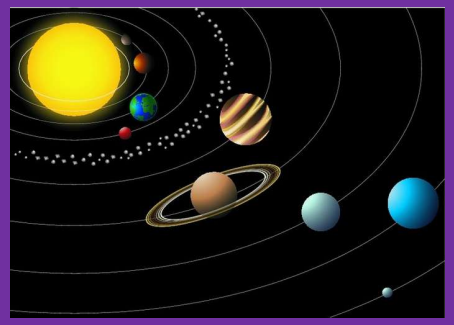
The Immensity of the Universe

- Solar Systems
- Galaxies
- The Andromeda Galaxy
- Aliens
- The Drake Equation
- Alien Inquiry



Solar System → big

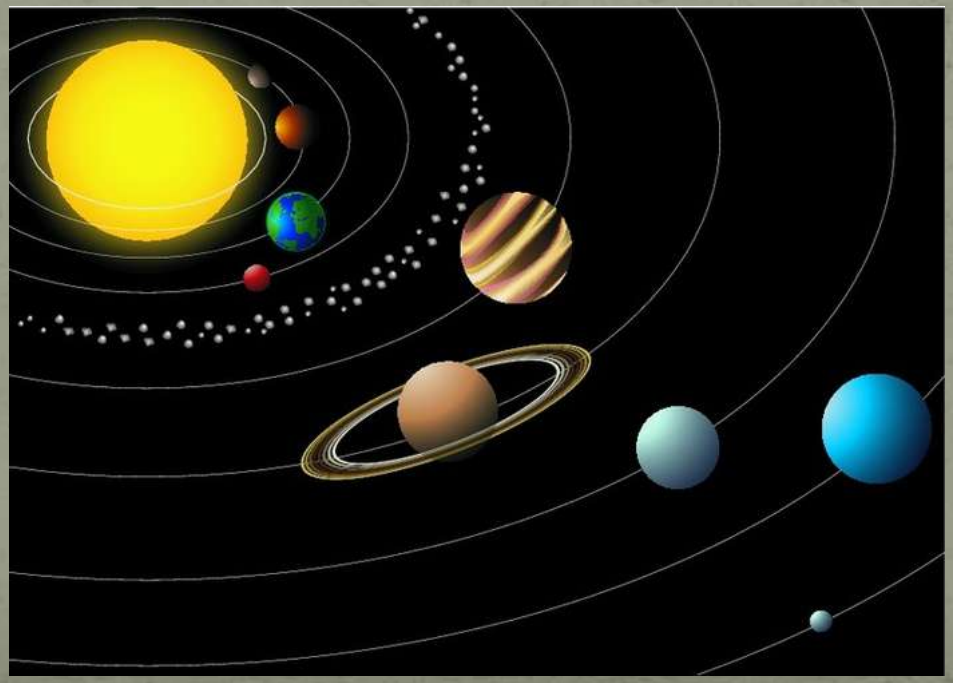
Galaxies → Bigger

Universe → BIGGEST

Universe Size Comparison

Solar System

- A Solar System is made up of all the **planets, moons, comets and asteroids that orbit the star.**
- Example – Our Solar System



Galaxy

- A group of stars (most with their own solar system)
- Example our galaxy is called the Milky Way Galaxy
- **There are between 100 – 300 billion stars in the Milky Way Galaxy!!**

Nearest Galaxy

- The nearest galaxy to the Milky Way is the Andromeda galaxy

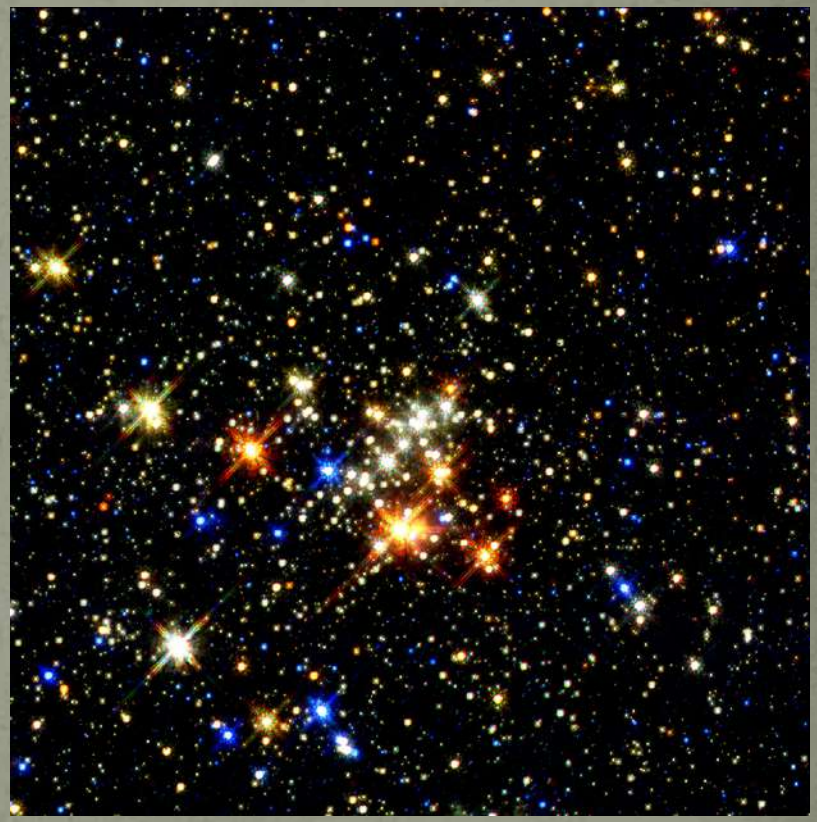
- It would take light traveling at 300,000 km/s about 2.7 million years to reach it!!

- **It would take about 155 billion years to travel there using our current technology!**

Number of Galaxies

- **There are approximately 200 000 000 000 (200 billion) galaxies in the Universe**

- Each galaxy will have about 300 000 000 000 (300 billion) stars



Do the math

- 200 000 000 000 galaxies x 300 000 000 000 stars / galaxy
- **= 60 000 000 000 000 000 000 000 (60 Sextillion) stars in the Universe each with their own planets and moons!!!!!!**

Aliens

- With that many planets and moons, it is hard to believe that aliens don't exist

The Drake Equation

The Drake Equation

- Used to calculate the odds of intelligent alien life
- $N = R^* \cdot f_p \cdot n_e \cdot f_l \cdot f_i \cdot f_c \cdot L$
- **R*** represents the number of stars in the Milky Way Galaxy
  - **Answer**: Current estimates are 100 billion.
- **fp** is the fraction of stars that have planets around them
  - **Answer**: Between 20-40%
- **ne** is the number of planets per star that are capable of sustaining life
  - **Answer**: Looking at our Solar System – 33%
- **fl** - on what percentage of the planets that are capable of sustaining life does life actually evolve?
  - **Answer**: Current estimates range from 100% (where life can evolve it will) down to close to 0%.
- **fi** is the fraction of **fl** where intelligent life evolves
  - **Answer**: Estimates range from 100% (intelligence is such a survival advantage that it will certainly evolve) down to near 0%.
- **fc** is the fraction of **fi** that will communicate
  - **Answer**: 10% to 20%
- **fL** is fraction of the planet's life during which the communicating civilizations live
  - **Answer**: This is the toughest of the questions. If we take Earth as an example, the expected lifetime of our Sun and the Earth is roughly 10 billion years. So far we've been communicating with radio waves for less than 100 years. How long will our civilization survive? Answer: If we survive for 10,000 years the answer will be 1/1,000,000th.
- **N**, the number of communicating civilizations in the galaxy.

The Drake Equation

- Lets figure it out using very conservative numbers.
- $N = R^* \cdot f_p \cdot n_e \cdot f_l \cdot f_i \cdot f_c \cdot L$

N, the number of communicating civilizations in the galaxy.

- **R*** = 100,000,000,000
- f_p = 40%
- n_e = 0.33
- f_l = 10%
- f_i = 10%
- f_c = 10%
- f_l = 1/10,000,000

Click here to calculate

$N = 100,000,000,000 \cdot 0.4 \cdot 0.33 \cdot 0.10 \cdot 0.10 \cdot 0.10 \cdot 0.0000001$

$N = 1.32$

The Drake Equation

- If N = 1.32, that means that there are 1.32 civilizations capable of communicating within the Milky Way Galaxy

- The number of galaxies thought to exist in the Universe is 200,000,000,000

- **Therefore the number of civilizations capable of communicating in the Universe would be approximately - 200,000,000,000 X 1.32 = 264,000,000,000 – 264 Billion!**

Student Inquiry Activity

1) What do you think they would look like and why?

2) Why haven't we found them yet?

3) What do you think would happen if we made contact?

4) Draw your alien but make sure you include reasons for their characteristics.

Through the Wormhole: Are We Alone?