A Learning Activity Package Approach to Junior High School Science

Jerry Cunningham
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Dear Iowa Science Teacher:

I am pleased to be a part of science education in Iowa. Since my employment with the Department of Public Instruction in early September I have met many fine science teachers in Iowa.

Just a few words about my educational background. I attended elementary and secondary schools in west central Illinois. I received my first two degrees from Western Illinois University in Macomb, Illinois. Last May I received a doctorate in science education from the University of Northern Colorado in Greeley, Colorado.

My thrust in science education in Iowa will be aimed at the classroom teacher. I hope to be able to make service available to the classroom teacher by using key classroom teachers in Iowa.

I look forward to meeting all you teachers involved in teaching science, in the coming months.

If I can be of service to you, please contact me at the Grimes Building in Des Moines or call 515-281-3264.

Gary E. Downs
Consultant, Science Education
Division of Curriculum

A LEARNING ACTIVITY PACKAGE APPROACH TO JUNIOR HIGH SCHOOL SCIENCE

Jerry Cunningham
Ross Iverson
Miller Junior High School
Marshalltown, Iowa 50158

Introduction
When Sputnik went up so did the status of science in American schools and with the status came money and man power. The money came to individual classrooms as equipment and better trained teachers. A great deal of money and man-power went into developing curriculum projects. While most of these projects are very good, they are not always appropriate for specific times and places. The projects did provide a great many materials to choose from. Our classrooms were specific places and we had a desire to give our students the best possible science experience in the seventh and eighth grades. Our goals were to have a low-structured student centered program that made the best use of our physical facility, equipment, and teacher power. As a result, we formulated a design which included a format, procedures, and a set of materials.

We feel that our design is adaptable to many situations and may provide some ideas for you. The courses we teach are exploratory. We hope to offer the student a wide variety of new experiences while developing a continuing interest in the study of science and a systematic approach to solving problems.

Procedure and Philosophy
We use a "Learning Activity Package" (LAP) approach coupled with some lecture and use of many films. The course is predominantly laboratory oriented. The heart of the program centers on the LAP and the way it is used. An
explanation of the page, labeled "The Vascular Plants," will provide a feeling for our procedure and philosophy.

As you can see, the LAP we are using for illustration concerns "The Vascular Plants." This LAP is used with seventh and eighth graders. The "Test Day" blank is filled in with the test day which is also the date the LAP work is due.

A student can submit his LAP to the teacher for a grade as soon as he has achieved the grade desired. We encourage each student to strive for as high a grade as possible. For example, if a student decided to turn in his LAP for a "C" with a week to go before the due date, we will be very reluctant to take it. Instead, we will start discussing some of the supplemental activities selecting those we feel will have the highest interest for that particular student. If he can be talked into a "B" he may be able to be talked into an "A." If for some reason the test day comes and the work is not completed (and this does happen) we give them a grade for what they have with the promise that if and when more is turned in, the grade will be changed appropriately.

When the student hands a LAP in he gets the next one to start on. In this way we have what might be called a "modified continuous progress" program in that different students are working on different activities but they all have the same due date for packet completion.

Requirements
You will note that the first seven items on the packet are listed as requirements. These are the activities that we feel that each student must do in order to meet the basic objectives of the course. If he does these in a satisfactory manner he has earned a grade of "C."

As each requirement is completed (there is no particular order in which he must do these except that we do recommend that most students do the reading first) the student brings the completed work to an instructor for the instructor's O.K. or approval. If he receives the O.K. he may then go on to another activity.

An important part of our philosophy is that the acceptance level is not the same for all students. Some students will do a better job on one requirement than others. This is one of the places where individualized instruction becomes a vital factor in this program. We must know our students well enough to realize their capabilities and then encourage them to work to those levels.

Since this is a success-oriented course there must be some level of excellence at which all of the students may succeed. However, this level will vary from student to student. Students taking this course range from Special Education students to the "best" students in our school. They are all capable of succeeding at least to the "C" level.

Grades below "C" are reserved for students who do not, through lack of effort, meet the basic requirements. One of our goals is to see that this doesn't happen to anyone. We have not succeeded in this goal as yet but are getting closer to it. The last grading period we had zero "F's" and 11 "D's" for 222 students. The other grades were 61 "C's", 76 "B's", and 71 "A's" and three incompletes.

Supplemental Activities
There is no magic number of supplemental activities. Whenever we think of or see something that looks good we add it. Unlike the requirements, the supplemental activities do not have to be appropriate for all students. Moreover, it is not necessary to have enough equipment or books to accommodate a large number of students. In fact, you can have a supplemental activity listed even if you do not have the materials on hand. If a student wants to do one of these activities he can get what he needs. Don't underestimate their ability to improvise. If the student can't get materials he can always do a different activity. No one supplemental activity must be done by any student to get an "A". (Note supplemental activities number six.)

This leaves the proverbial door wide open to the students as well as to the instructor. A project can be so complex and involved that a young genius will find satisfaction from a worthy task completed or so simple that a special education student can find self satisfaction and derive a feeling of success.

While it is not necessary for any one supplemental activity to be available to all, it is essential that all students have some of these activities readily available. In this particular LAP supplemental activities 1, 2, and 9 can be completed by a large number of students. Supplemental activity number 3 on the other hand is available to only the top students even though the onion root tips are abundant in the classroom.
We encourage the student to set up a plan of attack when he starts a new LAP. The statement "only to be done after all requirements have been completed and approved" is included for our protection and the student's guidance even though it is not totally adhered to. For example, if a student knows he wants an "A" and sets out to get it, he can start any place. In fact, some activities or projects may take a waiting period of a week or more and should be started at the earliest opportunity. On the other hand, a student who must be pushed to get the requirements done will be encouraged to do those first. The student does not have to hand in or register a plan as is practiced in some "contract" grading systems. The individual attention given each student, combined with a knowledge of their past experiences, provides us the information we need to make demands on them.

The Open Lab
We feel that the Open Lab is a vital part of this program. Open Lab is a plan whereby students can come to the science area to work during any free time that they may have during the day. With traditional scheduling this could be during study hall or before or after school. With modular scheduling they may schedule themselves into the science area during what is commonly called unscheduled time. Of course this means that the lab area must have space for them to work and there must be an instructor available to supervise them while they are there. We are fortunate enough to be able to meet both of these requirements. The amount of open lab that can be held depends on such things as teacher scheduling. At the present time we have open lab 1/3 of the time. With additional planning and staffing we hope to make it at least 2/3 of the time next year.

It has been our experience that the open lab concept is much more valuable to the program than the Resource Center approach. With proper planning the resource materials needed (A.V., etc.) can be stationed in the lab areas. This relieves the teacher from the Resource Center area and makes them available to supervise the open lab space.

The Vascular Plants
(Plants with water pipes)

Name ____________________________
Class ____________________________
Test Day _________________________

Text: The World of Living Things (WLT)-
Chapter 5
Modern Science I - pages 269-276
Life - Its Form and Changes -
pages 274-305.

Requirements: SAVE ALL PAPERS

1. Read Chapter 5 of WLT, pp. 76-101 and answer in writing the "Check your understanding" questions on pages 85-88 and questions 4, 5, 6, and 7 on page 98.
3. Do "Seed Lab."
4. Do "Flower Lab."
5. Write out a short meaning to "The Vocabulary of Science" on pages 99-100 of WLT.
7. "Stomates Lab."

Supplemental Activities

1. Do "What are the Higher Plants" activity on pages 7 and 8.
2. Do "Living Chloroplast Lab."
3. Do the "Onion Root Tip Lab."
4. Seed Cone Collection.
5. Twig Collection.
6. Independent projects - see instructors.
7. "Seed Germination Lab."
8. "Finding Water Pipes Lab."
9. "Fern Spore Case Lab."

Grades:
For a "C" - do requirements
For a "B" - do requirements plus 2 supplemental activities
For an "A" - do requirements plus 4 supplemental activities
Science Open Lab Schedule

Schedule yourself for at least 2 mods of open lab per cycle

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Behavioral Objectives

1. Given several pre-soaked seeds the student will be able to:
   a. Locate the seed coat, ovary scar or hilum and the pollen scar or micropyle with 80% accuracy.
   b. Determine if the seed is from a monocot or a dicot with 100% accuracy.

2. Given a simple flower the student will be able to locate and diagram the pistil, stigma, style, ovary, stamen, filament, anther, petals, sepals, receptacle, and stem with 80% accuracy.

3. Given a composite flower the student will be able to locate and diagram the same parts as in a simple flower and determine if each flower is perfect or imperfect with 75% accuracy.

4. The student will be able to demonstrate a knowledge of the "Vocabulary of Science" words by choosing the correct response to multiple choice questions with 80% accuracy.

5. Having completed the "Stomates Lab" the student will be able to prepare a wet mount slide showing stomates and diagram one of them showing epidermal cells, guard cells and the stoma.

6. Having completed the "Onion Root Tip Lab" the student will be able to prepare a wet mount slide using a square technique using acetocarmine and to be able to locate three or more mitotic cells.

7. Having completed the "Seed Cone Collection" the student will be able to identify cones with 60% accuracy.

8. Having completed the "Twig Collection" the student will be able to identify unknown twigs with 50% accuracy.

Vascular Plants

Concepts:
1. The fern is a plant that has rhizoids, leaves and stems but reproduces by spores.
2. Seeds of trees like the pines and hemlocks are produced in cones.
3. Plants take in minerals and dissolved solids through root hairs.
4. During the first year a two year plant stores food in its root.
5. The prothallium of the fern produces sperm and egg cells.
6. An example of a monocot is the corn plant.
7. The food part of a bean seed is called the cotyledon.
8. The transfer of pollen from one flower to the pistil of another flower is called cross-pollination.
9. A shrub is a woody plant with several more or less erect stems.
10. A corn plant has many underground roots called fibrous roots.
11. Deciduous trees lose their leaves each year.
12. In a tree, the layer of growing cells between the bark and the outer ring of wood is called the cambium.
13. Trees grow new shoots each year from their terminal buds.
14. Water is carried to the leaves of the plant through xylem tubes in the vascular bundles.
15. All plants that have flowers or cones produce seeds.
16. Grasses are nonwoody plants that have hollow stems.
17. Leaves get rid of excess water by a process called transpiration.
18. Grass plants have parallel veins and are monocots.
19. The seeds of pine trees are found in the cones.
20. The term vascular refers to the tubes or passages found in some plants.
21. For a seed to germinate it must have water, air and warmth.
22. Not all vascular plants produce seeds.
23. Some vascular plants produce spores.
24. Dicots and monocots are both angiosperms.

Audio Visual materials to be used in the Resource Center or Classroom. Check and see if they are available to you.

Film strips: 143 - Ferns and Fern Allies; 145 - Gymnosperms; 146 - Monocotyledons; 147 - Dicotyledons; 90 - Leaves of Plants; 91 - Flowers and Fruits; 29 - Flowers, Fruits and Seeds; 34 - Parts of Flowering Plants.

Tapes: WLT Chapter 5 - A and B pages 76-85; WLT Chapter 5 - C and D pages 85-98; Ecology - Water Pollution - Part II; Ecology - Air Pollution - Part III.


Seed Lab

A. Bean or Pea Seed
1. Examine the outer seed coat of a dry bean seed. On one side you should be able to find two structures. The larger is an oval shaped scar where the seed was attached to the ovary of the flower. Just above or beneath it, you should find a smaller round structure. This is the place where the pollen tube entered the ovule before the nucleus was fertilized.

Draw the edge view of the seed and the structures. Label the ovary scar or hilum, pollen tube scar or micropyle and seed coat.

2. Using a well soaked seed, remove the seed coats and spread the cotyledons apart. The young embryo plant can be found along the side of one cotyledon. The cotyledons contain the stored food used by the embryo to grow. Is this the seed of a monocotyledon or dicotyledon?

Draw the cotyledon to which the embryo is attached. Label the cotyledon, plumule and radicle. Remember that the plumule will become the stem and leaves of the seed plant. The radicle will become the roots.

B. Corn Seed
1. Examine the outer coat of the corn seed. You may find a small pore along the top where the silk (pistil) was attached to the seed. Remember that each corn seed has developed from an ovary. The young embryo plant will lie beneath the light colored, indented area on the side.

2. Cut the soaked corn seed (as shown below) . . . Find the stored food and the young embryo. The embryo has a plumule of many little white leaves folded around each other. The young radicle will be located under it. Between the embryo and the stored food is the cotyledon which absorbs foods for the young embryo to use. Is this the seed of a monocotyledon or dicotyledon?

Draw the inside of the corn seed. Label the seed coat, stored food, cotyledon, plumule and radicle.

Cut on dotted line
Flower Lab

Flowers can be divided into two major groups:
1. Simple Flowers: having only one set of reproductive organs.
2. Composite Flowers: those having more than one set of reproductive organs.

A perfect flower has both male and female organs and an imperfect flower has either male or female parts but not both.

A. Using a simple flower such as a petunia, geranium (which can be found in the greenhouse) or a passion flower. dissect it completely and make a drawing or a set of drawings that show every part and label the ........ . . . .

B. Using a composite flower do the same as in part A (Use a dandelion or a mum.) You will find it necessary to make 3 drawings, one showing the flower head in which you label the stem, sepals, receptacle, and petals. Next do a ray flower and show the stigma, style, ovary, making up the pistil and the petals. If you have a dandelion you will also find the stamen consisting of the anther and filament and will be finished. If you are using a mum you will need a third drawing of the disk flower showing both male and female parts.

C. Parts to label: (1) pistil; (2) stigma; (3) style; (4) ovary; (5) stamen; (6) anther; (7) filament; (8) petals; (9) sepals; (10) stem; (11) receptacle (label on composite only).
Optional: (1) ovule; (2) pollen.

Stomates Lab

Objectives: to observe stomates.
Materials: Zebrina leaf, compound microscope, slide, slip cover, water.
Procedures: Place one of the leaves under your microscope. Look at the upper surface. You should be able to see rows of stomates. If you can not see them, peel off the epidermis and make a wet mount slide.
(1) Make a drawing of the stomates and label epidermis cells, guard cells and the opening.
(2) Write a short paragraph describing the function of the stomates.

Supplemental Activity 1

What are the Higher Plants

1. What two structures distinguish the flowering plants from all other kinds of plants?
2. The drawings below show the arrangement of leaves on stems. Look in biology textbooks and label each kind of arrangement in the spaces at the right.

A. ________________
B. ________________
C. ________________

3. In a typical flower, which part is (a) the male sex structure? (b) female sex structure?
4. How are the sperm cells in the pollen grain carried to the ovule?
5. What three structures make up a complete seed?
6. From what part of the flower does the fruit develop?
7. What advantage to the growth of a plant is the scattering of the seeds?
8. Give an example of a plant that scatters its seeds by means of (a) wind; (b) shooting them out; (c) water; (d) animals.

Tell what each term means: flowering plants; conifers; cambium layer; pollination; embryo.

9. Answer in complete sentences the questions on page 276 of Modern Science I.
10. Answer 5 questions of 276 of Modern Science I.
Living Chloroplasts Lab

One of the most common features of our world is green plants. Although few things have more beauty than the many shades of green in the forest and fields, we usually take this greenness for granted without pausing to ask why plants are green.

For our first detailed observation of living green plant cells, we will use leaves of Elodea, a common flowering plant which is usually found in fresh-water lakes, ponds, streams, and similar bodies of water. We find it frequently in pet shops and variety stores where it is sold for planting in aquaria.

As you observe these living cells in action, keep in mind that the green cells of Elodea are very similar in general structure to the green cells of most plants we see growing, and that they perform a similar function: food manufacture in the presence of light (photosynthesis). The purpose of this exercise is to look inside the cells of Elodea to discover where the green pigment (chlorophyll) is located.

Materials: Elodea, compound microscope, slide and cover glass, eye dropper.

Procedure: Take one Elodea from bowl and break off one of the younger leaves near the tip of the branch. Place it bottom side up in a drop of water on a clean slide and put on a cover glass.

When you look at this preparation under low power, you will see that some cells seem to be packed with small green bodies. These bodies are chloroplasts.

(1) What is the difference in function between the cells that contain chloroplasts and those that do not contain chloroplasts?

If the materials have been properly prepared you should be able to observe movement of the chloroplasts. As they move in the cell, chloroplasts look like little green beads in a chain -- one following the next in rather regular order.

When you have found a cell showing movement of chloroplasts, observe it under high power.

(2) What is the shape of a single chloroplast?

(3) Where in the cell are the chloroplasts located?

Chloroplasts have no means of independent locomotion -- they cannot swim or creep around on their own.

(4) How then, can you account for their movement?

(5) Make a drawing of the Elodea cell. (Large) Label the chloroplasts and draw arrows indicating their direction of movement.

Supplemental Activity 3

Onion Root Tip Lab

The objective of this lab is to see the cells that are dividing in the growing root tip. It is hoped that you will be able to see the different stages of the nucleus as it is going through mitosis. Look up the term "mitosis" in one of your texts in order that you will know what it is you are looking for.

There are no drawings required but the instructor must check and approve your slide. You may draw on this sheet if you like. Answer the questions at the end.

Use onion root tips. Ask the instructor. If they are not available you will need to grow some.

1. First examine the outside of the root tip.
2. Next place the end one-fourth inch of the root tip on a slide and add two drops of acetocarmine.
3. Place the slide on a hotplate until only a small amount of liquid remains. Do not allow the slide to dry up. If it starts to boil remove it and allow to cool for a few moments and replace it.
4. Add another drop of acetocarmine and reheat.
5. Add another drop and reheat.
6. Add a drop of H2O.
7. Place a cover slip on slide and squash it down flat with your finger. Next slide the cover slip around to spread out the root tip. Be gentle!
8. Look first under low power and then under high looking for fingers like those shown on the wall chart or in the text books.
9. Have the instructor check your slide.

O.K. of slide __________
Date __________
Question: Which phases of mitosis can you observe in your slide? (See pages 46 and 47 of General Zoology or Botany pages 43 or 46).

A. Instructor's O.K. 
B. Instructor's O.K. 
C. Instructor's O.K. 
D. Instructor's O.K. 
E. Instructor's O.K. 

Supplemental Activity 4

Seed Cone Collection

1. Collect at least 6 different kinds (or more) of cones from Gymnosperms (ever greens).
2. Identify them.
3. Mount them for display and bring them to school to be checked.


Supplemental Activity 5

Twig Collection

1. Collect at least 6 different kinds (or more) of twigs. (no leaves just the twigs)
2. Identify them.
3. Mount them for display and bring them to school to be checked.


Seed Germination Lab

This activity will take at least a week (7 days). Allow enough time for it. The objective of this activity is to determine which factors affect seed germination. A seed can be thought of as a plant waiting for a place to grow and germination as to what happens first when the seed finds a place to grow. Possible factors which would affect germination are light, heat, moisture and oxygen. Your task, should you decide to take this mission, will be to determine what are the important factors in seed germination. Finally, you will make a statement stating the ideal conditions for seed germination.

To do this you will need some seeds (radish or bean), paper towels, a refrigerator, water and some containers. You may do this at home or at school. Be sure that each of your containers are clearly marked. You will have to run four tests at the same time so you will need four identical containers. For each test use ten seeds.

Procedure: (1) Fold the seeds in 4 paper towels (10 in each towel). Label them as follows: (a) wet-warm; (b) wet-cold; (c) dry-warm; (d) dry-cold. (2) Moisten the towels used in packet a and b. Leave the towels of packets c and d dry. (3) Place all packets in their respective containers. (4) Place the containers holding packets b and d in the refrigerator; place packets a and c in warm place (room temperature).

After 5-7 days fill in the chart below and answer the questions asked. If you do this at home bring the packets to school to show your instructor the results.

Fill in the chart with the number of seeds in each test which germinate (start growing).

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(1) Have you proved that seeds can germinate with air present? 
(2) Have you proved that a seed can germinate without air? 
(3) What have you proved about a need for light or darkness? 
(4) Do seeds need warmth to germinate? 
(5) Do seeds need moisture to germinate? 
(6) Which seeds germinate the best? 

Finding Water Pipes Lab

We are now studying vascular plants, that is, plants with water pipes. You may want to see and study these tubes. To do this, celery can be used.

A. The first thing to do is set the celery stock with leaves in colored water (you may color the water with ink or food coloring)
and allow it to set overnight or longer. Now examine the stalks or stem. What changes have taken place?

B. Next take a short piece of the stem and split it lengthwise (see page 140 of Life diagram 3 for more information on how to cut the stalk) and look at it under a dissecting stereoscope. Sketch one or two of the tubes that you split open.

C. Now cut a very thin cross section of the stem and examine it under a compound microscope. (See diagram 2 on page 140 of Life.) Sketch and label the pattern of water tubes.

D. Select a small piece of stem from a dicot (ask the instructor) and make a cross-section slide as you did with the celery and sketch and label the water tube pattern you see. (See figure 24.10 on page 335 of Modern Biology.)

Fern Spore Case Lab

Ferns are the only group of vascular plants that reproduce by spores. The others use seeds. You know, from past experience, that seeds are dispersed in many ways. Some seeds are carried by the wind like the milkweed. Birds carry poison ivy seeds, or seeds may be carried by water and animal's fur. The spores are very tiny and do not move except by the wind, water, and a "spring snapper." When the air is moist the spore cases which contain the spores, open spring. The edge of the spore case opens up and acts as a coiled spring to propel the spores out into the world.

In this activity you will be looking at a fern leaflet and seeing the springed spore case and some spores. Look at the diagram on page 78 of WLT.

A. From an instructor, get a fern leaflet and examine it. Notice how the edges are curled up in some places. These still have the spore cases in them! Those that are open and fuzzy on the back have already dispersed their spores.

B. Take a clean slide and place the leaflet on it and smash part of it with your finger and you will notice little black granules which are the spore cases. Use a microscope to examine them. Sketch one of the spore cases and label the "spring."

C. Next add water and a cover slip. Smash the cover slip down to force the spores out. Take a good look and have your slide checked by an instructor. Slide check ---------You may want to take a slide of spore cases and add water and heat them to see if you can make them snap open.

These types of methods have proved to be effective in our particular educational setting. We believe that the added incentives, which are provided for the learner by such methods, have enhanced the interests and the achievement of students. Therefore, we would like to see this model implemented into more classrooms throughout the state of Iowa.

DID YOU KNOW ABOUT OUR ACTIVITY?

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The Iowa Science Teachers is sponsoring the following activities for science teachers of Iowa.

Inland Waters Seminar . . . . Lake Okoboji
Earth Science Seminar . . . . Knoxville
Junior High Seminar . . . . Oskaloosa
Fall Programs . . . . . . . . . Des Moines, ISEA
Short Course . . . . . . . . . Ames
Iowa Academy Science
Teaching Section . . . . . . . . Grinnell
SSMA National Meeting . . . . Des Moines 73
St. Louis NSTA Regional . . 1972
Junior Academy Field Days
Bloody Run
Okoboji
Luther Camp

Earth Science
Aquatic Field
Winter Field

We are going to try to expand our program to include seminars in physics, chemistry and elementary science. We need teachers with ideas to join us in our effort to get science education moving. We will help supply the personnel for your idea. Get with us in our movement to place Iowa in the forefront of activity in science education.

2ND ANNUAL WORKSHOP ON INLAND WATERS SPAWNS
PROJECT ON LITTLE SIOUX

Milbert Krohn

The second annual workshop on Inland Waters held at Lakeside Laboratory at Lake West Okoboji has ended. Participants have returned to their home schools and are now engaged in