Development of Life
(continued – again)

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Cambrian “Explosion”

• Note the rapid growth in size from a cell, to a few cells (~3 GY); from a few cells to animals (~0.05 GY); from animals to large animals (~0.01 GY)

• Over only a few million years (versus BILLIONS before) every currently recognized phylum of life on Earth developed in the Cambrian explosion (!)
The Cambrian Explosion

• Initially, at least, land was still totally barren
• No trees, no plants, no critters, no evidence of bacterial life on land either
• The sea, on the other hand, was teeming with life!
What Enabled the Cambrian Explosion?

- O₂ levels jumped to nearly “modern” right before the Cambrian explosion
- All modern animals are O₂ breathers
- Perhaps the O₂ increase enabled a dramatic increase in diversity/size of animals
K-T Extinction

- Species extincted included:
  - Almost ALL large vertebrates on land (dinosaurs, etc.)
  - Most species of plankton and reef-dwelling animals
  - Tropical marine invertebrates
  - Many land plant species
- Again … these are entire species lost! Death toll for individual living beings >90% in many cases
- The greatest loss of species in the last 100 million years on Earth
Mass Extinctions

- We have seen the K-T and Permian extinctions
- Evidence for several others
Tertiary & Quarternary

- Age of mammals
- Human evolution timeline: Hominids appear about 5 MYr ago
- “Modern” humans are recent (last 150,000 years)
- Neanderthal Man co-existed for a while (250,000 to 30,000 years ago), but then went extinct
Tertiary & Quarternary

Millions of years ago

Hominids

A. afarensis
A. garhi
Homo habilis
H. erectus
H. neanderthalensis
H. sapiens

To chimpanzees

Ardipithecus
Australopithecus anamensis
A. africanus
A. robustus
A. boisei
H. heidelbergensis

NOTE: skulls not drawn to scale
Development of Intelligence

• Working definition of intelligence: **Capable of developing technology for interstellar communication**

• Radio works; so would lasers; still working on “subspace communicators”
Development of Intelligence

- Agriculture and human settlements about 13,000 years ago
- Writing, etc. about 5,000 years ago or so
- Pyramids and Ziggurats
- Transport via boats, etc.
- Telecommunication
- Space travel
- Most signs of “intelligence” limited to the past 50-100 years (!)
Is Intelligence Inevitable?

- We often think that evolution had the “goal” of producing us, or things a lot like us - After all, we are the pinnacle of evolution … right?
- But, nature had LOTS of opportunities to develop intelligence before, and it did not happen.
Is Intelligence Inevitable?

- Even for hominids, “intelligence” only developed in the last <200,000 years (that is <4% of hominid duration on Earth!)
- And … it only became obvious (according to our definition) in the last 100 years
- That’s about 0.002% of hominid duration on Earth
- Or … about 0.0000025% of the duration of life on Earth!!!