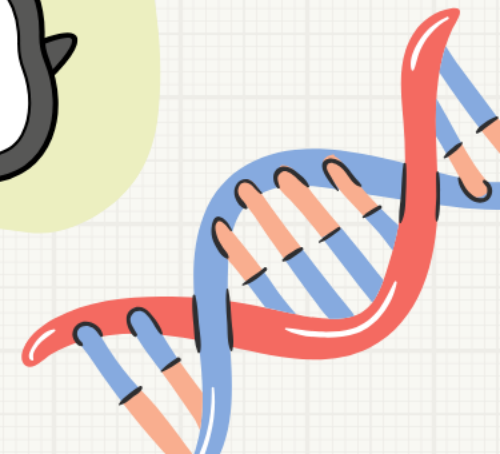
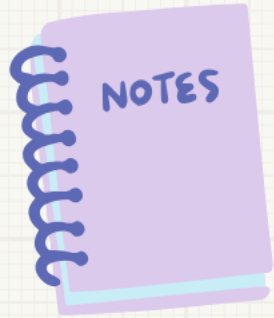
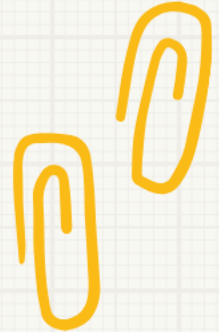




# AP Bio FRQ Fridays

2022 #3  
Enzymes & Experimental Design



# FRQ Friday #18

2022 #3

Fireflies emit light when the enzyme luciferase catalyzes a reaction in which its substrate, D-luciferin, reacts to form oxyluciferin and other products (Figure 1). In order to determine the optimal temperature for this enzyme, scientists added ATP to a solution containing D-luciferin, luciferase, and other substances needed for the reaction. They then measured the amount of light emitted during the first three seconds of the reaction when it was carried out at different temperatures.



Figure 1. Light is emitted as a result of the reaction catalyzed by luciferase.



# FRQ Friday #18

2022 #3

(a) Describe a characteristic of the luciferase enzyme that allows it to catalyze the reaction.

Accept one of the following:

- It has an active site/a shape that can bind with the substrate(s)/brings reactants together.
- It has a charge that is compatible with the substrate(s).

u.) A characteristic of the luciferase enzyme that allows it to catalyze the reaction is its specific active site. The enzyme's amino acids & their R-groups interact in such a way that gives luciferase its unique structure & active site so that its substrate fits into that active site & luciferase can catalyze the reaction by lowering its activation energy.



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2022 #3

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(b) Identify the dependent variable in the experiment.

- The amount of light emitted

b.) The dependent variable is the amount of light emitted during the first three seconds of the reaction.



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2022 #3

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(c) State the null hypothesis for the experiment.

- Temperature has no effect on the amount of light emitted.

c.) The null hypothesis is that temperature has no impact on the amount of light emitted by the reaction.



# FRQ Friday #18

2022 #3

Fireflies emit light when the enzyme luciferase catalyzes a reaction in which its substrate, D-luciferin, reacts to form oxyluciferin and other products (Figure 1). In order to determine the optimal temperature for this enzyme, scientists added ATP to a solution containing D-luciferin, luciferase, and other substances needed for the reaction. They then measured the amount of light emitted during the first three seconds of the reaction when it was carried out at different temperatures.

(d) A student claims that, as temperature increases, there will be an increase in the amount of light given off by the reaction in the first three seconds. **Support** the student's claim.

Accept one of the following:

- Higher temperature increases the frequency of collisions/interactions between molecules, resulting in an increase in reaction rate.
- The higher temperature results in a change to the active site that enhances substrate binding.



# FRQ Friday #18

2022 #3

(d) A student claims that, as temperature increases, there will be an increase in the amount of light given off by the reaction in the first three seconds. **Support** the student's claim.

Accept one of the following:

- Higher temperature increases the frequency of collisions/interactions between molecules, resulting in an increase in reaction rate.
- The higher temperature results in a change to the active site that enhances substrate binding.

d) With an increase in temperature, substrate molecules have more kinetic energy, so they move around more & faster, making it more likely that a substrate molecule will bump into or get pushed into the luciferase enzyme, bind to the enzyme's active site, undergo the reaction, & then emit light.

