Fifth Grade Star Lab

Space Systems: Stars and the Solar System

One of the great benefits of the STARLAB is the ability to control time. An entire year of patterns can be compressed into minutes or seconds. Students can watch where the sun rises and sets throughout the year for our latitude (39 degrees North) or the cycle of the moon phases. This becomes a real exercise in observation for students. They are able to watch the motion, see patterns and make predictions about the sun, moon and stars.

Day 1

5-ESS1-1 Support an argument that differences in the apparent brightness of the sun compared to other stars is due to their relative distances from Earth.

Science and Engineering Practice

- Engaging in Argument from Evidence – Support an argument with evidence, data or a model

Disciplinary Core Idea

- ESS1.A: The Universe and its Stars - The sun is a star that appears larger and brighter than other stars because it is closer. Stars range greatly in their distance from Earth.

Crosscutting Concept

- Scale, Proportion, and Quantity – Natural objects exist from the very small to the immensely large.

Activity 1: Seeing Stars (review)

(approximately 5-10 minutes)

STARFIELD CYLINDER

Procedure:

1. Begin with the side lamps on. Slowly turn down the side lamps. Adjust the projector brightness to its lowest setting. No stars should be seen. **Ask the students to describe what they see.**

2. Slowly increase the brightness of the projector with the Starfield Cylinder in place. **Ask students to tell you when they see the first star.** Continue to turn the knob until the entire starfield is lighted. Students should see thousands of stars. This represents our night sky.

3. Turn the projection brightness knob down from full brightness about ½ turn. Slowly turn on the slide lamps. This is like our sun rising. **Ask students if the stars are still in the sky.** Remind students that our sun is a star of medium brightness but it is closest to Earth so its light rays don't spread as far as other stars before reaching Earth, so we see only our suns light.

Activity 2: Star Color and Brightness

(approximately 20-30 minutes)

STARFIELD CYLINDER (set latitude at 39 degrees)

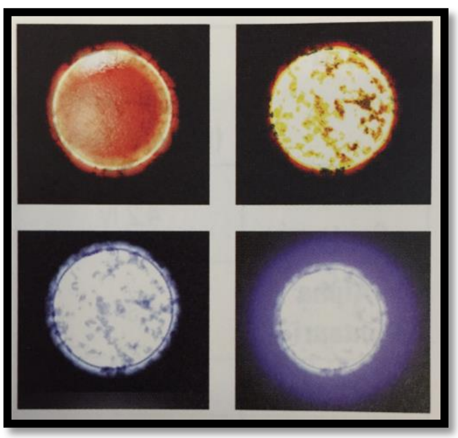
Procedure:

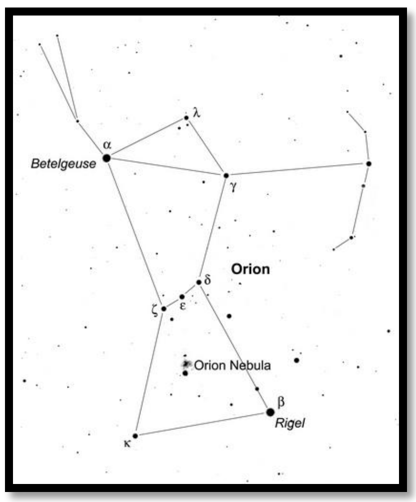
1. Tell students that the apparent brightness of a star is a measure of how bright it looks from Earth. Apparent brightness can be determined by:
    - Distance from Earth
    - Size
    - Temperature

2. Turn down the side lamps and turn the projector brightness to its highest setting. **Ask students to look for variations in star brightness.**

3. Explain that the color of a star is determined by its temperature.
    - Red stars are the coolest stars with a temperature of about 3,200 degrees Celsius
    - Blue-white stars are the hottest stars at temperatures over 20,000 degrees Celsius.
    - The sun appears yellow and the surface temperature is about 5,500 degrees Celsius.

Star	Distance from Earth (in light-years)
Proxima Centauri	4.2 ly
Alpha Centauri A	4.3 ly
Sirius	8.6 ly
Betelgeuse	643 ly
Rigel	773 ly





4. **Ask students to locate red stars** (Betelgeuse is the bright star in Orion's shoulder). **Ask students to locate blue-white stars** (Rigel is in Orion's heel)

5. Remind students that these stars are brighter than our Sun, but farther away.

6. Challenge students to find other bright stars or other colored stars and see if they know any of the names. It is okay if you or they do not…

Day 2

5-ESS1-2 Represent data in graphical displays to reveal patterns of daily changes in length and direction of shadows, day and night, and the seasonal appearance of some stars in the night sky.

Science and Engineering Practice

- Analyzing and Interpreting Data – Represent data in graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.

Disciplinary Core Idea

- ESS1.B: Earth and the Solar System - The orbits of Earth around the sun and of the moon around Earth, together with the rotation of Earth about an axis between its North and South poles, cause observable patterns. These include day and night; daily changes in the length and direction of shadows; and different positions of the sun, moon, and stars at different times of the day, month, and year.

Crosscutting Concepts

- Cause and Effect – Cause and effect relationships are routinely identified and used to explain change.

Activity 3: Sunrise and Sunset (seasons review)

(approximately 20-30 minutes)

STARFIELD CYLINDER (set latitude at 39 degrees)

The Sun: The Starfield Cylinder has twelve magnetic buttons around its circumference. These buttons mark the position of the Sun along the ecliptic and when one is removed, it shows where the Sun would appear in the sky for each month of the year. Each button is located directly above the name of a particular month listed on the cylinder platform on the projector. The position of the Sun has been set for approximately mid-month with the exception of March, June, September and December. On these months it has been offset to show the Sun on the 22nd of the month to represent the equinox. To remove a button, simply pull it out. Set the projector for the desired latitude and turn the cylinder so that the “Sun” is seen on the eastern horizon. This is sunrise. By turning on the daily motion switch, you will see the Sun slowly move across the sky until it finally sets. This allows you to observe the elevation of the Sun, location of sunrise and sunset and the relative amount of time it takes to cross the sky for each month of the year making it easy to demonstrate the reason for the seasons.

Procedure:

1. Prepare the Starfield cylinder by removing the button above December on the date scale. This opening will provide the light that will represent the sun.

2. Have the projector set so that the “sun” is about to rise in the east. This will place the “sun” in its most southern position. This will represent the position of the sun during December. Leave the side lamps on as you turn up the projector brightness light. Keeping the side lamps on will obscure most of the stars and will create a daylight effect, to some extent.

3. Tell the students to look toward the east as you turn on the motion of the projector, simulating sunrise. Have them follow the sun on its journey through the sky. Stop the motion when the sun sets in the west. Explain that this represents Winter.

4. Remove the button located above March on the date scale. Place that button in the opening above December. Repeat the procedure from sunrise to sunset. **Ask the students what was different in the path of the sun from December to March.** They should notice that this path takes the sun higher in the sky. Explain that this represents Spring.

5. Remove the button above June on the date scale. Place the button in the opening above March. Once again, set the projector to have the sun rise in the east. Turn on the motion and have the students follow the path of the sun again. **Ask the students to explain what has happened to the path of the sun as you have moved from December to March to June.** Explain that this represents Summer.

6. Remove the button above September on the date scale. Place the button in the opening above June. Once again, set the projector to have the sun rise in the east. Turn on the motion and have the students follow the path of the sun again. **Ask the students to explain what has happened to the path of the sun as you have moved from December to march to June to September.** Explain that this represents Fall.

7. **Ask students to explain how this demonstration explains the seasons.**

Activity 4: Stars through the Night

(approximately 20-30 minutes)
(you will need 15 sticky notes 5 labeled A, B, C)

STARFIELD CYLINDER (set latitude at 39 degrees)
Procedure:

1. **Ask the students from what direction does the sun rise? From what direction does the moon rise? Ask them if they know from what direction the stars rise?** They should respond that all of them “rise” in the east and “set” in the west. Make sure that the students realize that stars don’t really “rise” and “set”. It is the rotation of the Earth that is responsible for this apparent motion of the stars.

2. Set the Starfield cylinder for about 10:00 P.M. for your latitude. Explain that if they were to view the sky tonight from a dark location that the sky would appear as it does in the planetarium.

3. Pick out a couple of fairly bright stars that have just become visible above the eastern horizon. Have students place very small Post-its at the locations.

4. Turn on the projector’s motion until “one hour” has passed. It takes approximately 10 seconds for the cylinder to move a distance equal to one hour of time. Once again have students mark the location of the selected stars with Post-its. It may be best to have a couple of the students near the sides of the dome act as pointers. When you stop the motion, have them stand and place the Post-its in the correct locations. You may want to have the Post-its lettered; all A’s for one star, B’s for another and so on.

5. Continue this procedure for a number of hours, stopping each hour to mark the locations. Do the same for a star in the Big Dipper. Because it is a circumpolar constellation, its path will be different from the other stars that are being tracked.

6. After 5-6 hours of marking the locations, turn off the projector and turn up the side lamps.

7. Have the students notice the differences in the arcs formed by the individual stars. Some will be higher in the sky than others. Stars that started closer to the southern horizon will have lower arcs than those that started farther north.

8. Review with the students why stars in the circumpolar constellations are visible all year long and their paths form a circle. Keep in mind that circumpolar constellations revolve around the North Star, which is almost directly over our North Pole.

9. Finish the lesson by turning off the side lights and turning up the Starfield. Turn on the motion for a brief time and allow the students to follow the stars through the night sky.

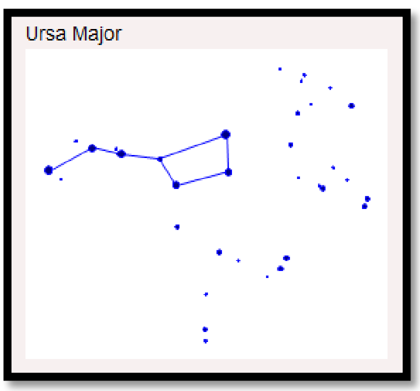
Activity 5: Constellations

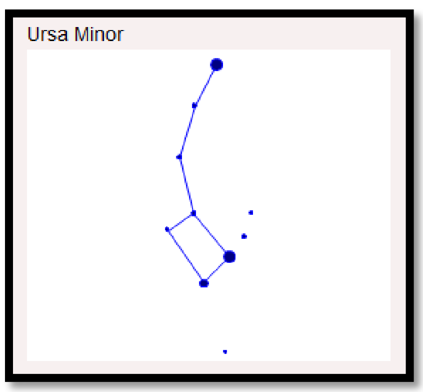
(approximately 20 – 30 minutes)

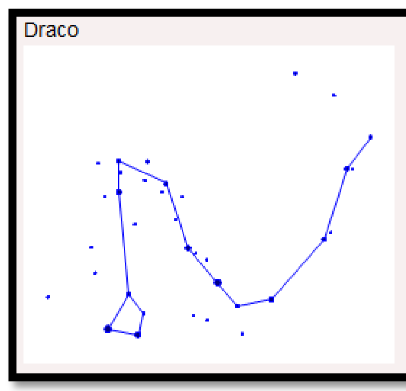
CONSTELLATION and STARFIELD CYLINDER (set latitude at 39 degrees)
Procedure:

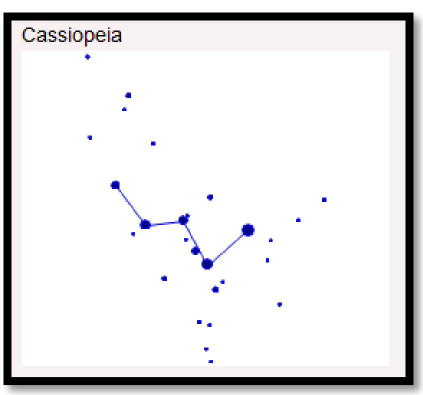
1. Have the Starfield Cylinder set for one of the fall months. Make your observation time about 9:00 P.M. for your latitude

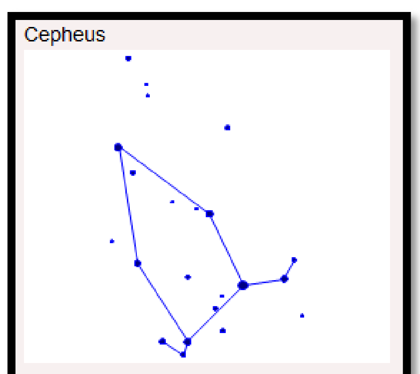
2. Find the position of the circumpolar constellations (Ursa Major, Ursa Minor, Draco, Cassiopeia, and Cepheus).











3. Rotate the projector month-by-month past the 9:00 P.M. observing time as indicated on the hour and date scale. (If the circumpolar constellations are observed at the same time each night throughout the year, they will appear to make a complete rotation around Polaris—the North Star).
    - A **circumpolar star** is a star that, viewed from a given latitude on Earth, never sets (that is, never disappears below the horizon), due to its proximity to one of the celestial poles. Circumpolar stars are therefore visible (from said latitude) for the entire night on every night of the year and would be continuously visible throughout the day too, except for our Sun's brightness.

4. **Ask students to identify the Big Dipper.** Discuss the idea that the Big Dipper is part of the constellation Ursa Major, the Big Bear. **It can be seen all year in the northern sky.**

5. Use the pointer stars at the edge of the Big Dipper cup to locate Polaris. Since Polaris (North Star) is at the tip of the handle of the **Little Dipper**, the constellation Ursa Minor, the Little Bear, is found. **It can also be seen all year in the northern sky.**

6. Cassiopeia is located on the opposite side of the North Star from the Big Dipper. **Draw a line through the pointer stars to the North Star and continue that line twice that distance to find the constellation.** Nicknamed the Lazy W, Cassiopeia is found high in the autumn evening sky. In summer it is found in the northeastern sky and in winter in the northwestern sky.

7. Next, move to **Cepheus**, who is located near his queen, Cassiopeia.
    - The top side of the Lazy W will point to Cepheus. Cepheus is made up of rather dim (low magnitude) stars. Its shape is basically a triangle on top of a box. Cepheus is upside down in the northeastern summer evening sky. He can be found high in the autumn evening sky and low in the spring sky.

8. Finally, **Draco the Dragon** appears next to Cepheus. He wraps his tail around Ursa Minor (Little Dipper). The stars between the Big and Little Dippers are the end of the dragon's tail. The main body of the dragon begins and stretches to the diamond-shaped head. The legs are very low magnitude stars, so look closely. Draco is high in the summer evening sky and low in the winter northern sky.