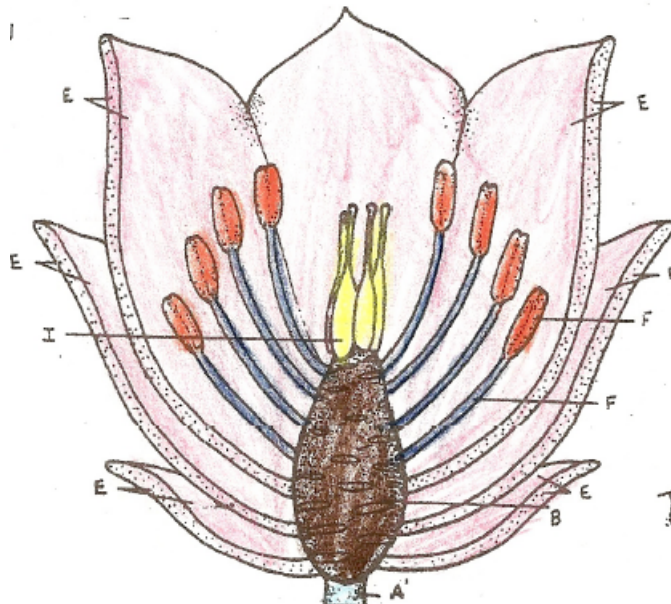
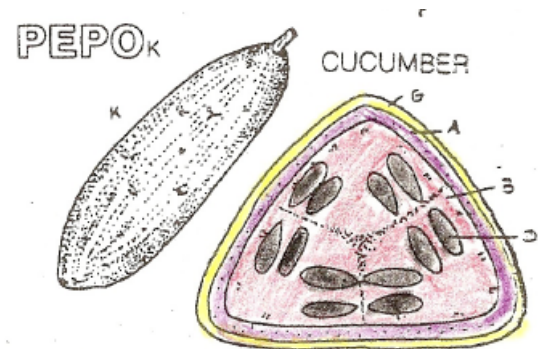
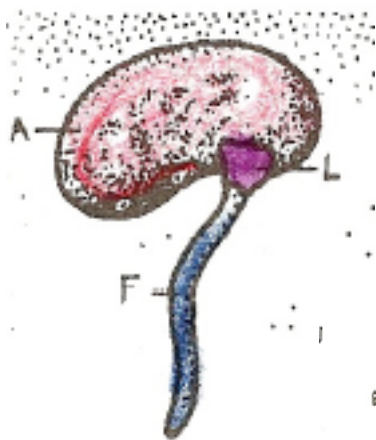


# The Flowering Plant: Plant Product Research Project

Douglas F. Haller, Ed. M.  
Version: January 2011

STEM Education Consultant  
[www.hallerconsulting.com](http://www.hallerconsulting.com)  
[doug@hallerconsulting.com](mailto:doug@hallerconsulting.com)



## Letter to the Educator

Dear Educator:

Flowering plants fascinate and delight. They surround us with beauty. They provide oxygen for life, food for consumption, and resources that meet many of our other needs. Plants offer an excellent opportunity to introduce students to life sciences. One can grow them, observe and describe them in detail, and dissect them without difficulty or hesitation. Plus, we can eat them, as students enjoy doing in the last laboratory activity of the course.

Once I began teaching, I adapted my undergraduate course on flowering plants to fit the interests and needs of my middle school students, primarily 6th graders. The course follows a simple organization spending approximately a week on each topic—seeds, flowers, fruits—and culminating with an independent research project and poster session on plant based products. In this botany unit, I intentionally left out the study of leaves and as a result, photosynthesis. At the time, photosynthesis was the providence of the 7th grade life science teachers in my school. I taught general science and engineering, providing 6th graders with a survey course of a variety of sciences throughout the school year.

In my years teaching this unit, I collected and organized a variety of existing resources to create a course that combined the best of the best. I cite sources of information and materials in this publication to the best of my ability and credit the original authors.

Please enjoy these lessons and don't forget to stop and smell the flowers!

Sincerely,

Douglas F. Haller, Ed. M.  
STEM Education Consultant  
[www.hallerconsulting.com](http://www.hallerconsulting.com)  
[doug@hallerconsulting.com](mailto:doug@hallerconsulting.com)

Boulder, CO 2011



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## Unit Organization

This unit of study is divided into three topics each lasting approximately a week plus an on-going research project. The independent project is introduced and supported in class but students primarily complete it independently as homework.

### Laboratory Investigations & Activities

The three main topics (seeds, flowers, fruits) contain several similar goals and each is taught using a similar approach. Each week students study the structure and function of basic parts of the seed, flower, and fruit. Each week they color and label images from an illustrated guide to botany. While studying each topic, students rotate through several stations that remain set up throughout the unit. At one station, students access selected Internet resources to help them learn vocabulary, look at additional specimens, or extend classroom activity and resources as necessary. A second station consists of samples of seeds, flowers, or fruits that students examine with the unaided eye, drawing and labeling what they observe. The third station consists of microscopes and/or hand-lenses that allow students to observe plant structures in greater detail. As with their unaided work, students draw and describe what they observe. Throughout the laboratory activities, all work is recorded in a simple lab book or log. Each entry is dated.

### Independent Research Project

The goal of the project is for students to independently research a plant and its uses. The plant products cannot include food or drink. I placed this limitation on the products to encourage students to learn about the many other uses of plants from medical applications to building materials. Detailed instructions for how to assign, support, and assess the project are provided in the project section of this document.

Introduce and explain your research project expectations within the first week of the unit. Set aside all or part of one class each week to explain expectations, model steps in the research process, or follow-up on student progress. Students present the results of their research, an essay and a poster at the end of the unit of study. The project provides students an opportunity to demonstrate their individual efforts and abilities. I had students write the 250-word essay, typed, answering specific questions as a precursor to producing the poster. The text on the poster was taken from the essay.

Materials for supporting independent student research are provided after the classroom lesson plans.

### Assessment

This unit offers a variety of assessment opportunities daily, weekly and at completion. Daily, evaluate student progress to maintain or complete coloring pages and laboratory books. Require students to complete all and evaluate them at the end of the unit. Weekly, or once each topic (seed, flower, fruit) is completed, test students ability to identify each structure and explain its function. This can be done using paper and pencil tests or laboratory-based tests.



Laboratory Assessments: To assess student ability to identify flowering plant structures and use laboratory equipment, include a laboratory based assessment once or twice during the unit of study. To do this, arrange the tables in a circle and create one sample or question at each seat for students to answer. For example, if there are 30 students, prepare 30 questions and/or samples. At each seat arrange a sample of some part of the seed, flower, or fruit for students to identify. To avoid confusion about what students must identify, use arrows or push pins to indicate the specific structure. Include the use of microscopes and/or hand lenses when appropriate. Time the test. Allow approximately 1 minute per question/station. Rotate the class from station to station. Make certain that the stations are numbered so that students and answers do not become confused. Provide a numbered answer sheet for each student that corresponds with the object or question at the station.

### ***Lesson Components & Organization***

Each lesson includes one or more of the following types of pages:

#### **Teacher Pages**

Teacher pages provide an overview of the set of activities on each topic (seeds, flowers, fruits, research project). Each activity is described individually in detail and numbered chronologically. These pages provide information on the role of the students, the goals of the activities, required materials or equipment, and directions for implementation, ideas for homework and extensions, and where appropriate assessment.

#### **Station Directions**

This unit depends upon students rotating through three stations (Internet, unaided eye, and aided eye). To support independent student work I provide a single page of directions for each station for each topic (seeds, flowers, fruits). Project each pages on to a wall or screen so that students refer to them as they work at the station. By projecting the directions for all to see, you free yourself for facilitating work of individuals or pairs while the students learn to work independently.

#### **Student Pages**

Some activities do not take place at the lab stations. In those cases, students receive a handout that provides them with directions and expectations. These pages have a different style of font and the words, Name, Partner, Date at the top to distinguish them from pages addressed to the teacher. Distribute and review each student page as an introduction to the activity.

#### **Lecture Notes**

To support specific content knowledge acquisition and the research project, I provide selected lecture or review notes. These will be clearly labeled and are designed to aid the teacher in preparing and delivering direct instruction about content, skills, or concepts.



# Plant Product Research Product

## *Project Overview*

In this project students perform independent research on plants and plant products. They produce a 250-word essay (typed) and a poster. The content of the essay and poster are based upon five questions provided below. The contents of the essay form the content for the text of the poster. As the due date for the posters arrives, students and teacher, plan a model professional conference poster session. They present their posters to peers and guests.

## **Advanced Preparation**

1. Copy and assemble the student pages into a single handout. See the following collection of papers.
2. Arrange a date and time to visit the library to help students select resources: books, periodicals, and Internet
3. Set a schedule for the due dates of various parts of the project: initial plant choice, list of references, brief responses to the five research questions, review of research notes cards, draft of essay, final essay, poster.
4. Arrange a date to hold the poster session. Have student make invitations for parents, peers, and members of the school community during class time and deliver them as homework or to the main office.
5. If working on a middle school team, collaborate with the Language Arts teacher to provide additional support for student research and writing.

**Teaching Time:** (0.5 to 1) 45-minute period per week, several weeks

## **Materials**

Individual

- (1) Packet of handouts consisting of the following items provided below: Note Taking Steps for a Research Project, Plant Research Project Questions, Plant Research Project Assessment Card, Peer Review Plant Poster Questions.



## Implementation

### Sample Project Schedule

| Week 1                | Week 2   | Week 3  | Week 4   | Week 5              |
|-----------------------|--|---|--|---------------------|
| Introduce the project | Visit the library to find sources                  | (Optional) Teach Research and Note Taking Skills                | Review draft of essay  | Collect essay       |
|                       | Require students to select a plant and its product | Assign students to bring their note cards to school for review. | Have students make and deliver invitations to parents, peers, school community | Collect poster      |
|                       | Assign students to identify 3-5 resources          | Assign the writing of the essay and the date of the draft.      |  | Hold Poster Session |

### Introducing the Project: Previewing Past Posters

After the first year of teaching this project, save several posters to share with successive classes of students. Select examples that meet all the requirements assigned and point out each to the students as you introduce or review the research project. Use these posters to introduce the project to students and explain your expectations.

Explain that the research project results in two products, an essay and a poster. Distribute and review the student handouts. Explain overall expectations for the project and that the project will be broken into smaller, more manageable tasks with specific due dates.

### Research Topics

To help your students identify a topic of research, below is a short list:

- Plants and parts used for pharmaceutical or medical purposes, example: foxglove/digitalis, spirea/aspirin
- Plants used to produce liquids and resins such as rubber, turpentine, example: conifers
- Fiber producing plants, example: flax
- Plants that produce paper products: aspen, hemlock, spruce
- Plants that produce perfumes: lavender, rose, jasmine
- Gum producing plants, such as: acacia
- Oil producing plants, example: palm, eucalyptus
- Pigment producing plants, example: mustard



## Research and Note Taking Skills

Students require support to complete this research project. I made my own set of note cards to share with them and to model my expectations. Below are images of the note cards. In addition, I required students to use 3-5 resources including both print and electronic/Internet. Each set of note cards was associated with one resource. Some students found it valuable to color code the note cards by topic and/or by source.

|   |
|---|
| Common & Latin Names                    |
| Common Name: Cotton                     |
| Latin Names: (genus) Gossypium          |
| (family) Malvaceae                      |
| (genus) Gossypium                       |
| (species) G. hirsutum and G. barbadense |
|   |
|   |
|   |
|   |

|   |
|---|
| Product Produced & Product Use  |
| Fiber Use - all round combination of properties useful for thousands of items |
| a) Fabrics: print cloth, sheets, coated fabrics                               |
| b) fine cotton goods: broadcloth for shirts, lawns and organdies for dresses  |
| c) napped cotton fabrics: flannels, moleskins, car interiors                  |
| d) cotton yarns: gloves, sweatshirts, mosquito netting, meat coverings        |
|   |
| Vocabulary  |
| Lawns: fine thin cotton fabric  |
| Organdies: fine transparent muslin with stiff finish                          |



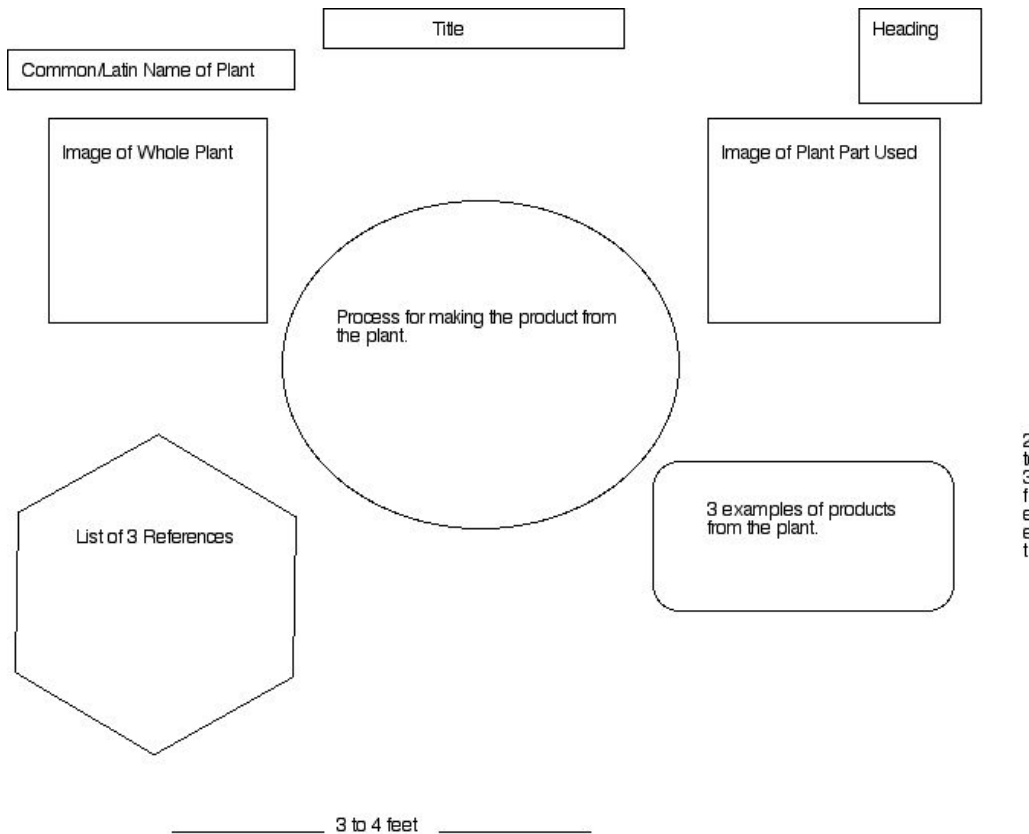


|  |   |
|--|---|
| Making Product   | 1 |
| Fiber  |   |
| Bale= 675 kg of seeds to make 225 kg of cotton lint                  |   |
| Gin- separates lint from seed; types of gins - saw gin & roller gins |   |
| Saw Gin- series of circular saws mounted horizontally                |   |
| lint is pulled from seed as it passes over saws                      |   |
| brushes & air suction remove lint from saws                          |   |
| press bales lint   |   |
|  |   |
|  |   |



## Sample Poster Layout

Students will easily demonstrate their artistic ability. Some need help with visualizing the poster layout and components. To meet this challenge, project an image such as the one below, while you explain expectations to students for the appearance of their poster. The various geometric shapes are just ways of showing different parts of the poster.



Name:

Date:

## Note Taking Steps for a Research Project

### Choosing a Resource

1. Know the topic or questions to be researched
2. Find sources of information
3. Preview sources to decide which are of use. Keep useful resources.
4. Carefully read a single source
5. Reread a source and highlight important information

### Note Card Format

1. Use one index card for each note/fact or answer to a question
2. Title each index card by type of information it provides; use short titles
3. Number cards if you have more than one per topic
4. Copy original information to cards; later write in your own words
5. Define new vocabulary at the bottom of cards as necessary
6. Color code cards; one color for each topic/question
7. Write the full title of the resource on the card and the page number of the quote.



Name:

Date:

## Plant Research Project Questions

### Directions

The following questions are the main points to address for this research project about plants and their products. Use additional paper if necessary.

1. What is the common name of your plant? What is the Latin name of the plant?

Common Name: \_\_\_\_\_

Latin Name: \_\_\_\_\_

2. What product or products does the plant produce? List as many as possible.

3. How is the plant product used? Be specific. Provide at least three examples.

4. What is the process for making the product from the plant? Describe the process in detail.

5. What part or parts of the plant is/are used in production? Use appropriate descriptive and scientific terms. Be specific.



Name:

Date:

## Plant Research Project Reference List

The following are the resources I have identified:

**Internet Address:** \_\_\_\_\_

### **Book**

Author: \_\_\_\_\_

Title: \_\_\_\_\_

Publisher: \_\_\_\_\_

Publication Date: \_\_\_\_\_

### **Periodical (Magazine or Newspaper)**

Author: \_\_\_\_\_

Story Title: \_\_\_\_\_

Magazine/Newspaper: \_\_\_\_\_

Title: \_\_\_\_\_

Publication Date: \_\_\_\_\_



Name:

Date:

## Plant Research Project Assessment Card

### ***Poster***

- \_\_\_\_\_ Heading: name of student, date, typed
- \_\_\_\_\_ Title: neat, informative, correct spelling, typed
- \_\_\_\_\_ Common and Latin Name: neat, informative, correct spelling, typed
- \_\_\_\_\_ Images of Plant: whole plant and part used in production, typed labels
- \_\_\_\_\_ List of References: neat, complete information, correct spelling, typed
- \_\_\_\_\_ Examples of Products: 1-3 examples, typed labels
- \_\_\_\_\_ Layout: neat, creative, good use of space
- \_\_\_\_\_ Size: meets recommended size limits 2-3ft by 3-4ft.

Raw Score:\_\_\_\_\_ Letter Grade:\_\_\_\_\_

### ***Essay***

Essay: The essay clearly answers the following questions in an organized manner:

- What is the common and Latin name of your plant?
- What product or products does the plant produce?
- What is the process for making the product from the plant?
- How is the plant product used?
- What part of the plant is used in production?

Grammar

Expression/writing style



Name:

Date:

## Peer Review: Plant Project Poster

### Directions

Review one poster. Read all the information on the poster and look at all the pictures. Answer the following questions:

1. What is the title of the poster?
2. What does the title tell you about the subject of the poster?
3. What plant is the poster about?
4. List the product(s) the plant produces?
5. What part of the plant is used for the product?
6. Do you like the way the poster looks? Why?
7. When you look at the poster what do you see first? Why?
8. What do you like most about the poster?
9. What would you change about the poster?



## Glossary

**ANTHER:** The male part of a flower which produces the pollen.

**CARPELS:** The female organs of a flower. They have three parts: 1) an ovary, holding one or more egg cells. 2) style and 3) stigma which is at the tip of the style and receives the pollen.

**CELLS:** One of the building blocks of which living things are made. Plants consist of many cells. Some may be specialized for particular jobs.

**CHLOROPHYLL:** Chlorophyll is the green matter that is needed to make food for the plants

**CHLOROPLASTS:** Chloroplasts are in the leaf cells and are full of chlorophyll (green matter).

**COTYLEDON:** The hard outer case of the seed which holds the embryo (baby part of the plant) and gives it a food supply.

**CORTEX:** In the root, it is the layer of cells between the center and the edge.

**DICOT (DICOTYLEDON):** A flowering plant that has 2 cotyledons in the embryo. The bean seed is a dicot. It has two special structures called cotyledons which are part of the embryo.

**DISSEMINATION:** The act or process of scattering or the state of being scattered widely. The process of seeds traveling from one place to another.

**DORMANT:** When a seed falls to the ground and may lie there "asleep"

**EMBRYO:** The developing life of a new plant or animal, due to the combining of male and female reproductive cells. The "baby" plant. The part of a seed that develops into a new plant.

**ENDOSPERM:** Monocot plants store food in a part of the seed called the endosperm.

**EPIDERMIS:** The out layer of cells on a plant. It protects the inside parts. It is like our skin.

**FERTILIZE:** To put manure or certain chemicals put in the soil as food for the plants.

**GERMINATION:** A seed begins to grow. The growth of a seed of a first tiny shoot and root.

**GAMETE:** The egg or the sperm in the flower.





**HITCHHIKE:** A seed travels by attaching itself to an animal or person.

**MONOCOTS (MONOCOTYLEDON):** A plant or seed that has only one cotyledon. The corn seed has only one cotyledon.

#### **OVARY**

The female part of the flower, which produces the eggs that are needed for making seeds

**PETAL:** One of the parts of a flower that is arranged in a circle. They are the colored part of the flower.

**PHOTOSYNTHESIS:** The process by which green plants use carbon dioxide, water and sunlight to make their own food. Made up of two words: photo, which means light, and synthesis, which means putting together. A plant puts water and carbon dioxide together. It uses light as its helper. It also uses chlorophyll as a helper. When these things are put together they make sugar and oxygen.

**PISTIL:** The female seed-producing part of a flower.

**POLLEN:** The fine powder produced by the anther inside a flower that contains the male sperm cells.

**POLLEN TUBE:** A tube that grows from a pollen grain on the stigma of a flower down through the style into the ovary.

**ROOT HAIRS:** They are like hair. They come out of the root like a branch. They absorb the water and food for the plant.

**SEED COAT:** The outer covering of a seed.

**SEPAL:** The outer green parts of the base of the flower. They protect the flower bud before it opens. Inside the sepals are the colored petals.

**STAMEN:** The male organ inside the petals. The part of a flower that produces pollen.

**STARCH:** A white food substance (sugar) that is made and stored in most plants.

**STELE:** The center of the root. It holds the veins that carry water and sugar.

**STIGMA:** The tip of the female part of the flower, which receives the male pollen grains

**STOMATA:** Tiny pores on the underside of the leaves (stomata-plural for stoma). Carbon dioxide and oxygen enter and leave the plant through these tiny pores.

**VASCULAR RAYS:** Cells in the root that carry water sideways



VEINS: Tubes which take water to each and every cell of the plant. The veins help to strengthen and support the plant.

XYLEM: Veins that carry water and food to the plant.

