NASA's New Horizons Mission to Pluto and Beyond

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This is a Galaxy. It has 100,000,000,000 stars.

The Sun is just one star in the Galaxy.





Jupiter Mercury, Venus, Earth, Mars Sun











Kuiper Belt





Easy to see: Sun Moon Mercury Venus Earth Mars Jupiter Saturn

Hard to see: Uranus Neptune Pluto Asteroids



1874: French Astronomer Le Verrier found errors in the position of Uranus, and discovered Neptune the next night.



1905: Percival Lowell started the search for 'Planet X' at Lowell Observatory, Arizona, USA.



1925: Clyde Tombaugh is hired to search for Planet X at Lowell Observatory in Arizona.



13" Pluto Discovery Telescope, Lowell Observatory















DISCOVERY OF THE PLANET PLUTO



January 23, 1930

January 29, 1930

1930: Discovery of Pluto



1932: Walt Disney also discovers Pluto



1978: Jim Christy discovers Pluto's moon Charon



1930: Pluto 1978: Pluto + Charon Discovered



1930: Pluto
1978: Pluto + Charon
2006: Pluto + Charon + Nix + Hydra Discovered



1930: Pluto
1978: Pluto + Charon
2006: Pluto + Charon + Nix + Hydra
2011: Pluto + Charon + Nix + Hydra + P4 Discovered



1930: Pluto
1978: Pluto + Charon
2006: Pluto + Charon + Nix + Hydra
2011: Pluto + Charon + Nix + Hydra + P4
2012: Pluto + Charon + Nix + Hydra + P4 + P5



Pluto Is...

- Very far away (40 AU = 6 billion km)
- Very cold (-250° C)
- Very small (1200 km)
- Very old (4.4 billion years)
- Very icy (nitrogen, methane, CO)



 Mostly ice & rock, with a very thin atmosphere: 100,000x less than Earth

... and that is almost all we know!

We know what Earth looks like... What will Pluto be like?












Meteor Crater, Arizona, USA



Tswaing Impact Crater, South Africa



Why go to Pluto?

 It's ancient: Exploring Pluto tells us what the primordial solar system was like.

• It's unlike all the other planets.

 It's the gateway to the thousands of bodies in the outer Solar System, and distant Solar Systems.







\$700M USD, from NASA Size of a very small car It is a robot - no people on it!

It will fly past Pluto, take pictures, and send them back over its radio.

It will keep flying - it doesn't land, and it never comes back to Earth.

New Horizons Spacecraft





New Horizons Spacecraft



'Ralph' Remote Sensing Package



Channel

Aperture Door

(Shown Open)

Objectives:

➢Ralph/MVIC: Global geology and geomorphology. Stereo and terminator images. Refine radii and orbits. Search for rings and satellites. Search for clouds and hazes.

Ralph/LEISA: Global composition maps, high resolution composition maps, temperatures from NIR bands.

ALICE: UV airglow and solar occultation to characterize Pluto's neutral atmosphere. Search for ionosphere, H, H₂, and C_xH_y . Search for Charon's atmosphere.



REX Radio Experiment



High Gain Antenna











USO

REX/transceiver uplink card

Objectives:

•Profiles of number density, temperature, and pressure in Pluto 's atmosphere, including conditions at surface. •Search for Pluto's ionosphere. Search for atmosphere and ionosphere on Charon. Measure masses and radii of Pluto and Charon, and masses of flyby KBOs. Measure disk- averaged microwave brightness temperatures (4.2 cm) of Pluto and Charon.

Core: Ralph, Alice, REX





IEM







USO



REX/transceiver uplink card















New Horizons Team+





New Horizons Shedding Light on Frontier Worlds









Lockheed-Martin Atlas V Rocket

Rocket:600,000 kgSpacecraft:478 kgCameras:20 kg


































New Horizons is the *fastest* spacecraft ever launched!

Vehicle	Time to get to the Moon's distance
Ferrari @ 250 kph	1600 hours
Apollo II	96 hours
New Horizons	9 hours

Pluto: July 2015

Jupiter: March 2007

Kuiper Belt: 2016-2020

Earth: January 2006



July 14, 2015 Pluto-Charon Encounter

- Six months of encounter science.
- Exceed Hubble resolution for 150 days.
- 5000x5000 pixel map of Pluto (500 m/pix)
- High-res 'postage stamps' of selected portions of surfaces (50 m/pix)
- Map Pluto night-side frost in Charon-light.
- Global composition maps.
- Radio & UV occultations of Pluto & Charon.
- Map surface temperatures.
- Directly measure Pluto's escape rate.
- Release all encounter data to public.



New Horizons KBO Encounters

- Expect one or two KBO encounters with KBOs that have diameters of 40 to 90 km.
 - Identical measurement objectives to Pluto-Charon.
 - Same geometry and design as Pluto-Charon encounter.
 - Observing begins 4 weeks before encounter.
 - Post-encounter studies continue for 2 weeks.
 - All data to Earth within 2 months.
 - Currently searching for target KBO from ground-based telescopes.



New Horizons Pluto Kuiper Belt Mission Profile



New Horizons at Jupiter: February 28 2007

New Horizon at Jupiter

February 28, 2007

Red = 1.59 μm (Deep Clouds) Green = 1.90 μm (Mid-level Clouds) Blue = 1.85 μm (Upper-Level Hazes) New Frontiers/LEISA February 28, 2007

Quiescent

Cassini/ISS December 29, 2000

Active



The rings of Jupiter, from New Horizons.

New Horizons searched for and found NO new small moons around Jupiter with size < 10 km.

What does this mean?

12. Aftere garo sivit, dan get he dwon dal resties of ies remain.

...with perhaps a few more too tiny to see.

Adrastea

Consolation Prize:

The Discovery of Ring Clumps

Volcanoes on Jupiter's Moon "lo"







10 years of surface changes

Galileo ~1997

New Horizons 2007

Volcanoes on lo



Five Missions for the Price of One

- 2003: When New Horizons was selected by NASA, Pluto had just one known moon, Charon.
- 2005: Two new moons discovered: Nix and Hydra
- 2006: Launch
- 2011: One more moon discovered: P4
- 2012: One more moon moon discovered: P5

All these new moons are great, but they give us a few problems...



 If there are five moons, there may be more moons, more rocks, more dust that we cannot see... and that could be dangerous. All these new moons are great, but they give us a few problems...



2.What do we call them??



SETT INSTITUTE | Pluto Rocks Help us name the smallest moons of Pluto

How to names Pluto's moons P4 and P5?

- We conducted one of the internet's largest polls ever at PlutoRocks.com
- Two weeks, 450,000 votes
- 180+ countries including South Africa, Zim, Namibia, Botswana, Lesotho...



Styx Kerberos





WHAT IS A PLANET?

Greek definition of Planet ($\pi\lambda\alpha\nu\eta\tau$):



planet ('plænit), *n*.¹ Forms: 3-6 planete, (4-6 -ette, 5 -ett, *Sc.* -ait, 6 *Sc.* -eit, 7 plannet(t), 5- planet.

[ME. a. OF. planete (F. planète), ad. late L. planõta or planõtõs (cited only in pl. planõtæ = cl. L. stellæ errantes), a. Gr. $\pi\lambda\alpha\nu\dot{\eta}\tau\eta\varsigma$ wanderer, hence, in pl. ($\dot{\alpha}\sigma\tau\epsilon\rho\epsilon\varsigma$) $\pi\lambda\alpha\nu\dot{\eta}\tau\alpha\iota$ wandering stars, planets, f. $\pi\lambda\alpha\nu\dot{\alpha}\nu$ to lead astray, in pass. to wander. (Another Gr. form was $\pi\lambda\dot{\alpha}\nu\eta\varsigma$, $-\eta\tau\sigma\varsigma$, in pl. $\pi\lambda\dot{\alpha}\nu\eta\tau\epsilon\varsigma$ $\dot{\alpha}\sigma\tau\epsilon\rho\epsilon\varsigma$, L. planõtes.)]

† 1. a. Old Astron. A heavenly body distinguished from the fixed stars by having an apparent motion of its own among them; each planet, according to the Ptolemaic system, being carried round the earth by the rotation of the particular sphere or orb in which it was placed. Obs.

The seven planets, in the order of their accepted distance from the Earth, were the Moon, Mercury, Venus, the Sun, Mars, Jupiter, and Saturn.

[c1050 Byrhtferth's Handboc in Anglia (1885) VIII. 320 pa steorran pe man hæi planete on lyden.]
 a1300 Cursor M. 1550 (Cott.) pe planetes all ar went again O pair first making in to pe state.
 c1400 Destr. Troy 4366 Venus the worthy..of planettes of prise has hor pure nome.

c1420 LYDG. *Assembly of Gods* 1695 The seuyn planettys Haue her propre names by astronomers. **c1470** HENRY *Wallace* xi. 500 Quhill day began to peyr; A thyk myst fell, the planet was not cleyr. **1481** CAXTON *Myrr.* i. xx. 60. A way that is comune to the vii planetes.

1600 NASHE Summer's Last Will D j. Resplendent Sol, chiefe planet of the heauens.

1621 BURTON Anat. Mel. i. ii. (1651) 45 Gregorius Tholosanus makes seven kindes of ætherial spirits or angels, according to the number of the seven Planets, Saturnine, Jovial, Martial.

1687 tr. *Marana's Turkish* Spy i. xii. 35 It is a great while since we have had any Commerce here with the Sun; there being forty nine Days since this beauteous Planet appeared to us.

1727 BAILEY vol. II. s.v., There is none of the Planets, except the Sun that shines with his own Light. **1766** PORNY *Heraldry* (1787) 19 Arms..are blazoned..by Planets, when they belong to Sovereign Princes, Kings, and Emperors. Historically, 'Planet' has referred to moons, stars, asteroids, and even the Sun.

Is Pluto a Planet?

Yes !!!

- It orbits the Sun
- It is big enough so that its own gravity makes it into a round ball
- It has five moons
- It has an atmosphere
- We've always called it a planet

No !!!

- It's smaller than the other planets
- Its orbit is egg-shaped and tilted
- It's just like the other 500 Kuiper Belt objects, and we don't call them planets
- If it was discovered today, we would not call it a planet

August 2006: International Astronomical Union, Prague

This group voted to call Pluto a 'Dwarf Planet.' But not everyone agrees, and this is how science works.

IAU Definition of Planet

"The IAU therefore resolves that "planets" and other bodies in our Solar System, except satellites, be defined into three distinct categories in the following way:

(1) A "planet" is a celestial body that (a) is in orbit around the Sun,
(b) has sufficient mass for its self-gravity to overcome rigid body
forces so that it assumes a hydrostatic equilibrium (nearly round) shape,
and (c) has cleared the neighborhood around its orbit.

(2) A "dwarf planet" is a celestial body that (a) is in orbit around the Sun, (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, (c) has not cleared the neighbourhood around its orbit, and (d) is not a satellite.

(3) All other objects except satellites orbiting the Sun shall be referred to collectively as "Small Solar-System Bodies".

Problem I: The 800+ extrasolar planets aren't 'planets'?
Problem II: But Jupiter isn't 'rigid'!
Problem III: Saturn isn't round!
Problem IV: Earth, Jupiter, Moon, etc have not 'cleared their neighborhood'!

HELP SUPPORT LOWELL OBSERVATORY

Vote with your wallet on the question below


- What is the difference between a koppie and a hill? It's a fine line...
- Science is a human process and our names will continue to evolve as we learn more about the world around us.

Pluto is a Planet. Get on with it and Look at the Sky! You can track New Horizons as it gets ready to arrive at Pluto July 14, 2015...

http://pluto.jhuapl.edu/

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