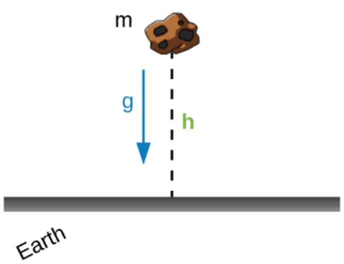
CONCEPT: Gravitational Potential Energy

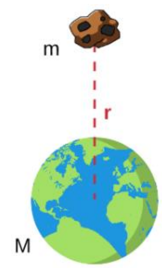
● In Gravitation, we use a different equation for Gravitational Potential Energy.

Grav. Potential Energy (Simple)	Grav. Potential Energy (Gravitation)
$U_G = mgh$	$U_G =$ ________



● Alternative for solving kinematics problems

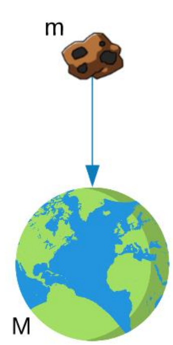
- g is **[constant | changing]**



● ____________ use kinematics!

- As **r** changes, g is **[constant | changing]**

EXAMPLE: An asteroid at rest falls to Earth from a distance of 6×10^7 m from Earth's center. What will be its impact speed?



EQUATIONS	CONSTANTS
$F_G = \frac{Gm_1m_2}{r^2}$ $\quad r = R + h$	$G = 6.67\times10^{-11}\ \frac{m^3}{kg\cdot s^2}$
$g_{surf} = \frac{GM}{R^2}$ $\quad g = \frac{GM}{r^2}$	$M_E = 5.97\times10^{24}$ kg
$U_G = -\frac{GMm}{r}$	$R_E = 6.37\times10^6$ m
$K_i + U_i + W_{NC} = K_f + U_f$	

- There's still *some* Grav. Potential Energy at the surface!

$$-\frac{GMm}{r} \rightarrow -\frac{GMm}{\_\_\_}$$

PRACTICE: How much energy is required to move a 1000-kg object from Earth's surface to a height twice Earth's radius?

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EXAMPLE: Two identical small planets of mass 7×10^{22} kg and radius 2×10^{6} m are initially at rest 5×10^{10} m apart. What is the speed of each planet when the two eventually collide?

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PRACTICE: You launch a rocket with an initial speed of 5×10^3 m/s from Earth's surface. At what height above the Earth will it have ¼ of its initial launch speed? Assume the rocket's engines shut off after launch.

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