

Name: _____ Period: _____ Date: _____

Open **peebedu.com** and navigate to **Enzyme Chaser**. You play an enzyme that never stops swimming. Drag anywhere or use the arrow keys to steer so a substrate enters your active site, where you break it into three products. Each of the six 30-second levels adds one condition, and the **numbered level buttons** on the title screen start any of them.

Free Response Questions

Question 1: Conceptual Analysis

Game Task: *Play Level 5 (Hot and cold) and read its instructions. Swim through a COLD zone, normal water (outside every zone) and the orange outer ring of a HOT zone (not its red TOO HOT center). In each, note your enzyme's shape, how fast molecules and your enzyme move, and whether you can still break substrates. Then swim into a TOO HOT center and try to break a substrate. Record what happens to your enzyme's shape, the message at the top of the screen, and the products counter. (Green noncompetitive inhibitors are a little faster than you, so start these checks right after the countdown and swim straight from zone to zone. If an inhibitor binds first, or you touch TOO HOT too soon, choose Play again when the level ends.)*

(A) (1 pt) **Describe** the relationship between the water temperature (COLD, normal water, HOT, TOO HOT) and enzyme activity, using what the game showed and told you: how fast molecules moved, how often enzyme and substrate met, and whether products could still form.

(B) (1 pt) **Explain** why reaction rate increases as the enzyme moves from COLD to normal to HOT water, but then sharply decreases in the TOO HOT center, where the temperature is beyond its optimum.

(C) (1 pt) **Predict** what would happen to the rate of protein digestion in the stomach of an ectothermic predator if its body temperature dropped significantly due to a sudden decrease in environmental temperature.

(D) (1 pt) **Justify** your prediction.

Question 2: Analyze Model / Visual Representation

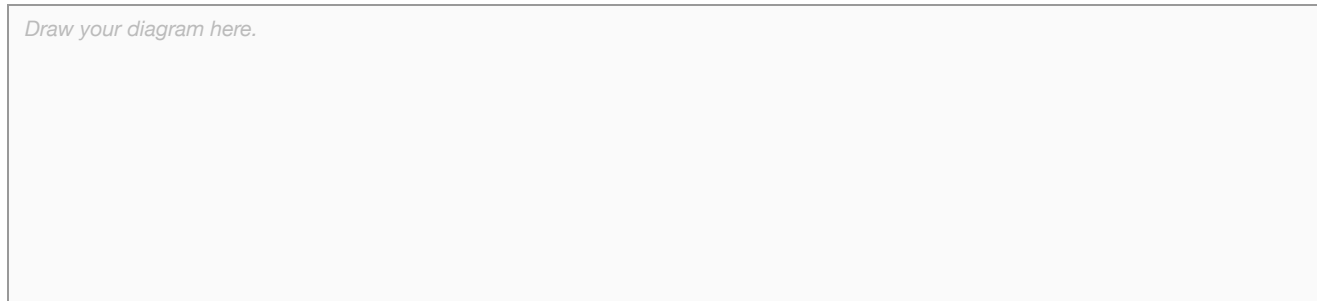
Game Task: Play Level 6 (Acid and base). Early in the level, while no message shows at the top of the screen, swim into the ACID or BASE zone and try to break a substrate there, watching your enzyme's shape and the message. Swim back into normal water, wait a moment, and note whether your enzyme recovers its shape and can form products again. Next, swim into a TOO HOT center, then back out to normal water, wait a few seconds, and note whether your enzyme recovers this time. (If an inhibitor binds before you finish the ACID or BASE check, or you touch a TOO HOT center too soon, choose Play again when the level ends.) In the game, heat damage always lasts for the rest of the level and acid or base damage always wears off once the enzyme is back in water at the right pH. Real enzymes can sometimes recover from a change in temperature or pH, but often not from a severe one.

(A) (1 pt) **Describe** what happens to an enzyme's catalytic function when its three-dimensional shape is disrupted by an environmental change.

(B) (1 pt) **Explain** why the enzyme regains its activity when it swims out of the ACID or BASE zone back into normal water after a temporary change in pH.

(C) (1 pt) **Represent** the effect of extreme heat on an enzyme by drawing a labeled diagram of the same enzyme at its optimal temperature and at a temperature well above its optimum, with the active site shown in each state.

Draw your diagram here.



(D) (1 pt) **Explain** how the interactions that hold a protein in its tertiary shape account for an enzyme losing its activity at high temperature.

3.2.A.1, 3.2.A.2