

HOMINOID CHROMOSOME COMPARISONS: An Addendum

Be sure to download and duplicate the high resolution page of chromosome diagrams from four hominoids: humans, chimpanzees, gorillas, and orangutans. Just showing your class this page on an overhead projector will stimulate all sorts of discussion. Besides the striking number of identical segments, even entire identical chromosomes, upon closer inspection, students may see places where chromosome inversions and fusions must have occurred. This is a 300 dpi, 1.5 MB page, so it is advised to use DSL or other high speed internet connection to download the file, at <http://www.indiana.edu/~ensiweb/lessons/chr.pdf.html>.

Because of the fine details and shading, we strongly recommend making a classroom set of the sheet of chromosomes from four hominoids on a high quality copy machine (ask about this at Kinko's or other copy store); it doesn't cost much more than the lesser quality machines which are ok for routine copies. Then either have them laminated, or place them in clear plastic sleeves for annual re-use without wear.

If you used Beth Kramer's "**Comparison of Hominoid Chromosomes**" on the ENSI site, you (or a sharp student) might notice that the human/chimp banding patterns on the four-hominoid set do not perfectly match those Beth used in her lesson. Her chromosomes came from an earlier study (by Yunis and Dunham, 1980, *Science*). The differences are probably due to improved technique by Yunis and Prakash (1982, *Science*), and possibly slight differences that arise with the precise timing protocols used in the two different studies.

Please consider using one of two other lessons as an alternative to the one posted on the ENSI site (by Beth Kramer). Beth's is very good in presenting the detailed process of chromosome comparisons, using the chromosomes from just two primate species (humans and chimpanzees).

Alternative #1 is a different approach, developed by ENSI webmater Larry Flammer for Don Johanson's "Becoming Human" site, "**The Chromosome Connection**," has students match bullet marks and relate this process to the comparison of chromosome banding. It proceeds to focus attention on the careful comparison of several chromosomes from humans and the great apes, recognizing the evidence for inversions, fissions and fusions that must have happened. Just as matching bullet marks clearly shows that the bullets came from the same gun, matching chromosome banding patterns clearly shows common origins (ancestry), and this is further extended to a cladogram that shows where the chromosome changes must have happened in the evolution of the hominoids (see "**Primate Cladogram**" at <http://www.indiana.edu/~ensiweb/lessons/chr.pdf.html>). Take a look at the lesson at www.becominghuman.org. On their home page, click on "**Learning Center**", then click on "**Chromosome Connection**" (where you, or your students, can move some chromosomes around to match a displayed set), then click on "**Lesson Plans**", then "**Chromosome Connection**." You can download all material to print out and use in your classes. A version of this was used by the author very successfully for many years in the 80s and 90s before his retirement. Something visual like this is often more compelling to students than the matching of DNA or amino acid sequences (which I also did, providing nice confirmatory evidence for common ancestry, along with hominoid skull comparisons).

Alternative #2 is a faster, more abbreviated version, "**Chromosome Clues**." It was developed for the PBS-Evolution *Teacher's Guide*, at <http://www.pbs.org/wgbh/evolution/educators/teachstuds/unit5.html>. While on that site, be sure to check out the many other excellent resources and lessons available.

In addition to doing a chromosome comparison lesson, be sure to take a look at these companion ENSI lessons to include at some point in your curriculum:

Hominoid Cranial Comparisons ("Skulls Lab") <http://www.indiana.edu/~ensiweb/lessons/hom.cran.html>

Molecular Sequences & Primate Evolution <http://www.indiana.edu/~ensiweb/lessons/mol.prim.html>.