



DESTINATION COSMOS

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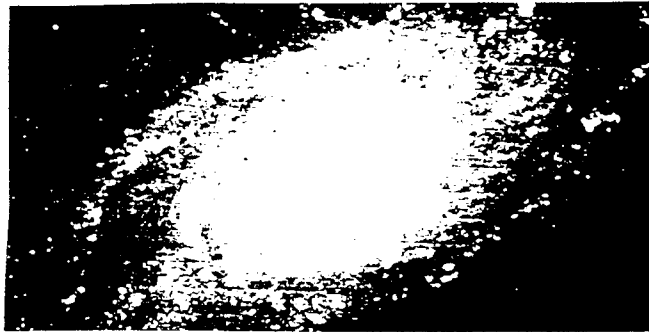


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DESTINATION COSMOS 20

This exciting 20 part astronomical series is a ticket to an amazing realm of time and space, with wall to wall graphics and interplanetary music. From impenetrable black holes to fiery inextinguishable giant stars we zoom to stars with planet worlds like our own, where gravity bends space into a black void; to planets like the secret red realm of Mars with possible traces of an ancient alien life, or our own earth, so often struck by massive fireballs from space (will the next one devastate our fragile planet?); or to the ever-expanding far edges of the universe in an unending quest for knowledge. 10min. each.

ALIENS!

Far out in space, sharing the view on board an alien spaceship. How would aliens find us here on Earth? Searching for other planetary systems, graphics reveal where alien life may lurk elsewhere.

Man seeks to find if other life forms exist on other planets; at this time we have received no clear signals from any alien civilization. The celebrated "face" on Mars turned out to have been a photographic illusion; radio telescopic search has found strange signals, but none definitely intentional; no chemical related to life on earth (e.g. a source of DNA) has been found in extraterrestrial surfaces so far explored. It is believed that billions of years ago comets may have brought to the earth water contaminated with the chemical elements required for life as we know it; similar conditions may have once existed for example on Mars. Water played a great role in our evolution; the origins of the oceans are a mystery, but it seems possible that there may have been Martian oceans perhaps 4 billion years ago. If that were the case, the elements of life—water, heat, and chemicals—may have been present. Microscopic life forms here on earth resemble possibly fossilized forms brought from Mars. Jupiter's moon Europa may hide an ocean beneath its surface. It is also possible that alien life forms might be so different from our own that we might not recognize them; if a planet has a low gravity the life-forms might resemble giant insects; if it is high there might be short, fat animals. Gravity and time scales might be so altered as also to be unrecognizable. It does appear definite that if there is alien life it would be on planets, not stars.

COSMIC RUBBLE

Hitching a ride on the tail of a comet, this is an encounter with the real-life space invaders which regularly cross our skies. Is it possible that comets once brought life to Earth from other worlds?

In 1997 a strange light shone in the earth's sky—Halley-Bopp appeared to more people than any other comet in our history. Even a small comet could uproot all life on earth. Most of a comet's life is lonely and cold, rarely venturing a little closer into a solar system's grip. Initially they sport no tail, but develop one as gravity distorts their progress through a system and pushes them in erratic movements. Comets come in all directions and at random; some hit the sun; some are sent in looping orbits that may take even thousands of years for their return; and some are captured to become a planet's moons. Astronomers believe that comets come from the large collection called the Alt

Cloud, a giant sphere of rubble. Apparently they froze to become the hearts of future comets. Halley's returns every 76 years, last appearing here in 1986; the space explorer "Giotto" was sent out to obtain close-ups of it. The explorer "Champillion" will attempt to actually land on a comet, while "Stardust" will attempt to obtain actual samples of materials in the tail of a comet. As the comets make the transit towards our sun, they initially are very small and indistinguishable, but near Mars the sun's rays melt the ice into gas, which spreads and gradually becomes a comet's halo; the dust forms yellow streaks, the vapor becomes a blue streak. Winds of charged particles emerge from the sun, blowing the tail to great and, wildly fluctuating lengths.

ONE SMALL STEP

In our children's lifetimes, space flight may become as common as catching a plane. What will it be like on board a spacecraft of the future, traveling to distant worlds?

In Kazakhstan Soviet-era rocket launchers assist with the ongoing Soyuz spacecraft program that included the MIR space station. Serviced by robots, the various versions of Soyuz spacecraft are still quite usable. The Soviets began in secrecy a huge undertaking which produced the October 4, 1957 orbit of the earth by Sputnik, Yuri Gagarin's historic 1961 flight, flights by 2 at a time, and the first space walk by Alexis Leonov. The goal was to place a man on the moon; as the American Apollo 11 approached the moon a Soviet robot landing attempt failed. The Americans built the giant Skylab but the program was not developed, and 1974 was the last time man walked on the moon. Despite the Challenger disaster the shuttle program continued, sometimes in conjunction with post-USSR Russia; the X-33 now in preparation is large enough to carry building blocks into space.

ROBOT RANGERS

To the limits of knowledge with the most incredible machines ever built. Graphics and animation bring to life the potential for robot missions to explore worlds where no human could survive.

Spacecraft are the robot rangers and mechanized explorers, both large and small, which reach out and touch other worlds on our behalf. They reveal the solar winds of Venus, their cameras transmit pictures of unprecedented accuracy and magnification, their robot arms retrieve and mini-laboratories analyze the contents of surface samples of these alien realms. Robot technology leads the way, preparing the ground for eventual actual human explorers. The July 4, 1997 Pathfinder landing on Mars for example collected samples of the Martian surface and returned them to the earth. The satellite robots are also used to explore comets, those giant collections of dirty snowballs and ice rubble that dart through space. The technology involved is incredible; the Galileo mission to Jupiter, for example, required its computers to be reprogrammed while in flight. Others ventured through bands of deadly radiation and clouds of ammonia to take photographs of Jupiter's moons; a Saturn probe will aim for Titan despite the nitrogenous atmosphere-the gases are so thick that they will engender a softer landing for the probe. Radio signals from some probes will be coming so far that it may take hours for them to arrive on earth.

ROCKY MIDGETS

Our solar system formed three other rocky worlds like earth – yet they're nothing like our home. A tour through them reveals how our solar system formed and visions of the future for planet Earth.

About 7 billion years ago huge stars exploded in one of the spiral arms of the Milky Way, seeding space with vast amounts of debris and leaving behind a cloud of dust, gas, and minerals that comprised the ancestors of our solar system, which, recycled and ingathered by gravity, became our planet and our bodies—we are the stuff of stars! It may be that a supernova exploded and the influence of gravity and temperature was such that our sun was formed; that when the sun shone it condensed some of the surrounding material into the 9 planets and assorted moons of our solar system. After Pluto and Uranus are the gas giants Jupiter, Neptune, and Saturn (with its rocky midget rings); Mercury with its runaway greenhouse effect; Venus, revolving backwards towards all the others; our earth and its dead moon with its 2000 mile diameter and a quarter of a million miles away from us; Mars, the red planet facing that giant nuclear furnace, the sun.

STARDUST

Our sky is strewn with glittering jewels. Where did the stars come from? Zooming out to a place where stars are forming, we find human life is only possible because we're made from the dust of dying stars.

A galaxy is a veritable star city comprised of billions of stars and dust where stars die and are reborn as new celestial lights; our own star was born like that. Astronomers look out into space for a look at our past and vision of our future, piecing together bits of information. Some stars are time bombs set ultimately to explode, such as the massive superstars, set to become supernovae. Ours will not explode but will become a hot star, a "white dwarf". The Milky Way galaxy to which we belong holds 100,000 to 200,000 million stars. Stars like ours are rather common, though ours is somewhat larger than many others. Currently it is about 1 million miles in diameter, but will ultimately swell to 60 million miles, a red giant. Many stars do not exist alone but in pairs, for example with small blue stars waltzing around red giants. Our nearest neighbor, however, is Alpha Centauri which consists of 3 stars—2 the same as our own and one a red, of the 3 the one closest to us. Some star groups are so close to one another that gravity causes them to become distorted into egg shapes and to pass materials between them; when a white dwarf steals from an older giant there can be explosions which create "supernovae."

From the earth we can see great bands of starlight. Many astronomers today don't work from night pictures of the sky and its stars, but rather from starlight of individual objects, in which the light, temperature, composition and even magnetic fields can be determined. Many stars are formed from the remains of other stars, as was perhaps our own. Some stars explode into supernovae, which are the only source for new iron. Some exploded stars leave pulsars, rotating neutron stars the size of a family automobile which radiate radio waves; others become black holes, which suck matter into oblivion.

TARGET: EARTH

Our world seems a peaceful place. But science reveals that it's often been hit by massive fireballs from space. Could one of them have wiped out the dinosaurs? Could the next one wipe out humanity?

Our earth may seem to be peaceful as it floats in space, but it has always been the target of ice, stone, rock, and metals hurtling through space; the near misses are far more common than we might care to think. A half-mile wide asteroid could destroy a continent, with less than a week's warning. Asteroids crashed into Quebec 200 million years ago, into Utah 100,000 million years ago, into Mexico 65 million years ago—perhaps the one that destroyed the world of the dinosaurs--, into Australia 200,000 years ago, into Siberia in 1908. The earth constantly moves through the tails of comets, creating meteor showers; 3 times a century we face a meteor storm with 100,000 shooting stars hurtling at us in a single hour! An asteroid or meteor that penetrates our atmosphere to the surface of the earth itself is called a meteorite. Scientists have found samples, some worth thousands of dollars, of rocks from other sites, such as the moon or even Mars. They have crashed through space, often encountering other space travelers. The largest gathering of these alien materials is in the zone between Mars and Jupiter, creating an "Asteroid Belt" with millions of asteroids. Though the first asteroids were discovered only about 100 years ago, the first ones still in space were seen in 1982 by the "Galileo"; one, "Ida," even has its own tiny moon. Asteroids could be partially deflected by nuclear missiles, but a better solution is probably to utilize "landers" to make near-misses of them. Eros will pass uncomfortably close to the earth in the 6000; some may be eventually mined for raw materials such as nickel, or even employed as space stations.

TELESCOPE TRAIL

From planet earth to the dawn of time ... a voyage through the eyes of the Hubble Space Telescope. It's a trip that spans more than space – crossing unimaginable time to the very start of the universe.

Far off in space the telescope locates a dying star; such is the nature of the universe, with its elements perpetually dying and being born. The 1989 Hubble telescope—borne aloft in the biggest payload a shuttle has ever carried—casts a candle across the mystery of the genesis of our universe. Astronomers have of course long tried to site telescopes where there are as few obstructions to clear sight as possible, but always there is the possibility of the atmosphere blurring vision. But the Hubble floats in space itself, where a vast mirror collects light; the light is bounced off a focused second mirror and shared between four others which concentrate respectively on infrared, close-ups, the very faint, and wide-angle images. The mirror was designed to be the most nearly perfect ever made, but once it was actually in orbit it was realized that it was blurring all shots. Computer processing helped sharpen the views—the Orion nebula, jets of gas, and most of Saturn, but ultimately the "Co-star" project was launched to correct its deficiencies. Now the Hubble revealed a spiral galaxy and its nursery; an explosion which occurred in 1054 in the Crab nebula left a radio pulsar marking its spot, and still sends waves of material into space; previously unseen details of Mars; and the weather patterns of Venus. Even now the Hubble helps paint a clearer picture of the universe's beginning and end.

TO INFINITY AND BEYOND

A journey through time to the future and the farthest reaches of space. How many galaxies are there out there? And what will be their fate? Graphics reveal the destiny of the universe could be a 'Big Crunch'.

Through telescopes the motion of planets can cause stars to apparently wobble! Stars emanate the light that planets reflect. Astronomers help map our place in the universe; it was by observation of Mars that the solar center of our system was confirmed. It takes 200 million years for our sun to orbit the galaxy. The galaxies move away from one another as the universe expands and space stretches; the expanses are so vast that we measure distances in light years moonlight takes 2.5 seconds to reach us, sunlight 8 minutes; it requires 4.5 hours for light to travel the breadth of the solar system, 100,000 years to cross the Milky Way, and an incredible 2.5 million years for light from the Andromeda galaxy to reach us. The color of these lights act as fingerprints. Most of the earliest stars and galaxies exploded; quasars are the remnants of stars, and in black holes gravity so contracts light that it cannot escape. There is nothing permanent or static about the universe.

MAGICAL MERCURY TOUR

Mercury is too close to the sun for most telescopes to see it, yet space probes show its surface is hot enough to fry a human body like bacon. Next door is weird Venus, where a day is longer than a year.

Named for the winged messenger of the classical gods, this planet has told us very little about itself. Located between the sun and our earth, it is the hottest location in our solar system outside of the sun itself—in fact, its surface is hot enough to melt lead! The smallest of the planets, it can rarely be seen because of its closeness to the sun. In 1974 Mariner 10, the first spacecraft to use the gravity of one planet to reach another, set out for Venus and Mercury, circling the latter twice and giving us the first actual images of this baked, barren world. Inasmuch as there is no lure for us to explore Mercury a manned flight is most improbable; for the time being the images sent by a long dead robot will remain our primary source. Radar and radio waves have established the great mystery of that planet—the hottest spot in the solar system has polar ice caps!

Except for the moon, Venus is the brightest object in our night sky, but telescope views of it are very disappointing, revealing only a yellowish landscape normally veiled in clouds. A Russian craft actually landed on its surface, sending back pictures. The space probe "Magellan" has also scanned it with radio waves, stitching together a picture of the whole planet. Venus spins backwards on its axis, probably the result of some ancient impact; its day, therefore, is longer than an earth year. Volcanoes on it indicate that even after 400 million years the planet is still in a state of some flux. It also has its equivalent of a "Grand Canyon" and a "Great Plain;" scientists speculate about what these features really mean.

EARTH ENCOUNTER

Zooming away from our everyday world, we return with alien eyes. Human beings think they're in control yet our sensors show Earth is at the mercy of mighty

forces which will always dwarf mankind.

Our planet—viewed through alien eyes! As we watch from space the sun grazes Antarctica, a pawn in the never-ending struggle between ice, land, and sea, while bacteria happily feed among the ruins of the ice ages. The earth's axis is tilted, influencing climate, seasons, and weather. The human impact is still not really known, but spots on the sun seem to render weather more chaotic than usual, and satellites in space reveal an ever-growing hole in the ozone layer over Antarctica. Volcanoes sprout through earth as the molten subsurface of our island home thrashes beneath the ever-moving tectonic plates. Millions of years ago the earth's landmasses formed one giant super continent, Panagaea, which eventually began to spread in various directions, and even today the continents move at about the same speed as our fingernails grow.

FLY ME TO THE MOON

The moon seems familiar, yet less than twenty humans have ever visited it. What would it be like to live on its surface and when will we all be able to take holidays to the moon?

Today the moon may seem to lie peacefully, but its dust was torn from Mother Earth. After gravity gathered it together some 32 to 4 million years ago it was bombarded by space missiles; the resulting craters (some as wide as 1000 miles) we have named as various "seas," though the moon was never anything but dry and barren. The moon remains for man a source of myths and magic, of dreams come true; there is extant of 30,000 year-old carving of the phases of the moon on a bone. Through travel to the moon still seems exotic, serious plans are underway to build permanent stations on the moon both for service and for leisure, for lunar hotels and staging ports to the stars. The moon is the source for our calendar's division into months, though it always presents the same side to the earth.

HOME OF THE BRAVE

What would it be like to live on Mars? Could we re-form its surface to make it more like Earth? Hitching a ride on board the Pathfinder probe, this film reveals the real progress being made towards that dream.

This segment speculates on the return of explorers from Mars perhaps 5-6,000 years in the future. The gargantuan endeavor would involve at least a 9 months, journey and entail transporting almost everything needed for several months. Finding water would be a major concern. Everything would be largely done by robots because there would be no atmosphere; in fact the first colonists might even have to make their own plant to provide fuel for any trip home. Because of the isolation and distance the largest challenge may eventually entire families and cities could live there and even an earth-like atmosphere be artificially maintained. Mars has some of the deepest canyons and the highest mountains known; Olympus Mons is the largest volcano in the solar system, measuring nearly 600 miles across.

ON MARS

For centuries, the red planet has fascinated people on earth. Now, computer graphics can take us there, revealing the secrets of a world where traces of ancient alien life may yet be confirmed.

Mars is about one-half the size of earth. The 1976 Viking spacecraft probe brought back soil samples suggesting that a life below Mars' surface was possible. Meteorites from Mars found on earth may contain samples of fossilized bacteria and /or materials from geysers. Mars must have once been much like earth. The July 4, 1997 landing employed robot explorers to investigate the surface dust and rocks that apparently came from a flood in the far distant past; Mars appears to have had polar ice caps of frozen water. Since it now appears to be largely cold dry desert it is postulated that any water remaining might be frozen underneath the surface.

REALM OF THE GIANTS

Beyond Mars lie worlds nothing like our own. What made the rings, intense radiation and strange magnetic fields around the giant gassy planets?

All of the outer planets are surrounded by rings, some of which seem much older, the product of moons and planets that shattered against each other—a reminder that each has a violent history. Jupiter is about 1300 times the size of the earth, with a diameter of 90,000 miles; Saturn is nearly as large, with diameter of 70,000 miles; while Uranus and Neptune weigh in at 30,000 miles each, and Pluto extends only 2,000 miles across. Site of never-ending storms, Jupiter has a giant storm, a “red spot,” observed from earth for over 400 years; composed primarily of gas, Jupiter may possess a rocky core. Saturn possesses 24 or more moons (including the largest, Titan, covered in ethane and methane white “snow”); were it possible to stand on Saturn, one would see blue skies and magnificent sunset—as well as rings of brilliant white ice. Neptune is blue colored and comprised of hydrogen and helium. Its rings (pale in comparison with Saturn) are held in place by gravity; one of its moons, Triton, is very large and the scene of vast geysers. The sun-blackened ice rings of Uranus appear to be much older than those of Saturn; indeed the planet itself is perhaps “secondhand,” reformed after some cosmic collision and tilted on its axis the wrong way. Nearby is its moon Miranda, filled with mountains, craters, and volcanoes.

JOURNEY TO JUPITER

Circling Jupiter, the Solar System's biggest planet, sensors reveal deadly radiation. But secure in virtual reality, we plunge down through Jupiter's giant red spot, deep into a hostile, gassy world.

Four hundred million miles from earth lies the giant ball of gas called Jupiter, 1300 times larger than our planet and a seven year trip away. In December 1995 the probe “Galileo” arrived in that area, but with a damaged mechanism. Its predecessors, Voyager I and Voyager II, had sent back many black and white stills of the largest planet, which is 300 times the mass of the earth and completes a revolution every 10 hours. The Voyager pictures revealed the 4 large moons of Jupiter—Io, Europa, Callisto, and Ganymede. Ganymede is a giant ball of ice, weathered by the ages; Io is scarred by

sulphur like a giant pizza; Callisto is a craters wreck of a world, while Europa has an ice-covered surface—but on none of these was there any sign of alien life. In 1992 astronomers watched in fascination as a comet whirled towards Jupiter; 2 full years later it crashed into the whirling giant in 26 pieces; the swirling clouds of Jupiter soon absorbed all the damage engendered by the comet fragments. The Hubble telescope photographed the various scars; future missions will have to record the evolutions of Jupiter.

RING WORLD RETURN

From Earth to Saturn's amazing skies. Besides its rings, among 22 moons this planet hides an extraordinary secret world. Titan is almost a second Earth in deep freeze. Could it ever spring to life?

Saturn's view of the sky is like nothing ever seen on the earth, with a silver rainbow and sunlight going from sunlight to sunlight. Saturn is not the only ringed world, but its rungs are the best known. Only 39 inches thick, the ring extends for more than 300,000 kilometers, making Saturn truly the "Lord of the Rings." "Voyager" in the 1980's revealed that there are thousands of rings, most of which are only a few million years old. Saturn has 26 moons, of which Titan (the largest and surrounded by clouds) resembles early earth. The planet requires 30 years for its orbit around the sun; it is so distant from the earth that radio signals would require 5 hours before it messages were received here. Like Jupiter it is largely gas, though it may have a solid core; like the earth it is tilted on its axis—our "Saturday" derives from its name. It is surrounded with great clouds and storms of ammonia. Neptune's rings are older and darker, some quite coal black. Even Jupiter has rings of dust.

MYSTERIOUS MOONS

Our planet is unusual in only having one moon-, Saturn has more than twenty. These strange worlds are little known, yet humans may visit them sooner than their parent planets.

Mars has two moons, which may be captured asteroids. Jupiter has at least 20, of which 4 are large enough that Galileo saw them with his early telescope sometime around 1610. One of these, Io, during eclipses shows its volcanoes—in fact, it's the most volcanically active body in the whole solar system. Apparently its core is comprised of sulfurous lava and molten rock. Another, Europa, could harbor alien live; its surface seems to be comprised of salty ice, and may mask even a warm-water ocean; perhaps someday space submarines will explore it and discover another life form. Saturn has at least 25 moons 'some of which are ice sculpted into mountains and plains. One, Titan, appears to be orange and black with a nitrogenous atmosphere. The Hubble telescope revealed it to be a cold location almost like an early earth frozen in time. In the year 2004 the "Huygen" craft is scheduled to drop a lander on Titan to determine if it could hold the chemical seeds of life. Another of Saturn's moons is almost like the "death star" of Star Wars; it is still reeling from some long-ago impact which left a scar a third the size of the entire moon. Saturn's rings are still young and therefore bright; but those of Neptune's moon Triton has long black stains and giant geysers that spew forth gas and

dust as revealed by "Voyager" in 1989. Even Pluto has a moon, Charon. Throughout the solar system the moons vary—some are in turmoil. some could harbor alien life; some asteroids even have moons; but in all the solar system gravity calls the tune.

EDGE OF DARKNESS

Past Saturn lie Uranus and Neptune with moons like Triton, its geysers spurting eight miles high. But the milestone at the end of our solar system is Pluto—one day a possible staging post on the path to outer space.

The sun is surrounded by a band of rocky inner worlds—Mercury, Venus, Earth, Mars; further out are the gas giants Jupiter, Saturn, Neptune, Uranus; and finally, there is tiny Pluto with its satellite Charon; from it the sun is a mere pinpoint of light! Neptune, Uranus, and Pluto were actually only discovered fairly recently; the Hubble telescope casts new eyes on the distant threesome. In 1986 Voyager sent the first images of Uranus. It has 5 moons, great balls of ice-like rock such as Miranda. Miranda may have once been very different; its surface of chunky ice is so varied that it seems to incorporate elements of Mars, mercury, and our own moon. In 1989 Voyager observed Neptune, that gargantuan ball of gas with 2 vast unending storms and a black spot. Clouds of helium, methane, and ammonia surround it; its moon, Triton, is bigger than our own and boasts giant geysers, some up to 8 miles wide. Pluto's moon Charon is probably like Triton, though it is possible it may also briefly have an atmosphere.

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