Stellar Navigation Curriculum

45 to 60 minutes, for 6th-8th grades

Note: This lesson plan is written to be used in the northern hemisphere.

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Objectives

Students will learn:

- Why stellar navigation was developed;
- How to use Polaris to determine compass points;
- How to use Polaris to estimate latitude; and
- How the stars would appear from at least three different latitudes.

Materials needed

- Flashlight
- Light and laser pointers
- Earth on a stick (globe with handles at north and south poles to represent axis)
- Sextant (optional)
- Digitarium® system set for the current date and time with atmospheric effects and landscape turned on

I. Introduction *(10 mins)*

A) Inform students that you'll be learning about stellar navigation today, and that you'll be using the planetarium to do so. You'll discuss some topics outside the dome, then go inside to learn more. Inside the dome you'll start with the night sky they're most familiar with—their own—then move to some different latitudes to see how the night sky would look.

B) Can anyone define the term stellar navigation? Why did people learn to navigate by the stars? What tools would they have used in addition to stars to help them find their way? ***[****Sextants, possibly early maps, sky charts.****]*** Why don't most people navigate by the stars now? What tools do people use now? Can any of you navigate using stars?

C) Review the terms latitude and longitude, using the Earth on a stick as a visual aid. How do we know the shape of the continents? Or even of the earth? Right, because earlier people from all over the earth explored their world and carefully recorded what they learned. We'll learn more about how they found their way when we go inside the dome.

D) Prepare to enter the planetarium—rules, expectations, etc. **NOTE: Bring the Earth on a stick into the dome with you!**

II. Introduction to Tonight's Sky *(15 mins)*

A) *[When all are in and seated, speed up time to let the sun set, then turn off atmospheric effects and landscape.]* Point out the date and time bar and encourage students to keep track of the sky time.

In the northern hemisphere, one star is particularly helpful for navigation: Polaris, the north star. Share the tip of first finding the Big Dipper ***[****let a student use a LIGHT pointer to point it out****]***, then using the 'pointer stars' to find Polaris. After finding the north star, go over the other directions, and bring up the cardinal points to help students remember which direction is which.

B) Inform students that the north star can help you determine not only which way is north, but also your latitude. The number of degrees that the north star is above the horizon is the same as the number of degrees for your latitude. For example, if you live in Seattle, you're at about 47.5 degrees north latitude, so Polaris will be about 47.5 degrees above the horizon.

How did people originally determine how far above the horizon the north star was? People developed a tool called a sextant to help them do so ***[****if you have one, show and briefly explain the sextant****]***. However, most people

nowadays don't carry sextants, so it's good to know a way to estimate latitude. Share with students the trick of using their fists to approximate their latitude, where one fist held at arm's length equals about ten degrees. ***[****Note: This will be most accurate for students sitting near the center of the dome.****]*** Have students figure out their approximate latitude using this trick, starting with the bottom of their fist at the horizon. *[Select the north star to make it easier for students to keep track of it.]*

C) Ask students why the north star can be used to determine latitude and directions. Inform students that the north star is directly over Earth's north pole ***[****hold up the Earth on a stick, with the north pole tilted toward the north star****]***, and that from our perspective, the north star doesn't seem to move much but all the other stars do. Speed up time to demonstrate this, emphasizing that the earth's rotation and revolution give us the changing views.

III. Where Are We? ***(15 to 20 minutes)***

A) Tell students that now that they know how to find the north star, they'll get some practice in finding their directions at their own latitude. Turn off the cardinal points, have the students hide their eyes, and carefully rotate the projector by at least 30 degrees. Have a student point out the north star.

B) Inform students that they're ready for another challenge: you'll be taking a trip to some different latitudes to learn how the stars would appear. Have the students cover their eyes, set your latitude for 80 degrees north, then let students uncover their eyes. Have a student point out the north star, then ask what latitude the projector is set for. Encourage students to use their fists to estimate latitude.

C) Ask students how the view of the stars is different near the north pole than from their home latitude. Take some predictions on how the stars will appear to move, then test those predictions by speeding up time.

D) Have the students cover their eyes, and set your latitude for 10 degrees north. Have a student point out the north star, then ask what latitude the projector is set for.

E) Ask students what they notice about the stars from this location near the equator. Take and test predictions on how the stars will appear to move. Draw students' attention to the fact that the Big Dipper is now sometimes below the horizon. How would they find Polaris if the Big Dipper were not visible?

F) **OPTIONAL:** Discuss stellar navigation in the southern hemisphere, showing students the southern sky. If there's not enough time for a full discussion, encourage students to research celestial navigation in the southern hemisphere, which is much more complicated than in the northern hemisphere.

G) Exit the planetarium and regroup outside.

IV. Conclusion *(5 minutes)*

A) When all are seated outside the planetarium, ask students if they believe they could find north in the night sky. Review how to use the Big Dipper to find Polaris, why Polaris is always visible in the northern hemisphere, and why stellar navigation was originally developed and is still helpful. Encourage students to find Polaris on the next clear night.