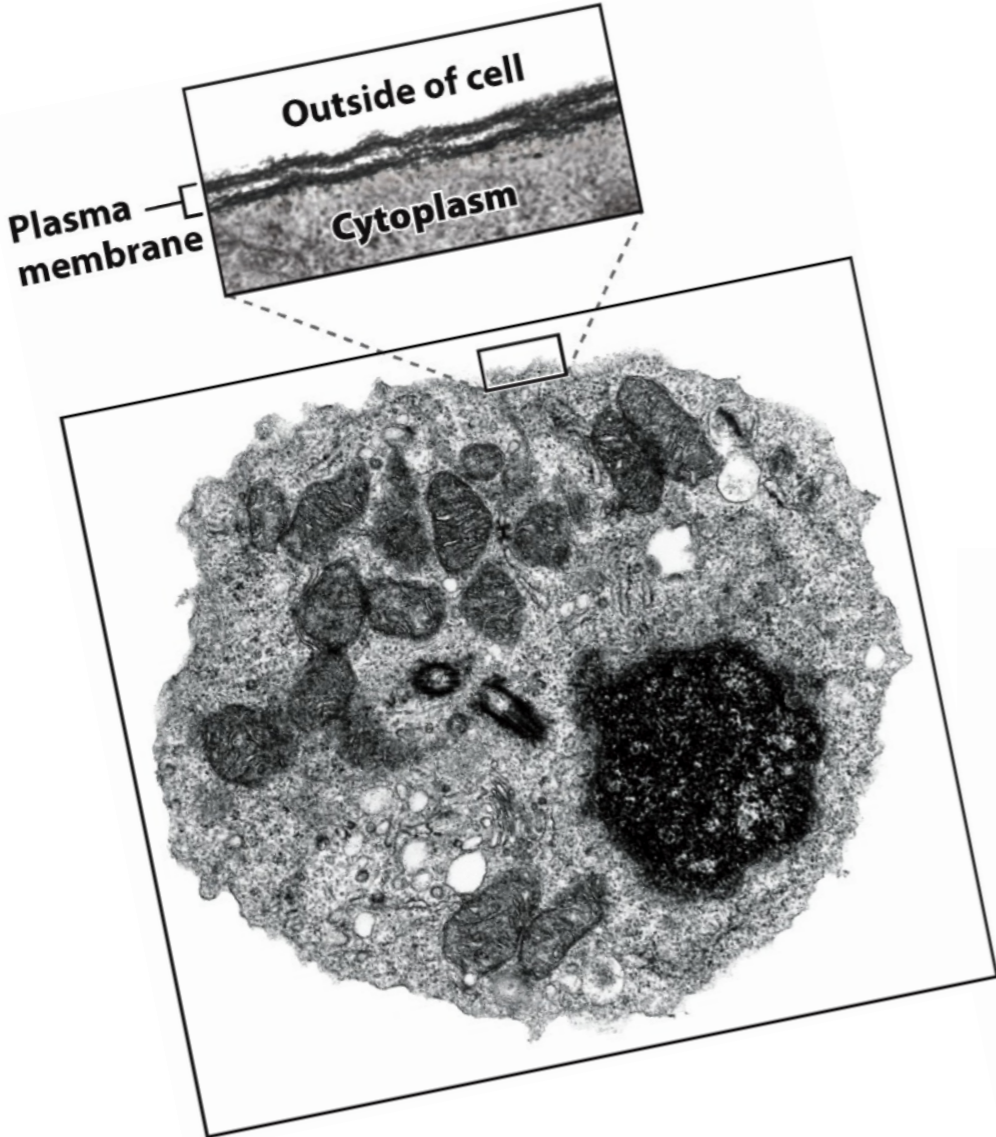


BIOL2107, Fall '23

Lecture 2



1 H 1.0079																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.179
11 Na 22.990	12 Mg 24.305											13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948
19 K 39.098	20 Ca 40.08	21 Sc 44.956	22 Ti 47.88	23 V 50.942	24 Cr 51.996	25 Mn 54.938	26 Fe 55.847	27 Co 58.933	28 Ni 58.69	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.59	33 As 74.922	34 Se 78.96	35 Br 79.909	36 Kr 83.80
37 Rb 85.4778	38 Sr 87.62	39 Y 88.906	40 Zr 91.22	41 Nb 92.906	42 Mo 95.94	43 Tc (99)	44 Ru 101.07	45 Rh 102.906	46 Pd 106.4	47 Ag 107.870	48 Cd 112.41	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.904	54 Xe 131.30
						75 Re 186.207	76 Os 190.2	77 Ir 192.2	78 Pt 195.08								
						107 Bh (264)											

Chemical symbol
 Atomic number
 Atomic mass
 (average of all isotopes)

Welcome to BIOL2107 CRN 86772 ▾



John Houghton posted on Aug 9, 2023 7:38 PM

Welcome to BIOL2107 CRN 86772, Fall'23

The home page for the course is: <https://biotech.gsu.edu/home2107.html>, which really is the point of reference for the course throughout the semester (see image below). Feel free to look over the home page for basic course information and to browse the various links on the website (before the beginning of the semester) to get some insight in to its structure -please alert me to any obvious "missed" links.

GeorgiaState University | DEPARTMENT OF BIOLOGY

Principles of Biology I BIOL2107 Fall'23 CRN 86772

Home ▾ BIOL 2107 ▾ Courses ▾ Resources ▾

Biology 2107, Fall '23

Location: Room 700 Langdale Hall
Time: Monday & Wednesday 5:30 pm - 6:45 pm
Credit Hours: 3 hrs

Lecturer: Dr. John Houghton
Office: 520 Petit Science Center
Laboratory: 657 Petit Science Center
email: jhoughton@gsu.edu
Office Phone: (404) 413-5390
Office hours: Mon, Wed: 2:00 pm - 3:00 pm ...or by appointment

Reference Text: *"Biology in Focus"* Cambell, 3rd Ed. Urry, Cain, Wasserman, Minorsky **ISBN: 0138263183**

"Biology in Focus" Cambell, 3rd Ed. Urry, Cain, Wasserman, Minorsky, Amaz... ..

I look forward to seeing everyone on August 21st at 5:30pm -when I will review the information in the course, all expectations and (hopefully) address any concerns that you will almost certainly have.

CHeers!~

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 Pearson

 [Student_Registration_Handout_houghton03951](#)

 [BIOL2107 HOME PAGE](#)

Student Registration Instructions for D2L Brightspace

First, open your Pearson content

1. Log in to D2L Brightspace as a student and enter your course.
2. Depending on your course setup, do one of the following. [Don't know your setup?](#)
 - Select **MyLab and Mastering** or **Access Pearson** in a module under Content Browser.
 - Select the **MyLab and Mastering** or **Access Pearson** widget.
 - Select a Pearson link in a module.
 - **Barnes & Noble, Follett Willo, RedShelf, and VitalSource:** Select the Course Materials link and then check your opt status. If applicable, select **Launch Courseware** or **Access Courseware**.
3. If prompted, select **Open Pearson**.
4. Select **Open MyLab & Mastering** to go to the course home page or select a link under Student Links.

Next, get access to your Pearson content

1. Link your student D2L Brightspace and Pearson accounts. In some cases, your Pearson account might be automatically created and linked for you.
2. If prompted, select an access option:
 - Enter a prepaid access code that came with your textbook or from the bookstore.
 - Buy access using a credit card or PayPal account.
 - If available, get temporary access without payment for 14 days.
3. Select **Go to my course**.

We recommend you always enter your Mastering Biology course from D2L Brightspace.

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 [Student_Registration_Handout_houghton03951](#)

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Biochemistry of Living forms “CHONPS”

1 H 1.0079																	2 He 4.003
3 Li 6.941	4 Be 9.012											5 B 10.81	6 C 12.011	7 N 14.007	8 O 15.999	9 F 18.998	10 Ne 20.179
11 Na 22.990	12 Mg 24.305											13 Al 26.982	14 Si 28.086	15 P 30.974	16 S 32.06	17 Cl 35.453	18 Ar 39.948
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55 Cs 132.905	56 Ba 137.34	71 Lu 174.97	72 Hf 178.49	73 Ta 180.948	74 W 183.85	75 Re 186.207	76 Os 190.2	77 Ir 192.2	78 Pt 195.08	79 Au 196.967	80 Hg 200.59	81 Tl 204.37	82 Pb 207.19	83 Bi 208.980	84 Po (209)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.025	103 Lr (260)	104 Rf (261)	105 Db (262)	106 Sg (266)	107 Bh (264)	108 Hs (269)	109 Mt (268)	110 (269)	111 (272)	112 (277)	113 (285)	114 (289)	115 (289)	116 (289)	117 (289)	118 (293)

Chemical symbol
Atomic number
Atomic mass
(average of all isotopes)

Lanthanide series

57 La 138.906	58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (145)	62 Sm 150.36	63 Eu 151.96	64 Gd 157.25	65 Tb 158.924	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.934	70 Yb 173.04
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Actinide series

89 Ac 227.028	90 Th 232.038	91 Pa 231.0359	92 U 238.02	93 Np 237.0482	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf (251)	99 Es (252)	100 Fm (257)	101 Md (258)	102 No (259)
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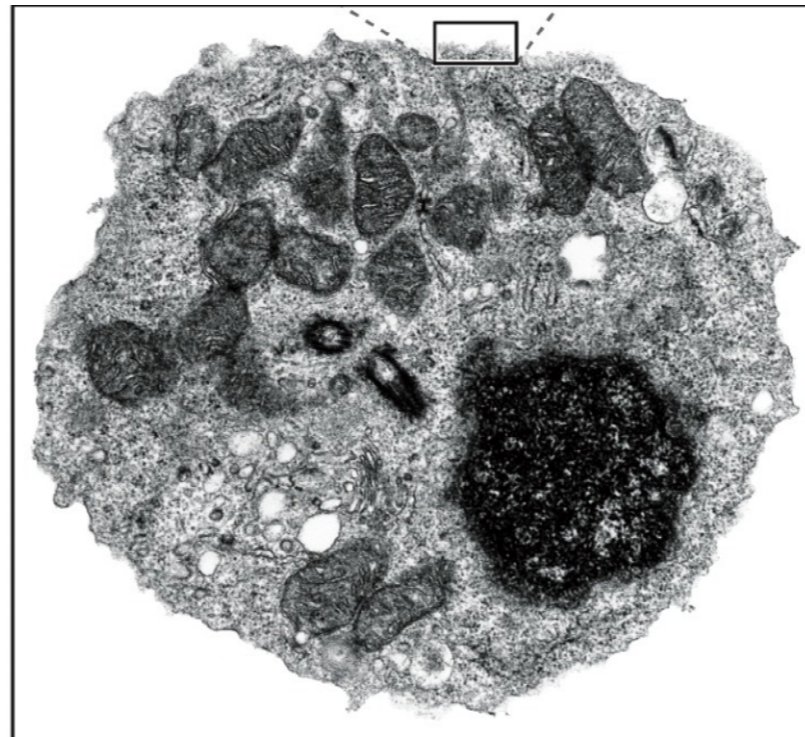
Animate or inanimate objects, living or dead organisms...

All living organisms adhere to the same **chemical and physical laws**

A **Scientific Law** is:

“a descriptive generalization about how some aspect of the natural world behaves **under stated circumstances**”.

So how is “Life” ultimately defined...



Transmission electron micrograph of a cell

Figure 1.14
Biology: How Life Works
© 2014 W. H. Freeman and Company

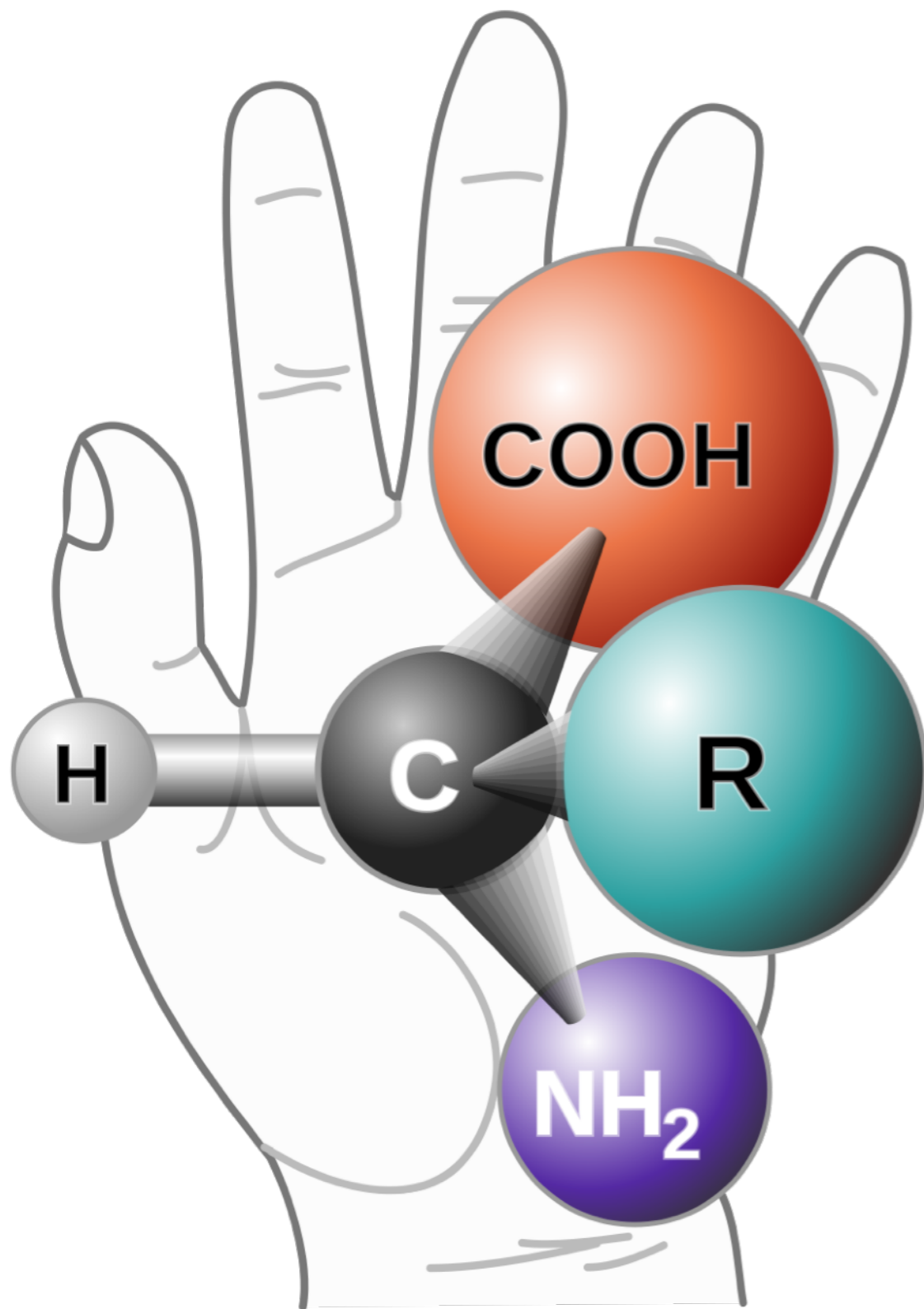
Living Organisms... **Cells**



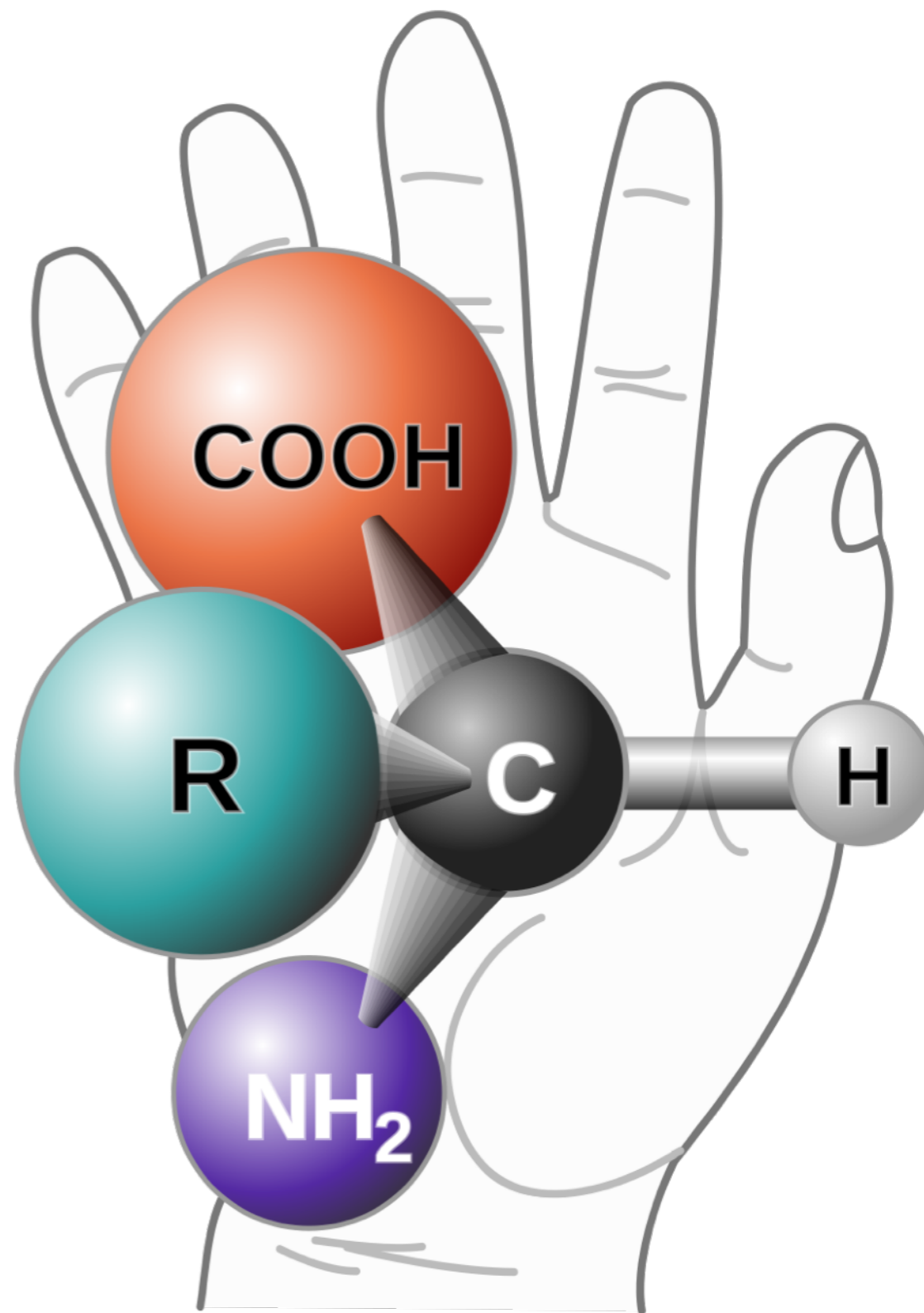
Which was first? Who is/was “more” correct?

The importance of a “handshake”

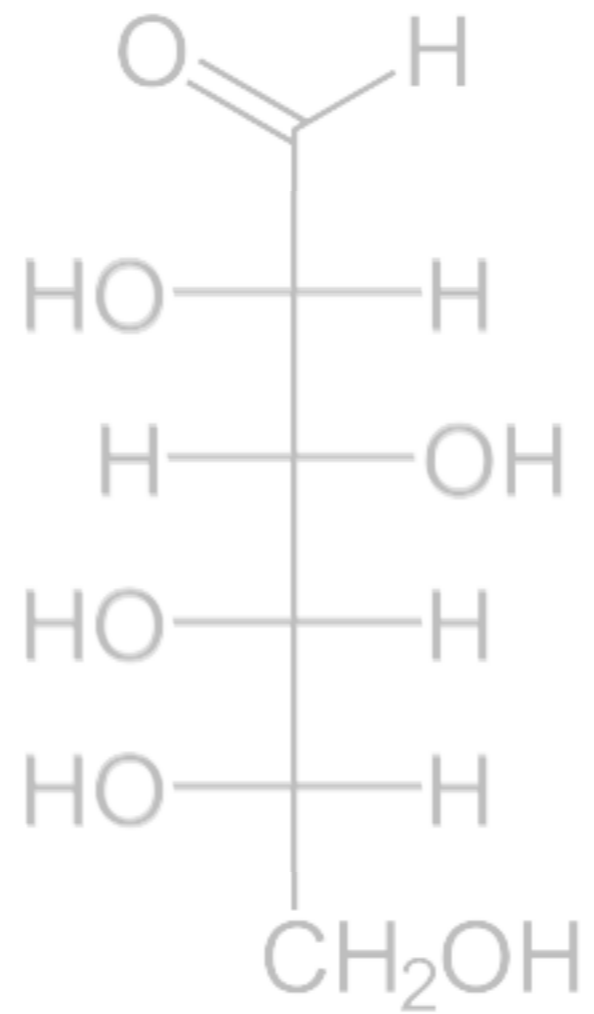




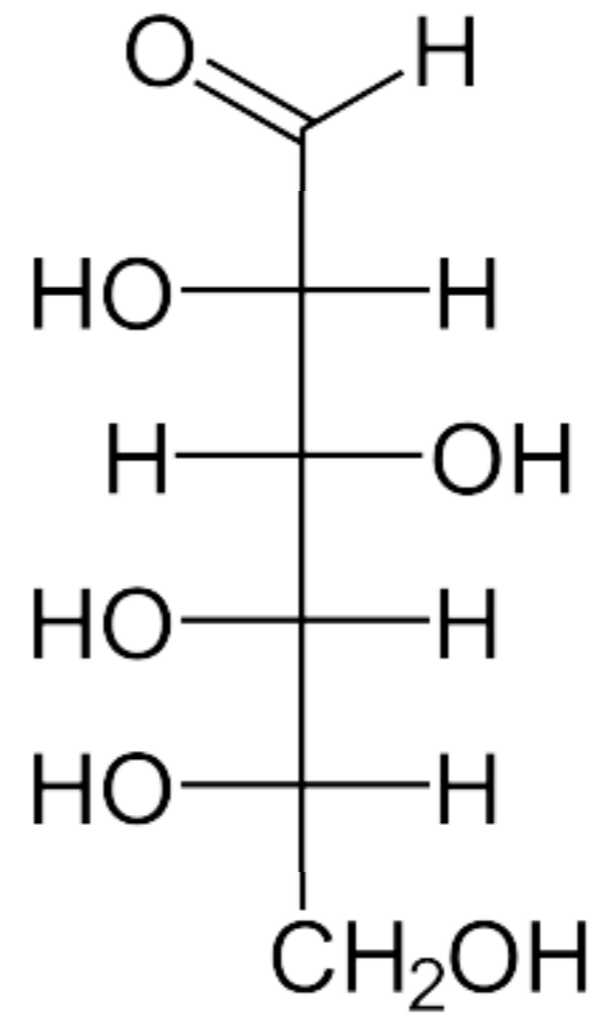
Left
Laevo



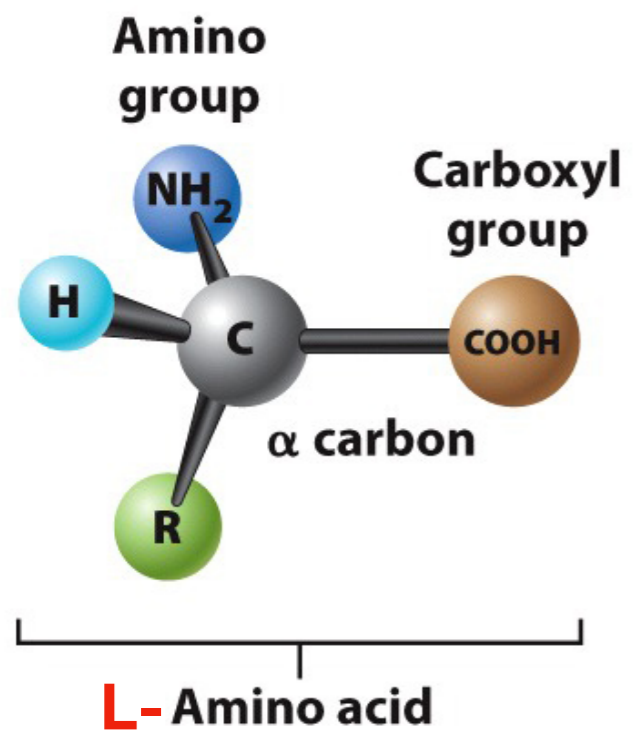
Right
Dextro



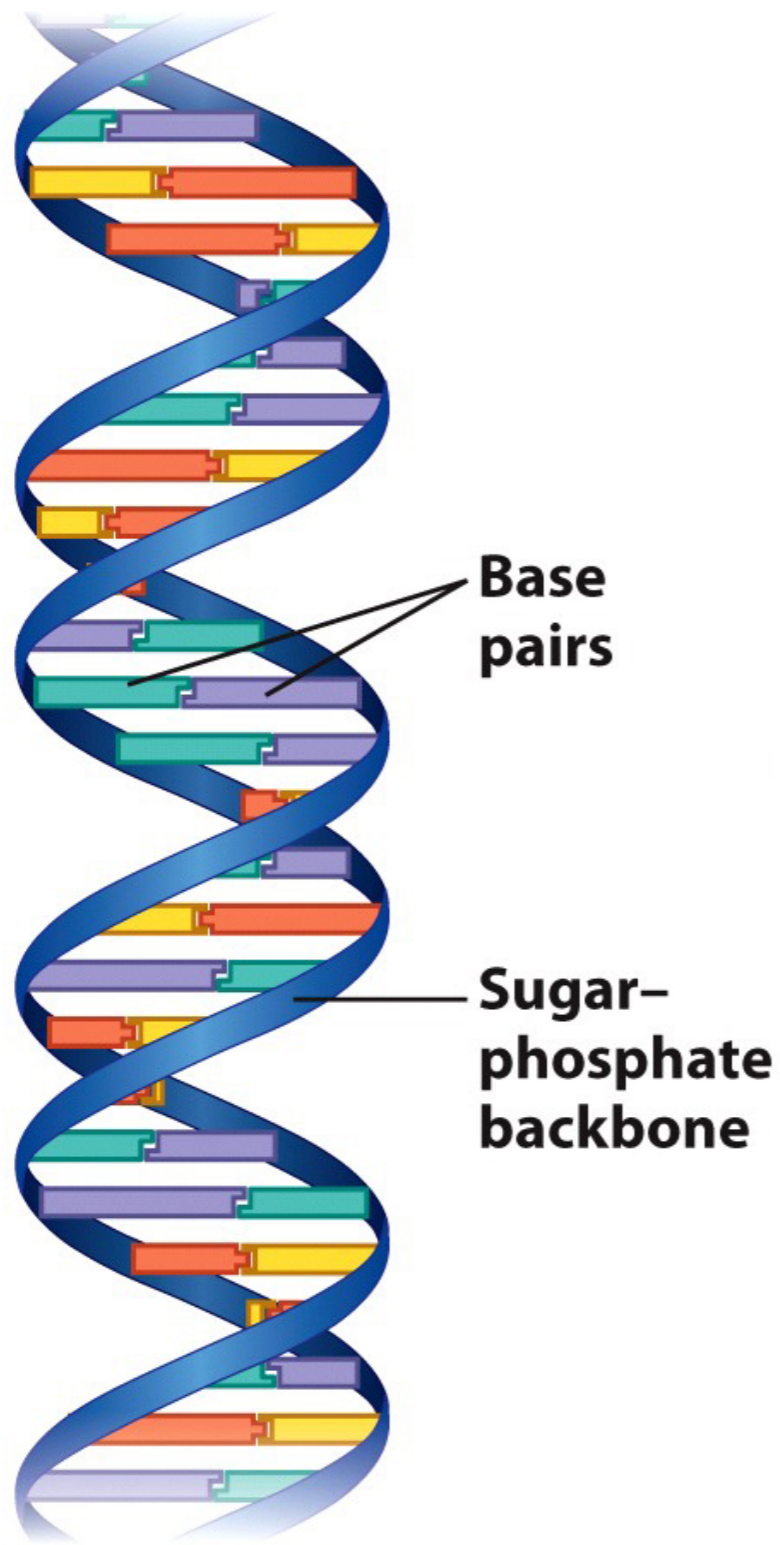
L-Glucose



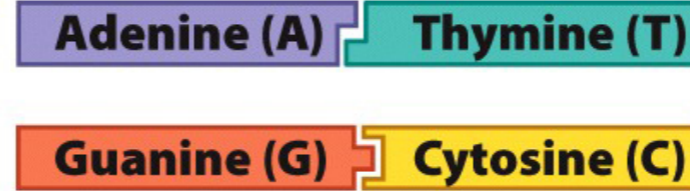
D-Glucose



a.



b.



c.

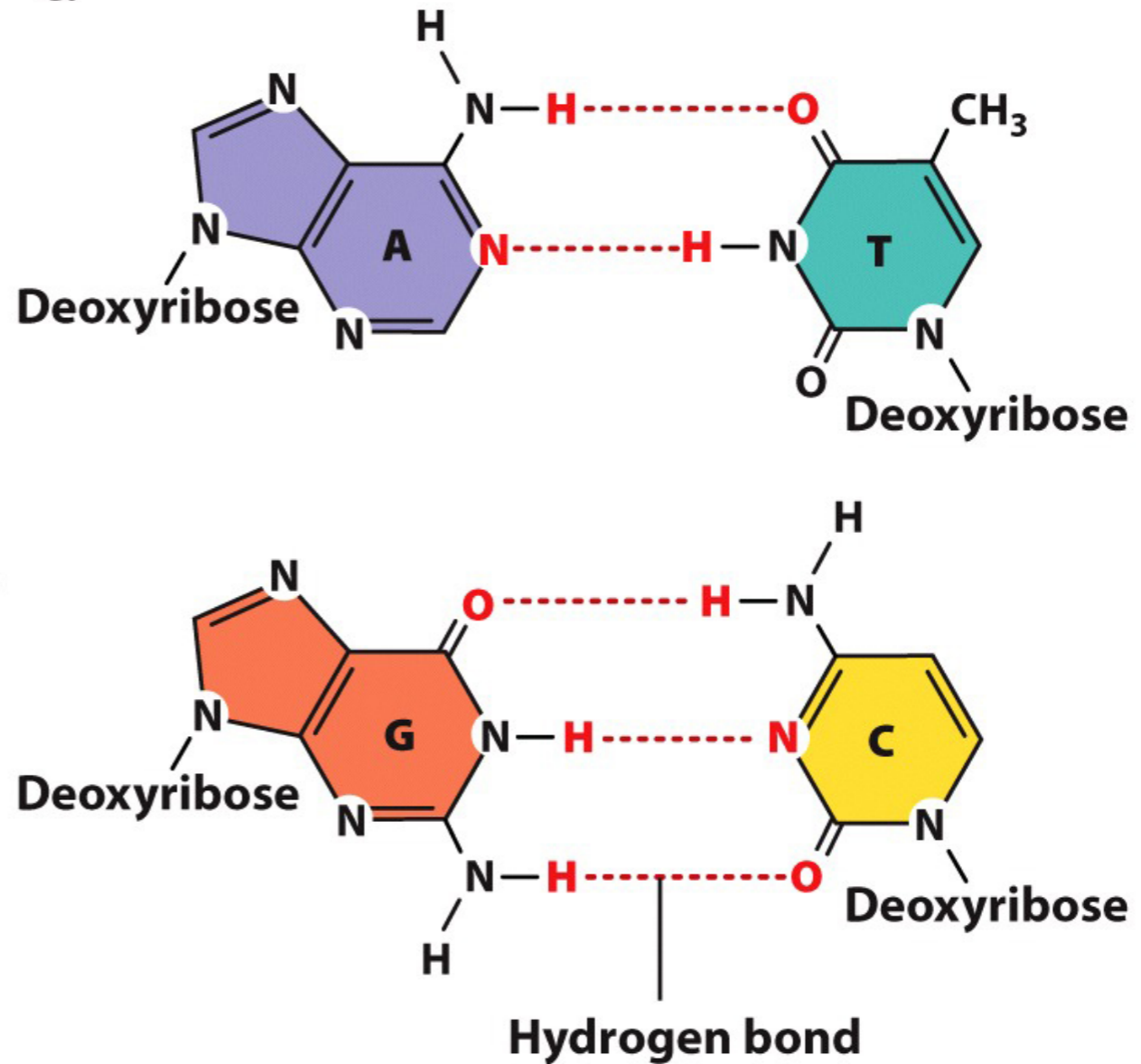


Figure 2.21

Biology: How Life Works

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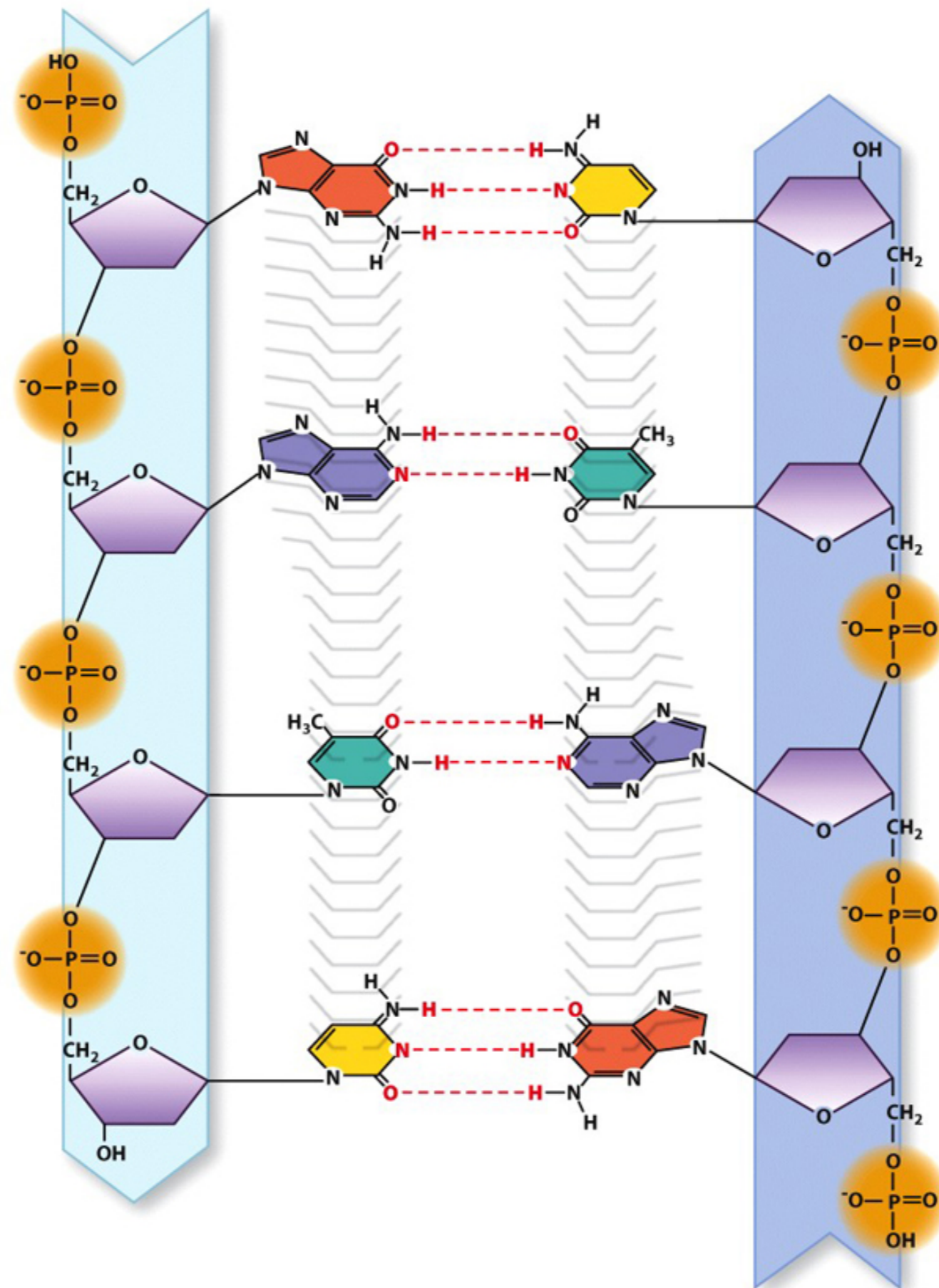


Figure 3.10
Biology: How Life Works
 © 2014 W. H. Freeman and Company

Stanford Report, October 17, 2007

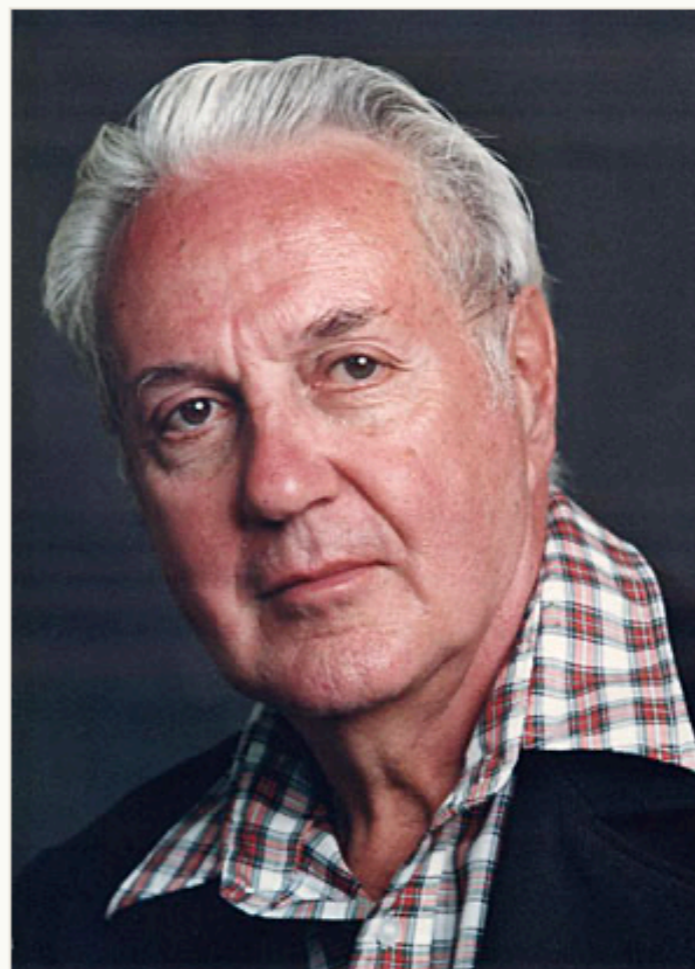
William Bonner, professor emeritus of chemistry, dead at 87

BY LOUIS BERGERON

William A. Bonner, professor emeritus of chemistry at Stanford University, died Oct. 1 at Cedar Crest Nursing and Rehabilitation Center in Sunnyvale, where he had been recuperating from heart failure. He was 87.

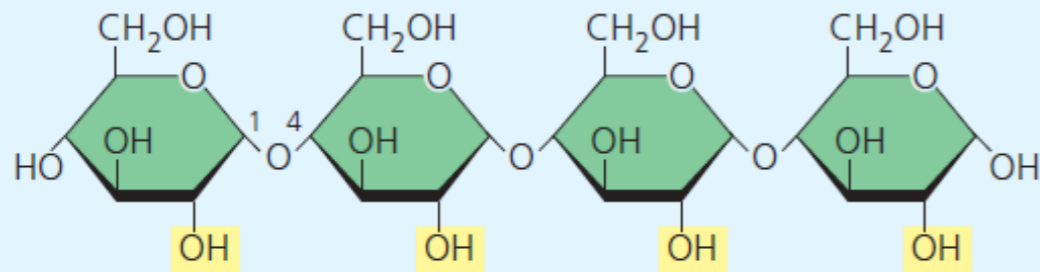
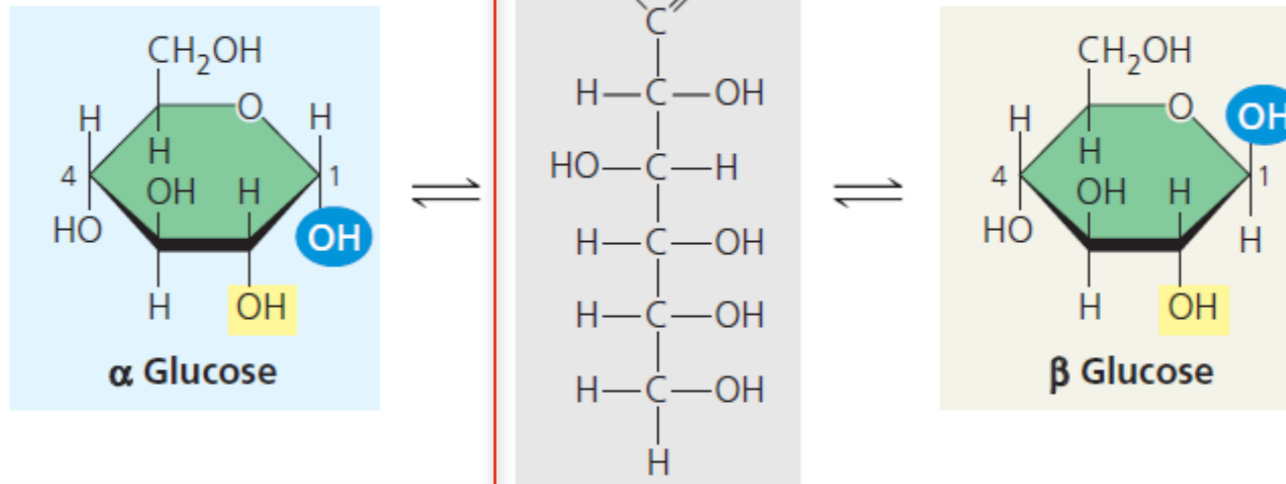
A member of the Stanford chemistry faculty for 37 years, his research interests centered on organic chemistry. In particular, he was intrigued with the question of how amino acids, the building blocks of proteins, developed the consistent structural asymmetry that enables proteins to fold themselves into the living structures that are the basis for all life on Earth.

Some organic molecules are asymmetric and characterized as either left-handed or right-handed, according to the orientation of the arrangement of atoms relative to the carbon core of the molecule. But while for most asymmetric molecules nature produces equal numbers of each orientation, the essential amino acids—and the proteins built of them—are almost exclusively left-handed. Why this should be so has puzzled scientists since its discovery.

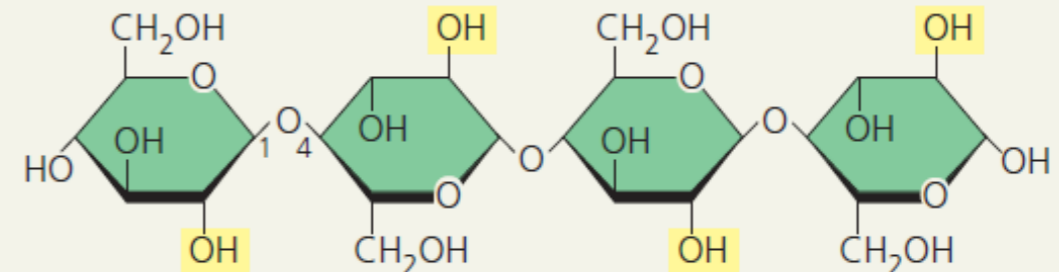


William Bonner

(a) **α and β glucose ring structures.** These two interconvertible forms of glucose differ in the placement of the hydroxyl group (highlighted in blue) attached to the number 1 carbon.



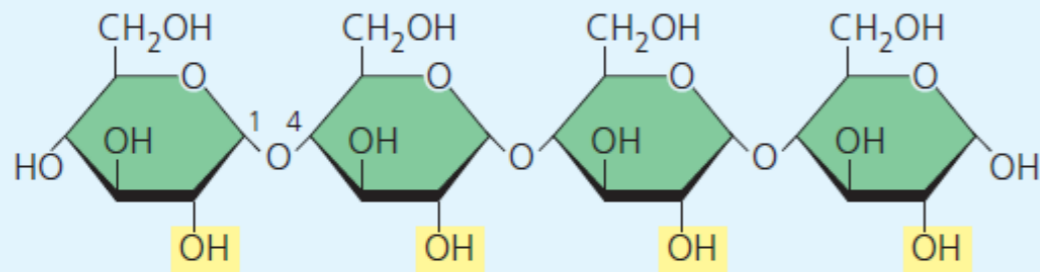
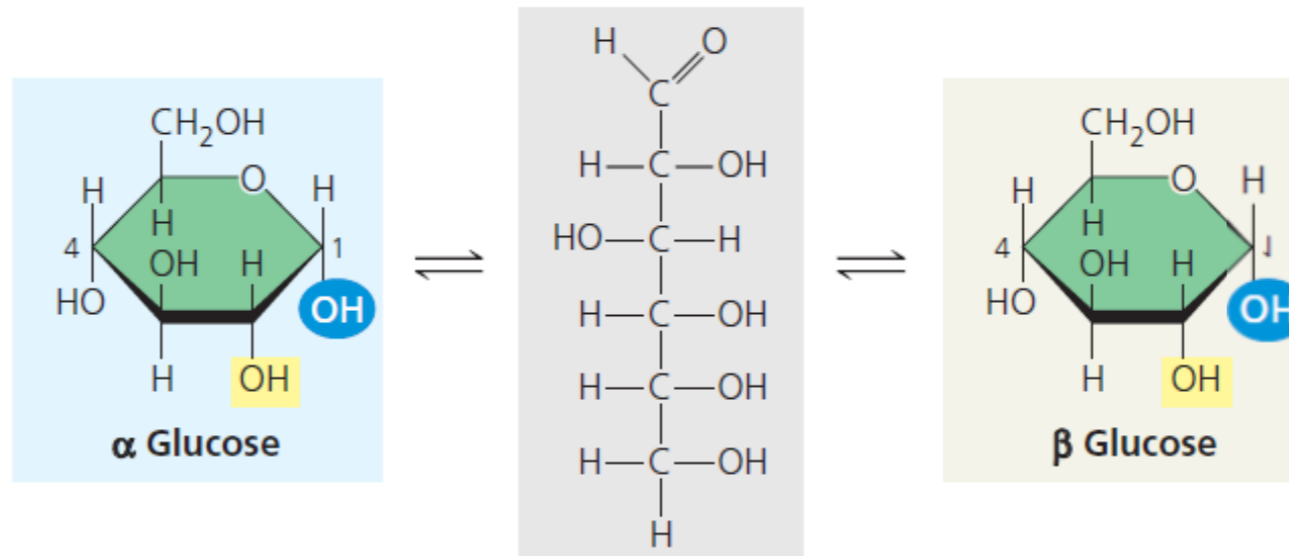
(b) **Starch: 1–4 linkage of α glucose monomers.** All monomers are in the same orientation. Compare the positions of the —OH groups highlighted in yellow with those in cellulose (c).



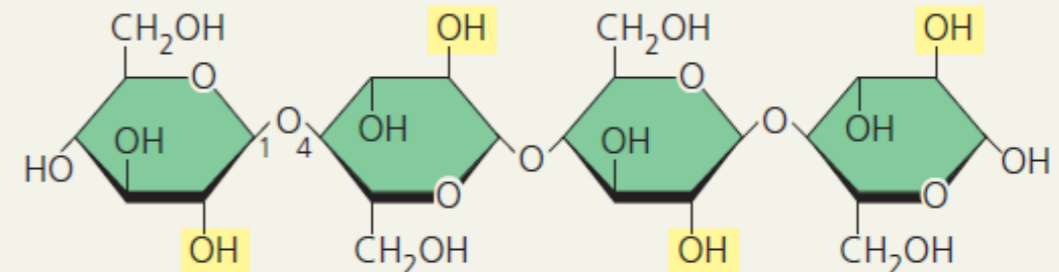
(c) **Cellulose: 1–4 linkage of β glucose monomers.** In cellulose, every β glucose monomer is upside down with respect to its neighbors. (See the highlighted —OH groups.)

▲ **Figure 5.7** Starch and cellulose structures.

(a) α and β glucose ring structures. These two interconvertible forms of glucose differ in the placement of the hydroxyl group (highlighted in blue) attached to the number 1 carbon.



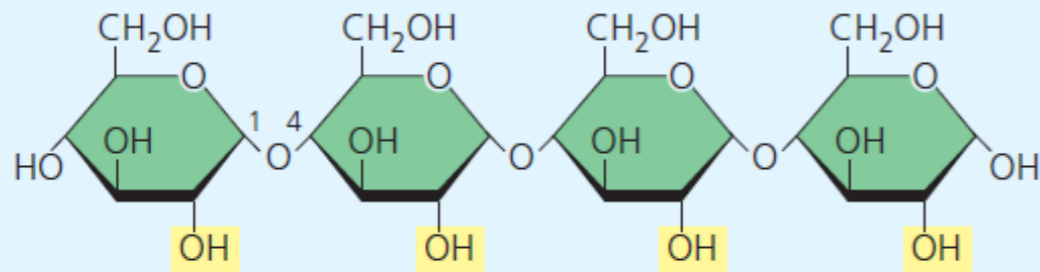
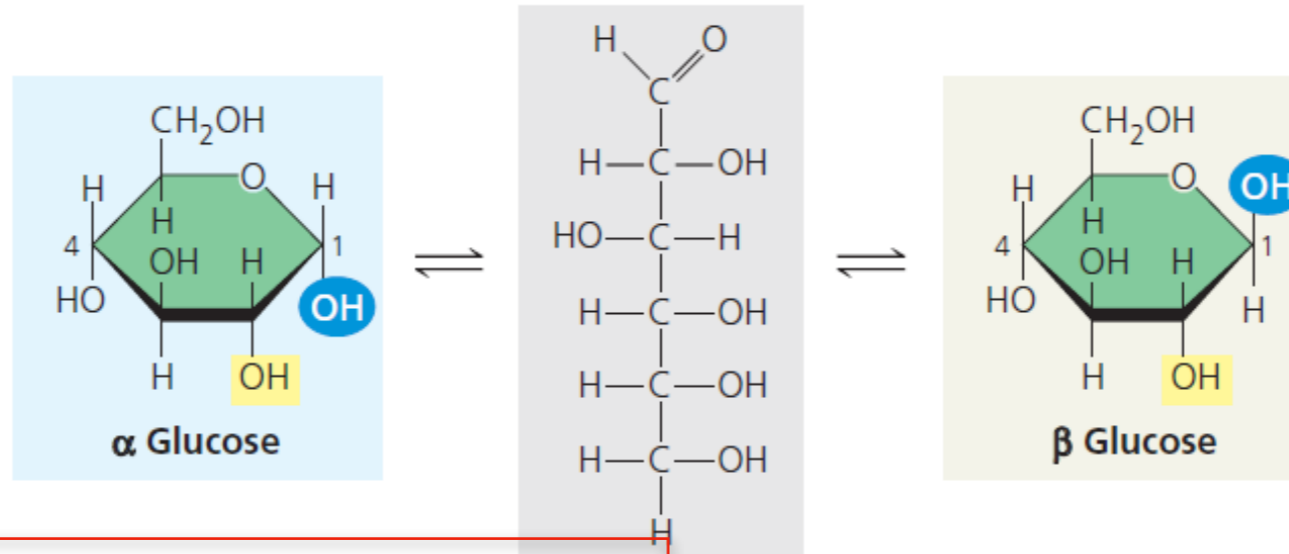
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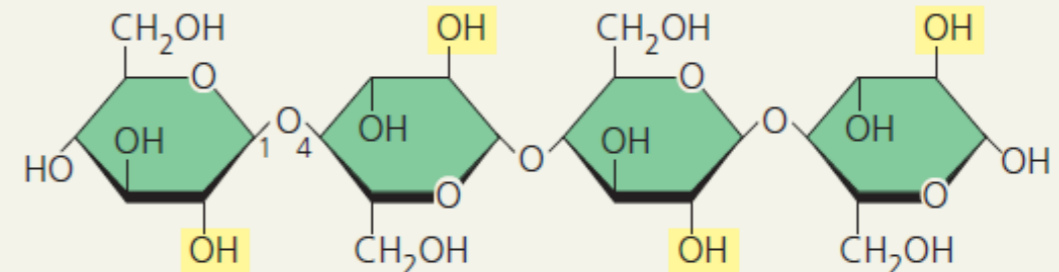
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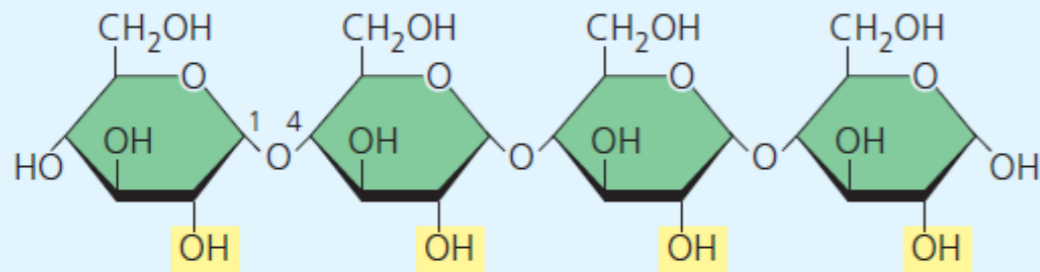
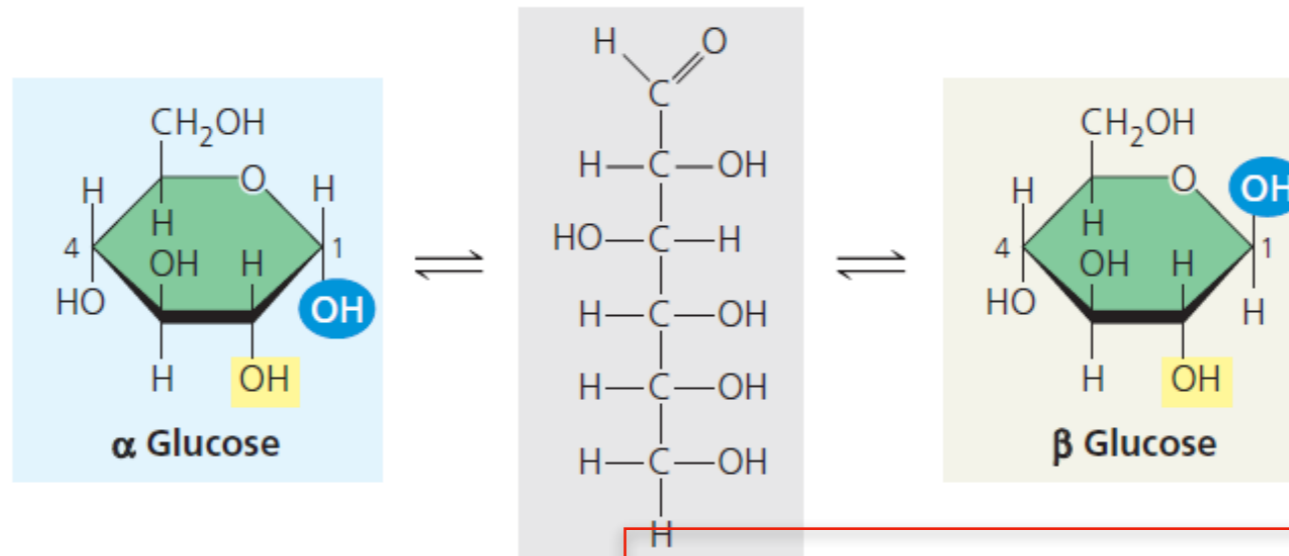
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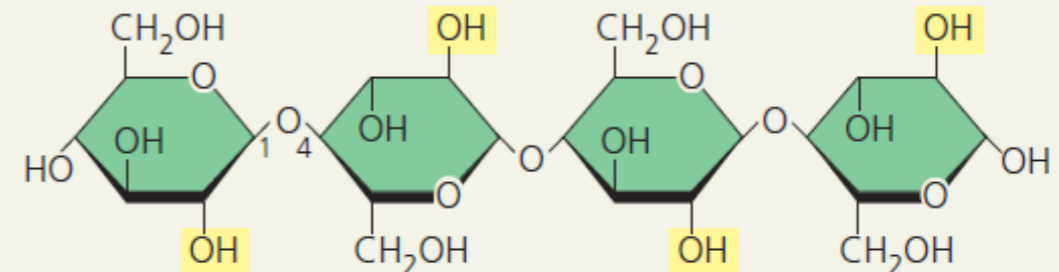
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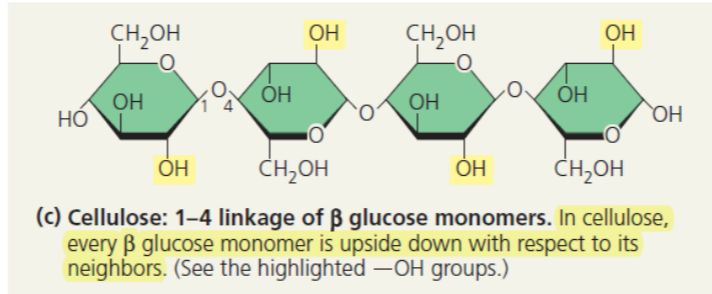
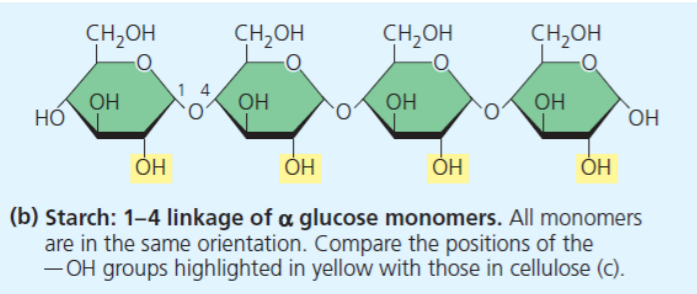
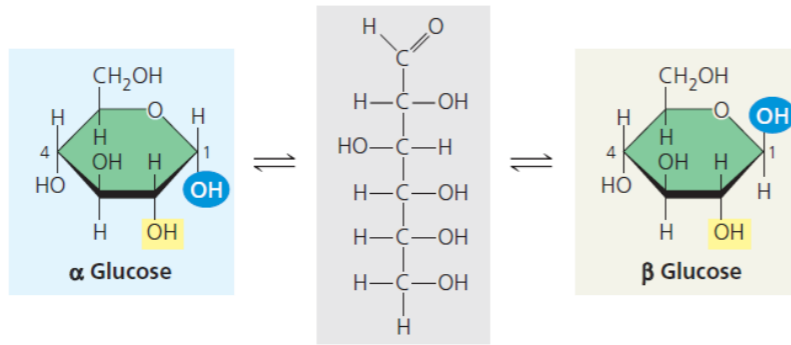
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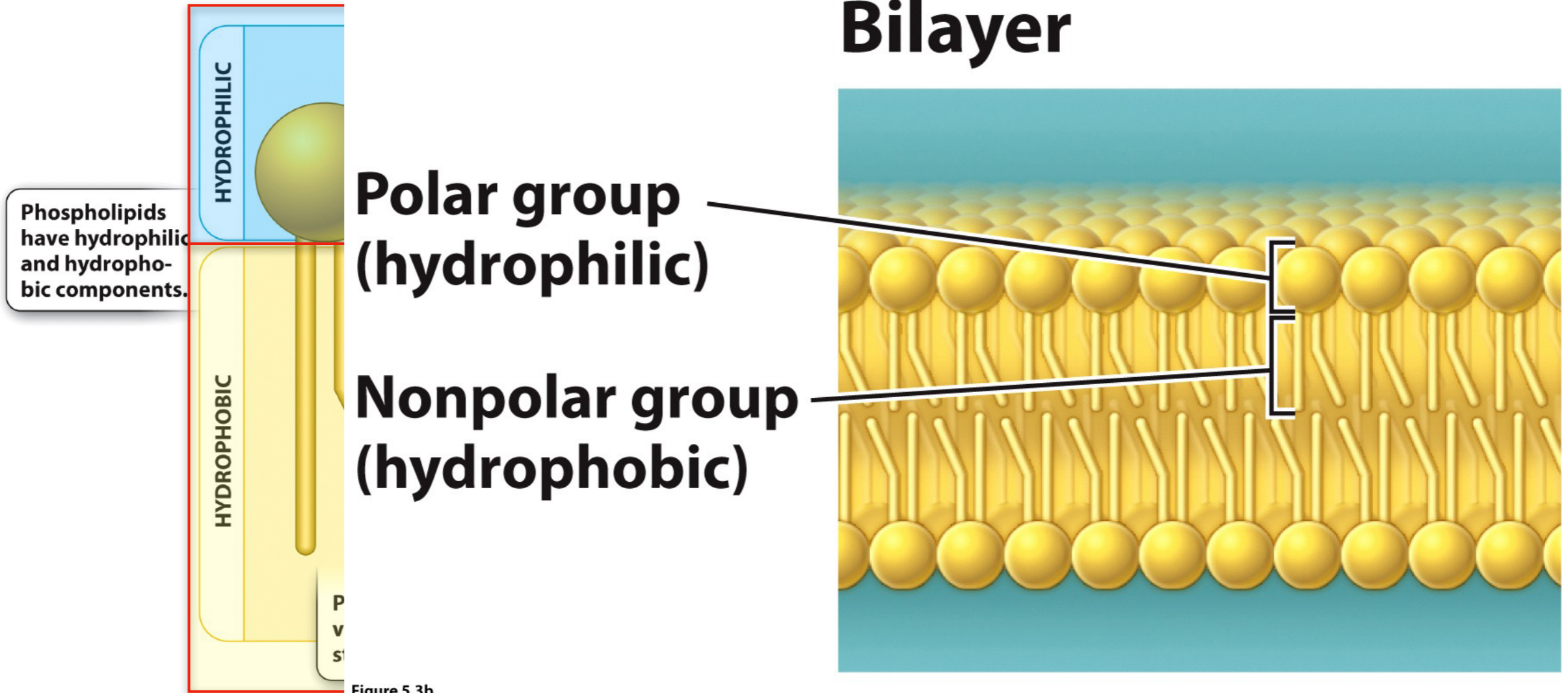
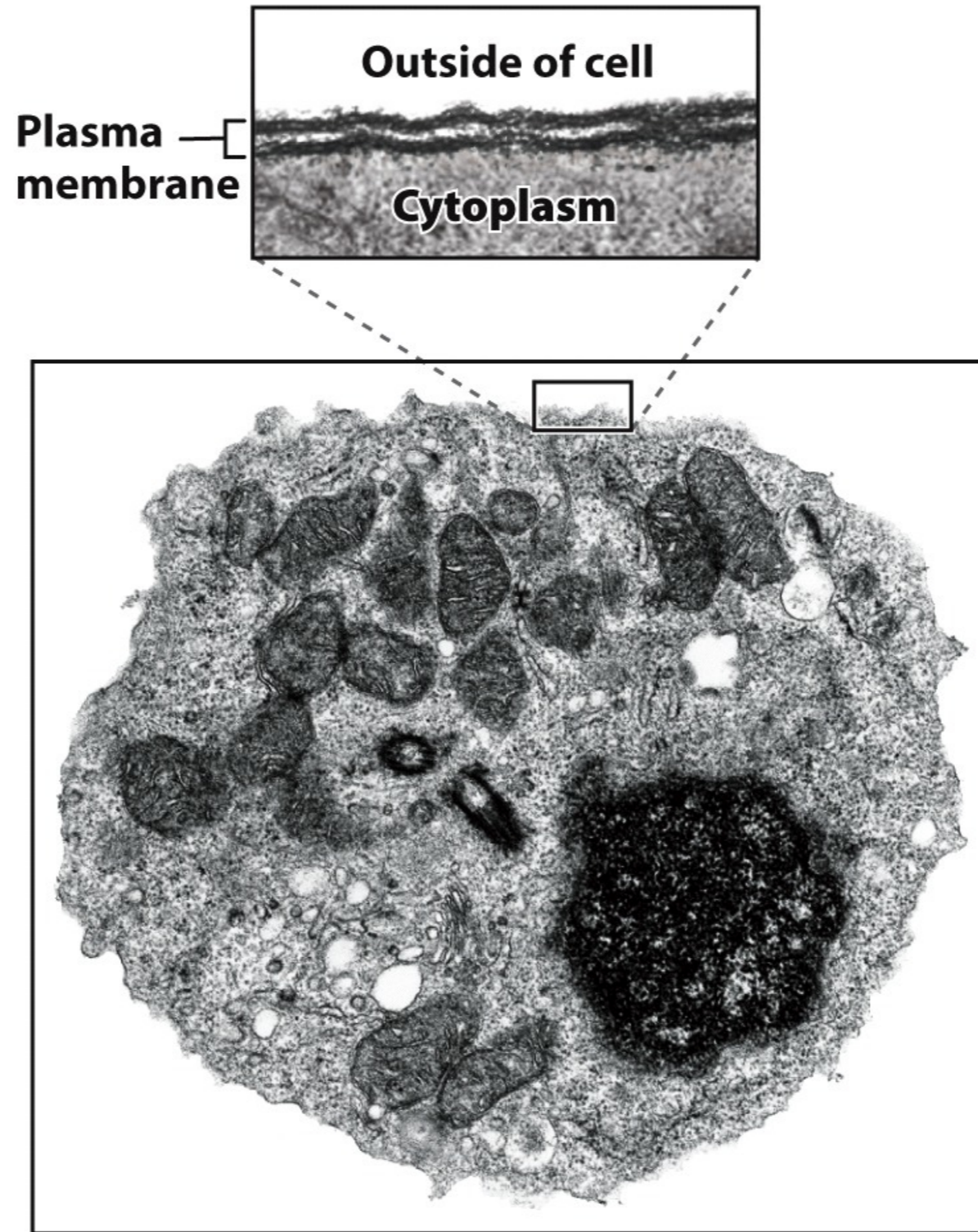


Figure 5.2
Biology: How Life Works
© 2014 W. H. Freeman and Company

Figure 5.3b
Biology: How Life Works
© 2014 W. H. Freeman and Company



Transmission electron micrograph of a cell

Figure 1.14
Biology: How Life Works
© 2014 W. H. Freeman and Company

Some of the “facts” of Life...?

- (a) Living organisms do exist -subject to the laws of chemistry and physics,
- (b) One of the central characteristics of living organisms (but clearly not the only one, is the presence and maintenance of some type of reproducible boundary.
- (c) the very act of living requires energy. But according to the "laws of physics.....energy can neither be created nor destroyed", so.....
- (d) to survive -at least in our world- living organisms use organic elements..."CHONPS " to effectively cycle and recycle the available energy in all its forms.....at the expense of the local environment.

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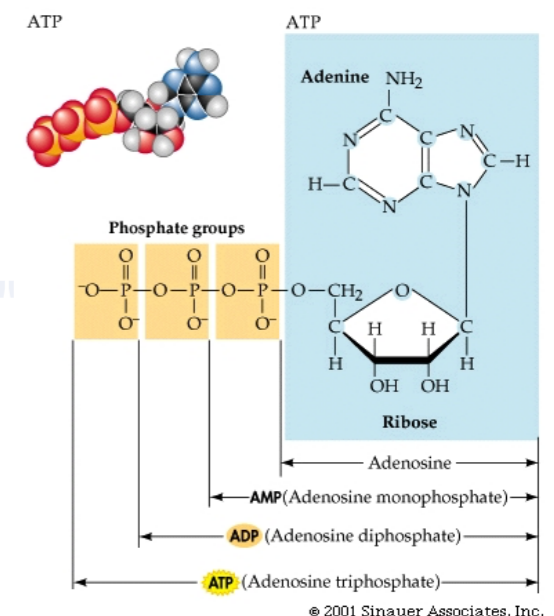
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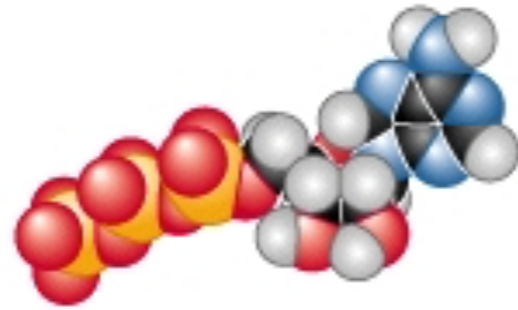
(c) the very act of living requires energy. But according to the "laws of physics.....energy can **neither be created nor destroyed**", so.....

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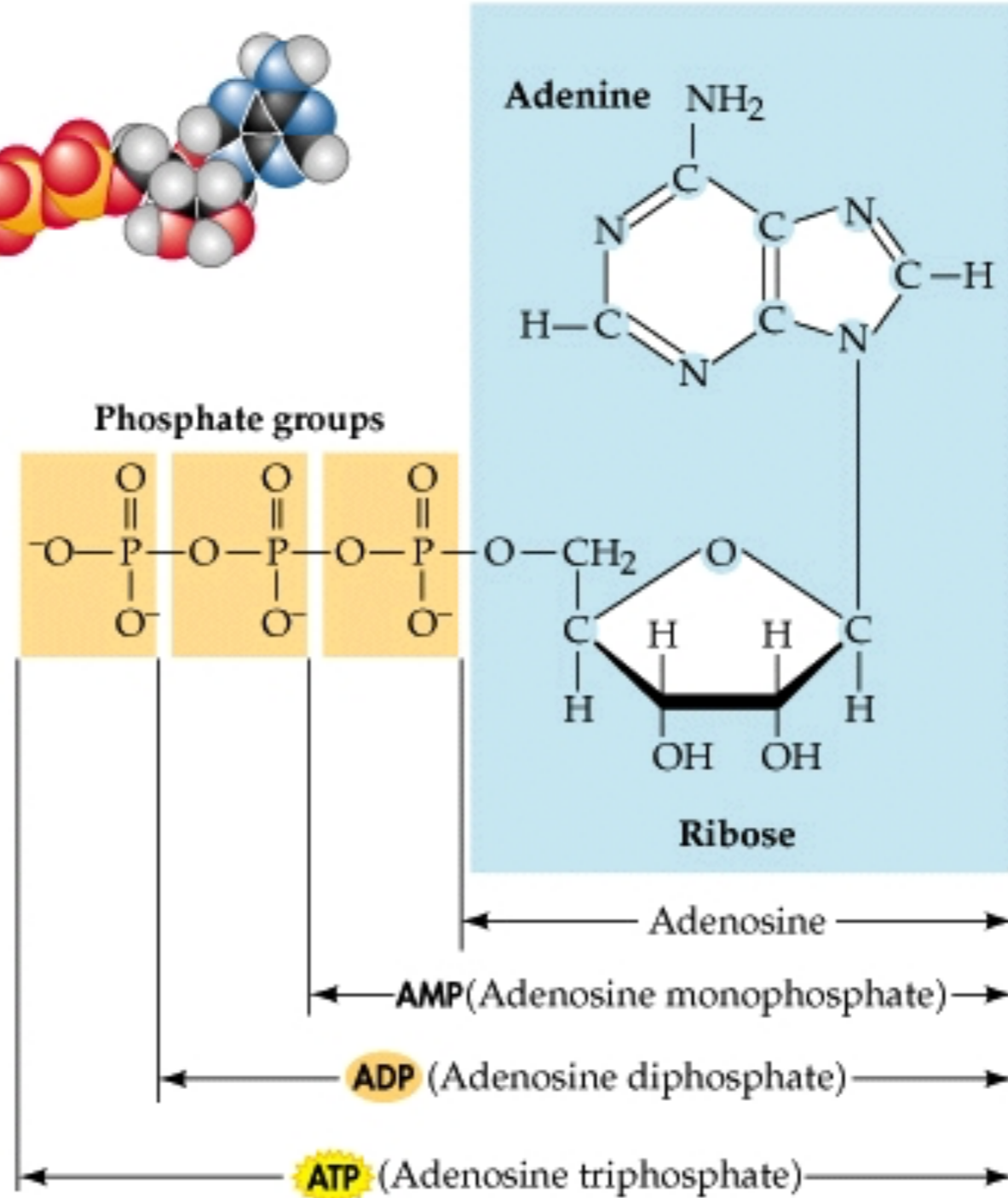
(e) Paradoxically, as a consequence of all these "requirements" suggest that a single living organism cannot exist (for any protracted length of time) by itself... ?



ATP



ATP



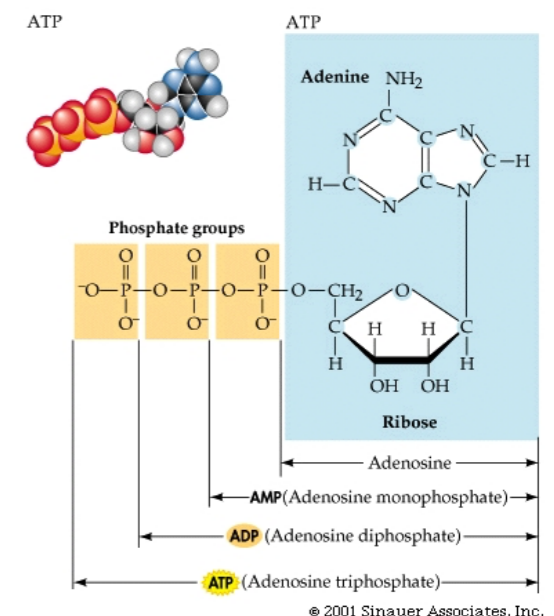
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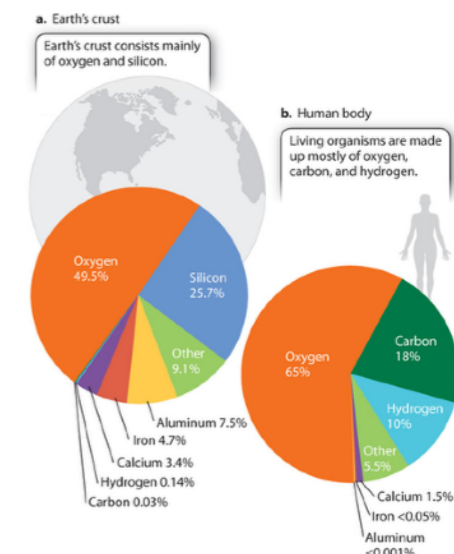
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Some of the “facts” of Life...?

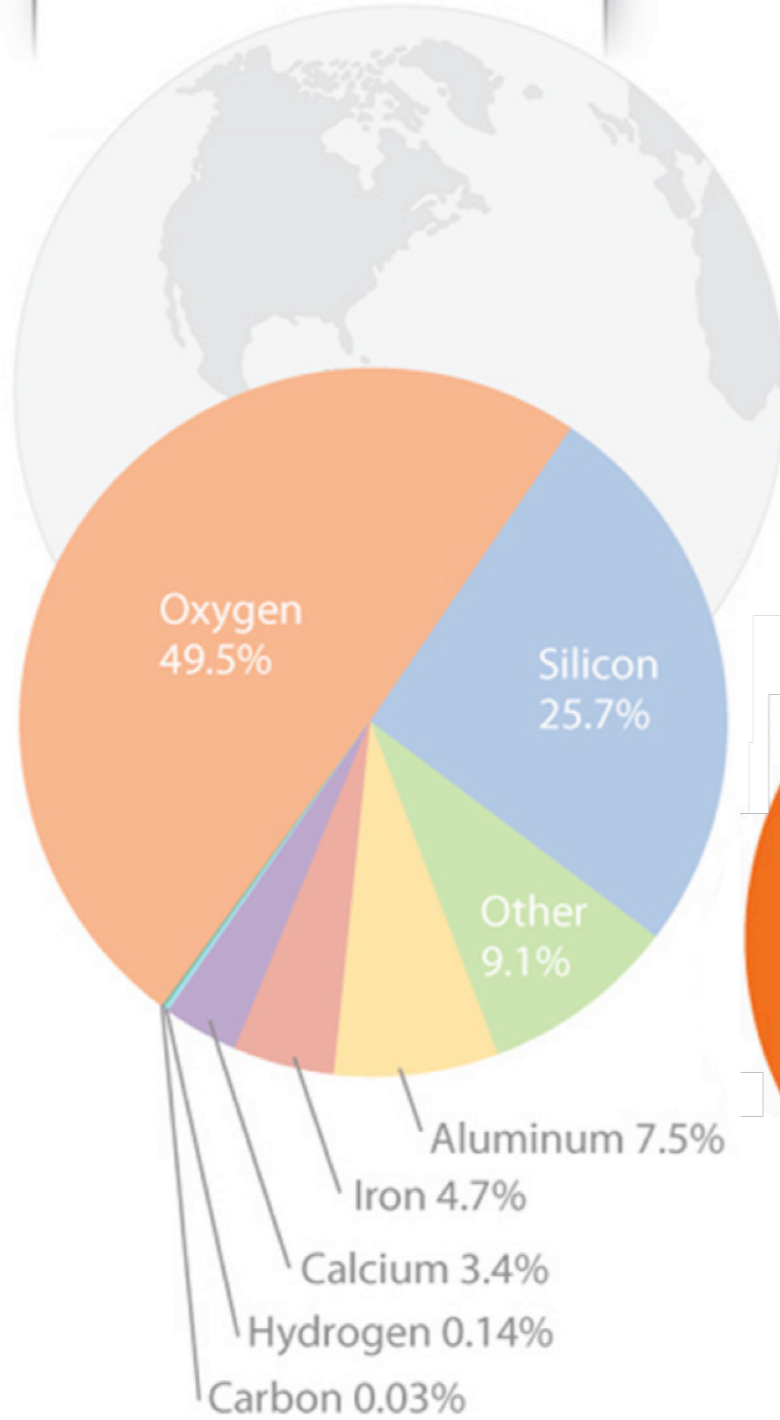
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“Life” is the ultimate capitalist.



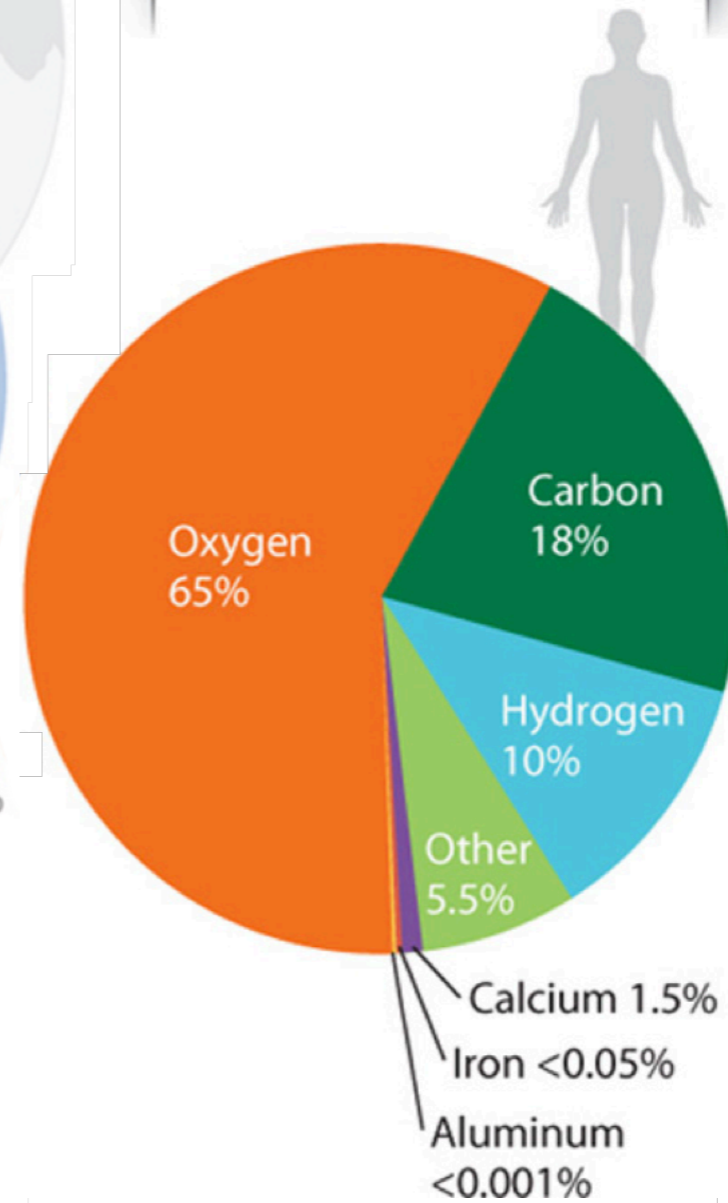
a. Earth's crust

Earth's crust consists mainly of oxygen and silicon.



b. Human body

Living organisms are made up mostly of oxygen, carbon, and hydrogen.



Some of the “facts” of Life...?

(a) Living organisms do exist -subject to the laws of chemistry and physics,

(b) One of the central characteristics of living organisms (but clearly not the only one, is the presence and maintenance of some type of reproducible boundary.

(c) the very act of living requires energy. But according to the "laws of physics.....energy can neither be created nor destroyed", so.....

(d) to survive -at least in our world- living organisms use organic elements..."CHONPS " to effectively cycle and recycle the available energy in all its forms.....at the expense of the local environment.

(e) Paradoxically, as a consequence of all these "requirements", I would suggest that a single living organism cannot exist (for any protracted length of time) by itself... ?



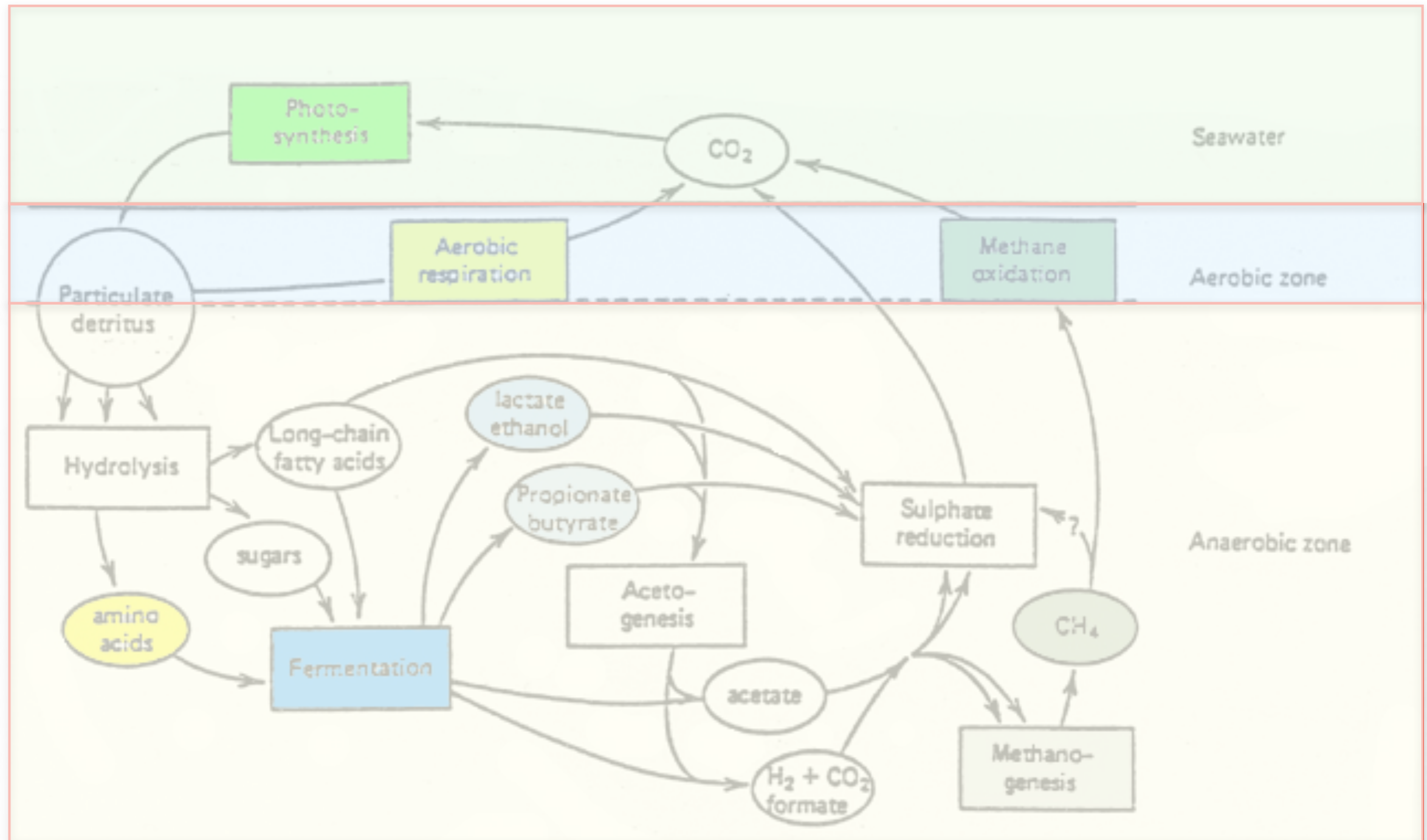


FIGURE 27.2

Degradation and cycling of organic matter in sediments in relation to bacterial sulphate reduction and methanogenesis. After T. H. Blackburn, "The Microbial Nitrogen Cycle," in Krumbein, W. E., ed., *Microbial Geochemistry*, Boston: Blackwell Publications (1983).



Gaia hypothesis.... ?

*...But what am I that dare
Fancy that I can
Better conduct myself or have more
Sense than a common man?*

William Butler Yeats "Stream and Sun at Glendalough"

The Scientific Method...

The **scientific method** is an empirical method of acquiring knowledge that has characterized the development of science since at least the 17th century (with notable practitioners in previous centuries). It involves careful observation, applying rigorous skepticism about what is observed, given that cognitive assumptions can distort how one interprets the observation. It involves formulating hypotheses, via induction, based on such observations; experimental and measurement-based statistical testing of deductions drawn from the hypotheses; and refinement (or elimination) of the hypotheses based on the experimental findings. These are *principles* of the scientific method, as distinguished from a definitive series of steps applicable to all scientific enterprises.^{[1][2][3]}





Biology -as a Scientific discipline- is ultimately a "truth-seeking process"...

It's assertions, however,
are NOT a collection of unassailable "truths".

Moreover, these "truths" can often be transitory...

US

CDC Changes Its Mind Again: CO~~X~~-VID-19 Is “Sometimes” Airborne

 The Washington Standard /  October 7, 2020

1
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Science

Because the Centers for Disease Control and Prevention cannot just give a straight answer or provide people with the truth, they have said the “smartest virus on Earth” is sometimes airborne. COVID-19 is apparently, not always airborne, but it can be.

If this makes no sense to you, you're not alone. The agency is once again claiming that the coronavirus can be airborne, but that it is not the main method of transmission. This is from a mainstream media source, and even they are feeling like this is a mixed message:

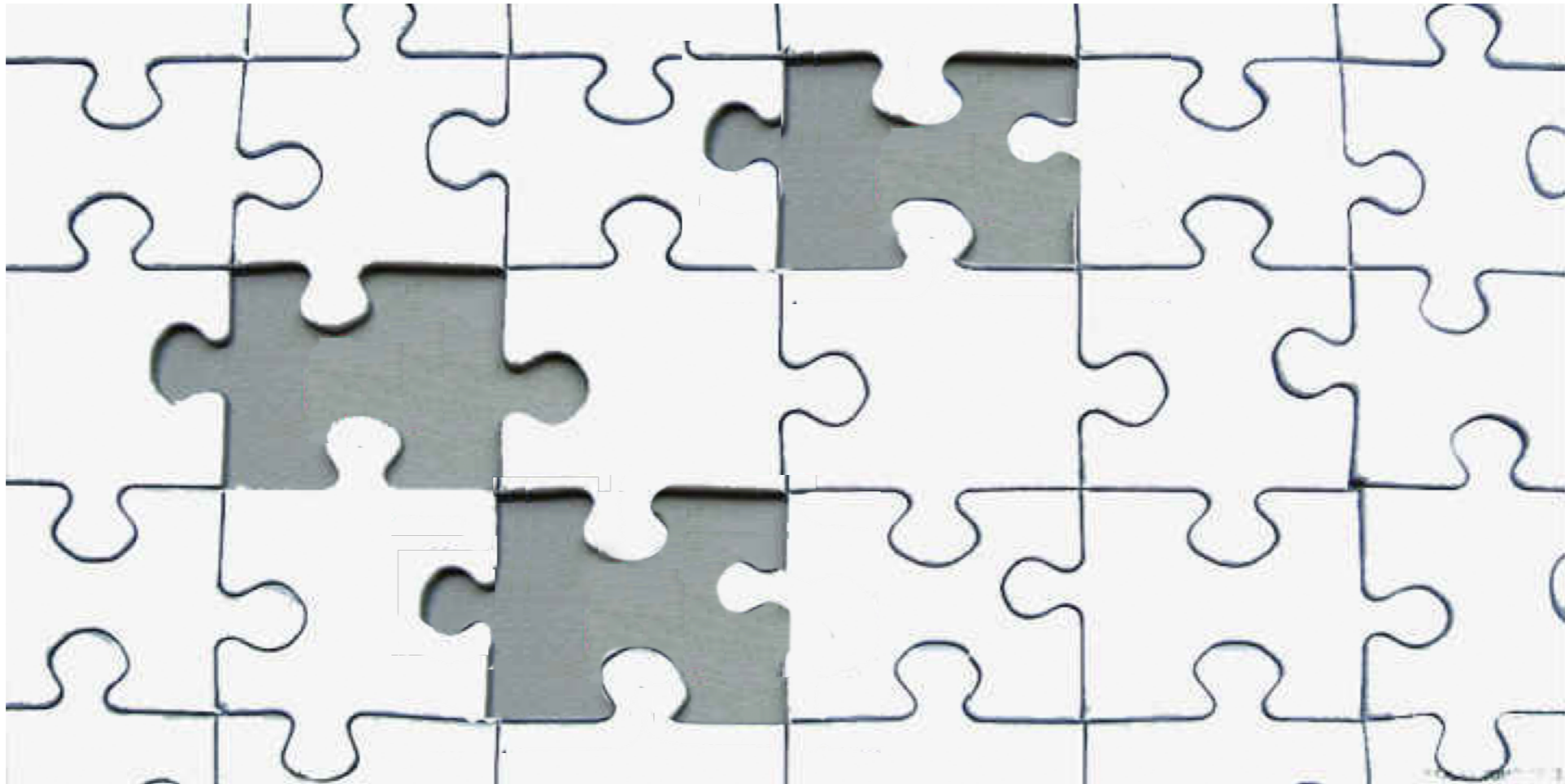
For the third time in less than a month, the Centers for Disease Control and Prevention has altered its guidance on how Covid-19 spreads. The agency said Monday that airborne transmission is possible, but that it's not the most common way the virus travels from person to person – a position that was published and then removed from its website in September. –NBC News

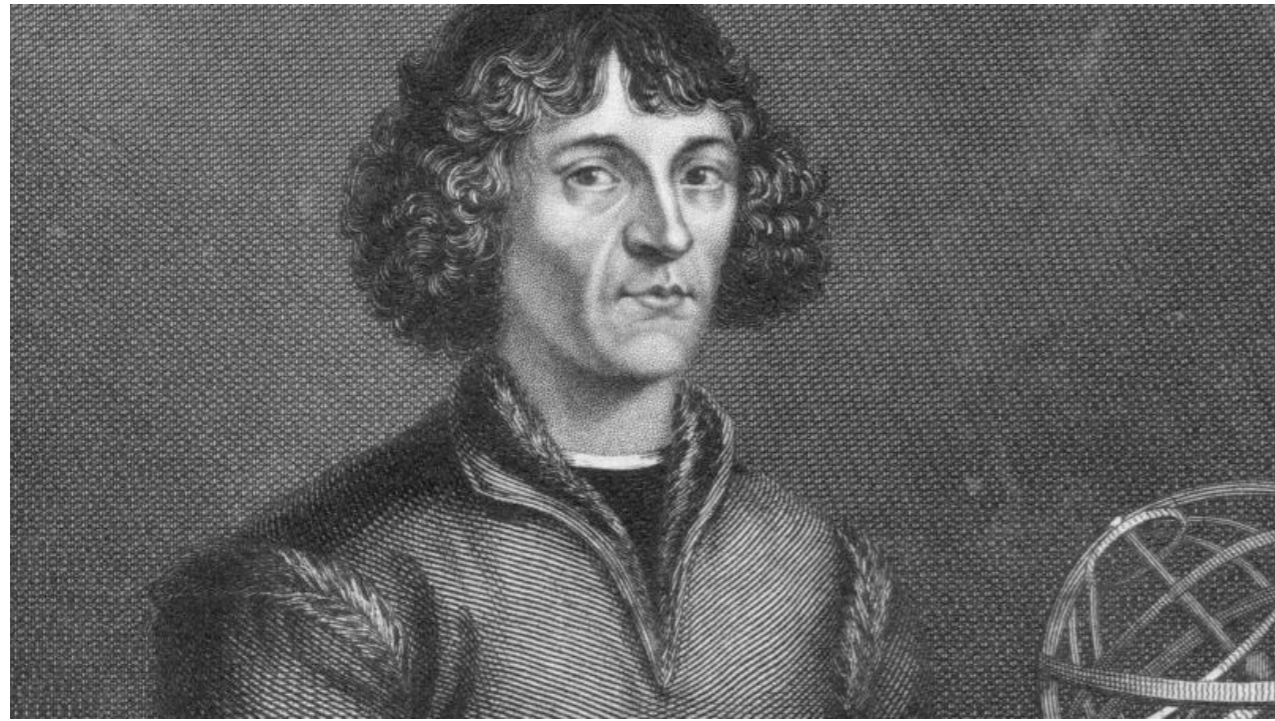
PHASE : INTERPRETATION
TWO :

SEIDMAN with Ledger



Science vs. Religion ?





Copernicus (1543) A 'Perfect Heaven', but the Sun, not the earth, is at it's centre

Galileo is convicted of heresy, 1633



NEW RESEARCH IN

Physical Sciences

Social Sciences

Biological Sciences

EDITORIAL

Science, evolution, and creationism

Francisco J. Ayala

PNAS January 8, 2008 105 (1) 3-4; <https://doi.org/10.1073/pnas.0711608105>

Article

Info & Metrics

PDF

On December 20, 2005, John E. Jones III, federal judge for the Middle District of Pennsylvania, issued a 130-page-long decision (*Kitzmiller v. Dover Area School District*) declaring that “The overwhelming evidence at trial established that ID [intelligent design] is a religious view, a mere re-labeling of creationism, and not a scientific theory ... ID is not supported by any peer-reviewed research, data, or publications.”

In 1984, the National Academy of Sciences (NAS) published *Science and Creationism: A View from the National Academy of Sciences*. A second edition was published in 1999. A third edition, sufficiently modified to deserve a new title, *Science, Evolution, and Creationism*, published on January 4, 2008 (1).

Science and Creationism was prepared by a committee of the NAS in response to statutes passed by the legislatures of, first, the state of Arkansas, and shortly thereafter, the state of Louisiana, that required that “creation science” be taught in public schools together with evolution. The Louisiana “Creation Act” was appealed all the way to the U.S. Supreme Court, which in 1987 (*Edwards v. Aguillard*) concluded that the act’s “primary purpose was to change the public school science curriculum to provide persuasive advantage to a particular religious doctrine that rejects the factual basis of evolution in its entirety. Thus, the Act is designed either to promote the theory of creation science that embodies a particular religious tenet or to prohibit the teaching of a scientific theory disfavored by certain religious sects. In either case, the Act violates the First Amendment” (1, p. 45). *Science and Creationism* was made part of an “amicus brief” submitted to the Supreme Court in *Edwards v. Aguillard* by the NAS, with the endorsement of the American Association for the Advancement of Science and other organizations.



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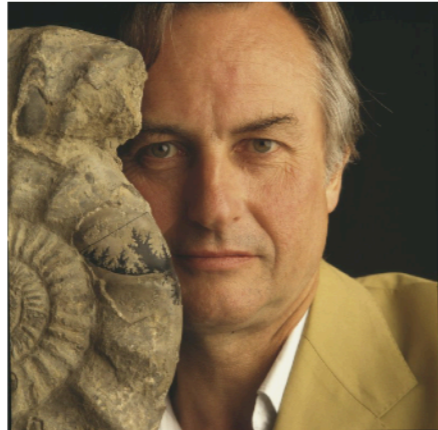
Article

- Argument from Design
- Evolution and Natural Selection
- Evolution and Religion
- Footnotes
- References

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Is Science a Religion? – Richard Dawkins



Is Science a Religion? – [Richard Dawkins](#)

The following article was first published in the *Humanist*, January/February 1997.

It is fashionable to wax apocalyptic about the threat to humanity posed by the AIDS virus, “mad cow” disease, and many others, but I think a case can be made that *faith* is one of the world’s great evils, comparable to the smallpox virus but harder to eradicate.

Faith, being belief that isn’t based on evidence, is the principal vice of any religion.

And who, looking at Northern Ireland or the Middle East, can be confident that the brain virus of faith is not exceedingly dangerous? One of the stories told to the young Muslim suicide bombers is that martyrdom is the quickest way to heaven — and not just heaven but a special part of heaven where they will receive their special reward of 72 virgin brides. It occurs to me that our best hope may be to provide a kind of “spiritual arms control”: send in specially trained theologians to deescalate the going rate in virgins.

Given the dangers of faith — and considering the accomplishments of reason and observation in the activity called science — I find it ironic that, whenever I lecture publicly, there always seems to be someone who comes forward and says, “Of course, your science is just a religion like ours. Fundamentally, science just comes down to faith, doesn’t it?”

Well, science is not religion and it doesn’t just come down to faith. Although it has many of religion’s virtues, it has none of its vices. Science is based upon verifiable evidence. Religious faith not only lacks evidence, its independence from evidence is its pride and joy, shouted from the rooftops. Why else would Christians wax critical of doubting Thomas? The other apostles are held up to us as exemplars of virtue because faith was enough for them. Doubting Thomas, on the other hand, required evidence. Perhaps he should be the patron saint of scientists.

One reason I receive the comment about science being a religion is because I believe in the fact of evolution. I even believe in it with passionate conviction. To some, this may superficially look like faith. But the evidence that makes me believe in evolution is not only overwhelmingly strong; it is freely available to anyone who takes the trouble to read up on it. Anyone can study the same evidence that I have and presumably come to the same conclusion. But if you have a belief that is based solely on faith, I can’t examine your reasons. You can retreat behind the private wall of faith where I can’t reach you.

Now in practice, of course, individual scientists do sometimes slip back into the vice of faith, and a few may believe so single-mindedly in a favorite theory that they occasionally falsify evidence. However, the fact that this sometimes happens doesn’t alter the principle that, when they do so, they do it with shame and not with pride. The method of science is so designed that it usually finds them out in the end.

The Scientific Method...

The **scientific method** is an empirical method of acquiring knowledge that has characterized the development of science since at least the 17th century (with notable practitioners in previous centuries). It involves careful observation, applying rigorous skepticism about what is observed, given that cognitive assumptions can distort how one interprets the observation. It involves formulating hypotheses, via induction, based on such observations; experimental and measurement-based statistical testing of deductions drawn from the hypotheses; and refinement (or elimination) of the hypotheses based on the experimental findings. These are *principles* of the scientific method, as distinguished from a definitive series of steps applicable to all scientific enterprises.^{[1][2][3]}



A Scientific Law is "a descriptive generalization about how some aspect of the natural world behaves.... under stated circumstances".

A Scientific Hypothesis is a "working assumption based upon observations" that can be tested.

A Scientific Theory is "an explanation of some natural phenomenon(a) that can incorporate facts, laws, inferences, and **tested hypotheses** to provide a conceptual framework that, **both** explains existing observations, **AND** predicts new ones -that are also able to be tested".

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The **Scientific Method** is founded upon two different logical approaches to resolve questions.

Collecting and analyzing observations can lead to important conclusions based on a type of logic called **inductive reasoning**.

Through induction, we derive generalizations from a large number of specific observations. The generalization “All organisms are made of cells” was based on two centuries of microscopic observations made by biologists examining cells in diverse biological specimens. Careful observations and data analyses, along with the generalizations reached by induction, are fundamental to our understanding of nature.

Inductive logic: A type of logic in which generalizations are based on a large number of specific observations

Deductive logic: A type of logic in which specific results are predicted from specific observations and / or a more “general” premise.

This type of logic was promoted by Aristotle in Ancient Greece.

This **Scientific Method**, itself, is ultimately predicate on two fundamental components...

(a) the use of logic -promoted by Aristotle in Ancient Greece, and

(b) a Russian proverb:

"Doveryai no Proveryai".

borrowed (with some effect) by **Ronald Reagan** in the '80's

As a logical argument, the Aristotelian form of logic or “syllogism” presents a

(a) major premise, (b) minor premise, (c) conclusion.

A syllogism is almost like a format of poetry, a Limerick or Haiku, if we were to compare it to poetry.

The major premise: the general statement of the argument is expressed.

The minor premise: states an example or supporting detail for why the major premise is a fact or might be a fact.

The conclusion: should extend from some conclusion of the major and minor premises.

Major premise: $A = B$

Minor premise: $B = C$

Conclusion: Therefore $A = C$

For the syllogism to be accepted as true, the first two premises must be **true statements** and must be proven to be so.

Unlike in Maths, two negatives do NOT equal a positive in syllogisms.

As a logical argument, the Aristotelian form of logic or “syllogism” presents a

(a) major premise, (b) minor premise, (c) conclusion.

A “syllogism” is almost like a format of poetry: a Limerick or Haiku -if we were to compare it to poetry.

There was an old man from <u>Nantucket</u> ,	Major Premise
Who kept all his cash in a <u>bucket</u> .	
But his daughter, named “ <u>Nan</u> ”,	Minor Premise
Ran away with a <u>man</u> ,	
...and as for the bucket, Nan “ <u>took it</u> ”.	Conclusion

A common form of “deductive reasoning” uses the concept of a conditional or hypothetical statement.

If it rains, then the sidewalks will become wet.

It is raining.

Therefore, the sidewalks are wet.

Be wary of “circular argument” manifesting as logical arguments, in which the conclusion turns out to be part of the premise.

Why is counterfeiting illegal?

I'll tell you why.

It is because it is wrong, and its against the law!



2003 - 2016

Scientist makes an Observation



Scientist has an idea:



Scientist Refines this idea into a(n) hypothesis.
an idea that is... **testable**



TESTED



Scientist makes a **prediction?**



Scientist Designs an experiment as to how to test the **hypothesis**



and **TESTS** the hypothesis?

...**Collects** the data.



...**Analyzes** the data.

Scientist Decides how he/she will know whether **data** supports or does not support the hypothesis.



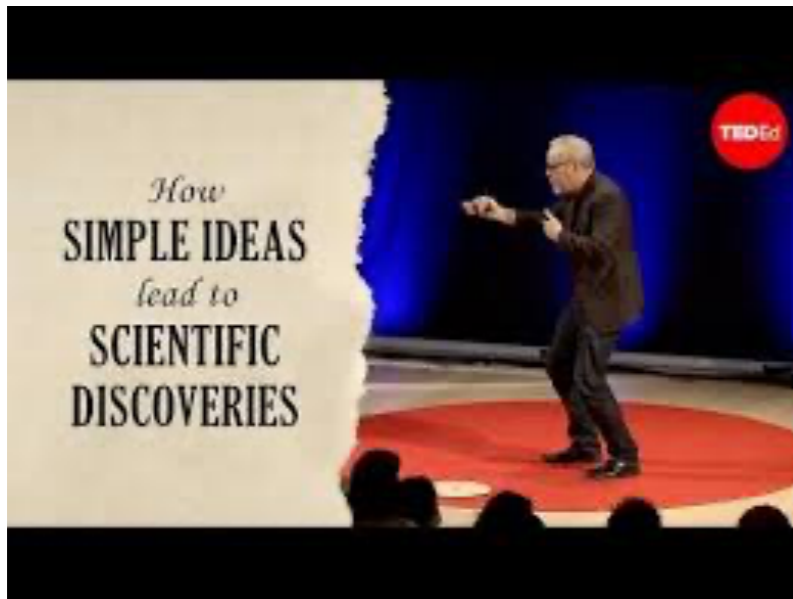
makes **observation(s)**...



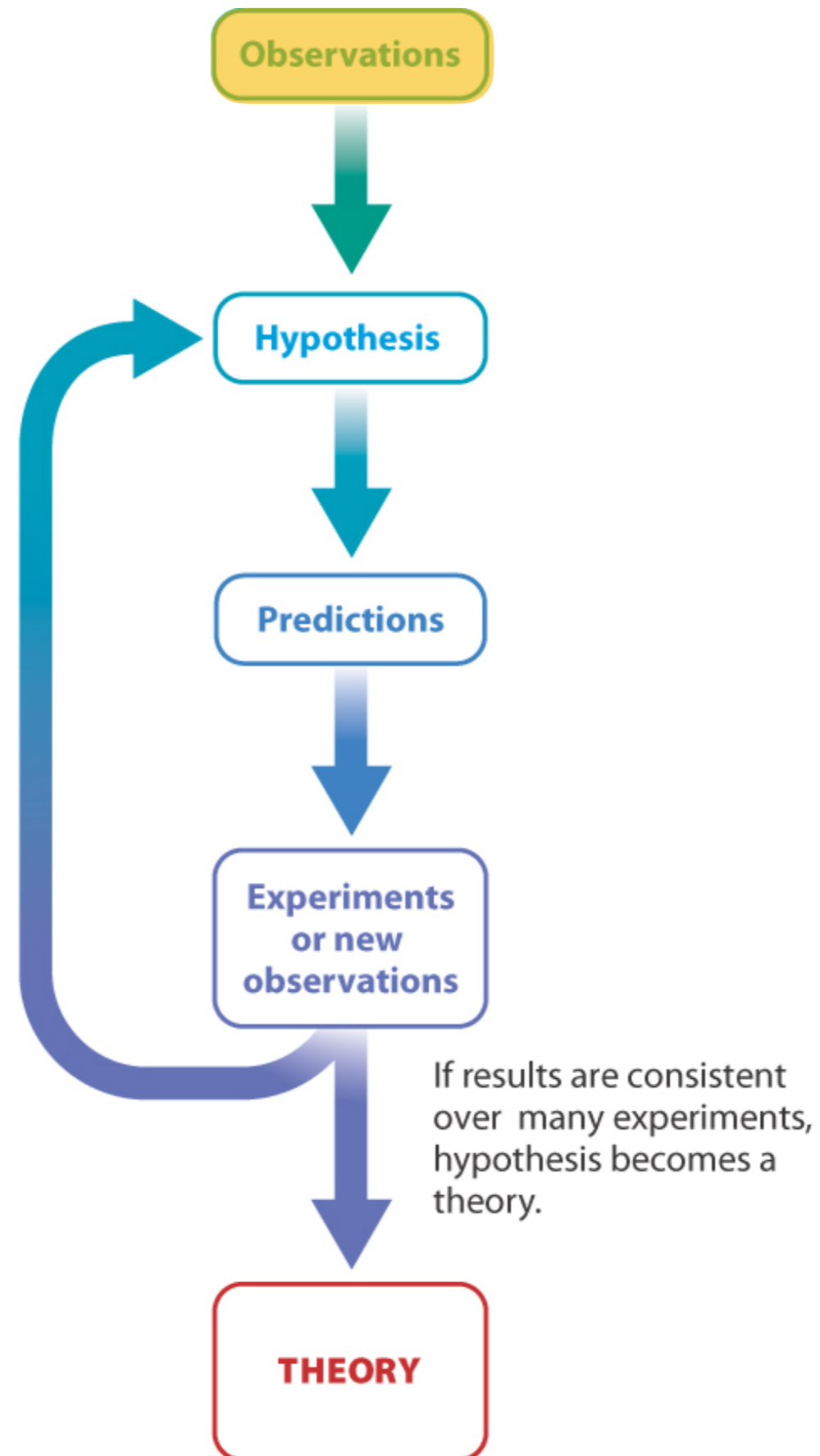
... derives a more "refined" **hypothesis**.



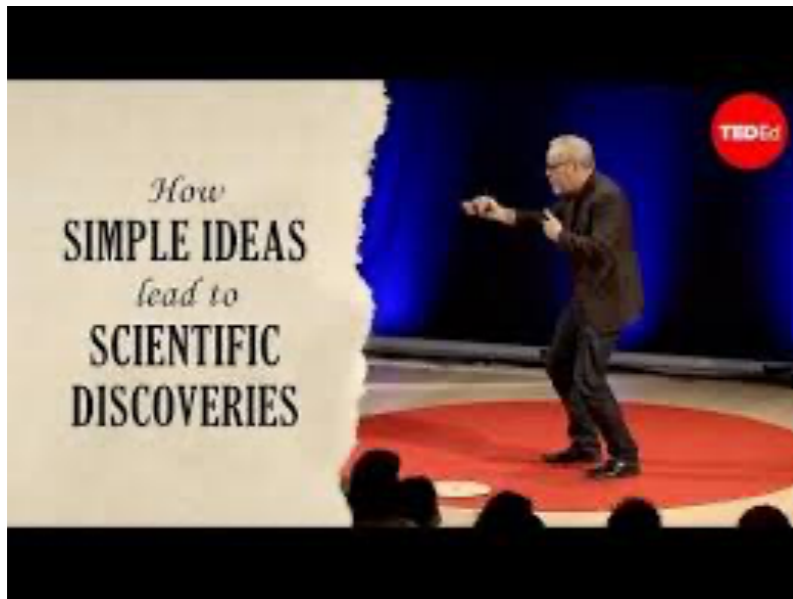
Scientific Method /approach



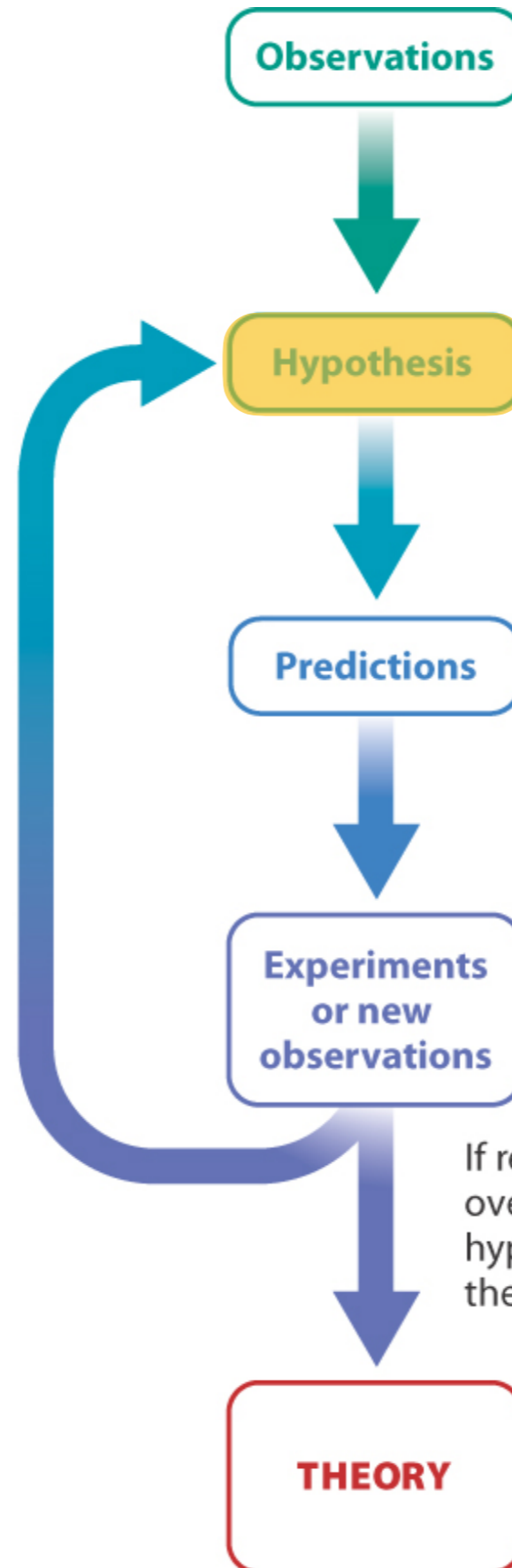
If results are not consistent, reject or revise hypothesis.



Scientific Method /approach



If results are not consistent, reject or revise hypothesis.



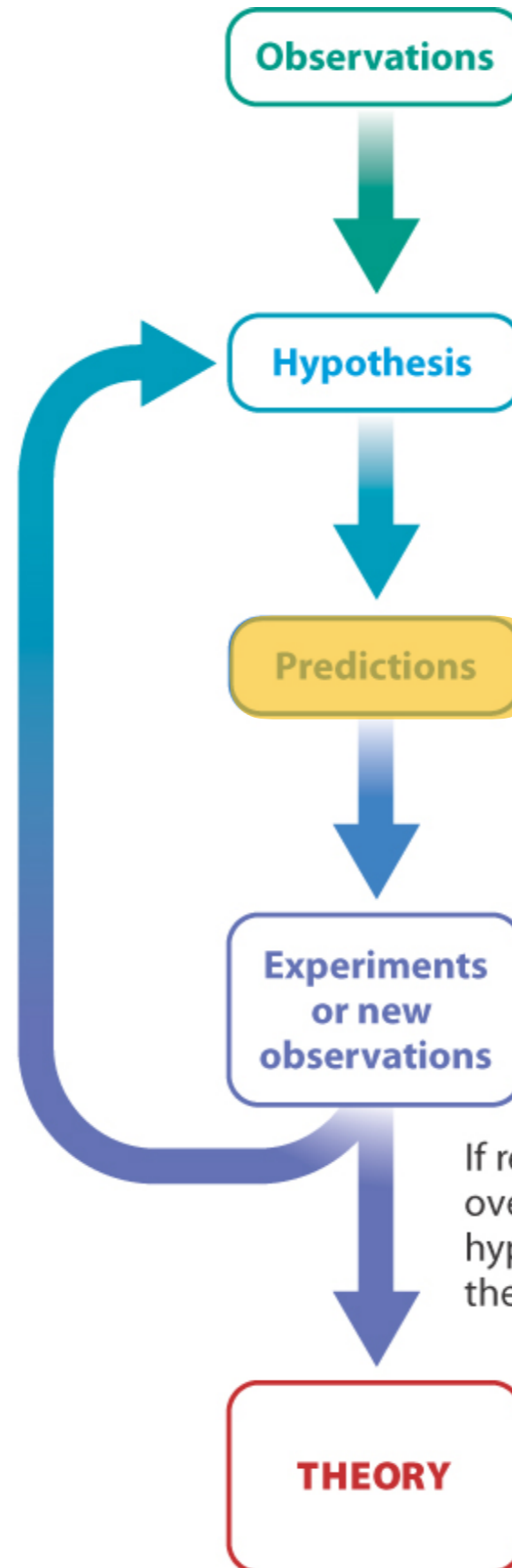
If results are consistent over many experiments, hypothesis becomes a theory.



Scientific Method /approach



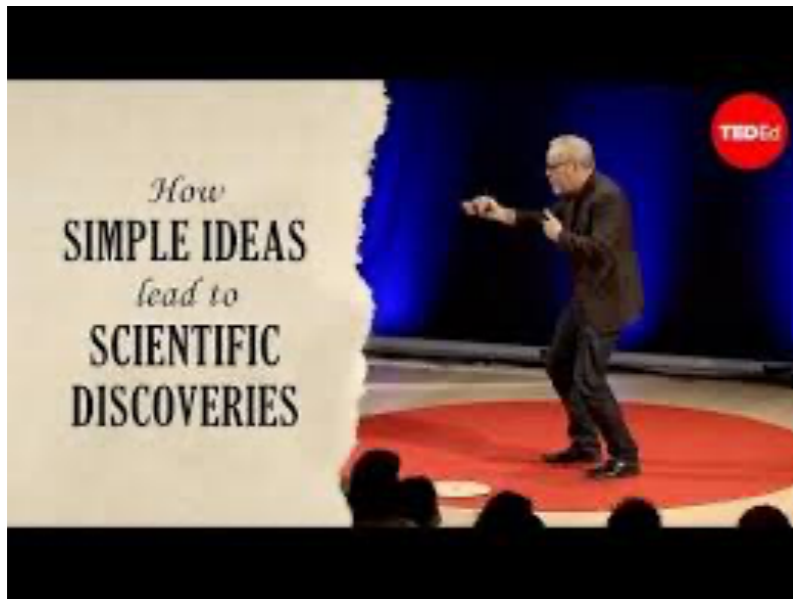
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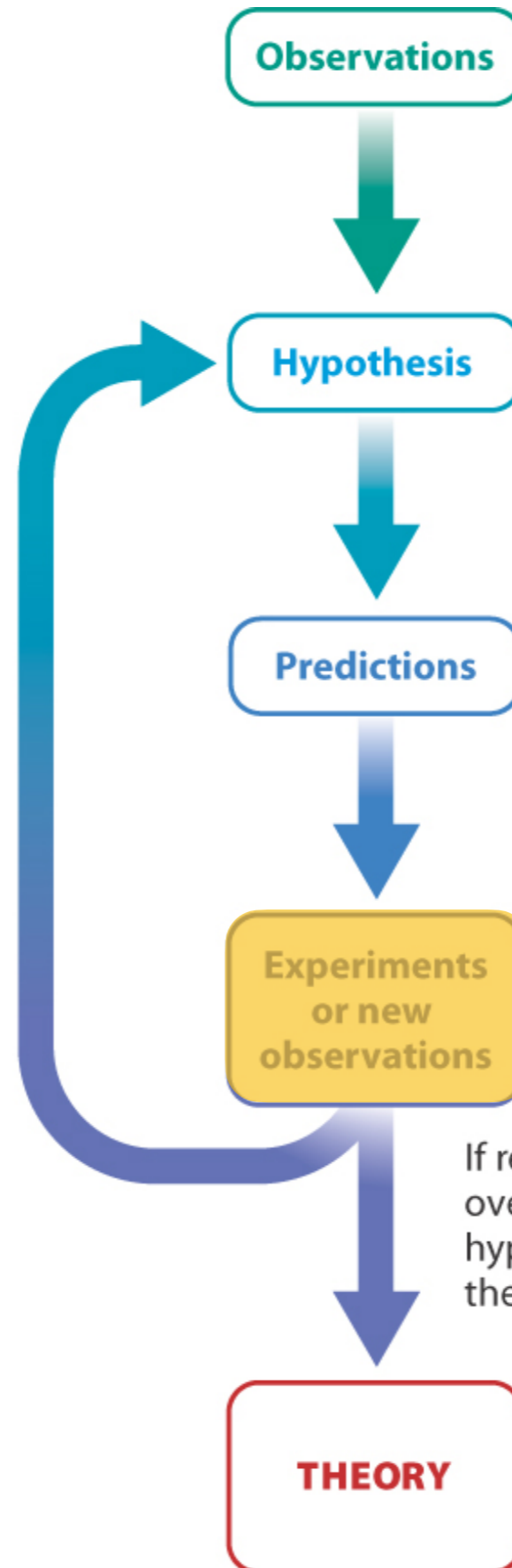
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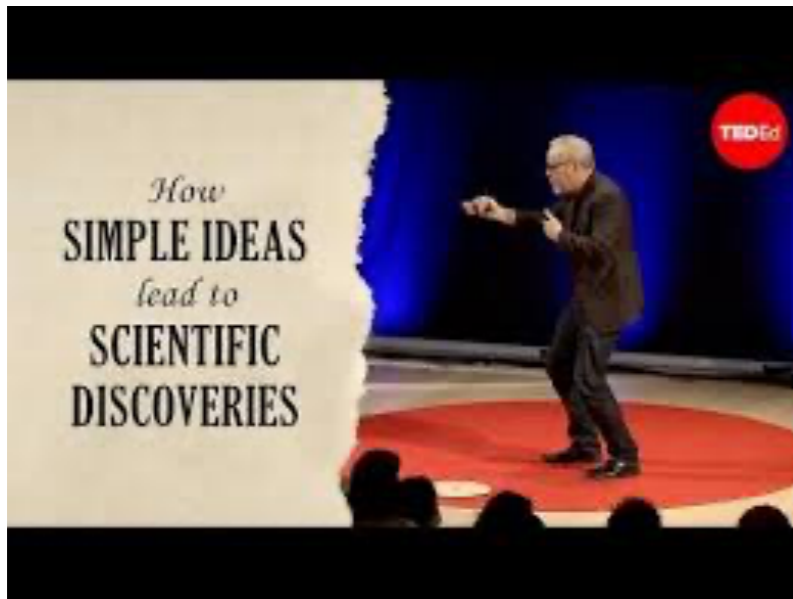
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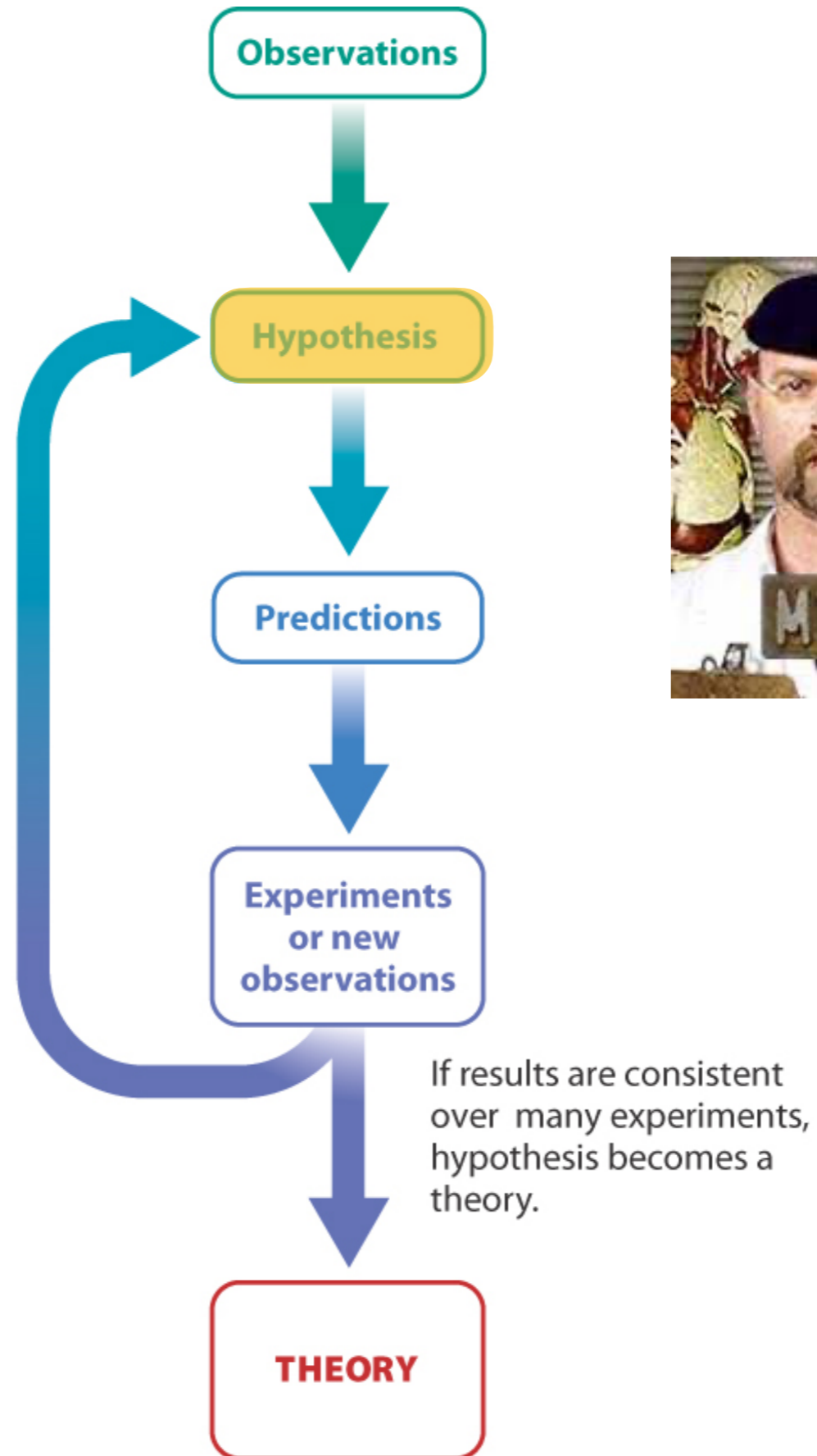
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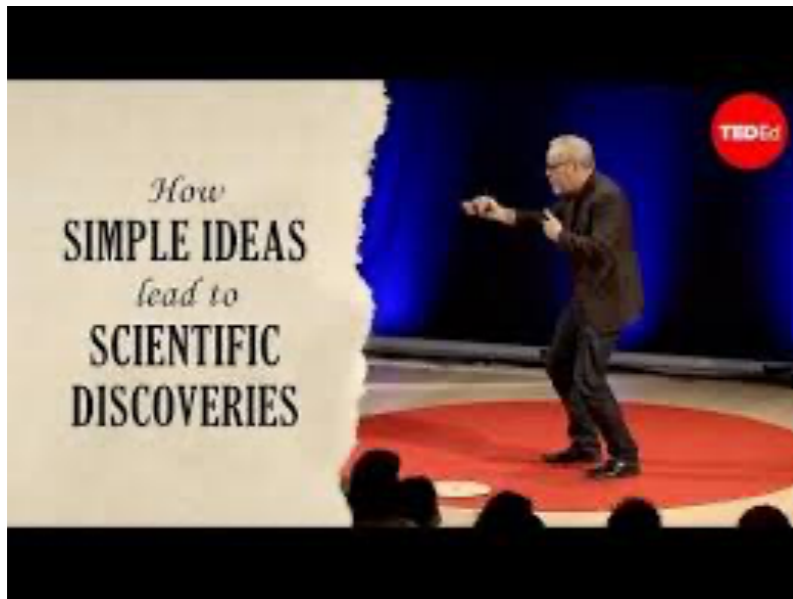
Scientific Method /approach



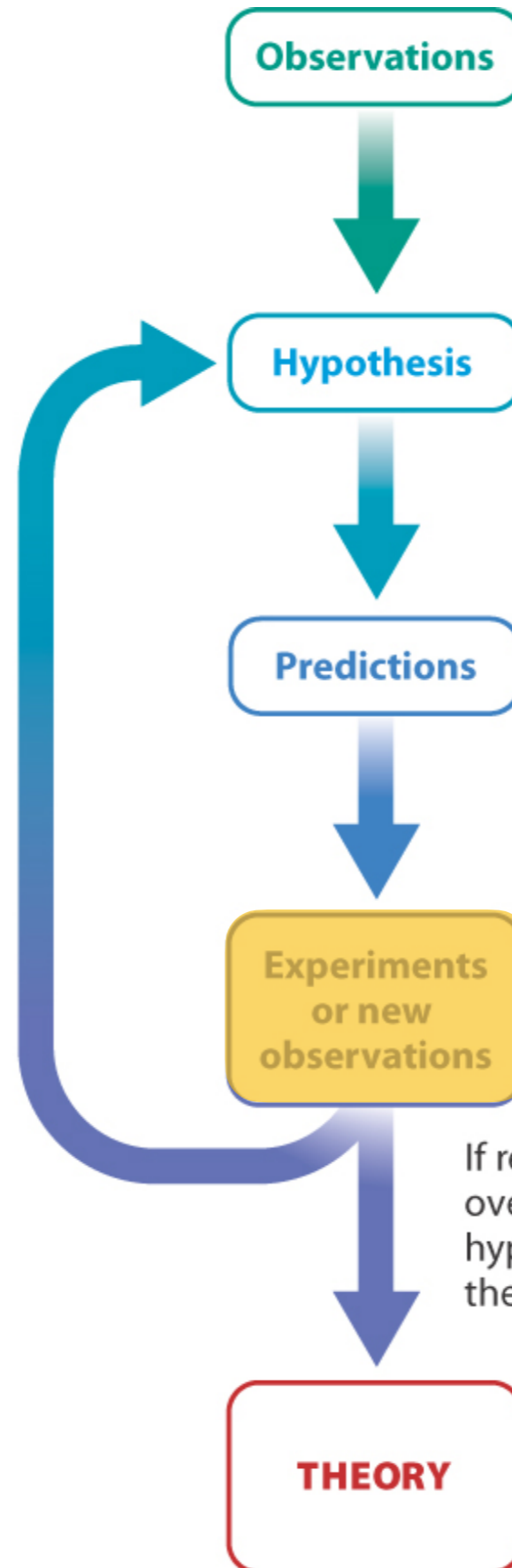
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Scientific Method /approach



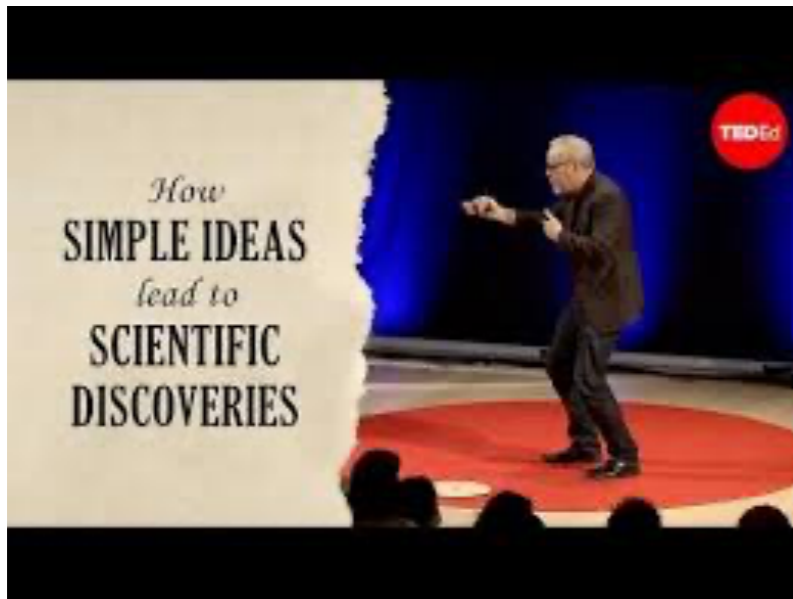
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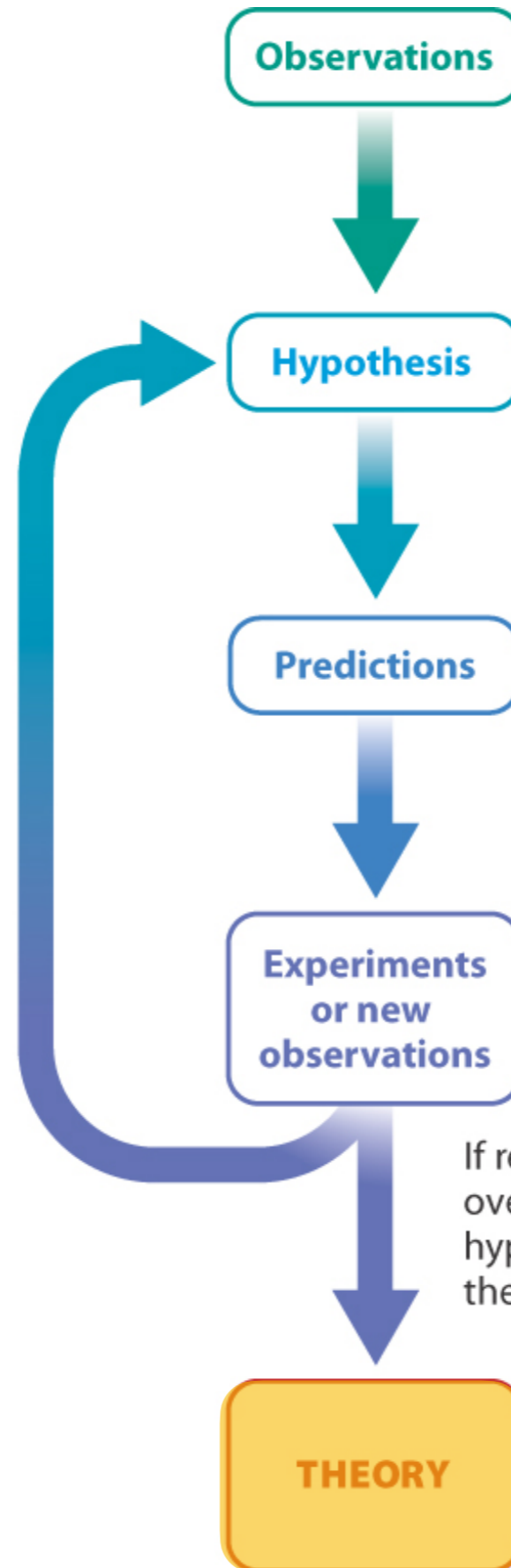
If results are consistent over many experiments, hypothesis becomes a theory.



Scientific Method /approach



If results are not consistent, reject or revise hypothesis.



If results are consistent over many experiments, hypothesis becomes a theory.



Of course, in Science almost ALL scientific statements and affirmations are based on “**Observations**” that should always be challenged/tested...
even at the premise...





The process of science is not linear, but instead involves backtracking, repetition, and feedback between different steps of the process. This

Scientific approach




Photo added by Erik Skytte

Sir Bernard Henry Spilsbury 👤

BIRTH 16 May 1877
Leamington Spa, Warwick District, Warwickshire, England

DEATH 17 Dec 1947 (aged 70)
London, City of London, Greater London, England

BURIAL [Golders Green Crematorium](#)
Golders Green, London Borough of Barnet, Greater London, England


PLOT Gardens of Remembrance

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Added by Kieran Smith


Sir Bernard Spilsbury was Britain's leading Home Office pathologist during the early 20th Century. Spilsbury worked on such high profile cases as the Crippen murder, Siddon case, 'Brides in the Bath' murders, 'Blazing car murder' and the Mahon case. His interest in crime led to him being recognised as the greatest medical detective of all time and one of the founders of modern forensic medicine. He was cremated on the 22nd December, the ashes scattered in the Gardens of Remembrance.

Bio by: [Kieran Smith](#)

Flowers • 47



You are remembered in my heart...
Left by [Tyler Ford](#) on 22 Nov 2019



Left by [AlixG](#) on 23 Oct 2019

[Leave a Flower](#) [View All](#)

Arthur Conan Doyle 👤

Writer



Sir Arthur Ignatius Conan Doyle KStJ DL was a British writer, who created the character Sherlock Holmes. Originally a physician, in 1887 he published *A Study in Scarlet*, the first of four novels and more than fifty short stories about Holmes and Dr. Watson.

[Wikipedia](#)

Born: May 22, 1859, [Edinburgh, United Kingdom](#)

Died: July 7, 1930, [Crowborough, United Kingdom](#)

Education: [The University of Edinburgh \(1876–1881\)](#), [MORE](#)

Movies: [Sherlock Holmes](#), [Holmes & Watson](#), [MORE](#)

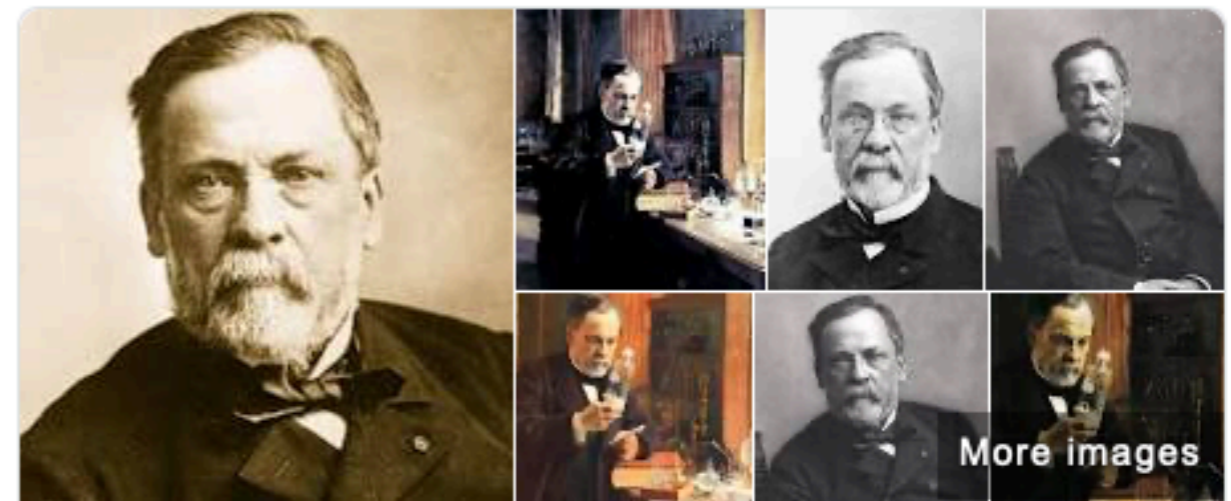
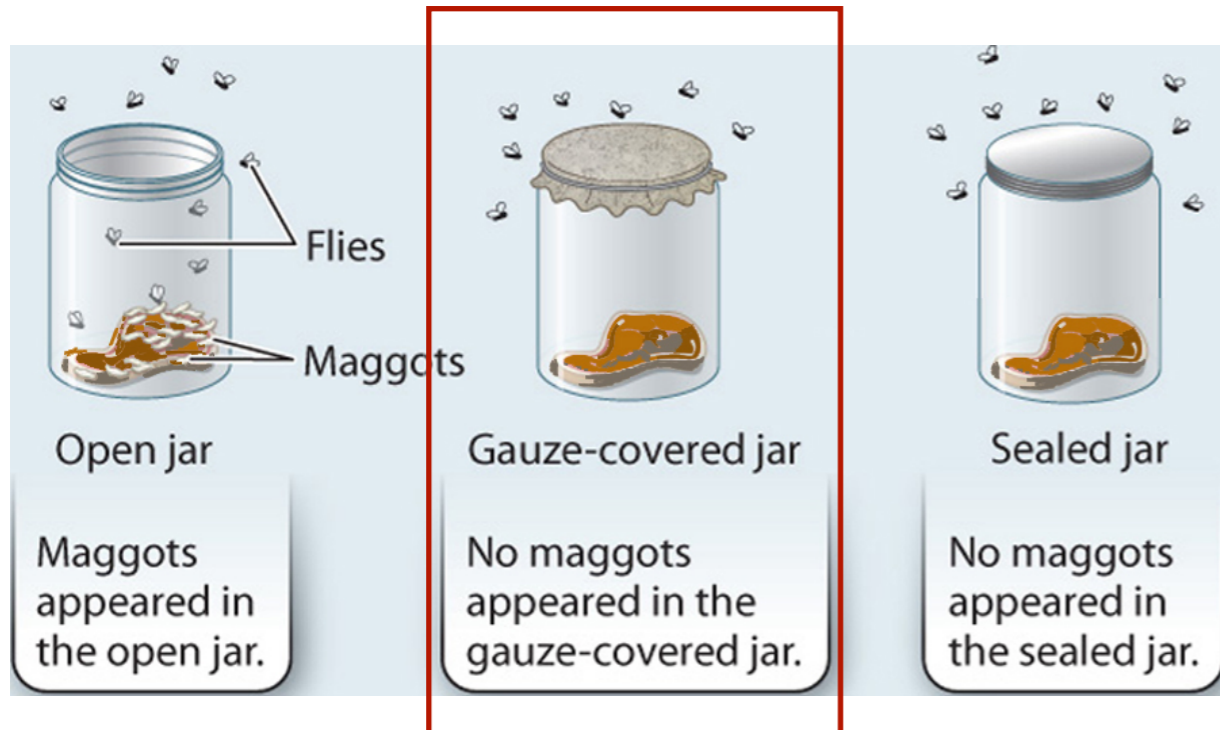
Quotes

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How often have I said to you that when you have eliminated the impossible, whatever remains, however improbable, must be the truth?

You see, but you do not observe.

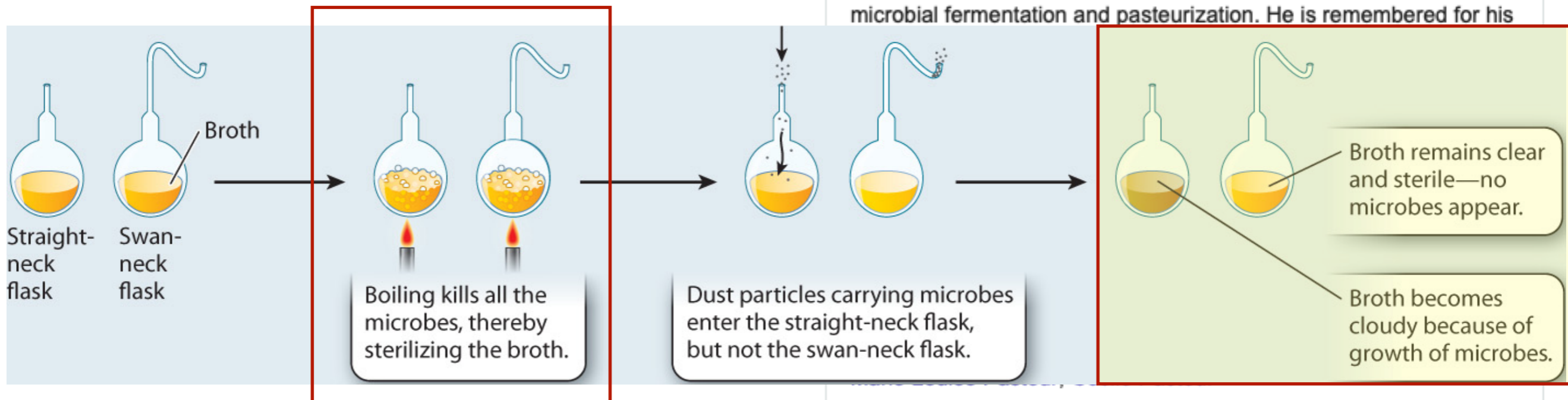
Where there is no imagination there is no horror.



Louis Pasteur

French biologist

Louis Pasteur was a French biologist, microbiologist and chemist renowned for his discoveries of the principles of vaccination, microbial fermentation and pasteurization. He is remembered for his



Viriola vaccinae Pox “of the cow”... Cowpox



As history tells it, young Edward Jenner heard a milkmaid brag that having cowpox made her immune to smallpox. And years later (1796), as a doctor, he drew matter from a cowpox pustule on the arm of a milkmaid to vaccinate a young test subject (depicted in the drawing above).c

The New York Academy of Medicine Library (nyamcenterforhistory.org)

"The idea that cowpox could prevent smallpox infection may actually have come from a man called Fewster, whose observations in 1768,"... of a farmer whom Jenner may have known in his youth... noticed farmers who had contracted cowpox were immune to small pox

Boylston. 2018

Edward Jenner
FRS FRCPE



Born	17 May 1749 Berkeley, Gloucestershire, England
Died	26 January 1823 (aged 73) Berkeley, Gloucestershire, England
Alma mater	St George's, University of London University of St Andrews
Known for	Smallpox vaccine Vaccination
	Scientific career
Fields	Medicine/surgery, natural history
Academic advisors	John Hunter



Figure 1.1: A hummingbird visiting a flower. This simple observation leads to questions: Why do hummingbirds pay so much attention to flowers? Why do they hover near red flowers?

"Let's say you **observe** a hummingbird like the one pictured in Fig. 1.1 hovering near a red flower, occasionally dipping its long beak into the bloom.

Questions:

What motivates this behavior?

Is the bird feeding on some substance within the flower?

Is it drawn to the flower by its vivid color?

What benefit, if any, does the flower derive from this busy bird?"

Observation

define/refine an **hypothesis...**



- The colour of flowers has a powerful effect upon humming bird behaviour.

Test, using deductive logic!!

if, then ...

“Failure is instructive”. The person who really thinks learns quite as much from his failures as from his successes.”

- John Dewey (20th Century philosopher)

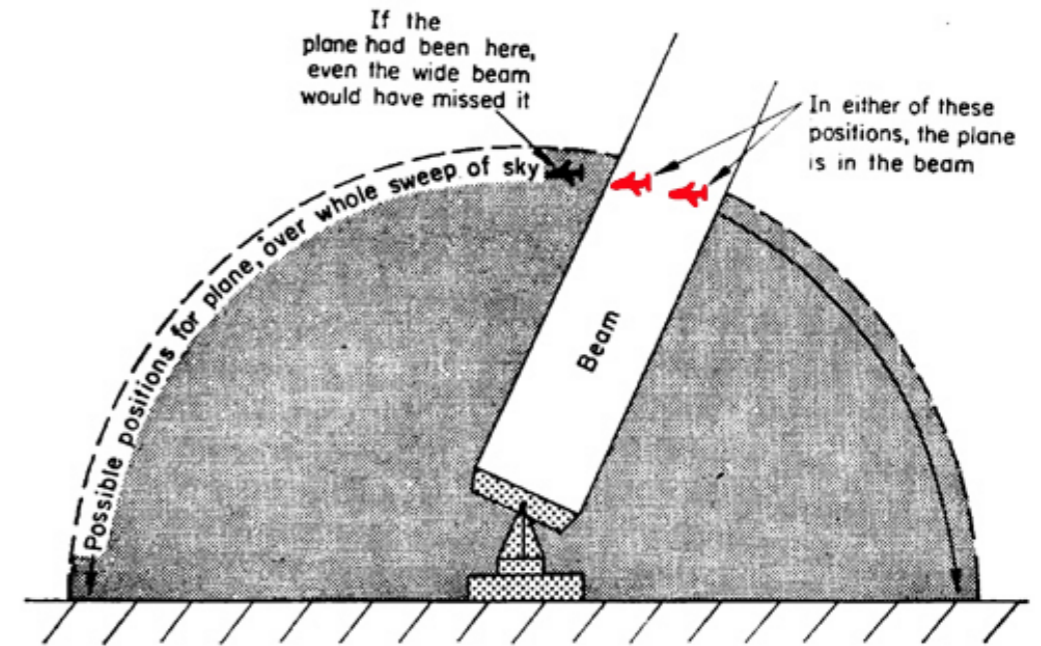


FIG. 3.2. Plane tracking analogy showing beam from searchlight flashed into a certain region of the sky. The plane may lie within the area of the beam or it may not. By definition the plane may be anywhere within range over the whole sweep of the sky.

The “art” in the “Science”

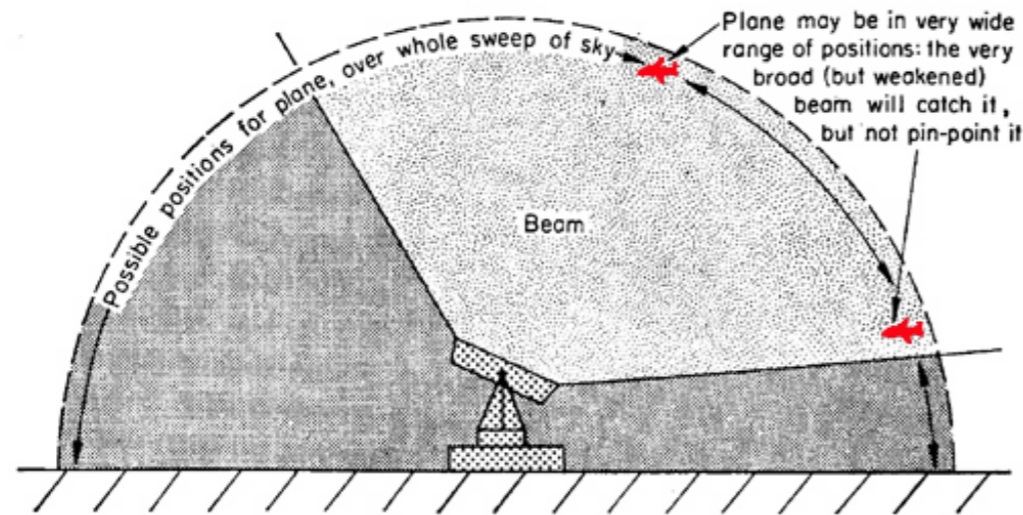


FIG. 3.4. If the beam from the searchlight is made sufficiently wide, this beam is almost sure to include the plane, but this information is of little use to the tracking mechanism.

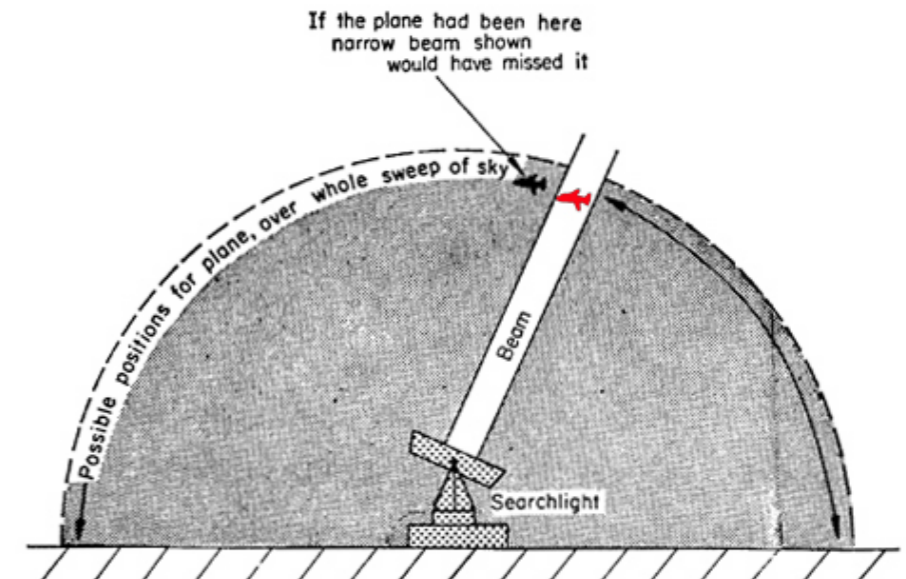


FIG. 3.6. The narrower the beam flashed from the searchlight, the greater the triumph if the plane lies within the beam.



**NULL
HYPOTHESIS**

...Proof by Contradiction

The Null Hypothesis: a scientific approach that is rooted in deductive logic, with the general aim being to refute or prove the null hypothesis to be FALSE.

Generally, therefore, the null hypothesis is the **opposite of** -or takes a contrary position to- the **hypothesis** that is really being tested... and would only be proven to be correct if the idea that is being tested turns out to be FALSE.

i.e. - in the case of the humming bird if you wanted to test the importance of colour of the flower on the behaviour of the bird the “null hypothesis” might be

"Flower Colour has NO EFFECT on the behaviour of the humming bird".

Now, if one is able to **REJECT** the “null hypothesis”, and indicate that colour DOES have an effect... then the alternative hypothesis...

...that there **IS** an effect is proven... "proof by contradiction" would stand... and the scientist can move forward from a somewhat broad hypothesis to a more specific, still testable hypothesis. In this case, perhaps to ask whether different colours have different effects upon the bird's behaviour.

Career Leaders & Records for Home Runs

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The **Barry Bonds perjury case** was a case of alleged [perjury](#) regarding use of [anabolic steroids](#) by former [San Francisco Giants](#) outfielder and all-time [Major League Baseball](#) career home run leader, [Barry Bonds](#), and the related investigations surrounding these accusations. On April 13, 2011, Bonds was convicted of one felony count of [obstruction of justice](#) for giving an incomplete answer to a question in grand jury testimony. A mistrial was declared on the remaining three counts of perjury, and those charges were dropped.

[1] The obstruction of justice conviction was upheld by an appellate panel in 2013, but a larger panel of the appellate court overturned the conviction in 2015.[2]

Rank	Player (yrs, age)	Home Runs	PA	Bats	HR Log
1.	Barry Bonds (22) *	762	12606	L	HR Log
2.	Henry Aaron+ (23)	755	13941	R	HR Log
3.	Babe Ruth+ (22)	714	10626	L	HR Log
4.	Alex Rodriguez (22)	696	12207	R	HR Log
5.	Albert Pujols (22, 42)	693	12921	R	HR Log
6.	Willie Mays+ (23)	660	12545	R	HR Log
7.	Ken Griffey Jr.+ (22)	630	11304	L	HR Log
8.	Jim Thome+ (22)	612	10313	L	HR Log
9.	Sammy Sosa (18)	609	9896	R	HR Log
10.	Frank Robinson+ (21)	586	11744	R	HR Log
11.	Mark McGwire (16)	583	7660	R	HR Log
12.	Harmon Killebrew+ (22)	573	9833	R	HR Log
13.	Rafael Palmeiro (20)	569	12046	L	HR Log
14.	Reggie Jackson+ (21)	563	11418	L	HR Log
15.	Manny Ramirez (19)	555	9774	R	HR Log
16.	Mike Schmidt+ (18)	548	10062	R	HR Log
17.	David Ortiz+ (20)	541	10091	L	HR Log
18.	Mickey Mantle+ (18)	536	9910	B	HR Log
19.	Jimmie Foxx+ (20)	534	9677	R	HR Log
20.	Willie McCovey+ (22)	521	9692	L	HR Log
19.	Jimmie Foxx+ (20)	534		R	HR Log
20.	Willie McCovey+ (22)	521		L	HR Log

8. [Jim Thome+](#) (22) 612 L [HR Log](#)

9. [Sammy Sosa](#) (18) 609 R [HR Log](#)