Worksheet 1
The Scale of the Earth and Moon

Instructions: Find a group of 3-4 students and use the clues and tools provided to measure the quantities listed below. Note that the point of this activity is less about getting the exact answer and doing so quickly, and much more about learning the format of this class and realizing that seemingly ill-posed problems can be solved using a few ingredients, your intuition and some math.

The available clues and tools include:

- Clue: My frequent flyer statement says that the distance between Los Angeles (LAX) and Boston (BOS) is 3000 miles.

- Clue: At the start of class today, it was 10:30am in Boston, and 7:30am in Los Angeles.

- Clue: When I was driving my car the other day, I looked at my speedometer and noticed I was going 100! Oh, wait, that was in km/hr. After setting my digital speedometer back to mph, I was only going 60.

- Clue: Johannes Kepler found that the period of a planet is proportional to its distance from the central mass such that $P^2 \propto a^3$. Newton modified this to be $P^2 = 4\pi^2 a^3/(GM)$ where M is the mass of the central body, $G \approx 7 \times 10^{-8}$ cm^3 g^{-1} s^{-2} and $\pi \approx 3$.

- Tool: A rock

- Tool: A scale

- Tool: A beaker

- Clue: An astronomer's rule of thumb is that the thumb as viewed at arm's length is $1°$ in angular diameter. The next time the moon is visible, you can verify that it is about half the size of your thumb at arm's length, or $0.5°$ in angular diameter.

Quantities to estimate. Do all math and express all answers in scientific notation. Express your final answer to **two (2)** significant figures.

1. The radius of the Earth, $R_\oplus =$ _____ cm

2. The mass of the Earth, $M_\oplus =$ _____ grams

3. The distance from the center of the Earth to the center of the Moon, $a_\mathbb{C} =$ _____ cm (also express in number of Earth radii)

4. The radius of the Moon, $R_\mathbb{C} =$ _____ cm (also express in units of $R_\oplus$)

5. The mass of the Moon, $M_\mathbb{C} =$ _____ grams (also express in terms of $M_\oplus$ [e.g. how many Earth masses?].)