Two Kinds of Change

Evaluate what evidence can show about chromosomes and traits

BIO.12.b "Obtain, evaluate, and communicate information about how errors during meiosis and environmental factors affect the expression of traits."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the steps linking a meiosis error to an extra chromosome, circle statements linking sunlight to skin color, and number the two claims that go beyond the evidence.

What Changed for Ari?

1. A school science club reads a fictional clinic report about Ari, whose cells contain 47 chromosomes, including three copies of chromosome 21. Most people have 46 chromosomes, with two copies of chromosome 21. During meiosis, the cell division that makes eggs and sperm, chromosome pairs should separate so each reproductive cell gets one copy. If chromosome 21 fails to separate, an egg or sperm can carry an extra copy. After fertilization, the resulting embryo may have three copies, a condition called trisomy 21. A chromosome-count test supports the extra-copy finding, but it cannot by itself show which parent's meiosis had the error.

2. The club also notices that Ari's forearm looks darker in a photo taken after a summer of outdoor work than in a winter photo. Sunlight contains ultraviolet radiation, which can signal skin cells to make more melanin, a pigment. Genes help regulate melanin production, but exposure can change how much pigment those cells make. A darker appearance does not mean Ari gained a chromosome or changed the DNA sequence of a pigment gene. Lighting and camera settings could also change how dark skin appears in photographs. Comparing skin under the same lighting would make the evidence about pigment stronger.

3. One club member argues that sunlight caused Ari's extra chromosome because the summer photo shows darker skin. Another says the chromosome-count result proves sunlight has no effect on any trait. Both claims go beyond the evidence. The chromosome result identifies a chromosome difference consistent with an error during meiosis, while repeated skin observations under matched lighting could support a change associated with sun exposure. Neither kind of evidence shows that sunlight caused the extra chromosome. To investigate that claim, researchers would need evidence about exposures before the egg or sperm formed and about meiosis itself. Different causes can influence different traits in the same person.

2 ANSWER WITH EVIDENCE

Use the passage

1. How could an error during meiosis lead to Ari having three copies of chromosome 21?

2. Why does the summer photo alone provide weak evidence that Ari's skin made more melanin?

3. A club member says Ari's chromosome-count result proves sunlight cannot affect any trait. How does the passage challenge that claim?

4. What evidence would researchers need to investigate the claim that sunlight caused Ari's extra chromosome?

3 YOUR TURN

Your own words

A rabbit has dark fur on its cool ears and pale fur on its warm back; in this breed, temperature affects a pigment-making enzyme. A separate rabbit has an extra chromosome in its cells. Write five sentences comparing the evidence for each observation, explaining how a meiosis error could produce the extra chromosome, and stating what the fur pattern cannot establish.

Two Kinds of Change

PART 1 · READ AND MARK

Underline the steps linking a meiosis error to an extra chromosome, circle statements linking sunlight to skin color, and number the two claims that go beyond the evidence. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How could an error during meiosis lead to Ari having three copies of chromosome 21?	**If chromosome 21 fails to separate during meiosis, an egg or sperm can carry an extra copy. After fertilization, the embryo may have three copies.**
2	Why does the summer photo alone provide weak evidence that Ari's skin made more melanin?	**Lighting or camera settings could make the skin appear darker. Observations under matched lighting would provide stronger evidence.**
3	A club member says Ari's chromosome-count result proves sunlight cannot affect any trait. How does the passage challenge that claim?	**The test shows an extra chromosome, but it does not test sunlight's effects on traits. Sunlight can affect melanin production.**
4	What evidence would researchers need to investigate the claim that sunlight caused Ari's extra chromosome?	**They would need evidence about exposures before the egg or sperm formed and about meiosis itself. Ari's photos and chromosome count do not establish that cause.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The first rabbit's cool ears have dark fur, while its warm back has pale fur, consistent with temperature affecting pigment production. Comparing the ears and back provides evidence of a link between temperature and fur color, though genes also affect the enzyme. The other rabbit's extra chromosome could have come from a chromosome pair failing to separate during meiosis in a parent. A chromosome-count test supports the extra-copy finding but does not show when the error occurred. The first rabbit's fur pattern cannot establish what caused the other rabbit's extra chromosome.

Accept explanations that distinguish evidence of an extra chromosome from evidence of an environmental effect on pigment. An extra chromosome is consistent with a meiosis error, but a chromosome count alone does not establish when the error occurred.