

Astronomy 230



Oct 31, 2006

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This class (Lecture 19):

Origin of Intelligence

Adam Molski

Kerry Doyle

Steven Novak

Next Class:

Origin of Intelligence

Alan Francis

Katelyn Swartz

Octavio Mendoza

Nov 7:

Jeffery Ungrund

Ian Gentile

Chris Blim

Presentations



- **Adam Molski:** Space Elevator
- **Kerry Doyle:** Alien Sensationalism in the Media
- **Steven Novak:** Astro Mega-structures

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Outline



- Summary of life on Earth.
- What is intelligence?
- Development of intelligence.
- Brains. Brains.
- The rise of the primates!

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Evolution of Intelligence

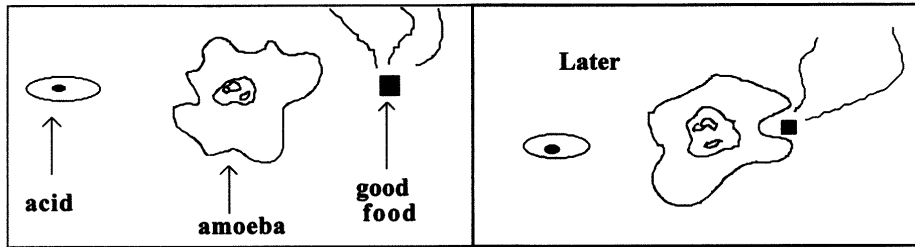


- Through diversity, evolution has resulted in an increase in the complexity of organisms on Earth.
- Can we associate complexity with intelligence?
- If intelligence is an advantageous trait, it is plausible that intelligence would increase over time.
- But, what is intelligence?

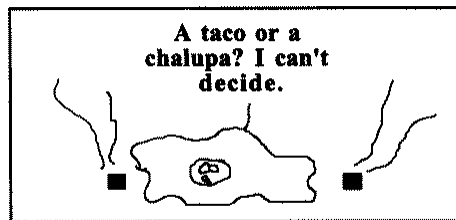
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An Amoeba Distinguishes



- Has a model of its environment.
- What if two pieces of food are placed nearby?

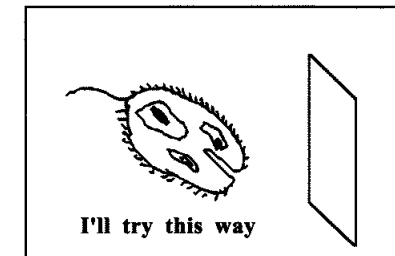
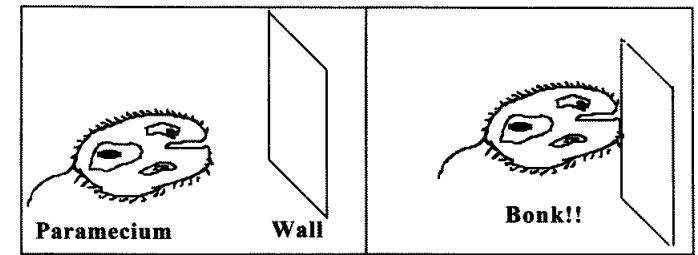


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The Intelligent Paramecium?



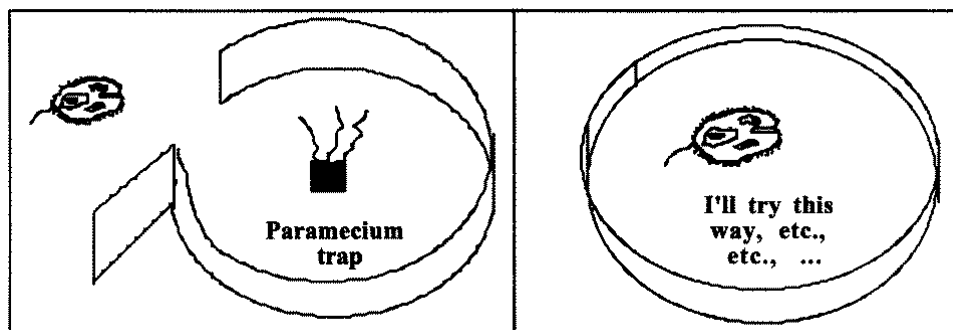
- Still one celled, but more complex.
- Has a kind of primitive memory.



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Intelligence Breakdown



- Doesn't realize to give up.
- Smarter than the amoeba, but no genius.
- With complexity does come some intelligence.
- There seems to be a continuum of intelligence.

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Evolution of Intelligence



- A general definition is “the ability to model the world, including the organism's own self”.
- But even single-celled animals seem to be able to do that to some degree.
- Can think of intelligence as a continuum, not a unique aspect of humans.
- Why then, does there seem to be a gap between us and the rest of life on Earth?

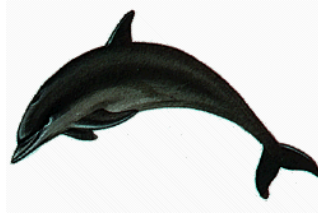
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Origin of Human Intelligence



- If we view intelligence as a continuum, then we are not essentially different than other organisms.
- Still need a quantitative measure of intelligence.
- Intelligence could be defined by the amount of information stored in the organism. DNA storage.

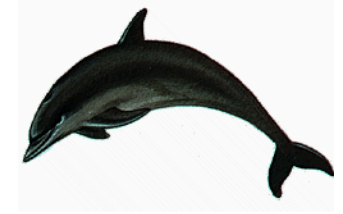


Spottet Dolphins sounds
<http://neptune.atlantis-intl.com/dolphins/sounds.html>

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DNA Storage



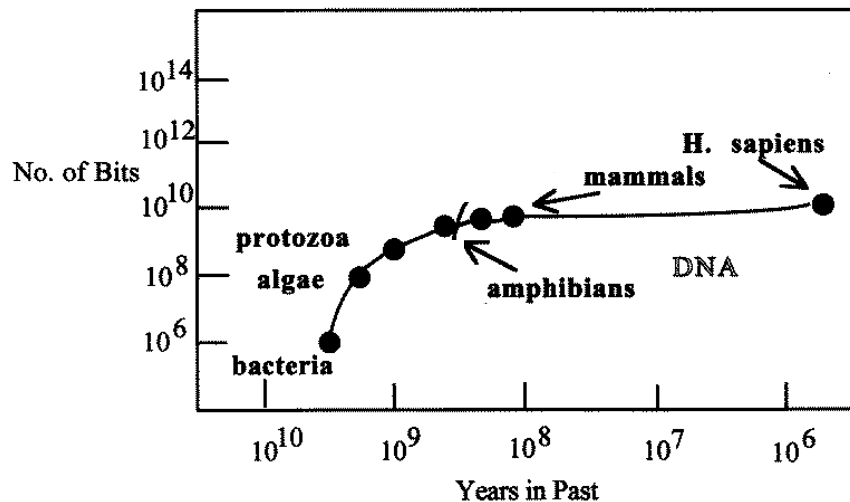
- We'll use bits of information
 - Yes = 1
 - No = 0
- Each DNA base has 2 bits of information– 4 options.
- Each codon has 3 bases or 6 bits (3×2)
- Humans have (3×10^9) bases \times 2 bits per base = 6×10^9 bits (~750 Mbytes), like 4000 books of 500 pages.

Spottet Dolphins sounds
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Development of Intelligence



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Caveats



- Existence of large amount of junk DNA makes it problematic to measure intelligence by number of DNA possibilities
 - Only about 2% of human DNA actually codes proteins, then humans have 1.2×10^8 bits (15 MB), or 800 books
 - For some organism the junk DNA is significant: Newts and lilies would have more than 10^{11} bits (12.5 GB).
- Keep in mind that less intelligent organism did not disappear, so there is **no trend** for organisms to get smarter.
- The **diversity** of life with time led to **some** species with intelligence.



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Limited Pockets in Genes



- There are limits to how much info genes can store.
- If you try to store too much info, mutations can wipe you out.
- For eukaryotes, the error rate is about 10^{-9} , limiting the amount of storage to about 10^{10} bits.
- What did life do?
- Evolution devised a new way (extra-genetic) to store information.
- Life developed a nervous system and brains.
More bits of storage that are R/W. We can learn!



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Info Storage in Brains?



- Information storage in DNA is straightforward, but in the brain?
- There are 10^{11} nerve cells (called neurons) in a human brain, but they do not work in binary form, more analog-based.
- And they are interconnected—a neuron can be connected (with synapses) to 10^3 other neurons.

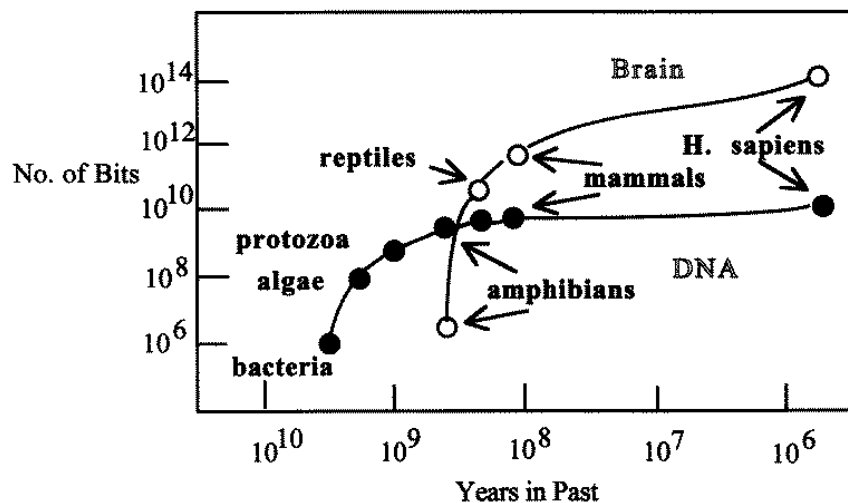


- An impulse triggers a chain of neurons to “fire” causing a reaction. So, really the information is stored in synapses. $10^{11} \times 10^3 = 10^{14}$ bits (12.5 Terabytes)

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Development of Intelligence



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Intelligence



- It seems that intelligence is a desirable trait.
- And we can argue for a rough connection between the rise of complexity and intelligence.
- Increased diversity is the key. With more organisms of all types, a more intelligent species is reasonable.
- Still, the point of the Drake equation is to find civilizations with which to communicate, so we need to think about developing human-like or better, intelligence.



<http://www.newenglandfilm.com/news/archives/03march/reviews.htm>

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Human-Level Intelligence



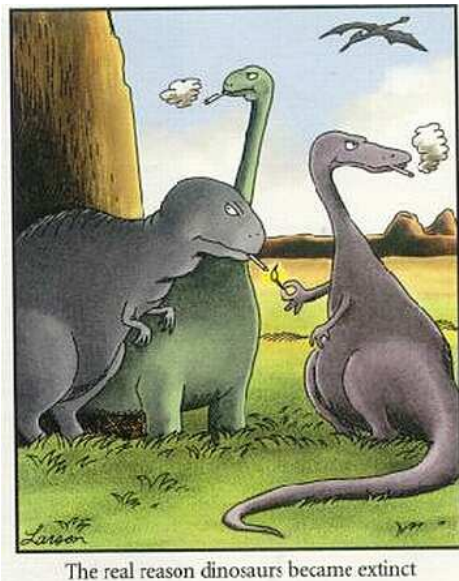
- Our species is the only one on Earth to have developed a technological civilization.
- How likely is that to happen on other planets?
- Actually the development of humans is still controversial, even among anthropologists. New fossils are appearing that change our understanding.
- Mammals first appeared on the fossil stage about 200 Myrs ago, but were minor players until about 65 Myrs ago.

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Less Credible Theories



<http://www.boundaryschools.com/fws/snidsmk.htm>

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