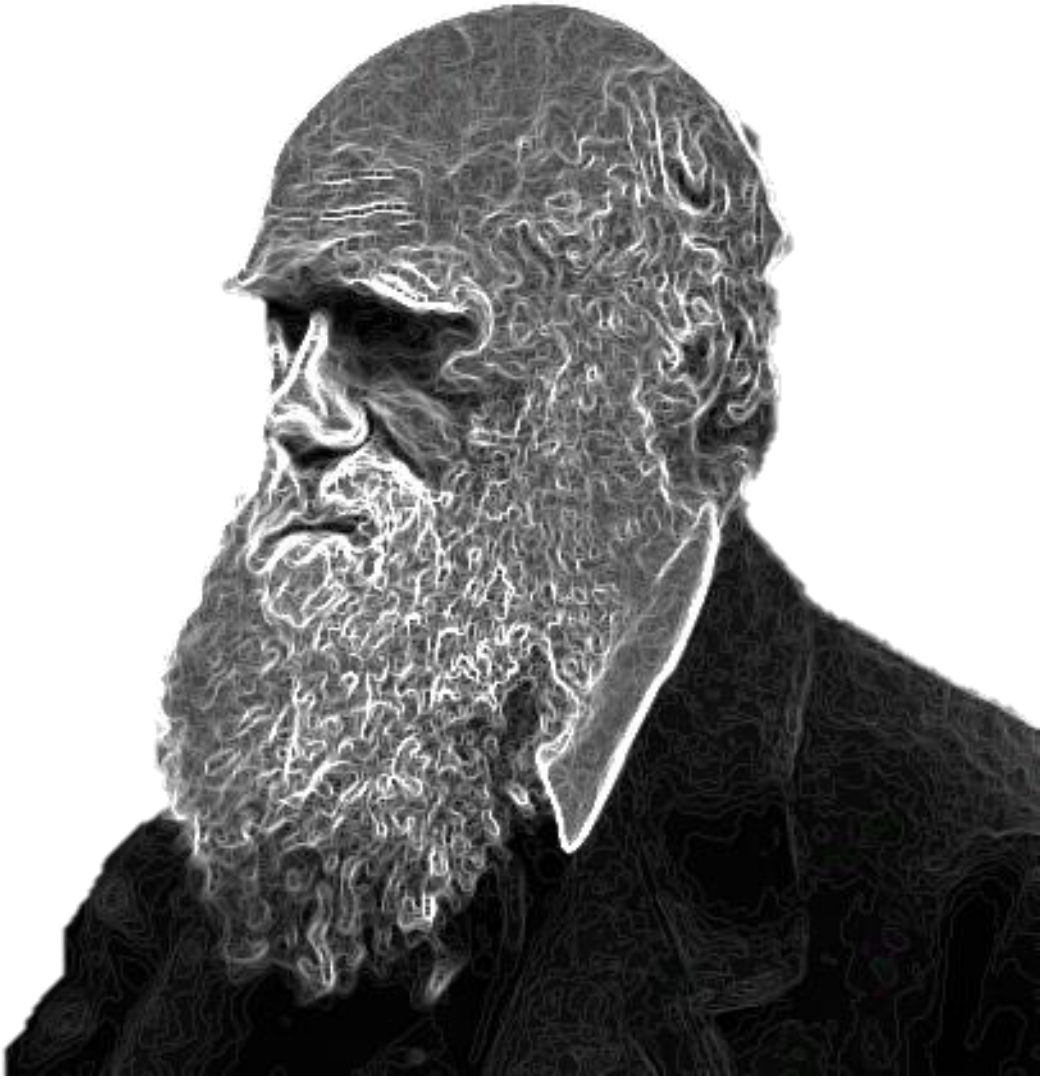
UNIT TWO: Overview of the 4 fields

Biological/Physical Anthropology – Darwin, Adaptation, and Evolution



UNIT TWO: Overview of the 4 fields

Unit 2: Overview: Week 2

This section covers a more detailed description of each of the 4 fields: Biological/Physical Anthropology, Archaeology, Linguistics, Cultural Anthropology:

2.1 Biological / Physical Anthropology

EXPLORE AND INTERACT ON WEBSITE

Go to the American Association of Physical Anthropologists and explore the "Career" section:
http://www.physanth.org/career/careers-physical-anthropology/

You should be able to explain:

What is biological anthropology?
What type of careers do they list for biological anthropology?
What type of careers do they list for physical anthropology?

2.1b Evolution:

READ THE FOLLOWING: 2.1b Evolution

Charles Darwin (1809-1882)

Charles Darwin's life as a scientist began when he took a position as naturalist aboard HMS Beagle, a ship charting the coastal waters of South America. As the ship circled the globe over a five-year period (1831-1836), Darwin puzzled over the diversity and distribution of life he observed. Observations and collections of materials made during these travels laid the foundation for his life's work studying the natural world.

As an example, the Beagle stopped five weeks in the Galapagos archipelago. There Darwin observed an unusual combination of species and wondered how they ended up on this island.

Darwin's observations on the diversity of plants and animals and their particular geographical distribution around the globe led him to question the assumption that species were immutable, established by a single act of creation. He reasoned that species, like the Earth itself, were constantly changing. Life forms colonized new habitats and had to survive in new conditions. Over generations, they underwent transmutation into new forms. Many became extinct. The idea of evolution slowly began to take shape in his mind.

In his 1859 publication On the Origin of Species, Darwin presented some of the main principles that explained the diversity of plants and animals around the globe: adaptation and natural selection. According to him, species were mutable, not fixed; and they evolved from other species through the mechanism of natural selection.

Darwin's theory of natural selection

In 1838, Darwin, at 28, had been back from his voyage on the Beagle for two years. He read Thomas Malthus's Essay on Population, which stated that human populations invariably grow until they are limited by starvation, poverty, and death, and realized that Malthus's logic could also apply to the natural world. This realization led Darwin to develop the principle of evolution by natural selection, which revolutionized our understanding of the living world.

His theory was published for the first time in 1859 in On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life.

Darwin's Postulates

The theory of adaptation and how species change through time follows three postulates:

- Struggle for existence: The ability of a population to expand is infinite, but the ability of any environment to support populations is always finite.

  Example: Animals require food to grow and reproduce. When food is plentiful, animal populations grow until their numbers exceed the local food supply. Since resources are always finite, it follows that not all individuals in a population will be able to survive and reproduce.

  - Variation in fitness: Organisms in populations vary. Therefore, some individuals will possess traits that enable them to survive and reproduce more successfully (producing more offspring) than others in the same environment.

  - Inheritance of variation: If the advantageous traits are inherited by offspring, then these traits will become more common in succeeding generations. Thus, traits that confer advantages in survival and reproduction are retained in the population, and traits that are disadvantageous disappear.

  -

Examples of adaptation by natural selection

During his voyage on the HMS Beagle, Darwin observed a curious pattern of adaptations among several species of finches (now called Darwin's finches) that live on the Galapagos Islands.

Several traits of finches went through drastic changes in response to changes in their environment. One example is beak depth:

- There was huge variation in beak depth among finches on the island; it affected the birds' survival and adaptation to local environmental changes.
  During a drought, finches with deeper beaks were more likely to survive than finches with shallow beaks (which were at a disadvantage because it was harder for them to crack larger and harder seeds).

  - Parents and their offspring had similar beak depths.

  Through natural selection, average morphology (an organism's size, shape and composition) of the bird population changed so that birds became better adapted to their environment.

Benefits and disadvantages of evolution

Individual Selection

Adaptation results from competition among individuals, not between entire populations or species.

Selection produces adaptations that benefit individuals. Such adaptation may or may not benefit the population or species. In the case of finches' beak depth, selection probably does allow the population of finches to compete more effectively with other populations of seed predators. However, this need not be the case. Selection often leads to changes in behavior or morphology that increase the reproductive success of individuals but decrease the average reproductive success and competitive ability of the group, population, and species.

Example of conflict between individual and group interests: All organisms in the population produce many more offspring than are necessary to maintain the species. A female monkey may, on average, produce 10 offspring during her lifetime. In a stable population, perhaps only two of these offspring will survive and reproduce. From the point of view of the species, the other eight are a waste of resources. The species as a whole might be more likely to survive if all females produced fewer offspring.

READ THE FOLLOWING:

Charles Darwin

One of the most profound impacts Darwin had was to change how we ordered life, from a ladder (like the Great Chain of Being) to a tree.

http://evolution.berkeley.edu/evolibrary/article/0_0_0/history_10

READ DENNIS O'NEIL'S DARWIN AND NATURAL SELECTION

BROWSE DARWIN'S ORIGINAL WORKS, ESPECIALLY ON THE ORIGIN OF SPECIES

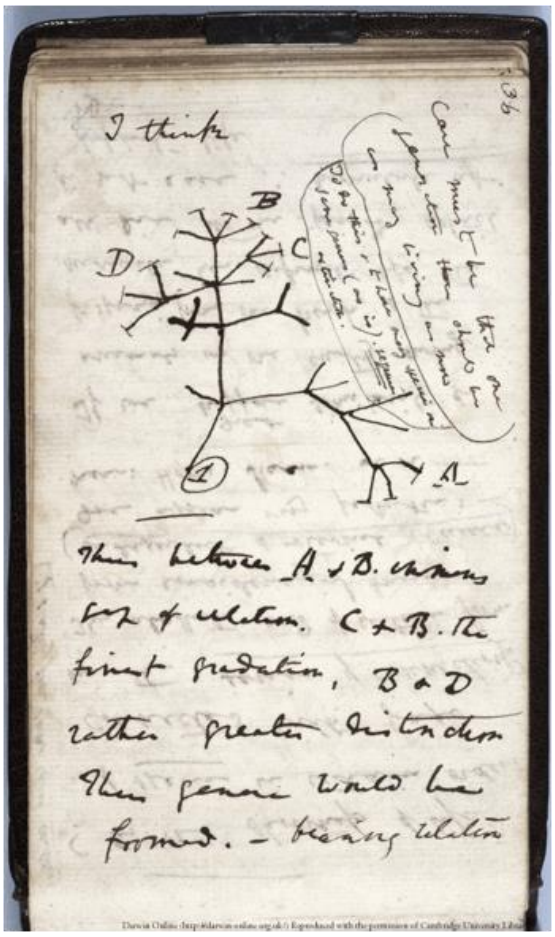


Figure 17 the page from **Darwin's 1837 notebook** showing his main "Eureka!" moment of evolutionary theory; (1) evolves into A, B, C, D, and (1) and everything in-between goes extinct

Darwin had an unremarkable personal life. He was not a great student, he did not have strong philosophical, political, or religious views.

(Look at the following for a good summary of Darwin's personal life)

> Darwin did not use evolution to promote atheism, or to maintain that no concept of God could ever be squared with the structure of nature. Rather, he argued that nature's factuality, as read within the magisterium of science, cannot resolve, or even specify, the existence or character of God, the ultimate meaning of life the proper foundations of morality, or any other question with the different magisterium of religion. [Gould 1999]

He was not oblivious to the social consequences of his findings, and was reluctant to publish.

(Watch Creation: a pretty good Hollywood movie about Darwin's personal and ethical problems; the story of how the movie was censored in the US says a lot about how this is still an important political issue).

Figure 18 **Creation** 2009

2.2.2.1 understanding natural selection

SKIM DARWIN'S 1859 ON THE ORIGIN OF SPECIES BY MEANS OF NATURAL SELECTION, OR THE PRESERVATION OF FAVOURED RACES IN THE STRUGGLE FOR LIFE. READ THE TABLE OF CONTENTS (III-IX) CAREFULLY

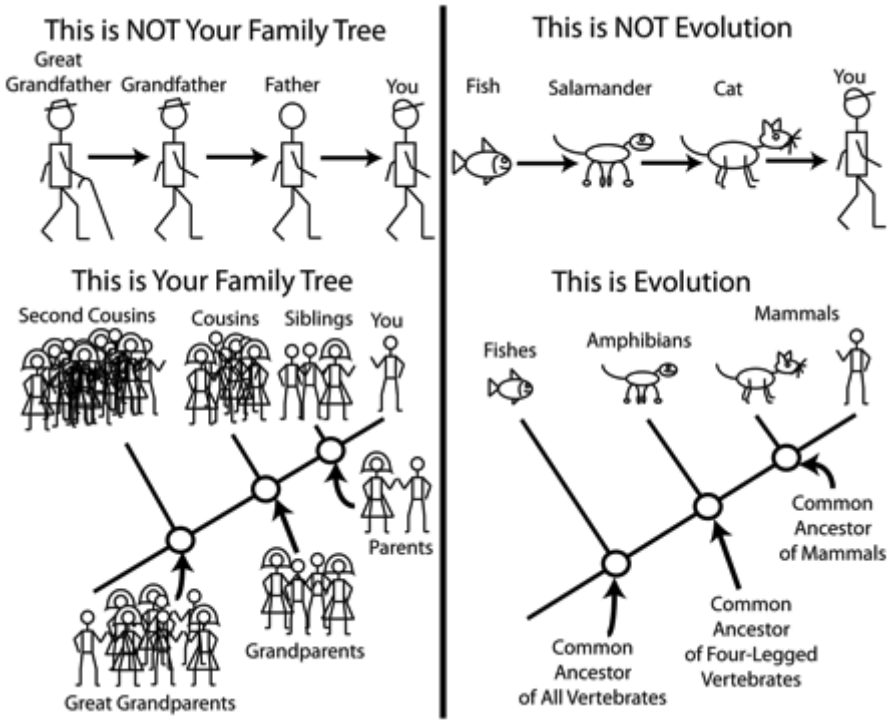


Figure 19 credit: M.F. Bonnan

Peppermoth example: A classic example of natural selection is the industrial melanism of the peppered moth. The same species of moth has black moths and white moths which

can interbreed. When they land on white tree bark, the black moths tend to be eaten, and they become rare. Because of industrial pollution, the bark turned black, and now the white moths became rare. They cleaned up the pollution, the bark became lighter, the white moths survived more than the black moths. There are a few problems with the research but it is still a great example of how evolution works.

Figure 20 Peppered Moths http://apbiomaedahs.weebly.com

(Play a video game that simulates Kettlewell's research:

http://peppermoths.weebly.com

Domestication of corn example: We see in the archaeological record of Mesoamerica how teosinte was selected over thousands of years and became corn.

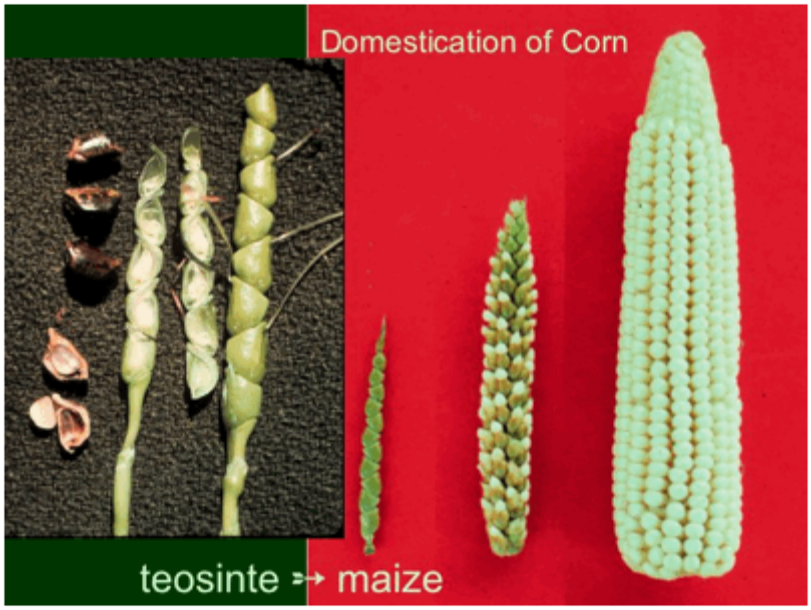


Figure 22 http://teosinte.wisc.edu/index.html

Part of Darwin's genius was to recognize that the process farmers and animal breeders use to change a species, was also a natural phenomenon, that competition in an environment of limited resources would select those individuals who were more fit for that environment, and he coined the phrase "natural selection"

*Research on the origins of corn

*Article on genes and dog size

2.2.2.1.1 sexual selection

Sexual selection is a mode of natural selection in which members of one biological sex choose mates of the other sex to mate with (intersexual selection), and compete with members of the same sex for access to members of the opposite sex (intrasexual selection). These two forms of selection mean that some individuals have better reproductive success than others within a population, either because they are more attractive or prefer more attractive partners to produce offspring.[1][2]

Peacocks gave Darwin a headache. Natural selection says you are more likely to survive and reproduce if you are camouflaged, if you stay hidden and avoid predators. But, what gave Darwin, and the male chauvinist scientists of his time, the most trouble was the idea that the female was responsible for choosing the mate and driving evolution. Female

peacocks selected to mate with males with the prettiest feathers, hence that trait became selected over time, as their genetic material was passed onto the next generation.

Figure 23 Female peahen and chick

Figure 24 Male peacock

You should be able to explain:

What are Darwin's Postulates? Why is this not simply "survival of the fittest"?

READ THE FOLLOWING: Genetics

Who discovered modern Genetics?

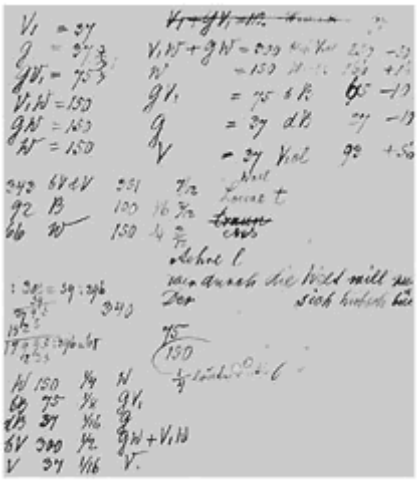
A monk named **Gregor Johann Mendel** who lived in the early to mid 1800s in the town of Brünn (now part of the Czech Republic) is considered the founder of modern genetics.

Gregor Mendel had studied statistics in Vienna and he wanted to bring some of the mathematics of that discipline to the study of plant breeding. He grew sweet pea plants and counted the properties of the children of hybrid crosses through generations to try to discern the rules that governed the transfer of properties from parent to child.

Gregor Mendel

Figure 25 Gregor Mendel [need citation]

The genius of Mendel is how he used mathematics to show how inheritance worked.



Courtesy of the Mendelianum, Moravian Museum, Brno.
Noncommercial, educational use only

Figure 26 Mendel counted peas

Why sweet peas?

Because sweet peas had clear unambiguous traits such as flower color and seed color. These traits made it easy to get good data.

What did Mendel discover?

Mendel's First Law - *The law of segregation* This law states that each parent has two copies of each trait (gene), but they only give one trait to their offspring and which one they give is random.

When one uses symbols to show the passage of traits, then one easily gets the 3:1 ratio that Mendel found in the second generation when he crossed true-breeding plants.

Mendel's Second Law - *The law of independent assortment* If you look at more than one trait such as coat color and flower color, these traits will sort independent of each other. The chance of getting one or the other coat color gene is 50/50 and the chance of getting one or the other flower color gene is also 50/50, therefore the ratio of the combinations of the two traits are decided purely by chance.

Important terms for understanding inheritance:

Phenotype - An expressed gene, what an organism looks like.

Genotype - What is in the genes. Which alleles an organism has.

Allele - Two or more different forms of the same trait such as blue eyes and brown eyes.

How does one solve a genetics problem correctly?

Follow these steps: 1. Write down the phenotype of the parents.

2. Write down the genotype of the parents.

3. Write down the gametes that each parent can give.

4. Show all possible combinations of these gametes. (A Punnett square makes this easy).

5. Figure out the phenotype for each of the genotypes shown in the square.

6. Count the number of organisms with each phenotype and write a ratio.

Punnett squares

A Punnett square is a grid or matrix that represents the outcomes of different combinations. They are often presented as proof of Mendel's *Principle of Segregation* and *Principle of Independent Assortment*. Punnett squares are graphic representations of sexual reproduction: all the possible sperm are one axis, all the possible eggs on the other, and in the middle are all the possible combinations of fertilization – the individual zygotes (fertilized egg) who develop into fetuses, babies, and then adults. About a hundred years after Mendel's experiment we got to look in a microscope to confirm Mendel's mathematics and we continue to explore Mendelian traits in humans.

Read: "Mendelian laws apply to human beings"

Tay-Sachs disease example:. The *HEXA gene on chromosome 15 makes part of an enzyme that is important for maintaining your central nervous system. If you have one or two normal alleles, you will not experience the disease, but if both your alleles have a Tay-Sachs mutation, then you will have different neurological problems usually starting as an infant. If you are a genetic counselor and a couple comes to you planning to have kids, and they are both carriers (heterozygotes), you want to be able to tell them what is the chance their baby will have Tay-Sachs. If we assign symbols to alleles, "t" = a Tay-Sachs mutation, and "T" = normal HEXA allele, then we can diagram the possible outcomes of fertilization.

	T	t
T	TT	Tt
t	Tt	tt

Statistically, 25% of their children will be normal (TT), 50% of their children will be carriers (Tt), and 25% of their children will be born with Tay-Sachs (tt). This principle works with most recessive diseases.

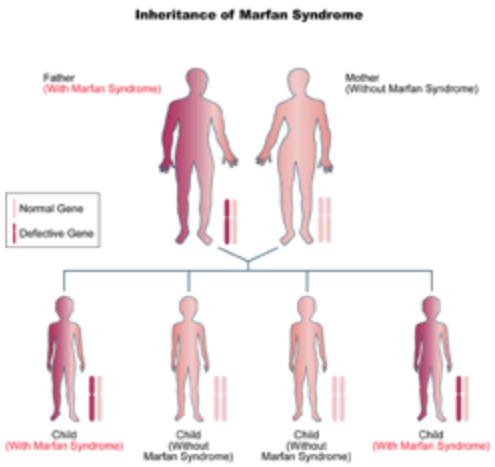


Figure 27 [need citation]

EXPLORE AND INTERACT ON WEBSITE

Check out the Punnett Square calculator:
http://scienceprimer.com/punnett-square-calculator

You should be able to explain:

Who was Gregor Mendel and what did he explain that Darwin could not?
What is a Phenotype and Genotype?
What is a Recessive Trait and Dominant Trait?
You should be familiar with Punnett squares.

READ THE FOLLOWING: Forces of Evolution

2.3 forces of evolution

One of the elegant things about evolutionary theory is it can describe phenomena on both the small scale and the large scale. We can use these same forces to explain microevolution – the change of an allele frequency of a population of the same species from one generation to the next; and we can use them to explain macroevolution – the change of one species into another species over long periods of time. This is similar to the way the theory of gravity can be used to describe the motion of molecular particles or large galaxies.

We use the word "force" to refer to a process that drives change, but thinking about evolution as a set of forces can be dangerous because it is easy to fall into the trap of thinking of evolution as a directional agent, pushing organisms towards an ultimate goal.

2.3.1 mutation

Mutation is the prime mover, the creator of all new alleles. *It is* the changing of the structure of a gene, resulting in a variant form that may be transmitted to subsequent generations, caused by the alteration of single base units in DNA, or the deletion, insertion, or rearrangement of larger sections of genes or chromosomes

* article on carcinogenic traditional medicine, notice the kinds of mutations this plant causes

2.3.2 natural selection - adaptation

Natural selection is the differential survival and reproduction of individuals due to differences in phenotype. It is a key mechanism of evolution, the change in the heritable traits characteristic of a population over generations. (Review Darwin's postulates above).

READ DENNIS O'NEIL'S DESCRIPTION OF NATURAL SELECTION WITH AN EMPHASIS ON POPULATION GENETICS.

Sickle Cell Anemia Example: What is sickle cell anemia and how can we learn about natural selection from it? How can sickle cell anemia be an example of adaptation? Read the following link: https://evolution.berkeley.edu/evolibrary/article/0_0_0/mutations_06

Similar to the discussion of Tay-Sachs disease, it is important to consider if the individual is a homozygote or heterozygote. At some point there was a mutation that caused a normal round blood cell to become a sickle shape. The sickle shape served as an "adaptation" to environments with malaria and therefore was passed on to future generations. The Malaria attaches to normal round blood cells, but not the sickle shaped ones. Those who were homozygote for the normal round blood cells were at higher risk for dying from Malaria. Hence those who were heterozygote, with both normal and sickle shaped blood cells would have a higher survival rate – they had an advantage. Unfortunately, if the individual was a homozygote for the recessive sickle cell, they could suffer pain, fatigue, and higher mortality rates.

2.3.3 migration

Migration is also called "gene flow" and you physically move the alleles from one population to another. The individual does not actually have to migrate to the new population, you just need to leave a few alleles, like sailors and tourists often do.

* article on coywolves and other hybrids which can be understood as a kind of gene flow and loosening of the species concept.

2.3.4 genetic drift

Random genetic drift, or genetic drift, is about statistics. The "drift" part has nothing to do with geographical movement (that would be migration/gene flow), what drifts is the allele frequency, like when you look at a graph of a complex system changing over time, and from a distance it make look like a straight line, but as you zoom in, the line becomes jagged, jumping up and down, the smaller your field of view, the more drastic the changes become.

A good way to understand genetic drift is to plan two trips to Viejas Casino, the first with $1,000,000,000 and the second with $100. Sit down at the cheapest table or slot machine you can find and start playing. For your first trip, your money will go up a little ($1,000,000,135) and down a little (down a little more because the House sets the odds $999,999,564) but after a few hours, you'll get bored and go home with around $1,000,000,000. Ok now go back with $100, your money will go up a little ($135) and down a little ($64), then up a little ($68), then down a little ($24) then up a little ($26) then down a little ($4) then up a little ($6) then down... whoops! no more money ($0), time to go home broke. The analogy here has to do

with population size and alleles. Every generation alleles are shuffled and with a huge population statistically the allele frequency will stay pretty much the same, but with a small population, the random fluctuations are more drastic, and allele frequencies can drop to zero. If an allele frequency drops to zero, the game's over, and it has gone from the gene pool.

Here's a statistics exercise called the Gambler's Fallacy that also shows the difference between flipping a few coins and flipping a thousand coins.

A bottleneck is where the population shrinks to the point where lots of alleles drop out like this. *The founder's effect* is where a small group of people move to a new area and start a new population. The new population may grow quickly, but even though the number of people grows, if there is no other force of evolution, the allele frequencies of the new population is determined by the small number of founders who might happen to not represent the population they left. There is no way a small number of people can represent the diversity of a large population. In statistics this is known as sampling error. When comparing the old and new population, they have different allele frequencies, so by definition, evolution has occurred, and we attribute this kind of evolution to *genetic drift.*

REVIEW DENNIS O'NEIL'S SMALL POPULATION SIZE EFFECTS

READ STANFORD'S ENCYCLOPEDIA OF PHILOSOPHY: RANDOM DRIFT

You should be able to explain: The forces of Evolution:

Vocabulary:

- Adaptation
- gene flow
- genetic drift
- mutation

1.Mutation: "Change in the DNA molecules of which genes and chromosomes are built" (Kottak 2010: 457, 82). Produces new variation. Can be helpful &/or harmful.

What is the peppermoth and why is it important for understanding evolution?
http://www.millerandlevine.com/km/evol/Moths/moths.html
Source: Ken Miller, Brown University

2.Genetic Drift ""Change in gene frequency that results not from natural selection but from chance; most common in small populations" (Kottak 2010: 459, 82). Random events in small population.

Can you give an example of genetic drift?

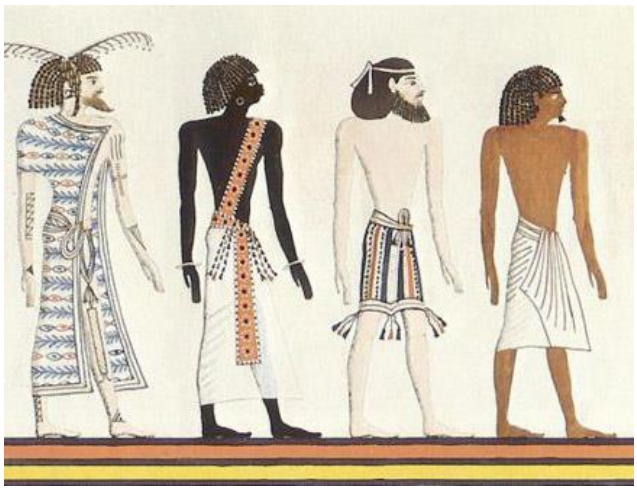
3.Gene flow: "Exchange of genetic material between populations of the same species through direct or indirect interbreeding" (Kottak 2010: 454, 83). Distributes new variation and limits speciation.

What does migration have to do with gene flow?

4.Adaptation: "The process by which organisms cope with environmental stresses" (Kottak 2010: 449, 3). Increases # alleles for adaptive traits.

READ THE FOLLOWING: Race: Culture or Evolution?

Deconstructing Race



Depicting (from left): a Berber, a Nubian, an Asiatic, and an Egyptian. An 1820 drawing of a relief from the tomb of Seti I.
https://upload.wikimedia.org/wikipedia/commons/c/cb/Egyptian_races.jpg See page for author [Public domain], via Wikimedia Commons

Key Terms & Concepts

- Biological plasticity
- Adaptation
- Biological fitness
- Acclimatization: short-term, developmental
- Genetic adaptation
- Environmentally specific
- Bergmann's Rule
- Allen's Rule
- Ethnicity
- Ethnic group
- Situational negotiation of identity
- Race
- Social construct
- Race in Brazil
- Race in the U.S
- One-drop rule (Hypodescent rule)

Deconstructing Race and Racism

Race was created long ago as a tool to separate humans from different areas on the globe in order to justify enslaving and belittling certain peoples of the world. Since its creation there has been a slow but steady attempt to deconstruct it. Of course, there have been many speed bumps along the way.

Deconstructing the social concept of race has been a major interest of Cultural Anthropology at least since **Franz Boas'** work on race and immigration in the early 1900's. The concept of race is important in many different areas of the discipline including cross-cultural studies, the way we look at ourselves vs. people we feel are different from us and many other areas. Race is not biological but it is supposed to be a way to classify biological differences by grouping people according to different characteristics that they have[1]. However, it is important to remember that race is not based on genetic features. There is no biological part of race. It is strictly a concept created by humans to try to better understand differences between us. The history of the relationship between anthropology and the concept of race is long and interesting. For more information see the American Anthropological Association Statement on "Race," http://www.aaanet.org/stmts/racepp.htm

Human Adaptations

Adaptations and adaptability

Humans have **biological plasticity**, or an ability to adapt biologically to our environment. An **adaptation** is any variation that can increase one's biological fitness in a specific environment; more simply it is the successful interaction of a population with its environment. Adaptations may be biological or cultural in nature. Biological adaptations vary in their length of time, anywhere from a few seconds for a reflex to a lifetime for developmental acclimatization or genetics. The biological changes that occur within an individual's lifetime are also referred to as **functional adaptations**. What type of adaptation is activated often depends on the severity and duration of **stressors** in the environment. A stressor is anything that disrupts homeostasis, which is a "condition of balance, or stability, within a biological system…" (Jurmain et al 2013: 322). Stressors can be abiotic, e.g., climate or high altitude, biotic, e.g., disease, or social, e.g., war and psychological stress. Cultural adaptations can occur at any time and may be as simple as putting on a coat when it is cold or as complicated as engineering, building, and installing a heating system in a building.

Types of Biological Adaptation

Acclimatization

This form of adaptation can take moments to weeks to occur and is reversible within an individual's lifetime no matter if it occurs when one is a child or an adult.

Short-term acclimatization can occur within seconds of exposure to a stressor. This type of response quickly reverses when the stressor is no longer present. Imagine stepping out of an air-conditioned building or car into a 90 degree day. Your body will quickly begin to perspire in an attempt to cool your body temperature and return to homeostasis. When the temperature declines, so will your perspiration. Tanning is another short-term response, in this case to increased UV-radiation exposure especially during summer months, which can occur within hours. Tans are generally lost during the winter when UV-radiation decreases.

Developmental Acclimatization

Developmental acclimatization occurs during an individual's growth and development. It is also called ontological acclimatization or developmental adjustment. Note that these cannot take place once the individual is fully grown. There is usually a "magic time window" of when the acclimatization can occur. This adaptation can take months to years to acquire.

A famous example of this is those who have grown up at high altitude vs. those who have moved to high altitude as adults. Those who were born at high altitude tend to develop larger lung capacities than do those who were not born at high altitude, but moved there later in life. However, developmental adjustment occurs in response to cultural stressors as well. Intentional body deformation has been documented throughout human history. The ancient Maya elite used cradle boards to reshape the skull. Foot binding in China, now an illegal practice, was considered a mark of beauty and enabled girls to find a wealthy spouse.

Genetics

Genetic adaptations can occur when a stressor is constant and lasts for many generations (O'Neil 1998-2013). The presence of the sickle cell allele in some human populations is one example. Keep in mind that genetic adaptations are **environmentally specific**. In other words, while a particular gene may be advantageous to have in one environment (AKA a genetic adaptation), it may be detrimental to have in another environment.

Human genetic adaptations and human variation

Skin color

Click on this link to watch a fantastic video explaining the interplay of skin color, UV, and vitamin D.

http://www.ted.com/talks/nina_jablonski_breaks_the_illusion_of_skin_color

Body size and shape

Inuit women

There are two ecological rules, known as *Bergmann's rule* and *Allen's rule,* that explain the variation in size and shape of bodies and extremities using latitude and temperature.

Bergmann's rule: Warm-blooded animals tend to have increasing body size with increasing latitude (toward the poles) and decreasing average temperatures. To understand Bergman's rule think of the best and worst radiator design, and ways to maximize and minimize the surface area to mass ratio which allows heat to dissipate or be conserved. Natural selection tends to make humans that way too. If you live in hot place and need to dissipate heat, you tend to have more surface area and less mass; you are gracile. If you live in a cold place and need to conserve heat, you tend to have more mass and less surface area; you are robust. This is the best explanation for the robusticy of Neandertals: they evolved during the ice ages. The principle also explains some differences between modern regional populations.

Allen's rule: A corollary of Bergmann's rule that applies to appendages. Warm-blooded animals tend to have shorter limbs with increasing latitude and decreasing average temperatures. The radiator analogy works for Allen's rule too, the longer the appendages the better they work to release heat, and the shorter the appendages, the more heat is conserved. So, people who live in cold climates for long periods of time, tend to have shorter arms and legs than people who live in hot climates.

These rules apply to most animal. Bears are great example: compare the long-legged tropical Sun Bear to the short-legged Polar bear. Human populations tend to follow this, for example the arctic Inuit tend to be stocky with short arms and legs compared to the Woodabe of sub-Saharan Africa who tend to be tall and thin. But there are some counter examples as well, the Aka live fairly close to the Woodabe, but they tend to be short. This counter example is probably best explained as part of the amazing human diversity on the African continent, where human evolution has occurred for the longest.

When organisms are more compact, they tend to conserve heat (due to a high mass:surface area ratio). When organisms are more linear, they tend to lose more heat (due to a low mass:surface area ratio).

This has been applied to humans. The idea is that populations toward the pole tend to be shorter and have shorter limbs than do people on the equator.

For example, the Inuit people of Canada (pictured above) tend to be shorter than the Maasai people of Kenya (pictured below):

Young Maasai men

Race

Technically, a race is a biologically classifiable **subspecies**. So, when we are asking, "Do human races exist?", what we're really asking is, "Are there biologically classifiable subspecies in humans?".

Here's the American Anthropological Association's statement on race and the American Association of Physical Anthropologists statement on race.

What are they saying?

Basically:

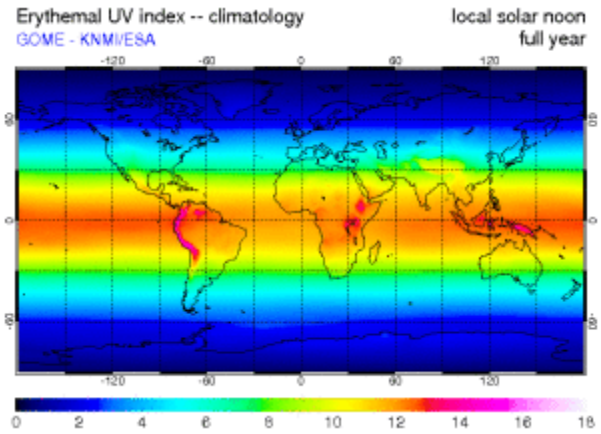
- race is an arbitrary categorization, races are not biologically distinct groups (in other words, race is a cultural construct, not a biological one)
- while groups of people who have lived together for a long time may have some alleles in common (for example, those that code for skin color or hair color), there is more genetic variation within races than there is between races
- the concept of race has historically been a tool that some people use to subjugate others

Further explore the concept of race, its history, and human variation.

Skin Color and UV Index

Map of Skin Color Distribution prior to 1940

—Darker skin is found in indigenous populations nearer to the equator. Lighter skin is found in indigenous populations further from the equator (see map above). There is more UV radiation near the equator (see map below). —The sun's UV rays can destroy folate levels. Folate is needed for DNA synthesis. Low folate levels contribute to birth defects such as spina bifida. —UV from the sun is needed for the body to create vitamin D. —Skin has to be dark enough to protect folate levels while light enough to create vitamin D.



Solar noon UV Index average for 1996-2002, based on GOME spectrometer data from ESA's ERS-2 satellite, as published by KNMI (Royal Netherlands Meteorological Institute).

Ethnicity & Race

Human beings seem to have an innate need to classify, perhaps due to the sheer volume of information that must be processed on any given day. This need extends beyond the need to classify the natural world around them, but to classify other human beings as well. In doing so, clear lines are drawn between themselves and others. These lines serve to identify to whom we have social obligations and with whom we are competing for resources. Culturally, two ways to do this is through identification of an individual's ethnicity or race.

Ethnicity refers to an ethnic group that a person identifies with or feels a part of to the exclusion of other groups. An **ethnic group** shares similar values and norms defined by such things as language (e.g., Hispanics), geography (e.g., Somalis), religion (e.g., Jews), or race (see discussion of race below). While this seems like a straightforward concept, it can be murky. Children of parents of different ethnicities may perceive themselves one way and others perceive them as something else. This can occur even among the siblings of or between generations in mixed-ethnic families. Ethnic identity is tied to social status, therefore, a person's ethnic identity may change depending on the context, where one ethnic identity is used in certain contexts and a different identity is used in another context. This is called the **situational negotiation of identity**.

Race is a cultural construct that groups people together based on perceived biological similarities. In the biological sciences, a race is a "geographically related subdivision of a species" (Gezen and Kottak 2014: 216). This definition does not apply to *Homo sapiens*. Genetically, it is clear that human groups have been interbreeding for millennia as we are genetically similar to one another. This is not to say that there is no diversity in human beings; one only has to look around to see some variability, but at a genetic level the diversity we see is, well, superficial.

Anthropology has contributed to the tenacity of the race concept throughout the years. Johann Friedrich Blumenbach (1752-1840), the father of physical anthropology, rejected external characteristics such as skin color to focus on skull shape to create five types: Caucasian, Mongolian, Malayan, Ethiopian, and American. Shortly after Blumenbach published his schema, skin color was attached to each of the racial types: white, yellow, brown, black, and red. Franz Boas (1858-1942) was the first anthropologist to challenge the essentialist approach. He pointed out essentialist schemes were based on the faulty assumption that there was a connection between skin color and temperament. In fact, no biological connection between skin color and temperament had ever been demonstrated. Boas argued that natural and cultural environment were keys to shaping behavior. Conducting a study of Sicilian immigrants over a ten-year period, Boas demonstrated that both behavior and biological characteristics could change based on the natural and cultural environment. The debate on and research into the usefulness, accuracy, and efficacy of the race concept continues. While all anthropologists acknowledge the inherent flaws in the concept, primarily that there are no biological human races, forensic anthropologists continue to use the concept to help law enforcement identify human remains. Forensic anthropologists use measurements from multiple features of the skeleton to predict biological affiliation. Nonetheless, most American anthropologists support the American Anthropological Association's position on race:

> In the United States both scholars and the general public have been conditioned to viewing human races as natural and separate divisions within the human species based on visible physical differences. With the vast expansion of scientific knowledge in this century, however, it has become clear that human populations are not unambiguous, clearly demarcated, biologically distinct groups. Evidence from the analysis of genetics (e.g., DNA) indicates that most physical variation, about 94%, lies within so-called racial groups. Conventional geographic "racial" groupings differ from one another only in about 6% of their genes. This means that there is greater variation within "racial" groups than between them. In neighboring populations there is much overlapping of genes and their phenotypic (physical) expressions. Throughout history whenever different groups have come into contact, they have interbred. The continued sharing of genetic materials has maintained all of humankind as a single species (American Anthropological Association 1998).

The complete statement is available at http://www.aaanet.org/stmts/racepp.htm.

One may wonder that if there are no biological human races, why does the concept persist? It persists because people live the experience of race. What this means is that people discriminate based on appearance, which includes not only skin color, but language, social behavior, etc.

We tend to separate people into ethnic categories, but we often use racial terms to identify these categories. Thus, one talks about "black" culture or "white" culture as if the color of one's skin is somehow connected to one's behavior. While the connection is clearly not

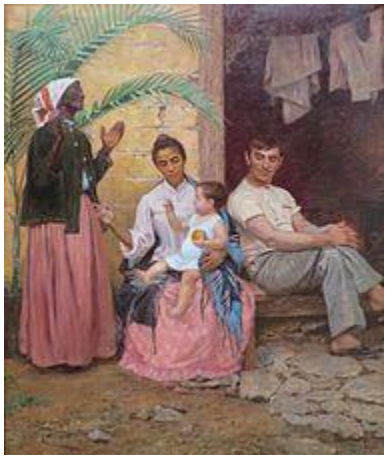
genetic, it is real nonetheless. An example can be found in the 2008 presidential election when then-candidate Obama was criticized by some leaders in the African American community for not being "black enough." Clearly, they were not talking about his skin color, but rather his lived experiences as a person of color. Obama did not go through the "typical" black experience of discrimination and the social injustice that goes along with it, because he was raised by a white family in biologically and ethnically diverse Hawaii. Using racial labels like "black" or "white" as shorthand for ethnic experiences may be useful and even necessary for Americans when talking about race. However, it also keeps alive the centuries-old essentialist notions about race and behavior (Brown 2010: 74).

As we have learned, there are many things that contribute to our personal identities. Cultural concepts about ethnicity, race, and gender create boxes that we are expected to operate within. Breaking free from those expectations can be a difficult and painful process as we place others into unfamiliar territory where their cultural expectations are negated. This creates conflict for all parties involved because of fear of the unknown; however, the end result can be one of change for the whole society not just the individuals involved.

Social Constructions of Race

As anthropologists and other evolutionary scientists have shifted away from the language of race to the term population to talk about genetic differences, historians, cultural anthropologists and other social scientists re-conceptualized the term "race" as a cultural category or social construct—a particular way that some people talk about themselves and others.

Brazil



Portrait "Redenção do Can" (1895), showing a Brazilian family each generation becoming "whiter".

Compared to 19th-century United States, 20th-century Brazil was characterized by a perceived relative absence of sharply defined racial groups. According to anthropologist Marvin Harris, this pattern reflects a different history and different social relations.

Basically, race in Brazil was "biologized", but in a way that recognized the difference between ancestry (which determines genotype) and phenotypic differences. There, racial identity was not governed by rigid descent rule, such as the one-drop rule, as it was in the United States. A Brazilian child was never automatically identified with the racial type of one or both parents, nor were there only a very limited number of categories to choose from,[117] to the extent that full siblings can pertain to different racial groups.[118]

Over a dozen racial categories would be recognized in conformity with all the possible combinations of hair color, hair texture, eye color, and skin color. These types grade into each other like the colors of the spectrum, and not one category stands significantly isolated from the rest. That is, race referred preferentially to appearance, not heredity, and appearance is a poor indication of ancestry, because only a few genes are responsible for someone's skin color and traits: a person who is considered white may have more African ancestry than a person who is considered black, and the reverse can be also true about European ancestry.[119] The complexity of racial classifications in Brazil reflects the extent of miscegenation in Brazilian society, a society that remains highly, but not strictly, stratified along color lines. These socioeconomic factors are also significant to the limits of racial lines, because a minority of pardos, or brown people, are likely to start declaring themselves white or black if socially upward,[120] and being seen as relatively "whiter" as their perceived social status increases (much as in other regions of Latin America).[121]

Self-reported ancestry of people from Rio de Janeiro, by race or skin color (2000 survey)[122]

Ancestry	brancos	pardos	pretos
European only	48%	6%	–
African only	–	12%	25%
Amerindian only	–	2%	–
African and European	23%	34%	31%
Amerindian and European	14%	6%	–
African and Amerindian	–	4%	9%
African, Amerindian and European	15%	36%	35%
Total	100%	100%	100%
Any African	38%	86%	100%

Fluidity of racial categories aside, the "biologification" of race in Brazil referred above would match contemporary concepts of race in the United States quite closely, though, if Brazilians are supposed to choose their race as one among, Asian and Indigenous apart, three IBGE's census categories. While assimilated Amerindians and people with very high quantities of Amerindian ancestry are usually grouped as caboclos, a subgroup of pardos which roughly translates as both mestizo and hillbilly, for those of lower quantity of Amerindian descent a

higher European genetic contribution is expected to be grouped as a pardo. In several genetic tests, people with less than 60-65% of European descent and 5-10% of Amerindian descent usually cluster with Afro-Brazilians (as reported by the individuals), or 6.9% of the population, and those with about 45% or more of Subsaharan contribution most times do so (in average, Afro-Brazilian DNA was reported to be about 50% Subsaharan African, 37% European and 13% Amerindian).[123][124][125][126]

If a more consistent report with the genetic groups in the gradation of miscegenation is to be considered (e.g. that would not cluster people with a balanced degree of African and non-African ancestry in the black group instead of the multiracial one, unlike elsewhere in Latin America where people of high quantity of African descent tend to classify themselves as mixed), more people would report themselves as white and pardo in Brazil (47.7% and 42.4% of the population as of 2010, respectively), because by research its population is believed to have between 65 and 80% of autosomal European ancestry, in average (also >35% of European mt-DNA and >95% of European Y-DNA).[123][127][128][129]

Ethnic groups in Brazil (census data)[130]

Ethnic group	white	black	pardo
1872	3,787,289	1,954,452	4,188,737
1940	26,171,778	6,035,869	8,744,365
1991	75,704,927	7,335,136	62,316,064

Ethnic groups in Brazil (1872 and 1890)[131]

Years	whites	pardos	blacks	Indians	Total
1872	38.1%	38.3%	19.7%	3.9%	100%
1890	44.0%	32.4%	14.6%	9%	100%

This is not surprising, though: While the greatest number of slaves imported from Africa were sent to Brazil, totalizing roughly 3.5 million people, they lived in such miserable conditions that male African Y-DNA there is significantly rare due to the lack of resources and time involved with raising of children, so that most African descent originally came from relations between white masters and female slaves. From the last decades of the Empire until the 1950s, the proportion of the white population increased significantly while Brazil welcomed 5.5 million immigrants between 1821 and 1932, not much behind its neighbor Argentina with 6.4 million,[132] and it received more European immigrants in its colonial history than the United States. Between 1500 and 1760, 700.000 Europeans settled in Brazil, while 530.000 Europeans settled in the United States for the same given time.[133]

European Union

According to European Council:

> The European Union rejects theories which attempt to determine the existence of separate human races.

— Directive 2000/43/EC[134]

The European Union uses the terms racial origin and ethnic origin synonymously in its documents and according to it "the use of the term 'racial origin' in this directive does not imply an acceptance of such [racial] theories".[134][135] Haney López warns that using "race" as a category within the law tends to legitimize its existence in the popular imagination. In the diverse geographic context of Europe, ethnicity and ethnic origin are arguably more resonant and are less encumbered by the ideological baggage associated with "race". In European context, historical resonance of "race" underscores its problematic nature. In some states, it is strongly associated with laws promulgated by the Nazi and Fascist governments in Europe during the 1930s and 1940s. Indeed, in 1996, the European Parliament adopted a resolution stating that "the term should therefore be avoided in all official texts".[136]

The concept of racial origin relies on the notion that human beings can be separated into biologically distinct "races", an idea generally rejected by the scientific community. Since all human beings belong to the same species, the ECRI (European Commission against Racism and Intolerance) rejects theories based on the existence of different "races". However, in its Recommendation ECRI uses this term in order to ensure that those persons who are generally and erroneously perceived as belonging to "another race" are not excluded from the protection provided for by the legislation. The law claims to reject the existence of "race", yet penalize situations where someone is treated less favourably on this ground.[136]

France

Since the end of the Second World War, France has become an ethnically diverse country. Today, approximately five percent of the French population is non-European and non-white. This does not approach the number of non-white citizens in the United States (roughly 28–37%, depending on how Latinos are classified; see Demographics of the United States). Nevertheless, it amounts to at least three million people, and has forced the issues of ethnic diversity onto the French policy agenda. France has developed an approach to dealing with ethnic problems that stands in contrast to that of many advanced, industrialized countries. Unlike the United States, Britain, or even the Netherlands, France maintains a "color-blind" model of public policy. This means that it targets virtually no policies directly at racial or ethnic groups. Instead, it uses geographic or class criteria to address issues of social inequalities. It has, however, developed an extensive anti-racist policy repertoire since the early 1970s. Until recently, French policies focused primarily on issues of hate speech—going much further than their American counterparts—and relatively less on issues of discrimination in jobs, housing, and in provision of goods and services.[137]

United States

In the United States, views of race that see racial groups as defined genetically are common in the biological sciences although controversial, whereas the social constructionist view is dominant in the social sciences.[138]

The immigrants to the Americas came from every region of Europe, Africa, and Asia. They mixed among themselves and with the indigenous inhabitants of the continent. In the United States most people who self-identify as African–American have some European ancestors, while many people who identify as European American have some African or Amerindian ancestors.

Since the early history of the United States, Amerindians, African–Americans, and European Americans have been classified as belonging to different races. Efforts to track mixing between groups led to a proliferation of categories, such as mulatto and octoroon. The criteria for membership in these races diverged in the late 19th century. During Reconstruction, increasing numbers of Americans began to consider anyone with "one drop" of known "Black blood" to be Black, regardless of appearance.[3] By the early 20th century, this notion was made statutory in many states.[4] Amerindians continue to be defined by a certain percentage of "Indian blood" (called blood quantum). To be White one had to have perceived "pure" White ancestry. The **one-drop rule or hypodescent rule** refers to the convention of defining a person as racially black if he or she has any known African ancestry. This rule meant that those that were mixed race but with some discernible African ancestry were defined as black. The one-drop rule is specific to not only those with African ancestry but to the United States, making it a particularly African-American experience.[139]

The decennial censuses conducted since 1790 in the United States created an incentive to establish racial categories and fit people into these categories.[140]

The term "Hispanic" as an ethnonym emerged in the 20th century with the rise of migration of laborers from the Spanish-speaking countries of Latin America to the United States. Today, the word "Latino" is often used as a synonym for "Hispanic". The definitions of both terms are non-race specific, and include people who consider themselves to be of distinct races (Black, White, Amerindian, Asian, and mixed groups).[141] However, there is a common misconception in the US that Hispanic/Latino is a race[142] or sometimes even that national origins such as Mexican, Cuban, Colombian, Salvadoran, etc. are races. In contrast to "Latino" or "Hispanic", "Anglo" refers to non-Hispanic White Americans or non-Hispanic European Americans, most of whom speak the English language but are not necessarily of English descent.

You should be able to explain:

Is race an innate biological fact or is it culturally determined?
(Explore the American Anthropological Website: Understanding Race)
http://www.understandingrace.org/humvar/index.html

How are "racial" characteristics associated with adaptation?

Summary Outline of this Chapter:

2.1 Biological / Physical Anthropology

Explore and interact on the American Association of Physical Anthropologists Website.

2.1b Evolution:

Darwin:

Darwin's Postulates

Genetics:

Gregor Mendel

Punnett Squares: (Read about Punnett squares, Introduction to Physical Anthropology, Arnie Schoenberg. Explore the Punnett Square calculator)

Forces of Evolution: Mutation, Natural Selection, Migration, Genetic Drift (Read excerpt & follow links from Introduction to Physical Anthropology, Arnie Schoenberg)

Race: Culture or Evolution:

Deconstructing Race and Racism
Human Adaptations (Bergmann's Rule, Allen's Rule)
Skin Color and UV Index
Ethnicity and Race
Social Constructions of Race
*Explore American Anthropological Association "Understanding Race."

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Darwin –

Source: Wikibooks "Pre-Darwinian and Darwinian Thoughts on Evolution", accessed 2/25/17.

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Charles Darwin

2 Charles Darwin

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    - Bamshad & Olson 2003
11. **Jump up ^** Sober 2000

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    - Crenshaw 1988
    - Conley 2007
    - Winfield 2007: "It was Aristotle who first arranged all animals into a single, graded scale that placed humans at the top as the most perfect iteration. By the late 19th century, the idea that inequality was the basis of natural order, known as the great chain of being, was part of the common lexicon."
33. Jump up ^ Lee 1997 citing Morgan 1975 and Appiah 1992
34. Jump up ^ See:
    - Sivanandan 2000
    - Muffoletto 2003

- McNeilly et al. 1996: Psychiatric instrument called the "Perceived Racism Scale" "provides a measure of the frequency of exposure to many manifestations of racism … including individual and institutional"; also assesses motional and behavioral coping responses to racism.
- Miles 2000

35. **Jump up ^** Owens & King 1999
36. **Jump up ^** King 2007: For example, "the association of blacks with poverty and welfare … is due, not to race per se, but to the link that race has with poverty and its associated disadvantages"–p.75.
37. **Jump up ^** Schaefer 2008: "In many parts of Latin America, racial groupings are based less on the biological physical features and more on an intersection between physical features and social features such as economic class, dress, education, and context. Thus, a more fluid treatment allows for the construction of race as an achieved status rather than an ascribed status as is the case in the United States"
38. **Jump up ^** See:
    - Brace 2000
    - Gill 2000
    - Lee 1997: "The very naturalness of 'reality' is itself the effect of a particular set of discursive constructions. In this way, discourse does not simply reflect reality, but actually participates in its construction"
39. ^ Jump up to: **a b c** Marks 2008, p. 28
40. ^ Jump up to: **a b** Smedley 1999
41. **Jump up ^** Meltzer 1993
42. **Jump up ^** Takaki 1993
43. **Jump up ^** Banton 1977
44. **Jump up ^** For examples see:
    - Lewis 1990
    - Dikötter 1992
45. ^ Jump up to: **a b c** Race, Ethnicity, and Genetics Working Group (October 2005). "The Use of Racial, Ethnic, and Ancestral Categories in Human Genetics Research". American Journal of Human Genetics **77** (4): 519–32. doi:10.1086/491747. PMC 1275602. PMID 16175499. Retrieved September 23, 2013.
46. **Jump up ^** Todorov 1993
47. **Jump up ^** Brace 2005, p. 27
48. **Jump up ^** Slotkin (1965), p. 177.
49. ^ Jump up to: **a b c** Graves 2001, p. 39
50. **Jump up ^** Marks 1995
51. **Jump up ^** Graves 2001, pp. 42–43
52. **Jump up ^** Stocking 1968, pp. 38–40
53. **Jump up ^** Desmond & Moore 2009, pp. 332–341
54. **Jump up ^** Camilo J. Cela-Conde and Francisco J. Ayala. 2007. Human Evolution Trails from the Past Oxford University Press p. 195
55. **Jump up ^** Lewin, Roger. 2005. Human Evolution an illustrated introduction. Fifth edition. p. 159. Blackwell
56. **Jump up ^** Stringer, Chris (2012). Lone Survivors: How We Came to Be the Only Humans on Earth. London: Times Books. ISBN 978-0805088915.
57. **Jump up ^** Currell & Cogdell 2006
58. **Jump up ^** Cravens 2010
59. **Jump up ^** See:
    - Cravens 2010
    - Angier 2000
    - Amundson 2005
    - Reardon 2005
60. **Jump up ^** See:
    - Smedley 2002
    - Boas 1912
61. **Jump up ^** See:
    - Marks 2002
    - Montagu 1941
    - Montagu 1942
62. **Jump up ^** Wilson & Brown 1953
63. **Jump up ^** See:
    - Keita et al. 2004
    - Templeton 1998
    - Long & Kittles 2003
64. **Jump up ^** Haig et al. 2006
65. ^ Jump up to: **a b** Waples & Gaggiotti 2006
66. ^ Jump up to: **a b c d e** Templeton 1998
67. **Jump up ^** See:
    - Amadon 1949
    - Mayr 1969
    - Patten & Unitt 2002

68. ^ Jump up to: **a b** Wright 1978
69. **Jump up ^** See:
    - Keita et al. 2004
    - Templeton 1998
70. **Jump up ^** Sesardic 2010
71. **Jump up ^** "Understanding Race and Human Variation: A Public Education Program". Anthropology News **47** (2): 7. 2006. doi:10.1525/an.2006.47.2.7.
72. ^ Jump up to: **a b** Lieberman & Jackson 1995
73. **Jump up ^** Brace 1964
74. ^ Jump up to: **a b** Livingstone & Dobzhansky 1962
75. **Jump up ^** Ehrlich & Holm 1964
76. **Jump up ^** Weiss 2005
77. **Jump up ^** Marks 2002
78. **Jump up ^** "The Human Family Tree Facts". National Geographic. Retrieved 3 August 2013.
79. **Jump up ^** Krulwich, Robert (2009-02-02). "Your Family May Once Have Been A Different Color". Morning Edition, National Public Radio.
80. **Jump up ^** Boyd 1950
81. **Jump up ^** Lieberman & Kirk 1997, p. 195
82. **Jump up ^** Molnar 1992
83. **Jump up ^** Human Genome Project 2003
84. ^ Jump up to: **a b c** Graves 2006
85. **Jump up ^** Hawks 2013, p. 438 "The shared evolutionary history of living humans has resulted in a high relatedness among all living people, as indicated for example by the very low fixation index (F_{ST}) among living human populations."
86. **Jump up ^** Lewontin 1972
87. **Jump up ^** Woodley, Michael A (19 August 2009). "Is Homo sapiens polytypic? Human taxonomic diversity and its implications.". Med. Hypotheses **74** (1): 195–201. doi:10.1016/j.mehy.2009.07.046. PMID 19695787.
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90. **Jump up ^** (Schwartz 2001), (Stephens 2003) (given in summary by Bamshad et al. 2004, p. 599)
91. **Jump up ^** Smedley & Smedley 2005, (Helms et al. 2005), [1]. Lewontin, for example argues that there is no biological basis for race on the basis of research indicating that more genetic variation exists within such races than among them (Lewontin 1972).
92. **Jump up ^** Smedley, A; Smedley, Brian (2005), "Race as Biology Is Fiction, Racism as a Social Problem Is Real" (PDF), American Psychologist **60** (1): 16–26, doi:10.1037/0003-066x.60.1.16
93. **Jump up ^** Long & Kittles 2003
94. **Jump up ^** Cavalli-Sforza, Luigi Luca (1994). The History and Geography of Human Genes. Princeton University Press. p. 136. ISBN 0691087504.
95. **Jump up ^** Edwards 2003
96. **Jump up ^** Dawkins, Richard; Wong, Yan (2005). The Ancestor's Tale: A Pilgrimage to the Dawn of Evolution. Houghton Mifflin Harcourt. pp. 406–407. ISBN 9780618619160. (Summarizing Edwards' thesis): We can all happily agree that human racial classification is of no social value and is positively destructive of social and human relations. That is one reason why I object to ticking boxes on forms and why I object to positive discrimination in job selection. But that doesn't mean that race is of "virtually no genetic or taxonomic significance." This is Edwards's point, and he reasons as follows. However small the racial partition of total variation may be, if such racial characteristics as there are highly correlated with other racial characteristics, they are by definition informative, and therefore of taxonomic significance.
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    - Cavalli-Sforza, Menozzi & Piazza 1994
    - Bamshad et al. 2004, p. 599
    - Tang et al. 2004
    - Rosenberg et al. 2005: "If enough markers are used… individuals can be partitioned into genetic clusters that match major geographic subdivisions of the globe."
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114. **Jump up ^** Imani Perry, More Beautiful and More Terrible: The Embrace and Transcendence of Racial Inequality in the United States (New York, NY: New York University Press, 2011), 24.
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168. **Jump up ^** Štrkalj, Goran; Solyali, Veli (2010). "Human Biological Variation in Anatomy Textbooks: The Role of Ancestry". Studies on Ethno-Medicine **4** (3): 157–161.
169. **Jump up ^** "Office of Minority Health". Minorityhealth.hhs.gov. 2011-08-16. Retrieved 2012-12-30.
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171. ^ Jump up to: **a b** Condit et al. 2003 In summary, they argues that, in order to predict the clinical success of pharmacogenomic research, scholars must conduct subsidiary research on two fronts: Science, wherein the degree of correspondence between popular and professional racial categories can be assessed; and society at large, through which attitudinal factors moderate the relationship between scientific soundness and societal acceptance. To accept race-as-proxy, then, may be necessary but insufficient to solidify the future of race-based pharmacogenomics.
172. **Jump up ^** Graves 2011
173. **Jump up ^** Fullwiley 2011
174. **Jump up ^** Harpending 2006, p. 458 "On the other hand, information about the race of patients will be useless as soon as we discover and can type cheaply the underlying genes that are responsible for the associations. Can races be enumerated in any unambiguous way? Of course not, and this is well known not only to scientists but also to anyone on the street."
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191. ^ Jump up to: **a b** Frank, Reanne. "Back with a Vengeance: the Reemergence of a Biological Conceptualization of Race in Research on Race/Ethnic Disparities in Health". Retrieved 2009-04-18.
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