



## Teaching Text Structure with *Understanding the Scale of the Universe*

### 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.

#### KEY IDEAS AND DETAILS

**RST.8–8.9.** Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.

#### 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.

### Text Structure

**About this strategy.** Understanding text structure enables readers to more strategically monitor comprehension and make sense of information while reading. Informational science text often contains text structures, such as compare and contrast, description, or time–order, that differ from more familiar narrative structures of fiction text. When students are explicitly taught how to identify and utilize a text's structure, they can focus their reading on key concepts and distinguish main ideas from extraneous details. In addition, attending to signal words in different text structures can highlight important relationships between ideas. Time–order text structure often includes signal words (such as *first*, *next*, *last*, *before*, *during*, *since*) or references to specific dates. For instance, in the article *Understanding the Scale of the Universe*, several paragraphs signal dates, which emphasizes the historical nature of this text.

### *Understanding the Scale of the Universe*

**About the article.** *Understanding the Scale of the Universe* reports key historical points in the development of scientists' expanding ideas of the vastness of space. One technique for investigating other galaxies was to measure stars' brightness to determine distances in space. Another very important tool was the use of the Hubble Telescope in space for clearer photos of other galaxies deep in space. These methods enabled scientists such as Henrietta Swan Leavitt and Edwin Hubble to discover galaxies beyond the Milky Way. This text includes informational text features of several photographs and captions.

**Flesch-Kincaid Grade Level Readability: 9.5; Lexile Framework for Reading: 1220**

### Getting Ready

- ★ Make one copy of the Time–Order Text Structure copymaster for each student.
- ★ Make one copy of the article *Understanding the Scale of the Universe* for each student.
- ★ Preview the URLs referenced in the teaching instructions.

## 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

- ★ **4A/M1bc** The universe contains many billions of galaxies, and each galaxy contains many billions of stars. To the naked eye, even the closest of these galaxies is no more than a dim, fuzzy spot.
- ★ **4A/M2de** Some distant galaxies are so far away that their light takes several billion years to reach Earth. People on Earth, therefore, see them as they were that long ago in the past.
- ★ **2C/M2b** Using mathematics to solve a problem requires choosing what mathematics to use; probably making some simplifying assumptions, estimates, or approximations; doing computations; and then checking to see whether the answer makes sense.
- ★ **3A/E2** Technology enables scientists and others to observe things that are too small or too far away to be seen otherwise and to study the motion of objects that are moving very rapidly or are hardly moving at all.
- ★ **1A/M2** Scientific knowledge is subject to modification as new information challenges prevailing theories and as a new theory leads to looking at old observations in a new way.

## Teaching Text Structure with *Understanding the Scale of the Universe*

### Activate and Build Background Knowledge

1. On the board, write the following guiding question: "**How did scientists long ago learn about distant galaxies?**"
2. Pose the guiding question and invite students to turn to a neighbor to talk about their ideas. Invite students to share with the class what they discussed with their partners.
3. Project and view the brief video about the discovery of the Andromeda Galaxy, which can be found at <http://hubblesite.org/newscenter/archive/releases/star/variable-star/2011/15/>.

### Set Purpose for Reading

1. Introduce the article *Understanding the Scale of the Universe* and explain that it tells about how scientists discovered distant galaxies, such as Andromeda. Explain that the article is organized in chronological sequence, also called time–order text structure. Tell students that understanding a text's structure makes it easier to understand.
2. Brainstorm familiar time–order words, such as *first, next, last*. Project and preview the article, pointing out the use of less familiar time–order words, such as *since, before, by, or on (date)*.
3. Distribute copies of the article and direct students to highlight dates and key information for how scientists changed their understanding over time. Challenge students to find at least five instances of time–order word use. Instruct students to pair up after reading and share the time–order words they found in the article.
4. Project a copy of the Time–Order Text Structure copymaster and point out how it is organized (one event goes in each space, similar to a time line). Solicit time–order words to record on the left-hand side of each box. Examples include *Since the 1600s, Before 1900, and By 1920*.
5. Invite students to locate the one event that does not include an exact date or time frame (Henrietta Swan Leavitt's method for measuring star brightness). Have students tell how they could represent this time frame on the graphic organizer (e.g., Between 1868 and 1921) and explain their reasoning (e.g., because those are the dates when she was alive). Ask where this information is found in the article. [In the caption.]
6. Distribute copies of the Time–Order Text Structure copymaster. Instruct students to select one date to record in each box and to record notes for each event.

## Teaching Text Structure with *Understanding the Scale of the Universe* (continued)

### Integrate Text and Experience

1. Rewatch the Andromeda Galaxy discovery video and ask students to listen for new time–order phrases in the narration (e.g., *less than a century ago*, *in the early 1920s*, and *recently*). Compare the use of these time–order words to those used in *Understanding the Scale of the Universe*.
2. Direct students' attention to the question at the beginning of the fifth paragraph of the article: *What evidence would you need to show that a smudge of light is actually at a distance far beyond the stars of the Milky Way?*
3. Explain that historical perspectives help us understand how scientists' ideas about space change over time. Discuss the development of tools for scientific investigation, such as telescopes, and their role in scientific discovery.

### Apply New Ideas

1. Return to the guiding question **How did scientists long ago learn about distant galaxies?** and prompt students to read just the photograph captions to gather information that answers this question.
2. Consider using the Time–Order Text Structure copymaster with other space science topics, such as the pictorial history of rockets, which is found at [http://www.nasa.gov/pdf/153410main\\_Rockets\\_History.pdf](http://www.nasa.gov/pdf/153410main_Rockets_History.pdf).
3. 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/>.
- ★ **Make concrete connections.**  
Have students make personal time lines, using important events from their own lives. Brainstorm events and then use a graphic organizer such as the Time–Order Text Structure copymaster to sequence events. Add time–order language to retell these events in narrative form.
- ★ **Enhance information processing.**  
Print out the descriptions from a pictorial history of rockets, found at [http://www.nasa.gov/pdf/153410main\\_Rockets\\_History.pdf](http://www.nasa.gov/pdf/153410main_Rockets_History.pdf). Select any number of events and cut them apart. Practice placing events in chronological order.
- ★ **Engage another learning modality.**  
Learn more about scientists' present-day investigations of the Milky Way Galaxy by listening to the podcast about SIM PlanetQuest found here: [http://www.nasa.gov/mp3/143175main\\_PlanetQuestPodcast04.mp3](http://www.nasa.gov/mp3/143175main_PlanetQuestPodcast04.mp3).

### NASA Resources

HubbleSite: <http://hubblesite.org/newscenter/archive/releases/star/variable-star/2011/15/>

History of Hubble: <http://www.nasa.gov/vision/universe/watchtheskies/hst15.html>

Andromeda Galaxy Image: [http://www.nasa.gov/multimedia/imagegallery/image\\_feature\\_009.html](http://www.nasa.gov/multimedia/imagegallery/image_feature_009.html)

Chronology of Lunar and Planetary Exploration: <http://nssdc.gsfc.nasa.gov/planetary/chrono1.html>

Calculate Star Distances: [http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/SMII\\_Problem5.html](http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/SMII_Problem5.html)

Calculate Star Brightness: [http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/SMII\\_Problem21.html](http://www.nasa.gov/audience/foreducators/topnav/materials/listbytype/SMII_Problem21.html)

Name \_\_\_\_\_ Date \_\_\_\_\_

## Time–Order Text Structure

Title of article: \_\_\_\_\_

| Date | Event |
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# Understanding the Scale of the Universe

Since the 1600s, scientists have accepted the fact that Earth is just one of several planets that orbit the Sun. Then, it became clear that the Sun is just one of many, many stars that make up the Milky Way Galaxy.



The Milky Way Galaxy surrounds us. We see it from the inside looking out. The arch-shaped band of stars across the sky is seen from Cerro Paranal, Chile. *Photo credit: Bruno Gilli/ESO.*

Before 1900, the word *galaxy* just meant the Milky Way. There were no other known galaxies. Since the invention of the telescope, astronomers had observed thousands of what we now know to be galaxies—but no one then knew what they were. Astronomers didn't know that they were separate from the Milky Way. They thought they were seeing star clusters or nebulae in our own Milky Way Galaxy.

By 1920, many scientists began to think that some of the objects they were seeing must be other galaxies like the Milky Way but separate from the Milky Way. They spoke of these separate clusters of stars as island universes.

Not all astronomers agreed with the idea of island universes beyond the Milky Way. They preferred the idea that these clusters were part of the Milky Way and were no farther away than the other star clusters and glowing nebulae. For years there were disagreements and debates, with neither side having quite enough evidence to prove its case. What evidence would you need to show that a smudge of light is actually at a distance far beyond the stars of the Milky Way?

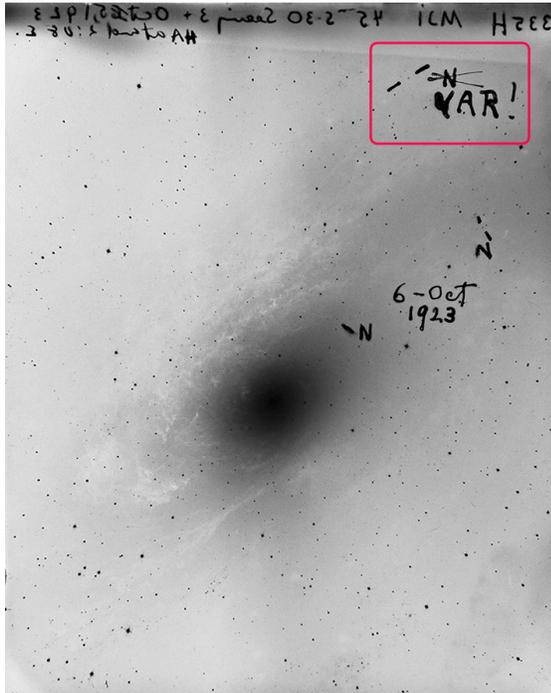


Henrietta Swan Leavitt

An astronomer named Henrietta Swan Leavitt (1868–1921) working at the Harvard College Observatory found a way to calculate the distance to a certain type of star in our galaxy by looking at astronomical photographs and studying how these stars regularly change in brightness. The data she collected and the techniques she developed became standard tools for astronomers to measure large distances in space.

Then in 1923, an astronomer named Edwin Hubble (1889–1953) used the biggest telescope available at the time to make the clearest photographs

of the Andromeda Galaxy. Before 1920, astronomers could not see if other galaxies were made of stars, glowing gas, or something unknown. Hubble's photograph showed that the Andromeda Galaxy was made of individual stars, and he even found stars of the type that Henrietta Swan Leavitt had studied. He was able to calculate that the Andromeda Galaxy is much more distant and much larger than anyone had imagined.



One of Hubble's photographic plates from October 6, 1923. It was used to determine stars' brightness and calculate the distance from Earth, which confirmed that Andromeda is outside the Milky Way Galaxy. *Photo courtesy of Carnegie Observatories.*



Edwin Hubble working at the Hooker telescope at Mount Wilson Observatory, California. He is most famous for his discovery that galaxies are spreading apart from one another, concluding that the Universe is expanding. The Hubble Space Telescope, the first large telescope in space, is named for him. *Photo courtesy of Carnegie Observatories.*



A satellite telescope took this photograph of Andromeda Galaxy, now known to be 2.5 million light-years away, but it is actually visible from Earth with the naked eye.

Even now, in the 21st century, astronomers are working to make measurements of distance more precise. There are missions to measure more accurately the distance to nearby stars, and there is research into measuring the most distant galaxies. The question of island universes is settled. Scientists no longer use the term. Everything we observe is part of a single Universe, which includes billions of galaxies that are indeed like islands of stars in a vast sea of seemingly empty space.

*Images not otherwise credited: courtesy of NASA.*