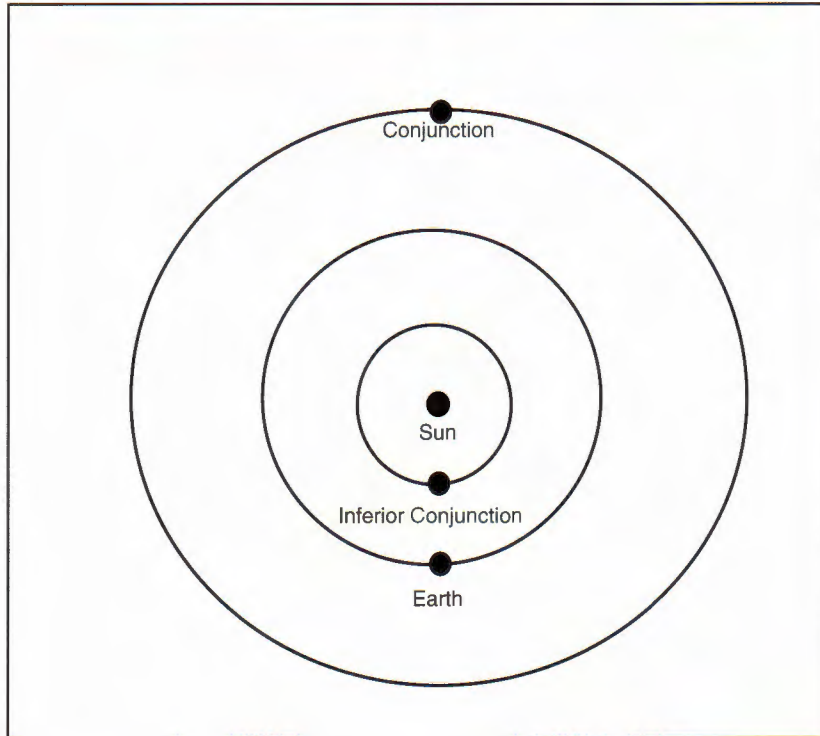


Close encounters in the sky



Looking up into the sky at night and seeing two or more bright objects near each other attracts our attention. We may see two planets next to each other or an even more striking combination, such as a crescent moon near a bright star or three bright objects clustered together. We call the close proximity of celestial objects a conjunction.

Conjunctions occur fairly frequently simply because of the sheer magnitude of celestial objects in the solar system that are in constant motion. As the planets, asteroids, and comets move along their respective orbital paths around the Sun, our view of their position also changes. Some of the most obvious changes occur in the position of objects relative to the Sun. From our viewpoint on Earth, an object will gradually shift from rising before the Sun to setting after the Sun. In some

instances, the Sun may appear to catch up and pass an object, and in other instances an object may appear to move from one side of the Sun to the other. The orbital speeds of the object and the Earth both play a part in how the object's motion is perceived.

During April, Mercury changes from an evening planet (setting east of the Sun) to a morning planet (rising west of the Sun). During this time it reaches the point along its orbital path where it moves between the Earth and Sun. When either of the two inner planets reaches this position it is said to be at inferior conjunction and is not visible from the Earth, just as a new moon is not visible during conjunction with the Sun. Saturn is also in conjunction with the Sun during April. However, it will be positioned on the opposite side of the Sun from the Earth.

Outer planets in this position are simply said to be in conjunction with the Sun. As Saturn continues along its orbital path, it too will become a morning planet (rising before the Sun).

Lunar conjunctions are also quite common. During its cycle of phases, the Moon routinely is in conjunction with planets and bright stars, forming picturesque arrangements when the Moon is in its crescent phase. On the evenings of April 1 and 28, for example, the very thin waxing crescent Moon will be less than a full moon diameter from the bright star Aldebaran, located in the constellation Taurus. On the twenty-third, there will be a very noticeable conjunction between the two brightest planets, Venus and Jupiter, and the waning crescent moon.

Because of its faster orbital speed, each morning Venus will move noticeably closer to Jupiter. On the morning of April 23, these two planets will be separated by less than half a degree—about the diameter of a full moon. The thin crescent moon will also join this conjunction. The next morning the Moon will be within one degree of the planet Mercury.

Heliocentric coordinates

To help my class visualize how the planets' orbits would look if viewed from far above the Sun's north pole, I ask students to plot the positions of the planets on polar graph paper using heliocentric coordinates, a circular coordinate system that measures a planet's relative angular position from the Sun (in degrees). I designate a concentric circle to represent each of the planet's orbits. After graphing the planets' positions for several dates over a specified time period, students label the dates for the points they've plotted. This clarifies the planets' movement in relation to one another and gives

students an idea of the planets' relative orbital velocities.

To prepare for the activity, provide students with a sheet of polar coordinate paper and the heliocentric coordinates of the visible planets for the month of April (Figure 1).

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Visible planets

Venus and Jupiter are visible over the eastern horizon before sunrise in April.

Figure 1. Heliocentric coordinates for visible planets				
	Apr 1	Apr 11	Apr 21	May 1
Mercury	176° 00'	211° 56'	241° 26'	269° 01'
Venus	236° 58'	252° 53'	268° 45'	284° 34'
Earth	191° 19'	201° 10'	210° 57'	220° 41'
Mars	28° 00'	33° 53'	39° 42'	45° 24'
Jupiter	337° 52'	338° 45'	339° 40'	340° 34'
Saturn	22° 56'	23° 17'	23° 38'	23° 59'

Moon phases

April

First Quarter - April 3
 Full Moon - April 11
 Last Quarter - April 19
 New Moon - April 26

May

First Quarter - May 3
 Full Moon - May 11
 Last Quarter - May 19
 New Moon - May 25

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