Fri 3:15 10/27

→ 09/27 Lecture (Wednesday)

speciation

formation of new species

- find time for group to office hours before the test
- email Dr Richardson about chem follow up
- two surveys due Fri (one extra credit)

exam one week from today! OCT 4

understand how skewed sex ratios affect genetic diversity (forest Sim 4)

extant means not extinct, they live now

Q hybridization: two species cross and produce fertile (?) offspring

keep in mind there is some tension and fuzziness with speciation

- mechanisms that prevent hybridization

some ambiguity b/c hard to apply the criteria + because a gradual process

behavioral isolation

ex. the meadowlarks

- they have different songs and only respond to the song of their own species

- is this assortative mating culminating in speciation?

temporal isolation

- most animals aren't fertile year round

- major changes due to evolution of genes that regulate development

development: single-celled organism (zygote) → maturity

caterpillar → butterfly

gene regulation

- for instance, cancer is unregulated cell division
- not all genes are active all the time
- cells in finger could make liver cells, only certain genes being activated (all the genetic info is in all the cells)

genes controlling gene regulation can cause big change

most ~~genes~~ mutations affecting development negatively affect development

but some are good

evolution isn't always little by little ~~thousands~~ thousands of years

intermediates not always necessary

look at these examples again

~~mutations~~ (im) mutations can be massive

small genetic change can cause massive phenotype change

kind of like domino effect, large ramifications

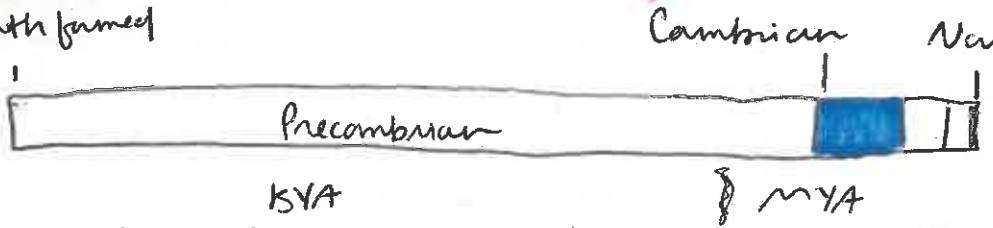
upshot:

this will be on the second exam

History of Life 09/27 Lecture

all species made of the same stuff, didn't evolve from completely separate biochemicals
sequence similarities among fundamental genes
- conserved among species
- ½ the same genes as a banana - why/how?
- perform the same critical function
- evolution doesn't seem to fix what isn't broken
- important set of genes not modified because no alternative has ever worked better
- some of our mitochondrial genes identical to some bacterial genes
→ supports evolution b/ gradual genetic change
no better way to explain this than one single common ancestor
3 Domains of Life: Bactria, Archaea, Eukarya
figure 1.17 / proximity → closeness/relatedness via DNA
- animals and plants diverge at the same point?
~~[illegible] the difference between Archaea and Eukarya in the [illegible]~~
figure 20.16
horizontal gene transfer (HGT)
- we have been saying reproductive isolation means stopped gene flow
- HGT really most relevant in early single celled organisms
- may have happened a lot w/o being recognized
- genetic engineering: artificial gene transfer
- not impossible for genes to move b/ cells and work
Archaea have been around the longest
Eukarya have nuclei, others don't
Bactria & Archaea DNA is circle w/ two ends
- how are genetic sequences so similar when the literal shape of DNA is so different
I didn't realize there were photosynthetic prokaryotes

4.5 bya Earth formed



cyanobacteria (blue green algae) but not actually algae ~~first~~ first put oxygen in the atmosphere - made an oxygenated atmosphere, which is necessary for many later organisms

lack of fossil evidence doesn't mean it didn't happen, we just working with what we have evidence of on the timeline

540 mya Cambrian explosion

- adaptive radiation to the niches, but how?
- many of these aren't still alive today

today/Archaea exist in "harsh" environments

- methanogens (generate methane in decomposing areas w/ no oxygen - doesn't decomposition generate oxygen?)
- halophile (salty environments) thermophiles (very hot environments)

Bacteria have peptidoglycan in cell walls (Archaea don't)

cyanobacteria are bacteria by cyanobacteria?

- enabled formation of stratospheric ozone layer
- ozone at the ground level is harmful to living things
- ozone in the stratosphere blocks UV
- CFCs damaged stratosphere → increased UV getting to us
- benefitted stratosphere best example of international climate action
- made it so anything could live on land (otherwise way too much UV on the earth)

How did organisms w/ chromosomes enclosed inside the membranes of cell nuclei (eukaryotes) arise?

"protists are a taxonomic hodge podge"

chromosomes not loose in the cell

Endosymbiont hypothesis for the origin of Eukaryotes

- bacteria eats another bacteria doesn't get digested, lives on,

then split further
- there are coral with cells living inside their cells
- coral bleaching (look at this later)
- chloroplasts + mitochondria similar in size to bacteria (how does this support eq. thought the absorbed bacteria was the nucleus)
- chloroplasts + mitochondria circle like bacteria
- chloroplasts + mitochondria have cyanobacterial DNA sequences and their DNA is circular like bacteria
- compelling evidence that eukaryotes are from bacteria (and we know bacteria are from Archae)

LAB 09/29 BIOLOGY

tends to be more text (which is based from data) than in chem lab
introduction usually ends with hypotheses ~~and the rest~~ in the remets
hugely relevant if you're going to be a bio major or something similar
defensible - 'yeah you can say that based off of those results'
3 features of data to describe in results sections of laboratory reports
1 not a literal description of the figures - takes some practice to realize what to say and how to say it
magnitudes, patterns, and surprises 3 clear things in the data you didn't expect to see, don't get to ignore data points that seem wrong - can't say "somebody sneezed up if you don't have clear evidence - don't dismiss as wrong or invalid
there are always trends and they could very well be random variation
be very careful to distinguish between what you know and what you think you know
~~[illegible]~~
look at the axes first
dependent variable still called the dependent variable even if found experimentally not to be

Graph 1 (photon fluxdensity)
1. The independent variable varied between 0 and 2000 μmol $m^{-2} s^{-1}$ for Amaranthus Palmeri and between 0 and about 1500 for Euphorbia fuhrerii. The net photosynthesis varied between below zero and almost 80 for Amaranthus palmeri and ~~between~~ between below zero and ~~[illegible]~~ less than
#below zero too topical
2. don't need fancy statistics to clearly tell pattern
Ef increase and then level out; Ap increased and looks like it may eventually level out
1. There is a substantial difference in the ranges (magnitude = how much higher)
3. no basis to find anything surprising - don't have to say there's nothing surprising if there is not anything surprising

Graph 2: 1. Magnitude of ≥10 µg/dL decreased to elimination ~~both~~ decreasing from 88% prevalence from 1976-1980 to 0% in 2011-2014; ≥5 µg/dL decreased from 100% from 1976-1980 to 1% in 2011-2014.

why did they look at children aged 1-5?

2. The prevalence of lead levels of both ≥10 µg/dL and ≥5 µg/dL in children age 1-5 saw substantial ~~decreases~~ and consistent decreases from 1976 to 2014 with initial decreases being the largest in magnitude and the size of the decrease becoming smaller in magnitude over time. - - - - - - - - - - - -

pretty strong pattern

only use the term skewed if you expected normal distribution

not a surprise but good ~~gaps~~ catch that there is gaps in the data - should use a consistent interval

Graph 3: this one has data and model results

There was an overall but consistent decrease in total ozone, which was not consistent with the model's projection, in "The magnitude matters" which predicted a consistent decrease followed by a stable increase

The data pretty consistently decrease and then increase everytime

"lot of choices when making a graph" thinks it's a mistake to connect the dots

not as firm or clear as the other graphs (part of the point)

this graph should go to zero (scaling issue)

this magnitude is biologically significant

there is a surprise around 2015

BIO 115 Exam Prep

speciation

→ The definition of species is naturally imperfect as nature is not driven by biological definitions. However, there are generally two definitions of a species; the first distinguishes different species based on an ability to interbreed with one another and produce fertile offspring in natural conditions. Therefore, according to this definition, members of the same species can interbreed and produce fertile offspring; members of different species may interbreed but produce sterile offspring. The other definition of species is

, which is very much related to species identification.

→ Similarity or dissimilarity in appearance is not ~~an automatic~~ a reliable means of species identification. Traits can be shared across species and vary within a species. But, a trait always and only present in one set of ~~organisms~~ populations or a population and never present in another population is compelling evidence for the existence of two different species (ie. a trait always present - good based of writing)

origin of new species ✓

- need more examples of sympatric speciation

mechanisms that prevent hybridization

- I think there are three but I don't very well remember

modes of evolution

I feel pretty good about this one

- should I have multiple examples for e/ selection

- example for stabilizing

disruptive selection

evolution basics

I feel pretty good about this too

Chapter 18 Textbook Questions

p 484

1. 2n+1 4. b 7. d
2. human 5. d 8. a
3. b 6. a 9. dispersal vs vicariance? → relocation to new region / physical division resultant of an environmental change
10. b
11. ~~autopolyploid vs allopolyploid? → source of extra chromosomes~~
12. a 13. c 14. d 15. a 16. c

21. why do island chains provide ideal conditions for adaptive radiation to occur?
- lots of niches because different environments

24. what do both rate of speciation models have in common?
- both include the same four factors affecting allele frequency

25. human will occur if there is no difference between the fitness level of the hybrids and the non-hybrids. ~~Being forced to occupy the same niche in the same area will result in either~~

Chapter 19 Textbook Questions

p503

~~X~~ population genetics is the study of how selective forces change the allele frequencies in a population over time

he's not going to ask what a certain subdiscipline is?

12. a cline is a gradual geographic variation across an ecological gradient
- example: size of deer increasing at higher latitudes (further from equator)

22. males w/ handicaps that survive must have good genetics
- example: male peacock tail feathers

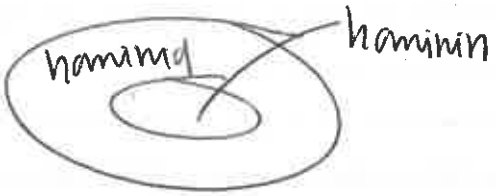
29.7 the evolution of primates

all primates descended from tree dwellers
- rotating shoulder joint, big toe separate from other toes (except in humans), and thumbs separate from fingers, stereoscopic vision

Strepsirrhines (turned-nose)	Haplorrhines (dry-nosed)
- generally nocturnal	- generally diurnal
- smell	- sight
- smaller size + brain	- anthropoids
- can make vitamin C	- cannot

primates generally produce one offspring / pregnancy, carry themselves upright
New World and Old World monkeys underwent separate adaptive radiation
humans & chimpanzees diverged from common hominoid ancestor ~ 6 MYA -
- hominin: species that evolved after this divergence (closer to humans than chimpanzees)
- humans bipedal, larger brains, fully opposable thumbs

relatively few hominin fossils
more than one hominin species alive at once historically
not all hominins ancestral to humans (some species died out)



this will be on the second examination

History of Life (cont.)

→ October 11th lecture

how are eukaryotes thought to have evolved from prokaryotes?
- endosymbiont hypothesis
- thought to have happened ~1.5 BYA
- chloroplasts and mitochondria similar in size to bacteria (so there not a vast size range for bacteria) also not that impressive on its own
- chloroplasts + bacteria + mitochondria all reproduce by splitting
- chloroplasts + mitochondria have their own circular DNA
  - unique from nucleus DNA?
  - chloroplast DNA similar sequencing as cyanobacteria

more compelling of the reasons

don't need to know the more detailed timelines from the book
don't need to memorize the exact years listed on his timeline
but do need to grasp the timeframe, so it is worth looking at and remembering the timeline
Cambrian explosion more precisely dated than other events on timeline

fossils don't normally form - rare event
Burgess Shale (Alberta, Canada) most famous site for fossils from that period
the names of periods are set by the fossils
explosion is a lot of adaptive radiation / a lot of speciation from a few ancestral organisms
conditions on the planet have been very different at some times in the past
- the atmosphere is now 20% oxygen, used to be 0% oxygen
- atmospheric oxygen from photosynthesis $CO_2 \rightarrow O_2$
- has been more oxygen in the past

- insects have holes in their body for gas exchange, not lungs ; have for a scale that varies on depends on how much oxygen is in the atmosphere
- more oxygen in atmosphere in the past meant massive insects
- how much CO_2 in atmosphere has also been different

now there has been net speciation, but in the past there have been mass extinction events (I worded this poorly)
don't need to memorize names and dates except for the Cretaceous - Tertiary mass extinction 65 mya (compare w/ dates on dragonfly slide, makes sense)
- the largest mass extinction was Permian - Triassic 250 mya 98% of ~~marine~~ species or levels
sixth one now being caused by us
- going extinct faster now than at normal background rates
marine species more likely to fossilize than land species
Cambrian explosion b/ pre Cambrian and Paleozoic
species can adapt to modest changes but not usually large changes
all of the mass extinctions thought to be associated w/ change in climate (temperature or moisture), which is caused by several factors (including natural ones) caused by plate tectonics
1. movement of continents alters ocean circulation patterns
- can be very different climates across the same latitudes
- think about EC vs WC waters even at same latitude, cold by Cali, warm by Carolina
- do we need to know mechanics of currents?
- oceans have huge potential to move heat around the planet
- locations of continent affect how water moves around the planet
2. tectonic plate movement can also cause massive volcanism