

Paper Plate Education

"Serving the Universe on a Paper Plate"

Activity: Rainbow Finder



Abstract: In this activity, rainbow seekers make an inexpensive device which illustrates that the primary rainbow is seen about 42 degrees up from the antisolar point, or up about four fists stacked above the top of the shadow of the viewer's head.

A typical rainbow ray is created from the dual refraction, singular reflection, and dispersion of sunlight as it encounters a spherical raindrop. The red color appears in a circle – a portion of which is seen as the rainbow arc – roughly 42 degrees from the antisolar point, as suggested by Rene Descartes in 1637.

The “height” of a rainbow above the horizon depends specifically on the altitude of the sun. When the sun is low, a rainbow is high. When the sun is high, a rainbow is low, perhaps even below the horizon.

To find a rainbow, an observer should place her back to the sun. The spot where the shadow of her head is cast is the antisolar point. Forty two degrees above the head shadow is where a rainbow would appear. The observer can stack her fists, held at arm's length, atop one another four times with the bottom fist appearing to rest on the head shadow. Above the fourth fist will be the rainbow.

The Paper Plate Rainbow Finder is a device that reinforces Descartes finding and eliminates confusion about where to look. Required materials are a paper plate, a protractor, and a pencil.

From the left edge of a paper plate, draw a line across the plate yet below the center point, with an arrow on the line where it terminates on the right edge of the plate. Label the line “To Head Shadow.” From the same starting point on the left, draw a line 42 degrees up from the first, also ending with an arrow. Label the second line “To Rainbow.”

Between the arrow heads on the crinkled perimeter of the plate, draw four clenched fists atop one another. Above the top fist draw a rainbow.

Below the bottom line, draw a person's shadow so that the tip of the shadow's head touches the bottom line. Above the bottom line, on top of the shadow's head, draw the shadows of four

clenched fists atop one another. The combined height of these smaller shadow fists are roughly the height of one fist drawn on the plate's perimeter.

Between the two lines, at the point of origin, draw an eyeball within the angle.

Your Paper Plate Rainbow Finder is ready for use. When water droplets from rain (or from a lawn sprinkler) are present on a sunny day, the observer places her back to the sun. The observer holds the paper plate so the drawn eyeball is near her eye. Turn the plate so the bottom line points to the top of the shadow of the observer's head. The observer then simply looks along the top line of sight to locate the rainbow.

A secondary bow, caused by *two* internal reflections in addition to the two refractions and dispersion, sometimes appears about 10 degrees above the primary rainbow and may also be drawn on the paper plate. Remember that its colors are inverted from the primary rainbow's colors.

See <http://www.unidata.ucar.edu/staff/blynds/rnbw.html> for more rainbow information.

Contributed by Chuck Bueter.

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[Site Map](#)

[Light Pollution](#)

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[Upcoming Events](#)

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