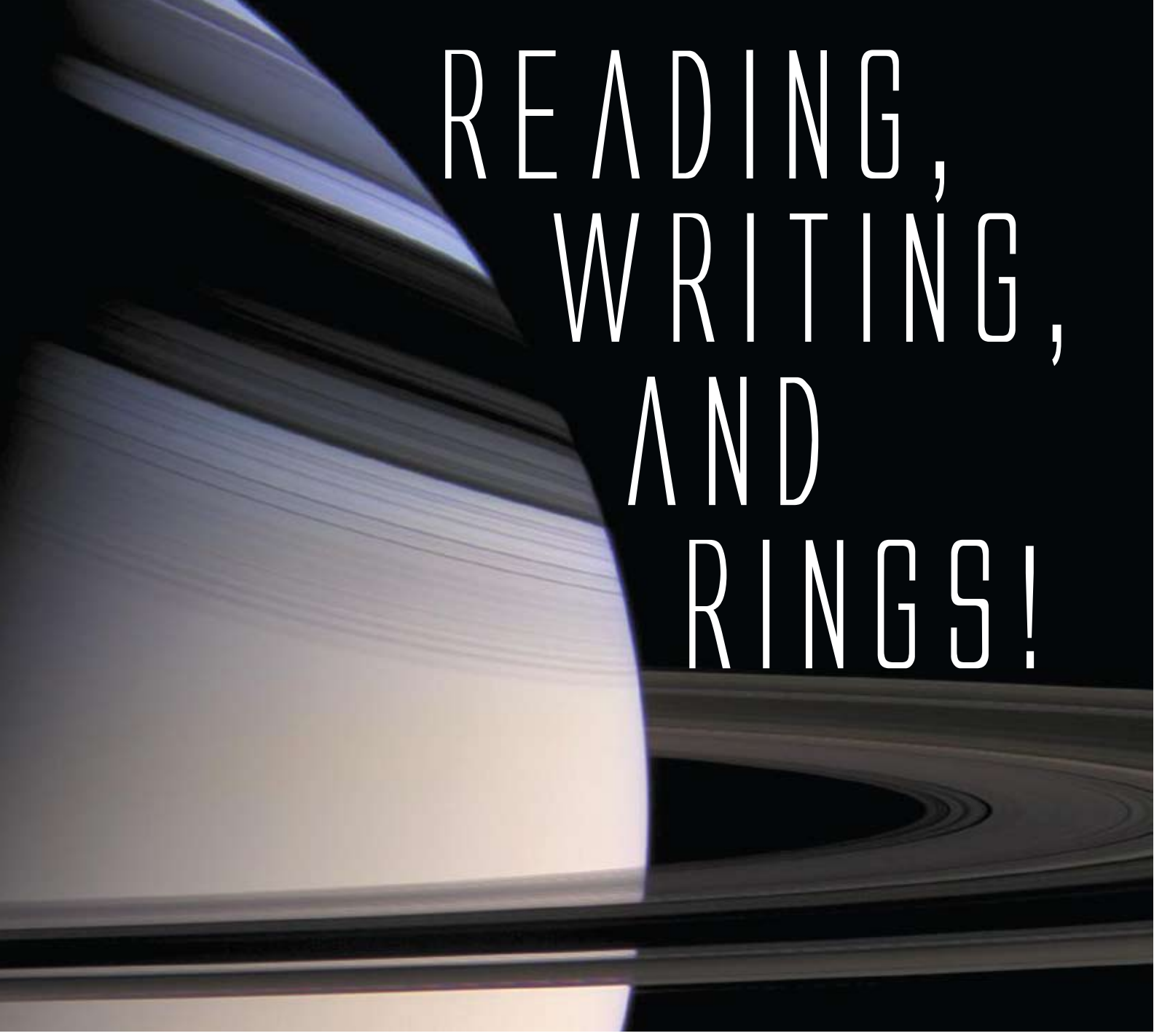

READING, WRITING, AND RINGS!

Free science-and-literacy units bring students inside NASA's Cassini-Huygens *mission to Saturn.*

By Pamela Aschbacher, Erika Li, and Art Hammon

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We face increasingly complex challenges in our world. To prepare for this, students need to stop thinking of science as only a body of knowledge to be memorized, and start treating science as a special way of thinking and investigating the natural world they live in. Students can develop this sophisticated understanding of science through doing some scientific investigations and engineering design projects in which language arts skills play an integral part.

Trying to accomplish those goals by inventing or adapting lessons that integrate science and literacy well, however, can be overwhelming. Like many teachers, you may feel you simply do not have the time. A set of new, free curriculum materials for grades 1–4 called *Reading, Writing, and Rings!* might meet your needs. It was created by a team of elementary teachers, literacy experts, and scientists just for this purpose. The materials can be downloaded from the web (see Internet Resources), and each lesson addresses specific language arts and science standards, so they can be taught as a full unit or used individually to supplement your required curriculum in language arts or science. We—a science teacher and education outreach specialist and two evaluators of educational programs—have been studying how these materials are being used by teachers, science specialists, and after-school teachers, and we now share the findings with you.

The Materials

Reading, Writing, and Rings! includes one unit for grades 1–2 and another for grades 3–4, although many of the lessons could be adapted for any elementary grade. Each unit has a teacher's manual with 10–12 lessons, graphics and photos, and a set of four reading booklets. The teacher's manual provides lots of support for each lesson including: learning objectives, national science standards and language arts standards addressed, background information about the science topics, teacher preparation guide and materials checklist, and website addresses for additional information and photos of Saturn. A free DVD *Ring World* is also available to complement the lessons.

One thing that sets these materials apart is that the lessons employ real data—never-before-seen photos of the mysterious world of Saturn and its moons and icy satellites—continuously sent back to Earth from the *Cassini-Huygens* spacecraft now orbiting Saturn even as you read this. Students are excited to peek "inside" a real space mission and are much more motivated to do the kinds of reading, writing, and speaking that scientists and engineers do. They also love being able to go online to find the latest photos and discoveries posted on the web as they happen through 2011, when the mission is scheduled to end.

This curriculum can also help students deepen their understanding of astronomy and engineering as living fields of inquiry with exciting career choices. Through the materials, students can learn ways that we can use technology to go where humans cannot in order to obtain new information about our world.

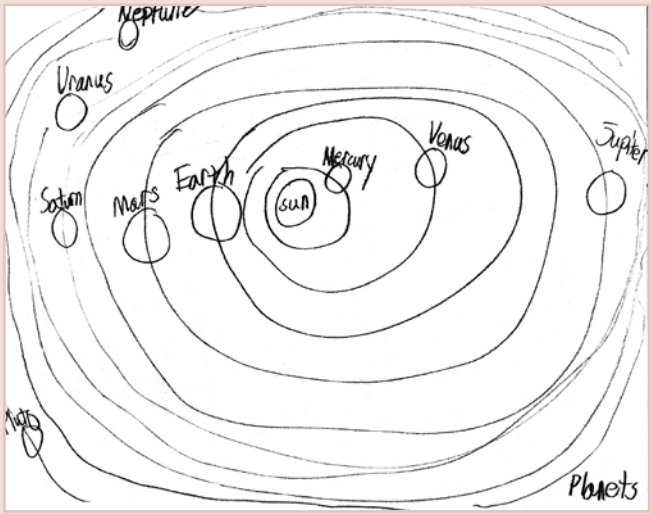
Integrating Literacy

Four nonfiction reading booklets collectively called *Introducing Saturn* accompany the curriculum. Teachers felt the booklets provided all the background knowledge they needed and gave young students valuable practice in learning to read nonfiction for information. And as students learn key concepts and interesting facts about Saturn and the solar system, they also develop literacy and scientific problem-solving skills through the activities.

Figure 1.

Example of progress in student understanding over time.

Prelesson drawing



Postlesson drawing

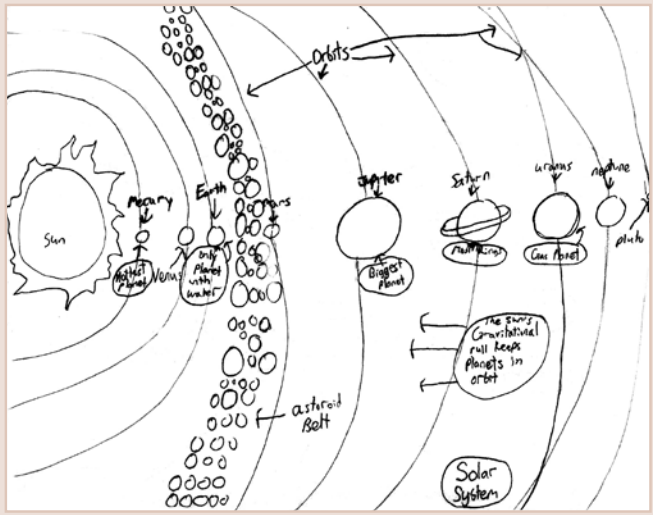


Figure 2.

A student's end-of-unit essay.

What I know about Saturn

By _____

I know that Saturn is far from the Sun. It is cold on Saturn. It is the sixth planet from the sun. It has no life. The black line on Saturn is the Cassini Di-vion [sic]. Saturn has rings, storms, and clouds. It goes counter-clockwise. On Saturn, 9 earths can fit on the diameter. Saturn's rings have ice and rocks. Sat-urn has lots of different gases. Saturn looks solid but it is not [sic] is made of different gases.

The Cassini Spacecraft was named after Jon Dominec [Jean Dominique Cassini]. The brown stripes on Saturn are clouds. Saturn is freezing. Saturn is huge like Jupiter. Saturn is enor-mous. The inner and outer rings are separated. Saturn has lots of storms. Saturn has a rocky area and a metallic hydrogen gas. Saturn's rings are out of lots of things. If somebody lives on Saturn they will die very quickly. Saturn has lots of things on it.

COURTESY OF THE AUTHORS

The Reading, Writing, and Rings! curriculum also provides opportunities for students to practice scientific illustration.

For example, in one grades 1–2 lesson, students learn that Saturn has many moons (52 at last count) and that *Cassini-Huygens* may continue to discover even more. Students examine images of 18 moons provided in the materials to see how they are alike and different, sort the images several times in different ways, and then write a descriptive paragraph describing the moons and explaining their sorting methods. Writing prompts for science notebooks include: *What are some of the differences among Saturn's moons? How many ways did you sort the moons of Saturn? What were those ways?* This activity encourages students to pay attention to a variety of characteristics such as color, shape, size, and surface texture. As students select data from a larger set and then describe their selection criteria, they are thinking and writing much like real scientists.

In other lessons, students are challenged to address issues similar to those the NASA team faced when designing the spacecraft. For example in grades 3–4, students are to devise and test a parachuting probe they design and make from inexpensive materials such as paper cups, cardboard cylinders, foil, plastic pieces cut from trashbags, corks, craft sticks, and tape. The probe must be able to fall from a high point, land safely, and float in liquid like the *Huygens* probe.

Students first experiment with parachutes made of tissue paper and kite string carrying metal washers in order to figure out how to fold and toss the chutes so that they open and how to slow the fall of the washer. Then they can experiment with different parachute designs and materials. Be sure students understand to change only one variable at a time in order to have a "fair" test. Then they can find out how well their best designs protect their probes when launched from a high point.

In this lesson, students also use discussion and writing as a tool for reflecting on their design process, solutions, and questions for future inquiry using the Saturn Discovery Log Writing Prompts (e.g., "In what ways did your design meet the criteria?" What changes would you like to make in your design? Why?" and "What do you think are the biggest challenges of being a spacecraft engineer?")

Cassini's compelling discoveries help students feel the intellectual excitement that motivates real scientists.

Student Assessments

Many of the lessons recommend that students keep a written record of their ideas in a science notebook, which can help students see the progress they have made. One teacher commented, "Writing in a science journal made what they learned more concrete for them and probably helped them remember it. Closure by journaling was so important." Teachers can also use the notebooks to informally gauge student progress and identify problem areas.

For example, comparing the drawings in Figure 1 (p. 49) reveals increased knowledge over time by this second-grade boy. He began the unit already knowing the names and relative locations of planets. Over the course of several lessons he learned that Saturn has rings and is larger than Earth but smaller than Jupiter; he also learned some other planet features and relative sizes and about the existence of the asteroid belt (although the drawing reveals he has a misconception about its location—it's actually between Mars and Jupiter).

Similarly, Figure 2 shows a second-grade student's end-of-unit essay about the *Huygens* probe landing on Titan. The student was a very shy English language learner who virtually never spoke or wrote in class until this unit, which the teacher credited with achieving a breakthrough for her. The length of the essay surprised the teacher and indicated to her that the Saturn lessons had inspired the student's deep thinking and newfound language expression. In fourth grade now, the student continues to participate successfully and with confidence in school.

Time for Space

Teachers use these lessons in a variety of ways. For example, one second-grade teacher taught all the lessons during the last three weeks of the year. Another teacher spread the lessons throughout the year to deepen her students' understanding of science while enlivening the required practice of literacy skills. Other teachers chose some of the lessons to complement required district science units, such as weather or the solar system, while after-school program staff said learning about a real space mission helped motivate their students in all grades to read, write, and discuss ideas.

In learning about Saturn in depth, students learn much about the solar system—from space weather patterns and geological features to solar object paths—so students can learn the fundamental concepts as well as analytical and process skills they need to succeed on state science standards. *Cassini's* compelling discoveries help students feel the intellectual excitement that motivates real scientists, which tends to increase their own interest in possible science and engineering careers.

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Internet Resource

Cassini-Huygens: Education Reading, Writing, and Rings!
http://saturn.jpl.nasa.gov/education/index.cfm

Connecting to the Standards

This article relates to the following *National Science Education Standards* (NRC 1996).

Content Standards

Grades K–4

Standard A: Science as inquiry
- Understanding about scientific inquiry

Standard B: Physical science
- Position and motion of objects

Standard D: Earth and Space
- Objects in the sky

Standard E: Science and Technology
- Abilities of technological design
- Understanding about science and technology

Standard E: History and Nature of Science
- Science as a human endeavor

National Research Council (NRC). 1996. *National science education standards*. Washington, DC: National Academy Press.