AP Biology
1999 Sample Student Responses

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1

1P1

Experimental Design

In order to test ~~xx~~ the effect of ~~environmental temperature~~ on light intensity, on the rate of photosynthesis, a controlled experiment must be set up. First, a hypothesis: If light intensity is changed, rate of photosynthesis will vary directly.

Set up ten vials, each under similar controls of temperature, height, wavelength of light, atmospheric conditions. Each vial should contain an equal amount of chloroplasts, obtained from blended spinach leaves dissolved in equal amounts of water. ~~These vials will perform photosynthesis.~~ Each vial will be subjected to a different wattage flourescent light bulb behind a glass wall. The wattages should range by equal intervals from 0 (no light) to 200 watts. This difference in light intensities will be the variable. The use of flourescent bulbs and the glass walls is to prevent heat created by the bulbs from skewing results. Each vial should be subjected to only the light from its bulb, each bulb set an equal distance from its vial. Each vial will also contain the substance DPIP, initially coloring the vials blue. DPIP will be our measuring device. First, measure the coloration of each vial initially (t=0) in a spectrometer, then turn on the lights. At 5 min. intervals, measure each vial's coloration in the spectrometer. As photosynthesis occurs, excited electrons will cause the DPIP to turn clear. So, the rate a vial turns clear directly correlates to the photosynthetic rate in the vial. Graph the rate of photosynthesis for each vial and compare results. The rate should steadily increase as light intensity increases, until leveling

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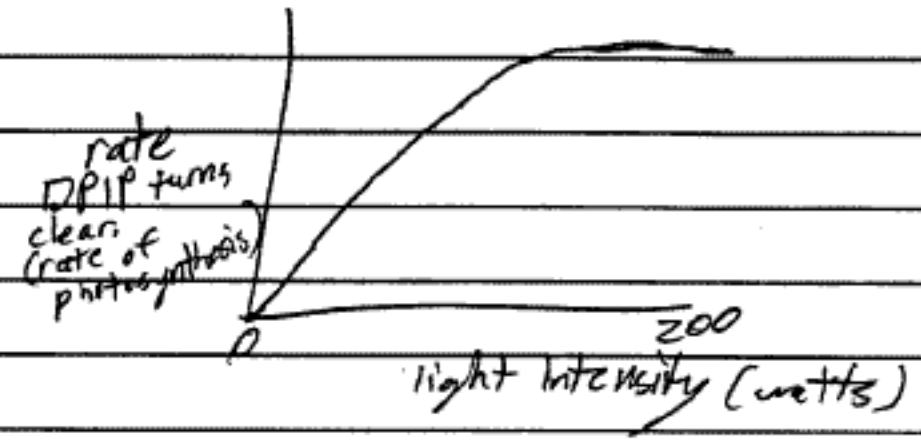
1P2

The leveling off indicates that light has ceased to be a limiting factor as chloroplasts ~~use up all the light they can~~ can only work so fast. ~~the~~ The experiment should be repeated, and multiple vials at each intensity would give more accurate and reliable results. The graph should look like this:



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1

1K

The rate of photosynthesis is affected by wavelength of light. To verify this fact an experiment could be done using test tubes of cyanobacteria in H_2O. The tubes would be stopped and a there would be a graduated collection tube to measure the amount of O_2 released. All test tubes would be prepared with the same number of bacteria and would be kept at the same temperature. A control tube would be exposed to normal sunlight. The other tubes would only be exposed to a certain wavelength of light. The rate of photosynthesis in each tube would be measured by the amount of O_2 produced. I would expect the rates of photosynthesis to be faster in red or blue light because those wavelengths are more readily absorbed by chlorophyll. The rate of photosynthesis, hence the amount of O_2 collected would be the lowest in green light wavelengths. Chlorophyll does not absorb green light. Therefore photosynthesis would take place at a very slow rate.

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1F

This expirimeint will determine the effect of enviornmental temperature in algea on the rate of photosynthesis. The first step would be to place all of one kiind of algea in a Lab. ~~For the~~ the first one could be placed under ideal conditions w/ a temperature of 32°F. The second could be placed under the temp. of 50°F & the same ideal conditions. The third could be placed under 70°F (same ideal conditions), & the fourth, 90°F (same ideal conditions). The rate of photosynthesis could be measured by how much O_2 ~~the~~ each plant gives off. After checking on the plants each day & giving them the same food & nutrients, after a week, it could be determined under which temp. photosynthesis occurred more rapidly. I would not expect the plants at the most extreme temps (30°F & 90°F) to carry out photosynthesis as rapidly as maybe the ones @ a more livable temp. It's hard for organisms to survive @ extreme temp. Just like ~~there~~ there are ideal conditions for humans to live in, there are ideal conditions for algea to live in. Transpiration could also help measure the rate of photosynthesis in algea.