Phy 202: Introduction to Environmental Physics (3 Units)

Course General Introduction and Course Outline (1hr)

The earth is our home, habitat. Uniquely designed for us. The source of energy is the sun. The skies provide navigation, calendar/clock, etc. Man not the only inhabitants of earth, we have the animals too. All forming a living ecosystem. The anthropic principle wonders at the unique design of the planet for life. (Light, Heat, Water, all members of the ecosystem depending on one another, etc). When we interact/interfere with this environment (everything else in the universe), we can impact it for our benefit or adversity. We need to talk about sustainable development (enjoying and innovating today without compromising tomorrow/developing such that no sector is thrown off-balance). We need to understand the structure, components and systems of the earth, our immediate environment. History of the earth could help in understanding today and planning for a sustainable tomorrow. E.g. in the important issues of global warming/climate change what relative contribution from the sun (cf ice ages), and Man? In this course we study all these at introductory level. The important point in this course is the need to think logically, holistically, and independently.

Assignment 1: List 10 environmental catastrophes (Floods, Volcanoes, Earthquakes, Mudslides, etc). that occurred in the last twelve months. For each, state location, dates, population affected, and mortality figure.

Course Outline
JO. Introduction to solid earth Physics:
- Earth's history 2.0 hr
- Interior structure 1.0 hr
- Interior motions 0.5 hr
- Ground water 1.0 hr
- Weathering 0.5 hr
- Erosions 0.5 hr
- Ecology *(Ecosystems, Pesticides, GMO, etc)* 2.0 hr

Quiz 1
OK.Elements of Atmospheric Physics:
- The earth's atmosphere – structure, types, and heat transfer
- Weather and its impact on Man
- Atmospheric Electricity

Mid-Semester Exam
OK.Introduction to Solar Physics:
- Solar atmosphere
- Solar activity and radiations

OK.The solar system: Planets, moons, comets, and meteors
Quiz 2
JO/OK.The Universe. Stars and Galaxies.
Final Exam

Course Lecturers:
Prof Joshua Ojo – Rm 122
Prof Kayode Owoade – Rm *

Recommended Texts: Encyclopaedia and Internet sources

2 Quizes
1 Mid-Semester Test
1 Final Exam
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I. Origin of the Earth:

1. Does the earth (in general, the physical universe) have a beginning/origin or not?
The universe is still alive (lots of processes), even though it is winding downward. The fact that it is not yet [entropy-speaking] dead implies it is not infinitely old. Hence it is generally accepted that the Universe must have had a beginning. Old theories such as "Steady State theory" which suggest that the Universe has always been and will always be, are no longer credible. The Universe is clearly slowing/winding down in agreement with the 2nd Law of Thermodynamics.

Note these two words. Related but very different!

1. Cosmogony: Study of the *origin* of the universe (cosmos)
2. Cosmology: Study of *fundamental structures* of the universe.

Cosmology is of course, conventional science, whereas, Cosmogony is not. (Repeatability is a major requirement in the Scientific Method; but no scientific investigator can either observe or repeat origins. An origin is a point of singularity!)

Though origin of the universe, of life, of man, etc all occurred in the past and are entirely beyond the reach of the *scientific method* in the proper sense, models could be postulated and current observable data could be inputted into those models to see how well they fit the predictions of the models.

2. Philosophy behind the Models of Origin Issues
In the question of Origin of all things, there are only two alternatives: Either some of the processes are by the design of some intelligent external force; or everything is naturalistic in origin, requiring no Designer or Creator i.e. "Nature" created itself and continues to evolve.

Whatever we choose to believe is purely by faith. Neither can be "scientifically" proved.

Making the issues less abstract: How did this Auditorium come to be here? Either designed or purely accidental! Both positions can be supported, at least in theory. Except you were there when it really happened, at the Origins. Examine the divergent, irreconcilable consequences of the two positions!

The case for the Evolution model gets more tenuous as we extend the issue, say to the Origin of a Book [Materials intricately put together + information!]

And finally, Evolution of Life [materials + information that must be complete from the beginning! => The Concept of Irreducible Complexity.]

Illuminating quote by a noted Evolutionist:

> "The theory of evolution itself [is] a theory universally accepted not because it can be proved by logically coherent evidence to be true but because the only alternative, special creation, is clearly incredible - Prof D.M.S. Watson

3. The Two Models

Evolution Axiom: The universe can be completely explained, at least in principle, in terms of natural laws and processes, as a self-contained system, without need of external preternatural/supernatural intervention. The very laws themselves, as well as energy, matter, space, and time have somehow developed naturally, having evolved from a primeval chaotic or randomized state into its present highly-structured complexity.

Although no generally acceptable theory (mechanisms) exist, the famous theories of the Origin of the Universe have been Steady State, Big-Bang, Inflationary Model. The Steady State model has actually been totally abandoned, even by Prof Fred Hoyle, its proponent.

Big Bang: This theory postulates that a primeval atom exploded about 10 – 20 billion years ago, and that molecules, stars, galaxies, and planets all gradually evolved from the expanding gases of this ancient explosion. Furthermore, the complex molecules that developed from the original exploding particles are said to have slowly evolved into living cells and, finally, into human beings.

Inflationary Universe: The universe (including all space and time) began as an infinitesimal particle which inflated to grapefruit size in its first 10^{-35} s of existence. This initial "cold big whoosh" was then followed by the standard "hot big bang"

Question: What about the origin of the initial primeval atom/particle-sized universe?

"It is then tempting to go one step further and speculate that the entire universe evolved from literally nothing"
Allan H. Guth and Paul J. Steinhards: "The Inflationary Universe". Scientific American. Vol 250 (May 1984), p. 128

An evolutionist summarizes all the existing theories of cosmogony/cosmology:

> "No existing view of the development of the cosmos is completely satisfactory and this includes the standard model, which leads to certain fundamental questions and problems"
> V.P. Weisskopt: "The origin of the Universe". American Scientist, vol 71 (Sept/Oct 1983), p. 474.

Creation/Design Axiom: The universe came into existence by the omnipotence, in accord with the omniscience of the creator. Everything created by fiat, *ex nihilo.*
Two important movements: The Intelligent Designer – refuses to address the possible identity of the creator. Could even be a force. Creation Movement identifies the creator as a personal sentient Being, whose attributes and ideas/outlooks are reflected in His creation.

Summary of the 2 Models and their predictions

Evolution Model	**Creation Model**
Continuing Naturalistic Origin of Basic Systems Net Present *Increase* in Organized Complexity of	*Completed* Supernatural Origin of Basic Systems Net Present *Decrease* in Organized Complexity of

The predictions of these two models, even if similar on some issues, are widely different in many other issues. Hence they can be scientifically studied to see which more accords with the current facts of science.

The Evolution Model clearly stresses that natural processes can bring things into existence and organize them into more complex systems (innovation and integration. A progress – evolution – into something better) while the Creation Model stresses that complex systems came into existence in the past and are being maintained as such in the present (conservation) except that if any "vertical" changes do take place, they necessarily must be in a "downward" rather than in an "upward" direction (disintegration). Unfortunately, even these clear cut distinctions don't necessarily end the debate. For instance are GMOs, transgenderism or transhumanism etc evolution into something better or degradation of already perfect systems?

Before we critique both models to see their strengths and weaknesses *viz-a-viz* reality, we note the following two important basic facts about the two models:

i. The Models are all-encompassing

The issues under discussion include everything in the universe - Cosmic, Chemical, Stellar and Planetary, Organic (life, supposedly from random mutations followed by natural selection), Macroevolution (species) and microevolution (variation). Even beyond physical and biological evolution, the origin of other human attributes such as mind, language, culture must also be included!

For example the predictions of both models include:

Evolution	*Creation*
New, more complex elements should be evolving	No new elements.
New, more complex Stars	No new more complex stars
New kinds of life – plants and animals	No new kinds (Extinctions may be, but no new ones)
New more complex human languages	No new more complex languages
The "egg came before the hen"	"The hen (and cock!) came before the egg"

(In reality the egg and the hen have the same level of complexity – so this is not so sound an example; but it provides clear illustration)

ii. The models are mutually exclusive

The idea that God used evolution is complete non-sense both in the evolutionist camp and the creationist camp. The key word in evolution is naturalistic and chance. No design, no designer, no preternaturals. Creation is the exact opposite. {Ironically though, many who profess creation have unconsciously embraced the idea that there is no purpose for their lives; and that their destinies are entirely in their own hands.}

A quote from Douglas Futuyma, a leading evolutionary biologist affirms this mutual exclusivity:

"Creation and evolution, between them, exhaust the possible explanations for the origin of living things. Organisms either appeared on the earth fully developed or they did not. If they did not, they must have developed from pre-existing species by some process of modification. If they did appear in a fully developed state, they must indeed have been created

by some omnipotent intelligence[1].

Various attempts to compromise on Creation such as Theistic Evolution, Progressive Creation, Day-Age Theory, Gap Theory etc can therefore not stand.[2]

4. Critiques of the Models

Though Evolution model tries to suggest mechanisms for the various origins in question (of the universe, life, species, etc) it fails in every one of them. The conclusions everywhere is that no generally accepted mechanism exists. The difference between Evolutionism and Creationism is that one still believes natural causes exist and can be found out (hence millions of dollars in research into cosmogony) whereas the other believes no ongoing natural mechanisms exists or can be found!

i. Problems with Creationism

- The "Lazy/fatalistic" implications. It kills initiative to seek knowledge
- Even though current facts bear this out, but how reasonable is it to say we are unique in the entire wide universe; despite our tiny inconsequential size (pale blue dot – Sagan)?
- Existence of "imperfections" and "vestigial organs" challenge the notion of an omnipotent and omniscient God.
- Many form of creationism exists, many based on myths and religious stories. There are myriad definitions of "God", ranging from a pantheistic god in eastern religions to a personal God in the monotheist religions of the Middle East, and animism in other parts of the world. Furthermore, in Creation Science, which is based entirely on science rather than any religion, there is the question of Old Earth versus Young Earth Creationists [the qualms don't affect the basic position that there is a Creator though].
- Implications (demands) of a personal Creator God! A personal omnipotent and omniscient Creator can not be ignored. Intelligent Designer appears to be the theory of the future, as a mid-ground.

ii. Problems with Evolutionism

- **Spontaneous Generation?** Harvard's Nobel Laureate in Biology, Dr George Wald declared:
  "One has only to contemplate the magnitude of this task to concede that the spontaneous generation of a living organism is impossible. Yet here we are – as a result, I believe of spontaneous generation"[3]

He later explained why he has chosen to believe what he knew to be impossible:

"The only alternative to some form of spontaneous generation is a belief in supernatural creation"[4]

Dr Wald considered this a greater impossibility! Evolution or Creation? Whatever choice we make is invariably dependent on Faith. Is there God or not?

- **No clear evidence that Evolution has ever happened in the past –** fossil record should be replete with intermediate/transitional forms. Not the one or two being argued about (amidst many proven fakes!). This lack of transitional forms has led to the proposition of the theory of "punctuated equilibrium"/ stasis. Paleontologist Steven M.

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[1] Douglas J. Futuyma, Science on Trial (New York: Pantheon Books, 1983), p. 197

[3] George Wald, in Scientific American, August, 1954

[4] and "Innovation in Biology," Scientific American, vol 199 (September 1958), p. 100

Stanley of Johns Hopkins University explains this concept:

> "The [fossil] record now reveals that species typically survive for a hundred thousand generations, or even a million or more, without evolving much. We seem forced to conclude that most evolution takes place rapidly, when species come into being by the evolutionary divergence of small populations from parent species. After their origins, most species undergo little evolution before becoming extinct.[5]

And according to Jay Gould of Harvard:

> "Thus, our model of "punctuated equilibria" holds that evolution is concentrated in events of speciation and that successful speciation is an infrequent event punctuating the stasis of large populations that do not alter in fundamental ways during the millions of years that they endure[6]

In short, evolution which means 'change' is characterized mainly by stasis, which means "no change". The "punctuations" that produce new species occur so rapidly and so rarely that they can never be observed. This explains why no mechanism could be even theoretically proposed to evolution, though of course, evolution has to be true…. else we are faced with God!

II. EARTH HISTORY: What has happened since the Earth came into being?

1. Why study earth's history? – History takes a careful look at the past in order to understand current present-day processes and predict the future.
E.g. Were there ice-ages and warm periods – implications for (anthropogenic) global warming buzz
Were the dinosaurs indeed wiped out by a global catastrophe (meteor strike on earth? ice-age? Etc?) - implications: could it happen again?
How is coal/oil etc formed? – economic implications (eg Should we intensify search for oil in the Nigerian side of the Chad basin or not?
Etc etc.

2. How to study earth's history
– Oral and written traditions (e.g. there is a global flood account in virtually every culture on earth. Most likely it happened!)
- tell-tale left-over signs and relics: The geographical features (gorges, mountains, caves, etc. cf crater counting on the moon, recent studies); fossils
- Intrapolate ongoing measurable processes (eg separation of the continents, of the moon from earth, increasing or decreasing levels of some distinct easy-to-measure parameter: saltiness of the seas, carbon-14 in trees, K-Ar ratio in rocks, tree rings, ice-core layers, etc). These measurable ongoing processes form the basis of dating.

3. History has always been a contentious subject – depending on who is telling it!

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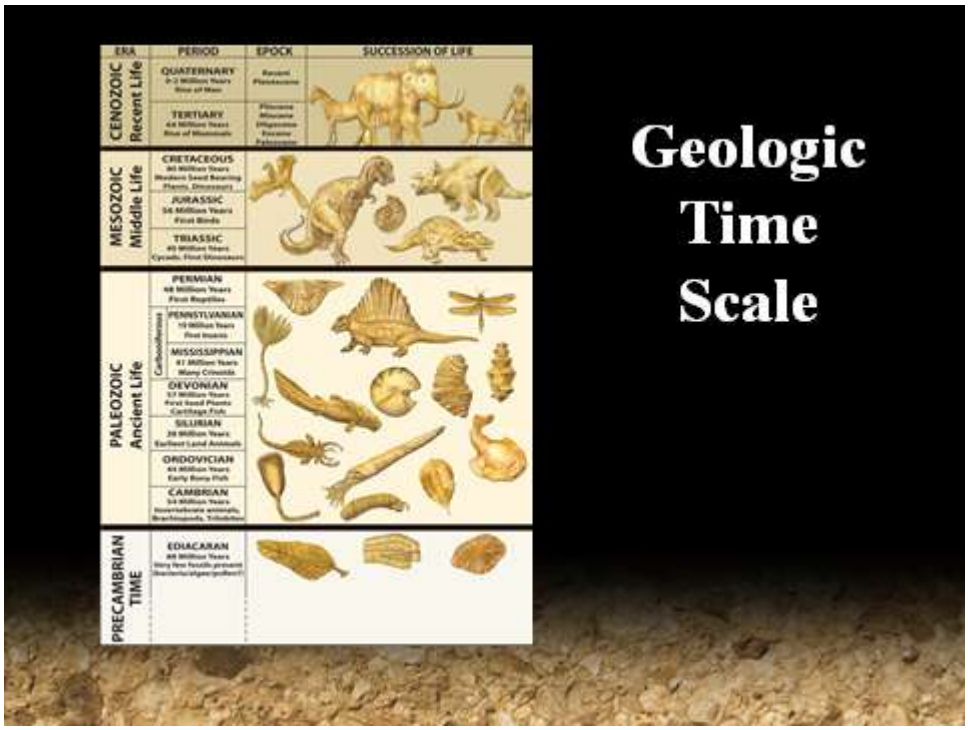
[5] Steven M. Stanley, The New Evolutionary Time-table: Fossils, Genes and the Origin of Species (Basic Books, Inc., 1981), preface.
[6] Stephen Jay Gould, "Is a New and General Theory of Evolution Emerging?" Paleobiology, vol 6, no 1 (1980), p. 125

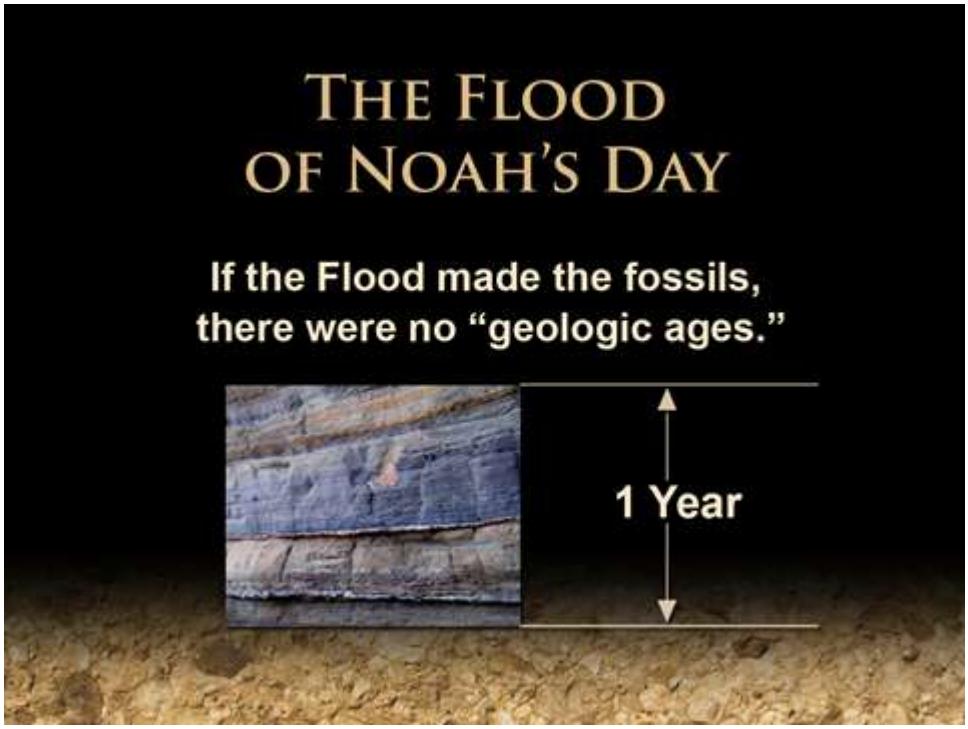
"Until the lions have their own historians, the history of the hunt will always glorify the hunter"- Chinua Achebe
(e.g. Who "discovered the river Niger?" Oduduwa: Coptic Christian, Royalty from Mecca, or Deity from Heaven?)
THERE MAY BE POCKETS OF FACTS, SOME OF WHICH MIGHT EVEN APPEAR CONTRADICTORY – HENCE DIFFERENT VERSIONS OF HISTORY. OF COURSE THERE IS ONLY ONE TRUTH.

4. In Earth's History, the two contending positions are: Uniformitarianism and Catastrophism. (In this class, both are allowed, provided you can state your reason to justify your position! Nigeria/the world direly needs people who can think creatively and independently)

5. Summary of the two positions:
Uniformitarianism: Lyellian (after Charles Lyell). Events in the past occurred in the same way as they do today – volcanism, erosion. There could be localized catastrophic events, but not global, and therefore not significantly affecting Earth's history. The fossil record is then assumed to reflect fossils **gently laid**, **undisturbed, in the strata** they are found. Thus the strata form a historic record => Eons (Pre-Cambrian, Phanerozoic)➔ Eras (Phanerozoic Eon: Paleozoic, Mesozoic, Cenozoic eras) ➔ Periods. (Cenozoic era: Tertiary, Quartenary periods).



Catastrophism: Drastic non-uniform events occur now and then to significantly alter available evidence. E.g aftermaths of a volcanic (cf Mt St Helen, May 18, 1980) eruption; Catastrophic Formation of Oil etc. The most important catastrophic effect on earth, according to catastrophism position is a Global Flood (aka Noah's Flood, evident in every culture worldwide – "Omoluabi", Ile-Ife, etc; Chinese even more profound, entrenched in their language!)



Fossils – Formation. Living Tissues in Fossils. "Living Fossils" (Coelacanth, Dragons=Dinosaurs, etc)

Discussion: Distinguish between fossils, artefacts, and ores. What is fossil fuel?

Fossils are **formed** in a number of different ways, but most are **formed** when a plant or animal dies in **a watery environment** and is buried in mud and silt. Soft tissues quickly decompose leaving the hard bones or shells behind. Over time sediment builds over the top and hardens into rock.

The Formation of Fossils - ScienceViews.com
scienceviews.com/dinosaurs/fossilformation.html

When animals, plants and other organisms die, they typically decay completely. But sometimes, when **the conditions are just right**, they're preserved as fossils.

Several different physical and chemical processes create fossils, according to the New York State Geological Survey.

Freezing, drying and encasement, such as in tar or resin, can create whole-body fossils that preserve bodily tissues. These fossils represent the organisms as they were when living, but these types of fossils are very rare.

Most organisms become fossils when they're changed through various other means.

i. The **heat and pressure** from being buried in **sediment** can sometimes cause the tissues of organisms — including plant leaves and the soft body parts of fish, reptiles and marine invertebrates — to release hydrogen and oxygen, leaving behind a residue of carbon.

   This process — which is **called carbonization, or distillation** — yields a detailed carbon impression of the dead organism in sedimentary rock.

ii. **The most common method of fossilization is called permineralization, or petrification**. After an organism's soft tissues decay in sediment, the hard parts — particularly the bones — are left behind.

   Water seeps into the remains, and minerals dissolved in the water seep into the spaces within the remains, where they form crystals. These crystallized minerals cause the remains to harden along with the encasing sedimentary rock.

iii. In another fossilization process, called **replacement**, the minerals in groundwater *replace the minerals* that make up the bodily remains after the water completely dissolves the original hard parts of the organism.

iv. **Fossils also form from molds and casts**. If an organism completely dissolves in sedimentary rock, it can leave an impression of its exterior in the rock, called **an external mold**. If that mold gets filled with other minerals, it becomes a cast.

   An internal mold forms when sediments or minerals fill the internal cavity, such as a shell or skull, of an organism, and the remains dissolve.

Organic remnants

In recent years, researchers have discovered that some fossils aren't just made of minerals. Fossil analyses have shown, for instance, that some retain organic material dated to the Cretaceous, a period that lasted from 65.5 million to 145.5 million years ago, and the Jurassic period, which lasted from 145.5 million to 199.6 million years ago

Tests suggest that these organic materials belong to dinosaurs because they match certain proteins from birds, which evolved from dinosaurs.

"It used to be that no one thought it was possible for any endogenous material — material that comes from the animal — could be left behind after the

fossilization process," said Ken Lacovara, the dean of the School of Earth and Environment at Rowan University in New Jersey. "[But] that's not really the case."

It's unclear how the organic material is preserved, but iron might help the proteins become cross-linked and unrecognizable, or unavailable to the bacteria that would otherwise consume them, Lacovara said. (Formaldehyde works in a similar way, cross-linking the amino acids that make up proteins, making them more resistant to decay, Mary Schweitzer, a molecular paleontologist at North Carolina State University, told Live Science.)

Another idea is "microbial masonry," Lacovara said. "It's possible that the bacteria that initially chomped through the tissue are secreting minerals as a waste product that then hermetically [airtight] seal a little bit of what remains behind," almost like a stone mason sealing off a structure, he told Live Science.

Moreover, sandstone — rock made of sand-size grains of minerals, sediments or inorganic material — seems to be the best type of environment for preserving organic material in fossils.

"Sandstone is like a bunch of volleyballs sitting on top of each other with big interstitial [spaced] areas between them," Lacovara said. "So it seems like rapid decay might promote the preservation process. Maybe we need the bacteria to get through fast and to chomp through the sediment so that they can sequester some of [the surviving organic material] in the process."
https://www.livescience.com/37781-how-do-fossils-form-rocks.html

Of course it is also possible and indeed very plausible, that the date assigned to the "fossils" was simply wrong by several orders of magnitude; and the fossils were indeed freshly formed.

BASIC PRINCIPLES OF DATING

Apart from situations where hard historical records are available, we have no way of dating the past without recourse to some far-reaching assumptions. Dating involves the study of a particular process occurring at a rate which is assumed known (usually constant), and based on further assumptions regarding initial and present states, an elapsed time interval to move from the initial state to the present can be calculated.
For instance, if we assumed that the rate of movement of sand from the top compartment into the bottom compartment in an hour glass-like device is constant, we can deduce a time interval from the present since that process started (i.e. a date), if we can measure the amount of sand in the bottom compartment and further assuming that the initial state of the compartment was known to start with. Hence before an absolute dating can be achieved

We must make at least 3 basic assumptions:

1. The initial state of the system being measured is known
2. The rate of transformation of the system into the present state is known (usually assumed constant)

Examples:

Continental Drift: Question

Answered step-by-step

Due to continental drift, Africa and South America are moving away from each other at a rate of 4 centimeters per year. The two coasts are currently separated by 5,000 km. Assuming this drift rate is constant, how long ago were the coasts touching? Give your answer in millions of years.

Earth-Moon distance

"The Moon is moving away from Earth at about 1.49 inches (3.78 centimeters) per year. And as it moves away, its orbital period increases and Earth's rotation slows down. Looking at the average rate of retreat over the last 4 billion years, it should take about 50 billion years before the Moon takes as long to complete one orbit as Earth takes to complete one rotation." What assumptions are implicit in this analysis?

3. The system has remained closed to external contributions during the whole period.
   The basic measurement is to characterize the present state of the system. The above assumptions apply to all dating – whether of the age of a foetus in the womb, or that of the earth. Obviously there are several processes/systems that can be used for dating the earth.

A few of these are listed: They all suggest the earth might be much more younger than conventionally held.

- **Salination of the Oceans:** If we measure the rates at which salts (or various other chemicals, up to 30 have been identified) are being added to the oceans by river and coastal erosion, depending on the particular salts/chemicals used, we obtain ages for the oceans ranging from a few thousands to a few hundred million years. This is assuming there were no salts in the oceans to start with, and the rate of salination has been constant. Both obviously incorrect and leading to gross exaggeration.
- **Decay of Earth's Magnetic field:** the earth's main dipole magnetic field is known to be decreasing. Extrapolating back in time, it is clear that the earth could not have supported life over 10,000 years ago. [Now believed to be oscillating]
- **Short -Term Comets**. As comets go around the sun in their elliptical orbits, they lose part of their materials in what is seen as the "tails". If the solar system had existed for billions of years, no comet should remain in circulation. Indeed, calculations based on Halley Comet give the age of the Solar System as only 23,000 years. (Nature, vol 339, May 11, 1989)

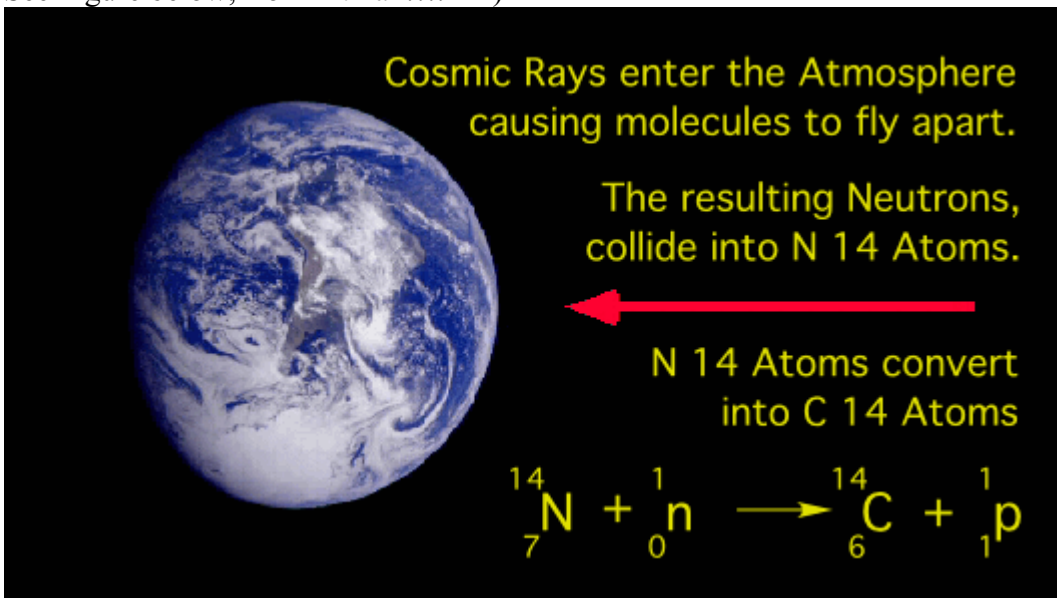
- **Meteoric Dust:** Considering that meteoric dust settles on earth at an estimated rate of 14.3 million tons per year, in the billions of years alleged as the age of the earth, we should have a layer of about 54 ft thick over the earth. On the moon where there is no atmosphere or oceans to disperse the dust, the Apollo team were bothered there would be hazard from the thick dust. It turned out that the dust is only about $1/8^{th}$ of an inch, corresponding to less than 10,000 years
- **Population growth:** If man had been on earth for the 100,000 years suggested by evolution theory, every single space on earth should have been filled with human beings!. In actual fact, following the practices used for dating, if we assume that the current population growth rate of about 2% has been uniform, and starting from one man and one woman, it will take only 1,100 years of exponential growth to generate the current human population of 6 billion! [Show]
- **Historical evidences:** The limit of recorded history and civilization for mankind is about 4,000 years (6,000 years if one believes in the book of Genesis in the Bible). What was man doing on earth prior to this time?

Contradicting dates ➔ Absolute dating versus Relative dating (using secondary sources)

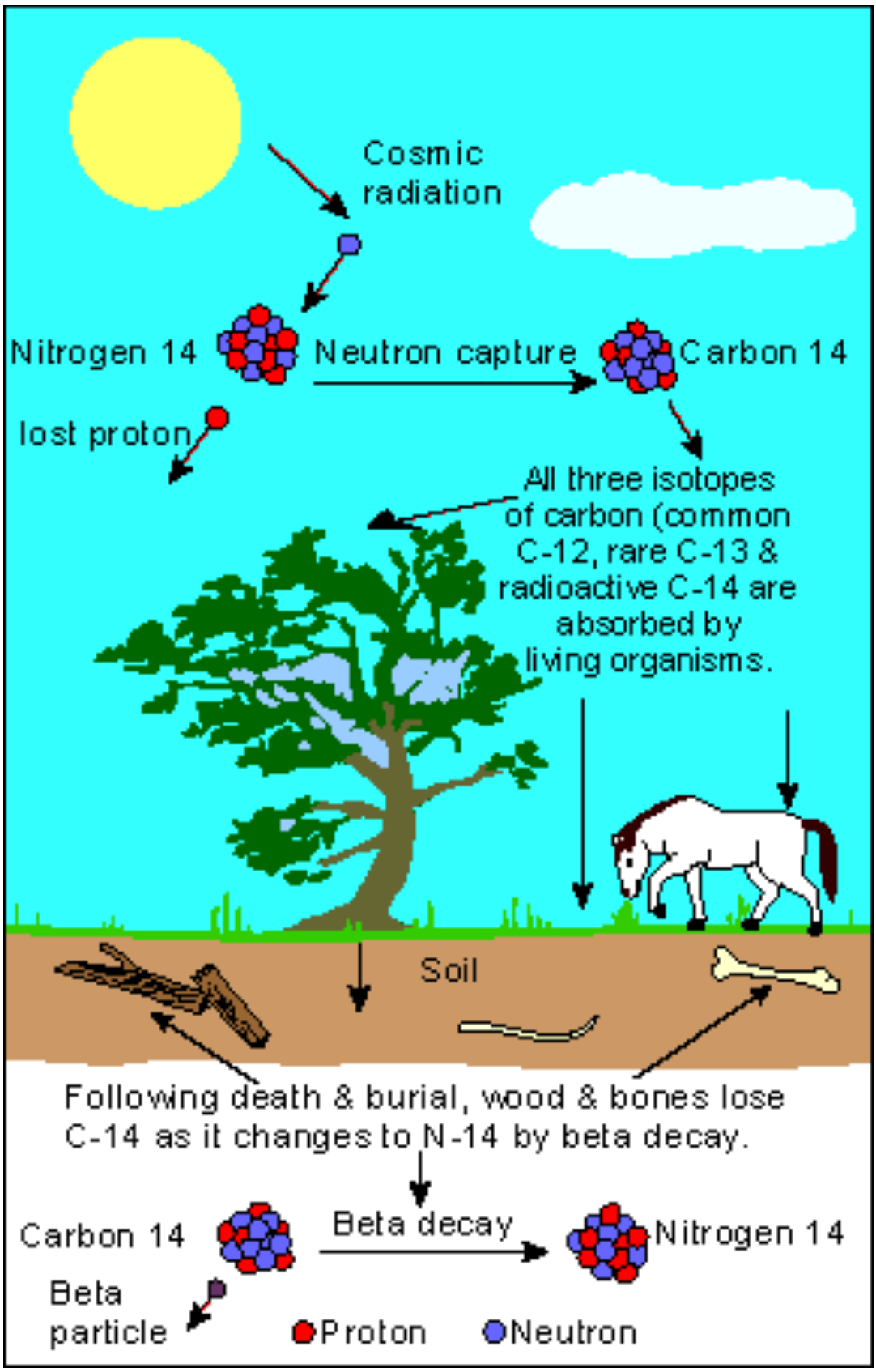
RadioDating: C-14, Longer-Lived Isotopes, Helium diffusion

. How is Carbon-14 formed?

The two stable isotopes of Carbon are C-12 (99%) and C-13 (1%). All other isotopes of Carbon, including C-14 are unstable and they have to be produced by nuclear interactions. Virtually all the C-14 in the atmosphere is produced as a result of interactions with neutrons ripped off from molecules as cosmic rays enter the earth's atmosphere from the outer space. See Figure below, from Pitman….***)



The C-14 so produced is also incorporated together with C-12 and C-13 into Carbon-dioxide molecules which plants take in. Since plants form the basic food form, C-14 is ultimately transferred into all living beings.


Cosmic radiation
Nitrogen 14
Neutron capture
Carbon 14
lost proton
All three isotopes of carbon (common C-12, rare C-13 & radioactive C-14 are absorbed by living organisms.
Soil
Following death & burial, wood & bones lose C-14 as it changes to N-14 by beta decay.
Carbon 14
Beta decay
Nitrogen 14
Beta particle
Proton
Neutron

How Carbon-14 Dating Works

by Marshall Brain
>>Tell a friend about this article!

Dating a Fossil

As soon as a living organism dies, it stops taking in new carbon. The ratio of carbon-12 to carbon-14 at the moment of death is the same as every other living thing, but the carbon-14 decays and is not replaced. The carbon-14 decays with its half-life of 5,700 years, while the amount of carbon-12 remains constant in the sample. By looking at the ratio of carbon-12 to carbon-14 in the sample and comparing it to the ratio in a living organism, it is possible to determine the age of a formerly living thing fairly precisely.

A formula to calculate how old a sample is by carbon-14 dating is:

$$\mathbf{t = [\ \ln (N_f/N_o) / (-0.693)\ ] \times t_{1/2}}$$

where ln is the natural logarithm, N_f/N_o is the percent of carbon-14 in the sample compared to the amount in living tissue, and $t_{1/2}$ is the half-life of carbon-14 (5,700 years).

So, if you had a fossil that had 10 percent carbon-14 compared to a living sample, then that fossil would be:

$$t = [\ \ln (0.10) / (-0.693)\ ] \times 5{,}700 \text{ years}$$

$$t = [\ (-2.303) / (-0.693)\ ] \times 5{,}700 \text{ years}$$

$$t = [\ 3.323\ ] \times 5{,}700 \text{ years}$$

$$\mathbf{t = 18{,}940 \text{ years old}}$$

Because the half-life of carbon-14 is 5,700 years, it is only reliable for dating objects up to about 60,000 years old.

The Basic difference in C14 dating from the regular longer-lived isotopes dating is that in Carbon dating, you are comparing the number of isotope C-14 (which is decaying) with the number of isotope C-12 which is not decaying. (It is stable.)

However for more of longer-lived isotopes, you are comparing the number of an unstable parent isotope with that of one of ITS OWN daughters.

Important points to note about C-14 dating:

Can only date objects that once lived or take in C-14 regularly; but stopped doing so at a point in time. The date refers to the point where intake of C-14 stopped.

Since the half-life of C-14 is 5700 yrs, cannot provide a date beyond 20 half-lives (20 x 5700 yrs) or roughly 100,000 years, since no detectable C-14 will remain in the sample.

The corollary to the above is that any object that has detectable C-14 cannot be more than 100,000 years old.

Assignment: Numerical example on C-14 dating. Comment on possible extraneous contributors.

Longer-lived Radioisotopes:

Helium Diffusion

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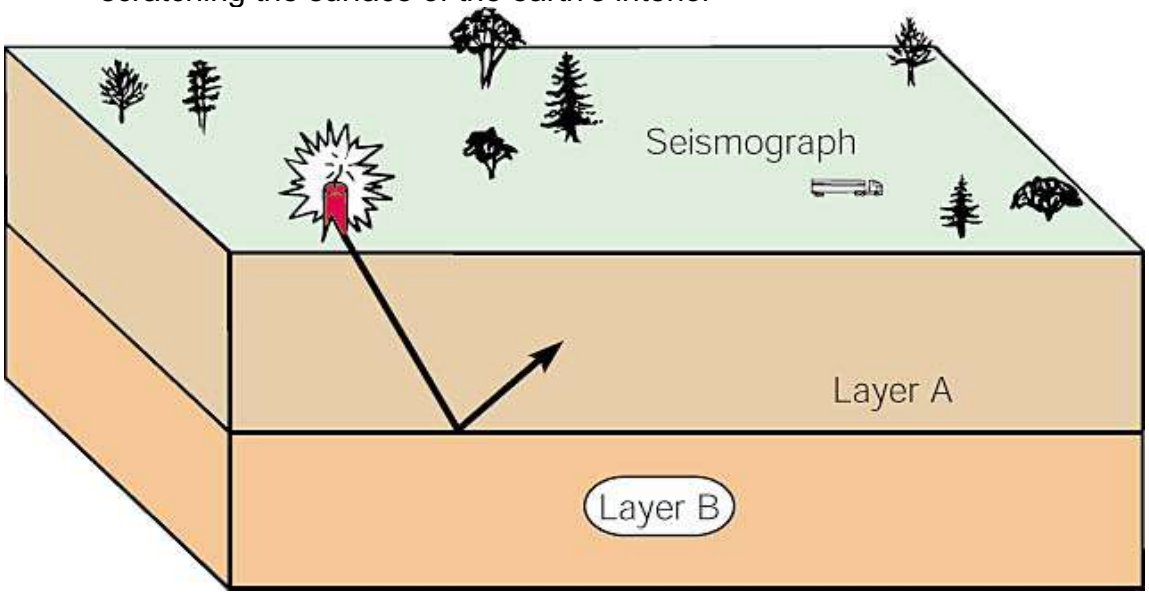
III. EARTH INTERIOR STRUCTURE

Compare the following studies: Geology (of earth's resources), Geography (of earth's shape and features), Ecology (organisms on earth)….. Environmental (combining all the previous and considering the earth as the environment in which we live and seek to exploit and sustainably develop)

How can we get information about the interior of the Earth?

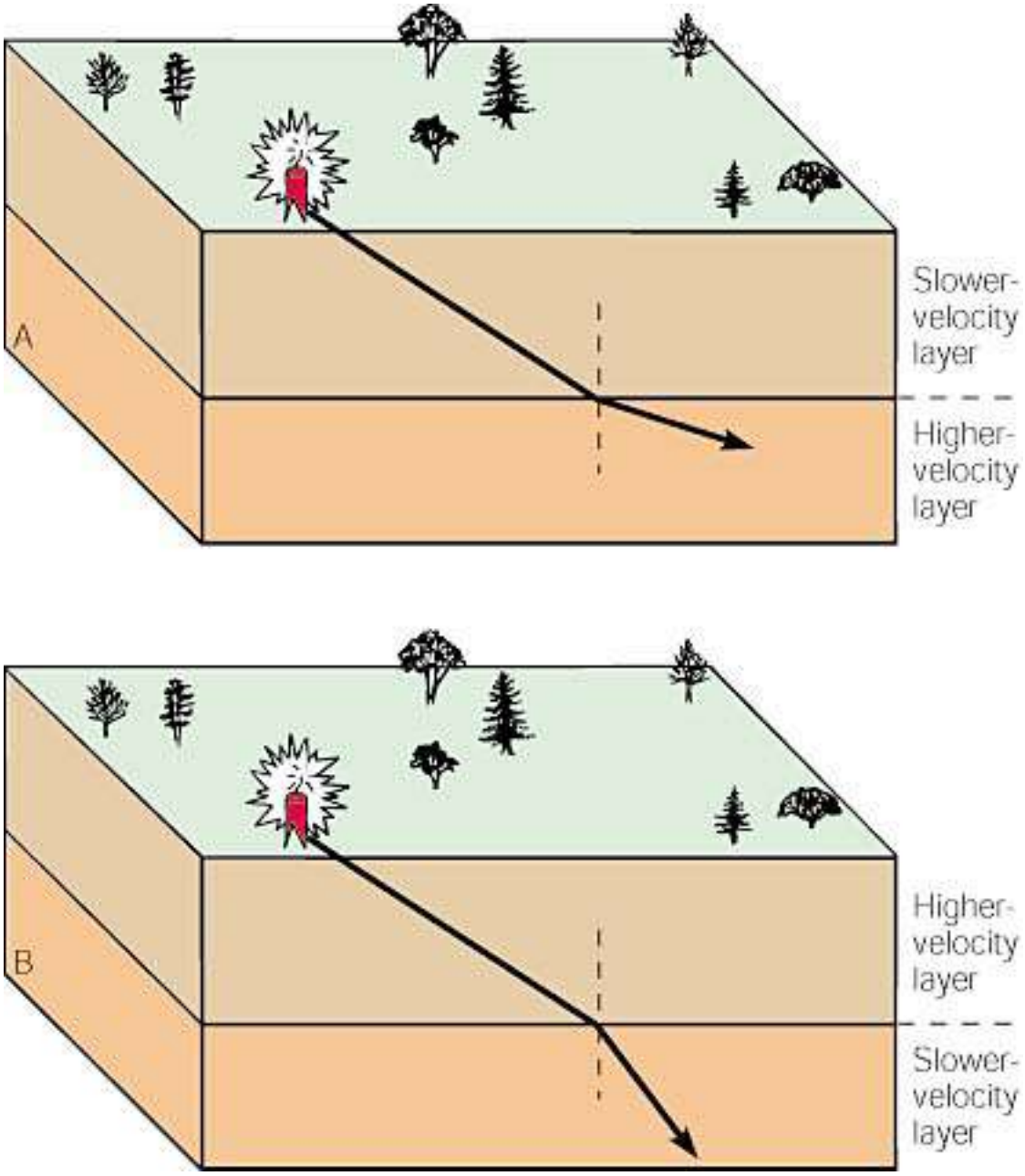
Study the terrain; dig wells (water, boreholes, oil wells), mining shafts; study fountains, earthquakes and volcanoes; apply seismic waves and observe their transmission/reflection properties.

- This drilling ship samples sediment and rock from the deep ocean floor. It can only sample materials well within the upper crust of the earth, however, barely scratching the surface of the earth's interior



- Seismic waves require a certain time period to reflect from a rock boundary below the surface. Knowing the velocity, you can use the time required to calculate the depth of the boundary.

Cf a numerical example. Cf ocean sounding.. ultrasonic imaging.



Slower velocity➔higher refractive index n. Fermat's principle of least time

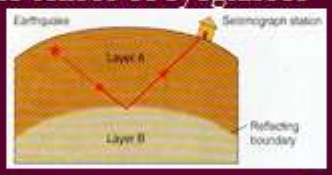
- (A)A seismic wave moving from a slower-velocity layer to a higher-velocity layer is refracted up. (B) The reverse occurs when a wave passes from a higher-velocity to a slower-velocity layer.

The Earth's Interior

Prepared by Betsy Conklin for
Dr. Isiorho

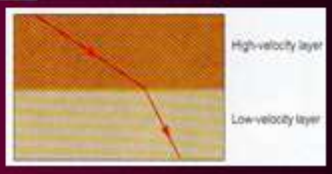
Evidence from Seismic Waves

- seismic reflection: the return of some of the energy of seismic waves to the earth's surface after the waves bounce off a rock boundary
- seismic refraction: the bending of seismic waves as they pass from one material to another, which is similar to the way that light waves bend when they pass through the lenses of eyeglasses



Seismic reflection

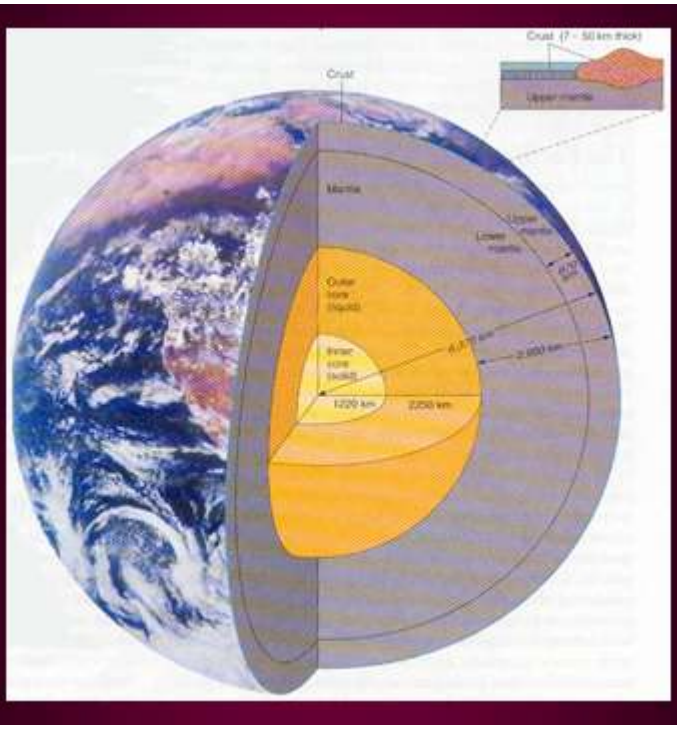
Low-velocity layer above high-velocity layer (seismic refraction)



High-velocity layer above low-velocity layer (seismic refraction)

The Earth's Internal Structure

- crust: the outer layer of rock, which forms a thin skin on the earth's surface
- mantle: a thick shell of rock that separates the crust above from the core below
- core: the central zone of the earth



The structure of Earth can be defined in two ways: by mechanical properties such as rheology, or chemically.
Mechanically, it can be divided into lithosphere, asthenosphere, mesospheric mantle, outer core, and the inner core.
Chemically, Earth can be divided into the crust, upper mantle, lower mantle, outer core, and inner core. The geologic component layers of Earth[3] are at the following depths below the surface:

Depth		
Kilometres	Miles	Layer
0–60	0–37	Lithosphere (locally varies between 5 and 200 km)
0–35	0–22	... Crust (locally varies between 5 and 70 km)
35–60	22–37	... Uppermost part of mantle
35–2,890	22–1,790	Mantle
210-270	130-168	... Upper mesosphere (upper mantle)
660–2,890	410–1,790	... Lower mesosphere (lower mantle)
2,890–5,150	1,790–3,160	Outer core
5,150–6,360	3,160–3,954	Inner core

The Crust

- Mohorovicic discontinuity (Moho for short): the boundary that separates the crust from the mantle
- Studies of seismic waves have shown
  - that the earth's crust is thinner beneath the ocean than beneath the continents
  - that seismic waves travel faster in oceanic crust than in continental crust

The Crust

The crust is the thin layer of solid, brittle material that covers the Earth. There are some differences in the crust depending on where on the surface you are.

The crust under the ocean is much thinner than the crust under the continents.

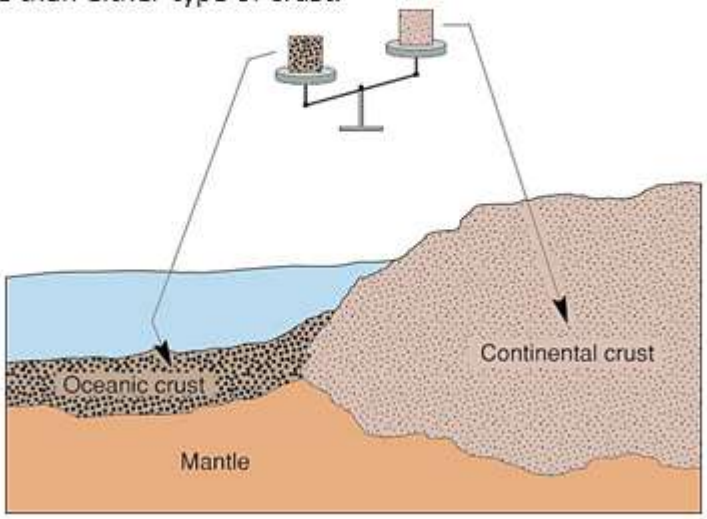
Seismic waves move faster through the oceanic crust that through the continental crust.

The material that makes up the crust is called **sial**

This is due to the fact that it is mostly made up of rocks containing silicon and aluminum.

The oceanic crust is called **sima** as it is made up mostly of rocks containing silicon and magnesium.

Continental crust is less dense, granite-type rock, while the oceanic crust is more dense, basaltic rock. Both types of crust behave as if they were floating on the mantle, which is more dense than either type of crust.



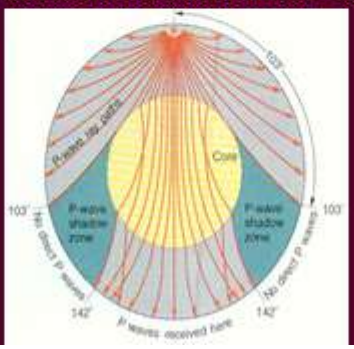
- The ocean contains chains of mountains called **oceanic ridges.**
- The ocean also contains long, narrow trenches that always run parallel to the continents, called **oceanic trenches.**

The Mantle

- because of the way seismic waves pass through the mantle, geologists believe that, like the crust, it is made of solid rock
- lithosphere: the outer shell of the earth that is relatively strong and brittle, made up of the crust and the upper mantle
- asthenosphere: a region of the earth's mantle that is of indeterminate thickness, behaves plastically, and is beneath the lithosphere

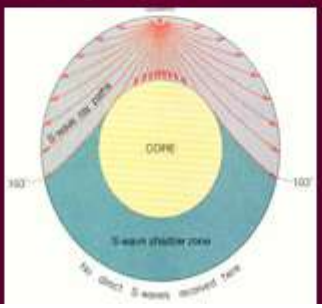
The Core

- P-wave shadow zone: the region on the earth's surface, 103° to 142° away from an earthquake epicenter, in which P waves from the earthquake are absent
- the way in which P waves are refracted within the earth's core suggests that the core has two parts, a liquid outer core and a solid inner core



The Core (cont.)

- S-wave shadow zone: the region on the earth's surface (at any distance more than 103° from an earthquake epicenter) in which S waves from the earthquake are absent
- The S-wave shadow zone seems to indicate that S waves do not travel through the core at all, if this is true, it implies that the core of the earth is a liquid, or at least acts like a liquid



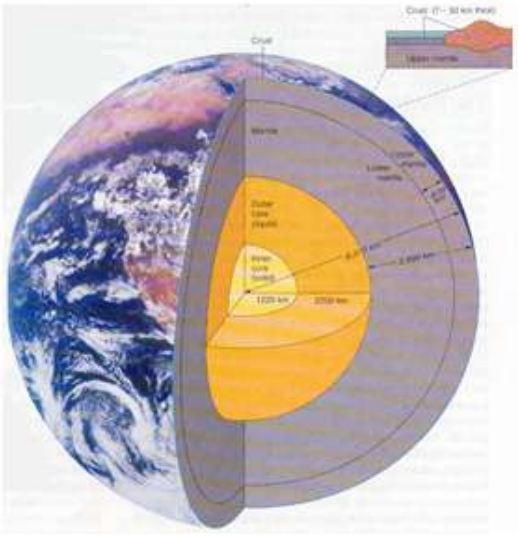
The Core-Mantle Boundary

- The boundary between the core and mantle is marked by great changes in density and temperature
- convection: a circulation pattern in which low density material rises and high density material sinks
- heavy portions of the mantle might sink to its base, but are unable to penetrate the denser core
- light portions of the core may rise to its top, but not into the mantle above

Heat Within the Earth

- geothermal gradient: the temperature increase with depth into the earth
- heat flow: the gradual loss of heat through the earth's surface

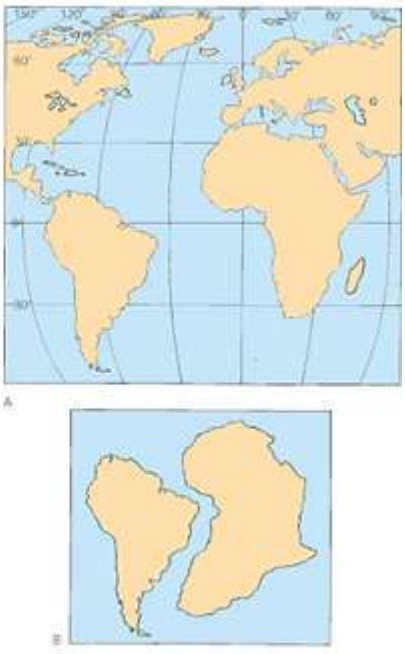
The interior **structure of the Earth** is layered in spherical shells, like an onion. These layers can be defined by their chemical and their rheological properties. Earth has an outer silicate solid crust, a highly viscous mantle, a liquid outer core that is much less viscous than the mantle, and a solid inner core.



Motions in the Earth's Interior

Convection between Core and Mantle as a result of temperature difference.. Volcanoes, earthquakes. Continental Drift

(A)Normal position of the continents on a world map. (B) A sketch of South America and Africa, suggesting that they once might have been joined together and subsequently separated by a continental drift.



Heat generated by radioactive decay in the Earth creates movement of rock
This movement of material is called **convection**
Convection occurs because hotter material will be less dense than its cooler surroundings and consequently will rise while cooler material sinks

Convection in the Earth's Interior
The crust and mantle are solid rock, although when heated, rock may develop convective Motions
These convective motions are slow, but are the cause of: earthquakes, volcanoes, the Earth'smagnetic field, and perhaps the atmosphere itself

Plate Tectonics

Rifting
Hot, molten material rises from deep in the Earth's interior in great, slow plumes that work their way to the surface. Near the surface, these plumes spread and drag the surface layers from below. The crust stretches, spreads, and breaks the surface in a phenomenon called **rifting**

Subduction
Where cool material sinks, it may drag crustal pieces together buckling them upward into mountains
If one piece of crust slip under the other, the process is called **subduction**
Rifting and subduction are the dominant forces that sculpt the landscape – they may also trigger earthquakes and volcanoes

As we discuss the environment, we must learn to put things in relative frames and perspectives. While we should not neglect the smaller fries, it is not right to focus on them to the detriment of bigger issues.
Eg, greenhouse effect is a scientific reality. Current global warming is a fact. But we must adopt holistic perspectives when discussing contributions of anthropogenic activities to global warming (same trend is reported on the other planets, for instance); and in building future scenarios, we must incorporate the historic/pre-historic patterns. In particular, are we headed for an ice age sometime soon?

DISCUSSION: ENVIRONMENTAL IMPACT OF MT ST HELENS VOLCANO. MAY 1980. See http://creation.com/lessons-from-mount-st-helens
Geological layers form in hours, Canyons carved quickly, Grooves not from glaciers, Forest destruction explains ancient coal and forests.
Yet, by volcanic standards, even in historic times, the Mount St Helens blast was relatively small, ejecting some 1 km^3 (0.2 cubic miles) of ash. The eruption of Vesuvius in ad 79 was three times larger, Krakatoa in 1883 was 18 times bigger, and Tambora in 1815 was 80 times larger. The volume of lava in the Deccan Traps in India is some 5 million times more.

NASA, while considering hazards to the planet via some catastrophic collision with some space debris, have admitted that a much urgent and severe catastrophe is imminent: Yellowstone!

Assignment: 1. Describe some strategies being proposed by the NASA to mitigate the potential explosion of the Yellowstone supervolcano.

2. Give a brief account of the explosion of Mt St Helens volcano on May 18, 1980, and highlight some of the lessons learnt about the core of the earth, and the consequences of catastrophic incidents on the environment.

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=======EXTRA READING==========

The rapid formation of coal and oil

(from https://www.creationworldview.org/

A question that I am frequently asked during the course of our presentations is, "If the earth is only 6,000 years old, then how did the fossil fuels of coal and oil come into existence?" Hopefully, I can make the answer simple to understand.

Coal and oil are found sandwiched between sedimentary rock layers. Sedimentary rock layers are basically layers of dried out mud. This means that all the layers, including the layers of coal and oil, were laid down primarily by the action of water in a flood. In addition, **almost all coal and oil is derived from vegetation.**

Coal (charred animal remains) and oil produced from animal remains contains nitrogen products that are not found in oil that comes from vegetable materials. Thus, it is easy to tell one type of deposit from the other.

Most people are startled to learn that coal and oil are basically the same thing. **The only real difference is the amount of water contained within the deposits!**

Laboratory research in the past few decades has shown that coal and oil may be formed quickly. In May of 1972, George R. Hill, Dean of the College of Mines and Mineral Industries wrote an article published in the *Journal of Chemical Technology* , now know as *Chemtech* . On p. 292, he commented:

"A rather startling and serendipitous discovery resulted. . . . These observations suggest that in their formation, high rank coals, . . . were probably subjected to high temperature at some stage in their history. A possible mechanism for formation of these high rank coals could have been a short time, rapid heating event."

What happened was that Hill made coal (indistinguishable from natural coal); and, he did it in six hours.

Over 20 years ago British researchers invented a way to turn household garbage into an oil suitable for use in home heating and for use in electric power plant generation. On February 26, 1982 , a reporter for the *Sentinel Star* quoted Noel McAuliffe of Manchester University.

"We are doing in 10 minutes what it has taken nature 150 million years to do."

While I completely disagree with his belief in a time period that existed 150 million years ago, his statement that oil was formed in only 10 minutes is the key point.

Natural coal may also be formed quickly. Argonne National Laboratories has reported on research proving that under natural conditions coal may be formed in only 36 weeks.

In an article published in Organic Geochemistry Vol. 6:463-471, 1984 (Oxidative Degradation Studies and Modern Concepts of the Formation and Transformation of Organic Constituents of Coals and Sedimentary Rocks, Ryoichi Hayatsu, Randall E. Winans, Robert L. McBeth, Robert G. Scott and Leon P. Moore, Chemistry Division Argonne National Laboratory, Argonne, IL 60439 USA.) it was reported that

all that was required for coal to form was that wood with kaolin clay as a catalyst must be buried deep enough that there is no oxygen, with a ground temperature of 150 degrees Celsius, and you will get coal in only 36 weeks. Further, it was noted that **if the temperature were higher, the coal would form faster.**

More on rapid formation of natural oil? Middleton, Holyland, Loewenthal and Bruner reported in *Journal of The Petroleum Exploration Society of Australia* , No. 24, 1996, pp. 6-12:

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WATER RESOURCES

Value of water on Earth. "Next global war will be on account of water". Cf Biblical times. Current, Israel's strategies to achieving water security in the desert.

Our bodies comprise mostly of water, we need regular rehydration (via intake) to survive. Bathing with water is more than social, it makes for good health. Water for sanitation more than social, diarrheal diseases (preventable by available of running water) is top killer in Nigeria! (about 17 dead every HOUR round the clock!). No water, no agriculture (cf Israel's drip root zone technology).

Some contemporary examples:

Aral Sea https://en.wikipedia.org/wiki/Aral_Sea

Formerly the fourth largest lake in the world with an area of 68,000 km² (26,300 sq mi), the Aral Sea began shrinking in the 1960s after the rivers that fed it were diverted by Soviet irrigation projects. By 2007, it had declined to 10% of its original size, splitting into four lakes: the North Aral Sea, the eastern and western basins of the once far larger South Aral Sea, and the smaller intermediate Barsakelmes Lake.[6]

By 2009, the southeastern lake had disappeared and the southwestern lake had retreated to a thin strip at the western edge of the former southern sea. In subsequent years occasional water flows have led to the southeastern lake sometimes being replenished to a small degree.[7] Satellite images by NASA in August 2014 revealed that for the first time in modern history the eastern basin of the Aral Sea had completely dried up.[8] The eastern basin is now called the Aralkum Desert.

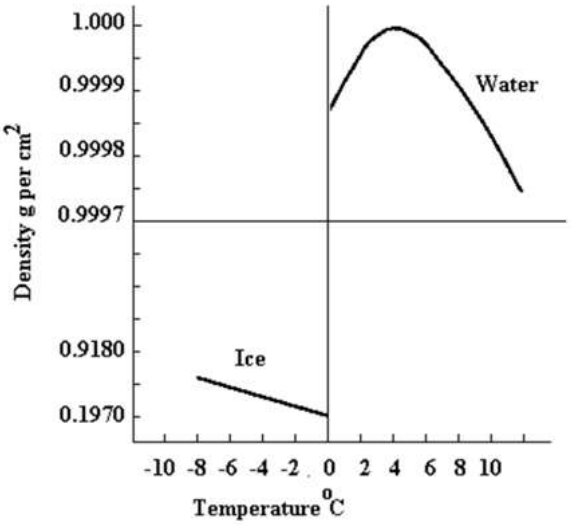
Question: Critique this recent popular presentation on the extinction of the Aral Sea, Uzbekistan https://www.facebook.com/nasdaily/videos/why-did-this-sea-vanish-and-turn-into-a-desert/561382441548405/

Lagdo Dam, Cameroon and Nigeria floods; https://saharareporters.com/2022/10/21/cameroonian-government-didnt-inform-us-releasing-water-lagdo-dam-nigerian-water

Anomalous density profile of water wrt temperature and implications for marine lifeforms.

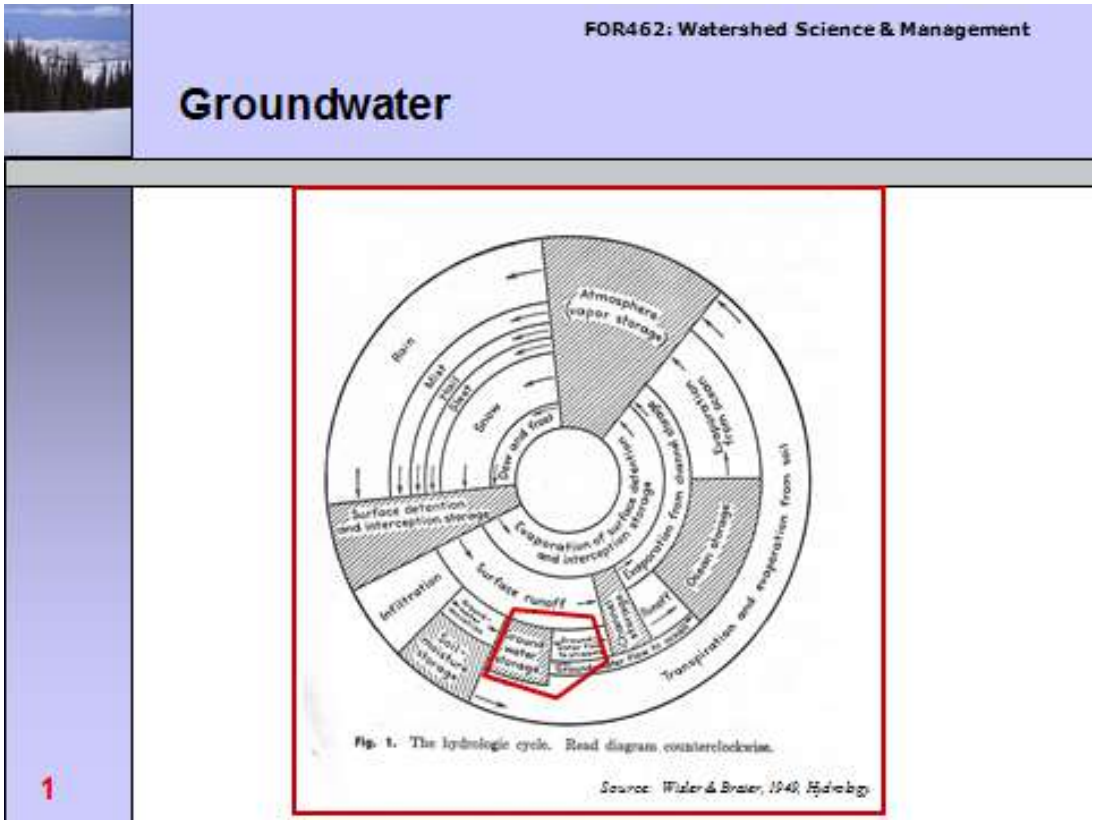
Anomalous Expansion of Water

In our discussion of volume expansivity, we mentioned that water has negative values for ß within the range 0°C and 4°C. That is as temperature increases from 0°C towards 4°C, the volume of water CONTRACTS rather than expand with increasing temperature. This is because water, because of its unique configuration of its molecules, has its maximum density at a temperature of 4°C. See diagram. Were this "anomalous" property not the situation, aquatic life would not be possible in those regions of the world where the rivers and lakes freeze during winter. The density of water at 4°C is higher than the density of ice (solid water), so no matter how much ice is formed on the surface of the lake, there is always liquid water below at a cozy temperature of 4°C.



The anomalous expansion of water is an abnormal property of water whereby it expands instead of contracting when the temperature goes from 4o C to 0o C, and it becomes less dense. The density is maximum at 4 degree centigrade and decreases below that temperature as shown in graph. The density becomes less and less as it freezes because molecules of water normally form open crystal structures when in solid form. (From https://www.toppr.com/ask/content/concept/anomalous-expansion-of-water-210020/)

The Hydrological cycle. The Vanished Sea (Sea). Dead Sea. Flooding: glaciers, hurricanes, tsunamis.



The Hydrological Cycle. Showing Storages (Ground Water storage highlighted by red marking)

Ocean . Atmospheric (Vapour storage). Surface Detention and Interception. Groundwater/Soil moisture. Vegetation/organisms. Glaciers.

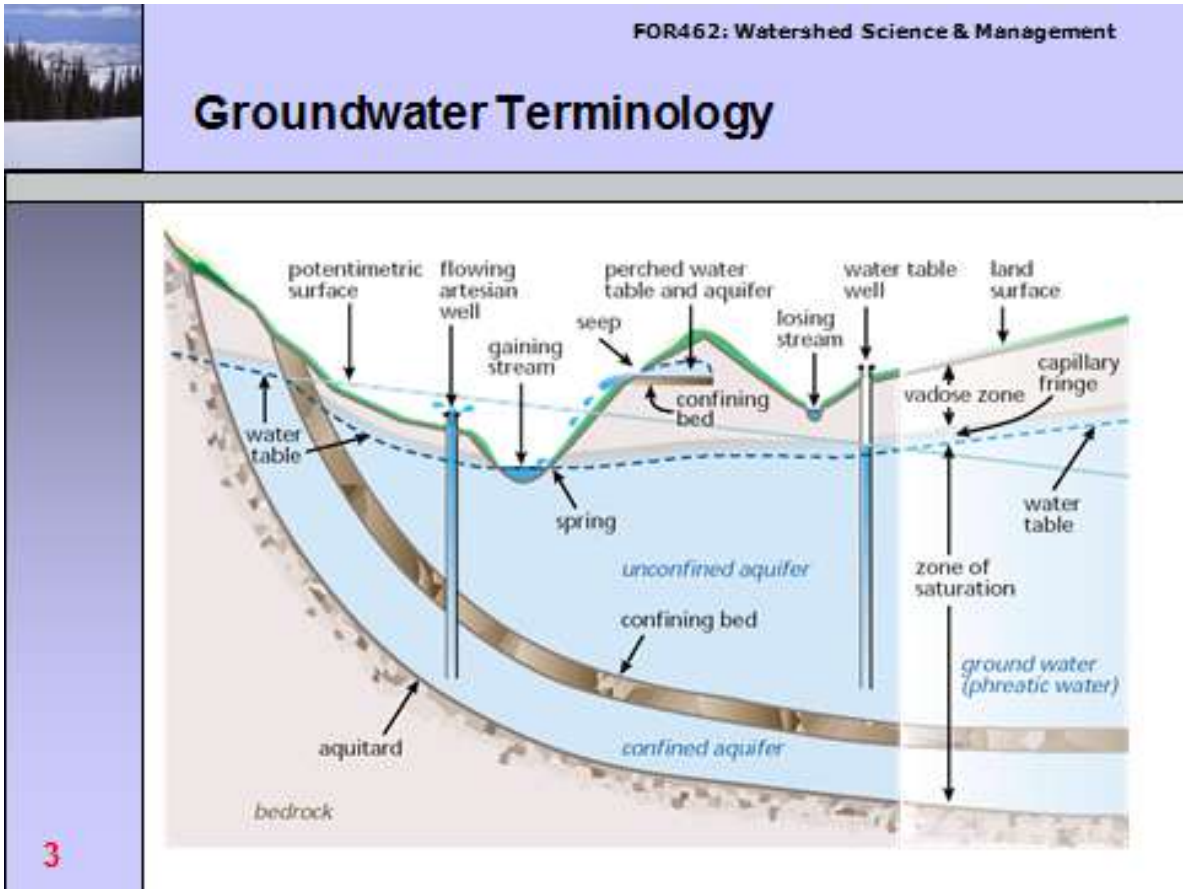
From Atmospheric: Rain, Mist, Dew, Sheet/hail, Snow….

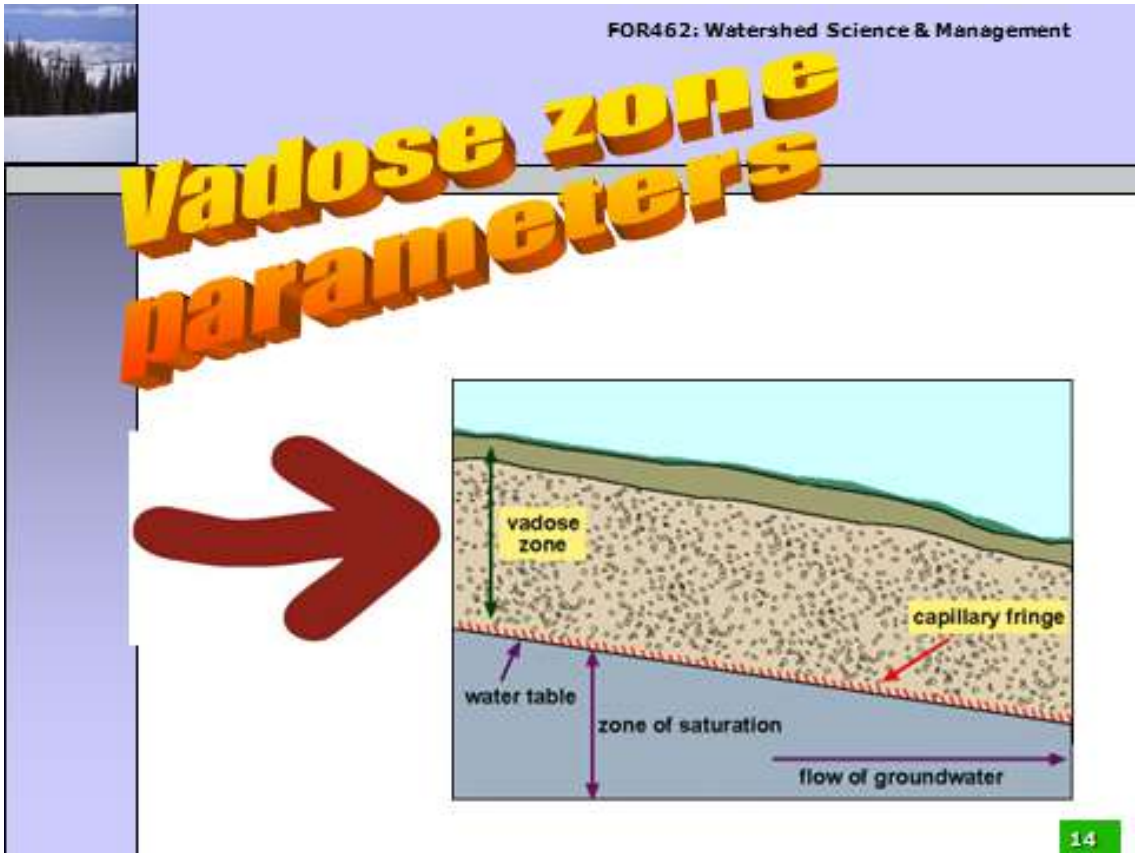
IV. GROUNDWATER

Groundwater is water located beneath the ground surface in soil pore spaces and in the fractures of lithologic formations. A unit of rock or an unconsolidated deposit is called an aquifer when it can yield a usable quantity of water. The depth at which soil pore spaces or fractures and voids in rock become completely saturated with water is called the water table. Groundwater is recharged from, and eventually flows to, the surface naturally; natural discharge often occurs at springs and seeps, and can form oases or wetlands. Groundwater is also often withdrawn for agricultural, municipal and industrial use by constructing and operating extraction wells. The study of the distribution and movement of groundwater is hydrogeology, also called groundwater hydrology.

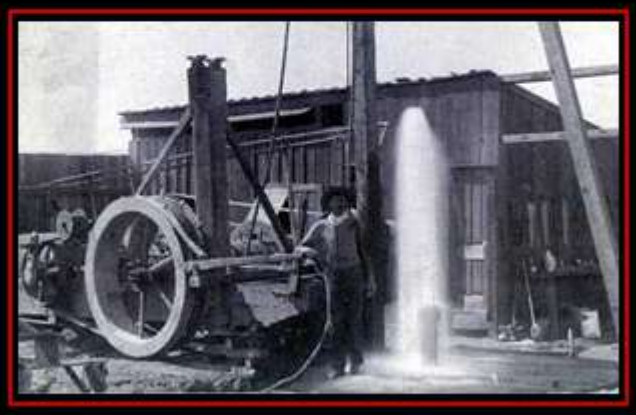
Typically, groundwater is thought of as liquid water flowing through shallow aquifers, but technically it can also include soil moisture, permafrost (frozen soil), immobile water in very low permeability bedrock, and deep geothermal or oil formation water. Groundwater is

hypothesized to provide lubrication that can possibly influence the movement of faults.





Artesian Well



Hyporheic Zone

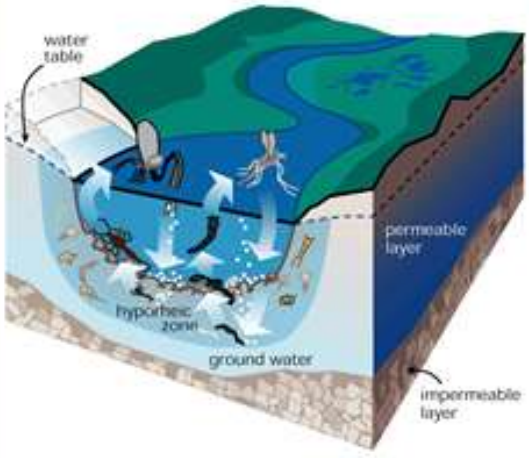


Fig. 2.35 – Hyporheic zone. Summary of the different zones of migration undergone by members of the stream benthic community.
In Stream Corridor Restoration: Principles, Processes, and Practices (10/98).
Interagency Stream Restoration Working Group (15 federal agencies)(USDA/NRCS).

- Zone where water is exchanged between surface and groundwater
- Controlled by geomorphology (upwelling and downwelling)
- Biochemical processing: water quality & habitat issues
- Temperature

Darcy's Law

Darcy's Law defines groundwater flow:

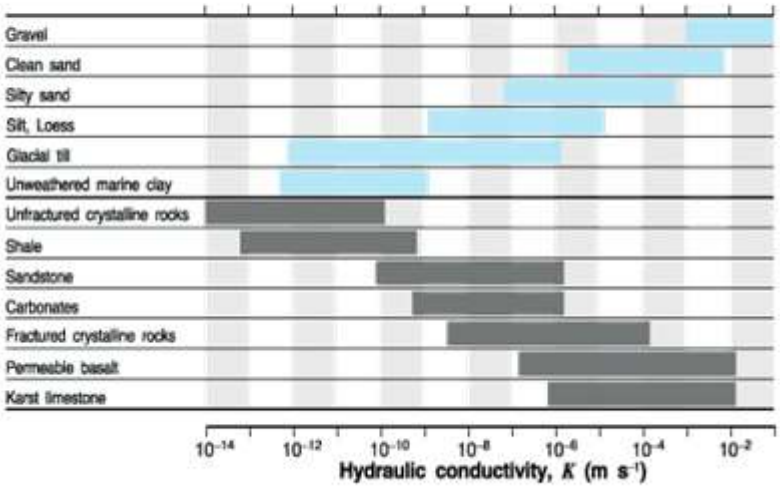
$$Q = k_v A \frac{dh_t}{dx}$$

where:
Q is discharge ($L^3 T^{-1}$)
k_v is the hydraulic conductivity ($L T^{-1}$)
A is area of flow (L^2), and
dh_t/dx is the gradient of pressure, or head

6

Calculate the discharge of groundwater through an Area of …… in a region of clay with a slope of …… Take the hydraulic conductivity of clay as

Hydraulic Conductivity (k_v)



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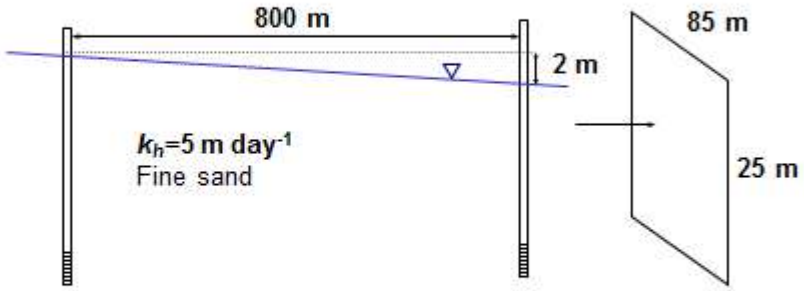
Hornberger, 1998

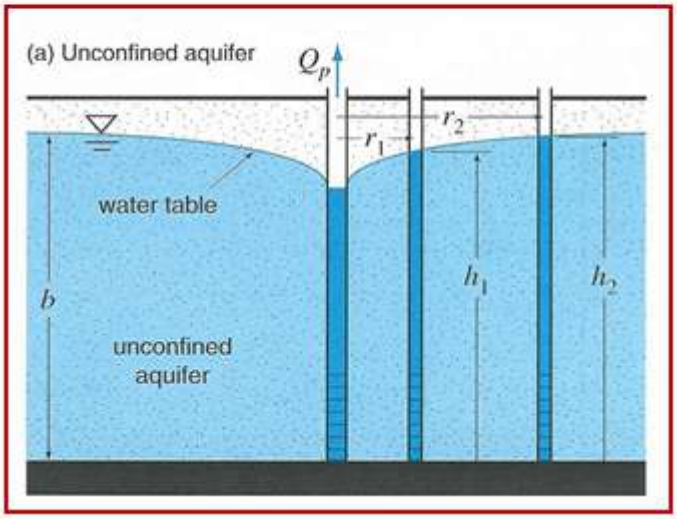
Example



$$Q = k_v A \frac{dh_t}{dx} = \left(5 \tfrac{\text{m}}{\text{day}}\right)\left(25\,\text{m} \times 85\,\text{m}\right)\left(\frac{2.0\,\text{m}}{800\,\text{m}}\right) = 26.6 \tfrac{\text{m}^3}{\text{day}}$$

8

Groundwater Development



9

GroundWater Issues in Lagos

Pollution, Availability, Others (Subsidence, Salt water intrusion)

(1) subsidence
(2) The heavy depletion of the resource which is a finite resource (only 6% of the earths groundwater resource is renewable in a human lifetime). A place like Lagos is particularly

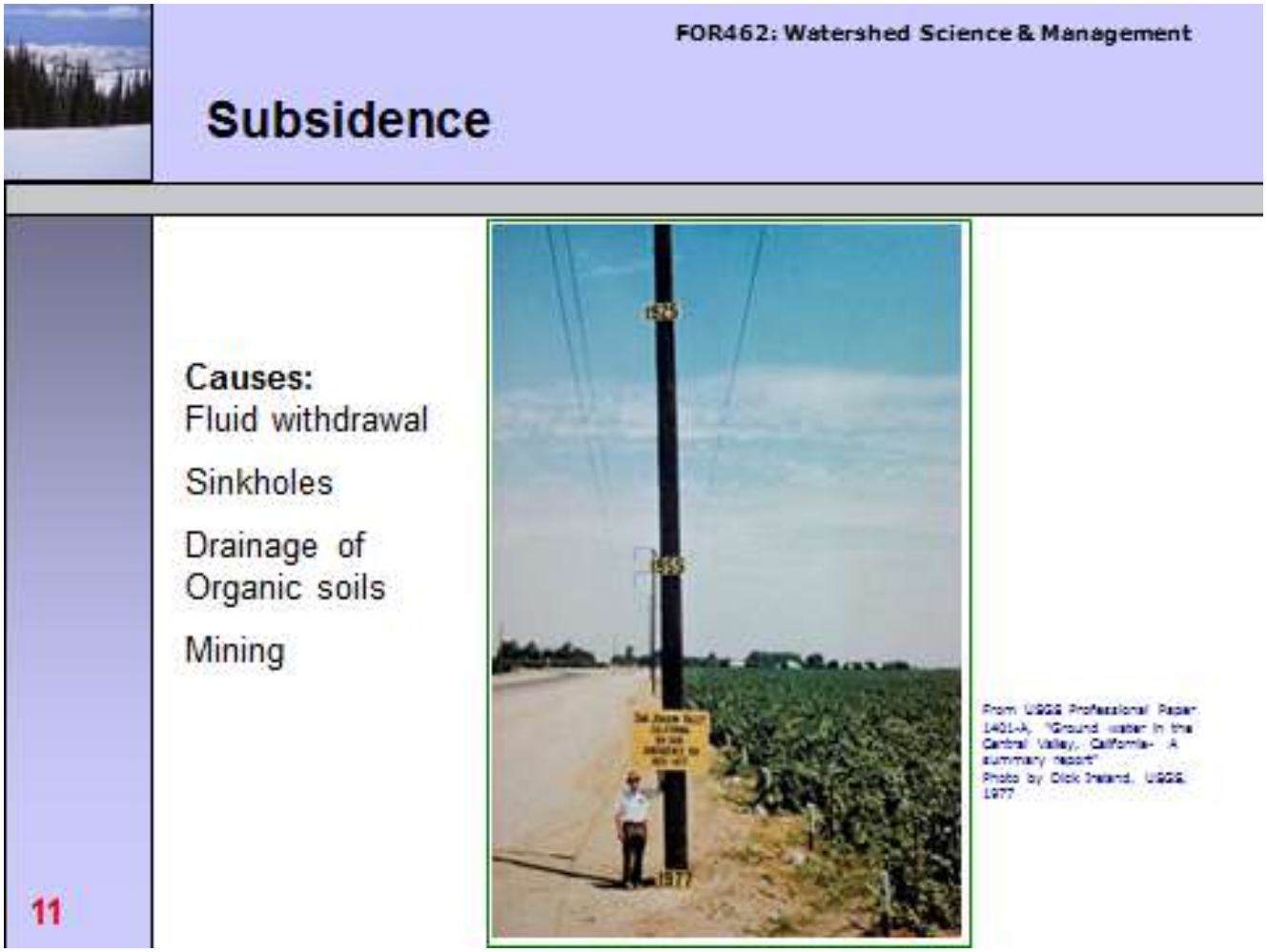
threatened with lack of water, considering the population ratio to the land mass
(3) The total absence of any serious form of monitoring and the effects of the depletion on the earth's crust
(4) The effect of salt water intrusion on the groundwater ecosystem (salt water is heavier and as Lagos is on the Atlantic coastline, with the reduction in the groundwater level, the salt water with intrude further inland).

What are the main issues in the proposed contentious Water resources Control Bill?

Subsidence

Main article: Groundwater-related subsidence

In its natural equilibrium state, the hydraulic pressure of groundwater in the pore spaces of the aquifer and the aquitard supports some of the weight of the overlying sediments. When groundwater is removed from aquifers by excessive pumping, pore pressures in the aquifer drop and compression of the aquifer may occur. This compression may be partially recoverable if pressures rebound, but much of it is not. When the aquifer gets compressed it may cause land subsidence, a drop in the ground surface. The city of New Orleans, Louisiana, is actually below sea level today, and its subsidence is partly caused by removal of groundwater from the various aquifer/aquitard systems beneath it. In the first half of the 20th century, the city of San Jose, California, dropped 13 feet from land subsidence caused by overpumping; this subsidence has been halted with improved groundwater management.



From USGS Professional Paper 1401-A, "Ground water in the Central Valley, California- A summary report"
Photo by Dick Ireland, USGS, 1977

Seawater intrusion

Generally, in very humid or undeveloped regions, the shape of the water table mimics the slope of the surface. The recharge zone of an aquifer near the seacoast is likely to be inland, often at considerable distance. In these coastal areas, a lowered water table may induce sea water to reverse the flow toward the sea. Sea water moving inland is called a saltwater intrusion. Alternatively, salt from mineral beds may leach into the groundwater of its own accord.

Mining

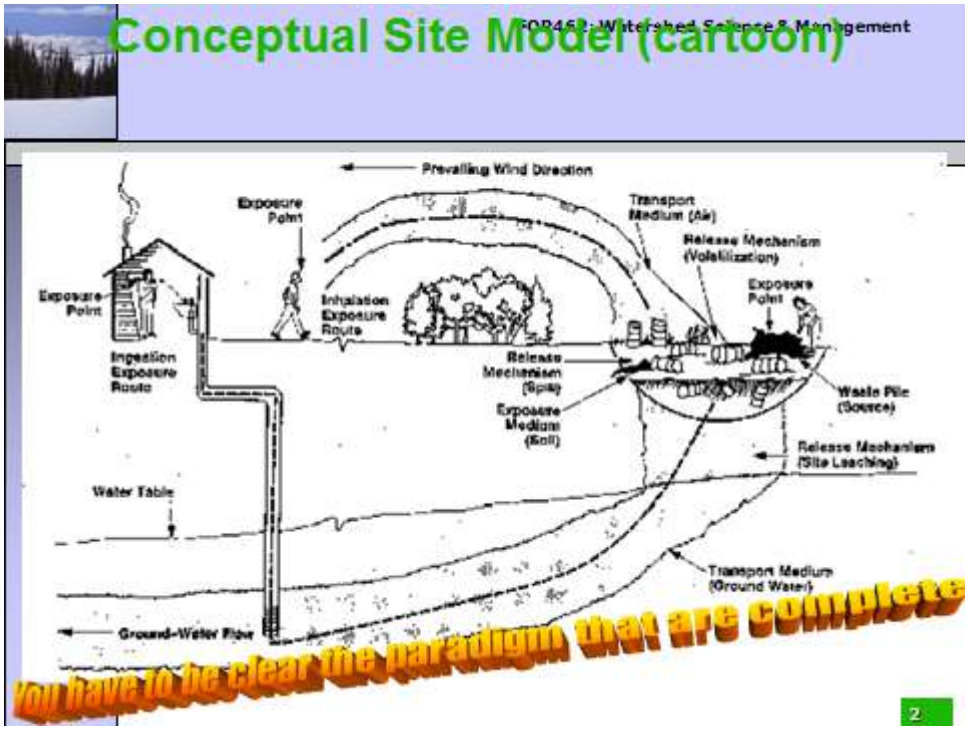
Sometimes the water movement from the recharge zone to the place where it is withdrawn may take centuries (see figure above). When the usage of water is greater than the recharge, it is referred to as *mining* water . Under those circumstances it is not a renewable resource.

POLLUTION:

Biological (Microorganisms leading to diseases like cholera, diarrhea, typhoid, etc) From Sewages, pit latrines, etc

Chemical – Organics (pesticides, herbicides (eg. Atrazine, roundup, etc), hormones in contraceptives; Inorganics (from industrial effluents, etc)

Radioactivity: From mining (naturally-occurring radioisotopes are brought from underground, released from the ores in a form that can dissolve in groundwater, etc; and radioisotopes deliberately introduced underground for a number of purposes e.g. in oil industry)



The Law regulating Ground Water pollution in Nigeria is the National Environmental (Surface and Groundwater Quality Control) Regulation 2011. (see below)

Federal Republic of Nigeria
Official Gazette

No. 49 **Lagos - 24th May, 2011** **Vol. 98**

Government Notice No. 136

The following is published as Supplement to this *Gazette* :

S. I. No.	*Short Title*	*Page*
22	National Environmental (Surface and Groundwater Quality Control) Regulations, 2011	B 693-727

PART B—GROUND WATER QUALITY CONTROL

19. Purpose.

20. Injection Wells, Landfills and Burrow Pits.

Schedule IV : Target and Intervention Values for Micro Pollutants for Groundwater.

Schedule V : Limit for Substances and Characteristics Affecting the Acceptability of Groundwater for Domestic Use.

Schedule VI : Microbiological Limits for Groundwater.

Injection Wells'

Class I: Wells used for re-injection of waste

Class II Wells used to inject fluids (oil and natural gas production)

Class III: Wells used for extraction of minerals

Class IV: wells used by generators of radioactive wastes

Class V: wells not included in classes I-IV.

2.Landfills and Burrow pits:

706

(2) *Landfills and Burrow Pits* : Landfills are natural or excavated holes or depressions used for burying waste material or refuse. Borrow pits are large holes that are primarily dug for the purpose of collecting earth materials usually soil, gravel or sand to be used at another location, but could also be used for burying waste material or refuse.

"*Formation Fluid*" means fluid present in a formation under natural onditions (as opposed to introduced fluids, such as drilling mud).

"*Groundwater*" means water found underground which partially or ompletely fills the open spaces between particles of soil and within rock rmations.

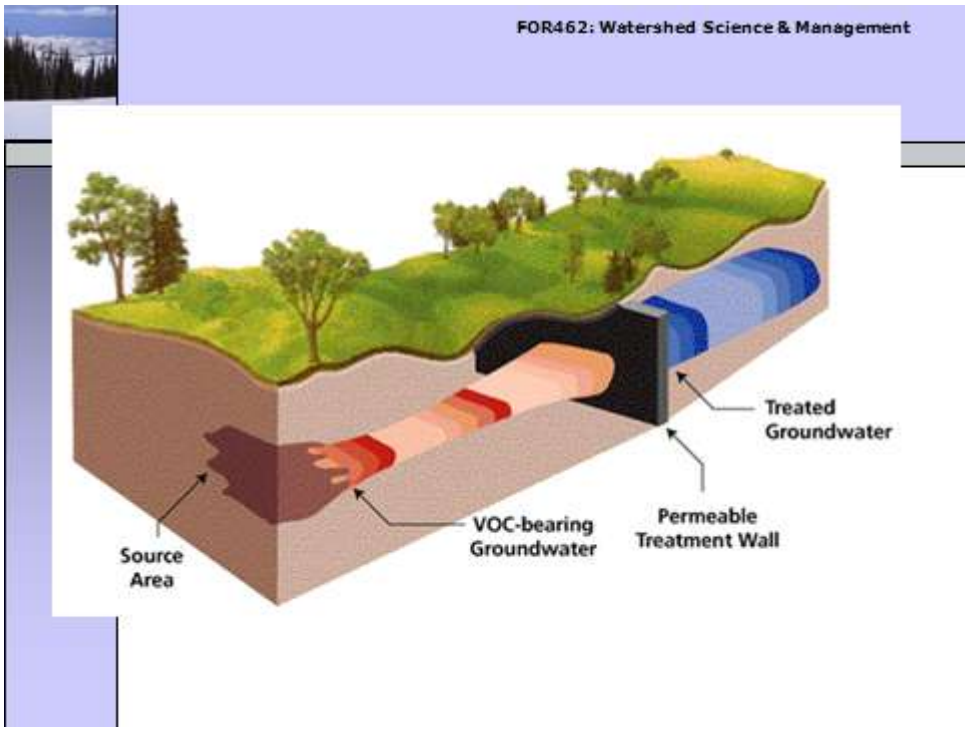
"*Fluid*" means any material or substance that is capable of movement whether in a semisolid, liquid, sludge, gas, or any other physical state.

"*Formation*" means a body of rock characterized by a degree of lithologic homogeneity, which is prevailingly, but not necessarily tabular and mapable on the earth's surface or traceable in the subsurface.

"*Formation Fluid*" means fluid present in a formation under natural conditions (as opposed to introduced fluids, such as drilling mud).

"*Groundwater*" means water found underground which partially or completely fills the open spaces between particles of soil and within rock formations.

"*Habitat*" means the area which provides direct support for a given species, population or community. It includes all environmental features that make up an area such as air, water, vegetation, soil, substrate and hydrologic characteristics.



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V. Weathering, Erosion, Ecology

From Wikipedia, the free encyclopedia
This article is about weathering of rocks and minerals. For weathering of polymers, see

A natural arch produced by erosion of differentially weathered rock in Jebel Kharaz (Jordan)

Weathering is the breaking down of rocks, soil, and minerals as well as wood and artificial materials through contact with the Earth's atmosphere, waters, and biological organisms. Weathering occurs *in situ* (on site), that is, in the same place, with little or no movement, and thus should not be confused with erosion, which involves the movement of rocks and minerals by agents such as water, ice, snow, wind, waves and gravity and then being transported and deposited in other locations.

Two important classifications of weathering processes exist – physical and chemical weathering; each sometimes involves a biological component. Mechanical or physical weathering involves the breakdown of rocks and soils through direct contact with atmospheric conditions, such as heat, water, ice and pressure (wind). The second classification, chemical weathering, involves the direct effect of atmospheric chemicals or biologically produced chemicals also known as biological weathering in the breakdown of rocks, soils and minerals.[1] While physical weathering is accentuated in very cold or very dry environments, chemical reactions are most intense where the climate is wet and hot. However, both types of weathering occur together, and each tends to accelerate the other.

The materials left over after the rock breaks down combined with organic material creates soil. The mineral content of the soil is determined by the parent material; thus, a soil derived from a single rock type can often be deficient in one or more minerals needed for good fertility, while a soil weathered from a mix of rock types (as in glacial, aeolian or alluvial sediments) often makes more fertile soil. In addition, many of Earth's landforms and landscapes are the result of weathering processes combined with erosion and re-deposition.

Physical weathering

Physical weathering, also recognized as mechanical weathering, is the class of processes that causes the disintegration of rocks without chemical change. The primary process in physical

weathering is abrasion Physical weathering can occur due to temperature, pressure, frost etc. For example, cracks exploited by physical weathering will increase the surface area exposed to chemical action, thus amplifying the rate of disintegration.

Abrasion by water, ice, and wind processes loaded with sediment can have tremendous cutting power, as is amply demonstrated by the gorges, ravines, and valleys around the world. In glacial areas, huge moving ice masses embedded with soil and rock fragments grind down rocks in their path and carry away large volumes of material. Plant roots sometimes enter cracks in rocks and pry them apart, resulting in some disintegration; Burrowing animals may help disintegrate rock through their physical action. However, such influences are usually of little importance in producing parent material when compared to the drastic physical effects of water, ice, wind, and temperature change. Physical weathering is also called mechanical weathering or disaggregation.

Thermal stress

Thermal stress weathering (sometimes called insolation weathering)[2] results from the expansion and contraction of rock, caused by temperature changes. For example, heating of rocks by sunlight or fires can cause expansion of their constituent minerals. **As some minerals expand more than others, temperature changes set up differential stresses that eventually cause the rock to crack apart**. Because the outer surface of a rock is often warmer or colder than the more protected inner portions, **some rocks may weather by exfoliation – the peeling away of outer layers.**

Frost weathering

A rock in Abisko, Sweden fractured along existing joints possibly by frost weathering or thermal stress

.

Ocean waves

Wave action and water chemistry lead to structural failure in exposed rocks

Coastal geography is formed by the weathering of wave actions over geological times or can happen more abruptly through the process of salt weathering.

Pressure release

See also: Erosion and tectonics

Pressure release could have caused the exfoliated granite sheets shown in the picture.

In pressure release, also known as unloading, overlying materials (not necessarily rocks) are removed (by erosion, or other processes), which causes underlying rocks to expand and fracture parallel to the surface.

Retreat of an overlying glacier can also lead to exfoliation due to pressure release.

Salt-crystal growth

Tafoni at Salt Point State Park, Sonoma County, California.

Salt crystallization, otherwise known as haloclasty, causes disintegration of rocks when saline solutions seep into cracks and joints in the rocks and evaporate, leaving salt crystals behind. These salt crystals expand as they are heated up, exerting pressure on the confining rock.

.

Biological effects on mechanical weathering

Living organisms may contribute to mechanical weathering (as well as chemical weathering, see 'biological' weathering below). Lichens and mosses grow on essentially bare rock surfaces and create a more humid chemical microenvironment. The attachment of these organisms to the rock surface enhances physical as well as chemical breakdown of the surface microlayer of the rock. On a larger scale, seedlings sprouting in a crevice and plant roots exert physical pressure as well as providing a pathway for water and chemical infiltration.

Chemical weathering

Comparison of unweathered (left) and weathered (right) limestone.

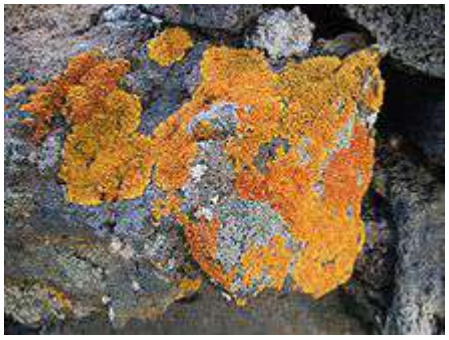
Chemical weathering changes the composition of rocks, often transforming them when water interacts with minerals to create various chemical reactions. Chemical weathering is a gradual and ongoing process as the mineralogy of the rock adjusts to the near surface environment. New or *secondary minerals* develop from the original minerals of the rock. In this the processes of oxidation and hydrolysis are most important. Chemical weathering is enhanced by such geological agents as the presence of water and oxygen, as well as by such biological agents as the acids produced by microbial and plant-root metabolism.

[ALSO ACID RAIN FOM POLLUTION]

The process of mountain block uplift is important in exposing new rock strata to the atmosphere and moisture, enabling important chemical weathering to occur; significant release occurs of Ca^{2+} and other ions into surface waters.[6]

Biological weathering

A number of plants and animals may create chemical weathering through release of acidic compounds, i.e. the effect of moss growing on roofs is classed as weathering. Mineral weathering can also be initiated and/or accelerated by soil microorganisms. Lichens on rocks are thought to increase chemical weathering rates. For example, an experimental study on hornblende granite in New Jersey, USA, demonstrated a 3x – 4x increase in weathering rate under lichen covered surfaces compared to recently exposed bare rock surfaces.[7]



Biological weathering of basalt by lichen, La Palma.
https://en.wikipedia.org/wiki/Weathering

VI. Erosion

(This is a big problem particularly in Eastern Nigeria!)

From Wikipedia, the free encyclopedia

An actively eroding rill on an intensively-farmed field in eastern Germany

In earth science, **erosion** is the action of surface processes (such as water flow or wind) that remove soil, rock, or dissolved material from one location on the Earth's crust, then transport it away to another location.[1] The particulate breakdown of rock or soil into clastic sediment is referred to as *physical* or *mechanical* erosion; this contrasts with *chemical* erosion, where soil or rock material is removed from an area by its dissolving into a solvent (typically water), followed by the flow away of that solution. Eroded sediment or solutes may be transported just a few millimetres, or for thousands of kilometres.

Natural rates of erosion are controlled by the action of geomorphic drivers, such as rainfall;

[2] bedrock wear in rivers; coastal erosion by the sea and waves; glacial plucking, abrasion, and scour; areal flooding; wind abrasion; groundwater processes; and mass movement

processes in steep landscapes like landslides and debris flows.

While erosion is a natural process, human activities have increased by 10-40 times the rate at which erosion is occurring globally. Excessive (or accelerated) erosion causes both "on-site" and "off-site" problems.

On-site impacts include decreases in agricultural productivity and (on natural landscapes) ecological collapse, both because of loss of the nutrient-rich upper soil layers. In some cases, the eventual end result is desertification.

Off-site effects include sedimentation of waterways and eutrophication of water bodies, as well as sediment-related damage to roads and houses. Water and wind erosion are the two primary causes of land degradation; combined, they are responsible for about 84% of the global extent of degraded land, making excessive erosion one of the most significant environmental problems worldwide.[5]:2[6]:1

Intensive agriculture, deforestation, roads, anthropogenic climate change and urban sprawl are amongst the most significant human activities in regard to their effect on stimulating erosion.[7] However, there are many prevention and remediation practices that can curtail or limit erosion of vulnerable soils.

Factors affecting erosion rates

Climate

The amount and intensity of precipitation is the main climatic factor governing soil erosion by water. The relationship is particularly strong if heavy rainfall occurs at times when, or in locations where, the soil's surface is not well protected by vegetation. This might be during periods when agricultural activities leave the soil bare, or in semi-arid regions where vegetation is naturally sparse. Wind erosion requires strong winds, particularly during times of drought when vegetation is sparse and soil is dry (and so is more erodible). Other climatic factors such as average temperature and temperature range may also affect erosion, via their effects on vegetation and soil properties. In general, given similar vegetation and ecosystems, areas with more precipitation (especially high-intensity rainfall), more wind, or more storms are expected to have more erosion.

Vegetative cover

See also: Vegetation and slope stability

Vegetation acts as an interface between the atmosphere and the soil. It increases the permeability of the soil to rainwater, thus decreasing runoff. It shelters the soil from winds, which results in decreased wind erosion, as well as advantageous changes in microclimate. The roots of the plants bind the soil together, and interweave with other roots, forming a more solid mass that is less susceptible to both water and wind erosion. The removal of vegetation increases the rate of surface erosion.[36]

Topography

The topography of the land determines the velocity at which surface runoff will flow, which in turn determines the erosivity of the runoff. Longer, steeper slopes (especially those without

adequate vegetative cover) are more susceptible to very high rates of erosion during heavy rains than shorter, less steep slopes. Steeper terrain is also more prone to mudslides, landslides, and other forms of gravitational erosion processes.[35]:28–30[37][38]

Tectonics

Main article: Erosion and tectonics

Tectonic processes control rates and distributions of erosion at the Earth's surface. If tectonic action causes part of the Earth's surface (e.g., a mountain range) to be raised or lowered relative to surrounding areas, this must necessarily change the gradient of the land surface. Because erosion rates are almost always sensitive to local slope (see above), this will change the rates of erosion in the uplifted area. Active tectonics also brings fresh, unweathered rock towards the surface, where it is exposed to the action of erosion.

Soils

If the rate of erosion is higher than the rate of soil formation the soils are being destroyed by erosion. While erosion of soils is a natural process, human activities have increased by 10-40 times the rate at which erosion is occurring globally. Excessive (or accelerated) erosion causes both "on-site" and "off-site" problems. On-site impacts include decreases in agricultural productivity and (on natural landscapes) ecological collapse, both because of loss of the nutrient-rich upper soil layers. In some cases, the eventual end result is desertification. Off-site effects include sedimentation of waterways and eutrophication of water bodies, as well as sediment-related damage to roads and houses. Water and wind erosion are the two primary causes of land degradation; combined, they are responsible for about 84% of the global extent of degraded land, making excessive erosion one of the most significant environmental problems worldwide.

See also

https://en.wikipedia.org/wiki/Erosion

Off-site effect of erosion: siltation and eutrophication. Roads degradation, houses, ancestral tombs etc washed away, etc.

Case Study: Siltation at Opa Dam, OAU, Ile-Ife

Eutrophication of the Lagos Lagoon/Water ways: Aquatic weeds (e.g. water hyacinths) – disrupt navigation, fishing, etc.

VII. Ecology

From Wikipedia, the free encyclopedia
For other uses, see Ecology (disambiguation).

Ecology (from Greek: οἶκος, "house", or "environment"; -λογία, "study of"[A]) is the scientific analysis and study of interactions among organisms and their environment. It is an interdisciplinary field that includes biology, geography, and Earth science.

Ecology includes **the study of interactions** organisms have with each other, other organisms, and with abiotic components of their environment. Topics of interest to ecologists include the diversity, distribution, amount (biomass), and number (population) of particular organisms, as well as cooperation and competition between organisms, both within and among ecosystems.

Ecosystems are composed of dynamically interacting parts including organisms, the communities they make up, and the non-living components of their environment.

Biodiversity *[Variety guarantees stability, prevents extinction in case of abrupt adverse changes/challenges in the environment]*

Main article: Biodiversity

Biodiversity refers to the variety of life and its processes. It includes the variety of living organisms, the genetic differences among them, the communities and ecosystems in which they occur, and the ecological and evolutionary processes that keep them functioning, yet ever changing and adapting.

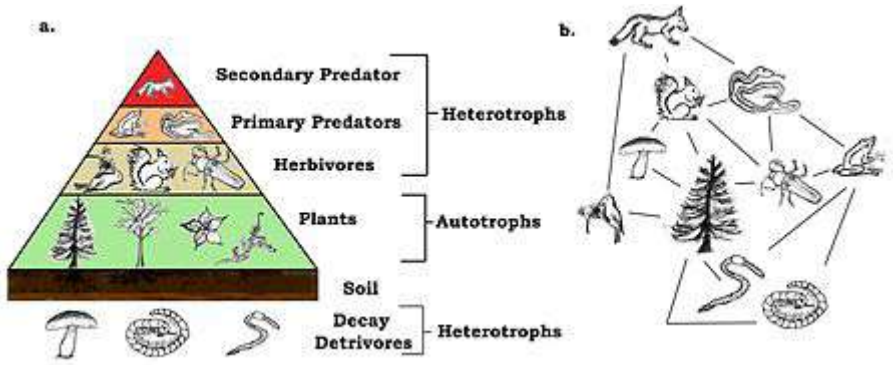
Noss & Carpenter (1994)[10]:5

Habitat

The habitat of a species describes the environment over which a species is known to occur and the type of community that is formed as a result.[22] More specifically, "habitats can be defined as regions in environmental space that are composed of multiple dimensions, each representing a biotic or abiotic environmental variable; that is, any component or characteristic of the environment related directly (e.g. forage biomass and quality) or indirectly (e.g. elevation) to the use of a location by the animal."[23]:745 For example, a habitat might be an aquatic or terrestrial environment. Also arboreal, others????? [e.g. underground (subterrannean) , caves, etc???]

Trophic levels

The trophic level of an organism is the number of steps it is from the start of the chain. A food web starts at tophic level 1 with primary producers such as pants can move to herbivores at level 2, carnivores at level 3 or higher, and typically finish with apex predators at level 4 or 5



A trophic pyramid (a) and a food-web (b) illustrating ecological relationships among creatures that are typical of a northern boreal terrestrial ecosystem

Ecological trophic pyramids are typically one of three kinds: 1) pyramid of numbers, 2) pyramid of biomass, or 3) pyramid of energy.[5]:598

[The pyramidal structure ensures sustainability]

A trophic level (from Greek *troph*, τροφή, trophē, meaning "food" or "feeding") is "a group of organisms acquiring a considerable majority of its energy from the adjacent level nearer the abiotic source."[79]:

Case Studies:

The peppered moth saga: Biodiversity, food web, and industrialization *[evolution? adaptation? or triumph of biodiversity?]*

The Netherlands superhighway: to build or not to build. Snakes migratory route and the ecosystem disruption

US shale-reserve: to exploit or not to exploit. Pressing energy needs, economics, politics, and environment.

However consider also the influence of capitalism (cf Confession of an Economic Hitman…..John Perkins)

Trees: to plant or not to plant!

'I will lecture you': Guyanese President schools journalist on emissions question

Guyanese President Irfaan Ali schooled a BBC journalist who questioned him about the country's carbon emissions over natural gas extractions from its coast. **https://oilnow.gy/featured/ali-in-fiery-exchange-with-bbc-journalist-about-guyanas-oil/ (pay special attention from minute 15:00 upwards).**

"I don't plant trees." So said Bill Gates onstage at *The New York Times*' recent climate summit. He added that it was "complete nonsense" to think that tree planting could solve climate change, and didn't mince words about how he felt about that notion: "Are we the science people or are we the idiots?"

https://www.fastcompany.com/90957447/bill-gates-says-complete-nonsense-planting-trees-solve-climate-change-why-we-should-do-it-anyway

The TWO major needs of organisms and community: Energy and Self-proliferation/continuity. Boils down to Food and Reproduction. Boils down to the SEED Concept. Without seed, food and reproduction cannot be sustained on the planet!

Note: Humans seek to satisfy more than these 2 basic needs!

TOPICAL ISSUES IN THE ENVIRONMENT AND ECOSYTEM

Joshua Ojo, 2016. Pesticides use and health in Nigeria
https://www.ajol.info/index.php/ijs/article/view/156080/145706

Joshua Ojo, 2017: Genetically modified organisms in agriculture

Whats is the Scientific Consensus on GMO in Foods in Nigeria - JOSHUA OJO

http://lsfnigeria.org/NJEH/

https://www.linkedin.com/pulse/what-scientific-consensus-gmo-foods-nigeria-joshua-femi-ojo/

You may locate the articles by Googling the relevant key words.

Download. Send your summary in TEN BULLET POINTS to jojo@oauife.edu.ng

Pesticides use and health in Nigeria

Joshua Ojo

Abstract

This review addresses pertinent environment-health issues related to the use of (synthetic) chemical pesticides, in agriculture and general household in Nigeria. It examines factors responsible for the well-cited data that 99% of the deaths associated with pesticides occur in developing countries like Nigeria, where only 25% of the world's production of pesticides is used. Such factors identified include: poor pesticide education leading to extensive misuse; issues with correct, effective, and safe applications of pesticides; the use of the cheaper but deadliest types of pesticides (in terms of persistence and toxicity); poor legislation and lack of enforcement of available legislation; lack of adequate information, knowledge, and awareness of the inherent dangers of pesticides; lack of training on correct handling of pesticides at home; absence of monitoring for pesticides residues on locally-consumed products, unlike the situation for products meant for export; and inadequacies in medical recognition and responses to pesticide poisoning. Other problems and issues associated with the use of pesticides were also examined. These include disruption of Ecological Balance and Collapse of Biodiversity; Unsustainable Chemical reliance; Pesticide Resistance; and economic issues. Solutions to ameliorate the situation were suggested. These include more public education, more intensive promotion of the Integrated Pest Management Scheme, green technology, and adoption of food irradiation by gamma rays to extend shelf lives of agricultural products.

Key words: Pesticides. Health Impacts.

Toyin Falola: 'An Ounce Is Enough': The Gold Industry and the Politics of Control in Colonial Western Nigeria. African Economic History, No. 20 (1992), pp. 27-50 Published by: African Studies Program at the University of Wisconsin--Madison Stable URL: http://www.jstor.org/stable/3601628

Full Text:

Genetically Modified Organisms

1. Distinguish between GMOs and Hybrids.
   Genetic content modified technologically: altered through removal, rearrangement, or introduction of genes (usually) from other species. Hybrids can encourage the expression of preferred traits, and even modification of genetic content, but within certain limits. Hybrids can occur through natural mating and can not happen across species. GMs forbidden by the laws of nature.
2. Briefly discuss five areas genetic modification is being applied in society.

Medical Research. Pharmaceuticals……. Agriculture.

3. List three major issues involved in the use of GMOs in agriculture.
   Health: mainly via inflammation in the digestive system - of humans. Environment: Ecosytem/Diversity – other living things. Economy: Very many industrialised nations have proscribed importation of GM agric products.

If you are interested in learning more about creation science, contact Mathew (0906 377 0522) for details.

Universe

UNIVERSE [universe] totality of matter and energy in existence. The study of the origin of the universe, or cosmos, is known as cosmogony, and that of its structure and evolution, cosmology . The age of the universe depends on which theory of cosmology one accepts. According to the big bang theory, favored by most scientists, the universe is between 10 and 20 billion years old. [Uniformitarian assumptions]. The steady-state theory holds that the universe has been in existence for all time.

Matter and Energy in the Universe

The matter in the universe is subject to various forces, but the greatest force on the cosmological scale is gravitation . This force pulls matter together to form stars , which either exist alone or are part of binary star or multiple star systems, or brown dwarfs , which are also known as "failed stars." Gravitation also acts to group billions of stars into galaxies and to group galaxies into clusters and superclusters. The main source of energy in the universe is the conversion of the matter of the stars into energy through thermonuclear reactions (see nuclear energy). These reactions continue throughout the different stages of stellar evolution (see also stellar populations) until the star has consumed all its available nuclear fuel.

The Size and Shape of the Universe

The first systematic theory of the size and shape of the universe that attempted to explain observed data was constructed by Ptolemy in the 2d cent. In this theory the solar system was thought to be the entire universe, with the earth at its center and the distant stars located just beyond the farthest planet. This belief was held until the 16th cent., when Copernicus advanced the idea that the sun, rather than the earth, is at the center of the system and that the stars are at very great distances compared to the planets. During the first part of the 20th cent., astronomers discovered that the sun is only one of billions of stars in the Milky Way galaxy and is located far from the galactic center. [Unique in its stability and planetary system]

Estimates of the size of the universe have been refined as methods of measuring galactic and extragalactic distances have improved. Close stellar distances were at first found by measuring a star's trigonometric parallax . A more powerful contemporary method is to analyze the light reaching the earth from an object by means of a spectroscope; the distance of a very faint object can be estimated by comparing its apparent brightness to those of similar objects at known distances. Another method depends on the fact that the universe as a whole appears to be expanding, as indicated by red shifts (see Doppler effect) in the spectral lines of distant galaxies. Hubble's law makes it possible to estimate their distances from the speed with which they are rushing away from the earth. At present the universe is believed to be at least 10 billion light-years in diameter. One problem with estimating the size of the universe is that space itself (or more properly, space-time) may be curved, as held by the general theory of relativity . This curvature would affect

measurements of distance based on the passage of light through space from objects as far away as 5 billion light-years or more.

Bibliography

See A. S. Eddington, The Expanding Universe (1933); J. H. Jeans, The Universe Around Us (4th ed. 1953); G. Gamow, The Creation of the Universe (1961); F. Hoyle, Man in the Universe (1966); L. B. Young, ed., Exploring the Universe (2d ed. 1971).

Author not available, ***UNIVERSE.***, The Columbia Encyclopedia, Sixth Edition 2006

For Prof Ojo's presentation on the Universe, see:
https://www.scribd.com/presentation/619356291/Star-of-Bethlehem-Presentation

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UNIVERSE [universe] totality of matter and energy in existence. The study of the origin of the universe, or cosmos, is known as cosmogony, and that of its structure and evolution, cosmology . The age of the universe depends on which theory of cosmology one accepts. According to the big bang theory, favored by most scientists, the universe is between 10 and 20 billion years old. The steady-state theory holds that the universe has been in existence for all time.

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The Solar System Overview

The solar system has one star, eight (formerly 9) planets, five dwarf planets, at least 290 planetary satellites (moons), more than 1.3 million asteroids, and about 3,900 comets. It is located in an outer spiral arm of the Milky Way galaxy called the Orion Arm, or Orion Spur. Our solar system orbits the center of the galaxy at about 515,000 mph (828,000 kph). It takes about 230 million years to complete one orbit around the galactic center.

We call it the solar system because it is made up of our star, the Sun, and everything bound to it by gravity – the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune; dwarf planets Pluto, Ceres, Makemake, Haumea, and Eris – along with hundreds of moons; and millions of asteroids, comets, and meteoroids.

https://science.nasa.gov/asteroids-comets-meteors/

The Sun, an extra-ordinary Star.

Most of us have heard that the Sun is an ordinary, typical, unremarkable star. But science shows we're actually anything but average. This fragment of the young star-forming region NGC 2014 showcases many stars that are bluer, more massive, and much shorter lived than our Sun.

Stars come with a variety of properties: mass, color, temperature, ionization, metallicity, age, etc. Although the Sun isn't a unique cosmic outlier, it isn't exactly typical, either.
With around two sextillion (~2×10^{21}) stars within the observable Universe, how do we compare?

Our Sun, a G-class star, is more massive than 95% of stars.
Most stars are lower than ours in metallicity: the fraction of heavy elements present.
Our Sun has greater enrichment than ~93% of all stars.
Only half of all stars are "singlets" like our Sun; the other half exist within multi-star systems.
We're not typically luminous, either.
The majority of stars are red dwarfs: cool, low in mass, and extremely long lived.

https://bigthink.com/starts-with-a-bang/sun-typical-star/#:~:text=Most%20of%20us%20have%20heard,shorter%20lived%20than%20our%20Sun.

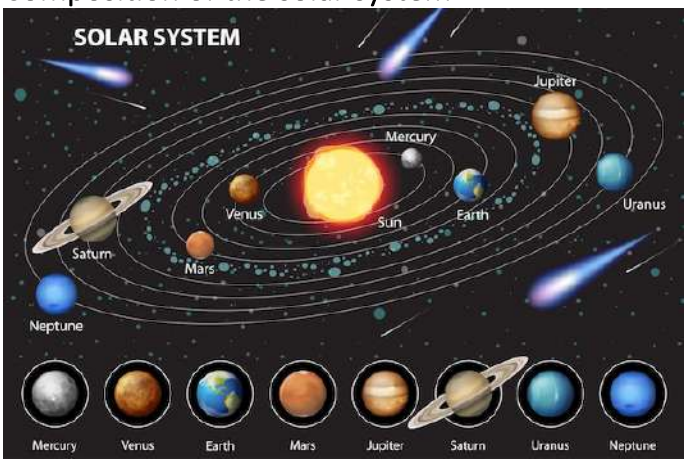
The sun has another property that is very important and unusual—its stability. Astronomers have spent some time looking for stars similar to the sun, because such stars might be conducive to sustaining life on any planets that orbit them. Astronomers have found a few solar twins that have the same temperature, size, mass, and brightness as the sun, but nearly all of them are variable. That is, they vary in brightness. With all the concern about global warming today, it ought to be obvious that a constant sun is essential for life.

On earth we are familiar with the sun's magnetic field because it is intimately involved with sunspots (or in the case of other stars, star spots). Every 11 years the number of spots and magnetic activity increase. During sunspot maximum, the sun frequently produces energetic flares that bathe the earth in an extra dose of particle radiation that can wreak havoc on earth and damage cells in living organisms. We can only imagine how destructive the radiation would be on planets orbiting other stars.
https://www.astronomy.com/observing/is-the-sun-an-oddball-star/

In new research, astronomers compared the brightness of our sun over time with data gathered on other stars by NASA's Kepler Space Telescope and by the European Space Agency's Gaia star-mapping mission. The result is a census of stars about the same size of our sun. But compared to these stars, our sun's brightness varies significantly less, suggesting that it is calmer than other stars of about the same size.

"We were very surprised that most of the sun-like stars are so much more active than the sun," Alexander Shapiro, a physicist at the Max Planck Institute for Solar System Research in Germany and a co-author on the new research, said in a statement.
https://www.space.com/lucky-to-have-a-weird-quiet-sun.html

Composition of the solar system



The orbits of the planets and other bodies of the solar system.

Located at the centre of the solar system and influencing the motion of all the other bodies through its gravitational force is the Sun, which in itself contains more than 99 percent of the mass of the system. The planets, in order of their distance outward from the Sun, are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune. Four planets—Jupiter through Neptune—have ring systems, and all but Mercury and Venus have one or more moons. Pluto had been officially listed among the planets since it was discovered in 1930 orbiting beyond Neptune, but in 1992 an icy object was discovered still farther from the Sun than Pluto. Many other such discoveries followed, including an object named Eris that appears to be at least as large as Pluto.

It became apparent that Pluto was simply one of the larger members of this new group of objects, collectively known as the Kuiper belt. Accordingly, in August 2006 the International Astronomical Union (IAU), the organization charged by the scientific community with classifying astronomical objects, voted to revoke Pluto's planetary status and place it under a new classification called dwarf planet. For a discussion of that action and of the definition of *planet* approved by the IAU, *see* planet.

THE UNIVERSE

Universe best/most simply understood, if we put the earth at the centre

The astonishing simplicity of everything – Neil Turok, Perimeter Institute.
https://www.youtube.com/watch?v=f1x9lgX8GaE

I. Astronomical vs Femtometre Distances; Space

Contemplating Vast Space.
Most of Matter is emply space. Most of the Universe is empty space.
Matter in space is separated by astronomical distances. Like specks in space.
In itself, most of "matter" is empty space! Cf nuclear (fm) and atomic (Å) dimensions ~ 1:100,000**.**
The Difficult-to-imagine vastness of space is vividly portrayed in a BBC Documentary at
https://www.youtube.com/watch?v=2iAytbmXYXE

At the same Documentary, a comment by a reader, Jaco Nel, also exquisitely points our attention at the other end of the spectrum, miniature space:

> **"And instead of zooming out, if we go the other direction and zoom in, the actual spectrum of size becomes even more mindblowing. From the size of a human, to a human hair, to a human cell, to molecules, to atoms, to electrons and quarks, all the way down to the smallest thing in the universe, the Planck length, at $1.6x10^{-35}$ (that's 16 preceded by 34 zeroes and a decimal point) you'll notice that we humans are relatively actually closer in size to the whole universe itself (@10^{26} metres) than we are to the smallest thing in the universe. An electron is 10^{-18} metres wide. So from the perspective of an electron, we humans are 100 light years large."**

Humongous Numbers.
100 thousand million stars in the Milkyway, our home galaxy.
100 -200 Billions galaxies in the Universe.

On the other hand:
~ 37 Trillions living cells in one Man. You are literally a galaxy on your own!
The DNA is not just the most complex structure in the Universe, it is enormously long – 2 metres intricately stacked into a micrometer size package!
Stretched out and placed end-to-end, the DNA in one man is about 108 billion kilometres long, about twice the diameter of the Solar System. (https://www.sciencefocus.com/the-human-body/how-long-is-your-dna/)

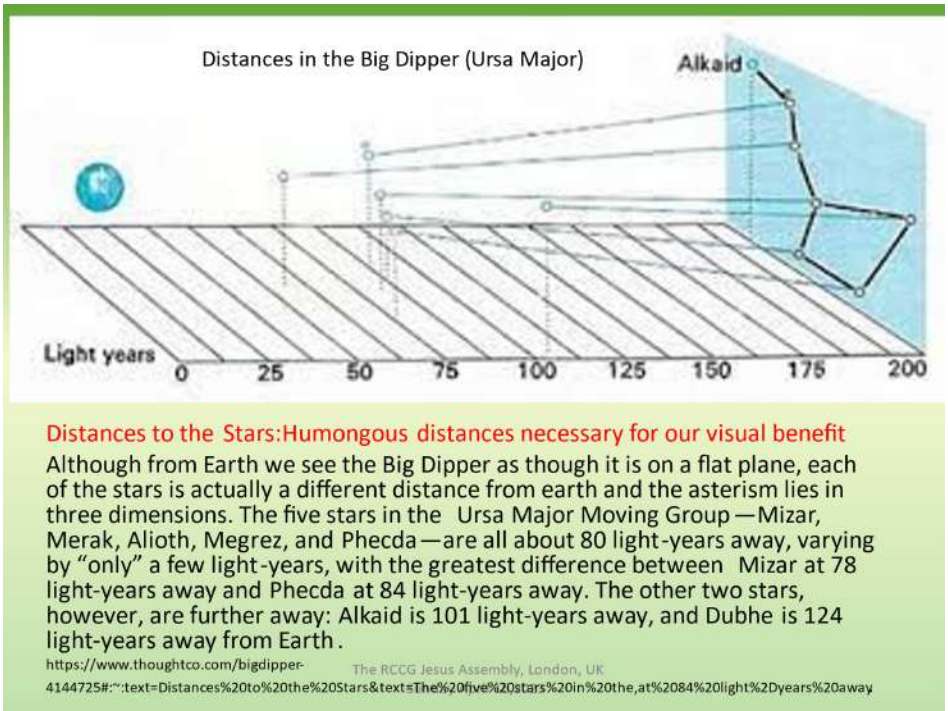
With Trillions of Man and Other Living Organisms (each with trillions of cells) residing on Planet Earth., it is extremely naïve seeing the planet as no more than "an insignificant speck of blue dot in space!"

The Anthropic Principle: The Universe is incredibly configured and fine-tuned for the benefits of Mankind. We may imagine that earth is an important planet, rather than conclude, as Carl Sagan concluded, (see video) that:
"*Our planet is a lonely speck, in the great enveloping cosmic dark. In our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves…..*",

- **Earth ideally positioned to receive starlight. Chance or design?**
- **For the stars to serve as indicators of seasons, they must be numerous infinitely. Yet not overwhelm earth with too bright light (night sky) or heat, or other radiations, they must be precisely flung out as they are at astronomical distances, and be of enormous sizes. Vast humongous space required.**
- **Must not be too dim either. Nearby stars must not hinder us from seeing distant ones. Also stars generally not to be visible in the day and therefore don't take over the rulership of day (from the Sun). Ditto, rulership of the night is given to the Moon, which also needs to have the exact correct reflectivity.**

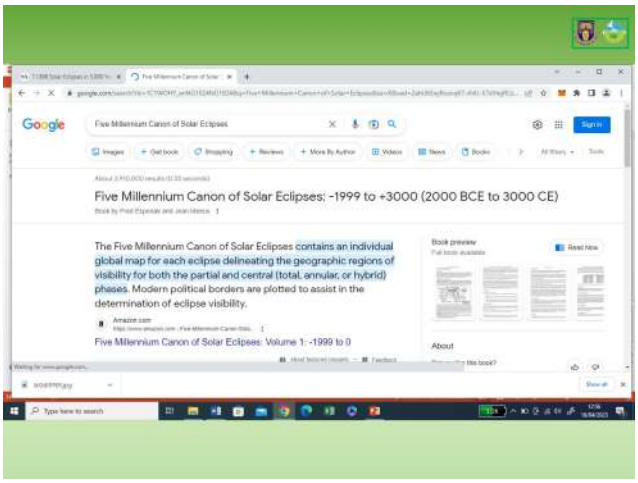
- **It takes infinite knowledge to set all these up! [See He made the Stars also, Stuart Burgess, pg.104).]**

- **Solar eclipses possible only because Sun and Moon have perfectly same size when viewed from earth. Sizes, Distances matched for meaningful view from earth. To serve as light and for signs, and measure of time.**
- **The Planets in the Solar System have identical brightness and sizes as the Stars (and the occasional Comets)**



https://www.thoughtco.com/big-dipper-4144725#:~:text=Distances%20to%20the%20Stars&text=The%20five%20stars%20in%20the,at%2084%20light%2Dyears%20away .

Movement of the planets so predictable that we can now predict exact date and time for Eclipses (of the sun, or moon) that happened 2000 years ago, and those coming in the next 3000 years!



Software for these simulations abound!

Thanks to the availability of fast computers and software such as Celestia, Starry Night, Stellarium, and SpaceEngine, we can now use Kepler's equations to recreate and precisely simulate the skylines as seen at any given location on earth for any particular date.

ISSUES WITH INTRODUCTION OF GMO FOODS IN NIGERIA

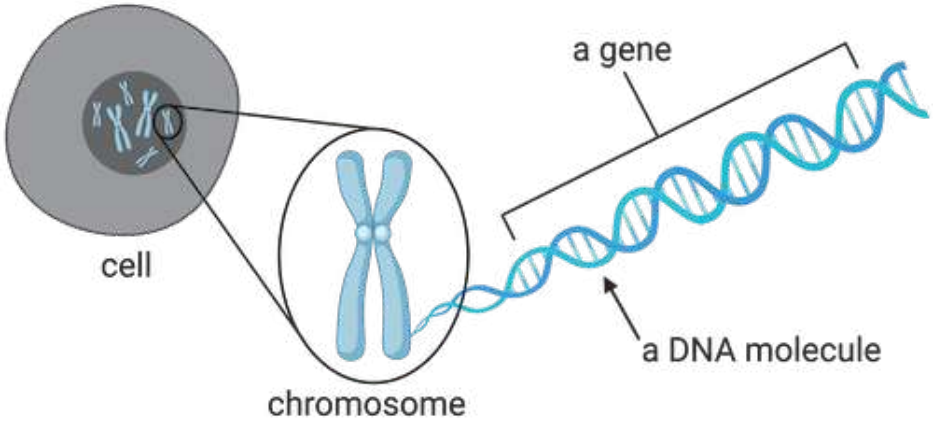
Special Lecture in PHY 202 – introduction to Environmental Physics
Wednesday 15th May, 2024

Joshua Ojo
Professor
Health Physics and Environment
Department of Physics and Engineering Physics,
Obafemi Awolowo University, Ile-Ife, Osun State

Email:: jojo@oauife.edu.ng

What is a gene?

“Genetic” is from Gene. This is the code, inherited, that instructs the cell what to build. You are literally sourced from the environment!



A gene is the basic physical and functional unit of heredity. Genes are made up of DNA. Some genes act as instructions to make molecules called proteins. However, many genes do not code for proteins. In humans, genes vary in size from a few hundred DNA bases to more than 2 million bases.”

Codes can be modified

Naturally, across millenia: Cross-breeding, hybrid)

In the Laboratory: In relatively recent times, artificially, Genetic Engineering. Biotechnology. …….

The **mule** is a domestic equine hybrid between a donkey and a horse. It is the offspring of a male donkey (a jack) and a

https://www.who.int/news-room/questions-and-answers/item/food-genetically-modified

World Health Organization | Health Topics | Countries | Newsroom | Emergencies

These questions and answers have been prepared by WHO in response to questions and concerns from WHO Member State Governments with regard to the nature and safety of genetically modified food.

What are genetically modified (GM) organisms and GM foods?

Genetically modified organisms (GMOs) can be defined as organisms (i.e. plants, animals or microorganisms) in which the genetic material (DNA) has been altered in a way that does not occur naturally by mating and/or natural recombination. The technology is often called "modern biotechnology" or "gene technology", sometimes also "recombinant DNA technology" or "genetic engineering". It allows selected individual genes to be transferred from one organism into another, also between nonrelated species. Foods produced from or using GM organisms are often referred to as GM foods.

The keyword here is that GMOs do not, cannot, occur naturally.
GMO is that which cannot occur in nature. It's forbidden.
IT INVOLVES TRANS-SPECIES, TRANS-KINGDOM, ETC

The keyword in the WHO definition is that GMOs do not, cannot, occur naturally. GMO is that which cannot occur in nature. It's forbidden. IT INVOLVES TRANS-SPECIES, TRANS-KINGDOM, ETC

Also the US Department of Agriculture:

"The Standard defines bioengineered foods as those that contain detectable genetic material that has been modified through certain lab techniques and cannot be created through conventional breeding or found in nature."
https://www.ams.usda.gov/rules-

"A genetically modified food is made with a genetically modified organism (GMO) or living thing. A GMO is an animal, plant, or microorganism. To genetically modify an animal, plant, or microorganism, scientists use the genetic engineering process, which is also called modern biotechnology, gene technology, or recombinant DNA technology.

First, they determine a trait they want the GMO to have – like being able to resist insects. **They then find an animal, plant, or microorganism with that trait, copy the gene with that trait, and insert it into the animal, plant, or microorganism.** They let the new GMO grow. If it's successful, it's shared."

Why GMOs? Some popular Examples

To resist insect pests or tolerate herbicides.

Bacillus thuringiensis (Bt) corn is a GMO corn that produces proteins that are toxic to certain insect pests but not to humans, pets, livestock, or other animals.
[BUT….gut health, environment,?]

Maximize Profit: To give higher yield (tonnage/hectare), To reach an important growth point faster, etc [BUT….quality, taste? Water use?…]

The AquAdvantage Salmon has been genetically modified
https://www.fda.gov/food/agricultural-biotechnology/gmo-crops-animal-food-and-beyond

Nutritional Fortification

Golden Rice – biofortified with precursors for Vit A
[BUT…. Redundant, food sovereignty?]

Golden Rice:

Featherless fowls: To maximize feeds, optimize processing of chicken, etc

Other Traits: Barking sheep, glowing animals, Transgenic animal models

7 genetically modified animals that glow in the dark::"**This is no party trick. These radiant sheep, dogs, and cats help further research of human diseases"** https://theweek.com/articles/464980/7-genetically-modified-animals-that-glow-dark

What's the problem with GMO foods?

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APRIL 25, 2024 Editors' notes

49 Twit Share Email

Philippine court blocks GMO 'golden rice' production over safety fears

Featured Last Comments Popular

Dice snakes found to use a variety of techniques to more effectively fake their own deaths

ype here to search 29°C Mostly cloudy

Dangers of GM corn spark huge trade dispute between the U.S. and Mexico

04/18/2024 / by Cassie B.

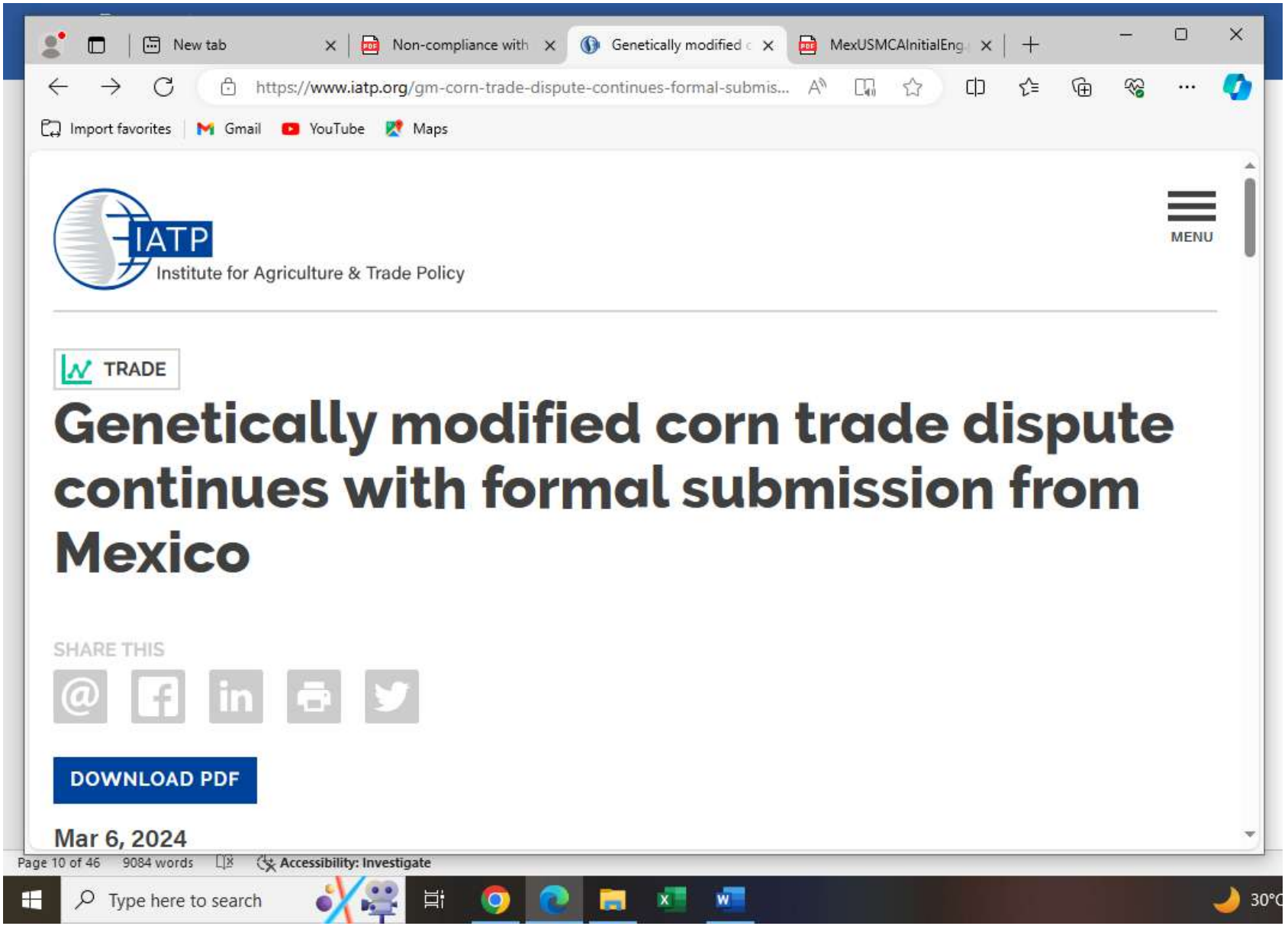
Mexico and the U.S. are currently engaged in a major trade dispute over genetically modified corn that could have a major impact on American agriculture.

Corn is considered a staple crop in Mexico and makes up a significant part of the diet there; it is consumed in 89 percent of all Mexican meals. The country has successfully stopped genetically modified corn from being grown there for the last quarter century to protect the ancient maize strains growing there, along with the health of their citizens.

The crop has been the subject of trade battles between the U.S. and Mexico before, but the current battle, which is now being argued before a United States-Mexico-Canada Agreement (USMCA) panel, relates to a presidential decree issued by Mexico last year banning genetically modified corn in dough and tortillas; the country also declared it will gradually replace genetically modified corn in all human and animal foods.

Dangers of GM corn spark huge trade dispute between the U.S. and Mexico (gmo.news)

Mexico is presenting 66 articles published in reputable, peer-reviewed journals demonstrating the health risks of genetically modified corn. These include reductions in nutritional content, organ damage, antibiotic resistance and cancer.


New tab
Non-compliance with
Genetically modified
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https://www.iatp.org/gm-corn-trade-dispute-continues-formal-submis...
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Genetically modified corn trade dispute continues with formal submission from Mexico
SHARE THIS
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Mar 6, 2024
Page 10 of 46
9084 words
Accessibility: Investigate
Type here to search
30°C

The submission provides evidence to justify precautionary measures to protect consumers from potential health impacts of GM corn imported from the U.S. and residues of glyphosate. According to the submission, Mexico's policies will have minimal impacts on U.S. producers: the policies affect only 1% of U.S. corn exports, white corn used for human consumption, with the overwhelming share of exports going to livestock feed. Mexico also documents the potential health risks from GM corn and glyphosate for a population that consumes ten times the amount of corn consumed by people in the U.S.

Key elements of Mexico's submission include:

- The scientific evidence of GMO safety presented by the U.S. is out of date, much of it from industry studies not supported by peer-review. According to Mexico, the U.S. did not present any peer-reviewed study showing it safe to eat large quantities of GM corn exposed to glyphosate in minimally processed form over a lifetime. Mexico makes the case that the U.S. regulatory process is not stringent enough ensure that products are safe for Mexicans to consume at high levels.
- On public health, the submission details that GM corn, especially Bt corn engineered to kill insect pests, can have adverse impacts on non-target animals. Mammals have been shown to suffer damage to their digestive systems from a GM trait that kills its targets by attacking their guts.
- Mexican tortillas have been proven to be contaminated with GM corn and glyphosate, the latter in residues from treatments of GM corn engineered to tolerate the herbicide featured in Roundup. Mexico shows that even low-level exposures can have negative long-term health impact.

List of countries that have prohibited or restricted genetically modified organisms (GMOs) as of 2024

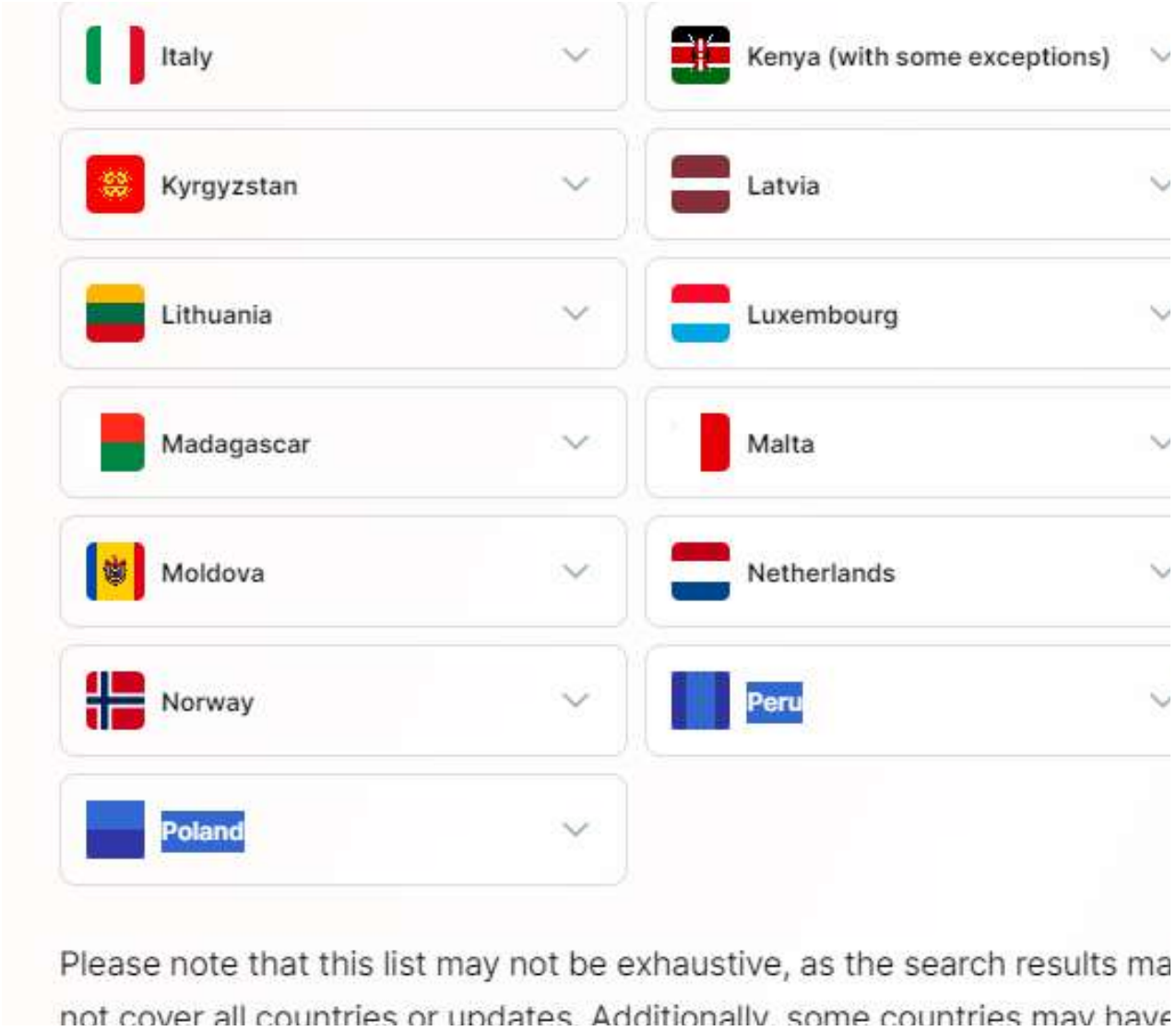
Based on the provided search results, the following countries have banned GMOs in 2024:

- Algeria
- Austria
- Bhutan
- Bosnia and Herzegovina
- Bulgaria
- Croatia
- Cyprus
- Denmark
- France
- Greece
- Hungary
- India (with some exceptions)

Follow up

What are the scien arguments for and bans?

How do GMO bans international trade exports?



To protect its citizens, Taiwan has banned GMOs in school lunches nationwide, making sure children don't eat the same toxic GMOs that the U.S. government gladly feeds children across America.

Taiwan's new laws also require nationwide GMO labeling of all foods, including foods served by restaurants and cafes.

Countries that Ban GMOs 2024

In the European Union the following countries have banned GMOS: **France, Germany, Austria, Greece, Hungary, the Netherlands, Latvia, Lithuania, Luxembourg, Bulgaria, Poland, Denmark, Malta, Slovenia, Italy, and Croatia.** In Africa, Algeria and Madagascar have banned GMOs, and in Asia, Turkey, ...

Greenpeace
greenpeace.org › international › story › 46310 › mexico-banned-gmos-next-steps

Mexico banned GMOs. What are the next steps? - Greenpeace Inte...

Nor does the decree allow the planting of transgenic corn, emphasising that authorisations for the use of genetically modified corn grain in the diet of **Mexican** people will not be granted, until replaced completely by sustainable and culturally appropriate alternatives, to be no later than ...

Geneticliteracyproject
geneticliteracyproject.org › home › gmo faqs › where are gmo crops and animals approve...

Where are GMO crops and animals approved and banned? - Geneti...

January 5, 2021 - According to a 2013 analysis, 26 countries had total or partial bans on GMOs, "including **Switzerland, Australia, Austria, China, India, France, Germany, Hungary, Luxembourg, Greece, Bulgaria, Poland, Italy, Mexico and Russia**," and that "significant restrictions on GMOs exist in about ...

Even in the US, the heat is on GM products. Mandatory Labeling begins on June 23 2025.

November 29, 2023

The U.S. Department of Agriculture (USDA) Agricultural Marketing Service (AMS) published a final rule to update the National Bioengineered Food Disclosure Standard's List of Bioengineered Foods.....

A final rule [https://www.federalregister.gov/d/2023-26059] establishing the list updates was published in the *Federal Register* on **November 29, 2023**. This final rule becomes effective on **December 29, 2023**. Mandatory compliance will begin on **June 23, 2025**.

The standard requires AMS to develop and update the list to identify Bioengineered products that are approved for production and in commercial production somewhere in the world. The standard at 7 CFR 66.1 defines bioengineered foods as those that contain detectable genetic material that has been modified through in vitro recombinant deoxyribonucleic acid techniques and for which the modification could not otherwise be obtained through conventional breeding or found in nature.

More information about the standard and the list are available on the AMS website at www.ams.usda.gov/rules-regulations/be/bioengineered-foods-list.

USDA is an equal opportunity provider, employer, and lender

Monsanto introduces GMO's into Nigeria as Burkina Faso phases out GMO cotton: Should we be concerned?

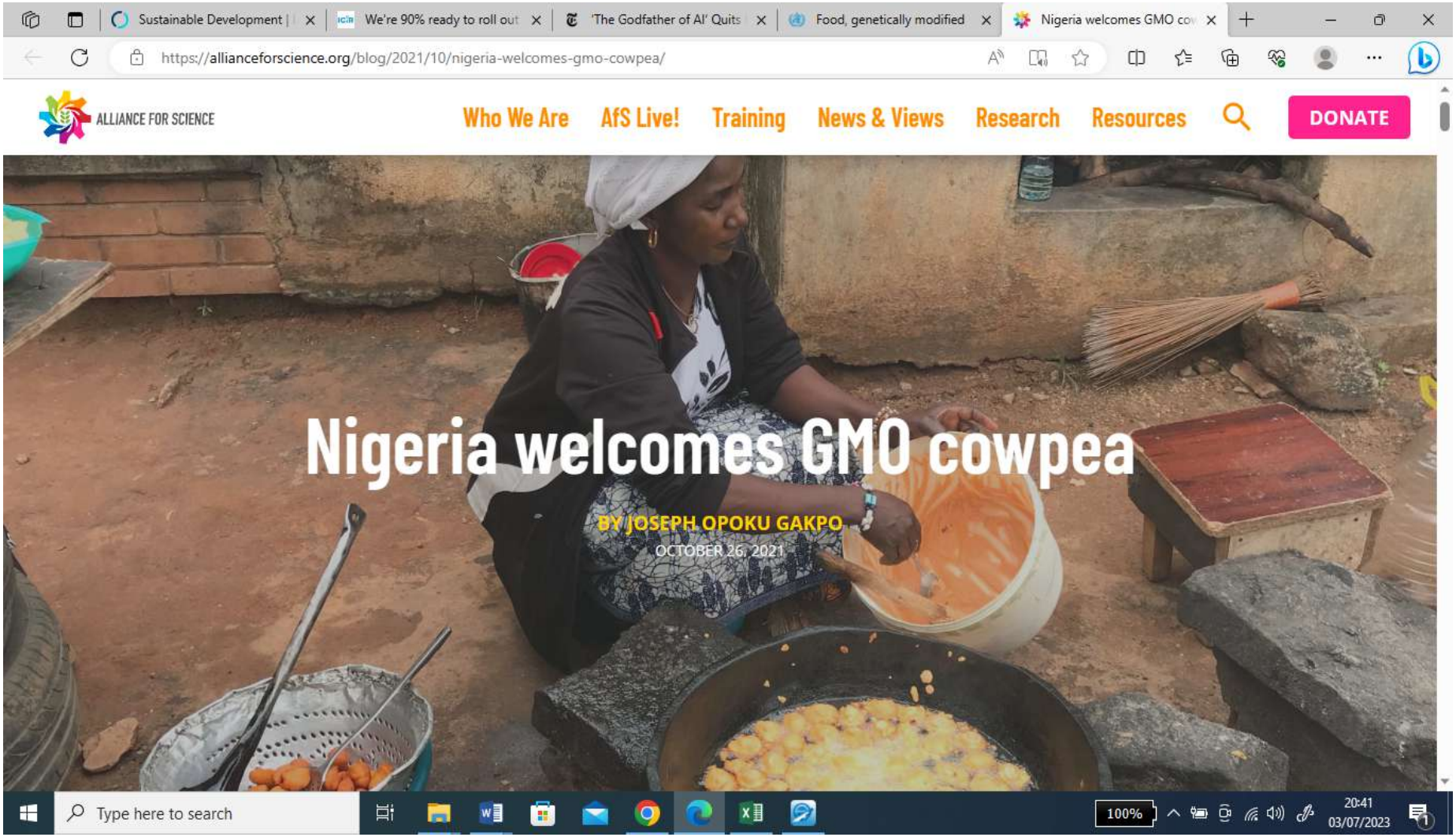
http://venturesafrica.com/weekly-economic-index-23/

Author Michael Nwakalor ; **Published** July 2, 2016

Despite Burkina Faso's abolishment of Genetically Modified cotton, Nigeria's National Biosafety Management Agency (NBMA) granted two permits to Monsanto Agriculture Limited, allowing for the commercial release and placing on the market of genetically modified crops.

Monsanto Agriculture Limited, a multinational agrochemical and biotechnology company, widely credited with the inception of Genetically Modified Organisms (GMO), was officially granted permission to introduce genetically modified cotton and undergo a confined field trial of maize. The decision to adopt pest resistant GMO seeds was taken in an effort to improve crop yields and decrease the use of pesticides that can pose a health risk. The use of these crops have been met with success elsewhere, including Burkina Faso where many farmers adopted the technology upon its introduction in 2003. In 2014, Burkina Faso had the largest number of total GM crop producers on the African continent. Studies show that despite the substantial cost of the Bt cotton (Bt refers to a toxin that kills one of the world's most common and pernicious cotton pests, the bollworm), local framers in Burkina Faso saw their yields and profits rise. **The average Bt cotton farming family gained 50 percent more profit than from conventional cotton however, despite this, the Burkinabé government announced their plans earlier this year to completely phase out Bt cotton by 2018.**

Why the reversal?



Now we have in beans mixed with genetic materials from bacteria, bacillus thurigensis (Bt)

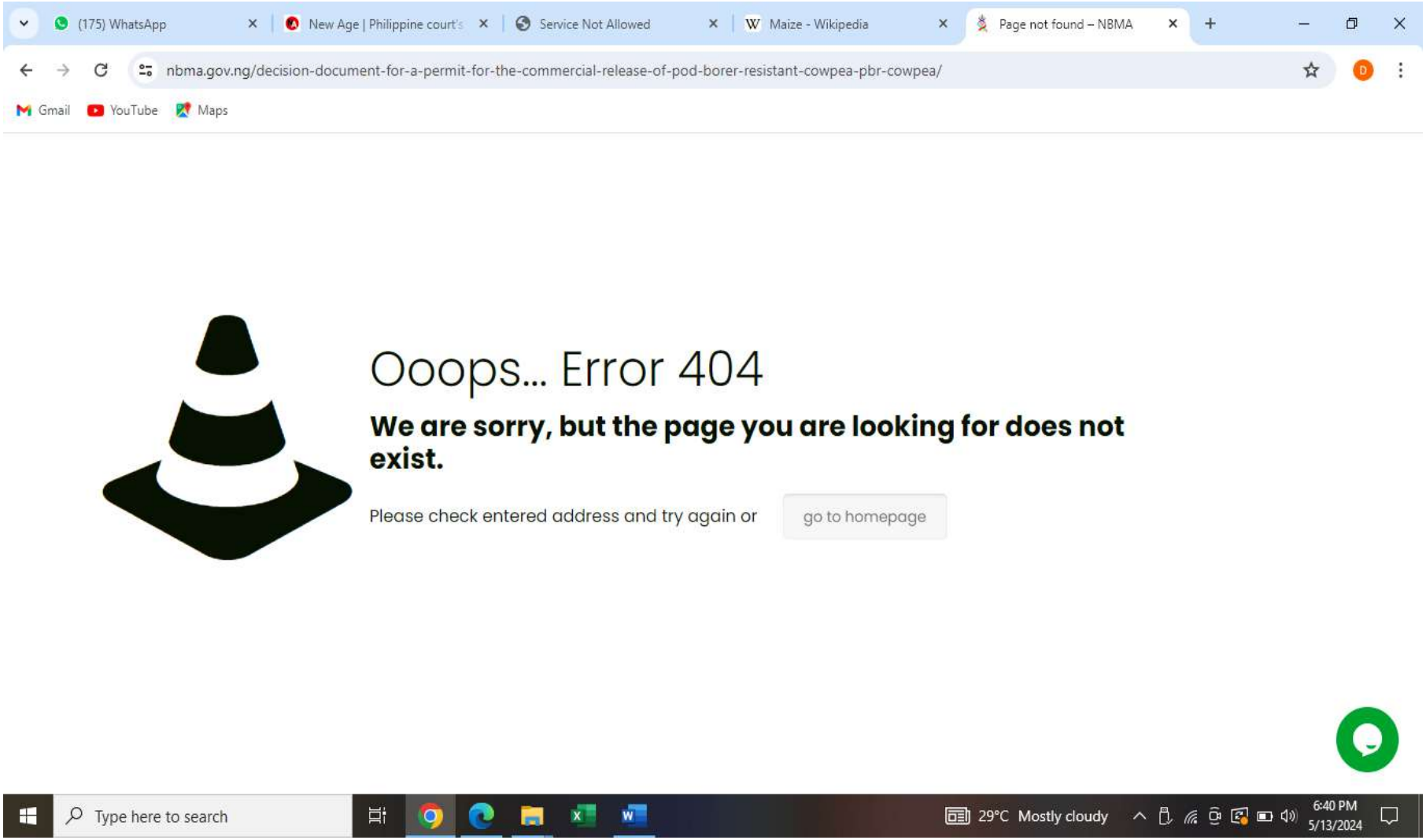
Criticisms trail Nigeria's approval of GMO Corn for planting

Tela maize is a maize variety that has been genetically engineered for improved insect resistance and drought tolerance, to boost farmers' yield per hectare and also complement existing demand gaps.

By Abdulkareem Mojeed
April 23, 2024
Reading Time: 7 mins read

Amidst concerns over the adoption of Genetically Modified Crops in Nigeria, the federal government, in January, approved the commercial release of four "Tela maize" varieties for commercial planting in the country.

https://nbma.gov.ng/decision-document-for-a-permit-for-the-commercial-release-of-pod-borer-resistant-cowpea-pbr-cowpea/



National Biosafety Management Agency

NBMA

Decision Document for a permit for the Commercial release of Pod Borer - Resistant Cowpea (PBR – Cowpea)-event AAT709A, genetically modified for lepidopteran insect pest (*Maruca vitrata)* resistance, issued to Institute for Agricultural Research (IAR), Zaria.

The *National Biosafety Management Agency Act 2015* is the law that guides the regulation of the practice of modern biotechnology, development, handling and use of genetically modified organisms (GMOs) in Nigeria. This decision document is prepared in line with Act and issued by the National Biosafety Management Agency (NBMA) as part of permit granted, to the Institute for Agricultural Research, for the commercialization of genetically modified Cowpea resistant to lepidopteran insect pest (*Maruca vitrata*).

Section 4

Authorization:

After a thorough analysis of the application dossier, Risk Assessment and Risk Management Plan prepared in connection with assessment of the application, it is unlikely that the proposed release will have adverse impact on the environment and human health. A permit is therefore granted to the Institute for Agricultural Research (IAR), Zaria, as applied for **with permit Code No: NBMA/CM/02**

Section 5

Duration of the Permit:

This Permit is with effect from 22nd January 2019 to 31st December 2022

ATTACHMENT A

Full Title: Commercialization of Pod-Borer Resistant Cowpea (PBR-Cowpea) (*Vigna unguiculata*) - Event AAT 709A

Organisation Details

a) Postal address: Institute For Agricultural Research, Ahmadu Bello University, P.M.B 1044, Zaria, Nigeria.
b) Email: mffaguji@hotmail.com, mfishiyaku@abu.edu.ng.
c) Telephone:(+2348051316887, +23469551355)
d) Fax: +23469550563

GMO Description

GMO covered by this Permit:

The Cowpea event AAT 709A is expressing the Cry1Ab protein that confers protection from certain lepidopteran insect pests of cowpea, principally the pod borer (*Maruca vitrata* Fabricius [Lepidoptera: Crambidae])

Parent Organism

Common Name: Cowpea (Beans)

Scientific Name: (*Vigna unguiculata* (L.) Walp.)

Modified traits

Category: Resistance to lepidopteran insect pest pod borer (*Maruca vitrata).*

Description: The GM cotton has been genetically modified by introduction of two genes containing crystal proteins toxic to insects.

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So, What exactly are the Problems with GMO Foods?

- **HEALTH**
  FOOD SOVEREIGNTY
  ENVIRONMENTAL
  ECONOMICS/TRADE

Health Issues Primary Concern! (and simple to determine too)

What Tests? (Food toxicity, Not field trials!)

Who Conducts the Tests? (Locals, with no conflict of interests!)

The Law in Nigeria
the Nigerian Biosafety Management Agency Act 2015,

- These include clear requirement for Public Display of applications, and Public Hearings (Part VII of the Act); and Mandatory Risk Assessment, and Conflict of Interest (Part VIII of the Act).

PART VIII - RISK ASSESSMENT AND MANAGEMENT

31. (1) Every applicant seeking approval for any genetically modified organism under this Act shall, prior to the submission of the application, carry out a mandatory risk assessment of the potential risk the genetically modified organism poses to human health, animal, plant or the environment in Nigeria. Mandatory risk assesment.

(2) The risk assessment mentioned in subsection (1) of this section shall be carried out in Nigeria and in accordance with policies and guidelines set forth by the Agency and under the Third Schedule to this Act. Third Schedule.

(3) Without prejudice to subsections (1) and (2) of this section, the Agency may constitute a National Biosafety Committee (NBC) to carry out risk assessment of any genetically modified organism under this Act.

(4) Where the National Biosafety Committee (NBC) carries out the risk

- In Nigeria, the products HAVE ALREADY BEEN DEVELOPED by Monsanto/Mayhco Agriculture Nigeria. Monsanto acquired by Bayer last year.
- (Science concluded. Only Commerce left)
- Field Trials are conducted and labeled "TESTS". But these are merely activities to check compatibility/optimum condition for growth etc.
- The major science left untouched is TOXICOLOGICAL TESTING/RISK ASSESSMENT

Monsanto…Mahyco ….Baye
One and the same! (Bill Gat
al)

Event Name and Code	Trade Name	
Cotton - *Gossypium hirsutum L.* : 27 Events		
Name: MON88913 x MON15985 Code: **MON-88913-8 x MON-15985-7**	**Roundup Ready™ Flex™ Bollgard II™ Cotton**	
Maize - *Zea mays L.* : 49 Events		
Name: GA21 x MON810 Code: **MON-ØØØ21-9 x MON-ØØ81Ø-6**	**Roundup Ready™ YieldGard™ maize**	
Potato - *Solanum tuberosum L.* : 28 Events		
Name: ATBT04-27 Code: **NMK-89367-8**	**Atlantic NewLeaf™ pot**	
Sugar Beet - *Beta vulgaris* : 1 Event		
Name: H7-1 Code: **KM-ØØØH71-4**	**Roundup Ready™ sugar beet**	
Tomato - *Lycopersicon esculentum* : 3 Events		
Name: FLAVR SAVR™ Code: **CGN-89564-2**	**FLAVR SAVR™**	
Wheat - *Triticum aestivum* : 1 Event		
Name: MON71800	**Roundup Ready™ wh**	

ISAAA
INTERNATIONAL SERVICE FOR THE ACQUISITION OF AGRI-BIOTECH APPLICATIONS

Reality

- To get approvals for each product, in the US, MONSANTO itself carries out the toxicological test and attaches the results
- (Nigeria's biosafety law 2015 has same illogical requirement)
- In most other countries, Europe and Asia: it is the national regulatory agencies that conduct the toxicology tests
- Nigeria (and other African countries): National Biosafety Management Agency simply cites the tests reported in the US. And, voila, *acuna matata!*

World Health Organization: Glyphosate Is A Probable Human Carcinogen

The World Health Organisation's cancer agency has declared the world's most widely used weedkiller – glyphosate – a "probable human carcinogen" in a move that will alarm the agrochemical industry and amateur gardeners.

Find the Full WHO IARC report here: http://www.thelancet.com

Carcinogenicity of tetrachlorvinphos, parathion, malathion, diazinon, and glyphosate

Authors

Kathryn Z Guyton, Dana Loomis, Yann Grosse, Fatiha El Ghissassi, Lamia Benbrahim-Tallaa, Neela Guha, Chiara Scoccianti, Heidi Mattock, Kurt Straif, on behalf of the International Agency for Research on Cancer Monograph Working Group, IARC, Lyon, France.

Abstract

Glyphosate is a broad-spectrum herbicide, currently with the highest production volumes of all herbicides. It is used in more than 750 different products for agriculture, forestry, urban, and home applications. Its use has increased sharply with the development of genetically modified glyphosate-resistant crop varieties. Glyphosate has been detected in air during spraying, in water, and in food. There was limited evidence in humans for the carcinogenicity of glyphosate. Case-control studies of occupational exposure in the USA,14 Canada,6 and Sweden7 reported increased risks for non-Hodgkin

Factor for Coronary Artery Disease

› Glyphosate Breakdown Increases Problems of Algal Blooms

› Glyphosate Herbicide Exposure Linked to Parkinson's Disease

› Glyphosate Based Herbicides are Genotoxic and Cytotoxic to Human Cells at Low Levels of Exposure

Categories

› Africa

› Animal Evidence

› Asia

› Australia

› Central America

› Europe

- *: "Scientific researchers found that 70 percent of female rats and 50 percent of male rats died prematurely when fed GMOs, almost all of them victims of cancer. In all, GMOs have been linked to 22 diseases. According to the American Academy of Environmental Medicine, 'animal studies indicate serious health risks associated with GM food consumption including infertility, immune dysregulation, accelerated aging, dysregulation of genes associated with cholesterol synthesis, insulin regulation, cell signaling, protein formation, and changes in the liver, kidney, spleen, and gastrointestinal system'."*

Int J Biol Sci 2009; 5(7):706-726. doi:10.7150/ijbs.5.706

Research Paper

A Comparison of the Effects of Three GM Corn Varieties on Mammalian Health

Joël Spiroux de Vendômois[1], François Roullier[1], Dominique Cellier[1,2], Gilles-Eric Séralini[1,3]

1. CRIIGEN, 40 rue Monceau, 75008 Paris, France
2. University of Rouen LITIS EA 4108, 76821 Mont-Saint-Aignan, France
3. University of Caen, Institute of Biology, Risk Pole CNRS, EA 2608, 14032 Caen, France

A long-term toxicology study on pigs fed a combined genetically modified (GM) soy and GM maize diet

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Journal of Organic Systems, 8(1), 2013

Carman, Vlieger, Steeg, Sneller, Robinson, Clinch-Jones, Haynes & Edwards

Figure 1. Different levels of stomach inflammation found (clockwise from top left): nil (from a non-GM-fed pig, number B41), mild (from a non-GM-fed pig, number B15), moderate (from a GM-fed pig, number C34) and severe (from a GM-fed pig, number D22).

Mexico presents scientific studies demonstrating the dangers of GM corn and glyphosate

Mexico is presenting 66 articles published in reputable, peer-reviewed journals demonstrating the health risks of genetically modified corn. These include reductions in nutritional content, organ damage, antibiotic resistance and cancer.

Why different results from official US and Elsewhere?

- Results from US, from the developers of the products, carry out only sub-chronic tests. Not chronic tests.
- Otherwise the results are essentially the same

NO "CONCLUSIVE EVIDENCE" CLAIM IS JUST A RUSE!

- The classical example in this respect was Prof Gilles-Eric Seralini in France. In one of his compelling studies, Seralini and his team in CRIIGEN, extended Monsanto's study of the effect of the Roundup-tolerant GM maize on rats from the 90 days Monsanto's scientists had conducted it so as to obtain permission to release the product, to the reasonable 2 years, expected to be able to study chronic effects.

- Using exact protocols, rat strains, etc as Monsanto, Seralini and his colleagues showed conclusively that the GM maize had significantly adverse health impacts (mainly on liver and kidney, in addition to causing tumours) in rats fed the GM NK603 maize!

- Prof Seralini was exhaustively maligned, and following extensive crude manipulations, the peer-reviewed and published paper was eventually fraudulently caused to be retracted.

Environmental Sciences Europe
a SpringerOpen Journal

RESEARCH Open Access

Republished study: long-term toxicity of a Roundup herbicide and a Roundup-tolerant genetically modified maize

Gilles-Eric Séralini[1*], Emilie Clair[1], Robin Mesnage[1], Steeve Gress[1], Nicolas Defarge[1], Manuela Malatesta[2], Didier Hennequin[3] and Joël Spiroux de Vendômois[1]

Abstract

Background: The health effects of a Roundup-tolerant NK603 genetically modified (GM) maize (from 11% in the diet), cultivated with or without Roundup application and Roundup alone (from 0.1 ppb of the full pesticide containing glyphosate and adjuvants) in drinking water, were evaluated for 2 years in rats. This study constitutes a follow-up investigation of a 90-day feeding study conducted by Monsanto in order to obtain commercial release of this GMO, employing the same rat strain and analyzing biochemical parameters on the same number of animals per group as our investigation. Our research represents the first chronic study on these substances, in which all observations including tumors are reported chronologically. Thus, it was not designed as a carcinogenicity study. We report the major findings with 34 organs observed and 56 parameters analyzed at 11 time points for most organs.

Results: Biochemical analyses confirmed very significant chronic kidney deficiencies, for all treatments and both sexes; 76% of the altered parameters were kidney-related. In treated males, liver congestions and necrosis were 2.5 to 5.5 times higher. Marked and severe nephropathies were also generally 1.3 to 2.3 times greater. In females, all treatment groups showed a two- to threefold increase in mortality, and deaths were earlier. This difference was also evident in three male groups fed with GM maize. All results were hormone- and sex-dependent, and the pathological profiles were comparable. Females developed large mammary tumors more frequently and before controls; the pituitary was the second most disabled organ; the sex hormonal balance was modified by consumption of GM maize and Roundup treatments. Males presented up to four times more large palpable tumors starting 600 days earlier than in the control group, in which only one tumor was noted. These results may be explained by not only the non-linear endocrine-disrupting effects of Roundup but also by the overexpression of the EPSPS transgene or other mutational effects in the GM maize and their metabolic consequences.

Conclusion: Our findings imply that long-term (2 year) feeding trials need to be conducted to thoroughly evaluate the safety of GM foods and pesticides in their full commercial formulations.

Keywords: Genetically modified; GMO; Roundup; NK603; Rat; Glyphosate-based herbicides; Endocrine disruption

Abstract

Background: The health effects of a Roundup-tolerant NK603 genetically modified (GM) maize (from 11% in the diet), cultivated with or without Roundup application and Roundup alone (from 0.1 ppb of the full pesticide containing glyphosate and adjuvants) in drinking water, were evaluated for 2 years in rats. This study constitutes a follow-up investigation of a 90-day feeding study conducted by Monsanto in order to obtain commercial release of this GMO, employing the same rat strain and analyzing biochemical parameters on the same number of animals per group as our investigation. Our research represents the first chronic study on these substances, in which all observations including tumors are reported chronologically. Thus, it was not designed as a carcinogenicity study. We report the major findings with 34 organs observed and 56 parameters analyzed at 11 time points for most organs

The major challenge to conducting valid Toxicological/Risk Assessment on GM Products – the Developers!

- Perhaps the toughest part of conducting a safety test on GM foods is getting the authorization or cooperation of the producers/marketers to do so.
- Claiming "proprietary rights" and insisting on complicated end-users' agreement legalities, Monsanto requires that scientists not commissioned by her, cannot carry out any study whatsoever on her GM seeds without due approval.
- And it goes without saying that approvals are only given to scientists and authorities deemed sympathetic to GMOs.

- In 2009, a group of scientists unable to bear the restrictions any longer, submitted a statement to the US Environmental Protection Agency (USEPA) protesting that *"as a result of restricted access, no truly independent research can be legally conducted on many critical questions regarding the (bio)technology."*
- The problem became so serious and embarrassing that the prestigious New Scientists journal had to weigh-in with an editorial passionately urging that the situation be re-dressed.

Assessing *toxic* Hazards

Epidemiology vs Lab toxicology

Acute toxicity: Studies investigating the effects of single doses of a substance.

Sub-chronic toxicity: Short-term, repeat-dose studies, generally having an exposure duration up to 90 days in rodents.

Chronic toxicity: Studies lasting for the greater part of the life span of the test animals, usually 18 months in mice and 2 years in rats.

Reproductive toxicity: Studies designed to provide general information about the effects of a test substance on reproductive performance in both male and female animals

Developmental toxicity: Studies in pregnant animals that examine the spectrum of possible *in utero* outcomes for the conceptus, including death, malformations, functional deficits and developmental delays.

.

Genotoxicity: Studies designed to determine whether test chemicals can perturb genetic material to cause gene or chromosomal mutations.

- Monsanto, has a history of false safety claims on her products (which included the deadly Agent Orange, glyphosate PCBs, aspartarme, etc) all vehemently declared safe by the corporation until later evidences proved otherwise. Even more interesting is the fact that organizations such as Greenpeace International and Friends of the Earth, have repeatedly revealed that Monsanto does NOT allow GMO foods to be served in her own staff canteens!

https://www.iatp.org/news/genetically-modified-food-banned-in-monsanto-staff-cafeteria

Genetically Modified Food Banned in Monsanto Staff Cafeteria

Dec 23, 1999

Associated Press | December 21, 1999 | By CAROLINE BYRNE, Associated Press Writer

LONDON - Genetically modified food has been banned from the staff cafeteria at Monsanto Co.'s UK headquarters by the company's own caterer, GM food giant Monsanto confirmed Tuesday.

Granada Food Services, whose customers include Monsanto's High Wycombe office near London, recently told clients it would not supply food containing GM soya and GM maize due to customer concerns.

In a statement to clients, Granada said the move was designed "to ensure that you, the customer, can feel confident in the food we serve."

Genetic engineering involves splicing a single gene from one organism to another. GM products, including Monsanto's genetically engineered corn, have recently met with safety concerns in parts of Europe and Asia.

In October, the European Union adopted new marketing rules requiring companies to label food as genetically modified if more than one

MONSANTO

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http://www.monsanto.com

August 8, 2014

Dr. Kevin Folta
University of Florida
Environmental Horticulture
1533 Fifield Hall
P.O. Box 110670
Gainesville, FL 32611

Dear Dr. Folta,

Please accept this unrestricted grant in the amount of $25,000.00 which may be used at your discretion in support of your research and outreach projects. The payment will be sent from Monsanto Accounts Payable in the near future.

Sincerely,

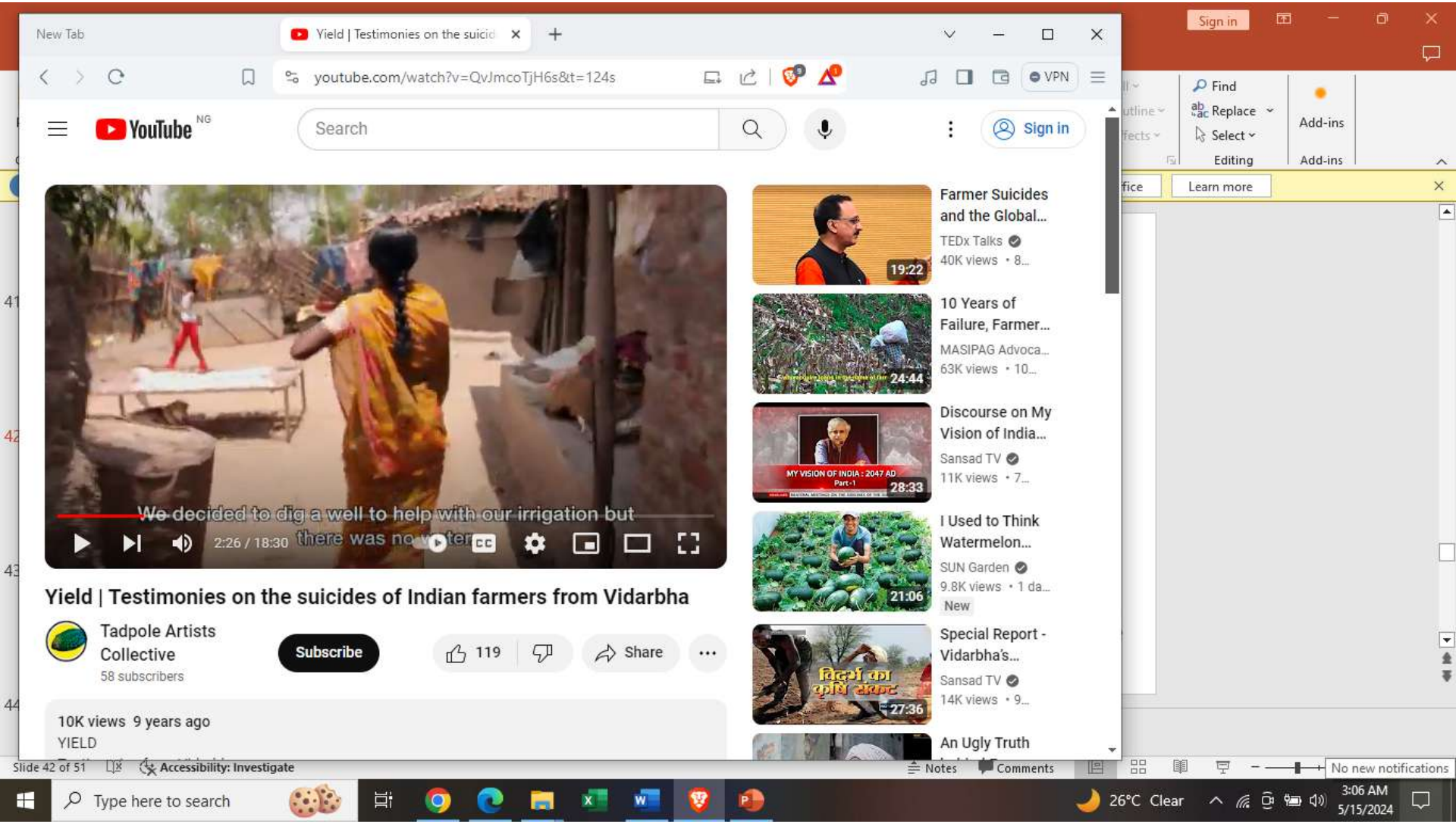
Mike Lohuis, Ph.D.
Director, Scientific Engagement
Monsanto Company

$25,000 Monsanto Money Letter To Kevin Folta Emerges: Univ. Of Florida Professor Promises 'A Solid Return On The Investment'

A question of Food Security

- GM seeds cannot co-habit peacefully with natural ones. They end up taking over, driving their natural counterparts into extinction. Indian Physicist **Vandana Shiva** lamented how Monsanto came to her country offering the seeds of their genetically-modified Bt-cotton for 7 rupees per kilogram, only to gradually raise the price to 17,000 rupees, once the farmers got stuck up with the product and the natural variant became scarce! According to India's Crime Records Bureau of Statistics, 296,466 farmers in that country committed suicide been 1995 and 2013 largely as a result of their inability to cope with the economic losses that attended their switching to GMO crops. Burkina Faso saw herself being sucked into the same vortex and has quickly retraced her steps to opt out of the same genetically-modified product effective next year

https://www.youtube.com/watch?v=QvJmcoTjH6s&t=124s



Economic Implications

- Traditional markets (Europe) will close
- They will try to open new ones in Africa – forced to thrive on their toxic food.
- As usual, starting from food donations. Even links to BH has been speculated, as people go for seed donations.

Dangers of GM corn spark huge trade dispute between the U.S. and Mexico

04/18/2024 / By Cassie B.

Mexico and the U.S. are currently engaged in a major trade dispute over genetically modified corn that could have a major impact on American agriculture.

Corn is considered a staple crop in Mexico and makes up a significant part of the diet there; it is consumed in 89 percent of all Mexican meals. The country has successfully

Failures certain for unsustainable product.

- Glyphosate-ready maize only promote use of more glyphosate (now declare carcinogenic). Manufactured, of course, by the same monopoly Monsanto.
- See recent US court judgement. 4000+ more pending! https://www.environewsnigeria.com/monsanto-ordered-to-pay-man-80m-in-weed-killer-cancer-trial/
- In any case "strait-jacket" solutions can not cage in nature. Ecological balance will be restored somehow. Requiring newer products some years down the line. etc.!

Desperate Search for New Hub, New Markets

- All these developments portend serious threats to the operations and profits of the Monsantos and Bayers of this world. Their desperate efforts to open up new market could therefore be better appreciated. This is why we must not underrate the desperate resolves of these fellows to break new grounds in our country, despite the clear loathsomeness of their project.

Not speculations… A purpose published!

- *"With the largest population and economy in Africa, Nigeria's embrace of GMOs could be a game-changer in spreading African acceptance of the technology. …..Even if anti-GMO NGOs are successful in scaring other African nations from adopting biotechnology, Nigeria's new generation of innovative crops will find their way across the continent. The country has very porous borders, and smuggling is rampant. As a result, GE seeds sanctioned for use in Nigeria are likely to be smuggled into neighboring countries…..This might prompt these nations to reconsider their bans on growing GMO crops and eventually lead to broad acceptance throughout the continent."*
- - Steven Cerier

Numerous dire consequences in the environment-health sector has been attributed to these unnatural products [22].

These aside, it is clear that this development is **unsustainable in that without the seed, there can be no future**. GMO products generally come deliberately rendered sterile or loaded with heavy proprietary restrictions.

Apart from the Environment-Health and Economy dimensions, GMOs also impact the Social dimension as they are the direct precursor for transgenderism.

A further vexing issue with the development of GMOs in the field of agriculture in Nigeria is that the products were all developed abroad and only brought in for cultivation and commercialization here. Hence **no development of local capacity** (of both scientific/human and technology) that would permit local intervention in the whole process.

Suggested Action Points

REVOKE CURRENT DUBIOUS AUTHORIZAATIONS FOR COMMERCIAL DEPLOYMENT OF GMOS

REQUIRE MANDATORY LABELLING;
CF Even in the US: There weren't requirements to label GM foods before January 2022. Now, manufacturers must label foods that contain GMOs under the National Bioengineered Food Disclosure Standard. If an ingredient meets the definition of a GMO, the food label must say so.
https://www.webmd.com/diet/genetically-modified-foods-overview

UNLESS, AND UNTIL A CRITICAL MASS OF CITIZENRY ARE EDUCATED AND ALERTED TO THIS SUBJECT MATTER, GOVERNMENT WILL CONTINUE TO FIND IT DIFFICULT TO RESIST THE POWERFUL MULTINATIONAL COMPANIES, AND NO CHANGE WILL HAPPEN. WITH DIRE CONSEQUENCE TO US ALL!

THANK YOU FOR YOUR ATTENTION

Send inquiries and comments
by Whatsapp to 0805 710 6482

CLASS NOTES

Phy 202

* Green house effect. * Global Warming

Two models of origin

* Evolution model ⇒ Controlled by natural law

* Creation of design Created by fiat, by an omnipotent and Omniscient being

* Summary of the two models

(1) Continuing, naturalistic origin of basic system ⇒ Evolution model | Important
(2) Net present increase in organized complexity of basic system

(1) Everything is completed ⇒ Creation model.
(2) Net present decrease in organized complexity of basic system

The models are mutually exclusive.

* remnant of things that once lived - fossils
* Precambria - where there is no life

Formation of fossils

Fossils form naturally but can be produced in the lab especially coals and petroleum
* There are found in fossils blood that can be billions of years old.
* living fossils are animals or life form that are prosumed to be extinct.

Basic Principle of fossils.

Basic Principles of Dating

(i) We know the initial state of the system

(ii) No extraneous source is accounted for (System enclosed)

(iii) Assume that the rate is known and has been the same in the whole period.

Question from Slide

V_z 4 cm/yr $\Rightarrow 4\times10^{-2}$ m/yr

$d = 5000\text{km} = 5\times10^{6}$ m

t $V = \frac{d}{t}$, $t = \frac{d}{V} \Rightarrow \frac{5\times10^{6}}{4\times10^{-2}}$ yrs

$t_{1/2}$ of C_{14} = 5760 yrs

C_{14} is formed from cosmic rays

$^{1}_{0}n + {}^{14}_{7}N \rightarrow {}^{14}_{6}C + {}^{1}_{1}p$

* C_{12} is stable

Carbon dating

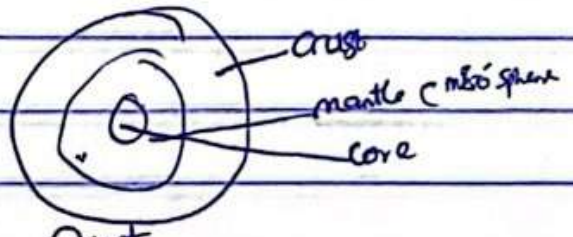
* When an organism dies, $\frac{C_{12}}{C_{14}}$ remains the same, but after 5760 yrs C_{14} decays to half, $\therefore \frac{C_{12}}{C_{14}}$ double. This can be used to determine how long the organism died.
* We can only use carbon dating for organisms that once lived (that once took in carbon).
* Must know a present $\frac{C_{12}}{C_{14}}$ and compare with previous $\frac{C_{12}}{C_{14}}$.
* Must be a living system.
* Might not be able to be measured anymore after 20 half lifes.

22nd April, 2024

The Earth Interior Structure

Deepest borehole → Kolar super deep, about 12km

We can get information about the interior of the earth by terrain, digging, studying earthquakes and volcanoes, apply Seismic Waves



Crust

* The earth's crust is thinner beneath the ocean than beneath the continent
* Seismic Wave travel faster in oceanic crust (i.e lower refracture index) than in continent crust (thick and higher refracture index)
* The continental crust is called SiAl
* Oceanic crust is called SiMa

Mantle

* Mantle is also made of solid rock

Core

The core is very hot (molten)

The Core-Mantle Boundary

* The boundary is marked by great change in density and temperature.
* The major source of heat in the core is radioactive decay

Read about rifting

Project nightfall

26th April, 2024

9JABAZ- - - -

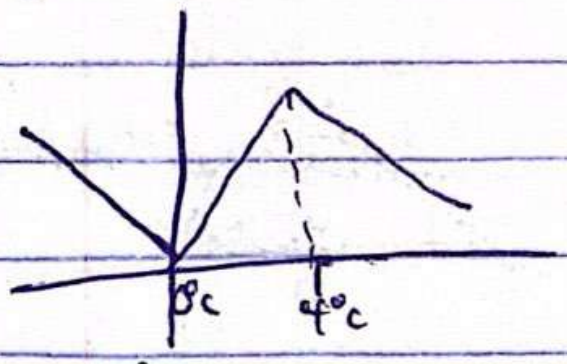
NAIJA-BAZ

Eruption of Volcano Mount st Helens is the most Studied Volcano event

Water Resources

Anomalous Expansion Of Water

From 0° - 4°C, increasing temperature, decreases volume, density increases



Phase Change

Without anomalous expansion of water, there will be no marine life.

& soil Moisture

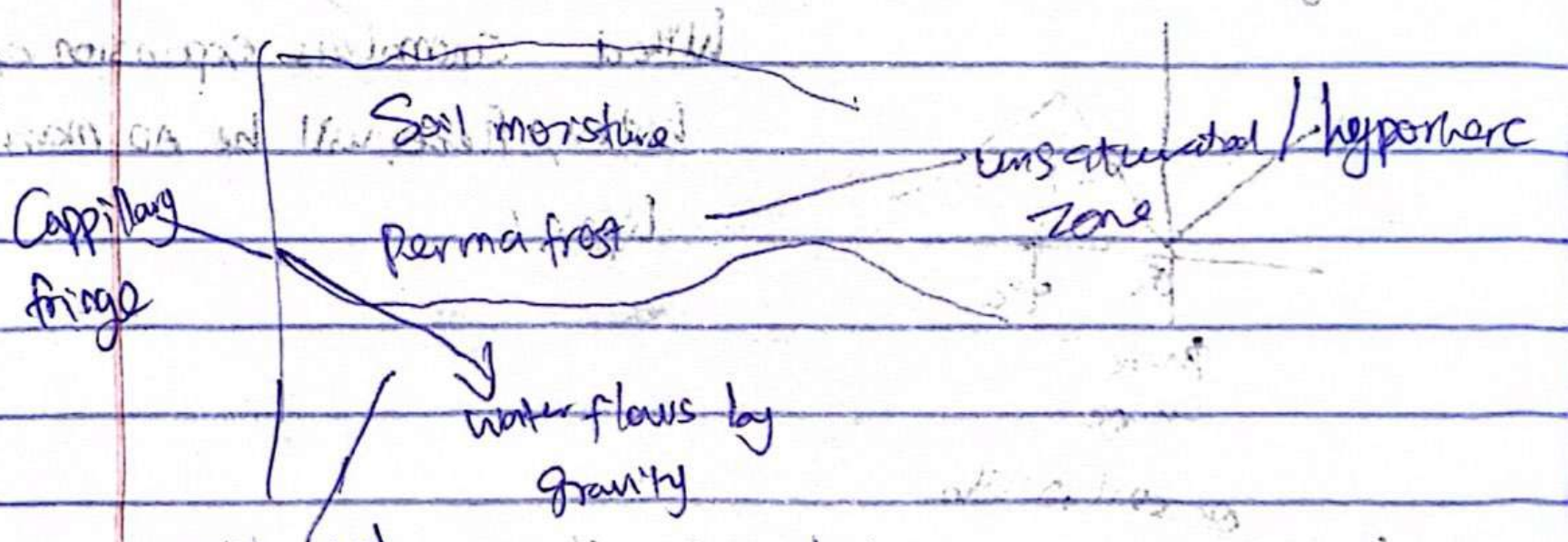
* Underground water is largest storage of water
* mist * dew * Ice * Sheet * frost
* Aral sea is found in Uzbekistan
* Dead sea is found between jordan - isreal, no life in it, because the salt content is too high, It is the lowest point/elevation on earth
Comes from jordan - input, output - only through evaporation

Ground water

Ground water has two zones
Saturated Zone / Hyporherch zone

(1) ~~(1) Soil moisture~~ : It is also called Unsaturated ~~zone~~ or vadose Zone consist of water, gas or soil moisture and also perma frost

(2) Saturated zone



Quantity of water flow $(Q) = \frac{dh}{dx} KA$

K = hydraulic conductivity (constant)

Darcy's law

Groundwater issues in Lagos

(i) Availability
(ii) Pollution : Biological, Chemical and Physical.
(iii) Subsidence
(iv) Salt water intrusion

→ issues in Lagos

Slide

(i) Origin of the Earth

It is generally agreed that the Universe must have had a beginning.

"Steady state theory" that suggested that the Universe has always been and will always be, are no longer credible. The Universe is slowing down in agreement with the 2nd law of Thermodynamics.

* Cosmogony is the study of the origin of the Universe → not a conventional science, repeatability of origin is not possible can't be scientifically proven
* Cosmology is the study of fundamental structures of the Universe → conventional science

Philosophy Behind the Models of Origin Issues

There are two alternatives:

(i) Some of the processes are ~~designed~~ by the design of some intelligent external force
(ii) Everything is naturalistic in origin, requiring no Designer or Creator

* Neither of these can be scientifically proven

The Two Models

(1) Evolution Axiom: It is explaining completely, the universe in principle, in terms of natural laws, without need of external supernatural intervention.

Stating that everything somehow developed naturally, having evolved from primeval state into its present highly-structured complexity.

(2) Creation/Design: Explains that the universe came to existence by the Omnipotence, in accordance with the omniscience of the creator, Created by fiat. It identifies the Creator as a scientific being, whose attributes and ideas are reflected in this creation

Summary:

Evolution Model	Creation Model
(1) Continuing Naturalistic origin of basic system	(1) Completed Supernatural origin of basic system
(2) Net present increase in organized complexity of basic system	(2) Net present decrease in organized complexity of basic System

* The models are all-encompassing
* The models are mutually exclusive: They are exact opposite of each other. The idea that God used evolution is complete non sense in both the evolutionist camp and creationist camp

Critiques of the Models

Problems with Creationalism

(1) The Lazy/fatalistic implication: It kills initiative to seek knowledge

(2) Existence of imperfections and vestigial organs challenge the notion of an omnipotent and omniscient God.

(3) Many form of creationism exist, many based on myths and religious stories

Problems with Evolutionism

(1) spontaneous generation

(2) No clear evidence that Evolution has ever happened in the past

class

6th May, 2024

* Subsidence causes flooding (New Orleans)
* NESREA — National environmental surface and groundwater

Weathering & Erosion

Weathering means the impact of weather/atmosphere/wind on object, on rocks, which leads to loss of the material winds. It is the breaking down of rock as well as wood through contact with the earth's atmosphere, water and biological organisms

A weathered rock is soil

⇒ Physical weathering : cold and dry weather
(i)
(ii) Chemical weathering : damp and cold weather
(iii) ~~Biological weathering~~

Weathering also causes formation of acid rain accelerating Chemical weathering

* High sulphur in crude precipate in the atmosphere forming H_2SO_4, acid rain
* Nigeria crude oil ⇒ sweet crude, low sulphur

Erosion is removal surface material of soil fom one location to another

Offsite effects include sedumentation of waterway and eutrophication

Factors Affecting Erosion

(i) Climate (ii) Vegetative cover (iii) Topography (iv) Tectonics (v) Soils

5th May

Ecology is the study of man's interaction with his environment. It is the scientific investigation organisms between organic and inorganic environment

Ecology is the investigation of total relation of animal to its Organic and inorganic environment

Ecology is the scientific study of the process of regulating the distribution and abundance of organism and the interaction among them. It is also the study of this Organism in turn mediate the transport and transportation of energy and matter in the biosphere

For example, the exploration of the Natural environment does resulted in the creation of numerous problems, which have adversely affected the ecosystem in our community, in all part of the world.

In some instances, Natural resources such as ~~fresh~~ soil has been destroyed, fresh water supply have been heavily polluted. With the result that our survival is now been threatened.

Conservation of Natural Resources

Some natural resources such as oil, ~~gold~~, gas, coal and metallic minerals are finite and irreplaceable, and the utilization of this must be carefully ~~consumed~~ Controlled

Other natural resources, forest, marine animals and water are replaceable, and the utilization of these must be ~~replaced~~ accompanied by

Class

Ecology is the study of interactions organisms have with each other, other organisms and with abiotic components

Biobwersity — Variety or diversity of living organisms

habitat is the place where organisms live to form a community

Biodiversity brings resilence to life

Habitats

Birds - Aboreal, rodent - Subterenial

140 people died in kenya flood

* Bleeding

⇒ mule is a domestic equine hybrid between a donkey and a horse. A mule is sterile, it can not reproduce

Genetically modified organism is reproduction that cannot and never occur naturally.

Crossbreeding/hybrids can occur naturally

Bt (Bacillus thuringiensis) corn is a GMO

Corn that produces proteins that are toxic to certain insect pest but not to human

Other examples; golden rice, featherless turkeys

Problems with GMO foods

(1) 2015: National BioSafety Management law

* Acute toxicity, * Sub chronic toxicity * Chronic toxicity
* reproductive toxicity

Food Security

* GM seeds end up taking over, driving out their natural counterparts into extinction

Suggested Action

(1) Revoke
(2) Mandatory Cabelling

PHY 202

Environmental Pollution

Pollution is the introduction of contaminant into the natural environment that causes adverse effect/changes.

It is the negative or undesirable changes in the environment usually the addition of some hazardous or detrimental substances.

It is also the presence of some substance on the environment that because of its chemical composition or thermal properties prevents the functioning of some natural process and produces undesirable environmental and health effects.

Pollution can take the form of chemical substance or energy

Chemical substance — CO, Methane etc.

Energy — Heat energy, noise, light etc

Pollutant are any substance which causes harmful effects or uneasiness in the organism

The component of pollution can be either foreign substance/energy or naturally occuring substances

Pollution is often classified as point source and non-point sources. Study have shown that pollution killed 11 million in 2015.

Major form of pollutant includes

(i) Noise pollution (ii) Radioactive Contaminant/pollution (iii) Visual pollution (iv) water pollution (v) air pollution (vi) plastic pollution (vii) Thermal pollution (viii) Light pollution (ix) land pollution (x) Soil pollution

Pollution has always been accompanied by civilization, started from historic time when man created the fire

Assignment

Write a short Note (not more than 10 lines) on;

(i) Noise pollution (ii) Soil pollution (iii) Radioactive pollution (iv) Air pollution (v) Water pollution

Classification of pollutant

(i) Primary pollutant (ii) Secondary pollutant

(i) Primary pollutant: They are those which remain in the form in which they are added to the environment.

(ii) Secondary pollutant: They are formed due to interaction of primary pollutant among themselves.

7th June, 2024

Cost of pollution

Pollution has a cost. Manufacturing activities that cause air pollution impose health and clean up cost in their activities. Pollution can also create cost for industries for firm producing the pollution chooses or are forced by regulation to reduce the amount of pollution that is being produced.

The associated cost for doing this are called abatements cost or marginal

abatement cost, if measured by each additional use.

Listed Most Polluted places

(1) Agbogbloshie, Ghana
(2) Chernobyl, Ukraine
(3) Citarum river, Indonesia
(4) Dzershinsk, Russia
(5) Hazaribagh, Bangladesh
(6) Kabwe, Zambia
(7) Kalimantan, Indonesia
(8) Matanza Riachuelo, Argentina
(9) Norilsk, Russia
(10) Niger River Delta, Nigeria

The earth atmosphere is a thin gaseous envelop that surrounds the solid and liquid surface of the earth, it extends upward for hundreds of kilometer, eventually mix with the interplanetary medium of the solar system.

Apart from helping to maintain life, the earth's atmosphere serve to maintain a fairly even temperature to shield the earth from harmful radiation e.g UV rays from the sun and to protect the earth from various small fragment (meterose) which continually rain down.

The Origin of the Atmos

The prevailing theoretical belief was that the earth had no atmosphere at all or shortly after the time of its formation, some 4.5 billion years ago, and that the atmosphere we observe today is believed to have come into existence as a result of explosion of volatile substance from the earth's interior in association with volcanic activities.

Volcanic eruption release on the earth surface 85% of water vapour, 10% of CO_2, and up to a few percent of nitrogen and sulphur or compounds of sulphur which serves as raw materials for composing the earth surface by undergoing various physical and chemical processes.

A large proportion about 99% of the water vapour released from active volcanics undergoes the condensation process in form of cloud and rain, thereby reducing its abundance in the atmosphere to a negligible percent (trace) that is usually observed.

Despite that no oxygen is released into the atmosphere through volcanic activities, there are at least two possible ways

(1) photodissociation of water

$$2H_2O \rightleftharpoons 2H_2 + O_2$$

This process requires the absorption of solar radiation, UV radiation

(2) photosynthesis reaction

$$H_2O + CO_2 \rightarrow CH_2O + O_2$$

This process requires the absorption of solar radiation (visible radiation). It is well established that the photosynthesis reaction has produced

Importance of nitrogen, oxygen, ozone
* Importance of ozone in the atmosphere

Significant amount of oxygen on the earth.

June 10, 2024

The Composition of Air

Dry air is about 78% Nitrogen, 21% O and 1% other gases, including CO_2 and Ar.

The amount of water vapour in air varies from 0 - 4%

Thus, dust, smoke and waste gases from industries and transportation and substances in air are not included among the gases listed in the table below

Gases of Earth Atmosphere

Gas	chemical symbol	% by volume	Sources/uses
Nitrogen	N_2	78.09	Fertilizer, amino acids, nitroglycerine
Oxygen	O_2	20.95	Animal aspiration/rocket fuel
Argon	Ar	0.93	electric light bulb, Welding
Carbondioxide	CO_2	0.03	Photosynthesis
water vapour	H_2O	0-4	Components of all life, absorbs earth heat
Neon	Ne	trace	Advertising signs
Helium	He	trace	welding, lighter than aircraft
Methane	CH_4	trace	Natural heating and cooking
Krypton	Kr	"	wavelength used to define length
Xenon	Xe	"	Electric flash bulbs
Hydrogen	H_2	"	welding fuel, production of ammonia
Ozone	O_3	"	For bleaching disinfectant, protection against UV rays

Population density of factors affecting temperature
green environment
amount of water vapour

Structure of the Atmosphere

* Troposphere is the closest to the earth surface

The atmosphere is divided into four layers based on temperature

(1) Troposhere: It is the layer where the constituents of earth dominates, contains 75% of the gases of the atmosphere, as well as dust and water vapour.

This layer is the zone where weather and cloud occur. The temperature decreases with increase in height in the troposphere.

Near the top of this layer, is between 8 - 20 km from the earth. The boundary called the tropopus acts as a ceiling to the weather zone.

(2) Stratosphere: It extends upward to about 50km from the earth, in the lower part of this layer/zone, the temperature is constant, -50°C. However, at 50km, the temperature rises to 0°C.

Stratosphere contains the Ozone layer.

The thin layer that seperates the stratosphere and mesosphere is called stratopus.

(3) Mesosphere: It extends upwards from about 50km to 80-85km, this layer is the coolest zone of the atmosphere. The temperature decreases to near -100°C at the top of mesosphere.

(4) Thermosphere: It extends from 80 - 80km upwards to the space. The temperature in the thermosphere increases quickly, because of the absorption of energy from the sun.

The Thermosphere is divided into two parts:

(1) ionosphere: Consists of ions, it is a layer

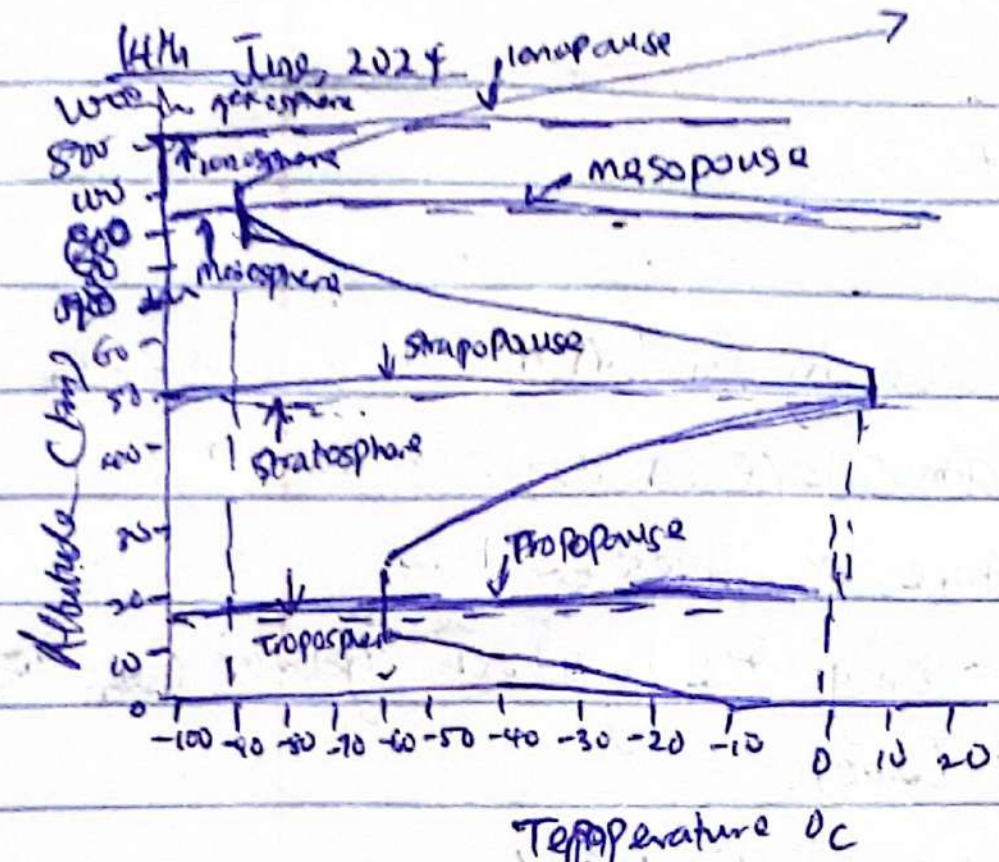
of electrical charged particles, that begin between 80 - 85 and above the earth surface

Air particles of the atmosphere are bombarded by energy from the space and form ions and free electrons. This charged particle are useful for communitation, because at night, they reflect radio waves, during the day however, radio reception is terrible over a long distance

(#) Exosphere; It begins at an attitude of 500 - 700 km and extends out into inter-planetary space, at this attitude, atoms and ions are very far apart, some gases in the exosphere actually escapes into space.

Particles of solar wind are concentrated into radiation layer, at about 13,000 - 16,000 km above the earth surface.

This layers are held in place by earth magnetic field



The Structure of the Atmosphere

The vertical variability of the atmospheric property (pressure, temperature, relative humidity) is much larger than the horizontal or temporal variability of this quantity.

It is therefore convenient to define a standard atmosphere which is horizontally and temporally averaged structure of atmosphere as function of the height only.

The following are the atmospheric structure that is affected as a function of altitude

1) Atmospheric composition as a function of height: The ratio of various gases constituent as any height or any level in the atmosphere, are determined by two competing physical processes

(1) Molecular diffusion

(ii) Mixing due to fluid motion

(i) Molecular Diffusion: This is cause by random molecular function which is tend to produce an atmosphere in which the mean molecular weight of the mixture of gases gradually decreases with height, to the point that only the lightest gases CH_4, He, H_2 are present at the highest level.

The relative effectiveness of the molecular diffusion increases in proportion to the root mean square velocity of the random molecular motion, and the mean free path between collision..

(ii) Mixing due to fluid Motion: In contrast to the molecular diffusion, the mixing due to the motion of macroscale air particles does not discriminate on the ~~motion~~ basis of the molecular weight. Within the range of the level where the process predominant, atmospheric composition tends to be independent of height.

Near an altitude of 100km, the two competing processes, are of roughly comparable importance, while well above 100km, the vertical mixing ~~with rate~~ of the atmospheric constituents is essentially controlled by molecular diffusion.

(2) Charged particle in the Atmosphere: Includes, molecular ion, electrons etc. This only account for a minute fraction of the mass of the atmosphere. However, they play a crucial role in the wide range of geophysical phenomenon including lightning, reflection of radio waves, fluctuation in the geomagnetic field and the maintainance of the fair weather electric field between the ~~atmosphere~~ earth surface, and the upper atmosphere.

There are a number of distinct difference physical process that contributes to the production of charged particles. This include;

(i) X-ray and UV-radiation from the sun, which ionizes air molecules

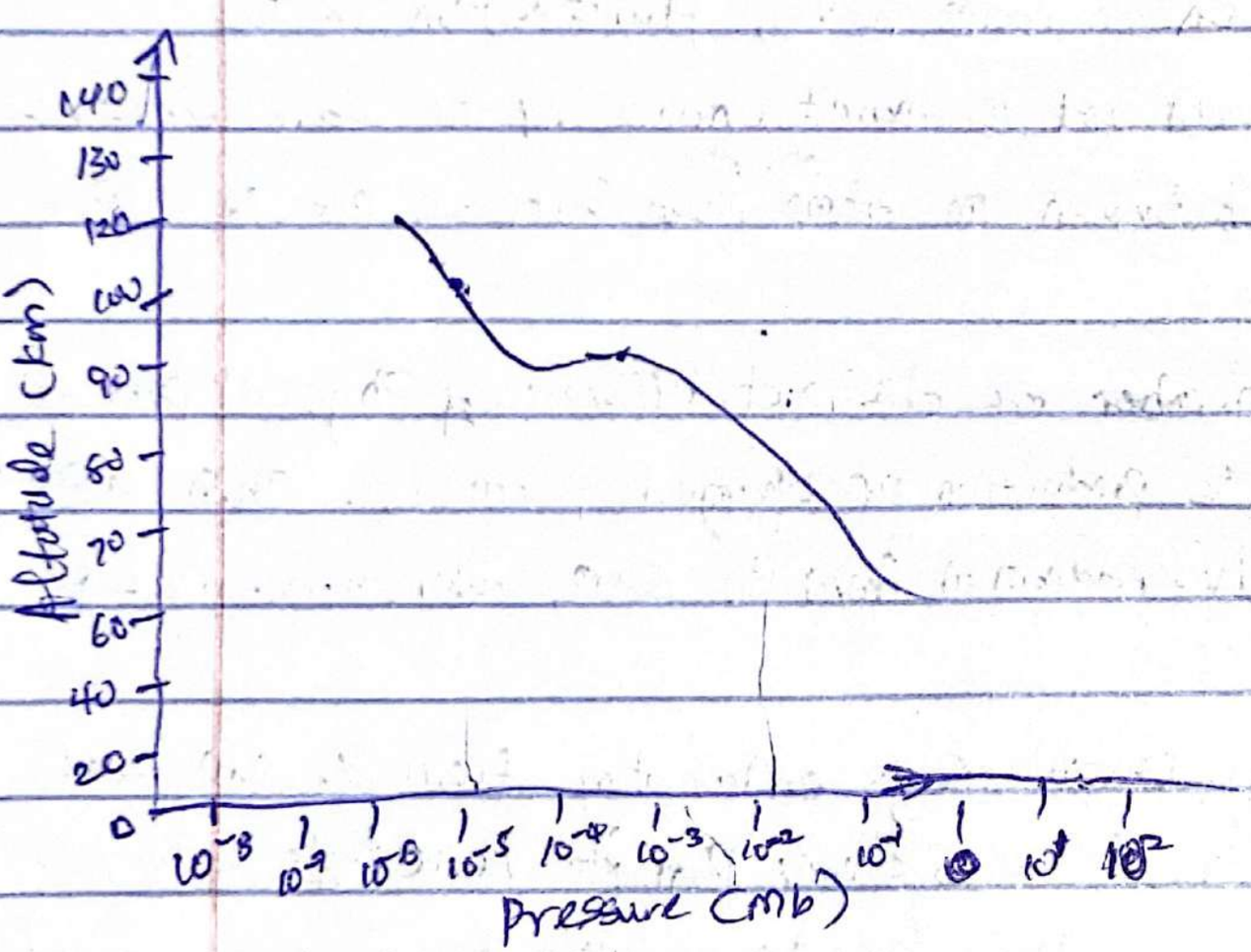
(ii) High energy cosmic rays emanating from the sun and sources outside the Solar System; ~~Reach~~ Penetrate into the lower atmosphere, where they leave with trace of ionized air molecules.

(iii) Electric charges can be seperated within the cloud

(iv) On land, the radioactive decay of substances within the earth crust provide additional sources of ions

(3) The temperature distribution within the structure of the earth: The vertical distribution of temperature for the standard atmosphere ~~diagram~~ in (fig. 1); which is ~~divided~~

defined by the four distinct layers called the tropopause, stratopause, mesopause, ionopause respectively



The logarithm of the pressure, drop off almost linearly with height. $\log P(z) \approx \log P(0) - B(z) \cdots (1)$ $P(z)$ = Pressure at height z above sea level

P_0 is the pressure at sea level. B is a constant which is related to the average slope of the pressure curve. From eq 1, it can be rewrite as:

$$\ln \frac{P(z)}{P(0)} \approx -\frac{z}{H} \quad \cdots \text{eqn (2)}$$

Note that we have used $\ln(x) = 2.3 \log x$ and $H = \frac{1}{2.3B}$, From eqn (2);

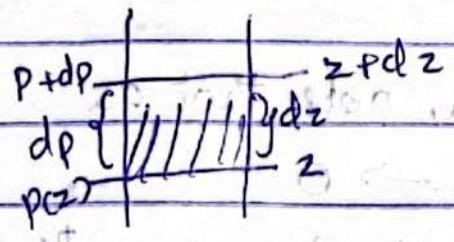
$$\frac{P(z)}{P(0)} = e^{-z/H}$$

$$P(z) = P(0)\, e^{-z/H} \quad \cdots (3)$$

eqn (3) shows that the atmospheric pressure drops of by a factor of $e^{-z/H}$ in passing upward through a layer of depth H.

Where H is called scale height

Hydrostatic Equation of the Atmosphere



Let's consider a unit cross sectional area of a vertical column of air, we can estimate the mass between the height z and z + dz

Mass = ρV for unit cross-sectional area

$m = \rho dz$

Force acting on the column is given by

$$P = \frac{F}{A} \Rightarrow F = P = mg = \rho g\, dz \quad \cdots (4)$$

$$P(z) - (P + dP) = \rho g dz$$

$$-dP(z) = \rho g dz$$

$$dP(z) = -\rho g\, dz \quad \cdots (5)$$

The hydrostatic equation of pressure, is given

$$\frac{dp(z)}{dz} = -\rho g \quad \cdots (5)$$

In equation (5), we make substitution of density using ideal gas equation $(PV = RT)$ $\left(V = \frac{m}{\rho}\right)$

$$\rho = \frac{mP}{RT}$$

$$\frac{dP(z)}{dz} = -\frac{mP}{RT} g$$

$$\frac{dp(z)}{dp} = \frac{mg}{RT} dz \quad \cdots \text{eqn (6)}$$

From eqn (6)

$$H = \frac{RT}{mg}, \quad \frac{dp(z)}{dp}$$

$$\frac{dp(z)}{dp} = -\frac{dz}{H} \quad \cdots (7)$$

Integrating both sides

$$\frac{\ln P(z)}{P(0)} = -\int_0^z \frac{dz}{H}$$

$$P(z) = P(0)\, e^{-\int_0^z \frac{dz}{H}}$$

where $P(0)$ is the pressure at $z = 0$, at surface

The quantity $H = \frac{RT}{mg}$ is scale height

Scale height is the increase in altitude needed to reduce the pressure by factor of e

Atmospheric Modelling

We can model the atmosphere using the hydrostatic equation for certain special atmospheric conditions.

Homogeneous = when the density is constant

For homogeneous atmosphere, the density is assumed to be constant and is independent of height. Using the hydrostatic eqm 5

$$\int_{P_0}^{0} dP(z) = -\int_0^H \rho g\, dz = -\rho g \int_0^H dz$$

$$P_0 = \rho g H$$

$$H = \frac{P_0}{\rho g}$$

Using the ideal gas equation, $(PV = RT)$ in one unit mass

$$P_0 = \rho RT$$

$$\Rightarrow H = \frac{RT}{g}$$

We can also calculate for decrease in temperature with height

$\frac{dT}{dz}$ = The lapse rate

↓ Temperature gradient

$$\frac{dp}{dz} = \frac{dp}{dT} \cdot \frac{dT}{dz} \quad \ldots (8)$$

$$\Rightarrow \frac{dT}{dz} = \frac{dp}{dz} \Big/ \frac{dp}{dT} \qquad (dp = -\rho g\, dz)$$

$$\frac{dp}{dz} = -\rho g \qquad \left(PV = RT,\ V = \frac{1}{\rho},\ \frac{P}{\rho} = RT,\ P = \rho RT\right)$$

$$P = \rho RT$$

$$\frac{dp}{dT} = \rho R$$

$$\Rightarrow \frac{dT}{dz} = -\frac{\rho g}{\rho R}$$

$$\frac{dT}{dz} = -\frac{g}{R} = -34.1\ ^\circ C/km \quad \ldots (9)$$

Isothermal = when the temperature is constant

At isothermal atmosphere, it is assumed that the temperature is constant (temperature is independent of height

using,

$$dp = -\rho g\, dz$$

Using the equation of state to substitute for ρ

$$dp = -\frac{Pg}{RT} dz \quad \ldots (10)$$

$$\int_{P_0}^{P_z} \frac{dp}{P} = -\int \frac{g}{RT} dz$$

$$\ln \frac{P(z)}{P_0} = -\frac{gz}{RT}$$

$$= -\frac{z}{H}, \text{ where } H = \frac{g}{RT}$$

$$P(z) = P_0 e^{-z/H}$$

In this expression, note that as $z \to \infty$, $P(z) \to 0$

In an isothermal atmosphere, the pressure decreases exponentially with height and the lapse rate of temperature in an isothermal atmosphere is zero

$$\frac{dT}{dz} = 0$$

Assignment

Write note on the following

(i) The solar atmosphere

(ii) The solar activities and radiation

(iii) The solar system ⇒ (i) planet
(ii) moon
(iii) Comet
(iv) meteors.

Heat Transfer

The density of the gas close to the region that's hotter begins to be lighter, so they come up

⇒ The sun is the source of most of earth's surface heat, heat is transferred as a result of difference in temperature energy from the sun more through space by radiation

Radiation ⇒ transfer of energy by means of electromagnetic waves is an important process for transferring Infrared radiation absorbed by the earth surface back into the atmosphere

Conduction is the transfer of heat through matters by the actual contact of molecules. Molecules are always in motion. Heated molecules move more rapidly than cooler ones, heat is transferred from the fast moving molecules to a slow moving molecules until are the molecules are moving on the same rate. Conduction occur on the earth surface as heated rocks or sanding beaches transfer heat to the surrouding air. Heat gained by the atmosphere by radiation or Conduction is usually transferred by convention

As air absorb energy, its molecules move faster and far apart. This movement decreases the density of the air. Cold dense air sinks forcing warm, less dense air upward. The transfer of heat due to density difference is called convention. Convention current causes a constant exchange of cold, dense air from less dense, warm air

How heat gets to the earth is (i) ~~Insolation~~ through insulation and energy budget.

* 30% of heat of the sun are reflected back to the atmosphere
* 17% is absorbed within the molecules of the gases.
* 22% is scattered within the particles
* only 31% of the heat of the sun gets to the earth surface.

The Energy Budget of the Earth

	Percentage of total energy
(1) Reflected and scattered to space	30%
(2) Held temporarily in the earth earth – atmosphere system	
(i) Absorbed by atmosphere – 17%	
(ii) Scattered to surface – 22%	
(iii) Arrive to surface unaffected – 31%	
70%	
Total	100%

Weather – state of the atmosphere

Parameter: pressure, air moisture (humidity),

Element of pressure: air pressure, wind speed, wind direction, temperature, relative humidy, the amount and height of cloud.

air pressure - aneroid barometer

temperature - minimum and maximum thermometer

Wet and dry bulb thermometer

Relative humidity - air hygrometer

Rainfall - rain guage

Wind direction & Speed - Cup anamometer

Sunshine - Sunshine recorder

Visibility - Visual

cloud - Selometer

Metrologist Species in giving greater information.

* The major thing that determine the weather is the cloud.

* Cloud are collection of tiny droplet of water in the atmosphere

* What determines cloud is the shape and altitude.

Types

(i) Cyrus cloud → associated with fair weather. 500-2000m

(ii) Cumulus cloud → thick and massive, developed during the day 500-1200m

(iii) Stratus cloud → occur in layers and often covers the

(iv) Nimbus cloud → produce precipitation, they are dark, grey cloud

Impact of Weather

(i) Transportation

(ii) Agriculture

(iii) Natural disaster

(iv) Air communication

Conduction is the transfer of heat through matter by the actual contact of molecules. Molecules are always in motion. Heated molecules move more rapidly than cooler molecules. Heat is transfered from the fast-moving molecules to slow-moving molecules until all molecules are moving at the same rate. Conduction occurs on Earth's surface as heated rocks or sandy beaches transfer heat to the surrounding air.

Heat gained by the atmosphere from radiation or conduction is usually transferred by convection. As air absorbs energy, its molecules moves faster and farther apart. This movement decreases the density of the air. Cold, dense air sinks, forcing warm, less dense air upward. This transfer of heat due to density differences is called Convection. Convection current cause a constant exchange of cold, dense air for less dense warm air.

Insolation and Earth's Energy Budget

Incoming Solar radiation is called insolation. About 30 percent of the incoming energy is reflected back into space before it reaches the earth's surface. Much of this is reflected by gases in the upper atmosphere. The rest is reflected by dust and clouds in the lower atmosphere. About

Question.....

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17 percent of the radiation is used up when it reacts with various gases in the atmosphere. About 22 percent of the solar radiation is scattered by the clouds but eventually reaches the earth's surface. This account for 69 percent of the total insolation that reaches the outer fringes of the atmosphere. The rest, 31 percent, is unaffected by the atmosphere.

The Energy budget of the Earth

	Percentage of Total Energy
1. Reflected and Scattered to space	30%
2. Held temporarily in the earth – atmosphere System	70%
(a) Absorbed by atmosphere	17%
(b) Scattered to Surface	22%
(c) Arrives at Surface Unaffected	31%
	70%

Some of this incoming solar radiation is used by plants to convert water and carbondioxide to plant tissue. Animals feed on plants. Heat is given off as plant and animal tissues are oxidized. Eventually, all of this energy is released back

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into the atmosphere. The rest of the incoming solar energy enters soil and rocks on the surface of the earth. Most of this energy is radiated back into space as heat. A small amount of it oxidizes certain minerals. The earth - atmosphere system absorbs solar energy, changes it, and radiates almost all of it back into space.

Weather

Weather refers to the state of the atmosphere i.e. its temperature, pressure and humidity for a place for a short period of time.

WEATHER

Weather is the current state of the [illegible] in terms of air pressure, wind, temperature, [illegible] The study of weather is concerned with the short-range changes in the atmospheric conditions.

The primary factor in bringing about weather changes is the general or planetary circulation of the atmosphere. The air motion arises because of the unequal heating of the

earth's surface at different latitudes by the sun and modified by the rotation of the earth.

To determine the state of the atmosphere at any given time, observations are made at weather stations throughout the world and by international agreement, these observations are made simultaneously using uniform standard procedures. Observations that can be made by an observer on the ground are called SURFACE observations, while those obtained by instruments that are carried aloft by balloons or rockets are called UPPER-AIR observations. Upper air observations are routinely carried out by using the following instruments: Pilot balloon (PIBAL), radiosondes or rawinsondes

Weather Elements

The weather elements are: air pressure, direction and velocity of the wind; temperature; relative humidity; amount, kind, and height of the clouds; the amount of rain or snow; the visibility; and the cloud ceiling (cloud height). These elements are observed and used in ~~predict~~ weather forcasting.

Several methods and devices are in use for the measurements of the weather elements. For example, in routine surface observations, the following instruments are in use for the

respective measurement.

(1) air pressure — Aneroid Barometer
(2) Temperature — Min. and Max. Thermometers
— Wet and Dry bulb thermometers
(3) Relative Humidity — Psychrometer
— hair hygrometer
(4) Rainfall — Rain gauge (bucket type)
(5) Wind (Vel. and Direction) — Cup anemometer
(6) Sunshine — Sunshine recorders
(7) Visibility — Visual Observation
(8) Cloud ceiling — Ceilometer
(9) Cloud type — Visual Observations

For upper air measurements (i.e at upper levels) e.g winds, pilot balloons are the device in use. Other weather elements such as temperature, pressure, heights are measured with a radiosonde.

A meteorologist collect weather information from weather stations. The information is plotted on maps. This information enables meteorologists to predict weather conditions.

A weather map is a compilation of weather data from many collecting stations. On a weather map, station models describe the local weather

of the collecting stations. Each station model shows the wind direction and speed, atmospheric pressure, temperature, dew point, amount and types of clouds, types of precipitation and other data.

CLOUDS

Clouds are collections of tiny droplets of water suspended in the air. Droplets may range from 0.005 to 0.1 millimeters in diameter. In clouds where large amounts of moisture are present, water droplets may join. When these droplets reach 2.0 to 6.5 mm in diameter, they may fall as rain. Rain is a form of precipitation. Snow, hail and sleet are also forms of precipitation.

* Clouds are classified according to their shapes and altitudes. The four basic types of clouds according to shape, are Cirrus, Cumulus, Stratus, and nimbus.

A cirrus cloud: it is a high, white, feathery cloud usually associated with fair weather. This type of cloud is composed of ice crystals or supercooled water, and may sometimes indicate that bad weather will occur in the near future.

Cumulus Clouds: are thick, puffy masses that look like heads of cauliflower with flat bottoms. Cumulus clouds usually develop during the day over land when columns of moist air are forced aloft and cooled to the dew point temperature.

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Question.....

Stratus clouds occur in layers and often cover the whole sky. Stratus clouds usually are only a few hundred metres thick but may extend over thousands of square kilometres.
Nimbus clouds: These produce precipitation. They are dark gray clouds that have ragged edges. Rain or snow falls continuously from the bottom of these clouds.

*Clouds classification according to heights

CLASS	TYPE	HEIGHT RANGE (m)
HIGH	Cirrus Cirrostratus Cirro Cumulus	6000 – 12000
MIDDLE	Altostratus Alto Cumulus	2000 – 6000
LOW	Strato Cumulus Stratus Nimbostratus	500 – 2000
VERTICAL CLOUD	Cumulus Cumulonimbus	500 – 12000

A Stratus cloud close to the ground is called FOG.

Question.....

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Impacts of weather on man.

Weather Bureaux or Meteorological stations are (scattered) all over the globe, including the oceans, using some of the most up-to-date weather instruments to gather a wide range of data as raw materials for the construction of weather maps or Synoptic charts. Professional meteorologists are able to forecast the weather fairly accurately from local observations and this can be used in:

(1) Transportation (sea, air, land) — reception of fogs, typhoons e.t.c

(2) Agriculture — forecast of drought, flooding, e.t.c. so farmers can plan.

(3) Natural Disasters: — Warning populace against Hurricanes, tornadoes etc.

(4) Air Communication — Radio/telephone receptions

The Sun Contains 99.86 percent of the mass of the Solar system. Because of its Sun's gravitational pull, it is the centre of the system around which other objects of the Solar System revolve.

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Question.....

THE SUN

The Sun is one of the billions of stars in our galaxy (called the milky way) and it is the closest to our planet earth.

The Sun is a small star with a mass of 1.989×10^{30} kg. The average distance from the earth (called 1 A.U. or Astronomical Unit) is 149×10^{6} km. An effective period of 27 days can be ascribed to the Solar rotation. It should be realised that the Sun is not a rigid rotating body. The rotation period of the Sun, as seen from the rotating earth, is a function of Solar latitude, varying from about 26 days at the equator to about 30 days at the pole.

The Sun can be described as a sphere of gas heated by a nuclear process. There are boundaries defined by differences in temperature, density, magnetic field strengths or other conditions based on the observable solar characteristics. It is important to note that such boundaries exist in a dynamic sense only. The boundaries do not in general prevent the flow of material.

Energy leaves the Sun in the form of electromagnetic radiation and corpuscular radiation, viz high speed protons, and other charged particles. Some uses the term 'Solar Constant' to define the radiant flux from

Question.....

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the Sun. This has a value of $1373\ Wm^{-2}$ ($1400\ Wm^{-2}$ approx) and it is the total energy falling on unit surface area, normal to the flux.

The total energy emitted by the Sun can be calculated by multiplying the Solar constant by the area of a sphere at the earth's mean distance, d, i.e it is

$$E = 4\pi d^2 \times 1373 = 3.88 \times 10^{26}\ W$$

If we assume that the radius of the sun is 6.69×10^8 m. Supposing that the surface behaves like a full radiator (a close approximation), then we can obtain its effective temperature from

$$\sigma T^4 = \frac{3.88 \times 10^{26}}{4\pi r^2}$$

$$\Rightarrow \quad T = 5770\ K \quad \text{(to whole number)}$$

This is the surface temperature of the Sun. However, the inner temperature is estimated to be about 20 million Kelvin.

The Features of the Sun.

These includes: ~~Photosphere~~, Sunspots, Corona, Solar wind, Solar flares, Solar rotation,

Also Photosphere, Chromosphere, ~~Aurora~~, Corona.

Question

The Solar System consists of the Sun and the nine
We can note that the Sun is the Center
of the Solar System. The planets revolve around
the Sun. NEVER LOOK DIRECTLY AT THE
BRIGHT SURFACE OF THE SUN. BE ESPECIALLY
CAREFUL NOT TO VIEW THE SUN DIRECTLY
THROUGH TELESCOPES OR BINOCULARS.
BLINDNESS!

(a) The Photosphere Chromosphere and the Corona

(i) The Photosphere

The photosphere is the surface of the Sun which emits the visible radiation that we see. It is about 250km thick. Its outer temperature is 6000°C. This temperature is higher than the average temperature of the earth's core. The pressure of the photosphere is low. It is only 0.0001 of the earth's air pressure at sea level.

(ii) The Chromosphere

Outward from the photosphere is the chromosphere. The density of the Chromosphere is much lower than the density of the photosphere. But the temperature becomes higher. The temperature ranges from 5000°C at the bottom of the chromosphere to 20 000°C at its top.

Question.....

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(iii) The Aurora ↳ with solar flares!

In night sky, we often notice flickering arcs, rays and curtains of light, this display of lights is called the aurora. The aurora is often brightly colored. It occurs in the upper atmosphere, usually near the poles. Auroras are brighter and can be seen farther from the poles during sunspot maximum. Solar flares also produce brilliant displays of auroras. The flares send out streams of charged particles. These particles interact with the earth's atmosphere and with its magnetic field. This causes the air to glow like a neon tube.

(iv) The Corona

This is a layer of very thin gases above the chromosphere. The corona can be seen as a pearly white light surrounding the sun during a total eclipse. The gas density is so low in this layer that the corona is almost a total vacuum. But the particles of the corona, mostly electrically charged atomic particles, move at very high speeds. The temperature of a substance depends on how fast its particles move. Because the particles in the corona move at high speeds, its temperature is about 1 000 000°C.

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(b) The Solar Flares and Aurora

These are sudden increases in brightness of the Chromosphere, often near Sunspot groups. Protons and electrons stream outward from these areas at speeds up to 1500 Kms. Many of these protons and electrons reach the Earth. Solar flares disturb radio reception and affect the Earth's magnetic field. Sometimes gases in Earth's upper atmosphere are excited by solar flares. These gases radiate lights known as the aurora borealis or northern lights. In the Southern Hemisphere, these lights are called the Aurora australis.

(c) Sunspots

They are relatively cool, dark areas on the Sun's surface. They are formed of gases moving upward from the Sun's interior. As the gases move upward they expand and become cooler. Sunspots first appear as small dark areas on the photosphere. They usually occur in groups with two large spots and from thirty to fifty smaller ones. There are always very strong magnetic fields between the groups. Temperatures in sunspots are about 4000°C i.e. about 2000°C cooler than the surface of the Sun. A Sunspot group last for an average of two weeks. However, some have lasted for more

Question.....

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than a month. The number of sunspots increases to a maximum on the average of every 11 years, hence, sunspot activity follows an 11-year cycle.

Sunspot groups are observed to move across the face of the sun. This is evidence that the Sun, like the earth, is spinning, or rotating. But the Sun rotates more ~~stb~~ slowly than the earth. Because the sun is made up of gases, part of it rotate at different velocities.

Solar Wind

The Solar wind is made up of ions and electrons that ~~out~~ outward from the Sun. The velocity ranges from 250 - 800 km/s and is strong after solar flare activity

The Solar wind results from the emission or flow of electrically charged particles from Solar flares, Sunspot and the corona.

The rapidly moving particles of the Solar wind flood outward from the sun. They strike all the bodies of the Solar System. As the particles move Foward the earth, they are captured by the earth's magnetic field. The magnetic field shifts the particles back and forth between the magnetic poles. This shifting protects the earth's surface from particles.

Solar-wind particles from flares have a great deal of energy. When the particles are trapped by the earth's magnetic field, they shift its lines of magnetic force. This effect is called a magnetic storm. A magnetic storm

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Question

Causes Compass needles on the earth to deflect. deflect. During a magnetic storm, a compass will not show the usual readings. If these high-energy particles could reach the surface of the earth they would damage living tissue. Astronauts in space would also be in danger from the harmful effects of such Solar-flare particles.

(e) Solar rotation

The Sun does not undergo a rigid body rotation. Its rotation can be measured by observing the movement on Sunspots across the visible disk of the Sun or by Spectroscopic methods. ~~The period of rotation of the Sun as determined from Sunspots observations is about~~

The rotation rate is not the same for all parts of the surface of the Sun. Gases at the Sun's equator move faster than those at the poles. The Sun's rotation rate as determined from Sunspots observation is about 25 days at the equator and 34 or 35 days at the poles.

(5)

Question

mass of the earth is m, R_{es} for circular motion round the sun;

$$\frac{GM_s m}{r_s^2} = m r_s \omega^2 = \frac{m r_s 4\pi^2}{T^2}$$

$T^2 \propto R^3$ $\Rightarrow$ $M_s = \frac{4\pi^2 r_s^3}{GT^2}$

$T^2 = \frac{R^3}{T^2}$

$\frac{M_s G T^2}{4\pi^2} = \frac{R^3}{T^2}$

$= \frac{4\pi^2 \times (1.5\times10^{11})^3}{6.7\times10^{-11} \times (365\times24\times3600)^2}$

$= 2\times10^{30}$ kg.

Main parts of the Solar System:

Planet	Mean Radius (km)	Mean Radius of Orbit (m)	Mean Density (g/cm³)	Total Mass	Period	
Sun	696000		1.4	333041	25	
Mercury	2434	5.79×10^{10}	6.03	0.055	59	?
Venus	6056	1.08×10^{11}	5.11	0.815	243.09	
Earth	6370	1.49×10^{11}	5.52	1.0000	1.00	
Mars	3370	2.28×10^{11}	4.16	0.1076	1.03	
Jupiter	69900	7.78×10^{11}	1.34	318.3839	0.40	
Saturn	58500	1.43×10^{12}	0.69			
Uranus	23300	2.87×10^{12}	1.58			
Neptune	22100	4.50×10^{12}	2.23			
Pluto	3000	5.90×10^{12}	4.1(?)	0.0736(?)	6.39	

Note 1 A.U $= 1.5\times10^{11}$ m

$\frac{GM_s m}{r^2} = \frac{mv^2}{r} \Rightarrow v^2 = \frac{GM_s}{r}$

$v = \frac{2\pi r}{T}$ $\quad \frac{GM}{r} = \frac{4\pi^2 r^2}{T^2}$

$GM = \frac{4\pi^2 r^3}{T^2} \Rightarrow \frac{r^3}{T^2} = \frac{GM}{4\pi^2}$

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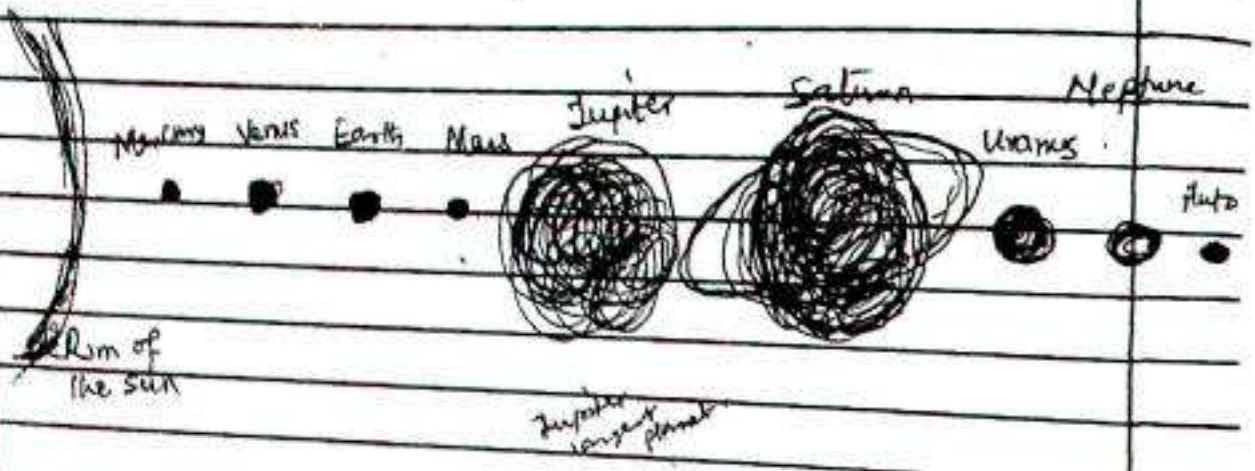
Question.....

Diagram to show the Relative Sizes of the Planets: The Solar System



A planet is an object in space that reflects light from a nearby star around which it revolves. The term planet means "to wander". Planets are different from stars. They are actually cold compared to the stars. Stars produce their own light (e.g Sun, star). Planets produce no light of their own. They shine only by reflected sunlight. Because of the Sun's gravitational pull, it is the central object around which other objects of the Solar System revolve. The planets move about the Sun in an elliptical orbit. An ellipse is a closed curve that is elongated.

For any object in motion about the Sun in an elliptical orbit, there will be some point in the orbit when that object is closest to the Sun. Likewise at another point it is farthest from the Sun. The point in an orbit when an object (Planet) is closest to the Sun is the **Perihelion**. The farthest

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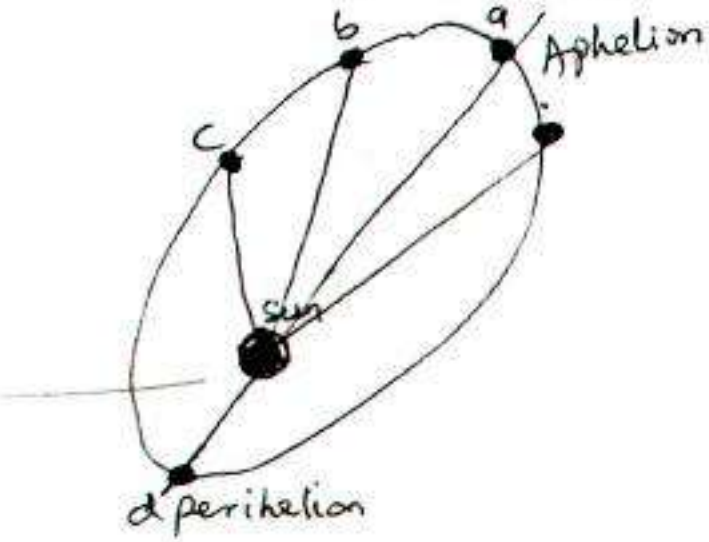
point in its orbit from the sun is the aphelion.
All objects in orbit have perihelions and aphelions.

Planets have elliptical orbits



• planets.

The Inner Planets

Mercury, Venus, Earth and Mars are the inner planets. The planets are relatively close to the sun. All are solid, rocklike bodies in contrast to the outer planets, which are mostly gaseous.

The Outer Planets

Jupiter

Jupiter, Saturn, Uranus, Neptune and Pluto are the outer planets. They are about 5 and 30 AUs from the sun. Essentially they are gaseous and much more massive than the terrestrial planets.

Moon is an astronomical body that orbits planet Earth and Earth's only permanent natural satellite
— It is the fifth largest natural satellite in the Solar System
— It is the largest among planetary satellite relative to the size of the planet

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The Moon.

The moon is located in space as a satellite body around the earth, where it is held in position by a gravitational interaction with the earth. The moon is believed to have been formed at about the same time as the earth's formation, and its surface is without any atmosphere.

→ The moon's surface, like Earth's consists of mountains, valleys and plains. But because of its low density (3.34×10^3 kg/m^3) and small size, the moon has no atmosphere. Thus, the surface processes that formed the moon's surface are much different from those that formed Earth's.

The orbit of the moon around the earth is approximately elliptical. Its period of revolution around the earth is equal to 27 days, 7 hours, 43 minutes, and 11.5 seconds — for a sidereal month (i.e the time it takes the moon to return to the same position with respect to the earth). The mean distance of the moon from the Earth is about 384,400 km, however, it varies in the course of each month. The angular velocity of its rotation around the earth is about 33 minutes of an arc per hour. The Earth ÷ moon mass ratio is 81.302 ± 0.001 and this gives the mass of the moon as 7.353×10^{22} kg. The gravitational acceleration value of the moon is 1.6 m/s^2 (Compare to Earth is 6 times of moon)

a low value — hence, responsible for the absence of atmosphere.

Lunar rocks, unlike Earth's rocks, have no traces of water in them. Lunar rocks do have tiny crystals of pure iron, which do not exist on Earth.

Instruments left on the moon by astronauts have recorded thousands of moonquakes. Moonquakes occur between 600 and 800km below the surface. Moonquakes are more frequent when Earth and moon are close together. Some characteristics of the moon's interior are suggested by moonquake records. Scientists have determined that the moon consists of several layers. The outer crust is about 60km thick on the side facing Earth and appears to be about 100km thick on the far side of the moon. Beneath the crust is a rigid layer extending to about 1000km.

The moon revolves once on its axis each time it orbits the earth. Thus it presents the same face to the earth bound observer. A remarkable feature about the lunar surface is cratering. Craters of all types up to about 25km across are scattered over the surface in great profusion. These craters frequently overlap one another.

There are two processes responsible for the present lunar landscape
(1) Crater-forming impact of numerous meteorites and other objects from space.
(2) Igneous and volcanic activity from within the moon.

The weathering of the moon's surface takes place in the total absence of atmosphere and water.
There is no transport of ~~erosion~~, Debris by river, glaciers, moving currents as occurs on Earth.
The weak gravitational forces of the moon causes very slow levelling out and redistribution of surface Debris from higher ground.

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Question.....

Comets

A comet is a mass of gases, cosmic dust, and small rocky particles that orbits the sun. Comets probes practically the entire interplanetary space from the corona to many Astronomical Units (AU) of distance. They have hyperbolic orbits and are perturbed by the planets especially Jupiter which has a family of them.

Basically many comets have three characteristic parts; The nucleus, head or coma and tail. The nucleus has a nearly star like appearance, it is considered to consist of solid material. Often the nucleus is not visible. The coma or head, is an atmosphere of spherical shape with the nucleus being at the centre. The Coma consists predominantly of neutral molecules and atoms with varying mixture of dust. There is a reduction in the surface brightness of the coma, as we go out from the nucleus, and shows no definite boundary. Quite often, the nucleus and coma together are called head. The tail shows the emission bands and lines due to ionized gases and a variable continuous emission arising from scattered sunlight. Both gas and dust may be present in the tail. There is no reason to believe that comets ever recover the mass driven into the tails and deposited (or dispersed) along the

The tail of a comet always points away from the sun

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orbit. Possibly this depletion of mass accounts for the finite life-time of the comets, and offers explanation why some comets are not observed to return.

When a comet approaches the sun (due to gravitational pull of passing stars) a cloud of dust and gas forms a halo called a coma around the nucleus. This coma may have a diameter greater than Jupiter's diameter of 142,800km. Since solar energy causes the gases in a comet to vaporize its brightness increases as it nears the sun. ~~The tail~~ can be observed.

The Halley's comet is periodic. It was first recorded in 240 B.C. Halley predicted the comet's return in 1758 based on its previous appearances. It has returned every 75 to 76yrs. Encke's comet orbit the sun every 3.28 yrs. More comets are still being discovered.

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Meteoroids Meteors and Meteorites

Meteoroids are small fragments of matter moving in space. Most meteoroids have masses smaller than one gram. They are quite often caught by the gravitational force of the earth. (They are important clues to the composition of matter in space) dragging them into the earth's atmosphere. Meteoroids has a high speed of entry as it passes from the outer to lower and denser part of the earth. Most

Meteors: are meteoroids that reach Earth's atmosphere. About 25 million meteors visible to the unaided eye occur every 24 hours over the entire planet. Most meteors are totally consumed by intense heat long before they reach the earth's surface. The larger meteors are more likely to survive encounter with the earth's atmosphere than the smaller ones.

Meteorites: are meteors that strike the Earth. If the meteors is too large it will hit the earth with such a tremendous force that the impact will destroy it and may produce a crater. The best example of such crater is in the Northern Arizona. It is believed that in the past the Earth's surface was covered by such craters but weathering has since removed traces of most of them.

The actual observed impact of a meteorite

The no of 'finds' are more than 'falls'

Stars and Galaxies

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is rare. But if observed it is called "Falls" indicating actual observation during entry and recovery soon after. Those meteorites recovered which were not observed during entry are collectively called Finds. (no eye witness any more than falls)

When a meteorite is discovered, the name of the nearest town/village is given to it.