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A DISSERTATION

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AN EVALUATION OF THE OUTCOME OF A GENERAL PHYSICAL SCIENCE

COURSE WITH RESPECT TO SPECIFIC OBJECTIVES

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CHAPTER I

INTRODUCTION

The ability to think critically has long been recognized as a desirable educational objective; in fact, the development of that ability is recognized as a major goal of instruction. If a course of study aims to provide educational experiences which will develop the ability to think critically, then in order to evaluate the effectiveness of this course of study we must secure evidence as to whether or not this desired growth on the part of students is taking place. Critical thinking may be defined as the ability to exercise a reasoned opinion involving careful judgment and to make correct assessments of statements. As a general education objective, critical thinking is not limited to course content, rather it is regarded as an outcome which should be provided by all the activities and problems in which the individual becomes involved.

An evaluation of the effectiveness of the entire curriculum in developing in students the ability to think critically is extremely difficult. The practical approach to this evaluation is to determine the contribution each field in the curriculum makes to the achievement of this general purpose.

The Problem

The purpose of this study is to determine the effectiveness of the college level general physical science course with respect to improving student ability to think critically. In conversations with teachers, the objectives of the course most commonly mentioned is the acquisition of factual subject matter which is usually in the form of memorized laws and principles. The development of scientific attitudes and the habits and skills characteristic of reflective thinking are major objectives of all sciences, and the course in general physical science can provide an excellent opportunity to develop the ability to think critically. In this study it is desired to determine how well the ability to think critically has been developed through the completion of a one-semester course in general physical science as taught in the state colleges of Oklahoma.

There are several ways in which an evaluation of the outcomes of a field of study may be made. Two of those methods are by the use of objective tests and by a survey of student opinion. The test will measure directly a given trait or achievement, while the survey will reveal or indicate whether or not, in the opinion of students, certain objectives are being achieved. Although the opinion of students is subject to the criterion of non-objectivity, it still is an indication of the direction in which a course is moving. Students are able to recognize whether or not the course requires them to do more than to memorize. That in itself is a general evaluation of a course and gives an indication as to whether or not the course provides opportunities for the student to develop the skill of critical thinking.

Need and Importance of the Study

This study on the effectiveness of general physical science as related to the development of critical thinking is of importance and interest for the following reasons:

1. The effectiveness of the general physical science course at the college level is of interest to many people in the various disciplines of science. From the inception of the course as a part of general education, there have been those individuals in areas such as chemistry and physics who have felt that a non-laboratory course could not present the concepts, the principles, and the understandings that could be obtained from a semester course in any given physical science discipline. They believed that the general physical science course would be a very shallow survey, a watered-down version of some basic course or courses which would be due to the emasculation of laboratory experiences. Then there are those who feel that a survey-type course, resorting to considerable demonstrations and problem-solving exercises, but which presents the basic concepts and shows the interrelations of science to other fields of knowledge, would be of more practical value and contribute more to scientific literacy than a limited concentration in a given field.

This study will not attempt, philosophically, to resolve this conflict of opinions, but rather will present evidence as to whether or not the general physical science course makes a significant contribution to the students' ability to think critically. The study will also present evidence of student opinion on the effectiveness of the course with respect to the benefits of laboratory experiences, stimulation of interest in science, developing basic understandings of principles and concepts, and developing ability to analyze situations and to think critically.

2. The study is important to the investigator as he is presently engaged in teaching the general physical science course. In conversations with colleagues, in reading of professional literature, and in personal evaluations, the question of the effectiveness of the general physical science course has been constantly recurring. Has it been accomplishing the objectives for which it was established?

Furthermore, science is and has been a topic of concern to laymen in recent years. The scientific and technological developments have been so numerous and rapid the past decade that the average citizen can scarcely expect to keep informed, yet never has there been a time in history when so many need to be more broadly educated in science. Many college students will acquire their total knowledge of physical science through the general physical science course, and it is important to the investigator to know whether or not and to what extent the objectives of this course are being achieved.

3. It is important to college administrators and to those who teach general education courses. General physical science as a part of the general education curriculum was introduced more than ten years ago as the result of the belief that such an educational experience would better fit the needs of many college students than the traditional courses in physics, chemistry, or geology then offered in the colleges. Such a course lets the student see the integrated whole of physical science and as such is a vital educational experience for the college student.

Scientific literacy is needed by each member of a culture such as ours which is so thoroughly based upon technology and scientific endeavor. It is believed that in order to make effective decisions in personal, civic, and national affairs, the citizen must have some knowledge of the processes and products of science.[1] An understanding of the major generalizations of science and the associated scientific attitudes are most important for the student who will not make an area of science his life work. Since college administrators are responsible for the efficiency of teaching and learning in their institutions, they must be concerned and they must make sure that the objectives of the courses taught and the needs of students are compatible. The administrator must also be concerned that the valid objectives are being achieved. This study will provide some evidence for evaluating the general physical science course with respect to its contribution to developing in the student the ability to think critically. The evidence should be of assistance to the administrators in determining whether or not the course is justified in terms of student achievement or gain, student and teacher time expended and financial expenditures.

Limitations of the Problem

In evaluating the physical science course, which is an important item in the curricula of the Oklahoma state colleges, it seems that a study would of necessity include a representative group of students from

[1]It is understood by the investigator that the processes of science are the attitudes, skills, and procedures of reflective thinking or the process of enquiry and a mode of thinking. The products of science are understood to be the acquisition of facts and technological applications.

each of the schools concerned. The decision was made to select at random a sample of students from two of the colleges concerned, since there is no reason to believe that students in the sample differ from or are not representative of the students in all the state colleges. One part of the study was limited to one specific objective and to students from Central State College. A second part of the study was limited to students from two of the schools, i.e. students from Northeastern State College at Tahlequah and Central State College at Edmond. Both of the schools involved are large enough and diverse enough in student body to give an adequate representation of the students enrolled in the state colleges. The study was further limited to one specific semester, the fall semester of 1964.

CHAPTER II

HISTORY OF THE PROBLEM

All people need to be educated more broadly than in the area of their speciality, and a function of general education is to expose students to the fundamentals of the disciplines into which modern learning is divided. This broad intellectual experience should be common to each student regardless of his own intellectual interests and vocational goals. The most striking changes in the college curriculum in the past twenty-five years have sprung from efforts to complement intellectual specialization with an education in the various disciplines adequate to understand the complex world in which we live. The achievement of this broad intellectual experience has been a purpose of general education.

The general education movement originated as a reaction to over-specialization and departmentalization of the curricula as presented by the colleges and universities. T. R. McConnell has observed:

> General education is a movement which began as a re-examination of the nature and purposes of liberal education and which is leading toward a revitalization of the liberal arts and perhaps to a complete reconsideration of the nature of the learning process.[1]

The word "movement" is well chosen, for the major common element of various approaches to general education is to be found in the reaction

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[1]T. R. McConnell, "General Education: An Analysis," The Fifty-First Yearbook of the National Society for Study of Education, (Chicago: University of Chicago Press, 1952), p. 1.

against the over-specialization permitted and even encouraged by the free elective system and the equally serious narrowness of training currently required in many fields of technical and professional preparation.

The President's Commission on Higher Education reports that:

> "'General education' is a term that has come to be accepted for those phases of non-specialized non-vocational learning which should be common experiences to all educated men and women."[1]

Although there exists a wide range of opinions on what these "common experiences" should be, there is general agreement on the objectives of such education. The varying interpretations of a given objective, the varying roles that objectives may play in a program, and the very real difficulty in implementing certain objectives, all tend to make general education programs and statements of general education objectives less interrelated than might be expected. As stated above, there is less disagreement about educational objectives than about the means of achieving them. The objectives listed below are illustrative of the better and most commonly accepted statements, and were adopted by the President's Commission.[2]

1. "To participate actively as an informed and responsible citizen in solving the social, economic, and political problems of one's community, state, and nation"

2. "To understand the common phenomena of one's physical environment, to apply habits of scientific thought to both personal and civic problems, and to appreciate the implications of scientific discoveries for human welfare"

3. "To understand the ideas of others and to express one's own effectively"

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[1]"Higher Education for American Democracy," _The Report of the President's Commission on Higher Education_, (New York: Harper and Brothers, 1947), p. 49.

[2]_Ibid._, p. 52.

4. "To attain a satisfactory emotional and social adjustment"

5. "To understand and enjoy literature, art, music, and other cultural activities as expressions of personal and social experiences, and to participate to some extent in some form of creative activity"

6. "To acquire and use the skills and habits involved in critical and constructive thinking"

Similarity or commonality of objectives does exist between a general education program or course and the specialized departmental course for which the major aim is preparation for further work in the same field. Instruction in any field has usually assumed that knowledge of that material would lead students to acquire broader backgrounds, relevant skills, attitudes, and points of view. But these latter outcomes were desirable by-products, which were thought to be more or less inevitable consequences. With the coming of general education however, the emphasis shifted to these other outcomes of attitudes, relevant skills, and points of view. To many teachers the question now seemed to become not whether students knew science, but rather whether they were critical thinkers with proper attitudes.

The introduction of programs of general education raised several problems for the teachers. There was general consensus that the teacher was now more directly concerned with certain skills, attitudes, and beliefs than he had been before. No longer able to appraise the success of his course and methods of instruction in the traditional manner, of scores on subject matter achievement tests, the measure of achievement in terms of the objectives of general education became a major issue for the teacher.

The commonality of objectives between the courses a department provides in general education and the courses provided for departmental majors presents a challenge as to whether general education ventures achieve the objectives of that area to any greater extent than do courses which they replaced. A comparison of educational programs which differ in objectives would require that a consideration of their merits include not only evidence of achievement of objectives but also an evaluation of the worth of these objectives. The latter would involve judgments and philosophy which cannot be objectively evaluated. The evaluation of all general education in comparison with specialized courses is, practically speaking, an impossible task.

A second aspect of this challenge rests in the diversity of means used to accomplish the same ends. The nature of this challenge was clearly stated by Dr. Earl McGrath when he said,

> To a large degree these developments known as general education have proceeded on the basis of a priori reasoning with little more than opinion to back up the assumptions on which they rest. With a few striking exceptions little attempt has been made to determine experimentally whether one arrangement of subject matter or one method of teaching is better than another or better than the more conventional forms and practices.[1]

One of the previaling objectives of general education has been that of acquiring the ability for critical thinking and analytical reasoning. From the beginning of science in the general education movement, considerable attention has been given to the contribution of science instruction for the promotion of thinking and reasoning as an outcome of such instruction. Although some disagreement has occurred regarding whether there is such a thing as scientific thinking as a definite and explicit process, agreement does exist that several kinds

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[1]Earl J. McGrath, "The Need for Experimentation and Research," General Education in Transition, ed. H. T. Morse, University of Minnesota Press (1951), p. 7.

of thinking and methods employed by scientists are of sufficient general application that they should be encouraged as an objective of science instruction. The development of a scientific attitude or of analytical reasoning would be of little value to a student if it stops with scientific phenomena, and cannot be or is not carried on into his post college life.

Rogers, who gives this word of advice to his science students, mentions the outcomes in terms of scientific thinking:

> Keep an understanding of science itself. If at some future time when you are a business head or major of a town, or what you will, you are faced by some problems and you weed out prejudice and humbug and say, "Let's experiment," or "Let's review reliable tests," or, "Let's consult a qualified expert," the course will have been worthwhile."[1]

The Setting

The official beginning of the general education program at the six Oklahoma State Colleges[2] was the school year of 1951-52, although experimental classes in general physical science were started two years earlier. Much preliminary work was done before this beginning by the Intercollege Curriculum Committee of the Oklahoma State Colleges. This committee was originally charged with a restudy of the total curriculum, however, the developing of the program of general education became a major part of their efforts.

Following an extensive study by the Committee with the assist-

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[1]Eric M. Rogers, "The Good Name of Science," Accent on Teaching: Experiments in General Education, ed. Sidney J. French, (New York: Harper and Brothers, 1954), p. 183.

[2]Northeastern at Tahlequah, Southeastern at Durant, East Central at Ada, Southwestern at Weatherford, Northwestern at Alva, and Central State at Edmond.

ance of representatives from the different schools, recommendations were made to the Council of Presidents of the colleges. This Council approved the recommendations and submitted these to the State Board of Regents of Oklahoma Colleges. On April 26, 1952, the Board of Regents adopted a resolution establishing general education as a part of the curriculum of all six state colleges.[1]

Prior to the adoption of the general education program by the state colleges, students in all the state colleges were required to take a four-hour course in any one of the physical sciences. For most students, however, this requirement could be satisfied only by a course in physics or chemistry. Under the general education plan, a four-hour course in general physical science, which introduces astronomy, geology, physics, and chemistry fulfills this requirement. For all practical purposes this course is a requirement for all students except those majoring in science, pre-medicine, or pre-engineering. Of course the student may elect to take four hours of chemistry or four hours of physics in lieu of this requirement, however, few students take that route.

This non-laboratory course which is drawn from and relates the physical science disciplines was placed in the curriculum of the state colleges with the expectation that non-science oriented students would benefit more from it than from an introductory course in physics or in chemistry. The general physical science course, as taught in the state colleges of Oklahoma, is predominately a lecture-demonstration type of course. The absence of laboratory experiences from the general physical

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[1]Oklahoma State Regents for Higher Education. A Resolution Regulating the Curricula of the Six State Colleges, adopted April 26, 1952.

science course has been considered by many as perhaps its chief weakness. The laboratory is the heart of science or perhaps even the heart of the educative process. The large size of classes and the lack of laboratory facilities, however, tend to discourage the use of methods other than lecture and demonstration.

Since its inception in 1952, no concentrated effort has been made to ascertain whether or not the objectives of the general physical science course are being attained. Faculty study groups at Central State College and at other state schools have investigated the general education program in terms of certification of teachers, but not specifically in terms of evaluation of the objectives of a course such as general physical science. All available information in regard to evaluation of the course has been the opinions of college teachers and college administrators. Nothing has been done with respect to testing whether or not students were achieving the objectives, or in sampling student opinion to see whether or not the consumers of the course feel it is accomplishing the desired outcomes. (See Table 2)

Review of Related Research

Until recently, evaluation of instruction in science was largely in terms of scores on factual type examinations both subjective and objective. The Commission on Secondary School Curriculum[1] pointed out the need and suggested techniques to accomplish the evaluation of success relative to objectives other than those which were content centered.

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[1] Commission of Secondary School Curriculum of the Progressive Education Association, Science in General Education, New York: Appleton-Century-Crofts, Inc., 1938.

These suggestions and others have stimulated evaluation studies of attitudes, critical thinking, misconceptions, application of understanding, changes in behavior, and prediction of success in science courses. These studies have been done on the college level as well as on the secondary school level.

The Science Committee[1] organized by the Cooperative Study of Evaluation in General Education gave serious consideration to the following objectives for general education in science. Underlying these objectives is the assumption that the science subject matter is a tool for attaining the objectives of general education and not an end in itself. The science course in general education should develop students who will be able:

1. To apply science knowledge to new problems and situations.
2. To read and evaluate news articles and popular writings on scientific developments.
3. To understand the point of view with which a scientist may approach his problems, and the kind of things he does.
4. To analyze scientific data summarized in maps, tables, charts, and graphs.
5. To understand the role, importance, and limitations of science in the modern world.
6. To face facts, to revise judgments, and to change behavior in the light of appropriate evidence.
7. To recognize the need for additional science knowledge in a situation, and to acquire it.

The first, second, and third of the above objectives were of greatest interest to the Committee, and were accepted as including most

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[1]Paul L. Dressel and L. B. Mayhew, Science Reasoning and Understanding, William C. Brown Company, Dubuque, Iowa, 1954.

of the ideas involved in the remaining four. Clearly, the reading and evaluation of current science material must involve the ability to apply science knowledge and the ability to demonstrate understanding of the scientific point of view as well as others such as critical analysis and judgment. The above list does not include a number of objectives which many teachers consider important. The objective of acquiring information of facts and principles was omitted because there exist many excellent tests which will measure this outcome.

A synthesis of the various statements of objectives of physical science instruction which have appeared from time to time yielded the following categories of objectives:[1] (a) development of understanding and insight into the forces and of the nature of the environment; (b) development of knowledge and understanding of facts, principles, and concepts of science; (c) development of personal habits and methods of science (recognizing and organizing of facts and data); (d) development of interest and appreciation for the benefits of science; and (e) development of democratic social attitudes toward the resources of science. Many educators and scientists are of the firm opinion that the most important aim of education at all levels is to teach students to think critically.[2]

What is critical thinking and why should it pervade in all listings of objectives? How do you do it and how does it differ from

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[1] S. S. Blanc, "Review of the Goals of Science Teaching," Science Education, January, 1952, pp. 48-49.

[2] T. Bently Edwards, "Measurement of Some Aspects of Critical Thinking," Journal of Experimental Education, XVIII (March, 1950), p. 263.

other mental or intellectual activities? According to John R. Pratt,[1] certain systematic methods of scientific thinking seem to produce much more progress than others. A particular method of doing scientific research is systematically used and taught by certain rapidly moving fields. This is an accumulative method of inductive inference and is so effective that Pratt has given it the name of "strong inference." This type of thinking involves the devising of alternate hypotheses, the devising of experiments in several ways with alternate possible outcomes which will exclude one or more hypothesis.

The characteristic of making the correct inference is only one of several facets of the ability to think critically. Other facets which must be considered are the ability to recognize unstated assumptions, to reason deductively from given premises, to weigh evidence and to distinguish between unwarranted generalization, to distinguish among arguments which are strong and important to the question at issue and those which are weak and unimportant or irrelevant. It also involves an attitude of wanting to have supporting evidence for opinions or conclusions; a knowledge of the methods of logical inquiry which help determine the weight of different kinds of evidence; and a skill in employing the above attitude and knowledge.

Burmester[2] has further described certain aspects of critical thinking. The student should be able to recognize a problem, to delimit a problem, to distinguish between relevant and irrelevant data, to recog-

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[1]John R. Pratt, "Strong Inference," Science, (October, 1964), p. 347.

[2]Mary A. Burmester, "Behavior Involved in the Critical Aspects of Scientific Thinking," Science Education, December, 1952, p. 71.

nize and accumulate facts related to the solution of the problem, and to apply generalizations to new situations.

Considerable thought has gone into the selection and refinement of objectives of instruction in science education; however, less effort seems to have gone into attempts to relate the defined objectives to the actual classroom practices in a realistic manner. Little attention has been given to determining if these objectives are being attained or to what degree attainments have been achieved. In like fashion, little effort has been expended to determine the effectiveness of various methods of presentation or of teacher and student activities to the expected objectives.

A number of studies related to laboratory instruction in physics has been made by Kuglak.[1] In these studies both objective-type tests and laboratory performance tests were employed in evaluating results. Two groups of students in elementary college physics were used to test the effectiveness of the lecture-demonstration and the lecture-laboratory methods. Kuglak found evidence to support the conclusion that individual laboratory method is superior for teaching manipulatory skills and techniques, but his evidence further suggested that laboratory instructional methods do not materially affect the learning of facts and principles of physics and the ability to apply them. Similar results were obtained in a second study in which the lecture method was employed and neither the demonstration nor the individual laboratory was used.

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[1] H. Kuglak, "Experimental Outcomes of Laboratory Instruction in Elementary College Physics," American Journal of Physics, (June, 1952), p. 136.

It was found by Krauskopf[1] that individual laboratory or field experiences were not indispensible in general education science courses. He found that visual aids were helpful for the treatment of some topics, but that lecture demonstrations and laboratory experiences are more effective than visual aids in achieving the objectives of general education.

Dearden[2] used four college general biology classes with the same instructor who kept the lecture portion of the course constant. The lectures were factual in nature and tended to follow the textbook. Each section or class met the same number of times per week but they were subjected to different treatment. One class used a laboratory along with the lecture, one used demonstrations, one used a workbook, and the fourth used a term paper. None of the methods was significantly superior to the others in promoting a more permanent learning of the course materials as shown by a retest after three months. He concluded that there was no significant difference in the achievement of the four groups as far as factual retention was concerned. No attempt was made to measure some of the other objectives such as insight and understanding of principles and concepts, or problem-solving ability, or ability to think critically.

Numerous studies have been made with respect to objectives of science in general education; of various teaching methods in obtaining these objectives; of subject matter area and the critical thinking objective; and of the contribution of laboratory or demonstration to the

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[1]K. B. Krauskopf, "Science in General Education at Mid-Century," Journal of Higher Education, XXII, February, 1951, p. 52.

[2]D. M. Dearden, "An Evaluation of the Laboratory in College General Biology," Journal of Experimental Education, March, 1960, pp. 241-47.

objectives. This study proposes to determine the extent to which the general physical science course contributes to the students' ability to think critically. The assumption that thinking skill acquired with one kind of subject matter may be applied in other subject matter areas is in line with modern psychological concepts regarding transfer of learning. Growth in the ability to do critical thinking in general physical science may serve as a unifying ideal between specialized courses and courses in general education.

CHAPTER III

TREATMENT OF THE PROBLEM

Population to be Studied

Students of Central State College and of Northeastern State College were selected for use in this study. There is no reason to believe that the students of these two schools are not representative of the students attending the six state colleges. Central State College is located in Edmond, near the metropolitan area of Oklahoma City and has a student body of nearly 7000 students from both the urban and rural high schools of the state. Northeastern State College located at Tahlequah in the eastern part of the state has an approximate enrollment of 4000 and these students also come from both urban and rural high schools. Students of these two schools should be typical and representative of the students attending the six state colleges.

Selection of Measuring Instrument

In selecting an instrument to test critical thinking ability, the decision was made to use the Watson-Glaser Critical Thinking Appraisal which hereafter in this study will be referred to as Watson-Glaser. This decision was based on several factors. First, the validity of the test rates high on soundness or logical correctness of the key and on content and is a result of more than twelve years of testing and refining.

It also has a high coefficient of reliability,[1] rating from .85 to .93 on the two forms. Second, it has well established norms. It is also well known and widely used. Third, the test offers a means for determining with the desired precision the relative level of a student's ability to think critically with regard to problems involving recognition of logical implications, interpretation of data, discrimination between strong and weak arguments, recognition of assumptions, and discrimination among degrees of probable inference. Fourth, it is easy to score, has three equivalent forms, and can be administered in less than one hour.

For the student survey, an instrument developed by the investigator was used. This questionnaire was based on or built around the prevailing objectives for the general physical science course as expressed by teachers, educators, and authorities in the field. It did, however, undergo testing by teachers and students before being administered to the experimental groups. (See Part II of Chapter IV)

Procedures

This study has two major parts. The first part consists of the problem of determining if a group of students is significantly different in their ability to think critically due to taking a course in general physical science. The second part is concerned with student evaluation of the course with respect to specific objectives. The survey is related to the first part in that it reveals student attitude toward the outcome

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[1]G. Watson and Edward M. Glaser, Watson-Glaser Critical Thinking Appraisal Manual, (New York: Harcourt, Brace and World, Inc. 1964), p. 13.

of critical thinking.

Part I

To determine if the general physical science course contributes materially to the students' ability to think critically, it was decided to use two experimental student groups from Central State College. One of the groups was enrolled in general physical science, the other was not taking the course. Both groups were taken from the entering freshman class for the fall semester of 1964. Throughout this study the group of students enrolled in the general physical science course will be referred to as the "science group." The other student group, those not enrolled in general physical science, will be designated as the "non-science group." Both of these student groups were given a pre-test and a post-test using two forms of the Watson-Glaser.

The non-science group consisted of 164 students selected from various freshman courses and they came principally from classes in government and physical education. The selection was limited to first semester freshmen who were not science or mathematics majors nor enrolled in a general physical science course. The members of the science group were also first semester freshmen who were not science or mathematics majors, but who were enrolled in a general physical science course. These 215 students were selected at random from eight sections of the general physical science course by taking the odd numbered students from the class roll.

During the first two weeks of the fall semester of 1964, the Watson-Glaser (Form Am) was administered to both groups. The students of both groups were informed that they were a part of an experimental study, that the results of the tests would have no bearing on their marks in the class, and they were encouraged to do their very best.

Near the close of the semester, during the first two weeks of January 1965, a second test was administered to a majority of these same students. The post-test was the Form Zm of the Watson-Glaser. Due to drop-outs, change of schedules, and absences on the date of the post-test, the number of students tested was considerably less than was tested earlier in the semester. The number completing the second test consisted of 179 science students and 119 of the non-science group. Data from the drop-out group was discarded and is not a part of this study.

The tests were scored and tabulated. The interpretation of raw scores was facilitated through the equating of Form Zm with Form Am. Through the procedure of equi-percentile equating, a raw score on one form was considered equivalent to a raw score having the same percentile rank on the other form. A difference in raw score would be attributed first to a difference in the two forms of the test rather than to changes in the individual tested with both forms. The determination of the equivalence of the two forms is necessary before comparing the scores. The equated score was placed on IBM cards along with other information such as identification number of the student, name of the student, sex, age, years of high school science, years of high school mathematics, and the standard score on the ACT.[1] Much of this information was obtained from the student's record in the Office of Admissions and Records of the college. The purpose of the recorded information was to provide five areas for choosing matched pairs of students before comparing the results

[1]American College Testing Program, Inc., Iowa City, Iowa

of the tests on critical thinking.

There were 179 IBM cards prepared for the science group and 119 for the non-science group. By use of the IBM 84 Sorter, these cards were sorted and matched by age, by sex, by years of high school mathematics, by years of high school science, and by relative scores on the ACT. On the latter item, a variation of a plus or minus one standard score was permitted because of a standard error in the test of 1.03.

Through the process of matching, a number of cards were eliminated because they were impossible to match. The result produced 82 matched pairs. From these 82 matched pairs consisting of 82 students from each of the two groups, the data for this portion of the study was obtained. The results of the two forms of the Watson-Glaser are tabulated in Table 1 with number one of the science group matched with number one of the non-science group and so forth. The students are paired all the way from number one through number eighty-two.

TABLE 1

Pre-Test (Am) and Post-Test (Zm) Scores on the Watson-Glaser

SCIENCE GROUP						NON-SCIENCE GROUP					
Student Number	Am	Zm	Student Number	Am	Zm	Student Number	Am	Zm	Student Number	Am	Zm
1	52	59	22	55	60	1	64	64	22	75	58
2	66	64	23	69	77	2	66	71	23	67	54
3	60	76	24	64	59	3	51	66	24	65	61
4	67	63	25	67	65	4	63	50	25	58	60
5	64	61	26	68	66	5	71	68	26	60	66
6	70	64	27	50	57	6	51	67	27	58	50
7	75	78	28	66	58	7	65	69	28	57	62
8	52	58	29	56	56	8	70	70	29	47	56
9	55	60	30	61	47	9	58	40	30	55	65
10	58	61	31	56	52	10	31	41	31	51	65
11	51	63	32	61	50	11	46	56	32	57	61
12	59	76	33	64	66	12	56	58	33	66	64
13	69	61	34	72	68	13	62	51	34	61	65
14	68	66	35	68	71	14	65	70	35	64	60
15	73	76	36	61	59	15	75	75	36	60	46
16	50	45	37	70	70	16	53	58	37	53	58
17	49	59	38	51	54	17	55	45	38	63	76
18	71	69	39	50	67	18	73	62	39	39	32
19	64	62	40	77	82	19	71	71	40	63	63
20	48	65	41	76	78	20	62	76	41	63	67
21	56	69	42	70	64	21	58	61	42	55	69

TABLE 1 CON'T.

Pre-Test (Am) and Post-Test (Zm) Scores on the Watson-Glaser

SCIENCE GROUP						NON-SCIENCE GROUP					
Student Number	Am	Zm	Student Number	Am	Zm	Student Number	Am	Zm	Student Number	Am	Zm
43	56	72	63	74	70	43	69	68	63	64	62
44	58	54	64	67	77	44	47	51	64	47	48
45	68	53	65	69	70	45	64	72	65	39	31
46	59	61	66	78	74	46	69	75	66	61	55
47	72	77	67	62	73	47	71	68	67	54	47
48	72	67	68	64	71	48	62	69	68	49	52
49	60	60	69	58	64	49	59	61	69	53	71
50	61	51	70	63	68	50	70	70	70	53	50
51	70	76	71	76	71	51	47	49	71	65	72
52	74	78	72	52	65	52	66	68	72	66	74
53	47	51	73	45	67	53	56	61	73	46	52
54	68	77	74	61	70	54	71	75	74	71	67
55	64	67	75	58	69	55	60	70	75	74	74
56	69	73	76	61	69	56	42	37	76	56	68
57	68	80	77	59	58	57	40	61	77	72	62
58	84	79	78	63	74	58	64	75	78	77	60
59	59	58	79	49	54	59	61	73	79	70	76
60	61	57	80	67	66	60	73	72	80	60	64
61	66	64	81	44	58	61	60	62	81	79	67
62	53	71	82	64	65	62	64	69	82	83	76

Part II

The second part of the study is concerned with the evaluation of the general physical science course as revealed through a survey of student opinion. It consists of three steps.

Step 1. A survey was made of the teachers of general physical science in the colleges of Oklahoma to determine the objectives of their courses. This survey was obtained through correspondence and through personal contact with teachers of the general physical science course in the state colleges. Returns were received from sixty per cent of the requests and four of the six schools were represented. To this list of objectives were added those expressed by curriculum authorities, by science educators, and by authors of physical science textbooks. From this list, the following categories of objectives were adopted for use in developing or building a student survey questionnaire. The objectives of the general physical science course as indicated through this survey are:

1. To emphasize certain basic concepts and their role in understanding the natural world.
2. To convey to the student something of the historical and philosophical development of physical science.
3. To emphasize the living nature of science.
4. To integrate and correlate the disciplines of science.
5. To give the non-science student an understanding of the four primary concepts: space, mass, time, and energy.
6. To stimulate interest in science.
7. To show the impact of science on man.
8. To develop the "scientific attitude" and "scientific thinking."
9. To develop the power of analysis.
10. To develop an appreciation for science and what scientists do.

11. To develop an understanding of the relationship of science to other fields of study.

12. To develop an awareness of the impact of science on social and national life and its implications for the future.

The order of the list is in no way intended to reflect the importance of the objectives. A number of the objectives mentioned by the respondents were eliminated because of duplication or they were combined with others.

Step 2. From the above objectives, a student survey questionnaire was prepared to be given to college students who were completing the general physical science course. The survey questionnaire underwent several revisions and it was tested on several groups of students who were enrolled in general physical science at Central State College in the spring of 1964. An attempt was made to eliminate ambiguous statements and to see if the statements or questions were understood.

During the fall of 1964, a limited number of these who were a part of the survey the previous spring were called in for an interview to see if their responses were consistent. Generally, these students thought the questions were clear and that responses were not difficult to make. The responses of this test group are not a part of this study.

Step 3. The field tested questionnaire was administered to 496 students at Central State College and to 210 students at Northeastern State College. All of these students were completing the general physical science course and the survey was made during the last two weeks of the semester in January 1965. Students completing the questionnaire were informed that no names were to appear on the response sheet; that their reactions to questions would have no bearing on their marks in the course;

and that a frank, honest, and unbiased opinion was solicited in the light of their experiences in the course during the present semester.

The results of the survey were tabulated and percentages computed as shown in Table 2.

Statistical Tools

Part I

In attempting to reach decisions, it is useful to make some assumptions about the populations involved. Such assumptions or hypotheses in general are statements about the probable distributions of the populations. In most instances, a statistical hypothesis is formulated for the sole purpose of rejecting or accepting it.

The statistical theory and methods employed in the construction and analysis of criteria play an ever increasing role in decision making. No matter how we decide problems arising in science, business, and every day life, we must face the risk of making a wrong choice and suffer whatever consequences are involved. A major task of modern statistics is to evaluate such risks and to provide criteria which minimize the chances of making wrong decisions.

For this study it was desired to determine if the science group which was enrolled in a general physical science course was significantly different in ability to think critically from the non-science group which was not enrolled in the course. A "t" test of the difference of means was utilized. First, the test was used to determine if a significant difference existed between pre-test and post-test of each group. Then the same statistical test was used to see if there was a significant difference between the two groups (science and non-science) on the pre-test,

TABLE 2

Number and Per Cent of Responses

Item	Yes Strong Agreement	Slightly To some Degree	Very Little	No None Disagree
1. Has this course been helpful in understanding some of the basic concepts of science?	432 61.27%	239 33.90%	27 3.97%	7 0.99%
2. Has the course been useful in conveying something of the historical development of physical science?	298 42.57%	326 46.57%	66 9.42%	10 1.42%
3. Has this course been useful to you in emphasizing the living nature of science; i.e. that science is a living vibrant area of man's knowledge?	286 40.62%	313 44.46%	84 11.93%	20 2.84%
4. Has this course been useful in conveying to you something of the philosophical development of physical science?	129 18.40%	320 45.64%	196 27.96%	41 5.84%
5. Has this course tended to show the integration and correlation of the various disciplines of science?	199 28.14%	316 44.69%	150 21.21%	41 5.79%
6. Has this course tended to increase your interest in science?	254 36.07%	255 36.22%	121 17.18%	74 10.51%
7. Has this course tended to show the impact of science on the social and national life and its implications for the future?	256 36.31%	260 36.87%	148 20.99%	41 5.81%
8. Has this course increased your understanding of the natural world; i.e. understanding natural phenomena in your environment?	335 47.51%	255 36.17%	87 12.34%	24 3.40%
9. Have your ideas of nature or natural phenomena changed since taking this course?	168 23.79%	273 36.66%	159 22.52%	106 15.01%
10. Has your feeling or attitude toward science improved by taking this course?	219 31.06%	275 39.00%	128 18.15%	82 11.63%
11. Has your interest in science increased through the taking of this course?	226 32.01%	246 34.84%	142 20.11%	89 12.60%

TABLE 2 CON'T.

	Item	Yes Strong Agreement	Slightly To some Degree	Very Little	No None Disagree
12.	Do you feel that this course may help to develop in you an understanding and appreciation of the scientific methods and develop in you the ability to apply it?	164 23.39%	291 41.51%	168 23.96%	58 8.27%
13.	Do you feel that this course may help you to reason or think logically?	172 24.46%	341 48.50%	138 19.63%	54 7.68%
14.	Do you think this course has helped your power of analysis?	122 17.34%	333 47.30%	190 26.98%	49 6.96%
15.	Do you think that actual experimental laboratory work would have been useful?	317 44.90%	152 21.52%	157 22.23%	80 11.33%
16.	Do you feel that this course has helped you to gain an appreciation of the nature of science and what scientists do?	288 40.90%	303 43.03%	90 12.78%	23 3.26%
17.	Do you think that through this course you have a better understanding of the relation of science to other fields of study?	244 34.60%	308 43.68%	110 15.60%	31 4.39%
18.	Do you feel this course will be as valuable to you as four hours of physics, chemistry, or astronomy, or some other physical science?	401 56.79%	152 21.52%	72 10.19%	81 11.47%
19.	Do you think that this course has helped you in the understanding of the concepts of space, mass, and time?	375 53.19%	240 34.04%	74 10.49%	14 1.98%
20.	Was the course too mathematical in nature?	189 26.77%	172 24.36%	104 14.73%	240 33.99%
21.	Were the demonstrations helpful in developing understanding of principles and concepts?	449 63.77%	167 23.72%	55 7.81%	32 4.54%
22.	Were the films helpful in developing understandings?	229 32.48%	166 23.54%	86 12.19%	127 18.01%

and if a significant difference existed between the two groups on the post-test.

The null hypothesis was formulated, that there was no difference between the two groups on the pre-test or the post-test. Also the same hypothesis was adopted, that there was no significant difference between the pre-test and post-test by either group. If a difference exists, and is not significant at the one percent level, it may reasonably be attributed to chance. This called for four statistical tests: (1) a test of the means of the science group on the Am form and on the Zm form; (2) a test of the means of the non-science group on the Am form and the Zm form; (3) a test of the means of the science group and the non-science group with respect to the Am form only; and (4) a test of the difference of means of the same two groups on the Zm test.

The level of significance was set at one percent because it was desired to avoid rejecting a true hypothesis. Rejecting a true hypothesis, which is a Type I error, would mean in this case assuming that a difference exists when actually there is no difference. The consequences of this decision then would be to continue the general physical science course under the impression that it is making a contribution to the ability of students to think critically when it is not. With respect to the objective of critical thinking, this would mean a waste of student time and money as well as an expense to the college. On the other hand, if the significance level is low, there is greater chance of making the Type II error, that of accepting a false hypothesis. This would mean accepting a condition of no difference when there actually is a difference. The consequences of this decision would be to discard the general physical science course as being of no value or of limited value in contributing to the ability of students to think critically. The Type I error is preferred to Type II because it is less serious. We are more willing to retain a course which is making a doubtful contribution than to discard one which may be making a significant contribution.

Statistical Tools

Part II

Survey information is much more difficult to analyze and evaluate than the more direct test results. The responses were tallied and the frequencies were determined. From this the percentages were computed.

To treat these data statistically, it was decided to group the first two responses as affirmative because they were "strong agreement" or "slight agreement." The last two responses were treated as negative as they were "little" or "strongly disagree." Then a priori reasoning was used assuming that in a chance situation fifty percent of the responses would be affirmative and fifty percent would be negative. On this assumption, statistical tests were made on observed results as compared to the expected results.

The affirmative responses (first two responses) were tested against the negative responses (last two responses) by the "z" test of difference between proportions. Then the Chi square test was used to see if significant differences occurred among the four responses. The one percent level of confidence was imposed in both cases. These results are shown in Table 5.

CHAPTER IV

RESULTS

Part I

The data as shown in Table 1 reveal the results of the pre-test (Am Form) and the post-test (Zm Form) of the Watson-Glaser Critical Thinking Appraisal Test. This table shows how the scores varied from student to student and from test to test. The table gives the scores by matched pairs with student number one of the science group matched with student number one of the non-science group. Each pair is matched from number one through number eighty-two on the basis of the five criteria mentioned in Chapter III.

The mean as computed on the Am test for the science group was 62.58 with a range of 47 to 84, and a standard deviation of 8.18. On the same test the non-science group had a mean of 60.45, a range of 31 to 83 and a standard deviation of 9.77. The results of the Zm test show that the science group had a mean of 65.36, with a range of 45 to 83 and a standard deviation of 8.40. The non-science group had a mean of 61.96, with a range of 31 to 76 and a standard deviation of 10.41 on the Zm form.

A statistical analysis of the means of the science group on the two forms (Am and Zm) revealed a "t" score of 2.224 which is significant at the five percent and two and one half percent level, but not significant at the one percent level. The same "t" test applied to the non-science group shows a "t" score of .961 which is not statistically significant.

When we compare the science group and the non-science group on the Am test, an analysis of the means reveal a "t" score of 1.56 which is not significant. However, when we compare the two groups on the Zm form we get a "t" value of 2.377 which is significant at the one percent level.

In comparing the science group and the non-science group on the improvement made from Am test to Zm test, it was found that both groups made some increase in scores as shown by the increase in means. Neither group made significant improvement from pre-test to post-test, however, it must not be overlooked that the science group did make substantially more improvement because the results were significant at the five percent and two and one half percent level.

It is only when we compare the two groups on the Zm form do we find a difference which is significant at the one percent level. From this we would reject the hypothesis of no difference and conclude that the course in general physical science does contribute to the improvement of the students' ability to think critically. It is quite definite that from these data, the science group made more improvement during the semester under study than did the non-science group. It must also be kept in mind that there are other factors involved in developing this ability and it must not be overlooked that this ability cannot be developed to a high degree in a one-semester course.

Statistical results are shown in Tables 3 and 4.

TABLE 3

Means and Standard Deviation

Group	Test Form	Mean	Standard D.	Variance
Science	Am Form	62.58	8.18	67.17
Science	Zm Form	65.36	8.40	70.61
Non-Science	Am Form	60.45	9.77	95.49
Non-Science	Zm Form	61.96	10.41	108.99

TABLE 4

"t" Score and Level of Significance

Group	Mean Am Form	Mean Zm Form	S. D. Am Form	S. D. Zm Form	"t" Value
Science	62.58	65.36	8.18	8.40	2.224*
Non-Science	60.45	61.96	9.77	10.17	.961

Test Form	Science Mean	Non-Science Mean	Science S. D.	Non-Science S. D.	" t"
Am Form	62.58	60.45	8.18	9.77	1.56
Zm Form	65.36	61.96	8.40	10.17	2.377**

* significant at .025 level
** significant at .01 level

Part II

Very good response was received on the survey questionnaire. More than 900 response sheets were returned, however, 194 were rejected as incomplete. From the 706 completed forms Table 2 was developed. On all twenty-two questions or statements the majority of those responding reported favorably to the course. The "Yes, Strong Agreement" response receiving generally a higher percentage than the "Slight, Agree to Some Extent" response. The sum of the two affirmative responses exceeded the two negative responses on all items. The Chi square and the "z" estimate of proportions tests showed a significant difference in all cases with the exception of item number twenty. Other than the predominately affirmative trend of the responses, there were no apparent patterns to the student reactions. Students were consistent in their reactions as shown by responses number six and number ten which indicated that 72% and 70% thought their interest in and attitude toward science had increased or improved through the taking of the course.

Of particular interest to this study were the responses to items thirteen and fourteen, which are directly related to Part I of the study. The affirmative responses comprise 73% and 64% of the total. This would indicate that students think the course in general physical science helped them to improve in their ability to think critically and improved their processes of analysis. The results on Part I substantiated this belief because the science group did make more improvement than did the non-science group.

Approximately 77% of these students felt that the general physical science course would be as valuable to them as a semester course in chemistry or physics or any of the other physical sciences. Student opinion was high on the value of the demonstrations, however, about 66% felt that actual laboratory experience would have been very beneficial. This indicates that in student opinion there is a need for more student activities, i.e. more situations in which students may actually become involved.

Students generally rated the course high in "helpful in understanding the basic concepts of science," in emphasizing "that science is a living, vibrant area of man's knowledge," in development of "understanding natural phenomena in the environment." These questions not only received a high percentage of the "strong agreement" response but the "slight, to some degree" reaction was also very high.

Items number twenty and twenty-two were of interest, too, because they were the items which received the highest percent of negative votes. A relatively high percentage of the students (52%) thought that the course was too mathematical in nature as shown by response to number twenty. This may be indicative of at least two things: students are weak in mathematics background and/or the course is quantitative in nature. One explanation of the high number of negative responses to item number twenty-two which was related to the value of films in the course, was the fact that in some sections or classes no films were used. Comments written in the margin of the response sheets by students indicated this even though they had marked the "no, strongly disagree" response.

Table 5 gives the results of the survey in terms of percentages of affirmative and negative responses and the "z" scores.

TABLE 5

Percentage of

Affirmative and Negative Responses

Item	Affirmative in percentage	Negative in percentage	z .01 = 2.56
1.	94.97	4.89	20.52
2.	89.14	10.84	21.28
3.	85.08	14.77	18.63
4.	64.04	33.80	7.27
5.	72.83	27.00	12.27
6.	72.29	27.68	11.75
7.	73.18	26.80	12.28
8.	83.68	15.74	17.96
9.	62.45	37.52	6.60
10.	70.06	29.78	10.68
11.	66.85	32.71	9.01
12.	64.90	32.23	7.72
13.	72.96	27.31	12.12
14.	64.62	33.94	7.72
15.	66.42	33.56	8.78
16.	73.93	16.04	17.95
17.	78.28	19.99	15.07
18.	78.31	21.66	15.15
19.	87.23	12.47	19.84
20.	51.13	48.72	.60*
21.	87.49	12.35	19.92
22.	56.02	30.20	3.18

* significant at .01 level

CHAPTER V

SUMMARY AND CONCLUSIONS

The purpose of this study has been to determine the effectiveness of the college level general physical science course in preparing students to think critically, and to determine if the course was meeting other prescribed objectives. For the first part of the study, two groups of first semester freshmen were used. These groups of eighty-two each were matched with respect to age, sex, ACT score, high school mathematics background, and high school science background. They differed in treatment in that one was enrolled in a general physical science course and the other was not. Both groups were tested at the beginning of the semester with a form of the Watson-Glaser, then both were given a posttest near the close of the semester with a different form of the Watson-Glaser. The study involved students randomly selected from the freshman class of Central State College and a survey of seven hundred and six students from Central State College and Northeastern State College. This sample is sufficient to adequately represent the student bodies and the general education students who are enrolled in the state colleges.

The Null Hypothesis was adopted assuming that there were no significant differences between the two groups and the one percent level of confidence was imposed. This hypothesis was not rejected except in the comparison of the two groups on the post-test (Zm Form). It was evident from the results of the science group on the two forms that this group made more improvement in its ability to think critically than did the non-science group. The difference of the science group on the pre-test and the post-test was significant at the five percent and two and one half percent level.

A survey of over seven hundred students enrolled in the course of general physical science gave some interesting information on student opinion of the course. The responses definitely indicate that students generally are satisfied with the course as it is now offered. The survey supported the findings of the test portion of the study in that the majority of students felt that the course helped them to think logically and helped them to better analyze information and data.

In light of the evidence provided by this study, it is concluded that the general physical science course does contribute to the improvement of the ability to think critically. There was a significant improvement of the science group over the non-science group on the Zm form and the science group also made greater gain from pre-test to post-test although this gain was not significant at the one percent level.

The student survey also provides evidence to support the conclusion that the general physical science course is achieving other objectives to some degree. Students report a favorable impression of the course, as 65% to 70% indicated that the course helped them to analyze information and helped them to think and reason more logically. In all twenty-two items on the survey, a majority of the students gave a favorable opinion. Apparently the general physical science course is doing well on many of its objectives and should remain a part of the general education curricula.

In spite of this favorable report, there remain several weaknesses and several areas where improvements may be made. The study suggests from student opinion, for example, that in the area of laboratory experiences and student activities that there is need for improvement and further study.

Educational Implications and Recommendations

Within the limits of this study, the results show an encouraging difference achieved by the science group over the non-science group. Perhaps the testing of students over a period of two or three semesters would give more reliable results. The study, however, indicates that within the framework of the general physical science course there is definitely opportunity for the students to develop in their ability to analyze and to think critically. In the opinion of this investigator, much depends upon the teacher and his use of demonstrations in the absence of laboratory experiences or upon the teacher and the use of demonstrations in combination with the laboratory. Much also depends upon the use of problem-solving situations and the use of tests which are more subjective in nature and which require the student to think. Problem-solving does not necessarily imply the use of mathematics, but it does imply such problems which provide an opportunity to stretch the students' abilities and to extend what they have been taught beyond the immediate dimensions within which they were taught. When properly conceived and planned, problems exercise the students' abilities to analyze situations and provide opportunities to use insight, judgment, intuition, and other mental processes. Students derive real satisfactions from solving problems and especially so if the problems cast the student in the role of discoverer.

The evaluation of the general physical science course as reflected in the student survey would indicate that it is achieving to some extent the objectives for which it was designed. It apparently is meeting some of the needs and the non-laboratory course is certainly less costly to maintain for it requires less teacher time as well as less physical equipment. Is the laboratory necessary to the teaching of general education science? Has it been proved experimentally to be superior to the demonstration method for purposes of general education? It is granted that some skills learned in the laboratory are essential in a number of professions. However, it is an open question as to whether these skills are of value outside the scientific occupations.

Certain procedures in the laboratory can be used to accomplish some of the objectives of general education. But is it not possible to accomplish these objectives by other means? Many teachers believe that it is. Problem solving experiences, which are common in the laboratory, may be enjoyed by the students without the actual manipulation of equipment. Then, too, it is the belief of this investigator that certain "traditional" laboratory exercises are of little or no value to the general student. It is believed that long hours spent in making detailed drawings or in following "cook book" directions to predetermined results are largely wasted. It was the concensus of the students surveyed that actual laboratory work would have been beneficial even though there was general satisfaction with the demonstrations. More thought and more planning must go into the demonstrations if laboratory facilities are not available. It is possible that individual laboratory kits purchased by the student might be a solution in schools where laboratories and laboratory equipment are not feasible.

This study also has implications as to the future of general education. With the increased pressure from the graduate schools and the curriculum revisions in the secondary schools, the college must critically re-evaluate its role in the educative process and decide what should be the nature of the college educational experience. Specifically, colleges are going to have to decide what should be the nature of the general education component of courses in such areas as science. Some factors are quite clear. The nature of specialization today and for the predictable future is such that successful specialists must themselves be educated in broad principles. We will have the scientists, the engineers, and the social scientists in the future, but their work may be uncertain or decidedly different twenty or thirty years from now. In the face of these uncertainties, the curriculum should develop mastery of broad principles which can be utilized in a variety of ways. More emphasis in the curricula must be given to developing the student's ability to think, to express himself, and to assume responsibility for continuing his own education.

This would imply that general physical science as a part of the general education program may become more important in the process of providing these broad experiences that seem essential. The course may be strengthened by improving the demonstrations and the problem-solving situations and by providing more meaningful laboratory experiences so that it may make a greater contribution at the undergraduate level and in the area of adult education. It is definitely believed that more student participation in the demonstrations, in laboratory activities, and in problem-solving experiences will greatly enhance the course in general physical science at the college level.

Suggestions for Future Investigations

The results of this study clearly indicate certain areas in which further investigations may and should be made. Although the data presented here indicates that the general physical science course contributes to the ability of students to think critically, there no doubt, are numerous other factors that also contribute to this ability. Other subject-matter areas should be investigated to determine the effects that they may have on critical thinking. Of paramount interest would be a similar study with a general physical science course which utilizes ample laboratory experiences along with the lecture and demonstrations.

Another interesting study would be an investigation into the effects of the general physical science on student attitudes and particularly student attitude toward science. Does the course actually stimulate interest as shown by the survey and does this interest carry over to such an extent that students enroll in additional science courses? How many students whose interest was stimulated through the physical science course become science majors?

It would be well to examine the effectiveness of the science taught in the elementary schools by elementary teachers whose only exposure to the physical sciences was a four-hour course in general physical science. This study would probably involve the examining of teacher certification as well as the science background of the teacher other than general physical science.

Most of the colleges will continue to be hampered by increased enrollments and by a shortage of laboratory facilities. An experimental study on the value or effectiveness of individual student-purchased laboratory kits appears to be a worthwhile project. In fact, it may well be a partial solution to the problem of increased class size and insufficient laboratory space and equipment.

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GENERAL PHYSICAL SCIENCE SURVEY

This survey questionnaire has as its purpose the evaluation of the course in General Physical Science. You, as a student who has completed the course or are now enrolled in it, can best do this. We would like to have your true, unbiased opinions. Your responses will not affect your mark in the course. No grades are given and no names are to be placed on the response sheet. Consider each item carefully before marking your response.

READ CAREFULLY BEFORE MAKING YOUR RESPONSE

1. Has course been helpful in understanding some of the basic concepts of science?

2. Has the course been useful in conveying something of the historical development of physical science?

3. Has this course been useful to you in emphasizing the living nature of science, i.e. that science is a living vibrant area of man's knowledge?

4. Has this course been useful in conveying to you something of the philosophical development of physical science?

5. Has this course tended to show the integration and correlation of the various disciplines of science?

6. Has this course tended to increase your interest in science?

7. Has this course tended to show the impact of science on the social and national life and its implication for the future?

8. Has this course increased your understanding of the natural world: i.e. understanding natural phenomena in your environment?

9. Have your ideas of nature of natural phenomena changed since taking this course?

10. Has your feeling or attitude toward science improved by taking this course?

11. Has your interest in science increased through the taking of this course?

12. Do you feel that this course may help to develop in you an understanding and appreciation of the scientific method and develop in you the ability to apply it?

13. Do you feel that this course may help you to reason or think logically?

14. Do you think this course has helped your power of analysis?

15. Do you think that actual experimental laboratory work would have been useful?

16. Do you feel that this course has helped you to gain an appreciation of the nature of science and what scientists do?

17. Do you think that through this course you have a better understanding of the relation of science to other fields of study?

18. Do you feel this course will be as valuable to you as four hours of physics, or chemistry, or astronomy, or some other physical science?

19. Do you think that this course has helped you in the understanding of the concepts of space, mass, and time?

20. Was the course too mathematical in nature?

21. Were the demonstrations helpful in developing understanding of principles and concepts?

22. Were the films helpful in developing understandings?

RESPONSE SHEET

Your responses will vary in degree, but as best you can evaluate your feelings and attitudes. Indicate your response by checking or placing an X in the appropriate circle which most closely or nearly approximates your true opinion and/or feeling.

Responses:
1. Very much, --strong agreement
2. Slightly, --to some degree
3. Very little
4. None, --disagree

	1	2	3	4
1.	0	0	0	0
2.	0	0	0	0
3.	0	0	0	0
4.	0	0	0	0
5.	0	0	0	0
6.	0	0	0	0
7.	0	0	0	0
8.	0	0	0	0
9.	0	0	0	0
10.	0	0	0	0
11.	0	0	0	0

	1	2	3	4
12.	0	0	0	0
13.	0	0	0	0
14.	0	0	0	0
15.	0	0	0	0
16.	0	0	0	0
17.	0	0	0	0
18.	0	0	0	0
19.	0	0	0	0
20.	0	0	0	0
21.	0	0	0	0
22.	0	0	0	0

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TEST DEPARTMENT

757 THIRD AVENUE, NEW YORK 17, NEW YORK

27 May 1965

Mr. Clarence C. Yoesting
Central State College
Division of Science
Edmond, Oklahoma

Dear Mr. Yoesting:

We are happy to learn that your research study is nearing completion and will be looking forward to receiving a copy of your findings, especially those sections containing reports of results on the Watson-Glaser Critical Thinking Appraisal. We wish you success in your finals and will be looking forward to congratulating you on your new degree.

Permission to include copies of Watson-Glaser Critical Thinking Appraisal, Forms Am and Zm in the appendix of your dissertation is set forth in this letter. Under this agreement it is understood that the test booklets so bound will not be available to the general university population or to the public. Permission to reproduce the booklets as part of the dissertation report by microfilming or other device as required routinely by the Graduate School is also granted. Reproduction of the test, in whole or in part, for any other purpose is not covered by this permission.

Sincerely

Harold F. Bligh

Harold F. Bligh, Ph.D.
Managing Editor

HFB:AC

WATSON-GLASER CRITICAL THINKING APPRAISAL *Form* AM

by GOODWIN WATSON
Professor of Education, Teachers College, Columbia University

and EDWARD MAYNARD GLASER
Edward Glaser & Associates, Consulting Psychologists, Pasadena

DIRECTIONS:

This booklet contains several different types of tests designed to find out how well you are able to reason analytically and logically.

Do not turn this page until instructed to do so. Do not make any marks on this test booklet. All answers are to be marked on the separate Answer Sheet provided. If you wish to change an answer, be sure to erase your old answer completely.

Published by World Book Company, Yonkers-on-Hudson, New York, and Chicago, Illinois. Printed in U.S.A. WGCTA : AM-6 b

TEST 1. *Inference*

DIRECTIONS. An *inference* is a conclusion which a person draws from certain observed or supposed facts. Thus, from the electric light visible behind the window shades and from the sound of piano music in a house, a person might *infer* that someone is at home. But this inference may or may not be correct. Possibly the people in the house went out leaving the lights on, and the piano music could be coming from a radio or phonograph they left playing.

In this test each exercise begins with a *statement of facts* which you are to regard as true. After each statement of facts you will find several possible inferences — that is, inferences which some persons might make from the stated facts. Examine each inference separately, and make a decision as to its degree of truth or falsity.

On the Answer Sheet you will find for each inference spaces marked with the letters T, PT, ID, PF, and F. For each inference make a mark on the Answer Sheet under the appropriate letter as follows:

T — if you think the inference is *definitely true;* that it properly follows from the statement of facts given.

PT — if, in the light of the facts given, you think the inference is *probably true;* that there is better than an even chance that it is true.

ID — if you decide that there are *insufficient data;* that you cannot tell from the facts given whether the inference is likely to be true or false; if the facts provide no basis for judging one way or the other.

PF — if, in the light of the facts given, you think the inference is *probably false;* that there is better than an even chance that it is false.

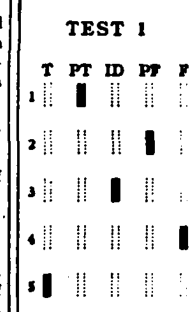
F — if you think the inference is *definitely false;* that it is wrong, either because it misinterprets the facts given, or because it contradicts the facts or necessary inferences from those facts.

Sometimes, in deciding whether an inference is probably true or probably false, you will have to use certain commonly accepted knowledge or information which practically every person knows. This will be illustrated in the example which follows.

Here is the example; the correct answers are indicated in the block at the right.

EXAMPLE. A thousand eighth-grade students recently attended a voluntary week-end conference in a Midwestern city. At this conference questions of race relations and means of achieving lasting world peace were chosen by the students for discussion, since these were the problems the students felt to be most vital today.

1. As a group, the students who attended this conference had a keener interest in humanitarian or broad social problems than most eighth-grade students have..............................
2. The majority of these students were between the ages of 17 and 18..........
3. The students came from all sections of the country........................
4. The students discussed only labor relations problems.....................
5. Some eighth-grade students felt that discussion of race relations and means of achieving world peace might be worthwhile...........................



In the above example, inference 1 is *probably true* (PT) because (as is common knowledge) most eighth-grade students are not likely to evidence such serious concern with broad social problems.

Inference 2 is *probably false* (PF) because (common knowledge) there are relatively few eighth-grade students in the United States between 17 and 18 years of age.

There is no evidence for inference 3. Thus there are *insufficient data* (ID) for making a judgment in the matter.

Inference 4 is *definitely false* (F) because it is given in the statement of facts that race relations and means for achieving world peace were the problems discussed.

Inference 5 necessarily follows from the given facts; it therefore is *true* (T).

In the exercises which follow, more than one of the inferences from a given statement of facts may be true (T), or false (F), or probably true (PT), or probably false (PF), or have insufficient data (ID) to warrant any conclusion. That is, you are to consider each inference by itself.

Make a heavy black mark in the space under the letter that you think best describes each inference. If you change an answer, erase thoroughly. Make no extra marks on the answer sheet.

An English teacher arranged for the students in one of her classes to see the movie *Great Expectations*, while the students in other classes studied the book itself, without seeing the picture. Tests to measure appreciation and understanding of the story were administered immediately upon completion of each type of instruction. On all tests the class which was taught with the aid of the movie did better. The class which saw the movie became so interested that before the semester was over most of those students read the book, entirely on their own initiative.

1. The tests to measure appreciation and understanding of the story were administered both to the students who saw the picture and to those who only studied the book. . . . .
2. The children who were taught with the aid of the motion picture were required to read the book before the end of the semester. . . . .
3. Pupils who see movies instead of reading books lose interest in reading. . . . .
4. Most of the children in the class which saw the picture would have preferred to study the book *Great Expectations* in the usual way without the aid of the movie. . . . .
5. The teacher who conducted the experiment will hereafter try to use motion pictures when they are available, as an aid in teaching literary appreciation.
6. Pupils can learn more about any given subject from motion pictures than they can from books. . . . .

The first newspaper in America, edited by Ben Harris, appeared in Boston September 25, 1690, and was banned the same day by Governor Simon Bradstreet. The editor's long fight to continue his little paper and print what he wished marks an important episode in the continuing struggle to maintain a free press.

7. The editor of the first American newspaper died within a few days after his paper was banned. . . . . .
8. Governor Bradstreet felt he had the legal authority to ban Ben Harris's paper. . . . .
9. The editor of this paper wrote articles against taxes of the kind which later brought about the "Boston Tea Party.". . . . .
10. Ben Harris was a man of persistence in holding to some of his interests and convictions. . . . .

Some time ago a crowd gathered in Middletown, Mississippi, to hear the new president of the local Chamber of Commerce speak. He said, "I am not asking, but demanding, that labor unions accept their full share of responsibility for civic betterment and community interests. I am not asking, but demanding, that they join the Chamber of Commerce." The listening representatives of the Central Labor Unions applauded enthusiastically. Three months later all the labor unions in Middletown were represented in the Chamber of Commerce, where they served enthusiastically on committees, spoke their minds, and participated actively in the civic betterment projects.

11. Both the labor union representatives and the other members of the Chamber of Commerce came to recognize one another's problems and viewpoints better through their Chamber of Commerce contacts.
12. Labor unions' participation in the Middletown Chamber of Commerce has largely eliminated worker-management disputes in that town. . . . .
13. The active participation of the labor unions caused friction at the meetings of the Chamber of Commerce.
14. The union representatives soon regretted having accepted the invitation to participate in the Chamber of Commerce. . . . .
15. Many of the Chamber of Commerce members came to feel that their president had been unwise in asking the union representatives to join the Chamber. . . . .
16. The representatives of the Central Labor Unions joined the Chamber of Commerce against the desires of the great majority of their membership. . . . .

Studies have shown that there is relatively much more tuberculosis among Negroes in the United States than among whites. There is no difference, however, in rate of tuberculosis between Negroes and whites who have the same level of income. The average income of whites in the United States is considerably higher than the average income of Negroes.

17. Tuberculosis can be cured. . . . .
18. Raising the economic level of Negroes would reduce tuberculosis. . . . .
19. Tuberculosis is less prevalent among Negroes with relatively high incomes than among Negroes with relatively low incomes. . . . .
20. Whether a white person is rich or poor makes no difference in the likelihood of his getting tuberculosis.

Go on to the next page.

TEST 2. *Recognition of Assumptions*

DIRECTIONS. An *assumption* is something supposed or taken for granted. When someone states, "I'll graduate in June," he takes for granted or assumes that he will be alive in June, that he will remain in school until that time, that he will pass his courses, and similar things.

Below are a number of statements. Each statement is followed by several proposed assumptions. *You are to decide for each assumption whether it necessarily is taken for granted in the statement.*

If you think the given assumption is taken for granted in the statement, make a heavy mark between the dotted lines under "ASSUMPTION MADE" in the proper place on the Answer Sheet. If you think the assumption is not necessarily taken for granted in the statement, make a heavy line under "ASSUMPTION NOT MADE" on the Answer Sheet.

Below is an example: the block at the right shows how these items should be marked on the Answer Sheet.

If you do not see why the answers marked are right, ask the examiner to explain. In some cases more than one of the given assumptions is necessarily made; in other cases none of the given assumptions is made.

EXAMPLE. STATEMENT: "We need to save time in getting there, so we'd better go by plane."

PROPOSED ASSUMPTIONS:

1. Going by plane will take less time than going by some other means of transportation. (It is assumed in the statement that greater speed of a plane over other means of transportation will enable the group to get to their destination in less time.) ....
2. It is possible to make plane connections to our destination. (This is necessarily assumed in the statement, since, in order to save time by plane, it must be possible to go by plane.)....
3. Travel by plane is more convenient than travel by train. (This assumption is not made in the statement — the statement has to do with saving time, and says nothing about convenience or about any other specific mode of travel.) ....

TEST 2

	ASSUMPTION MADE	NOT MADE
1	▌	⁞
2	▌	⁞
3	⁞	▌

STATEMENT: "Let us immediately build superior armed force and thus keep peace and prosperity."

PROPOSED ASSUMPTIONS:

21. If we have superior armed force, that will insure the maintenance of peace and prosperity..........
22. Unless we increase our armaments immediately we shall have war................................
23. We now have peace and prosperity...............

STATEMENT: "A wise man will save at least twelve dollars each week out of his earnings."

PROPOSED ASSUMPTIONS:

24. No fools have sense enough to save twelve dollars a week.......................................
25. A person needs to be wise in order to save twelve dollars a week.................................

STATEMENT: "Even if all the wealth in the country suddenly were to be distributed equally, some people soon would again become rich and others poor."

PROPOSED ASSUMPTIONS:

26. The real causes of wealth and poverty would not be much affected by such Socialism.................
27. Our present economic system is better than such Socialism.

STATEMENT: "Mary isn't going to invite John to her party."

PROPOSED ASSUMPTIONS:

28. Mary hasn't yet had her party...................
29. Mary now doesn't like John.....................
30. The party will be at Mary's house...............

STATEMENT: "Live in the city of Zenith — lowest taxes."

PROPOSED ASSUMPTIONS:

31. Efficient management of a city implies lower taxes.
32. An important consideration in deciding where to live is avoidance of high taxes...................
33. The people of Zenith are content with their present city government................................

STATEMENT: "Our school is fortunate in having all American pupils, so we have no race problems."

PROPOSED ASSUMPTIONS:

34. American pupils do not present any race problems.
35. If we practiced democracy, there would be no race problem.......................................
36. A school is unfortunate if its pupils are of varied nationalities..................................

Go on to the next page.

TEST 3. *Deduction*

DIRECTIONS. Each exercise below consists of two statements (premises) followed by several proposed conclusions. For the purposes of this test, consider the two statements in each exercise as true without exception. Read the first conclusion beneath the statements, and if you think it *necessarily follows from the statements given*, answer by making a heavy black mark between the pair of dotted lines under "CONCLUSION FOLLOWS" in the corresponding blank on the Answer Sheet. If you think it is *not* a *necessary* conclusion from the given statements, then put a heavy black mark under "CONCLUSION DOES NOT FOLLOW," even though you may believe it to be true from your general knowledge.

Likewise read and judge each of the other conclusions. Try not to let your prejudices influence your judgment — just stick to the given statements and judge each conclusion as to whether it necessarily follows from them. Mark all your answers on the Answer Sheet.

Here is an example; the block at the right shows how your answers should be marked on the Answer Sheet.

EXAMPLE. Some holidays are rainy. All rainy days are boring. Therefore —

1. No clear days are boring. (The conclusion does not follow, as you cannot tell from these statements whether or not clear days are boring and some may be.) . . . .
2. Some holidays are boring. (The conclusion necessarily follows from the statements, since, according to them, the rainy holidays must be boring.) . . . .
3. Some holidays are not boring. (The conclusion does not follow from the statements even though you may know that some holidays are very pleasant.) . . . .

TEST 3

	CONCLUSION FOLLOWS	CONCLUSION DOES NOT FOLLOW
1	⁞	▮
2	▮	⁞
3	⁞	▮

All musicians are temperamental. Some musicians are not proud. Therefore —

37. All temperamental people are musicians . . . .
38. No proud people are temperamental . . . .
39. Some proud people are musicians . . . .

No jockey is a heavyweight boxer. All heavyweight boxers are large men. Therefore —

40. No jockey is a small man . . . .
41. No heavyweight boxer is a small man . . . .
42. Jockeys are small men . . . .

Some cannibals are sincere idealists. All cannibals are fanatics. Therefore —

43. Some sincere idealists are fanatics . . . .
44. Some fanatics are sincere idealists . . . .
45. No fanatics are sincere idealists . . . .
46. All fanatics are cannibals . . . .

All mice that are injected with substance "A" develop disease "X." Mouse #24 was not injected with substance "A." Therefore —

47. Mouse #24 did develop disease "X." . . . .
48. Not all mice with numbers between 20 and 30 were injected with substance "A." . . . .
49. Mouse #24 did not develop disease "X." . . . .

No Republican is a Democrat. All Democrats favor prosperity. Therefore —

50. Republicans favor prosperity . . . .
51. No Republican opposes prosperity . . . .
52. No Democrat opposes prosperity . . . .
53. No Republican favors prosperity . . . .

All Jews feel friendly toward the State of Israel. David feels friendly toward the State of Israel. Therefore —

54. David is not friendly toward the Arabs . . . .
55. David is Jewish . . . .
56. Some non-Jews also feel friendly toward the State of Israel . . . .

If an adult has the ability to give love to others, he must have received love as a child. Some adults did not receive love when they were children. Therefore —

57. Some adults do not have the ability to give love to others . . . .
58. If an adult received love as a child, he has the ability to give love to others . . . .

If a person is superstitious, he believes fortunetellers. Some people do not believe fortunetellers. Therefore —

59. No superstitious person doubts fortunetellers . . . . .
60. If a person is not superstitious, he will not believe fortunetellers . . . .
61. If a person believes fortunetellers, he is superstitious . . . .

Go on to the next page.

TEST 4. *Interpretation*

DIRECTIONS. Each exercise below consists of a short paragraph followed by several proposed conclusions.

For the purpose of this test assume that everything in the short paragraph is true. The problem is to judge whether or not each of the proposed conclusions logically follows beyond a reasonable doubt from the information given in the paragraph.

If you think that the proposed conclusion follows *beyond a reasonable doubt* (even though it may not follow absolutely and necessarily), then make a heavy black mark between the appropriate dotted lines under the "CONCLUSION FOLLOWS" column on the Answer Sheet. If you think that the conclusion does *not* follow beyond a reasonable doubt from the facts given, then make a mark under "CONCLUSION DOES NOT FOLLOW."

In some cases more than one of the proposed conclusions may follow; in other cases none of the conclusions may follow.

A report of the U. S. Census states that during 1940 there were approximately 1,656,000 marriages and 264,000 divorces granted in the United States.

62. Getting a divorce is a quick and easy matter in the United States.................................

63. If the above ratio still holds true, then about six times as many people get married each year as get divorced....................................

64. The divorce rate in the United States is much too high.......................................

Victims of radiation sickness (for example, after an atomic explosion) are likely to die of anemia because the blood-building properties of the bone marrow are damaged. In everyday medical practice, X-ray dosages have to be worked out with utmost care to keep the patient from falling prey to radiation sickness. Experimenting on rabbits, Dr. Leon Jacobson found that when the spleen and appendix were protected with lead, the animals survived what would otherwise have been a fatal overdose of X rays. The undamaged spleen and appendix make enough blood to enable the damaged tissue to recover.

65. If from the blood-forming organs a substance could be isolated which would speed an individual's recovery from radiation sickness, that substance probably would also enable X-ray patients to take heavier doses.......................................

66. Dr. Jacobson's experiments on rabbits should be tried on a sufficiently large scale with people to see whether the same results would hold true..........

Usually I fall asleep promptly, but about twice a month I drink coffee in the evening; and whenever I do, I lie awake and toss for hours after I go to bed.

67. My problem is mostly mental; I am over-aware of the coffee when I drink it at night, anticipating that it will keep me awake, and therefore it does........

68. I don't fall asleep promptly after drinking coffee at night because the caffeine in coffee stimulates my nervous system for several hours after drinking it...

At the end of the semester the pupils in Mr. Black's class averaged 10 points higher than the pupils in Miss Walter's class on the same geometry test. Mr. Black and Miss Walter used a somewhat different method of teaching geometry.

69. Mr. Black probably is a better teacher than Miss Walter......................................

70. The pupils in Mr. Black's class were brighter as a group than the pupils in Miss Walter's class, and therefore they learned more easily................

71. The method used by Mr. Black in teaching geometry was superior to the method used by Miss Walter...

When Great Britain began to offer free public medical service, the government was surprised because far more people than they had expected came for eyeglasses and dental work.

72. People who previously had neglected their eyes and teeth now chose to have such treatment..........

73. People who didn't really need these services sought them because they were free.....................

74. People in Great Britain previously had been careless about the state of their eyes and teeth............

75. The British public was pleased with the government health program................................

Go on to the next page.

TEST 4. *Interpretation* (*Continued*)

The *Los Angeles Times* made a survey of the number of men and women drivers involved in automobile accidents in the Los Angeles area during a given period of time. They found that men drivers were involved in 1210 accidents while women drivers were involved in only 920 accidents.

76. If the survey figures constitute a representative sample, men drivers are involved in accidents more frequently than women drivers in the Los Angeles area. . . . .
77. More men than women drive cars in the Los Angeles area. . . . .
78. Women are safer drivers than men in the Los Angeles area. . . . .

Intelligence tests show that Negro children in Northern cities surpass Negro children in Southern cities but do not score as high as white children in Northern cities.

79. White children as a group score higher because they are born with higher native intelligence than Negro children. . . . .
80. The Negro families who moved to the North are on the average more intelligent than those who remained in the South . . . .
81. Northern Negroes receive better schooling than Southern Negroes, which in turn influences performance on the tests. . . . .

The history of the last two thousand years shows that wars have become steadily more frequent and more destructive, the twentieth century being the bloodiest on record.

82. Mankind has not advanced as much in the art of keeping peace as it has in the science of waging war.
83. Wars are caused by basic traits of selfishness, greed, and pugnacity, which are rooted in human nature. .
84. Increased industrialization, competitiveness, and improved weapons bring on increasingly frequent wars. . . . .
85. There will be increasingly frequent future wars, and they will become steadily more destructive than past wars. . . . .

Go on to the next test.

TEST 5. *Evaluation of Arguments*

DIRECTIONS. In making decisions about important questions it is desirable to be able to distinguish between arguments that are *strong* and those which are *weak* in so far as the question at issue is concerned.

Strong arguments must be both important and directly related to the question.

Weak arguments may not be directly related to the question, even though they may be of great general importance; or they may be of minor importance; or they may be related to trivial aspects of the question.

Below is a series of questions. Each question is followed by three or four arguments. *For the purpose of this test you are to regard each argument as true.* The problem then is to decide whether it is a STRONG argument or a WEAK argument.

You are to answer by making a heavy mark on the Answer Sheet under "STRONG" if you think the argument is strong, or by making a heavy mark under "WEAK" on the Answer Sheet if you think the argument is weak. When evaluating an argument, judge it on its own merit; try not to let counter-arguments or your own attitude toward the question influence your judgment. Judge each argument separately. In some questions all the arguments may be STRONG, in others all may be WEAK.

Here is an example. The block at the right shows how these arguments should be marked on the Answer Sheet. Study them carefully until you know just what is expected of you. Note that the argument is evaluated as to how well it supports the side of the question indicated.

EXAMPLE. Should all young men go to college?

1. Yes; college provides an opportunity for them to learn school songs and cheers. (This would be a silly reason for spending years of one's life in college.)
2. No; a large per cent of young men do not have enough ability or interest to derive any benefit from college training. (If this is true, as the directions require us to assume, it is a weighty argument against all young men going to college.)
3. No; excessive studying permanently warps an individual's personality. (This argument, although of great general importance when accepted as true, is not directly related to the question, because attendance at college does not necessarily require excessive studying.). . . . .

TEST 5

ARGUMENT

	STRONG	WEAK
1		■
2	■	
3		■

Go on to the next page.

Remember that for the purpose of this test each argument is to be regarded as true.

Can rich and poor people who happen to oppose each other at law obtain approximately equal justice from the courts?

86. No; a rich person can hire better lawyers and technical experts, pay for the time of more witnesses, and continue the fight in higher courts. . . . .
87. No; rich people win the majority of their lawsuits against poor people. . . . .

Should married women be eligible for employment as public school teachers if they are otherwise qualified?

88. No; there are more single women in our country than there are school-teaching jobs. . . . .
89. Yes; women tend to become better teachers after marriage. . . . .
90. No; a mother's first responsibility is to her own children. . . . .

Should infants be fed by regular schedule rather than whenever they seem to be hungry?

91. No; babies know best when they are hungry and ready to eat. . . . .
92. Yes; children must sooner or later learn that they can't always have their own way. . . . .
93. Yes; a regular schedule is easier for the parents. . . .

Should the government take over all the main industries in the country, employ all who want to work, and offer the products at cost prices?

94. No; so much concentration of economic and bureaucratic power in government would undermine our personal and political freedom.
95. No; elimination of competition and the profit motive would result in much less initiative for production of useful new goods and services. . . . .
96. Yes; the government already operates post offices, highways, parks, military forces, public health services, and other public services. . . . .

Should groups in this country who are opposed to some of our government's policies be allowed unrestricted freedom of press and speech?

97. Yes; a democratic state thrives on free and unrestricted discussion, including criticism. . . . .
98. No; if given full freedom, opposition groups would disunite the American people, weaken our position, and ultimately lead to loss of our democracy. . . . . . .
99. No; the countries opposed to our form of government do not permit the free expression of our point of view in their territory. . . . .

Go back and check your work.

WATSON GLASER

Critical Thinking Appraisal

FORM **ZM**

BY GOODWIN WATSON
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DIRECTIONS: This booklet contains five types of tests designed to find out how well you are able to reason analytically and logically.

Do not turn this page until instructed to do so.
Do not make any marks on this test booklet.
All answers are to be marked on the separate Answer Sheet provided.
If you wish to change an answer, be sure to erase your old answer completely.

TEST 1: Inference

DIRECTIONS

An inference is a conclusion which a person draws from certain observed or supposed facts. Thus, from the electric light visible behind the window shades and from the sound of piano music in a house, a person might infer that someone is at home. But this inference may or may not be correct. Possibly the people in the house went out leaving the lights on, and the piano music could be coming from a radio or phonograph they left playing.

In this test, each exercise begins with a statement of facts which you are to regard as true. After each statement of facts you will find several possible inferences — that is, conclusions which some persons might make from the stated facts. Examine each inference separately, and make a decision as to its *degree* of truth or falsity.

For each inference you will find spaces on the Answer Sheet labeled T, PT, ID, PF, and F. For each inference make a mark on the Answer Sheet under the appropriate label as follows:

T *if you think the inference is definitely TRUE; that it properly follows beyond a reasonable doubt from the statement of facts given.*

PT *if, in the light of the facts given, you think the inference is PROBABLY TRUE; that there is better than an even chance that it is true.*

ID *if you decide that there are INSUFFICIENT DATA, that you cannot tell from the facts given whether the inference is likely to be true or false; if the facts provide no basis for judging one way or the other.*

PF *if, in the light of the facts given, you think the inference is PROBABLY FALSE; that there is better than an even chance that it is false.*

F *if you think the inference is definitely FALSE; that it is wrong, either because it misinterprets the facts given, or because it contradicts the facts or necessary inferences from those facts.*

Sometimes, in deciding whether an inference is probably true or probably false, you will have to use certain commonly accepted knowledge or information which practically every person has. This will be illustrated in the example which follows.

Look at the example in the next column; the correct answers are indicated in the block at the right.

EXAMPLE

Two hundred eighth-grade students voluntarily attended a recent week-end student forum conference in a Midwestern city. At this conference, the topics of race relations and means of achieving lasting world peace were discussed, since these were the problems the students selected as being most vital in today's world.

1. As a group, the students who attended this conference showed a keener interest in humanitarian or broad social problems than have most eighth-grade students............
2. The majority of these students were between the ages of 17 and 18......
3. The students came from all sections of the country..................
4. The students discussed only labor relations problems................
5. Some eighth-grade students felt that discussion of race relations and means of achieving world peace might be worthwhile..............

TEST 1
Inference

	T	PT	ID	PF	F
1		▮			
2				▮	
3			▮		
4					▮
5	▮				

In the above example, inference 1 is probably true (PT) because (as is common knowledge) most eighth-grade students are not likely to show so much serious concern with broad social problems. It cannot be considered definitely true from the facts given because these facts provide no certain knowledge about the kind and degree of concern with world problems which other eighth-grade students might express. It is also possible that some of these students volunteered mainly because they wanted a week-end outing.

Inference 2 is probably false (PF) because (common knowledge) there are relatively few eighth-grade students in the United States between 17 and 18 years of age.

There is no evidence for inference 3. Thus there are insufficient data (ID) for making a judgment on the matter.

Inference 4 is definitely false (F) because it is given in the statement of facts that the topics of race relations and means of achieving world peace were the problems chosen for discussion.

Inference 5 necessarily follows from the given facts; it therefore is true (T).

In the exercises which follow, more than one of the inferences from a given statement of facts may be true (T), or false (F), or probably true (PT), or probably false (PF), or have insufficient data (ID) to warrant any conclusion. That is, you are to consider each inference by itself.

Make a heavy black mark in the space under the label that you think best describes each inference. If you change an answer, erase thoroughly. Make no extra marks on the Answer Sheet.

Go on to the next page ▶

Go ahead with the exercises below.

The town of Westfield, beginning twenty years ago, has been taking title to farms lost by their owners as a result of nonpayment of taxes. By this time the town has set out some 3600 acres of community forest on this land. The pine trees have grown well. The town forest yielded $25,000 net profit on lumber last year and $23,500 the year before. Local authorities believe that the net profit on the lumber will continue to grow and eventually reach $100,000 a year from just the present 3600 acres.

1. The town spends more to cut and sell the lumber than it gains from the sales . . . .
2. If the individual owners had planted trees just prior to loosing their farms, they would have made enough profit immediately from those trees to pay back taxes and retain their farms . . . .
3. The Westfield community forest contains several varieties of salable trees . . . .
4. The town of Westfield is continuing to buy up tax-delinquent farms to be set aside as community forest . .
5. The Westfield community forest will yield an annual net profit of $100,000 within two or three years . . . . . .

When a Negro family bought a home in a suburban residential district where only white families of various nationalities had lived before, a mob stoned the house and broke many windows. The mayor, at the unanimous request of his Committee on Race Relations, sent extra police to keep order in this district.

6. The immediate white neighbors of the Negro family liked them and did not join the mob . . . .
7. The regular police patrol assigned to that district failed to prevent the mob from damaging the home purchased by the Negro family . . . .
8. The Committee on Race Relations wanted to reduce open conflicts between the white and Negro people in the district . . . .
9. The Negro family sold the house after a few months and moved elsewhere . . . .
10. Within one month following this event, all the white families in that district sold their homes and moved away.

In 1946 the United States Armed Forces conducted an experiment called "Operation Snowdrop" to find out what kinds of military men seemed to function best under severe Arctic climatic conditions. Some of the men selected came from Northern European stock while others came from Latin or Mediterranean stock; some were stout and some were thin; some were draftees and some volunteers; some had normal blood pressure while some had slightly high or low blood pressure. All of the participants in "Operation Snowdrop" were given a training course in how to survive and function in extreme cold. At the conclusion of the experiment it was found that the only two factors among those studied which distinguished between men whose observable performance was rated as "effective" and those rated as "ineffective" on the Arctic maneuvers were: (1) desire to go (volunteer versus draftee), and (2) degree of knowledge and skill regarding how to live and protect oneself under Arctic conditions.

11. Despite the training course given to all of the participants in "Operation Snowdrop," some exhibited greater Arctic survival knowledge or skill than others . . . .
12. The Armed Forces expected that some future military operations might be carried on in the Arctic . . . .
13. A majority of the men who participated in "Operation Snowdrop" thoroughly disliked that experience . . . .
14. As a group, the men of Nordic backgrounds were found to function more effectively under severe Arctic conditions than did those of Latin backgrounds . . . .
15. Participants who were normal in weight and blood pressure were found much better than other participants at acquiring skills to protect themselves under Arctic conditions . . . .

Mr. Brown, who lives near the town of Salem, was brought before the Salem municipal court for the fifth time in the past month on a charge of keeping his dance hall open after midnight. He again pleaded guilty and was fined the maximum, $100, as in each earlier instance.

16. It was to Mr. Brown's advantage to keep his dance hall open regularly after 12 o'clock, even at the risk of paying frequent fines . . . .
17. Mr. Brown's dance hall was held by the judge to be within the legal jurisdiction of the town of Salem . . . . . .
18. Mr. Brown repeatedly flouted the midnight closing law in hopes of getting it repealed . . . .
19. The maximum fine of $100 was fully effective in keeping all dance halls in the vicinity of Salem closed after midnight . . . .
20. The midnight closing law was enacted only because one of the regular patrons of the dance hall complained to the police about the noise . . . .

Go on to the next page ▶

TEST 2: Recognition of Assumptions

DIRECTIONS

An assumption is something presupposed or taken for granted. When someone states, "I'll graduate in June," he takes for granted or assumes that he will be alive in June, that the school will judge him to be eligible for graduation in June, and similar things.

Below are a number of statements. Each statement is followed by several proposed assumptions. You are to decide for each assumption whether a person, in making the given statement, is really making that assumption — i.e., taking it for granted, justifiably or not.

If you think the given assumption is taken for granted in *the statement, make a heavy mark between the dotted lines* under "ASSUMPTION MADE" in the proper place on the Answer Sheet. If you think the assumption is *not* necessarily taken for granted in the statement, make a heavy line under "ASSUMPTION NOT MADE" on the Answer Sheet.

Below is an example. The block at the right shows how these items should be marked on the Answer Sheet. If you do not see why the answers marked are right, ask the examiner to explain.

In some cases more than one of the given assumptions is necessarily made; in other cases none of the given assumptions is made.

EXAMPLE

Statement: "We need to save time in getting there so we'd better go by plane."

Proposed assumptions:

1. Going by plane will take less time than going by some other means of transportation. (It is assumed in the statement that the greater speed of a plane ove. the speeds of other means of transportation will enable the group to reach its destination in less time.)
2. There is plane service available to us for at least part of the distance to the destination. (This is necessarily assumed in the statement, since, in order to save time by plane, it must be possible to go by plane.)
3. Travel by plane is more convenient than travel by train. (This assumption is not made in the statement -- the statement has to do with saving time, and says nothing about convenience or about any other specific mode of travel.)

TEST 2
Assumption

	Made	Not made
1	▮	
2	▮	
3		▮

Go ahead with the exercises in the next column

Statement: "Consult your physician to find out whether a tranquilizer will help your particular case."

Proposed assumptions:

21. Tranquilizers may be of help to some people........
22. People should not take a tranquilizer without first consulting their physician........................
23. If your physician does not think a tranquilizer will help your case, he will prescribe some other treatment.....

Statement: "If you don't believe me, I'll prove it to you logically."

Proposed assumptions:

24. Logical proof will cause you to alter your belief about the matter under discussion....................
25. What I present as a logical proof will influence your thinking..................................
26. There is convincing evidence that can be presented in support of my point. ....

Statement: "The proper aim of education in a free society is to prepare the individual to make wise decisions."

Proposed assumptions:

27. People who have been educated in a free society will not make unwise decisions........................
28. Some educational systems in our society do not have the proper aim.............................
29. Some kinds of education can help individuals make wise decisions...............................
30. In a society that is not free, the individual cannot make any decisions...............................

Statement: "I want to be sure I don't ever get typhoid fever. I'm traveling to South America, so I shall go to my physician and get typhoid injections before I sail."

Proposed assumptions:

31. If I don't take the injections, I shall become ill with the fever...
32. Taking typhoid injections will prevent me from getting typhoid fever...................................
33. Typhoid fever is more common in South America than it is where I live..................................

Statement: "If war is inevitable, we'd better launch a preventive war now while we have the advantage."

Proposed assumptions:

34. War is inevitable................................
35. If we fight now, we are more likely to win than we would be if forced to fight later.................
36. If we don't launch a preventive war now, we'll lose any war that may be started by an enemy later...........

Go on to the next page ▶

TEST 8: Deduction

DIRECTIONS

In this test, each exercise consists of two statements (premises) followed by several suggested conclusions. For the purposes of this test, consider the two statements in each exercise as true without exception. Read the first conclusion beneath the statements. If you think it necessarily follows from the statements given, make a heavy black mark between the pair of dotted lines under "CONCLUSION FOLLOWS" in the corresponding blank on the Answer Sheet. If you think it is *not* a necessary conclusion from the given statements, put a heavy black mark under "CONCLUSION DOES NOT FOLLOW," even though you may believe it to be true from your general knowledge.

Likewise, read and judge each of the other conclusions. Try not to let your prejudices influence your judgment — just stick to the given statements (premises) and judge each conclusion as to whether it *necessarily* follows from them.

The word "some" in any of these statements means an indefinite part or quantity of a class of things. "Some" means *at least* a portion, and *perhaps* all of the class. Thus, "Some holidays are rainy" means *at least* one, possibly more than one, and *perhaps* even all holidays are rainy.

Study the example carefully before starting the test.

EXAMPLE

Some holidays are rainy. All rainy days are boring. Therefore

1. No clear days are boring. (The conclusion does not follow. You cannot tell from the statements whether or not clear days are boring. Some may be.)........................
2. Some holidays are boring. (The conclusion necessarily follows from the statements, since, according to them, the rainy holidays must be boring.)..
3. Some holidays are not boring. (The conclusion does not follow even though you may know that some holidays are very pleasant.).........

TEST 3
Conclusion

	Follows	Does not follow
1		▮
2	▮	
3		▮

Go ahead with the exercises below.

All radicals are foreign-born. No patriotic citizen is a radical. Therefore —

37. No foreign-born person is a patriotic citizen..........

38. No radical is either native-born or a patriotic citizen.

39. No patriotic citizen is foreign-born..................

40. Some foreign-born people are patriotic citizens........

Some Russians would like to control the world. All Russians seek a better life for themselves. Therefore —

41. Some people who would like to control the world seek a better life for themselves..........................

42. Some people who seek a better life for themselves would like to control the world..........................

43. All Russians are basically dissatisfied with their present standard of living................................

Rice and celery must have a good deal of moisture in order to grow well, but rye and cotton grow best where it is relatively dry. Rice and cotton grow only where it is hot, and celery and rye only where it is cool. In Timbuktu, it is very hot and damp. Therefore —

44. The temperature or moisture conditions in Timbuktu are not favorable for growing a celery crop.........

45. The temperature and moisture conditions in Timbuktu are favorable for growing a rice crop..............

46. The temperature or moisture conditions in Timbuktu are not favorable for growing a cotton or a rye crop...

All members of symphony orchestras enjoy playing classical music. All members of symphony orchestras spend long hours practicing and rehearsing. Therefore —

47. All persons who spend long hours practicing and rehearsing classical music are members of a symphony orchestra.......................................

48. Musicians who play classical music do not mind spending long hours practicing.............................

49. Some musicians who spend long hours practicing and rehearsing enjoy playing classical music................

In one town there are 52 classes in the five elementary schools. Each class contains from 10 to 40 pupils. Therefore —

50. There are at least two classes with exactly the same number of pupils.................................

51. No school contains fewer than 10 classes.............

52. Most classes contain more than 15 pupils.............

53. There are more than 500 pupils in these elementary schools...

No progressive people are self-satisfied. Some Americans are progressive. Therefore —

54. Some Americans are not self-satisfied................

55. Some Americans are self-satisfied...................

No responsible leader can avoid making difficult decisions. Some responsible leaders dislike making difficult decisions. Therefore —

56. Some difficult decisions are distasteful to some people..

57. Irresponsible leaders avoid things they dislike.........

58. Some responsible leaders do things they dislike doing..

If a person thinks straight, he will define the problem to be solved. Some people do not define the problem to be solved. Therefore —

59. Persons who do not think straight will not define the problem to be solved.............................

60. Persons who define the problem to be solved are straight thinkers.......................................

61. Some people do not think straight...................

Go on to the next page ▶

TEST 4: Interpretation

DIRECTIONS

Each exercise below consists of a short paragraph followed by several suggested conclusions.

For the purpose of this test assume that everything in the short paragraph is true. The problem is to judge whether or not each of the proposed conclusions logically follows beyond a reasonable doubt from the information given in the paragraph.

If you think that the proposed conclusion follows beyond a reasonable doubt (even though it may not follow absolutely and necessarily), then make a heavy black mark between the appropriate dotted lines under the "CONCLUSION FOLLOWS" column on the Answer Sheet. If you think that the conclusion does *not* follow beyond a reasonable doubt from the facts given, then make a mark under "CONCLUSION DOES NOT FOLLOW."

In some cases more than one of the suggested conclusions may follow; in other cases none of the conclusions may follow.

Here is an example; the block at the right shows how your answers should be marked on the Answer Sheet.

EXAMPLE

A study of vocabulary growth in children from eight months to six years shows that the size of spoken vocabulary increases from zero words at age eight months to 2562 words at age six years. Therefore --

1. None of the children in this study had learned to talk by the age of six months. (The conclusion follows beyond a reasonable doubt, since, according to the statement, the size of the spoken vocabulary at eight months was zero words.)..........

2. Vocabulary growth is slowest during the period when children are learning to walk. (The conclusion does not follow, as there is no information given which relates growth of vocabulary to walking.)................

TEST 4 Conclusion	Follows	Does not follow
1	▮	¦¦
2		▮

Go ahead with the exercises below.

At the end of the semester the pupils in Mr. Black's class averaged 10 points higher than the pupils in Miss Walter's class on the same geometry test. Mr. Black and Miss Walter used a somewhat different method of teaching geometry.

62. Mr. Black maintained better discipline in his class than Miss Walter did in hers............................

63. The pupils in Mr. Black's class were brighter as a group than the pupils in Miss Walter's class, and therefore they learned more easily...............................

64. The 10-point higher average score achieved by Mr. Black's geometry class over Miss Walter's was due to the superiority of the teaching method used by Mr. Black...

In a certain city where school attendance laws are rigidly enforced, it was found that only 15 per cent of the male school population had a perfect attendance record during any single school semester. Among those who sold newspapers, however, 25 per cent had a perfect attendance record during the same period.

65. Strict enforcement of school attendance laws in this city did not prevent 85 per cent of boys of school age from being absent sometime during each semester..........

66. If truants were given jobs selling newspapers, their school attendance would improve.........................

67. ~~Less than~~ 15 per cent of those boys who did not sell newspapers had a perfect attendance record during any single semester...................................

When the United States Steel Corporation was created in 1902, it was the largest corporation America had known up to that time. It produced twice as much steel as all of its domestic competitors together. In 1957 the United States Steel Corporation produced less than 30 per cent of the steel that was made in America.

68. In 1902 the United States Steel Corporation produced no less than 66 per cent of the total domestic output of steel.

69. In 1957 domestic competitors turned out more than twice as much steel as the United States Steel Corporation produced...................................

70. The United States Steel Corporation produced less steel in 1957 than it did in 1902.........................

Jane's posture used to be poor, she dressed in bad taste, had very few friends, was ill at ease in company, and in general was quite unhappy and maladjusted. Then a close friend recommended that she visit Dr. Baldwin, a reputed expert on helping people to improve their personalities. Jane took this recommendation, and after three months of treatment by Dr. Baldwin she carried herself well, dressed attractively, was more at ease and more popular, and in general felt much happier.

71. Had it not been for Dr. Baldwin's treatment, Jane would not have improved............................

72. Jane's improvement was caused solely by the treatment given her by Dr. Baldwin..........................

Go on to the next page ▶

Several studies have shown that Southern Negroes make lower scores on intelligence tests than Northern Negroes, but that the average measured intelligence of Southern Negro children who move North at a sufficiently early age increases each year until their average measured intelligence approaches that of the Northern Negroes.

73. Southern Negro children who move North before they can talk eventually tend to approach the level of the Northern Negro children in intelligence as measured by the tests used. . . . .

74. The increase is due to the relative superiority of the schools Negroes attend in the North. . . . .

75. Some children progressively improve their standing on certain tests which are supposed to measure intelligence.

A salesman for Brown's Liniment claimed that his product would promptly soothe sore muscles in the body because it would penetrate very quickly to the affected parts. He poured ten drops of the liniment on a thick piece of sole leather, and the liniment quickly went through this substance.

76. The salesman deliberately misrepresented his product. .

77. The salesman implied that a liquid which would penetrate sole leather would also penetrate to muscles under the skin. . . . .

78. The salesman's demonstration was good evidence for his claim that the liniment would promptly soothe sore muscles in the body. . . . .

79. There is no relationship between the liniment's ability to penetrate this particular piece of sole leather and its ability to penetrate into the human body. . . . .

In 1940, 60.4 per cent of adults (persons 25 years of age and older) had completed eight grades or less of schooling, while 4.6 per cent had completed four or more years of college. In 1960, 40.0 per cent of adults had completed eight grades or less, while 7.1 per cent had completed four or more years of college.

80. In 1940, most adults had not graduated from high school.

81. If the trend toward more education continues at the rate indicated by the above figures, then by 1970 more than 25 per cent of adults will have completed four or more years of college. . . . .

82. In 1960, for every adult who had completed four or more years of college, there were more than five adults who had completed not more than eight grades of schooling.

A sleeping wife was awakened by a dream that she had suffered a sharp blow across her mouth. Later that night her husband returned from a fishing trip which he had taken alone in a rowboat some miles away. His front teeth had been knocked out by a sharp blow from the oar of his boat. The husband's accident and the wife's dream came at exactly the same time.

83. The sleeping wife could not have learned about her husband's accident at the instant it occurred by any ordinary form of communication. . . . .

84. The facts reported in this case can be accounted for only by the operation of mental telepathy. . . . .

85. The dream was a chance coincidence which was not really influenced by the accident. . . . .

Go on to the next page ▶

TEST 5: Evaluation of Arguments

DIRECTIONS

In making decisions about important questions, it is desirable to be able to distinguish between arguments that are strong and arguments that are weak, as far as the question at issue is concerned. An argument to be strong must be both important and directly related to the question.

An argument is weak if it is not directly related to the question, even though it may be of great general importance; or if it is of minor importance; or if it is related only to trivial aspects of the question.

Below is a series of questions. Each question is followed by several arguments. *For the purpose of this test you are to regard each argument as true.* The problem then is to decide whether it is a STRONG or a WEAK argument.

Make a heavy mark on the Answer Sheet under "STRONG" if you think the argument is strong, or under "WEAK" if you think the argument is weak. Judge each argument separately on its own merit; try not to let your personal attitude toward the question influence your evaluation.

In the example, note that the argument is evaluated as to how well it supports the side of the question indicated.

EXAMPLE

Should all young men in the United States go to college?

1. Yes; college provides an opportunity for them to learn school songs and cheers. (This would be a silly reason for spending years in college.) . . . . . .
2. No; a large per cent of young men do not have enough ability or interest to derive any benefit from college training. (If this is true, as the directions require us to assume, it is a weighty argument against all young men going to college.) . . . .
3. No; excessive studying permanently warps an individual's personality. (This argument, although of great general importance when accepted as true, is not directly related to the question, because attendance at college does not necessarily require excessive studying.) . . . .

TEST 5

Argument

	Strong	Weak
1		
2		
3		

When the word "should" is used as the first word in any of the following questions, its meaning is "Would the proposed action promote the general welfare of the people in the United States?"

Go ahead with the exercises below.

Should the government provide "baby bonuses" to help support each dependent child in a family so that the family standard of living is not lowered by having children?

86. Yes; many families who cannot now afford it would then provide proper child care, and this would greatly improve the general health of the nation . . . .

87. No; such bonuses would seriously undermine parents' sense of personal responsibility for their own families . . .

88. No; government provision of "baby bonuses" would cost some additional public expenditure of money . . . .

Would the addition of a labor party basically promote the general welfare of the people of the United States?

89. No; a labor party would make it unattractive for private investors to risk their capital in business ventures, thus causing sustained large-scale unemployment . . . .

90. Yes; differences between Republicans and Democrats today are not so great as differences between liberals and conservatives within those parties . . . .

91. No; labor unions have at times called strikes in a number of important industries . . . .

Is it possible for man to develop a controllable death ray that will, under certain conditions, kill all living things on which it is focused?

92. Yes; powerful concentrations of radioactive energy already can kill animals under certain conditions . . . .

93. No; some physicists have already tried to develop a controllable death ray and have not been able to do so . .

94. No; if man ever does develop such a ray, he also will work on countermeasures to reduce or offset its effects.

Should the government continue to pay farmers the cost of soil-conservation practices on their own land?

95. Yes; abundant crops in the United States are vitally needed, and farmers are unlikely to undertake the practices which are necessary to assure abundant future crops unless they get paid for the extra work involved . . . . . .

96. No; soil conservation is an easy-to-apply and not-very-expensive farming practice which will greatly increase the owner's likelihood of making a better personal living from his land . . . .

97. No; farmers have historically been a powerful pressure group on Congress, but today most of the population lives in cities . . . .

Should pupils be excused from public schools to receive religious instruction during school hours in their own churches?

98. No; having public-school children go off to their separate churches during school hours would create greatly increased friction and sustained feelings of bitterness among different groups of children and their parents . .

99. Yes; religious instruction would help overcome moral weakness and lack of individual purpose, both of which appear to be current problems in our nation . . . .

100. Yes; religious instruction is exceedingly important to the preservation of our democratic values . . . .

Go back and check your work.