A Survey of Introductory College Genetics Courses

An Honors Thesis (ID 499)
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The pivotal role of genetics in modern science suggests that genetic discoveries are likely to affect all of contemporary society. Such concerns as the genetic relationships of human beings to each other and to other organisms and the impact of modern knowledge of genetics on ethics, values, and social relations were found to be important aspects of biology education in a study on scientific literacy. Moreover, Radford and Bird-Stewart claim that the majority of the population will have some involvement in their lifetimes with a genetically caused medical condition and that this is sufficient argument for universal genetics education. In 1985, the importance of genetics in the undergraduate curriculum was the subject of a two-day symposium, "Science as a Way of Knowing III-Genetics," held at the annual meeting of the American Society of Zoologists. While this symposium documented the importance of genetics in the biology curriculum, with 15 major papers being presented, the speakers offered no baseline data on what is currently being taught in the nation's genetics classrooms. Twenty years ago, however, a study of this type was conducted to examine the approaches then being used in teaching the introductory genetics course at the college level.

In view of the overwhelming progress made in genetics during the last two decades, a new investigation was conducted to elucidate the following information about general genetics courses as they are currently being taught across the U.S.: (1) the academic environment in which the genetics course is taught; (2) the subject matter and laboratory content of the course; (3) the number and preparation of the instructional staff; and (4) the special teaching approaches employed in presenting course content.
Materials and Methods

A questionnaire, sent to 232 geneticists, was the method by which data were collected for this investigation. The names and addresses of the individuals to whom the questionnaire was sent were obtained from the 1988-89 membership directory of the Genetics Society of America (GSA). GSA members who were obviously in non-teaching and research positions were not included in the survey.

Of those surveyed, 58 percent (135) responded by returning a completed questionnaire. The responding geneticists represented four year colleges and universities located in 39 of the 50 states (Figure 1).

Data concerning the type of institution (state, independent/non-profit, denominational) and its enrollment were obtained from the Education Directory of Colleges and Universities and Peterson’s Higher Education Directory.

Data and Discussion

Institutions and Enrollment

Figure 1 illustrates the geographical distribution of the 135 colleges and universities from which completed questionnaires were received. Summarized in Tables 1 and 2 are data on the types of institutions and their enrollments.

Academic-year Calendar and Number and Length of Lectures

The focus of this study is to determine what is being taught in today’s genetics classrooms; hence, the amount of formal instructional time available to students is an important consideration. The data revealed
that 65.9 percent of the 135 responding institutions operated on two semesters of 14, 15, or 16 weeks; an additional 7.4 percent employed two semesters with variations of 12, 13, or 18 week sessions; finally, one school had an academic year of three semesters of 12 weeks each. The quarter system was employed at the colleges and universities of 20.7 percent of the respondents, with 21 institutions operating on a system of three quarters of 10 or 11 weeks and seven institutions using four quarters of 10 weeks each. Additionally, 2.2 percent of the institutions have two semesters of 12 or 14 weeks plus an intersession of five or four weeks, respectively. The remaining 3.1 percent did not respond to the question.

A further consideration of time was examined through the number of lectures per week and the length of each lecture period. The data disclosed that 54.4 percent of the institutions require three lecture periods; 28.7 percent use two lecture periods; 12.5 percent have four periods; and 0.7 percent use five lectures per week. Additionally, one institution offered genetics with either two or three lectures per week with a total of 150 minutes of lecture time for both options. Five institutions, 3.7 percent, did not respond to the question. Lecture length was found to be 50 minutes in 64.0 percent, and 75 minutes in 16.2 percent of the institutions. The remaining 19.8 percent of the schools employed a variety of lecture times ranging from 55 to 120 minutes.

From the preceding data, one can conclude that genetics is taught primarily on the semester system using three lecture periods of 50 minutes each per week. The survey conducted 20 years ago by Straney and Mertens\textsuperscript{12} revealed the same time limitations for the genetics course.
Department, Course Title, Course Number, and Prerequisites

The introductory genetics course was found to be taught within departments of biology or life sciences in 93 percent of the institutions surveyed. The remaining seven percent of the instructors indicated that the course is taught in genetics, zoology or science/mathematics departments. This finding is a reflection of the fact that questionnaires were sent primarily to instructors in departments of biology.

The majority of institutions surveyed, 71.9 percent, indicated the title of the genetics course to be "Genetics" or "General Genetics." Additionally, 16.3 percent of the institutions employed such titles as "Introduction to Genetics," "Principles of Genetics," and "Fundamentals of Genetics." Fourteen, 10.4 percent, of the instructors did not respond to the question. The 1969 study\textsuperscript{12} found that 82 percent of the responding institutions included the word "genetics" in their course titles.

In the present study, course numbers for the genetics course varied widely among the institutions surveyed. The most commonly used system of numbering, found at 72.6 percent of the schools, is the hundreds classification, with courses in the 100s generally being for freshmen, courses in the 200s for sophomores and so on. Eighty-three of the instructors teach courses at the 200 and 300 levels; eight schools use a 100 level, four a 400 level, and three a 500 level course. Of the remaining respondents, 33 were from institutions which use an entirely different numbering system, and four did not reply to the question. In contrast, the earlier study\textsuperscript{12} reported that most institutions employed a 300 or 400 level number for the general genetics course.

General biology is a prerequisite for introductory genetics at 92 percent of the responding institutions, while chemistry is required by 57
percent. A prerequisite of four to eight semester or quarter hours each of biology and chemistry is required by most institutions; however, 54 respondents indicated a requirement of more than eight hours of each subject. Among the other prerequisites most frequently listed were zoology, calculus, physics, and biochemistry. Since the 1969 study\textsuperscript{12}, the requirement of general biology as a prerequisite for the genetics course has increased by approximately five percent, while the requirement of chemistry has increased nearly 15 percent.

Genetics as a Required Course in the Biology Curriculum

Approximately 77 percent of all respondents indicated that the introductory genetics course is a requirement for biology majors. Of the 108 institutions offering a biology teaching major, 60 percent required genetics. Nearly one-half of the institutions having pre-medical and pre-dental study, 126 and 120 schools respectively, required genetics, while only one-third of the 85 schools with a biochemistry major include genetics in their curricular requirements. Several institutions also indicated a genetics requirement in areas such as medical technology, pre-veterinary medicine, psychology, and agriculture.

Compared to data collected 20 years ago\textsuperscript{12}, the requirement for biology majors to complete an introductory genetics course appears to have increased by only two percent. In contrast, the requirement for biology teaching majors appears to have decreased by nearly two percent. These minor differences may only reflect sampling errors, however. The requirement of genetics for pre-medical and pre-dental students has remained virtually unchanged, while one-third as opposed to the previous one-fourth of the institutions now require genetics for biochemistry majors. Considering the exponential increase in knowledge of genetics over
the last two decades, and recognizing the impact of genetics on all
disciplines of biology, one might have hoped that the requirement of a
genetics course for biology majors would have increased dramatically. With
the importance of genetics education in the undergraduate curriculum being
recognized in the "Science as a Way of Knowing" symposium\(^9\) and in many
other published articles over the last decade, the apparent two percent
decline in the genetics requirement for biology teaching majors is
especially disappointing.

Course Materials and Content

Approximately 55 percent of the responding institutions use one of
three textbooks: *An Introduction to Genetic Analysis*\(^{13}\) by Suzuki,
Griffiths, Miller, and Lewontin; *Concepts of Genetics*\(^8\) by Klug and
Cummings; or Russell's *Genetics*\(^{11}\). Another 19 percent indicated using
either *Principles of Genetics*\(^4\) by Fristrom and Clegg or *Basic Genetics*\(^6\) by
Hartl, Freifelder, and Snyder. The remaining 26 percent of the
institutions use one or more of the many genetics textbooks on the market.

Summarized in Table 3 are data on the amount of lecture time devoted to
major topics usually covered in a general genetics course. In analyzing
these data, the amount of lecture time per topic was broken down into three
categories: one-half to less than three hours, three to less than five
hours, and five or more hours of lecture. Ninety or more percent of the
individuals responding to each topic spent one-half to less than three
hours on each of the following topics: probability and chi-square,
multiple alleles and complex gene loci, structural changes in chromosomes,
numerical changes in chromosomes, and polygenic and multifactorial
inheritance. Approximately 55 percent of the respondents who include
lectures on Mendelism - segregation and independent assortment, and on gene
action, protein synthesis, and the genetic code reported using three or more instructional hours to treat these topics. Additionally, 64 percent of the respondents devoted three or more lecture hours to linkage, crossing-over, and gene mapping in their courses. The 1969 study\textsuperscript{12} revealed that gene action, linkage, and Mendelism—in that order—were the three most emphasized topics in the genetics course. In Table 3, the percentage of those not reporting on a particular topic may be attributed to omission of the topic, covering the topic in another manner (i.e., the textbook readings, the laboratory, or a separate course), or a difference in the questionnaire's topic breakdown from that used by the instructor. Furthermore, instructors were given a space denoted as "other" with which to include topics not specified in the questionnaire. Seventy-three percent of the 80 respondents who indicated additional topics were covered, spent three or more lecture hours on such areas as: developmental genetics, gene regulation, and recombinant DNA technology.

Laboratory Work

A variety of laboratory requirements were observed among the responding institutions. Ninety-three, 69 percent, of the 135 responding colleges and universities have either a mandatory or optional laboratory. A majority of these schools have one three-hour laboratory session per week. This was also the finding for number and length of laboratory sessions in the 1969 study\textsuperscript{12}. However, in the present study, two and three laboratories per week were reported by some respondents and laboratory length varied from two to four hours. In addition to regularly scheduled laboratory periods, 92 percent of the instructors indicated that the laboratory room was open for student use at other times during the week.
Laboratory manuals were employed by only one-third of the instructors. One-half of these instructors reported using *Genetics Laboratory Investigations* by Gardner, Mertens, and Hammersmith. Additional laboratory exercises were compiled from various sources: nearly three-fourths of the instructors composed their own laboratory investigations, one-fifth employed computer programs, while over one-fourth used some combination of the above resources.

The amount of laboratory time spent on various topics is indicated in Table 4. The data show a strong emphasis on transmission genetics with 43 percent of the instructors who cover this topic spending 16 or more hours of laboratory instructional time. Furthermore, 64 percent of the instructors who stressed microbial and molecular genetics spent from six to less than 16 hours of laboratory time on that topic. However, mammalian and population genetics were not covered as extensively, with most instructors spending only one to less than six hours on each topic.

Instructors were also asked to list any other laboratory topics not covered in the questionnaire; other such topics included were cytogenetics and biochemical genetics. The 1969 study reported a strong emphasis on transmission genetics in the general genetics laboratory. In the present study, transmission genetics was again found to be of much significance; however, microbial and molecular genetics was treated by nearly as many instructors.

The most common genetics laboratory organism, *Drosophila melanogaster*, is used by 100 percent of the 93 laboratory instructors. The frequency with which other organisms are used in the genetics laboratory is reported in Table 5. Several respondents indicated using additional organisms, including *Mus musculus, Saccharomyces cerevisiae, Salmonella typhimurium,*
and *Homo sapiens*. Straney and Mertens\(^{12}\) found the most commonly used organisms to be *D. melanogaster* and *Zea mays*. While *D. melanogaster* is still reported to be the most widely used organism, *Escherichia coli* was found to be used by 73 percent of the laboratory instructors.

Instructional Personnel

While 135 individuals responded to the questionnaire, 199 faculty were reported to be involved in teaching the general genetics course. Ninety-five percent (189) of the instructors hold a Ph.D. degree, three percent have an M.S., and two percent a B.S. degree. Nearly 70 percent of the 199 instructors indicated genetics or a specialized area in genetics to be their major discipline. The remaining faculty reported specializing in areas such as cell biology, zoology, molecular biology, biochemistry, and cytology.

Special Instructional Techniques

A relatively small number of respondents employ four special instructional techniques in the introductory genetics course: independent study—24.2 percent; audio-tutorial—10.4 percent; team-teaching—15.6 percent; and computer assisted instruction—28.9 percent. These findings are similar to those of the 1969 survey\(^{12}\) in which Straney and Mertens stated that special teaching approaches were not widely adopted in teaching general genetics.

A variety of approaches were indicated by the respondents employing the independent study concept. The number of weeks devoted to independent study varies from five to seven for the majority of those responding, while variations from two weeks through the entire academic term were observed. Two-thirds of the instructors assigned a study topic to the students;
however, the remaining instructors left the topic to the students' discretion. To complete the independent study, 32 of the 33 instructors required a written report; in addition, eight of the instructors also required an oral presentation.

The 10.4 percent of the respondents employing audio-tutorial instruction reported using videotapes and films twice as frequently as audio instructional tapes. A small proportion of the instructors were responsible for the development of these materials, while the majority used commercially prepared instructional materials. Most institutions do not conduct group viewing and listening sessions, but instead, use individual instructional facilities. Of those respondents conducting group viewings, more than one-half have follow-up discussions over which the instructor usually presides. Finally, two-thirds of the respondents employing this approach do not include it on a definite schedule throughout the course.

Fifteen percent of the respondents reported using a team-teaching approach in the introductory genetics course. The majority of the teams consisted of two instructors, while others reported teams of three and five members. Generally, the course was divided on the basis of each instructor's area of expertise.

Twenty-nine percent of the respondents employ computer assisted instruction in the general genetics course. Among the most popular commercial computer programs are Catlab, Linkover, and Gene Machine. Additionally, 15 percent of the instructors using this special teaching approach write their own course-related programs. The computer programs were related to the genetics course in various ways: incorporated into class lecture--36 percent; incorporated into laboratory sessions--33 percent; left as optional to the student--33 percent; and assigned as
out-of-class tutorials and review—31 percent. In the 1969 study\textsuperscript{12}, only 4 percent of 226 instructors were found to be using programmed instruction in book format. Currently, computer assisted instruction, a more sophisticated and useful instructional tool, is much more widely used.

Summary

The nature of the introductory genetics course taught in four-year colleges and universities across the nation was determined by a questionnaire completed by 135 genetics instructors located in 39 states. The majority of the respondents reported that the general genetics course is taught on a semester system with three lecture periods of 50 minutes each. Sixty-nine percent of the instructors indicated that either a mandatory or optional laboratory was offered to supplement the course. Typically, the laboratory was reported to be offered as a single three-hour period per week. Introductory genetics is generally taught as a sophomore or junior level course with prerequisites in biology and chemistry. Over three-fourths of the respondents reported that their institutions require a genetics course of biology majors, while only slightly more than one-half require genetics for biology teaching majors. Instructors stress the following topics in their genetics lectures: Mendelism, linkage, crossing-over, and gene mapping; and gene action, protein synthesis, and the genetic code. Laboratory instructors indicated a strong emphasis on transmission, microbial and molecular genetics with 100 percent of them using \textit{Drosophila melanogaster} and 73 percent using \textit{Escherichia coli} in the laboratory investigations. Of the 199 scientists involved in teaching introductory genetics, 189 hold the Ph.D. degree and nearly 70 percent have earned their degrees in the field of genetics. The study disclosed that
independent study and computer assisted instruction are the most widely adopted special teaching techniques.
References

1. ASHG, GSA, ABMG. Membership directory. Bethesda, Maryland: American Society of Human Genetics, Genetics Society of America, American Board of Medical Genetics; 1988.


Table 1. Frequencies of different types of institutions from which information was obtained

<table>
<thead>
<tr>
<th>Types of Institutions</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
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<tr>
<td>State</td>
<td>78</td>
<td>57.8</td>
</tr>
<tr>
<td>Independent/Non-Profit</td>
<td>32</td>
<td>23.7</td>
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<tr>
<td>Denominational</td>
<td>24</td>
<td>17.8</td>
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<tr>
<td>No Information</td>
<td>1</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td><strong>135</strong></td>
<td><strong>100.0</strong></td>
</tr>
<tr>
<td>Enrollment</td>
<td>Frequency</td>
<td>Percentage</td>
</tr>
<tr>
<td>--------------------</td>
<td>-----------</td>
<td>------------</td>
</tr>
<tr>
<td>0-1,000</td>
<td>5</td>
<td>3.7</td>
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<tr>
<td>1,001-5,000</td>
<td>36</td>
<td>26.7</td>
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<td>5,001-10,000</td>
<td>27</td>
<td>20.0</td>
</tr>
<tr>
<td>10,001-15,000</td>
<td>23</td>
<td>17.1</td>
</tr>
<tr>
<td>15,001-20,000</td>
<td>13</td>
<td>9.6</td>
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<tr>
<td>20,001-25,000</td>
<td>10</td>
<td>7.5</td>
</tr>
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<td>25,001-30,000</td>
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<td>8.1</td>
</tr>
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<td>30,001-35,000</td>
<td>6</td>
<td>4.4</td>
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<td>Greater than 35,000</td>
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<td></td>
<td>135</td>
<td>100.0</td>
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Table 3. Lecture time devoted to specific topics

<table>
<thead>
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<th>Topic</th>
<th>Hours of Lecture</th>
<th>Number reporting</th>
<th>Percent not reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mitosis, meiosis, gametogenesis, sporogenesis</td>
<td>92 27 1</td>
<td>120</td>
<td>11.1</td>
</tr>
<tr>
<td>Mendelism: segregation, and independent assort.</td>
<td>54 50 15</td>
<td>119</td>
<td>11.9</td>
</tr>
<tr>
<td>Probability and chi-square</td>
<td>102 11 0</td>
<td>113</td>
<td>16.3</td>
</tr>
<tr>
<td>Sex chromosomes and the role of sex in gene transmission and expres-</td>
<td>100 11 0</td>
<td>115</td>
<td>14.8</td>
</tr>
<tr>
<td>Linkage, crossing-over and gene mapping</td>
<td>44 63 14</td>
<td>121</td>
<td>10.4</td>
</tr>
<tr>
<td>Multiple alleles and complex gene loci</td>
<td>110 8 1</td>
<td>119</td>
<td>11.9</td>
</tr>
<tr>
<td>Structural changes in chromosomes</td>
<td>111 9 0</td>
<td>120</td>
<td>11.1</td>
</tr>
<tr>
<td>Numerical changes in chromosomes</td>
<td>114 6 0</td>
<td>120</td>
<td>11.1</td>
</tr>
<tr>
<td>The structure of the hereditary material, DNA</td>
<td>72 43 4</td>
<td>119</td>
<td>11.9</td>
</tr>
<tr>
<td>Transcription and translation of the genetic material</td>
<td>66 47 9</td>
<td>121</td>
<td>9.6</td>
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<td>Topic</td>
<td>Hours of Lecture</td>
<td>Number reporting&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Percent not reporting</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>------------------</td>
<td>-------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Gene action, protein synthesis and the genetic code</td>
<td>53 55 10</td>
<td>118</td>
<td>12.6</td>
</tr>
<tr>
<td>Mutations, mutagenesis, radiation genetics</td>
<td>106 17 1</td>
<td>124</td>
<td>8.1</td>
</tr>
<tr>
<td>Polygenic and multifactorial inheritance</td>
<td>94 3 0</td>
<td>97</td>
<td>20.1</td>
</tr>
<tr>
<td>Recombination in fungi, bacteria, and viruses</td>
<td>65 34 7</td>
<td>106</td>
<td>21.5</td>
</tr>
<tr>
<td>Population genetics and the Hardy-Weinberg law</td>
<td>55 39 14</td>
<td>108</td>
<td>20.0</td>
</tr>
<tr>
<td>Other</td>
<td>22 13 45</td>
<td>80</td>
<td>40.7</td>
</tr>
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</table>

<sup>a</sup>out of 135 respondents
Table 4. Laboratory time devoted to specific topics

<table>
<thead>
<tr>
<th>Topic</th>
<th>Hours of laboratory instruction</th>
<th>Percent of 93 not reporting</th>
</tr>
</thead>
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<tr>
<td></td>
<td>1-5+</td>
<td>6-10+</td>
</tr>
<tr>
<td>Transmission genetics</td>
<td>13</td>
<td>17</td>
</tr>
<tr>
<td>Microbial and molecular genetics</td>
<td>11</td>
<td>23</td>
</tr>
<tr>
<td>Mammalian genetics</td>
<td>22</td>
<td>12</td>
</tr>
<tr>
<td>Population genetics</td>
<td>27</td>
<td>11</td>
</tr>
<tr>
<td>Other</td>
<td>16</td>
<td>14</td>
</tr>
</tbody>
</table>

³93 of the 135 respondents replied to questions pertaining to an optional or mandatory laboratory for the genetics course
Table 5. Organisms commonly used in the introductory genetics course

<table>
<thead>
<tr>
<th>Organism</th>
<th>Frequency</th>
<th>Percent of 93</th>
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<tbody>
<tr>
<td><em>Drosophila melanogaster</em></td>
<td>93</td>
<td>100.0</td>
</tr>
<tr>
<td><em>Sordaria fimicola</em></td>
<td>42</td>
<td>45.2</td>
</tr>
<tr>
<td><em>Neurospora crassa</em></td>
<td>20</td>
<td>21.5</td>
</tr>
<tr>
<td><em>Bacillus subtilis</em></td>
<td>12</td>
<td>12.9</td>
</tr>
<tr>
<td><em>Escherichia coli</em></td>
<td>68</td>
<td>73.1</td>
</tr>
<tr>
<td>Phage T4 and/or T2</td>
<td>41</td>
<td>44.1</td>
</tr>
<tr>
<td><em>Nicotiana tabacum</em></td>
<td>10</td>
<td>10.8</td>
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<tr>
<td><em>Zea mays</em></td>
<td>42</td>
<td>45.2</td>
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<tr>
<td>Other</td>
<td>42</td>
<td>45.2</td>
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Figure legend

Figure 1. Geographic distribution of survey respondents.
APPENDICES

Appendix A-Questionnaire
Appendix B-Cover Letter
Appendix C-Reminder
Appendix D-Addressees
Appendix E-Genetics Textbooks
APPENDIX A

A SURVEY OF COLLEGE INTRODUCTORY GENETICS COURSES

1. On what calendar basis is the institution operated?
   Semesters: 2 of _____ weeks each; 3 of _____ weeks each
   Quarters: 3 of _____ weeks each; 4 of _____ weeks each
   Other, specify details ________________________________

2. In which department(s) is general genetics taught?
   ___________________________________________________

3. Please provide the following data about the Introductory Genetics course:
   Course number(s) __________; Course name____________________________
   Estimated annual enrollment __________
   Prerequisites: (a) General Biology _______ No. of hours_________
                  (b) Chemistry _______ No. of hours __________
                  (c) Specific grade average _______ if so, what? ______
                  (d) Permission of Department Chairperson __________
                  (e) Other __________________________________

4. Students pursuing many curricula have an interest in and need for understanding genetics. Please check the appropriate category for each group of students attending your college/university.

<table>
<thead>
<tr>
<th>Students</th>
<th>Genetics is Required</th>
<th>Genetics is Recommended</th>
<th>Genetics is Elective</th>
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<tbody>
<tr>
<td>(a) Biology majors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(b) Biochemistry majors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(c) Pre-med students</td>
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</tr>
<tr>
<td>(d) Pre-dental students</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e) Biology teaching majors</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(f) Other, specify</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
5. Is the course restricted to undergraduates? Yes _____ No _____ 25

6. How many lecture periods are required per week?

One______ Two_____ Three_____ Four_____ Other_______

7. What is the length of each lecture period?

50 minutes_____ 75 minutes_____ 90 minutes_______ Other_______

8. Please check the textbook(s) used:

___ (a) Ayala & Kiger: Modern Genetics, 2nd ed. (1984)
___ (b) Brewer & Sing: Genetics (1983)
___ (c) Burns, G.W.: The Science of Genetics, 5th ed. (1983)
___ (d) Elseth & Baumgardner: Genetics (1984)
___ (e) Farnsworth, M.W.: Genetics, 2nd ed. (1988)
___ (f) Fincham, J.R.S.: Genetics (1983)
___ (g) Fristrom & Clegg: Principles of Genetics, 2nd ed. (1988)
___ (k) Jenkins, J.B.: Genetics, 2nd ed. (1970)
___ (m) Pecei, G.P.: Genetics (1982)
___ (o) Russell, P.J.: Genetics (1986)
___ (q) Strickberger, M.W.: Genetics, 3rd ed. (1985)
___ (s) Tamarin, R.H.: Principles of Genetics, 2nd ed. (1982)
___ (t) Zubay, G.: Genetics (1987)
___ (u) Other, specify author, title, etc.: ____________________________
9. How much lecture time (in hours or minutes) is devoted to each of the following topics?

[ ] (a) Mitosis, meiosis, gametogenesis, sporogenesis

[ ] (b) Mendelism: segregation and independent assortment

[ ] (c) Probability and Chi Square

[ ] (d) Sex chromosomes and the role of sex in gene transmission and expression

[ ] (e) Linkage, crossing-over and gene mapping

[ ] (f) Multiple alleles and complex gene loci

[ ] (g) Structural changes in chromosomes

[ ] (h) Numerical changes in chromosomes

[ ] (i) The structure of the hereditary material, DNA

[ ] (j) Transcription and translation of the genetic material

[ ] (k) Gene action, protein synthesis and the genetic code

[ ] (l) Mutations, mutagenesis, radiation genetics

[ ] (m) Polygenic and multifactorial inheritance

[ ] (n) Recombination in Fungi, Bacteria, and Viruses

[ ] (o) Population genetics and the Hardy-Weinberg Law

[ ] (p) Other topics, please specify ____________________________

10. How many laboratory periods are held per week?

Zero______ One______ Two______ Three______ Other______

11. If you have a laboratory period, what is its length?

Two hours______ Three hours______ Four hours______ Other______

12. Are lab facilities open to students other than at specified lab hours?

Yes______ No______

13. If yes, at what times and for how long are these facilities made available?

________________________________________________________________________
14. What is the source of the lab exercises?
   (a) Published laboratory manual
      1. Demerec and Kaufman: *Drosophila Guide*
      2. Gardner, E.J. et al.: *Genetics Laboratory Investigations*
      3. Strickberger, M.W.: *Experiments in Genetics with Drosophila*
      5. Other, specify: ________________________________
   (b) Investigations compiled from various sources
   (c) Instructor composes own lab investigations
   (d) Computer Programs
   (e) Combination of the above
   (f) Other, please specify ________________________________

15. How much laboratory time (in hours or minutes) is devoted to each of the following areas?
   (a) Transmission genetics
   (b) Microbial and molecular genetics
   (c) Mammalian genetics
   (d) Population genetics
   (e) Other, please specify ________________________________

16. Which organisms are used in laboratory work?
   (a) *Drosophila melanogaster*
   (b) *Sordaria fimicola*
   (c) *Neurospora crassa*
   (d) *Bacillus subtilis*
   (e) *Escherichia coli*
   (f) *Phage T4 and/or T2*
   (g) *Nicotiana tabacum*
   (h) *Zea mays*
   (i) Other, specify ________________________________

17. How many individuals are involved on the instructional staff of this course?
    Faculty______ Grad. Assist.______ Undergrad. Assist.______
    Technician_______ Other_______
18. What is the highest degree earned and major field of study of each principal course instructor?

<table>
<thead>
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<th>degree</th>
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</table>

19. Are the lab instructors: Faculty members? Grad. Assist.? Undergrad. Assist.? Other?

20. Are any special teaching approaches employed?
   (a) Independent study
       Yes (Ans. 20A below) No
   (b) Audio-tutorial
       Yes (Ans. 20B below) No
   (c) Team-teaching
       Yes (Ans. 20C below) No
   (d) Computer assisted instruction
       Yes (Ans. 20D below) No
   (e) Other, specify

20A. Independent study
   1. How much of the term is devoted to independent study?
      No. of weeks
   2. Do students choose their own topics? Yes No
   3. What is the final requirement for completion of this work?
      A written report? An oral presentation?

20B. Audio-tutorial
   1. Are audio instructional tapes used? Yes No
   2. Are videotapes and films used? Yes No
   3. Who prepares these instructional materials?
   4. Are small group sessions held for viewing and listening?
      Yes No
   5. Is a "tape" lab set up for individual instruction?
      Yes No
   6. Are these sessions followed by discussions?
      Yes No
   7. Who presides over these groups?
8. Is the use of this teaching approach on a definite schedule throughout the course? Yes ___ No ___

20C. Team teaching

1. How many instructors are involved in team teaching? ______

2. How many of the above instructors are involved in lecture? _____

3. How many of the above instructors are involved in lab? ______

4. What is the basis for dividing course content among instructors?

5. Are discussion groups held with all instructors involved?

   Yes ___ No ___

6. Does each instructor preside over a small discussion group?

   Yes ___ No ___

20D. Computer assisted instruction

1. Which of the following commercial computer programs are used in the course?

   (a) Biorbreeed      (e) Gene Machine
   (b) CatLab          (f) Heredity Dog
   (c) Genetics Construction (g) Human Genetic Disorders Kit
   (d) Genetic Engineer's Toolbox (h) Mitosis and Meiosis
   (i) Protein Synthesis/Codon (j) Other

2. How are the computer programs related to the class?

   (a) Incorporated into class lecture
   (b) Assigned as out-of-class tutorials and review
   (c) Left as optional to the student
   (d) Other, please specify
Dear Geneticist:

Due to the many advances in science, instructors must continuously revise and update their courses and curriculum. The need for such revision is evident when one analyzes data collected in a study completed twenty years ago. This national study examined the general approach to teaching the introductory genetics course (Journal of Heredity 60(4): 223-227, July-Aug, 1969). In view of the overwhelming progress made in genetics, it seems appropriate to update and re-evaluate this course information. Therefore, we are undertaking a new national survey of the introductory genetics program. We request your assistance in this endeavor. The completion of the enclosed questionnaire will be greatly appreciated. If you do not teach an introductory genetics course, we would appreciate your help in forwarding this survey to the appropriate instructor at your college or university. If such a course is not taught at your institution, please return the survey unanswered. A pre-addressed, stamped envelope for the return of the questionnaire is enclosed.

The information collected will be used to re-evaluate and revise the existing course in general genetics at Ball State University. We also expect to summarize our findings in a manuscript which will be submitted to an appropriate journal for publication.

Your cooperation will be appreciated and is necessary for the success of this endeavor. We will be glad to furnish you with the results of the survey, and any information you provide will remain confidential. In the event that a publication results from this study, you will be provided with an appropriate reprint.

Sincerely,

Susan M. Sheley
Undergraduate Fellow

Thomas R. Mertens
Professor of Biology
Dear Geneticist:

This is a little reminder concerning the questionnaire that was sent to you on November 15, 1988 pertaining to the introductory genetics course at your institution. Since we have not received your response, we would like to encourage you to complete the questionnaire and return it at this time. We value your input and greatly appreciate your participation. Thank you for your effort.

Sincerely,

Thomas R. Mertens
Professor of Biology

Susan M. Sheley
Undergraduate Fellow
APPENDIX D

This appendix contains all the addressees who were sent questionnaires, those with a (+) responded.

RESPONDENTS AND STATE                        COLLEGE OR UNIVERSITY

ALABAMA
Angus, Robert A.                                 +University of Alabama-Birmingham
Brennen, Mark D.                                 +University of Alabama-University

ALASKA
Smoker, William                                  University of Alaska

ARIZONA
Church, Kathleen                                  Arizona State University
Kidwell, Margaret G.                              +University of Arizona

ARKANSAS
Etges, William J.                                 +University of Arkansas

CALIFORNIA
Bendigkeit, Harold E.                            +Deanza College
Berlani, Roberta E.                               +Santa Clara University
Bernstein, Sanford E.                             San Diego State University
Bowen, Saraen T.                                 +San Francisco State University
Bryant, Stephen H.                                +Calif. State Poly. Univ.-Pomona
Center, Elizabeth M.                              College of Notre Dame
Chihara, Carol J.                                 +University of San Francisco
Cohen, Larry W.                                   Pomona College
Daly, Kevin R.                                    Calif. State Univ.-Northridge
Englesberg, Ellis                                 Univ. of Calif.-Santa Barbara
Fitch, Walter                                     +University of Southern Calif.
Fowler, Robert G.                                 +San Jose State University
Fryxell, Karl J.                                  +Univ. of California-Riverside
Goodenow, Robert S.                               +Univ. of Calif.-Berkeley
Kroman, Ronald A.                                 +Calif. State Univ.-Long Beach
Mangan, Jerome                                    +Calif. State Univ.-Fresno
Mays-Hoopes, Laura L.                             +Occidental College
Mevriam, Virginia                                 +Loyola-Marymount University
Phinney, Bernard O.                               Univ. of Calif.-Los Angeles
Sanders, Mark                                     +Univ. of Calif.-Davis
Simovich, Marie A.                                +University of San Diego
Sokoloff, Alexander                               +Calif. State Univ.-San Bernardino
Stansfield, William D.                            +Calif. State Poly. Univ.-San Luis Obispo
Stern, Herbert                                    Univ. of Calif.-La Jolla
Yanofsky, Charles                                 +Stanford University

COLORADO
Dixon, Linda K.                                    +Univ. of Colorado-Denver
Fogleman, James C.                                 +Univ. of Denver
Mattoon, James R.                                  +Univ. of Colorado-Colorado Springs
Nash, Donald J.                                    Colorado State University
COLORADO
Spencer, Albert W. +Fort Lewis College

CONNECTICUT
Adams, Michael +Eastern Conn. State Univ.
Donnelly, Robert J. +Wesleyan University
Dutton Jr., Lee University of Connecticut
Halliburton, Richard +West Conn. State Univ.
Martinez, Robert M. +Quinnipiac College
Ruddle, Frank H. Yale University

DELAWARE
Gaffney, Patrick Michael University of Delaware

FLORIDA
Baylis Jr., John R. West Florida University
Cochrane, Bruce J. +University of South Florida
Kuhn, David T. University of Central Florida
Tracey Jr., Martin L. +Florida International Univ.

GEORGIA
Bennett, Sara N. Georgia Southern College
Clark, Flora M. Columbus College
Geever, Robert F. University of Georgia
L'Hernault, Steven W. Emory University

HAWAII
Shimakawa, Ellen Chaminade University
Stuart, W. Dorsey University of Hawaii-Manoa

IDAHO
Zemetra, Robert S. +University of Idaho

ILLINOIS
Bennett, Jack +Northern Illinois University
Brockman, Herman E. +Illinois State Univ.-Normal
Brown, Edward H. Univ. of Illinois-Urbana
Feder, Juliana H. Lake Forest College
Geer, Billy W. Knox College
Griesbach, Robert A. +Depaul University
Juergensmeyer, Elizabeth +Judson College
Laten, Howard M. Loyola University
Lerner, Jules M. +Northeastern Illinois Univ.
Parker, Nancy University of Southern Illinois
Spiess, Eliot B. +University of Illinois-Chicago
Spofford, Janice B. +University of Chicago
Thompson, Vinton Roosevelt University

INDIANA
Bender, Harvey A. University of Notre Dame
Berkovitz, Anna W. +Purdue University
Fogle, Thomas A. +St. Mary's College
Jones, Duvall A. +St. Joseph's College
Malacinski, George Indiana University
INDIANA
Mertens, Thomas R.
Polley, Lowell D.
Sheffer, Richard D.
+Ball State University
+Indiana University Northwest

IOWA
Eiben, Galen J.
Kein, Paul
Montelone, Beth A.
Seager, Robert D.
+Wartburg College
+University of Iowa
+University of Northern Iowa

KANSAS
Bode, Vernon C.
Hedrick, Philip W.
Sarachek Alvin
Wolf, Thomas M.
Burkholder, John H.
University of Kansas
Wichita State University
Washburn University
+McPherson College

KENTUCKY
Cobbs, Gary Allen
Ebersole, Lynn Alan
Service, Philip M.
University of Louisville
+Northern Kentucky University
+University of Kentucky

LOUISIANA
Batzer, Mark A.
Parker Jr., James N.
+Louisiana State University
+McNeese State University

MAINE
Pelliccia, Joseph G.
+Bates College

MARYLAND
Bradley, Brian P.
Fyrberg, Eric
Gethman, Richard C.
Paquin, Louise A.
University of Maryland-Catonsville
Johns Hopkins University
+Univ. of Maryland-Baltimore County
+Western Maryland College

MASSACHUSETTS
Altschuler, Marsha I.
Asato, Yukio
Boyle, Judith Ann
Hexter, William M.
Hoffman, George R.
Knight, Jeffrey A.
Seyfried, Thomas N.
Tamarin, Robert H.
Williams College
+Southern Massachusetts University
Tufts University
Amherst College
+Holy Cross College
+Mount Holyoke College
Boston College
+Boston University

MICHIGAN
Arking, Robert
Backer, James S.
Johnson, Douglas I.
Leslie, James F.
Murnik, Mary R.
Nieuwkoop, Anthony
Pelzer, Charles F.
+Wayne State University
+Concordia College
University of Michigan-Ann Arbor
+Adrian College
+Ferris State College
+Hope College
+Saginaw Valley State University
Michigan
Snyder, Thomas P. +Michigan Tech University
Yu, Shih-an +Eastern Michigan University

Minnesota
Backer, James S. +Concordia College-Moorehead
Hartung, Nancy Z. College Saint Thomas
Hedman, Stephen C. +University of Minnesota-Duluth
Kalumuck, Karen E. St. Olaf College
Klein, Keith K. +Mankato State University
Plantenberg, Dunstan College St. Benedict
Sulerud, Ralph L. +Augsburg College
Weibust, Robert S. +Moorehead State University
Woodward, Val W. +University of Minnesota-St. Paul

Mississippi
Labonne, Stephen G. University of Mississippi

Missouri
Newton, Kathleen J. University of Missouri-Columbia
Patton, John C. Washington University
Strickberger, Monroe W. University of Missouri-St. Louis

Montana
Brussard, Peter F. +Montana State University

Nebraska
Duncan, Garry A. +Nebraska Wesleyan University
Hayhome, Barbara A. +University of Nebraska-Omaha
Keeler, Katherine H. +University of Nebraska-Lincoln

Nevada
Storm, Leonard W. University of Nevada-Las Vegas
Vig, Baldev K. +University of Nevada-Reno

New Hampshire
Berger, Edward Michael +Dartmouth College

New Jersey
Krause, Eliot +Seton Hall University
Passmore, Howard C. Rutgers University
Price, James Vincent Princeton University
Weisbrot, David R. +William Paterson College

New Mexico
Johnson, William W. +University of New Mexico

New York
Belote, John +Syracuse University
Borowsky, Richard L. New York University
Bukovasan, Laura A. State Univ. New York-Oneonta
Butzel, Henry M. Union College
Chalfie, Martin +Columbia University
Cunningham, Richard Preston State Univ. New York-Albany
NEW YORK
Eaton, Norman
Garrett, Jinnie M.
Hatman, Stanley
Jha, Krishna K.
Johnsen, Roger Craig
Knonpka, Ronald
Lin, Yue J.
MacIntyre, Ross
Margolin, Paul
Miles, Philip G.
Mohler, James P.
Nemerofsky, Arnold
Pietras, Dennis F.
Royston, Moira E.
Rudner, Rivka
Wasserman, Marvin
Brooklyn College
+Hamilton College
+University of Rochester
Hunter College
+Adelphi University
+Clarkson College
+St. Johns University
+Cornell University
City College
State Univ. New York-Amherst
Barnard College
+State University College
+State Univ. New York-Buffalo
+St. Joseph's College
Hunter College
+Queens College

NORTH CAROLINA
Anderson, Steven M.
Bedinger, Patricia A.
Bewley, Glenn C.
Cluck, Terry W.
Dodd, Diane
Shull, Jr., K. Kenneth
Travis, James
+Univ. of North Carolina-Greensboro
+Univ. of North Carolina-Chapel Hill
North Carolina State University
+Campbell University
+Univ. of North Carolina-Wilmington
Appalachian State University
+Univ. of North Carolina-Charlotte

NORTH DAKOTA
Fleischer, Robert Carl
University of North Dakota

OHIO
Bischoff, William L.
Brauner, Soren
Doerder, Paul
Falk, Darrell R.
Falkenthal, Scott
McDougall, Kenneth J.
Paquin, Charlotte Elder
Town, Chris
Underwood, Eileen M.
University of Toledo
Ashland College
+Cleveland State University
Mount Vernon Nazarene College
+Ohio State University
University of Dayton
+University of Cincinnati
+Case Western Res. University
Bowling Green State University

OKLAHOMA
Hellack, Jenna Jo
Thompson Jr., James N.
Wills, John W.
+Central State University
University of Oklahoma
Oklahoma University

OREGON
Duffy, Patricia A.
Newman, Lester J.
Spragne, George
+Eastern Oregon State University
+Portland State University
University of Oregon
<table>
<thead>
<tr>
<th>State</th>
<th>Names and Institutions</th>
</tr>
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</table>
| Pennsylvania | Baker, Frank T. Indiana University Pennsylvania  
|             | Finger, Irving Haverford College  
|             | Guild, Greg +University of Pennsylvania  
|             | Hiraizumi, Kazuo +Gettysburg College  
|             | Infanger, Sister Ann +Seton Hill College  
|             | Lambert, Lisa A. +Chatham College  
|             | Lopes, John M. Carnegie-Mellon University  
|             | Marks, Robert W. +Villanova University  
|             | Michel, Kenneth E. +Slippery Rock University  
|             | Morrison, William J. +Shippensburg University  
|             | Rappaport, Harry P. Temple University  
|             | Samollow, Paul B. Lehigh University  
|             | Selander, Robert K. Penn State University  
|             | Tonzetich, Jr., John +Bucknell University  
|             | Wooldridge, David P. +Pennsylvania State University  
|             | Wurst, Glen G. +Allegeny College  
| Rhode Island| Rothman, Frank G. +Brown University  
| South Carolina| Dawson, Wallace D. University of South Carolina  
|             | Fleming-Finlay, Mary Benedict College  
|             | Yardley, Darrell G. Clemson University  
| Tennessee   | Benner, David +East Tennessee State Univ.  
|             | Jones, Larry Hudson +University of the South  
| Texas       | Alexander, Mary L. Southwest Texas State University  
|             | Dewees, Andrew A. +Sam Houston State University  
|             | Doe, Frank I. +University of Dallas  
|             | Erdman, Howard E. +Texas Woman's University  
|             | Hartman, Philip S. Texas Christian University  
|             | Holman, John D. Texas A & M University  
|             | Jackson, Raymond C. Texas Tech University  
|             | McIver, Con W. +University of Texas-Tyler  
|             | McCrady, William B. +University of Texas-Arlington  
|             | Orr, William C. +Southern Methodist University  
|             | Pierce, Benjamin A. +Baylor University  
|             | Stone, William H. +Trinity University  
| Utah        | Levy, Jack N. University of Utah  
|             | Simmons, John R. Utah State University  
| Vermont     | Saul II, George B. +Middlebury College  

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<thead>
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<td>Petersen, Nancy S.</td>
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### APPENDIX E

**Genetics Textbooks Used By Responding Instructors**

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<thead>
<tr>
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<th>Title</th>
<th>Publisher</th>
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<tr>
<td>Ayala and Kiger</td>
<td>Modern Genetics 2nd</td>
<td>Benjamin/ Cummings</td>
<td>1984</td>
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<tr>
<td>Burns</td>
<td>The Science of Genetics 5th</td>
<td>Macmillan</td>
<td>1983</td>
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<td>Farnsworth</td>
<td>Genetics 2nd</td>
<td>Harper &amp; Row</td>
<td>1988</td>
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<td>Gardner and Snustad</td>
<td>Principles of Genetics 7th</td>
<td>John Wiley and Sons</td>
<td>1984</td>
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<tr>
<td>Goodenough</td>
<td>Genetics 3rd</td>
<td>Saunders College</td>
<td>1984</td>
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<tr>
<td>Hartl, et al.</td>
<td>Basic Genetics</td>
<td>Jones and Bartlett</td>
<td>1988</td>
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<td>Klug and Cummings</td>
<td>Concepts of Genetics 2nd</td>
<td>Merrill</td>
<td>1986</td>
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<td>Rothwell</td>
<td>Understanding Genetics 4th</td>
<td>Oxford Univ. Press</td>
<td>1988</td>
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<td>Russell</td>
<td>Genetics</td>
<td>Little, Brown and Company</td>
<td>1986</td>
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<td>Snyder, et al.</td>
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<td>Jones and Bartlett</td>
<td>1985</td>
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<td>Strickberger</td>
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<td>Macmillan</td>
<td>1985</td>
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<tr>
<td>Sutton</td>
<td>Human Genetics 4th</td>
<td>Harcourt, Brace</td>
<td>1988</td>
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<tr>
<td>Thompson</td>
<td>Primer of Genetic Analysis</td>
<td>Cambridge</td>
<td>1987</td>
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<td>Zubay</td>
<td>Genetics</td>
<td>Benjamin/ Cummings</td>
<td>1987</td>
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