

Pluto and the Kuiper Belt (plus "Planet Nine"): A Resource Guide

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This brief guide sets out non-technical resources on the outermost region of our solar system, suitable for recommending to students. It doesn't pretend to be comprehensive, but simply a snapshot of some of what is currently available.

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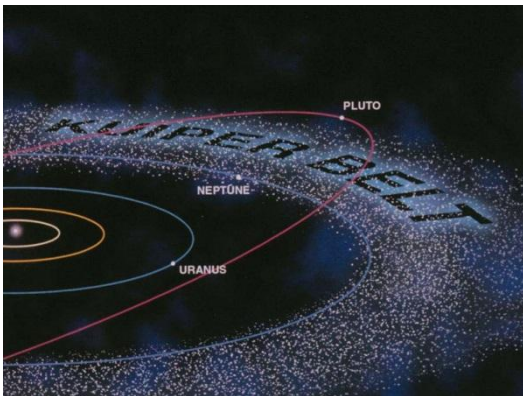
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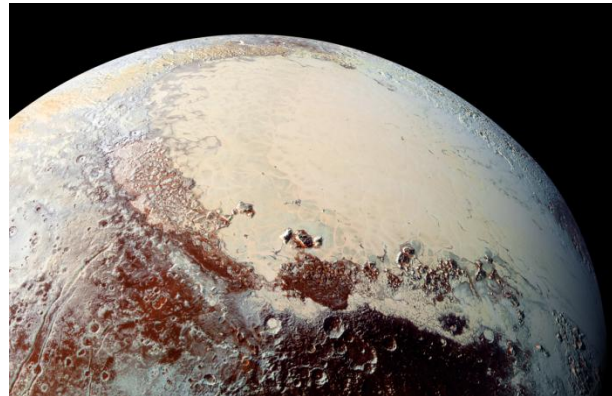
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Kuiper Belt Diagram



Close-up of Pluto from New Horizons

Pluto: History

Printed Materials

a. Discovering Pluto and Its Moons

Falk, D. "More Than a One Hit Wonder: Clyde Tombaugh" in *Astronomy*, Feb 2006, p. 40. A profile of Pluto's discoverer.

Harrington, R. and Harrington, B. "The Discovery of Pluto's Moon" in *Mercury* (the magazine of the Astronomical Society of the Pacific), Jan./Feb. 1979, p. 1.

Hoyt, W. *Planets X and Pluto*. 1980, U. of Arizona Press. History of the search for Pluto and other outer planets.

Levy, D. *Clyde Tombaugh: Discoverer of Pluto*. 1991, U. of Arizona Press. Biography of the discoverer with lots of stories from personal interviews.

Schilling, G. "A Bump in the Night: The Discovery of Charon" in *Sky & Telescope*, June 2008, p. 24.
Shindler, K. & Amundson, L. "How Pluto Got its Name" in *Astronomy*, Mar. 2016, p. 44.

b. Pluto's Dwarf Planet Status

Gingerich, O. "Losing it in Prague: The Inside Story of Pluto's Demotion" in *Sky & Telescope*, Nov. 2006, p. 34. A scientist and historian who was involved in the Pluto discussions at the International Astronomical Union tells the story of what happened and why. (This article is on the Web; see below.)
Grinspoon, D. "It's Not About Pluto: Exoplanets are Planets Too!" in *Sky & Telescope*, Aug. 2013, p. 14. A column updating the issues about the IAU's planet definition and how it applies to planets around other stars.
Weintraub, David *Is Pluto a Planet? A Historical Journey through the Solar System*. 2008, Princeton University Press. Only partly about Pluto; more about the process of discovering what a planet is.

c. Pluto Before New Horizons

Stern, A. "Journey to the Farthest Planet" in *Scientific American*, May 2002. Preview of the New Horizons mission and an introduction to Pluto and its neighborhood, as understood then.
Stern, A. & Mitton, J. *Pluto and Charon: Ice Worlds at the Ragged Edge of the Solar System*, 2nd ed. 2005, Wiley. Good summary of our modern view of these outer worlds.
Stern, A. & Weaver, H. "How We Discovered Pluto's New Worlds" in *Astronomy*, June 2006, p. 44. On the discovery and meaning of Pluto's two smaller moons.
Stern, A. "Pluto: Up Close and Personal" in *Astronomy*, July 2015, p. 22. Previewing our knowledge of the Pluto system before the flyby.
Talcott, R. "How We'll Explore Pluto" in *Astronomy*, July 2010, p. 24. Previewing the New Horizons mission and its instruments.
Villard, R. "Are Pluto and Earth Two of a Kind?" in *Astronomy*, June 2006, p. 48. On the idea that the satellites of both worlds formed in giant collisions.

Web Materials

a. Discovering Pluto and its Moons

Marcialis, R. "The Discovery of Charon: Happy Accident or Timely Find" (from the Journal of the British Astronomical Association):
<http://adsabs.harvard.edu/full/1989JBAA...99...27M>
Showalter, M. "How to Catch a Moon or Two of Pluto's":
<http://www.astrosociety.org/wp-content/uploads/2013/02/ab2012-106.pdf> (on the

discovery of small satellites around Pluto, written by the person who discovered several of them)

Tombaugh, C. "The Discovery of Pluto: Generally Unknown Aspects of the Story": <https://astrosociety.org/wp-content/uploads/2013/02/ab2009-23.pdf> (in Tombaugh's own words)

b. Pluto's Dwarf Planet Status

The International Astronomical Union public web pages on the 2006 Pluto decision: http://www.iau.org/public_press/themes/pluto/ (Extensive background information and questions and answers, as well as the full wording of their recommendation)

An insider's report on what happened at the 2006 IAU meeting by Owen Gingerich (from *Sky & Telescope*):

http://www.physics.sfsu.edu/~cool/TEACHING/a490/spring07/readings/gingerich_pluto_S&T_nov06.pdf or <http://burro.case.edu/Academics/USNA229/plutoiau.pdf>

Response to the IAU Resolutions by Mark Buie:

<http://www.boulder.swri.edu/~buie/pluto/iaureponse.html> (A noted Pluto expert responds briefly to the IAU decision.)

"The Great Planet Debate": <http://gpd.jhuapl.edu/> (In August 2008, as part of a scientific conference on the definition of a planet, astronomers Mark Sykes and Neil Tyson held a non-technical public debate on the IAU's definition. You can listen to or view the debate and read about it at this web site.) For a report on the debate by veteran science reporter J. Kelly Beatty, see:

<http://www.skyandtelescope.com/community/skyblog/newsblog/27012684.html>

Fraknoi, A., ed. "Teaching What a Planet Is: A Roundtable on the Educational Implications of the New Definition of a Planet" (in *Astronomy Education Review*, 2006): <http://dx.doi.org/10.3847/AER2006028>

Pluto: After New Horizons

Printed Materials

Beatty, J.K. "Charon and Company" in *Sky & Telescope*, Dec. 2016, p. 36. What New Horizons revealed about the five moons of Pluto.

Beatty, J.K. "Pluto's Perplexing Atmosphere" in *Sky & Telescope*, Nov. 2016, p. 18.

Beatty, J.K. "Pluto's Amazing Story" in *Sky & Telescope*, Oct. 2016, p. 14. On the New Horizons discoveries about Pluto's surface features.

Cruikshank, D. & Sheehan, W. *Discovering Pluto: Exploration at the Edge of the Solar System*. 2018, U. of Arizona Press. A nice introduction by an astronomer who specializes in Pluto and an astronomical historian.

Stern, A. "The Pluto System Explored" in *Astronomy*, Nov. 2015, p. 24. Very early results from the mission.

Stern, A. "Hot Results from a Cool Planet" in *Astronomy*, May 2016, p. 28. Results from the mission once there was time to evaluate them.

Stern, A. "Puzzled by Pluto" in *Astronomy*, Sep. 2017, p. 22. Later results from the mission analysis.

Stern, A. "Pluto Revealed" in *Scientific American*, Dec. 2017, p. 40. On New Horizons discoveries.

Stern, A. & Grinspoon, D. *Chasing New Horizons: Inside the Epic First Mission to Pluto*. 2018, Picador. A popular-level book, by the team leader and a noted planetary scientist/author.

Web Materials

New Horizons mission website at Johns Hopkins: <http://pluto.jhuapl.edu/> (See, for example, their nice summary page on "What we Know": <http://pluto.jhuapl.edu/Participate/learn/What-We-Know.php>)

Alan Stern's PI Perspective Columns about New Horizons discoveries: <http://pluto.jhuapl.edu/News-Center/PI-Perspectives-Archives.php>

New Horizons Video Archive: <http://pluto.jhuapl.edu/Multimedia/Videos/index.php>

Space.com's New Horizons summary and recent posts: <https://www.space.com/18377-new-horizons.html>

Pluto page at NASA's Solar System Exploration Site: <https://solarsystem.nasa.gov/planets/pluto>

Google Map of Pluto: <https://www.google.com/maps/space/pluto/> (you can zoom in)

Alan Stern talks about Pluto after New Horizons at 2017 AAAS Meeting: <https://www.youtube.com/watch?v=Ard7cczf5II>

Jeff Moore discusses New Horizons discoveries in the Silicon Valley Astronomy Lecture series: <https://www.youtube.com/watch?v=87hYBkcbLOI&t=317s>

Alan Stern and David Grinspoon discuss the New Horizons mission, its origins, its challenges, and (briefly) its results, a Silicon Valley Astronomy Lecture: <https://www.youtube.com/watch?v=SJ2lwXV6LrM&t=1680s>

Observing Pluto

Talcott, R. "In Pursuit of Pluto" in *Astronomy*, July 2017, p. 56. Observing both Pluto and Charon using large amateur telescopes.

Bakich, M. "How to Hunt Down Pluto" in *Astronomy*, July 2013, p. 60. About equipment and techniques to find the faint speck.

Kuiper Belt (and Ultima Thule)

Printed Materials

- Brown, Mike *How I Killed Pluto and Why It Had It Coming* (2010, Spiegel and Grau). Superb popular account of the discovery of Eris and other dwarf planets, by the leader of the scientific team.
- Jewett, D. "What Else is Out There?" in *Sky & Telescope*, Mar. 2010, p. 20. On the discovery of objects beyond Neptune and what else might be in that region.
- Lakdawalla, E. "Pluto and the Kuiper Belt" in *Sky & Telescope*, Feb. 2014, p. 18. Excellent 8-page update of the worlds beyond Neptune and the characteristics of the zone they inhabit.
- Littmann, M. "Dark Beasts of the Trans-Neptunian Zoo" in *Sky & Telescope*, Nov. 2007, p. 26. On the members of the Kuiper Belt. (Also, see his "From Chaos to the Kuiper Belt," Sep. 2007, p. 23.)
- Reddy, F. "The Tenth Planet" in *Astronomy*, Nov. 2005, p. 68. About the discovery of Eris and early attempts to figure out how to classify it.
- Regas, D. "The Search for More Plutos" in *Astronomy*, July 2011, p. 30. Profile of Mike Brown and his work finding dwarf planets beyond Pluto.
- Rusch, E. *The Planet Hunter: The Story Behind What Happened to Pluto*. 2007, Cooper Square. A children's book on Mike Brown and how his discovery of Eris led to the change in our view of Pluto.
- Sheppard, S. "Beyond the Kuiper Belt" in *Sky & Telescope*, Mar. 2015, p. 26. On Sedna, and what lies beyond.
- Stern, A. "New Horizons Explores the Kuiper Belt" in *Astronomy*, Feb. 2018, p. 26. Detailed article on our modern understanding of the Belt and what the spacecraft will do there.
- Stern, A. "Secrets of the Kuiper Belt" in *Astronomy*, Apr. 2010, p. 30. History of discovery and understanding of the objects in the belt.

Web Materials

- Pluto, Eris and the Dwarf Planets of the Outer Solar System (a 2007 public lecture at the Smithsonian by Michael Brown):
<http://www.youtube.com/watch?v=WHNO079G1i8>
- Mike Brown's Planets: <http://www.mikebrownsplanets.com/> (A wonderful blog kept by one of the leading discoverers of Trans-Neptunian objects, with good behind-the-scenes information.)
- NASA's Kuiper Belt page (on the Solar System Exploration site):
<https://solarsystem.nasa.gov/planets/kbos/indepth> (brief overview)
- Redd, Nola Taylor: Facts about the Kuiper Belt (a 2017 article):
<https://www.space.com/16144-kuiper-belt-objects.html>
- Lemonick, M. "Pluto and Beyond" in *Scientific American*, 2014 (on missions to explore the Kuiper Belt): <https://www.scientificamerican.com/article/kuiper-belt-missions-could-reveal-the-solar-systems-origins/>
- Kuiper Belt page at the New Horizons mission:
<http://pluto.jhuapl.edu/Participate/learn/What-We-Know.php?link=The-Kuiper-Belt>

NASA Fact Sheet on the New Horizons Kuiper Belt object flyby:

http://pluto.jhuapl.edu/common/content/factsheet/17-04341_NASA-NHKEM_12-11-17.pdf

BBC Radio Program on the Kuiper Belt and Beyond (2017, 43 min):

<http://www.bbc.co.uk/programmes/b08g7ttx>

How I Killed Pluto and Why It Had It Coming (a 2011 Silicon Valley Astronomy Lecture by Michael Brown): http://www.youtube.com/watch?v=7pbj_llmiMg

Pluto, Eris and the Dwarf Planets of the Outer Solar System (a 2007 public lecture at the Smithsonian by Michael Brown):

<http://www.youtube.com/watch?v=WHNO079G1i8>

Ultima Thule Flyby:

March 18, 2019 Press Briefing on Ultima Thule flyby: <http://pluto.jhuapl.edu/News-Center/Press-Conferences/index.php?page=2019-03-18>

New Horizons News Archive: <http://pluto.jhuapl.edu/News-Center/index.php#News>

Alan Stern's Report on the Flyby: http://pluto.jhuapl.edu/News-Center/PI-Perspectives.php?page=piPerspective_01_17_2019

New York Times report on latest findings:

<https://www.nytimes.com/2019/03/18/science/ultima-thule-new-horizons.html>

Wikipedia Page for Ultima Thule (with good background information):

[https://en.wikipedia.org/wiki/\(486958\)_2014_MU69](https://en.wikipedia.org/wiki/(486958)_2014_MU69)

(The New) Planet X or Planet 9

Brown, M. "How We Discovered Planet Nine" in *Astronomy*, June 2016, p. 20. From the team leader, a discussion of the observations.

Brown, M. "Quick Study: The Planet 9 Hypothesis" in *Physics Today*, Mar. 2019:

<https://physicstoday.scitation.org/doi/10.1063/PT.3.4172>

Gibbs, W. "Is there a Giant Planet Lurking Beyond Pluto?" in *IEEE Spectrum*, July 2017:

<https://spectrum.ieee.org/aerospace/satellites/is-there-a-giant-planet-lurking-beyond-pluto>

Hand, E. "Astronomers Say Neptune-Size Planet Lurks Beyond Pluto" (Jan. 2016 article about the paper in *Science* making Planet X more likely):

<http://www.sciencemag.org/news/2016/01/astronomers-say-neptune-sized-planet-lurks-beyond-pluto>

Lemonick, M. "The Search for Planet X" in *Scientific American*, Feb. 2016, p. 30. Finding a super-Earth sized planet in the Kuiper Belt or beyond.

Sako, Masao: "The Search for Planet Nine" – 2018 TED talk:

<https://www.youtube.com/watch?v=wHaUmXk1qs4>

Sheppard, S. "The Hunt for Planet X" in *Sky & Telescope*, Oct. 2017, p. 16. The evidence for a larger planet and how to hunt for it.