FIGURES & TABLES

Hugh Ross, PhD

The CREATOR and the COSMOS

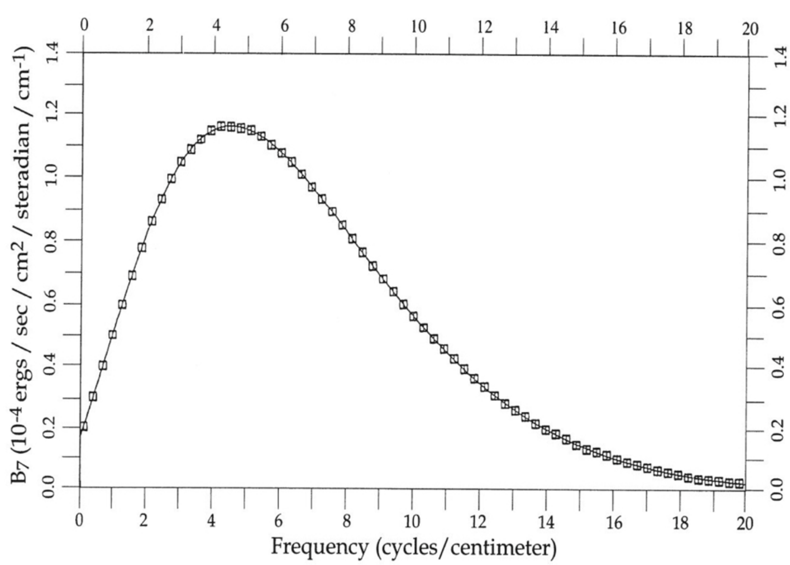
How The Latest Scientific Discoveries Reveal God

rtb PRESS
Covina, CA

FIGURE 4.1

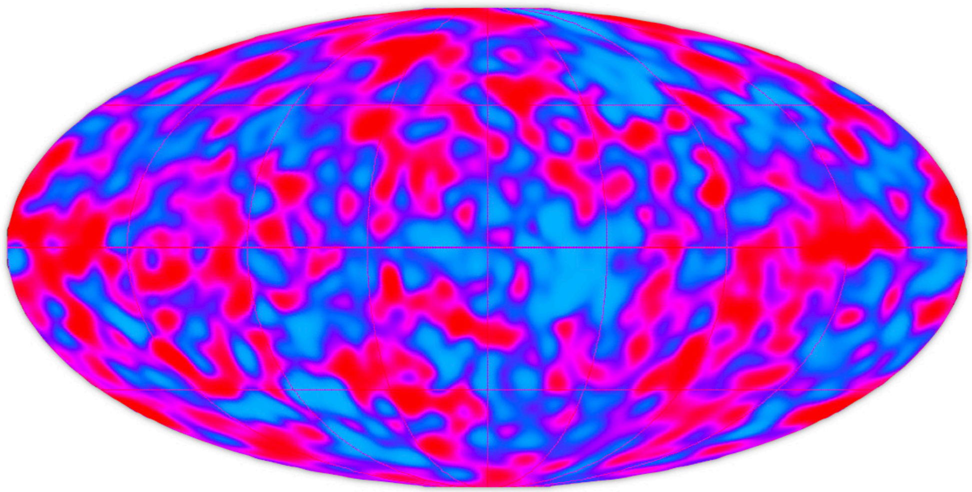
Cosmic Background Explorer (COBE) Satellite
—Courtesy of Jet Propulsion Laboratory, NASA

FIGURE 4.2



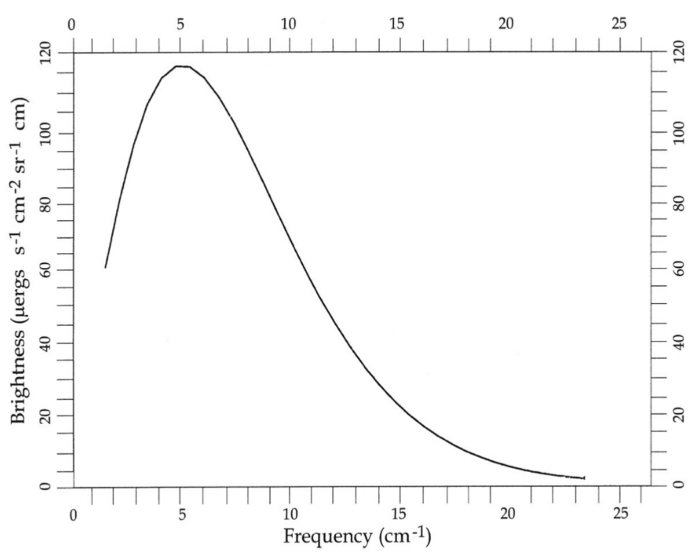
COBE's First Measurements of the Cosmic Background Radiation Spectrum at the North Galactic Pole
The measured temperature for the background radiation was 2.735° centigrade above absolute zero. Deviations between COBE's results and the spectrum for a perfect radiator (curve) measured less than 1% over the entire range of observed frequencies.
—Courtesy of John Mather, Goddard, NASA

FIGURE 4.3



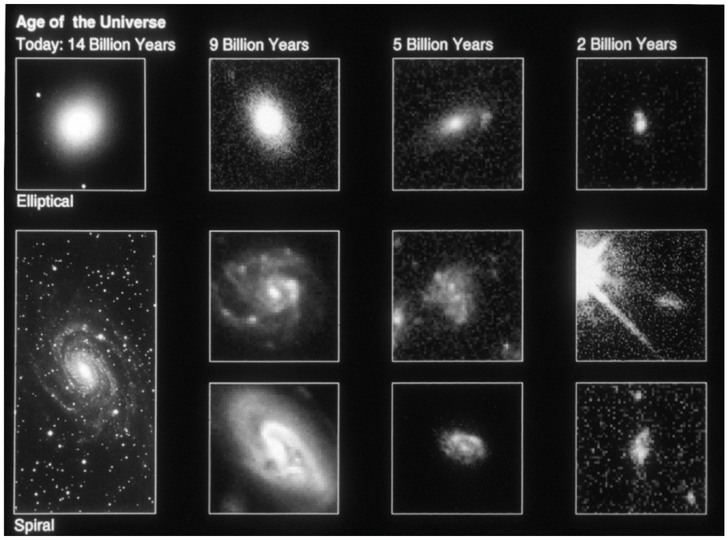
Microwave Map of the Whole Sky Made from One Year of Data Taken by COBE's Differential Microwave Radiometers (DMR)
The Milky Way Galaxy lies horizontally across the middle of the map. Astronomers used data from all three DMR wavelengths to model and remove emissions from our galaxy. This map revealed, for the first time, temperature fluctuations in the cosmic background radiation. Amplitudes of the fluctuations explain the birth and growth of galaxies and galaxy clusters.
—Photo courtesy of Jet Propulsion Laboratory, NASA

FIGURE 4.4



1993 COBE Satellite Results of the Spectrum of the Cosmic Background Radiation
Deviations between COBE's measurements and the spectrum for a perfect radiator (curve) are less than 0.03% over the entire range of observed frequencies. This is strong direct evidence for a hot big bang creation event.
—Courtesy of John Mather, Goddard, NASA

FIGURE 4.5



A Photo Album History of the Universe
These Hubble Space Telescope images show elliptical and spiral galaxies at stages roughly equivalent to infancy, childhood, youth, and middle age (its current developmental stage).
—Courtesy of R. STScI/NASA

TABLE 5.1

density component	symbol	measured value
mass density	Ω_m	0.2934 ± 0.0107
relativistic particle density	Ω_{rel}	8.52×10^{-5}
gravity wave energy density	Ω_{gw}	$< 1.7 \times 10^{-7}$
dark energy density	Ω_Λ	0.707 ± 0.012
cosmic spatial curvature parameter	Ω_k	-0.0009 ± 0.0014 (average)
total cosmic density	Ω_{total}	1.000 ± 0.001

Values of Cosmic Density Components

FIGURE 6.1

12 billion light years away

2 billion light years away

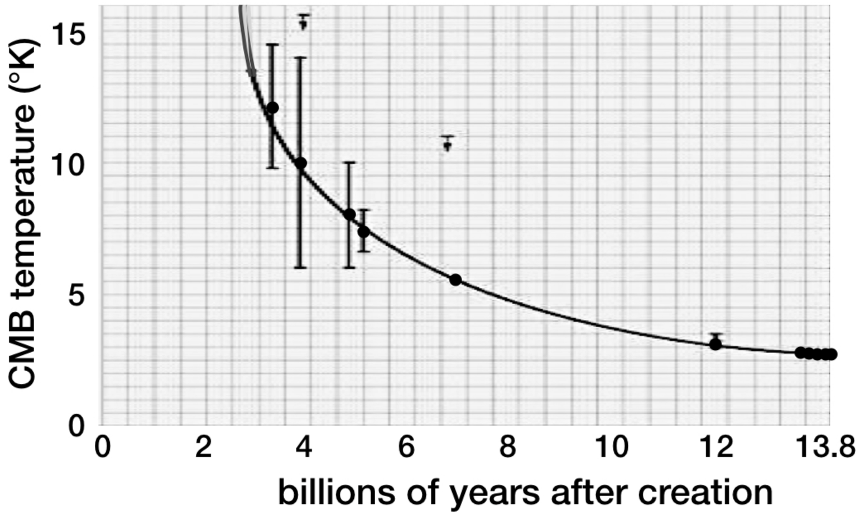
Galaxy Separations at Two Different Distances
Image credits: NASA, ESA, ACS Science Team, N. Benitez and H. Ford (JHU), T. Broadhurst (Racah Institute of Physics/Hebrew University), M. Clampin and G. Hartig (STScI), G. Illingworth (UCO/ Lick Observatory)

TABLE 6.1

measuring method	**cosmic expansion rate** (kilometers/second/megaparsec)
masers in NGC 6264 (direct distance method)[28]	68 ± 9.0
masers in NGC 5765b (direct distance method)[29]	66.0 ± 6.0
masers in UGC 3789 (direct distance method)[30]	68.9 ± 7.1
masers in NGC 4258 (direct distance method)[31]	72.0 ± 3.0
cosmic background radiation temperature fluctuations (WMAP)[32]	69.32 ± 0.80
cosmic background radiation temperature fluctuations (Planck)[33]	67.3 ± 1.2
baryon acoustic oscillation[34]	67.3 ± 1.1
cepheids/type Ia supernovae (corrected for star formation bias)[35]	70.6 ± 2.6
Chen, Kumar, Ratra compilation[36]	68.3 ± 2.7
mean value	**68.64 ± 1.83**

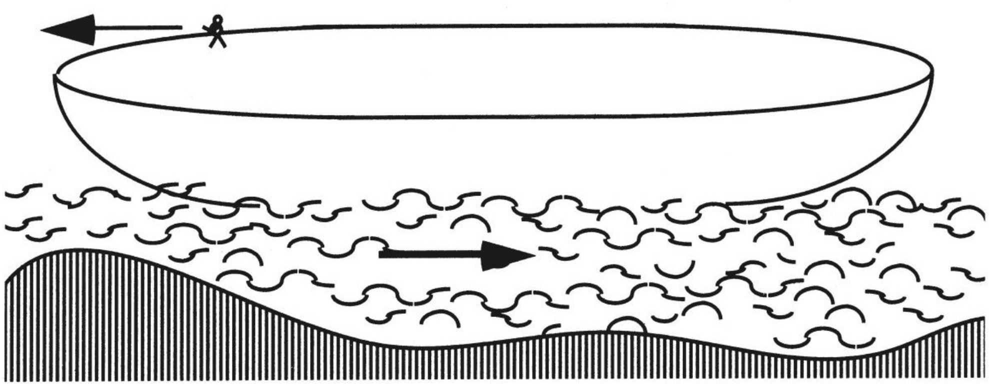
Latest Precision Measurements of the Cosmic Expansion Rate

FIGURE 6.2



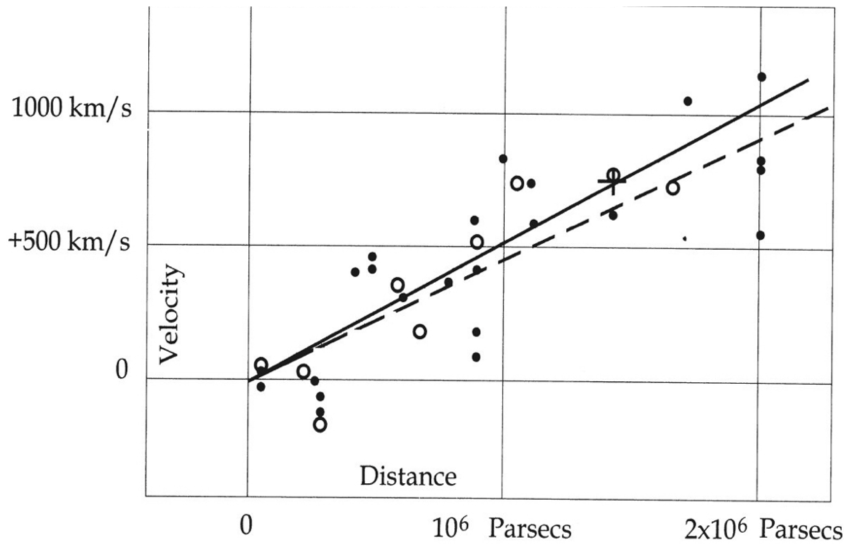
Evidence of Cooling from the Big Bang Creation Event
The curve is the predicted cooling of the universe according to the biblically described features of the origin and history of the universe with a cosmic age of 13.79 billion years and an average cosmic expansion rate at 68.65 kilometers/second/megaparsec. The dots and error bars are actual temperature measurements of the cosmic microwave background radiation (i.e., radiation remaining from the cosmic creation event) made at different distances or lookback times.
Credit: Reasons to Believe

FIGURE 7.1



Principle of Invariance
If a ship's captain were jogging along his vessel at 10 mph while the ship sailed at 10 mph, the captain would be moving at 20 mph (relative to the shore) when jogging in the direction of the ship's motion, and 0 mph when jogging in the opposite direction. This law has been known since the days of Galileo. However, in velocity of light experiments, the motion of the observer proves entirely irrelevant. The velocity of light does not vary with the motion of the observer.
Credit: Reasons to Believe

FIGURE 7.2



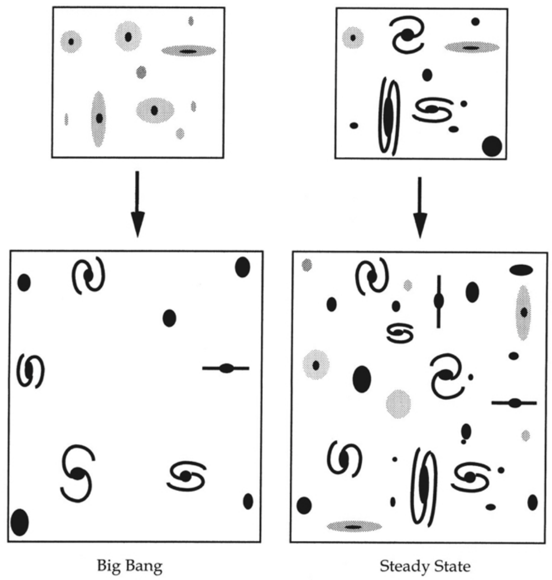
Hubble's Original Velocity-Distance Relation[11]
Velocities (kilometers per second) at which several galaxies are moving away from us are plotted against estimated distances. One parsec equals 3.26 light-years, where one light-year equals 5.9 trillion miles. The cross represents the mean of measurements made on twenty-two other galaxies. All measurements shown here were made before 1929.

As Hubble's plot demonstrates, the more distant the galaxy, the faster it moves away from us. Such a relationship between velocity and distance implies that the entire universe must be experiencing a general expansion.
—From *Proceedings of the National Academy of Sciences*

FIGURE 7.3

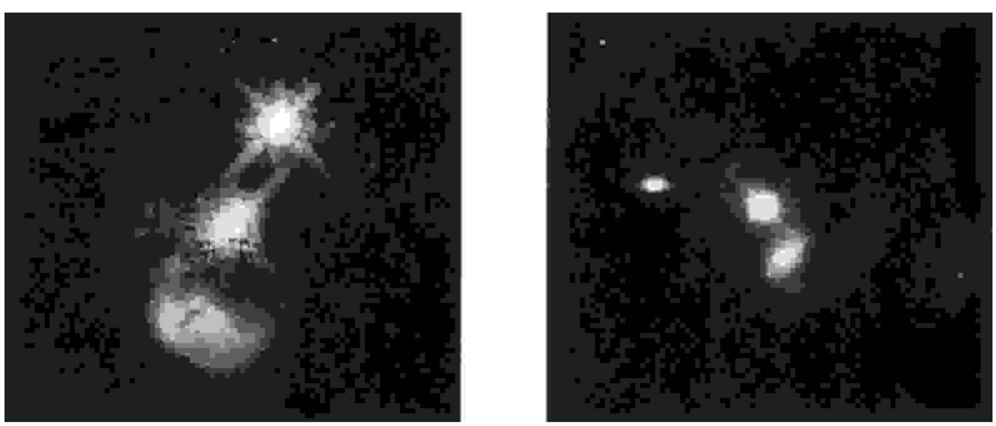
Einstein and Hubble
Photo shows (from left) Albert Einstein and Edwin Hubble at the Mount Wilson 100-inch telescope near Pasadena, California, where Hubble made his observations that demonstrated the galaxies are expanding away from one another.
—Photo courtesy of the Huntington Library

FIGURE 8.1



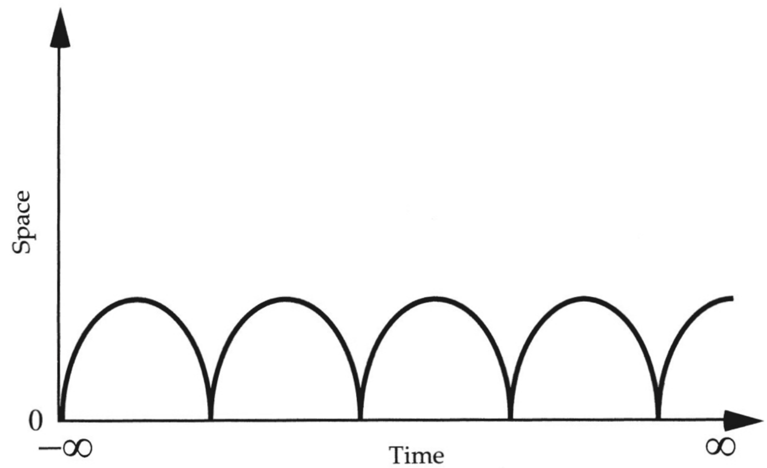
Big Bang Growth versus Steady State Growth
In a big bang universe, the density of matter thins out and the mean age for the galaxies advances. All big bang models predict a finite age for the universe. In a steady state universe, new matter is spontaneously and continuously created. The density of matter remains the same, and the mean age for the galaxies is constant. On a large scale, nothing changes with time. All steady state models assume the universe is infinite in age and extent. Since the light of very distant galaxies takes considerable time to reach us, astronomers can look into the past to see which growth pattern the universe follows.
Credit: Reasons to Believe

FIGURE 8.2



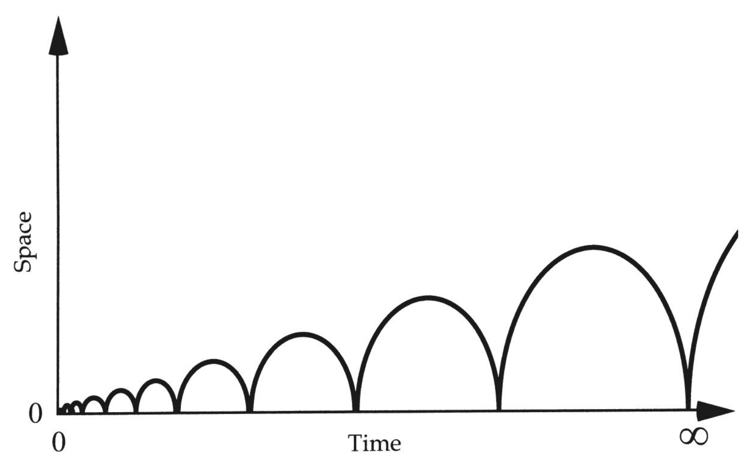
Images from the Hubble Space Telescope of Newborn Quasars
In the image on the left, a large galaxy (center) is colliding with a supergiant galaxy (bottom) at about a million miles per hour. The image on the right shows another such collision.
Credit: NASA

FIGURE 9.1



The Infinitely Oscillating Universe Model
In the oscillating universe model suggested by physicists like Robert Dicke and John Gribbin, the universe alternates for infinite time between phases of expansion and contraction. Gravity halts the expansion and generates a succeeding phase of contraction. An unknown physical mechanism is proposed to somehow bounce the universe from a period of contraction into a period of expansion, and the characteristics of the contraction and expansion phases are presumed not to vary significantly with time.
Credit: Reasons to Believe

FIGURE 9.2



Thermodynamic Dissipation within an Oscillating Universe
Even if the universe conceivably could oscillate, it could not have been oscillating for infinite time. The laws of thermodynamics compel the maximum diameter of the universe to increase from cycle to cycle. Therefore, such a universe could look forward to an infinitely long future, but only a finite past. The ultimate moment of creation, at most, could be pushed back to only about a trillion years ago.

Notice that as time goes on the humps grow larger and larger. Looking backward in time, they grow smaller and smaller to a starting point in the not-too-distant past. From the perspective of physics, the universe could not bounce more than about a dozen times—a number far short of infinity.
Credit: Reasons to Believe

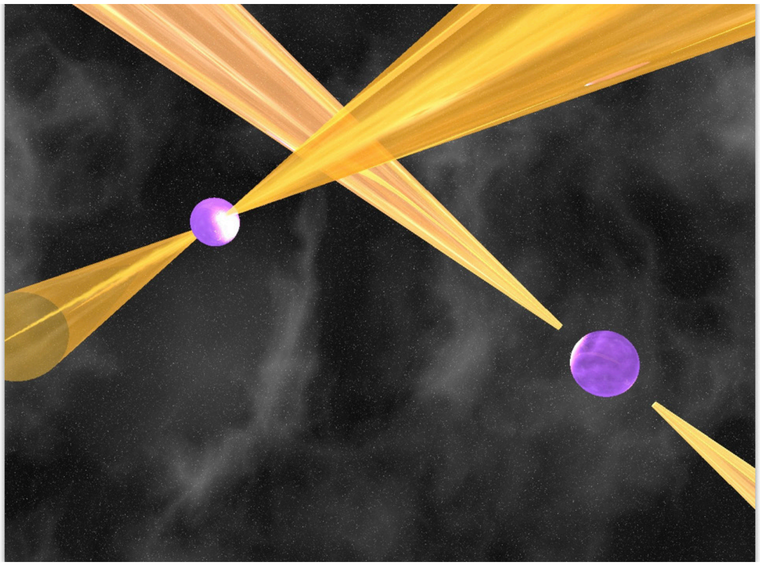
TABLE 9.1

If the universe oscillates, then that means it behaves like an engine or a system designed to perform work. The ability of a system or engine to perform work or to oscillate depends on its mechanical efficiency. The universe literally ranks as the worst engine in all existence. Its mechanical efficiency is so low that oscillation is impossible.

System or Engine	Mechanical Efficiency
diesel engine	40%
gasoline engine	30%
steam engine	13%
human body engine	1%
universe	0.00000001%

Mechanical Efficiencies of Some Common Systems

FIGURE 10.1



Double Pulsar Binary
This artist's impression of the double binary pulsar PSR J0737-3039 shows the collimated beams of radiation from each pulsar that result from the rapid rotation and strong magnetic fields of the two neutron stars. The two neutron stars are not shown to scale. If they were depicted as two marbles, they would be about 750 feet apart.
Credit: Michael Kramer, Jodrell Bank Observatory, University of Manchester

FIGURE 10.2

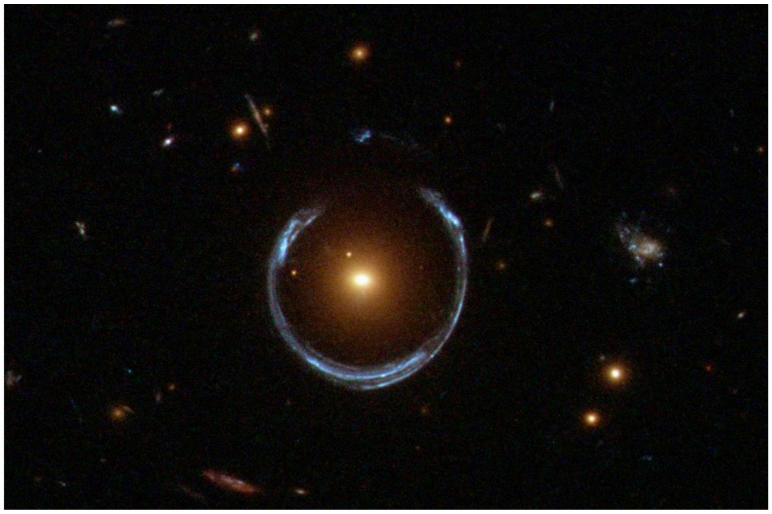
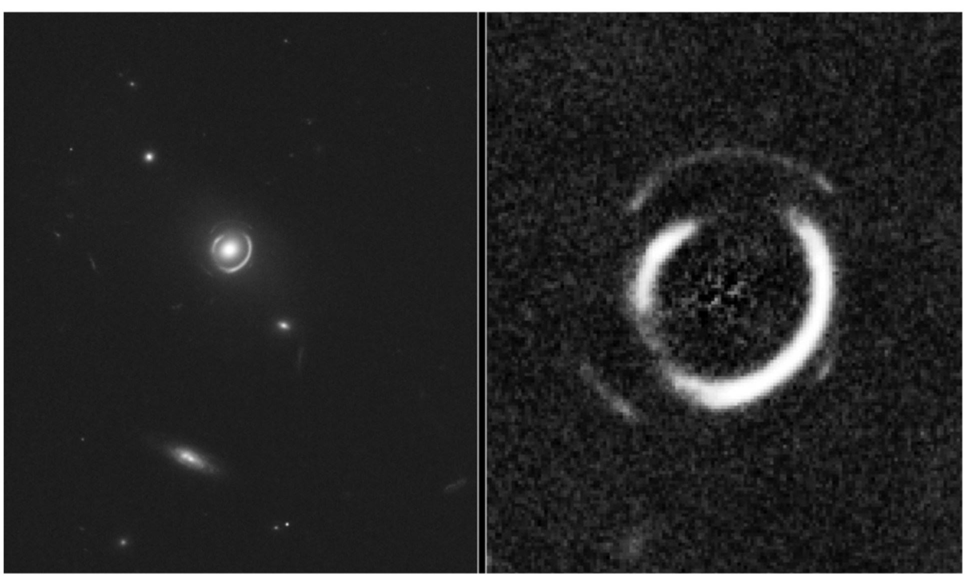


Image of a Nearly Complete Einstein Ring at Optical Wavelengths
The gravity of the luminous foreground red galaxy, LRG 3-757, has gravitationally distorted the light of a much more distant blue galaxy.
Credit: NASA/ESA/Hubble Space Telescope (STScI/AURA)

FIGURE 10.3



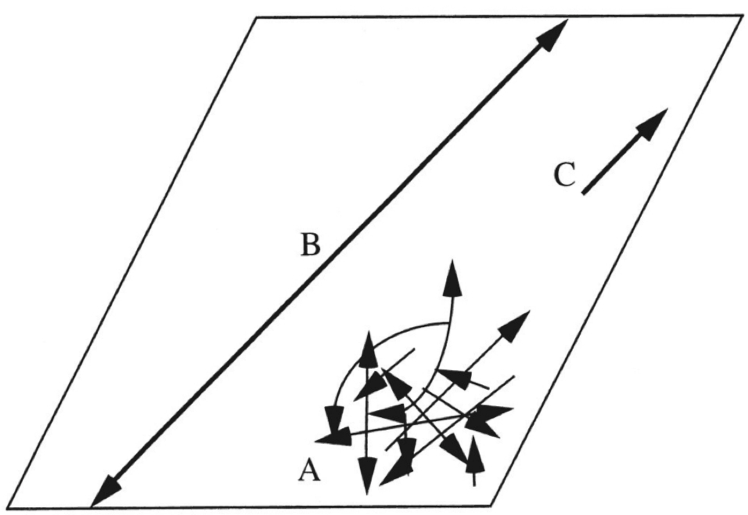
Double Einstein Ring Image by the Hubble Space Telescope
Credit: NASA/ESA/STScI/SLACS Team

TABLE 11.1

> In the beginning God created the heavens and the earth. (Genesis 1:1)
> By faith we understand that the universe was formed at God's command, so that what is seen was not made out of what was visible. (Hebrews 11:3)

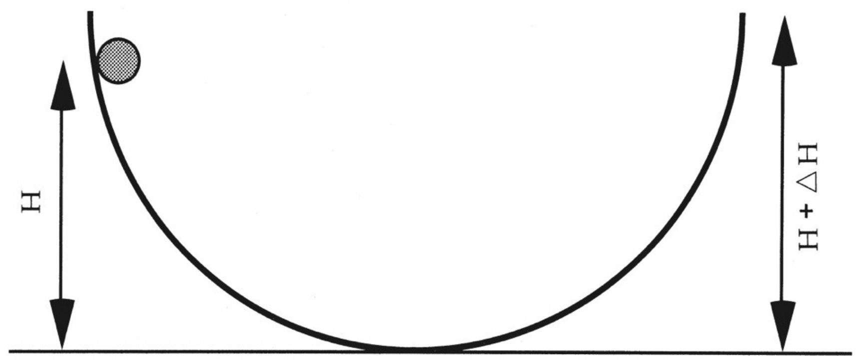
Some Bible Verses Teaching God's Extradimensional Capacities

FIGURE 11.1



God's Time Frame Relative to Our Time Frame
If time were two-dimensional rather than one-dimensional, it would be some kind of plane rather than a line. In this case, an infinite number of time lines (A) would run in an infinite number of directions. This, according to general relativity and the Bible, is the minimal situation with the Creator. If the Creator were to so choose, he could move and operate for infinite time, forward and backward, on a time line (B) that never intersects or touches the time line of our universe (C).
Credit: Reasons to Believe

FIGURE 13.1



Quantum Tunneling
In classical physics a marble released from height H will roll down the side of a bowl and up the other side to the same height H, assuming the absence of friction. Since the lip of the bowl is at a height of H + ΔH, the marble will remain forever trapped inside the bowl. But the uncertainty principle of quantum mechanics states that for a quantum particle there must always exist a minimum uncertainty in the energy of the particle. This uncertainty implies that a quantum particle released from height H has a finite possibility of exceeding H + ΔH on the other side. The smaller ΔH is relative to H, the greater the possibility. Also, the faster the particle can travel from one side to the other (the less shallow the bowl), the greater the possibility. So quantum tunneling implies that a quantum mechanical particle can escape from the bowl, whereas a typical marble could not.
Credit: Reasons to Believe

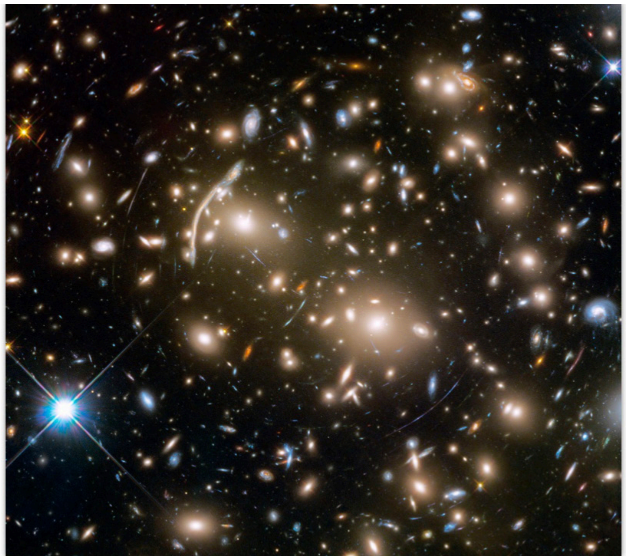
TABLE 15.1

In surveying the scientific literature over an 18-year time period, the scientific team at Reasons to Believe has demonstrated that the more astronomers and physicists learn about the universe, the more features of the universe and the laws of physics must be fine-tuned to make the existence of microbial life possible somewhere within the universe. A list of the specific fine-tuned features and scientific literature citations is available at reasons.org/finetuning.

survey date[20]	number of known fine-tuned features
1989	15
1991	17
1995	26
2001	35
2004	86
2006	140

Cosmic Design Needed for Simple Life

FIGURE 17.1

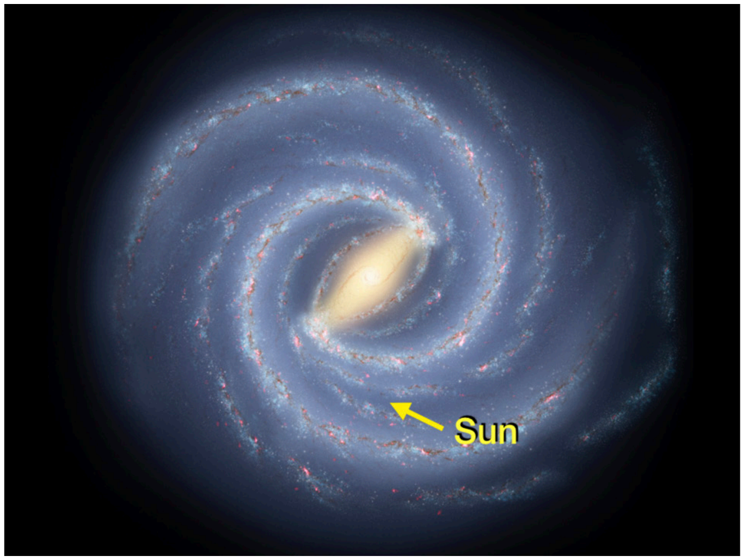


The Abell 370 Galaxy Cluster
Most galaxies reside in rich clusters of galaxies like Abell 370. In such clusters the densities and sizes of galaxies rule out the possible existence of advanced life. Every object in this image is a galaxy except for the two blue-white crossed spots in the lower left and upper right of the image, which are stars in our own galaxy.
Credit: NASA/ESA/Jennifer Lotz and the HFF Team (STScI)

FIGURE 17.2

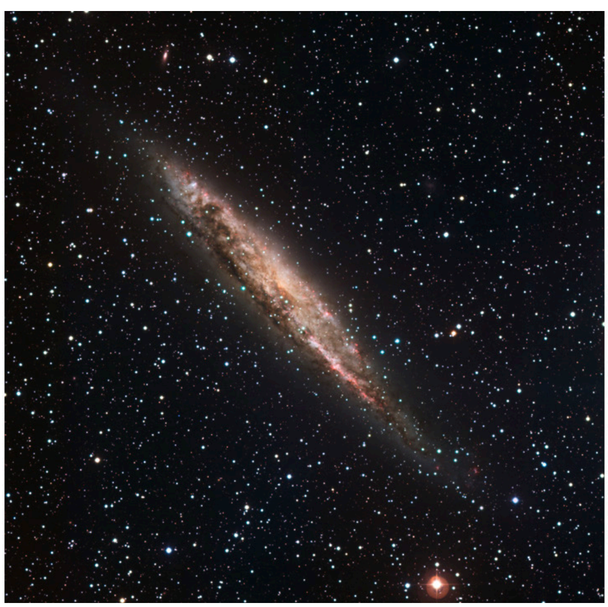
The Local Group Galaxy Cluster
The Andromeda Galaxy and its two prominent dwarf galaxy partners, M32 and NGC 205, are to the upper left. Below the Andromeda Galaxy is the dwarf spiral galaxy M33, the third largest galaxy in the Local Group. To the lower right is the MWG and above it the fourth and fifth largest galaxies in the Local Group: the Large and Small Magellanic Clouds, respectively. The other approximately 100 dwarf galaxies in the Local Group are too small and too faint to show up in this map.
Credit for the galaxy images: NASA/ESA/ESO/R. Hurt, Caltech-JPL, map by author

FIGURE 17.3



The Milky Way Galaxy
Astronomers produced this image of our galaxy by piecing together maps of different regions of our galaxy at radio, infrared, optical, and ultraviolet wavelengths. No other known galaxy has such symmetrical spiral arms with the just-right spacings advanced life requires. The Sun and its system of planets are presently halfway between the Perseus and Sagittarius spiral arms.
Credit: NASA/JPL-Caltech, R. Hurt (SSC)

FIGURE 17.4



NGC 4945, the Galaxy Most Similar to the Milky Way Galaxy
Though roughly the same size as the MWG, NGC 4945 has an active nucleus, much more prominent star forming regions, and spiral arms far from symmetrical.
Credit: European Southern Observatory

TABLE 17.1

1. liquid water habitable zone
2. ultraviolet habitable zone
3. photosynthetic habitable zone
4. ozone habitable zone
5. planetary rotation-rate habitable zone
6. planetary rotation axis tilt habitable zone
7. tidal habitable zone
8. astrosphere habitable zone
9. atmospheric electric field habitable zone

Known Planetary Habitable Zones

TABLE 17.2

The following elements are catastrophic for life, especially advanced life, if ingested in soluble form at either too high or too low a concentration level:[44]

boron	iron
fluorine	cobalt
sodium	nickel
magnesium	copper
phosphorus	zinc
sulfur	arsenic
chlorine	selenium
potassium	bromine
vanadium	molybdenum
chromium	tin
manganese	iodine

Vital Poisons

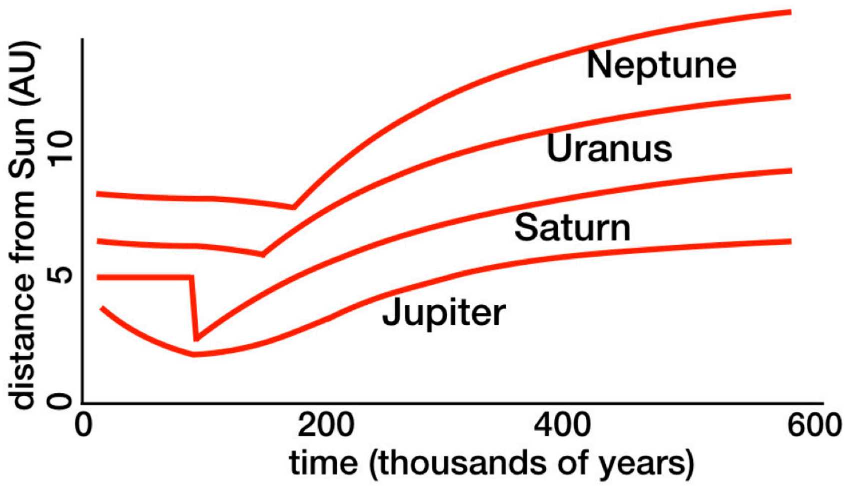
TABLE 17.3

The fractional abundance of magnesium (by mass) in Earth's crust is nearly identical to the fractional abundance of magnesium in the entire Milky Way Galaxy. (The light elements, hydrogen and helium, that escape Earth's gravity are not included). Thus, magnesium provides a helpful measuring stick for comparison purposes. For each element listed below, the number indicates how much more or less abundant it is in Earth's crust, relative to magnesium's abundance, as compared to its average abundance throughout the Milky Way Galaxy, relative to magnesium's abundance. Asterisks denote "vital poisons," essential elements that are toxic or lethal to humans if too much or too little is ingested. The water measure compares the amount of water in and on Earth, relative to the minimum amount planet formation models predict for a planet the mass of Earth orbiting a star identical to the Sun at the same distance from the Sun.[47]

carbon*	1,200 times less	zinc*	6 times more
nitrogen*	2,400 times less	arsenic*	5 times more
fluorine*	50 times more	selenium*	30 times less
sodium*	20 times more	yttrium	50 times more
aluminum	40 times more	zirconium	130 times more
phosphorus*	4 times more[48]	niobium	170 times more
sulfur*	60 times less[49]	molybdenum*	5 times more
chlorine*	3 times more	silver	3 times more
potassium*	90 times more	tin*	3 times more
calcium	20 times more	antinomy	10 times more
titanium	65 times more	iodine*	4 times more
vanadium*	9 times more	gold	5 times less
chromium*	5 times less	lead	170 times more
manganese*	3 times more	uranium	340 times more
nickel*	20 times less	thorium	610 times more
cobalt*	6 times less	water	250 times less
copper*	21 times more		

Relative Abundances of Advanced-Life Critical Heavy Elements in Earth's Crust

FIGURE 17.5



Grand Tack Migration
This illustration shows the Grand Tack migration pattern of the solar system's current gas giant planets. One astronomical unit (AU) = distance from Earth to the Sun.
Credit: Reasons to Believe