**Title: Out of This World!**

**Brief Overview:**

This learning unit integrates the disciplines of science, language arts, and mathematics by engaging second and third grade students in measurement and graphing activities based on the theme of planets.

Students will use the skills of data collection, organization, representation, interpretation, and inferencing as they pertain to information about each of the nine planets in our Solar System.

**NCTM 2000 Principles for School Mathematics:**

- **Equity:** *Excellence in mathematics education requires equity - high expectations and strong support for all students.*
- **Curriculum:** *A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.*
- **Teaching:** *Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.*
- **Learning:** *Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.*
- **Assessment:** *Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.*
- **Technology:** *Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning.*

**Links to NCTM 2000 Standards:**

- **Content Standards**

**<u>Number and Operations</u>**
Students understand numbers, ways of representing numbers, relationships among numbers, and number systems.

**<u>Geometry</u>**
Students use visualization and spatial reasoning to solve problems both within and outside of mathematics.

**Measurement**
Students understand attributes, units, and systems of measurement. They apply a variety of techniques, tools, and formulas for determining measurements.

**Data Analysis and Probability**
Students pose questions and collect, organize, and represent data to answer those questions; interpret data using methods of exploratory data analysis; and develop and evaluate inferences, predictions, and arguments that are based on data.

- **Process Standards**

**Problem Solving**
Students build new mathematical knowledge through their work with problems; develop a disposition to formulate, represent, abstract, and generalize in situations within and outside mathematics; and monitor and reflect on their mathematical thinking in solving problems.

**Reasoning and Proof**
Students recognize reasoning and proof as essential and powerful parts of mathematics. They make and investigate mathematical conjectures.

**Communication**
Students organize and consolidate their mathematical thinking to communicate with others; express mathematical ideas coherently and clearly to peers, teachers, and others; extend their mathematical knowledge by considering the thinking and strategies of others; and use the language of mathematics as a precise means of mathematical expression.

**Connections**
Students recognize and use connections among different mathematical ideas; understand how mathematical ideas build on one another to produce a coherent whole; and recognize, use, and learn about mathematics in contexts outside of mathematics.

**Representation**
Students create and use representations to organize, record, and communicate mathematical ideas; develop a repertoire of mathematical representations that can be used purposefully, flexibly, and appropriately; and use representations to model and interpret physical, social, and mathematical phenomena

**Grade/Level:**

Grades 2-3

**Duration/Length:**

This unit is divided into three parts. The amount of time to present each part will vary.

**Prerequisite Knowledge:**

Students should have working knowledge of the following skills:

- Ordinal numbers and position on the number line
- Concepts of near and far
- Measuring in inches
- Concept of "distance across" (diameter)
- Concept of ordinal numbers
- Concept of range
- Alphabetizing
- Mathematical representations of bar graph, tree graph, and glyph
- Concept of Fahrenheit temperatures "above 0" and "below 0"
- Brainstorming techniques

**Student Outcomes:**

**Part I**

Students will:

- participate in activities that provide them with factual information on the planets.
- learn a mnemonic device for the planets names based on their distance from the sun.
- order the planets in relation to their distance from the sun.
- be made aware that planets can be grouped according to several categories including: distance from the sun, composition, and size.
- organize, interpret, analyze, and display information using unifix cubes, charts, and a tree diagram.
- complete a tree diagram as a means of evaluating the information about each plant.

**Part II**

Students will:

- measure the width of classroom objects using non-standard units.
- investigate the concept of "inch" as a standard unit of measure.
- determine the diameter of bubbles in inches.
- graph the diameter of bubbles on a bar graph.

**Part III**

Students will:

- categorize planets according to "hot", "cold", and/or "temperate" based on the range of their daily temperatures.

- brainstorm ideas relative to appropriate clothing, food, and drink for each planet based on its range of temperature.
- create a glyph incorporating the brainstorming data.

**Materials/Resources/Printed Materials:**

- Bulletin board showing the sun and planets
- Student Resource Sheets
- Teacher Resource Sheets
- Multi-colored Unifix cubes
- Ingredients for bubble solution: soap, water, glycerin, coloring
- Objects for non-standard measurement: paper clips, unifix cubes
- Inch rulers for standard measurement
- Website: www.nasa.gov

**Development/Procedures:**

**Part I:**

- Ask the students to brainstorm information they know regarding the planets in our Solar System. The information will be recorded on chart paper, and whenever the name of a planet is mentioned, this will be highlighted in a different color in order to emphasize the name of the planets.
- Display the bulletin board with a representation of the Sun and the nine planets. The planets will be scattered throughout the bulletin board **in no particular order.**
- Students will analyze the brainstormed list to see if all the planets have been named. If not, the missing planets should be added and highlighted.
- Present the following scenario to the students:

  Aliens have invaded our Solar System and upset the order of the planets from the sun. Prior to the invasion, the nine planets had been lined up in a particular order. The only piece of information that was left after the invasion was a piece of paper that had the following message**: My Very Educated Mother Just Served Us Nine Pizzas.** Scientists believe this is a clue to the original order of the planets in their distance from the Sun. **Our job is to take this information, and see if we can line up the planets in their original order using the message left by the aliens.**
- Write the following sentence on the board: **My Very Educated Mother Just Served Us Nine Pizzas.**
- Students will brainstorm for possible explanations for the clue.
- Introduce the concept of unifix cubes as a representation for the planets. The teacher will present a chart that pairs a particular unifix cube color with a specific planet. This planet/color combination will remain consistent throughout the activities for Part I.
- Students will complete Activity A and Activity B on Student Resource Sheet #1. Answer key can be found on Teacher Resource #1.

- Introduce the concept that the nine planets can be grouped in many ways according to various attributes. These attributes include distance from the Sun, composition, size, and classification as inner or outer planets.
- Students will complete Activity C on Student Resource Sheets #2 and 3.
- Discuss the concept of inner and outer, and the relationship of this concept with the relative position of the planets.
- Students will complete Activity D on Student Resource Sheet #4.
- Discuss the concept ordinal numbers and the relationship of this concept with the relative position of the planets.
- Students complete Activity E on Student Resource Sheets #5 and 6.
- Discuss the concept of grouping planets according to their composition of either solid or gas.
- Students will complete Activity F on Student Resource Sheet #7.
- Discuss the concept of grouping planets according to their size, either small or giant.
- Students will complete Activity G on Student Resource Sheet #8.
- As an evaluative measure for Part I, students will complete the tree diagram based on the attributes of size, composition, and classification. (Student Resource Sheet #9)

**Part II:**

**Warm Up:**

- Students will use unifix cubes, paper clips, and a ruler to measure various classroom objects in inches around the room.
- Ask which manipulative (paper clips, unifix cubes, or a ruler) best represented an inch to measure classroom objects.

**Student Activity 1:**

- Give students Student Resource Sheet #10 with a chart of classroom items to be measured with unifix cubes, a ruler, and paper clips.

**Warm Up:**

- Give straws, heavy white paper, and bubble solution with tempera paint mixed into the solution to the students. Advise students to dip straws into solution to blow five bubbles on white paper.

**Student Activity 2:**

- Pass out Student Resource Sheet #11and instruct students to plot their data of the five bubbles blown on the bar graph provided.
- Have students interpret and analyze the data on the bar graphs, Student Resource Sheet #12.

**Part III A: Mission Possible**

- Read the opening vignette to the students. (Teacher Resource Sheet #2)
- Brainstorm with students what information they would need to know to determine what to pack for space travel.
- Put up a large Venn diagram based on Student Resource Sheet #13, which also is distributed to the students.
- Ask for student volunteers to come up to the diagram and place taped, color coded symbols of the planets in their appropriate places according to whether the planet is "cold", "sometimes cold/sometimes hot", or "hot". Students will work on their Venn diagrams at their desks. Continue to call on students until all nine planets are displayed. While planets are being placed, engage students in a discussion about why they placed their planet symbols where they did. Ask how the information that they learned earlier on in the unit about each planet's relative distance from the sun informed their decision about planet placement.
- Pass out previously duplicated copies of the completed Planet Temperatures Chart, Teacher Resource Sheet #3. Ask students to compare their copies of the completed chart with the large Venn diagram that they helped to complete. Make any needed adjustments.
- Divide students into cooperative groups with four to five students in each group. Explain to students that their task is to analyze the data and interpret it.

  **Analyze**: look closely at
  **Interpret**: explain
  **Data**: information that you see

- Ask a volunteer to add these vocabulary words written on separate sheets of oak tag, to your cumulative word wall, if you have one.
- Hand each cooperative group a large sheet of paper. Ask each group to choose a "recorder" and a "reporter". Tell the groups to analyze the data on the Venn diagram and interpret the data by telling the recorder facts, like "Venus is the only planet that is always hot" and inferences like, "I'd probably have a better chance of surviving temperature-wise on Mercury or Mars than I would on Saturn."
- Challenge the groups to come up with ten facts and/or inferences based on the data in five minutes. Help and guide students with their reasoning.
- When the timer goes off, see which groups were able to meet the time challenge.
- Choose a "tally communicator", and another student to call on group members to share their information. Write information on the board as the student volunteer calls on group members to share. The "tally communicator" puts a tally mark next to each statement on the board that is written more than once.
- Ask students to review with you what they have learned as a result of these activities. Explore with students how these skills of data gathering and interpretation can be useful in other parts of their lives.

**Part III B: <u>The Great Bulging Backpack Glyph</u>**

- Call students, one at a time, to come up to the front of the classroom and reach deep into the "mystery rocket" (an oatmeal container with a pointed top to look like a rocket) to pull out his/her planet destination. Tell them that their destination should be kept "top secret"! No one should disclose which planet they will visit.
- Distribute a copy of <u>Student Resource Sheet #14</u> to each student. Review the definition of a "glyph" with students and how it is a useful tool for displaying data.
- Explain to students that the next task is to create an accurate glyph that gives correct information about the planet that they will visit.
- Put up a giant, laminated picture of a backpack. Model a sample backpack display with the help of students. Ask them to help you figure out the name of the planet destination based on the information about temperature, food, and alphabetical order that you have chose to display.
- Dismiss students to "quiet" places to complete their glyph. Make sure that there is an abundance of construction paper and glue. Encourage students to be creative about their backpack, making them large enough for an informative bulletin board. Color clues may help the viewer to accurately identify the planet. Remind students that although their preparation should be done on their own, their goal should be to cause the viewer to determine the planet name quickly and accurately.
- Ask those students who finish more quickly to make a list of what food, drink, and clothing they would like to bring with them on their trip.
- When all glyphs are completed, ask the class to come back together.
- Choose a volunteer to share his/her glyph with the class. Without disclosing the name of the planet, encourage anyone with an identical glyph data to join the student at the front of the class. When the whole group is assembled, have them ask the rest of the class to identify the group's planet destination.
- Call on another student with a different planet destination until all of the class has become part of a "planet group".
- Ask students to meet with their "planet groups" to come up with five questions that they would like to ask the other groups. The questions may be from Part III of the unit, but students should also feel free to include questions from Parts I or II of "Out of This World".
- Students come together as a class and take turns asking each other questions. Students may enjoy a Mars Bar each as they review the unit together in conclusion.

**Performance Assessment:**

- Continuous assessment throughout all activities using teacher observation
- Assessment using student resource activity sheets
- Participation in large group brainstorming activities
- Accuracy in completing tables, charts, graphs, Venn diagram, tree diagram, and glyph

**Extension/Follow Up:**

- Determine various ways to find out which planet, e.g.…Mars or Mercury…is the closest to the sun without actually looking at a visual representation of the planets and their relative positions in space.
- Pick a planet, and from the visual representations on the resource sheet, write a paragraph that would include the information relative to its ordinal position from the Sun, its composition, size, and classification as an inner or outer planet.
- Develop a key using information on size, composition, and classification as an inner or outer planet in order to create a glyph as a representation of a particular planet.

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Student Resource Sheet #1

**Background Information:**

The nine planets on our Solar System are: Pluto, Earth, Saturn, Uranus, Mars, Jupiter, Mercury, Venus, and Neptune.

**Activity A:**

Using the information above, place the names of the planets in "ABC" order. Remember "Ma" comes before "Me".

1.
2.
3.
4.
5.
6.
7.
8.
9.

**Activity B:**

Place the name of each planet under the word that represents it in the following sentence:

(Hint: The first planet's name has been filled in for you.)

| My | Very | Educated | Mother | Just |
|---|---|---|---|---|
| Mercury | _____ | _____ | _____ | _____ |

| Served | Us | Nine | Pizzas |
|---|---|---|---|
| _____ | _____ | _____ | _____ |

Teacher Resource Sheet #1

**Teacher Key**

**Background Information:**

The nine planets on our Solar System are: Pluto, Earth, Saturn, Uranus, Mars, Jupiter, Mercury, Venus, and Neptune.

**Activity A:**

Using the information above, place the names of the planets in "ABC" order. Remember "Ma" comes before "Me".

1. Earth
2. Jupiter
3. Mars
4. Mercury
5. Neptune
6. Pluto
7. Saturn
8. Uranus
9. Venus

**Activity B:**

Place the name of each planet under the word that represents it in the following sentence:

(Hint: The first planet's name has been filled in for you.)

| | | | | |
|---|---|---|---|---|
| My | Very | Educated | Mother | Just |
| Mercury | Venus | Earth | Mars | Jupiter |
| Served | Us | Nine | Pizzas | |
| Saturn | Uranus | Neptune | Pluto | |

Student Resource Sheet #2
Representation of Data with Unifix Cubes

**Background Information**:

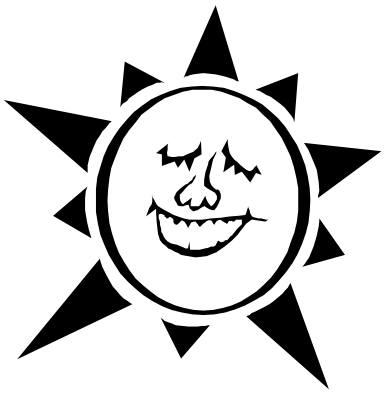
Planets can be grouped in many ways. For example, they can be grouped by their distance from the sun, by their composition and by their size.

For all of the following activities we will be using Unifix cubes. Each planet will be represented by a different color. This will be our color code for the next three activities:

| **Planet** | **Color** |
|---|---|
| Earth | Light Blue |
| Jupiter | Yellow |
| Mars | Black |
| Mercury | Red |
| Neptune | Brown |
| Venus | Orange |
| Pluto | White |
| Saturn | Dark Blue |
| Uranus | Green |
| Venus | Orange |

**Activity C:**

Go back to Activity B. Look at the names of the planets as they appear in order under the sentence: **M**y **V**ery **E**ducated **M**other **J**ust **S**erved **U**s **N**ine **P**izzas. On the next page, use your unifix cubes and the color code to arrange the planets in order of their distance from the sun. Color in the chart on the next page to match the colors of your unifix cubes.



**Planets Distance from the Sun**
(Arranged by color)

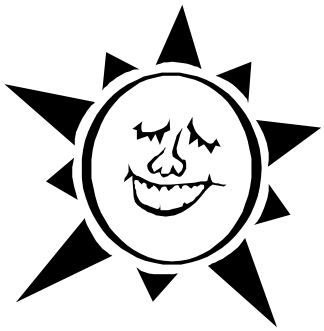
Student Resource Sheet #4
Representation of Data with Unifix Cubes

**Background Information:**

We have just learned that our nine planets can be grouped together in many ways, and that one way to group them is by their distance from the Sun. The first four planets that are closest to the Sun are called the **Inner Planets**. The last five planets are called the **Outer Planets** because they are farthest from the Sun.

**Activity D:**

Look at our planet chart. Using your unifix cubes and the color code, line up the Inner Planets in their order from the Sun. Then take your remaining unifix cubes and according to their color, line up the Outer Planets in order from the sun. Fill in the chart below with the correct colors for the **Inner** and **Outer** planets



| Inner Planets | Outer Planets |
|---|---|
| | |
| | |
| | |
| | |
| | |

Student Resource Sheet #5
Representation of Data with Unifix Cubes

**Background Information**:

When we talk about ordinal numbers, we are referring to the position or place of something. For example, if a child won a relay race, we would say that she or he came in **first**. The child who came in next in the relay race would have come in **second**. First and second are ordinal numbers.

**Activity E:**

Here are the names of the planets in ABC order.

| PLANETS | ORDINAL NUMBER |
|---|---|
| Earth | _____ |
| Jupiter | _____ |
| Mars | _____ |
| Mercury | first___ |
| Neptune | _____ |
| Pluto | _____ |
| Saturn | _____ |
| Uranus | _____ |
| Venus | _____ |

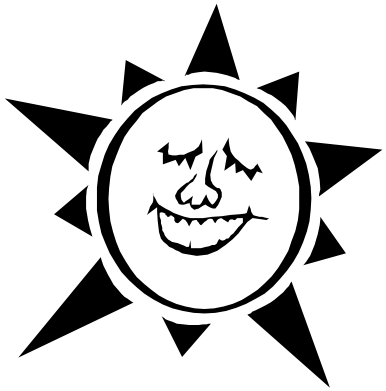
On the next page, assign an ordinal number to each planet based on its distance from the Sun. Place the number next to the name of the planet. The ordinal numbers that we will be using are:

first
second
third
fourth
fifth
sixth
seventh
eighth
ninth

The first one has been done for you.

Student Resource Sheet #6

Take your unifix cubes and show the planets in order of their position from the sun.
Color in the chart below with the same colors as your unifix cube.



Ordinal Position of Planets

| |
|---|
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| |
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| |
| |
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| |
| |

Student Resource Sheet #7
Representation of Data with Unifix Cubes

**Background Information**:

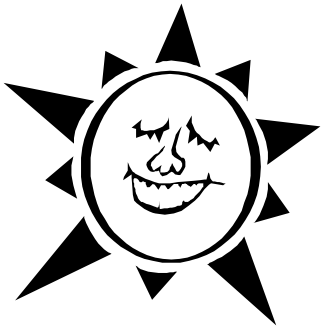
Our nine planets can also be grouped according to composition. When we say composition, we are talking about what the planets are made of. Planets that are made up mostly of rock and metal are called **Rocky Planets**. These planets are very heavy and move slowly. Planets that are made up mostly of gases are called the **Gas Planets**. These planets are light for their sizes. They are just like a big air balloons and they move very quickly.

The **Rocky Planets** are: Mercury, Venus, Earth, Mars, and Pluto.

The **Gas Planets** are: Jupiter, Saturn, Uranus, and Neptune.

**Activity F**:

Using your Unifix cubes, group all the Rocky planets together and then group all the Gas planets together. Remember to look at our color code chart for each planet. After you have finished, color in the chart below for each group -- Rocky or Gas.



| Rocky | Gas |
|---|---|
| | |
| | |
| | |
| | |
| | |

Student Resource Sheet #8
Representation of Data with Unifix Cubes

**Background Information:**

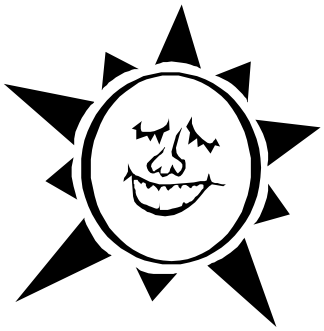
Our nine planets can also be grouped according to size. Planets fall into two categories: **Small Planets** -- because they are so tiny or **Giant Planets** -- because they are so large.

The following planets are the Small Planets: Mercury, Venus, Earth, Mars, and Pluto

The following planets are the Giant Planets: Jupiter, Saturn, Uranus, and Neptune

**Activity G:**

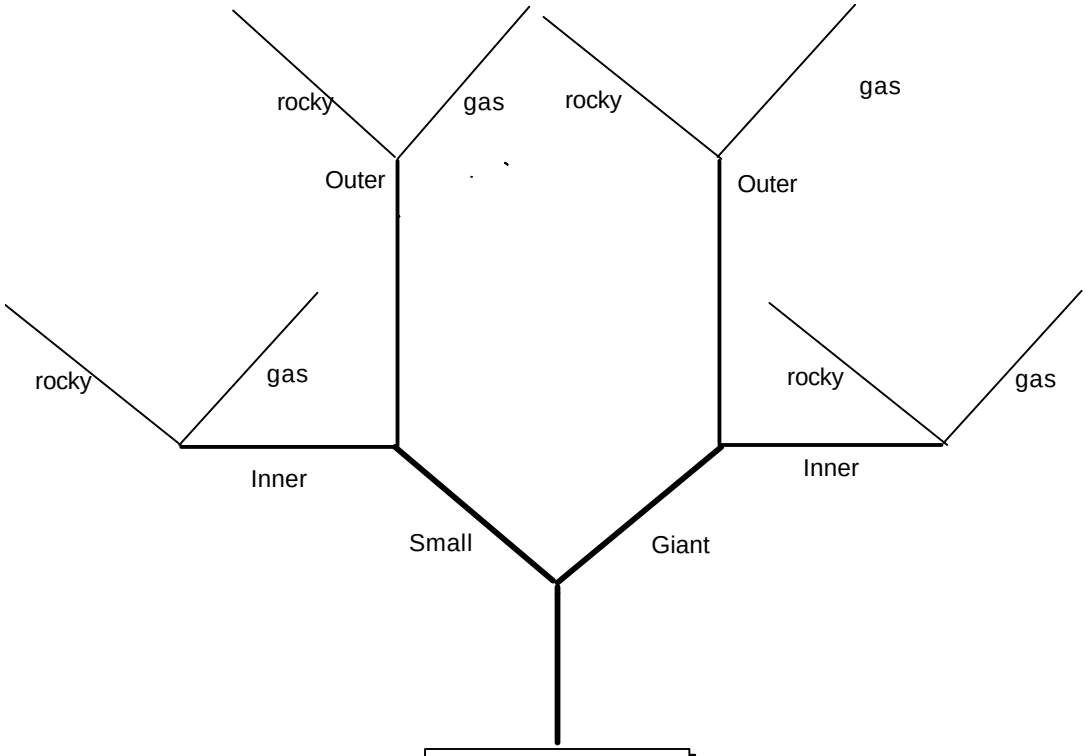
Using your Unifix cubes, group all the Small Planets together and then group all the Giant Planets together. Remember to look at our color code chart for each planet. After you have finished, color in the chart below for each group -- Small and Giant.



| Small | Giant |
|---|---|
| | |
| | |
| | |
| | |
| | |

Student Resource Sheet #9

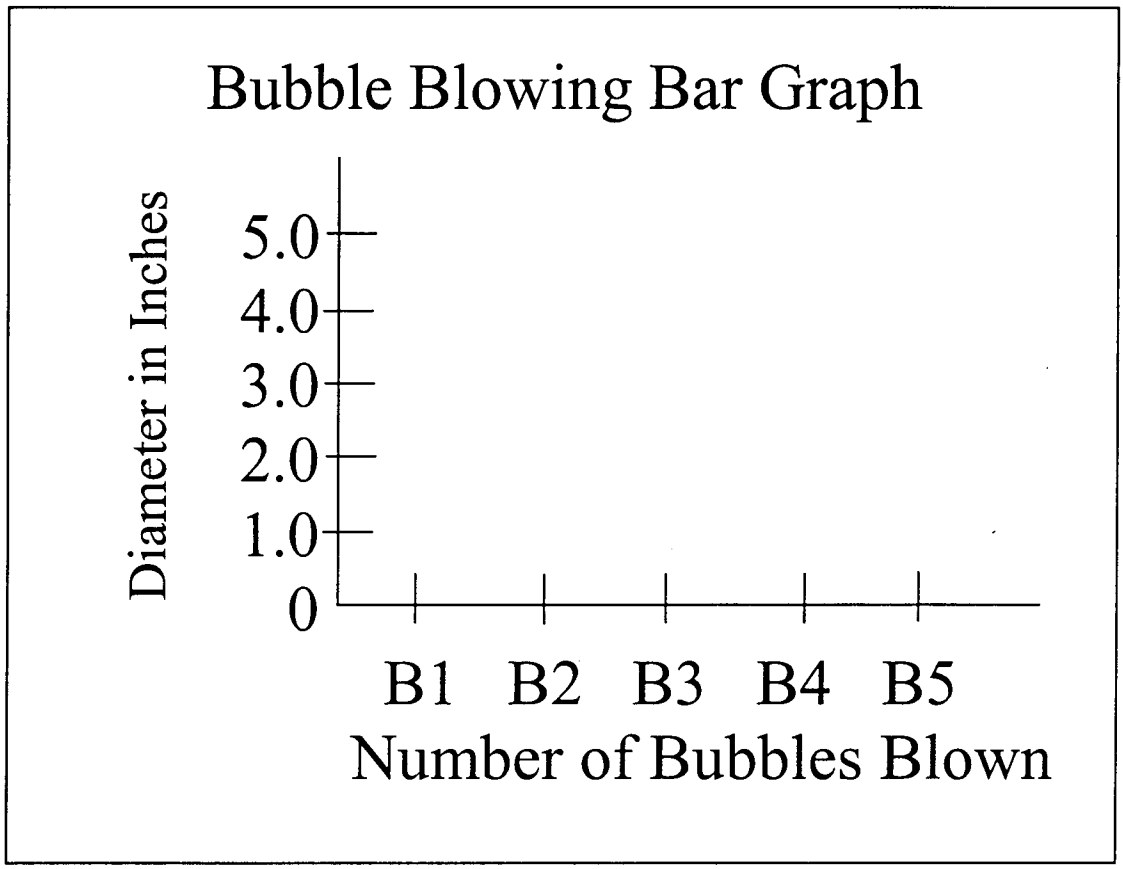
Student Evaluation Form
Part I



Given unifix cubes, paper clips, and a ruler, measure the length in inches of each of the following items found in the classroom:

| | Unifix Cubes | Paper Clips | Ruler |
|---|---|---|---|
| Side of Desk | 22 inches | 15 inches | 14 inches |
| Chair | 20 inches | 15 inches | 15 inches |
| Pencil | 10 inches | 8 inches | 7.5 inches |
| Pen | 8 inches | 6 inches | 5.5 inches |
| Glue | 8.5 inches | 6 inches | 5 inches |
| Lunchbox | 11.5 inches | 10 inches | 10 inches |
| Notebook | 9 inches | 8.5 inches | 8.5 inches |
| Textbook | 10 inches | 8.5 inches | 8.5 inches |
| Your Name | 3 inches | 2.5 inches | 2.5 inches |

After blowing five bubbles, measure the diameter of each of the five bubbles and record the data on the bar graph below.



1. Which bubble has the largest diameter?

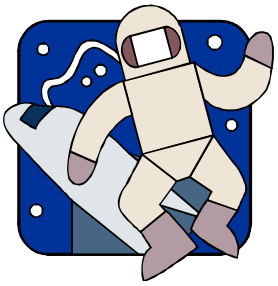
2. Which bubble has the smallest diameter?

3. If you subtract the smallest bubble diameter from the largest bubble diameter, what is the difference in the two bubble sizes?

4. Are there more bubbles with small diameters or large diameters?

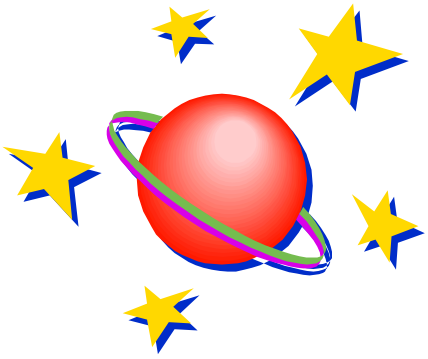
5. Compare diameter of bubbles blown to actual pictures of planets and their diameters. Look to see which planet could be compared to a bubble.

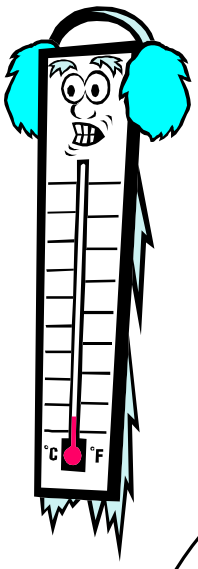
# Mission Possible Vignette



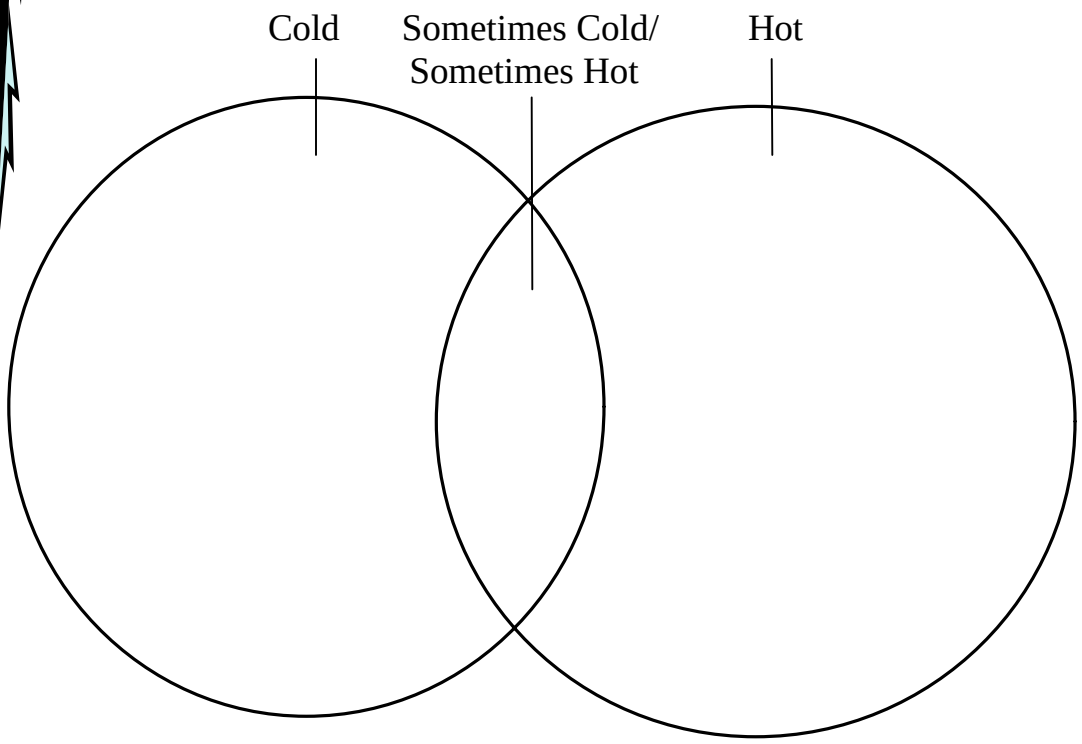
You have done such an excellent job in space school. You have each been chosen to travel across one of the nine planets of the solar system. Decide what you will need to pack in your space travel backpack for your stay on your chosen planet.

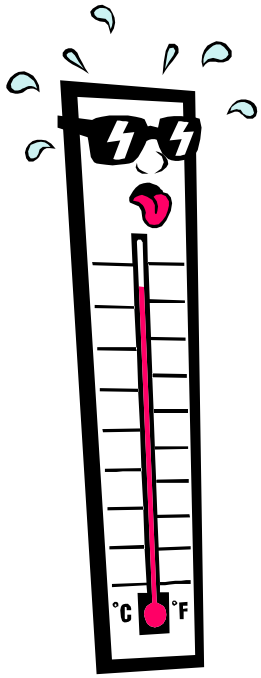
First, categorize the planets by their temperature using your Venn diagram. Once you know the temperature you will be able to decide what you need to pack.






## Planet Temperature Chart

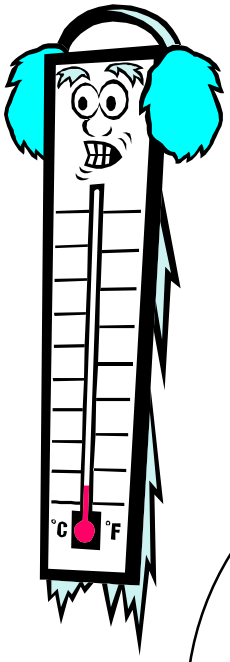


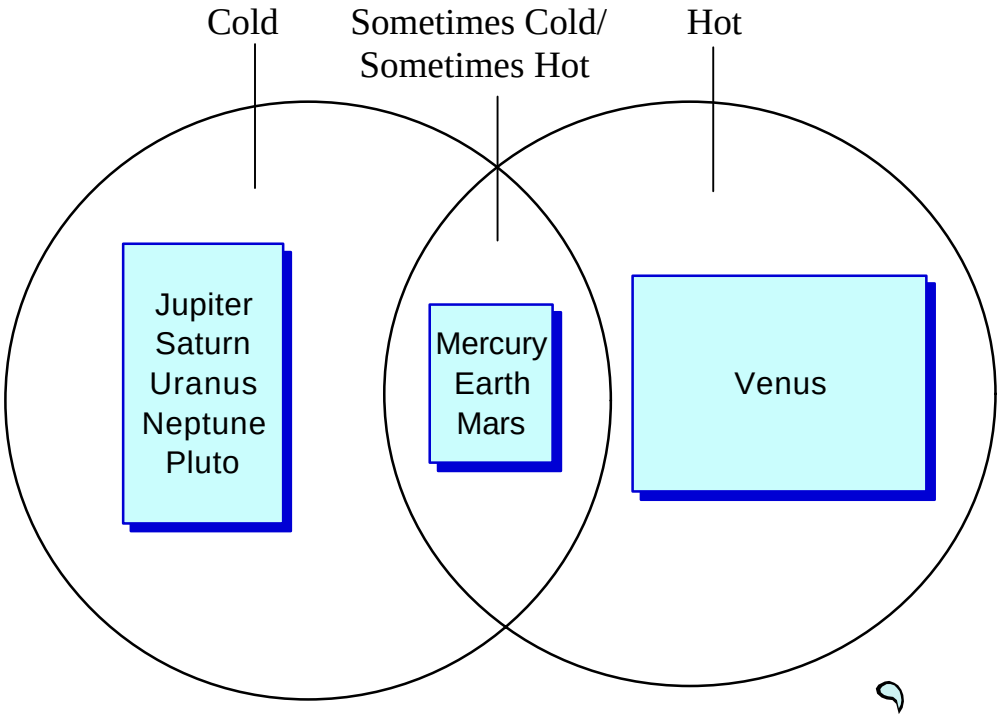



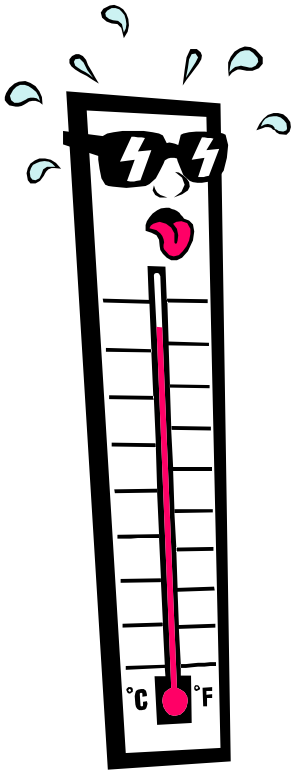
Teacher Resource Sheet #3

**Teacher Key**

# Planet Temperatures



Student Resource Sheet #14

# The Great Bulging Backpack Glyph

**Name of Astronaut**:

## Glyph Key:

**Number of straps:** 1 = Always very cold
2 = Sometimes cold/sometimes hot
3 = Always very hot

**Food:**

 = Close to the sun

 = Medium close to the sun

 = Far from the sun

**Buckle Shape:**

 = Name of planet begins with letter A-J

 = Name of planet begins with letter K-P

 = Name of planet begins with letter Q-Z