

Title: Space Weights**Brief Overview:**

Students will explore the effect of gravitational force. Using bottles filled with sand, the teacher will demonstrate the differences in weight. Students will then calculate their personal weight on each planet within the solar system. Comparison of and graphing results will enable the students to experience g-force on a personal level. Estimation, computation, ratio and proportion skills will be refined and reinforced.

Links To NCTM Standards:

- **Mathematics as Problem Solving**

Students will demonstrate their ability to solve problems in mathematics which include the use of fractions, whole numbers and proportions. They will need to determine which information is pertinent to the task.

- **Mathematics as Communication**

Students will demonstrate their ability to communicate mathematically by discussing the results of their graphs and by writing their observations and explanations of their responses. They will read, write, display, graph and draw results of gathered information.

- **Mathematics as Reasoning**

Students will reason mathematically by gathering evidence from graphs, making conjectures, and drawing conclusions from their calculations.

- **Mathematical Connections**

Students will demonstrate their ability to apply skills in mathematics to science by using gravity ratio to calculate weight on planets within our solar system.

- **Computation**

Students will demonstrate their ability to solve problems by estimating, and using arithmetic operations with technology where appropriate to calculate weights from fractional information.

- **Number Relationships**

Students will demonstrate their ability to describe and apply number relationships using concrete and abstract materials. They will choose appropriate operations, describe effects of operations on numbers as in applying ratios and proportions, and scale drawings with written explanations.

- **Statistics**

Students will demonstrate their ability to organize and display data.

- **Patterns/Relationships**

Students will demonstrate their ability to generalize a relationship from collected data.

Grade/Level:

Grades 6, 7, and 8

Duration/Length:

This unit should take approximately 5-7 days.

Prerequisite Knowledge:

Students should have a working knowledge of the following skills:

- Estimating
- Multiplying of simple and mixed fractions
- Using resource materials to gather information for written reports
- Using graphs
- Rounding to the nearest 10
- Using calculators when needed
- Making scale drawing
- Using ratio and proportion

Objectives

Students will:

- estimate.
- use math skills to perform individual and group work.
- work in cooperative groups.
- display information.
- use mathematical skills to complete an interdisciplinary project.
- use scale drawings to further demonstrate proportion skills.

Materials/Resources:

- Worksheets
- Graph paper
- Calculators
- Resource materials
- 3 plastic bottles with different weights
- Beans and paper plates
- Acetate sheets or tracing paper

Development/Procedures:**Day 1:**

- Introduce lesson with a discussion of the effects of gravitational forces on planets.
- Demonstrate different weights with plastic bottles filled with sand; empty bottle for Planet Lite-o, 1/2 filled bottle for Earth and filled bottle for Planet Hefty. (Covered or painted bottles to hide contents are suggested.)
- Complete Activity 1A as a class using 60 lbs. as a sample weight. (Discuss in class.)
- Complete Activity 1A individually. (Check and discuss in class - note: all graphs should be the same.)
- Complete Activity 2 individually for homework.

Day 2:

- Discuss Activity 2 results in class.
- Complete Activity 2A individually in class.
- Discuss and compare graphs in groups. (All graphs should be proportionally the same.)
- OPTIONAL: Record results of several groups on transparencies and compare on an overhead.

Day 3

- Complete Activity 3 individually.
- Check and discuss results.

Day 4:

- Using information from completed Activity 3, in small groups complete Activity 4.
- Worksheet will be immediately evaluated by teacher with rubric scoring.
- Complete and discuss Activity 4A.

Day 5:

- OPTIONAL: Choice of 2 scale drawing extension activities.

Performance Assessment:

Student assessment will be based on the completion of the separate worksheets. A general rubric will be used for all activities. The completion of one of the extension activities will also lead to additional assessments.

Extension/Follow Up:

Students will be given a choice of several extension activities. The first will be to research and display several facts about a planet of their choice (examples: written, collage, mobile, power point...). The second choice will be to make a scale drawing of an object as in a piece of machinery that could be used for exploration on one of the planets. The drawing can be made either to their own proportions on paper or life-size on the playground as a large group activity. The last activity for the students will be to design a tri-fold travel brochure to the planet of their choice.

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ACTIVITY #1

NAME _____

Sample Student's Weight 60 lbs.

Use the following formula:

Student's Weight x Gravity Ratio

** Example: 60 lbs. x 3/10 =18 lbs. (on Mercury)

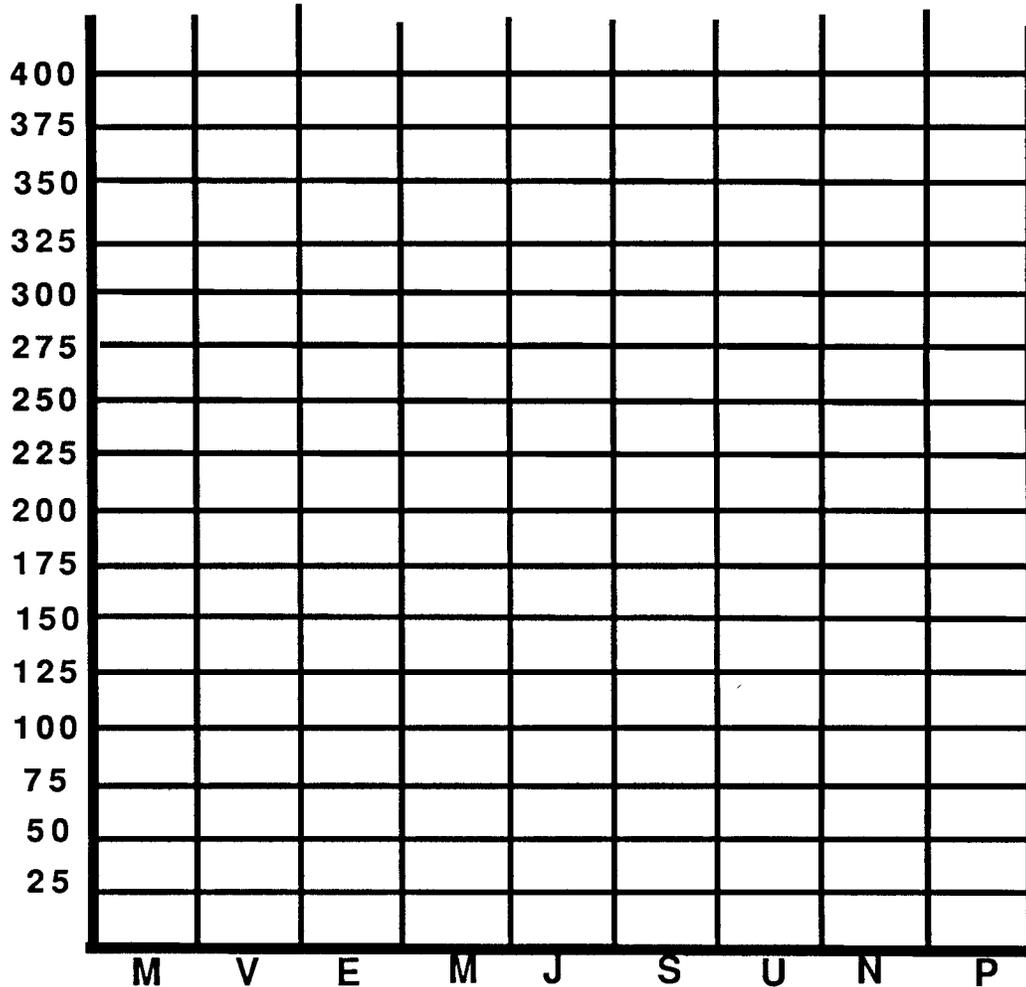
<u>PLANETS</u>	<u>GRAVITY RATIO</u>	<u>ESTIMATE</u>	<u>WEIGHT</u>
Mercury	3/10	_____	_____
Venus	7/8	_____	_____
Earth	1	_____	_____
Mars	3/8	_____	_____
Jupiter	2 5/8	_____	_____
Saturn	1 1/5	_____	_____
Uranus	9/10	_____	_____
Neptune	1 1/10	_____	_____
Pluto	7/10	_____	_____

Discuss what effect gravity has on weight as you travel throughout the solar system.

ACTIVITY #1A

NAME _____

Starting with Mercury, make a bar graph that shows the student's weight for each planet. Be sure to give your graph a title.



How does your graph compare with other students?

ACTIVITY #2

NAME _____

Weight _____ (Round to the nearest 10 lbs.)

Using your weight - *estimate* then *calculate* your weight for each planet.

<u>PLANETS</u>	<u>GRAVITY RATIO</u>	<u>ESTIMATE</u>	<u>WEIGHT</u>	<u>%*</u>
Mercury	3/10	_____	_____	_____
Venus	7/8	_____	_____	_____
Earth	1	_____	_____	_____
Mars	3/8	_____	_____	_____
Jupiter	2 5/8	_____	_____	_____
Saturn	1 1/5	_____	_____	_____
Uranus	9/10	_____	_____	_____
Neptune	1 1/10	_____	_____	_____
Pluto	7/10	_____	_____	_____

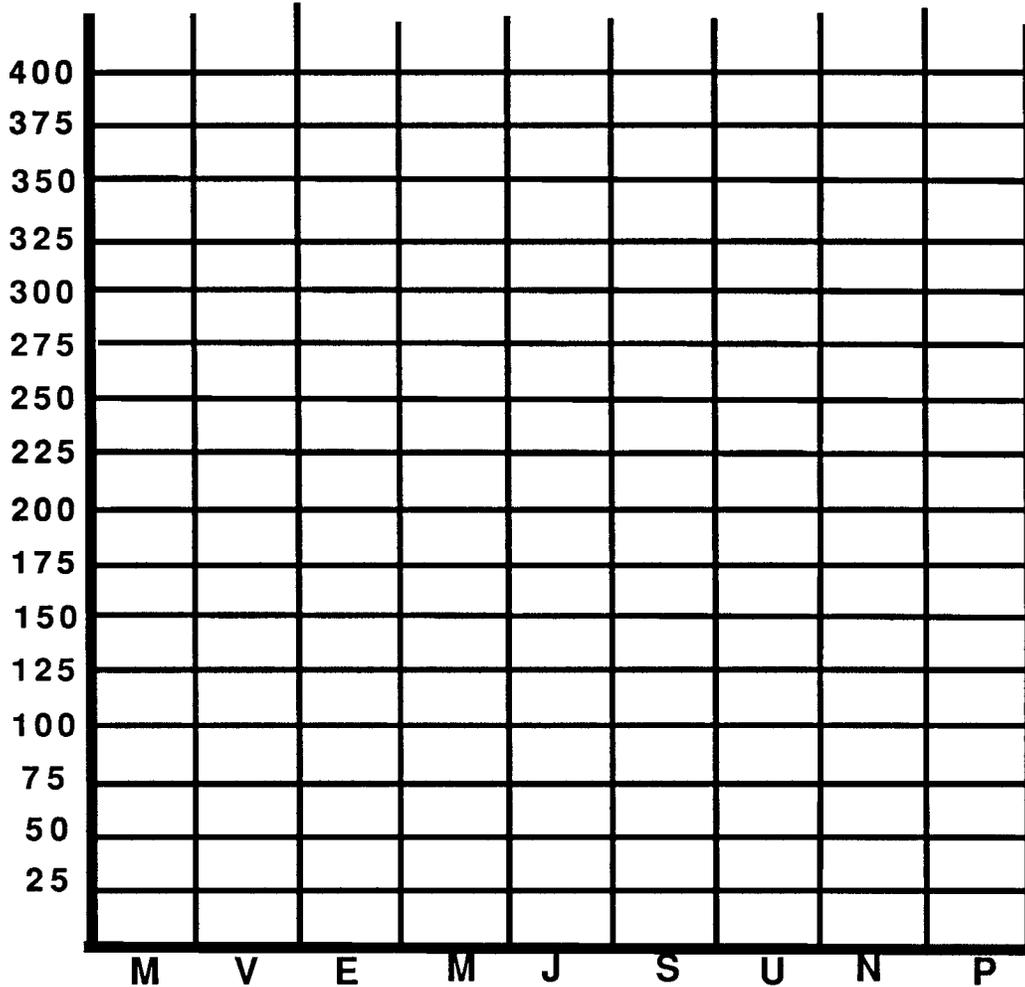
Discuss what effect gravity has on your weight as you travel throughout the solar system.

%* -- Calculated planet weight/Earth weight

ACTIVITY #2A

NAME _____

Starting with Mercury, make a bar graph that shows your weight on each planet. Be sure to give your graph a title.



Compare your graphs of 1A and 2A

1) In a group discuss your findings and write them below.

ACTIVITY #3

NAME _____

Planet Hefty's gravitational force is twice that of Earth. Planet Lite-o's gravitational force is one half that of Earth. The Spacemo family is planning a stellar vacation. Calculate the weight of each family member on both planets. Complete the chart below.

Remember! Formula: Earth Weight X Gravitational Pull =

<u>Spacemo's</u>	<u>Earth Weight</u>	<u>Planet Hefty</u>	<u>Planet Lite-o</u>
Gosmo	200 lbs.	_____	_____
Astra	140 lbs.	_____	_____
Jenna	80 lbs.	_____	_____
Rocco	60 lbs.	_____	_____
Comet (the dog)	120 lbs.	_____	_____

*Write a brief summary statement describing what the Spacemo's vacation weights will be on Planet Hefty and Planet Lite-o.

ACTIVITY #4

NAME _____

Your group is to create a model of the weights of the Spacemo family at home and on vacation. You will need to set up a proportion to calculate family bean weights.

$$\text{SAMPLE: } \frac{1 \text{ bean}}{20 \text{ lbs}} = \frac{x \text{ beans}}{\text{known weight}}$$

Calculate and record results below:

<u><i>Spacemo's</i></u>	<u><i>Earth Weight</i></u> (in beans)	<u><i>Planet Hefty</i></u> (in beans)	<u><i>Planet Lite-o</i></u> (in beans)
Gosmo	_____	_____	_____
Astra	_____	_____	_____
Jenna	_____	_____	_____
Rocco	_____	_____	_____
Comet (the dog)	_____	_____	_____

Create a model for each family member:

- 1) Use a paper plate for each family member.
- 2) Represent all 3 planets on each plate.
- 3) Place corresponding beans in the appropriate planet area.
- 4) Notify teacher when above components are ready for evaluation.
- 5) Write a brief summary of your findings.

ACTIVITY SCORE: _____ TEACHER INITIALS: _____

ACTIVITY #4A

NAME _____

1) What effect does the Gravitational Force of each planet have on the family during their trip?

2) **BRAINSTORM!** -- What adjustments do you think the family needed to make as they visited each planet?

RUBRIC SCORING

The following rubric can be used for each activity:

- 4 - All components/calculations completed correctly
- 3 - Most components/calculations completed correctly
- 2 - Fair completion of components/calculations
- 1 - Poor completion of components/calculations

ACTIVITY #1

NAME Answer Key

Sample Student's Weight 60 lbs

Use the following formula:

Student's Weight x Gravity Ratio

** Example: 60 lbs. x 3/10 = 18 lbs. (on Mercury)

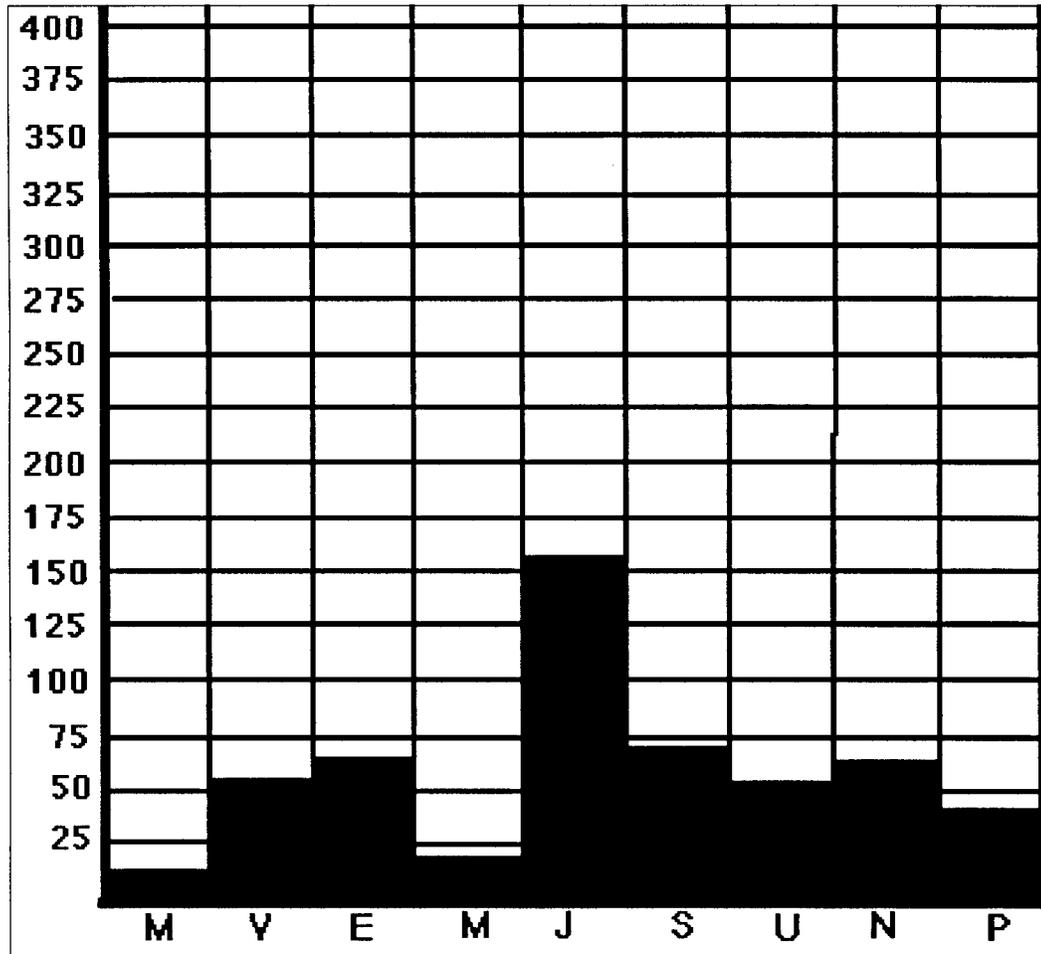
<u>PLANETS</u>	<u>GRAVITY RATIO</u>	<u>ESTIMATE</u>	<u>WEIGHT</u>
Mercury	3/10	_____	<u>18</u>
Venus	7/8	_____	<u>52.5</u>
Earth	1	_____	<u>60</u>
Mars	3/8	_____	<u>22.5</u>
Jupiter	2 5/8	_____	<u>157.5</u>
Saturn	1 1/5	_____	<u>72</u>
Uranus	9/10	_____	<u>54</u>
Neptune	1 1/10	_____	<u>66</u>
Pluto	7/10	_____	<u>42</u>

Discuss what effect gravity has on weight as you travel throughout the solar system.

ACTIVITY #1A

NAME Answer Key

Starting with Mercury, make a bar graph that shows the student's weight for each planet. Be sure to give your graph a title.



GRAPH TITLE: "MY WEIGHT ON EACH PLANET"
VERTICAL AXIS: "WEIGHT IN POUNDS"
HORIZONTAL AXIS: "PLANETS"

How does your graph compare with the other students?

ACTIVITY #3

NAME Answer Key

Planet Hefty's gravitational force is twice that of Earth. Planet Lite-o's gravitational force is one half that of Earth. The Spacemo family is planning a stellar vacation. Calculate the weight of each family member on both planets. Complete the chart below.

Remember! Formula: Earth Weight X Gravitational Pull =

<u>Spacemo's</u>	<u>Earth Weight</u>	<u>Planet Hefty</u>	<u>Planet Lite-o</u>
Gosmo	200 lbs	<u>400</u>	<u>100</u>
Astra	140 lbs.	<u>280</u>	<u>70</u>
Jenna	80 lbs.	<u>160</u>	<u>40</u>
Rocco	60 lbs.	<u>120</u>	<u>30</u>
Comet (the dog)	120 lbs.	<u>240</u>	<u>60</u>

*Write a brief summary statement describing what the Spacemo's vacation weights will be on Planet Hefty and Planet Lite-o.

ACTIVITY #4

NAME Answer Key

Your group is to create a model of the weights of the Spacemo family at home and on vacation. You will need to set up a proportion to calculate family bean weights.

$$\text{SAMPLE: } \frac{1 \text{ bean}}{20 \text{ lbs}} = \frac{x \text{ beans}}{\text{known weight}}$$

Calculate and record results below:

	<u><i>Spacemo's Earth Weight</i></u> (in beans)	<u><i>Planet Hefty</i></u> (in beans)	<u><i>Planet Lite-o</i></u> (in beans)
Gosmo	<u>10</u>	<u>20</u>	<u>5</u>
Astra	<u>7</u>	<u>14</u>	<u>3.5</u>
Jenna	<u>4</u>	<u>8</u>	<u>2</u>
Rocco	<u>3</u>	<u>6</u>	<u>1.5</u>
Comet (the dog)	<u>6</u>	<u>12</u>	<u>3</u>

Create a model for each family member:

- 1) Use a paper plate for each family member.
- 2) Represent all 3 planets on each plate.
- 3) Place corresponding beans in the appropriate planet area.
- 4) Notify teacher when above components are ready for evaluation.
- 5) Write a brief summary of your findings.

ACTIVITY SCORE: _____ TEACHER INITIALS: _____