

Theory of Evolution

- addresses how life has changed on earth over time
- does not address origin of universe, solar system, & earth
- does not address origin of life

The Big Bang addresses origin of universe & life

- scientists estimate Big Bang occurred 15 billion yrs ago
- Earth formed ~4.6 bill yrs ago

- evidence: moon rocks & meterorites can be dated to 4.5-4.6 bill yrs ago, this is indirect evidence

- how can we determine ages?

- by radiometric dating we can get an absolute age
 - you should realize that "absolute" just means we can estimate the age in years, it does not mean that it is exact

- radioactive isotopes are used in radiometric dating
 - these isotopes are unstable & will decay into stable isotopes at a steady rate

- these isotopes have a half-life
 - half-life is the time required for half of radioactive atoms to decay

- to calculate age of sample, you use proportion of radioactive to stable isotopes

- we can also use "relative age"

- in this type of dating, we are not determining an age
 - instead we are determining whether fossils are older or younger than other fossils by looking at layers in earth

early atmosphere of earth

hot, volcanic gases present: N_2 , CO_2 , H_2O vapor, CO ,
ammonia NH_3 , methane gas CH_4 , hydrogen sulfide H_2S
 O_2 not present

could not have supported life as we know it today
early on oxygen was bound in CO_2 & H_2O

early earth was hostile environment, besides hot volcanic gases,
damaging UV rays of sun penetrated down to earth
today ozone O_3 protects us from sun
ozone formed after mill of yrs of O_2 added to atmosphere

so, how did life arise in this hostile environment?

3 hypotheses of origin of life

1-life originally arose elsewhere & brought here

problem: does not explain origin, can't test this

2-life arose by unknown means

problem: can't test idea

3-life arose from inorganic substances interacting together in this hostile environment

what are inorganic substances? elements &

compounds not directly making up living organisms

organic compounds: chemicals made by and chemicals that make up living organisms

proteins, carbohydrates, fats, nucleic acids

must have these organized together to get life

all life can be boiled down to its most basic level as a series of chemical interactions

the origin of life was a chemical process

this hypothesis can be and has been tested in labs

no, we have not *created* life in labs, but we have

shown that the elements of life, organic molecules can be created in a lab

one more hypoth that is not testable: deity created life

Heterotroph hypothesis (hypothesis #3)

life originated in a complex soup of inorganic materials
only need some E source to force inorganic materials to
interact w/each other

E source: lightning, UV radiation, radioactivity, heat
all organic compounds contain C, H, O in differing
arrangements

these elements were present in other forms in the
inorganic soup of the early earth

Miller & Urey's experiment p.20-23

heterotroph hypothesis explaining origin of life says:

1-abiotic substances had to make small simple organic
molecules

2-something had to organize those molecules into larger
more complex organic molecules

3-these molecules had to be able to copy themselves &
become self-replicating

ultimately, scientists think a cell membrane structure (large,
complex organic molecule) formed around other organic
molecules----->first cell

oldest known microfossils or fossil microorganisms
are tiny, single-celled organisms similar to today's
bacteria or prokaryotic cells
found in rocks 3.5 billion yrs old

have found single-celled filamentous bacteria that can
photosynthesize dating to 2.8 billion yrs old

when photosynthesis evolved, the atmosphere of the earth
began changing, oxygen was released in copious
amounts, this helped to create the ozone, which led to
the evolution of more complex life

the first eukaryotic cells date to 2.1 billion yrs old
so how did we get from prokaryotic cells to eukaryotic cells?
Endosymbiont Hypothesis

What is symbiosis? when 2 different species live together in
a relationship

there are 3 types of symbiotic relationships

1-mutualism: both species benefit from relationship
clown fish & sea anemone
lichens: algae & fungus

2-parasitism: one species benefits, other is harmed
tapeworm, heartworm, leech, tick

3-commensalism: one benefits, other is not affected
barnacles on whales, remora on sharks

So what is the Endosymbiont Hypothesis?

this hypothesis proposes that eukaryotes evolved when
larger prokaryotes engulfed smaller prokaryotes

this is one way prokaryotes got food

but instead of digesting them, they formed a symbiotic
relationship

eventually, the internal organisms (endosymbionts)
could no longer live on their own

so, the larger organisms now had other membrane-
bound structures inside of them and when they
reproduced, those structures also reproduced

these notes have told us how life could have arisen and how
we could get from prokaryotic to eukaryotic cells, but how do
we get speciation occurring?