Lesson Title	Do Green Leaves only have Green Pigment?
Length of Lesson	60 minutes
Created By	Lucas Pounders
Subject	Botany
Grade Level	8-12th
State Standards	1a,b,c,e,f,g; 2,d,e
DOK Level	1,2,3
DOK Application	Identify, Observe, Hypothesize,
National Standards	A. Inquiry : Life Science
Graduate Research Element	Light Refraction and Color

Student Learning Goal:
It is the intention of this lesson to allow students to research, hypothesis, inquire through asking question, and come to a conclusion of why we see the green pigment color in plants. Students should understand that the pigment of green plants as well as plants of other colors is the light that is refracted by the plant. Students should also understand that other pigment color not refracted by the sun is absorbed by the plant or overpowered by the amount of chlorophyll.

State Standards:
INQUIRY
1. Apply inquiry-based and problem-solving processes and skills to scientific investigations.
a. Conduct a scientific investigation demonstrating safe procedures and proper care of laboratory equipment. (DOK 2)
• Safety rules and symbols
• Proper use and care of the compound light microscope, slides, chemicals, etc.
• Accuracy and precision in using graduated cylinders, balances, beakers, thermometers, and rulers
b. Formulate questions that can be answered through research and experimental design. (DOK 3)
c. Apply the components of scientific processes and methods in classroom and laboratory investigations (e.g., hypotheses, experimental design, observations, data analyses, interpretations, theory development). (DOK 3)
e. Analyze procedures, data, and conclusions to determine the scientific validity of research. (DOK 3)
f. Recognize and analyze alternative explanations for experimental results and to make predictions based on observations and prior knowledge. (DOK 3)
g. Communicate and defend a scientific argument in oral, written, and graphic form. (DOK 3)
LIFE SCIENCE

2. Distinguish among the characteristics of botanical organization, structure, and function.
d. Apply the modern classification scheme utilized in naming plants to identify plant specimens. (DOK 2)
• Classification scheme used in botany
• Classification of native Mississippi plants
e. Use inquiry to investigate and discuss the physical and chemical processes of plants. (DOK 3)
• Relationships among photosynthesis, cellular respiration, and translocation
• Importance of soil type and soil profiles to plant survival
• Mechanism of water movement in plants
• Effects of environmental conditions for plant survival
• Tropic responses of a plant organ to a given stimulus

National Standards:
9-12: Science as Inquiry Standards: Understanding about scientific inquiry

Materials Needed (supplies, hand-outs, resources):
5 different green colored leaves (supply one of each per student or student group)
rubbing alcohol
5 strips of a coffee filter (approx. 1in. X 5 in.) per student or student group
1 ruler
5 plastic glass per student or student group
5 pencil per student or student group
5 small pieces of tape per student or student group

Lesson Performance Task/Assessment:
Students are to be evenly dispersed into groups of no more than 4. Each group is to be given a "set" of five leaves, a plastic cup with approximately 2cm of alcohol in the bottom, a ruler, and five strips of a coffee filter. Students are to take the leaves one by one and scratch them until the chlorophyll of each is exposed they will then take the leaves and rub them against the strips of coffee filter in the center (make sure to label). Students will then take the coffee filter paper and tape them to a pencil. This will then be placed over the plastic cup with just the tip of the coffee filter paper touching the alcohol in the bottom of the cup. Over the course of the next 40± minutes the students are to record the beginning state and any changes that occur at 15 minute intervals. After this has been completed ask the students to try and explain any happenings or the lack there of.

Lesson Relevance to Performance Task and Students:
Students will have to explain their findings through this experiment and relate these finding to the changing of colors in the fall.

Anticipatory Set/Capture Interest:
Open by asking the students, "Is green the only color in a green leaf?", and ask them to write a hypothesis stating yes or no and explaining why they feel the way they do.

Guided Practice:
Lead the students in a discussion with their peers to explain the reasoning behind different colors in a green leaf and why those colors are not present until the changing of colors in the fall.

Independent Practice:
Students are to find a leaf and record the change in color as it dries. They must identify the type of leaf and the majority pigment after the chlorophyll dries.

Remediation and/or Enrichment:
Remediation: Follow Individualized IEP
Enrichment:
1.) Name at least two different types of pigments found in plants.
2.) What colors do these pigments refract and which colors do these pigments absorb?

Check(s) for Understanding:
Ask questions to understand the student's point of view during the post lab discussion. The enrichment and remediation should also allow the teacher to tell of understanding of the lesson topic.

Closure:
Class discussion of the information covered and the final conclusions that were drawn. There can be a final correct answer or it could be left open ended for more discussion and another lesson.

Possible Alternate Subject Integrations:
Plant Biology

Teacher Notes:
Make sure of the time of year before deciding to do this lesson. It is best done in the summer and spring but can be retrofitted for use in the fall and winter by growing plants indoors. Always perform the lesson by yourself to troubleshoot before presenting in class!