Honors Biology Name _____

Photosynthesis Date _____

Theodor Engelmann's Experiment

Theodor Wilhelm Engelmann was a German scientist. In 1883, he performed his famous *action spectrum experiment* to learn which wavelengths (colors) of light were the most effective in carrying out photosynthesis in the green alga. He used a modified microscope equipped with a prism in order to produce the visible light spectrum on a microscope slide.

Engelmann used this device to illuminate a strand of filamentous photosynthetic algae with light from the visible spectrum, exposing different sections of the algae to different wavelengths (or colors of light). He added aerobic bacteria to this setup and noted where the bacteria accumulated in the greatest numbers to reveal which wavelengths work best for photosynthesis. He noted that the oxygen-dependent bacteria accumulated near the parts of the alga that were illuminated with red and blue light demonstrating that those are the wavelengths that work best for photosynthesis. How do we know this? The alga released more oxygen in the red and blue light as a result of a greater rate of photosynthesis. This greater concentration of oxygen allowed the aerobic bacteria to proliferate in these regions.

Summary:

1. Engelmann passed white light through a prism and exposed a filament of alga to the different wavelengths of the visible light spectrum.
2. He placed <u>aerobic</u> bacteria (require O_2) with the alga to determine which segments of the alga were performing the most photosynthesis and thus releasing the most oxygen.
3. The bacteria congregated in greatest numbers near the part of the alga that was exposed to the red and blue wavelengths.

Engelmann's experiment demonstrated that red and blue light are the most effective energy source for photosynthesis.

Absorption Spectra

An absorption spectrum is a graph showing the amount of light absorbed by the different wavelengths of light.

As you can see the absorption spectrum corroborates Engelmann's findings.

Note that there are 3 different pigments shown:

- Chlorophyll a → blue-green
- Chlorophyll b → yellow-green
- Carotenoids → yellows, oranges, reds

Carotenoids are accessory pigments whose primary function is photoprotection—to absorb and dissipate excess light energy to protect the chlorophyll from too much damaging light energy.
Humans have melanin which serves the same purpose.

Action Spectra

The action spectrum is graph showing the rate of photosynthesis at different wavelengths of light.

The rate of photosynthesis is based on a measure of the amount of CO_2 consumed or the amount of O_2 released.

As you can see the absorption spectrum also corroborates the work of Engelmann.

What wavelengths of light are most effective in driving photosynthesis?