Objective:

Students will learn how radio waves transmit signal information that helps give us satellite pictures by creating their own pixelated picture.

Arkansas State Standards Addressed:

Science:

PS.7.8.6 Explain how energy is transferred through waves: seismic waves, sound waves, water waves, electromagnetic waves.

PS.7.8.7 Describe how waves travel through different kinds of media

PS.7.8.11 Investigate examples of real world uses of the electromagnetic spectrum

PS.7.8.13 Compare ways to transfer information: sound, light, radio, microwave energy

PS.7.8.14 Investigate careers, scientists, and historical breakthroughs related to waves and the electromagnetic spectrum.

Activity:

This activity is from the book *Beyond the Solar System* by Mary Kay Carson, available at BPL.

Materials needed include:

- Graph paper
- Colored pencils or markers in black, blue, red, brown, green, and yellow
- A copy of the *Make a Radio Picture* numbers, attached

Radio waves are big, low frequency waves on the electromagnetic spectrum that astronomers utilize to study distant objects. Radio telescopes focus on and collect these invisible waves and convert them into a signal that a computer records and stores. In order to visualize how signal information can become pictures, students will create their own pixelated picture utilizing graph paper and colored pencils. This activity would be a great activity for use in conjunction with a lesson on waves, particularly radio waves. Before starting the activity, consider showing students examples of pictures of different galaxies generated by a different wavelength of light. For example, see page 81 in the book *Beyond the Solar System* for comparative pictures of the Centaurus A galaxy.

Give each student a piece of graph paper. Have them outline a grid 30 squares wide and 20 squares tall. Across the top row, have students write the alphabet, one letter in each grid. Because there are 30 spaces, they will also need to add AA, BB, CC, and DD after Z.

Next, give each student a copy of the *Make a Radio Picture* numbers. Have them copy each string of numbers into the corresponding column.

After they have completed transferring the numbers to the graph paper, they can proceed with coloring each square based on its number. Each pixel space has a single number that translates into a color. White is 0, black is 1, blue is 2, green is 3, red is 4, brown is 5, and yellow is 6.

Once everything is colored, students will have uncovered a mystery picture. As an extension for this activity, students could experiment with creating their own coded image for a friend or partner to decode.

Additional Resources at Bentonville Public Library:

The following resources are specifically about electromagnetic waves and how scientists use these waves in exploring space. Accelerated Reader Levels are included when available. All items are available for checkout at Bentonville Public Library; call numbers are included in brackets. Online resources are available through BPL's Student Portal: http://www.bentonvillelibrary.org/student-portal/

Books

- *Beyond the Solar System* by Mary Kay Carson. Non-Fiction. [JNF 520.9 CAR]
- *Energy and Waves Through Infographics* by Rebecca Rowell. AR Reading Level: 4.7. Non-Fiction. [JNF 621.042 ROW]
- *Light: Investigating Visible and Invisible Electromagnetic Radiation* by Chris Woodford. Non-Fiction. [JNF 535 WOO]
- *Mysteries of the Universe: How Astronomers Explore Space* by Andrew Einspurch. AR Reading Level: 4.9 Non-Fiction [JNF 919.904 EIN]
- *Star Spotters: Telescopes and Observatories* by David Jefferis. Non-Fiction. [JNF 522 JEF]
- *Waves: Energy on the Move* by Darlene Stiles. AR Reading Level: 6.4. [JNF 531.1133 STI]
- *What Are Light Waves?* by Robin Johnson. AR Reading Level: 3.2. Non-Fiction. [JNF 535 JOH]

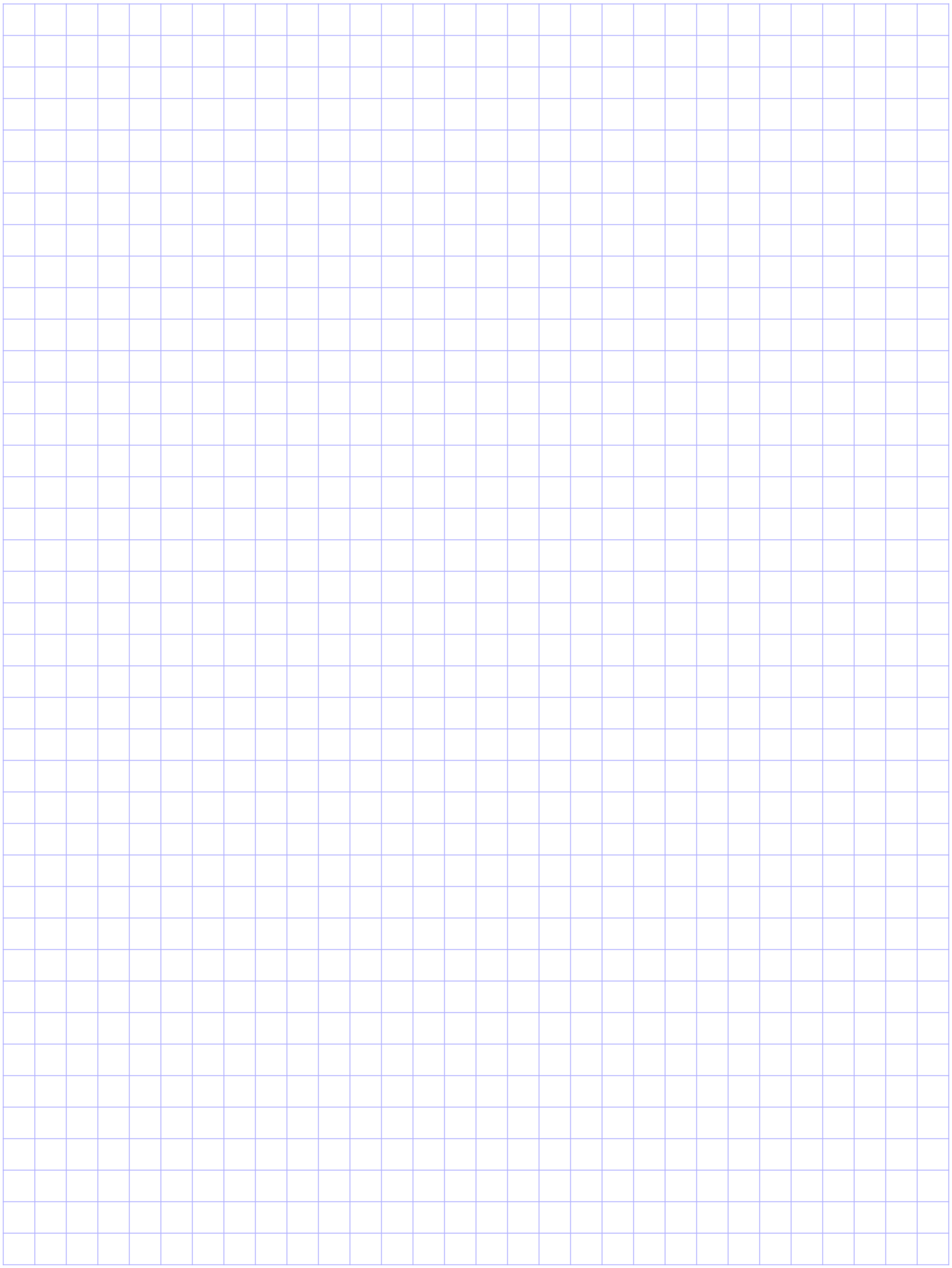
Videos

- *Electromagnetic Energy*. DVD. [JVID 539.2. ELE]

Online Resources

- *Sky Spy Safari.* Available through the eLibrary Science database, on the BPL Student Portal, under Interactives/Astronomy. Provides various views of celestial objects such as galaxies, nebulas, and star clusters using different types of telescopes, including radio telescopes.

***Explore Space* Exhibit Information:**
Explore Space: A Cosmic Journey, a traveling exhibition for libraries, is part of the STAR Library Education Network (STAR_Net) led by the National Center for Interactive Learning at the Space Science Institute. Exhibit partners include the American Library Association, the Lunar and Planetary Institute, and Afterschool Alliance. Explore Space is supported through a grant from the National Science Foundation.



Make a Radio Picture

A: 2 2 2 2 2 1 1 2 2 2 2 2 2 1 1 2 2 2 2
B: 2 2 2 2 2 1 3 1 2 2 2 2 1 3 1 2 2 2 2
C: 2 2 2 2 2 1 6 3 1 2 2 1 3 6 1 2 2 2 2
D: 2 2 2 2 2 2 1 6 3 1 1 3 6 1 2 2 2 2 2
E: 2 2 2 2 2 2 1 3 6 3 3 6 3 1 2 2 2 2 2
F: 2 2 2 2 2 2 2 2 1 6 6 6 6 1 2 2 2 2 2 2
G: 2 2 2 2 2 2 2 2 2 1 6 6 1 2 2 2 2 2 2 2
H: 2 2 2 2 2 2 2 2 2 1 3 6 1 2 2 2 2 2 2 2
I: 2 2 2 2 2 2 2 2 1 3 3 3 3 1 2 2 2 2 2 2
J: 2 2 2 2 2 2 2 2 1 3 3 6 3 1 2 2 2 2 2 2
K: 2 2 2 2 2 2 2 1 3 3 3 3 3 3 1 2 2 2 2 2
L: 2 2 2 2 2 2 2 1 3 3 6 3 6 3 1 2 2 2 2 2
M: 2 2 2 2 2 1 6 3 3 3 3 3 3 6 1 2 2 2 2
N: 2 2 2 2 1 3 3 3 5 6 6 5 3 3 3 1 2 2 2
O: 3 3 3 3 1 3 6 3 3 3 3 3 3 6 3 1 2 2 2
P: 2 2 1 1 1 3 3 3 6 6 6 6 3 3 3 1 2 2 2
Q: 2 1 1 1 3 3 3 3 5 5 3 3 3 3 3 1 2 2
R: 2 1 1 1 3 3 3 6 6 6 6 6 6 3 3 3 1 1 2
S: 2 2 1 1 3 3 3 3 5 5 5 3 3 3 3 3 1 1 2
T: 2 2 2 1 3 3 6 6 6 6 6 6 6 3 3 1 2 2
U: 2 2 2 1 1 3 3 3 3 3 3 3 3 3 3 1 1 2 2
V: 2 0 2 2 1 3 3 3 3 3 3 3 3 3 3 1 2 2 2
W: 2 2 2 2 1 3 3 3 5 5 3 3 3 3 3 1 2 2 2
X: 2 0 2 2 1 3 3 5 0 1 5 3 4 3 3 1 2 2 2
Y: 2 2 2 2 2 1 3 5 1 1 5 3 4 3 1 2 2 2 2
Z: 2 2 0 2 2 2 1 3 5 5 3 3 4 1 2 2 2 2 2
AA: 2 2 2 2 2 2 1 3 3 3 3 3 4 1 2 2 2 2 2
BB: 2 2 2 2 0 2 2 1 1 1 1 1 1 2 2 2 2 2 2
CC: 2 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2 2 2 2
DD: 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2

0 = white **4 = red**
1 = black **5 = brown**
2 = blue **6 = yellow**
3 = green

Make a Radio Picture

A: 2 2 2 2 2 1 1 2 2 2 2 2 2 1 1 2 2 2 2
B: 2 2 2 2 2 1 3 1 2 2 2 2 1 3 1 2 2 2 2
C: 2 2 2 2 2 1 6 3 1 2 2 1 3 6 1 2 2 2 2
D: 2 2 2 2 2 2 1 6 3 1 1 3 6 1 2 2 2 2 2
E: 2 2 2 2 2 2 1 3 6 3 3 6 3 1 2 2 2 2 2
F: 2 2 2 2 2 2 2 2 1 6 6 6 6 1 2 2 2 2 2 2
G: 2 2 2 2 2 2 2 2 2 1 6 6 1 2 2 2 2 2 2 2
H: 2 2 2 2 2 2 2 2 2 1 3 6 1 2 2 2 2 2 2 2
I: 2 2 2 2 2 2 2 2 1 3 3 3 3 1 2 2 2 2 2 2
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K: 2 2 2 2 2 2 2 1 3 3 3 3 3 3 1 2 2 2 2 2
L: 2 2 2 2 2 2 2 1 3 3 6 3 6 3 1 2 2 2 2 2
M: 2 2 2 2 2 1 6 3 3 3 3 3 3 6 1 2 2 2 2
N: 2 2 2 2 1 3 3 3 5 6 6 5 3 3 3 1 2 2 2
O: 3 3 3 3 1 3 6 3 3 3 3 3 3 6 3 1 2 2 2
P: 2 2 1 1 1 3 3 3 6 6 6 6 3 3 3 1 2 2 2
Q: 2 1 1 1 3 3 3 3 5 5 3 3 3 3 3 1 2 2
R: 2 1 1 1 3 3 3 6 6 6 6 6 6 3 3 3 1 1 2
S: 2 2 1 1 3 3 3 3 5 5 5 3 3 3 3 3 1 1 2
T: 2 2 2 1 3 3 6 6 6 6 6 6 6 3 3 1 2 2
U: 2 2 2 1 1 3 3 3 3 3 3 3 3 3 3 1 1 2 2
V: 2 0 2 2 1 3 3 3 3 3 3 3 3 3 3 1 2 2 2
W: 2 2 2 2 1 3 3 3 5 5 3 3 3 3 3 1 2 2 2
X: 2 0 2 2 1 3 3 5 0 1 5 3 4 3 3 1 2 2 2
Y: 2 2 2 2 2 1 3 5 1 1 5 3 4 3 1 2 2 2 2
Z: 2 2 0 2 2 2 1 3 5 5 3 3 4 1 2 2 2 2 2
AA: 2 2 2 2 2 2 1 3 3 3 3 3 4 1 2 2 2 2 2
BB: 2 2 2 2 0 2 2 1 1 1 1 1 1 2 2 2 2 2 2
CC: 2 2 2 2 2 2 2 2 2 1 1 2 2 2 2 2 2 2 2
DD: 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2

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