Thermodynamics

Enduring Understanding
The fluid interactions and thermodynamics process are governed by conservation laws.

Essential Questions
5. Why is there not a delta in front of symbol Q for heat?
6. When is work done by a gas undergoing a thermodynamic process?

Fluids and Thermodynamics
AP Physics 1/2

Energy

Non Mechanical Energy

Heat

Laws of Thermodynamics
Zeroth Law - $T_A = T_B$; $T_B = T_C$; $T_A = T_C$
First Law - $\Delta U = Q + W$
Second Law - Heat will not flow spontaneously from a cold object to a hot object. Any system which is free of external influences becomes more disordered (entropy increases) with time.
Third Law - It is impossible to reduce the temperature of a system to absolute zero in a finite number of steps

Solid

Transmission

$$\frac{Q}{\Delta T} = \frac{kA\Delta T}{L}$$

Solid, Liquid and Gas

Heating

$Q = mc\Delta T$

Gas

$PV = nRT$
$\Delta U = Q + W$
$K = \frac{3}{2}k_B T$

Useful Conversions
1 atm = 101300 Pa
1000 L = 1 m^3

Isobaric (Charles Law)	Isovolumetric Isochoric (Gay-Lussac's Law)	Isothermal (Boyles Law)	Adiabatic (Ideal Gas Law)
$\Delta P = 0$	$\Delta V = 0$	$\Delta T = 0$	$Q = 0$
$\Delta U = Q + W$	$W = 0$	$\Delta U = 0$	$\Delta U = W$
$W = -P\Delta V$ $W = -nR\Delta T$	$\Delta U = Q$	$Q = -W$	$W = -P\Delta V$ $W = -nR\Delta T$

Definitions
+W = gas is compressed
−W = gas expands
+Q = gas gains heat
−Q = gas loses heat

Graphs
Work = area beneath P vs. V graph
Clockwise = −W; Heat Engine
Counterclockwise = +W; Refrigertor
Adiabatic curve is STEEPER than Isothermal