Microevolution and Macroevolution

- How does Microevolution add up to macroevolution?
- What are species?
- How are species created?
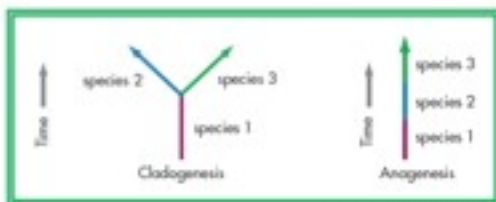- What are anagenesis and cladogenesis?

Species Concepts

- **Biological species concept**: Defines species as interbreeding populations reproductively isolated from other such populations.

- **Evolutionary species concept**: Defines species as evolutionary lineages with their own unique identity.

- **Ecological species concept**: Defines species based on the uniqueness of their ecological niche.

- **Recognition species concept**: Defines species based on unique traits or behaviors that allow members of one species to identify each other for mating.

Reproductive Isolating Mechanisms

- Premating RIMs

    Habitat isolation
    Temporal isolation
    Behavioral isolation
    Mechanical incompatibility

- Postmating RIMs
    Sperm-egg incompatibility
    Zygote inviability
    Embryonic or fetal inviability

Modes of Evolutionary Change

Cladogenesis

Evolution is

"the simple way by which species (populations) become exquisitely adapted to various ends"

All characteristics are due to the four forces

- Mutation creates new alleles - new variation

- Genetic drift moves these around by chance

- Gene flow moves these from one population to the next creating clines

- Natural selection increases and decreases them in frequency through adaptation

Clines

Adaptation?

- An adaptation is an evolved phenotypic trait that increases an organism's reproductive success? that increases their fitness

Success measured as **Fitness**

- Success in natural selection is the ability to put one's genes in the next generation

- This can be directly or indirectly

- Those who put more genes into the next generation are more "fit" than others

Effects on Fitness

- Own reproduction
    - survivorship
    - health
    - sexual opportunities
        - sexual selection
- Reproduction of relatives
    - kin selection

Sexual selection

Kin selection

-helping kin helps
own genes

-Vervet alarm calls
  -Chimp patrols
  - bees or ants

Relatedness
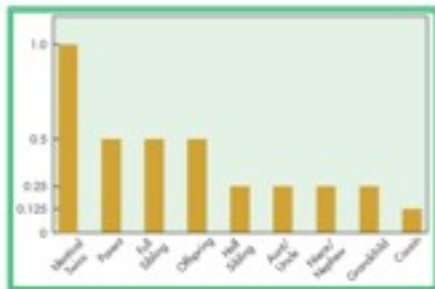
Human variation today is a result of evolution. It is the result of the four forces of evolution shaping our diversity.

Studying Human Variation -
a Biocultural approach

Biology is intertwined with human cultural behavior and both shape human diversity

We have evolved through the 4 forces of evolution intertwined with cultural behavior
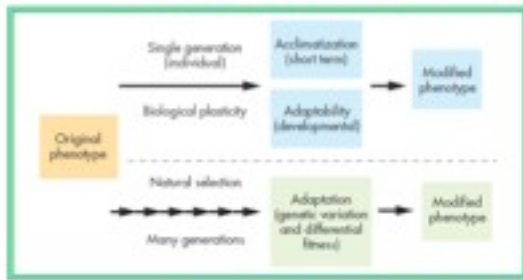
Adaptation

- any change in an organism, either temporary or permanent, biological or cultural, short or long term, involving physiological, structural, behavioral or structural changes, aimed at improving the organisms functional performance in the face of environmental stress

Genetic adaptation

- only such changes that is the result of natural selection

Adaptability and Acclimatization

Original phenotype

Single generation (individual) → Acclimatization (short term) → Modified phenotype

Biological plasticity → Adaptability (developmental)

Natural selection

Many generations → Adaptation (genetic variation and differential fitness) → Modified phenotype

Genetic Adaptation

Example - lactose tolerance

lactose tolerance is due to the lactase persistence allele (2q21)

Across the world...

TABLE 5.2   Lactose-Absorption Rates in Different Populations

Population	Percentage Lactose Absorbers
Africa	
Bantu (West Africa)	4
Watusi (East Africa)	82
Nilotic (Sudan)	24
South Africa	17
Asia	
South India	33
Japan	8
Thailand	2
Taiwan Chinese	0
Europe	
Britain	94
Germany	85
Sweden	100
Italy	25-30

Across the world...

NORTH AMERICA	
European American	80-94
African American	25-30
Apache	0
Chippewa	30
PACIFIC	
Fiji	0
New Zealand Maori	36
Australian Aborigines	16
Papua New Guinea	11

Source: Allen & Cheer (1996), Molnar (2002)

Southeast Asians	98%
Asian Americans	90%
Alaskan Eskimo	80%
African Americans Adults	75%
Mexicans from rural	73.8%
North American Jews	58.8%
Greek Cypriots	66%
Cretans	56%
Mexican American Males	55%
Indian Adults	50%
African American Children	45%
Indian Children	20%
Caucasians of N. European and Scandinavian decent	5%

The A haplotype conferring lactose tolerance has an 86% frequency in the northern European population, but only 36% in southern European populations.

WHY?

- high frequency in populations with a long history of dairying and using milk

- tolerance selected for in populations with dairy in diet

- even a modest selective advantage (5 -10%) could result in high frequencies in just 6000 years

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Example: Sickle cell

Clinal map of Sickle Cell

Sickle Cell
and Malaria

percent of
population
that has the
sickle-cell allele
(hemoglobin S)

endemic
falciparum malaria

	Relative fitness
HbAHbA	0.85
HbAHbS	1.00
HbSHbS	0-0.33

What do humans need to adapt to?

Skin color
and solar
radiation