"How Flowers Changed the World"
The Evolution of Angiosperms

GRADE LEVEL
Grades 9-12

SUBJECTS
Science/Biology

ESTIMATED TIME
Two 50-minute sessions

"The truth is, however, that there is nothing very 'normal' about nature. Once upon a time, there were no flowers at all."

OVERVIEW

The following lesson and study guide presents questions relating to the Eiseley essay, "How Flowers Changed the World" (from Eiseley's book *The Immense Journey*, published in 1957). The goal of this lesson is to help the student develop a better understanding and appreciation for the significance of the evolution of the angiosperms. Most biology textbooks will cover this material, but by taking advantage of the lively account of this subject matter by Eiseley, students may find it more intriguing and significant.

MATERIALS AND TECHNOLOGY

- A copy of the essay "How Flowers Changed the World" from *The Loren Eiseley Reader*
- A geologic timeline and biology textbook (or Internet access)
- The handout accompanying this lesson plan.

PREPARATION

1. Read Eiseley's essay, "How Flowers Changed the World" and make sure there are enough copies of the essay for each student.
2. Make copies of all handouts and have all materials available for use.

   It is interesting to note that plant fossils found in Nebraska figure prominently in the origin of the flowering plants. An outstanding reference to these fossils can be found in the August 1994 issue of *Museum Notes* (published by the University of Nebraska State Museum). This issue is

titled, "The Abominable Mystery of The First Flowers: Clues from Nebraska and Kansas," and is written by M.R. Bolick and R.K. Pabian. The Nebraska State Museum indeed features Nebraska fossils that represent perhaps the earliest angiosperms.

INSTRUCTIONAL PLAN

STUDENT OBJECTIVES

In this series of lessons, students will

- describe the reproductive advances of gymnosperms in comparison to mosses and ferns.
- describe the reproductive advances of angiosperms in comparison to gymnosperms.
- place the following in the correct evolutionary sequence, from oldest to most recent: gymnosperms, ferns, algae, angiosperms.
- describe the adaptations of the following plant parts: pollen, seeds, fruits; and
- explain the impact of the flowering plants on the animal kingdom.

PROJECT SEQUENCE

This study guide may be used by the teacher as he/she leads a class discussion, or it may be used directly by students working individually or in groups.

NAME_____
DATE_____

"How Flowers Changed the World" : A Study Guide

Background: "How Flowers Changed the World" is an essay from Loren Eiseley's most popular book, *The Immense Journey*.

Directions: After reading this essay, answer the following questions. You will also need to have access to a biology textbook and a geologic time line.

> *"The truth is, however, that there is nothing very 'normal' about nature. Once upon a time, there were no flowers at all."*
>
> "How Flowers Changed the World," p. 28

Introduction

1. Eiseley states that observers from the far side of our solar system could have perceived only one change in the whole history of the planet Earth. Describe this change and explain what would have been responsible for it.

2. What is Eiseley referring to when he notes the wandering fingers of green?

3. What was the soundless, violent explosion that Eiseley refers to?

4. Why could this be referred to as an explosion?

First Land Plants

1. What type of plants were the first to appear on land?

2. Eiseley notes that these plants clung of necessity to swamps and watercourses and did not move to drier areas. Why were these plants not successful on drier land?

3. In these earlier land plants, how were sperm transferred from one plant to another?

4. Name the geologic era and period when the first land plants emerged? How many millions of years ago was this? What were the dominant land animals during this geologic time?

Animal Life

1. Eiseley describes the animal life in the Age of Reptiles (Mesozoic) using the following terms and phrases: "*... a sleepier world...Tyrannosaurus...would stalk mindlessly... ...grave sleepwalking intentness....a world in slow motion ...*" According to Eiseley, what type of metabolism did these animals have that justified these descriptions? (note: today, dinosaur metabolism is a hotly debated issue; consider researching this issue further!)

2. Give a more thorough discussion of this type of metabolism, using other resource material.

3. A high metabolic rate and the maintenance of a constant body temperature are characteristics of _____ . Biologists use the term *homeothermic* to describe this type of metabolism. Why is this a more appropriate term?

4. What two groups (classes) of vertebrates have this type of metabolism?

5. According to Eiseley, what are some of the advantages of this type of metabolism?

6. Eiseley describes two demands for this type of metabolism. What are they?

7. Eiseley notes that the appearance of the flowering plants parallels the rise of birds and mammals. How did the rise of flowering plants affect the success of birds and mammals?

The Gymnosperms

1. What are some present-day examples of gymnosperms?

2. Name the geologic era and period when the first gymnosperms emerged? How many millions of years ago was this? Name some animals that lived during this time.

3. The sperm of these plants are contained in pollen grains. Eiseley notes that, because of this adaptation, the march over drier regions could be extended. Why did pollen allow these plants to be more successful than the earliest land plants?

4. Gymnosperms also were among the first group of plants to have seeds. A seed contains a young plant (embryo) and some nourishment (food source) for the young plant (see diagram of seed). What advantages does the seed give to the survival of the offspring?

5. Describe and sketch the life cycle of a gymnosperm. Include in your description the following: male cone, female cone, pollen, sperm, egg, seed. (use other resource material).

Angiosperms--the flowering plants

1. According to the geologic time line, when did the flowering plants first arise?

2. What animals were dominant during this period when the flowering plants arose? Were mammals and birds very successful at this time?

3. Describe the dominant plant life on earth when the flowering plants first arose. (What is Eiseley referring to when he states that all is "stiff, formal, upright and green, monotonously green"?)

4. What was the source of the explosion that occurred in the Eiseley living room?

5. In addition to flowers, angiosperms have fruits. A fruit is a structure that covers the seed. The word angiosperm actually means _____ seed . What does the term gymnosperm mean? (use alternate resource)

6. The fruit is an important adaptation because it helps disperse (transport) the seed. Why is this an important adaptation to a plant species? (note the Eiseley statement, A plant, a fixed, rooted thing, immobilized in a single spot, had devised a way of propelling its offspring across open space.)

7. Were the wisteria pods in the Eiseley living room fruits? Why?

8. List several other fruits and means of seed dispersal that Eiseley thought of after discovering the exploded wisteria pod. (note: are all fruits edible?)

9. Using a biology textbook, sketch a diagram of a typical flower and label the following: anthers, pistil, ovary, petals, sepals. Under the diagram, state the function of the anthers, pistil, and ovary. Answer the following: (a) where do the seeds form? (b) where does the fruit form? (c) what is the

difference between pollination and fertilization?

10. Were the first flowering plants probably pollinated by wind or insects?

11. What is the advantage of insect pollination over wind pollination?

12. Eiseley states that the older (non-flowering) plants began to fade away under this unequal contest. Why did he refer to this as an unequal contest?

13. What are the three sources of food that come from flowering plants? How did these affect the success of warm-blooded animals that have high metabolism?

14. The term co-evolution refers to the joint change of two interacting species. How does this apply to insects and flowering plants? (Include one example from the essay)

15. Grasses are flowering plants. Do grass flowers have large, colorful petals? How are grass flowers pollinated? Using examples from the essay, explain how the advent of grasses affected animal life on earth.

16. In the last paragraph of the essay, Eiseley states that, "The weight of a petal has changed the face of the world and made it ours." In your own words, write one paragraph summary of how flowers have indeed changed the world.