

Making Something out of Nothing

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Introduction:

Everything we see; the Sun, Planets, Galaxies, the Orion Nebula, each other...really something to see, aren't they, but what really makes it all up. Space, and a little bit of matter...and –That's- what matters~ the Matter. Every-thing is made up of matter- made up of atoms and they are really-really small...so all that smallness adds up to make the big stuff...even our heads~ which can certainly swell to enormous dimensions~(blows up a balloon).

From the Insignificant to the Majestic:

Atoms and Space~ atoms are basically a whole lot of space~ But to understand how an atom is basically space itself, we have to get small for a minute...really small. **Atoms~ def.** *the smallest indivisible unit a thing can be divided into and still maintain its original properties.* Atoms are mostly space themselves. An Example- a **nucleus** is calculated to be 1 million billionth the volume of the entire atom-having less than 1/100,000th the diameter of the entire electron cloud. Think of a brick- enlarge its atoms to the size of ping-pong balls and their nuclei would be the size of a grain of talcum powder. Enlarge an atom to the size of the Louisiana Superdome- some 700 feet in diameter, and the nucleus could be represented by a 1/12th of an inch steel ball bearing hanging from the top. If you could take all the space out of the atoms of Earth, the entire Earth would fit under the dome.

Lets look at this another way...lets consider density. How dense is dense? For that matter how hard is hard and what really is a liquid or a gas? Density is a good way of looking at the difference between gases, liquids, and solids. The more compact the atoms are, the denser the matter is. The more atoms there are in a set volume, the denser the matter is. As we move less dense than a gas, we move into what we call a vacuum. A vacuum is a measure of how not dense, or rarified an area of space is.

Commercial vacuums can generate a vacuum 99.99999% void of all air. The best cyclotrons can produce a vacuum several thousand times better than that...The **Orion Nebula** is a **Billion atoms and molecules of gas/cubic yard** of space and we see it as very 'solid' but is it? The space it resides in is called interstellar space and is still 10 million times less dense than our BEST vacuum ever produced~! **Interstellar space** contains roughly **1 atom per cubic inch**.

Intergalactic space is naturally even less dense- **1 atom/cubic yard**~! This is about as dense as a square 125,000 miles a side filled with the air in your refrigerator. If all the matter of the cosmos were uniformly distributed, it would amount to just a few atoms/cubic yard. Take ½ a grain of rice and expand it to the size of Earth and the atoms in it would be about as scarce.

So~ just how dense is that air we breath~? **1 cu/yard** contains about **50 trillion trillion** atoms (100 million trillion/cu in) as compared to the Orion Neb. at a billion atoms/cu

yard. A small cloud contains about 1 cup full of water...not much different than the air we breathe, yet we can see it. Comet Hale Bopp~ its 50 million mile tail looked substantial, but we could see stars thru it. If compressed to the density of air, the entire tail would fit in a 10 mile wide cube~! Astronomer Fred Whipple said this of comet tails..."they are the most that has ever been made of the least."

So you see, *matter* is basically made up of **Space**.

Space~ speaking of space...how big is this arena we call the cosmos that contains all this space filled matter? Well...to understand that, we have to get **big...really big!**

Lets start with something we know...a basketball and the Earth, both of which we should be fairly familiar with. Picture Earth the size of a basketball, and the Moon would be a softball 30 feet away and Mars would be a **soccer ball 1 mile away**.

Our **Sun** is another thing all together...at 1 million miles in diameter~! Lets picture the Sun the size of a Basketball sitting on homeplate~ **Mercury** would be a pellet of birdseed 35 feet away, ½ way to the pitchers mound, **Earth** would be a sunflower at first base 90 feet away, **Jupiter** would be a 1 inch marble 450 feet away just over center field wall, and **Pluto** (yes, we'll consider it a planet), would be a grain of pepper 3,500 feet away beyond the parking lot~! On this scale, the Solar System would be a 1 mile diameter ball with a basketball at its center. The Oort cloud would be 1000 times the distance of Neptune and comets would be motes of dust in Baltimore circling our basketball in Yankee stadium in New York. At this scale, the **next closest sun** would be 5000 miles away in Honolulu. Now at the speed of *Star Trek*, with stars passing at the rate of 1-2 every second, we'd have to be traveling at **500 million times the speed of light**~!

So what do you think our Milky Way galaxy would look like at this scale...? If all the stars of the Milky Way were the size of our sun in this basketball example, the galaxy would be **125,000 miles wide**~! This is pretty hard to wrap our noodles around so lets change the scale and make our solar system fit into a **coffee cup**. At this scale, the Milky Way would be the size of the **continental United States**~! Still too big, shrink the entire **MILKY WAY** down to fit into a coffee cup and the next distant galaxy – Andromeda- would be another coffee **cup floating in space 7 feet away**. We're talking about a lot of nothing in a lot of SPACE~! At this scale, if two galaxies were to collide, and they do, what would be the chances of two stars colliding in all that space? About the same chance of two snails running into each other on the continental United States. That's a lot of space~!

Distance and Scale~ I know this is boggling so lets try looking at it using miles and inches. Our Sun is roughly 1 million miles in diameter. That's an astronomically big number, but actually it isn't...you see an Astronomical Unit (AU) is the span we use to measure distances within the solar system, rather like inches to feet or yards to a mile. It is the Earth/Sun distance, 93 million miles. There are 1760 yards to a mile, or 5280 feet. This is **63,360 inches**. (See why we measure miles with yards~) We are 1 AU from the Sun, Pluto is 40 AU from the sun~ quick, how many miles is that?? $93 \text{ mil} \times 40 = 3$

billion 720 million miles. Even at this scale, measuring distances outside the Solar System we have to use yet another ‘yard stick’...the light year. This is not a measure of time, it is a measure of distance- the distance a photon of light travels in one year. Light travels at 176,000 mile/second that equates to **5.8 Trillion miles in a year**. Using this measurement, the Sun is 8 ½ Light minutes away. Pluto 5.6 light hours, the next closest star system, 4 ½ light years. To compare a light year to a mile, there are as many inches in a mile (63, 360) as there are AU in a light year. **(93 million to 5.8 trillion)** Do the math.

So with all this Stuff, galaxies, Planets, all matter...how much is out there. Roughly 100 billion galaxies each with roughly 100 billion stars. It would take every human being on Earth counting them at a rate of 5 stars/sec 10,000 years to count them all.

Now that’s a lot of something out of nothing.













