

## Phun with Photosynthesis

## Teacher's Guide

**Subject:** Integrated Science (Life; Physical), Mathematics

**Topic:** Photosynthesis, transfer of energy, forms of energy, producers, plants, engineering, solar cells, adaptations

**Summary:** Students will use light sensitive beads to observe how sunlight can cause rapid physical and chemical changes in what it strikes. They will calculate the total surface area of leaves exposed to the sun on a saw palmetto plant. They will calculate how many photoelectric cells would equal the solar energy capturing ability of the saw palmetto plant they measured. The students will design and make a tree using photoelectric cells as leaves. There will be a nature walk on a trail in the park observing a number of things about photosynthesis such as: there are many different leaf shapes and sizes, why trees try to grow straight up, and what happens when sunlight can't reach herbaceous plants due to shadowing.

**Objectives:** After completing the field lab, students will be able to:

1. Explain that photosynthesis is the most important process on the surface of the earth for living things.
2. List the steps in the process of photosynthesis by making a flow chart.
3. Produce measureable electricity by placing photoelectric cells into a tree form.
4. Explain why photoelectric cells are an environmentally sound way to produce electricity.

**Ecosystem:** Pine Flatwoods

**Equipment** Photoelectric Cells (12)      Graph paper in cm sq      Light Sensitive Beads  
Scissors      Materials to make tree frames

### Background

- **Vocabulary:** element, atom, ion, nucleus, electron, catalyst, enzyme, NADP, ADP, ATP, rubisco, energy levels
- **Reference Materials:** Information gained from Phun with Photosynthesis PowerPoint presented at school prior to the field lab.
- **Equipment Training:** tools used for solar trees
- Make a flow chart that shows the basic steps of photosynthesis (water, carbon dioxide, oxygen, hydrogen, glucose).
- How plants make more complex chemicals from sugar such as starches.
- What the complex chemical chlorophyll is and how it acts as a catalyst in photosynthesis.

### Procedure (Engage; Explore; Explain):

1. The students will be in the pavilion at the park where they can readily observe the green world all around them. This green color comes from the plants constantly producing chlorophyll in their leaves.
2. The steps in photosynthesis will be reviewed and the importance of this process for all living things on the surface of earth will be expressed.
3. Light sensitive beads will be exposed to sunlight and the analogy of the process of the beads turning color to what happens to chlorophyll in to sunlight will be covered.
4. We will look at a saw palmetto plant, determine the total number of leaves on the plant, calculate the surface of a leaf using graph paper, and calculate the total surface area of the leaves on the entire plant. This is the total area of the plant exposed to sunlight.
5. Look at the similarities of energy changes involved in the palmetto plant capturing sunlight and sunlight hitting photoelectric cells. The students will make a tree using photoelectric cells and compare the electric energy produced.
6. There will be a photosynthesis walk on the Gopher Tortoise Trail. We will look at the advantages of different leaf shapes and sizes, how all plants strive to get their leaves exposed to the sun, and what happens to plants when they are deprived of sunlight.

### **Sunshine State Standards:**

**Science:** SC.7.P11.2; SC.7P.10.1; SC.7.L.15.2

## Southport Panther Experience Savannahs Preserve State Park Life Program

### Phun with Photosynthesis Data Sheet

#### General Information

Name:	Date:
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#### Student Hypothesis and Rationale

How does the surface area of plant leaves compare with the surface area of photoelectric cells in their ability to capture solar energy?

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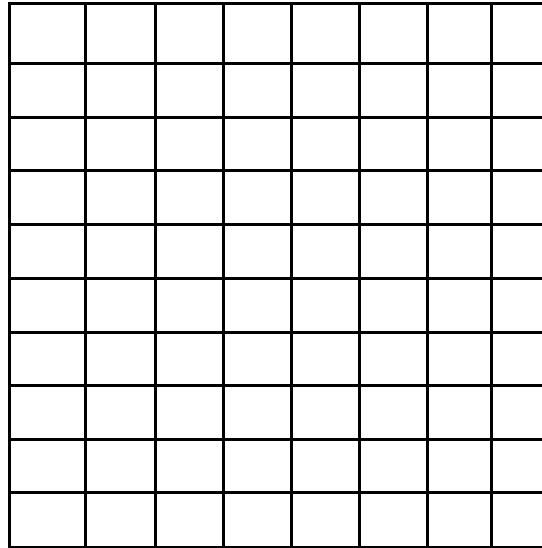
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#### Field Observations/Measurements/Data

##### Saw Palmetto vs. Photoelectric Cell.....

1. Number of saw palmetto leaf blades on one frond . \_\_\_\_\_
2. Number of fronds on entire saw palmetto plant. \_\_\_\_\_
3. Total number of frond blades on entire palmetto plant. \_\_\_\_\_
4. Lay their leaf on graph paper.
5. Outline the leaf with a marker, and then remove the leaf.
6. Count the squares the leaf blade covered on the graph paper.  
(Count partially covered squares that were more than half covered as one square and ignore the squares that were less than half covered.)

7. Record number of squares covered. \_\_\_\_\_



8. Each square on your sheet is one centimeter by one centimeter so the answer to question six is the area of one side of the leaf in cm sq.

9. Total leaf area exposed to the sun. Answer to question six times two.  
(Both sides of the leaf are exposed to the sun.) \_\_\_\_\_ cm sq

10. Multiply the answer to question seven by the answer to question three. (Number of leaf blades on the entire saw palmetto plant times the total area of one leaf blade exposed to the sunlight.) \_\_\_\_\_ cm sq

11. A photoelectric cell performs just one function: it uses the sun's energy to produce electricity. Because of this, it requires less total energy for this one process than a plant requires for the complex process of photosynthesis. In photosynthesis, the energy of sunlight is used to power eighty different chemical reactions. It has been calculated that a photoelectric cell is six times as efficient as a plant leaf in using the energy of sun light to produce electricity.

12. So, divide the answer to question eight by six to determine how many square centimeters an array of photoelectric cells would have to cover to capture the same amount of solar energy as one palmetto plant. \_\_\_\_\_ cm sq

13. Divide the answer to question nine by the area of one photoelectric cell you used

which is 22.9 centimeters squared. \_\_\_\_\_

**The answer to question 13 is how many of your photoelectric cells it would take to capture the same amount of the suns energy as your saw palmetto plant captures.**

## SOLAR PROJECT: DESIGN & IMPLEMENTATION

Your group's mission is to design and create a solar tree. Your tools include: solar cells, a wooden base, dowels, tape, and connecting wires. Try to design your tree so that it will capture the maximum amount of sun light, using the structures of natural plants as inspiration. When you have completed your tree, test its efficiency with different devices such as fan motors, lights and music boxes. Can your team's tree capture more energy than the others?

How well did your tree work compared with trees made by the other groups?

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How could you change your tree to make it work better?

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What ideas did you take from trees or bushes in the park, and did you find them helpful?

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