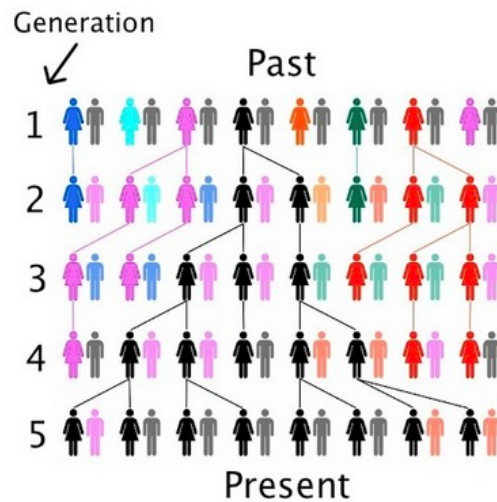
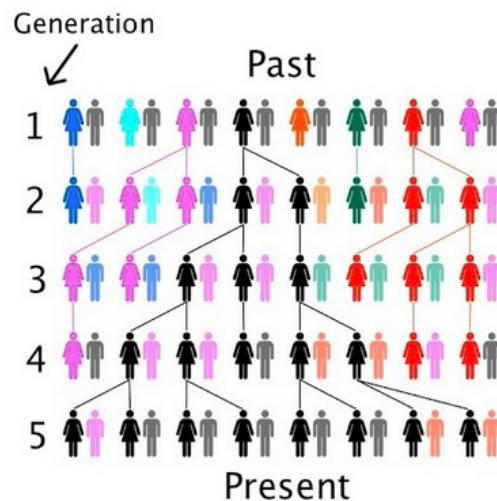


Lesson 11 Human Ancestry and Evolution

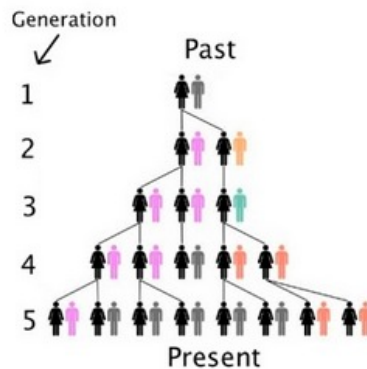
1. This diagram of lineages is based only on genetic data. From which part of the genome must the data have come? Select any and all that apply.



- A. X chromosome
B. Y chromosome
C. a large sample of SNVs across the entire genome
D. mitochondrial DNA
2. True or False. The founder effect is what is represented in this diagram and is a possible explanation for how the black lineage's DNA was able to persist through all five generations when the other lineages' did not.



3. Choose the correct combinations of IBD scores that would pertain to the different generations of the black lineage only (Note that there are no sibling, cousin, or aunt/uncle relationships depicted). Select any and all that apply.



- A. Rows 2 and 3 share 50% IBD; Rows 1 and 5 are 6.25%
 B. Rows 1 and 2 share 75% IBD; Rows 3 and 5 share 25% IBD;
 C. Rows 2 and 3 share 75% IBD; Rows 4 and 5 share 75% IBD
 D. Rows 1 and 5 share 6.25% IBD; Rows 2 and 4 share 50% IBD
 E. Rows 1 and 4 share 12.5% IBD; Rows 3 and 5 share 25% IBD
4. This is an ancestry composition diagram for a hypothetical 23andMe customer, showing the percent DNA that comes from each of 22 populations worldwide. It reflects where ancestors lived about 500 years ago, before ocean-crossing ships and airplanes existed. 99.8% of this person's DNA comes from Europe (the other 0.02% is unassigned). Does this mean that her most ancient ancestors did not come "out of Africa?" Explain.



- A. Yes
 B. No

5. On average, what would you expect the approximate IBS score (not IBD!) to be between this hypothetical 23andMe customer and the following people? Write a number (percentage) for each option. Your choices are 0%, 50%, 70%, 75%, and 85%.
 - A. Her mother ____%
 - B. A native Nigerian ____%
 - C. Her husband of European descent ____%
 - D. Her child ____%
 - E. A native Japanese ____%

6. Everyone has 2 parents, 4 grandparents, 8 great-grand parents, etc. This pattern can be modeled with a simple formula: 'k' generations ago, everyone had 2^k ancestors. If this is the extent of our model, it would imply that the size of the population grows infinitely when we go back in time. Why is this reasoning incorrect? Select any and all that apply.
 - A. Because of inbreeding, some of my ancestors are counted several times.
 - B. Bottlenecks ensured that the population stayed small.
 - C. Not every individual in a given generation will have kids.

7. If everyone in a large population had 3% of their genome coming from Neanderthal one generation ago, what is the expected percentage of Neanderthal ancestry in members of the present generation? Why?
 - A. 0%
 - B. 1.5%
 - C. 3.0%
 - D. 4.5%
 - E. 6.0%

8. Assume we have sampled individual genomes at many locations worldwide and there are no immediate selection pressures on any populations. To estimate which location was colonized most recently, we would look for the population where:
 - A. Genetic diversity is highest
 - B. Genetic diversity is about the average of all the other populations
 - C. Genetic diversity is lowest
 Why?

9. Assume we have a method that detects total amount of DNA that is Identical by Descent (IBD) between two individuals. For a pair of individuals, we know only that they share 50% of their DNA IBD. Are the individuals parent-child, or siblings? (We assume that there is no inbreeding).
 - A. We cannot distinguish, we don't have enough data.
 - B. Parent-child, because siblings don't share 50% IBD
 - C. Siblings, because parent-child don't share 50% IBD
 - D. We cannot distinguish between parent-child and sibling relationships with IBD.

10. Now assume our IBD detection method gives us the chromosomal distribution of IBD segments too. If all the of the IBD segments are on the same chromosome, which of the following is true?
- A. Then the relationship is parent-child.
 - B. Then the relationship is siblings.
 - C. Then the relationship cannot be parent-child or siblings.
11. When comparing genomes to uncover differences, scientists choose SNV sampling over random sampling. Why is SNV sampling better for identifying genomic differences? Select any and all that apply.
- A. All human genomes are over 99% identical
 - B. Random sampling is more expensive
 - C. SNVs are defined as variable regions in the genome
 - D. Random sampling will usually result in no differences
12. You are comparing genomes between two very unrelated humans. What is the percent match expected for each of the following? Match the letter of the percentage to each scenario.
- | | |
|-----------------------------|---------|
| ___ SNV sampling and IBS | a. ~99% |
| ___ Random Sampling and IBS | b. ~70% |
| ___ SNV sampling and IBD | c. <1% |
13. What is the IBS score for each of the following 5 SNV sampling comparisons? Please write your answer as a percentage or decimal for each one.

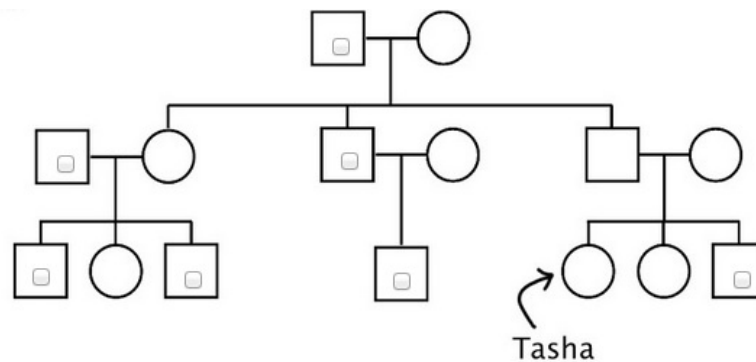
	SNV 1	SNV 2	SNV 3	SNV 4	SNV 5
Person 1	GA	TT	CA	GT	AA
Person 2	AG	TC	CG	GT	CC
Person 3	GA	CT	GC	GT	CA
Person 4	GT	TT	CA	GA	AA

14. IBS indicates genetic identity with an individual, whereas IBD indicates genetic relatedness with an individual. Assuming no inbreeding, indicate whether each of the following relationships would be expected to have a higher IBS or IBD score.

Higher IBS Higher IBD

Parent-Child
 Aunt-nephew
 Grandfather-granddaughter
 2nd cousins

15. Look at the following pedigree.

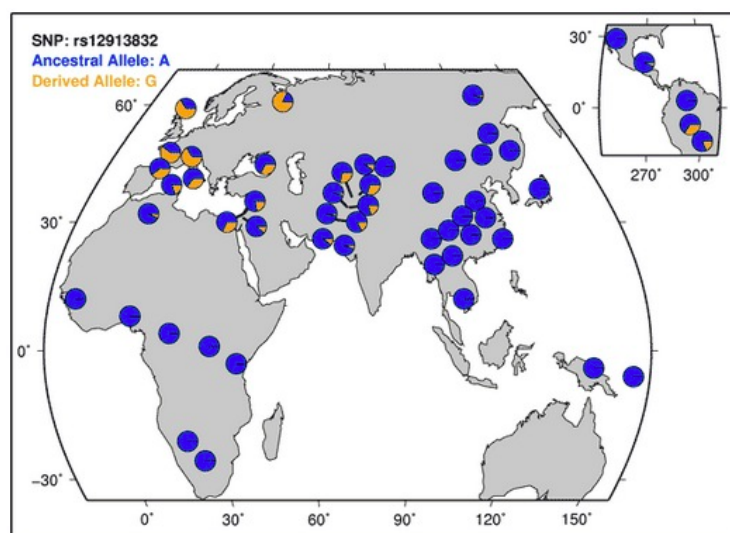


Tasha is female and wants to trace her paternal lineage. However, her father is deceased so she must find a DNA sample elsewhere. Select all individuals in the pedigree that would give Tasha information about her paternal lineage.

16. True or False. The lack of recombination between sex chromosomes as well as mitochondrial chromosomes is what makes random genome sampling not as effective as SNV sampling for determining genomic differences. Why?

17. After a large population analysis of the SNV (G allele) that is associated with causing blue eyes instead of brown (rs12913832), a map was generated to demonstrate the allelic frequencies. Which region would you think is nearest to where this mutation originated? Why?

- A. Africa
- B. Central/South America
- C. Eastern Asia
- D. Northwestern Europe
- E. Southeastern Asia



18. Fill in the blanks to make the statement true.

All modern humans originated in _____ and migrated outwards in what was called the Great Human _____. Neandertals evolved in _____ and the Middle East, and evidence suggests _____ with humans.

[Word bank: *interbreeding, Africa, expansion, Europe*]

19. Select the underlined word in the following paragraph that is incorrect. Then write the correct word that should replace it.

Chimpanzees are distant ancestors to humans that have 48 chromosomes instead of 46 because our chromosome 2 is a fusion of two smaller chimpanzee chromosomes.

20. For each of the following family members, rank them in order of whom you would expect to share the most (1) to least (5) identity by descent (IBD).

- | | |
|----------------------------|-------|
| A. 1st cousin | _____ |
| B. Great-great grandmother | _____ |
| C. Father | _____ |
| D. Aunt | _____ |
| E. 2nd cousin | _____ |