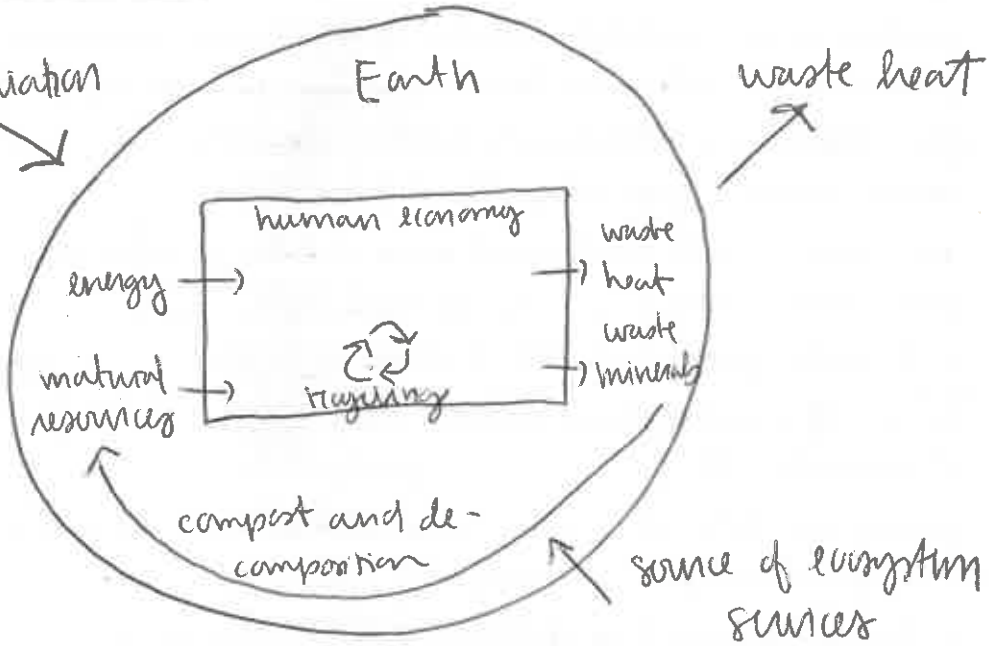
THE DIAGRAM

will be on at least either the mid term or final

- bring questions about it before the beginning of Monday's class



ecological view of how the world works

materials is another word for nutrients

"elements don't go in and go out"

"economy" = the things people do

just seems like such an exhausting everyday calculus (side note)

the box isn't a physical barrier

can only get away w/ energy → waste heat if the energy is renewable

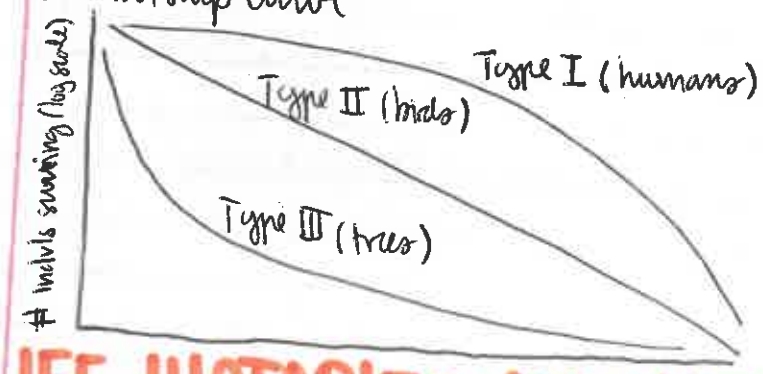
45.1 POPULATION DEMOGRAPHY

demography - statistical study of population dynamics over time
life tables → life expectancy of individuals w/i a population
population size (N) and population density
body mass ↓, pop density ↑ and vice versa
quadrat - random samples to make guesses about entire population
mark and recapture can guess entire population size

$$\frac{\#\text{ marked first catch} \times \text{total }\#\text{ second catch}}{\#\text{ marked second catch}} = N$$

- imperfect method

species dispersion patterns - spatial r/tship b/ members of a pop
- uniform, random, or clumped
- more telling than population density
life tables: divide into age and sexes, may include mortality rate
mortality rate = $\frac{\#\text{ of indivds dying}}{\#\text{ indivds surviving}} \times 1000$
survivorship curve



45.2 LIFE HISTORIES AND NATURAL SELECTION

species life history → series of events over its lifetime
- affect life table
- genetically determined and shaped by the environment + natural selection
all species have an energy budget
fecundity: potential reproductive capacity of an individual w/i a pop
(no one inventing cons/comm/etc.

fecundity inversely related to amount of parental care in animals
- remember the energy budget - energy trade off / evolution any fitness
- plants w/ low fecundity → energy-rich, high yield seeds and vv
different energy strategies - dif ~~org~~ species reach reproductive ages at different times
semelparity: species reproduces once and then dies
- causes debated ex. bamboo
iteroparity: species reproduce repeatedly during their lives

45.3 ENVIRONMENTAL LIMITS TO POPULATION GROWTH

Malthus → exponential growth
- ex: bacteria - accelerating population growth rate (↑ # of organisms added in each generation → J-shaped growth curve

$\frac{dN}{dt} = bN - dN = (b-d)N$ $\frac{dN}{dt} = rN$ r=0 → zero population growth

different species have different intrinsic rates of ~~growth~~ increase (bacteria > human)
- maximal growth rate = biotic potential or r_{max}

exponential growth only possible w/ unlimited resources
- "struggle for existence" → competition for limited resources

logistic growth model
carrying capacity (K) = max # N an environment can support

$\frac{dN}{dt} = r_{max} N \frac{(K-N)}{K}$ pop growth slows @ higher N values → S-shaped curve - exponential, ↓ growth rate, levels off

phenotypic variation → intraspecific competition NT, comp ↑

45.4 POPULATION DYNAMICS AND REGULATION

K varies (often higher in summer than in winter) natural events can alter K

density-dependent factors - density affects growth rate and mortality of the population

density-independent factors

mostly biotic - predation, inter and intraspecific competition, levels of waste, and disease

- denser pop tend ↑ mortality rate (more comp ↑, ↓ reproductive rates)
- low prey density ↑ mortality in predator

ex. giant intestinal roundworm

- denser pop of parasite, lower fecundity of worm

~~females smaller~~

typically abiotic - weather, natural disasters, pollution

- dense pops better able to recover than sparse pops after natural disaster/harsh winter/etc

K-selected species ——— r-selected species

K-selected species	r-selected species
- selected by stable, predictable environments	- large # of small offspring
- exist close to K (intra comp is high)	- changing environments
- fewer offspring, longer gestation, long-term parental care, ↓ mature @ birth	- self sufficient at birth
- plants that live long, ↓ remain on parent plant	- low energy content offspring in plants
	- less competition and less longevity

this theory doesn't account for age-specific mortality

demographic-based models being developed, incorporating pop age structure and mortality factors with r- and K-selection

45.5 HUMAN POPULATION GROWTH

we have ↑ K (agriculture, etc) and these technologies have changed the earth (depletion of ozone, climate change) which will affect K

human pop growing exponentially but still below biotic potential

human growth rate predicted to slow
humans able to overcome density-dependent growth regulation
age structure - proportion of a population at different age ranges
- remember the demographic transition model from APHUG
one-child policy in China
pop growth → endangerment of natural environment

45.6 COMMUNITY ECOLOGY

all pop in same habitat = community
- species diversity as an community level
predation and herbivory
- cycling of lynx and hare) - more than predation affects prey pop levels
- some plants have mechanisms to defend against herbivory
- herbivory → seed distribution for plants (mutualism)
species are not static - evolutionary forces
- mechanical defenses: thorns on plants or hard shells on turtles
- chemical defenses: toxicity
- camouflage: avoid detection by blending in w/ surroundings
- aposematic coloration: warning coloration
- Batesian mimicry: harmless species mimics warning colors of harmful species
- Mullerian mimicry ?: - same coloration
- Emsleyan/Mertinenan mimicry - deadly prey mimics less dangerous one
competitive exclusion principle → two species cannot occupy the same niche in a habitat - different species cannot coexist in a community if they are competing for all of the same resources
- avoided if evolution creates resource partitioning
symbioses - close interactions b/ individuals of different species over an extended period of time, impacting the abundance and distribution of the interacting populations

commensalism = +/0 ex. nest and tree
mutualism = +/+ termites/protozoa (digest cellulose)
parasitism = +/-
- parasite = organism that lives in or on another living org and derives nutrients from it

communities: structure (demographics) + dynamics (change over time)
foundation species - greatest influence on structure, usually primary producers; may physically benefit environment (ex: coral skeletons lived in by other species)
biodiversity: species richness and relative abundance (species evenness)
- greatest species richness typically greater nearer the equator
relative species abundance - # of individuals in a species relative to the total # of individuals in all species
- foundation species typically have the highest relative abundance
keystone species - their presence is key to maintaining biodiversity
environmental disturbances affect community dynamics
primary succession - land first colonized by living things
secondary succession - part of an ecosystem is disturbed and remnants of the previous community remain
pioneer species
equilibrium state = climax community

10/23

2nd lecture

ecology-intro-biomes

the rivets are to the airplane what species are to an ecosystem
ecosystem is a human construct to talk about the interactions in the environment
we don't know how many rivets the plane can lose and still be okay
- we don't test that lol - we don't know for sure which are the most to lose
- same w/ species + ecosystem with full certainty - only some predictability
- have to be hopeful that we haven't damaged them to crash point
ecology - the study of the distribution and abundance of organisms (very narrow)
everything that affects and the consequences of those distributions + abundances
population has increased a lot - growth rate starting to flatten though

Herman Daly's Guidelines for Sustainability
↳ ecological economist - understood economy was in the box, dependent on environment
1. renewable resources should not be depleted faster than they are regenerated
2. waste should not be produced faster than they are assimilated (made harmless)
- can makes its weight in air pollution every year, literally burning gas
- plants assimilate CO_2 (make it nonproblematic O_2)
3. nonrenewable resources should not be depleted faster than substitutes are developed
- harder to know if you're breaking this rule than the other two

violations of each rule:
1.
2. greenhouse gases, persistent organic pollutants,

3. fossil fuels, various metals, phosphorus
- phosphorus is mined from rocks now - 1/2 of known P was in Morocco
- before, we got phosphorus from islands of bird poop - literally mined away
- throwing away food → making it useless as you mix it w/ other trash
present activities aren't sustainable because they degrade ecosystem services.
We depend on ecosystem services.

readings from 10/23-25 not on exam
changing deadline on two simulations

10/25

BIOMES

"biome + ecosystem almost synonymous on land"
↳ assemblage of plants associated w/ certain climate
= ecosystem = community

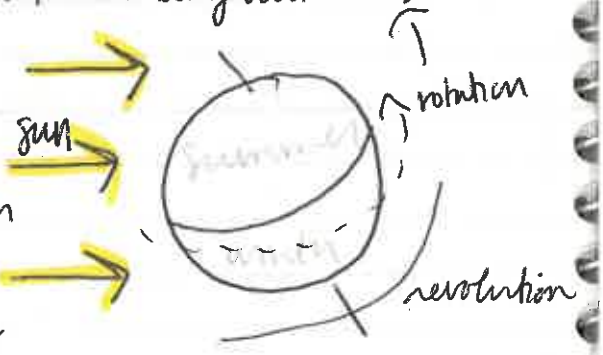
slide 32: total transformation of our vegetation - are we a new biome?
- historically, this was tall grass prairie, blackland prairie
the reason I-35 is where it is because there is fertile soil
- it's really not that easy to replace ecosystem services

slide 33: Boreal forest

slide 34: tropical rainforest
climate → plants → animals

slide 35 - distribution of biomes
- is mountains a biome?
different species across biomes but similar b/c convergent evolution
precip and temp → climate (largely)

slide 36 these lines are not exactly there
Why does temp + water availability (precip) vary around the planet?
- climate (long term average) vs weather (daily variation)
- wind and water currents
- amount of sunlight a place gets
- proximity to equator because more light energy per area near equator than near the poles (think about why/how it's so much warmer at noon than any other time of day)
- tilt → seasons with varied length of the day
- not as much seasonality at the equator



Latitudinal patterns in moisture:
* practice explaining this to someone else
warmth from sun causes gas to produce infrared radiation
hits molecules in atmosphere and is absorbed

air warmed from heat given off from the ground because the sun hits
- sun doesn't directly heat the air; the sun heats ground which
warms air
- hot air rises (warm gas rises) updrafts
~~crosses of Hadley~~
- dry air blowing across something damp gets wetter ↗ wet mean = hu
- cools as it rises → moisture in it condenses → rain falls
- won't go up forever - gravity decreases as air - goes north or south
- goes down while not holding much moisture L, deserts @ 30°N or S
- how come it rises more before shifting direction closer to the equator?
- more air coming behind it, so it doesn't go straight down
- hard to appreciate how big updrafts
wind tends to blow ~~south~~ or southeast or northwest
- don't need to be able to explain Coreolis effect
updraft gets weaker as you move toward poles because of difference in
intensity of sunlight
thank you Jesus for who you are and for being so good to me
global ocean conveyer — damp off the ocean or dry off land toward ocean?
- direction of wind as it goes over the ocean
- in general, proximity to ocean makes winter warmer and summer cooler than if inland (water has higher specific heat than land; ocean deeper than land surface)
rain shadow effect
- air has to go up to pass mountain range
- altitude has an effect on temp of air
modern people have altered the vegetation
watch YouTube video at the end

ecology introduction - homes end of exam 2 coverage

don't write the lab w/o carefully looking at the handout
review the updated lab on Moodle
le

cm.

MIGHGR43 3 of 5 130, 132 r_1 13.500 r_2 13.015 r_3 14.250 r_4 11.230
MIGHGR61 1 of 1 160 148 r_1 13.000 r_2 17.500 r_3 7.000 r_4 12.500

Group 12 - TXSHC112 check radius measurements
r_1: 168.0 r_2: 114.0 r_3: 116.2 r_4: 141.0

reread what a pvalue is

test: november 1st

REVIEW PERIOD

10/30

HGT - just know that it happened. don't need to know the mechanics or the consequences
↳ be able to define it

figure 23.5 2 (16 human evolution), slide 10
- don't have to memorize the details because they shift around
- should know four million year timescale; separate lineages from Lucy, including the homo genus but not all ancestral to humans
- know that some of them went extinct relatively recently
- know the magnitudes

common ancestor: how many generations since, not # of divergences
- most similar ≠ most closely related
  ↳ most similar in genetic sequencing (can't tell genetic similarity w/o knowing the genes)

relatedness among modern species determined by how recent a common ancestor was shared

cyanobacteria were photosynthetic but did not have chloroplasts
- chloroplasts came after eukaryotes

if the book has a more detailed timeline, ignore it

all mass extinctions (5) between Cambrian explosion and now)

the primates most similar to the early ones are the prosimians
- there's been more evolutionary change in our lineage than in the lemurs but were the same amount of times removed
- Lucy is after the split from chimpanzees

diversity of life diversity has gone up generally, but sharp drops during periods of mass extinctions (the increase not necessarily steady)

Hadley cells air moves and how it moves is determined by pressure gradients
- make sure you're able to connect this to latitudinal patterns