Why are Plants Green?

Name \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Date \_\_\_\_\_\_\_\_\_\_\_\_\_Per \_\_\_\_

Introduction

A pigment is a molecule that absorbs light in the visible portion of the electromagnetic spectrum. The leaves of most plants are rich in pigments. These pigments absorb light and convert it into chemical energy to fuel the production of sugars. The primary photosynthetic pigment is *chlorophyll a*. Other pigments such as *chlorophyll b* and *carotenoids* are referred to as accessory pigments. These absorb light and funnel the energy to *chlorophyll a*.

Different pigments absorb different colors (wavelengths) of light. Some pigments might absorb blue light better than other wavelengths of light, for example. Others may absorb all of the colors well, or none.

A spectrophotometer is a machine used by scientists to measure the absorbance of light by substances. The better a pigment absorbs a color (wavelength) of light, the higher its percent of absorbance reading. The data in Table 7.1 show spectrophotometer readings for two plant chlorophylls.

**Table 7.1**

|  |  |  |
| --- | --- | --- |
| **Wavelength (nanometers)/Color** | **Chlorophyll *a* %Absorption** | **Chlorophyll *b* %Absorption** |
| 400 | 32 | 8 |
| 425 | 60 | 29 |
| 450 | 10 | 62 |
| 475 | 3 | 51 |
| 500 | 0 | 8 |
| 525 | 0 | 0 |
| 550 | 4 | 3 |
| 575 | 2 | 4 |
| 600 | 4 | 2 |
| 625 | 3 | 20 |
| 650 | 21 | 29 |
| 675 | 44 | 4 |
| 700 | 12 | 0 |

1. Study Table 7.1 and think about the experimental setup. What variable is being manipulated? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. What is the responding variable? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3. Explain how you know which variable is which. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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|  |  |  |
| --- | --- | --- |
| **color** | **wavelength interval** | **frequency interval** |
| [**red**](http://en.wikipedia.org/wiki/Red) | ~ 700–630 nm | ~ 430–480 THz |
| [**orange**](http://en.wikipedia.org/wiki/Orange_(colour)) | ~ 630–590 nm | ~ 480–510 THz |
| [**yellow**](http://en.wikipedia.org/wiki/Yellow) | ~ 590–560 nm | ~ 510–540 THz |
| [**green**](http://en.wikipedia.org/wiki/Green) | ~ 560–490 nm | ~ 540–610 THz |
| [**blue**](http://en.wikipedia.org/wiki/Blue) | ~ 490–450 nm | ~ 610–670 THz |
| [**violet**](http://en.wikipedia.org/wiki/Violet_(color)) | ~ 450–400 nm | ~ 670–750 THz |

4. Match the color of visible light with the wavelength range and record the color for each wavelength on the data table.

Remember:

speed of light = wavelength x frequency

…so red light has longest wavelength and lowest frequency while violet light has the shortest wavelength and highest frequency. Red light has relatively \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy than violet light which has relatively \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ energy than red light.

5. **Graph the data.** A. Label the axes. Put the units of measure inside parentheses. B. Make your scale fit the allotted grid paper space. Label the numbers at the origin and then space major numbers along the scale. Put in enough numbers to be easily read, but don’t clutter the scale with too many numbers crammed together.

C. Title the graph. Make sure the authors name (you!) and date are shown. 4. Use one color line for connecting the *chlorophyll a* points and another color for *chlorophyll b*. Label each line with the name of the chlorophyll.

6. Along the X axis use the colors VIBGYOR to shade in a rainbow along the matching wavelengths. In other words, put a color band along the wave numbers on the X axis so the reader can see the light color corresponding to the wavelengths. Blue is quite a large band of color. You can use a light blue near green and darker blue for the rest of the blue band shading into violet.

7. Based on the data and your graphs, what can you conclude about the two chlorophylls and their absorption spectra?

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8. Explain how the two spectra are similar. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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9. Explain how the two spectra are different. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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10. If some wavelengths of light are absorbed by chlorophylls; what happens to the other wavelengths that are not absorbed? Give any possibilities you can think of.

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11. What is white light composed of? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

12. White light is shining on a red object. The object is reflecting \_\_\_\_\_\_\_\_\_\_\_ light and absorbing \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

13. Chlorophylls are the predominant pigments in leaves. Based on the data and your graph, give a possible explanation for why plants are green.

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14. Based on the light absorption data, explain which color(s) of light are the most important for photosynthesis.

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15. How might you design an experiment to test your ideas in the last question? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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