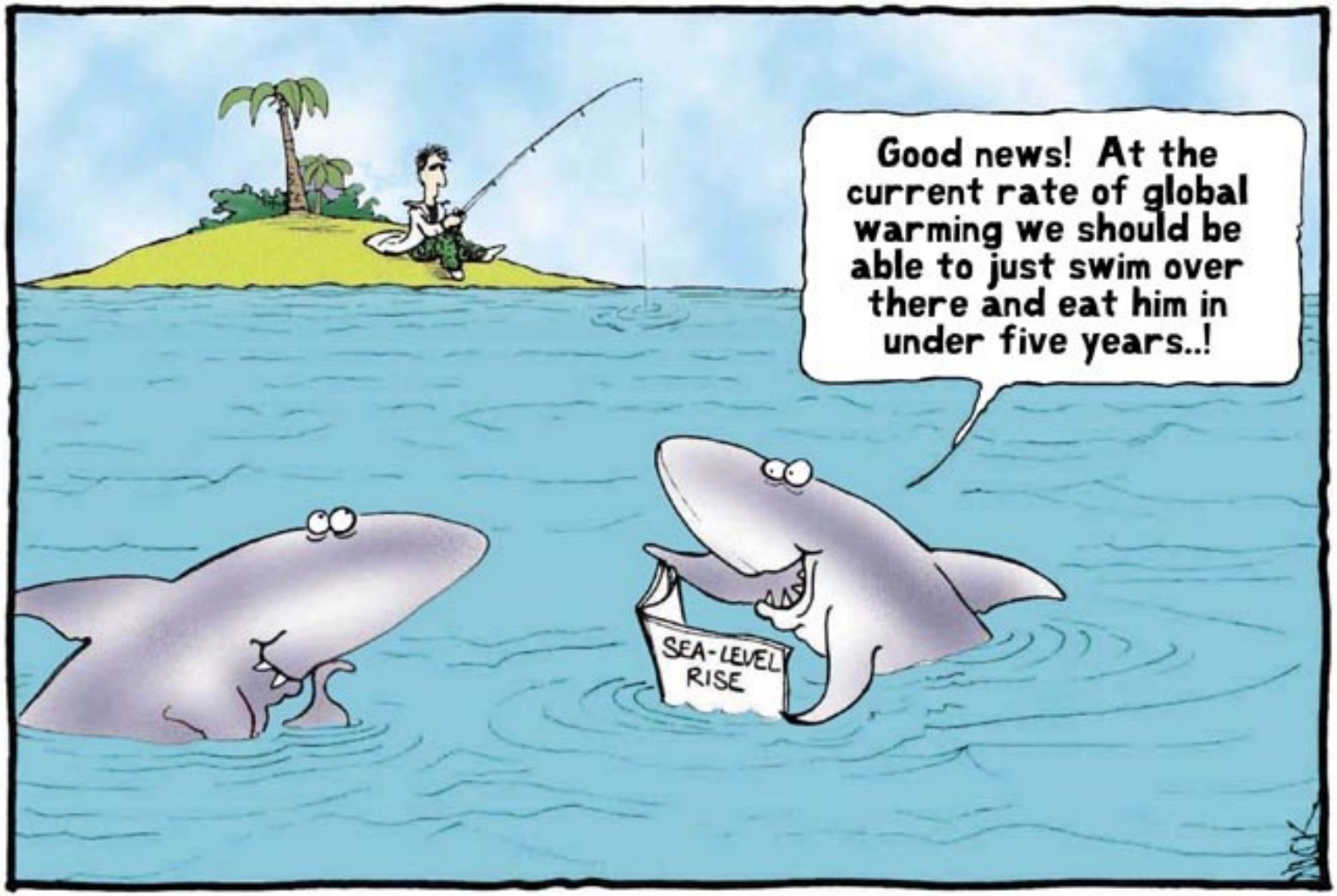
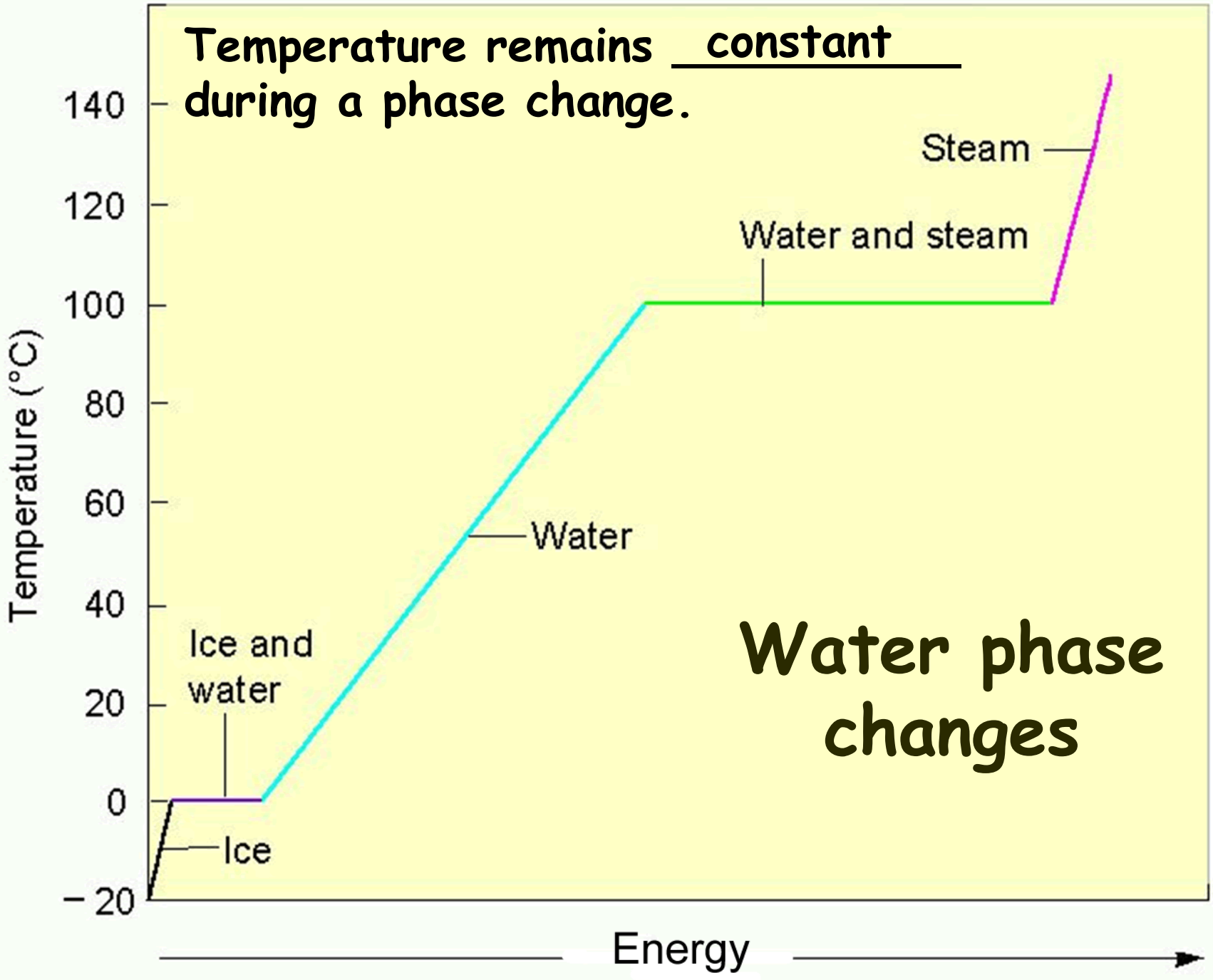
Phase Changes



Courtesy www.lab-initio.com

CA Standards

- *Students know* energy is released when a material condenses or freezes and is absorbed when a material evaporates or melts.


Temperature remains constant during a phase change.
140
120
100
80
60
40
20
0
– 20
Temperature (°C)
Steam
Water and steam
Water
Ice and water
Ice
Energy
Water phase changes

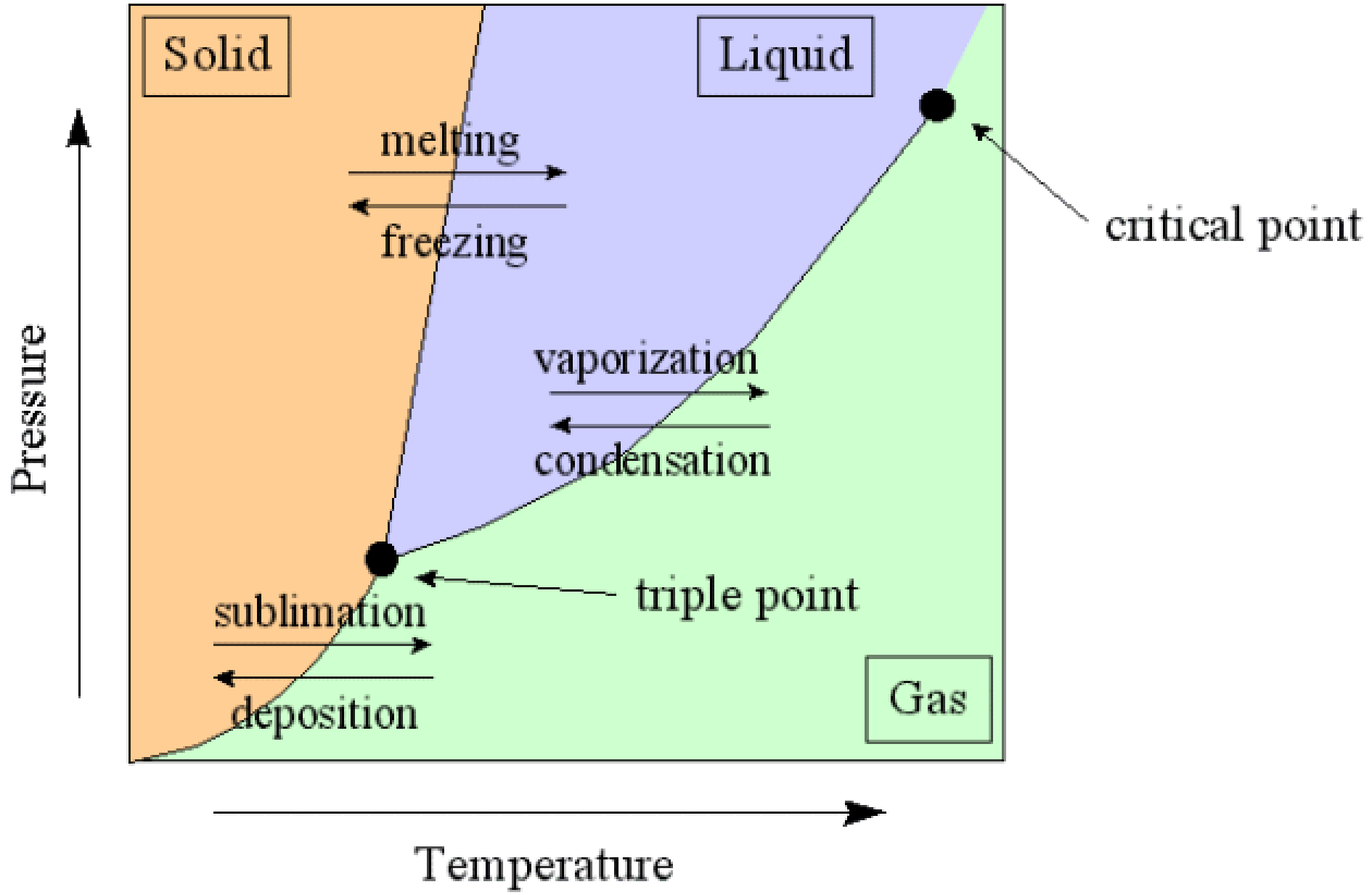
Effect of Pressure on Boiling Point

Boiling Point of Water at Various Locations			
Location	Feet above sea level	P_{atm} (kPa)	Boiling Point (°C)
Top of Mt. Everest, Tibet	29,028	32	70
Top of Mt. Denali, Alaska	20,320	45.3	79
Top of Mt. Whitney, California	14,494	57.3	85
Leadville, Colorado	10,150	68	89
Top of Mt. Washington, N.H.	6,293	78.6	93
Boulder, Colorado	5,430	81.3	94
Madison, Wisconsin	900	97.3	99
New York City, New York	10	101.3	100
Death Valley, California	-282	102.6	100.3

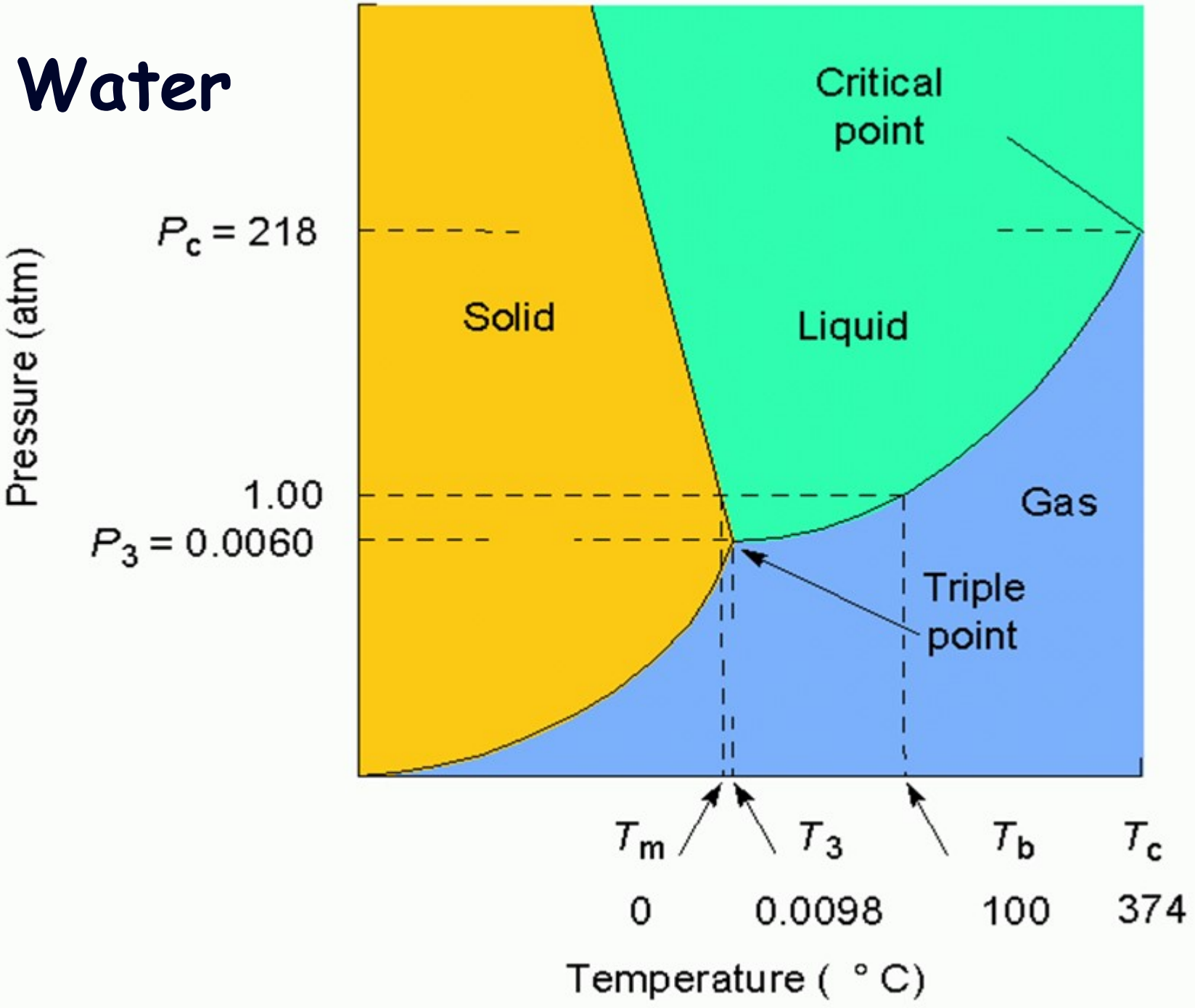
Phase Diagram

- Represents phases as a function of temperature and pressure.
- Critical temperature: temperature above which the vapor can not be liquefied.
- Critical pressure: pressure required to liquefy AT the critical temperature.
- Critical point: critical temperature and pressure (for water, T_c = 374°C and 218 atm).

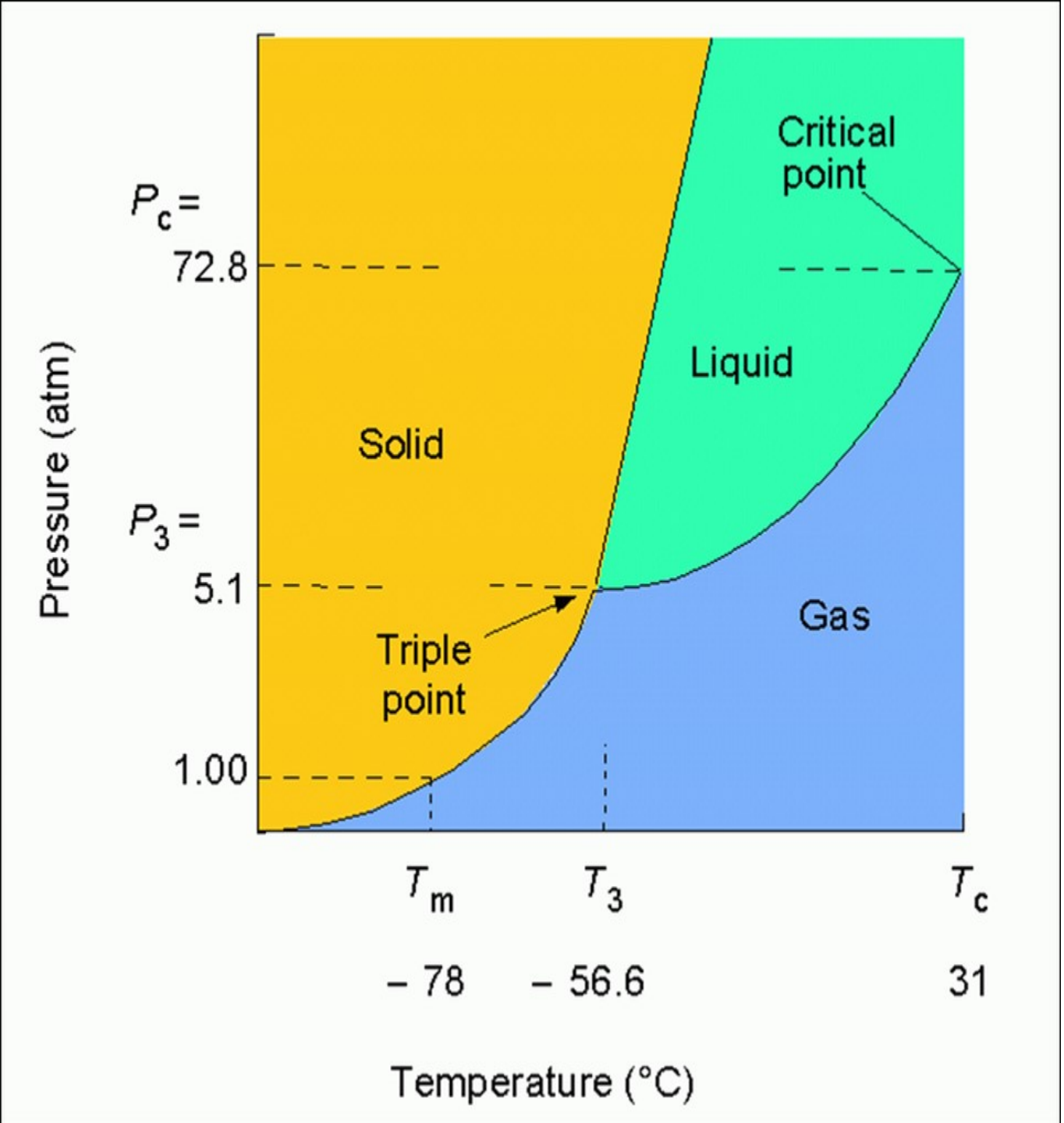
Phase changes by Name



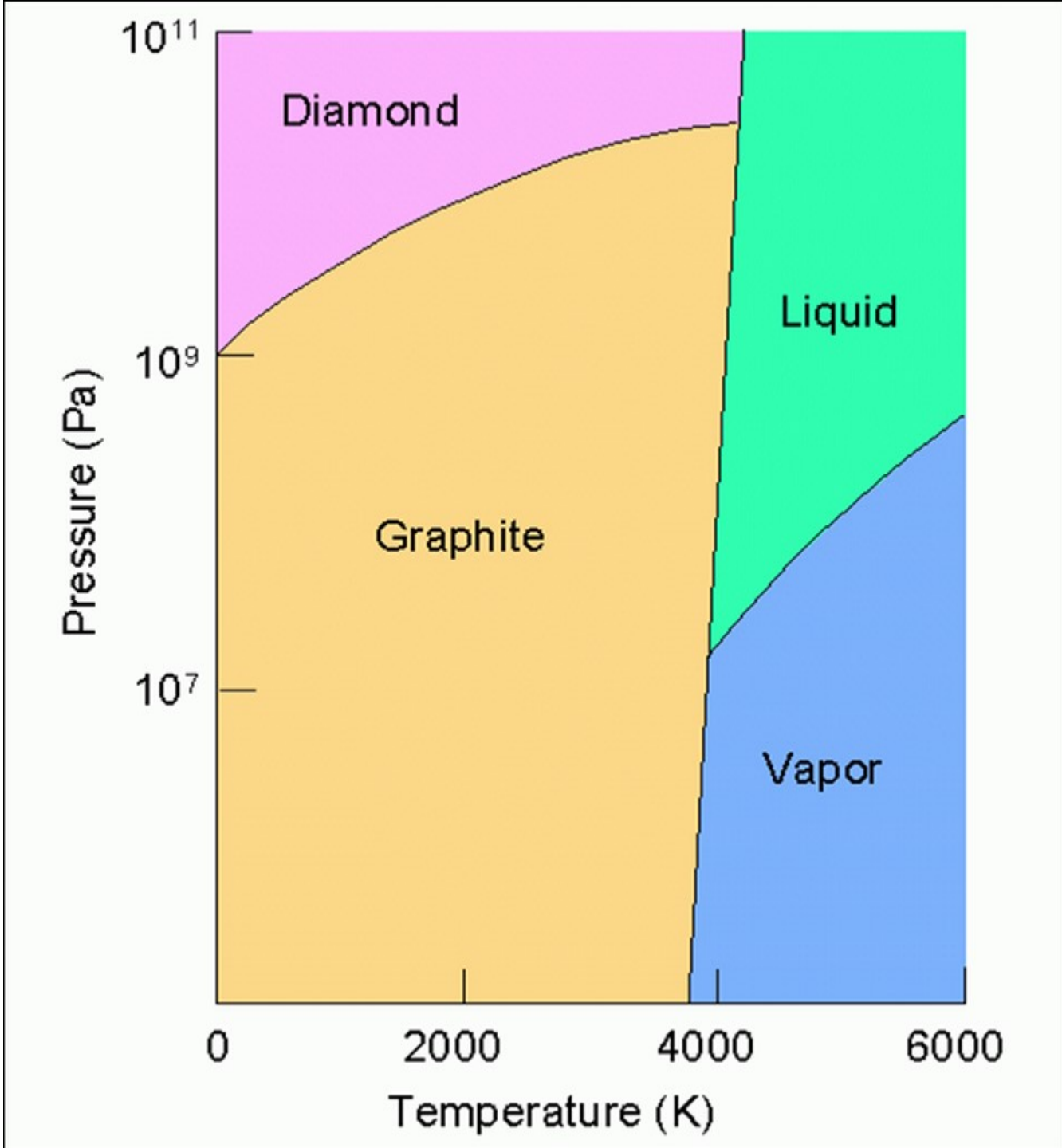
Water


Critical point
P_c = 218
Solid
Liquid
Gas
1.00
P_3 = 0.0060
Triple point
Pressure (atm)
T_m
T_3
T_b
T_c
0
0.0098
100
374
Temperature (° C)

Phase Diagram for Carbon dioxide



Phase Diagram for Carbon



Phase Diagram for Sulfur