Enzyme controlled reactions answers

Plants make their own food using photosynthesis. Food is important for plants and organisms that feed on plants. Optimal photosynthesis rates produce maximum plant yields. First, an enzyme is a specific protein with a unique form. The main purpose of an enzyme is to catalyze a reaction. This means that the reaction is accelerated, but concentrations of reagents or products are unchanged. An enzyme will only react with a substrate, so these reactions are very specific. There are two main ways in which the enzyme and substrate interact 1) Lock and the hypothesis of key 2) Induced adjustment hypothesis The first is when the substrate shape fits precisely into the ENZYME ACTIVATION SITE. As competitors have also been found to initiate enzymatic reactions, the substrate and enzyme may be somewhat flexible, which means an induced adjustment model. Then: E+ S -> ES. This, however, is a very high energy reaction and therefore needs a huge input of energy. This is called activation energy. The transition state formed is in greater energy than substrates or products. Hydrogen peroxide (H2O2) is a byproduct of respiration and is done in all living cells. Hydrogen peroxide is harmful and should be removed as soon as it is produced in the cell. Cells make the catalase enzyme to remove hydrogen peroxide. This research analyzes the rate of oxygen production by catalase in pure potatoes as the concentration of hydrogen peroxide varies. Oxygen produced in 30 seconds is collected over water. Then the reaction rate is calculated. Class Organization You could perform this research as a demonstration at two different concentrations, or with groups of students each working with a different concentration of hydrogen peroxide. Individual students can then take time to collect repeated data. Groups of three could work to collect results for 5 different concentrations and rotate the roles of device handler, result reader and scribe. The performance and comparison of class results allows students to search for anomalous and inconsistent data. Pneumatic cochlear appliances and chemicals/plastic bowl/access to proper sink of conical water bottle, 100 cm3, 2 syringe (2 cm3) to fit the second hole of the rubber bung, 1 measuring cylinder, 100 cm3, 1 measuring cylinder, 50 cm3, 1 clamp holder, head and clamp, 2 Stopwatch/peroxide hydrogen stopwatch, concentration range, 10 vol, 15 vol, 20 vol, 25 vol and 30 vol, 2 cm3 per group of each concentration (Note 1) Pure, fresh potato, beaker with syringe to measure at least 20 cm3, 20 cm3 per group per concentration per (Note 2) Bung 2-fured, to fit conical vials of 100 cm3 – delivery tube in a hole (connected to rubber tubes of 50 cm) Health & Safety and Technical notes Use eye protection and cover clothing when handling hydrogen peroxide. Wash puree splashes puree peroxide of the skin immediately. Be aware of increased pressure if the reaction vessels become blocked. Be careful when inserting the bung into the tapered bottle – it needs to be a tight fit, so push and twist the bung carefully. Read our standard health & safety guidance 1 Hydrogen peroxide: (See CLEAPSS Hazcard) Solutions smaller than 18 vol are LOW HAZARD. Solutions at concentrations of 18-28 vol are IRRITATING. Take care when removing the cap from the reagent vial, as the gas pressure may have accumulated inside. Dilute immediately before use and put in a clean brown bottle, as the dilution also dilutes the decomposition inhibitor. Keep in brown bottles because hydrogen peroxide degrades faster in light. Discard any unused solution. Do not return the solution to the stock bottles, as contaminants may cause decomposition and the stock bottle may explode after a while. 2 Pure potato can irritate some people's skin. Make cool for each lesson, as catalase activity visibly reduces more than 2/3 hours. You may need to add water to make it less viscous and easier to use. Potato discs react very slowly. 3 If the bubbles in the rubber pipe are too large, insert a glass pipette or glass tube into the end of the rubber tube. PROCEDURE SAFETY: Use eye protection and protect clothes from hydrogen peroxide. Rinse peroxide and pure potato spatter from the skin as soon as possible. Prepare a hydrogen peroxide diluted enough just before the lesson. Arranged in brown bottles (Note 1). b Make fresh pure potatoes for each lesson (Note 2). c Comcommake 2-fured bungs as described in the list of appliances and in the diagram. Investigation d Use the large syringe to measure 20 cm3 of pure potato in the conical jar. and Place the bung safely in the bottle - twist and push carefully. f Fill the trough, bowl or sink with water. g Fill the measuring cylinder of 50 cm3 with water. Invert it over the water trough, with the open end under the surface of the water in the bowl, and with the end of the rubber pipe on the measuring cylinder. Staple in place. h Measure 2 cm3 of hydrogen peroxide in the 2 cm3 syringe. Place the syringe in place on the bung of the bottle, but do not push the plunger immediately. i Check that the rubber tube is secured in the measuring cylinder. Push the plunger into the syringe and immediately start the stopclock. j After 30 seconds, observe the volume of oxygen in the measuring cylinder in an appropriate table of results. (Note 3.) k Empty and rinse the tapered bottle. Measure another 20 cm3 pure potato. Reassemble the appliance, fill the measuring cylinder and repeat from g to j with another concentration of hydrogen peroxide. Use a 100 cm3 measuring cylinder for peroxide concentrations of above 20 vol. l Calculate the oxygen production rate in cm3/s.m Plot a graph of the oxygen production rate against hydrogen peroxide. Teaching notes Note the units to measure the concentration of hydrogen peroxide – these are not SI units. Hydrogen peroxide of 10 vol will produce 10 cm3 of oxygen from each cm3 that decomposes. (Note 1.) In this procedure, 2 cm3 of hydrogen peroxide of 10 vol will release 20 cm3 of oxygen if the reaction is completed. 2 cm3 of liquid is added to the bottle each time. Thus, if the appliance is free of leaks, 22 cm3 of water should be displaced in the measuring cylinder with hydrogen peroxide of 10 vol. Oxygen is soluble in water, but dissolves only slowly in water at normal ambient temperatures. Use this information as a check on the practical configuration. Values below 22 cm3 show that oxygen has escaped, or hydrogen peroxide has not fully reacted, or the concentration of hydrogen peroxide is not as expected. Invite students to explain how values above 22 cm3 can happen. A 0.± 0.05 cm3 error in measuring 30 vol hydrogen peroxide could make a ± 1.5 cm3 error in oxygen production. The liver also contains catalase, but the handling of asines is more controversial with students and introduces a higher risk of hygiene. In addition, the reaction is so vigorous that mixing bubbles can take pieces of liver to the delivery tube. If collecting the gas over the water is complicated, and you have access to a 100 cm3 gas syringe, you could collect the gas instead. Be sure to securethe gas syringe safely, but carefully. The reaction is exothermic. Students may notice the heat if they put their hands in the tapered jar. How will this affect the results? Health and Safety Verified, September 2008 Downloads Download the Student Sheet Investigating an Enzyme-Controlled Reaction: Concentration of Catalase and Hydrogen Peroxide (67 KB) with Questions and Answers Web Links Microscale Investigations with Catalase – which was transcribed for this site in The Catalase Activity Investigation in Different Plant Tissues. (Website accessed October 2011) 2011)

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