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CONSTRUCTION OF A UNIT OF PROGRAMMED INSTRUCTION  
" IN HEALTH EDUCATION

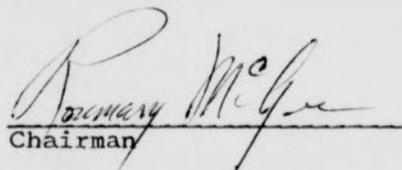
by

Sandra Ann Woolen  
" "

A Thesis Submitted to  
the Faculty of the Graduate School at  
The University of North Carolina at Greensboro  
in Partial Fulfillment  
of the Requirements for the Degree  
Master of Science in Physical Education

Greensboro  
June, 1965

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WOOLEN, SANDRA ANN. Construction of a Unit of Programmed Instruction in Health Education. (1965) Directed by Dr. Rosemary McGee. pp. 165

The purpose of this study was to construct and validate a programmed unit of instruction on the human circulatory system. This program was designed for use in basic health education courses on the college level. A secondary purpose of the study was to obtain an observation of the application of programmed instruction among college students engaged in the study of basic health education.

Sixty-seven freshmen and sophomore women from The University of North Carolina at Greensboro were used as subjects.

The material for the program content was classified into five parts and program objectives were formulated from the pre-determined material. The program frames were constructed in strict accordance with the program objectives.

An objective test was designed for use as a pre-program and post-program evaluation of knowledge relating to program content.

A pilot study was conducted to determine needed revisions on both the program and knowledge test.

After the subjects were pre-tested, a program was given to each of them to complete outside of class. Upon individual completion of the program, each subject was post-tested. An evaluation of the method of programmed learning and of the constructed program was written by each subject.

The standard advocated by the American Institute for Research was used as a criterion for program validation.

The knowledge test was subjected to the statistical procedure for curricular validity and to the Kuder-Richardson formula for reliability. Using the pre-test and post-test scores, the matched-pairs design was used to determine the mean improvement (of knowledge) within the group.

It was concluded from this study that the constructed program, The Circulatory System: A Practical Approach, is a valid unit of programmed instruction. The accompanying knowledge test demonstrates curricular validity and adequate reliability. All findings in this study indicate programmed instruction to be a very effective method of learning and teaching that can be profitably employed in the academic discipline of health education.

## ACKNOWLEDGEMENT

The author wishes to express her appreciation to Dr. Esther B. White for her cooperation during the testing phase of the program; to Mrs. Betty Harmon for help and guidance in the printing of the program; and to her parents for their enduring patience and support.

A very sincere acknowledgement is extended to Dr. Rosemary McGee for her untiring assistance and invaluable guidance during the course of this study, and to Miss Nancy Angle for her wonderful assistance and continuous encouragement which were instrumental in making this study possible.

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## CHAPTER I

### INTRODUCTION

The education profession is constant in its effort to seek, determine, and utilize the most effective methods for teaching and learning. Throughout the history of formal education a variety of theories and methods have evolved which are applicable to the educational process. Dedicated to the professional purpose of directing others to knowledge, educators must always be cognizant of the fact that life is fluid. This fluidity encompasses all phases of life, living, and learning. Therefore, in keeping abreast of all changes and discoveries which affect knowledge and learning, educators can never be content with a static process in a changing environment.

Shortly after the mid-point of the present century, a method of learning emerged from the laboratories of educational psychologists and appeared as unique on the horizon of formal education. The underlying principle of programmed learning originated two thousand years ago. A striking evidence of this is seen in Plato's Meno in which Socrates' "programmed instruction" for geometry is recorded. The tutorial method is a more recent antecedent of programming. The technique involving exchange of questions and answers between the tutor and the student as they explore new and sequential material shows an inherent similarity to programmed

instruction. From such evidences it becomes apparent that programmed learning is an emergent process, not an accomplishment of this century alone.

The basic concept of programmed instruction is to guide the student along a self-instructed path from fact to fact and insight to insight. Lysaught formally defined programmed instruction as:

. . . the process of arranging materials to be learned in a series of small steps designed to lead a student through self instruction from what he knows to the unknown of new and more complex knowledge and principles. (18:16)

The principles of programmed instruction further explain and define its substance. Fry (6) lists some principles of programmed instruction as:

- (1) the subject matter is broken up into small units called frames
- (2) each frame calls for a response of some type
- (3) there is immediate feedback reinforcement
- (4) frames have a form of sequence
- (5) each program has a specific goal
- (6) the student is able to vary his own rate of learning
- (7) program revisions are determined by student response.

When compared to the traditional method of teaching, programmed instruction is probably advantageous from two distinct viewpoints: (1) the student is allowed to progress at his

individual rate of learning, (2) the teacher is freed from dull-type exercises of teaching and can then function to enrich the learning of fast learners and do remedial work with the slow learners. Program instruction was not designed to replace the classroom teacher. It is complementary to the teacher in that it allows the teacher to spend time in concentrated and creative efforts to meet the needs of each individual student.

Programming has lent itself to numerous forms of construction. The linear (extrinsic) and branching (intrinsic) forms have emerged as the two dominant and most widely used types. The linear form, also called "extrinsic", was developed and advocated by B. F. Skinner, a Harvard psychologist. Lysaught and Williams (18) described the linear form according to the following characteristics:

- (1) single ordered sequential development of the material to be followed from the first through the last item
- (2) short items (frames)
- (3) sequences built through graduated development
- (4) constructed responses by student
- (5) immediate exposure of correct responses rectifying any error
- (6) a format which is either horizontal or vertical

Schramm (27) stated that approximately nineteen out of every twenty programs that are being developed are of this type.

The second form, known as branching, also called "intrinsic" and "scrambled", was developed by Norman Crowder. Some

characteristics of this form are listed by Lysaught and Williams (18):

- (1) testing and decision-making
- (2) multi-choice responses
- (3) responses which answer "why"
- (4) provisions for those who do not succeed on the initial test
- (5) a sequence determined by the student's answers
- (6) a text in the form of a scrambled book

The method of programmed instruction has proven to be an efficient and successful approach to learning in areas of education. Schramm stated, "Programmed instruction has been tried, and has accomplished learning, at every level from pre-school to graduate professional school. It has been used successfully with slow learners and on mature, superior students." (27:45) The elementary, junior high, and senior high schools form the nucleus of the areas which are using programmed instruction in their curriculums. It is the belief of this writer that this method of instruction should be employed more to facilitate and enrich learning on the college level.

The author has a special interest in the human circulatory system. This is an exciting and intricate area of study. Knowledge of the circulatory system is also pertinent to the lay public in that heart and circulatory diseases rank as the number one cause of death in the United States. (8) A college course in basic health education should be concerned with providing the

student a basic knowledge of this system and its implications for everyday living. The writer asserts that the approach to this subject should be one of a more practical nature than is practiced by the average teacher of health education. It is contended that less emphasis be placed on the anatomical and physiological complexities which are beyond a very basic understanding and that more emphasis be placed on those aspects of the circulatory system which directly interest and concern the student as a citizen and future responsible member of the family, home, and community.

At the present time, there is no apparent evidence of published programmed instruction materials designed for use in a college course of basic health education. Along with this finding and the belief that programmed learning is based on sound educational principles, the writer proposes that this current theory of learning is applicable to the area of health education, specifically to the structured and factual subject matter of the circulatory system.

## CHAPTER II

### STATEMENT OF PROBLEM

The purpose of this study was to construct and validate a programmed unit of instruction on the human circulatory system. This program was designed for use in basic health education courses on the college level. A secondary purpose of the study was to observe the application of programmed learning among college students engaged in the study of basic health education.

The author chose to program a unit on the human circulatory system for two distinct reasons:

- (1) The material is highly structured and factual and, therefore, lends itself suitably to programming.
- (2) The human circulatory system is a subject of wide interest to the general public because many lives are affected by abnormalities and/or diseases of this system.

After studying the various forms of programming and evaluating each in relation to the selected unit, the author chose to write the program in the linear, constructed-response form using a vertical format.

## DEFINITION OF TERMINOLOGY

For purposes of consistency and understanding in this study the following definitions and concepts were accepted and employed:

\*PROGRAMMED INSTRUCTION -- the method of designing materials to be learned in a series of small units which lead the student from known to unknown knowledge through self instruction. (18)

LINEAR PROGRAM -- a form of programming which develops the material in an ordered sequence of short items to which the student writes out his own response and immediately compares it to the given correct response for each item. (18)

INTRINSIC PROGRAM -- a form of self instruction designed through interaction with the student to present adaptive, tutorial material in a sequence based on the student's previous responses. (18)

VERTICAL FORMAT -- that design which gives the correct answer either to the side of or below each frame. (6)

FRAME -- a small step or item designed to include a stimulus, a response, and a reinforcement. (18)

STIMULUS -- that material contained within each frame which acts to elicit a response from the student. (18)

---

\*There is obvious ambiguity and inconsistency among authors in the spelling of the word "programmed". Some spell it "programmed"; others spell it "programed". This should be noted in the reading of Chapter III. This author chose to use the form, "programmed".

REINFORCEMENT -- the method of giving correct answers for each frame to serve as a reward for the student's response and to promote learning from the consequence of his response. (18)

CONSTRUCTED RESPONSE -- that part of each frame which requires the student to formulate and write out his own response. (18)

PANEL -- reference material which is organized in conjunction with the program but handled separately so that the student can make reference to it over a series of items. (18)

## CHAPTER III

### REVIEW OF LITERATURE

#### PART I - THE THEORETICAL CONCEPT OF LEARNING

Americans have probably demanded more of education than any other nation. This demand has been well served, but only through a shared faith grounded in the conviction that the future of the nation may well be predicted from the role assigned to the schools. It is obvious to the discerning that efforts must be continuous and flexible in safeguarding an education designed to perpetuate and develop the ideals of democracy and the institutions of a free society. American culture has undergone many radical and peripheral changes throughout its history. These changes have had considerable bearing upon the theory and practice of education today. A relative area that has felt the impact of change is the psychology of learning. This author wishes to lay a groundwork for programmed learning (instruction) by justifying it as having an integral place in the theoretical concept of learning.

#### Learning Defined

Hilgard and Marquis state, "Learning is a relatively permanent change in behavior potentiality which occurs as a result of reinforced practice." They further expand this definition by

saying that learning widely influences our lives at every turn,  
 ". . . accounting in part for the best and worst in each of us."  
 (15:6)

Melton's definition of learning is broad-termed to encompass  
 ". . . all forms of relatively permanent modifications of behavior  
 resulting from experience." (58:96) He states that learning must  
 organize the comprehension of the acquisition of the following:

. . . attitudes, motives, effective and emotional  
 responses, mental sets, simple and complex discrimi-  
 native acts, serial verbal and motor acts, motor  
 and perceptual skills, meanings, concepts and  
 abstractions, and various cognitive capabilities  
 that go under such names as ideational problem  
 solving, thinking, reasoning, decision-making, and  
 even creative invention. (58:96)

It should be noted that the word "behavior" is incorporated  
 into the above definitions of learning. By such assertions it  
 becomes obvious that learning shapes behavior, or, that changes  
 in behavior result from experiences in learning. Deterline (5)  
 states that learning is the factor through which we adapt our  
 responses in order to interact consistently and effectively with  
 our environment. Hilgard agrees that ". . . so much of man's  
 diverse behavior is the result of learning." (10:1) Thus it  
 seems feasible to accept the theory that man's learning experi-  
 ences are basic to his behavioral outcomes.

### Theories of Learning

Through the ages psychologists have scientifically attempted  
 to develop a learning method which would best provide man the oppor-  
 tunity to harmoniously modify and adapt himself to his culture and

environment. They have hypothesized, tested, and accepted various theories of learning. No one particular theory has crystallized as being predominantly best or all-powerful in meeting educational needs. Hilgard (10) states that there are two major families of learning theories: (1) cognitive theories and (2) stimulus response theories. The cognitive theories include those of Tolman, Lewin, and the Gestalt psychologists. The stimulus-response family includes the diverse theories of Thorndike, Guthrie, Skinner and Hull. The differences between the theories primarily arise from differences in their interpretation. This assumption is made on the following basis: "All the theorists accept all the facts." (10:9) In essence, each theorist believes his way to be most fruitful.

A basic issue within the stimulus-response family of theories has been the interpretation of the word "reinforcement." This has led to a division within the group--contiguity-theorists and reinforcement-theorists. The contiguity-theorist believes that the results of reinforcement are derived from his theory (stimulus and response are contiguous). The reinforcement-theorist argues that some reinforcement is always present when learning occurs; therefore he denies the mere contiguous conditioning.

The process of programmed learning (instruction) has emerged as a derivation of the reinforcement-theory. An understanding of this theory will aid in justifying programmed learning as being soundly based on educational learning principles.

The reinforcement theory of learning evolved from experimental psychologists' laboratory work. Experimental psychologists such as Pavlov, Thorndike, Hull, Guthrie, Skinner, and others have demonstrated how a laboratory animal or a human could be conditioned to make a desired response to a given stimulus. (27) According to Dewey, (33) learning occurs when the learner performs, makes a correct response, and is rewarded for his performances. The modern principle of reinforcement (derived from Thorndike's "Law of Effect" - 1913), claims behavior to be a trial and error process in which "connections" are strengthened between a stimulus (situation) and a response (behavior) only if success or satisfaction (reinforcement) follows the response. (5) Deterline refers to reinforcement as ". . . the occurrence of a consequence which strengthens the behavior that produced the consequence" (5:27), or in simple terms, the situational characteristics when reinforced, become more likely to produce the same response again.

Klaus (53) and Lumsdaine (16) conclude that there is sufficient evidence which states that the principles of learning, discovered by laboratory experimentation with lower animals, also hold true as being rules of learning applicable to human complex behavior. Klaus further asserts that this application enables us to use the knowledge of behavioral science as inputs to education.

Principles of Programmed Instruction

Five hundred years ago, Comenius sought to specify a type of education ". . . that would cause a student to learn more and the teacher to teach less." (27:18) The roots of programmed instruction are deeply embedded in the theory of education and in the psychological learning theory (reinforcement-theory).

Evaul wrote:

The effectiveness of programmed instruction is based on the theory of reinforcement . . . when certain behavior (in the case of programmed instruction, the correct response) is rewarded (by the knowledge that the response is correct), the probability of repeating the response is increased (learning). (43:27)

Lysaught lists generalizations of the reinforcement theory which are applicable to programmed instruction:

- (1) an individual learns or changes his actions (behavior) by observing the consequences of his actions
- (2) consequences that strengthen the possibility of repetition are called reinforcements
- (3) quick reinforcement after performance yields greater possibility that the performance (behavior) will be repeated
- (4) the more often reinforcement occurs the more likely the act will be repeated
- (5) absence or delay of reinforcement weakens the probability of repetition
- (6) intermittent reinforcement increases the length of time a student will persist at a task without further reinforcement
- (7) learning behavior can be developed or shaped gradually by differential reinforcement

- (8) motivational effects of reinforcement yield greater probability for repetition
- (9) behavior can be developed into a complex pattern by shaping the simple elements and combining them into chainlike sequences. (18:7)

Lysaught further generalized by saying, ". . . the reinforcement theory provides a rationale for believing that a complex body of learning can be separated into its smallest components" (18:8); and concludes that the practice of reinforcement forms the crux of any learning program.

In 1929 Thorndike and Gates wrote:

If, by a miracle of mechanical ingenuity, a book could be so arranged that only to him who had done what was directed on page one would page two become visible, and so on, much that now requires personal instruction could be managed by print. (11:v)

That miracle of mechanical ingenuity has become a reality in the form of programmed instruction.

Dr. George Stoddard, Chancellor of New York University, has referred to programmed instruction as being devoted to the ". . . spinal cord of learning and retention." (60:174) Eigen refers to this type instruction as a ". . . powerful new weapon in an arsenal for the war against ignorance." (42:242) In 1961 the American Educational Research Association, The American Psychological Association, and The Department of Audiovisual Instruction of the National Education Association made the following joint statement:

The use of self-instructional programmed learning materials in teaching machines and similar devices [textbooks] represents a potential contribution of great importance

to American education. But this contribution can be realized best only if users have information with which to evaluate self-instructional materials. (6:180)

(This statement is followed by a set of guidelines suggested for use in evaluating programmed instruction materials.)

Green (9) wrote of programmed instruction as the first application of scientific investigations of the learning process to the practical problems of education. Skinner (17:59) observed the curious fact that early studies of the learning process were not concerned with teaching. Klaus (53) concluded that teachers' obligations to students are two-fold: they must give guidance as to what to learn, and then how to learn. Komoski (54) recognizes programming as a technology of instruction which makes possible a rigorous and objective analysis of what happens in instruction.

McNiel, as cited by Lumsdaine and Glaser, (16) observed the striking similarity of the principles of programmed instruction to the accepted and well-known rules for teaching set forth by Comenius in the seventeenth century. The following is a list of Comenius' rules for effective teaching:

- a. all things should be taught in due succession and only one thing should be taught at a time
- b. nothing must be learned by rote; comprehension is the light of memory and we should see that whatever has been presented is also understood
- c. whatever is taught should be taught straightforwardly, and not in a complicated manner
- d. order, position, and connections of objects should be studied

- e. a subject should not be left until it is thoroughly understood
- f. stress should be laid on the differences which exist between things, in order that knowledge may be clear and distinct
- g. learning should proceed from the known to the unknown
- h. instruction should be fitted to the comprehension of the learner
- i. children must learn by doing
- j. in every subject that consists of several parts, these parts should be linked together as much as possible. (16:656)

Glaser (17) concluded that perhaps the most tremendous impact of the entire programmed instruction movement is the fact that its involved notions allow consideration for very careful control of the learner's behavior. He expounded on this conclusion:

The essential task of programmed instruction is to evoke specific forms of behavior from the student and through appropriate reinforcement bring them under the control of specific subject matter stimuli. As a student goes through a learning program, certain of his responses must be strengthened and shaped from initial unskilled behavior to subject matter competence. (17:8)

Experimental psychologists have determined the characteristics of an environment which seem best for learning. This environment is described as being one in which the learner is active; the learner gets frequent and immediate feedback on his performance; learning proceeds gradually and sequentially from the simple to the complex; the learner is allowed to develop his own best pace of learning; the teacher's strategies are constantly reappraised on the basis of an objective analysis of

the learner's activity. (55) Many of the principles of programmed instruction have arisen from the above findings. A significant similarity may be observed by examining the following principles of programmed instruction as suggested by Lysaught and Williams (18):

- (1) each learning experience is an individual affair and a constant interaction is maintained between the student and the material
- (2) motivation is strengthened by reinforcement
- (3) mastery of subject matter is positioned within the grasp of any student
- (4) each single item must be understood before progressing to the next one
- (5) the principle of readiness is encompassed by keeping the student alert and busy
- (6) a mechanism is offered for dealing with the range of individual differences in ability
- (7) concrete goals are established before the program is constructed
- (8) an opportunity is afforded for individual tutelage, for constant evaluation of a student's progress, and for unremitting review of the program's own effectiveness in achieving its educational goals

#### Program Paradigms

In an attempt to determine a method most effective in achieving the goals of programmed instruction, programmers have come forth with various techniques of preparing instructional materials. The radical differences between styles might well result from varying interpretations of the learning theories

with injections of the programmer's own theories of clarity, format, and subject matter presentations. (33) Although techniques may differ, all have a number of features in common: the learner must respond; relatively frequent confirmation must be supplied to the learner; the program must consist of small units of content. (33)

Two of the paradigms have emerged as dominant. The first method is the linear paradigm developed by Fred Skinner of Harvard University. The second type of construction method is the intrinsic paradigm, developed by Norman Crowder.

The principles of linear programming correlate with the learning advocacy of Dr. John Dewey and Dr. E. R. Guthrie, outstanding learning theorists. The feature of linear programming is a low error rate. This makes it possible to avoid aversive stimulation and subsequent frustration in the learning environment. (33) Goldstein and Gotkin stated:

The aim of linear programs is to evoke specific forms of behavior and, through differential reinforcement bring the behavior under the control of specific stimuli. The frames in a linear program utilize 'prompts', 'cues', or 'clues' in order to minimize the probability of the learner's making an error. By a gradual diminishing or 'fading' of clues the learner is led to the desired terminal behavior. (46:29)

Lysaught (18) lists some of the characteristics of the linear paradigm: items are short and sequences are built through gradual development; a written constructed-response to each frame is required of the student; immediate exposure of the correct answer to each frame rectifies any error; the material is developed in an ordered, sequential manner. The text format for linear programming may be either horizontal or vertical.

In comparison to the linear method, the intrinsic paradigm shows obvious basic differences. The intrinsic method assumes that a student learns from reading. This assumption ". . . tends to encourage guessing and permits the practice of errors."

(33:Day 5) Intrinsic programming attempts to parallel the tutorial approach to learning. The similarity lies in the intrinsic approach of presenting a passage of material, giving a multiple-choice question to determine the student's grasp of the material, and tailoring the next portion of the material presentation in terms of the student's response. Crowder stated, "In intrinsic programming the questions serve primarily a diagnostic purpose, and the basis of the technique is the fact that the diagnosis so made can be promptly utilized to furnish specific remedial material to the student." (36:252)

## PART II - RESEARCH IN PROGRAMMED INSTRUCTION

### Style Study

Several experimental studies have been done to determine any significant differences between the construction styles in programmed instruction. Feldhusen and Birt (44) concluded that there are no significant differences among the different styles. Eigen (41) compared three methods of presenting programmed instruction. He found no statistically significant inter-mode differences between the use of a vertical format textbook, a horizontal format textbook, and a teaching machine.

### Method Study

The comparison of the programmed method of teaching to the conventional teaching method has aroused the keen interest of many educators. Cronbach (35) has made a survey of such studies and concludes that all studies indicate that programmed instruction is as effective as conventional procedures in teaching facts and verbally mediated responses. He also suggests that programmed instruction takes the principle of readiness more seriously than does any other teaching procedure. Smith (61) used freshmen cadets at the United States Air Force Academy as subjects in comparing the conventional classroom teaching method with the programmed instruction method. He summarized:

. . . it is not possible to conclude that either the conventional classroom method of teaching or programmed instruction can produce better learning. However, the study does indicate strongly [0.1 per cent level of significance] that the time required to achieve this learning can be reduced through the application of programmed instruction. (61:419)

Evaul (43) stated that over one hundred experiments demonstrate the successful effectiveness of programmed instruction.

Schramm concluded:

Programmed instruction has been tried, and has accomplished learning, at every level from preschool (Alter, Eigen, and King, 1962; Glaser, Taber, et al., 1961) to graduate professional school (Ferster, 1960; Green, 1962). It has been used successfully with slow learners (Smith and Quackenbush, 1960; Stolurow, 1961) and on mature, superior students (Jensen, 1949). (27:45)

### Related Study

Many researchers are concerned with various aspects of programmed instruction beyond its effectiveness. Naumann (59)

asserted that student evaluation, at least at the college level, should be a definite part of the total instructional plan. His study was concerned with the effects of programmed instruction at the college level. His subjects were students from Harvard University, Oberlin College, and Central Washington State College. He reported that the students had generally favorable attitudes about their work with the programmed instruction method. Klaus and Deterline (5) concluded that students preferred teachers and programs when given a choice of teachers, textbooks, and programs. Smith reported:

The students being taught by programmed instruction did, on the whole, respond favorably to this method of programmed instruction, did consider it more efficient, and did feel that they had more opportunity to receive individual assistance from the teacher than under more conventional methods. (61:419)

Some researchers have been interested in the comparison of active response to passive response in learning. Gates (16) reported a pronounced advantage for active responses when he compared merely reading material to actively attempting to recall or recite it. Lumsdaine and Gladstone (16) compared active response to passive review. They reported a superiority for active response.

The cost of developing and using programs has caused considerable interest. The Sandia Corporation (27) reported some cost figures on teaching by programmed instruction: To teach Russian by the conventional method cost \$57.15 per completion; the programmed instruction cost \$20.19 per completion. Algebra taught conventionally cost \$20.50 per completion; to teach it by program was \$16.79.

### Implications For Application

The continuing expansion of knowledge necessitates the teaching and mastering of more subject matter during a span of time which seems socially impossible to lengthen. Education for excellence is being advocated increasingly, and our schools and colleges are being required to educate larger numbers of students without proportionate rises in cost. These and other pressures to increase educational effectiveness necessitate continuous searching for efficient methods to meet the needs of an increasing population that is becoming more and more educational-minded. In light of this situation, it seems pertinent to consider the remarks of Klaus:

. . . it should be pointed out that programmed instruction is still in a research and development phase. It is known that for many educational objectives, at least, programmed materials can be used as the primary source of instruction. There is also some reason to believe that properly prepared programs may assume a larger instructional burden than has previously been thought possible in that they may replace more conventional forms of instruction to a greater and greater degree as time goes on. It should be pointed out, however, that programmed instruction is not a panacea in education. Programmed instruction will not be used wisely, for example, until we have overcome some of the problems of more thoroughly identifying and defining goals in education. The question currently facing education is no longer whether or not programmed instruction can contribute to educational practices, but how soon the necessary research can be accomplished both to make well prepared program materials available for achieving desired educational outcomes, and to provide greater understanding in the most advantageous use of these materials. (70:3)

PART III - HEALTH EDUCATION

The purpose of part three was to survey the implications for using the method of programmed instruction in the area of health education. In order to meet this purpose, it seemed pertinent to review the basic principles and modern methods of health instruction.

In a joint publication by the National Education Association and the American Medical Association, health education is defined as ". . . the process of providing learning experience for the purpose of influencing knowledge, attitudes, or conduct relating to individual, community, or world health." (32:4) Means states:

Throughout the history of mankind, health has stood as a basic and intrinsic determinant of individual behavior and national strength. From preliterate times to the present it has reflected the culture, the customs and the mores of society. It was in turn influenced by the prevailing atmosphere of constant change. (20:372)

As a result of keeping abreast of the new expanse in knowledge and the general developments in methodology and psychology in education, health education has experienced several extremes in attempting to bring about more effective living through the eras of the factual didactic, traditional, and "health habit" methods of teaching. The modern period (since 1940) of methodology is characterized by a balance of the extremes and a more realistic return to the "problems" approach. The objectives of modern methodology are aimed at developing scientific knowledge, wholesome attitudes, and desirable health practices. These objectives form the basis for sound and effective health education. (20)

What individuals learn may at times be vastly different from what they are taught. When the teacher makes use of modern knowledge concerning the way people learn, he can transform dry, academic and ineffective health instruction into a vital, interesting, life-saving and result-producing program. (32:174)

In view of this reasoning, teachers now place strong emphasis on the functional aspects of health teaching as a means of enabling the students to accept the responsibility for their personal and community health. (26)

Kilander (14) asserted that methods which can be used in health teaching are the same as those used to teach other subjects. He also stated that many educators believe selection of health teaching methods and materials merits more careful consideration than many other areas because of the need to develop desirable attitudes and behavior as well as knowledge. In realizing this need, the selection of teaching methods should be based on the primary objective of the day's lesson or the unit as a whole.

Some conventional methods of teaching health are listed below:

- (1) reading assignments - using textbooks and supplementary materials
- (2) lecture
- (3) recitation
- (4) independent study and/or project
- (5) lecture-discussion
- (6) problem - solving
- (7) group - discussion (14)

Several studies have been made to determine the effectiveness of various methods of teaching health. Rohaly (72) compared the relative effectiveness of three different methods of teaching college health. She found no significant differences attributable to methods of lecture-discussion, lecture, and recitation. All three groups showed significant gains in knowledge.

Kaplan (69) used college freshmen as subjects in comparing the conventional teaching methods of health education to a problem-solving method employing television presentations and discussion sessions. The two groups showed no significant differences in factual knowledge gains, but the latter group scored significantly better in problem-solving ability.

Beasley (65) taught an introductory health course over closed-circuit television to three hundred and twelve college students. The results showed significant student gains toward Beasley's course objectives and also revealed that the students had high regard for this method of teaching.

Jones (68) compared three different methods of teaching college health. He found the lecture, lecture-discussion, and small group discussion methods to be effective in increasing health knowledge. The lecture-discussion method appeared to be superior.

Fodor (66) made a comparative study of two approaches to health instruction at the college level. The results showed no significant difference in knowledge gains between a group having the lecture approach and a group having a varied-presentation

approach. However, Fodor concluded that the latter group showed significantly greater appreciation for and interest in the course.

Veenker and Ismail (64) found no significant differences in using the problem-solving method, lecture method, and discussion method to teach college health.

Dearborn (37) found that strikingly significant differences and deficiencies (93% to 3%) exist in the health knowledge of students who have completed high school. He suggested:

Were pre-testing a regular procedure in school health classes, the strikingly wide variations in individual, class, and even institutional performances would be demonstrated, together with the corresponding opportunities for the adjustment of instruction to the differences, and the consequent increase of knowledge gained in the course. (37:299)

Kilander (14) observed methods of teaching knowledge, facts and scientific information. The most valuable methods included the use of written materials ". . . which the student can read at his own pace and in his own privacy where concentration on the topic is needed." (14:60)

#### Health Education and Programmed Instruction

Redd (60) observed little discussion of incorporating programmed instruction in health into the curriculum. Some educators argue that there is no place for programmed instruction in health because of activity outcomes desired and the nature of instruction involved. In argument with this school of thought, it seems reasonable to note the direct implications, from research and leaders in health, for programmed instruction in health education.

Direct implications for using programmed instruction in health education were found in the literature. Evaul stated, "In health education, for example, there is much factual knowledge that may be effectively taught by programmed instruction, leaving class time free for fruitful discussions and other learning experiences." (43:27)

Redd wrote, "Professionally alert health and physical educators have an obligation to examine, evaluate and experiment with these educational tools [programmed instruction] to determine their potential value in the field." (60:174) He further suggested that the precise and logical aspects of the health curriculum are best suited for programmed instruction.

Health courses should not be programmed as a whole, however specific areas in the health curriculum lend themselves well to this procedure. The study of anatomical and physiological processes can be enhanced by these methods. (60:175)

#### PART IV - PROGRAMMED INSTRUCTION IN HEALTH EDUCATION

The writer was unable to locate any published programmed instruction text or unit designed for use in a college course of basic health education. Dr. Mary K. Beyrer (78) reported on January 19, 1965 (letter on file) that Helen Lou Tinnin of The Ohio State University had completed (summer 1964) a doctoral study entitled The Development, Standardization, and Pilot Testing of an Auto-Instructional Program in Health Education on The Topic of Cigarette Smoking. Dr. Beyrer (78) also reported that Ruth E. Tandy of The Ohio State University was currently conducting a follow-up study on Tinnin's work.

In specific regard to programmed instruction of the circulatory system as a segment of basic college health education, no such published or unpublished materials could be located.

A programmed instruction manual on the circulatory system was written and designed for use in nursing education by Sackheim. (24) This program was the only one that could be located which dealt specifically with the circulatory system.

Such a lack of reported research and literature on the development and use of programmed instruction tests and materials in health education indicated a need for programs to be designed and constructed for use in college health education.

## CHAPTER IV

### PROCEDURE

The following sequence of procedures was employed to construct and validate a programmed unit of instruction on the human circulatory system. This program was designed for use in basic health education courses on the college level.

This study also allowed for an evaluative observation to be made of the application of programmed learning among college students engaged in the study of basic health education.

#### Subjects

Sixty-seven freshmen and sophomore college women enrolled in the Health Education 101 course at The University of North Carolina at Greensboro were used as subjects for this study. The total number of subjects comprised two spring semester classes which were taught by Dr. Esther B. White. All subjects reported having had a basic health course in either senior or junior high school. Six of the subjects had had previous experience with or knowledge of programmed instruction. There was no reason to think this group deviated in any way from the normal college population involved in the study of basic health education.

#### Construction of the Program

There is no one standard method and format for program construction. Various methods and combinations of methods have

been used. The review of literature indicated the linear, constructed-response method to be the most widely-used in program construction. (18, 27) The vertical format was adopted from the standpoint of economy and efficiency.

The pre-determined material for the program content was divided into the following five sequential and inter-related parts:

- I A General Introduction
- II The Blood: A Part of the Circulatory System
- III The Heart: A Part of the Circulatory System
- IV The Blood Vessels: A Part of the Circulatory System
- V Physiology of Circulation

Program objectives. Programmed instruction objectives differ from the usual teaching objectives in that they are developed in terms of the specific behavior desired from the students as they complete each major part of the program.

Using Mager's (19) book as a guideline, a descriptive and detailed outline of program objectives was formulated from the five-part breakdown of the material content. (See Appendix A)

The program objectives served a two-fold purpose: (1) to specify what the student should be able to do upon completing each major presentation of program material, and (2) to guide the programmer in the development of the program.

Frame writing. The program itself was constructed in strict accordance with the previously determined objectives. Each frame was constructed according to the specific response

desired and typed on a 4" x 6" index card. Criterion frames (see Appendix B) were the first to be constructed. They paralleled the objectives. The second type of frames to be constructed were the copy frames (including some discovery frames). The copy frames were derived from the criterion frames. The third type of frames, practice frames, were synonomous outgrowths of the copy frames. A fourth type of frames, the review or wrap-up frames, were formulated by collating and inter-relating the other three types of frames. Throughout the program these four types of frames were used in the following sequence to present each new portion of the material: (1) copy frame (occasional discovery frame), (2) practice frame/s, (3) criterion frame, (4) intermittent review frame. An example of the presentation sequence is shown in Appendix C. Cartoon sketches and pertinent diagrams were used in many frames as learning aids and motivators. These were hand sketched by Miss Nancy Angle.

Periodic critical evaluations and suggestions by Dr. Hildegard Johnson of the School of Home Economics of The University of North Carolina at Greensboro and Mr. Alex Andres, Program Consultant of the American Institute for Research, were sought and appropriately incorporated into the program during its construction and revision phases. Suggestions such as the following were given and used: (1) employment of the Miller line-drawing method for review frames (see Appendix H - Frame 313), (2) a more extensive use of cartoon and diagram enrichment, (3) a more

extensive use of phonics, mnemonics, and alliteration, (4) use of inter-relation frames.

During the development of the program, frames were tested informally from time to time by several friends and colleagues of the programmer. Their constructive comments and response results proved helpful in frame revisions and in anticipating problems which might accrue. This pre-testing of the frames during the development of the program would have been more ideal and desirable if members of the target population might have been used. Time was the limiting factor.

Panels. At intervals in the program it was necessary to provide supplementary illustrations as aids to student comprehension. These supplementary illustrations are referred to as "Panels". (See Appendix D) The programmer sketched the simplified panels by hand on master stencils and they were reproduced on a multilith multigraph machine.

Pilot study. A pilot study was made in an effort to determine any necessary revisions in the program and accessory materials. Three students, not otherwise associated with this study, were used as subjects. The programmer purposely chose two second-semester high school seniors and one second-semester college freshman. The reasoning behind this selection was to include, as near as possible, a typical sampling of the target population which usually consists mainly of first and second-semester college freshmen. Since this pilot study was made during the second semester, few first-semester college freshmen

were available; thus the selection of second-semester high school seniors seemed to exemplify most the typical freshmen beginning the first semester of college work. According to the evaluation of the subjects' instructors and their academic records, one subject was ranked as scholastically superior; one as average; one as below average. The ranked variation in scholastic aptitude was purposeful in exposing the program to the varying levels of student intelligence and learning rates.

Each subject in the pilot study sat with the programmer while taking the program. The subjects responded orally, asking questions or making constructive comments, as they proceeded through the program. On an error-rate sheet the programmer recorded each incorrect response, including the subject's explanation as to why the incorrect response was made. (See Appendix E) General comments and reactions (verbal and gesticulatory) were also recorded as each subject took the program. The three error-rate sheets, containing all the information mentioned above, were analyzed and compared. Program revisions were made as indicated in the analysis and comparison of the error-rate sheets. Revisions, as indicated by the pilot study results, shown in Table I, consisted mainly of rewording several frames and clarifying a few of the cartoon-like sketches which serve as discovery frames.

Mechanics of preparation. Program frames are usually presented in a textbook, a machine, or on index cards. In preparing the program for student use, the programmer decided to

TABLE I

## PILOT STUDY SUMMARY

Subject	Pre-Test Time	Pre-Test Score**	Program Errors	Program Time***	Post-Test Time	Post-Test Score**	Given
High School Senior Superior Student	:30	51	6	4:45	:45	99	48 hrs.*
High School Senior Average Student	:30	45	17	5:50	:25	98	24 hrs.*
College Fresh- man Below Average Student	:40	30	20	5:20	:45	92	Immedi- ately*

\* After completion of the program

\*\* Possible 100 points

\*\*\* Intermittent program study sessions averaged approximately 60 to 90 minutes for individual subjects in the pilot study and program validation phases.

design and print it in such a manner that it would appeal to the student's idea of an acceptable and effective text. The frames were typed on a master stencil (specific for use in the multilith multigraph reproducing machine). The cartoon sketches and panels were drawn on the master sheets with a reproducing pen. The master stencils were reproduced on a multilith multigraph machine. The covers and "sliders" were designed by the programmer and printed in a commercial printery. For economical reasons the programmer bound each program with a plastic spiral.

#### Construction of the Test

The one-hundred item test was designed to be used as a pre-program and post-program objective evaluation of the students' knowledge of the material content of the program; thus demonstrating any knowledge improvement, and thereby indirectly reflecting the effectiveness of the program.

After reviewing the literature and copies of several current standardized health education knowledge tests (73, 74, 75, 76), a multiple-choice test format was selected, consisting of questions with incomplete stems and four responses from which to choose the correct or best answer.

The test items were constructed in strict accordance with the specified objectives of each of the five parts of the program. Each of the test questions was classified as belonging to one of the five parts. From this classification, a percentage of the total test questions was determined for each part. The same procedure was used to determine the number and percentage of frames

in each part to assure proportional content balance between the two instruments. (See Table II on page 43)

The original test was administered to the subjects in the pilot study prior to and after they completed the program. (See Table I) Indicated question and response revisions were made. The revisions were minor in degree, consisting mainly of rewording and clarification. The final revision of the test (see Appendix F) was printed on the multilith multigraph machine.

#### Administration of the Pre-test

The subjects were given, prior to the pre-test, a detailed explanation of the purpose of this study and explicit instructions for all phases of their participation. The test was administered during a regular class meeting. Each student was given a copy of the test and a one-hundred item answer sheet. (See Appendix G) The students were cautioned to avoid any unjustifiable guessing at answers to questions on material about which they had no knowledge. Each answer sheet was scored on the basis of the total number of correct responses.

#### Administration of the Program

Since only six subjects reported having had previous experience with or knowledge of programmed instruction, an extensive explanatory discussion of programmed instruction was used as a preparatory measure. It was stressed that this program was intended as a supplementary teaching and learning aid for the specified segment of the course content.

After the pre-test was completed a copy of The Circulatory System: A Practical Approach\* (see Appendix H) was given to each subject. A mimeographed error-rate sheet (see Appendix I) was enclosed in each program for the purpose of specifying incorrect responses and personal reactions for the frames on which the subjects might wish to comment.

The program design and format were carefully explained to the subjects. Attention was called to the instruction page, "To the Student", in the program. This page was carefully read and discussed, after which examples of the various types of frame constructions were pointed out and explained. Instructions were given on the use of the "slider" which was included in each program for the purpose of covering the answer column in the left margin of each page. (See Appendix J)

Adequate space was left on the second page of the program for the purpose of obtaining student evaluation and opinion. Each subject was requested to tear out that page, after completing the program, and, without signing her name, to write her own personal evaluation of the method of programmed learning as experienced through this program. In conjunction with the evaluation, the subjects were asked to write their personal reactions to and constructive comments, unfavorable as well as favorable, about the different aspects of this particular program. The programmer carefully explained the importance of the evaluations and

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\*The Circulatory System: A Practical Approach will hereafter be referred to as "the program".

truthfulness in the preparation of them; also extreme care was taken in explaining that the evaluations would in no way have any effect on the subjects' achievement grades in the health course.

As a means of determining the average amount of time necessary to complete the program, the subjects were requested to note on the error-rate sheet the length of time spent.

The subjects were instructed to work independently on the program and to avoid using any source material other than the program itself. They were informed that time would be allotted at the beginning of each class period for any questions or discussion about the program content. The subjects were encouraged to ask questions or initiate class discussions about facts, concepts, issues, or recent developments which would be pertinent to and conjunctive with the program content. The programmer attended each class period for the purpose of answering any questions and moderating any discussions. The subjects' questions and discussions mainly centered around such topics as the Rh factor, arteriosclerosis, atherosclerosis, and heart attack. It was interesting to note the subjects' continued interest, as demonstrated by questions and discussion, in the programmed learning theory as compared to the various methods of learning and teaching. This was probably a natural reaction from the subjects since it was their first experience with this relatively new method of learning.

### Administration of the Post-test

The literature suggests that since programmed instruction is geared to the individual's learning rate, the post-test should be given to individuals after they complete the program and indicate their readiness to take the test.

The above suggestion was fully discussed with the class professor, and, with her approval was adopted as the method for post-testing. Each student indicated her readiness to take the post-test by returning the completed program manual to the programmer and requesting a copy of the post-test and an answer sheet. The subjects were instructed to complete the test outside of class and return it at the beginning of the next class period.

It was carefully explained to the subjects that their teacher had decided to use individual post-test scores as a test grade to be averaged as a part of each student's semester grade since the program content was a segment of the course content.

The programmer reminded the subjects that the University honor system was certainly applicable to this phase, as well as all other phases, of the study.

### Statistical Techniques

Knowledge test. The validation of the knowledge test was based on the calculation of its curricular validity.

The means and standard deviations of the pre and post-test scores were calculated. In order to determine any significant gain of knowledge, thus reflecting the effectiveness of the program, the mean of the differences was calculated using matched pairs and was statistically tested by the Z test of significance.

The Kuder-Richardson formula for reliability was applied to the post-test data to determine the internal consistency of

the knowledge test. The coefficient as calculated by this technique may be understood as the "lower limit" of reliability.

Program. The American Institute for Research (77) advocates using the response error-rate as the measure for program validation. According to the American Institute for Research, ninety per cent of all subjects should write correct answers to ninety per cent of the total responses called for in the program. In order to determine the validity of the program the following steps were taken:

1. each response in the program was counted
2. ten per cent of the total number of responses was calculated as a means of determining the error allowance
3. the total number of incorrect responses for each subject was obtained from the individual error-rate sheets. (The programmer double checked each error-rate sheet against all responses in each completed program.)
4. a record was kept of subjects having an error-rate exceeding the ten per cent allowance

The mean error-rate was calculated as an extraneous point of interest to indicate the average number of incorrect responses made by the subjects.

## CHAPTER V

### ANALYSIS AND INTERPRETATION OF DATA

The purpose of this study was to construct and validate a programmed unit of instruction on the circulatory system to be used as a segment of a basic health education course on the college level. A secondary purpose was to observe, through subject evaluation, the application of programmed learning among college students engaged in the study of basic health education.

The subjects in this study were sixty-seven freshmen and sophomore women enrolled in two Health 101 classes during the spring semester, 1965, at The University of North Carolina at Greensboro.

A discussion of each statistical procedure follows. The discussion includes the treatment of data, the analysis of data, and the interpretation of the findings.

#### Knowledge Test

Validity. The validation of the knowledge test was based solely on the calculation of its curricular validity or content balance. The common use of an Item Analysis for test validity was ruled out as inappropriate for this type of objective evaluation in programmed instruction. A principle of programmed instruction is to reduce the number of errors in the learning

process, thereby resulting in consistently high achievement scores on the evaluation instrument. Such grouping of scores at the top of the range produces a curve skewed from normality. As evidenced in Table II, the percentage of emphasis on the knowledge test is appropriately in proportion with the percentage of emphasis in the content of the program. Thus, the knowledge test demonstrates curricular validity.

Pre and post-test scores. The pre-test mean (Table III) was substantially low, indicating that the subjects as a group possessed a minimum knowledge of the circulatory system before their exposure to the programmed instruction.

Employing the matched pairs design, the pre-test and post-test scores for each individual were used to determine the mean improvement of the group. Statistical significance was determined by subjecting the mean improvement to the Z formula for correlated means. (30)

The gain in knowledge proved to be extremely significant at the .001% level of confidence. (Table III) It is pertinent to note that the null hypothesis can be rejected at the .001% level of confidence if the Z is as large as 3.47. The improvement of knowledge in this study produced a Z of 25.25, thus indicating a difference far above that required to substantiate its significance.

This significant improvement is also obvious in comparing the pre and post-test means. On the one-hundred item test, the post-test mean of 95 was 48 points higher than the pre-test mean, indicating the substantial improvement in knowledge.

TABLE II

## CURRICULAR VALIDITY OF KNOWLEDGE TEST

Content Material	Test Questions		Program Frames	
	#	%	#	%
Part I - A General Introduction	2	2	15	5
Part II - The Blood	41	41	116	37
Part III - The Heart	14	14	58	19
Part IV - The Blood Vessels	13	13	45	14
Part V - Physiology of Circulation	30	30	79	25
Total	100	100%	313	100%

TABLE III

PRE-TEST AND POST-TEST MEANS, STANDARD DEVIATIONS,  
AND SIGNIFICANCE OF THE DIFFERENCES

Test	N	Range	Mean	$\sigma$	$M_{diff.}$	Z*	Level of Significance
Pre-test	67	20-86	46.66	16.60	48.06	25.25	.001%
Post-test	67	81-100	94.90	3.92			

\* Z of 2.66 for 66 degrees of freedom necessary to be significant at the 1% level of confidence.

Reliability. The Kuder-Richardson procedure (2) was applied to the post-test data as an indication of the reliability of the knowledge test. (Table IV)

TABLE IV

## RELIABILITY COEFFICIENT OF THE KNOWLEDGE TEST

Item	N	$r_{tt}$
Knowledge Test	67	.69

The writer suggests that the test of reliability is also inappropriate for this test, as was the Item Analysis for its validity, due to the underlying principle in programmed instruction which produces this unique grouping of scores at the top of the range. Although the correlation coefficient was acceptable, it should be noted that this was probably due to the large number of test items.

Program

The validity of the program was determined by employing the standard advocated by the American Institute for Research that ninety per cent of the subjects must correctly respond to ninety per cent of the total number of responses in the program. Within the three-hundred and thirteen frames, there was a total of 1,754 responses. The ten per cent error allowance was calculated as

175 errors. This can further be explained by stating that sixty subjects must make at least 1,579 correct responses, or, no more than seven subjects may make more than 175 incorrect responses.

The program proved to be extremely valid (Table V) since one hundred per cent of the subjects made correct responses to ninety-eight per cent of the total number of responses in the program. One subject made thirty-three errors, or 1.88%, out of the total 1,754 responses. This was the highest error-rate scored on the program. Seventy-five per cent of the subjects had an error-rate of less than ten, or .57%. The mean error-rate was 6.7, or .38% of the total number of responses, skewed somewhat by the extreme thirty-three.

The average amount of time necessary to complete work on the program was calculated from the time figures reported on the error-rate sheet of each subject. This procedure revealed that the subjects required an average time of three hours and fifty-three minutes to complete the program. This amount of time is well within the usual over-all class time allowed for covering this segment of course content by the traditional method of teaching and learning. Thus, by using programmed instruction class time was freed for pertinent discussions and enrichment of the programmed material.

### Evaluation

A secondary purpose of this study was to observe, through evaluation by the subjects, the application of programmed learning

TABLE V

## PROGRAM VALIDITY

Error-Rate*		Subjects**	
Number	%	Number	Cum. %
0	0	7	10
1	.06	7	20
2	.11	2	23
3	.17	6	32
4	.22	9	44
5	.29	5	51
6	.34	5	58
7	.40	3	63
8	.46	3	68
9	.51	5	75
10	.57	1	77
11	.63	5	84
12	.68		
13	.74		
14	.80		
15	.86	2	87
16	.91	1	89
17	.97	1	91
18	1.03	1	93
19	1.08	2	96
20	1.14		
21	1.20		
22	1.25		
23	1.31		
24	1.37		
25	1.43	1	98
26	1.48		
27	1.54		
28	1.60		
29	1.65		
30	1.71		
31	1.77		
32	1.82		
33	1.88	1	100

\* Total number of responses = 1,754

\*\* Total number of subjects = 67

among college students engaged in the study of basic health education. In order to obtain straight-forward comments from each subject in her own way of thinking, the programmer avoided using a check-list type of evaluation sheet. The contents of the evaluations were perused and found to naturally form several salient categories which are thought to be the most pertinent to the inclusive evaluation sought by the programmer. (Table VI) These categorical comments were written by only the number of subjects shown, not by the entire group of subjects. On the whole, most subjects wrote discriminative evaluations; some few evaluations were too brief and general to be of incorporative value.

Over fifty per cent of the subjects reported that being able to progress at their individual learning rates was highly satisfying. One subject stated that her rate of progress was slowed by having to follow the frame sequence strictly.

Most of the twelve subjects who were unfavorably impressed with programmed instruction (learning) critically rejected all aspects of the process. It was interesting to note that a large percentage of these twelve subjects reported having previous knowledge of a large portion of the program content from such sources as strong health and biology courses in high school and recent biology courses in college.

A significantly large percentage of the subjects stated that they would like to use programmed instruction in such academic disciplines as history, the sciences, health education and mathematics.

TABLE VI

CATEGORIZED EVALUATION COMMENTS  
N = 67

Significant Categories	Number of Subjects Making Comments	Percentage of Total Subjects
Programmed Instruction Favorable	55	82
Programmed Instruction Unfavorable	12	18
Programmed Instruction Effective Method of Learning	61	92
Preferred Programmed Instruction Over Traditional Textbook	17	25
Liked Repetition Theory in Programmed Instruction	13	20
Disliked Repetition Theory in Programmed Instruction	7	10
Program Too Elementary	12	18
Learning Aids and Motivators Appealing	10	15
Learning Aids and Motivators Non-appealing	4	1

In summary, this study revealed that the theory of programmed learning and the program, The Circulatory System: A Practical Approach, received highly favorable evaluation by the participating subjects.

## CHAPTER VI

### SUMMARY AND CONCLUSIONS

The purpose of this study was to construct and validate a programmed unit of instruction on the human circulatory system. This program was designed for use in basic health education courses on the college level. A secondary purpose of the study was to obtain an observation, through evaluation by the subjects, of the application of programmed instruction among college students engaged in the study of basic health education.

Sixty-seven freshmen and sophomore women, enrolled in two 1965 spring semester classes of Health Education 101 at The University of North Carolina at Greensboro, were used as subjects for this study.

The material for program content was determined and classified into five program parts. Detailed objectives for each of the five parts were formulated from the pre-determined material for program content. The program was constructed using a fairly consistent frame sequence: (1) copy frame (occasional discovery frame), (2) practice frame/s, (3) criterion frame, (4) intermittent review frame/s. The frames were constructed in strict accordance with the program objectives.

A one-hundred item objective knowledge test was designed for use as a pre-program and post-program evaluation of knowledge relating to the program content.

A pilot study was conducted to determine needed revisions on both the program and the knowledge test.

Indicated revisions were made and the program and test were reproduced on a multilith multigraph machine. An error-rate sheet, a "slider", and space for evaluation by the subject, were all included in each program.

The pre-test was administered to the subjects to determine the pre-program levels of knowledge relating to the program content.

A program was given to each subject to complete outside of class. Each subject recorded all incorrect responses, time spent on the program, and pertinent comments on an error-rate sheet that was handed in with the completed program. The programmer attended each regular class meeting for the purpose of answering questions and moderating any discussion.

Each subject indicated her readiness to be tested at the completion of her program. A knowledge test and an answer sheet were given to each individual to complete and return at the next class period.

A written evaluation of the method of programmed learning, and, also of The Circulatory System: A Practical Approach was made by each subject.

Findings

1. The statistical procedure for curricular validity was employed to determine the validity of the knowledge test. A high curricular validity was established.
2. The knowledge test was subjected to the Kuder-Richardson statistical formula for reliability. An acceptable reliability coefficient resulted.
3. The pre-test and post-test scores of each individual were compared. The matched-pairs design was used to determine the mean improvement (of knowledge) within the group. The calculated mean improvement was then subjected to the Z formula for statistical significance. The mean of the differences between the pre and post-tests was 48.06 and was statistically significant at the .001% level of confidence. These data revealed a very high degree of knowledge improvement on the program content.
4. The standard advocated by the American Institute for Research was used as a criterion for program validation. The program proved to be extremely valid because more than ninety per cent of the subjects had lower than a ten per cent error-rate on the program. The mean error-rate of the program was 6.7. This is an error-rate of .38% for the over-all group.
5. The average amount of time necessary to complete work on the program was three hours and fifty-three minutes.

6. A perusal and categorical analysis of the subjects' evaluations revealed that the theory and method of programmed learning and the specific program constructed for this study were regarded as highly acceptable and favorable among a large majority of the subjects.

### Conclusions

The following conclusions are indicated within the framework of this study:

1. The constructed program, The Circulatory System: A Practical Approach, is a valid unit of programmed instruction for use in a basic course of health education on the college level.
2. The accompanying knowledge test relating to the program content has curricular validity and adequate reliability.
3. Programmed instruction is a very effective method of learning and teaching that can be profitably employed in the academic discipline of health education.

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## APPENDIX A

### PROGRAM OBJECTIVES

#### THE HUMAN CIRCULATORY SYSTEM: A PRACTICAL APPROACH

##### OBJECTIVES FOR PART I: GENERAL INTRODUCTION

The student must be able to:

- A. Relate the importance of the circulatory system in providing life-support to the human body:
  1. the transportation system of the body
  2. transports the materials required by the body for the maintenance of life
  
- B. Name the three component parts of the circulatory system in functional order:
  1. the heart is a pump
  2. blood is a liquid pumped by the heart
  3. blood vessels are "pipe lines" through which the blood flows

##### OBJECTIVES FOR PART II: THE BLOOD

The student must be able to:

- A. Define blood:

A tissue composed of cells and liquid plasma which circulates as a fluid throughout the body.
  
- B. Write the characteristics of blood:
  1. the average human body contains about six quarts of blood
  2. small amounts of blood may safely be spared at intervals - donating a pint of blood every six to ten weeks is safe
  3. taste of blood:
    - a. slightly metallic
    - b. salty
  4. blood is slightly alkaline in reaction and cannot deviate more than a slight amount from that state if life is to continue

- C. List the three specific types of blood cells:
1. the red blood cells
  2. the white blood cells
  3. the platelets
- D. Write a characteristic function of each type of blood cell:
1. red cells carry oxygen to body tissues:  
made possible by hemoglobin, in the red cells,  
which has an affinity for oxygen
  2. white blood cells fight infection by a defense  
called phagocytosis
  3. platelets initiate the clotting of blood
- E. Understand and write an explanatory summation of the four common blood types:
1. important to successful blood transfusions
  2. four common blood types:
    - a. A
    - b. B
    - c. AB
    - d. O
  3. bloods of the donor and recipient must be compatible in order to carry out a successful transfusion
  4. danger of transfusing with the wrong blood type (mixing)
    - a. clumping of the blood cells (agglutination)
    - b. could cause fatal injury as the agglutinated blood passes through the vessels of the heart or brain
- F. Define the Rh factor:  
an inherited substance found in the blood of 85% of the human race
- G. Write specific facts about the Rh factor:
1. so named because it was first found in the Rhesus monkey
  2. blood which contains the Rh factor is typed "Rh positive"
  3. blood which does not contain the Rh factor is typed "Rh negative"
  4. Rh factor incompatibility problem in pregnancy
    - a. only if the husband is Rh positive and the wife is Rh negative
    - b. the first child is usually normal and unaffected
    - c. any child, after the first baby, may be affected by the agglutination of red cells
      1. condition known as erythroblastosis

2. condition in baby is treated and corrected by replacement transfusion
    - the baby's blood is replaced immediately after birth by a transfusion of a proportionate amount of Rh negative blood
  - d. this problem is a matter of concern for the attending physician
- H. Understand and write factual information about the specified common blood maladies:
1. simple anemia is a hemoglobin deficiency in the red cells
    - a. the anemic person usually looks very pale and tires very easily
    - b. treated by prescribed diet and medication
  2. leukemia is a disease characterized by an abnormal increase in the number of white cells
    - a. often thought of in lay terms as "cancer of the blood"
    - b. no known cure for the disease
    - c. often is fatal to children and adults
  3. hemophilia is an hereditary disease in which the blood takes an abnormally long time to clot
    - a. most commonly seen in males
    - b. no known cure

#### OBJECTIVES FOR PART III: THE HEART

The student must be able to:

- A. Write an interpretation of the general descriptive characteristics of the heart as a vital organ of the human body:
  1. the heart is a hollow organ composed mostly of muscle tissue
  2. the heart is about the size of a person's fist
  3. located in the chest, near the midline of the body and directed slightly to the left
- B. Describe the basic structure of the heart:
  1. the heart is divided into a left and right side by a muscular wall called the septum
  2. each side of the heart is divided into an upper and lower chamber (four chambers in all)
    - a. upper chambers called auricles (right and left)
    - b. lower chambers called ventricles (right and left)
  3. valves (flaps of tissue) are located at the entrance and exit of each ventricle
    - a. valves direct the flow of blood
    - b. the sounds heard in the heart are due to the closing of the valves

- C. Describe the basic function of the heart:
- the primary function of the heart is to pump blood to all parts of the body
    1. the heart is able to pump blood by means of contracting its own muscle
    2. the right auricle receives impure (used) blood from the body tissues and the left auricle receives pure (unused) blood from the lungs
    3. the right ventricle pumps impure blood to the lungs to be oxygenated (purified) and the left ventricle pumps pure blood to all parts of the body
- D. Understand and describe the common structural maladies of the heart:
1. heart murmur is a condition caused by the failure of a valve in the heart to close completely, thus allowing some of the blood to flow backward
    - a. may be a mild to serious condition
    - b. if it occurs in a child, it is often outgrown
  2. "blue babies" - a condition in newborn babies caused by a gap in the septum which divides the two ventricles
    - a. the baby's skin has a bluish-look because impure blood is allowed to mix with pure blood
    - b. the condition can be corrected by surgical repair

#### OBJECTIVES FOR PART IV: THE BLOOD VESSELS

The student must be able to:

- A. Define blood vessels:
- a closed circuit of hollow tubes (pipelines) through which the blood flows to all body parts
- B. Name the three kinds of blood vessels:
1. arteries
  2. veins
  3. capillaries
- C. Write a descriptive statement about each type of blood vessel:
1. arteries - "distributors"
    - a. lead away from the heart ("A" - away)
    - b. carry pure blood away from the heart to all body parts
    - c. have thick elastic walls in order to withstand the pumping force of the heart

2. veins - "collectors"
    - a. lead to the heart
    - b. carry impure blood back to the heart from the body tissues
    - c. walls of the veins are thinner than those of the arteries
  3. capillaries - "linkers"
    - a. microscopic vessels which carry blood from small arteries to small veins
    - b. represent the "link" in making the circulation of blood a "closed-circuit"
- D. Define and differentiate between two common diseases of the blood vessels:
1. arteriosclerosis
    - a. degenerative disease of the arteries in which the walls become progressively hard and brittle, therefore decreasing the elasticity of the arteries
    - b. occurs most frequently in aged people
    - c. increases the possibility of a break in the wall (rupture) of the artery
  2. atherosclerosis
    - a. a degenerative disease of the arteries caused by deposits of fatty substances, largely cholesterol, on the inside of the arteries
    - b. the lining thickens and hardens, narrowing the channel through which the blood flows
    - c. may eventually cause a complete blockage of an artery

#### OBJECTIVES FOR PART V: PHYSIOLOGY OF CIRCULATION

The student must be able to:

- A. List the three specified branches of the circulatory system:
  1. pulmonary circulation
  2. systemic circulation
  3. coronary circulation
- B. Specify the function of each branch system of circulation
  1. pulmonary circulation is that part of the "closed-circuit" which carries blood from the heart to the lungs and then back to the heart
  2. systemic circulation is that part of the "closed-circuit" which carries blood from the heart to all body parts and then back to the heart
  3. coronary circulation is that part of the "closed-circuit" which supplies only the heart muscle itself

- C. Write a concise statement about the heart rhythm:
1. the heart automatically establishes an ordered rhythm to its function
    - a. contraction phase - ventricles work, auricles rest
    - b. relaxation phase - ventricles relax, auricles work
    - c. resting phase - entire heart rests briefly
- D. Write an interpretation of the effects of body activity on pulse-heart rate:
1. the normal pulse rate (heart beats per minute) varies with age and exercise
    - a. the pulse rate in the average adult is approximately 72
    - b. the heart beats faster (rise in pulse rate) while a person is engaged in any form of exercise; but returns to normal shortly after exercise
    - c. the heart beats most slowly during sleep - (heart rests for about 28 seconds out of each minute)
- E. Define blood pressure:
- blood pressure is the force with which the blood pushes against the walls of the arteries
1. normal blood pressure and pulse vary under many of the same circumstances
  2. a blood pressure reading of 120/80 is normal at age twenty
- F. Understand and describe the specified physiological disorders of circulation:
1. hypertension (high blood pressure)
    - a. persistently high blood pressure
    - b. may result from reasons such as:
      - (1) undue and prolonged physical stress
      - (2) undue and prolonged emotional stress
      - (3) arteriosclerosis and atherosclerosis
    - c. causes weakening of the heart due to the excess amount of work imposed on the heart
  2. heart attack
    - a. occurs when a blood clot blocks one of the coronary arteries
    - b. heart attacks are usually caused by hypertension, arteriosclerosis, and atherosclerosis
    - c. the attack is usually sudden, but the underlying cause might have been developing over a long period of time
    - d. attacks may range from mild to fatal
    - e. because of recent advances in medical knowledge, more and more heart attack victims are leading normal or almost normal lives

## 3. "stroke"

- a. technically known as apoplexy
- b. a sudden rupture or clogging of a blood vessel in the brain
- c. caused by hypertension and arteriosclerosis
- d. generally occurs late in life
- e. may be "light" to fatal in range.

APPENDIX B

CRITERION FRAMES

Criterion Frames for Part I Objectives

Frame

7. The purpose of the circulatory system, commonly called the (1)\* \_\_\_\_\_, is to provide (2)\* \_\_\_\_\_ by (3)\* \_\_\_\_\_.
- 

14. The circulatory system is composed of an organ called the (1) \_\_\_\_\_ which (2) \_\_\_\_\_ a liquid called (3) \_\_\_\_\_ to all parts of the body through tubes known as (4)\* \_\_\_\_\_.
- 

Criterion Frames for Part II Objectives

19. Using the material from the first three frames, write your own definition of blood.

Blood is \*\* \_\_\_\_\_.

---

21. The average adult body contains about \* \_\_\_\_\_ of blood.
-

24. It is safe to donate (1)\* \_\_\_\_\_  
of blood at intervals of about  
(2)\* \_\_\_\_\_.

---

29. If life is to continue, the blood  
must maintain its slightly  
\* \_\_\_\_\_.

---

33. The taste of blood is slightly  
(1) \_\_\_\_\_ and (2) \_\_\_\_\_.

---

39. Blood is composed of (1) \_\_\_\_\_  
cells, (2) \_\_\_\_\_ cells, and  
(3) \_\_\_\_\_.

---

44. The function of the red blood cells  
is \* \_\_\_\_\_.

---

48. The function of the (1)\* \_\_\_\_\_  
cells is to (2)\* \_\_\_\_\_  
by a process called (3) \_\_\_\_\_.

---

51. Hemorrhage is prevented by the  
helpful function of the (1) \_\_\_\_\_  
which serve to (2)\* \_\_\_\_\_.

---

54. An important factor in the success-  
ful transfusion of blood is the  
correct \* \_\_\_\_\_.

---

57. List the four common blood types

1. \_\_\_\_\_
  2. \_\_\_\_\_
  3. \_\_\_\_\_
  4. \_\_\_\_\_
-

60. If a person needs blood, he must be transfused with \*\*\_\_\_\_\_.
- 
63. When incompatible blood types are mixed by transfusion, there is a grave danger that \*\*\_\_\_\_\_.
- 
66. Agglutinated blood may cause  
 (1) \_\_\_\_\_ as it passes through the  
 (2) \_\_\_\_\_ and (3) \_\_\_\_\_.
- 
76. Define the substance first found in the blood of the Rhesus monkey.  
 \*\*\_\_\_\_\_.
- 
82. The Rh factor was first discovered in the blood of the (1)\*\_\_\_\_\_. 85% of the human race have (2)\*\_\_\_\_\_ blood; 15% have (3)\*\_\_\_\_\_ blood.
- 
90. The Rh factor might present a reproduction problem only if the blood of the (1) \_\_\_\_\_ is (2)\*\_\_\_\_\_ and the blood type of the (3) \_\_\_\_\_ is (4)\*\_\_\_\_\_. What are the possible consequences of this problem of the parents who plan to have a large family?  
 (4)\*\*\_\_\_\_\_.
- 
100. Newborn babies may be affected by a condition known as (1)\_\_\_\_\_. This condition will only occur if (2)\*\*\_\_\_\_\_, and after the (3)\*\_\_\_\_\_ (which pregnancy/s). The red blood cells of the infant will (4)\_\_\_\_\_ and may cause death if not

corrected (5)\* \_\_\_\_\_ (when?)  
by a (6)\* \_\_\_\_\_ (how?).

---

103. You would not be allowed to donate a pint of blood if your blood test showed you to have a condition called (1) \_\_\_\_\_ which is caused by (2)\* \_\_\_\_\_.

---

109. Draw lines to connect words in Column I which are associated with words in Column II:

- |                          |                              |
|--------------------------|------------------------------|
| 1. simple blood disorder | 1. anemic                    |
| 2. deficiency            | 2. phagocytosis              |
| 3. symptoms              | 3. anemia                    |
| 4. treatment             | 4. hemoglobin                |
| 5. descriptive adjective | 5. vigorous exercise         |
|                          | 6. agglutination             |
|                          | 7. diet and medication       |
|                          | 8. paleness and tires easily |
- 

120. Leukemia, commonly called (1)\* \_\_\_\_\_, is a very serious disease caused by (2)\* \_\_\_\_\_. The disease is fatal because (3)\*\* \_\_\_\_\_.

---

126. A serious hereditary blood disease, which often causes hemorrhage, affects mostly (1) \_\_\_\_\_ who are commonly referred to as (2) \_\_\_\_\_. This condition is called (3) \_\_\_\_\_ and is caused by (4)\*\* \_\_\_\_\_. There (5) \_\_\_\_\_ (is/is not) a cure for this disease.

---

## Criterion Frames for Part III Objectives

136. The heart is a working (1) \_\_\_\_\_  
 which is about the size of a  
 (2) \_\_\_\_\_ and is located (3)\*  
 \_\_\_\_\_.
- 

142. The heart is divided down the  
 middle by the (1) \_\_\_\_\_.  
 A right and left side result  
 from that division. Each side  
 contains an (2)\* \_\_\_\_\_ and a  
 (3)\* \_\_\_\_\_, making a total  
 number of (4)\* \_\_\_\_\_.
- 

145. Study panel three and label the  
 four chambers of the heart  
 below:



- 1.\* \_\_\_\_\_  
 2.\* \_\_\_\_\_  
 3.\* \_\_\_\_\_  
 4.\* \_\_\_\_\_
- 

148. Flaps of tissue called (1) \_\_\_\_\_  
 are located at the entrance and  
 exit of each (2) \_\_\_\_\_.
- 

151. Describe the heart valves. (include  
 function and location)

Heart valves are \*\* \_\_\_\_\_.

---

163. Supply the missing words:

Blood without oxygen is called  
 (1)\* \_\_\_\_\_. It is brought  
 back to the heart and received  
 in the (2)\* \_\_\_\_\_. Then it  
 flows down into the (3)\* \_\_\_\_\_  
 which pumps it to the (4) \_\_\_\_\_  
 for a fresh supply of (5) \_\_\_\_\_.

---

168. Supply the missing words:

"Pure" blood comes from the  
 (1) \_\_\_\_\_ to the (2)\* \_\_\_\_\_  
 of the heart. From there it  
 flows downward into the  
 (3)\* \_\_\_\_\_ which pumps it to  
 (4)\* \_\_\_\_\_.

---

175. Use the following "key" words to  
 make a descriptive statement  
 about a heart murmur.

DEFECTIVE, CLOSE, BACKWARD, COM-  
 PLETELY, BLOOD, VALVE, FAILURE,  
 FLOW OR LEAK, THUS.

---

184. Fill in the missing words:

A "Blue Baby" is born with a  
 (1) \_\_\_\_\_ in the part of the  
 (2) \_\_\_\_\_ which divides the  
 (3) \_\_\_\_\_. The baby has  
 a bluish-appearance because  
 (4)\* \_\_\_\_\_ is allowed to  
 mix with the (5)\* \_\_\_\_\_  
 that is pumped to all parts of  
 the body. Thus, the body parts  
 are deprived of the normal supply  
 of (6) \_\_\_\_\_.

---

#### Criterion Frames for Part IV Objectives

191. Blood vessels may be defined as  
 \*\* \_\_\_\_\_.

---

194. Name the three kinds of blood  
 vessels by labelling the following  
 "carriers" which vary in size,  
 strength, and purpose:



1. \_\_\_\_\_ 2. \_\_\_\_\_ 3. \_\_\_\_\_

---

199. Supply the missing words:

Vessels whose walls are (1) \_\_\_\_\_  
and (2) \_\_\_\_\_ are called  
(3) \_\_\_\_\_. They lead  
(4)\* \_\_\_\_\_ the heart,  
carrying (5)\* \_\_\_\_\_ to  
(6)\* \_\_\_\_\_.

---

204. Using the following "key" words,  
form a statement about veins:

"IMPURE", VESSELS, WALLS, RETURN,  
BLOOD, VEINS, ARTERIES, HEART,  
THINNER.

---

---

207. Supply the missing words in the  
following statement:

In order for blood to flow in  
a (1)\* \_\_\_\_\_, the (2) \_\_\_\_\_  
and (3) \_\_\_\_\_ must be linked  
together by microscopic vessels  
called (4) \_\_\_\_\_.

---

222. Formulate a definition of arter-  
iosclerosis from what you have  
learned.

\*\* \_\_\_\_\_.

---

228. Supply the missing words in the  
following paragraph:

An artery may become completely  
(1) \_\_\_\_\_ due to the  
(2) \_\_\_\_\_ of the walls which  
is caused by abnormal deposits of  
(3) \_\_\_\_\_. This disease is  
called (4) \_\_\_\_\_.

---

## Criterion Frames for Part V Objectives

237. Name the three main system branches of circulation:

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

---

240. Write a statement about the function of the pulmonary branch of circulation. \*\* \_\_\_\_\_.

---

243. Explain the function of the systemic branch of circulation. \*\* \_\_\_\_\_.

---

245. -The pulmonary circulation involves transportation to the lungs.  
 -The systemic circulation involves transportation to all body parts.  
 -The \_\_\_\_\_ circulation involves supplying the heart itself.

---

264. Match the letters in Column II to the numbers in Column I.

- |                          |   |
|--------------------------|---|
| ___ 1. resting phase     | a. the left side of the heart is contracting while the right side is relaxing |
| ___ 2. relaxation phase  | b. auricles relax and ventricles contract                                     |
| ___ 3. contraction phase | c. auricles contract and ventricles relax                                     |
|                          | d. the right auricle and right ventricle are relaxing                         |
|                          | e. the heart is doing no work   |
-

273. Supply the missing words:

The number of heart beats per minute is called the (1)\_\_\_\_ rate. The average pulse rate of about (2)\*\_\_\_\_ may vary with (3)\_\_\_\_ and (4)\_\_\_\_. During exercise the pulse rate (5)\_\_\_\_, but returns to (6)\_\_\_\_ shortly after the exercise. The heart beats (7)\_\_\_\_ during (8)\_\_\_\_ than at any other time.

276. Define blood pressure:

\*\* \_\_\_\_\_.

287. High blood pressure, technically called (1)\_\_\_\_ causes the heart to gradually weaken due to the excess amount of work imposed on it.

What gradually happens to the heart of a person who has hypertension? (2)\*\* \_\_\_\_\_.

299. Make a descriptive summary of heart attack by supplying the missing words:

Possible causes: (1)\_\_\_\_, (2)\_\_\_\_, (3)\_\_\_\_.  
 Effect on heart: Formation of a (4)\*\_\_\_\_ causes a (5)\_\_\_\_ in one of the (6)\*\_\_\_\_ of the heart. Possible range of severity: (7)\_\_\_\_ to (8)\_\_\_\_. Prognosis or outlook for survivors: (9)\*\* \_\_\_\_\_.

306. Refer back to the frame you just finished and from it formulate a descriptive and concise paragraph on "stroke".

\*\* \_\_\_\_\_.

APPENDIX C

EXAMPLE OF FRAME CONSTRUCTION SEQUENCE

Example of a copy frame

234. There are three main branch systems of circulation:
1. pulmonary (pull'-mow-nay-ree)
  2. systemic (sis-tim'-ik)
  3. coronary (car'-oh-nay-ree)

Three main branches of circulation are:

- (1) pulmonary
- (2) systemic
- (3) coronary

- (1) \_\_\_\_\_
  - (2) \_\_\_\_\_
  - (3) \_\_\_\_\_
- 

Example of a practice frame

235. Blood circulates through various parts of the body in branch systems. Three of these are called (1) \_\_\_\_\_, (2) \_\_\_\_\_, and (3) \_\_\_\_\_.

- (1) systemic
  - (2) pulmonary
  - (3) coronary
- 

Example of a practice frame

236. The three main branch systems of circulation are:
- a. pulmonary, ciliary, coronary
  - b. systemic, pulmonary, coronary
  - c. systemic, coronary, filary
  - d. systemic, pulmonary, ciliary

b.

---

Example of a criterion frame

237. Name the three main branches of circulation:

- (1) systemic
- (2) pulmonary
- (3) coronary

- (1) \_\_\_\_\_
  - (2) \_\_\_\_\_
  - (3) \_\_\_\_\_
- 

Example of a review frame

246. The three main branches of blood circulation are:

- (1) systemic
- (2) pulmonary
- (3) coronary

- (1) \_\_\_\_\_
  - (2) \_\_\_\_\_
  - (3) \_\_\_\_\_
-



APPENDIX D

ILLUSTRATION OF SUPPLEMENTARY MATERIAL



- view of the heart  
- viewed slightly to the left

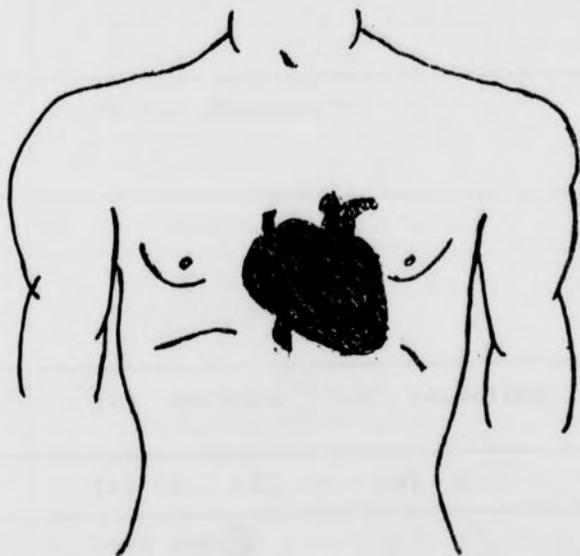
PANEL I

EXTERNAL VIEW OF THE HEART



PANEL II

LOCATION OF THE HEART



- near mid-line of the chest
- directed slightly to the left

APPENDIX E

ERROR-RATE SHEET - EXAMPLES OF INCORRECT RESPONSES  
AND COMMENTS FROM PILOT STUDY

PROGRAM TITLE The Circulatory System NAME Jane Dow  
 PROGRAMMER Sandra A. Woolen SECTION College Freshman  
 PRETEST 40  
 POSTTEST 98  
 ERROR-RATE 9  
 Time spent 4:55

FRAME #	INCORRECT RESPONSE	COMMENTS
8	failed to interpret #2 picture	picture not self-explanatory
55	wrote "clot" instead of "agglutinate"	"remembered the word 'clump' used with 'agglutinate' and it made me think of 'clot'."
90	"blood disorder"	"remembered #87 and confused it with #90."
101		There is a difference between "caused" in the statement and "characterized" in the question.
140	(1) auricle (2) ventricle	"I jumped ahead of the program."
298	(1) a (2) b (4) c	"Somewhat ambiguous"
305	Left out ③	
310		"Good way to review."

## APPENDIX F

NAME \_\_\_\_\_

SECTION \_\_\_\_\_

TEST ON THE CIRCULATORY SYSTEM  
PROGRAMMED INSTRUCTION

Instructions: PLEASE DO NOT WRITE ON THE TEST ! Place the letter of the best or correct answer in the blank on the answer sheet.

1. The circulatory system is often thought of as the
  - a. coronary system.
  - b. pulmonary system.
  - c. lymphatic system.
  - d. transportation system.
2. The circulatory system is most important because it
  - a. pumps blood from the heart.
  - b. keeps the blood from becoming "impure".
  - c. provides the lungs with a supply of oxygen.
  - d. provides life-support to the body.
3. The average adult body contains about
  - a. 3-4 quarts of blood.
  - b.  $\frac{1}{2}$  gallon of blood.
  - c. 6 quarts of blood.
  - d. 5 pints of blood.
4. Clumping of red cells is called
  - a. clotting.
  - b. hemorrhage.
  - c. a thrombus.
  - d. agglutination.
5. A person in need of blood must be transfused with
  - a. AB blood type.
  - b. a compatible type of blood.
  - c. an incompatible type of blood.
  - d. O+ blood type.
6. Erythroblastosis is corrected by
  - a. surgery.
  - b. medication.
  - c. special diet.
  - d. replacement transfusion.
7. Hemophilia most frequently affects
  - a. children.
  - b. adults.
  - c. males.
  - d. females.
8. A baby with erythroblastosis must be treated
  - a. immediately after birth.
  - b. before the first birthday.
  - c. before he is taken from the hospital.
  - d. before he starts to school.
9. If your blood type is A- and you receive a transfusion of blood type O+
  - a. there will be no dangerous effects.
  - b. erythroblastosis might occur.
  - c. agglutination might occur.
  - d. hemophilia might occur.

10. The function of the red blood cells is to
  - a. fight infection.
  - b. carry oxygen to the tissues.
  - c. initiate the clotting of blood.
  - d. color the venous blood.
11. A reproduction problem involving the Rh factor incompatibility is called
  - a. phagocytosis.
  - b. erythroblastosis.
  - c. atherosclerosis.
  - d. leukemia.
12. Death is most likely to result when agglutinated blood passes through the
  - a. stomach and lungs.
  - b. stomach and liver.
  - c. lungs and liver.
  - d. heart and brain.
13. An anemic person usually appears
  - a. pale and tires easily.
  - b. bluish and breathes rapidly.
  - c. thin and wiry.
  - d. nervous and high-strung.
14. If your blood type is O+
  - a. it is a common type but does not contain the Rh factor.
  - b. it is a common type and contains the Rh factor.
  - c. you may receive blood of any type.
  - d. you may donate blood to any person.
15. Rh+ means that
  - a. the blood does not contain the Rh factor.
  - b. the blood can be donated to anyone.
  - c. the blood contains the Rh factor.
  - d. the blood is rich in hemoglobin.
16. There is no known cure for
  - a. erythroblastosis.
  - b. hemophilia.
  - c. leukemia.
  - d. b. and c.
17. The only kind of tissue in the body which is composed of cells and liquid plasma is called
  - a. lymph.
  - b. skeletal muscle tissue.
  - c. cardiac muscle tissue.
  - d. blood.
18. The function of the white blood cells is called
  - a. agglutination.
  - b. phagocytosis.
  - c. erythroblastosis.
  - d. reactivation.
19. An inherited blood substance first found in the blood of a monkey is the
  - a. Rh factor.
  - b. gamma globulin.
  - c. hemoglobin.
  - d. fibrinogen.

20. Anemia is caused by
- a decrease in white blood cells.
  - an increase in iron.
  - a hemoglobin deficiency.
  - a fibrinogen deficiency.
21. It is safe to donate a pint of blood about
- every 3-4 weeks.
  - every 2 weeks.
  - every 6-10 weeks.
  - every 12-16 weeks.
22. The four common blood types are
- A, B, C, O.
  - O, A, AB, B
  - A, B, AB, AC.
  - A, O, OC, AB.
23. The initiation of blood clotting is begun by the
- red cells.
  - white cells.
  - leucocytes.
  - platelets.
24. The Rh factor is found in
- 15 % of all humans.
  - 40 % of all humans.
  - 85 % of all humans.
  - 95 % of all humans.
25. The Rh factor may present a reproduction problem
- if both parents are Rh - .
  - if both parents are Rh+ .
  - if the mother is Rh - and the father is Rh+ .
  - if there is a family history of the problem.
26. An abnormal increase in the number of white blood cells causes a condition known as
- anemia.
  - leukemia.
  - hypertension.
  - arteriosclerosis.
27. It is not safe to lose at any given time more than
- one pint of blood.
  - two pints of blood.
  - 1-3 pints of blood.
  - $1\frac{1}{2}$ -2 pints of blood.
28. The body's natural defense against infection is called
- erythroblastosis.
  - phagocytosis.
  - lymphocytosis.
  - leukemia.
29. Agglutination of the red cells may be associated with
- transfusing with an incompatible blood type
  - anemia.
  - erythroblastosis.
  - a. and c.
30. The reaction of blood is
- slightly acid.
  - slightly alkaline.
  - neutral.
  - very acid.

31. Hemoglobin is a substance found in the
  - a. white cells.
  - b. red cells.
  - c. platelets.
  - d. plasma.
32. Mixture of incompatible bloods may result in
  - a. agglutination in the recipient's blood.
  - b. murmur in the recipient's heart.
  - c. atherosclerosis in the recipient's vessels.
  - d. hemorrhage by the recipient.
33. Parents-to-be with incompatible Rh factor types do not have to worry about the problem affecting the
  - a. first two babies.
  - b. first three babies.
  - c. second baby.
  - d. first baby.
34. Blood has a taste which is
  - a. slightly sweet and chalky.
  - b. slightly metallic and salty.
  - c. slightly acid.
  - d. slightly bitter.
35. Leukemia is commonly called
  - a. "tired blood".
  - b. "bleeder's disease".
  - c. "hardening of the arteries".
  - d. "cancer of the blood".
36. Assistance in preventing hemorrhage is supplied by the
  - a. white cells.
  - b. red cells.
  - c. platelets.
  - d. lymphocytes.
37. The one which is not a type of blood cell is the
  - a. red cell.
  - b. platelet.
  - c. white cell.
  - d. lymphatic cell.
38. Anemia is usually treated and corrected by
  - a. surgery.
  - b. a replacement transfusion.
  - c. prescribed medication and diet.
  - d. supplementing the diet with carbohydrates.
39. Oxygen is attracted into the blood by
  - a. white cells.
  - b. platelets.
  - c. hemoglobin.
  - d. plasma.
40. The Rh factor reproduction problem might affect
  - a. the first baby.
  - b. each baby after the first pregnancy.
  - c. each baby after the second pregnancy.
  - d. each baby after the third pregnancy.

41. Hemophilia is an hereditary disorder characterized by
  - a. too many red cells.
  - b. too many platelets.
  - c. inability of the blood to clot normally.
  - d. inability of the blood to become oxygenated.
42. Transfusions are successful only when
  - a. the donor's blood is O+ .
  - b. the blood types are correctly matched.
  - c. the blood types are determined to be compatible.
  - d. b. and c.
43. Hemorrhage may be associated with
  - a. leukemia.
  - b. hemophilia.
  - c. erythroblastosis.
  - d. heart attack.
44. The heart is divided into a right and left side by the
  - a. septum.
  - b. valve.
  - c. auricles.
  - d. ventricles.
45. Impure blood from the body tissues is returned to the heart and received in the
  - a. left auricle.
  - b. left ventricle.
  - c. right auricle.
  - d. right ventricle.
46. A gap or hole in that part of the septum which divides the ventricles of the newborn's heart causes a malady known as
  - a. anemia.
  - b. erythroblastosis.
  - c. murmur.
  - d. "blue baby".
47. The blood is kept flowing in the same direction in the heart by the
  - a. ventricles.
  - b. valves.
  - c. auricles.
  - d. coronary arteries.
48. The lower chambers of the heart are called
  - a. auricles.
  - b. ventricles.
  - c. valves.
  - d. a. and b.
49. The receiving chambers of the heart are called
  - a. valves.
  - b. auricles.
  - c. ventricles.
  - d. coronary arteries.
50. A condition associated with the heart valves is called
  - a. agglutination.
  - b. arteriosclerosis.
  - c. murmur.
  - d. "blue baby".

51. After impure blood is oxygenated in the lungs, it returns to the heart and is received in the
  - a. left auricle.
  - b. left ventricle.
  - c. right auricle.
  - d. right ventricle.
52. Impure blood is pumped to the lungs by the
  - a. left auricle.
  - b. left ventricle.
  - c. right auricle.
  - d. right ventricle.
53. The work of the heart is made possible primarily by
  - a. muscular contraction.
  - b. septal division.
  - c. auricular relaxation.
  - d. muscular striation.
54. A heart murmur is characterized by
  - a. a decrease in pulse rate.
  - b. a leakage of blood within the heart.
  - c. a defective septum.
  - d. a defective auricle.
55. Valves are located at the entrances and exits of the
  - a. auricles.
  - b. ventricles.
  - c. auricles and ventricles.
  - d. coronary arteries.
56. Oxygenated blood is pumped to all parts of the body by the
  - a. left auricle.
  - b. left ventricle.
  - c. right auricle.
  - d. right ventricle.
57. A "Blue Baby's" skin actually appears bluish because
  - a. the blood is flowing too slowly.
  - b. impure blood is mixing with pure blood.
  - c. the aorta is leaking.
  - d. a. and c.
58. Vessels which carry oxygenated blood to all parts of the body are called
  - a. capillaries.
  - b. arteries.
  - c. veins.
  - d. coronary arteries.
59. A degenerative arterial disease which is primarily caused by old age and characterized by gradual hardening of the arterial walls is called
  - a. arteriosclerosis.
  - b. atherosclerosis.
  - c. murmur.
  - d. hypertension.
60. Blood is carried away from the heart by the
  - a. veins.
  - b. arteries.
  - c. capillaries.
  - d. vessels.

61. A degenerative disease of the arteries, caused by deposits of fatty substances in their linings, is called
  - a. leukemia.
  - b. erythroblastosis.
  - c. atherosclerosis.
  - d. arteriosclerosis.
62. Arteriosclerosis causes the possible danger of
  - a. a blood clot in a coronary artery.
  - b. hemorrhage.
  - c. agglutination.
  - d. a. and c.
63. Hollow tubes through which the blood flows are called
  - a. arteries.
  - b. veins.
  - c. capillaries.
  - d. vessels.
64. Blood flows through all of the following vessels except the
  - a. lymphatic vessels.
  - b. arteries.
  - c. veins.
  - d. capillary vessels.
65. In atherosclerosis, the fatty deposits are mainly composed of
  - a. polysaccharides.
  - b. disaccharides.
  - c. cholesterol.
  - d. a. and b.
66. Vessels which have the thickest and most elastic walls are called
  - a. veins.
  - b. capillaries.
  - c. arteries.
  - d. lymphatics.
67. An artery which is affected by atherosclerosis is characterized by
  - a. thickened and hardened lining.
  - b. thin walls.
  - c. narrowed passageway through which the blood flows.
  - d. a. and c.
68. Impure blood is returned to the heart through the
  - a. arteries.
  - b. capillaries.
  - c. veins.
  - d. a. and c.
69. The capillaries are important because they
  - a. link the arteries and heart.
  - b. link the arteries and veins.
  - c. make it possible for blood to flow in a closed-circuit.
  - d. b. and c.
70. Atherosclerosis is most commonly associated with
  - a. heart attack.
  - b. erythroblastosis.
  - c. hemorrhage.
  - d. murmur.

71. Heart attack is a sudden illness associated with the
  - a. femoral arteries.
  - b. carotid arteries.
  - c. pulmonary arteries.
  - d. coronary arteries.
72. Blood is carried back and forth between the heart and lungs by the
  - a. hepatic branch of circulation.
  - b. systemic branch of circulation.
  - c. coronary branch of circulation.
  - d. pulmonary branch of circulation.
73. During the "resting phase" of the heart's work the
  - a. auricles rest.
  - b. ventricles rest.
  - c. valves rest.
  - d. entire heart rests.
74. Recent medical findings indicate that
  - a. most surviving heart attack victims can never return to their former occupations.
  - b. most surviving heart attack victims will have to live a very modified life.
  - c. many surviving heart attack victims are returning to work within a three-week period of time.
  - d. many surviving heart attack victims are leading normal or almost normal lives.
75. Which of the following is a normal blood pressure for your age group
  - a. 80/60.
  - b. 92/60.
  - c. 120/80.
  - d. 140/88.
76. A sudden blockage or rupture of a vessel causes a "stroke" which
  - a. is never fatal.
  - b. may range from moderate to severe.
  - c. may range from light to fatal.
  - d. severely handicaps the person for the rest of his life.
77. During the "contraction phase" of the heart's rhythm
  - a. the auricles contract.
  - b. the ventricles contract.
  - c. the auricles and ventricles contract.
  - d. the valves contract.
78. Apoplexy refers to a circulatory disorder in the
  - a. heart muscle.
  - b. aorta.
  - c. brain.
  - d. valves of the heart.
79. The normal pulse rate in the average adult is about
  - a. 40 beats per minute.
  - b. 58 beats per minute.
  - c. 72 beats per minute.
  - d. 92 beats per minute.
80. A gradual and permanent rise in blood pressure may be caused by
  - a. exercise.
  - b. scant diet.
  - c. chronic anemia.
  - d. aging.

81. A blood clot blockage predisposes
  - a. a murmur.
  - b. a heart attack.
  - c. a "Blue-Baby"
  - d. erythroblastosis.
82. The pulse rate will
  - a. vary with exercise.
  - b. increase during sleep.
  - c. decrease with hypertension.
  - d. increase shortly after exercise.
83. Blood pressure may be caused to vary by some of the same factors which cause
  - a. the pulse pressure to vary.
  - b. the pulse rate to vary.
  - c. the oxygen rate to vary.
  - d. b. and c.
84. a circulatory disorder of the brain is known as
  - a. erythroblastosis.
  - b. apoplexy.
  - c. hemophilia.
  - d. meningitis.
85. The "relaxation phase" of the heart's action is characterized by
  - a. relaxation of the auricles.
  - b. relaxation of the ventricles.
  - c. relaxation of the auricles and ventricles.
  - d. relaxation of the valves.
86. Apoplexy is characterized by
  - a. pain in the chest.
  - b. swelling of the ankles.
  - c. a blood clot or hemorrhage of a coronary artery.
  - d. a blood clot or hemorrhage in the brain.
87. Body tissues are supplied with blood which is transported by the
  - a. systemic branch of circulation.
  - b. pulmonary branch of circulation.
  - c. coronary branch of circulation.
  - d. hepatic branch of circulation.
88. During sleep, the heart
  - a. rests.
  - b. slows its beating pace.
  - c. continues to beat at its normal pace.
  - d. beats slower than at any other time.
89. Persistently high blood pressure is characteristic of a condition technically called
  - a. arteriosclerosis.
  - b. atherosclerosis.
  - c. heart attack.
  - d. hypertension.
90. The heart, as a working muscle, requires for itself a blood supply which is carried by the
  - a. systemic branch of circulation.
  - b. pulmonary branch of circulation.
  - c. coronary branch of circulation.
  - d. hepatic branch of circulation.

91. Shortly after a period of physical exercise, the healthy heart
  - a. continues to beat at an increased rate.
  - b. pumps more blood.
  - c. slows down to its normal pace.
  - d. has to work harder to get more oxygen into the blood.
92. Apoplexy may be described by all of the following statements except
  - a. it is a circulatory disorder of the heart.
  - b. it usually occurs among the aged.
  - c. it results in either a vessel blockage or hemorrhage.
  - d. it may range from light to fatal.
93. The force with which the blood pushes against the arterial walls is measured by
  - a. pulse pressure.
  - b. blood pressure.
  - c. cardiac pressure.
  - d. contraction pressure.
94. Hypertension is usually a cause of
  - a. heart attack.
  - b. apoplexy.
  - c. murmur.
  - d. a. and b.
95. Hypertension may result from any or all of the following except
  - a. diet lacking in polysaccharides.
  - b. undue and prolonged physical and emotional stress.
  - c. arteriosclerosis.
  - d. atherosclerosis.
96. Although the underlying cause of a heart attack may have been developing over a long period of time
  - a. the person is always aware of the developing trouble.
  - b. the physician can detect it by use of X-ray.
  - c. the attack itself is usually sudden.
  - d. the symptoms are slow to develop during the attack.
97. Apoplexy is usually caused by
  - a. atherosclerosis and hypertension.
  - b. arteriosclerosis and hypotension.
  - c. hypertension and heredity.
  - d. hypertension and arteriosclerosis.
98. Hypertension will gradually cause
  - a. anemia.
  - b. weakening of the veins.
  - c. murmur.
  - d. weakening of the heart.
99. The first heart attack
  - a. is nearly always fatal.
  - b. is never fatal.
  - c. may range from moderate to severe.
  - d. may range from mild to fatal.
100. Apoplexy usually occurs most frequently in
  - a. children.
  - b. males.
  - c. middle aged.
  - d. aged.

APPENDIX G  
ANSWER SHEET SHOWING KEY FOR TEST ANSWERS  
ANSWER SHEET --- HEALTH ---

Place the answer you select in the blank beside the question number.

Name \_\_\_\_\_ Section \_\_\_\_\_ Date \_\_\_\_\_

d	26.	b	51.	a	76.	c
d	27.	a	52.	d	77.	b
c	28.	b	53.	a	78.	c
d	29.	d	54.	b	79.	c
b	30.	b	55.	b	80.	d
d	31.	b	56.	b	81.	b
c	32.	a	57.	b	82.	a
a	33.	d	58.	b	83.	b
c	34.	b	59.	a	84.	b
b	35.	d	60.	b	85.	b
b	36.	c	61.	c	86.	d
d	37.	d	62.	b	87.	a
a	38.	c	63.	d	88.	d
b	39.	c	64.	a	89.	d
c	40.	b	65.	c	90.	c
d	41.	c	66.	c	91.	c
d	42.	d	67.	d	92.	a
b	43.	b	68.	c	93.	b
a	44.	a	69.	d	94.	d
c	45.	c	70.	a	95.	a
c	46.	d	71.	a	96.	c
b	47.	b	72.	d	97.	d
d	48.	b	73.	d	98.	d
c	49.	b	74.	d	99.	d
c	50.	c	75.	c	100.	d

APPENDIX H

THE CIRCULATORY SYSTEM: A PRACTICAL APPROACH

The Program

OLD COUNCIL HOUSE  
BOND STREET  
OCTOBER 1958

NAME \_\_\_\_\_  
SECTION \_\_\_\_\_

TO THE STUDENT

This new type of textbook is called a "Program". The material to be learned is presented in small steps or units called "frames". Each frame contains (1) a small amount of material for you to read thoroughly and (2) a question pertaining to that material. You are to write a correct response in the space provided beside each question. The correct answers for the questions are listed in the left margin of each page. You are to cover the entire list of answers with the "slider" that is provided. After you have written your answer, move the "slider" downward just enough to expose the correct answer to that question, and check your answer. If your answer is correct, proceed to the next frame; if it is not correct, go back and re-study the material so that you can understand it and write the correct answer. You must proceed through the book in this manner. DO NOT SKIP ANY FRAMES !

This program is designed to let you progress through it at your own rate (speed) of learning. DO NOT RUSH ! It is suggested that you work on the program during times when there will be a minimum of interference or distractions.

- 
- \*\*\* PLEASE NOTE: If a question blank is preceded by:
1. no star = response is only one word
  2. one star = response contains more than one word
  3. two stars = write response in your own words
- 

EXAMPLES:

ANSWERS

red

1. Blood is a red liquid which flows through the body.

The color of blood is \_\_\_\_\_.

---

2. Blood is a red liquid which flows through the body.

through the body

Blood flows \* \_\_\_\_\_.

---

3. Blood may be defined as a red liquid which flows through the body.

Blood is a red liquid which flows through the body.

Write a definition of blood.

\*\* \_\_\_\_\_

---

**STUDENT EVALUATION:**

After completing the program, tear out this sheet and write on it your reactions to this type of instruction.

PART 1

A GENERAL INTRODUCTION  
TO  
THE CIRCULATORY SYSTEM

ANSWERS

MEET A MAN OF IMPORTANCE!



*Hi! My name is "Circulation Charlie". You'll be seeing a lot of me in your program. I'm in your corner!*

1. The circulatory system provides life-support vital to the human body.

provide life-support to the body

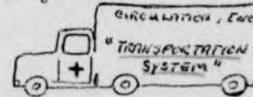
The vital purpose of the circulatory system is to \* \_\_\_\_\_.

the circulatory system provides life support to the body

2. Why is the circulatory system important to the human body? \*\* \_\_\_\_\_

transportation system

3. The circulatory system is commonly thought of as the \* \_\_\_\_\_ of the body.



(1) provide life-support to the body  
(2) transportation system

4. The circulatory system, whose purpose is to (1) \* \_\_\_\_\_, is commonly called the (2) \* \_\_\_\_\_.

by transporting the materials needed by the body.



"CHARLIE"

How do I "support life"?

\* \_\_\_\_\_

transporting the materials needed by the body.

6. Just as the engine is responsible for transporting the materials needed to make a car function, the circulatory system is vital to body function by \* \_\_\_\_\_.

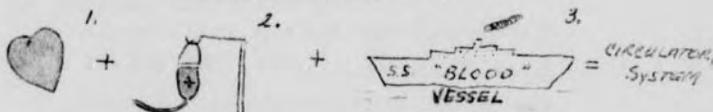
- (1) transportation system
- (2) provide life-support to the body.
- (3) transporting materials needed by the body for the maintenance of life.

7. The purpose of the circulatory system, commonly called (1)\* \_\_\_\_\_, is to provide (2)\* \_\_\_\_\_ by (3)\* \_\_\_\_\_

- 1. heart
- 2. blood
- 3. blood vessels

8. The three parts of the circulatory system are:

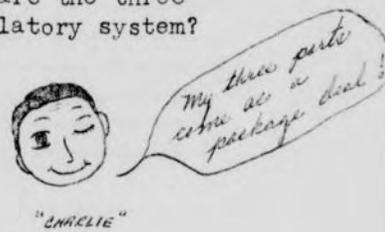
- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_



9. Which of the following are the three parts of the circulatory system?

b., d., f.

- a. spleen
- b. heart
- c. brain
- d. blood
- e. liver
- f. blood vessels



10. The parts of an irrigation system are similar in nature to the parts of the circulatory system.

no response

<u>IRRIGATION</u>		<u>CIRCULATION</u>
Pump	← "motor" →	Heart
Water	← "liquid" →	Blood
Hose	← "pipe-line" →	Blood vessels

heart

11. The circulatory system contains a pump which is an organ called the \_\_\_\_\_.



blood

12. The liquid part of the circulatory system is called \_\_\_\_\_.



18. Blood is a (1) \_\_\_\_\_ composed of which two of these substances: (2) \_\_\_\_\_

- (1) tissue
- (2) b. and c.

- a. vitamins
- b. cells
- c. liquid plasma
- d. bile

19. Using the material from the first three frames, write a definition of blood.

a tissue composed of cells and liquid plasma

Blood is \*\* \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_.

20. A household bucket holds about the same quantity of liquid as there is blood in the average adult body—about \* \_\_\_\_\_.



six quarts

21. The average adult body contains about \* \_\_\_\_\_ of blood.

six quarts



"AVERAGE ARTHUR"

22. Small amounts of blood, such as donating one pint every 6 to 10 weeks, may be safely spared at proper intervals.

- (1) one pint
- (2) 6 to 10 weeks

The body can safely spare (1)\* \_\_\_\_\_ of blood at intervals of every (2)\* \_\_\_\_\_.



"SAMARITAN SUSIE"  
"PAYS IT SOBE!"

23. When you donate blood, the technician never takes more than \_\_\_\_\_

- c.
- a. 2 pints
- b. 2 quarts
- c. 1 pint
- d.  $1\frac{1}{2}$  pints

- (1) one pint  
(2) every 6 to 10 weeks

24. It is safe to donate (1)\* \_\_\_\_\_  
of blood at intervals of about  
(2)\* \_\_\_\_\_.



25. Blood has a slightly metallic and salty taste.

The taste of blood is not very pleasant;  
it tastes <sup>slightly</sup> \_\_\_\_\_  
and \_\_\_\_\_.

salty  
metallic



26. Blood tastes like sea water and aluminum.

It is (1) \_\_\_\_\_ and (2) \_\_\_\_\_

salty  
metallic

27. As opposed to acid, the blood is slightly alkaline in reaction.

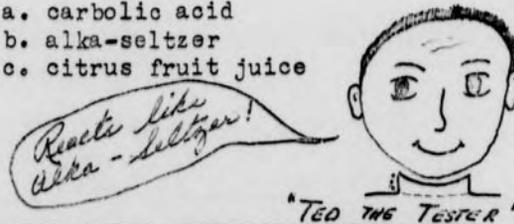
alkaline reaction

The blood has a slightly \* \_\_\_\_\_  
\_\_\_\_\_.

28. In a lab test, the reaction of blood may be compared to the reaction of:

b.

- a. carbolic acid
- b. alka-seltzer
- c. citrus fruit juice



alkaline reaction

29. If life is to continue, the blood must maintain its slightly \* \_\_\_\_\_  
\_\_\_\_\_.

30. It is time for a quick review on what you've learned about the blood.  
THINK NOW!

a tissue composed of cells  
and liquid plasma

Your definition of blood was:\*\* \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

six quarts

31. The average adult body contains about  
\* \_\_\_\_\_ of blood.



- (1) one pint
- (2) 6 to 10 weeks

32. It is safe to donate (1)\* \_\_\_\_\_  
of blood about every



(2)\* \_\_\_\_\_.

*Remember me?*

*"Remember me?"*

- (1) metallic
- (2) salty

33. The taste of blood is slightly (1) \_\_\_\_\_  
and (2) \_\_\_\_\_.



*Ugh!*

*"Taste and Texture"*

alkaline reaction

34. A laboratory test will show that blood  
has a slightly \* \_\_\_\_\_.



*Reacts like  
"Bicarb" too!!*

*"Test the Testes"*

35. Blood contains red cells, white cells,  
and platelets.

- (1) red
- (2) white
- (3) platelets

There are three kinds of cells in the  
blood:

(1) \_\_\_\_\_ cells, (2) \_\_\_\_\_ cells and (3) \_\_\_\_\_



*I contain 3  
kinds of  
cells!*

red

36. The color of the bullfighter's cloak  
is the same as the \_\_\_\_\_ cells  
in the blood.

white

37. The color of a bride's dress is the same  
as the \_\_\_\_\_ cells of the blood.

platelets

38. A "small plate" might help you to remember the third type of blood cell called \_\_\_\_\_.

- (1) red
- (2) white
- (3) platelets

39. Blood is composed of (1) \_\_\_\_\_ cells, (2) \_\_\_\_\_ cells, and (3) \_\_\_\_\_.



"THE BRIDE"



"A LITTLE ONE!"

- (1) oxygen
- (2) red blood cells

40. The body tissues need (1) \_\_\_\_\_ which is carried to them by the (2)\* \_\_\_\_\_.



"RUBY THE RED CELL"

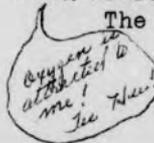
- (1) oxygen
- (2) red cells

41. Body tissues are supplied with (1) \_\_\_\_\_ by the (2)\* \_\_\_\_\_.

42. The red cells contain an important substance called hemoglobin, (he'-mow-glow-ben), which attracts the oxygen that is to be carried to the body tissues.



"HELEN HEMOGLOBIN"



- (1) hemoglobin
- (2) attracts oxygen
- (3) carried to the body tissues

The important substance in the red cells is (1) \_\_\_\_\_ which (2)\* \_\_\_\_\_ that is to be (3)\* \_\_\_\_\_.

43. Formulate a meaningful statement by using these "key" words:

The red cells contain hemoglobin which attracts oxygen to be carried to the body tissues.

HEMOGLOBIN, RED CELLS, OXYGEN, BODY TISSUES, CARRIED, ATTRACTS.

\*\*

To carry oxygen to all body tissues.

44. The function of the red cells is \_\_\_\_\_.

45. White blood cells fight infection by phagocytosis. (fag-oh-sigh-toe'-sis)



"CHARLIE"

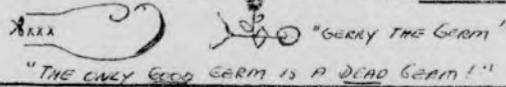
Practice saying it aloud! spell it loud!

- (1) white
- (2) fight infection
- (3) phagocytosis

The function of the (1) \_\_\_\_\_ cells is to (2)\* \_\_\_\_\_ by a process known as (3) \_\_\_\_\_.

- (1) infection
- (2) white cells
- (3) phagocytosis

46. Just as a soldier fights the enemy,  
 an enemy of the body, (1) \_\_\_\_\_,  
 \_\_\_\_\_, is fought off by  
 the (2)\* \_\_\_\_\_ through  
 a process called (3) \_\_\_\_\_.



- (1) infection
- (2) white cells
- (3) phagocytosis

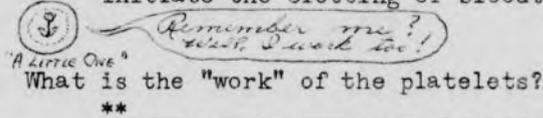
47. When you cut your finger, you are  
 protected from (1) \_\_\_\_\_  
 by the (2)\* \_\_\_\_\_ through  
 a process called (3) \_\_\_\_\_.

- (1) white cells
- (2) fight infection
- (3) phagocytosis

48. The function of the (1)\* \_\_\_\_\_  
 is to (2)\* \_\_\_\_\_ by a  
 process called (3) \_\_\_\_\_.

Platelets initiate the  
 clotting of blood.

49. The platelet cells of the blood  
 initiate the clotting of blood.



- (1) platelet
- (2) initiate the clotting  
 of blood

50. Just as freezing temperature is neces-  
 sary to turn water into ice, the  
 blood needs (1) \_\_\_\_\_ cells  
 to (2)\* \_\_\_\_\_.

- (1) platelets
- (2) initiate the clotting  
 of blood

51. Hemorrhage is prevented by the help-  
 ful function of the (1) \_\_\_\_\_  
 which serve to (2)\* \_\_\_\_\_.

blood types are correctly  
 matched.

52.



*You should know your blood  
 type! In case of emergency  
 it would save your life!*

Because blood types differ among people,  
 blood transfusions depend upon  
 correct matching of blood types.

Transfusions are successful only when  
 \* \_\_\_\_\_.

53. Is this statement "true" or "false" ?

In order for a transfusion to be suc-  
 cessful, the blood types must be  
 correctly matched, or compatible.

true

matching of blood types\  
or blood type.

54. An important factor in the successful  
transfusion of blood is the  
correct \* \_\_\_\_\_.



\_\_\_\_\_.

55.



*We may look alike!  
But there's really  
quite different!!*

There are four common blood types:

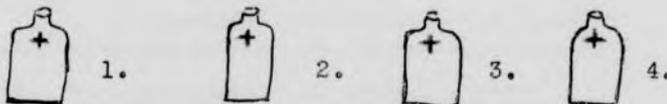
The four common types of blood are:

- (1) A
- (2) B
- (3) AB
- (4) O

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_
- (3) \_\_\_\_\_
- (4) \_\_\_\_\_

- 1. A
- 2. B
- 3. AB
- 4. O

56. Name the four types of blood by labelling  
the bottles:



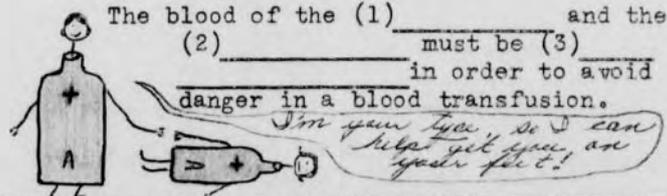
57. List the four common blood types:

- (1) A
- (2) B
- (3) AB
- (4) O

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_
- (3) \_\_\_\_\_
- (4) \_\_\_\_\_

58. In order to be transfused, the blood  
of a donor must be compatible with  
that of the recipient.

- (1) donor
- (2) recipient
- (3) compatible



59. Before a donor can give blood to some-  
one who is in need of it, the  
donor's blood must be typed and  
determined to be \*\* \_\_\_\_\_

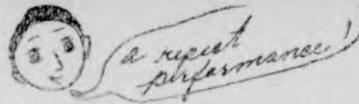
compatible with the blood  
of the recipient.

blood that is compatible  
with his.

60. If a person needs blood, he must be  
transfused with \*\* \_\_\_\_\_



68.



Label each bottle of blood, using the four common blood type letters.

- 1. A
- 2. B
- 3. AB
- 4. O



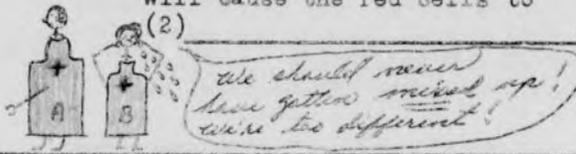
compatible with the recipient's blood.

69. The donor's blood must be \*\* \_\_\_\_\_.



- (1) incompatible
- (2) agglutinate

70. Mixture of (1) \_\_\_\_\_ bloods will cause the red cells to (2) \_\_\_\_\_.



- (1) death
- (2) heart
- (3) brain

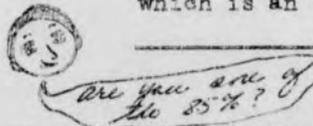
71. Agglutinated blood may cause (1) \_\_\_\_\_ as it passes through the



- (1) 85
- (2) Rh factor
- (3) inherited substance found in the blood.

72. The Rh factor is an inherited substance found in the blood of 85% of the human race.

(1) \_\_\_\_\_ % of all people have blood containing the (2)\* \_\_\_\_\_ which is an (3)\* \_\_\_\_\_.



- (1) Rh factor
- (2) an inherited substance found in the blood of 85% of the human race.

73. 15% of the human race have blood not containing the (1)\* \_\_\_\_\_ which is defined as (2)\* \_\_\_\_\_.

74. The Rh factor was so named because it was first discovered in the blood of the Rhesus monkey.

Rhesus monkey

The Rh factor was first discovered in the \* \_\_\_\_\_.



75. The Rh factor is named for which of the following animals: ?
- "Rickey" the Rooster
  - "Rob" the Rabbit
  - "Rhesus" the Monkey
  - "Race" the Raccoon

the Rh factor is an inherited substance found in the blood of 85% of all humans.

76. Name and define the substance first found in the blood of the Rhesus monkey.
- \*\*

77.



*You're "positive" with it and "negative" without it!*

Blood which contains the Rh factor is typed as "Rh positive" ( Rh + ).  
Blood not containing the Rh factor is typed as "Rh negative" ( Rh - ).

- contains the Rh factor
- does not contain the Rh factor

Rh+ means that the blood (1)\*\*  
Rh- means that the blood (2)\*\*

- Rh positive
- contains the Rh factor

78.



*I'm one of the 85%. My blood is (1)\*. That means it (2)\*.*

*"POSITIVE FETE"*

- Rh negative
- does not contain the Rh factor

79.



*I'm in the MINORITY & My blood is (1)\*. That means it (2)\*.*

*"NEGATIVE MAN"*

80.



*EXTRA!  
EXTRA!*

Here's an example of what your blood type might be:

O+ (your blood belongs to group "O" and contains the Rh factor.)

no response

This ( O+ ) is the most common blood type.

81. The Rh factor is found in the blood of what per cent of the total population?

- 25%
- 50%
- 85%



*It's time for a quick review!*

- (1) Rhesus monkey
- (2) Rh<sup>+</sup>
- (3) Rh<sup>-</sup>

82. The Rh factor was first discovered in the blood of the (1)\*  
 \_\_\_\_\_ . 85% of the human  
 race have (2)\* \_\_\_\_\_ blood;  
 15% have (3)\* \_\_\_\_\_ blood.

83. Recall that the Rh factor is hereditary. This factor might present a reproduction problem, for the physician to handle, only if a pregnant mother is "Rh negative" and the father is "Rh positive".

If the pregnant mother is Rh negative and the father is Rh positive.

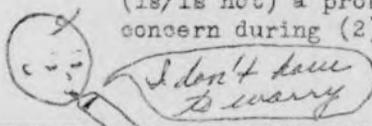
Under what principle condition might the Rh factor cause a problem in reproduction? \*\* \_\_\_\_\_

the wife is Rh negative and the husband is Rh positive.

84. An Rh factor problem of concern for the physician occurs when\*\* \_\_\_\_\_

- (1) is not
- (2) pregnancy or reproduction

85. If the husband and wife's Rh factors are the same, there (1) \_\_\_\_\_ (is/is not) a problem of possible concern during (2) \_\_\_\_\_.



86. The first baby is not affected by the unlike Rh types of the parents.



*We're one more happy family.*

If the Rh types of the parents differ, the difference does not affect the \* \_\_\_\_\_ born to them.

first baby

87. If the parents' Rh types differ, which baby will not be affected?

a.

- a. first \_\_\_\_\_
- b. second \_\_\_\_\_
- c. third \_\_\_\_\_

- (1) Rh<sup>-</sup>
- (2) Rh<sup>+</sup>
- (3) will not be affected.

88. If a wife, who is typed (1)\* \_\_\_\_\_ has a husband typed (2)\* \_\_\_\_\_, becomes pregnant for the first time, the baby\*\* \_\_\_\_\_.

89. Each baby, after the first, may be affected by the unlike Rh types of the parents.



*Why couldn't I have been first!*

The first baby isn't affected but \*\* \_\_\_\_\_

each baby after the first may be affected by the Rh factor pregnancy problem.

- (1) mother
- (2) Rh -
- (3) father
- (4) Rh+
- (5) the first baby is unaffected. Each baby thereafter may be affected by the different Rh factor types of the parents.

90. The Rh factor might present a reproduction problem if the blood type of the (1) \_\_\_\_\_ is (2) \_\_\_\_\_ and the blood type of the (3) \_\_\_\_\_ is (4) \_\_\_\_\_.

What are the possible consequences of this problem for the parents who plan to have a large family? (5)\*\* \_\_\_\_\_

91. The illness, in newborn babies, resulting from the Rh factor is called, "Erythroblastosis".  
(ee-ree-throw-blas-toe'-sis)

- (1) newborn babies
- (2) erythroblastosis

The Rh factor disorder which affects (1)\* \_\_\_\_\_ is called (2) \_\_\_\_\_.



*It's a big word for such a little one! But you can say it by practicing aloud.*

92. The technical name for the Rh factor disorder in newborn babies is (1) \_\_\_\_\_.

- (1) erythroblastosis
- (2) any pregnancy after the first

During which pregnancy/s might this occur? (2)\*\* \_\_\_\_\_

93. In erythroblastosis, the babies' red blood cells agglutinate.

- (1) agglutinate
- (2) erythroblastosis

The red cells will (1) \_\_\_\_\_ in the blood of the newborn baby who has (2) \_\_\_\_\_.



*Here's that word again! Agglutination!*

- (1) incompatible
- (2) mixed or transfused
- (3) agglutinate
- (4) erythroblastosis

94. Just as the blood cells will "clump" if (1) \_\_\_\_\_ blood types are (2) \_\_\_\_\_, they will also (3) \_\_\_\_\_ in a baby stricken with (4) \_\_\_\_\_.



*Our mixed cells do the same thing as the baby's!*

95. Erythroblastosis is corrected by a "replacement transfusion" immediately after birth.



*The "Doc" replaced my "suk" blood with a healthy kind!*

erythroblastosis is corrected by a replacement transfusion immediately after birth.

How and when is erythroblastosis corrected?  
\* \_\_\_\_\_

- (1) by a replacement transfusion  
 (2) immediately after birth

96. Erythroblastosis is corrected by a  
 (1)\* \_\_\_\_\_, when?  
 (2)\* \_\_\_\_\_.



*Newborn liver is a  
 fibrous hard ready  
 to plug!*

during any pregnancy after the  
 first if the mother is Rh - and  
 the father is Rh + .

97. Under what condition might the Rh  
 factor present a problem of con-  
 cern for the physician ?

\*\* \_\_\_\_\_

98. The first baby of parents who have  
 unlike Rh types:

- a. is not affected  
 b. may be affected \_\_\_\_\_.



*2-2-2*

each baby after the first

99. The Rh pregnancy problem may affect  
 \*\* \_\_\_\_\_  
 (which babies?)

100. Supply the missing words:

- (1) erythroblastosis  
 (2) the mother has Rh - blood and  
 the father has Rh+ blood  
 (3) the first pregnancy  
 (4) agglutinate  
 (5) immediately  
 (6) replacement transfusion

Newborn babies may be affected by a  
 condition known as (1) \_\_\_\_\_.  
 This condition will only occur if  
 (2)\*\* \_\_\_\_\_  
 \_\_\_\_\_ and after the (3)\*  
 \_\_\_\_\_ (which pregnancy/s).  
 The red blood cells of the infant  
 will (4) \_\_\_\_\_ and may  
 cause death if not corrected  
 (5) \_\_\_\_\_ (when?) by a  
 (6)\* \_\_\_\_\_ (how).

101.



*Remember the word  
 "HEMOGLOBIN"?*

Anemia (uh-knee'-me-uh) is a blood  
 disorder caused by a deficiency of  
 hemoglobin in the red blood cells.

- (1) deficiency of hemoglobin  
 in red blood cells  
 (2) anemia

A blood disorder characterized by  
 (1)\* \_\_\_\_\_  
 \_\_\_\_\_ is called (2) \_\_\_\_\_.

102. Deduct the following answers:

HEMOGLOBIN DEFICIENCY = BLOOD DISORDER =

anemia

103. You will not be allowed to donate a pint of blood if your blood test showed you to have a condition called (1) \_\_\_\_\_, which is caused by (2)\* \_\_\_\_\_.

- (1) anemia
- (2) a deficiency of hemoglobin in the red blood cells

104. An anemic (uh-knee'-mick) person usually appears very pale and tires easily.



If your blood test showed you to be anemic what two symptoms would you probably have?

- (1) appear pale
- (2) tire easily

(1)\* \_\_\_\_\_  
 (2)\* \_\_\_\_\_

105. Solve the following equation by using the symptoms of the blood disorder:

pale appearance and tires easily

ANEMIA = \*\* \_\_\_\_\_ + \*\* \_\_\_\_\_

106. The two characteristic symptoms of anemia are:

- (1) appears pale\or paleness
- (2) tires easily\or tiredness

(1)\*\* \_\_\_\_\_  
 (2)\*\* \_\_\_\_\_

107. Anemia is easily treated and corrected by prescribed medication and diet.



"ANDY ANEMIA"

- (1) diet
- (2) medication

The treatment for anemia is (1) \_\_\_\_\_ and (2) \_\_\_\_\_ which are prescribed by the physician.

108. Which two of the following treatments are prescribed for anemia?

a. and c.

- a. an appropriate diet
- b. bed rest
- c. appropriate medication
- d. surgery

109. Draw lines to connect words in Column I which are associated with words in Column II:

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_
- 4. \_\_\_\_\_
- 5. \_\_\_\_\_
- 6. \_\_\_\_\_
- 7. \_\_\_\_\_
- 8. \_\_\_\_\_

- |                          |                             |
|--------------------------|-----------------------------|
| 1. simple blood disorder | 1. anemic                   |
| 2. deficiency            | 2. phagocytosis             |
| 3. symptoms              | 3. anemia                   |
| 4. treatment             | 4. hemoglobin               |
| 5. descriptive adjective | 5. vigorous exercise        |
|                          | 6. agglutination            |
|                          | 7. diet and medication      |
|                          | 8. paleness and tire easily |

110. A second and more serious blood disease, caused by an abnormal increase in the number of white blood cells, is called leukemia. (loo-key'-me-uh)



*Too many of us guys  
far out (leukemia)*

A serious disease associated with white cells is called (1) \_\_\_\_\_ which is caused by (2)\* \_\_\_\_\_.

- (1) leukemia  
(2) abnormal increase in white blood cells

111. An abnormal increase in the number of white cells causes the blood disease known as:

b.

- a. erythroblastosis  
b. leukemia \_\_\_\_\_  
c. agglutination  
d. anemia

112. Frame #111 lends itself to a review for you! Put on your thinking cap and breeze through the review!

each baby  
erythroblastosis

The first baby of parents with unlike Rh factors will be normal, but \* \_\_\_\_\_, after the first, might have a disease called \_\_\_\_\_.

113. The clumping of red blood cells, as in erythroblastosis, is called \_\_\_\_\_.

agglutination

114. A deficiency in (1) \_\_\_\_\_ causes a blood disorder known as (2) \_\_\_\_\_.

- (1) hemoglobin  
(2) anemia

115. Define leukemia to include the causes:

a serious blood disease caused by an abnormal increase in the number of white blood cells.

\*\* \_\_\_\_\_  
\_\_\_\_\_.

116. Use the following "key" words to make a complete definition of leukemia:

leukemia is a blood disorder caused by an abnormal increase in the number of white cells.

ABNORMAL, CELLS, DISORDER, WHITE, BLOOD, INCREASE, LEUKEMIA, NUMBER

\*\* \_\_\_\_\_  
\_\_\_\_\_.

117. Leukemia is commonly referred to as "cancer of the blood".

cancer of the blood

A common name for leukemia is \* \_\_\_\_\_.

118. Just as hemophilia is commonly called "bleeder's disease" leukemia is commonly called:
- "tired blood"
  - "stitch in the side" \_\_\_\_\_
  - "cancer of the blood"
  - "inner ear trouble"

c.

119. There is no known cure for leukemia.



*Just can't figure this one out!*

"DR. DAN"

Unfortunately "cancer of the blood", technically called (1) \_\_\_\_\_, cannot be (2) \_\_\_\_\_.

- leukemia
- cured

120. Leukemia, commonly called (1)\* \_\_\_\_\_ is a very serious disease caused by (2)\* \_\_\_\_\_.

- "cancer of the blood"
- an abnormal increase in the number of white blood cells
- there is no known cure

The disease is fatal because (3)\*\* \_\_\_\_\_.

121. Hemophilia (he-mow-filly'-uh), commonly called "bleeder's disease", is an hereditary disease characterized by inability of the blood to clot within the normal time limit.

An hereditary blood disease called (1) \_\_\_\_\_, and commonly referred to as (2)\* \_\_\_\_\_, is due to the (3)\* \_\_\_\_\_.

- hemophilia
- bleeder's disease
- inability of the blood to clot within the normal time limit.

122. The blood clotting time in people not afflicted by (1) \_\_\_\_\_, averages about (2)\* \_\_\_\_\_.



*The overall clotting time is about 5 minutes!*

- hemophilia
- 5 minutes

- 123.



*It's most commonly seen in males - They're called "Bleeders"!*

"Bleeder's disease", technically known as (1) \_\_\_\_\_, predominantly affects (2) \_\_\_\_\_ who are referred to as (3) \_\_\_\_\_ because (4)\*\* \_\_\_\_\_.

- hemophilia
- males
- "bleeders"
- their blood is unable to clot within the normal time limit of 5 minutes.

124. A hemophiliac (he-moe-filly'-ak), commonly called a "bleeder", always faces the dangerous possibility of hemorrhage because (1)\*\* \_\_\_\_\_.

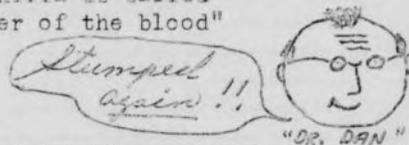
- (1) his blood won't clot within the normal time limit of 5 minutes
- (2) males

This condition is most commonly seen in (2) \_\_\_\_\_.

125. Like leukemia:

- a. hemophilia affects the white cells
- b. hemophilia has no known cure
- c. hemophilia is called "cancer of the blood"

b. \_\_\_\_\_



126. A serious hereditary blood disease, which often causes hemorrhage, affects mostly (1) \_\_\_\_\_ who are commonly referred to as (2) \_\_\_\_\_. This condition is called (3) \_\_\_\_\_ and is caused by (4)\*\* \_\_\_\_\_.

- (1) males
- (2) "bleeders"
- (3) hemophilia
- (4) inability of the blood to clot within the normal time of 5 minutes.
- (5) is not

There (5) \_\_\_\_\_ (is/ is not) a cure for this disease.

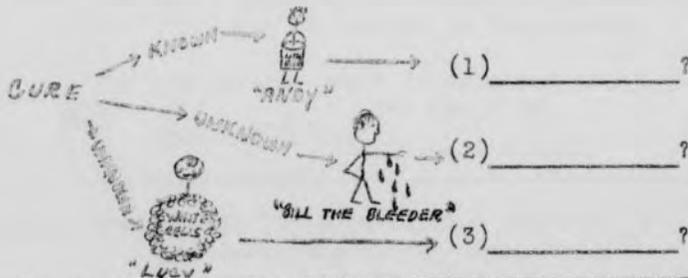
127. You've just finished PART II ! Before proceeding to PART III, let's quickly review the three common blood disorders !



no response

128. Name the diseases to which this diagram refers.

- (1) anemia
- (2) hemophilia
- (3) leukemia



129. Match the letters in Column II with the numbers in Column I.

- e 1.
- c 2.
- b 3.
- a 4.
- d 5.

- 1. "bleeder" a. erythroblastosis
- 2. "cancer of the blood" b. anemia
- 3. hemoglobin deficiency c. leukemia
- 4. pregnancy problem d. agglutination
- 5. "clumping" of red cells e. hemophilia
- f. dyspepsia
- g. phagocytosis

- (1) hemoglobin deficiency
- (2) abnormal increase in the number of white cells
- (3) inability of blood to clot in average time of 5 minutes.

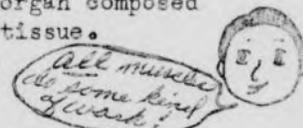
130. Anemia is caused by (1)\*\* \_\_\_\_\_  
Leukemia is caused by (2)\*\* \_\_\_\_\_  
Hemophilia is caused by (3)\*\* \_\_\_\_\_

### PART III

#### THE HEART: A PART OF THE CIRCULATORY SYSTEM

131. The heart is a hollow organ composed mostly of muscle tissue.

\*\*\*SEE PANEL I, page 21.



- (1) hollow organ
- (2) muscle tissue

The pump of the circulatory system is actually a (1)\* \_\_\_\_\_ composed mostly of (2)\* \_\_\_\_\_

muscle

132. The biceps is a muscle which flexes the arm; the heart is a \_\_\_\_\_ which pumps blood to all parts of the body.

133. The heart is about the size of a person's fist and is located in the chest.

- (1) fist
- (2) chest

The size of the heart is compared to a (1) . The heart is located in the (2) \_\_\_\_\_.

134. Study PANEL II, page 21, and write a statement describing where the heart is located:

- (1) fist
- (2) near the mid-line of the chest and directed slightly to left

The heart is about the size of a (1) \_\_\_\_\_ and is located (2)\* \_\_\_\_\_

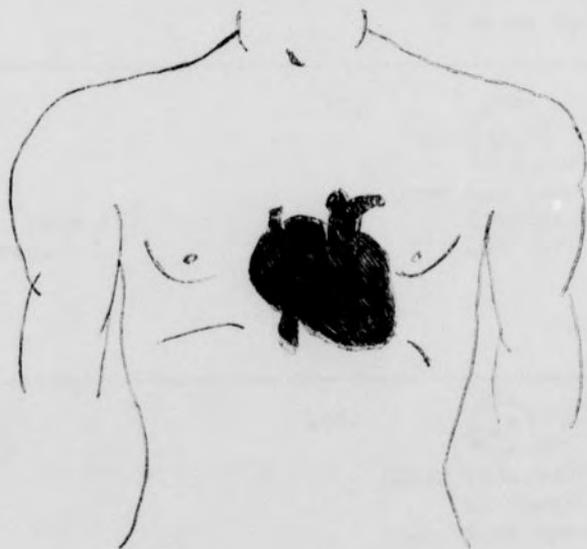
PANEL I

EXTERNAL VIEW OF THE HEART



PANEL II

LOCATION OF THE HEART



- near mid-line of the chest
- directed slightly to the left

135. Many people think that the heart is completely situated in the left side of the chest.

the heart is near the mid-line of the chest and directed slightly to the left.

After studying PANEL II, page 21, disprove this erroneous belief.

\*\*

- (1) muscle  
(2) fist  
(3) near the mid-line of the chest and directed slightly to left.

136. The heart is a working (1) \_\_\_\_\_ which is about the size of a (2) \_\_\_\_\_ and is located (3) \*\* \_\_\_\_\_

137. The heart is divided into a right and left side by a muscular wall called the septum.

\*\*\* See PANEL III, page 23, and note that "right" and "left" is referring to the heart as it is contained in the body --- not as you look at it.

- (1) septum  
(2) muscular wall

The interior of the heart is vertically bisected by the (1) \_\_\_\_\_ which is a (2)\* \_\_\_\_\_.

septum

138. Just as a wall partition makes one large room become two small rooms; the heart is divided into two sides by the \_\_\_\_\_.

turn to PANEL III, page 23, to check your answer.

139.



*Study Panel III, page 23, Again!!*

Draw and label that structure which divides the heart into right and left sides.



140.



*See Panel III*

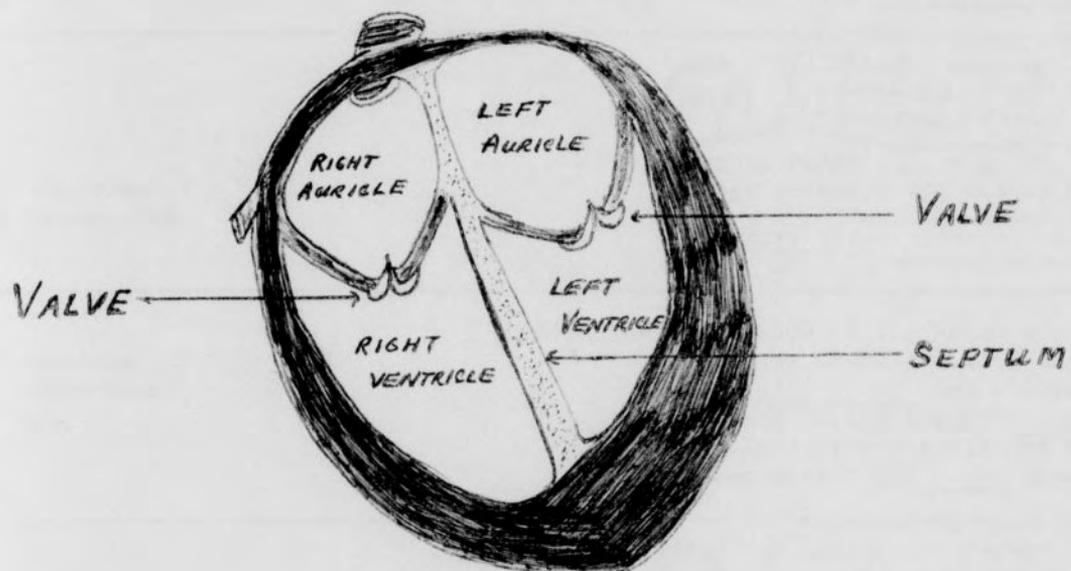
Each side of the heart is divided into an upper and lower chamber making four chambers in all.

- (1) upper chamber  
(2) lower chamber

The heart contains four chambers: an (1)\* \_\_\_\_\_ and a (2)\* \_\_\_\_\_ on each side.

PANEL III

AN INTERNAL VIEW OF THE HEART



141. Is the following statement "true" or "false" ?

The heart is made up of four chambers; two upper chambers and two lower chambers.

true

142. The heart is divided down the middle by the (1) \_\_\_\_\_. A right and a left side result from that division. Each side contains an (2)\* \_\_\_\_\_ and a (3)\* \_\_\_\_\_, making a total of (4)\* \_\_\_\_\_.

- (1) septum
- (2) upper chamber
- (3) lower chamber
- (4) four chambers

143.



*Practice saying:*  
- auricles (oh'-ree-kuls)  
- ventricles (ven'-tree-kuls)

As shown in PANEL III, page 23, the upper chambers are called (1) \_\_\_\_\_, and the lower chambers are called (2) \_\_\_\_\_.

- (1) auricles
- (2) ventricles

144. The right side of the heart contains an upper chamber called the (1) \_\_\_\_\_ and a lower chamber called the (2) \_\_\_\_\_. Does the left side contain the same structures? (3) \_\_\_\_\_ (yes or no)

- (1) auricle
- (2) ventricle
- (3) yes

145.



*Here's a "crutch"!  
Auricles are above  
"A" = "A"*

Study PANEL III, page 23, and label the four chambers of the heart below:

1. right auricle
2. right ventricle
3. left auricle
4. left ventricle



- 1.\* \_\_\_\_\_
- 2.\* \_\_\_\_\_
- 3.\* \_\_\_\_\_
- 4.\* \_\_\_\_\_

146.



*Refer to Panel III  
and observe the two  
valves shown!*

Flaps of tissue called valves are located at the entrance and exit of each ventricle.

- (1) ventricles
- (2) flaps of tissue
- (3) valves

At the entrance and exit of the (1) \_\_\_\_\_ are (2)\* \_\_\_\_\_ called (3) \_\_\_\_\_.

- (1) flaps of tissue  
 (2) valves

147. Just as soldiers guard the entrance and exit of an air base, the entrances and exits of the ventricles are guarded by (1)\* \_\_\_\_\_ called (2) \_\_\_\_\_.



- (1) valves  
 (2) ventricle

148. Flaps of tissue called (1) \_\_\_\_\_ are located at the entrance and exit of each (2) \_\_\_\_\_.

directing the flow of blood



The opening and closing of the valves serve the purpose of \* \_\_\_\_\_.

*I'm like a door - always "opening" and "closing"!*

"VANCE THE VALVE"

150.



*I keep it from flowing backward!*

The proper opening and closing of the valves keep all the blood flowing in the same direction, thus preventing:

- a. a downward flow of the blood
- b. a backward flow of the blood
- c. a forward flow of the blood

b.

flaps of tissue which are located at the entrances and exits of the ventricles, and function to direct the flow of blood.

151. Describe the heart valves. (include location and function)  
 Heart valves are\*\* \_\_\_\_\_



*Each time I "close" I make a sound. These are the sounds you hear in your heart!*

152. Re-study PANEL III, page 23, and answer the following REVIEW questions :

muscle tissue

The heart is composed mostly of \* \_\_\_\_\_.

- (1) fist  
 (2) near the mid-line of the chest  
 and directed slightly to the left

153. The heart is about the size of a  
 (1) \_\_\_\_\_ and is located  
 (2)\* \_\_\_\_\_.

- (1) septum  
 (2) upper chamber  
 (3) auricles  
 (4) lower chamber  
 (5) ventricles

154. A right and a left side of the heart  
 result from a division by the  
 (1) \_\_\_\_\_. Each side con-  
 tains an (2)\* \_\_\_\_\_  
 called the (3) \_\_\_\_\_ and  
 a (4)\* \_\_\_\_\_ called the  
 (5) \_\_\_\_\_.

- (1) valves  
 (2) at the entrance and exit of  
 each ventricle  
 (3) direct the flow of blood in  
 the heart.

155. Flaps of tissue called (1) \_\_\_\_\_  
 are located (2)\* \_\_\_\_\_  
 and function to  
 (3)\* \_\_\_\_\_,  
 thus preventing any blood leakage  
 in the heart.

- (1) to pump blood  
 (2) muscle contraction

The function of the heart is (1)\* \_\_\_\_\_  
 \_\_\_\_\_; this is done  
 by means of (2)\* \_\_\_\_\_.

- (1) contraction  
 (2) muscle

157. If a water-filled balloon is squeezed,  
 water will spurt from the balloon;  
 likewise, blood will spurt from  
 the heart when it is squeezed by  
 the (1) \_\_\_\_\_ of its  
 (2) \_\_\_\_\_.



158.



*My auricles are  
 Reception Rooms!*

"HEARTY HARRY"

The right auricle receives "impure"  
 blood from the body tissues.

Blood that has been used by body tissues  
 is received by the \* \_\_\_\_\_.

right auricle

159.



*Impure or used, blood  
 has no oxygen in it!*

"HARRY"

The following statement is false! Make  
 it true by substituting correct  
 words.

The left auricle receives "pure" blood  
 from body tissues.

the right auricle receives impure  
 blood from the body tissues.

\*\*

- (1) impure  
(2) right auricle

160. Veins bring (1) \_\_\_\_\_ blood from the body tissues and it is received in the (2)\* \_\_\_\_\_.

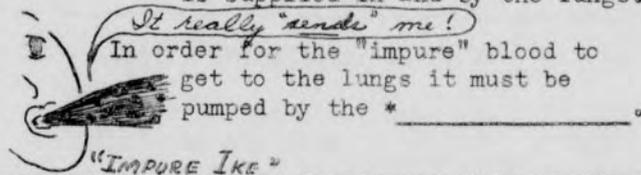
161. The right ventricle pumps the "impure" blood to the lungs for purification, or oxygenation.

- (1) right ventricle  
(2) lungs

"Impure" blood is pumped by the (1)\* \_\_\_\_\_ to the (2) \_\_\_\_\_ where it is oxygenated.

162. "Impure" blood needs oxygen which is supplied in and by the lungs.

right ventricle

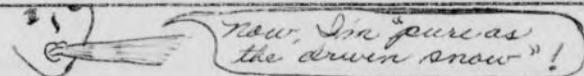


163. Supply the missing words:

- (1) impure blood  
(2) right auricle  
(3) right ventricle  
(4) lungs  
(5) oxygen

Blood without oxygen is called (1)\* \_\_\_\_\_ . It is brought back to the heart and received in the (2)\* \_\_\_\_\_ . Then it flows down into the (3)\* \_\_\_\_\_ which pumps it to the (4) \_\_\_\_\_ for a fresh supply of (5) \_\_\_\_\_ .

164.



The oxygenated blood returns to the heart from the lungs. It is received in the left auricle.

- (1) lungs  
(2) left auricle

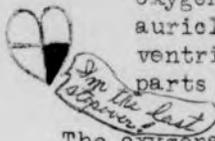
"Pure" blood coming from the (1) \_\_\_\_\_ is received in the (2)\* \_\_\_\_\_ of the heart.

165. When the "pure" blood containing oxygen comes back to the heart, it is received in the:

c.

- a. right auricle \_\_\_\_\_  
b. right ventricle \_\_\_\_\_  
c. left auricle \_\_\_\_\_  
d. left ventricle \_\_\_\_\_

166. The "pure" blood, which contains oxygen, flows out of the left auricle and down into the left ventricle which pumps it to all parts of the body.



- (1) left ventricle
- (2) all parts of the body

The oxygenated blood leaves the left auricle and flows into the (1)\* \_\_\_\_\_ which pumps it to (2)\* \_\_\_\_\_.

- (1) oxygenated/or purified
- (2) all body parts
- (3) left ventricle

167. Blood which has been (1) \_\_\_\_\_ is pumped to (2)\* \_\_\_\_\_ by the (3)\* \_\_\_\_\_.

168. Supply the missing words :

- (1) lungs
- (2) left auricle
- (3) left ventricle
- (4) all parts of the body

"Pure" blood comes from the (1) \_\_\_\_\_ to the (2)\* \_\_\_\_\_ of the heart. From there it flows downward into the (3)\* \_\_\_\_\_ which pumps it to (4)\* \_\_\_\_\_.

169. Now, do you see the "whole" of the heart function ?

It's kinda' like a pony express "relay station" : The "tired" horses (impure blood) are fed and freshened (blood is oxygenated), and then continue to carry the mail to all people near and far (to all body parts) !

no response

170.



*Oops! I forgot to say you all about this Review!*

Match the letters with the numbers:

- d 1.
- h 2.
- c 3.
- g 4.
- a 5.
- e 6.
- b 7.
- f 8.

- |  |                       |
|--|-----------------------|
| ___ 1. receives impure blood from body parts       | a. septum             |
| ___ 2. pumps pure blood to all body parts          | b. muscle contraction |
| ___ 3. contains oxygen                             | c. "pure" blood       |
| ___ 4. receives oxygenated blood from the lungs    | d. right auricle      |
| ___ 5. divides the heart into right and left sides | e. right ventricle    |
| ___ 6. pumps impure blood to the lungs             | f. lungs              |
| ___ 7. makes it possible for the heart to "pump"   | g. left auricle       |
| ___ 8. oxygenates the blood                        | h. left ventricle     |
|  | i. impure blood       |
|  | j. brain              |

no response

171. Of course, the heart can have defects, diseases, etc., just as any other part of the body. I'm sure you've heard of the terms, "heart murmur" and "blud babies". These two conditions are both caused from defects in the structure of the heart.

Let's learn a little about each &

172.



Remember the VALVES?

If not - go back and review frame #151.

A heart murmur is usually caused by the failure of a defective valve to close completely, thus allowing some of the blood to flow or leak backward.

\*\*\*REFER TO PANEL IV, page 30 &

- (1) murmur
- (2) valve
- (3) close completely
- (4) some of the blood to flow or leak backward

A heart (1) \_\_\_\_\_ is a condition usually caused by a defective (2) \_\_\_\_\_ which is unable to (3)\* \_\_\_\_\_, thus causing (4)\* \_\_\_\_\_.



"VANCE"

It's the "closing" that I can't seem to do properly!

173.



See Panel IV, page 30!

- (1) murmur
- (2) incomplete closure
- (3) valve
- (4) a backward leakage of blood

A heart (1) \_\_\_\_\_ results from (2)\* \_\_\_\_\_ of a defective (3) \_\_\_\_\_, which allows (4)\*\* \_\_\_\_\_.

174. The right ventricle pumps blood to the (1) \_\_\_\_\_ to be (2) \_\_\_\_\_. At the entrance of the right ventricle is a flap of tissue called a (3) \_\_\_\_\_. If this valve has a defect and cannot (4)\* \_\_\_\_\_ then some of the blood will (5)\* \_\_\_\_\_ into the right auricle instead of it all being pumped forward to the lungs. This disorder is called a (6)\* \_\_\_\_\_.

- (1) lungs
- (2) oxygenated or purified
- (3) valve
- (4) close completely
- (5) flow backward
- (6) heart murmur

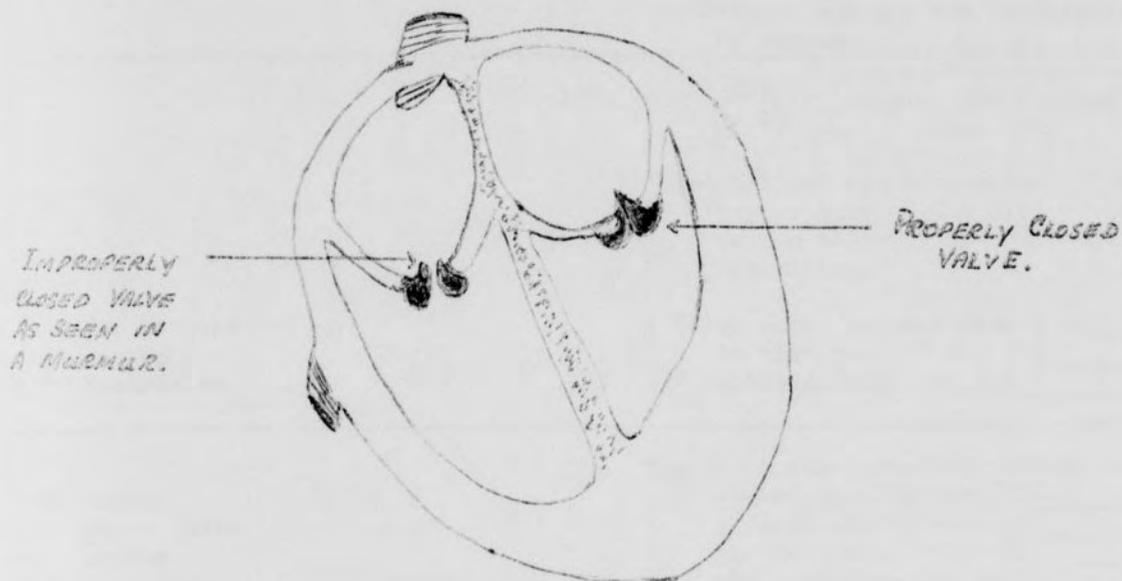
175. Use the following "key" words to make a descriptive statement about a heart murmur.

Heart murmur is a condition caused by the failure of a defective valve to close completely, thus allowing some of the blood to flow backward.

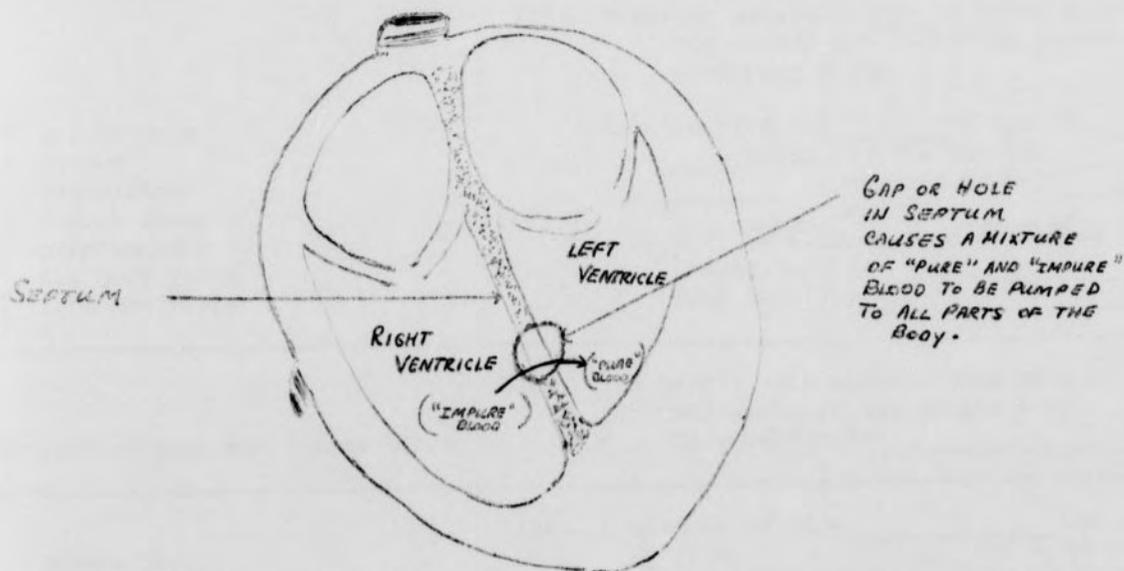
DEFECTIVE, CLOSE, BACKWARD, COMPLETELY, BLOOD, VALVE, FAILURE, FLOW OR LEAK, THUS

\*\*

PANEL IV  
HEART MURMURS



PANEL V  
"BLUE BABIES"



176.



EXTRA!  
READ ALL ABOUT IT!

no response

- A murmur may be classified in a range from "mild to serious".
- If it occurs in a child, it is often outgrown.
- Serious murmurs can be corrected by surgery.

177.



Refer to Panel V,  
Page 30!

"Blue babies" are babies born with a gap or hole in the part of the septum which divides the two ventricles.

- (1) gap or hole
- (2) septum
- (3) ventricles

A "blue baby" suffers from a (1) \_\_\_\_\_  
in that part of the (2) \_\_\_\_\_  
which divides the (3) \_\_\_\_\_.

- (1) septum
- (2) gap or hole
- (3) septum
- (4) ventricles

178. The right and left sides of the heart are divided by the (1) \_\_\_\_\_.  
A "blue baby" has a (2) \_\_\_\_\_  
in that part of the (3) \_\_\_\_\_  
which divides the (4) \_\_\_\_\_.

a gap or hole in that part of the septum which divides the ventricles

179. A "blue baby" results from a structural defect characterized by a \*\* \_\_\_\_\_.

- (1) gap or hole
- (2) septum
- (3) ventricles
- (4) impure blood
- (5) pure blood
- (6) all body parts
- (7) left ventricle

180. \*\*\*Study carefully all of PANEL V, page 30, and answer the following questions from your study:

Because of a (1) \_\_\_\_\_ in the (2) \_\_\_\_\_  
which divides the (3) \_\_\_\_\_  
, a mixture of (4)\* \_\_\_\_\_  
and (5)\* \_\_\_\_\_  
will be allowed, and therefore  
pumped to (6)\* \_\_\_\_\_  
from the (7)\* \_\_\_\_\_.

a mixture of pure and impure blood

181. The baby's skin appears blue because all parts of the baby's body have received\*\* \_\_\_\_\_.

- (1) impure blood
- (2) pure blood
- (3) blue

182. A mixture of (1)\* \_\_\_\_\_ and (2)\* \_\_\_\_\_ will cause the baby to appear (3) \_\_\_\_\_ because all parts of its body are deprived of their normal amount of oxygen.

- (1) their normal amount of oxygen  
 (2) pure blood  
 (3) impure blood

183. All parts of the body are deprived  
 of (1)\* \_\_\_\_\_  
 if there is a mixture of  
 (2)\* \_\_\_\_\_ and  
 (3)\* \_\_\_\_\_.

184. Fill in the missing words:

- (1) gap or hole  
 (2) septum  
 (3) ventricles  
 (4) impure blood  
 (5) pure blood  
 (6) oxygen

A "blue baby" is born with a (1) \_\_\_\_\_  
 in the part of the (2) \_\_\_\_\_  
 which divides the (3) \_\_\_\_\_.  
 The baby has a bluish appearance  
 because (4)\* \_\_\_\_\_ is  
 allowed to mix with the (5)\* \_\_\_\_\_  
 that is to be pumped to  
 all parts of the body. Thus, the  
 body parts are deprived of a normal  
 supply of (6) \_\_\_\_\_.

no response

185.



A "blue baby's" condition can be  
 successfully corrected by  
 surgical repair !!

186. Match the letters with the numbers:

- b 1.  
a 2.  
d 3.  
c 4.  
e 5.

- |  |                             |
|--|-----------------------------|
| _____ 1. condition of newborn babies         | a. murmur                   |
| _____ 2. condition occurs at site of a valve | b. "blue baby"              |
| _____ 3. inadequate oxygen supply            | c. septal gap               |
| _____ 4. hole between ventricles             | d. bluish appearance        |
| _____ 5. defective valve                     | e. incomplete valve closure |

check your answer by comparing  
 to PANEL IV, page 30.



check your answer by comparing to  
 PANEL V, page 30.

188. Circle and darken the area which,  
 if defective, will cause a  
 "blue baby" condition.



THE BLOOD VESSELS: A PART OF THE CIRCULATORY SYSTEM

189.



*Refer to Panel VI, page 34*

The blood vessels form a closed circuit system of hollow tubes (pipe lines) through which the blood flows to all body parts.

- (1) all body parts
- (2) closed circuit
- (3) blood vessels

Blood flows to (1)\* \_\_\_\_\_  
 through a (2)\* \_\_\_\_\_  
 of hollow tubes called (3)\* \_\_\_\_\_.



"VIRGIL THE VESSEL"

190. Just as water flows through pipe lines to all homes in a city, blood flows to all parts of the body via a (1)\* \_\_\_\_\_

- (1) closed circuit
- (2) blood vessels

system composed of (2)\* \_\_\_\_\_.

a closed circuit system of hollow tubes through which the blood flows to all parts of the body.

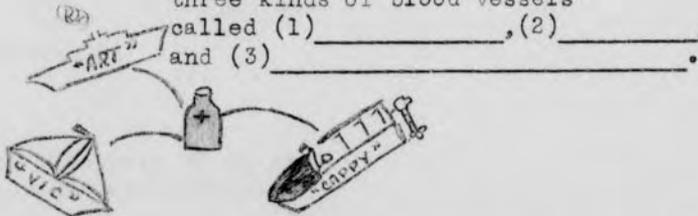
191. Blood vessels may be defined as \*\* \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_.



*See Panel VII, page 34.*

192. The circulatory system is served by three kinds of blood vessels

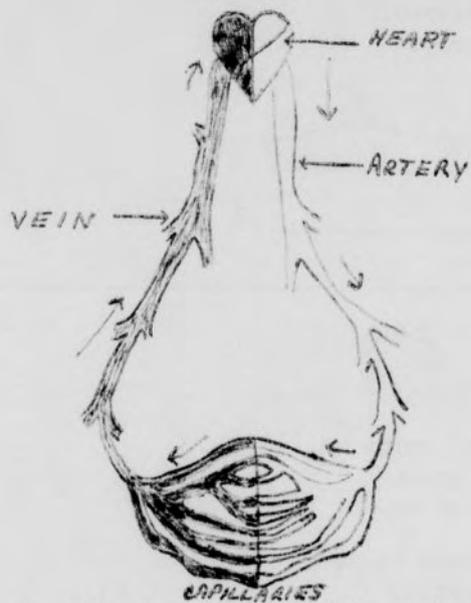
- (1) arteries
- (2) veins
- (3) capillaries



193. Three types of blood cells, (1) \_\_\_\_\_, (2) \_\_\_\_\_, and (3) \_\_\_\_\_ flow through the three kinds of vessels, (4) \_\_\_\_\_, (5) \_\_\_\_\_, and (6) \_\_\_\_\_.

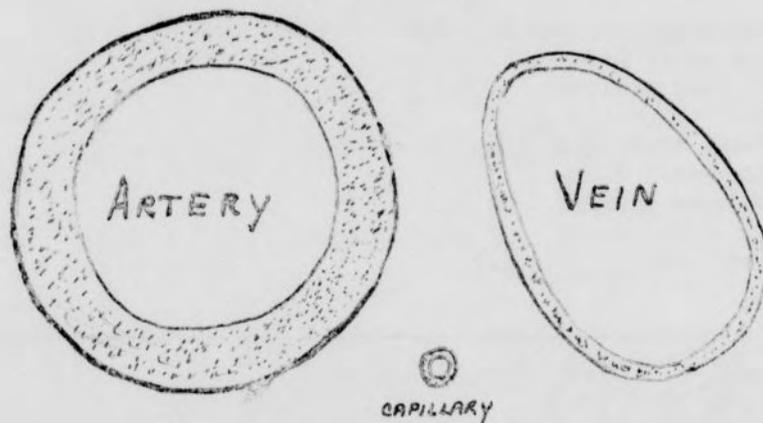
- (1) red
- (2) white
- (3) platelets
- (4) arteries
- (5) veins
- (6) capillaries

PANEL VI



Heart, arteries, capillaries, and veins  
constitute closed circuit circulation of blood in the body.

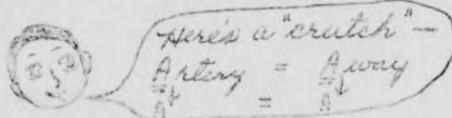
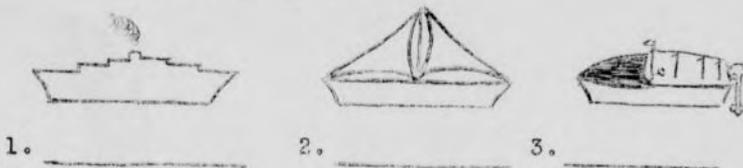
PANEL VII



Contrast of size and thickness of walls of  
arteries, veins, and capillaries.

194. Name the three kinds of blood vessels by labelling the following carriers which vary in size, strength, and purpose.

1. arteries
2. veins
3. capillaries



195. Arteries lead away from the heart to carry "pure" blood to all body parts.

- (1) away from
- (2) arteries

"Pure" blood flows (1)\* \_\_\_\_\_  
 (direction?) the heart through the  
 (2) \_\_\_\_\_.

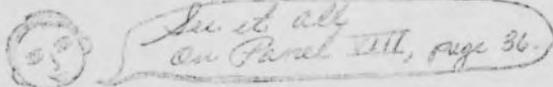


196. If the following statement is true, check true; if it is not true, correct it.

All body parts receive "pure" blood which flows through arteries leading away from the heart.

true

(1) \_\_\_\_\_ true or (2)\*\* \_\_\_\_\_



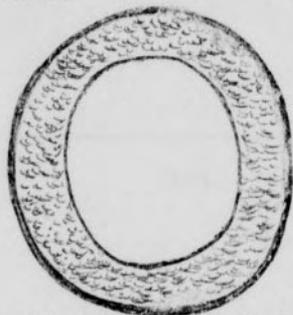
197. Arteries must have thick elastic walls in order to withstand the pressure put on them by the pumping force of the heart. The arteries must have (1) \_\_\_\_\_ which are (2) \_\_\_\_\_ and (3) \_\_\_\_\_.

- (1) walls
- (2) thick
- (3) elastic



PANEL VIII

ARTERY - A "Distributor"



- wall is thick and elastic
- distributes "pure" blood to all parts of the body

PANEL IX

VEIN - A "Collector"



- wall is thinner than artery
- collects and returns "impure" blood to the heart

PANEL X

CAPILLARIES - "Linkers"



- microscopic
- the "linking" vessels between arteries and veins
- final part of the closed circuit of blood vessels

- (1) walls
- (2) thick
- (3) elastic

198. Just as a hose must be strong and pliable enough to withstand the force of the water, the arterial (1) \_\_\_\_\_ must be (2) \_\_\_\_\_ and (3) \_\_\_\_\_ to withstand the force of the blood as it is pumped by the heart.

- (1) thick
- (2) elastic
- (3) arteries
- (4) away from
- (5) pure blood
- (6) all body parts

199. SUPPLY THE MISSING WORDS:

Vessels whose walls are (1) \_\_\_\_\_ and (2) \_\_\_\_\_ are called (3) \_\_\_\_\_. They lead (4)\* \_\_\_\_\_ the heart, carrying (5)\* \_\_\_\_\_ to (6)\* \_\_\_\_\_.

200.



*Study Panel IX, page 36 and answer the following questions!*

- (1) impure blood
- (2) veins

Vessels through which (1)\* \_\_\_\_\_ is returned to the heart are called (2) \_\_\_\_\_.



- (1) impure blood
- (2) toward
- (3) veins

201. Vessels carrying (1)\* \_\_\_\_\_ (2) \_\_\_\_\_ (direction) the heart are known as (3) \_\_\_\_\_.



*My direction is just the opposite from the 'arteries'!*

202.



*I'm not under such pressure!*

\*\*\* REFER TO PANEL IX, PAGE 36.

- (1) thick
- (2) elastic
- (3) thinner

Arteries must have walls which are (1) \_\_\_\_\_ and (2) \_\_\_\_\_ in order to endure the pressure force of the heart's pumping thrust; but because veins do not have that force executed on them, their walls are (3)\*\* \_\_\_\_\_.

203.



*Refer to Panel VII, page 34, Again!*

check your answer by PANEL VII,  
*page 30.*

Make a comparative drawing of an artery and a vein.

204. Using the following "key" words, form a statement about veins.

"IMPURE", VESSELS, WALLS, RETURN, BLOOD, VEINS, ARTERIES, HEART, THINNER.

veins are vessels, with walls thinner than those of arteries, which return "impure" blood to the heart.

\*\*  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_.

205.



*Study Panels VI, page 34, and X, page 36.*

- (1) capillaries
- (2) arteries
- (3) veins
- (4) closed circuit

Microscopic vessels called (1) \_\_\_\_\_ link (2) \_\_\_\_\_ and (3) \_\_\_\_\_; thus the three types of blood vessels form a (4)\* \_\_\_\_\_ for the circulation of blood.

206. Arteries are "distributors"  
veins are "collectors"  
\_\_\_\_\_ are "linkers"

capillaries

207. SUPPLY THE MISSING WORDS IN THE FOLLOWING STATEMENT:

In order for blood to flow in a (1)\* \_\_\_\_\_, the (2) \_\_\_\_\_ AND (3) \_\_\_\_\_ must be "linked" together by microscopic vessels called (4) \_\_\_\_\_.

- (1) closed circuit
- (2) arteries
- (3) veins
- (4) capillaries



*A tip-off!  
It's review time!*

208. Blood vessels are hollow tubes through which blood flows:
- in an open manner throughout the body
  - in a closed circuit network
  - in a general non-directed path

b.

209. Name the three kinds of blood vessels:
- \_\_\_\_\_
  - \_\_\_\_\_
  - \_\_\_\_\_

- arteries
- veins
- capillaries

210. "Impure" blood is (1)\* \_\_\_\_\_ the heart through the (2) \_\_\_\_\_.

- returned/OK taken to
- veins

211. Vessels which supply all (1)\* \_\_\_\_\_ are called (2) \_\_\_\_\_.
- They lead (3)\* \_\_\_\_\_ the heart, carrying (4)\* \_\_\_\_\_.

- body parts
- arteries
- away from
- pure or oxygenated blood

212. Vessels which "link" together the (1) \_\_\_\_\_ and (2) \_\_\_\_\_ are called (3) \_\_\_\_\_.

- arteries
- veins
- capillaries

213. The heart exerts a "pumping" pressure on the (1) \_\_\_\_\_ which must have (2) \_\_\_\_\_ that are (3) \_\_\_\_\_ and (4) \_\_\_\_\_ in order to withstand the pressure.

- arteries
- walls
- thick
- elastic

214. Microscopic vessels which are necessary for the blood to flow in a closed circuit network are called \_\_\_\_\_.

capillaries

215.



*Practice saying these words aloud!*

- There are two very common diseases of the blood vessels:
- arteriosclerosis  
(are-tear'-ee-ch-sklee-row-sis)
  - atherosclerosis  
(a-ther-oh-sklee-row-sis)
- BOTH DISEASES INVOLVE ONLY THE ARTERIES !**

no response

216. Arteriosclerosis is a degenerative disease causing the arteries to become progressively harder and more brittle.

- (1) harder
- (2) more brittle
- (3) arteriosclerosis

A disease which causes the arteries to become progressively (1) \_\_\_\_\_ and (2)\* \_\_\_\_\_ is called (3) \_\_\_\_\_.

arteriosclerosis  
to harden and become brittle

217. A degenerative disease of the arteries which affects our senior citizens is \_\_\_\_\_. It causes the arteries \* \_\_\_\_\_.



*My arteries are just stiff and brittle and I'm SENIOR SAM.*

218. An arterial disease which occurs mostly in (1)\* \_\_\_\_\_ and increases the possibility of a rupture in any affected artery is called (2) \_\_\_\_\_.

- (1) older people
- (2) arteriosclerosis
- (3) rupture

This disease may ultimately cause an affected artery to (3) \_\_\_\_\_.

219. Is the following statement "true" or "false" ?

Arteriosclerosis is a degenerative disease which might be attributed to old age, and is characterized by a gradual hardening and brittleness of the arteries causing them to lose their elasticity.

true

true or false? \_\_\_\_\_.

220. Hardening of the arteries often causes an affected artery to rupture.

a.

- a. true
- b. false \_\_\_\_\_.

221. An arterial disease associated with (1)\* \_\_\_\_\_ is called

- (1) old age
- (2) arteriosclerosis
- (3) hardening
- (4) brittleness
- (5) an artery may rupture

(2) \_\_\_\_\_. The disease causes a gradual (3) \_\_\_\_\_ and (4) \_\_\_\_\_ of the arteries. Because of the changes in the walls of the arteries, there is a strong and dangerous possibility that (5)\*\* \_\_\_\_\_.

arteriosclerosis is a degenerative arterial disease which occurs among the aged, causing the arteries to harden with a strong possibility of rupturing.

222. Formulate a definition of arteriosclerosis from what you have learned.

\*\*

223.



*This one gets to me, also!*

"SENIOR SAM"

Atherosclerosis (a-ther-~~o~~-ch-sklee-row-sis) is a degenerative disease of the arteries caused by deposits of fatty substances, mainly cholesterol, on the inside of the arteries.

- (1) fatty substances
- (2) cholesterol
- (3) atherosclerosis

Deposits of (1)\* \_\_\_\_\_, mainly (2) \_\_\_\_\_, on the inside of arteries cause a disease called (3) \_\_\_\_\_.

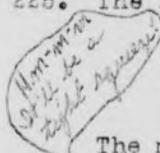
- (1) cholesterol
- (2) arteries
- (3) atherosclerosis
- (4) thicken
- (5) harden

224. Increasingly large deposits mainly of (1) \_\_\_\_\_ on the inside of the (2) \_\_\_\_\_ causes the lining to thicken and harden.

This condition is known as (3) \_\_\_\_\_ and it causes the lining of the arteries to (4) \_\_\_\_\_ and (5) \_\_\_\_\_.

- (1) blockage
- (2) blood clot

225. The inside of an artery affected by atherosclerosis will progressively narrow and result in a blockage that will cause a blood clot to form.



The narrowing of space in an artery will eventually result in a (1) \_\_\_\_\_ and cause the formation of a (2)\* \_\_\_\_\_.



"UNABLE ARTERY"

- (1) rupture
- (2) blockage
- (3) blood clot

226. Arteriosclerosis may cause an artery to (1) \_\_\_\_\_ thus resulting in a hemorrhage.

Atherosclerosis is most apt to cause a (2) \_\_\_\_\_ in an artery, resulting in the formation of a (3)\* \_\_\_\_\_.

227. Arteriosclerosis is mainly caused  
by old age.

increasingly large deposits  
of cholesterol on the lining  
of the arteries.

Atherosclerosis most commonly occurs  
late in life, but it is directly  
caused by \*\* \_\_\_\_\_  
\_\_\_\_\_.

228. Supply the missing words in the  
following paragraph:

- (1) blocked
- (2) thickening
- (3) cholesterol
- (4) atherosclerosis

An artery may become completely  
(1) \_\_\_\_\_ due to the  
(2) \_\_\_\_\_ of the walls  
which is caused by abnormal  
deposits of (3) \_\_\_\_\_.  
This disease is called (4) \_\_\_\_\_.

229.



*Review time!*

- (1) ruptured
- (2) hardening and brittleness of  
an artery
- (3) arteriosclerosis

Hemorrhage will result from an artery  
that has (1) \_\_\_\_\_  
because of the (2)\*\* \_\_\_\_\_  
\_\_\_\_\_ that is caused  
mainly by old age. This condition  
is referred to as (3) \_\_\_\_\_.

230. Complete blockage of an artery,  
resulting in a blood clot will  
occur when the inside of the  
artery has thickened from large  
deposits of \_\_\_\_\_.

c.

- a. carbohydrates
- b. proteins
- c. cholesterol
- d. sugars

- (1) arteriosclerosis
- (2) atherosclerosis

231. Age is the primary causative factor  
of (1) \_\_\_\_\_.  
Cholesterol deposits primarily  
cause (2) \_\_\_\_\_.

232. The ultimate danger of arteriosclerosis  
is from (1)\* \_\_\_\_\_,  
resulting in hemorrhage from  
the artery.

- (1) a ruptured artery / or rupture
- (2) blood clot

The ultimate danger of atherosclerosis  
is a (2)\* \_\_\_\_\_,  
which has formed due to decreased  
space inside the artery.

233. Make a simple drawing which demonstrates a comparison of the size and characteristics of arteries, veins and capillaries.

check your drawing with  
PANEL VII, page 34.

PART V

PHYSIOLOGY OF CIRCULATION

234.



*Practice pronouncing them!*

There are three main branch systems of circulation:

1. pulmonary (pull'-mow-nay-ree)
2. systemic (sis-tim'-ik)
3. coronary (car'-oh-nay-ree)

Three main branches of circulation are:

- (1) pulmonary
- (2) systemic
- (3) coronary

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_
- (3) \_\_\_\_\_

235.



*Here's a "crutch"!  
"Sis pulls me CAR!"  
systemic pulmonary coronary*

Blood circulates through various parts of the body in branch systems.

Three of these are called

- (1) systemic
- (2) pulmonary
- (3) coronary

- (1) \_\_\_\_\_
- (2) \_\_\_\_\_
- and (3) \_\_\_\_\_

236. The three main branch systems of circulation are:



*Say them blood!*

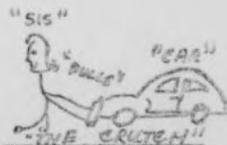
- a. pulmonary, ciliary, coronary
- b. systemic, pulmonary, coronary
- c. systemic, coronary, filinary
- d. systemic, pulmonary, ciliary

b. \_\_\_\_\_

237. Name the three main branches of circulation:

1. systemic
2. pulmonary
3. coronary

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_



238.



*The word "Pulmonary" always refers to the Lungs!!*

The pulmonary branch of circulation is that part of the closed circuit which carries blood back and forth between the heart and lungs.

- (1) heart
- (2) lungs
- (3) pulmonary branch

The circulation branch between the (1) \_\_\_\_\_ and (2) \_\_\_\_\_ is called the (3)\* \_\_\_\_\_ of circulation.

239. Is the following statement "true" or "false" ?

The blood is transported back and forth between the heart and lungs by pulmonary circulation.

true

240. Write a statement about the function of the pulmonary branch of circulation

the pulmonary branch of circulation transports blood back and forth between the heart and lungs.

\*\* \_\_\_\_\_

241.



*I travel all over the body!!*  
"SYSTEMIC SIS"

Systemic circulation is that branch of the closed circuit which carries blood from the heart to all body parts and then back to the heart.

- (1) heart
- (2) all body parts
- (3) systemic branch

Blood is transported between the (1) \_\_\_\_\_ and (2)\* \_\_\_\_\_ by the (3)\* \_\_\_\_\_ of circulation.

- (1) all body parts
- (2) systemic branch

242. A branch of circulation that generally supplies (1)\* \_\_\_\_\_ is called the (2)\* \_\_\_\_\_ of circulation.

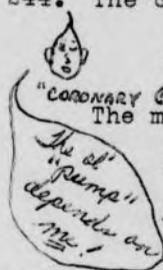
the systemic branch of circulation supplies all body parts.

243. Explain the function of the systemic branch of circulation.

\*\* \_\_\_\_\_

244. The coronary branch of circulation supplies blood to the heart muscle itself.

- (1) heart
- (2) coronary branch



The muscular organ called the (1) \_\_\_\_\_ is supplied with blood which flows through the (2)\* \_\_\_\_\_ of circulation.

245. The pulmonary circulation involves transportation to the lungs. The systemic circulation involves transportation to all body parts. The \_\_\_\_\_ circulation involves supplying the heart itself.

coronary

246.



*Quick Review Remember the "crutch"!*

The three main branches of blood circulation are:

- 1. systemic
- 2. pulmonary
- 3. coronary

- 1. \_\_\_\_\_
- 2. \_\_\_\_\_
- 3. \_\_\_\_\_

247. The pulmonary branch of circulation carries blood:  
a. to all body parts  
b. to the lungs \_\_\_\_\_  
c. to the heart itself \_\_\_\_\_

b.

248. The systemic branch of circulation carries blood:  
a. to all body parts  
b. to the brain \_\_\_\_\_  
c. to the heart itself \_\_\_\_\_

a.

249. The coronary branch of circulation carries blood:  
a. to nourish the lungs \_\_\_\_\_  
b. to nourish the stomach \_\_\_\_\_  
c. to nourish the heart \_\_\_\_\_

c.

250. The heart performs according to an automatic rhythm.

- (1) heart
- (2) rhythm



The (1) \_\_\_\_\_ beats in an automatic (2) \_\_\_\_\_.

*"HEARTY HARRY"*

*I'm just full of rhythm!*

- (1) heart
- (2) rhythm

251. Just as you dance to a certain rhythm, your (1) \_\_\_\_\_ beats in a certain (2) \_\_\_\_\_ which has been automatically established.

252.

*"HARRY" I have a "3-phase" rhythm!*

The first phase of the heart's rhythm is the "contraction phase" in which the ventricles contract and the auricles relax.

- (1) first phase
- (2) contraction phase

The ventricles pump and the auricles relax during the (1)\* \_\_\_\_\_ of rhythm which is called the (2)\* \_\_\_\_\_.

- (1) first phase
- (2) contraction phase

253. During the (1)\* \_\_\_\_\_ of the heart's rhythm, the ventricles contract and the auricles relax. This phase is called the (2)\* \_\_\_\_\_.

- (1) rhythm
- (2) first phase
- (3) contraction phase

254. The heart works to an automatic (1) \_\_\_\_\_ which is divided into three phases. The ventricles work and the auricles relax during the (2)\* \_\_\_\_\_ which is called the (3)\* \_\_\_\_\_.

- (1) second phase
- (2) relaxation phase
- (3) ventricles relax while the auricles work.

255. During the second phase, called "relaxation", the ventricles relax and the auricles work.

Immediately after the first phase comes the (1)\* \_\_\_\_\_ of rhythm called the (2)\* \_\_\_\_\_ in which the (3)\*\* \_\_\_\_\_.

b.

256. The ventricles relax and the auricles work during which phase of the heart's rhythm ?  
a. first - contraction phase  
b. second - relaxation phase  
c. third - hypnotic phase

257. Carefully restudy frames #252-256 ,  
you will see that the rhythm  
phases are named according to  
the action state of the ventricles;  
likewise, you will see that the  
action state of the auricles  
is just the opposite.

- (1) contraction phase
- (2) the ventricles contract  
and the auricles relax

During the first phase of rhythm called  
the (1)\* \_\_\_\_\_,  
what is happening to the heart?  
(2)\*\* \_\_\_\_\_.

258. Describe the action states of the  
ventricles and auricles during  
the second rhythmic phase which  
called the (1)\* \_\_\_\_\_.

- (1) relaxation phase
- (2) ventricles relax while  
the auricles work

(2)\*\* \_\_\_\_\_.

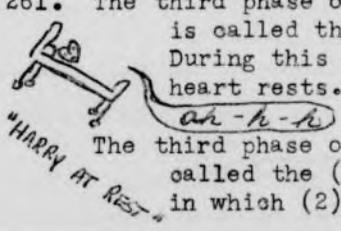
259. The rhythmic phases of the heart's  
work are so named according to  
the action state of the (1) \_\_\_\_\_.  
During the first phase,  
called the (2)\* \_\_\_\_\_,  
the (3) \_\_\_\_\_ are (4) \_\_\_\_\_  
(action) while the (5) \_\_\_\_\_  
are (6) \_\_\_\_\_ (action).

- (1) ventricles
- (2) contraction phase
- (3) ventricles
- (4) contracting
- (5) auricles
- (6) relaxing

260. In contrast to phase one of the heart's  
rhythm, the action of phase two,  
called the (1)\* \_\_\_\_\_,  
is characterized by:  
(2)\*\* \_\_\_\_\_.

- (1) relaxation phase
- (2) the ventricles relax  
while the auricles work

261. The third phase of the heart rhythm  
is called the resting phase.  
During this period, the entire  
heart rests.

  
The third phase of the heart rhythm is  
called the (1)\* \_\_\_\_\_  
in which (2)\* \_\_\_\_\_.

- (1) resting phase
- (2) the entire heart rests

262. The entire heart is at rest during  
which phase of its rhythm ?  
a. first phase - contraction phase  
b. second phase - relaxation phase  
c. third phase - resting phase

c. \_\_\_\_\_.

263. By learning the three phases of heart rhythm you can perceive that the ventricles and auricles do not work at the same time.

the auricles and ventricles do not work at the same time. While the auricles are contracting, the ventricles are relaxing; and vice-versa.

Make a concise and general statement about the work of the auricles and ventricles\*\* \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_.

264. Match the letters in Column II to the numbers in Column I;

- e 1.  
c 2.  
b 3.

- \_\_\_\_ 1. resting phase  
\_\_\_\_ 2. relaxation phase  
\_\_\_\_ 3. contraction phase

- a. the left side of the heart is contracting while the right side is relaxing.  
b. auricles relax and ventricles contract.  
c. auricles contract and ventricles relax.  
d. the right auricle and right ventricle are relaxing.  
e. the heart is doing no work.

265. The normal pulse rate or heart beat per minute varies with such factors as age and exercise. The pulse rate of the average adult is about 72 beats per minute.

- (1) 72 times per minute  
(2) age  
(3) exercise

In the average adult, the heart beats about (1)\*\_\_\_\_\_.  
This normal rate may vary with such factors as (2)\_\_\_\_\_  
and (3)\_\_\_\_\_.

266. The average pulse rate of about (1)\*\_\_\_\_\_ might vary with (2)\*\_\_\_\_\_.

- (1) 72 beats per minute  
(2) age and exercise

267. What two factors might cause the average pulse rate of 72 to vary ?

- b. a. sex and age  
b. age and exercise \_\_\_\_\_  
c. food and drink  
d. body build and sex

268.



*Exercise really  
pegs me up!!*

"HARRY"

The rate of the heart beat is increased while a person is engaged in any form of physical exercise; but returns to normal shortly after the exercise stops.

- (1) exercise
- (2) increased
- (3) returns to normal

While a person is engaged in (1) \_\_\_\_\_, the rate of the heart beat is (2) \_\_\_\_\_, but shortly after the exercise is stopped, the rate (3)\* \_\_\_\_\_.

- (1) faster / rapidly
- (2) rise / or increase
- (3) returns to normal

269. During exercise the heart beats (1) \_\_\_\_\_ causing the pulse rate to (2) \_\_\_\_\_; but shortly after the exercise is stopped, the pulse rate (3)\* \_\_\_\_\_.

- (1) rise or increase
- (2) does not return to normal shortly after exercise

270. It is normal for the pulse rate to (1) \_\_\_\_\_ during exercise; but abnormal if it (2)\* \_\_\_\_\_.

271. When you are sleeping your heart beats slower than at any other time; during sleep it rests about 28 seconds out of each minute.



*B-Z-Z-Z*

your heart can rest more because it beats slower during sleep than at any other time

In relation to your heart, why is it important that you get an adequate amount of sleep?

\*\* \_\_\_\_\_

- (1) beats faster
- (2) beats slower than at any other time.

272. During exercise the heart (1)\* \_\_\_\_\_  
During sleep the heart (2)\* \_\_\_\_\_.

273. Supply the missing words:

- (1) pulse
- (2) 72 per minute
- (3) age
- (4) exercise
- (5) increases
- (6) normal
- (7) slower
- (8) sleep

The number of heart beats per minute is called the (1) \_\_\_\_\_ rate. The average pulse rate of (2)\* \_\_\_\_\_ may vary with (3) \_\_\_\_\_ and (4) \_\_\_\_\_. During exercise the pulse rate (5) \_\_\_\_\_, but returns to (6) \_\_\_\_\_ shortly after the exercise. The heart beats (7) \_\_\_\_\_ during (8) \_\_\_\_\_ than at any other time.

274. Blood pressure is defined as the pressure exerted on the walls of the arteries by the blood.

- (1) blood
- (2) arteries
- (3) blood pressure

The force of the (1) \_\_\_\_\_ pushing against the walls of the (2) \_\_\_\_\_ is measured as (3)\* \_\_\_\_\_.

275. Vessels which carry blood away from the heart are called (1) \_\_\_\_\_.

- (1) arteries
- (2) arteries
- (3) blood pressure

The force by which the heart pumps the blood through these vessels causes a pressure on the walls of the (2) \_\_\_\_\_. This forced pressure is measured as (3)\* \_\_\_\_\_.

blood pressure is the amount of pressure put on the arterial walls by the force of the blood.

276. Define blood pressure:

\*\* \_\_\_\_\_  
\_\_\_\_\_.

277.



*A short cut!  
Blood pressure is  
often written as "B/P"!*

The blood pressure may be caused to vary by the same factors which also cause the pulse rate to vary.

- (1) age
- (2) exercise
- (3) blood pressure

The pulse rate may vary with such factors as (1) \_\_\_\_\_ and (2) \_\_\_\_\_. These factors also cause the (3)\* \_\_\_\_\_ to vary.

278. Exercise has the same temporary effect on the blood pressure as it has on the pulse : \_\_\_\_\_.

b.

- a. a temporary decrease
- b. a temporary increase
- c. no effect

279. Increase in age may cause a gradual and permanent rise in the blood pressure.

may cause a gradual and permanent rise in blood pressure

How might aging affect blood pressure?

\*\* \_\_\_\_\_  
\_\_\_\_\_.

280. Blood pressure and pulse rate may be affected only temporarily by exercise; in contrast they may be affected permanently by age.

age may cause a permanent effect; exercise causes a temporary effect.

Contrast the effects of age and exercise on blood pressure and pulse rate.

\*\*

- 
281. A B/P instrument reading of 120/80 (one-twenty over eighty) is considered normal for a person about twenty years old.

120/80

If you are about 20, what is your normal B/P ? \_\_\_\_\_.

- 
282. Match the correct letter to each number:

c 1.  
d 2.  
a 3.  
b 4.

- |  |                                   |
|--|-----------------------------------|
| _____ 1. blood force on arterial walls                       | a. blood pressure 120/80          |
| _____ 2. effect of exercise on blood pressure and pulse rate | b. gradual and permanent increase |
| _____ 3. normal B/P for you                                  | c. blood pressure                 |
| _____ 4. possible effect of aging on B/P                     | d. temporary increase             |
|  | e. no effects                     |
|  | f. B/P 140/90                     |
|  | g. pulse rate                     |

- 
283. The prefix "hyper" means "above normal"  
The prefix "hypo" means "below normal"

blood pressure which is above normal

In regard to blood pressure, the condition known as hypertension (hi-per-ten-chun) is described as\*\* \_\_\_\_\_.

- 
- 284.



*Practice pronouncing and spelling "HYPERTENSION"!*

Hypertension is a malady characterized by:

- a. persistently low B/P
- b. persistently high pulse rate
- c. persistently high B/P
- d. persistently low pulse rate

c.

285. Persistently high blood pressure, called (1) \_\_\_\_\_, is caused by such reasons as:
- prolonged physical and emotional stress
  - arteriosclerosis
  - atherosclerosis

- (1) hypertension  
 (2) prolonged physical and emotional stress, arteriosclerosis, atherosclerosis

High blood pressure may be caused by (2)\*\* \_\_\_\_\_.

286. Choose three possible causes of hypertension:
- a. prolonged emotional and physical stress
  - b. prolonged lack of carbon dioxide
  - c. arteriosclerosis
  - d. hemophilia
  - e. anemia
  - f. atherosclerosis

a., c., f.

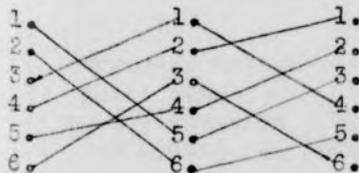
287. High blood pressure, technically called (1) \_\_\_\_\_ causes the heart to gradually weaken due to the excess amount of work imposed on it.

- (1) hypertension  
 (2) gradually weakens (because of excess work imposed on it)

What gradually happens to the heart of a person who has hypertension? (2)\*\* \_\_\_\_\_.

288. In hypertension the heart is forced to pump harder and faster, thus causing \*\* \_\_\_\_\_.
- the heart to weaken (from excess work)

289. Draw connecting lines from words in Column I which are associated with or related to words in Column II, and do the same for Column II and III.



- |                                  |   |                                |
|----------------------------------|---|--------------------------------|
| 1. hyper-                        | 1. below normal                               | 1. possible blockage of artery |
| 2. arteriosclerosis              | 2. cholesterol deposits on inside of arteries | 2. weakens heart               |
| 3. hypo-                         | 3. B/P  | 3. hypertension                |
| 4. atherosclerosis               | 4. forces excess work                         | 4. hypotension                 |
| 5. physical and emotional stress | 5. above normal                               | 5. possible rupture of artery  |
| 6. pressure on arterial walls    | 6. hardening of the arteries                  | 6. 120/80 normal               |

290. High blood pressure is technically known as (1) \_\_\_\_\_ and is caused by such factors as (2)\*\* \_\_\_\_\_

- (1) hypertension
- (2) prolonged physical and emotional stress, arteriosclerosis, atherosclerosis
- (3) weaken
- (4) the excess amount of work imposed on it.

which will gradually cause the heart to (3) \_\_\_\_\_ due to (4)\*\* \_\_\_\_\_.

291.



*Remember the coronary arteries? What is their function?*

Heart attack is a condition which occurs when a blood clot forms and blocks one of the coronary arteries of the heart.

occurs when a blood clot forms and blocks one of the coronary arteries of the heart.

Describe the occurrence of a heart attack.

\*\*

292. If the following statement is true, check "true"; if it is not, then correct it to make it true.

a heart attack results from a blood clot which blocks one of the coronary arteries.

A heart attack results from a hemorrhage of one of the pulmonary veins of the heart.

\_\_\_\_\_ "true" or \*\* \_\_\_\_\_

293. The underlying cause/s of a heart attack may be from hypertension, arteriosclerosis, or atherosclerosis.

The three possible underlying causes of a heart attack are:

1. hypertension
2. arteriosclerosis
3. atherosclerosis

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_

- (1) coronary arteries
- (2) blood clot
- (3) a. hypertension, b. arteriosclerosis, c. atherosclerosis

294. A heart attack occurs when one of the (1)\* \_\_\_\_\_ is blocked by a (2)\* \_\_\_\_\_ which is usually due to (3) a. \_\_\_\_\_ b. \_\_\_\_\_ c. \_\_\_\_\_

- (1) a blood clot which forms and blocks one of the coronary arteries
- (2) hypertension
- (3) arteriosclerosis
- (4) atherosclerosis

295. The heart attack is usually sudden, but the underlying cause, (1)\*\*

\_\_\_\_\_ ,  
 \_\_\_\_\_ ,  
 might have been developing over a long period of time due to such causes as: (2) \_\_\_\_\_ ,  
 (3) \_\_\_\_\_ , or (4) \_\_\_\_\_ .

296. Heart attacks differ in severity, they may range from "mild" to "fatal". Many surviving victims are now leading normal or almost normal lives.

- (1) they may range from "mild" to "fatal"
- (2) many survive and lead normal or almost normal lives.

How may heart attacks differ in severity among people ?  
 (1)\*\* \_\_\_\_\_ ;  
 and what is the outlook for many surviving victims ? (2)\*\* \_\_\_\_\_ .

297. A medical term for "outlook" is "prognosis" ↓

prognosis is for a normal, or almost normal, life afterward.

What is the prognosis of many victims who survive a heart attack ?

\*\* \_\_\_\_\_ .

298. Match the correct letters to the numbers ↓

- c 1.
- a 2.
- d 3.
- b 4.
- e 5.

- 1. blood clot blockage
- 2. sudden attack
- 3. outlook or prognosis
- 4. heart attack
- 5. a cause
- a. slowly developed underlying cause
- b. may be mild to fatal
- c. coronary artery
- d. normal, or almost normal, life
- e. arteriosclerosis
- f. anemia
- g. always fatal

299. Make a descriptive summary of heart attack by supplying the missing words:

- (1) hypertension
- (2) arteriosclerosis
- (3) atherosclerosis
- (4) blood clot
- (5) blockage
- (6) coronary arteries
- (7) mild
- (8) fatal
- (9) many live normal or almost normal lives

Possible causes: (1) \_\_\_\_\_,  
(2) \_\_\_\_\_, (3) \_\_\_\_\_.

Effect on heart: Formation of a (1)\* \_\_\_\_\_  
\_\_\_\_\_ causes a (5) \_\_\_\_\_  
in one of the (6)\* \_\_\_\_\_  
of the heart.

Possible range of severity: (7) \_\_\_\_\_  
to (8) \_\_\_\_\_.

Prognosis or outlook for survivors :  
(9)\*\* \_\_\_\_\_.

---

300. A "stroke" is a circulatory disorder of the brain and is technically named apoplexy (a-poe-plex-ee)

- (1) circulatory disorder of the brain
- (2) apoplexy

A "stroke" is a (1)\* \_\_\_\_\_  
\_\_\_\_\_ technically called  
(2) \_\_\_\_\_.

---

301. Another name for "stroke" is (1) \_\_\_\_\_.  
It is usually caused by hyper-  
tension and/or arteriosclerosis.

- (1) apoplexy
- (2) a. hypertension  
b. arteriosclerosis

Name two causes of heart attack and apoplexy: (2) a. \_\_\_\_\_,  
b. \_\_\_\_\_.

---

302. Apoplexy, commonly called (1) "\_\_\_\_\_",  
is caused by (2) \_\_\_\_\_ and/or  
(3) \_\_\_\_\_ which results  
in a sudden rupture or blockage  
of a blood vessel in the brain.

- (1) stroke
- (2) hypertension
- (3) arteriosclerosis
- (4) there is a sudden rupture/or blockage of a blood vessel in the brain.

Describe what happens, physiologically,  
when apoplexy occurs (4)\*\* \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_.

---

303. Blockage of a (1)\* \_\_\_\_\_ in the  
(2) \_\_\_\_\_ results in a condition  
called "heart attack".

- (1) coronary artery
- (2) heart
- (3) blood vessel
- (4) brain
- (5) apoplexy

Blockage or rupture of a (3)\* \_\_\_\_\_  
in the (4) \_\_\_\_\_ results in a  
"stroke", technically called  
(5) \_\_\_\_\_.

---

304. Apoplexy, which is caused by  
(1) \_\_\_\_\_ and/or  
(2) \_\_\_\_\_, generally  
occurs late in life, and, like  
heart attack, may range in  
severity from "light" to "fatal".

- (1) hypertension  
(2) arteriosclerosis  
(3) late in life  
(4) light to fatal.

At what stage of life do most "strokes"  
occur ? (3)\* \_\_\_\_\_ ;  
and what is the possible range of  
severity ? (4)\* \_\_\_\_\_ .

305. Circle the numbers which are descriptive  
of a "stroke" :

② ③ ⑤ ⑦ ⑨ ⑫

1. circulatory disorder of the heart
2. circulatory disorder of the brain
3. apoplexy
4. anemia
5. occurs usually among the aged
6. occurs mostly among children
7. caused by hypertension and arteriosclerosis
8. caused by agglutination and hemophilia
9. results in either hemorrhage or blockage
10. results in either hypotension or anemia
11. always fatal
12. might be light to fatal in severity

Stroke, technically called apoplexy,  
is a circulatory disorder of the  
brain, caused by hypertension and  
arteriosclerosis, and resulting in  
either a hemorrhage or a blockage  
of a vessel in the brain. Stroke  
usually occurs among the aged and  
the attacks may range from "light"  
to "fatal" in severity.

306. Refer back to the frame you just  
finished and from it formulate  
a descriptive and concise para-  
graph on "stroke" .

\*\*

307.



*Put on your thinking  
cap and get ready  
for the 3 questions!*

- (1) hypertension  
(2) apoplexy  
(3) heart attack

The technical name for high blood  
pressure is (1) \_\_\_\_\_ .  
The technical name for "stroke"  
is (2) \_\_\_\_\_ .  
The condition in which a coronary  
artery is involved is (3)\* \_\_\_\_\_ .

308. Choose the numbers which relate the causes of each of the following illnesses: (may use numbers more than once)

2, 3, 5 a.  
1, 3 b.  
1, 3, 5 c.

\* \_\_\_\_\_ a. hypertension  
\* \_\_\_\_\_ b. apoplexy  
\* \_\_\_\_\_ c. heart attack

1. hypertension
2. prolonged physical and emotional stress
3. arteriosclerosis
4. agglutination
5. atherosclerosis

---

309. Match the correct letters with the numbers:

b 1.  
e 2.  
a 3.

\_\_\_\_\_ 1. apoplexy  
\_\_\_\_\_ 2. heart attack  
\_\_\_\_\_ 3. hypertension

- a. persistently high blood pressure
- b. rupture or blockage of vessel in brain
- c. agglutination
- d. increase in white cells
- e. blood clot in coronary artery
- f. Rh factor problem

---

THE LAST FOUR FRAMES REVIEW THE ENTIRE PROGRAM. THEY ARE CONCERNED WITH YOUR ABILITY TO ASSOCIATE AND INTERRELATE FACTS AND CONCEPTS.

\*\*THE ANSWERS WILL BE FOUND AT THE BOTTOM OF EACH PAGE INSTEAD OF IN THE LEFT MARGIN. USE YOUR "SLIDER" HORIZONTALLY TO COVER THE ANSWERS AT THE BOTTOM OF EACH PAGE.

310. Draw lines connecting words in Column I which are related to Column II, and Column II with Column III :

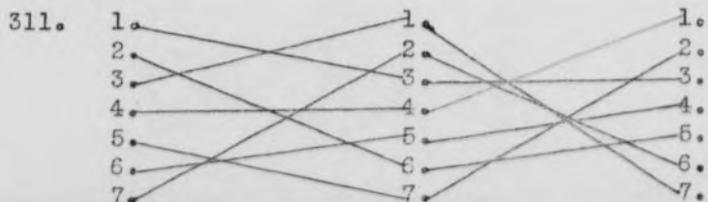
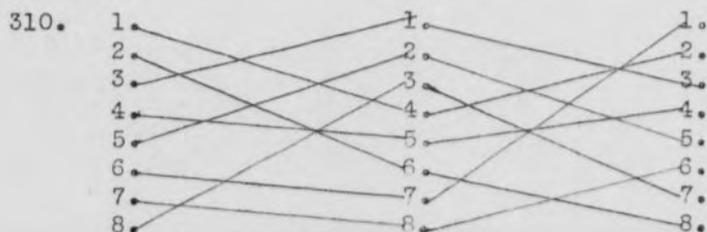
- | I   | II                   | III                                      |
|---|----------------------|--|
| 1. phagocytosis                           | 1. initiate clotting | 1. appears pale - tires easily           |
| 2. red blood cells                        | 2. erythroblastosis  | 2. fights infection                      |
| 3. platelets                              | 3. hereditary        | 3. prevents hemorrhage                   |
| 4. blood types                            | 4. white blood cells | 4. necessary for transfusion             |
| 5. Rh factor pregnancy problem            | 5. compatibility     | 5. agglutination of red cells            |
| 6. hemoglobin deficiency                  | 6. hemoglobin        | 6. no known cure                         |
| 7. abnormal increase in white blood cells | 7. anemia            | 7. blood fails to clot                   |
| 8. hemophilia                             | 8. leukemia          | 8. carries oxygen to supply body tissues |

311.



*More practice in Line Drawing!*

- | I                                   | II                  | III                                  |
|-------------------------------------|---------------------|--------------------------------------|
| 1. direct flow of blood in heart    | 1. veins            | 1. connection closed circuit         |
| 2. divides heart into two sides     | 2. arteriosclerosis | 2. thick walls                       |
| 3. carry "impure" blood to heart    | 3. valves           | 3. murmurs                           |
| 4. microscopic "linkers"            | 4. capillaries      | 4. rupture of vessel in brain        |
| 5. carry "pure" blood to body parts | 5. "stroke"         | 5. "blue babies"                     |
| 6. arteriosclerosis                 | 6. septum           | 6. heart attack                      |
| 7. cholesterol deposits             | 7. arteries         | 7. walls thinner than arterial walls |



312. Draw lines from words in Column I to numbers of words in Column II which show relationships. Do the same for Column II and Column III.

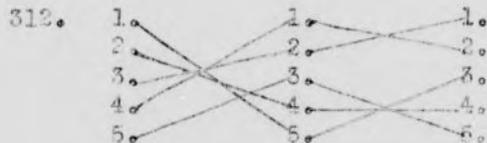
- | I                        | II                | III                            |
|--------------------------|-------------------|--------------------------------|
| 1. pulmonary circulation | 1. auricles       | 1. rhythmic muscle contraction |
| 2. systemic circulation  | 2. heart          | 2. upper chambers              |
| 3. coronary circulation  | 3. ventricles     | 3. oxygenation of blood        |
| 4. "receptors"           | 4. all body parts | 4. "to" and "from"             |
| 5. "distributors"        | 5. lungs          | 5. lower chambers              |

313. Continue showing relationships by the use of connecting lines.

- | I                      | II                   | III                     |
|------------------------|----------------------|-------------------------|
| 1. heart rate          | 1. hypertension      | 1. 120/80 normal        |
| 2. arterial pressure   | 2. brain             | 2. blood clot           |
| 3. heart attack        | 3. pulse             | 3. heart weakens        |
| 4. high blood pressure | 4. blood pressure    | 4. ruptured vessel      |
| 5. apoplexy            | 5. coronary blockage | 5. varies with exercise |



*THE END!  
Now it's test time!  
Don't let yourself  
and the teacher!  
- an "A" please!*





APPENDIX J

SLIDER

## APPENDIX K

INDICATED NEED FOR FRAME REVISIONS  
AS SUMMARIZED FROM ERROR-RATE SHEETS

Frame	Response Number	Diagnostic Criticisms
8	2	Diagram #2 not depictive enough
19		(Stem) - insert "of this part" after "frames"
25		(Wording of question) - change "too" to "slightly"
40		Cartoon needs more projection since it is used as a discovery measure
46	1	Cartoon caption is misleading in arriving at specified answer
64	3	#3 cartoon sketch not a true depiction of "death" - moreso "poison"
70	1	Omit last sentence in cartoon caption - the word "different" was used as a synonym for specified response
73	2	Failed to specifically call for the inclusion of "85% of the human race."
88	1,2,3	Wording of entire frame needs to be clarified
97		Question needs clarity and specificity
109	1,2	Need more discriminatory associations in Column II
132		Failed to recognize "muscle" as a clue
136	1	Need for discrimination to get "muscle" instead of "organ"
140	1,2	Should parallel specified responses with panel material
149		Cartoon unnecessary and misleading
157		Stem needs discriminatory clarification
181		Need to include "a mixture of" in the stem
186	1,3	Need to be more discriminatory in choices
189		(Stem) - use of "hollow tubes" and "pipe lines" should be omitted
198	2,3	"strong" and "pliable" are indicated as synonymous responses
252	1,2	(Question) wording needs clarity and discrimination
269	1	"beats" should be changed - confused as a noun instead of verb
273	2	Statement should specifically call for the figure
295	1	Reword stem - ambiguous with frame #293
298	1,2,4	Need more discriminatory responses

APPENDIX L

INDICATIONS FOR SPECIFIC TEST ITEM REVISIONS  
 (Rank order of items missed ten times or more on post-test)

Item Number	Times Missed
62	31
97	20
55	16
67	13
14	11
27	11
73	11
9	10
42	10
69	10
83	10

## APPENDIX M

## RAW DATA

Subject	Pre-Test Score (100 possible)	Post-Test Score (100 possible)	Error-Rate (1,754 possible)	
			#	%
1	56	100	6	.34
2	46	93	6	.34
3	34	100	0	
4	22	95	4	.22
5	54	97	9	.51
6	65	95	5	.29
7	25	83	3	.17
8	45	93	2	.11
9	79	98	18	1.03
10	58	99	4	.22
11	73	96	0	
12	73	96	1	.06
13	78	95	1	.06
14	55	96	1	.06
15	26	96	8	.46
16	59	94	4	.22
17	47	92	1	.06
18	26	86	33	1.88
19	50	90	9	.51
20	47	97	9	.51
21	74	99	6	.34
22	30	95	16	.91
23	50	95	0	
24	53	94	8	.46
25	72	96	0	
26	30	91	7	.40
27	62	98	4	.22
28	33	93	1	.06
29	39	97	11	.63
30	48	97	3	.17
31	47	93	25	1.43
32	33	81	0	
33	21	91	0	
34	50	88	5	.29
35	47	99	7	.40
36	25	99	15	.86
37	31	87	10	.57
38	30	96	19	1.08
39	35	100	9	.51
40	62	92	4	.22
41	45	99	17	.97