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Genetics

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#### Romanov assignment

#### <u>History</u>

1. Nicholas II was the last Romanov to hold power in Russia. What was his title? Tzar of Russia was his title.

2. How long had the Romanov family been in power in Russia? The Romanov family remained in power for 300 years.

3. Nicholas II abdicated the throne. Who took power then? The Bolsheviks

4. What happened to Nicholas II and his family after he abdicated the throne? Bolshevik forces assassinated Nicholas II and his family.

5. One of the reasons that the family of Nicholas II was executed (vs. just imprisoned) was because there was a fear that the White Russian Army would save them. Who was the White Russian Army? Anti-Bolshevik Russian soldiers formed the White Russian Army.

## <u>Hemophilia</u>

One of the pedigree charts found at the end of this assignment comes from the Module powerpoint lecture notes.

6. How was Alix, the wife of Nicholas II, related to Queen Victoria of England? Alix is Queen Victoria's granddaughter.

7. On what chromosome is the gene that, when mutated, causes hemophilia and how does this contribute to its inheritance pattern? Hemophilia is caused by a gene on the X-chromosome that is inherited most typically from females since it is X-linked recessive.

Both Queen Victoria and Alix are designated as being carriers for hemophilia.

8. What does it mean to be a carrier for a disease? Being a disease carrier implies you have the disease plus the potential to pass on the disease's genetic mutation.

9. Why aren't males considered carriers for hemophilia? Clotting factor genes are not found on the Y chromosome.

10. In a couple of sentences, describe the physiology of the disease hemophilia. Hemophilia is a hereditary bleeding condition that occurs when the body's clotting factors are inadequate. The irregularity of the clotting factors causes a lack of clumping of blood, which is essential to create a clot to seal a wound site.

(Yes, I know it is severe bleeding because the blood cannot clot. But WHY can't the blood clot? Be *very* specific.)

11. What type of hemophilia (A or B) is (probably) represented in the pedigree chart? Hemophilia B is represented in most European families

12. Describe the mutation (at the molecular level) that apparently caused hemophilia in Alix, (and probably all of the European families that had hemophilia). Be *very* specific. Hemophilia B, often known as Christmas sickness, is an x-linked hereditary condition characterized by a lack of factor IX. Factor IX is a single-chain glycoprotein that aids the intrinsic system in converting factors X to Xa and VII to FVIII. It is vitamin-K dependent. In the absence of these components, clot formation is impeded, resulting in bleeding in the joints, GI, cardiovascular, and pulmonary systems.

13. How could the mutation you described in #12 result in a faulty gene product? Be *very* specific in your description. Because the component is X-linked, a defective genetic coding may occur. Because it is recessive, both parents must pass on the x gene for the child to be born.

14. The Romanov's son, Alexis, had hemophilia. Describe how Alexis genetically acquired hemophilia. (Use a Punnett square. You can either draw a table or line up the genotypes.) Alexis was born with hemophilia because his mother, Alix, was a hemophilia carrier. Because a guy lacks a second X chromosome, the condition is x-linked, and if he inherits the gene, he will get the disease. As a result, Alexis was born with the hemophilia gene on his one X chromosome and was a hemophiliac.

	X <sup>H</sup>	Х
Х	X <sup>H</sup> X	XX
Υ	X <sup>H</sup> Y	XY

15. Using a Punnett square (again, draw a table or line up the genotypes), explain why only males in the pedigree chart have hemophilia. (Choose at least one of the males represented in the pedigree chart, and show his parents in the Punnett square.) When glancing at the pedigree chart, it looks that Leopold, the son of Queen Victoria and Prince Albert, has the same genetic potential as Alexis. Because hemophilia is X-linked recessive, females will have the gene on both of their X-chromosomes to show symptoms, but males can show symptoms with only one x-chromosome gene because they only have one chromosome. As a result, males are more likely to get hemophilia than females, who are just carriers.

	X <sup>H</sup>	Х
X	X <sup>H</sup> X	XX
Y	X <sup>H</sup> Y	XY

16. Is it possible for a female to inherit hemophilia, and, if so, how? Hemophilia is more common in males, but it may also be inherited by women, and if they do, it's because one or both of their X chromosomes are afflicted.

17. Some historians speculate that Alexis' hemophilia condition could have led to the Russian Revolution. Explain. Rasputin was a Siberian mystic who was claimed to have used hypnosis to assist Alexei heal, although there are few verified stories of him doing so. Regardless, both of Alexei's parents felt Rasputin could help him stay well. When Rasputin was shot by nobles, Alexei's illness swiftly deteriorated, and he and his family were murdered within a year and a half, this was highlighted even

more. The Russian Revolution began with the collapse of the Romanov family. You should look up the faith healer Rasputin and read about his relationship to the Romanov family.

## Molecular Analysis of People in a Mass Grave

18. Two "graves" were discovered near Yekaterinburg, Russia. Describe the number of bodies in each grave. There were nine remains in the first burial. There were two bodies in the second burial.

19. When were these graves discovered? In 1991 and 2007

20. What type of testing was done to confirm <u>sex</u> and <u>familial relationships</u> among the remains found in the mass grave? STR and Y-STR Testing

21. Genetically, what does STR "stand" for? Be very specific in your answer. Short tandem repetitions are abbreviated as STR. These are short DNA sequences that are repeated numerous times on each chromosome to represent a specific chromosomal position.

22. HRH Prince Philip, the Duke of Edinburgh, provided mitochondrial DNA used to identify Alix and her three daughters. HRH Prince Philip, the Duke of Edinburgh, is married to Queen Elizabeth II of England. Wait, isn't Queen Elizabeth II related to Queen Victoria? So why was *Prince Philip's* mitochondrial DNA used? (To help you answer this question, look at the second pedigree chart.) Tsarina's sole living descendant is Prince Philip. They were able to prove his relationship to her and the three kids using his mDNA.

23. Who was missing from the mass grave (the one with the most skeletons)? The son of Nicholas II, Alexei, and one of the Tsar's daughters believed to be either Anastasia or Maria.

## Molecular Analysis of People in a Mass Grave, cont.

24. The Duke of Fife and Princess Xenia provided mitochondrial DNA used to identify Nicholas. One of these is a female and another is a male. Does that matter? What general statement can you make about their genetic relationship to Nicholas and Alexandra? Are these people still living? It makes no difference whether one is male or female because mitochondrial DNA is involved. However, this demonstrates their relationship through their maternal relatives.

25. What was discovered in the mitochondrial DNA of Nicholas that was not identified in either the Duke of Fife or Princess Xenia? The point of heteroplasmy in the 16169 gene position that differed in the C to T ratio.Tsr Nicholas' ratio was C/T.

26. What is the term given to the existence of two (or more) genetically different mitochondria in the cell? Heteroplasmy

27. What three types of DNA were used to test the remains found in a second grave? STR/Nuclear, mitochondrial, and ancient DNA are three types of DNA.

28. Of the three types of DNA you listed in #28, which one would have been used specifically to identify Alexis? **Y-STR testing is the sort of DNA testing that would have been used to identify Alexis.** 

29. What was the source of the DNA used to identify Alexis? Mitochondrial

30. Was Anastasia in the grave in which Alexis was found? Anastasia was believed to have died during the execution, however it is unclear whether Maria or Anastasia was buried with Alexis.

# Who Wants to Be Anastasia?

Apparently, about 200 people have wanted to be Anastasia and have claimed to be her! One of the most famous imposters was a woman named Anna Anderson (Manahan).

31. Give a brief history (2-3 sentences) of Anna Anderson-both her claims and what is thought to be true. Anna Anderson was discovered after attempting suicide by leaping into a canal in Berlin. Ms. Unknown was her initial moniker since she had no idea who she was and refused to tell anyone. She found herself in an institution, where she told a nurse she was the long-lost duchess Anastasia, which set off a chain of identifications. Living relatives of the late duchess, on the other hand, said she was not Anastasia and had no tie to her.

32. Where in the US did Anna Anderson eventually settle and why? She subsequently relocated to New York City, where she took the name Anna Anderson. Her proclamations of grand duchess hood made her well-known in a variety of social groups. However, she continued to act out in bizarre ways, resulting in her being sent to yet another institution.

33. What were the sources of Anna Andersons's nuclear DNA? Prior to her cremation, samples of her hair and gut were taken.

34. What were the sources of Nicholas' and Alix's nuclear DNA? Their sources of DNA were from their skeletal remains

35. What type of analysis was done on DNA from Anna Anderson, Nicholas, and Alix?

Mitochondrial DNA was extracted from all three and analyzed using STR and mtDNA.

36. Anna Anderson's mitochondrial DNA was compared to the mitochondrial DNA of what two "other" people? Carl Maucher, the Duke of Edinburgh, and the Tsarina's grand nephew

37. A hypervariable region of the mitochondrial DNA was analyzed. Define a hypervariable region. The place inside the D-loop of mitochondrial DNA where nucleotide base pairs repeat

38. What were the conclusions from the mitochondrial DNA comparisons? They came to the conclusion that the two distinct samples taken, hair and intestinal, and tests conducted at three different laboratories, all of which yielded similar results, indicated that the hair and intestine samples originated from Anna Anderson herself.

The article which describes the analysis of Anna Anderson's DNA was published in 1995.
When were all of Nicholas' and Alix's children finally accounted for? In 2007

40. What did you learn from doing this assignment? I discovered a lot about Russian and European history and heritage that I was previously unaware of. I had no idea that after all those years, we could utilize DNA to achieve such significant discoveries. It's certainly fascinating, and it's made me realize how versatile genetics can be.

Source:

• *Old Dominion University*. (n.d.). Retrieved December 11, 2021, from https://www-nature-com.proxy.lib.odu.edu/articles/ng0195-9.pdf.