National Aeronautics and Space Administration

Teaching Scientific Comparison Writing with *Pluto and Charon*

strategy guide

Common Core State Standards for English Language Arts Literacy in Science & Technical Subjects, Grades 6–8

CRAFT AND STRUCTURE

RST.6–8.5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.

INTEGRATION OF KNOWLEDGE AND IDEAS

RST.6–8.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

RANGE OF READING AND LEVEL OF TEXT COMPLEXITY

RST.6–8.10. By the end of grade 8, read and comprehend science/technical texts in the grades 6–8 text complexity band independently and proficiently.

Scientific Comparison Writing

About this strategy. Scientific comparison writing is a thoughtfully structured genre that uses the langauge of comparison and rich description to draw parallels between two or more things. Based on careful observations, comparisons are the basis of classification in science and provide scientists with evidence for describing the relationships among things in the natural world. In a scientific comparison, similarities are usually grouped together in one paragraph, while differences are grouped in another. For example, in the article *Pluto and Charon*, the first paragraph describes characteristics that Charon shares with other moons in the Solar System; the second paragraph describes contrasts between Charon and other moons. When teaching students to write scientific comparisons, a graphic organizer called a Venn diagram is often a useful tool for organizing details and information prior to writing.

Pluto and Charon

About the article. *Pluto and Charon* compares the dwarf planet Pluto with its relatively large moon Charon. Like other moons in our Solar System, Charon orbits Pluto. Unlike other moons, however, the size and mass of Charon make it orbit Pluto in an unusual way. Because Charon is so large compared to Pluto, the two Solar System objects are desribed as orbiting a spot between them, rather than around a spot in the center of the planet. In contrast, most planets are more massive than their moons, so the orbital center is the center of the planet.

Flesch-Kincaid Grade Level Readability: 7.4; Lexile Framework for Reading: 1030

Getting Ready

- ★ Make one copy of the Scientific Comparison Writing copymaster and one copy of the *Pluto and Charon* article for each student.
- ★ Identify and highlight examples of comparison language in the article (e.g., *it has one thing in common with*, *is different from*, *are more similar to each other*).
- ★ Create a large Venn diagram. Label one circle "Charon" and the other circle "Other Moons."
- ★ Preview the URLs referenced in the teaching instructions.

Educational Product
Educators & Students | Grades 6–8

Disciplinary Literacy in Science

Literacy is an integral part of science. Practicing scientists use reading, writing, and oral communication to explain their findings, conduct research, connect to the work of other scientists, and communicate ideas to a variety of audiences. Situating literacy instruction in a content area, such as science, has several benefits. First, it helps students develop ways of thinking that are characteristic to the discipline. By building background knowledge, science also helps students access high-level content in text that often can be difficult to grasp. Finally, science provides an authentic reason for reading—to better understand the science ideas under study. Reading, like science, can be an act of inquiry when there are genuine questions to be investigated.

AAAS Benchmarks for Scientific Literacy

★ **4G/H1** Gravitational force is an attraction between masses. The strength of the force is proportional to the masses and weakens rapidly with increasing distance between them.

★ **4G/M1** Every object exerts gravitational force on every other object. The force depends on how much mass the objects have and on how far apart they are. The force is hard to detect unless at least one of the objects has a lot of mass.

★ **4G/M2** The Sun's gravitational pull holds Earth and other planets in their orbits, just as the planets' gravitational pulls keep their moons in orbit around them.

★ **4F/M3b** If a force acts toward a single center, the object's path may curve into an orbit around the center.

★ **3A/E3** Measuring instruments can be used to gather accurate information for making scientific comparisons of objects and events and for designing and constructing things that will work properly.

Scientific Comparison Writing with *Pluto and Charon*

Activate and Build Background Knowledge

1. On the board, write the following guiding question: **"Why do scientists compare different objects in the Solar System?"**
2. Pose the guiding question and invite students to turn to a neighbor to talk about their ideas.
3. Project the images that contributed to the discovery of Pluto's moon Charon, found at http://solarsystem.nasa.gov/multimedia/display.cfm?IM_ID=572.
4. Explain that careful observations and comparisons can lead scientists to make new discoveries or to change previous explanations of old discoveries. Provide time for students to examine the images before eliciting student comparisons of the two images.

Set Purpose for Reading

1. Introduce the article *Pluto and Charon* and tell students it compares the orbital pattern between the dwarf planet Pluto and its moon Charon to the orbits of other moons around their respective planets.
2. Explain that the article uses comparison language to clarify similarities and differences. Project your highlighted copy of the article and discuss a few examples with students.
3. Distribute one copy of the article to each student and invite students to read it with a partner, working together to identify evidence in the text that describes similarities and differences between Charon and other moons.
4. After students have finished reading the article, point out the Venn diagram you prepared. Explain that similarities between the objects being compared are recorded in the overlapping secton of the circles and differences in the outer parts of the circles. Invite pairs to share similarities and differences they found between Charon and other moons while reading. Record ideas in the Venn diagram.

Integrate Text and Experience

1. Invite a pair of students to demonstrate the orbits shown in the illustration on page 2 of the article.
2. Project two images from the Hubble Space Telescope found here: http://www.nasa.gov/mission_pages/

Scientific Comparison Writing with *Pluto and Charon* (continued)

hubble/science/pluto-moon.html. Prompt students to make observations that compare the image taken on June 28, 2011 with the image taken on July 3, 2011.

3. Project the view of combined images showing the orbital pattern of each moon, found at http://www.nasa.gov/images/content/571868main_i1123ay.jpg. Discuss how scientists compare to make explanations about new discoveries.
4. Add new ideas to the Venn diagram to make comparisons between the orbit of these objects and others that students read about in the article.

Apply New Ideas

1. Distribute one copy of the Scientific Comparison Writing copymaster to each student and point out the structure of a comparison paragraph (topic sentence, similarities, transition sentence, differences, conclusion).
2. Model how to organize ideas from the Venn diagram in paragraph form and give students time to work on their own paragraphs. Remind students to use comparison language.
3. Discuss making comparisions by returning to the guiding question **Why do scientists compare different objects in the Solar System?**
4. See below for additional and updated NASA resources.

Additional Support for Students with Dyslexia

★ **Modify reading materials.** The student articles and copymasters are available in the Dyslexie font, a typeface developed to help individuals with dyslexia read more fluently. For more information, see http://www.studiostudio.nl/.

★ **Provide explicit instruction.** Consider previewing the text with students and using different annotations to signal similarilites and differences when reading the article. For instance, you might have students circle evidence of similarities between the two objects being compared and underline evidence of differences between the two objects. You might also point out categories of comparison, such as size, distance, and mass.

★ **Make concrete connections.** Introduce students to a Venn diagram, using two familiar objects. For instance, have students compare and contrast two animals (e.g., a dog and a cat) or two different sports (e.g., soccer and baseball).

★ **Enhance information processing.** To support students in making comparisons, pull out key phrases or sentences from the article and type them onto a piece of paper. Cut each phrase or sentence into a strip. Prior to reading the article, work with students to physically sort the strips into the sections of a smaller Venn diagram.

NASA Resources

NASA Podcast: http://www.nasa.gov/multimedia/podcasting/twan_transcript_012006.html

Pluto Data: http://solarsystem.nasa.gov/planets/profile.cfm?Object=Pluto&Display=OverviewLong

Diameter of the Moon Classroom Activity: http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/Diameter_Moon.html

Hubble News Releases: http://hubblesite.org/newscenter/archive/releases/2012/32/

Dwarf Planet Activity: http://www.dawn-mission.org/DawnClassrooms/dwarf_planet/index.asp

Orbit App: http://spaceplace.nasa.gov/how-orbits-work/

Name _____ **Date** _____

Scientific Comparison Writing

Title of article:_____

_____

(Topic sentence)

_____

_____

(Similarities)

_____

_____

_____

_____

_____

(Transition sentence)

_____

_____

(Differences)

_____

_____

_____

_____

_____

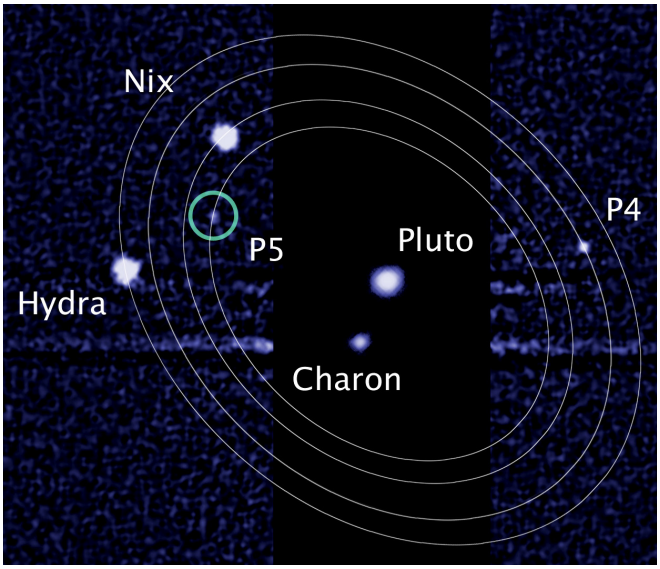
(Conclusion)

_____

_____

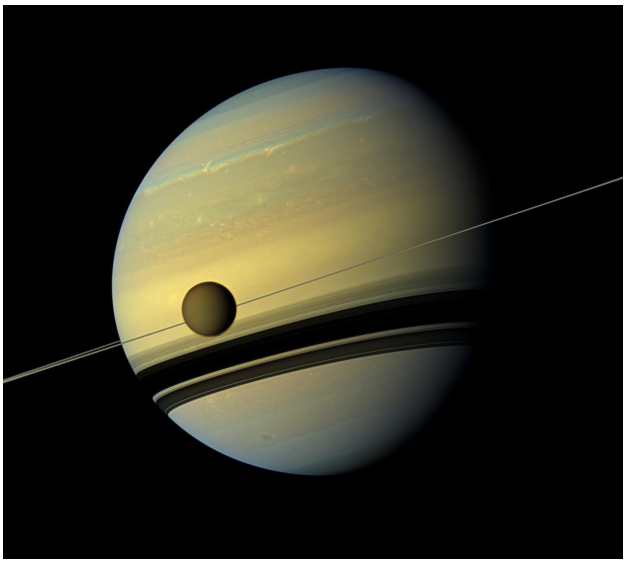
Pluto and Charon

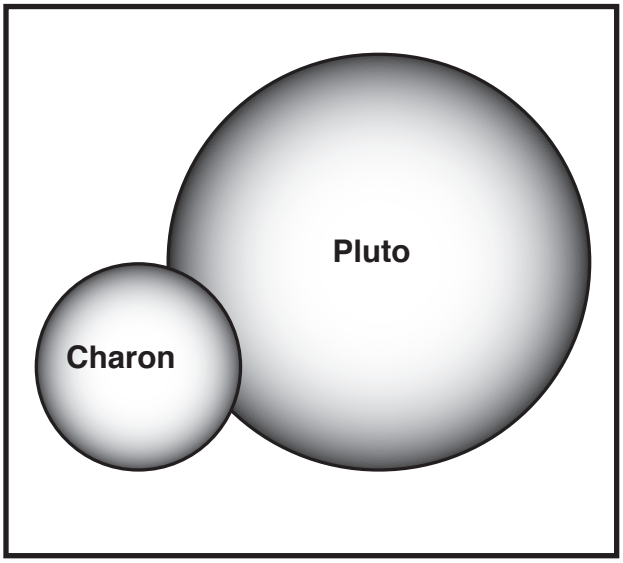
Pluto is not classified as a planet anymore. Some call it a dwarf planet, but it has one thing in common with most of the true planets in the Solar System—it has moons. Scientists have observed five moons, but there may be more. Pluto's largest moon, Charon, is different from other moons in the Solar System in a few important ways. In fact, it is so different that some scientists say that Pluto and Charon are more like a double-dwarf planet instead of a dwarf planet with a moon.



A space telescope's photo of Pluto and its five moons, July 2012.

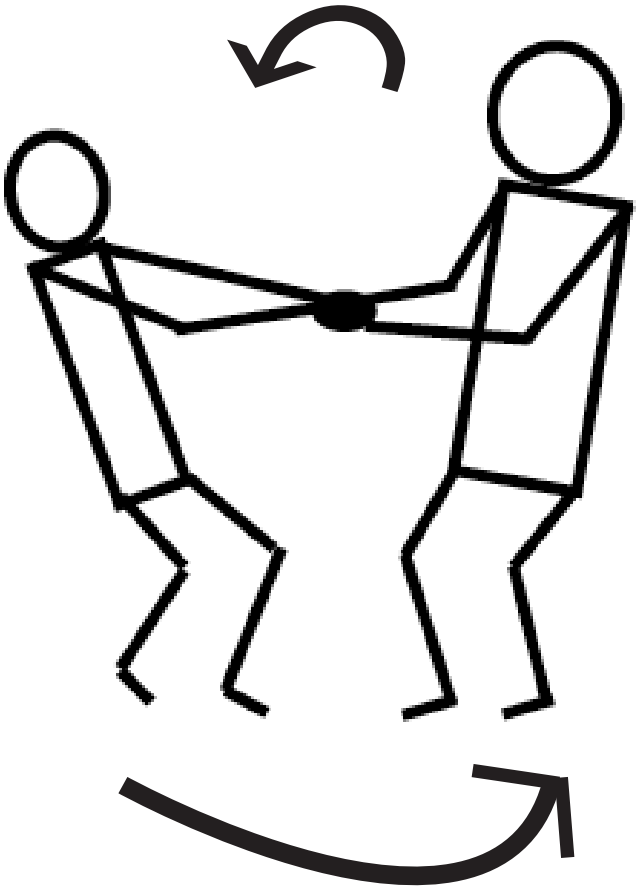
In comparison with Pluto, Charon's size and mass make it special. The diameter of Charon is just over half the diameter of Pluto. Even though that makes it smaller than Pluto, it means that Charon is big for a moon. No other moon in the Solar System is so similar in size to the planet that it orbits. For example, Saturn's largest moon, Titan, is only about 1/23rd the diameter of Saturn itself. Charon's mass is about 1/8th the mass of Pluto. Although that is a much smaller mass, the masses of Pluto and Charon are more similar to each other than the masses of any other pair of planets and moons. Saturn is about 4,300 times more massive than Titan.


Saturn is about 23 times wider than its largest moon, Titan.



Pluto is only about two times wider than its largest moon, Charon.

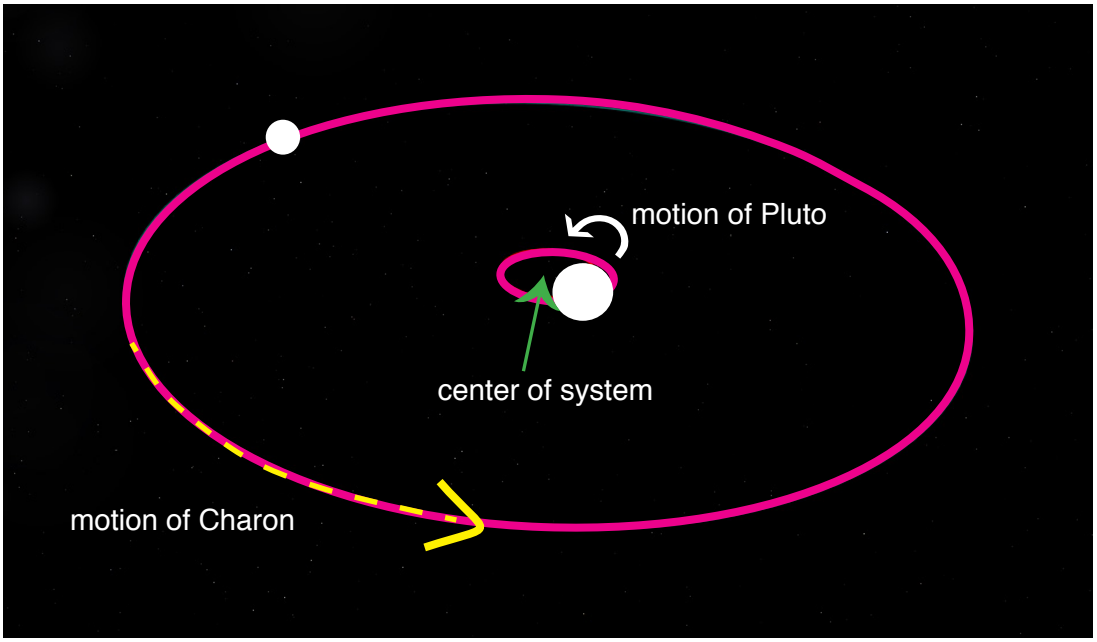
The similarity of the masses of Charon and Pluto makes them orbit in an unusual way. You could say that Charon does not really orbit Pluto—Pluto and Charon orbit around each other! The center of the Pluto–Charon system is somewhere between the two.



Think of Pluto and Charon as two people, a heavier person and a lighter person, both holding hands and spinning. Their arms and hands are like the gravity that hold Pluto and Charon in orbit around each other. The lighter person moves around the heavier person, but the heavier person moves around, too. They both orbit a spot near where their hands meet, but closer to the heavier person.

It is the same with Pluto and Charon. They are always pulling toward each other with the force of gravity, and they orbit a spot between them that is about 2,000 kilometers from the center of Pluto.

Other objects and their moons affect one another in a similar way but with an important difference. For instance, Earth and its Moon both orbit a spot that is between the center of the Moon and the center of Earth, but that spot is actually inside Earth. It is the same way with all other moons and planets in the Solar System. They orbit a spot between their centers, but that spot is always inside the planet because the planet is much bigger and more massive.



All photographic images courtesy of NASA.