

2026 Earth & Environmental Science Olympiad Exam Resources

Materials

You will need a scientific calculator, writing utensil, and scratch paper for working out.

Universal constants, equations & units

Unit or constant	Symbol	Value
Astronomical unit, the average distance between Sun and Earth	AU	$1.496 \times 10^{11} \text{ m}$
Light year	Ly	$9.461 \times 10^{15} \text{ m}$
Parsec	pc	$3.261 \text{ light years} = 3.085 \times 10^{16} \text{ m}$
Speed of light	c	$299,792,458 \text{ m/s} \approx 3 \times 10^8 \text{ m/s}$
Universal gravitational constant	G	$6.67 \times 10^{-11} \text{ Nm}^2 \text{ kg}^{-2}$
Universal gas constant	R*	$8.3144598 \text{ J/(mol} \cdot \text{K)}$
Molar mass of Earth's air	M	0.0289644 kg/mol
Earth's equatorial circumference		$40,075 \text{ km}$
Earth's longitudinal circumference		$40,008 \text{ km}$
Earth's orbital velocity		$107,000 \text{ km/hr}$
Mars' mass		$6.417 \times 10^{23} \text{ kg}$
Mars' radius		3389.5 km
Anum (year)	a	$8,760 \text{ hr} = 3.1536 \times 10^7 \text{ s}$
Years before present	a BP	(M)ega = 10^6 ; (G)iga = 10^9
Thousands of years BP	ka	
Millions of years BP	Ma	
Billions of years BP	Ga	

Unit Conversions

Kelvin (K) to degrees Celsius (°C): $T_{(^{\circ}\text{C})} = T_{(\text{K})} - 273.15$

Pascals (Pa) to Millibars (mb): $P_{(\text{mb})} \times 100 = P_{(\text{Pa})}$

Note: $1 \text{ Pa} = 1 \frac{\text{N}}{\text{m}^2}$

Gravitational Potential Energy

$$U = \frac{-GMm}{r}$$

Where U is the gravitational potential energy of an object with mass m , at a point r from a central mass M , and G is the universal gravitational constant.

Hydrostatic / Lithostatic Pressure

$$P = \rho gh$$

Where P is the pressure at the base of a column of water/rock; where ρ is water/rock density, g is acceleration due to gravity, and h is the column depth.

Inverse Square Law for Radiation Intensity

$$I \propto \frac{1}{r^2}$$

Where I is radiation intensity, and r is the distance between the radiation source and the observer

Kinetic Energy

$$K = \frac{1}{2}mv^2$$

Where K is the kinetic energy of an object with mass m , moving at a velocity v

Spheres of the Earth





INTERNATIONAL CHRONOSTRATIGRAPHIC CHART

www.stratigraphy.org International Commission on Stratigraphy

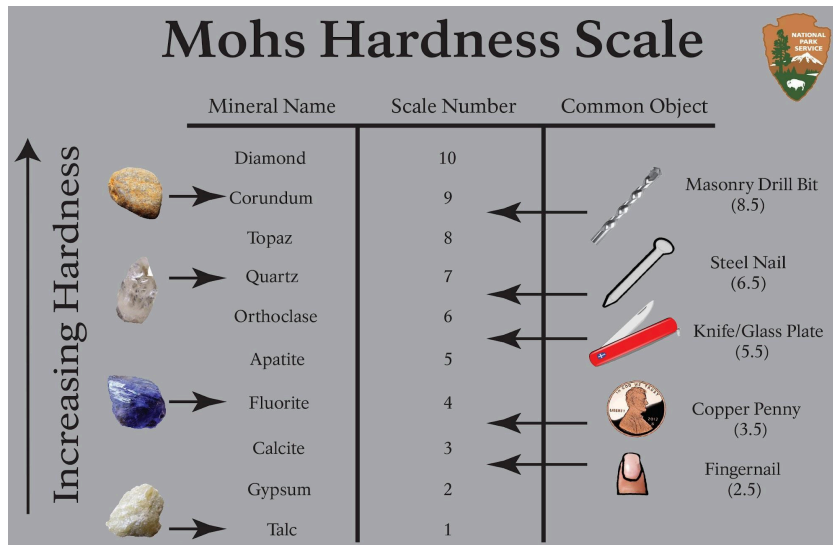


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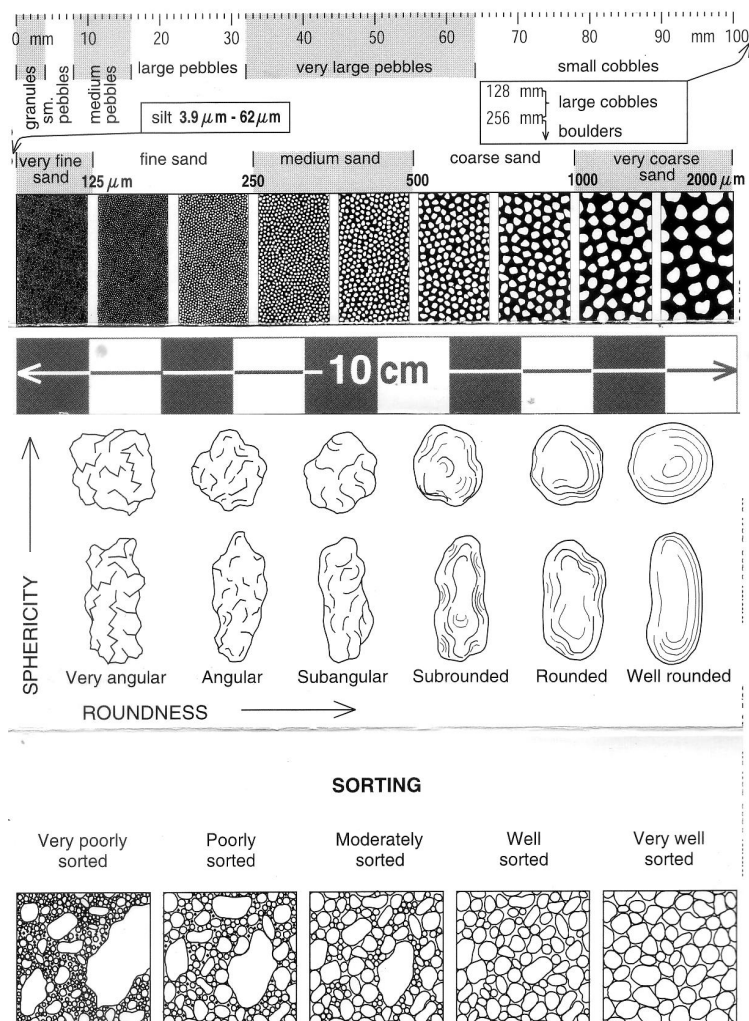
Eonothem / Eon		System / Period		Series / Epoch		Stage / Age		GSSP	
Eratthem / Era									
Cenozoic		Quaternary		Holocene		Present		0.0002	
				Pleistocene		0.0117		0.774	
				Pliocene		2.58		3.600	
				Messinian		5.333		7.246	
				Tortonian		11.63		13.82	
				Serravallian		15.98		20.45	
				Langhian		23.04		27.30	
				Burdigalian		33.9		37.71	
				Chattian		41.03		48.07	
				Oligocene		56.00		59.24	
				Eocene		61.66		66.00	
				Lutetian		72.2 ± 0.2		83.6 ± 0.2	
				Ypresian		86.7 ± 0.2		89.8 ± 0.3	
				Thanetian		93.9 ± 0.2		100.5 ± 0.1	
				Selandian		113.2 ± 0.3		121.4 ± 0.6	
				Danian		125.77		132.6 ± 0.6	
				Maastrichtian		137.05 ± 0.2		143.1 ± 0.6	
				Campanian					
				Santonian					
				Coniacian					
				Turonian					
				Cenomanian					
				Albian					
				Aptian					
				Barremian					
				Hauterivian					
				Valanginian					
				Berriasian					

Eonothem / Eon		System / Period		Series / Epoch		Stage / Age		GSSP	
Eratthem / Era									
Mesozoic		Jurassic		Upper		Tithonian		149.2 ± 0.7	
						Kimmeridgian		154.8 ± 0.8	
						Oxfordian		161.5 ± 1.0	
						Bathonian		165.3 ± 1.1	
						Bajocian		168.2 ± 1.2	
						Aalenian		170.9 ± 0.8	
						Toarcian		174.7 ± 0.8	
						Pliensbachian		184.2 ± 0.3	
						Sinemurian		192.8 ± 0.3	
						Hettangian		199.5 ± 0.3	
						Rhaetian		201.4 ± 0.2	
								~ 205.7	
								~ 227.3	
								~ 237	
								241.464 ± 0.28	
								247.0	
								251.807 ± 0.024	
								254.14 ± 0.07	
								259.887 ± 0.094	
								266.9 ± 0.4	
								274.4 ± 0.4	
								283.3 ± 0.4	
								290.1 ± 0.26	
								293.52 ± 0.17	
								298.9 ± 0.15	
								303.7 ± 0.1	
								307.0 ± 0.1	
								315.2 ± 0.2	
								323.4 ± 0.4	
								330.3 ± 0.4	
								346.7 ± 0.4	
								359.86 ± 0.19	

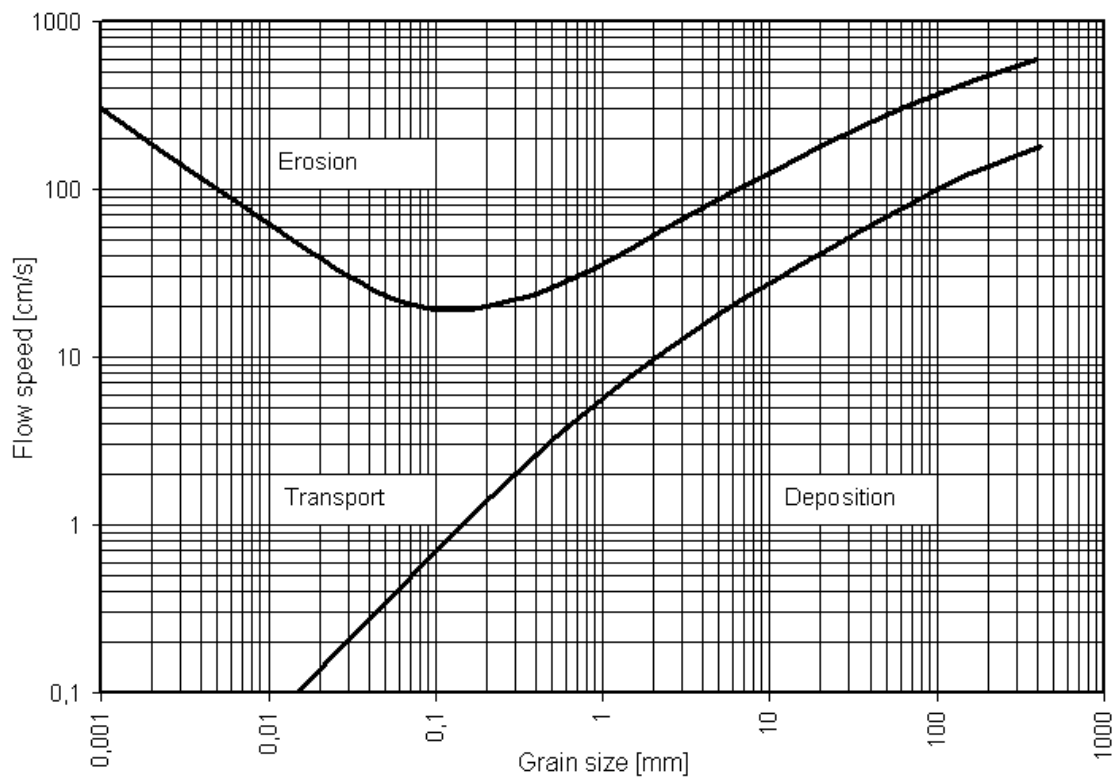
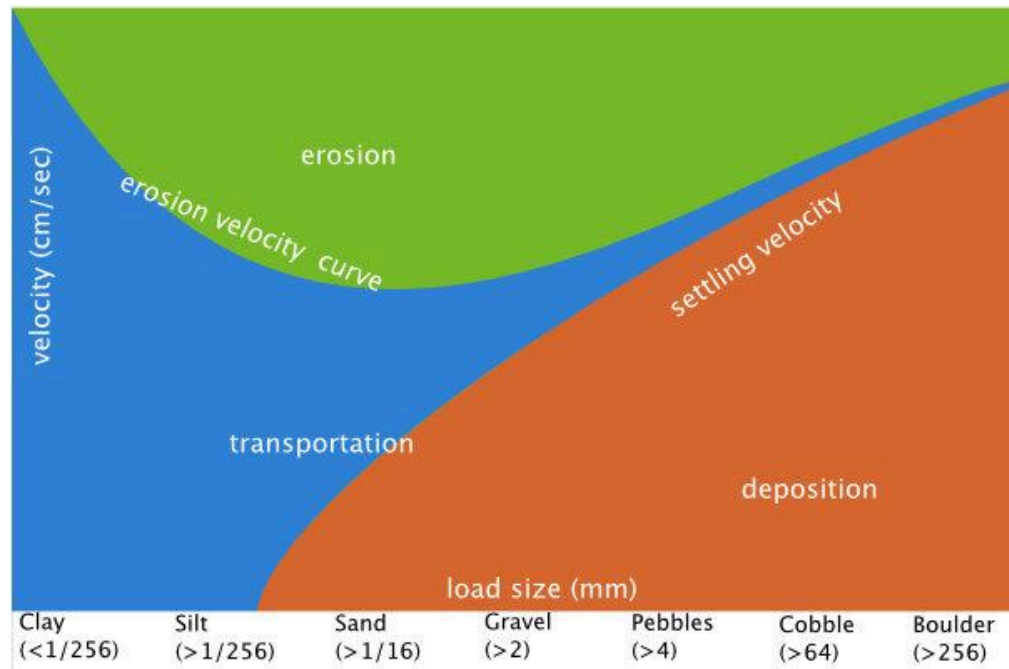
Phanerozoic										Eonothem / Eon
Paleozoic										Eratthem / Era
										System / Period
										Series / Epoch
										Stage / Age
										GSSP
										numerical age (Ma)
										336.86 ± 0.19
Devonian										
Lower										
Lochkovian										419.62 ± 1.36
Pidoli										422.7 ± 1.6
Ludlow										425.0 ± 1.5
Wenlock										426.7 ± 1.5
Shennoudian										430.6 ± 1.3
Landoverly										432.9 ± 1.2
Telychian										438.6 ± 1.0
Aeronian										440.5 ± 1.0
Rhuddanian										443.1 ± 0.9
Hirnantian										445.2 ± 0.9
Katian										452.8 ± 0.7
Sandbian										458.2 ± 0.7
Upper										
Middle										
Dapingian										469.4 ± 0.9
Floian										471.3 ± 1.4
Lower										
Tremadocian										477.1 ± 1.2
										486.85 ± 1.5
Cambrian										
Furongian										Stage 10
										~ 491.0
										~ 494.2
										~ 497.0
										~ 500.5
Maolingian										~ 504.5
										~ 506.5
										~ 514.5
Series 2										~ 521.0
										Stage 3
										Stage 4
										~ 528.0
Terreneuvian										Fortunian
										538.8 ± 0.6



Grain size card



Hjulström diagram – sediment size vs behavior in water



Palaeocurrent patterns

The flow direction of fluids carrying sediments can be determined from characteristic sedimentary structures built as the deposits are laid down. These structures include pebble imbrication, long-axis orientation, cross-lamination, cross-bedding, flute marks and ripple profiles.



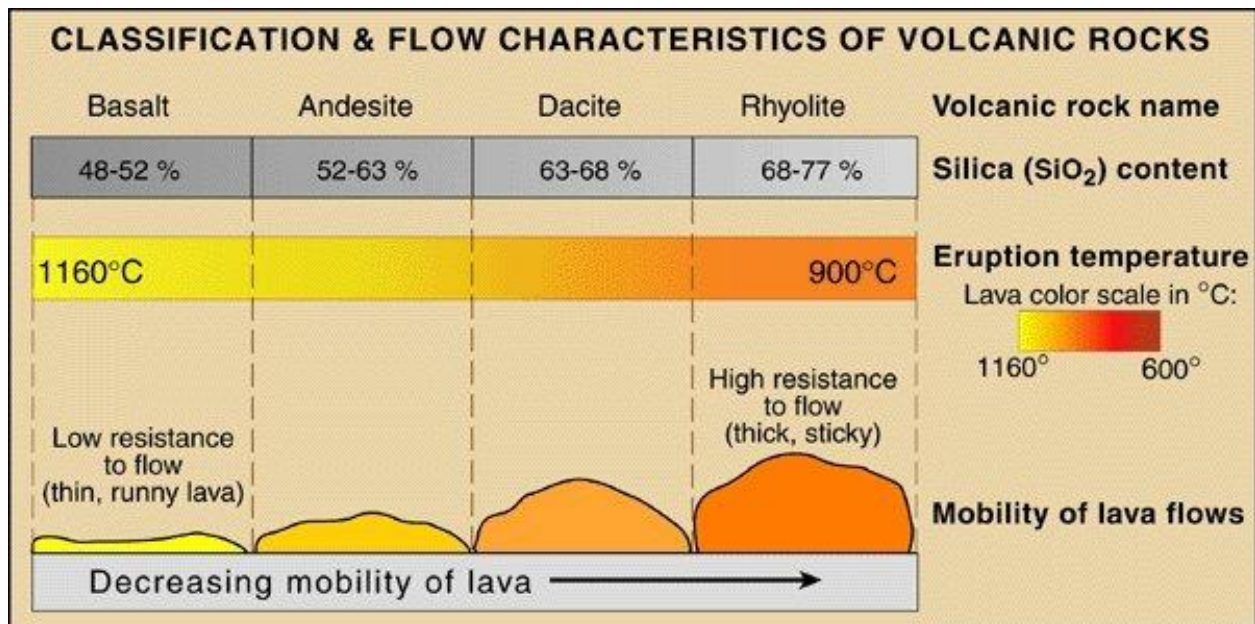
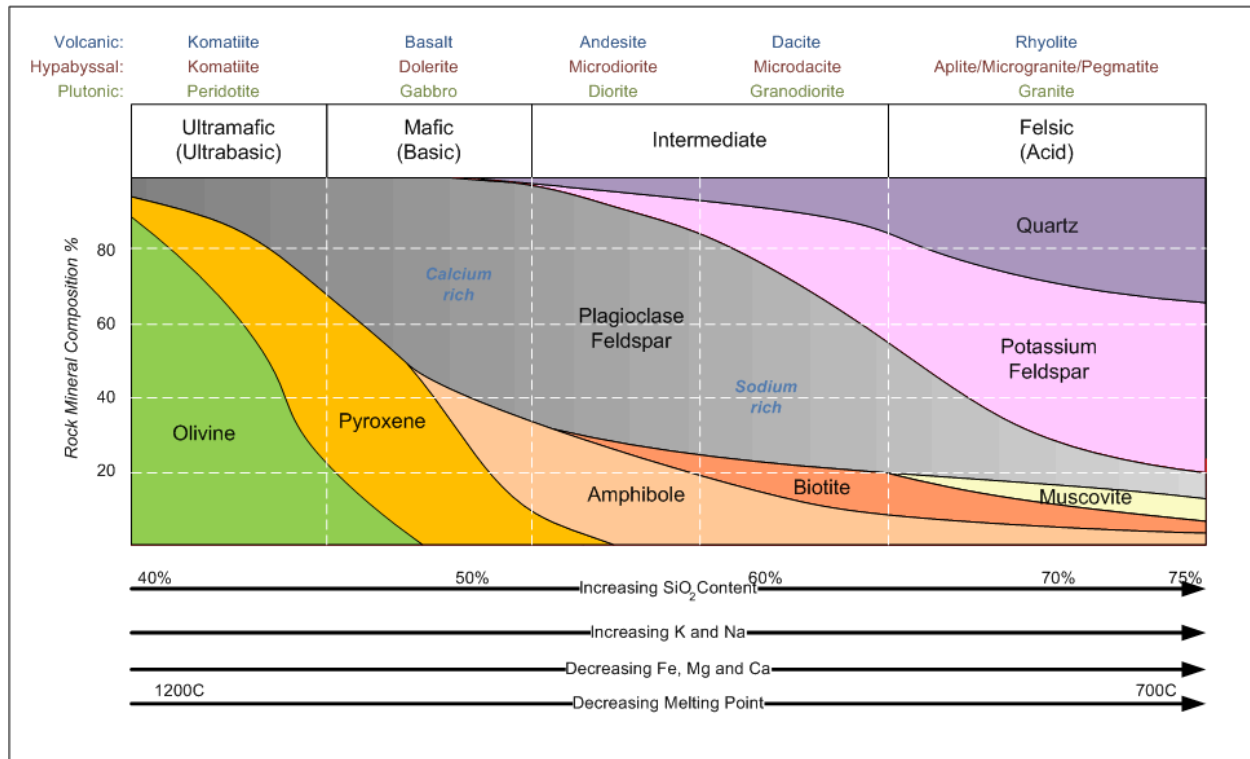
These structures can be preserved in ancient sedimentary rocks, enabling palaeocurrent measurements (aka, direction of flow at the time).

A rose diagram enables quick insight into the depositional environment for each strata. Each wedge represents a count 'bin' for intervals of 5° to 30° . The radial length of each wedge is proportional to the count frequency for that bin.

When viewed this way, patterns emerge as summarised below:

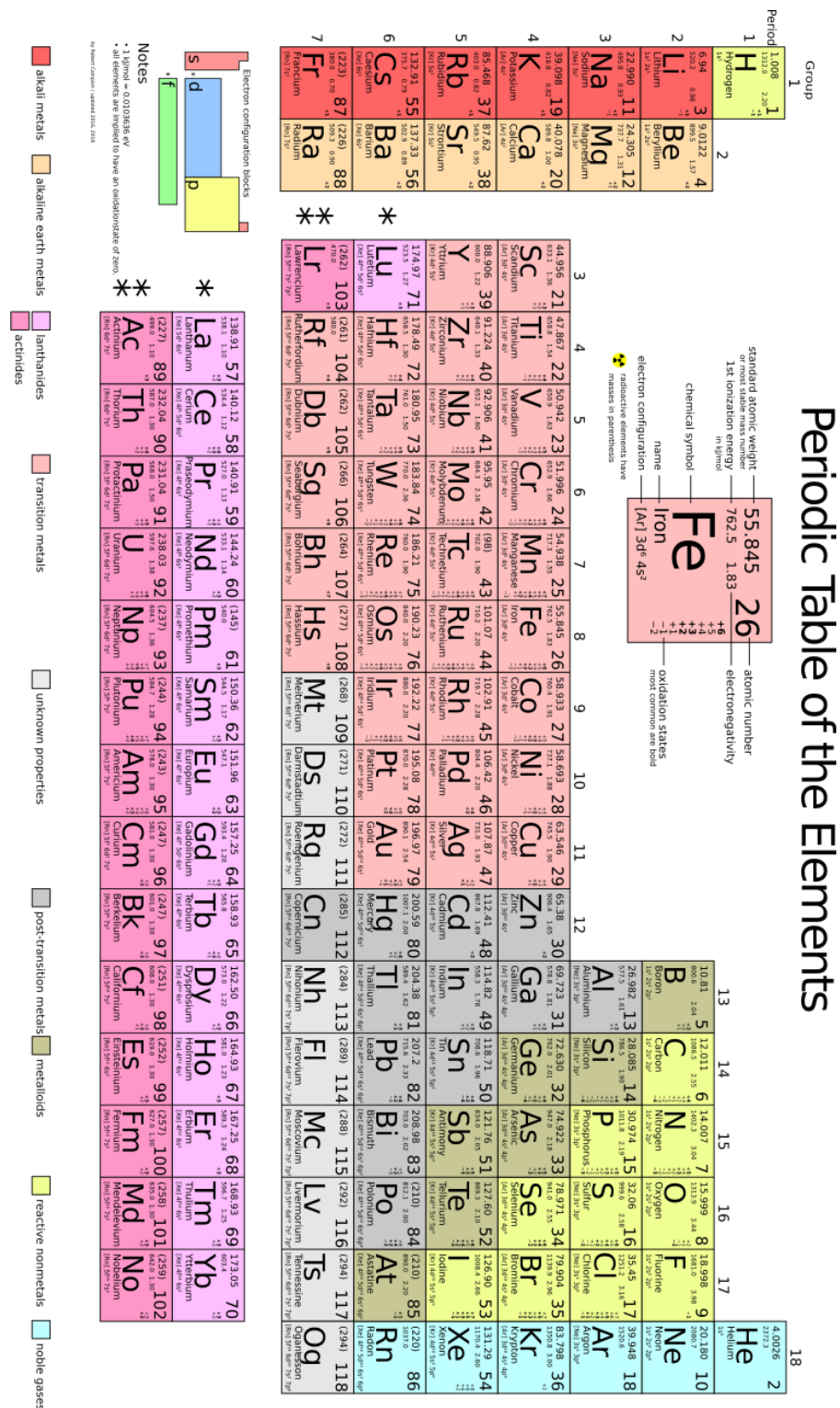
Environment of deposition	Palaeocurrent vector pattern	Regional pattern
River – braided	Unimodal – low variability	Often fan-shaped
River – meandering	Unimodal – high variability	
Wind blown dunes	Unimodal, bimodal or polymodal	Large variations over vast distances
Deltas	Unimodal	Radiating
Shorelines	Mostly bimodal	Mostly on-shore / off shore
Marine turbidites	Mostly unimodal	Often fan-shaped

Igneous classification chart



Chemistry

Periodic Table



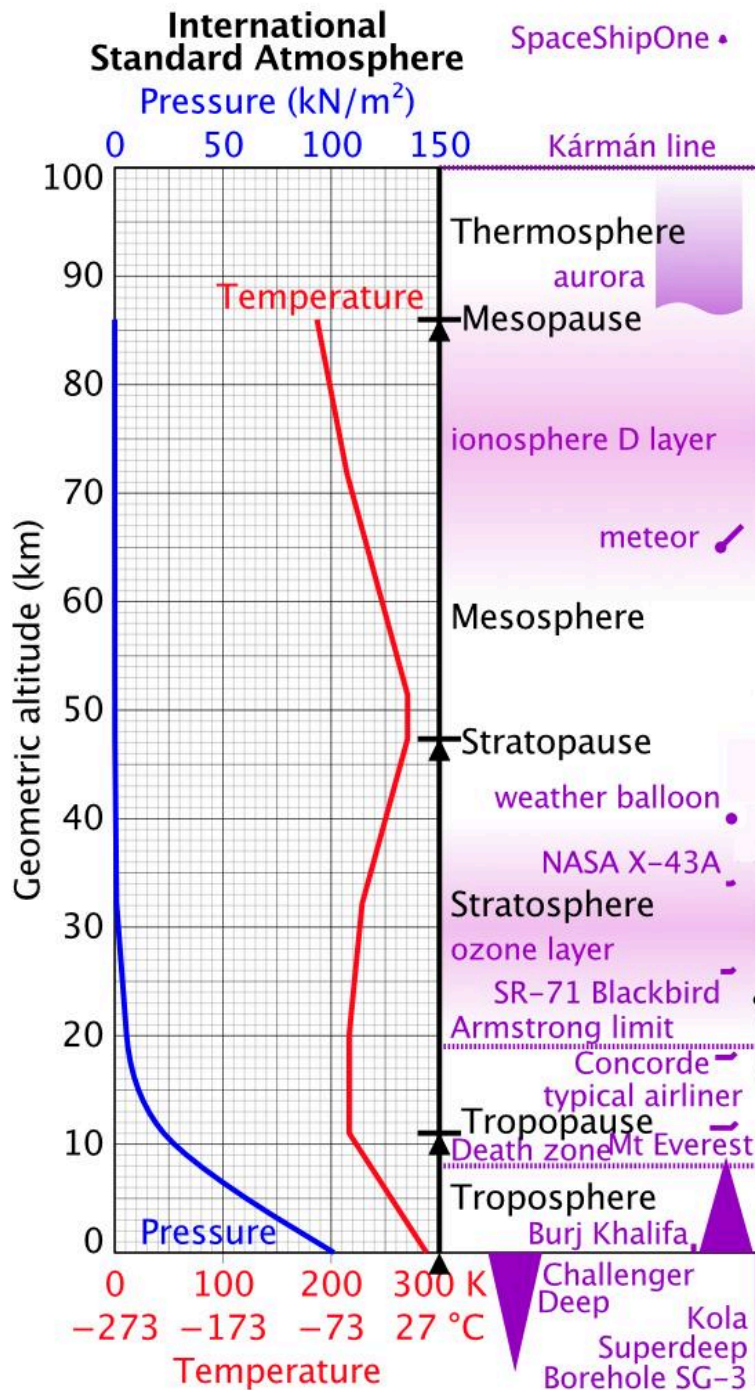
Atmosphere

Greenhouse Gases

Gas	Atmospheric Concentration	Residence time	GWP*/ 20 a
Water vapor	Highly variable - other values estimated assuming dry atmosphere	~10 days	<0.001
Nitrogen (N ₂)	78%	1.6 10e7 a	
Oxygen (O ₂)	21%	3,000-10,000 a	
Argon (Ar)	1%		
Helium (He)	5.24 ppm	10e6 a	
Carbon dioxide (CO ₂)	0.04%	3-4 a	1
Nitrous oxide (N ₂ O)		121 a	273
Methane (CH ₄)	1.92 ppm	12 a	80
CFCs		Weeks to 1000s a	10s-1000s
Hydrogen (H ₂)		4-8 a	
Carbonyl sulfide (COS)		~2a	
Ozone (O ₃)	0.07 ppm	100 days	
Carbon disulfide (CS ₂)		40 days	
Carbon monoxide (CO)	0.10 ppm	~60 days	
Formaldehyde (CH ₂ O)		5-10 days	
Sulfur dioxide (SO ₂)		days to weeks	
Ammonia/ium (NH ₃ + NH ₄ ⁺)	trace	2-10 days	
Nitrogen dioxide (NO ₂)		0.5-2 days	
Nitrogen oxide (NO)		0.5-2 days	
Hydrogen sulfide (H ₂ S)		1-5 days	
Dimethyl sulfide (CH ₃ SCH ₃)		0.7 days	

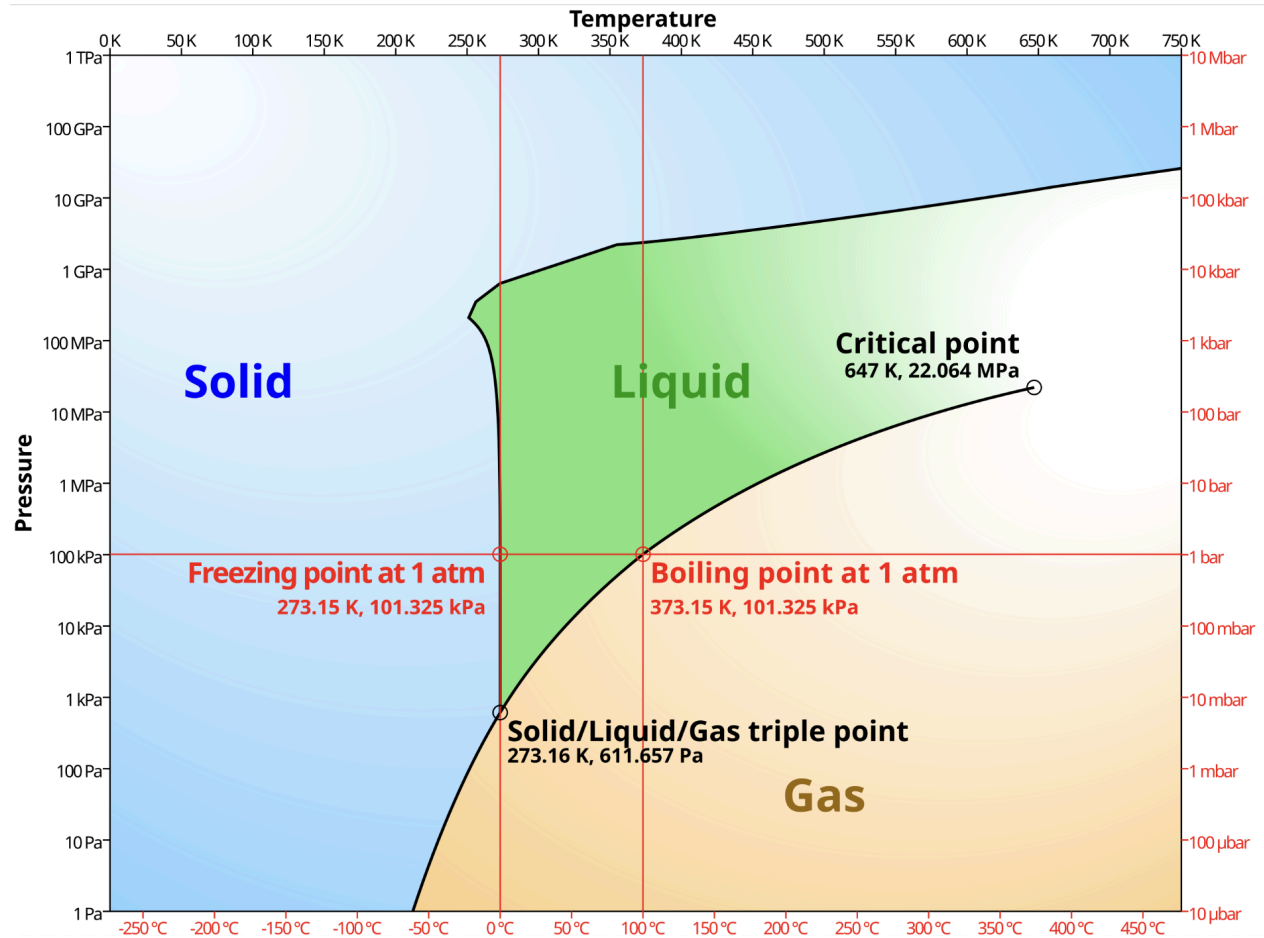
*GWP = Global Warming Potential, a measure of how much global warming 1 tonne of the greenhouse gas has relative to 1 tonne of CO₂.

Temperature and pressure profile for Earth's atmosphere



Hydrology & Meteorology

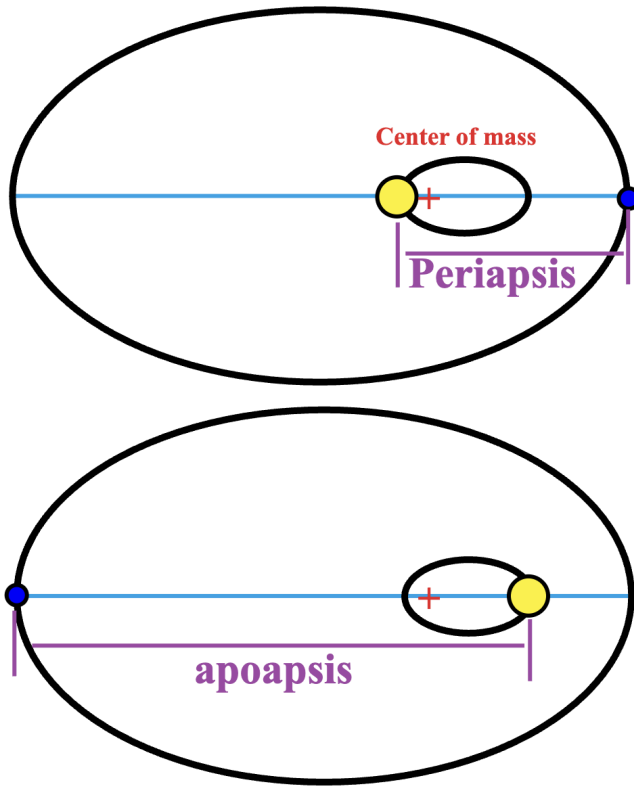
Temperature-Pressure Phase diagram of water



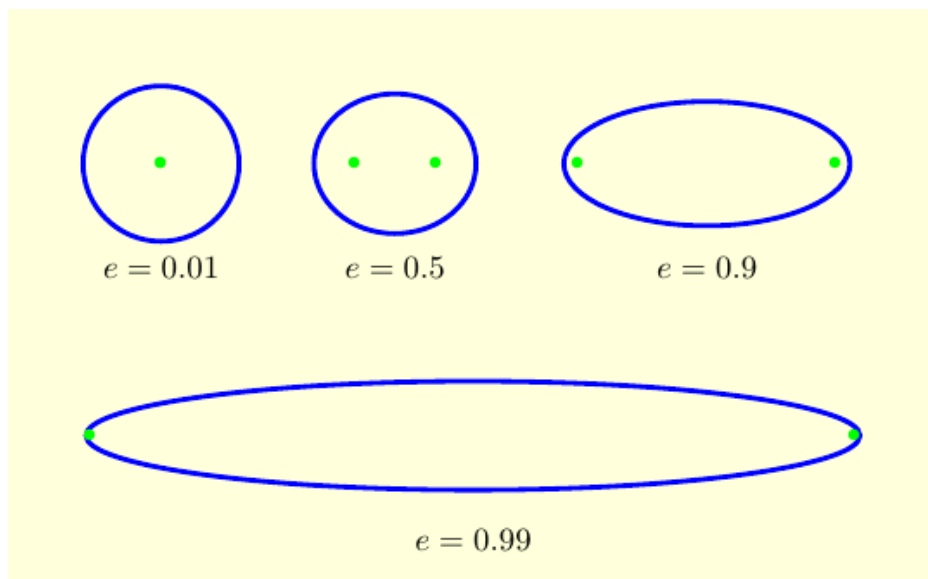
Temperature-pressure water phase stability diagram, indicating key transitions. (1 Pa = 1 N/m²)

Astronomy

Elliptical Orbit Parameters



Ellipse Eccentricities

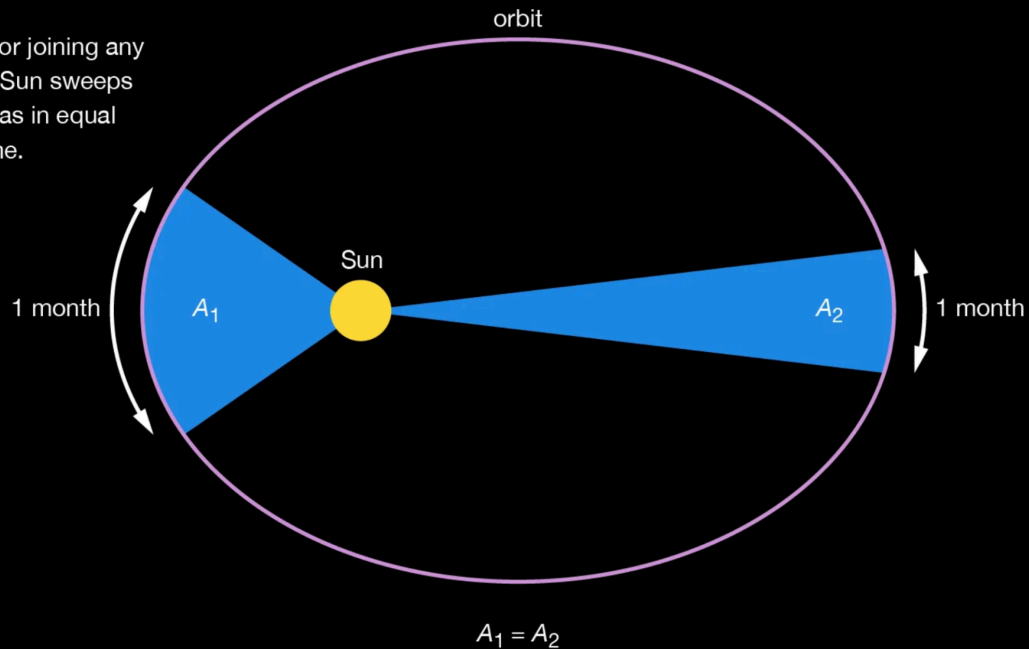


Kepler's 2nd Law

Kepler's laws of planetary motion

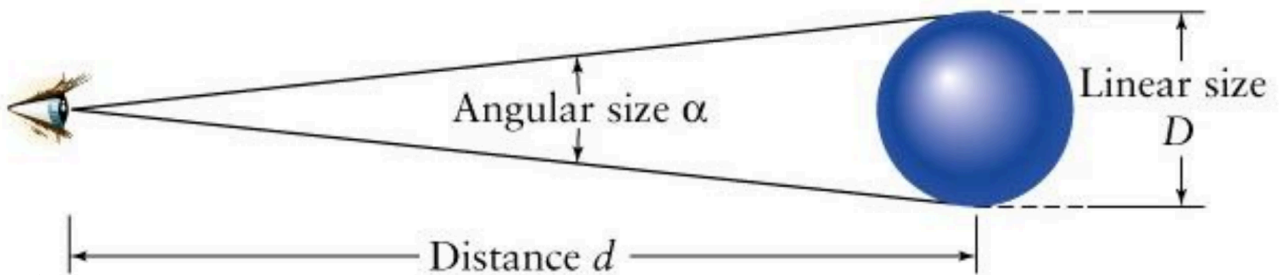
Second law

A radius vector joining any planet to the Sun sweeps out equal areas in equal lengths of time.



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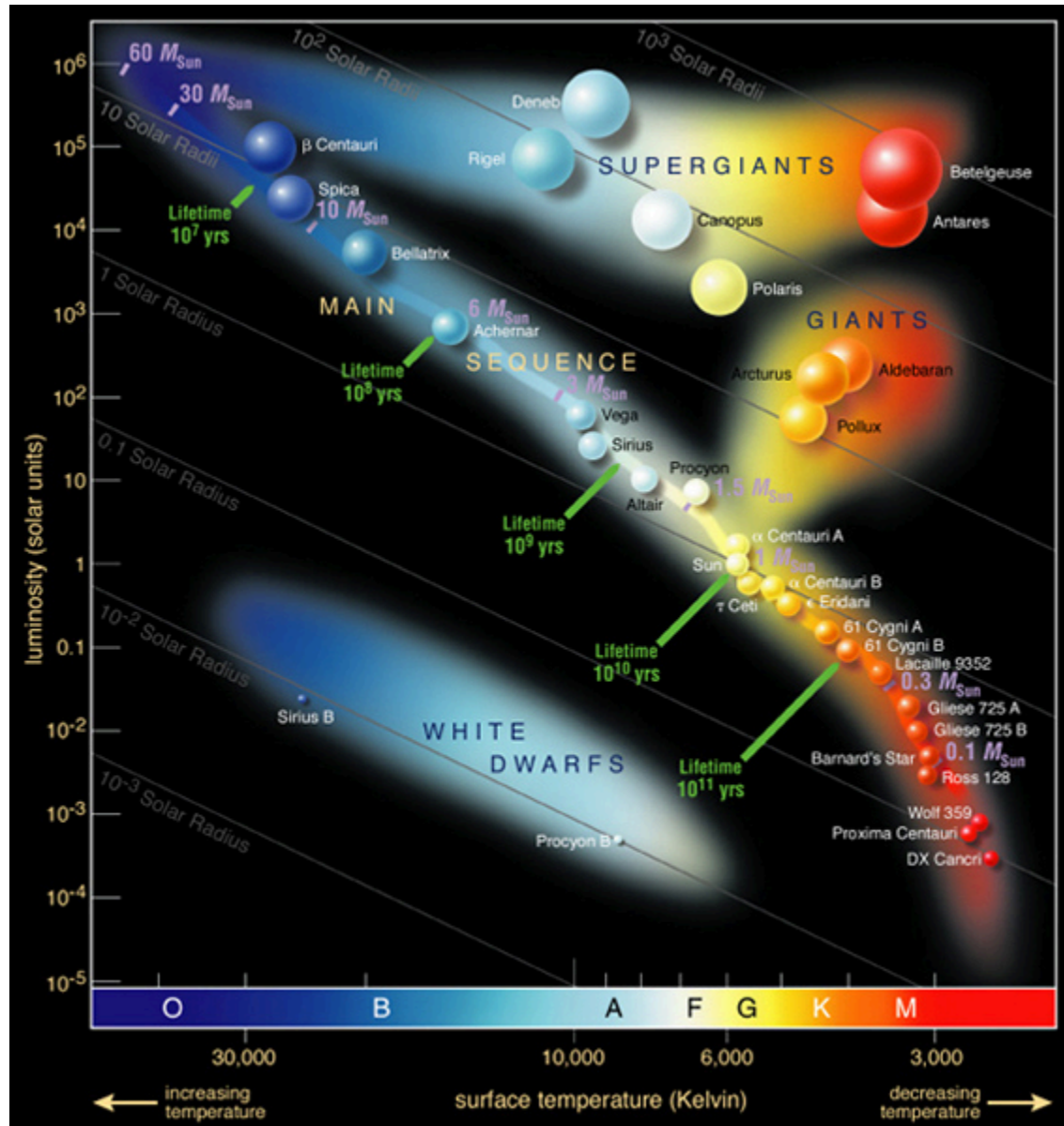
Angular Size



$$\alpha = \frac{D}{d}$$

Where α is measured in radians.

Hertzsprung-Russell Diagram



Stellar Lifetimes

Spectral Type	O5	B0	A0	F0	G0	K0	M0
Mass (solar)	40	15	3.5	1.7	1.1	0.8	0.5
B-V	-1.2	-0.3	0.0	0.3	0.6	0.8	1.4
MS Lifetime	1.0×10^6	1.1×10^7	4.4×10^8	3.0×10^9	8.0×10^9	1.7×10^{10}	5.6×10^{10}

MS = main sequence

Stellar Output over Lifecycle

