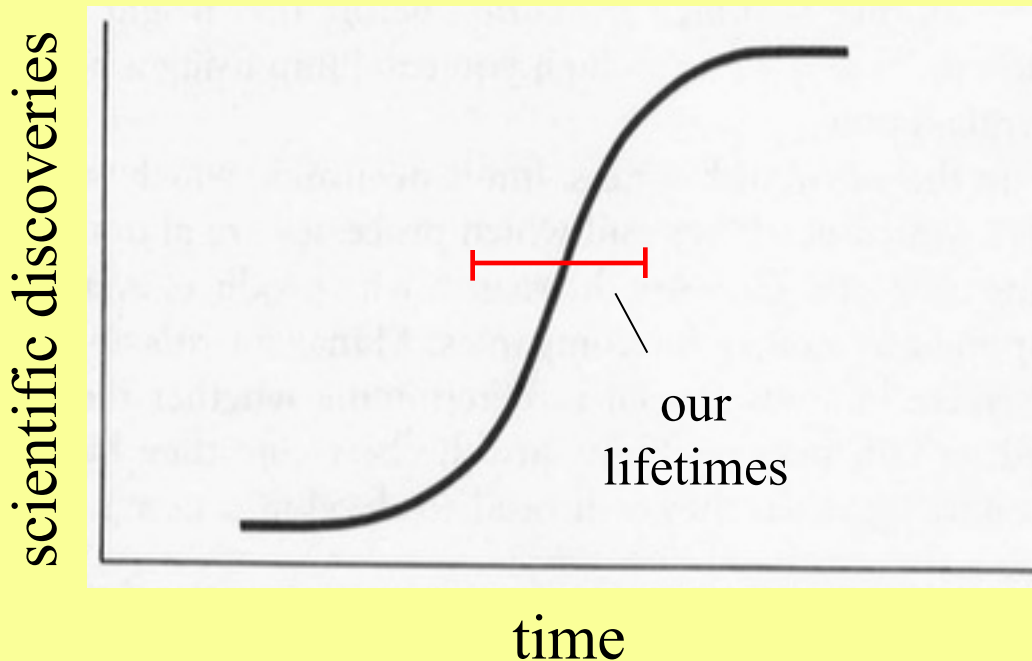


**10 recent discoveries that have
changed the debate about design in
the universe**

Part I

Our opinion

within 40 yrs of our lifetimes:

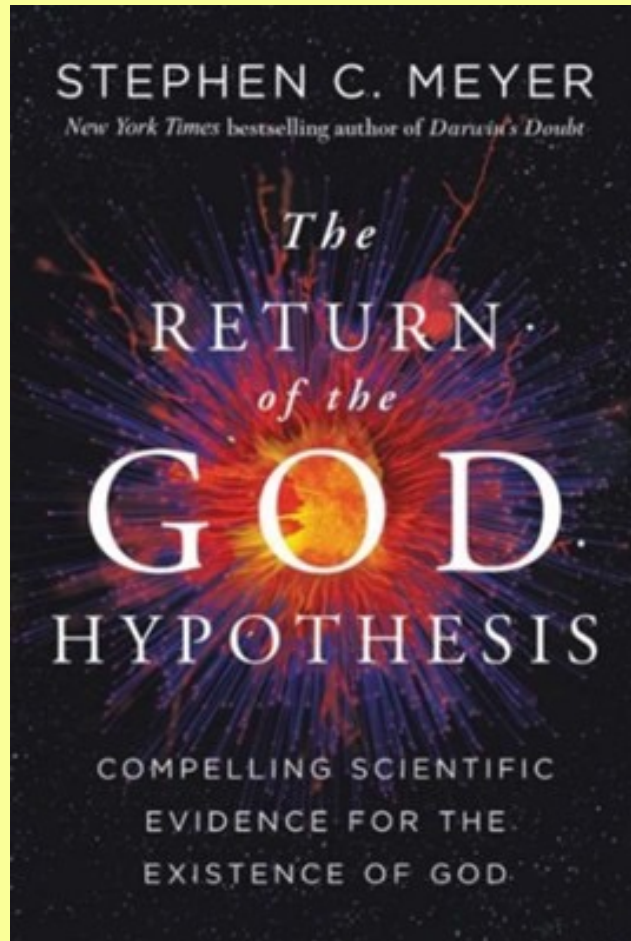


expansion of the universe
CMB

fine-tuning in physics
molecular basis of life
genome sequences
model of particle physics
map brain functions
molecular machines
software of cell
exoplanets
etc

This is a unique time in the history of humanity

Two very recent books covering 3 topics

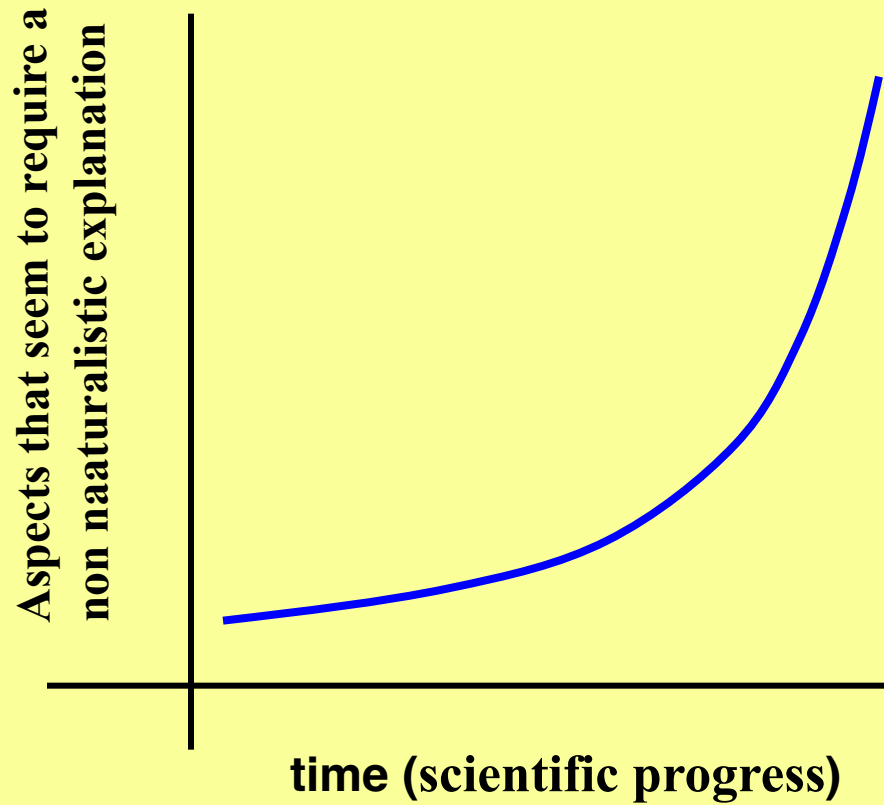


2021



2022

Our View: Trend with scientific progress



**How does it function?
Where did it come from?**



**The natural laws explain how it functions
but do not explain where it comes from.**

Resources (Discovery Institute):

<https://www.discovery.org/video-series/long-story-short/>

<https://scienceuprising.com/>

<https://michaelbehe.com/videos/secrets-of-the-cell/>

<https://www.youtube.com/user/DiscoveryScienceNews>

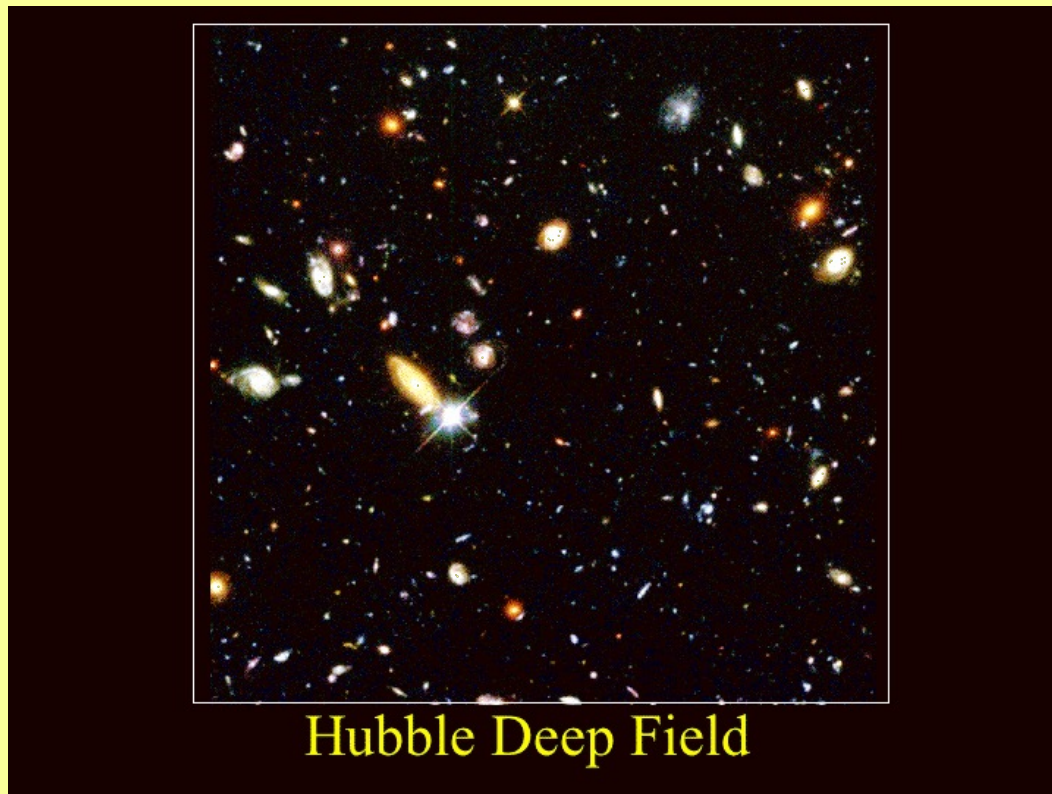
<https://intelligentdesign.org/>

10 recent discoveries that have changed the debate about design in the universe

- 1. The universe (space-time, matter, energy) had a beginning and will have an end.**

Some important observations

1. Light and other forms of radiation are detected that originated from sources which are now very large distances (billions of light-years) away **and moving away from us.**

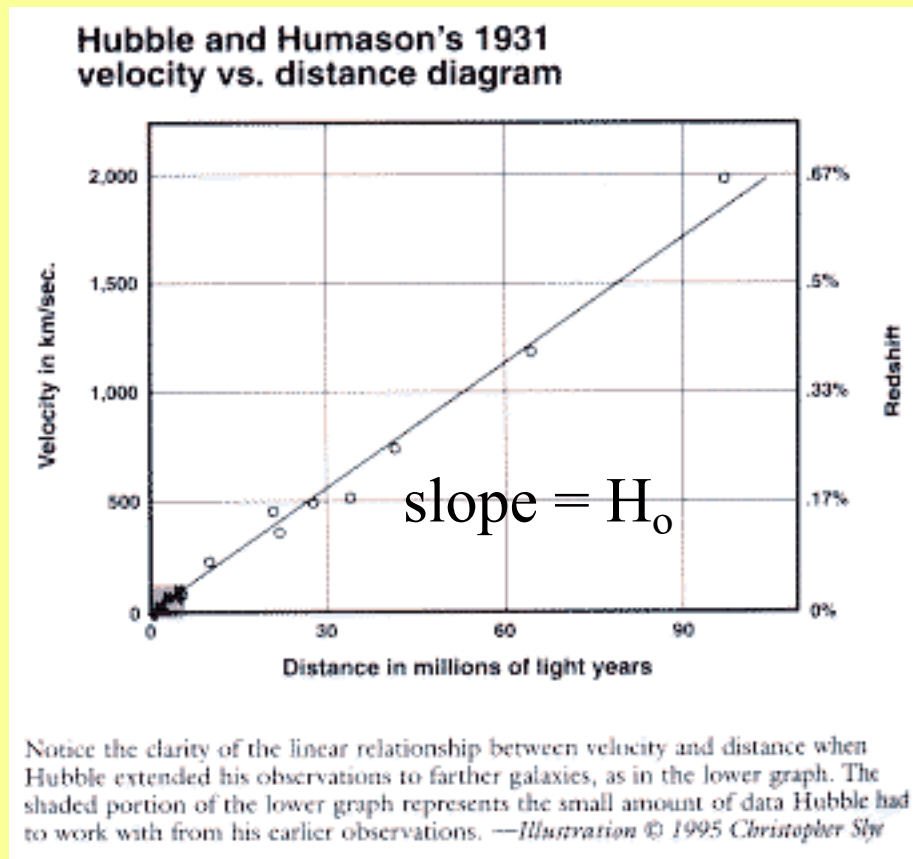


Some important observations

2. Red shifts - the wavelengths of radiation from each galaxy are shifted toward the red side of the spectrum by a factor roughly proportional to the distance of the galaxy from us.



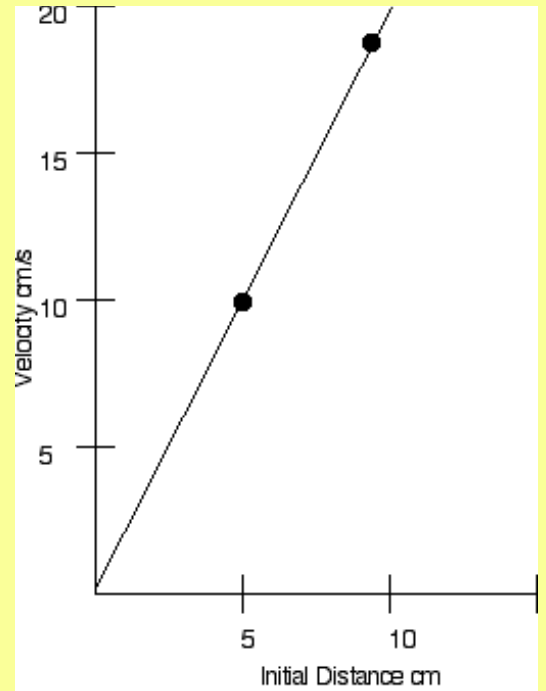
Edwin Hubble



The universe is expanding

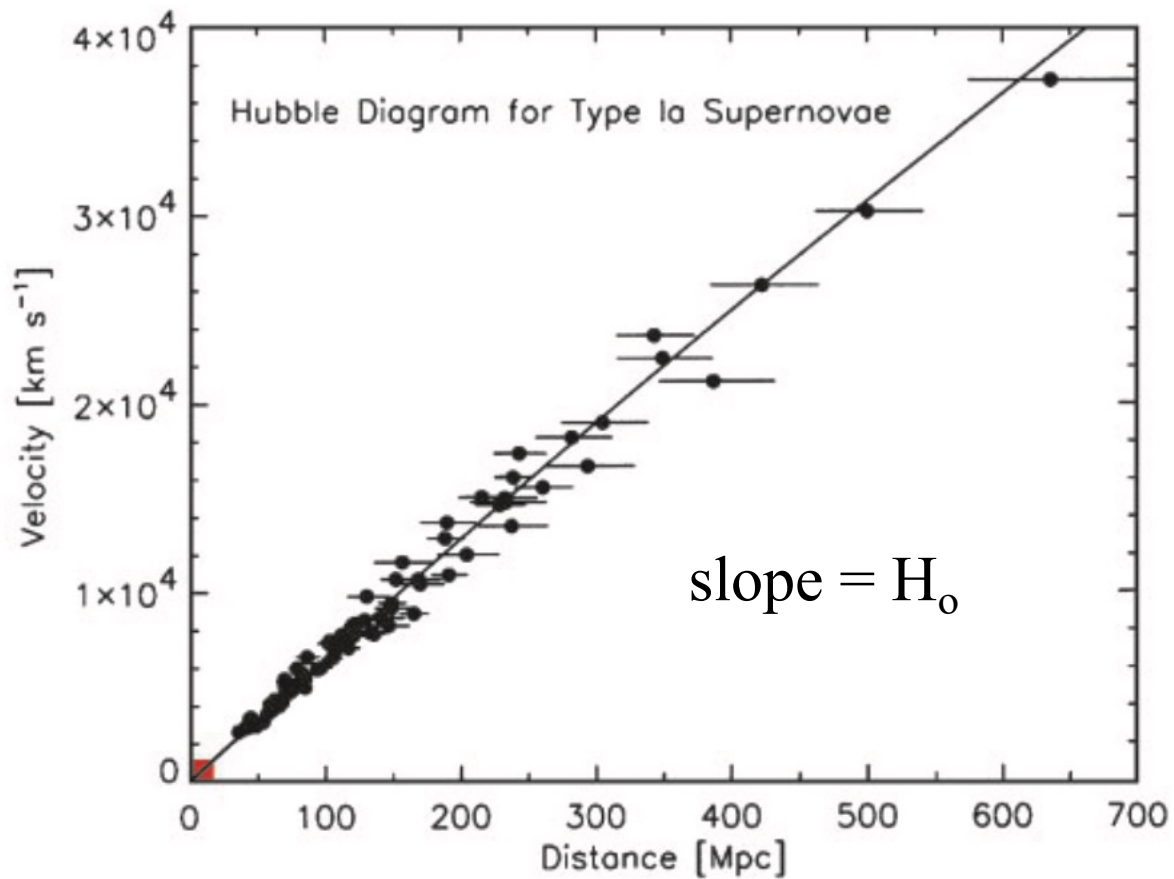
1931

Some important observations

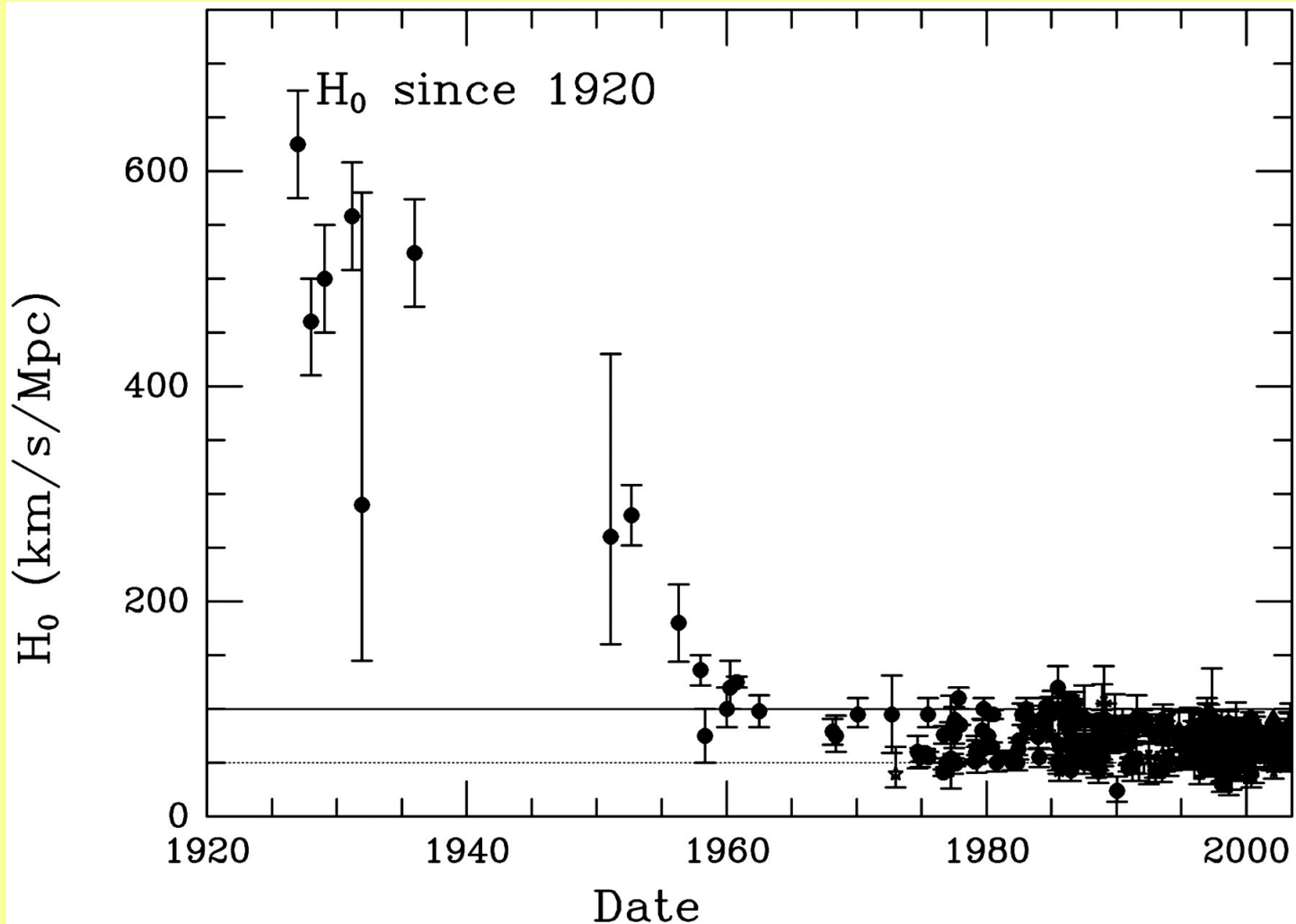


- light gets stretched en route
- galaxies recede faster at greater distances

Improvements since 1922



Since 1922

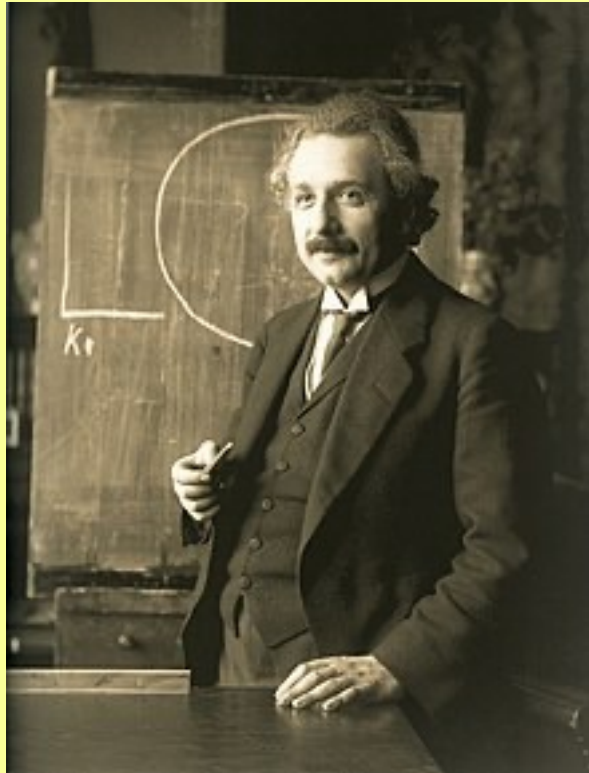


An important calculation



In 1922, prior to Hubble's measurements, Einstein's equations of general relativity (1915) were solved by Aleksandre Friedmann, a Russian physicist, showing that the universe could not be static.

An important calculation



“The results concerning the non-stationary universe contained in [Friedmann’s] work appear to me suspicious. In reality, it turns out that the proposed solution given in it does not satisfy the field equations.”

A. Einstein, *Euvres choisies*, vol III, *Relativités* p 103.

Einstein later realized that he made a mistake

This result provoked strong reactions:

“Philosophically, the notion of a beginning of the present order of nature is **repugnant** to me”

Arthur Eddington *Nature* 450, 127, (1931)

“I would like to reject it”

Phillip Morrison, *God and the Astronomers*,
1992, p 104

“**Distasteful** to the scientific mind”

Robert Jastrow, *God and the Astronomers*,
1992, p 105

Another important calculation



In 1948, Robert Hermann and Ralph Alpher predicted that a radiation should be left over from the initial creation event. They predicted the temperature and the wavelength distribution of that radiation.

$$3000 \text{ }^\circ\text{K} / 550 \text{ (expansion factor)} = \sim 5 \text{ }^\circ\text{K}$$

Some important observations

3. Cosmic microwave background (CMB) radiation – 1965

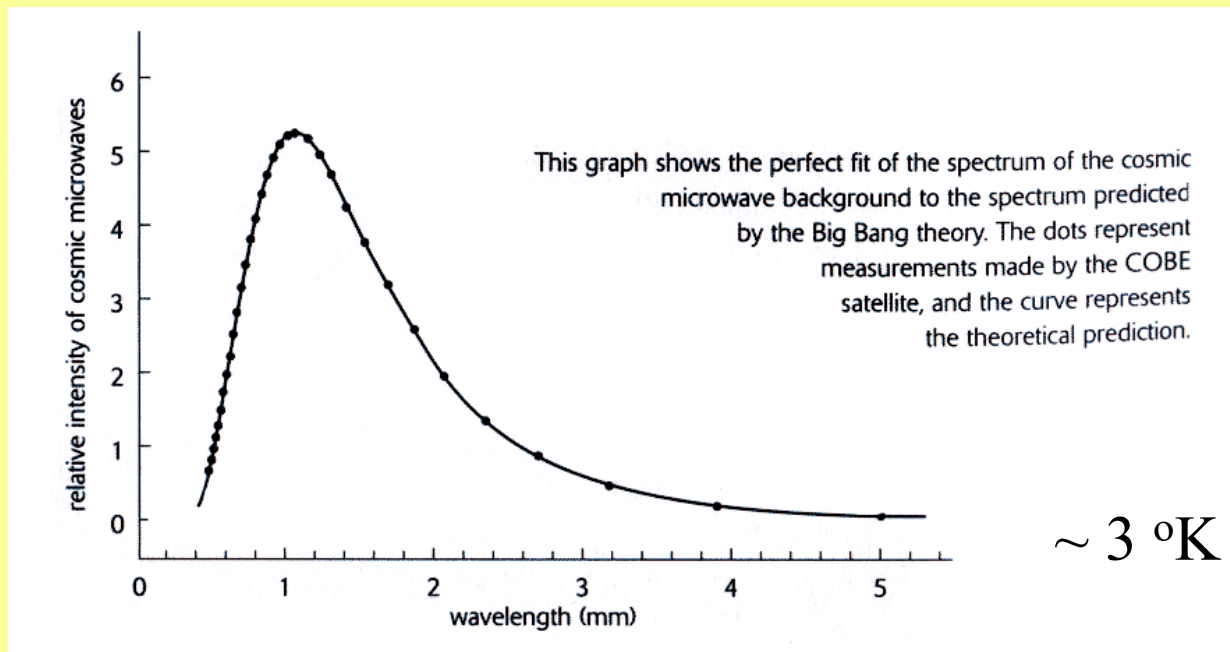


Arno Penzias and
Robert Wilson,

Bell Labs

Some important observations

3. Cosmic microwave background (CMB) radiation, nearly uniform in all directions. This radiation does not come from a single source, rather it exists at every point in the universe. Believed to represent radiation with a red-shift of 1,100. It is the earliest phenomenon that we will ever observe.



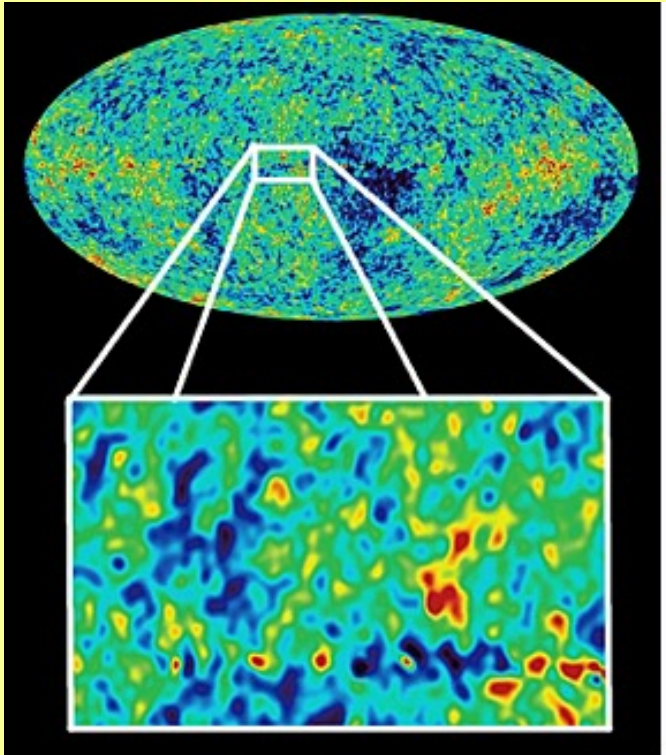
The universe expanded from a very hot, dense state

discovered by Penzias and Wilson, 1965

Some important observations

4. Discovery of fluctuations in CMB (explains how galaxies formed)

1992



avg $T = 2.7 \text{ }^\circ\text{K}$

fluctuations of
1 part in 100,000

George Smoot



From Smoot Cosmology Group website

Important theoretical developments:

**1973: Hawking-Penrose-Ellis singularity theorems
based on general relativity**

**2003: Borde-Guth-Vilenkin theorem
generalized proof for a beginning to space, time
matter, and energy for any expanding universe**

“With the proof now in place, cosmologists can no longer hide behind the possibility of a past-eternal universe ... There is no escape, they have to face the problem of a cosmic beginning.”

Vilenkin, Many Worlds in One , p 176

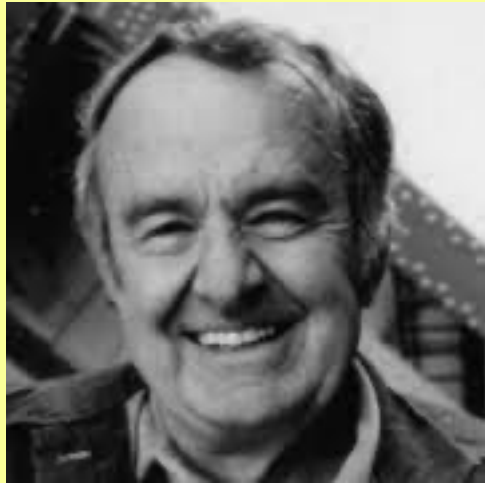
Implication

**there was a beginning to space, time matter,
and energy**

“If we extrapolate this prediction to its extreme, we reach a point when all distances in the universe have shrunk to zero. ... We cannot continue physical reasoning, or even the concept of spacetime, through such an extremity. ... On this view the big bang represents the creation event; the creation not only of all the matter and energy in the universe, but also of space-time itself.”

Paul Davies, Spacetime Singularities in
Cosmology, 1978

Alan Sandage



observational
astronomer

> 500 publications

“Here is evidence of what can only be described as a super natural event. There is no way that this could have been predicted within the realm of physics as we know it. ...

I now have to go from a stance as a complete materialistic rational scientist and say this super natural event, to me, gives at least some credence to my belief that there is some design put in the universe.”

Alan Sandage, *quoted in Return of the God Hypothesis*, 2021, p 108



NASA scientist,
astronomer

"For the scientist who has lived by his faith in the power of reason, the story ends like a bad dream. He has scaled the mountains of ignorance; he is about to conquer the highest peak; as he pulls himself over the final rock, he is greeted by a band of theologians who have been sitting there for centuries."

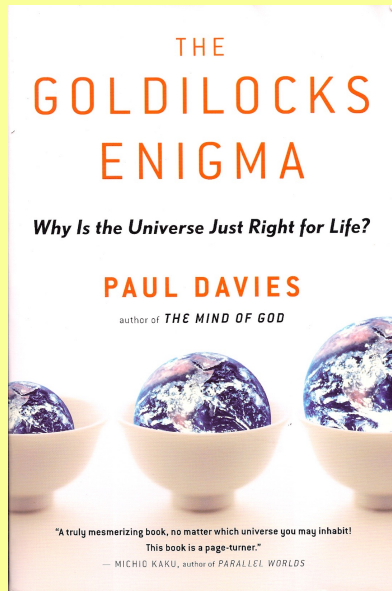
R. Jastrow, *God and the Astronomers*, 1992,
pg 107.

Summary:

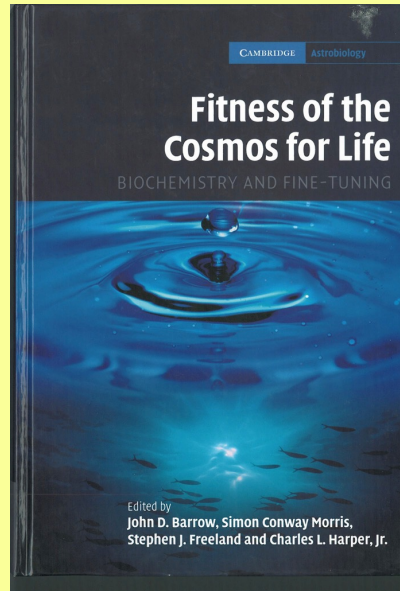
**The universe (space-time, matter, energy)
had a beginning and will have an end.**

10 recent discoveries that have changed the debate about design in the universe

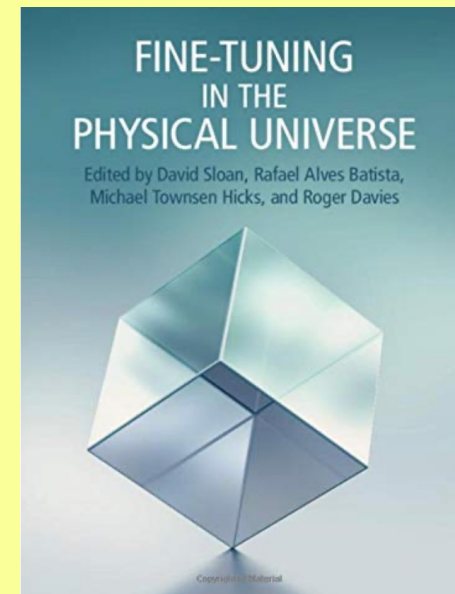
2. The laws of physics, the fundamental constants, and the initial conditions of our Universe, are fine-tuned to allow for the possibility of life



2006



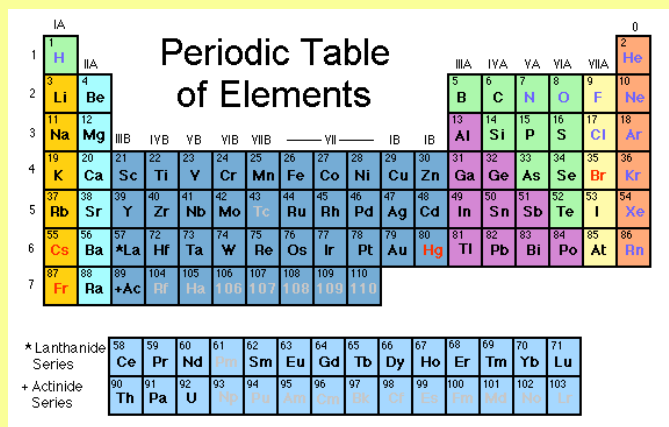
2008



2020

Very important recent discovery

The precise values of these constants and initial conditions are critical for the universe to support life!



The image shows a standard periodic table of elements. The title is "Periodic Table of Elements". The table is organized into groups (IA, IIA, IIIA, IVB, VB, VIB, VII, VIIA, VIIIA, IIB, IB, IIB) and periods (1 to 7). The elements are color-coded by groups: IA (yellow), IIA (orange), IIIA (green), IVB (light green), VB (light blue), VIB (blue), VII (purple), VIIA (pink), VIIIA (light purple), IIB (light blue), IB (light blue), and IIB (light blue). The lanthanide series (Ce to Lu) and actinide series (Th to Lr) are shown at the bottom of the table.

Period	IA	IIA	IIIA	IVB	VB	VIB	VII	VIIA	VIIIA	IIB	IB	IIB	0					
1	H	He																
2	Li	Be	B	C	N	O	F	Ne										
3	Na	Mg	Al	Si	P	S	Cl	Ar										
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	*La	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	+Ac	Rf	Ha	106	107	108	109	110								

* Lanthanide Series
+ Actinide Series

-formation and stability of the elements

-ability to form chemical compounds

-types of stars and rates of burning

-etc

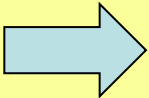
Timeline: Some important events on this topic

The Fitness of the Environment

Lawrence Henderson, 1913

The Unreasonable Effectiveness of Mathematics in the
Natural Sciences

Eugene Wigner, 1960

 Large Number Coincidences and the Anthropic Principle in
Cosmology

Brandon Carter, 1973

The Anthropic Cosmological Principle

John Barrow and Frank Tipler, 1986

Categories

1. Initial conditions:

- initial entropy

- expansion rate (cosmological constant)

- initial mass density

- tuning of “inflaton field”

2. Laws and constants of physics

3. Masses of fundamental particles

Constants and Ratios

Boltzmann's constant	$k = 1.38 \times 10^{-23} \text{ J/}^\circ\text{K}$
Planck's constant	$\hbar = 6.63 \times 10^{-34} \text{ J/s}$
Speed of light	$c = 3.00 \times 10^8 \text{ m/s}$
Gravitational constant	$G = 6.67 \times 10^{-11} \text{ (N} \cdot \text{m}^2\text{)/kg}$
Weak force constant	$g_w = 1.43 \times 10^{-62} \text{ (SI units)}$
Strong force constant	$g_s = 15 \text{ (SI units)}$
Hubble constant	$H = 2 \times 10^{-18} \text{ (SI units)}$
Cosmological constant	$L = <10^{-53} \text{ (SI units)}$
Cosmic photon/proton ratio	$S = 10^9 \text{ (SI units)}$
Permittivity of free space	$\epsilon = 8.85 \times 10^{-12} \text{ (SI units)}$
Rest mass of a neutron	$M_n = 1.674 \times 10^{-27} \text{ kg}$
Rest mass of an electron	$M_e = 9.11 \times 10^{-31} \text{ kg}$
Rest mass of a proton	$M_p = 1.672 \times 10^{-27} \text{ kg}$
Electron or proton unit charge	$e = 1.6 \times 10^{-19} \text{ coul}$
Mass-energy relation	$c^2 = (E/m) \text{ J/kg}$

The four fundamental forces

		<u>rel. strength</u>
Strong nuclear force	(SF)	1
Weak nuclear force	(WF)	10^{-6}
Electromagnetic force	(EMF)	1/137
Gravitational force	(GF)	6×10^{-39}

Electromagnetic force - electrical charges, magnetism

If EMF were slightly weaker, electrons wouldn't be held in their orbits

If EMF were slightly stronger, electrons couldn't be shared among different atoms

Either way, no chemistry and no life!

The four fundamental forces

		<u>rel. strength</u>
Strong nuclear force	(SF)	1
Weak nuclear force	(WF)	10^{-6}
Electromagnetic force	(EMF)	1/137
Gravitational force	(GF)	6×10^{-39}

Strong nuclear force - holds nucleus together

If: **SF/EMF x 1.02** no stable hydrogen
 SF/EMF x 0.95 few if any elements other than hydrogen

Ward and Brownlee, Rare Earth, 2000.

Ratio of mass of proton to mass of electron (1,836)

This ratio determines the characteristics of orbits of electrons about nuclei. If this ratio were slightly different there would be no chemistry, and no life. S. Hawking cites this example as one of the many fundamental numbers in nature, and he says

"The remarkable fact is that the values of these numbers seem to have been **very finely adjusted** to make possible the development of life".

S. Hawking, *A Brief History of Time*, 1988, pg 125.



Fine structure constant and carbon atoms

It is true, for example, that the **fine structure constant α has to be close to 1/137 for carbon atoms to exist**, and carbon atoms are required for us to be here writing about cosmology. However, these arguments have nothing to do with explaining what physical laws led to this particular value of α

[Regarding a recent theory by S. Hawking and T. Hertog on this topic]

...it sounds to me a lot like the **despised fine-tuning**.

B. Richter, Physics Today, Oct 2006 p 8-9.

Some other examples

Ratio of the masses
of a neutron to the
proton

1 part in
1000

Lewis and Barnes, *A Fortunate Universe*, p. 79.

Ratio of the Weak
Nuclear Force to
the Strong Nuclear
Force

1 part in
10,000

Martin Rees, "Large Numbers and Ratios in
Astrophysics and Cosmology," *Philosophical
Transactions of the Royal Society London A*, 310
(1983): 317; Lewis and Barnes, *A Fortunate
Universe*, p. 78.

Ratio of the
Electromagnetic
Force to Gravity

1 part in
 10^{40}

Davies, *The Accidental Universe*, pp. 71-73.



“The really amazing thing is not that life on earth is balanced on a knife-edge, but that the entire universe is balanced on a knife-edge and would be total chaos if any of the natural constants were off even slightly..”

P. Davies, *The Goldilocks Enigma*, 2006, pg 149.



"A common sense interpretation of the facts suggests that a **superintellect has monkeyed with physics**, as well as with chemistry and biology, and that there are no blind forces worth speaking about in nature. The numbers one calculates from the facts seem to me **so overwhelming as to put this conclusion almost beyond question.**"

Fred Hoyle, "The Universe: Past and Present Reflections", Annual Reviews of Astronomy and Astrophysics, 20 (1982), 16.



"Astronomy leads us to a unique event, a universe which was created out of nothing and **delicately balanced to provide exactly the conditions required to support life**. In the absence of an absurdly-improbable accident, the observations of modern science seem to suggest an underlying, one might say, supernatural plan."

Arno Penzias, quoted by Walter Bradley in "The Designed 'Just-so' Universe", 1999.

Summary:

It is a fact that the universe is fine-tuned to an astonishing degree at the most fundamental level to allow for the possibility of life

**From these two discoveries it is
unavoidable that something
really amazing has to be true!**

Possible Explanations

1. God
2. Infinite universes (Multiverse, Spider-Man film)
3. Our universe is a computer program (The Matrix)

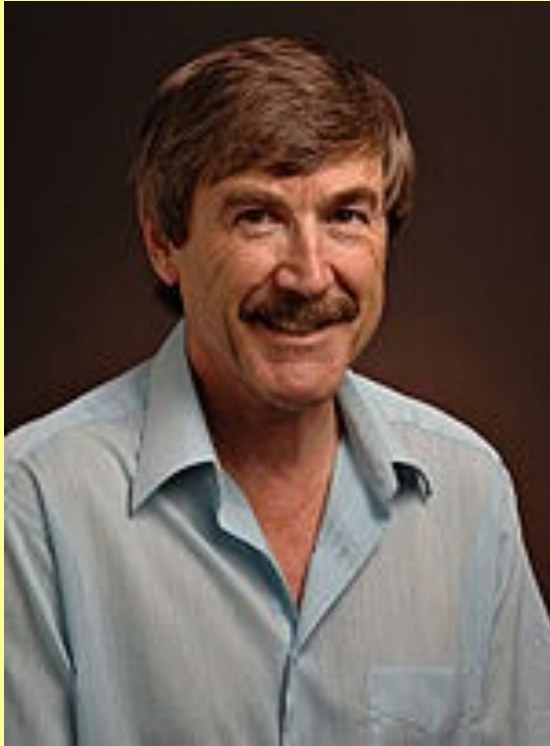
A graphic with a yellow background. At the top is a large image of Tom Holland as Spider-Man. Below it, the text "SPIDER-MAN" is written in large white letters, and "MULTIVERSE" is written in smaller white letters below it. A red circle with a white question mark is positioned between the top and bottom images. The bottom section is split into two smaller images: one of Andrew Garfield as Spider-Man on the left and one of Tobey Maguire as Spider-Man on the right.

SPIDER-MAN

MULTIVERSE



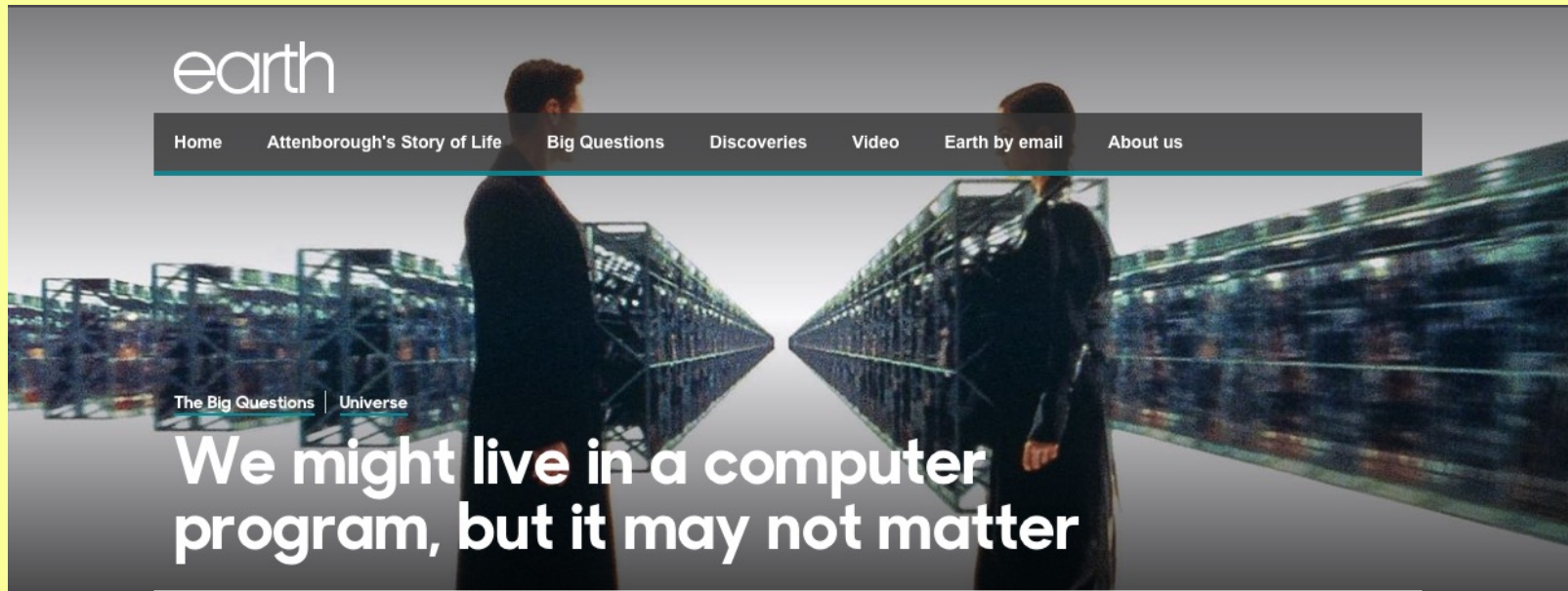
Multiverse?



“... it represents a huge departure from the way we normally do science, and many scientists are aghast at it. But ... it may be the only answer.”

Paul Davies, *The Goldilocks Enigma*, p 150.

Our universe is a computer program



Several physicists have suggested that our Universe is not real and is instead a giant simulation. Should we care?

By Philip Ball

5 September 2016

*This story is part of BBC Earth's "Best of 2016" list, our greatest hits of the year. **Browse the full list.***

Some scientists argue that there are already good reasons to think we are inside a simulation. One is the fact that our Universe looks designed.

The constants of nature, such as the strengths of the fundamental forces, have values that look fine-tuned to make life possible. Even small alterations would mean that atoms were no longer stable, or that stars could not form. Why this is so is one of the deepest mysteries in cosmology.

**10 recent discoveries that have
changed the debate about design in
the universe**

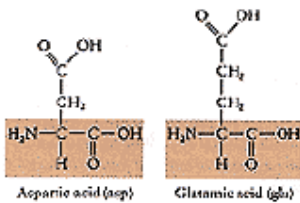
**3. Functional sequences of proteins are
incredibly rare**

Proteins

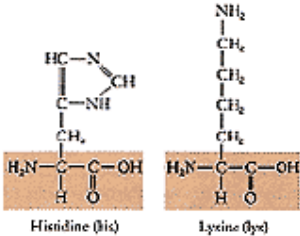
Amino acids

(20 in proteins)

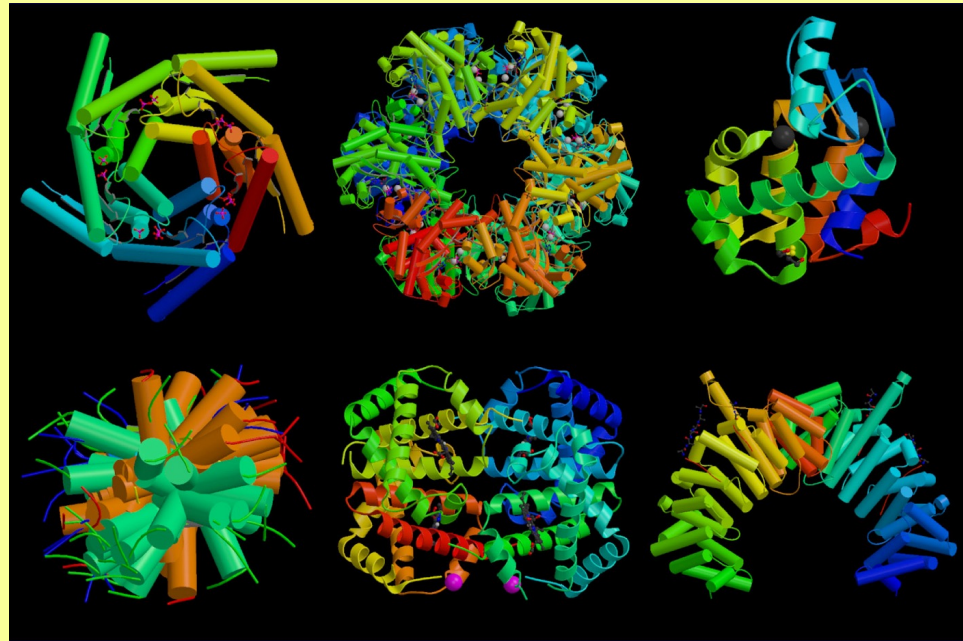
Acidic (negatively charged at pH 7)



Basic (positively charged at pH 7)



chains of amino acids fold into 3D structures



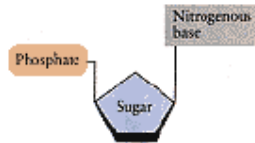
A chain of amino acids:

QYAPQTQSGRTSIVHLFEWRWVDIALECYRLGPKGFGGVQVSPNENVVVTNPSRPWWERYQPVSYKLCTRSGNENEFR
DMVTRCNNVGVRIYVDAVINHMCSGSAAAGTGTTCSYCNPGSREFPAVPYSAWDFNDGKCKTASGGIESYNDPYQVRDC
QLVGLLDLALEKDYVRSMIADYLNKLIDIGVAGFRIDASKHMWPGDIKAVLDKLNHLNTNWFAPGSRPFIFQEVIDLGGE
AIKSSEYFGNGRVTEFKYGAKLGTVVRKWSGEKMSYLNWGEWGFMPDRALVFDNHDNQRGHGAGGSSILTFWDARL
YKVAVGFMLAHPYGFTRVMSSYRWARNFVNGEDVNDWIGPPNNGVIKEVTINADTTCGNDWVCEHRWREIRNMVWFRNV
VDGEPFANWWDNGSNQVAFGRGNGRFIVFNDDWQLSSTLQTGLPGGTCDVISGDKVGNSTGTGIKVYVSSDGTAQFSIS
NSAEDPFIAIHAESKL

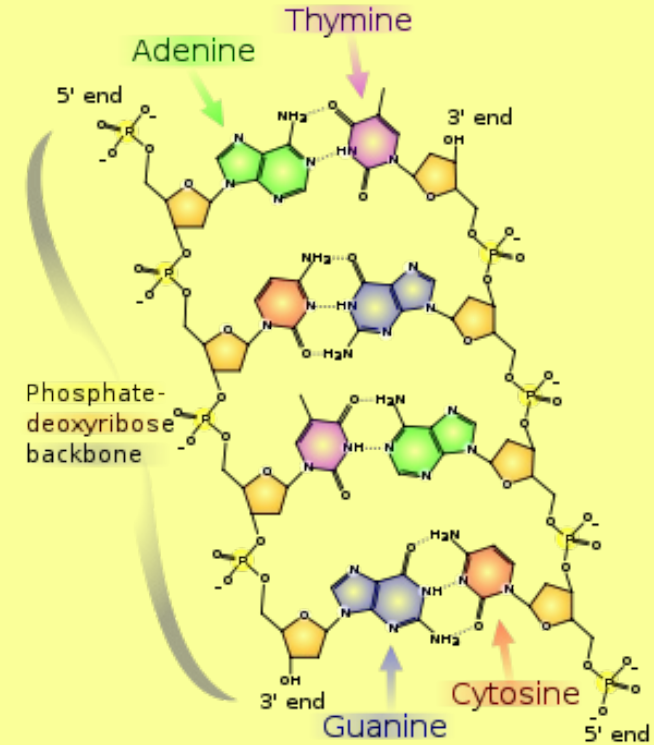
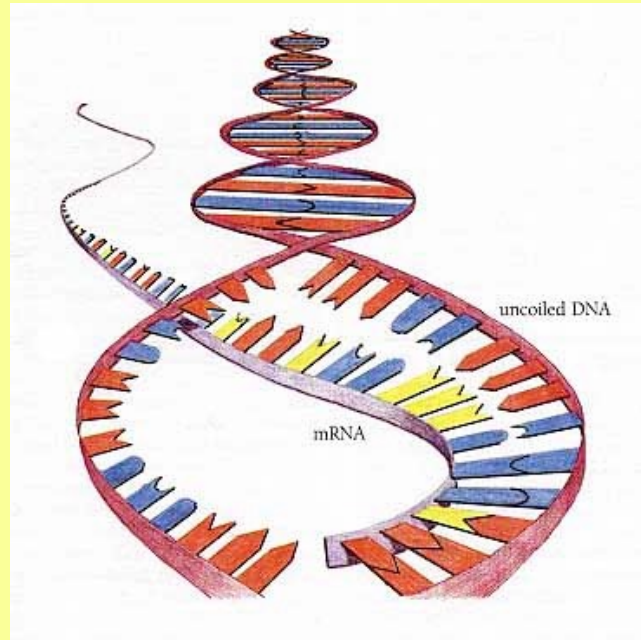
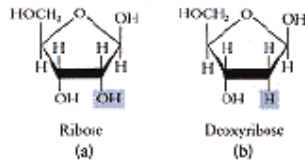
DNA

Nucleotides

(4 in DNA and RNA)



3-30 A nucleotide is made up of three different subunits: a phosphate group, a five-carbon sugar, and a nitrogenous base. As we shall see in Chapter 14, nucleotides can be linked together in long chains by condensation reactions involving the hydroxyl groups of the phosphate and sugar subunits.



A chain nucleotides:

ATCGCCTATATAGCGTACAATGGCTACATCGCCTATATAGCGTACAATGGCTACGTAGCTACGATGCTAGCTAGCTAGC
 GCTACATCGCCTATATAGCGTACAATGGCTACGTAGCTACGATGCTAGCTAGCTAGCATCGCCTATATAGCGTACAATGGCTAC
 ATCGCCTATATAGCGTACAATGGCTACGTAGCTACGATGCTAGCTAGCTAGCATCGCCTATATAGCGTACAATGGCTACATCGC
 CTATATAGCGTACAATGGCTACGTAGCTACGATGCTAGCTAGCTAGCATCGCCTATATAGCGTACAATGGCTACATCGCCTATAT
 AGCGTACAATGGCTACGTAGCTACGATGCTAGCTAGCTAGCGCTACATCGCCTATATAGCGTACAATGGCTACGTAGCTACGAT
 GCTAGCTAGCTAGCATCGCCTATATAGCGTACAATGGCTACATCGCCTATATAGCGTACAATGGCTACGTAGCTACGATGCTAG
 CTAGCTAGCATCGCCTATATAGCGTACAATGGCTACATCGCCTATATAGCGTACAATGGCTACGTAGCTACGATGCTAGCTAGC
 TAGC

History



**Structure of DNA
– 1953**

**DNA stores
information in a
4-letter code**

**Precise sequences
of proteins are
critical**

Mathematical Challenges to the Neo-Darwinian Interpretation of Evolution.

Wistar Symposium, Philadelphia, April 1966.

Protein sequence space is too large to be searched

20^L where L is the length of the protein (ex. 20^{150})

Analogy: written language

“Protein sequence space is too large to be searched.”

50 characters with spaces

Analogy: written language

“Protein sequence space is too large to be searched.”



a
b
c
d
e
f
g
h
i
J
.
.
.

27 possibilities (26 letters + space)

Analogy: written language

“Protein sequence space is too large to be searched.”



a
b
c
d
e
f
g
h
i
J
.
.
.

27 possibilities (26 letters + space)

Analogy: written language

“Protein sequence space is too large to be searched.”



a
b
c
d
e
f
g
h
i
J
.
.
.

27 possibilities (26 letters + space)

Analogy: written language

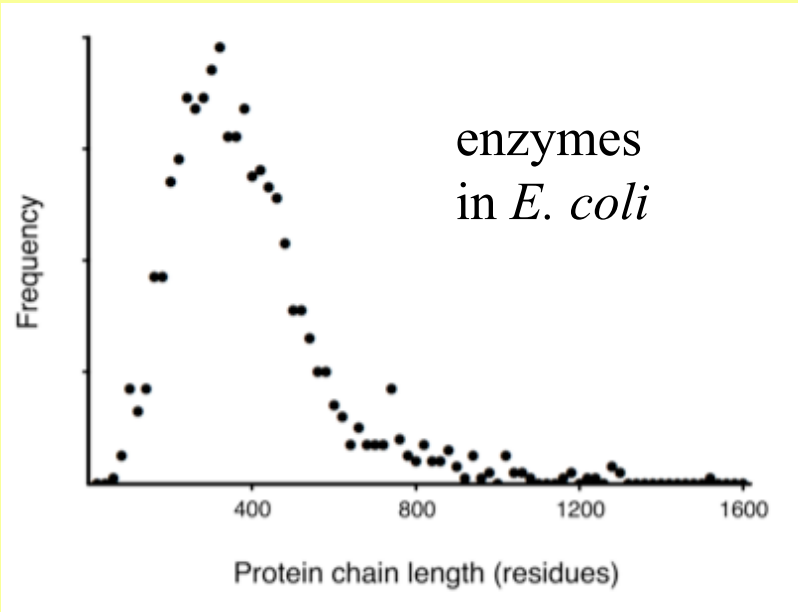
“Protein sequence space is too large to be searched.”

27^{50} possible sequences

How many are functional?

Two critical aspects

A.



20 types of amino acids, chains of amino acids 300 units long

20^{300} Possible sequences

Only a miniscule fraction of sequence space can be searched!

B. What fraction of sequences fold: ???

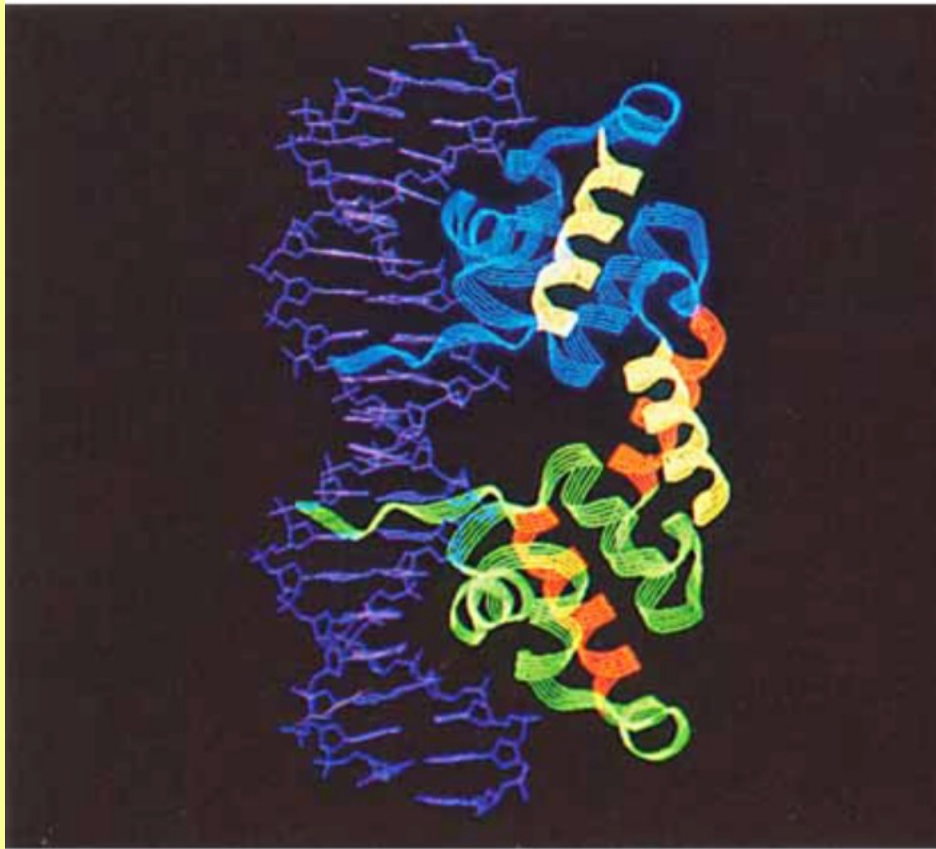
Three methods

1. Make sequences randomly and see how many fold
(forward approach)
2. Start with the folded protein and mutate portions
(reverse approach)
3. Analyze sequences in the protein data bank

Three methods

- ~~1. Make sequences randomly and see how many fold~~ too slow
2. Start with the folded protein and mutate portions
3. Analyze the sequences in the protein data bank

1990



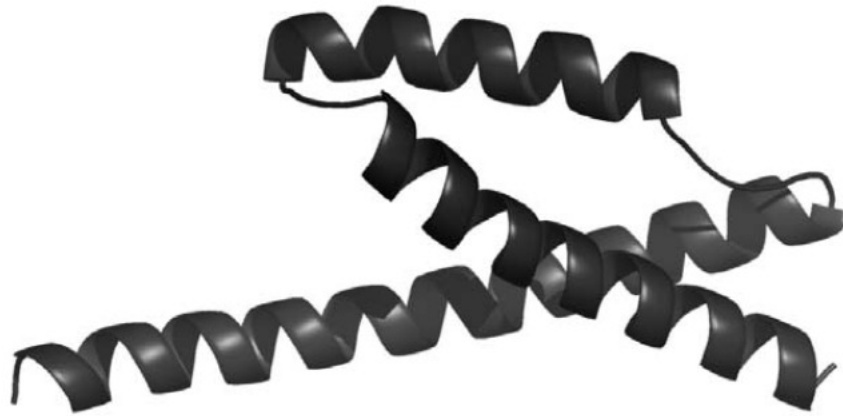
Estimated
fraction of
sequences that
adopt this fold

1 in 10^{63}

λ Repressor - 92 amino acids

Reidhaar-Olsen and Sauer. Proteins: Struct.
Funct. and Genetics , 7, 306, **1990**.

a

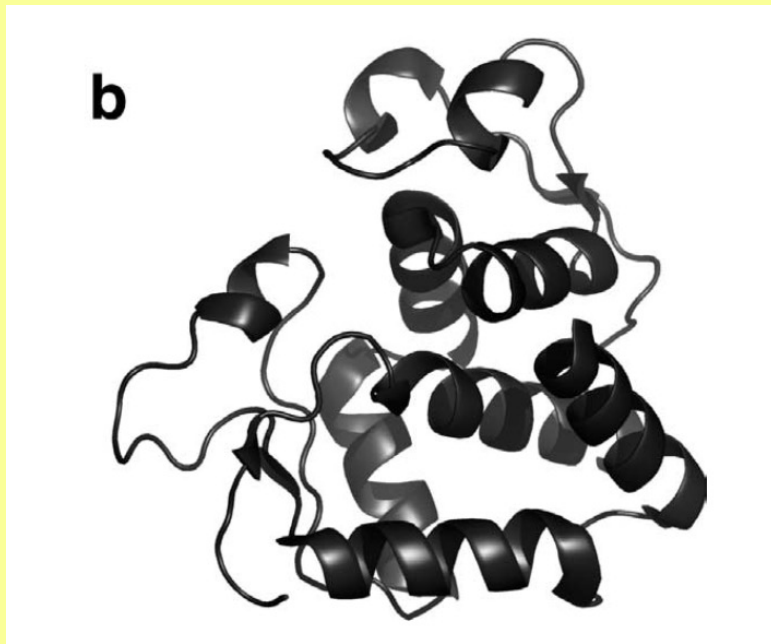


Estimated
fraction of
sequences that
adopt this fold

1 in 10^{24}

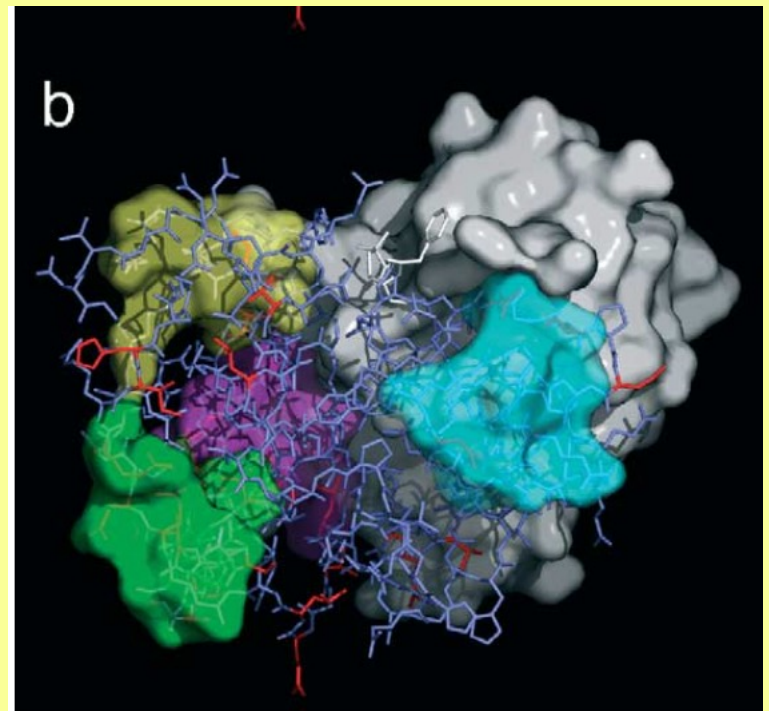
chorismate mutase - 93 amino acids

Taylor et al, Proc. Natl Acad. Sci. USA, 98,
10596–10601, **2001**.



β -lactamase, large domain
153 amino acids

Douglas Axe, J. Molec. Biol.
341, 1295, **2004**.

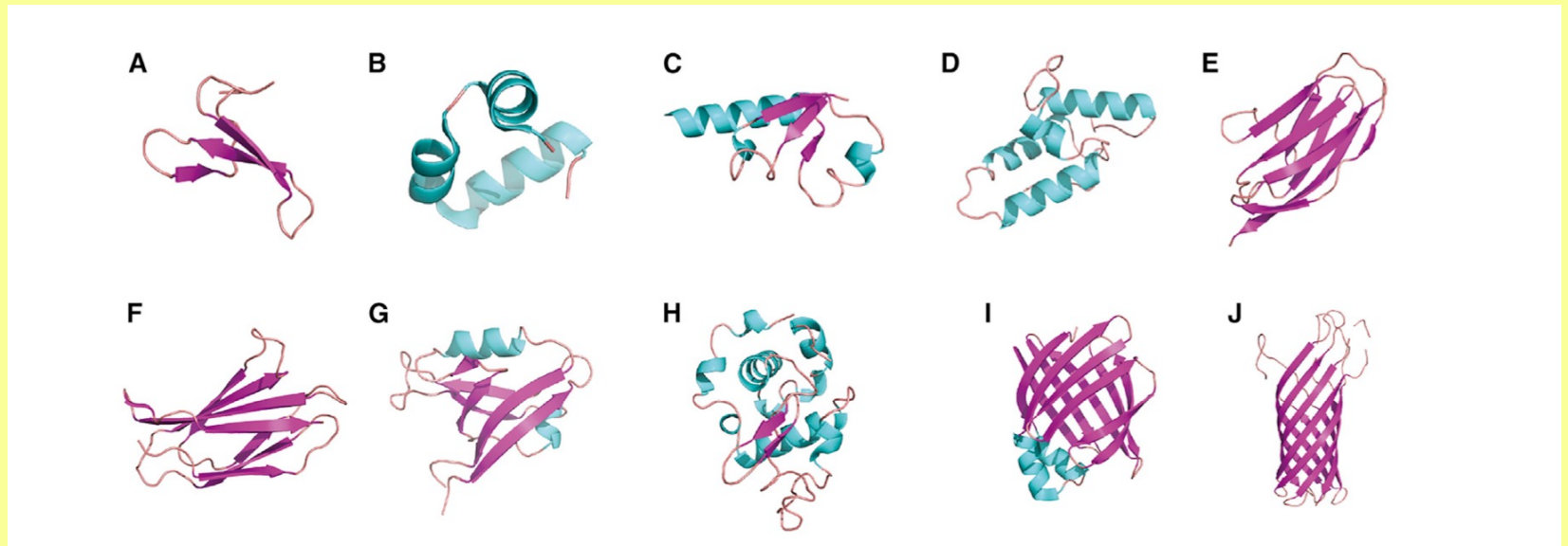


β -lactamase, large domain
153 amino acids

1 in 10^{64}

Method 3: bioinformatics

Protein folds they studied



Method 3: bioinformatics

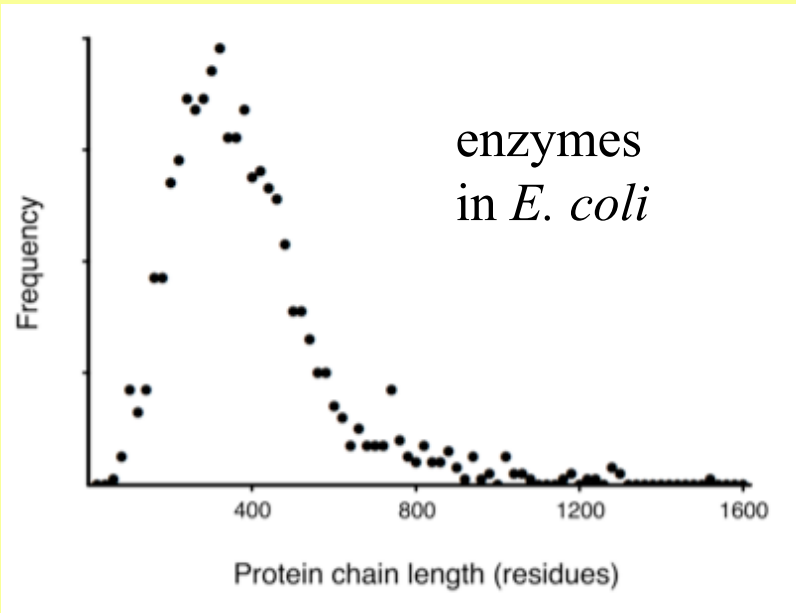
SC – sequence capacity
SC* – fraction of total

TABLE 1 Estimates of SC

Protein	<i>L</i>	Fold	SC	SC*	<i>M</i>
WW	35	all- β	9.9×10^{21}	2.9×10^{-24}	5800
Villin	35	all- α	1.6×10^{13}	4.7×10^{-33}	759
NTL9	56	α/β	3.2×10^{19}	4.4×10^{-54}	4828
IM7	87	all- α	1.6×10^{27}	1.1×10^{-86}	536
Titin I27	89	all- β	2.0×10^{78}	3.2×10^{-38}	55,422
TNfn3	90	all- β	8.5×10^{78}	6.9×10^{-39}	66,289
PDZ	94	α/β	1.2×10^{73}	5.8×10^{-50}	30,176
α -LA	123	α/β	1.1×10^{39}	1.0×10^{-121}	934
IFABP	131	α/β	3.0×10^{59}	1.1×10^{-111}	1691
OmpA	171	all- β	7.9×10^{96}	2.6×10^{-126}	31,397

L refers to the protein length, SC* is the absolute SC normalized by the total number of possible sequences (20^L), and *M* is the number of sequences in the MSA for each protein family.

A.



20 types of amino acids, chains of amino acids 150 units long

20^{150} possibilities

Only a miniscule fraction of sequence space can be searched!

B. Fraction that fold (for 150 residue protein):

1 in 10^{64} (J. Molec. Biol. 2004)

< 1 in 10^{100} (Biophysical J. 2017)

Only a miniscule fraction are functional!

How were the functional sequences found?

“Overall, what the field of protein evolution needs are some plausible, solid hypotheses to explain how random sequences of amino acids turned into the sophisticated entities that we recognize today as proteins. Until that happens, the phenomenon of the rise of proteins will remain, as Tawfik says, **“something like close to a miracle.”**”

“Close to a Miracle: Researchers are debating the origins of proteins”

J. Amer. Soc. for Biochem. and Molec. Biol. Oct 2013

Summary:

Protein sequence space is far too large to be searched and functional sequences are incredibly rare.

No one knows how they were found or where they came from.

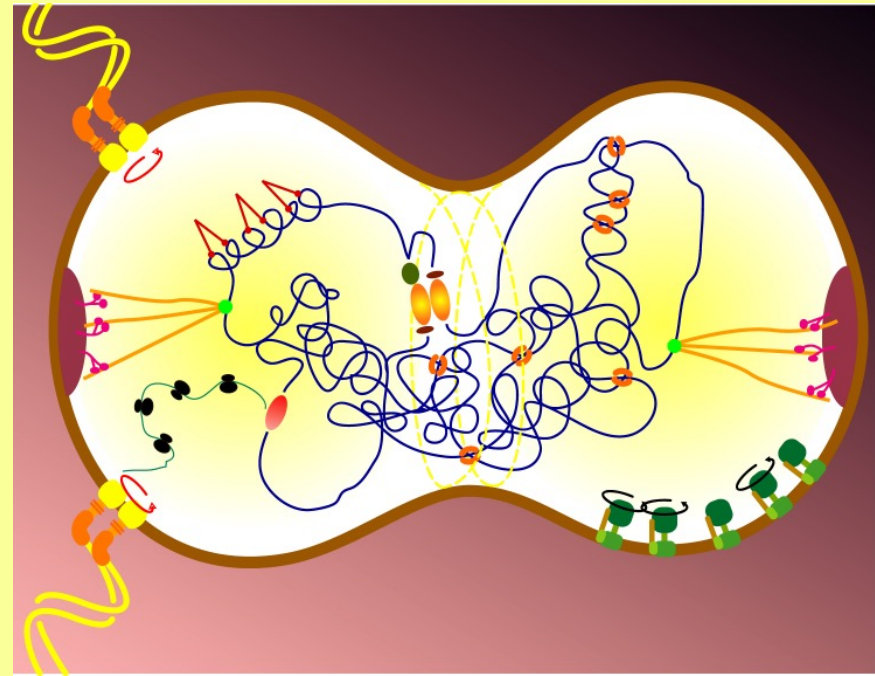
**10 recent discoveries that have
changed the debate about design in
the universe**

- 4. The number of genes in the simplest
free-living organism is about 450**

Minimal cells

Lots of Jobs to Do:

- Getting food and fuel
- Eliminating waste
- Converting raw materials to useful stuff
- Building molecular machines
- Repairing damage
- Copying and protecting genetic information
- Dividing the cell
- Controlling and coordinating all these
- Etc.



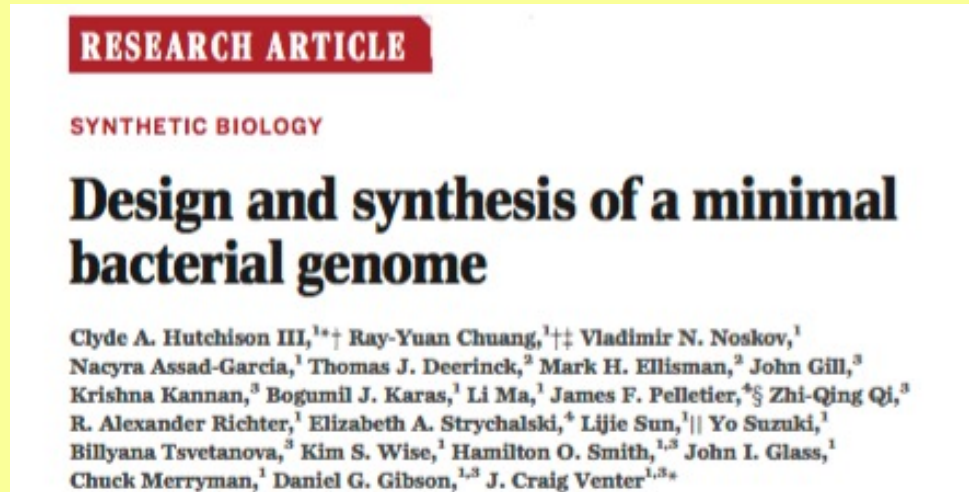
There is a machine (or system of machines) for every job

There is a system for making machines (central genetic apparatus)

There is a system of coordination among the machines

Minimal cells

Science 351, aad6253 (2016)



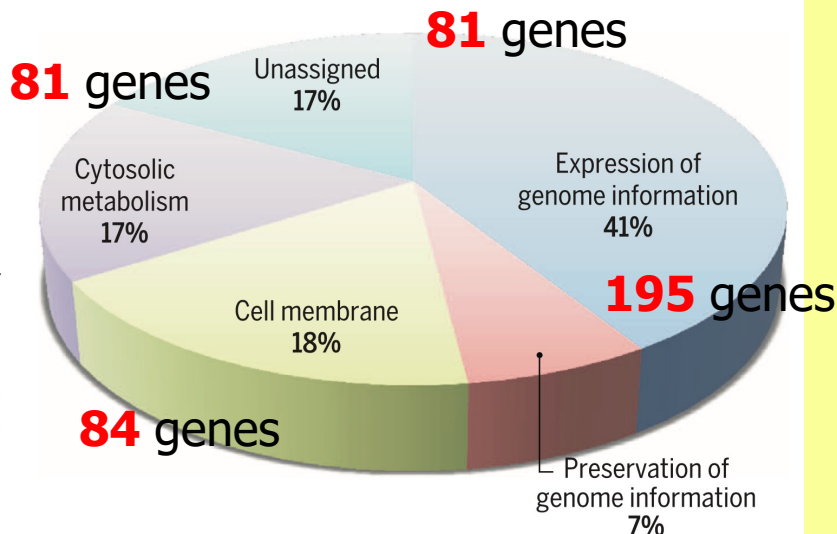
Original *Mycoplasma mycoides* genome has **901** genes

M. capricolum with synthesized minimal genome from *M. mycoides* can survive with **473** genes

438 protein-coding
35 RNA genes

Fig. 6. Partition of genes into four major functional groups.

Syn3.0 has 473 genes. Of these, 79 have no assigned functional category (Table 1). The remainder can be assigned to four major functional groups: (i) expression of genome information (195 genes); (ii) preservation of genome information (34 genes); (iii) cell membrane structure and function (84 genes); and (iv) cytosolic metabolism (81 genes). The percentage of genes in each group is indicated.



Growth in rich medium

There is no such thing as a simple form of life!

"We now know not only of the existence of a break between the living and non-living world, but also that it represents the most dramatic and fundamental of all the discontinuities of nature. Between a living cell and the most highly ordered non-biological system, such as a crystal or snowflake, there is **a chasm as vast and absolute as it is possible to conceive.**"

M. Denton, *Evolution: A Theory in Crisis*, pg 250.

Ideas to explain life:

- 1. Infinite universes**
- 2. A simpler form of “life” came before the current forms and has since vanished.**
- 3. Life on earth was seeded by aliens**

Infinite Universes:

Biology Direct



Hypothesis

Open Access

The cosmological model of eternal inflation and the transition from chance to biological evolution in the history of life

Eugene V Koonin*

Address: National Center for Biotechnology Information, National Library of Medicine, National Institutes of Health, Bethesda, MD 20894, USA

Email: Eugene V Koonin* - koonin@ncbi.nlm.nih.gov

* Corresponding author

Published: 31 May 2007

Received: 10 May 2007

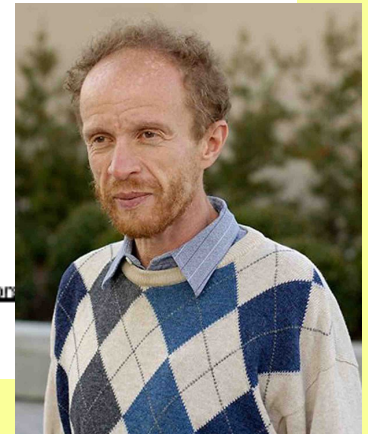
Biology Direct 2007, 2:15 doi:10.1186/1745-6150-2-15

Accepted: 31 May 2007

This article is available from: <http://www.biology-direct.com/content/2/1/15>

© 2007 Koonin; licensee BioMed Central Ltd.

This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/2.0/>) which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.




Eugene Koonin
Senior Investigator
NIH

Infinite Universes:

Abstract

Background: Recent developments in cosmology radically change the conception of the universe as well as the very notions of "probable" and "possible". The model of eternal inflation implies that all macroscopic histories permitted by laws of physics are repeated an infinite number of times in the infinite multiverse. In contrast to the traditional cosmological models of a single, finite universe, this worldview provides for the origin of an infinite number of complex systems by chance, even as the probability of complexity emerging in any given region of the multiverse is extremely low. This change in perspective has profound implications for the history of any phenomenon, and life on earth cannot be an exception.

Hypothesis: Origin of life is a chicken and egg problem: for biological evolution that is governed, primarily, by natural selection, to take off, efficient systems for replication and translation are required, but even barebones cores of these systems appear to be products of extensive selection. The currently favored (partial) solution is an RNA world without proteins in which replication is catalyzed by ribozymes and which serves as the cradle for the translation system. However, the RNA world faces its own hard problems as ribozyme-catalyzed RNA replication remains a hypothesis and the selective pressures behind the origin of translation remain mysterious. Eternal inflation offers a viable alternative that is untenable in a finite universe, i.e., that a coupled system of translation and replication emerged by chance, and became the breakthrough stage from which biological evolution, centered around Darwinian selection, took off. A corollary of this hypothesis is that an RNA world, as a diverse population of replicating RNA molecules, might have never existed. In this model, the stage for Darwinian selection is set by anthropic selection of complex systems that rarely but inevitably emerge by chance in the infinite universe (multiverse).



A simpler form of “life” came before the current forms of life and has since vanished.

RNA world

Metabolism (proteins) first

Assembly theory?

Summary:

There is no such thing as a simple form of life!

Life as it exists today is far beyond the reach of chance in a finite universe.

Summary

- 1. The universe (space-time, matter, energy) had a beginning and will have an end.**
- 2. The laws of physics, the fundamental constants, and the initial conditions of the universe are fine-tuned to allow for the possibility of life**
- 3. Protein sequence space is far too large to be searched and functional sequences of proteins are incredibly rare
(~1 in 10^{65})**
- 3. The number of genes in the simplest free-living organism is about 450**

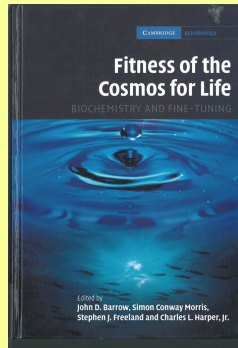
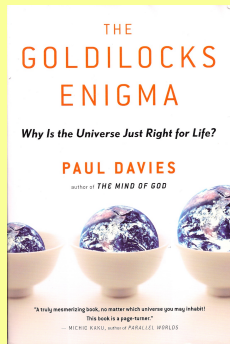
Extra slides

10 recent discoveries that have changed the debate about design in the universe

1. The universe had a beginning and will have an end
2. The Universe is fine-tuned to allow for life
3. Only a miniscule fraction of proteins are functional
4. About 450 genes in the simplest free-living organism
5. Life is based on a digital information processing system
6. Molecular machines and sophisticated software algorithms are essential to all life-forms
7. Random mutation + natural selection has severe limitations
8. The earth is fine-tuned to allow for life
9. In the fossil record new body plans appear without precursors
10. The junk-DNA paradigm has been shown to be false

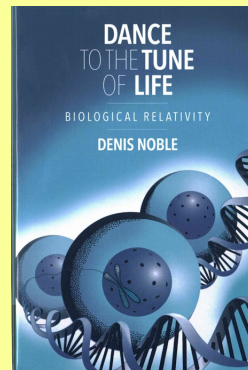
Physical Sciences

fine-tuning
anthropic coincidences
habitability
discoverability
intelligibility
physical laws
etc



Life Sciences

origin of life
molecular machines
hardware and software of cells
micro and macro evolution
basic charact. of fossil record
etc

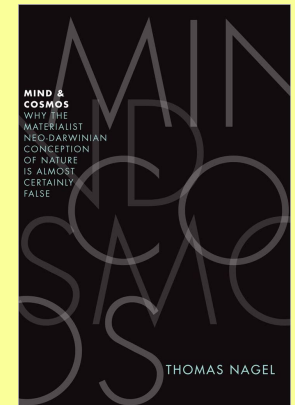


Cognitive Sciences

mind/brain
consciousness
personhood
abstract thought
reasoning
free will
etc

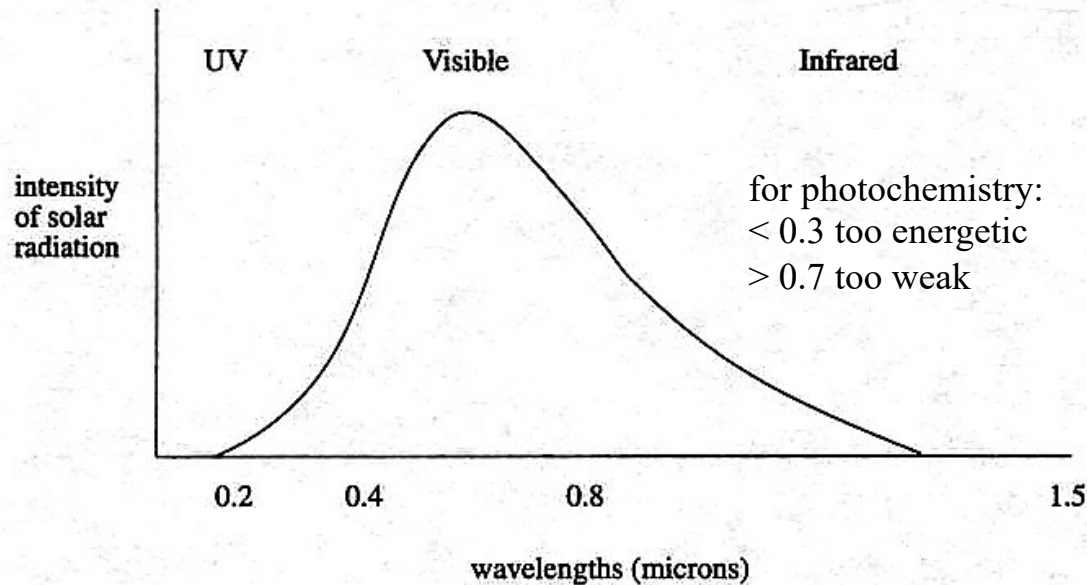


Thomas Nagel
NYU

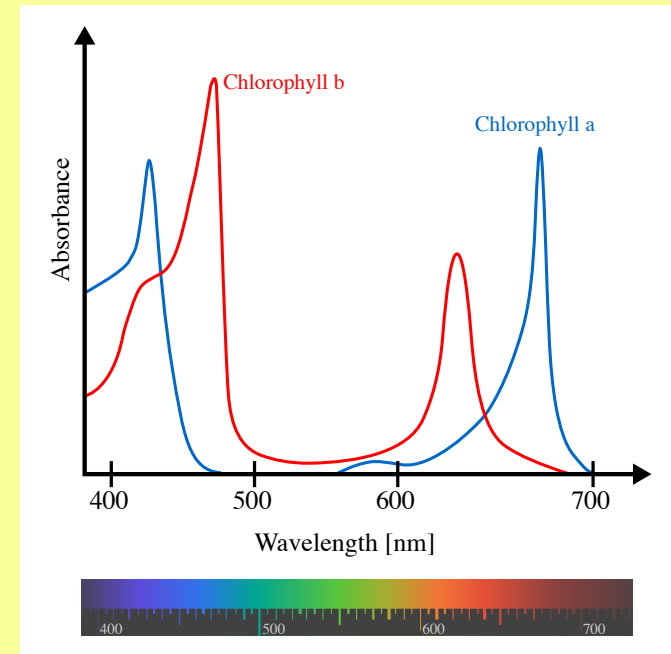


Energy from sun matched with that needed for photochemistry

The solar spectrum, showing the intensity of the sun's radiation between 0.1 and 1.50 microns.



solar spectrum



absorbance spectrum
of chlorophyll

Energy from sun matched with that needed for photochemistry

$$m_p^2 G / [h c] \sim [e^2 / \{h c\}]^{12} [m_e / m_p]^4$$

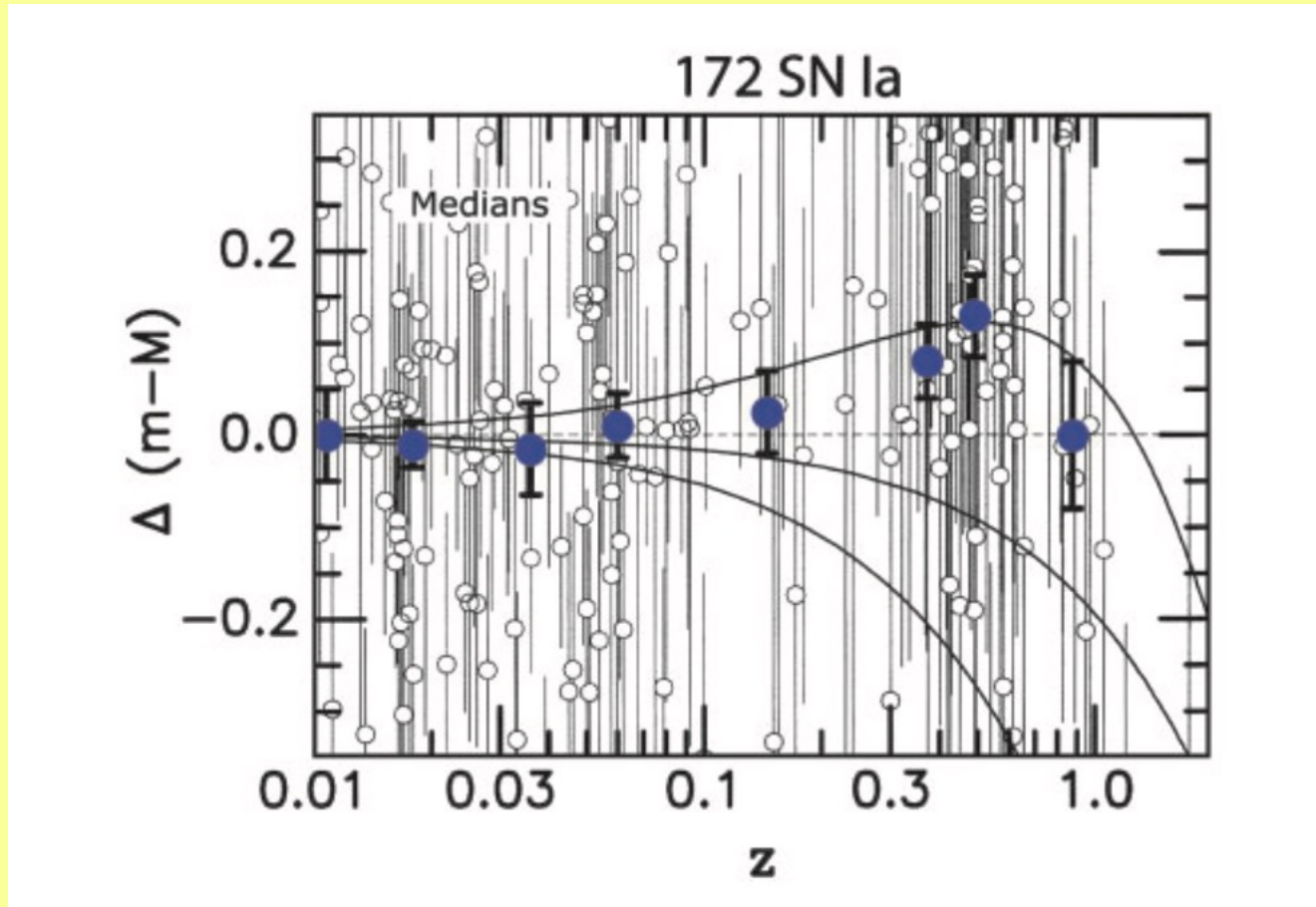
$$\alpha_G \sim [\alpha_{EM}]^{12} [m_e / m_p]^4$$

$$5.2 \times 10^{39} > \sim [2.2 \times 10^{39}]$$

from The Anthropic Cosmological Principle, 1986, p336

This occurs because the values of the universal constants h , c , G , m_e , m_p , e are **just right**.

Improvements since 1922



Some major issues in cosmology:

1. According to current models, ~95% of the stuff of the universe is “dark. (effects detected without observable causes)
 - dark matter
 - dark energy
2. Hubble tension – different measurements give different values for the Hubble constant

For a good summary see:

<https://www.livescience.com/space/after-2-years-in-space-the-james-webb-telescope-has-broken-cosmology-can-it-be-fixed>