AN ABSTRACT OF THE THESIS OF

Patricia D. Morrell for the degree of Master of Science
in Science, Mathematics, and Computer Science Education
presented on October 20, 1988.

Title:   The Effects of Computer Assisted Instruction on
Student Achievement in High School Biology

Abstract approved: *Redacted for Privacy*
                              Thomas E. Evans

The purpose of this study was to determine if
computer assisted instructional (CAI) tutorials in high
school biology differ in effectiveness in terms of
student academic achievement when compared with the more
traditional lecture/discussion type of instruction.
Additionally, student attitudes toward CAI were measured
using a student attitude questionnaire.

The sample was three general biology classes.
Alphabetical class ranking lists were prepared, which
were then alternately separated into the treatment group
and control group, producing three sets of two groups of
students of comparable academic achievement in the
subject matter.  The control group received the
traditional lecture/discussion photosynthesis lesson and
the treatment group, the CAI photosynthesis unit.  For

the genetics lesson, the two groups reversed roles, with the former control group receiving the CAI instruction.

Posttest results indicated that there was no significant difference in student achievement between the two instructional methods. Tutorial CAI's appear to be equal to traditional classroom instruction in their effectiveness in teaching new materials.

On the whole, students who worked with the CAI in photosynthesis were more favorable to this method of instruction than those who worked with the genetics CAI unit.

The Effects of Computer Assisted Instruction
on Student Achievement in High School Biology

by

Patricia Drozdowski Morrell

A THESIS

submitted to

Oregon State University

in partial fulfillment of
the requirement for the
degree of

Master of Science

Completed October 20, 1988

Commencement June 1989

APPROVED:

Professor of Science, Mathematics and Computer Science
Education, in charge of major

Head of Department of Science, Mathematics and Computer
Science Education

Dean of ᴳʳᵃᵈᵘᵃᵗᵉ ˢᶜʰᵒᵒˡ

Date thesis is presented     October 20, 1988

# ACKNOWLEDGEMENTS

# TABLE OF CONTENTS

# LIST OF APPENDICES

# LIST OF FIGURES

# LIST OF TABLES

# THE EFFECTS OF COMPUTER ASSISTED INSTRUCTION
## ON STUDENT ACHIEVEMENT IN HIGH SCHOOL BIOLOGY

## INTRODUCTION

Computers first found their way into the classroom in the early 1960's. In less than three decades, computers have become as commonplace in most school districts as books. Computer literacy and programming courses have been and are springing up like flowers after a spring rain. Unfortunately, use of computers by subject area teachers at the middle and high school levels has not blossomed. Bangert-Drowns, et al. (1985) reported that "high schools are treating their computers more as objects for study than as teaching tools," with more than 85% of computer use limited to computer education classes--a statement backed by McManes, et al. (1985).

There are several reasons why computers are not widely used as an educational tool. The high cost of hardware and software, which have dropped considerably in price over the years, still prohibits many schools from providing classroom sets (Darnowski, 1968; Farthing, 1975; Forman, 1982). Good quality software is scarce and much software is limited to run on only one computer system (Forman, 1982; Summerlin and Gardner, 1973; Tocci, 1981). School curricula have not been redisigned for effective use of computers (Mojowski, 1987). Finally,

little information is available on how effective

computers are when used as teaching

tools (Bangert-Drowns, et al. 1985; Forman, 1982;

Ybarrondo, 1984).

The effectiveness of computer drill and practice

programs on basic skills attainment and on the

enhancement of classroom activities by computer

simulations has been the topic of many previous

investigations (Bangert-Drowns, et al., 1985; Edwards, et

al., 1975; Farthing, 1975; Forman, 1982; Gallagher, 1987;

Harding County Board of Education, 1984; Kulik, et al.,

1983; Nakhleh, 1983; Smith, 1984; Summerlin and Gardner,

1973). However, few studies have been reported that deal

with the computer's effectiveness as a tutor, a role for

which the computer is well-suited (Summerlin and Gardner,

1973; Ybarrondo, 1984). If teachers are to make

decisions on when and how to best use computers in their

classrooms, more research in this area is needed.

## Statement of the Problem

The objectives of this study are to determine the

effectiveness of tutorial-type computer assisted

instruction (CAI) on high school students' achievement in

biology, to compare the effects of CAI versus the

traditional lecture/discussion type presentation on

selected scholastic groups, and to assess student
attitudes toward CAI.

## Definitions

Specific meanings of special terms used in this text
are as follows:

Achievement - grade a student receives on a teacher-made
post-test;

Tutorial - self-paced program used by students to learn
new material.

## Design of the Study

Tutorial-type CAI lessons will be written for two
topics in biology; namely, photosynthesis and genetics.
Three high school biology classes will serve as the
sample population. Each class will be divided into two
similar academic groups. For the first lesson, one group
from each class will serve as the control and receive
traditional lecture/discussion type instruction while the
other half of the classes will work in the computer room
with the developed CAI program. For the second lesson,
the groups will reverse their instructional mode: the
students who worked with CAI will receive a
lecture/discussion type of instruction and vice versa.
Achievement will be measured by administering a posttest
to both the control and treatment groups. The results
will be analyzed using a t-test. After working with the
CAI lesson, students will complete an attitude

questionnaire.  A line-item analysis will be performed on the surveys.

## Organization of Remainder of Study

The remainder of this thesis is organized into four chapters.  Chapter II contains a review of the related literature and research.  Chapter III describes the research design and methodology.  The results are presented in Chapter IV.  Chapter V is devoted to the discussion and conclusion of the study and recommendations for further research and practice.

REVIEW OF RELATED LITERATURE AND RESEARCH

Educational computer programs are generally grouped into two main divisions: those used to manage instruction (CMI) and those used to assist in instruction (CAI). CMI is used in calculating student grades, organizing student data, and other record-keeping functions. CAI is used directly in teaching and can be categorized as drill and practice, tutorial, simulation and tools for problem-solving, creating, etc. (Edwards, et al., 1975; Forman, 1982; Nakhleh, 1983; Vargas, 1986).

Some authors contend that the incorporation of computers into classrooms is necessary to ensure computer literacy (Luehrmann, 1980 as cited in Forman, 1982; Nakhleh, 1983). A search of the literature, however, provides many educational-based reasons to incorporate CAI into a school's curriculum (Edwards, et al., 1975; Farthing, 1975; Forman, 1982; McEwing and Roth, 1985b; Nakhleh, 1983; Summerlin, 1971; Summerlin and Gardner, 1973; Suppes, et al. 1985). A summary of these reasons is that a computer provides:

1. individualized instruction - the material and pace of presentation can be tailored to the needs of each student;

2. positive and varied reinforcement - graphics, sound, color, etc.;

3. immediate feedback;

4. active learner involvement;

5. endless patience;

6. review - the students can stop the program and redo sections where they need additional work and practice;

7. simulation of experiences not possible in the traditional classroom;

8. time for the teacher to work with each student on an individual basis; and

9. self-evaluations.

Additionally, the use of computers as tutors can increase the number and levels of courses made available to students. Computers can be used to target areas of greatest difficulty for students, and they can decrease teachers' record-keeping time (Gittinger, 1986; Suppes, et al. 1985; Ware, 1983).

In spite of these advantages, problems with computers as teaching aids do exist. Aside from those previously listed, other hindrances include the time involved in choosing a computer system and in selecting appropriate software, plus the training needed for teachers to be able to use computers in their daily teaching (Forman, 1982; Nakhleh, 1983).

Work has been done on the effectiveness of CAI; however, much of the literature does not differentiate between the specific types of CAI and reports on it in general terms. The results range from complete agreement to contradictory. Learning time was one area in which most of the studies agreed. Studies by Bangert-Drowns,

et al. (1985), Edwards, et al. (1975), Forman (1982),
McEwing and Roth, (1985a), Schloss, et al. (1984),
Summerlin (1971), Summerlin and Gardner (1973), and
Summerville (1984) suggest that CAI reduces learning
time; i.e., the time required for learning a specific
amount of material. Only one study (Carnes, 1985) showed
no significant difference in learning rate between CAI
and traditional instructional methods. Attitude toward
CAI instruction was another area of concurrence among the
researchers. Students were favorable to learning with
this method (Bangert-Drowns, et al. 1985; Forman, 1982;
Kulik, et al., 1983; Summerlin and Gardner, 1973;
Ybarrondo, 1984). Additionally, students were reported
to find CAI motivational (McEwing and Roth, 1985a;
Summerlin and Gardner, 1973).

Results of research on all other areas examined
proved to be inconclusive. Concerning retention of
subject matter by students, studies reviewed by Edwards,
et al. (1975) and Forman (1982), as well as the study
conducted by Summerlin and Gardner (1973), favor greater
retention using CAI. Conversely, Kulik, et al. (1983)
and McEwing and Roth (1985a) reported on studies that
suggest traditional teaching yields higher retention
rates. Carnes (1985) reported no significant difference
in retention between the two treatments.

The existing research has provided no conclusive
findings on whether achievement was higher using CAI or

traditional instruction. Studies by Carnes (1985), Narthasilpa (1984), and Ybarrondo (1984) showed no significant difference in achievement on tests by students taught using the two methods. Schloss, et al. (1984) found the achievement of students using CAI equalled or was greater than those receiving traditional instruction. Summerlin and Gardner (1973) and Wainwright (1984) reported that students receiving traditional instruction performed better on post-tests than students receiving CAI. Conversely, studies reviewed by Wallenberg, et al. (1985) and Kulik, et al. (1983) showed that CAI produced higher achievement scores. Summerville (1984) found no difference in test scores between students receiving the two instructional methods; however, significant differences were found between the means of the two groups, with the CAI group receiving the higher mean score. The review by Edwards, et al. (1975) included nine studies favoring achievement by CAI, eight studies producing little or no difference between the two treatments, and three studies yielding mixed results.

Even though the jury is still out on the effectiveness of CAI over traditional instruction on achievement levels, many studies suggest that CAI seemed to be most effective for the low level students as opposed to average and higher achievement level students (Bangert-Drowns, et al., 1985; Forman, 1982; Kulik, et al., 1983), and it is offered that reluctant learners

performed better using CAI (Forman, 1982). Several researchers suggested supplementing traditional instruction with CAI may be more effective than traditional instruction alone (Edwards, et al., 1975; Farthing, 1975; Summerlin, 1971; Ware, 1983).

When considering the findings of the related research, it is important to note the limitations of these studies. Most reviews did not list any particulars about how the studies were conducted. As stated previously, the specific form of CAI used was not noted in many cases. Sample sizes for many studies were not listed, and few studies were used as the basis for the concluding statements. For example, the review by Edwards, et al. (1975) reported on only two studies that dealt with the effect of CAI on different ability levels. Grade levels for the data ranged from first grade through college, with some reports failing to indicate a grade level. Bangert-Drowns, et al. (1985) criticizes reviews that have been done for reporting on studies of only marginal quality; i.e., studies without control groups and ones that inadequately report statistical results and/or produce inconsistent results. These authors included some of the studies reported on by Kulik, et al. (1983) in their negative comments.

If one looks for information just on science tutorials in secondary schools, little has been published. Of the 500 titles examined by Bangert-Drowns,

et al. (1985), only 42 were found to meet their criteria for selection. These criteria were as follows: (1) tested in actual classrooms in grades 7-12; (2) conducted in the field; (3) included control groups; (4) free from methodological flaws; and (5) having obtainable copies of results. Only one of these 42 studies was in high school science! Edwards, et al. (1975) listed no high school science tutorials in their review. Summerlin and Gardner (1973) stated that their literature search showed CAI in science to be an inadequately tested area. Ybarrondo (1984) also found the literature to be lacking in this area. Gallagher (1987) provides a good summation: "...computer applications to science instruction is a fertile field of inquiry" (p. 364).

Two studies, however, seem to be of particular relevance to this study. Ybarrondo (1984) investigated the effectiveness of a simulation and review tutorial on student achievement in a high school advanced biology course. The unit was on population genetics/evolution. The sample population consisted of 77 junior and senior students, separated into two comparable achievements groups with 39 in the CAI group and 38 in the control. The unit consisted of a three-week lesson taught by Ybarrondo. Both groups used the same text, study materials, lecture notes and the like. During the 15-day period, the experimental group worked two days with CAI. The first was a computer simulation of natural selection;

the control group paralleled this activity with a bean-counting laboratory exercise. Additionally, one day of CAI was used by the experimental group as a tutorial for review, reinforcement and remediation.

A posttest was administered to both groups. Analysis of the data by means of a t-test showed no significant difference between the achievment of the two groups at $p < 0.05$. Students' attitudes working with CAI were polled, and the results showed students were very interested in working with other CAI programs and found their experience to be favorable.

The main limitation of this study, as noted by Ybarrondo, is the selection of the sample. These advanced biology students had a mean overall grade point average of 3.42 and thus did not represent a normal distribution of high school students. He suggests the study be repeated with general biology students. Also, the posttest consisted of ten true/false questions, thirty multiple choice questions and a choice of three of five essays. The use of essays and permitting a choice seems questionable. The essay section was worth 30% of the final test grade, which means a portion of the tests were not directly comparable. Additionally, no evidence was presented that efforts were made to determine the validity and reliability of the criterion instrument.

Summerlin and Gardner (1973) performed a study on tutorial-type CAI in high school chemistry. The sample

consisted of 110 high school students, with 58 randomly assigned to the experimental group and 52 serving as the control. Both groups were tested for and exhibited similar academic ability. The control group was taught in an informal lecture-discussion manner while the experimental group reported to a computer center where the same information was presented to them through the tutorial CAI. The CAI students took a posttest of 60 objective items when they completed the program. The same posttest was administered to the control students after three weeks of teaching. Two months after the completion of the study, a second posttest was administered to all students to test their retention of the material. The results showed that the control group performed significantly higher than the experimental group on both posttests. Summerlin and Gardner also reported that CAI students completed the unit in a shorter time span. Seventy-two percent of the CAI group completed the work in less than half the time required by the traditionally instructed group. Students using CAI were reported to have had a favorable attitude toward that mode of instruction.

According to the researchers, their findings suggest "that a lengthy tutorial CAI program is probably not the most efficient and effective use of teacher, student and computer time" but the "positive aspects of CAI (that is, postive student interest, attitude, and time economy)

outweight the negative aspects" (Summerlin and Gardner, 1973, p. 81).

The existing literature and research reveal an obvious need for more investigations on the effective use of tutorial-type CAI on the secondary level. This is particularly true in the area of science.

## RESEARCH DESIGN AND METHODOLOGY

This chapter lists the criteria that led to choosing photosynthesis and introductory genetics as the topics for this study. It explains the selection of the student sample, the preparation of teaching materials, and the treatment used in this study. Finally, it outlines how the data collected will be analyzed. The null hypothesis to be tested is: no significant difference will be found between the means of the posttest scores of students receiving the CAI instruction and students receiving lecture/discussion treatment for the same material.

### Topic Selection

The units chosen for this study were photosynthesis and introductory genetics. These two areas were selected for the following reasons: (1) students find them troublesome; (2) the content can be easily adapted to a tutorial; (3) the introductory material can be presented in a short period of time; and (4) the topics lend themselves to objective testing.

### Selection of the Sample

The three classes of general biology students at Scio High School, Scio, Oregon, were used in this study. The students in each class period were listed alphabetically in decreasing order based on their first

and second term biology letter grade. The lists were then alternately separated into the treatment group and control group, producing three sets of two groups of comparable achievement in the subject matter. For the photosynthesis lesson, 27 students were in the control group and 29 were in the treatment group; the genetics lesson had 27 in the control group and 27 in the treatment group.

### Preparation of Teaching Materials

The text used in the biology course was <u>Biological Science:  An Ecological Approach</u>, BSCS Green Version, Fifth Edition (1982). The lessons prepared followed the material presented in this text. The learning objectives for the photosynthesis unit were as follows:  upon completing this unit, the students will:

1.  define photosynthesis;

2.  describe the photosynthetic experiments of van Helmont, Priestly and Ingenhousz;

3.  discuss the role of chlorophyll in the photosynthetic process;

4.  demonstrate the use of chromatography to separate plant pigments;

5.  write the chemical equation for the process of photosynthesis;

6.  explain the importance of ATP and ADP in the cell's energy process;

7. state what occurs in the dark and light reactions of photosynthesis; and

8. identify factors that affect the rate of photosynthesis.

A complete set of detailed teaching plans was written to meet these objectives. Objectives 1 and 2 were covered in one class period on the first day. Objectives 3, 5 and 6 were covered in one class period on the second day. Objective 4 was met through a laboratory activity in one class period on the third day, and the final two objectives were covered in one class period on the fourth day. The length of a class period was 49 minutes.

A tutorial-type CAI was then developed in the Applesoft BASIC language based on the teaching plans (Appendix A). The same objectives were covered. Objective 4 was met in the same manner as in the traditional teaching instructions; i.e., students were directed to complete the same laboratory activity. The CAI was prepared following the previously outlined guidelines suggested for effective software development [Klopfer, et al. (1983), Nakhleh (1983), and Vargas (1986)]. The software included graphics and text and was user-paced. Self-test quizzes were included, which provided brief explanations for incorrect responses. User involvement was stressed. For example, the key to be pressed to advance to the next screen was occasionally varied to ensure a student was indeed reading the

information presented. A student manual was also developed to accompany the software (Appendix B).

A 20 question multiple choice question posttest was written to test the objectives. Some of the test questions were taken from <u>Resource Book of Test Items,</u> <u>Biological Science: An Ecological Approach, BSCS Green</u> <u>Version, 5th Edition</u> (1982), while others were original (Appendix C).

Dr. Margaret Niess of the Department of Science, Mathematics and Computer Science Education at Oregon State University, Corvallis, Oregon, compared the teaching plans with the tutorial software to ensure the two methods paralleled each other and met the stated objectives. She also examined the test for content validity.

The learning objectives for the genetics unit were as follows: upon completion of this unit, the students will:

1. use the terms cross and filial;

2. associate Mendel with genetics;

3. distinguish among gene, trait and allele;

4. differentiate between and identify phenotype and genotype of given examples;

5. differentiate between homozygous and heterozygous;

6. use the terms dominant and recessive in relation to genotypes and crosses;

7.  apply (and identify) Mendel's three principles of
dominance, segregation and independent assortment; and

8.  use Punnett squares to perform simple and multiple
crosses.

Again, a full set of detailed teaching plans was
prepared.  The objectives were covered over a three-day
teaching regime.  A tutorial CAI was developed (Appendix
D) and an accompanying student manual was written
(Appendix E). The test for this unit was partly original
and partly taken from Resource Book of Test Items,
Biological Science:  An Ecological Approach, BSCS Green
Version, 5th Edition (1982) and consisted of 18 multiple
choice questions, 4 matching questions and the
construction of a Punnett Square for a simple cross
(Appendix F).  These materials were also reviewed for
compliance and validity by Dr. Niess.

Writing the tutorial CAI and appropriate testing
required a great deal of time.  From this experience, I
can concur with Summerlin (1971) and Darnowski (1968)
that it takes approximately 100 man hours for each one
hour of CAI produced.

A survey was written to assess student attitudes
toward CAI (Appendix G).  The instrument was comprised of
25 questions to be answered on a scale of five choices
ranging from strongly agree to strongly disagree.  To
ensure the tone of the question would not affect a
student's response, most of the statements were included

in two places on the questionnaire, written once favoring CAI and again in unfavorable wording. The user was also asked for comments and/or suggestions. Signing the form was optional.

## Treatment

The students were not told that they were to be part of a study but rather were told that they were going to try something new: some of them would be taught by computer while the others would remain in class. The students were then divided into the appropriate groups. This initially created an uproar on the part of many of the control students which calmed when they were told that later in the term they would work with the computers while the others stayed in class. Most students were enthusiastic about the opportunity to work with the computers. Several were skeptical, but all were willing to participate.

Each student in the treatment group received his/her own copy of the student manual. Aside from reporting to class for attendance, there was no instructional contact with their regular biology class during the tutorial period. After checking in, the treatment group went directly to the computer room and worked with the tutorial CAI until the end of each class session. These students were directed to work at their own pace through the program, take notes in the accompanying manual and go

over any sections as often as they wished. Generally, the students worked independently, but occasional hardware problems required students to pair up for parts of the tutorials. When students completed the tutorial, they were given the attitude survey to complete. The students did not rejoin the regular class until the end of the three-day (genetics) or four-day (photosynthesis) scheduled time frame.

The control group met in the regular classroom. Teaching was performed in the usual informal lecture/discussion style. The blackboard was used as a visual teaching tool. The aforementioned teaching plans were carefully followed so as not to deviate from the prescribed instruction.

At the close of each of the two units, the groups were reunited and the posttest was administered. There was a span of two months between the two selected CAI units.

## Analysis

The posttests were graded and the students' test scores were entered into the Number Cruncher Statistical System, Version 5.01 (Kaysville, Utah) for statistical analysis. The null hypothesis to be tested is: no significant difference will be found between the means of the posttest scores of students receiving the CAI

instruction and students receiving lecture/discussion treatment for the same material.

To help in analyzing the student attitude questionnaires, the five categories of student responses on the questionnaire were assigned numerical values as follows:  strongly agree = 5 points, agree = 4 points, undecided = 3 points, disagree = 2 points, and strongly disagree = 1 point.  The questionnaires from the two treatment groups were analyzed separately.  Average response values were calculated by multiplying the number of students responding in each particular response category by the numerical value assigned to that category.  The products were added and divided by the number of respondents.  The responses to each question by the two treatment groups were statistically analyzed question by question, by means of a t-test, using the Number Cruncher Statistical System.

RESULTS

## Student Achievement

Students' posttest scores on the achievement test were analyzed by means of t-tests. The computer-generated statistical data on student performance on the posttest for the photosynthesis unit are summarized in Table 1.

---

TABLE 1

TWO SAMPLE T-TEST RESULTS OF
POSTTEST ACHIEVEMENT SCORES OF STUDENTS
COMPLETING THE TRADITIONAL AND CAI
PHOTOSYNTHESIS UNITS

|  | Traditional | CAI |
|---|---|---|
| Number in Sample | 27 | 29 |
| Mean* | 14.70 | 14.17 |
| t value | -.5941287 | |
| Probability | 0.5549 | |

*maximum score = 20 points

---

From Table 1 it can be seen that no significant difference was found between the means of posttests of students receiving the two treatments at the 0.05 confidence level. As a result, the null hypothesis of no significant difference in achievement between the control and treatment groups was accepted at the 0.05 level.

Table 2 summarizes the computer-generated statistical data on student performance on the posttest for the genetics unit.

TABLE 2

TWO SAMPLE T-TEST RESULTS OF
POSTTEST ACHIEVEMENT SCORES OF STUDENTS
COMPLETING THE TRADITIONAL AND CAI GENETICS UNITS

|                    | Traditional | CAI |
|--------------------|-------------|-----|
| Number in Sample   | 27          | 27  |
| Mean*              | 17.22       | 15.33 |
| t value            | -1.632631   |     |
| Probability        | 0.1086      |     |

*maximum score = 25 points

Again, the null hypothesis is accepted as no
significant difference was found between the posttest
means at the 0.05 level.  However, the confidence level
was much lower for this unit (0.1086) than for the
photosynthesis unit (0.5549).

A paired t-test was used to compare the scores of
the students who participated in the photosynthesis CAI
and traditional genetics lessons.  The students' posttest
scores were converted from raw points to percentages for
each of the paired t-tests so the scores could be
compared.  Table 3 summarizes these data.

There was no significant difference between the
means of these posttest scores at the 0.05 level, and the
null hypothesis is accepted.

## TABLE 3

PAIRED T-TEST RESULTS OF
POSTTEST ACHIEVEMENT SCORES OF THE SAME STUDENTS
RECEIVING DIFFERENT TREATMENT FOR 2 UNITS:
CAI PHOTOSYNTHESIS UNIT AND
TRADITIONAL GENETICS UNIT

|  | Photosynthesis - CAI | Genetics - Traditional |
|---|---|---|
| Number in Sample | 27 | 27 |
| Mean* | 71.11 | 68.89 |
| t value | | 0.7770964 |
| Probability | | 0.44411 |
| Correlation Coefficient | | 0.5316 |

*maximum score = 100 points

A graph depicting the correlation of posttest scores for students receiving the CAI photosynthesis unit and the traditional genetics unit is represented as Figure 1.

Table 4 includes the results of the paired t-test, probability and correlation coefficient for the scores of the students who participated in the genetics CAI and traditional photosynthesis lesson.

## TABLE 4

PAIRED T-TEST RESULTS OF
POSTTEST ACHIEVEMENT SCORES OF THE SAME STUDENTS
RECEIVING DIFFERENT TREATMENTS FOR TWO UNITS:
CAI GENETICS UNIT & TRADITIONAL PHOTOSYNTHESIS UNIT

|  | Genetics - CAI | Photosynthesis - Traditional |
|---|---|---|
| Number in Sample | 27 | 27 |
| Mean* | 61.41 | 72.41 |
| t value | 3.436659 | |
| Probability | 0.0020 | |
| Correlation Coefficient | 0.6000 | |

*maximum score = 100 points

FIGURE 1

Comparison of Posttest Scores for Students Receiving
the CAI Photosynthesis Unit and the Traditional
Genetics Unit
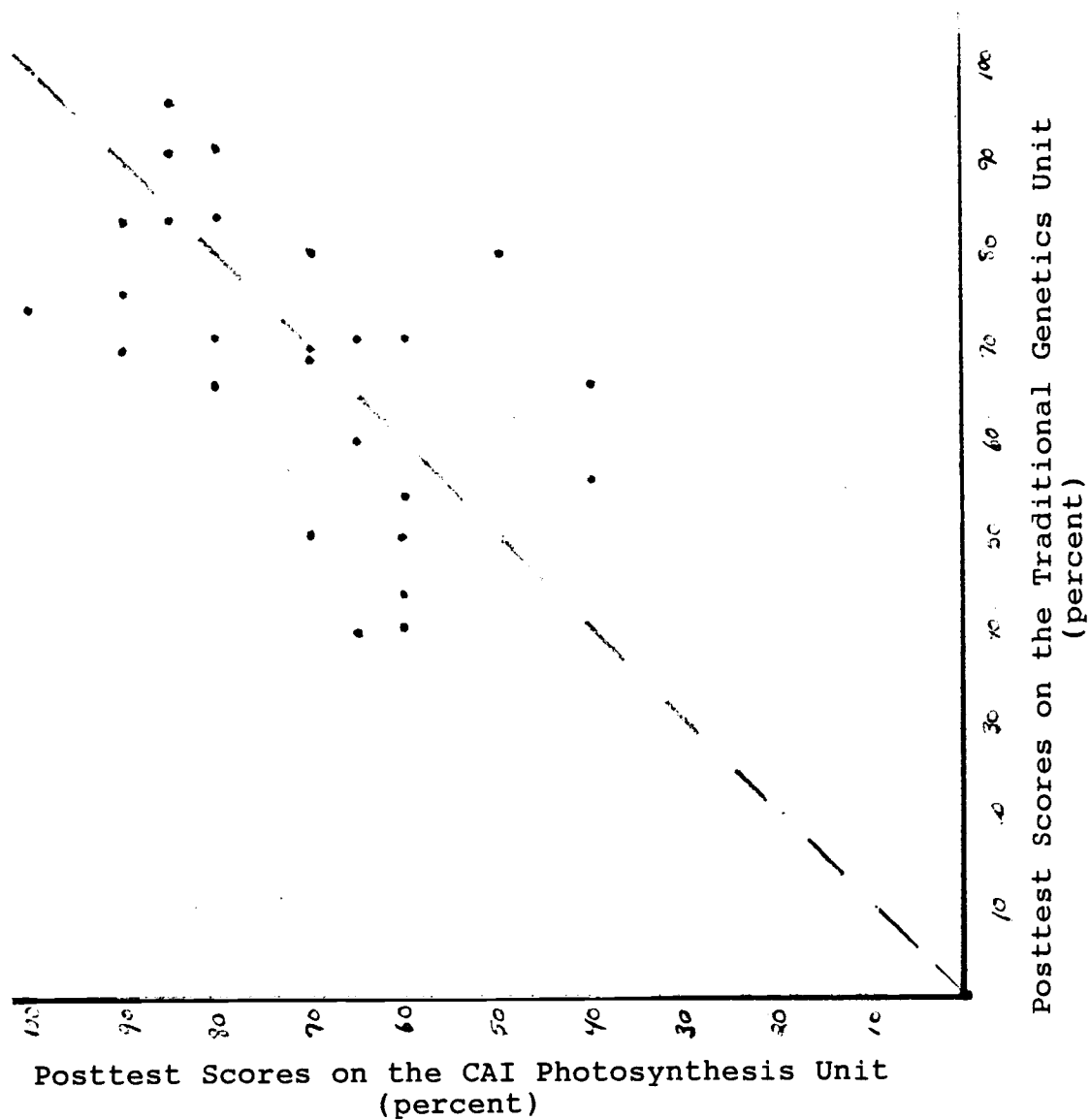
The data do show a difference between the means of the posttest scores which is statistically significant at the 0.05 level. The null hypothesis is rejected.

A graph depicting the correlation of posttest scores for students receiving the CAI genetics unit and the traditional photosynthesis unit is represented as Figure 2.

A paired t-test was computed to compare each student's achievement using the two treatments. The statistical data are summarized in Table 5.

TABLE 5

PAIRED T-TEST RESULTS OF
POSTTEST ACHIEVEMENT SCORES OF THE SAME STUDENTS
COMPARING CAI AND TRADITIONAL TREATMENTS

|  | CAI | Traditional |
|---|---|---|
| Number in Sample | 54 | 54 |
| Mean* | 66.26 | 70.46 |
| t value | -1.815816 | |
| Probability | 0.0751 | |
| Correlation Coefficient | 0.5104 | |

*maximum score = 100 points

The null hypothesis is accepted at the 0.05 level. No significant difference exists between the posttest means.

A graph depicting the correlation of posttest scores for students receiving the two educational treatments is represented as Figure 3.

FIGURE 2

Comparison of Posttest Scores for Students Receiving
the CAI Genetics Unit and the Traditional Photosynthesis
Unit



Posttest Scores on the CAI Genetics Unit
(percent)
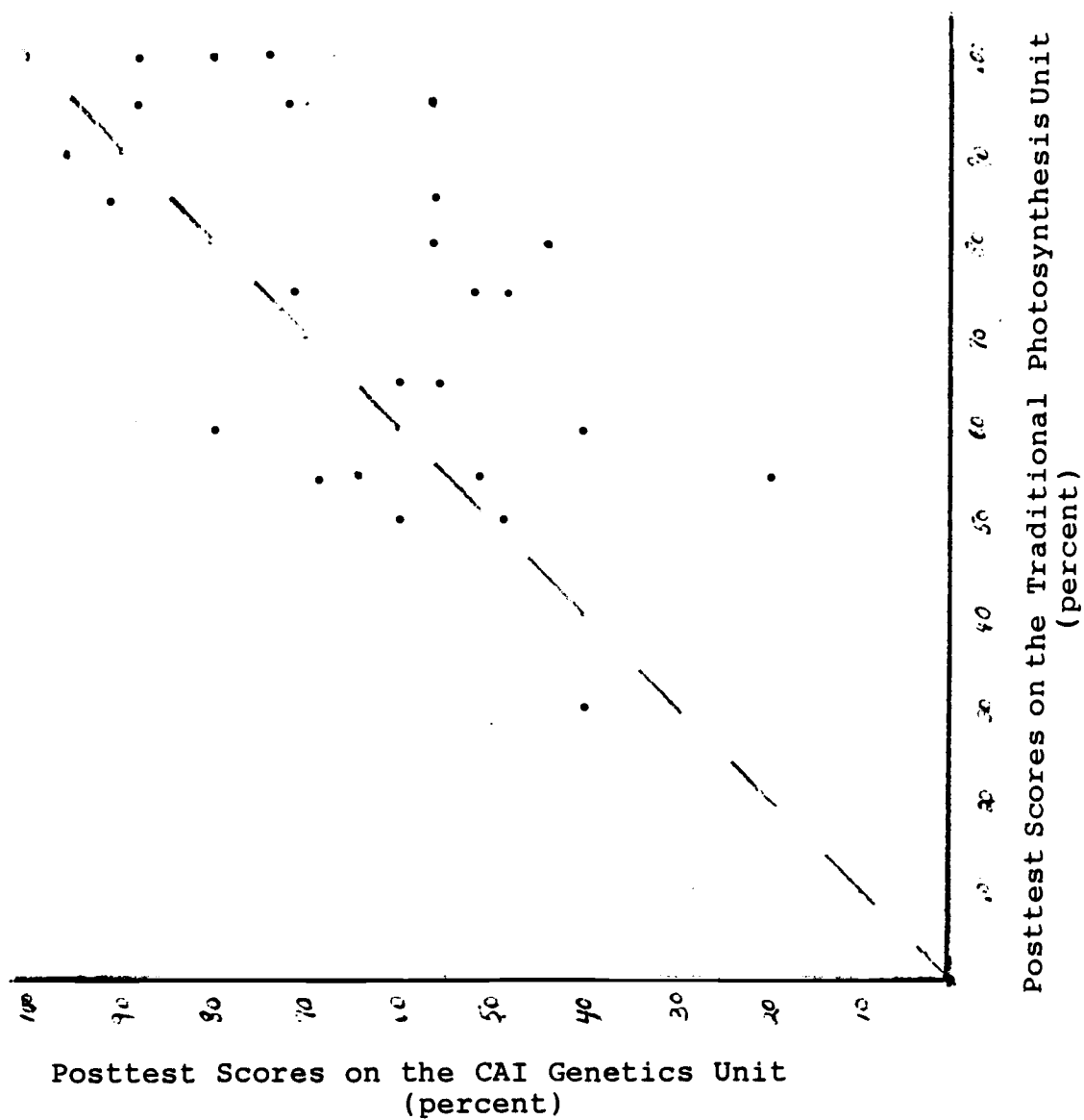
FIGURE 3

Comparisons of Posttest Scores for Students Receiving
the Two Educational Treatments:  CAI and Traditional
Lecture/Discussion
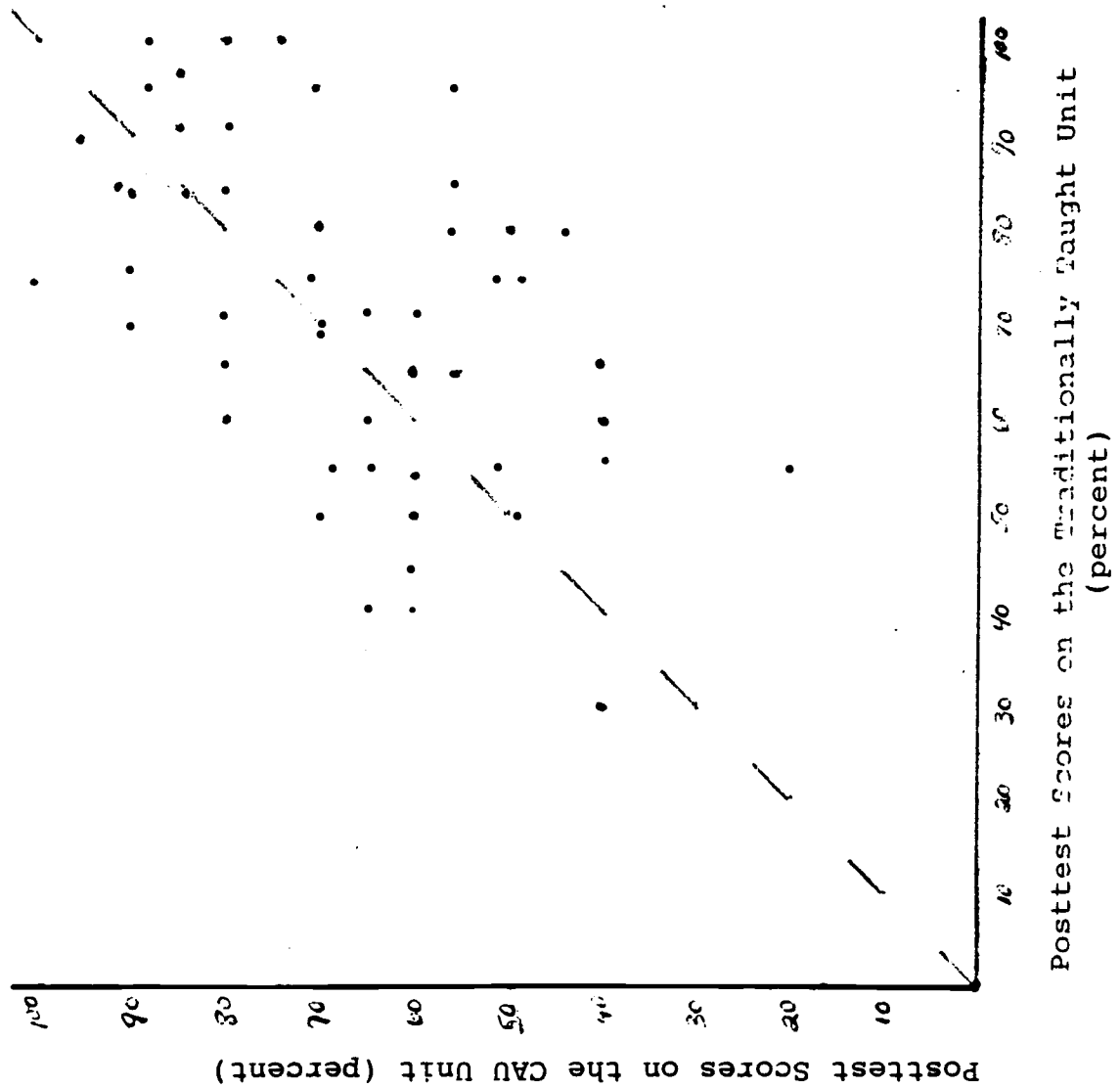
In summation, the data show that for both the photosynthesis and genetics units, the posttest achievement scores of students receiving CAI instruction did not differ significantly from those of students receiving traditional instruction.

## Student Attitude

The student responses to the questionnaire measuring student attitude toward CAI were tabulated and analyzed by assigning point values to each of the response categories as explained previously. The percentages of students choosing the five response categories for each statement upon completion of the photosynthesis CAI unit, as well as the average response values, are shown in Table 6. Comparable data from those students completing the genetics CAI unit are listed in Table 7.

The responses of the students from both groups were retabulated to make an overall composite. Each student's response, regardless of whether he participated in the genetics or the photosynthesis CAI units, was compiled for each statement on the questionnaire, percentages calculated, and the average response value figured. The collective response percentages and average response values are presented in Table 8.

A number of students wrote comments on their questionnaires. These are listed, identified by instructional unit, in Table 9.

TABLE 6

PERCENT RESPONSES IN 5 CATEGORIES AND
THE AVERAGE RESPONSE VALUE ON THE STUDENT ATTITUDE QUESTIONNAIRE
COMPLETED BY STUDENTS PARTICIPATING IN THE
CAI PHOTOSYNTHESIS UNIT[a]

| Statement | Student Response Category | | | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | SA | A | UN | D | SD | Avg[b] |
| no one cared if I learned | 0 | 4 | 20 | 40 | 36 | 1.92 |
| more involved with computer than lesson | 0 | 12 | 20 | 52 | 16 | 2.28 |
| worked at own pace | 36 | 52 | 8 | 4 | 0 | 4.20 |
| *CAI is too mechanical | 4 | 8 | 8 | 54 | 25 | 2.13 |
| uncomfortable with CAI | 12 | 4 | 0 | 48 | 36 | 2.20 |
| CAI is time efficient | 24 | 60 | 12 | 4 | 0 | 4.04 |
| CAI is more motivating than classroom instruction | 44 | 28 | 8 | 8 | 12 | 3.84 |
| CAI makes the subject more interesting | 44 | 28 | 12 | 8 | 8 | 3.92 |
| CAI is too impersonal | 0 | 4 | 36 | 48 | 12 | 2.64 |
| Prefer classroom teaching | 8 | 12 | 24 | 16 | 40 | 2.32 |
| Didn't care if missed a question | 4 | 12 | 0 | 60 | 24 | 2.24 |
| Liked the material before CAI | 4 | 32 | 44 | 16 | 4 | 3.16 |
| *Liked the material after CAI | 4 | 63 | 33 | 0 | 0 | 3.71 |
| Want more CAI units | 44 | 36 | 8 | 4 | 8 | 4.04 |
| Pressured to hurry up | 12 | 16 | 12 | 40 | 20 | 2.60 |
| Computer is not distracting | 20 | 60 | 8 | 12 | 0 | 3.88 |
| CAI is impersonal | 0 | 16 | 48 | 36 | 0 | 2.80 |

TABLE 6 (con't.)

| Statement | Student Response Category | | | | | |
| | SA | A | UN | D | SD | Avg[b] |
|---|---|---|---|---|---|---|
| CAI makes the material less interesting | 20 | 8 | 4 | 48 | 20 | 2.60 |
| *Comfortable with CAI | 42 | 42 | 4 | 8 | 4 | 4.08 |
| CAI is inefficient timewise | 8 | 20 | 8 | 48 | 16 | 2.56 |
| Classroom teaching is more motivating than CAI | 12 | 8 | 16 | 28 | 36 | 2.32 |
| Prefer CAI | 44 | 24 | 12 | 12 | 8 | 3.84 |
| Didn't like the material before CAI | 8 | 20 | 40 | 32 | 0 | 3.04 |
| *Didn't like the material after CAI | 0 | 16 | 25 | 58 | 0 | 2.58 |
| Do not want more CAI units | 16 | 0 | 8 | 24 | 52 | 2.04 |

a  Twenty five students completed the questionnaire, except for questions marked with an asterisk which had 24 responses.

b  The response categories are as follows:  SA = strongly agree, A = agree, UN = undecided, D = disagree, SD = strongly disagree.  Avg is the abbreviation for average.  The average response value for each item was calculated as follows:  Numerical values were assigned to the response categories, with SA awarded 5 points, A getting 4 points, etc. down to SD with 1 point.  These values were multiplied by the number of actual responses in that category for each statement.  The resulting products were added and divided by the number of respondents for that particular item.

TABLE 7
PERCENT RESPONSES IN 5 CATEGORIES AND
THE AVERAGE RESPONSE VALUE ON THE STUDENT ATTITUDE QUESTIONNAIRE
COMPLETED BY STUDENTS PARTICIPATING IN THE
CAI GENETICS UNIT[a]

| Statement | Student Response Category | | | | | AVG[b] |
| --- | --- | --- | --- | --- | --- | --- |
| | SA | A | UN | D | SD | |
| No one cared if I learned | 0 | 14 | 41 | 32 | 14 | 2.55 |
| More involved with computer than lesson | 14 | 32 | 9 | 36 | 9 | 3.05 |
| Worked at own pace | 27 | 27 | 27 | 18 | 0 | 3.64 |
| CAI is too mechanical | 9 | 27 | 46 | 9 | 9 | 3.18 |
| Uncomfortable with CAI | 23 | 23 | 18 | 36 | 0 | 3.32 |
| CAI is time efficient | 4 | 23 | 32 | 27 | 14 | 2.77 |
| CAI is more motivating than classroom instruction | 18 | 27 | 4 | 27 | 23 | 2.91 |
| CAI makes the subject more interesting | 9 | 27 | 5 | 41 | 18 | 3.14 |
| CAI is too impersonal | 18 | 9 | 64 | 9 | 0 | 3.36 |
| Prefer classroom teaching | 46 | 18 | 18 | 9 | 9 | 3.72 |
| Didn't care if missed a question | 5 | 14 | 14 | 55 | 14 | 2.41 |
| *Liked the material before CAI | 0 | 62 | 29 | 0 | 10 | 3.42 |
| Liked the material after CAI | 0 | 36 | 32 | 23 | 9 | 2.95 |
| Want more CAI units | 18 | 18 | 18 | 14 | 32 | 2.77 |
| Pressured to hurry up | 14 | 37 | 18 | 27 | 5 | 3.27 |
| Computer is not distracting | 9 | 36 | 32 | 14 | 9 | 3.23 |
| CAI is impersonal | 9 | 32 | 55 | 5 | 0 | 3.45 |
| CAI makes the material less interesting | 14 | 41 | 18 | 23 | 5 | 3.36 |

TABLE 7 (con't.)

| Statement | SA | A | UN | D | SD | AVG[b] |
|---|---|---|---|---|---|---|
| Comfortable with CAI | 5 | 32 | 32 | 23 | 9 | 3.00 |
| CAI is inefficient timewise | 5 | 9 | 50 | 27 | 9 | 2.73 |
| Classroom teaching is more motivating than CAI | 46 | 9 | 36 | 5 | 5 | 3.86 |
| Prefer CAI | 5 | 9 | 18 | 32 | 36 | 2.14 |
| Didn't like the material before CAI | 5 | 9 | 41 | 36 | 9 | 2.64 |
| Didn't like the material after CAI | 5 | 27 | 55 | 9 | 5 | 3.18 |
| Do not want more CAI units | 36 | 27 | 5 | 18 | 14 | 3.55 |

(Header spanning: Student Response Category)

a  Twenty-two students completed the questionnaire, except for the question marked with an asterisk which had 21 responses.

b  The response categories are as follows:  SA = strongly agree, A = agree, UN = undecided, D = disagree, SD = strongly disagree.  Avg is the abbreviation for average.  The average response value for each item was calculated as follows:  Numerical values were assigned to the response categories, with SA awarded 5 points, A getting 4 points, etc. down to SD with 1 point.  These values were multiplied by the number of actual responses in that category for each statement.  The resulting products were added and divided by the number of respondents for that particular item.

## TABLE 8

### PERCENT RESPONSES IN 5 CATEGORIES AND
### THE AVERAGE RESPONSE VALUE ON THE STUDENT ATTITUDE QUESTIONNAIRE
### COMPLETED BY STUDENTS PARTICIPATING IN
### CAI UNITS[a]

| Statement | Student Response Category | | | | | AVG[b] |
|---|---|---|---|---|---|---|
| | SA | A | UN | D | SD | |
| No one cared if I learned | 0 | 9 | 30 | 36 | 26 | 2.27 |
| More involved with computer than lesson | 6 | 21 | 15 | 45 | 13 | 2.64 |
| Worked at own pace | 32 | 40 | 17 | 11 | 0 | 3.94 |
| *CAI is too mechanical | 6 | 17 | 26 | 33 | 17 | 2.63 |
| Uncomfortable with CAI | 17 | 13 | 8 | 43 | 19 | 2.72 |
| CAI is time efficient | 15 | 43 | 21 | 15 | 6 | 3.45 |
| CAI is more motivating than classroom instruction | 32 | 28 | 6 | 17 | 17 | 3.40 |
| CAI makes the subject more interesting | 28 | 28 | 8 | 23 | 13 | 3.55 |
| CAI is too impersonal | 9 | 6 | 49 | 30 | 6 | 2.98 |
| Prefer classroom teaching | 26 | 15 | 21 | 13 | 25 | 2.77 |
| Didn't care if missed a question | 4 | 13 | 6 | 57 | 19 | 2.32 |
| *Liked the material before CAI | 2 | 46 | 37 | 9 | 7 | 3.28 |
| *Liked the material after CA | 2 | 50 | 33 | 11 | 4 | 3.35 |
| Want more CAI units | 32 | 28 | 13 | 9 | 19 | 3.45 |
| Pressured to hurry up | 13 | 26 | 15 | 34 | 13 | 2.91 |
| Computer is not distracting | 15 | 49 | 19 | 13 | 4 | 3.57 |
| CAI is impersonal | 4 | 23 | 51 | 21 | 0 | 3.11 |
| CAI makes the material less interesting | 17 | 23 | 11 | 36 | 13 | 2.96 |
| *Comfortable with CAI | 24 | 37 | 17 | 15 | 6 | 3.57 |

TABLE 8 (con't.)

| Statement | Student Response Category | | | | | AVG[b] |
|---|---|---|---|---|---|---|
| | SA | A | UN | D | SD | |
| CAI is inefficient timewise | 6 | 15 | 28 | 38 | 13 | 2.96 |
| Classroom teaching is more motivating than CAI | 28 | 9 | 26 | 17 | 21 | 3.04 |
| Prefer CAI | 26 | 17 | 15 | 21 | 21 | 3.04 |
| Didn't like the material before CAI | 6 | 15 | 40 | 34 | 4 | 2.85 |
| *Didn't like the material after CAI | 2 | 22 | 39 | 35 | 2 | 2.87 |
| Do not want more CAI units | 26 | 13 | 6 | 21 | 34 | 2.57 |

a  Forty-seven students completed the questionnaire, except for the question marked with an asterisk which had 46 responses.

b  The response categories are as follows:  SA = strongly agree, A = agree, UN = undecided, D = disagree, SD = strongly disagree.  Avg is the abbreviation for average.  The average response value for each item was calculated as follows:  Numerical values were assigned to the response categories, with SA awarded 5 points, A getting 4 points, etc. down to SD with 1 point.  These values were multiplied by the number of actual responses in that category for each statement.  The resulting products were added and divided by the number of respondents for that particular item.

Individual t-tests for each question on the survey were computed to compare the responses of the students receiving the CAI treatment on photosynthesis and on genetics. Statistical differences at the 0.05 level were shown to exist in the two groups' responses for all questions except numbers 3, 11, 12, 15, 20, and 23. The t-values, degrees of freedom, and probability values for all questions are presented in Table 10.

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TABLE 9
COMPILATION OF STUDENTS' WRITTEN COMMENTS ON
THE STUDENT ATTITUDE QUESTIONNAIRE
AFTER COMPLETING A CAI UNIT

The following were written in the comments section on the questionnaires completed by students receiving the CAI treatment for the photosynthesis unit:

Science has never been a very interesting subject to me. Working with the CDI I enjoyed it more. It's harder to understand it in class.

I liked the CDI but I wouldn't want to use it for every unit. Maybe every other one or every two units. It was fun and more interesting but you couldn't ask questions about things you didn't understand. If we were to do it again, I think we should be able to ask questions and maybe work with partners.

I like it a lot better when you teach me. I understand it a lot better.

I liked the CDI because I like computers and I thought it was fun. But Mrs. Morrell is a great teacher and I learn more from her.

I enjoyed using the computers because it wasn't boring and I learned.

I thought CDI was very helpful for me. I was a lot more interested and I wanted to learn. I think CDI is really neat.

I like using the computer better. I think I learned more on the computer than hearing and taking notes.

TABLE 9 (con't.)

I like to do it in class because it's easier to ask questions, and we can discuss things, but I still learned things using CDI, so I can learn either way, but I enjoy in-class discussion more. I like the humor in the program, it kept it from being too boring.

The only bad thing is if you don't understand, there is no way to get help. But I thought it was a good experience.

I liked CDI, but I didn't learn as much.

\*   \*   \*   \*   \*

The following were written in the comments section on the questionnaires completed by students receiving the CAI treatment for the genetics unit:

I didn't understand things, and there was no way to ask questions.

I felt like I was really confused because the teacher wasn't there to help me when I was confused (and believe me I AM!!!)

I felt that I didn't understand the material as well as I did with the classroom material. It was harder to understand.

I think the classroom teaching is better because if there are any questions then we can ask you. We can't ask the computer any questions.

When in the classroom, it is easier to ask questions on things that you don't understand. In CDI there's no one to ask questions to if you don't understand.

I did not understand when I was done. You could not ask it questions or in a certain section you could not get special help. I don't think it is fair for us to be the victims of this torture. It will go down on our grade how we did on the test and if we did not get good grades it was not our fault that we did not understand it.

I like CDI. We need a break from being in the classroom being talked to all period. It was quieter in the other room. We could get up and move around a little when we got stiff. I think it was easier to understand.

It was a cool way to learn in school. Ain't I no fool or a stubborn mule. That cool.

**TABLE 10**
AVERAGE RESPONSE VALUE, t-VALUES, AND PROBABILITY VALUES
FOR EACH ITEM ON THE STUDENT ATTITUDE QUESTIONNAIRE
COMPLETED BY STUDENTS PARTICIPATING IN CAI UNITS[a]

| Statement | Photo | Genetics | t-value | Prob.[b] |
|---|---|---|---|---|
| No one cared if I learned | 1.92 | 2.55 | -2.416 | 0.020 |
| More involved with computer than lesson | 2.28 | 3.05 | -2.336 | 0.025 |
| Worked at own pace | 4.20 | 3.64 | 2.023 | 0.050 |
| *CAI is too mechanical | 2.21 | 3.18 | -3.183 | 0.003 |
| Uncomfortable with CAI | 2.08 | 3.32 | -3.381 | 0.002 |
| CAI is time efficient | 4.04 | 2.77 | 4.667 | 0.000 |
| CAI is more motivating than classroom instruction | 3.84 | 2.91 | 2.190 | 0.034 |
| CAI makes the subject more interesting | 3.92 | 2.68 | 3.246 | 0.002 |
| CAI is too impersonal | 2.32 | 3.36 | -4.334 | 0.000 |
| Prefer classroom teaching | 2.32 | 3.82 | -3.780 | 0.000 |
| Didn't care if missed a question | 2.12 | 2.41 | -0.938 | 0.353 |
| *Liked the material before CAI | 3.16 | 3.43 | -0.996 | 0.325 |
| *Liked the material after CAI | 3.71 | 2.95 | 3.131 | 0.004 |
| Want more CAI units | 4.04 | 2.77 | 3.157 | 0.003 |
| Pressured to hurry up | 2.60 | 3.27 | -1.840 | 0.072 |
| Computer is not distracting | 3.88 | 3.23 | 2.245 | 0.030 |
| CAI is impersonal | 2.80 | 3.45 | -3.101 | 0.003 |
| CAI makes the material less interesting | 2.60 | 3.36 | -1.996 | 0.052 |
| *Comfortable with CAI | 4.08 | 3.00 | 3.382 | 0.002 |
| CAI is inefficient timewise | 2.56 | 2.72 | -0.520 | 0.606 |

TABLE 10 (CON'T.)

| Statement | Photo | Genetics | t-value | Prob.[b] |
|---|---|---|---|---|
| Classroom teaching is more motivating than CAI | 2.32 | 3.86 | -4.062 | 0.000 |
| Prefer CAI | 3.84 | 2.14 | 4.609 | 0.000 |
| Didn't like the material before CAI | 3.04 | 2.64 | 1.464 | 0.150 |
| *Didn't like the material after CAI | 2.58 | 3.18 | -2.493 | 0.016 |
| Do not want more CAI units | 2.04 | 3.54 | -3.482 | 0.001 |

a  Forty-seven students completed the questionnaire, except for the question marked with an asterisk which had 46 responses.

b  The response categories available to the respssondents were as follows: SA = strongly agree, A = agree, UN = undecided, D = disagree, SD = strongly disagree.  The average response value for each item was calculated as follows:  Numerical values were assigned to the response categories, with SA awarded 5 points, A getting 4 points, etc. down to SD with 1 point.  These values were multiplied by the number of actual responses in that category for each statement.  The resulting products were added and divided by the number of respondents for that particular item.  Photo represents the heading for the average response value in the Photosynthesis CAI Unit.  Genetics represents the heading for the average response value in the Genetics CAI unit.  Prob. is the abbreviation for probability value.

# SUMMARY, CONCLUSION, DISCUSSION AND RECOMMENDATIONS

## SUMMARY

The purpose of this study was to determine if CAI tutorials in high school biology differed in effectiveness in terms of student academic achievement when compared with the more traditional lecture/discussion type of instruction. Additionally, student attitudes toward CAI were measured using a student attitude questionnaire. The results indicated that there is no significant difference in student achievement on posttests between the two treatment methods. Tutorial CAI's appear to be equal in their effectiveness in teaching new material as traditional classroom instruction.

On the whole, students who worked with the CAI in photosynthesis were more favorable to this method of learning than those working with the genetics CAI unit.

Since no significant difference was found between the posttest mean scores for the two treatments, CAI tutorials cannot be ruled out as a means of instruction. However, students did score higher on the photosynthesis unit and students from that unit preferred the CAI-type instruction. It would appear from this work, that CAI tutorials would be more beneficial modes of instruction in units that are conceptually simple and do not present many new vocabulary terms.

## Conclusion and Discussion

## Relationship between CAI and Achievement

All the data indicated that the CAI tutorials used in this study had the same effect on student academic achievement as the more traditional lecture/discussion presentations of the instructional material. Analyses of both the photosynthesis and genetics unit revealed no significant difference in posttest achievement scores of students receiving the two treatments. Comparing all students' scores on an achievement test for CAI mode of presentation with all students' scores for the lecture/discussion presentation, again no significant difference between the two treatments was evident.

The data showed that the CAI and lecture/discussion methods of presentation of the unit on photosynthesis had a very similar effect on student achievement based on posttest scores. The means were not significantly different (14.17/20 for CAI and 14.70/20 for lecture/discussion) having a probability level of 0.5549. The instructional material for this unit was fairly straight-forward. There were few vocabulary words being introduced to the student and the concepts were relatively simple. All students in this study, and probably all students at the high school level, had some notion of what photosythesis is from grade school

in the lower grades, enriching the material. It also reinforced a concept introduced earlier in the biology course; namely, the relationship between bonds and energy.

The data from the genetics unit showed treatments by CAI and lecture/discussion, while not significantly different, were not as similar in their effect on student achievement based on posttest scores compared with the photosynthesis unit. The probability level for the genetics block is 0.1126. The means for the two treatments in genetics showed the lecture/discussion method yielded a higher test average (17.22/25) than the CAI (15.33/25).

There may be several possible reasons to explain why the different treatments in photosynthesis produced posttest scores more comparable than the genetics block. The genetics unit had many new terms and abstract concepts. For the most part, students were not familiar with the material presented in this unit. Compared with the photosynthesis, the genetics unit was of a higher level in Bloom's taxonomy. Accordingly, the posttest scores were lower for this unit than the photosynthesis lessons, regardless of treatment. The genetics unit required more abstract thought, deductive reasoning and application.

In conclusion, it would appear that CAI tutorials can be more effective in promoting student achievement if

the unit being presented is one students are familiar with and serves to enhance and extend present student knowledge. Conversely, the data suggest that CAI tutorial units are less effective substitutes for lecture/discussion treatments in areas where concepts are new, terms are many, and thinking is on higher levels.

Pairing the posttest results of students on both treatments supported the use of CAI tutorials for less abstract units. There was no significant difference at the 0.05 level between the means of posttests of students receiving CAI for photosynthesis and traditional instruction for genetics. There was a significant difference at that level, however, in posttest scores for students receiving CAI for genetics and traditional instruction for photosynthesis.

Correlation coefficients for all paired t-tests showed no strong correlations between a students' scoring on posttests after traditional instruction and CAI presentation, as Figures 1, 2, and 3 graphically depicted. It can be concluded that in this study no particular achievement level group appeared to score higher on posttests after traditional versus CAI modes of instructional presentation.

Student Attitudes toward CAI

The questions and response values of the photosynthesis group and genetics group are shown in

Tables 7 and 8, respectively. Student comments are listed in Table 9; and the statistical analysis of the groups' responses are presented in Table 10.

There were definite differences in student attitude toward CAI depending on which CAI unit the student worked with. In general, few students from either group found CAI units to be too mechanical or complicated to use. They did not feel as though no one cared about whether or not they learned and were themselves concerned with selecting the correct responses when prompted by the computer. However, the students working with the CAI photosynthesis unit were more favorable toward CAI treatment than those working with the CAI genetics unit.

Those students in the photosynthesis CAI unit felt the treatment was an efficient use of their time, not impersonal, and were comfortable with the treatment. In contrast, the genetics CAI group disagreed their time was used efficiently and were less certain as to how impersonal the treatment was and how comfortable they felt with the treatment.

The photosynthesis group found CAI to be more motivating than classroom instruction while the genetics group found CAI to be less so. Additionally, the first group leaned toward the feeling that CAI made the material more interesting while the latter disagreed.

More revealing were the results that the photosynthesis group did not favor traditional classroom

instruction over CAI and wanted more CAI units. Conversely, the genetics group did not prefer CAI units and did not want more units taught in this manner.

Evidence that CAI treatment had a negative effect on those students participating in the genetics unit was shown in their feelings toward the class material before and after the CAI treatment. In both the genetics and photosynthesis group, the students were undecided as to whether or not they disliked the material before the CAI presentation; no significant difference was found between the means of the two groups on this question. After treatment, however, the students' attitudes changed. The photosynthesis group now disagreed with the statement that they did not like the material while the genetics group agreed! This difference is significant.

In conclusion, based on the results of the questionnaires and the additional comments provided by some students, it would appear that those in the photosynthesis CAI unit were more favorable to learning with a computerized tutorial than those students working with the genetics CAI unit. Given the higher mean posttest scores on the photosynthesis test, one has to wonder whether the attitude of the students affected their results or whether the photosynthesis material was indeed easier to learn making the entire experience a more favorable one for those students involved.

## Recommendations

It is intuitively obvious that more studies need to be done to determine the effects of CAI tutorials on student achievement in high school science. This study, like most others, did not offer much light on the academic worth of using CAI tutorials in our classrooms.

I have some recommendations concerning replication of this particular study. First, the student sample size needs to be increased. I was limited by Scio High School's small student body. A wider base might offer more interesting, revealing data. Second, I would suggest that several teachers participate in the replication. Student academic achievement can be influenced by the teacher of the instructional material. Since I was the only teacher in this study, it may be that the academic achievement of students receiving the lecture/discussion treatment was more of a reflection of my teaching skills rather than of the method itself. If several teachers lecture using the prepared materials, the instructional bias could be investigated as a possible variable or removed. Additionally, I would suggest that the students work in groups of 2 or 3 on the computers. The biggest complaint of the CAI students was the inability to ask questions. If they were working consistently in groups, perhaps the group could collectively deal with problems as they arose.

The inability to question the teacher points to a major area of weakness in this and similar studies. They are removed from the reality of the daily classroom. If I were to use the tutorials as part of my teaching materials, I would be able to field questions from the students as they arise. In a controlled set-up, this is not possible as I would, in effect, be teaching the group the computer is supposed "to teach." The effectiveness of using a teacher/CAI tutorial coupling versus traditional lecture/discussion methods is an area that has not been and should be more fully investigated.

A main drawback to the use of computers in science classrooms today is the lack of quality software available. If software were written following the guidelines research has shown to be effective, I feel there would be less apprehension concerning the incorporation of computerized lessons into the schools.

The question of the effect of CAI instruction on student academic achievement in high school biology still remains unanswered. However, due to the positive attitudes student have toward working with CAI units, it is an area that merits further research.

LITERATURE CITED

Bangert-Drowns, R. L., Kulik, J. A., & Kulik, C. C. (1985). Effectiveness of computer-based education in secondary schools. Journal of Computer-Based Instruction, 12(3), 59-68.

BSCS. (1982). Biological Science: An Ecological approach. BSCS Green Version (5th ed.). Boston: Houghton Miffin Co.

Bork, A. (1984). Computers in education today and some possible future. Phi Delta Kappan, 66, 239-243.

Carnes, E. R. (1985). Microcomputer tutorial physics programs with advance organizers used in various size groups. Dissertation Abstracts International, 46(5):1241A.

Darnowski, V. S. (1968). Computer-aided instruction. A tool for science teaching in the 70's. The Science Teacher, 35, 22-28.

Edwards, J., Norton, S., Taylor, S., Weiss, M., & Dusseldorp, R. (1975). How effective is CAI? A review of the research. Educational Leadership, 33, 147-153.

Farthing, F. (1975). Computer-assisted instruction: some current literature. In Department of Computer Science, University of Oregon (Ed.), Computers in Educational Resource Handbook. Oregon: University of Oregon.

Forman, D. (1982). Search of the literature. The Computing Teacher, 9(5), 37-51.

Gallagher, J. J. (1987). A summary of research in science education - 1985. Science Education, 71, 358-364.

Gittinger, J. D. (1986). Mobile-computer-assisted instruction in rural New Mexico. ED266903.

Hardin County Board of Education. (1984). The fourth basic: computer skills. Final Report. ED259146.

Klopfer, L. E., Abegg, G. L., Batoff, M. E., Doyle, J., Finley, F. N., Horak, W., Keane, J., Luncsford, D., & Lunetta, V. N. (1983). Microcomputer software evaluation instrument. Version 1983. The Science Teacher, 51(1), 95-98.

Kulik, J. A., Bangert, R. L., & Williams, G. W. (1983). Effects of computer-based teaching on secondary school students. Journal of Educational Psychology, 75, 19-26.

McEwing, R. A. & Roth, G. L. (1985a). Computer-based instruction - an examination of communication patterns. Media and Methods, 21(7), 18-22+.

McEwing, R. A. & Roth, G. L. (1985b). Individualized learning with computer-based instruction. Educational Technology, 25(5), 30-32.

McManus, J., Cannings, T., McCall, C. (1985). Developing instructional applications at the secondary level. The computer as a tool. ED265850.

Meyer, D. E. & Mayer, W. V. (1982). Resource Book of Test Items, Biological Science: An Ecological Approach, BSCS Green Version (5th Ed.). Colorado: Houghton Mifflin Co.

Mojowski, C. (1987). Technology and curriculum: will the promised revolution take place? NASSP Bulletin, 71(496):113-118.

Nakhleh, M. B. (1983). An overview of microcomputers in the secondary science curriculum. The Journal of Computers in Mathematics and Science Teaching, 3, 13-21.

Narthasilpa, A. (1984). The effects of microcomputer instruction on knowledge in computer programming and attitudes of science education students. Dissertation Abstracts International, 45(9)2826A.

Schloss, P. J., Schloss, C. N., & Cartwright, G. P. (1984). Efficacy of four ratios of questions and highlights to text in computer assisted instructional modules. Journal of Computer-based Instruction, 11(4), 103-106.

Smith, S. G. (1984). Computer-assisted instruction on a microcomputer. Journal of Chemical Education, 61, 864-66.

Summerlin, L. (1971). Student attitudes toward computer-assisted instruction in chemistry. The Science Teacher, 38(4),29-32.

Summerlin, L. & Gardner, M. (1973). A study of tutorial-type computer assisted instruction in high school chemistry. Journal of Research in Science Teaching, 10(1), 75-82.

Summerville, L. J. (1984). The relationship between computer-assisted instruction and achievement levels and learning rates of secondary school students in first year chemistry. Dissertaion Abstracts International, 46(3)8510891.

Suppes, P. & Fortune, R. F. (1985). Computer-assisted instruction: possibilities and problems. <u>NASSP Bulletin</u>, <u>69</u>(480), 30-34.

Tocci, S. (1981). The microcomputer/biology "interface." <u>The Science Teacher</u>, <u>48</u>(5):60-62.

Vargas, J. S. (1986). Instructional Design flaws in computer-assisted instruction. <u>Phi Delta Kappan</u>, <u>67</u>, 738-744.

Wainwright, C. L. (1984). The Effectiveness of a computer-assisted instruction package in supplementing teaching of selected concepts in high school chemistry: writing formulas and balancing chemical equations. <u>Dissertation Abstracts International</u>, DA8424757.

Ware, R. J. (1983). Use of computer instruction in rural schools to increase curriculum opportunities for the colelge bound student. ED231582.

Wollenberg, J. P., Handley, H. M., & Enochs, J. R. (1985). Differences in achievement with computer assisted instruction: implications for varying student learning styles. <u>Educational Technology</u>, <u>25</u>, 51.

Ybarrondo, B. A. (1984). A study of the effectiveness of computer-assisted instruction in the high school biology classroom. ED265015.

APPENDICES

APPENDIX A:  Printout of the CAI Photosynthesis Unit

```
5   REM   PHOTOSYNTHESIS TUTORIAL
10  REM   BY PATRICIA DROZDOWSKI MORRELL
12  PRINT   CHR$ (4);"BRUN LOMEM:": &  LOMEM: 16384
15  REM   FEBRUARY, 1987
16  REM   VARIABLE LIST
17  REM   N$=NAME, G$=GET VARIABLE; RIGHT = NUMBERS OF RIGHT ANSWERS PER U
    NIT
18  REM   I=LOOP COUNTER, C$=MENU CHOICE
19  REM   Q$=QUIT CHOICE
25  REM   INITIALIZATION BLOCK
26  DIM N$(30)
27  DIM W$(9)
30  REM   **********   DRIVER     **********
35  REM   INTRODUCTORY GRAPHICS
40  GOSUB 200
45  REM   MAIN MENU
50  GOSUB 285
55  IF C$ = "C" THEN   GOSUB 300
60  IF C$ = "D" THEN   GOSUB 2000
70  IF C$ = "D" THEN   GOSUB 2000
80  TEXT : HOME : PRINT "YOU HAVE COMPLETED THIS FILE, AGENT     ";N$
100 END
200 REM   INTRODUCTORY GRAPHICS
205 TEXT : HOME
210 HTAB 7: VTAB 6: PRINT "NATIONAL SCIENCE ARCHIVES"
220 VTAB 13: HTAB 9: PRINT "FILE NUMBER:  C6H1206"
221 FLASH
225 HTAB 9: VTAB 20: PRINT "CLASSIFIED INFORMATION"
230 FOR I = 1 TO 4000: NEXT I
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```
235    TEXT : HOME
240    HTAB 11: VTAB 5: INVERSE : PRINT "SECURITY CLEARANCE"
244    NORMAL
245    VTAB 15: INPUT "ENTER THE SECRET CODE WORD:   ";W$
255    IF W$ <  > "SUNLIGHT" THEN  PRINT "CLEARANCE DENIED": FOR I = 1 TO 1
       000: NEXT I: GOTO 100
260    PRINT : INPUT "ENTER YOUR LAST NAME:   ";N$
265    PRINT : PRINT "STATUS:   ";
266    FLASH : PRINT "CLEARED"
267    PRINT : NORMAL
270    PRINT "PRESS ANY KEY TO ENTER THE   DOCUMENTS   ROOM"
275    GET G$
280    RETURN
285    REM  MAIN MENU
286    TEXT : HOME
288    PRINT "NATIONAL SCIENCE ARCHIVES"
289    PRINT "FILE NO.:   C6H12O6"
292    PRINT : PRINT "THIS DISK CONTAINS THE FILE OF BACK-     GROUND INFORM
       ATION ON YOUR ASSIGNMENT.   IT IS A GOOD PLACE TO START!"
293    PRINT : PRINT "OTHER FILES INCLUDE:"
294    PRINT : PRINT "HISTORICAL DEVELOPMENT - DISK NUMBER 2"
295    PRINT : PRINT "BIOCHEMISTRY OF PHOTOSYNTHESIS - DISK   NUMBER THREE"
       : PRINT : PRINT "EFFECTS OF ENVIRONMENTAL FACTORS - DISK NUMBER FOUR
       "
296    PRINT : PRINT "IF YOU WANT THIS 'STARTER' FILE, TYPE C": PRINT : PRINT
       "IF YOU WANT A DIFFERENT FILE, NOTE THE  NUMBER OF THE DISK YOU'LL N
       EED AND TYPE D": INPUT C$
297    IF C$ = "C" THEN  GOTO 299
298    IF C$ <  > "D" THEN  INPUT "CHOOSE C OR D:   ":C$
299    RETURN
300    REM  BACKGROUND INFORMATION
301    TEXT : HOME
302    GOSUB 10000: REM    DR. A:VTAB 21
303    VTAB 21: PRINT "WELCOME, AGENT ";N$;"."
305    PRINT "I AM DR. ARTY CHOKE, AUTHOR OF THE      FILES ON PHOTOSYNTHES
       IS.
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306   GOSUB 5000: REM    CONTINUE:VTAB 21
307   PRINT "I WILL GUIDE YOU THROUGH WHAT INFORMA-   TION IS AVAILABLE ON
      THIS IMPORTANT      TOPIC."
308   GOSUB 5000: REM   CONTINUE
309   HOME : VTAB 21
310   PRINT "FIRST, LET'S START BY BREAKING UP THE   WORD PHOTOSYNTHESIS."
      : GOSUB 5000
318   GOSUB 10100: REM   LIGHT
319   HOME : VTAB 21
320   INPUT "WHAT DOES PHOTO MEAN?   ";G$
325   IF G$ = "LIGHT" THEN   PRINT "CORRECT!"
327   IF G$ < > "LIGHT" THEN   PRINT "NOT QUITE.   PHOTO MEANS LIGHT."
328   GOSUB 5000: REM   CONTINUE
329   GOSUB 10200: REM   SYNTHESIS PICTURE
330   HOME : VTAB 21
331   PRINT "DO YOU KNOW WHAT SYNTHESIS MEANS?"
332   HOME : VTAB 21
333   PRINT "BASICALLY, SYNTHESIS MEANS TO BUILD UP  - START WITH SIMPLE T
      HINGS AND MAKE      SOMETHING COMPLEX."
334   GOSUB 5000: HOME
335   TEXT : HOME
337   PRINT "SO, PHOTOSYNTHESIS REQUIRES LIGHT ENERGY AND IS A PROCESS OF
      BUILDING COMPLEX   MOLECULES FROM SIMPLE MOLECULES."
338   PRINT : PRINT : PRINT "A MORE CONVENTIONAL DEFINITION IS:"
339   FOR I = 1 TO 1500: NEXT I: SPEED= 75
340   PRINT "PHOTOSYNTHESIS IS THE PROCESS BY WHICH   GREEN PLANTS (AND A F
      EW OTHER ORGANISMS)CONVERT LIGHT ENERGY INTO CHEMICAL      ENERGY (F
      OOD).   IN THIS CASE, THE FOOD   IS A SUGAR CALLED GLUCOSE."
341   SPEED= 255: PRINT : PRINT : GOSUB 5000
342   GOSUB 10300: REM   FLOWER GRAPHICS
344   HOME : VTAB 21
345   PRINT "LET'S DISCUSS LIGHT ENERGY."
346   INPUT "WHAT IS THE MAIN SOURCE OF ALL THE      EARTH'S ENERGY?   ";G$

347   IF G$ = "SUN" THEN   PRINT "GOOD GOING, AGENT ";N$;"!"
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348  IF G$ < > "SUN" THEN   PRINT "SORRY, YOU MUST KNOW THIS.   GUESS AGAI
     N.CHECK YOUR NOTEBOOK!": GOTO 345
349  GOSUB 5000: HOME : VTAB 21
350  PRINT "DID YOU KNOW THAT LESS THAN HALF OF THE SUN'S ENERGY ACTUALLY
     REACHES THE EARTH?": GOSUB 5000: HOME
351  TEXT : HOME
352  PRINT "MOST OF THE SUN'S ENERGY IS ABSORBED OR REFLECTED BACK BEFORE
     IT REACHES THE     EARTH'S ATMOSPHERE!"
353  PRINT : PRINT
354  INPUT "GUESS WHAT PERCENT OF THE SUN'S ENERGY  IS ACTUALLY USED BY P
     RODUCERS IN PHOTO- SYNTHESIS:   ";G$
355  PRINT : PRINT "BE REALISTIC!"
356  PRINT : INPUT "TRY AGAIN:   ";G$
357  PRINT : PRINT "THE CORRECT ANSWER IS 1%."
358  PRINT : PRINT "ISN'T THAT AMAZING?": PRINT : PRINT : GOSUB 5000: HOME

359  GOSUB 10400: VTAB 21
360  PRINT "WHAT DO YOU THINK WOULD HAPPEN TO US IF ALL THE SUN'S ENERGY
     REACHED THE EARTH?"
361  FOR I = 1 TO 3000: NEXT I
362  PRINT "FRIED PLANET, ANYONE?"
363  GOSUB 5000: HOME
364  TEXT : HOME
365  PRINT "THIS LEADS US TO AN IMPORTANT CONTRIBU- TION OF GREEN PLANTS.
     "
366  PRINT : PRINT "THINK BACK TO WHAT THE ORIGINAL ATMOS-  PHERE OF THE
     EARTH WAS LIKE.  "
367  PRINT : PRINT "IT WAS HOT, WITH METHANE, AMMONIA, WATER VAPOR, AND H
     YDROGEN."
368  PRINT : PRINT "WHAT GAS, ESSENTIAL FOR US (AND PLANTS),WAS MISSING?"

369  PRINT : INPUT "YOUR GUESS:   ";G$
370  IF G$ = "OXYGEN" THEN   PRINT "RIGHT!": PRINT
371  IF G$ < > "OXYGEN" THEN   PRINT "COME ON, YOU REMEMBER...IT'S OXYGEN
     !"
372  PRINT
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375  PRINT "PRODUCERS, THROUGH PHOTOSYNTHESIS, GIVE US FREE OXYGEN.": PRINT
     : PRINT "FREE OXYGEN IS OXYGEN MOLECULES THAT     'STAND ALONE.'; THE
     Y ARE NOT COMBINED   WITH SOMETHING ELSE."
376  PRINT : INPUT "WHICH OF THE FOLLOWING IS AN EXAMPLE OF FREE OXYGEN (
     A) OH, (B) CHO, (C) NHO     (D) O     YOUR CHOICE:  ";G$
377  IF G$ = "D" THEN  PRINT "WHAT A CHEMIST!"
378  IF G$ < > "D" THEN  PRINT "I THINK YOU NEED TO REREAD THIS PAGE!
     THE CORRECT CHOICE IS D": FOR I = 1 TO 5000: NEXT I
379  GOSUB 5000: HOME
380  GOSUB 10300: HOME : VTAB 21
381  PRINT "THANKS TO PLANTS AND PHOTOSYNTHESIS WE  HAVE FREE OXYGEN TO B
     REATHE.SOME OF THISFREE OXYGEN RECOMBINED INTO OZONE.": GOSUB 5000: HOME
     : VTAB 21
382  INPUT "IS OZONE (3 MOLECULES OF OXYGEN) AN      EXAMPLE OF FREE OXYGE
     N? (Y/N)";G$
383  IF G$ < > "N" AND G$ < > "Y" THEN  PRINT "PLEASE ENTER A Y OR N": GOTO
     382
384  IF G$ = "N" THEN  PRINT "WHOOPS! YOU MADE A MISTAKE.": GOSUB 5000
385  IF G$ = "Y" THEN  PRINT "SUPER!": GOSUB 5000
386  GOSUB 10600: HOME : VTAB 21: GOSUB 17000
387  GOSUB 10000: HOME : VTAB 21: PRINT "ARE YOU REMEMBERING TO TAKE NOTE
     S ON     THIS, AGENT ";N$;" ?"
388  GOSUB 5000: GOSUB 10700: HOME : VTAB 21
389  PRINT "OF COURSE, BESIDES OXYGEN, PHOTOSYN-      THESIS PROVIDES US WI
     TH CHEMICAL ENERGY IN THE FORM OF FOOD!"
390  GOSUB 5000: HOME : GOSUB 10000: HOME : VTAB 21: PRINT "HOW DO PLANTS
      MAKE FOOD? WHAT ARE THE  SIMPLE MOLECULES THEY USE?  ANSWERS TO  T
     HESE CAN BE FOUND IN OTHER FILES.  BUT": GOSUB 5000: HOME
391  VTAB 21: PRINT "FIRST, LET'S REVIEW THIS FILE!!": PRINT : GOSUB 5000

392  TEXT : HOME
393  TEXT : HOME : PRINT "WHAT IS THE PURPOSE OF THE OZONE LAYER?": PRINT
     : PRINT "    (A) SHIELD EARTH FROM MUCH OF THE   SUN'S RADIATION"
394  PRINT : PRINT "    (B) AIDS IN PHOTOSYNTHESIS": PRINT : PRINT "
     (C) IT WAS RESPONSIBLE FOR KEEPING THE EARTH'S ATMOSPHERE WARM"
395  PRINT : PRINT : INPUT "YOUR ANSWER:   ";G$: PRINT
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396   IF G$ = "B" THEN   PRINT "THE PLANTS MADE THE OZONE LAYER.   THE     COR
      RECT CHOICE IS A.": GOSUB 5000: GOTO 400
397   IF G$ = "C" THEN   PRINT "IT DID JUST THE OPPOSITE!   THE CORRECT   ANS
      WER IS A": GOSUB 5000: GOTO 400
398   IF G$ = "A" THEN   PRINT "GREAT!   CONTINUE'":RIGHT = RIGHT + 1: GOSUB
      5000: GOTO 400
399   PRINT "CHOOSE A B OR C": GOTO 395
400   TEXT : HOME : VTAB 7: PRINT "WHICH OF THE FOLLOWING IS FALSE?"
401   PRINT : PRINT "      (A) THE PROCESS OF PHOTOSYNTHESIS   PRODUCES LIGH
      T ENERGY"
402   PRINT : HTAB 5: PRINT "(B) PLANTS MAKE FREE OXYGEN"
403   PRINT : HTAB 5: PRINT "(C) MOST OF THE SUN'S RADIATION DOES NOT REAC
      H THE EARTH"
404   PRINT : INPUT "YOUR SELECTION:   ";G$
405   PRINT : IF G$ = "A" THEN   PRINT "TERRIFIC! READY FOR THE LAST QUESTI
      ON?":RIGHT = RIGHT + 1: GOTO 410
406   PRINT : IF G$ = "B" THEN   PRINT "THIS IS TRUE.   THE CORRECT CHOICE I
      S A.": GOTO 410
407   PRINT : IF G$ = "C" THEN   PRINT "REMEMBER WHAT THE OZONE LAYER DOES?
         IT BLOCKS MOST OF THE SUN'S RAYS FROM REACHING THE EARTH.   THE COR
      RECT CHOICE IS A.": GOTO 410
408   PRINT "CHOOSE A, B, OR C!": GOTO 404
410   PRINT : GOSUB 5000: TEXT : HOME
412   VTAB 7: PRINT "WHICH OF THE FOLLOWING IS NOT TRUE ABOUT SYNTHESIS RE
      ACTIONS?"
413   PRINT : PRINT "      (A) AN EXAMPLE OF THIS REACTION IS PHOTOSYNTHESI
      S"
414   PRINT : PRINT "      (B) IT IS THE PROCESS OF BREAKING   DOWN LARGE MO
      LECULES INTO SMALLER      MOLECULES"
420   PRINT : PRINT "      (C) THEY RESULT IN THE FORMATION OFCOMPLEX MOLEC
      ULES"
422   PRINT : INPUT "YOUR ANSWER:   ";G$: PRINT
430   IF G$ = "B" THEN   PRINT "CORRECT!   SYNTHESIS GOES FROM SMALL TO    BI
      G!":RIGHT = RIGHT + 1: GOTO 451
435   IF G$ = "A" THEN   PRINT "LOOK AT THE WORD PHOTOSYNTHESIS.   SYN- THE
      SIS IS A PART OF IT.   YOU SHOULD HAVECHUSEN B.": GOTO 451
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440   IF G$ = "C" THEN  PRINT : PRINT "SYNTHESIS MEANS TO GO FROM SIMPLE T
      O   COMPLEX.  THE CORRECT CHOICE IS B.": GOTO 451
450   PRINT "YOU MUST SELECT A, B, OR C.": GOTO 422
451   PRINT : GOSUB 5000: TEXT : HOME
452   VTAB 4: IF RIGHT < 2 THEN  PRINT "YOU DIDN'T DO WELL ON THE QUIZ.  P
      ERHAPS YOU  SHOULD REREAD THIS FILE BEFORE      GOING ON, AGENT ";N$:
      GOTO 490
453   VTAB 10: IF RIGHT = 3 THEN  PRINT "YOU DID QUITE WELL, AGENT ";N$: PRINT
      : PRINT "FOR YOUR NEXT SET OF INSTRUCTIONS TYPE    AN E."
454   VTAB 4: IF RIGHT = 2 THEN  PRINT "YOU DID OK.  YOU CAN DECIDE IF YOU
      WANT TO REVISIT THIS FILE OR CONTINUE."
490   PRINT : PRINT : GOSUB 5000
491   RETURN
2000   REM  INSTRUCTIONS
2010   TEXT : HOME
2020   VTAB 10
2025   PRINT "REMOVE THIS DISK AND PLACE THE NUMBERED DISK YOU NEED INTO T
      HE DISK DRIVE."
2028   PRINT : PRINT "TYPE PR#6 AND "
2030   PRINT : PRINT "PRESS THE RETURN KEY."
2040   GOTO 100
2050   RETURN
5000   REM  CONTINUE
5005   INPUT "TYPE C TO CONTINUE OR E TO EXIT.";G$
5010   IF G$ = "E" THEN  GOTO 45
5011   IF G$ = "C" THEN  GOTO 5025
5017   GOTO 5005
5025   RETURN
10000   REM  DR. A GRAPHICS
10001   HGR : HCOLOR= 3
10002   HPLOT 90,140 TO 110,128 TO 110,104 TO 70,104 TO 70,84 TO 80,76 TO
       90,84 TO 70,84 TO 90,84 TO 90,96
10003   HPLOT 90,96 TO 110,96 TO 110,80 TO 80,60 TO 80,24 TO 100,36 TO 120
       ,24 TO 140,36 TO 160,24 TO 180,36 TO 200,24 TO 200,60
10004   HPLOT 200,60 TO 170,80 TO 170,96 TO 190,96 TO 190,84 TO 200,80 TO
       210,84 TO 190,84 TO 210,84 TO 210,104 TO 170,104 TO 170,128
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10005   HPLOT 170,128 TO 190,140 TO 160,140 TO 140,124 TO 120,140 TO 90,14
        0
10006   HPLOT 110,116 TO 170,116
10007   HPLOT 140,80 TO 140,116
10008   HPLOT 150,104 TO 150,96 TO 160,96 TO 160,104 TO 150,104
10009   HPLOT 110,88 TO 120,80 TO 130,88 TO 140,80 TO 150,88 TO 160,80 TO
        170,88
10010   HPLOT 110,64 TO 120,72 TO 160,72 TO 170,64
10011   HPLOT 100,44 TO 120,44 TO 120,52 TO 100,52 TO 100,44
10012   HPLOT 160,44 TO 180,44 TO 180,52 TO 160,52 TO 160,44
10013   HPLOT 160,40 TO 180,40
10014   HPLOT 120,40 TO 100,40
10015   RETURN
10100   REM   LIGHT
10101   HGR : HCOLOR= 3
10102   HPLOT 120,150 TO 120,120 TO 80,100 TO 80,50 TO 110,35 TO 170,35 TO
        200,50 TO 200,100 TO 160,120 TO 160,150 TO 120,150
10104   HPLOT 120,140 TO 160,140
10106   HPLOT 120,130 TO 160,130
10108   HPLOT 210,105 TO 240,120
10110   HPLOT 210,70 TO 240,70
10112   HPLOT 210,45 TO 240,30
10114   HPLOT 170,30 TO 200,15
10116   HPLOT 140,5 TO 140,25
10118   HPLOT 110,30 TO 80,15
10120   HPLOT 70,45 TO 40,30
10122   HPLOT 70,70 TO 40,70
10124   HPLOT 70,105 TO 40,120
10126   RETURN
10200   REM   SYNTHESIS PICTURE
10201   HGR : HCOLOR= 3
10202   HPLOT 50,136 TO 110,136 TO 110,64 TO 50,64 TO 50,136
10204   HPLOT 125,80 TO 115,80 TO 115,100 TO 125,100
10206   HPLOT 70,56 TO 70,40 TO 80,48 TO 70,56
10208   HPLOT 55,56 TO 55,40 TO 65,48 TO 55,56
10210   HPLOT 85,24 TO 100,24 TO 100,36 TO 85,36 TO 85,24
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10212   HPLOT 170,36 TO 235,36 TO 235,108 TO 170,108 TO 170,36
10214   HPLOT 190,88 TO 190,96 TO 215,96 TO 215,88
10216   HPLOT 195,80 TO 210,80 TO 210,68 TO 175,68 TO 195,80
10218   HPLOT 210,64 TO 220,52 TO 230,64 TO 210,64
10220   HPLOT 195,64 TO 185,52 TO 175,64 TO 195,64
10222   RETURN
10300   REM  FLOWERS
10301   HGR : HCOLOR= 3
10302   HPLOT 0,140 TO 250,140
10304   HPLOT 42,20 TO 56,20 TO 70,30 TO 70,45 TO 56,55 TO 42,55 TO 28,45 TO
        28,30 TO 42,20
10306   HPLOT 49,15 TO 49,0: HPLOT 56,15 TO 70,5
10308   HPLOT 77,25 TO 91,15: HPLOT 77,35 TO 91,35
10310   HPLOT 77,45 TO 91,55: HPLOT 56,60 TO 70,70: HPLOT 49,60 TO 49,75
10312   HPLOT 42,60 TO 28,70: HPLOT 28,50 TO 14,60: HPLOT 21,35 TO 7,35
10314   HPLOT 21,25 TO 7,15: HPLOT 35,15 TO 21,5
10316   HPLOT 77,120 TO 77,140: HPLOT 70,125 TO 77,130 TO 84,125
10318   HPLOT 77,105 TO 77,115: HPLOT 70,115 TO 84,105: HPLOT 70,105 TO 84
        ,115: HPLOT 70,110 TO 84,110
10320   HPLOT 147,120 TO 147,140: HPLOT 140,125 TO 147,130 TO 154,125
10322   HPLOT 140,105 TO 154,115: HPLOT 140,115 TO 154,105
10324   HPLOT 147,105 TO 147,115: HPLOT 140,110 TO 154,110
10326   HPLOT 217,105 TO 217,115: HPLOT 210,105 TO 224,115
10328   HPLOT 210,110 TO 224,110: HPLOT 210,115 TO 224,105
10330   HPLOT 217,120 TO 217,140: HPLOT 210,125 TO 217,130 TO 224,125
10332   RETURN
10400   REM  FRIED PLANET
10401   HGR : HCOLOR= 3
10402   FOR X = 100 TO 190 STEP 30
10404   HPLOT X,5 TO X - 10,10 TO X,15 TO X - 10,20 TO X,25
10406   NEXT X
10408   HPLOT 80,95 TO 80,45 TO 110,30 TO 180,30 TO 210,45 TO 210,95 TO 18
        0,110 TO 110,110 TO 80,95
10410   HPLOT 80,85 TO 60,95 TO 60,115 TO 80,130 TO 210,130 TO 230,115 TO
        230,95 TO 210,85
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10412   HPLOT 190,40 TO 170,45 TO 170,55 TO 200,70 TO 200,85 TO 170,90 TO
    200,95
10414   HPLOT 140,110 TO 160,90 TO 160,80 TO 160,70 TO 160,65 TO 140,55 TO
    140,40 TO 160,30
10416   HPLOT 90,40 TO 100,45 TO 100,60 TO 130,75 TO 100,90 TO 100,95 TO 1
    10,100 TO 110,110
10418   HPLOT 80,65 TO 90,70 TO 90,90 TO 80,95
10420   RETURN
10600   REM  HERO FLOWER
10601   HGR : HCOLOR= 3
10602   HPLOT 70,65 TO 70,150
10604   HPLOT 55,85 TO 70,100 TO 85,85
10606   HPLOT 50,10 TO 90,50: HPLOT 50,50 TO 90,10
10608   HPLOT 70,5 TO 70,55: HPLOT 50,30 TO 90,30
10610   HPLOT 70,30 TO 65,15 TO 70,5 TO 75,15 TO 70,30
10612   HPLOT 70,30 TO 80,25 TO 95,30 TO 80,35 TO 70,30 TO 75,45 TO 70,55 TO
    65,45 TO 70,30
10614   HPLOT 70,30 TO 60,35 TO 40,30 TO 60,25 TO 70,30
10616   HPLOT 130,40 TO 130,20 TO 135,30 TO 140,20 TO 140,40
10618   HPLOT 150,20 TO 155,30 TO 160,20: HPLOT 155,30 TO 155,40
10620   HPLOT 160,80 TO 165,80: HPLOT 175,90 TO 175,70 TO 185,70 TO 185,80
    TO 175,80 TO 185,90
10622   HPLOT 190,70 TO 200,70 TO 200,90 TO 190,90 TO 190,70
10624   HPLOT 145,70 TO 145,90: HPLOT 155,70 TO 155,90: HPLOT 145,80 TO 15
    5,80
10626   HPLOT 170,70 TO 160,70 TO 160,90 TO 170,90
10628   RETURN
10700   REM  COW
10701   HGR : HCOLOR= 3
10702   HPLOT 120,130 TO 120,140: HPLOT 132,130 TO 132,140
10704   HPLOT 156,130 TO 156,140: HPLOT 162,115 TO 168,111
10706   HPLOT 120,125 TO 120,130 TO 162,130 TO 162,115 TO 126,115 TO 126,1
    25 TO 114,125 TO 114,105
10708   HPLOT 114,110 TO 126,110: HPLOT 126,105 TO 126,125
10709   HPLOT 162,130 TO 162,140
10712   FOR X = 24 TO 186 STEP 6
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10714    HPLOT X,140 TO X,150
10716    NEXT X
10718    HPLOT 42,70 TO 30,60 TO 30,25 TO 42,15 TO 66,15 TO 78,25 TO 78,60 TO
         66,70 TO 42,70
10720    HPLOT 66,10 TO 78,0: HPLOT 84,70 TO 96,80
10722    HPLOT 78,20 TO 90,10: HPLOT 72,75 TO 84,85
10724    HPLOT 84,30 TO 96,30: HPLOT 54,75 TO 55,85
10726    HPLOT 84,55 TO 96,55: HPLOT 42,75 TO 30,85: HPLOT 30,65 TO 18,75: HPLOT
         12,55 TO 24,55
10728    HPLOT 18,10 TO 30,20: HPLOT 12,30 TO 24,30: HPLOT 30,0 TO 42,10: HPLOT
         54,0 TO 54,10
10730    HPLOT 246,150 TO 204,150 TO 204,85 TO 246,85
10732    HPLOT 234,150 TO 234,130 TO 246,130
10734    HPLOT 210,100 TO 210,90 TO 216,95 TO 222,90 TO 222,100
10736    HPLOT 234,100 TO 228,100 TO 228,95 TO 234,95
10738    HPLOT 246,100 TO 240,100 TO 240,90 TO 246,90
10740    HPLOT 210,85 TO 210,55 TO 216,50 TO 234,50 TO 240,55 TO 246,50
10742    HPLOT 240,55 TO 240,85
10744    RETURN
17000    REM  WHOOPS
17001    HOME : VTAB 21: PRINT "WELL, OZONE BLOCKS MUCH OF THE SUN'S      RAY
         S FROM REACHING OUR PLANET.": GOSUB 5000
17002    HOME : VTAB 21: PRINT "IT LED TO THE COOLING OF THE EARTH'S      ATM
         OSPHERE AND...": GOSUB 5000
17003    HOME : VTAB 21
17004    PRINT "MADE THE EARTH AN INHABITABLE PLACE FOR ALL ORGANISMS!": GOSUB
         5000
17005    RETURN

5   REM   PHOTOSYNTHESIS TUTORIAL
10   REM   BY PATRICIA DROZDOWSKI MORRELL
12   PRINT  CHR$ (4);"BRUN LOMEM:": &  LOMEM: 16384
15   REM   FEBRUARY, 1987
16   REM   VARIABLE LIST
17   REM   N$=NAME, G$=GET VARIABLE; RIGHT = NUMBERS OF RIGHT ANSWERS PER U
         NIT
18   REM   I=LOOP COUNTER, C$=MENU CHOICE
19   REM   Q$=QUIT CHOICE
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25    REM   INITIALIZATION BLOCK
26    DIM N$(30)
29    DIM W$(9)
30    REM "*********   DRIVER   **********
35    REM   INTRODUCTORY GRAPHICS
40    GOSUB 200
45    REM   MAIN MENU
50    GOSUB 285
55    IF C$ = "C" THEN  GOSUB 500
60    IF C$ = "D" THEN  GOSUB 2000
80    TEXT : HOME : PRINT "YOU HAVE COMPLETED THIS FILE, AGENT     ";N$
100   END
200   REM   INTRODUCTORY GRAPHICS
205   TEXT : HOME
210   HTAB 7: VTAB 6: PRINT "NATIONAL SCIENCE ARCHIVES"
220   VTAB 13: HTAB 9: PRINT "FILE NUMBER:   C6H1206"
221   FLASH
225   HTAB 9: VTAB 20: PRINT "CLASSIFIED INFORMATION"
230   FOR I = 1 TO 4000: NEXT I
235   TEXT : HOME
240   HTAB 11: VTAB 5: INVERSE : PRINT "SECURITY CLEARANCE"
244   NORMAL
245   VTAB 15: INPUT "ENTER THE SECRET CODE WORD:   ";W$
255   IF W$ <  > "SUNLIGHT" THEN  PRINT "CLEARANCE DENIED": FOR I = 1 TO 1
      000: NEXT I: GOTO 100
260   PRINT : INPUT "ENTER YOUR LAST NAME:   ";N$
265   PRINT : PRINT "STATUS:   ";
266   FLASH : PRINT "CLEARED"
267   PRINT : NORMAL
270   PRINT "PRESS ANY KEY TO ENTER THE   DOCUMENTS   ROOM"
275   GET G$
280   RETURN
285   REM   MAIN MENU
286   TEXT : HOME
288   PRINT "NATIONAL SCIENCE ARCHIVES"
289   PRINT "FILE NO.:   C6H1206"
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293  PRINT : PRINT "THIS DISK CONTAINS THE FILE ON THE       HISTORICAL DE
     VELOPMENT OF PHOTOSYNTHESIS"
294  PRINT : PRINT "OTHER FILES AVAILABLE ARE:"
295  PRINT : PRINT "BACKGROUND INFORMATION - DISK NUMBER ONE"
296  PRINT : PRINT "BIOCHEMISTRY OF PHOTOSYNTHESIS - DISK   NUMBER TWO"
297  PRINT : PRINT "EFFECTS OF ENVIRONMENTAL FACTORS - DISK NUMBER THREE"

298  PRINT : INPUT "IF THE HISTORICAL FILE IS WHAT YOU WANT,TYPE C.  IF Y
     OU WANT A DIFFERENT FILE,  NOTE THE NUMBER OF THE DISK YOU'LL NEED A
     ND TYPE D:  ";C$
299  IF C$ = "C" THEN   GOTO 305
300  IF C$ <  > "D" THEN  INPUT "YOU MUST CHOOSE C OR D:   ";C$
305  RETURN
500  REM  HISTORICAL DEVELOPMENT
501  GOSUB 10000: REM    DR. A:VTAB 21
502  PRINT "LET'S REVIEW A COMMON SCIENTIFIC        PRINCIPLE:  THE LAW O
     F CONSERVATION OF  MATTER": GOSUB 5000
503  HOME : VTAB 21: PRINT "MATTER CANNOT BE CREATED NOR DESTROYED. HOW D
     OES THIS RELATE TO PHOTOSYNTHESIS?": GOSUB 5000: HOME : VTAB 21
504  GOSUB 10900: HOME : VTAB 21
506  PRINT "CONSIDER A SEED!  WHAT HAPPENS TO THE   MASS OF THE SEED AFTE
     R IT IS PLANTED AND BEGINS TO GERMINATE?": GOSUB 5000: HOME : VTAB 2
     1
508  PRINT "OBVIOUSLY, IT GROWS LARGER!  IF THE LAW OF CONSERVATION OF MA
     TTER IS TRUE, WHAT GIVES THE PLANT ITS NEW SUBSTANCE?": GOSUB 5000: HOME
509  HOME : VTAB 21
510  GOSUB 10000
511  HOME : VTAB 21
514  PRINT "HOP ABOARD MY TIME TRAVELLER AND WE'LL  GO BACK SEVERAL HUNDR
     ED YEARS AND SEE   HOW SCIENTISTS SOLVED THIS PUZZLE!": GOSUB 5000
516  TEXT : HOME
518  VTAB 5: HTAB 13: INVERSE : PRINT "TIME TRAVELLER": NORMAL
520  VTAB 10: PRINT "DESTINATIONS:  1.   1500'S"
522  PRINT : PRINT "                 2.   1600'S"
524  PRINT : PRINT "                 3.   1700'S"
```

```
526   PRINT : PRINT "                    4.   PRESENT"
528   VTAB 20: PRINT "I'M SORRY, AGENT ";N$
530   PRINT "THE TIME TRAVELLER WON'T WORK UNLESS YOUBUCKLE YOUR SEAT BELT
      !"
531   PRINT "WHEN YOU'RE READY, HIT THE R KEY."
532   INPUT G$
533   IF G$ < > "R" THEN  PRINT "TIME WAITS FOR NO ONE!": GOTO 531
535   IF G$ = "R" THEN  GOSUB 5000
537   GOSUB 10800: HOME : VTAB 21
540   PRINT "HERE WE ARE IN THE 16TH CENTURY.  REMEM-BER, MUCH OF THE SCIE
      NTIFIC KNOWLEDGE WE TAKE FOR GRANTED TODAY...": GOSUB 5000
541   HOME : VTAB 21: PRINT "WAS NOT KNOWN AT THIS TIME.  (BIOLOGY WAS JUS
      T A GROWING CHILD!)": GOSUB 5000
542   GOSUB 10900
543   HOME : VTAB 21: PRINT "LET'S GO BACK TO OUR SEED.  MARY, MARY, PLANT
      S HER GARDEN, BUT HOW DOES HER     FLOWERS GROW?": GOSUB 5000: HOME
      : VTAB 21
544   PRINT "SCIENTISTS AT THIS TIME, KNOWING THE LAWOF CONSERVATION OF MA
      TTER, ASSUMED SOIL WAS THE SOURCE OF NEW PLANT MATERIAL!": GOSUB 500
      0: HOME
546   GOSUB 10000: REM   DR. A
547   HOME : VTAB 21
548   PRINT "THIS IDEA WAS WIDELY ACCEPTED AND LASTED UNTIL THE 17TH CENTU
      RY.  LET'S BOARD   THE TIME MACHINE AGAIN AND GO THERE!": GOSUB 5000

550   TEXT : HOME
551   VTAB 5: HTAB 13: INVERSE : PRINT "TIME TRAVELLER": NORMAL
553   VTAB 10: HTAB 8: PRINT "DATELINE:  17TH CENTURY"
555   VTAB 15: PRINT "WE MADE IT!"
556   PRINT : PRINT "FIRST WE'LL VISIT VAN HELMONT.  JAN VAN HELMONT WAS A
       BELGIAN CHEMIST.  IN THE  EARLY 1600'S HE SET UP AN EXPERIMENT TO T
      EST THE HYPOTHESIS THAT SOIL WAS THE  SOURCE OF NEW PLANT GROWTH."
557   GOSUB 5000: GOSUB 11000: REM  VAN HELMONT
558   HOME : VTAB 21
559   PRINT "THIS IS JAN VAN HELMONT!  JAN, PLEASE   TELL US ABOUT YOUR EX
      PERIMENT!": GOSUB 5000
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```
560   TEXT : HOME
561   PRINT "I'D BE DELIGHTED!": PRINT : PRINT
562   PRINT "I PLANTED A 5 POUND WILLOW TREE IN A TUBCONTAINING 200 POUNDS
      OF SOIL.  THE TUB WAS COVERED TO BE SURE NOTHING ELSE GOT INTO THE
      SOIL.  THE ONLY THING I ADDED  TO THE TUB WAS PURE RAINWATER."
564   PRINT : PRINT "I TENDED THE TREE FOR 5 YEARS THEN RE-  WEIGHED THE P
      LANT AND SOIL."
566   VTAB 20: GOSUB 5000
568   TEXT : HOME
569   VTAB 5: HTAB 10: PRINT "VAN HELMONT'S RESULTS"
570   VTAB 7: HTAB 23: PRINT "PLANT          SOIL"
572   VTAB 9: PRINT "STARTING WEIGHT        5            200"
574   VTAB 11: PRINT "ENDING WEIGHT         169          199"
576   VTAB 13: PRINT "DIFFERENCE           +164          -1"
578   PRINT : PRINT : PRINT : PRINT "WHAT COULD JAN VAN HELMONT CONCLUDE W
      AS "
579   HTAB 18: INVERSE : PRINT "NOT": NORMAL
580   PRINT : PRINT "THE SOURCE OF PLANT MATTER?"
585   PRINT : INPUT "YOUR ANALYSIS:   ";G$
586   IF G$ <  > "SOIL" THEN  PRINT : PRINT "THIS IS THE 17TH CENTURY!  IT
       COULDN'T  HAVE BEEN THE SOIL!"
587   IF G$ = "SOIL" THEN  PRINT : PRINT "ABSOLUTELY CORRECT!"
588   PRINT : GOSUB 5000
589   GOSUB 10000: HOME : VTAB 21
590   PRINT "LET'S MOVE ON TO THE LATE 1700'S!       ARE YOU REMEMBERING T
      O USE YOUR SPECIAL NOTEBOOK, AGENT ";N$;"?": GOSUB 5000: HOME : VTAB
      21
592   PRINT "WE'LL BE VISITING WITH JOSEPH PRIESTLY  PRIESTLY, NOT SURPRIS
      INGLY, WAS AN        ENGLISH CLERGYMAN (AND CHEMIST!)": GOSUB 5000
594   HOME : VTAB 21: PRINT "HE DID A SERIES OF EXPERIMENTS THAT      PROVE
      D USEFUL IN DETERMINING THE SOURCE OF PLANT MATTER.  IT'S ALL YOURS,
      JOE": GOSUB 5000
596   TEXT : HOME
598   PRINT "WELCOME TO MY LAB."
599   PRINT
```

```
600    PRINT "FOR MY FIRST EXPERIMENT, I PLACED A MINTSHOOT IN A CONTAINER
       OF WATER AND PLACEDA GLASS JAR OVER THESE."
602    PRINT : PRINT "WHAT DO YOU THINK HAPPENED TO THE PLANT?   (A) IT SOO
       N DIED; (B) IT LIVED FOR   SEVERAL MONTHS"
603    PRINT : INPUT "YOUR ANSWER:  ";G$
604    IF G$ = "A" THEN  PRINT "THAT'S WHAT I THOUGHT WOULD HAPPEN, TOO BUT
       IT DIDN'T!!"
605    IF G$ = "B" THEN  PRINT "YOU MUST BE A PSYCHIC!"
606    IF G$ <  > "A" AND G$ <  > "B" THEN  PRINT "YOUR CHOICES ARE A OR B"
       : GOTO 602
608    PRINT : PRINT "WHAT DO YOU THINK HAPPENS WHEN YOU PLACEA GLASS JAR O
       VER A BURNING CANDLE:        (A) NOTHING; (B) IT GOES OUT"
609    PRINT : INPUT "YOUR ANSWER:  ";G$
610    IF G$ = "A" THEN  PRINT "NO!  IT WENT OUT!"
612    IF G$ = "B" THEN  PRINT "YOU ARE A SUPER AGENT!"
614    IF G$ <  > "A" AND G$ <  > "B" THEN  PRINT "CHOOSE A OR B, PLEASE!":
       GOTO 609
616    PRINT : PRINT "DO YOU KNOW WHY THE CANDLE GOES OUT?   WHAT GAS DOES
       IT NEED, AGENT ";N$"
618    PRINT "(A) OXYGEN; (B) HYDROGEN; (C) CARBON      DIOXIDE
620    INPUT G$
621    IF G$ <  > "A" AND G$ <  > "B" AND G$ <  > "C" THEN  PRINT "YOUR CHO
       ICES ARE A B OR C!": GOTO 616
623    IF G$ = "A" THEN  PRINT "OXYGEN IS RIGHT!"
624    IF G$ = "B" OR G$ = "C" THEN  PRINT "OXYGEN IS THE GAS THAT IS NEEDE
       D!"
625    PRINT : PRINT : GOSUB 5000
626    TEXT : HOME
628    PRINT "DR. CHOKE TELLS ME HE HAS SKETCHES OF MYEXPERIMENTS IN YOUR N
       OTEBOOK.  WHY DON'TYOU LOOK AT THEM AS WE GO THROUGH THE   REST OF M
       Y WORK."
630    PRINT : PRINT "FOR MY SECOND EXPERIMENT, I PLACED A LITCANDLE UNDER
       A JAR WITH A MINT SHOOT.   THE CANDLE STAYED LIT FOR SEVERAL DAYS!"
632    PRINT : INPUT "WHAT DO YOU THINK THE PLANT WAS           PRODUCING?  "
       ;G$
633    IF G$ = "OXYGEN" THEN  PRINT "BUBBLY RIGHT AGAIN!"
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635    IF G$ < > "OXYGEN" THEN   PRINT "IF THE CANDLE NEEDS OXYGEN TO BURN,
       THENTHE MINT MUST BE PRODUCING OXYGEN."
636    VTAB 15: GOSUB 5000
637    TEXT : HOME
638    PRINT "I TRIED ONE MORE EXPERIMENT.  "
640    PRINT "I PLACED A MOUSE AND A MINT PLANT UNDER A JAR.  GUESS WHAT HA
       PPENED!!!!"
642    PRINT : PRINT "THE MOUSE LIVED!"
644    PRINT : PRINT "I CAN SUM MY WORK UP BY SAYING IT WAS I WHO PROVED PL
       ANTS RELEASE OXYGEN"
645    PRINT : PRINT "WELL, I DID HAVE ONE MINOR PROBLEM.      NO ONE, INCLU
       DING MYSELF, WAS ABLE TO   REPEAT MY EXPERIMENTS SUCCESSFULLY!"
647    PRINT : PRINT "AT LEAST, NOT FOR MANY YEARS."
648    PRINT : PRINT : PRINT : GOSUB 5000
650    GOSUB 10000: HOME
651    VTAB 21
652    PRINT "ACTUALLY IT ONLY TOOK 5 YEARS FOR SOME- ONE TO GET PRIESTLY'S
        EXPERIMENTS TO    WORK.": GOSUB 5000
654    GOSUB 11100: REM   INGENHOUSZ
655    HOME : VTAB 21
656    PRINT "THE MAN TO REPLICATE PRIESTLY'S WORK SUCCESSFULLY WAS JAN ING
       ENHOUSZ.  HE FOUND THAT PLANTS DO PRODUCE OXYGEN, BUT...": GOSUB 500
       0
658    HOME : VTAB 21: PRINT "ONLY IF THEY'RE IN THEY'RE EXPOSED TO   LIGHT
       !": GOSUB 5000
659    GOSUB 10000
660    HOME : VTAB 21: PRINT "APPARENTLY, PRIESTLY OVERLOOKED THIS      IMPOR
       TANT FACTOR, WHEN HE REARRANGED    HIS LAB!": GOSUB 5000
661    HOME
662    VTAB 21: PRINT "LET'S OOUTLINE THESE IMPORTANT DISCOVER-IES AND THE
       ONES THAT FOLLOWED BEFORE WELEAVE THIS TIME PERIOD.": GOSUB 5000
664    TEXT : HOME
666    HTAB 8: PRINT "HISTORY OF PHOTOSYNTHESIS"
668    PRINT : PRINT : PRINT "1.  VAN HELMONT FOUND SOIL WAS NOT THE  SOURC
       E OF NEW PLANT MATTER.  WATER WAS."
```

```
670  PRINT : PRINT : PRINT "2.   PRIESTLY DISCOVERED PLANTS PRODUCE    OXYGE
     N."
672  PRINT : PRINT : PRINT "3.   INGENHOUSZ SHOWED PLANTS NEED LIGHT IN OR
     DER TO PRODUCE OXYGEN."
673  PRINT : GOSUB 5000: TEXT : HOME
674  PRINT : PRINT : PRINT "LATER DISCOVERIES SHOWED"
676  PRINT : PRINT : PRINT "4.   ONLY GREEN PLANT TISSUES RELEASE    OXYGE
     N IN LIGHT."
678  PRINT : PRINT : PRINT "5.   PLANTS GROWING IN LIGHT TAKE IN      CARBO
     N DIOXIDE."
680  VTAB 17: PRINT "BUCKLE UP FOR YOUR TRIP TO THE PRESENT.": GOSUB 5000
     : PRINT
690  TEXT : HOME : HTAB 13: INVERSE : PRINT "TIME TRAVELLER": NORMAL
691  PRINT : PRINT "DATELINE:  PRESENT": PRINT : PRINT
692  VTAB 4: PRINT "WELL, BY THE 1840'S WE KNEW THAT PLANTS ABSORBED LIGH
     T ENERGY AND CHANGED IT     INTO CHEMICAL ENERGY WHICH THEY STORED   I
     N THEIR CELLS (HENCE THE PLANTS GET     BIGGER)."
694  PRINT : PRINT "IN THE PROCESS, THE PLANTS TOOK IN WATERAND CARBON DI
     OXIDE AND RELEASED OXYGEN. "
696  PRINT : PRINT "THEREFORE, CARBON DIOXIDE AND WATER MUSTBE THE SIMPLE
      MOLECULES USED IN THE      SYNTHESIS REACTIONS OF PHOTOSYNTHESIS!"
697  PRINT : PRINT : GOSUB 5000: TEXT : HOME
698  PRINT : PRINT "HOW THIS ALL HAPPENS CAN BE FOUND IN    THE FILE ON D
     ISK NUMBER 3"
699  VTAB 10: PRINT "FOR NOW, TEST YOURSELF WITH THE FOLLOW- ING QUESTION
     S."
700  VTAB 18: GOSUB 5000
701  TEXT : HOME : PRINT "WHAT DID VAN HELMONT SHOW WAS NECESSARY FOR ADD
     ITIONAL PLANT MATERIAL?"
702  PRINT : PRINT "      (A) SOIL": PRINT : PRINT "      (B) WATER": PRINT
     : PRINT "      (C) LIGHT": PRINT : PRINT "      (D) OXYGEN"
703  INPUT G$
705  IF G$ = "A" THEN  PRINT : PRINT "THE SOIL DIDN'T LOSE HARDLY ANY WEI
     GHT! WATER IS THE SOURCE.": GOSUB 5000: GOTO 710
706  IF G$ = "B" THEN  PRINT : PRINT "CORRECT!":RIGHT = RIGHT + 1: GOSUB
     5000: GOTO 710
```

```
707  IF G$ = "C" THEN   PRINT : PRINT "LIGHT WAS NEEDED, BUT THE MATTER TH
     AT    HELPED ADD TO PLANT MATERIAL IS WATER.": GOSUB 5000: GOTO 710
708  IF G$ = "D" THEN   PRINT : PRINT "PLANTS PRODUCE OXYGEN DURING PHOTOS
     YN- THESIS.  THEY TAKE IN WATER.": GOSUB 5000: GOTO 710
709  PRINT : PRINT "ENTER A,B ,C OR D": GOTO 703
710  TEXT : HOME : PRINT "WHAT DID INGENHOUSZ SHOW WAS NECESSARY  FOR PLA
     NTS TO RELEASE OXYGEN?"
711  PRINT : PRINT "     (A) SOIL": PRINT : PRINT "     (B) WATER": PRINT
     : PRINT "     (C) LIGHT": PRINT : PRINT "     (D) DARKNESS"
712  INPUT G$
713  IF G$ = "A" OR G$ = "B" OR G$ = "D" THEN   PRINT : PRINT "LIGHT WAS N
     EEDED.  REMEMBER PRIESTLY'S  MINT EXPERIMENTS!": GOSUB 5000: GOTO 72
     0
716  IF G$ = "C" THEN   PRINT : PRINT "BRIGHT, I MEAN RIGHT YOU ARE!": GOSUB
     5000:RIGHT = RIGHT + 1: GOTO 720
717  PRINT "CHOOSE A, B, C, OR D": GOTO 712
720  TEXT : HOME
721  PRINT "PRIESTLY COULDN'T SUCCESSFULLY REPEAT   HIS MINT EXPERIMENTS
     BECAUSE HE WAS      LACKING"
722  PRINT : PRINT "     (A) SOIL": PRINT : PRINT "     (B) LIGHT": PRINT
     : PRINT "     (C) WATER": PRINT : PRINT "     (D) OXYGEN"
723  INPUT G$
724  IF G$ = "A" OR G$ = "C" OR G$ = "D" THEN   PRINT : PRINT "INGENHOUSZ
     SHOWED HE WAS LACKING LIGHT!": GOSUB 5000: GOTO 730
725  IF G$ = "B" THEN   PRINT : PRINT "INGENHOUSZ WOULD BE SO PROUD!": GOSUB
     5000:RIGHT = RIGHT + 1: GOTO 730
726  PRINT "CHOOSE A, B, C, OR D": GOTO 723
730  TEXT : HOME
731  IF RIGHT < 2 THEN   PRINT "HISTORY DOESN'T SEEM TO BE YOUR STRONG  PO
     INT.  I THINK YOU SHOULD REDO THIS    FILE BEFORE MOVING ON.": GOSUB
     5000: GOTO 750
733  IF RIGHT = 2 THEN   PRINT "YOU'RE OK WITH HISTORY.  YOU CHOOSE      WH
     ETHER YOU WANT TO REDO THIS FILE OR   MOVE ON.": PRINT : GOSUB 5000:
      GOTO 750
735  IF RIGHT = 3 THEN   PRINT "YOU'RE A REGULAR HISTORIAN!  GOOD JOB!": PRINT
     : GOSUB 5000
```

```
750    RETURN
2000   REM   CHANGE FILE DIRECTIONS
2010   TEXT : HOME
2020   VTAB 10
2025   PRINT "REMOVE THIS DISK AND PLACE THE NUMBERED DISK YOU NEED INTO T
       HE DISK DRIVE"
2028   PRINT : PRINT "TYPE PR#6"
2030   PRINT : PRINT "AND PRESS THE RETURN KEY"
2040   GOTO 100
2041   RETURN
5000   REM   CONTINUE
5005   INPUT "TYPE C TO CONTINUE OR E TO EXIT.";G$
5010   IF G$ = "E" THEN  GOTO 45
5011   IF G$ = "C" THEN  GOTO 5025
5017   GOTO 5005
5025   RETURN
10000    REM   DR. A GRAPHICS
10001    HGR : HCOLOR= 3
10002    HPLOT 90,140 TO 110,128 TO 110,104 TO 70,104 TO 70,84 TO 80,76 TO
       90,84 TO 70,84 TO 90,84 TO 90,96
10003    HPLOT 90,96 TO 110,96 TO 110,80 TO 80,60 TO 80,24 TO 100,36 TO 120
       ,24 TO 140,36 TO 160,24 TO 180,36 TO 200,24 TO 200,60
10004    HPLOT 200,60 TO 170,80 TO 170,96 TO 190,96 TO 190,84 TO 200,80 TO
       210,84 TO 190,84 TO 210,84 TO 210,104 TO 170,104 TO 170,128
10005    HPLOT 170,128 TO 190,140 TO 160,140 TO 140,124 TO 120,140 TO 90,14
       0
10006    HPLOT 110,116 TO 170,116
10007    HPLOT 140,80 TO 140,116
10008    HPLOT 150,104 TO 150,96 TO 160,96 TO 160,104 TO 150,104
10009    HPLOT 110,88 TO 120,80 TO 130,88 TO 140,80 TO 150,88 TO 160,80 TO
       170,88
10010    HPLOT 110,64 TO 120,72 TO 160,72 TO 170,64
10011    HPLOT 100,44 TO 120,44 TO 120,52 TO 100,52 TO 100,44
10012    HPLOT 160,44 TO 180,44 TO 180,52 TO 160,52 TO 160,44
10013    HPLOT 160,40 TO 180,40
10014    HPLOT 120,40 TO 100,40
```

```
10015   RETURN
10800   REM  CARRIAGE
10801   HGR : HCOLOR= 3
10802   HPLOT 250,100 TO 30,100 TO 30,30 TO 120,100 TO 250,45 TO 50,45
10804   HPLOT 65,100 TO 100,120 TO 65,140 TO 30,120 TO 65,100
10806   HPLOT 215,100 TO 250,120 TO 215,140 TO 180,120 TO 215,100
10810   HPLOT 180,45 TO 130,0 TO 200,0 TO 250,45
10812   HPLOT 250,45 TO 250,100
10814   RETURN
10900   REM  SEED
10901   HGR : HCOLOR= 3
10902   HPLOT 30,50 TO 250,50
10904   HPLOT 170,125 TO 190,115 TO 190,90 TO 180,85 TO 150,100 TO 130,100
        TO 110,110 TO 90,110 TO 80,105 TO 80,90 TO 130,65 TO 170,65 TO 180,
        75 TO 180,85
10906   HPLOT 180,75 TO 200,90 TO 200,115 TO 220,130
10908   HPLOT 200,115 TO 200,140: HPLOT 190,115 TO 190,135
10910   HPLOT 200,115 TO 190,115
10912   RETURN
11000   REM  VAN HELMONT
11001   HGR : HCOLOR= 3
11002   HPLOT 45,75 TO 45,35 TO 85,15 TO 165,15 TO 205,35 TO 205,95 TO 125
        ,140 TO 45,95 TO 45,75 TO 25,65 TO 25,50 TO 45,50
11004   HPLOT 205,75 TO 225,65 TO 225,50 TO 205,50
11006   HPLOT 75,30 TO 85,25 TO 105,25 TO 115,30 TO 75,30
11008   HPLOT 135,30 TO 145,25 TO 165,25 TO 175,30 TO 135,30
11010   HPLOT 85,45 TO 85,35 TO 105,35 TO 105,45 TO 85,45: HPLOT 95,45 TO
        95,40 TO 105,40
11012   HPLOT 145,45 TO 145,35 TO 165,35 TO 165,45 TO 145,45: HPLOT 155,45
        TO 155,45 TO 155,40 TO 165,40
11014   HPLOT 125,55 TO 135,60 TO 125,65 TO 115,60 TO 125,55
11016   HPLOT 105,95 TO 145,95 TO 135,100 TO 115,100 TO 105,95
11018   HPLOT 125,70 TO 145,85 TO 165,85 TO 165,80 TO 175,80 TO 175,90 TO
        145,90 TO 125,80
11020   HPLOT 125,80 TO 105,90 TO 75,90 TO 75,80 TO 85,80 TO 85,85 TO 105,
        85 TO 125,70
```

```
11022   RETURN
11100   REM   TABLE
11101   HGR : HCOLOR= 3
11102   HPLOT 7,100 TO 7,10 TO 56,10 TO 56,100 TO 7,100
11104   HPLOT 21,55 TO 14,50 TO 14,25 TO 21,20 TO 42,20 TO 49,25 TO 49,50 TO
        42,55 TO 21,55
11106   HPLOT 14,60 TO 70,135: HPLOT 21,60 TO 84,130: HPLOT 35,60 TO 91,11
        5
11108   HPLOT 49,60 TO 91,105: HPLOT 49,52 TO 98,95
11110   HPLOT 56,135 TO 105,95 TO 231,95 TO 196,135 TO 56,135
11112   HPLOT 98,135 TO 98,105 TO 161,105 TO 161,135
11114   HPLOT 112,115 TO 112,130: HPLOT 105,120 TO 112,125 TO 119,120: HPLOT
        105,115 TO 112,120 TO 119,115
11116   HPLOT 133,130 TO 133,115 TO 147,115 TO 147,130 TO 133,130: HPLOT 1
        26,120 TO 133,125 TO 126,130
11118   HPLOT 126,125 TO 133,125: HPLOT 147,125 TO 154,125: HPLOT 154,120 TO
        147,125 TO 154,130
11120   HPLOT 133,115 TO 126,115 TO 133,110 TO 133,115
11122   HPLOT 147,115 TO 147,110 TO 154,115 TO 147,115
11124   RETURN
5   REM   PHOTOSYNTHESIS TUTORIAL
10   REM   BY PATRICIA DROZDOWSKI MORRELL
15   REM   FEBRUARY, 1987
16   REM   VARIABLE LIST
17   REM   N$=NAME, G$=GET VARIABLE; RIGHT = NUMBERS OF RIGHT ANSWERS PER U
        NIT
18   REM   I=LOOP COUNTER, C$=MENU CHOICE
19   REM   Q$=QUIT CHOICE
25   REM   INITIALIZATION BLOCK
26   DIM N$(30)
27   DIM W$(9)
28   PRINT  CHR$ (4);"BRUN LOMEM:": &  LOMEM: 16384
30   REM   ********** DRIVER   **********
35   REM   INTRODUCTORY GRAPHICS
40   GOSUB 200
45   REM   MAIN MENU
```

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50    GOSUB 285
55    IF C$ = "C" THEN  GOSUB 800
65    IF C$ = "D" THEN  GOSUB 2000
80    TEXT : HOME : PRINT "YOU HAVE COMPLETED THIS FILE, AGENT     ";N$
100   END
200   REM   INTRODUCTORY GRAPHICS
205   TEXT : HOME
210   HTAB 7: VTAB 6: PRINT "NATIONAL SCIENCE ARCHIVES"
220   VTAB 13: HTAB 9: PRINT "FILE NUMBER:  C6H1206"
221   FLASH
225   HTAB 9: VTAB 20: PRINT "CLASSIFIED INFORMATION"
230   FOR I = 1 TO 4000: NEXT I
235   TEXT : HOME
240   HTAB 11: VTAB 5: INVERSE : PRINT "SECURITY CLEARANCE"
244   NORMAL
245   VTAB 15: INPUT "ENTER THE SECRET CODE WORD:  ";W$
255   IF W$ <  > "SUNLIGHT" THEN  PRINT "CLEARANCE DENIED": FOR I = 1 TO 1
      000: NEXT I: GOTO 100
260   PRINT : INPUT "ENTER YOUR LAST NAME:  ";N$
265   PRINT : PRINT "STATUS:  ";
266   FLASH : PRINT "CLEARED"
267   PRINT : NORMAL
270   PRINT "PRESS ANY KEY TO ENTER THE  DOCUMENTS   ROOM"
275   GET G$
280   RETURN
285   REM   MAIN MENU
286   TEXT : HOME
288   PRINT "NATIONAL SCIENCE ARCHIVES"
289   PRINT "FILE NO.:  C6H1206"
290   PRINT : PRINT "THIS DISK CONTAINS THE FILES ON THE BIO-CHEMISTRY OF
      PHOTOSYNTHESIS"
291   PRINT : PRINT "THE OTHER FILES AVAILABLE ARE:"
292   PRINT : PRINT "BACKGROUND INFORMATION - DISK NUMBER ONE"
293   PRINT : PRINT "HISTORICAL DEVELOPMENT - DISK NUMBER TWO"
294   PRINT : PRINT "EFFECTS OF ENVIRONMENTAL FACTORS - DISK NUMBER FOUR"
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295   PRINT : PRINT "IF THE FILE ON CHEMISTRY IS WHAT YOU     WANT TO VIEW,
      TYPE C"
296   PRINT : PRINT "IF YOU WANT A DIFFERENT FILE, NOTE THE  NUMBER OF THE
      DISK YOU'LL NEED AND TYPE D"
297   INPUT C$
298   IF C$ = "C" THEN  GOTO 300
299   IF C$ < > "D" THEN  INPUT "CHOOSE C OR D:  ";C$
300   RETURN
800   REM  BIOCHEMISTRY .
802   TEXT : HOME
804   PRINT "READY TO TACKLE THE BIOCHEMICAL ASPECTS OF PHOTOSYNTHESIS:   H
      OW PLANTS MAKE FOODFROM CARBON DIOXIDE AND WATER."
806   PRINT : PRINT "TO MAKE THIS PARTICULAR FILE EASIER TO  USE, I'VE DIV
      IDED IT INTO SUBSECTIONS.": PRINT : GOSUB 5000
808   TEXT : HOME : PRINT : PRINT : HTAB 6: PRINT "SUBSECTIONS OF DISK NUM
      BER 3"
810   PRINT : PRINT : HTAB 5: PRINT "BIOCHEMISTRY OF PHOTOSYNTHESIS"
811 RIGHT = 0
812   PRINT : PRINT : PRINT "(A) ROLE OF PLANT PIGMENTS": PRINT : PRINT : PRINT
      "(B) ADP/ATP CYCLE": PRINT : PRINT : PRINT "(C) LIGHT AND DARK REACT
      IONS"
814   PRINT : PRINT : INPUT "WHICH SUBSECTION WOULD YOU LIKE:   ";G$
816   IF G$ = "A" THEN  GOSUB 850: GOTO 824
818   IF G$ = "B" THEN  GOSUB 975: GOTO 824
820   IF G$ = "C" THEN  GOSUB 1170: GOTO 824
821   GOTO 814
824   TEXT : HOME : PRINT "TYPE S FOR ANOTHER BIOCHEMICAL SUB-     SECTION
      ": PRINT : PRINT "OR": PRINT : PRINT "TYPE D FOR A COMPLETELY DIFFER
      ENT FILE  OR TO QUIT FOR THE DAY"
825   PRINT : PRINT : INPUT G$
826   IF G$ = "S" THEN  GOTO 808
827   IF G$ = "D" GOTO 45
828   GOTO 824
830   RETURN
850   REM  PIGMENTS SUBROUTINE
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851    TEXT : HOME : PRINT "IF YOU ARE TUNING IN AFTER DOING THE LABACTIVIT
       Y, TYPE L.": PRINT : PRINT "IF YOU HAVE NOT DONE THE CHROMOTAGRAPHY
       LAB YET, JUST PRESS ANY KEY AND RETURN  TO CONTINUE."
852    INPUT G$: IF G$ = "L" GOTO 900
853    GOSUB 11300: HOME : VTAB 21
854    INPUT "IN WHICH CELL PART DOES PHOTOSYNTHESIS  OCCUR: (A) MITOCHOND
       RIA; (B) NUCLEUS; (C) CHLOROPLASTS  YOUR ANSWER:  ";G$
856    IF G$ < > "C" THEN  PRINT "CHLOROPLASTS ARE THE PLACE!"
857    IF G$ = "C" THEN  PRINT "COLORFULLY CORRECT!"
858    GOSUB 5000: HOME
859    VTAB 21: PRINT "SCIENTISTS PROVED THIS BY REMOVING THESESTRUCTURES.
        THE CELL WITHOUT CHLORO-   PLASTS COULD NOT PHOTOSYNTHESIZE": GOSUB
       5000: HOME
860    VTAB 21: PRINT "HOWEVER, THE REMOVED CHLOROPLASTS COULD": GOSUB 5000

862    TEXT : HOME : VTAB 5: HTAB 7: PRINT " STRUCTURE OF CHLOROPLASTS:"
864    PRINT : PRINT : PRINT "CHLOROPLASTS ARE MADE UP OF MANY LAYERS,BUT C
       ONTAIN BASICALLY TWO PARTS:"
866    PRINT : PRINT "GRANA - CAPTURES THE LIGHT ENERGY OF THESUN": PRINT
867    PRINT "STROMA - WHERE ENERGY IS USED TO MIX    CARBON DIOXIDE AND OX
       YGEN TO MAKE THE   'FOOD'.": PRINT
868    PRINT : PRINT : PRINT "A PICTURE OF A CHLOROPLAST CAN BE FOUND IN YO
       UR NOTEBOOK."
870    PRINT : GOSUB 5000
872    TEXT : HOME : VTAB 5: PRINT "TO CAPTURE LIGHT, PLANTS HAVE VARIOUS
        PIGMENTS.  YOU SHOULD REMEMBER THAT PIG-MENTS ARE CHEMICAL COMPOUND
       S THAT ABSORBCERTAIN WAVELENGTHS OF LIGHT."
873    PRINT : PRINT "A LIST OF PIGMENTS AND THE COLORS THEY  EACH REFLECT
       CAN BE FOUND IN YOUR       NOTEBOOK."
874    PRINT : PRINT "WHICH OF THE PIGMENTS DO YOU THINK IS   THE MOST IMPO
       RTANT FOR ABSORBING THE    LIGHT ENERGY USED IN PHOTOSYNTHESIS?"
875    PRINT : PRINT "(HINT:  CHOOSE ONE FROM THE LIST IN YOURNOTEBOOK)"
876    PRINT : INPUT "YOUR CHOICE:  ";G$: PRINT
877    IF G$ < > "CHLOROPHYLL" THEN  PRINT "WHOOPS!  THE CORRECT PIGMENT I
       S GREEN.  TRY AGAIN.": GOTO 876
879    IF G$ = "CHLOROPHYLL" THEN  GOSUB 11300: HOME
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880  VTAB 21: PRINT "RIGHT! CHLOROPLASTS ARE IMPORTANT IN   PHOTOSYNTHES
     IS MAINLY BECAUSE THEY PRO- DUCE AND CONTAIN CHLOROPHYLL.": GOSUB 50
     00
884  TEXT : HOME : VTAB 5: PRINT "YOU SHOULD NOW DO THE CHROMOTAGRAPHY LA
     B"
886  PRINT : PRINT "BASICALLY, THIS LAB WILL ENABLE YOU TO   SEPARATE MANY
     OF THE PLANT PIGMENTS     FOUND IN SPINACH LEAVES."
888  PRINT : PRINT "FULL DIRECTIONS CAN BE FOUND IN YOUR    NOTEBOOK, ALO
     NG WITH GUIDELINES."
890  PRINT : PRINT "BE SURE TO COMPLETE THE LAB WRITE UP ANDTURN IT IN WH
     EN YOU HAVE COMPLETED THE  ACTIVITY.": PRINT : GOSUB 5000
900  REM  REVIEW
927  TEXT : HOME : PRINT "REVIEW TIME, AGENT ";N$
928  PRINT : PRINT "IN WHAT CELL STRUCTURE DOES PHOTOSYN-   THESIS OCCUR?
     ": PRINT : PRINT "     (A) CHLOROPLASTS": PRINT : PRINT "     (B) CH
     LOROPHYLL": PRINT : PRINT "     (C) NUCLEUS"
929  INPUT G$: PRINT
930  IF G$ = "C" THEN  PRINT "THAT'S THE 'BRAIN' BUT NOT WHERE PHOTO- SYN
     THESIS OCCURS.  THE CORRECT CHOICE ISCHLOROPLASTS": GOTO 934
931  IF G$ = "B" THEN  PRINT "THAT'S THE PIGMENT NEEDED.  THE CELL    STR
     UCTURE WHERE THAT IS FOUND, THOUGH,  IS THE CHLOROPLAST!": GOTO 934
932  IF G$ = "A" THEN  PRINT "I'M GREEN WITH ENVY!  YOU'RE SO SMART'";RIG
     HT = RIGHT + 1: GOTO 934
933  PRINT "CHOOSE A B OR C": GOTO 929
934  PRINT : GOSUB 5000: TEXT : HOME
935  VTAB 5: PRINT "CHLOROPHYLL IS AN IMPORTANT PLANT       PIGMENT MOSTL
     Y BECAUSE IT IS:"
936  PRINT : PRINT "     (A) GREEN": PRINT : PRINT "     (B) INVOLVED IN
     TRAPPING LIGHT     ENERGY": PRINT : PRINT "     (C) FOUND IN SPINACH
     "
937  PRINT : INPUT G$: PRINT
938  IF G$ = "B" THEN  PRINT "YOU ARE CORRECT!":RIGHT = RIGHT + 1: PRINT
     : GOTO 942
939  IF G$ < > "A" AND G$ < > "C" THEN  PRINT "PLEASE CHOOSE A B OR C":
     GOTO 937
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77

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940   IF G$ <  > "B" THEN   PRINT "THIS IS TRUE, BUT IT'S NOT WHY CHLORO-
      PHYLL IS MOST IMPORTANT.  IT'S NEEDED   BECAUSE IT TRAPS LIGHT ENERG
      Y.": GOTO 942
942   PRINT : GOSUB 5000
945   TEXT : HOME : VTAB 5: PRINT "WHAT IS A METHOD THAT CAN BE USED TO
      SEPARATE PLANT PIGMENTS:": PRINT : PRINT "     (A) PHOTOSYNTHESIS":
      PRINT : PRINT "     (B) SCANNING ELECTRON MICROSCOPY": PRINT : PRINT
      "     (C) CHROMOTAGRAPHY"
946   PRINT : INPUT G$
947   IF G$ = "C" THEN   PRINT "WHAT A SUPER SLEUTH!":RIGHT = RIGHT + 1: PRINT
      : GOTO 950
948   IF G$ = "A" OR G$ = "B" THEN   PRINT "READ YOUR CHOICES AGAIN.  THE C
      ORRECT   METHOD IS CHROMOTAGRAPHY.  IT'S THE     METHOD YOU USED IN
      YOUR LAB!": PRINT : GOTO 950
949   PRINT : PRINT "CHOOSE A B OR C": GOTO 946
950   PRINT : GOSUB 5000
951   TEXT : HOME : IF RIGHT = 3 THEN   PRINT "YOU'RE DOING VERY WELL, AGEN
      T ";N$: GOTO 955
952   TEXT : HOME : IF RIGHT = 2 THEN   PRINT "YOU MAY BE READY FOR THE NEX
      T SECTION!": GOTO 955
953   IF RIGHT < 2 THEN   PRINT "I RECOMMEND YOU GO THROUGH THIS FILE     AG
      AIN, AGENT ";N$: GOTO 955
955   PRINT : GOSUB 5000
956   RETURN
975   REM   ATP.ADP
976   TEXT : HOME : VTAB 5: PRINT "CONGRATULATIONS, AGENT ";N$: PRINT "YOU
      'RE NOW READY TO HANDLE THE SYNTHESISREACTIONS THAT OCCUR IN PHOTOSY
      NTHESIS": PRINT : PRINT : PRINT
977   GOSUB 5000
978   TEXT : HOME : PRINT "TEST YOUR MEMORY.": PRINT : PRINT "WE LEARNED T
      HAT PLANTS TAKE IN WHAT TWO SUBTANCES?"
979   PRINT : PRINT "     (A) CARBON DIOXIDE AND WATER": PRINT : PRINT "
      (B) OXYGEN AND WATER": PRINT : PRINT "     (C) SOIL AND CARBON DI
      OXIDE"
980   PRINT : INPUT G$: PRINT
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981   IF G$ = "B" OR G$ = "C" THEN  PRINT "YOUR MEMORY DIDN'T DO WELL.  TH
      E CORRECTCHOICE IS A:  CARBON DIOXIDE AND WATER": GOTO 985
982   IF G$ = "A" THEN  PRINT "YOU COULD PUT AN ELEPHANT TO SHAME WITH YOU
      R MEMORY SKILLS!  GOOD JOB!": GOTO 985
983   PRINT "YOUR CHOICES ARE A B OR C.  TRY AGAIN": GOTO 980
985   PRINT : PRINT "THESE TWO ARE OUR SIMPLE COMPOUNDS "
986   PRINT : GOSUB 5000: TEXT : HOME
987   PRINT : PRINT "WHAT DID GREEN PLANTS GIVE US?": PRINT : PRINT "
      (A) CARBON DIOXIDE AND FOOD"
988   PRINT : PRINT "      (B) WATER AND FOOD": PRINT : PRINT "      (C) OXY
      GEN AND FOOD"
999   PRINT : PRINT "THINK ABOUT IT"
1000   FOR I = 1 TO 4000: NEXT I
1002   PRINT : PRINT "DID YOU GUESS CHOICE C": PRINT : PRINT "IF YOU DID,
      YOU'RE RIGHT!"
1003   PRINT : GOSUB 5000: TEXT : HOME : PRINT "YOUR LAST QUESTION (FOR NO
      W):"
1004   PRINT : PRINT "WHAT WAS NECESSARY FOR PLANTS TO CARRY  ON PHOTOSYNT
      HESIS:"
1006   PRINT : PRINT "      (A) LIGHT ENERGY": PRINT : PRINT "      (B) CHEM
      ICAL ENERGY": PRINT : PRINT "      (C) MECHANICAL ENERGY"
1008   PRINT : INPUT "I'LL LET YOU REALLY GUESS THIS TIME.    YOUR CHOICE:
      ";G$
1010   IF G$ = "A" THEN  PRINT : PRINT "TERRIFIC!": GOTO 1015
1012   IF G$ < > "B" AND G$ < > "C" THEN  PRINT : PRINT "THAT'S NOT EVEN
      A CHOICE!"
1013   PRINT : PRINT "THE CORRECT FORM OF ENERGY IS LIGHT!    REMEMBER:  P
      HOTO?"
1015   PRINT : PRINT : GOSUB 5000: TEXT : HOME
1016   PRINT : PRINT : PRINT "USING WHAT WE JUST REVIEWED, WE CAN    WRIT
      E THE CHEMICAL EQUATION FOR PHOTO-  SYNTHESIS."
1017   PRINT : PRINT "THE CARBON DIOXIDE AND WATER COMBINE, INTHE PRESENCE
      OF LIGHT ENERGY TO MAKE    GLUCOSE (A SUGAR - FOOD) AND OXYGEN."
1018   PRINT : PRINT "THIS CHEMICAL EQUATION IS WRITTEN IN    YOUR NOTEBOO
      K.  SPEND SOME TIME NOW TO  REVIEW THIS FORMULA."
1019   PRINT : GOSUB 5000
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1023   TEXT : HOME : PRINT "I HAVE A TOUGH QUESTION FOR YOU."
1025   PRINT : PRINT "IS THE OXYGEN RELEASED BY THE PLANT      DURING PHOTO
       SYNTHESIS COMING FROM THE   CARBON DIOXIDE OR THE WATER?"
1027   PRINT : INPUT "WHAT DO YOU THINK?  (A) CARBON DIOXIDE; (B) WATER ";
       G$
1029   IF G$ < > "A" AND G$ < > "B" THEN  PRINT : PRINT "YOU HAVE TO CHO
       OSE BETWEEN A AND B!": GOTO 1027
1031   IF G$ = "B" THEN  PRINT : PRINT "YOU ARE A WHIZ'  SCIENTISTS RAN MA
       NY    EXPERIMENTS TO FIGURE OUT THE SOURCE OF OXYGEN WAS INDEED THE
       WATER!": GOTO 1036
1034   PRINT : PRINT "SCIENTISTS RAN MANY EXPERIMENTS TO      FIGURE OUT T
       HE SOURCE OF OXYGEN WAS     ACTUALLY THE WATER!"
1036   PRINT : GOSUB 5000
1037   TEXT : HOME : PRINT "BACK TO OUR REACTION...
1038   PRINT : PRINT "PHOTOSYNTHESIS ACTUALLY OCCURS IN        TWO REACTION
       S."
1040   PRINT : PRINT "BEFORE I CAN EXPLAIN THESE TO YOU, WE   MUST LEARN S
       OMETHING ABOUT HOW CELLS     STORE ENERGY."
1042   PRINT : PRINT "WHAT DO WE BREAK TO GET ENERGY?": PRINT : INPUT "I'L
       L GIVE YOU A HINT, IT'S GOT 5 LETTERSBEGINS WITH A B AND ENDS IN S:
       ";G$
1044   IF G$ = "BONDS" THEN  PRINT "WHAT AN AGENT!  RIGHT, AGAIN!": GOTO 1
       046
1045   IF G$ < > "BONDS" THEN  PRINT "REALLY, NOW!  WE BREAK BONDS TO GET
              ENERGY!"
1046   PRINT : GOSUB 5000
1048   TEXT : HOME : PRINT "IN PLANT CELLS (AND IN OUR CELLS) IS A   CHEMIC
       AL CALLED ADENOSINE TRIPHOSPHATE  OR ATP FOR SHORT."
1050   PRINT : INPUT "WHAT DOES TRI MEAN?  ";G$
1060   PRINT : PRINT "YOU KNOW TRI MEANS THREE!"
1061   PRINT : GOSUB 5000: TEXT : HOME
1062   PRINT : PRINT "SO ATP IS A CHEMICAL CALLED ADENOSINE   THAT HAS THR
       EE PHOSPHATE GROUPS BONDED  TO IT."
1064   PRINT : PRINT "YOUR NOTEBOOK HAS A SKETCH OF HOW        CHEMISTS WOU
       LD DRAW THE FORMULA FOR THISCOMPOUND."
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1056  PRINT : PRINT "NOTICE THE WAVY LINES BETWEEN THE          PHOSPHATE GR
OUP.  WAVY LINES MEAN THESE BONDS ARE EASY TO BREAK."
1068  PRINT : PRINT "WHAT WOULD BE RELEASED IF WE BREAK OFF A PHOSPHATE G
ROUP?"
1070  PRINT : PRINT "WHEN YOU THINK YOU KNOW THE ANSWER,        CONTINUE."
1072  PRINT : PRINT : GOSUB 5000
1073  TEXT : HOME : VTAB 12: HTAB 17: INVERSE : PRINT "ENERGY": NORMAL
1074  VTAB 18: PRINT "WERE YOU RIGHT?  I HOPE SO!": PRINT : GOSUB 5000
1075  TEXT : HOME : PRINT "HOW MANY PHOSPHATE GROUPS ARE LEFT AFTERWE BRE
AK THAT BOND IN ATP?"
1077  PRINT : PRINT "LOOK AT THE SKETCHES IN YOUR NOTEBOOK.  IF ONE BOND
IS BROKEN, ONLY 2 PHOSPHATE GROUPS WOULD BE LEFT."
1079  PRINT : PRINT "WHAT DO YOU THINK THE RESULTING COMPOUNDIS CALLED?"
1080  PRINT : PRINT "IT'S NOW CALLED ADENOSINE DIPHOSPHATE ORADP. "
1082  PRINT : PRINT "ADP IS  ADENOSINE WITH 2 PHOSPHATE        GROUPS BONDE
D TO IT."
1084  PRINT : PRINT "ATP HAS 3 PHOSPHATE GROUPS AND ADP HAS  2 PHOSPHATE
GROUPS."
1086  PRINT : GOSUB 5000
1089  TEXT : HOME
1090  PRINT "IF ENERGY IS STORED IN BONDS, WHICH      COMPOUND HAS MORE EN
ERGY ATP OR ADP?"
1092  PRINT : INPUT G$
1094  IF G$ = "ADP" THEN  PRINT "COUNT THE BONDS IN THE SKETCHES.  ATP
HAS MORE!  MORE BONDS USUALLY MEANS MORESTORED ENERGY"
1096  IF G$ = "ATP" THEN  PRINT "ARE YOU SURE YOU'RE AN AGENT AND NOT A
CHEMIST?"
1097  IF G$ <  > "ADP" AND G$ <  > "ATP" THEN  PRINT "CHOOSE BETWEEN ATP
AND ADP": GOTO 1090
1098  PRINT : PRINT "IF I BREAK A PHOSPHATE GROUP OFF OF ATP AND RELEASE
ENERGY, I'LL GET ADP.  "
1099  PRINT : PRINT "IF I DO JUST THE OPPOSITE, I CAN CHANGE ADP BACK INT
O ATP."
1100  PRINT : PRINT "LET'S TRY IT THIS WAY": PRINT : GOSUB 5000: PRINT
1102  GOSUB 11400: REM  ATP/ADP SKETCH
1103  HOME

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1104   VTAB 21: PRINT "OUR BODY STORES ENERGY BY PUTTING IT IN TO ADP TO M
       AKE ATP.": PRINT : GOSUB 5000: HOME
1106   VTAB 21: PRINT "OUR BODY GETS ENERGY BY BREAKING THE     LAST PHOSPH
       ATE BOND IN ATP AND MAKING   ADP.": GOSUB 5000
1108   TEXT : HOME
1109   HOME
1110   VTAB 10: PRINT "PERSONALLY, I LIKE TO THINK OF ATP AS ANENERGY JAR.
          ENERGY JARS ARE LIKE COOKIEJARS.": PRINT : PPINT : PRINT
1112   PRINT "A COOKIE JAR HOLDS COOKIES.  AFTER YOU  FILL IT, YOU PLACE T
       HE LID ON.   TO GET  COOKIES OUT, YOU TAKE THE LID OFF.": PRINT : GOSUB
       5000
1114   GOSUB 11500: HOME : REM   JARS
1116   VTAB 21: PRINT "ATP HOLDS ENERGY.  WHEN IT'S FULL, THE  LID (THIRD
       PHOSPHATE GROUP) IS ATTACHED.": GOSUB 5000: HOME
1118   VTAB 21: PRINT "WHEN ENERGY IS NEEDED, THE THIRD PHOS-  PHATE GROUP
       IS REMOVED.": GOSUB 5000
1119   GOSUB 16000
1120   HOME : VTAB 21
1122   PRINT "THE REVERSE IS ALSO TRUE.": PRINT : GOSUB 5000
1124   TEXT : HOME
1125   VTAB 10
1126   INPUT "IN PLANTS, WHAT IS THE SOURCE OF ENERGY USED TO CONVERT ADP
       BACK INTO ATP?";G$
1127   IF G$ < > "SUN" THEN  PRINT OH,AGENT,";N$:PRINT "YOUKNOWTHESUNIS."
       :GOSUB 5000
1128   IF G$ = "SUN" THEN  PRINT "RIGHT!  THE SUN!  YOU'RE SO BRIGHT.": GOSUB
       5000
1130   TEXT : HOME : PRINT "HAVE YOU REALLY UNDERSTOOD THIS, AGENT  ";N$
1132   PRINT : PRINT "WHICH HAS MORE ENERGY STORED IN IT (A) ATP OR (B) AD
       P"
1134   PRINT : INPUT "YOUR CHOICE:  ";G$
1136   IF G$ = "B" THEN  PRINT : PRINT "ADP HAS ONLY 2 PHOSPHATE GROUPS.
          ATP HAS THREE.  THEREFORE, ATP HAS MORE ENERGY BECAUSE IT HAS
       MORE BONDS.": GOTO 1140
1137   IF G$ = "A" THEN  PRINT : PRINT "GREAT CHOICE!":RIGHT = RIGHT + 1: GOTO
       1140
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1138   PRINT "CHOOSE A OR B, PLEASE": GOTO 1134
1140   PRINT : PRINT : GOSUB 5000
1142   TEXT : HOME : PRINT "WHEN THE CELL NEEDS ENERGY, WHICH DOES   IT DO?
       "
1143   PRINT : PRINT "       (A) BREAK THE BOND BETWEEN THE      LAST PHOSPHA
       TE GROUPS OF ATP": PRINT : PRINT "       (B) BUILD THE BOND BETWEEN TH
       E LASTPHOSPHATE GROUPS OF ADP"
1144   PRINT : PRINT "       (C) BREAK THE BOND BETWEEN THE LASTPHOSPHATE GR
       OUPS OF ADP"
1145   PRINT : INPUT G$
1146   IF G$ = "A" THEN  PRINT : PRINT "WAY TO GO!":RIGHT = RIGHT + 1: GOTO
       1150
1147   IF G$ = "B" OR G$ = "C" THEN  PRINT : PRINT "THINK AGAIN.   BONDS IN
       ATP ARE BROKEN TORELEASE ENERGY.": GOTO 1150
1148   PRINT : PRINT "YOU MUST ENTER A B OR C": GOTO 1145
1150   PRINT : PRINT : GOSUB 5000
1152   TEXT : HOME : PRINT "WHEN THE CELL WANTS TO STORE ENERGY,    WHAT D
       OES IT DO?"
1153   PRINT : PRINT "       (A) BREAK THE BND BETWEEN THE LAST PHOSPHATE GR
       OUPS OF ATP": PRINT : PRINT "       (B) ADD A BOND TO THE LAST PHOS-
       PHATE GROUP OF ADP": PRINT : PRINT "       (C) BREAK THE BOND BETWEEN
       THE LASTPHOSPHATE GROUPS"
1155   PRINT : INPUT G$
1157   IF G$ = "A" OR G$ = "C" THEN  PRINT "SORRY.   THE CELLS STORES ITS E
       NERGY BY  BUILDING THE LAST PHOSPHATE BOND IN ADP.": GOTO 1160
1158   IF G$ = "B" THEN  PRINT : PRINT "YOU'RE COOKING NOW!":RIGHT = RIGHT
       + 1: GOTO 1160
1159   PRINT : PRINT "A B OR C, PLEASE": GOTO 1155
1160   PRINT : GOSUB 5000: TEXT : HOME
1161   IF RIGHT = 3 THEN  PRINT "GREAT JOB!  YOU'RE READY TO GO ON.": GOSUB
       5000: GOTO 1165
1162   IF RIGHT < 2 THEN  PRINT "I THINK YOUARE A BIT FUZZY ABOUT ATP ANDA
       DP.  YOU SHOULD PROBABLY GO THROUGH    THIS SECTION AGAIN.": GOSUB 5
       000: GOTO 1165
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1164   IF RIGHT = 2 THEN   PRINT "YOU HAVE A FAIR UNDERSTANDING OF ATP.    Y
       OU DECIDE WHETHER YOU WANT TO LOOK      THROUGH THIS FILE AGAIN OR MO
       VE ON.": GOSUB 5000: GOTO 1165
1165   RETURN
1170   TEXT : HOME
1171   VTAB 10: PRINT "YOU ARE AN AMAZING AGENT!  YOU'VE COME   SO FAR IN U
       NDERSTANDING PHOTOSYNTHESIS!": PRINT : PRINT : PRINT
1172   PRINT "LET'S PROCEED WITH THE TWO REACTIONS OF PHOTOSYNTHESIS.": PRINT
       : GOSUB 5000
1173   TEXT : HOME
1174   PRINT "THE 2 REACTIONS OF PHOTOSYNTHESIS ARE    THE LIGHT REACTION A
       ND THE DARK REACTION"
1175   PRINT : PRINT "THE LIGHT REACTION CAN ONLY OCCUR WHEN   THE PLANT IS
       EXPOSED TO LIGHT."
1176   PRINT : PRINT "THE DARK REACTION DOESN'T NEED LIGHT.    IT CAN OCCUR
       IN BOTH THE LIGHT AND THE  DARK."
1177   PRINT : PRINT "LET'S SEE WHAT HAPPENS IN EACH.": PRINT : PRINT : GOSUB
       5000
1178   TEXT : HOME
1179   INVERSE : PRINT "LIGHT REACTION": NORMAL
1180   PRINT : PRINT "1.  LIGHT ENERGY IS TRAPPED BY THE GREENPLANT PIGMEN
       T, CHLOROPHYLL"
1181   PRINT : PRINT "2.  ENERGY IS STORED IN ATP": PRINT : PRINT "3.  SOM
       E ENERGY IS USED TO SPLIT WATER  MOLECULES.  THE HYDDROGEN IS HELD B
       Y    CARRIER MOLECULES BUT THE OXYGEN LEAVES THE CELL AND ENTERS THE
       ATMOSPHERE."
1182   PRINT : PRINT "SO, IN THE LIGHT REACTION, THE SUN'S     ENERGY IS AB
       SORBED BY THE PLANT AND      STORED IN ATP.  ALSO, WATER IS SPLIT AND
       OXYGEN IS RELEASED."
1183   PRINT : GOSUB 5000
1184   TEXT : HOME : INVERSE : PRINT "DARK REACTION": NORMAL
1185   PRINT : PRINT "1.  CARBON DIOXIDE COMBINES WITH THE     HYDROGEN (GO
       TTEN FROM THE WATER) TO FORMGLUCOSE."
1186   PRINT : PRINT "2.  SINCE NEW BONDS ARE BEING MADE,      ENERGY IS US
       ED.  THIS ENERGY COMES FROM ATP, CHANGING IT INTO ADP."
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1187   PRINT : PRINT "THEREFORE, IN THE DARK REACTION, GLUCOSEIS MADE AND
       ATP IS CONVERTED TO ADP."
1188   PRINT : GOSUB 5000: TEXT : HOME
1189   PRINT "OUR PHOTOSYNTHESIS EQUATION IS NOW        COMPLETE.  "
1190   PRINT : PRINT "YOUR NOTEBOOK HAS A SKETCH WHICH         SIMPLIFIES T
       HE ENTIRE REACTION OF PHOTO-SYNTHESIS, INDICATING WHAT HAPPENS IN
       THE LIGHT AND IN THE DARK REACTIONS."
1191   PRINT : PRINT "TAKE A FEW MOMENTS NOW TO REVIEW THIS    DRAWING.": PRINT
       : GOSUB 5000: TEXT : HOME
1192   PRINT "LET'S MAKE SURE YOU'VE BEEN ABLE TO       ABSORB ALL THIS, SUP
       ER SLEUTH!"
1193   PRINT : PRINT "YOU WILL BE GIVEN A PHOTOSYNTHETIC EVENTINDICATE WHE
       THER IT OCCURS IN THE LIGHT REACTION (L) OR IN THE DARK REACTION (D)
          PLEASE ENTER THE APPROPRIATE LETTER  WHEN PROMPTED": PRINT : PRINT

1194   GOSUB 5000: GOSUB 17100: REM   QUESTIONS
1195   IF RIGHT = 5 THEN  PRINT "EXCELLENT JOB!!!  PERFECT SCORE!:GOSUB 50
       00:GOTO 1199
1196   TEXT : HOME
1197   IF RIGHT < 3 THEN  PRINT "YOU SEEM TO BE IN THE DARK ABOUT THESE  T
       WO REACTIONS.  BETTER GO THROUGH THIS  SECTION AGAIN.": GOSUB 5000: GOTO
       1199
1198   IF RIGHT < 5 THEN  PRINT "NOT TOO BAD.  YOU GOT MOST OF THESE      R
       IGHT.": GOSUB 5000: GOTO 1199
1199   RETURN
2000   REM  QUIT OR CHANGE FILE ROUTINE
2010   TEXT : HOME
2020   VTAB 10
2025   PRINT "REMOVE THIS DISK AND PLACE THE NUMBERED DISK YOU NEED INTO T
       HE DISK DRIVE."
2030   PRINT : PRINT "TYPE PR#6"
2035   PRINT : PRINT "PRESS THE RETURN KEY"
2040   GOTO 100
2050   RETURN
5000   REM  CONTINUE
5005   INPUT "TYPE C TO CONTINUE OR E TO EXIT:   ";G$
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5010    IF G$ = "L" THEN   GOTO 45
5011    IF G$ = "C" THEN   GOTO 5025
5017    GOTO 5005
5025    RETURN
11300   REM   CHLOROPLAST
11301   HGR : HCOLOR= 3
11302   FOR Y = 45 TO 110 STEP 5
11304   HPLOT 56,Y TO 98,Y
11306   NEXT Y
11308   FOR Y = 45 TO 110 STEP 5
11310   HPLOT 140,Y TO 182,Y
11312   NEXT Y           .
11314   FOR Y = 45 TO 110 STEP 5
11316   HPLOT 217,Y TO 252,Y
11318   NEXT Y
11320   HPLOT 28,60 TO 252,60
11322   HPLOT 28,85 TO 252,85
11324   HPLOT 28,105 TO 252,105
11326   RETURN
11340   HPLOT 140,Y TO 182,Y
11400   REM   ATP
11401   HGR : HCOLOR= 3
11402   HPLOT 18,42 TO 18,14 TO 30,14 TO 30,42: HPLOT 18,28 TO 30,28
11404   HPLOT 36,14 TO 48,14: HPLOT 42,14 TO 42,42
11406   HPLOT 54,42 TO 54,14 TO 66,14 TO 66,28 TO 54,28
11408   HPLOT 72,28 TO 102,28 TO 96,21: HPLOT 96,35 TO 102,28
11410   HPLOT 108,42 TO 108,14 TO 120,14 TO 120,42: HPLOT 108,28 TO 120,28

11412   HPLOT 126,42 TO 126,14 TO 132,14 TO 138,21 TO 138,35 TO 132,42 TO
        126,42
11414   HPLOT 144,42 TO 144,14 TO 156,14 TO 156,28 TO 144,28
11416   HPLOT 168,21 TO 168,35: HPLOT 162,28 TO 174,28
11418   HPLOT 192,42 TO 180,42 TO 180,14 TO 192,14: HPLOT 180,28 TO 186,28

11420   HPLOT 204,21 TO 204,35: HPLOT 198,28 TO 210,28
11422   HPLOT 216,42 TO 216,14 TO 228,14 TO 228,28 TO 216,28
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11424   HPLOT 18,140 TO 18,112 TO 30,112 TO 30,140: HPLOT 18,126 TO 30,126

11426   HPLOT 36,140 TO 36,112 TO 42,112 TO 48,119 TO 48,133 TO 42,140 TO
        36,140
11428   HPLOT 54,140 TO 54,112 TO 66,112 TO 66,126 TO 54,126
11430   HPLOT 78,119 TO 78,133: HPLOT 72,126 TO 84,126
11432   HPLOT 102,140 TO 90,140 TO 90,112 TO 102,112: HPLOT 90,126 TO 96,1
        26
11434   HPLOT 114,119 TO 114,133: HPLOT 108,126 TO 120,126
11436   HPLOT 126,140 TO 126,112 TO 138,112 TO 138,126 TO 126,126
11438   HPLOT 144,126 TO 174,126 TO 168,119: HPLOT 168,133 TO 174,126
11440   HPLOT 180,140 TO 180,112 TO 192,112 TO 192,140: HPLOT 180,126 TO 1
        92,126
11442   HPLOT 198,112 TO 210,112: HPLOT 204,112 TO 204,140
11444   HPLOT 216,140 TO 216,112 TO 228,112 TO 228,126 TO 216,126
11446   RETURN
11500   REM  JARS
11501   HGR : HCOLOR= 3
11503   HPLOT 30,120 TO 30,15 TO 66,15 TO 66,120 TO 30,120
11504   HPLOT 30,85 TO 66,85: HPLOT 30,50 TO 66,50
11506   HPLOT 42,45 TO 42,25 TO 54,25 TO 54,35 TO 42,35
11508   HPLOT 42,80 TO 42,60 TO 54,60 TO 54,70 TO 42,70
11510   HPLOT 42,115 TO 42,95 TO 54,95 TO 54,105 TO 42,105
11512   HPLOT 30,140 TO 30,130 TO 36,130 TO 36,140: HPLOT 30,135 TO 36,135

11514   HPLOT 42,130 TO 54,130: HPLOT 48,130 TO 48,140
11516   HPLOT 60,140 TO 60,130 TO 66,130 TO 66,135 TO 60,135
11518   HPLOT 186,50 TO 186,15 TO 222,15 TO 222,50 TO 186,50
11520   HPLOT 198,45 TO 198,25 TO 210,25 TO 210,35 TO 198,35
11522   HPLOT 180,5 TO 168,5 TO 168,25 TO 180,25: HPLOT 168,15 TO 174,15
11522   HPLOT 180,5 TO 168,5 TO 168,25 TO 180,25: HPLOT 168,15 TO 174,15
11524   HPLOT 150,50 TO 150,35 TO 162,25: HPLOT 156,25 TO 162,25 TO 162,30

11526   HPLOT 132,120 TO 132,50 TO 168,50 TO 168,120 TO 132,120
11528   HPLOT 132,85 TO 168,85
11530   HPLOT 144,115 TO 144,95 TO 156,95 TO 156,105 TO 144,105
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11532   HPLOT 144,80 TO 144,60 TO 156,60 TO 156,70 TO 144,70
11534   HPLOT 138,140 TO 138,130 TO 144,130 TO 144,140: HPLOT 138,135 TO 1
        44,135
11536   HPLOT 150,140 TO 150,130 TO 156,135 TO 150,140
11538   HPLOT 162,140 TO 162,130 TO 168,130 TO 168,135 TO 162,135
11540   RETURN
16000   REM   JARS 2
16001   HGR : HCOLOR= 3
16002   HPLOT 80,24 TO 110,24 TO 110,52 TO 80,52 TO 80,24
16004   HPLOT 80,88 TO 110,88 TO 110,116 TO 80,116 TO 80,88
16006   HPLOT 80,116 TO 110,116 TO 110,144 TO 80,144 TO 80,116
16008   HPLOT 90,52 TO 90,56
16010   HPLOT 90,60 TO 90,64
16012   HPLOT 90,68 TO 90,72
16014   HPLOT 90,76 TO 90,80
16018   HPLOT 85,80 TO 90,84 TO 95,80
16020   HPLOT 90,48 TO 90,32 TO 100,32 TO 100,40 TO 90,40
16022   HPLOT 105,60 TO 95,60 TO 95,68 TO 105,68
16024   HPLOT 95,68 TO 95,76 TO 105,76
16026   HPLOT 90,112 TO 90,96 TO 100,96 TO 100,104 TO 90,104
16028   HPLOT 190,148 TO 190,156
16030   HPLOT 200,156 TO 200,148 TO 205,148 TO 205,152 TO 200,152
16032   HPLOT 90,140 TO 90,124 TO 100,124 TO 100,132 TO 90,132
16034   HPLOT 80,156 TO 80,148 TO 85,148 TO 85,156
16036   HPLOT 80,152 TO 85,152
16038   HPLOT 90,148 TO 95,152 TO 90,156 TO 90,148
16039   HPLOT 100,156 TO 100,148 TO 105,148 TO 105,152 TO 100,152
16040   HPLOT 175,144 TO 175,60 TO 205,60 TO 205,144 TO 175,144
16042   HPLOT 175,88 TO 205,88
16044   HPLOT 175,116 TO 205,116
16046   HPLOT 185,84 TO 185,68 TO 195,68 TO 195,76 TO 185,76
16048   HPLOT 185,112 TO 185,96 TO 195,96 TO 195,104 TO 185,104
16050   HPLOT 185,140 TO 185,124 TO 195,124 TO 195,132 TO 185,132
16052   HPLOT 175,156 TO 175,148 TO 180,148 TO 180,156
16054   HPLOT 175,152 TO 180,152
16056   HPLOT 185,148 TO 195,148
```

```
16058   RETURN
17000   REM   WHOOPS
17001   HOME : PRINT "WELL, OZONE BLOCKS MUCH OF THE SUN'S      RAYS FROM RE
        ACHING OUR PLANET.": GOSUB 5000
17002   HOME : PRINT "IT LED TO THE COOLING OF THE EARTH'S      ATMOSPHERE A
        ND...": GOSUB 5000
17003   HOME
17004   PRINT "MADE THE EARTH AN INHABITABLE PLACE FOR ALL ORGANISMS!": GOSUB
        5000
17005   RETURN
17100   REM   QUESTIONS FOR LIGHT/DARK REACTIONS
17101   TEXT : HOME : PRINT "CHOOSE L FOR LIGHT REACTION OR D FOR      DARK
        REACTION"
17102   PRINT : PRINT "CAN OCCUR IN THE DARK"
17103   PRINT : INPUT G$
17105   IF G$ = "L" THEN  PRINT "LIGHT ONLY OCCURS IN THE LIGHT!": GOTO 17
        110
17106   IF G$ = "D" THEN  PRINT "GOOD START":RIGHT = RIGHT + 1: PRINT : PRINT
        : GOTO 17110
17107   PRINT "ENTER L OR D": GOTO 17103
17110   PRINT : PRINT : PRINT "ENERGY IS ABSORBED AND ATP IS FORMED"
17112   PRINT : INPUT G$
17113   IF G$ = "D" THEN  PRINT "LIGHT ENERGY IS ABSORBED DURING THE      L
        IGHT REACTION": GOTO 17116
17114   IF G$ = "L" THEN  PRINT "HATS OFF TO YOU!":RIGHT = RIGHT + 1: PRINT
        : PRINT : GOTO 17116
17115   PRINT "CHOOSE L OR D": GOTO 17112
17116   PRINT : PRINT : GOSUB 5000
17118   TEXT : HOME : PRINT "REMINDER:  CHOOSE L FOR LIGHT OR D FOR  DARK"

17120   PRINT : PRINT "ENERGY IS USED SO ADP IS MADE"
17122   PRINT : INPUT G$
17124   IF G$ = "D" THEN  PRINT "ABSOLUTELY!":RIGHT = RIGHT + 1: PRINT : PRINT
        : GOTO 17128
```

```
17126   IF G$ = "L" THEN  PRINT "ENERGY IS ABSORBED DURING THE LIGHT RE- A
         CTION SO IT CAN BE USED IN THE DARK RE-ACTION": PRINT : PRINT : GOTO
         17128
17127   PRINT "ENTER L OR D": GOTO 17122
17128   PRINT "OXYGEN IS RELEASED"
17130   PRINT : INPUT G$
17131   IF G$ = "L" THEN  PRINT "THAT'S RIGHT! WATER IS BROKEN DOWN AND  T
         HE OXYGEN IS RELEASED IN THE LIGHT!":RIGHT = RIGHT + 1: PRINT : GOTO
         17134
17132   IF G$ = "D" THEN  PRINT "WATER IS BROKEN DOWN IN THE LIGHT       R
         EACTION.. THE HYDGROGEN IS SAVED BUT   THE OXYGEN IS RELEASED.": PRINT
         : GOTO 17134
17133   PRINT "ENTER L OR D": GOTO 17130
17134   PRINT : GOSUB 5000
17135   TEXT : HOME : PRINT "LAST QUESTION OF THE SECTION.   REMEMBER L FOR
         LIGHT AND D FOR DARK"
17137   PRINT : PRINT : PRINT "GLUCOSE IS PRODUCED."
17139   PRINT : INPUT G$
17140   IF G$ = "L" THEN  PRINT : PRINT "FOOD MAKING HAPPENS IN THE DARK."
         : GOTO 17143
17141   IF G$ = "D" THEN  PRINT : PRINT "YOU SURE KNOW WHEN THE FOOD'S BEI
         NG MADE": GOTO 17143
17142   PRINT "CHOOSE L OR D": GOTO 17139
17143   PRINT : GOSUB 5000: RETURN
17503   RETURN

3   REM   PHOTOSYNTHESIS TUTORIAL
10  REM   BY PATRICIA DROZDOWSKI MORRELL
15  REM   FEBRUARY, 1987
16  REM   VARIABLE LIST
17  REM   N$=NAME, G$=GET VARIABLE; RIGHT = NUMBERS OF RIGHT ANSWERS PER U
         NIT
18  REM   I=LOOP COUNTER, C$=MENU CHOICE
19  REM   Q$=QUIT CHOICE
25  REM   INITIALIZATION BLOCK
26  DIM N$(30)
27  DIM W$(9)
```

```
29    PRINT  CHR$ (4);"BRUN LOMEM:": &  LOMEM: 16384
30    REM  *********  DRIVER   **********
35    REM  INTRODUCTORY GRAPHICS
40    GOSUB 200
45    REM  MAIN MENU
50    GOSUB 285
55    IF C$ = "C" THEN  GOSUB 1200
65    IF C$ = "D" THEN  GOSUB 2000: GOTO 100
70    TEXT : HOME : PRINT "IF YOU WANT TO REVIEW THIS FILE, TYPE AN R.  IF Y
      OU ARE THROUGH, TYPE A Q.:  ": INPUT G$
71    IF G$ = "R" THEN  GOTO 45
72    IF G$ = "Q" THEN  TEXT : HOME : PRINT "YOU HAVE COMPLETED ALL THE FIL
      ES IN THE NATIONAL SCIENCE ARCHIVES DATA BASE NO. C6H1206."
73    PRINT : PRINT "WE HOPE YOU HAVE ENJOYED THIS PRIVILEGE!"
100   END
200   REM  INTRODUCTORY GRAPHICS
205   TEXT : HOME
210   HTAB 7: VTAB 6: PRINT "NATIONAL SCIENCE ARCHIVES"
220   VTAB 13: HTAB 9: PRINT "FILE NUMBER:  C6H1206"
221   FLASH
225   HTAB 9: VTAB 20: PRINT "CLASSIFIED INFORMATION"
230   FOR I = 1 TO 4000: NEXT I
235   TEXT : HOME
240   HTAB 11: VTAB 5: INVERSE : PRINT "SECURITY CLEARANCE"
244   NORMAL
245   VTAB 15: INPUT "ENTER THE SECRET CODE WORD:   ";W$
255   IF W$ < > "SUNLIGHT" THEN  PRINT "CLEARANCE DENIED": FOR I = 1 TO 1
      000: NEXT I: GOTO 100
260   PRINT : INPUT "ENTER YOUR LAST NAME:   ";N$
265   PRINT : PRINT "STATUS:  ";
266   FLASH : PRINT "CLEARED"
267   PRINT : NORMAL
270   PRINT "PRESS ANY KEY TO ENTER THE  DOCUMENTS   ROOM"
275   GET G$
280   RETURN
285   REM  MAIN MENU
```

```
286   TEXT : HOME
288   PRINT "NATIONAL SCIENCE ARCHIVES"
289   PRINT "FILE NO.:  C6H1206"
290   PRINT : PRINT "THIS DISK CONTAINS THE FILE ON WAYS THE ENVIRONMENT C
      AN AFFECT PHOTOSYNTHESIS"
292   PRINT : PRINT "OTHER FILES AVAILABLE ARE:"
293   PRINT : PRINT "BACKGROUND INFORMATION - DISK NUMBER ONE"
294   PRINT : PRINT "HISTORICAL DEVELOPMENT - DISK NUMBER TWO"
295   PRINT : PRINT "BIOCHEMISTRY OF PHOTOSYNTHESIS - DISK   NUMBER THREE"

296   PRINT : PRINT "IF THE ENVIRONMENTAL FILE IS WHAT YOU   WANT, TYPE C"

297   PRINT : PRINT "IF YOU WANT A DIFFERENT FILE, NOTE THE  NUMBER OF THE
      DISK YOU'LL NEED AND TYPE D"
298   INPUT C$
299   IF C$ = "C" THEN  GOTO 305
300   IF C$ <  > "D" THEN  PRINT "YOU MUST PICK C OR D": GOTO 293
305   RETURN
1200  REM  EFFECTS OF ENVIRONMENTAL FACTORS
1202  TEXT : HOME : GOSUB 10000
1203  HOME : VTAB 21
1204  PRINT "I'VE TAUGHT YOU ALMOST EVERYTHING I KNOWABOUT PHOTOSYNTHESIS
      , AGENT ";N$: GOSUB 5000
1205  HOME : VTAB 21
1206  PRINT "THERE'S ONLY ONE MORE AREA TO LOOK AT...HOW ENIRONMENTAL FAC
      TORS AFFECT THE RATEOF PHOTOSYNTHESIS": GOSUB 5000
1208  TEXT : HOME : VTAB 5: PRINT "YOUR NOTEBOOK LISTS SIX ENVIRONMENTAL
       FACTORS THAT MAY HAVE AN EFFECT ON HOW  MUCH PHOTOSYNTHESIS CAN BE
       CARRIED ON BYA PLANT."
1210  PRINT : PRINT : PRINT "WE'LL DISCUSS THEM INDIVIDUALLY, START- ING
      WITH RADIANT ENERGY."
1212  PRINT : PRINT : PRINT : PRINT "HOW WOULD RADIANT ENERGY AFFECT A
          PLANT'S PHOTOSYNTHETIC RATE?"
1214  PRINT : PRINT "WHICH PLANT DO YOU THINK WOULD PHOTOSYN-THESIZE MORE
      , A PLANT NEAR (A) THE NORTHPOLE; OR (B) THE EQUATOR"
1216  PRINT : INPUT G$: PRINT : PRINT
```

```
1217  IF G$ <  > "A" AND G$ <  > "B" THEN   GOTO 1214
1218  IF G$ = "A" THEN   PRINT "PLANTS THERE ARE STUNTED!  B IS THE      CO
      RRECT CHOICE"
1220  PRINT : PRINT "OBVIOUSLY, THE AMOUNT OF SUNLIGHT AND   THE INTENSIT
      Y OF THE SUNLIGHT AFFECTS   THE RATE OF PHOTOSYNTHESIS.": PRINT : PRINT
      : PRINT : GOSUB 5000
1222  TEXT : HOME : VTAB 5: PRINT "WHAT ABOUT TEMPERATURE?"
1224  PRINT : PRINT : PRINT : PRINT "WHAT WOULD HAPPEN TO A PALM TREE PLA
      NTEDIN GREENLAND OR TO A DOUGLAS FIR PLANTEDIN NEVADA?"
1226  PRINT : PRINT : INPUT "ARE PLANTS ADAPTED TO GROW IN A       PART
      ICULAR CLIMATE? (Y/N)     ";G$
1228  IF G$ <  > "N" AND G$ <  > "Y" THEN   PRINT "CHOOSE Y OR N": GOTO 12
      26
1230  IF G$ = "N" THEN   PRINT "DO YOU REALLY THINK NOT?   "
1232  PRINT : PRINT "OF COURSE THEY ARE!  THE PLANTS FUNCTIONBEST WHEN GR
      OWN IN A TEMPERATURE THEY   ARE SUITED FOR!  SINCE DEAD OR SICKLY
      PLANTS DON'T PHOTOSYNTHESIZE MUCH,      TEMPERATURE CAN AFFECT PHOTO
      SYNTHETIC   RATE."
1234  PRINT : PRINT : GOSUB 5000
1236  TEXT : HOME : VTAB 5: PRINT "HERE'S A TOUGHER ONE"
1237  PRINT : PRINT
1238  PRINT "CAN THE AMOUNT OF CARBON DIOXIDE CHANGE THE AMOUNT OF PHOTOS
      YNTHESIS A PLANT CANDO? (Y/N)"
1240  PRINT : INPUT G$
1242  IF G$ <  > "N" AND G$ <  > "Y" THEN   PRINT "PLEASE TYPE A Y OR N": GOTO
      1238
1244  PRINT : PRINT "READY FOR THE CORRECT ANSWER..."
1245  PRINT : PRINT "EITHER CHOICE IS CORRECT!"
1247  PRINT : PRINT "INCREASING THE AMOUNT OF CARBON DIOXIDE AVAILABLE TO
      THE PLANT CAN INCREASE THE PHOTOSYNTHETIC RATE, BUT ONLY UPTO A
      CERTAIN POINT."
1248  PRINT : PRINT "PERHAPS THE NEXT GRAPH WILL BE HELPFUL   IN EXPLAININ
      G THIS"
1250  PRINT : PRINT : GOSUB 5000
1252  TEXT : HOME : GOSUB 11200
1253  HOME : VTAB 21
```

```
1254   PRINT "EXTRA CARBON DIOXIDE CAN HELP A PLANT,   BUT EVENTUALLY INCRE
       ASING AMOUNTS OF CARBON DIOXIDE HAVE NO ADDITIONAL EFFECT.": GOSUB 5
       000
1256   TEXT : HOME : VTAB 5: PRINT "MINERALS AND WATER CAN AFFECT PHOTO-
       SYNTHETIC RATE SIMILAR TO THE WAY      TEMPERATURE CAN."
1258   PRINT : PRINT "DIFFERENT PLANTS NEED DIFFERENT AMOUNTS OF WATER AND
       MINERALS.  A HEALTHY PLANT PHOTOSYNTHESIZES MORE THAN AN UNHEALTHY
       ONE, SO..."
1260   PRINT : PRINT "YOU CAN TAKE IT FROM THERE, AGENT ";N$
1262   PRINT : PRINT : GOSUB 5000
1264   TEXT : HOME : PRINT : PRINT : PRINT : PRINT "FINALLY, AIR POLLUTION
       CAN ALSO HAVE AN EFFECT ON PHOTOSYNTHESIS.  PLANT LEAVES CAN BE DIR
       ECTLY AFFECTED BY POLLUTION."
1266   PRINT : PRINT "IF LEAVES ARE DAMAGED, PHOTOSYNTHETIC   RATE WILL DE
       CREASE."
1268   VTAB 12: GOSUB 5000
1270   TEXT : HOME : GOSUB 10000
1271   HOME : VTAB 21
1272   PRINT "IT'S BEEN A PLEASURE TRAVELLING WITH YOUTHROUGH THESE FILES,
       ";N$: GOSUB 5000
1273   HOME : VTAB 21
1274   PRINT "I HOPE YOU'VE LEARNED ALL YOU NEEDED TO KNOW.  GOOD DAY!": GOSUB
       5000
1276   TEXT : HOME : VTAB 15: HTAB 14: FLASH : PRINT "U R G E N T"
1278   NORMAL : VTAB 21: GOSUB 5000
1280   TEXT : HOME : PRINT "TO:    OUR TOP SCIENTIFIC SECRET AGENT"
1281   PRINT : PRINT "FROM:  (SORRY, THAT'S STILL CLASSIFIED)
1283   PRINT : PRINT "DATE:   NOW"
1285   PRINT : PRINT "RE:      PROGRESS
1287   PRINT : PRINT "HAVE YOU COMPLETED YOUR RESEARCH AT THE ARCHIVES?"
1288   PRINT : PRINT "YOU MUST ACT NOW TO SOLVE OUR PROBLEMS"
1290   PRINT : PRINT "HERE IS A LIST OF WHAT WE'RE GROWING    WHERE.  CAN
       YOU TELL US WHAT WE'RE       DOING WRONG?"
1292   PRINT : PRINT "A RESPONSE FORM IS LOCATED IN YOUR NOTE-BOOK."
1294   PRINT : PRINT "WE AWAIT YOUR REPLY."
1296   PRINT : GOSUB 5000
```

```
1298  TEXT : HOME : PRINT "YOU MAY REMEMBER THAT DR. ZEA MAYS      DEVELO
      PED CORN SEEDS THAT PRODUCED EARS UPTO SIX FEET LONG!"
1300  PRINT : PRINT "WE MOVED HIS RESEARCH INTO THE DARK     BASEMENT ARE
      A OF THE HEADQUARTER LABS SOFOREIGN SPIES WOULDN'T STEAL OUR SECRET
      RECIPE FOR THE SEEDS."
1301  PRINT : PRINT "ALL THE PLANTS ARE DYING.  WHAT MAY BE  WRONG?"
1302  PRINT : PRINT "(WRITE YOUR ANALYSIS ON THE FORM IN YOURNOTEBOOK.)"
1304  PRINT : PRINT : GOSUB 5000
1305  TEXT : HOME : PRINT "DR. TOM ATOES' PEPER PLANTS WERE DOING  WONDER
      FULLY IN THE GREENHOUSE.  WHEN HE TRANSPLANTED THEM IN THE PLOTS ALO
      NGSIDETHE INDUSTRIAL PARK, ALL THE PLANTS      STARTED TO WILT."
1307  PRINT : PRINT "WRITE YOUR ANALYSIS OF WHAT MAY BE WRONG WITH DR. AT
      OES' PLANTS ON YOUR NOTEBOOKFORM."
1309  PRINT : PRINT : GOSUB 5000
1310  TEXT : HOME : PRINT "DR. M. GLORY IS OUR REKNOWN FLOWERING   PLANT
      EXPERT.  HE HAS PLANTED A NEW      BREED OF ROSES IN HIS FAVORITE GAR
      DEN    SPOT (THE SAME SPOT HE'S USED FOR 15     YEARS!)."
1311  PRINT : PRINT "THE ROSES WON'T GROW.  IN FACT NOTHING  HE'S PLANTED
      WILL GROW ON HIS FAVORITE  PLOT!"
1314  PRINT : PRINT "CAN YOU TELL WHAT'S WRONG?"
1316  PRINT : PRINT : GOSUB 5000
1318  TEXT : HOME : PRINT "DR. G. A. SEOUS FOUND THAT ADDING CARBONDIXOID
      E TO HER BRUSSEL SPROUTS HELPED   THEM TO GROW FASTER."
1320  PRINT : PRINT "SHE DEVISED A SYSTEM WERE 50 TIMES THE  NORMAL AMOUN
      T OF ATMOSPHERIC CARBON      DIOXIDE CAN BE ABSORBED BY THE PLANT."
1322  PRINT : PRINT "HER RESULTS ARE DISAPPOINTING.  THE      PLANTS AREN'
      T GROWING ANY MORE QUICKLY  THAN THE CONTROL PLANTS."
1324  PRINT : PRINT "CAN YOU TELL WHY?  (REMEMBER TO USE YOURNOTEBOOK FOR
      M.)"
1326  PRINT : PRINT : GOSUB 5000
1330  GOSUB 10000: HOME : VTAB 21
1331  PRINT "HI, AGENT ";N$: PRINT : GOSUB 5000: HOME
1332  VTAB 21: PRINT "IT'S ME IN THE FLESH AND BLOOD.  I'VE   JUST RETURN
      ED FROM A RESEARCH EXPEDITIONIN THE AMAZON.": GOSUB 5000: HOME
```

```
1334   VTAB 21: PRINT "WHAT GREENERY IS THERE!  I HEARD YOU   USED MY ARC
       HIVES.  BOY, THIS COUNTRY'S  FOOD SUPPLY IS A MESS!": GOSUB 5000: HOME

1338   VTAB 21: PRINT "COULDN'T HELP BUT OVERHEAR WHAT THE TOP BRASS WAS A
       SKING.  DID YOU FIGURE OUT   WHAT THOSE BANANAS WERE DOING WRONG": GOSUB
       5000
1340   TEXT : HOME : PRINT "COMPARE YOUR ANALYSIS WITH MINE:"
1342   PRINT : PRINT "1.  DR. ZEA MAYS PLANTS NEED LIGHT."
1343   PRINT : PRINT "2.  POLLUTION FROM THE FACTORIES IS      KILLING ATOE
       S' CROPS."
1344   PRINT : PRINT "3.  DR. M. GLORY'S SOIL NEEDS MINERALS  ADDED TO IT!
        SHE'S BEEN USING IT TOO   LONG!!"
1346   PRINT : PRINT "4.  A LITTLE EXTRA CARBON DIOXIDE IS    GOOD, BUT TO
       O MUCH ISN'T BETTER.          INCREASING THE VOLUME OF CARBON DIOXIDE
       HAS NO EFFECT ONCE IT GOES BEYOND A      CERTAIN LIMIT--AS DR. G.A.SE
       OUS HAS DONE"
1348   PRINT : PRINT : GOSUB 5000
1349   GOSUB 10000
1350   HOME : VTAB 21: PRINT "WELL, I'M OFF IN SEARCH OF EXOTIC MUSH- ROOM
       S!  THANKS FOR HELPING THE TOP BRASSSOLVE THEIR BOTANY PROBLEMS!": GOSUB
       5000
1352   RETURN
2000   REM  QUIT OR CHANGE FILE ROUTINE
2010   TEXT : HOME
2020   VTAB 10
2025   PRINT "IF YOU WOULE LIKE.TO GET A DIFFERENT    FILE TYPE A D."
2028   PRINT : PRINT : PRINT "IF YOU PLAN TO QUIT FOR THE DAY TYPE    A Q.
       "
2030   VTAB 17: PRINT : INPUT "YOUR CHOICE:   ";Q$
2040   IF Q$ <  > "D" AND Q$ <  > "Q" THEN  PRINT : PRINT "INVALID CHOICE.
        PLEASE RE-ENTER.": GOTO 2030
2050   RETURN
3711   IF G$ <  > "OXYGEN" THEN  PRINT "COME ON, YOU REMEMBER...IT'S OXYGE
       N!"
5000   REM  CONTINUE
5005   INPUT "TYPE C TO CONTINUE OR E TO EXIT.";G$
```

```
5010   IF G$ = "E" THEN   GOTO 45
5011   IF G$ = "C" THEN   GOTO 5025
5017   GOTO 5005
5025   RETURN
10000   REM   DR. A GRAPHICS
10001   HGR : HCOLOR= 3
10002   HPLOT 90,140 TO 110.128 TO 110,104 TO 70,104 TO 70,84 TO 80,76 TO
        90,84 TO 70,84 TO 90,84 TO 90,96
10003   HPLOT 90,96 TO 110,96 TO 110,80 TO 80,60 TO 80,24 TO 100,36 TO 120
        ,24 TO 140,36 TO 160,24 TO 180,36 TO 200,24 TO 200,60
10004   HPLOT 200,60 TO 170,80 TO 170,96 TO 190,96 TO 190,84 TO 200,80 TO
        210,84 TO 190,84 TO 210,84 TO 210,104 TO 170,104 TO 170,128
10005   HPLOT 170,128 TO 190,140 TO 160,140 TO 140,124 TO 120,140 TO 90,14
        0
10006   HPLOT 110,116 TO 170,116
10007   HPLOT 140,80 TO 140,116
10008   HPLOT 150,104 TO 150,96 TO 160,96 TO 160,104 TO 150,104
10009   HPLOT 110,88 TO 120,80 TO 130,88 TO 140,80 TO 150,88 TO 160,80 TO
        170,88
10010   HPLOT 110,64 TO 120,72 TO 160,72 TO 170,64
10011   HPLOT 100,44 TO 120,44 TO 120,52 TO 100,52 TO 100,44
10012   HPLOT 160,44 TO 180,44 TO 180,52 TO 160,52 TO 160,44
10013   HPLOT 160,40 TO 180,40
10014   HPLOT 120,40 TO 100,40
10015   RETURN
11200   REM   CO2 GRAPH
11201   HGR : HCOLOR= 3
11202   HPLOT 50,10 TO 50,105 TO 260,105
11204   HPLOT 50,105 TO 140,60 TO 260,60
11206   HPLOT 60,120 TO 60,110 TO 80,110 TO 80,115 TO 60,115 TO 80,115 TO
        80,120
11208   HPLOT 90,120 TO 90,110 TO 100,115 TO 110,110 TO 110,120
11210   HPLOT 120,110 TO 140,110 TO 130,110 TO 130,120
11212   HPLOT 140,120
11214   HPLOT 180,110 TO 160,110 TO 160,120 TO 180,120
```

```
11216   HPLOT 190,110 TO 210,110 TO 210,120 TO 190,120 TO 190,110
11218   HPLOT 220,120 TO 230,120 TO 220,125 TO 220,125 TO 220,130 TO 230,1
     30
11220   HPLOT 30,15 TO 10,15 TO 10,25 TO 30,25 TO 30,20 TO 20,20
11222   HPLOT 10,40 TO 10,30 TO 30,30 TO 30,35 TO 10,35 TO 30,40
11224   HPLOT 10,60 TO 10,70 TO 20,60 TO 30,70 TO 30,60
11226   HPLOT 10,75 TO 30,75 TO 20,75 TO 20,85
11228   HPLOT 10,45 TO 30,45 TO 30,55 TO 10,55 TO 10,45
11230   HPLOT 10,90 TO 10,100
11232   HPLOT 10,95 TO 30,95 TO 30,90 TO 30,100
11234   RETURN
```

APPENDIX B:  Student manual for the CAI Photosynthesis

## NOTE

You are a famous scientific secret agent.
In a moment you will be given a crucial
assignment. Materials are being provided
to help you with your mission. Please
make use of BOTH the computer and this
notebook as you work on this case.

Redo each section as many times as needed
until you understand it BEFORE moving on
to the next subunit!

TO:     You, our top scientific secret agent

FROM:   (Sorry, that's classified information)

DATE:   Today

RE:     National Crisis


As you know, the country is in a perilous situation.  Our
food supply is dwindling.  New crops aren't growing.  The
top brass have tried their best but, knowing nothing
about plants, their efforts have been unsuccessful.

Our top botanist has disappeared and we haven't been able
to locate him.

YOU are our only hope!!!

You must gather what information you can about how plants
make food, analyze what we're doing, and correct the
situation...before it's too late.

We know you will accept this mission.  We've arranged
special clearance for you to use the national Scientific
Archives.

The secret code work is:  SUNLIGHT

We've also make up a special notebook for you to use in
jotting down notes.  It's attached to this memo.

We know you will not fail us!

Good luck.

# S P E C I A L

# N O T E B O O K

## A)   Using the Archives

Your first step is to do research at the National
Scientific Archives.

Place the floppy disk marked "Top Secret" into the slit
in the disk drive, close the flap, and turn the computer
on.   Further directions will appear on the monitor.
Remember, you'll need to use the secret code word to
enter the files.

On/Off Switch behind base

Monitor

Disk Drive
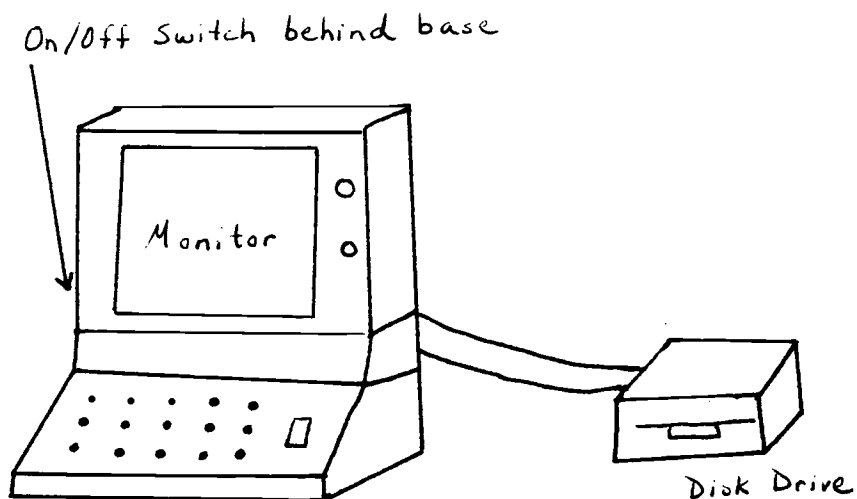
NATIONAL SCIENTIFIC ARCHIVES
FILE NUMBER:   C6H12O6

DISK ONE
Background Information

Dr. Artie Choke:   famous botanist hired by the National
Scientific Archives in 2306 to write the file on
photosynthesis.   Presently, he is the nation's top (and
only) botanist.

Photo:


Synthesis:


Photosynthesis:


Free Oxygen:


Ozone:



(The sun is the main source of energy for the earth.)

Important contributions of photosynthesis:
1.   free oxygen
2.   food

DISK TWO
History File

The source of matter for plant growth was originally
thought to be

_____.

Now we know better!

Scientific Experiments and Results:

1.  van Helmont

2.  Priestly

3.  Ingenhousz

# PRIESTLY'S EXPERIMENTS
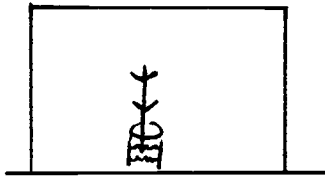


**Mint under glass**
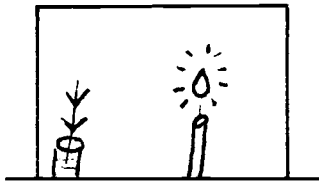
Mint & Candle under glass
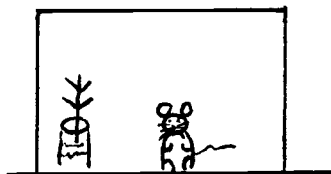


Mint & Mouse under glass

History of Photosynthesis

1. van Helmont found soil was not the source of plant matter. Water was.

2. Priestly discovered plants produce oxygen.

3. Ingenhousz "refined" Priestly's experiments and found that plants do produce oxygen but only in the presence of light.

4. Only green plant tissues release oxygen in light.

5. Plants growing in light take in carbon dioxide.

DISK THREE
Biochemistry

## Role of Chlorophyll

Plant pigments include:

1.   chlorophyll - green pigment; comes in 5 forms:   a, b, c, d, e.   Chlorophyll is the most common plant pigment.
2.   carotene - orange pigment
3.   xanthophyll - yellow pigment
4.   anthocyanin - red pigment
5.   tanin - brown pigment


Chloroplasts contain the green pigment

_____ which is the main pigment used in photosynthesis.


## Lab on Chromatography

Attached are sheets describing a lab activity you are to do at this point.  The purposes of the lab are:  (1) to demonstrate the principle of chromatography; and (2) to determine what pigments can be found in spinach leaves. Complete the lab write up and turn it in when you have completed the activity.  (Pigment has already been extracted for you.  You will find a vial on the lab table.)

## ADP/ATP CYCLE

The chemical equation for photosynthesis is:

$$6\ CO_2 + 6\ H_2O \longrightarrow C_6H_{12}O_6 + 6\ O_2$$

(carbon dioxide)   (water)           (glucose)      (oxygen)
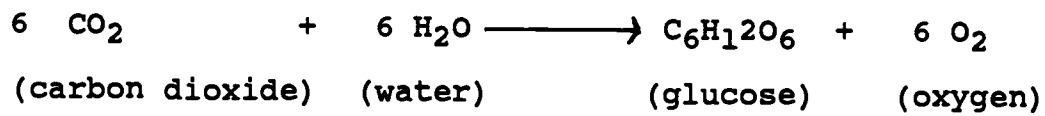
What is glucose?

ATP - adenosine triphosphate (adenosine + 3 phosphate groups)

ADP - adenosine diphosphate (adenosine + 2 phosphate groups)

Which has more energy, ADP or ATP? _____

ATP $\longrightarrow$ Energy + ADP + Phosphate

ADP + Energy + Phosphate $\longrightarrow$ ADP

Therefore, when cells store energy, ATP is formed and when cells use energy, ADP is formed.

TO:     You, our top scientific secret agent

FROM:   (Sorry, that's classified information)

DATE:   Today

RE:     Your Progess

How's your work coming?

I don't know how much longer our stored food resources
will hold out!

## Dark and Light Reactions

Light Reaction - can only happen in the presence of light

Dark Reaction - can happen in light or dark.  It does NOT require light.

## STEPS OF PHOTOSYNTHESIS:

### Light Reaction

1.


2.


3.



### Dark Reaction

1.


2.

Summary of Photosynthesis

```
        Water                    Carbon Dioxide

          │                            │
          ▼                            ▼
      ┌────────┐                   ┌────────┐
      │ LIGHT  │       ATP         │ DARK   │
      │        │    ────────▶      │        │
Light │        │       ADP         │        │        Glucose
──────▶│        │    ◀────────      │        │    ──────────▶
Energy │        │                   │        │
      │REACTION│                   │REACTION│
      └────────┘                   └────────┘
          │                            │
          ▼                            ▼
       Oxygen                        Water
```
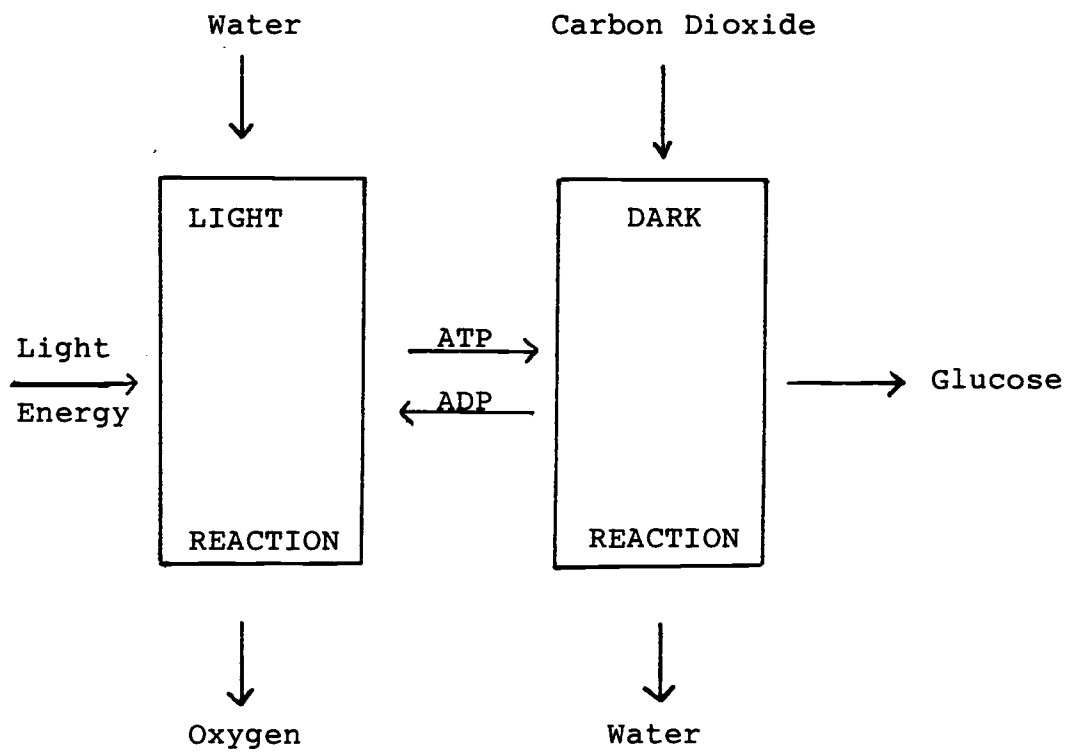
DISK FOUR

## <u>Environmental Factors that Affect Photosynthesis:</u>

1. Radiant Energy

2. Temperature

3. Carbon Dioxide

4. Water

5. Minerals

6. Air Pollution

Notes on Problems from Headquarters

| PROBLEMS | ANALYSIS |
|----------|----------|
| 1. Plants growing in the dark | 1. |
| 2. Plants near industrial area | 2. |
| 3. Over-used soil | 3. |
| 4. Excess carbon dioxide | 4. |

Did your analysis match Dr. Choke's?

If not, check over your notes and revisit the Archives!!

If the did, thanks for "saving the country"!

APPENDIX C:  Posttest for the CAI and Traditional
Photosynthesis Unit

I.  Multiple Choice.  Choose the BEST answer.

_____1.  In the dark reactions of photosynthesis, the
products of the light reaction are used to make (a)
cellulose; (b) chlorophyll; (c) glucose; (d) lactic acid

_____2.  The oxygen on which organisms depend for cellular
respiration is supplied to the atmosphere by (a)
fermentation; (b) ozone breakdown; (c) photosynthesis; (d)
protein synthesis

_____3.  In the light reactions of photosynthesis, plants
use light energy to split (a) carbon from carbon dioxide;
(b) hydrogen from water; (c) nitrogen from nitrates; (c)
phosphorous from phosphates

_____4.  The light reactions of photosynthesis store some of
the absorbed energy in (a) ATP; (b) chlorophyll; (c)
glucose; (d) oxygen

_____5.  The dark reactions of photosynthesis are so named
because they do NOT (a) require light; (b) take place in
green leaves; (c) take place in light; (d) use energy
obtained from light

_____6.  The starting materials of photosynthesis are (a)
glucose; (b) oxygen and water; (c) carbon dioxide and water;
(d) carbon dioxide and oxygen

_____7.  In what form do producers store the energy that is
obtained from sunlight (a) body heat; (b) chemical bonds;
(c) mechanical energy; (d) nuclear energy

_____8.  Humans have worked to improve the efficiency of
photosynthesis in many plants, especially crop plants, but
the gains have been erased by the damage humans cause plants
in (a) crop-harvesting techniques; (b) soil fertilization;
(c) soil irrigation; (d) water and air pollution

_____9.  Light energy is converted into a form useful to all
organisms through (a) fermentation; (b) respiration; (c)
protein synthesis; (d) photosynthesis

_____10.  The site of photosynthesis within the plant cells
is (a) chlorophyll; (b) chloroplasts; (c) mitochondria; (d)
nucleus

_____11.  Which of the following results in a chemical
separation of parts of a compound (a) chromatography; (b)
photosynthesis; (c) catalyst; (d) synthesis reactions

_____12. The end-products of photosynthesis are (a) carbon and hydrogen; (b) carbon and oxygen; (c) glucose and carbon; (d) glucose and oxygen

_____13. I found that plants can carry out photosynthesis only if they are in the light (a) van Helmont; (b) Priestly; (c) Ingenhousz; (d) Schleiden

_____14. I may have been lacking in technique but I found plants gave off oxygen (a) van Helmont; (b) Priestly; (c) Ingenhousz; (d) Schleiden

_____15. The pigment responsible for trapping the light energy used in photosynthesis is (a) chloroplasts; (b) grana; (c) chlorophyll; (d) ATP

_____16. The energy plants use to make glucose comes from (a) breaking bonds in ATP; (b) breaking bonds in ADP; (c) building bonds in ATP; (d) building bonds in ADP

_____17. Which of the following is NOT true (a) any increase in carbon dioxide will always increase photosynthetic rate; (b) mineral content of the soil affects photosynthetic rate; (c) changing the amount of available radiant energy will affect the photosynthetic rate; (d) temperature must suit the plant for an optimum photosynthetic rate

II. The next 3 questions are based on the following statements about photosynthesis. Select the statement that is supported by each experiment.

    I. Carbon dioxide is a necessary raw material.
   II. Oxygen is an end product of the reaction.
  III. Chlorophyll absorbs light energy
   IV. Only certain wavelengths of light are effective.

_____18. Corn plants with completely yellow leaves will die even when supplied with carbon dioxide, water, sunlight and optimal temperatures. (Choose I, II, III or IV.)

_____19. A green plant sealed in a container will increase in weight if an animal of sufficient size is enclosed.

_____20. A flask containing chloroplasts and water is placed in the light. A glowing splint will burn when placed in the flask.

APPENDIX D: Printout of the CAI Genetics Unit

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10    REM   GENETICS
20    REM   BY PATRICIA D. MORRELL, 4/87
35    REM   INITIALIZATION BLOCK
36    REM   G$=GET COMMAND
39    REM   H$=HELP
95    REM   DRIVER
96    PRINT  CHR$ (4);"BRUN LOMEM:": &  LOMEM: 16384
100   GOSUB 1000: REM   INTRODUCTION
110   PRINT : PRINT  CHR$ (4);"RUN MENU
140   END
1000  REM   INTRODUCTION
1010  GOSUB 8000: REM   INTRO SCREEN
1020  GOSUB 8050: REM   GENES SCREEN
1030  GOSUB 8100: REM   GREGOR'S
1040  VTAB 21: PRINT "WELCOME TO GREGOR'S GENE MACHINE!      THE WORLD'S
      LARGEST GENE CENTER!"
1041  FOR I = 1 TO 3000: NEXT I
1050  TEXT : HOME
1060  PRINT "BECAUSE OUR FACILITY IS SO LARGE AND WE HAVE SO MANY AISLES
      FOR BROWSING,       GREGOR'S PROVIDES A FREE, ROUND THE      CLOCK SH
      UTTLE SERVICE TO ITS CUSTOMERS."
1065  PRINT : PRINT "THERE ARE THREE SHUTTLE SYSTEMS; EACH   ONE SERVICES
      ONE MAIN BRANCH OF OUR      WAREHOUSE."
1066  PRINT
1067  PRINT "A LISTING OF OUR 'TRANSIT SYSTEM' CAN BE FOUND ON THE NEXT S
      CREEN AND IN THE      SHOPPING/TOUR BOOKLET PROVIDED TO ALL   OUR VISI
      TORS."
1068  VTAB 23: PRINT "PRESS ANY KEY TO CONTINUE": GET G$
1069  RETURN
8000  REM   INTRO SCREEN
8002  TEXT : HOME
8004  PRINT "SERGIO"
8006  VTAB 3: HTAB 22: PRINT "LEVIS 501"
8008  VTAB 5: HTAB 3: PRINT "CALVIN"
8010  VTAB 8: HTAB 29: PRINT "VANDERBILT"
8012  VTAB 10: HTAB 18: PRINT "NESSE"
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8014    VTAB 13: HTAB 7: PRINT "LEES"
8016    VTAB 15: HTAB 25: PRINT "WRANGLERS"
8020    VTAB 23: PRINT "JEANS COME AND JEANS GO, BUT..."
8025    FOR I = 1 TO 5000: NEXT I
8030    RETURN
8050    REM   GENES SCREEN
8051    TEXT : HOME : HGR
8052    HCOLOR= 3
8053    HPLOT 40,40 TO 10,40 TO 10,80 TO 40,80 TO 40,60 TO 25,60
8054    HPLOT 90,40 TO 60,40 TO 60,80 TO 90,80: HPLOT 60,60 TO 80,60
8055    HPLOT 110,80 TO 110,40 TO 140,80 TO 140,40
8056    HPLOT 190,40 TO 160,40 TO 160,80 TO 190,80: HPLOT 160,60 TO 190,60
8057    HPLOT 210,75 TO 210,80 TO 240,80 TO 240,60 TO 210,60 TO 210,40 TO 2
        40,40 TO 240,45
8060    VTAB 23: PRINT "LIVE ON FOREVER"
8061    FOR I = 1 TO 3000: NEXT I
8070    RETURN
8100    REM   GENE SHOP
8101    TEXT : HOME : HGR : HCOLOR= 3
8102    HPLOT 20,10 TO 230,10 TO 230,155 TO 20,155 TO 20,10
8103    HPLOT 100,155 TO 100,100 TO 150,100 TO 150,155
8104    HPLOT 40,80 TO 80,80 TO 80,140 TO 40,140 TO 40,80
8107    HPLOT 170,80 TO 210,80 TO 210,140 TO 170,140 TO 170,80
8109    HPLOT 185,85 TO 175,85 TO 175,90 TO 185,90 TO 185,95 TO 175,95
8110    HPLOT 185,110 TO 185,120 TO 195,120
8112    HPLOT 180,110 TO 185,100 TO 190,110: HPLOT 183,105 TO 188,105
8114    HPLOT 205,125 TO 195,125 TO 195,135 TO 205,135: HPLOT 195,130 TO 20
        5,130
8116    HPLOT 45,90 TO 53,90 TO 53,95 TO 55,95 TO 55,100 TO 45,100 TO 45,90

8118    HPLOT 45,95 TO 53,95
8119    HPLOT 55,105 TO 65,105: HPLOT 55,115 TO 65,115: HPLOT 60,105 TO 60,
        115
8120    HPLOT 75,120 TO 65,120 TO 65,130 TO 75,130 TO 75,125 TO 70,125
8122    HPLOT 60,70 TO 60,60 TO 65,70 TO 70,60 TO 70,70
·8124    HPLOT 80,70 TO 80,60 TO 90,60 TO 90,70: HPLOT 80,65 TO 90,65
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8126    HPLOT 110,60 TO 100,60 TO 100,70 TO 110,70
8128    HPLOT 120,60 TO 120,70: HPLOT 120,65 TO 130,65: HPLOT 130,60 TO 130
        ,70
8129    HPLOT 140,60 TO 150,60: HPLOT 140,70 TO 150,70: HPLOT 145,60 TO 145
        ,70
8130    HPLOT 160,70 TO 160,60 TO 170,70 TO 170,60
8132    HPLOT 190,70 TO 180,70 TO 180,60 TO 190,60: HPLOT 180,65 TO 190,65
8234    HPLOT 100,40 TO 90,40 TO 90,50 TO 100,50 TO 100,45 TO 95,45
8236    HPLOT 120,40 TO 110,40 TO 110,50 TO 120,50: HPLOT 110,45 TO 120,45
8238    HPLOT 130,50 TO 130,40 TO 140,50 TO 140,40
8240    HPLOT 160,40 TO 150,40 TO 150,50 TO 160,50: HPLOT 150,45 TO 160,45
8242    HPLOT 60,20 TO 50,20 TO 50,30 TO 60,30 TO 60,25 TO 55,25
8244    HPLOT 70,30 TO 70,20 TO 80,20 TO 80,25 TO 70,25 TO 80,30
8246    HPLOT 100,20 TO 90,20 TO 90,30 TO 100,30: HPLOT 90,25 TO 100,25
8248    HPLOT 120,20 TO 110,20 TO 110,30 TO 120,30 TO 120,25 TO 115,25
8250    HPLOT 130,30 TO 130,20 TO 140,20 TO 140,30 TO 130,30
8252    HPLOT 150,30 TO 150,20 TO 160,20 TO 160,25 TO 150,25 TO 160,30
8254    HPLOT 170,20 TO 170,25
8256    HPLOT 190,20 TO 180,20 TO 180,25 TO 190,25 TO 190,30 TO 180,30
8257    RETURN
10   REM   GENETICS
20   REM   BY PATRICIA D. MORRELL, 4/87
35   REM   INITIALIZATION BLOCK
36   REM   G$=GET COMMAND
39   REM   H$=HELP
95   REM   DRIVER
96   PRINT  CHR$ (4);"BRUN LOMEM:": &  LOMEM: 16384
105   GOSUB 1070: REM   MENU
107   TEXT : HOME
110   IF G$ = "1" THEN   PRINT "TYPE PR#6": PRINT : PRINT "HIT THE RETURN K
      EY": PRINT : PRINT "THEN TYPE RUN SHUTTLE ONE": GOTO 140
120   IF G$ = "2" THEN   PRINT "TYPE PR#6": PRINT : PRINT "HIT THE RETURN K
      EY": PRINT : PRINT "THEN TYPE RUN SHUTTLE TWO": GOTO 140
130   IF G$ = "3" THEN   PRINT "TYPE PR#6": PRINT : PRINT "HIT THE RETURN K
      EY": PRINT : PRINT "THEN TYPE RUN SHUTTLE THREE": GOTO 140
140   END
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1070  REM   MENU
1071  TEXT : HOME : PRINT : PRINT "ROUTE        DESTINATION"
1080  PRINT "_____              _____"
1090  PRINT : PRINT "  1       TERMINOLOGY AREA - A GOOD          PL
      ACE TO START, ESPECIALLY IF        IT'S YOUR FIRST TIME HERE!"
1100  PRINT : PRINT "  2       SIMPLE CROSS SECTION -            CO
      NTAINS PUNNETT SQUARES AND          BASIC TRAIT SUPPLIES (OF
              COURSE, INSTRUCTIONS ARE              INCLUDED IN ALL OU
      R KITS!)."
1110  PRINT : PRINT "  3       TWO TRAIT CROSS SUPPLIES -           HO
      USES OUR KIT MATERIALS FOR          THOSE OF YOU WHO ARE MORE"
1111  PRINT "             EXPERIENCED AND WANT TO TRY         SOMETHING
      A LITTLE MORE                CHALLENGING!"
1120  PRINT : INPUT "WHICH SHUTTLE WOULD YOU LIKE TO BOARD?";G$
1121  IF G$ = "1" OR G$ = "2" THEN  GOTO 1200
1122  IF G$ = "3" THEN  GOTO 1200
1123  PRINT "I'M SORRY, THAT ROUTE IS NOT COVERED BY OUR SHUTTLES.  WE ON
      LY SERVICE 1, 2, 3.": GOTO 1120
1200  RETURN
1    REM   GENETICS
3    REM   BY PATRICIA D. MORRELL, 4/87
5    REM   INITIALIZATION BLOCK
7    REM   G$=GET COMMAND
9    REM   H$=HELP
11   REM   DRIVER
13   PRINT  CHR$ (4);"BRUN LOMEM:": &  LOMEM: 16384
15   REM   TERMINOLOGY
17   GOSUB 8300: REM   GUIDE
19   VTAB 21: PRINT "OUR FIRST STOP ON ROUTE 1 IS OUR STORY  ROOM. HERE'S
      OUR FAVORITE STORY TELLER, GREGOR MENDEL, HIMSELF!"
21   GOSUB 7000
23   TEXT : HOME
25   GOSUB 8400: REM   MENDEL
27   VTAB 21: PRINT "HI, VALUED CUSTOMER!  I'M GREGOR MENDEL,FOUNDER OF TH
      IS GLORIOUS ENTERPRISE.": GOSUB 7000: HOME : VTAB 21
29   PRINT "WHAT A PLACE - WHERE PEOPLE LIKE YOU    CAN COME TO CROSS ROUN
      DS AND WRINKLEDS  OR LONGS AND SHORTS OR INFLATED AND ": GOSUB 7000
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31   HOME : VTAB 21
33   PRINT "YELLOWS WITH CONSTRICTED AND GREENS OR  OOH! SORRY.   I DO TEND
        TO LET MYSELF GETOVERLY EXCITED ABOUT THE POSSIBILITIES!": GOSUB 70
     00
35   HOME : VTAB 21: PRINT "LET ME START AT THE BEGINNING.": GOSUB 7000
37   GOSUB 8500: REM  GARDEN SCENE
39   VTAB 21: PRINT "I WAS IN MY GARDEN GROWING MY PEAS AND INOTICED SOME
        WERE TALL AND SOME WERE    SHORT, SOME WERE YELLOW AND SOME GREEN.":
        GOSUB 7000
41   HOME : VTAB 21: PRINT "IN ALL, I OBSERVED 7 DIFFERENT TRAITS.  IF YOU
        LOOK IN YOUR SHOPPING/TOUR GUIDE YOU'LL SEE THEM ALL LISTED...": GOSUB
        7000
43   HOME : VTAB 21: PRINT "AFTER MY BIOGRAPHY!": GOSUB 7000
45   HOME : GOSUB 8400: VTAB 21: PRINT "SO I BEGAN TO CROSS CERTAIN PLANTS
        TO   SEE IF I COULD GET THE TRAITS I WANTED  AND, I FOUND I COULD'"
     : GOSUB 7000
47   HOME : VTAB 21: PRINT "FOR EXAMPLE, I COULD MAKE A TALL GREEN  PLANT
        OR A SHORT GREEN PLANT JUST BY    KNOWING WHICH PLANTS TO USE AS PAR
        ENTS!": GOSUB 7000
49   GOSUB 8400: VTAB 21: PRINT "I BECAME SO GOOD AT PICKING THE TRAITS  I
        WANTED IN MY PEAS, I THOUGHT I'D SHARETHAT KNOWLEDGE WITH FOLKS LIK
        E YOU!": GOSUB 7000
51   GOSUB 8100: VTAB 21: PRINT "SO I OPENED THIS GENE SHOP WHERE YOU    C
        OULD COME, LET ME SHOW YOU WHAT I KNOW,AND...": GOSUB 7000: HOME
53   VTAB 21: PRINT "SELL YOU KITS TO TRY YOUR OWN HAND AT   'DESIGNING' O
        FFSPRING!": GOSUB 7000
55   GOSUB 8400: VTAB 21: PRINT "THE REST IS HISTORY!": GOSUB 7000
57   HOME : VTAB 21: PRINT "I'LL LET YOU CONTINUE ON WITH YOUR TOUR.": PRINT
     : GOSUB 7000
59   HOME : VTAB 21: PRINT "AS YOUR GUIDE MAY HAVE TOLD YOU, THE    DESTIN
        ATION OF ROUTE 1 IS THE             TERMINOLOGY ROOM.": GOSUB 7000
61   HOME : VTAB 21: PRINT "AS WITH MOST THINGS, TO EXPLAIN MY IDEASTO YOU
        , YOU FIRST NEED TO BE FAMILIAR   WITH SOME TERMS.
63   VTAB 21: PRINT "YOUR SHOPPING/TOUR GUIDE HAS A LIST OF  THESE AND PLA
        CES FOR YOU TO TAKE NOTES. PLEASE ENJOY YOUR VISIT TO MY SHOP.   ": GOSUB
        7000
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65   HOME : VTAB 21: PRINT "I'LL CHECK IN ON YOU LATER": GOSUB 7000
67   GOSUB 8300: REM  GUIDE
69   VTAB 21: PRINT "AS MENDEL MENTIONED, YOUR BOOKS WILL BE VERY USEFUL T
       O YOU AS YOU GO THROUGH    THIS AREA.  PLEASE TURN TO PAGE 3.": GOSUB
       7000
71   HOME : VTAB 21: PRINT "FILL IN YOUR GUIDE AS WE GO ALONG."
73   GOSUB 7000
75   TEXT : HOME : PRINT "GENETICS IS THE SPECIALIZED BRANCH OF   BIOLOGY
       THAT DEALS WITH HEREDITY."
77   PRINT : INVERSE : PRINT "GENETICS TERMINOLOGY": NORMAL
79   PRINT : PRINT "GENETICS IS THE SPECIALIZED BRANCH OF   BIOLOGY THAT D
       EALS WITH HEREDITY."
81   PRINT : PRINT "THE FIRST THREE TERMS ARE INTERRELATED."
83   PRINT : INVERSE : PRINT "GENE": NORMAL : PRINT "PORTION OF DNA WHICH
       CONTROLS THE EXPRESSION OF HEREDITARY CHARACTERISTICS."
85   PRINT : INVERSE : PRINT "TRAIT": NORMAL : PRINT "CHARACTERISTIC CARRI
       ED BY A GENE"
87   PRINT "(THEREFORE, GENES CODE FOR TRAITS!)"
89   PRINT : INVERSE : PRINT "ALLELE": NORMAL : PRINT "FORM OF A GENE": PRINT

91   PRINT "ONE GENE MAY HAVE MORE THAN ONE CHOICE  OF OUTCOMES."
93   PRINT : PRINT "THE NEXT SCREEN WILL EXPLAIN THIS!!": PRINT : GOSUB 70
       00
95   TEXT : HOME : PRINT "FOR EXAMPLE, ONE GENE DETERMINES THE    SHAPE OF
       PEAS."
97   PRINT : PRINT "A PEA HAS TWO SHAPES.": PRINT : PRINT "A PEA CAN BE RO
       UND OR WRINKLED."
99   PRINT : PRINT "THEREFORE, THIS GENE HAS TWO ALLELES."
101   VTAB 23: GOSUB 7000
103   TEXT : HOME : PRINT "LET'S SEE IF YOU UNDERSTAND ALLELES."
105   PRINT : PRINT "PEA PLANTS CAN BE SHORT OR TALL."
107   PRINT : PRINT "ONE GENE HAS THE CODE FOR THE TRAIT      HEIGHT.  "
109   PRINT : PRINT "HOW MANY ALLELES DOES THE GENE FOR PEA  PLANT HEIGHT
       HAVE?"
111   PRINT : INPUT "YOUR GUESS:   ";G$
113   IF G$ = "2" THEN  PRINT "CORRECT!!"
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115  PRINT : PRINT "THE PLANT CAN BE (1) TALL OR (2) SHORT   THEREFORE, T
     HE ONE GENE HAS TWO FORMS. SO, THE NUMBER OF ALLELES IS TWO!"
117  VTAB 23: PRINT "LET'S TRY ANOTHER": PRINT : GOSUB 7000
119  TEXT : HOME : PRINT "ONE GENE CODES FOR THE POD SHAPE OF PEAS": PRINT
     : PRINT "PODS CAN BE INFLATED OR CONSTRICTED."
121  PRINT : INPUT "HOW MANY ALLELES DOES THE GENE FOR POD  SHAPE HAVE?";
     G$
123  PRINT : IF G$ = "2" THEN  PRINT "WAY TO GO!"
125  PRINT "IF ONE GENE HAS TWO FORMS, IN THIS CASE INFLATED OR CONSTRICT
     ED, THEN THE GENE  HAS TWO ALLELES."
127  VTAB 23: GOSUB 7000
129  TEXT : HOME : PRINT "LET'S TRY A TOUGHIE!"
131  PRINT : PRINT "OUR BLOOD TYPE CAN BE A, B, AB, OR O."
133  PRINT : PRINT "HOW MANY ALLELES DOES THE GENE FOR BLOODTYPE HAVE:   1
     , 2, 3 OR 4"
135  PRINT : INPUT "YOUR CHOICE:   ";G$
137  IF G$ = "3" THEN  PRINT "GREAT!  YOU WEREN'T FOOLED!": GOTO 147
139  IF G$ = "1" OR G$ = "2" GOTO 145
141  IF G$ = "4" GOTO 145
143  PRINT : PRINT "YOU MUST CHOOSE 1, 2, 3, OR 4": GOTO 135
145  PRINT : PRINT "GOT YOU!  THE CORRECT CHOICE IS 3."
147  PRINT : PRINT "THE THREE ALLELES ARE A, B AND O"
149  PRINT : PRINT "AB IS A COMBINATION OF A AND B--NOT A    SEPARATE ALLE
     LE."
151  VTAB 20: PRINT "OUR NEXT TERM'S AN EASY ONE"
153  PRINT : GOSUB 7000
155  TEXT : HOME : INVERSE : PRINT "CROSS": NORMAL : PRINT "MATING BETWEE
     N DIFFERENT INDIVIDUALS OF THE SAME SPECIES."
157  PRINT : PRINT "WHEN MENDEL WANTED TO 'MAKE' A NEW        OFFSPRING PEA
     PLANT, HE CROSSED TWO     PARENT PLANTS."
159  PRINT : PRINT : PRINT "DO YOU REMEMBER WHAT HAPPENS TO CHROMO- SOMES
     DURING GAMETE FORMATION?"
161  PRINT : PRINT "THE HOMOLOGUES SEGREGATE (A FANCY WAY TOSAY SEPARATE)
     ."
163  PRINT : PRINT "IF THE CHROMOSOMES SEGREGATE AND CHROMO-SOMES ARE COL
     LECTIONS OF GENES, THEN WE CAN SAY ALLELES SEGREGATE DURING GAMETE F
     ORMATION."
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165   PRINT : PRINT "KEEP THIS IN MIND FOR LATER!"
167   PRINT : GOSUB 7000
169   GOSUB 8700: HOME
171   VTAB 21: PRINT "WHEN WE MOVE ON TO DO OUR KIT SELECTIONSYOU'LL SEE B
      OXES LIKE THE ONE ABOVE.   WHAT DOES THIS LABELLING MEAN?": GOSUB 7
      000
173   HOME : VTAB 21
175   PRINT "GENERALLY, A LETTER IS ASSIGNED TO A    GENE'S TRAIT.  THIS E
      XAMPLE KIT CROSSES PEAS OF DIFFERENT SHAPES.": GOSUB 7000
177   HOME : VTAB 21: PRINT "PEAS CAN BE ROUND OR WRINKLED.  HOW MANYALLEL
      ES ARE THERE FOR SHAPE?"
179   INPUT "YOUR GUESS:  ";G$
181   IF G$ = "2" THEN  PRINT "CORRECT!"
183   PRINT "THERE ARE TWO ALLELES FOR SHAPE:  ONE ISWRINKLED AND THE OTHE
      R IS ROUND.": GOSUB 7000
185   HOME : VTAB 21: PRINT "THE CAPITAL R STANDS FOR THE ALLELE THATCODES
       FOR ROUND.": PRINT : GOSUB 7000
187   HOME : VTAB 21: PRINT "THE LOWER CASE R REPRESENTS THE ALLELE  FOR W
      RINKLED.": PRINT : GOSUB 7000
189   HOME : VTAB 21: PRINT "WE USE THE SAME LETTER BECAUSE IT'S THE SAME
      GENE!  LET'S TRY ANOTHER KIT.": GOSUB 7000
191   GOSUB 8800: REM   CROSS T
193   : HOME : VTAB 21: PRINT "PEA PLANTS CAN BE TALL OR SHORT.  ONE   GENE
      , OR LETTER."
195   INPUT "WHAT DOES THE CAPITAL T STAND FOR (TALL OR SHORT):   ";G$
197   IF G$ = "SHORT" THEN  PRINT "GUESS AGAIN": GOTO 195
199   IF G$ = "TALL" THEN  PRINT "GREAT!": GOTO 203
201   PRINT "YOUR CHOICES ARE TALL OR SHORT!": GOTO 195
203   PRINT "WHAT DOES THE LOWER CASE T STAND FOR?"
205   INPUT G$
207   IF G$ = "SHORT" THEN  PRINT "ASTOUNDING!": GOTO 211
209   IF G$ < > "SHORT" THEN  PRINT "IF CAPITAL T IS TALL, THE ONLY OPTIO
      N   LEFT FOR THE LOWER CASE T IS SHORT!"
211   GOSUB 7000: HOME : VTAB 21
213   PRINT "LET'S EXPLAIN LABELLING A LITTLE        FURTHER.": PRINT : GOSUB
      7000
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215    GOSUB 8700: HOME : VTAB 21: PRINT "OUR FIRST KIT WAS A CROSS BETWEEN
       TWO    DIFFERENT KINDS OF INDIVIDUALS.": GOSUB 7000
217    TEXT : HOME : PRINT "THE RR INDIVIDUAL IS CONSIDERED A "
219    PRINT : HTAB 12: INVERSE : PRINT "HOMO";
221    NORMAL : PRINT "ZYGOTE."
223    PRINT : PRINT "HOMO MEANS THE SAME SO A HOMOZYGOUS       INDIVIDUAL HA
       S THE SAME 2 ALLELES FOR A TRAIT.   IN THIS CASE, 2 UPPER CASE R'S."
225    PRINT : PRINT "AS YOU CAN SEE FROM YOUR GUIDE BOOK,     HOMOZYGOUS AR
       E ALSO CALLED TRUE-BREEDINGOR PUREBREDS."
227    PRINT : PRINT "LET'S LOOK AT OUR KIT AGAIN": GOSUB 7000
229    GOSUB 8700
231    HOME : VTAB 21: PRINT "THE SECOND PARENT HAS AN UPPER CASE R   AND A
       LOWER CASE R.   THESE ALLELES ARE   NOT THE SAME.": GOSUB 7000
233    TEXT : HOME : PRINT "DO YOU KNOW A PREFIX FOR DIFFERENT?      (HINT:
       IT BEGINS WITH AN 'H')"
235    PRINT : PRINT "AFTER YOU'VE THOUGHT OF THE WORD, KIT   ANY KEY TO CH
       ECK YOUR GUESS."
237    GET Z$
239    PRINT "THE PREFIX IS HETERO.   WERE YOU RIGHT?"
241    PRINT : PRINT : INVERSE : PRINT "HETERO";
243    NORMAL : PRINT "ZYGOUS DESCRIBES AN ORGANISM       HAVING TWO DIFFERE
       NT ALLELES FOR A TRAIT"
245    PRINT : PRINT "A HETEROZYGOTE IS OFTEN CALLED A HYBRID."
247    VTAB 23: GOSUB 7000
249    TEXT : HOME : PRINT "LET'S CHECK OURSELVES."
251    PRINT : PRINT "WHAT CODES FOR A TRAIT?"
253    PRINT : INPUT "(PRESS THE RETURN KEY WHEN YOU THINK YOUKNOW THE ANSW
       ER.)";G$
255    PRINT : PRINT "DID YOU GUESS GENES?"
257    PRINT : INPUT "WHAT IS A FORM OF A GENE CALLED?";G$
259    PRINT : PRINT "ALLELES IS THE CORRECT ANSWER!"
261    PRINT : PRINT "IF YOU DID NOT REMEMBER THESE WORDS,    REREAD THE DE
       FINITIONS SHEET IN YOUR    GUIDE BOOK BEFORE GOING ON."
263    VTAB 23: GOSUB 7000
265    TEXT : HOME : PRINT "I'M GOING TO PRESENT YOU WITH A GENE    PAIR.
       YOU'RE TO TELL ME IF IT IS FROM  A HOMOZYGOTE OR A HETEROZYGOTE!"
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267    PRINT : PRINT "LET'S MAKE IT EASIER."
269    PRINT : PRINT "TYPE 1 FOR HOMOZYGOTE AND                    TYPE 2 FOR HE
       TEROZYGOTE."
271    PRINT : PRINT "READY?"
273    PRINT : PRINT "T"; CHR$ (244)
275    PRINT : INPUT "YOUR ANSWER (1 OR 2):    ";G$
277    PRINT : IF G$ = "1" THEN   PRINT "HOMO MEANS THE SAME.   THIS PAIR HAS
       TWO DIFFERENT ALLELES.   IT IS A HETEROZYGOTE": GOTO 283
279    PRINT : IF G$ = "2" THEN   PRINT "HOW RIGHT YOU ARE!": GOTO 283
281    PRINT : PRINT "CHOOSE 1 OR 2": GOTO 275
283    PRINT
285    PRINT : PRINT "TRY THIS ONE:"
287    PRINT : PRINT "TT"
289    PRINT : INPUT "HOMOZYGOUS (1) OR HETEROZYGOUS (2):   ";G$
291    IF G$ = "1" THEN   PRINT : PRINT "WHAT A QUICK LEARNER!": GOTO 297
293    IF G$ = "2" THEN   PRINT : PRINT "HOMO MEANS THE SAME.   BOTH THESE AL
       LELESARE THE SAME SO THE INDIVIDUAL IS A       HOMOZYGOTE.": GOTO 297
295    PRINT : PRINT "YOUR CHOICE IS 1 OR 2": GOTO 289
297    PRINT : PRINT "LET'S CHANGE GENES"
299    PRINT : PRINT "RR"
301    INPUT "YOUR CHOICE (1) OR (2):   ";G$
303    IF G$ = "2" THEN   PRINT "SINCE BOTH THESE ALLELES ARE THE SAME    THE
       INDIVIDUAL IS A HOMOZYGOTE.": GOTO 309
305    IF G$ = "1" THEN   PRINT "EXCELLENT!": GOTO 309
307    PRINT "YOU MUST CHOOSE 1 OR 2": GOTO 301
309    PRINT : PRINT  CHR$ (244);
311    PRINT  CHR$ (244)
313    PRINT : INPUT "1 FOR HOMOZYGOUS OR 2 FOR HETEROZYGOUS:   ";G$
315    IF G$ = "1" THEN   PRINT "MENDEL WOULD BE SO PROUD.": GOTO 321
317    IF G$ = "2" THEN   PRINT "HETEROZYGOTE MEANS DIFFERENT ALLELES.    THI
       S INDIVIDUAL HAS THE SAME TWO ALLELESSO IT'S A HOMOZYGOTE.": GOTO 32
       1
319    PRINT "YOUR CHOICE IS 1 OR 2": GOTO 313
321    PRINT : PRINT "IF YOU DIDN'T GET AT LEAST 3 CORRECT,    CHECK BACK OV
       ER YOUR NOTES ON THE DIFFERENCES BETWEEN HOMOZYGOTES AND            H
       ETEROZYGOTES BEFORE GOING ON."
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323  PRINT : GOSUB 7000
325  TEXT : HOME
327  PRINT "WHAT DOES A PLANT WITH TT LOOK LIKE?
329  PRINT : PRINT "T";
331  PRINT  CHR$ (244);
333  PRINT "?"
335  PRINT : PRINT  CHR$ (244);
337  PRINT  CHR$ (244);
339  PRINT "?"
341  PRINT : PRINT "THIS BRINGS US TO OUR LAST FEW TERMS   (FOR THIS PAR
     T OF THE TOUR, ANYWAY!)
343  VTAB 23: GOSUB 7000
345  TEXT : HOME : PRINT : INVERSE : PRINT "GEN";
347  NORMAL : PRINT "OTYPE"
349  PRINT "TELLS US WHICH ";
351  INVERSE : PRINT "GEN";
353  NORMAL : PRINT "ES AN INDIVIDUAL"
355  PRINT "ACTUALLY HAS.  THE TECHNICAL DEFINITION IS:   ALLELES FOR A P
     ARTICULAR TRAIT   CARRIED BY THE CHROMOSOMES OF AN        INDIVIDUA
     L."
357  PRINT : PRINT : INVERSE : PRINT "PH";
359  NORMAL : PRINT "ENOTYPE IS THE ";
361  INVERSE : PRINT "PH";
363  NORMAL : PRINT "YSICAL EXPRESSION OF THE GENOTYPE.  IT TELLS WHAT TH
     E"
365  PRINT "INDIVIDUAL LOOKS LIKE."
367  PRINT : PRINT "THE EXAMPLE IN THE FOLLOWING SCREEN WILLMAKE SOME SEN
     SE OF THESE WORDS FOR YOU."
369  VTAB 23: GOSUB 7000
371  TEXT : HOME : PRINT "A PEA WITH THE ALLELES TT IS A TALL      PLANT."

373  PRINT : PRINT "A PEA WITH ALLELES T";
375  PRINT  CHR$ (244);
377  PRINT " IS ALSO A TALL PLANT."
379  PRINT : PRINT "THE PHENOTYPE (HOW IT LOOKS) IS THE SAMEFOR BOTH:  TA
     LL"
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381   PRINT : PRINT "THE GENOTYPES (THE ALLELES THE        INDIVIDUALS H
      AVE) ARE NOT THE SAME!"
383   PRINT : PRINT "SO WE CAN TELL THE PHENOTYPE BY LOOKING BUT NOT THE G
      ENOTYPE."
385   PRINT : PRINT "HOW CAN PEA PLANTS WITH DIFFERENT       ALLELES LOOK
      THE SAME?  HOW DO WE GET A SHORT PLANT?"
387   VTAB 23: GOSUB 7000
389   GOSUB 8900
391   VTAB 21: PRINT "DOMINANT ALLELES ARE LIKE DOMINANT       PEOPLE.  THE
      Y WILL ";
393   INVERSE : PRINT "ALWAYS";
395   NORMAL : PRINT " BE SEEN IF "
397   PRINT "THEY'RE PRESENT.": GOSUB 7000
399   HOME : VTAB 21: PRINT "THEY'RE THE BIG CHEESE SO THEY'RE       REPRE
      SENTED BY THE 'BIG' LETTER.": GOSUB 7000
401   GOSUB 9000: REM   TT
403   HOME : VTAB 21: PRINT "ARE THESE PLANTS :(A) BOTH TALL OR       (B) O
      NE TALL, ONE SHORT"
405   INPUT "YOUR CHOICE :";G$
407   IF G$ = "A" THEN   PRINT "THAT WAS A TALL ORDER BUT YOU FILLED IT PER
      FECTLY!": GOTO 413
409   IF G$ = "B" THEN   PRINT "BOTH PLANTS WILL BE TALL": GOTO 413
411   PRINT "YOU MUST CHOOSE A OR B": GOTO 403
413   GOSUB 7000
415   HOME : VTAB 21: PRINT "IF THERE'S AT LEAST ONE CAPITAL LETTER  THE D
      OMINANT TRAIT WILL BE SEEN.": PRINT : GOSUB 7000
417   GOSUB 9100: REM   REC T
419   HOME : VTAB 21: PRINT "A RECESSIVE TRAIT IS SHOWN BY A LOWER   CASE
      LETTER"
421   PRINT : GOSUB 7000
423   HOME : VTAB 21: PRINT "A RECESSIVE TRAIT IS NOT SEEN IF A       RECES
      SIVE ALLELE IS PAIRED WITH A        DOMINANT ALLELE": GOSUB 7000
425   HOME : VTAB 21: PRINT "REMEMBER:  A DOMINANT TRAIT TAKES OVER  WHENE
      VER IT'S PRESENT.": PRINT : GOSUB 7000
427   HOME : VTAB 21: PRINT "RECESSIVE TRAITS WILL ONLY BE SEEN IF   BOTH
      ALLELES FOR THE TRAIT ARE RECESSIVETHAT IS, THE ALLELES ARE HOMOZYGO
      US.": GOSUB 7000
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429   TEXT : HOME
431   HTAB 12: PRINT  CHR$ (244);
433   PRINT  CHR$ (244)
435   PRINT : PRINT "THIS PLANT IS SHORT BECAUSE BOTH ALLELESARE RECESSIVE
      "
437   PRINT : PRINT : HTAB 12: PRINT "T";
439   PRINT  CHR$ (244)
441   PRINT : PRINT "NOW WE KNOW THIS PLANT IS TALL.  THE      RECESSIVE IS
      TOO 'SHYT'TO BE SEEN.  THE DOMINANT HAS CONTROL."
443   VTAB 23: GOSUB 7000
445   TEXT : HOME : PRINT "ONE ADDITIONAL NOTE:"
447   PRINT : PRINT "YOU CAN DESCRIBE A GENE PAIR AS BEING     HETEROZYGOUS
      , WHICH MEANS IT HAS ONE     DOMINANT ALLELE AND ONE RECESSIVE ALLELE
      "
449   PRINT : PRINT "IF A GENE PAIR IS HOMOZYGOUS, HOWEVER,  YOU MUST SAY
      IF IT'S HOMOZYGOUS DOMINANTOR HOMOZYGOUS RECESSIVE.  ARE BOTH ITS  A
      LLELES UPPER CASE OR LOWER CASE LETTERS"
451   PRINT : PRINT : GOSUB 7000
453   GOSUB 8300: REM  GUIDE
455   HOME : VTAB 21: PRINT "LET'S SEE IF THIS 'SUNK IN'.  WHILE WE  HAVE
      A LENIENT EXCHANGE POLICY, WE DON'TWANT YOU PURCHASING THE WRONG KIT
      S!": GOSUB 7000
457   LET C = 0
459   TEXT : HOME : PRINT "I'LL GIVE YOU GENE PAIRS THAN ASK YOU   QUESTIO
      NS ABOUT THEM.  PLEASE TYPE IN   THE NUMBER OF THE ANSWER!"
461   PRINT : PRINT : HTAB 12: PRINT "P";
463   PRINT  CHR$ (240)
465   PRINT : INPUT "HOMOZYGOUS (1) OR HETEROZYGOUS (2) :   ";G$
467   IF G$ = "1" THEN  PRINT : PRINT "SORRY, A MIXED PAIR IS HETEROZYGOUS
      ": GOTO 473
469   IF G$ = "2" THEN  PRINT : PRINT "GREAT START":C = C + 1: GOTO 473
471   PRINT "YOUR CHOICE IS 1 OR 2!": GOTO 465
473   PRINT : PRINT : PRINT "WW"
475   PRINT : INPUT "HOMOZYGOUS (1) OR HETEROZYGOUS (2) :   ";G$
477   IF G$ = "1" THEN  PRINT : PRINT "RIGHT YOU ARE!":C = C + 1: GOTO 483
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479  IF G$ = "2" THEN  PRINT "BOTH ALLELES ARE THE SAME.   THE PLANT ISHOM
     OZYGOUS.": GOSUB 7000: GOTO 483
481  PRINT "YOUR CHOICES APE 1 OR 2": GOTO 475
483  PRINT : PRINT "LET'S GET A LITTLE HARDER!": PRINT : GOSUB 7000
485  TEXT : HOME : PRINT "LET T = TALL AND ";
487  PRINT  CHR$ (244);
489  PRINT " = SHORT"
491  PRINT : PRINT "WHAT'S THE GENOTYPE OF A HOMOZYGOUS      DOMINANT PLAN
     T?"
493  PRINT "(A) TT"
495  PRINT "(B) ";
497  PRINT  CHR$ (244);
499  PRINT  CHR$ (244)
501  PRINT "(C) T";
503  PRINT  CHR$ (244)
505  PRINT : INPUT "YOUR CHOICE:   ";G$
507  PRINT
509  IF G$ = "A" THEN  PRINT "MARVELOUS!": GOTO 517
511  IF G$ = "B" THEN  PRINT "DOMINANCE IS SHOWN BY CAPITAL LETTERS.  THE
        CORRECT CHOICE IS A.": GOTO 517
513  IF G$ = "C" THEN  PRINT "HOMOZYGOUS MEANS BOTH ALLELES ARE ALIKE.THE
        CORRECT CHOICE IS A.": GOTO 517
515  PRINT "PLEASE CHOOSE A, B, OR C": GOTO 505
517  VTAB 23: GOSUB 7000
519  TEXT : HOME : PRINT "WHAT IS THE GENOTYPE OF A HOMOZYGOUS    RECESSI
     VE PLANT?"
521  PRINT : PRINT "(A)   TT"
523  PRINT : PRINT "(B)   ";
525  PRINT  CHR$ (244);
527  PRINT  CHR$ (244)
529  PRINT : PRINT "(C)   T";
531  PRINT  CHR$ (244);
533  PRINT : INPUT "YOUR CHOICE:   ";G$
535  PRINT
537  IF G$ = "A" THEN  PRINT "THE CORRECT CHOICE IS B.  HOMO MEANS    SAM
     E AND RECESSIVE IS THE SMALL LETTER.": GOTO 545
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539   IF G$ = "B" THEN  PRINT "HOW BIG OF YOU TO PICK THE RIGHT CHOICE!":C
      = C + 1: GOTO 545
541   IF G$ = "C" THEN  PRINT "THE CORRECT CHOICE IS B.   HOMO MEANS      SAM
      E": GOTO 545
543   PRINT : PRINT "YOUR CHOICES ARE A, B, OR C": GOTO 533
545   PRINT : GOSUB 7000: TEXT : HOME
547   PRINT : PRINT "WHAT'S THE PHENOTYPE OF A HOMOZYGOUS      DOMINANT PLAN
      T?"
549   PRINT : PRINT "(A) TT"
551   PRINT : PRINT "(B) SHORT"
553   PRINT : PRINT "(C) TALL"
555   PRINT : INPUT "YOUR SELECTION:   ";G$
557   PRINT
559   IF G$ = "A" THEN  PRINT "PHENOTYPE WANTS TO KNOW APPEARANCE NOT   WHA
      T GENES THE INDIVIDUAL HAS!  THE       CORRECT ANSWER IS C": GOTO 567
561   IF G$ = "B" THEN  PRINT "TALL IS THE DOMINANT TRAIT.   THE CORRECTSEL
      ECTION IS C": GOTO 567
563   IF G$ = "C" THEN  PRINT "ABSOLUTELY!":C = C + 1: GOTO 567
565   PRINT "YOUR CHOICES ARE A, B, OR C": GOTO 555
567   VTAB 23: GOSUB 7000
569   TEXT : HOME
571   PRINT "HOW MANY ALLELES ARE THERE FOR HEIGHT INPEA PLANTS?"
573   INPUT "YOUR NUMBER:   ";G$
575   PRINT
577   IF G$ = "2" THEN  PRINT "THAT'S RIGHT!":C = C + 1: GOTO 581
579   PRINT "THERE ARE TWO ALLELES:  ONE CODING FOR   TALL AND ONE CODING F
      OR SHORT!": GOTO 581
581   VTAB 23: GOSUB 7000
583   TEXT : HOME
585   IF C < 5 THEN  PRINT "I DON'T THINK YOU'RE READY TO START       PRACTI
      CING WITH KITS YET.  PRESS THE S   WHEN PROMPTED AND TAKE SHUTTLE ROU.
      TE 1   TO GO BACK THROUGH THIS SECTION OF THE  WAREHOUSE AGAIN.": GOTO
      591
587   PRINT "I THINK YOU'VE MASTERED THIS PART OF THEWAREHOUSE WELL ENOUGH
      !  LET'S MOVE ON   AND SHOW YOU OUR MERCHANDISE!"
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589   PRINT : PRINT "WHEN PRUMPTED SWITCH SHUTTLES AND TAKE  THE ONE MARKE
      D ROUTE 2!"
591   VTAB 23: GOSUB 7000
593   TEXT : HOME : PRINT "YOU'RE NO LONGER ON THE SHUTTLE ROUTE.  RUN MEN
      U TO FIND YOUR WAY BACK!"
595   END
7000  REM   SWITCH ROUTINE
7001  INPUT "TYPE S TO SWITCH OR C TO CONTINUE:  ";G$
7002  IF G$ = "S" THEN   PRINT   CHR$ (4);"RUN MENU
7003  IF G$ = "C" THEN   RETURN
7004  GOTO 7001
7005  RETURN
8100  REM   GENE SHOP
8101  TEXT : HOME : HGR : HCOLOR= 3
8102  HPLOT 20,10 TO 230,10 TO 230,155 TO 20,155 TO 20,10
8103  HPLOT 100,155 TO 100,100 TO 150,100 TO 150,155
8104  HPLOT 40,80 TO 80,80 TO 80,140 TO 40,140 TO 40,80
8107  HPLOT 170,80 TO 210,80 TO 210,140 TO 170,140 TO 170,80
8109  HPLOT 185,85 TO 175,85 TO 175,90 TO 185,90 TO 185,95 TO 175,95
8110  HPLOT 185,110 TO 185,120 TO 195,120
8112  HPLOT 180,110 TO 185,100 TO 190,110: HPLOT 183,105 TO 188,105
8114  HPLOT 205,125 TO 195,125 TO 195,135 TO 205,135: HPLOT 195,130 TO 20
      5,130
8116  HPLOT 45,90 TO 53,90 TO 53,95 TO 55,95 TO 55,100 TO 45,100 TO 45,90

8118  HPLOT 45,95 TO 53,95
8119  HPLOT 55,105 TO 65,105: HPLOT 55,115 TO 65,115: HPLOT 60,105 TO 60,
      115
8120  HPLOT 75,120 TO 65,120 TO 65,130 TO 75,130 TO 75,125 TO 70,125
8122  HPLOT 60,70 TO 60,60 TO 65,70 TO 70,60 TO 70,70
8124  HPLOT 80,70 TO 80,60 TO 90,60 TO 90,70: HPLOT 80,65 TO 90,65
8126  HPLOT 110,60 TO 100,60 TO 100,70 TO 110,70
8128  HPLOT 120,60 TO 120,70: HPLOT 120,65 TO 130,65: HPLOT 130,60 TO 130
      ,70
8129  HPLOT 140,60 TO 150,60: HPLOT 140,70 TO 150,70: HPLOT 145,60 TO 145
      ,70
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8130    HPLOT 160,70 TO 160,60 TO 170,70 TO 170,60
8132    HPLOT 190,70 TO 180,70 TO 180,60 TO 190,60: HPLOT 180,65 TO 170,65
8234    HPLOT 100,40 TO 90,40 TO 90,50 TO 100,50 TO 100,45 TO 95,45
8236    HPLOT 120,40 TO 110,40 TO 110,50 TO 120,50: HPLOT 110,45 TO 120,45
8238    HPLOT 130,50 TO 130,40 TO 140,50 TO 140,40
8240    HPLOT 160,40 TO 150,40 TO 150,50 TO 160,50: HPLOT 150,45 TO 160,45
8242    HPLOT 60,20 TO 50,20 TO 50,30 TO 60,30 TO 60,25 TO 55,25
8244    HPLOT 70,30 TO 70,20 TO 80,20 TO 80,25 TO 70,25 TO 80,30
8246    HPLOT 100,20 TO 90,20 TO 90,30 TO 100,30: HPLOT 90,25 TO 100,25
8248    HPLOT 120,20 TO 110,20 TO 110,30 TO 120,30 TO 120,25 TO 115,25
8250    HPLOT 130,30 TO 130,20 TO 140,20 TO 140,30 TO 130,30
8252    HPLOT 150,30 TO 150,20 TO 160,20 TO 160,25 TO 150,25 TO 160,30
8254    HPLOT 170,20 TO 170,25
8256    HPLOT 190,20 TO 180,20 TO 180,25 TO 190,25 TO 190,30 TO 180,30
8257    RETURN
8300    REM   GUIDE
8301    TEXT : HOME : HGR : HCOLOR= 3
8302    HPLOT 100,45 TO 150,45 TO 150,110 TO 140,120 TO 110,120 TO 100,110 TO
        100,45
8303    HPLOT 100,60 TO 150,60 TO 140,70 TO 110,70 TO 100,60
8304    HPLOT 110,50 TO 105,50 TO 105,55 TO 110,55 TO 110,53 TO 108,53
8305    HPLOT 115,50 TO 115,55 TO 120,55 TO 120,50
8306    HPLOT 125,50 TO 125,55
8307    HPLOT 130,50 TO 132,50 TO 135,53 TO 132,55 TO 130,55 TO 130,50
8308    HPLOT 145,50 TO 140,50 TO 140,55 TO 145,55: HPLOT 140,53 TO 145,53
8309    HPLOT 105,80 TO 105,75 TO 115,75 TO 115,80
8310    HPLOT 135,80 TO 135,75 TO 145,75 TO 145,80
8311    HPLOT 107,85 TO 107,80 TO 113,80 TO 113,85 TO 107,85
8315    HPLOT 137,85 TO 137,80 TO 143,80 TO 143,85 TO 137,85
8316    HPLOT 120,90 TO 130,90 TO 130,100 TO 120,100 TO 120,90
8318    HPLOT 110,105 TO 115,110 TO 135,110 TO 140,105
8319    RETURN
8400    REM   MENDEL
8401    TEXT : HOME : HGR : HCOLOR= 3
8402    HPLOT 90,45 TO 100,35 TO 150,35 TO 160,45 TO 160,115 TO 140,130 TO
        110,130 TO 90,115 TO 90,45
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8403  HPLOT 95,50 TO 100,45 TO 110,45 TO 115,50: HPLOT 100,50 TO 110,50 TO
      110,65 TO 100,65 TO 100,50: HPLOT 102,65 TO 102,60 TO 108,60 TO 108,
      65
8404  HPLOT 135,50 TO 140,45 TO 150,45 TO 155,50: HPLOT 140,50 TO 150,50 TO
      150,65 TO 140,65 TO 140,50: HPLOT 142,65 TO 142,60 TO 148,60 TO 148,
      65
8405  HPLOT 125,65 TO 130,70 TO 125,75 TO 120,70 TO 125,65
8406  HPLOT 110,90 TO 120,80 TO 130,80 TO 140,90: HPLOT 115,85 TO 115,90
8407  HPLOT 120,80 TO 120,90: HPLOT 125,80 TO 125,90: HPLOT 130,80 TO 130
      ,90
8408  HPLOT 135,85 TO 135,90
8411  HPLOT 90,30 TO 90,45: HPLOT 95,25 TO 95,40
8412  LET X = 100
8413  FOR I = 1 TO 11
8414  HPLOT X,20 TO X,35
8415  LET X = X + 5
8416  NEXT I
8417  HPLOT 155,25 TO 155,40: HPLOT 160,30 TO 160,45
8418  HPLOT 95,80 TO 95,120: HPLOT 100,85 TO 100,122: HPLOT 105,95 TO 105
      ,127
8419  LET X = 110
8420  FOR I = 1 TO 7
8421  HPLOT X,100 TO X,130
8422  LET X = X + 5
8423  NEXT I
8424  HPLOT 145,95 TO 145,127: HPLOT 150,90 TO 150,122: HPLOT 150,85 TO 1
      50,120
8425  HPLOT 155,80 TO 155,120
8427  RETURN
8500  REM  PEAS
8501  TEXT : HOME : HGR : HCOLOR= 3
8502  HPLOT 30,130 TO 30,50: HPLOT 30,80 TO 20,70: HPLOT 30,120 TO 20,110
      : HPLOT 30,60 TO 40,50: HPLOT 30,110 TO 40,100
8503  HPLOT 30,40 TO 35,45 TO 30,50 TO 25,45 TO 30,40
8504  HPLOT 40,50 TO 40,45 TO 50,45 TO 50,40 TO 45,40 TO 45,50 TO 40,50
8505  HPLOT 20,70 TO 20,65 TO 10,65 TO 10,60 TO 15,60 TO 15,70 TO 20,70
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8506   HPLOT 30,90 TO 40,80
8507   HPLOT 40,100 TO 40,95 TO 50,95 TO 50,90 TO 45,90 TO 45,100 TO 40,10
       0
8508   HPLOT 40,80 TO 40,75 TO 50,75 TO 50,70 TO 45,70 TO 45,80 TO 40,80
8509   HPLOT 20,110 TO 20,105 TO 10,105 TO 10,100 TO 15,100 TO 15,110 TO 2
       0,110
8510   HPLOT 100,130 TO 100,50: HPLOT 100,60 TO 90,50: HPLOT 100,80 TO 110
       ,70: HPLOT 90,100 TO 100,110: HPLOT 100,120 TO 110,110
8511   HPLOT 100,40 TO 105,45 TO 100,50 TO 95,45 TO 100,40
8512   HPLOT 90,45 TO 90,50 TO 85,50 TO 85,45 TO 90,45
8513   HPLOT 110,70 TO 110,65 TO 120,65 TO 120,60 TO 115,60 TO 115,70 TO 1
       10,70
8514   HPLOT 90,80 TO 90,75 TO 80,75 TO 80,70 TO 85,70 TO 85,80 TO 90,80
8515   HPLOT 100,90 TO 90,80
8516   HPLOT 80,90 TO 85,90 TO 85,100 TO 90,100 TO 90,95 TO 80,95 TO 80,90

8517   HPLOT 110,110 TO 110,105 TO 120,105 TO 120,100 TO 115,100 TO 115,11
       0 TO 110,110
8518   HPLOT 160,90 TO 160,130: HPLOT 160,125 TO 165,120: HPLOT 160,100 TO
       165,95: HPLOT 150,105 TO 160,110
8519   HPLOT 160,80 TO 165,85 TO 160,90 TO 155,85 TO 160,80: HPLOT 165,95 TO
       165,90 TO 170,90 TO 170,95 TO 165,95
8520   HPLOT 140,100 TO 140,95 TO 145,95 TO 145,105 TO 150,105 TO 150,100 TO
       140,100
8521   HPLOT 165,120 TO 165,115 TO 175,115 TO 175,110 TO 170,110 TO 170,12
       0 TO 165,120
8522   HPLOT 220,80 TO 225,85 TO 220,90 TO 215,85 TO 220,80: HPLOT 220,90 TO
       220,130
8523   HPLOT 220,125 TO 210,120: HPLOT 220,110 TO 225,105: HPLOT 220,100 TO
       215,95
8524   HPLOT 225,105 TO 225,100 TO 230,100 TO 230,105 TO 225,105
8525   HPLOT 200,115 TO 200,110 TO 205,110 TO 205,120 TO 210,120 TO 210,11
       5 TO 200,115
8526   HPLOT 205,85 TO 210,85 TO 210,95 TO 215,95 TO 215,90 TO 205,90 TO 2
       05,85
8527   RETURN
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```
8700    REM   CROSS R
8701    TEXT : HOME : HGR : HCOLOR= 3
8702    HPLOT 20,90 TO 20,40 TO 50,40 TO 50,60 TO 20,60 TO 50,90
8703    HPLOT 60,90 TO 60,40 TO 90,40 TO 90,60 TO 60,60 TO 90,90
8704    HPLOT 110,40 TO 140,90: HPLOT 110,90 TO 140,40
8705    HPLOT 160,90 TO 160,40 TO 190,40 TO 190,60 TO 160,60 TO 190,90
8708    HPLOT 200,90 TO 200,60: HPLOT 200,70 TO 210,60 TO 225,60 TO 230,70
8709    RETURN
8800    REM   T
8801    TEXT : HOME : HGR : HCOLOR= 3
8802    HPLOT 20,45 TO 50,45: HPLOT 35,45 TO 35,95
8803    HPLOT 75,95 TO 75,45: HPLOT 60,45 TO 90,45
8804    HPLOT 110,45 TO 140,95: HPLOT 140,45 TO 110,95
8806    HPLOT 160,45 TO 190,45: HPLOT 175,45 TO 175,95
8808    HPLOT 210,60 TO 210,95: HPLOT 200,70 TO 220,70
8810    RETURN
8900    REM   DOM T
8901    TEXT : HOME : HGR : HCOLOR= 3
8902    HPLOT 10,30 TO 30,30 TO 40,40 TO 40,70 TO 30,80 TO 10,80 TO 10,30
8903    HPLOT 50,60 TO 70,60 TO 70,80 TO 50,80 TO 50,60
8904    HPLOT 80,80 TO 80,60 TO 90,70 TO 100,60 TO 100,80
8905    HPLOT 110,60 TO 130,60: HPLOT 110,80 TO 130,80: HPLOT 120,60 TO 120
        ,80
8906    HPLOT 140,80 TO 140,60 TO 160,80 TO 160,60
8907    HPLOT 170,80 TO 170,60 TO 190,60 TO 190,80: HPLOT 170,70 TO 190,70
8908    HPLOT 200,80 TO 200,60 TO 220,80 TO 220,60
8910    HPLOT 230,60 TO 250,60: HPLOT 240,60 TO 240,80
8911    HPLOT 100,100 TO 150,100: HPLOT 125,100 TO 125,150
8912    RETURN
9000    REM   T
9001    TEXT : HOME : HGR : HCOLOR= 3
9002    HPLOT 20,45 TO 50,45: HPLOT 35,45 TO 35,90
9003    HPLOT 70,45 TO 100,45: HPLOT 85,45 TO 85,90
9004    HPLOT 150,45 TO 180,45: HPLOT 165,45 TO 165,90
9005    HPLOT 200,70 TO 220,70: HPLOT 210,60 TO 210,90
9006    RETURN
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9016   HPLOT 95,70 TO 115,70 TO 110,60 TO 100,60 TO 95,70 TO 95,75 TO 100,
       80 TO 110,80 TO 115,75
9100   REM   REC T
9101   TEXT : HOME : HGR : HCOLOR= 3
9102   HPLOT 5,60 TO 5,80: HPLOT 5,65 TO 15,60 TO 25,60
9103   HPLOT 35,70 TO 55,70 TO 50,60 TO 40,60 TO 35,70 TO 35,75 TO 40,80 TO
       50,80 TO 55,75
9104   HPLOT 85,65 TO 80,60 TO 70,60 TO 65,65 TO 65,75 TO 70,80 TO 80,80 TO
       85,75
9105   HPLOT 95,70 TO 115,70 TO 110,60 TO 100,60 TO 95,70 TO 95,75 TO 100,
       80 TO 110,80 TO 115,75
9106   HPLOT 125,80 TO 140,80 TO 140,70 TO 125,70 TO 125,60 TO 140,60
9108   HPLOT 165,60 TO 150,60 TO 150,70 TO 165,70 TO 165,80 TO 150,80
9110   HPLOT 180,60 TO 180,80
9112   HPLOT 195,60 TO 205,80 TO 215,60
9113   HPLOT 225,70 TO 245,70 TO 240,60 TO 230,60 TO 225,70 TO 225,75 TO 2
       30,80 TO 240,80 TO 245,75
9114   HPLOT 120,100 TO 120,120: HPLOT 115,110 TO 125,110
9115   RETURN
1    REM   GENETICS
3    REM   BY PATRICIA D. MORRELL, 4/87
5    REM   INITIALIZATION BLOCK
7    REM   G$=GET COMMAND
9    REM   H$=HELP
11   REM   DRIVER
13   PRINT   CHR$ (4);"BRUN LOMEM:": & LOMEM: 16384
15   REM   SIMPLE CROSSES
17   TEXT : HOME : GOSUB 8300
19   HOME : VTAB 21: PRINT "HOP ABOARD TO GET TO THE SIMPLE CROSS    SECTIO
       N!": PRINT : GOSUB 7000
21   HOME : VTAB 21: PRINT "IT'LL TAKE US A FEW MINUTES TO REACH OURSIMPLE
         CROSS KIT AISLES, SO SIT BACK ANDRELAX AND ENJOY THE SCENERY.": GOSUB
         7000
23   GOSUB 9300: REM   MARKER
25   HOME : VTAB 21: PRINT "OUR FIRST HISTORICAL MARKER! HERE IS    WHERE
       MENDEL GAVE US THE F WORD..        FILIAL.": GOSUB 7000
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27  HOME : VTAB 21: PRINT "FILIAL MEANS 'SON' IN LATIN.": PRINT : GOSUB 7
    000
29  HOME : VTAB 21: PRINT "TO KEEP TRACK OF CROSSES, MENDEL USED A CAPITA
    L F AND NUMBERS FOR EACH SUCCES-  SIVE GENERATION FROM CHOSEN PARENT
    S.": GOSUB 7000
31  HOME : VTAB 21: PRINT "YOUR SHOPPING GUIDE HAS A SKETCH OF WHATI MEAN
    , AS DOES THE NEXT SCREEN!": GOSUB 7000
33  TEXT : HOME
35  PRINT "PARENTS ARE THE STARTING GENERATION."
37  PRINT : PRINT "CROSSING PARENTS RESULTS IN THE FIRST    FILIAL GENERAT
    ION OF THE F ."
39  PRINT "                          1"
41  PRINT : PRINT : PRINT "CROSSING THE F  GENERATION YIELDS THE"
43  PRINT "               1       "
45  PRINT "F , OR SECOND FILIAL GENERATION."
47  PRINT " 2"
49  PRINT : PRINT : PRINT "CROSSING F 'S PRODUCES THE F 'S"
51  PRINT "           2                 3"
53  PRINT : PRINT "AND SO ON..."
55  PRINT : PRINT "WHAT WILL CROSSING F 'S GIVE YOU?"
57  PRINT "                    7"
59  PRINT : INPUT "YOUR NUMBER:   ";G$
61  PRINT "CROSSING F 'S RESULTS IN F 'S!."
63  PRINT "         7               8"
65  PRINT : GOSUB 7000
67  GOSUB 9400
69  HOME
71  VTAB 21: PRINT "WE'RE APPROACHING PRINCIPLE ROW!": PRINT : GOSUB 7000

73  HOME : VTAB 21: PRINT "MENDEL GAVE US 3 PRINCIPLES. TWO OF    THESE
    CAN BE SEEN ON THIS ROUTE!": GOSUB 7000
75  GOSUB 9500
77  HOME : VTAB 21: PRINT "HERE'S THE FIRST ONE:              THE PR
    INCIPLE OF DOMINANCE.": GOSUB 7000
79  TEXT : HOME : PRINT "PRINCIPLE OF DOMINANCE"
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81   PRINT : PRINT "WHEN ALLELES OF A GENE PAIR FOR A          PARTICULAR TRA
     IT ARE DIFFERENT, THE      EFFECT OF   ONE, THE DOMINANT, WILL BE   SH
     OWN AND THE EFFECT OF THE OTHER, THE   RECESSIVE, WILL BE HIDDEN."
83   PRINT : PRINT "WHAT THIS MEANS, IN ENGLISH, IS IF AN    INDIVIDUAL IS
     A HYBRID, THE DOMINANT    TRAIT IS THE ONE THAT IS SEEN."
85   PRINT : PRINT "FOR EXAMPLE, T";
87   PRINT  CHR$ (244);
89   PRINT " IS A HYBRID FOR HEIGHT."
91   PRINT "THE PLANT IS TALL BECAUSE THE DOMINANT  ALLELE TAKES OVER."
93   PRINT : PRINT "YOU MIGHT REMEMBER WORKING WITH THIS     PRINCIPLE ALON
     G ROUTE 1."
95   PRINT : PRINT : GOSUB 7000
97   GOSUB 9600: REM  MARKER
99   HOME : VTAB 21: PRINT "WE'RE APPROACHING THE SECOND PRINCIPLE!": PRINT
     : GOSUB 7000
101  TEXT : HOME : HTAB 8: PRINT "PRINCIPLE OF SEGREGATION"
103  PRINT : PRINT "THE PRINCIPLE OF SEGREGATION STATES THATGENES CONTROL
     LING FOR A PARTICULAR TRAITSEPARATE DURING GAMETE FORMATION.       T
     HEREFORE, EACH GAMETE CARRIES ONLY ONE ALLELE OF EACH GENE PAIR."
105  PRINT : PRINT "REMEMBER, YOU GET HALF OF A CHROMOSOME  PAIR FROM EAC
     H PARENT.  SINCE GENES ARE ON THE CHROMOSOMES, YOU GET HALF THE    G
     ENES FROM ONE PARENT AND THE CORRESPONDING HALF FROM THE OTHER."
107  PRINT : PRINT "THAT'S BASICALLY WHAT THIS PRINCIPLE     SAYS."
109  PRINT : PRINT : PRINT : GOSUB 7000
111  GOSUB 8300
113  HOME : VTAB 21: PRINT "WE'RE HERE AT THE SIMPLE CROSS KITS     AREA.
       PLEASE WATCH YOUR STEP GETTING   OFF THE SHUTTLE.": GOSUB 7000
115  GOSUB 8400
117  HOME : VTAB 21: PRINT "SO, YOU'RE READY TO START SELECTING     GENES
      FOR THE TRAITS YOU WANT.  THAT IS OUR SPECIALITY AT THE GENE MACHIN
     E!": GOSUB 7000
119  HOME : VTAB 21: PRINT "LET ME HELP YOU WITH YOUR FIRST SIMPLE   CROSS
      KIT.  WE'RE RUNNING A SPECIAL ON  PEA SHAPE TODAY.": GOSUB 7000
121  HOME : VTAB 21: PRINT "HAVE A COMPLIMENTARY KIT!!": PRINT : GOSUB 70
     00
123  GOSUB 9700
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125  HOME : VTAB 21: PRINT "R IS THE ALLELE FOR ROUND PEAS."
127  PRINT  CHR$ (242);
129  PRINT " IS THE ALLELE FOR WRINKLED PEAS"
131  GOSUB 7000
133  HOME : VTAB 21
135  PRINT "WHAT OFFSPRING WILL WE GET IF WE CROSS  THESE TWO PARENTS?": GOSUB
     7000
137  GOSUB 8400
139  HOME : VTAB 21: PRINT "LET'S GO THROUGH THE INSTRUCTION SHEET. FOLLO
     W ALONG WITH THE ONE IN YOUR GUIDE BOOK.": GOSUB 7000
141  TEXT : HOME : HTAB 14: PRINT "INSTRUCTIONS"
143  PRINT : PRINT "THERE ARE ONLY TWO STEPS NEEDED TO      PREDICT WHAT
     GENE COMBINATIONS (OFF-    SPRING) ARE POSSIBLE FROM CROSSING TWO  P
     ARENTS."
145  PRINT : PRINT "1.  COME UP WITH ALL POSSIBLE GAMETES."
147  PRINT : PRINT "REMEMBER, EACH GAMETE CARRIES ONLY ONE  ALLELE FOR A
     TRAIT."
149  PRINT : PRINT "LET'S TRY THE MOM FIRST."
151  PRINT : GOSUB 7000: TEXT : HOME
153  PRINT : PRINT "THE MOTHER'S POSSIBLE GAMETES (NOTE THE KEY WORD IS P
     OSSIBLE.  WE MUST CONSIDER ALL POSSIBILITIES.)"
155  PRINT : PRINT "SHE HAS ONLY R'S TO OFFER.  SO BOTH HER GAMETES WILL
     BE THE DOMINANT GENE FOR    SHAPE."
157  PRINT : PRINT "YOU TRY THE DAD.  WHAT CAN HIS GAMETES  BE? (PLEASE P
     RESS THE RETURN KEY WHEN   YOU THINK YOU KNOW.)"
159  PRINT : PRINT "DID YOU GUESS THAT ALL HIS SPERM WILL    CARRY ";
161  PRINT  CHR$ (242);
163  PRINT ", THE RECESSIVE ALLELE?"
165  PRINT : PRINT "LET'S MOVE ON TO STEP 2."
167  GOSUB 7000: TEXT : HOME
169  PRINT "2.  CROSS THE PARENTS' GAMETES.  "
171  PRINT "THERE ARE 3 WAYS YOU CAN DO THIS STEP."
173  PRINT : PRINT "1.  THINK IT THROUGH LOGICALLY (WHICH   MAY BE THE HA
     RDEST OPTION)"
175  PRINT : PRINT "2.  CALCULATE PROBABILITIES (EASIER      THAN NUMBER 1
     BUT NOT THE EASIEST      CHOICE)."
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177  PRINT : PRINT "3.   CONSTRUCT A PUNNETT SQUARE (THE      WISEST CHOICE
     )"
179  PRINT : PRINT "I'LL BE HAPPY TO EXPLAIN OPTION NUMBER  3!"
181  PRINT : PRINT : PRINT : GOSUB 7000
183  GOSUB 8400
185  HOME : VTAB 21: PRINT "CONSTRUCTING A PUNNETT SQUARE IS EASY!  BE SU
     RE TO FOLLOW ALONG WITH YOUR BOOK.": GOSUB 7000
187  GOSUB 9800
189  HOME : VTAB 21: PRINT "FIRST, MAKE A SQUARE AND, FOR THIS      EXAMP
     LE, DIVIDE IT INTO 4'S.": GOSUB 7000
191  GOSUB 9850
193  HOME : VTAB 21: PRINT "NEXT, PLACE THE FEMALE'S POSSIBLE      GAMET
     ES ALONG THE TOP EDGE (ONE GAMETE  PER BOX).": GOSUB 7000
195  GOSUB 9860
197  HOME : VTAB 21: PRINT "THEN PLACE THE MALE'S POSSIBLE GAMETES  DOWN
     THE LEFT HAND COLUMN (AGAIN, ONE    GAMETE PER BOX).": GOSUB 7000
199  GOSUB 9870
201  HOME : VTAB 21: PRINT "FINALLY,  FILL IN EACH BOX OF THE SQUAREBY PL
     ACING THE FEMALE GAMETE AND MALE    GAMETE TOGETHER IN ONE BOX, AS SH
     OWN.": GOSUB 7000
203  GOSUB 9890
205  HOME : VTAB 21: PRINT "FOLLOW THE SAME PROCEDURE UNTIL ALL THE BOXES
      ARE FILLED IN.": GOSUB 7000
207  HOME : VTAB 21: PRINT "ALL THE FIRST FILIAL OFFSPRING FROM      CROSS
     ING RR AND ";
209  PRINT  CHR$ (242);
211  PRINT  CHR$ (242);
213  PRINT " WILL BE HYBRIDS.  ALL WILL BE ROUND.": GOSUB 7000
215  GOSUB 8400
217  HOME : VTAB 21: PRINT "LET'S TRY CROSSING THE FIRST FILIAL      GENER
     ATION."
219  PRINT : GOSUB 7000
221  GOSUB 9900
223  HOME : VTAB 21: PRINT "BOTH OUR PLANTS ARE HYBRIDS SO EACH      PAREN
     T CAN OFFER 2 DIFFERENT ALLELES:"
225  PRINT "R AND ";
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227   PRINT  CHR$ (242)
229   GOSUB 7000
231   GOSUB 9800
233   HOME : VTAB 21: PRINT "CONSTRUCT THE SQUARE.  (THERE'S ONE      PROVI
      DED IN THE BOOKLET.)": GOSUB 7000
235   GOSUB 9950
237   HOME : VTAB 21: PRINT "PLACE THE POSSIBLE ALLELES OF THE MOM    ACROS
      S THE TOP AND THE POSSIBLE ALLELES OF THE DAD DOWN THE SIDE.": GOSUB
      7000
239   GOSUB 9980
241   HOME : VTAB 21: PRINT "FILL IN THE BOXES.  USE THE FEMALE       GAMET
      E ON TOP OF THE COLUMN AND THE MALEGAMETE TO THE LEFT OF THE ROW.": GOSUB
      7000
243   HOME : VTAB 21: PRINT "NOTE THAT WITH HYBRIDS, THE CAPITAL      LETTE
      R IS GENERALLY WRITTEN FIRST.": GOSUB 7000
245   HOME : VTAB 21: PRINT "FILL IN YOUR PUNNETT SQUARE BEFORE       CONTI
      NUING!": PRINT : GOSUB 7000
247   GOSUB 10000
249   HOME : VTAB 21: PRINT "DOES YOUR FILLED IN BOX LOOK LIKE THIS? WHAT
      ARE THE GENOTYPES? THE PHENOTYPES? WRITE YOUR ANSWERS IN YOUR GUIDE.
      ": GOSUB 7000
251   TEXT : HOME : PRINT "WHEN CROSSING TWO HYBRIDS, YOU WILL        ALWAYS
      GET A 3:1 PHENOTYPE RATIO AND A  1:2:1 GENOTYPE RATIO."
253   PRINT : PRINT "PHENOTYPE:"
255   PRINT : PRINT "3 OF THE OFFSPRING ARE ROUND"
257   PRINT "1 OF THE OFFSPRING IS WRINKLED"
259   PRINT : PRINT : PRINT "GENOTYPE:"
261   PRINT : PRINT "ONE IS HOMOZYGOUS DOMINANT"
263   PRINT "TWO ARE HETEROZYGOUS"
265   PRINT "ONE IS HOMOZYGOUS RECESSIVE"
267   PRINT : GOSUB 7000: TEXT : HOME
269   PRINT : PRINT "REMEMBER!  PREDICTING OFFSPRING ONLY    TELLS YOU ABO
      UT PROBABLE OUTCOMES NOT    ACTUAL RESULTS!"
271   PRINT : PRINT "USING A PUNNETT SQUARE JUST TELLS THE": HTAB 18: INVERSE
      : PRINT "ODDS": NORMAL : PRINT "OF GETTING OFFSPRING WITH CERTAIN TR
      AITS."
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273  PRINT : GOSUB 7000
274  TEXT : HOME : PRINT "AS YOU MAY HAVE GUESSED, THIS SECTION   OF OUR
     WAREHOUSE IS QUITE LARGE. YOU   WILL HAVE TO TAKE ANOTHER SHUTTLE T
     O SEETHE REST OF THIS AREA!"
275  PRINT : PRINT "PLEASE TYPE PR#6, PRESS THE RETURN KEY   THEN TYPE RUN
     SHUTTLE TWO A."
276  PRINT : PRINT "THAT WILL GET YOU TO THE PROPER SHUTTLE CONNECTION."
277  PRINT : PRINT "MENDEL WILL BE WAITING THERE FOR YOU!"
278  END
7000  REM   SWITCH ROUTINE
7001  INPUT "TYPE S TO SWITCH OR C TO CONTINUE:   ";G$
7002  IF G$ = "S" THEN   PRINT   CHR$ (4);"RUN MENU
7003  IF G$ = "C" THEN   RETURN
7004  GOTO 7001
7005  RETURN
8300  REM   GUIDE
8301  TEXT : HOME : HGR : HCOLOR= 3
8302  HPLOT 100,45 TO 150,45 TO 150,110 TO 140,120 TO 110,120 TO 100,110 TO
      100,45
8303  HPLOT 100,60 TO 150,60 TO 140,70 TO 110,70 TO 100,60
8304  HPLOT 110,50 TO 105,50 TO 105,55 TO 110,55 TO 110,53 TO 108,53
8305  HPLOT 115,50 TO 115,55 TO 120,55 TO 120,50
8306  HPLOT 125,50 TO 125,55
8307  HPLOT 130,50 TO 132,50 TO 135,53 TO 132,55 TO 130,55 TO 130,50
8308  HPLOT 145,50 TO 140,50 TO 140,55 TO 145,55: HPLOT 140,53 TO 145,53
8309  HPLOT 105,80 TO 105,75 TO 115,75 TO 115,80
8310  HPLOT 135,80 TO 135,75 TO 145,75 TO 145,80
8311  HPLOT 107,85 TO 107,80 TO 113,80 TO 113,85 TO 107,85
8315  HPLOT 137,85 TO 137,80 TO 143,80 TO 143,85 TO 137,85
8316  HPLOT 120,90 TO 130,90 TO 130,100 TO 120,100 TO 120,90
8318  HPLOT 110,105 TO 115,110 TO 135,110 TO 140,105
8320  RETURN
8400  REM   MENDEL
8401  TEXT : HOME : HGR : HCOLOR= 3
8402  HPLOT 90,45 TO 100,35 TO 150,35 TO 160,45 TO 160,115 TO 140,130 TO
      110,130 TO 90,115 TO 90,45
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8403    HPLOT 95,50 TO 100,45 TO 110,45 TO 115,50: HPLOT 100,50 TO 110,50 TO
        110,65 TO 100,65 TO 100,50: HPLOT 102,65 TO 102,60 TO 108,60 TO 108,
        65
8404    HPLOT 135,50 TO 140,45 TO 150,45 TO 155,50: HPLOT 140,50 TO 150,50 TO
        150,65 TO 140,65 TO 140,50: HPLOT 142,65 TO 142,60 TO 148,60 TO 148,
        65
8405    HPLOT 125,65 TO 130,70 TO 125,75 TO 120,70 TO 125,65
8406    HPLOT 110,90 TO 120,80 TO 130,80 TO 140,90: HPLOT 115,85 TO 115,90
8407    HPLOT 120,80 TO 120,90: HPLOT 125,80 TO 125,90: HPLOT 130,80 TO 130
        ,90
8408    HPLOT 135,85 TO 135,90
8411    HPLOT 90,30 TO 90,45: HPLOT 95,25 TO 95,40
8412    LET X = 100
8413    FOR I = 1 TO 11
8414    HPLOT X,20 TO X,35
8415    LET X = X + 5
8416    NEXT I
8417    HPLOT 155,25 TO 155,40: HPLOT 160,30 TO 160,45
8418    HPLOT 95,80 TO 95,120: HPLOT 100,85 TO 100,122: HPLOT 105,95 TO 105
        ,127
8419    LET X = 110
8420    FOR I = 1 TO 7
8421    HPLOT X,100 TO X,130
8422    LET X = X + 5
8423    NEXT I
8424    HPLOT 145,95 TO 145,127: HPLOT 150,90 TO 150,122: HPLOT 150,85 TO 1
        50,120
8425    HPLOT 155,80 TO 155,120
8427    RETURN
9300    REM  FILIAL
9301    TEXT : HOME : HGR : HCOLOR= 3
9302    HPLOT 40,10 TO 210,10 TO 210,140 TO 40,140 TO 40,10
9303    HPLOT 50,25 TO 50,35: HPLOT 60,25 TO 60,35: HPLOT 50,30 TO 60,30
9304    HPLOT 65,25 TO 75,25: HPLOT 70,25 TO 70,35: HPLOT 65,35 TO 75,35
9305    HPLOT 90,25 TO 80,25 TO 80,30 TO 90,30 TO 90,35 TO 80,35
9306    HPLOT 92,25 TO 105,25: HPLOT 100,25 TO 100,35
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9307  HPLOT 110,25 TO 120,25 TO 120,35 TO 110,35 TO 110,25
9308  HPLOT 110,25 TO 120,25 TO 120,35 TO 110,35 TO 110,25
9309  HPLOT 125,35 TO 125,25 TO 135,25 TO 135,30 TO 125,30 TO 135,35
9310  HPLOT 140,25 TO 150,25: HPLOT 140,35 TO 150,35: HPLOT 145,25 TO 145
      ,35
9311  HPLOT 165,25 TO 155,25 TO 155,35 TO 165,35
9312  HPLOT 170,35 TO 170,25 TO 180,25 TO 180,35: HPLOT 170,30 TO 180,30
9314  HPLOT 185,25 TO 185,35 TO 195,35
9315  HPLOT 80,125 TO 80,115 TO 85,125 TO 90,115 TO 90,125
9316  HPLOT 95,125 TO 95,115 TO 105,115 TO 105,125: HPLOT 95,120 TO 105,1
      20
9317  HPLOT 110,125 TO 110,115 TO 120,115 TO 120,120 TO 110,120 TO 120,12
      5
9318  HPLOT 125,115 TO 125,125: HPLOT 135,115 TO 125,120 TO 135,125
9319  HPLOT 150,115 TO 140,115 TO 140,125 TO 150,125: HPLOT 140,120 TO 14
      7,120
9320  HPLOT 155,125 TO 155,115 TO 165,115 TO 165,120 TO 155,120 TO 165,12
      5
9321  HPLOT 170,65 TO 170,85 TO 180,85
9322  HPLOT 150,85 TO 150,65 TO 160,65 TO 160,85: HPLOT 150,75 TO 160,75
9323  HPLOT 130,65 TO 140,65: HPLOT 135,65 TO 135,85: HPLOT 130,85 TO 140
      ,85
9324  HPLOT 110,65 TO 110,85 TO 120,85
9325  HPLOT 90,65 TO 100,65: HPLOT 90,85 TO 100,85: HPLOT 95,65 TO 95,85
9326  HPLOT 70,85 TO 70,65 TO 80,65: HPLOT 70,75 TO 80,75
9327  RETURN
9400  TEXT : HOME : HGR : HCOLOR= 3: REM  PRINCIPLE
9401  HPLOT 40,10 TO 210,10 TO 210,140 TO 40,140 TO 40,10
9402  HPLOT 50,50 TO 50,30 TO 60,30 TO 60,40 TO 50,40
9403  HPLOT 70,50 TO 70,30 TO 80,30 TO 80,40 TO 70,40 TO 80,50
9404  HPLOT 90,30 TO 90,50
9405  HPLOT 100,50 TO 100,30 TO 110,50 TO 110,30
9406  HPLOT 130,30 TO 120,30 TO 120,50 TO 130,50
9407  HPLOT 150,50 TO 150,30 TO 160,30 TO 160,40 TO 150,40
9408  HPLOT 170,30 TO 170,50 TO 180,50
9409  HPLOT 200,30 TO 190,30 TO 190,50 TO 200,50: HPLOT 190,40 TO 200,40
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9410    HPLOT 140,30 TO 140,50
9411    HPLOT 100,90 TO 100,70 TO 110,70 TO 110,80 TO 100,80 TO 110,90
9412    HPLOT 160,120 TO 160,100 TO 165,100 TO 170,105 TO 170,115 TO 165,12
        0 TO 160,120
9413    HPLOT 120,70 TO 130,70 TO 130,90 TO 120,90 TO 120,70
9414    HPLOT 140,70 TO 140,90 TO 145,80 TO 150,90 TO 150,70
9415    HPLOT 80,120 TO 80,100 TO 90,100 TO 90,120: HPLOT 80,110 TO 90,110
9416    HPLOT 140,120 TO 140,100 TO 150,100 TO 150,120: HPLOT 140,110 TO 15
        0,110
9417    HPLOT 100,100 TO 100,120: HPLOT 110,100 TO 110,120: HPLOT 100,110 TO
        110,110
9418    HPLOT 130,100 TO 120,100 TO 120,120 TO 130,120: HPLOT 120,110 TO 13
        0,110
9420    RETURN
9500    TEXT : HOME : HGR : HCOLOR= 3: REM   DOMINANCE
9501    HPLOT 40,10 TO 210,10 TO 210,140 TO 40,140 TO 40,10
9502    HPLOT 45,60 TO 50,60 TO 55,65 TO 55,75 TO 50,80 TO 45,80 TO 45,60
9503    HPLOT 65,60 TO 75,60 TO 75,80 TO 65,80 TO 65,60
9504    HPLOT 85,80 TO 85,60 TO 90,80 TO 95,60 TO 95,80
9505    HPLOT 105,60 TO 105,80
9506    HPLOT 115,80 TO 115,60 TO 125,80 TO 125,60
9507    HPLOT 205,60 TO 190,60 TO 190,80 TO 205,80: HPLOT 190,70 TO 205,70
9508    HPLOT 135,80 TO 135,60 TO 145,60 TO 145,80: HPLOT 135,70 TO 145,70
9509    HPLOT 155,80 TO 155,60 TO 165,80 TO 165,60
9510    HPLOT 185,60 TO 175,60 TO 175,80 TO 185,80
9599    RETURN
9600    REM   SEGREGATION
9601    TEXT : HOME : HGR : HCOLOR= 3
9602    HPLOT 40,10 TO 210,10 TO 210,140 TO 40,140 TO 40,10
9603    HPLOT 190,80 TO 190,60 TO 200,80 TO 200,60
9604    HPLOT 175,60 TO 185,60 TO 185,80 TO 175,80 TO 175,60
9605    HPLOT 170,60 TO 170,80
9609    HPLOT 155,60 TO 165,60: HPLOT 160,60 TO 160,80
9610    HPLOT 140,80 TO 140,60 TO 150,60 TO 150,80: HPLOT 140,70 TO 150,70
9611    HPLOT 60,60 TO 50,60 TO 50,70 TO 60,70 TO 60,80 TO 50,80
9612    HPLOT 75,60 TO 65,60 TO 65,80 TO 75,80: HPLOT 65,70 TO 75,70
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9613    HPLOT 70,60 TO 80,60 TO 80,80 TO 90,80 TO 90,70 TO 85,70
9614    HPLOT 95,80 TO 95,60 TO 105,60 TO 105,70 TO 95,70 TO 105,80
9615    HPLOT 120,60 TO 110,60 TO 110,80 TO 120,80: HPLOT 110,70 TO 120,70
9616    HPLOT 135,60 TO 125,60 TO 125,80 TO 135,80 TO 135,70 TO 130,70
9617    HPLOT 140,80 TO 140,60 TO 150,60 TO 150,80: HPLOT 140,70 TO 150,70
9618    RETURN
9700    REM  R
9701    TEXT : HOME : HGR : HCOLOR= 3
9702    HPLOT 20,90 TO 20,40 TO 50,40 TO 50,60 TO 20,60 TO 50,90
9703    HPLOT 60,90 TO 60,40 TO 90,40 TO 90,60 TO 60,60 TO 90,90
9705    HPLOT 110,40 TO 140,90: HPLOT 110,90 TO 140,40
9707    HPLOT 160,60 TO 160,90: HPLOT 160,70 TO 170,60 TO 185,60 TO 190,70
9708    HPLOT 210,60 TO 210,90: HPLOT 210,70 TO 220,60 TO 235,60 TO 240,70
9709    RETURN
9800    REM  SQUARE
9801    TEXT : HOME : HGR : HCOLOR= 3
9802    HPLOT 75,40 TO 175,40 TO 175,140 TO 75,140 TO 75,40: HPLOT 125,40 TO
        125,140: HPLOT 75,90 TO 175,90
9805    RETURN
9850    REM  RR
9851    GOSUB 9800
9852    HPLOT 95,35 TO 95,15 TO 105,15 TO 105,25 TO 95,25 TO 105,35
9853    HPLOT 145,35 TO 145,15 TO 155,15 TO 155,25 TO 145,25 TO 155,35
9854    RETURN
9860    REM  RR
9861    GOSUB 9850
9862    HPLOT 55,55 TO 55,70: HPLOT 55,60 TO 60,55 TO 70,55
9863    HPLOT 55,110 TO 55,125: HPLOT 55,115 TO 60,110 TO 70,110
9865    RETURN
9870    REM  RR
9871    GOSUB 9860
9872    HPLOT 85,75 TO 85,55 TO 95,55 TO 95,65 TO 85,65 TO 95,75
9873    HPLOT 105,75 TO 105,65: HPLOT 105,70 TO 110,65 TO 115,65
9875    RETURN
9890    REM  FILLED IN
9891    GOSUB 9870
```

```
9892    HPLOT 135,75 TO 135,65 TO 145,55 TO 145,65 TO 135,65 TO 145,75
9893    HPLOT 155,65 TO 155,75: HPLOT 155,70 TO 160,65 TO 165,65
9894    HPLOT 85,130 TO 85,110 TO 95,110 TO 95,120 TO 85,120 TO 95,130
9895    HPLOT 105,130 TO 105,120: HPLOT 105,125 TO 110,120 TO 115,120
9896    HPLOT 155,120 TO 155,130: HPLOT 155,125 TO 160,120 TO 165,120
9897    HPLOT 135,130 TO 135,110 TO 145,110 TO 145,120 TO 135,120 TO 145,13
        0
9899    RETURN
9900    REM  R HYBRID
9901    TEXT : HOME : HGR : HCOLOR= 3
9902    HPLOT 20,90 TO 20,40 TO 50,40 TO 50,60 TO 20,60 TO 50,90
9903    HPLOT 60,60 TO 60,90: HPLOT 60,70 TO 70,60 TO 85,60 TO 90,70
9904    HPLOT 110,40 TO 140,90: HPLOT 110,90 TO 140,40
9906    HPLOT 160,90 TO 160,40 TO 190,40 TO 190,60 TO 160,60 TO 190,90
9908    HPLOT 210,60 TO 210,90: HPLOT 210,70 TO 220,60 TO 235,60 TO 240,70
9910    RETURN
9950    REM  MORE
9951    GOSUB 9800
9952    HPLOT 95,35 TO 95,15 TO 105,15 TO 105,25 TO 95,25 TO 105,35
9953    HPLOT 145,25 TO 145,35: HPLOT 145,30 TO 150,25 TO 155,25
9954    HPLOT 55,75 TO 55,55 TO 65,55 TO 65,65 TO 55,65 TO 65,75
9955    HPLOT 55,110 TO 55,125: HPLOT 55,115 TO 60,110 TO 65,110
9956    RETURN
9970    HPLOT 135,75 TO 135,55 TO 145,55 TO 145,65 TO 135,65 TO 145,75
9980    REM  FILL IN
9982    GOSUB 9950
9983    HPLOT 85,75 TO 85,55 TO 95,55 TO 95,65 TO 85,65 TO 95,75
9984    HPLOT 100,75 TO 100,55 TO 110,55 TO 110,65 TO 100,65 TO 110,75
9985    RETURN
10000   REM  ALL DONE
10001   GOSUB 9980
10002   HPLOT 135,75 TO 135,55 TO 145,55 TO 145,65 TO 135,65 TO 145,75
10003   HPLOT 155,65 TO 155,75: HPLOT 155,70 TO 160,65 TO 165,65
10004   HPLOT 85,130 TO 85,110 TO 95,110 TO 95,120 TO 85,120 TO 95,130
10005   HPLOT 105,130 TO 105,120: HPLOT 105,125 TO 110,120 TO 115,120
10006   HPLOT 155,120 TO 155,130: HPLOT 155,125 TO 160,120 TO 165,120
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10007   HPLOT 135,120 TO 135,130: HPLOT 135,125 TO 140,120 TO 145,120
10008   RETURN
10050   REM  Y
10051   GOSUB 9800
10052   HPLOT 95,15 TO 100,25 TO 105,15: HPLOT 100,25 TO 100,35
10053   HPLOT 140,15 TO 145,25 TO 150,15: HPLOT 145,25 TO 145,35
10054   HPLOT 55,55 TO 60,65 TO 65,55: HPLOT 60,65 TO 60,75
10055   HPLOT 55,110 TO 60,115 TO 65,110: HPLOT 60,115 TO 60,120
10056   RETURN
10060   REM  MORE
10061   GOSUB 10050
10062   HPLOT 85,55 TO 90,65 TO 95,55: HPLOT 90,65 TO 90,75
10063   HPLOT 105,55 TO 110,65 TO 115,55: HPLOT 110,65 TO 110,75
10064   RETURN
10070   REM  MORE
10071   GOSUB 10060
10072   HPLOT 135,55 TO 140,65 TO 145,55: HPLOT 140,65 TO 140,75
10073   HPLOT 155,55 TO 160,65 TO 165,55: HPLOT 160,65 TO 160,75
10074   RETURN
10080   REM  LAST
10081   GOSUB 10070
10082   HPLOT 85,105 TO 90,115 TO 95,105: HPLOT 90,115 TO 90,125
10083   HPLOT 105,115 TO 110,120 TO 115,115: HPLOT 110,120 TO 110,125
10084   RETURN
10090   REM  MORE
10091   GOSUB 10080
10092   HPLOT 135,105 TO 140,115 TO 145,105: HPLOT 140,115 TO 140,125
10093   HPLOT 155,115 TO 160,120 TO 165,115: HPLOT 160,120 TO 160,125
10094   RETURN
1   REM   GENETICS
3   REM   BY PATRICIA D. MORRELL, 4/87
5   REM   INITIALIZATION BLOCK
7   REM   G$=GET COMMAND
9   REM   H$=HELP
11  REM   DRIVER
13  PRINT  CHR$ (4);"BRUN LOMEM:": &  LOMEM: 16384
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15   REM   SIMPLE CROSSES
275    GOSUB 8400
276    HOME : VTAB 21: PRINT "GLAD TO SEE YOU MADE THE CORRECT          CONNE
       CTION!": GOSUB 7000
277    HOME : VTAB 21: PRINT "ARE YOU READY TO TRY SOME MORE CROSS      KITS?
          LET'S DO ANOTHER ONE TOGETHER.": GOSUB 7000
279    TEXT : HOME : PRINT "KIT #32"
281    PRINT : PRINT "Y = YELLOW"
283    PRINT  CHR$ (249);
285    PRINT " = GREEN"                                                     1
287    PRINT : PRINT "CONTENTS:  1 HOMOZYGOUS YELLOW FEMALE
       HETEROZYGOUS YELLOW MALE"
289    PRINT : PRINT "STEP ONE:  LIST POSSIBLE GAMETES"
291    PRINT : PRINT "WHAT ARE THE POSSIBLE GAMETES OF THE     FEMALE:"
293    PRINT "       (A) YY"
295    PRINT "       (B) ";
297    PRINT  CHR$ (249);
299    PRINT  CHR$ (249)
301    PRINT "       (C) Y";
303    PRINT  CHR$ (249)
305    PRINT : INPUT "YOUR DECISION:   ";G$
307    IF G$ = "A" THEN  PRINT "YOU'RE AS YELLOW AS THE SUN (OR SHOULD  I S
       AY PEA PLANT?)": GOTO 313
309    IF G$ = "B" OR G$ = "C" THEN  PRINT "HOMOZYGOUS DOMINANT MEANS 2 CAP
       ITAL      LETTERS.  CHOICE A IS CORRECT.": GOTO 313
311    PRINT "CHOOSE A, B OR C": GOTO 305
313    PRINT : PRINT "WHAT ARE THE POSSIBLE GAMETES OF THE     HETEROZYGOUS
       MALE?"
315    PRINT : PRINT "       (A) YY"
317    PRINT "       (B) ";
319    PRINT  CHR$ (249);
321    PRINT  CHR$ (249)
323    PRINT "       (C) Y";
325    PRINT  CHR$ (249)
327    PRINT : INPUT "YOUR DECISION:   ";G$
329    IF G$ = "C" THEN  PRINT "RIGHT YOU ARE!": GOTO 335
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331   IF G$ = "A" OR G$ = "B" THEN  PRINT "HETEROZYGOUS MEANS ONE OF EACH!
      THE    CORRECT ANSWER IS C.": GOTO 335
333   PRINT "YOUR CHOICES ARE A, B, OR C": GOTO 327
335   PRINT : GOSUB 7000
337   GOSUB 9800
339   HOME : VTAB 21: PRINT "STEP 2.   CONSTRUCT A SQUARE": PRINT : GOSUB 7
      000
341   GOSUB 10050
343   HOME : VTAB 21: PRINT "STEP 3.   PLACE THE GAMETES OF THE FEMALEALONG
      THE TOP AND THE GAMETES OF THE    MALE DOWN THE SIDE": GOSUB 7000
345   HOME : VTAB 21: PRINT "LET'S FILL IN THE BOXES WITH THE CROSSESREMEM
      BER:  ALWAYS USE THE FEMALE FROM   THE TOP AND MALE FROM THE LEFT.":
      GOSUB 7000
347   GOSUB 10060
349   HOME : VTAB 21: PRINT "IN THE TOP BOX, THE FEMALE IS Y AND THE MALE
      IS Y SO YY GOES IN THE BOX.": GOSUB 7000
351   GOSUB 10070
353   HOME : VTAB 21: PRINT "IN THE TOP RIGHT BOX, THE FEMALE IS Y   AND A
      GAIN THE MALE IS Y, SO YY GOES IN  THIS BOX, TOO.": GOSUB 7000
355   GOSUB 10080
357   HOME : VTAB 21: PRINT "IN THE LOWER BOX, THE FEMALE IS Y AND   THE M
      ALE IS ";
359   PRINT  CHR$ (249);
361   PRINT "SO Y ";
363   PRINT  CHR$ (249);
365   PRINT " IS PLACED IN THE"
367   PRINT "BOX"
368   GOSUB 7000
369   HOME : VTAB 21: PRINT "DO THE LAST BOX YOURSELF.": PRINT : GOSUB 700
      0
371   GOSUB 10090
373   HOME : VTAB 21: PRINT "I HOPE YOUR COMPLETED SQUARE LOOKS LIKE THIS!
      ": PRINT : GOSUB 7000
375   TEXT : HOME
377   PRINT "LAST STEP:   ANALYZE OUR RESULTS"
379   PRINT : PRINT "WHAT ARE THE POSSIBLE PHENOTYPES?"
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381  PRINT : PRINT "        (A) ALL YELLOW"
383  PRINT "      (B) ALL GREEN"
385  PRINT "       (C) HALF YELLOW, HALF GREEN"
387  PRINT : INPUT "YOUR ANSWER:   ";G$
389  PRINT
391  IF G$ = "A" THEN  PRINT "THE PLANTS MAY BE YELLOW BUT I'M GREEN  WIT
     H ENVY AT YOUR WISDOM!": GOTO 399
393  IF G$ = "B" OR G$ = "C" THEN  PRINT "YOU'RE FORGETTING THE PRINCIPLE
      OF     DOMINANCE.  EACH OFFSPRING HAS AT LEAST ONE Y SO THE YELLOW
     WILL SHOW.": GOTO 399
395  PRINT "OF DOMINANCE.  ANY TIME A DOMINANT": PRINT "ALLELE IS PRESENT
     , IT WILL BE SEEN.": PRINT "EACH OFFSPRING HAS AT LEAST ONE Y, SO": PRINT
     "ALL OF THEM WILL SHOW THE DOMINANT": PRINT "YELLOW": GOTO 399
397  PRINT : PRINT "YOUR CHOICE IS A, B OR C": GOTO 387
399  PRINT : PRINT : GOSUB 7000
401  TEXT : HOME : VTAB 5: PRINT "WHAT ARE THE POSSIBLE GENOTYPES?"
403  PRINT : PRINT "(A) HOW MANY OFFSPRING ARE HOMOZYGOUS   RECESSIVE"
405  INPUT "YOUR NUMBER:   ";G$
407  PRINT
409  IF G$ = "0" THEN  PRINT "YOU ARE A BUDDING GENETICIST IF I EVER  SAW
     ONE!!": GOTO 423
411  IF G$ > "4" THEN  PRINT "ARE YOU SURE?": GOTO 425
413  IF G$ <  > "0" THEN  PRINT "CHECK YOUR SQUARE AGAIN.  THERE AREN'T
     ANY OFFSPRING WITH THE GENOTYPE ";
415  PRINT  CHR$ (249);
417  PRINT  CHR$ (249)
419  PRINT "THE CORRECT ANSWER, THEN, IS 0."
421  PRINT
423  PRINT "HOW MANY ARE HOMOZYGOUS DOMINANT?"
425  INPUT "YOUR NUMBER:   ";G$
427  PRINT
429  IF G$ = "2" THEN  PRINT : PRINT "YOU SURE CAN COUNT THEM!": GOTO 433

431  PRINT "ONLY TWO OF THE OFFSPRING HAVE A PAIR OFCAPITAL Y'S.  CHECK Y
     OUR SQUARE AGAIN.": GOTO 433
433  PRINT : PRINT "HOW MANY ARE HETEROZYGOUS?"
```

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435    INPUT "YOUR NUMBER:   ";G$
437    IF G$ = "2" THEN  PRINT : PRINT "I AM. IMPRESSED!": GOTO 445
439    IF G$ > "4" THEN  PRINT "DON'T BE SILLY": GOTO 435
441    PRINT : PRINT "TWO OF THE OFFSPRING HAVE THE COMBO OF  Y AND ";
443    PRINT  CHR$ (249)
445    PRINT : GOSUB 7000
447    GOSUB 8400
449    HOME : VTAB 21: PRINT "I THINK YOU'RE READY TO TRY SOME KITS    ALONE
       .  WORK WITH THE KITS LISTED IN      YOUR BOOK AND CHECK BACK WITH ME.
       ": GOSUB 7000
451    HOME : VTAB 21: PRINT "START WITH KIT 47.  WHEN YOU'RE DONE,    PRESS
       THE C KEY AND WE'LL COMPARE OUR  RESULTS.": GOSUB 7000
453    HOME : VTAB 21: PRINT "YOU'RE READY TO CHECK THE RESULTS OF KIT 47 A
       LREADY?! ONLY PRESS THE C KEY IF    YOU REALLY TRIED IT YOURSELF!": GOSUB
       7000
455    TEXT : HOME : PRINT "KIT NUMBER 47"
457    PRINT : PRINT "HETEROZYGOUS YELLOW X HETEROZYGOUS        YELLOW"
459    PRINT : PRINT "Y";
461    PRINT  CHR$ (249);
463    PRINT "  X  Y";
465    PRINT  CHR$ (249)
467    PRINT : PRINT "MOM'S ALLELES:  Y, ";
469    PRINT  CHR$ (249)
471    PRINT : PRINT "DAD'S ALLELES:  Y, ";
473    PRINT  CHR$ (249)
475    PRINT : PRINT "PHENOTYPES:  3 YELLOW"
477    PRINT "              1 GREEN"
479    PRINT : PRINT "GENOTYPES:  1 HOMOZYGOUS DOMINANT"
481    PRINT "              1 HOMOZYGOUS RECESSIVE"
483    PRINT "              2 HETEROZYGOTES (OR HYBRIDS)"
485    PRINT : PRINT "IF YOU WANT TO SEE THE PUNNETT SQUARE TYPE A P"
487    PRINT : PRINT "IF YOU WANT TO GO ON TO THE NEXT KIT, TYPE A C."
489    INPUT "YOUR PLEASURE:   ";G$
491    IF G$ = "P" THEN  GOSUB 10110: HOME : VTAB 21: LET G$ = "C": GOTO 49
       3
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493  IF G$ = "C" THEN   PRINT : PRINT "PLEASE WORK ON KIT 52 IN YOUR BOOK!
         CHECK BACK WHEN YOU'RE DONE.": PRINT : GOSUB 7000: GOTO 497
495  PRINT "YOU MUST CHOOSE P OR C": GOTO 489
497  TEXT : HOME : PRINT "KIT NUMBER 52"
499  PRINT : PRINT "HOMOZYGOUS RECESSIVE X HETEROZYGOUS     YELLOW"
501  PRINT : PRINT "FEMALE'S GAMETES:   ";
503  PRINT  CHR$ (249);
505  PRINT ", ";
507  PRINT  CHR$ (249)
509  PRINT : PRINT "MALE'S GAMETES:  Y, ";
511  PRINT  CHR$ (249)
513  PRINT : PRINT "PHENOTYPES:  2 GREEN"
515  PRINT "             2 YELLOW"
517  PRINT : PRINT "GENOTYPES:  2 HOMOZYGOUS RECESSIVE"
519  PRINT "             2 HETEROZYGOTES"
521  PRINT : PRINT "IF YOU WANT TO SEE THE PUNNETT SQUARE TYPE A P"
523  PRINT : PRINT "IF YOU WANT TO GO ON TO THE NEXT KIT, TYPE A C."
525  INPUT "YOUR PLEASURE:   ";G$
527  IF G$ = "P" THEN  GOSUB 10150: GOTO 533
529  IF G$ = "C" THEN  GOTO 533
531  PRINT "YOU MUST CHOOSE P OR C": GOTO 525
533  GOSUB 8400
535  HOME : VTAB 21: PRINT "TRY OUR T SERIES.                    T = T
     ALL    ";
537  PRINT  CHR$ (244);
539  PRINT " = SHORT": PRINT : GOSUB 7000
541  HOME : VTAB 21: PRINT "KIT T7 IS A GOOD ONE!  CHECK BACK WITH  ME SO
     ON!": GOSUB 7000
543  TEXT : HOME : PRINT "KIT T7"
545  PRINT : PRINT "FEMALE'S GAMETES:   ";
547  PRINT  CHR$ (244);
549  PRINT ", ";
551  PRINT  CHR$ (244)
553  PRINT : PRINT "MALE'S GAMETES:  T, T"
555  PRINT : PRINT "PHENOTYPES:  4 TALL"
557  PRINT : PRINT "GENOTYPES:  4 HETEROZYGOTES"
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559   PRINT : PRINT "WOULD YOU LIKE TO SEE THE PUNNETT SQUAREFOR THIS CROS
      S?  (Y/N)"
561   INPUT "PLEASE TYPE IN Y OR N:   ";G$
563   IF G$ = "Y" THEN   GOSUB 10200: TEXT : HOME : GOTO 567
565   IF G$ < > "N" THEN   GOTO 561
567   PRINT : PRINT "START WORKING ON KIT T12.  WE'LL COMPAREOUR RESULTS W
      HEN YOU'RE DONE!."
569   PRINT : GOSUB 7000
571   TEXT : HOME : PRINT "KIT T12"
573   PRINT : PRINT "HOMOZYGOUS TALL X HETEROZYGOUS"
575   PRINT : PRINT "FEMALE'S GAMETES:  T, T"
577   PRINT : PRINT "MALE'S GAMETES:  T, "
579   PRINT  CHR$ (244)
581   PRINT : PRINT "PHENOTYPES:  4 TALL"
583   PRINT : PRINT "GENOTYPES:  2 HETEROZYGOTES"
585   PRINT : PRINT "           2 HOMOZYGOUS DOMINANT"
587   PRINT : PRINT "WOULD YOU LIKE TO SEE THE PUNNETT SQUAREFOR THIS CROS
      S?"
589   INPUT "PLEASE TYPE Y OR N:   ";G$
591   IF G$ = "Y" THEN   GOSUB 10230: TEXT : HOME : GOTO 597
593   IF G$ = "N" THEN   GOTO 597
595   GOTO 589
597   PRINT : PRINT "WE'RE UPTO MY MOST FAVORITE KIT!        CHALLENGE KIT
      T13.  ARE YOU UP FOR IT?": PRINT : GOSUB 7000
599   TEXT : HOME : PRINT "CHALLENGE KIT:  T13"
601   PRINT : PRINT "HOMOZYGOUS SHORT X TALL"
603   PRINT : PRINT "FEMALE'S GAMETES:  ";
605   PRINT  CHR$ (244);
607   PRINT " ,";
609   PRINT  CHR$ (244)
611   PRINT : PRINT "MALE'S GAMETES:  T, T"
613   PRINT "                  OR"
615   PRINT "                  T, ";
617   PRINT  CHR$ (244)
619   PRINT : PRINT "(HERE'S WHERE THE CHALLENGE COMES IN!)"
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621   PRINT : PRINT "TO FIGURE OUT WHICH GENOTYPE THE MALE IS, WE CAN LOOK
      AT THE OFFSPRING."
623   PRINT : PRINT "THREE OF THE 'BABY' PEA PLANTS   ARE TALL AND ONE IS
      SHORT."
625   PRINT : PRINT "CAN YOU FIGURE THIS OUT?  "
627   PRINT : PRINT "WHEN YOU HAVE, TYPE ANY KEY!"
629   GET G$
631   PRINT : PRINT "WELL, SUPER SLEUTH, DID YOU DECIDE THE  FATHER IS A H
      YBRID?  DO YOU KNOW WHY?"
633   PRINT : PRINT "THE SHORT OFFSPRING HAS THE GENOTYPE "
635   PRINT   CHR$ (244);
637   PRINT   CHR$ (244)
639   PRINT : PRINT "IF ONE ALLELE COMES FROM EACH PARENT,   THE MOTHER GA
      VE ONE ";
641   PRINT   CHR$ (244);
643   PRINT " AND THE FATHER"
645   PRINT "HAD TO GIVE THE OTHER ";
647   PRINT   CHR$ (244)
649   PRINT "SO THE FATHER MUST BE T";
651   PRINT   CHR$ (244)
653   PRINT : PRINT "IF YOU TURN TO THE NEXT PAGE IN YOUR    TOUR BOOK, A
      PUNNETT SQUARE 'PROOF' IS  PROVIDED FOR YOU."
655   PRINT : GOSUB 7000
657   TEXT : HOME : PRINT "IF YOU CORRECTLY PREDICTED THE OUTCOMES OF THES
      E KITS, THEN YOU'RE READY TO SEE THE REST OF OUR STORE!"
659   PRINT : PRINT "PRESS THE S KEY FOR A SHUTTLE AND CATCH THE ROUTE 3 S
      HUTTLE TO GET TO OUR        MULTIPLE CROSS AREA."
661   PRINT : PRINT "IF YOU FEEL YOU AREN'T QUITE UP TO OUR  MORE COMPLICA
      TED KITS YET, PRESS THE S  KEY FOR A SHUTTLE AND CATCH THE ROUTE 2.I
      T'LL TAKE YOU BACK THROUGH THIS AREA."
663   PRINT : PRINT "SEE YOU, LATER!"
665   GOSUB 7000
667   PRINT "YOU'RE NO LONGER AT A SHUTTLE STOP."
669   END
7000  REM   SWITCH ROUTINE
7001  INPUT "TYPE S TO SWITCH OR C TO CONTINUE:   ";G$
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7002    IF G$ = "S" THEN   PRINT   CHR$ (4);"RUN MENU
7003    IF G$ = "C" THEN   RETURN
7004    GOTO 7001
7005    RETURN
8300    REM  GUIDE
8301    TEXT : HOME : HGR : HCOLOR= 3
8302    HPLOT 100,45 TO 150,45 TO 150,110 TO 140,120 TO 110,120 TO 100,110 TO
        100,45
8303    HPLOT 100,60 TO 150,60 TO 140,70 TO 110,70 TO 100,60
8304    HPLOT 110,50 TO 105,50 TO 105,55 TO 110,55 TO 110,53 TO 108,53
8305    HPLOT 115,50 TO 115,55 TO 120,55 TO 120,50
8306    HPLOT 125,50 TO 125,55
8307    HPLOT 130,50 TO 132,50 TO 135,53 TO 132,55 TO 130,55 TO 130,50
8308    HPLOT 145,50 TO 140,50 TO 140,55 TO 145,55: HPLOT 140,53 TO 145,53
8309    HPLOT 105,80 TO 105,75 TO 115,75 TO 115,80
8310    HPLOT 135,80 TO 135,75 TO 145,75 TO 145,80
8311    HPLOT 107,85 TO 107,80 TO 113,80 TO 113,85 TO 107,85
8315    HPLOT 137,85 TO 137,80 TO 143,80 TO 143,85 TO 137,85
8316    HPLOT 120,90 TO 130,90 TO 130,100 TO 120,100 TO 120,90
8318    HPLOT 110,105 TO 115,110 TO 135,110 TO 140,105
8320    RETURN
8400    REM  MENDEL
8401    TEXT : HOME : HGR : HCOLOR= 3
8402    HPLOT 90,45 TO 100,35 TO 150,35 TO 160,45 TO 160,115 TO 140,130 TO
        110,130 TO 90,115 TO 90,45
8403    HPLOT 95,50 TO 100,45 TO 110,45 TO 115,50: HPLOT 100,50 TO 110,50 TO
        110,65 TO 100,65 TO 100,50: HPLOT 102,65 TO 102,60 TO 108,60 TO 108,
        65
8404    HPLOT 135,50 TO 140,45 TO 150,45 TO 155,50: HPLOT 140,50 TO 150,50 TO
        150,65 TO 140,65 TO 140,50: HPLOT 142,65 TO 142,60 TO 148,60 TO 148,
        65
8405    HPLOT 125,65 TO 130,70 TO 125,75 TO 120,70 TO 125,65
8406    HPLOT 110,90 TO 120,80 TO 130,80 TO 140,90: HPLOT 115,85 TO 115,90
8407    HPLOT 120,80 TO 120,90: HPLOT 125,80 TO 125,90: HPLOT 130,80 TO 130
        ,90
8408    HPLOT 135,85 TO 135,90
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8411   HPLOT 90,30 TO 90,45: HPLOT 95,25 TO 95,40
8412   LET X = 100
8413   FOR I = 1 TO 11
8414   HPLOT X,20 TO X,35
8415   LET X = X + 5
8416   NEXT I
8417   HPLOT 155,25 TO 155,40: HPLOT 160,30 TO 160,45
8418   HPLOT 95,80 TO 95,120: HPLOT 100,85 TO 100,122: HPLOT 105,95 TO 105
       ,127
8419   LET X = 110
8420   FOR I = 1 TO 7
8421   HPLOT X,100 TO X,130
8422   LET X = X + 5
8423   NEXT I
8424   HPLOT 145,95 TO 145,127: HPLOT 150,90 TO 150,122: HPLOT 150,85 TO 1
       50,120
8425   HPLOT 155,80 TO 155,120
8427   RETURN
9800   REM   SQUARE
9801   TEXT : HOME : HGR : HCOLOR= 3
9802   HPLOT 75,40 TO 175,40 TO 175,140 TO 75,140 TO 75,40: HPLOT 125,40 TO
       125,140: HPLOT 75,90 TO 175,90
9805   RETURN
9850   REM   RR
9851   GOSUB 9800
9852   HPLOT 95,35 TO 95,15 TO 105,15 TO 105,25 TO 95,25 TO 105,35
9853   HPLOT 145,35 TO 145,15 TO 155,15 TO 155,25 TO 145,25 TO 155,35
9854   RETURN
10001   GOSUB 9980
10002   HPLOT 135,75 TO 135,55 TO 145,55 TO 145,65 TO 135,65 TO 145,75
10003   HPLOT 155,65 TO 155,75: HPLOT 155,70 TO 160,65 TO 165,65
10004   HPLOT 85,130 TO 85,110 TO 95,110 TO 95,120 TO 85,120 TO 95,130
10005   HPLOT 105,130 TO 105,120: HPLOT 105,125 TO 110,120 TO 115,120
10006   HPLOT 155,120 TO 155,130: HPLOT 155,125 TO 160,120 TO 165,120
10007   HPLOT 135,120 TO 135,130: HPLOT 135,125 TO 140,120 TO 145,120
10008   RETURN
```

```
10050    REM  Y
10051    GOSUB 9800
10052    HPLOT 95,15 TO 100,25 TO 105,15: HPLOT 100,25 TO 100,35
10053    HPLOT 140,15 TO 145,25 TO 150,15: HPLOT 145,25 TO 145,35
10054    HPLOT 55,55 TO 60,65 TO 65,55: HPLOT 60,65 TO 60,75
10055    HPLOT 55,110 TO 60,115 TO 65,110: HPLOT 60,115 TO 60,120
10056    RETURN
10060    REM  MORE
10061    GOSUB 10050
10062    HPLOT 85,55 TO 90,65 TO 95,55: HPLOT 90,65 TO 90,75
10063    HPLOT 105,55 TO 110,65 TO 115,55: HPLOT 110,65 TO 110,75
10064    RETURN
10070    REM  MORE
10071    GOSUB 10060
10072    HPLOT 135,55 TO 140,65 TO 145,55: HPLOT 140,65 TO 140,75
10073    HPLOT 155,55 TO 160,65 TO 165,55: HPLOT 160,65 TO 160,75
10074    RETURN
10080    REM  LAST
10081    GOSUB 10070
10082    HPLOT 85,105 TO 90,115 TO 95,105: HPLOT 90,115 TO 90,125
10083    HPLOT 105,115 TO 110,120 TO 115,115: HPLOT 110,120 TO 110,125
10084    RETURN
10090    REM  MORE
10091    GOSUB 10080
10092    HPLOT 135,105 TO 140,115 TO 145,105: HPLOT 140,115 TO 140,125
10093    HPLOT 155,115 TO 160,120 TO 165,115: HPLOT 160,120 TO 160,125
10094    RETURN
10110    REM  HYBRIDS
10111    GOSUB 9800
10112    HPLOT 55,55 TO 60,65 TO 65,55: HPLOT 60,65 TO 60,75
10113    HPLOT 55,110 TO 60,115 TO 65,110: HPLOT 60,115 TO 60,120
10114    HPLOT 90,15 TO 95,25 TO 100,15: HPLOT 95,25 TO 95,35
10115    HPLOT 140,25 TO 145,30 TO 150,25: HPLOT 145,30 TO 145,35
10116    HPLOT 85,55 TO 90,65 TO 95,55: HPLOT 90,65 TO 90,75
10118    HPLOT 105,55 TO 110,65 TO 115,55: HPLOT 110,65 TO 110,75
10119    HPLOT 135,55 TO 140,65 TO 145,55: HPLOT 140,65 TO 140,75
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10120    HPLOT 155,65 TO 160,70 TO 165,65: HPLOT 160,70 TO 160,75
10121    HPLOT 85,105 TO 90,115 TO 95,105: HPLOT 90,115 TO 90,125
10122    HPLOT 105,115 TO 110,120 TO 115,115: HPLOT 110,120 TO 110,125
10123    HPLOT 135,115 TO 140,120 TO 145,115: HPLOT 140,120 TO 140,125
10124    HPLOT 155,115 TO 160,120 TO 165,115: HPLOT 160,120 TO 160,125
10125    HOME : VTAB 21: PRINT : GOSUB 7000
10126    RETURN
10150    REM  Y
10151    GOSUB 9800
10152    HPLOT 55,55 TO 60,65 TO 65,55: HPLOT 60,65 TO 60,75
10153    HPLOT 95,25 TO 100,30 TO 105,25: HPLOT 100,30 TO 100,35
10154    HPLOT 145,25 TO 150,30 TO 155,25: HPLOT 150,30 TO 150,35
10155    HPLOT 55,110 TO 60,115 TO 65,110: HPLOT 60,115 TO 60,120
10156    HPLOT 85,55 TO 90,65 TO 95,55: HPLOT 90,65 TO 90,75
10157    HPLOT 105,65 TO 110,70 TO 115,65: HPLOT 110,70 TO 110,75
10158    HPLOT 135,55 TO 140,65 TO 145,55: HPLOT 140,65 TO 140,75
10159    HPLOT 155,65 TO 160,70 TO 165,65: HPLOT 160,70 TO 160,75
10160    HPLOT 85,110 TO 90,115 TO 95,110: HPLOT 90,115 TO 90,120
10161    HPLOT 105,110 TO 110,115 TO 115,110: HPLOT 110,115 TO 110,120
10162    HPLOT 135,110 TO 140,115 TO 145,110: HPLOT 140,115 TO 140,120
10163    HPLOT 155,110 TO 160,115 TO 165,110: HPLOT 160,115 TO 160,120
10164    HOME : VTAB 21: PRINT : GOSUB 7000
10165    RETURN
10200    REM  T
10201    GOSUB 9800
10202    HPLOT 95,25 TO 105,25: HPLOT 100,20 TO 100,35
10203    HPLOT 145,25 TO 155,25: HPLOT 150,20 TO 150,35
10204    HPLOT 55,55 TO 65,55: HPLOT 60,55 TO 60,75
10205    HPLOT 55,105 TO 65,105: HPLOT 60,105 TO 60,125
10206    HPLOT 85,55 TO 95,55: HPLOT 90,55 TO 90,75
10207    HPLOT 105,65 TO 115,65: HPLOT 110,60 TO 110,75
10208    HPLOT 135,55 TO 145,55: HPLOT 140,55 TO 140,75
10209    HPLOT 160,60 TO 160,75: HPLOT 155,65 TO 165,65
10210    HPLOT 90,105 TO 90,125: HPLOT 85,105 TO 95,105
10211    HPLOT 105,115 TO 115,115: HPLOT 110,110 TO 110,125
10212    HPLOT 135,105 TO 145,105: HPLOT 140,105 TO 140,125
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10212    HPLOT 155,115 TO 155,115: HPLOT 160,110 TO 160,125
10214    HOME : VTAB 21: PRINT : GOSUB 7000
10215    RETURN
10230    REM  T
10231    GOSUB 9800
10232    HPLOT 95,15 TO 105,15: HPLOT 100,15 TO 100,35
10234    HPLOT 145,15 TO 155,15: HPLOT 150,15 TO 150,35
10236    HPLOT 55,55 TO 65,55: HPLOT 60,55 TO 60,75
10238    HPLOT 60,105 TO 60,120: HPLOT 55,110 TO 65,110
10240    HPLOT 85,55 TO 95,55: HPLOT 90,55 TO 90,75
10242    HPLOT 105,55 TO 115,55: HPLOT 110,55 TO 110,75
10244    HPLOT 135,55 TO 145,55: HPLOT 140,55 TO 140,75
10246    HPLOT 155,55 TO 165,55: HPLOT 160,55 TO 160,75
10248    HPLOT 85,105 TO 95,105: HPLOT 90,105 TO 90,125
10250    HPLOT 105,115 TO 115,115: HPLOT 110,110 TO 110,125
10252    HPLOT 135,105 TO 145,105: HPLOT 140,105 TO 140,125
10254    HPLOT 155,115 TO 165,115: HPLOT 160,110 TO 160,125
10256    HOME : VTAB 21: PRINT : GOSUB 7000
10257    RETURN
10   REM   GENETICS
20   REM   BY PATRICIA D. MORRELL, 4/87
35   REM   INITIALIZATION BLOCK
36   REM   G$=GET COMMAND
39   REM   H$=HELP
95   REM   DRIVER
96   PRINT  CHR$ (4);"BRUN LOMEM:": &  LOMEM: 16384
100  REM   PROGRAM
102  GOSUB 8300
104  HOME : VTAB 21: PRINT "WELCOME TO ROUTE 3.  OUR DESTINATION:   THE A
     ISLES OF OUR MULTIPLE TRAITS CROSS KITS!": GOSUB 7000
108  HOME : VTAB 21: PRINT "YOU'LL NEED YOUR THINKING CAPS FOR THIS PART
     OF OUR SHOP!": GOSUB 7000
110  TEXT : HOME : PRINT "MANY OF OUR CUSTOMERS ASK US WHY WE HAVEAN AREA
     OF MULTIPLE TRAITS.": PRINT : PRINT
112  PRINT "WE ANSWER THAT QUESTION WITH OUR OWN    QUESTIONS:"
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114   PRINT : PRINT "IS A PEA PLANT JUST TALL OR SHORT?       OR IS IT SHOR
      T AND YELLOW OR TALL AND    WRINKLED?"
116   PRINT : PRINT "DON'T WE INHERIT MORE THAN ONE PAIR OF  GENES AT A TI
      ME?"
118   PRINT : PRINT "I COULD KEEP GOING ON, BUT I THINK YOU  UNDERSTAND TH
      AT THIS PART OF OUR SHOP   HOUSES OUR MOST 'NATURAL' KITS."
120   PRINT : PRINT "WATCH YOUR STEP GETTING OFF THE SHUTTLE.": PRINT : GOSUB
      7000
122   GOSUB 8400
124   HOME : VTAB 21: PRINT "HOWDY!   I WAS HOPING I'D SEE YOU HERE.  THERE
      'S NO ONE BETTER THAN I TO EXPLAIN MY THIRD PRINCIPLE TO YOU!": GOSUB
      7000
126   HOME : VTAB 21: PRINT "I MUST ADMIT, IT'S ONE OF MY BEST!       THE P
      RINCIPLE OF INDEPENDENT ASSORTMENT": GOSUB 7000
128   HOME : VTAB 21: PRINT "LET'S START WITH KIT M6.  CROSS TWO      HETER
      OZYGOUS ROUND AND HETEROZYGOUS      YELLOW PLANTS.  (SEE YOUR BOOK!)"
      : GOSUB 7000
130   HOME : VTAB 21: PRINT "FIRST THINGS FIRST.  WHAT DOES THIS MEANIN TE
      RMS OF GENOTYPES?": GOSUB 7000
132   TEXT : HOME : PRINT "HERE WE GO!"
134   PRINT : PRINT "HETEROZYGOUS ROUND IS R";
136   PRINT  CHR$ (242)
138   PRINT : PRINT "HETEROZYGOUS YELLOW IS Y";
139   PRINT  CHR$ (249)
141   PRINT : PRINT "SO THE FEMALE IS R";
142   PRINT  CHR$ (242);
144   PRINT "Y";
145   PRINT  CHR$ (249);
147   PRINT " AND THE MALE IS R";
149   PRINT  CHR$ (242);
150   PRINT "Y";
151   PRINT  CHR$ (249)
153   PRINT : PRINT "WHEW!"
155   PRINT : PRINT "NOW, LET'S DECIDE ON THE GAMETE        POSSIBILITIES
      !"
156   PRINT : PRINT : GOSUB 7000
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158   TEXT : HOME : PRINT "WE HAVE TO MAKE ALL POSSIBLE
      TIONS FOR EACH PARENT."
160   PRINT : PRINT "LET'S START WITH THE FEMALE."
161   PRINT : PRINT "FEMALE'S GENOTYPE:   R";
162   PRINT   CHR$ (242);
163   PRINT "Y";
164   PRINT   CHR$ (249)
166   PRINT : PRINT "THE R CAN PAIR WITH THE Y OR WITH THE ";
169   PRINT   CHR$ (249)
170   PRINT : PRINT "THE ";
171   PRINT   CHR$ (242);
173   PRINT " CAN PAIR WITH THE Y OR WITH THE ";
174   PRINT   CHR$ (249)
175   PRINT : PRINT "SO, ALL POSSIBLE COMBINATIONS ARE RY, R";
176   PRINT   CHR$ (249)
178   PRINT   CHR$ (242);
180   PRINT "Y, ";
181   PRINT   CHR$ (242);
183   PRINT   CHR$ (249)
185   PRINT : PRINT "HOW DO WE KNOW WHICH IS RIGHT?": PRINT : GOSUB 7000
187   TEXT : HOME : PRINT "THIS IS WHERE MY THIRD PRINCIPLE COMES   IN HAND
      Y."
188   PRINT : PRINT "THE PRINCIPLE OF INDEPENDENT ASSORTMENT SAYS WHEN TWO
       TRAITS ARE STUDIED IN THE SAME CROSS, THE GENES FOR ONE TRAIT     A
      SSORT INDEPENDENTLY OF THE GENES FOR   THE OTHER."
190   PRINT : PRINT "IN OTHER WORDS, EACH ALLELE FROM ONE    TRAIT CAN MAT
      CH UP WITH WHATEVER ALLELESARE AVAILABLE FOR THE OTHER TRAIT!"
191   PRINT : PRINT "BACK TO OUR EXAMPLE, ALL THOSE         COMBINATIONS
      ARE POSSIBLE.": PRINT : GOSUB 7000
193   TEXT : HOME : PRINT "SINCE THE MALE IS THE SAME GENOTYPE AS  THE FEM
      ALE, HIS POSSIBLE GAMETES ARE THESAME:   RY, R";
194   PRINT   CHR$ (249);
195   PRINT ", ";
197   PRINT   CHR$ (242);
198   PRINT "Y, ";
199   PRINT   CHR$ (242);
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200   PRINT   CHR$ (249)
202   PRINT : PRINT "DO YOU REMEMBER WHAT WE DO NEXT?"
204   PRINT : PRINT "WE CONSTRUCT A PUNNETT SQUARE!           (ONLY WE MAY
      HAVE TO MAKE THIS ONE A BITBIGGER!)": PRINT : PRINT : GOSUB 7000
206   GOSUB 10300
208   HOME : VTAB 21: PRINT "SINCE THERE ARE 4 POSSIBLE GAMETE       COMBI
      NATIONS, OUR SQUARE MUST HAVE 4     BOXES ACROSS AND 4 BOXES DOWN.": GOSUB
      7000
210   GOSUB 10350
212   HOME : VTAB 21: PRINT "NOW, LIST THE FEMALE PAIRS ACROSS THE   TOP A
      ND THE MALE'S DOWN THE SIDE.   IT'S ALMOST THE SAME AS BEFORE!": GOSUB
      7000
214   GOSUB 10400
216   HOME : VTAB 21: PRINT "MAKE THE CROSSES:   REMEMBER TO USE THE   FEMAL
      E ON THE TOP AND THE MALE ON THE   LEFT. ": GOSUB 7000
218   HOME : VTAB 21: PRINT "PLACE ALLELES FOR THE SAME TRAIT NEXT TOEACH
      OTHER IN THE BOX, FIRST THE CAPITALTHEN THE SMALL LETTER.": GOSUB 70
      00
220   GOSUB 10450
222   HOME : VTAB 21: PRINT "YOUR COMPLETED SQUARE SHOULD LOOK LIKE  THIS.
      ": PRINT : GOSUB 7000
224   TEXT : HOME : PRINT "WHAT ARE THE RESULTING PHENOTYPES?"
226   PRINT : PRINT "(REMEMBER TO ACCOUNT FOR BOTH TRAITS!) "
228   PRINT : PRINT "DO THIS BOX BY BOX."
230   PRINT : PRINT "LOOKING AT YOUR SQUARE, IN THE TOP BOX  WE HAVE A ROU
      ND, YELLOW PLANT."
232   PRINT : PRINT "IN THE NEXT BOX OVER IS ANOTHER ROUND,  YELLOW PLANT.
      "
234   PRINT : PRINT "COMPLETE YOUR TALLY AND COMPARE YOUR     RESULTS WITH
      MINE!": PRINT : GOSUB 7000
236   TEXT : HOME : PRINT "THE RESULTING PHENOTYPES ARE:"
238   PRINT : PRINT "9 ROUND, YELLOW"
240   PRINT "3 WRINKLED, YELLOW"
242   PRINT "3 ROUND, GREEN"
244   PRINT "1 WRINKLED, GREEN"
246   PRINT : PRINT "DID YOU GET IT?  I HOPE SO!"
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248   PRINT : PRINT " LET'S TACKLE THE GENOTYPES.  DID THE     GUIDE REMIND
      YOU TO BRING ALONG YOUR     THINKING CAPS.  YOU'LL NEED THEM NOW!"
250   PRINT : PRINT "ONCE YOUR 'CAP' IS ON, CONTINUE ONWARD!": PRINT : GOSUB
      7000
252   TEXT : HOME : PRINT "TO INTERPRET GENOTYPES, AGAIN GO BOX BY BOX.  R
      EMEMBER, BOTH TRAITS HAVE TO BE  ACCOUNTED FOR!"
254   PRINT : PRINT "LOOKING BACK AT OUR PUNNETT SQUARE, THE FIRST BOX IS
      HOMOZYGOUS ROUND,          HOMOZYGOUS YELLOW."
255   PRINT : PRINT "THE NEXT BOX IS HOMOZYGOUS ROUND,        HETEROZYGOUS
      YELLOW."
256   PRINT : PRINT "MAKE A TALLY OF YOUR GENOTYPES AND PRESS C TO COMPARE!
      ": PRINT : GOSUB 7000
258   TEXT : HOME : PRINT "HERE'S MY LIST!"
260   PRINT : PRINT "1 HOMOZYGOUS ROUND, HOMOZYGOUS YELLOW"
261   PRINT "2 HETEROZYGOUS ROUND, HOMOZYGOUS YELLOW"
262   PRINT "2 HOMOZYGOUS ROUND, HETEROZYGOUS YELLOW"
264   PRINT "4 HETEROZYGOUS ROUND, HETEROZYGOUS      YELLOW"
266   PRINT "1 HOMOZYGOUS ROUND, HOMOZYGOUS GREEN"
268   PRINT "2 HETEROZYGOUS ROUND, HOMOZYGOUD GREEN"
270   PRINT "1 HOMOZYGOUS WRINKLED, HOMOZYGOUS      YELLOW"
272   PRINT "2 HOMOZYGOUS WRINKLED, HETEROZYGOUS     YELLOW"
274   PRINT "1 HOMOZYGOUS WRINKLED, HOMOZYGOUS GREEN"
275   PRINT : PRINT "NOW YOU KNOW WHY YOU NEEDED A THINKING  CAP!": GOSUB
      7000
280   GOSUB 8400
282   HOME : VTAB 21: PRINT "IF YOU WERE OBSERVANT, YOU WOULD HAVE    SEEN
      THAT THE PARENTS IN OUR CROSS WERE DIHYBRIDS:  HYBRIDS FOR BOTH TRAI
      TS!": GOSUB 7000
284   HOME : VTAB 21: PRINT "THE PHENOTYPES OF A DIHYBRID CROSS ARE  ALWAY
      S A 9:3:3:1 RATIO.  SEE YOUR BOOK  FOR AN EXPLANATION OF THESE NUMBE
      RS!": GOSUB 7000
286   HOME : VTAB 21: PRINT "LET'S TRY KIT M18.": PRINT : GOSUB 7000
287   HOME : VTAB 21: PRINT "IT CROSSES A HETEROZYGOUS ROUND AND HOMOZYGOU
      S GREEN WITH HOMOZYGOUS WRINKLED   AND HOMOZYGOUS GREEN": GOSUB 7000
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286  TEXT : HOME : PRINT "FIRST, SET UP THE MALE POSSIBILITIES."
290  PRINT : PRINT "FEMALE GENOTYPE:"
291  PRINT "  HETEROZYGOUS ROUND = R";
292  PRINT  CHR$ (242)
293  PRINT "  HOMOZYGOUS GREEN = ";
294  PRINT  CHR$ (249);
295  PRINT  CHR$ (249)
298  PRINT : PRINT "COMBINATIONS POSSIBLE = R";
299  PRINT  CHR$ (249);
304  PRINT ", ";
305  PRINT  CHR$ (242);
306  PRINT  CHR$ (249);
308  PRINT ", "
310  PRINT "THERE ARE ONY 2 DIFFERENT COMBINATIONS  POSSIBLE."
314  PRINT : PRINT "MALE GENOTYPE:
316  PRINT "  HOMOZYGOUS WRINKLED = ";
318  PRINT  CHR$ (242);
320  PRINT  CHR$ (242)
322  PRINT "  HOMOZYGOUS GREEN = ";
324  PRINT  CHR$ (249);
326  PRINT  CHR$ (249)
328  PRINT "COMBINATIONS POSSIBLE:   ";
330  PRINT  CHR$ (242);
331  PRINT  CHR$ (249)
332  PRINT "THERE IS ONLY ONE POSSIBLE COMBINATION!"
334  PRINT : PRINT "NEXT, SET UP A SQUARE.  SINCE THERE ARE ONLY 2 POSSIB
     LE FEMALE COMBINATIONS AND ONLY 1 MALE COMBINATION, WE CAN TAKE A  S
     HORT CUT ON THE SQUARE AND MAKE IT A    TWO BY ONE!": PRINT : GOSUB 7
     000
366  GOSUB 10540
368  HOME : VTAB 21: PRINT "NOW MAKE YOUR CROSSES": PRINT : GOSUB 7000
370  GOSUB 10520
372  HOME : VTAB 21: PRINT "YOUR CHART SHOULD AGREE WITH THIS ONE!": PRINT
     : GOSUB 7000
374  TEXT : HOME : PRINT "FINALLY, ANALYZE THE SQUARE!"
376  PRINT : PRINT "WHAT ARE THE PHENOTYPES?"
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490   GOSUB 8400
491   HOME : VTAB 21: PRINT "I HAVE TIME TO WORK ON ONE MORE KIT WITHYOU B
      EFORE I HAVE TO LEAVE TO GREET THE NEXT GROUP OF CUSTOMERS.": GOSUB
      7000
494   HOME : VTAB 21: PRINT "TRY KIT M57.  WHY DON'T YOU WORK THIS    ONE O
      UT COMPLETELY FIRST, THEN CHECK     YOUR OUTCOMES WITH ME!": GOSUB 70
      00
496   HOME : VTAB 21: PRINT "ARE YOU SURE YOU'RE READY TO CHECK YOUR OFFSP
      RING POSSIBILITIES WITH ME?  DON'T PRESS THE C KEY UNTIL YOU ARE!": GOSUB
      7000
500   TEXT : HOME : PRINT "FEMALE GENOTYPE:   T";
501   PRINT  CHR$ (244);
502   PRINT "R";
505   PRINT  CHR$ (242)
506   PRINT : PRINT "POSSIBLE COMBINATIONS:  TR, ";
508   PRINT  CHR$ (244);
509   PRINT  CHR$ (242);
510   PRINT ", ";
512   PRINT  CHR$ (244);
513   PRINT "R, ";
514   PRINT  CHR$ (244);
516   PRINT  CHR$ (242)
518   PRINT : PRINT "THE MALE'S GENOTYPE AND POSSIBLE GENE    COMBINATIONS
      ARE EXACTLY THE SAME AS THEFEMALE'S"
520   PRINT : PRINT "THE PHENOTYPES OF THE OFFSPRING ARE:"
522   PRINT : PRINT "9 TALL AND ROUND"
524   PRINT "3 TALL AND WRINKLED"
526   PRINT "3 SHORT AND ROUND"
528   PRINT "1 SHORT AND WRINKLED"
530   PRINT : PRINT "I THINK I'LL LIST THE GENOTYPES ON THE  NEXT SCREEN!"
      : PRINT : GOSUB 7000
535   TEXT : HOME : PRINT "THE POSSIBLE GENOTYPES ARE:"
537   PRINT : PRINT "1 HOMOZYGOUS TALL, HOMOZYGOUS ROUND"
539   PRINT "2 HETEROZYGOUS TALL, HOMOZYGOUS ROUND"
540   PRINT "2 HOMOZYGOUS TALL, HETEROZYGOUS ROUND"
541   PRINT "4 HETEROZYGOUS TALL, HETEROZYGOUS ROUND"
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378   PRINT "HALF ARE ROUND AND GREEN AND          HALF ARE WRINKLED AND
      GREEN"
380   PRINT : PRINT "REMEMBER, ONE DOMINANT ALLELE MAKES THE DOMINANT TRAI
      T VISIBLE!"
382   PRINT : PRINT "I'LL LET YOU FIGURE OUT THE GENOTYPES!  (BIG OF ME, I
       KNOW!)"
384   PRINT "WHEN, AND ONLY WHEN YOU HAVE TRIED TO   LIST ALL GENOTYPES, Y
      OU MAY TYPE A Z TO CONTINUE!"
394   INPUT G$
395   IF G$ <  > "Z" THEN  PRINT "YOU MUST FOLLOW DIRECTIONS!": GOTO 384
396   PRINT : PRINT "ARE YOU SURE YOU'RE READY?"
398   PRINT : PRINT "HERE GOES!"
400   PRINT : PRINT "HALF ARE HETEROZYGOUS ROUND, HOMOZYGOUS GREEN"
402   PRINT "HALF ARE HOMOZYGOUS WRINKLED,          HOMOZYGOUS GREEN"
404   PRINT : PRINT "REMEMBER, HOMO MEANS SAME AND HETERO    MEANS DIFFERE
      NT!"
406   PRINT : PRINT "TAKE A FEW MINUTES TO REVIEW THIS CROSS."
408   PRINT : PRINT : GOSUB 7000
410   GOSUB 8400
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543   PRINT "1 HOMOZYGOUS TALL, HOMOZYGOUS WRINKLED"
544   PRINT "2 HETEROZYGOUS TALL, HOMOZYGOUS WRINKLED"
545   PRINT "1 HOMOZYGOUS SHORT, HOMOZYGOUS ROUND"
546   PRINT "2 HOMOZYGOUS SHORT, HETEROZYGOUS ROUND"
547   PRINT "1 HOMOZYGOUS SHORT, HOMOZYGOUS WRINKLED"
549   PRINT "CHECK YOUR LIST AGAINST MINE!": PRINT : GOSUB 7000
550   GOSUB 8400
552   HOME : VTAB 21: PRINT "THANK YOU FOR STOPPING BY!  I HOPE YOU  ENJOY
      ED WORKING WITH MY KITS AS MUCH AS I DID!": GOSUB 7000
554   HOME : VTAB 21: PRINT "BY THE WAY, WE'LL SOON ACCEPT VISA AND  MASTE
      RCARDS TO MAKE IT MORE CONVENIENT  FOR YOU TO PURCHASE KITS IN THE F
      UTURE!": GOSUB 7000
556   HOME : VTAB 21: PRINT "I PREPARED A SPECIAL COLLECTION OF KITS FOR Y
      OU TO TRY.  THEY'RE INCLUDED IN    YOUR TOUR GUIDE (AT NO EXTRA CHAR
      GE!!)": GOSUB 7000
558   HOME : VTAB 21: PRINT "PLESE WORK ON THEM AFTER YOU LEAVE THE  GENE
      MACHINE!": GOSUB 7000
560   GOSUB 10600
562   HOME : VTAB 21: PRINT "THANK YOU FOR YOUR PATRONAGE!           HAPPY
      CROSSING!"
600   END
7000  REM  SWITCH ROUTINE
7001  INPUT "TYPE S TO SWITCH OR C TO CONTINUE:   ";G$
7002  IF G$ = "S" THEN  GOTO 105
7003  IF G$ = "C" THEN  RETURN
7004  GOTO 7001
7005  RETURN
8300  REM  GUIDE
8301  TEXT : HOME : HGR : HCOLOR= 3
8302  HPLOT 100,45 TO 150,45 TO 150,110 TO 140,120 TO 110,120 TO 100,110 TO
      100,45
8303  HPLOT 100,60 TO 150,60 TO 140,70 TO 110,70 TO 100,60
8304  HPLOT 110,50 TO 105,50 TO 105,55 TO 110,55 TO 110,53 TO 108,53
8305  HPLOT 115,50 TO 115,55 TO 120,55 TO 120,50
8306  HPLOT 125,50 TO 125,55
8307  HPLOT 130,50 TO 132,50 TO 135,53 TO 132,55 TO 130,55 TO 130,50
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8308   HPLOT 115,50 TO 149,50 TO 149,55 TO 145,55: HPLOT 140,53 TO 145,53
8309   HPLOT 105,80 TO 105,75 TO 115,75 TO 115,80
8310   HPLOT 135,80 TO 135,75 TO 145,75 TO 145,80
8311   HPLOT 107,85 TO 107,80 TO 113,80 TO 113,85 TO 107,85
8315   HPLOT 137,85 TO 137,80 TO 143,80 TO 143,85 TO 137,85
8316   HPLOT 120,90 TO 130,90 TO 130,100 TO 120,100 TO 120,90
8318   HPLOT 110,105 TO 115,110 TO 135,110 TO 140,105
8319   RETURN
8400   REM  MENDEL
8401   TEXT : HOME : HGR : HCOLOR= 3
8402   HPLOT 90,45 TO 100,35 TO 150,35 TO 160,45 TO 160,115 TO 140,130 TO
       110,130 TO 90,115 TO 90,45
8403   HPLOT 95,50 TO 100,45 TO 110,45 TO 115,50: HPLOT 100,50 TO 110,50 TO
       110,65 TO 100,65 TO 100,50: HPLOT 102,65 TO 102,60 TO 108,60 TO 108,
       65
8404   HPLOT 135,50 TO 140,45 TO 150,45 TO 155,50: HPLOT 140,50 TO 150,50 TO
       150,65 TO 140,65 TO 140,50: HPLOT 142,65 TO 142,60 TO 148,60 TO 148,
       65
8405   HPLOT 125,65 TO 130,70 TO 125,75 TO 120,70 TO 125,65
8406   HPLOT 110,90 TO 120,80 TO 130,80 TO 140,90: HPLOT 115,85 TO 115,90
8407   HPLOT 120,80 TO 120,90: HPLOT 125,80 TO 125,90: HPLOT 130,80 TO 130
       ,90
8408   HPLOT 135,85 TO 135,90
8411   HPLOT 90,30 TO 90,45: HPLOT 95,25 TO 95,40
8412   LET X = 100
8413   FOR I = 1 TO 11
8414   HPLOT X,20 TO X,35
8415   LET X = X + 5
8416   NEXT I
8417   HPLOT 155,25 TO 155,40: HPLOT 160,30 TO 160,45
8418   HPLOT 95,80 TO 95,120: HPLOT 100,85 TO 100,122: HPLOT 105,95 TO 105
       ,127
8419   LET X = 110
8420   FOR I = 1 TO 7
8421   HPLOT X,100 TO X,130
8422   LET X = X + 5
```

```
8423    NEXT I
8424    HPLOT 145,95 TO 145,122: HPLOT 150,90 TO 150,122: HPLOT 150,85 TO 1
        50,120
8425    HPLOT 155,80 TO 155,120
8427    RETURN
10300   REM  BIG SQUARE
10301   TEXT : HOME : HGR : HCOLOR= 3
10302   HPLOT 35,30 TO 215,30 TO 215,150 TO 35,150 TO 35,30
10303   HPLOT 35,60 TO 215,60: HPLOT 35,90 TO 215,90: HPLOT 35,120 TO 215,
        120
10304   HPLOT 80,30 TO 80,150: HPLOT 125,30 TO 125,150: HPLOT 170,30 TO 17
        0,150
10305   RETURN
10350   REM  GAMETES
10351   GOSUB 10300
10352   HPLOT 45,25 TO 45,5 TO 55,5 TO 55,15 TO 45,15 TO 55,25
10353   HPLOT 60,5 TO 65,15 TO 70,5: HPLOT 65,15 TO 65,25
10356   HPLOT 90,25 TO 90,5 TO 100,5 TO 100,15 TO 90,15 TO 100,25
10357   HPLOT 105,15 TO 110,20 TO 115,15: HPLOT 110,20 TO 110,25
10358   HPLOT 135,15 TO 135,25: HPLOT 135,20 TO 140,15 TO 145,15
10360   HPLOT 150,15 TO 155,20 TO 160,15: HPLOT 155,20 TO 155,25
10362   HPLOT 180,25 TO 180,15: HPLOT 180,20 TO 185,15 TO 190,15
10364   HPLOT 200,5 TO 205,15 TO 210,5: HPLOT 205,15 TO 205,25
10365   HPLOT 5,55 TO 5,35 TO 15,35 TO 15,45 TO 5,45 TO 15,55
10366   HPLOT 20,35 TO 25,45 TO 30,35: HPLOT 25,45 TO 25,55
10367   HPLOT 5,85 TO 5,65 TO 15,65 TO 15,75 TO 5,75 TO 15,85
10369   HPLOT 20,75 TO 25,80 TO 30,75: HPLOT 25,80 TO 25,85
10370   HPLOT 5,100 TO 5,110: HPLOT 5,105 TO 10,100 TO 15,100
10372   HPLOT 20,100 TO 25,105 TO 30,100: HPLOT 25,105 TO 25,110
10374   HPLOT 5,135 TO 5,145: HPLOT 5,140 TO 10,135 TO 15,135
10376   HPLOT 20,125 TO 25,135 TO 30,125: HPLOT 25,135 TO 25,145
10378   RETURN
10400   REM  MORE
10401   GOSUB 10350
10402   HPLOT 40,50 TO 40,40 TO 45,40 TO 45,45 TO 40,45 TO 45,50
10403   HPLOT 50,50 TO 50,40 TO 55,40 TO 55,45 TO 50,45 TO 55,50
```

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10404    HPLOT 60,40 TO 63,45 TO 65,40: HPLOT 63,45 TO 63,50
10406    HPLOT 70,40 TO 73,45 TO 75,40: HPLOT 73,45 TO 73,50
10407    RETURN
10450    REM   EVEN MORE
10451    GOSUB 10400
10452    HPLOT 85,50 TO 85,40 TO 90,40 TO 90,45 TO 85,45 TO 90,50
10453    HPLOT 95,50 TO 95,40 TO 100,40 TO 100,45 TO 95,45 TO 100,50
10455    HPLOT 105,40 TO 108,45 TO 110,40: HPLOT 108,45 TO 108,50
10456    HPLOT 115,45 TO 118,48 TO 120,45: HPLOT 118,48 TO 118,50
10457    HPLOT 130,50 TO 130,40 TO 135,40 TO 135,45 TO 130,45 TO 135,50
10458    HPLOT 140,45 TO 140,50: HPLOT 140,48 TO 143,45 TO 145,45
10460    HPLOT 150,40 TO 153,45 TO 155,40: HPLOT 153,45 TO 153,50
10462    HPLOT 160,45 TO 163,48 TO 165,45: HPLOT 163,48 TO 163,50
10463    HPLOT 175,50 TO 175,40 TO 180,40 TO 180,45 TO 175,45 TO 180,50
10465    HPLOT 185,50 TO 185,45: HPLOT 185,48 TO 188,45 TO 190,45
10466    HPLOT 195,40 TO 198,45 TO 200,40: HPLOT 198,45 TO 198,50
10467    HPLOT 205,40 TO 208,45 TO 210,40: HPLOT 208,45 TO 208,50
10468    HPLOT 40,80 TO 40,70 TO 45,70 TO 45,75 TO 40,75 TO 45,80
10469    HPLOT 50,80 TO 50,70 TO 55,70 TO 55,75 TO 50,75 TO 55,80
10470    HPLOT 60,70 TO 63,75 TO 65,70: HPLOT 63,75 TO 63,80
10471    HPLOT 70,75 TO 73,78 TO 75,75: HPLOT 73,78 TO 73,80
10472    HPLOT 85,80 TO 85,70 TO 90,70 TO 90,75 TO 85,75 TO 90,80
10473    HPLOT 195,70 TO 198,75 TO 200,70: HPLOT 198,75 TO 198,80
10474    HPLOT 205,75 TO 208,78 TO 210,75: HPLOT 208,78 TO 208,80
10475    HPLOT 95,80 TO 95,70 TO 100,70 TO 100,75 TO 95,75 TO 100,80
10476    HPLOT 140,75 TO 140,80: HPLOT 140,78 TO 142,75 TO 145,75
10477    HPLOT 60,100 TO 63,105 TO 65,100: HPLOT 63,105 TO 63,110
10478    HPLOT 60,130 TO 63,135 TO 65,130: HPLOT 63,135 TO 63,140
10479    HPLOT 130,80 TO 130,70 TO 135,70 TO 135,75 TO 130,75 TO 135,80
10480    HPLOT 175,80 TO 175,70 TO 180,70 TO 180,75 TO 175,75 TO 180,80
10481    HPLOT 150,75 TO 153,78 TO 155,75: HPLOT 153,78 TO 153,80
10482    HPLOT 160,75 TO 163,78 TO 165,75: HPLOT 163,78 TO 163,80
10483    HPLOT 40,110 TO 40,100 TO 45,100 TO 45,105 TO 40,105 TO 45,110
10484    HPLOT 50,135 TO 50,140: HPLOT 50,138 TO 53,135 TO 55,135
10485    HPLOT 105,75 TO 108,78 TO 110,75: HPLOT 108,78 TO 108,80
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10486    HPLOT 105,130 TO 108,135 TO 110,130: HPLOT 108,135 TO 108,140
10487    HPLOT 115,135 TO 118,138 TO 120,135: HPLOT 118,138 TO 118,140
10488    HPLOT 130,135 TO 130,140: HPLOT 130,138 TO 133,135 TO 135,135
10489    HPLOT 140,135 TO 140,140: HPLOT 140,138 TO 143,135 TO 145,135
10490    HPLOT 150,130 TO 153,135 TO 155,130: HPLOT 153,135 TO 153,140
10491    HPLOT 160,135 TO 163,138 TO 165,135: HPLOT 163,138 TO 163,140
10492    HPLOT 175,135 TO 175,140: HPLOT 175,138 TO 178,135 TO 180,135
10493    HPLOT 185,135 TO 185,140: HPLOT 185,138 TO 188,135 TO 190,135
10494    HPLOT 195,130 TO 198,135 TO 200,130: HPLOT 198,135 TO 198,140
10495    HPLOT 205,130 TO 208,135 TO 210,130: HPLOT 208,135 TO 208,140
10496    HPLOT 115,75 TO 118,78 TO 120,75: HPLOT 118,78 TO 118,80
10497    HPLOT 85,110 TO 85,100 TO 90,100 TO 90,105 TO 85,105 TO 90,110
10498    HPLOT 95,105 TO 95,110: HPLOT 95,108 TO 98,105 TO 100,105
10499    HPLOT 70,130 TO 73,135 TO 75,130: HPLOT 73,135 TO 73,140
10500    HPLOT 105,105 TO 108,108 TO 110,105: HPLOT 108,108 TO 108,110
10501    HPLOT 85,140 TO 85,130 TO 90,130 TO 90,135 TO 85,135 TO 90,140
10502    HPLOT 50,105 TO 50,110: HPLOT 50,108 TO 53,105 TO 55,105
10503    HPLOT 70,105 TO 73,108 TO 75,105: HPLOT 73,108 TO 73,110
10504    HPLOT 115,105 TO 118,108 TO 120,105: HPLOT 118,108 TO 118,110
10505    HPLOT 130,105 TO 130,110: HPLOT 130,108 TO 133,105 TO 135,105
10506    HPLOT 140,105 TO 140,110: HPLOT 140,108 TO 143,105 TO 145,105
10507    HPLOT 150,105 TO 153,108 TO 155,105: HPLOT 153,108 TO 153,110
10509    HPLOT 160,105 TO 163,108 TO 165,105: HPLOT 163,108 TO 163,110
10510    HPLOT 175,105 TO 175,110: HPLOT 175,108 TO 178,105 TO 180,105
10511    HPLOT 185,105 TO 185,110: HPLOT 185,108 TO 188,105 TO 170,105
10512    HPLOT 195,100 TO 198,105 TO 200,100: HPLOT 198,105 TO 198,110
10513    HPLOT 205,105 TO 208,108 TO 210,105: HPLOT 208,108 TO 208,110
10514    HPLOT 40,140 TO 40,130 TO 45,130 TO 45,135 TO 40,135 TO 45,140
10515    HPLOT 95,135 TO 95,140: HPLOT 95,138 TO 98,135 TO 100,135
10516    HPLOT 185,75 TO 185,80: HPLOT 185,78 TO 188,75 TO 190,75
10518    RETURN
10520    REM  M18.2
10521    GOSUB 10540
10522    HPLOT 80,85 TO 80,65 TO 90,65 TO 90,75 TO 80,75 TO 90,85
10523    HPLOT 95,75 TO 95,85: HPLOT 95,80 TO 100,75 TO 105,75
10524    HPLOT 110,75 TO 115,80 TO 120,75: HPLOT 115,80 TO 115,85
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10525   HPLOT 125,75 TO 130,80 TO 135,75: HPLOT 130,80 TO 130,85
10527   HPLOT 145,75 TO 145,85: HPLOT 145,80 TO 150,75 TO 155,75
10528   HPLOT 160,75 TO 160,85: HPLOT 160,80 TO 165,75 TO 170,75
10529   HPLOT 175,75 TO 180,80 TO 185,75: HPLOT 180,80 TO 180,85
10530   HPLOT 190,75 TO 195,80 TO 200,75: HPLOT 195,80 TO 195,85
10531   RETURN
10540   REM  M18
10541   TEXT : HOME : HGR : HCOLOR= 3
10542   HPLOT 75,60 TO 135,60 TO 205,60 TO 205,90 TO 75,90 TO 75,60: HPLOT
        140,60 TO 140,90
10543   HPLOT 60,70 TO 65,75 TO 70,70: HPLOT 65,75 TO 65,80
10544   HPLOT 45,70 TO 45,80: HPLOT 45,75 TO 50,70 TO 55,70
10545   HPLOT 185,40 TO 190,45 TO 195,40: HPLOT 190,45 TO 190,50
10546   HPLOT 170,40 TO 170,50: HPLOT 170,45 TO 175,40 TO 180,40
10547   HPLOT 110,40 TO 115,45 TO 120,40: HPLOT 115,45 TO 115,50
10548   HPLOT 95,50 TO 95,30 TO 105,30 TO 105,40 TO 95,40 TO 105,50
10549   RETURN
10550   REM  TWO BY ONE
10550   REM  TWO BY ONE
10552   TEXT : HOME : HGR : HCOLOR= 3
10552   TEXT : HOME : HGR : HCOLOR= 3
10554   HPLOT 60,80 TO 60,50 TO 190,50 TO 190,80 TO 60,80: HPLOT 125,50 TO
        125,80
10554   HPLOT 60,80 TO 60,50 TO 190,50 TO 190,80 TO 60,80: HPLOT 125,50 TO
        125,80
10556   HPLOT 75,45 TO 75,25 TO 85,25 TO 85,35 TO 75,35 TO 85,45
10556   HPLOT 75,45 TO 75,25 TO 85,25 TO 85,35 TO 75,35 TO 85,45
10558   HPLOT 100,25 TO 105,35 TO 110,25: HPLOT 105,35 TO 105,45
10558   HPLOT 100,25 TO 105,35 TO 110,25: HPLOT 105,35 TO 105,45
10560   HPLOT 140,35 TO 140,45: HPLOT 140,40 TO 145,35 TO 150,35
10560   HPLOT 140,35 TO 140,45: HPLOT 140,40 TO 145,35 TO 150,35
10562   HPLOT 165,35 TO 170,40 TO 175,35: HPLOT 170,40 TO 170,45
10562   HPLOT 165,35 TO 170,40 TO 175,35: HPLOT 170,40 TO 170,45
10564   HPLOT 20,60 TO 20,70: HPLOT 20,65 TO 25,60 TO 30,60
10564   HPLOT 20,60 TO 20,70: HPLOT 20,65 TO 25,60 TO 30,60
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10563  HPLOT 60,80 TO 60,110 TO 190,110 TO 190,80: HPLOT 125,80 TO 125,11
       9: HPLOT 20,105 TO 20,85 TO 30,85 TO 30,95 TO 20,95 TO 30,105
10566  HPLOT 40,60 TO 45,65 TO 50,60: HPLOT 45,65 TO 45,70
10566  HPLOT 40,60 TO 45,65 TO 50,60: HPLOT 45,65 TO 45,70
10567  HPLOT 40,85 TO 45,95 TO 50,85: HPLOT 45,95 TO 45,105
10568  RETURN
10568  RETURN
10570  REM  TWO BY ONE MASTER
10572  GOSUB 10550
10574  HPLOT 65,75 TO 65,55 TO 75,55 TO 75,65 TO 65,65 TO 75,75
10575  HPLOT 65,105 TO 65,85 TO 75,85 TO 75,95 TO 65,95 TO 75,105
10576  HPLOT 80,75 TO 80,65: HPLOT 80,70 TO 85,65 TO 90,65
10576  HPLOT 80,75 TO 80,65: HPLOT 80,70 TO 85,65 TO 90,65
10578  HPLOT 95,55 TO 100,65 TO 105,55: HPLOT 100,65 TO 100,75
10578  HPLOT 95,55 TO 100,65 TO 105,55: HPLOT 100,65 TO 100,75
10579  HPLOT 80,105 TO 80,85 TO 90,85 TO 90,95 TO 80,95 TO 90,105: HPLOT
       95,85 TO 100,95 TO 105,85: HPLOT 100,95 TO 100,105
10580  HPLOT 110,65 TO 115,70 TO 120,65: HPLOT 115,70 TO 115,75
10580  HPLOT 110,65 TO 115,70 TO 120,65: HPLOT 115,70 TO 115,75
10582  HPLOT 130,75 TO 130,65: HPLOT 130,70 TO 135,65 TO 140,65
10582  HPLOT 130,75 TO 130,65: HPLOT 130,70 TO 135,65 TO 140,65
10584  HPLOT 145,75 TO 145,65: HPLOT 145,70 TO 150,65 TO 155,65
10584  HPLOT 145,75 TO 145,65: HPLOT 145,70 TO 150,65 TO 155,65
10586  HPLOT 160,65 TO 165,70 TO 170,65: HPLOT 165,70 TO 165,75
10586  HPLOT 160,65 TO 165,70 TO 170,65: HPLOT 165,70 TO 165,75
10588  HPLOT 175,65 TO 180,70 TO 185,65: HPLOT 180,70 TO 180,75
10588  HPLOT 175,65 TO 180,70 TO 185,65: HPLOT 180,70 TO 180,75
10589  HPLOT 110,85 TO 115,95 TO 120,85: HPLOT 115,95 TO 115,105: HPLOT 1
       30,105 TO 130,85 TO 140,85 TO 140,95 TO 130,95 TO 140,105
10590  HPLOT 160,85 TO 165,95 TO 170,85: HPLOT 165,95 TO 165,105
10591  HPLOT 145,95 TO 145,105: HPLOT 145,100 TO 150,95 TO 155,95
10592  HPLOT 175,95 TO 180,100 TO 185,95: HPLOT 180,100 TO 180,105
10593  RETURN
10600  REM  EXIT
10601  TEXT : HOME : HGR : HCOLOR= 3
10602  HPLOT 20,10 TO 230,10 TO 230,155 TO 20,155 TO 20,10
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10603   HPLOT 100,155 TO 100,100 TO 150,100 TO 150,155
10605   HPLOT 100,70 TO 90,70 TO 90,80 TO 100,80: HPLOT 90,75 TO 100,75
10607   HPLOT 110,70 TO 120,80: HPLOT 120,70 TO 110,80
10609   HPLOT 130,70 TO 140,70: HPLOT 130,80 TO 140,80: HPLOT 135,70 TO 13
    5,80
10610   HPLOT 150,70 TO 160,70: HPLOT 155,70 TO 155,80
10612   HPLOT 40,40 TO 30,40 TO 30,50 TO 40,50
10614   HPLOT 50,50 TO 50,40 TO 60,40 TO 60,50 TO 50,50
10616   HPLOT 70,50 TO 70,40 TO 75,50 TO 80,40 TO 80,50
10618   HPLOT 100,40 TO 90,40 TO 90,50 TO 100,50: HPLOT 90,45 TO 100,45
10620   HPLOT 130,50 TO 130,40 TO 140,40 TO 140,50: HPLOT 130,45 TO 140,45

10622   HPLOT 160,40 TO 150,40 TO 150,50 TO 160,50 TO 160,45 TO 155,45
10624   HPLOT 170,50 TO 170,40 TO 180,40 TO 180,50: HPLOT 170,45 TO 180,45

10626   HPLOT 190,40 TO 200,40: HPLOT 195,40 TO 195,50: HPLOT 190,50 TO 20
    0,50
10628   HPLOT 210,50 TO 210,40 TO 220,50 TO 220,40
10630   RETURN
```

APPENDIX E:   Student Manual for the CAI Genetics Unit

TOUR/SHOPPING GUIDE

TO

GREGOR'S GENE MACHINE

COMPLETE THE FOLLOWING ASSIGNMENTS AS YOU PROGRESS
THROUGH THE GENE MACHINE!!

SHUTTLE ONE:

pg. 587 I, J

SHUTTLE TWO & TWO A:

pg. 587 P

SHUTTLE THREE:

Complete the Cross Worksheet

Gregor Mendel's Shuttle Service

| Route Number | Destination |
|---|---|
| 1 | TERMINOLOGY AREA - a good place to start, especially if it's your first time here! |
| 2 | SIMPLE CROSS SECTION - contains Punnett Squares and basic trait supplies (of course, instructions are included in all our kits!) |
| 3 | TWO TRAIT CROSS SUPPLIES - houses our kit materials for those of you who are more experienced and want to try something a little more challenging! |

Anytime you feel you are finished with your shopping in one area, type an S and you will be returned to the shuttle depot where you may catch another shuttle of your choice!

NOTE:

To change shuttles:

1.  Type the S key when prompted (S to switch C to continue).

2.  A listing of routes will appear; decide which one you want.

3.  Type in your shuttle choice.

4.  The following directions will appear:

    a) Type PR#6

    b) Press Return

    c) Type RUN (and the name previously given to you)

       For Route One:  SHUTTLE ONE

       For Route Two:  SHUTTLE TWO     or

                                  SHUTTLE TWO A  depending on whether you want the beginning or the latter half

       For Route Three:  SHUTTLE THREE

5.  Press Return.

Gregor Mendel was an Austrian monk, mathematician and biologist who did most of his work in the 1800's. He is known as the Father of Genetics because of his advances in that field!

Mendel studied seven basic traits of pea plants:

1. seed shape - round vs. wrinkled

2. seed color - yellow vs. green

3. seed coat color - colored vs. white

4. pod shape -inflated vs. constricted

5. pod color - green vs. yellow

6. flower position - axial vs. terminal

7. stem length - long vs. short.

GENETICS - specialized branch of biology that deals with heredity

## GENETICS TERMINOLOGY

1.  GENE - portion of DNA which controls the expression of hereditary characteristics.  They code for traits.

2.  TRAIT -

3.  ALLELE - form of a gene.
Example:  Pea plants can be short or tall.  One gene has the code for this trait.  Therefore, this gene has 2 alleles (forms):  tall or short!

4.  CROSS - shown by an "X".

Note:  alleles segregate during gamete formation!

5.  HOMOZYGOUS - true-breeding; purebreed.

6.  HETEROZYOUS - hybrid.

7. GENOTYPE - the actual alleles an individual has for a trait.

8. PHENOTYPE - how an individual appears.

9. DOMINANT - always seen.

For example: Rr and RR are both round individuals because R is dominant.

10. RECESSIVE - seen only when homozygous for the trait.

For example: rr is wrinkled because both alleles are recessive.

PARENTS (starting generation)

FILIAL ("son" generation )

$$PARENT \times PARENT \longrightarrow F_1$$

(The $F_1$ generation is the first filial generation.)

$$F_1 \times F_1 \longrightarrow F_2$$

(Crossing members of the $F_1$ generation

gives rise to the $F_2$.)

Crossing members of the $F_2$ generation gives rise to

the $F_3$ generation and

so on...

What will crossing members of the $F_7$ generation yield?

Mendel's First Two Principles:

1.  PRINCIPLE OF DOMINANCE

When the alleles of a gene pair for a particular trait are different, the dominant trait is the one that is seen.

2.  PRINCIPLE OF SEGREGATION

Chromosome pairs are separated during gamete formation, making each gamete carry only one allele of each gene pair.

PEA-SHAPE CROSS

RR X rr

## BASIC CROSS KIT INSTRUCTIONS

(Note:  These instructions can be used with ANY kit!!!)

1.  Come up with all possible gametes.
(Remember each gamete carries only one allele for a trait.)

Mother's genotype:  RR

Father's genotype:  rr


Possible female gametes:  R, R

Possible male gametes:    r, r


2.  CROSS THE PARENTS' GAMETES.  Use a Punnett Square

a) Make a box.

b) List the female's possible gametes along the top (1 per box).

c) List the male's possible gametes along the side (1 per box).

d) Cross.  (Place the female's gamete from above and the male's gamete from the left into the same box.  Follow the same crossing procedure until all boxes are filled.)

|  | R | R |
|---|---|---|
| r | R r | R r |
| r | R r | R r |

## 3. ANALYZE YOUR RESULTS.

Phenotypes of offspring:  All are round.

Genotypes of offspring:   All are hybrids.

\*   \*   \*   \*   \*   \*   \*   \*   \*   \*   \*   \*   \*   \*

CROSS KIT Rr X Rr

1.  Mother's genotype:  heterozygous (Rr)

    Father's genotype:  heterozygous (Rr)

    Possible female gametes:  R, r
    Possible male gametes:    R, r

2.  Make a square and Cross.



3.  List Phenotypes:


    List Genotypes:

KIT #47

Cross a heterozygous yellow female with a heterozygous yellow male.

Female's Genotype:

Male's Genotype:

Possible Female Gametes:

Possible Male Gametes:

Cross:

Phenotypes of Offspring:

Genotypes of Offspring:

KIT #52

Cross a homozygous recessive female with a heterozygous
yellow male.
(Recessive is green!)

Female's Genotype:

Male's Genotype:

Possible Female Gametes:

Possible Male Gametes:

Cross:

Phenotypes of Offspring:

Genotypes of Offspring:

KIT #T7

Cross a homozygous short with a homozygous tall!

Female's Genotype:

Male's Genotype:

Possible Female Gametes:

Possible Male Gametes:

Cross:

Phenotypes of Offspring:

Genotypes of Offspring:

KIT #T12

Cross a homozygous tall female with a heterozygous tall male.

Female's Genotype:

Male's Genotype:

Possible Female Gametes:

Possible Male Gametes:

Cross:

Phenotypes of Offspring:

Genotypes of Offspring:

KIT #T13

***Challenge***

Cross a homozygous short female with a tall male.

What is the genotype of the male if three offspring are tall and one is short?

|   | t | t |
|---|---|---|
| T | Tt | Tt |
| T | Tt | Tt |

Short is NOT possible.

|   | t | t |
|---|---|---|
| T | Tt | Tt |
| t | tt | tt |

Short IS possible.

## Mendel's Third Principle

PRINCIPLE OF INDEPENDENT ASSORTMENT

When two traits are studied in the same cross, the alleles for one trait can mix and match with the alleles for the other trait. The alleles for each trait assort indepndently of each other. This kit will explain this principle.

KIT #M6

Cross two heterozygous round, heterozygous yellow plants.

Mom's genotype:   RrYy
Dad's genotype:   RrYy

Possible female gametes:   R r Y y
                           RY, Ry, rY, ry

Possible male gametes:   R r Y y
                         RY, Ry, rY, ry

Cross:

|  | R Y | R y | r Y | r y |
|---|---|---|---|---|
| R Y | RRYY | RRYy |  |  |
| R y |  |  |  |  |
| r Y |  |  |  |  |
| r y |  |  |  |  |

Phenotype of Offspring:

9 Dominant for both traits

3 Dominant for one and recessive for the second

3 Dominant for the second and recessive for the first

1 Recessive for both traits


Genotypes of Offspring:

KIT #M18

Cross a heterozygous round, homozygous green female with
a homozygous wrinkled, homozygous green father.

Female genotype:

Male genotype:

Possible female gametes:

Possible male gametes:

Cross:



Phnotypes of Offspring:

Genotypes of Offspring:

KIT #M57

Cross two plants that are heterczygous tall and heterozygous round.

Female genotype:

Male genotype:

Female gametes:

Male gametes:

Cross:

Phenotypes of Offspring:

Genotypes of Offspring:

Biology Practice Crosses

SHOW ALL WORK!

1. In a certain plant, yellow fruit (Y) is dominant to white fruit (y). A heterozygous plant with yellow fruit is crossed with a plant with white fruit. Determine the probable genotypic and phenotypic ratios resulting from this cross.

2. In a certain animal, black fur (B) is dominant to white fur (b). Determine the expected genotypic and phenotypic ratios resulting from crosses between (a) homozygous black X white; (b) two heterozygous blacks; and (c) heterozygous black X white.

3. Suppose that in outer space there exist creatures in which purple eyes (P) are dominant to yellow eyes (p). Two purple-eyed creatures mate and produce six offspring. Four of them have purple eyes and two have yellow eyes. What are the genotypes of the parents? The phenotypes? What are the genotypes of the offspring?

4. In guinea pigs, black coat color (B) is dominant to albino (b). Cross a heterozygous pig with a homozygous dominant pig. What are the pheno and genotypes of the $F_1$ generation?

Try these DIHYBRID crosses:

5. In fruit flies, red eyes (R) are dominant to magenta eyes (r). Long wing (L) is dominant to short wing (l). A heterozygous red-eyed, short-winged male is bred to a magenta eyed, heterozygous long-winged female. What percentage of their offspring should have magenta eyes and short wings?

6. Back to guinea pigs, remember that black coat color (B) is dominant to albino (b). Rough coat (R) is dominant to smooth coat (r). Two animals are selected for breeding. Their genotypes are BBRR and bbrr. Specify the expected genotypic and phenotypic ratios (a) in the F generation; (b) in the F generation; and (c) among the offspring produced by crossing one of the F pigs with a pig having the genotype BBRr.

7. Let Y = yellow, y = green, R = round, r = wrinkled. Cross plant A (homozygous yellow and heterozygous round) with plant B (heterozygous for color and homozygous wrinkled). What are the phenotypes and genotypes of the resulting offspring?

APPENDIX F:  Posttest for the CAI and Traditional Genetics Unit

Choose the BEST answer.

<u>Multiple Choice</u>

_____1.  Today, geneticists refer to Mendel's true-breeding (purebred) parent pea plants as (a) codominant for the traits in question; (b) dominant for the traits in question; (c) heterozygous for the traits in question; (d) homozygous for the traits in question.

_____2.  Hybrid means the same as (a) dominant; (b) heterozygous; (c) homozygous; (d) mutant

_____3.  A gene whose effect remains hidden when it is paired with a different gene is called (a) codominant; (b) dominant; (c) mutant; (d) recessive

_____4.  The genetic makeup of an individual for a trait being studied is called that individual's (a) genotype; (b) pedigree; (c) phenotype; (d) variability

_____5.  An individual in which the two genes of a pair that affect a particular trait are identical is said to be (a) dihybrid; (b) heterozgyous; (c) homozygous; (d) hybrid

_____6.  B represents the gene for a dominant characteristic and b its recessive allele.  If a Bb individual mates with a bb individual, (a) all offspring will be dominant; (b) all offspring will be recessive; (c) half of the offspring will be dominant and half recessive; (d) three quarters of the offspring will be dominant and one quarter recessive

_____7.  How many heterozygous offspring would you expect if two parents who were heterozygous for a trait produced an F generation of 40 individuals (a) 5; (b) 10; (c) 15; (d) 20

_____8.  An organism has alleles Rr.  It is said to be (a) homozygous; (b) heterozygous; (c) dominant; (d) pure

_____9.  The term that describes an organism with the same two alleles for a gene is (a) heterozygous; (b) phenotype; (c) dominant; (d) homozygous

_____10.  A trait seen only if it is present as a homozygous pair is (a) dominant; (b) hybrid; (c) recessive; (d) genetic

_____11.  Tall is dominant.  When a pure tall and a pure short pea plant are crossed, the offspring are (a) all short; (b) all tall; (c) all medium sized; (d) 3 tall to 1 short

_____12. For a recessive trait (r) to show in the offspring, the offspring must have the genes (a) Rr; (b) RR; (c) rr; (d) rR

_____13. He was famous for his genetic discoveries of pea plants (a) Mendel; (b) Watson; (c) Crick; (d) Pasteur

_____14. The Latin word "son" used to describe generations in crosses is (a) offspring; (b) parenti; (c) filial; (d) soni

_____15. When 2 hybrids are crossed, the resulting phenotypes are always (a) 3:1; (b) 2:2; (c) 1:2:1; (d) 4:0

_____16. In a dihybrid cross, the resulting phenotype is always (a) 4:4:4:4; (b) 3:1; (c) 9:3:3:1; (d) 9:7

_____17. Which of these is not a principle set forth by Mendel's work (a) Principle of Dominance; (b) Principle of Segregation; (c) Principle of Nondisjunction; (d) Principle of Independent Assortment

_____18. A form of a trait is (a) gene; (b) allele; (c) DNA; (d) RNA

Matching

_____1. structure on chromosomes that determines an hereditary trait

_____2. characteristic carried by a gene

_____3. mating between different varieties of organisms

_____4. actual alleles an organism has for a particular trait

(a) trait

(b) cross

(c) phenotype

(d) genotype

(e) gene

Create a Punnett Square and determine the genotypes and phenotypes of the offspring produced from the following parents:

Heterozygous yellow plant  X  Homozygous yellow plant

(Note: yellow (Y) is dominant over green (y).)

APPENDIX G:   Student Attitude Questionnaire

Please answer the following questions honestly. Additional comments or suggestions are welcomed! Please write them on the back of this paper. (CDI = computer directed instruction unit)

SA = strongly agree

A = agree

UN = undecided

D = disagree

SD = strongly disagree

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|---|---|---|---|---|---|
| 1. working with CDI made me feel like no one cared whether I learned or not. | SA | A | UN | D | SD |
| 2. I was more involved in working with the computer than I was with understanding the lesson. | SA | A | UN | D | SD |
| 3. I felt I could work at my own pace. | SA | A | UN | D | SD |
| 4. CDI makes learning too mechanical. | SA | A | UN | D | SD |
| 5. I felt uncomfortable working with the CDI. | SA | A | UN | D | SD |
| 6. CDI was an efficient use of my time. | SA | A | UN | D | SD |
| 7. CDI was more motivating to me than usual classroom teaching. | SA | A | UN | D | SD |
| 8. CDI makes the subject matter more interesting. | SA | A | UN | D | SD |
| 9. CDI was too impersonal. | SA | A | UN | D | SD |
| 10. I prefer usual classroom teaching over CDI. | SA | A | UN | D | SD |
| 11. I didn't care whether or not I missed a question because no one would know. | SA | A | UN | D | SD |
| 12. My feelings toward the course material before using CDI were favorable. | SA | A | UN | D | SD |
| 13. My feelings toward the course materials after using CDI were favorable. | SA | A | UN | D | SD |
| 14. I would like to have more units presented using a CDI approach. | SA | A | UN | D | SD |
| 15. I felt pressured to hurry up and get done. | SA | A | UN | D | SD |
| 16. The computer did not distract me from the lesson I was working on. | SA | A | UN | D | SD |
| 17. CDI was impersonal. | SA | A | UN | D | SD |
| 18. CDI makes the subject matter less interesting. | SA | A | UN | D | SD |
| 19. I felt comfortable working through the CDI. | SA | A | UN | D | SD |
| 20. CDI was an inefficient use of my time. | SA | A | UN | D | SD |
| 21. Classroom teaching is more motivating to me than CDI. | SA | A | UN | D | SD |
| 22. I prefer CDI over usual classroom instruction. | SA | A | UN | D | SD |
| 23. My feelings toward the class material before using CDI were unfavorable. | SA | A | UN | D | SD |
| 24. My feelings toward the class material after using CDI were unfavorable. | SA | A | UN | D | SD |
| 25. I would not like to have more units presented using a CDI approach. | SA | A | UN | D | SD |

Please use the flip side of this page for comments!