

# **Our Solar System:** **A Squared Away Unit**

---

# ● Table of Contents ●

<b>Introduction to Our Solar System . . . . .</b>	<b>1</b>
<b>General Directions . . . . .</b>	<b>10</b>
Using the Concept Content Rubric . . . . .	15
Jigsaw Groupings. . . . .	18
<b>Special Directions and Resources for Teachers</b>	
Before Starting This Unit . . . . .	19
Summary Materials List . . . . .	20
Styrofoam Display Models . . . . .	22
Preparing Styrofoam-Ball Planets. . . . .	24
Paper Cut-out Display Models. . . . .	25
Preparing Paper Cut-out Planets . . . . .	26
Preparing Model Supports and Mounts. . . . .	27
Preparing Model Bases. . . . .	29
Preparing the Sun and Constellations . . . . .	31
Setting up the Classroom Planetarium . . . . .	33
Setting up the Classroom Planetarium Map. . . . .	35
Preparing Horizon Screens. . . . .	36
Preparing Scale Models . . . . .	37
Scale-Model Planet Sizes. . . . .	40
Scale-Model Orbit Measurements . . . . .	41
Planet Summary Page . . . . .	42
<b>Lesson Plans</b>	
Instruction Block One: Solar System Formation, Description of Planets . . . . .	43
Instruction Block Two: Scale of Solar System and Other Objects . . . . .	57

# ● Table of Contents ●

Instruction Block Three: Revolution and Rotation .....	74
Instruction Block Four: Seasonal Constellations, Morning and Evening Stars, Circumpolar Constellations, and the Zodiac .....	86
Instruction Block Five: Golden Square Challenge .....	107

## **Duplication**

Stop/Think/Draw/Write Template .....	112
Paper-Planet Patterns .....	113
Time Disk Left .....	114
Time Disk Right .....	115
Cooperative Group Work Rubric .....	116
Concept Content Rubric .....	117
Pretest/Posttest .....	118
Introduction .....	122
How Our Solar System Formed .....	123
The Real Story About Pluto .....	125
News Flash: New Buttons Found! .....	126
Button Sets .....	127
What's a Planet? .....	128
Mercury .....	129
Venus .....	130
Earth .....	131
Mars .....	132
Jupiter .....	133
Saturn .....	134
Uranus .....	135
Neptune .....	136

# ● Table of Contents ●

Getting to Know Your Planet .....	137
Jigsaw Task 1 .....	138
Jigsaw Task 2 .....	139
Jigsaw Task 3 .....	140
Jigsaw Tasks 4, 5, and 6 .....	141
Jigsaw Decisions: Dividing Planets Into Two Groups.....	142
Stop/Think/Draw/Write 1 .....	143
Quick Team Quiz 1 .....	144
Square One Test .....	145
Ptolemy vs. Copernicus .....	146
Ptolemy vs. Copernicus Projects.....	148
Reference Page for Your Calculations .....	149
Appreciating Distances .....	150
Sunlight Travels to Planets .....	151
Traveling in the Space Shuttle to Other Planets .....	152
Stop/Think/Draw/Write 2 .....	153
Math Challenge .....	154
The Ecliptic.....	155
Stop/Think/Draw/Write 3 .....	156
Quick Team Quiz 2.....	157
Square Two Test .....	158
Rotation and Revolution .....	159
Stop/Think/Draw/Write 4 .....	161
Rotation and Revolution Worksheet .....	162
Revolution and Wandering Planets .....	163
Wandering Planets Worksheet .....	164

# ● Table of Contents ●

Stop/Think/Draw/Write 5 .....	165
The Fate of Early Small Bodies .....	166
Stop/Think/Draw/Write 6 .....	168
The Modern Solar System .....	169
The Modern Solar System Activity .....	172
Modern Solar System Activity Directions .....	173
Quick Team Quiz 3 .....	174
Square Three Test .....	175
The Grand Calendar Maker .....	177
Falling in a Circular Orbit .....	180
Observing Seasonal Constellations .....	181
Seasonal Constellations Chart .....	182
Observing Planets .....	183
Planets Chart .....	184
Stop/Think/Draw/Write 7 .....	185
Zodiac Constellations Chart .....	186
Stop/Think/Draw/Write 8 .....	187
Different Views From Earth .....	188
Quick Team Quiz 4 .....	189
Square Four Test .....	190
Why Do Comets Appear Suddenly? .....	192
Golden Square Stop/Think/Draw/Write .....	195
Special Awards .....	196
<b>Teacher Feedback Form .....</b>	<b>198</b>
<b>Release Form for Photographic Images . . .</b>	<b>199</b>

## Instruction Block One

*Solar System Formation, Description of Planets*



Small group

### Teaching tip

Be certain you have given the **Pretest** and corrected it so that you have some idea of your students' pre-knowledge.



### Teaching tip

Use the **Concept Content Rubric** or **Cooperative Group Work Rubric** to award points to teams. Keeping track of points sometimes motivates teams to make stronger efforts.  
4-rating = 10 points,  
3-rating = 7, 2-rating = 4,  
1-rating = 1.



Read or say

### Teaching tip

If you would rather have the students read this introduction on their own, you can download it from the CD and create a handout.



## Lesson Plan

Day 1

### 1. Introduction to *Squared Away*

- Distribute the folders and review the roles and responsibilities that will change *only* after they take a Squared Away test.
- Discuss the importance of cooperative work and review briefly the **Cooperative Group Work Rubric** in the folder.
- Allow teams two minutes to come up with a team name that has to do with astronomy. Have the Recorders write their team name neatly on the folder.

### 2. Introduction to *Our Solar System*

- Read or retell:**

#### *Introduction*

Like most students, you know that we live on Earth, one of a group of planets that belong to our solar system. Since before recorded time, ancient peoples have watched the Sun, moon, planets, and stars rise in the eastern night sky, arc overhead, and disappear in the west. From these observations, early astronomers incorrectly deduced that Earth was at the center of the solar system and that all the heavenly bodies revolved around us. This geocentric, or earth-centered, interpretation lasted for a long time.

#### *The observer's view*

These early astronomers were handicapped because they only could see space from the surface of our planet. Imagine how an ant would view the plates of food on a picnic table. Everything would be on a flat surface and some things would be hidden behind others. That's how our view of the other planets looks. Now imagine the same picnic table as seen by a bird in a tree over that table. All items on the table would be clearly visible, including distance and direction from plate to plate.

### **The Classroom Planetarium**

Eventually, Nicolaus Copernicus and others described the solar system as it really is, with the Sun at its center and the planets orbiting around. But in this *Squared Away* unit, you will have a powerful advantage—models! You will build a Classroom Planetarium that will allow both the ant's view across the solar system and the bird's down-looking view. You will use models to recreate the Sun and the planets in orbit around you. Other markings will serve as constellations of stars. You will be able to imitate the daily turning of Earth and its yearly progress around the Sun. Through the use of these models, you will be able to study the solar system in ways that were not available to ancient astronomers, nor to many people today.

- b. Engage student in a brief discussion about observing the night sky. Have they ever noticed anything special? Has anyone looked the night sky within the last two days? Did they realize that when they look at the night sky, it's not that different from what ancient peoples saw when they looked up at night?

### **3. Formation of the solar system**

- a. Give Managers copies of **How Our Solar System Formed**. Read as a whole class or as a team activity.
- b. After reading the both pages, ask the Leaders to brainstorm with their teams to come up with 5–6 steps that summarize how the solar system was formed. The Recorders should write the steps on lined paper. These steps should be very brief, like an outline. Give them this hint to start them:

Over 4 billion years ago the whole process started with the **nebula** and then gravity took over.

- c. After five minutes or so, ask the teams to report their steps. Compare the steps among teams. Discuss the wording and the order of the steps. They should include 1) Nebula → 2) Gravity causes dust and gas to collect into clumps. → 3) Clumps grow larger. → 4) Forms a spinning disc → 5) Gravity forms Sun at center. → 6) Planets form and clear their orbits.



Read or say



Read or say

## Instruction Block One

### Solar System Formation, Description of Planets

#### Teaching tip

Notes about the button activity:



This activity is designed to replicate the changing classifications needed to accommodate the addition of new members that are outliers of a standing group. The linkage between this activity and the reclassification of Pluto is that in both cases the discovery of additional members required a new group and a new sorting question.

Large groups are typically parsed into smaller groups as a means of identifying similarities and to bring order to an otherwise heterogeneous mass.

The mechanism used in this activity is the dichotomous key. The biggest stumbling block for students trying to develop a key is that they tend to pose open-ended questions—"How tall is the student?" Key questions must be of the "either/or" format—"Is the student taller than 50 inches?" This will be an important task for you, to assist the teams, checking and correcting questions. This will be especially important in the first round of button sorting.

Some students may think that each button square represents two buttons, not that each square includes a top and bottom view of the same button. Correct this misunderstanding as necessary. Some students may be unfamiliar with post-style buttons and therefore won't think of them as having no hole through the button. It will be helpful for you to display a few of this button type and ask someone to explain how it is sewn onto a garment.

#### Teaching tip

Students need to commit to memory



the three attributes of all planets. They should know why Pluto was reclassified.

## 4. The Real Story About Pluto

- Give Managers the handout entitled **The Real Story About Pluto** and the *top half* of the **Button Sets** sheet. Be certain students only see the top half of the button set for the first part of this activity. Read through the handout as a whole-class activity. Stop, and have teams generate the first button question.
- After they have sorted the buttons for the first time using their question, give Managers the handout **News Flash: New Buttons Found!** and the second set of buttons from bottom half of the **Button Sets** page. Read the page. Stop, and develop the second button question.
- Have students sort all the buttons using both questions they designed.
- Discussion.** The students were happy with their first division, but then realized they needed to have a new division. Why did they need a new division? (Answer: They found a lot of new two-holed buttons.) How did this change the organization of buttons? (Answer: The original division was "holes" or "no holes" buttons. The lonely two-holed button seemed to be an anomaly in the four-holed group when there was only one two-holed button. With the addition of all the new two-hole buttons, it became clear that the two-holed buttons were not really part of the four-holed buttons, but part of their own group. The result was three groups: no holes, four-holed, and two-holed.)
- Give Managers copies of **What's a Planet?** for each member of their team. Decide if you want this to be a team activity or a whole-class activity. If a team activity, Readers must read the handouts while the other team members read along.
- Discussion.** Have team Leaders summarize why Pluto was reclassified. Reinforce the concept that to be a true planet, the celestial body must have three attributes (orbits Sun, round, and has cleared orbit). Pluto has two of the three because it does not clear its orbit. Tell them that astronomers have now found 15 dwarf planets and expect to find more.

## 5. Getting to Know Your Planet

- Tell teams what planet(s) they are responsible for. Give Managers copies of the planet information sheets for their team and the handout called **Getting to Know Your Planet**.
- This is a team activity. Remind students of their roles. Team members should read along as the Reader reads the information sheet. The



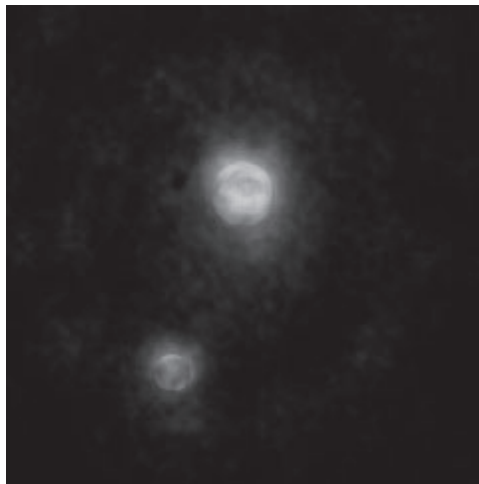
whole team should work together to answer the questions on the **Getting to Know Your Planet** sheet. The Leader should make sure that all the answers are correct and the numbers are written clearly so they will be easy to read tomorrow.

- c. As the students work, set up the materials for making the planet display models.

## 6. Making display models of the planets

- a. Give Managers the materials to make the display (non-scale) planets. Go over the directions from the "Special Directions and Resources for Teachers" section (pages 22–30). Allow students a couple of minutes to visit the Internet to see the color of their planet. Provide paint, markers, or crayons for students to use to decorate their planet. It should look like the drawings or photos on the Internet.
- b. **Homework.** Introduce the students to the old memory aid of **My Very Excellent Mother Just Served Us Nice (Pizza)**.

Now that Pluto is no longer considered a planet, invite teams to come up with a new mnemonic. Many will only change "Nice Pizza" to "Nachos", and that's okay. The goal here is to have students memorize the order from the Sun. Have them memorize the **correct spelling** of the planets, too.



### Teaching tip

The summary of planet attributes is found on page 42.



### Teaching tip

Decorating the planets can be done at centers, for homework, or during class time. For paper planets, it is advisable that students let the glue dry overnight.

## Instruction Block One

*Solar System Formation, Description of Planets*

### Instruction Block One

*Day 2*

**Square One concepts/skills**—*Students will understand that:*

- our solar system includes a central star, eight planets, several dwarf planets, an asteroid belt, comets, and asteroids
- eight named planets orbit in order around the Sun
- planets are recognizable by general size, color, and special attributes (rings, spots, etc.)
- the eight planets fall into two broad categories: dense, rocky terrestrial planets inside the asteroid belt with few moons and no rings (Mercury, Venus, Earth and Mars), and less dense gas giants outside the asteroid belt with many moons and rings (Jupiter, Saturn, Uranus, and Neptune).

#### **Materials**

- Wide colored markers or crayons to color graphs

#### **Duplicate**

- **Jigsaw Task 1**—*1 per team*
- **Jigsaw Task 2**—*1 per team*
- **Jigsaw Task 3**—*1 per team*
- **Jigsaw Tasks 4, 5, and 6**—*1 per team*
- **Jigsaw Decisions**—*1 per team*
- **Stop/Think/Draw/Write 1**—*class set*
- **Quick Team Quiz 1**—*class set*
- **Square One Test**—*class set*

#### **Teaching tip**

Use the **Concept Content Rubric** or **Cooperative Group Work Rubric** to award points to teams. Keeping track of points sometimes motivates teams to make stronger efforts.



#### **Lesson-plan schedule:**

- Review of mnemonic: M-V-E-M-J-S-U-N
- Jigsaw activity
- Stop/Think/Draw/Write 1
- Quick Team Quiz 1
- Square One Test
- Optional Activities for Instruction Block One

## Lesson Plan

### Day 2

1. Arrange the room and send students into teams. Give Managers the team folders.

### 2. Mnemonic

Invite teams to share how they are going to remember the order of planets from Mercury to Neptune. Consider recognizing clever mnemonics that are actually easy to remember. Have Leaders quickly quiz their team to make sure they know the order.

### 3. Classifying planets: jigsaw activity

- a. Students need their planet information sheets and their **Getting to Know Your Planet** worksheet for the jigsaw activity. If the team made two models, they need the information on the two planets. When they leave their home team, they should take their papers with them.
- b. This will be a **jigsaw activity**. Individual students from every team will leave their team and form four new teams that must complete specific tasks. When the tasks are complete, the individuals will return to their original teams to share the information they have discovered. See page 18 for more information about jigsawing.
- c. Send students to their Task teams. Each team member should bring his/her copies of their planet handouts to the Task team.

Leaders make up Task 1 team.  
Readers make up Task 2 team.  
Writer (Recorders) make up Task 3 team.  
Managers make up Tasks 4, 5, and 6 team.

- d. Distribute Tasks handouts, one per member of the Task team. (All Leaders get a copy of handout for Task 1, etc. Students will need markers or crayons to complete the Task graphs.
- e. Ask one person in each team to read the Task and allow all the team members to share their planet information so that the tasks are completed for all eight planets. All team members must have the information for all eight planets before they leave the Task group.
- f. Allow Task teams 5–10 minutes to work on their tasks. Walk around the room as they work to give individual attention to anyone who may be off-track. Remind students to work carefully and make sure they understand so they can explain to their teammates when they return to their original group.



Small group

Allow Task teams 5–10 minutes to work



#### Teaching tip

Consider duplicating a couple of extra copies of all Task papers in case a student makes a big mistake that they can't correct neatly.