

# the search for life are we alone?

## FROM THE HALL OF PLANET EARTH:

### DISTANCE AND ENERGY

Life needs energy, and the Earth has two sources: the heat of the Sun and Earth's own internal heat. The amount of energy received from the Sun is determined by the Sun's brightness and Earth's distance from the Sun. The internal heat of Earth comes mainly from the decay of radioactive elements.

### A PROTECTIVE SHIELD

Only a portion of the Sun's radiation reaches the surface of Earth. Charged particles and radiation harmful to life are deflected by Earth's magnetic field and absorbed by the atmosphere.

### PROPER TEMPERATURE RANGE

Earth's average temperature is 15°C, with a range between -50°C and 50°C. In contrast, the average temperature of its neighbor Venus is 482°C, and that of its other neighbor, Mars, is -63°C. Venus is warmer because it is closer to the Sun and is blanketed by a thick insulating atmosphere. Mars is colder because it is farther from the Sun and has almost no atmosphere.

**THE LIVING PLANET** – *Life on Earth can exist as a result of a balance between the following conditions.*

### WATER

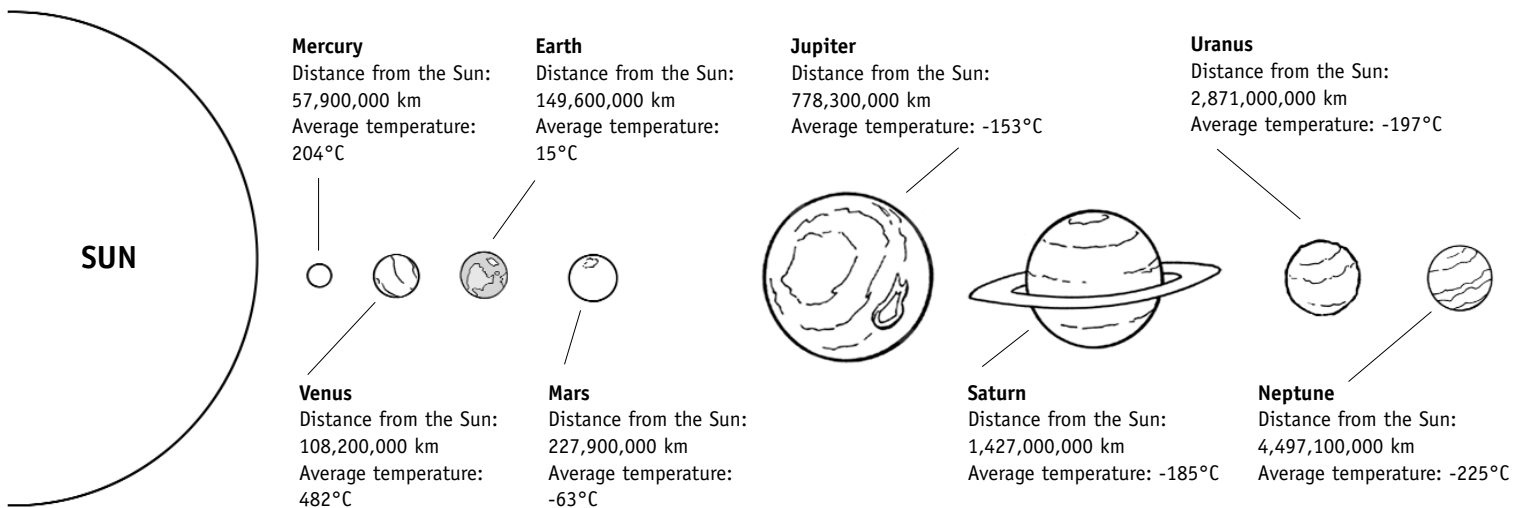
The properties of water regulate Earth's temperature. While water is freezing to form ice, the water/ice system temperature cannot drop below the freezing point, 0°C. Likewise, while water is transforming to vapor, the temperature of the water/vapor system cannot go above boiling, or 100°C. This phenomenon exerts natural limits on the temperature range of Earth.

### THE RIGHT INGREDIENTS

Our planet has abundant quantities of the six elements that comprise 95 percent of all living organisms: carbon, oxygen, hydrogen, sulfur, phosphorus, and nitrogen. These elements, particularly carbon, are crucial for building cells and tissues and for the basic chemical processes of life as we know it.

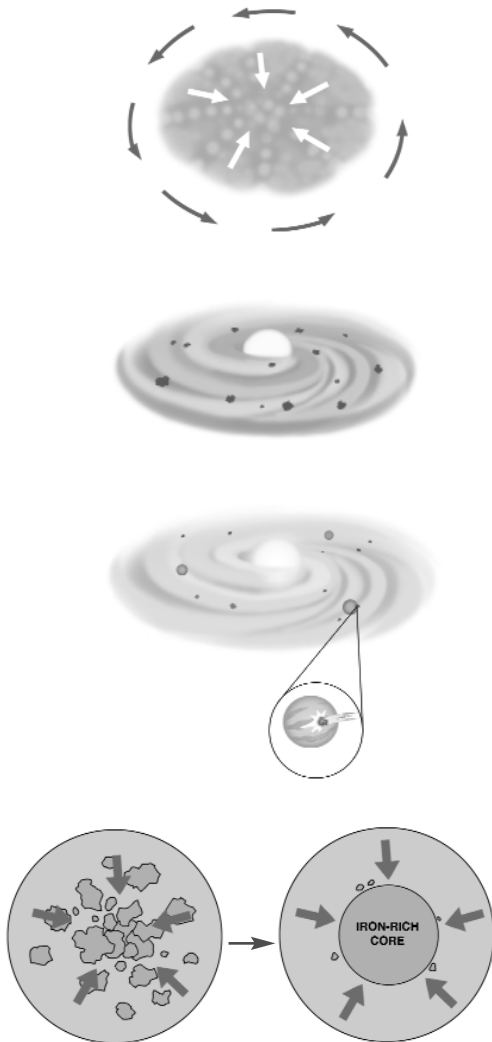
**How would life on Earth be affected by the following changes:**

- The Sun grew larger?
- Earth's atmosphere thinned?
- Earth had no moon?
- A greater number of large asteroids hit Earth?



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## FORMATION OF OUR SOLAR SYSTEM



The Sun and the planets formed together, 4.6 billion years ago, from a cloud of gas and dust called the solar nebula.

### COLLAPSE AND ROTATION

The slowly rotating solar nebula collapsed under its own gravity to form a rapidly rotating disk, with the Sun at the center. Collisions of gas and dust within the disk concentrated the material into a thin plane.

### CONDENSATION

The inner regions of the solar nebula were hot, allowing only rocky material to condense. The rocky terrestrial planets formed there. Gases and ices condensed in the cooler outer regions, where the gas giant planets and their icy moons and comets formed.

### ACCRETION

Small bodies collided, stuck together, and slowly built up the terrestrial planets. Such accretion also built up the cores of the gas giants until they were massive enough for their gravity to capture the abundant gases.

### DIFFERENTIATION

The terrestrial planets, as well as the larger moons and asteroids, have spherical layers that were created by melting and differentiating. Heavier elements sank to the center, forming iron-rich cores. Lighter materials were buoyed upward to form the outer rocky layers.

*Interactive kiosks on the ground floor of the **Hall of the Universe** further illustrate planet formation.*

In the *Hall of the Universe*, on the lower level, is an Ecosphere. This enclosed spherical aquarium is a complete ecosystem.

- What life requirements discussed in the Space Show do you see present in the Ecosphere?
- What is the energy source for this ecosystem?

