Warm-up:

1. $M_{Earth} = 5.98 \cdot 10^{24}\ kg$ $M_{Human} = 70\ kg$ $F_g = \left(6.67 \cdot 10^{-11}\ \frac{N m^2}{kg^2}\right) \cdot \left(\frac{(5.98 \cdot 10^{24}) \cdot 70}{(6.38 \cdot 10^{6})^2}\right) = \boxed{686\ N}$

distance from center of Earth = $6.38 \cdot 10^{6}\ m$.

What is F_{grav}?

Torque Your Way In

An object rotates because a **torque** acts on it. When you exert a force at the end of a wrench in order to rotate it (along with the bolt it is attached to), you may not have thought about the fact that you applied the force perpendicular to the handle. The longer the wrench's handle, the less force you have to apply, because the amount of torque is equal to the product of the force times the distance to the axis about which it is rotating.

2. Use the relationship of torque to force and distance to explain the following two small mysteries in your kitchen. Why is it easier to open a cabinet door when the doorknob is at the end of the door than when it is in the middle of the door? Why is a big doorknob easier to turn than a small one?

↳ Greater distance = less force applied

- Torque = Force · Lever arm length
  $\tau = N \cdot m$

- Rotational Inertia: resistance to changes in rotational motion
  ↳ depends on net torque → causes a change in rotational inertia

- Angular Momentum = angular velocity (centripetal) · rotational inertia
  $L = \omega \cdot I$
  L = angular momentum
  ω = angular velocity
  I = rotational inertia

- Law of conservation of momentum applies here also!
  ↳ $L_i = L_f \rightarrow I_i \omega_i = I_f \omega_f$