THE SOURCE Workbook

Chapter 2 – THE DESIGN OF THE PLANET EARTH

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The Source Workbook - Answers

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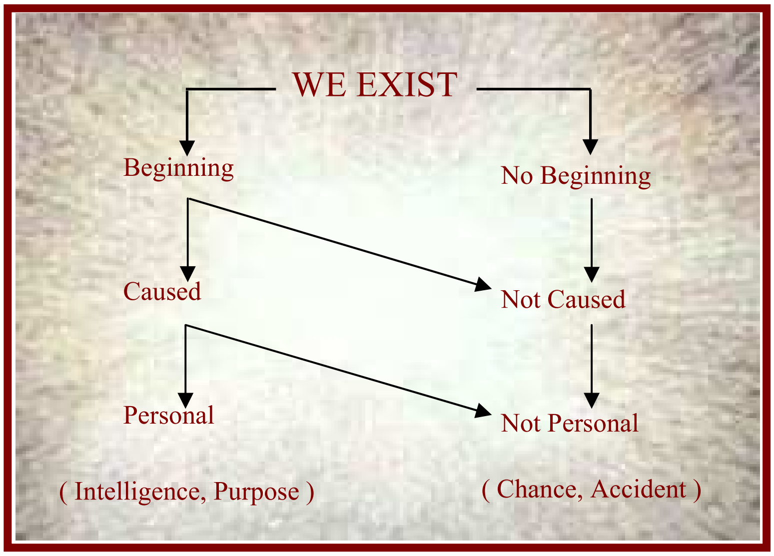

Figure 2.1: The Logic Flow of a Cosmological Argument.

The alternative must be that, out of a complete void, matter just "popped" into existence. Interestingly, also included along with matter is the space to contain it and the time to regulate it. The normal idea one often associates with the Big Bang "popping" into existence is that it happened in a great expanse of existing space. However, the term "void" is used to denote an undefined "spaceless" location because space and time were included as a part of the created universe. It has been determined that intergalactic space, or the space between the galaxies of the universe, is filled with an unsubstantiated plasma matter that has an average density of less than one atom per cubic meter. Science calls this plasma the "**spacetime continuum*," which seems to be comprised of a "fabric" of dark matter and energy as defined by Einstein's gravity **field equations*.

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q-20.1 If the universe was both caused and had a beginning, what final question must we ask?
Was the cause personal or non-personal? In other words, was it caused by an intelligence or did it just happen naturally by processes which are unknown at present?

q-20.2 If the cause was personal, what kind of creation would we expect to find?
We would expect to find a creation that exhibits attributes such as intelligence, purpose, design and planning. We should also find a body of natural laws that would allow us to investigate its cause and existence. This means that the cause would not be a scientific "**magic bullet*."

* ***Spacetime continuum* --** The four-dimensional coordinate system (3 dimensions of space and 1 of time) in which physical events are located. Usual synonym: space-time

* ***Field* –** Fields can be described as "force fields" which are thought to be forces that can influence objects without any apparent connecting cause. The two most familiar fields would be electrical/magnetic and gravitational. This is a complicated matter and a subject of continuous research to find additional subatomic particles within a family of particles called "gauge bosons," which may be the "connecting causes" that make the fields work across empty space.

* ***Magic Bullet:* (MS Encarta)** -- Easy Solution: a quick and easy solution for a difficult problem, or a means of accomplishing the impossible.

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q-21.1 What means will we use to interpret the significance of the "just right" conditions found to exist on the earth?

We will use the mathematical laws of "probability" to determine if all of earth's obviously hospitable conditions are a chance happening or evidence for creation by an intelligent designer.

q-21.2 What problems arise when one looks for the "right kind" of galaxy to support human life?

Not all galaxies are the same and most of them cannot support life as we know it. There is good evidence to show that only about 1% of all the galaxies in existence could possibly support life. We need to find a "type Sb" (normal) spiral galaxy. Therefore, we will use the number 1 in 100 (1%) to describe the odds of finding a galaxy to support life by chance alone. What do we expect this investigation to reveal? We would expect to find a creation that exhibits attributes such as intelligence, purpose, design and planning. We should also find a body of natural laws that would allow us to investigate its cause and existence. We actually honor God when we seek to discover the mysteries of His creation.

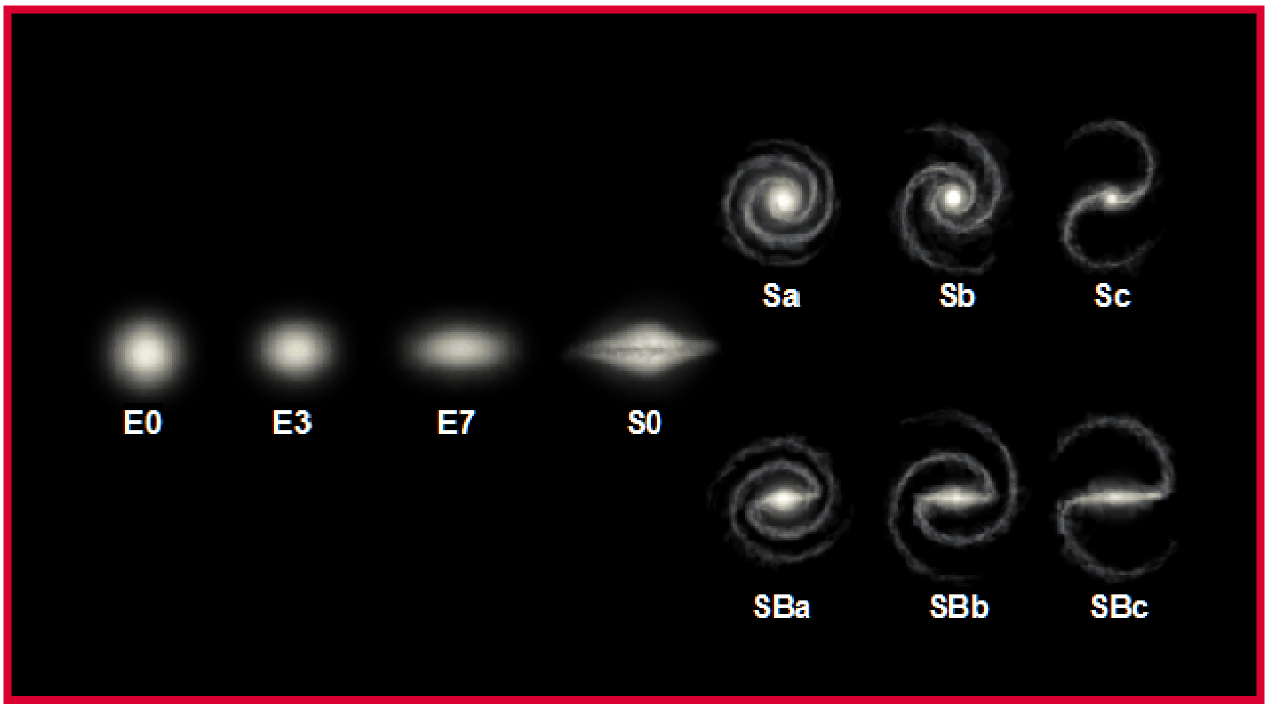

Figure 2.2: Examples of different types of Galaxies.

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q-22.1 Why would our solar system have to be carefully positioned within a galaxy?

With minor exceptions, most of the area within a galaxy would not be life supporting. The region within a galaxy that can support life is called the Galactic Habitable Zone (GHZ). The GHZ is determined by satisfying two basic requirements: the availability of material to build a habitable planet and adequate protection from harmful cosmic threats. The big bang produced hydrogen and helium and little else. Over the next 10 billion years or so, stars were processing this raw mix of simple elements into a rich stew of complex or heavy elements. Within their hot cores, the ratio of metal atoms to the number of hydrogen atoms—that is, the "metallicity"—gradually increased to its present value. When such a mature star finally finishes its life cycle, it explodes, leaving a large amount of heavier elements behind that can form another smaller star with accompanying rocky planets. In this way, metallicity is an important part of planet building. Without enough metals in the original parent star, no planets can form at all from its remains, because rocky chunks of a certain minimum size are needed to start the new planet-building process. The resulting star around which the planets form will reflect the metallicity of its deceased parent star. We believe it is by God's design that our sun itself is about 40 percent richer in metal than other stars that formed at about the same time and location in the galactic disk. This increased metal content made it possible for the Earth to be positioned at the proper location which gave life the head start it needed to flourish. (Scientific American, October, 2001)

q-22.2 So what are the odds of finding a sun like ours situated within the safe region of a galaxy?

By using volumetric calculations, we can determine the odds to be about 1 in 150.

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q-23.1 Name some of the problems that arise when searching for the right kind of star to serve as a life-supporting sun?

While there are said to be over 100 billion stars in a galaxy, only a small number would have the characteristics necessary to support life. The Hubble telescope was used to determine that about 5% or about 5 billion of all the stars in the galaxy could possibly qualify for the sun's role.

q-23.2 What is "Roche's Limit?"

Pronunciation: *Roche* -- (rōsh)

The Roche limit, sometimes referred to as the Roche radius, is the minimum distance a semi-solid planet can orbit its parent star or sun. The closer a planet gets, the greater the force-difference in the pull of gravity between the planet's front and back side. This makes the planet's shape begin to deform to look like a sideways tear drop when it starts to elongate toward the star, as shown in Figure 2.3. If it gets closer than the Roche radius, then the planet's side closest to the star will start stretching so much that the planet tears into pieces. Structurally stiff bodies, such as space satellites, are strong enough internally so that they do not change shape due to the pull of earth's gravity. For that reason, they will never be torn apart no matter how close they get. The term Roche-radius is named after Édouard Albert Roche, the French astronomer who first calculated this theoretical limit in 1848.

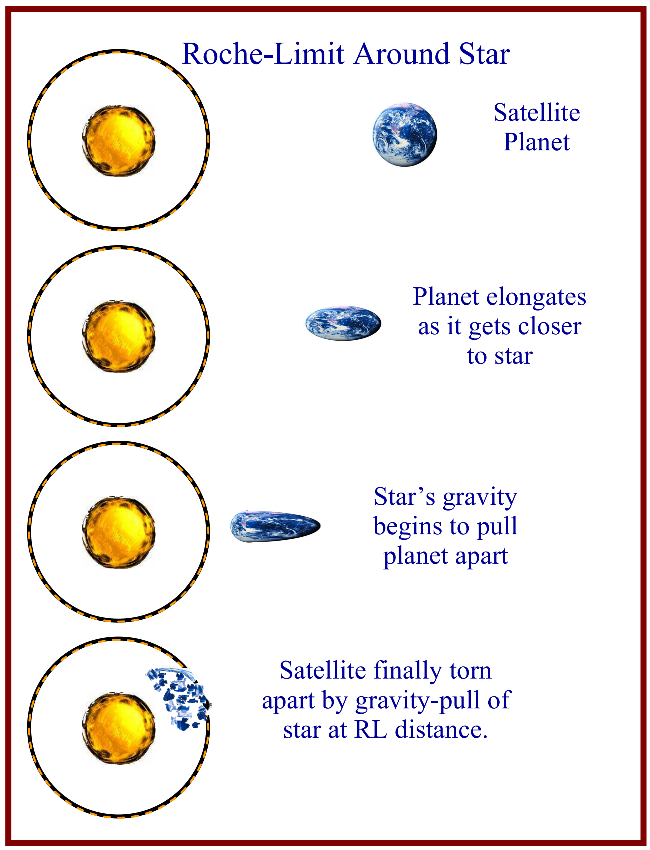

Figure 2.3: Roche Limit is the reason liquid core planets cannot hold together if they are closer than Roche's calculated distance from the parent star.

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q-24.1 What other factors must we consider in searching for a sun-like star?

We have to eliminate a number of improperly sized stars from our list.

q-24.2 What odds do we eventually end up with for getting a sun-like star?

After carefully considering all of the qualifying factors, we can estimate that approximately 100 million or about 2% of the remaining 5 billion stars will be acceptable as sun-star possibilities. This reduces to a probability ratio of finding the right star to about 1 in 1000. (100 billion original total stars divided by 100 million sun-star possibilities)

q-24.3 How does water relate to the earth's distance from the sun?

It is important that the earth be just the right distance from the sun for the earth's surface temperature to allow water to exist in all three of its phases. These phases are ice, water, and steam, all of which have specific temperature requirements associated with them.

q-24.4 What are the odds of finding a planet just the right distance from its sun?

Using our solar system as a model and including the asteroid belt as an unformed planet, we will conservatively estimate the odds to be 1 planet (earth) in 10 solar system planet positions or about 1 in 10. As stated, this probability model also includes the asteroid belt situated between the planets of Mars and Jupiter. For the sake of simplicity, we will apply this 10 to 1 model in our calculation estimate involving all the necessary life supporting features inherent in our solar system. As a point of interest, we should note why the asteroid belt didn't form into a planet and what possible consequences this poses for earth today. It is because the belt of unformed planetary debris is positioned in a transition zone that is subject to the conflicting gravitational forces that exist between the inner rocky planets and the large outer gas planets. As a result, the millions of rocks, now called asteroids, couldn't stick together to form a planet due to constantly being pulled in two different directions at the same time. Even today, the conflicting forces occasionally cause a large sized asteroid to leave the belt and head for our sun by a path that may intercept the earth's orbit. Also, for convenience, we will continue to recognize Pluto as a planet because a 1 in 10 probability model is more convenient to use.

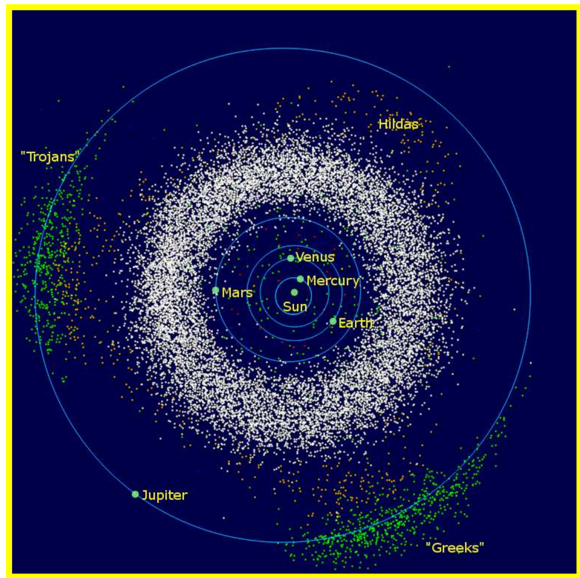

Figure 2.4: Asteroid Belt positioned in unstable gravitational zone between Mars and Jupiter.

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q-25.1 What does "planetary tilt" have to do with maintaining right temperatures on the earth's surface?

The earth's tilt (inclination) varies between 22.1 and 24.5 degrees. Because of this, when the orbit of the earth places it farthest from the sun (apogee), the part of the earth with the greatest land mass is mostly facing the sun. Conversely, when the earth is closest to the sun, the part of the earth with the greatest water area is closest to the sun. This differing ratio of land area vs. water area causes the heat from the sun to be properly distributed over the earth's surface, even though the distance from the sun varies during the earth's annual orbit.

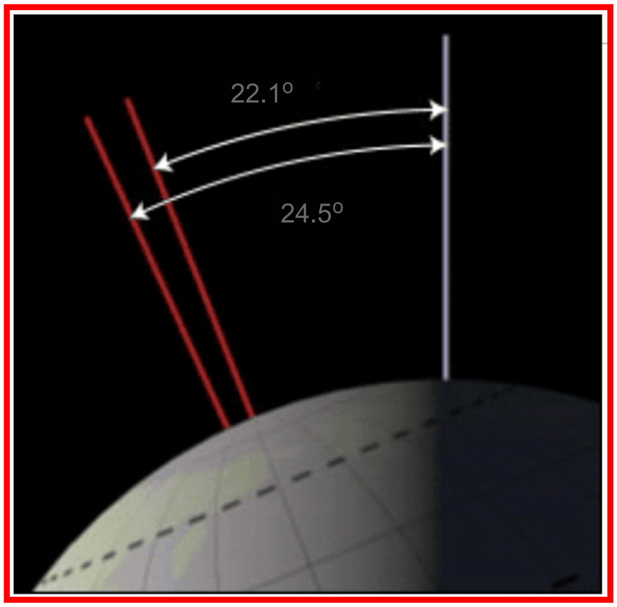

Figure 2.5: Earth's inclination or tilt varies

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q-26.1 What three other features of the earth are related to maintaining its tilt and to protecting it from being hit by destructive meteors and/or "charged particles" which are continuously radiating from the sun?

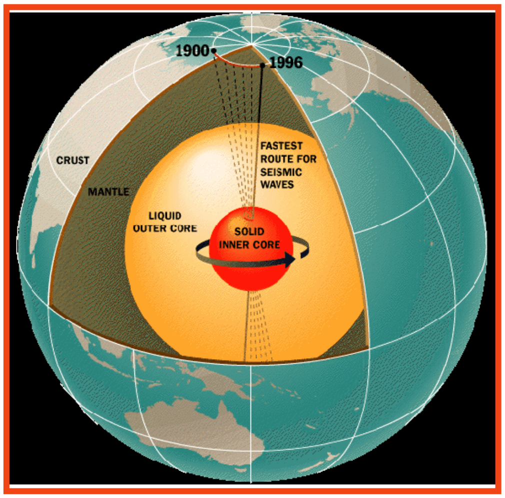

Figure 2.6: The earth's necessary components which produce a magnetic field that protects us from harmful cosmic radiation.

The three other features are the moon, the atmosphere, and the earth's magnetic field.

1) The range of the earth's tilt varies between 22.1° and 24.5°, during a 41,000-year period. At present, the tilt is in its decreasing mode. This small 2.4 degree range is maintained primarily by the moon's gravitational influence. Other planets, without such a stabilizing influence, may have an unacceptable tilt variation. For example, on Mars the range is believed to be between 15° and 35°. 2) The atmosphere acts to protect the earth from space debris. If we didn't have a thick atmosphere, the earth's surface would be more likely to resemble the pocked-marked surface of mars or the moon. 3) The magnetic field of the earth is believed to be caused by what is called the "dynamo effect" due to the earth's rotation. At the heart of our planet lies a solid iron ball, with a temperature equal to the sun's surface. Researchers call it "the inner core." The inner core is 70% as wide as the moon, and it spins at its own rate, which is about 0.2 degrees of longitude per year faster than the Earth's surface above it. Surrounding the inner core is a much deeper layer of liquid iron known as "the outer core." The earth's magnetic field comes from this outer ocean of iron that seethes and roils like water in a pan on a hot stove. The outer core also has hurricanes powered by the Coriolis forces caused by the earth's rotation. To determine our probability ratio, we have again used the

solar system model to set the odds for these necessary features to have occurred by accident at 1 in 10.

q-26.2 Why is it good design for the earth to have more water in the southern hemisphere than in the northern hemisphere?

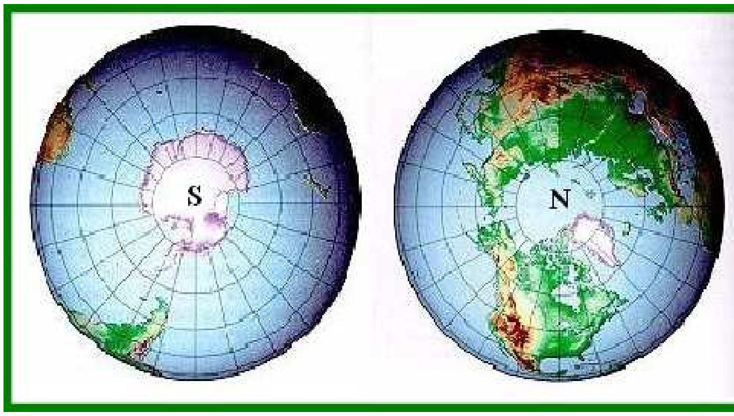

Figure 2:7: See difference between Northern and Southern hemisphere's distribution of land. The South has 20% more water area than the North.

There is a more balanced distribution of heat over the earth because a land mass area reflects less energy and absorbs more heat at a much faster rate than a volume of water. So when the sun is closest, we need a larger area of water facing it (southern hemisphere) to reflect a significant portion of the heat away, causing the water to warm slowly. Conversely, when the sun is farthest away, we would want a larger land mass area facing the sun (northern hemisphere) because it tends to heat up quickly and not lose as much by reflection. This is exactly the balance we find in operation on earth because of its tilt. These special features also reduce to a 1 in 10 chance or odds of occurring accidentally.

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q-27.1 How do the large outer planets protect the earth?

The outer planets act as gravitational magnets that draw interstellar asteroids and comets away from hitting the earth. The odds of 1 in 10 for this beneficial feature to have happened by chance are again based upon the solar system model. For a recent example, in 1994 over twenty fragments of comet Shoemaker-Levy 9 collided with the planet Jupiter. The comet, discovered the previous year by astronomers Carolyn and Eugene Shoemaker and David Levy, was observed by astronomers at hundreds of observatories around the world as it crashed into Jupiter's southern hemisphere.

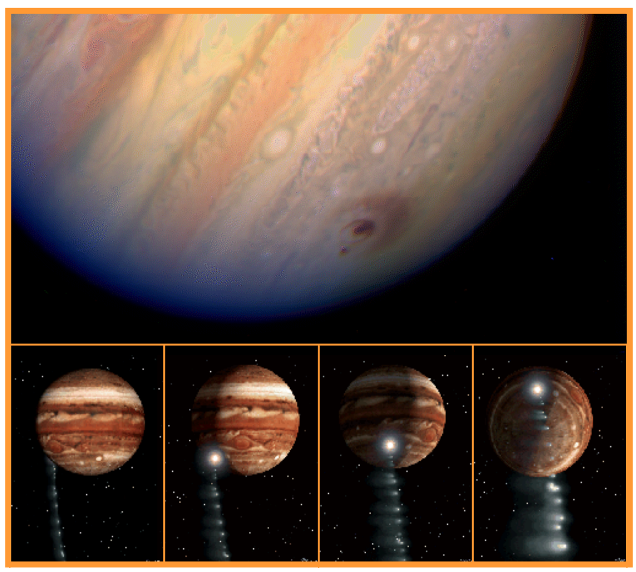

Figure 2.8: From July 16 through July 22, 1994, pieces of the Comet Shoemaker-Levy 9 collided with Jupiter. This is the first collision of two solar system bodies ever to be observed, and the effects of the comets impacts on Jupiter's atmosphere have been simply spectacular and beyond anyone's expectations. Comet Shoemaker-Levy 9 consisted of at least 21 discernable fragments with diameters estimated to be as large as 2 kilometers.

q-27.2 What is the difference between something happening individually or simultaneously?

Multiple events acting simultaneously are far less likely to happen than individual events acting alone.

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q-28.1 How do you figure the probabilities of multiple events happening simultaneously?

The total probability of a series of events is determined by multiplying all of the individual probabilities together as shown in The Source Figure 2.4. For instance, if you flip one coin, you will have a 50% chance that it will come up heads. However, if you flip two coins together, you will have only a 25% chance (0.5 x 0.5 = 0.25) that both will come up heads.

q-28.2 Based on simple probabilities, what are the odds that a planet like the earth would develop accidentally?

As shown in The Source Figure 2.4, the odds work out to be 1 in 150 thousand million million (150 x 1,000 x 1,000,000 x 1, 000,000). This can also be expressed in scientific notation as 150 x 10^15 or 150 followed by 15 zeros. A similar but more exhaustive calculation was made by Hugh Ross. His calculation estimated that, for the 322 hospitable conditions for the earth to have occurred accidentally, the probability would to be ~ 10^304 . He also noted that an estimate, based upon scientific principles, determined that the maximum possible number of earth-like planets in the universe was only about ˜ 10^22 . This leaves a staggering 1 chance in 10 followed by 282 zeros required for all the conditions to occur.

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q-29.1 What are the odds that you could survive jumping out of an airplane without a parachute?

Figure 2.9: Michael Homes filmed by James Boole.

This is a rather difficult question to answer because there have not been any actual studies to determine an accurate answer. However, it is recognized that the chances of survival are "slim to nothing." Nevertheless, since the sport of skydiving has become popular, we are hearing about more and more surviving incredible experiences that result from hitting the ground in excess of 50 miles per hour. Take the case of Shayna Richardson of Joplin Missouri. On October 9, 2005, when the lines of her parachute got hopelessly tangled, she hit an asphalt parking lot face down and survived. Actually, because it was later discovered that she was two weeks pregnant, two individuals survived the impact. A similar incident happened to Michael Homes in December of 2006, when the lines of his parachute malfunctioned. Fortunately, he survived landing in a dense blackberry patch after falling about 10,000 feet. Michael's experience is unique in that he recorded the whole incident with his helmet camera. Technically, none of these experiences satisfies the conditions of our question because all of these survivors had parachutes that malfunctioned. However, a man named Jeb Corliss is experimenting with a "wing-suit" which he claims will enable him to safely jump from an airplane without a parachute. If that happens, we will have to revise the above question to accommodate the changing times.

q-29.2 What questions are raised by the "parachute" example?

Correspondingly, do you think that anyone who knows the facts would choose to believe that the earth just happened by chance when the likelihood of being right is less than surviving a 10,000 foot jump without a parachute? This is an important question because the choice can also be a life and death decision.

Figure 2.10: Jeb Corliss and his Wing-suit.

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End of Chapter 2