WHAT ARE PLANETS MADE OF?
Of the nine planets in our solar system, the four inner planets—Mercury, Venus, Earth, and Mars—are relatively small, dense, and rocky. The rocky layers are mainly silica. The centers of these planets are metal, mostly iron and nickel. The outer planets include Jupiter, Saturn, Uranus, and Neptune. Each is primarily a large ball of dense gas, mainly hydrogen, with some methane, ammonia and helium. Pluto is the outermost of the nine planets. It is a very small, rocky ball of ice and frozen methane.

CATALYSTS make things happen.
They speed up reactions and make some ingredients combine that could not without them.

TRAVEL GUIDE TO THE SOLAR SYSTEM
by David Wright

EARTH IS JUST ONE OF NINE PLANETS that orbit Sol, the star we call the sun.

Scientists have learned a lot about our solar neighborhood during the past few decades. Planetary geologists study the extreme conditions on Earth and other planets in an effort to understand what those bodies are like and how they formed. Astrobiologists study life under Earth's most hostile conditions in an effort to predict where life might exist on other planets. To date, the only place life has been found is on the surface of the Earth. And the surface is just one part of our planet—a thin zone between the atmosphere and crust. Earth can be divided into layers like an onion: atmosphere, crust, mantle, outer core and inner core.

Conditions everywhere but the surface appear intolerable to life. Ten miles above Earth's surface, the temperature is 110 degrees below zero. The pressure is only one-tenth of that found at the surface. The upper atmosphere is bombarded with high-energy solar radiation. The gases there are chemically reactive. Earth's crust is made of pieces called tectonic plates. Earthquakes can occur as a result of the incredibly slow but powerful motion of tectonic plates sliding next to each other. Volcanoes are found in the areas where these plates crunch together. Below the crust lies the mantle. It is made of rocky materials, mostly silica. Below the mantle lie the outer and inner cores, made of molten iron and nickel. Gravity squeezes all of Earth's layers toward the center. The temperature at the inner core is 13,000 degrees Fahrenheit. That's as hot as the surface of the sun. The pressure at Earth's center is 4 million atmospheres. That's 50 times greater than the pressure needed to make diamonds! Compared to Earth as a whole, the surface has only a very narrow range of conditions.
New Star
Watching the Earth

Scientists use satellite images to study comets, asteroids, and other planets. At ASU, researchers use the same technology to study cities and deserts right here on Earth. The Advanced Spaceborne Thermal Emission Radiometer (ASTER) peers down at the Earth from a NASA satellite launched in early 2000. The device is part of the Mission to Planet Earth project. ASTER produces both color and infrared images of the Earth. Scientists use different techniques to analyze the images, which can reveal a wealth of information. Phoenix is among 100 cities being studied as part of this project. The project also focuses on deserts around the world, including Arizona's Sonoran Desert. Scientists will watch these areas for changes in size and vegetation, among other things.

All the outer gas-giant planets have rings like Saturn's. However, they are so thin and faint that they were unknown until recently. Scientists were able to detect the rings with powerful new telescopes, and by visiting spacecraft.

THEMIS used both infrared and visible light to make this image. Infrared light reveals the temperature of the Earth. Most of the view is of the night side of Earth. The instrument measured temperatures of minus 58 degrees Fahrenheit in Antarctica and about 48 degrees Fahrenheit in Australia. The readings were within a few degrees of temperatures measured by humans on the Earth.
Earth is a very special place.

Of course, we humans have a biased opinion about this planet, because the temperature, pressure, and chemical composition on Earth are ideal for supporting a wide variety of life forms. However, conditions on planetary neighbors in our solar system are quite different. Compared to these other places, the surface of Earth seems rather mild, but that’s what makes it home.

Things to do when you visit

Mercury: Fry in solar radiation—you need sunscreen of 250 SPF
Venus: Get cooked, crushed and dissolved in acid
Mars: Puff up and freeze
Jupiter: Weigh as much as you and your best friend together

The sun is made mostly from the two lightest elements in the universe, hydrogen and helium. Despite the ultra-light building materials, the sun has almost 100 times more mass than all the rest of the planets in the solar system combined. The sun’s crushing gravity squeezes and heats gases to temperatures of 15 million degrees—hot enough to trigger nuclear fusion reactions. These reactions power the sun and result in the light we see and the heat we feel here on Earth. Above, the image shows huge loops of ionized gas that follow magnetism that swirls out from our sun. The loops are many times bigger than the entire Earth.

Mercury is the planet closest to the sun. It receives tremendous amounts of solar radiation. There is almost no atmosphere to help distribute this energy evenly. The temperature on the sunlit side of Mercury is 800 degrees Fahrenheit, hot enough to melt lead into a gooey soup. But a different world exists on the dark side. Temperatures there can plunge to a frigid 280 degrees below zero. No other planet is so different from one side to the other. Mercury also lacks an atmosphere to protect the surface from meteorite impacts. As a result, Mercury is heavily cratered, just like Earth’s moon.

Venus is Earth’s closest planetary neighbor. The second planet does not receive as much solar radiation as Mercury. However, Venus has an atmosphere heavy in carbon dioxide, a powerful greenhouse gas. The thick atmosphere traps heat from the sun causing the temperature on Venus to soar above 900 degrees Fahrenheit. That’s hotter than the sunny side of Mercury! On Venus, thick clouds of sulfuric acid are blown around by hurricane winds of up to 220 miles per hour. The air pressure there is about 90 times sea level on Earth, which would not make for a pleasant visit. You would be cooked, crushed, and dissolved in minutes.

Here on Earth, a wide range of conditions produce many different environments for living things. The Earth’s poles are frigid. The equator is sweltering. The atmosphere at the highest mountaintops is too thin for humans to breathe. At the bottom of deep ocean trenches, the pressure of seawater is so great it can crush a submarine. Near a volcano, acidic gases burn skin, lungs, and eyes. Near the Dead Sea and Great Salt Lake, soil is severely alkaline. Yet most of Earth’s surface supports life that is well suited to its environment.
Our sun is a relatively small, medium temperature star. Astronomers call it a yellow dwarf. Giant, hot stars such as Rigel—found in the constellation Orion—give off much more light at wavelengths of blue and ultraviolet. Cooler, red-giant stars such as Betelgeuse (pronounced “beetle juice”)—also found in Orion—have a huge wispy outer atmosphere. Betelgeuse would fill our Solar System from the sun to the orbit of Mars.

Pluto is the smallest planet. Astronomers at the Lowell Observatory in Flagstaff, Ariz., discovered Pluto in 1930. It is the only planet known to have solid methane ice. Some scientists believe Pluto is about the same today as it was when the solar system was formed 4.6 billion years ago.

In addition to the nine planets, there are 61 moons within our solar system. Some of these moons have dramatically different conditions. Triton is a moon of Neptune. At 391 degrees below zero, Triton is the coldest object in the solar system. Jupiter's moon Io has many active volcanoes that shoot plumes of lava hundreds of miles above the surface. On Miranda, a moon of Uranus, cliffs stretch more than 12 miles high. Asteroids, comets, and meteors fill out the picture. A few asteroids such as Vesta are large enough to qualify as tiny planets, though none have atmospheres. All these small bodies are thought to be remnants of the original formation of the solar system, mere crumbs left after the monster gas giants gobbled most of the gas and dust available to form planets.

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