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:

Redacted for Privacy
Professor of Science, Mathematics and Computer Science Education, in charge of major

Redacted for Privacy
Head of Department of Science, Mathematics and Computer Science Education

Redacted for Privacy

Dean of Graduate School

Date thesis is presented October 20, 1988
ACKNOWLEDGEMENTS

I would like to thank Dr. Jake Nice and Dr. Tom Dick for serving on my graduate committee. I would also like to express my appreciation to Dr. Tom Evans for his advice, time, guidance, and for serving as my major professor. I am especially grateful for having worked with Dr. Maggie Niess. Not only did she get me interested in working with computers, but throughout my graduate studies she was always available to answer my questions, give me assistance, and provide educational and moral support.

Of course, this study would not have been possible without the students! I appreciate the enthusiasm and cooperation of the students I worked with in biology at Scio High School in 1986-87. I am also grateful for the varied assistance of Bob Croff, Nancy Flagg, Susan Smith and Jerry Hull.

Last, but certainly not least, I am most appreciative of all the encouragement, assistance, prodding, and love my husband Jeff has showered me with throughout my degree program. I couldn't, or rather wouldn't, have done as well without his support.
# TABLE OF CONTENTS

## INTRODUCTION
- Statement of the Problem  
- Definitions  
- Design of the Study  
- Organization of Remainder of Study

## REVIEW OF RELATED LITERATURE AND RESEARCH

## RESEARCH DESIGN AND METHODOLOGY
- Topic Selection  
- Selection of the Sample  
- Preparation of Teaching Materials  
- Treatment  
- Analysis

## RESULTS
- Student Achievement  
- Student Attitude

## SUMMARY, CONCLUSION, DISCUSSION AND RECOMMENDATIONS
- Summary  
- Conclusion and Discussion  
  - Relationship between CAI and Achievement  
  - Student Attitudes toward CAI  
- Recommendations

## LITERATURE CITED

## APPENDICES
- Appendix A  
  - Printout of the CAI Photosynthesis Unit
- Appendix B  
  - Student Manual for the CAI Photosynthesis Unit
- Appendix C  
  - Posttest for the CAI and Traditional Photosynthesis Units
- Appendix D  
  - Printout of the CAI Genetics Unit
- Appendix E  
  - Student Manual for the CAI Genetics Unit
- Appendix F  
  - Posttest for the CAI and Traditional Genetics Units
- Appendix G  
  - Student Attitude Questionnaire
# LIST OF APPENDICES

<table>
<thead>
<tr>
<th>Appendix</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Printout of the CAI Photosynthesis Unit</td>
<td>51</td>
</tr>
<tr>
<td>B</td>
<td>Student Manual for the CAI Photosynthesis Unit</td>
<td>99</td>
</tr>
<tr>
<td>C</td>
<td>Posttest for the CAI and Traditional Photosynthesis Units</td>
<td>116</td>
</tr>
<tr>
<td>D</td>
<td>Printout of the CAI Genetics Unit</td>
<td>118</td>
</tr>
<tr>
<td>E</td>
<td>Student Manual for the CAI Genetics Unit</td>
<td>179</td>
</tr>
<tr>
<td>F</td>
<td>Posttest for the CAI and Traditional Genetics Units</td>
<td>200</td>
</tr>
<tr>
<td>G</td>
<td>Student Attitude Questionnaire</td>
<td>202</td>
</tr>
<tr>
<td>Figure</td>
<td>Page</td>
<td></td>
</tr>
<tr>
<td>--------</td>
<td>------</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>28</td>
<td></td>
</tr>
</tbody>
</table>

**1** Comparison of posttest scores for students receiving CAI photosynthesis unit and the traditional genetics unit

**2** Comparison of posttest scores of students receiving CAI genetics unit and the traditional photosynthesis unit

**3** Comparison of posttest scores for students receiving the two educational treatments: CAI and traditional lecture/discussion
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Two sample t-test results of posttest achievement scores of students completing the traditional and CAI photosynthesis units</td>
<td>22</td>
</tr>
<tr>
<td>2</td>
<td>Two sample t-test results of posttest achievement scores of students completing the traditional and CAI genetics units</td>
<td>23</td>
</tr>
<tr>
<td>3</td>
<td>Paired t-test results of posttest achievement scores of the same students receiving different treatments for 2 units: CAI photosynthesis unit and traditional genetics unit</td>
<td>24</td>
</tr>
<tr>
<td>4</td>
<td>Paired t-test results of posttest achievement scores of the same students receiving different treatments for 2 units: CAI genetics unit and traditional photosynthesis unit</td>
<td>24</td>
</tr>
<tr>
<td>5</td>
<td>Paired t-test results of posttest scores of the same students comparing CAI and traditional treatments</td>
<td>26</td>
</tr>
<tr>
<td>6</td>
<td>Percent responses in 5 categories and the average response value on the Student Attitude Questionnaire completed by students participating in the CAI photosynthesis unit</td>
<td>30</td>
</tr>
<tr>
<td>7</td>
<td>Percent responses in 5 categories and the average response value on the Student Attitude Questionnaire completed by students participating in the CAI genetics unit</td>
<td>32</td>
</tr>
<tr>
<td>8</td>
<td>Percent responses in 5 categories and the average response value on the Student Attitude Questionnaire completed by all students participating in CAI units</td>
<td>34</td>
</tr>
<tr>
<td>9</td>
<td>Compilation of students' written comments on the Student Attitude Questionnaire after completing a CAI unit</td>
<td>36</td>
</tr>
<tr>
<td>10</td>
<td>Average response value, t-value, and probability values for each item on the Student Attitude Questionnaire completed by students participating in CAI units</td>
<td>38</td>
</tr>
</tbody>
</table>
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 redesigned 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

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 achievement 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, positive 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 Biological Science: An Ecological Approach, 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 Resource Book of Test Items,
Biological Science: An Ecological Approach, BSCS Green
Version, 5th Edition (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>
<thead>
<tr>
<th>Number in Sample</th>
<th>Traditional</th>
<th>CAI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>27</td>
<td>29</td>
</tr>
<tr>
<td>Mean*</td>
<td>14.70</td>
<td>14.17</td>
</tr>
<tr>
<td>t value</td>
<td>-.5941287</td>
<td></td>
</tr>
<tr>
<td>Probability</td>
<td>0.5549</td>
<td></td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th></th>
<th>Traditional</th>
<th>CAI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number in Sample</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Mean*</td>
<td>17.22</td>
<td>15.33</td>
</tr>
<tr>
<td>t value</td>
<td>-1.632631</td>
<td></td>
</tr>
<tr>
<td>Probability</td>
<td></td>
<td>0.1086</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th></th>
<th>Photosynthesis - CAI</th>
<th>Genetics - Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number in Sample</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Mean*</td>
<td>71.11</td>
<td>68.89</td>
</tr>
<tr>
<td>t value</td>
<td></td>
<td>0.7770964</td>
</tr>
<tr>
<td>Probability</td>
<td></td>
<td>0.44411</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td></td>
<td>0.5316</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th></th>
<th>Genetics - CAI</th>
<th>Photosynthesis - Traditional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number in Sample</td>
<td>27</td>
<td>27</td>
</tr>
<tr>
<td>Mean*</td>
<td>61.41</td>
<td>72.41</td>
</tr>
<tr>
<td>t value</td>
<td></td>
<td>3.436659</td>
</tr>
<tr>
<td>Probability</td>
<td></td>
<td>0.0020</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td></td>
<td>0.6000</td>
</tr>
</tbody>
</table>

*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>
<thead>
<tr>
<th>TABLE 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>PAIRED T-TEST RESULTS OF POSTTEST ACHIEVEMENT SCORES OF THE SAME STUDENTS COMPARING CAI AND TRADITIONAL TREATMENTS</td>
</tr>
<tr>
<td>CAI</td>
</tr>
<tr>
<td>---</td>
</tr>
<tr>
<td>Number in Sample</td>
</tr>
<tr>
<td>Mean*</td>
</tr>
<tr>
<td>t value</td>
</tr>
<tr>
<td>Probability</td>
</tr>
<tr>
<td>Correlation Coefficient</td>
</tr>
</tbody>
</table>

*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*

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>UN</th>
<th>D</th>
<th>SD</th>
<th>Avg^b</th>
</tr>
</thead>
<tbody>
<tr>
<td>no one cared if I learned</td>
<td>0</td>
<td>4</td>
<td>20</td>
<td>40</td>
<td>36</td>
<td>1.92</td>
</tr>
<tr>
<td>more involved with computer than lesson</td>
<td>0</td>
<td>12</td>
<td>20</td>
<td>52</td>
<td>16</td>
<td>2.28</td>
</tr>
<tr>
<td>worked at own pace</td>
<td>36</td>
<td>52</td>
<td>8</td>
<td>4</td>
<td>0</td>
<td>4.20</td>
</tr>
<tr>
<td>*CAI is too mechanical</td>
<td>4</td>
<td>8</td>
<td>8</td>
<td>54</td>
<td>25</td>
<td>2.13</td>
</tr>
<tr>
<td>uncomfortable with CAI</td>
<td>12</td>
<td>4</td>
<td>0</td>
<td>48</td>
<td>36</td>
<td>2.20</td>
</tr>
<tr>
<td>CAI is time efficient</td>
<td>24</td>
<td>60</td>
<td>12</td>
<td>4</td>
<td>0</td>
<td>4.04</td>
</tr>
<tr>
<td>CAI is more motivating than classroom instruction</td>
<td>44</td>
<td>28</td>
<td>8</td>
<td>8</td>
<td>12</td>
<td>3.84</td>
</tr>
<tr>
<td>CAI makes the subject more interesting</td>
<td>44</td>
<td>28</td>
<td>12</td>
<td>8</td>
<td>8</td>
<td>3.92</td>
</tr>
<tr>
<td>CAI is too impersonal</td>
<td>0</td>
<td>4</td>
<td>36</td>
<td>48</td>
<td>12</td>
<td>2.64</td>
</tr>
<tr>
<td>Prefer classroom teaching</td>
<td>8</td>
<td>12</td>
<td>24</td>
<td>16</td>
<td>40</td>
<td>2.32</td>
</tr>
<tr>
<td>Didn't care if missed a question</td>
<td>4</td>
<td>12</td>
<td>0</td>
<td>60</td>
<td>24</td>
<td>2.24</td>
</tr>
<tr>
<td>Liked the material before CAI</td>
<td>4</td>
<td>32</td>
<td>44</td>
<td>16</td>
<td>4</td>
<td>3.16</td>
</tr>
<tr>
<td>*Liked the material after CAI</td>
<td>4</td>
<td>63</td>
<td>33</td>
<td>0</td>
<td>0</td>
<td>3.71</td>
</tr>
<tr>
<td>Want more CAI units</td>
<td>44</td>
<td>36</td>
<td>8</td>
<td>4</td>
<td>8</td>
<td>4.04</td>
</tr>
<tr>
<td>Pressured to hurry up</td>
<td>12</td>
<td>16</td>
<td>12</td>
<td>40</td>
<td>20</td>
<td>2.60</td>
</tr>
<tr>
<td>Computer is not distracting</td>
<td>20</td>
<td>60</td>
<td>8</td>
<td>12</td>
<td>0</td>
<td>3.88</td>
</tr>
<tr>
<td>CAI is impersonal</td>
<td>0</td>
<td>16</td>
<td>48</td>
<td>36</td>
<td>0</td>
<td>2.80</td>
</tr>
</tbody>
</table>
### TABLE 6 (con't.)

<table>
<thead>
<tr>
<th>Statement</th>
<th>SA</th>
<th>A</th>
<th>UN</th>
<th>D</th>
<th>SD</th>
<th>Avg</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAI makes the material less interesting</td>
<td>20</td>
<td>8</td>
<td>4</td>
<td>48</td>
<td>20</td>
<td>2.60</td>
</tr>
<tr>
<td>*Comfortable with CAI</td>
<td>42</td>
<td>42</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>4.08</td>
</tr>
<tr>
<td>CAI is inefficient time wise</td>
<td>8</td>
<td>20</td>
<td>8</td>
<td>48</td>
<td>16</td>
<td>2.56</td>
</tr>
<tr>
<td>Classroom teaching is more motivating than CAI</td>
<td>12</td>
<td>8</td>
<td>16</td>
<td>28</td>
<td>36</td>
<td>2.32</td>
</tr>
<tr>
<td>Prefer CAI</td>
<td>44</td>
<td>24</td>
<td>12</td>
<td>12</td>
<td>8</td>
<td>3.84</td>
</tr>
<tr>
<td>Didn't like the material before CAI</td>
<td>8</td>
<td>20</td>
<td>40</td>
<td>32</td>
<td>0</td>
<td>3.04</td>
</tr>
<tr>
<td>*Didn't like the material after CAI</td>
<td>0</td>
<td>16</td>
<td>25</td>
<td>58</td>
<td>0</td>
<td>2.58</td>
</tr>
<tr>
<td>Do not want more CAI units</td>
<td>16</td>
<td>0</td>
<td>8</td>
<td>24</td>
<td>52</td>
<td>2.04</td>
</tr>
</tbody>
</table>

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 UNITa

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

^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>
<thead>
<tr>
<th>Statement</th>
<th>Student Response Category</th>
<th>Avg&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>No one cared if I learned</td>
<td>0 9 30 36 26</td>
<td>2.27</td>
</tr>
<tr>
<td>More involved with computer than lesson</td>
<td>6 21 15 45 13</td>
<td>2.64</td>
</tr>
<tr>
<td>Worked at own pace</td>
<td>32 40 17 11 0</td>
<td>3.94</td>
</tr>
<tr>
<td>*CAI is too mechanical</td>
<td>6 17 26 33 17</td>
<td>2.63</td>
</tr>
<tr>
<td>Uncomfortable with CAI</td>
<td>17 13 8 43 19</td>
<td>2.72</td>
</tr>
<tr>
<td>CAI is time efficient</td>
<td>15 43 21 15 6</td>
<td>3.45</td>
</tr>
<tr>
<td>CAI is more motivating than classroom instruction</td>
<td>32 28 6 17 17</td>
<td>3.40</td>
</tr>
<tr>
<td>CAI makes the subject more interesting</td>
<td>28 28 8 23 13</td>
<td>3.55</td>
</tr>
<tr>
<td>CAI is too impersonal</td>
<td>9 6 49 30 6</td>
<td>2.98</td>
</tr>
<tr>
<td>Prefer classroom teaching</td>
<td>26 15 21 13 25</td>
<td>2.77</td>
</tr>
<tr>
<td>Didn't care if missed a question</td>
<td>4 13 6 57 19</td>
<td>2.32</td>
</tr>
<tr>
<td>*Liked the material before CAI</td>
<td>2 46 37 9 7</td>
<td>3.28</td>
</tr>
<tr>
<td>*Liked the material after CAI</td>
<td>2 50 33 11 4</td>
<td>3.35</td>
</tr>
<tr>
<td>Want more CAI units</td>
<td>32 28 13 9 19</td>
<td>3.45</td>
</tr>
<tr>
<td>Pressured to hurry up</td>
<td>13 26 15 34 13</td>
<td>2.91</td>
</tr>
<tr>
<td>Computer is not distracting</td>
<td>15 49 19 13 4</td>
<td>3.57</td>
</tr>
<tr>
<td>CAI is impersonal</td>
<td>4 23 51 21 0</td>
<td>3.11</td>
</tr>
<tr>
<td>CAI makes the material less interesting</td>
<td>17 23 11 36 13</td>
<td>2.96</td>
</tr>
<tr>
<td>*Comfortable with CAI</td>
<td>24 37 17 15 6</td>
<td>3.57</td>
</tr>
</tbody>
</table>
TABLE 8 (con't.)

<table>
<thead>
<tr>
<th>Statement</th>
<th>Student Response Category</th>
<th>SA</th>
<th>A</th>
<th>UN</th>
<th>D</th>
<th>SD</th>
<th>Avg&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>CAI is inefficient timewise</td>
<td></td>
<td>6</td>
<td>15</td>
<td>28</td>
<td>38</td>
<td>13</td>
<td>2.96</td>
</tr>
<tr>
<td>Classroom teaching is more motivating than CAI</td>
<td></td>
<td>28</td>
<td>9</td>
<td>26</td>
<td>17</td>
<td>21</td>
<td>3.04</td>
</tr>
<tr>
<td>Prefer CAI</td>
<td></td>
<td>26</td>
<td>17</td>
<td>15</td>
<td>21</td>
<td>21</td>
<td>3.04</td>
</tr>
<tr>
<td>Didn't like the material before CAI</td>
<td></td>
<td>6</td>
<td>15</td>
<td>40</td>
<td>34</td>
<td>4</td>
<td>2.85</td>
</tr>
<tr>
<td>*Didn't like the material after CAI</td>
<td></td>
<td>2</td>
<td>22</td>
<td>39</td>
<td>35</td>
<td>2</td>
<td>2.87</td>
</tr>
<tr>
<td>Do not want more CAI units</td>
<td></td>
<td>26</td>
<td>13</td>
<td>6</td>
<td>21</td>
<td>34</td>
<td>2.57</td>
</tr>
</tbody>
</table>

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

<sup>b</sup> 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.

<table>
<thead>
<tr>
<th>TABLE 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>COMPILATION OF STUDENTS' WRITTEN COMMENTS ON THE STUDENT ATTITUDE QUESTIONNAIRE AFTER COMPLETING A CAI UNIT</td>
</tr>
</tbody>
</table>

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>
<thead>
<tr>
<th>Statement</th>
<th>Photo</th>
<th>Genetics</th>
<th>t-value</th>
<th>Prob. b</th>
</tr>
</thead>
<tbody>
<tr>
<td>No one cared if I learned</td>
<td>1.92</td>
<td>2.55</td>
<td>-2.416</td>
<td>0.020</td>
</tr>
<tr>
<td>More involved with computer than lesson</td>
<td>2.28</td>
<td>3.05</td>
<td>-2.336</td>
<td>0.025</td>
</tr>
<tr>
<td>Worked at own pace</td>
<td>4.20</td>
<td>3.64</td>
<td>2.023</td>
<td>0.050</td>
</tr>
<tr>
<td>*CAI is too mechanical</td>
<td>2.21</td>
<td>3.18</td>
<td>-3.183</td>
<td>0.003</td>
</tr>
<tr>
<td>Uncomfortable with CAI</td>
<td>2.08</td>
<td>3.32</td>
<td>-3.381</td>
<td>0.002</td>
</tr>
<tr>
<td>CAI is time efficient</td>
<td>4.04</td>
<td>2.77</td>
<td>4.667</td>
<td>0.000</td>
</tr>
<tr>
<td>CAI is more motivating than classroom instruction</td>
<td>3.84</td>
<td>2.91</td>
<td>2.190</td>
<td>0.034</td>
</tr>
<tr>
<td>CAI makes the subject more interesting</td>
<td>3.92</td>
<td>2.68</td>
<td>3.246</td>
<td>0.002</td>
</tr>
<tr>
<td>CAI is too impersonal</td>
<td>2.32</td>
<td>3.36</td>
<td>-4.334</td>
<td>0.000</td>
</tr>
<tr>
<td>Prefer classroom teaching</td>
<td>2.32</td>
<td>3.82</td>
<td>-3.780</td>
<td>0.000</td>
</tr>
<tr>
<td>Didn't care if missed a question</td>
<td>2.12</td>
<td>2.41</td>
<td>-0.938</td>
<td>0.353</td>
</tr>
<tr>
<td>*Liked the material before CAI</td>
<td>3.16</td>
<td>3.43</td>
<td>-0.996</td>
<td>0.325</td>
</tr>
<tr>
<td>*Liked the material after CAI</td>
<td>3.71</td>
<td>2.95</td>
<td>3.131</td>
<td>0.004</td>
</tr>
<tr>
<td>Want more CAI units</td>
<td>4.04</td>
<td>2.77</td>
<td>3.157</td>
<td>0.003</td>
</tr>
<tr>
<td>Pressured to hurry up</td>
<td>2.60</td>
<td>3.27</td>
<td>-1.840</td>
<td>0.072</td>
</tr>
<tr>
<td>Computer is not distracting</td>
<td>3.88</td>
<td>3.23</td>
<td>2.245</td>
<td>0.030</td>
</tr>
<tr>
<td>CAI is impersonal</td>
<td>2.80</td>
<td>3.45</td>
<td>-3.101</td>
<td>0.003</td>
</tr>
<tr>
<td>CAI makes the material less interesting</td>
<td>2.60</td>
<td>3.36</td>
<td>-1.996</td>
<td>0.052</td>
</tr>
<tr>
<td>*Comfortable with CAI</td>
<td>4.08</td>
<td>3.00</td>
<td>3.382</td>
<td>0.002</td>
</tr>
<tr>
<td>CAI is inefficient timewise</td>
<td>2.56</td>
<td>2.72</td>
<td>-0.520</td>
<td>0.606</td>
</tr>
<tr>
<td>Statement</td>
<td>Photo</td>
<td>Genetics</td>
<td>t-value</td>
<td>Prob.</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>-------</td>
<td>----------</td>
<td>---------</td>
<td>--------</td>
</tr>
<tr>
<td>Classroom teaching is more motivating than CAI</td>
<td>2.32</td>
<td>3.86</td>
<td>-4.062</td>
<td>0.000</td>
</tr>
<tr>
<td>Prefer CAI</td>
<td>3.84</td>
<td>2.14</td>
<td>4.609</td>
<td>0.000</td>
</tr>
<tr>
<td>Didn't like the material before CAI</td>
<td>3.04</td>
<td>2.64</td>
<td>1.464</td>
<td>0.150</td>
</tr>
<tr>
<td>*Didn't like the material after CAI</td>
<td>2.58</td>
<td>3.18</td>
<td>-2.493</td>
<td>0.016</td>
</tr>
<tr>
<td>Do not want more CAI units</td>
<td>2.04</td>
<td>3.54</td>
<td>-3.482</td>
<td>0.001</td>
</tr>
</tbody>
</table>

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 respondents 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

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 photosynthesis 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


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


APPENDIX A: Printout of the CAI Photosynthesis Unit
REM INTRODUCTORY GRAPHICS
GOSUB 200
REM MAIN MENU
GOSUB 285
IF C$ = "C" THEN GOSUB 300
IF C$ = "D" THEN GOSUB 2800
IF C$ = "D" THEN GOSUB 2800
TEXT : HOME : PRINT "YOU HAVE COMPLETED THIS FILE, AGENT" ; N$
TEXT: HOME
HTAB 11: VTAB 5: INVERSE: PRINT "SECURITY CLEARANCE"
NORMAL
VTAB 15: INPUT "ENTER THE SECRET CODE WORD: ";W$
IF U$ = "SUNLIGHT" THEN PRINT "CLEARANCE DENIED": FOR I = 1 TO 1000: NEXT I: GOTO 100
PRINT: INPUT "ENTER YOUR LAST NAME: ";N$
PRINT: PRINT "STATUS: ";FLASH: PRINT "CLEARED"
PRINT: NORMAL
PRINT "PRESS ANY KEY TO ENTER THE DOCUMENTS ROOM".
GET G$
RETURN
REM MAIN MENU
PRINT "NATIONAL SCIENCE ARCHIVES"
PRINT "FILE NO.: C6H12O6"
PRINT "THIS DISK CONTAINS THE FILE OF BACKGROUND INFORMATION ON YOUR ASSIGNMENT. IT IS A GOOD PLACE TO START!"
PRINT "OTHER FILES INCLUDE:"
PRINT "HISTORICAL DEVELOPMENT - DISK NUMBER 2"
PRINT "BIOCHEMISTRY OF PHOTOSYNTHESIS - DISK NUMBER THREE"
PRINT "EFFECTS OF ENVIRONMENTAL FACTORS - DISK NUMBER FOUR"
PRINT "IF YOU WANT THIS 'STARTER' FILE, TYPE C": PRINT "IF YOU WANT A DIFFERENT FILE, NOTE THE NUMBER OF THE DISK YOU'LL NEED AND TYPE D": INPUT C$
IF C$ = "C" THEN GOTO 299
IF C$ < > "D" THEN INPUT "CHOOSE C OR D: ";C$
RETURN
REM BACKGROUND INFORMATION
TEXT: HOME
GOSUB 10000: REM DR. A:VTAB 21
VTAB 21: PRINT "WELCOME, AGENT ";N$; "."
PRINT "I AM DR. ARTY CHoke, AUTHOR OF THE FILES ON PHOTOSYNTHESIS IS."
I will guide you through what information is available on this important topic.

First, let's start by breaking up the word photosynthesis.

What does photo mean? 

If G$ = "LIGHT" THEN PRINT "CORRECT!"

If G$ < "LIGHT" THEN PRINT "Not quite. Photo means light."

Photosynthesis requires light energy and is a process of building complex molecules from simple molecules.

Photosynthesis is the process by which green plants (and a few other organisms) convert light energy into chemical energy (food). In this case, the food is a sugar called glucose.

Let's discuss light energy.

What is the main source of all the Earth's energy? 

If G$ = "SUN" THEN PRINT "Good going, Agent "
IF G$ = "SUN" THEN PRINT "SORRY, YOU MUST KNOW THIS. GUESS AGAIN. CHECK YOUR NOTEBOOK!": GOTO 348
GOSUB 5000: HOME : VTAB 21
PRINT "DID YOU KNOW THAT LESS THAN HALF OF THE SUN’S ENERGY ACTUALLY REACHES THE EARTH?": GOSUB 5000: HOME
TEXT : HOME
PRINT "MOST OF THE SUN’S ENERGY IS ABSORBED OR REFLECTED BACK BEFORE IT REACHES THE EARTH’S ATMOSPHERE!"
PRINT : PRINT
INPUT "GUESS WHAT PERCENT OF THE SUN’S ENERGY IS ACTUALLY USED BY PRODUCERS IN PHOTOSYNTHESIS: "; G$
PRINT : PRINT "BE REALISTIC!"
PRINT : INPUT "TRY AGAIN: " ; G$
PRINT : PRINT "THE CORRECT ANSWER IS 1%." : PRINT : PRINT : GOSUB 5000: HOME
GOSUB 10400: VTAB 21
PRINT "WHAT DO YOU THINK WOULD HAPPEN TO US IF ALL THE SUN’S ENERGY REACHED THE EARTH?"
FOR I = 1 TO 3000: NEXT I
PRINT "FRIED PLANET, ANYONE?"
GOSUB 5000: HOME
TEXT : HOME
PRINT "THIS LEADS US TO AN IMPORTANT CONTRIBUTION OF GREEN PLANTS."
PRINT : PRINT "THINK BACK TO WHAT THE ORIGINAL ATMOSPHERE OF THE EARTH WAS LIKE."
PRINT : PRINT "IT WAS HOT, WITH METHANE, AMMONIA, WATER VAPOR, AND HYDROGEN."
PRINT : PRINT "WHAT GAS, ESSENTIAL FOR US (AND PLANTS), WAS MISSING?"
PRINT : INPUT "YOUR GUESS: " ; G$
IF G$ = "OXYGEN" THEN PRINT "RIGHT!": PRINT
IF G$ < "OXYGEN" THEN PRINT "COME ON, YOU REMEMBER...IT’S OXYGEN!"
PRINT
PRINT "PRODUCERS, THROUGH PHOTOSYNTHESIS, GIVE US FREE OXYGEN.";
PRINT "FREE OXYGEN IS OXYGEN MOLECULES THAT ‘STAND ALONE.’; THE
Y ARE NOT COMBINED WITH SOMETHING ELSE."
PRINT : INPUT "WHICH OF THE FOLLOWING IS AN EXAMPLE OF FREE OXYGEN
A) OH, (B) CHO, (C) NHO (D) O YOUR CHOICE: ";G$
IF G$ = "D" THEN PRINT "WHAT A CHEMIST!"
IF G$ < "D" THEN PRINT "I THINK YOU NEED TO REPEAT THIS PAGE!
THE CORRECT CHOICE IS D": FOR I = 1 TO 5000: NEXT I
GOSUB 5000: HOME
GOSUB 10300: HOME: VTAB 21
PRINT "THANKS TO PLANTS AND PHOTOSYNTHESIS WE HAVE FREE OXYGEN TO B
REATHE. SOME OF THIS FREE OXYGEN RECOMBINED INTO OZONE.";
GOSUB 5000: HOME : VTAB 21
INPUT "IS OZONE (3 MOLECULES OF OXYGEN) AN
EXAMPLE OF FREE OXYGEN? (Y/N)";G$
IF G$ < "Y" THEN PRINT "PLEASE ENTER A Y OR N": GOTO 382
IF G$ = "N" THEN PRINT "WHOOPS! YOU MADE A MISTAKE.";
GOSUB 5000
GOSUB 10600: HOME : VTAB 21: GOSUB 17000
GOSUB 10000: HOME : VTAB 21: PRINT "ARE YOU REMEMBERING TO TAKE NOTE
S ON THIS, AGENT ";N$; "?"
GOSUB 5000: GOSUB 10700: HOME : VTAB 21
PRINT "OF COURSE, BEHIND FREE OXYGEN, PHOTOSYN-
THESIS PROVIDES US WITH CHEMICAL ENERGY IN THE FORM OF FOOD!"
GOSUB 5000: HOME : GOSUB 10000: HOME : VTAB 21: PRINT "HOW Do PLANTS
MAKE FOOD? WHAT ARE THE SIMPLE MOLECULES THEY USE? ANSWERS TO T
Hese CAN BE FOUND IN OTHER FILES. BUT": GOSUB 5000: HOME
VTAB 21: PRINT "FIRST, LET’S REVIEW THIS FILE!!": PRINT : GOSUB 5000
TEXT : HOME
TEXT : HOME : PRINT "WHAT IS THE PURPOSE OF THE OZONE LAYER?": PRINT
PRINT "(A) SHIELD EARTH FROM MUCH OF THE SUN’S RADIATION"
PRINT : PRINT "(B) AIDS IN PHOTOSYNTHESIS": PRINT : PRINT " (C) IT WAS RESPONSIBLE FOR KEEPING THE EARTH’S ATMOSPHERE WARM"
PRINT : PRINT : INPUT "YOUR ANSWER: ":G$: PRINT
396 IF G$ = "B" THEN PRINT "THE PLANTS MADE THE OZONE LAYER. THE CORRECT CHOICE IS A."; GOSUB 5000: GOTO 400
397 IF G$ = "C" THEN PRINT "IT DID JUST THE OPPOSITE! THE CORRECT ANSWER 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 LIGHT 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 REACH THE EARTH"
404 PRINT : INPUT "YOUR SELECTION: " ; G$
405 PRINT : IF G$ = "A" THEN PRINT "TERRIFIC! READY FOR THE LAST QUESTION?"; RIGHT = RIGHT + 1: GOTO 410
406 PRINT : IF G$ = "B" THEN PRINT "THIS IS TRUE. THE CORRECT CHOICE IS A."
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 REACTIONS?"
413 PRINT : PRINT "(A) AN EXAMPLE OF THIS REACTION IS PHOTOSYNTHESIS"
414 PRINT : PRINT "(B) IT IS THE PROCESS OF BREAKING DOWN LARGE MOLECULES INTO SMALLER MOLECULES"
420 PRINT : PRINT "(C) THEY RESULT IN THE FORMATION OF COMPLEX MOLECULES"
422 PRINT : INPUT "YOUR ANSWER: " ; G$; PRINT
430 IF G$ = "B" THEN PRINT "CORRECT! SYNTHESIS GOES FROM SMALL TO BIG!"; RIGHT = RIGHT + 1: GOTO 451
435 IF G$ = "A" THEN PRINT "LOOK AT THE WORD PHOTOSYNTHESIS. SYM- THE SIS IS A PART OF IT. YOU SHOULD HAVE CHosen B."; GOTO 451
140 IF G$ = "C" THEN PRINT : PRINT "SYNTHESIS MEANS TO GO FROM SIMPLE TO 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. PERHAPS 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 THE 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 HPLLOT 90,140 TO 110,128 TO 110,104 TO 70,104 TO 70,84 TO 90,84 TO 90,64 TO 90,40 TO 90,128
10003 HPLLOT 90,96 TO 110,96 TO 110,76 TO 80,76 TO 80,60 TO 80,40 TO 100,36 TO 120,24 TO 140,36 TO 160,24 TO 180,36 TO 200,24 TO 200,60
10004 HPLLOT 200,60 TO 170,60 TO 170,96 TO 190,96 TO 190,84 TO 200,84 TO 210,84 TO 190,84 TO 210,84 TO 210,104 TO 170,104 TO 170,128
10005 HPLLOT 170,128 TO 190,140 TO 160,140 TO 140,121 TO 120,140 TO 90,14
0
10006 HPLLOT 110,116 TO 170,116
10007 HPLLOT 140,98 TO 140,116
10008 HPLLOT 150,104 TO 150,96 TO 160,96 TO 160,104 TO 150,104
10009 HPLLOT 110,83 TO 120,80 TO 130,88 TO 140,88 TO 150,88 TO 160,88 TO
170,88
10010 HPLLOT 110,64 TO 120,72 TO 160,72 TO 170,64
10011 HPLLOT 100,44 TO 120,44 TO 120,52 TO 100,52 TO 100,44
10012 HPLLOT 160,44 TO 180,44 TO 180,52 TO 160,52 TO 160,44
10013 HPLLOT 160,40 TO 180,40
10014 HPLLOT 120,40 TO 100,40
10015 RETURN
10100 REM LIGHT
10101 HGR 1 HCOLOR= 3
10102 HPLLOT 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 HPLLOT 120,140 TO 160,140
10106 HPLLOT 120,130 TO 160,130
10108 HPLLOT 210,105 TO 240,120
10110 HPLLOT 210,70 TO 240,70
10112 HPLLOT 140,38 TO 200,38
10114 HPLLOT 140,5 TO 140,25
10118 HPLLOT 110,30 TO 80,15
10120 HPLLOT 100,45 TO 40,30
10122 HPLLOT 70,70 TO 40,70
10124 HPLLOT 70,105 TO 40,120
10126 RETURN
10200 REM SYNTHESIS PICTURE
10201 HGR 1 HCOLOR= 3
10202 HPLLOT 50,136 TO 110,136 TO 110,64 TO 50,64 TO 50,136
10204 HPLLOT 125,80 TO 115,80 TO 115,100 TO 125,100
10206 HPLLOT 70,56 TO 70,40 TO 80,48 TO 70,56
10208 HPLLOT 55,56 TO 55,40 TO 65,48 TO 55,56
10210 HPLLOT 85,24 TO 100,24 TO 100,36 TO 85,36 TO 85,24
REM FLOWERS
HGR : HCOLOR = 3
H Pool 0,140 TO 250,140
H Pool 42,20 TO 56,20 TO 70,30 TO 70,45 TO 56,55 TO 42,59 TO 28,45 TO 28,38 TO 42,20
H Pool 49,15 TO 49,0,9; H Pool 56,15 TO 70,5
H Pool 77,25 TO 91,15; H Pool 77,35 TO 91,35
H Pool 42,60 TO 28,70; H Pool 28,50 TO 14,60; H Pool 21,35 TO 7,35
H Pool 21,25 TO 7,15; H Pool 35,15 TO 21,5
H Pool 77,120 TO 77,140; H Pool 70,125 TO 77,130 TO 84,125
H Pool 77,105 TO 77,115; H Pool 70,115 TO 84,105; H Pool 70,105 TO 84,115; H Pool 70,110 TO 84,110
H Pool 147,120 TO 147,140; H Pool 140,125 TO 147,130 TO 154,125
H Pool 140,105 TO 154,115; H Pool 140,115 TO 154,105
H Pool 147,105 TO 147,115; H Pool 148,110 TO 154,110
H Pool 217,105 TO 217,115; H Pool 218,105 TO 224,115
H Pool 210,110 TO 224,110; H Pool 210,115 TO 224,105
H Pool 217,120 TO 217,140; H Pool 210,125 TO 217,130 TO 224,125
H Pool 217,105 TO 217,115; H Pool 210,115 TO 224,105
H Pool 217,105 TO 217,115; H Pool 210,115 TO 224,125
RETURN
REM FRIED PLANET
HGR : HCOLOR = 3
FOR X = 100 TO 190 STEP 30
H Pool X,5 TO X - 10,10 TO X - 10,20 TO X,25
NEXT X
H Pool 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
H Pool 80,95 TO 60,95 TO 60,115 TO 80,130 TO 210,130 TO 230,115 TO 230,95 TO 210,85
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 96,18: HPLOT 73,75 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 30,35: 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 210,95 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 RAYS FROM REACHING OUR PLANET.": GOSUB 5000
17002  HOME : VTAB 21: PRINT "IT LED TO THE COOLING OF THE EARTH'S ATMOSPHERE 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 DRZOOWSKI MORRELL
12  PRINT CHR$ (4);"BRL LOMEM:: & LOMEM: 16384
15  REM FEBRUARY, 1987
16  REM VARIABLE LIST
17  REM N$=NAME, G$=GET VARIABLE; RIGHT = NUMBERS OF RIGHT ANSWERS PER UNIT
18  REM I=LOOP COUNTER, C$=MENU CHOICE
19  REM Q$=QUIT CHOICE
25 REM INITIALIZATION BLOCK:
26 DIM N$(30)
28 DIM W$(#)
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" IN$ 
100 END
200 REM INTRODUCTORY GRAPHICS
205 TEXT: HOME
210 HTAB 7: VTAB 6: PRINT "NATIONAL SCIENCE ARCHIVES"
220 VTAB 13: HTAB 7: PRINT "FILE NUMBER: C6H1206"
225 FLASH
225 HTAB 9: VTAB 28: 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 1000: 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"
PRINT "THIS DISK CONTAINS THE FILE ON THE HISTORICAL DEVELOPMENT OF PHOTOSYNTHESIS"

PRINT "OTHER FILES AVAILABLE ARE:" Print  
PRINT "BACKGROUND INFORMATION - DISK NUMBER ONE"
PRINT "BIOCHEMISTRY OF PHOTOSYNTHESIS - DISK NUMBER TWO"
PRINT "EFFECTS OF ENVIRONMENTAL FACTORS - DISK NUMBER THREE"

PRINT "IF THE HISTORICAL FILE IS WHAT YOU WANT, TYPE C. IF YOU WANT A DIFFERENT FILE, NOTE THE NUMBER OF THE DISK YOU'LL NEED AND TYPE D": C$ 
IF C$ = "C" THEN GOTO 305
IF C$ < > "D" THEN INPUT "YOU MUST CHOOSE C OR D": C$
RETURN

REM HISTORICAL DEVELOPMENT
GOSUB 10000: REM DR. AVTAB 21
PRINT "LET'S REVIEW A COMMON SCIENTIFIC PRINCIPLE: THE LAW OF CONSERVATION OF MATTER": GOSUB 5000
HOME: VTAB 21: PRINT "MATTER CANNOT BE CREATED NOR DESTROYED. HOW DOES THIS RELATE TO PHOTOSYNTHESIS?": GOSUB 5000: HOME: VTAB 21
GOSUB 10000: HOME: VTAB 21
PRINT "CONSIDER A SEED! WHAT HAPPENS TO THE MASS OF THE SEED AFTER IT IS PLANTED AND BEGINS TO GROW?": GOSUB 5000: HOME: VTAB 21
PRINT "OBVIOUSLY, IT GROWS LARGER! IF THE LAW OF CONSERVATION OF MATTER IS TRUE, WHAT GIVES THE PLANT ITS NEW SUBSTANCE?": GOSUB 5000: HOME

HOME: VTAB 21
GOSUB 10000
HOME: VTAB 21
PRINT "HOP ABOARD MY TIME TRAVELLER AND WE'LL GO BACK SEVERAL CENTURIES!": GOSUB 5000
TEXT: HOME
VTAB 5: HTAB 13: INVERSE: PRINT "TIME TRAVELLER": NORMAL
VTAB 10: PRINT "DESTINATIONS: 1. 1500'S" 
PRINT "2. 1600'S"
PRINT "3. 1700'S"
PRINT : PRINT "THE TIME TRAVELLER WON'T WORK UNLESS YOU BUCKLE YOUR SEAT BELT!"
PRINT "WHEN YOU'RE READY, HIT THE R KEY."
INPUT G$
IF G$ < "R" THEN PRINT "TIME WAITS FOR NO ONE!": GOTO 531
IF G$ = "R" THEN GOSUB 5000
GOSUB 10900: HOME : VTAB 21
PRINT "HERE WE ARE IN THE 16TH CENTURY. REMEMBER, MUCH OF THE SCIENTIFIC KNOWLEDGE WE TAKE FOR GRANTED TODAY...": GOSUB 5000
HOME : VTAB 21: PRINT "WAS NOT KNOWN AT THIS TIME. (BIOLOGY WAS JUST A GROWING CHILD!)": GOSUB 5000
GOSUB 10900
HOME : VTAB 21: PRINT "LET'S GO BACK TO OUR SEED. MARY, MARY, PLANTS HER GARDEN, BUT HOW DOES HER FLOWERS GROW?": GOSUB 5000: HOME : VTAB 21
PRINT "SCIENTISTS AT THIS TIME, KNOWING THE LAW OF CONSERVATION OF MATTER, ASSUMED SOIL WAS THE SOURCE OF NEW PLANT MATERIAL!": GOSUB 5000: HOME
GOSUB 10900: REM DR. A
HOME : VTAB 21
PRINT "THIS IDEA WAS WIDELY ACCEPTED AND LASTED UNTIL THE 17TH CENTURY. LET'S BOARD THE TIME MACHINE AGAIN AND GO THERE!": GOSUB 5000
TEXT : HOME
VTAB 5: HTAB 13: INVERSE : PRINT "TIME TRAVELLER": NORMAL
VTAB 10: HTAB 8: PRINT "DATELINE: 17TH CENTURY"
VTAB 15: PRINT "WE MADE IT!"
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 TEST THE HYPOTHESIS THAT SOIL WAS THE SOURCE OF NEW PLANT GROWTH."
GOSUB 5000: GOSUB 11080: REM JAN VAN HELMONT
HOME : VTAB 21
PRINT "THIS IS JAN VAN HELMONT! JAN, PLEASE TELL US ABOUT YOUR EXPERIMENT!": GOSUB 5000
PRINT "I'D BE DELIGHTED!": PRINT PRINT
PRINT "I PLANTED A 5 POUND WILLOW TREE IN A TUB CONTAINING 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."
PRINT PRINT "I TENDED THE TREE FOR 5 YEARS THEN RE-WEIGHED THE PLANT AND SOIL."
VTAB 20: GOSUB 5000
TEXT : HOME
VTAB 5: HTAB 10: PRINT "VAN HELMONT'S RESULTS"
VTAB 7: HTAB 23: PRINT "PLANT SOIL"
VTAB 9: PRINT "STARTING WEIGHT 5 200"
VTAB 11: PRINT "ENDING WEIGHT 169 199"
VTAB 13: PRINT "DIFFERENCE +164 -1"
PRINT PRINT PRINT PRINT "WHAT COULD JAN VAN HELMONT CONCLUDE WAS "
HTAB 10: INVERSE : PRINT "NOT": NORMAL
PRINT : PRINT "THE SOURCE OF PLANT MATTER?"
PRINT : INPUT "YOUR ANALYSIS: "G$
IF G$ < "SOIL" THEN PRINT PRINT "THIS IS THE 17TH CENTURY! IT COULDN'T HAVE BEEN THE SOIL!"
IF G$ = "SOIL" THEN PRINT PRINT "ABSOLUTELY CORRECT!"
PRINT : GOSUB 5008
GOSUB 10000: HOME : VTAB 21
PRINT "LET'S MOVE ON TO THE LATE 1700'S! ARE YOU REMEMBERING TO USE YOUR SPECIAL NOTEBOOK, AGENT "N$": GOSUB 5000: HOME : VTAB 21
PRINT "WE'LL BE VISITING WITH JOSEPH PRIESTLY PRIESTLY, NOT SURPRISINGLY, WAS AN ENGLISH CLERGYMAN (AND CHEMIST!): GOSUB 5000
HOME : VTAB 21: PRINT "HE DID A SERIES OF EXPERIMENTS THAT PROVED USEFUL IN DETERMINING THE SOURCE OF PLANT MATTER. IT'S ALL YOURS, JOE": GOSUB 5000
TEXT : HOME
PRINT "WELCOME TO MY LAB."
FOR MY FIRST EXPERIMENT, I PLACED A MINT SHOOT IN A CONTAINER OF WATER AND PLACED A GLASS JAR OVER THESE.

WHAT DO YOU THINK HAPPENED TO THE PLANT? (A) IT SOON DIED; (B) IT LIVED FOR SEVERAL MONTHS

IF G$ = "A" THEN PRINT "THAT'S WHAT I THOUGHT WOULD HAPPEN, TOO BUT IT DIDN'T!!"
IF G$ = "B" THEN PRINT "YOU MUST BE A PSYCHIC!"
IF G$ < "A" AND G$ < "B" THEN PRINT "YOUR CHOICES ARE A OR B" GOTO 602

WHAT DO YOU THINK HAPPENS WHEN YOU PLACE A GLASS JAR OVER A BURNING CANDLE: (A) NOTHING; (B) IT GOES OUT

IF G$ = "A" THEN PRINT "NO! IT WENT OUT!"
IF G$ = "B" THEN PRINT "YOU ARE A SUPER AGENT!"
IF G$ < "A" AND G$ < "B" THEN PRINT "CHOOSE A OR B, PLEASE!": GOTO 609

DO YOU KNOW WHY THE CANDLE GOES OUT? WHAT GAS DOES IT NEED, AGENT "JIM"?

(A) OXYGEN; (B) HYDROGEN; (C) CARBON DIOXIDE

INPUT G$

IF G$ < "A" AND G$ < "B" AND G$ < "C" THEN PRINT "YOUR CHOICES ARE A B OR C": GOTO 616

OXYGEN IS RIGHT!

OXYGEN IS THE GAS THAT IS NEEDED!

DO YOU KNOW WHY THE PLANT WAS PRODUCING?

OXYGEN"

BUBBLY RIGHT AGAIN!"
IF G$ (>) "OXYGEN" THEN PRINT "IF THE CANDLE NEEDS OXYGEN TO BURN, THEN THE MINT MUST BE PRODUCING OXYGEN."

IF USE "OX GEN" THEN PRINT "IF THE HANDLE HEEDS C/(GT:r TO BQH, THEN THE MINT MUST LE PRODUCING 0,./GEN."

PRINT "I TRIED ONE MORE EXPERIMENT."
PRINT "I PLACED A MOUSE AND A MINT PLANT UNDER A JAR. GUESS WHAT HAPPENED!!!"
PRINT "THE MOUSE LIVED!"
PRINT "I CAN SUM MY WORK UP BY SAYING IT WAS I WHO PROVED PLANTS RELEASE OXYGEN"
PRINT "WELL, I DID HAVE ONE MINOR PROBLEM. NO ONE, INCLUDING MYSELF, WAS ABLE TO REPEAT MY EXPERIMENTS SUCCESSFULLY!"
PRINT "AT LEAST, NOT FOR MANY YEARS."
PRINT PRINT : PRINT : PRINT : GOSUB 5000
GOSUB 10000: HOME
VTAB 21
PRINT "ACTUALLY IT ONLY TOOK 5 YEARS FOR SOME-ONE TO GET PRIESTLY'S EXPERIMENTS TO WORK."; GOSUB 5000
GOSUB 11100: REM INGENHOUSZ
HOME : VTAB 21
PRINT "THE MAN TO REPLICATE PRIESTLY'S WORK SUCCESSFULLY WAS JAN INGENHOUSZ. HE FOUND THAT PLANTS DO PRODUCE OXYGEN, BUT..."; GOSUB 5000
HOME : VTAB 21: PRINT "ONLY IF THEY'RE IN THEY'RE EXPOSED TO LIGHT!"; GOSUB 5000
GOSUB 10000
HOME : VTAB 21: PRINT "APPARENTLY, PRIESTLY OVERLOOKED THIS IMPORTANT FACTOR, WHEN HE REARRANGED HIS LAB!"; GOSUB 5000
HOME
VTAB 21: PRINT "LET'S OUTLINE THESE IMPORTANT DISCOVERIES AND THE ONES THAT FOLLOWED BEFORE WE LEAVE THIS TIME PERIOD."; GOSUB 5000
TEXT : HOME
HTAB 8: PRINT "HISTORY OF PHOTOSYNTHESIS"
PRINT PRINT : PRINT "I. VAN HELMONT FOUND SOIL WAS NOT THE SOURCE OF NEW PLANT MATTER. WATER WAS."
PRIESTLY DISCOVERED PLANTS PRODUCE OXYGEN.

INGENHOUSZ SHOWED PLANTS NEED LIGHT IN ORDER TO PRODUCE OXYGEN.

LATER DISCOVERIES SHOWED ONLY GREEN PLANT TISSUES RELEASE OXYGEN IN LIGHT.

PLANTS GROWING IN LIGHT TAKE IN CARBON DIOXIDE.

"BUCKLE UP FOR YOUR TRIP TO THE PRESENT."

”IN THE PROCESS, THE PLANTS TOOK IN WATER AND CARBON DIOXIDE AND RELEASED OXYGEN."

"THEREFORE, CARBON DIOXIDE AND WATER MUST BE THE SIMPLE MOLECULES USED IN THE SYNTHESIS REACTIONS OF PHOTOSYNTHESIS!"

"HOW THIS ALL HAPPENS CAN BE FOUND IN THE FILE ON DISK NUMBER 3"

"FOR NOW, TEST YOURSELF WITH THE FOLLOWING QUESTION:

WHAT DID VAN HELMONT SHOW WAS NECESSARY FOR ADDITIONAL PLANT MATERIAL?

(A) SOIL  (B) WATER  (C) LIGHT  (D) OXYGEN"

IF G$ = "A" THEN PRINT "THE SOIL DIDN'T LOSE HARDLY ANY WEIGHT! WATER IS THE SOURCE."
IF G$ = "B" THEN PRINT "CORRECT!"; RIGHT = RIGHT + 1
707 IF G$ = "C" THEN PRINT : PRINT "LIGHT WAS NEEDED, BUT THE MATTER THAT HELPED ADD TO PLANT MATERIAL IS WATER." : GOSUB 5000 : GOTO 710
708 IF G$ = "D" THEN PRINT : PRINT "PLANTS PRODUCE OXYGEN DURING PHOTOSYNTHESIS. 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 PLANTS 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 NEEDED. REMEMBER PRIESTLY'S MINT EXPERIMENTS!": GOSUB 5000 : GOTO 720
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 POINT. 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 WHETHER YOU WANT TO REBO 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
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 THE 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 HPL0T 90,140 TO 110,128 TO 110,104 TO 70,104 TO 70,84 TO 80,84 TO 80,76 TO 90,84 TO 70,84 TO 90,84 TO 90,96
10003 HPL0T 90,96 TO 110,96 TO 110,88 TO 80,60 TO 80,24 TO 100,36 TO 120,24 TO 160,24 TO 180,36 TO 200,24 TO 200,80
10004 HPL0T 200,80 TO 170,80 TO 170,96 TO 190,96 TO 190,84 TO 200,84 TO 210,84 TO 190,84 TO 210,84 TO 210,104 TO 170,104 TO 170,128
10005 HPL0T 170,128 TO 190,140 TO 160,140 TO 140,124 TO 120,140 TO 90,14
10006 HPL0T 110,116 TO 170,116
10007 HPL0T 140,80 TO 140,116
10008 HPL0T 150,104 TO 150,96 TO 160,96 TO 160,104 TO 150,104
10009 HPL0T 110,88 TO 120,80 TO 130,88 TO 140,80 TO 150,88 TO 160,88 TO 170,88
10010 HPL0T 110,64 TO 120,72 TO 160,72 TO 170,64
10011 HPL0T 100,44 TO 120,44 TO 120,52 TO 100,52 TO 100,44
10012 HPL0T 160,44 TO 180,44 TO 180,52 TO 160,52 TO 160,44
10013 HPL0T 160,48 TO 180,40
10014 HPL0T 120,40 TO 180,40
10815 RETURN
10820 REM CARRIAGE
10821 HGR : HCOLOR = 3
10822 HPLT 250,100 TO 30,100 TO 30,80 TO 120,100 TO 250,45 TO 50,45
10824 HPLT 65,100 TO 100,120 TO 65,140 TO 30,120 TO 65,100
10826 HPLT 215,100 TO 250,120 TO 215,140 TO 180,120 TO 215,100
10830 HPLT 180,45 TO 130,0 TO 200,0 TO 250,45
10832 HPLT 250,45 TO 250,100
10834 RETURN
10850 REM SEED
10851 HGR : HCOLOR = 3
10852 HPLT 30,50 TO 250,50
10854 HPLT 170,125 TO 190,115 TO 191,95 TO 180,85 TO 150,100 TO 130,100
10856 TO 110,110 TO 90,110 TO 80,105 TO 60,90 TO 130,65 TO 170,65 TO 180,
75 TO 130,85
10858 HPLT 180,75 TO 260,90 TO 200,115 TO 220,130
10860 HPLT 200,115 TO 200,140; HPLT 190,115 TO 190,135
10862 HPLT 200,115 TO 190,115
10864 RETURN
11000 REM VAN HELMONT
11001 HGR : HCOLOR = 3
11002 HPLT 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 HPLT 205,75 TO 225,65 TO 225,50 TO 205,50
11006 HPLT 75,30 TO 85,25 TO 105,25 TO 115,30 TO 75,30
11008 HPLT 135,30 TO 145,25 TO 165,25 TO 175,30 TO 135,30
11010 HPLT 85,45 TO 85,35 TO 105,35 TO 105,45 TO 85,45; HPLT 95,45 TO
95,40 TO 105,40
11012 HPLT 145,45 TO 145,35 TO 165,35 TO 165,45 TO 145,45; HPLT 155,45
TO 155,40 TO 165,40
11014 HPLT 125,35 TO 135,60 TO 125,65 TO 115,60 TO 125,55
11016 HPLT 105,95 TO 145,95 TO 135,100 TO 115,100 TO 185,95
11018 HPLT 125,70 TO 145,65 TO 165,65 TO 165,80 TO 175,80 TO 175,90 TO
145,90 TO 125,80
11020 HPLT 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 HPL 7,100 TO 7,10 TO 56,10 TO 56,100 TO 7,100
11104 HPL 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 HPL 14,60 TO 70,135: HPL 21,60 TO 84,130: HPL 35,60 TO 91,115
11108 HPL 49,60 TO 91,105: HPL 49,52 TO 98,95
11110 HPL 56,135 TO 185,95 TO 231,95 TO 196,135 TO 56,135
11112 HPL 98,135 TO 98,105 TO 161,105 TO 161,135
11114 HPL 112,115 TO 112,130: HPL 105,120 TO 112,125 TO 119,120: HPL 105,115 TO 112,120 TO 119,115
11116 HPL 133,130 TO 133,115 TO 147,115 TO 147,130 TO 133,130: HPL 126,120 TO 133,125 TO 126,130
11118 HPL 126,125 TO 133,125: HPL 147,125 TO 154,125: HPL 154,120 TO 147,125 TO 154,130
11120 HPL 133,115 TO 126,115 TO 133,110 TO 133,115
11122 HPL 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 UNIT
18 REM I=LOOP COUNTER, C$=MENU CHOICE
19 REM Q$=QUIT CHOICE
25 REM INITIALIZATION BLOCK
26 DIM N$(38)
27 DIM W$(9)
28 PRINT CHR$(4);"BRUN LOMEM:" & LOMEM: 16384
30 REM ************* DRIVER *************
35 REM INTRODUCTORY GRAPHICS
40 GOSUB 200
45 REM MAIN MENU
50 GOSUB 285
55 IF C$ = "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 1000: 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"
PRINT: PRINT "IF THE FILE ON CHEMISTRY IS WHAT YOU WANT TO VIEW, TYPE C" 
PRINT: PRINT "IF YOU WANT A DIFFERENT FILE, NOTE THE NUMBER OF THE DISK YOU'LL NEED AND TYPE D"
INPUT C$
IF C$ = "C" THEN GOTO 300
IF C$ < > "D" THEN INPUT "CHOOSE C OR D: ";C$
RETURN
REM BIOCHEMISTRY
TEXT: HOME
PRINT "READY TO TACKLE THE BIOCHEMICAL ASPECTS OF PHOTOSYNTHESIS: HOW PLANTS MAKE FOOD FROM CARBON DIOXIDE AND WATER."
PRINT: PRINT "TO MAKE THIS PARTICULAR FILE EASIER TO USE, I'VE DIVIDED IT INTO SUBSECTIONS."; PRINT: GOSUB 5000
TEXT: HOME: PRINT: PRINT: H TAB 6: PRINT "SUBSECTIONS OF DISK NUMBER 3"
PRINT: PRINT: PRINT: H TAB 5: PRINT "BIOCHEMISTRY OF PHOTOSYNTHESIS"
RIGHT = 0
PRINT: PRINT: PRINT: PRINT "(A) ROLE OF PLANT PIGMENTS": PRINT: PRINT: PRINT "(B) ADP/ATP CYCLE": PRINT: PRINT: PRINT "(C) LIGHT AND DARK REACTIONS"
PRINT: PRINT: INPUT "WHICH SUBSECTION WOULD YOU LIKE: ";G$
IF G$ = "A" THEN GOSUB 850: GOTO 824
IF G$ = "B" THEN GOSUB 975: GOTO 824
IF G$ = "C" THEN GOSUB 1170: GOTO 824
GOTO 814
GOTO 814
TEXT: HOME: PRINT "TYPE S FOR ANOTHER BIOCHEMICAL SUBSECTION";
PRINT: PRINT "OR": PRINT: PRINT: PRINT "TYPE D FOR A COMPLETELY DIFFERENT FILE OR TO QUIT FOR THE DAY"
PRINT: PRINT: INPUT G$
IF G$ = "S" THEN GOTO 888
IF G$ = "D" GOTO 45
GOTO 824
RETURN
REM PIGMENTS SUBROUTINE
851 TEXT: HOME: PRINT "IF YOU ARE TUNING IN AFTER DOING THE LABACTIVITY, TYPE L."; PRINT: PRINT "IF YOU HAVE NOT DONE THE CHROMATOGRAPHY 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) MITOCHONDRIA; (B) NUCLEUS; (C) CHLOROPLASTS YOUR ANSWER: ";G$
855 IF G$ < "C" THEN PRINT "CHLOROPLASTS ARE THE PLACE!"
856 IF G$ = "C" THEN PRINT "COLORFULLY CORRECT!"
857 GOSUB 5000: HOME
858 VTAB 21: PRINT "SCIENTISTS PROVED THIS BY REMOVING THESE STRUCTURES. THE CELL WITHOUT CHLOROPLASTS COULD NOT PHOTOSYNTHESIZE": GOSUB 5000: HOME
859 VTAB 21: PRINT "HOWEVER, THE REMOVED CHLOROPLASTS COULD": GOSUB 5000
860 TEXT: HOME: VTAB 5: HTAB 7: PRINT "STRUCTURE OF CHLOROPLASTS:" PRINT: PRINT "CHLOROPLASTS ARE MADE UP OF MANY LAYERS, BUT CONTAIN BASICALLY TWO PARTS!"
861 PRINT: PRINT "CRANA - CAPTURES THE LIGHT ENERGY OF THE SUN": PRINT
862 PRINT "STROMA WHERE ENERGY IS USED TO MIX CARBON DIOXIDE AND OXYGEN TO MAKE THE 'FOOD'": PRINT
863 PRINT: PRINT "A PICTURE OF A CHLOROPLAST CAN BE FOUND IN YOUR NOTEBOOK."
864 PRINT: GOSUB 5000
865 TEXT: HOME: VTAB 5: PRINT "TO CAPTURE LIGHT, PLANTS HAVE VARIOUS PIGMENTS. YOU SHOULD REMEMBER THAT PIGMENTS ARE CHEMICAL COMPOUNDS THAT ABSORB CERTAIN WAVELENGTHS OF LIGHT."
866 PRINT: PRINT "A LIST OF PIGMENTS AND THE COLORS THEY EACH REFLECT CAN BE FOUND IN YOUR NOTEBOOK."
867 PRINT: PRINT "WHICH OF THE PIGMENTS DO YOU THINK IS THE MOST IMPORTANT FOR ABSORBING THE LIGHT ENERGY USED IN PHOTOSYNTHESIS?"
868 PRINT: PRINT "(HINT: CHOOSE ONE FROM THE LIST IN YOUR NOTEBOOK)"
869 PRINT: INPUT "YOUR CHOICE: ";G$: PRINT
870 IF G$ < "CHLOROPHYLL" THEN PRINT "WHOOPS! THE CORRECT PIGMENT IS GREEN. TRY AGAIN."; GOTO 875
871 IF G$ = "CHLOROPHYLL" THEN GOSUB 11300: HOME
TEXT HOME VTAB 5 PRINT "YOU SHOULD HOW DO THE CHROMOTAGRAPHY LAB"
PRINT "BASICALLY, THIS LAB WILL ENABLE YOU TO SEPARATE MANY OF THE PLANT PIGMENTS FOUND IN SPINACH LEAVES."
PRINT "FULL DIRECTIONS CAN BE FOUND IN YOUR NOTEBOOK, ALONG WITH GUIDELINES."
PRINT "BE SURE TO COMPLETE THE LAB WRITE UP AND TURN IT IN WHEN YOU HAVE COMPLETED THE ACTIVITY."
REM REVIEW
TEXT HOME PRINT "REVIEW TIME, AGENT "; IN$ INPUT G$: PRINT IF G$ = "C" THEN PRINT "THAT'S THE 'BRAIN' BUT NOT WHERE PHOTOSYNTHESIS OCCURS. THE CORRECT CHOICE IS CHLOROPLASTS": GOTO 934 IF G$ = "B" THEN PRINT "THAT'S THE PIGMENT NEEDED. THE CELL STRUCTURE WHERE THAT IS FOUND, THOUGH, IS THE CHLOROPLAST!": GOTO 934 IF G$ = "A" THEN PRINT "I'M GREEN WITH ENVY! YOU'RE SO SMART!": RIGHT = RIGHT + 1: GOTO 934 PRINT "CHLOROPHYLL IS AN IMPORTANT PLANT PIGMENT MOSTLY BECAUSE IT IS!": PRINT "(A) GREEN": PRINT "(B) INVOLVED IN TRAPPING LIGHT ENERGY": PRINT "(C) FOUND IN SPINACH" PRINT "CHOOSE A B OR C": GOTO 929 PRINT "YOU ARE CORRECT!":RIGHT = RIGHT + 1: PRINT GOTO 942 IF G$ < "A" AND G$ > "C" THEN PRINT "PLEASE CHOOSE A B OR C": GOTO 937
IF G$ = "B" THEN PRINT "THIS IS TRUE, BUT IT'S NOT WHY CHLOROPHYLL IS MOST IMPORTANT. IT'S NEEDED BECAUSE IT TRAPS LIGHT ENERGY.": GOTO 942
PRINT : GOSUB 5000
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) CHROMATOGRAPHY"
PRINT : INPUT G$
IF G$ = "C" THEN PRINT "WHAT A SUPER SLEUTH!": RIGHT = RIGHT + 1: PRINT : GOTO 950
IF G$ = "A" OR G$ = "B" THEN PRINT "READ YOUR CHOICES AGAIN. THE CORRECT METHOD IS CHROMATOGRAPHY. IT'S THE METHOD YOU USED IN YOUR LAB!": PRINT : GOTO 950
PRINT : PRINT "CHOOSE A B OR C": GOTO 946
GOSUB 5000
TEXT : HOME : IF RIGHT = I THEN PRINT "YOU'RE DOING VERY WELL, AGENT ";N$: GOTO 955
TEXT : HOME : IF RIGHT = 2 THEN PRINT "YOU MAY BE READY FOR THE NEXT SECTION!": GOTO 955
IF RIGHT < 2 THEN PRINT "I RECOMMEND YOU GO THROUGH THIS FILE AGAIN, AGENT ";N$: GOTO 955
PRINT : GOSUB 5000
RETURN
REM ATP.ADP
TEXT : HOME : VTAB 5: PRINT "CONGRATULATIONS, AGENT ";N$: PRINT "YOU'RE NOW READY TO HANDLE THE SYNTHESIS REACTIONS THAT OCCUR IN PHOTOSYNTHESIS": PRINT : PRINT : PRINT
GOSUB 5000
TEXT : HOME : PRINT "TEST YOUR MEMORY.": PRINT : PRINT "WE LEARNED THAT PLANTS TAKE IN WHAT TWO SUBSTANCES?"
PRINT : PRINT "(A) CARBON DIOXIDE AND WATER": PRINT : PRINT "(B) OXYGEN AND WATER": PRINT : PRINT "(C) SOIL AND CARBON DIOXIDE"
PRINT : INPUT G$ : PRINT
981 IF G$ = "B" OR G$ = "C" THEN PRINT "YOUR MEMORY DIDN'T DO WELL. THE CORRECT CHOICE IS A: CARBON DIOXIDE AND WATER": GOTO 985
982 IF G$ = "A" THEN PRINT "YOU COULD PUT AN ELEPHANT TO SHAME WITH YOUR 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) OXYGEN AND FOOD"
989 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 NOW):";
1004 PRINT : PRINT "WHAT WAS NECESSARY FOR PLANTS TO CARRY ON PHOTOSYNTHESIS?"
1006 PRINT : PRINT "(A) LIGHT ENERGY": PRINT : PRINT "(B) CHEMICAL ENERGY": PRINT : PRINT "(C) MECHANICAL ENERGY"
1008 PRINT : INPUT "I'LL LET YOU REALLY GUESS THIS TIME. YOUR CHOICE:"
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: PHOTOSYNTHESE?"
1015 PRINT : PRINT : GOSUB 5000: TEXT : HOME
1016 PRINT : PRINT : PRINT "USING WHAT WE JUST REVIEWED, WE CAN WRITE THE CHEMICAL EQUATION FOR PHOTOSYNTHESIS."
1017 PRINT : PRINT "THE CARBON DIOXIDE AND WATER COMBINE IN THE PRESENCE OF LIGHT ENERGY TO MAKE GLUCOSE (A SUGAR - FOOD) AND OXYGEN."
1018 PRINT : PRINT "THIS CHEMICAL EQUATION IS WRITTEN IN YOUR NOTEBOOK. SPEND SOME TIME NOW TO REVIEW THIS FORMULA."
1019 PRINT : GOSUB 5000
I have a tough question for you.

Is the oxygen released by the plant during photosynthesis coming from the carbon dioxide or the water?

What do you think? (A) Carbon dioxide; (B) Water.

If $G < "A"$ and $G < "B"$ then print: You have to choose between A and B! GOTO 1027

If $G = "B"$ then print: You are a whiz! Scientists ran many experiments to figure out the source of oxygen was indeed the water! GOTO 1036

Scientists ran many experiments to figure out the source of oxygen was actually the water.

Back to our reaction...

Photosynthesis actually occurs in two reaction s.

Before I can explain these to you, we must learn something about how cells store energy.

What do we break to get energy? I'll give you a hint, it's got 5 letters begins with a B and ends in s: "$G$"

If $G = "BONDS"$ then print: What an agent! Right, again! GOTO 1

If $G < "BONDS"$ then print: Really, now! We break bonds to get energy!

In plant cells (and in our cells) is a chemical called adenosine triphosphate or ATP for short.

What does tri mean? "$G$"

You know tri means three.

GOSUB 5000: TEXT: HOME

So ATP is a chemical called adenosine that has three phosphate groups bonded to it.

Your notebook has a sketch of how chemists would draw the formula for this compound.
PRINT: PRINT "NOTICE THE WAVY LINES BETWEEN THE PHOSPHATE GROUPS. WAVY LINES MEAN THESE BONDS ARE EASY TO BREAK."

PRINT: PRINT "WHAT WOULD BE RELEASED IF WE BREAK OFF A PHOSPHATE GROUP?"

PRINT: PRINT "WHEN YOU THINK YOU KNOW THE ANSWER, CONTINUE."

PRINT: PRINT: GOSUB 5000

TEXT: HOME: VTAB 12: HTAB 17: INVERSE: PRINT "ENERGY": NORMAL

VTAB 18: PRINT "WERE YOU RIGHT? I HOPE SO!": PRINT: GOSUB 5000

TEXT: HOME: PRINT "HOW MANY PHOSPHATE GROUPS ARE LEFT AFTER WE BREAK THAT BOND IN ATP?"

PRINT: PRINT "LOOK AT THE SKETCHES IN YOUR NOTEBOOK. IF ONE BOND IS BROKEN, ONLY 2 PHOSPHATE GROUPS WOULD BE LEFT."

PRINT: PRINT "WHAT DO YOU THINK THE RESULTING COMPOUND IS CALLED?"

PRINT: PRINT "IT'S NOW CALLED ADENOSINE DIPHOSPHATE OR ADP." "ADP IS ADENOSINE WITH 2 PHOSPHATE GROUPS BONDED TO IT."

PRINT: PRINT "ATP HAS 3 PHOSPHATE GROUPS AND ADP HAS 2 PHOSPHATE GROUPS."

PRINT: GOSUB 5000

TEXT: HOME

PRINT: "IF ENERGY IS STORED IN BONDS, WHICH COMPOUND HAS MORE ENERGY? ATP OR ADP?"

PRINT: INPUT G$"ADP"

IF G$ = "ADP" THEN PRINT "COUNT THE BONDS IN THE SKETCHES. ATP HAS MORE! MORE BONDS USUALLY MEANS MORE STORED ENERGY"

IF G$ = "ATP" THEN PRINT "ARE YOU SURE YOU'RE AN AGENT AND NOT A CHEMIST?"

IF G$ <> "ADP" AND G$ <> "ATP" THEN PRINT "CHOOSE BETWEEN ATP AND ADP": GOTO 1090

PRINT: PRINT "IF I BREAK A PHOSPHATE GROUP OFF OF ATP AND RELEASE ENERGY, I'LL GET ADP."

PRINT: PRINT "IF I DO JUST THE OPPOSITE, I CAN CHANGE ADP BACK INTO ATP."

PRINT: PRINT "LET'S TRY IT THIS WAY": PRINT: GOSUB 5000: PRINT

GOSUB 11400: REM ATP/ADP SKETCH

HOME
VTAB 21: PRINT "OUR BODY STORES ENERGY BY PUTTING IT IN TO ADP TO MAKE ATP."; PRINT : GOSUB 5000: HOME

VTAB 21: PRINT "OUR BODY GETS ENERGY BY BREAKING THE LAST PHOSPHATE BOND IN ATP AND MAKING ADP."; GOSUB 5000

TEXT : HOME

HOME

VTAB 18: PRINT "PERSONALLY, I LIKE TO THINK OF ATP AS AN ENERGY JAR. ENERGY JARS ARE LIKE COOKIE JARS."; PRINT : PRINT : PRINT

PRINT "A COOKIE JAR HOLDS COOKIES. AFTER YOU FILL IT, YOU PLACE THE LID ON. TO GET COOKIES OUT, YOU TAKE THE LID OFF."; PRINT : GOSUB 5000

HOME

HOME

HOME

VTAB 21: PRINT "ATP HOLDS ENERGY. WHEN IT'S FULL, THE LID (THIRD PHOSPHATE GROUP) IS ATTACHED."; GOSUB 5000: HOME

VTAB 21: PRINT "WHEN ENERGY IS NEEDED, THE THIRD PHOSPHATE GROUP IS REMOVED."; GOSUB 5800

GOSUB 11500: HOME : REM JARS

VTAB 21: PRINT "IN PLANTS, WHAT IS THE SOURCE OF ENERGY USED TO CONVERT ADP BACK INTO ATP?"; G$:

IF G$ < "SUN" THEN PRINT OH,AGENT,"; N$: PRINT "YOU KNOW THE SUN." : GOSUB 50130

IF G$ = "SUN" THEN PRINT "RIGHT! THE SUN! YOU'RE SO BRIGHT." : GOSUB 5000

HOME : VTAB 21

PRINT "HAVE YOU REALLY UNDERSTOOD THIS, AGENT?"; N$: PRINT "WHICH HAS MORE ENERGY STORED IN IT (A) ATP OR (B) ADP?"

INPUT "YOUR CHOICE: "; G$

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

IF G$ = "A" THEN PRINT : PRINT "GREAT CHOICE!"; RIGHT = RIGHT + 1: GOTO 1140
PRINT "CHOOSE A OR B, PLEASE": GOTO 1134
PRINT : PRINT : GOSUB 5006
TEXT : HOME : PRINT "WHEN THE CELL NEEDS ENERGY, WHICH DOES IT DO?"
PRINT : PRINT "(A) BREAK THE BOND BETWEEN THE LAST PHOSPHATE GROUPS OF ATP": PRINT : PRINT "(B) BUILD THE BOND BETWEEN THE LAST PHOSPHATE GROUPS OF ADP"
PRINT : PRINT "(C) BREAK THE BOND BETWEEN THE LAST PHOSPHATE GROUPS OF ADP"
INPUT G$
IF G$ = "A" THEN PRINT : PRINT "WAY TO GO!": RIGHT = RIGHT + 1: GOTO 1158
IF G$ = "B" OR G$ = "C" THEN PRINT : PRINT "THINK AGAIN. BONDS IN ATP ARE BROKEN TO RELEASE ENERGY."; GOTO 1150
PRINT : PRINT "YOU MUST ENTER A B OR C": GOTO 1145
PRINT : PRINT : GOSUB 5000
TEXT : HOME : PRINT "WHEN THE CELL WANTS TO STORE ENERGY, WHAT DOES IT DO?"
PRINT : PRINT "(A) BREAK THE BOND BETWEEN THE LAST PHOSPHATE GROUPS OF ATP": PRINT : PRINT "(B) ADD A BOND TO THE LAST PHOSPHATE GROUP OF ADP": PRINT : PRINT "(C) BREAK THE BOND BETWEEN THE LAST PHOSPHATE GROUPS"
INPUT G$
IF G$ = "A" OR G$ = "C" THEN PRINT "SORRY. THE CELLS STORES ITS ENERGY BY BUILDING THE LAST PHOSPHATE BOND IN ADP."; GOTO 1160
IF G$ = "B" THEN PRINT : PRINT "YOU'RE COOKING NOW!": RIGHT = RIGHT + 1: GOTO 1160
PRINT : PRINT "A B OR C, PLEASE": GOTO 1155
GOSUB 5000: TEXT : HOME
IF RIGHT = 3 THEN PRINT "GREAT JOB! YOU'RE READY TO GO ON."; GOSUB 5000: GOTO 1165
IF RIGHT < 2 THEN PRINT "I THINK YOU ARE A BIT FUZZY ABOUT ATP AND ADP. YOU SHOULD PROBABLY GO THROUGH THIS SECTION AGAIN."; GOSUB 5000: GOTO 1165
IF RIGHT = 2 THEN PRINT "YOU HAVE A FAIR UNDERSTANDING OF ATP. YOU DECIDE WHETHER YOU WANT TO LOOK THROUGH THIS FILE AGAIN OR MOVE ON."
: GOSUB 5000: GOTO 1165

RETURN

1170 TEXT : HOME

1171 VTAB 10: PRINT "YOU ARE AN AMAZING AGENT! YOU'VE COME SO FAR IN UNDERSTANDING 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 AND 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 PIGMENTS, CHLOROPHYLL"

1181 PRINT : PRINT "2. ENERGY IS STORED IN ATP": PRINT : PRINT "3. SOME ENERGY IS USED TO SPLIT WATER MOLECULES. THE HYDROGEN IS HELD BY 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 ABSORBED 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 (OBTAINED FROM THE WATER) TO FORM GLUCOSE."

1186 PRINT : PRINT "2. SINCE NEW BONDS ARE BEING MADE, ENERGY IS USED. THIS ENERGY COMES FROM ATP, CHANGING IT INTO ADP."
1187 PRINT : PRINT "THEREFORE, IN THE DARK REACTION, GLUCOSE IS MADE AND
ATP IS CONVERTED TO ADP."
1188 PRINT : GOSUB 5900 : 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 PHOTOSYNTHESIS, INDICATING WHAT HAPPENS IN
THE LIGHT AND IN THE DARK REACTIONS."
1191 PRINT : PRINT "TAKE A FEW MOMENTS NOW TO REVIEW THIS DRAWING."
1192 PRINT : 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 EVENT. INDICATE WHE
OTHER IT OCCURS IN THE LIGHT REACTION (L) OR IN THE DARK REACTION (D)
PLEASE ENTER THE APPROPRIATE LETTER WHEN PROMPTED": 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$
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 118 STEP 5
11304 HPLOT 56,Y TO 98,Y
11305 NEXT Y
11306 FOR Y = 45 TO 118 STEP 5
11308 HPLOT 140,Y TO 182,Y
11310 NEXT Y
11312 FOR Y = 45 TO 118 STEP 5
11314 HPLOT 217,Y TO 252,Y
11316 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
HPlot 18,140 to 18,112 to 30,112 to 30,140: HPlot 18,126 to 30,126
HPlot 36,140 to 36,112 to 42,112 to 48,119 to 48,133 to 42,140 to 36,140
HPlot 54,140 to 54,112 to 66,112 to 66,126 to 54,126
HPlot 78,119 to 78,133: HPlot 72,126 to 64,126
HPlot 102,140 to 90,140 to 90,112 to 102,112: HPlot 90,126 to 96,126
HPlot 114,119 to 114,133: HPlot 108,126 to 120,126
HPlot 126,140 to 126,112 to 138,112 to 138,126 to 126,126
HPlot 144,126 to 174,126 to 168,119: HPlot 168,133 to 174,126
HPlot 160,140 to 180,112 to 192,112 to 192,140: HPlot 180,126 to 192,126
HPlot 192,112 to 210,112: HPlot 204,112 to 204,140
HPlot 216,140 to 216,112 to 228,112 to 228,126 to 216,126
RETURN
REM JARS
HSet HColor= 3
HPlot 30,120 to 30,15 to 66,15 to 66,120 to 30,120
HPlot 30,85 to 66,85; HPlot 38,50 to 66,50
HPlot 42,45 to 42,25 to 54,25 to 54,35 to 42,35
HPlot 42,80 to 42,60 to 54,60 to 54,70 to 42,70
HPlot 42,115 to 42,95 to 54,95 to 54,105 to 42,105
HPlot 30,140 to 30,138 to 36,130 to 36,140: HPlot 30,135 to 36,135
HPlot 42,130 to 54,130: HPlot 48,130 to 48,140
HPlot 60,140 to 66,130 to 66,120 to 66,135 to 60,135
HPlot 186,50 to 194,15 to 222,15 to 222,50 to 186,50
HPlot 198,45 to 198,25 to 210,25 to 210,35 to 198,35
HPlot 180,5 to 168,5 to 180,25 to 168,25 to 168,15 to 174,15
HPlot 180,5 to 168,5 to 180,25 to 168,25 to 168,15 to 174,15
HPlot 156,50 to 156,35 to 162,25: HPlot 156,25 to 162,25 to 162,30
HPlot 132,120 to 132,50 to 168,50 to 168,120 to 132,120
HPlot 132,85 to 148,85
HPlot 144,115 to 144,95 to 156,95 to 156,105 to 144,105
11532  HPL 144,00 TO 144,40 TO 156,40 TO 156,80 TO 144,80 TO 144,00
11534  HPL 138,40 TO 138,130 TO 144,130 TO 144,40: HPL 138,135 TO 144,135
11536  HPL 150,140 TO 150,130 TO 156,135 TO 150,140
11538  HPL 162,140 TO 162,130 TO 168,130 TO 168,135 TO 162,135
11540  RETURN
16000  REM JARS 2
16001  HG: HCOLOR= 3
16002  HPL 80,24 TO 110,24 TO 110,52 TO 80,52 TO 80,24
16004  HPL 80,88 TO 110,88 TO 110,116 TO 80,116 TO 80,88
16006  HPL 80,116 TO 110,116 TO 110,144 TO 80,144 TO 80,116
16008  HPL 90,52 TO 90,56
16010  HPL 90,60 TO 90,64
16012  HPL 90,68 TO 90,72
16014  HPL 90,76 TO 90,80
16018  HPL 85,80 TO 90,84 TO 95,80
16020  HPL 90,48 TO 90,32 TO 100,32 TO 100,40 TO 90,40
16022  HPL 105,60 TO 95,60 TO 95,68 TO 105,68
16024  HPL 95,68 TO 95,76 TO 105,76
16026  HPL 90,112 TO 90,96 TO 100,96 TO 100,104 TO 90,104
16028  HPL 190,148 TO 190,156
16030  HPL 200,156 TO 200,148 TO 205,148 TO 205,152 TO 200,152
16032  HPL 90,140 TO 90,124 TO 100,124 TO 100,132 TO 90,132
16034  HPL 80,156 TO 80,148 TO 85,148 TO 85,156
16036  HPL 80,152 TO 85,152
16038  HPL 90,148 TO 95,152 TO 90,156 TO 90,148
16039  HPL 100,156 TO 100,148 TO 105,148 TO 105,152 TO 100,152
16040  HPL 175,144 TO 175,60 TO 205,60 TO 205,144 TO 175,144
16042  HPL 175,88 TO 205,88
16044  HPL 175,116 TO 205,116
16046  HPL 185,84 TO 185,68 TO 195,68 TO 195,76 TO 185,76
16048  HPL 185,112 TO 185,96 TO 195,96 TO 195,104 TO 185,104
16050  HPL 185,140 TO 185,124 TO 195,124 TO 195,132 TO 185,132
16052  HPL 175,156 TO 175,148 TO 180,148 TO 180,156
16054  HPL 175,152 TO 180,152
16056  HPL 185,148 TO 195,148
16058 RETURN
17000 REM WHOOPS
17001 HOME: PRINT "WELL, OZONE BLOCKS MUCH OF THE SUN'S RAYS FROM REACHING OUR PLANET."; GOSUB 5000
17002 HOME: PRINT "IT LED TO THE COOLING OF THE EARTH'S ATMOSPHERE AND..."; 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$
17104 IF G$ = "L" THEN PRINT "LIGHT ONLY OCCURS IN THE LIGHT"; GOTO 17110
17105 IF G$ = "D" THEN PRINT "LIGHT ENERGY IS ABSORBED DURING THE LIGHT REACTION"; GOTO 17116
17106 IF G$ = "D" THEN PRINT "GOOD START"; RIGHT = RIGHT + 1; PRINT: PRINT: GOTO 17110
17107 PRINT "ENTER L OR D"; GOTO 17103
17108 PRINT: PRINT: PRINT "ENERGY IS ABSORBED AND ATP IS FORMED"
17109 PRINT: INPUT G$
17110 IF G$ = "D" THEN PRINT "LIGHT ENERGY IS ABSORBED DURING THE LIGHT REACTION"; GOTO 17116
17111 IF G$ = "L" THEN PRINT "HATS OFF TO YOU!"; RIGHT = RIGHT + 1; PRINT: PRINT: GOTO 17110
17112 PRINT "CHOOSE L OR D"; GOTO 17112
17113 PRINT: PRINT: GOSUB 5000
17114 TEXT: HOME: PRINT "REMINDER: CHOOSE L FOR LIGHT OR D FOR DARK"
17115 PRINT: PRINT "ENERGY IS USED SO ADP IS MADE"
17116 PRINT: INPUT G$
17117 IF G$ = "D" THEN PRINT "ABSOLUTELY!"; RIGHT = RIGHT + 1; PRINT: PRINT: GOTO 17120
IF G$ = "L" THEN PRINT "ENERGY IS ABSORBED DURING THE LIGHT REACTION 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 THE 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 REACTION.. THE HYDROGEN 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."
17141 IF G$ = "D" THEN PRINT : PRINT "YOU SURE KNOW WHEN THE FOOD'S BEING 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 UNIT
18 REM I=LOOP COUNTER, C$=MENU CHOICE
17 REM Q$=QUIT CHOICE
25 REM INITIALIZATION BLOCK
26 DIM N$(30)
27 DIM W$(9)
REM INTRODUCTORY GRAPHICS
GOSUB 200
REM MAIN MENU
GOSUB 285
IF C$ = "C" THEN GOSUB 1200
IF C$ = "D" THEN GOSUB 2008: GOTO 100
TEXT : HOME : PRINT "IF YOU WANT TO REVIEW THIS FILE, TYPE ANR. IF YOU ARE THROUGH, TYPE A Q.:": INPUT G$
IF G$ = "R" THEN GOTO 45
IF G$ = "Q" THEN TEXT : HOME : PRINT "YOU HAVE COMPLETED ALL THE FILES IN THE NATIONAL SCIENCE ARCHIVES DATA BASE NO. C6H1206."
PRINT : PRINT "WE HOPE YOU HAVE ENJOYED THIS PRIVILEGE!"
END
REM INTRODUCTORY GRAPHICS
TEXT : HOME
HTAB 7: VTAB 6: PRINT "NATIONAL SCIENCE ARCHIVES"
VTAB 13: HTAB 9: PRINT "FILE NUMBER: C6H1206"
FLASH
HTAB 9: VTAB 20: PRINT "CLASSIFIED INFORMATION"
FOR I = 1 TO 4000: NEXT I
TEXT : HOME
HTAB 11: VTAB 5: INVERSE : PRINT "SECURITY CLEARANCE"
NORMAL
VTAB 15: INPUT "ENTER THE SECRET CODE WORD: "; W$
IF W$ <> "SUNLIGHT" THEN PRINT "CLEARANCE DENIED": FOR I = 1 TO 1000: NEXT I: GOTO 100
PRINT : PRINT "ENTER YOUR LAST NAME: "; N$
PRINT : PRINT "STATUS: ";
FLASH : PRINT "CLEARED"
PRINT : NORMAL
PRINT "PRESS ANY KEY TO ENTER THE DOCUMENTS ROOM"
GET G$
RETURN
REM MAIN MENU
TEXT : HOME  
PRINT "NATIONAL SCIENCE ARCHIVES"
PRINT "FILE NO.: C6H1206"
PRINT : PRINT "THIS DISK CONTAINS THE FILE ON WAYS THE ENVIRONMENT CAN AFFECT PHOTOSYNTHESIS"
PRINT : PRINT "OTHER FILES AVAILABLE ARE:"  
PRINT : PRINT "BACKGROUND INFORMATION - DISK NUMBER ONE"
PRINT : PRINT "HISTORICAL DEVELOPMENT - DISK NUMBER TWO"
PRINT : PRINT "BIOCHEMISTRY OF PHOTOSYNTHESIS - DISK NUMBER THREE"
PRINT : PRINT "IF THE ENVIRONMENTAL FILE IS WHAT YOU WANT, TYPE C"
PRINT : PRINT "IF YOU WANT A DIFFERENT FILE, NOTE THE NUMBER OF THE DISK YOU'LL NEED AND TYPE D"
INPUT CS
IF CS = "C" THEN GOTO 305
IF CS < > "D" THEN PRINT "YOU MUST PICK C OR D": GOTO 293
RETURN
REM EFFECTS OF ENVIRONMENTAL FACTORS
TEXT : HOME : GOSUB 10000
HOME : VTAB 21
PRINT "I'VE TAUGHT YOU ALMOST EVERYTHING I KNOW ABOUT PHOTOSYNTHESIS, AGENT":N$: GOSUB 5000
HOME : VTAB 21
PRINT "THERE'S ONLY ONE MORE AREA TO LOOK AT...HOW ENVIRONMENTAL FACTORS AFFECT THE RATE OF PHOTOSYNTHESIS": GOSUB 5000
TEXT : HOME : VTAB 5: PRINT "YOUR NOTEBOOK LISTS SIX ENVIRONMENTAL FACTORS THAT MAY HAVE AN EFFECT ON HOW MUCH PHOTOSYNTHESIS CAN BE CARRIED ON BYA PLANT."
PRINT : PRINT : PRINT "WE'LL DISCUSS THEM INDIVIDUALLY, STARTING WITH RADIANT ENERGY."
PRINT : PRINT : PRINT : PRINT "HOW WOULD RADIANT ENERGY AFFECT A PLANT'S PHOTOSYNTHETIC RATE?"
PRINT : PRINT : PRINT "WHICH PLANT DO YOU THINK WOULD PHOTOSYNTHESIZE MORE, A PLANT NEAR (A) THE NORTH POLE; OR (B) THE EQUATOR"
INPUT G$: PRINT
1217 IF G$ < > "A" AND G$ < > "B" THEN GOTO 1214
1218 IF G$ = "A" THEN PRINT "PLANTS THERE ARE STUNTED! B IS THE CORRECT CHOICE"
1222 TEXT : HOME : VTAB 5 : PRINT "WHAT ABOUT TEMPERATURE?"
1224 PRINT : PRINT : PRINT "WHAT WOULD HAPPEN TO A PALM TREE PLANTED IN GREENLAND OR TO A DOUGLAS FIR PLANTED IN NEVADA?"
1226 PRINT : PRINT : INPUT "ARE PLANTS ADAPTED TO GROW IN A PARTICULAR CLIMATE? (Y/N) " : G$ : GOSUB 5000
1228 IF G$ < > "N" AND G$ < > "Y" THEN PRINT "CHOOSE Y OR N": GOTO 1226
1230 IF G$ = "N" THEN PRINT "DO YOU REALLY THINK NOT? "
1232 PRINT : PRINT "OF COURSE THEY ARE! THE PLANTS FUNCTION BEST WHEN GROWN IN A TEMPERATURE THEY ARE SUITED FOR! SINCE DEAD OR SICKLY PLANTS DON'T PHOTOSYNTHESIZE MUCH, TEMPERATURE CAN AFFECT PHOTOSYNTHETIC RATE."
1234 PRINT : PRINT : GOSUB 5000
1236 TEXT : HOME : VTAB 5 : PRINT "HERE'S A TOUGHER ONE"
1237 PRINT : PRINT : PRINT : PRINT "CAN THE AMOUNT OF CARBON DIOXIDE CHANGE THE AMOUNT OF PHOTOSYNTHESE A PLANT CAN DO? (Y/N)"
1240 PRINT : INPUT G$ : GOSUB 5000
1242 IF G$ < > "N" AND G$ < > "Y" THEN PRINT "PLEASE TYPE A Y OR N": GOTO 1242
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 EXPLAINING THIS"
1250 PRINT : PRINT : GOSUB 5000
1252 TEXT : HOME : GOSUB 11208
1253 HOME : VTAB 21
PRINT "EXTRA CARBON DIOXIDE CAN HELP A PLANT, BUT EVENTUALLY INCREASING AMOUNTS OF CARBON DIOXIDE HAVE NO ADDITIONAL EFFECT."
PRINT "MINERALS AND WATER CAN AFFECT PHOTOSYNTHETIC RATE SIMILAR TO THE WAY TEMPERATURE CAN."
PRINT "DIFFERENT PLANTS NEED DIFFERENT AMOUNTS OF WATER AND MINERALS. A HEALTHY PLANT PHOTOSYNTHESIZES MORE THAN AN UNHEALTHY ONE, SO..."
PRINT "YOU CAN TAKE IT FROM THERE, AGENT ";N$
PRINT "FINALLY, AIR POLLUTION CAN ALSO HAVE AN EFFECT ON PHOTOSYNTHESIS. PLANT LEAVES CAN BE DIRECTLY AFFECTED BY POLLUTION."
PRINT "IF LEAVES ARE DAMAGED, PHOTOSYNTHETIC RATE WILL DECREASE."
PRINT "IT'S BEEN A PLEASURE TRAVELLING WITH YOUTHROUGH THESE FILES, ";N$: PRINT "ROM: (SORRY, THAT'S STILL CLASSIFIED)"
PRINT "DATE: NOW"
PRINT "RE: PROGRESS"
PRINT "HAVE YOU COMPLETED YOUR RESEARCH AT THE ARCHIVES?"
PRINT "YOU MUST ACT NOW TO SOLVE OUR PROBLEMS"
PRINT "HERE IS A LIST OF WHAT WE'RE GROWING WHERE. CAN YOU TELL US WHAT WE'RE DOING WRONG?"
PRINT "A RESPONSE FORM IS LOCATED IN YOUR NOTE-BOOK."
PRINT "WE WAIT YOUR REPLY."
PRINT 60SUB 5000
1298 TEXT: HOME: PRINT "YOU MAY REMEMBER THAT DR. ZEA MAYS DEVELOPED CORN SEEDS THAT PRODUCED EARS UP TO SIX FEET LONG!"
1300 PRINT: PRINT "WE MOVED HIS RESEARCH INTO THE DARK BASEMENT ARE A OF THE HEADQUARTER LABS SO FOREIGN 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 YOUR NOTEBOOK."
1304 PRINT: PRINT: GOSUB 5000
1305 TEXT: HOME: PRINT "DR. TOM ATOE'S PEPPER PLANTS WERE DOING WONDERFULLY IN THE GREENHOUSE, WHEN HE TRANSPLANTED THEM IN THE PLOTS ALONGSIDE THE INDUSTRIAL PARK, ALL THE PLANTS STARTED TO WILT."
1307 PRINT: PRINT "WRITE YOUR ANALYSIS OF WHAT MAY BE WRONG WITH DR. ATOE'S PLANTS ON YOUR NOTEBOOK FORM."
1309 PRINT: PRINT: GOSUB 5000
1310 TEXT: HOME: PRINT "DR. M. GLORY IS OUR REKOWN FLOWERING PLANT EXPERT. HE HAS PLANTED A NEW BREED OF ROSES IN HIS FAVORITE GARDEN 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 CARBON DIOXIDE TO HER BRUSSEL SPROUTS HELPED THEM TO GROW FASTER."
1320 PRINT: PRINT "SHE DEvised A SYSTEM WHERE 50 TIMES THE NORMAL AMOUNT 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 YOUR NOTEBOOK FOR M.)."
1326 PRINT: PRINT: GOSUB 5000
1330 GOSUB 10000: HOME: UTAB 21
1331 PRINT "HI, AGENT " ; s: PRINT: GOSUB 5000: HOME
1332 UTAB 21: PRINT "IT'S ME IN THE FLESH AND BLOOD. I'VE JUST RETURNED FROM A RESEARCH EXPEDITION IN THE AMAZON.": GOSUB 5000: HOME
WHAT GREENERY IS THERE! I HEARD YOU USED MY ARC HIVES. BOY, THIS COUNTRY'S FOOD SUPPLY IS A MESS!": GOSUB 5000: HOME

COULDN'T HELP BUT OVERHEAR WHAT THE TOP BRASS WAS ASKING. DID YOU FIGURE OUT WHAT THOSE BANANAS WERE DOING WRONG": GOSUB 5000

TEXT : HOME : PRINT "COMPARE YOUR ANALYSIS WITH MINE!"
PRINT : PRINT "1. DR. ZEA MAYS PLANTS NEED LIGHT."
PRINT : PRINT "2. POLLUTION FROM THE FACTORIES IS KILLING ATOE S' CROPS."
PRINT : PRINT "3. DR. M. GLORY'S SOIL NEEDS MINERALS ADDED TO IT! SHE'S BEEN USING IT TOO LONG!!"
PRINT : PRINT "4. A LITTLE EXTRA CARBON DIOXIDE IS GOOD, BUT TOO MUCH ISN'T BETTER. INCREASING THE VOLUME OF CARBON DIOXIDE HAS NO EFFECT ONCE IT GOES BEYOND A CERTAIN LIMIT--AS DR. G.A.SOUS HAS DONE"
PRINT : PRINT : GOSUB 5000
GOSUB 10000
HOME : VTAB 21: PRINT "WELL, I'M OFF IN SEARCH OF EXOTIC MUSH-ROOMS! THANKS FOR HELPING THE TOP BRASS SOLVE THEIR BOTANY PROBLEMS!": GOSUB 5000
RETURN
REM QUIT OR CHANGE FILE ROUTINE
TEXT : HOME
VTAB 10
PRINT "IF YOU WOULD LIKE TO GET A DIFFERENT FILE TYPE A D."
PRINT : PRINT "IF YOU PLAN TO QUIT FOR THE DAY TYPE A Q."
VTAB 17 : PRINT : INPUT "YOUR CHOICE: " ; Q$
IF Q$ < > "D" AND Q$ < > "Q" THEN PRINT : PRINT "INVALID CHOICE. PLEASE RE-ENTER." : GOTO 2030
RETURN
IF G$ < > "OXYGEN" THEN PRINT "COME ON, YOU REMEMBER...IT'S OXYGEN!"
REM CONTINUE
INPUT "TYPE C TO CONTINUE OR E TO EXIT." ; G$
5014 IF G$ = "E" THEN GOTO 45
5011 IF G$ = "G" THEN GOTO 5025
5017 GOTO 5005
5025 RETURN
10000 REM DR. A GRAPHICS
10001 HGR : HCOLOR= 3
10002 HFL0T 90,140 TO 110,128 TO 110,104 TO 70,104 TO 70,84 TO 88,76 TO 90,84 TO 70,84 TO 90,96
10003 HFL0T 90,96 TO 110,96 TO 110,80 TO 88,60 TO 88,24 TO 100,36 TO 120,24 TO 140,36 TO 160,36 TO 200,24 TO 200,60
10004 HFL0T 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 210,96 TO 210,96 TO 170,84
10005 HFL0T 170,128 TO 190,140 TO 160,140 TO 140,124 TO 120,140 TO 90,148
10006 HFL0T 110,116 TO 170,116
10007 HFL0T 140,80 TO 140,116
10008 HFL0T 150,104 TO 150,96 TO 160,96 TO 160,104 TO 160,104 TO 150,104
10009 HFL0T 110,88 TO 120,80 TO 130,88 TO 140,88 TO 150,88 TO 160,88 TO 170,88
10010 HFL0T 110,64 TO 120,72 TO 160,72 TO 170,64
10011 HFL0T 160,44 TO 120,44 TO 120,52 TO 160,52 TO 160,44
10012 HFL0T 160,44 TO 180,44 TO 180,52 TO 160,52 TO 160,44
10013 HFL0T 160,48 TO 180,48
10014 HFL0T 120,48 TO 180,48
10015 RETURN
11200 REM CO2 GRAPH
11201 HGR : HCOLOR= 3
11202 HFL0T 50,10 TO 50,105 TO 260,105
11204 HFL0T 50,105 TO 140,60 TO 260,60
11206 HFL0T 60,120 TO 80,110 TO 88,115 TO 88,115 TO 80,120
11208 HFL0T 90,120 TO 98,110 TO 100,115 TO 100,115 TO 110,120
11210 HFL0T 120,110 TO 140,110 TO 130,110 TO 130,120
11212 HFL0T 140,120
11214 HFL0T 160,110 TO 160,120 TO 180,120
HPLT 190,110 TO 210,119 TO 210,120 TO 190,110
HPLT 220,120 TO 220,125 TO 220,125 TO 220,130 TO 230,1
30
HPLT 30,13 TO 10,15 TO 10,25 TO 30,25 TO 30,25 TO 20,20
HPLT 10,40 TO 10,30 TO 30,30 TO 30,35 TO 10,35 TO 30,40
HPLT 10,60 TO 10,70 TO 20,60 TO 30,70 TO 30,80
HPLT 10,75 TO 30,75 TO 20,75 TO 20,85
HPLT 10,45 TO 30,45 TO 30,55 TO 10,55 TO 10,45
HPLT 10,90 TO 10,100
HPLT 10,95 TO 30,95 TO 30,90 TO 30,100
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.
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.
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
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.
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:

\[ 6 \text{ CO}_2 + 6 \text{ H}_2\text{O} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6 \text{ O}_2 \]

(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 $\rightarrow$ Energy + ADP + Phosphate

ADP + Energy + Phosphate $\rightarrow$ 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 Progress

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 → Light Reaction → Oxygen

Light Energy

Carbon Dioxide → Dark Reaction → Glucose

ATP

ADP

Water
Environmental Factors that Affect Photosynthesis:

1. Radiant Energy
2. Temperature
3. Carbon Dioxide
4. Water
5. Minerals
6. Air Pollution
## Notes on Problems from Headquarters

<table>
<thead>
<tr>
<th>PROBLEMS</th>
<th>ANALYSIS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Plants growing in the dark</td>
<td>1.</td>
</tr>
<tr>
<td>2. Plants near industrial area</td>
<td>2.</td>
</tr>
<tr>
<td>3. Over-used soil</td>
<td>3.</td>
</tr>
<tr>
<td>4. Excess carbon dioxide</td>
<td>4.</td>
</tr>
</tbody>
</table>
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
10 REM GENETICS
20 REM BY PATRICIA D. MORRELL, 4/87
35 REM INITIALIZATION BLOCK
36 REM G$=GET COMMAND
37 REM H$=HELP
75 REM DRIVER
95 REMDRIVER
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 3080: 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 SHUTTLE 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 SCREEN AND IN THE SHOPPING/TOUR BOOKLET PROVIDED TO ALL OUR VISITORS."
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"
VTAB 13: HTAB 7: PRINT "LEES"
VTAB 15: HTAB 25: PRINT "WRANGLERS"
VTAB 23: PRINT "JEANS COME AND JEANS GO, BUT..."
FOR I = 1 TO 5000: NEXT I
RETURN
REM GENES SCREEN
TEXT : HOME : HGR
HCOLOR= 3
HPlot 40,40 TO 10,40 TO 10,80 TO 40,80 TO 40,60 TO 25,60
HPlot 90,40 TO 60,40 TO 60,80 TO 90,80: HPlot 60,60 TO 80,60
HPlot 110,80 TO 110,40 TO 140,80 TO 140,40
HPlot 190,40 TO 160,40 TO 160,80 TO 190,80: HPlot 160,60 TO 190,60
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
VTAB 23: PRINT "LIVE ON FOREVER"
FOR I = 1 TO 3000: NEXT I
RETURN
REM GENE SHOP
TEXT : HOME : HGR : HCOLOR= 3
HPlot 20,10 TO 230,10 TO 230,155 TO 20,155 TO 20,10
HPlot 100,155 TO 100,100 TO 150,100 TO 150,155
HPlot 40,80 TO 80,80 TO 80,140 TO 80,140 TO 40,80
HPlot 170,80 TO 210,80 TO 210,140 TO 210,140 TO 170,80
HPlot 185,85 TO 175,85 TO 175,95 TO 185,90 TO 185,95 TO 175,95
HPlot 185,110 TO 185,120 TO 195,120
HPlot 180,110 TO 185,100 TO 190,110: HPlot 185,105 TO 185,105
HPlot 205,125 TO 195,125 TO 195,135 TO 205,135: HPlot 195,130 TO 20
5,130
HPlot 45,90 TO 53,90 TO 53,95 TO 55,95 TO 55,100 TO 45,100 TO 45,90
HPlot 45,95 TO 53,95
HPlot 55,105 TO 65,105: HPlot 55,115 TO 65,115: HPlot 60,105 TO 60,
115
HPlot 75,120 TO 65,120 TO 65,130 TO 75,130 TO 75,125 TO 70,125
HPlot 60,70 TO 60,60 TO 65,70 TO 70,60 TO 70,70
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,
8129  70: HPLOT 140,60 TO 150,60: HPLOT 140,70 TO 150,70: HPLOT 145,60 TO 145,
8130  70
8132  HPLOT 160,70 TO 160,60 TO 170,70 TO 170,60
8234  HPLOT 180,60 TO 90,40 TO 100,50 TO 100,45 TO 95,45
8236  HPLOT 190,70 TO 180,70 TO 180,60 TO 190,60: HPLOT 180,65 TO 190,65
8240  HPLOT 100,40 TO 110,40 TO 110,50 TO 120,50: HPLOT 110,45 TO 120,45
8242  HPLOT 130,60 TO 130,50 TO 140,50 TO 140,40
8244  HPLOT 160,40 TO 150,40 TO 150,50 TO 160,50: HPLOT 150,45 TO 160,45
8246  HPLOT 190,70 TO 180,70 TO 180,60 TO 190,60: HPLOT 180,65 TO 190,65
8248  HPLOT 100,70 TO 100,60 TO 110,70 TO 110,60
8250  HPLOT 120,60 TO 120,70: HPLOT 120,65 TO 130,65: HPLOT 130,60 TO 130,
8252  70: HPLOT 140,60 TO 150,60: HPLOT 140,70 TO 150,70: HPLOT 145,60 TO 145,
8254  70
8256  HPLOT 170,20 TO 170,25
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 KEY": PRINT : PRINT "THEN TYPE RUN SHUTTLE ONE": GOTO 140
120 IF G$ = "2" THEN PRINT "TYPE PR#6": PRINT : PRINT "HIT THE RETURN KEY": PRINT : PRINT "THEN TYPE RUN SHUTTLE TWO": GOTO 140
130 IF G$ = "3" THEN PRINT "TYPE PR#6": PRINT : PRINT "HIT THE RETURN KEY": PRINT : PRINT "THEN TYPE RUN SHUTTLE THREE": GOTO 140
140 END
1070 REM MENU
1071 TEXT : HOME : PRINT : PRINT "ROUTE DESTINATION"
1080 PRINT ": " : "" : "TERMINOLOGY AREA - A GOOD PL ACHE TO START, ESPECIALLY IF IT’S YOUR FIRST TIME HERE!"
1090 PRINT : PRINT " 1 " : "SIMPLE CROSS SECTION - NTAINS PUNNETT SQUARES AND BASIC TRAIT SUPPLIES (OF COURSE, INSTRUCTIONS ARE INCLUDED IN ALL OUr KITS!) ." : ""
1100 PRINT : PRINT " 2 " : "TWO TRAIT CROSS SUPPLIES - Ho USES OUR KIT MATERIALS FOR THOSE OF YOU WHO ARE MORE EXPERIENCED AND WANT TO TRY SOMETHING NEW"
1110 PRINT " 3 " : "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 ONLy 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 $GET COMMAND
9 REM $HELP
11 REM DRIVER
13 PRINT CHR$(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
HOME: VTAB 21
PRINT "YELLOWS WITH CONSTRICTED AND GREENS OR OOH! SORRY, I DO TEND TO LET MYSELF GET HOVERLY EXCITED ABOUT THE POSSIBILITIES": GOSUB 7000

HOME: VTAB 21; PRINT "LET ME START AT THE BEGINNING": GOSUB 7000
GOSUB 8500: REM GARDEN SCENE
VTAB 21: PRINT "I WAS IN MY GARDEN GROWING MY PEAS AND NOTICED SOME WERE TALL AND SOME WERE SHORT, SOME WERE YELLOW AND SOME GREEN": GOSUB 7000

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

HOME: VTAB 21: PRINT "AFTER MY BIOGRAPHY": GOSUB 7000
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

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 PARENTS": GOSUB 7000
GOSUB 8400: VTAB 21: PRINT "I BECAME SO GOOD AT PICKING THE TRAITS I WANTED IN MY PEAS, I THOUGHT I'D SHARE THAT KNOWLEDGE WITH FOLKS LIKE YOU": GOSUB 7000

GOSUB 8100: VTAB 21: PRINT "SO I OPENED THIS GENE SHOP WHERE YOU COULD COME, LET ME SHOW YOU WHAT I KNOW, AND...": GOSUB 7000: HOME
VTAB 21: PRINT "SELL YOU KITS TO TRY YOUR OWN HAND AT 'DESIGNING' OFFSPRING": GOSUB 7000
GOSUB 8400: VTAB 21: PRINT "THE REST IS HISTORY": GOSUB 7000
HOME: VTAB 21: PRINT "I'LL LET YOU CONTINUE ON WITH YOUR TOUR": PRINT : GOSUB 7000

HOME: VTAB 21: PRINT "AS YOUR GUIDE MAY HAVE TOLD YOU, THE DESTINATION OF ROUTE 1 IS THE TERMINOLOGY ROOM": GOSUB 7000
HOME: VTAB 21: PRINT "AS WITH MOST THINGS, TO EXPLAIN MY IDEAS TO YOU, YOU FIRST NEED TO BE FAMILIAR WITH SOME TERMS.

VTAB 21: PRINT "YOUR SHOPPING/TOUR GUIDE HAS A LIST OF THESE AND PLACES FOR YOU TO TAKE NOTES. PLEASE ENJOY YOUR VISIT TO MY SHOP": GOSUB 7000
HOME: VTAB 21: PRINT "I'LL CHECK IN ON YOU LATER": GOSUB 7000
GOSUB 8300: REM GUIDE
HOME: VTAB 21: PRINT "AS MENDEL MENTIONED, YOUR BOOKS WILL BE VERY USEFUL TO YOU AS YOU GO THROUGH THIS AREA. PLEASE TURN TO PAGE 3.": GOSUB 7000
HOME: VTAB 21: PRINT "FILL IN YOUR GUIDE AS WE GO ALONG."
GOSUB 7000
TEXT: HOME: PRINT "GENETICS IS THE SPECIALIZED BRANCH OF BIOLOGY THAT DEALS WITH HEREDITY."
PRINT: INVERSE: PRINT "GENETICS TERMINOLOGY": NORMAL
PRINT: PRINT "GENETICS IS THE SPECIALIZED BRANCH OF BIOLOGY THAT DEALS WITH HEREDITY."
PRINT: PRINT "THE FIRST THREE TERMS ARE INTERRELATED."
PRINT: INVERSE: PRINT "GENE": NORMAL: PRINT "PORTION OF DNA WHICH CONTROLS THE EXPRESSION OF HETEROGENN TRAITS!"
PRINT: INVERSE: PRINT "TRAIT": NORMAL: PRINT "CHARACTERISTIC CARRIED BY A GENE"
PRINT: PRINT "(THEREFORE, GENES CODE FOR TRAITS!)"
PRINT: INVERSE: PRINT "ALLELE": NORMAL: PRINT "FORM OF A GENE": PRINT
PRINT: PRINT "ONE GENE MAY HAVE MORE THAN ONE CHOICE OF OUTCOMES."
PRINT: PRINT "THE NEXT SCREEN WILL EXPLAIN THIS!!": PRINT : GOSUB 7000
TEXT: HOME: PRINT "FOR EXAMPLE, ONE GENE DETERMINES THE SHAPE OF PEAS."
PRINT: PRINT "A PEA HAS TWO SHAPES.": PRINT : PRINT "A PEA CAN BE ROUND OR WRINKLED."
PRINT: PRINT "THEREFORE, THIS GENE HAS TWO ALLELES."
VTAB 23: GOSUB 7000
TEXT: HOME: PRINT "LET'S SEE IF YOU UNDERSTAND ALLELES."
PRINT: PRINT "PEA PLANTS CAN BE SHORT OR TALL."
PRINT: PRINT "ONE GENE HAS THE CODE FOR THE TRAIT HEIGHT."
PRINT: PRINT "HOW MANY ALLELES DOES THE GENE FOR PEA PLANT HEIGHT HAVE?"
PRINT: INPUT "YOUR GUESS: " ; G$
IF G$ = "2" THEN PRINT "CORRECT!!"
PRINT: PRINT "THE PLANT CAN BE (1) TALL OR (2) SHORT THEREFORE, THE ONE GENE HAS TWO FORMS, SO, THE NUMBER OF ALLELES IS TWO!"

VTAB 23: PRINT "LET'S TRY ANOTHER": PRINT: GOSUB 7000

TEXT: HOME: PRINT "ONE GENE CODES FOR THE POD SHAPE OF PEAS": PRINT: PRINT "PODS CAN BE INFLATED OR CONSTRUCTED."

PRINT: INPUT "HOW MANY ALLELES DOES THE GENE FOR POD SHAPE HAVE?": G$

PRINT: IF G$ = "2" THEN PRINT "WAY TO GO!"

PRINT: IF ONE GENE HAS TWO FORMS, IN THIS CASE INFLATED OR CONSTRUCTED, THEN THE GENE HAS TWO ALLELES.

VTAB 23: GOSUB 7000

TEXT: HOME: PRINT "LET'S TRY A TOUGHIE!"

PRINT: PRINT "OUR BLOOD TYPE CAN BE A, B, AB, OR O."

PRINT: PRINT "HOW MANY ALLELES DOES THE GENE FOR BLOODTYPE HAVE: 1, 2, 3 OR 4"

PRINT: INPUT "YOUR CHOICE: ": G$

PRINT: IF G$ = "3" THEN PRINT "GREAT! YOU WEREN'T FooLED!": GOTO 147

PRINT: IF G$ = "1" OR G$ = "2" GOTO 145

PRINT: IF G$ = "4" GOTO 145

PRINT: PRINT "YOU MUST CHOOSE 1, 2, 3, OR 4": GOTO 135

PRINT: PRINT "GOT YOU! THE CORRECT CHOICE IS 3."

PRINT: PRINT "THE THREE ALLELES ARE A, B AND O"

PRINT: PRINT "AB IS A COMBINATION OF A AND B--NOT A SEPARATE ALLELE."

VTAB 20: PRINT "OUR NEXT TERM'S AN EASY ONE"

PRINT: GOSUB 7000

TEXT: HOME: INVERSE: PRINT "CROSS": NORMAL: PRINT "MATING BETWEEN DIFFERENT INDIVIDUALS OF THE SAME SPECIES."

PRINT: PRINT "WHEN MENDEL WANTED TO 'MAKE' A NEW OFFSPRING PEA PLANT, HE CROSSED TWO PARENT PLANTS."

PRINT: PRINT "DO YOU REMEMBER WHAT HAPPENS TO CHROMOSOMES DURING GAMETE FORMATION?"

PRINT: PRINT "THE HOMOLOGUES SEGREGATE (A FANCY WAY TO SAY SEPARATE) ."

PRINT: PRINT "IF THE CHROMOSOMES SEGREGATE AND CHROMO-SOMES ARE COLLECTIONS OF GENES, THEN WE CAN SAY ALLELES SEGREGATE DURING GAMETE FORMATION."
PRINT "KEEP THIS IN MIND FOR LATER!"

PRINT: GOSUB 7000
GOSUB 8700: HOME
VTAB 21: PRINT "WHEN WE MOVE ON TO DO OUR KIT SELECTIONS, YOU'LL SEE BOXES LIKE THE ONE ABOVE. WHAT DOES THIS LABELLING MEAN?": GOSUB 7000
HOME: VTAB 21
PRINT "GENERALLY, A LETTER IS ASSIGNED TO A GENE'S Trait. This example kit crosses peas of different shapes.": GOSUB 7000
HOME: VTAB 21: PRINT "PEAS CAN BE ROUND OR WRINKLED. HOW MANY ALLELES ARE THERE FOR SHAPE?"
INPUT "YOUR GUESS: "; G$
IF G$ = "2" THEN PRINT "CORRECT!"
PRINT "THERE ARE TWO ALLELES FOR SHAPE: ONE IS WRINKLED AND THE OTHER IS ROUND.": GOSUB 7000
HOME: VTAB 21: PRINT "THE CAPITAL R STANDS FOR THE ALLELE THAT CODES FOR ROUND.": PRINT; GOSUB 7000
HOME: VTAB 21: PRINT "THE LOWER CASE R REPRESENTS THE ALLELE FOR WRINKLED.": PRINT; GOSUB 7000
HOME: VTAB 21: PRINT "WE USE THE SAME LETTER BECAUSE IT'S THE SAME GENE! LET'S TRY ANOTHER KIT.": GOSUB 7000
GOSUB 8800: REM CROSS T
HOME: VTAB 21: PRINT "PEA PLANTS CAN BE TALL OR SHORT. ONE GENE, OR LETTER."
INPUT "WHAT DOES THE CAPITAL T STAND FOR (TALL OR SHORT): "; G$
IF G$ = "SHORT" THEN PRINT "GUESS AGAIN!": GOTO 195
IF G$ = "TALL" THEN PRINT "GREAT!": GOTO 203
PRINT "YOUR CHOICES ARE TALL OR SHORT!": GOTO 195
PRINT "WHAT DOES THE LOWER CASE T STAND FOR?"
INPUT G$
IF G$ = "SHORT" THEN PRINT "ASTOUNDING!": GOTO 211
IF G$ <> "SHORT" THEN PRINT "IF CAPITAL T IS TALL, THE ONLY OPTION LEFT FOR THE LOWER CASE T IS SHORT!"
GOSUB 7000: HOME: VTAB 21
PRINT "LET'S EXPLAIN LABELLING A LITTLE FURTHER.": PRINT; GOSUB 7000
215 GOSUB 8700: HOME : VTAB 21: PRINT "OUR FIRST KIT WAS A CROSS BETWEEN TWO DIFFERENT KINDS OF INDIVIDUALS."; GOSUB 7800
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 HAS 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 ARE ALSO CALLED TRUE-BREEDING OR PUREBREDS."
227 PRINT : PRINT "LET'S LOOK AT OUR KIT AGAIN": GOSUB 7800
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 7800
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 CHECK 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 DIFFERENT ALLELES FOR A TRAIT"
245 PRINT : PRINT "A HETEROZYGOUS IS OFTEN CALLED A HYBRID."
247 VTAB 23: GOSUB 7800
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 YOU KNOW THE ANSWER.)"; 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 DEFINITIONS SHEET IN YOUR GUIDE BOOK BEFORE GOING ON."
263 VTAB 23: GOSUB 7800
265 TEXT : HOME : PRINT "I'M GOING TO PRESENT YOU WITH A GENE PAIR. YOU'RE TO TELL ME IF IT IS FROM A HOMOZYGOUS OR A HETEROZYGOUS!"
PRINT: PRINT "LET'S MAKE IT EASIER."
PRINT: PRINT "TYPE 1 FOR HOMOZYGOUS AND
TEROZYGOTE."
PRINT: PRINT "READY?"
PRINT: PRINT "T"; CHR$ (244)
PRINT: INPUT "YOUR ANSWER (1 OR 2): "; G$
PRINT: IF G$ = "1" THEN PRINT "HOMO MEANS THE SAME. THIS PAIR HAS
TWO DIFFERENT ALLELES. IT IS A HETEROZYGOTE": GOTO 283
PRINT: IF G$ = "2" THEN PRINT "HOW RIGHT YOU ARE!": GOTO 283
PRINT: PRINT "CHOOSE 1 OR 2": GOTO 275
PRINT
PRINT: PRINT "TRY THIS ONE:"  
PRINT: PRINT "TT"
PRINT: INPUT "HOMOZYGOUS (1) OR HETEROZYGOUS (2): "; G$
IF G$ = "1" THEN PRINT "WHAT A QUICK LEARNER!": GOTO 297
IF G$ = "2" THEN PRINT "HOMO MEANS THE SAME. BOTH THESE AL
LELES ARE THE SAME SO THE INDIVIDUAL IS A  HOMOZYGOTE."; GOTO 297
PRINT: PRINT "YOUR CHOICE IS 1 OR 2": GOTO 289
PRINT: PRINT "LET'S CHANGE GENES"
PRINT: PRINT "RR"
PRINT: INPUT "YOUR CHOICE (1) OR (2): "; G$
IF G$ = "2" THEN PRINT "SINCE BOTH THESE ALLELES ARE THE SAME
INDIVIDUAL IS A HOMOZYGOTE."; GOTO 309
IF G$ = "1" THEN PRINT "EXCELLENT": GOTO 309
PRINT "YOU MUST CHOOSE 1 OR 2": GOTO 301
PRINT: PRINT CHR$ (244);
PRINT: PRINT CHR$ (244)
PRINT: INPUT "1 FOR HOMOZYGOUS OR 2 FOR HETEROZYGOUS: "; G$
IF G$ = "1" THEN PRINT "MENDEL WOULD BE SO PROUD."; GOTO 321
IF G$ = "2" THEN PRINT "HETEROZYGOTE MEANS DIFFERENT ALLELES, THI
S INDIVIDUAL HAS THE SAME TWO ALLELES SO IT'S A HOMOZYGOTE."; GOTO 32
1
PRINT "YOUR CHOICE IS 1 OR 2": GOTO 313
PRINT: PRINT "IF YOU DIDN'T GET AT LEAST 3 CORRECT, CHECK BACK OV
ER YOUR NOTES ON THE DIFFERENCES BETWEEN HOMOZYGOTES AND
HETEROZYGOTES BEFORE GOING ON."
WHAT DOES A PLANT WITH TT LOOK LIKE?

PRINT "T";
PRINT Chr$(244);
PRINT "?
PRINT Chr$(244);
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRINT "?
PRIN
PRINT : PRINT "THE ALLELEs THE INdIVIDUALs HAVE ARE NOT THE SAME!"
PRINT : PRINT "SO WE CAN TELL THE PHENOTYpe BY LOOKING BUT NOT THE GENOTYPE."
PRINT : PRINT "HOW CAN PEA PLANTS WITH DIFFERENT ALLELES LOOK THE SAME? HOW DO WE GET A SHORT PLANT?"
VTAB 23: GOSUB 7000
GOSUB 8900
VTAB 21: PRINT "DOMINANT ALLELES ARE LIKE DOMINANT PEOPLE. THEY WILL ";
INVERSE : PRINT "ALWAYS"
NORMAL : PRINT "BE SEEN IF "
PRINT "THEY'RE PRESENT." : GOSUB 7000
HOME : VTAB 21: PRINT "THEY'RE THE BIG CHEESE SO THEY'RE REPRESENTED BY THE 'BIG' LETTER." : GOSUB 7000
GOSUB 9000 : REM TT
HOME : VTAB 21: PRINT "ARE THESE PLANTS :(A) BOTH TALL OR (B) ONE TALL, ONE SHORT"
INPUT "YOUR CHOICE :";G$
IF G$ = "A" THEN PRINT "THAT WAS A TALL ORDER BUT YOU FILLED IT PERFECTLY!": GOTO 413
IF G$ = "B" THEN PRINT "BOTH PLANTS WILL BE TALL": GOTO 413
PRINT "YOU MUST CHOOSE A OR B": GOTO 403
GOSUB 7000
HOME : VTAB 21: PRINT "IF THERE'S AT LEAST ONE CAPITAL LETTER THE DOMINANT TRAIT WILL BE SEEN." : PRINT : GOSUB 7000
GOSUB 9180 : REM REC T
HOME : VTAB 21: PRINT "A RECESSIVE TRAIT IS SHOWN BY A LOWER CASE LETTER"
PRINT : GOSUB 7000
HOME : VTAB 21: PRINT "A RECESSIVE TRAIT IS NOT SEEN IF A RECESSIVE ALLELE IS PAIRED WITH A DOMINANT ALLELE": GOSUB 7000
HOME : VTAB 21: PRINT "REMEMBER: A DOMINANT TRAIT TAKES OVER WHEN EVER IT'S PRESENT." : PRINT : GOSUB 7000
HOME : VTAB 21: PRINT "RECESSIVE TRAITS WILL ONLY BE SEEN IF BOTH ALLELES FOR THE TRAIT ARE RECESSIVE THAT IS, THE ALLELES ARE HOMOZYGO US." : GOSUB 7000
439 TEXT : HOME
431 HTAB 12: PRINT CHR$ (244):
433 PRINT CHR$ (244)
435 PRINT : PRINT "THIS PLANT IS SHORT BECAUSE BOTH ALLELES ARE 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 'SHY' 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,
449 PRINT : PRINT "IF A GENE PAIR IS HOMOZYGOUS, HOWEVER, YOU MUST SAY
451 PRINT : PRINT : GOSUB 7000
453 GOSUB 0300: REM GUIDE
455 HOME : VTAB 21: PRINT "LET'S SEE IF THIS 'SUNK IN'. WHILE WE HAVE
457 LET C = 0
459 TEXT : HOME : PRINT "I'LL GIVE YOU GENE PAIRS THAN ASK YOU QUESTIONS ABOUT THEM. PLEASE TYPE IN THE NUMBER OF THE ANSWER!"
461 PRINT : PRINT : HTAB 12: PRINT "P":
463 PRINT CHR$ (248)
465 PRINT : INPUT "HOMOZYGOUS (1) OR HETEROZYGOUS (2) : ";G$
467 IF G$ = "1" THEN PRINT : PRINT "SORRY, A MIXED PAIR IS HETEROZYGOUS"
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 "WUh"
475 PRINT : INPUT "HOMOZYGOUS (1) OR HETEROZYGOUS (2) : ";G$
477 IF G$ = "1" THEN PRINT : PRINT "RIGHT YOU ARE!";C = C + 1: GOTO 483
479 IF G$ = "A" THEN PRINT "BOTH ALLELES ARE THE SAME. THE PLANT IS HOMOZYGOUS.": GOSUB 7000: GOTO 483
481 PRINT "THE CHOICES ARE 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 PLANT?"
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 RECESSIVE 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 SAME AND RECESSIVE IS THE SMALL LETTER."; GOTO 545
IF G$ = "B" THEN PRINT "HOW BIG OF YOU TO PICK THE RIGHT CHOICE!": C = C + 1: GOTO 545

IF G$ = "C" THEN PRINT "THE CORRECT CHOICE IS B. HOMO MEANS SAME": GOTO 545

PRINT "YOUR CHOICES ARE A, B, OR C": GOTO 533

PRINT "WHAT'S THE PHENOTYPE OF A HOMOZYGOUS DOMINANT PLANT?"

PRINT "(A) TT"
PRINT "(B) SHORT"
PRINT "(C) TALL"
PRINT INPUT "YOUR SELECTION: "; G$

IF G$ = "A" THEN PRINT "PHENOTYPE WANTS TO KNOW APPEARANCE NOT WHAT GENES THE INDIVIDUAL HAS! THE CORRECT ANSWER IS C": GOTO 567

IF G$ = "B" THEN PRINT "TALL IS THE DOMINANTTrait. THE CORRECT SELECTION IS C": GOTO 567

IF G$ = "C" THEN PRINT "ABSOLUTELY!": C = C + 1: GOTO 567

PRINT "YOUR CHOICES ARE A, B, OR C": GOTO 555

VTAB 23: GOSUB 7000

TEXT HOME

PRINT "HOW MANY ALLELES ARE THERE FOR HEIGHT IN PEA PLANTS?"

INPUT "YOUR NUMBER: "; G$

IF G$ = "2" THEN PRINT "THAT'S RIGHT!": C = C + 1: GOTO 581

PRINT "THERE ARE TWO ALLELES: ONE CODING FOR TALL AND ONE CODING FOR SHORT!": GOTO 581

VTAB 23: GOSUB 7000

TEXT HOME

IF C < 5 THEN PRINT "I DON'T THINK YOU'RE READY TO START PRACTICING WITH KITS YET. PRESS THE S WHEN PROMPTED AND TAKE SHUTTLE ROUTE 1 TO GO BACK THROUGH THIS SECTION OF THE WAREHOUSE AGAIN.": GOTO 591

PRINT "I THINK YOU'VE MASTERED THIS PART OF THE WAREHOUSE WELL ENOUGH! LET'S MOVE ON AND SHOW YOU OUR MERCHANDISE!"
PRINT "WHEN PROMPTED SWITCH SHUTTLES AND TAKE THE ONE MARKED ROUTE 2!"
VTAB 23: 60:SUB 7000
TEXT : HOME : PRINT "YOU'RE NO LONGER ON THE SHUTTLE ROUTE. RUN MENU U TO FIND YOUR WAY BACK!"
END
REM SWITCH ROUTINE
INPUT "TYPE S TO SWITCH OR C TO CONTINUE: ":G$
IF G$ = "S" THEN PRINT CHR$(4):"RUN MENU"
IF G$ = "C" THEN RETURN
GOTO 7001
RETURN
REM GENE SHOP
TEXT : HOME : HGR : HCOLOR= 3
HLOT 20,10 TO 230,10 TO 230,155 TO 20,155 TO 20,10
HLOT 100,155 TO 100,100 TO 150,100 TO 150,155
HLOT 40,80 TO 80,80 TO 80,140 TO 40,140 TO 40,80
HLOT 170,80 TO 210,80 TO 210,140 TO 170,140 TO 170,80
HLOT 185,85 TO 175,95 TO 175,90 TO 185,90 TO 185,95 TO 175,95
HLOT 185,110 TO 185,120 TO 195,120
HLOT 180,110 TO 185,100 TO 190,110: HLOT 183,105 TO 188,105
HLOT 205,125 TO 195,125 TO 195,135 TO 205,135: HLOT 195,130 TO 20 5,130
HLOT 45,90 TO 53,90 TO 55,95 TO 55,100 TO 45,100 TO 45,90
HLOT 45,95 TO 53,95
HLOT 55,105 TO 65,105: HLOT 55,115 TO 65,115: HLOT 60,105 TO 60, 115
HLOT 75,120 TO 65,120 TO 65,130 TO 75,130 TO 75,125 TO 70,125
HLOT 60,70 TO 60,60 TO 65,70 TO 70,60 TO 70,70
HLOT 80,70 TO 80,60 TO 90,60 TO 90,70: HLOT 80,65 TO 90,65
HLOT 110,60 TO 100,60 TO 100,70 TO 110,70
HLOT 120,60 TO 120,70: HLOT 120,65 TO 130,65: HLOT 130,60 TO 130 ,70
HLOT 140,60 TO 150,60: HLOT 140,70 TO 150,70: HLOT 145,60 TO 145 ,70
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 102.45 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 140.58
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 130.88 TO 138.90
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 150.120
8425  HPLOT 155.80 TO 155.120
8427  RETURN
8500  REM PEA
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
8503  HPLOT 30,40 TO 30,45 TO 30,50 TO 30,45 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 10,66 TO 15,60 TO 15,70 TO 20,70
REM CROS R
TEXT : HOME : HGR : HCOLOR= 3
HPL OT 20,90 TO 20,40 TO 50,40 TO 50,60 TO 20,60 TO 50,90
HPL OT 60,90 TO 60,40 TO 90,40 TO 90,60 TO 60,60 TO 90,90
HPL OT 110,40 TO 140,90: HPL OT 110,90 TO 140,40
HPL OT 160,90 TO 160,40 TO 190,40 TO 190,60 TO 160,60 TO 190,90
HPL OT 200,90 TO 200,60: HPL OT 200,70 TO 210,60 TO 225,60 TO 230,70
RETURN
REM T
TEXT : HOME : HGR : HCOLOR= 3
HPL OT 20,45 TO 50,45: HPL OT 35,45 TO 35,95
HPL OT 75,95 TO 75,45: HPL OT 60,45 TO 90,45
HPL OT 110,45 TO 140,95: HPL OT 140,45 TO 110,95
HPL OT 160,45 TO 190,45: HPL OT 175,45 TO 175,95
HPL OT 210,60 TO 210,95: HPL OT 200,70 TO 220,70
RETURN
REM DOM T
TEXT : HOME : HGR : HCOLOR= 3
HPL OT 10,30 TO 30,30 TO 40,40 TO 40,70 TO 30,80 TO 10,80 TO 10,30
HPL OT 50,60 TO 70,60 TO 70,80 TO 50,80 TO 50,60
HPL OT 88,60 TO 90,60 TO 90,70 TO 100,60 TO 100,80
HPL OT 110,60 TO 130,60: HPL OT 110,80 TO 130,80: HPL OT 120,60 TO 120,80
HPL OT 140,60 TO 140,60 TO 160,80 TO 160,60
HPL OT 170,80 TO 170,60 TO 190,60 TO 190,80: HPL OT 170,70 TO 190,70
HPL OT 200,60 TO 200,60 TO 220,80 TO 220,60
HPL OT 230,60 TO 250,60: HPL OT 240,60 TO 240,80
HPL OT 100,100 TO 150,100: HPL OT 125,100 TO 125,150
RETURN
REM T
TEXT : HOME : HGR : HCOLOR= 3
HPL OT 20,45 TO 50,45: HPL OT 35,45 TO 35,95
HPL OT 70,45 TO 100,45: HPL OT 85,45 TO 85,95
HPL OT 150,45 TO 180,45: HPL OT 165,45 TO 165,95
HPL OT 200,70 TO 220,70: HPL OT 210,60 TO 210,90
RETURN
REM GENETICS
BY PATRICIA D. MORRELL, 4/87
INITIALIZATION BLOCK
REM G$=GET COMMAND
REM H$=HELP
REM DRIVER
PRINT CHR$ (4);"BRUN LOMEM": & LOMEM: 16384
REM SIMPLE CROSSES
TEXT : HOME : GOSUB 8300
HOME : VTAB 21: PRINT "HOP ABOARD TO GET TO THE SIMPLE CROSS SECTIO
N!": PRINT : GOSUB 7000
HOME : VTAB 21: PRINT "IT'LL TAKE US A FEW MINUTES TO REACH OURSINGLE
CROSS KIT AISLES, SO SIT BACK ANDRELAX AND ENJOY THE SCENERY.": GOSUB
7000
GOSUB 9300: REM MARKER
HOME : VTAB 21: PRINT "OUR FIRST HISTORICAL MARKER! HERE IS WHERE
MENDEL GAVE US THE F WORD." FILIAL": GOSUB 7000
HOME: VTAB 21: PRINT "FILIAL MEANS 'SON' IN LATIN."; PRINT: GOSUB 7000
HOME: VTAB 21: PRINT "TO KEEP TRACK OF CROSSES, MENDEL USED A CAPITAL F AND NUMBERS FOR EACH SUCCESSIVE GENERATION FROM CHOSEN PARENTS."; GOSUB 7000
HOME: VTAB 21: PRINT "YOUR SHOPPING GUIDE HAS A SKETCH OF WHAT I MEAN, AS DOES THE NEXT SCREEN!"; GOSUB 7000
HOME: VTAB 21: PRINT "PARENTS ARE THE STARTING GENERATION."
PRINT: PRINT "CROSSING PARENTS RESULTS IN THE FIRST FILIAL GENERATION OF THE F."
PRINT: PRINT "1"
PRINT: PRINT: PRINT "CROSSING THE F GENERATION YIELDS THE F, OR SECOND FILIAL GENERATION."
PRINT: PRINT "2"
PRINT: PRINT: PRINT "CROSSING F'S PRODUCES THE F'S"
PRINT: PRINT "3"
PRINT: PRINT: PRINT "AND SO ON..."
PRINT: PRINT "WHAT WILL CROSSING F'S GIVE YOU?"
PRINT: PRINT "7"
PRINT: INPUT "YOUR NUMBER: "; G$;
PRINT: PRINT: PRINT "CROSSING F'S RESULTS IN F'S!"
PRINT: PRINT "9"
PRINT: GOSUB 7000
HOME
VTAB 21: PRINT "WE'RE APPROACHING PRINCIPLE ROW!"; PRINT: GOSUB 7000
HOME: VTAB 21: PRINT "MENDEL GAVE US 3 PRINCIPLES. TWO OF THESE CAN BE SEEN ON THIS ROUTE!"; GOSUB 7000
GOSUB 9500
HOME: VTAB 21: PRINT "HERE'S THE FIRST ONE: THE PRINCIPLE OF DOMINANCE."; GOSUB 7000
TEXT: HOME: PRINT "PRINCIPLE OF DOMINANCE"

WHAT THIS MEANS, IN ENGLISH, IS IF AN INDIVIDUAL IS A HYBRID, THE DOMINANT TRAIT IS THE ONE THAT IS SEEN.

FOR EXAMPLE, THE PLANT IS TALL BECAUSE THE DOMINANT ALLELE TAKES OVER.

YOU MIGHT REMEMBER WORKING WITH THIS PRINCIPLE ALONG ROUTE 1.

WE'RE APPROACHING THE SECOND PRINCIPLE: PRINCIPLE OF SEGREGATION

THE PRINCIPLE OF SEGREGATION STATES THAT GENES CONTROLLING FOR A PARTICULAR TRAIT SEPARATE DURING GAMETE FORMATION. THEREFORE, EACH GAMETE CARRIES ONLY ONE ALLELE OF EACH GENE PAIR.

REMEMBER, YOU GET HALF OF A CHROMOSOME PAIR FROM EACH PARENT. SINCE GENES ARE ON THE CHROMOSOMES, YOU GET HALF THE GENES FROM ONE PARENT AND THE CORRESPONDING HALF FROM THE OTHER.

THAT'S BASICALLY WHAT THIS PRINCIPLE SAYS.

WE'RE HERE AT THE SIMPLE CROSS KITS AREA. PLEASE WATCH YOUR STEP GETTING OFF THE SHUTTLE.

SO, YOU'RE READY TO START SELECTING GENES FOR THE TRAITS YOU WANT. THAT IS OUR SPECIALITY AT THE GENE MACHINE!

LET ME HELP YOU WITH YOUR FIRST SIMPLE CROSS KIT. WE'RE RUNNING A SPECIAL ON PEA SHAPE TODAY.

HAVE A COMPLIMENTARY KIT!!
HOME: VTAB 21: PRINT "R IS THE ALLELE FOR ROUND PEAS."
132 PRINT CHR$ (242);
PRINT "IS THE ALLELE FOR WRINKLED PEAS"
GOSUB 7000
HOME: VTAB 21
PRINT "WHAT OFFSPRING WILL WE GET IF WE CROSS THESE TWO PARENTS?": GOSUB 7000
GOSUB 8400
HOME: VTAB 21: PRINT "LET'S GO THROUGH THE INSTRUCTION SHEET. FOLLOW W ALONG WITH THE ONE IN YOUR GUIDE BOOK.": GOSUB 7000
TEXT: HOME: HTAB 14: PRINT "INSTRUCTIONS"
PRINT: PRINT "THERE ARE ONLY TWO STEPS NEEDED TO PREDICT WHAT GENE COMBINATIONS (OFFSPRING) ARE POSSIBLE FROM CROSSING TWO PARENTS."
PRINT: PRINT "1. COME UP WITH ALL POSSIBLE GAMETES."
PRINT: PRINT "REMEMBER, EACH GAMETE CARRIES ONLY ONE ALLELE FOR A TRAIT."
PRINT: PRINT "LET'S TRY THE MOM FIRST."
PRINT: GOSUB 7000: TEXT: HOME
PRINT: PRINT "THE MOTHER'S POSSIBLE GAMETES (NOTE THE KEY WORD IS POSSIBLE. WE MUST CONSIDER ALL POSSIBILITIES.)"
PRINT: PRINT "SHE HAS ONLY R'S TO OFFER. SO BOTH HER GAMETES WILL BE THE DOMINANT GENE FOR SHAPE."
PRINT: PRINT "YOU TRY THE DAD. WHAT CAN HIS GAMETES BE? (PLEASE PRESS THE RETURN KEY WHEN YOU THINK YOU KNOW.)"
PRINT: PRINT "DID YOU GUESS THAT ALL HIS SPERM WILL CARRY ";
PRINT CHR$ (242);
PRINT ", THE RECESSIVE ALLELE?"
PRINT: PRINT "LET'S MOVE ON TO STEP 2."
GOSUB 7000: TEXT: HOME
PRINT "2. CROSS THE PARENTS' GAMETES."
PRINT "THERE ARE 3 WAYS YOU CAN DO THIS STEP."
PRINT: PRINT "1. THINK IT THROUGH LOGICALLY (WHICH MAY BE THE HARDEST OPTION)"
PRINT: PRINT "2. CALCULATE PROBABILITIES (EASIER THAN NUMBER 1 BUT NOT THE EASIEST CHOICE)."
PRINT "3. CONSTRUCT A PUNNETT SQUARE (THE WISEST CHOICE)
"
PRINT "I'LL BE HAPPY TO EXPLAIN OPTION NUMBER 3!"
PRINT : PRINT : PRINT : PRINT : GOSUB 7000
GOSUB 8400
HOME : VTAB 21: PRINT "CONSTRUCTING A PUNNETT SQUARE IS EASY! BE SURE TO FOLLOW ALONG WITH YOUR BOOK.": GOSUB 7000
GOSUB 9800
HOME : VTAB 21: PRINT "FIRST, MAKE A SQUARE AND, FOR THIS EXAMPLE, DIVIDE IT INTO 4'S." : GOSUB 7000
GOSUB 9850
HOME : VTAB 21: PRINT "NEXT, PLACE THE FEMALE'S POSSIBLE GAMETES ALONG THE TOP EDGE (ONE GAMETE PER BOX).": GOSUB 7000
GOSUB 9860
HOME : VTAB 21: PRINT "THEN PLACE THE MALE'S POSSIBLE GAMETES DOWN THE LEFT HAND COLUMN (AGAIN, ONE GAMETE PER BOX).": GOSUB 7000
GOSUB 9870
HOME : VTAB 21: PRINT "FINALLY, FILL IN EACH BOX OF THE SQUARE BY PLACING THE FEMALE GAMETE AND MALE GAMETE TOGETHER IN ONE BOX, AS SHOWN." : GOSUB 7000
GOSUB 9890
HOME : VTAB 21: PRINT "FOLLOW THE SAME PROCEDURE UNTIL ALL THE BOXES ARE FILLED IN." : GOSUB 7000
GOSUB 9890
HOME : VTAB 21: PRINT "ALL THE FIRST FILIAL OFFSPRING FROM CROSSING RR AND "
PRINT CHR$ (242);
PRINT CHR$ (242);
PRINT " WILL BE HYBRIDS. ALL WILL BE ROUND." : GOSUB 7000
GOSUB 8400
HOME : VTAB 21: PRINT "LET'S TRY CROSSING THE FIRST FILIAL GENERATION."
PRINT : GOSUB 7000
GOSUB 9900
HOME : VTAB 21: PRINT "BOTH OUR PLANTS ARE HYBRIDS SO EACH PARENT CAN OFFER 2 DIFFERENT ALLELES;"
PRINT "R AND " ;
PRINT CHR$(242)
GOSUB 7000
GOSUB 9800
HOME : VTAB 21: PRINT "CONSTRUCT THE SQUARE. (THERE'S ONE PROVIDED IN THE BOOKLET.)": GOSUB 7000
GOSUB 9950
GOSUB 9980
HOME : VTAB 21: PRINT "NOTE THAT WITH HYBRIDS, THE CAPITAL LETTER IS GENERALLY WRITTEN FIRST." : GOSUB 7000
HOME : VTAB 21: PRINT "FILL IN YOUR PUNNETT SQUARE BEFORE CONTINUING!": PRINT : GOSUB 7000
GOSUB 10000
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
TEXT : HOME : PRINT "WHEN CROSSING TWO HYBRIDS, YOU WILL ALWAYS GET A 3:1 PHENOTYPE RATIO AND A 1:2:1 GENOTYPE RATIO."
PRINT : PRINT "PHENOTYPE;"
PRINT : PRINT "3 OF THE OFFSPRING ARE ROUND"
PRINT "1 OF THE OFFSPRING IS WRINKLED"
PRINT : PRINT "GENOTYPE;"
PRINT "ONE IS HOMOZYGOUS DOMINANT"
PRINT "TWO ARE HETEROZYGOUS"
PRINT "ONE IS HOMOZYGOUS RECESSIVE"
PRINT : GOSUB 7800 : TEXT : HOME
PRINT : PRINT "REMEMBER! PREDICTING OFFSPRING ONLY TELLS YOU ABOUT PROBABLE OUTCOMES NOT ACTUAL RESULTS!"
PRINT : PRINT "USING A PUNNETT SQUARE JUST TELLS THE" : HTAB 18: INVERSE PRINT "ODDS": NORMAL : PRINT "OF GETTING OFFSPRING WITH CERTAIN TRAITS."
PRINT: GOSUB 7000
TEXT: HOME: PRINT "AS YOU MAY HAVE GUESSED, THIS SECTION OF OUR WAREHOUSE IS QUITE LARGE. YOU WILL HAVE TO TAKE ANOTHER SHUTTLE TO SEE THE REST OF THIS AREA!"
PRINT: PRINT "PLEASE TYPE PR#6, PRESS THE RETURN KEY THEN TYPE RUN SHUTTLE TWO A."
PRINT: PRINT "THAT WILL GET YOU TO THE PROPER SHUTTLE CONNECTION."
PRINT: PRINT "MENDEL WILL BE WAITING THERE FOR YOU!"
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 HPL 100,45 TO 150,45 TO 150,110 TO 140,120 TO 110,120 TO 100,110 TO 100,45
8303 HPL 100,60 TO 150,60 TO 140,70 TO 110,70 TO 100,60
8304 HPL 110,50 TO 105,50 TO 105,55 TO 110,55 TO 110,53 TO 108,53
8305 HPL 115,50 TO 115,55 TO 120,55 TO 120,50
8306 HPL 125,50 TO 125,55
8307 HPL 130,50 TO 132,50 TO 135,53 TO 132,55 TO 130,55 TO 130,50
8308 HPL 145,50 TO 140,50 TO 140,55 TO 145,55: HPL 140,53 TO 145,53
8309 HPL 105,80 TO 105,75 TO 115,75 TO 115,80
8310 HPL 135,80 TO 135,75 TO 145,75 TO 145,80
8311 HPL 107,85 TO 107,80 TO 113,80 TO 113,85 TO 107,85
8315 HPL 137,85 TO 137,80 TO 143,80 TO 143,85 TO 137,85
8316 HPL 128,90 TO 130,90 TO 138,100 TO 120,100 TO 120,90
8318 HPL 110,105 TO 115,110 TO 135,110 TO 140,105
8320 RETURN

8400 REM MENDEL
8401 TEXT: HOME: HGR: HCOLOR= 3
8402 HPL 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
REMFILIAL

TEXT: HOME: HGR: HCOLOR= 3

HPLOT 40,10 TO 210,10 TO 210,140 TO 40,140 TO 40,10

HPLOT 50,25 TO 50,35: HPLOT 60,25 TO 60,35: HPLOT 50,30 TO 60,30

HPLOT 65,25 TO 75,25: HPLOT 70,25 TO 70,35: HPLOT 65,35 TO 75,35

HPLOT 90,25 TO 90,25 TO 80,30 TO 90,30 TO 90,35 TO 80,35

HPLOT 92,25 TO 105,25: HPLOT 100,25 TO 100,35
9410  HPLOT 140,30 TO 140,50
9411  HPLOT 100,70 TO 100,70 TO 110,70 TO 110,80 TO 130,80 TO 110,90
9412  HPLOT 160,120 TO 160,100 TO 150,100 TO 170,105 TO 170,115 TO 165,120
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 150,110
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 130,110
9419  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 70,60 TO 75,60 TO 75,70 TO 70,80 TO 65,80 TO 65,60
9504  HPLOT 85,60 TO 90,60 TO 95,60 TO 95,80 TO 90,80 TO 85,80 TO 85,60
9505  HPLOT 105,60 TO 105,80
9506  HPLOT 115,60 TO 115,80 TO 125,60 TO 125,80
9507  HPLOT 120,60 TO 190,60 TO 190,80 TO 195,80 TO 190,70 TO 205,70
9508  HPLOT 135,60 TO 135,80 TO 145,60 TO 145,80 TO 135,70 TO 145,70
9509  HPLOT 155,60 TO 155,60 TO 165,60 TO 165,80 TO 155,80
9510  HPLOT 185,60 TO 185,60 TO 175,60 TO 175,80 TO 185,80
9511  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 190,60 TO 190,60 TO 200,60 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
9606  HPLOT 155,60 TO 155,60: HPLOT 160,60 TO 160,80
9607  HPLOT 140,60 TO 140,60 TO 150,60 TO 150,80: HPLOT 140,70 TO 150,70
9608  HPLOT 60,60 TO 50,60 TO 50,70 TO 60,70 TO 60,80 TO 50,80
9609  HPLOT 75,60 TO 55,60 TO 55,80 TO 75,80: HPLOT 75,70 TO 75,70
REM R HYBRID
TEXT : HOME : HGR : HCOLOR = 3
HPLOT 20,90 TO 20,40 TO 50,40 TO 50,60 TO 20,60 TO 50,90
HPLOT 60,60 TO 60,90 : HPLOT 60,70 TO 70,60 TO 85,60 TO 90,70
HPLOT 110,40 TO 140,90 : HPLOT 110,90 TO 140,40
HPLOT 160,90 TO 160,40 TO 190,40 TO 190,60 TO 160,60 TO 190,90
HPLOT 210,60 TO 210,90 : HPLOT 210,70 TO 220,60 TO 235,60 TO 240,70
RETURN
REM MORE
GOSUB 9800
HPLOT 95,35 TO 95,15 TO 105,15 TO 105,25 TO 95,25 TO 185,35
HPLOT 145,25 TO 145,35 : HPLOT 145,38 TO 150,25 TO 155,25
HPLOT 55,75 TO 55,55 TO 65,55 TO 65,65 TO 55,65 TO 65,75
HPLOT 55,110 TO 55,125 : HPLOT 55,115 TO 60,110 TO 65,110
RETURN
HPLOT 135,75 TO 135,55 TO 145,55 TO 145,65 TO 135,65 TO 145,75
REM FILL IN
GOSUB 9950
HPLOT 85,75 TO 85,55 TO 95,55 TO 95,65 TO 85,65 TO 95,75
HPLOT 100,75 TO 100,55 TO 110,55 TO 110,65 TO 100,65 TO 110,75
RETURN
REM ALL DONE
GOSUB 9980
HPLOT 135,75 TO 135,55 TO 145,55 TO 145,65 TO 135,65 TO 145,75
HPLOT 155,65 TO 155,75 : HPLOT 155,70 TO 160,65 TO 165,65
HPLOT 85,138 TO 85,110 TO 95,110 TO 95,120 TO 85,120 TO 95,130
HPLOT 105,130 TO 105,120 : HPLOT 105,125 TO 110,120 TO 115,120
HPLOT 155,120 TO 155,130 : HPLOT 155,125 TO 160,120 TO 165,120
HPLT 135,120 TO 135,130: HPLT 135,125 TO 140,120 TO 145,120
RETURN
REM Y
GOSUB 9880
HPLT 95,15 TO 100,25 TO 105,15: HPLT 100,25 TO 100,35
HPLT 140,15 TO 145,25 TO 150,15: HPLT 145,25 TO 145,35
HPLT 55,55 TO 60,65 TO 65,55: HPLT 60,65 TO 60,75
HPLT 55,110 TO 60,115 TO 65,110: HPLT 60,115 TO 60,120
RETURN
REM MORE
GOSUB 10050
HPLT 85,55 TO 90,65 TO 95,55: HPLT 90,65 TO 90,75
HPLT 105,55 TO 110,65 TO 115,55: HPLT 110,65 TO 110,75
RETURN
REM MORE
GOSUB 10060
HPLT 135,55 TO 140,65 TO 145,55: HPLT 140,65 TO 140,75
HPLT 155,55 TO 160,65 TO 165,55: HPLT 160,65 TO 160,75
RETURN
REM LAST
GOSUB 10070
HPLT 85,105 TO 90,115 TO 95,105: HPLT 90,115 TO 90,125
HPLT 105,115 TO 110,120 TO 115,115: HPLT 110,120 TO 110,125
RETURN
REM MORE
GOSUB 10080
HPLT 135,105 TO 140,115 TO 145,105: HPLT 140,115 TO 140,125
HPLT 155,115 TO 160,120 TO 165,115: HPLT 160,120 TO 160,125
RETURN
REM GENETICS
REM BY PATRICIA D. MORRELL, 4/87
REM INITIALIZATION BLOCK
REM GS=GET COMMAND
REM H$=HELP
REM DRIVER
PRINT CHR$ (4);"BRUN LOMEM:" & LOMEM: 16384
15 REM SIMPLE CROSSES
275 GOSUB 8400
276 HOME: VTAB 21: PRINT "GLAD TO SEE YOU MADE THE CORRECT
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"
287 PRINT: PRINT "CONTENTS: 1 HOMOZYGOS YELLOW FEMALE
HETEROZYGOS YELLOW MALE"
289 PRINT: PRINT "STEP ONE: LIST POSSIBLE GAMES" 
291 PRINT: PRINT "WHAT ARE THE POSSIBLE GAMES 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 "HOMOZYGOS 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 GAMES OF THE 
HETEROZYGOS
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
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 9000
339 HOME : VTAB 21: PRINT "STEP 2. CONSTRUCT A SQUARE": PRINT : GOSUB 7000
341 GOSUB 10050
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
351 GOSUB 10070
353 HOME : VTAB 21: PRINT "IN THE TOP RIGHT BOX, THE FEMALE IS Y AND AGAIN 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 MALE 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 7000
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?"
PRINT : PRINT " (A) ALL YELLOW"
PRINT " (B) ALL GREEN"
PRINT " (C) HALF YELLOW, HALF GREEN"
PRINT : INPUT "YOUR ANSWER: ";G$
PRINT
IF G$ = "A" THEN PRINT "THE PLANTS MAY BE YELLOW BUT I'M GREEN WITH ENVY AT YOUR WISDOM!" : GOTO 399
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
PRINT "OF DOMINANCE. ANY TIME A DOMINANT ALLELE IS PRESENT, IT WILL BE SEEN." : PRINT "EACH OFFSPRING HAS AT LEAST ONE Y, SO ALL OF THEM WILL SHOW THE DOMINANT." : PRINT "YELLOW": GOTO 399
PRINT : PRINT "YOUR CHOICE IS A, B OR C": GOTO 387
PRINT : PRINT : GOSUB 7000
TEXT : HOME : VTAB 5: PRINT "WHAT ARE THE POSSIBLE GENOTYPES?"
PRINT : PRINT "(A) HOW MANY OFFSPRING ARE HOMOZYGOUS RECESSIVE"
INPUT "YOUR NUMBER: ";6$
PRINT
IF G$ = "8" THEN PRINT "YOU ARE A BUDDING GENETICIST IF I EVER SAW ONE!!": GOTO 423
IF G$ > "4" THEN PRINT "ARE YOU SURE?": GOTO 425
IF G$ < "0" THEN PRINT "CHECK YOUR SQUARE AGAIN. THERE AREN'T ANY OFFSPRING WITH THE GENOTYPE ";
PRINT CHR$ (249); PRINT CHR$ (249)
PRINT "THE CORRECT ANSWER, THEN, IS 0."
PRINT : PRINT "HOW MANY ARE HOMOZYGOUS DOMINANT?"
INPUT "YOUR NUMBER: ";G$
PRINT
IF G$ = "2" THEN PRINT : PRINT "YOU SURE CAN COUNT THEM!": GOTO 433
PRINT "ONLY TWO OF THE OFFSPRING HAVE A PAIR OF CAPITAL Y'S. CHECK YOUR SQUARE AGAIN." : GOTO 433
PRINT : PRINT "HOW MANY ARE HETEROZYGOUS?"
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
READY?! 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
IF G$ = "I' THEN PRINT : PRINT "PLEASE WORK ON KIT 52 IN YOUR BOOK!
CHECK BACK WHEN YOU'RE DONE." : PRINT : GOSUB 7000: GOTO 497

PRINT "YOU MUST CHOOSE P OR C": GOTO 489

TEXT : HOME : PRINT "KIT NUMBER 52"
PRINT : PRINT "HOMOZYGOUS RECESSIVE X HETEROZYGOUS YELLOW"
PRINT : PRINT "FEMALE'S GAMETES: ";
PRINT CHR$ (249);
PRINT ";
PRINT CHR$ (249)
PRINT PRINT "MALE'S GAMETES: Y, ";
PRINT CHR$ (249)
PRINT PRINT "PHENOTYPES: 2 GREEN"
PRINT "; 2 YELLOW"
PRINT PRINT "GENOTYPES: 2 HOMOZYGOUS RECESSIVE";
PRINT "; 2 HETEROZYGOTES"
PRINT PRINT "IF YOU WANT TO SEE THE PUNNETT SQUARE TYPE A P"
PRINT PRINT "IF YOU WANT TO GO ON TO THE NEXT KIT, TYPE A C."
PRINT "YOUR PLEASURE: ";G$
IF G$ = "P" THEN GOSUB 10150: GOTO 533
IF G$ = "C" THEN GOTO 533
PRINT "YOU MUST CHOOSE P OR C": GOTO 525
GOSUB 8400
HOME : VTAB 21: PRINT "TRY OUR T SERIES. T = T"
ALL ";
PRINT CHR$ (244);
PRINT " = SHORT": PRINT : GOSUB 7000
HOME : VTAB 21: PRINT "KIT T7 IS A GOOD ONE! CHECK BACK WITH ME SO
ON!": GOSUB 7000
TEXT : HOME : PRINT "KIT T7"
PRINT : PRINT "FEMALE'S GAMETES: ";
PRINT CHR$ (244);
PRINT ";
PRINT CHR$ (244)
PRINT PRINT "MALE'S GAMETES: T, T"
PRINT PRINT "PHENOTYPES: 4 TALL"
PRINT PRINT "GENOTYPES: 4 HETEROZYGOTES"
Would you like to see the Punnett Square for this cross? (Y/N)

Please type Y or N:

If G$ = "Y" then GOSUB 10200: TEXT : HOME : GOTO 567

If G$ <> "N" then GOTO 561

Start working on Kit T12. We'll compare our results when you're done!

Input "Please type in Y or N": G$

If G$ = "Y" then GOSUB 10230: TEXT : HOME : GOTO 597

If G$ = "N" then GOTO 597

Would you like to see the Punnett Square for this cross?

Are you up for it?

Challenge Kit T13. Are you up for it?

Challenge Kit T13.

Homozygous short x tall

Female's gametes: T, T

Male's gametes: T, T

Phenotypes: 4 tall

Genotypes: 2 heterozygotes

2 homozygous dominant

Would you like to see the Punnett Square for this cross?

(Here's where the challenge comes in!)
PRINT: PRINT "TO FIGURE OUT WHICH GENOTYPE THE MALE IS, WE CAN LOOK AT THE OFFSPRING."
PRINT: PRINT "THREE OF THE 'BABY' PEA PLANTS ARE TALL AND ONE IS SHORT."
PRINT: PRINT "CAN YOU FIGURE THIS OUT?"
PRINT: PRINT "WHEN YOU HAVE, TYPE ANY KEY!"
GET G$
PRINT: PRINT "WELL, SUPER SLEUTH, DID YOU DECIDE THE FATHER IS A HYBRID? DO YOU KNOW WHY?"
PRINT: PRINT "THE SHORT OFFSPRING HAS THE GENOTYPE "
PRINT CHR$ (244); CHR$ (244)
PRINT: PRINT "IF ONE ALLELE COMES FROM EACH PARENT, THE MOTHER GAVE ONE ";
PRINT CHR$ (244); PRINT " AND THE FATHER"
PRINT: PRINT "HAD TO GIVE THE OTHER ";
PRINT CHR$ (244)
PRINT: PRINT "SO THE FATHER MUST BE T";
PRINT CHR$ (244)
PRINT: PRINT "IF YOU TURN TO THE NEXT PAGE IN YOUR TOUR BOOK, A PUNNETT SQUARE 'PROOF' IS PROVIDED FOR YOU."
PRINT: GOSUB 7000
TEXT: HOME: PRINT "IF YOU CORRECTLY PREDICTED THE OUTCOMES OF THESE KITS, THEN YOU'RE READY TO SEE THE REST OF OUR STORE!"
PRINT: PRINT "PRESS THE S KEY FOR A SHUTTLE AND CATCH THE ROUTE 3 SHUTTLE TO GET TO OUR MULTIPLE CROSS AREA."
PRINT: PRINT "IF YOU FEEL YOU AREN'T QUITE UP TO OUR MORE COMPLICATED KITS YET, PRESS THE S KEY FOR A SHUTTLE AND CATCH THE ROUTE 2. I'LL TAKE YOU BACK THROUGH THIS AREA."
PRINT: PRINT "SEE YOU, LATER!"
GOSUB 7000
PRINT "YOU'RE NO LONGER AT A SHUTTLE STOP."
END
REM SWITCH ROUTINE
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 HPLT 100,45 TO 150,45 TO 150,110 TO 140,120 TO 110,120 TO 100,110 TO 100,45
8303 HPLT 100,60 TO 150,60 TO 140,70 TO 110,70 TO 100,60
8304 HPLT 110,50 TO 105,50 TO 105,55 TO 110,55 TO 110,53 TO 108,53
8305 HPLT 115,50 TO 115,55 TO 120,55 TO 120,50
8306 HPLT 125,50 TO 125,55
8307 HPLT 130,50 TO 132,50 TO 135,53 TO 132,55 TO 130,55 TO 130,50
8308 HPLT 145,50 TO 140,50 TO 140,55 TO 145,55: HPLT 148,53 TO 145,53
8309 HPLT 105,80 TO 105,75 TO 115,75 TO 115,80
8310 HPLT 135,80 TO 135,75 TO 145,75 TO 145,80
8311 HPLT 107,85 TO 107,80 TO 113,80 TO 113,85 TO 107,85
8312 HPLT 137,85 TO 137,80 TO 143,80 TO 143,85 TO 137,85
8313 HPLT 120,90 TO 130,90 TO 130,100 TO 120,100 TO 120,90
8314 HPLT 110,105 TO 115,110 TO 135,110 TO 140,105
8315 RETURN
8400 REM MENDEL
8401 TEXT : HOME : HGR : HCOLOR= 3
8402 HPLT 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 HPLT 95,50 TO 100,45 TO 110,45 TO 115,50: HPLT 100,50 TO 110,50 TO 110,65 TO 100,65 TO 100,50: HPLT 102,65 TO 102,60 TO 108,60 TO 108,65
8404 HPLT 135,50 TO 140,45 TO 150,45 TO 155,50: HPLT 140,50 TO 150,50 TO 150,65 TO 140,65 TO 140,50: HPLT 142,65 TO 142,60 TO 148,60 TO 148,65
8405 HPLT 125,65 TO 130,70 TO 125,75 TO 120,70 TO 125,65
8406 HPLT 110,90 TO 120,80 TO 130,80 TO 140,90: HPLT 115,95 TO 115,90
8407 HPLT 120,80 TO 120,90: HPLT 125,80 TO 125,90: HPLT 130,80 TO 130,90
8408 HPLT 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 150,120
8425  Hplot 155,80 to 155,120
8426  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 155,75 to 155,55 to 165,55 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
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
REM T
GOSUB 9800
HPLOT 95,15 TO 105,15: HPLOT 100,15 TO 100,35
HPLOT 145,15 TO 155,15: HPLOT 150,15 TO 150,35
HPLOT 55,55 TO 65,55: HPLOT 60,55 TO 60,75
HPLOT 60,105 TO 60,120: HPLOT 55,110 TO 65,110
HPLOT 85,55 TO 95,55: HPLOT 90,55 TO 90,75
HPLOT 105,55 TO 115,55: HPLOT 110,55 TO 110,75
HPLOT 135,55 TO 145,55: HPLOT 140,55 TO 140,75
HPLOT 155,55 TO 165,55: HPLOT 160,55 TO 160,75
HPLOT 85,105 TO 95,105: HPLOT 90,105 TO 90,125
HPLOT 105,115 TO 115,115: HPLOT 110,110 TO 110,125
HPLOT 135,105 TO 145,105: HPLOT 140,105 TO 140,125
HPLOT 155,115 TO 165,115: HPLOT 160,110 TO 160,125
HOME : VTAB 21: PRINT : GOSUB 7000
RETURN
REM GENETICS
REM BY PATRICIA D. MORRELL, 4/87
REM INITIALIZATION BLOCK
REM G$=GET COMMAND
REM H$=HELP
REM DRIVER
PRINT CHR$(4);"BRUN LOMEM:" & LOMEM: 16384
REM PROGRAM
GOSUB 8380
HOME : VTAB 21: PRINT "WELCOME TO ROUTE 3. OUR DESTINATION: THE AISLES OF OUR MULTIPLE TRAITS CROSS KITS!"; GOSUB 7000
HOME : VTAB 21: PRINT "YOU'LL NEED YOUR THINKING CAPS FOR THIS PART OF OUR SHOP!"; GOSUB 7000
TEXT "MANY OF OUR CUSTOMERS ASK US WHY WE HAVE AN AREA OF MULTIPLE TRAITS."; PRINT "WE ANSWER THAT QUESTION WITH OUR QUESTIONS!"
PRINT : PRINT "IS A PEA PLANT JUST TALL OR SHORT? OR IS IT SHORT AND YELLOW OR TALL AND WRINKLED?"
PRINT : PRINT "DON'T WE INHERIT MORE THAN ONE PAIR OF GENES AT A TIME?"
PRINT : PRINT "I COULD KEEP GOING ON, BUT I THINK YOU UNDERSTAND THAT THIS PART OF OUR SHOP HOUSES OUR MOST 'NATURAL' KITS."
PRINT : PRINT "WATCH YOUR STEP GETTING OFF THE SHUTTLE."
PRINT : GOSUB 7000
HOME : VTAB 21: PRINT "HOWDY! I WAS HOPING I'D SEE YOU HERE. THERE'S NO ONE BETTER THAN I TO EXPLAIN MY THIRD PRINCIPLE TO YOU!"
PRINT : GOSUB 7000
HOME : VTAB 21: PRINT "I MUST ADMIT, IT'S ONE OF MY BEST! THE PRINCIPLE OF INDEPENDENT ASSORTMENT"
HOME : VTAB 21: PRINT "LET'S START WITH KIT M6. CROSS TWO HETEROZYGOUS ROUND AND HETEROZYGOUS YELLOW PLANTS. (SEE YOUR BOOK!)
PRINT : GOSUB 7000
HOME : VTAB 21: PRINT "FIRST THINGS FIRST. WHAT DOES THIS MEAN IN TERMS OF GENOTYPES?"
PRINT : GOSUB 7000
TEXT : HOME : PRINT "HERE WE GO!"
PRINT : PRINT "HETEROZYGOUS ROUND IS R"
PRINT : CHR$ (242)
PRINT : PRINT "HETEROZYGOUS YELLOW IS Y"
PRINT : CHR$ (249)
PRINT : PRINT "SO THE FEMALE IS R"
PRINT : CHR$ (242)
PRINT "Y"
PRINT : CHR$ (249)
PRINT "AND THE MALE IS R"
PRINT : CHR$ (242)
PRINT "Y"
PRINT : CHR$ (249)
PRINT : PRINT "WHHEW!"
PRINT : PRINT "NOW, LET'S DECIDE ON THE GAMETE POSSIBILITIES!"
PRINT : GOSUB 7000
TEXT : HOME : PRINT "WE HAVE TO MAKE ALL POSSIBLE COMBINATIONS FOR EACH PARENT."
PRINT : PRINT "LET'S START WITH THE FEMALE."
PRINT : PRINT "FEMALE'S GENOTYPE: R";
PRINT CHR$ (242);
PRINT "Y";
PRINT CHR$ (249)
PRINT "THE R CAN PAIR WITH THE Y OR WITH THE ";
PRINT CHR$ (249)
PRINT "THE ";
PRINT CHR$ (242);
PRINT CHR$ (242);
PRINT " CAN PAIR WITH THE Y OR WITH THE ";
PRINT CHR$ (249)
PRINT CHR$ (242);
PRINT "SO, ALL POSSIBLE COMBINATIONS ARE RY, R";
PRINT CHR$ (249);
PRINT ", ";
PRINT CHR$ (242);
PRINT "Y, ";
PRINT CHR$ (242);
PRINT "Y, ";
PRINT "HOW DO WE KNOW WHICH IS RIGHT?": PRINT : GOSUB 7000
TEXT : HOME : PRINT "THIS IS WHERE MY THIRD PRINCIPLE COMES IN HAND Y."
PRINT : PRINT "THE PRINCIPLE OF INDEPENDENT ASSORTMENT SAYS WHEN TWO TRAITS ARE STUDIED IN THE SAME CROSS, THE GENES FOR ONE TRAIT ASSORT INDEPENDENTLY OF THE GENES FOR THE OTHER."
PRINT : PRINT "IN OTHER WORDS, EACH ALLELE FROM ONE TRAIT CAN MATCH UP WITH WHATEVER ALLELES ARE AVAILABLE FOR THE OTHER TRAIT!"
PRINT : PRINT "BACK TO OUR EXAMPLE, ALL THOSE COMBINATIONS ARE POSSIBLE.": PRINT : GOSUB 7000
TEXT : HOME : PRINT "SINCE THE MALE IS THE SAME GENOTYPE AS THE FEMALE, HIS POSSIBLE GAMETES ARE THE SAME: RY, R";
PRINT CHR$ (249);
PRINT ", ";
PRINT CHR$ (242);
PRINT "Y, ";
PRINT CHR$ (242);
PRINT CHR$(249)
PRINT "DO YOU REMEMBER WHAT WE DO NEXT?"
PRINT "WE CONSTRUCT A PUNNETT SQUARE! (ONLY WE MAY HAVE TO MAKE THIS ONE A BIT BIGGER!)": PRINT
GOSUB 7000
GOSUB 10300
HOME: VTAB 21: PRINT "SINCE THERE ARE 4 POSSIBLE GAMETE COMBINATIONS, OUR SQUARE MUST HAVE 4 BOXES ACROSS AND 4 BOXES DOWN."; GOSUB 7000
GOSUB 10350
HOME: VTAB 21: PRINT "NOW, LIST THE FEMALE PAIRS ACROSS THE TOP AND THE MALE'S DOWN THE SIDE. IT'S ALMOST THE SAME AS BEFORE!": GOSUB 7000
GOSUB 10400
HOME: VTAB 21: PRINT "MAKE THE CROSSES: REMEMBER TO USE THE FEMALE ON THE TOP AND THE MALE ON THE LEFT."; GOSUB 7000
HOME: VTAB 21: PRINT "PLACE ALLELES FOR THE SAME TRAIT NEXT TO EACH OTHER IN THE BOX, FIRST THE CAPITAL THEN THE SMALL LETTER."; GOSUB 7000
GOSUB 10450
HOME: VTAB 21: PRINT "YOUR COMPLETED SQUARE SHOULD LOOK LIKE THIS.": PRINT
GOSUB 7000
TEXT: HOME: PRINT "WHAT ARE THE RESULTING PHENOTYPES?"
PRINT "(REMEMBER TO ACCOUNT FOR BOTH TRAITS!)
PRINT "DO THIS BOX BY BOX."
PRINT "LOOKING AT YOUR SQUARE, IN THE TOP BOX WE HAVE A ROUND, YELLOW PLANT."
PRINT "IN THE NEXT BOX OVER IS ANOTHER ROUND, YELLOW PLANT."
PRINT "COMPLETE YOUR TALLY AND COMPARE YOUR RESULTS WITH MINE!": PRINT
GOSUB 7000
TEXT: HOME: PRINT "THE RESULTING PHENOTYPES ARE:
PRINT "9 ROUND, YELLOW"
PRINT "3 WRINKLED, YELLOW"
PRINT "3 ROUND, GREEN"
PRINT "1 WRINKLED, GREEN"
PRINT "DID YOU GET IT? I HOPE SO!"
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. REMEMBER, 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 PRES&O 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, HOMOZYGOUS 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 TRAITS!": GOSUB 7000
284 HOME: VTAB 21: PRINT "THE PHENOTYPES OF A DIHYBRID CROSS ARE ALWAYS A 9:3:3:1 RATIO. SEE YOUR BOOK FOR AN EXPLANATION OF THESE NUMBERS!": 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 HOMOZYGOUS GREEN WITH HOMOZYGOUS WRINKLED AND HOMOZYGOUS GREEN": GOSUB 7000
PRINT "FIRST, SET UP THE POSSIBLE COMBINATIONS."
PRINT "FEMALE GENOTYPE:
HETEROZYGOUS ROUND = R";
PRINT CHR$ (242)
PRINT "HOMOZYGOUS GREEN = ";
PRINT CHR$ (249)
PRINT CHR$ (249)
PRINT "COMBINATIONS POSSIBLE = R";
PRINT CHR$ (249);
PRINT ", ";
PRINT CHR$ (242);
PRINT CHR$ (249);
PRINT ", ",
PRINT "THERE ARE ONLY 2 DIFFERENT COMBINATIONS POSSIBLE."
PRINT "MALE GENOTYPE:
HOMOZYGOUS WRINKLED = ";
PRINT CHR$ (242);
PRINT CHR$ (242)
PRINT "HOMOZYGOUS GREEN = ";
PRINT CHR$ (249)
PRINT CHR$ (249)
PRINT "COMBINATIONS POSSIBLE: ";
PRINT CHR$ (242);
PRINT CHR$ (242);
PRINT CHR$ (249)
PRINT "THERE IS ONLY ONE POSSIBLE COMBINATION!"
PRINT "NEXT, SET UP A SQUARE. SINCE THERE ARE ONLY 2 POSSIBLE FEMALE COMBINATIONS AND ONLY 1 MALE COMBINATION, WE CAN TAKE A SHORT CUT ON THE SQUARE AND MAKE IT A TWO BY ONE!": PRINT : GOSUB 7000
GOSUB 10540
HOME : VTAB 21: PRINT "NOW MAKE YOUR CROSSES": PRINT : GOSUB 7000
GOSUB 10520
HOME : VTAB 21: PRINT "YOUR CHART SHOULD AGREE WITH THIS ONE!": PRINT : GOSUB 7000
TEXT : HOME : PRINT "FINALLY, ANALYZE THE SQUARE!"
PRINT : PRINT "WHAT ARE THE PHENOTYPES?"
GOSUB 8400
HOME: VTAB 21: PRINT "I HAVE TIME TO WORK ON ONE MORE KIT WITH YOU BEFORE I HAVE TO LEAVE TO GREET THE NEXT GROUP OF CUSTOMERS."; GOSUB 7000
HOME: VTAB 21: PRINT "TRY KIT M57. WHY DON'T YOU WORK THIS ONE OUT COMPLETELY FIRST, THEN CHECK YOUR OUTCOMES WITH ME!"; GOSUB 7000
HOME: VTAB 21: PRINT "ARE YOU SURE YOU'RE READY TO CHECK YOUR OFFSPRING POSSIBILITIES WITH ME? DON'T PRESS THE C KEY UNTIL YOU ARE!"; GOSUB 7000
TEXT: HOME: PRINT "FEMALE GENOTYPE: T";
PRINT CHR$ (244); PRINT "R";
PRINT CHR$ (242)
PRINT "POSSIBLE COMBINATIONS: TR, ";
PRINT CHR$ (244); PRINT "R, ";
PRINT "", ";
PRINT CHR$ (244);
PRINT "R, ";
PRINT CHR$ (244);
PRINT CHR$ (242)
PRINT "THE MALE'S GENOTYPE AND POSSIBLE GENE COMBINATIONS ARE EXACTLY THE SAME AS THE FEMALE'S"
PRINT "THE PHENOTYPES OF THE OFFSPRING ARE:
PRINT "9 TALL AND ROUND"
PRINT "3 TALL AND WRINKLED"
PRINT "3 SHORT AND ROUND"
PRINT "1 SHORT AND WRINKLED"
PRINT "I THINK I'LL LIST THE GENOTYPES ON THE NEXT SCREEN!"
PRINT GOSUB 7000
TEXT: HOME: PRINT "THE POSSIBLE GENOTYPES ARE:
PRINT "1 HOMOZYGOUS TALL, HOMOZYGOUS ROUND"
PRINT "2 HETEROZYGOUS TALL, HOMOZYGOUS ROUND"
PRINT "2 HOMOZYGOUS TALL, HETEROZYGOUS ROUND"
PRINT "4 HETEROZYGOUS TALL, HETEROZYGOUS ROUND"
HALF ARE ROUND AND GREEN AND
HALF ARE WRINKLED AND
GREEN

REMEMBER, ONE DOMINANT ALLELE MAKES THE DOMINANT TRAIT VISIBLE!

I'LL LET YOU FIGURE OUT THE GENOTYPES! (BIG OF ME, I KNOW!)

WHEN, AND ONLY WHEN YOU HAVE TRIED TO LIST ALL GENOTYPES, YOU MAY TYPE A 2 TO CONTINUE!

INPUT G$

IF G$ < > "2" THEN PRINT "YOU MUST FOLLOW DIRECTIONS!": GOTO 384

ARE YOU SURE YOU'RE READY?

HERE GOES!

HALF ARE HETEROZYGOUS ROUND, HOMOZYGOUS GREEN
HALF ARE HOMOZYGOUS WRINKLED, HOMOZYGOUS GREEN

REMEMBER, HOMO MEANS SAME AND HETERO MEANS DIFFERENT!

TAKE A FEW MINUTES TO REVIEW THIS CROSS.

GOSUB 7000

GOSUB 8400
PRINT "1 HOMOZYGOUS TALL, HOMOZYGOUS WRINKLED"
PRINT "2 HETEROZYGOUS TALL, HOMOZYGOUS WRINKLED"
PRINT "1 HOMOZYGOUS SHORT, HOMOZYGOUS ROUND"
PRINT "2 HOMOZYGOUS SHORT, HETEROZYGOUS ROUND"
PRINT "1 HOMOZYGOUS SHORT, HOMOZYGOUS WRINKLED"
PRINT "CHECK YOUR LIST AGAINST MINE!": PRINT : GOSUB 7000
GOSUB 8400
HOME : VTAB 21: PRINT "THANK YOU FOR STOPPING BY! I HOPE YOU ENJOYED WORKING WITH MY KITS AS MUCH AS I DID!": GOSUB 7000
HOME : VTAB 21: PRINT "BY THE WAY, WE'LL SOON ACCEPT VISA AND MASTERCARDS TO MAKE IT MORE CONVENIENT FOR YOU TO PURCHASE KITS IN THE FUTURE!": GOSUB 7000
HOME : VTAB 21: PRINT "I PREPARED A SPECIAL COLLECTION OF KITS FOR YOU TO TRY. THEY'RE INCLUDED IN YOUR TOUR GUIDE (AT NO EXTRA CHARGE!!)": GOSUB 7000
HOME : VTAB 21: PRINT "PLEASE WORK ON THEM AFTER YOU LEAVE THE MACHINE!": GOSUB 7000
GOSUB 10680
HOME : VTAB 21: PRINT "THANK YOU FOR YOUR PATRONAGE! HAPPY CROSSING!"
END
REM SWITCH ROUTINE
INPUT "TYPE S TO SWITCH OR C TO CONTINUE: ";G$
IF G$ = "S." THEN GOTO 105
IF G$ = "C" THEN RETURN
GOTO 7001
RETURN
REM GUIDE
TEXT : HOME : HGR : HCOLOR= 3
HPlot 100,45 TO 150,45 TO 150,110 TO 140,120 TO 110,120 TO 100,110 TO 100,45
HPlot 100,60 TO 150,60 TO 140,70 TO 110,70 TO 100,60
HPlot 110,50 TO 105,50 TO 105,55 TO 110,55 TO 110,53 TO 100,53
HPlot 115,50 TO 115,55 TO 120,55 TO 120,50
HPlot 125,50 TO 125,55
HPlot 120,56 TO 132,50 TO 132,53 TO 132,55 TO 130,55 TO 130,50
REM MENDEL

TEXT : HOME : HGR : HCOLOR= 3

LET X = 100

FOR I = 1 TO 11
  HPLOT X,28 TO X,35
  LET X = X + 5
NEXT I

LET X = 110

FOR I = 1 TO 7
  HPLOT X,100 TO X,130
  LET X = X + 5
8423 NEXT I
8424 HPL0T 145,95 TO 145,147: HPL0T 159,90 TO 159,122: HPL0T 150,85 TO 150,120
8425 HPL0T 155,80 TO 155,120
8427 RETURN
10300 REM BIG SQUARE
10301 TEXT : HOME : HGR : HCOLOR= 3
10302 HPL0T 35,30 TO 215,38 TO 215,150 TO 35,150 TO 25,30
10303 HPL0T 35,68 TO 215,60: HPL0T 35,90 TO 215,90: HPL0T 35,120 TO 215,128
10304 HPL0T 80,30 TO 80,150: HPL0T 125,30 TO 125,150: HPL0T 170,30 TO 170,150
10305 RETURN
10308 REM GAME TES
10310 GOSUB 10300
10352 HPL0T 45,25 TO 45,5 TO 55,5 TO 55,15 TO 45,15 TO 55,25
10353 HPL0T 60,5 TO 65,15 TO 70,5: HPL0T 65,15 TO 65,25
10354 HPL0T 90,25 TO 90,5 TO 100,5 TO 100,15 TO 90,15 TO 100,25
10355 HPL0T 105,15 TO 110,25 TO 115,5 TO 115,15: HPL0T 110,25 TO 110,25
10356 HPL0T 135,15 TO 135,25: HPL0T 135,20 TO 140,15 TO 145,15
10357 HPL0T 150,15 TO 155,20 TO 160,15: HPL0T 155,20 TO 155,25
10362 HPL0T 180,25 TO 180,15: HPL0T 180,20 TO 185,15 TO 190,15
10364 HPL0T 200,15 TO 205,15 TO 210,5: HPL0T 205,15 TO 205,25
10365 HPL0T 5,55 TO 5,35 TO 15,35 TO 15,45 TO 5,45 TO 15,55
10366 HPL0T 20,35 TO 25,45 TO 30,35: HPL0T 25,45 TO 25,55
10367 HPL0T 5,85 TO 5,65 TO 15,65 TO 15,75 TO 5,75 TO 15,85
10369 HPL0T 20,75 TO 25,80 TO 30,75: HPL0T 25,80 TO 25,85
10370 HPL0T 5,100 TO 5,110: HPL0T 5,105 TO 10,100 TO 15,100
10372 HPL0T 20,100 TO 25,105 TO 30,100: HPL0T 25,105 TO 25,110
10374 HPL0T 5,135 TO 5,145: HPL0T 5,140 TO 10,135 TO 15,135
10376 HPL0T 20,125 TO 25,135 TO 30,125: HPL0T 25,135 TO 25,145
10378 RETURN
10400 REM MORE
10401 GOSUB 10350
10402 HPL0T 40,50 TO 40,40 TO 45,40 TO 45,45 TO 40,45 TO 45,50
10407 HPL0T 50,50 TO 50,40 TO 55,40 TO 55,45 TO 50,45 TO 55,50
10404 HPLT 60,40 TO 63,45 TO 65,40: HPLT 63,45 TO 63,50
10406 HPLT 70,40 TO 73,45 TO 75,40: HPLT 73,45 TO 73,50
10407 RETURN
10450 REM EVEN MORE
10451 GOSUB 10400
10452 HPLT 85,50 TO 85,40 TO 90,40 TO 90,45 TO 85,45 TO 90,50
10453 HPLT 95,50 TO 95,40 TO 100,40 TO 100,45 TO 95,45 TO 100,50
10455 HPLT 105,40 TO 108,45 TO 110,45: HPLT 108,45 TO 108,50
10456 HPLT 110,45 TO 118,48 TO 120,45: HPLT 118,48 TO 118,50
10457 HPLT 130,50 TO 135,40 TO 135,45 TO 130,45 TO 135,50
10458 HPLT 140,45 TO 140,50: HPLT 140,48 TO 143,45 TO 145,45
10460 HPLT 150,40 TO 153,45 TO 155,40: HPLT 153,45 TO 153,50
10462 HPLT 160,45 TO 163,48 TO 165,45: HPLT 163,48 TO 163,50
10463 HPLT 175,50 TO 175,40 TO 180,40 TO 180,45 TO 175,45 TO 180,50
10465 HPLT 185,50 TO 185,45 TO 190,45: HPLT 185,48 TO 188,45 TO 190,45
10466 HPLT 195,40 TO 198,45 TO 200,40: HPLT 198,45 TO 198,50
10467 HPLT 205,40 TO 208,45 TO 210,40: HPLT 208,45 TO 208,50
10468 HPLT 40,80 TO 40,70 TO 45,70 TO 45,75 TO 40,75 TO 45,80
10469 HPLT 50,80 TO 50,70 TO 55,70 TO 55,75 TO 50,75 TO 55,80
10470 HPLT 60,70 TO 63,75 TO 65,70: HPLT 63,75 TO 63,80
10471 HPLT 70,75 TO 73,78 TO 75,75: HPLT 73,78 TO 73,80
10472 HPLT 85,80 TO 85,70 TO 90,70 TO 90,75 TO 85,75 TO 90,80
10473 HPLT 95,70 TO 98,75 TO 100,70: HPLT 98,75 TO 198,80
10474 HPLT 205,75 TO 208,78 TO 210,75: HPLT 208,78 TO 208,80
10475 HPLT 95,80 TO 95,70 TO 100,70 TO 100,75 TO 95,75 TO 100,80
10476 HPLT 140,75 TO 140,80: HPLT 140,78 TO 142,75 TO 145,75
10477 HPLT 60,100 TO 63,105 TO 65,100: HPLT 63,105 TO 63,110
10478 HPLT 60,130 TO 63,135 TO 65,130: HPLT 63,135 TO 63,140
10479 HPLT 130,80 TO 130,70 TO 135,70 TO 135,75 TO 130,75 TO 135,80
10480 HPLT 175,80 TO 178,70 TO 180,70 TO 180,75 TO 175,75 TO 180,80
10481 HPLT 150,75 TO 153,78 TO 155,75: HPLT 153,78 TO 153,80
10482 HPLT 168,75 TO 165,78 TO 165,75: HPLT 163,78 TO 163,80
10483 HPLT 40,110 TO 40,100 TO 45,100 TO 45,105 TO 40,105 TO 45,110
10484 HPLT 50,135 TO 50,138 TO 53,135 TO 55,135
10485 HPLT 105,75 TO 108,78 TO 110,75: HPLT 108,78 TO 108,80
REM M18.2
GOSUB 10540
HPLOT 80,85 TO 80,65 TO 90,65 TO 90,75 TO 80,75 TO 90,85
HPLOT 95,75 TO 95,85 TO 100,75 TO 105,75
HPLOT 110,75 TO 115,80 TO 120,75 TO 115,85
10525 HPLT 125.75 TO 130.75 TO 135.75: HPLT 130.75 TO 135.75
10527 HPLT 145.75 TO 145.85: HPLT 145.80 TO 150.75 TO 155.75
10528 HPLT 160.75 TO 160.85: HPLT 160.80 TO 165.75 TO 170.75
10529 HPLT 175.75 TO 180.75 TO 185.75: HPLT 180.75 TO 185.75
10530 HPLT 190.75 TO 195.75 TO 200.75: HPLT 195.75 TO 200.75
10531 RETURN
10540 REM M18
10541 TEXT : HOME : HGR : HCOLOR= 3
10542 HPLT 75.60 TO 185.60 TO 205.60 TO 205.75 TO 75.75 TO 75.60: HPLT 140.60 TO 140.75
10543 HPLT 60.70 TO 65.75 TO 70.75 TO 75.75 TO 65.75 TO 65.70
10544 HPLT 45.70 TO 45.70 TO 45.75 TO 50.75 TO 50.75
10545 HPLT 185.40 TO 190.40 TO 195.40 TO 190.40 TO 190.40
10546 HPLT 170.40 TO 170.40 TO 175.40 TO 180.40 TO 180.40
10547 HPLT 110.40 TO 115.45 TO 120.45 TO 125.45 TO 125.45
10548 HPLT 95.50 TO 105.30 TO 105.40 TO 115.40 TO 115.40
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 HPLT 60.80 TO 60.50 TO 190.50 TO 190.80 TO 60.80: HPLT 125.50 TO 125.80
10554 HPLT 60.80 TO 60.50 TO 190.50 TO 190.80 TO 60.80: HPLT 125.50 TO 125.80
10556 HPLT 75.45 TO 75.25 TO 85.25 TO 85.45 TO 75.45 TO 75.25
10556 HPLT 75.45 TO 75.25 TO 85.25 TO 85.45 TO 75.45 TO 75.25
10558 HPLT 180.25 TO 185.25 TO 190.25 TO 195.25 TO 180.25 TO 185.25
10558 HPLT 180.25 TO 185.25 TO 190.25 TO 195.25 TO 180.25 TO 185.25
10560 HPLT 140.35 TO 140.45 TO 145.45 TO 150.35 TO 140.35 TO 140.45
10560 HPLT 140.35 TO 140.45 TO 145.45 TO 150.35 TO 140.35 TO 140.45
10562 HPLT 165.35 TO 175.40 TO 175.35 TO 175.40 TO 175.35
10562 HPLT 165.35 TO 175.40 TO 175.35 TO 175.40 TO 175.35
10564 HPLT 20.60 TO 20.40 TO 20.70: HPLT 20.60 TO 25.60 TO 30.60
10564 HPLT 20.60 TO 20.40 TO 20.70: HPLT 20.60 TO 25.60 TO 30.60
10603  HPLUT 100,155 TO 100,100 TO 150,100 TO 150,155
10605  HPLUT 100,70 TO 90,70 TO 90,80 TO 100,80: HPLUT 90,75 TO 100,75
10607  HPLUT 110,70 TO 120,30: HPLUT 120,70 TO 110,80
10609  HPLUT 130,70 TO 140,70: HPLUT 130,80 TO 140,80: HPLUT 135,70 TO 13
5,80
10610  HPLUT 150,70 TO 160,70: HPLUT 155,70 TO 155,80
10612  HPLUT 40,40 TO 30,40 TO 30,50 TO 40,50
10614  HPLUT 50,50 TO 50,40 TO 60,40 TO 60,50 TO 50,50
10616  HPLUT 70,50 TO 70,40 TO 80,40 TO 80,50
10618  HPLUT 100,40 TO 90,40 TO 90,50 TO 100,50: HPLUT 90,45 TO 100,45
10620  HPLUT 130,50 TO 130,40 TO 140,40 TO 140,50: HPLUT 130,45 TO 140,45
10622  HPLUT 150,40 TO 150,50 TO 160,50 TO 160,45 TO 155,45
10624  HPLUT 170,50 TO 170,40 TO 180,40 TO 180,50: HPLUT 170,45 TO 180,45
10626  HPLUT 190,40 TO 200,40: HPLUT 195,40 TO 195,50: HPLUT 190,50 TO 20
0,50
10628  HPLUT 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

<table>
<thead>
<tr>
<th>Route Number</th>
<th>Destination</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>TERMINOLOGY AREA - a good place to start, especially if it's your first time here!</td>
</tr>
<tr>
<td>2</td>
<td>SIMPLE CROSS SECTION - contains Punnett Squares and basic trait supplies (of course, instructions are included in all our kits!)</td>
</tr>
<tr>
<td>3</td>
<td>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!</td>
</tr>
</tbody>
</table>

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)

\[ \text{PARENT} \times \text{PARENT} \rightarrow F_1 \]

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

\[ F_1 \times F_1 \rightarrow F_2 \]

(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 × 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.)

\[
\begin{array}{cc}
R & R \\
R & R \\
R & R \\
R & R \\
\end{array}
\]
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.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

3. List Phenotypes:

   List Genotypes:
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:
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:
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?

```
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>t</td>
</tr>
<tr>
<td>t</td>
<td></td>
</tr>
</tbody>
</table>
```

- Short is NOT possible.

```
<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>t</td>
</tr>
<tr>
<td>t</td>
<td></td>
</tr>
</tbody>
</table>
```

- 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 independently 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:

\[
\begin{array}{cccc}
  RY & RY & Y & Y \\
  RY & RY & Y & Y \\
  Y & Y & Y & Y \\
  Y & Y & Y & Y \\
\end{array}
\]
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:

Phenotypes of Offspring:

Genotypes of Offspring:
Cross two plants that are heterozygous 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 F1 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 F1 generation; (b) in the F2 generation; and (c) among the offspring produced by crossing one of the F1 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.

Multiple Choice

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) heterozygous; (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 (a) trait

2. characteristic carried by a gene (b) cross

3. mating between different varieties of organisms (c) phenotype

4. actual alleles an organism has for a particular trait (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 welcome. 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

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 course material before using CDI were unfavorable. SA A UN D SD
24. My feelings toward the course 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!