NASA’s New Horizons Mission To Pluto

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

The Sun is just one star in the Galaxy.
Our Solar System

🌟 ← Sun

Jupiter
Saturn
Uranus
Our Solar System

Mercury, Venus, Earth, Mars

Sun
Our Solar System

Jupiter

Mercury, Venus, Earth, Mars

Sun
Our Solar System

Mercury, Venus, Earth, Mars, Sun, Jupiter, Saturn
Our Solar System

Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Sun
Our Solar System

Mercury, Venus, Earth, Mars

Sun

Jupiter

Saturn

Uranus

Neptune
Our Solar System

- Sun
- Mercury, Venus, Earth, Mars
- Jupiter
- Saturn
- Uranus
- Neptune
- Pluto
Our Solar System

- Sun
- Mercury, Venus, Earth, Mars
- Jupiter
- Saturn
- Uranus
- Neptune
- Pluto
- 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.
1930: Discovery of Pluto
1932: Walt Disney also discovers Pluto
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
- Very cold
- Very small
- Very old

... and that is almost all we know!
We know what Earth looks like...
What will Pluto be like?
Tswaing Impact Crater, South Africa
Why Study Pluto?

Pluto’s surface is probably the oldest in the whole Solar System.

So, studying Pluto tells us what the Solar System was like 5 billion years ago!
$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.
Radio

Battery

Camera
‘Ralph’ Remote Sensing Package

Objectives:
- **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, H$_2$, and C$_x$H$_y$. Search for Charon’s atmosphere.
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

- Radiator, Cold Stage
- Radiator, Warm Stage
- MVIC
- LEISA
- Aperture
- Electronics
- Flexures to Spacecraft
- High Gain Antenna
- IEM
- Slit Assembly
- Detector
- Zero Order Trap
- Grating
- OAP Mirror
- Baffles
- SOC Pick-off Mirror
- Solar Occultation Channel
- Aperture Door (Shown Open)
- Aperture Opening
- USO
- REX/transceiver uplink card
Lockheed-Martin Atlas V Rocket

Rocket: 575,198 kg
Spacecraft: 478 kg
Cameras: 20 kg
DO NOT FEED THE ALLIGATORS

ALLIGATORS BECOME AGGRESSIVE TOWARDS PEDESTRIANS AND WILL HAVE TO BE DESTROYED
New Horizons is the **fastest** spacecraft ever launched!

<table>
<thead>
<tr>
<th>Mission</th>
<th>Time to get to the Moon’s distance</th>
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<tbody>
<tr>
<td>New Horizons</td>
<td>4 hours</td>
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<tr>
<td>Apollo 11</td>
<td>96 hours</td>
</tr>
<tr>
<td>Bloodhound</td>
<td>251 hours</td>
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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)
Jovian Polar Lightning

Lightning Strike Sequence

Examples of Polar Lightning Strikes
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?
We began with large and small bodies...with perhaps a few more too tiny to see.

After erosion, only the two largest bodies remain.

Adrastea

Metis

...with perhaps a few more too tiny to see.
Consolation Prize:

The Discovery of Ring Clumps
Volcanoes on Jupiter’s Moon “Io”
10 years of surface changes

Galileo
~1997

New Horizons
2007
Volcanoes on Io
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...

1. 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??
How to name 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...
Greek definition of Planet: ‘Wandering star’

**planet** (’plænt), *n.* 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. planēta or planētōs (cited only in pl. planētē), a. Gr. πλανήτης wanderer, hence, in pl. (ἀστέρες) πλανήται wandering stars, planets, f. πλανάω to lead astray, in pass. to wander. (Another Gr. form was πλανής, -ῆς, in pl. πλανήτες ἀστέρες, L. planētēs.)]

†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 ἡ στερράν ἢβε μαρι ἅη αἰνετον πλανετα σε υδον.]

[a1300 Cursor M. 1550 (Cott.) ἡ στερράν ἡ αἰνετον πλανετα σε υδον ἢβε μαρι ἅη αἰνετον πλανετα σε υδον]

[c1400 Destr. Troy 4368 Venus the worthy...of planetes of prise has hor pure nome.

[c1420 LYDG. Assembly of Gods 1695 The seyn planetys 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.i. Resplendent Sol. chiefe planet of the heauens.

[1621 BURTON Anat. Mel. i. ii. 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.
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.
"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 should Pluto be called?

Planet
Dwarf Planet
Other
I don’t care! I just want to support Lowell
• 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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