AP Bio FRQ Fridays

2019 #3
Cellular Respiration (PDC)

FRQ Friday #8

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The pyruvate dehydrogenase complex (PDC) catalyzes the conversion of pyruvate to acetyl-CoA, a substrate for the Krebs (citric acid) cycle. The rate of pyruvate conversion is greatly reduced in individuals with PDC deficiency, a rare disorder.

(a) **Identify** the cellular location where PDC is most active.

Identification (1 point)

- Mitochondria
- Mitochondrial matrix

a. PDC is most active in a cell's mitochondria.

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(b) **Make a claim** about how PDC deficiency affects the amount of NADH produced by glycolysis AND the amount of NADH produced by the Krebs (citric acid) cycle in a cell. **Provide reasoning** to support your claims based on the position of the PDC-catalyzed reaction in the sequence of the cellular respiration pathway.

(1 point per row; 2 points max.)

	Claim	Reasoning
Glycolysis	No change	• Glycolysis continues; PDC is not needed. • Glycolysis occurs before conversion of pyruvate to acetyl-CoA.
Krebs cycle	Decrease	• The Krebs cycle is greatly reduced/slowed down if there is no/less acetyl-CoA. • The Krebs cycle occurs after conversion of pyruvate to acetyl-CoA.

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b. A PDC deficiency does not change the amount of NADH produced [redacted] by glycolysis, but it decreases the amount of NADH produced in the Krebs cycle. This occurs because the PDC-catalyzed reaction to make acetyl CoA occurs after glycolysis, leading to no impact, and before the Krebs cycle. Without acetyl CoA, the Krebs cycle cannot occur, so a PDC deficiency would halt all NADH production in this step.

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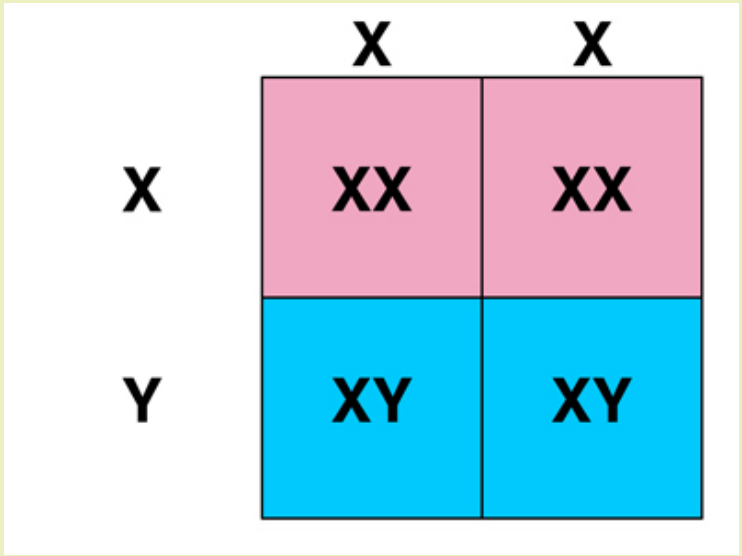
(c) PDC deficiency is caused by mutations in the *PDHA1* gene, which is located on the X chromosome. A male with PDC deficiency and a homozygous female with no family history of PDC deficiency have a male offspring. **Calculate** the probability that the male offspring will have PDC deficiency.



Calculation (1 point)

- The probability of inheritance is 0.
- The offspring cannot/will not have PDC deficiency.

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Calculation (1 point)

- The probability of inheritance is 0.
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c. Male - X^mY, where m= mutation

Female - XX

X X

X^m X^mX X^mX

Y XY XY

There is a 0% probability that a male offspring will have PDC deficiency.