


ASTR 4800 - Space Science: Practice & Policy

Today: Introduction to Outer Space

- **Reading:** Chapter 2 in McDougall.



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Space in the News: All Systems Go for Artemis 1 Mission

Ali Moran

Why should NASA feel the need to compete with the private sector when they have been collaborating, including within the Artemis Program's plans for Gateway?

<https://www.moondaily.com/reports/All-systems-go-for-Artemis-1-mission-to-Moon-999.html>




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Introduction to Outer Space

Explanatory Statement Prepared by President Eisenhower's Science Advisory Committee
James Killian, Chair & President's Science Advisor
March 26, 1958



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Reasons for a Space Program in 1958

- Compelling urge to explore and to discover (Edmund Hillary).
- Development of space technology for defense (ICBMs, satellite spying).
- National prestige (create confidence of other nations in U.S. technology).
- Scientific observations and experiments enhancing knowledge of Earth, solar system, & universe.

Have any of these reasons changed today?

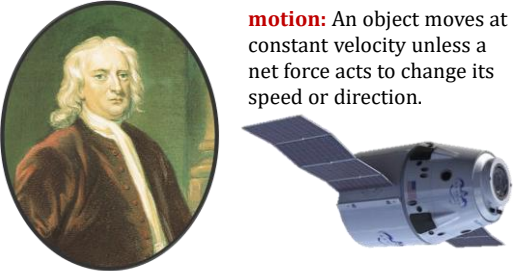


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The physical principles governing spaceflight: Newton's three laws of motion

Newton's first law of motion: An object moves at constant velocity unless a net force acts to change its speed or direction.




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Newton's second law of motion

Force = mass × acceleration = ma



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Newton's third law of motion

For every force, there is always an *equal and opposite* reaction force.



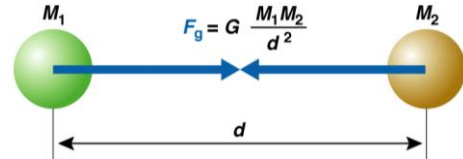
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What determines the strength of gravity?

The Universal Law of Gravitation:

1. Every mass attracts every other mass.
2. Attraction is *directly* proportional to the product of their masses.
3. Attraction is *inversely* proportional to the *square* of the distance between their centers.



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Why satellites stay up



- $F = ma$, F = force, m = mass, a = acceleration.
 - For gravity, $F = GM_E M_s / R^2$.
 - $a = v^2 / R$, where v = orbital velocity.
- $\Rightarrow V = [GM_E / R]^{1/2}$

Class Exercise:

How would you calculate the orbital radius for geosynchronous orbit?

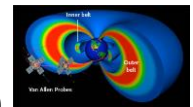
This tells us what thrust and engine capability our rockets must have!

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What science can be done from space with a satellite (in 1958)?

- Sample strange new environment (van Allen radiation belts, space weather, General Relativity experiments).
- Look down on the Earth (remote sensing, weather forecasting).
- Look out into the Universe (X-rays, ultraviolet, infrared, long wavelength radio).



Still true today!

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The Moon and Mars (1958)

- What is the origin and history of the Moon? Fluid core? Nature of lunar surface?
- "We know quite enough about Mars to suspect that it may (have) supported some form of life".



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