The gravitational constant $G = 6.67 \times 10^{-8} \frac{cm^3}{gm\, s^2}$.

- a sugar cube is about 1 gm and about 1 cm^3.
- The numerical value of G is telling us that two sugar cubes placed 1 cm apart in space take about $1/\sqrt{G}$ seconds $\approx$ 1 hr to come together. Natural units for gravity are thus "cgh" because they make $G \sim 1$.

$$\vec{F}_1 = -\vec{F}_2 \; ; \qquad m_1 \ddot{\vec{r}}_1 + m_2 \ddot{\vec{r}}_2 = 0$$

- integrate 1 time wrt time

$$m_1 \dot{\vec{r}}_1 + m_2 \dot{\vec{r}}_2 = \vec{a} \quad \leftarrow \text{constant vector}$$

- integrate another time wrt time.

$$m_1 \vec{r}_1 + m_2 \vec{r}_2 = \vec{a}t + \vec{b}$$

defn. of center of mass: $\vec{R} = \dfrac{m_1 \vec{r}_1 + m_2 \vec{r}_2}{m_1 + m_2}$

get $\dot{\vec{R}} = \dfrac{\vec{a}}{m_1 + m_2} = (\text{constant})$

$$\vec{R} = \frac{\vec{a}t}{m_1 + m_2} + \frac{\vec{b}}{m_1 + m_2}$$

The momentum of the 2-body system is conserved, and the center of mass moves with constant velocity.

knowing the motion of the system as a whole, all that is required is to know the motion of body 1 WRT body 2.