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A Cross-Comparison of the Contributions of Obstacle Course Training and Extended Motor Ability Development to Physical Fitness and Motor Ability

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A CROSS-COMPARISON OF THE CONTRIBUTIONS OF OBSTACLE COURSE TRAINING AND EXTENDED MOTOR ABILITY DEVELOPMENT TO PHYSICAL FITNESS AND MOTOR ABILITY

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TABLE OF CONTENTS

CHAPTER PAGE

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

THE PROBLEM AND DEFINITION OF TERMS

Educational curriculum in a particular subject is viewed as a carefully planned and selected sequence of related experiences. In the area of physical education, these experiences involve the physical aspects of men and the curriculum should be directed toward the development of man's body and the use and understanding of his voluntary movements.

Many concepts of what should be learned have developed within the physical education curriculum because of the varied nature of physical experiences. These concepts include sportsmanship, respect for others, respect for authority, honesty, implementation of spiritual and moral values, learning of rules and regulations, improvement of the cardiovascular, digestive and muscular systems, skill in movement patterns, exercises, rhythm, balance, equilibrium, games, sports, and dances.

The general concepts of intellectual, social-emotional and spiritual development result, directly or indirectly, from two major concepts--motor ability and physical fitness. The need for improvement in these two important areas has been evident in recent years.

President John F. Kennedy showed his concern for physical fitness when he said,

> The harsh fact of the matter is that there are an increasing number of young Americans who are neglecting their bodies--whose physical fitness is not what it should be--who are getting soft, and such softness on the part of the individual citizen can help to strip and destroy the vitality of our nation (6:14-17).

Regarding motor ability Eleanor Methany writes, "It is a basic concern of physical education that man develops his capacity for controlled voluntary movement" (9:83).

This study investigated a means of improving physical fitness while at the same time developing general motor ability. It was the belief of the author that if physical fitness was improved, then general motor development would more readily follow. The changes that occurred in two comparable groups of students who participated in different physical education programs were measured in this investigation.

I. THE PROBLEM

Statement of the Problem

This study measured the changes in physical fitness and motor ability that occurred among comparable groups who participated in two different physical education programs.

Specifically the study determined what changes in physical fitness and motor ability development occurred among sophomore boys at Central Kitsap High School who

participated in two different programs. The two programs were:

I. A class session comprised of three time units, each lasting about one third of the class per day.

   A. Fifteen minutes for warm-ups in the form of group calisthenics.

   B. Fifteen minutes for organized individual skill practice to be used in game activities such as kicking and throwing.

   C. Fifteen minutes for motor ability developed while playing games such as fleetball.

II. A second program comprised of a class session similar to the above plan with one exception: Sessions B and C were shortened five minutes daily to allow the additional section of obstacle course training for ten minutes.

The evaluation and interpretation of the information received from testing the two groups are discussed in this paper.

Importance of the Study

Most of the concepts taught today in physical education classes at the high school level indicate that a balanced program should be offered to all students who enter this program. To be a balanced program, two major areas must be covered.

1. Physical fitness: The development of a sound body to be fit to carry on the work that lies ahead in one's life (5:36).

2. Motor skills: A degree of neuromuscular skill so that one may perform a skill in both work and play to some degree of perfection (1:125).

If the average public school curriculum allowed sufficient time for class sessions, these two concepts of physical fitness and motor ability would not be hard to inculcate. However, in most secondary schools, a class session or period is sixty minutes in length, actually yielding forty-five minutes of class time usable for physical education activities. Suiting-up and showering time occupy the other fifteen minutes.

It is important to construct a program that will meet the criteria of physical fitness and motor ability adequately and within a set time limit because of the time factor inherent in a school situation.

Limitations of the Study

This study has three basic limitations:

1. Eighty sophomore boys at Central Kitsap High School during the fall of 1967 were used.
2. The change recorded was one capable of being measured by the Oregon Simplification of the PFI and the McCloy's General Motor Ability Test.
3. The experimental program lasted for nine weeks because of the quarter academic system at Central Kitsap High School.

Basic Assumptions and Hypothesis

It was a basic assumption that the administration of Central Kitsap High School in its scheduling of sophomore boys produced random sampling within the two groups used in the study.

Other assumptions were:

1. The obstacle course by its nature was conducive to developing agility, endurance, strength, coordination and skills.

2. The instructor conducted both physical education programs in the same manner.

It was a general assumption that obstacle course training would improve physical fitness because of the nature of the engaged physical activity. The hypothesis was that the physical fitness and motor ability developed by participating in obstacle course training would increase by a significant amount over an extended motor ability development program.

II. DEFINITIONS OF TERMS USED

Experimental period. One quarter or nine weeks as the administrative calendar is set up at Central Kitsap.

Motor ability. Achievement in basic motor skills as well as a combination of motor educability and achievement.

Physical fitness. That type of fitness produced by physical training. Persons who function physically at high levels of efficiency are said to be in good condition, in excellent training or "physically fit."

Physical fitness level. That level of performance that will be measured by the Oregon Simplification of the Physical Fitness Index (PFI).

Motor ability level. That level of performance that will be measured by the McCloy General Motor Ability Test.

Obstacle course (general). A utilization of natural surroundings to create a course that contains high speed running, jumps, climbing, hanging and crawling, with the obstacles set apart to engage the use of different muscle groups.

Central Kitsap obstacle course. A winding trail six hundred yards in length through woods near the high school. There are thirteen obstacles spaced throughout the course (See Figures 1-8, Appendix B, 53-62).

CHAPTER II

REVIEW OF LITERATURE

This chapter presents two phases of literature. Fitness examines other programs and studies that have been aimed at fitness improvement. Obstacle courses are discussed in two phases: (1) obstacle course training, and (2) related studies that have used the obstacle course as a tool of research.

Present Physical Fitness Programs

One very highly publicized fitness program started at the Naval Academy in Annapolis on June 18, 1956. This was the President's Conference on Fitness of American Youth requested by former President Eisenhower. The conference developed into a national awareness program with recommended goals urging all schools, as well as the people of the United States, to strive for a national standard of physical fitness (18).

The Blue Book, Youth Physical Fitness (13), published by the most recent President's Council of Youth Fitness, recommended elements for the improvement of the physical fitness of all children and youth with school-centered programs.

Their recommended basic school program consists of at least fifteen minutes per day of conditioning exercises to

build vigor, strength, flexibility, endurance, and balance. Most emphasis is placed on group calisthenics with the remaining available time used for a variety of activities in areas of individual, group, and team sports. In almost all cases, test batteries and standards have been established to aid in measuring achievement and diagnosing weaknesses.

Circuit Training Program

Circuit training, developed at the University of Leeds, England, was originated to meet a limited educational objective of "bodies straight and strong". Although the basic aims are physical fitness as stressed within the physical education development of young men, the circuit training program is flexible enough to improve skill exercise (10:5-6).

But it must also be stated that for the full attainment of skill development, a high degree of functional vigor must be present. The flexible nature can be incorporated into the particular program used. Many different people in groups have used the basic plan to establish an exercise group that will benefit their needs.

Characteristics of Circuit Training

With the flexible nature of circuit training, it is impossible to define or describe the exact program that can be used or is used. It is recommended that certain phases be

included to meet all physical needs:

1. Strength: The capacity of an individual to exert muscular force against a resistance (10:14);

2. Muscular Endurance: The capacity of the individual to continue performance of relatively heavy localized activity (10:16);

3. Power: Horse power or work rate--the product of force and velocity (10:16).

Within these basic requirements, there are three programs that can vary the emphasis of the problem under construction. First, stamina training must be regular and continued over a long period. Second, outings should be frequent but not necessarily prolonged. Third, starting slowly, the intensity of the program must be gradually increased.

Strength training utilizes a high work rate reached by short intensive spells of activity against a high and progressively higher resistance.

The general format for a circuit training program is that general stations are set up around the floor where skills or exercises can be done. A chart of directions is found at each station. Upon finishing an assigned program, the student advances to the next station. The controlling factors which make this type of exercise flexible are the type of skills used, the repetitions used, and the manner in which the student is challenged. There are three ways of controlling this exercise program.

1. Time limitation with set repetitions.
2. Increasing levels of repetition with no time limit.
3. Weight or overload principles increasing based on maximum effort.

Whatever method is adopted, improvement in fitness will be shown in the ability to do more work in a specific time or a certain amount of work in less time (10:40).

The appeal of circuit training at the university level, confirms the belief that the following factors account for its popularity.

1. A period of hard physical work in a short time
2. Each student works at his own rate
3. Students know in advance what they are going to be required to do and they can work independently to reach that requirement
4. Students enjoy the freedom of circuit training programs because each student is treated as one but does not have to react as one class
5. The circuit layout is very attractive and the students enjoy the element of movement that is present in such a program
6. Each student can evaluate himself on his improvement in fitness whether it is a form of time, weights added, or repetitions added in completing his program (10:41).

The LaSierra Physical Education Program

Stan LeProtti, formerly at LaSierra High School in Carmichael, California, has worked with different forms of circuit training for the past few years (8). Two of his developments were the LaSierra Controlled Weight Training

Circuit and the LaSierra Physical Fitness Program (which also follows the circuit training method).

These programs are very rigid in the manner in which they are run. In the weight training circuit program, the instructor controls the entire class by two methods. He may adjust the time periods per exercise with each student using the same weight at each station with the goal to increase repetitions or he may increase the weight and leave the time the same. Word commands were used for starting, stopping, and rotating the groups through each station.

In the second program, a general fitness is emphasized with concentration on the upper body. LeProtti advocates straight exercise circuits that utilize calisthenic exercises and available apparatus either indoors or outdoors.

In the indoor program, equipment such as peg boards, leg boards, ropes, stall bars, overhead ladders, parallel bars and horizontal bars are used. In the outdoor program the equipment ranges from chinning bars, forty foot cable swing grip, peg boards, ropes and a track for running. In both programs the student starts at one end of the above equipment stations and completes each skill at his rate, then moves on to the next station. At the completion of the course, he would run the distance back to the starting line, competing against time (8:[n.p.]).

According to Morgan and Adamson (10), if speed is to be used to determine increased fitness, the performer must be

instructed as to the value of completing each exercise properly. If not done properly, form will break down and the participant will not receive full benefit from this circuit.

Buckley (1966) conducted a study on the physical fitness effects of two different conditioning programs. One of these programs was circuit training. Ninth grade boys were used in his study which ran over a twelve week period. By a comparison of the pre-test and the post-test, it was found that significant changes took place in both groups. In the circuit training troup, the boys increased significantly in the standing broad jump, while in the calisthenic group, there was a significant increase in the shuttle run. Regarding the physical fitness level, either maintaining or improving, both methods did an adequate job. According to Buckley:

> Circuit training lends itself to all around development of muscular endurance, muscular strength and circulatory endurance. In contrast to formal mass calisthenics, circuit training provides motivation and opportunity for the individual to develop at his own rate. It merits a place in the physical education program (2).

The circuit training program is very similar to the obstacle course training. Some of the main advantages as well as the disadvantages are comparable. For example, motivation plays an important role in both programs. However, motivation is difficult to measure.

Obstacle Course Training

Very little has been written about obstacle course training in recent years. The original idea came from the armed forces that used obstacle courses to train men for war-time conditions. "It develops physical capacities, fundamental skills and abilities that are important to soldiers in combat operations. Soldiers must be able to carry, crawl, creep, climb, walk, run, and jump" (15:58). These goals are the basic movement patterns that are needed for skill development.

Within the department of the Army's Technical Manual, Physical Conditioning (12:273), they use the name obstacle and confidence course with the added goal as not only a physical conditioner but a vehicle to develop confidence as his spirit of daring is challenged to complete the course. Here, too, they state that this is a valuable part of their conditioning program but must not be used exclusively.

Related Studies

In the 1940's when the obstacle courses were being used by the Armed Forces quite extensively, Carlos Wear (16:116) constructed multiple obstacle runs for the main purpose of classifying junior high school boys into homogeneous groups. The groups were to be used for physical education activities, so in a sense he was grouping according to motor ability skill. The procedure Wear followed was of

a subjective nature in which a group of boys would run the course and be rated through observation on physical activity ability. The rating was 5-4-3-2-1, which in turn would place the boy in a particular group.

It was found that the lowest correlation between the obstacle run and ability grouping was .508. But from the first trial to the second trial of ability grouping it was found that reliability coefficient rating jumped to .949, a high degree of relationship.

In more recent studies published in Measurement and Evaluation in Physical Education the obstacle run was used as one segment of a test to show motor ability. The reliability coefficient was .91, while the validity coefficient from a larger but similar test was .94. When applied to McCloy's run, throw, and jump test the rating was only .65. This same source indicates the obstacle race was used to measure physical fitness (14:344).

Summary

The literature indicates the importance of physical fitness in today's physical education program. The use of circuit training techniques was shown to be an effective means of increasing physical fitness. Obstacle course training was found to be quite similar to the circuit training programs in that a sequence of particular skills was followed

and participant's improvement could be noted by a decrease in time required to complete the course.

If obstacle course training proves to be an effective means of increasing physical fitness and motor ability, and the literature suggests this to be true, then this study may be useful as a guide for others who are attempting to achieve similar goals.

CHAPTER III

PROCEDURES OF INVESTIGATION

The purpose of this study was to cross-compare two physical education programs as to the measurable effects they would have on tenth grade boys. Two experimental groups were used with two tests to measure physical fitness and motor ability. Each experimental group was first pre-tested in physical fitness and motor ability, then subjected to the different physical education programs. At the end of a nine-week unit, they were post-tested so that changes might be evaluated.

I. INSTRUMENTS OF MEASUREMENT

The two factors that this study dealt with were physical fitness and general motor ability. To test each of these factors, two well-known tests were chosen. For physical fitness the Oregon Simplification of Rogers Physical Fitness Index Test battery was used. For general motor ability the McCloy's General Motor Ability Test was used.

Oregon Simplification of the Physical Fitness Index

This test was derived from the Rogers Physical Fitness Index Battery that has been used for both boys and girls at four levels of education: elementary, junior high, senior high, and college. This original test had six items which

contained two basic elements of physical fitness: muscular strength and muscular endurance. Thus, the "Physical Fitness Index (PFI) is a score derived from comparing an achieved strength index with a norm based upon the individual's sex, weight, and age. It is a measure of the basic physical fitness elements" (3:184).

It was found by Clarke and Carter as cited by Clarke (3:209) in their efforts to simplify the basic six-test battery of the PFI that by dropping two of the test items, that a high correlation (.996) was upheld. Thus, the Oregon Simplification test battery which consists of four test items could be used to determine each boy's PFI score.

The various parts of this test in the order in which they were administered will be described in the following paragraphs.

The back lift. The dynamometer was used. The purpose of this test item and this instrument is to measure the strength of all back muscles. To administer this test the tester must follow a constant and set pattern so that each test subject performs at his best as the test is designed.

1. With the feet in the proper position on the base of the dynamometer, the subject is told to stand erect with hands placed on the front of his thighs, fingers extended downward. The tester should then hook the chain so that the bar level is just below the finger tips. The subject should grasp the handle firmly at the ends of the bar, with thumb clenching fingers and with one palm forward and one palm backward.

It is highly important not to bend the back too much, as the resultant poor leverage is conducive to a poor lift as well as to the possibility of strain. With the back properly bent, however, there is very little likelihood of injury from lifting.

2. The subject should lift steadily. Care should be taken to keep the knees straight. The tester should grasp the subject's hands firmly during the lift.

3. The subject's feet should be flat on the platform. It is necessary to retest after shortening the chain, if he attempts to lift by standing on his toes. Any initial lateral sway should be immediately checked.

4. At the end of lifting effort, the back should be almost straight. If not, repeat the test (3:187-188).

Leg Lift. The leg lift is used to test the strength of the large muscles of the leg.

1. The subject should hold the bar with both hands together in the center, both palms down, so that it rests at the junction of thighs and trunk. Care should be taken to maintain this position after the belt has been put in place and during the lift.

2. The loop end of the belt is slipped over one end of the handle or crossbar: the free end of the belt should be looped around the other end of the bar, tucking it in under so that it rests next to the body. In this position, the pressure of the belt against the body and the resultant friction of the free end against the standing part holds the bar securely. The belt should be placed as low as possible over the hips and gluteal muscles.

3. The subject should stand with his feet in the same position as for the back lift. The knees should be slightly bent. Maximum lifts occur when the subject's legs are nearly straight at the end of the lifting effort. Experienced testers become

adept at estimating the potential lift by noting the degree of muscularity of the subject's legs; as a consequence they will start the stronger subjects at a lower chain link, so as to allow for the extra distention in the dynamometer. If too high a link is used, the subject's knees may snap into hyper-extension during the lift, although an alert tester can always anticipate such an occurrence and interrupt the performance.

4. Before the subject is instructed to lift, the tester should be sure that the arms and back are straight, the head erect, and the chest up. These details are of great importance to accurate testing. Beginners will err in results by one hundred to three hundred or more pounds if the single detail of leg angle is wrong. Therefore, even experienced testers repeat leg-lift tests for most subjects immediately, changing slightly the length of chain--even by twisting, if a link seems too great.

5. Record the best of two or three tests (3:190).

Pull-up test. The purpose of this test is to measure the strength of the upper arm and shoulder girdle. The boys' pull-up test is administered from a chinning bar. The bar should be high enough from the floor so that the feet of the tallest boy do not touch the floor when performing the test. If this is impossible, it will be necessary for tall individuals to bend their knees in order not to touch the feet on the floor in lowering the body to straight-arm hang.

In taking the pull-up test, the subject hangs from the bar with the use of the forward hand grip and chins himself as many times as he can. In executing this movement, he should pull himself until his arms are straight. He should not be permitted to kick, jerk, or use a hip motion.

Dipping test. The purpose of this test is to measure the strength of the upper arm and shoulder girdle area.

> The subject should stand at the end of the parallel bars, grasping one bar in each hand. He jumps to the form support position with arms straight (this counts one). He lowers his body until the angle of the upper arm and forearm is less than a right angle, then pushes up to the straight-arm position (this counts two). This movement is repeated as many times as possible. The subject should not be permitted to jerk or kick when executing dips (3:193).

McCloy's General Motor Ability Test

This test was designed by McCloy as cited by Clarke (3:290-91) "to measure the developed capacity of an individual for participation in a wide range of physical activities" (3:290). It is composed of a simple test of strength (chinning strength) and a number of track and field events.

> In the development of the General Motor Ability Tests, results on individual test elements were correlated with two total scores on a large battery of achievement tests. The elements finally selected to form the test gave as high a prediction of general motor ability as was given by any other combination of events (3:291).

These items are as follows.

Fifty yard dash. Fifty yards were measured off on a firm track surface with two lime lines used to indicate the start and finish. One boy at a time was tested allowing him a ten minute rest between each trial run. Three trial runners were given to each testee with the best time recorded.

Standing broad jump. Two metal tapes were attached to the gym floor four feet apart. The end line of the basketball court was used as the stand mark. Each subject would place his toes just behind the end line for his starting position. Three jumps were allowed in succession, marking and recording the best of his three jumps.

Shot-put. An eight pound shot was used within the high school regulation ring under the same rules that govern a high school competitive track meet. Each student was allowed three throws with the use of stakes to mark their best throw. Each contestant's throws were measured immediately upon completion of the trials.

Running high jump. High school track equipment was utilized. For a starting height the bar was set at 3'0" and advanced 1" per jump. Each subject was allowed three misses at a particular high until his previous high was recorded. All legal forms of jumps were allowed according to high school track and field rule book.

II. ORGANIZATION OF TEST SITUATION

The following criteria were considered in the organization of the testing situation.

Subjects used. At Central Kitsap High School there are three tenth grade boys' physical education classes. Prior to this study it was decided that all participating boys that were scheduled for the fourth and sixth period classes would take part in this study. Fifth period was eliminated because the boys had just eaten lunch.

Health status. Only those students that were physically able to participate in a normal high school physical education class were tested.

Subject orientation. At the first meeting of the class all students were informed that they were taking part in a thesis study. Orientation followed describing the purpose of the study, procedure, and manner in which tests would be administered, and the manner in which the tests would be recorded. At that point the class was informed that all students would participate in a prescribed physical education program and again be tested to determine if any improvements had been made.

Dates of administration. The pre-test was given the first two weeks of school and the post-test followed after a nine-week physical education program unit.

Materials needed. The materials needed for the test were test directions found in Clarke (3:184-292), dynamometer,

pull-up bars, dip bars, fifty-yard measuring tape, stop watch, lime, athletic tape, eight-pound shot, shot marking stakes, shot-put ring, high-jump standards, and bar.

Student helpers. In each physical education class four upper class squad leaders were assigned. These students recorded all scores in each test given.

III. COLLECTION OF DATA

Recording scores. Each of the two classes were devided into four groups (squads) with one squad leader assigned to each group. The squad leaders recorded all raw scores on a score recording sheet. At the end of both pre-tests and post-tests these scores were transferred to a "class composite score sheet" for further evaluation (see Table I, Appendix A, page 42).

Test scoring. The eight test items from the two tests were scored first by a raw score of feet, inches, pounds, seconds, and/or number.

In the McCloy's Motor Ability Test the raw scores of four events (fifty yard dash, shot put, running high jump, and standing broad jump) were changed into common track and field points to gain a total value (see Table II, Appendix A, page 43).

Chinning strength was computed by inserting the raw score of number of chins into the equation (CS=1.77[wt.] + 3.42[chins] - 46).

Tables III and IV (Appendix A, pages 44-45)were used in assistance to figure out the above equations. The final General Motor Ability Score was computed by inserting the two above scores (track and field score and chinning strength score) into this final equation: General Motor Ability Score = .1022 (track & field points) + .3928 (chinning strength) (see Tables V and VI, Appendix A, pages 46-48).

In computing the Oregon Simplification of the Rogers Physical Fitness Index Test Battery, first arm strength must be determined to complete the needed information. To compute arm strength four raw scores items were inserted into the equation: Arm strength = (dips + pull-ups) $(\frac{\text{Weight}}{10}$ + Height - 60). The arm strength score was then inserted into the final equation that computed the Physical Fitness Index Score.

Physical Fitness Index Score = (1.07 leg lift] + 1.06 [arm strength] + 1.42 [backlift] + 194). Tables VII, VIII, and IX were used in aiding in computing this equation (see Appendix A, pages 49-51).

The formulas used for final analysis of the above data can be found in Table X in the Appendix A, page 52.

III. ORGANIZATION OF EXPERIMENTAL PROGRAMS

The organization of both experimental programs was set up within the normal physical education classes already established at Central Kitsap High School. Each physical education class runs on a fifty-five minute block basis daily with the same group of boys. Two classes were chosen because of their position in the daily school programming. The fourth period class (experimental group A) is prior to lunch and the six period class (experimental group B) is the final period of the day. These two classes were chosen so that time blocks within the experimental program could be constant. Should the class run overtime, the only thing the students would lose would be lunch or a short period after school.

Experimental Group A

The experimental group A program consisted of three segments of time.

1. A ten minute group calisthenics warm-up period. This consisted of eleven exercises:
   a. Side straddle hops (10)
   b. Toe touchers (10)
   c. Push-ups (10)
   d. Stride hops (10)
   e. Sprinters (10)
   f. Push-ups (10)
   g. Run in place (10 counts)

h. Toe hops (10)

i. Push-ups (10)

j. Sit-ups (10)

k. Leg raisers (10)

2. A fifteen minute motor skills period. This period consisted of motor skill development reached by running, passing, and kicking drills in the game of fleetball.

3. A ten minute period for additional motor skill development utilizing the game of fleetball. A high degree of supervision was used to insure that all students aimed their goals at perfection in the development of their ability to pass, kick, and run correctly with the football.

Experimental Group B

The experimental group B program consisted of three segments of time. The first two were the same as group A. The third segment of time (ten minutes) was used for running the obstacle course.

For details of what the obstacle course consisted of, see the illustrations in Figures 1-8. These drawings show what obstacles were placed in the course and the directions for completing each item to its completion.

The student's time of completion over the course was used to measure improvement.

Duration of the Experimental Study

The time between the pre-test and the post-test was nine weeks. During this interval both groups A and B participated in their respective programs. The duration of nine

weeks was chosen due to three factors:

1. One quarter of the school year is a nine-week period at Central Kitsap High School.

2. The unit would be terminated for grading purposes.

3. J. W. Kistler at Louisiana State University ran an eight-week training program with 1,650 men very similar to the Central Kitsap study.

His class period consisted of approximately eight minutes of calisthenics and four bouts of exercise, each five minutes in duration. During the calisthenics stress was placed on stretching and bending exercises, sit-ups, push-ups, and deep-knee bends. The five-minute bouts of exercise were devoted to all-out chinning, obstacle-course running, personal-combat activities, and running (7:23).

Kistler administered three tests, a pre-test, a mid-term, and a post-test, in five areas: (1) a five-minute run for distance, (2) an obstacle course run for time, (3) push-up test, (4) chinning test, and (5) sit-up test (7:24).

1. The findings of this study would seem to justify the statement that significant improvement may be achieved in the physical fitness elements of strength, endurance, and agility through a specific training program devoted to these elements.

2. The time required for achieving physical fitness of the type involved in this study is not excessive.

3. Of the physical fitness elements investigated in this study, endurance of the cardio-respiratory type appears to be the most difficult to improve. Strength and endurance of the type measured in doing sit-ups and chinnings are most amenable to improvement through systematic training procedures.

4. An appreciable per cent of men actually demonstrate retrogression in ability to perform in motor activities of the type used in this study, during a training period of eight weeks.

CHAPTER IV

ANALYSIS OF DATA

The results of this study show that groups A and B, in comparing the quotient point means, stayed even or raised in all test items but one, the fifty-yard dash. The group B, the obstacle course training group, increased at a higher mean rate than group A, the extended motor ability group, in five out of eight test items. The three items in which group A showed mean improvement over group B were the high jump, broad jump, and fifty yard dash. These three items were from the McCloy's motor ability test battery, both groups dropped in one item but group A dropped less than group B. These findings can be found in Table XI.

The results of comparing group A to group B in the pre-test indicated that the groups were statistically equal with one exception. Group B scored significantly higher on the fifty yard dash test. The difference between mean scores computed to a "t" of 2.14 which was significant at the .05 level of confidence (Table XII).

In comparing the pre-test to post-test scores of group A, the following information was discovered. In seven out of eight tests, group A increased in mean scores. In two of these test items, arm strength and back lift, the increase was significant at the .05 and .01 levels of confidence,

TABLE XI

PRE-TEST AND POST-TEST SCORES FOR GROUPS A AND B
SHOWING GAINS IN QUOTIENT POINT
AND PFI POINT MEANS

	PFI			McCloy's Motor Ability				
Test Item	Leg Press	Arm Strength	Back Lift	Broad Jump	Chinning Strength	50-yard Dash	Shot Put	High Jump
Group A								
Pre-Test	1020	385	325	289	222	359	254	283
Post-Test	1054	480	379	301	226	344	264	298
GAIN	+34	+95	+54	+12	+4	-15	+10	+15
Group B								
Pre-Test	1047	432	359	310	219	400	265	300
Post-Test	1168	560	419	310	228	389	290	313
GAIN	+121	+128	+60	---	+9	-11	+25	+13

TABLE XII

GROUPS A AND B ON PRE-TEST

TEST ITEM	"t"	SIGNIFICANCE
Leg Lift	.40	---
Arm Strength	.89	---
Chinning Strength	.31	---
Broad Jump	1.14	---
Back Lift	1.80	---
50 yard Dash	2.14	.05
Shot Put	.59	---
High Jump	.93	---

respectively. The mean increase for arm strength was 95 points with a "t" of 1.99. For the back lift the mean increase was 54 points, with a "t" of 3.14 (Table XIII).

Similar results were discovered when the results of pre-test and post-test scores were compared for group B. Group B increased means in seven out of eight test items. The back lift mean difference computed to have a "t" of 2.99 which was statistically significant at the .01 level (Table XIV).

After the nine week controlled experimental period with each group participating in their respective programs, the post-test was given. From that test a comparison between group A and group B test items revealed the following information. Group A increased mean scores in all test items but one. Their pre-test mean of 359 dropped to 344 in the fifty yard dash.

Group B increased their mean in six out of eight test items. One, the broad jump, stayed constant at a mean of 310 while the fifty yard dash mean of 400 dropped to 389.

In two test items group B scored significantly higher. The back lift mean differences computed to have a "t" of 2.15, significant at the .05 level, as was the fifty yard dash with a "t" of 2.42 (Table XV).

In cross-comparing the two test scores, the Oregon Simplification Test Battery, of group A and group B, the

TABLE XIII

GROUP A PRE-TEST AND POST-TEST

TEST ITEM	"t"	SIGNIFICANCE
Leg Lift	.58	---
Arm Strength	1.99	.05
Chinning Strength	.04	---
Broad Jump	.60	---
Back Lift	3.14	.01
50 yard Dash	.90	---
Shot Put	.59	---
High Jump	.76	---

TABLE XIV

GROUP B PRE-TEST AND POST-TEST

TEST ITEM	"t"	SIGNIFICANCE
Leg Lift	1.51	---
Arm Strength	1.86	---
Chinning Strength	.87	---
Broad Jump	.00	---
Back Lift	2.99	.01
50 yard Dash	.52	---
Shot Put	1.02	---
High Jump	.62	---

TABLE XV

GROUPS A AND B ON POST-TEST

TEST ITEM	"t"	SIGNIFICANCE
Leg Lift	1.55	---
Arm Strength	1.22	---
Chinning Strength	.20	---
Broad Jump	.47	---
Back Lift	2.15	.05
50 yard Dash	2.42	.05
Shot Put	1.13	---
High Jump	1.48	---

following information resulted: Group B, with the obstacle course training, showed a significant gain from pre-test to post-test over group A in the Oregon Simplification Test Battery. The "t" computed to 2.11 which was significant at the .05 level of confidence. Group A, with the extended motor training, showed a significant gain from pre-test to post-test over group B in the McCloy's general motor ability test. With a 2.37 "t" it was significant at the .05 level of confidence (Table XVI).

TABLE XVI

A CROSS-COMPARISON OF PRE-TEST AND POST-TEST SCORES IN BOTH PHYSICAL FITNESS AND MOTOR ABILITY TESTS

PHYSICAL FITNESS TEST	Pre	to	Post	Significance
	"t"	"t"	"t"	
Group A		1.63		----
	.63		1.59	
Group B		2.11		.05
Significance	---		---	
MOTOR ABILITY TEST	**Pre**	**to**	**Post**	**Significance**
	"t"	"t"	"t"	
Group A		2.37		.05
	.65		1.16	
Group B		.64		----
Significance	---		---	

CHAPTER V

SUMMARY, FINDINGS, CONCLUSIONS, AND RECOMMENDATIONS

I. SUMMARY

The purpose of this study was to determine the effects of two different physical education programs on the physical fitness and motor ability level of tenth grade boys. The two tests were administered at the start of the school year to ascertain the subjects' present condition.

Following the nine weeks in their respective experimental physical education programs, the two tests were again administered to evaluate the subjects' physical fitness and motor ability condition. The pre-test and post-test scores were used to compute the mean differences and the standard error of the difference. The final task was to compute "t", in order to determine any statistically significant differences between the two experimental groups in the two areas, physical fitness and motor ability development.

II. FINDINGS

Significant changes in some aspects of fitness were noted by comparing itemized test scores of Groups A and B, pre-tests and post-tests. The comparing of pre-test to post-test data showed that the extended motor ability training, Group A, increased significantly in arm strength and back

lift. A comparison of itemized post-tests data of group A and B showed group B increased significantly in the back lift and fifty yard dash. The fifty yard dash, which had a .05 level of significance is not important except that the groups were unequal at the start of the experimental period and remained uneven at its conclusion.

III. CONCLUSIONS

The original hypothesis was that physical fitness and motor ability development of experimental group B, participating in obstacle course training, would increase by a significant amount over experimental group A, participating primarily in extended motor ability training. This hypothesis cannot be satisfactorily supported.

Both experimental physical education programs appear to have done an adequate job of either maintaining or improving the physical fitness and motor ability level of the participants. Group A showed a significant increase in motor ability, whereas group B had significant increase in physical fitness.

Based upon the findings of this study, one can generalize that students exposed to a specific type of program can be expected to show corresponding effects.

IV. RECOMMENDATIONS

The following recommendations concerning the study are offered for consideration:

1. Obstacle course training was found to be a highly motivating experience for the participants in that they were continuously trying to better their previous time for running through the course. The inclusion of a program of this type in a physical education class may enhance the achieving of physical fitness goals.

2. The inclusion of a greater variety of obstacles might better achieve motor ability goals as well as physical fitness.

3. The obstacle course provides a tool where improvement can be objectively shown and graded accordingly. For this reason it is recommended that it be included in a physical education class.

4. A study might be made for an eighteen week period (nine weeks longer than this study) to see if the findings of this study are substantiated or any further changes can be found.

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APPENDIX A

TABLES I-X

TABLE I

CLASS COMPOSITE RECORD FOR THE OREGON SIMPLIFICATION OF STRENGTH AND PHYSICAL FITNESS TEST AND MCCLOY'S MOTOR ABILITY TEST

Group_____ Test_____ (Data Sheet) Date_____

NAME OF STUDENT	Height	Weight	Leg Press	Dips	Pull-ups	Running high jump	Standing broad jump	50-yard dash	8 lb. shot put	Back lift

TABLE II

QUOTIENT SCORING TABLE FOR TRACK AND FIELD

QUOTIENT POINTS	50 YARD DASH	STAND BROAD	RUNNING	8 LB. SHOT
97	10.2	5"	8"	17
105	10.0	7"	9"	18
113	9.8	9"	10"	19
122	9.6	11"	11"	20
131	9.4	0"	0"	21
142	9.2	2"	1"	22
153	9.0	4"	2"	23
165	8.8	6"	3"	24
179	8.6	8"	4"	25
194	8.4	10"	6"	26
210	8.2	0"	7"	27
228	8.0	2"	9"	29
248	7.8	5"	10"	30
271	7.6	8"	0"	32
295	7.4	11"	2"	34
323	7.2	2"	4"	36
354	7.0	6"	6"	38
389	6.8	10"	8"	40
427	6.6	2"	10"	42
471	6.4	5"	0"	45
521	6.2	11"	3"	48
577	6.0	4"	6"	51
642	5.8	9"	9"	55
719	5.6	3"	0"	59

TABLE III

TABLE FOR COMPUTING CHINNING STRENGTH OF BOYS

Weight, Pounds
Values for 1.77 Weight -46

Weight										
50	42.5	44.3	46.0	47.8	49.6	51.4	53.1	54.9	56.7	58.4
60	60.2	62.0	63.7	65.5	67.3	69.1	70.8	72.6	74.4	76.1
70	77.9	79.7	81.4	83.2	85.0	86.8	88.5	90.3	92.1	93.8
80	95.6	97.4	99.1	100.9	102.7	104.5	106.2	108.0	109.8	111.5
90	113.3	115.1	116.8	118.6	120.4	122.2	123.9	125.7	127.5	129.2
100	131.0	132.8	134.5	136.3	138.1	139.9	141.6	143.4	145.2	146.9
110	148.7	150.5	152.2	154.0	155.8	157.6	159.3	161.1	162.9	164.6
120	166.4	168.2	169.9	171.7	173.5	175.3	177.0	178.8	180.6	182.3
130	184.1	185.9	187.6	189.4	191.2	193.0	194.7	196.5	198.3	200.0
140	201.8	203.6	105.3	207.1	208.9	210.7	212.4	214.2	216.0	217.7
150	219.5	221.3	223.0	224.8	226.6	228.4	230.1	231.9	233.7	235.4
160	237.2	239.0	240.7	242.5	244.3	246.1	247.8	249.6	251.4	253.1
170	254.9	256.7	259.4	260.2	262.0	263.8	265.5	267.3	269.1	270.8
180	272.6	274.4	276.1	277.9	279.7	281.5	283.2	285.0	286.8	288.9
190	290.3	292.1	293.8	295.6	297.4	299.2	300.9	302.7	304.5	306.2
200	308.0	309.8	311.5	313.3	316.9	315.1	316.9	320.4	322.2	323.9

TABLE IV

CHINS

Values for 3.42

Chins	0	1	2	3	4	5	6	7	8	9
0	0.0	3.4	6.8	10.3	13.7	17.1	20.5	23.9	27.4	30.8
10	34.2	37.6	41.0	44.5	47.9	51.3	54.7	58.1	61.6	65.0
20	68.4	71.8	75.2	78.7	82.1	85.5	88.9	92.3	95.8	99.2
30	102.6	106.0	109.4	112.0	116.3	119.7	123.1	126.5	130.0	133.4

TABLE V

TRACK AND FIELD POINTS
FOUR EVENTS

1022 Total Points

	0	10	20	30	40	50	60	70	80	90
100	10.22	11.24	12.26	13.29	14.31	15.33	16.35	17.37	18.40	19.42
200	20.44	21.46	22.48	23.51	24.53	25.55	26.57	27.59	28.62	29.64
300	30.66	31.68	32.70	33.73	34.75	35.77	36.79	37.81	38.84	39.86
400	40.88	41.90	42.92	43.95	44.97	45.99	47.01	48.03	49.05	50.08
500	51.10	52.12	53.14	54.17	55.19	56.21	57.23	58.26	59.28	60.30
600	61.32	62.34	63.36	64.39	65.41	66.43	67.45	68.47	69.50	70.52
700	71.54	72.56	73.58	74.61	75.63	76.65	77.67	78.69	79.72	80.74
800	81.75	82.78	83.80	84.83	85.86	86.87	87.89	88.91	89.94	90.96
900	91.98	93.00	94.20	95.05	96.07	97.10	98.11	99.13	100.16	101.18
1000	102.20	103.22	104.24	105.27	106.29	107.31	108.33	109.35	110.35	111.40
1100	122.42	113.44	114.46	115.49	116.51	117.53	118.55	119.57	120.60	121.62
1200	122.64	123.66	124.68	125.71	126.73	127.75	128.77	129.78	130.82	131.84
1300	132.86	133.88	134.90	135.93	136.95	137.97	138.99	140.00	141.04	142.06
1400	143.08	144.10	145.12	146.15	147.17	148.19	149.21	150.23	151.26	152.28
1500	153.30	154.32	155.34	155.34	157.39	158.41	159.43	160.45	161.48	162.50
1600	163.52	164.54	165.60	166.59	167.61	168.63	169.65	170.67	171.70	172.72
1700	173.74	174.76	175.78	176.81	177.83	178.85	179.87	180.89	181.92	182.94
1800	183.96	184.98	186.00	187.03	188.05	189.05	190.09	191.11	192.14	193.16

INTERPOLATION TABLE

1	.1	4	.41	7	.71
2	.2	5	.51	8	.82
3	.31	6	.61	9	.92

TABLE VI

CHINNING STRENGTH (ALL BOYS)

.3928 (Chinning Strength)

	0	1	2	3	4	5	6	7	8	9
40						17.68	18.07	18.46	18.85	19.25
50	19.64	20.03	20.43	20.82	21.21	21.60	22.00	22.39	22.78	23.18
60	23.57	23.96	24.35	24.75	25.14	25.52	25.92	26.32	26.71	27.10
70	27.50	27.89	28.28	28.67	29.07	29.46	29.85	30.25	30.64	31.03
80	31.42	31.82	32.31	32.60	33.00	33.39	33.78	34.17	34.57	34.96
90	35.35	35.74	36.14	36.53	36.92	37.32	37.71	38.10	38.49	38.89
100	39.28	39.67	40.07	40.46	40.85	41.24	41.64	42.03	42.42	42.82
110	43.21	43.60	43.99	44.39	44.78	45.17	45.56	45.96	46.35	46.74
120	47.14	47.53	47.92	48.31	48.71	49.10	49.49	49.89	50.28	50.67
130	51.06	51.46	51.85	52.24	52.64	53.03	53.42	53.81	54.21	54.60
140	54.00	55.38	55.78	56.17	56.56	56.96	57.35	57.54	58.13	58.53
150	58.02	59.31	59.71	60.10	60.49	60.88	61.28	61.67	62.06	62.46
160	62.85	63.24	63.63	64.03	62.42	64.81	65.20	65.60	65.99	66.38
170	66.78	67.17	67.56	67.95	68.35	68.74	69.13	69.53	69.92	70.31
180	70.70	71.10	71.49	71.88	72.28	72.67	73.06	73.45	73.85	74.24
190	74.63	75.02	75.42	75.81	76.20	76.60	76.99	77.38	77.77	78.17
200	78.56	78.95	79.35	79.74	80.13	80.52	80.92	81.31	81.70	82.10
210	82.49	82.88	83.27	83.67	84.06	84.45	84.84	85.24	85.63	86.02
220	86.42	86.81	87.20	87.59	87.99	88.38	88.77	89.17	89.56	89.95
230	90.34	90.74	91.13	91.52	91.92	92.31	92.70	93.09	93.49	93.88
240	94.27	94.66	95.06	95.45	95.84	96.24	96.63	97.02	97.41	97.81
250	98.20	98.59	98.99	99.38	99.77	100.16	100.56	100.95	101.34	101.74
260	102.13	102.52	102.91	103.31	103.70	104.09	104.48	104.88	105.27	105.66
270	106.06	106.45	106.84	107.23	107.63	108.02	108.41	108.81	109.20	109.59

TABLE VI (continued)

280	109.98	110.38	110.77	111.16	111.56	111.95	112.34	112.73	113.13	113.52
290	113.91	114.30	114.70	115.09	115.48	115.88	116.27	116.66	117.05	117.45
300	117.84	118.23	118.63	119.02	119.41	119.80	120.20	120.59	120.98	121.38
310	121.77	122.16	122.55	122.05	123.34	123.73	124.12	124.52	124.91	125.30
320	135.70	126.09	126.48	126.87	127.27	127.66	128.05	128.45	128.84	129.23
330	129.62	130.00	130.41	130.80	131.20	131.59	131.98	132.37	132.77	133.16
340	133.55	133.94	134.34	134.73	135.12	135.52	135.91	136.30	136.69	137.09

TABLE VII

OREGON SIMPLIFICATION OF STRENGTH AND PHYSICAL FITNESS INDICES
TABLES FOR COMPUTATION OF REGRESSION EQUATION
SENIOR HIGH SCHOOL BOYS

B Equation: $\frac{1.07\ (\text{Leg Lift}) + 1.06\ (\text{Arm Strength}) + 1.42\ (\text{Back Lift}) + 194}{1.07\ (\text{Leg Lift})}$

	0	10	20	30	40	50	60	70	80	90
300	321	332	342	353	364	375	385	396	407	417
400	428	439	449	460	471	482	492	503	514	524
500	535	546	556	567	578	589	599	610	621	631
600	642	653	663	674	685	696	706	717	728	738
700	749	760	770	781	792	803	813	824	835	845
800	856	867	877	888	899	910	920	931	942	952
900	963	974	984	995	1006	1017	1027	1038	1049	1059
1000	1070	1091	1091	1102	1113	1124	1134	1145	1156	1166
1100	1177	1189	1198	1209	1220	1231	1241	1252	1263	1273
1200	1284	1295	1305	1316	1327	1338	1348	1359	1370	1380
1300	1391	1402	1412	1423	1334	1445	1455	1466	1477	1487
1400	1498	1509	1519	1530	1541	1552	1562	1572	1584	1594
1500	1605	1616	1626	1637	1648	1659	1669	1680	1691	1701
1600	1712	1723	1733	1744	1755	1766	1776	1787	1798	1808
1700	1819	1830	1840	1851	1862	1873	1883	1894	1905	1915
1800	1926	1937	1947	1958	1969	1980	1990	2001	2012	2022
1900	2033	2044	2054	2065	2076	2087	2097	2108	2119	2129
2000	2140	2151	2161	2172	2183	2194	2204	2215	2226	2236

TABLE VIII

OREGON SIMPLIFICATION OF STRENGTH AND PHYSICAL FITNESS INDICES
TABLES FOR COMPUTATION OF REGRESSION EQUATION
SENIOR HIGH SCHOOL BOYS

B Equation: 1.07 (Leg Lift) + 1.06 (Arm Strength) + 1.42 (Back Lift) + 194
1.06 (Rogers Arm Strength)

	0	10	20	30	40	50	60	70	80	90
		11	21	32	42	53	64	74	85	95
100	106	117	127	138	148	159	170	180	191	201
200	212	223	233	244	254	265	276	286	297	307
300	318	329	339	350	360	371	382	392	403	413
400	424	435	445	456	466	477	488	498	509	519
500	530	541	551	562	572	583	594	604	615	625
600	636	647	657	668	678	689	700	710	721	731
700	742	753	763	774	784	795	806	816	827	837
800	848	859	869	880	890	901	912	922	933	943

TABLE IX

OREGON SIMPLIFICATION OF STRENGTH AND PHYSICAL FITNESS INDICES
TABLES FOR COMPUTATION OF REGRESSION EQUATION
SENIOR HIGH SCHOOL BOYS

Back Lift

	0	10	20	30	40	50	60	70	80	90
200	284	298	312	327	341	355	369	383	398	412
300	426	440	454	469	483	497	511	525	540	554
400	568	582	596	611	625	639	653	667	682	696
500	710	724	738	753	767	781	795	809	824	838
600	852	866	880	895	909	923	937	951	966	980

TABLE X

FORMULAS USED FOR ANALYSIS OF DATA

MEAN	$M = \frac{EX}{N}$
MEAN DIFFERENCE	$M\ diff. = M_1 - M_2$
STANDARD DEVIATION	$\sigma = \sqrt{\frac{EX^2}{N} - M^2}$
STANDARD ERROR OF THE DIFFERENCE	$diff. = \sqrt{\sigma M_1^2 + \sigma M_2^2}$
STANDARD ERROR OF THE MEAN	$M = \frac{\sigma}{\sqrt{N-1}}$
"t"	$t = \frac{M\ diff.}{\sigma\ diff.}$

APPENDIX B

FIGURES 1-8

CHARACTERISTICS OF OBSTACLE COURSES

Obstacle courses could be built or established either indoors or outdoors. In either case certain characteristics will follow true for both situations. The War Department Field Manual, Physical Training, (15) gives in detail the basic requirements for constructions of an obstacle course. They point out that:

1. Obstacle courses are not standardized. The use of the topography condition, if outside, will always vary the structure of the course.
2. The course should utilize the natural surroundings as well as available equipment. Trees, rocks, hills, and streams are great natural obstacles.
3. Obstacle courses must be constructed for high speed performance with as much emphasis on prevention of injuries.
4. The width of such courses must be six to eight men wide to provide space for keen competition.
5. The obstacles themselves should number from fifteen to twenty-five within a distance of three hundred to four hundred and fifty yards in length. Separation and types of obstacles must be analyzed to (1) use different muscle groups and (2) arrange it so that the obstacles at the start of the courses are the large sized obstacles that can

handle a large number, while the difficult obstacles are in the middle with the easiest obstacles placed at the end to prevent injuries because of fatigue.

6. The obstacles and courses are patterned to be placed in a "U" or "8" shape so that one instructor can observe them and time them as well.
7. Varied types of obstacles can be used: hurdles three and a half feet high, balance beams, walls, overhead ladders, parallel bars, and climbing.

HOW AN OBSTACLE COURSE WORKS

Upon completion of setting up or constructing an obstacle course, a general procedure must follow before the course is used. Each obstacle must be introduced, explained, demonstrated, and practiced at a slow rate. The next phase is to practice each obstacle while learning the course pattern at a slow speed with the emphasis on completing each event. The final phase, running the course under time, follows the directed path completing each obstacle correctly.

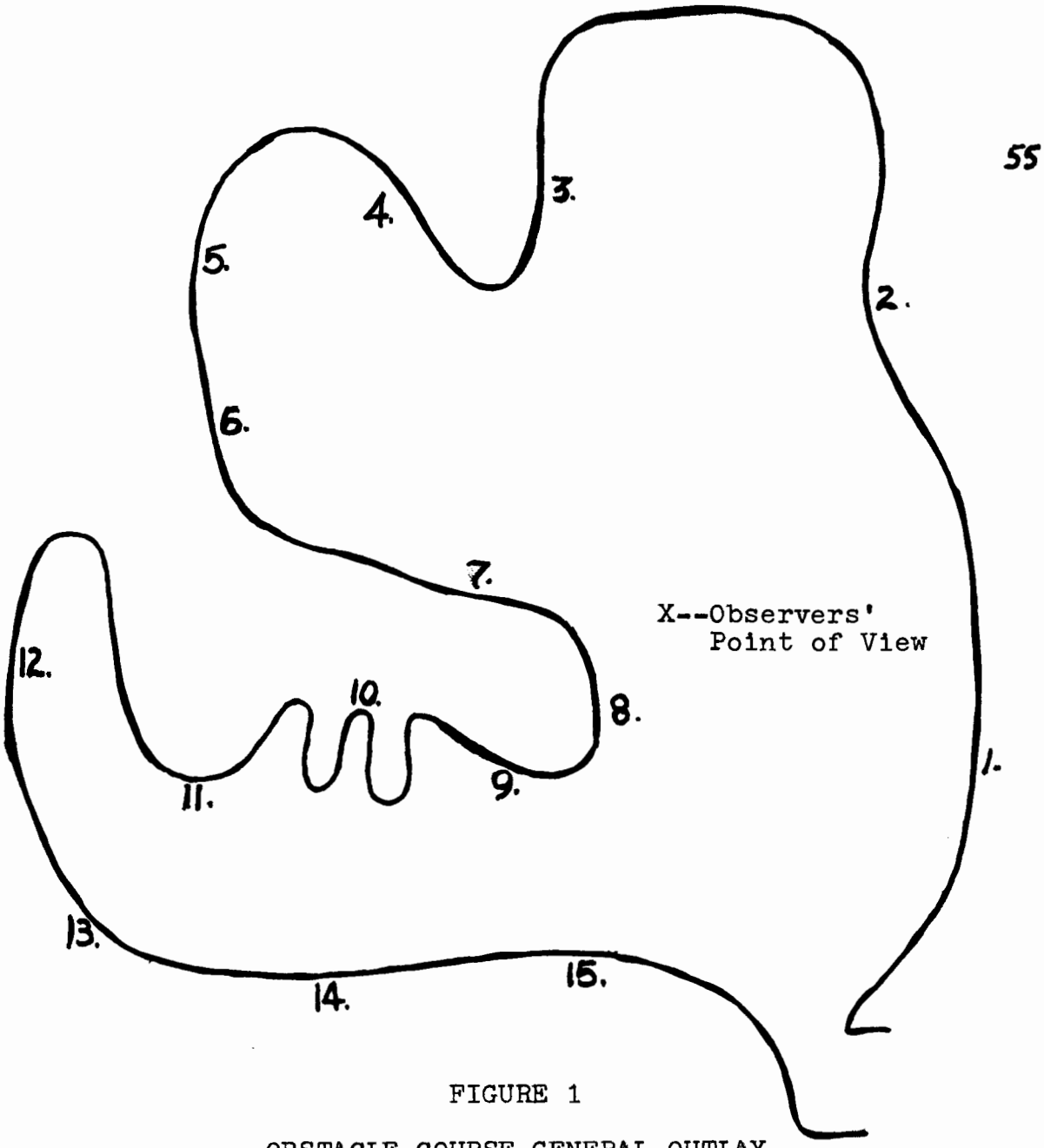

FIGURE 1

OBSTACLE COURSE GENERAL OUTLAY

a. The Path was a six foot path cut out of one acre of forest land.

b. The Path was completely fenced on Both sides.

c. The Path had three inches of sawdust spred on top to prevent injuries in case of a fall.

d. Fifteen obstacles were spred along the path to be mastered.

e. Each student ran the course once each day being timed only when he could master all the obstacles.

f. All obstacles were made large enough to allow more than one participant an obstacle at a time.

g. The course was 600 yards in length.

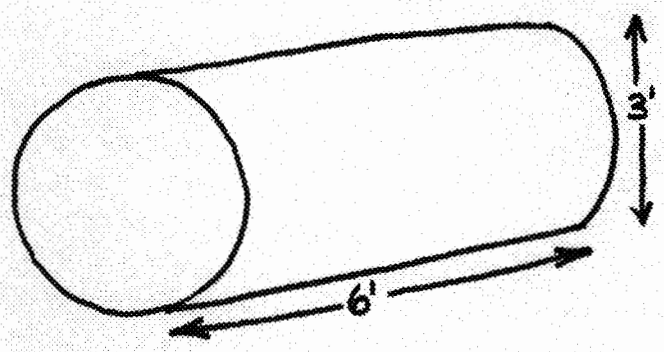

FIGURE 2

JUMPS OF STEEL PIPE

a. These are obstacles 1, 3, 4, 9, 11, and 13.

b. The student must jump each pipe without touching it with either his feet or hands.

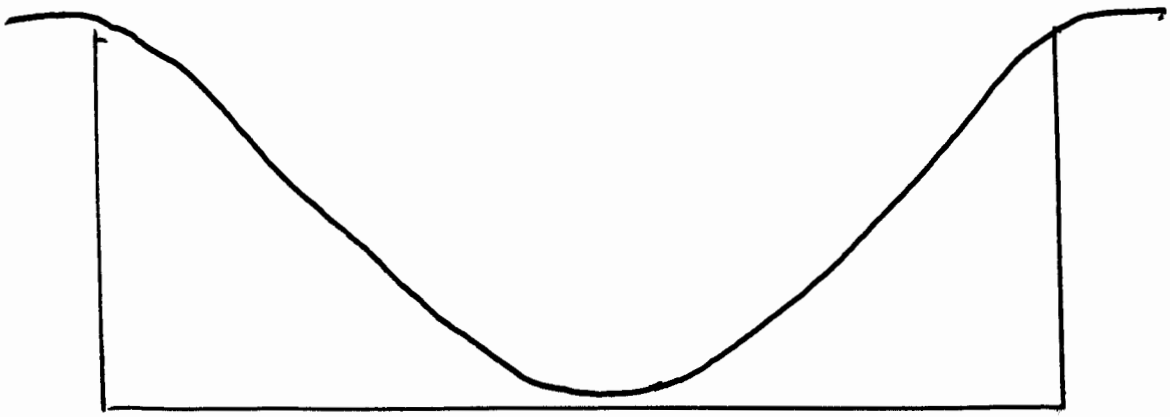

FIGURE 3

HILL RUNNING

a. These are obstacles 2 and 12.

b. The student must learn to run both down and up hills in an effort to maintain his speed.

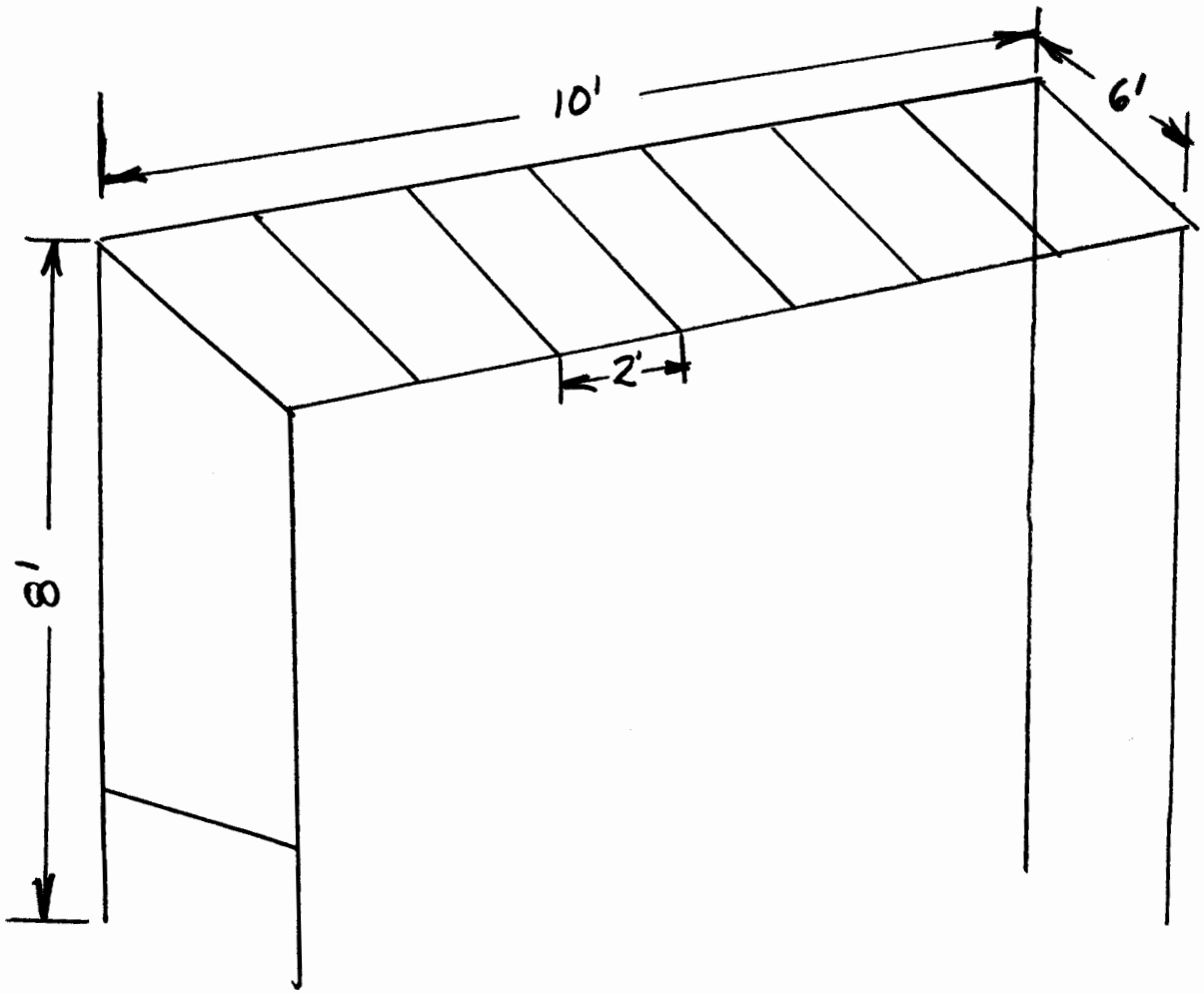

FIGURE 4

OVERHEAD LADDERS

a. These are obstacles 5 and 14.

b. The student must hit each cross bar and he cannot touch the ground once he starts. Swing is allowed in a monkey type of advancement along the ladder.

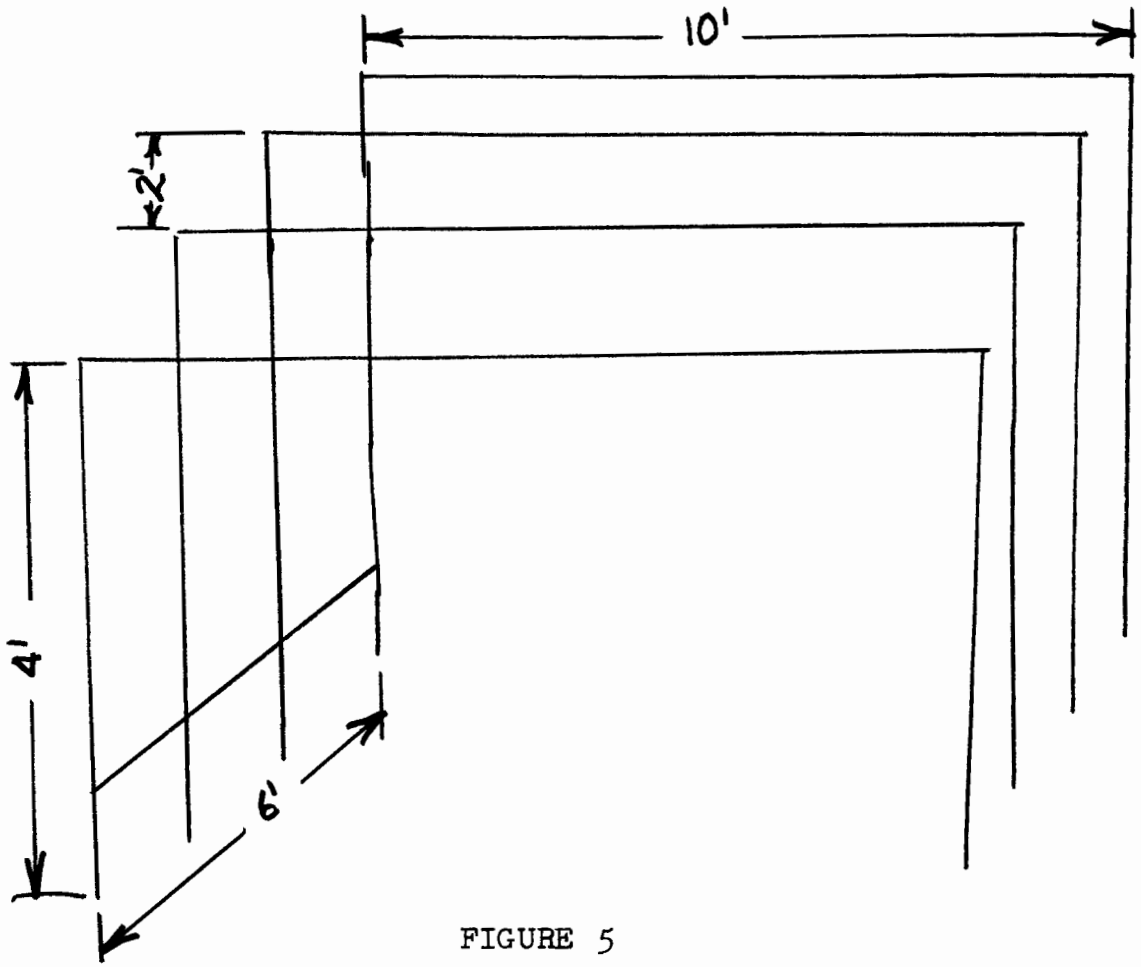

FIGURE 5

PARALLEL CHUTES

a. These are obstacles 6 and 15.

b. The student must walk on his hands with a stiff arm support and start at the beginning and not drop off until he reaches the end.

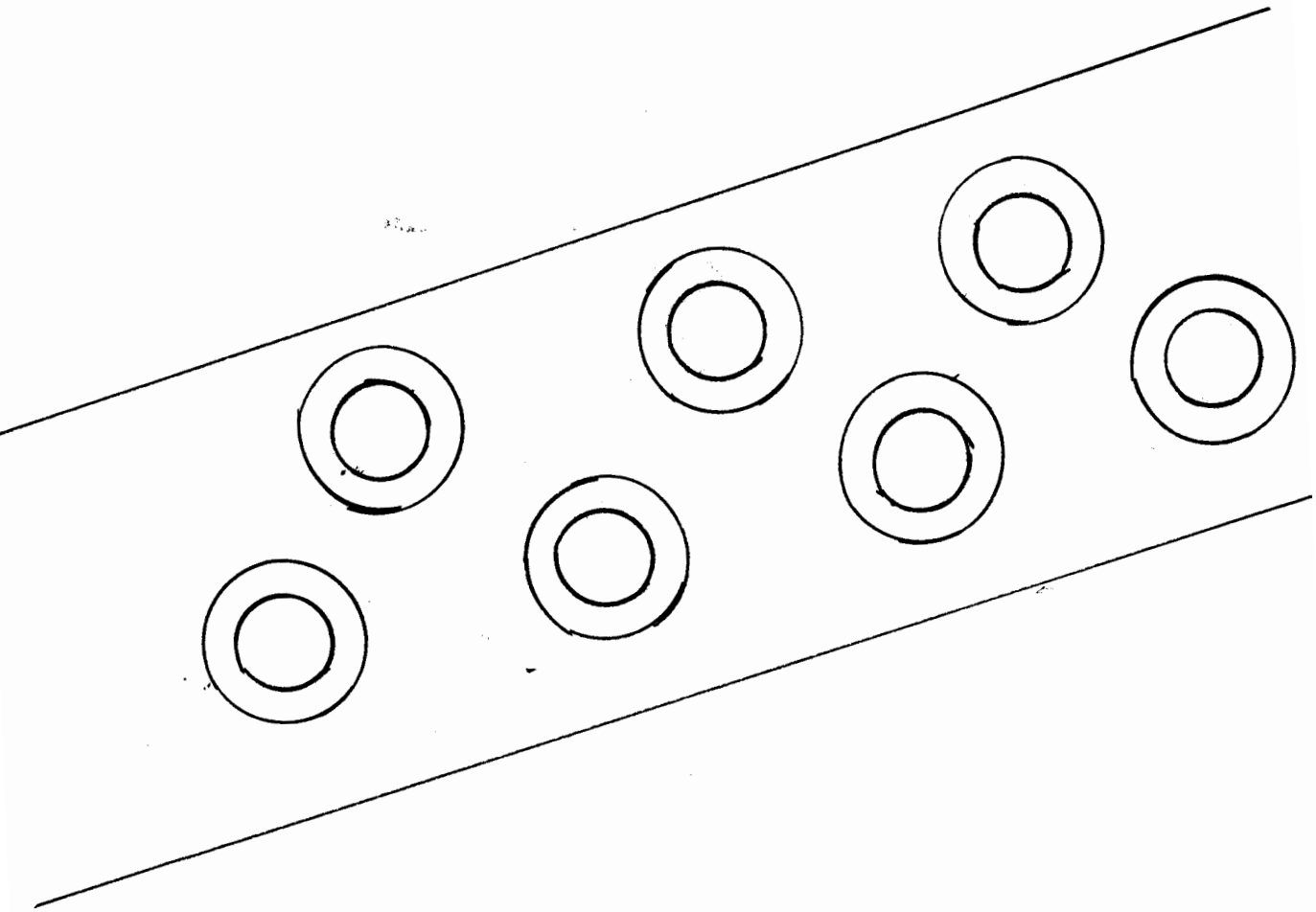

FIGURE 6

TIRE RUN

a. This is obstacle 7.

b. Twelve tires were placed along the path two feet apart and ahead. Each student must either step in the middle or on each tire to complete the obstacle.

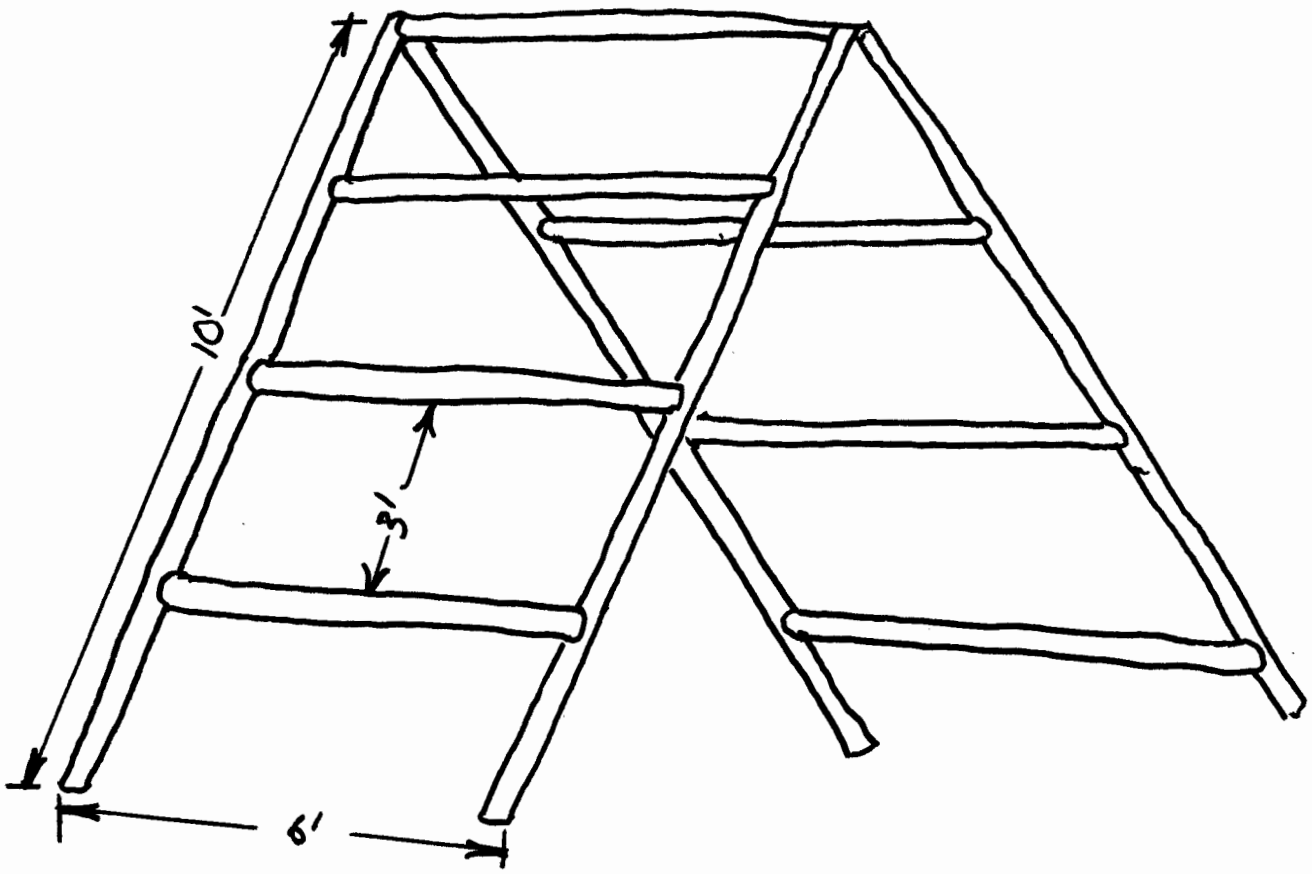

FIGURE 7

LADDER WALL

a. This is obstacle 8.

b. Each student must climb over the obstacle to complete the skill. All cross bars must be touched by either his hands or feet. No jumping off the obstacle.

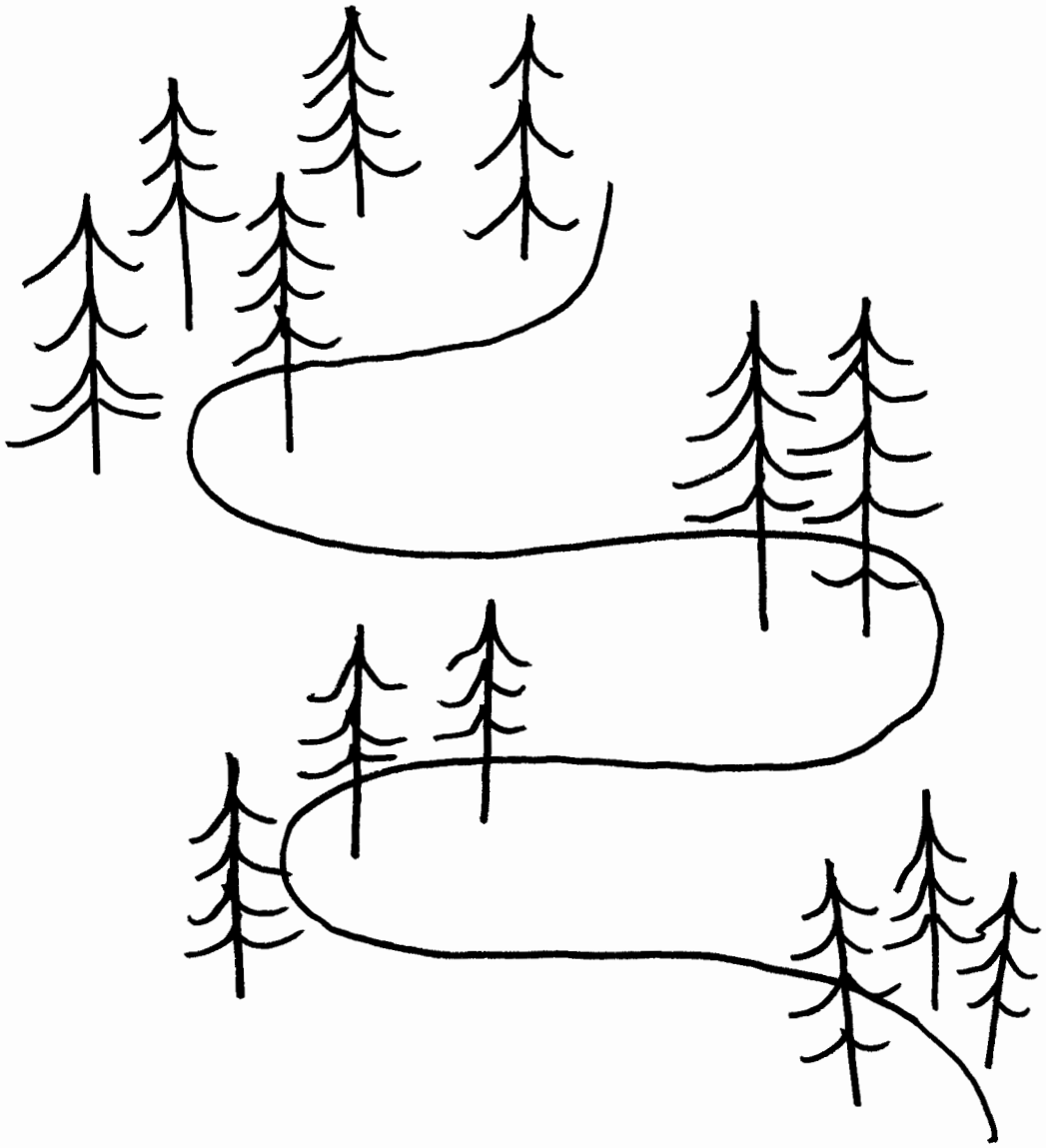

FIGURE 8

SIG RUN

a. This is obstacle 10.

b. The path was cut to make each student run a sig pattern around trees to emphasize body co-ordination in running corners.