

## 4.1: Prelude to Putting the First Law to Work

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As has been seen in previous chapters, many important thermochemical quantities can be expressed in terms of partial derivatives. Two important examples are the molar heat capacities  $C_p$  and  $C_V$  which can be expressed as

$$C_p = \left( \frac{\partial H}{\partial T} \right)_p$$

and

$$C_V = \left( \frac{\partial U}{\partial T} \right)_V$$

These are properties that can be measured experimentally and tabulated for many substances. These quantities can be used to calculate changes in quantities since they represent the slope of a surface ( $H$  or  $U$ ) in the direction of the specified path (constant  $p$  or  $V$ ). This allows us to use the following kinds of relationships:

$$dH = \left( \frac{\partial H}{\partial T} \right)_p dT$$

and

$$\Delta H = \int \left( \frac{\partial H}{\partial T} \right)_p dT$$

Because thermodynamics is kind enough to deal in a number of **state variables**, the functions that define how those variable change must behave according to some very well determined mathematics. This is the true power of thermodynamics!

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