7.1.5 e2 Mass vs. Weight Narrative

Time: 45 minutes	**Anchor Phenomena:** An astronaut is able to jump many feet on the moon even though he is wearing a very heavy spacesuit.
Big Idea: Gravitational pull between objects depends on the mass of the two objects.	
CCCs System and system models Analyzing and interpreting data	**Practices** **Engaging in argument from evidence** **-Using mathematics and computational thinking**

EPISODE SNAPSHOT: Students compare and contrast tools to measure mass and weight and calculate their weight on other planets.

GATHERING

Explain to the students that they are going to compare and contrast three different tools used to measure mass and weight: a triple-beam balance, a spring scale (that measures in Newtons), and an electronic scale. (Note: this explore activity can be done without electronic scales if your school does not have them.) Do not explain what tools measure which property. Demonstrate for the class how to use and read each tool. Break the students into small groups and give each group a triple-beam balance, spring scale, and electronic scale. Have various objects for them to measure or let them choose their own. Students record the measurements on their student handout. There should not be much difference between the measurements from the triple-beam balance and the electronic scale, but the spring scale measurements should be recorded in Newtons (units of force) and will be different from the other two. Students record observations that were made during the activity. Students write down questions they may have about the tools.

Have some of the students share their observations and questions. Discuss the differences between the scales and the measurements. Ask the students to explain how each of the scales work, researching the scales if necessary or you can supplement the information. Below is the information they should end up with.

Types of scales	What property does it measure? What units does it use? How does it work?
Spring Scales	measures weight in Newtons (force) by gravity pulling on the mass of the object and stretching the spring
Electronic Scales	Measures mass in grams by using weight to calculate the mass
Triple Beam Balance	measures mass in grams by comparing it to another object's mass (the sliders on the beams)

REASONING

Ask the students which of the three scales would read the same on a different planet. Have them discuss it in small groups and then call on some students to share what they think. Guide them to see that the only scale that would read the same is the triple-beam balance because it compares the mass of two objects. The spring scale reading will change if gravity changes. The electronic scale will also change if gravity changes.

Based on what they learned about the scales, have the students construct definitions for mass, weight, and gravity. They should already know mass from learning about Newton's Laws. Help them record the units each property is measured in. Have them discuss in small groups and then share with the class how this property might be changed. Below is a table of the information they should end up with.

Science Terms

	Measure of	Measured in	Changes when
Mass	How much matter is in an object	grams /kilograms	You remove part of the object or add to the object
Weight	How much gravity pulls on you	Newtons	If you change the amount of gravity (going to another planet)

		(measures force)	or by changing the mass of the object (more massive objects weigh more, less massive objects weigh less.
Gravity	The force of attraction between the mass of two objects in a system	Newtons	Change the mass of the object/planet Change the distance between the objects in the system

COMMUNICATING

Students have communicated as they write and discuss the scales and the definitions of the science terms.

The students communicate their understanding as they use **mathematics and computational thinking** to calculate their weight and determine their mass at other locations in the solar system. You may want to have a bathroom scale on hand to help students who don't know their weight on Earth. You can also just have them estimate their weight on Earth. Try to let them figure out the weights, but if they get stuck, tell them they need to divide if the gravity is weaker and multiply if the gravity is stronger. If there is no gravity, there is no weight. Their mass should never change. To be consistent with the information they recorded with their science terms, they should convert their weight to kilograms. Here is an example of what the end result should be.

	What is your weight on . . .	What is your mass on. . .
The earth	140 lbs	63kg
The Moon The moon's gravity is 6 times weaker than it is here.	23 lbs	63kg
Jupiter Jupiter's gravity is 2.5 times stronger than it is here.	350 lbs	63kg
The Sun The sun's gravity is 28 times stronger than it is here.	3,920 lbs	63kg
In space There is little to no gravity in space	0lbs	63 kg

Students engage in argument using evidence from what they learned to answer the question: Why do different scales use different units and make different measurements? They must discuss the differences between mass and weight.

Assessment: The summary is the assessment for this unit. Proficient students can communicate that triple-beam balances and electronic scales measure mass in grams and spring scales measure weight in Newtons. Mass is a measure of the amount of matter in an object and does not change if the gravitational pull changes. Weight is a measure of how much gravity pulls on a mass and changes when the gravitational pull changes.	**Materials, resources, handouts, etc:** • Triple-beam balances • Spring scales • Electronic scales • Objects to measure • Optional: bathroom scale • Optional: calculators • 7.1.5 e2 Mass vs. Weight student handout • Mass vs Weight Slideshow (optional)