

Chlorophyll Fluorescence Teachers Notes

Background Chemistry

Grinding the spinach leaves disrupts the normal structure of the leaf cells and releases 'chlorophyll a'. Normally, chlorophyll would absorb light energy that excites an electron which is then transferred to an acceptor molecule. However, in this experiment, the excited electron is not transferred anywhere and the energy is released again as light, i.e. an electron gets excited to a higher energy level by a photon of light and then releases it again when the energy is not transferred anywhere else.

Under normal lighting conditions, the solution appears green because the chlorophyll is absorbing red light from all directions. Under darkened conditions, the chlorophyll is absorbing red light from the torch and then releasing it again so we see the solution as red.

Relevance to solar energy

Quantum dots are also fluorescent because they absorb light and then re-emit it. However, if we build them into solar cells we can capture the energy before it gets re-emitted, just like a plant does with the energy absorbed by chlorophyll. This energy can then be converted into electrical energy.

Excitonic solar cells are often likened to plants because the mechanism used to generate electricity is a similar one to the process of photosynthesis. This is because they use a two-step process whereby the sunlight absorption is a separate step to charge separation, i.e. we absorb light first, then we separate the electron from the molecule to leave a hole. This is similar to photosynthesis.

In more traditional solar cells the light absorption and charge separation happen in the same step. By separating the steps it is easier to use the best material for each step (for example, the best absorbing dye and the best conducting material that easily separates charges) whereas in a combined step the material has to be able to do both jobs.

During the experimental

Other leaves containing chlorophyll will work, but spinach works particularly well.

If the filter paper does not hold in place in the funnel well, wet the paper with some acetone.

Links to the curriculum

- Light absorption
- Fluorescence
- Photosynthesis
- Plants
- Energy levels and electrons

Safety

Below is some general safety information for the chemicals used in this experiment. See appropriate Hazcards for more details.

Acetone (Propanone) - $(\text{CH}_3)_2\text{CO}$

- Emergency Harmful if swallowed: wash mouth with plenty of water and call for medical aid. Wash off skin with plenty of water. Flush out eye with plenty of water for 10 minutes and call for medical help.
- Protection Wear safety glasses.
- Disposal Dispose of with plenty of water down the sink.

References

This experiment was taken from the Renewable Energy Roadshow (www.renewableenergyroadshow.org) who adapted it from an activity described at <http://waynesword.palomar.edu/photosyn1.htm>.