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High school students achievement of college level work through the phase achievement system (PAS)

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HIGH SCHOOL STUDENTS ACHIEVEMENT OF COLLEGE LEVEL WORK THROUGH THE PHASE ACHIEVEMENT SYSTEM (PAS)

A Project

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Master of Science

by

Dwight D. Lassen

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This project, by Dwight D. Lassen, is accepted in its present form by the Department of Zoology of Brigham Young University as satisfying the project requirement for the degree of Master of Science.

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Date

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INTRODUCTION

While some high school graduates know what they want immediately after graduation, few are at all certain of how they want to earn a living. Perhaps students are not adequately prepared in high school for life after graduation, since many apparently do not understand their interests and abilities well enough to make personal aptitude evaluations. If the objective of high schools is to help prepare students for their respective futures, as stated by Talbot and Winget (1973), they may be falling considerably short of satisfying it.

The "Cardinal Principles of Secondary Education," reported by Kingsley (1918), was published by the Commission on the Reorganization of Secondary Education in the hopes of reorganizing and establishing new objectives. This was done in order that American education could meet the needs of a changing society, since earlier objectives no longer met the then current needs. In this report, Kingsley (1918) stated that ". . . the satisfactory completion of any well-planned high school curriculum should be accepted as a preparation for college."

The commission then attempted to reorganize the principles for secondary education to make them more applicable — preparation for a college education being one (Kingsley, 1918). The objectives established by this commission resulted in the seven cardinal principles of secondary education: (1) acquisition of health education, (2) proficiency in reading, writing, arithmetic, written and oral expression, (3) development of qualities to become a worthy member of a familty, (4) provision of vocational education, (5) provision of civic education, (6) demonstration of worthy use of leisure time, and (7) the development of ethical character. These seven cardinal principles are, to a large degree, still used in secondary education.

Eight goals for public education in Utah were set forth in 1957 (Winget, 1967) and revised in 1972 (Talbot and Winget, 1973). This revision was the result of an eight state study to determine objectives that meet current and future needs. These eight goals are referred to as "maturity goals", each with its own list of objectives suggesting attributes of a person after the goals are achieved. The eight goals are: (1) intellectual, (2) ethical-moral-spiritual, (3) emotional, (4) social, (5) physical, (6) environmental, (7) aesthetic, and (8) productive. When these goals are compared to Kingsley's seven cardinal principles, it appears that generalized objectives have not changed much during 54 years, since most of them deal with students' moral character, citizenship, and vocational competencies.

If educational objectives are being met, high school graduates should, among other things, be aware of their educational and vocational needs and plan accordingly. Studies by Flanagan (1961) and

Berdie (1963) determined if high school graduates knew what they wanted to do for a livelihood after graduation. Berdie (1963) worked with 45,000 students who graduated in 1960 and Flanagan (1964) with 3,000 students who graduated in 1961. They both concluded that 67% of the graduating high school students usually pursued vocational and educational plans that were made for only one year following graduation, but by two years, only 27% continued with their original plans. Clearly, most of these students were not certain what they wanted to do for a living.

Assuming one objective of high school is to provide students with the ability to make educational and vocational decisions, then schools must orient students as effectively as possible to the many opportunities available to them, such as: vocational schools, business schools, military training, colleges, etc. Results of a high school graduate intention survey given to the 1972 high school graduates in Utah indicated that 71.7% of the graduates intended to pursue a vocational or college training (Jacobs, 1972). Of this group 79.5% planned attending a two year college, or full university.

Since higher academic training is often considered a continuation of high school instruction, orientation to the rigors of university work and its academic expectations is often neglected in spite of the ever presence of catalogues, applications and counselors who can assist students in accessing colleges and universities. Programs exposing college and university expectations might profitabley be made available in high schools to help students understand the level of rigor expected in college work. Participation in these types of programs would enable students to evaluate their ability to do university work and increase their likelihood of selecting activities which would insure success.

The purpose of this project is to determine the likelihood of high school students achieving at a university level. If students are able to achieve university level work in biology there may be additional university programs which could be given to high schools to help students prepare for vocational schools, colleges, and universities. These may enable students to become more competent in their educational and vocational decisions.

METHODS

Implementation Methods

Senior students from 2 of 11 sections of a Human Biology course at Orem High School (Orem, Utah) were included in this experiment. They had all completed one year of high school Biology and 11% had completed a basic Chemistry course. A formal introduction of the Phase Achievement System (PAS), (Fig. 1), was provided these students on September 4, 1973 by the investigator (Mr. Dwight D. Lassen), following a special lecture on "What is Science," given by their regular instructor (Mr. John C. Hendrix). The introduction was given by the investigator to discourage misunderstandings of how the experiment was to function. Students were given verbal and written instructions about the PAS organization, evaluation proceedures, and how their regular instructor could be used to answer questions about the project.

Four PAS phases (Cell Structure and Function, Principles of Reproduction, Principles of Inheritance, and Theories of Evolution) were made available to participating students. These are only four of 25 in the Biology course "Bioscience and Man" at Brigham Young University (Fig. 1). Each phase in the course at Brigham Young University is numbered, the four used in the project, listed above, are

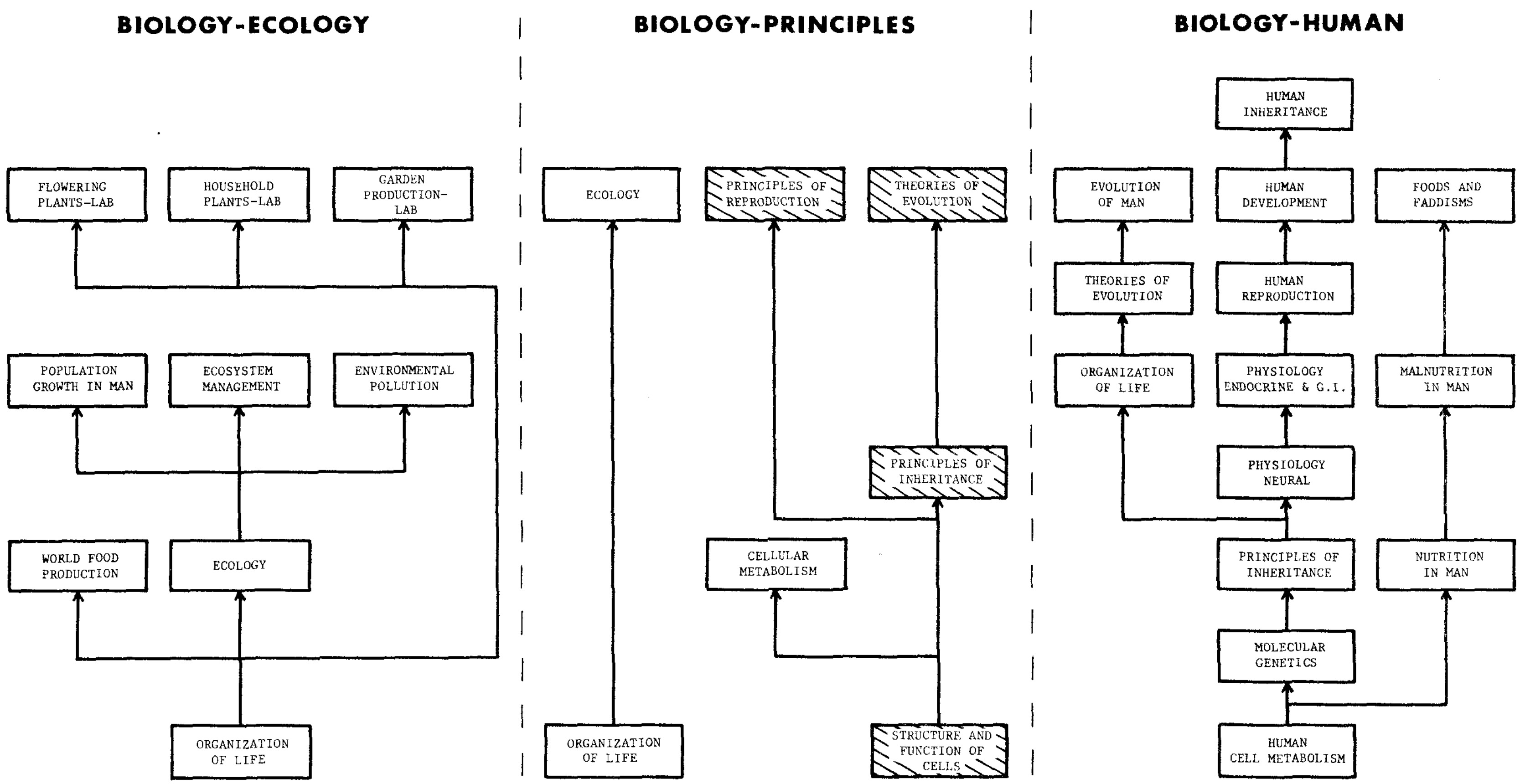

Figure 1

Phase Achievement System:
Phase Sequence

respectively numbered 3, 6, 7, and 13. Each phase was written to contain the instructional objectives and instructions for accessing the learning resources required by students to gain an appropriate understanding. Resource materials were specifically correlated with the phase objectives to aid students in satisfying the objectives (Appendix).

The four phases used in this experiment were correlated with comparable units taught in the Human Biology course at Orem High School; thus, providing continuity between the experimental first semester and the established second semester of instruction (Table 1). To do this, some of the units normally provided during the second semester were taught the first semester.

It was evident during the course of this project that Orem High School students were experiencing difficulty with the PAS reading resource materials. As a possible solution it was suggested to the regular instructor, by the investigator, that he attempt to supplement the PAS reading with materials used in the regular Human Biology program. The regular instructor also suggested that non-reading resources such as films and recording tapes be made available to students to assist them in satisfying the PAS objectives.

At the conclusion of the project it was learned by the investigator that the regular instructor had permitted students to discontinue the experimental project and complete the regular Human Biology program

Table 1

Correlation of Human Biology Units and the PAS Phases at Orem High School, Fall Semester, 1973

Human Biology Units	PAS Phases
The Origin and Characteristics of Life Biochemistry and Energetics The Cell DNA	Structure and Function of Cells
Sex Cell Formation Hormones and Reproduction The Reproductive System Human Embryology	Principles of Reproduction
Prenatal Influences Simple Inheritance Chromosomal Aspects of Genetics The Manipulation of Human Genes	Principles of Inheritance
Mechanisms of Evolution Human Evolution	Theories of Evolution

as another option.

Evaluation Methods

Students were given a pre-test at the beginning of the semester to determine how well they understood concepts covered in the four phases. The test consisted of 60 multiple choice questions divided into four appropriate sections, each with 15 questions. The questions for each phase were selected randomly from a pool of 150-200 questions written by those at Brigham Young University who wrote the phase objectives. These tests, along with others used during the project were also available to students studying "Bioscience and Man" at Brigham Young University. As the Orem High School students completed their studies of the objectives for each phase, they could elect to challenge the phase tests each Friday. These tests, like the pre-test sections, consisted of 15 multiple choice questions and were graded; 13-15=A, 12=B, 10-11=C, and 9=D. If students failed to pass a test or scored poorly they could take another for the same phase on any succeeding Friday; thus, they could take tests as many times as required to achieve a score acceptable to them. The grade students received for a phase was determined from the score he/she obtained the last time the phase was challenged, providing it was passing. Similar testing flexibilities were also available to students at Brigham Young University.

General information questionaires were also used in this project, one dealing with the background and interest of the participating students and a second with an evaluation of the PAS. These questionaires were given to students at the conclusion of the project. Information received from these questionaires was used to help understand student ambition, interest in the PAS, reading difficulties, and whether they understood the PAS.

Analytical Methods

Data obtained in this project were from three sources; (1) pre- and post-test scores, (2) test scores from Brigham Young University students participating in the PAS during the 1973 Fall term, and (3) background and interest expressed by students through questionaires. All test scores were separated according to achievement level (A, B, C, and D), failing students were not counted since the PAS did not consider them to be participants until phase tests were passed.

The course was designed so that students either received a grade as a participant or were considered as one who had not taken the course. Progress made by the Orem High School students was measured with pre- and post-test scores to determine if significant learning had taken place. Preparation for college level work, as a second measure, was assessed from the PAS test scores, analyzed to determine if significant differences existed in the level of learning between the Orem High School students and Brigham Young University students.

To determine if significant differences existed between pre- and post-test scores, the non-paired T-test (α=.05) was used (Roscoe, 1969). Means of the pre-test scores for the experimental phases were statistically compared with means of the post-test scores for the same phases. In this way students learning within each phase was statistically determined. The chi-square goodness of fit test (α=.05) was used to determine whether the observed frequency distribution (experimental high school post-test scores) differed significantly from a hypothesized or expected frequency distrubution (Brigham Young University test scores) (Roscoe, 1969). It was necessary to pool some of the phase results to make it possible to correctly analyze them (Table 2). Phase #13 was not analyzed at all because no students participated in it, even though some had attempted to pass the tests. This was due, in part, to the fact that only two weeks of study were left at the end of the semester to spend on this phase instead of the usual five.

Test results are not only a measure of intelligence and academic preparation, but also of one's attitude about a project or those who are in charge of it. Indifference, frustration, and the inability to work with people are also problems students face which may effect their abilities to learn. Questionaire results were used only to help understand the attitudes of students participating in the project, and were not used to explain students performance.

Table 2

Phase Grades Earned by Orem High School (Orem) and Brigham Young University (BYU) Students Participating in the PAS

Phase	Group	Scores (percent of students) A	B	C	D	Total Students
3	Orem	31	31	19	19	16
	BYU	34	31	25	10	59
6	Orem	50	36	14[a]	0[a]	14
	BYU	34	15	36	15	59
7	Orem	14[a]	14[a]	57[a]	14[a]	7
	BYU	39	23	31	6	64
3	Orem	0	0	0	0	0
	BYU	34	36	2	1	50

[a]Scores for the C and D groups of phase #6, for A and B groups of phase #7, and for C and D groups of phase #7 were combined before statistical analyses.

RESULTS

Pre- and post-test scores for the Orem High School students are listed in Table 3. The PAS scores for both Orem High School and Brigham Young University students for phases 3, 6, 7, and 13 are grouped by grade in Table 2. Statistical analyses showed a significant difference ($t=5.4617$, $df=107$, phase #3; $t=4.4771$, $df=94$, phase #6; $t=3.0317$, $df=70$, phase #7) in pre- and post-test scores of the experimental group ($\alpha=.05$). Post-test scores for Orem High School and Brigham Young University groups were not significant ($\chi^2=38.2$, $df=4$, phase #3; $\chi^2=40.6$, $df=4$, phase #6; $\chi^2=19.5$, $df=3$, phase #7) for phases 3, 6, 7, and 13.

The attrition rate of students participating in the PAS project can be seen in Fig. 2. About 50% of the Brigham Young University students that registered for the PAS during the 1973 Fall term were considered non-participators either because of withdrawl from the program or failure to pass the phase tests. Attitudes and interests of the Orem High School students, as received through questionaires, are listed in Table 4.

Table 3

PAS Test Scores of Participating Experimental Students at Orem High School

Student No.	Pre-test Scores				Post-test Scores[a]			
	Phase 3	Phase 6	Phase 7	Phase 13	Phase 3	Phase 6	Phase 7	Phase 13
1	1	0	4	1	6	3	-	-
2	3	3	4	1	2	3	3	-
3	3	5	4	3	5	3	1	-
4	3	3	3	4	2	4	2	-
5	2	3	4	4	5	8	3	-
6	1	1	5	3	3	12	-	-
7	3	5	1	6	1	12	8	-
8	1	1	4	3	5	3	-	-
9	2	6	5	1	14	4	3	-
10	5	6	3	6	2	-	-	-
11	3	2	6	3	5	4	-	-
12	1	4	5	3	4	3	-	-
13	2	5	3	3	1	1	-	-
14	3	5	5	7	12	13	13	4
15	2	3	2	2	5	3	-	-
16	2	5	2	4	4	7	-	-
17	2	3	5	2	3	14	-	-
18	0	3	8	2	11	4	-	-
19	3	1	3	9	5	3	-	-
20	1	2	4	5	12	8	-	4
21	4	3	2	5	4	-	-	-
22	4	4	5	6	12	13	7	-
23	3	5	1	2	3	1	-	-
24	6	4	2	5	9	6	-	-
25	5	1	8	1	4	12	-	-
26	5	3	7	3	3	12	10	-
27	4	2	5	3	3	-	-	-
28	7	5	6	3	5	-	-	-

Table 3 (continued)

Student No.	Pre-test Scores				Post-test Scores[a]			
	Phase 3	Phase 6	Phase 7	Phase 13	Phase 3	Phase 6	Phase 7	Phase 13
29	3	1	6	4	1	-	-	-
30	2	2	5	3	4	1	4	-
31	4	0	2	2	10	14	10	-
32	4	6	5	5	6	1	-	-
33	0	0	0	2	3	-	-	-
34	4	4	4	6	5	11	7	-
35	2	6	3	4	13	13	10	3
36	3	2	3	3	13	4	-	-
37	3	5	3	2	2	-	-	-
38	2	3	6	5	12	8	5	-
39	2	1	3	3	3	-	-	-
40	1	0	3	0	9	-	-	4
41	6	4	5	3	5	14	9	-
42	3	4	4	3	8	-	-	-
43	1	5	3	1	2	1	-	-
44	1	0	0	1	2	5	8	-
45	5	5	5	5	11	1	-	-
46	4	3	5	6	7	-	-	-
47	1	2	2	3	-	5	-	-
48	6	2	7	3	13	3	-	-
49	3	8	4	7	13	11	-	-
50	2	5	7	4	7	-	-	-
51	5	3	5	5	9	13	11	-
52	5	4	5	1	8	2	-	-
53	3	5	4	3	2	-	-	-
54	6	2	2	3	3	-	-	-
55	2	4	1	5	12	12	-	-

[a]Dash indicates post-tests were not taken.

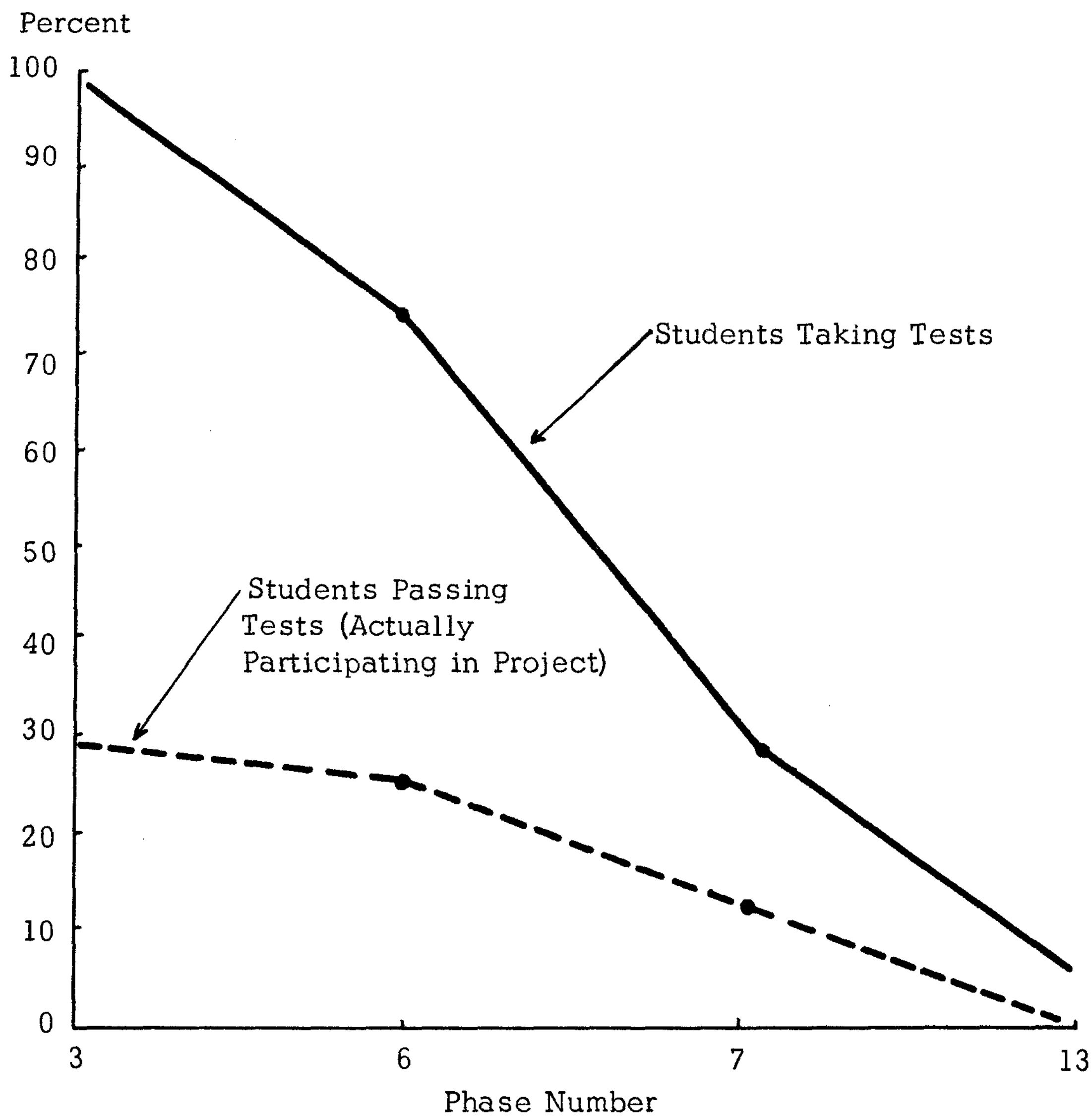

Figure 2

Attrition Rate of Orem High School
Student Participation in the PAS

Table 4

PAS Evaluation and Student Background Questionaire Responses for all Experimental Students at Orem High School

	Response (Percent)[a]								
Question	Yes	No	1	2	3	4	5	6	7
[a]How do you rate the PAS project?			22	69	3	0			
[a]How would you rate the PAS supplementary reading material?			19	72	6	0			
[a]Now that you have worked with college level material, how do you rate its difficulty?							22	72	0
Have you completed a course in chemistry?	11	89							
Are you presently enrolled in a chemistry course?	0	100							
Have you taken a biology course prior to this year?	70	22							
Do you understand what the Phase Achievement System (PAS) is?	47	50							
Did you read the explanatory handout on the PAS project?	33	64							

Table 4 (continued)

Question	Response (Percent)[a]								
	Yes	No	1	2	3	4	5	6	7
Do you feel as though you were sufficiently oriented to the PAS project at the beginning of the semester?	39	53							
Did your teacher help you to understand the PAS project?	67	25							

[a]Numbers are used for responses listed as follows: (1) too difficult for high school, (2) difficult but not too difficult, (3) average, (4) easy, (5) harder than I had expected, (6) the same as I had expected, and (7) easier than I had expected.

CONCLUSIONS AND DISCUSSION

After pre- and post-test data from the PAS tests had been analyzed, two conclusions were made: (1) Orem High School students made significant improvement in learning from the time they took the pre-tests until they took the post-tests, and (2) significant differences could not be demonstrated between the Orem High School students and the Brigham Young University students in the PAS achievement levels for phases 3, 6, and 7.

While significant differences were not evident between the experimental Orem High School and Brigham Young University students in the PAS test performance (Table 2), a higher percentage of the high school students did, in fact, choose not to participate in the PAS project (Fig. 2) An optional program made available to them by their regular instructor provided the means through which 93% dropped out of the PAS project altogether. The investigator, after talking with the regular instructor and interviewing many students, felt that most changed to the optional program because of an inability to successfully pass tests in the alloted number of weeks given for the study of each phase (Table 3). Test scores for all phases averaged 6.7 which is not passing.

Questionaire results (Table 4) indicated that many students had little interest in becoming involved with the PAS, probably because too tew actually understood what the PAS was, since only a few of them read the explanatory material given at the beginning of the semester (Table 4). This general lack of understanding and involvement with the project is possibly one reason why students were inclined to drop out of the PAS in favor of the optional program.

Many who dropped out of the PAS project had reading problems which made it difficult for them to work with the project. Interviews by the regular instructor with students indicated that they could not understand the PAS supplementary reading material well. Even when less difficult reading materials were provided, these students could not work effectively with the PAS objectives because of the level at which they were written. Only two of the experimental students did especially well with the PAS project, and they both concluded that the PAS was difficult; but since the objectives were clearly written, the reading material correlated effectively with the objectives, and the tests could be taken repeatedly; they could do well if they worked at it. They also reported that their classmates dropped out of the project largely because the effort required by the project was greater than they were willing to commit.

Many Brigham Young University students enrolled in the PAS were also unwilling to commit the effort needed to succeed. Professor

Clive D. Jorgensen (coordinator of the PAS at Brigham Young University) concluded that nearly 50% of the students did not succeed in the PAS because they were not accountable for a grade at the conclusion of a term. These students could procrastinate their work in the PAS and then elect not to take credit for the course at the end of a term, thereby not being penalized academically for their procrastination. It is probable that many of the Orem High School students also procrastinated serious study of the PAS material and then found themselves unprepared for the phase tests. These students eventually elected to change to the optional program.

The option to change into the regular biology program (made by the regular instructor) made it difficult to evaluate the exact reasons why so many students dropped out of the project. Comments made by Orem High School students in conversation casually and in interviews, coupled with the observation of student behavior with respect to the PAS at the university level, strongly indicate that the conclusions drawn earlier in this discussion are valid. One would wonder, however, what the performance of Orem High School students would have been if no optional program had been made available to them and if students had been forced to be accountable for their PAS performances at the conclusion of the semester. This study demonstrated that some high school students are able to achieve at college level work, but the experimental design and subsequent changes encouraged only highly motivated students to achieve. A follow-up study in which alternatives are not provided is necessary to understand how well high school students generally could do with college level programs.

LITERATURE CITED

LITERATURE CITED

Berdie, Ralph F., and Albert B. Hood. Trends in Post-High School Plans Over an 11-Year Period. Cooperative Research Project No. 951, University of Minnesota, Minneapolis, Minnesota, 1963.

Flanagan, John C., and others. The American High School Student. Cooperative Research Project No. 635, University of Pittsburgh, Pittsburgh, Pennsylvania, 1964.

Jacobs, Richard W. Personal communication. February 1974.

Kingsley, Clarence D. Cardinal Principles of Secondary Education. Bulletin, 1918, No. 35, Department of the Interior, Washington Government Printing Office, 1918.

Talbot, Walter D., and Lerue Winget. Goals and General Objectives of Education in Utah. Office of Utah State Board of Education, 1973.

Winget, Lerue. Curriculum Framework for Utah Schools. Utah State Board of Education, 1967.

APPENDIX

Phase #7
—Principles of Inheritance—

Statement of the Phase

You can readily see that the outward (phenotypic) appearances or characteristics of plants and animals are passed from parents to their offspring. These characteristics are said to be inherited by the offspring—the process known as heredity or genetics.

Our current level of knowledge concerning how genetic characteristics are inherited has had a long, although recently accelerated history. Genetics as a "science" perhaps had its beginning with Gregor Mendel in the latter part of the nineteenth century when he published what resulted in a formulation of the "laws of heredity." These early works, although discovered somewhat later, provided the inspiration that started the ever accelerating interest and research effort that continues today. We will explore some of the principles of inheritance that will provide the basis for an expanded understanding of inheritance in man, evolution, selective breeding, etc.

There are some who conceive of "Genetics," the principles of inheritance, as the focal point for all biology—from Ecology to Biochemistry. And well they might, since the behavior of an organism in its environment, as well as the behavior of a molecule in its cellular environment are genetically controlled. Thus, you certainly must have this information if you are to put all of the biological processes together, but it will require more than just the molecular aspects of inheritance, since gene action is tantamount to an explanation of inheritance. Mendel worked with interactions of only a few genes, all of which demonstrated complete dominance and recessive qualities. From these, it was possible to determine some of the early explanations of how heves act and establish some simple prediction of character inheritance, based on probabilities of occurrence. These can be used to explain characteristics of importance such as sex ratios, but fails to explain others that are determined by genes demonstrating incomplete dominance or other interactions.

In addition to incomplete dominance, we now understand appreciable about multiple alleles, epistasis, polygenic inheritance, gene linkage, chromosome mapping, and evolutionary changes (genetic changes). All of these are essential to a workable knowledge of human inheritance, plant and animal breeding, as well as a working knowledge of evolution and adaptation of species to survive and occupy available ecological niches.

The manipulation of inheritable characteristics by man has been in evidence throughout recordable history, although the operating principles were certainly always not understood. Many of the domestic animals, farm crops and ornamentals we use today have a long history of selective breeding, while others have been developed during more intensive research.

As our knowledge of Genetics increases, we are closing in on a more complete understanding of man, his characteristics, behavior and diseases. Genes on chromosomes share in the responsibility for human pigmentation, intelligence, physical abilities, etc.; as well as diseases such as metabolic abnormalities, blindness, deafness, allergies, and sub-normal IQs. Control of these diseases requires a basic knowledge of nucleic acid chemistry (molecular genetics) along with a great deal of genetic engineering research; otherwise we must be content with medical treatments. We have the responsibility to safeguard the results of this research to insure its beneficial effects rather than additional diseases. This includes not only research results, but environmental contaminants as well.

In addition, the whole field of population genetics must be introduced since it provides the essentials of how genes are moved through a population, as well as how they are maintained—and this includes man. There is presently a profound interest in genetic engineering (manipulation of the actual genes to control disease or produce a desirable characteristic as opposed to selective breeding), but the implications are complicated in the processes of gene behavior in the populations. Future decisions on genetic manipulations depends on a thorough understanding of population genetics, thus it must be considered a vital part of your biological experiences. Principles will be introduced in this phase from the point of view of the way genes are made and how they behave in the cells as well as in the population. The application, although introduced here, will be deferred to subsequent phases.

Objectives for the Phase

Once you have completed your studies of Inheritance, you should be prepared to satisfy the following objectives, as they are represented by questions on the phase examinations. While you are studying these materials, many new terms will be encountered; and even though they are not all specified in the objectives, the examinations will assume that you have a working knowledge of them. Evaluations of your knowledge of the Principles of Inheritance will be made when you challenge the examinations, which you may do whenever you feel competent. The challenged examination might also be used to assess your personal progress, and may be repeated as many times as necessary to achieve the competence you desire. The examinations consist of all multiple choice objective questions.

A. We will recognize the structure of DNA and RNA, their role in gene identification and action and their change during cell division, by understanding that:	RESOURCE KEY

1. DNA and RNA (mRNA, tRNA, rRNA) differ structurally in the types of nucleotides which make up each kind of molecule and in the sequence of these nucleotides.	Text 42-51, 160-168 (Interleaf 15.1)
2. Genes are made of nucleotides as are chromosomes made of genes.	Text 160-168
3. DNA undergoes different physical changes in each phase of mitosis and meiosis which are important in the orderly process of DNA replication and cell division.	pp. 470-482 Baker and Allen
4. Genes are responsible for protein synthesis which in turn is responsible for phenotypic characteristics in an organism.	Text 168-181
B. We will recognize the work of Gregor Mendel in terms of its scientific value and impact on the science of genetics by understanding that:	
1. The training and background of Mendel in science and mathematics aided him in the interpretation of his experimental data.	
2. Mendel's choice of characters in his experiments contributed greatly to his successful results and hence in the formulation of his laws of inheritance.	R7-1, pp. 2-6

3. The attitudes of Mendel's contemporaries prevented his conclusions from being further developed until 34 years after his death. — R7-3, pp. 45-46

4. Mendel's written experimental results and observations were lost until the turn of the century when they were re-discovered and recognized for their true scientific value. — R7-3, p. 46

C. We will understand the application of Mendelian principles as they are used today by understanding:

1. The following terms as they are applied to monohybrid and/or dihybrid crosses: P_1 generation, F_1 generation, F_2 generation, homozygous, heterozygous, genotypic ratio, genotype, phenotypic ratio, phenotype, gamete, homologous, dominant, recessive, locus, and punnett square. — R7-1, pp. 1-10

2. The processes which occur in a monohybrid cross which substantiate Mendel's laws of dominance and segregation. — R7-1, pp. 2-6

3. The processes which occur in a dihybrid cross which substantiate Mendel's law of independant assortment. — R7-1, pp. 6-7

4. The ability science has to predict many phenotypic and genotypic characteristics in plants and animals.	
5. The process by which the genotype of parents and grandparents can be determined from their offspring.	
D. We will look at non-Mendelian principles in terms of how they occur and how they answer problems not resolvable by Mendelian principles by understanding:	
1. The following processes: incomplete dominance, multiple alleles, epistasis, polygenic inheritance, evolutionary change, gene linkage, and chromosome mapping.	R7-1, pp. 7-28
2. How genes are mapped.	R7-1, pp. 26-28
3. How normal probabilities are disrupted when incomplete dominance, multiple alleles, epistasis, polygenic inheritance, and linkage are present.	R7-1, pp. 7-28
4. The function of test crosses and how they are made.	R7-1, pp. 2-6
5. How some genetic characteristics, such as color blindness and hemophilia, are sex linked.	pp. 160-166 Curtis

6. How spontaneous mutations occur and their effect on the organism.	R7-2, pp. 36-37
E. We will visualize the total population gene pool and understand how it is maintained and how it is effected by adaptation, mutation, and evolution by understanding:	
1. How both dominant and recessive characteristics are maintained in a gene pool.	R7-2, pp. 40-41
2. How the Hardy-Weinberg law operates.	R7-2, p. 41
3. The role natural selection and evolution play in a gene pool.	R7-2, pp. 38-40
4. The effect deletions, inversions, translocations, and duplications have on natural selection and mutation.	Text 181-184
5. The genetic explanation for inheritable defects in metabolism.	Text 175-185

Resources - Reprints

R7-1. Principles of Inheritance. Chapter 18 in Life Sciences by Gerald J. Tortora and Joseph F. Becker. MacMillan. Supplement, pp. 1-35.

R7-2. The Evolutionary Process: Mechanisms. Chapter 20 (part) in Life Sciences by Gerald J. Tortora and Joseph F. Becker. MacMillan. Supplement, pp. 36-41.

R7-3. Mendelian Genetics. Chapter 12 in Biology Today by Preston Adams . . . Robert H. Whittaker. CRM Books. Supplement, pp. 42-47.

Resources - Text and Texts on Reserve

Text

Bennett, P. B. . . . J. D. Watson. 1972. The Physical Basis of Life. CRM Books, Del Mar, California. 229 p.

Texts on Reserve

Baker and Allen. The Study of Biology, Second Ed. Addison-Wesley. pp. 495-521.

Curtis. Invitation to Biology, Worth. pp. 135-166.

Keeton. Biological Science, Second Ed. Norton. pp. 465-497.

Tortora and Becker. Life Science, MacMillan. pp. 460-507.

Weisz. The Science of Biology, Fourth Ed. McGraw-Hill. pp. 521-535.

HIGH SCHOOL STUDENTS ACHIEVEMENT OF COLLEGE LEVEL WORK

THROUGH THE PHASE ACHIEVEMENT SYSTEM (PAS)

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ABSTRACT

Senior high school students in a Human Biology course were given college level work through the Phase Achievement System (PAS), a biology course at Brigham Young University (BYU). Statistical analysis showed significant growth in high school student learning through the PAS. When ability to work with PAS was measured, significant differences between the high school and college groups were not evident. A high percentage of college and high school students dropped out of the PAS, probably because students could fail at the PAS without experiencing academic failure.

COMMITTEE APPROVAL: