

*THE PRIVILEGED PLANET*

*04/26/05*

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*58 Minutes*

1. *Lift off at Cape Kennedy. Rocket transporting Voyager spacecraft blasts off.  
Supers:*

*We will not cease from exploration.  
And the end of all our exploring will be to arrive at  
where we started.  
And know the place for the first time.*

*T.S. Elliot*

**NARRATION**

LATE IN THE SUMMER OF 1977, AN HISTORIC MISSION OF EXPLORATION WAS LAUNCHED.

2. *Voyager flight animation*

**NARRATION**

TWIN SPACECRAFT, CHRISTENED—"VOYAGER" 1 AND 2—BROKE FREE FROM THE EARTH'S GRAVITY, ON JOURNEYS TO THE OUTER REACHES OF THE SOLAR SYSTEM.

3. *Voyager at Jupiter and Saturn*

**NARRATION**

THEIR PRIMARY DESTINATIONS WERE THE FOUR GIANT OUTER PLANETS—JUPITER, SATURN, URANUS, AND NEPTUNE.

4. *Voyager at Neptune and Saturn*

**NARRATION**

FOR 13 YEARS, THE VOYAGERS PROBED THESE MYSTERIOUS WORLDS AT CLOSE RANGE, WHILE COLLECTING DATA AND TRANSMITTING STUNNING IMAGES BACK TO EARTH.

5. *Voyager turns. Layer insert pix of planets into frame*

**NARRATION**

AMONG THOUSANDS OF PICTURES OF PLANETS AND MOONS, PERHAPS THE MOST MEMORABLE WAS RECORDED ON FEBRUARY 14, 1990, WHEN VOYAGER 1 APPROACHED THE EDGE OF THE SOLAR SYSTEM...THEN TURNED BACK TOWARD THE SUN.

6. *Voyager picture. Wide sun to earth*

**NARRATION**

WITH ITS WIDE AND NARROW ANGLE CAMERAS, THE SPACECRAFT CAPTURED UNPRECEDENTED VIEWS OF OUR HOME STAR AND SIX OF ITS ORBITING PLANETS.

7. *Voyager picture (CU earth in ray of sunlight.).*

**NARRATION**

ONE OF THEM APPEARED AS A SMALL PALE DOT ENGULFED BY A RAY OF SUNLIGHT. IT WAS THE EARTH ... FROM NEARLY FOUR BILLION MILES AWAY.

8. *CU Voyager*

9. *Zoom in toward pale blue dot*

**NARRATION**

WHILE THE WORLD GAZED INTENTLY AT THIS PINPOINT OF LIGHT, TIMELESS QUESTIONS ABOUT ITS MEANING, PURPOSE, AND SIGNIFICANCE SUDDENLY TOOK ON NEW RELEVANCE...

10. *Transition to Earth for titles*

**NARRATION**

...AND, ONCE AGAIN--AS IN AGES PAST--WE PAUSED TO CONSIDER OUR PLANET'S ROLE WITHIN THE GRAND SCHEME OF THE UNIVERSE.

11. *Start to rotate earth. Move camera. Reveal moon as titles play.*

*Illustra Media Presents*

*The Privileged Planet*

*The Search for Purpose in the Universe*

12. *Dusk over Greek pillars.*

**NARRATION**

THE MYSTERY OF THE EARTH'S SIGNIFICANCE IN THE UNIVERSE HAS CHALLENGED PHILOSOPHY AND SCIENCE FOR MORE THAN 2000 YEARS.

13. *Old astronomical charts and pictures.*

**NARRATION**

EARLY PERCEPTIONS WERE SHAPED BY THE WORK OF THE GREEK SCHOLARS ARISTOTLE AND PTOLEMY.

THEY TAUGHT THAT THE EARTH SAT MOTIONLESS (IN THE CENTER OF THE HEAVENS) WHILE THE MOON, SUN AND OTHER STARS AND PLANETS REVOLVED AROUND IT.

THIS GEOCENTRIC VIEW WAS THE FOUNDATION OF WESTERN COSMOLOGY FOR 18 CENTURIES.

14. *Copernicus portrait*

**NARRATION**

THEN, IN 1543, THE POLISH ASTRONOMER, NICHOLAS COPERNICUS, IGNITED A REVOLUTION.

15.

**NARRATION**

IN HIS BOOK, “ON THE REVOLUTIONS OF THE HEAVENLY SPHERES,” COPERNICUS ARGUED THAT THE EARTH WAS NOT STATIONARY ... BUT, INSTEAD, ORBITED WITH THE OTHER PLANETS AROUND THE SUN.

16. *Sun centered solar system disgam*

**NARRATION**

FOR THE FIRST TIME A CORRECT UNDERSTANDING OF THE MECHANICS AND STRUCTURE OF THE SOLAR SYSTEM WAS IN SIGHT.

17. *Dennis Danielson*

**DENNIS DANIELSON**

“The idea of the moving earth... seemed to violate some fundamental principle. But Copernicus somehow had the mental power to imagine what, even to him, seemed absurd.”

“So he thought the impossible—the earth moves. And once you imagine the earth moving (instead of the sun), the mathematics of that cosmic machine started to make sense. It was the key that unlocked one of the great mysteries of the universe.”

18. *Pan from ancient astronomer to globe, then to earth*

**NARRATION**

COPERNICUS HAD LAID THE CORNERSTONE FOR MODERN ASTRONOMY.

19. *Solar system model. Start with CU of orbiting earth and pull back to reveal solar system/moving planets. Super “Copernican Principle.”*

**NARRATION**

YET, 400 YEARS AFTER HIS DISCOVERY, THE EMPIRICAL FACT THAT OUR PLANET WAS NOT THE CENTER OF THE SOLAR SYSTEM HAD EVOLVED INTO WHAT IS NOW KNOWN AS “THE COPERNICAN PRINCIPLE”—THE IDEA THAT THE EARTH OCCUPIES NO PREFERRED PLACE IN THE UNIVERSE.

20. *Interview—Jay Richards*

**JAY RICHARDS**

Copernicus had a theoretical way of explaining the apparent motion of the planets across the sky. That's all it was. It wasn't a theory that told us whether or not the earth was special. Or whether we played some importance in the scheme of things. Or, whether every place in the universe was the same as every other place.

21. *Aerial over Ocean*

**JAY RICHARDS**

“Nevertheless, this reinterpretation of Copernicus became prominent in the 20<sup>th</sup> century. It's often called the ‘principle of mediocrity.’ This principle says that our location and our status are mediocre. They're unexceptional.

As a result, we should not assume that we are in any way privileged...or that the universe was designed with us, or beings like us, in mind.”

22. *Carl Sagan portrait*

**NARRATION**

THE COPERNICAN PRINCIPLE—AND THE CONCEPT OF THE EARTH'S INSIGNIFICANCE—WAS POPULARIZED DURING THE 1970S AND '80S BY THE LATE ASTRONOMER, CARL SAGAN.

IN HIS BEST-SELLING BOOK, *PALE BLUE DOT*, SAGAN WROTE:

23. *Voyager photo—slow pull back*

**NARRATION (Alt. Voice)**

“Because of the reflection of sunlight...the Earth seems to be sitting in a beam of light, as if there were some special significance to this small world. But, it's just an accident of geometry and optics.

Look again at that dot. That's here. That's home. That's us....Our posturing, our imagined self-importance, the delusion that we have some privileged position in the universe, are challenged by this point of pale light. Our planet is a lonely speck in the great enveloping cosmic dark.”

24. *TL night sky/ Mt. Wilson*

**NARRATION**

ONE REASON FOR THE WIDESPREAD ACCEPTANCE OF THE COPERNICAN PRINCIPLE CAN BE TRACED TO A DISCOVERY MADE ON THIS MOUNTAINTOP OVER LOOKING LOS ANGELES.

25. *Telescope CU's*

**NARRATION**

BETWEEN 1921 AND 1926, THE ASTRONOMER, EDWIN HUBBLE, USED THIS TELESCOPE TO MAKE SOME OF THE MOST IMPORTANT DISCOVERIES IN THE HISTORY OF SCIENCE .

26. *Hubble archive*

**NARRATION**

THROUGH THE WINDOW OF THE MT. WILSON OBSERVATORY, HUBBLE UNVEILED THE TRUE MAGNITUDE OF THE UNIVERSE.

27. Interview—Robert Jastrow/ telescope shots

**ROBERT JASTROW**

“At the time Hubble was doing his work, many astronomers believed that the galaxy—our galaxy—marked the edge of the universe, and there was nothing beyond it.”

28. *Telescope shot/ BW space photo*

**NARRATION**

EDWIN HUBBLE ALTERED THIS PERCEPTION OF THE UNIVERSE WHEN HE USED THE MOST POWERFUL TELESCOPE OF HIS DAY TO PHOTOGRAPH INDISTINCT OBJECTS IN SPACE, LONG THOUGHT TO BE NEARBY CLOUDS OF GAS AND DUST.

HUBBLE DETERMINED THAT THESE PATCHES OF LIGHT WERE ACTUALLY INDIVIDUAL GALAXIES—MANY AS LARGE, OR LARGER, THAN OUR OWN MILKY WAY.

29. *Jastrow on camera/ HST million galaxies*

**ROBERT JASTROW**

“The implication of what he found was that the universe consists of, indeed, billions of galaxies, each with many billions of stars and planets...and it was a universe with a wealth of numbers and variety that transcended the imagination of both laymen and astronomer. He, in effect, enlarged the boundaries of the universe.”

30.

**NARRATION**

EDWIN HUBBLE REVEALED THAT THE MILKY WAY GALAXY (ENCOMPASSING MORE THAN 100 BILLION STARS INCLUDING OUR SUN) WAS A MERE PINPOINT OF LIGHT IN THE UNIVERSE.

31. *Telescope/archive photos*

**ROBERT JASTROW**

“...When Hubble found that there were many galaxies, we saw that our galaxy was nothing distinguished at all—just one ordinary galaxy among billions ...and that’s the ultimate extension of the Copernican Principle.”

32.

**NARRATION**

MORE THAN 80 YEARS HAVE PASSED SINCE EDWIN HUBBLE’S DISCOVERY, YET TODAY, ITS PROFOUND IMPLICATIONS STILL EVOKE A FUNDAMENTAL QUESTION.

DOES CONTEMPORARY SCIENTIFIC KNOWLEDGE ACTUALLY CONFIRM THE COPERNICAN PRINCIPLE’S PRIMARY CLAIM...

THAT THE EARTH AND THE LIFE IT SUSTAINS EXIST WITHOUT PURPOSE OR SIGNIFICANCE IN THE UNIVERSE?

33. *Super quote over deep space image*

**SUPERIMPOSE**

*“The universe is populated by innumerable Earths and, perhaps, innumerable forms of life.”*

*Robert Jastrow*

34. *Deep space scenes/ radio telescopes*

**NARRATION**

AN OUTGROWTH OF THE COPERNICAN PRINCIPLE IS THE BELIEF THAT HABITABLE PLANETS AND COMPLEX LIFE ARE ABUNDANT THROUGHOUT OUR GALAXY AND THE REST OF THE COSMOS.

35. *Radio telescopes*

PERHAPS NO SCIENTIFIC ENDEAVOR HAS BEEN INFLUENCED MORE DEEPLY BY THIS IDEA, THAN THE RESEARCH PROGRAM CALLED, “SETI.”

36. *Interview Seth Shostak*

**SETH SHOSTAK**

“Well, SETI (which is, of course, the search for extraterrestrial intelligence) is trying to do just that. We’re searching for extra terrestrial intelligence, in other words we are looking for aliens that are at least as clever as we are. Now, we try and do that—not by trying to go there (as they do in the movies), or waiting for them to come here...we try to find these aliens, if you will, at home on the basis of eavesdropping on signals they might be sending our way...”

37. *Goldstone radio telescope sequence*

**SETH SHOSTAK**

“...so we use large telescopes, pointed at other star systems to try and find these tell-tale signs that there’s some cosmic company out there.”

38. *Radio telescopes*

**NARRATION**

SINCE 1960, SETI RESEARCHERS HAVE UTILIZED RADIO TELESCOPES, THROUGHOUT THE WORLD, TO MONITOR TRANSMISSIONS FROM DISTANT REGIONS OF THE MILKY WAY.

WHILE NO DEFINITIVE SIGNS OF INTELLIGENT LIFE HAVE EVER BEEN DETECTED, THESE INVESTIGATIONS HAVE TRIGGERED MUCH SPECULATION ABOUT THE POSSIBILITY OF EXTRATERRESTRIAL CIVILIZATIONS.

39. *Seth Shostak/deep space*

**SETH SHOSTAK**

“...Estimates vary all over the place. Carl Sagan ...thought there might be millions of civilizations that are kind of contemporaries of ours.

40. *Milky Way animation*

**SETH SHOSTAK**

“I can imagine that ...within the Milky Way galaxy, the number of contemporary intelligent civilizations, I think is, probably, in the thousands, maybe hundreds of thousands ...

“...But the bottom line, actually, when people ask, ‘why do you think that they’re out there,’ is that the universe is extraordinarily rich and extraordinarily vast...the number of stars that we can see is on the order of 10 thousand billion billion star systems...so, unless there’s something very special, miraculous, if you will, about our solar system, about our planet Earth...unless there is something extraordinarily unusual about it, then what happened here must have happened many times in the history of the universe.”

41. *Mars rover*

**NARRATION**

THE ASSUMPTION THAT HABITABLE PLANETS AND EXTRA TERRESTRIAL LIFE ARE ABUNDANT, HAS INSPIRED NOT ONLY THE SETI PROGRAM, BUT ALSO THE NEW SCIENCE OF ASTROBIOLOGY... AND THE SEARCH FOR BIOLOGICAL EVIDENCE OF LIVING ORGANISMS, PAST AND PRESENT.

42. *ESA search for planets*

**NARRATION**

SINCE 1995, THIS SEARCH HAS EXTENDED BEYOND OUR SOLAR SYSTEM AS ASTROBIOLOGISTS HAVE IDENTIFIED MORE THAN 100 PLANETS ORBITING NEARBY STARS.

43. *Reveal earth from behind moon.*

**NARRATION**

EACH OF THEM IS A GAS GIANT...MUCH LIKE JUPITER

WHILE FEW SCIENTISTS BELIEVE THAT THESE ALIEN WORLDS CAN SUSTAIN EVEN SIMPLE LIFE, THEIR DISCOVERIES REPRESENT IMPORTANT STEPS TOWARD ANSWERING A QUESTION THAT WILL SHAPE ASTRONOMY IN THE 21<sup>ST</sup> CENTURY:

ARE HABITABLE PLANETS RARE OR COMMON IN THE UNIVERSE?

44. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

I'm an astrobiologist, and the area that I've done the most work in is, lately is in the field of extra solar planets.

45. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

"...What motivates me is just to examine the conditions necessary for life and look elsewhere in the universe and see if those conditions are met anywhere else. And the answer could be 'yes' and the answer could be 'no.' And either answer is interesting...."

46.

**NARRATION**

GUILLERMO GONZALEZ WORKS AS A RESEARCH SCIENTIST IN NASA'S ASTROBIOLOGY PROGRAM.

HIS INTEREST IN THIS FIELD IS TIED TO HIS EARLY FASCINATION WITH THE PROSPECT OF LIFE BEYOND THE EARTH.

47. *Guillermo Gonzalez intro / Apollo footage*

**GUILLERMO GONZALEZ**

"I grew up in the 1960s and like most other people of my generation, I was really amazed by the Apollo lunar landings and that really inspired me and had something to do with my getting interested in astronomy.

48. *Milky Way picture*

**GUILLERMO GONZALEZ**

"In my early years, I came to believe, very strongly, that there must be other civilizations out there, that the galaxy was teeming with life. So I was a strong supporter of the search for extra-terrestrial intelligence ...

My belief wasn't based on any real hard-core scientific arguments. It was just the impression that I had, that the galaxy was such a big place.

49. *Guillermo Gonzalez on camera*

**GUILLERMO GONZALEZ**

"And I didn't give the other side of the equation much thought. In other words, there's two sides of the equation. There's the number of stars, the number of trials, if you will. But, the other side is the factors ...it takes a lot of factors to have a habitable planet in a planetary system."

50. *Factors montage*

**NARRATION**

FOR GONZALEZ AND OTHER ASTROBIOLOGISTS, THESE FACTORS—REQUIRED FOR THE EARTH'S HABITABILITY—BECAME THE FOCUS OF EXTENSIVE RESEARCH.

51. *Interview Charles Beichman/ Nasa*

**CHARLES BEICHMAN**

"We've demonstrated in dozens of different ways, that the laws of physics and chemistry that pertain in a laboratory anywhere on Earth, apply anywhere in the solar system, apply anywhere in the galaxy, and out, in many cases, to the most distant galaxies that we can see."

52. *Interview Bijan Nemati*

**BIJAN NEMATI**

"There are, indeed, unchanging physical laws in the universe that apply to the entirety of the universe. They are not localized to one place."

53. *Big surf*

**NARRATION**

THIS CONSISTENCY IN THE LAWS OF PHYSICS AND CHEMISTRY HAS LED MANY RESEARCHERS TO CONCLUDE THAT THE FACTORS NECESSARY FOR COMPLEX LIFE ON EARTH, ARE ALSO THE BEST PARAMETERS IN THE SEARCH FOR HABITABLE PLANETS ELSEWHERE IN THE UNIVERSE.

54. *Rushing water*

MOST SERIOUS DISCUSSIONS ABOUT THESE FACTORS BEGIN WITH THE SAME PREREQUISITE—LIQUID WATER.

55. *Interview Bijan Nemati*

**BIJAN NEMATI**

“All the searches that are being done for life elsewhere...their starting position is a terrestrial class planet, with water.”

56. *Lake material*

**NARRATION**

IT IS NOW WIDELY RECOGNIZED THAT THE CHEMICAL PROPERTIES OF WATER ARE EXQUISITELY SUITED FOR CARBON-BASED LIFE.

57. *Lake/water drops*

**NARRATION**

THESE PROPERTIES INCLUDE WATER’S ABILITY TO DISSOLVE AND TRANSPORT THE CHEMICAL NUTRIENTS VITAL TO ALL LIVING ORGANISMS ...

58. *Lake*

**NARRATION**

... AND ITS UNMATCHED CAPACITY TO ABSORB HEAT FROM THE SUN—A PROCESS CRITICAL FOR REGULATING THE EARTH’S SURFACE TEMPERATURE.

59. *CU water drop falls to pond. Concentric circles dissolve to Solar System animation*

**NARRATION**

IN LIQUID FORM, WATER IS AN EXTRAORDINARY SUBSTANCE ...AND ITS EXISTENCE HINGES UPON ANOTHER FACTOR ESSENTIAL TO COMPLEX LIFE—A PLANET’S DISTANCE FROM ITS HOME STAR.

60. *Interview Kevin Grazier*

**KEVIN GRAZIER**

“It’s like what they say in real estate, ‘location...location...location.’

(on-camera)

A habitable planet lives in what we call the ‘Goldilocks Zone.’ It’s not too hot. It’s not too cold. It’s just right. And when I say, ‘just right,’ I mean, just right for water.”

61. *Interview Charles Beichman*

**CHARLES BEICHMAN**

“Liquid water really helps define the habitable zone. If it’s too hot, the water just boils away, you can’t get condensed water. If it’s too cold (as it is on Mars, today), it just freezes out.”

62. *Animation - Define habitable zone*

**NARRATION**

WITHIN OUR SOLAR SYSTEM, THE HABITABLE ZONE IS RELATIVELY NARROW—BEGINNING WELL OUTSIDE THE ORBIT OF VENUS AND ENDING SHORT OF THE ORBIT OF MARS.

63. *Animation—moves us closer to sun. Follow with Venus footage.*

**NARRATION**

IF THE EARTH WERE JUST 5% CLOSER TO THE SUN, IT WOULD BE SUBJECT TO THE SAME FATE AS VENUS—A RUNAWAY GREENHOUSE EFFECT, WITH TEMPERATURES RISING TO NEARLY 900 DEGREES FAHRENHEIT.

64. *Animation—earth surface turns into Mars.*

**NARRATION**

CONVERSELY, IF THE EARTH WERE ABOUT 20% FARTHER FROM ITS HOME STAR, CARBON DIOXIDE CLOUDS WOULD FORM IN ITS UPPER ATMOSPHERE—INITIATING THE CYCLE OF ICE AND COLD THAT HAS STERILIZED MARS.

65. *Interview Jay Richards*

**JAY RICHARDS**

“The presence of liquid water is a necessary condition for life. But it is not a sufficient condition.

After all, there may be liquid water under the frozen surfaces of Mars and Jupiter’s moon, Europa ...but there’s very little chance that complex life exists in either of these places.

"You see, contrary to what the Copernican Principle might suggest, the recipe for life is much more complex than “just add water.”

66. *Morph—dead planet to Earth*

**NARRATION**

IF A RECIPE FOR A PLANET CAPABLE OF SUPPORTING COMPLEX LIFE REALLY DID EXIST...THEN WHAT INGREDIENTS—BEYOND LIQUID WATER—MIGHT BE REQUIRED?

THE LIST OF NECESSARY FACTORS CONTINUES TO GROW.

67. *Effx followed by aerials over the Earth/ graphic-- “terrestrial planet.”*

**GUILLERMO GONZALEZ**

“We live on this paper-thin crust on the Earth...if the Earth’s crust were significantly thicker, then, plate tectonic recycling could not take place.”

68. *Aerials over Earth*

**NARRATION**

THE EARTH’S CRUST VARIES IN THICKNESS FROM ABOUT FOUR TO THIRTY MILES. IT CONSISTS OF MORE THAN A DOZEN TECTONIC PLATES THAT ARE IN CONSTANT MOTION.

THIS DYNAMIC GEOLOGY REGULATES THE PLANET’S INTERIOR TEMPERATURE, RECYCLES CARBON, MIXES CHEMICAL ELEMENTS ESSENTIAL TO LIVING ORGANISMS...AND SHAPES THE CONTINENTS.

69. *Animation—Sun’s radiation/ magnetic field animation*

**NARRATION**

DEEP WITHIN THE EARTH’S INTERIOR THE MOVEMENT OF LIQUID IRON GENERATES A PROTECTIVE MAGNETIC FIELD ESSENTIAL TO COMPLEX LIFE.

70.

**NARRATION**

IF OUR PLANET WERE SMALLER, ITS MAGNETIC FIELD WOULD BE WEAKER, ALLOWING THE SOLAR WIND TO STRIP AWAY OUR ATMOSPHERE ...SLOWLY TRANSFORMING THE EARTH INTO A DEAD, BARREN WORLD MUCH LIKE MARS.

71. *Interview Bijan Nemati*

**BIJAN NEMATI**

“We need an oxygen atmosphere...and the oxygen/nitrogen atmosphere that the Earth has is necessary for complex life.”

72. *Atmosphere from space*

**NARRATION**

AS SEEN FROM SPACE, THE EARTH’S ATMOSPHERE GLOWS AS A THIN BLUE RIBBON OF LIGHT.

73. *Nitrogen 78%, 21% Oxygen 21%, 1% CO<sub>2</sub>, and Other Gases 1%*

**NARRATION**

MEASURING LESS THAN 1% OF THE PLANET’S DIAMETER, IT IS COMPOSED OF A MIXTURE OF NITROGEN, OXYGEN, AND CARBON DIOXIDE.

74. *TL clouds*

**NARRATION**

AS A RESULT, OUR ATMOSPHERE ENSURES A TEMPERATE CLIMATE, PROTECTION FROM THE SUN'S RADIATION, AND THE CORRECT COMBINATION OF GASES NECESSARY FOR LIQUID WATER AND COMPLEX LIFE.

75. *Moon*

**KEVIN GRAZIER**

“For the size of a planet like Earth, our moon is big. The current thinking is that if our moon didn't exist, neither would we.”

76. *Moon orbits Earth/ axis designation*

**NARRATION**

ONE-FOURTH THE SIZE OF THE EARTH, THE MOON'S POWERFUL GRAVITATIONAL PULL STABILIZES THE ANGLE OF ITS AXIS AT A NEARLY CONSTANT 23 AND A-HALF DEGREES.

THIS ENSURES RELATIVELY TEMPERATE SEASONAL CHANGES ... AND THE ONLY CLIMATE IN THE SOLAR SYSTEM MILD ENOUGH TO SUSTAIN COMPLEX LIVING ORGANISMS.

77. *Sun*

**KEVIN GRAZIER**

“If we find life out there—especially complex or even, intelligent life--it will be around a star similar to our own.”

78. *Sun*

**NARRATION**

WE ORBIT WHAT IS KNOWN AS A “SPECTRAL TYPE G2, DWARF MAIN SEQUENCE” STAR. IT IS WELL SUITED FOR OUR NEEDS.

79. *Animation – shrinking sun*

**NARRATION**

IF THE SUN WERE LESS MASSIVE (LIKE 90% OF THE STARS IN THE GALAXY), THE HABITABLE ZONE WOULD BE SMALLER.

TO REMAIN WITHIN ITS BOUNDRIES, THE EARTH WOULD HAVE TO BE POSITIONED CLOSER TO ITS STAR. HERE, INCREASED GRAVITY WOULD LOCK OUR PLANET'S ROTATION INTO SYNCHRONIZATION WITH ITS ORBIT.

80. *Animation – Earth lock orbit*

**NARRATION**

WHILE, ONE SIDE OF THE EARTH CONTINUALLY FACED THE SUN AND INCREASED RADIATION FROM SOLAR FLARES... THE DARK SIDE OF THE PLANET WOULD LAY SHROUDED IN PERPETUAL COLD AND ICE.

IT IS UNLIKELY COMPLEX LIFE COULD TOLERATE THESE DRASTIC EXTREMES IN TEMPERATURE.

81. *Interview Kevin Grazier*

**KEVIN GRAZIER**

“A lot of things went right on Earth to have yielded complex life. Absolutely.”

82. *Interview Bijan Nemati*

**BIJAN NEMATI**

“The number of factors that have been postulated has grown. Currently the typical number you’ll see in a typical list would have something like 20.”

83. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

“We find that we need to be in the right location in the galaxy...that we’re inside the Circumstellar Habitable Zone of a star...that we’re in a planetary system with giant planets that can shield the other planets from too many comet impacts...that we’re orbiting the right kind of star that’s not too cool or not too hot... that we’re on a planet that has a moon that can stabilize the tilt of its axis...that we’re on a planet that’s a terrestrial planet...a planet that has a crust that’s just thick enough to maintain plate tectonic activity...that has enough heat in its interior that its still circulating its liquid iron core so it can generate a magnetic field...that has an atmosphere that has enough oxygen to allow for complex organisms to survive...that has enough water and enough continents that allow for the diversity of life and an active biodiversity that you need to support complex creatures such as ourselves...”

84.

**GUILLERMO GONZALEZ**

“All these factors have to be met at one place and time in the galaxy if you’re going to have a planet as habitable as the Earth, which you need for complex and even technological life.”

85. *NASA Earth at night/ super equation*

**NARRATION**

IN AN ATTEMPT TO ESTIMATE THE PROBABILITY OF ATTAINING THIS COMBINATION OF FACTORS, SIMULTANEOUSLY, SOME RESEARCHERS HAVE DEVELOPED EQUATIONS—ASSIGNING A CONSERVATIVE “ONE-IN-TEN” VALUE TO EACH FACTOR DEEMED NECESSARY FOR ADVANCED LIFE.

86. *Factors in the equation with 1/10's*

**BIJAN NEMATI**

“...if every element has to be there at the same time. You have to multiply the probabilities ... And that’s what makes the probability at the end so small. You’ve got 10% of this and 10% of that. And these things rapidly multiply to exceedingly small numbers.

“... numbers on the order of  $10^{-15}$ , which is one one-thousandth of one, one trillionth.

“... and it’s a number like that, that you have to compare to the 100 billion stars that are in the galaxy. 100 billion is a very large number, but a thousandth of a trillionth is much, much smaller.

“On their face value, these probabilities are speaking. What they are telling us that is ‘this can't happen, or this is very unlikely to happen in the galaxy.’ And that’s where the evidence is pushing us.”

87. *Puzzle pieces fall make earth*

**GUILLERMO GONZALEZ**

“There are many probabilistic resources in the galaxy. But, on the other side of the coin, are all of these factors that you need. You have to get just right in order to have just one habitable planet like the Earth ...and that leads me to conclude that yes, we’re rare in the galaxy.”

88. *Brownlee in lab*

**NARRATION**

WHILE A GROWING BODY OF SCIENTIFIC EVIDENCE MAY SUPPORT THIS HYPOTHESIS, DOES THE POSSIBILITY THAT OUR PLANET IS RARE WITHIN THE GALAXY IMPLY ANYTHING ABOUT ITS SIGNIFICANCE?

89. *Brownlee in lab/ book cover*

**NARRATION**

RECENTLY, ASTRONOMER, DONALD BROWNLEE CONSIDERED THIS QUESTION IN THE BEST SELLING BOOK, “*RARE EARTH: WHY COMPLEX LIFE IS UNCOMMON IN THE UNIVERSE.*”

90. *Interview Don Brownlee*

**DON BROWNLEE**

“There’s a general feeling that nature wants to make earth-like planets and that, naturally, life will evolve on them...and, naturally, evolve into something like us, and yet...”

“...the conditions, the environmental conditions on a planet that would allow more complex creatures similar to people or plants and animals is very rare.”

“...and so, we wrote the book, *Rare Earth*, to point out that the Earth is, actually, a rather special place...”

91. *Microbes/ complex life*

**NARRATION**

BROWNLEE CONTENDS THAT, WHILE RELATIVELY SIMPLE MICROBIAL LIFE MAY THRIVE ON PLANETS THROUGHOUT THE UNIVERSE...PLANETS CAPABLE OF SUSTAINING COMPLEX LIFE ARE EXCEEDINGLY UNCOMMON.

92. *Interview Don Brownlee*

**DON BROWNLEE**

“The entire universe is highly hostile to life. If you compare all the known places in the universe, none of them compare to Earth.”

93. *Plant life on earth*

**DON BROWNLEE**

“We live in a very special environment, that provides what we need. Air, food, stable conditions...so the Earth is almost like a giant organism where systems are interacting in a way that allows animals to survive.”

94. *Interview Don Brownlee*

**DON BROWNLEE**

“The real question is, ‘why did this happen?’ Was it just a matter of luck or not?”

(vo)

If you look at thousands of planets, only a small fraction of them, a very small fraction, will be truly Earth-like.”

95. *Cosmic slot machine*

“So if we are very rare, we did win the cosmic lottery. So, we’re a lucky planet. We’re just in a very fortunate place.”

96. *Interview Jay Richards*

**JAY RICHARDS**

"When you consider "chance" as an explanation for a planet like Earth, you have to look at it in the context of the universe, as a whole.

97. *Interview Jay Richards*

**JAY RICHARDS**

While the odds appear astonishingly small that you'd get all the right ingredients to support complex life at this one place in the galaxy, you have to keep in mind that our galaxy is just one of perhaps a hundred billion galaxies in the observable universe.

98. *Interview Jay Richards*

**JAY RICHARDS**

"... still, logically, I think you have to ask yourself, 'What if this convergence of factors didn't come about as the result of simply a cosmic lottery...or a mere fluke or luck? But, what if it's the result of some larger underlying purpose or design?"

99. *Earth from space*

"And if the Earth does exist for a purpose, is there any way that we could tell?"

100. *Eclipse shadow moves over Earth.*

**NARRATION**

ON OCTOBER 24th, 1995, A RARE NATURAL PHENOMENON UNEXPECTEDLY TRIGGERED A UNIQUE SEARCH FOR AN ANSWER.

101. *India eclipse footage. Location. Scientists setting up equipment.*

**GUILLERMO GONZALEZ**

"It started with an experience I had in 1995. I went to observe a total eclipse of the Sun in India. It was my first and only total eclipse of the sun. It was a spectacular event. It's just an experience for all the emotions. ..."

102. *People watch eclipse/filtered eclipse*

**GUILLERMO GONZALEZ**

"Either astronomers who can understand the whole phenomenon...who can predict it to within a second of time anywhere on the Earth, or a local native are equally in awe, in reacting in the same way to this incredible phenomenon.

"...It really left a big impression on me."

103. *Real time eclipse.*

**NARRATION**

FOR 51 UNFORGETTABLE SECONDS, GUILLERMO GONZALEZ (AND THOUSANDS OF OTHERS) LOOKED ON IN WONDER AT THIS RARE ASTRONOMICAL EVENT

104.

**NARRATION**

GONZALEZ WOULD LATER REFLECT UPON BOTH THE MYSTERIOUS BEAUTY HE HAD WITNESSED IN THE NORTH INDIAN SKIES...AND THE FACTORS THAT HAD MADE IT POSSIBLE.

105.

**GUILLERMO GONZALEZ**

“The requirements for producing a total eclipse of the sun are a luminous body, in our case the sun...

106. *Positional animation*

**GUILLERMO GONZALEZ**

“...an eclipsing body (in our case, the moon)...and an observer platform (in our case the surface of the Earth). And they all have to be in a straight line in space.”

107. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

“The apparent size of the moon in the sky has to be almost exactly the same as the apparent size of the sun of the sky. They’re both about half a degree.”

108. *Animation*

**GUILLERMO GONZALEZ**

“The sun is four hundred times bigger than the moon, but it’s four hundred times further away.

“So, there’s this coincidence people have noted for centuries...but they just said, ‘oh well, it’s a coincidence’...and shrugged their shoulders...”

109. *Move in slowly on animation toward moon*

**NARRATION**

AS GONZALEZ EXAMINED THIS RARE ALIGNMENT OF SUN, MOON, AND EARTH, HE RECOGNIZED THE IMPORTANCE OF THESE CELESTIAL BODIES TO THE EXISTENCE OF COMPLEX LIFE ON OUR PLANET.

110. *Move over moon to reveal Earth*

**NARRATION**

THE GRAVITATIONAL PULL EXERTED BY OUR MOON, FOR EXAMPLE, IS STRONG ENOUGH TO REGULATE THE EARTH'S CLIMATE BY STABILIZING ITS TILT AND HELPING TO CIRCULATE THE WARM AND COLD WATERS OF ITS OCEANS.

111. *Sun/ocean*

**NARRATION**

WHILE OUR PLANET'S DISTANCE FROM THE SUN PERMITS BOTH LIQUID WATER AND AN OXYGEN-RICH ATMOSPHERE.

112. *Sunset/ocean*

**GUILLERMO GONZALEZ**

“You have to have the right distance of the observer's home planet from its host star and you have to have a large moon.

113. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

“And so there's this very strong overlap between the requirements for producing eclipses and the requirements for habitability, for having a planet that can support life.”

114. *Magazine/ article*

**NARRATION**

IN 1999, GONZALEZ DESCRIBED THIS RELATIONSHIP BETWEEN OUR SURVIVAL AND OUR ABILITY TO OBSERVE SOLAR ECLIPSES IN THE JOURNAL, *ASTRONOMY AND GEOPHYSICS*.

HIS IDEAS INTRIGUED PHILOSOPHER, JAY RICHARDS.

115. *Interview Jay Richards*

**JAY RICHARDS**

“I had been focusing my research in cosmology, and in particular on applying probability theory to the fine tuning of the laws of physics. I had a strong sense this evidence pointed toward some sort of wider purpose to the universe.

116. *Article*

**JAY RICHARDS**

“Then I read Gonzalez's work and I had the same feeling that he did. That perfect solar eclipses were sort of the tip of the iceberg...the first instance of an entire class of evidence that provides a way for judging if the universe is the result of a fluke or some impersonal process, or the result of purpose or design.”

117. *Research papers*

**NARRATION**

IN THE SUMMER OF 1999, GONZALEZ AND RICHARDS INITIATED A PROGRAM OF JOINT RESEARCH.

118. *Eclipse photo montage*

**NARRATION**

THEY BEGAN THEIR STUDY BY CONSIDERING A CHARACTERISTIC OF SOLAR ECLIPSES LITTLE KNOWN OUTSIDE THE SCIENTIFIC COMMUNITY:

THESE STRIKING EVENTS ARE NOT ONLY COMPELLING TO OBSERVE...THEY ALSO OPEN A PORTAL ONTO THE PHYSICS AND CHEMISTRY OF THE ENTIRE UNIVERSE.

119. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

“Really, you can think of eclipses as a giant natural experiment, a set up that allows us to observe a part of the sun...

.... that’s critical towards understanding how its light is produced in its atmosphere.”

120. *Interview Bijan Nemati*

**BIJAN NEMATI**

“The fact that the Earth is going around the sun and the moon is around the Earth, and the sizes and the distances between the Earth and the moon and the sun are just so to give you a perfect solar eclipse is a wondrous thing...

121. *Corona*

....because it allows us to measure the constituents of the upper layer of the sun’s atmosphere.”

122. *Scientist looks at eclipse through glass filter/ TL wide eclipse*

**NARRATION**

DURING A SOLAR ECLIPSE, THE MOON FITS SO PERFECTLY OVER THE SUN THAT IT SHIELDS ITS BLINDING LIGHT, PROVIDING ASTRONOMERS WITH A VIEW OF THE STAR’S ATMOSPHERE, OTHERWISE IMPOSSIBLE TO EXPERIENCE.

123. *Chromosphere CU/ Flash spectrum*

**NARRATION**

AT THE MOMENT OF TOTALITY, THE PINKISH ARC OF THE CHROMOSPHERE (THE ATMOSPHERE'S INNERMOST LAYER) BECOMES VISIBLE—AND WITH IT, A RAINBOW-LIKE BAND CALLED THE “FLASH” SPECTRUM APPEARS WHEN THE SUN IS VIEWED THROUGH A PRISM.

124. *CU flash spectrum with calibration grid/ super over sun or GG book picture*

**NARRATION**

THE ECLIPSE OF 1870 LED TO AN UNDERSTANDING OF THE STRUCTURE OF THE SUN'S CHROMOSPHERE AND THE DISCOVERY OF HELIUM—THE SECOND MOST ABUNDANT ELEMENT IN THE UNIVERSE.

125. *Old spectrum photo (use photo BW from book)*

**GUILLERMO GONZALEZ**

The spectrum is probably the single greatest source of information about a star. “And it was during a couple of historic eclipses in the nineteenth century that astronomers figured out how the spectrum of the sun is produced. And they were only able to figure it out because of the particular circumstances during a total eclipse.”

126. *Eclipse photo—full sun and chromosphere*

**NARRATION**

THESE CIRCUMSTANCES ARE BOTH PRECISE AND CRUCIAL

127. *Animate larger moon blocking out chromosphere, spectrum disappears*

**NARRATION**

IF OUR MOON WERE SLIGHTLY LARGER, IT WOULD PARTIALLY BLOCK OUR VIEW OF THE CHROMOSPHERE AND DIMINISH ITS SPECTRAL LIGHT.

128. *Animate smaller moon/ sun and impact upon chromosphere and spectrum*

**NARRATION**

A SMALLER MOON WOULD ALLOW TOO MUCH LIGHT FROM THE SUN—DESTROYING OUR VIEW OF THE SOLAR ATMOSPHERE AND FLASH SPECTRUM.

129. *Distant stars*

**GUILLERMO GONZALEZ**

“And so you have to have a nearly perfect match between the sun and the moon so you don’t hide the chromosphere.

And that insight, afforded by eclipses in the nineteenth century, is what finally what permitted astronomers to figure out how the spectra of distant stars are produced.

“... That, really, opened up stellar astrophysics. And allowed us to understand how other stars work...because distant stars, after all, are other suns.”

130. *Camera shutter / sepia photo plates*

**NARRATION**

THE RELATIONSHIP BETWEEN ECLIPSES AND SCIENTIFIC DISCOVERY WAS ALSO REVEALED IN THE SPRING OF 1919.

131. *Eddington/ Eclipse photo*

**NARRATION**

ON MAY THE 29th, RESEARCH TEAMS, HEADED BY BRITISH ASTRONOMER, ARTHUR EDDINGTON, PHOTOGRAPHED THE SUN AND ADJACENT STARS IN THE HYADES STAR CLUSTER, DURING THE DARKNESS OF TOTALITY.

132. *Eddington reversed eclipse/ Einstein portrait/ light bending diagram*

**NARRATION**

LATER ANALYSIS OF THE PICTURES VERIFIED THAT THE SUN’S GRAVITY BENT LIGHT FROM DISTANT STARS TRAVELING TOWARD THE EARTH AT THE ANGLE ALBERT EINSTEIN HAD PREDICTED.

133. *Old Eclipse/ E=MC2 formula*

**NARRATION**

EINSTEIN’S THEORY OF RELATIVITY (AN IDEA THAT REVOLUTIONIZED OUR UNDERSTANDING OF THE UNIVERSE), HAD BEEN CONFIRMED DURING A TOTAL SOLAR ECLIPSE.

134.

**GUILLERMO GONZALEZ**

“That experiment was only possible during eclipses because the stars become visible during a total eclipse.

135. *Interview Guillermo Gonzalez*

“They are very important to the history of science, and...the best place in the entire solar system to view solar eclipses is from the surface of the Earth. I’ve actually calculated the circumstances for eclipses from all the other planets and all the other moons (about sixty five of them), the major moons.

136. *People watching an eclipse*

**GUILLERMO GONZALEZ**

“...And, its an amazing coincidence the one place that has observers, is the one place that has the best eclipses.”

137. *NASA People watching eclipse*

**NARRATION**

WITHIN THE GOSSAMER LIGHT OF A SOLAR ECLIPSE, GONZALEZ AND RICHARDS RECOGNIZED A FASCINATING CONNECTION BETWEEN THE FACTORS NECESSARY FOR BOTH COMPLEX LIFE AND SCIENTIFIC OBSERVATION.

BUT, WAS THIS MERELY AN ISOLATED FLUKE OF NATURE...OR A GLIMPSE AT A PRINCIPLE AND A PURPOSE FUNDAMENTAL TO THE UNIVERSE AS A WHOLE?

138. *Interview Jay Richards*

**JAY RICHARDS**

“That was the million dollar question that we continually had before us.

“What if those things that make a planet habitable also make that planet the best place for making scientific discoveries? That is, what if those rare locations in the universe that are compatible with observers like ourselves, are also the best places, overall, for making observations?”

139.

**NARRATION**

FOR THREE YEARS, RICHARDS AND GONZALEZ METICULOUSLY TESTED THEIR IDEA AGAINST EVIDENCE GATHERED FROM A WIDE RANGE OF SCIENTIFIC DISCIPLINES.

140.

IN THE 2004 BOOK, “THE PRIVILEGED PLANET,” THEY PUBLISHED THEIR HYPOTHESIS:

**SUPERIMPOSITION**

“The same narrow circumstances that allow us to exist also provide us with the best overall setting for making scientific discoveries.”

141. *Galaxy / atmosphere shot*

**JAY RICHARDS**

“In the book we detail more than a dozen examples of the correlation between life and discovery. And they’re not quirky, marginal examples. Each treats a condition critical to its respective scientific field. Some deal with remote things, like the nature of galaxies. Others, are much closer to home.”

142. *Shot of clouds dissipating and sun breaking through, followed by a series of TL clouds.*

**NARRATION**

WHILE A PERFECT SOLAR ECLIPSE WAS THE CATALYST FOR GONZALEZ AND RICHARDS’ HYPOTHESIS...

...THEIR OBSERVATIONS WOULD NEVER HAVE BEEN POSSIBLE WITHOUT ANOTHER, MORE FAMILIAR EXAMPLE OF THE CORRELATION BETWEEN LIFE AND DISCOVERY--THE ATMOSPHERE OF THE EARTH.

143. *Guillermo Gonzalez interview (in box), atmosphere from space montage*

**GUILLERMO GONZALEZ**

“It’s striking when you see pictures of the Earth from the Apollo missions or other spacecraft and you see this very thin layer of the atmosphere surrounding the Earth. It sustains all the life that we know on Earth.

144. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

“And so you need a certain mix of elements to support a complex biosphere like ours, not just any atmosphere will do.”

145. *Voyager/ Galileo/ Magellan space craft*

**NARRATION**

OUR APPRECIATION OF THE EARTH’S ATMOSPHERE HAS INCREASED SIGNIFICANTLY DURING THE PAST 40 YEARS, AS EXPLORATORY SPACECRAFT HAVE PROBED THE SOLAR SYSTEM.

146. *Spacecraft fly-bys*

**NARRATION**

THESE MISSIONS HAVE CONFIRMED, THAT WITHIN THE SUN’S FAMILY OF MORE THAN 70 PLANETS AND MOONS, THE EARTH IS ONE OF SEVEN BODIES ENVELOPED BY A THICK CANOPY OF GAS.

147. *Earth*

**NARRATION**

YET, AMONG THESE SEVEN, ONLY THE EARTH’S ATMOSPHERE CAN SUSTAIN COMPLEX LIFE ...AND ONLY THE EARTH’S ATMOSPHERE IS TRANSPARENT.

148. *Interview Guillermo Gonzalez (in box) views of Earth from space.*

**GUILLERMO GONZALEZ**

“...It’s an atmosphere that’s made up of mostly oxygen and nitrogen with very little carbon dioxide and very little other carbon compounds or atoms in the atmosphere that gives you a transparent atmosphere.

149. *Surface of Titan*

Guillermo Gonzalez

“If we had too much carbon in the atmosphere, we’d get hazes ...organic hazes in the atmosphere. Like you see on the large moon Titan, for example.”

150. *CU Titan and other planets/ thick clouds from Earth*

**NARRATION**

THE DENSE SHROUD OF GAS THAT BLANKETS SATURN’S LARGEST MOON, RESEMBLES THE ATMOSPHERES SURROUNDING NEPTUNE, URANUS, SATURN, JUPITER—AND THE GREENHOUSE CAULDRON OF VENUS.

NONE OF THESE ALIEN WORLDS KNOW THE STARS ...OR EVEN OFFERS A CLEAR VIEW OF THE SUN.

151.

**JAY RICHARDS**

“Now, of course, if you were suddenly transported to Titan or Venus, or one of the outlying gas giant planets, the lack of a clear view of the universe wouldn’t really be much of an issue...because you’d be dead.

But, that’s precisely the point. If we’re right...if the conditions for habitability and scientific discovery appear in the same places, then you’re going to get conditions like you do on Earth—an atmosphere that sustains complex life, like ourselves...and also enables scientific discovery of the universe around us.”

152. *Shuttle shots of earth*

**NARRATION**

THE VIRTUES OF SUCH AN ATMOSPHERE ARE CONTINUALLY TESTED.

153. *Earth moving/ radiation*

**NARRATION**

AS THE EARTH MOVES THROUGH SPACE, IT IS BOMBARDED BY RADIATION FROM THROUGHOUT THE UNIVERSE.

154. *Radiation from sun/ supernova explosion*

**NARRATION**

THIS RADIATION IS EMITTED BY THE SUN...AND OTHER CELESTIAL OBJECTS INCLUDING SUPERNOVAS AND DISTANT GALAXIES.

155. *Super names over Earth/ EM spectrum with names*

**NARRATION**

IT REACHES OUR PLANET IN WAVELENGTHS DESCRIBED AS GAMMA, X-RAY, ULTRAVIOLET, VISIBLE, INFRARED, MICROWAVE AND RADIO. TOGETHER, THEY COMPRISE THE ELECTROMAGNETIC SPECTRUM.

156. *EM spectrum*

**NARRATION**

ALMOST ALL OF THESE WAVELENGTHS ARE INVISIBLE TO THE EYE... AND EITHER LETHAL OR USELESS TO ORGANIC LIFE.

YET, WITHIN THIS SPECTRUM OF FREQUENCIES-- A THIN SLIVER OF RADIATION PROVES ESSENTIAL TO PLANTS, ANIMALS, AND HUMAN BEINGS.

157. *Interview Jay Richards*

**JAY RICHARDS**

“In other words, there’s really just a very narrow part of the electromagnetic spectrum that’s going to be useful for living processes like photosynthesis. It’s not as if life could have evolved to use gamma radiation or x-ray radiation or something like that. There’s really just a narrow part of the spectrum that would be useful to life processes.

Well, as it turns out, that’s also the same narrow part of the spectrum that is the most informative about the various structures we discover in the universe around us.”

158. *EM scale*

**NARRATION**

THESE SPECIFIC FREQUENCIES (THAT ENABLE PLANTS TO MANUFACTURE FOOD AND ASTRONOMERS TO OBSERVE THE COSMOS), REPRESENT LESS THAN 1 TRILLIONTH OF A TRILLIONTH OF THE UNIVERSE’S RANGE OF NATURAL ELECTROMAGNETIC EMISSIONS.

159.

**NARRATION**

FORTUNATELY, IT IS THE TYPE OF LIGHT OUR SUN PRODUCES IN ABUNDANCE...AND THAT MOST EASILY PENETRATES THE FILTERING SHIELD OF OUR ATMOSPHERE TO REACH THE SURFACE OF THE EARTH.

160.

**GUILLERMO GONZALEZ**

It's a remarkable coincidence that the kind of atmosphere that's needed for complex life, like ourselves, does not preclude that life from observing the distant universe."

161.

**GUILLERMO GONZALEZ**

"...it's a surprise. It's something that you wouldn't expect just chance to produce. Why would the universe be such that those places that are most habitable also offer the best opportunity for scientific discovery?"

162. *Guillermo at work*

**NARRATION**

IN 1997, GUILLERMO GONZALEZ BEGAN A STUDY OF THE EARTH'S SPECIFIC LOCATION WITHIN THE MILKY WAY GALAXY.

IT WOULD EVENTUALLY LEAD HIM TO MORE EVIDENCE OF A CORRELATION BETWEEN LIFE AND DISCOVERY.

163. *Habitable zone diagram.*

**GUILLERMO GONZALEZ**

"Just as our location in the Solar System is optimized for habitability, so is our location in the galaxy.

164. *Guillermo Gonzalez in box/ Milky Way model*

**GUILLERMO GONZALEZ**

"We inhabit a spiral galaxy which means that it's highly flattened, it has a spherical bulge in the center and has spiral arms and we live about half way between the center of the galaxy and the edge."

165. *Guillermo Gonzalez looking over galaxy illustration*

**NARRATION**

WORKING CLOSELY WITH ASTROBIOLOGISTS PETER WARD AND DONALD BROWNLEE, GONZALEZ COMPARED OUR POSITION IN THE MILKY WAY TO OTHER REGIONS WITHIN AN OFTEN HOSTILE GALAXY.

166. *Galactic Core animation*

**GUILLERMO GONZALEZ**

“The galaxy has a lot of dangers and, perhaps the most dangerous place in the galaxy is a galactic center.”

167. *Dense stars/ supernovas*

**DON BROWNLEE**

“...Well, in the center of the galaxy, the density of stars is very high—with supernovas, and other things that could harass life, right in the dead center of our galaxy.”

168. *Black hole*

**GUILLERMO GONZALEZ**

“You also have a giant black hole at the very center of the galaxy and if it were to have a close encounter with a star passing near, it would rip it to shreds and form an accretion disc around it and emit lots of radiation, particle radiation and electromagnetic radiation, gamma rays, X-rays ....

169. *Galaxy core—move out toward edge*

**NARRATION**

WHILE A BLACK HOLE, EXPLODING STARS, AND DEADLY RADIATION WOULD MAKE COMPLEX LIFE VIRTUALLY IMPOSSIBLE NEAR THE GALACTIC CORE...

THE OUTER EDGE OF THE MILKY WAY POSES OTHER CHALLENGES TO HABITABILITY.

170. *Edge of galaxy*

**DON BROWNLEE**

"In the outer regions, the situation is much more subtle. We live on a planet made out of iron, magnesium, silicon, and oxygen

If we went in the more distant regions of our galaxy...out toward the outer edge ...the abundance of these heavy elements are lower...

171. *Edge of galaxy*

**GUILLERMO GONZALEZ**

...there probably aren't enough heavy elements to build Earth size planets that can support life.

172. . *Full galaxy*

**GUILLERMO GONZALEZ**

“So there's a happy medium . . . between the dangerous galactic center and the outer edge of the galaxy.”

173. *Galactic Habitable Zone*

**NARRATION**

GONZALEZ, BROWNLEE, AND WARD LABELED THIS REGION (WHERE COMPLEX LIFE IS POSSIBLE WITHIN THE MILKY WAY)-- THE “GALACTIC HABITABLE ZONE.”

174. *Magazine article*

**NARRATION**

THEIR THEORY WAS FIRST PUBLISHED IN 2001...AND, HAS SINCE RECEIVED GROWING ACCEPTANCE AMONG ASTROBIOLOGISTS.

175. *Overlap Galactic Habitable Zone*

**GUILLERMO GONZALEZ**

“There’s a lot more research that needs to be done to determine just how wide the habitable zone is, but I think there’s general agreement, that, “Yes, there are definitely places in the galaxy that you cannot have civilizations because they’re very dangerous, and there are places where you just have a very low abundance of heavy elements...”

176. *Galaxy full—move toward arms*

**NARRATION**

WHILE THESE OBSTACLES TO HABITABILITY ARE MINIMIZED FAR FROM THE CORE AND EDGE OF THE MILKY WAY, GONZALEZ HAS ALSO IDENTIFIED LARGE AREAS WITHIN THE GALACTIC HABITABLE ZONE, ITSELF, WHICH ARE LESS HOSPITABLE TO COMPLEX LIFE.

177. *Supernova explosions*

**GUILLERMO GONZALEZ**

“Even within the habitable zone in the galaxy, it’s broken by the spiral arms ... which are dangerous places. That’s where most of the supernovae go off in the galaxy. That’s where the star formation is taking place.

178. *Interview Bijan Nemati*

**BIJAN NEMATI**

“We don’t want to be too close to a spiral arm. We want to be outside a spiral arm at about the right region of the galaxy.”

179. *Between galactic arms*

**NARRATION**

IT APPEARS THIS IS PRECISELY WHERE THE EARTH IS LOCATED—IN THE RELATIVELY SAFE AND UNCROWDED REGION BETWEEN THE SAGITARIUS AND PERSEUS ARMS OF THE MILKY WAY.

180. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

“Location is everything. And so we occupy that special place in the galaxy where habitability is optimized, threats are minimized, and we have enough building blocks to build an Earth.”

181. *Galactic Habitable zone*

**NARRATION**

GUILLERMO GONZALEZ AND JAY RICHARDS HAVE CONDUCTED RESEARCH ON ANOTHER FACET OF THE GALACTIC HABITABLE ZONE.

THEY NOW ARGUE THAT THE EARTH IS ALSO LOCATED IN THE BEST SETTING WITHIN OUR GALAXY FOR ASTRONOMICAL RESEARCH.

182. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

“As it turns out, our position in the universe is not only critical for life but it’s also surprisingly important for making scientific discoveries.”

183. *View between galactic arms*

**GUILLERMO GONZALEZ**

We’re located near the mid-plane of the galaxy, a fairly highly flattened galaxy, between spiral arms in the region with very low dust extinction. While we are in the plane in the galaxy, that does not obscure a large part of the sky so we can have very clear views.

184.

**NARRATION**

FOR MORE THAN A CENTURY, THIS NEARLY IDEAL PLATFORM OF OBSERVATION HAS ENABLED ASTRONOMERS TO STUDY THE STRUCTURE OF THE MILKY WAY.

185. *Starry sky*

LOOKING TOWARD THE CONSTELLATION SAGITTARIUS ON A CLEAR NIGHT, FOR EXAMPLE, WE SEE THAT THE STARS IN OUR GALAXY ARE NOT UNIFORMLY DISTRIBUTED ACROSS THE SKY.

INSTEAD, THEY APPEAR AS PART OF A CONCENTRATED BAND --A FLATTENED DISK OF STARS, DUST, AND GAS 100 THOUSAND LIGHT YEARS IN DIAMETER.

186. *Milky Way night sky*

**GUILLERMO GONZALEZ**

“The Milky Way band in the night sky is us looking edge on into the plane of the galaxy.”

“If we were living in the center of the galaxy things would be much more spherically distributed, so it would be very hard to distinguish things inside the galaxy from things that are outside.”

187. *Move toward galaxy core*

**GUILLERMO GONZALEZ**

“It’s also very dusty...much dustier toward the galactic center than it is in our region. And so, views of the distant universe would be much more difficult to obtain. They would be much more compromised.”

188. *Travel through spiral arm*

**NARRATION**

SIMILAR PROBLEMS WOULD EXIST FOR ASTRONOMERS WORKING ON A PLANET LOCATED WITHIN ANY OF THE GALAXY’S SPIRAL ARMS.

HERE, DENSER CONCENTRATIONS OF DUST CLOUDS AND GAS ILLUMINATED BY STARS WOULD MAKE IT DIFFICULT TO DETERMINE THE SHAPE OF THE MILKY WAY ...OR TO DISTINGUISH THE STARS IN OUR GALAXY FROM THE REST OF THE UNIVERSE.

189. *Interview Jay Richards*

**JAY RICHARDS**

“On the surface of the Earth, we’re really in the optimum position for seeing both the nearby structure of the Milky Way galaxy, as well as seeing the distant cosmos, as a whole.

So, once again, we see that best location for habitability and for producing a habitable planet is also the best overall position in the universe for scientific discovery. In this case, at the galactic scale.”

190. *Super:*

*“The most incomprehensible thing about the universe is that it is comprehensible.”*

*Albert Einstein*

191. *Interview Jay Richards*

**JAY RICHARDS**

“For centuries, the fact that we can discover things about the universe has really been something of a mystery.

Why would beings like ourselves be able to discover a universe like this? Why is what we think about the universe...why would it correspond to the way things really are?”

192. *Interview Paul Davies*

**PAUL DAVIES**

“...our ability to discern and understand the universe is a fundamental part of what makes the universe tick. So that we’re linked into it (this isn’t an accident, a trivial little by-product--it is something that is linked to the great cosmic scheme of things. Now, I have no idea how that linkage works, why it’s there, or, any of that sort, but I’m very, very struck by the fact that we can understand the universe in such exquisite detail, and at such a deep level.”

193. *Observatory*

**NARRATION**

THE SPECTACULAR PROGRESS OF MODERN ASTRONOMY AND PHYSICS IS THE PRODUCT OF A UNIVERSE ACCESSIBLE TO THE HUMAN EYE AND MIND.

194. *Super forces/ constants. End with “gravity.”*

**NARRATION**

IT IS A UNIVERSE GOVERNED BY LAWS AND FORCES THAT, LITERALLY, HOLD OUR PLANET EARTH—AND THE ENTIRE COSMOS--TOGETHER...AND ARE FINELY CALIBRATED TO ALLOW FOR BOTH COMPLEX LIFE AND SCIENTIFIC DISCOVERY.

195. *Interview Robin Collins*

**ROBIN COLLINS**

“...if you didn’t have something like gravity that pulled matter together, you wouldn’t never get planets, you wouldn’t get stars, you wouldn’t get any complex organisms...

If you didn’t have the strong nuclear force, there would be nothing to hold protons and neutrons together in the nucleus. So you wouldn’t have any atoms. So no chemistry.

If you didn’t have the electromagnetic force, you’d have no bonding between chemicals. You’d have no light.”

196.

**ROBIN COLLINS**

“...and the list goes on. You need all these sorts of fundamental principles. They have to be in place in order for life to occur. Wipe out one of these principles, wipe out one of these laws—no life.”

197.

**NARRATION**

DURING THE PAST 40 YEARS, SCIENTISTS HAVE DETERMINED THE RELATIVE STRENGTHS OF EACH OF THESE PRIMARY LAWS AND FORCES.

THESE STRENGTHS ARE SO CRITICALLY BALANCED, THEY ARE OFTEN DESCRIBED AS BEING, “FINELY-TUNED.”

198. *Interview Jay Richards*

**JAY RICHARDS**

“...if you’re to take the basic, fundamental constants of nature;, and you were to change these, even slightly, or you were to pick their values at random – you would almost never get a universe that would be habitable in any sort of way.

That is, you couldn’t have galaxies, you couldn’t have planets, you couldn’t have complex biological organisms, if these fundamental constants were even slightly different – slightly stronger, slightly weaker than they actually are in this universe. That’s the idea of fine-tuning.”

199. *Constants adjustment machine / universe*

**NARRATION**

TO BETTER APPRECIATE THIS CONCEPT, IMAGINE A MACHINE ABLE TO CONTROL THE STRENGTHS OF EACH OF THE PHYSICAL CONSTANTS.

200.

IF YOU CHANGED—EVEN SLIGHTLY FROM ITS CURRENT SETTING—THE STRENGTH OF ANY ONE OF THESE FUNDAMENTAL FORCES (SUCH AS GRAVITY), THE IMPACT ON COMPLEX LIFE WOULD BE CATASTROPHIC.

201.

**ROBIN COLLINS**

“...if you increased it by a little bit—no large scale life forms could exist...anything that was more than the size of a pea would be completely crushed.

So you might be able to get life of a very, very primitive sort, like bacteria, but you could never get conscious observers.”

202. *Interview Paul Davies*

**PAUL DAVIES**

“This is one of a long list of properties in underlying physics that seem to be prerequisites for a universe with life. For, example, the strengths of the other forces are all important. The masses of the sub-atomic particles. If all of these things were even a little bit different, then certainly, life as we know it could not exist.

203. *Constants adjustment machine*

**NARRATION**

THESE FORCES AND CONSTANTS ARE ANOTHER EXAMPLE OF THE CORRELATION BETWEEN LIFE AND DISCOVERY...FOR NOT ONLY ARE THEY FINELY TUNED FOR OUR EXISTENCE, THEY CAN ALSO BE UNDERSTOOD.

204.

**GUILLERMO GONZALEZ**

“It’s remarkable how well the laws work, and not only that it’s remarkable how simple they are. And that also is related to the discoverability of the laws.”

205.

**NARRATION**

ALBERT EINSTEIN WROTE, “I HAVE DEEP FAITH THAT THE PRINCIPLES OF THE UNIVERSE WILL BE BOTH BEAUTIFUL AND SIMPLE.”

FOR NEARLY 400 YEARS, SCIENTISTS HAVE DISCOVERED AN ELEGANT SIMPLICITY IN THE MATHEMATICAL EQUATIONS THAT EXPRESS AND UNLOCK THE LAWS OF THE COSMOS.

206. *Interview Jay Richards*

**JAY RICHARDS**

“... it’s been said that many of the most important theories in theoretical physics can be written on a single sheet of paper and this, I think, ought to be considered surprising – that such...such a simple formula or equation could have such far reaching applications to a very complicated and very large universe.

207. *Interview Robin Collins*

**ROBIN COLLINS**

“What you have is a universe that is not only finely tuned for life to occur, but also has a beautiful, elegant mathematical structure, and a structure such that we can discover that structure.

208. *Interview Paul Davies*

**PAUL DAVIES**

“Most scientists take it for granted that the world is both ordered and intelligible. And, the intelligible part, I find, is really quite extraordinary. It’s one thing to accept the universe as ordered, but ordered in a way that human beings are capable of understanding is an extraordinary thing.

“And so the question naturally arises—‘what is the explanation for that?’”

209.

MANY WHO HAVE PONDERED THIS MYSTERY OF AN INTELLIGIBLE UNIVERSE ARGUE THAT IT CANNOT BE EASILY EXPLAINED AWAY.

210. *Interview Robin Collins*

**ROBIN COLLINS**

“From naturalistic assumptions, you would not expect the universe to be understandable by human reason. After all, within the standard naturalistic story, human reason was developed to be able to hunt prey, get around in the everyday world, attract mates.

211. *Interview Paul Davies*

**PAUL DAVIES**

“We have certain skills, for example--we can jump streams and catch falling apples—which are necessary for getting by in the world.

“...but, why is it that we also have the ability to discern , for example, what’s going on inside atoms or inside black holes. These are completely outside the domain of everyday experience...totally surface requirements...not at all necessary for good Darwinian survival ...

212. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

“Discoverability of the universe is something we didn’t need for our existence. This is something additional to it. It seems that whatever the source of the universe is, it intended that it contain observers who can discover.”

213. *Interview Jay Richards*

**JAY RICHARDS**

“You put observers in the best places for observing. That is, if you’re going to do things intelligently, that’s what you’d do.”

214. *Interview Jay Richards*

**JAY RICHARDS**

“...the nature of our planet, the nature of its atmosphere, the location in the solar system, the type of solar system it’s in, even the type of star that we’re around and the location within the galaxy, are optimal for making a wide range of scientific discoveries. It turns out that those are also all the very most...most important conditions for a habitable planet, that is for a planet that’s conducive to beings like us and without which we could not survive. I think, that’s just the sort of pattern that ought to suggest to people conspiracy, rather than mere coincidence.”

215. *Interview Guillermo Gonzalez*

**GUILLERMO GONZALEZ**

“...there’s something about the universe that can’t be simply explained just by the impersonal forces of nature and atoms colliding with atoms. And so, you have to reach for something beyond the universe to try to account for it.”

216. *Copernicus diagrams*

**NARRATION**

SUCH AN APPROACH LIES AT THE FOUNDATION OF MODERN SCIENCE.

217. *Diagrams/ Copernicus*

**NARRATION**

IN HIS SEARCH FOR A MORE ELEGANT DESCRIPTION OF THE SOLAR SYSTEM, NICHOLAS COPERNICUS WAS MOTIVATED BY HIS DESIRE TO COMPREHEND WHAT HE CALLED, “THE MECHANISM OF THE UNIVERSE, WROUGHT FOR US BY A SUPREMELY GOOD AND ORDERLY CREATOR...THE SYSTEM THE BEST AND MOST ORDERLY ARTIST OF ALL FRAMED FOR OUR SAKE.”

218. *Interview Dennis Danielson*

**DENNIS DANIELSON**

“And so he imagined this analogy of a workman or craftsman making something that worked well and was beautiful. That analogy wasn’t one of his conclusions...that analogy was one of his assumptions.”

219. *Interview Jay Richards*

**JAY RICHARDS**

“The founders of modern science like Copernicus and Kepler and Galileo and Newton himself believed that the universe was the product of a mind – that it was intelligible to beings like ourselves because the universe itself was the product of an intelligent being.”

220. *Interview Paul Davies*

**PAUL DAVIES**

“They were driven by this notion that this was, essentially, a theological quest. They were uncovering God’s handiwork in the way the world works.”

“I mean, what a thought—we can glimpse the mind of God. We can actually figure out how God put the universe together. So there is a hidden subtext in nature which can be exposed through this procedure we call, ‘science.’”

221. *Mt. Wilson observatory/ begin trip out*

**NARRATION**

THOUGH MOST SCIENTISTS NO LONGER THINK IN SUCH EXPLICITLY THEOLOGICAL TERMS, RECENT EVIDENCE MAY AGAIN POINT TO AN EARTH FAR DIFFERENT FROM THE CONTEMPORARY IMAGE OF A PALE BLUE DOT LOST IN A COSMIC SEA.

222. *Interview Jay Richards/ trip through the universe*

**JAY RICHARDS**

“We’ve often been told, especially in the 20<sup>th</sup> century, that the universe does not have us in mind. That is, that we exist in a very large universe and that the universe was not designed for beings like us.. We are simply life that happened to come about on a tiny little planet, surrounding a tiny, insignificant star, in a run of the mill galaxy, within a very large universe, that was not intended.

223. *Interview Jay Richards*

**JAY RICHARDS**

Our argument suggests something completely different. It suggests that the universe was intended, that the universe exists for a purpose. And, that purpose isn’t simply for beings like ourselves to exist, but for us to extend ourselves, beyond our small and parochial home to view the universe at large –to discover the universe and, in fact perhaps, to consider whether that universe points beyond itself

224. *Travel through large scale structure of the Universe*

**NARRATION**

AS WE GAZE EVER DEEPER INTO THE UNIVERSE, WE ARE  
INEVITABLY DRAWN BACK TO TIMELESS QUESTIONS:

WHAT IS THE SOURCE OF THE COSMOS...AND, WHAT IS OUR  
PURPOSE WITHIN IT?

WHILE ANSWERS WILL ALWAYS BE DEBATED, VALUABLE NEW  
INSIGHTS ARE NOW AT HAND...EMERGING FROM A CORNER OF THE  
UNIVERSE WHERE COMPLEX LIFE AND SCIENTIFIC DISCOVERY  
HAVE CONVERGED, ON AN EXTRAORDINARY PLANET CALLED  
EARTH.

225. *Credits*