

Adapted from: Smith, Margaret Schwan, Victoria Bill, and Elizabeth K. Hughes. "Thinking Through a Lesson Protocol: Successfully Implementing High-Level Tasks." *Mathematics Teaching in the Middle School 14* (October 2008): 132-138.

<p>PART 1: SELECTING AND SETTING UP A MATHEMATICAL TASK</p>	
<p>What are your mathematical goals for the lesson? (i.e., what do you want students to know and understand about mathematics as a result of this lesson?)</p>	<p>*Students will be able to find the center, spread, and overall shape of a set of data.</p> <p>*Students will recognize that a measure of center is a summary of all of its values with a single number while a measure of variation describes how its values vary with a single number.</p> <p>*Students will be able to create a graph plot (number line and dot plot) with the data they are given.</p>
<ul style="list-style-type: none"> • What are your expectations for students as they work on and complete this task? • What resources or tools will students have to use in their work that will give them entry into, and help them reason through, the task? • How will the students work— independently, in small groups, or in pairs—to explore this task? • How will students record and report their work? 	<p>Expectations: Display the numerical data in a dot plot and box and whiskers plot. Understand that the data can be described by its center, spread, and overall shape. Recognize the measures of center and variation in the data.</p> <p>Tools: Chart with number of moons and rotation of planets. Calculator Pencil Paper Graph Paper Any manipulatives that you have available throughout the year.</p> <p>Grouping: Small group or partners.</p> <p>Students will need to report their data in a visual way. They will record this in their math journal.</p>

<p>How will you introduce students to the activity so as to provide access to <i>all</i> students while maintaining the cognitive demands of the task?</p>	<p>-Start with the pictures attached at the end. (Space, planet comparisons) -Discuss how the NASA program is ending. -Show shuttle launch. http://www.nasa.gov/multimedia/videogallery/index.html?media_id=100244431</p> <p>-Question- In the summer of 2011, NASA launched the last space shuttle into space. Private companies are now bidding for the new space contract. You have been asked to summarize some key points of the universe focusing on the following statistical data: number of moons of the planets, diameters of the planets, and the rotation of planets. Your responsibility is to display the data using both a dot plot and box plot in order to show some of the amazing discoveries this wonderful program has given us.</p>
<p>PART 2: SUPPORTING STUDENTS' EXPLORATION OF THE TASK</p>	
<p>As students work independently or in small groups, what questions will you ask to—</p> <ul style="list-style-type: none"> • help a group get started or make progress on the task? • focus students' thinking on the key mathematical ideas in the task? • assess students' understanding of <ul style="list-style-type: none"> key mathematical ideas, problem- solving strategies, or the representations? • advance students' understanding of the mathematical ideas? 	<ul style="list-style-type: none"> *How are you going to organize this? Why? *Which display goes best for each set of data? Why do you feel that way? *Does it matter which display you use? *What does this data tell you when organized? *Why did you display it this way? *Are the measures of central tendency represented in your visual display? What are they? *How does your visual display show the range? What is it? *What is the overall shape of your data? Does your display represent that well? *What informal conclusions can you draw from your data?

How will you ensure that students remain engaged in the task?

- What assistance will you give or what questions will you ask a student (or group) who becomes quickly frustrated and requests more direction and guidance is solving the task?
- What will you do if a student (or group) finishes the task almost immediately? How will you extend the task so as to provide additional challenge?

*What do you know?

*How can you organize the data so that it makes more sense to you?

*Can you create your own planet and figure out how that will affect the statistical data and finding?

*Now write a letter to the company summarizing your conclusions.

PART 3: SHARING AND DISCUSSING THE TASK

How will you orchestrate the class discussion so that you accomplish your mathematical goals?

- Which solution paths do you want to have shared during the class discussion? In what order will the solutions be presented? Why?
- What specific questions will you ask so that students will—
 1. make sense of the mathematical ideas that you want them to learn?
 2. expand on, debate, and question the solutions being shared?
 3. make connections among the different strategies that are presented?
 4. look for patterns?
 5. begin to form generalizations?

What will you see or hear that lets you know that *all* students in the class understand the mathematical ideas that you intended for them to learn?

Discussion:

- *Have students show their graphs first, and then move into the measurements.
- *Order doesn't matter as long as they can prove why they chose a certain visual display (graph).
- *Why did you order it the way you did?
- *Why did you use the visual display that you did?
- *Would it have been easier to use a different method?
- *Which measure of central tendency best describes the data from your graph?
- *How did your measurements change when you added your own planet?
- *What connections do you see between your graph and the other graphs?
- *Are any of these graphs misleading? If so, which ones and why?

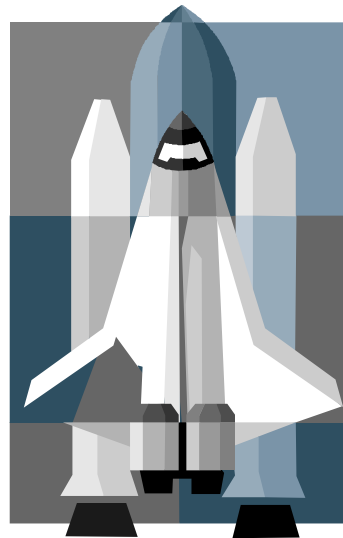
What you should see/hear:

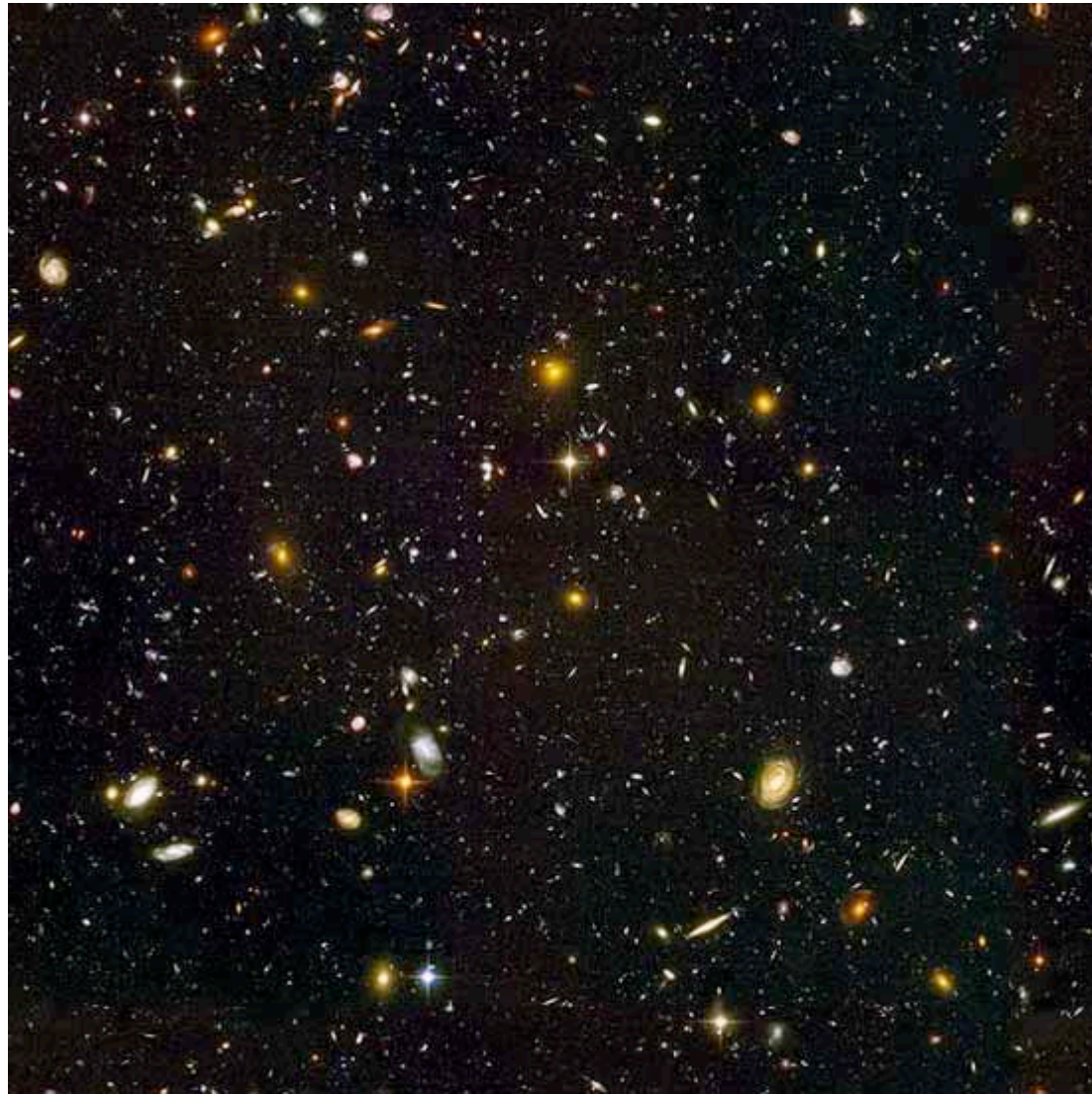
- *You should see graphs with appropriate scales.
- *You should hear correct terminology.
- *Their measurements should be correct.
- *They should be able to verbally prove how their new planet affected the data.
- *They should be able to verbally prove why they chose a certain graph to display their data.

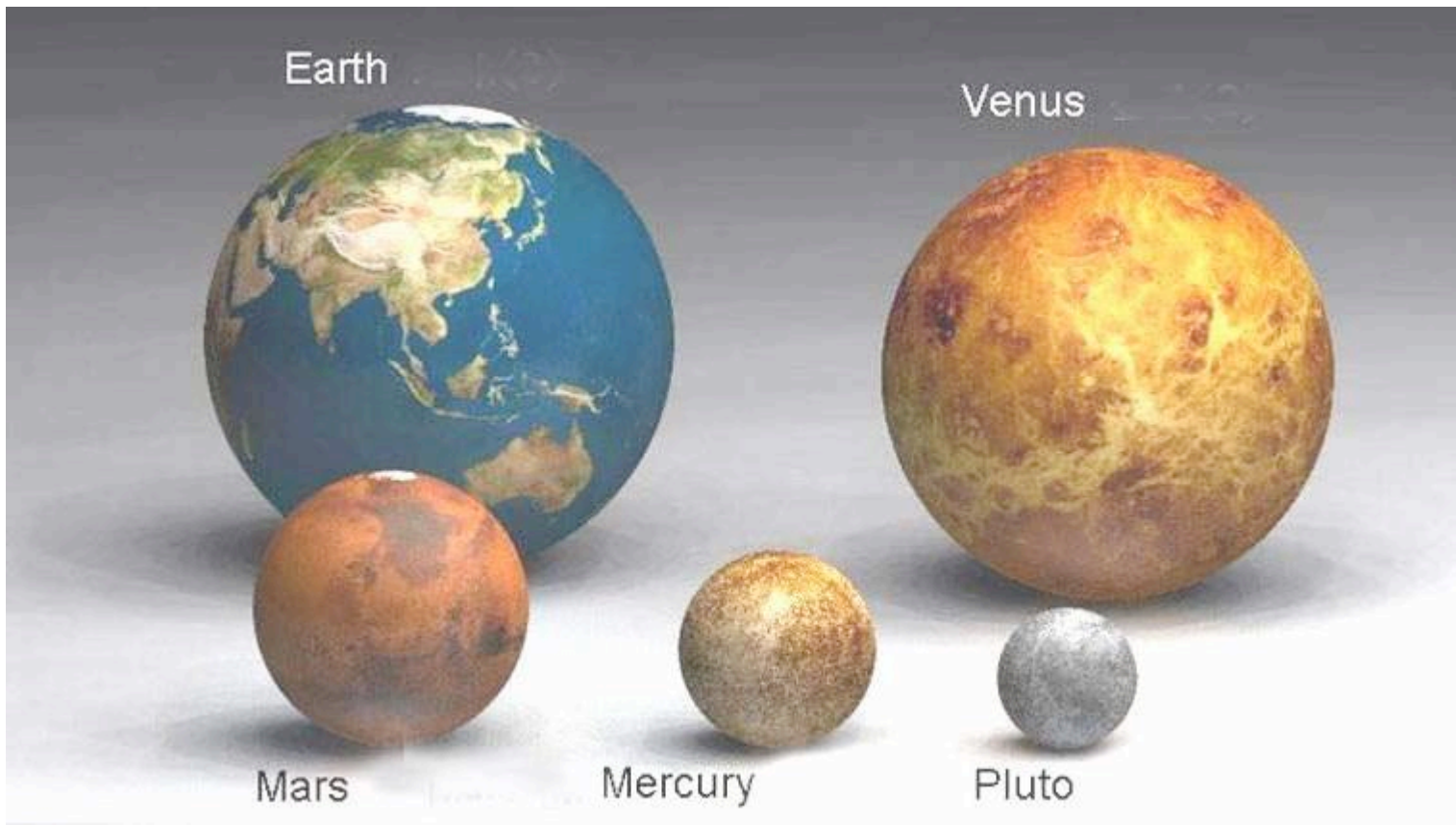
Blast Off! SP 2, 3, & 4

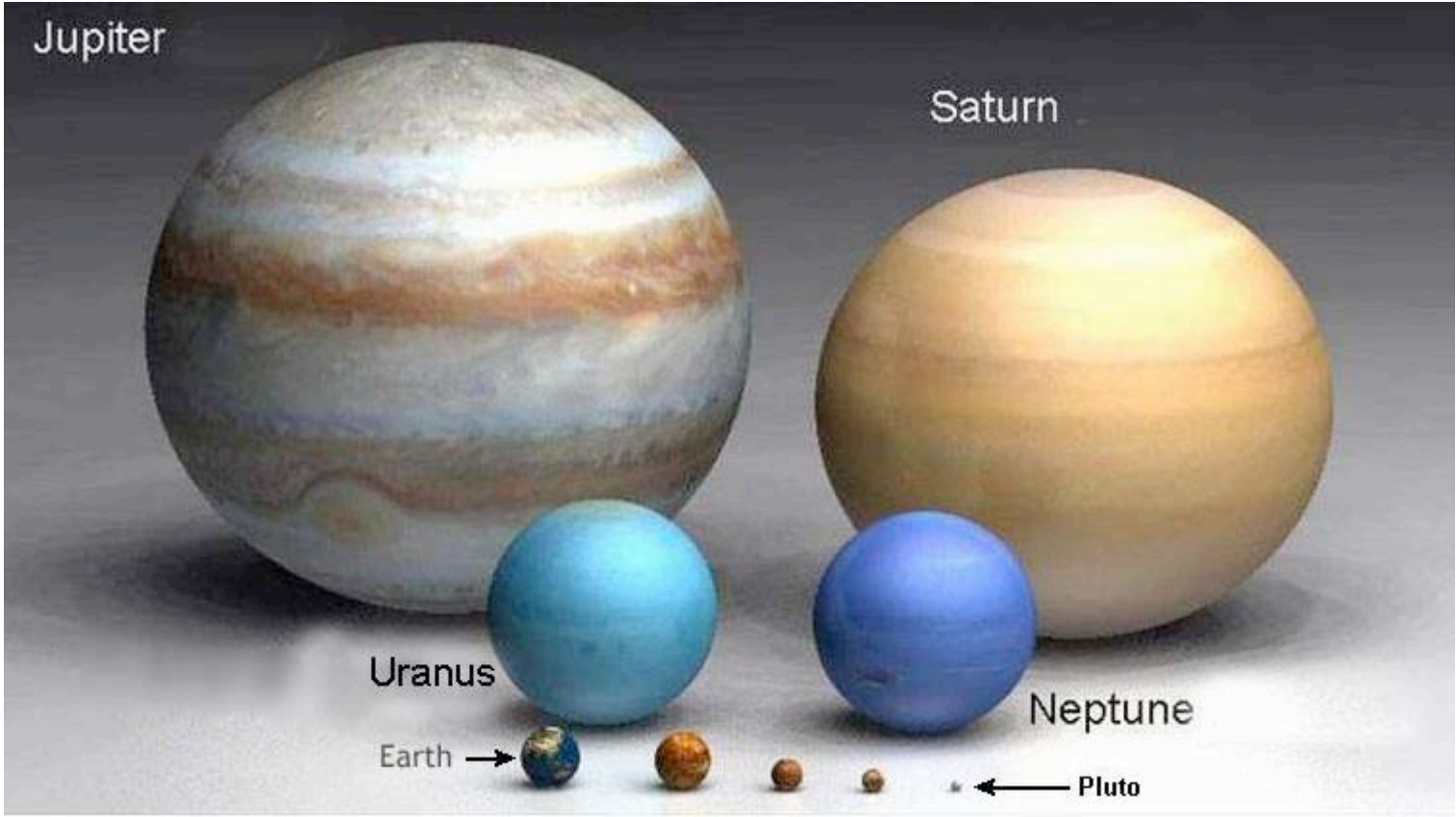
In the summer of 2011, NASA launched the last Space Shuttle into space. Private companies are now bidding for the new space contract. You have been asked to summarize some key points of the universe focusing on the following statistical data: number of moons of the planets, diameters of the planets, and the length of rotation of the planets.

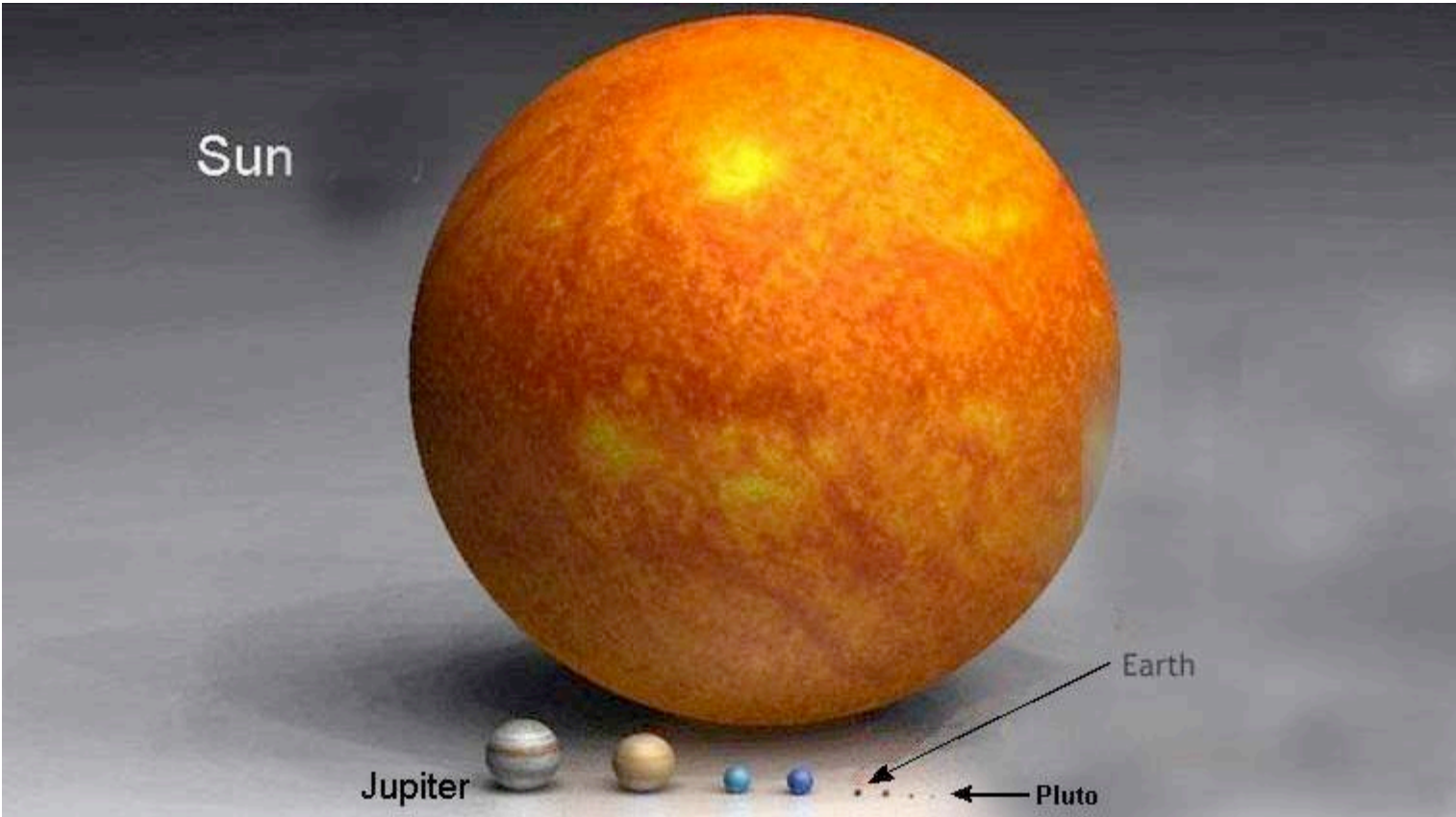
1. Your responsibility is to display the data (number of moons of the planets, diameters of the planets, and the length of rotation of the planets) using both a dot plot and box plot in order to show some of the amazing discoveries this wonderful program has given us.
2. Find the measures of central tendency (mean, median, and mode), the spread (range), and the overall shape of the data.
3. You have discovered a new planet. Name your planet and decide how many moons it has, the length of rotation and the diameter of your planet. How does this new planet change the measures of central tendency, the spread, and the overall shape of your data?











Charting the Planets

Planet	Mercury	Venus	Earth	Mars	Jupiter	Saturn	Uranus	Neptune	Pluto
	Symbol								
Roman god	Mercury	Venus	(none)	Mars	Jupiter	Saturn	(none)	Neptune	Pluto
Greek god	Hermes	Aphrodite	Gaea	Ares	Zeus	Kronus	Uranus	Poseidon	Hades
Distance from Sun (millions of km)	59.7	108.2	149.6	227.9	778.3	1,429.4	2,875	4,504.4	5,915.8
Astronomical Unit (AU)	.4	.7	1	1.5	5.2	9.5	2	30.1	39.5
Diameter (km)	4,880	12,100	12,756	6,794	143,200	120,000	51,800	49,528	2,330
Revolution (Year)	88 days	225 days	365.25 days	687 days	11.86 years	29.46 years	84 years	165 years	248 years
Rotation (Day)	59 days	243 days retrograde	23 hrs 56 min	24 hrs 37 min	9 hrs 55 min	10 hrs 40 min	17 hrs 12 min retrograde	18 hrs	6 days retrograde
Surface Temperature	-300° to 800° F	850° F	-125° to 130° F	-190° to 600° F	-170° F	-215° F	-280° F	-235° F	-385° F
Moons	0	0	1	2	60	31	21	11	1
Rings	0	0	0	0	0	Thousands	11	5	0
Tilt of Axis	.01°	177.4°	23.5°	25.19°	3.13°	26.7°	97.8°	28.3°	119.6°
Atmosphere	Virtually None	Carbon Dioxide	Nitrogen Oxygen	Carbon Dioxide	Hydrogen Helium	Hydrogen Helium	Hydrogen Helium Methane	Hydrogen Helium Methane	Methane +?
Color	Brown	Yellow	Blue Green White	Red	Multi-colored	Multi-colored	Bluish-green	Blue	?