

Size, Mass, and Gravitational Force

You will now explore how size relates to the mass and surface gravity of a planet.

Part 1: Sorting the Planets

1. Put the *Solar System Cards* from the previous activity in size order from the smallest world to the largest, and record this order.

2. Consult the *Solar System Cards* and order the planets from least to greatest for mass and then for surface gravitation. (NOTE: The gaseous planets don't really have surfaces. The "surface gravitation" reported for these planets is determined by each planet's identified radius even though there is no surface there.)

Part 2: Exploring Gravity

3. Discuss what you already know or believe about "gravity," using the following questions as guidelines:

What does gravity do or cause?

Do all objects fall at the same speed? Explain.

Why does a car weigh more than a bicycle?

If a car and bicycle were on the moon, would the car still weigh more than the bicycle? Explain.

Is the gravity on the moon different from gravity on Earth? Explain.

4. Read FYI: *Stories of Gravity* and FYI: *Gravitational Force*. Complete the reading guide and questions after reading.

5. To calculate the weight of an object on planet P, you need the mass of the object and the gravitational acceleration at the surface of planet P.

$$\text{Weight on Planet P} = (\text{Mass}) \times (\text{Surface Gravitational Acceleration of Planet P})$$

Compare the gravitational forces experienced on other planets by calculating how much the various objects listed below weigh on each of the worlds shown in Table 1-1. (The mass of an object is not equal to weight. Weight is a force measured in pounds or Newtons; mass is how much matter is in an object (kg). Using kg and m/s^2 , the equation above will yield weight in Newtons (N).)

Planet	Surface Acceleration	100 kg person Weight	899 kg Curiosity Rover Weight	14,696 kg Lunar Lander Weight
Mercury	3.7 m/s^2			
Venus	8.9 m/s^2			
Earth	9.8 m/s^2			
Earth's Moon	1.6 m/s^2			
Mars	3.7 m/s^2			
Jupiter	23.2 m/s^2			
Saturn	10.4 m/s^2			
Uranus	8.7 m/s^2			
Neptune	11.0 m/s^2			

- On which planet does an object weigh the most? The least?
- Why do you weigh more on Earth than you would on Mars?
- An astronaut doesn't weigh anything while in orbit, but does this mean that there isn't any gravity in space? Explain.