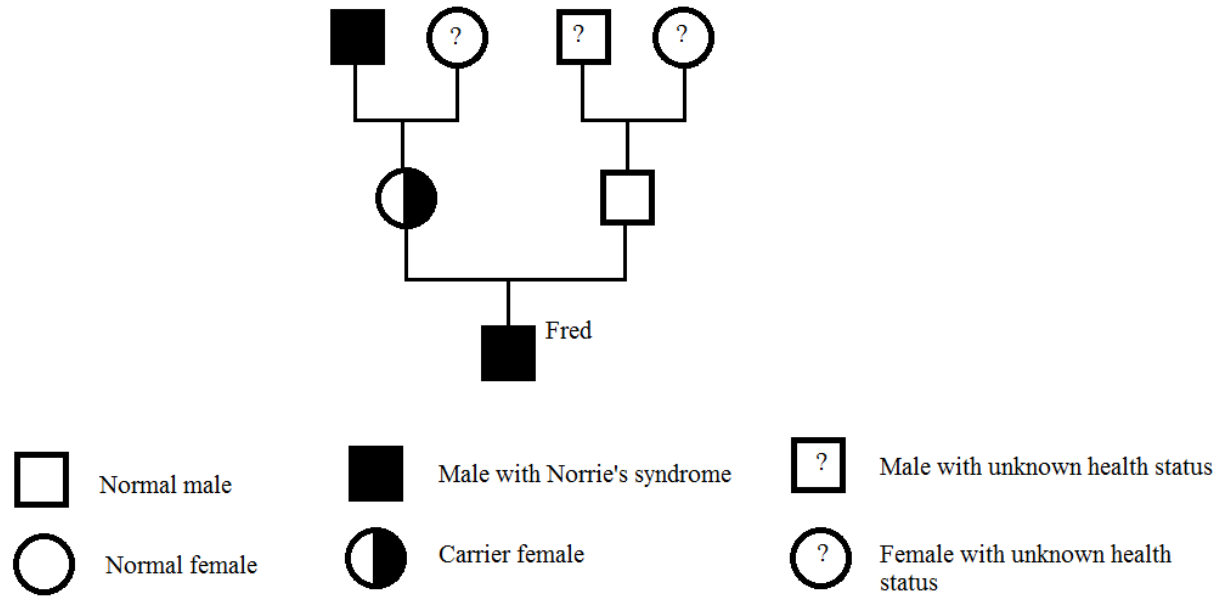
Question #66819, Biology / Genetics

Fred has Klinefelter syndrome (XXY) along with Norrie's syndrome, an X-linked recessive disorder which causes cataracts. Fred's mother and his father both do not have Norrie's syndrome. Fred's mother's father does have Norrie's Syndrome. Assuming Fred's Kleinfelter Syndrome arose from nondisjunction in meiosis, then identify the parent and specific meiotic division where the disjunction error most likely occurred. Explain your answer using a pedigree and diagram to show the nondisjunction.

Solution

As Norrie's syndrome is an X-linked recessive disorder, persons carrying two X chromosomes should have both of them affected. In addition, if male with single X chromosome does not suffer from the disease, he must carry X-chromosome with the normal copy of the gene. It means that Fred must have both X chromosomes with the disease allele, while Fred's father is unlikely to have the affected X chromosome and he did not donate it to Fred. At the same time, his mother's father was suffering from Norrie's syndrome. It means that he passed the affected X chromosome to his daughter, who is a carrier. Fred's mother has one normal X chromosome and one affected. Thus, non-disjunction occurred during the development of egg cell, and it was Fred's mother, who passed the affected chromosomes to him.

The following Pedigree chart can be created for the family:



As the chromosomes donated by Fred's mother were identical and both carried the disease allele, non-disjunction occurred, at the stage of meiosis, when identical structures are separated. It happens during meiosis II, when sister chromatids have to separate. It can be represented in the following way: