



## Feeling the Effects

**Objective:** Students will complete three activities that model the effects of lower gravity. They will compare weight, bone density, and blood flow on Earth and Mars.

**Materials Needed:**

- Activity 1 – Weight Comparison
  - Two containers, labeled Earth and Mars
  - Dry beans
  - Newspaper (or another item to prevent rattling)
  - Calculators
- Activity 2 – Bone Density Comparison
  - Styrofoam cups (2 per student)
  - Pencil/scissor (to poke holes)
  - Marker (to label cups)
- Activity 3 – Blood Flow Comparison
  - String
  - Marker (to mark on the string)

**Summary of Student Action:**

Students will complete three activities. They can be completed in any order.

Activity 1: Weight Comparison

There will be two containers: one labeled Earth and one labeled Mars. Students will pick up both and feel the approximate weight difference. These containers represent the same objects on each planet and how heavy it would be.

Activity 2: Bone Density Comparison

Students get two Styrofoam cups and will label one Earth and one Mars. Students should carefully poke 5-10 holes in the Earth cup around the sides. They can use their pencil for this or you can set out pens or scissors for them to use. They will then do approximately 30 holes for the Mars cup. The cup should be covered in holes, but still be intact. Students will place the cups upside-down and feel the relative strength of each. They can then carefully break both by pressing down on the cup. They should notice the relative effort it took to break each.

### Activity 3: Blood Flow Comparison

Students will be comparing the size of their ankles on Earth and on “Mars.” Starting with Earth, they will wrap a string around their ankle and, using a marker, mark the distance on the string it took to go around their ankle (i.e, measuring the circumference of their ankle). Then, they lay on the ground with their legs up for one minute, allowing blood to flow out of their ankles. With their legs still in the air, they will use the same string and a different color marker to measure the circumference of their ankles and compare the difference in size.

#### ***Setup Instructions:***

- Activity 1: Weight Comparison
  - Place sticker or tape on each container, labeled with Earth or Mars. There should be an equal number of each.
  - Fill the Mars container with nothing or with newspaper.
  - If possible, use a scale to take the mass or weight of the Mars container.
  - Fill the Earth container with a few cups of beans, and fill the rest with newspaper or another material to prevent the beans from rattling. Fill with enough beans/newspaper so that the Earth container is about 3x the mass or weight of the Mars container.
  - You can vary the amount of beans or the materials inside the containers; all that matters is that the Earth container is about 3x the weight or mass of the Mars container.
  - Place Earth and Mars containers together, near the set of student instructions.
  - Put out a few calculators for students to use to calculate how much they would weigh on Mars.
  
- Activity 2: Bone Density Comparison
  - Put out Styrofoam cups, marker, and scissors (if using), near the instructions.
  
- Activity 3: Blood Flow Comparison
  - Put out string, scissors, and markers. You can either cut a few models that are 1ft long for students to use as a guide when measuring their string or you can put out some rulers (either true rulers or paper rulers).

#### ***Additional Notes:***

- The scientific explanations behind all the activities are listed on the instruction sheet. The blood flow concept can be challenging and abstract for students, so that may need additional explanation.

### PHASE THREE: FEELING THE EFFECTS

*What happens in lower gravity?*

*The gravity on Earth is 9.8 m/s<sup>2</sup>. The gravity on Mars is 3.7 m/s<sup>2</sup>. What does this mean? How would this affect your body? Would you be able to tell a difference? Let's find out!*

This phase has three activities:

- Weight Comparison
- Bone Density Comparison
- Blood Flow Comparison

#### Weight Comparison:

*Do you think things will feel heavier or lighter on Mars? Do you think there will be a significant difference? Or, do you think things will weigh about the same? Make a prediction.*

- Pick up the cannister labeled EARTH. Now, pick up the object labeled MARS. This is the same object on each planet. What do you notice?

***What does this mean?*** With less gravity on Mars, there is less force pushing down on the object, so it weighs less and appears to be lighter. The mass would remain the same, but the weight changes.

***How much would you weigh on Mars?*** Take your weight and, using a calculator, multiply it by 0.375. That's how much you would weigh on Mars!

#### Bone Density Comparison:

1. Take two Styrofoam cups. Write Earth on one Styrofoam cup. Write Mars on the other.
2. Using a pen or pencil, poke 5 holes around the side of the EARTH cup.
3. Put between 25-30 holes around the sides of the MARS cup. Be careful not to destroy the cup!
4. Place the cups upside-down on the table and **GENTLY** press on them.

What do you notice? Is one stronger than the other?

Try to break both cups. Which is easier to break? Why do you think that is? How does this relate to gravity?

***What does this mean?*** These cups represent the bones of someone on Earth and on Mars. With less gravity on Mars, bones don't have to support as much weight, so they begin to deteriorate (or weaken). If you aren't using them as much, they lose their strength and become more fragile, like the Styrofoam cup labeled Mars.

**\*Note:** Bones do not develop holes. This is only used to represent less dense and weaker bones.

### Blood flow comparison:

1. Cut a piece of string 1-foot long.
2. Wrap the string around your ankle. Using a marker, make a mark where the end of the string comes back into the rest of the string; you are measuring the distance around your ankle.
3. Lay on the floor near a wall with your legs in the air against the wall.
4. Hold this for one minute.
5. Using a different color marker, measure around your ankle again, while your leg is still in the air. You may need someone to help you with this.
6. Compare your two marks.

What do you notice? How do you think this relates to gravity?

***What does this mean?*** Believe it or not, gravity affects our blood flow. Gravity helps the blood from our heart get down to our feet. With less gravity helping it flow down, like on Mars, there is more blood on the upper half of the body and less in the lower half. This is why when astronauts get back from the International Space Station (in microgravity), their faces look puffy and their legs and ankles look smaller.