

Cosmic Chemistry: Planetary Diversity

STUDENT DATA SHEET—PART 1

Are We Related? Looking for Patterns In Planetary Diversity

Data Table 1

| Planet | Average Distance From Sun | Diameter (at equator) | | |
|---------|---------------------------|-----------------------|---------|-----------|
| | AUs | 10^6km | Km | Earth = 1 |
| Mercury | 0.387 | 57.90 | 4,880 | .38 |
| Venus | 0.723 | 108.20 | 12,100 | .95 |
| Earth | 1.000 | 149.60 | 12,760 | 1.00 |
| Mars | 1.524 | 227.90 | 6,790 | .53 |
| Jupiter | 5.203 | 778.30 | 142,900 | 11.20 |
| Saturn | 9.539 | 1,427.00 | 121,500 | 9.45 |
| Uranus | 19.180 | 2,870.00 | 51,120 | 4.00 |
| Neptune | 30.060 | 4,497.00 | 49,500 | 3.80 |
| Pluto | 39.530 | 5,914.00 | 6,000 | .50 |

Sources: See Note 1

Data Table 2

| Planet | Average Distance From Sun | Average Temperature | |
|---------|---------------------------|---------------------|------|
| | AUs | 10^6km | °C |
| Mercury | 0.387 | 57.90 | 260^ |
| Venus | 0.723 | 108.20 | 465 |
| Earth | 1.000 | 149.60 | 15 |
| Mars | 1.524 | 227.90 | -23 |
| Jupiter | 5.203 | 778.30 | -150 |
| Saturn | 9.539 | 1,427.00 | -180 |
| Uranus | 19.180 | 2,870.00 | -210 |
| Neptune | 30.060 | 4,497.00 | -220 |
| Pluto | 39.530 | 5,914.00 | -220 |

Note. ^Mercury's "days," noon to noon, are equal to 176 Earth days, so it has a "daylight" side whose temperature averages 350 °C and a "night time" side, with an average temperature of -170 °C.

Sources: See Note 2

Data Table 3

| Planet | Average Distance From Sun | | Relative Period of Rotation on Own Axis^ (in days) Earth=1 |
|---------|---------------------------|--------------------|---|
| | AUs | 10 ⁶ km | |
| Mercury | 0.387 | 57.90 | 58.65 |
| Venus | 0.723 | 108.20 | 243.01 ♦ |
| Earth | 1.000 | 149.60 | 1.00 |
| Mars | 1.524 | 227.90 | 1.03 |
| Jupiter | 5.203 | 778.30 | .41 |
| Saturn | 9.539 | 1,427.00 | .44 |
| Uranus | 19.180 | 2,870.00 | .72 ♦ |
| Neptune | 30.060 | 4,497.00 | .63 |
| Pluto | 39.530 | 5,914.00 | 6.38 |

Note. ^Relative to the stars, ♦ Indicates retrograde motion

Sources: See Note 3

Data Table 4

| Planet | Average Distance From Sun | | Relative Mass Earth=1 | Relative (Average) Density Earth=1 |
|---------|---------------------------|--------------------|--------------------------|--|
| | AUs | 10 ⁶ km | | |
| Mercury | 0.387 | 57.90 | .0550 | 1.00 |
| Venus | 0.723 | 108.20 | .8140^ | .95 |
| Earth | 1.000 | 149.60 | 1.0000 | 1.00 |
| Mars | 1.524 | 227.90 | .1080^ | .71 |
| Jupiter | 5.203 | 778.30 | 317.8000^ | .24 |
| Saturn | 9.539 | 1,427.00 | 95.2000^ | .13 |
| Uranus | 19.180 | 2,870.00 | 14.5000^ | .24 |
| Neptune | 30.060 | 4,497.00 | 17.2000^ | .29 |
| Pluto | 39.530 | 5,914.00 | .0025^ | .38 |

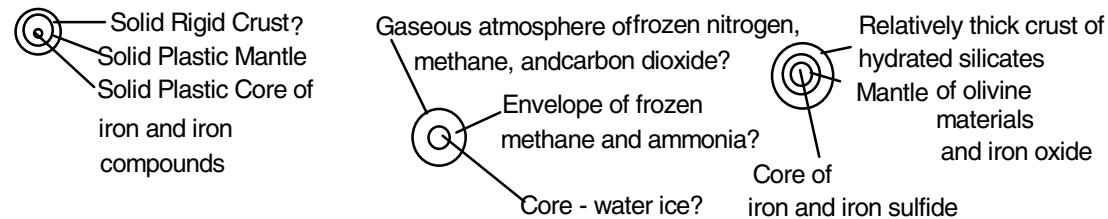
Note. ^Rounded from Darwin Space Infrared interferometer project, May 21, 1998, NSSDC Planetary Science, which, in most cases showed at least one more significant digit in the measurement.

Sources: See Note 4

Below you will find diagrams of internal structures of planets. Do not read more into these diagrams than is warranted. The overall diameters of these cross-sectional diagrams are drawn to scale. Since even the constituents of some internal partitions are, in some cases, conjecture, the size of the partitions should not be considered as you look for patterns or groupings of the planets based on internal structures.



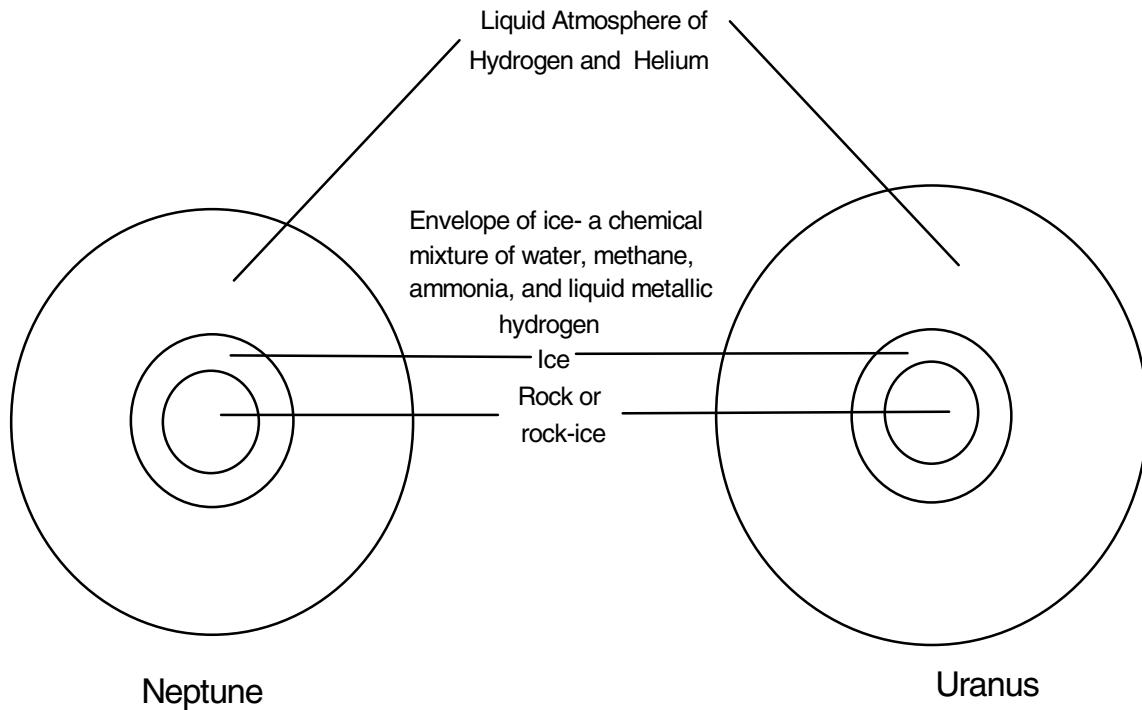
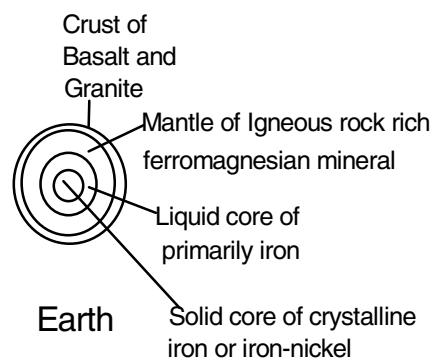
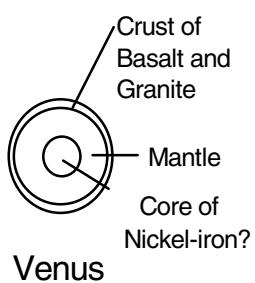
DIAGRAMS OF INTERNAL STRUCTURES OF PLANETS (1.5 cm = 12,760 km)

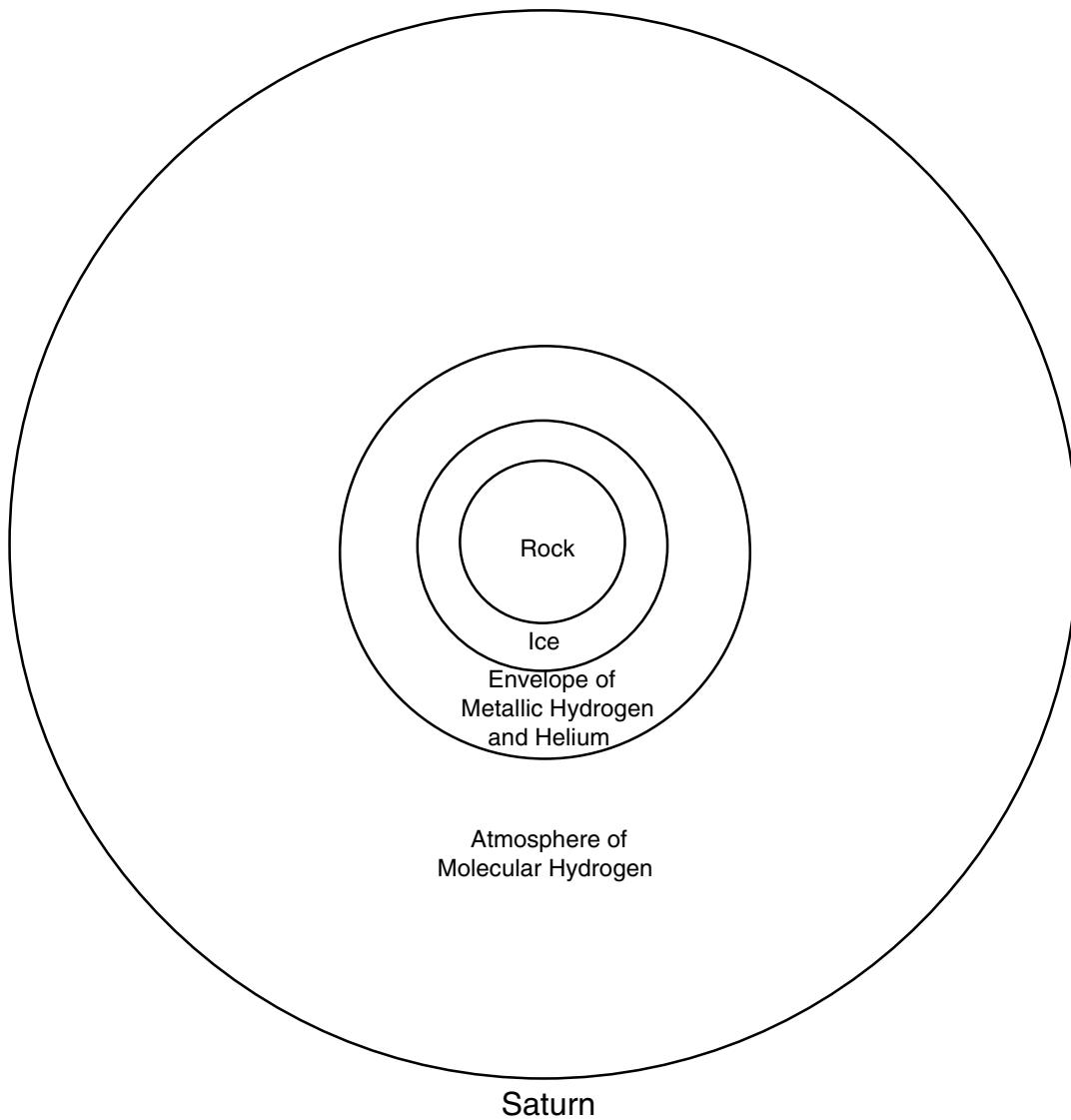


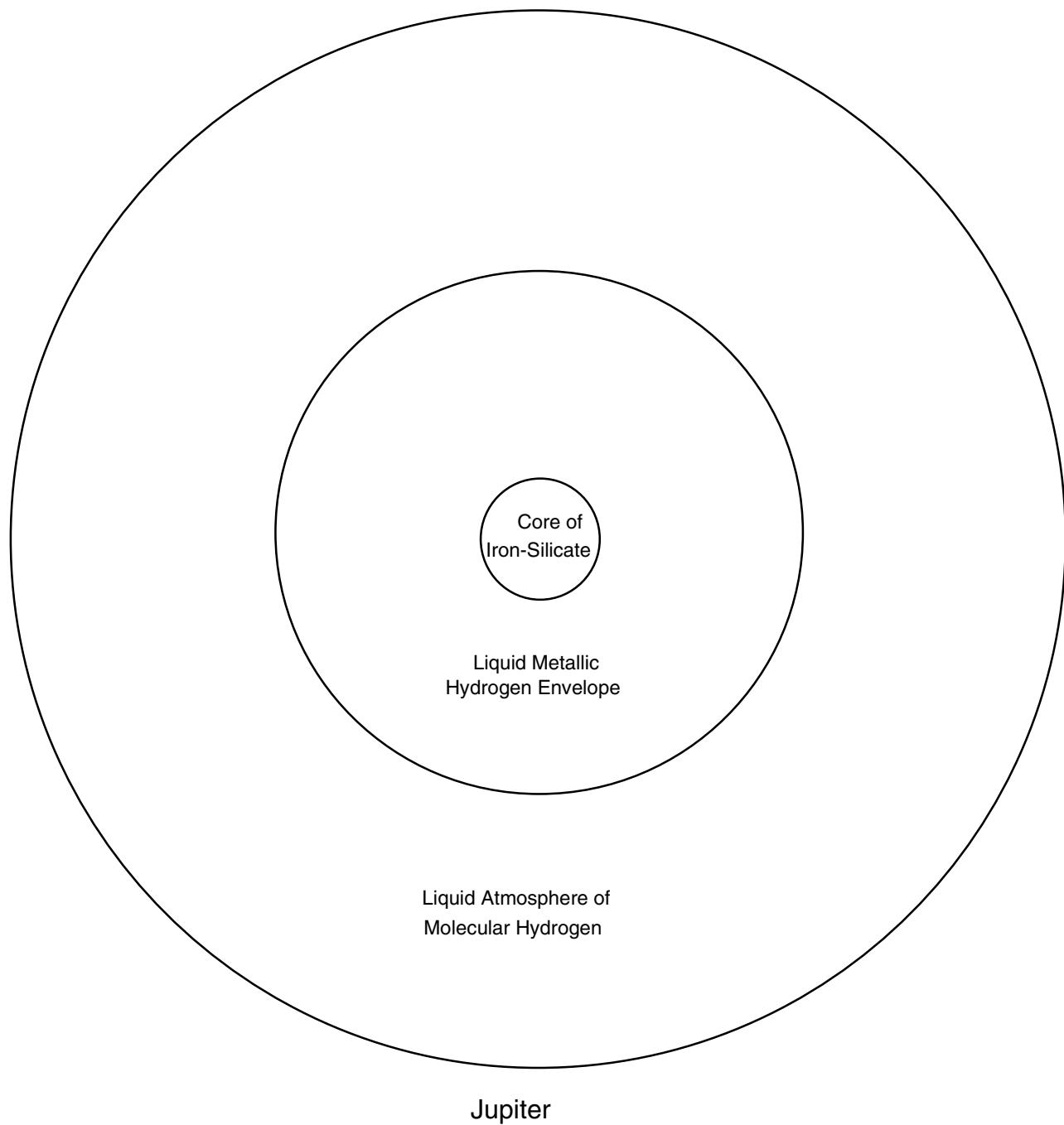
Mercury

Pluto

Mars







Data Table 5

| Planet | Pressure | Atmospheric Constituents |
|---------|-----------------------------------|---|
| Mercury | 10^{-15} atm | He (42%), Na (42%), O ₂ (15%); traces (in ppm) of H ₂ (10,000), K (2,000) |
| Venus | 90 atm | CO ₂ (96%), N ₂ (3.5%); traces (in ppm) of H ₂ O (100), SO ₂ (150) Ar (70), CO (40), Ne (5-7), He (5.2-12), HCl (0.4), HF (.01), Kr (0.7) |
| Earth | 1 atm | N ₂ (78 %), O ₂ (21%), H ₂ O (1 %), Ar (.93 %); traces (in ppm) of CO ₂ (330), Ne (18), He 5.2, Kr (1.1), Xe (.087), CH ₄ (1.5), H ₂ (.5), N ₂ O (.3), CO (.12), NH ₃ (.01), NO ₂ (.001) |
| Mars | .007 atm | CO ₂ (95 %), N ₂ (2.7 %), Ar, (1.6 %), O ₂ (.13%) ; traces (in ppm) of CO (700), H ₂ O (300), Ne (2.5), Kr (.3), Xe (0.8), O ₃ (.1) |
| Jupiter | 1 bar at lowest observable levels | 90% H ₂ , 10% He, .0001% H ₂ O, .02% CH ₄ , .03% NH ₃ , traces of C ₂ H ₆ , C ₂ H ₄ , C ₂ H ₂ , C ₆ H ₆ , CH ₃ C ₂ H, PH ₃ , GeH ₄ , and CO |
| Saturn | 1 bar at lowest observable levels | 94-97% H ₂ , 3% He, 0.2% CH ₄ , 0.03 NH ₃ , traces of C ₆ H ₆ , C ₂ H ₂ , and PH ₃ |
| Uranus | Unknown | 83% H ₂ , 15% He, 2% CH ₄ , traces of C ₂ H ₆ , C ₂ H ₂ , |
| Neptune | Unknown | H ₂ , He, CH ₄ (presumed to be similar to that of Uranus) |
| Pluto | Unknown | CH ₄ ? N ₂ ? CO ₂ ? |

Sources: See Note 5

Data Table 6

| Planet | Particulate Compostion | Altitude | Areal Distribution | Optical Depth τ^{\wedge} |
|---------|-------------------------------|----------|--|-------------------------------|
| Mercury | none | | | |
| Venus | sulfuric acid | 50-80 | everywhere | ≈ 25 |
| Earth | sulfuric acid | 12-30 | everywhere | .003-.3# |
| | sulfates, silicates, seasalt, | 0-12 | everywhere | |
| | organics | | (spatially variable) | |
| | water | 0-12 | 50% cloud cover | 5 |
| Mars | dust | 0-50 | everywhere | .3-6## |
| | water, ice | 0-50 | winter polar region | ≈ 1 |
| | | | morning fog; isolated clouds many places | $\approx .001$ |
| | CO ₂ ice | 0-25 | winter polar region | ≈ 1 |

\wedge Optical depth is a measure of the degree to which particles interact with sunlight; when τ is much less than 1, very little sunlight is scattered or absorbed; when τ is large, the opposite is true

#Sulfuric acid values high after volcanic eruptions

##Maxima due to dust during global dust storms

Sources: See Note 6

The detection instruments in space craft have provided us with much defining information regarding the atmospheres of the planets, especially Venus, Mars, Mercury, Jupiter, and Saturn, as well as some characteristics of Uranus' cloud-top atmosphere.

Data Table 7

| Planet | Surface Gravity | Period of Revolution | Number of Known Moons | Rings | Inclination of Axis | Inclination of Orbit to Ecliptic |
|----------------|------------------------------|-----------------------------------|-----------------------|------------------|---------------------|----------------------------------|
| | Compared to Earth (multiply) | Earth Days (D) Earth Years (Y) | | | Degrees | Degrees |
| Mercury | 0.38 | 87.97 D | 0 | None | 0 | 7.00 |
| Venus | 0.905 | 224.7 D | 0 | None | 177.3 | 3.39 |
| Earth | 1 | 365.26 D | 1 | None | 23.5 | 0.00 |
| Mars | 0.377 | 686.98 D | 2 | None | 25.2 | 1.85 |
| Jupiter | 2.53 | 11.86 Y | 16 | 1 | 3.08 | 1.31 |
| Saturn | 1.14 | 29.46 Y | 20 + | Thousands | 26.7 | 2.49 |
| Uranus | 0.90 | 84.07 Y | 15 | 11 | 97.9 | 0.77 |
| Neptune | 1.14 | 164.82 Y | 8 | 5 | 29.6 | 1.77 |
| Pluto | 0.08 | 248.6 Y | 1 | None | 122 | 17.15 |

Sources: See Note 7

Note 1: Sources for data in Table 1 are:

Darwin Space Infrared Interferometer Project. (May 21, 1998). [NSSDC Planetary Science](#).

Henbest, N. (1992). [The Planets: Portraits of New Worlds](#). New York: Nigel Viking, Penguin Group.

Kaufmann, III, W. J. (1978). [Exploration of the Solar System](#). New York: William J.. Macmillan Publishing Co.

Smoluchowski, R. (1983). [The Solar System](#). New York: Scientific American Library, An imprint of Scientific American Books, Inc.

Note 2: Sources for data in Table 2 are:

Darwin Space Infrared Interferometer Project. (May 21, 1998). [NSSDC Planetary Science](#).

Henbest, N. (1992). [The Planets: Portraits of New Worlds](#). New York: Nigel Viking, Penguin Group.

Kaufmann, III, W. J. (1978). [Exploration of the Solar System](#). New York: William J.. Macmillan Publishing Co.

Smoluchowski, R. (1983). [The Solar System](#). New York: Scientific American Library, An imprint of Scientific American Books, Inc.

Note 3: Sources for data in Table 3 are:

Henbest, N. (1992). [The Planets: Portraits of New Worlds](#). New York: Nigel Viking, Penguin Group.

Kaufmann, III, W. J. (1978). [Exploration of the Solar System](#). New York: William J.. Macmillan Publishing Co.

Smoluchowski, R. (1983). [The Solar System](#). New York: Scientific American Library, An imprint of Scientific American Books, Inc.

http://vraptor.jpl.nasa.gov/voyager/vgrnep_fs.html

Note 4: Sources for data in Table 4 are:

Henbest, N. (1992). [The Planets: Portraits of New Worlds](#). New York: Nigel Viking, Penguin Group.

Kaufmann, III, W. J. (1978). [Exploration of the Solar System](#). New York: William J.. Macmillan Publishing Co.

Smoluchowski, R. (1983). [The Solar System](#). New York: Scientific American Library, An imprint of Scientific American Books, Inc.

Note 5: Sources for data in Table 5 are:

The New Solar System, J. Kelly Beatty and Andrew Chaikin, ed. Sky Publishing Corporation, Cambridge, MA, 1999.
The Solar System, Roman Smoluchowski. Scientific American Library. An imprint of Scientific American Books, Inc., New York, 1983.
Exploration of the Solar System, William J. Kaufmann, III. Macmillan Publishing Co, Inc., New York, 1978.
The Planets: Portraits of New Worlds, Nigel Henbest, Viking, Penguin Group. New York, NY, 1992.
Exploring the Solar System, Nicholas Booth, Cambridge University Press, 1995.
New Worlds: Discoveries from Our Solar System, Werner Von Braun, Frederick I. Ordway, Anchor Press/Doubleday, Garden City, NY, 1979.
Solar System Evolution: A New Perspective, Stuart Ross Taylor, Cambridge University Press, 1992.
Darwin Space Infrared Interferometer Project. (May 21, 1998). [NSSDC Planetary Science](#).
Henbest, N. (1992). The Planets: Portraits of New Worlds. New York: Nigel Viking, Penguin Group.
Kaufmann, III, W. J. (1978). Exploration of the Solar System. New York: William J.. Macmillan Publishing Co.
Smoluchowski, R. (1983). The Solar System. New York: Scientific American Library, An imprint of Scientific American Books, Inc.

Note 6: Sources for data in Table 6 are:

The New Solar System, J. Kelly Beatty and Andrew Chaikin, ed. Sky Publishing Corporation, Cambridge, MA, 1999.
The Solar System, Roman Smoluchowski. Scientific American Library. An imprint of Scientific American Books, Inc., New York, 1983.
Exploration of the Solar System, William J. Kaufmann, III. Macmillan Publishing Co, Inc., New York, 1978.
The Planets: Portraits of New Worlds, Nigel Henbest, Viking, Penguin Group. New York, NY, 1992.
Exploring the Solar System, Nicholas Booth, Cambridge University Press, 1995.
New Worlds: Discoveries from Our Solar System, Werner Von Braun, Frederick I. Ordway, Anchor Press/Doubleday, Garden City, NY, 1979.

Note 7: Sources for data in Table 7 are:

Our Solar System at a Glance, NASA Informational Summaries, June 1991.

Star Date Guide to the Solar System, The University of Texas at Austin McDonald Observatory, Damond Benningfield and Susan Schorn, Austin, TX, 1998.