

Top Ten Signs Your Astronomy Professor May Be Nuts

(based on Lee Carkner List)



- 10) The title of every lecture is: "Man, Them Stars is Hot!".
- 9) His so-called "telescopes" are really just paper towel rolls covered in aluminum foil.
- 8) To illustrate the vastness of the universe, he makes everybody walk to Springfield.
- 7) Thinks he's married to the slide remote.
- 6) Your grade is based entirely on how many ping-pong balls you can fit in your mouth.
- 5) His so-called Drake Equation video is really just an old episode of Alf.
- 4) He makes everyone wear a soup pot on their head to protect the class from "Klingon mind control lasers".
- 3) About 90% of all classes involve dressing monkeys up to look like Frank Drake.
- 2) When you go to his office hours, he is always hiding under the desk so that the "space squirrels" can't get him.
- 1) The only observing advice he ever gives is, "Keep an eye out for the mothership."

Astronomy 330:

Extraterrestrial Life



This class (Lecture 24):

Evolution of Technology

Kevin Brenner

Connor Bailey

Next Class:

Evolution of Worldview

Sean Sarcu

Saloni Sheth



Article Forum open— selection due tonight
2 x 2 page pdf articles due April 28th

Music: *Concerning the UFO Sighting near Highland, Illinois*
— Sufian Stevens

Last HW #2



Jeffrey Lu
http://www.dailygalaxy.com/my_weblog/2014/01/nasas-star-trek-future-a-warp-drive-solution-for-faster-than-light-space-travel-a-2013-most-popular.html
purely theoretical since it is currently impossible to create a warp drive, so the ideas and concepts they talk about are very speculative

Drake Equation

That's 2.7 intelligent systems/year

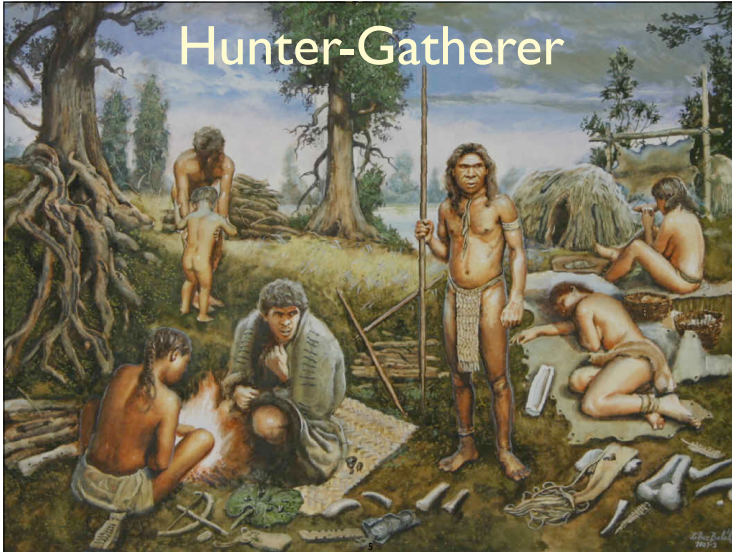
Frank
Drake



$$N = R_* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

# of advanced civilizations we can contact in our Galaxy today	Star formation rate	Fraction of stars with planets	# of Earthlike planets per system	Fraction on which life arises	Fraction that evolve intelligence	Fraction that commu- nicate	Lifetime of advanced civilizations
30 stars/ yr	0.8 systems/ star	4×0.47 = 1.88 planets/ system	0.2 life/ planet	0.3 intel./ life	comm./ intel.	yrs/ comm.	

Hunter-Gatherer



Early humans hunted and gathered for the largest fraction of human's time on the planet.

Homo Sapiens into modern form about 100 kya and first exhibited modern behavior 40 kya and first agriculture 10 kya

Hunter-Gatherer



Homo Sapiens were hunter-gatherers until about 10 kya

Implied small, nomadic tribes with few possessions.

Generally, fair and easy life:

Four hour workday
No midterms/finals

Everyone worked to get food
No Astronomy professors

But no **surpluses**

When things go bad, they go
VERY bad



Stone Age Transformation



x

The Transition



Statue dated to 11000 years ago.
Note that first farmers did not do better than hunting gathering.. missing nutrients usually.



Younger Dryas Event

Global cooling event
Drought in the Levant?

Natufian culture

First farmers?

Base camp
Hunter-Gatherer
Partially sedentary
Descendants were farmers



Horticulture: Tending wild crops
Agriculture: Planting specific crops

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Agriculture



Agriculture first developed north and east of the Fertile Crescent, between 11,000 and 9,500 BCE. A cold, dry period called the "Younger Dryas Event" led to a decrease in the quantity of wild plants available. People began to cultivate plants to increase the availability of food sources. Einkorn, rye, bread wheat, and lentils were the first plants to be cultivated, followed by other forms of wheat and barley. The domestication of animals followed the domestication of plants in the Middle East. Sheep and goats were domesticated first (around 6,500 BCE). Cattle and pigs were domesticated about 1000 years later.



Farming believed to start in Levant.

Mixed hunting with foraging

Climate change drove cultivation of crops?

and domestication of animals?

Cultivation supported larger communities
Required storage, planting, seed selection
New societal organizations

Wild grains and animals were present in this area

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Neolithic Founder Crops



Emmer Wheat



Einkorn Wheat



Barley



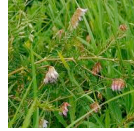
Lentil



Pea



Chickpea



Bitter Vetch



Flax

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Cereals

- Emmer wheat (*Triticum dicoccum*, descended from the wild *T. dicoccoides*)
- Einkorn wheat (*Triticum monococcum*, descended from the wild *T. boeoticum*)
- Barley (*Hordeum vulgare/sativum*, descended from the wild *H. spontaneum*)

Pulses

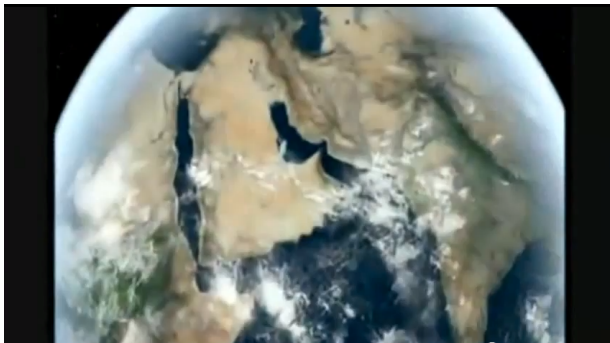
- Lentil (*Lens culinaris*)
- Pea (*Pisum sativum*)
- Chickpea (*Cicer arietinum*)
- Bitter vetch (*Vicia ervilia*)

Other

- Flax (*Linum usitatissimum*)

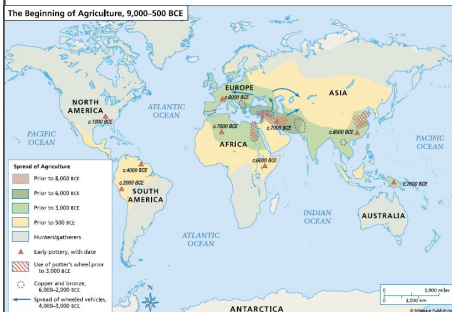
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Neolithic Agriculture



x

Agriculture



Agriculture spread to

Mesopotamia

Nile River Valley

Indus River Valley

Far East (independent?)



Rice

Long term settlements:

Cultural Evolution
Tool development

Information Storage
Energy Sources

10



Agriculture



Domestication of animals quickly followed



Goat

8000 years ago

Meat & Milk
Wool



Pig

7000 years ago

Meat
Reduce Waste



Cow

6500 years ago

Meat, Milk, Hides
Draft animal



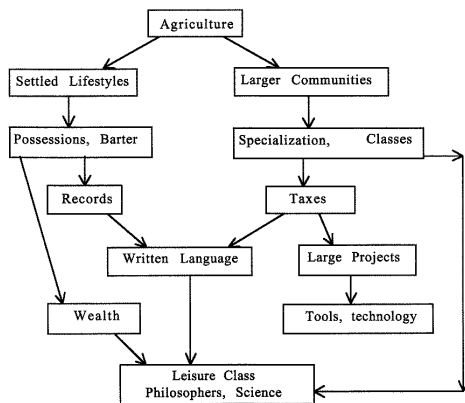
Horse

3000 years ago

Draft animal
Faster communication

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Importance of Agriculture



Question



What cultural break-through eventually allowed for professional scientist, like Astronomy professors?

- a) Telescopes
- b) Religion
- c) The spoken word
- d) Agriculture
- e) Monkeys

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D

Group Think



Cultural Evolution

What critical factors affected the cultural development of our species?

x

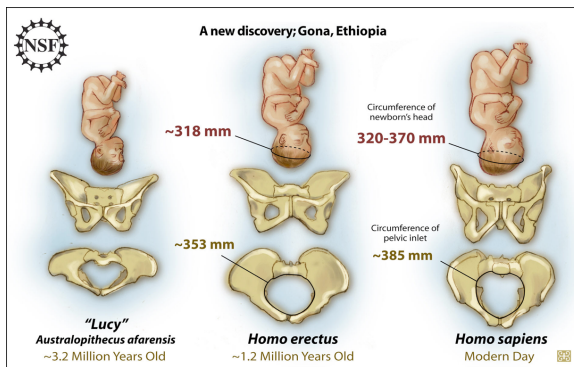
What do you think?

Why/

Language & Information



Human brain is limited in size by birth canal

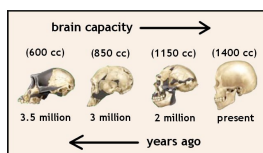


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Language & Information



Human brain is limited in size & capacity



First method would have been verbal communication



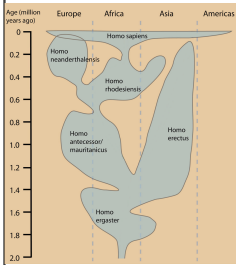
Require **extrasomatic** information storage

감사합니다 Natick
 Danke Ευχαριστώ Dalu
 Thank You Köszönöm
 Grazie Спасибо Dank Tack
 谢谢 Merci See
 ありがとう

Crucial development

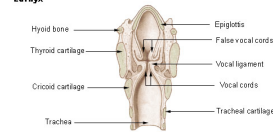
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Language & Information



Origin of language not understood.

No fossils: Tongue, Lips, Vocal Organs, and Ears



Evolutionary adaptations to make and hear sounds.

Homo Ergaster likely first to vocalize

Homo heidelbergensis auditory changes to middle and outer ear

Hypoglossal canal and nerve controversy (indicative of speech?)
first arose ~400,000 years ago in Australopithecines

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But the origins of language are not well understood- no fossils. Probably in hunting parties for large prey. The control of the tongue is through the hypoglossal canal (hole) in the skull. In humans it is twice as large as chimps. First arose about 400,000 yrs ago in Australopithecines.

Recent studies of hypoglossal canal with other primates shows no correlation with size and speech.

Vocalizations



Neanderthals talk like us?

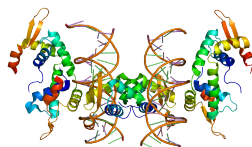
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The Language Gene?



Forkhead Box Protein P2 (FOXP2)

KE Family: Half suffered severe specific language impairment



Disorder tied to mutations in FOXP2 gene - lack fine motor movements of tongue and lips

Language Gene?



Human FOXP2 differs from



Neanderthal



Chimpanzee



Mouse



Zebra Finch

Same

2 amino acids

3 amino acids

7 amino acids

Did speech evolve with hominin branch?

Blocking FOXP2 in Zebra Finch
impairs song learning



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Written Record



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Oral language is clearly limited. Development of written language provided a powerful, new source of info storage. Earliest appearance was in Sumer- present day Iraq (8500 BCE).

Probably started from economic need- barter or receipts. Common by 3000 BCE. Written records of taxes and a ruling class- the rise of civilization. Move from symbols to syllabic language developed by 1500 BCE.

The Historical Record



Written record is powerful
information storage method

Marks originally developed for
economic need?

Origins unclear:

Mesopotamia?

Balkans?

Others?

Coevolution

Communication of ideas?

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Language



x

Writing Numbers



Written language improved extrasomatic storage

Tally marks originated
around 30,000 years ago



Record keeping originated around 4000
years ago in Zagros region of Iran



Different tokens
represented different
quantities (1, 10, 100).

To avoid counterfeiting

Clay-baked envelope
Seal markings

Different tokens
represented different
objects (goat or sheep).



x

String of tokens, sealed in clay envelope

Numbers & Math



x

Writing



Proto-Writing

Symbols to represent meaning but not language



Vinča Script (> 6500 years ago)

Cuneiform Sumer

Symbols to represent language



Sumerian (~5000 years ago)

Phoenician alphabet

Very commonly used writing system due to merchants



~3000 years ago

http://en.wikipedia.org/wiki/Vinča_signs

These symbols have been found on many of the artifacts excavated from sites in south-east Europe, in particular from Vinča near Belgrade, but also in Greece, Bulgaria, Romania, eastern Hungary, Moldova, southern Ukraine and the former Yugoslavia. The artifacts date from between the 7th and 4th millennia BC and those decorated with these symbols are between 8,000 and 6,500 years old.

X

Question



Language and writing are examples of

- a) culture.
- b) the FOXP2 gene.
- c) extra-somatic storage.
- d) how daddy went to jail.
- e) early government.

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C

ASTR 330: Lecture 23

X

April 15, 2014

Extrasomatic Storage



Cuneiform Writing



3000 BCE

Printing Press



1456 ACE

Telegraph



1844 ACE

Radio



1895 ACE



1927 ACE



1946 ACE



1969 ACE

Do these increase the **intelligence** of our **species**?

- Printing press (1456) – number of books jumped from 10,000 to 10 million in 50 yrs.

http://www.sfcityguides.org/public_guidelines.html?article=343&submitted=TRUE&srch_text=&submitted2=&topic=Inventions

<http://americaninventors.blogspot.com/2009/06/eniac-computer.html>

<http://www.history.com/topics/invention-of-the-internet>

- Huge extrasomatic storage: Well above brain storage

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How to Communicate



Modern Electronics



1948



1959

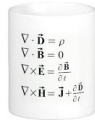
Silicon Age



Physics Required:

PHYS 212 University Physics:
Elec & Mag

PHYS 214 Univ Physics:
Quantum Physics



Stone Age (Silicates) to Stone Age (Silicon)

x

Question



Which of the following is **not** an example of an extrasomatic storage technique?

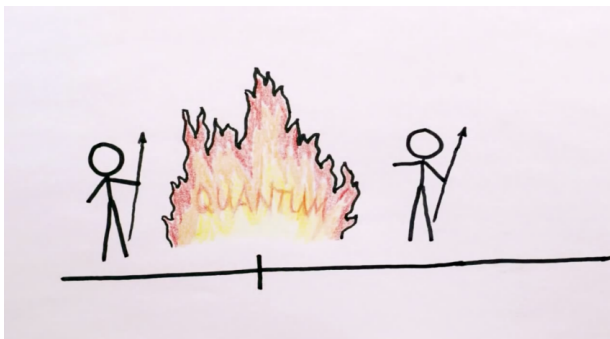
- a) Brain synapses
- b) Wikipedia
- c) Printing press
- d) Language
- e) None of the above.

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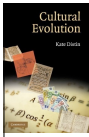
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A

Communication



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Cultural Evolution



What does this mean?

A continuation of natural selection?

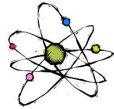
Will evolution to intelligence naturally lead to technology?

Punctuated Equilibrium



Competition between cultures?

Episodic progress mixed with dark ages



**Technology
& Learning**

Is fate of civilizations is extinction, but knowledge lived on via cultural diffusion.

Cultural Evolution



What is likelihood technology develops on other worlds?



One sample to study



Agriculture developed independently

Mexico (Maize)

Eastern US (Sunflowers)

Andes (Potatoes)

Papua (Sugarcane)

Writing developed independently

Sumer

China

Americas

Egypt?

India?



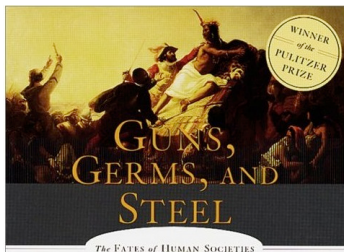
Wheel only developed in Mesopotamia, Caucasuses, and Central Europe?

Toys in S.America (no beast of burden)

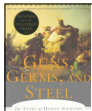
Recent developments are more easily communicated

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Cultural Evolution



x



Cultural: *What ifs?*



Large beasts of burden lived in the Americas?

Gunpowder invented in the Americas?

Germs in Americas were deadly to Europeans

Similar cultural devastation in Pacific Islands



Dodo Bird



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Techno Pop

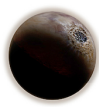


Is technology development natural evolutionary step in drive for intelligence?

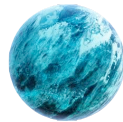
Does it depend on type of host Planet?



Desert



Metal Poor



Water

Competition between Civilizations?

Psychology of the Intelligence?

Meek

Violent



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Cultural Evolution



Cultural Evolution = **FAST**

< 1 second of one day (*our* culture in *Earth* existence)



Agriculture enabled civilizations

Development of Language

Increase in Extrasomatic Storage

We live in Si age



Does the development of technology produce correct worldview?

27

40,000 years out of 4 billion is less than one second from one day.