

Science AMA Series: I'm Dr. Bonnie Buratti, an astronomer at NASA's Jet Propulsion Lab. I've worked on missions such as Cassini and New Horizons. I hope to answer your questions about the planets. AMA!

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Abstract

Hi, I'm Dr. Bonnie Buratti, and I've worked at NASA's Jet Propulsion Laboratory for 35 years. Most recently I've been on the following missions: Cassini to Saturn, New Horizons to Pluto, and Rosetta to a comet. I'm interested in what planets are made of and what it would be like if we just stood on their surfaces. I'm fascinated by all the exotic things we've found – sulfur volcanoes on Io, methane lakes on Titan, polar caps of dry ice on Mars, and nitrogen glaciers on Pluto. I'd like to share my excitement about what we've found with you. I just published a book, “Worlds Fantastic, Worlds Familiar”, that is a personal guide through the Solar System. I describe how landforms on the planets are similar to those on the Earth, only often more fantastic. I'll be back at 2 pm ET (11 am PT) to answer your questions, ask me anything! edit: 1:28 PM PST - Thank you to the entire /r/science community for your participation and thoughtful questions. I would also like to thank the mods for their great stewardship and seamless setup (especially Nate).

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BONNIE_BURATTI [R/SCIENCE](#)

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If budget and construction time wasn't an issue, what would your dream mission/probe to work on be?

[CX316](#)

I would like to see an orbiter around Titan (Pluto would be a strong second choice) with several landers on the ground to explore its lakes and Earth-like terrain.

1) Have you ever discovered anything that turned out to be absolutely not what people thought it was/was going to be? If so, what was it and what were people banking it would be?

2) If you could choose a single unanswered question that pertains to your field to have a definitive answer for, what would that question be?

3) What's the current 'head-scratcher' for your field?

P.S. Your name rolls off the tongue very smoothly, saying both your first and last name as a single word stirs up images of mythological creatures. :D

[Luk3ling](#)

1) I was part of the Cassini team that discovered an active water plume on Enceladus, the frozen ice moon of Saturn. When it first looked like there was something strange about Enceladus, we thought it was a thin atmosphere. In July 2005, we got permission to move the spacecraft closer to Enceladus -

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about 300 miles. We found a "smoking gun" of a hot south pole that was spewing out active jets of water ice particles. This little ice moon had active geysers!

2) Is there life elsewhere in the Universe?

3) How did life originate? When I was a graduate student we thought it began in shallow warm seas - with the help of energy provided by lightning - sort of a "primordial soup". Now we think it began in deep, hot oceanic vents, so-called "smokers". But we're still not sure how it actually began. My personal "head-scratcher" is: if life arose at sometime, why isn't it still arising now? Maybe it is, but we don't recognize it.

How can everyday people get involved and help with NASA and space exploration?

[zaballosc](#)

We have a lot of opportunities. One of the most popular is the Solar System Ambassadors Program. NASA trains people to go out and publicize what NASA is doing.

Just following missions and talking to your friends about them increases the excitement surrounding space exploration and science in general. What scientists do is the heritage of the American people, as you support us through your tax dollars.

What planet or moon in the solar system is most ideal for terraforming for people to easily live on without significant assistance from Earth?

[NorthernLight](#)

None of the planets or moons is particularly suited to life as we know it on Earth, but some scientists are thinking about terraforming Mars. We believe there is a lot of water trapped in the upper crust of Mars, so that would have to be melted. A bigger problem is the atmosphere. The atmosphere on Mars is thin - less than 1% of Earth's - and of course there is no oxygen in it. Some method of producing the nitrogen and oxygen that make up the Earth's atmosphere would have to be devised.

One of the most intriguing ideas is that when the sun dies and blows off its outer layer and becomes a giant star (don't worry, that won't happen for another 5 billion years) the icy moons of Jupiter and Saturn will turn into Ocean Worlds.

What's being done / researched at the moment to help us move away from chemical fuels and travel large distances easier and quicker?

[pob_91](#)

Many spacecraft, including the Dawn mission to explore the two large asteroids Vesta and Ceres, use ion propulsion. This method uses a bit of xenon gas ions and acts slowly and surely to move the spacecraft. Building bigger engines using ion propulsion is one method that will get us away from chemical fuels.

In 1999 JPL launched [Stardust](#) to collect samples from comet Wild 2 and return to earth. The mission was successful with the return of Stardust in 2006. The aerogel technology worked and scientists are able to study numerous "comet" samples.

Is it possible to use the same technology to collect samples from the rings around other planets (Saturn) and return to earth? If so, what valuable information could be obtained by such a mission that would benefit scientists?

[Quiglius](#)

Yes - you've already designed a great mission! Some scientists at JPL are looking at using aerogel to capture particles from the active plume of Enceladus. The main thing we would look for is organic molecules, the building blocks of life. We think the ocean that powers the plumes has all the elements for a "habitable environment" - where life can exist and even thrive - liquid water, heat, and food (the organic molecules). We haven't found life there yet, or anyplace outside the Earth, but we are really looking.

How far would a space probe be able to travel before it couldn't transmit data back to Earth? Thanks for doing this by the way!

[random850](#)

Lots of knowledgeable comments already. One additional thing - NASA engineers are working on optical communications using the visible part of the spectrum rather than radio waves.

When is the earliest you expect to start realistically planning for sending things towards the nearest exoplanets?

[monkeyslut](#)

As the answer below me states, we're starting, but we need funding. Right now we're focusing on telescopic observations to understand exoplanets. Is there liquid water there that would harbor life? Is there oxygen that might indicate life? Which exoplanets have atmospheres or oceans?

If you could construct one interesting and funny pub quiz question about your field of work, what would it be? Oh, and the answer, of course. :)

[wanikiyaPR](#)

I've been struggling with the great question for the last hour because I'm a nerd and i'm not funny. But how's this:

How many planets are there? (Meaning is Pluto a planet?) Answer: Bbbbiillions (said in Carl Sagan's inimitable voice) Then you start talking about exoplanets. There are 100-200 billion stars in our galaxy alone, and a large fraction - say a half - have planets. Then there are 100 billion galaxies in our Universe. Soon you are talking about mind-boggling numbers....

Thanks for sharing your knowledge and experience with us Dr. Buratti. I'm curious to know more about the basic techniques of planetary science within our solar system. What tools do you use to determine the composition of ore, lakes, glaciers, etc during a flyby mission?

Also, if you had to make an educated guess, will Cassini impact a surface or be crushed due to atmospheric pressure on its final flight into Saturn?

[rabbiferret](#)

The main tool is curiosity and persistence. The instruments that we used to find lakes on Titan had to pierce through its dense atmosphere, so we used radar and an infrared camera.

For Pluto, we just needed a camera to see its glaciers staring right at us. We didn't expect to find them so easily.

I'm pretty certain Cassini will be crushed by Saturn's atmosphere. It will be sad for me as this gallant robot dies, as I've worked on this mission for over 20 years.

As an aspiring astronomer, what do you actually do in your job. Like what tasks do you need to perform and what are some good skills to have

[nitewarlord](#)

Most of what I do is plan observations for spacecraft and analyze data. You do need to be very persistent, because most discoveries are hidden deep in the data. You need to have command of a wide range of science and math, but you also need to work well on a team and be able to both communicate your ideas well to others and listen well.

What do we know about Ceres? I don't know why it fascinates me, but it does.

[BoreJam](#)

Ceres - the first asteroid discovered which reigned as a planet for decades - turned out to be way more than we expected. There is a crater that has what appears to be water ejected from it in the recent past. There are evaporate deposits all in and around this crater. Ceres probably has a subsurface ocean. Again, another habitable environment.

How far are we from terraforming planets?

[gee349](#)

One main problem is the cost would be immense. It's hard to justify.

What's the most realistic space movie you've seen?

[J916Q](#)

I really liked the Martian (Mars does have big dust storms) and Deep Impact was good. But if we are talking about my favorite space movie of all time it would have to be The Day the Earth Stood Still. I really liked its depiction of a scientist who was suddenly confronted with knowledge from a higher civilization. May or may not be realistic, depending on what is out there.

Hello Dr. Buratti, I wanted to say that I'm also interested in working with nasa one day and I was curious as to what inspired you to pursue this career

[TheCrimsonKing](#)

I describe an episode in my book "Worlds Fantastic Worlds Familiar" in which I was home sick one day reading a child's book on astronomy by Dot and Sy Barlowe. I came across an artist's conception of

Venus that showed a hot, tropical world with jungle plants. I was just drawn in by that fascinating image, and my fascination has just never stopped.

What is the work environment like working at NASA? Is there always a lot of pressure on you, or other people with similar roles or statuses to you?

[Bored_redditar](#)

Working at NASA JPL is really exciting, loaded with curious, knowledgeable, driven people. There is pressure, but since we're creating new knowledge and exploring new frontiers all the time the great rewards offset the pressure. When that great discovery comes, all the drudgery of the scientific enterprise seems worth it.

I live in a small town in Asia and I am an engineering student. We have a very basic theoretical course on satellite communication. How would you suggest that students like me understand the practical implementations of concepts without any access to CubeSat groups or any type of local community?

Edit: am->an

[UmairHussaini](#)

You're really on the right track. Everything is basic physics. If you learn this material well, you can apply it to any problem. Many space missions have web sites that are packed with specific information.

What are some big misconceptions about astronomy?

[LeoXale](#)

I think the biggest misconception is that astronomy is a collection of facts. Our knowledge changes all the time, and much of what we know is uncertain. Doubt and controversy drive all science, not just astronomy. We know of 62 moons around Saturn for example, but there are probably more.

I like the answer below about distance. The sister misconception is a failure to understand how empty space is.

Many nations and companies have set their sites on landing on Mars. Elon Musk has even announced his desires for a terraformed Mars. Does Mars have the best potential for visitation/colonization or might another planet be more suited, such as a rumored habitable atmospheric layer on Venus?

[Nazladrion](#)

I think Mars is still our first choice for the human presence, as it has a solid surface, the temperatures are the closest to our own, and there is water ice at least in the polar caps and below the surface. The habitable atmospheric layer on Venus is a stretch at attempting to find any place on Venus where some type of life might be.

What is your favourite planet outside our solar system? Why and what is so interesting about it?

[lethal_forcekins](#)

I really like the seven sisters of the Trappist-1 system. I find it interesting because it's so different from our own Solar System. It shows that what you find is often unexpected. First it's around a dim small star unlike our Sun, and the planets are all orbiting close in. Some are in the habitable zone, so astronomers are trying to figure out the nature of these seven planets and how life could exist there.

Hi Dr. Buratti. I'm currently a student in high school and an aspiring aerospace engineer. Working at NASA is like a dream to me. Care to tell us your story on how you came to work at JPL?

P.S. I know many scientists say that The Martian was a rather realistic movie, but in your opinion how accurate was it?

[Tactical_toast1](#)

Well, I'm a scientist, so I did have to get a PhD first. But most of our engineers have bachelors or masters degrees. One thing that really helps is interning at JPL or another NASA center over the summer during college. JPL's web page has information on that.

The Martian has been nitpicked to death, but that takes the fun out of it. It's accurate enough. JPL was depicted pretty well. You do have to laugh at yourself.

What is the coolest landform you know of?

[fapattick](#)

It would have to be Titan's lakes. These are the only examples of standing liquid outside of the Earth, and we can see streams flowing into them, and deltas. Uncannily Earthlike.

In a binary star system, what would be the likelihood of life occurring on any of its planets given what I can only assume would be very irregular orbits leading to planets wandering out of the Goldilocks zone? Would stable planets even be a thing in binary star systems? Thanks again!

[huscarl18](#)

Scientists have looked at this problem and they have shown that there are stable orbits for planets in a binary system, although you make a good point that it would be unlikely for these orbits to stay in the "Goldilocks zone" at all times. But imagine seeing two suns in the sky.

Hey Dr. Burrati, What do you think about the potential manned missions to Mars?

[Archer2408](#)

Well, working at JPL, I do exclusively robotic spacecraft, but there's nothing more inspirational than astronauts and crewed missions, so I'm all for it.

Even though you deal with it every day do you stop and just freak out/be in awe of the universe sometimes? I mean, it's pretty cool.

[I_am_Jacks_colon](#)

Not just sometimes - all the time. When someone asked Wm. Herschel (who discovered Uranus) why

he was an astronomer - the asker implied astronomy was useless - Herschel said when he looked up at the wonder and beauty of the night sky he couldn't understand why everyone didn't become an astronomer.

What motivates you every morning to go to work and get stuff done? Do you have a natural 'get up and go' attitude or do you have to push yourself to find that spark?

[GHUATS](#)

Every day it seems there's something new. There is hard work and often frustration, but the discovery at the end makes it all worth it. I was one of the first people to see the sun glint off the alien sea of Titan. I feel most of us scientists have boundless curiosity that drives us.

I work with the Public Relations people at JPL doing fact checking, and it seems every other day there is an announcement of new discovery I wasn't even aware of.

Are there any plans to send a rover to Mercury? Especially to the places at the poles, where there is water?

Do you think Mercury could support a human colony?

[covor](#)

There are no plans right now. Because of the extreme temperatures and lack of an atmosphere, any colony would be an enclave with life-sustaining amenities. But the water at the poles does make Mercury attractive.

Have we figured out why Saturn has that enormous hexagon on its north pole?

[notTHATwriter](#)

There are some models that explain the hexagon as a group of convection cells. It's 6-sided as a hexagon occupies space efficiently. (Notice dried mud - it's also often 6-sided). If you have a boiling pot of pea soup, you can often see a similar type of hexagon. The physics is similar.

What are your thoughts on the potential of the being a "Planet Nine" 5 times the size of Earth in the outer reaches of our solar System?

[airlaflair](#)

There is some evidence for it - not ironclad but enough to make a search worthwhile. We will discover things in that search regardless if a planet is there or not, many new Kuiper Belt Objects for example.

What (closest) planet has the most usefull materials? (As in metals and other resources.)

[lightsoaring](#)

It's actually the asteroids. Some of them are metal rich and contain rare elements. But it would be expensive to extract them and transport them to Earth. The Moon has a lot of titanium, but again the same problem with extracting and transporting.

Hello. Who owns the planets?

[Clorpet](#)

I'm not a lawyer, but I believe international space treaties make the planets owner-free.

Hey, thanks for doing an AMA! You have my dream job (I'm 19) so I'm very excited to read your answers.

My question is, with Cassini, we were able to hear some interesting sounds while it was passing through the rings of Saturn, so will NASA try to gather more sounds during Cassini's descent into Saturn in September?

[robetyarg](#)

Saturn has a lot of charge particles in its magnetosphere and various acoustic waves. These sounds are outside the human range of hearing but for educational purposes scientists often brings these sounds into the range of our hearing so we can imagine better what is happening. Also check out the "singing comet" that the Rosetta spacecraft discovered.

As a young student (18), aspiring to follow a career in space, what would you say is a good way to get involved in positions such as yours. (At the moment I'm following the path of aerospace engineering)

[Jerg11](#)

You're on a good track. Just press on. It helps to intern or do research for one of your professors. Also pay attention to non-science courses, as writing and communication are important.

Do you think NASA is receiving the proper funding currently?

[iHateWashington](#)

We could do so much more with more funding, providing good jobs and inspiring a nation with discovery and spin-offs. I mean you can argue that the tech industry is the spin-off from NASA's first wave of missions to the Moon, Mars, etc.

When NASA builds probes why are they usually so unique? Voyager 1&2 and Spirit/Opportunity are the exceptions is my understanding.

Why only 1 Cassini and 1 New Horizons? Where is all the cost if not designing and building 1-off probes? Wish a dozen Cassini had been launched.

[gordonmcdowell](#)

The answer below is good. Also, Cassini was originally a pair, but the second one - CRAF, the Comet Rendezvous Asteroid Flyby - was going to a comet and an asteroid. It got cut because of a funding shortfall. I was on that mission as a young scientist and was so disappointed to have it ended. Cassini has made up for it, but I would have liked to see both missions.

If you could, would you move to mars within the next 20 years?

[bootcampboi](#)

No, I do not have the right stuff. I even hate to fly in airplanes. I'll stay on Earth.

How long will we get data from new horizons? What is the signal strength at transmission and reception from new horizons?

[blove1150r](#)

We will get a lot of data when we encounter the Kuiper Belt Object 2014 MU 69 in Jan. 1, 2019. After that, New Horizons will continue to send back data on the environment as it exits the Solar System. How long it transmits depends on a lot of factors - getting funding to do it, and the performance of the Deep Space Network of radio telescopes being two.

In the missions with which you've been involved, what was the one thing that was discovered that most surprised you?

[SKIP_2mylou](#)

Glaciers on Pluto

As an aspiring astronomer I am in awe of what you do. Do you have any tips on how to excel in this field? Are there any common obstacles/mistakes I should be aware of?

[silverqveen](#)

Never give up and overcome disappointment.

How do you feel about Pluto not being in the planets club? I've heard that what they've essentially done is engineer the definition of a planet to disqualify Pluto from being one.

[Hoboneer](#)

Pluto has an atmosphere, a system of moons, and is active. It seems to me way more than something that isn't a planet.

In the next 10 years, what major question in your field do you believe will be answered that could potentially lead to a breakthrough?

[ninjapickle24](#)

Is there life outside the Earth?

What is the best way to enter your field if you're a high school student with a passion for science but struggles in math?

[theguyfromacrossthe](#)

Two ways: you could either go into a related field such as science writing or journalism, or enter a field of science that isn't heavily mathematical (but they all have some math, generally up to calculus), biology perhaps. The crewed space program hires a lot of biologists and physicians.

How do we know the composition of Martian soil? Like how do we know what materials are similar enough to start practicing making bricks out of it? Thanks!

[ben-atwork](#)

Our landers - most recently Curiosity - have instruments onboard that can analyse martian soil and derive their composition. Some orbiters can do the same. There are minerals that could only have formed in standing water, showing that Mars was once warmer and wetter.

Also there are some meteorites on Earth that are from Mars. These give us hints on the martian rock composition.