Photosynthesis

As you know well from biology, all energy in biological systems ultimately comes from the sun. You know that "photosynthesis converts light energy into chemical energy", but what does that actually mean? We've spent plenty of time in this course unpacking what we mean by "chemical energy", and now you're going to investigate how light affects chemical energy and the other way around.

Photosynthesis is a complex process with many steps, but we're just going to focus on the first part: a photon (with a wavelength around 680 nm) is absorbed by a chlorophyll molecule in Photosystem II, and an electron is ejected from the photosystem (specifically from P680, a special chlorophyll molecule at the center of the photosystem). This electron goes to to another molecule which is the primary electron acceptor (and they're still debating exactly which molecule that is, but we won't worry about that here). That's as far as we'll go today. (After this, a whole lot of chemistry happens.)

1) First of all, just to review, what do we mean by "chemical energy"? Based on what you've done in this class, can "chemical energy" be explained in terms of other forms of energy? What does it mean for a system to have "more" or "less" chemical energy?

2) What is a possible explanation for why photons with wavelengths around 680 nm (red light) will get this process going, and other photons won't?

3) When a photon is absorbed by a chlorophyll molecule, an electron in the chlorophyll is excited, and then there are three possible things that could happen next:

- **Fluorescence:** The chlorophyll emits another photon.
- **Resonance transfer:** The chlorophyll excites an electron in a neighboring chlorophyll molecule. (How?)
- **Photochemistry:** The electron is ejected, and accepted by the primary electron acceptor.

As a group, draw diagrams illustrating each of these processes, to help visualize what's going on.

4) Let's start with just one of the processes: photochemistry. Draw energy bar charts for each step of the process. This requires defining your system and deciding on the number of steps and which forms of energy are relevant. (Note that in the How a Kinesin Walks activity you were given the steps as the "frames" of the "movie"; here you'll have to decide for yourselves what steps are worth representing.) Is the total energy conserved? (How can you tell?) Is there anything that can't be represented on the bar chart?

5) Repeat this for the other two processes (fluorescence and resonance transfer).