

NAME _____
SID _____

The University of California, Berkeley
Department of Integrative Biology
IB35AC: Human Biological Variation
Exam 1, 50 points
8 October 2015

INSTRUCTIONS:

1. **Print** your name and SID atop the front page of this exam LEGIBLY.
 2. Make sure that your exam has 6 double-sided pages. There are twelve pages to this exam.
 3. **Print** your name and student identification number on your answer sheet form LEGIBLY.
 4. **Mark the VERSION (A or B) of your midterm in the “exam version” box of your answer sheet.**
 5. Questions must be answered on the answer sheet with a #2 pencil or a blue or black ink pen.
 6. **Be sure to complete and sign the honor code on the back of this page.**
 7. You may qualify your answer to any question by writing, in ink, next to the question on the question sheet (NOT the answer sheet). However, **INCORRECT QUALIFICATION WILL RESULT IN THE LOSS OF POINTS EVEN IF THE ANSWER IS CORRECTLY MARKED!**
 8. IF you qualify a question and want us to consider it, you must indicate which questions you are qualifying at the bottom of this cover page AND turn your exam booklet (this packet of paper) in with your scantron.
 9. The most important thing that you can do is to **READ AND REREAD EACH QUESTION CAREFULLY** before answering. Choose the **BEST** answer. Answer only what is asked.
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QUALIFICATION BOX

Do you have any qualifications you want us to consider? Check the box if yes:
And be sure to turn in this exam booklet at the end of the exam period.

Exam question numbers with qualifications: _____

You need to make sure that we can easily discern qualifications from notes you may have written to yourself. You also need to make sure that we can read your full name at the top of this page of your exam.

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As a member of the UC Berkeley community,
I act with honesty, integrity, and respect for others.

Your signature:

Be sure to sign the honor code.

Instructions for Questions # 1-50

- A. Follow instructions on the answer sheet.
 - B. Print your name and student identification number on the answer sheet.
 - C. Write on the answer sheet (in the exam version box) which version of the exam you are using.
 - D. Use a #2 pencil or a black or blue ink pen on the answer sheet.
 - E. On True/False questions, mark "A" for True and "B" for False.
 - F. On Multiple Choice questions, mark the appropriate answer.
 - G. THERE IS ONLY ONE BEST ANSWER FOR EACH QUESTION.
 - H. You may qualify your answers by writing your qualification next to the appropriate question. DO NOT WRITE QUALIFICATIONS ON YOUR ANSWER SHEET. Incorrect qualifications will result in loss of points even if the answer is correctly entered on the answer sheet.
 - I. Start with answer space #1 on the answer sheet. Check that you end this section with space #50 on the answer sheet.
 - J. Each question is worth 1 point. There are 50 possible points.
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1. You and Lady Gaga are members of the same genus and species, *Homo sapiens*. Back in the 1700's a man named Carl Von Linne came up with this classification system. In which Linnean family are you and Lady Gaga categorized?
 - a. Canidae
 - b. Chordata
 - c. *Pan paniscus*
 - d. Hominidae
 - e. Primates
2. Which of the following is NOT one of the three domains of life?
 - a. Bacteria
 - b. Marsupalia
 - c. Eucaryota
 - d. Archaea
3. The most taxonomic diversity among extant vertebrates is found within:
 - a. Mammals
 - b. Bony fish
 - c. Frogs
 - d. Dinosaurs
 - e. Reptiles
4. According to the biological species concept, the man sitting close to you and Lady Gaga are members of the same species because
 - a. They belong to the same evolutionary lineage.
 - b. They are within two standard deviations of the same mean for height.
 - c. They recognize each other as potential mates and could have viable offspring together.
 - d. They are both heterodont with 5% sexual dimorphism.

5. Humans share DNA similarities with daffodils.
 - a. True
 - b. False

6. Not having a tail is a _____ trait in humans relative to all other apes. Bipedalism in humans is a _____ trait relative to the last common ancestor with chimpanzees.
 - a. primitive ... convergent
 - b. derived ... homologous
 - c. derived ... primitive
 - d. primitive ... primitive
 - e. primitive ... derived

7. The John T. Scopes trial of 1924 in Tennessee was about whether or not creation science should be taught alongside evolution in science classrooms in public schools.
 - a. True
 - b. False

8. Charles Darwin is credited with which of the following early concepts of evolutionary theory?
 - a. Natural selection
 - b. Malthusian catastrophe
 - c. Inheritance of acquired characteristics
 - d. Uniformitarianism
 - e. Catastrophism

9. What does “sexual dimorphism” mean in the context of biology?
 - a. Males compete against each other for female mates.
 - b. Males and females are pair-bonded.
 - c. Sexual activities are used for social purposes and not just reproduction, such as with the bonobos.
 - d. Females from the same species come in two different morphs.
 - e. Males and females differ systematically from each other, for example, in body size.

10. A taxonomic _____ represents a group of species that have a similar adaptive strategy in terms of habitat, locomotion, etc. For example, _____ represents large bipedal apes that still retained adaptations for significant tree-climbing, lived in closed woodland habitats about 4.5 million years ago, and were pair-bonded.
 - a. family ... *Homo sapiens*
 - b. species ... hominids
 - c. order ... Primates
 - d. family ... hominids
 - e. genus ... *Ardipithecus*

11. The square teeth in the very back of an adult human's mouth are called:
- molars
 - canines
 - premolars
 - incisors
 - deciduous
12. Which of the following models predicts that our species evolved directly from the Neanderthals?
- Replacement
 - Candelabra
 - A Little Introgression
 - Multiregionalism
 - None of the above
13. The bone with the next to last epiphysis in the human skeleton to fuse in ontogeny, the humerus, is located:
- In your hand
 - In your arm
 - Between your hip and knee joints
 - At the back of your head
 - At the base of your spine
14. Why is it difficult to apply the Biological Species Concept to extinct populations?
- It is too difficult to compare different parts of skeletons between populations.
 - It is difficult to know for sure if members of two extinct populations interbred.
 - We cannot assess if members of two extinct populations lived in different habitats.
 - We cannot determine if a lineage maintained its integrity through time from fossils.
 - All of the above.
15. The genus *Australopithecus* differs from *Homo* in that it
- Only existed before *Homo* and never simultaneously
 - Was bipedal
 - Has never been found outside of Africa
 - Certainly never used stone tools
 - Hated *Ardipithecus*
16. Acheulean stone tools differ from Oldowan stone tools in that they:
- Were made by the robust species of *Australopithecus*
 - Required a systematic imposition of pre-conceived form for manufacture
 - Are found at the earliest hominid fossil sites in Africa
 - Substituted for a canine honing complex
 - None of the above

Please double-check to make sure you entered the correct version of your exam on your answer sheet.

17. In your second discussion section and in lecture, you have had the opportunity to study and discuss the morphology of modern human crania from various places around the world. You learned about tented nasal bones, sharp nasal sills, and Carabelli's cusps on the maxillary molars. Forensic scientists often use variation in traits such as these to determine the _____ of bones recovered from crime scenes. Traits like these have been shown to _____ modern human populations.
- Geographic ancestry... only imperfectly differentiate
 - Ontogenetic age... be identical across
 - Health... vary little between
 - Primitive features... evolve at different rates across
 - Idiosyncratic nature... vary little between
18. *The following scenario is partly fictional:* One million years ago, a small group of *Homo erectus* decided to follow a herd of wildebeest on a migratory path that took them much farther north than they had gone before. As they walked and walked, they decided that this new territory looked quite hospitable, and they decided to move their homes. One of the hunters went back to convince a few more *Homo erectus* individuals to join them. Ultimately, over 500 of them traveled north, and then far west for thousands of kilometers. They eventually ended up on a landmass that gradually became an island. Since they did not have boats, and couldn't swim very far, these individuals couldn't leave the island. Consequently, they never came into contact with the relatives that they left behind. Resources on this island were scarce, and there was intense selection against the bigger individuals who needed more calories just to survive. About 500,000 years later, the ocean levels dropped. Three foot tall hominids from the island then came into contact with five foot tall hominids on the mainland. They interacted much the way that olive and hamadryas baboons do – they mated. Which of the following is illustrated by this scenario?
- Inheritance of acquired characteristics
 - Homo erectus* became polytypic
 - Allopatric speciation
 - Sympatric speciation
 - Genetic drift
19. For one of your assigned readings, we sent you to the University of California's Museum of Paleontology's Understanding Evolution. Here, you learned how climate change over the last 100 years has effected the range distribution and genetic variation of alpine chipmunks. Thinking about how little variation there is in human mtDNA, what would be a reasonable hypothesis about *Homo sapiens* 200,000 years ago based on what scientists observed about these chipmunks?
- Climate change induces a faster mutation rate in human mtDNA.
 - Humans lived in mountainous regions 200,000 years ago.
 - A variety of cold adaptations have evolved since our ancestors who lived in eastern Africa 200,000 years ago.
 - Humans likely evolved fur for a brief time during the last glacial maximum.
 - 200,000 years ago human population size was reduced, as was their geographic range.

20. The European Global History of Health Project (described in one of your reading assignments) explored the health of ~11,000 humans as recorded in their skeletal remains. The researchers found that the health of these early Europeans has been _____ between 3,000 to 200 years ago:
- Improving
 - Deteriorating
21. As you experienced first-hand in your first discussion section, in order to know whether anatomical traits are primitive or derived you need an outgroup. We can also use fossils as evidence of what putative ancestors may have looked like. For the hominid lineage – all of our ancestors since our split with the chimpanzee/bonobo lineage – the fossil evidence for the human-chimpanzee last common ancestor (LCA) is scarce because:
- Apes were extremely rare during the Miocene.
 - Most of the primates known from the mid-Miocene are Old World monkeys, who are from a different Linnean family than we are.
 - The LCA lived in the Paleocene, a time from which we have essentially no fossil record.
 - Fossiliferous sediments dating to between 10-7 million years ago are extremely rare in central and eastern Africa.
22. One of your reading assignments for lecture was written by Prof. Tim White, who co-directs a project in that Afar Region of Ethiopia from which many of the fossils we've talked about in class were found. Prof. White wrote about the sequence of the fossil record in this region. Add into this sequence some of the other events during human evolution that we have discussed in lecture and some of your other readings. Which of the following lists places these major events in human evolution in the correct chronological order, from oldest (to the left) to youngest (to the right)?
- Ardipithecus*, *Proconsul*, *Homo*, *Australopithecus*
 - Oldowan tools, Acheulean tools, Agriculture, occupation of Siberia
 - Reduced canine dimorphism, fully-committed bipedalism, fur-less dark skin, migration into South America
 - Migration into the Americas, Neanderthals, pair-bonding, iPhones
 - Agriculture, megalithic structures thought to be religious, Acheulean hand-axes, the Last Glacial Maximum
23. In one of your assigned readings, Frank Sulloway, describes Charles Darwin's shift from a belief in Intelligent Design to his theory of evolution by natural selection. One of the perhaps surprising insights Sulloway wrote about is that Darwin was so entrenched in the immutability of species that he:
- Did not record which Galapagos Island the finches he collected came from, but luckily his assistant did.
 - Collected so many turtle specimens from the Galapagos Islands that the Beagle almost sank.
 - Originally wrote *On the Origin of Species* to be about divine creation.
 - Did not study any of the fossils from South America.
 - Rejected divine creation almost immediately after setting foot on the first of the Galapagos Islands he visited.

24. Charles Darwin was trained in a “Baconian” approach to science, in which the facts speak for themselves. After noticing that the biological facts he witnessed on the voyage of the Beagle did not accord with Intelligent Design, he gradually moved toward a hypothetico-deductive approach. The *Origins of Species* is a strong example of posing an hypothesis, setting up expectations that stem from this hypothesis, and then:
- Collecting evidence in an attempt to prove it is correct.
 - Collecting evidence in an attempt to prove it is incorrect.
 - Developing a strong philosophical argument for why we should not ask these types of questions.
 - Explaining why it is impossible to explore scientific research about things that happened in the past.
25. Just the other day, NASA scientists reported finding evidence of water on Mars. As you know, this planet is farther away from the Sun than is Earth, and as such, has a much colder global temperature. Let’s imagine that a group of about 10,000 astronauts travels to Mars, but while they are there, a catastrophe hits Earth. They are unable to return. These people figure out how to live there, breathe the Martian atmosphere and live outside all the time. Just over 250,000 years later, humans from Earth manage to make it back to Mars. They are surprised to see that the descendants of the astronauts have evolved following Allen’s Rule. What does this mean?
- They had shorter arms and legs than Earth-living people.
 - They had larger brains than Earth-living people.
 - They had wider nasal apertures than Earth-living people.
 - They were larger than Earth-living people.
 - They lived in moral darkness, like the Neanderthals.
26. Turner Syndrome is the genetic condition of having only one sex chromosome, an X. What is the term for this type of genetic mutation?
- Frameshift
 - Missense
 - Silent
 - Insertion
 - Aneuploidy
27. How many pairs of chromosomes do chimpanzees have?
- Two less than humans.
 - The same number as humans.
 - One more than humans.
 - Five times the number in butterflies.
28. True or False: Because the last common ancestor for all of modern human mtDNA variation is estimated to have lived ~200,000 years ago, we know that all of human genetic variation must also coalesce at the same time.
- True
 - False

29. You are a biologist interested in better understanding how the human populations within Africa are biologically related to each other. Which of the following approaches would be the most appropriate for addressing your research question?
- Archaeological evidence for plant domestication
 - Prevalence of lactase persistence
 - A study of preferred hairstyles among men
 - Developmental genetics
 - Allele frequency differences across a number of different genes
30. If you are 2 standard deviations below the mean for a phenotypic trait, such as arm length:
- You are close to the average arm length for the population.
 - You are an outcast to society and do not belong in the group.
 - Your phenotypic expression is probably bimodal.
 - You are below the mean for other phenotypes as well.
 - Most of the population has longer arms than you do.
31. The frequency of lactase persistence is different across populations, such that it is quite common in some populations and quite rare in others. These differences vary in large part because
- Some populations evolved into *Homo sapiens* earlier than others, and as such, not all of them have yet achieved the derived state of lactase persistence.
 - The populations that practice pastoralism have created an environment in which lactase persistence is an advantageous phenotype.
 - Populations that have a higher rate of Rickets have been selected for lighter skin color and lactase persistence in order to increase the Vitamin D and calcium up-take from the diet.
 - Women in some populations are more repulsed than others by the diarrhea and intestinal gases caused by lactose intolerance, and as such, sexual selection has brought lactase persistence to higher frequency.
32. True or False: A trait cannot be considered an adaptation if it is beneficial in one environment but disadvantageous in a different environment.
- True
 - False
33. The coalescence for modern human and Neanderthal mtDNA haplotypes is estimated to have occurred when:
- Stone tools were first being used (based on what we know from the archaeological record)
 - The earliest diaspora of hominids outside of Africa was taking place
 - The last (most recent) ice age ended
 - Hominids similar to those represented by the Bodo cranium were alive, and spears were being used (based on what we know from the archaeological record)
 - The Clovis culture was flourishing

34. When scientists describe chimpanzees and gorillas as polytypic, what does that mean?
- There is sexual dimorphism within gorilla and chimpanzee species.
 - There are multiple species within the chimpanzee and gorilla genera.
 - There are multiple morphotypes, or forms, within the various species of chimpanzees and gorillas.
 - None of the above.
35. The genetic variation observed within our species:
- Is equivalent to the amount of genetic variation seen within one subspecies of chimpanzee
 - Is equivalent to the amount of genetic variation seen within one species of gorilla
 - Is equivalent to all of the genetic variation seen within the genus *Pan* (chimpanzees)
 - Is equivalent to all of the genetic variation in the *Pan* and *Gorilla* genera combined
36. Human genetic distance correlates with geographic distance. What does this mean?
- This means that human races are biologically distinct.
 - This means that humans travel long distances to find mates.
 - This means that human variation does not correlate with geography.
 - This means that human genetic variation is clinal.
 - This means that humans are all remarkably genetically similar to each other.
37. Gregor Mendel studied how traits, such as wrinkled versus smooth peas, were inherited from generation to generation in pea plants. His decision to study these particular traits in pea plants was fortuitous because they are primarily _____, making the discovery of his Laws of Inheritance fairly straightforward.
- Monogenic
 - Oligogenic
 - Nongenic
 - Polygenic
38. A population with a wider range of environmental factors influencing height will likely have a lower heritability estimate for height than will a population with fewer environmental (non-genetic) influences. Which of the following is the most accurate explanation as to why?
- The genetic contribution is likely the same in both populations, but the population with more non-genetic effects will have more variation overall. This means that the amount of the phenotypic variation that is caused by genetic effects is proportionately smaller, and therefore, the heritability estimate is lower.
 - Non-genetic effects can turn off the effects of genes, making a phenotype less influenced by genetic effects, and thereby have a lower heritability estimate.
 - The entire premise of this question is wrong, as higher heritability estimates are typically estimated for populations that have larger non-genetic contributions to the phenotypic variation.

39. Which of these is an example of convergence?
- Dark skin color in two Sub Saharan African populations
 - Skin getting darker over a lifetime with increased exposure to sun
 - Light skin color in both Europeans and Asians
 - Supplementation of the diet with vitamin D rich food in the Inuits
40. The epidemic of Kuru disease in the Fore of Papua New Guinea was caused by an infectious agent called a "prion." A person can come become infected with a prion disease in what way(s)?
- Inheritance of a PrP allele that is predisposed to malform.
 - Spontaneous mutation of the PrP protein.
 - Consuming (eating) infected tissue.
 - All of the above.
 - A and C
41. Use your knowledge of evolution to identify which of the following people has a phenotype that is derived relative to the earliest members of the species *Homo sapiens* (i.e., 160,000 years ago)?
- A person whose body can digest milk after childhood
 - A person with a heterodont dentition.
 - A person with darkly pigmented skin
 - All of the above
 - A and C
42. In lecture on Tuesday this week, you learned about the HapMap project, which explores human genetic and phenotypic variation. Using these datasets, researchers found an Asian-specific allele of the gene EDAR that is associated with thicker hair. This allele appears to have undergone positive selection. What else do we know about EDAR?
- Variation in EDAR is also responsible for lactase persistence.
 - A different allele of EDAR was found in the ancient DNA of Neanderthals and is associated with the red hair phenotype.
 - Severe mutations in EDAR result in abnormal development of teeth, hair & eccrine sweat glands.
 - EDAR underlies variation in pigmentation levels in fish and in humans.
43. At what stage of embryonic development is folate deficiency in the mother most detrimental for a fetus?
- 1st trimester
 - 2nd trimester
 - 3rd trimester
 - After birth
 - Puberty
44. True or False: *Pan troglodytes* and *Pan paniscus* appear to have speciated from a last common ancestor through the process of sympatric speciation.
- True
 - False

45. The evidence for cannibalism in the American southwest is BEST demonstrated at the Cowboy Wash site in Colorado by which of the following?
- The presence of human myoglobin in coprolites.
 - Human bone fragments that had evidence of being heated/burned.
 - The presence of valuable cultural artifacts, such as clay pots and stone tools that had been abandoned at the site.
 - The location of a fossilized human feces found in the hearth.
 - The fracture and damage to the human bones matches the fracture and damage made to animal bones during butchery.
46. Which of the following traits is not shared by all extant mammals?
- Give birth to live offspring
 - Heterodont
 - Nourish their young with milk
 - Hair/fur
47. Geographic ancestry cannot be reliably estimated from:
- The crania of elderly people
 - The post-cranial skeleton
 - The crania of juveniles and infants
 - A and B
 - B and C
48. Two male chimpanzees fight for access to the highest quality females to mate with. The most specific name for the type of selection that is acting on the male chimpanzee that wins and is afforded access to the best females to mate with and have fertile offspring with is:
- Directional selection
 - Disruptive selection
 - Bimodal selection
 - Intrasexual selection
 - Intersexual selection
49. What aspect of *Ardipithecus* morphology suggests that they may have been pair-bonded?
- Divergent big toe
 - Aspects of the dentition
 - Spinal curvature
 - Sexually dimorphic pelvis
50. A good example of an oligogenic trait in humans is
- height
 - eye color
 - earlobe attachment
 - weight

You made it to the end of the exam... congratulations!