

The school year in space

The opportunities for planet observation this school year will not be as good as last spring when we were able to view six planets at once (including the Earth!). The only visible evening planet until the end of November is Venus, and its brilliance will continue to dominate the evening skies after sunset, at least during September. Venus is currently in retrograde motion, westward relative to the horizon. Retrograde motion occurs when a planet has a motion opposite to the regular motion (prograde motion)—sort of like counterclockwise versus clockwise. All planets move eastward, prograde, however when the Earth passes an outer planet, the outer planet appears to go backward or retrograde for a few days to a few months depending on the planet. Within the next month Venus will pass between the Earth and the Sun, reaching inferior conjunction. Then, over the remainder of the school year, it will become increasingly visible over the eastern horizon before sunrise.

The elusive planet Mercury, the innermost planet, will complete more than two of its yearly cycles during the school year. It will move from morning sky viewing during October, to December evening viewing, back to morning viewing during February, again to the morning skies of April, and finally back to the evening skies during June. And you thought your schedule was busy!

Some of the other planets will eventually make appearances too. Mars will be on the other side of the Sun as the school year starts, and therefore, not visible. However by the end of the school it will be rising at sunset and will be visible all night. The two giant planets, Jupiter and Saturn, are easily

seen in the pre-dawn hours before sunrise. Both planets are well above the eastern horizon by sunrise as the school year opens. By the end of the school year, the two planets will have moved into the night skies and be visible all night long.

Eclipses

During this school year the necessary alignment between the Earth, Moon, and Sun for an eclipse will occur four times, resulting in two lunar eclipses and two solar eclipses. Both lunar eclipses occur when our hemisphere is turned toward the Sun. The most favorable eclipse will occur on May 16, 2003 as the total eclipse will be visible from the eastern half of the United States. From the western half of the United States the eclipse will be in progress as the moon rises. The partial lunar eclipse on November 20th, while visible, will not be remarkable, as the Moon only passes through the Earth's outer, fainter, penumbral shadow. While we will be able to view a lunar eclipse this year, neither of the solar eclipses will be visible from the United States.

Launches

There will be several launches during the coming school year including several assembly missions to the International Space Station. This coming fall the Planetary Society, in cooperation with members of the Russian space industry, has scheduled the launch of a solar sailing spacecraft to orbit the Earth. Using a former submarine-launched ballistic missile as the launch vehicle, the plan is to place the spacecraft in a low Earth orbit and unfurl the sail material. The solar sail "flies" by reflecting sunlight rather than by interaction with the solar wind. The light particles (photons) of sunlight strike the reflective material of the solar sail. By slowing down the photon the sail gains

the energy or momentum the moving photon has and is slightly pushed. Because the sail is reflective the photons also bounce, or are reflected back the way they came. (This is a neat example of Newton's third law of equal and opposite reactions.) The net result is that, over time, these slight pushes will accumulate and the spacecraft accelerates.

The plan is to test this method as a means of spacecraft propulsion by measuring any gains in the orbital energy of the spacecraft. At the close of the school year, NASA has scheduled a launch of the *Mars Exploration Rover A*, one of a pair of rovers being sent to Mars during 2003.

Artist's rendering shows the International Space Station after all assembly is complete in 2003.

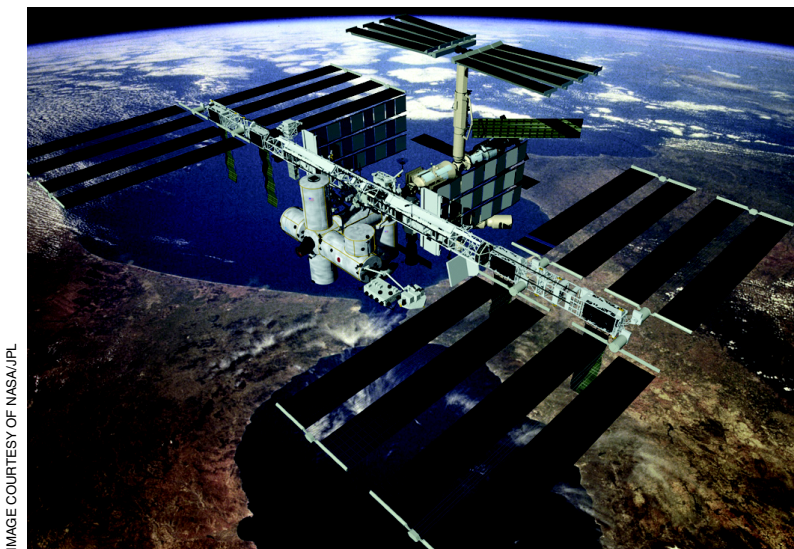


IMAGE COURTESY OF NASA/JPL

ISS missions

The International Space Station continues to grow as the next several assembly missions will contribute to its size. Plans for additions include more truss segments, a cart to move equipment along the truss segments, more cooling radiators, the Raffaello Multi-Purpose Logistics Module, other modules, an external stowage platform, as well as a crew exchange as the Expedition 6 crew is replaced by the Expedition 7 crew.

Visible planets

- Venus is visible over the southwest horizon and sets approximately two hours after the Sun.
- Saturn rises shortly after midnight and is visible over the southeast horizon before sunrise.
- Jupiter rises a few hours before sunrise and is visible over the northeastern horizon.

Moon phases

	September
New Moon	9/07
First quarter	9/13
Full Moon	9/21
Last quarter	9/29

Internet resources

- Planetary Society Solar Sail Project—www.planetary.org/solarsail/index2.html
- September equinox—www.equinox-and-solstice.com/html/autumnal_equinox.html
- STS-113 ISS Assembly—www.spaceflight.nasa.gov/shuttle/

archives/sts-113/index.html, www.spaceflight.nasa.gov/station/assembly/flights/11a.html

- Leonids meteor shower—www.comets.amsmeteors.org/meteors/showers/leonids.html
- Lunar eclipse—sunearth.gsfc.nasa.gov/eclipse/LEplot/LEplot2001/LE2002Nov20N.gif
- Solar eclipse—sunearth.gsfc.nasa.gov/eclipse/SEplot/SEplot2001/SE2002Dec04T.gif
- Geminid meteor shower—www.comets.amsmeteors.org/meteors/showers/geminids.html
- December solstice—www.equinox-and-solstice.com/html/winter_solstice.html
- Launch of SIRTf—www.jpl.nasa.gov/releases/2002/release_2002_48.html
- Launch of STS-114, ISS assembly mission—www.spaceflight.nasa.gov/station/assembly/flights/ulf1.html
- March equinox—www.equinox-and-solstice.com/html/vernal_equinox.html
- ISS assembly mission—www.spaceflight.nasa.gov/station/assembly/flights/ulf1.html
- STS-115, ISS assembly mission—www.spaceflight.nasa.gov/station/assembly/flights/12a.html
- Cassini mission to Saturn—www.jpl.nasa.gov/cassini
- Astronomy Week—www.astroleague.org/all/astroday/astroday.html
- Astronomy Day—www.astroleague.org/all/astroday/astroday.html
- Lunar eclipse—sunearth.gsfc.nasa.gov/eclipse/LEplot/LEplot2001/LE2003May16T.gif
- Launch of Mars Express—spdex.estec.esa.nl/content/doc/83/2179_.htm
- Launch of Mars Exploration Rover A—mars.jpl.nasa.gov/mer
- Annular solar eclipse—sunearth.gsfc.nasa.gov/eclipse/SEplot/SEplot2001/SE2003May31A.gif

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The school year in space: 2002-2003

September

TBA	Cosmos 1 Volna Launch (Solar Sail Mission)
9/01	Mercury at greatest eastern elongation (27 degrees)
9/07	New Moon
9/13	First quarter Moon
9/21	Full Moon
9/23	September equinox
9/29	Last quarter Moon

October

10/06	STS-113 Launch, Space Shuttle <i>Endeavour</i> , Space Station assembly mission 11A
10/06	<i>Progress M1</i> Soyuz-U Launch (ISS 10P)

10/06	New Moon
10/13	Mercury at greatest western elongation (18 degrees)
10/13	First quarter Moon
10/21	Full Moon
10/27	Daylight Saving Time—Set clock back 1 hour (North America, Europe)
10/29	Last quarter Moon

November

11/04	New Moon
11/11	First quarter Moon
11/19	Leonids meteor shower peak (potential meteor storm)

- 11/20 Full Moon
- 11/20 Lunar eclipse
- 11/27 Last quarter Moon

December

- 12/04 Solar eclipse (visible from southern Africa)
- 12/04 New Moon
- 12/05 Moon occults Mercury
- 12/11 First quarter Moon
- 12/13 Geminids meteor shower peak
- 12/17 Saturn at opposition
- 12/19 Full Moon
- 12/22 December solstice
- 12/26 Mercury at its greatest eastern elongation (19 degrees)
- 12/27 Last quarter Moon

January

- 1/02 New Moon
- 1/03 Quadrantids meteor shower peak
- 1/04 Earth at perihelion (0.983 AU from Sun)
- 1/09 SIRTf *Delta 2* launch
- 1/10 First quarter Moon
- 1/11 Venus is at greatest western elongation (47 degrees)
- 1/16 STS-114 Launch, Space Shuttle *Atlantis*, Space Station assembly mission
- 1/18 Full Moon
- 1/25 Last quarter Moon
- 1/27 Moon occults Mars

February

- 2/01 New Moon
- 2/02 Jupiter at opposition
- 2/04 Mercury at greatest western elongation (25 degrees)
- 2/09 First quarter Moon
- 2/16 Full Moon
- 2/21 Mercury passes 1.5 degrees from Neptune
- 2/23 Last quarter Moon

March

- 3/03 New Moon
- 3/04 Mercury passes 1.5 degrees from Uranus
- 3/11 First quarter Moon
- 3/12 Venus passes 0.2 degrees from Neptune
- 3/18 Full Moon
- 3/21 March equinox
- 3/25 Last quarter Moon
- 3/28 Venus passes 0.1 degrees from Uranus

April

- 4/01 New Moon
- 4/06 Daylight Saving Time—Set clock ahead 1 hour (North America)
- 4/09 First quarter Moon
- 4/16 Full Moon
- 4/23 Last quarter Moon
- 4/24 STS-115 Launch, Space Shuttle *Endeavour*, Space Station Flight 12A

May

- 5/01 *Cassini*, Trajectory Correction Maneuver #19 (TCM-19)
- 5/02 New Moon
- 5/05 Astronomy Week
- 5/07 Mercury transits the Sun
- 5/09 First quarter Moon
- 5/10 Astronomy Day
- 5/14 Mars passes 2.0 degrees from Neptune
- 5/16 Full Moon
- 5/15 Lunar eclipse
- 5/23 *Mars Express* Soyuz-Fregat Launch (Mars Orbiter/Lander)
- 5/22 Last quarter Moon
- 5/26 Mercury passes 2.2 degrees from Venus
- 5/31 New Moon
- 5/30 Annular solar eclipse