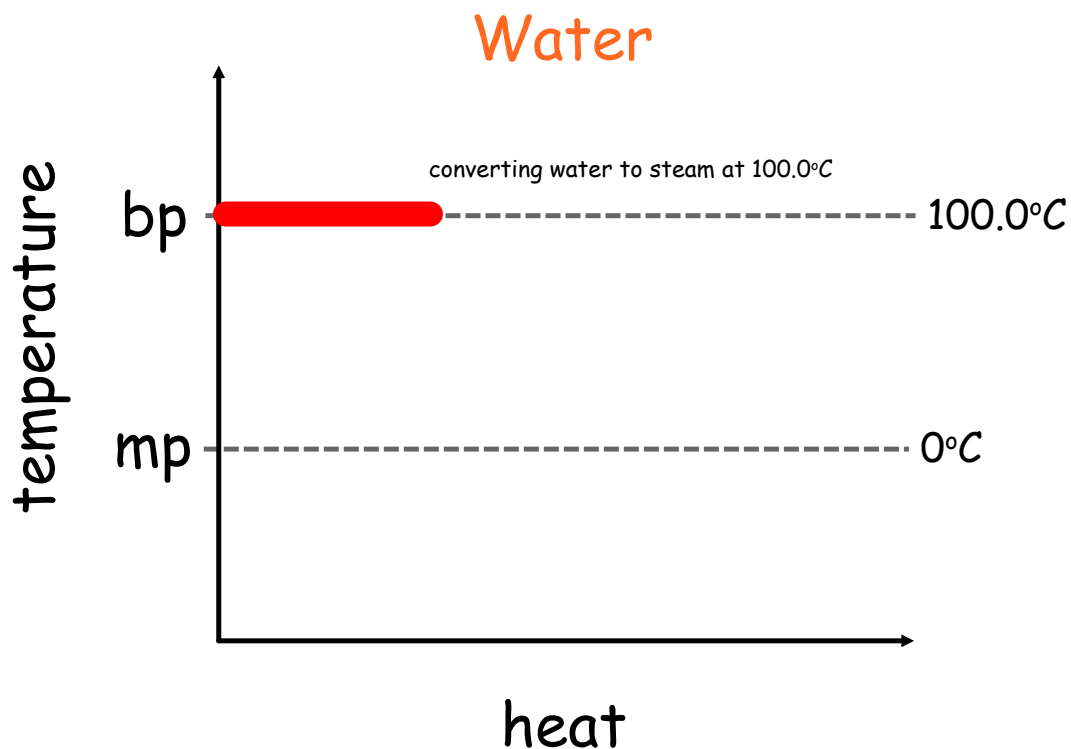
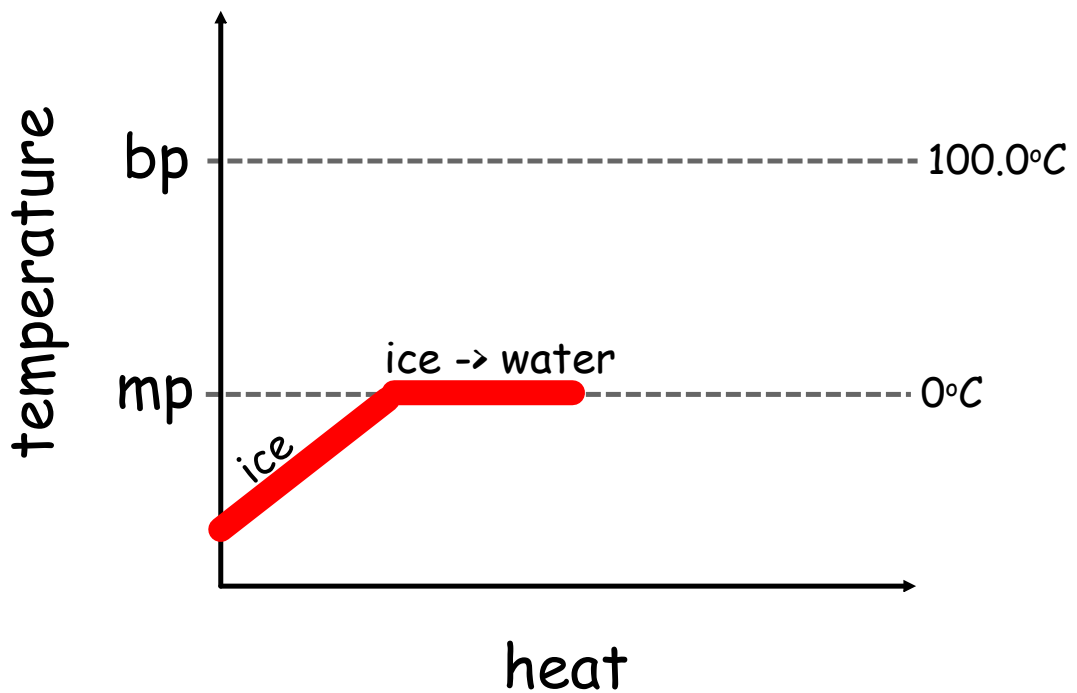


## Total Energy Changes

So far, there has been no actual temperature change. We have been looking at state changes at a given temperature.

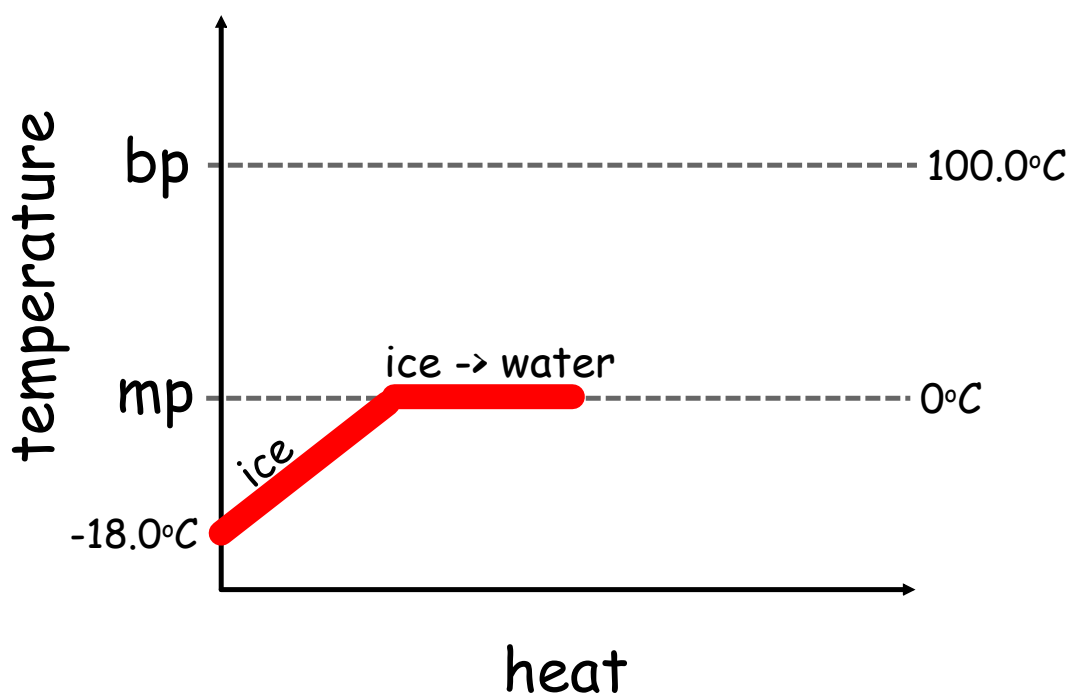


But what if we wanted to find how much energy it took to change from one state to another?

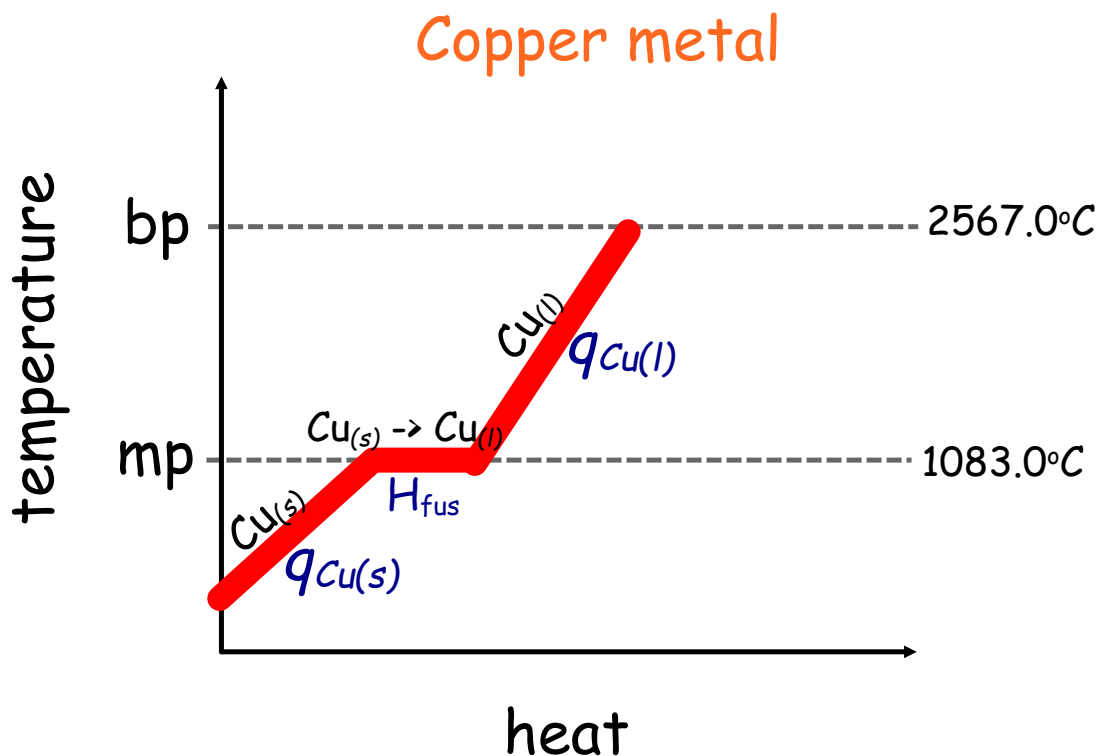


Example:

How much energy to heat 650 g of ice at  $-18.0^{\circ}\text{C}$  to water at  $0^{\circ}\text{C}$ ? (Answer = 240 kJ)



Using the graph we can see where any substance will change states based on its melting and boiling points. The position between the state changes then tells us the amount of energy it takes to get there.



### Example

A  $7.50 \times 10^3$  g block of ice at  $-15.25^\circ\text{C}$  was placed in a room to cool it down. If it ended up as water at  $5.75^\circ\text{C}$ , find the total amount of energy (in kJ) it removed from the room. (Hint: total energy)  **$[2.92 \times 10^3 \text{ kJ}]$**

Example:

An ice cube tray was filled with 525.0 mL of water at  $15.25^{\circ}\text{C}$  and placed in the freezer. The water then froze to a temperature of  $-18.0^{\circ}\text{C}$ .

- (a) Draw a heating curve (graph) for this scenario.
- (b) How much energy would the freezer have to remove from the water to make it ice at  $-18.0^{\circ}\text{C}$ ? [ $E_{\text{total}} = -228 \text{ kJ}$ ]

# Enthalpy Change and Total Enthalpy Change Worksheet

Sometimes a reaction can cause a state change as well.

Example:

What mass of propane ( $H_c = -2240$  kJ/mol) would need to be burned to heat 75.0 g of ice at  $-15.0^\circ\text{C}$  to water at  $85.0^\circ\text{C}$ ?



## State Change Problems #2

## Heat in Changes of State (Part 2)