Decoding Starlight Exhibit Guide

Teacher Edition (A)

This teacher edition provides much more detailed information than what the students are expected to learn. We provide this information to provide more background that may help you enrich interactions between you and your students.

Star Light, Star Bright

Sunlight is starlight.

The Sun is our closest star. Because it is so close, it appears as a disk of light in the sky. Other stars appear as points of light because they are so much farther away from us.

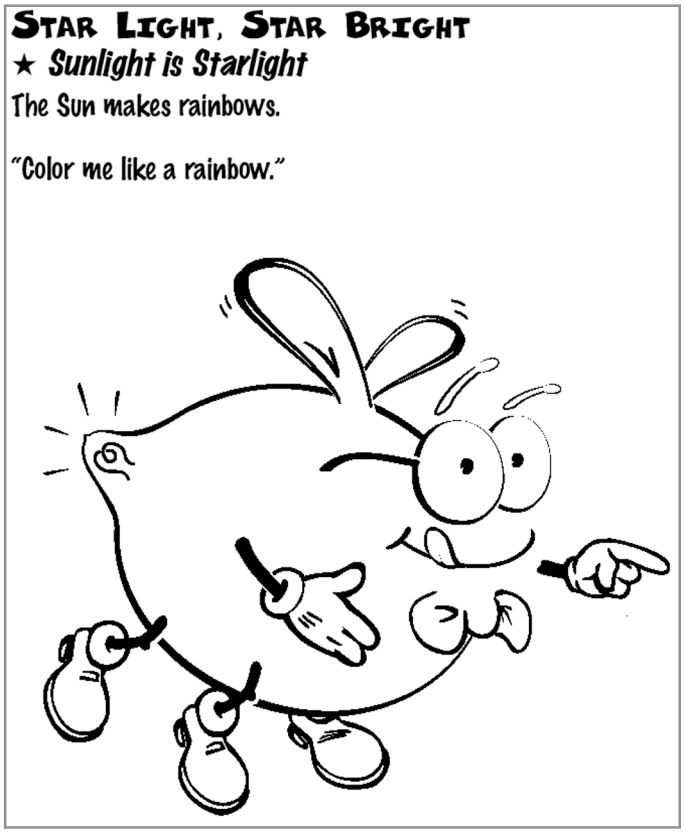
The Sun makes rainbows.

There are two images to see: an image of the Sun, and the Sun's spectrum. The light from the Sun forms both these images, but the spectrum is special.

The bright disk above the color spectrum is a real image of the Sun that the heliostat projects. Look closely – you will probably see sunspots! The dark vertical line is the slit where sunlight enters the Solar Spectrum Projector. Only the light passing through the slit appears in the Sun's spectrum.

On the right side of the exhibit is a model that represents the Sun and Solar Spectrum Projector. Students can slide a grating in and out of the light beam to make their own spectrum on the wall. Help them observe what happens to the light on the wall with the grating in and out of the beam: What changes? What is the color order in the spectrum?

This light is coming from the Sun. Students may notice the heliostat and think it is coming from "that projector." The heliostat gathers the sunlight and sends it to the Solar Spectrum Projector. You can see the sunbeam above your head if you stand by the exhibit introduction panel in the lobby.



Related TEKS: K.4(A), 3.11(D)
Related NSES: K - 4 Physical science: properties of objects and materials, light.

Rainbow vs. Spectrum

The bright band of color below the Sun's image is the Sun's spectrum. Both the Solar Spectrum Projector (SSP) spectrum and a rainbow contain the same colors of sunlight. But there are differences.

1. *The Sun's spectrum includes absorption lines*. Astronomers call these absorption lines because chemical elements in the Sun have absorbed light of a particular wavelength (color), then emitted light of the same wavelength in another direction away from the heliostat. So the beam of sunlight that enters the heliostat and SSP is dimmer at these particular wavelengths, resulting in narrow dim color features. The "line" is just an image of the slit that acts like a light-door into the SSP.
2. *The SSP spreads the solar spectrum horizontally, like a rectangle. Rainbows appear as semicircles, or arcs in the sky.* Tiny water drops spread out the colors of sunlight much like a prism. Both a prism and water drop refract light, which changes the direction the light travels according to its wavelength (color). However, a grating inside the Solar Spectrum Projector produces a spectrum through different processes: diffraction and interference.

"Color me like a rainbow."

An excellent result would be the colors sequenced in proper order (red, orange, yellow, green, blue, violet **or** violet, blue, green, yellow, orange, red) and appearing only once. (Some students may draw multiple "rainbows" to fill up the space.)

What are the big ideas?

The Sun is a star. Astronomers study a star's light to learn about the star. Light that we can see is actually composed of many colors, just like musical chord is composed of many notes that you hear all at once. A grating or a prism can separate light into colors, or spectrum, that an astronomer can examine. The Sun's spectrum is not a picture of the Sun.

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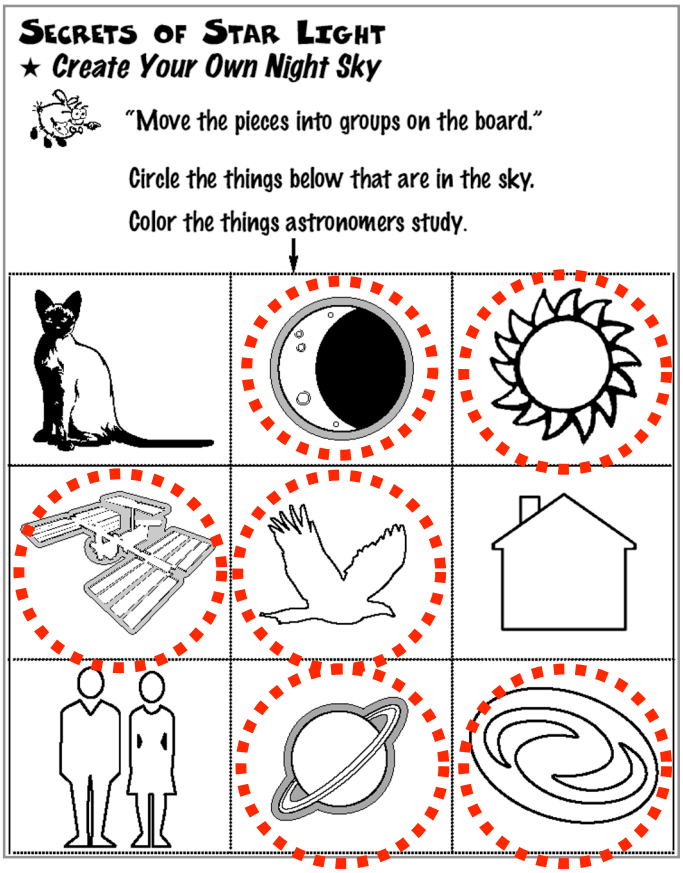
Secrets of Star Light
Create your own night sky

This sorting and classifying activity allows students to physically move the pieces on the magnet board. Students should be encouraged to talk about the pieces that they handle. After moving the magnets, students may circle and color their guide.



The drawing includes the following elements:

Top row, from left to right:
- Cat - not in the sky - not studied by astronomers
- Moon - in sky - studied by astronomers
- Sun - in sky - studied by astronomers

Middle row:
- Hubble Space Telescope - in sky - used by astronomers
- Bird - in sky - not studied by astronomers
- House - not in sky - not studied by astronomers

Bottom row:
- People - not in sky - not studied by astronomers
- Planet - in sky - studied by astronomers
- Galaxy - in sky - studied by astronomers

What are the big ideas?

Although there are many objects in the sky, not all are of interest to astronomers. Astronomers study objects beyond the atmosphere of Earth.

Related TEKS: K.6(A), 1.6(A)
Related NSES: K - 12 Unifying concepts and processes: systems, order, and organization.
K - 4: Earth and space science: objects in the sky.

Some books for young students:

Under 4 years of age:
Goodnight Moon by Margaret Wise Brown **ISBN:** 0060207051 (Classic picture book)
Children of the Sun by Art L'Hommedieu **ISBN:** 0859539377 (A book on planets)

Ages 4-8:
And If the Moon Could Talk by Kate Banks **ISBN:** 0374302995 (picture book)
The Magic School Bus Lost in the Solar System by Joanna Cole **ISBN:** 0590414291
- in Spanish **El Autobus Magico En El Sistema Solar ISBN:** 0590464299

The Moon Seems to Change by Franklyn M. Branley **ISBN:** 0064450651
The Moon Book ISBN: 0823412970
The Planets in Our Solar System (Let's-Read-and-Find-Out Science, Stage 2) ISBN: 006445178
The Planets by Gail Gibbons **ISBN:** 0823410404
Stargazers ISBN: 0823415074
Sunshine Makes the Seasons (Let's-Read-and-Find-Out Science) ISBN: 0064450198

Ages 6 - 9
One Small Square, The Night Sky by Donald M. Silver **ISBN:** 0070580456 (about the region near the constellation Orion)
All About Space by Sue Becklake **ISBN:** 0613453557

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Gathering StarLight

Telescope slide

Draw the colors.

The colors should be the same as in the first activity (coloring Mac) and in the same order.

In additional to offering the younger student a kinesthetic experience of using the slide, the exhibit repeats the sequence of color and the connection that a telescope collects light in many different colors.

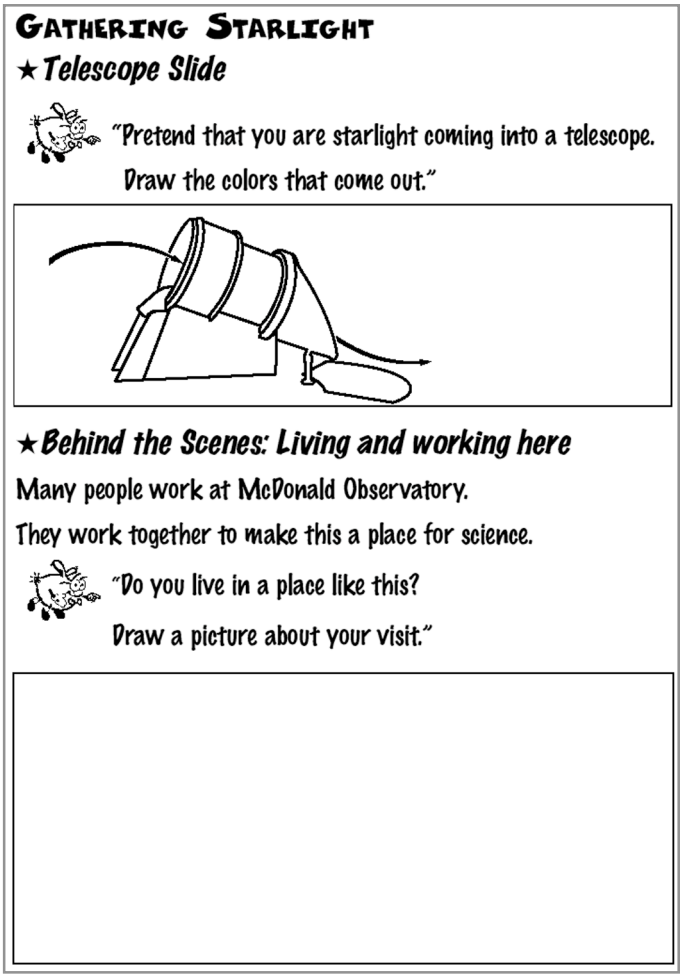
Behind the scenes: Living and working here

Do you live in a place like this?

This may pose a question that you may want to explore in your post-visit discussion at school, that is, how the Observatory environment compares to their home environment.

Draw a picture about your visit.

There is no wrong answer to this activity. Students may show a surprising range of answers (from memories of the bus trip or lunch, to touring a telescope or doing an activity). You may want the students to label their picture. It could form the focus for a writing assignment when they return to school. Some students may want to draw pictures of their impressions with their own communities to compare to the observatory.



What are the big ideas?

The important points here are:

1. McDonald Observatory is a place for science.
2. An entire community of people with different skills and types of jobs are needed at an observatory.

The Observatory as a community:

Operating and managing an observatory requires a diverse group of dedicated and talented people from diverse backgrounds and expertise. In many ways, the Observatory resembles a small town.

Related TEKS: K.4(A)
Related NSES: K - 4: History and nature of science: science as a human endeavor.

McDonald Observatory's "Main Street" connects all the major facilities together. McDonald Observatory's "Main Street" begins at Highway 118, continues past the Visitors Center, winds up Mount Locke, circles the summit, and ends at the Harlan J. Smith 2.7-meter Telescope dome. Just like many small towns and cities, there is a welcome sign near the entrance. On the right is the McDonald Observatory Visitors Center. Further up is a road running by the firehouse and into the main residential area of the Observatory. The Observatory has a fire engine and emergency medical equipment. Notice the park and swimming pool as you drive by. You may also see the school bus that carries children who live here from the Observatory to nearby Fort Davis schools.

As the "Main Street" wanders up the side of Mt. Locke, you'll note the spur road on the left leads to the Hobby-Eberly Telescope and the Laser Ranging Station. Just a bit further up, much like a town square, the road circles the summit of Mt. Locke to connect major Observatory facilities: the physical plant building where staff build new or fix existing equipment and maintain Observatory trucks and vehicles; the Transient Quarters where visiting astronomers eat and sleep; resident-staff's homes; and a road leading to the smaller 0.7 and 0.8-m telescopes.

Finally, "Main Street" passes the Struve 2.1-meter Telescope dome, which acts like a town hall for the Observatory and stands on the summit of Mt. Locke. Inside are the Observatory's main administrative offices, including the Superintendent's office. Mailboxes for all the residents are in this building. At the end of "Main Street" stands the 2.7-meter Harlan J. Smith Telescope dome.

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Timeless Exploration

Making Sense of the Universe

The rabbit in the center of this Mimbres Bowl replica is thought to represent the Moon. Count the arches on the rabbit's back. They number 29, close to the number of days in the Moon's phase cycle, or synodic period, which is 29.53 days. Perhaps this was one way that the Mimbres brought the heavens to Earth, and integrated the sky into their culture.

American Indians drew constellations, created starlore, and built structures in alignment with the sky long before Europeans arrived on American shores. They tracked the motions of the Sun to help them decide when to plant crops, move their camps, or stage sacred rituals. They crafted explanations for meteor showers and the northern lights, and saw a pathway to the afterlife in the Milky Way.

Some tribes built great circles of stones to help them predict the changing seasons. Others built great ceremonial centers in alignment with the Sun and stars. And still others built great mounds of earth to reflect the patterns they saw in the heavens.

All of these activities were attempts to build order into the heavens as well as their daily lives. They reflected a close bond between the people and their environment – in the sky and on the ground. And they reflected an even closer bond between the secular and the sacred: The Sun, Moon, and stars were not just physical objects following well-defined paths across the sky; they were gifts from the gods. They told the people where they came from, where they were going, and how to live their lives.

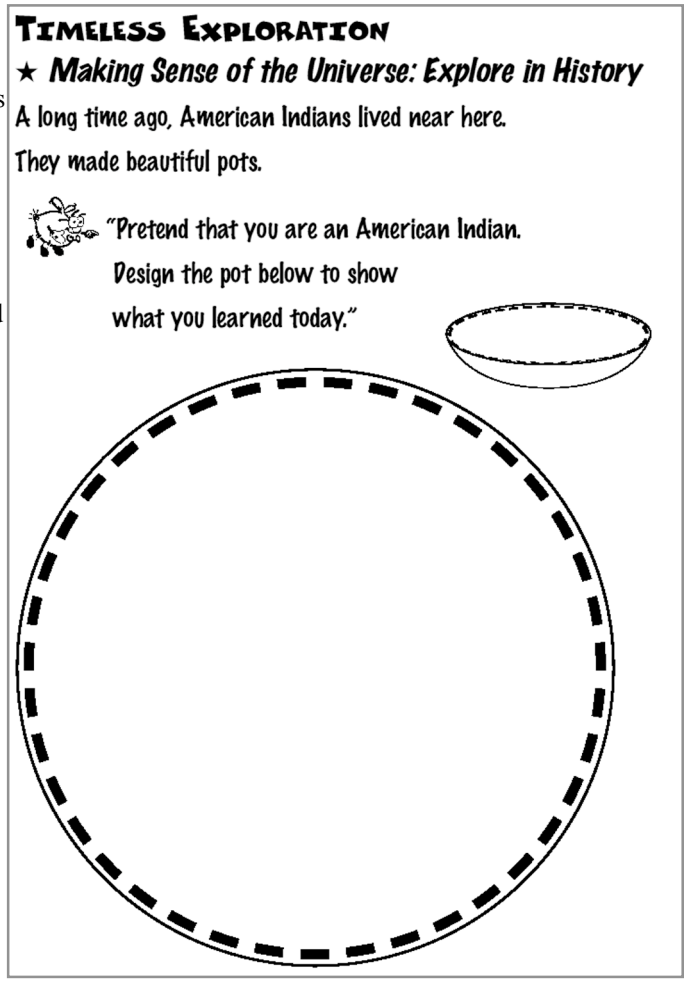
Resources:

Mimbres bowls: Brody, J. J. *"Mimbres painted pottery."* Santa Fe (N.M.) 1977

StarDate Native Skies: http://stardate.org/nativeskies/

Student drawings:

Students may choose to draw anything they like in the space provided. You may wish to use these drawings as a prompt for a writing assignment about their Observatory experience. It is unlikely that students of this grade level will attempt to follow the Mimbres example of linking an everyday object (the rabbit) with their conceptual understanding of the heavens. However, it is likely that the students will select an object or event that impressed them in some way. Their discussion of the drawings may offer a rich opportunity to extend their Student Field Experience.



Related NSES: K - 4: Science as a human endeavor.