

Part I: History

1. The Romanov's in Russian history were the last ruling Russian imperial family that ruled for 300 years before the Bolshevik Revolution in February of 1917 from 1613-1917.
2. The Romanov lineage from 1613-1917 includes the following reigning monarchs after the accession of the first Romanov tsar Michael I in 1613 to the Romanov's demise in 1917: Elizabeth (1741-1761), Catherine II (1762-1796), Paul I (1796-1801), Alexander I (1801-1825), Nicholas I (1825-1855), Alexander II (1855-1881), Alexander III (1881-1894), and Nicholas II (1894-1917). The last ruling Russian monarch, Tsar Nicholas II, and his wife Tsarina Alexandra Feodorovna or Alix of Hesse had four daughters (grand duchesses) in the names of Olga, Tatiana, Maria, and Anastasia as well as one son named Alexei (Tsarevich).
3. Nicholas II had the title of tsar, which carries the meaning of a male Russian ruler, monarch, emperor, or king.
4. Following the Bolshevik Revolution in 1917, Nicholas II abdicated his crown as an offer to his brother, Grand Duke Michael, who declined the offer, and Nicholas II and his family were exiled in Yekaterinburg, Russia. From a geopolitical perspective, Nicholas II was forced to abdicate his crown because of his ineffective leadership as a strict autocrat and revolutionary forces in the February revolution of 1917. The devastating events of the Russo-Japanese War led to the Russian Revolution of 1905 in which Nicholas II signed a manifesto for a more just ruling of a representative government and civil liberties in Russia that satisfied the revolutionary groups at that time. However, Nicholas II did not fulfill his agreements in the manifesto, so the Bolsheviks and other revolutionary groups gained support. In 1914, Nicholas II led Russia into another devastating war (World War I) with many losses and ineffective leadership. Public support for Nicholas II eroded and many riots ensued with revolutionary groups. Nicholas II's demise came about in March 1917 when the army garrison at Petrograd joined striking workers in support of socialist reforms, so Nicholas II was forced to abdicate his crown as he could not meet those demands or be supported in his ruling against revolutionary forces. After Nicholas II abdicated his crown, a provincial government was installed to replace him. In November 1917, the Bolshevik revolutionaries led by Vladimir Lenin took control of the government.
5. Nicholas II's family consisted of his wife Alexandra Feodorovna or Alix of Hesse and their children by the names of Olga, Tatiana, Maria, Anastasia, and Alexei. After Nicholas II and his family were exiled to Yekaterinburg, Russia, they and their servants were executed by the Yekaterinburg Soviet forces or the Bolsheviks in July 1918 in the cause of the working class and socialist reforms. Nicholas II, his wife, and three of their children were found in a mass grave in 1991. Nicholas II's son Alexei and daughter Maria were found in another grave in 2007.

Additional sources used:

Blakemore, E. (2019). Why Czar Nicholas II and the Romanovs were murdered. HISTORY.

<https://www.history.com/news/romanov-family-murder-execution-reasons>

History.com editors. (2023). Czar Nicholas II abdicates Russian throne. HISTORY.

<https://www.history.com/this-day-in-history/czar-nicholas-ii-abdicates>

The Museum of Russian Art. (2015). Romanov family tree. <https://tmora.org/online-exhibitions/dinner-with-the-tsars-russian-imperial-porcelain/introduction/romanov-family-tree/>

Part II: Hemophilia

6. Nicholas II's wife, Alix, is Queen Victoria's granddaughter. According to the pedigree chart, the line of descent is drawn from the first generation of Queen Victoria and her mating line to Prince Albert to the second generation representing her daughter Alice. Alice's mating line to Louis IV has a line of descent tracing to the third generation representing Alix as the daughter of Alice and the granddaughter of Queen Victoria.

7. Hemophilia is a group of bleeding disorders that inhibit the blood clotting process. The two forms of hemophilia are hemophilia A (factor VIII deficiency) and hemophilia B (factor IX deficiency). When a hemorrhage or wound forms, a coagulation cascade forms to aid in blood clotting that requires coagulation or clotting factor proteins. Hemophilia causes excess bleeding when one or more factors are deficient, missing, or nonfunctional. Hemophilia could be mild with symptoms apparent following surgery or an injury involving open wounds. Hemophilia could be more severe with an abnormal bleeding episode or spontaneous bleeding including internal bleeding and bleeding into joints. Hemophilia can be lethal in a small number of cases of severe bleeding. Source: Penn Medicine

8. Hemophilia B is represented in the pedigree chart. When Tsarevich Alexei/Alexis was found in a grave in 2007, his DNA was obtained, and modern genetic technology found he had a substitution mutation on his X chromosome in the splice acceptor site of exon 4 in the F9(factor IX) gene. Alexei had a lack in factor IX protein that is responsible for hemophilia B.

9. Alexei genetically acquired hemophilia from his hemophiliac carrier mother Alix through a mutated X-linked recessive allele of factor IX that is represented as "h."

10. Only males in the pedigree chart can have hemophilia with a hemophiliac carrier mother giving her sons a 50% chance of inheriting her mutated X-linked recessive allele of factor IX. The hemizygous son(s) with one copy of the mutant allele will be a hemophiliac, whereas the daughter(s) cannot acquire two copies of the X-linked mutant allele with an unaffected father.

See all Punnett squares on the next page.

11. When an unaffected male and carrier female mate, they can have daughters who have a 50% chance of being unaffected with two copies of normal blood clotting factor or a 50% chance of being a carrier with a copy of a mutant X-linked recessive allele of factor IX from the carrier mother and a copy of a normal blood clotting factor from the unaffected father. In the situation of Leopold being a hemophiliac and Helene being unaffected, the daughters have a 100% chance of being hemophiliac carriers but not hemophiliacs due to Helene being unaffected with two copies of the normal blood clotting factor alleles. A daughter can only be a hemophiliac by a chance of 50% if a carrier mother in the pedigree chart mated with a hemophiliac male. **See all Punnett squares on the next page.**

12. Alexei's sisters can be determined to be carriers or homozygous for normal blood clotting factors with the use of Mendel's testcross. If a carrier sister mates with an unaffected

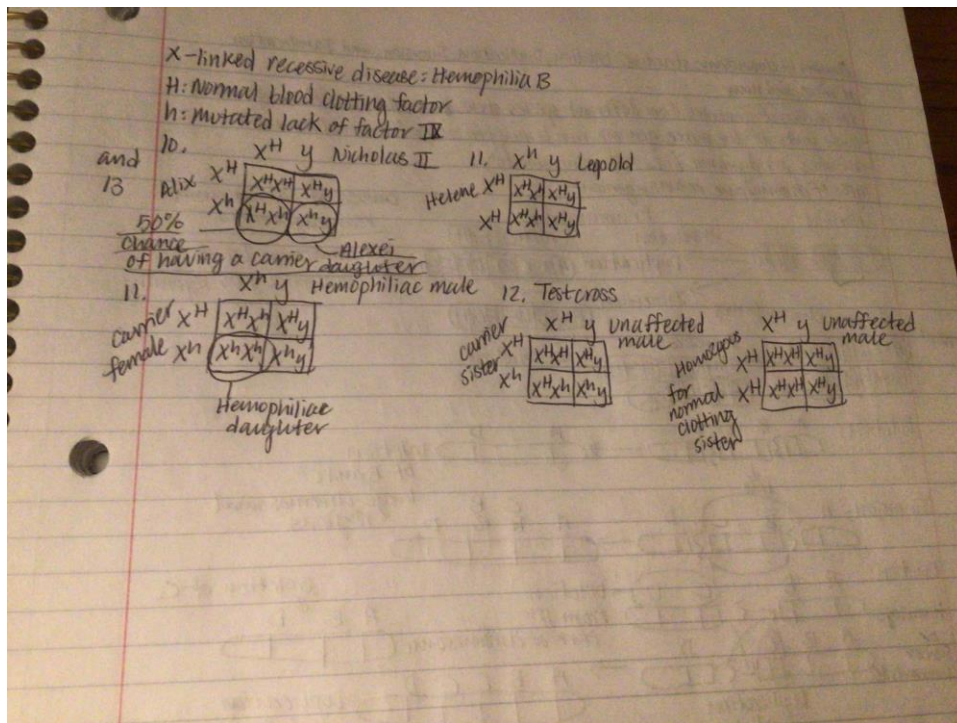
hemizygous male, her sons have a 50% chance of being hemophiliacs. If a sister that is homozygous for normal blood clotting factors mates with an unaffected hemizygous male, her sons have a 100% chance of being unaffected. **See all Punnett squares on the next page.**

13. The probability of a carrier mother and an unaffected father having a carrier daughter is 50% as the carrier daughter would inherit one copy of the mutant X-linked recessive allele of factor IX from her carrier mother.

14. The probability that a carrier mother and an unaffected father have 4 carrier daughters is $\frac{1}{2} * \frac{1}{2} * \frac{1}{2} * \frac{1}{2} = 0.0625$ probability of each event happening (product rule). This equates to a 6.25% chance.

15. None of Alexei's sisters had hemophilia because they have a 50% chance of being carriers or homozygous for normal blood clotting factors. This is due to the fact that females need two copies of the mutant X-linked recessive allele to be hemophiliacs while Alexei is hemizygous for the mutant X-linked recessive allele.

Punnett squares:



16. Alix believed Rasputin the mystic saved her son Alexei's life as she thought slight cuts would kill him with hemophilia. The public grew suspicious of Rasputin's power and historians believe this could have led to the Russian Revolution although Alexei's condition was kept hidden from the public. Historians believe this because the faith healer seemed to be an agent helping the Romanov's gain back the Russian monarchy against the Bolsheviks.

Source: Blakemore, E. (2019). Why Czar Nicholas II and the Romanovs were murdered. HISTORY. <https://www.history.com/news/romanov-family-murder-execution-reasons>

