

AMERICAN MUSEUM OF NATURAL HISTORY 

OUR PLACE in SPACE



A Kid's Guide to the Universe

A Sizzling Hot
Interview with the **SUN**

IS THERE LIFE ON MARS?
Get the Facts!

Lost in Space? Learn
Your "LONG ADDRESS"

www.amnh.org

ONE-ON-ONE



Hey, Stella Stardust here. Welcome to another cosmic conversation. Let's give a warm welcome to the Sun!

STELLA: You know, everyone here on Earth loves your work. If it weren't for you, we wouldn't be here.

SUN: Thanks, Stella. I've been cranking out energy for billions of years—and not one day off.

STELLA: Impressive. Your agent told me that you're the biggest star in the universe. Is that true?

SUN: Actually, no. My agent tends to exaggerate. I'm just a medium-sized star. To my fans on Earth, I look much bigger than the other stars in the sky. That's because I'm much closer to you than the other stars. I'm 93 million miles away from you. The bigger stars are millions of times farther away from your planet.

STELLA: I can't believe it. You, the Sun, are just an average, ordinary, run-of-the-mill star!

SUN: Hey, take it easy. I may be an average star, but I'm still a LOT bigger than your puny planet. Guess how many Earth-sized planets could fit inside me?

STELLA: I don't know. Maybe ten?

SUN: Not even close! More than a million! I'm big and I've got lots of mass. That's why I've got a lot of gravity. You guys don't call this the "solar system" for nothing. "Solar" means "sun." This is my show. All the planets, comets, and asteroids orbit around ME.

STELLA: I know you star types tend to be touchy about age, but how old are you?

SUN: Well, I began shining about 4.6 billion years ago. It was so long ago I don't remember the exact day.

STELLA: Was it a Sunday? Just kidding. Actually, I'm curious to know how stars begin. What's your story?

SUN: We stars begin as huge spinning clouds of gas and dust. Gravity pulls the gas and dust together in round clumps, which get hot. At that point, we're called protostars. Eventually we get hot enough to start fusing hydrogen atoms together, which releases energy. Then we really shine. Stars are born in batches, which are like star nurseries. Then, over millions of years, these stars drift apart and spread out around the galaxy.

STELLA: Let's turn to a delicate subject. How do stars die?

SUN: After stars like me shine for billions of years, we eventually run out of fuel. When that happens, we swell up as much as 100 times bigger and are called red giants. Astronomers predict that I'll eventually become a red giant. At that time, my heat will vaporize the inner planets—Mercury, Venus, and Earth.

STELLA: That sounds really scary.

SUN: Don't worry. That won't happen for about 5 billion years! After I become a red giant, I'll lose my outer gas layers and reveal my inner core, known as a white dwarf. When I'm a white dwarf, I'll be only as big as Earth, but still very hot, and very dense. Finally, I'll cool down and disappear from view.

STELLA: I hear that some stars die differently. What's a supernova?

SUN: When a star more massive than I gets old and runs out of nuclear fuel, it blows up in a great flash of light called a supernova. This explosion splatters the star's guts in all directions.

STELLA: I'd like to show the people at home a picture of a star that exploded as a supernova. Its remains are called the Crab Nebula.



WITH THE SUN

SUN: What a mess that star made. Want to know something amazing? Humans saw this star explode in the year 1054. But the explosion actually happened about 6,000 years before that.

STELLA: *Huh?*

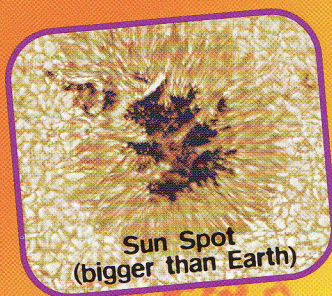
SUN: I'll explain. Stars give off light, right? Light travels incredibly fast—at a speed of 186,000 miles per second. Light can travel from Earth to the Moon in about one second. My sunlight reaches you Earthlings in about eight minutes. Most stars are much farther away. That's why astronomers don't use miles when they talk about the distances between stars. That's like describing the distance between New York and Los Angeles in inches! Astronomers talk about light-years. A light-year is the distance light travels in one year. Since the star in that picture was about 6,000 light-years away from Earth when it exploded, it took about 6,000 years for us to get the "newsflash."

STELLA: *In Hollywood, I meet a lot of people filled with hot air. What gases are inside you?*

SUN: Ah, you want to know what gives me that special glow! Well, like most other stars, I'm made up of mostly two gases, hydrogen and helium. These light gases stay close to me because of my massive gravity. Inside, I'm so hot that I use a fancy process called thermonuclear fusion. By turning hydrogen into helium, I create lots of energy. It makes me shine.

STELLA: *This may be a little rude, but what are those dark splotches on you? Are those, like, star "zits"?*

SUN: (sigh) No, those dark splotches are called sunspots. All normal stars have them. They look dark because they're cooler than the gases around them. By the way, when I say "cooler," keep in mind that my outside is about 10,000° F. That's many times hotter than the hottest kitchen oven. My inner core is even hotter, something like 30,000,000° F.



Sun Spot
(bigger than Earth)

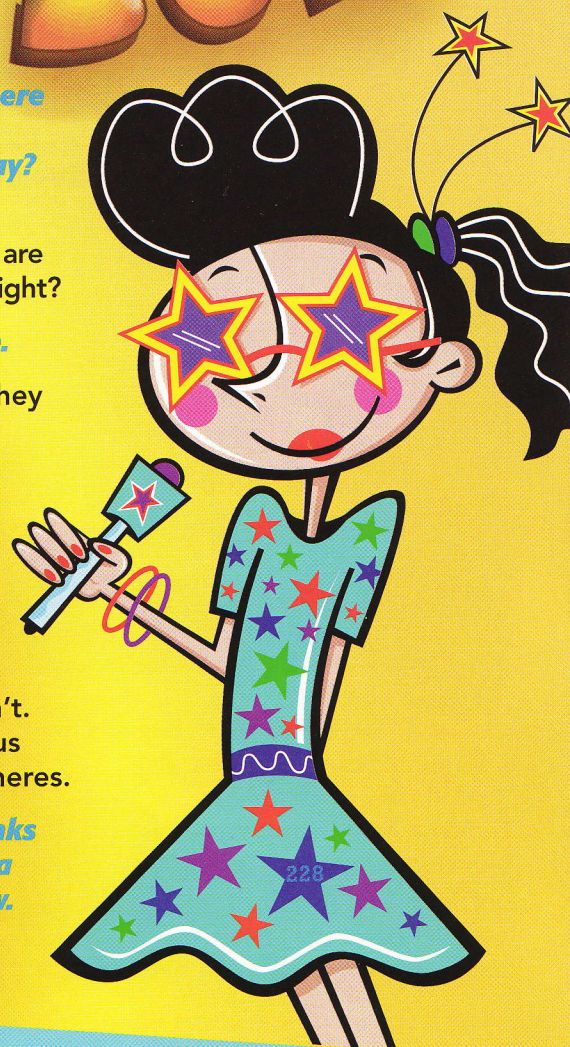
STELLA: *Is there anything else you'd like to say?*

SUN: You think your sunglasses are "star-shaped," right?

STELLA: *Sure.*

SUN: Well, if they were really "star-shaped," they'd be round. You Earthlings have the strange idea that stars have points. We don't. Gravity keeps us shaped like spheres.

STELLA: *Thanks to the Sun for a great interview. Good night.*



If You Could Interview a Star...

- 1 Write down a question you would want to ask the Sun or some other star.
- 2 E-mail your question to us at:

starquestions@amnh.org

Some of the questions sent in will be answered on our Web site.



Milky Way as seen from Earth



Q&A
with
**Astronomer
Julianne
Dalcanton**

Q. Are all galaxies like the Milky Way?

A. No. Galaxies come

in lots of different sizes. Smaller ones have millions

of stars, while bigger ones contain billions. Galaxies also have different shapes.

Some are spiral galaxies, like the Milky Way. Some are egg-shaped elliptical galaxies, and the rest are called irregular galaxies.

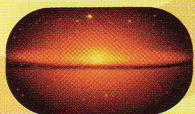


Spiral



Irregular

Q. What's your favorite galaxy, and why?



**Sombrero
Galaxy**

A. I'm fond of the "Sombrero Galaxy" because it shows how "3-D" galaxies are.

Most galaxies look like flat paintings in the sky, but with the Sombrero, you really get the impression that it's this big **THING** sitting out there in space!

Q. Is it fun being an astronomer?

A. Definitely. I often travel to interesting places like Hawaii and Chile. That's because the best telescopes in the world are located on high mountains in remote places, where it's dry and dark at night. When I need to study stars all night, I sometimes have to blast music to stay awake.

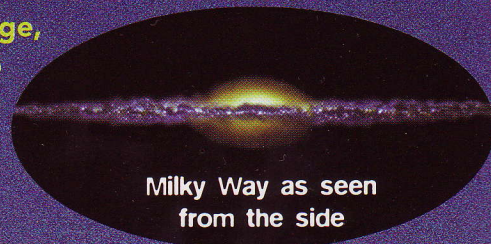
Picture the solar system—all the planets, asteroids and comets whirling in orbit around our nearest star, the Sun. You might think that the Sun is sitting still in the center of it all. But the Sun is on the move, too. It's just one of hundreds of billions of stars swirling around a place called...

The Milky

The Milky Way is a huge collection of stars, dust and gas. It's called a spiral galaxy because if you could view it from the top, it would look like a spinning pinwheel. The Sun is located on one of the spiral arms, about 25,000 light-years away from the center of the galaxy. Even if you could travel at the speed of light (186,000 miles per second), it would take you about 25,000 years to reach the middle of the Milky Way.

The Milky Way gets its name from a Greek myth about the goddess Hera who sprayed milk across the sky. In other parts of the world, our galaxy goes by other names. In China it's called the "Silver River," and in the Kalahari Desert in Southern Africa, it's called the "Backbone of Night."

If you could see our galaxy from the side, it would look like a huge, thin disk with a slight bump in the center. This flat shape is caused by the galaxy spinning around. Everything in our spinning galaxy would fly off into space if it weren't for the force of gravity.



Milky Way as seen from the side

Without a telescope, we can see about 6,000 stars from Earth. That may seem like a lot of stars, but it's actually only a small part of the whole. If you think of the entire galaxy as a giant pizza, all the stars you can see from Earth fall within about one pepperoni on that pizza. In fact, for every star you can see, there are more than 20 million you cannot see. Most of the stars are too faint, too far away or blocked by clouds of cosmic dust.

Way Galaxy

Our solar system
is here! →

Milky Way as
seen from below

Astronomers estimate that there are more
than **100 BILLION** stars in our galaxy.

How Much is a **BILLION**?

A billion is a huge number to imagine. Here's one way to think about it:

10 oranges would fill a large salad bowl.

1,000 oranges would fill a pick-up truck.

1 million oranges would fill a big swimming pool.

1 billion oranges would fill a stadium to the brim.

Writing big numbers can take a lot of space.

If you write a 1 followed by 3 zeros, you get 1,000 = one thousand.

If you write a 1 followed by 6 zeros, you get 1,000,000 = one million.

If you write a 1 followed by 9 zeros, you get one billion! It's your turn. Write out one billion below:

_____, _____, _____, _____

Takes time, right? And astronomers often deal with even larger numbers such as a trillion (12 zeros) and a quadrillion (15 zeros). So, when astronomers write numbers with lots of zeros, they use a shorthand called **scientific notation**. Instead of writing out a 1 followed by 9 zeros, they write a billion like this: **10^9** . It's your turn to use scientific notation.

Write a trillion here _____

Write a quadrillion here _____

More or Less Than a **BILLION**?

Look over this list. After you read each item, see if you can figure out, "Is this number more or less than a billion?"

If you think the item is **more**, circle the **↑**. If you think it's **less**, circle the **↓**.

- ↑ ↓ 1. hairs on your head
- ↑ ↓ 2. seconds since you were born
- ↑ ↓ 3. people in the U.S.
- ↑ ↓ 4. people in the world
- ↑ ↓ 5. inches between New York and Los Angeles
- ↑ ↓ 6. cells in your body
- ↑ ↓ 7. letters mailed each week in the U.S.
- ↑ ↓ 8. gallons of water Americans flush down their toilets every day

Check the back cover to see how you did. Which items on the list surprised you the most?

Can you figure out two other things that are more than a billion?

DON'T BE LOST IN SPACE

When someone asks you where you live, you probably give the name of your street or maybe your city and state. Or, if you are traveling abroad, you might mention your home country. But once you leave our planet, that kind of information doesn't really matter.

That's why astronomers at the American Museum of Natural History are using the "Long Address." In the universe, you need to focus on the big picture. Earth is one of the planets that orbits the Sun. The Sun is one of billions of stars in the Milky Way Galaxy. Our galaxy is one of several thousand galaxies in the Virgo Supercluster, which is only a small part of the entire universe.

To help you remember your address in space, here's a song to the tune of "Twinkle, Twinkle, Little Star."

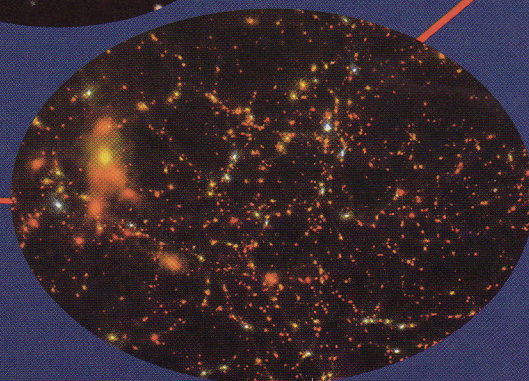
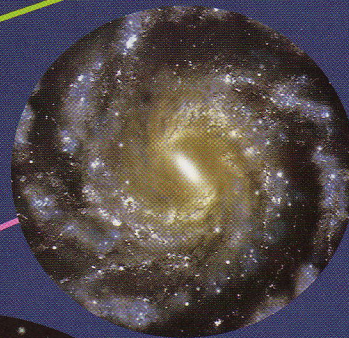
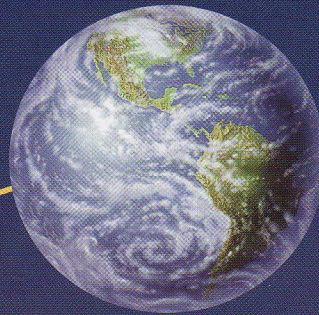
STREET you live on, CITY, STATE.
Think that's your address? But wait!
Don't forget your place of birth:
Home to billions—**PLANET EARTH.**

'Round the shining Sun we go.
It's the big star of our show.
Moons and planets, let's not list 'em.
Let's just say our **SOLAR SYSTEM.**

Nearly all the stars you see
Orbit in our galaxy.
In a spiral, they will stay
Moving through the **MILKY WAY.**

Our galaxy's just one of more.
There are galaxies galore,
Diff'rent sizes, shapes and luster,
In the **VIRGO SUPERCLUSTER.**

Distant galaxies disperse,
In the growing **UNIVERSE.**
Now you know our place in space.
Keep it handy, just in case.



LEARN YOUR "LONG ADDRESS"

Your Name _____

Your Street _____

Your City _____

Your State and Zip Code _____

Your Country _____

★ Your Planet _____

★ Your Planetary System _____

★ Your Galaxy _____

★ Your Galaxy Cluster _____

★ The Universe _____

Send a letter to a friend or relative using his or her "Long Address."

WHAT'S NEXT?

Although scientists have learned a great deal about the universe, there are still many mysteries yet to be explained.

- ★ *Is there other intelligent life in the universe?*
- ★ *What happens inside a black hole?*
- ★ *What happened before the Big Bang?*
- ★ *Will the universe expand forever?*

Questions like that can make your head spin. But asking good questions is the way astronomers begin to search for answers. Everything you've read in this magazine is the best of what we know at this time, given the tools we have. But astronomers are discovering new things all the time.

So, search for the latest astronomy news, ask BILLIONS of questions, and at night, don't forget to look up!

