1. Make enough copies of the Dipper Clock template for each student to have one.

2. Give the students the Dipper Clock templates and paper fasteners and have them assemble it using steps 3 to 6.

3. Cut out the two parts of the Dipper Clock template.

4. Punch a small hole through the center of each piece of the Dipper Clock template.

5. Center the small, dark inner circle over the larger, outer circle of the Dipper Clock.

6. Fasten the two halves together with a paper fastener (brad).

7. Your Dipper clock is now ready to use. (To tell time using your Dipper Clock you will need a clear night sky.)

8. Go outside on the first clear night and stand facing north. If you are facing the Big Dipper you are facing north.

9. Turn the outer circle of your Dipper Clock so the present month is at the top of the dial. The red-filtered flashlight will help you read the Dipper Clock without losing your night vision.

10. Look at the Big Dipper in the sky. Turn the inner circle of the Dipper Clock so the clock's Dipper has the same orientation as the Big Dipper in the sky.

11. The notched window of your Dipper Clock now shows you the time of night. (The Dipper Clock shows standard time. If you are on daylight savings time, add one hour to the time your Dipper Clock shows.)

12. You can also use the Dipper Clock to predict the orientation of the Dipper at different times of night through the year.

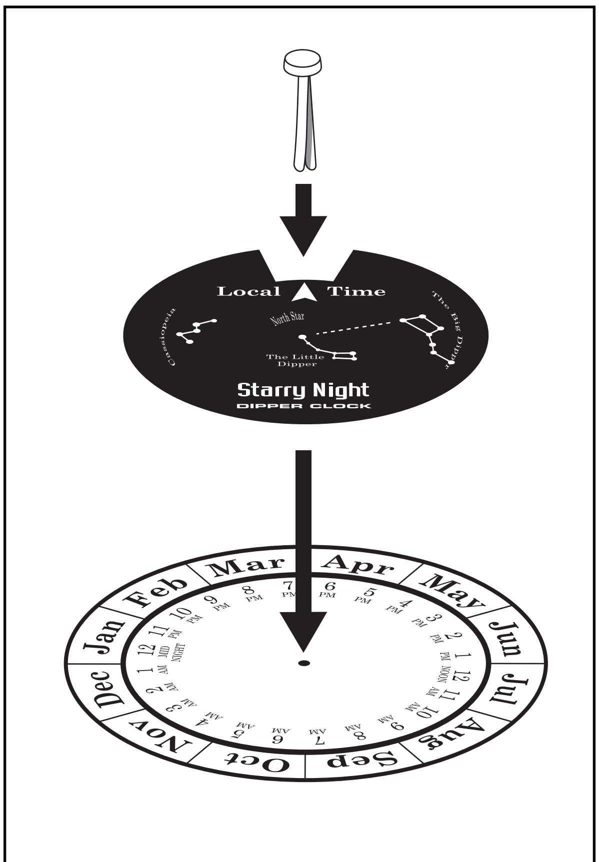


Figure E2.1
Fasten the two halves of the Dipper Clock template with the paper fastener.

*Based on the Star Clocks activity in Sky Challenger, from the Lawrence Hall of Science Planetarium (http://lhs.berkeley.edu/planetarium), University of California, Berkeley. Original version may be found at http://lhs.berkeley.edu/StarClock/starclock.html.

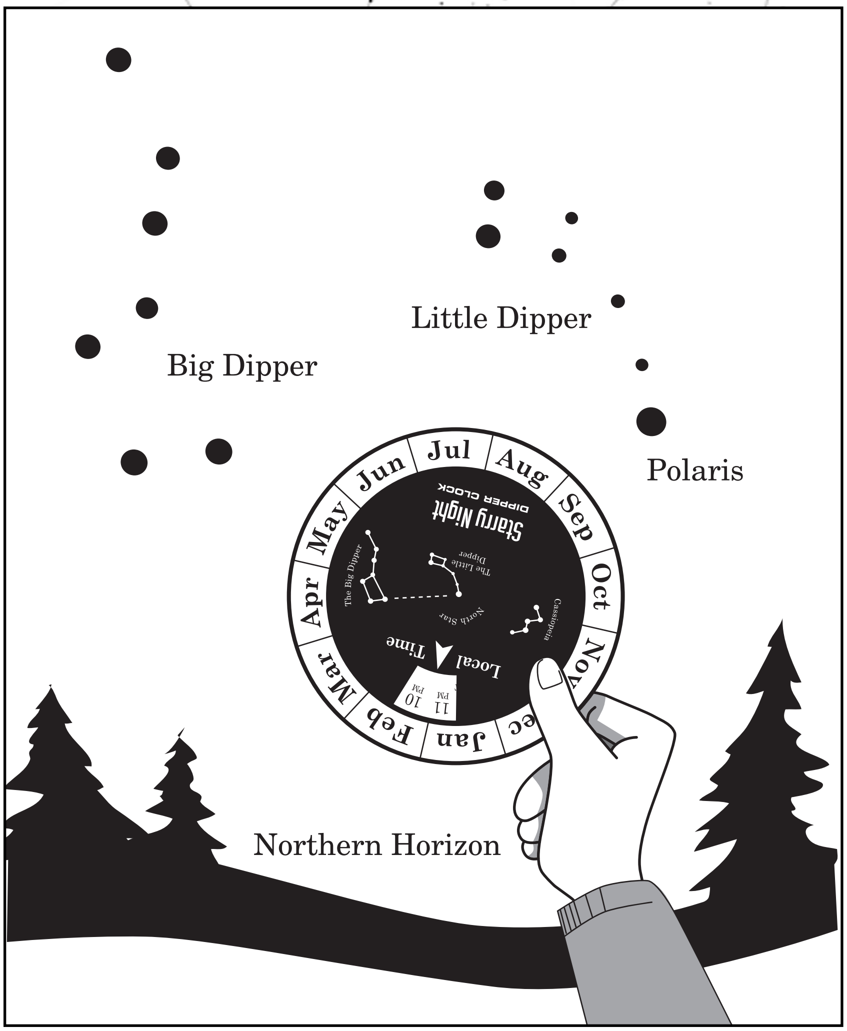


Figure E2.2
Using the Dipper Clock to tell the time.

Discussion Questions

A. How long does it take the Big Dipper to complete one rotation around the North Star?

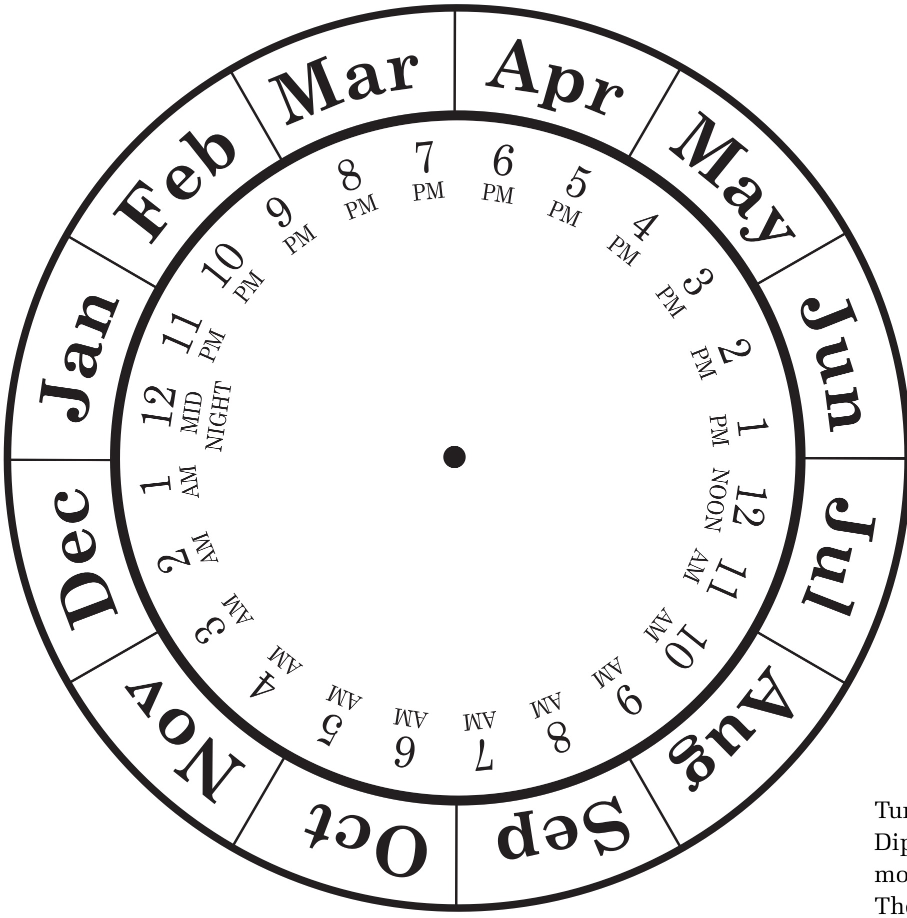
B. Does the Big Dipper always lie in the same orientation at the same time of night throughout the year?

C. How is the changing position of the Big Dipper related to the seasonal shift of the constellations?

The Big Dipper completes one rotation around the North Star in one day. This apparent motion is caused by Earth's daily rotation on its axis.

As students use their Dipper Clocks, they will see that the position of the Big Dipper changes both with time of night and with time of year. This second and slower change is caused by Earth's revolution around the Sun in its yearly orbit.

Every day Earth's orbital motion carries it forward around the Sun. If we look very closely at the same star every day at the exact same time of day, we see that Earth's forward orbital motion has shifted our view of the constellations by a small amount. Each star rises four minutes earlier every day. This includes the stars of the Big Dipper. Over the course of an entire year, the stars and the Big Dipper advance by a complete circle. They come back to the point where they started one year ago.



Turn the outer circle of your Dipper Clock so the present month is at the top of the dial. The red-filtered flashlight will help you read the Dipper Clock without destroying your night vision.

Look at the Big Dipper in the sky. Turn the inner circle of the Dipper Clock so the clock's Dipper has the same orientation as the Big Dipper in the sky.

The notched window of your Dipper Clock now shows you the time of night. (The Dipper Clock shows standard time. If you are on daylight savings time, add one hour to the time your Dipper Clock shows.)

You can also use the Dipper Clock to predict the orientation of the Dipper at different times of night through the year.