central C atom is bonded to H atoms on the top, bottom, left and right making it a total of four bonds.



Three dimensional structure shows a central grey sphere connected to four white spheres in a tetrahedral shape.

The number of valence sites repeats periodically as atomic weight increases, and occasionally even this regular repetition is imperfect. Atoms of similar atomic weight often have quite different properties, while some which differ widely in relative mass behave almost the same. Dalton's atomic theory considers atoms to be indestructible spheres whose most important property is mass. This is clearly inadequate to account for the macroscopic observations of the elements. In order to continue using the atomic theory, we must attribute some underlying structure to atoms. If both valence and atomic weight are determined by that structure, we should be able to account for the close but imperfect relationship between these two properties. The next section will describe some of the experiments which led to current theories about just what this atomic structure is like.