Name _____

The Iron Lady of Paris

Fill in the circle by the correct answer. Then answer questions 3, 4, and 5.

1. Which two words from the passage are synonyms?
   - Ⓐ barbarous, venerable
   - Ⓑ degrading, deformed
   - Ⓒ apparatus, iron-lattice
   - Ⓓ monument, edifice

2. What significant event happened to the Eiffel Tower in 1930?
   - Ⓐ Construction of it was finally finished.
   - Ⓑ Its design won a contest.
   - Ⓒ It was no longer the tallest structure in the world.
   - Ⓓ It became the tallest structure in the world.

3. How did critics' opinions of the Eiffel Tower differ from fairgoers' opinions?

   _____

   _____

4. What does the author mean by "equal credit...should go to" in paragraph 3?

   _____

   _____

5. What conclusions can you draw from "flexible, but not too flexible" in paragraph 4?

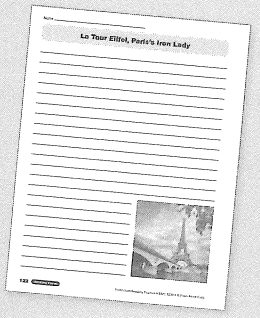
   _____

   _____

Write About the Topic

Use the Writing Form to write about what you read.

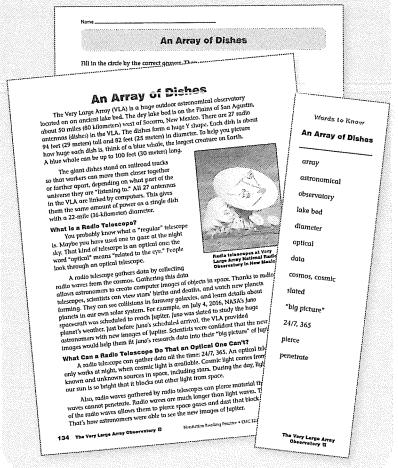
Use evidence to justify this statement: "Today's Parisians value the Eiffel Tower far more highly than Parisians did in 1889."



The Very Large Array Observatory

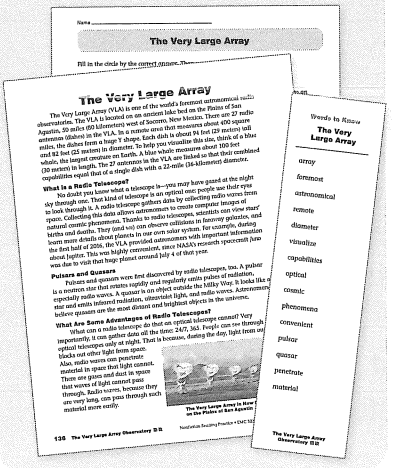
Level 1 ■

Words to Know list, Reading Selection, and Reading Comprehension questions



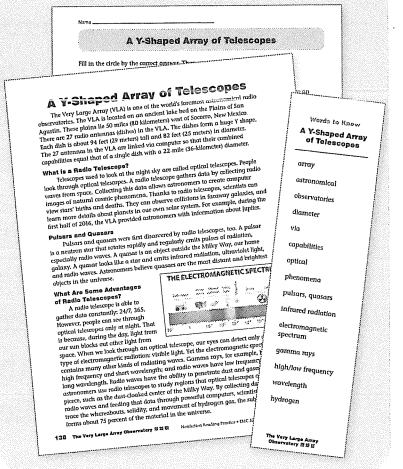
Level 2 ■■

Words to Know list, Reading Selection, and Reading Comprehension questions



Level 3 ■■■

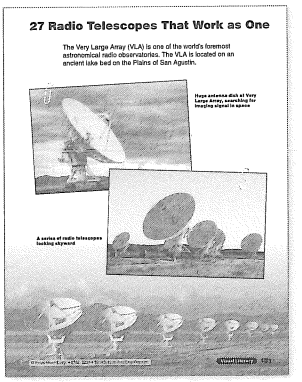
Words to Know list, Reading Selection, and Reading Comprehension questions



Assemble the Unit

Reproduce and distribute one copy for each student:

- Visual Literacy page: 27 Radio Telescopes That Work as One, page 131
- Level 1, 2, or 3 Reading Selection and Reading Comprehension page and the corresponding Words to Know list
- Graphic Organizer of your choosing, provided on pages 180–186
- Writing Form: Radio Telescopes in a Very Large Array, page 132



Visual Literacy

Introduce the Topic

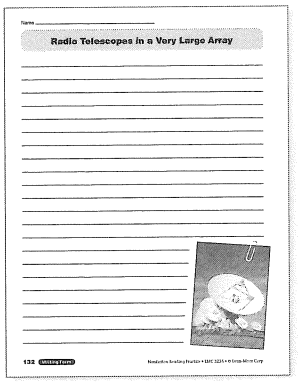
Read aloud and discuss the "27 Radio Telescopes That Work as One" captions and photos on the Visual Literacy page. Explain that these huge dishes are located on the plains of New Mexico.

Read and Respond

Form leveled groups and review the Words to Know lists with each group of students. Instruct each group to read their selection individually, in pairs, or as a group. Have students complete the Reading Comprehension page for their selection.

Write About the Topic

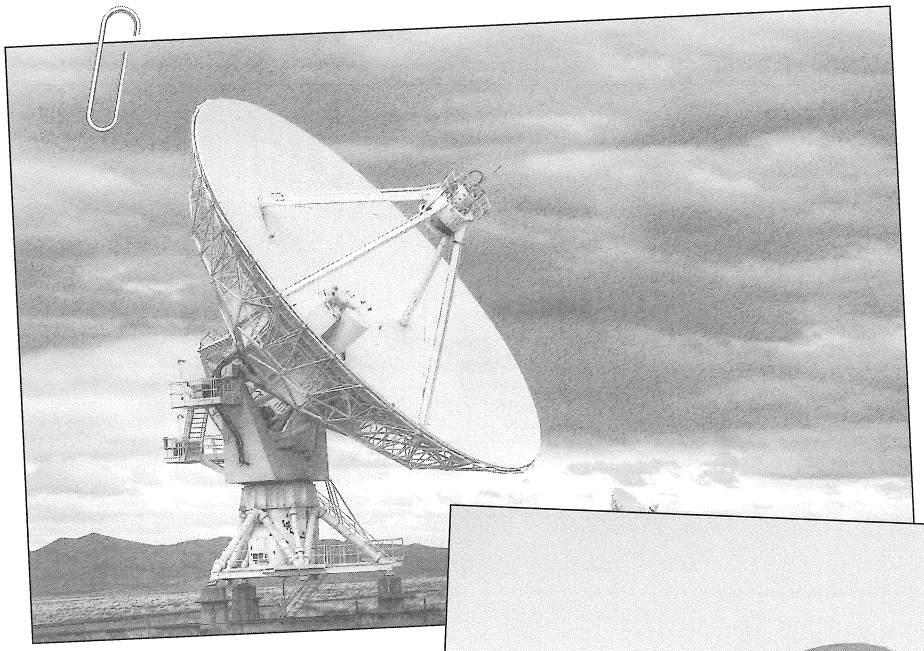
Read aloud the leveled writing prompt for each group. Tell students to use the Graphic Organizer to plan their writing. Direct students to use their Writing Form to respond to their prompt.



Writing Form

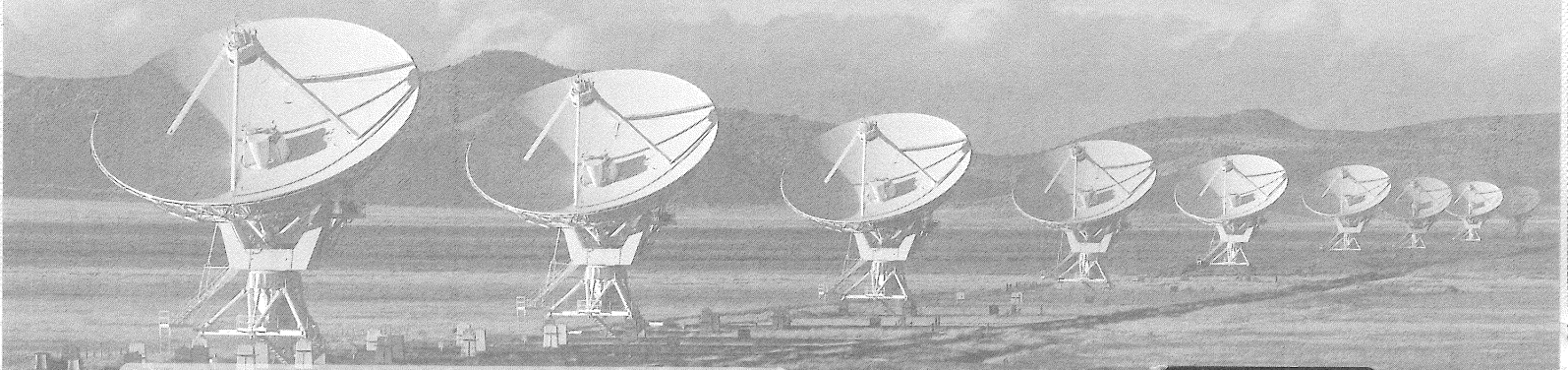
27 Radio Telescopes That Work as One

The Very Large Array (VLA) is one of the world's foremost astronomical radio observatories. The VLA is located on an ancient lake bed on the Plains of San Agustin.



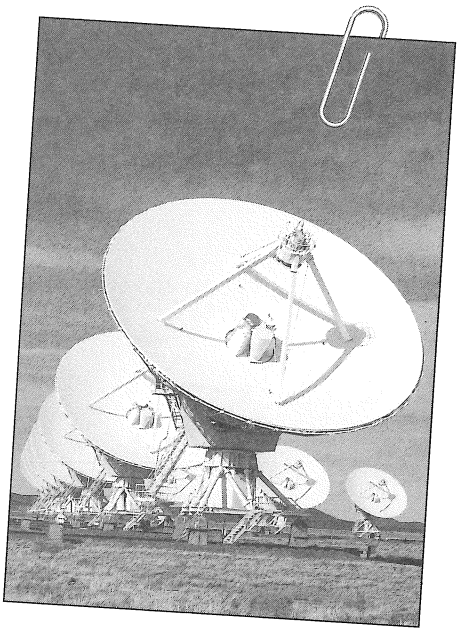
Huge antenna dish at Very Large Array, searching for imaging signal in space

A series of radio telescopes looking skyward



Name _____

Radio Telescopes in a Very Large Array



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Words to Know

An Array of Dishes

array

astronomical

observatory

lake bed

diameter

optical

data

cosmos, cosmic

slated

"big picture"

24/7, 365

pierce

penetrate

The Very Large Array Observatory ■

Words to Know

The Very Large Array

array

foremost

astronomical

remote

diameter

visualize

capabilities

optical

cosmic

phenomena

convenient

pulsar

quasar

penetrate

material

The Very Large Array Observatory ■■

Words to Know

A Y-Shaped Array of Telescopes

array

astronomical

observatories

diameter

via

capabilities

optical

phenomena

pulsars, quasars

infrared radiation

electromagnetic spectrum

gamma rays

high/low frequency

wavelength

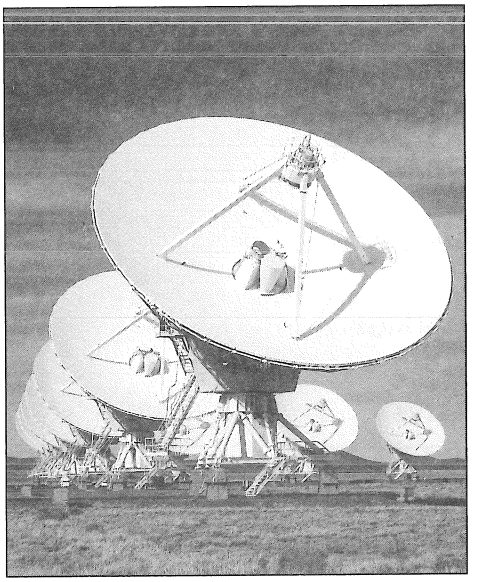
hydrogen

The Very Large Array Observatory ■■■

An Array of Dishes

The Very Large Array (VLA) is a huge outdoor astronomical observatory located on an ancient lake bed. The dry lake bed is on the Plains of San Agustin, about 50 miles (80 kilometers) west of Socorro, New Mexico. There are 27 radio antennas (dishes) in the VLA. The dishes form a huge Y shape. Each dish is about 94 feet (29 meters) tall and 82 feet (25 meters) in diameter. To help you picture how huge each dish is, think of a blue whale, the largest creature on Earth. A blue whale can be up to 100 feet (30 meters) long.

The giant dishes stand on railroad tracks so that workers can move them closer together or farther apart, depending on what part of the universe they are "listening to." All 27 antennas in the VLA are linked by computers. This gives them the same amount of power as a single dish with a 22-mile (36-kilometer) diameter.



Radio telescopes at Very Large Array National Radio Observatory in New Mexico

What is a Radio Telescope?

You probably know what a "regular" telescope is. Maybe you have used one to gaze at the night sky. That kind of telescope is an optical one; the word "optical" means "related to the eye." People look through an optical telescope.

A radio telescope gathers data by collecting radio waves from the cosmos. Gathering this data allows astronomers to create computer images of objects in space. Thanks to radio telescopes, scientists can view stars' births and deaths, and watch new planets forming. They can see collisions in faraway galaxies, and learn details about planets in our own solar system. For example, on July 4, 2016, NASA's *Juno* spacecraft was scheduled to reach Jupiter. *Juno* was slated to study the huge planet's weather. Just before *Juno*'s scheduled arrival, the VLA provided astronomers with new images of Jupiter. Scientists were confident that the new images would help them fit *Juno*'s research data into their "big picture" of Jupiter.

What Can a Radio Telescope Do That an Optical One Can't?

A radio telescope can gather data all the time: 24/7, 365. An optical telescope only works at night, when cosmic light is available. Cosmic light comes from all known and unknown sources in space, including stars. During the day, light from our sun is so bright that it blocks out other light from space.

Also, radio waves gathered by radio telescopes can pierce material that light waves cannot penetrate. Radio waves are much longer than light waves. The length of the radio waves allows them to pierce space gases and dust that block light. That's how astronomers were able to see the new images of Jupiter.

Name _____

An Array of Dishes

Fill in the circle by the correct answer. Then answer questions 3, 4, and 5.

1. Which two words are antonyms?
   - Ⓐ array, group
   - Ⓑ cosmos, universe
   - Ⓒ gathering, scattering
   - Ⓓ pierce, penetrate

2. The author uses the length of a blue whale to help readers imagine how _____.
   - Ⓐ large the Plains of San Agustin are in square miles
   - Ⓑ far the Very Large Array is from towns or cities
   - Ⓒ huge the Y shape of the Very Large Array must be
   - Ⓓ tall and wide each dish in the Very Large Array is

3. What is one main difference between an optical telescope and a radio telescope?

   _____

   _____

4. In what two ways does a radio telescope work better than an optical one?

   _____

   _____

5. What does the word "array" mean in the name "VLA"? Explain how you know.

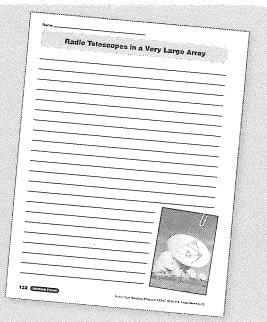
   _____

   _____

Write About the Topic

Use the Writing Form to write about what you read.

Summarize the text by answering the questions Who?, What?, Where?, When?, Why?, and How?



The Very Large Array

The Very Large Array (VLA) is one of the world's foremost astronomical radio observatories. The VLA is located on an ancient lake bed on the Plains of San Agustin, 50 miles (80 kilometers) west of Socorro, New Mexico. There are 27 radio antennas (dishes) in the VLA. In a remote area that measures about 400 square miles, the dishes form a huge Y shape. Each dish is about 94 feet (29 meters) tall and 82 feet (25 meters) in diameter. To help you visualize this size, think of a blue whale, the largest creature on Earth. A blue whale measures about 100 feet (30 meters) in length. The 27 antennas in the VLA are linked so that their combined capabilities equal that of a single dish with a 22-mile (36-kilometer) diameter.

What is a Radio Telescope?

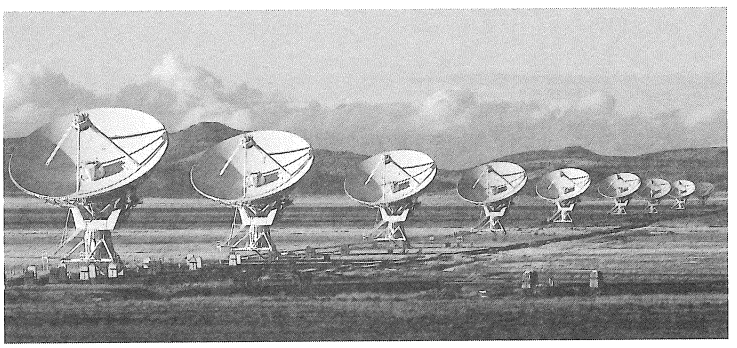
No doubt you know what a telescope is—you may have gazed at the night sky through one. That kind of telescope is an optical one: people use their eyes to look through it. A radio telescope gathers data by collecting radio waves from space. Collecting this data allows astronomers to create computer images of natural cosmic phenomena. Thanks to radio telescopes, scientists can view stars' births and deaths. They (and we) can observe collisions in faraway galaxies, and learn more details about planets in our own solar system. For example, during the first half of 2016, the VLA provided astronomers with important information about Jupiter. This was highly convenient, since NASA's research spacecraft *Juno* was due to visit that huge planet around July 4 of that year.

Pulsars and Quasars

Pulsars and quasars were first discovered by radio telescopes, too. A pulsar is a neutron star that rotates rapidly and regularly emits pulses of radiation, especially radio waves. A quasar is an object outside the Milky Way. It looks like a star and emits infrared radiation, ultraviolet light, and radio waves. Astronomers believe quasars are the most distant and brightest objects in the universe.

What Are Some Advantages of Radio Telescopes?

What can a radio telescope do that an optical telescope cannot? Very importantly, it can gather data all the time: 24/7, 365. People can see through optical telescopes only at night. That is because, during the day, light from our sun blocks out other light from space. Also, radio waves can penetrate material in space that light cannot. There are gases and dust in space that waves of light cannot pass through. Radio waves, because they are very long, can pass through such material more easily.



The Very Large Array in New Mexico, on the Plains of San Agustin

Name _____

The Very Large Array

Fill in the circle by the correct answer. Then answer questions 3, 4, and 5.

1. The diameter is the length _____.
   - Ⓐ around the middle of a three-dimensional ball, like our Earth's equator
   - Ⓑ of a straight line that passes from one point on a circle through its center to an opposite point on the circle
   - Ⓒ of a straight line that passes from the middle of one dish to the middle of another
   - Ⓓ of one side of a square that measures about 400 square miles in area

2. The author uses the length of a blue whale to help readers visualize how _____.
   - Ⓐ large the Plains of San Agustin are in square miles
   - Ⓑ remote the Very Large Array is from towns or cities
   - Ⓒ huge the Y shape of the Very Large Array must be
   - Ⓓ tall and wide each dish in the Very Large Array is

3. Sum up one main difference between an optical telescope and a radio telescope.

   _____

   _____

4. How do astronomers and scientists use the data from the radio waves?

   _____

   _____

5. What does the word "penetrate" mean in the last paragraph? Explain how you know.

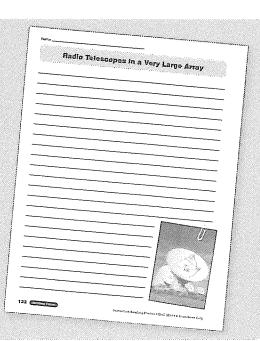
   _____

   _____

Write About the Topic

Use the Writing Form to write about what you read.

Answer the questions Who?, What?, Where?, When?, Why?, and How? to summarize the text.



A Y-Shaped Array of Telescopes

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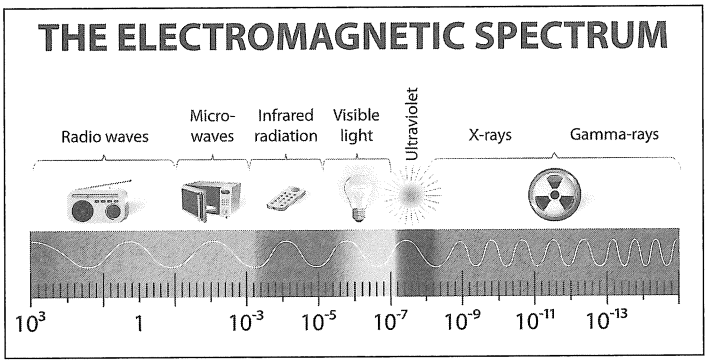
What is a Radio Telescope?

Telescopes used to look at the night sky are called optical telescopes. People look through optical telescopes. A radio telescope gathers data by collecting radio waves from space. Collecting this data allows astronomers to create computer images of natural cosmic phenomena. Thanks to radio telescopes, scientists can view stars' births and deaths. They can observe collisions in faraway galaxies, and learn more details about planets in our own solar system. For example, during the first half of 2016, the VLA provided astronomers with information about Jupiter.

Pulsars and Quasars

Pulsars and quasars were first discovered by radio telescopes, too. A pulsar is a neutron star that rotates rapidly and regularly emits pulses of radiation, especially radio waves. A quasar is an object outside the Milky Way, our home galaxy. A quasar looks like a star and emits infrared radiation, ultraviolet light, and radio waves. Astronomers believe quasars are the most distant and brightest objects in the universe.



What Are Some Advantages of Radio Telescopes?

A radio telescope is able to gather data constantly: 24/7, 365. However, people can see through optical telescopes only at night. That is because, during the day, light from our sun blocks out other light from space. When we look through an optical telescope, our eyes can detect only one type of electromagnetic radiation: visible light. Yet the electromagnetic spectrum contains many other kinds of radiating waves. Gamma rays, for example, have high frequency and short wavelength; and radio waves have low frequency and long wavelength. Radio waves have the ability to penetrate dust and gases, so astronomers use radio telescopes to study regions that optical telescopes cannot pierce, such as the dust-cloaked center of the Milky Way. By collecting data from radio waves and feeding that data through powerful computers, scientists can trace the whereabouts, solidity, and movement of hydrogen gas, the substance that forms about 75 percent of the material in the universe.