**Photosynthesis: Overview**

**Instructor:**

**Grade level: 9-12**

**Created/last edited/submitted:**

**Lesson Summary:**

This lesson focuses on anatomy of parts of plant that play critical roles in photosynthesis. The lesson plan has a jigsaw puzzle activity to help students understand the function of plant cells in photosynthesis, light-dependent and light-independent reactions.

Each plant cell contains chloroplasts. Chloroplasts contain chlorophylls. Chlorophylls help absorb red, blue and other visible wavelengths of light, but reflect green wavelengths of light. That is why leaves in general are green. The fluid insides of the chloroplast is called stroma, where the light-independent reactions happen. Inside of a chloroplast, there are also stacks of folded membranes that are called thylakoid. A stack of several thylakoids is called granum.

Inside of a thylakoid is thylakoid lumen. Thylakoid membrane, a phosphor-bilipd layer, has electron transport chain, where are some complex proteins and molecules that span this membrane, such as Photosystem I and II complex, Chlorophyll A molecules, Beta Carotene molecules, and so on. Thylakoid membranes also are where light-dependent reactions occur.

**Lesson Objectives:**

Students will be able to draw, label and explain parts of plant cell that play critical roles in photosynthesis.

**Materials:**

1. Puzzle piece of parts of plant cells
2. Big Post It paper for presentation
3. Tapes
4. Small Post It note
5. Markers

**Vocabulary:**

**Chloroplast:** Part of a plan cell where the photosynthesis occur

**Chlorophyll:** Chlorophyll can be found in the thylakoid membranes of chloroplasts. It facilitate to absorb the photon of light.

**Light-dependent reactions (Photosystem I and Photosystem II):** The reaction involves sunlight and water (H2O) to form ATP, NADPH.

**Light-independent reactions (Calvin cycle):** The reaction involves CO2, and uses ATP and NADPH that are formed from light-dependent reactions to produce glucose.

**Photon:** Photon is an elementary particle. It is a small unit of light. Photons oscillate along a path that carrier for electromagnetic force, which are measured as wavelengths.

**Pigments (molecules):** Pigments can be found in the thylakoid membranes of chlorophyll. It facilitate to absorb the photon of light.

**Photosynthesis:** It is the process that plants use to take carbon dioxide (CO2), water (H2O), and sunlight to produce sugars (carbohydrates) and oxygen (O2).

**Stroma:** Fluid filled space inside chloroplast, where photosynthesis light-independent reactions happened.

**Thylakoids:** Dislike structure of chloroplast. Thylakoid membranes are where photosynthesis light-dependent reactions happened.

**Thylakoid lumen:** Fluid space inside thylakoids.

**Time Required:**

1 hour

**Standards/Benchmarks Addressed:**

1. **Indiana Science Standards Biology**

B. 1.5. Develop and use a model to illustrate the hierarchical organization of interacting system that provide specific functions within multicellular organisms.

1. **Next Generation Science Standards**

HS-LS1-2. Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.

**Classroom Instruction:**

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| **Introduction:**1. Ask students what plants need to grow?
2. Ask students what do they know about photosynthesis?
 | **Comments:**These are two questions could help you understand students’ prior knowledge about plants and photosynthesis. |
| **Activity (Science/Math/Design or Engineering):**1. Give students the puzzle pieces
2. Ask students to construct a model to illustrate the hierarchical of a plant cell that provide specific functions of photosynthesis.
3. Ask students to use the arrows, vocabularies, and pictures that you give to them to illustrate part of a plant cells that play important roles in photosynthesis.
4. Ask students to discuss what their model looks like with their team and use the tapes to arrange their model on the big Post It paper.
5. Told students this model is like a “zoom in” model. The puzzle pieces that you give to them are not in the same scale.
6. Told students that they can use small Post It notes and markers to add information into their model if they like.
7. After students finish their illustration, have students present their model.
8. Show and talk about what the correct model is look like.
 | **Comments:**Let students’ try to put the puzzle first by using their prior knowledge. After show and talk about the correct model, ask students where they need to make changes on their model. In addition, if they understand why they need to make changes. |
| **Closure:**1. Have students made changes on their model
2. Have students added notes on their model that they have made changes
3. Have students put the poster on the wall for later lesson to use.
 | **Comments:**Students will need the poster for the next lesson, light-dependent and light-independent reactions. Therefore, ask students to put their poster on the wall for later to use. |

**Assessment:**

**Pre-Activity Assessment**

**Activity Embedded Assessment**

**Post-Activity Assessment**

 **Support Materials**

**Student Handout/Worksheet**

**Design Brief/Story/Context**

**References:**