

evolution or the timing and rate at which it occurred. A criticism often leveled by creationists is that only evidence for evolution in presented in the classroom. On the other hand, there has been a concerted effort among educators to develop critical thinking skills among students. Students are encouraged to evaluate evidence and are expected to be able to sort through alternative explanations and possibly conflicting theories. In applying this notion to evolution, there is no better reference than Darwin himself who devoted a full chapter, plus portions of several others in the *Origin of Species*, to pointedly and exhaustively question his theory of descent with modification, that is, natural selection. Darwin's caution may have anticipated the antithesis of knowledge-based learning, labeled as ignorance-based instruction. Uncertainty, incompleteness, and questioning are hallmarks of this approach. This paper argues that it would be both scientifically sound and educationally stimulating to produce textbooks, course materials and laboratory exercises that not only "teach the facts", but promote the learning of what presently is incompletely known or actively debated. An example of this kind of lesson using radiometric dating of the fossil record is presented.

Midtarsal flexibility in ape foot dynamics, early hominid footprints and bipedalism. D.J. MELDRUM, Dept. Biological Sciences, Idaho State University, Pocatello, ID 83209-8007. R.E. WUNDERLICH, Center for Locomotion Studies, Penn State University, University Park, PA 16802.

As early as 1935, Eftman & Manter noted themidtarsal flexibility present in chimpanzees and contrasted it with the comparatively rigid platform of the human foot. The dorsiflexion of the heel segment at the transverse tarsal joint was referred to as the "midtarsal break." It permits the independent actions of the grasping forefoot and the levering hindfoot during climbing. At some point after the transition to habitual bipedalism, the ape grasp-climb adaptation and midfoot flexibility were lost, thereby increasing the mechanical advantage of the ankle plantarflexors. This improved the efficiency and economy of distance walking and running. Others have subsequently made note of this distinction of the ape foot, but the kinematics and correlated tarsal relationships of themidtarsal break have received limited consideration.

We set out to characterize themidtarsal break using several methods. We videographed two chimpanzees and humans during bipedal and quadrupedal (chimpanzee) locomotion with simultaneous lateral, plantar and fore-aft views and recorded the distribution and magnitude of plantar pressures. Lateral and A-P radiographs of the foot of one anesthetized chimpanzee were used to visualize tarsal relationships through the range of midfoot movements. Ape and human footprints were examined to document the potential effects of amidtarsal break on footprint configuration.

During stance phase of chimpanzee bipedalism and bipedalism, a pronounced dorsiflexion of the hindfoot accompanies high midfoot peak plantar pressures, relative to those observed in human bipedalism. Radiographs indicate that the flexion of themidtarsal region occurs primarily at the talonavicular joint and to a lesser degree at the calcaneocuboid

joint. High midfoot pressures during themidtarsal break are often indicated by a pressure ridge in chimpanzee footprints, not observed in human prints. Our data provide a novel perspective on the interpretation of the often controversial Laetoli trackway, the oldest direct evidence of hominid bipedalism. Preliminary examination suggests evidence of a relatively ape-like midtarsal flexibility and the lack of a consistently present longitudinal arch.

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Mitochondrial DNA D-loop sequence variation within and between Yanomami villages. D. A. MERRIWETHER (Michigan), K. Green (Michigan), D. E. Crews (Ohio State), and J. V. NEEL (Michigan)

Blood was drawn on over 3000 Yanomami from 52 villages in Brazil between 1966 and 1976 by the Neel lab, and from 100 individuals from ten Yanomami villages in the 1990s by the Crews lab. DNA was extracted over the last three years, and mtDNA and Y chromosome typing has proceeded on the unrelated individuals from this sample. Mitochondrial DNA D-Loop sequence variation (nts 15975-00048 and 00008-00430 were amplified and sequenced in both directions on an ABI 377XL automated sequencer) was collected and examined in a subset of these villages and samples. Expansion times (using pairwise sequence distance distributions), gene flow (using Maddison and Slatkin's cladistic approach), and heterozygosity were examined in this subset. The Yanomami prove to be quite variable, both within villages, with many mitochondrial haplotypes observed, and between villages (where haplotype frequencies and private polymorphisms vary from village to village). The patterns of variation is contrasted with the genealogical structures of the villages.

We also show preliminary data on Testes Specific Protein Y (TSPY) variation in the Yanomami. The TSPY gene has proven to be suitably polymorphic for studying within-population Y-chromosome variation. Previously only short tandem repeat polymorphisms were polymorphic enough for examining within population variation. Since STRs are often phylogenetically uninformative due to the high level of homoplasies, it is preferable to find a more discrete system with a lower forward/backward mutation rate, such as is described here). We present sequence variation from 780 nts of the first intron (and flanking exonic sequence) of the TSPY gene from a random sample of unrelated Yanomami.

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Sexual dimorphism in the modern human femur: Application of linear and areal data. K.A. METZGER, C. LACOSTE, Department of Anthropology, University of California, Santa Cruz, Santa Cruz, CA 95064.

Previous studies of sexual determination and sexual dimorphism of the human femur have generally focused

solely upon linear data taken directly off of bone (Black, 1978; DiBennardo and Taylor, 1979; MacLaughlin and Bruce, 1983). In this study, linear data are combined with photographic areal measurements in order to provide a novel approach to the study of sexual dimorphism. In addition to expanding the range of possible measurements, such an approach allows for insight into dimorphism as it relates to muscle attachment sites on the bone.

A sample of 107 male and female femora was chosen from the Terry and W. Montague Cobb Collections in Washington, D.C. All individuals were designated as Caucasian and had completed femoral growth. Nine linear measurements as well as photographs of a standardized posterior aspect were taken and all photographs were digitized. In order to analyze areas of muscle attachment representing different muscle groups, standardized digital manipulations were made on the photographs and UTHSCSA ImageTool<sup>®</sup> was used to quantify areas.

Statistical testing conducted to determine differences in univariate measurements from the Terry and W. Montague Cobb Collections showed no significant differences with a confidence level of 99%. A similar analysis showed no significant differences among individuals in different age groups. Univariate and multivariate analysis of linear measurements indicated that femoral head diameter was the most accurate predictor of sex, producing correct discrimination 86.9% of the time. Additionally, femoral collo-diaphyseal angle was not statistically different between males and females ( $\alpha=0.01$ ).

Analysis of areal measurements provided discrimination percentages of lesser utility. However, it also indicated that male and female femoral morphologies showed very few differences in ratios of areas of muscle attachment. Proportions of attachment sites in all measured areas were not statistically different, suggesting that any variance seen between males and females was confined solely to factors relating to size as opposed to ones of proportionality.

**Enamel microdefects in a modern sample.** L.M. MIFSUD and M.K. MARKS, Department of Anthropology, University of Tennessee, Knoxville, TN 37996

Developmental defects in tooth enamel (Wilson bands) have been routinely utilized by bioarchaeologists to ascertain prehistoric and historic fetal/maternal, infant and childhood morbidity. Wilson bands have been employed to develop inter-/intra-tooth chronology, underscore temporal relationships, and measured against other non-specific dental and skeletal stress indicators.

While hypoplasias are assignable within contemporary groups and their frequencies readily related to clinical events associated with sub-standard existence, microdefect patterns among such groups are unstudied and questions remain regarding chronology, sensitivity and distribution.

Teeth (N=237) were donated by African- and European-American patients from ten public health clinics and oral surgeons' offices in Tennessee and California. Age, sex, and socioeconomic background were provided focusing on mandibular canines and maxillary

central incisors. Like previous prehistoric research, these Wilson band frequencies indicate much greater sensitivity than enamel hypoplasias.

Similar to that research, first, second and third year frequencies were 1, 76 and 17%, respectively, which is common finding traditionally associated with weaning cycles. However, unlike previous findings, incisor and canine were equally susceptible to Wilson band development.

Finally, there is an obvious negative correlation between socioeconomic status and Wilson bands. Yet, regardless of socioeconomic, European-Americans displayed a significantly greater morbidity frequency compared to African-Americans (41%). This project not only confirms previous research on prehistoric samples but addresses demographic concerns involving differential susceptibility in living groups regardless of economic challenges that affect health.

**Hand preferences for feeding in free-living simakobu monkeys (*Simias concolor*):** The effects of posture and balance. C.T. MILLER, Anthropology, University of Colorado at Boulder, CO 80309. L.M. PACIULLI, D.P.A.S., S.U.N.Y. at Stony Brook, NY 11794.

Traditionally, handedness has been considered to be a unique human phenomenon. However, recent evidence has shown that behavioral lateralities exist in many other primates as well as some nonprimate animals. A number of factors have been hypothesized to affect the degree of handedness in nonhuman primates. One of these is the posture an animal assumes while feeding. Investigations into the positional behavior of free-living primates have demonstrated that animals frequently alter their posture while feeding. This study tested the hypothesis that an animal who switches its posture alters the hand used to perform a specific activity accordingly and at the same time must maintain a stable feeding stance. We recorded hand use while feeding in four free living simakobu monkeys (*Simias concolor*) at the Betumonga Research Station (North Pagai Island, Indonesia). The postures observed included sitting, vertical grasping, tripod reaching, and extended reaching. A total of 457 instances of hand use while feeding was collected. The monkeys exhibited different degrees of individual level hand preference for feeding in the various postures. In addition to individuals demonstrating a preferred hand for feeding, the monkeys also exhibited a preference as to which hand supported the body during this activity. The degree of lateral bias for the support hand was significantly stronger when the animal braced itself on a large branch than a weaker, terminal branch. During instances when the non-feeding hand was free (i.e., not engaged in any activity), each individual exhibited a right hand preference for feeding. Thus, these data not only demonstrate individual hand preferences in a free-living primate species and its variability according to posture, but also a correlation between stability while feeding and the degree of hand preference.

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