Chromosome Clues

Trace meiotic errors through karyotype evidence

BIO.3A.3 "Investigate chromosomal abnormalities (e.g., Down syndrome, Turner's syndrome, and Klinefelter syndrome) that might arise from errors in meiosis (nondisjunction) and how these abnormalities are identified (karyotypes)."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline each chromosome count in the passage and circle the chromosome pattern linked to each named condition. Use your marks to trace how a meiotic error can change a karyotype.

What a Chromosome Count Reveals

1. At a genetics clinic, a lab technician arranges the chromosomes from one cell into a karyotype, an ordered display that makes chromosome counts visible. Most human body cells have 46 chromosomes in 23 pairs. Meiosis usually makes eggs or sperm with 23 chromosomes each. If chromosomes fail to separate in meiosis, an error called nondisjunction, one gamete may receive 24 chromosomes and another may receive 22. When either joins a typical 23-chromosome gamete, the resulting cell can have 47 or 45 chromosomes. A karyotype can show the count, but not which parent supplied the unusual gamete.

2. Imagine three reports on the technician's desk. One karyotype shows 47 chromosomes, including three copies of chromosome 21. This pattern is trisomy 21, also called Down syndrome. A second shows 45 chromosomes with just one X chromosome and no second sex chromosome. This pattern is Turner syndrome. A third shows 47 chromosomes with two X chromosomes and one Y chromosome. This pattern is Klinefelter syndrome. Each pattern can begin when nondisjunction produces a gamete with an extra chromosome or a missing one. The chromosome pattern helps identify a condition, but a karyotype does not predict every person's health or abilities.

3. To read a report, start with the total and then inspect the chromosome involved. A total of 47 does not, by itself, name a condition: an extra chromosome 21 differs from an extra sex chromosome. Likewise, a total of 45 needs more detail before a condition can be identified. A typical karyotype also cannot reveal whether the error occurred during the first or second division of meiosis. It records the chromosomes present in the sampled cells, not the exact path that produced them. This distinction matters when explaining what the evidence supports and what remains unknown.

2 ANSWER WITH EVIDENCE

Use the passage

1. A report shows 47 chromosomes, including three copies of chromosome 21. Which condition does this identify, and what gamete count could explain the total?

2. A report shows 45 chromosomes with one X and no second sex chromosome. Identify the condition and explain how a gamete with 22 chromosomes could produce this count.

3. Down syndrome and Klinefelter syndrome can both appear in reports with 47 chromosomes. What chromosome evidence distinguishes them?

4. If a karyotype shows a chromosome pattern caused by nondisjunction, can it identify which meiotic division went wrong? Explain using the passage.

3 YOUR TURN

Your own words

An early embryo's cell has 47 chromosomes, including three copies of chromosome 12 and the sex chromosomes X and Y. In three sentences, explain a possible meiotic error and gamete counts, state what the karyotype establishes, and name one conclusion it cannot support.

ANSWER KEY

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HIGH SCHOOL · BIO.3A.3

PART 1 · READ AND MARK

Underline each chromosome count in the passage and circle the chromosome pattern linked to each named condition. Use your marks to trace how a meiotic error can change a karyotype. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	A report shows 47 chromosomes, including three copies of chromosome 21. Which condition does this identify, and what gamete count could explain the total?	**Down syndrome. A gamete with 24 chromosomes could have joined a typical gamete with 23.**
2	A report shows 45 chromosomes with one X and no second sex chromosome. Identify the condition and explain how a gamete with 22 chromosomes could produce this count.	**Turner syndrome. A gamete missing a sex chromosome could have joined a typical 23-chromosome gamete, producing 45 chromosomes.**
3	Down syndrome and Klinefelter syndrome can both appear in reports with 47 chromosomes. What chromosome evidence distinguishes them?	**Down syndrome has three copies of chromosome 21. Klinefelter syndrome has two X chromosomes and one Y chromosome.**
4	If a karyotype shows a chromosome pattern caused by nondisjunction, can it identify which meiotic division went wrong? Explain using the passage.	**No. A typical karyotype shows the chromosomes present in sampled cells, not whether the error occurred in the first or second meiotic division.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

Nondisjunction could have made a gamete with 24 chromosomes, including an extra chromosome 12, that joined a typical gamete with 23. The karyotype establishes that the sampled cell has 47 chromosomes, three copies of chromosome 12, and X and Y sex chromosomes. It cannot show which parent supplied the extra chromosome or which meiotic division went wrong.

Accept either parent as the possible source of the 24-chromosome gamete. Do not accept a named condition based only on the passage's chromosome 12 pattern.