Biological Anthropology, Spring 2014

COURSE Biological Anthropology, Biology 7, Lecture - MWF 10:30-11:35 am (Brousseau 233, Lab - W 2:45-5:45 pm (233 Brousseau)

INSTRUCTOR: Greg Smith (Brousseau 236, 631-4448, gsmith@stmarys-ca.edu)

COURSE DESCRIPTION: Study of the variation and evolution of the human species and its place in nature. Molecular, Mendelian and population genetics serve as a basis to discussions of natural selection and how that affects biological and physiological adaptation. The emphasis of this course explores why we see broad variations among Homo sapiens and how these variations affect humans in their life cycle, health and culture.

OFFICE HOURS: TBD, some Fridays 11:35-12:30, we can also determine a mutually agreed upon time if you cannot meet at these scheduled times

REQUIRED TEXTS: **The Human Species**, 9th Edition, by John Relethford and **Biological Anthropology, An Introductory Reader**, 6th Edition, by Michael Alan Park

EXAMS: There will be 3 - 4 exams and 1 final given during the semester. The exams will consist of a combination of matching, true-false, multiple choice, short answer fill-in and essay questions. The exams and final will not be cumulative, however some information presented during the semester may be incorporated into subsequent lectures. **Simple regurgitation of terms is not an indication of biological knowledge. Your ability to understand the information regardless of how it is presented or how it is used in a question is important to your success in this course.** There may also be laboratory quizzes and data reports given during the semester. These will reflect the background information, laboratory procedures and techniques presented for each week's lab.

Please note: I will drop your lowest exam score at the end of the semester before calculating your final lecture average. Because of this, I do NOT give make-up exams. For example, if you miss an exam for ANY reason, the score from that exam will probably end up being the score that I would drop.

Notice: Correct spelling of the biological terms is essential to the correct use of Biological Anthropology terminology. This is a normal expectation for this subject. Accurate spelling is expected for full credit on all exams. You must take the final exam.

GRADES AND METHOD OF GRADING: The final grade for the course will be based on both the lecture and laboratory components. Your lecture portion will be determined

by your lecture average and participation in the class. The final grade for the course will be determined primarily by your lecture exam scores. Your laboratory conduct and contributions will affect your final grade. The final grading scale will be as follows:

90 – 100%	=	A
80 – 89	=	B
70 – 79	=	C
60 – 69	=	D
below 60	=	F

ATTENDANCE:
Attendance is expected. If you miss a lecture, not only will you miss the lecture material but also the information that results from student questions and discussions. Also, I ask that you arrive to class on time. **Excessive absences and/or a pattern of coming into class late will negatively affect your final grade**.

ACADEMIC HONOR CODE
Saint Mary's College expects every member of its community to promote and abide by ethical standards, both in conduct and exercise of responsibility towards other members of the community. Academic Honesty must be demonstrated at all times to maintain the integrity of scholarship and the reputation of the College. Academic dishonesty is a
serious violation of College policy because, among other things, it undermines the bonds of trust and honesty between members of the community and betrays those who may eventually depend upon the College's academic integrity and knowledge.

As an expression of support for academic integrity throughout the Saint Mary's learning community and as an administrative tool to discourage academic dishonesty, Saint Mary's has implemented an Academic Honor Code. The Academic Honor Code has been approved by the ASSMC Student Body, the Faculty Academic Senate, the Provost and the President of Saint Mary's College.

PLEDGE
All students, whether undergraduate or graduate, are expected to sign a pledge to follow this Academic Honor Code. The pledge reads as follows:

As a student member of an academic community based in mutual trust and responsibility, I pledge:
- to do my own work at all times, without giving or receiving inappropriate aid;
- to avoid behaviors that unfairly impede the academic progress of other members of my community; and
- to take reasonable and responsible action in order to uphold my community's academic integrity.

If I catch any student committing an act of plagiarism or cheating, I will report that student to the Honor Council.

St. Mary's College Statement of Accommodations
Reasonable and appropriate accommodations, that take into account the context of the course and its essential elements, for individuals with qualifying disabilities, are extended through the office of Student Disability Services. Students with disabilities are encouraged to contact the Student Disability Services Coordinator at (925) 631-4164 to set up a confidential appointment to discuss accommodation guidelines and available services.

Additional information regarding the services available may be found at the following address on the Saint Mary's website: http://www.stmarys-ca.edu/academics/academic-advising-and-achievement/student-disability-services.html

Spelling disabilities: correct spelling of the following terms is essential to the correct use of biological terms and a normal expectation of this subject. Accurate spelling is expected for full credit on all exams.

Food: Please do not bring food or drink into the classroom, the class is held in a lab room. Even though the table tops have been cleaned, they have been exposed to various chemicals.

CELL PHONES, ETC.: I do want to see nor hear your cell phones, smart phones, etc. Please turn them off and put them away before class begins.

COURSE OBJECTIVES:
The student will learn:

- about the genetic bases for protein synthesis and reproduction and how these affect phenotypes

- what leads to genetic variation in a population

- how natural selection affects the genetic profile of a population

- why there is genetic variability in the response to disease

- how humans have responded to environmental pressures

- about the reproductive developmental phases an human development

- how reproductive function affects fertility and population demographics

- what human variations are evident today

- how mental ability is assessed

- about the evidence of human evolution

COURSE OUTCOMES
The student will be able to:

- describe the process and outcome of gene expression

- apply the effects of genetic variation to specific populations in the world

- describe the organization of the human body from simplest to most complex

- describe how humans would be affected by changes in their environment

- describe how anatomical knowledge can be used to identify fossil or forensic material

- demonstrate proficiency of the skills taught in the laboratory

- evaluate articles related to biological anthropology

- demonstrate an understanding of scientific concepts, principles and theories that explain the natural and physical world

- collect, analyze and interpret empirical data gathered in a laboratory or field setting

- examine social or ethical issues that arise in the process of scientific inquiry or out of scientific or technoligical developments

Individual topics

I. Genetics and cell function

Pages	
12-14,	**Science** (observation, measurement, comparisons - read loosely
14, 20-25	• fact, hypothesis, theory
34-36	**Genetics**
	DNA (phosphate, ribose, bases (adenine, thymine, guanine, cytosine))
37-38	1) protein synthesis (base pair rules, helicase, coding strand, template strand, read 3' to 5', RNA polymerase)
	2) genetic information
	• transcription - mRNA
	• translation - (codon, anticodon, triplet paris, tRNA, amino acids)
38-41	• gene (structural vs. functional proteins)
	Cell cycle
	• DNA replication (helicase, primase - RNA primer, polymerase III, polymerase I, Okazaki fragments, ligase, telomeres)
41-43	**Mitosis**
Appendix A1-2	• cell cycle - interphase (G1, S, G2) and mitosis
to A 1-3	• prophase - chromosomes super-coil, nuclear membrane disappears, centrioles and spindle fibers
	• metaphase - chromatids at equator, centromere attachment
	• anaphase - chromatid separation = daughter chromosomes
	• telophase - cell membrane pinches off, nuclear membrane reforms, chromosomes uncoil
41-43	**Meiosis**
Appendix A1-2	• 1st division - centromeres do not split
to A1-5	• next division - like mitosis
52a	• crossing over
	• aneuploidy - nondysjunction (Turner's Syndrome, Klinefelter's Syndrome, "Super" males, Triplo-X females, Down Syndrome)
44-54	**Mendelian genetics**
	• Law of segregation
	• Law of independent assortment

- defintions: locus, alleles, genotype (homozygous, heterozygous), dominant vs. recessive, codominance, independent assortment, polygenic traits, pleiotropic traits

62-67 **Microevolution (population genetics)**
- genotype frequency
- allele frequency
- Hardy-Weinberg equilibrium (p2 + 2pq + q2 = 1)
  1) random mating (nonrandom-inbreeding, assortative)

74-78 2) genetic drift (population size)
78-80 3) gene flow (migration)
68-74 4) natural selection (fitness)
55-59 5) mutation (frameshift, nonsense, missense, neutral, silent)
67-68

80-83 • summary

86-93 **Speciation** (reproductive isolation)
Box 4.1, page 91 • gradualism vs. punctuationalism

End of material for Exam 1

II. Natural Selection in Humans

364-367 **Sickle cell anemia**
- abnormal hemoglobin molecule
- Falciparum malaria (mosquitoes and Plasmodium bacterium)
- heterozygotes and homozygous recessive
- agriculture, DDT

Thalessemia
- hemoglobin chain missing
- resistance to malaria

70-71 **Tay-Sachs**
- Jews of Eastern European descent
- heterozygote - selective advantage?
- homozygous - lethal degeneration of nervous system

Cystic fibrosus
- tubules of glands – abnormal mucus
- selected for heterozygotes

G6PD
- X chromosome – enzyme that protects red blood cells
- mefloquine administration caused problems in some geographic groups
- associated with fava bean sensitivity, leads to hemolysis

47 **ABO**
- surface antigens
- see geographic distributions (different allele frequencies among populations)
- cline for type B in Europe
- advantage/disadvantage associated with cancers and infectious diseases

Rh
- Rh– mother / Rh+ fetus

Duffy blood group
- associated with malaria

405–408 **Disease and Human Adaptation**
409
- genetic, metabolic, degenerative, cell malignancy and infectious
- cultural effects
- urbanization (preindustrial versus industrial)
- rituals (schistosomiasis, kuru and gefilte fish (tapeworms))
- ergot poisoning

Immune system
- major histocompatability complex (human leukocyte antigens and associated molecules)
- **white blood cells**
  macrophage
  lymphocytes (B cells and T cells (helper, killer, suppressor and memory))
- communication molecules (interleukin 1, interleukin 2, BCGF, BCDF)
- autoimmune disease
- vaccine

Human Leukocyte Antigens (HLA)
- 7 closely linked loci on chromosome 6

- 100 known antigens (potential of 30 million)
- recognition of foreign antigens

411–417 **Epidemiologic Transition Model**
- pretransitional and posttransitional populations
- deaths due to infectious diseases versus noninfectious diseases
- decrease death rate and epidemic spikes
- definitions (epidemiology, contagious versus noncontagious, epidemic, endemic and pandemic)

AIDS
- retrovirus (mechanism of reproduction)
- opportunistic diseases (Kaposi's sarcoma and pneumocystis carnii)

Emergent and reemergent diseases
- tuberculosis, hepatitis, influenza, malaria, bovine spongioform encephalopathy

68 **Polymorphisms**
- maintain 2 or more alleles due to selection of the heterozygote
- cladogram
- 28% of all loci in humans are polymorphic
- much of variation is neutral
- redundancy in DNA code

Earwax
- cerumen glands similar to sweat glands
- odor – sexual behavior

End of material for Exam 2

III. Biological adaptation

379 **Biological Adaptation versus Biological Acclimatization (physiological adaptation)**
- definition, time factor

368–372 **Ultraviolet radiation and degree of skin pigmentation**
- biochemical pathway (eumelanin, phaeomelanin)
- evolutionary perspective
- skin color matched to sunlight to regulate vitamin D production

- habitation of areas away from equator
- light skin less susceptible to cold injury
- selection for light skin

Thermal Environment
- response to environment temperature and humidity

382-384 **Body size and shape**
- decrease body size / increase distance from equator
- decrease fertility success with body extremes
- Bergmann's rule - increase body mass / decrease surface area
- Allen's rule - colder climates -> shorter limbs
- nasal index
- cephalic index
- cultural effect (hunter, gatherers versus agriculturalists)

380, 386 **Cold Stress (acclimatization)**
- effects on distribution of blood flow, metabolic rate and insulation
- relationship of face shape and nose shape to cold environment?

380-381, 386-388 **Heat and humidity**
- heat (body shape, skin pigmentation, circulation of blood close to skin, decrease muscle mass and fat, sweating)
- humidity (narrow nose)

388-392 **High altitude**
- lower O2 pressure and humidity, high solar radiation, limited nutrition
- increased ventricle size, rbc count and heart rate
- high infant mortality, low birth weights, larger placentas, slower overall maturation and delayed sexual maturation
- use of alcohol and coca

392-394 **Dietary adaptation**
- importance of meat early on
- effects of agricultural revolution

375-376 **Lactose intolerance**
- gene for lactase - does it turn off or remain active?
- harmful effects
- why are populations intolerant and others tolerant
- increase lactose absorption -> increase distance from equator

394–397 **Dietary intake**

- definitions of undernutrition, malnutrition, kwashiorkor and marasmus
- malnourished mothers (difficult labor, increased premature births, increased number of children with birth defects, and increased prenatal mortality)
- malnourished infants and children (decrease birth weight and effects of poor lactation)
- last trimester (decreased brain size, weight and cell number)

Modernization

- obesity, hypertension

Anatomical adaptations to diet

Hazards of Modern Life

- natural radiation (interstellar and earth's crust)
- artificial sources (nuclear weapons, nuclear power plants and medical sources)
- chemical (mutagen, carcinogen and teratogen)
- natural substances (aflatoxin, common foods, cyclamate and caffeine)

Crowding

- strong correlation between social pathologies and number of people per room
- overcrowding:
  1) disrupts ovulation, spermatogenesis and lactation
  2) increased incidence of abortions, stillbirths and infant mortality
  3) increased aggression

Noise

- loss of sleep and decreased concentration

Paleopathology (what was present in the past?)

- osteoarthritis and ankylosing spondylitis
- venereal syphilis
- trephination
- dental hypoplasia

End of material for Exam 3

IV. Human Development

Reproductive success in humans
- factors resulting in only 10-15% of zygotes conceived will reproduce
- decline in reproductive rates
- selective pressures on fertility

Life cycle
- proliferation
- differentiation
- cell growth rates

Bone development
- cartilage (epiphyseal plates)
- ossification centers
- X-rays show bone and not cartilage

Life stages

179
- **prenatal** (fertilization -> birth)
  1) fertilization of oocyte
  2) transport of zygote
  3) implantation (placenta formation)
  4) second week - differentiation (gastrulation)
  5) embryo (from two weeks to 2 months), growth during second and third trimester
  6) fetus

179-182 **postnatal**
  1) infancy (1 year) rapid growth
  2) childhood (infancy to puberty) slow relatively constant rate of growth
  3) puberty - maturation of reproductive system and development of secondary sexual characteristics
  4) adolescence (growth spurt, hormonally controlled, sexual differences)
  5) adulthood

- growth curves (accelerations in height growth)

DIFFERENTIAL GROWTH
- **body mass** (spurt during infancy and adolescence)

- **fat** (males and females - brown fat during infancy, brown fat and yellow fat decrease during childhood) (during adolescence, decrease for males, increase slightly for females with a redistribution)
- **muscle** (slow increase for males and females into puberty) (greater increase for males during adolescence - testosterone)
- **brain and head growth** (during last trimester, during infancy and childhood)
- 80% of adult size by age 4 (birth canal limits size)
- **sexual maturation** (delayed to acquire knowledge and size for survival)
- **catch-up growth** (post-stress spurts, hormonally controlled?, critical time windows)

168-169 **EVOLUTION OF GROWTH**

- brain (humans 4 X's, other primates 2 X's)
- humans - postnatal growth extended
- adolescent spurt - seen in some other primates, but not as noticeable

BIOLOGICAL INFLUENCES

Genetics (height closely related within a generation)

Hormonal (hypothalamic releasing factors and pituitary hormones)

- **growth hormone** (general target cells, stimulate **somatomedin** by liver)
- **adrenocorticotrophic hormone** (secondary source of reproductive hormones, midchildhood spurt = adrenarche)
- **thyroxin** (controls metabolic rate, increase gastrointestinal function)
- **follicle stimulating hormone** (male - spermatogenesis, female starts oocyte and follicle development)
- **luteinizing hormone** (male - testosterone, female - maturation of follicle, ovulation and luteinization)
- **pineal gland** (amount of light -> melatonin (inhibits GRF))

Male reproductive system

- **Gonadotropic releasing factor** (stimulates secretion of **FSH** (spermatogenesis) (**inhibin**) and **LH** (testosterone)
- **testosterone** (hair production, enlargement of larynx, increase thickness of skin, increase size of bones, increase muscle proteins and increase propensity for baldness (with genes for it))

Female reproductive system

- **GRF** (stimulates secretion of **FSH** (follicle development) and **LH** (complete follicle development, ovulation and luteinization)
- follicle development (membrana granulosa, antrum (liquor folliculi), theca interna (androgens) and theca externa)
- ovulation (due to LH)
- luteinization (LH causes membrana granulosa -> granulosa lutein (estrogen) and theca interna -> theca lutein (progesterone) = corpus luteum (which persists for only a week with no fertilization), no fertilization - corpus luteum ---> corpus albicans (estrogen and progesterone inhibit GRF (no new follicles develop))

Estrogen
- puberty: epiphyseal plate ossification and increased fat deposition
- menstrual cycle and pregnancy: proliferative phase of endometrium, develops duct system of breasts and stimulates secretion of **relaxin** to relax pubic symphysis

Progesterone
- menstrual cycle and pregnancy: secretory phase of endometrium
- and continued development of duct system of breast

- Estrogen and progesterone both inhibit GRF and prolactin

Fertilization and Pregnancy
- fertilization occurs in uterine tube
- ovum (blastula) travels into uterine cavity for implantation (about 6 days)
- placenta develops in endometrium - secretes **human gonadotropic factor** (HCG) which signals corpus luteum to continue to secrete estrogen and progesterone (placenta eventually takes over estrogen and progesterone secretion)
- placenta also secretes **human placental lactogen** and **human chorionic thyrotropin**

Parturition
- stretch reflex of uterine muscle layer
- oxytocin

Lactation
- at birth, placenta separates from endometrium and estrogen and progesterone inhibition is removed -> prolactin causes milk production
- **prolactin / prolactin inhibitory factor**

• **oxytocin** – milk letdown

417 **Menarche**
• age of onset

FERTILITY PATTERNS
!Kung
• average interval between births = 44 months
• breast feeding pattern of !Kung women versus Western women
• prolactin inhibition of GRF?
• duration of breast feeding

Northern Mexico
• decreased number of births (family planning services)
• economic forces

Box 17.2 **Baby Boom (1946 – 1964)**
page 422, •increased economic growth
424–425 • increased demand for labor (restricted immigration)
• young men entered well paying jobs earlier (salaries allowed larger families)
• mid–60's –women realized and caused social, economic and educational changes –> delayed marriage and having children
• decreased average number of children per family

403–405 **DEMOGRAPHICS**

Population growth
• change in population = births + immigrants – (deaths + emigrants)
• exponential growth under ideal conditions
• carrying capacity

408–409 **Ireland**
population changes from 1700 to present
• Catholic doctrine
• men needed land and women needed dowry
• introduction of potato (good nutrition and grew in wider range of soil types)
• fathers subdivided land and passed these parcels on to more sons and earlier
• Blight wiped out crops for 5 years –> 1.5 million people dies and 1 million people emigrated

420 **Demographic transition theory**
- states that as population becomes more economically developed there will be a decrease in the death rate followed by a decrease in the fertility rate

Population pyramids
- represents distribution of age and gender makeup of population

Stage I
- high fertility, high mortality --> stable population size

Stage II (developing population)
- increased fertility, decreased mortality (health care) -> increasing population size

Stage III (developed)
- decreased fertility, decreased mortality -> little growth

Population trends in the world

End of material for Exam 4

V. Human Variation

334-337 **Race** (race versus species?)
- Egyptians (color association)
- Johann Blumenbach (race catagories, coined term caucasian)
- Thomas Huxley (Adam and Eve view)
- monogenists versus polygenists
- Linnaeus

Early anthropologists
- Samuel Morton (measured cranial cavities)
- Anders Retzius (cephalic index - dolichocephalic, brachycephalic)
- Paul Broca and A. von Torok

349-341 **Typology**
- what critieria should be used
- basic assumption that “races” have not changed over the years

350-351 **Geographic distance and genetic variation**

Univariate analysis

- Cline (B allele and Aborigines tawny hair)
- cranial shape and climate (cold climates and wider skulls, warm climates and narrow skulls)
- nasal index (width of nose/height) (high narrow nose in dry environment, low wide nose in moist environment), Aborigines
- fingerprint morphology

Multivariate analysis

- R. D. Lewonton (work looking at several loci for 7 "races")
  1) 6% of total variation occurred **among** the races
  2) 94% of total variation occurred **within** the races (e.g. from one family to another, or local groups)
  3) additional 8.3% of variation occurs in large population units within a race

- Workman (studied 8 alleles from 7 loci related to blood cells)
  1) Claxton's blacks' alleles are more similar to West Coast Africans'
  2) G6PD and Sickle allele frequencies are closer to whites' (no natural selection for malaria advantages)

344-346 **Race and Behavior**

- Linnaeus (assigned behavioral traits to races)

Race and intelligence

- Arthur Jensen (stated that he estimates heritability of intelligence at 75%) (believes that environmental effect is minimal and can be accounted for)
- critics (IQ test is an inadequate measure of intelligence and it does not consider environment)
- intelligence (probably controlled by many genes, can one test determine all aspects?)

376 Environment and intelligence

- Leon Kamin (disputed Sir Cyril Burt's work with identical twins)
- Scarr
  1) interracial children who were adopted by white advantaged parents
  2) scores of black children increased once instructions were made more comprehensible

- Willerman (4 year old black children with mixed parents although scores were higher with white mothers, marital status made a difference)
- nutrition (deficiency of nutrients can hinder intellectual development and can lead to behavioral problems)
- other stresses can affect intellectual development (social and environmental)

Cultural Practices
- deformations of the body (circumcision, tattoos)
- Kwakiutl Indians (use head boards on newborns)
- Punans (slit ear lobes and hang weights)
- Posture (childhood posture can dictate what you can do as an adult)
- Ecuadorian skeletons (metatarsals and phalanges have bony projections due to hyperdorsiflexion of toes)
- folk taxonomy in movies and television

118-122, 219-221 **Primates (general information)**
- primitive and contemporary - many are arboreal (3-D environment)
- skeleton is generalized not specialized
- hands and feet (in many) can be used for grasping
- vision (binocular - overlapping fields of vision and stereoscopic - signal processing in brain)
- skull features (orbit is enclosed circumferentially, foramen magnum faces downward and middle ear is encased by bone)

figure 5.9, page 123 **Grades of Primate Evolution**

Grade I (tree shrew)

1) does not fit into any one category (biochemically closer to bats or rabbits)
2) long snout, eyes do not face forward, has claws not nails, grasping hands and feet
3) good model for earliest primates (70-65 mya)

Strepsirhines

124 **Grade II (lemurs of Madasgascar and lorises)**
- primitive traits (long snouts (rely on smell), orbit not completely enclosed in back, claws on some digits)
- developed traits (some digits have nails, well developed vision (although not completely stereoscopic), and prolonged lifespans)

Grade III (tarsiers)
- traditionally grouped with Prosimians, biochemically closer to anthropoids, orbit completely enclosed in back, snout less projecting, flexible upper lip and bony ear canal like anthropoids

Haplorhines

127-128 **Grade IV (monkeys)**

New World
- almost exclusively arboreal, most have prehensile tail, dental formula - 2-1-3-3 (marmosets - 2-1-3-2), quadrupeds (some are brachiators)
- platyrrhine (broad nose with nostrils facing outward)
- spider monkeys, marmosets

128 **Old World**
- widely distributed ecologically, dental formula - 2-1-2-3, all quadupeds, sometimes erect -> ischial callosities, have nonprehensile tails, exhibit changes of external genitalia during estrus
- catarrhine (narrower noses, nostrils facing downward)
- baboons, macaques

Parallel evolution of monkeys
- similar morphology despite being separated for 30 mya
- similar environment affecting natural selection

Grade V (hominoids)
- no tails, larger brain and over-all size, most K-selected, dental formula - 2-1-2-3 (exhibit Y5 lower molars versus 4 cusps for monkeys), shoulder characteristics (larger and stronger clavicle, joint is flexible, scapula is more posterior), wrists are more flexible (cartilage pad)
- categories:
  1) lesser apes (gibbons) - Hylobatids
  2) great apes (orangutan, chimpanzee, gorilla)
  3) humans
- great apes and humans are categorized as Hominids
- humans are additionally categorized as Hominins

Primate comparison
- karyotype (chromosome numbers, shapes, banding)
- detailed protein analysis (great similarity between humans and great apes)

- antigenic distance (not as precise but less costly and easier to do)
- DNA hybridization (recombine strands of DNA from 2 species being compared)

168-170 **Comparison of humans with other hominids**

- large brain (3 X's what it should be for our body when compared to other primates)
- proportionately more cerebral cortex
- 20% of body metabolism is for our brain (double that of most other primates)

171-175
- bipedalism (big toe moved in for pushing off, femur "angles in" for support, vertebral column is relatively vertical, pelvis is wider than it is long (gluteus medius is more important than gluteus maximus for support by one lower limb during gait)

177
- reproduction (estrus, why this was lost in humans)

End of material for final