Exploring the Night Sky

Activity UCIObs – 8
Grade Level: 3 – 12

Standards: This activity addresses this specific California Science Content Standard:
Gr 3 *Earth Science:*
4a. Students know the patterns of stars stay the same, although they appear to move across the sky nightly, and different stars can be seen in different seasons.

What Is This Activity About?

This activity gives students a chance to use a night sky map to explore the night sky.

What Will Students Do?

Students will learn how to use a night sky map by going outside a night and locating planets and constellations. Students will learn how to find the North Star and how the stars move across the sky over time. Students will see that stars have different colors and earn that it arises because of their different temperatures and evolutionary stages.

Tips and Suggestions:

This outdoor exercise requires a dark enough location so that you can see a few dozen bright stars and planets. An Excellent night sky maps for the current month can be found on-line for free at http://www.skymaps.com. Include the optional material to make this lesson appropriate for children in Grade 8 and above.

What Will Students Learn?

Concepts: The Celestial Sphere, Motions of Objects in the Night Sky

Inquiry Skills: Observing, Mapping, Measuring Angular Positions on the Sky
Big Ideas: Spatial Reasoning, Patterns of Change

What you will need:

Night Sky Map (1 per student)
Optional: 3-dimensional Celestial Sphere
Optional: Green Laser Pointer
Optional: Posters Illustrating the Sizes of Stars

Teacher Preparation:

1. If you are unfamiliar with basic astronomy and moon phases, please read the accompanying document entitled Night_Sky_Lectures.pdf by T. Smecker-Hane. This will teach you all you need to know to do this activity.

2. Photocopy the night sky maps so that you have one per student. Excellent night sky maps for the current month can be found on-line for free at http://www.skymaps.com.

3. Get out the optional equipment: a green laser pointer and a 3-dimensional Celestial Sphere. You can buy celestial spheres from the Astronomical Society of the Pacific's on-line Astroshop (http://www.astrosociety.org). Although they are expensive ($429), they are very useful in helping students conceptualize the heavens and the Sun's apparent motion across the celestial sphere.

Teacher's Classroom Instructions:

1. This exercise will take about 20 to 30 minutes although it can be shortened or lengthened as needed.

2. Introduce the Celestial Sphere: Take out the 3-dimensional Celestial Sphere and explain to students that star's don't move very much relative to each other on a human timescale because they are so far away from the Sun (although planets do wander through the heavens) so we can consider them as fixed points on the Celestial Sphere. Explain that Constellations are random groupings of stars that look like a particular person, animal or object, e.g., Gemini, the twins, or the Big Dipper also known as Ursa Major (the big bear).

3. Celestial Sphere Facts: The Milky Way's flattened disk forms a faint band of light that forms a great circle on the Celestial Sphere. The path of the Sun across the sky defines the Ecliptic Plane, which is another great circle on the Celestial Sphere. As the Earth rotates around the Sun, in 1 year or 12 months the Sun will "appear" to move through the 12 constellations of the Zodiac. You can only see half the Celestial Sphere at a given time because the other half is blocked by the Earth.

4. Hand out night sky maps and explain how to use it. East and West are flipped compared to a geography map because you're supposed to hold it over your head while looking at it. Try this out by locating the Big Dipper. Have them face North (the Observatory door faces North) and hold the "North" side of the sky map facing downward. Find the Big Dipper then follow the pointer stars to locate the North Star Polaris. *Optional:* Use the green laser pointer to identify specific stars.

5. Explain that the motion of the night sky over the course of a night is due to the Earth's rotation on its axis. The rate is 360 degrees/24 hrs = 15 degrees/hr.

6. Explain how to measure angles on the sky. The width of a fist held at arm's length is approximately 10 degrees. The width of a finger held at arm's length is approximately 2 degrees. Any star can be specified by giving two angles on the sky, e.g., altitude and azimuth.

7. *Optional:* Explain that the altitude of Polaris (the angle between Polaris and nearest point on the horizon) is equal to your latitude on the Earth. Irvine's latitude is +34 degrees. Measure the altitude of Polaris and see if it agrees.

8. Find the Ecliptic Plane on the Night Sky map and see what planets are visible then find them in the night sky. Is the Moon visible? Note that it should also be located near the Ecliptic Plane.

9. Find two stars in the sky that have different colors (orange vs blue/white) and explain that the difference in color is due to the fact that the stars have different surface temperatures. For example, these stars are good to illustrate the different colors of stars:

   In Spring - Arcturus & Spica or Sirius & Procyon
   In Summer – Vega, Altair & Arcturus
   In Fall – Vega, Altair, Arcturus & Deneb
   In Winter – Betelgeuse & Rigel (both in Orion) & Capella

Optional: Show the students the posters on the relative sizes of stars, which you can find inside the UCI Observatory or on-line at http : //www.physics.uci.edu/~observat/ Physical_Scales.html. The table below lists some of the physical properties of some of the brightest stars visible in the night sky.

Star Name	***Category***	***Sp Type***	***Approx Mass ($M_\odot$)***	***L ($L_\odot$)***	***T (K)***	***R ($R_\odot$)***
Rigel	Supergiant	B8I	17	40,000	10,000	67
Deneb	Supergiant	A2I	20	54,000	8500	110
Antares	Supergiant	A1.5I	16	65,000	3,500	800
Betelgeuse	Supergiant	M2I	18	105000	3,500	731
Aldebaran	Red Giant	K5III	1.7	425	4000	44
Arcturus	Red Giant	K2III	1	210	4300	26
Capella	Red Giant	G5III	2.7	78	4,900	12
Pollux	Red Giant	K0III	1.9	32	4,900	8
Spica	MS	B1III-IV	10.2	12000	22,000	7.4
Altair	MS	A7V	1.8	11	7,000	1.6
Procyon	MS	F5IV-V	1.4	7.7	7,700	205
Vega	MS	A0V	2.1	37	9,600	2.3
Sirius A	MS	A1V	2.0	25	9,900	1.7
Sun	MS	G2V	1.0	1.0	5,800	1

10. Locate some of the other brighter constellations in the night sky, e.g., the Summer Triangle, Cassiopeia, or Orion. Which ones you can easily see will depend critically on how dark the sky is at your location and whether or not the moon is visible.

11. Conduct a lively question and answer session with the students.