How to get to the moon

- Energy Analysis provides a framework to estimate what is needed to get to the moon.
- Kinetic Energy, Delta-vee, Δv, is added by the rocket motor.
- Change in Energy

- PE/m = GM/R
- KE/m = ½ v^2
- Centripital Force = mv^2/r
- Orbital Kinetic Energy large near earth, more than half Δv to escape Earth.
- Sub-orbital part (near earth) is small.

Energy Analysis

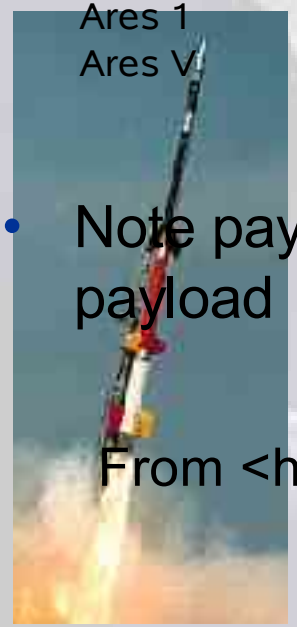
	Potential E./m	Delta E/m From Surface	Delta V m/s SQRT(2*E/m)
Escape (Earth)	0.00E+000	6.26E+007	1.12E+4
Moon Surface	-1.41E+006		1.68E+3 (Lunar Esc)
Earth-moon	-1.05E+006	6.16E+007	1.11E+4
Orbit (400km)	-5.89E+007	3.70E+006	8.14E+3
Orbit (0 km)	-6.26E+007		7.91E+3 M v^2/r^2
Sub-orbit (400km)	-5.89E+007	3.70E+006	2.72E+3
Earth Rotation			4.63E+2
Earth Surface	-6.26E+007		

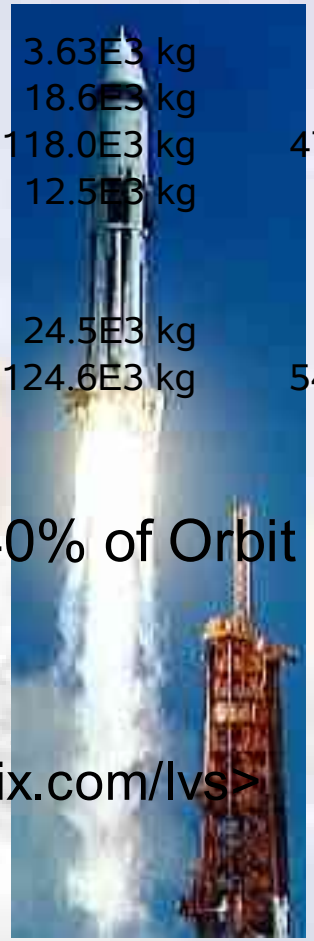
Constants	MKS units	
G	6.67E-011	
Earth Mass (Me)	5.98E+024	
Lunar Mass (Ml)	7.36E+022	
Earth Radius (Re)	6.37E+006	3960 Mi
Lunar Radius (Rl)	3.48E+006	
Earth-Moon Distance (l	3.80E+008	3960 Mi

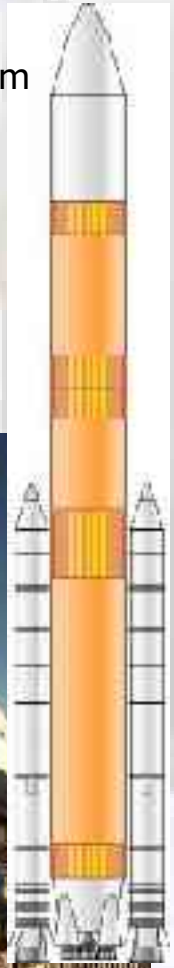
Rocket Payloads

Rocket Specifications

	Lift Off Thrust	Mass 2 Orbit	Mass 2 Moon	Sounding
Estes C6	15 N			
Black Brant V	0.11E6 N			68 kg Up to 390 km
Atlas (I)	1.9E6 N	3.63E3 kg		
Saturn 1B	7.3E6 N	18.6E3 kg		
Saturn V	33.7E6 N	118.0E3 kg	47.0E3 kg	
Shuttle	25.7E6 N	12.5E3 kg		
Shuttle SRB	11.5E6 N			
Shuttle Orbiter	6.8E6 N			
Ares 1	13.9E6 N	24.5E3 kg		
Ares V	32.6E6 N	124.6E3 kg	54.6E3 kg	







- Note payload to moon is ~40% of Orbit payload

From <http://www.astronautix.com/lvs>