Official Guide to the Edge of the Universe

HUBBLE™

NASA

A HYPER-QUEST™, INC.
PRODUCTION

in association with
Ringling Multimedia Corporation

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Installation Instructions

Please see jewel case insert card.

The Universe Awaits You...

Hyper-Quest's ASTRONOMICA contains three specially-designed modules:

— **The Quest** (many of the puzzles can be played over and over with different challenges each time.)

— A detailed **Astronomical Reference module** (this can be accessed from within the Quest game at any time.)

— An **Amazing Facts** trivia game to test your speed and knowledge (this section can only be accessed from the main menu.)

The Quest begins...

ASTRONOMICA begins when your friend Sara, wakes you in the middle of the night to lead you on a journey that will take you to the edge of the universe.

You and Sara must break into the mammoth SkyQuest complex to find her missing father, Dr. Mayer, an eccentric astronomer who disappeared while working on his life-long passion, Astronomica. This top-secret supercomputer may eventually reveal the fate of the universe ...for better or worse.

Once inside, Sara discovers that something is terribly wrong. The powerful computer system is out of control. Her father may be trapped and in grave danger. Working against time and a menacing night watchman, you must help Sara reboot the system.

Astronomica's master switch has been thrown...things are out of control and headed for sure disaster...only YOU can help. Only YOU can unlock the fate of the universe.

Your Mission...

Make your way through the Exploratorium and reset each of the challenging exhibits. Then rejoin Sara and rescue her father to discover the fate of the universe...

Inside the Exploratorium...

Sara sends you to the first exhibit in the foyer called "Where in the Universe?" You must reset this before you can enter the Exploratorium. Don't worry if it takes a few tries...you'll figure it out. Once inside, work through the exhibit rooms one by one. Each exhibit contains two puzzles, which you must solve before you can move on to the next room. In the Planetarium, you'll find eight "arcade puzzles." You can play these in any order you choose. But you must solve all the puzzles in the Exploratorium before you can rejoin Sara for further instructions.

Watch for surprises—you may think you know it all, but some clues may be hidden...and dangerous.

Need help?

If you need help with the exhibits, you can select the "?" button on the puzzle control panel.

- Call on one of your mentors for hints.
  - 15th-century Italian astronomer, Galileo Galilei
  - Nobel prize-winning physicist, Albert Einstein
  - SkyQuest's space telescope director, Elaine Overton
  - Two super-smart, super-cool university Grad Students, Beverly Dawson and Miguel Santiago.
- Or select the reference book icon to look up definitions and information.
- You can select the "i" button to replay the audio instructions.

Don't Get Caught!

Look out for the Night Watchman — if he catches you, it's game over! (Don't be discouraged. Just jump right back in the game.) You can distract him if you know how... look for clues throughout the game. And be sure to check the wall monitors before you leave each exhibit room.

Getting Around...

- Sara will pop in from time to time, but mostly, you're on your own.
- Use your mouse to point in the direction you want to go, click and you're there.
- Clickable items are highlighted in flourescent green. If you get lost, check the SkyQuest Complex Floor Plan on pages 20-21.
- Be adventurous! This is a quest — explore everything!
- Many puzzles contain elements which appear differently each time you play. It's like a new game every time!

Amazing Facts

After you've finished **The Quest**, play this astronomical trivia game to test your knowledge. Win or lose, it's there just for fun! (It can only be selected from the main menu.)

Attention Questoids :

If you really want to play this game well, take a few minutes to read through this booklet. You'll find overviews and useful hints for each puzzle and the real scoop on Dr. Mayer and **Astronomica!** And you may end up knowing more about astronomy than your teachers!

The real power of science is its success.

—George Abell, ***Exploration of the Universe***

(Harcourt Brace, 1993)

THE PLAYERS

Dr. Mayer

Sara

Sal

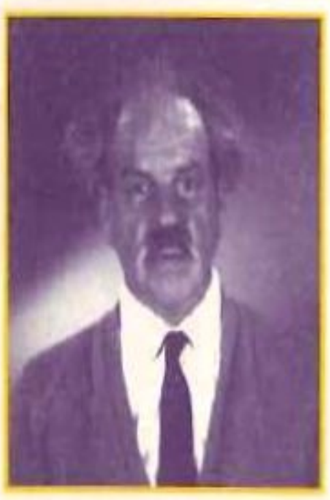
• ***Dr. Mayer:*** Dr. John Mayer is a brilliant astronomer and a visionary. His passion for the wonders of our universe has led him to create the supercomputer, Astronomica. He has been working at SkyQuest since 1975, routinely observing the night skies. At the same time, Dr. Mayer has secretly been compiling information which may take us into realms undreamed of by scientists in the past. Tonight, on the eve of his greatest breakthrough, his project has been shut down. Bordering on madness, he has taken matters into his own hands!

• ***Sara:*** Sara Mayer, our 15-year old heroine, is Dr. Mayer's daughter. She's smart, independent, and resourceful. She's worked at her father's lab during summer vacations and knows computers inside and out. She knows what her father has been up to... and she knows what Astronomica can do!

• ***Sal, the Night Watchman:*** Sal Salvatore has a very colorful past – which his many tattoos illustrate. He's not too bright, but he's a dangerous man with a gun! He takes his job and his uniform seriously – and he doesn't like intruders! As you'll find out, "short-attention-span Sal" is easily distracted. So use whatever means you can during the game to keep him off your back!

THE MENTORS

Galileo Galilei



Albert Einstein

• ***Galileo Galilei: (1564-1642)*** Italian astronomer and physicist, Galileo, was the first to use a telescope to study the stars in 1610. He was an

outspoken supporter of Copernicus' theory that the sun, not the Earth, forms the center of the solar system. He dared to argue with authority, which eventually led to his imprisonment by the 1633 Inquisition. Ask Galileo for help on questions about the stars. But don't be confused by some of his answers – he was quite a practical joker!

• ***Albert Einstein: (1879-1955)*** This German-born physicist is best-known for his astronomical IQ and his theory of relativity, which completely changed the way we look at space and time. He was indeed a genius, whose love of mankind and curiosity about the universe led him to many great discoveries and won him a Nobel Prize in 1921. Ask him for help with cosmology, deep space and weird science!

ADDITIONAL MENTORS

Miguel

Beverly

Elaine Overton

• ***Miguel Santiago:*** After visiting the U.S. as an exchange student from Bolivia during his senior year in high school, Miguel returned to the University of Arizona for his undergraduate degree. At 22, he's now working on a doctorate in astrophysics, and helping out Dr. Mayer at SkyQuest. Miguel's favorite pastime is mountain climbing – where he can be closer to the stars.

• ***Beverly Dawson:*** After graduating with honors from Swarthmore, Beverly worked as a research assistant for two years at the Overlook Observatory in Saugerties, NY. Now, she's working on her PhD in chaos theory. When she's not studying or working part-time at SkyQuest, she's jamming on the saxophone at clubs around town.

• ***Elaine Overton:*** Elaine is the no-nonsense telescope director of the SkyQuest Planetarium. Oxford-educated and a member of the Royal Astronomical Association in London, England, she is precise and demanding. Her love for her work is surpassed only by her devotion to her bulldog, Rex, which she brings to work with her every day. If you seek her help, be sure to listen carefully to what she says – she doesn't repeat herself!

History of SkyQuest Complex

The original observatory building was built in the 1930s. Support facilities, such as workshops for telescopes, instruments, a library and a lab for developing photographs were added later as an annex.

During subsequent years, renovations continued. A second observatory with a larger telescope was added next to the original observatory and a connecting building between the two was built to house more facilities for support and personnel.

In the seventies, a museum and exploratorium were built for the public to visit and learn about astronomy. At first, the displays were simple with a few hands-on working exhibits and display cases.

By the eighties, exhibits were updated and 3-D holographic projections were added. A military contract provided financing to build a false observatory dome to house a secret government project. This dome now contains Dr. Mayer's AstroLab, which houses the supercomputer, Astronomica. A maze of tunnels connects this dome to the rest of the complex.

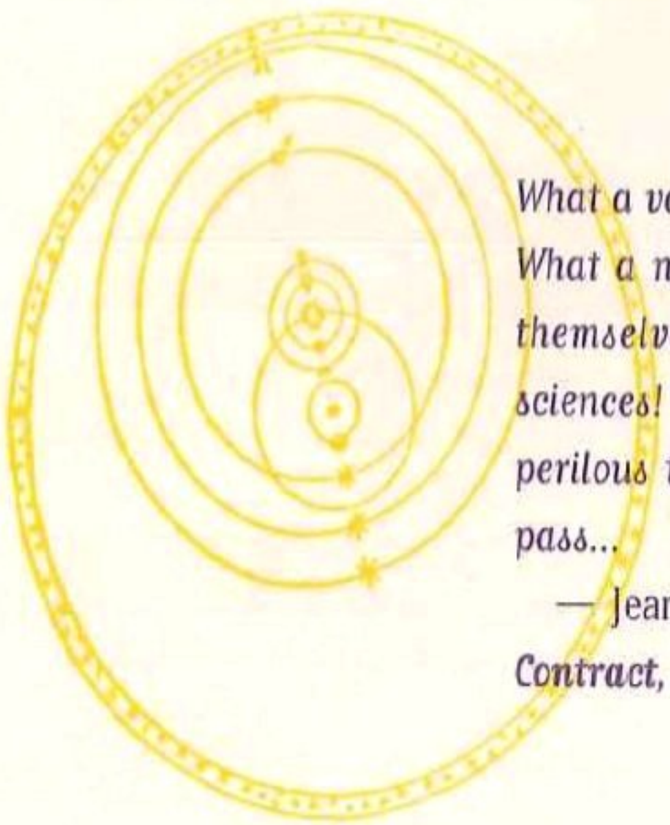
Astronomica Specs

Astronomica is a superconductivity-based, multi-processing, cryogenically-cooled computer, using the latest optical storage technology. It has 1,024 processors that are all built of ceramic superconducting materials that can only operate at several hundred degrees below zero—cooled by liquid nitrogen.

Liquid Nitrogen Storage Area

The supercomputer, Astronomica, is cryogenically cooled by liquid nitrogen. Storage tanks are kept in the tunnel. Pipes extend throughout the AstroLab area as they carry Liquid Nitrogen from the storage area to the monolithic supercomputer and vast network of servers .

If pressure builds up to critical mass, the tanks and array of pipes will explode and could destroy the SkyQuest complex.



What a variety of dangers surrounds us! What a number of wrong paths present themselves in the investigation of the sciences! Through how many errors, more perilous than truth itself...must we not pass...

— Jean Jacques Rousseau, ***The Social Contract***, 1712-1778

Dr. Mayer's Journals

DR. MAYER'S JOURNALS

The following excerpts are from Dr. Mayer's Astronomica journals, written when he was a teaching assistant, working on his doctorate at Columbia University and as the Director of the SkyQuest AstroLab.

• 1.26.75—Today, while I was watching one of my students perform a simple electrical experiment, I formed a wild impression of a powerful device designed to compute all the known data about astronomy. If such a thing were possible—some supercomputer—it could provide astronomers with answers about the final fate of the universe.

• 2.10.75 —I had a dream last night that I was alone in a darkened room. Gradually, I saw a complex, glowing control panel built into the wall in front of me. As I watched, a thousand colored lights began flashing and then a door opened. I felt a cold wind on my face and without a moment's hesitation, I walked through the doorway into the deep, unfathomable blackness of space.

• 3.13.75 —I haven't slept for 48 hours. There must be something I'm missing. The calculations seem correct, but the prototypes continue to fail.

• 5.08.75—The SkyQuest Observatory in New Mexico is interested in my project. They have asked me to take over as Director immediately.

• 6.15.76—I have finally completed a prototype...Astro Junior. Now I must convince the SkyQuest Foundation to give me the money I need to build the real thing.

• 11.16.76—Construction begins in two months. There is no doubt that my dream will be a reality. I knew that if I continued to believe in myself everything would work out.

• 8.16.77—Problems, problems, problems. More than a year since Astro Junior and construction on the new wing is bogged down. There may not be enough money to finish. Elvis, the King, died today.

• 6.12.78—A new government grant. I am a new man. The supercomputer will be built as a top-secret project in the shell of the observatory dome. Endless red tape and security clearances for everyone, but it's worth it.

• 4.01.79—It's April Fool's Day. I have decided to link together several powerful computers into one gigantic system that will feed Astronomica.

• 1.29.82—My daughter, Sara, was born at 09:45. Colette is happy and well, but angry at me for working so late. She took a cab to the hospital. Once I solve some final technical problems, we'll have another child of sorts—Astronomica.

• 3.09.83—I have been designing dozens of exhibits and displays that will make the basic principles of astronomy come alive for kids!

• 10.18.85—Superconductivity is the answer I have been searching for. If certain metals, alloys and ceramics are cooled to near zero temperatures, electricity flows through them without resistance. I am proceeding at once to redesign Astronomica to make use of superconductivity.

• 2.14.87—Valentine's Day. As a gift to Colette, I have completed a model for the first astronomical holographic exhibit. It is ahead of its time, so naturally the Board of Directors is complaining about the money I need to build it. So many men of vision are discouraged because of short-sightedness in others!

• 10.31.88 — The doctors say Colette is very ill. Sara and I are extremely worried. We both depend on her so much.

COLETTE MAYER
2.14.87

• 7.30.92—I have not written since my dear Colette's death. As a tribute to her memory, she will live on as the voice of Astronomica.

• 4.15.95—The grand opening of the Exploratorium was a success. The Board is thrilled with the publicity and has agreed to my 15 million dollar request.

• 8.29.96—I finally completed the liquid nitrogen system. With any luck, Astronomica will be operational next fall.

• 7.28.97—I am so close. Only months away from the completion of more than 20 years of work.

• 9.15.97.—I received notice today. They're shutting down Astronomica. Those fools! Do they think they can stop me now? I have just finished a videotape for Sara. I know she'll find it and understand.

SkyQuest
1 Mountain View Drive
Questa, New Mexico

September 15, 1997

Dr. John Mayer, Director
SkyQuest AstroLab
101 Observatory Way
Questa, New Mexico

Dear Dr. Mayer:

As you know, the Foundation's Board of Directors has been reviewing your recent request for additional funds for the Astronomica Project. We have finally reached a unanimous decision.

Although the Board certainly shares your enthusiasm for this exciting experiment and would like to see it completed, we do have some reservations which have affected our final vote.

First and foremost, there has been no consistent and formal accounting for the 15 million dollar grant awarded two years ago. Your barely legible notes describing complex fiber optic networks, massive computer memory banks, cooling systems and other technological advancements are not acceptable as formal reports.

You seem to have lost sight of **ASTRONOMICA's** original practical goals and have taken the project on a quest for your own personal vision.

Therefore, it is with profound regret that we must inform you that your request for additional funding has been denied. **The ASTRONOMICA PROJECT is hereby canceled, effective immediately.**

The Board certainly appreciates your considerable talent, determination and effort on this project and wishes you the very best in future endeavors.

Sincerely yours,

Kenneth D. Ingersol

Kenneth D. Ingersol, Chairman

WELCOME TO THE EXPLORATORIUM

THE EXHIBITS

WHERE IN THE UNIVERSE? *(Opening Puzzle)*

Every time you start the game, you must go through the "Where in the Universe?" exhibit. There's no time limit — you can explore the universe as much as you like. But remember, you must identify the location of all seven objects each time you play.

Overview: The universe is so enormous that all of its objects — largest to smallest — cannot be shown at once. Astronomers solve this problem by using different scales. For example, you couldn't show a galaxy on a map of the solar system because it would be too large to fit. On the other hand, if you tried to show our solar system on a map of the galaxy, it would be too small to see.

Objective: Like a game of "hide and seek," your goal is to find hidden objects in the universe. Seven objects will appear and you must pick the correct scale from 1-9 in which each can be clearly seen.

MYSTERIES OF THE PLANETS

The nine planets, whose names are familiar to everyone, are each unique worlds of wonder. This is our own neighborhood in space, the place where telescopes reveal the most detail. It is the only celestial arena close enough to allow our robot spacecraft to visit. The information they have sent back to scientists about the planets is far more than had been discovered in all the previous history of humankind!

Of the nine planets, five (Mercury, Venus, Mars, Jupiter and Saturn) have been known since prehistoric times. Early civilizations did not suspect that these planets were made of the same elements as we find here on Earth. They regarded them as gods and gave them names and meanings based on how they looked in the night sky.

Mars, for example, looking like a red ball of fire or blood in the sky, came to be associated with the god of war. Saturn, the slowest moving of the ancient planets, was imagined to be heavy and sluggish. Mercury's fast orbital speed reminded people of the swift messenger god, and they named it after him. These early beliefs contributed to words we use today — such as the "martial arts," a "saturnine disposition," and a "mercurial personality."

In reality, planets naturally divide themselves into two groups. The first four in order of distance from the sun (Mercury, Venus, Earth and Mars) are small and rocky, and have about the same general hardness or density as Earth. We call these the Inner or Terrestrial Planets. Earth is the largest of this group. Their orbits are spaced tightly together and they all take about two years or less to revolve around the sun.

A wide gap after Mars brings us to the Outer or Jovian Planets. (Jupiter,

Saturn, Uranus, Neptune and Pluto.) These are enormous and have very different compositions from the inner planets. Jovian planets are light and gaseous and composed mostly of hydrogen. They are so fluffy, in fact, that they would float or barely sink in water. In addition, Jovian planets have large, widely-separated orbits that give them long journeys around the sun, ranging from 12 to 128 years.

The "planetary puzzles" in this exhibit bring out fascinating, thought-provoking aspects of each of these unique planets, such as their appearances and why so many of them have rings. Like all of ASTRONOMICA's puzzles, they are challenging enough to be fun and they are scientifically accurate adventures in astronomy.

Puzzle # 1 - Planetary Pinball

Here, players must shoot different sized balls toward the "gravity well" of the sun. The angle and the speed of the ball must be correct, or else the planet or comet will crash into the sun, another planet, or fly off into space, never to return. The goal is to "create" an actual solar system by sending planet-sized balls flying at many miles per second toward the sun, to be captured in orbit.

Overview: The sun holds nine planets in the web of its gravity. Each planet orbits at just the right speed and distance from the sun in order to remain stable.

Objective: Imagine you're playing pinball. You must shoot the planets towards the sun, so that they are captured in the orbit that matches the real solar system. Start with the comets, the giant outer planets, and then the inner planets.

Control Panel

The Comets

Comets can come from any direction and their orbits are wild, stretched oval paths that quickly whip around the sun — that's typical for these tiny balls of ice.

Transition to Outer Planets

As we move in closer to the sun, we first encounter the realm of the gas giant planets. Shoot them into their correct orbits.

Transition to Inner Planets

Phase II completed....Now you must shoot the faster-moving inner planets into their more tightly-spaced orbits.

HINTS:

ELAINE: Try to create round orbits. Comets have wild, elliptical orbits but the planets' paths are fairly even.

BEVERLY: The inner planets always move faster than the outer planets.

MIGUEL: You'll need more speed for Mercury, Venus, Earth and Mars. They have to balance a stronger pull from the sun to keep from being dragged in. The outer planets take it slow and easy.

EINSTEIN: An important part of genius is not to give up.

GALILEO: What are you talking about? The planets are like meatballs. Throw them at the sun and let them cook.

Puzzle # 2 - Create a Ring

Here, you can adjust the size of a moon's orbit and also its composition. Your goal is to change an ordinary satellite orbiting a planet into a beautiful ring system, like Saturn's.

Overview: The same kinds of things happen as in Planetary Pinball, when moons revolve around planets, except that there is an added danger. When certain conditions are created, the moon will break up into millions of pieces to form a ring.

Objective: Earth's moon may break apart to form a ring in a few billion years. But why wait? See if you can create the conditions now that cause a moon to form a ring around its parent planet.

HINTS:

ELAINE: Half the planets have moons that have already broken up. It will happen to our own Earth moon one day.

BEVERLY: The harder they are, the less likely they are to break apart.

MIGUEL: If the moon is closer to a planet than 1 1/2 times its own radius, it will break apart.

EINSTEIN: Think! If a moon gets too close to its planet, the planet's gravity will tear it apart.

GALILEO: In my time, I thought the rings around the planets looked like handles on a cup. I can't help you here.

DEEP SPACE

Let's think about distances. Let's travel in our imaginations for a whole year at the speed of light. We choose lightspeed because it is the fastest speed possible — 186,000 miles per second! We travel for a year because this would carry us exactly one lightyear, or six trillion miles.

At this point, we would have left the familiar planets far behind and approached "deep space," the realm of the stars. An easy way to decide if an astronomical object is in deep space is to remember that if it's past our solar system of planets and is lightyears away, it's automatically in deep space. In fact, deep space makes up virtually the entire universe.

Clouds of gas and dust (nebulas) are found here, and so are stars, and cities of stars — or galaxies. Every star visible in the night sky and all of its forms — from white dwarfs to super-dense neutron stars to black holes — are part of our own Milky Way galaxy, a colossal spiral of a trillion suns and probably an equal number of unseen planets.

Other galaxies, such as Andromeda and M33, floating dreamily in the remote alleyways of the universe, are also in deep space. Only telescopes and other observational instruments see into that faraway empire, by gathering the light of distant stars, galaxies and nebulas.

In deep space, a million dangers await you. Ultra-strong gravity can pull you in. Violent tidal forces can rip you apart. Lethal radiation, vaporizing heat and freezing cold are all forces that must be guarded against. In these puzzles, we'll travel into the hidden realm of deep space...and back again.

Puzzle # 1 - Dangers of Deep Space

Overview: Space is a dangerous place. Lethal radiation, violent tidal forces, vaporizing heat, gravity and other dangers threaten your spacecraft and your life.

Objective: Imagine you are an astronaut in training. You must quickly identify the object ahead of you and protect yourself against its effects on your spacecraft and your crew.

HINTS:

ELAINE: Not everything is as dangerous as it looks. Acting too quickly — and taking action when none is needed — can be almost as bad as waiting too long.

MIGUEL: If there's a threat that is real, act fast. If the threat comes from tidal forces or gravity, it means you're getting too close and your engines might not be strong enough to pull you out of there.

BEVERLY: You can't defend yourself against some dangers. Sometimes when the going gets tough, the tough get the heck out of there .... fast!

EINSTEIN: Danger in space? Space isn't dangerous — people are dangerous!

GALILEO: Danger? The only danger I cared about was being burned at the stake. That's real. Anyway, no one but angels will ever fly to the stars.

Puzzle # 2 - Where Am I?

Overview: Congratulations. You're almost home. But where are you in Earth's solar system? The scene in front of you can only be found in one place in the known universe. Your instruments will tell you about the conditions outside your spacecraft.

Objective: Your objective is simple. Figure out exactly where you are, so that you can get back to Earth.

HINTS:

Location #1

ELAINE: Hmm, that's a pretty bright sun in the sky.

BEVERLY: If the sky is totally black, then there's no atmosphere. What planet could you be on?

MIGUEL: Boy, everything looks pretty hot and dry here.

EINSTEIN: This is the fastest moving planet. Its changing orbit helped prove my theory of relativity.

GALILEO: You're far away, that's for sure. I remember what planets look like through my telescope, but I don't know what it's like to be there.

Location #2

ELAINE: The air looks awfully thick and hot there. I wonder why it makes people think of love?

BEVERLY: Some say it's our sister planet. But I wouldn't want a sister that's so stuffy and unpleasant.

MIGUEL: This is the hottest surface in the solar system — and it's not even the planet that's nearest to the sun. Weird!

EINSTEIN: Remember, the more we know about the planets, the more we know about ourselves.

GALILEO: We Italians love this planet - it's so romantic!

Location #3

ELAINE: People used to think there were canals here. No canals, but the planet does have a pink sky.

BEVERLY: This is the most likely planet for future colonization.

MIGUEL: I'd give anything to be a member of a manned mission to this world. Some say it'll happen around the year 2020. Now, that's a vision of the future!

EINSTEIN: This is the most likely planet for humans to visit. But perhaps we should solve our earthly problems first before we take them into space.

GALILEO: In my day, astrologers called the Red Planet the god of war.

Location #4

ELAINE: It's really quite simple. The moon with the shortest name orbits the largest planet.

BEVERLY: This moon is larger than our own and has the most active volcanoes in the known universe.

MIGUEL: You can see this moon tonight through an ordinary pair of binoculars — if you know where to find the giant it orbits around.

EINSTEIN: This moon seems to slow down and speed up because of the changing distance between it and Earth.

GALILEO: I was the first person to see this moon through a telescope.

Location #5

ELAINE: Its name comes from the fact that it's such a giant moon. It's the largest moon orbiting the planet Saturn.

BEVERLY: This is the only moon in the solar system that has an atmosphere. That's why it's not easy to see Saturn in the sky.

MIGUEL: What a view of Saturn from this huge moon! Too bad its nitrogen atmosphere blocks out the stars.

EINSTEIN: This moon orbits the 2nd most beautiful planet. We live on the loveliest world — I always hoped we could keep it that way.

GALILEO: I spotted this moon first. You can too, through ordinary binoculars.

"Men at some times are masters of their fates: the fault. . .is not in our stars, but in ourselves. . . ."

— William Shakespeare, ***Julius Caesar,*** Act I, Scene II

Location #6

ELAINE: You're on the moon orbiting a giant green planet that's tilted at a bizarre angle. What a strange place to be!

BEVERLY: This moon is easy to pronounce. But almost everyone pronounces the name of its parent planet wrong. Actually, it sounds a little rude no matter how you say it.

MIGUEL: Imagine orbiting a planet sideways, so that the sun seems to go around the sky like a bull's eye? This is strange stuff, man.

EINSTEIN: The tilt of this moon's planet is backwards, like many peoples' ideas. In truth, helping the human race and being kind to people — that's where the greatest treasure is found.

GALILEO: I've never heard of this place. Anywhere near Verona?

Location #7

ELAINE: This was the last place the Voyager spacecraft visited. It's also the most distant planet in the solar system — for now.

BEVERLY: Wow, look at the beautiful blue color of Neptune in the sky. This moon even has erupting geysers. Awesome!

MIGUEL: This moon sounds like the whatchamacallit that the god Neptune holds in his hand as he explores the sea. You know, it's that spear with three prongs.

EINSTEIN: This is one of the coldest places in the universe, relatively speaking, of course.

GALILEO: This world was discovered two centuries after I lived.

Location #8

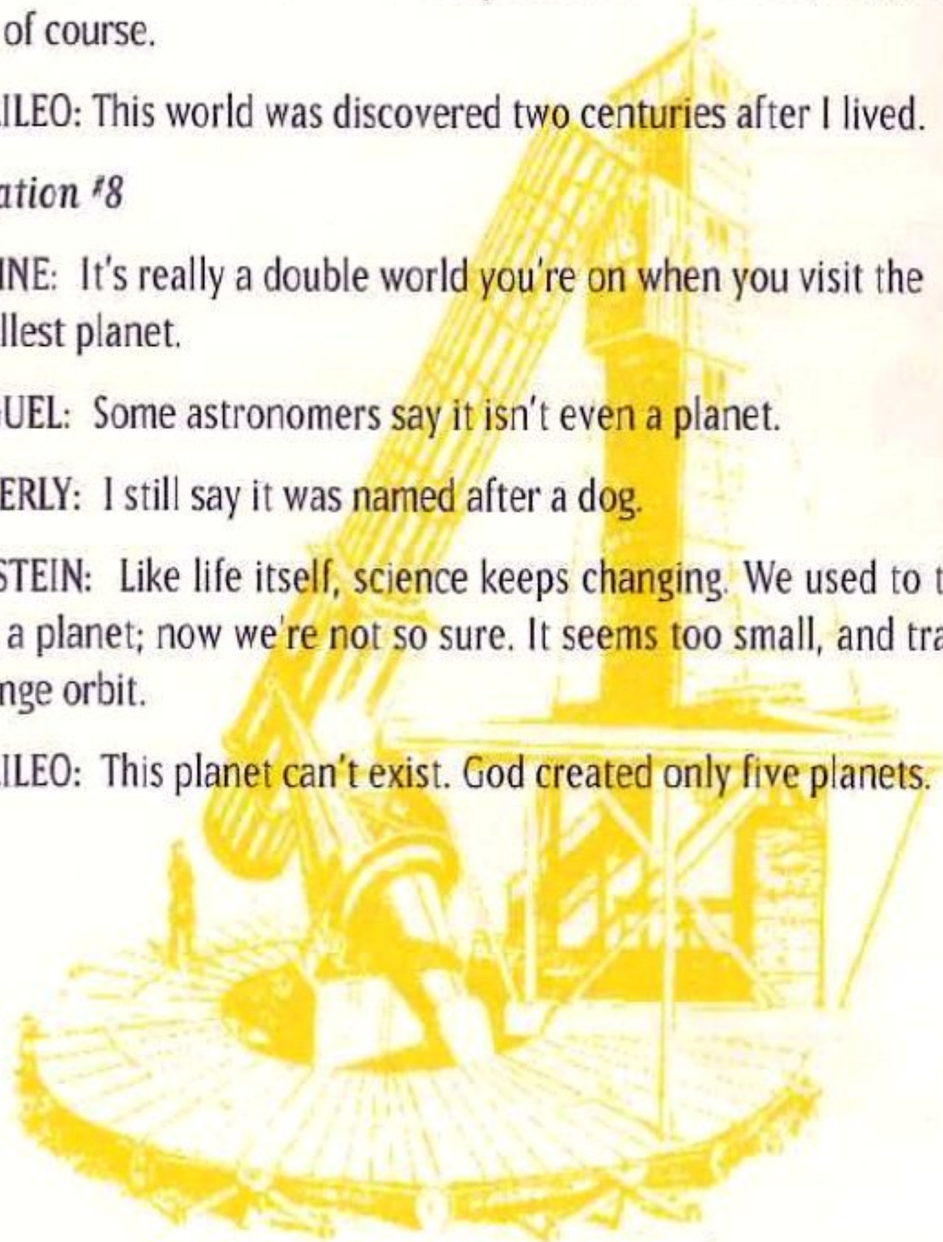
ELAINE: It's really a double world you're on when you visit the smallest planet.

MIGUEL: Some astronomers say it isn't even a planet.

BEVERLY: I still say it was named after a dog.

EINSTEIN: Like life itself, science keeps changing. We used to think this was a planet; now we're not so sure. It seems too small, and travels in a strange orbit.

GALILEO: This planet can't exist. God created only five planets.



RIDDLES OF THE SUN AND MOON

We only have two discs in our sky — the sun, with its power and mystery, around which all life revolves, and the moon, whose gray, dead surface is the only place beyond Earth walked on by humans. That they appear the same size in the sky is one of the greatest illusions of nature.

In reality, the two spheres couldn't be more different. The sun is a typical white star, weighing 330,000 times more than Earth. It occupies so much space that a million Earths dropped inside wouldn't quite fill it. Fortunately it's a very stable star (many other stars aren't so stable in energy output). The sun is not expected to give our planet serious trouble for almost a billion more years, when it will grow 10 percent hotter.

The moon, by contrast, would scarcely be worth a second glance if it were located elsewhere in the universe. Though it is a large satellite when compared to most of the solar system's other moons, it's small potatoes by astronomical standards. Still, at 2,160 miles, it's one quarter of Earth's diameter. It shows us more detail than any other object when seen through simple telescopes or binoculars.

Because the moon's orbit is oval, it moves nearer and farther from the Earth as it circles us each month. The moon directly affects us because it exerts a stronger gravitational pull on the side of Earth that faces it (stronger than the side facing away.) This pull is called the "tidal effect." Combined with the sun's influence, it produces a tidal force that is always ebbing and flowing.

The moon's tidal pull affects Earth's ocean tides, causing them to rise and fall twice each day. But the strength of these tides keeps changing. Some times high tides are really high and low tides are extremely low. At other times they're more wishy-washy.

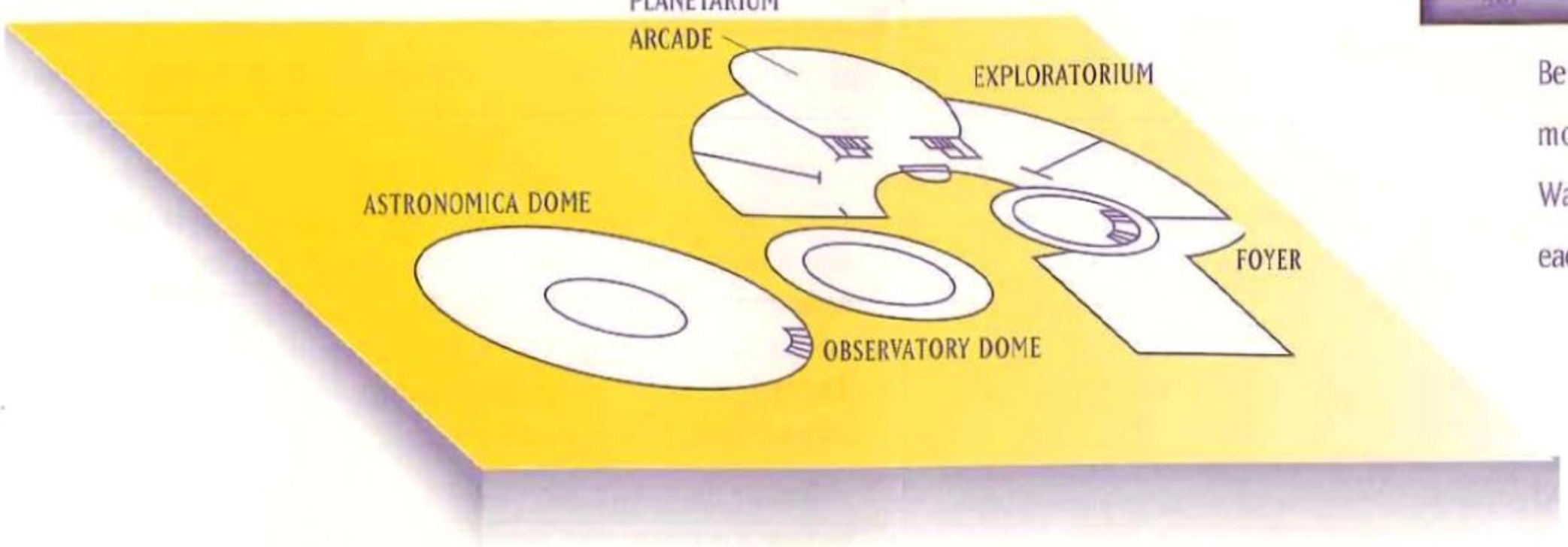
The moon's orbit is also tilted, so that the moon's shadow usually misses the Earth, and the Earth's shadow misses the moon. But if you catch the moon at one of its crossing points, and if it's full or new at that moment, an eclipse will happen. Occasionally, the moon perfectly covers the sun and produces one of the most beautiful spectacles of nature — the total solar eclipse.

Total solar eclipses are among the most beautiful sights in nature. Partial solar eclipses and total lunar eclipses are also well worth watching, though less dramatic. Eclipses always involve shadows of the Earth landing on the moon, or the other way around.

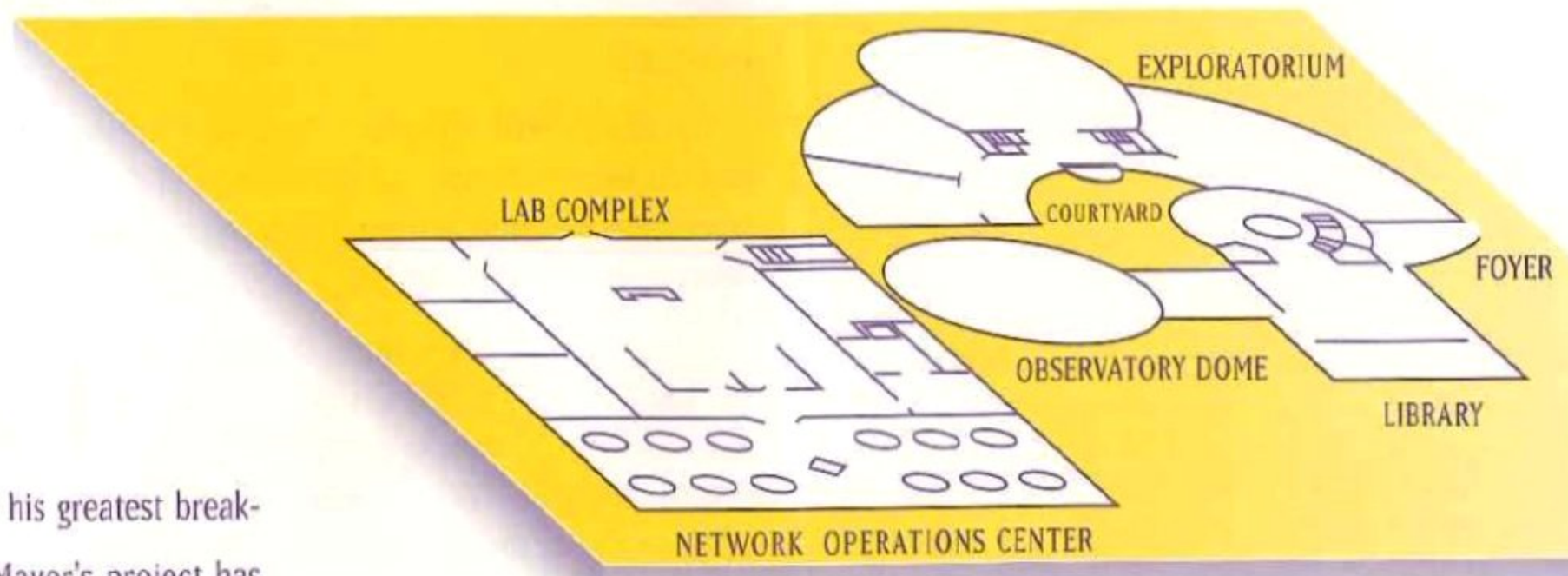
SKYQUEST ASTROLAB

FLOOR PLANS

SECOND FLOOR



FIRST FLOOR



On the eve of his greatest breakthrough, Dr. Mayer's project has been shut down. Bordering on madness, he has taken matters into his own hands!

Be sure to check the wall monitor for the Night Watchman before leaving each Exhibit Room.

The nitrogen in our DNA, the calcium in our teeth, the iron in our blood, the carbon in our apple pies were made in the interiors of collapsing stars. We are made of starstuff.

—Carl Sagan, ***Cosmos,*** (Random House, New York, 1980)

Puzzle # 1 - Create an Eclipse

Overview: Eclipses depend on the plane of the moon's orbit. Sometimes, when the moon passes in front of the Sun, a solar eclipse occurs. At other times, when the moon goes into the Earth's shadow, a lunar eclipse occurs.

Objective: You must manipulate the positions of the Earth, Moon and Sun in order to create a solar or lunar eclipse.

HINTS:

ELAINE: The tilted orbit of the moon allows the moon's shadow to touch the Earth only at certain times of the year.

BEVERLY: A lunar or solar eclipse only occurs at a full or new moon.

MIGUEL: A lunar eclipse happens when the moon goes into Earth's shadow.

EINSTEIN: My relativity theory was confirmed by watching a star's position change during a solar eclipse.

GALILEO: Eclipses prove what I said all along, that the Earth does go around the sun.

Puzzle # 2 - Types of Eclipses

Overview: Different types of eclipses happen almost every year on Earth.

Objective: When the moon stops, match the type of eclipse taking place with the correct location on the map of the continents.

HINTS:

ELAINE: Total solar eclipses can only be seen at specific locations, but lunar eclipses can be seen from half the Earth.

BEVERLY: How well do you know geography? Notice that the moon's shadow touches just a tiny part of the Earth.

MIGUEL: If the moon is too far away, its shadow doesn't quite reach the Earth. Then you don't have a total eclipse.

EINSTEIN: Most people have seen lunar eclipses, but total solar eclipses are very rare. None will happen in America until the year 2017.

GALILEO: You must never observe the sun through your own telescope. I learned the hard way and lost my eyesight doing just that.

"One small step for man, one giant leap for mankind."

– Neil Armstrong on stepping on the surface of the moon, July 20, 1969.

SECRETS OF THE NIGHT SKY

Unlike the other exhibits, this one contains puzzles that explore the actual night sky. The constellations are a part of astronomy open to everyone and it's fun to learn about them. It's also easy to look for meteors that whiz across the sky several times every hour on every clear night, or even to buy an inexpensive telescope to explore the moon and the planets.

Stars arrange themselves in constellations — patterns that our ancestors named and passed down to us from earlier times. Some of these names are thousands of years old and are steeped in mythology and legend. Others were identified and invented just a few centuries ago.

All stars and star patterns cross the sky from left to right, and then seem to sink downward and to the right below the horizon. After an hour has passed, you can see that the constellations have moved. This is caused by the rapid spinning of our planet. Only the North Star remains in the same spot, because the axis of the Earth's rotation points in its direction.

Large observatories with specialized telescopes are scattered around the world, usually on isolated mountain tops. Some are much better than others for viewing particular wonders of the universe.

For example, the largest Russian telescope, located in the far north, cannot peek over the Earth's curve to see objects in the southern hemisphere. Some observatories look at particular parts of the energy spectrum but are blind to others. You wouldn't use a toaster to make soup, and you wouldn't use an optical telescope to examine something that shows up only on radio waves. You'd need a radio telescope. You'd use a solar telescope to look at the sun, not at the galaxies.

The puzzles in this exhibit examine the constellations and the infinite drama parading over our heads every night. They also look at a few of the fantastic observatories that monitor special events seen in the heavens around the world.

Puzzle # 1 - Identify the Constellations

Overview: The stars form patterns in the night sky. Long ago, people named constellations after animals, objects or mythological figures in order to help them find their way from place to place on long journeys. They could look up into the sky and know where they were on Earth.

Objective: As you look at each section of the sky, decide which picture matches a real constellation.

HINTS:

ELAINE: The stars are real, but not all the shapes are.

BEVERLY: Remember, these patterns were dreamed up long ago when myths were more important than they are now.

MIGUEL: Some constellations really look like the figures they're supposed to be. For most, though, you need a great imagination.

EINSTEIN: Remember, when you look out into space, you're also looking back into time.

GALILEO: I used to make my living reading the stars for wealthy Renaissance patrons.

Puzzle # 2 - Observatories of the World

Overview: Observatories use large telescopes to see objects that, unlike the constellations, appear hidden in the night sky. Many observatories were built especially because you could see best from their clear locations.

Objective: Identify the observatory where you can see unique objects or events. You must use the right tool, so go to the best observatory to get the job done.

HINTS:

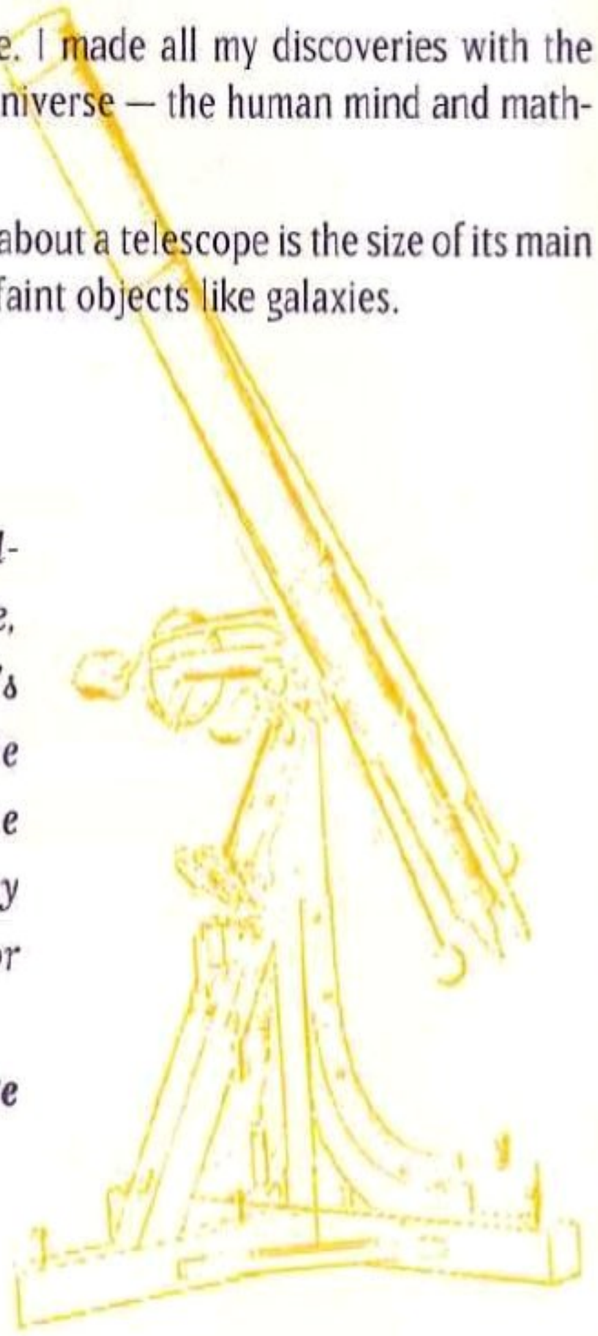
ELAINE: It's important to pick the right tool for the right job.

BEVERLY: Location, location, location!

MIGUEL: An object in the sky never rises for a telescope located in the opposite hemisphere. An object in the north can only be seen from an observatory in the north.

EINSTEIN: I never used a telescope. I made all my discoveries with the most powerful instruments in the universe — the human mind and mathematics.

GALILEO: The most important thing about a telescope is the size of its main mirror. Big telescopes are best for faint objects like galaxies.



Light from faraway galaxies, riding the contours of curved space, become as dappled as the moon's reflection on a pond in a gentle breeze. Out there, awaiting some future Hubble or Herschel, lie many a tale of things past, or passing, or to come.

— Timothy Ferris, ***Coming of Age in the Milky Way,*** (Morrow, 1988)

SPACE TRAVEL

Several of the Exploratorium rooms contain exhibits that would have made sense even in ancient times. The motions of the moon and the rhythms of eclipses, for instance, were well known to the Mayan Indians and early Greeks 2500 years ago. Not so with space travel. Here is a human activity that is unique to our century.

In just the past few decades, humans have rushed outward into space with vigor. It is now routine for astronauts to spend a week or more orbiting Earth. Some have lived beyond our protective atmosphere for a year at a time.

Perhaps even more impressive, if less celebrated, have been our amazing robot probes, whose visits to other worlds of the solar system have made all previous planetary knowledge obsolete.

The first step in space travel was to design the right kind of rocket to boost probes into space. Different fuels, structures, stages and shapes each serve different purposes. For example, if a rocket is to be flown outside Earth's atmosphere, it doesn't have to be sleek and streamlined because it will meet no air resistance. That's why the Lunar Landing Module looked like a giant insect, during the Apollo missions to the moon.

The former Soviet Union concentrated on the planet Venus with great success, while American probes to every planet except for Pluto have been, in most cases, triumphant beyond our wildest dreams.

The earliest spacecraft, the Mariner series, whizzed past Mars, Venus, and Mercury in the early and middle 1970s. In an instant, we learned that Mars had craters and clouds — features that had never been suspected. Mercury became transformed from its centuries-old appearance as a fuzzy disc to a cratered ball of endless complexity.

Next came the Viking mission in 1976, which landed two spacecraft on Mars and performed fascinating biological experiments. Thousands of pictures taken from two sites on opposite sides of the Red Planet make up the bulk of our knowledge about this most earth-like of all known worlds.

Just a year later, the two greatest odysseys ever carried out by humans were launched. Although these Voyager spacecraft were designed only to visit Jupiter and Saturn, they kept working for years and years. This was more than enough time to visit Uranus in 1986 and Neptune in 1989. Their beautifully detailed pictures are now part of our experience.

Thanks to them we've all seen close-up pictures of the swirling storm on Jupiter called the Red Spot. We've been thrilled by many wonders — the beautiful rings of Saturn revealed as hundreds of individual ringlets, the wall of green that is Uranus and the planet-sized moons of these giants — whole worlds unto themselves.

Still the voyage continues. Venus has now been radar-mapped with breathtaking clarity by the orbiting American spacecraft, Magellan. Astronomers wait eagerly for images from Galileo, the high-tech craft now on its way to Jupiter. This will be the first spacecraft to orbit any giant planet.

We can only scratch the surface of these epic adventures to the planets. The puzzles in this exhibit are mere highlights in the vast realm of space travel, but they'll give you a real feel for what it's like to be an astronaut.

Puzzle # 1 - Build a Rocket

Overview: Our first step in exploring the universe will be to build a space station orbiting Earth. Only from a space station can we reach the stars. Different fuels, life support systems, communications and propulsion systems are required for different kinds of missions.

Objective: You are now a cadet. In order to become a pilot, you must complete several missions.

HINTS:

ELAINE: Wasting fuel or building a larger-than-necessary spacecraft is just as bad as one that's too wimpy to do the job.

BEVERLY: Ask yourself. What do you really need to send up?

MIGUEL: Be careful. Some kinds of fuels are too dangerous to use here on Earth.

EINSTEIN: My formula, $E=mc^2$, might be useful to reach the stars someday.

GALILEO: Rocket? Oh yes, I remember — that's one of DaVinci's inventions, no?

Puzzle # 2 - Plot a Course

Overview: You are now returning from deep space. Your navigational system has failed.

Objective: You must manually pilot your craft back to Earth without getting lost, which would waste your fuel and life support systems! Look carefully at your star chart and make the correct choices to get back to Earth.

HINTS:

ELAINE: Pay attention to what different star clusters look like. Each has its own personality.

BEVERLY: Don't confuse blue stars with orange ones.

MIGUEL: Careful! A hard left turn is very different from a gentle left! Right?

EINSTEIN: Learn what different types of objects look like. A planetary nebula is a cloud of gas that looks like a smoke ring.

GALILEO: You know they named a spacecraft after me? It's going to Jupiter.

STRANGE LIGHTS AND COLORS

Astronomy is a peculiar science because all of our knowledge arrives in the form of light. Our eyes are the only tools we have, and since stars are seen as tiny points of light through even the largest telescopes, most of our knowledge boils down to extracting mountains of information from simple dots!

Small wonder that we quickly notice any departure from the normal lights of the sky. Flashes, unusual patterns and colors, and odd experiences always catch our interest.

The sun's rhythm of storms, which creates a powerful 'solar wind' of atoms, can sweep across Earth's magnetic field with such force that they generate heavy duty electrical charges. This causes gases high in our atmosphere to produce the beautiful Aurora Borealis.

Other lights and patterns emerge both by day and night. When the moon or sun shines through a thin layer of clouds or dust, light breaks down into all of its many colors. This is called refraction. It can produce strange rings, discs and colors.

In reality, beautiful and bizarre designs, such as giant halos around the sun and moon, happen every week or two and are visible from most of the United States. We don't notice them because we just don't look up at the sky!

In this exhibit room we look at some causes of these strange lights, and learn how to see them for ourselves.

Puzzle # 1 - Atmospheric Phenomena

Overview: Many of the sky's most awesome sights originate in the Earth's atmosphere. Sunlight or moonlight shining through tiny ice crystals, water droplets, dust or passing clouds create beautiful and unusual patterns.

Objective: Using the effects on your control panel, create the phenomena that appear on your screen.

HINTS:

ELAINE: A sky that is dusty or humid removes the blue from the light spectrum, leaving a red glow.

Stars are the source of the energy by which all beings live. When the light of the last star is extinguished, life must end throughout the universe.

– Robert Jastrow, ***Red Giants and White Dwarfs,*** (Norton, 1979)

BEVERLY: Light refracted through tiny ice crystals creates shapes that are sharply defined.

MIGUEL: Water droplets in clouds make a hazy ring or ray.

EINSTEIN: A corona begins right at the edge of the sun or moon. With a halo there's a big empty space inside the ring.

GALILEO: Add one ingredient at a time. And go slow, eh?

Puzzle # 2 - Create an Aurora

Overview: The Northern Lights or Aurora Borealis is caused by pieces of atoms streaming toward Earth from the sun, interacting with Earth's magnetic field and gases in our atmosphere.

Objective: Manipulate solar activity to create different states of the Aurora Borealis throughout the sun's 11-year cycle.

HINTS:

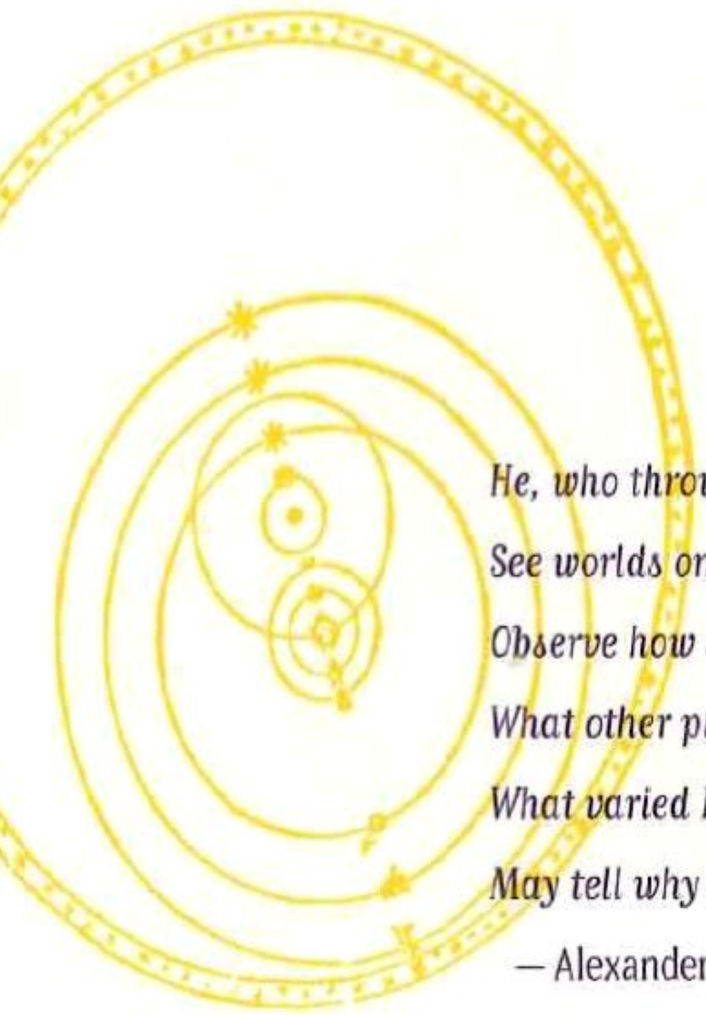
ELAINE: The aurora can take on many different shapes.

BEVERLY: You don't need to go to Alaska to see the Northern Lights. A great display happens every few years in most of the U.S.

MIGUEL: Electricity produced by the sun's atoms lights up gases a hundred miles overhead to make these beautiful patterns.

EINSTEIN: I spent my life in large cities. Go to the country if you want to see an aurora. You need dark skies.

GALILEO: I never saw an aurora. Italy's too far from Earth's magnetic north pole, where they most often appear.



He, who through vast immensity can pierce,
See worlds on worlds compose one universe,
Observe how system into system runs,
What other planets circle other suns,
What varied Being peoples every star,
May tell why Heaven has made us as we are.

— Alexander Pope, ***Essay on Man,*** 1733

WEIRD SCIENCE

People love the unusual and are attracted to the strange and unbelievable. The field of astronomy has forever provided such oddities — perhaps more than any other science.

From a search for "Planet X" to predictions that we would collide with Halley's comet and end the world (which was never possible), there has never been a shortage of "weird science." Other weird science is simply a hoax, a fraud or a belief. Astrology, the belief that planets affect our lives, has been used for centuries to predict the future. Many confuse astronomy and astrology because they sound alike, and because they both use planet and constellation names.

Some weird science is strange, but scientifically possible. The Weird Science exhibit takes us to places where unbelievable things can really happen, and where reality may seem more like science fiction than science. For example, looking out into space really means looking back in time, since it takes time for images of distant stars and galaxies to reach us. It works the other way around, too. There are places in the universe where Earth's past can be viewed — right at this moment!

For example, anyone with a super-telescope on Pluto would now be seeing images that left Earth more than five hours ago. Places farther from Earth "see" events that occurred earlier and earlier in Earth's history.

The faster you travel — or the stronger gravity is — the slower your clocks run and the more distances in front of you become squashed and shrunk. While this may seem too bizarre to be true, many experiments have shown that these strange effects really happen. This is called time dilation — the warping of time and space predicted by Einstein.

Time dilation could be used to our advantage. After all, there really is no way to reach the stars in a human lifetime unless time itself shrinks enough to let us live longer. By choosing the correct speed and the correct amount of "time warp," only five years will go by for someone in a spacecraft while 25,000 years pass on Earth. This would allow us to reach the center of our galaxy. How about getting back again? No problem — if your calculations are correct!

On yet other worlds, strange gravitational effects can make everyday activities very different from what we're used to. Sports activities would be fun no matter where you traveled in the cosmos, but well-known games would take on alien characteristics when you go beyond the familiar conditions found on Earth. The rules would have to change due to variations in gravity in different locations. Astronomy is not just fascinating — it is strange and incredible, and it offers experiences that are totally impossible on Earth.

Puzzle # 1- Backwards Time Viewer

Overview: Looking out into space means looking back into time. If intelligent aliens are watching us right at this moment, they are seeing images from Earth's past. The farther they are from us, the farther back into our history they are seeing.

Objective: Imagine you are an alien with a super-telescope, watching an event in Earth's history. Where in the universe would you have to be to "see" the event on the screen?

HINTS:

ELAINE: Because Earth is only 5 billion years old, any aliens living more than 5 billion lightyears away would not see us at all. Light from Earth would not have had time to reach them!

BEVERLY: Figure out how many lightyears away from Earth the star is, that's how many years into our past an alien would be seeing right now.

MIGUEL: Hey, dude, if you know your history, this is a snap.

EINSTEIN: Remember that the farther into space you are, the farther into the past you are looking. Even traveling at the speed of light, images take a very long time to cross the vast distances of the universe.

GALILEO: Looking through even a small telescope like mine, you can see millions of years into the past. Telescopes are time machines.

Puzzle # 2 - Time Dilation

Overview: Time Dilation means that if you travel fast enough, time slows down and distances shrink for you. Your clocks slow down. Your heartbeat slows down and you don't notice the difference. On Earth, time remains the same for everyone else.

Objective: You must determine the right speed to make time warp and space shrink just enough so that you can get to the center of the galaxy in your own lifetime. You must also accelerate at the correct rate so that both you and your crew survive the G-forces!

HINTS:

Elaine: If the center of the galaxy is 25,000 lightyears away, that doesn't mean it would take 25,000 years to travel there.

Elaine: Just like in your family car, the faster you accelerate the more you are pushed back in your seat. This feeling is a G-force.

Beverly: Even at the speed of the space shuttle, 20,000 miles per hour, time hardly slows down at all. You must travel much faster than this.

Beverly: One G-force matches the gravity of Earth and is comfortable for people. Imagine what a G-force of 100 would be like!

Miguel: It doesn't just happen on Star Trek. Time really warps and space really shrinks near the speed of light.

Miguel: You know how it is...time goes by fast when you're having fun, and slow when you're not.

Einstein: The faster you go, the more time slows down and space warps and shrinks.

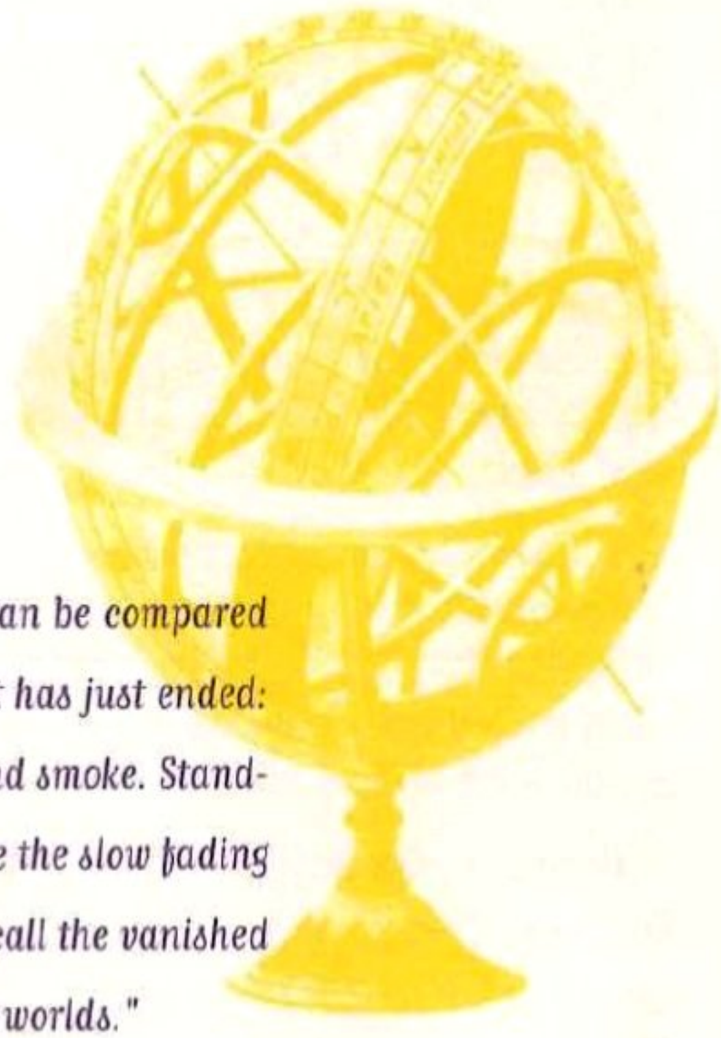
Einstein: According to the formulas in my theory of relativity, the slowing of time and the shrinking of space only become important very near the speed of light.

Galileo: None of this makes sense. How can time slow down? Maybe your watch is broken, eh?

Einstein Speech:

Here on Earth, everyone's pretty much traveling at the same speed, so time passes the same for everyone. But if you could speed up to nearly the fantastic velocity of light, your heartbeat, your clocks and the way you grow older would all slow down! You could live long enough to explore the stars! And yet time would still feel the same to you.

Only people left behind, who weren't going at your speed, could tell the difference. While a year or two passed for you, thousands of years would pass back on Earth.



"the evolution of the world can be compared to a display of fireworks that has just ended: some few red wisps, ashes and smoke. Standing on a cooled cinder, we see the slow fading of the suns, and we try to recall the vanished brilliance of the origin of the worlds."

– Father Lemaître, cited in ***Red Giants and White Dwarfs,*** by Robert Jastrow (Norton, 1979)

THINGS THAT EXPLODE — OR DISAPPEAR

All stars start out as hydrogen gas. Even such fearsome explosives as hydrogen bombs are playthings compared to the energy found in the smallest, feeblest stars. The sun, for example, is in the process of exploding all the time with the power of billions of hydrogen bombs.

An H-bomb converts hydrogen to energy very poorly when it explodes — only 0.7% efficiency. But the sun is so efficient that it is continually losing five million tons of its weight in hydrogen each second!

How fast a star burns its fuel and therefore how hot it is, what color it will be, how long it will live, how it will die, and whether the death will be quiet or violent — these are all decided by a star's weight or mass of hydrogen. White dwarfs, super-dense neutron stars, black holes — all these will evolve from a normal star that has a suitable weight of hydrogen to start out with.

When it comes to stars, red is coolest, yellow and white are hotter and blue is the fiercest, hottest of all. A star will be very hot when it's using lots of fuel, which it does when there's great pressure at its core. This happens if a star starts out heavy in hydrogen. Remember, a star's weight decides everything about it.

Explosions in the usual sense of the word occur among the stars and galaxies. Novas and supernovas are stars that blow up. They typically leave behind an expanding, twisted cloud of debris, plus a tiny core. Supernovas occur among massive stars that have gravitationally added or "captured" shells of new material from nearby companion stars. When this material ignites, the resulting explosion frequently emits the light of a billion suns.

Other stars undergo internal explosions that change their size and brightness less dramatically — but can nonetheless cause them to vanish from our sight. Still others periodically fade and disappear for an entirely different reason. They belong to two star systems whose members eclipse each other.

Such variable stars comprise an entire field of study for astronomers and provide amateur stargazers with endless fascination. The puzzles in Things That Explode — or Disappear make a fun experience out of learning about the odd lights in the sky that either violently explode, or wink on and off as if from a sorcerer's spell.

Puzzle # 1 - Create a Star

Overview: There are many different kinds of stars. But no matter what a star's color, temperature, brightness and life expectancy happen to be, they all depend on one simple universal element — hydrogen.

Objective: Create various types of stars by pumping in the right amount of hydrogen. Light it and stand back. See how many different stars you can create.

HINTS:

ELAINE: Too little mass — 500 earth weights — and you'll create a planet, not a star!

BEVERLY: Be careful you don't put in too much hydrogen. Heavy stars have short lives.

MIGUEL: Sometimes you have to stick around and wait to see what cooks. Black holes don't form right away.

EINSTEIN: Don't ignore your mistakes. You'll need to remember what you did later.

GALILEO: I always wondered what makes the stars shine.

Puzzle # 2 - Spaceship Earth

Overview: In all the universe — all the stars and planets in all the galaxies — Earth is the only place to support life as we know it. Our unique combination of atmosphere, gravity, water and sunlight combine to make our planet habitable.

Objective: Our life support system on Spaceship Earth is in trouble. As dangers threaten this beautiful environment, select the right combination of actions to save it. Your goal is to return the Earth to its natural balance.

HINTS:

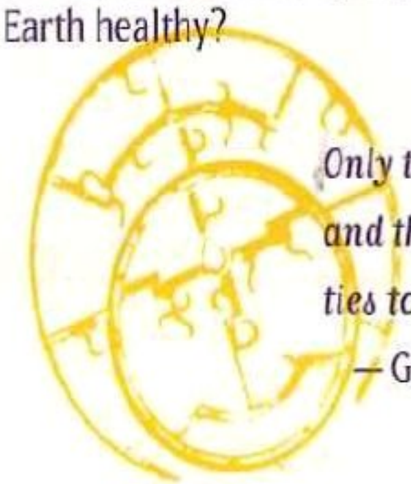
ELAINE: If carbon dioxide from burning fuel continues to increase, Earth's atmosphere will be as unlivable as Venus. Proper management of power will help a lot.

BEVERLY: Don't be a wimp. We're going to have to fix this mess. See if you can figure out what it takes to solve this puzzle.

MIGUEL: C'mon, get with the program. It takes more than one solution to fix a problem.

EINSTEIN: You don't have to be a genius to realize that we are our own worst enemies. People themselves are creating the biggest problems.

GALILEO: In the 1500s, we had plenty of garbage right in our own backyards. You've made so much progress, why not use your knowledge to keep the Earth healthy?



Only the blind need a guide. Those with eyes and those with a mind must use these faculties to discern for themselves.

— Galileo Galilei

PLANETARIUM PUZZLES

You're in the Arcade! You're on your own here - no mentors to help you. Play the games! Explore! Have Fun!

Interplanetary Baseball: Let's play baseball! The problem is, you are the only one on your team and you will encounter wildly different gravitational fields on other planets. Where in space will gravity let you be both batter and outfielder?

Save the Whale: This baby whale is trapped in shallow water. Some tides are higher than others and we need an unusually strong tide to save him. To produce such a tide, you need the perfect combination of barometric pressure, wind and the moon's position within its lunar orbit.

Astronomy or Astrology?: Are you confused by the difference between astronomy and astrology? Astrology is the belief that the stars affect our lives, while astronomy is the scientific study of the universe.

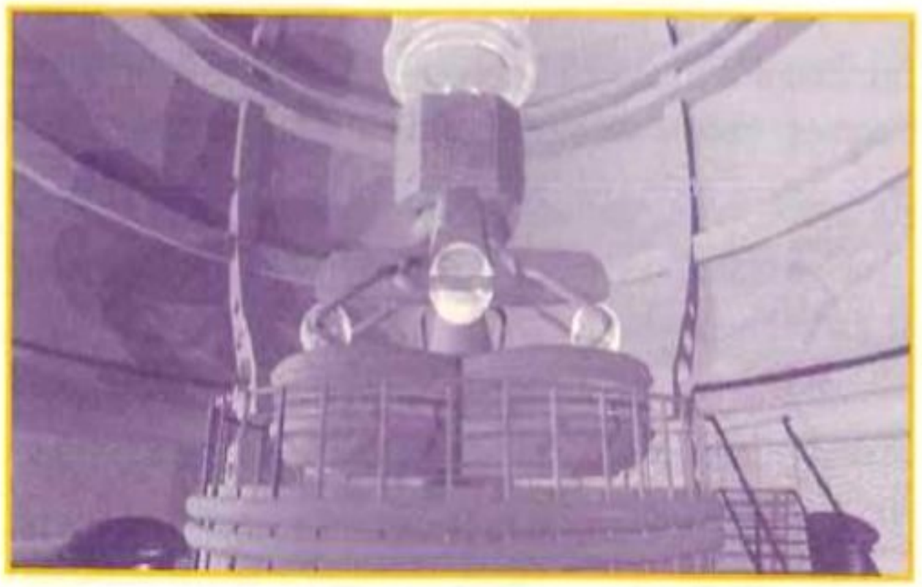
Lightning Zapper: In order to get from San Francisco to Woodstock, you must supply your train with enough power to cross the entire United States. You can zap it with a bolt of lightning, or a bolt of Jupiter-sized lightning, or other energy sources.

Save the Hubble: The Hubble, our sharpest telescope, is falling out of orbit. Launch a space shuttle and grab it before it's too late!

Place the Planets: A place for everything and everything in its place — that's the motto of the universe. Select a planet and fire it into its correct position.

Target Jupiter: Here's your chance to blast Jupiter with a comet. Figure out the correct angle and velocity – then go for it!

Launch a Probe: You're going to launch a probe from Earth to Mars. The secret is to launch it at the precise velocity and at the precise moment when both planets are in their best orbital positions.



BUILD A TELESCOPE

If you find this exhibit, you're not only on your way to being an astronomer, you're a pretty good detective, too! — and you're almost ready to go back to the lab and help Sara rescue her father!

Overview: Most of our knowledge of astronomy comes through the use of telescopes — the right mirrors in the right positions, plus the best choice of magnification will let you see the object at its clearest.

Objective: A telegram has arrived at SkyQuest, asking for your help. Before you can assist with your observation, you must put the telescope back together and choose the best magnification for the job!

HINTS:

ELAINE: Once you have the mirrors in place, just try different powers of magnification.

BEVERLY: The highest magnification is usually not the best choice. It makes objects dim and fuzzy.

MIGUEL: Wrong mirrors will give you blurry or blank images. The large mirrors send the light towards smaller mirrors near the telescope's eyepiece.

EINSTEIN: Exploring the universe with a telescope is not only more interesting, it makes you more interesting!

GALILEO: I loved building telescopes — building them can be as much fun as looking through them!

Mind-stretching explorations await us in our immediate neighborhood and envelop us as soon as the sun sets. Such "ordinary" experiences as twilight and blackness are, when we examine them, as astounding as the smoke rings of "forbidden radiation" that float among the night's distant suns.

—Bob Berman, *introduction,* ***Secrets of the Night Sky,*** (Morrow, 1995)

BIRTH AND DEATH OF A UNIVERSE

This is what we call Cosmology. Cosmology explores the beginning, the structure and the fate of the universe.

When powerful circumstances, such as the collapse of massive stars weighing a million times more than Earth, force space and time to curve back upon itself like a breaking wave, strange objects such as pulsars or black holes result. These stretch our powers of understanding, and even test the limits of present science. More than being unbelievably strange in their own right, they make us imagine the possibility of other dimensions.

Who is not fascinated by the idea of space itself warping? Or a "straight path" carrying the traveler on a curving voyage? Or time running ever slower around the weird super-hard globes discovered in the past few decades? Even their names — neutron stars, black holes, white dwarfs — sound fascinating. While such strange effects were predicted long ago by Einstein, they are still baffling to most people.

There is a single puzzle in the "Birth and Death of a Universe" exhibit room, but it's the most important one of all. Here you must create a universe — our universe.

Most astronomers believe that everything started with a giant explosion that we call, for lack of a better name, the Big Bang. Exactly why or how it started is unclear, but from the moment of that huge explosion, 10 to 20 billion years ago, all clusters of galaxies in the universe have been spreading apart.

If the explosion had been just a little different, the universe would have been very different from the way it is.

An explosion less powerful could not have resisted the awesome gravity of everything pulling in on itself. The universe would have quickly collapsed, and that would have been the end of the story.

If the explosion had been more powerful, every atom would have been blown off in a slightly different direction, producing a universe of giant fog, without any form or structure to it.

The different possible fates of the universe, too, depended on what happened in that first instant.

So, pretend you are all-powerful and could create the universe from a giant explosion. Choose the amount of force you wish to use, light the fuse, and see what happens.

Create a Universe (Closing Puzzle)

Overview: Most astronomers believe that the universe began with the Big Bang, a giant explosion of just the right force. Too great and it would have spread out into a giant fog. Too little and it would have collapsed back into a black hole.

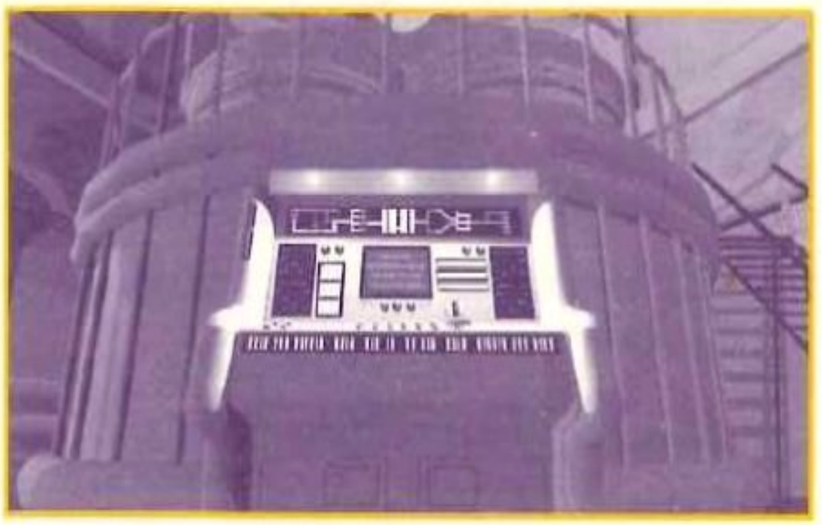
Objective: Assume that our universe began just as a previous universe collapsed. Your goal is to detonate the explosion at just the right moment to give birth to our universe!

EINSTEIN'S SPEECH

Does the universe have a birth and a death? Or does it just exist forever?

By using our biggest telescopes to look back in time, we can compare how things were with how they are now, to predict the future.

Most astronomers feel we are now on the verge of having enough information to decide when the universe was born, and what will ultimately happen to it. This means we are living in one of the most exciting times in all of history!



FINAL MISSION

Congratulations! You have brought Astronomica back to life!

One final mission awaits you – to rescue Dr. Mayer. He alone can unlock the secrets of Astronomica. . .but what will she reveal?

Was Einstein right? Are we on the verge of discovering the fate of the universe? Could there be more than one? Are we ready for the answers? What will we do when we find them?

One thing is certain.- we must continue to explore the riddles of this vast and amazing universe - from our own planet Earth to our most distant galactic neighbors - our very destiny depends on it!

Answers to Where Am I?

Location #1- Mercury, #2 - Venus, #3 - Mars, #4 - Io, #5 - Titan
#6 - Miranda, #7 - Triton/Neptune, #8 - Pluto

Cast of Characters

Night Watchman	Damon Jones
Dr. Mayer	Doug Jones
Sara	Jamie Childs
Voice of Astronomica	Joanie Stewart
Einstein	Eric Tavares
Galileo	Ian Sullivan
Elaine Overton	Kay Daphne
Beverly Dawson	Daphne McDowell
Miguel Santiago	Wilmer Calderon

Astronomy Expert: Bob Berman, *Overlook Observatory*

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Producers: Julia Mair
Karlo Kilayko

Director: Karlo Kilayko

Live Action Director: Joanie Stewart

Video: *Florida Mobile Video Productions*
Joel Van Citters, Blue Screen Director
Michael Mullins, Director of Photography
Bill Kavis, Technical Director

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Amazing Facts Section: Henry Shilling

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