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MCB41: Second Midterm **Spring 2009**

Before you start, print your name and student identification number (S.I.D) at the top of <u>each</u> page. There are 7 pages including this page.

You will have 50 minutes for the 100-point exam. The value of each question is given at the beginning of the question.

Place your answer on the front of the page. Only answers in that space will be graded.
You may write in pencil; however, to preserve your rights to a regrade, you must write your answers in pen.

Good luck!

_____
This section is for grading. Do not write here.

1(30)_____	2(10)_____	3(10)_____	4(20)_____
5(15)_____	6(8)_____	7(7)_____	

EXAM SCORE: _____

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1. (30 points) Mix and Match. Match the most appropriate term or statement from column 2 to the term or statement in column 1. Use each term or statement from column 2 only once.

Column 1

14_____ mtDNA

10_____testosterone

3_____FISH

7_____carrier

5_____trisomy 21

11_____SRY

1_____phenylalanine

2_____Sickle Cell disease

8_____α hydroxyreductase deficiency

13_____karyotype

9_____evidence for gay gene(s)

15_____determines sex in some reptiles

6_____ Congenital adrenal hyperplasia

12_____uses selected embryos for fertilization

4_____rationale for forced sterilization in U.S.

Column 2

1. accumulates in babies with PKU
2. results from hemoglobin defect
3. technique to detect DNA using fluorescently labeled probes
4. Eugenics
5. caused by nondisjunction
6. Excess androgen in XX individuals
7. heterozygous
8. XY individuals feminized
9. twin studies
10. regulated by SRY
11. on the Y chromosome
12. Preimplantation Genetic Diagnosis
13. display of mitotic chromosomes
14. maternally inherited
15. temperature

2 points for each correct answer

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2. (10 points) Calico cats have patches of black and orange fur, and are heterozygous for the orange and black alleles of a coat color gene. A calico cat had a mother with black fur.

What sex is the calico cat? What chromosome and fur color allele did the cat inherit from its father? Explain your reasoning. (5 points)

The cat inherited an X chromosome from her father. Because the cat is a Calico and thus a mosaic, she has two X chromosomes and is a female. Therefore she must have inherited an X from both parents.

A littermate of the calico cat is a black female with a single X chromosome and no Y chromosome. Explain what could have happened to generate this cat. Be specific. (5 points)

Because the cat is black, it inherited its only X chromosome from its mother; we know from the previous question that the father is an orange cat. A nondisjunction event occurred during either meiosis I or meiosis II in the father such that the sex chromosomes did not split properly. The sperm that fertilized the egg did not donate any sex chromosomes, which resulted in a black female cat with a single X chromosome.

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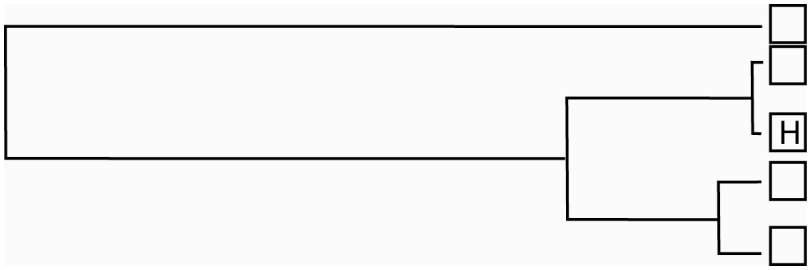
3. (10 points) The genomes of 5 animals (R, M, H, C and F) were sequenced and analyzed. It appeared that overall the protein coding domains were conserved. The percentage of average conservation is shown in the table below

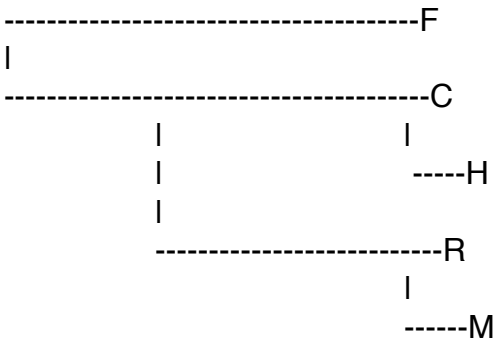
	R	M	H	C	F
R		95%	79%	79%	25%
M	95%		79%	79%	25%
H	79%	79%		99%	25%
C	79%	79%	99%		25%
F	25%	25%	25%	25%	

To which animal is H to most related? (4 points) __C_____

To which animal is R the most related? (4 points)___B_____

Fill in the animal's name in the squares of the phylogenetic tree below (H is given) (2 points)





4. (20 points) Five propositions are listed below. The statements are either correct or there is something wrong with them. Pick four of the statements and briefly describe what is wrong with them. (5 points each)

One of the Eugenic approaches in this country was to sterilize cattle that displayed negative traits.

Humans, not cattle were sterilized.

Fruitless is transcribed in male fruit flies but not in females to control male sexual behavior.

Fruitless is transcribed in both males and females, but the mRNA is spliced differently in the two genders, leading to different sexual behavior.

Polymerase Chain Reaction is preferentially used to amplify mtDNA sequences from samples of extinct species because the mitochondrial genome has so few genes.

DNA degrades after an animal dies. Since there are thousands of copies of mtDNA in each cell, there is a better chance of retrieving mtDNA from a long-dead animal than nuclear DNA, of which there are only two copies per cell.

The reason that geneticists believe Ashkenazi Jews have such a high frequency of Tay Sachs disease is because of the founder effect, in which carriers for the disease gene have an advantage because they are resistant to particular infectious diseases.

The founder effect is where a small group splits off from the larger population, and, purely by chance, has a larger percentage of carriers for a disease gene than the original population.

In mammals and in the fruit fly *Drosophila melanogaster* XXY individuals develop as males.

XY flies will develop as females, because gender in flies is determined by the ratio of X chromosomes to sets of autosomes. Since XXY flies have two X chromosomes and two sets of autosomes, they will develop as females.

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5. (15 points) What is the probability of having an affected child if: (Explain your reasoning)

a) Both parents are carriers for an autosomal recessive disease?

25% of the children will be homozygous for the trait.

b) One parent is heterozygous for an autosomal dominant trait and the other does not carry the dominant allele?

50% because 1/2 of the children will inherit the dominant allele.

c) If the mother is a carrier for an X-linked recessive trait and the father is unaffected?

Sons will have a 50% chance of being affected because they only have one X that they inherit from their mother. Daughters will not be affected because they inherit a normal X from their father.

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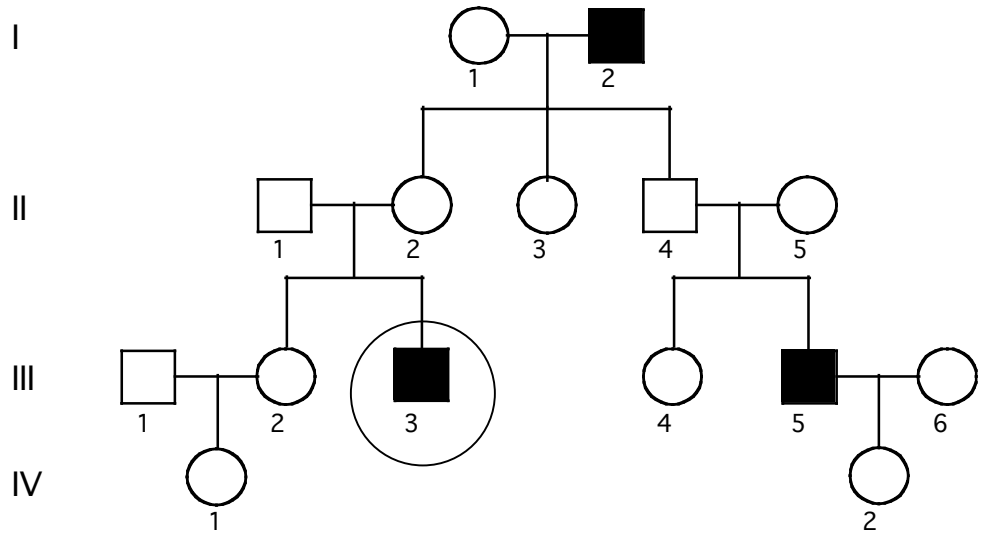
6. (8 points) Allan Wilson and his colleagues proposed that modern humans evolved in Africa about 200,000 years ago. Explain how analysis of variation in mtDNA among different groups of people led Allan Wilson to conclude that humans originated in Africa.

mtDNA of Africans is more diverse than any other group of people. This led the investigators to postulate that Africans have been around longer than any other group, allowing their mtDNA sequences to accumulate more differences. You could have used a diagram to explain this idea.

7. (7 points) Below is a pedigree for a genetic disease. Define the individuals that have the same mtDNA and Y chromosome as the affected male that is circled. Use the nomenclature generation-number. The circled individual is III-3.



same Y: II-1
same mtDNA: I-1, II-2, -3, -4, III-2
points were taken off for the wrong answer.