Tracing Cancer Risk

Read, mark, and evaluate a model of melanoma risk.

BIO.11.b "Obtain, evaluate, and communicate information about how the interplay of heritable risk factors, somatic mutations, and environment influences human disease."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the inherited risk factor, circle the environmental source of DNA damage, and number the steps from DNA damage to a possible tumor. Use your marks to trace how the factors interact.

Two Siblings, Different Outcomes

1. Two siblings, Ana and Luis, inherit the same altered copy of CDKN2A, a gene that helps keep cell division under control. This inherited variant is present in cells throughout their bodies and raises their risk of melanoma, a cancer that begins in pigment-making skin cells. It does not mean either sibling will develop cancer. A melanoma usually involves additional changes that arise in particular skin cells during life. These acquired changes are called somatic mutations. Unlike the inherited variant, a somatic mutation in one skin cell is not passed from parent to child.

2. At 24, Ana works outdoors and often skips sun protection. Luis usually works indoors and covers his skin during long days outside. Ultraviolet (UV) radiation from sunlight can damage DNA in exposed skin cells. If a cell accumulates somatic mutations that disrupt controls on division, it may multiply into a tumor. Their inherited variant makes the control system less effective, while UV exposure can add new DNA damage. These influences can interact, but protection reduces exposure rather than erasing inherited risk. UV can also raise melanoma risk in someone without this inherited variant.

3. Years later, Ana is diagnosed with melanoma, while Luis has not developed it. Their different experiences fit the idea that inherited risk and UV exposure both matter, but two siblings cannot prove that UV caused Ana's cancer. Chance, other genes, and unrecorded exposures may differ between them. A clinician could compare each sibling's sun history and medical records, but those records alone cannot identify every mutation that led to a tumor. This case is a model of risk, not a prediction: an inherited variant changes the odds, environmental exposure may cause damage, and somatic mutations can help drive disease.

2 ANSWER WITH EVIDENCE

Use the passage

1. Suppose a mutation appears in one of Ana's skin cells during her life. How would it differ from the CDKN2A variant she inherited?

2. Explain how Ana's inherited variant and UV exposure could work together to raise her melanoma risk.

3. Do the siblings' different outcomes prove that UV caused Ana's melanoma? Use evidence from the passage to explain.

4. If Luis later develops melanoma despite covering his skin outdoors, would that contradict the passage's model? Explain.

3 YOUR TURN

Your own words

Imagine a person inherits a variant that weakens DNA repair, often breathes radon gas that damages DNA, and later develops a lung tumor with a new mutation in its cells. In three or four sentences, explain how these factors could interact and why this story alone cannot prove what caused the tumor.

Tracing Cancer Risk

PART 1 · READ AND MARK

Underline the inherited risk factor, circle the environmental source of DNA damage, and number the steps from DNA damage to a possible tumor. Use your marks to trace how the factors interact. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Suppose a mutation appears in one of Ana's skin cells during her life. How would it differ from the CDKN2A variant she inherited?	**The new mutation would be somatic and limited to that cell and its descendants. Ana inherited the CDKN2A variant, which is present in cells throughout her body.**
2	Explain how Ana's inherited variant and UV exposure could work together to raise her melanoma risk.	**The inherited variant makes control of cell division less effective. UV can damage DNA in skin cells, adding opportunities for somatic mutations that disrupt division and may lead to a tumor.**
3	Do the siblings' different outcomes prove that UV caused Ana's melanoma? Use evidence from the passage to explain.	**No. Ana had more UV exposure and developed melanoma, but chance, other genes, or unrecorded exposures may also have differed between the siblings.**
4	If Luis later develops melanoma despite covering his skin outdoors, would that contradict the passage's model? Explain.	**No. Covering his skin reduces UV exposure but does not erase his inherited risk or rule out somatic mutations.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

The inherited variant could make it harder for the person's cells to repair damaged DNA. Breathing radon could add DNA damage in lung cells. A somatic mutation in one of those cells could then help it grow into a tumor. The story does not prove radon caused the tumor because other exposures or chance could have contributed.

Accept models that distinguish an inherited risk factor from a mutation acquired in tumor cells and describe radon as a possible source of DNA damage. Responses should treat the proposed cause as uncertain, not proven.