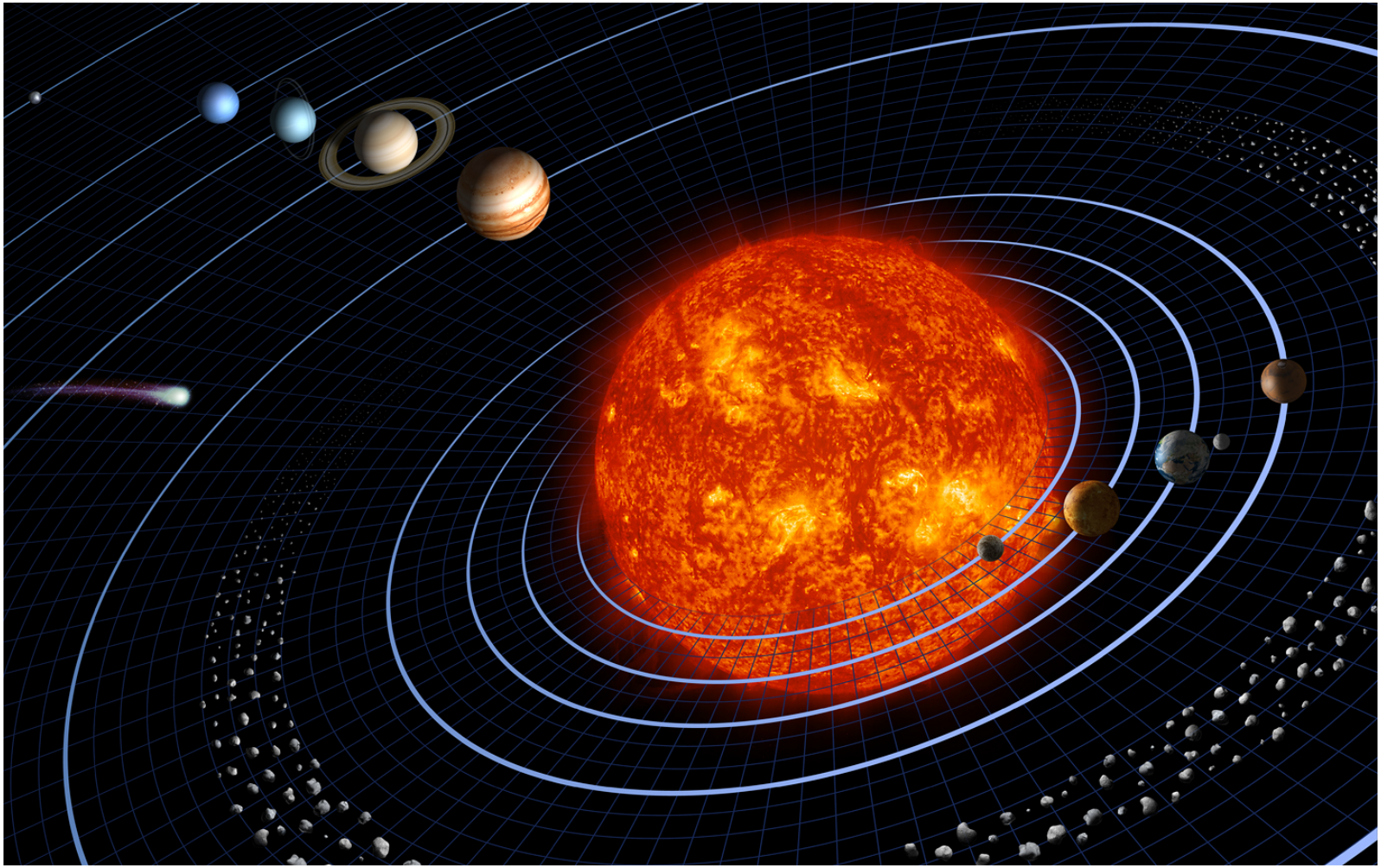
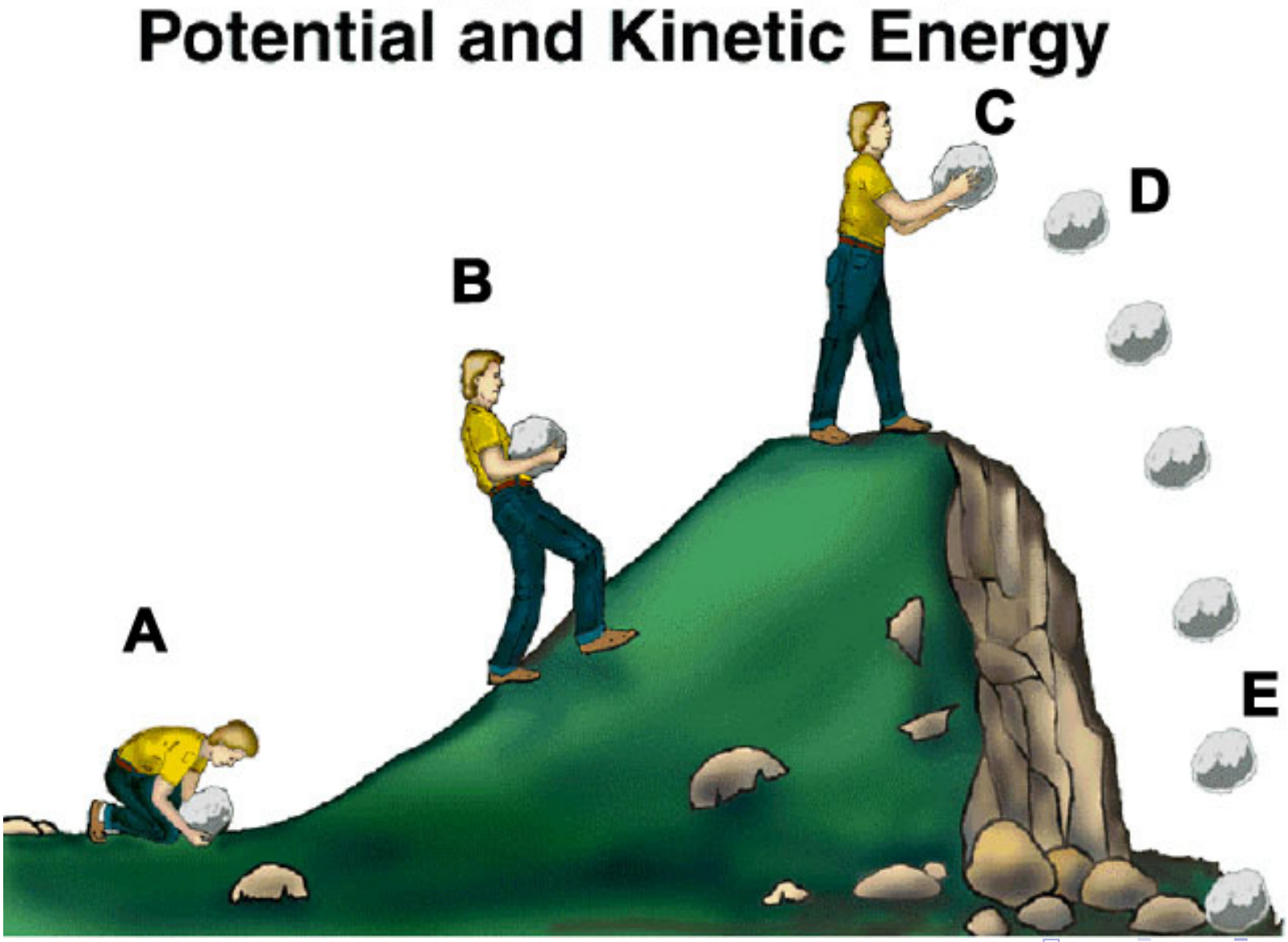
Universal Gravitation



Satellite Motion

How fast does a Volkswagon Beetle have to be moving in order to sustain an orbit a mere 1 km above the surface of the earth? What about 200 km above the surface?

Energy Review



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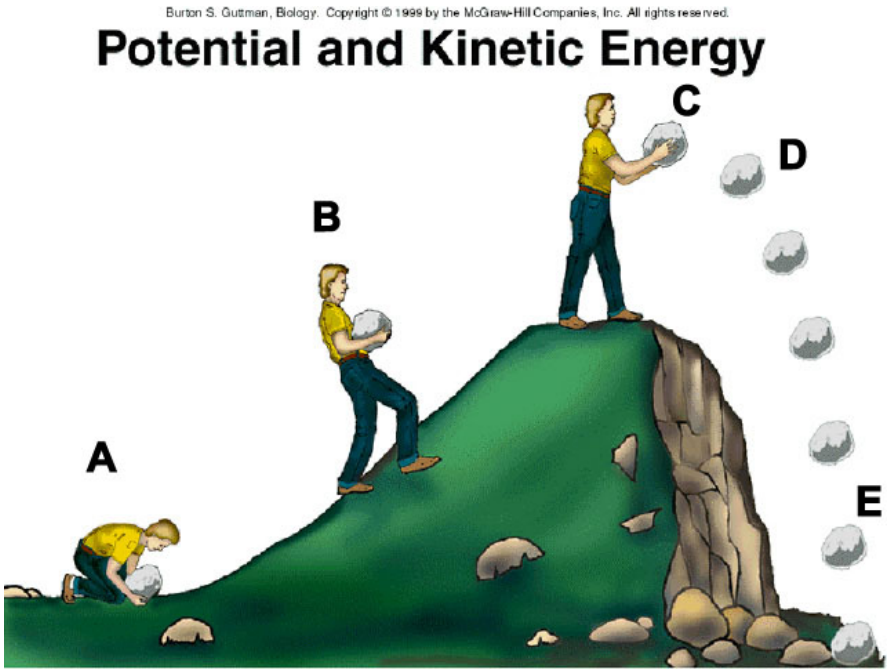

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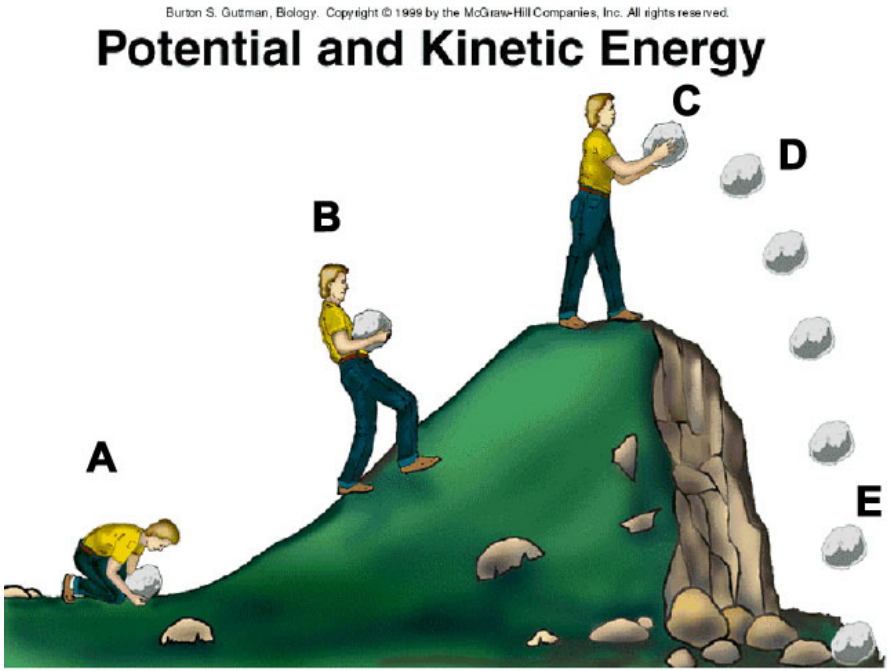

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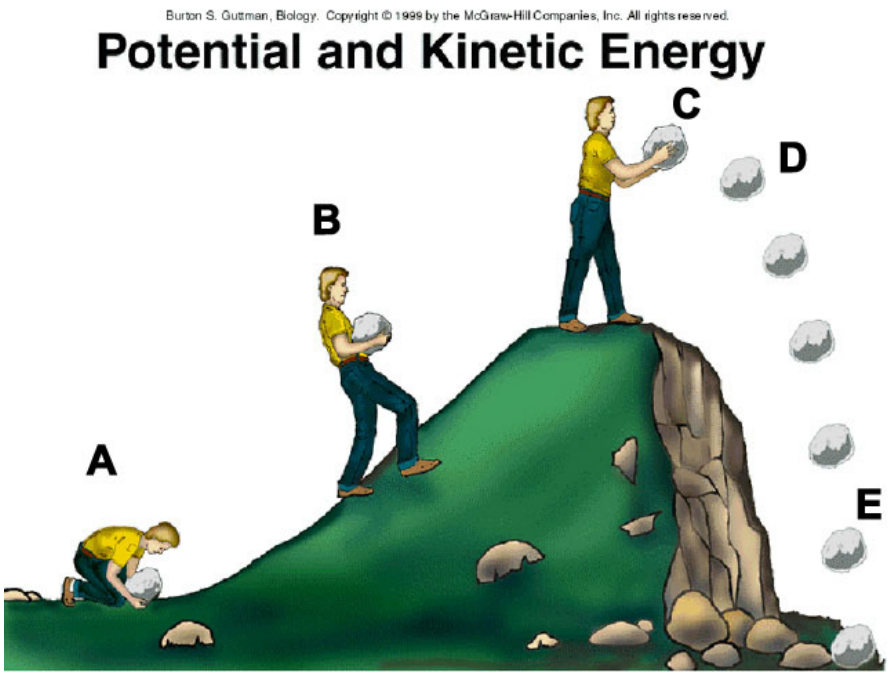

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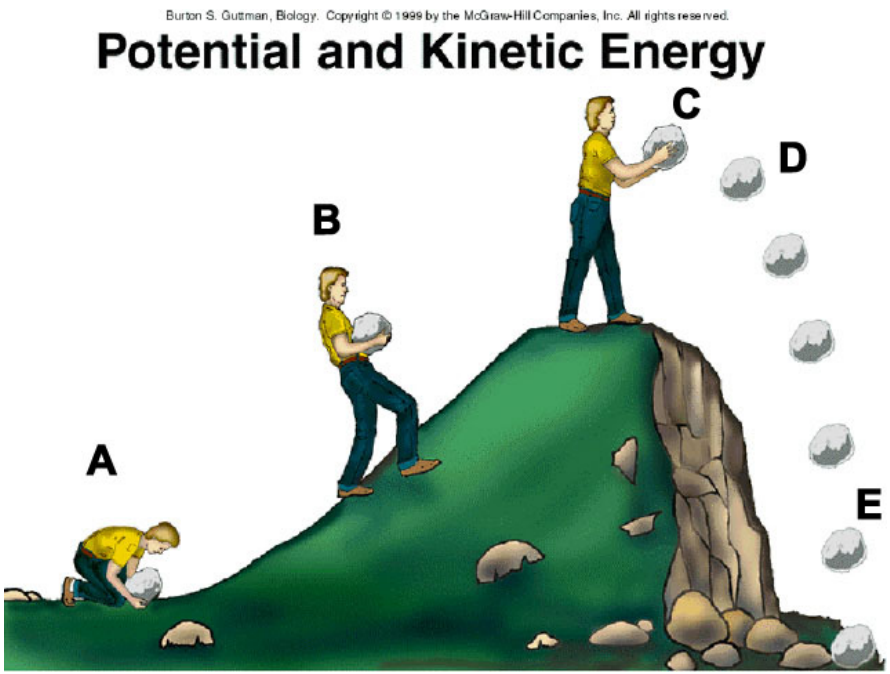

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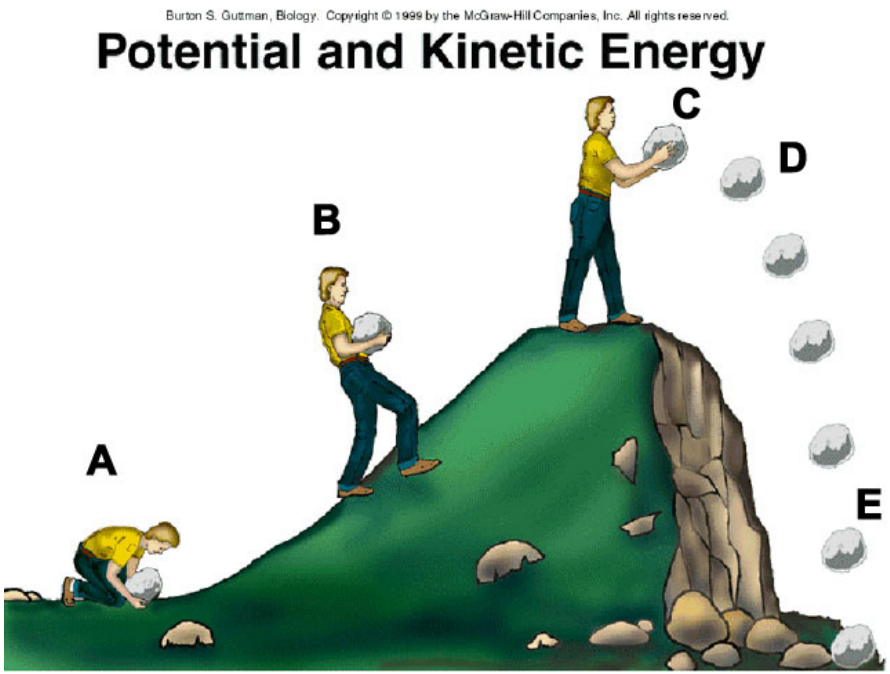

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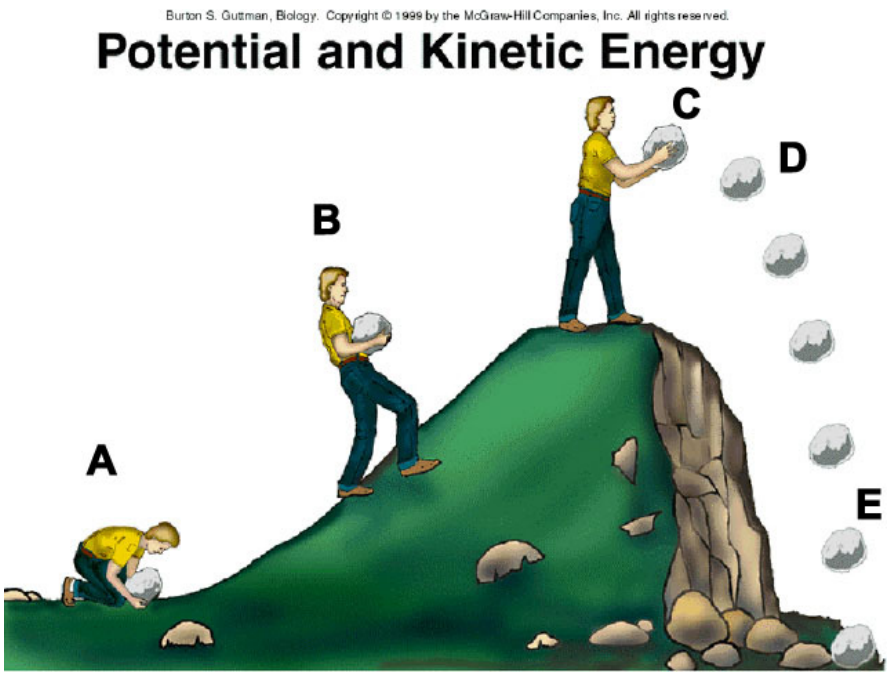

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- Where is there **work** being done on the rock?

Potential Energy

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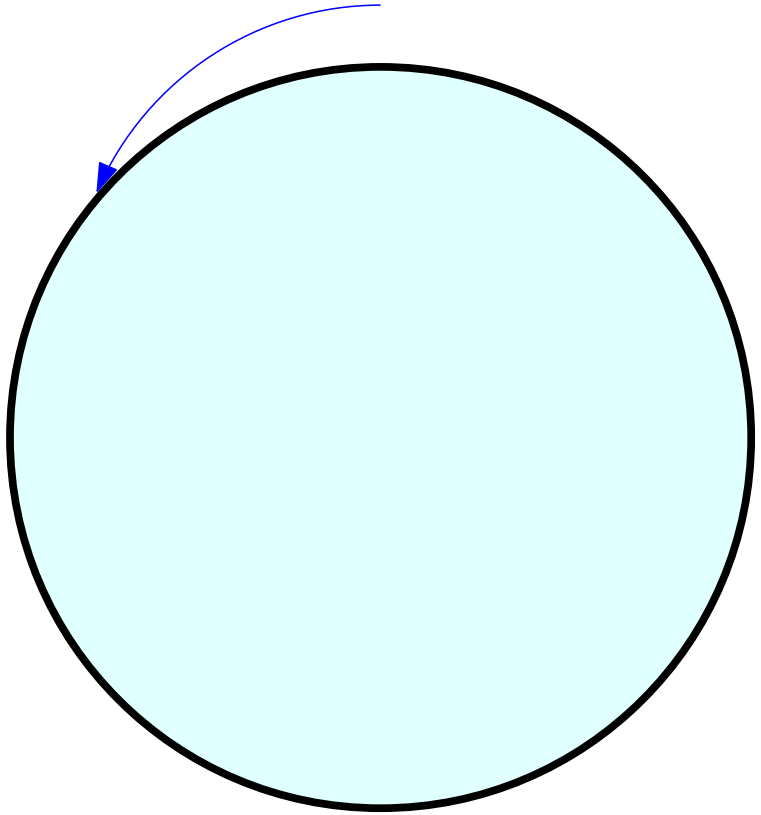
What does it mean if $U = 0$? How far away is that?

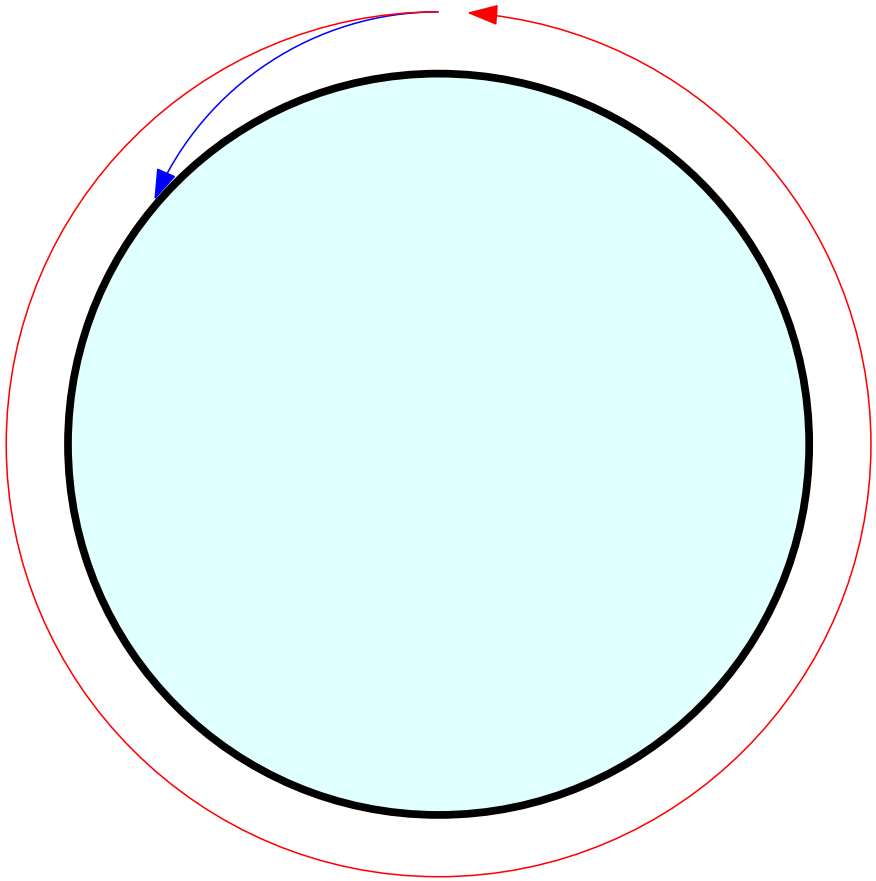
Projectiles, Again

If we launch a projectile at the surface of the earth, it will follow a predictable path.



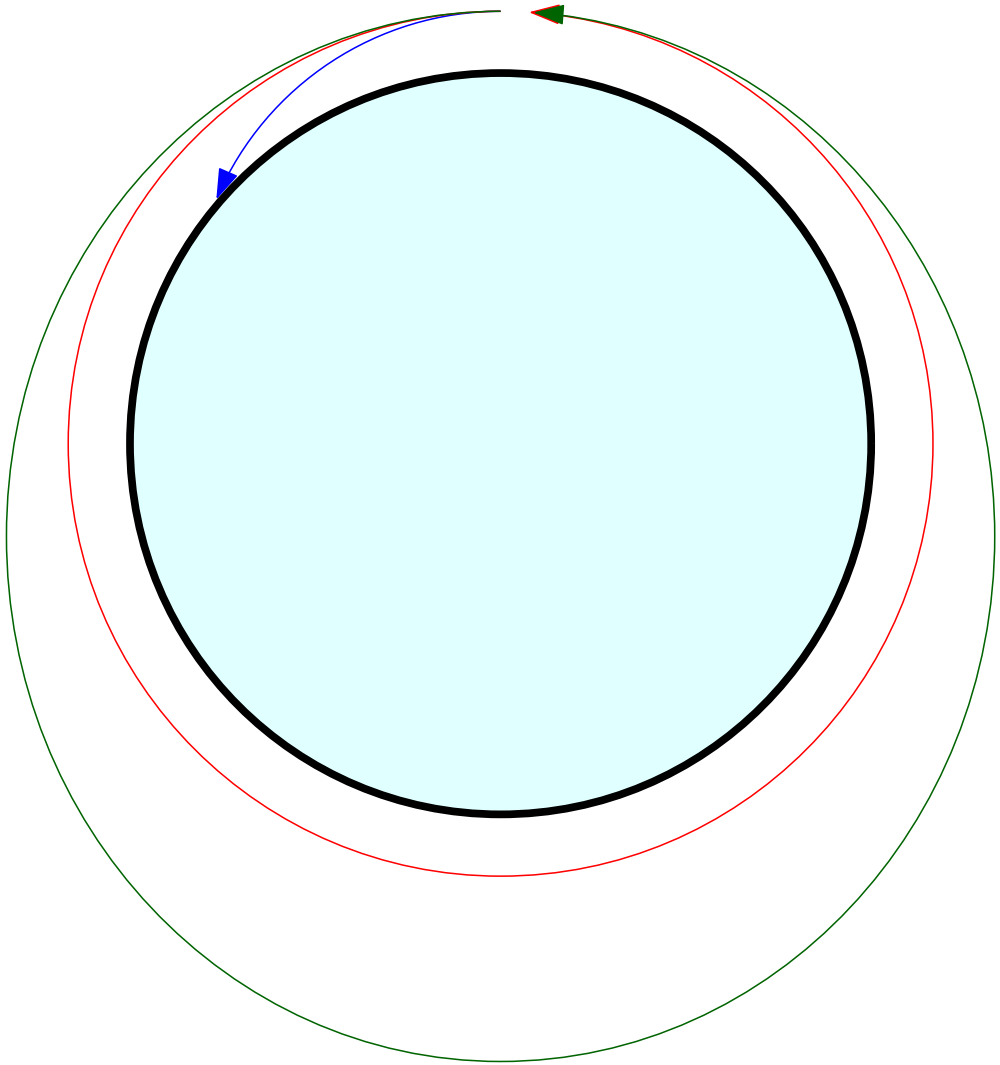
Projectiles, Again

If we launch a projectile hard enough, it will follow a different kind of predictable path.



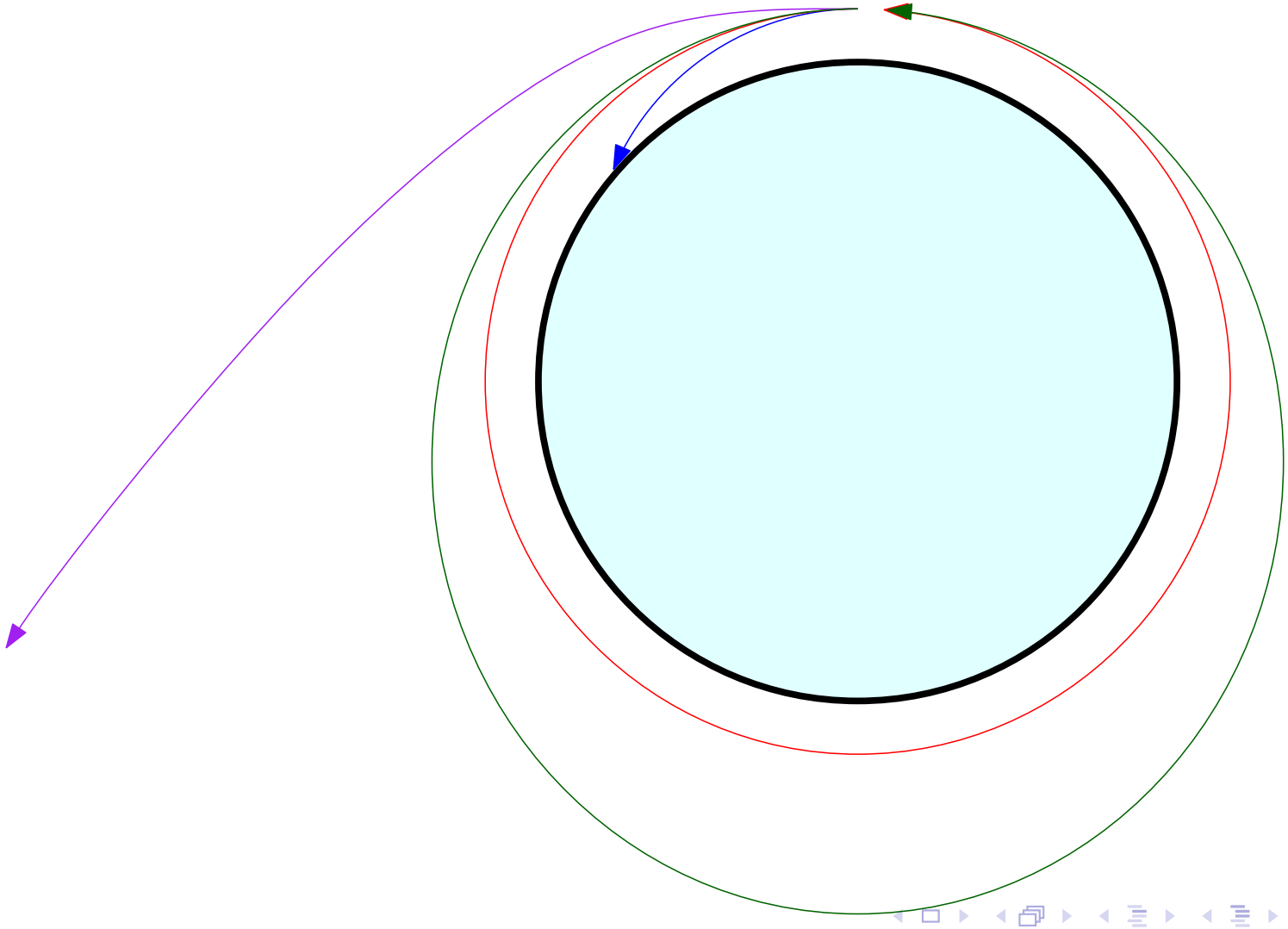
Projectiles, Again

Satellites can also assume elliptical orbits.



Projectiles, Again

If we launched something hard enough, it would never come back, nor would it assume an orbit



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Or using U:

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Escape Velocity

$$\mathsf{KE}_\circ + U_\circ = \mathsf{KE}_f + U_f$$

$$\frac{1}{2}m_1 v_\circ^2 - G\frac{m_1 m_2}{r_\circ} = 0 + 0$$

$$v_e = \sqrt{\frac{2Gm}{r}}$$

Black Holes

To approximate black hole physics, we can consider a body with an escape velocity greater than or equal to the speed of light.

$$c = 3.0 \times 10^8 \text{ m/s}$$

Black Holes

What is the *event horizon* of a black hole with 11 times the mass of our sun?