Paper Plate Education

"Serving the Universe on a Paper Plate"

Activity: The Platisphere


This and several other activities from the *Paper Plate Astronomy* videotape and DVD are now available online as **free streaming video**!

A planisphere (pronounced "plane is feer") is a device that represents the sphere of stars on a plane surface. In this activity we will make a *Platisphere* (pronounced "plate is feer") , which depicts the circumpolar stars on the surface of a paper plate. Variations of the Platisphere include a tactile version, a children's version, and a photographic version, plus the Drinking Gourd activity and Gemini's Signature activity. A planisphere that you may download and print is available online.

To make the Platisphere you first make the starfield plate. Using astronomy software, print out a star chart of the north circumpolar stars centered on Polaris. Select a limiting magnitude of 3.5; field of view equal to 100 degrees; horizon being transparent; the meridian line indicated; and the starfield set for January 1 at midnight. Cut off extra paper from the star chart to include the circle of stars from Polaris down through 40 degrees of declination.

Click the appropriate link to access a chart of the north circumpolar stars for the desired latitude:

- Latitude = 08 degrees North or Latitude = 08 degrees North, *4th* magnitude stars (Sri Lanka)
- Latitude = 20 degrees North
- Latitude = 30 degrees North
- Latitude = 40 degrees North
- Latitude = 50 degrees North

To mass-produce enough Platispheres for an entire class, center and affix the chart to the top of a stack of 9-inch black paper plates. Clamp the stack so as not to cover any stars. Using a drill or drill press, drill a hole through the stack of plates at each of the stars shown on the top star chart. (As an alternative, you can make one template plate, which students individually place over their blank black plate. Students then mark the stars on their plate using the holes of the template.)

Where the meridian line extends to the perimeter of the paper plate, drill a large hole to indicate the "Up" position for January 1 at midnight.

When you hold the plate so the stars are shown with the hole up, the starfield should coincide with the real sky view as the Third Millennium begins.

Next make a local horizon plate. On the center of a larger (10-inches or more) white plate, punch a hole. As an option, attach a small strip across the bottom of the plate and draw a scene to the north, including trees or buildings as reference points. To mass-produce local horizons, tape a horizon template onto a stack of large white plates and cut local features out of the plates using a band saw or scroll saw.

Secure the optional foreground horizon to the white background plate so as to have a three-dimensional look. Slide the black starfield plate between them and secure the black plate with a paper fastener through Polaris and through the hole on the white plate.

The foreground horizon should be low enough to cut off the star Alkaid (at the end of the Dipper's handler) from view as the black plate is rotated through 360 degrees. As shown in this northern mid-latitude example, this suggests that Alkaid is technically not a circumpolar star from much of the Great Lakes viewing area. Your device is ready to use.

Circumpolar stars appear to rotate counterclockwise around the north pole, which is conveniently marked in the sky by Polaris, the North Star. Unlike the seasonal stars seen toward the south, circumpolar stars and their respective constellations are visible throughout the year. From the northern mid-latitudes region, the major circumpolar constellations are Ursa Minor (The Little Bear), Ursa Major (The Great Bear), Cepheus (The King), Cassiopeia (The Queen), and Draco (The Dragon).

Because the earth rotates once per day, the circumpolar stars appear essentially to travel around Polaris every 24 hours. Each hour the stars sweep through 15 degrees of sky. Therefore if you were to note the position of a circumpolar constellation at, say, 9:00 PM, you would find that six hours later at 3:00 AM the constellation would have rotated 90 degrees around Polaris. A long-duration photograph depicts this stellar motion as a smear of concentric arcs called star trails.

When the indicator hole on the perimeter of the plate is *centered on top* of the plate held vertical, the Platisphere sky is aligned for *January 1 at Midnight*. Relative to this starting point, you will align your dial with the current sky by positioning the indicator to the current date and time.

The white background plate and foreground horizon will remain stationary and upright as you rotate the black starfield plate through the hours and months.

Commercial pla***n***ispheres are often crowded with many stars and look intimidating with months, days, and hours around the perimeter. With the paper Pla***t***isphere you can opt to eliminate the superfluous stars and text. The children's version of the Platisphere allows you to set the starfield with the aid of a seasonal picture for a clue.

To use the Platisphere, first set the dial to the current date. Because the earth revolves 360 degrees around the sun in 365 days, the sky seems to shift about 1 degree per day. Mentally subdivide the plate into 12 pieces of a pie to mark the 12 months of the year. Rotate the indicator *counterclockwise*, or "starwise," the appropriate amount from January 1.

For example, if your current date is September 1, spin the indicator through ¾ of a year, or 9/12 of a plate, or 270 degrees. The dial now depicts the sky as it appears on September 1, but at midnight. Next you must set the time relative to midnight.

Again, the stars appear to rotate *counterclockwise*, or "starwise," 15 degrees every hour. If the current time is before midnight, spin the dial the appropriate amount clockwise to "reverse" time. If the current time is after midnight, spin the dial forward in time to "catch up" to actual time.

For example, if the time to which you want to set the dial is 9:00 p.m., spin the indicator hole clockwise (back in time) through 3/24ths of a day, or 1/8th of a plate, or 45 degrees. Your Platisphere would then show the stars aligned to the real sky for September 1 at 9:00 p.m.

VARIATIONS:

Three variations of the Platisphere were displayed at the 2000 GLPA Annual Conference—a tactile version, a children's version, and a photographic version.

In the Platisphere Tactile, visually impaired students of Dr. David Hurd touch the holes of the starfield plate as they would a Braille star chart. Videotape excerpts show students of David Hurd experiencing circumpolar stars and the stars' motion through the hours and through the months.
(Image courtesy of David Hurd.)



In the Platisphere for Children suggested by April Whitt, students draw four seasonal scenes on the background plate that align with a window cut into the starfield plate, which itself has fewer constellations drilled out. This window is positioned just to the right, or east, of Cassiopeia so that the starfield corresponds to early evening hours for the respective seasons. See April Whitt's entry on page 155 of the *Proceedings of the 33rd Annual GLPA Conference* (1997 in Cleveland) for a similar application.




In the Photographic Plate students predict the star trails created from a long duration exposure. Put a pen in a star hole and sweep an arc, moving the black starfield plate through the number of hours for your exposure time. Return to the starting time and repeat the procedure for each of the stars. Remove the starfield plate to reveal the smear of stars predicted from an exposure of your given duration.





In Gemini's Signature, a more technical application of both the Platisphere and the Photographic Plate, different latitudes yield different photographic star trails.







Contributed by Chuck Bueter.

GLPA Proceedings, 2000, pp. 67-68, with excerpts from demo Paper Plate Astronomy videotape.

[Note: This activity is included in the *Paper Plate Astronomy video/DVD/streaming video*.]