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| **Title of Unit** | Photosynthesis – How to harvest light | | | | |
| **Date and Approach for Unit Development** | July 23rd 2013 | | | | |
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| **Context** | A 200 level cell biology unit,  20 minutes  We would anticipate that a unit on photosynthesis would fit mid-way through a semester course in cell biology. The unit on capturing light energy would be part of a larger unit on photosynthesis. See first slide in presentation with a pyramid depicting the goals. | | | | |
| **Abstract** | In this “tidbit” students will generate a vignette in which they dramatize how light energy is harvested and converted to chemical energy. In order to understand the role of light-capturing pigments and the process of photophosphorylation, students will personify of various components in the light reactions.  This activity will appeal to the kinesthetic as well and the audio and visual learner. | | | | |
| **Rationale** | The idea for the unit arose from the movie we saw during the first morning of our Summer Institute about the public’s alternative conceptions about the source of material in plant growth. The topic was chosen because of our dismay over responses to a question regarding how a seed grows into a plant. Students aren’t aware that plants both photosynthesize and respire. Also students are not aware of where oxygen is used and where is comes from. | | | | |
| **Preparatory homework**  (all materials on the wiki) | Understand nature of light.  Anatomy of a plant cell – label organelles relevant to photosynthesis.  Memorize the equation for photosynthesis.  Review diagram describing light and dark reactions | | | | |
|  | **Goal(s)** | | **Outcome(s)**: | | **Assessment(s):** |
| #1 To understand the difference between autotrophs and heterotrophs and the spectrum of species/cell types that photosynthesize | |  | |  |
| #2. To be able to inventory the physical, chemical and biological components of photosynthesis**.** | |  | |  |
| #3. To describe the structure and function relationships within the chloroplast or prokaryotic membranes.  Understanding the molecular reactions of the light and dark reactions and the role of RuBisco in carbon fixation | |  | |  |
| #4. Explain how light energy is harvested and converted to chemical energy. To understand the role of light-capturing pigments; photophosphorylation. | | We will just list outcomes for our tidbit section #4 on the pyramid.   * Be able to define the role of pigment in light capturing. * Dramatize   + the ETC   + the proton motive force. | | **Formative assessment**  Clicker questions  Dramatization  **Summative assessment**  Test question(s) requiring students to draw the electron transport chain and photophosphorylation  Test question asking how light and dark reactions are interdependent.  Give an example of a redox reaction in both light and dark reactions. |
| #5 To be able to articulate the relationship between photosynthesis and respiration | |  | |  |
| **Incorporation of Scientific Teaching Themes** | | | | | |
| **Active Learning**   1. Answering clicker questions 2. Enacting the dramatization of electron   transport chain   1. Players describing their role 2. Peer feedback | | **Assessment**  Teacher will measure learning by evaluating the student’s ability to self -direct in the dramatization activity and correct use of props.  clicker questions.  Though summative assessment mentioned previously  Students will self-evaluate learning by observing and critiquing peer groups. | | **Diversity**  Three learning styles are accommodated, audio, visual and kinesthetic.  Student’s participation is obligatory. | |
| ***Activities outside of class:***  Preparatory homework  ***Activities in class:***  Prezi presentation  ***Activities during tidbit:***   * Clicker questions * “Biology theatre” for photophosphorylation. | | ***Pre-assessments:***  List organisms that photosynthesis  Label a diagram showing structure of chloroplast  ***Post-tidbit assessments:***  See summative assessments above  **Post assessment**  Question about chemoautotrophy. Be able to compare chemoautotophy and photoautotrophy. | |  | |

Sample Presentation Plan (detailed schedule with approximate timing for unit)

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| **Session 1** | | | |
| **Time (min)** | Learning Outcome(s) | Activity/assessment | Explanation, notes, suggestions, tips |
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| **Session 2** | | | |
| **Time (min)** | Learning Outcome(s) | Activity/assessment | Explanation, notes, suggestions, tips |
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| **Session 3 add more sessions as needed** | | | |
| **Time (min)** | Learning Outcome(s) | Activity/assessment | Explanation, notes, suggestions, tips |
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Resources for Teaching the Unit

1. Labels for students to write on key photosynthesis players
2. Markers
3. Props to represent Protons (eg marshmallows), Electrons ( eg kisses) Photosystems ( eg chairs or buckets), Photons (eg Flashlight for Sun)
4. Clickers or alternative method to answer questions

Summary of Feedback

Have a director appointed for each group

Incorporation of higher-order cognitive questions

Further summative assessment requested

Consider increasing the number of ‘players’ in the electron transport chain

Consider expanding the use of props

Acknowledgements

HHMI

NASI Directors

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The University of Hawaii at Manoa

**Review literature**:  
From Mike Adams at Eastern CT State Univ:  
[http://www.easternct.edu/~adams/Resources/Lab4%20Hill%20Rx.pd](http://www.easternct.edu/%7Eadams/Resources/Lab4%20Hill%20Rx.pd)  
Nature Education on photosynthesis:  
<http://www.nature.com/scitable/topicpage/photosynthetic-cells-14025371>  
  
**Harvard student survey:**  
<http://www.learner.org/resources/series28.html>  
**Prezi:**  
<http://prezi.com/t4ajm5snbfdw/?utm_campaign=share&utm_medium=copy&rc=ex0share>