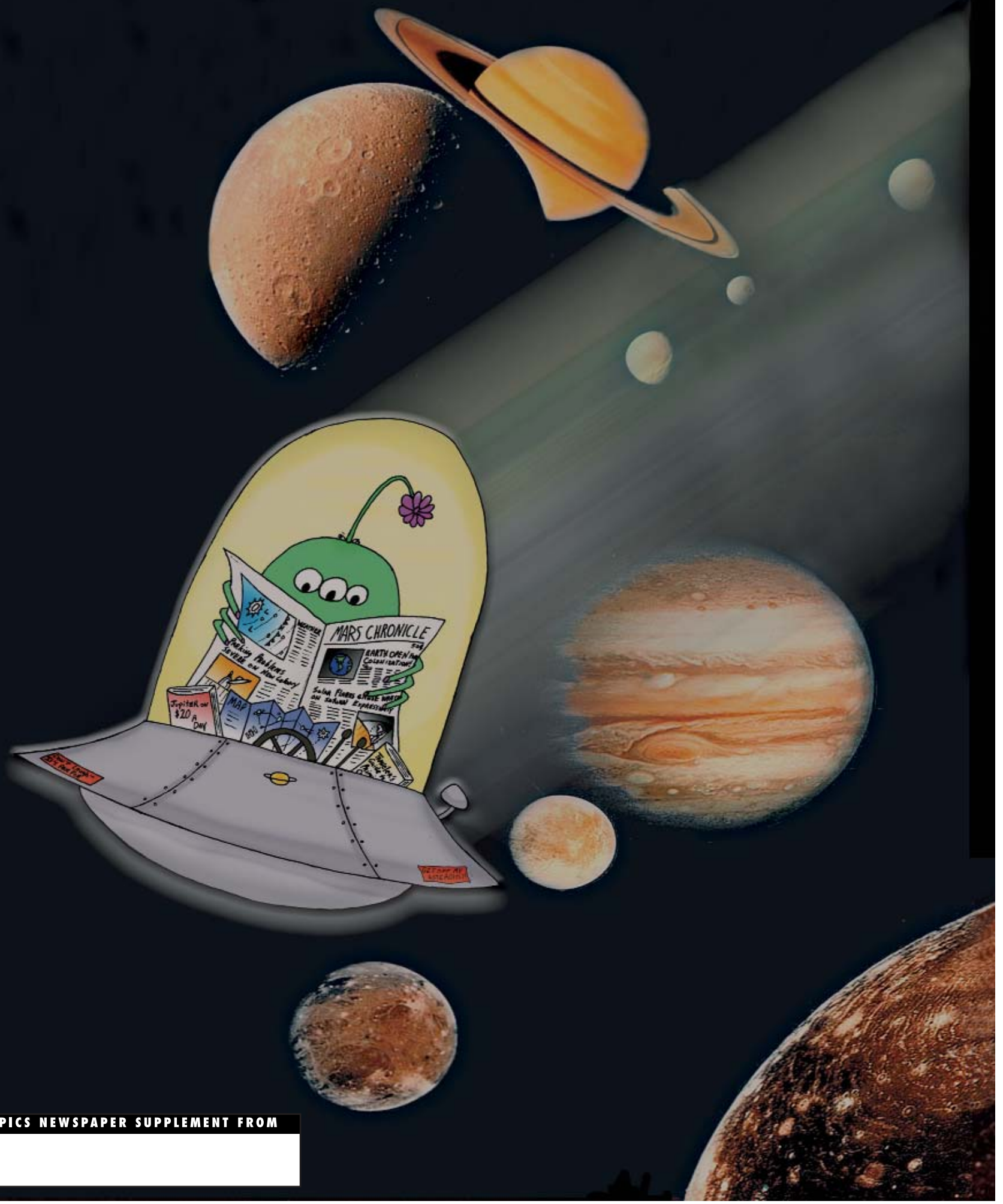
Space Mysteries



A HOT TOPICS NEWSPAPER SUPPLEMENT FROM

The questions & where to find the answers

Note to Educators:

Since the dawn of history, people have stared at the night sky and wondered what was out there. Ancient civilizations have created intricate stories and myths to explain the beautiful array of light they see in the dark. We have joined their number.

We have spent hundreds of years imagining alien life forms. Many of us claim to have seen them. Tales of flying saucers and oddly formed creatures have captured our imaginations. It doesn't matter whether aliens are real and walking among us. What's important is that we *imagine* they might be. What better way to capture the attention of kids who grew up watching "Star Wars" and "The X-Files."

This publication explores alien legends in realistic, scientific terms. Using aliens as a starting point, it discusses concepts in math, physics, astronomy, biology, and history in an exciting and eye-catching way. As children read about aliens, they will learn lessons that can be used both in your classroom and in their lives.

This publication has been designed to be used with your local newspaper. Many of the activities have students refer to information that can be found in a newspaper. Be sure to study the activities beforehand, so that you will have the materials on hand as students need them. Hopefully, students will use this and the information you teach to learn, create, and reach for the stars.

Remember, the truth is out there. Good luck!

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Photographs courtesy NASA, SETI Institute

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Space Glossary: Boldly know words you've never known before!

Alien — Any creature in a place other than its normal surroundings. Examples would be a Japanese beetle in North America, a woman from the United States travelling in Guatemala, or a creature from another planet visiting Earth.

Centrifugal force — The force that pushes outward on something moving in a circle.

Environment — An organism's surroundings that affect its development. For instance, the environment of Ohio River fish is made up of water, mud at the river bottom, algae, and pollutants. Collectively, *the* environment is made of all the physical conditions of the surface of the planet Earth.

Evolution — The process by which organisms adapt to their environment by changing over long periods of time. Physical evolution involves the development of random, genetic mutations. If these mutations help an organism survive better in its environment, they are more likely to be passed on to the organism's offspring. Over time, these mutations accumulate, creating an entirely new species.

Galaxy — A large group of millions of stars. Galaxies come in many different shapes and sizes. Some look like giant, shapeless clouds. Others have a more definite shape, like a whirling pinwheel. Stars in a galaxy orbit a galactic core at the galaxy's center. The sun is part of the Milky Way galaxy, which is 100,000 light years across and contains 200 million stars.

Gravity — The natural force exerted by all objects with mass that attracts them toward each other. The more mass an object has, the stronger the force of the gravity it exerts.

Light Year — A unit of measurement used for extremely big distances. A light year is defined as the distance light travels in one year's time, about 5 trillion miles. The nearest star to Earth, other than the sun, is Proxima Centauri, which floats in space about 4 light years away.

Mass — The amount of material contained inside an object. Everything has mass, even air.

Nebula — A huge cloud of gas and dust floating in space. The plural is nebulae. In many nebulae, dust and gas clump in swirling balls which sometimes ignite in nuclear fusion to become stars.

Nuclear fusion — The process that takes place in the core of stars to create the stars' heat and light. Two atoms of one element, typically hydrogen in young stars, fuse to form another element, typically helium. In older stars that have expended their supply of hydrogen, helium fuses into carbon.

Orbit — To travel in circles around an object due to the force of gravity. For instance, the Earth orbits the sun because it moves in circles around the sun.

Organism — Another word for life form. Organisms can include blue whales 100 feet long weighing 200 tons, a fungus stretching for miles, a microscopic bacteria, or a student sitting at a desk in a school.

Planet — A large mass composed either of rock or gas that orbits, or travels in circles around a star. Earth is a planet.

Satellite — An object that orbits, or travels in circles around a planet. The moon is a natural satellite of Earth. The International Space Station and the Hubble Telescope are artificial satellites.

Star — A huge ball of hot, bright gas, mostly hydrogen, burning through a process called nuclear fusion. One example of a star would be any of the millions of bright points of light seen in the night sky. Another would be the sun.

Supernova — The violent, sudden explosion of a star, during which the core collapses violently while the outer layers of the star are thrown into space. For a month, a star undergoing a supernova will be the brightest object in a galaxy. Supernovas are extremely rare. Light from the last recorded supernova reached Earth in 1987. Before that, a supernova hadn't been seen since the 17th century.

ALIEN HISTORY

The history of aliens is a guessing game. Nobody knows if aliens from space exist. What do you think?

What we do know about aliens is that humans have wondered about them longer than you might think. Ever since people discovered that other planets drifted through space, people have wondered whether strange beings might walk the surface of those planets.

In the late 1800s, people started theorizing about aliens from Mars. The theory caught on when an astronomer from Arizona named Percival Lowell looked at the surface of Mars through his telescope and saw what looked like canals, artificial channels of water purposefully built by intelligent beings. Martian hysteria spread.

In 1898, a writer named H. G. Wells published a story called "War of the Worlds," in which Martians invaded the Earth. Even when astronomers proved that Lowell's canals were natural land features that had nothing to do with water or aliens, people clung to the idea.

In the early 20th century, people everywhere began writing stories of aliens. Radio shows from the 1920s and '30s like "Buck Rogers" and "Flash Gordon" told stories of humans travelling to faraway places to fight wars with people from other planets.

In the 1950s, alien tales spread to comic books, movies and TV shows. Children spent Saturday afternoons watching matinees of "The Day the Earth Stood Still," a movie about alien invaders. It was one of thousands of movies about aliens made then.

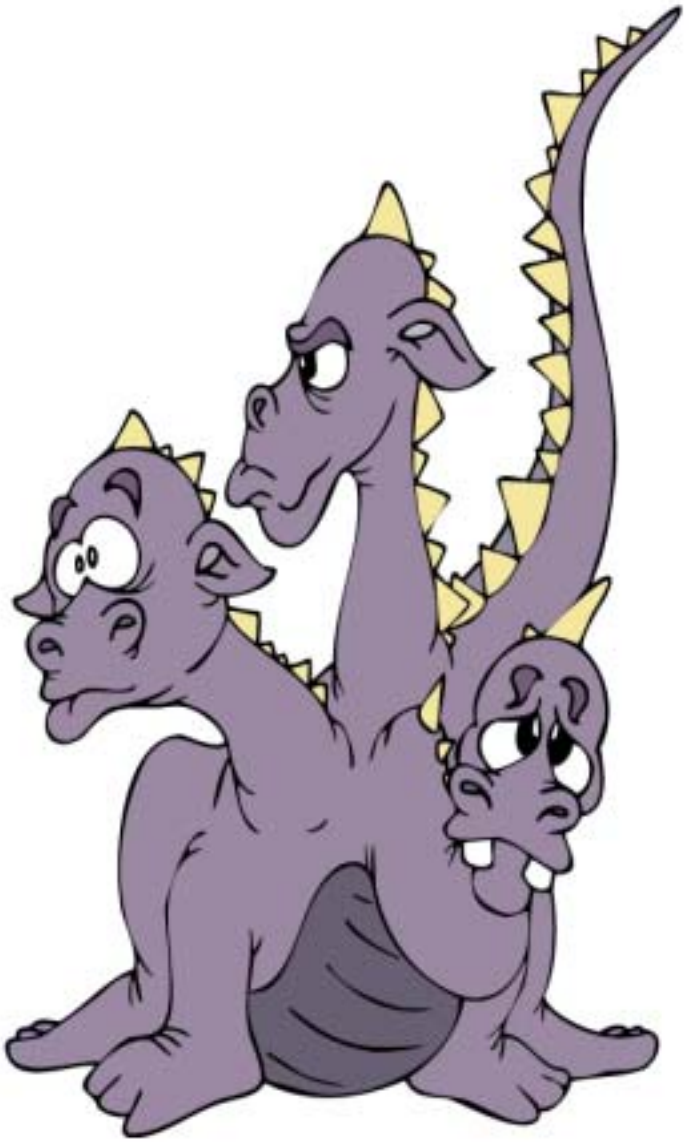
At this time, people also began seeing strange objects in the sky. They reported seeing bright lights or metal disks or "flying saucers." People called these lights "UFOs," or Unidentified Flying Objects. Many people assumed UFOs were space ships carrying aliens to study the earth.

One famous incident took place on July 7, 1947, when a farmer outside Roswell, New Mexico reported that a UFO crashed at his farm. Over the next two days, the *Roswell Daily Record* reported that pieces of a space ship and the bodies of four aliens were found at the crash site. The U.S. Air Force investigated the incident and denied these reports, saying it was a hoax.

Reports of UFOs kept coming, however, and in December, 1947, the Air Force created "Project Blue Book," a program that investigated UFO reports. Between 1947 and the 1969, the project explained sightings as meteors, weather balloons, or other phenomena, discounting much of the UFO hysteria.

The fascination remained. In the 1960s, "Star Trek" premiered on television, portraying future humans working with alien races to operate a space ship. In the '70s, the movie "Star Wars" told the story of humans and aliens in a galaxy far, far away. In the '80s, TV launched its next "Star Trek" generation. And in the '90s, the television show "X-Files" followed the story of two government agents on the trail of aliens.

Now, at the dawn of a new millennium, aliens appear everywhere. We see them in movies and television shows, on T-shirts and key chains. Aliens have become part of our culture. Whether they're real or not, they're here to stay.



I saw an ALIEN!

Kathie Grimes of Butler County, Kentucky always liked the tranquility of life away from the city. She lived in a trailer on a southwestern Kentucky hill in the middle of farm land, far from city lights and noise. Nothing ever happened out there.

That is, nothing ever happened until a quiet night in 1997. Kathie was watching television in her living room when she heard a strange noise, a low, quiet hum. She walked to the front door, peered out the window, and saw nothing. The hum grew louder.

She walked out the door, onto her front porch, looked around for a moment, and then gazed up.

There in the sky, directly above her head, a huge, dark object blocked out the stars. Kathie froze. She could see nothing of what the object looked like, just that it was massive and motionless, floating in air.

Minutes later, Kathie saw a bright green light leave the dark object, travel to a field near her property and land. As the green light grew brighter, Kathie decided that was a good time to go in the house.

"I wasn't going to go down there and see what that was," Kathie said. "No way."

The next day, Kathie did walk down to the field where she'd seen the object land.

"I saw this big burnt area," she said. "And I felt this intense energy, as if something very strong had been there. I haven't been able to go back to that place since."

You may think this story sounds weird, but to millions of people like Kathie Grimes, the tale seems quite reasonable. Like Grimes, these people say they have seen UFOs.

A co-worker of Grimes', Michael Hayden, remembers an incident when he was a child.

"I was about 13 years old," Michael said. "My mother was driving us somewhere, and, for no reason, she stopped the car. We got out and looked up and just froze. We couldn't move."

What Michael and his mother saw when they looked to the sky defied explanation. A huge metal object hovered 50 feet above their heads. Michael said the object must have been as long as a football field, maybe bigger. He stayed there for several minutes, and then suddenly, without making a sound, the object was gone. It disappeared.

Since 1998, Kathie Grimes has been involved with an organization called MUFON, the Mutual Unidentified Flying Object Network. This is a worldwide organization boasting tens of thousands of members, all dedicated to finding an explanation for the UFO phenomenon. Some investigate reports of UFO sightings, looking for evidence. Others give lectures and write books, offering possible explanations.

Most MUFON members have seen something like what Kathie and Michael describe, an object floating in the sky. Others tell of visits from aliens, most often described as small, gray beings with huge eyes and shiny skin. A few — including Kathie — say they have been taken into alien ships.

"Most people look at you like you're crazy when you talk about things like this," said Kathie. "They don't want to believe it really happens."

Does it really happen? Most members of the scientific community don't think so.

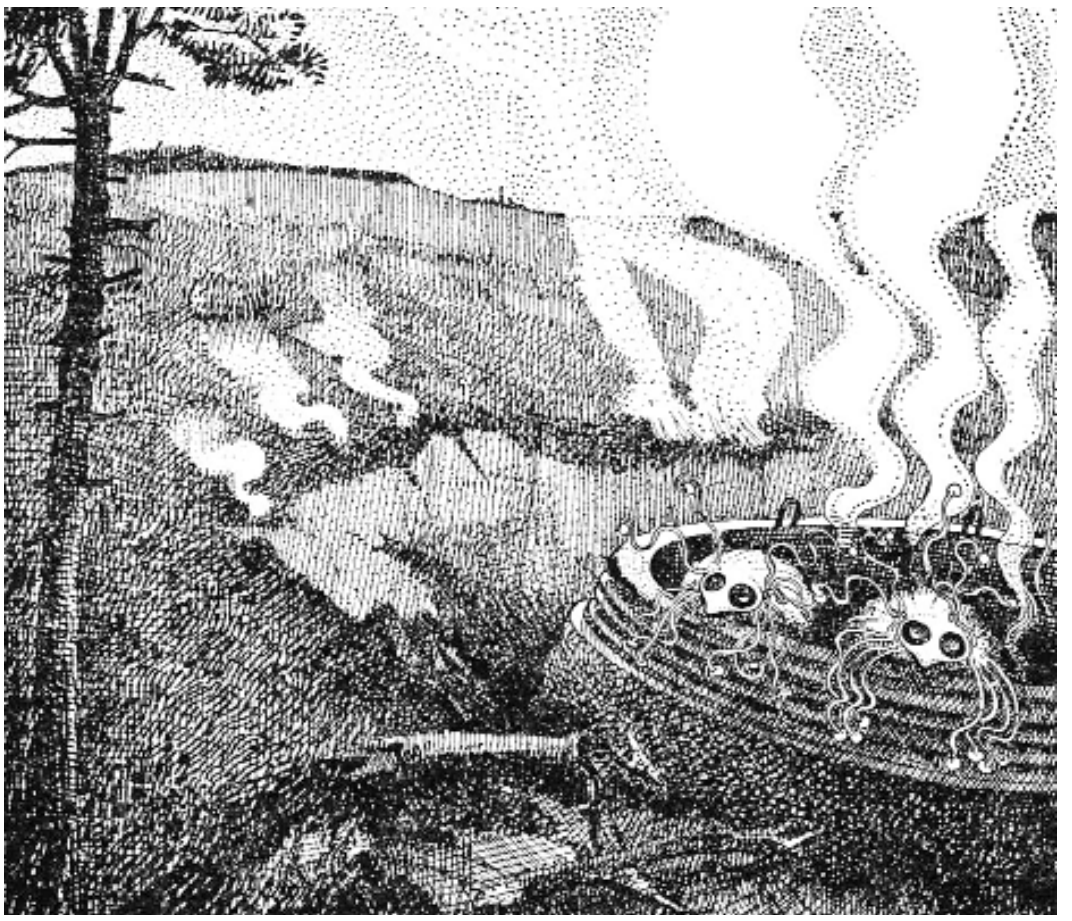
But who can say for sure?

MUFON can't track the number of people in the world who claim to have seen strange things in the sky, but they have documented thousands of cases.

They suspect the number might reach millions.

Imagine that. Thousands, even millions, of people, all claiming to have seen the same things.

Is it really happening? No one knows. You have to decide for yourself.



STARS and Planets and Galaxies, oh my!

Could creatures from beyond really travel across space in flying saucers? Where would they come from?

That question is easier to answer than you might think. If there really are aliens, they probably come from a planet just like we do. They probably look up into a sky to see a sun, a moon or two, and a vast collection of stars at night.

Planets come in two basic varieties: rocky planets like Earth — which also are called terrestrial planets — and huge planets made of gas, called jovian planets. Terrestrial planets are smaller than jovian planets. The jovian planet Jupiter has a diameter 80 times as big as planet Earth!

The solar system, where we live, is made up of nine planets — Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. Mercury, Venus, Earth, Mars, and Pluto are terrestrial planets. The others are Jovian planets.

Earth and the other planets of the solar system orbit the sun, which means they travel around the sun in a generally circular path. The amount of time a planet takes to make one orbit is called a year. The closer a planet is to the sun, the shorter the distance it has to travel to make a full orbit and the shorter its year. Mercury, the closest planet, has a year lasting 88 days. Earth, the third planet, has a year lasting just over 365 days. The farthest planet, Pluto, has a year lasting 270 Earth years.

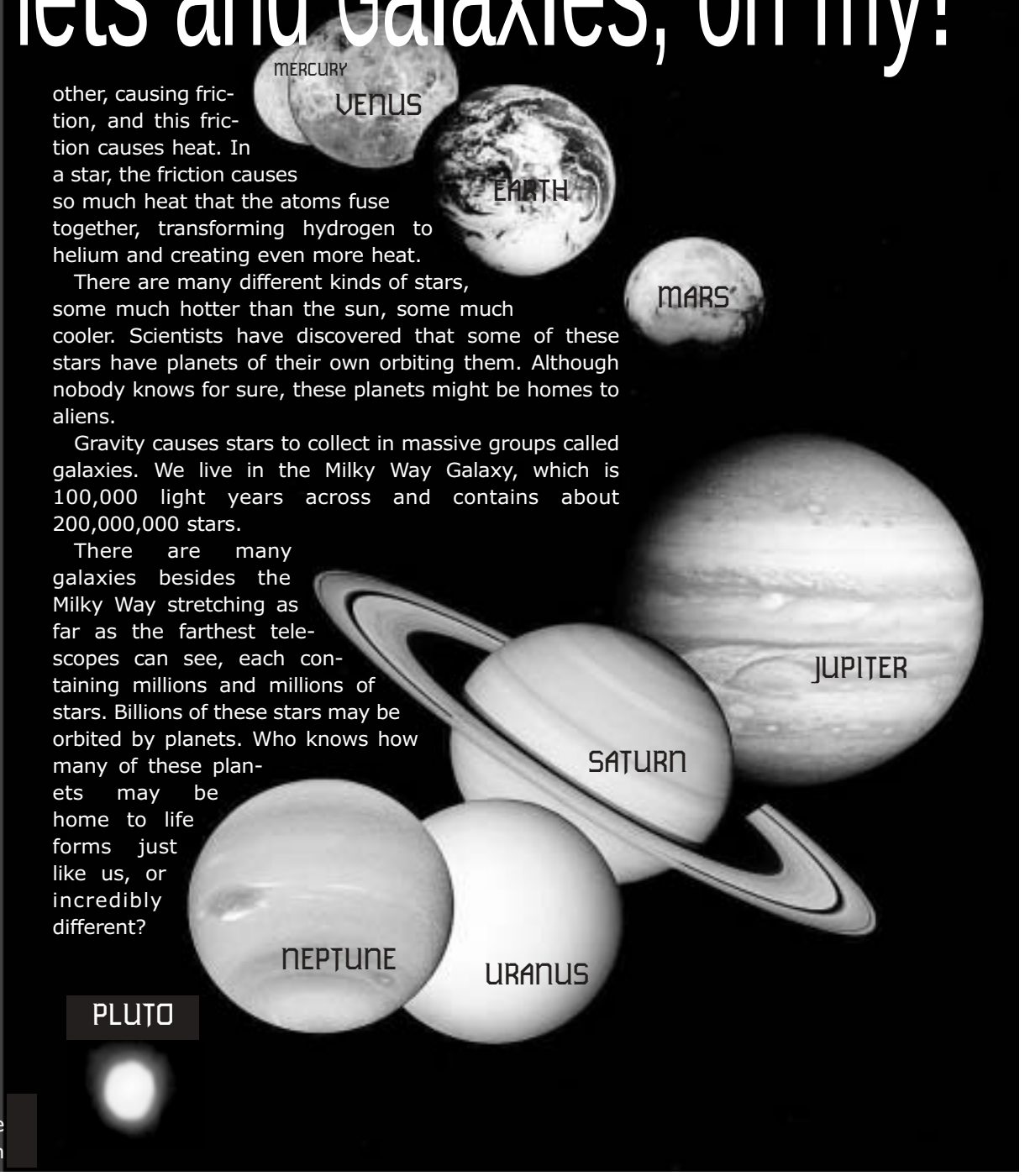
If aliens exist, they probably don't come from any of the planets in our solar system, because scientists believe the only planet that can support life is Earth.

The sun is a star, and only one star of millions. A star is a large ball of gas — mostly hydrogen, with some helium and other elements thrown in — that is burning through a process called nuclear fusion. A star contains so much gas in one place that gravity squeezes the gas, creating incredible pressure. The gas molecules are so close that they rub up against each other, causing friction, and this friction causes heat. In a star, the friction causes so much heat that the atoms fuse together, transforming hydrogen to helium and creating even more heat.

There are many different kinds of stars, some much hotter than the sun, some much cooler. Scientists have discovered that some of these stars have planets of their own orbiting them. Although nobody knows for sure, these planets might be homes to aliens.

Gravity causes stars to collect in massive groups called galaxies. We live in the Milky Way Galaxy, which is 100,000 light years across and contains about 200,000,000 stars.

There are many galaxies besides the Milky Way stretching as far as the farthest telescopes can see, each containing millions and millions of stars. Billions of these stars may be orbited by planets. Who knows how many of these planets may be home to life forms just like us, or incredibly different?



WHAT'S AN ORBIT?

Moons orbit planets; planets orbit stars; stars orbit the center of the galaxy. But, what does orbit mean? Why does it happen?

One object "orbits" another when it travels in a circle around the object. If you ride your bike in circles around your little sister after she falls and scrapes her knee, you are orbiting her.

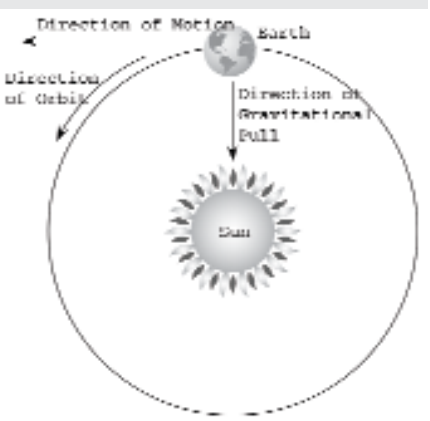
The difference is that planets don't orbit stars to be mean. They do it because of gravity. I'm sure you know about gravity. It's what made your sister fall in the first place. Gravity is the force exerted by all objects, pulling them toward one another. Everything has gravity. Bigger things tend to have more gravity, but not because they're big. They have more gravity because they have more mass — they contain more material. For instance, it takes more material to make a marble than a styrofoam ball the same size because the stuff inside is more densely packed. The marble has more mass.

You're little and have only a little mass, so you only have a little gravity — so little, you can't even tell. The Earth is really big and really massive, so it has a lot of gravity. This is why things fall. Earth's gravity pulls them toward the planet's center.

Since the sun has 330,000 times more mass than the Earth, it has a whole lot more gravity. Just like the earth pulls your sister toward its center, the sun pulls the Earth toward its center. We are falling toward the sun!

Don't start worrying about air conditioning bills, though, because at the same time the sun's gravity pulls us toward it, the Earth is pushed by inertia in a direction perpendicular to the pull of gravity. When you combine these two forces, you come up with an orbit — the Earth moves in a circle around the sun. Although the Earth is falling toward the sun, it's moving fast enough that it misses. That's a good way to describe an orbit — falling toward the ground, but missing.

So why do spaceships, like the space shuttle, orbit a planet instead of stopping in space? The space shuttle only goes about 300 miles into space, not high enough to escape Earth's gravity. If it didn't move around the Earth, it would fall back to the planet\. So NASA launches the space shuttle into orbit, letting it travel around the Earth, falling toward the ground, but missing.



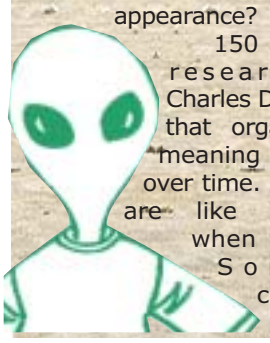
YOU SAY YOU WANT AN EVOLUTION

If you watch movies or TV, you already may have seen an alien. They probably looked like big insects. Or maybe they were skinny with big heads. They might even have looked like humans, except for their pointy ears.

What would real aliens look like?

The answer to that question depends on where they come from. After all, you don't look like you do for the heck of it. Your shape, size, color, even they way you move is affected by your environment, the nature of the place where you live.

How does environment affect appearance?

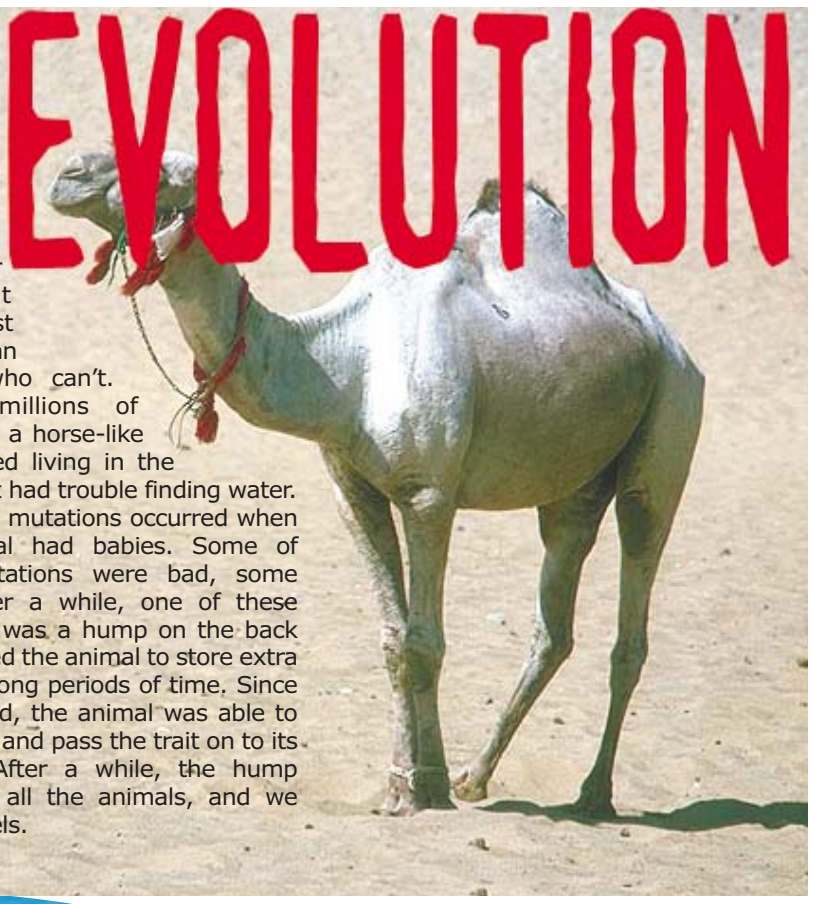


150 years ago, a researcher named Charles Darwin theorized that organisms evolve, meaning they change over time. Most organisms are like their parents when they're born. Sometimes, changes pop up for little reason. Maybe the baby will have an extra finger, or a different lung structure, or no eyes. These changes are called mutations.

Most mutations are bad. A baby animal born without eyes will have trouble finding food and escaping predators. It won't live very long. Some mutations help an organism. What if the baby animal had been born with super-strong eyes that let it see farther than all the other animals? Then it could find more food than any of its friends, and see trouble coming in time to warn the herd.

Animals with beneficial mutations live longer than other animals and have more of a chance to reproduce. Some of their babies might carry the trait, letting them live longer and reproduce more. Eventually, the trait spreads through all the animals. After millions of years, enough new traits may pop up that the animal will look completely different.

Different environments call for different traits to survive. Think of deserts. In hot deserts, animals who can go longer without water last longer than animals who can't. Perhaps millions of years ago, a horse-like animal tried living in the desert, but had trouble finding water. Over time, mutations occurred when this animal had babies. Some of these mutations were bad, some good. After a while, one of these mutations was a hump on the back that allowed the animal to store extra water for long periods of time. Since it was good, the animal was able to live longer and pass the trait on to its children. After a while, the hump spread to all the animals, and we have camels.



Where does all this LIFE come from?

"Organism" is another word for life form. On Earth, organisms are everywhere you look, from the highest mountain to the deepest ocean. Some organisms are huge. Blue whales weigh almost 200 hundred tons and grow to over 100 feet long. Other organisms are so small you need a microscope to see them.

Nobody really knows where such organisms originated. Some scientists believe life started billions of years ago when chemicals floating in ancient oceans combined to create amino acids, the chemicals that form deoxyribonucleic acid, also called DNA. DNA is the stuff contained in every cell that determines what we look like.

Regardless of how life started, the Earth had all the basic ingredients to keep it going: energy, water, and air.

How does life use these ingredients?

• Energy. Without energy, organisms could not move or grow. All the energy used by organisms comes from the sun in the form of light and heat. Plants absorb this energy and use it to process nutrients, helping them grow. Animals take energy from food. All energy in food comes from the sun through plants. Think about what you eat. Everything is either a plant or an animal that has eaten a plant.

• Water. Water has been called the foundation of life. A person can survive for weeks without food, but can only go a few days without water.

Organisms use water to cool down when they get hot. Water lets them move nutrients around the body (your blood is mostly water), and it lets them take energy from food by dissolving substances into chemicals.

• Air. The air organisms breathe is carried to their cells, where it takes energy from nutrients in a chemical reaction. Animals use oxygen from air to do this. After the reactions are finished, the oxygen is turned into another type of gas, carbon dioxide. Plants work just the opposite way. They use carbon dioxide and sunlight to cause a reaction which takes energy from nutrients.

NEWSPAPER ACTIVITIES

Learning Standards: describing features of goods, evaluating environmental impact of humans, understanding how organisms adapt to their environment.

1. Look at advertisements in your newspaper. How do advertisers make people want to buy their products? What could an alien advertiser say about Earth to make other aliens want to come here?

2. Animals evolve over millions of years, but can be destroyed in almost no time if their environments are threatened. Find articles in your newspaper about environmental damage here on Earth. How might that damage affect the organisms that live in that environment? Think of things you can do to prevent further damage.

3. Animals adapt to their environments. Create a planet with the characteristics you want it to have. How strong is the gravity? How hot is it? How bright is its sun? Design the animals that would survive on your planet.

A Nebula — a large cloud of gas and dust where stars are formed.

Imagine yourself on a dark, clear night, resting on a hill miles and miles from city lights. Look up to the dark sky and what do you see? Spread out before you all across the darkness, a million glittering points of light decorate the heavens.

Did you ever think that one of these points of light may be circled by a planet, and that on a hill on the dark side of this planet, an alien may be looking at the sky, dreaming of you?

Although it may be hard to believe, each of these points of light is a massive star, as big and bright as the sun that lights our day. In fact, our sun is one of the smaller stars in the sky. The largest may be 100 times wider than the sun. But then again, the smallest stars will be smaller than the Earth. Our galaxy, the Milky Way, contains over 200,000,000 stars of many different sizes.

Where did all these stars come from?

Nobody has ever seen the birth of a star. The process takes millions of years to complete, so everything we know of it comes from scientific theory.

Theories say that stars begin as huge clouds of dust and gas — mostly hydrogen — trillions of miles across. One of these clouds is called a nebula.

All objects exert gravity, the force that pulls objects toward one another. In a nebula, the gravity created by the dust particals pulls the dust and gas closer together until it forms a ball.

The motion of these particals moving toward one another starts the ball spinning. As more gas is pulled into the cloud, atoms of hydrogen run into each other, creating heat. More and more atoms collide, producing more heat.

After millions of years, the temperature of the cloud's center rises to 15 million degrees. This is hot enough to convert hydrogen to helium through a process called nuclear fusion. Nuclear fusion produces even more light and heat. Once fusion begins, the ball is called a star.

Stars only burn as long as they have fuel to keep them going. Some stars last a few hundred million years. Our sun will burn 10 billion years. Right now, the sun is about 5 billion years old.

Once the sun burns the last of its hydrogen, its core will collapse, creating enough pressure and heat for nuclear fusion to start converting helium to carbon. The outer shell of the sun will expand to swallow the inner planets, including Earth. Then, when the helium burns out, the sun will collaspe again, this time to a white dwarf, a tiny star about as big as the Earth.

White dwarfs continue to burn whatever fuel is left, until someday, far, far into the future, even they will die, leaving only cold embers.

Stars with a lot more mass than the sun die a lot more violently in what is called a supernova. The core of the star collapses a lot faster and with enough force to blow the star's outer shell away in a violent explosion. For a month, the star will become brighter than all the stars in the galaxy put together.

When the supernova fades, what is left will collapse into either a white dwarf, or, if enough mass is present, a black hole. Black holes are massive, but tiny. All their material is compressed into an object only a few miles across or smaller. They produce so much gravity that nothing can escape — no material, no energy, no heat, no light.

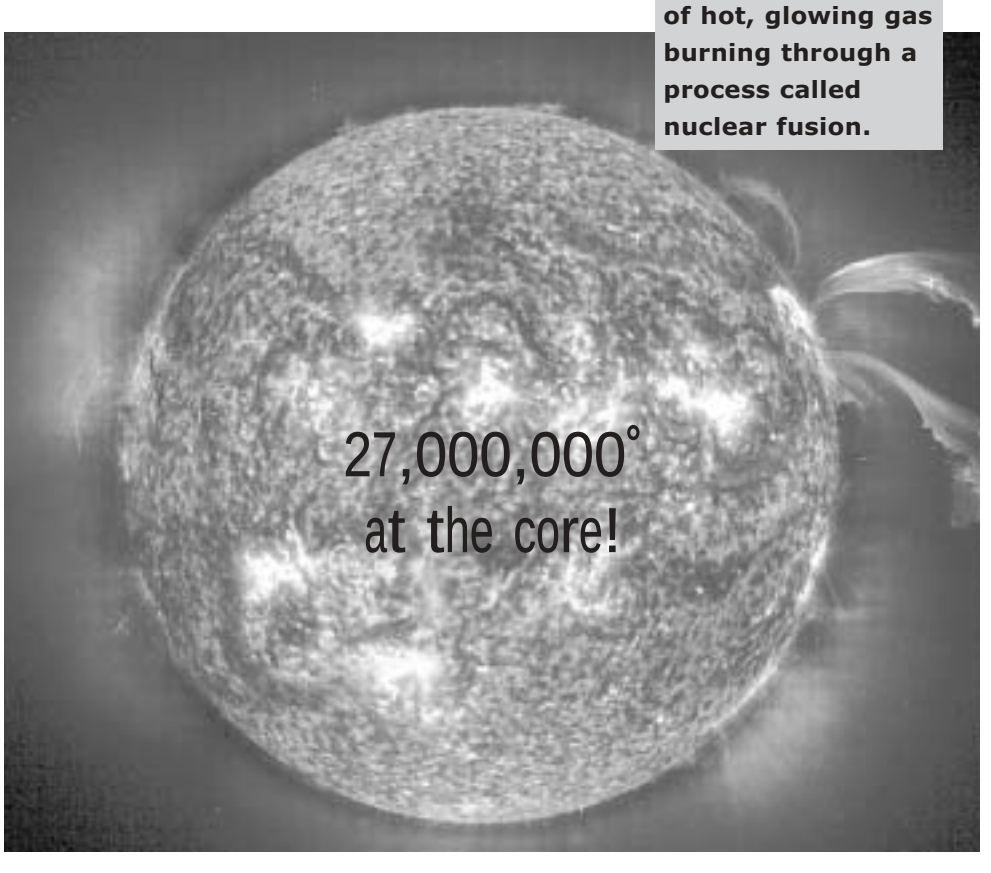
Take a look inside a star

Ever wonder what's inside the sun to make it work?

The sun is made up of four separate layers. At the center is the core, a ball of superheated gas where the nuclear fusion that produces light and heat takes place. The core of the sun is a whopping 27,000,000°!

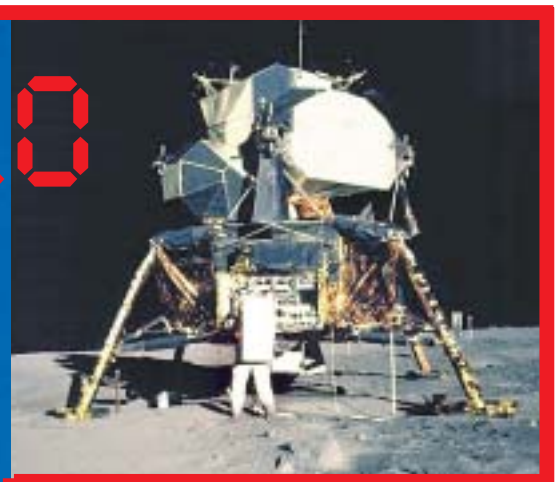
Energy leaves the core and moves into a layer of gas called the radiative zone. All the heat and light in this zone move outward. The energy eventually reaches the convection zone, where it begins traveling faster, pushed along by the motion of the gases. As the energy heats the gas in the convection zone, the gas rises to the surface. The energy radiates away from the surface, letting the gas cool and sink back into the sun's interior.

The temperature at the sun's surface is about 10,000°. It's always a bad idea to look directly at the sun's surface because it's so bright. Scientists look at the surface through filters. They see millions of bright circles surrounded by darker areas. The bright cricles are rising, superhot gas. The darker areas are gas that has cooled and is falling. Scientists also see dark splotches called sunspots. Sunspots are cool areas where fierce magnetic storms rage. Scientists don't really know what they are or what causes them.



Star — a huge ball of hot, glowing gas burning through a process called nuclear fusion.

Apollo



After years of hard work by hundreds of scientists, astronauts, and engineers, the United States sent the first human beings to the moon in a program called "Apollo." The name Apollo comes from the Greek god of light.

The spaceships of Apollo operated in stages. First, the ship launched into space atop a 200-foot-tall Saturn V rocket.

Once in space, the living modules of Apollo separated from the rocket. The rocket fell back to Earth, either burning up in the atmosphere or hitting the ocean.

The living modules accelerated to the moon, a trip that took about two days. At the moon, two astronauts piloted the landing module to the moon's surface, while a third stayed in space, orbiting the moon aboard the lunar orbiter. The astronauts in the landing module spent about three days exploring and collecting rock samples, then climbed back into the lander. Half of the lander served as a launch pad for the rest, which traveled back into space to reattach to the orbiter. The orbiter then traveled back to Earth. Once there, the astronauts climbed into the re-entry capsule and fell to earth, leaving the orbiter and lander in space.

Apollo flew 17 missions, six of which landed on the moon, allowing 12 people to walk its surface. The Apollo program that sent people to the moon was envisioned in 1960. It ended in 1975. Many people believe it was humans' greatest technological achievement.

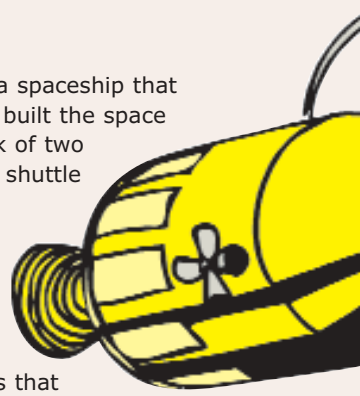
In order for peope to live in space, they need a space station.

Humans have built three different space stations. Skylab was the first. Launched in 1973 by the United States, Skylab was never very successful. Technical problems caused the space agency to abandon the station. Skylab crashed to the Pacific Ocean in 1979.

The next station was Mir, launched by the Soviet Union in 1986. Despite a series of glitches, including a collision with a supply ship, Mir was a resounding success. People lived in the station for almost 15 years. Financial shortages forced the Russians to abandon the station in 2000. The station crashed to the Pacific in March, 2001.

The third and largest station is the International Space Station, called Alpha by some. A partnership of five governments and alliances operates the station, including the United States, Russia, the European Union, Japan, and Canada. Astronauts have lived on the International Space Station since 2000. When complete, the station will be as long as three football fields. It will be the largest human-made object ever to have existed in space.

Shuttles



In the late '70s, the United States wanted a spaceship that could go to space more than once, so they built the space shuttle. The shuttle is launched on the back of two rocket boosters, which disconnect from the shuttle and fall to Earth.

The first shuttle, called *Columbia*, was launched in 1981.

Bringing a shuttle home

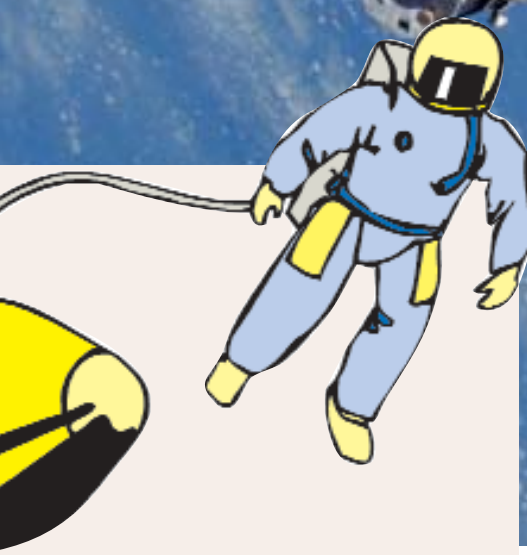
In the painting below, a space shuttle re-enters the Earth's atmosphere. Notice the heat at the bottom of the ship? Where does that come from?

Try this experiment: take your right hand and rub it over your left arm very fast. What do you feel? Heat! This heat is caused by friction. When two objects rub against one another, the pressure of that contact causes friction, which produces heat.

Spaceships move at thousands of miles per hour while in orbit. That's okay in space, but that's way too fast when the ship wants to land. At that speed, the ship creates friction with the molecules in the air, causing a lot of heat. That's why most meteors never hit the ground. They burn up because of their friction with the air.

So how does the space shuttle survive? The bottom of the shuttle is covered with black ceramic tiles which absorb much of the heat and reflect the rest, protecting the ship and the astronauts inside.

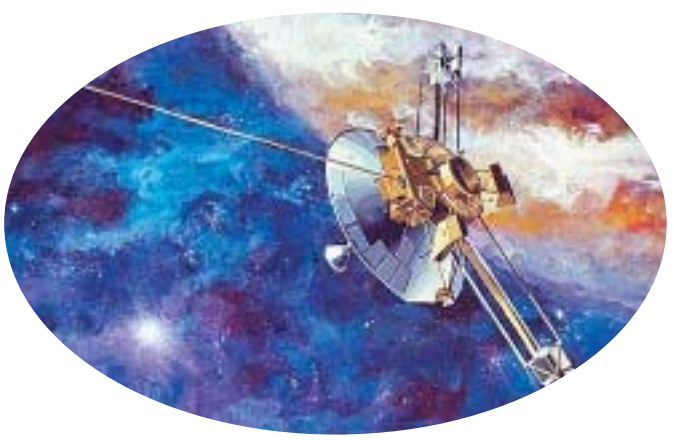
SPACE STATIONS



PROBES

Starting in the late 1950s, the United States and the Soviet Union began launching computerized probes to explore the solar system. Hundreds of these probes have left Earth in the last 50 years. Some have landed on planets like Mars or Venus. Some have explored asteroids and comets. Some have simply orbited the sun taking photographs and measurements.

The Pioneer and Voyager programs featured some of the most notable probes. Both these programs included dozens of probes designed to explore the planets. The most famous were Pioneer 10, Pioneer 11, Voyager 10, and Voyager 11. Most of the photographs we have of Jupiter, Saturn, Neptune, Uranus, and the moons of these planets came from these four probes, launched between 1972 and 1979. In the late '80s and early '90s, Pioneer 10 and Voyager 11 left the solar system to travel through space for eternity.



How fast is too fast?

What if aliens do exist? What if they know we're here? What would it take for them to visit?

The answer isn't a simple one. Sure, you might say that if they build a spaceship, they can come. Well, a spaceship isn't easy to build, and any spaceship headed for Earth must cover an incredible distance.

The closest star to our solar system is Proxima Centauri, which floats in space about 4.2 light years away. Proxima Centauri is part of a double star system, however, where gravity would make the formation of planets unlikely. Aliens probably don't live there.

A planet where aliens might live would be trillions and trillions and trillions of miles away, too far to fly to in the family sedan.

Simple, you say. They'll build spaceships that go really fast. There lies the problem.

Back in 1905, a physicist and mathematician named Albert Einstein developed what is called the Special Theory of Relativity, which he used to describe the motion of objects through space.

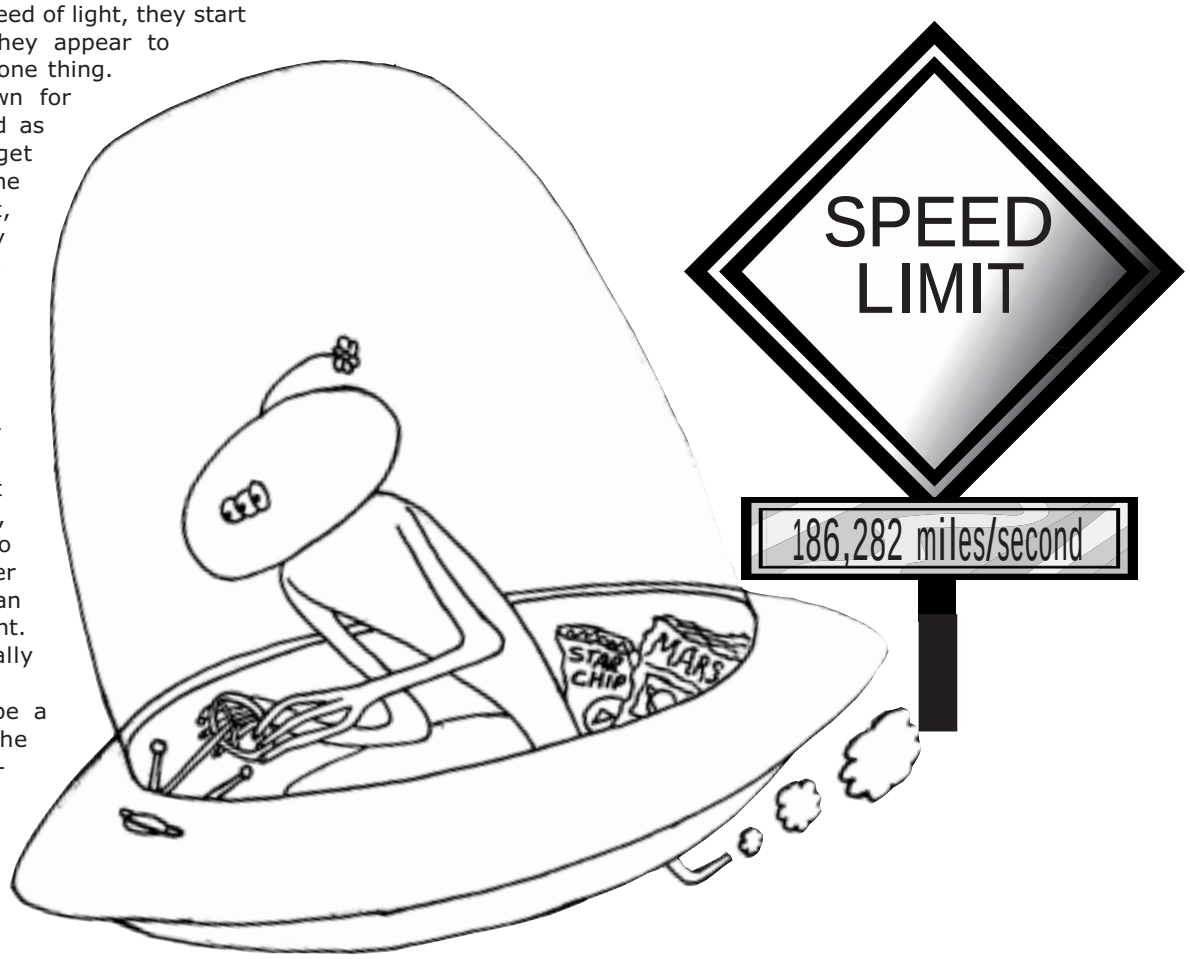
Using math calculations, Einstein showed that matter and energy are two forms of the same thing and that the two are interchangeable.

Einstein determined that as objects approach the speed of light, they start acting funny. They appear to get shorter, for one thing. Time slows down for the objects. And as the objects get really close to the speed of light, any energy they produce starts to become mass, slowing the objects down.

What does this mean for aliens? Basically, that no spaceship, according to Einstein, will ever travel faster than the speed of light. It is physically impossible.

Could there be a way around the theory of relativity? Science fiction writers like to think so, because it makes contact with aliens much easier. But so far, scientists haven't discovered a way. The universal speed limit seems to be 186,282 miles per second.

So even if aliens lived on a planet circling Proxima Centauri, and even if those aliens had a spaceship that could travel as fast as possible, it would still take them 4 years to get here. But if aliens exist, they probably live on planets much farther away, maybe 50 or 100 light years or even further. If they're going to come to Earth, they're going to be in their spaceships for a long, long time.



NEWSPAPER ACTIVITIES

Learning Standards: brainstorming, understanding the marketplace, creating graphics, comparing, contrasting

1. Pretend you're an alien student getting ready to take a field trip to Earth. What would you bring with you? Brainstorm a list.

2. Newspapers have classified advertisements, where people can sell cars and houses. Look through some of these ads. What if you were trying to sell a spaceship? Write a classified ad for an alien newspaper.

3. What do you think a spaceship should look like? Draw one of your own. Be sure to remember everything you'd need — food, water, air, energy, gravity, and whatever else you want.

4. What would be the requirements to work as an astronaut? Write an astronaut help wanted ad. Do other jobs have similar requirements? Look in your newspaper to find some.

What's a light year?

When you flip a light switch, how long is the bulb on before you see the light? How long does it take light to travel from the lamp to your eyes?

You may think it's instantaneous. It seems like it is. But light doesn't instantly go from place to place. Just like everything else, light has to travel to get anywhere. When you turn on a lamp, light travels from the lamp to your eyes, and that takes time.

Of course, light moves very, very fast. That's why you don't notice a delay when you flip a light switch. The light jumps to your eyes at a tremendous speed.

Scientists have determined that light travels at a whopping 186,282 miles per second! That's fast enough to go around the Earth at the equator almost seven times in a single second.

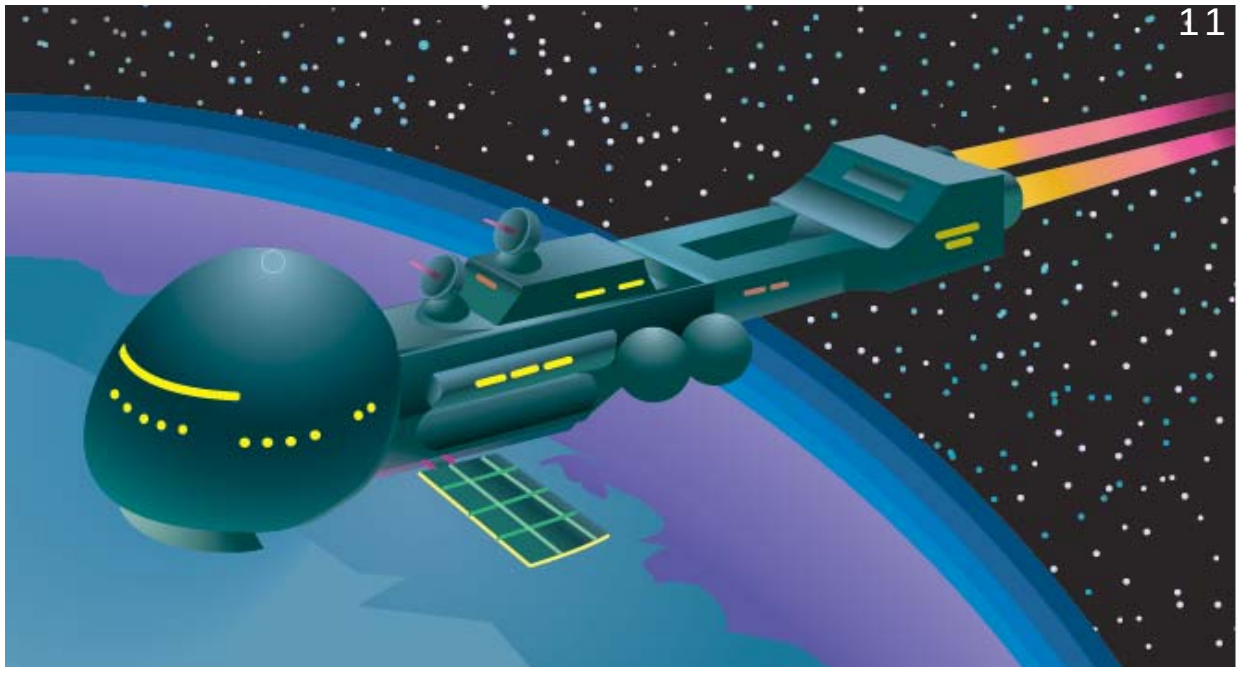
That seems very fast, until you start dealing with vast distances like those in outer space.

Light takes a little more than 7 minutes to travel the 92 million miles between Earth and the sun. That means if you glance at the sun, you're actually seeing what the sun looked like 7 minutes ago. Light reaches Pluto, the farthest planet, four and a half hours after it leaves the sun! With stars, the delay is even more noticeable. Light from the closest star to the solar system, Proxima Centauri, takes more than four years to reach Earth.

Because stars are so far apart, scientists saw that measuring distances in miles was awkward. Proxima Centauri, for instance, is about 20 trillion miles away. The distance in miles to the Andromeda galaxy, on the other hand, is so huge, you'd need a 1 followed by 19 zeros to write the number!

So scientists came up with the light year. A light year is defined as the distance light travels in a year's time, about 5 trillion miles. Proxima Centauri, then, is 4.2 light years away, while Andromeda is 2 million light years distant. Both measures are much easier numbers to handle.

WHAT'S IN A SPACESHIP?



If aliens come to Earth, they'll have to spend years confined in their spaceship. They'll be far away from any source of food, water, or other supplies. Outer space has none of these items. Space is a vacuum, an area of space where nothing exists, not even air. Aliens will have to take with them everything they need to survive for many years .

Imagine if you had to pack everything you eat in a year in a single suitcase. How would aliens do this?

First, they'd have to consider everything they'd need to live: food, water, and air. There are two ways they could approach the situation. They could build a huge spaceship with lots and lots of storage space for just a few aliens, or they could recycle.

On Earth, scientists already have started experimenting with small, self-contained, self-sustaining environments. These are enclosed spaces with no contact with the outside world. Even the air is separate from the air outside. These environments contain plants to supply food and oxygen. Water circulates through a filtration system. People drink the water or use it to water plants. Waste water is purified to produce new, clean water. People lived in one such enclosed environment, the Biosphere II in Arizona, for two years.

Aliens could create a similar environment in a spaceship, sustaining them for the journey. But they would still be short a few items: energy and gravity.

As you've learned, gravity is caused by mass. You feel gravity on a planet because the planet has enough mass to produce a lot of gravity. Building a spaceship big enough to produce gravity would take incredible resources, and the aliens would have to find an engine big enough to push it. Not likely.

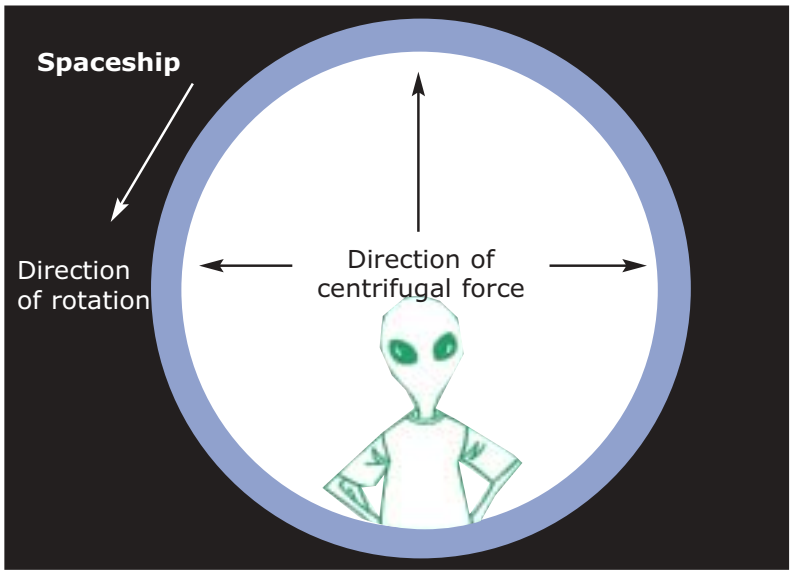
Earth scientists theorize that gravity could be simulated using centrifugal force. This is a force based on Isaac Newton's second law, that an object that is sitting still or moving will naturally want to keep sitting still or keep moving in the same direction as before. This is called inertia. Because of inertia, objects want to move in a straight line. When they turn, inertia pushes the objects back away from the direction they were turning in what is called centrifugal force. You notice this when riding in a car that turns a corner. Centrifugal force makes you lean to one side.

Scientists suggest that you could build a spaceship in the shape of a wheel or a long cylinder. When that wheel or cylinder spins fast enough, centrifugal force would push anything inside toward the inside of the outer surface, sort of like gravity in reverse.

Energy is more complicated. The people in Biosphere II used solar energy, but a spaceship would travel too far away from light when it travels between stars. An alien spaceship would need an incredible amount of power, both for light and heat inside the ship, and to drive the ship through space.

The most powerful way scientists know to produce power is nuclear fusion, the action that powers the sun. Nobody has figured out how to reproduce fusion on Earth in a way that can be controlled. Perhaps aliens have figured it out. Or perhaps they use some form of power we can't begin to imagine. Right now, only the aliens know.

What if you had to pack everything you eat in a year in a single suitcase? How would you do it?



DESTINATION EARTH

If getting to Earth is so hard for aliens, why would they bother coming here at all?

There are several possible reasons. One is that Earth is probably a rare planet in the universe. There's plenty of water here, which all life forms need. And there's plenty of oxygen, the gas most life forms would probably breathe.

But then, humans haven't been kind to the planet. We keep polluting our air and our water, making it less attractive to aliens — and ourselves — all the time.

Earth has a lot of resources aliens might want to use, plenty of metals and minerals aliens might find attractive. The planet also still contains a lot of fossil fuels like oil and natural gas that aliens might use for energy. But then, we use fossil fuels for energy too, and we've almost used them up.

Finally, Earth has something guaranteed to be on no other planet in the universe — us! Maybe aliens would look at Earth, see a growing civilization, and decide that we're worth studying.

MEET THE REAL ALIEN HUNTERS

Astronomer Seth Shostak examines a suspicious radio wave displayed on a computer at the huge radio telescope in Aricebo, Puerto Rico. Shostak is a member of the SETI Institute's Project Phoenix, which searches for evidence of alien signals in radio waves.

It may sound like something people do only in movies or on television shows, but there are actually people who look for aliens for a living! No joke!

Just ask Seth Shostak, an astronomer with the SETI Institute in Mountain Valley, California.

"I have loved astronomy since I was eleven years old," said Shostak. "This is a lifelong dream."

Shostak hunts aliens through a program called SETI. The word SETI (seh-tee) is an acronym that stands for Search for Extra-Terrestrial Intelligence. There are actually seven separate SETI programs operating in the world today. The SETI Institute's Project Phoenix is the largest, employing 120 astronomers, computer scientists, and engineers. These aren't the people you see on television hunting for clues of aliens here on Earth. In fact, while many involved in SETI believe aliens exist, most don't believe aliens have visited our planet.

If humans use radio, then extra-terrestrial civilizations probably would use radio, too.

Instead, SETI personnel turn their attention to the stars, looking for evidence of extra-terrestrial life in radio signals.

Radio signals are a form of electromagnetic wave. There are many other types of electromagnetic waves in nature. One other type is visible light.

The SETI program assumes that aliens will develop technology the same way humans did. About 100 years ago, humans developed technology to control radio waves and produce artificial signals. Radio waves carry songs to our cars, shows to our TVs, and voices to our cell phones.

It's a pretty good guess that if humans use radio, aliens would, too.

Since radio signals are a form of energy similar to light, they travel at the speed of light. And when they're emitted, they travel in all directions.

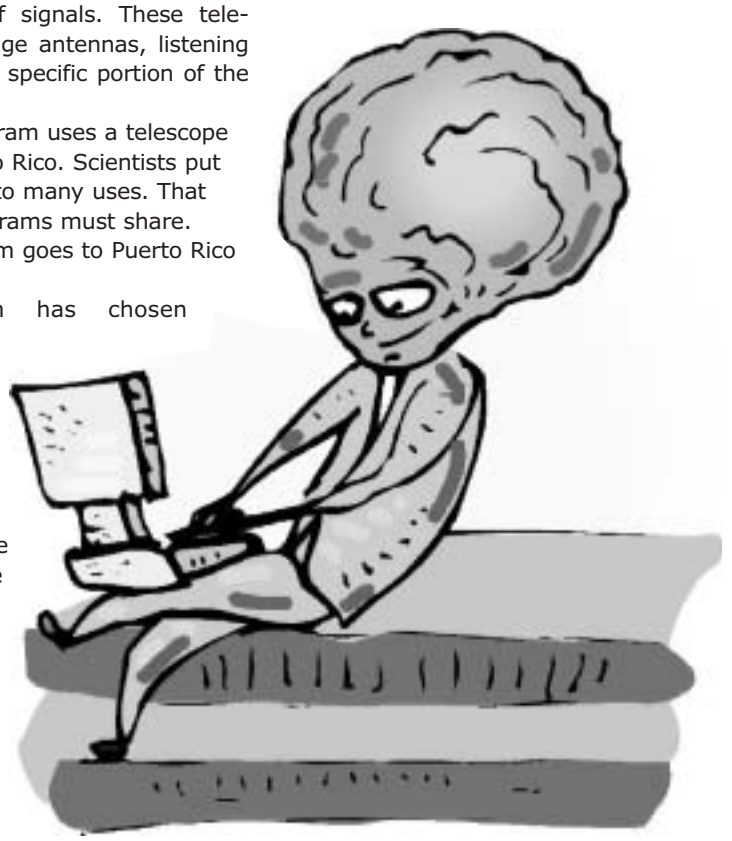
Radio signals have formed a sphere around the Earth since the first signals were sent 100 years ago. That sphere expands at the speed of light, passing more and more star systems as they go. Signals that left Earth 100 years ago form a sphere 100 light years in radius. Shostak figures that the signals carrying episodes of "I Love Lucy," a television show produced in the 1950s, wash over a new star system every day. An alien with the right equipment on a planet orbiting Vega, a star 20 light years away, may at this very moment be watching "Gilligan's Island."

At the same time, alien radio signals emitted at Vega 20 years ago would just now be reaching Earth. If we could detect those signals, we would have proof that alien life forms exist.

You can't just turn on a radio and start fiddling with a knob, though. Alien signals would be very weak. SETI programs use giant radio telescopes to comb the sky in search of signals. These telescopes act as huge antennas, listening to signals from a specific portion of the sky.

Shostak's program uses a telescope in Arecibo, Puerto Rico. Scientists put radio telescopes to many uses. That means SETI programs must share. Shostak's program goes to Puerto Rico twice a year.

The program has chosen 1,000 solar systems within 100 light years of Earth as candidates for alien civilizations. During their time at Arecibo, the group spends a few hours pointing the telescope to each of these candidates, listening for artificial signals. A computer analyzes thousands of signal frequencies.



"What we're looking for is a long monotone whistle," Shostak said. "This would be a carrier wave for another, weaker signal. There's no known artificial cause for such a signal, so if we hear something like that, we're probably hearing aliens."

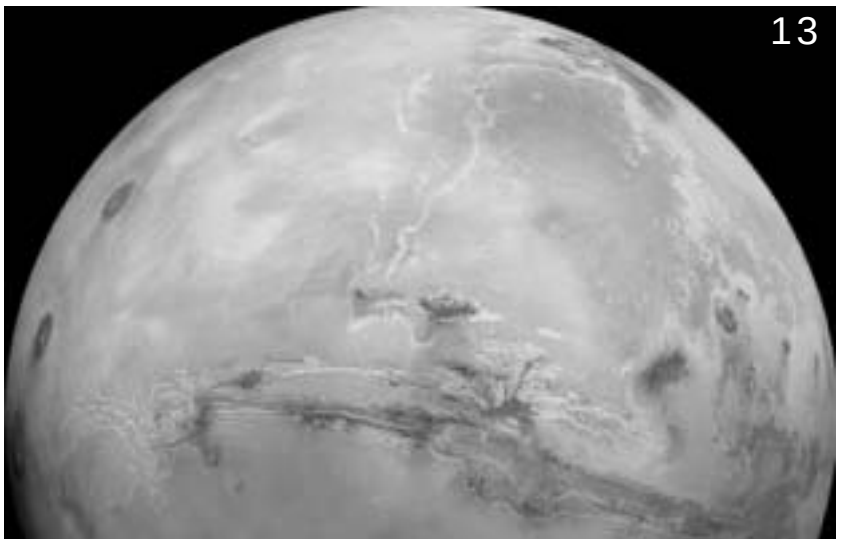
What happens if SETI hears an alien signal?

"We get maybe five or six good candidates a day," said Shostak. Each candidate signal is put through a number of tests to make sure the signal actually does come from beyond the solar system and isn't a satellite or some other human-made signal bouncing off a cloud or a mountain. So far, no signals have panned out.

What if one did? Could we talk to the aliens? Could we go visit?

"Travel between stars takes so much energy that it's virtually impossible for a biological life form," said Shostak. "It's possible we could communicate with them, but maybe not. We're still limited by the speed of light, and we may spend generations figuring out what they're saying. ... But just knowing they're there would affect our civilization like nothing else ever has."

Was there life on MARS?



Scientists can't say with assurance that aliens exist. Heck, scientists haven't found proof that any type of life exists anywhere but on Earth! For all we know, what we see around us on this one planet may be the only life anywhere in the entire universe.

And then again, maybe not. Something as mundane as a rock might hold the proof.

You know about the nine planets orbiting the sun in the solar system. What you might not know is that thousands of tiny rocks also orbit the sun. These rocks are called asteroids. Some are hundreds of miles across. Others are as small as tiny grains of sand.

Sometimes, these rocks fall to Earth. The asteroids that burn up as they enter the atmosphere are called meteors. Meteors that last long enough to hit the ground are called meteorites.

Scientists believe that 16 million years ago, a meteorite hit the planet Mars. The force of the impact threw large chunks of the planet into space, where they drifted around for a while as asteroids. About 13,000 years ago, one of these chunks fell to Earth, landing in Antarctica. Researchers found this meteorite in 1984 and named it ALH84001.

So what, you say. Scientists found a space rock from Mars. Big deal.

In 1996, it did become a really big deal. While examining the rock, researchers from the Johnson Space Center discovered microscopic formations that looked a lot like fossilized bacteria looks in rocks on Earth. The researchers theorized that this was exactly what they'd found, fossilized bacteria that had ridden an asteroid to Antarctica.

The researchers aren't sure they're right, but if they are, this would mean that life once existed on Mars. And if life could exist on Mars, then that would mean life isn't confined to Earth. Life could exist anywhere in the universe. And if life could exist, it could grow, evolve, and develop a civilization.

Evidence suggests that Mars isn't alone in the solar system. In 1995, a United States space probe called Galileo started exploring the planet Jupiter and its moons. Scans of the magnetic fields produced by three of the larger moons, Europa, Callisto, and Ganymede, suggest that beneath a thick layer of ice, the moons might hold oceans of water.

What does this mean? As you've learned, life needs three things to exist: water, energy, and air. If water exists someplace, the other two elements are easy to come by. For instance, water contains oxygen. The energy could come from heat produced by undersea volcanos. Jupiter's moon Io has huge volcanos as a result of the gravitational forces of Jupiter pushing and pulling the moon's surface. If Io has volcanos, the other moons probably do, too, only buried under ice.

While any life that did exist on the moons of Jupiter would be primitive — probably nothing more than a few bacteria — it would still be a significant find. This would mean that life is much more common than we'd ever imagined, that it could exist anywhere, and that some alien civilization trillions of miles away might be examining bacteria on some of its own moons.

ALH84001 – the Martian meteorite

Asteroid – a rock or piece of debris orbiting the sun, ranging in size from microscopic to miles across.

Meteor – an asteroid that burns up as it falls into a planet's atmosphere

Meteorite – an asteroid that survives a fall into a planet's atmosphere and hits the ground.

More than 100,000 large asteroids orbit the sun. Smaller asteroids number in the millions!

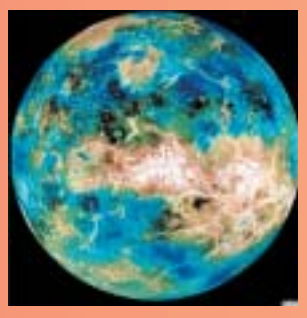
THE PLANETS

Mercury

Diameter: 3,030 miles
Length of Day: 58.65 Earth days
Average Distance from Sun: 35.9 million miles
Surface Gravity: 0.38 x Earth
Temperature: -300° F to 800° F
Minimum Distance from Earth: 28 million miles
Satellites: 0
Fun Fact: The closest planet to the sun is actually one of the coldest, at night at least. Mercury has no atmosphere to hold in heat, so all the heat escapes into space during the long night.

Earth

Diameter: 7,926 miles
Length of Day: 24 hours
Length of year: 365.25 days
Average Distance from Sun: 92 million miles
Temperature: -128° F to 136° F
Satellites: 1 (Moon)
Fun Fact: Home to the human race and all known life in the universe. The only world where water is known to exist in liquid state.



Venus

Diameter: 7,545 miles
Length of Day: 243 Earth days
Length of year: 225 Earth days
Average Distance from Sun: 67 million miles
Surface Gravity: 0.90 x Earth
Temperature: 900° F average
Minimum Distance from Earth: 25 million miles
Satellites: 0
Fun Fact: Venus is the hottest planet in the solar system due to a thick atmosphere composed of greenhouse gases like carbon dioxide. Heat energy from the sun that enters the atmosphere does not leave.

Mars

Diameter: 4,217 miles
Length of Day: 24 hours
Length of year: 687 Earth days
Average Distance from Sun: 227 million miles
Temperature: -116° F to 32° F
Satellites: 2
Fun Fact: Mars is called the red planet, because of the iron-rich red sands that cover the surface. Scientists theorize that frozen water may exist beneath these sands as permafrost.

THE PLANETS

Jupiter

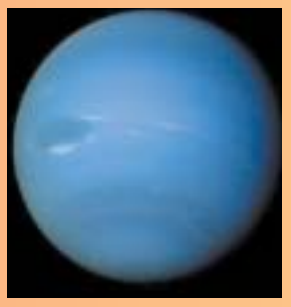
Diameter: 88,736 miles
Length of Day: 9 hours 55 minutes
Length of year: 12 Earth years
Average Distance from Sun: 483 million miles
Temperature at Cloud Tops: -101° F
Satellites: 16 known
Fun Fact: Jupiter is the largest planet in the solar system, almost massive enough to become a star. Giant storms dominate the surface. One of these storms, the Great Red Spot, has existed for at least 300 years.

Saturn

Diameter: 74,500 miles
Length of Day: 10 hours 14 minutes
Length of year: 29.5 Earth years
Average Distance from Sun: 889 million miles
Temperature at Cloud Tops: -274° F
Satellites: 18 known
Fun Fact: Saturn is best known for its huge rings, which spread across thousands of miles. These rings are composed of tiny particles of dust and ice which orbit the planet due to gravity.

Uranus

Diameter: 32,000 miles
Length of Day: 17 hours 14 minutes
Length of year: 84 Earth years
Average Distance from Sun: 2.85 billion miles
Temperature at Cloud Tops: -328° F
Satellites: 15 known
Fun Fact: Uranus has a axial tilt of 84°— the planet is turned on its side. This gives it some of the weirdest seasons in the solar system, where temperatures can vary wildly.



Neptune

Diameter: 30,760 miles
Length of Day: 17 hours 6 minutes
Length of year: 165 Earth years
Average Distance from Sun: 4.5 billion miles
Temperature at Cloud Tops: -346° F
Satellites: 8 known
Fun Fact: Scientists believe Neptune's moon, Triton, may have geysers of water shooting into a thin, frigid atmosphere. The surface of the moon may be covered with frozen water that could sustain life.

Pluto?

Diameter: 1,430 miles
Length of Day: 6 Earth days, 9 hours
Length of year: 248 Earth years
Average Distance from Sun: 4.47 billion miles
Temperature: -380° F
Satellites: 1 known (Charon)
Fun Fact: Scientists aren't even sure whether Pluto is a planet or a ball of ice. Some consider Pluto a double planet system, as its moon, Charon, orbits very closely and is almost the same size. For 20 years of its orbit, Pluto actually passes inside the orbit of Neptune, making it the 8th planet for a while. This last took place from 1979 to 1999, and will happen again starting in the year 2227.

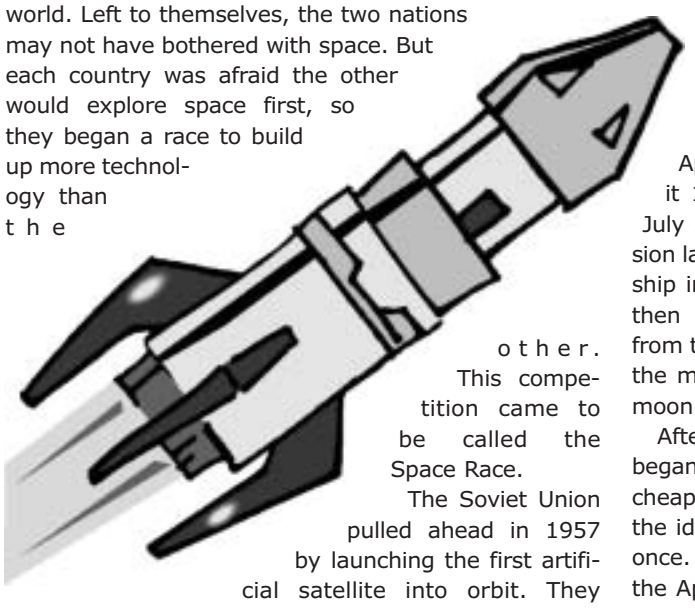
WHEN humans TURN ALIEN

People looked at the stars and dreamed of space for thousands of years. The true age of human exploration of space, however, began only sixty years ago, with the development of rockets.

Rockets are long, slender objects pushed into the sky by the explosive release of gas from their undersides. The first known rockets were developed by the Chinese thousands of years ago. In modern times, Germany and the United States began developing larger rockets during World War II as a way of delivering bombs.

Simply having rockets was not enough to interest people in exploring space. They needed a reason. That reason was the Cold War.

After World War II, the United States and the Soviet Union grew to be the most powerful nations in the world. Left to themselves, the two nations may not have bothered with space. But each country was afraid the other would explore space first, so they began a race to build up more technology than the other. This competition came to be called the Space Race.



The Soviet Union pulled ahead in 1957 by launching the first artificial satellite into orbit. They called it Sputnik. Sputnik was little more than a hollow metal ball a little over a foot in diameter with a radio transmitter inside, but it challenged the people living in the United States. They pushed for a more ambitious space program. Technology progressed rapidly.

In January, 1958, the Soviets launched Luna 1, the first space probe to fly past the moon. The United States followed a few months later with Pioneer 4. The space race took a new turn in 1961, when the Soviets sent the first human into an Earth orbit, a "cosmonaut" named Yuri Gagarin. The United States sent astronaut Alan Shepard into a brief, suborbital flight in 1961, but didn't send an astronaut into orbit until 1962, when John Glenn took his first trip into space.

On May 25, 1961, U.S. President John F. Kennedy gave a speech before Congress in which he proposed the improbable, that by the end of the 1960s, the United States would send people to the moon. The next 10 years were devoted to achieving that goal, developing what came to be called the Apollo program.

In December, 1968, three astronauts on the Apollo 8 mission travelled to the moon and orbited it 10 times before returning home safely. And on July 20, 1969, two astronauts on the Apollo 11 mission landed on the moon's surface. They left the spaceship in space suits, collected rocks and soil for study, then returned to Earth three days later. Astronauts from the United States made five more trips to land on the moon. No other nation has sent a mission to the moon.

After the Apollo missions ended, space programs began focusing on ways to make space exploration cheaper. The U.S. space program then came up with the idea of a spaceship that could be used more than once. Up to that point, spaceships like those used in the Apollo missions could only make a single trip into space. In the late '70s, the program developed the space shuttle, a spaceship launched into space by two rockets attached to its underside. The shuttle would then glide back to Earth and land like an airplane. The first space shuttle, *Columbia*, was launched in 1981. Columbia is still in service, as are its companion shuttles, *Discovery, Atlantis, and Endeavour.* Another United States shuttle, *Challenger*, was destroyed in an explosion during launch in January, 1986, killing all seven astronauts on board.

The Soviets also developed a space shuttle, called *Buran*, which they never used. Economic troubles in the Soviet Union caused them to abandon much of their space program. Much like its space program, the Soviet Union collapsed in 1991, splintering into a collection of 15 separate, independent nations.

The Soviets did make one final achievement in space, however, with the launch of Mir, the most durable space station ever to have flown. Launched in 1986, Mir stayed in orbit 15 years, and was constantly occupied 14 of those years. While the station suffered a number of technical glitches, including a collision with an unmanned supply ship, Mir served as a perfect platform for scientists to conduct years of scientific studies in space. The station was abandoned in 2000, and crashed to Earth in a controlled descent in 2001.

Today, the most powerful nation of the former Soviet Union, Russia, continues its space exploration. Instead of racing against the United States, the two nations work together, along with the European Union, Japan, and Canada, to operate a new space station. When completed, this station will be the largest human-made object ever launched into space. Meanwhile, probes continue to go to planets and explore the solar system, and some people talk of a possible human mission to Mars.

When it comes to outer space, history is only the beginning. Perhaps someday, humans will be the aliens, walking the surface of a distant world far, far away.

Left, a space shuttle lifts off into space, with the help of two rocket boosters that detach once the shuttle reaches orbit. The dark object between the boosters is a tank to carry extra fuel. The tank also detaches.

Right, Russia's Mir space station drifts in orbit. Launched in 1986, Mir is the longest-lasting space station ever launched. The cost of operating the station eventually proved too expensive, and Russia abandoned the station in the year 2000. Mir fell to the Pacific Ocean in March, 2001.