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

Part III

Part I

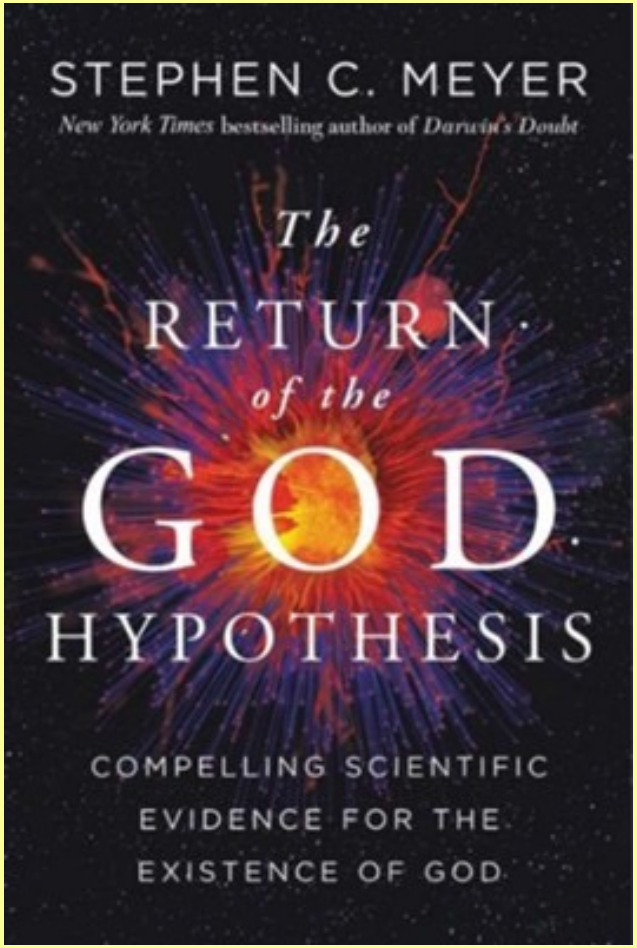
1. **The universe (space-time, matter, energy) had a beginning and will have an end.**

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

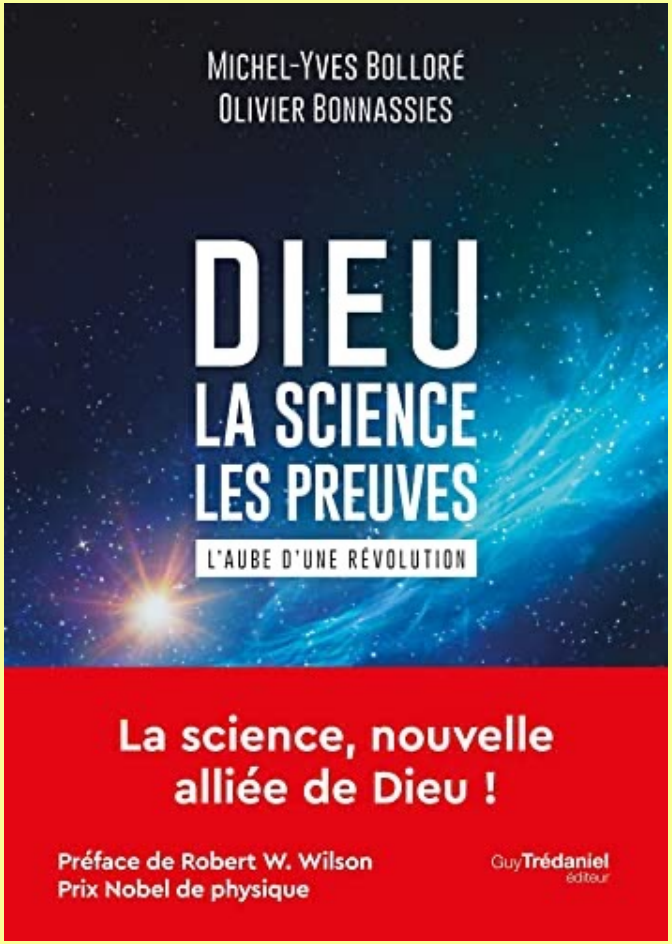
3. **Functional sequences of proteins are incredibly rare.**

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

Two very recent books covering 3 topics



2021



2022

These discoveries are not controversial – but conclusions differ!

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

These discoveries are not controversial – but conclusions differ!

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.

"But I can't accept it"

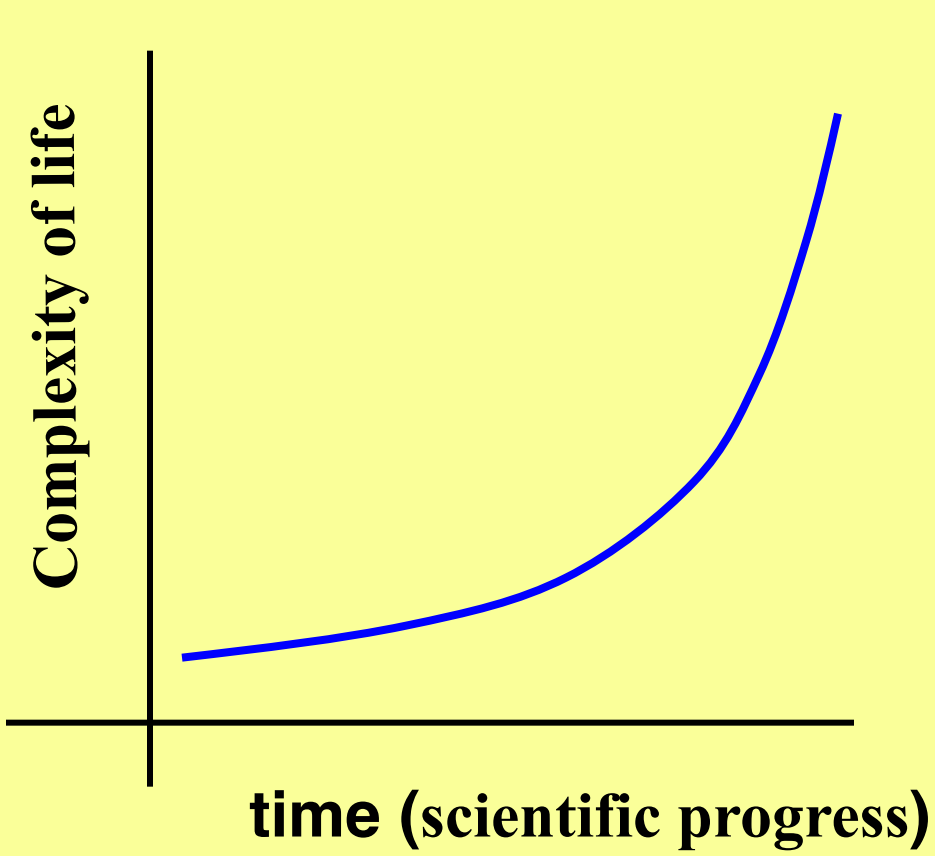
Part II

5. **Life is based on a digital information processing system**

6. **Molecular machines and sophisticated software algorithms are essential to all life-forms**

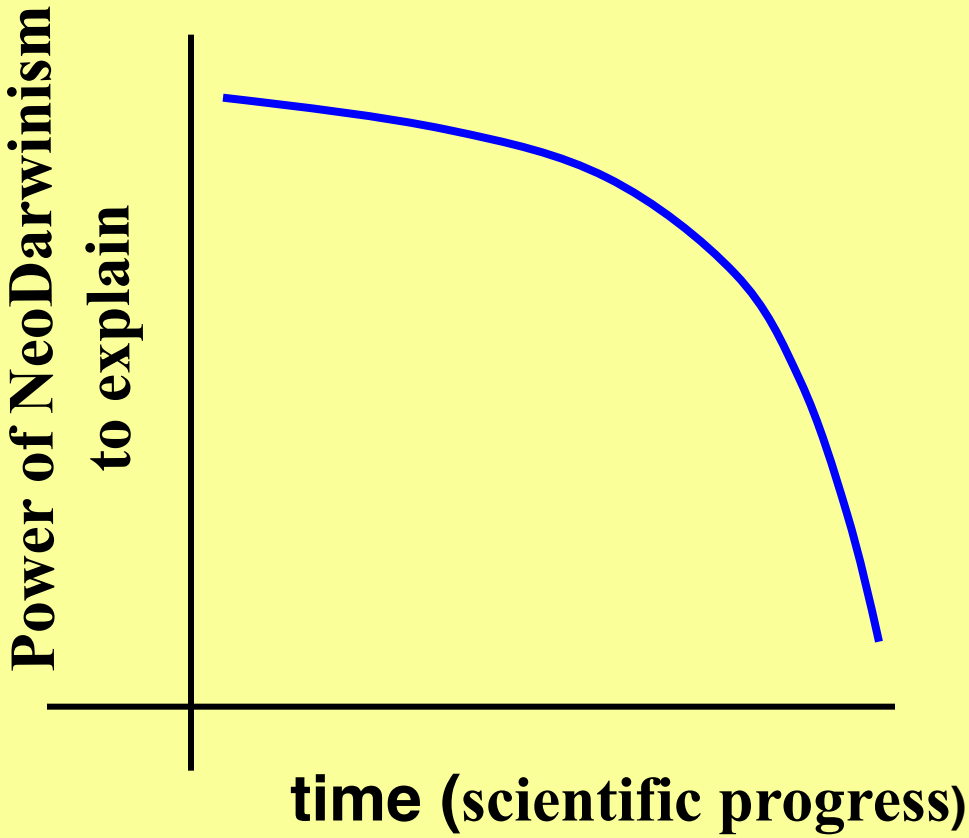
7. **Random mutation + natural selection has severe limitations**

Trend with scientific progress



discoveries #5, #6

Trend with scientific progress



discovery #7

Based on this evidence, some conclude design

The New York Times Magazine

The Turning of an Atheist

By Mark Oppenheimer

Nov. 4, 2007

Antony Flew

David Gelernter

Prof. of computer science
Yale University

Essay by David Gelernter

GIVING UP DARWIN

2019

Based on this evidence, some conclude design

Biochemist
Lehigh University

Michael Behe

Curator fossil insects
State Museum of Natural History
Stuttgart, Germany

Günter Bechley

… but some do not

Thomas Nagel, NYU

"I confess to an ungrounded assumption of my own, in not finding it possible to regard the design alternative as a real option"
Mind and Cosmos, pg 12

"I can't accept it. I am a materialist"

Video interview,
Privilidged Planet

Richard Lewontin

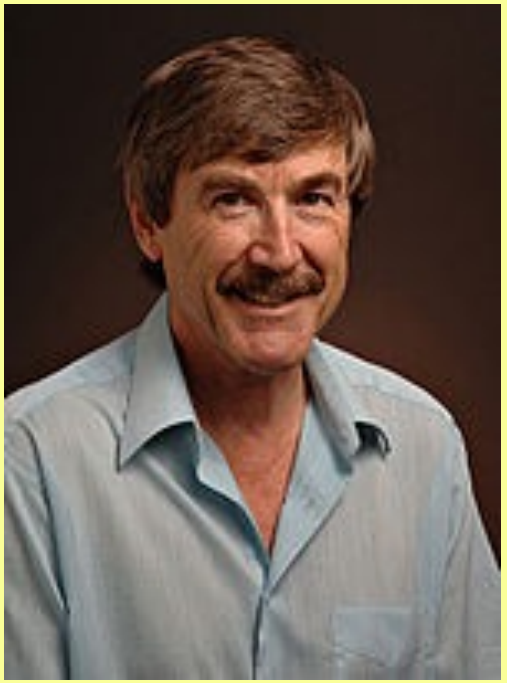
"…materialism is absolute, for we cannot allow a Divine Foot in the door."

New York Review of Books Jan 9, 1997.

… but some do not

"I would go along with you, Denis, except that what you are arguing **would let God back in**."

Dance to the Tune of Life



"… **the dreaded T word**: *teleology*. … Teleology, or final causation, is **taboo** in orthodox science."

The Goldilock Enigma

How bad can it get before cause(s) outside nature can be considered?

"Even if all the data point to an intelligent designer, such an hypothesis is excluded from science because it is not naturalistic."

S. C. Todd, Nature, 410:(6752): 423, 1999.

For some people no amount of data will ever be enough!

Part III

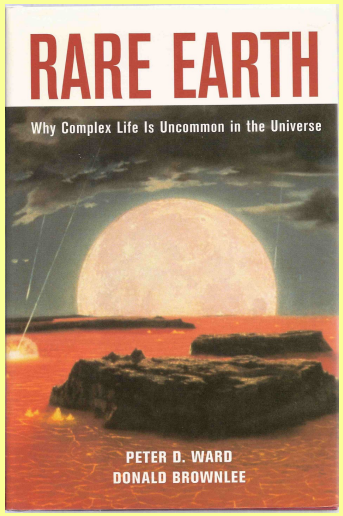
8. So many highly improbable factors make earth habitable that it is VERY unlikely that another truly "earth-like" planet exists in our galaxy

9. The "junk DNA" paradigm has been shown to be false. Most, if not all, noncoding DNA has function.

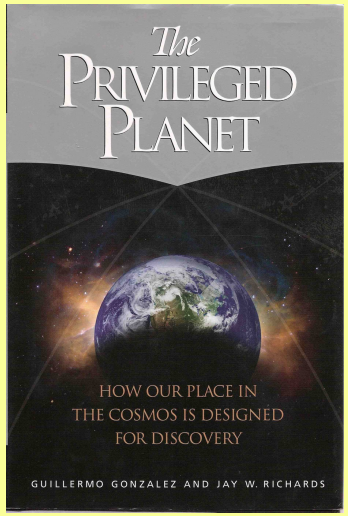
10. The Cambrian (and other) explosions in the fossil record are not consistent with the Darwinian model of gradual evolution.

8. **So many highly improbable factors make earth habitable that it is VERY unlikely that another truly "earth-like" planet exists in our galaxy**

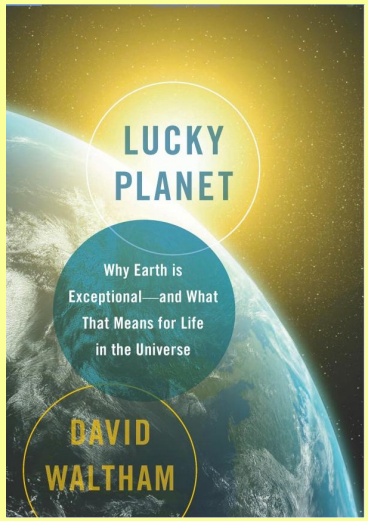
How exceptional is the Earth?



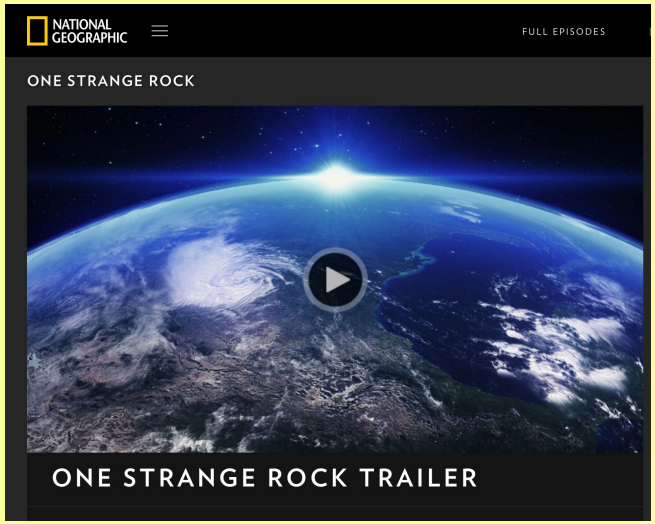
2000



2004



2014

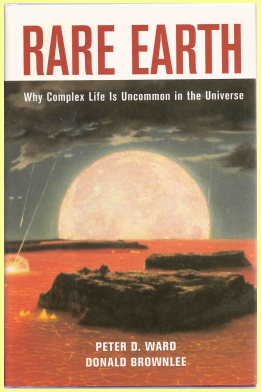


2018

How exceptional is the Earth?

"Most of the Universe is too cold, too hot, too dense, too vacuous, too dark, too bright, or not composed of the right elements to support life. … of all the known celestial bodies, Earth is unique in both its physical properties and its proven ability to sustain life…."

"From the biased viewpoint of Earthlings, however, **it does appear that Earth is quite a charmed planet**."



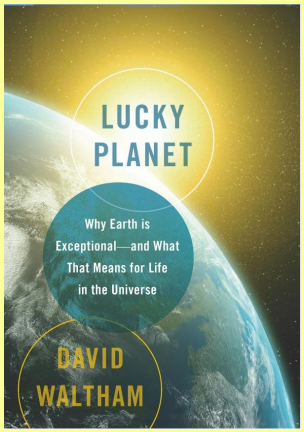
P. Ward and D. Brownlee, Rare Earth, 2000, p 37.

How exceptional is the Earth?

"The Earth is a **precious jewel** in space possessing a rare combination of qualities that happen to make it **almost perfect for life**. … Personally, I no longer have doubts. The evidence points towards the Earth being a very peculiar place; perhaps the only highly-habitable planet we will ever find.

..almost too good to be true.

David Waltham, Lucky Planet, 2014, p 1,2.



Factors required for habitability

type of star
orbital distance
orbital eccentricity
moon (size and proximity)
planet size
magnetic field
other planets – low eccentricity, coplanar, a Jupiter-like
amount of atmosphere
amount of O_2 in atmosphere
amount of CO_2 in atmosphere
amount of water
amount of radioactive elements
amount of Fe and nickel
crustal composition
plate tectonics
etc

Probability of another habitable planet

$\sim 10^{11}$ planets in our **galaxy**

$$\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right) = \frac{1}{10^{12}}$$

If 6 finely-tuned factors exist, then we should not expect another earth-like planet in the entire galaxy!!

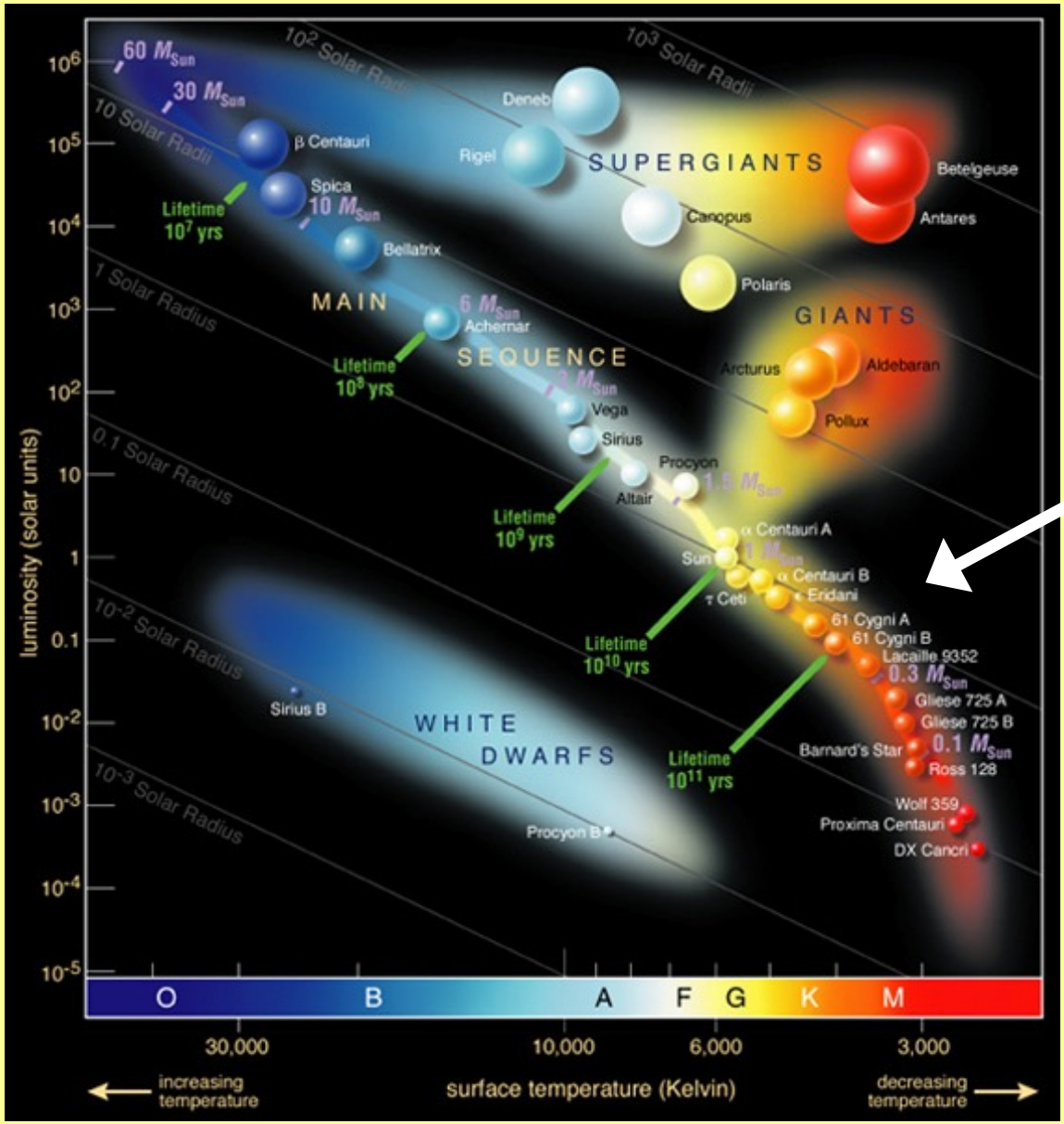
$\sim 10^{22}$ planets in the observable **universe**

$$\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right)x\left(\frac{1}{100}\right) = \frac{1}{10^{22}}$$

If 11 finely-tuned factors exist, then we should not expect another earth-like planet in the entire observable universe!!

types of star

Luminosity (power output)



main sequence stars:

fusing hydrogen to helium

Hertzsprung-Russel StarData.png

surface temperature (size)

The sun

(G-type, main sequence)

Just-right size:

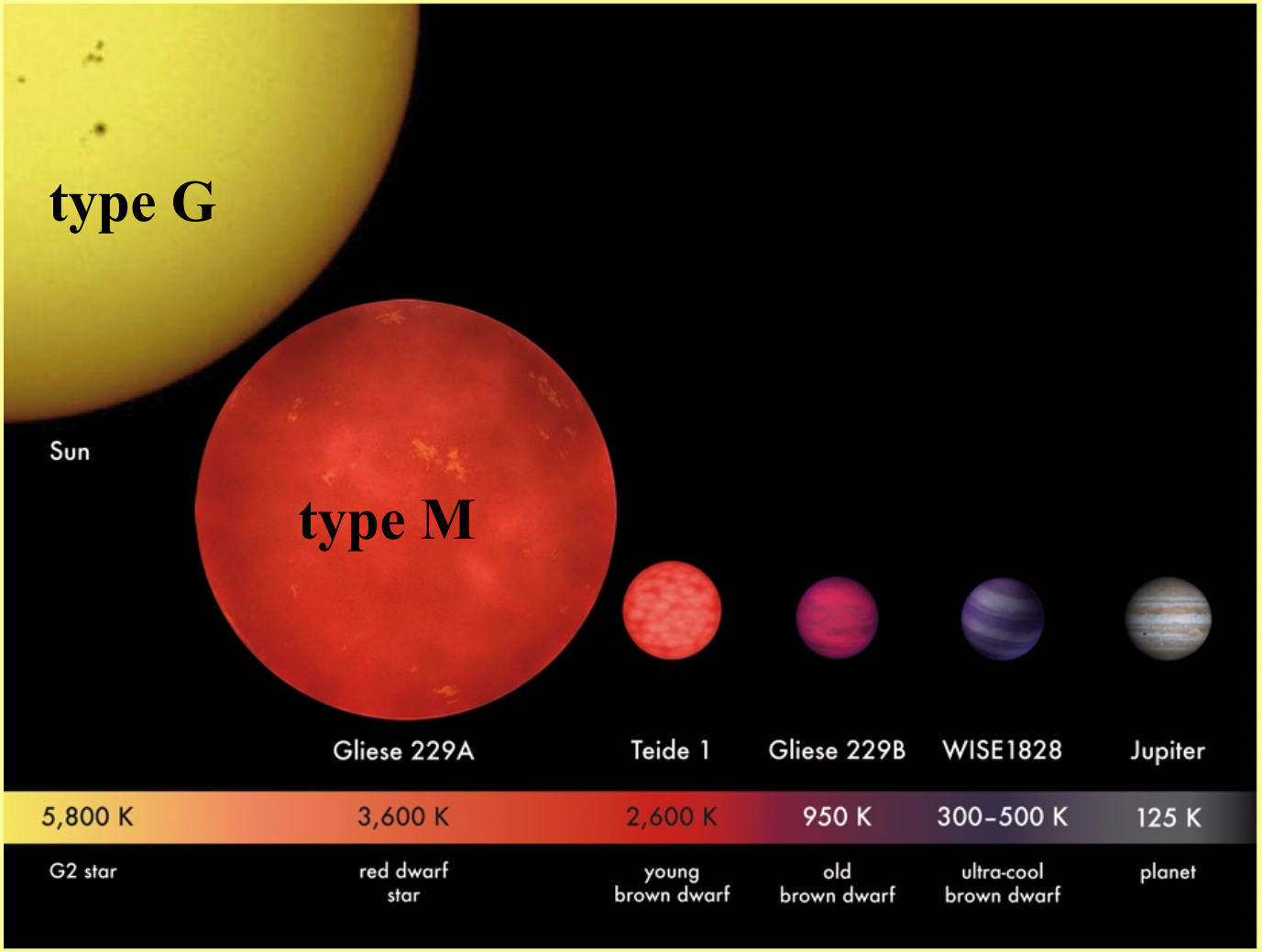
bigger - hotter, burns faster, more erratic

smaller - cooler, habitable zone closer in, its gravity would slow a planet's rotation too much

5% of stars in our galaxy are similar to our sun

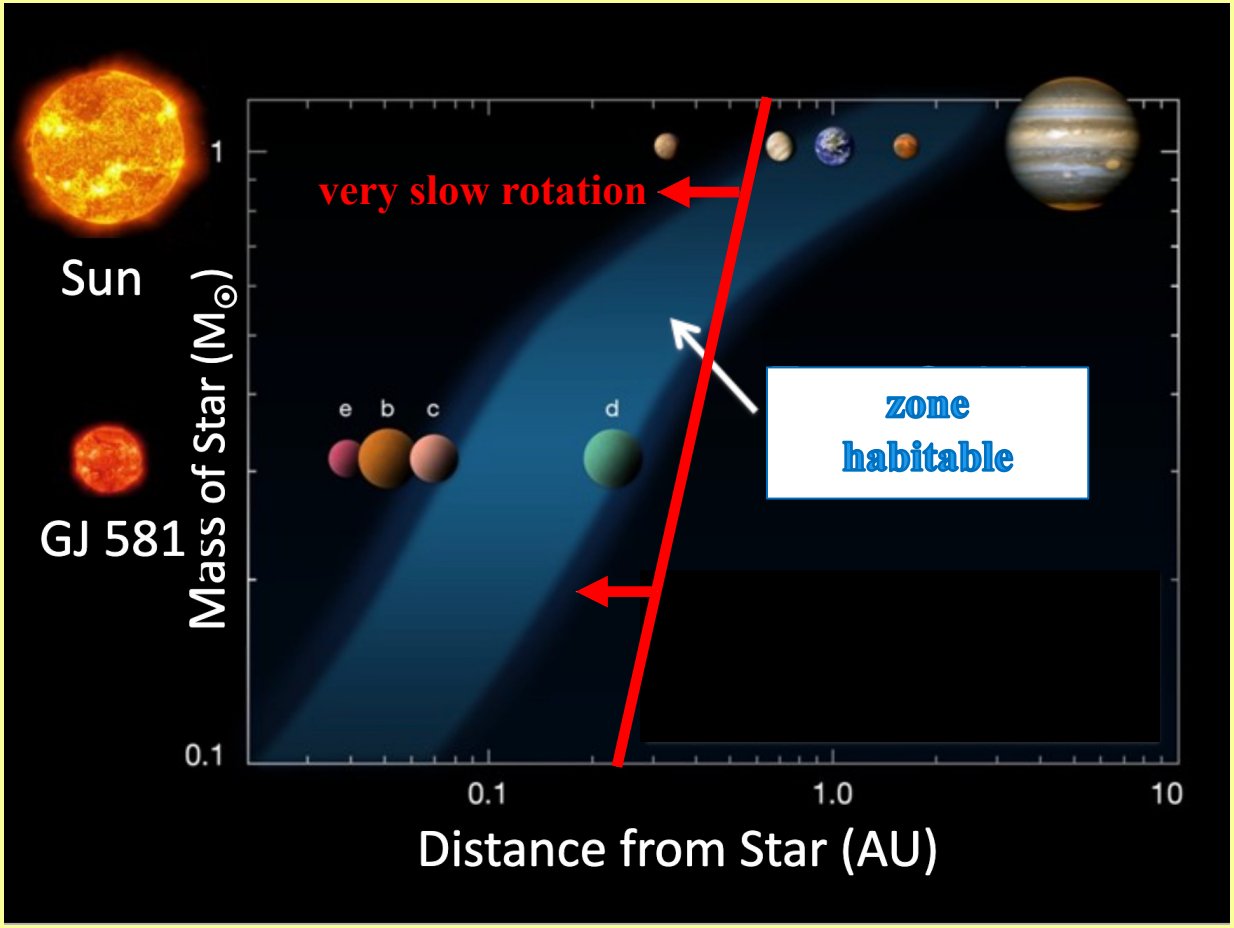
~80% are type M, red dwarf stars
(highly unlikely to support habitable planets)

Comparison of some star types



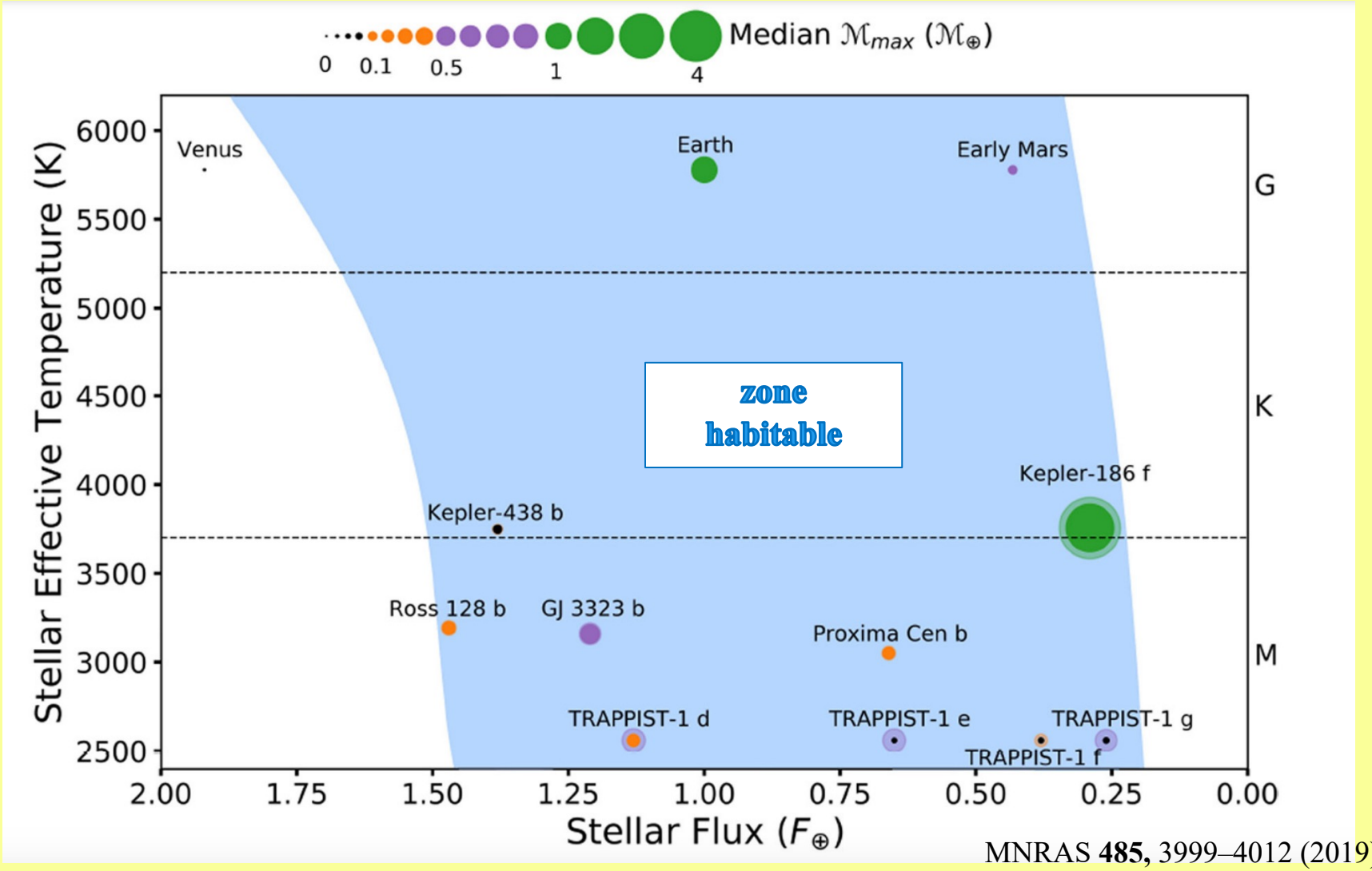
% (galaxy): 5% 80%

Type of star



Tidal locking: the same region of the planet will always face the sun

Type of star



MNRAS **485,** 3999–4012 (2019)

The 9 exoplanets that most resemble the earth in the habitable zone rotate very slowly!

Type of star

Other problems with type M stars:

Concentration of CO and CO_2: (Astrophysical J. 2019, 878, 19)

Dangerous solar flares are more frequent: (Radio Exploration of Planetary Habitability, vol 49, May 2017)

type G: 5/100

equivocates on the definition of "earth-like"

only one factor conssidered

Jan 7 2015

More Earth-like planets found

Life is conceivable on such near-twins

BY SETH BORENSTEIN
THE ASSOCIATED PRESS

WASHINGTON — Earth has a few more near-twin planets outside our solar system, tantalizing possibilities in the search for extraterrestrial life.

Astronomers announced Tuesday that, depending on definitions, they have confirmed three or four more planets that are about the same size as Earth and are in the not-too-hot, not-too-cold "Goldilocks Zone" for liquid water to form.

These planets are likely to be rocky like Earth and not gas giants or ice worlds. They get about the same heat from their star as we get from the sun, according to the latest results from NASA's planet-hunting Kepler telescope.

But don't book your flights yet.

They may be close to Earth in size and likely temperature in the gargantuan scale of the universe, but they aren't quite close enough for comfort.

Consider two of the new planets, the nearest to Earth discovered to date. If they have atmospheres similar to Earth's — a big if — one would be a toasty 140 some degrees and the other would hover around zero, said study lead author Guillermo Torres, an astronomer at the Harvard-Smithsonian Center for Astrophysics.

Life conceivably could evolve and adapt to those temperatures, he said.

Oh, and they aren't actually within commuting distance of Earth. Those two are 500 and 1,100 light-years away; a light-year is 5.9 trillion miles.

What's important, said SETI Institute astronomer Douglas Caldwell, a study co-author who presented the findings at the American Astronomical Society meeting in Seattle, is that astronomers are a bit closer to finding twins of Earth and answering the age-old question, are we alone?

"These planets do exist; we didn't know that before," Torres said in a phone interview from Cambridge, Mass. "What we're really looking for is signs of life eventually. We're not there yet. It will take many years, but this is the first step."

Torres' team confirmed earlier discoveries and added new ones, bringing the total known number of planets that are no bigger than twice Earth's size and in the habitable temperature zone to eight or nine. But that's only from a short search of a small part of our galaxy, so Torres believes that Earth-like planets are common throughout the cosmos, though he cannot prove it yet.

Torres likes to include one planet that would bump the new findings from three to four, but Caldwell said that planet may or may not be habitable.

It doesn't matter much. "We do not need to talk about the one or two exoplanets that could be like Earth, we are finding so many," said Lisa Kaltenegger, director of Cornell University's Pale Blue Dot Institute. She wasn't part of the study.

DAVID A. AGUILAR/HARVARD-SMITHSONIAN CENTER FOR ASTROPHYSICS/AP

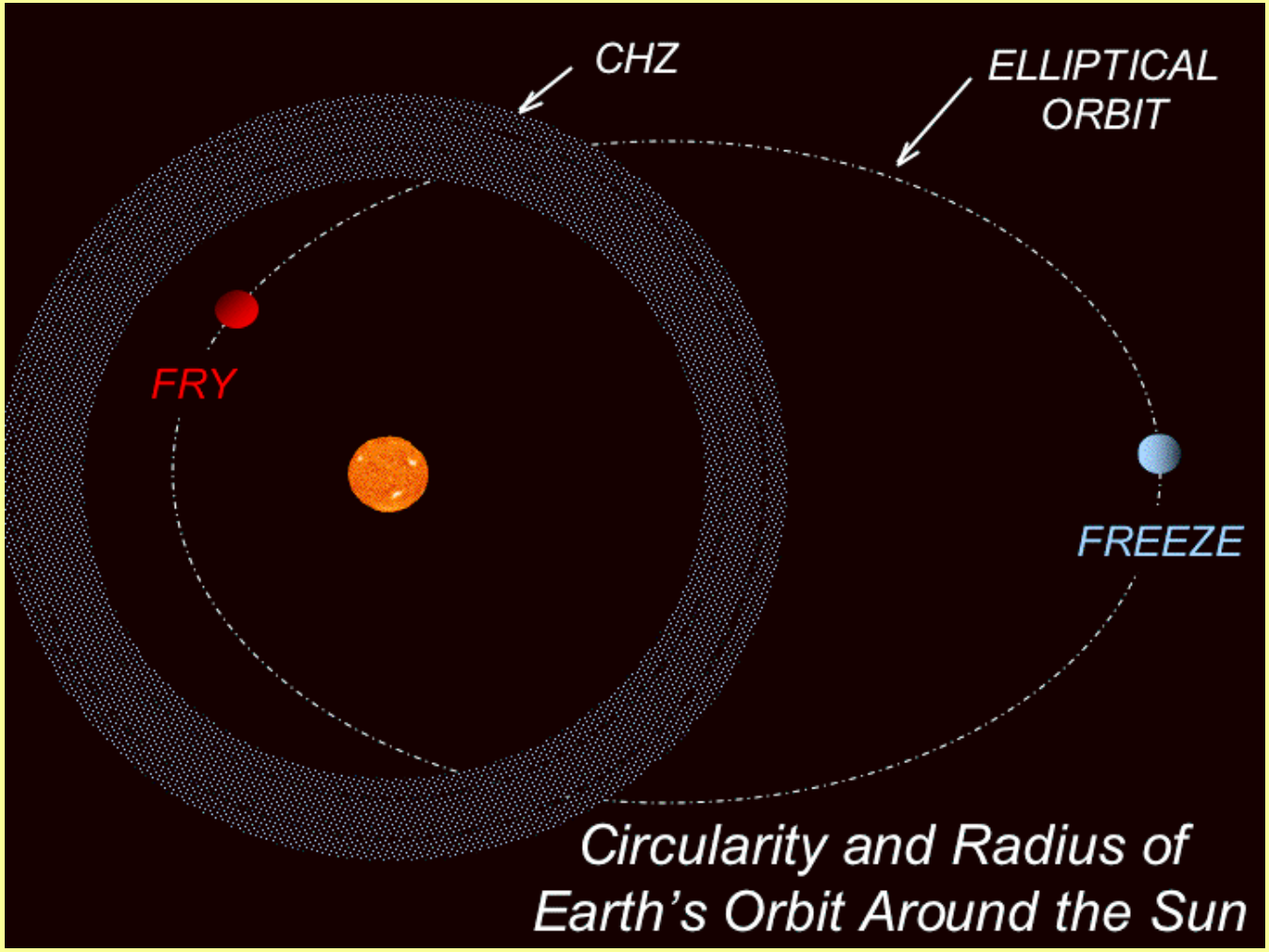
An artist's conception depicts an Earth-like planet orbiting an evolved star that has formed a "planetary nebula." Astronomers have just found 3 or 4 new such planets.

Why Study Red Dwarf Stars?

Nevertheless, the last few years have seen renewed interest in the potential habitability of planets in orbit about low luminosity objects. This shift occurred because terrestrial-sized planets are easiest to detect around low luminosity hosts, due to the larger mass and radius of the planet relative to the star. Furthermore, these objects are the most abundant in the solar neighborhood.

Barnes et al, Astrobiology 2013, 13, 225.

Earth's orbit around the sun



Freezing and boiling of water set conservative limits

Earth's size

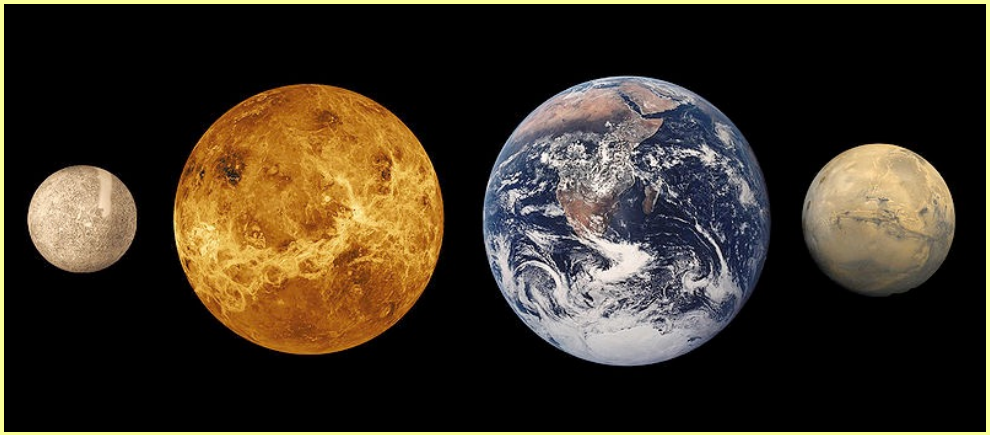
"Earth's size is **just about right** - not too small that its gravity was too weak to hold the atmosphere and not so large that its atmosphere would hold too much atmosphere including harmful gases …

F. Press and R. Siever, Earth, 1986, p 4. Quoted in Nature's Destiny p 92

22
100

Earth-sized,
in
habitable zone

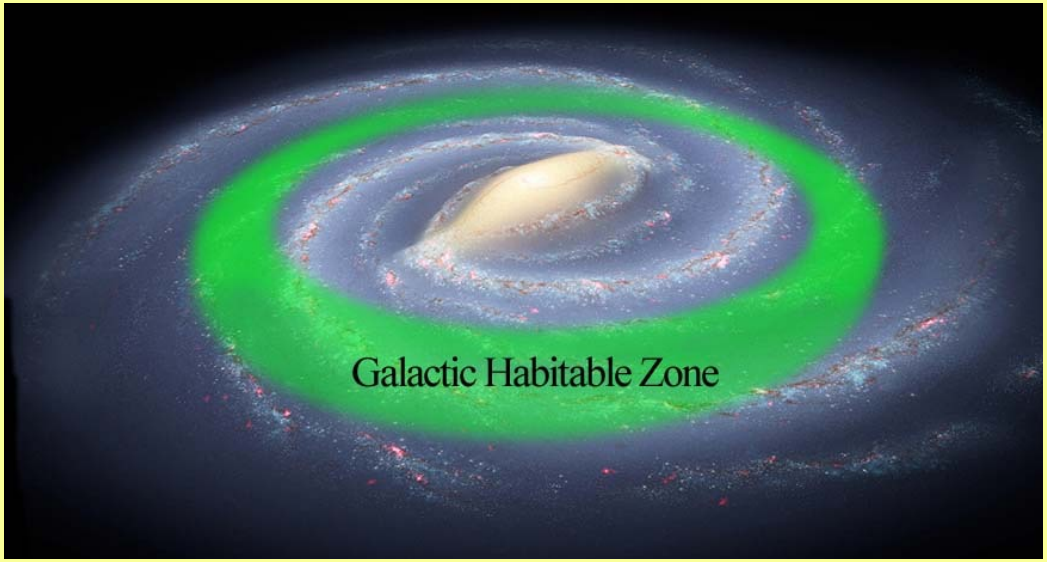
(PNAS, 110
19273, 2013)

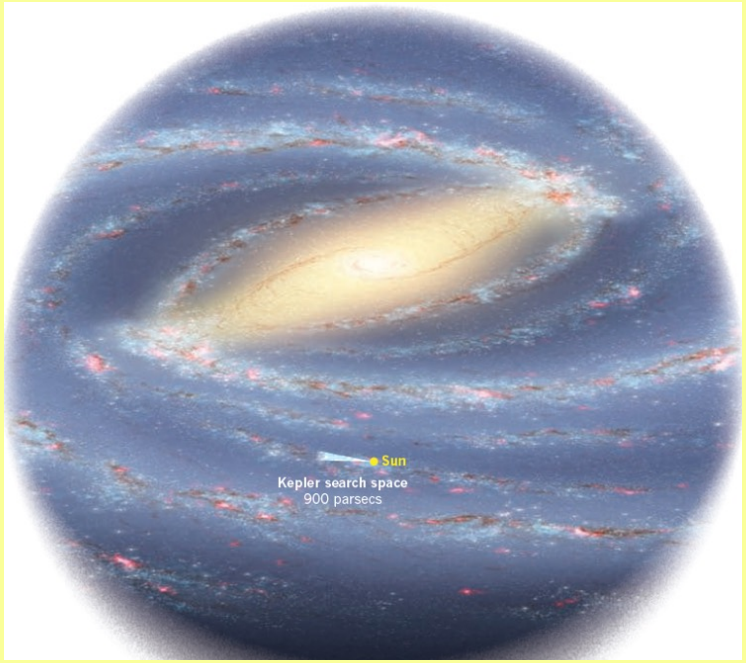


The size of the earth is also important to enable a sufficiently strong magnetic field and also for plate tectonics / carbon cycling

(PSJ 2:208, 2021)

Position in the Milky Way





Too close to the center: gamma rays, X rays, cosmic rays, supernovas, black holes, the gravity of other stars will perturb the stability of our system

Too far from the center: lack of elements necessary for life

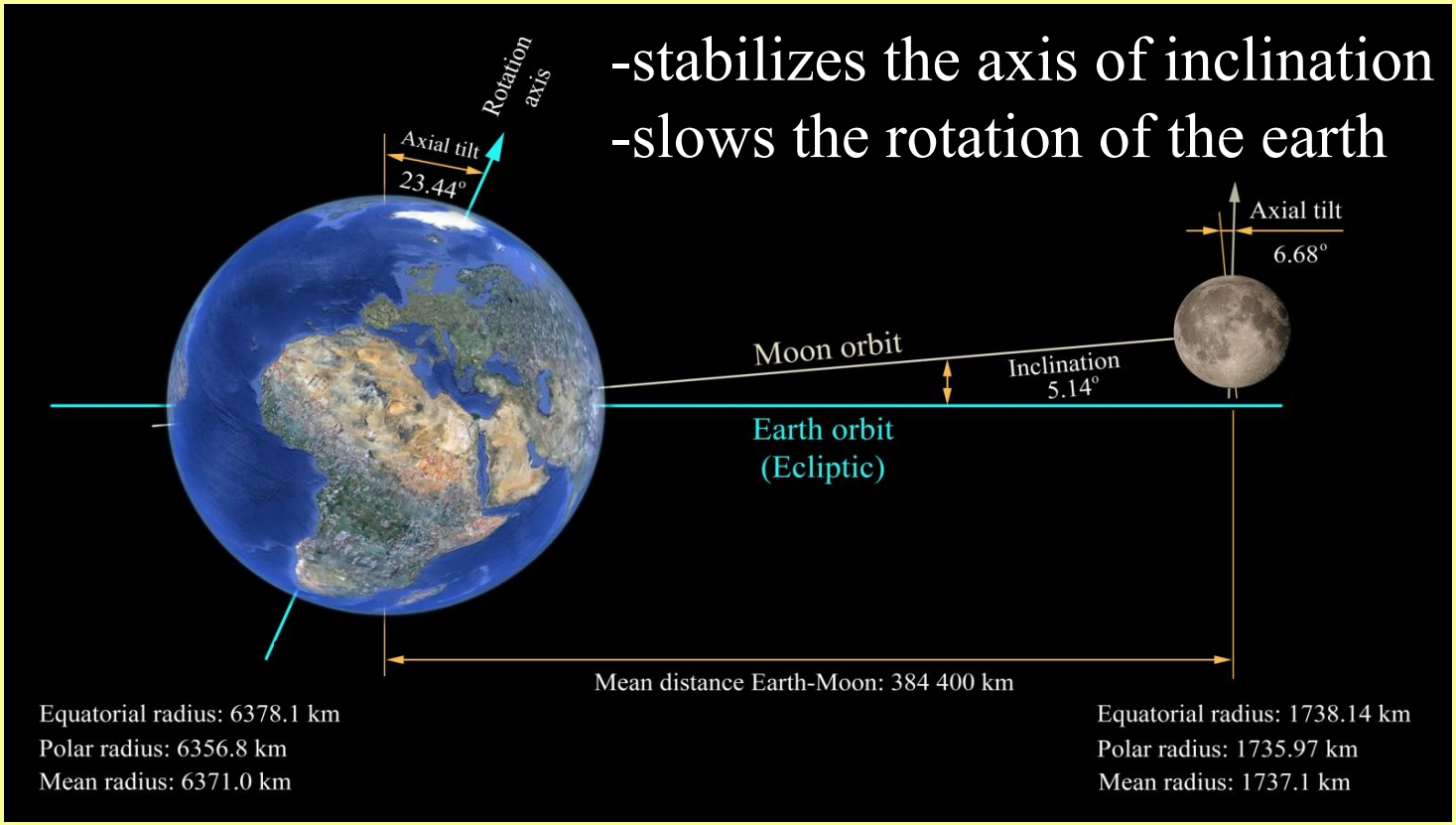
$(\frac{1}{100})$

galactic habitable zone (Icarus 152, 185-200, 2001)

The moon

"We owe our present climate stability to **an exceptional event**: the presence of the Moon."

Jacques Laskar, quoted in Rare Earth p 224.
(french. mathematician)



J. Laskar, P Robutel Nature 361, 608, 1993

The moon is very large and very close to the earth.

Giant impact hypothesis

https://moon.nasa.gov/inside-and-out/formation/

-little water on the moon
-isotopic composition similar to those on the earth
(O, Ti, Cr, W)
-deficiency of volatile elements

"to produce such a massive moon, the impacting body had to be the **right size**, it had to impact the **right point** on the Earth, and the impact had to have occurred at just the **right time** in the Earth's growth process."

Rare Earth p 231.

Giant impact hypothesis

In a recent survey of debris disks nearby newly forming stars, 1 star in 500 showed a hot dense debris disk that likely was the result of a large collision.

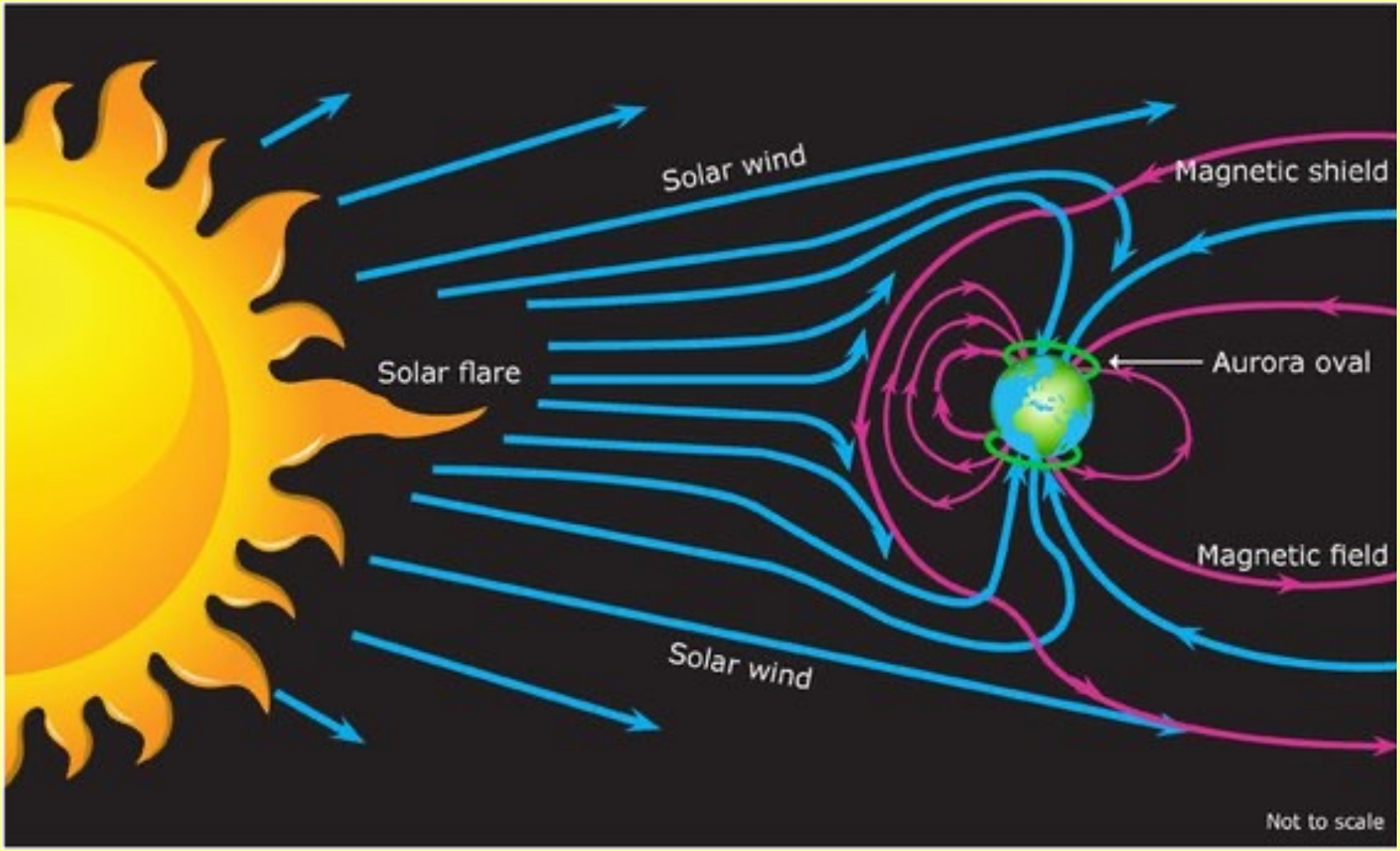
Gorlova et al, The Astrophysical Journal 2007, 670, 516

(1/500) x (??)

(prob, of a large collision) (fraction of collisions that form moon with the right properties)

1/100: Nature Commun. 12, 35, 2021

Magnetic Field – protects us from the sun

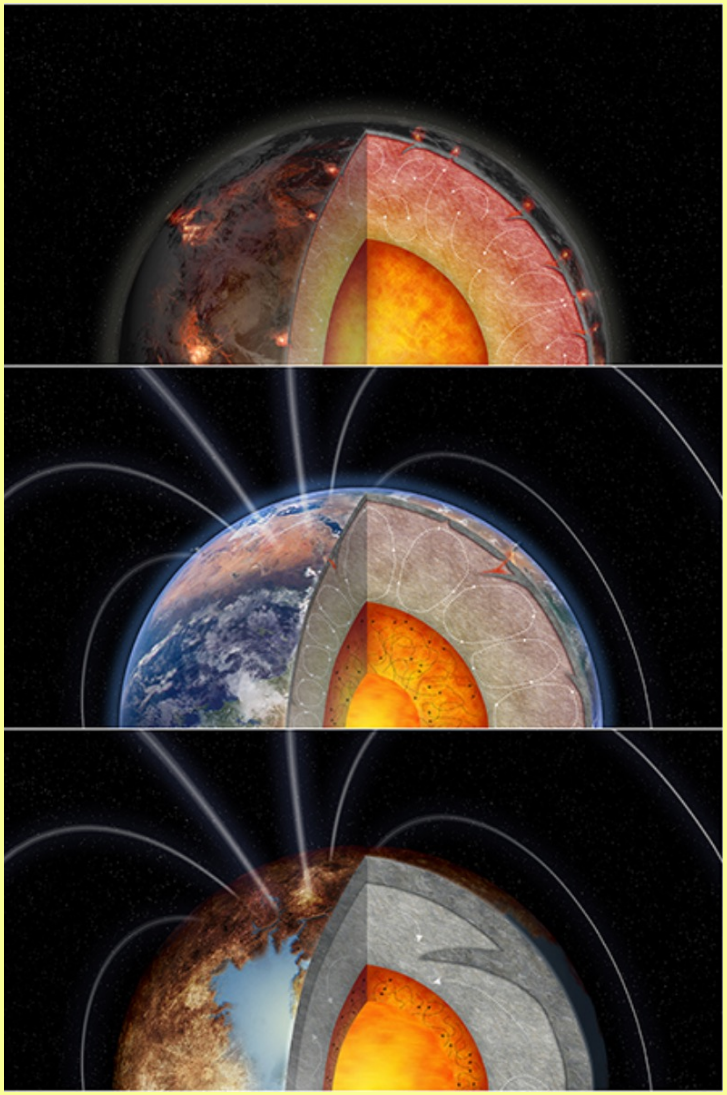


Radioactive elements in the core

thorium 232 – 0.0012%, uranium 238 – 0.0004 % (mass)

Too much

No magnetic field, extreme vulcanism



Just right quantity

The earth:
Magnetic field and plate tectonics

Not enough

Magnetic field but no plate tectonics

https://news.ucsc.edu/2020/11/planet-dynamos.html

The Astrophysical Journal Letters, 903:L37, 2020

Where do these radioactive elements come from?

(synthesis of elements in stars)

thorium and uranium - long lifetimes

Synthesized by fusion of neutron stars –
very rare events!

A planet must form near one of these rare events

(The Astrophysical Journal Letters, 903, 2, L37, 2020)

Where do these radioactive elements come from?

It is tempting to speculate that **Earth is habitable in part because it has a "Goldilocks" concentration of radiogenic elements**: high enough to permit long-lasting dynamo activity and plate tectonics, but not so high as to cause extreme volcanism and a dynamo outage.

(The Astrophysical Journal Letters, 903, 2, L37, 2020)

Earth's elemental composition

the Earth's **delicately balanced heat engine** **is disrupted**

The right amount of water: 0.07% by mass

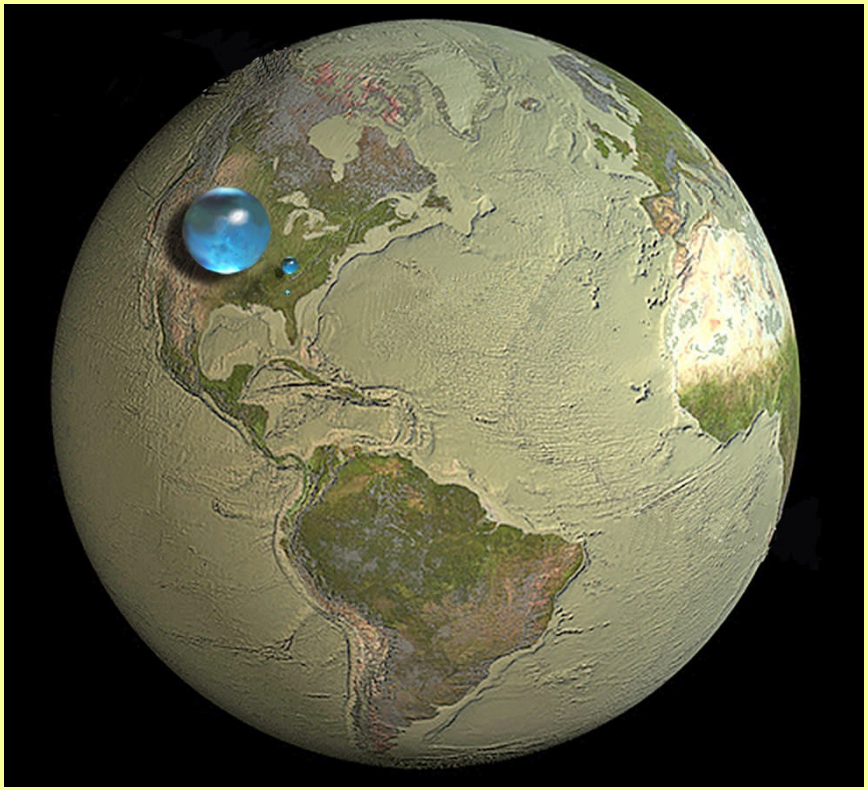
If **too much water** - all land is covered

"with even twice as much water, Earth would have ended up as an abyssal planet entirely covered with deep blue water - a true "water world" …"

Ward and Brownlee Rare Earth, p 47

If **too little water** - global temperatures would fluctuate too much

Ward and Brownlee Rare Earth, p 264



Credit: Howard Perlman, USGS/illustraion by Jack Cook, WHOI

"thus the planet's remarkable mixture of land and oceans is **a balancing act**. … This **fortuitous combination** may be the most important factor that ultimately made life possible." **Ward and Brownlee Rare Earth, p 53.**

The right amount of water

"Discovering how Earth acquired its supply of water is one of the most critical concerns of the new field of astrobiology. As we pointed out in an earlier chapter, water was not abundant in the inner regions of the solar system when planets formed. There was far more water in the outer regions of the solar system than among the inner planets. **Where did our water come from**?"

Still subject of debate, comets - heavy bombardment?

Ward and Brownlee Rare Earth, p 261.

The right amount of water

"An enigma of Earth's formation is its composition and particular location in the solar system…. A grand paradox of terrestrial planets is that if they form close enough to the star to be in its habitable zone, they typically end up with very little water and a dearth of primary life-forming elements such as nitrogen and oxygen, compared with bodies that formed in the outer solar system. **In other words, the planets that are in the right place, and thus have warm surfaces, contain only minor amounts of the ingredients necessary for life".**

"the origin of biogenic elements is a subject of considerable speculation."

from "asteroidal and cometary debris" ?

Rare Earth, p 45, 48.

Earth's elemental composition

Enough metal for iron- and nickel-rich liquid core

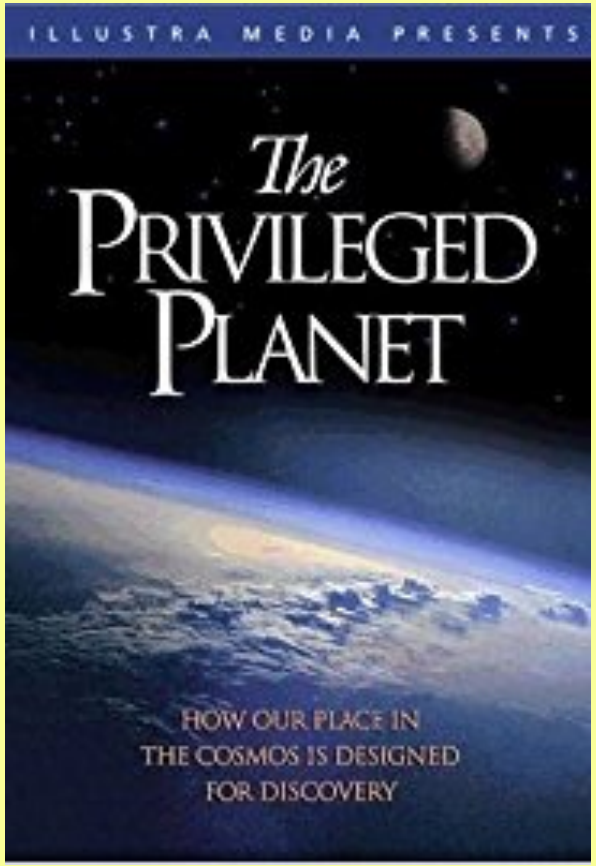
Enough radioactive elements for long period of radioactive heating (uranium, thorium, potassium)

Composition allowed very thin outer crust of low density - plate tectonics

"The thickness, and stability of the Earth's core, mantle, and crust could have come about only through the **fortuitous** assemblage of the correct elemental building blocks".

Ward and Brownlee, Rare Earth, p 51.

How exceptional is the Earth?



2004

https://www.youtube.com/watch?v=QmIc42oRjm8

What does it take to make a habitable planet?

$\sim 10^{11}$ planets in our **galaxy**

$$\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right) = \frac{1}{10^{12}}$$

If 6 finely-tuned factors exist, then we have no right to expect another earth-like planet in the entire galaxy!!

$$\left(\frac{22}{100}\right) \times \left(\frac{5}{100}\right) \times \left(\frac{1}{100}\right) \times \left(\frac{1}{2}\right) \times \left(\frac{1}{500}\right)\left(\frac{1}{100}\right) \times \left(\frac{1}{2}\right)\left(\frac{3}{100}\right) \times \left(\frac{?}{100}\right) \times \left(\frac{?}{100}\right) \times \left(\frac{?}{100}\right) \times \ldots.$$

- $\left(\frac{22}{100}\right)$ Earth-sized, in habitable zone (PNAS, 110 19273, 2013)
- $\left(\frac{5}{100}\right)$ G-type, main sequence star
- $\left(\frac{1}{100}\right)$ galactic habitable zone (Icarus 152 185-200, 2001; the physics arXiv blog)
- $\left(\frac{1}{2}\right)$ rocky
- $\left(\frac{1}{500}\right)\left(\frac{1}{100}\right)$ moon (large, close) (The Astrophysical Journal 2007, 670, 516, Nature Commun. 12, 35, 2021)
- $\left(\frac{1}{2}\right)\left(\frac{3}{100}\right)$ other planets: low eccentricity coplanar Jupiter (PNAS 113, 11431, 2016)
- $\left(\frac{?}{100}\right)$ right amount of water
- $\left(\frac{?}{100}\right)$ right amount of radioactive elements (magnetic field, plate tectonics)
- $\left(\frac{?}{100}\right)$ atmosphere (c.f. Venus)

What does it take to make a habitable planet?

$\sim 10^{11}$ planets in our **galaxy**

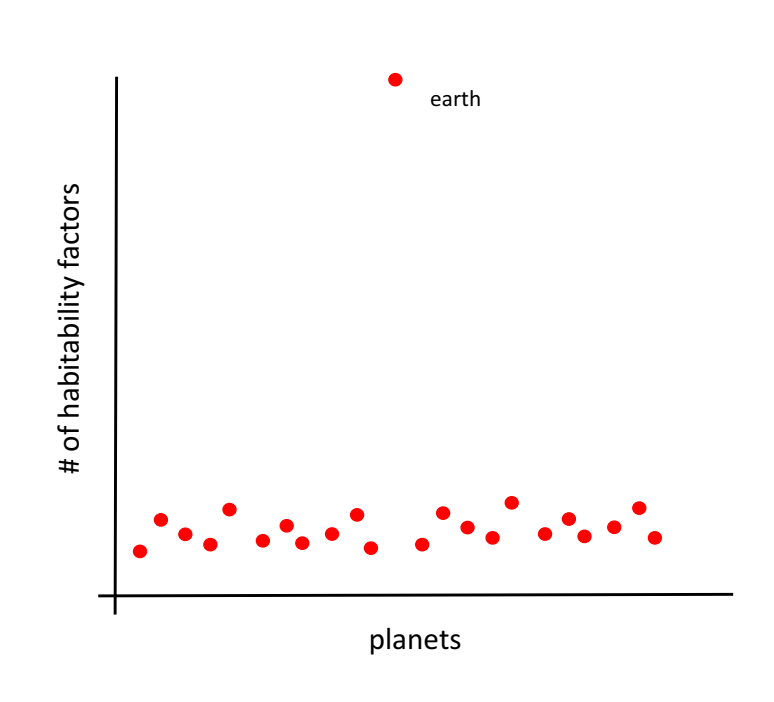
$$\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right)\times\left(\frac{1}{100}\right) = \frac{1}{10^{12}}$$

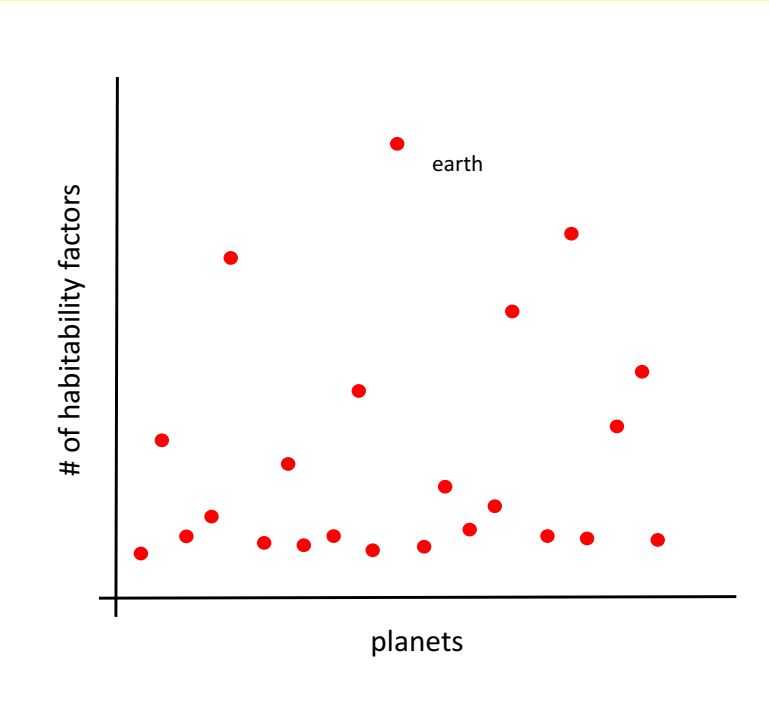
If 6 finely-tuned factors exist, then we have no right to expect another earth-like planet in the entire galaxy!!

$$\frac{2}{10^{11}} \times \left(\frac{?}{100}\right) \times \left(\frac{?}{100}\right) \times \left(\frac{?}{100}\right) \times \ldots$$

- $\frac{2}{10^{11}}$:
  - Earth-sized, in habitable zone (PNAS, 110 19273, 2013)
  - G-type, main sequence star
  - galactic habitable zone (Icarus 152 185-200, 2001; the physics arXiv blog)
  - rocky
  - moon (large, close) (The Astrophysical Journal 2007, 670, 516, Nature Commun. 12, 35, 2021)
  - other planets: low eccentricity coplanar Jupiter (PNAS 113, 11431, 2016)
- $\left(\frac{?}{100}\right)$: right amount of water
- $\left(\frac{?}{100}\right)$: right amount of radioactive elements (magnetic field, plate tectonics)
- $\left(\frac{?}{100}\right)$: atmosphere (c.f. Venus)

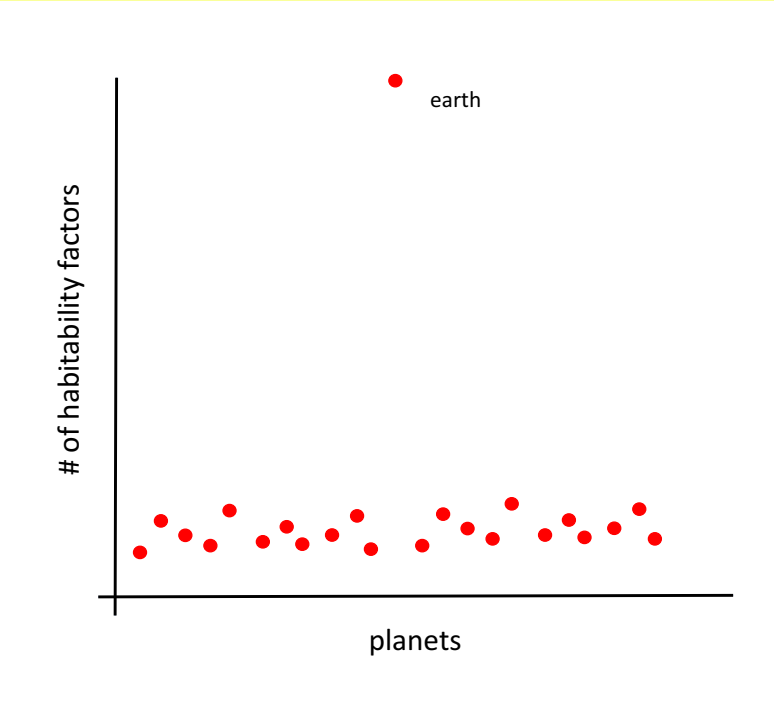
How exceptional is the Earth?

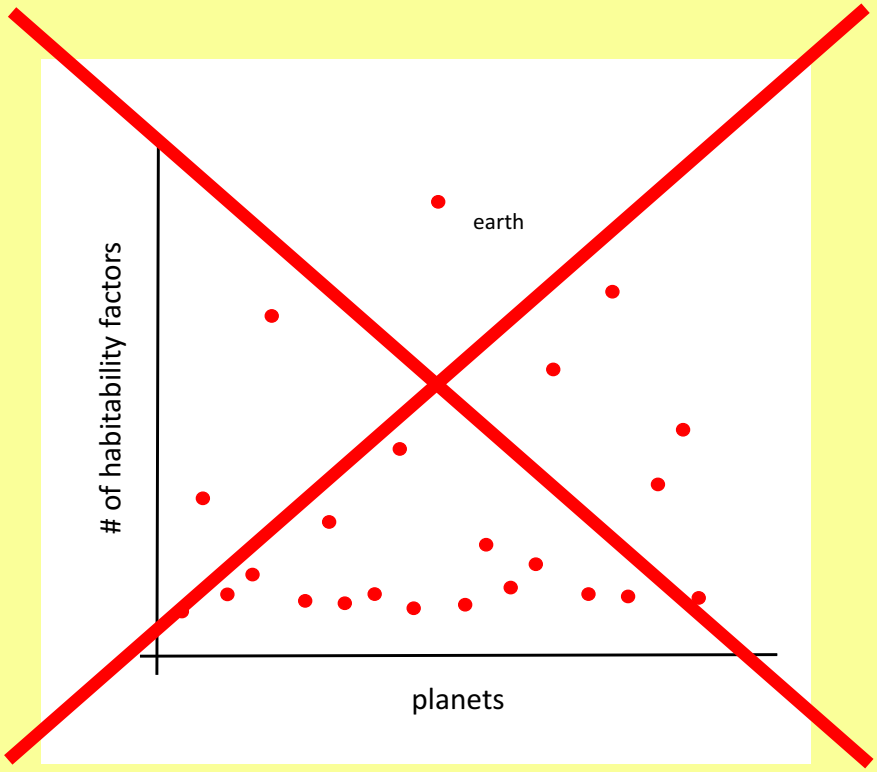




conceptual – not real data

How exceptional is the Earth?





evidence supports this view

Guillermo Gonzalez – Privileged Planet

68 refereed scientific papers

Two years prior to his consideration for tenure, approximately 130 members of the faculty of Iowa State University signed a statement co-authored by assistant professors Michael Clough, James Colbert and Hector Avalos, opposing "all attempts to represent Intelligent Design as a scientific endeavor."

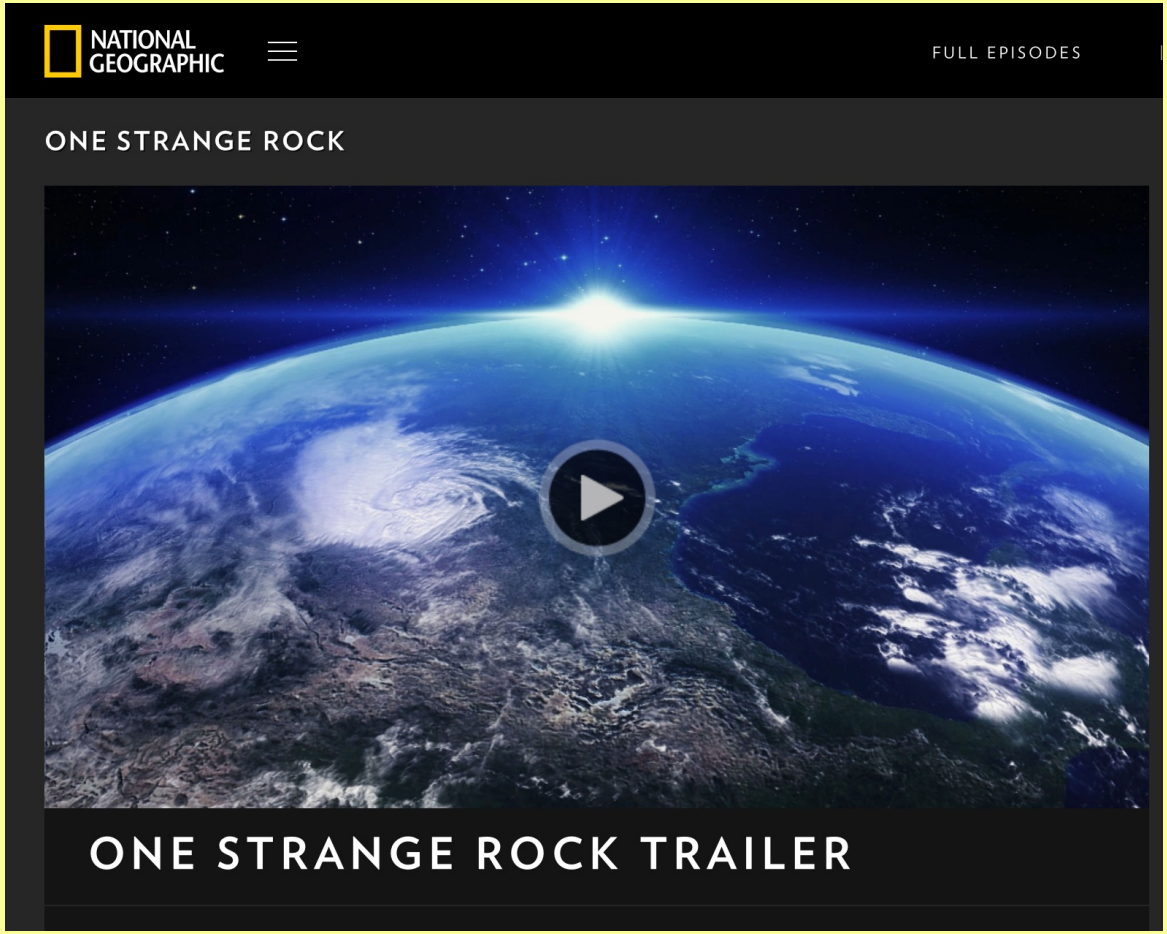
Wikipedia

2001 — Co-authored cover story in *Scientific American*.
2002 — Feature story on Gonzalez's research published in *Nature*.
Began construction of new telescope attachment to discover extrasolar planets.
2004 — Feature story on Gonzalez's research published in *Science.*
The Privileged Planet published.
2007 — denied tenure at Iowa State University

his story: https://www.discovery.org/a/4058/

Guillermo Gonzalez vindicated

National Geographic March, 2018



http://channel.nationalgeographic.com/u/kcOIVhcWjca1n65QtmFg_5vIMZ9j1S1CXT46o65HkAANx6SUvJvQAQfYjGC0CkQwGNSgnX54f2aoFg/?_ga=2.133686797.2068496915.1521591357-1729018746.1430339770

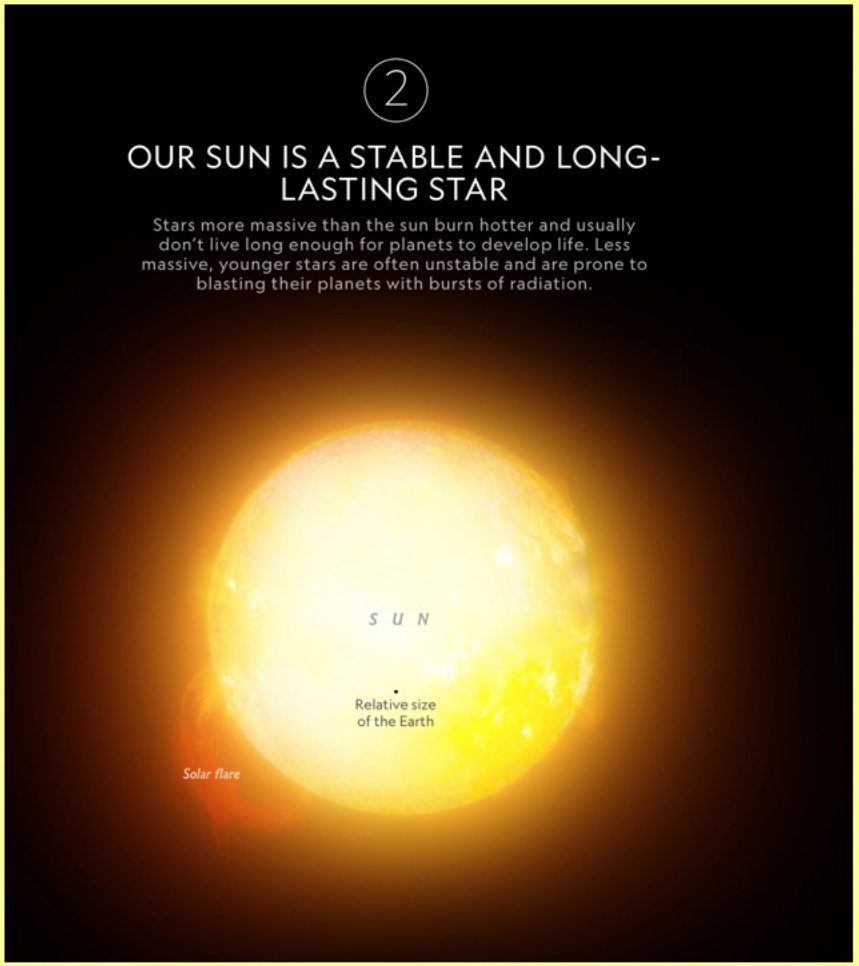
One Strange Rock

National Geographic March 2018

13 things that make life on earth possible

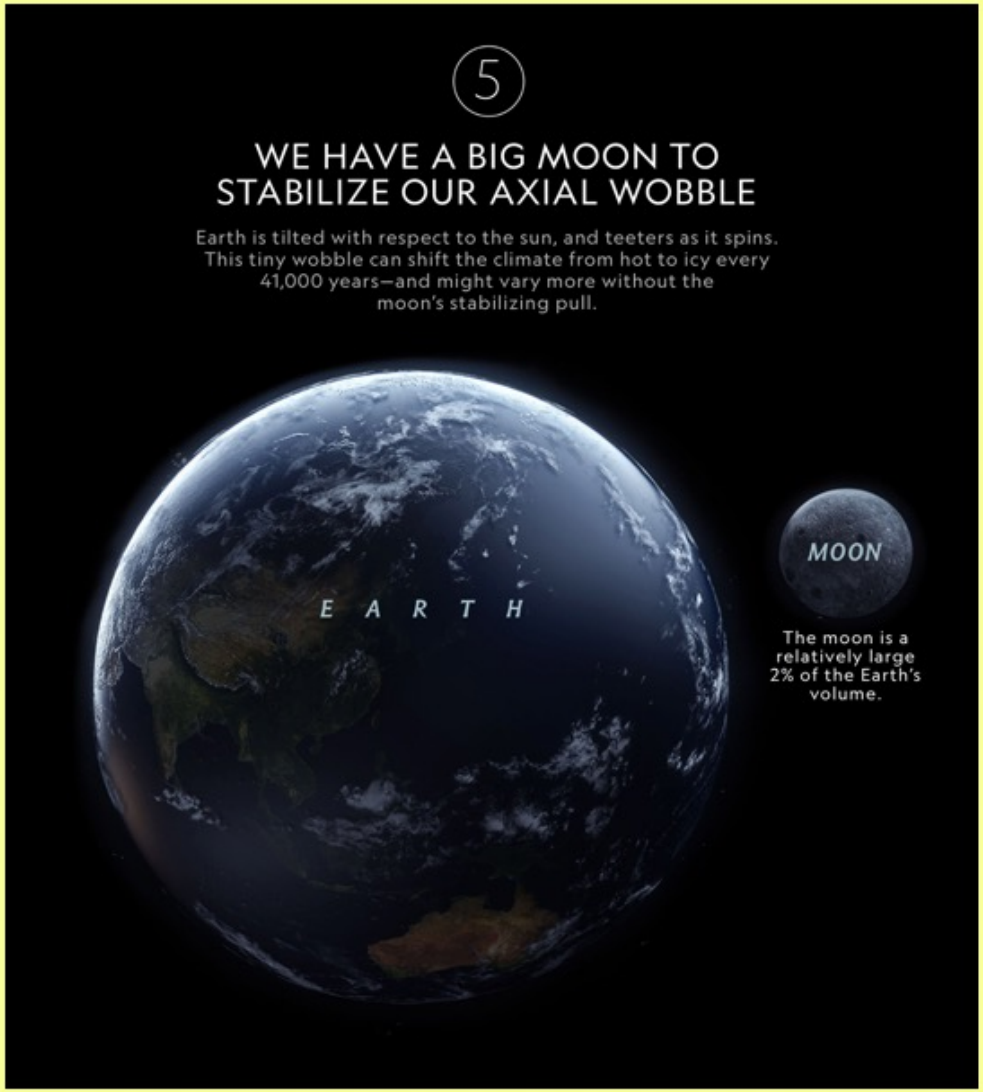
1. Our planet recycles life friendly carbon over time
2. We have an ozone layer to block harmful rays
3. We have a big moon to stabilize our axial wobble
4. Earth's varied surfaces support many life-forms
5. Our magnetic field deflects solar tempests
6. We're at just the right distance from the sun
7. We're safely away from gas giants
8. The sun is a stable long-lasting star
9. We have the right stuff to host a dynamic core
10. We have giant planets that protect us from afar
11. Our sun offers protection from galactic debris
12. Our galatic path steers us clear of hazards
13. Our location is far from stellar crowds

One Strange Rock



One Strange Rock

One Strange Rock



How to define an “Earth-like” planet? (How many factors?)

THIS WEEK

EDITORIALS

Earth 2.0

The hunt is on for a distant planet similar to our own. Astronomers should decide just how similar it needs to be, before the candidates start pouring in.

Nature 470, 5, 2011

How to define an "Earth-like" planet? (How many factors?)

As more data are analysed, they will probably produce a string of reports of ever-smaller planets, until we get an Earth-sized example. Many of these small planets are likely to orbit M-dwarfs, by far the most numerous type of star in the Universe (see page 27). The habitable zone around these stars is very narrow, but Kepler may find a rocky planet there. Would that be the first Earth-like planet? Probably not if, as seems likely, it were to be tidally locked, so that one side faced permanently towards the star.

What about planets that orbit larger stars? Does a first Earth-like planet have to orbit in the habitable zone of a G2-type star, similar to the Sun? If so, must the planet be Earth-sized? And is the focus on a habitable zone defined in terms of liquid water appropriate? As

Nature 470, 5, 2011

How to define an "Earth-like" planet? (How many factors?)

The answers to these questions are important because the public-relations rewards of planet-hunting — and planet-finding — are great. The temptation to hype each discovery is equally large, but so is the scope for confusion and public scorn, especially given the rabid response on some blogs to NASA announcements. Set the bar for 'Earth-like' planets too low, and a string of repeated discoveries could be overwhelming. Set the bar too high, and a planet that meets the strict criteria may not emerge at all. If that were to happen, the Kepler mission would risk being viewed as a failure — which it most certainly is not.

"As more data are analysed, they will produce a string of reports of planets."

Nature 470, 5, 2011

Recent headlines or articles:

Two Billion Earthlike Planets in the Milky Way: How Many Will Prove to Support Advanced Life?

Found: An Earthlike Planet, at Last ***Time*** *Sept 2010*

Earth-like planets pile up ***Nature.com*** *Newsblog Aug 19, 2011*

"NASA's 'holy grail': Entire new solar system that could support alien life discovered"

In all, there might be 40 billion potentially habitable worlds sitting just in our galaxy, the Milky Way, astronomers estimate.

The Independent 2017

Summary:

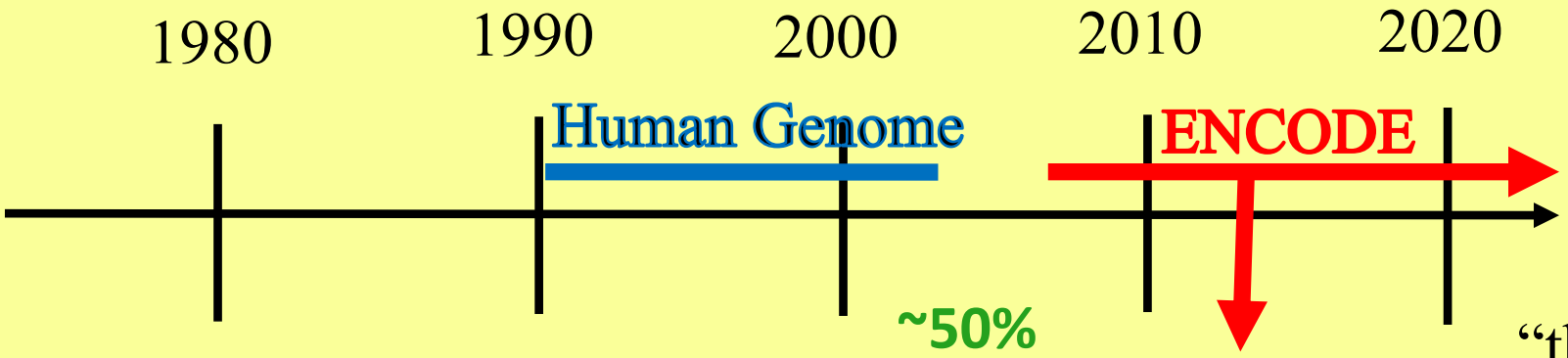
So many highly improbable factors make earth habitable that it is VERY unlikely that another truly "earth-like" planet exists in our galaxy.

The surprising fact is that conditions on earth are such that we can thrive, not just survive

The term "earth-like" is equivocated to manipulate the public.

9. The “junk DNA” paradigm has been shown to be false. Most, if not all, noncoding DNA has function

(thanks to Casey Luskin, Discovery Institute, for help with content)



"junk" DNA

>90% genome is **garbage**

"selfish" DNA

~50% genome is **non functional**

Francis Collins
Denis Alexander
etc

ENCODE: at least 80% genome is **functional**

"the days of junk DNA are over"

Origin of the term "junk" DNA

S. Ohno

Department of Biology,
City of Hope Medical Center,
Duarte, Calif. 91010, U.S.A.

Received 28 October 1971

An Argument for the Genetic Simplicity of Man and other Mammals

There is a finite upper limit to the number of gene loci which an organism can afford to have. An organism having 3×10^6 or so gene loci would exterminate itself from an unbearable mutation load. Yet, the mammalian genome is large enough to accommodate that many gene loci.

Natural selection is essentially conservative. A new gene with a hitherto non-existent function can not be created unless a temporary escape from the relentless pressure of natural selection is provided by gene duplication. However, the chance of a redundant copy of an old gene emerging as a new gene is considerably smaller than of that copy becoming degenerate. Perhaps for this reason, evolution from simpler life forms to mammals appears to have been accompanied not only by successive additions of new gene loci, but also by accumulation in the genome of a great deal of degenerate "nonsense" DNA base sequences. At least 90% of the mammalian genomic DNA appears to represent "nonsense" DNA base sequence of various kinds.

All in all, it appears that the calculations made by Muller, Kimura and others are not far off the mark and that at least 90% of our genomic DNA is "junk" or "garbage" of various sorts.

Journal of Human Evolution (1972) **1**, 651–662

Nature Vol. 284 17 April 1980

REVIEW ARTICLES

Selfish genes, the phenotype paradigm and genome evolution

W. Ford Doolittle & Carmen Sapienza

Department of Biochemistry, Dalhousie University, Halifax, Nova Scotia, Canada B3H 4H7

Natural selection operating within genomes will inevitably result in the appearance of DNAs with no phenotypic expression whose only 'function' is survival within genomes. Prokaryotic transposable elements and eukaryotic middle-repetitive sequences can be seen as such DNAs, and thus no phenotypic or evolutionary function need be assigned to them.

Selfish DNA: the ultimate parasite

L. E. Orgel & F. H. C. Crick

The Salk Institute, 10010 N. Torrey Pines Road, La Jolla, California 92037

The DNA of higher organisms usually falls into two classes, one specific and the other comparatively nonspecific. It seems plausible that most of the latter originated by the spreading of sequences which had little or no effect on the phenotype. We examine this idea from the point of view of the natural selection of preferred replicators within the genome.

Forrest Mims, 1994:
submitted a letter to
Science warning against
assuming that “junk” DNA
was “useless.”

“Rejected Letter to the Editor to Science” (Dec. 1, 1994):
forrestmims.org/publications.html

“Indeed, design can foster inquiry where traditional evolutionary approaches obstruct it. Consider the term “junk DNA.” …. Thus on an evolutionary view we expect a lot of useless DNA. If, on the other hand, organisms are designed, we expect DNA, as much as possible, to exhibit function. And indeed, the most recent findings suggest that designating DNA as “junk” merely cloaks our current lack of knowledge about function. … Design encourages scientists to look for function where evolution discourages it.”

— William Dembski, “Intelligent Science and Design,” *First Things*, Vol. 86:21-27 (October 1998).

Francis Collins

NIH

Denis Alexander

Faraday Inst. Sci and Relig.

"Mammalian genomes are littered with [Repetitive DNA], with **roughly 45 percent of the human genome** made up of such genetic **flotsam and jetsam**."

The Language of God **(2006):**

"50% of our genomes … are composed of **non-functional, parasitic DNA…"**

Creation or Evolution: Do We Have to Choose **(2008)**

2013 Textbook *Evolution: Making Sense of Life*

Denis Alexander

Faraday Inst. Sci and Relig.

"**Over half** of the genome is composed of neither genes, nor vestiges of human genes, nor regulatory regions. Instead, it is made up of **parasite-like segments of DNA**..."

(Carl Zimmer & Douglas Emlen, p. 132)

The ENCODE Project

ARTICLE

doi:10.1038/nature11247

An integrated encyclopedia of DNA elements in the human genome

The ENCODE Project Consortium*

Nature 2012, 489, 57

"The **vast majority** (80.4%) of the human genome participates in at least one biochemical RNA- and/or chromatin-associated event in at least one cell type."

GENOMICS

ENCODE Project Writes Eulogy For Junk DNA

www.sciencemag.org **SCIENCE** VOL 337 7 SEPTEMBER 2012

Published by AAAS

"When researchers first sequenced the human genome, they were astonished by how few traditional genes encoding proteins were scattered along those 3 billion DNA bases. Instead of the expected 100,000 or more genes, the initial analyses found about 35,000 and that number has since been whittled down to about 21,000. In between were megabases of 'junk,' or so it seemed. This week, 30 research papers, including six in *Nature* and additional papers published by *Science*, **sound the death knell for the idea that our DNA is mostly littered with useless bases.**"

THE SCIENCES

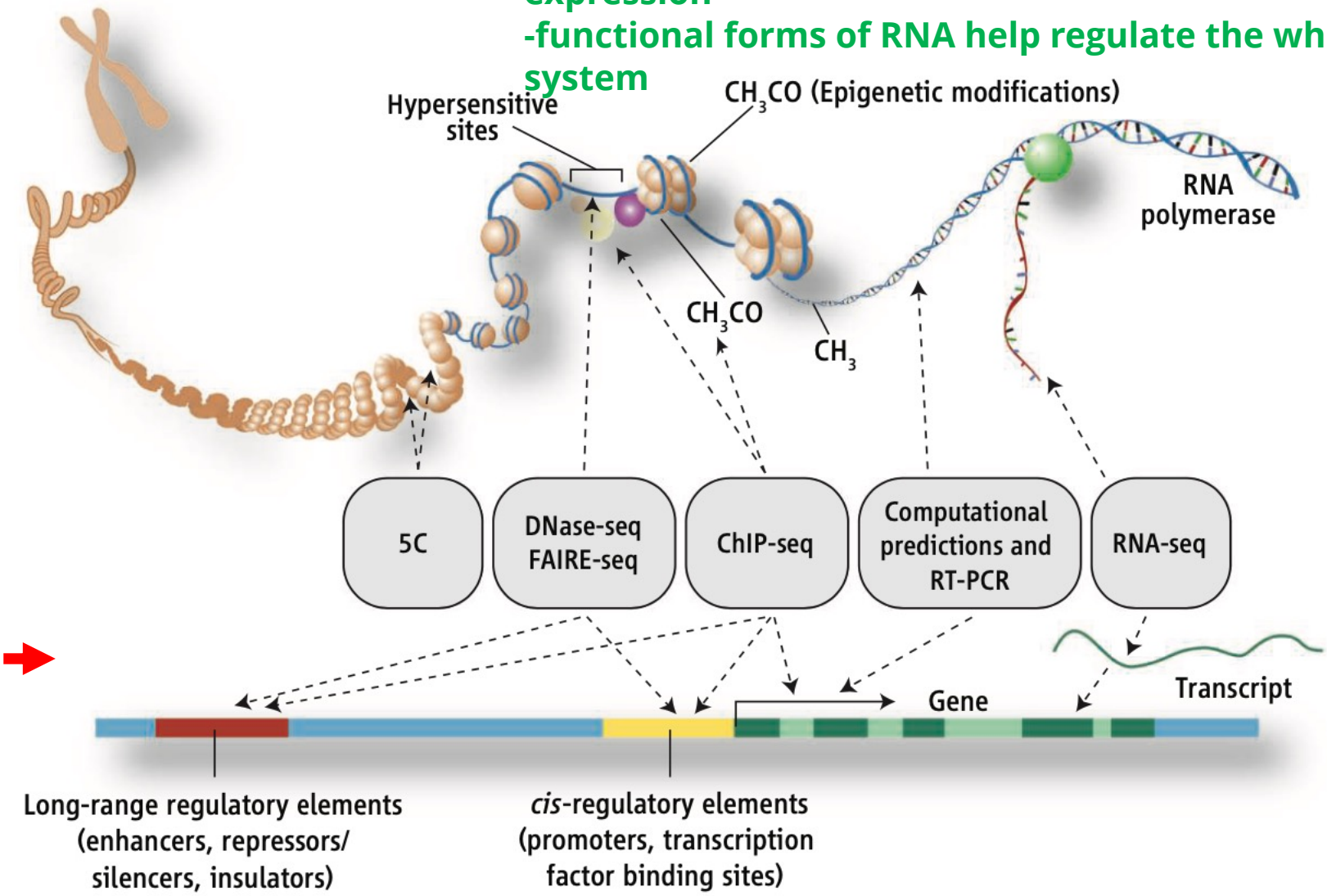
ENCODE: the rough guide to the human genome

Not Exactly Rocket Science | By Ed Yong | Sep 5, 2012 11:00 AM

And what's in the remaining 20 percent? Possibly not junk either, according to **Ewan Birney**, the project's Lead Analysis Coordinator and self-described "cat-herder-in-chief". He explains that ENCODE only (!) looked at 147 types of cells, and the human body has a few thousand. A given part of the genome might control a gene in one cell type, but not others. If every cell is included, functions may emerge for the phantom proportion. "It's likely that 80 percent will go to 100 percent," says Birney. "We don't really have any large chunks of redundant DNA. This metaphor of junk isn't that useful."

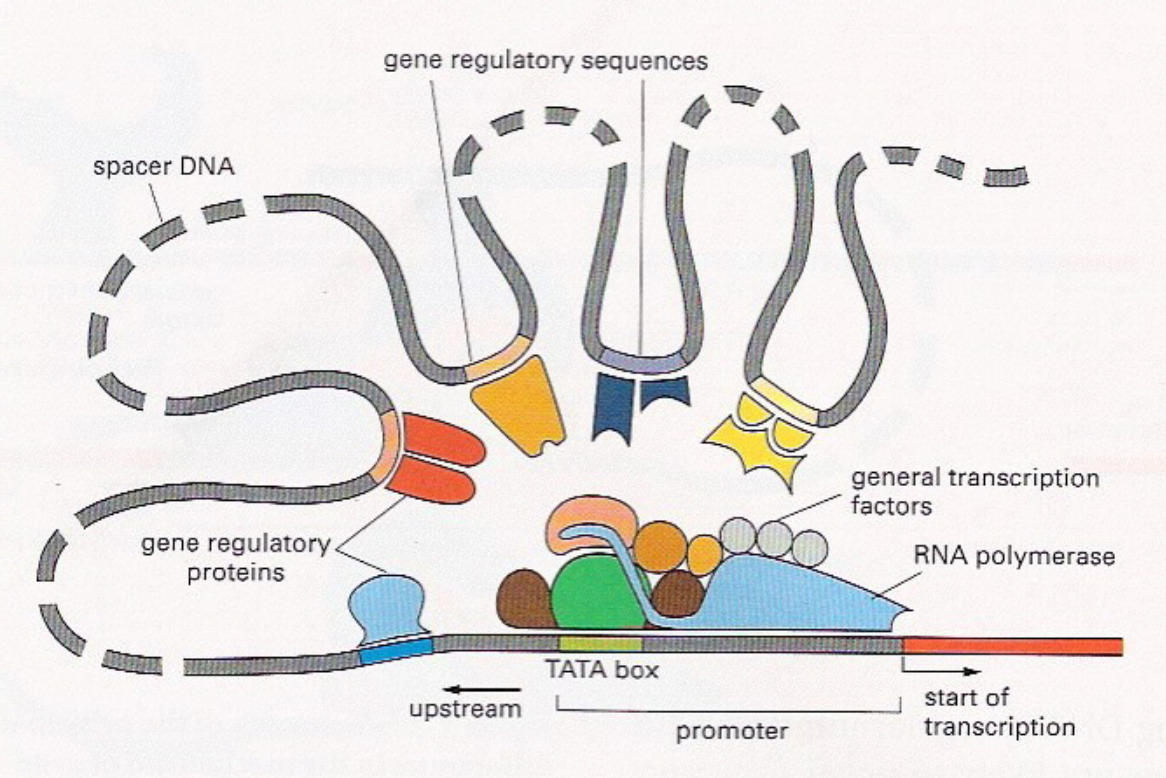
NIH website:

-proteins specifically interact with DNA
-chemical modifications of DNA influence gene expression
-functional forms of RNA help regulate the whole system



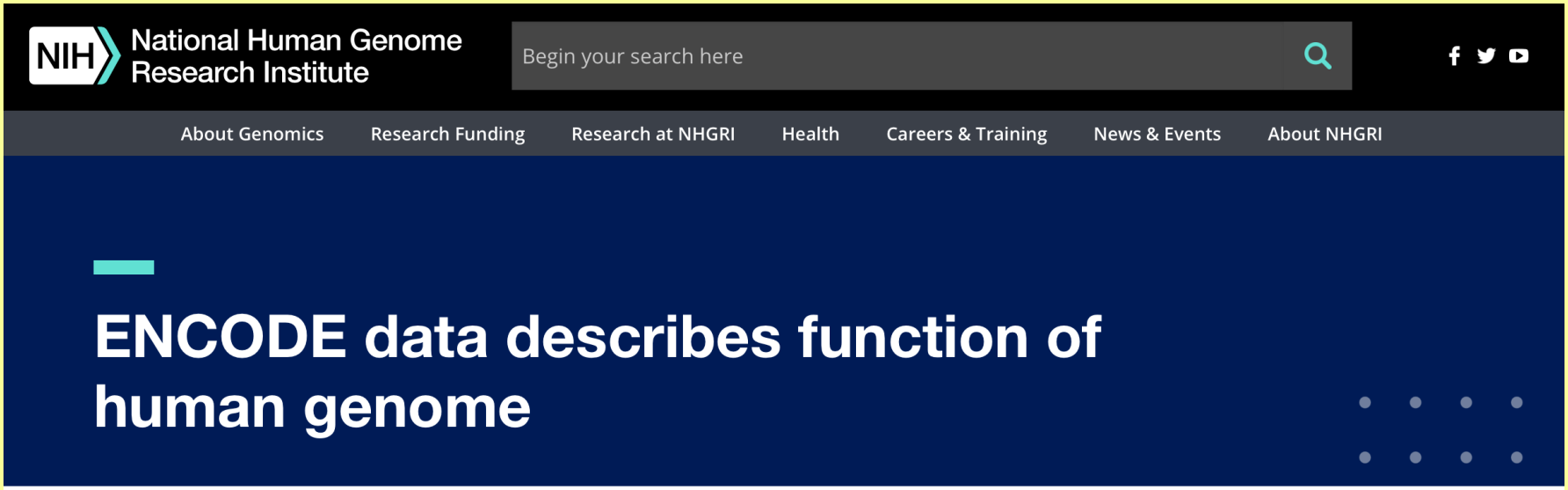
DNA

Zooming in. A diagram of DNA in ever-greater detail shows how ENCODE's various tests (gray boxes) translate DNA's features into functional elements along a chromosome.



"In animals and plants, it is not unusual to find the regulatory sequences of a gene dotted over distances of 50,000 nucleotide pairs…"

from
"Essential
Cell Biology"
Alberts et al



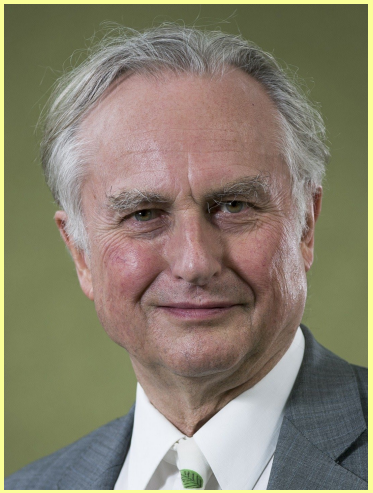
"During the early debates about the Human Genome Project, researchers had predicted that only a few percent of the human genome sequence encoded proteins, the workhorses of the cell, and that the rest was junk. **We now know that this conclusion was wrong**," said Eric D. Green, M.D., Ph.D., director of the National Human Genome Research Institute (NHGRI), a part of the National Institutes of Health. "**ENCODE has revealed that most of the human genome is involved in the complex molecular choreography required for converting genetic information into living cells and organisms**."

"By carefully piecing together a simply staggering variety of data, we've shown that the human genome **is simply alive with switches, turning our genes on and off and controlling when and where proteins are produced**. ENCODE has taken our knowledge of the genome to the next level, and all of that knowledge is being shared openly."

https://www.genome.gov/27549810/2012-release-encode-data-describes-function-of-human-genome

some reactions

Richard Dawkins, before Encode:

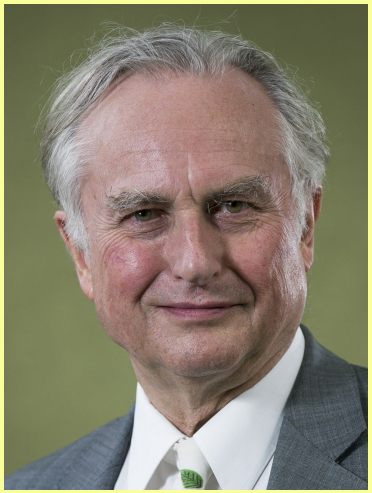


Dawkins in 1976: “The true ‘purpose’ of DNA is to survive, no more and no less. The simplest way to explain the surplus DNA is to suppose that it is a **parasite**…”

Dawkins in 2004: “[C]reationists might spend some earnest time speculating on why the Creator should bother to **litter genomes with untranslated pseudogenes and junk tandem repeat DNA**.”

Dawkins in 2009: “the greater part (95 per cent in the case of humans) of the genome might as well not be there, for all the difference it makes.”

Dawkins in 2012, Post-Encode:

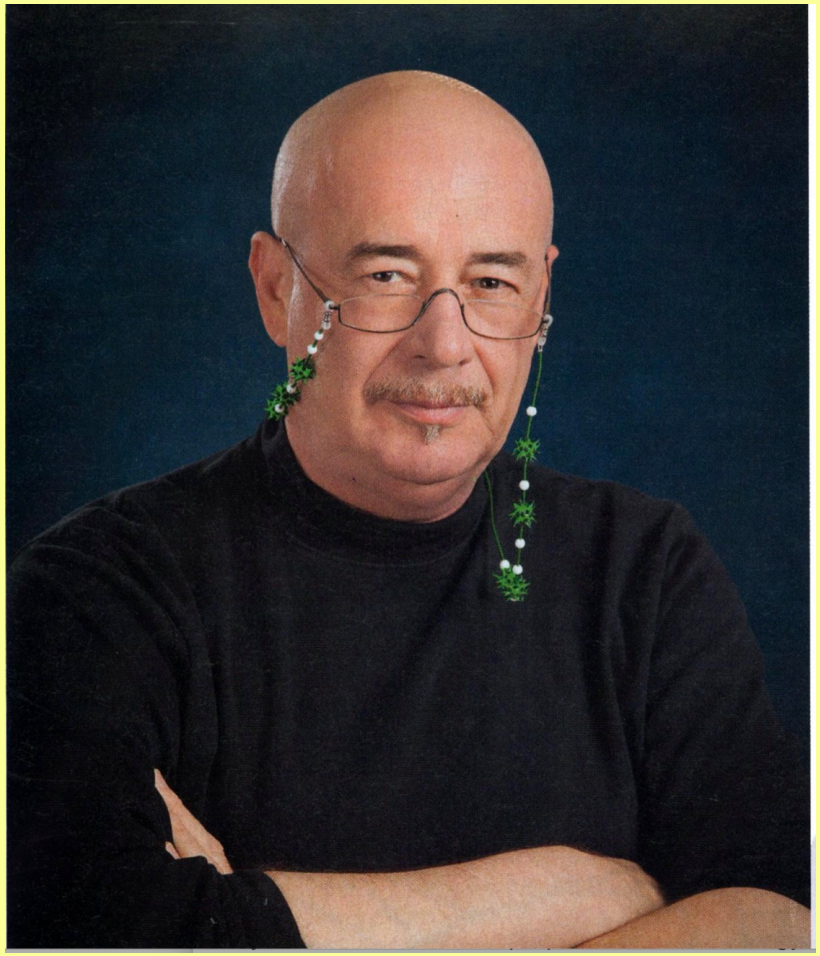


"There are some creationists who are jumping on [ENCODE] because they think it's awkward for Darwinism. Quite the contrary, of course, it **is exactly what a Darwinist would hope for**—to find usefulness in the living world."

"[W]e thought that only a minority of the genome was doing something, namely that minority which actually codes for protein. And now we find that **actually the majority of it is doing something**."

"the rest [of the genome] which had previously been written off as junk" is now understood as "the program" that's "calling into action the protein coding genes."

"Jonathan Sacks and Richard Dawkins at BBC RE:Think festival 12 September 2012" 12:57-14:10

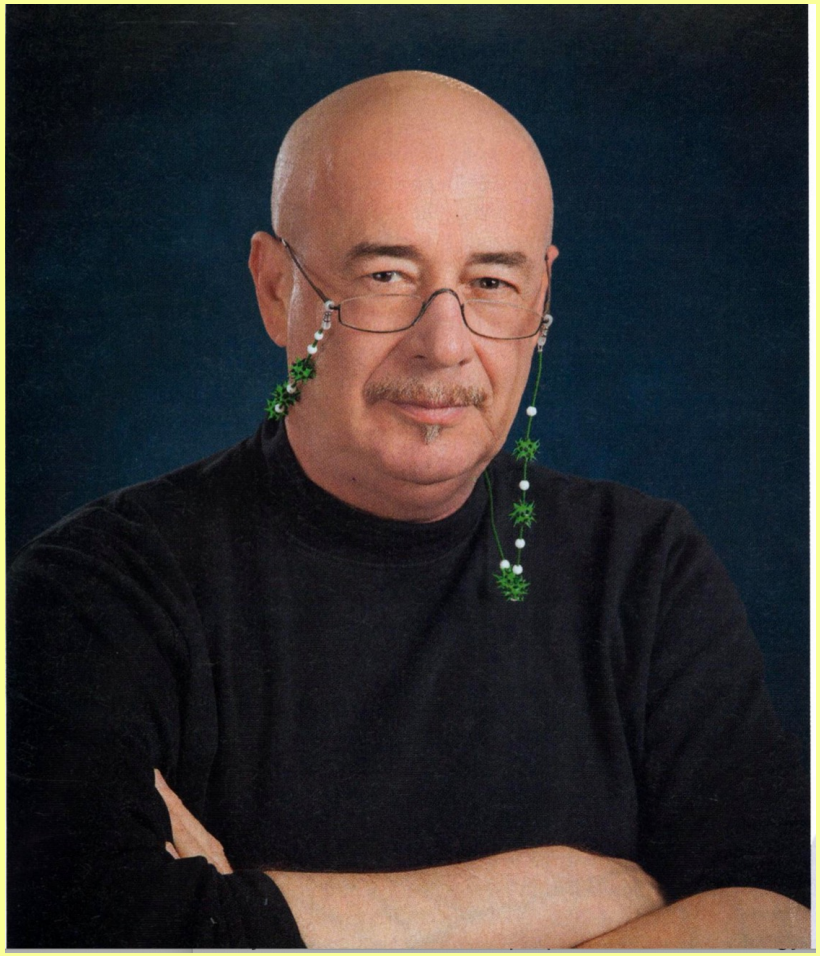


Dan Graur, Univ. of Houston

"If the human genome is indeed devoid of junk DNA as implied by the ENCODE project, then a long, undirected evolutionary process cannot explain the human genome. If, on the other hand, organisms are designed, then all DNA, or as much as possible, is expected to exhibit function. **If ENCODE is right, then Evolution is wrong**"

Lecture at U. of Houston,

quoted on p. 234 of Naturalism and Its Alternatives in Scientific Methodologies)



Dan Graur, Univ. of Houston

1. No correlation between genome size and an organism's complexity. "The onion's genome is five times larger than ours,"

2. There are the ubiquitous transposable elements that are mostly inactive, and defunct genes (pseudogenes)

3. Conservation is the metric that geneticists should use to measure function. By his measure, only 5 to 15 percent of the human genome is functional

An Upper Limit on the Functional Fraction of the Human Genome

Dan Graur*

Department of Biology and Biochemistry, University of Houston, TX

*Corresponding author: E-mail: dgraur@uh.edu.

Accepted: July 6, 2017

Genome Biol. Evol. 2017, 9, 1880

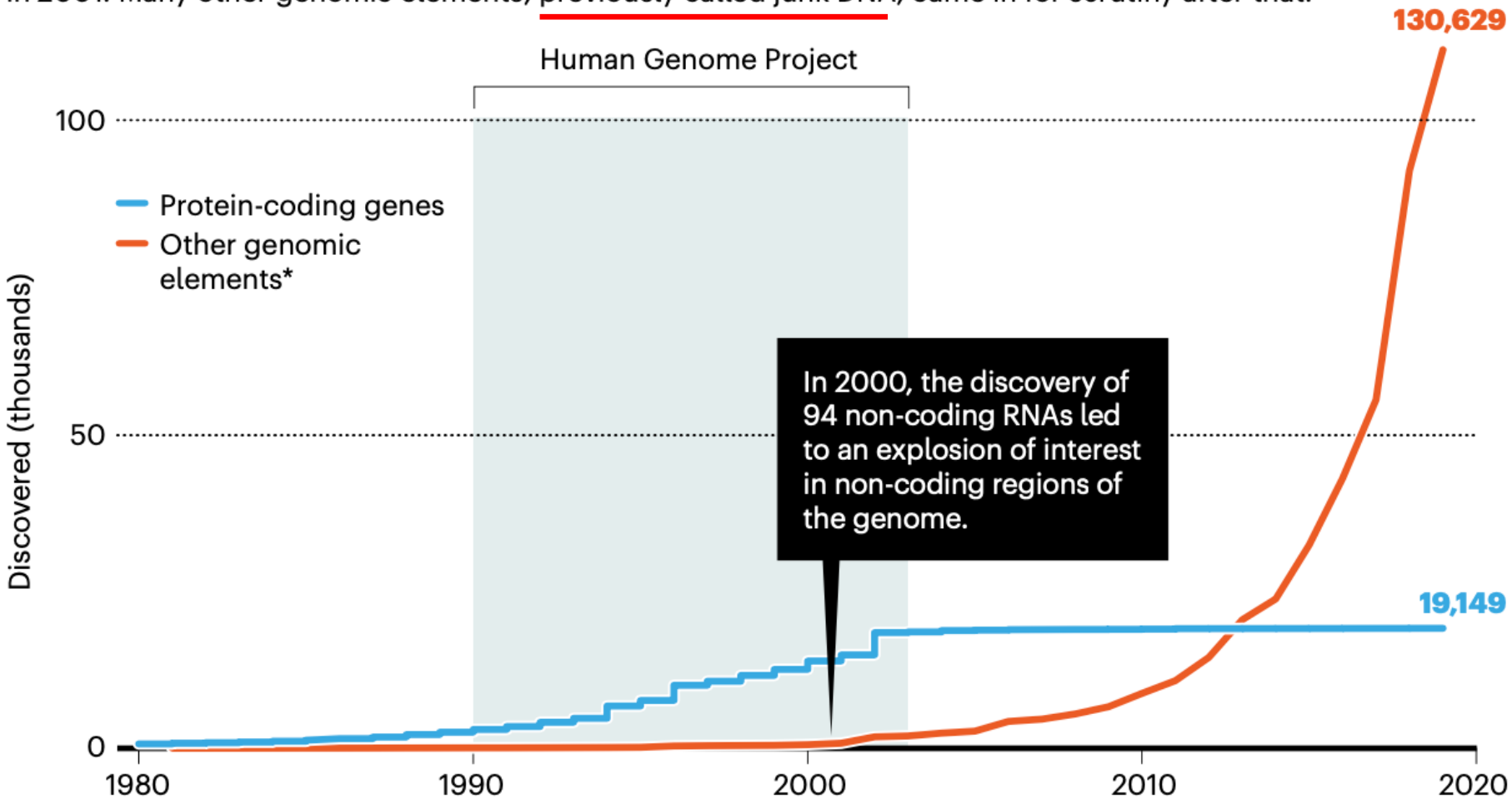
Definitions

Throughout this paper, the term "function" is used to denote selected effect function, that is, a capacity that has been shaped by and is maintained by natural selection (Wright 1973; Graur et al. 2013, 2015; Brunet and Doolittle 2014). The selected effect function stands in contradistinction with the causal role function (or activity), which is ahistorical and nonevolutionary, and merely describes what an entity does (Cummins 1975; Amundson and Lauder 1994). A genomic segment is considered to possess a selected effect function if at least one out of all the possible mutations that can affect its sequence is deleterious (Graur 2016, pp. 492–496).

Updates since 2012

Non-coding elements

Most protein-coding genes were discovered before the first draft of the Human Genome Project (HGP) in 2001. Many other genomic elements, previously called junk DNA, came in for scrutiny after that.



Satellite-Like W-Elements: Repetitive, Transcribed, and Putative Mobile Genetic Factors with Potential Roles for Biology and Evolution of *Schistosoma mansoni*

Maria Stitz[1,†], Cristian Chaparro[2,†], Zhigang Lu[1], V. Janett Olzog[3], Christina E. Weinberg[3], Jochen Blom[4], Alexander Goesmann[4], Christoph Grunau[2,*], and Christoph G. Grevelding[1,*]

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[†]These authors contributed equally to this work.

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Accepted: 28 August 2021

HHR sequence of W26.2 in the *S. japonicum* genome by BLASTn, we found no hit (data not shown).

Discussion

The days of "junk DNA" are over. When the senior authors of this article studied genetics at their respective universities, the common doctrine was that the nonprotein coding part of eukaryotic genomes consists of interspersed, "useless" sequences, often organized in repetitive elements such as

Recently Discovered Functions for "Junk" DNA

Allou et al. 2021 (*Nature*): Long noncoding (lnc) RNAs involved in **limb formation**

Harding et al. 2021 (*Virus Evolution*): Endogenous retroviruses **fight virus infections**

Senft and Macfarlan 2021 (*Nature Reviews Genetics*): Repetitive DNA (transposable elements) **control development** in mammals

Shapiro 2022 (*BioSystems*): Repetitive DNA (transposable elements) responsible for many lineage specific differences—i.e., involved in **forming new body plans**

Johnsson et al. 2022 (*Nature Genetics*): Long noncoding RNAs **regulate protein expression** and **control the cell cycle**, such as controlling apoptosis

Recently Discovered Functions for "Junk" DNA

Wei et al. 2022 (*Cell Reports*): Junk DNA involved in **forming fear-related memories & phobias**

Spivey 2022 (BioPharm), Zahn 2022 (*Science*); Pennisi 2022 (*Science*): Junk DNA encodes vital **immune**-related and **metabolism-related** functions

Feng et al. 2022 (*Nucleic Acids Research*): Pseudogenes are **translated into proteins**

Johansson et al. 2022 (*Cell Stem Cell*): Non-coding junk DNA **regulates gene expression in human and chimp brains**, and may explain our brain differences

Marx 2022 (*Nature Methods*): Noncoding RNAs involved in **cell differentiation, development**

some still debate “function”

Biology & Philosophy (2022) 37: 29
https://doi.org/10.1007/s10539-022-09854-1

Not functional yet a difference maker: junk DNA as a case study

Joyce C. Havstad[1] · Alexander F. Palazzo[2]

Received: 15 October 2021 / Accepted: 24 March 2022 / Published online: 2 July 2022

Junk DNA

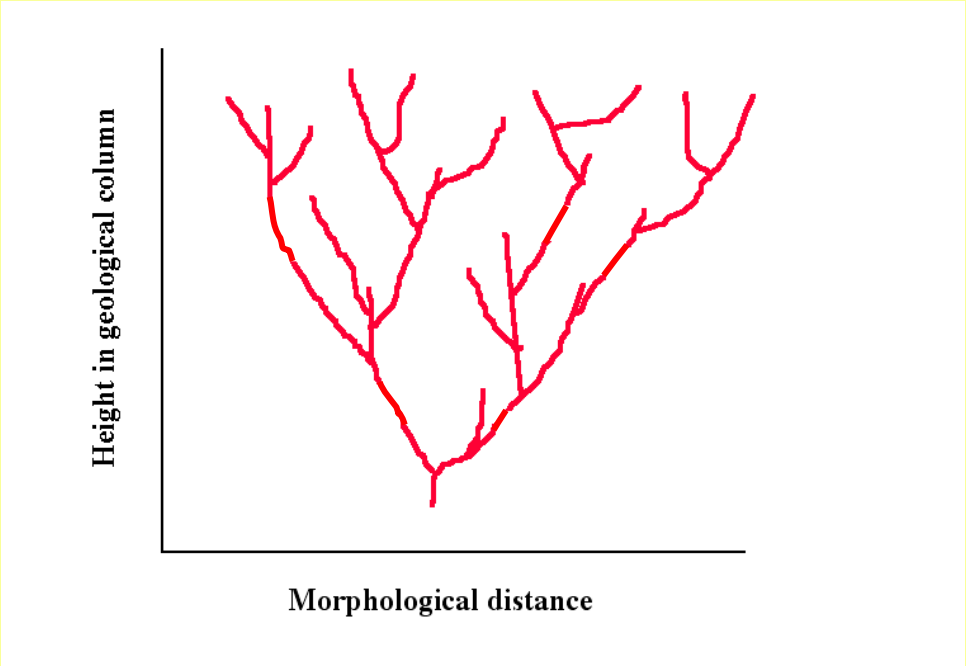
It is widely agreed (Ponting and Hardison 2011; Rands et al. 2014; Ponting 2017) that approximately 90% of the human genome is not subject to purifying selection and hence—at least according to typical accounts of function in molecular biology—is not functional. Despite this, we argue that paradigmatically "non-functional" DNA, commonly referred to as junk DNA, is still a difference maker (in Waters' [2007] sense). The fact that there are entities which matter (as they affect cell physiology), yet which are not necessarily sculpted by organism-level natural selection, has profound implications for the evolution of humans, and multicellular life in general.

Summary:

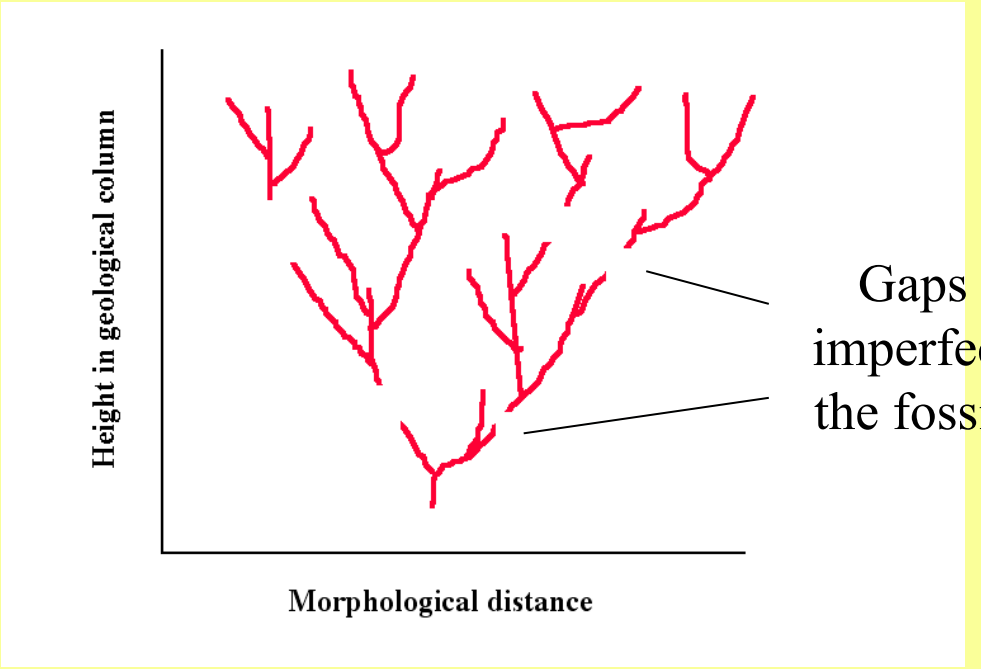
The “junk DNA” paradigm has been shown to be false. Most, if not all, noncoding DNA has function

10. **The Cambrian (and other) explosions in the fossil record are not consistent with the Darwinian model of gradual evolution.**

Expectation based on common ancestry and gradual evolution



Expectation based on common ancestry and gradual evolution



Darwin's expectations

"why, if species have descended from other species by insensibly fine gradations, do we not everywhere see **innumerable transitional forms**?

"the number of intermediate and transitional links between all living and extinct species must have been **inconceivably great**"

"[Since] innumerable transitional forms must have existed, why do we not find them imbedded in **countless numbers** in the crust of the earth? Why is not every geological formation and **every stratum full of such intermediate links**? Geology assuredly does not reveal any such finely graduated organic chain; and this is perhaps is the most obvious and gravest objection which can be urged against my theory."

C. Darwin quoted in The Origin of Species By Means of Natural Selection, 1974, pg 202, 292.

Basic Characteristics of the Fossil Record

1. layers with succession of first appearances
2. abrupt appearance
3. stasis
4. abrupt disappearance
5. “top-down” pattern (rather than “bottom-up”)

Basic Characteristics of the Fossil Record

Vertebrates

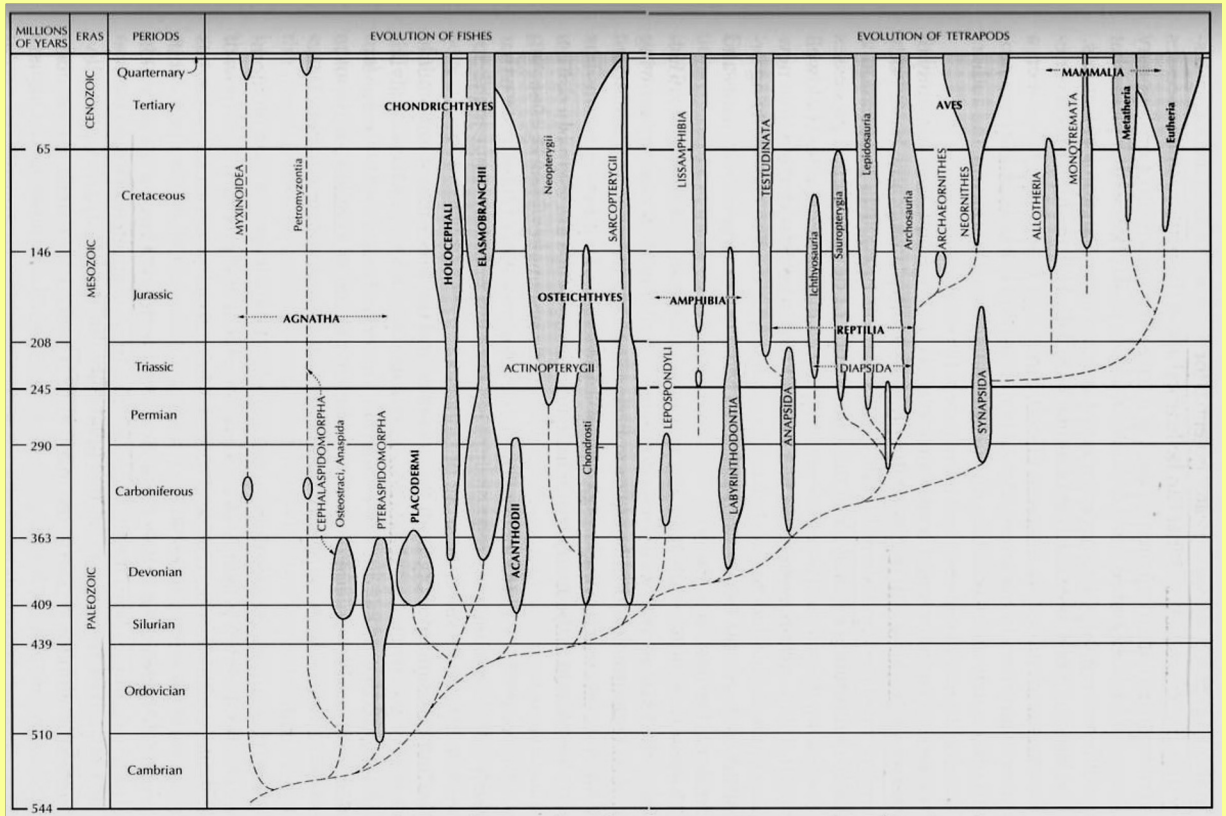


Figure 1.5. General pattern of vertebrate evolution. From *Analysis of Vertebrate Structure* by Hildebrand, 4th ed. Copyright © 1995. Reprinted by permission of John Wiley & Sons, Inc.

From "Patterns and Processes of Vertebrate Evolution", R. L. Carroll

Figure 1.5 of Chap. 1: "Current problems in evolutionary theory"

Placental mammals

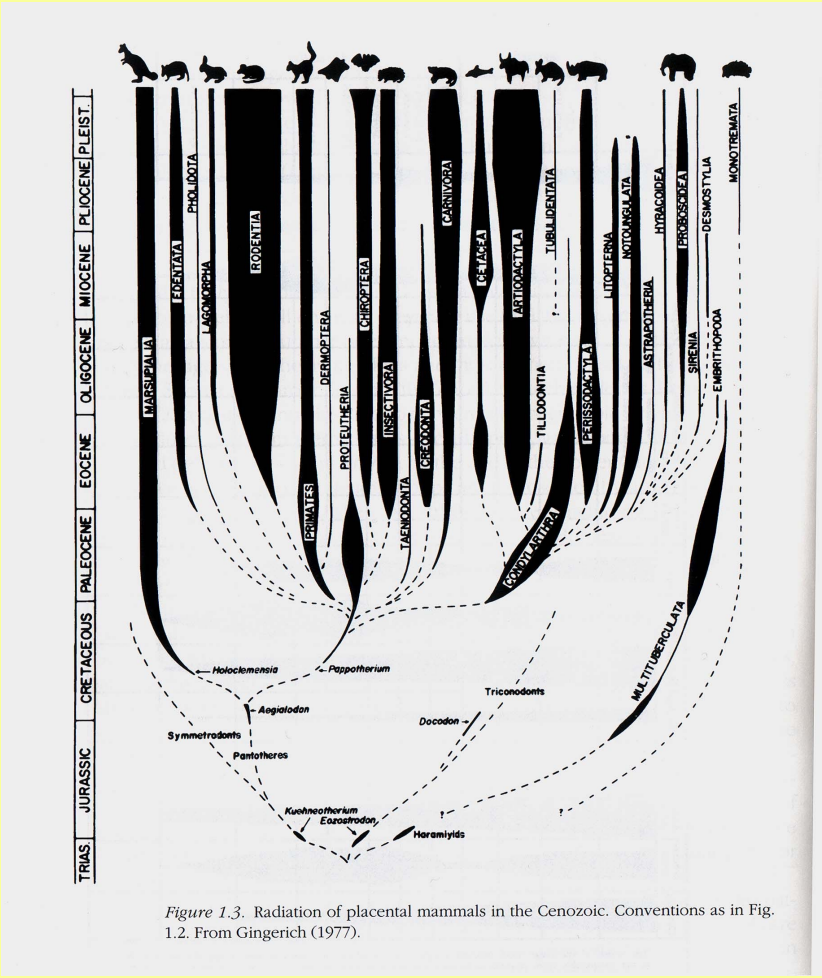


Figure 1.3. Radiation of placental mammals in the Cenozoic. Conventions as in Fig. 1.2. From Gingerich (1977).

From "Patterns and Processes of Vertebrate Evolution", R. L. Carroll

Figure 1.3 of Chap. 1: "Current problems in evolutionary theory"

Major vascular plant groups

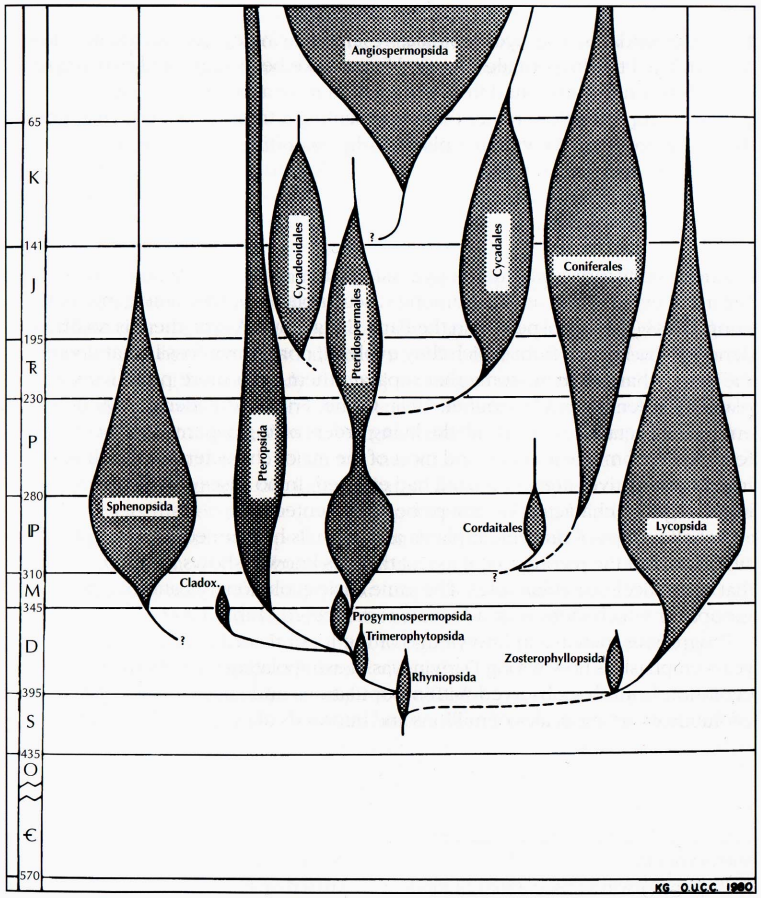


Figure 1.4. Generalized phylogenetic relationships of major vascular plant groups as understood in 1980. Conventions as in Figs. 1.2 and 1.3. From Knoll and Rothwell (1981).

From "Patterns and Processes of Vertebrate Evolution", R. L. Carroll

Figure 1.4 of Chap. 1: "Current problems in evolutionary theory"

”Instead of showing gradual and continuous change through time, the major lineages **appear suddenly** in the fossil record, already exhibiting many of the features by which their modern representatives are recognized. It must be assumed that evolution occurs much more rapidly *between* groups than *within* groups. For most of their evolutionary history, fundamental aspects of the anatomy and way of life of these lineages **do not change significantly**. Very few intermediates between groups are known from the fossil record.”

R. L. Carroll, “Patterns and Processes of Vertebrate Evolution” p 2, 4.

The greatest riddle of evolution has been the following puzzle: while Darwin argued that new species emerge through a slow, gradual accumulation of tiny mutations, **the fossil record reveals a very different scenario - the sudden emergence of whole new species, with no apparent immediate ancestors.**

J. H. Schwartz, Sudden Origins, 1999, inside cover.

"The gaps in the fossil record are real, however. The absence of a record of any important branching is quite phenomenal. Species are usually static, or nearly so, for long periods, species seldom and genera never show evolution into a new species or genera but replacement of one by another, and change is more or less abrupt. ... The origin of no innovation of large evolutionary significance is known. ... Large evolutionary innovations are not well understood. None has ever been observed, and we have no idea whether any may be in progress. **There is no good fossil record of any**."

R. Wesson, Beyond Natural Selection, 1991, pg 45.

"The known fossil record **fails to document a single example of phyletic (gradual) evolution accomplishing a major morphologic transition** and hence offers no evidence that the gradualistic model can be valid."

S. Stanley, Macroevolution, pg 39.

"Evolution cannot forever be going on somewhere else. Yet that's how the fossil record has struck many a forlorn paleontologist looking to learn something about evolution."

N. Eldredge, Reinventing Darwin, 1995.

"**The extreme rarity of transitional forms in the fossil record persists as the trade secret of paleontology**. The evolutionary trees that adorn our textbooks have data only at the tips and nodes of their branches: the rest is inference, however, reasonable, not the evidence of the fossils. Yet Darwin was so wedded to gradualism that he wagered his entire theory on a denial of the literal record.

Darwin's argument still persists as the favored escape of most paleontologists from the embarrassment of **a record that seems to show so little of evolution**.

S. J. Gould, "Evolution's Erratic Pace" *Natural History* , 86, 1977.

The Cambrian Explosion:
the abrupt appearance of nearly all phyla

(phyla - basic body plans, greatest differences within the animal kingdom)

"The gaps which separate species: dog/cat, rat/mouse etc are utterly trivial compared with, say, that between a primitive terrestrial mammal and a whale or a primitive terrestrial reptile and an Ichthyosaur; and **even these relatively major discontinuities are trivial alongside those which divide major phyla such as molluscs and arthropods**."

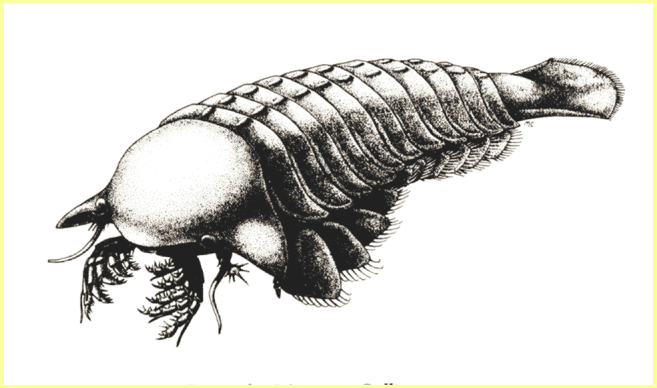
M. Denton, Evolution: A Theory in Crisis, pg 193.

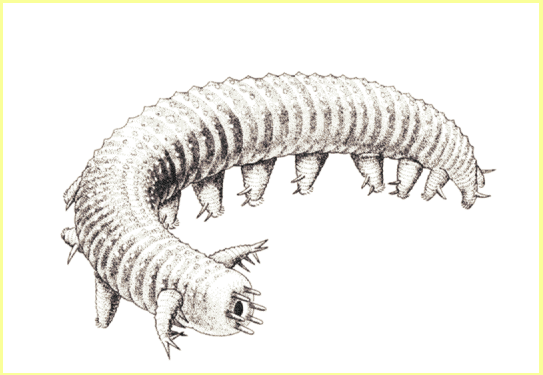
"The fossil record had caused Darwin more grief than joy. Nothing distressed him more than the **Cambrian explosion, the coincident appearance of almost all complex organic designs** ... "

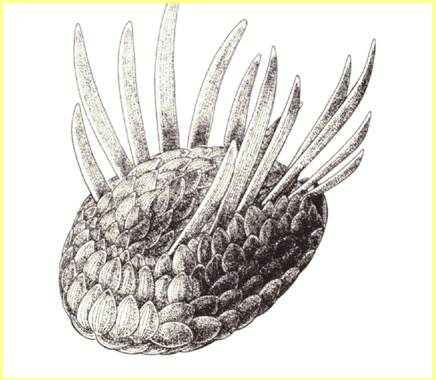
S. Gould, The Panda's Thumb, pg 238, 239.

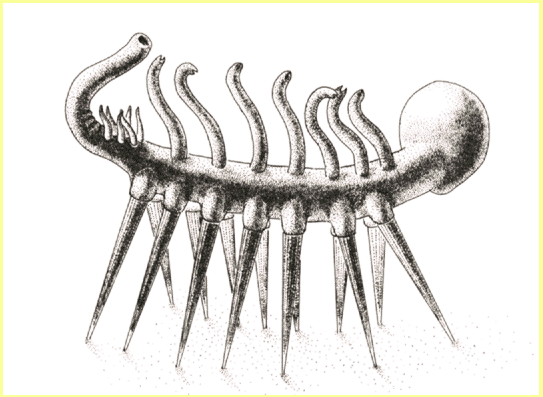
The Cambrian explosion

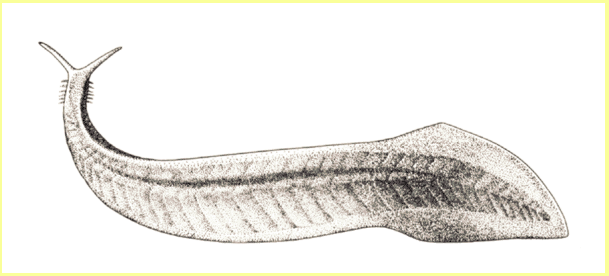
(artist renderings)

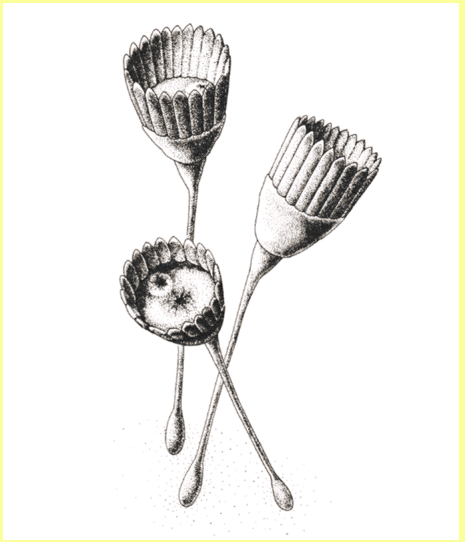




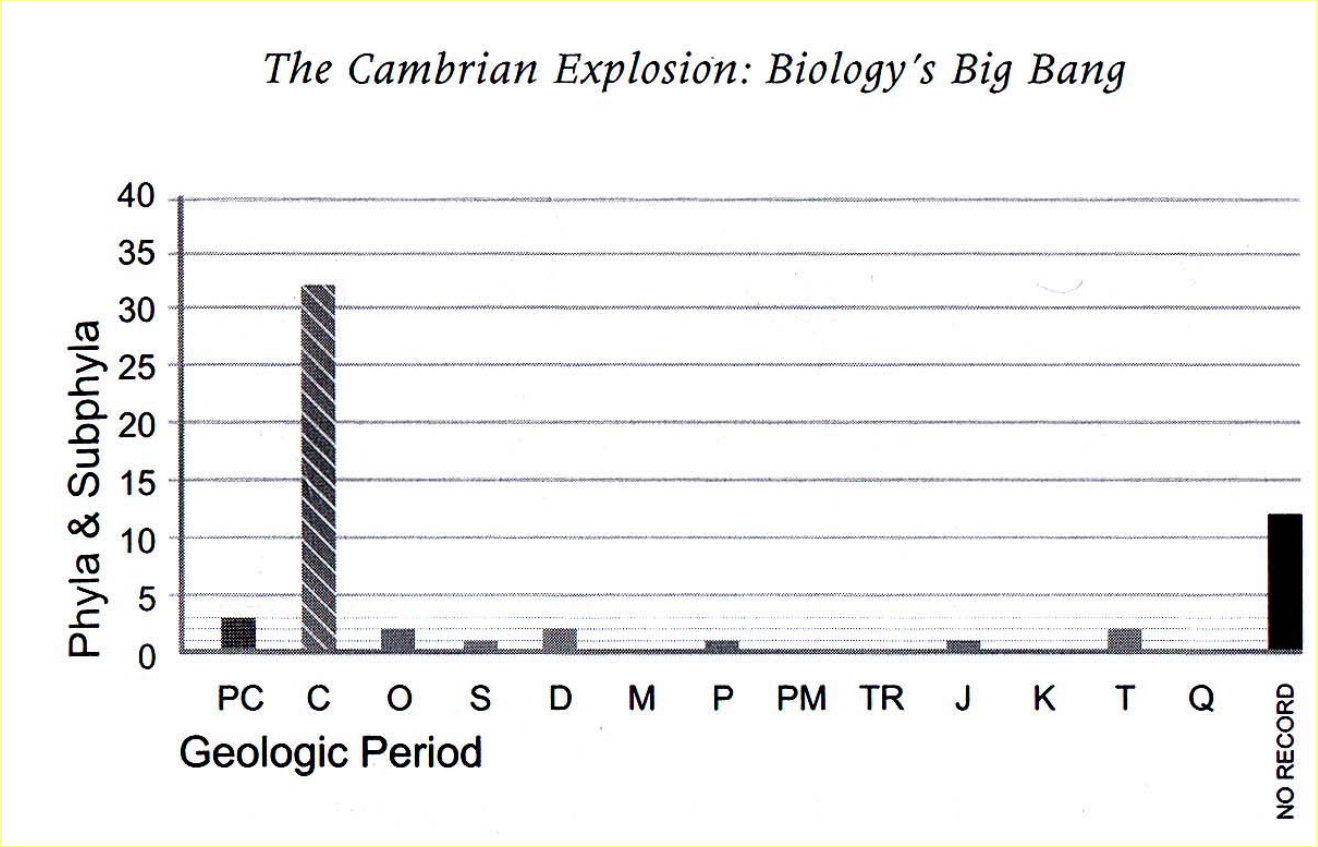








from “Wonderful Life”, S. J. Gould

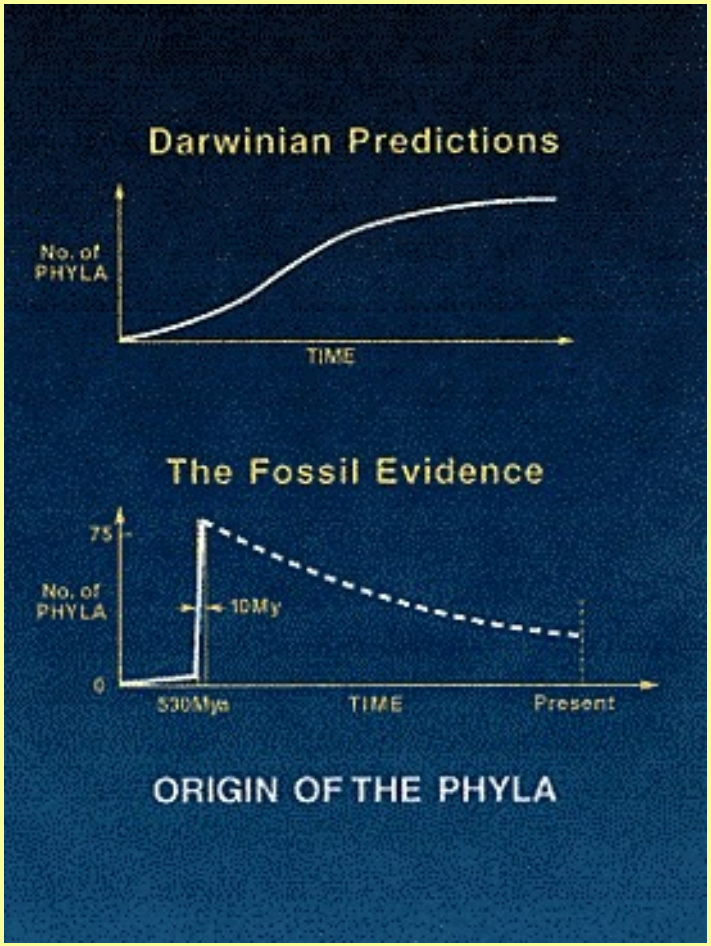


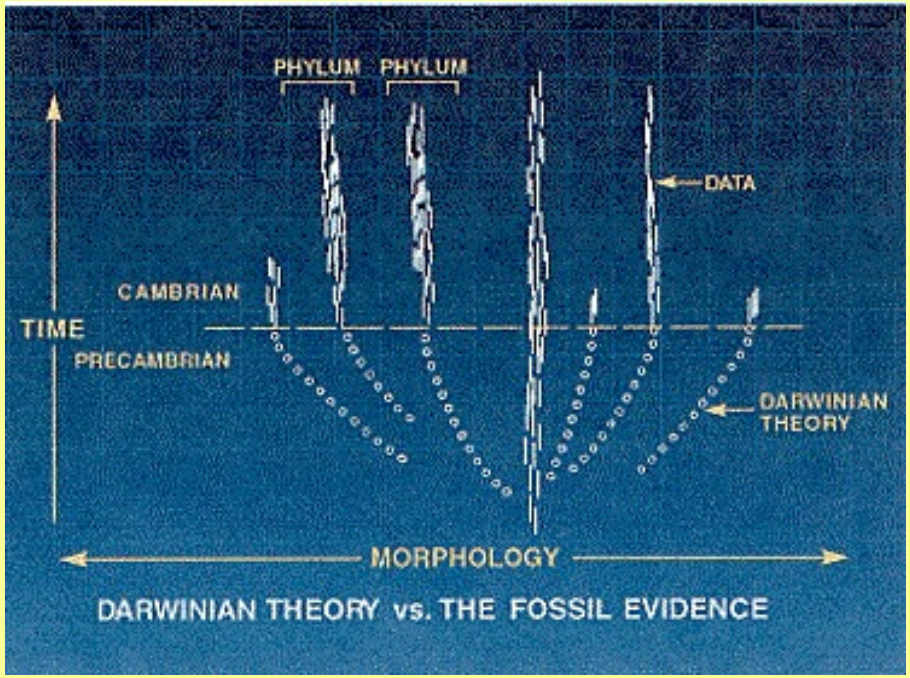
from Darwinism, Design, and Public Education, pg 351

The Cambrian Explosion

"bottom up"

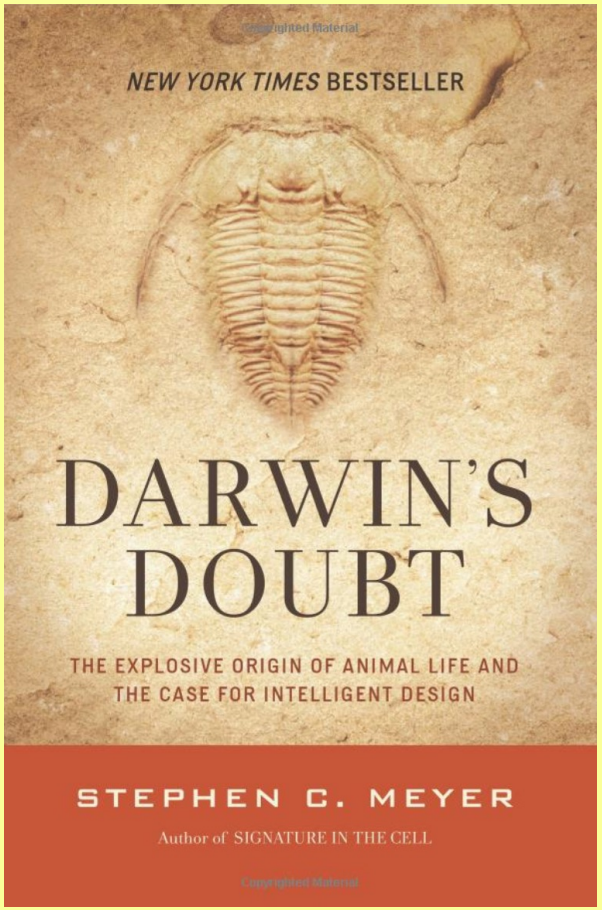
"top down"





"top-down" pattern (rather than "bottom-up")

Darwin's Doubt - Steven C. Meyer



Günter Bechly

Paleoentomologist,
former curator of the
Museum of Natural History, Stuttgart Germany

https://www.youtube.com/watch?v=V15sjy7gtVM
10:45 – 20:06

His story:
https://www.youtube.com/watch?v=jZwXzWAA6pI&t=15s

Summary

8. **So many highly improbable factors make earth habitable that it is VERY unlikely that another truly "earth-like" planet exists in our galaxy**

9. **The "junk DNA" paradigm has been shown to be false. Most, if not all, noncoding DNA has function.**

10. **The Cambrian (and other) explosions in the fossil record are not consistent with the Darwinian model of gradual evolution.**

Extra slides

Issues with Red Dwarf Stars

1. Tidal locking (extreme temperature differences between the two sides, most water would condense on cold side, little or no mag field)
2. Intense tidal heating – surface heating due to friction would bake off any water
3. Most radiation is IR, water absorbs IR
4. Extended violent pre-main sequence stage, high variation in flux, flaring, intense X-ray and UV, strip off atmosphere

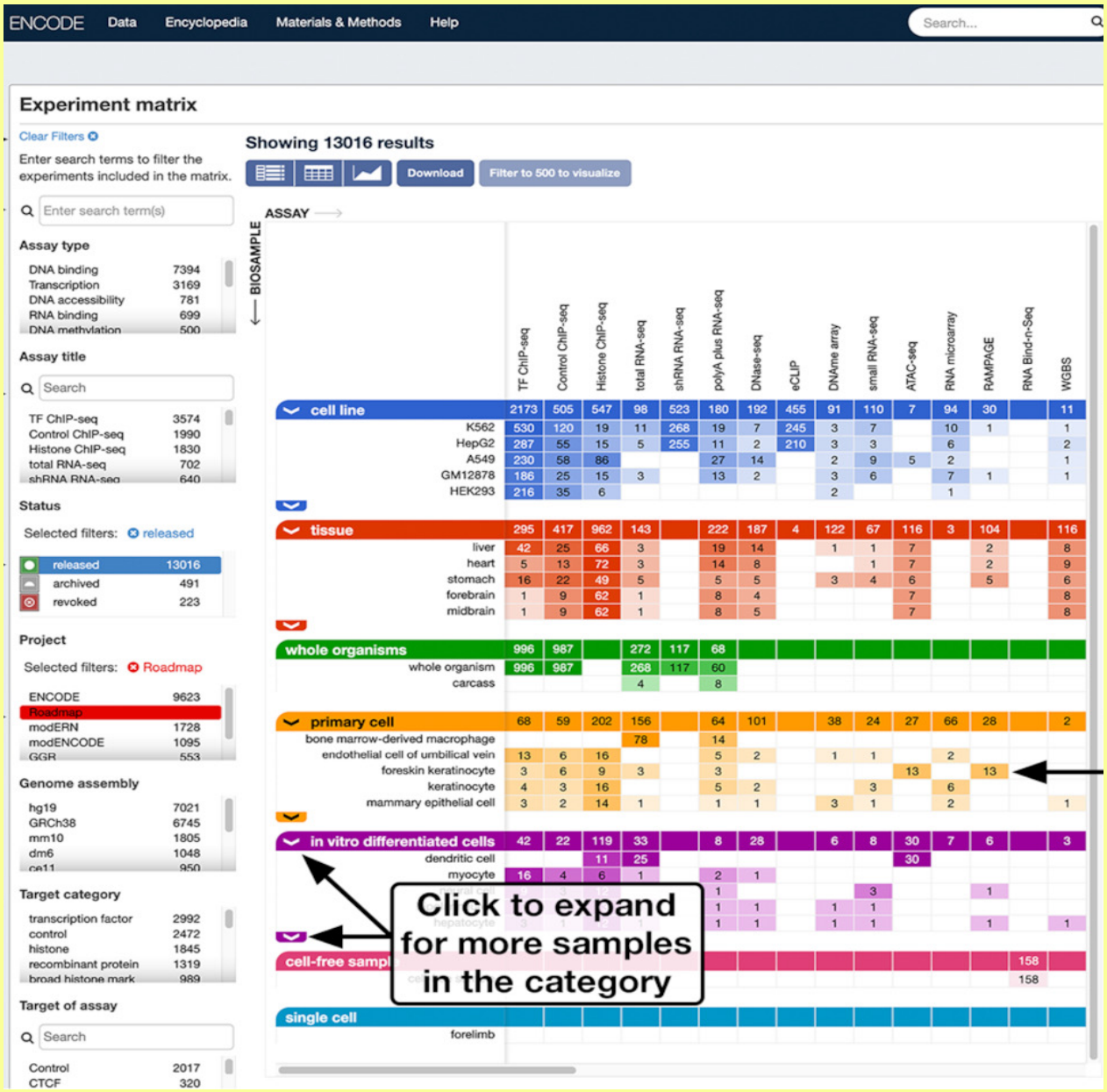
Tidal heating: As a planet moves from its closest approach to the star, to the furthest point, and back again, the gravitational force changes, being inversely proportional to distance squared. This difference creates an oscillating strain on the planet that causes its shape to vary periodically. The rigidity of the planet resists the changes in shape, and friction generates heat. This energy production is called tidal heating.

ENCODE DATA PRORTAL

40 assays

Assay Targets:

Histone
Transcription factor
Broad histone mark
Narrow histone mark
RNA binding protein
Chromatin remodeler
Cofactor
RNA polymerase complex
Other context
DNA repair
Cohesin
DNA replication
tag



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/