Class 1

- The behavioral biology of women and the biological anthropology approach
- Common misconceptions about the interaction of biology and behavior
- Models of how behavior and biology DO interact

The biological anthropology approach

- Focus on things human have in common throughout different cultures
- Explore reasons why human cultures may differ

Common misconceptions about the interaction of biology and behavior

- One on one relationship between genes and behavior
- If something is "natural" or biological it is right or justified → the Naturalistic Fallacy
- Behavior is either nature or nurture
- If something has biological basis it can't be changed
- **True:** environment can change the expression of behaviors that are influenced by biology

Models of how behavior and biology DO interact

- Biology and behavior behave in a facultative (occurring in response to change) manner
    - Biologically based behaviors are not necessarily less labile or context dependent than culturally constructed behaviors
- Sex biased investment occurs in animals as well as humans
- Timbergen's 4 Biologies
    - Phylogeny (evolutionary history)
    - Adaptation (ultimate function)
    - Mechanism (proximate function)
    - Ontogeny (development, lived experience, culture)

Class 2 - Primate Females and How Humans are Different

- Know the names and basic features of the different living hominoids
- Describe the life history features that are shared between apes and humans
- Know how the hominoids differ in their sexual/reproductive/social systems
- Describe the features of the human social/sexual system that are unique
- Explain why cooking was so important in human evolution and impacts our social structure

Names and basic features of hominoids

The Apes (all-inclusive)

- Great apes (Bonobo, Chimp, Orangutan, and Gorilla)
- Lesser apes (gibbons and siamang)
- Humans are related most closely to chimpanzees (common ancestor 6-7 million years ago)
- Generally larger body size
- No tail
- Shortened trunk (lower back is built for stability)
- Very flexible shoulder joint (suspensory adaptation)

- Facial hair
- Voice changes
- Broadening of shoulders

The order is different due to hormone levels.

Understand hormonal changes that occur during puberty

In both sexes TESTOSTERONE is responsible for the initiation of skeletal development and ESTRADIOL is responsible for the cessation of skeletal development. Important to note that hormones do not have genders. May think of TESTOSTERONE as being an important Male hormone. But, also critical for females. Just as estradiol is critical for males. Also, note that the timing of development is later for boys than for girls.

- First change: in the hypothalamus due to failing sensitivity of hypothalamus to negative feedback because the negative feedback bar is set lower when you hit puberty
- Second: the pituitary gland makes more FSH and LH which leads to the development of LH pulses
- Age 8: adolescent growth spurt begins, androgen stimulates growth of long bones
- Androgen from adrenal gland stimulate growth of pubic and axillary hair (sweat glands, body odor)
- Increase in estradiol (8-9 year olds) starts, which causes development of breast, uterus, vagina, part of pelvis
- Breasts develop

Explain the hypotheses for what triggers puberty and what is the best explanation

- Pelvic Size Hypothesis → girls much reach an appropriate age of skeletal development in order to reproduce
- Gluteal ephemeral fat → hip circumference was the greatest predictor of menarche because GF is used throughout pregnancy and lactation
- Psychosocial factors
    - Without a father there is earlier menarche (when you get your period first)

Evidence against menstrual synchrony

- Didn't control for chance in study because you expect 25% of overlap to be by chance
- Study hasn't been consistently replicated
- No consistent predictors and why it would evolve

Class 8 - Evolution of Menstruation

- What happens during menstruation and the structure and function of spiral arteries
- Explain and critically evaluate the different hypothesis for the evolution of menstruation
- Menstrual taboos
- Describe common features of menstrual taboos

Pair Bonds and Marriage

Understand different kinds of pair bonds and hormones involved

- Definition of a pair bond = long last affiliations involving intimacy, sexual contact, preferential proximity, emotional attachment with relative exclusivity
    - Chimps and bonobos don't have pair bonds and they're our closest related species
    - Other animals are pair bonded too
- Don't have to be the same gender (even in other species)

Evolution of pair bonds

- Species with pair bonds also evolved neurological and physiological mechanisms to promote pair bonding
- If pair bonds are important for reproductive success, via offspring survival, then those with the mechanisms to promote pair bonding would be more successful and pass on those genes
- Underpinning of pair bonds may persist even if the initial reasons they evolved are no longer
- relevant - many human pair bonds don't involve raising children.

Hormones Involved

- If pair bonds impact our physiology positively, then it makes sense why humans would want to form a pair bond
    - Based on neuroendocrine system that evolved to support parent-offspring bonds, but that supports nurturance
        - Oxytocin = nurturance
    - Coupled with physiological system to promote sexual contact and reproduction
        - Testosterone = sexual intimacy

Types of Pair Bonds

- <u>Monogamy</u> = a 2-point pair bond
    - Each person is in 1 pair bond (A is with B and B is with A)
- <u>Polygony or polyandry</u> = embedded 2-point pair bonds where one pair bond in the middle is a multi-point pair bond (A is with B and B is also with C)
- <u>Polyamory</u> = embedded 2-point pair bonds where multiple partners are in multiple pairs (A is with B who's also with C who's also with D)

Human Marriage Systems

- Slight polygny - 51%
- General polgyny - 31%
- Monogamy - 17%

Percentage of people living in different types of systems

- Monogamy - 82%

Serial Monogamy

- Response to social/religiously imposed monogamy

Explain reasons humans may form pair bonds

- Bodyguard Hypothesis → human females form a pair bond with a male to protect them and their children from other males
    - Married women have less sexual assault (from non-partners)
    - Effect may be exaggerated in modern context

        - Enzymes produced by trophoblast digest the endometrial epithelium and embryo burrows into blood rich tissues
        - Enzymes suppress mother's immune reaction
    - Day 12
        - A thousand cells planted on the wall of the uterus
        - Endometrium thickens
        - Cervix sealed by mucus plug
        - Muscles of uterus become softer and more elastic
- Implantation (day 13-21)
    - Establishment of the placenta
    - Blastocyst embedded in uterine lining
    - HCG rescue
        - Trophoblast produces HCG to signal to mother she's pregnant
        - Mimics LH
        - Maintains the corpus luteum so it will keep producing estradiol and progesterone
    - Overview:
        - First the zygote forms a morula after initial cell division
        - At 8-cell stage, differentiates tissues, becomes compact ball merula
        - Forms blastocyst
            - Trophoblast
            - Inner cell mass
        - Trophoblast "hatches" out of zona pellucida for implantation
- Embryonic phase
    - Weeks 3-8
    - Embryo
    - Establishment of the placenta
        - Digestion of material tissue to release metabolic substrates which are taken up by growing conceptus
        - Called primary decidualization reaction
    - Formation of basic body plan and development of major organs
    - Limbs grow, fingers distinct, ovaries and teste
    - All major systems developed by 8 weeks
- Fetal phase
    - Fetus
    - Weeks 9-38
    - Growth and further development of body tissues and organs
    - Fetus doubles in length
    - Intestines outside body
    - Penis distinguishable

Describe the hormones produced during pregnancy and physiology of the placenta

- **HCG** during pregnancy
    - Levels fall after 8-10 weeks when embryo takes over steroid production

    - In response, prolactin is synthesized and secreted from lactotrophs in the anterior pituitary
    - Prolactin stored in secretory granules in cytoplasm of lactotrophs
    - Prolactin stimulates mammary glands (alveoli) to produce milk
    - Amount of prolactin affected by strength and duration of nipple stimulation
    - Suckling increases milk production
    - Prolactin approaches level of non-lactating women in 4-6 hours
    - Need regular nipple stimulation to keep prolactin levels elevated
- Milk letdown: milk passes from alveoli via ducts to the storage sinuses
- Suckling stimulates mothers autonomic sensory nerves in the breast
- Sends message to the hypothalamus
- Causes posterior pituitary to produce oxytocin
- Oxytocin stimulates muscle cells in breast to contract
- Milk is squeezed into lactiferous duct with then drains into the lactiferous sinus
- Milk in sinus can be accessed via sucking
- Nipple stimulation most potent stimulus of oxytocin, but can also be released from infant cry

Mechanics of breastfeeding

- Babies latch onto the areola, not the nipple
- Need constant suckling or prolactin will drop

Composition of breast milk

Colostrum

- Produced in first few days after birth
- High in protein, low in fat and lactose
- Rich in immunoglobulins
- Establishes normal bacterial flora of infant's digestive track
- Provides epidermal growth factors for final maturation of infant gut

Breast milk immunity

- Immunoglobulins in breast milk protects newborns against infectious disease
- Peyer's patches in maternal gut stimulate production of lymphocytes
- Lymphocytes lodge in breast and produce lgA in breast milk which coats baby's intestines and prohibits foreign objects from getting through

Breast Milk protection

- 3rd largest component of breast milk are human milk oligosaccharides - 200 complex sugars
- Coat lining of infant's intestine protecting against noxious bacteria
- Toxic bacteria and viruses dock to these sugars so protects infant

Milk composition

- Foremilk → milk stored in ducts
    - Low fat, low protein, watered down
    - ⅓ of total milk volume each nursing
- Hindmilk → milk stored in alveolar cells and released during let down
    - High fat, high protein

- Women's bodies change to accommodate the complex demands of activities that women undertake throughout life
- Women's bodies are often evaluated by others and women often respond by trying to change their bodies
- All types of body types, even in sports

Cross cultural female beauty

- The more subsistence-oriented a society is and the more energetically expensive womens' work, the more body fat in women is thought to be attractive
- 81% of cultures in the HRAF preferred plumpness as a female body characteristic
- Fat viewed as a symbol of self-worth and sexuality in many non-industrial populations
- Fat associated with being well-nourished and healthier, earlier menarche, and more robust hormonal functioning

Recently, fat has lost its place in female beauty standards

- Conflicting messages! Body trends change every year but women's bodies haven't changed
- Western beauty standards:
    - Being thin associated with being higher status, control of eating in a food abundant society (through time and money)
    - Women often judged professionally according to body image
    - Women with more "female" bodies are considered less competent

Understand explanations for why humans are fat

Where fat is stored

- Fat is located in "depots" on the body
- Expansion of adipose tissue (and muscle) on hip and thigh during adolescence
- Femoral and buttock depots easily mobilized during lactation
- Fat distribution also related to bipedalism

Fat facts

- Primates are fat amongst mammals
    - Longer gestation, lactation, and offspring dependency
- Humans are particularly fat among primates
- Women between 16 and 18 are 26-28% body fat
- Men between 16 and 18 are 14% body fat
- Estrogen promotes deposition of fat on hips and thighs
- Fat is laid down at puberty and during pregnancy

Why humans are fat

- Fat as protection against energetic depletion
    - Buffer against periods of low food availability (may have been common during evolution)
    - Selection for fatness in Samoans
    - Hunger is prevalent for humans
    - !Kung: food variation by season
- Fat and the human baby's brain
    - Human babies may be fat to buffer energy needs of expensive large brain
- Fat for reproduction

- Fisher-Muller **"Ratchet Hypothesis"** → in asexual reproductions, organisms just keep accumulating genetic mutations, there is no way to get rid of them. Sexual reproduction brings together and purges those individuals with "bad" mutations
- Prediction: the higher mutation rate, the greater advantage of sexual reproduction
- Problems:
    - Is it really a sufficient explanation?
    - Group selectionist → selection happens at the level of the individual, not the species
    - Doesn't explain why it benefits the individual

Allows for beneficial recombination

- Williams **"Lottery Hypothesis"** → in unstable environments, do not want multiple copies of the same 'ticket'
- Prediction: sexual organisms would be more common in unstable environments
    - Not supported
- Problems:
    - Overall, sexual organisms are more stable in unstable environments
- Graham Bell "**Tangled Bank Hypothesis"** → showed that sexual reproduction is more common in constant environments, not unstable ones. Sexual reproduction avoids over specialization
- W.D. Hamilton: "**the Red Queen Hypothesis"** → stay one step ahead of parasites
    - Animals with longer generation times hae more recombination
    - In long living organisms, short lived parasites have a long time to adapt
    - Thus, more recombination helps keep the host "ahead" of the parasites

How did sex evolve?

- Tiny gametes: energetically inexpensive to produce in big numbers
- Intermediate gametes: too large to produce in big quantities but too small to support early embryogenesis without
- Gamete differentiation: disruptive selection (go for the two extremes and not the middle)
    - Tiny gamete = "protosperm"
    - Large gamete = "proto ovum"
- Many small gametes compete to combine with large gametes

Mammalian Sex Determination

- Sex Chromosomes → XX females and XY males
- Regular genes and prenatal hormones in order to determine gonadal and phenotypic (external) sex
    - They're not ALWAYS the same, sometimes sex chromosomes don't align with phenotypic sex
- In birds, females are the XY, or heterozygous sex
- Undifferentiated embryo
    - All humans start off as sexual bi-potential
    - Both phenotypic structures are homologous to each other

Internal Differentiation

    - Vaginna narrows by 30% or more because of enlarged tissues
    - Clitoris pulled back against the public bone
    - Labia minora may double or triple in size
    - Color changes develop
- Orgasm
    - Through intercourse alone → indirectly from penile shaft distention (manual traction) of labia minora at opening of vagina, indirectly stimulates the clitoris
    - Direct manual stimulation
    - Contractions at 0.8 second intervals average
    - Average time = 4 minutes (masturbation) and 10 minutes (intercourse)
- Resolution
    - Return to pre-orgasmic state

Female Orgasm Debate

- In intercourse:
    - 25% of women always orgasm
    - 35% frequently
    - 26% sometimes
    - 10% rarely
    - 5% never
- In males, orgasm is linked to ejaculation which is linked to conception, but for women it's unclear, leading to debate whether women need to have orgasms or do they just have them because men have them?

Other ways:
- 95% through masturbation
- 1.5% through vaginal insertion alone
- Little cross-cultural information (mostly Western info)

Multiple Orgasms?
- 14% report return to plateau phase
- Less common in men (only 3% in adults)

Non-adaptive:
- Females have low variance in reproductive success (RS)
    - Averages between 0-15
    - Males have much more
- Variance in sexual behavior does not affect a woman's RS
    - Asserts that women who are more sexual don't have more children
- Problem with the debate:
    - Assumes female orgasm = female sexuality

Questions about female sexuality?

- Within an individual:
    - T levels decrease in response to severe malnutrition
    - T levels and sperm quality decrease in response to overtraining
    - Moderate levels of decreased energy have no effect on sperm quality
    - Decreased energy availability may affect behavior and reproductive effort

Testosterone and Fathering

- Married men with children have lower testosterone levels than married men w/out children or unmarried men
- Fathering causes T go down OR men with lower T are more likely to become fathers
- Biggest drop in T were men with babies
- It's about "nurturance" not just being a father