



**AN INVESTIGATION OF THE RELATIONSHIP BETWEEN GRIP  
STRENGTH AND ACHIEVEMENT IN PHYSICAL EDUCATION**

**by  
Wayne Franklin Tinkle**

**A THESIS**

**Submitted to the College of Education of Michigan  
State University of Agriculture and Applied  
Science in partial fulfillment of the  
requirements for the degree of**

**MASTER OF ARTS**

**Department of Health, Physical Education, and Recreation**

**1956**



### ACKNOWLEDGMENT

I wish to thank Dr. Henry Montoye for his patience and guidance in the preparation of this thesis.

I am also grateful to Dr. John W. Truitt and Mr. Earl Mahoney for their interest and suggestions, and to my wife, Betty, for her understanding throughout the preparation of this investigation.

W. F. T.





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AN ABSTRACT OF A THESIS

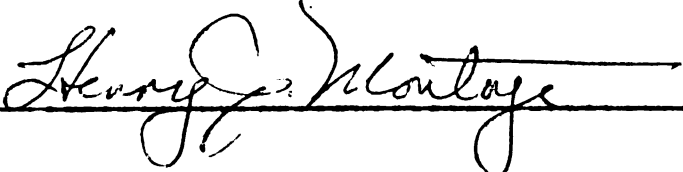
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Approved

A handwritten signature in cursive script, reading "Henry J. Montoya", is written over a horizontal line.



Many studies have indicated that grip strength is an important factor in physical fitness, athletic ability, general strength, and general organic vigor. It was the purpose of this investigation to correlate grip strength with achievement in physical education among college men. The subjects for this experiment were six hundred and thirty-five college freshmen and sophomore men who were participating in physical education activities. Their right and left grip strength were measured, together with age, height, and weight. Grip strength was then correlated with the final letter grade received in physical education. Pertinent intercorrelations of these measurements were investigated.

### Conclusions

After a statistical analysis was made, the following conclusions appear justified:

1. Grip strength is important to achievement in physical education at Michigan State University.
2. Right grip strength is highly correlated with left grip strength.
3. A significantly larger proportion of left handed men have stronger right hands, as compared to right handed men with stronger left hands.
4. College students who are physically weak could benefit from a course to improve strength.



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## CHAPTER I

### INTRODUCTION

The practical problems of everyday physical activities are the concern of everyone. It is not only the athlete or the student of physical education who is affected by varying degrees of speed, endurance, strength, and skill during work or play. Every person is vitally affected by the capacity and limitations of his body, the most effective ways of relieving or delaying fatigue, and the possible techniques for improving physical fitness and efficiency.

One of the most important elements in any muscular contraction or correlation is strength. Activities such as weight-lifting or wrestling demand more muscular effort during each contraction than does walking or jumping out of the path of a car. The reasons for their extra muscular effort is that large muscle groups are used vigorously. The strength of a muscle and the amount of work it can do depends upon its cross section construction, which can be increased by exercise.<sup>1</sup> As muscle fibers are unable to

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<sup>1</sup>Peter V. Karpovick, Physiology of Muscular Activity. (Philadelphia and London: W. B. Saunders Co., 1953), p. 13.

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reproduce, any increase must be due to changes within the fibers present, such as thickening and toughening of the sarcolemma and increase in the amount of connective tissue within the muscle. In every muscle there are latent or unused fibers and fibers that are small from lack of use. These muscles will develop in response to the increased demand made upon them.<sup>2</sup>

The actual gain in power of a muscle as a result of use, however, is out of all proportion to its gain in size; therefore, the quality of the contraction is improved. Such factors as the following account for this change: fuel is made more available and in greater amounts; oxygen is more abundant, owing to improved circulation of blood through the muscle; and better coordination of the action of the individual muscle fibers and more complete use of all fibers are realized. Functionally, the strength and effectiveness of the stimulus are an important factor in the actual realization of muscle power. Exercises involving strong muscular contractions, repeated until fatigue sets in, contribute to the development and coordination of these factors,

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<sup>2</sup>  
Ibid., p. 5-6.



and results in the increased strength of muscles and the ability to apply muscular power effectively.<sup>3</sup>

These are some of the reasons why body strength must always be a paramount concern to the physical educator, as upon it depends the individual's ability to learn physical skills, to maintain body vigor, and to resist fatigue. Moreover, endurance is based upon strength. No one can be expected to take an active role in physical education activities if he is physically weak and inefficient.

In "competitive" activities, educational objectives and precepts of fair play will be realized most completely only when the powers of opposing teams or individuals have been equalized.<sup>4</sup> There are, of course, many viewpoints concerning equalization of competition. Rogers<sup>5</sup> lists the following as educational values of equality:

1. Present health is best protected and promoted when opponents are equal. Players enjoy the game more: joy is a great immediate health tonic. It is even possible that the total effects on health and vitality of a game of checkers played with intense enjoyment

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<sup>3</sup>Harrison H. Clarke, Application of Measurement to Health and Physical Education (New York: Prentice-Hall, Inc., 1950), p. 58.

<sup>4</sup>Frederick R. Rogers, Fundamental Administrative Measures in Physical Education (Newton, Mass.: The Pleiades Co., 1937), p. 130.

<sup>5</sup>Ibid., p. 133.

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will be more beneficial than a basketball battle "played" under protest in a spirit of rebellion and hate. On the other hand, when opponents are badly matched, especially in physical strength, the weaker player will be harmed or will harm himself physically. It is a curious fact that scholastic players often forget that joy and satisfaction are always keenest when opponents are equally matched.

2. Enjoyment also leads to habits of playing. Such habits serve to assure future health. If opponents are badly matched, especially in physical power, there will be less desire to renew the contest or to repeat the experience with others.

3. Courage and perseverance may be acquired by meeting, without flinching, the many new and dangerous situations which team game events provide. But satisfaction must attend if courage or perseverance is to be strengthened. It is essential that the situation not be too difficult for the strength, physical or moral, of the student.

4. Self-respect and self-confidence may be learned if satisfaction attends activities. If shame attends there will be learning, but it will be self-pity, an inferiority complex and perhaps worse qualities.

5. Fair play can only be inculcated by teaching students to refuse to give or receive advantages. A habit of bullying will result if students are taught to accept and take advantage of opponents' weaknesses.

6. Cooperation will be learned when players derive satisfaction through submerging their egos in group accomplishment. The team game situation is an ideal one in which to learn this equality.

7. Courtesy and sympathy may be learned by actually thinking of "the other fellow." When a team wins today and loses tomorrow (this is the rule only when opponents are nearly equal) generous sympathy for losers and proper respect for winners may be learned. It must be apparent that the foregoing values or objectives in some respect coincide with most physical educators' philosophy toward this field.



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Ability grouping is an important pedagogical procedure. There is doubt in the minds of experienced physical educators that class instruction is more efficient when the abilities of groups are similar. Heterogeneous grouping presents a serious problem in class instruction, as class work is usually geared to the ability of the less able pupils. Instruction adapted to the ability of the average student becomes too difficult for the poor performers and too easy for the good ones. Equating, however, brings together students of equal ability, all of whom are ready for instruction on the same level.

It is stated in H. Harrison Clarke's text, Application of Measurement to Health and Physical Education<sup>6</sup>, that homogeneous grouping may also be far more important in physical education than in scholastic phases of the educational program. The manner of an individual's participation in many physical activities is dependent to a large extent upon what he does and how he reacts to the actions of those with whom he is participating. For example, the greatest football player cannot catch a forward pass if the ball is thrown badly. Correlative and opposite efforts of this sort are not required in English, mathematics, or other academic classes.

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<sup>6</sup>Clarke, op. cit., p. 222.

Purpose of  
the Study

It is the purpose of this study to ascertain the correlation between a single test of strength and the achievement of a group of college men participating in a physical education activity program. If a high correlation is forthcoming, the strength test used may be of real value to physical education for use in classifying heterogenous groups.

Instrument  
Employed

The Narrogansett hand dynamometer apparatus was selected for the testing instrument. Because of its economical and expedient value, the hand dynamometer was believed by the writer to be one of the most practical measuring instruments obtainable by schools interested in conducting a program of classification within their physical education department.

Subjects  
Used

The answer to the question proposed by this study was obtained through analysis of the data gathered on six hundred and thirty college freshmen and sophomores. These men were taking part in a required program of physical education activities at Michigan State University.

Limitations  
of the Study

One limitation that might be significant is the procedure used in testing the subjects. The tester was granted permission to be present when certain physical education classes were in session. He then

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went from squad to squad giving the grip strength test. Each group received a single explanation and was then tested for grip strength. In the event that a subject's hand or fingers slipped, he was retested at the end of that testing period. Only two tests were taken with each hand. It was, therefore, felt by the tester that the students who were tested again may have had some advantage because of a practice attempt and were more highly motivated in that they wanted to score higher on the second test. It should, however, be made clear that only very few received a second test.

The only motivational factor was an individual's desire to surpass the score of the others in his squad. This may have been a limitation if some of the men felt they were weak and therefore did not exert maximum effort. It is also feasible that this single motivating factor could produce maximum effort on the part of all the men tested.

Although this writer presents no evidence of the influence of the time of day on physiological output, it may have been a factor in this study. Since these tests were given during the regular class periods, testing was in progress from eight o'clock in the morning until five o'clock in the afternoon.

Another limitation which could affect this study is the week within the school term in which the men were tested.

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 5. I have been a member of the American Society of Clinical Pharmacology since 1954.  
 6. I have been a member of the American Society of Therapeutic Radiology and Oncology since 1954.  
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In testing six hundred and thirty-five men during regular classes, it was impossible to cover all the classes in one day or even one week. Consequently, some men may have had an opportunity to improve their grip strength by participating longer in physical activities than some of the others tested.

The results of this study could also have been affected by the differences in the individuals grading the subjects for their test. Even though a similar grading scale was used [See Appendix A], individual instructors will grade differently. This one possible limitation could, however, be one of the most positive factors in this study, for if the grip strength scores correlate highly with the letter grade received, regardless of the grader, it would apparently be a good test of the relationship of grip strength to achievement measured by a letter grade in physical education activity courses. The courses selected are defined in Appendix A.

The apparatus used in this study may have been a limitation. The measuring scale of the Narrogansett Grip Strength Measuring Instrument was calibrated from 0 to 200 pounds. In calibration, no error greater than one pound was observable, yet one limitation of this instrument is that it cannot be adjusted to better fit the hand size of the different men being tested. This would make it possible for the men whose hands fit the instrument to be measured more accurately.





This study shows the relationship between mean grip strength scores and the letter grade achieved by the men tested. [For a definition of the activities and grading scale used, see Appendix A.]

Organization of the Remainder of the Study      The review of literature is in Chapter II. The method of collecting data is in Chapter III, and Chapter IV contains the results of the statistical techniques used in the study. The final chapter, Chapter V, includes the summary, conclusions, and recommendation.



## CHAPTER II

### REVIEW OF THE LITERATURE

A great many physical educators indicate increasing interest in finding a test that will measure objectively the fitness of the body as a whole; a test, according to Clarke<sup>1</sup>, that will be sensitive to the effects upon the organism of lack of exercise, of faulty health habits, and of organic drains; a test that can be understood, interpreted, and used by individuals trained in physical education. Not only is a test needed for evaluating the physical fitness benefits of the physical education program, but such a test is needed also to select those boys and girls who are deficient in this essential quality, so that their particular needs may be studied and improved.

Strength tests, although they do not measure all aspects of fitness as physical educators view the problem, do deal with a basic element of the individual's general physical status. They have been used successfully in practical field situations, both as a means of selecting

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<sup>1</sup>Harrison H. Clarke, Application of Measurement of Health and Physical Education (New York: Prentice-Hall, Inc., 1950), p. 58.



students for remedial and developmental classes and for general classification in physical activities.

If it were possible to isolate an individual muscle used in any skill, the measured strength test of that muscle would be the best general measure of particular skills, short of repetition of the skills themselves. The pianist has strong forearms; the archer strong extensor muscles in the left upper arm, strong flexor muscles in the right forearm and upper arm, also strong back muscles. The swimmer is well developed throughout his body. The runner has strong legs, etc. This, of course, says Rogers<sup>2</sup>, is due to the constant use of the muscles involved.

Rogers<sup>3</sup> also states that as a general measure of all-round skill, probably no measures have higher validity than those of strength. Dynamometers are reliable, objective, economical, and interesting measuring devices. Consequently, strength tests by means of dynamometers are among the most useful for measuring general skill.

Although strength is very important to general motor performance, it is not an end in itself.<sup>(2)</sup> Riedman<sup>4</sup>, in her

<sup>2</sup>Frederick R. Rogers, The Fundamental Administrative Measures in Physical Education (Newton, Mass.: The Pleiades Co., 1937), p. 38.

<sup>3</sup>Ibid., p. 39.

<sup>4</sup>Sarah R. Riedman, The Physiology of Work and Play (New York: The Dryden Press, 1950), p. 173.





book The Physiology of Work and Play, illustrates in fact that development of strength for its own sake may have distinctly harmful effects. As an objective, the mere development of the size and power of the muscles has no meaning. Bulging muscles and weight-lifting power may have "stunt" value, but do not necessarily add to the effectiveness of motor ability or endurance. Strength, however, is essential as a requisite for successful participation in physical activity, for learning new skill, and for maintaining the support of the trunk and internal organs.

The positive and very high correlation of muscular strength to general health, physical fitness, or capacity for activity can hardly be questioned. With no strength there can be no physical activity; moreover, when muscular strength is low, all other life functions are handicapped. Physical educators are coming increasingly to recognize, therefore, that the development of muscular strength is of prime importance in any rational physical education program, although there are limits beyond which it is improper to go in the improvement of any particular individual's physical power.<sup>5</sup>

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<sup>5</sup>F. R. Rogers, "The Significance of Strength in Revealing Physical Strength Fitness," The Research Quarterly, 5:43-46, October, 1934.



In the latter connection, the training curve obtained by Karpovick and Pestrecov<sup>6</sup> on inmates of a county jail and of college students is significant. The subjects worked on stationary bicycles five days a week, pedaling as long as possible, until exhaustion supervened. The investigators discovered that "training curves" were not the same for the different men. The reason given for this dissimilarity was the great difference in the relative strength of the men.

The stronger men among both the jail inmates and the students increased in endurance, and more rapidly than did the weak ones. When the experiment began in the jail, certain men had such poor physical strength that four weeks were spent in general body-building exercise. Strength was shown definitely to be of importance in developing endurance.

The importance of muscular system in education is stated uncompromisingly by J. M. Tyler in Growth and Education:<sup>7</sup>

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<sup>6</sup>Clarke, op. cit., p. 59.

<sup>7</sup>John Mason Tyler, Growth and Education (New York: Houghton Mifflin Co., 1907), p. 39.



The Muscular System must be of far greater importance and have far greater latent capacities than we usually supposed. It is the strategic center from and through which we can reach, exercise and strengthen all the organs essential to life which are beyond the direct control of the will. It is also the key to the development of the brain.

The development and proper use of the muscular system is considered the key-note to successful program of physical education; therefore, physical educators have spent much time, energy, and effort to develop tests that would indicate the degree of development or the potential of the muscular system. It is apparent that tests of qualities such as locomotion, manipulation, transportation, coordination, and strength are valid measures of physical capacity. Specifically, any strains or drains of the physical structure will be reflected in weaker musculature and any deficiencies of structure or function will also be reflected.

The best proof of the validity of strength tests as measures of physical capacity is yielded by observations available to anyone. When activity is restricted by disease, the patients lose their strength rapidly. The muscular weakness of invalids is proverbial. Their fitness for "purposeful physical activity" is admittedly low. It is interesting, by comparison, to observe the rapid improvement in the strength of convalescents. We observe their muscles gaining power by use. Again, health and strength are highly correlated. If one were to speak with a trainer



of any athletic team, he could supplement the above observations with many others. A common cold is reflected by weaker musculature; sprained joints have great effect on performance. Even fatigue and undernourishment are reflected in the disease of efficiency in body performance.

It is possible to find a great many tests dealing with strength in physical education literature. All of these tests are important to the physical educator in that they furnish him with the physiological factors that determine the reactions of his students to the program. Physical measures such as lung capacity, grip strength, back strength, leg strength, arm strength or combinations of all these are usual tests administered by physical educators.

The tests mentioned do not measure all voluntary muscles, or even all the larger muscles generally considered to be of paramount importance to physical activity. A large sample of these is measured, however, including practically all of the more important muscle groups. Moreover, the relationship between the strength of various muscle or muscle groups must be fairly high, because it would be almost impossible to exercise one muscle or a group of muscles without involving other parts of the anatomy, as it would be to grade a part of a student's performance.

The instructor who wishes to rank his pupils by objective tests must be certain that the tests have a





coefficient of reliability of at least .8. Unless the tests have that degree of reliability, the instructor cannot be sure that he is ranking his pupils accurately. In selecting tests, the choice should be made when possible from those which give proof of acceptable reliability. In reading the literature on physical education tests, the student will find that much of the early work was done without consideration of reliability, and that tests have been devised and used without a check for this essential element. The work which is based on such tests is as likely to be inaccurate as would be the measuring time with which a watch if the watchmaker put his instrument together and placed it on the market without checking its accuracy.<sup>8</sup>

To determine the general and specific purposes which should underlie the physical education programs in our schools, many tests have been developed and used. Some, of course, have been more useful to the field of physical education than others. One of the methods of measuring general skill or athletic ability is by sampling and testing specific representative skills. An excellent example of

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<sup>8</sup>G. M. Rusch and G. D. Stoddard, Tests and Measurements in High School Instruction (Yonkers-on-Hudson, New York: World Book Company, 1927), p. 57.

1. The first part of the paper is devoted to the study of the  
 2. properties of the function  $f(x)$  which is defined by the  
 3. equation  $f(x) = \frac{1}{2} (f(x-1) + f(x+1))$ . It is shown that  
 4. this function is linear and that its graph is a straight line.  
 5. The second part of the paper is devoted to the study of the  
 6. properties of the function  $g(x)$  which is defined by the  
 7. equation  $g(x) = \frac{1}{3} (g(x-1) + g(x) + g(x+1))$ . It is shown  
 8. that this function is quadratic and that its graph is a parabola.  
 9. The third part of the paper is devoted to the study of the  
 10. properties of the function  $h(x)$  which is defined by the  
 11. equation  $h(x) = \frac{1}{4} (h(x-1) + h(x) + h(x+1) + h(x+2))$ . It is shown  
 12. that this function is cubic and that its graph is a cubic curve.  
 13. The fourth part of the paper is devoted to the study of the  
 14. properties of the function  $k(x)$  which is defined by the  
 15. equation  $k(x) = \frac{1}{5} (k(x-1) + k(x) + k(x+1) + k(x+2) + k(x+3))$ . It is shown  
 16. that this function is quartic and that its graph is a quartic curve.  
 17. The fifth part of the paper is devoted to the study of the  
 18. properties of the function  $l(x)$  which is defined by the  
 19. equation  $l(x) = \frac{1}{6} (l(x-1) + l(x) + l(x+1) + l(x+2) + l(x+3) + l(x+4))$ . It is shown  
 20. that this function is quintic and that its graph is a quintic curve.  
 21. The sixth part of the paper is devoted to the study of the  
 22. properties of the function  $m(x)$  which is defined by the  
 23. equation  $m(x) = \frac{1}{7} (m(x-1) + m(x) + m(x+1) + m(x+2) + m(x+3) + m(x+4) + m(x+5))$ . It is shown  
 24. that this function is sextic and that its graph is a sextic curve.  
 25. The seventh part of the paper is devoted to the study of the  
 26. properties of the function  $n(x)$  which is defined by the  
 27. equation  $n(x) = \frac{1}{8} (n(x-1) + n(x) + n(x+1) + n(x+2) + n(x+3) + n(x+4) + n(x+5) + n(x+6))$ . It is shown  
 28. that this function is septic and that its graph is a septic curve.  
 29. The eighth part of the paper is devoted to the study of the  
 30. properties of the function  $o(x)$  which is defined by the  
 31. equation  $o(x) = \frac{1}{9} (o(x-1) + o(x) + o(x+1) + o(x+2) + o(x+3) + o(x+4) + o(x+5) + o(x+6) + o(x+7))$ . It is shown  
 32. that this function is octic and that its graph is an octic curve.  
 33. The ninth part of the paper is devoted to the study of the  
 34. properties of the function  $p(x)$  which is defined by the  
 35. equation  $p(x) = \frac{1}{10} (p(x-1) + p(x) + p(x+1) + p(x+2) + p(x+3) + p(x+4) + p(x+5) + p(x+6) + p(x+7) + p(x+8))$ . It is shown  
 36. that this function is nonic and that its graph is a nonic curve.  
 37. The tenth part of the paper is devoted to the study of the  
 38. properties of the function  $q(x)$  which is defined by the  
 39. equation  $q(x) = \frac{1}{11} (q(x-1) + q(x) + q(x+1) + q(x+2) + q(x+3) + q(x+4) + q(x+5) + q(x+6) + q(x+7) + q(x+8) + q(x+9))$ . It is shown  
 40. that this function is decic and that its graph is a decic curve.

The author wishes to express his appreciation to the  
 Department of Mathematics, University of Toronto, for the  
 facilities and support which have made this work possible.

this type is the Cozens' "Measure of General Athletic Ability for College Men."<sup>9</sup> It consists of seven tests, scored by multiplying the tests made, and by adding the resulting scores. The test is conducted as follows: the instructor counts the number of dips on parallel bars times 6, plus baseball throw per distance [12 inch ball] times 1.5, plus football punt for distance times 1.0, plus standing broad jump times 1.0, plus quarter mile run times 1.2, plus long dives times 7, plus a dodging run times 1.0.

Though the validity and reliability of this test is higher than that of the strength index, it is expensive in time and apparatus. As yet no norms have been developed for weight and age.

A number of other tests of general athletic ability have been devised. These usually include tests of running and jumping, and the handling of balls. In 1905 Meylan<sup>10</sup> set up a general measure by combining strength tests with physicians' health ratings, an endurance test, and four tests on gymnastic apparatus. Points were assigned on an arbitrary basis, but no reliable norms were established.

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<sup>9</sup>F. W. Cozens, "The Measurement of General Athletic Ability in College Men," University of Oregon Press, p. 129.

<sup>10</sup>Rogers, Fundamental Administrative Measures in Physical Education, op. cit., p. 39.



Other tests followed. The "Sargent Physical Test of Man"<sup>11</sup> has some possibilities as a single measure of "general athletic ability" and has been the subject of several experiments. But it also lacks reliability. Consequently, its validity is low as a measure of any function. In this test the subject jumps vertically as high as possible. The jump is measured by a variety of means devised by Sargent, Schwiger, Engelhardt, Bovard, and Cozens and J. H. McCurdy.<sup>12</sup>

Using shadows and great care in observations McCurdy<sup>13</sup> was able to secure fair reliability by having each subject repeat the test several times on three different occasions and by using the best record. No norms are available for sex, weight, or age, and the test has not been used to determine programs or to measure achievement.

In a discussion of some of the tests for athletic ability, the Brace Test<sup>14</sup> of motor ability should be included. This test was the first of its kind, and at the time it was published it was intended for use as a measurement of general motorability. It was composed of twenty

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<sup>11</sup>Ibid., p. 39.

<sup>12</sup>Ibid., p. 39.

<sup>13</sup>Ibid., p. 40.

<sup>14</sup>David K. Brace, Measuring Motor Ability (New York: A. S. Barnes and Company, 1927), p. 171.



stunts, each of which was scored in terms of success or failure. The number of successive stunts was interpreted in the form of a T score. This test is still regarded as good, but since it was intended to be a test of general motor ability, some stunts were included which were primarily dependent upon strength, and other elements were included which were not particularly related to what is termed motor ability.

General athletic ability is more than skill. In fact, skill by itself is of minor importance in competitive athletic activities, especially where bodily contact, endurance, and supreme efforts are necessary. The most skillful tennis player would be impotent even when opposed to a beginner if the expert were too weak to stand. In other words, muscular strength is the "sine qua non" for athletic performance. Indeed, it is the most important single quality contributing to successful performance in most of the athletic activities of American school boys and college students.<sup>15</sup>

The majority of the tests mentioned thus far have been concerned with general motor ability. Another facet of physical education measurement is that of physical capacity. The individual measures adopted for the "Strength Index" battery are generally called physical capacity tests.

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<sup>15</sup> Rogers, Fundamental Administrative Measures in Physical Education, op. cit., p. 136.

the first of these is the fact that the system is not a simple one, but a complex one, involving many different factors, and the second is the fact that the system is not a static one, but a dynamic one, involving many different factors. The first of these is the fact that the system is not a simple one, but a complex one, involving many different factors, and the second is the fact that the system is not a static one, but a dynamic one, involving many different factors.

The first of these is the fact that the system is not a simple one, but a complex one, involving many different factors, and the second is the fact that the system is not a static one, but a dynamic one, involving many different factors. The first of these is the fact that the system is not a simple one, but a complex one, involving many different factors, and the second is the fact that the system is not a static one, but a dynamic one, involving many different factors. The first of these is the fact that the system is not a simple one, but a complex one, involving many different factors, and the second is the fact that the system is not a static one, but a dynamic one, involving many different factors.

The first of these is the fact that the system is not a simple one, but a complex one, involving many different factors, and the second is the fact that the system is not a static one, but a dynamic one, involving many different factors. The first of these is the fact that the system is not a simple one, but a complex one, involving many different factors, and the second is the fact that the system is not a static one, but a dynamic one, involving many different factors.

The first of these is the fact that the system is not a simple one, but a complex one, involving many different factors, and the second is the fact that the system is not a static one, but a dynamic one, involving many different factors.



They were selected as the most objective, reliable, and valid of a great many strength tests which might have been chosen.

The Physical Capacity test<sup>16</sup> consists of measures of lung capacity, strength of right and left grip, back strength, leg strength, and arm strength. The last is measured by the number of dips and pull-ups scored by a formula which takes weight and height into consideration. The initial purposes of this test were (1) to find a method of classifying boys for athletic competition, and (2) to find a measure of physical fitness.

The author found the test elements to be highly reliable with  $r$ 's which range from .86 to .97. Only leg strength and back strength were below .9. These reliabilities are high--much higher than the majority of tests in use in physical education. To prove the validity of the measure as an indicator of athletic ability, the scores on the Physical Capacity tests were correlated with an Athletic Index. The Athletic Index consisted of the 100 yard dash, the running broad jump, the running high jump, and the bar vault. These were combined in a single score in which

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<sup>16</sup>Ruth B. Glassow and Marian R. Broer, Measuring Achievement in Physical Education (Philadelphia and London: W. B. Saunders Company, 1943), p. 272.



running was given a weight of 10; high jump, 5; broad jump, 1. The bar vault was omitted from the test, and the shot-put and a measure called skill were added. Skill was "computed by adding points in baseball and football throw [accuracy] tests to 5 times the number of basketball goals scored."<sup>17</sup> In this group, dash, high jump, and shot-put were weighted two and the other elements were weighted one.

Rogers<sup>18</sup> found for high school boys, a correlation of .81 between the Athletic Index and the Physical Capacity Test. Using the measures which are commonly used for classification, age, height, and weight, Rogers found a correlation coefficient of .62. He concludes that the physical capacity score is a better basis for classification for athletes than is the best combinations of age, height, and weight.

The correlation coefficients and Predictive Indices of the computed Athletic Index with physical measures are reported in the table on the following page.

The product-moment correlation coefficient between the Strength Index and the criterion Index of Athletic

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<sup>17</sup>Ibid., p. 272.

<sup>18</sup>Rogers, Fundamental Administrative Measures in Physical Education, op. cit., p. 273.

$$\begin{array}{c} \bullet \\ \bullet \end{array}$$

1. The first step in the process of the investigation is the identification of the problem. This is done by the investigator, who is usually a member of the research team. The investigator will identify the problem by looking at the data and trying to find out what is going on. This is done by looking at the data and trying to find out what is going on.

2. The second step is to collect data. This is done by the investigator, who will collect data from the subjects of the study. This is done by looking at the data and trying to find out what is going on.

3. The third step is to analyze the data. This is done by the investigator, who will analyze the data and try to find out what is going on. This is done by looking at the data and trying to find out what is going on.

4. The fourth step is to draw conclusions. This is done by the investigator, who will draw conclusions from the data and try to find out what is going on. This is done by looking at the data and trying to find out what is going on.

5. The fifth step is to write a report. This is done by the investigator, who will write a report about the results of the investigation. This is done by looking at the data and trying to find out what is going on.

6. The sixth step is to present the results. This is done by the investigator, who will present the results of the investigation to the research team. This is done by looking at the data and trying to find out what is going on.

7. The seventh step is to discuss the results. This is done by the investigator, who will discuss the results of the investigation with the research team. This is done by looking at the data and trying to find out what is going on.

8. The eighth step is to conclude the investigation. This is done by the investigator, who will conclude the investigation and try to find out what is going on. This is done by looking at the data and trying to find out what is going on.

9. The ninth step is to write a final report. This is done by the investigator, who will write a final report about the results of the investigation. This is done by looking at the data and trying to find out what is going on.

10. The tenth step is to present the final report. This is done by the investigator, who will present the final report to the research team. This is done by looking at the data and trying to find out what is going on.

Ability was .76. The correlation-ratio was 184. It should be noted here that these correlations are nearly threetimes as high as the correlation between weight and athletic ability, and nearly twice as high as the correlation between athletic ability and the best theoretical combination of age, height, and weight.

TABLE I  
CORRELATIONS AND PREDICTIVE INDICES: ATHLETIC  
INDEX WITH PHYSICAL MEASURES<sup>19</sup>

Athletic Index With	r	P. I.
Age	.50	.134
Height	.50	.134
Weight	.51	.140
Lung Capacity	.59	.193
Right Grip	.68	.267
Left Grip	.68	.267
Back Lift	.66	.267
Leg Lift	.64	.232
Pushups	.67	.158
Pullups	.59	.193

While studying Rogers' strength norms, Cureton<sup>20</sup> found that the actual computed Pearson r by the scattergram method was  $r = .321$ . The data appeared to be quite rectilinear. Age is neglected because age is not closely

<sup>19</sup>Ibid., p. 137.

<sup>20</sup>T. K. Cureton, Physical Fitness Appraisal and Guidance (New York: The C. V. Mosley Company, 1947), p. 378.



correlated with the Strength Index [ $r = .1347$ ] in these data. Rogers assumed a perfect correlation with weight, whereas the best line of regression was only a correlation of .321. A multiple regression solution combining height and weight to predict the Strength Index correlated .321. Since age correlates .134 and height correlated .199, weight alone is indicated as the important base for norms within the age span of these college men.

In all studied where strength is a variable, weight seems to be an important factor. In his study on arm strength and athletics, McCloy thought weight was so important that it should be subtracted from strength index formulas. In the use of strength tests the individual's actual strength is decided by the average strength for those of his age and weight.<sup>21</sup> In a person of good muscular development, the muscles constitute approximately forty per cent of the body weight. Increase in weight due to training, would develop the particular muscle weight faster than the entire body weight. Therefore, strength would increase faster than load; and increase in height would be accompanied by an increase in weight.<sup>22</sup> Hence, from a

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<sup>21</sup>C. H. McCloy, "The Apparent Importance of Arm Strength in Athletics," The Research Quarterly, 2:11, March, 1934.

<sup>22</sup>Ibid.

[illegible]



purely theoretical, mechanical point of view, height alone would seem to have little influence on performance, aside from the accompanying increase in weight.<sup>23</sup>

The correlation between a strength index determined from the test items explained, and a Strength Index derived from any other group of tests measuring other important muscle groups, must be very high--probably above .90 to .90. Intercorrelations among individual tests used in the Strength Index battery are printed in Table II.

TABLE II  
INTERCORRELATIONS OF PHYSICAL CAPACITY TESTS<sup>24</sup>

Strength	Grip	Back	Leg	Arm	Lung
Grip Strength	--	.81	.68	.66	.67
Back Strength	.81	--	.76	.60	.69
Leg Strength	.68	.76	--	.59	.58
Arm Strength	.66	.60	.59	--	.48
Lung Strength	.67	.69	.58	.48	--

<sup>23</sup>C. H. McCloy, Tests and Measurements in Health and Physical Education (New York: Appleton-Century-Crofts, Inc., 1942), p. 26.

<sup>24</sup>Ibid., p. 39.



Strength tests were the earliest and are, perhaps, the most fundamental measures of physical health and vitality available. Certainly they measure functions which are indispensable to normal human life; functions, however, whose improvement yields increased health and happiness to individuals. They are, perhaps, the most fundamental of all measures for physical educators, whose duty is to change behavior "by means of or through large muscle activity."

Another area that has received a great deal of attention has been the testing of physical fitness. Physical fitness can be defined to mean the capacity for purposeful physical activity, not to be identified entirely with physical health. General physical fitness depends predominately on muscular efficiency obtained through exercise. The beneficial effects of exercise are commonly attributed to the development of muscle alone; however, the most significant contribution of rational exercise to body fitness is the effect exercise has in developing the organs of the body. In fact, exercise is the best known means by which we may effect such development.<sup>25</sup>

Objective proof that strength tests measure general physical fitness is illustrated by Smiley.<sup>26</sup> An experimental ??

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<sup>25</sup>Peter V. Karpovick, Physiology of Muscular Activity (Philadelphia and London: W. B. Saunders Co., 1953), p.28.

<sup>26</sup>D. F. Smiley and C. W. Chamberlain, "Functional Health and the Physical Fitness Index," The Research Quarterly, March 1931, p. 193-198.



sixty-five Cornell Students was chosen at random, each student of whom was given a complete physical examination by the University staff examining physicians, and was rated by Smiley into one of three categories in terms of functional health: If in the opinion of the physician the subject was handicapped in any way that would likely impair his normal efficiency he was rated "C"; those subjects who were in average functional health, and whose defects, if any, were present, were not of a sufficient magnitude to impair their normal functions, were rated "B"; those who were markedly superior, who were free from defects, whose health habits were such that they would likely be in an efficient state day in and day out, were rated "A." The data used to determine health ratings included thirty-seven items.

Following the medical examinations Chamberlain gave strength tests and rated each student as A, B, or C according to the Physical Fitness Index.

The two sets of ratings were then compared. The results are summarized below:<sup>27</sup>

1. The P.F.I. rating agreed with the medical rating in 36 out of 42 average subjects.
2. The P.F.I. rating agreed with the medical rating in 3 out of 5 superior cases.

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<sup>27</sup> Ibid., p. 193.



3. The P.F.I. rating agreed with the medical rating in 13 out of 19 handicapped cases.
4. In the entire group the two ratings agreed in 52 out of 65 cases--an average 80 per cent agreement.
5. The correlation coefficient was .60.

Rogers<sup>28</sup> illustrates the validity of strength tests as measures of general physical fitness by examples of strength tests revealing deficiencies which had not been discovered by medical examination until poor strength test indicated a strain.

These examples by Smiley<sup>29</sup> and Rogers<sup>30</sup> appear to present obvious relationships between strength measures and general physical fitness. The relationships found are of fundamental importance to both the individuals and the physical educator because they correlate higher with personal success and the success of the physical-educator program. The results of physical examination for duty with the Armed Services in each of the World Wars has brought to the front a need for emphasis of the general physical fitness of American males. Physical educators with well-conducted programs of physical education are in a position to carry part

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<sup>28</sup> Rogers, Fundamental Administrative Measures in Physical Education, op. cit., p. 126.

<sup>29</sup> Smiley, op. cit., pp. 193-198.

<sup>30</sup> Rogers, Fundamental Administrative Measures in Physical Education, op. cit., p. 126.

1. The first step in the process of identifying a problem is to define the problem clearly. This involves identifying the symptoms of the problem and determining the scope of the problem. Once the problem has been defined, the next step is to identify the causes of the problem. This involves identifying the factors that are contributing to the problem and determining the underlying causes of the problem. Once the causes of the problem have been identified, the next step is to develop a plan of action to address the problem. This involves identifying the steps that need to be taken to solve the problem and determining the resources that will be needed to implement the plan. Once a plan of action has been developed, the next step is to implement the plan. This involves carrying out the steps that have been identified in the plan and monitoring the progress of the implementation. Finally, the last step in the process is to evaluate the results of the implementation. This involves assessing the effectiveness of the plan and determining whether the problem has been solved.

2. The second step in the process of identifying a problem is to identify the causes of the problem. This involves identifying the factors that are contributing to the problem and determining the underlying causes of the problem. Once the causes of the problem have been identified, the next step is to develop a plan of action to address the problem. This involves identifying the steps that need to be taken to solve the problem and determining the resources that will be needed to implement the plan. Once a plan of action has been developed, the next step is to implement the plan. This involves carrying out the steps that have been identified in the plan and monitoring the progress of the implementation. Finally, the last step in the process is to evaluate the results of the implementation. This involves assessing the effectiveness of the plan and determining whether the problem has been solved.

3. The third step in the process of identifying a problem is to develop a plan of action to address the problem. This involves identifying the steps that need to be taken to solve the problem and determining the resources that will be needed to implement the plan. Once a plan of action has been developed, the next step is to implement the plan. This involves carrying out the steps that have been identified in the plan and monitoring the progress of the implementation. Finally, the last step in the process is to evaluate the results of the implementation. This involves assessing the effectiveness of the plan and determining whether the problem has been solved.

4. The fourth step in the process of identifying a problem is to implement the plan. This involves carrying out the steps that have been identified in the plan and monitoring the progress of the implementation. Finally, the last step in the process is to evaluate the results of the implementation. This involves assessing the effectiveness of the plan and determining whether the problem has been solved.

5. The fifth step in the process of identifying a problem is to evaluate the results of the implementation. This involves assessing the effectiveness of the plan and determining whether the problem has been solved.

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of this responsibility to increase the physical efficiency of American youth.

The tests of primary importance to this study are those concerned with grip strength. Grip strength is concluded to be the earliest and one of the best forms of dynamometer tests used for testing specific muscle groups.<sup>31</sup> The majority of research on grip strength has been in reference to its use as a measure of growth and development and as a test in a battery of tests relative to physical fitness or motor ability.

Rogers,<sup>32</sup> in the original investigation of grip strength as a measure of changing bodily condition, reports a study performed on an adult male subject who, after being trained in the grip-test technique, tested himself once daily or oftener. His findings were as follows:

- A. His grip strength dropped 30 points (from 170 to 140) before he was aware of approaching influenza.
- B. An unusually fatiguing day (90 holes of golf and a barn dance) resulted in no change in grip strength at bed time, but a drop of 30 points was recorded the following morning.
- C. Exhausting fatigue of the forearms caused drops of 35 to 60 points, depending upon the degree of exhaustion induced, with corresponding delay in return to normal.

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<sup>31</sup>W. P. Brown, Applied Anatomy and Kinesiology (Philadelphia: Lea and Febiger, 1949), p. 36.

<sup>32</sup>Frederick Rand Rogers, "The Significance of Strength Tests in Revealing Physical Condition," Research Quarterly, V, 3 (October, 1934), p. 43.

the Institute of Health Economics, University of Edinburgh, Edinburgh, Scotland, UK

— *Elaboración propia.*

10. The following are the names of the persons who have been appointed to the various committees of the Board of Directors:

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 The purpose of the document is to provide a detailed description of the project's objectives, scope, and timeline.

Wylie<sup>33</sup> reports the grip history of a forty year old male subject. His normal grip strength, determined after repeated tests, was 125. For reasons unsuspected at the time, his grip steadily dropped six pounds in three weeks. Diagnosed as afflicted by intestinal parasitism, he was hospitalized and a seven foot tapeworm was removed. During the next eight weeks, the subject's grip rose to 145.

Blakeman, Jackson, and Rogers<sup>34</sup> concluded from a study they conducted that grip tests are likely to prove invaluable to athletic coaches in selecting players and substitutes for any game involving large muscle activity and in deciding when and whether or not to return tired players to games.

The following findings are of special significance to physical education:

1. As compared with "dynamic" strength [dash, broad jump, jump and reach, distance throw], static dynamometric strength is more closely associated with biological growth, suggesting a dependence upon constitutional factors expressed in physical measurements and in physical education.

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<sup>33</sup>James A. Wylie, "1938 Case Reports of Physical Ailments and Grip Strength Tests," (Boston: Boston University, 1938). (Mimeographed.)

<sup>34</sup>Frederick Rand Rogers, "The PFI Analogue and Complement of the I.Q.," School and Society, Vol. 50, No. 1296, (October 28, 1939), p. 546.

The following information is being furnished to you for your information and guidance. It is requested that you advise the Bureau of any changes in the information furnished herein. The information is being furnished to you for your information and guidance. It is requested that you advise the Bureau of any changes in the information furnished herein. The information is being furnished to you for your information and guidance. It is requested that you advise the Bureau of any changes in the information furnished herein.

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2. Among boys, a positive relationship of strength to "prestige" traits is apparent, which is regarded as evidence of the role of physical prowess in the adolescent value system. This relationship is not so definite for girls.

3. Superior strength in boys is a part of a complex physical characteristics valued highly during the adolescent period. The absence of this trait is a handicap which can be overcome only by strongly compensating personal traits in other areas also highly valued.

4. (a) Strong boys: A tendency was evidenced for strength to be associated with a good physique, physical fitness, early maturation, social prestige, and social stimulus value and an apparently satisfactory level of personal adjustment.

(b) Weak boys: These boys had a pronounced tendency toward an asthenic physique, later maturation, poor health record, social difficulties and lack of status, feelings of inferiority and personal maladjustment in other areas.

5. (a) Strong boys: These boys were also high in adjustment in most categories, except that of school adjustment. In general they showed an improvement with age.

(b) Weak boys: These boys were poorly adjusted and in general their ratings were marked by downward trends.

It is the duty of the Government to protect the public health and safety of the people. The Government has a responsibility to ensure that the food and drugs that are sold in the United States are safe, effective, and of high quality. The Government has a duty to protect the public from the harmful effects of counterfeit drugs and food.

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Their social reactions tended to be stereotyped either in withdrawal or in extroversion attention-seeking.

Despite the use of meager strength-testing procedures, the Berkley study clearly indicates the importance of physical abilities, especially strength, in the social and psychological adjustment of adolescent boys. Therefore, it becomes obligatory for the physical educator who wished to meet the individual social needs of his boys to consider the adequacy of their basic strength and to take appropriate steps to improve the status of those who are physically weak.

A study by Bookwalter<sup>35</sup> exemplifies the comparative closeness between increases in grip strength and increases in physical growth and development, illustrated by body weight. There were only three prominent irregularities in grip strength growth patterns pointed out. There was a deviation of this growth pattern and grip strength increase at 100--120 pound interval and also a definite drop in grip strength growth or increase after the 200 pound weight interval was reached. In the majority of the sampling there was little increase in grip strength beyond the physical growth of 200 pounds of body weight. The third deviation in the

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<sup>35</sup>Karl W. Bookwalter, "Grip Strength Norms for Males," The Research Quarterly, 50:249, October, 1946.





growth pattern between body weight and grip strength is the difference in acceleration of increased strength of the right and left hand. The left mean grip strength of males from nine to twenty-four years of age and up tends to increase with age. The rate of increase is slow from nine to fourteen; there is a speeding up in the rate of increase of grip strength growth between fourteen and seventeen years of age. The greatest increase in grip strength appears between sixteen and seventeen. A few small irregularities appeared in the mean grip strength scores between seventeen and twenty-four and up, where the rate of growth begins to slow down.

The right grip strength of males also increases between nine and twenty-four years of age. The rate of increase is slow and regular between nine and fourteen years of age. The rate of increase is more rapid between fourteen and seventeen with the greatest increase coming at sixteen years of age. Increase in grip strength is slower beyond sixteen, but regular through twenty-three, with a rise occurring at twenty-four years of age. However, a plateau appears at sixteen, which is less pronounced than that of the left hand. Right hand mean grip strength by age has shown less irregularity than the left hand.

According to Bookwalter's<sup>36</sup> study on grip strength norms for males, it is illustrated that left grip strength

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<sup>36</sup>Bookwalter, op. cit., p. 249.

1. The first step in the process of creating a new product is to identify a market need. This involves conducting market research to determine what consumers want and are willing to pay for. Once a need is identified, the next step is to develop a concept for a product that meets this need. This is often done through brainstorming sessions with a team of designers and engineers.

2. The second step is to create a prototype of the product. This allows the designers to test their concept and make any necessary adjustments before moving forward with production. Prototyping can be done in a variety of ways, from simple 3D printing to more complex methods like injection molding.

3. The third step is to conduct a feasibility study. This involves assessing the technical, financial, and market viability of the product. It's important to determine if the product can be manufactured at a cost that allows for a profit, and if there is a sufficient market demand to sustain the product.

4. The fourth step is to develop a business plan. This document outlines the company's strategy for marketing, selling, and distributing the product. It also includes financial projections and a timeline for development and launch.

5. The fifth and final step is to launch the product. This involves manufacturing the product at scale, setting up distribution channels, and implementing a marketing campaign to generate awareness and drive sales.

6. After the product is launched, it's important to monitor its performance in the market. This includes tracking sales, customer feedback, and any issues that may arise with the product or the manufacturing process. Based on this feedback, the company may need to make adjustments to the product or its marketing strategy.

7. Finally, it's important to consider the long-term sustainability of the product. This involves thinking about how the product can evolve over time to meet changing market needs and staying ahead of competitors.

is consistently lower than the right grip strength, but is more regular in its growth progression. The right grip strength shows more erratic growth progression in that it increases more rapidly at any given body weight intervals than does the left hand. The right grip strength can be from three to thirteen pounds greater than the left grip strength.

Another interesting feature in relation to handedness and growth is that in the American male beyond the age of fifteen, there is about 3 kg. difference in the average grip strength of the right and left hand. Whereas for the Australians the difference was less than 1.5 kg. This fact would indicate that American people who live in a mechanical age are not called upon to be ambidexterous. Likewise, the absence of a marked dextrality in Australians is perhaps the result of social habits and a motion of tool users having a tendency to become more unidexterous.

What is known as ambidexterity<sup>37</sup> is, to a large extent, the result of a social conformity of the naturally left handed individuals. Smidley,<sup>38</sup> in his studies on handedness, also reports the fact that there is a correlation between height and weight and physical measurements. Grip

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<sup>37</sup>Ira S. Wite, Handedness: Right and Left (Boston: Lothrop, Lee and Shepard, Co., 1934), p. 61.

<sup>38</sup>Ibid., p. 190.

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strength is correlated between .2 and .3 with height and between .4 and .5 with weight.

Schwartz, Britton, and Thompson<sup>39</sup> in 1928 used grip strength measurements in their investigation of the physical development and posture of school children and adults between the ages of three and sixty-five years. They found that grip strength increased rapidly up to approximately age twenty, but did not reach its maximum until about the age of thirty. After age thirty there was a gradual decline in strength.

In a recent study conducted by Burke, Tuttle, Thompson, Janney, and Weber,<sup>40</sup> data relative to maximum grip strength and grip strength endurance as related to age were collected from 311 male subjects ranging in age from twelve to seventy-nine. The data indicated the following: There is a rapid increase in both maximum grip strength and grip strength endurance from twelve to twenty-five years of age. After the twenty-fifth year there is a gradual decrease in both maximum grip strength and grip strength endurance up

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<sup>39</sup>L. L. Schwartz, R. A. Britton, and L. R. Thompson, Public Health Bulletin No. 179 (Washington: U. S. Public Health Service, 1928), passim.

<sup>40</sup>W. E. Burke, W. W. Tuttle, C. W. Thompson, D. C. Janney, and R. J. Weber, "The Relation of Grip Strength and Grip Strength Endurance to Age," Journal Applied Physiology, 5:628, 1953.

to the age of seventy-nine years. The maximum grip strength and the grip strength endurance of the seventy-five to seventy-nine year age group was approximately equal to that of the twelve to fifteen year old group. The study also suggests that the individuals with the greatest maximum grip strength have a greater grip strength endurance index. These studies point out specific information that show a significant relationship between grip strength and physiological growth and development.



## CHAPTER III

### METHOD OF COLLECTING DATA

The data for this study were collected during regular sessions of Physical Education activity classes at Michigan State University. The testing began during the second week of the term and continued for the next eight weeks.

In an effort to secure a more complete indication of the relationship of grip strength to general physical achievement, the investigator selected students from various activity courses to be tested. These included apparatus stunts, badminton, beginning swimming, beginning tumbling, fencing, trampoline, and wrestling. An explanation of these courses can be found in Appendix A. This variety of courses was also selected as insurance against a specific experience in physical education that might tend to increase or develop grip strength.

It was not the plan of the writer to use grip strength as a competitive tool between classmates, but rather as a measure to use in comparison with the letter grade received in that physical education activity course.

For this reason the tests were given, while classes were in session, but in small groups whenever possible.





The test was administered in the following manner:

1. Magnesium carbonate was put on the hand to insure that the hand was dry.

2. The tester set the indicator on zero and placed the dynamometer face down in the palm of the student's hand, with the larger concave pressing edge to heel of palm. This was done to prevent fingers from hindering the movement of the indicator and to allow the instrument to best fit the student's hand.

3. To prevent the fingers from slipping over the edge, the convex edge of the dynamometer is placed against the fingers rather than the palm.

4. The students were instructed to keep their hand away from the body when making the test.

5. Each student was given two tests with each hand, alternating right and left with a ten second interval between each test.

6. The score was read to the nearest pound. The tests were all given at the same time to reduce the possibility of practice or improved grip strength.

7. Each student was checked to see if he had control of the apparatus. If a student's hand did slip the test was disregarded and repeated after the other men in that group had been tested.

For each student tested the writer was the recorder, reading and recording the grip strength score to the nearest



pound. The following data were recorded on a prepared work sheet: student's name, class, birthday, present age [to the closest month], height to closest inch, weight to closest pound, handedness--right or left, and grip strength score. [See Appendix B for these data.]

So the students would not have opportunity to practice, all the testing was completed in a single class period. The two scores of each hand were recorded, but the better score of each hand was selected to be used in this study.

At the end of the term the investigator was permitted to use all the class records and recorded on the prepared work sheet the letter grades received by each student.

[illegible]

1. The first step is to identify the problem. This involves understanding the current situation and the goals that need to be achieved.

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## CHAPTER IV

### RESULTS

Results of the Grip Strength Test. In an effort to analyze the grip strength test itself, the various trails were inter-correlated. The resulting coefficients appear on Table III.

TABLE III  
CORRELATION COEFFICIENTS BETWEEN VARIOUS  
GRIP STRENGTH TESTS

Y Variable	X Variable	N	M y	M x	r**
1st test Right Hand	2nd test Right Hand	642	130.7	128.3	0.802*
1st test Left Hand	2nd test Left Hand	655	120.7	117.7	0.838*
Best Grip with Right Hand	Best Grip with Left Hand	648	129.2	133.3	0.581
Best Grip with Strong Hand	Best Grip with Weak Hand	646	133.2	121.5	0.810

\*Coefficient of reliability

\*\*All of these values are significant at a probability of less than 0.001.

The correlation coefficients when computed illustrated that there was close interrelationship between all the variables compared. Although the correlation of the two tests

# REPORT

## 1. SUMMARY

The purpose of this report is to provide a summary of the results of the investigation conducted during the period from January 1, 1961, to December 31, 1961. The investigation was conducted in accordance with the plan of work approved by the Board of Directors on January 1, 1961.

## 2. INTRODUCTION

The investigation was conducted in accordance with the plan of work approved by the Board of Directors on January 1, 1961. The plan of work was approved by the Board of Directors on January 1, 1961.

Item	Quantity	Value	Unit	Remarks	Remarks
Item 1	100	\$100.00	Each	Item 1	Item 1
Item 2	200	\$200.00	Each	Item 2	Item 2
Item 3	300	\$300.00	Each	Item 3	Item 3
Item 4	400	\$400.00	Each	Item 4	Item 4
Item 5	500	\$500.00	Each	Item 5	Item 5

## 3. CONCLUSION

The investigation was conducted in accordance with the plan of work approved by the Board of Directors on January 1, 1961. The plan of work was approved by the Board of Directors on January 1, 1961.

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on the left hand was highest  $r = 0.838$ , it was felt by the investigator that this indicated a small strength decrement between these two tests. This would lead one to assume that the left hand reaches a point of maximal output. The test with the right hand shows, however, that the right hand can be expected to show a greater difference in subsequent tests. In this investigation where most of the subjects were right handed, the correlation coefficient was  $r = 0.802$ .

The relatively low coefficient correlation of the best right hand grip strength test and best left hand grip strength indicated that it would be impractical to arbitrarily select just one hand in measuring grip strength. It was necessary to select the measures that would give us the most inclusive information on both the strong and the weak hand.

The correlation selected to be compared with letter grade was the combination of the best score with the strong hand and the best score with the weak hand. This comparison was indicative of the similarity of grip strength of strong individuals. Although the mean scores illustrate a 12.7 difference in pounds, the correlation coefficient was  $r = 0.810$ . This correlation coefficient shows that the strong individuals are strong with both hands when compared with the weaker subjects tested in this investigation.





Results of the  
Letter Grade  
and Grip Strength

The measure of achievement for the students in this study is their final letter grades, A, B, C, D, or F. The scale used in the classes for determining letter grade are similar. [See Appendix A.] The individual instructor was never informed of the grip strength and hence could not use the information in grading. Each student received a grade that was determined entirely by his work in the course activities. This writer only saw the final grade received by the students who had been his subjects in this study.

Because there were so few F's received by the students tested, the letter grade catagories of D and F were combined, giving four letter grade groups. The data obtained by comparing mean grip strength and the various letter grade groups are illustrated in Table IV. These data indicate a marked difference of grip strength between the letter grade groups.

TABLE IV  
MEAN GRIP STRENGTH SCORES FOR  
VARIOUS LETTER GRADE GROUPS

Letter Grade Groups	Sum of Best Right and Left Grip Strength	Number
A	264.27	144
B	260.39	250
C	250.59	196
D and F	244.73	45

The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry must be supported by proper documentation, such as receipts or invoices. This ensures transparency and allows for easy verification of the data.

The second part of the document outlines the procedures for handling discrepancies. It states that any difference between the recorded amount and the actual amount must be investigated immediately. The responsible party should identify the cause of the error and take steps to correct it. This process helps to maintain the integrity of the financial records.

The third part of the document describes the methods for reconciling accounts. It explains that accounts should be reconciled regularly, typically at the end of each month. This involves comparing the internal records with the bank statements to ensure they match. Any differences should be noted and explained.

The fourth part of the document discusses the importance of keeping records for a sufficient period of time. It notes that many jurisdictions require businesses to retain financial records for a minimum of seven years. This is to ensure that the records are available for audit or legal proceedings if needed.

The fifth part of the document provides information on the consequences of non-compliance. It states that failing to maintain accurate records or failing to comply with retention requirements can result in penalties, fines, or even legal action. Therefore, it is crucial for businesses to follow the guidelines outlined in the document.

The sixth part of the document offers advice on how to implement effective record-keeping systems. It suggests using clear and consistent labeling for all records and ensuring that the records are stored in a secure and accessible location. Regular training for staff is also recommended to ensure everyone understands the importance of accurate record-keeping.

The seventh part of the document discusses the role of technology in record-keeping. It mentions that many businesses now use accounting software to manage their financial records. While this can be helpful, it is important to ensure that the software is reliable and that the data is backed up regularly.

The eighth part of the document provides a summary of the key points discussed. It reiterates the importance of accuracy, transparency, and compliance in financial record-keeping. It encourages businesses to take the time to implement and maintain a robust record-keeping system.

The ninth part of the document includes a section on frequently asked questions. It addresses common concerns, such as how to handle lost receipts or how to deal with disputes over transactions. The answers provide practical guidance to help businesses resolve these issues.

The tenth part of the document concludes with a statement of intent. It expresses the goal of the document, which is to provide a comprehensive guide to financial record-keeping for businesses. It hopes that the information provided will be helpful and that businesses will take the necessary steps to ensure their records are accurate and compliant.

Appendix A

Sample Record-Keeping System

Date	Description	Amount	Source	Destination
2023-01-01	Initial deposit	\$10,000.00	Bank of America	Business Account
2023-01-05	Payment received	\$500.00	Customer A	Business Account
2023-01-10	Payment received	\$750.00	Customer B	Business Account
2023-01-15	Payment received	\$1,200.00	Customer C	Business Account
2023-01-20	Payment received	\$300.00	Customer D	Business Account
2023-01-25	Payment received	\$600.00	Customer E	Business Account
2023-01-30	Payment received	\$450.00	Customer F	Business Account
2023-02-01	Payment received	\$800.00	Customer G	Business Account
2023-02-05	Payment received	\$200.00	Customer H	Business Account
2023-02-10	Payment received	\$900.00	Customer I	Business Account
2023-02-15	Payment received	\$1,100.00	Customer J	Business Account
2023-02-20	Payment received	\$350.00	Customer K	Business Account
2023-02-25	Payment received	\$700.00	Customer L	Business Account
2023-02-28	Payment received	\$550.00	Customer M	Business Account
2023-03-01	Payment received	\$1,300.00	Customer N	Business Account
2023-03-05	Payment received	\$400.00	Customer O	Business Account
2023-03-10	Payment received	\$850.00	Customer P	Business Account
2023-03-15	Payment received	\$250.00	Customer Q	Business Account
2023-03-20	Payment received	\$950.00	Customer R	Business Account
2023-03-25	Payment received	\$1,050.00	Customer S	Business Account
2023-03-30	Payment received	\$300.00	Customer T	Business Account
2023-04-01	Payment received	\$750.00	Customer U	Business Account
2023-04-05	Payment received	\$450.00	Customer V	Business Account
2023-04-10	Payment received	\$1,150.00	Customer W	Business Account
2023-04-15	Payment received	\$200.00	Customer X	Business Account
2023-04-20	Payment received	\$900.00	Customer Y	Business Account
2023-04-25	Payment received	\$1,000.00	Customer Z	Business Account
2023-04-30	Payment received	\$350.00	Customer AA	Business Account
2023-05-01	Payment received	\$700.00	Customer AB	Business Account
2023-05-05	Payment received	\$550.00	Customer AC	Business Account
2023-05-10	Payment received	\$1,300.00	Customer AD	Business Account
2023-05-15	Payment received	\$400.00	Customer AE	Business Account
2023-05-20	Payment received	\$850.00	Customer AF	Business Account
2023-05-25	Payment received	\$250.00	Customer AG	Business Account
2023-05-30	Payment received	\$950.00	Customer AH	Business Account
2023-06-01	Payment received	\$1,050.00	Customer AI	Business Account
2023-06-05	Payment received	\$300.00	Customer AJ	Business Account
2023-06-10	Payment received	\$750.00	Customer AK	Business Account
2023-06-15	Payment received	\$450.00	Customer AL	Business Account
2023-06-20	Payment received	\$1,150.00	Customer AM	Business Account
2023-06-25	Payment received	\$200.00	Customer AN	Business Account
2023-06-30	Payment received	\$900.00	Customer AO	Business Account
2023-07-01	Payment received	\$1,000.00	Customer AP	Business Account
2023-07-05	Payment received	\$350.00	Customer AQ	Business Account
2023-07-10	Payment received	\$700.00	Customer AR	Business Account
2023-07-15	Payment received	\$550.00	Customer AS	Business Account
2023-07-20	Payment received	\$1,300.00	Customer AT	Business Account
2023-07-25	Payment received	\$400.00	Customer AU	Business Account
2023-07-30	Payment received	\$850.00	Customer AV	Business Account
2023-08-01	Payment received	\$250.00	Customer AW	Business Account
2023-08-05	Payment received	\$950.00	Customer AX	Business Account
2023-08-10	Payment received	\$1,050.00	Customer AY	Business Account
2023-08-15	Payment received	\$300.00	Customer AZ	Business Account
2023-08-20	Payment received	\$750.00	Customer BA	Business Account
2023-08-25	Payment received	\$450.00	Customer BB	Business Account
2023-08-30	Payment received	\$1,150.00	Customer BC	Business Account
2023-09-01	Payment received	\$200.00	Customer BD	Business Account
2023-09-05	Payment received	\$900.00	Customer BE	Business Account
2023-09-10	Payment received	\$1,000.00	Customer BF	Business Account
2023-09-15	Payment received	\$350.00	Customer BG	Business Account
2023-09-20	Payment received	\$700.00	Customer BH	Business Account
2023-09-25	Payment received	\$550.00	Customer BI	Business Account
2023-09-30	Payment received	\$1,300.00	Customer BJ	Business Account
2023-10-01	Payment received	\$400.00	Customer BK	Business Account
2023-10-05	Payment received	\$850.00	Customer BL	Business Account
2023-10-10	Payment received	\$250.00	Customer BM	Business Account
2023-10-15	Payment received	\$950.00	Customer BN	Business Account
2023-10-20	Payment received	\$1,050.00	Customer BO	Business Account
2023-10-25	Payment received	\$300.00	Customer BP	Business Account
2023-10-30	Payment received	\$750.00	Customer BQ	Business Account
2023-11-01	Payment received	\$450.00	Customer BR	Business Account
2023-11-05	Payment received	\$1,150.00	Customer BS	Business Account
2023-11-10	Payment received	\$200.00	Customer BT	Business Account
2023-11-15	Payment received	\$900.00	Customer BU	Business Account
2023-11-20	Payment received	\$1,000.00	Customer BV	Business Account
2023-11-25	Payment received	\$350.00	Customer BW	Business Account
2023-11-30	Payment received	\$700.00	Customer BX	Business Account
2023-12-01	Payment received	\$550.00	Customer BY	Business Account
2023-12-05	Payment received	\$1,300.00	Customer BZ	Business Account
2023-12-10	Payment received	\$400.00	Customer CA	Business Account
2023-12-15	Payment received	\$850.00	Customer CB	Business Account
2023-12-20	Payment received	\$250.00	Customer CC	Business Account
2023-12-25	Payment received	\$950.00	Customer CD	Business Account
2023-12-30	Payment received	\$1,050.00	Customer CE	Business Account
2023-12-31	Payment received	\$300.00	Customer CF	Business Account

Relationship Between  
the Various Letter  
Grade Groups

Table IV illustrates that a significant difference occurred between all letter grade groups. A comparison of the mean grip strength score and the letter grade grouping clearly points out that the stronger students, as measured by grip strength, received the higher grades.

In addition, critical ratios of the differences between all letter grade groups were calculated. The results in Table V verify that differences in the mean grip strength of each letter grade group is more significant than could be attributed to chance alone. This indicates still further the relationship between grip strength and the achievement of the subjects in this investigation.

TABLE V

CRITICAL RATIOS FOR THE COMPARISON OF MEAN GRIP  
STRENGTH AMONG VARIOUS LETTER GRADE GROUPS

Letter Grade Comparisons	Critical Ratio	Probability
A vs B	4.1318	.000
A vs C	3.2575	.002
A vs DF	2.7812	.006
B vs C	2.3266	.020
B vs DF	2.8377	.004
C vs DF	2.1820	.029

Variables Affecting  
Grip Strength

No marked relationship is readily discernible between age, height and weight, and grip strength. However, there is an apparent

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relationship between one of these variables, weight and grip strength. In order to establish the influence of each of these three variables on mean grip strength, a correlation coefficient was computed. In this correlation the mean of these variables for all the subjects tested was compared with the mean grip strength scores, as was indicated from the raw data weight was the most significant  $r = .451$ , results are illustrated in Table VI.

TABLE VI  
CORRELATION COEFFICIENTS BETWEEN GRIP  
STRENGTH AND OTHER VARIABLES

Variables Correlated with Mean Grip Strength*	M	r	Number	P
Weight	159.7	.451	639	.000
Height	70.3	.326	641	.000
Age	19.06	.118	642	.003

\*Mean grip strength for all classes in this investigation are in Appendix C.

To supplement the data obtained from the results of the above correlation, a partial correlation was computed. It was possible with this statistical procedure to eliminate the effect any one variable had upon the other in respect of mean grip strength. Although there was a correlation of  $r = 0.637$  between weight and height, weight was the most



prominent factor. The partial correlations are shown in Table VII. Because age-and-weight and age-and-height had such low correlation coefficients,  $r = 0.028$  and  $r = 0.047$  respectively, further analysis of age did not appear necessary.

TABLE VII

PARTIAL CORRELATION COEFFICIENT BETWEEN VARIABLE  
HEIGHT AND WEIGHT AND GRIP STRENGTH

Variables Correlated	Variable Partialled Out	N	Partial r	Probability
Mean Grip Strength and Weight	Height	635	.34	less than .01
Mean Grip Strength and Height	Weight	635	.057	greater than .05

It was assumed from the analyses of the data collected that weight could be an important factor in the predicting of mean grip strength scores. Consequently, residuals were computed using the following line of regression derived from data collected on weight and grip strength;  $Y = .76X + .36$ . Where  $Y$  = predicted grip strength in pounds;  $X$  = weight in pounds.

Predicted grip strength and actual grip were compared, and if the sum of the two best grip strength scores was lower than the predicted grip strength, a minus residual was recorded for that student; if the predicted grip strength





score was below the actual sum of the two best grip strength scores, a plus residual was recorded. This tabulation was done for each student in all the classes tested. [See Appendix B for all data on residuals.] The final results were compared with the four letter grade groupings in Table VIII.

TABLE VIII  
GRIP STRENGTH RESIDUALS FOR EACH LETTER GRADE

Letter Grade Achieved Groups	Mean Grip Residuals	Number
A	+6.06	144
B	-1.72	250
C	-3.45	196
D and F	-11.59	45

In order to further define the residuals a critical ratio was computed. The critical ratios for A, B, and C letter grade groups were not significantly different from the residuals computed from the raw scores. However, when the critical ratios of the D and F groups were compared, the difference was more significant. This would indicate that as the men gained in weight, either by fleshiness or size beyond a certain point, their grip strength did not gain proportionately.

Table IX present this information, which further verifies the relationship of weight to grip strength.

[illegible]

1. *Chlorophyll a* (Chl *a*)

**TABLE IX**  
**CRITICAL RATIOS FOR THE COMPARISON OF RESIDUALS**  
**AND THE VARIOUS LETTER GRADE GROUPS**

Letter Grade Comparisons	Critical Ratio	Probability
A vs B	2.12	0.034
A vs C	3.07	0.002
A vs DF	6.66	0.000
B vs C	1.84	0.065
B vs DF	4.31	0.000
C vs DF	3.44	0.000

During the tabulation and recording of the results of this study, it was observed that some of the subjects who had stated that they were right handed had stronger left hands. Table X shows the number of subjects whose so-called opposite hands were stronger.

**TABLE X**  
**THE COMPARISON OF GRIP STRENGTH SCORES AND HANDEDNESS**

Men	Strong Right Hand	Strong Left Hand	$\chi^2$	P
Right Handed Men	452	51	35.7	Less Than 0.001
Left Handed Men	21	26		

The ratio of left-handed men with strong right hands was so great, as compared to right-handed men with strong left hands, that several assumptions were made. The influence of a right handed society has so channeled the

# Figure 1

Figure 1 shows the results of the analysis of the data from the experiment. The data are presented in the form of a table and a graph.

Time (min)	Concentration (g/l)	Temperature (°C)
0	0.0	20.0
10	0.1	20.0
20	0.2	20.0
30	0.3	20.0
40	0.4	20.0
50	0.5	20.0
60	0.6	20.0
70	0.7	20.0
80	0.8	20.0
90	0.9	20.0
100	1.0	20.0

The data in the table show that the concentration of the solution increases linearly with time. The temperature remains constant at 20.0°C throughout the experiment.

The graph in Figure 1 shows the concentration of the solution as a function of time. The concentration increases linearly from 0.0 g/l at 0 min to 1.0 g/l at 100 min. The temperature remains constant at 20.0°C throughout the experiment.

# Figure 2

Figure 2 shows the results of the analysis of the data from the experiment. The data are presented in the form of a table and a graph.

Time (min)	Concentration (g/l)	Temperature (°C)
0	0.0	20.0
10	0.1	20.0
20	0.2	20.0
30	0.3	20.0
40	0.4	20.0
50	0.5	20.0
60	0.6	20.0
70	0.7	20.0
80	0.8	20.0
90	0.9	20.0
100	1.0	20.0

The data in the table show that the concentration of the solution increases linearly with time. The temperature remains constant at 20.0°C throughout the experiment.

The graph in Figure 2 shows the concentration of the solution as a function of time. The concentration increases linearly from 0.0 g/l at 0 min to 1.0 g/l at 100 min. The temperature remains constant at 20.0°C throughout the experiment.

muscular experiences of naturally left-handed people that there is very little difference between grip strength and handedness. This ratio also illustrates that continued use does develop muscular efficiency.

1. The first step in the process of the development of a new product is the identification of a market need.

2. The second step is the selection of a product concept that meets the market need.

3. The third step is the development of a product prototype.

4. The fourth step is the testing of the product prototype.

## CHAPTER V

### SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Many studies have indicated that grip strength is an important factor in physical fitness, athletic ability, general strength and general organic vigor. It was the purpose of this investigation to correlate grip strength with achievement in physical education among college men. The subjects for this experiment were six hundred and thirty-five college freshmen and sophomore men who were participating in physical education activities. Their right and left grip strength were measured, together with age, height, and weight. Grip strength was then correlated with the final letter grade received in physical education. Pertinent intercorrelations of these measurements were investigated.

Conclusions After a statistical analysis was made, the following conclusions appear justified:

1. Grip strength is important to achievement in physical education at Michigan State University.
2. Right grip strength is highly correlated with left grip strength.
3. A significantly larger proportion of left handed men have stronger right hands, as compared to right handed men with stronger left hands.



100

Figure 1. The effect of the concentration of the *Agrobacterium* suspension on the transformation efficiency of *Agrobacterium* strains.

• *Staphylococcus aureus* (Staph aureus) is a common cause of skin infections, such as abscesses, impetigo, and cellulitis. It can also cause more serious infections, such as pneumonia, sepsis, and toxic shock syndrome.

— *Journal of the American Medical Association*, 1990, 263: 1000-1001

religions, and the religious and political movements that have emerged in the last century.

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

„Ich bin ein Mann, der seine Interessen nicht verliert.“

— *Univariate and multivariate analyses* —

On the other hand, the *Journal of the American Medical Association* (JAMA) has been a vocal proponent of the medical model of disability. In 1991, JAMA published an editorial titled "Disability: A Social Construct or a Medical Reality?" which argued that disability is a medical condition that should be treated by the medical profession (JAMA, 1991). This editorial was a response to a growing movement within the disability community to challenge the medical model and to promote a social model of disability. The social model of disability argues that disability is a result of social barriers and discrimination, rather than a medical condition. It advocates for the removal of these barriers and the promotion of social inclusion for people with disabilities.

1. What is the purpose of the study?

1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 26

— 222 —

• **Explain** the importance of the **business plan** in the business process.

Figure 1. The effect of the concentration of the *Agrobacterium* strain on the transformation efficiency of *Agrobacterium* strain.

**DATE:** \_\_\_\_\_

1987, 1988, 1989, 1990, 1991, 1992, 1993, 1994, 1995, 1996, 1997, 1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 26

● **注意：** 在 2013 年 12 月 1 日以前，在《公司法》第 147 条第 2 款中，规定的是“不得担任公司的董事、监事、高级管理人员”，而并非“不得担任公司的董事、监事、高级管理人员或者其他职务”。

[illegible]

• *Staphylococcus aureus* (Staph aureus)

1. *Journal of the American Medical Association*, 1997; 277: 1033-1037.

● 1990年12月，在《中国环境报》上，刊登了“中国环境状况令人堪忧”的文章，指出中国环境状况令人堪忧，呼吁全社会关注环境问题。

4. College students who are physically weak could benefit from a course to improve strength.
5. An individual's weight is more closely correlated with grip strength than either his height or age.
6. The statistical analysis of the data demonstrated that raw grip strength scores are nearly as accurate in predicting achievement, as are tests that consider weight in the evaluation. Although as you compare the A, B, and C student with the D and F students, weight is more significant.

Recommendations      The following recommendations are made for additional investigation with grip strength:

1. A similar investigation using female college subjects might prove interesting.
2. An investigation in which achievement was predicted from grip strength scores would present additional data.
3. A study to ascertain the length of time needed to increase strength enough to improve achievement in physical education would prove advantageous.
4. A study could be conducted correlating grip strength and personality with college success.



5. Another investigation that might be significant would be to establish at what age strength becomes important to physical education achievement.
6. An experiment that compared grip strength to success in various sports could be given some thought.

the 1990s, the number of people in the world who are illiterate has increased from 1.2 billion to 1.5 billion. The number of illiterate people in the world is expected to reach 1.7 billion by the year 2015. The number of illiterate people in the world is expected to reach 1.7 billion by the year 2015.

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1. The first part of the report deals with the general situation of the country and the progress of the work during the year. It is divided into two main sections: the first section deals with the general situation and the second section deals with the progress of the work.

2. The second part of the report deals with the results of the work during the year. It is divided into two main sections: the first section deals with the results of the work in the field of research and the second section deals with the results of the work in the field of education.

3. The third part of the report deals with the financial situation of the institution during the year. It is divided into two main sections: the first section deals with the income and the second section deals with the expenditure.

4. The fourth part of the report deals with the personnel of the institution during the year. It is divided into two main sections: the first section deals with the staff and the second section deals with the students.

5. The fifth part of the report deals with the general conclusions of the year's work. It is divided into two main sections: the first section deals with the achievements and the second section deals with the problems.

6. The sixth part of the report deals with the recommendations for the future work. It is divided into two main sections: the first section deals with the general recommendations and the second section deals with the specific recommendations.

7. The seventh part of the report deals with the appendixes. It is divided into two main sections: the first section deals with the statistical tables and the second section deals with the other documents.

8. The eighth part of the report deals with the index. It is divided into two main sections: the first section deals with the subject index and the second section deals with the author index.

9. The ninth part of the report deals with the bibliography. It is divided into two main sections: the first section deals with the books and the second section deals with the other documents.

10. The tenth part of the report deals with the conclusion. It is divided into two main sections: the first section deals with the general conclusion and the second section deals with the specific conclusion.



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[illegible]

the 1990s, the number of people in the world who are under 15 years of age is expected to increase from 1.1 billion to 1.5 billion. The number of people aged 65 and over is expected to increase from 200 million to 400 million. The number of people aged 15 and over is expected to increase from 3.5 billion to 4.5 billion. The number of people aged 15 and over is expected to increase from 3.5 billion to 4.5 billion. The number of people aged 15 and over is expected to increase from 3.5 billion to 4.5 billion.

1. *Chlorophyll *a** and *Chlorophyll *b** were determined by the method of Arar and Collins (1971) using a Shimadzu 1601 UV-Visible Spectrophotometer. The concentration of chlorophyll was expressed in  $\mu\text{g mL}^{-1}$ .

1. *Chlorophyll *a** was determined in 100% methanol extracts of the leaves and stems of the plants. The extracts were centrifuged at 1000g for 10 min and the supernatant was used for the determination of chlorophyll *a*. The concentration of chlorophyll *a* was determined by the method of Arar and Johnson (1999).

[illegible][illegible]

• **Prevalence** – the proportion of a population that has a disease at a particular point in time

## **APPENDIXES**

1. *Chlorophyll a* and *Chlorophyll b* were determined by the method of Lichtenthaler and Whistler (1973). The total chlorophyll content was determined by the method of Arar and Cook (1980). The carotenoid content was determined by the method of Lichtenthaler and Whistler (1973). The total carotenoid content was determined by the method of Arar and Cook (1980). The total carotenoid content was determined by the method of Arar and Cook (1980).

## APPENDIX A

### Definition of Courses Selected for this Study from the Service Curriculum Syllabus of Courses in Physical Education for Men Michigan State University

#### Educational Philosophy

This physical education curriculum is based upon the thesis that one of mankind's basic needs is the desire for expression in physically wholesome and mentally stimulating activities. To that end, we offer a program of instruction and guidance in a wide range of skills fundamental which can satisfy basic needs and will contribute to socially efficient living.

#### Curriculum Organization

The service curriculum in physical education for men consists of five general areas, namely: Aquatics, combatives, games, stunts, and adapted sports for the physically handicapped. There are a total of twenty-seven courses represented in all the areas.

#### Physical Education Requirements

Physical education is required of all men students during the freshman and sophomore years, or until completion of six quarters of physical education unless excused by the Health Service. Veterans of the armed forces are exempt from physical education. Students who have reached their 30th birthday are exempt from physical education. Exemption certificates must be secured by the student from the Registrar and presented at enrollment. If for any reason, a course is deferred, it must be made up.

#### Grade Scale

The grade scale for all courses except those in the aquatic series is standard. The range is listed as follows: 90 or more points, A; 80 to 89 points, B; 70 to 79 points, C; 60 to 69 points, D; 59 points or less, F.

The grades on this scale are considerably lower than a standard scale used for academic courses at Michigan State, and this discrepancy should probably be explained. This scale was arrived at following considerable debate at a meeting of the Department committee chairmen. The general feeling expressed indicated that because of the lack of good physical

## Introduction

The purpose of this study is to determine the effect of the use of the word "and" in the English language. The study is based on the following assumptions:

## Methodology

The study is based on the following assumptions: (1) The use of the word "and" in the English language is a function of the context in which it is used. (2) The use of the word "and" in the English language is a function of the speaker's intention. (3) The use of the word "and" in the English language is a function of the listener's interpretation.

## Results and Discussion

The study found that the use of the word "and" in the English language is a function of the context in which it is used. The study also found that the use of the word "and" in the English language is a function of the speaker's intention. The study also found that the use of the word "and" in the English language is a function of the listener's interpretation.

## Conclusion

The study found that the use of the word "and" in the English language is a function of the context in which it is used. The study also found that the use of the word "and" in the English language is a function of the speaker's intention. The study also found that the use of the word "and" in the English language is a function of the listener's interpretation. The study also found that the use of the word "and" in the English language is a function of the speaker's intention.

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education programs at the secondary level, boys have not had adequate activity experiences and are not advanced as much in a physical sense as they are academically. This point, of course, is open to debate and probably will not be settled until the extended use of this scale has supplied information for further study.

#### Tennis - PE 100c

##### 1. Objectives:

- A. The conduct objective of this course is:  
playing tennis according to social and hygiene standards. The standard of achievement is - reasonably well.
- B. The control or immediate course objectives are:
  - 1. Service (simple alive)
  - 2. Forehand (grip and stroke)
  - 3. Backhand
  - 4. Net Play (volley - smash)
  - 5. Court Tactics (doubles play)
  - 6. Rules

2. Examination and Grading Plan:	<u>Points</u>
A. Skill performance	60
B. Competition play	20
C. Written examination rules and techniques	10
D. Healthmanship and sportsmanship	10
	<u>100</u>

#### Badminton PE 100c

##### 1. Objectives:

- A. The conduct objective of this course is:  
playing badminton according to social and hygiene standards. The standard of achievement is: reasonably well.
- B. The control or immediate course objectives are:
  - 1. Service (long-short)
  - 2. Forehand (clear - drop - rally)
  - 3. Backhand (clear - net - midcourt)
  - 4. Smash (deep - short)
  - 5. Court tactics (doubles play)
  - 6. Rules

2. Examination and Grading Plan:	<u>Points</u>
1. Skill performance	60

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1. The first step in the process of the development of a new product is the identification of a market need. This is done by conducting market research, which involves gathering information about the needs and wants of potential customers. This information is then used to develop a product that meets these needs and wants.

2. The second step is the development of a business plan. This plan outlines the company's goals, objectives, and the strategies that will be used to achieve them. It also includes a financial forecast, which shows the expected revenue and expenses over a period of time.

3. The third step is the development of a prototype. This is a small-scale model of the product that is used to test the design and to gather feedback from potential customers. The prototype is usually made of a material that is easy to work with, such as wood or plastic.

4. The fourth step is the development of a marketing plan. This plan outlines the strategies that will be used to promote the product and to reach potential customers. It includes information about the target market, the competitive environment, and the marketing mix (product, price, place, and promotion).

5. The fifth step is the development of a production plan. This plan outlines the processes that will be used to manufacture the product. It includes information about the raw materials, the equipment, and the labor that will be required.

6. The sixth step is the development of a distribution plan. This plan outlines the strategies that will be used to get the product to the customer. It includes information about the distribution channels, the logistics, and the pricing.

7. The seventh step is the development of a sales plan. This plan outlines the strategies that will be used to sell the product. It includes information about the sales force, the sales territories, and the sales goals.

8. The eighth step is the development of a financial plan. This plan outlines the company's financial needs and the strategies that will be used to meet them. It includes information about the capital requirements, the sources of funds, and the financial ratios.

9. The ninth step is the development of a risk management plan. This plan outlines the strategies that will be used to identify, assess, and mitigate the risks that the company faces.

10. The tenth step is the development of a legal plan. This plan outlines the strategies that will be used to ensure that the company is in compliance with all applicable laws and regulations.

11. The eleventh step is the development of a human resources plan. This plan outlines the strategies that will be used to attract, develop, and retain the talent that the company needs. It includes information about the recruitment process, the training and development programs, and the compensation and benefits packages.

12. The twelfth step is the development of an information systems plan. This plan outlines the strategies that will be used to manage the company's information resources. It includes information about the hardware, the software, and the data.

13. The thirteenth step is the development of a quality management plan. This plan outlines the strategies that will be used to ensure that the product meets the highest quality standards. It includes information about the quality control process, the quality improvement programs, and the customer feedback mechanisms.

14. The fourteenth step is the development of an environmental management plan. This plan outlines the strategies that will be used to manage the company's environmental impact. It includes information about the environmental assessment process, the environmental improvement programs, and the environmental reporting mechanisms.

15. The fifteenth step is the development of a social responsibility plan. This plan outlines the strategies that will be used to ensure that the company is acting in a socially responsible manner. It includes information about the social responsibility assessment process, the social responsibility improvement programs, and the social responsibility reporting mechanisms.



	<u>Points</u>
B. Competition Play	20
C. Written examination on rules and techniques	10
D. Healthmanship and sportsmanship	<u>10</u>
	100

## Group Games PE 100F

### 1. Objectives:

- a. The conduct objective of this course is: Playing Group Games according to social and hygienic standards. The standard of achievement is: Reasonably well.
- b. The control or immediate course objectives are:
  - (1) To acquire knowledge of various group games and relays.
  - (2) To acquire techniques, skills and abilities in leading group games.
  - (3) To develop poise, self-confidence and leadership abilities.
  - (4) To learn to play and enjoy a variety of group games, to express yourself and to have fun.
  - (5) To gain abilities and knowledge which will prove valuable to you later on as a parent, in raising your children, and as a leader in your community.

### 2. Examination and Grading Plan

- a. Individual Presentation . . . . . 30 points
  - (1) Choice of activity within age group assigned.
  - (2) Preparation.
  - (3) Pedagogy and Technique employed.
  - (4) Voice.
  - (5) Explanation.
  - (6) Organization.
  - (7) Written description of game  
(to be typed and handed in)
- b. Committee Presentation of Games and Relays for an entire period . . . . . 25 Points
  - (1) Same criteria as above plus a lesson plan and description of games for entire period.
- c. Individual Participation in Games . . . . . 25 points
  - (1) Effort
  - (2) Attitude

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(3) Sportsmanship	
(4) Healthmanship	
d. Written examination on relays, games and rules . . . . .	10 Points
e. Healthmanship and Sportsmanship . . . . .	10 Points
Total	<u>100 Points</u>

### Handball PE 1001

#### 1. Objectives

- a. The conduct objective of this course is: Playing handball according to social and hygienic standards. The standard of achievement is: Reasonable well.
- b. The control or immediate course objectives are:
  - (1) Be able to serve.
  - (2) Return serves and volley.
  - (3) Use placement shots
  - (4) Take a correct position on the court when playing

#### 2. Examination and Grading Plan:

a. Performance Test (Round Robin Scores). . . . .	60 Points
b. Demonstration Test (5 places, 4 points each). . . . .	20 Points
c. Written examination on rules and techniques. . . . .	10 Points
d. Healthmanship and sportsmanship . . . . .	<u>10 Points</u>
	100 Points

### Bowling PE 100k

1. Objectives: The conduct objective of this course is: Bowling according to social and hygienic standards. The standard of achievement is: Reasonable well.

#### 2. Teaching Procedure

- a. Selecting a ball to fit your hand
- b. How to hold a bowling ball
- c. The stance
- d. Foot work
- e. Three, four or five step delivery
- f. How to bowl straight, curve, or hook ball.
- g. The pushaway
- h. The back swing
- i. How to slide
- j. Bending versus stooping
- k. How to make a strike
- l. How to make a spare
- m. How to score a game

1. *Journal of the American Medical Association*, 1997; 277: 1033-1036.

Figure 1. The effect of the number of trials on the number of correct responses. The number of correct responses was significantly higher than the number of incorrect responses in all cases. Error bars represent the standard error of the mean.

the 1990s, the number of people in the world who are illiterate has increased from 400 million to 600 million. The number of illiterate people in the world is expected to reach 700 million by the year 2015. The number of illiterate people in the world is expected to reach 800 million by the year 2020. The number of illiterate people in the world is expected to reach 900 million by the year 2025. The number of illiterate people in the world is expected to reach 1 billion by the year 2030. The number of illiterate people in the world is expected to reach 1.1 billion by the year 2035. The number of illiterate people in the world is expected to reach 1.2 billion by the year 2040. The number of illiterate people in the world is expected to reach 1.3 billion by the year 2045. The number of illiterate people in the world is expected to reach 1.4 billion by the year 2050. The number of illiterate people in the world is expected to reach 1.5 billion by the year 2055. The number of illiterate people in the world is expected to reach 1.6 billion by the year 2060. The number of illiterate people in the world is expected to reach 1.7 billion by the year 2065. The number of illiterate people in the world is expected to reach 1.8 billion by the year 2070. The number of illiterate people in the world is expected to reach 1.9 billion by the year 2075. The number of illiterate people in the world is expected to reach 2 billion by the year 2080. The number of illiterate people in the world is expected to reach 2.1 billion by the year 2085. The number of illiterate people in the world is expected to reach 2.2 billion by the year 2090. The number of illiterate people in the world is expected to reach 2.3 billion by the year 2095. The number of illiterate people in the world is expected to reach 2.4 billion by the year 2100.

### 3. Examination and Grading Plan

a. Demonstration . . . . .	40 Points
b. Accuracy . . . . .	40 Points
c. Written examination. . . . .	10 Points
d. Healthmanship. . . . .	5 Points
e. Sportsmanship. . . . .	5 Points

#### Beginning Swimming 101A

##### 1. Objectives:

- a. The conduct objective of this course is: Performing aquatic skills according to social and hygienic standards.
- b. The specific activities taught along with the standard of achievement for each are listed below:
- c. Activities on Skill Sheet
  - (1) Crawl Stroke - 42 feet Minimum
  - (2) Re-check - 75 feet Maximum
  - (3) Elementary Back - 42 feet
  - (4) Re-check - 75 feet
  - (5) Breast Stroke - 42 feet
  - (6) Re-check - 75 feet
  - (7) Side Stroke - 42 feet
  - (8) Re-check - 75 feet
  - (9) Distance Swim - 42 feet
  - (10) Distance Swim - 24 yards
  - (11) Distance Swim - 50 yards
  - (12) Distance Swim - 100 yds.
  - (13) Sustained Swim - 1 minute
  - (14) Sustained Swim - 2 minutes
  - (15) Sustained Swim - 3 minutes
  - (16) Sustained Swim - 4 minutes
  - (17) Sustained Swim - 5 minutes
  - (18) Sculling and Floating
  - (19) Treading
  - (20) Jumping and Diving
  - (21) Underwater
  - (22) Plunge Dive

#### Advanced Swimming 101b

##### 1. Objectives:

- a. The conduct objective of this course is: Performing aquatic skills according to social and hygienic standards.



- b. The specific activities taught along with the standard of achievement for each are listed below:

<u>Activities</u>		<u>Grading Scale</u>				
		A	B	C	D	F
Crawl Stroke		10	9	8	7	6
Breast Stroke		"	"	"	"	"
Side Stroke		"	"	"	"	"
El. Back Stroke		"	"	"	"	"
Distance Swim	Laps:					
(1 mile - 27 laps)	27 - 23	22 - 18	17 - 10	9 - 5	4 - 0	
Points Maximum Tot.	10	8	7	6	5	
Sustained Swim						
Time (Minutes)	30	29 - 25	24 - 20	19 - 15	14 - 10	
Points	10	8	7	6	5	
Maximum total	10 points					
Watermanship Skills						
Plunge Glide						
Distance	1 width	1st lane	2nd	3rd	4th	
Points	4	3	2	1	0	
Maximum Total	4 points					
Tread Water						
Time	15 min.	10 - 14	9 - 7	6 - 3	3 - 0	
Points	4	3	2	1	0	
Maximum Total	4 points					
Diving and Jumping	4	3	2	1	0	
(From Deck, low board, high board, surface)	A point for performing each event.					
Maximum total	4 points					
Underwater Swim						
Distance	1 length	20 yds.	15 yds.	10 yds.	5 yds.	
Points	4	3	2	1	0	
Maximum total of points for underwater swim of	4 points.					
Carries	1 length					
(Head, hair, cross chest tired swimmers)	4	3	2	1		
Maximum total--4	A point for each event					
Written Examination	10	9	8	7	6	
(On Rules, Techniques and Water Safety)						
Maximum Total	10 points					
Healthmanship and Sportsmanship						
Maximum Total	10 points					





## Individual Tumbling PE 102a

1. **Objective:** The primary objectives of the course are: Performing tumbling stunts, according to social and hygienic standards. The specific activities taught in this phase of the course and the standards of achievement set for each are given below:

### Individual Tumbling Stunts

1. Forward roll.
2. Backward roll.
3. Squat stand. 10 seconds.
4. Running dive. Roll and come to stand.
5. Head stand. 10 seconds.
6. Hand stand. 10 seconds.
7. Elbow head stand. 10 seconds.
8. Cartwheel, left, both hands and feet touching line.
9. Forearm stand. 10 seconds.
10. Round off - legs pass through vertical position and snap down. Land with feet pointing toward starting position.
11. Double elbow lever. Hold for 10 seconds.
12. Bridge over - execution.
13. Fish flop - (Forward or backward) in good form.
14. Backward roll to hand stand. Hold 5 seconds.
15. Head stand push to hand stand. Hold 5 seconds.
16. Back roll to head stand - execution and hold 5 seconds.
17. Snap-up - land and remain on feet without stepping back.
18. Neck spring - land and remain on feet without stepping back.
19. Running forward hand spring - land and remain on feet without stepping back.
20. Standing forward head spring - land and remain on feet without stepping back.
21. Hand stand - snap down.
22. Running front somersault. Land and remain on feet without stepping back.
23. Back somersault. Land and remain on feet without stepping back.
24. Back hand spring (standing or round-off). Landing and remain on feet without stepping back.
25. Optional Stunts: The stunts and standards of achievement for each must be approved by the instructor.
  - a. Kip up - no hands.
  - b. Hand walk - 20 feet
  - c. Chest rock to hand stand.
26. **Routines:** The routines may include stunts taught in class or other stunts, and must be approved by the instructor.



- a. Cartwheel - round off - back roll - back roll to head stand - push to hand stand.
- b. Hand spring - round off - back roll - back extension.
- c. Hand spring - dive roll - neck spring - back roll to hand stand.
- d. Back roll - forward roll - neck spring.
- e. Dive roll - forward roll - hand spring - head stand.
- f. Round off - back roll to head stand - forward roll - neck spring.
- g. Squat stand - head stand - head stand push to hand stand - snap down.

(These are suggestions. Others routines may be devised if preferred.)

## 2. Examination and Grading plan:

Performance test, 24 stunts, 3 points each . . . . .	72 points
Performance test, 2 routines, 4 points each. . . . .	8 points
Each routine will be made up of five stunts which will not be repeated in the other routine. Performance tests will begin the fifth week and continue through the end of the term. Each student will receive four trials at each stunt and routine.	
Written examination . . . . .	10 points
Healthmanship and Sportsmanship. . . . .	<u>10</u> points
Total	100 points

Any or all of the optional stunts may be substituted for the required stunts.

## Doubles Tumbling - 102b

1. Objectives: Performing doubles tumbling according to social and hygienic standards. The specific activities in this phase of the course, and the standard of achievement set for same, are given below:

A. Like Part Stunts - Each man must alternate as a bottom man and a top man.

1. Chain roll forward - each man travels in each position 20 feet.
2. Chain roll backward - each man travels in each position 20 feet.
3. Backward roll over feet and hands - performer lands and remains on feet.



4. Neck lift and back somersault - two complete cycles.
5. Neck lift and forward handspring - two complete cycles.
6. Hand stand and pull - over - two complete cycles.
7. Double roll, hand to foot - each man travels in each position 20 feet.
8. Back to back and over and half turn - two complete cycles.
9. Back bends - double - two complete cycles.
10. Combined forward and backward roll - two complete cycles.

B. Unlike Part Stunts - Man has choice of either being a bottom man or a top man.

1. Snap-out. Performer's back arched, land and remain on feet.
2. Knee shoulder balance. Hold ten seconds.
3. Shoulder mount from bottom man's thigh - execution and hold position for ten seconds.
4. Back somersault by lift at side. Land and remain on feet.
5. Shoulder mount jumping from back of bottom man. Execution and hold position for ten seconds.
6. Groin pitch. Land and remain on feet.
7. Handspring from front lying support with leg lift.
8. Jump to thrower's knees and pull up. Hold position ten seconds.
9. High arm hand balance. Hold ten seconds.
10. Knee shoulder spring. Performer lands and remains on feet.
11. Shoulder mount from in front of man.
12. Squat vault between bottom man's arms. Land and remain on feet.
13. Hand clasp and jump in and out over bottom man's arms.
14. Handspring over thrower's head. Land and remain on feet.
15. Snap up to thrower's waist in front to seat on shoulders.
16. Low hand to hand from thrower's hips. Hold position ten seconds.
17. Low arm balance. Hold ten seconds.
18. Shoulder balance on feet only. Hold ten seconds;
19. Toe pitch backward somersault. Land and remain on feet.
20. Back and foot balance push top man into hand to hand handstand - hold five seconds.

• The first of these is the fact that the system is not a simple one, and that it is not possible to describe it in a simple way.

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• The twenty-third is that the system is not a simple one, and that it is not possible to describe it in a simple way.

• The twenty-fourth is that the system is not a simple one, and that it is not possible to describe it in a simple way.

## 2. Examination and Grading Plan:

Performance test - 10 like part stunts, 2 points	
each . . .	.20 points
Performance test - 20 unlike part stunts, 3 points	
each . . .	.60 points
Written examination . . . . .	.10 points
Healthmanship and Sportsmanship . . . . .	.10 points
Total points	<u>1.00</u>

### Apparatus Stunts PE 102 c

1. Objectives: Performing apparatus skills according to social and hygienic standards. The specific activities taught in this phase of the course, and the standards of achievement set for each, are given below:

#### A. Horizontal Bar

1. Back hip pullover and underswing dismount.
2. Long underswing - dismount at end of backward swing.
3. Backward hip circle.
4. Knee swing up - other leg over and dismount to stand.
5. Single knee circle backward.
6. Single knee circle forward.
7. Forward hip circle.
8. Glide kip.
9. Double knee circle backward.
10. Drop kip - underswing dismount.
11. Hook swing dismount.
12. Backward uprise.
13. Double knee circle forward.

#### Optional Stunts

1. Back kip.
2. Monkey hang.

#### B. Parallel Bars

1. Corkscrew mount.
2. Upper arm and roll forward.
3. Back roll layout.
4. Front vault dismount.
5. Rear vault dismount.
6. Back uprise.
7. Single leg cuts.
8. Kip from upper arm.
9. Handstand.

• *Journal of the American Medical Association*, 2000; 283: 2669-2674

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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1972	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1973	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
1974	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78																						

*Journal of Management Studies*, 19(1), 67-80.

[illegible]

1. The first group of people who are not in the labor force are those who are not in the labor force because they are not in the labor force.

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1. *Chlorophyll a* and *Chlorophyll b* were determined by the method of Arar and Collins (1971) using a Shimadzu 1601 UV-Visible Spectrophotometer.

1. The first step is to identify the problem or question that needs to be addressed. This involves understanding the context and the specific requirements of the task.

2. Next, it is important to gather relevant information and data. This can be done through research, consultation with experts, or by analyzing existing data sets.

3. Once the information is gathered, the next step is to develop a plan or strategy to solve the problem. This plan should outline the steps to be taken and the resources needed.

4. The fourth step is to implement the plan. This involves carrying out the tasks outlined in the plan and monitoring progress as you go.

5. Finally, it is important to evaluate the results of the process. This involves comparing the actual outcomes with the expected results and identifying any areas for improvement.



10. Glide kip.
11. Front uprise.
12. From flexed support - fast forward roll.
13. Double cut off and facing outward.

#### Optional Stunts

1. Rear vault 1/2 twist.
2. Swing into handstand.

#### C. Horse

1.   a. Squat vault                    ]  
      b. Straddle vault                ]  
      c. Frank vault                    ]  
      d. Front vault                    ]  
      e. Rear vault                    ]   Perform 4 vaults  
  ]   1 point
2. Single leg circles or cuts in saddle - left leg over - left leg back - right leg over - right leg back.   L - L - R - R
3. Single leg circles in saddle - L - R - L - R
4. Single and doubles circles in saddle L-R (LR)  
   R-R
5. Right leg complete circle under left.
6. Feint and rear vault dismount.
7. Regular scissors.
8. Flank mount and leg circles.(LR)   L-R
9. Straddle mount and leg circles. L-R
10. Both legs astride right arm - double rear vault dismount.
11. Reverse scissors.

#### Optional Stunts

1. Single leg circles on croupe (L-L-R-R)
2. Triple rear vault dismount from astride right arm.

#### D. Rings (Still and Swinging)

1. Inverted hand into nest hand (Still and swinging).
2. Tap on swing and swing in inverted flex hang.
3. Front double cut off (still).
4. Front double cut off at the end of back swing.
5. Back double cut off (still).
6. Back double cut off on end of forward swing.
7. Muscle Up - Fall into flexed inverted hand (still).
8. Dislocate (Still).

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9. Dislocate at end of back swing.
10. Dislocate at end of front swing.
11. Uprise at end of back swing.
12. Kip (False grip - Still).
13. Kip at end of back swing.

#### Optional Stunts

1. Uprise at end of front swing.
2. Drop uprise at end of back swing.

Routines: Each student is asked to learn one routine on each piece of apparatus. Since routines are expected on both the still and the flying rings, the student will be asked to perform five routines.

#### Control Objectives:

1. Skill in executing the movements involved in performing the stunts and routines listed above.
2. Knowledge of the nomenclature commonly used in connection with apparatus stunts.
3. Knowledge of the principles involved in performance of apparatus and tumbling stunts.
4. Disposition to participate in a sportsmanlike manner.
5. Disposition to participate in a healthmanlike manner.
6. Condition to perform apparatus and tumbling stunts for one half hour without undue fatigue.

#### 2. Examination and Grading Scale

Performance test, 40 stunts, 1 point each . . .	40 points
Performance test, 5 routines, 5 points each . .	25 points
Optional tests, 5 stunts, 3 points each. . . .	15 points
These optional stunts may be taken from the stunts taught in the course, or other stunts developed by the student. The standard of achievement must be approved by the instructor.	
Written Final Examination . . . . .	10 points
Healthmanship and Sportsmanship . . . . .	<u>10</u> points

Total points 100

#### Tap Dancing 102e

##### 1. Objectives:

- a. The conduct objective of this course is: Performing tap dancing according to social and hygienic standards. The standard of achievement is reasonably well.

1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

2. Once the problem is identified, the next step is to define the objectives and goals of the project. This helps to clarify what needs to be achieved and provides a clear direction for the team.

3. The third step is to develop a plan or strategy to address the problem. This involves breaking down the problem into smaller, manageable tasks and determining the resources needed to complete each task.

4. The fourth step is to implement the plan. This involves putting the strategy into action and monitoring progress to ensure that the project is on track.

5. The final step is to evaluate the results of the project. This involves assessing the outcomes against the objectives and goals and identifying any areas for improvement.

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the 1990s, the number of people in the world who are under 15 years of age is expected to increase by 1.5 billion, from 1.1 billion in 1990 to 2.6 billion in 2010. The number of people aged 65 and over is expected to increase by 1.1 billion, from 0.4 billion in 1990 to 1.5 billion in 2010. The number of people aged 15-64 is expected to increase by 1.5 billion, from 1.1 billion in 1990 to 2.6 billion in 2010. The number of people aged 65 and over is expected to increase by 1.1 billion, from 0.4 billion in 1990 to 1.5 billion in 2010. The number of people aged 15-64 is expected to increase by 1.5 billion, from 1.1 billion in 1990 to 2.6 billion in 2010.

*Journal of Management Education* 30(6)

1. The first step in the process is to identify the problem or issue that needs to be addressed. This involves gathering information and understanding the context of the problem.

2. Once the problem is identified, the next step is to define the objectives and goals of the project. This helps to clarify what needs to be achieved and provides a clear direction for the team.

3. The third step is to develop a plan or strategy to address the problem. This involves breaking down the problem into smaller, manageable tasks and determining the resources needed to complete them.

4. The fourth step is to implement the plan. This involves putting the strategy into action and monitoring progress to ensure that the project is on track.

5. The final step is to evaluate the results of the project. This involves assessing the outcomes against the objectives and goals and identifying any areas for improvement.

*Journal of Management Education* 30(6)p.789-804

1. The first step in the process is to identify the problem. This involves gathering information about the situation and understanding the needs of the stakeholders involved.

2. Once the problem is identified, the next step is to develop a plan. This involves setting goals and determining the steps that need to be taken to achieve those goals.

3. The third step is to implement the plan. This involves putting the plan into action and monitoring progress.

4. The final step is to evaluate the results. This involves assessing the effectiveness of the plan and making adjustments as needed.

1. The first group of variables includes the following:
 

- **Age**: The age of the respondent in years.
- **Gender**: The gender of the respondent (Male or Female).
- **Ethnicity**: The ethnicity of the respondent (White, Black, Asian, Hispanic, or Other).
- **Education**: The highest level of education completed by the respondent (High School, Bachelor's, Master's, or Doctorate).
- **Income**: The annual household income in US dollars.
- **Health**: The self-reported health status of the respondent (Excellent, Good, Fair, or Poor).
- **Marital Status**: The marital status of the respondent (Married, Divorced, Widowed, or Single).
- **Employment**: The employment status of the respondent (Employed, Unemployed, or Retired).
- **Home Ownership**: Whether the respondent owns their home (Yes or No).
- **City**: The city where the respondent lives (New York, Los Angeles, Chicago, Houston, or Phoenix).
- **State**: The state where the respondent lives (California, Texas, Florida, New York, or Illinois).
- **Country**: The country where the respondent lives (USA or Other).

1. *Chlorophyll a* and *Chlorophyll b* were determined by the method of Lichtenthaler and Whistler (1973). The total chlorophyll content was determined by the method of Arar and Cook (1980). The carotenoid content was determined by the method of Lichtenthaler and Whistler (1973).

1. *Chlorophyll a* and *Chlorophyll b* were determined by the method of Arar and Collins (1971).

•

- b. The control or immediate course objectives are learning the steps of the following dances:

1. The Broadway Special
  - (a) Sevens crossing front
  - (b) Sevens crossing rear
  - (c) Peg leg left
  - (d) Peg leg right
  - (e) Chorus hop
  - (f) Full circle
2. The Panama Fling
  - (a) Strike hop
  - (b) The Buffalo
  - (c) The Rock Away
  - (d) The Broken rhythm
  - (e) Fidgety Feet

## 2. Examination and Grading Plan

- |   |           |
|---|-----------|
| A. Preliminary Examination in two dances,       |           |
| 13 points each . . . . .                        | 26 points |
| B. Final Examination in two dances,             |           |
| 27 points each . . . . .                        | 54 points |
| C. Written Examination on knowledge of routines |           |
| and assigned reading . . . . .                  | 10 points |
| D. Healthmanship, Sportsmanship . . . . .       | 10 points |

Total Points      100

## Ice Skating PE 1021

1. Objectives: The primary objectives of this course are:
1. To learn the fundamental skills of ice skating;
  2. to appreciate and enjoy ice skating as a social and healthful activity;
  3. to provide practice time under supervision.
- The specific activities taught in this course are given below. The standard of achievement for each of the techniques, unless otherwise specified is: reasonable well.

### 1. Beginning Skating

- a. Gain confidence in balance
- b. Bend the knees while skating
- c. Bring knees together for balance as you shift from one leg to the other.
- d. Learning to stop
  - (1) Flex the knees, lean forward, toes in
  - (2) Horizontal stop
- e. Changing direction
  - (1) Swinging turn
  - (2) Horizontal stop and change of direction
- f. Skating backward (length of rink)
- g. Couple skating

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2. Speed Skating
  - a. Skill in executing movements involved in speed skating.
  - b. Knowledge of the principles involved in speed skating.
  - c. Knowledge of the terms and phrases commonly used in connection with speed skating
  - d. Sportsman like etiquette
3. Figure Skating
  - a. Knowledge of the principles involved in figure skating.
  - b. Knowledge of common figure skating terminology.

## 2. Examination and Grading Plan

a. General skating . . . . .	40 points
b. Speed skating . . . . .	20 points
c. Figure skating. . . . .	20 points
d. Written Examination . . . . .	10 points
e. Healthmanship . . . . .	5 points
f. Sportsmanship . . . . .	5 points

Total Points 100

## Individual Athletics PE 102k

### 1. Objectives:

- a. Participating in individual athletic events according to social and hygienic standards.
- b. The control or immediate course objectives are: Performing the events listed below reasonable well.

<u>Activities</u>	<u>Standard of Achievements</u>
220 (one lap). . . . .	30 seconds
880 ( 1/2 mile). . . . .	2:45.0
75 dash . . . . .	9.5 seconds
Running Broad Jump . . . . .	17 feet
Running High Jump. . . . .	Height of performer's nipples
Wall climb. . . . .	9 sec. (10 yds. and return)
Standing Hop, Step, and Jump. . .	4 times performer's height
Standing Broad Jump . . . . .	2 feet plus performer's height
Rope climb. . . . .	9 seconds
Chins. . . . .	12 times (regular grasp)
Pushups . . . . .	25 times
Situps . . . . .	40 times

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## 2. Examination and Grading Plan

- a. Performance test (12 events allowed 4 official trials at each event) Activities No. 1, 2, 3, 6, 9, 10 evaluated at 8 points each . . . . . 48 points
- Activities No. 4,5,7,8,11,12, evaluated at 7 points each. . . . . 42 points
- b. Healthmanship and Sportsmanship. . . . . 10 points

Total points        100

## Boxing PE 103a

### 1. Objectives:

- a. The conduct objective of this course is: Performing boxing skills reasonable well; acquaint students with the rules of boxing.
- b. The control or immediate course objectives are:
  - 1. Fundamental position
    - a. The feet
    - b. The trunk
    - c. The left arm and hand
    - d. The right arm and hand
    - e. The head
    - f. The unorthodox position
      - (1) The left-handed boxer
  - 2. Fundamental blows
    - a. Blows (include variations)
      - (1) The left jab . . . No. 1
        - (a) Execution-full extension-through target
      - (2) The straight right . . No. 2
        - (a) Execution-shifting of weight-shoulder and hip follow through
      - (3) The left hook . . . No. 3
        - (a) Execution - precision and coordination; proper holding of hand and arm; weight shifted with pivot.
      - (4) Left uppercut . . . No. 4
        - (a) Execution - dropping left shoulder palm faced in; arm moves out and up; follow through with pivot.
      - (5) Right upper cut . . No. 5
        - (a) Execution- dropping right shoulder; same as left uppercut
  - 3. Fundamental Footwork
    - a. Advance
      - (1) The forward shuffle
      - (2) The quick advance
    - b. Retreat

2. *Intergovernmental relations* – the relationship between the state and local government.

[illegible]

Number of hauls	<i>P. setiferus</i> (%)	<i>P. setiferus</i> + <i>P. setiferus</i> + <i>P. setiferus</i> (%)	<i>P. setiferus</i> + <i>P. setiferus</i> + <i>P. setiferus</i> (%)
1	10	10	0
2	20	20	0
3	30	30	0
4	40	40	0
5	50	50	0
6	60	60	0
7	70	70	0
8	80	80	0
9	90	90	0
10	100	100	0

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1. What is the purpose of the document?

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1. The first part of the document is a list of names and their corresponding addresses. The names are: John Doe, Jane Smith, and Bob Johnson. The addresses are: 123 Main St, New York, NY 10001; 456 Elm St, New York, NY 10002; and 789 Oak St, New York, NY 10003.

2. The second part of the document is a list of names and their corresponding addresses. The names are: Alice Brown, Charlie White, and David Green. The addresses are: 101 Main St, New York, NY 10004; 202 Elm St, New York, NY 10005; and 303 Oak St, New York, NY 10006.

3. The third part of the document is a list of names and their corresponding addresses. The names are: Eve Black, Frank Blue, and Grace Red. The addresses are: 404 Main St, New York, NY 10007; 505 Elm St, New York, NY 10008; and 606 Oak St, New York, NY 10009.

4. The fourth part of the document is a list of names and their corresponding addresses. The names are: Henry Yellow, Irene Purple, and Jack Orange. The addresses are: 707 Main St, New York, NY 10010; 808 Elm St, New York, NY 10011; and 909 Oak St, New York, NY 10012.

5. The fifth part of the document is a list of names and their corresponding addresses. The names are: Karen Silver, Larry Gold, and Mary Bronze. The addresses are: 1010 Main St, New York, NY 10013; 1011 Elm St, New York, NY 10014; and 1012 Oak St, New York, NY 10015.

6. The sixth part of the document is a list of names and their corresponding addresses. The names are: Nick Copper, Olivia Iron, and Peter Steel. The addresses are: 1013 Main St, New York, NY 10016; 1014 Elm St, New York, NY 10017; and 1015 Oak St, New York, NY 10018.

7. The seventh part of the document is a list of names and their corresponding addresses. The names are: Quinn Tin, Rachel Lead, and Sam Zinc. The addresses are: 1016 Main St, New York, NY 10019; 1017 Elm St, New York, NY 10020; and 1018 Oak St, New York, NY 10021.

8. The eighth part of the document is a list of names and their corresponding addresses. The names are: Tina Nickel, Victor Platinum, and Wendy Silver. The addresses are: 1019 Main St, New York, NY 10022; 1020 Elm St, New York, NY 10023; and 1021 Oak St, New York, NY 10024.

9. The ninth part of the document is a list of names and their corresponding addresses. The names are: Xavier Gold, Yvonne Bronze, and Zach Copper. The addresses are: 1022 Main St, New York, NY 10025; 1023 Elm St, New York, NY 10026; and 1024 Oak St, New York, NY 10027.

10. The tenth part of the document is a list of names and their corresponding addresses. The names are: Adam Iron, Bella Steel, and Chris Tin. The addresses are: 1025 Main St, New York, NY 10028; 1026 Elm St, New York, NY 10029; and 1027 Oak St, New York, NY 10030.

11. The eleventh part of the document is a list of names and their corresponding addresses. The names are: Daniel Lead, Emily Zinc, and Frank Nickel. The addresses are: 1028 Main St, New York, NY 10031; 1029 Elm St, New York, NY 10032; and 1030 Oak St, New York, NY 10033.

12. The twelfth part of the document is a list of names and their corresponding addresses. The names are: Grace Platinum, Henry Silver, and Irene Gold. The addresses are: 1031 Main St, New York, NY 10034; 1032 Elm St, New York, NY 10035; and 1033 Oak St, New York, NY 10036.

13. The thirteenth part of the document is a list of names and their corresponding addresses. The names are: Jack Bronze, Karen Copper, and Larry Iron. The addresses are: 1034 Main St, New York, NY 10037; 1035 Elm St, New York, NY 10038; and 1036 Oak St, New York, NY 10039.

14. The fourteenth part of the document is a list of names and their corresponding addresses. The names are: Mary Steel, Nick Tin, and Olivia Lead. The addresses are: 1037 Main St, New York, NY 10040; 1038 Elm St, New York, NY 10041; and 1039 Oak St, New York, NY 10042.

15. The fifteenth part of the document is a list of names and their corresponding addresses. The names are: Peter Zinc, Quinn Nickel, and Rachel Platinum. The addresses are: 1040 Main St, New York, NY 10043; 1041 Elm St, New York, NY 10044; and 1042 Oak St, New York, NY 10045.

16. The sixteenth part of the document is a list of names and their corresponding addresses. The names are: Sam Silver, Tina Gold, and Victor Bronze. The addresses are: 1043 Main St, New York, NY 10046; 1044 Elm St, New York, NY 10047; and 1045 Oak St, New York, NY 10048.

17. The seventeenth part of the document is a list of names and their corresponding addresses. The names are: Wendy Copper, Xavier Iron, and Yvonne Steel. The addresses are: 1046 Main St, New York, NY 10049; 1047 Elm St, New York, NY 10050; and 1048 Oak St, New York, NY 10051.

18. The eighteenth part of the document is a list of names and their corresponding addresses. The names are: Zach Tin, Adam Lead, and Bella Zinc. The addresses are: 1049 Main St, New York, NY 10052; 1050 Elm St, New York, NY 10053; and 1051 Oak St, New York, NY 10054.

19. The nineteenth part of the document is a list of names and their corresponding addresses. The names are: Chris Nickel, Daniel Platinum, and Emily Silver. The addresses are: 1052 Main St, New York, NY 10055; 1053 Elm St, New York, NY 10056; and 1054 Oak St, New York, NY 10057.

20. The twentieth part of the document is a list of names and their corresponding addresses. The names are: Frank Gold, Grace Bronze, and Henry Copper. The addresses are: 1055 Main St, New York, NY 10058; 1056 Elm St, New York, NY 10059; and 1057 Oak St, New York, NY 10060.

21. The twenty-first part of the document is a list of names and their corresponding addresses. The names are: Irene Iron, Jack Steel, and Karen Tin. The addresses are: 1058 Main St, New York, NY 10061; 1059 Elm St, New York, NY 10062; and 1060 Oak St, New York, NY 10063.

22. The twenty-second part of the document is a list of names and their corresponding addresses. The names are: Larry Lead, Mary Zinc, and Nick Nickel. The addresses are: 1061 Main St, New York, NY 10064; 1062 Elm St, New York, NY 10065; and 1063 Oak St, New York, NY 10066.

23. The twenty-third part of the document is a list of names and their corresponding addresses. The names are: Olivia Platinum, Peter Silver, and Quinn Gold. The addresses are: 1064 Main St, New York, NY 10067; 1065 Elm St, New York, NY 10068; and 1066 Oak St, New York, NY 10069.

24. The twenty-fourth part of the document is a list of names and their corresponding addresses. The names are: Rachel Bronze, Sam Copper, and Tina Iron. The addresses are: 1067 Main St, New York, NY 10070; 1068 Elm St, New York, NY 10071; and 1069 Oak St, New York, NY 10072.

25. The twenty-fifth part of the document is a list of names and their corresponding addresses. The names are: Victor Steel, Wendy Tin, and Xavier Lead. The addresses are: 1070 Main St, New York, NY 10073; 1071 Elm St, New York, NY 10074; and 1072 Oak St, New York, NY 10075.

26. The twenty-sixth part of the document is a list of names and their corresponding addresses. The names are: Yvonne Zinc, Zach Nickel, and Adam Platinum. The addresses are: 1073 Main St, New York, NY 10076; 1074 Elm St, New York, NY 10077; and 1075 Oak St, New York, NY 10078.

27. The twenty-seventh part of the document is a list of names and their corresponding addresses. The names are: Bella Silver, Chris Gold, and Daniel Bronze. The addresses are: 1076 Main St, New York, NY 10079; 1077 Elm St, New York, NY 10080; and 1078 Oak St, New York, NY 10081.

28. The twenty-eighth part of the document is a list of names and their corresponding addresses. The names are: Emily Copper, Frank Iron, and Grace Steel. The addresses are: 1079 Main St, New York, NY 10082; 1080 Elm St, New York, NY 10083; and 1081 Oak St, New York, NY 10084.

29. The twenty-ninth part of the document is a list of names and their corresponding addresses. The names are: Henry Tin, Irene Lead, and Jack Zinc. The addresses are: 1082 Main St, New York, NY 10085; 1083 Elm St, New York, NY 10086; and 1084 Oak St, New York, NY 10087.

30. The thirtieth part of the document is a list of names and their corresponding addresses. The names are: Karen Nickel, Larry Platinum, and Mary Silver. The addresses are: 1085 Main St, New York, NY 10088; 1086 Elm St, New York, NY 10089; and 1087 Oak St, New York, NY 10090.

31. The thirty-first part of the document is a list of names and their corresponding addresses. The names are: Nick Gold, Olivia Bronze, and Peter Copper. The addresses are: 1088 Main St, New York, NY 10091; 1089 Elm St, New York, NY 10092; and 1090 Oak St, New York, NY 10093.

32. The thirty-second part of the document is a list of names and their corresponding addresses. The names are: Quinn Iron, Rachel Steel, and Sam Tin. The addresses are: 1091 Main St, New York, NY 10094; 1092 Elm St, New York, NY 10095; and 1093 Oak St, New York, NY 10096.

33. The thirty-third part of the document is a list of names and their corresponding addresses. The names are: Tina Lead, Victor Zinc, and Wendy Nickel. The addresses are: 1094 Main St, New York, NY 10097; 1095 Elm St, New York, NY 10098; and 1096 Oak St, New York, NY 10099.

34. The thirty-fourth part of the document is a list of names and their corresponding addresses. The names are: Xavier Platinum, Yvonne Silver, and Zach Gold. The addresses are: 1097 Main St, New York, NY 10100; 1098 Elm St, New York, NY 10101; and 1099 Oak St, New York, NY 10102.

35. The thirty-fifth part of the document is a list of names and their corresponding addresses. The names are: Adam Bronze, Bella Copper, and Chris Iron. The addresses are: 1100 Main St, New York, NY 10103; 1101 Elm St, New York, NY 10104; and 1102 Oak St, New York, NY 10105.

36. The thirty-sixth part of the document is a list of names and their corresponding addresses. The names are: Daniel Steel, Emily Tin, and Frank Lead. The addresses are: 1103 Main St, New York, NY 10106; 1104 Elm St, New York, NY 10107; and 1105 Oak St, New York, NY 10108.

37. The thirty-seventh part of the document is a list of names and their corresponding addresses. The names are: Grace Zinc, Henry Nickel, and Irene Platinum. The addresses are: 1106 Main St, New York, NY 10109; 1107 Elm St, New York, NY 10110; and 1108 Oak St, New York, NY 10111.

38. The thirty-eighth part of the document is a list of names and their corresponding addresses. The names are: Jack Silver, Karen Gold, and Larry Bronze. The addresses are: 1109 Main St, New York, NY 10112; 1110 Elm St, New York, NY 10113; and 1111 Oak St, New York, NY 10114.

39. The thirty-ninth part of the document is a list of names and their corresponding addresses. The names are: Mary Copper, Nick Iron, and Olivia Steel. The addresses

- (1) The backward shuffle
  - (2) The forced retreat
- c. Circling
  - (1) Circling to the left
  - (2) Circling to the right
- 4. Elements of Defense
  - a. Blocking
    - (1) The catch - open glove
    - (2) Forearm block
    - (3) Parrying
      - (a) Outside parry
      - (b) Inside parry
      - (c) Cross parry
  - b. Slipping - Movement of head to left or right
  - c. Ducking - Head and body forward
  - d. Weaving - Movement of upper body down, to left and right
  - e. Rolling - sway of body or head with blow
  - f. Sidestepping - to left step with left, to right step with right
  - g. Clinching - Grasp arms: Keep body close and arms locked
  - h. The rockaway - shifting weight to rear foot
- 5. Elements of Attack
  - a. Leading - shuffling in while throwing blows; aggressor
  - b. Feinting - Feint and blow for camouflage of intended blow - eyes important
  - c. Drawing - Decoy an opponent into throwing punch you expect, then counter
  - d. Infighting - stay inside opponents arms; get in by slipping, sidestep, etc., move in punching
- 6. The counter-attack for a left-hand lead.
  - a. The outside parry and left jab
  - b. The outside parry and left hook
  - c. The inside parry and left jab
  - d. The single parry and left hook
  - e. The inside right to the chin
- 7. Bag Punching
- 8. Rope skipping
- 9. Knowledge of rules - See Boxing Guide, 1949

## 2. Examination and Grade Plan

A.	Healthmanship . . . . .	5 points
B.	Sportsmanship . . . . .	5 points
C.	Written examination on rules (10 question- 1 point each) . . . . .	10 points
D.	Demonstration (5 skills - 4 points each) . . .	20 points



E. Bag Punching (20 contacts - 12 seconds) . . .	10 points
F. Rope Skipping (120 revolutions - 1 minute) . .	10 points
G. Performance (Boxing-3 one minute rounds) . .	<u>40</u> points
Total Points	100

## Wrestling PE 103b

### 1. Objectives:

- a. Conduct objectives
  - (1) Perform amateur wrestling skills reasonable well.
  - (2) Increase the physical condition and muscular tone of the body.
  - (3) Stimulate interest, understanding, and appreciation of amateur wrestling.
- b. Control objectives: (Outline of wrestling skills taught)
  - (1) Wrestling holds from starting position on feet, to mat.
    - (a) Take downs and go behinds
      - 1. Starting position on feet
      - 2. Slip under arm and behind from the different starting positions.
      - 3. Arm drag
      - 4. Leg drive
      - 5. Leg dive counters; and holds that develop when countering take downs.
    - (b) Take opponent to the mat from behind.
  - (2) Hold downs and riding holds. (Pinning procedure is shown from each ride)
    - (a) Bar arm rides
      - 1. Referee's starting position for offense and defense
      - 2. Bar arm rides
      - 3. Head on arm rides
      - 4. Long waist lock rides - locked variation "Tulsa Ride"
      - 5. Bar arm in reverse crook of elbow (chicken wing).
    - (b) Leg break downs and rides
      - 1. Push hips down and pull hips down.
    - (c) Arms and legs riding combinations
      - 1. Scissor rides
      - 2. Blanket rides
  - (3) Escape and reverse holds
    - (a) Sit outs
    - (b) Wings and side rolls
    - (c) Switch and reverse variations from switch
    - (d) Pull leg over head (scissor defense)
  - (4) Pin holds (blocks and counters)



- (a) Bar arm and half Nelson
- (b) Half Nelson and crotch hold
- (c) Hammer lock and half Nelson
- (d) Double grapevine and half Nelson
- (e) Top scissor and half Nelson
- (f) Cradle; jack knife cradle with three quarter Nelson
- (g) Reverse half Nelson
- (h) Locked, reverse half Nelson with bar under back
- (i) Bar arm in reverse crook of elbow and half Nelson (chicken wing)
- (j) Locked long waist lock ride with pin (Tulsa ride)
- (k) Hook scissor and half Nelson
- (l) Cross body stretcher (guillotine)

#### Outline Class Procedure:

- a. Warm-up exercises: Each class is opened with five minutes of warm-up exercises especially designed to develop, warm up and strength the muscles used most in wrestling.
- b. The first part of the wrestling period is devoted to reviewing of skills previously learned.
- c. The next part of the period is devoted to the learning of new skills. As new skills are added some of the old ones are dropped.
- d. Each class ends with a short wrestling match of one to three minutes.
- e. Examination: Three one minute bouts are wrestled at mid-term and the last week. Each student is graded during the term on how well he learns the holds, blocks and counters as demonstrated in class. Written examination covering the rules and general wrestling knowledge may be given during the last week.

#### 2. Examination and Grading Plan

- a. Skill demonstrated in learning holds, blocks and counters . . . . . 40 points
- b. Performance: Final three minute, mid-term and regulate class period matches. 40 points
- c. Written examination on rules and techniques . . . . . 10 points
- d. Healthmanship, sportsmanship, attitude, and attendance. . . . . 10 points

Total points 100





## Beginning Foil Fencing 103e

### 1. Objectives:

- a. The conduct objective of this course is: Fencing foil according to social and hygienic standards.  
The standard of achievement is: Reasonably well.
- b. The control and immediate course objectives are:
  - (1) To appreciate fencing as a sport and recreation.
  - (2) To learn the necessary fundamental skills and their uses.
  - (3) To gain proficiency through practice.
  - (4) To read materials in the field.
  - (5) To write a final quiz on rules and techniques.
  - (6) To demonstrate proficiency in the various skills, viz.,
    - (a) On guard
    - (b) Advance
    - (c) Retreat
    - (d) Lunge
    - (e) Advance and lunge
    - (f-g) Disengage from 4th and 6th to opposite high line.
    - (h-i) Simple parries of 4th and 6th and ripostes.
    - (j-k) 2 in 4th and 6th
    - (l-m) Counter parries of 4th and 6th and ripostes
    - (n-o) Simple parries of 7th and 8th and ripostes
    - (p) Beat attach in 4th

### 2. Examination and Grading Plan

- a. Demonstration examination in 16 skills  
(5 points each) . . . . . 80 points
- b. Written final examination . . . . . 10 points
- c. Healthmanship and sportsmanship . . . . . 10 points

Total points      100

1. The first part of the document is a list of names.

2. The second part is a list of dates.

3. The third part is a list of places.

4. The fourth part is a list of events.

5. The fifth part is a list of people.

6. The sixth part is a list of things.

7. The seventh part is a list of actions.

8. The eighth part is a list of results.

9. The ninth part is a list of conclusions.

10. The tenth part is a list of recommendations.

11. The eleventh part is a list of suggestions.

12. The twelfth part is a list of proposals.

13. The thirteenth part is a list of plans.

14. The fourteenth part is a list of goals.

15. The fifteenth part is a list of objectives.

16. The sixteenth part is a list of outcomes.

17. The seventeenth part is a list of impacts.

18. The eighteenth part is a list of effects.

19. The nineteenth part is a list of consequences.

20. The twentieth part is a list of results.

21. The twenty-first part is a list of outcomes.

22. The twenty-second part is a list of impacts.

23. The twenty-third part is a list of effects.

24. The twenty-fourth part is a list of consequences.

APPENDIX B

MICHIGAN STATE COLLEGE  
DEPARTMENT OF PHYSICAL EDUCATION, HEALTH  
AND RECREATION FOR MEN

GRADUATE STUDIES AND RESEARCH

TABULATION SHEET

DATE OF TABULATION MAY 1, 1955

TABULATED BY W. F. TINKLE

TONIC RAW DATA ON GRIP STRENGTH

	A				B				C				D				F			
	$\Sigma x$	N	Mx	$\Sigma x^2$	$\Sigma x$	N	Mx	$\Sigma x^2$	$\Sigma x$	N	Mx	$\Sigma x^2$	$\Sigma x$	N	Mx	$\Sigma x^2$	$\Sigma x$	N	Mx	$\Sigma x^2$
1 100F	4473	18	248.50	118493	5102	19	268.52	131912	2367	10	236.70	569509	2177	1	217.00	47089				
2 100F				6219	6219	24	259.54	646971	4163	18	231.27	1042133								
3 101A	3549	13	273.00	982409	2942	12	245.16	728772	580	2	290.00	169000								
4 102A	1803	7	257.57	1473115	1820	7	260.00	479128	2721	11	250.08	684063	1777	7	253.85	463233	694	3	231.10	16412
5 102A	2434	9	272.87	587705	174	3	258.00	206342	1559	6	259.83	428526	957	4	239.25	235231	262	1	262.00	68644
6																				
7 102B	1572	6	262.00	410718	2179	8	272.37	607731	4063	15	270.86	1104727	438	2	219.00	96644				
8 102B	741	3	247.00	185573	1228	5	246.82	304818	1197	5	239.40	290707	802	3	267.33	214486				
9 102C	1311	5	262.00	346891	1511	6	253.34	384574	538	2	269.00	145972	226	1	226.00	51076	753	3	244.33	181077
10 102C	1912	7	273.14	526792	971	4	242.75	239448	1224	5	245.80	307315	941	4	235.25	223995				
11 102K	1040	4	260.00	274856	5305	20	245.25	1417301	3048	12	254.00	789449	281	1	281.00	78961				
12					4697	19	247.15	1080183	3206	13	246.61	793267	1195	5	239.00	293157	266	1	266.00	70756
13 103A	797	3	265.56	225377	3213	12	267.75	813393	2228	9	247.55	556508								
14 103A	1943	7	279.51	546519	3045	13	280.38	979623	1774	7	255.20	457428								
15 103B	1074	4	268.50	292086	1590	6	265.00	426002	2943	12	245.25	732049	745	3	248.33	187929	253	1	253.00	64009
16 103E	230	1	230.00	52900	2885	11	262.27	768501	1027	4	257.77	267597								
17 200C	1556	6	259.66	406074	1704	7	243.42	418118	1933	8	241.62	471675	546	2	273.00	151508				
18 103B	2255	8	281.87	653415	2283	9	253.66	586965	1814	7	259.14	471536	249	1	249.00	62001				
19 200E	1085	4	271.25	300863	4338	16	270.08	1089161	3700	14	268.28	992166								
20																				
21 200I	1375	5	275.00	385955	3411	13	262.38	912787	1869	8	233.62	440275								
22 200K	915	3	305.00	282213	2509	10	250.90	641217	3000	12	250.00	763726								
23 202E	503	2	251.50	126517	1630	6	271.66	444176	2812	11	255.63	729402	923	4	230.75	213501				
24 202I	4350	17	258.23	138110	2919	11	245.36	787241	498	2	249.00	122449								
25 202I	3131	12	260.91	778003	2218	9	246.44	555360	847	3	282.33	243795								
26																				
27	38055	144	264.27		65098	250	260.39		49116	196	250.59		9297	38	244.65		2208	9	245.33	
28																				
29				$\Sigma x^2$ 10102644					$\Sigma x^2$ 12437319							$\Sigma x^2$ 2316811			$\Sigma x^2$ 545898	
30																				
31									$D+F$											
32									$N = 47$											
33									$Mx = 244.78$											
34									$\Sigma x^2 = 28622709$											
35																				

# APPENDIX B

MICHIGAN STATE COLLEGE  
DEPARTMENT OF PHYSICAL EDUCATION, HEALTH  
AND RECREATION FOR MEN  
GRADUATE STUDIES AND RESEARCH

DATE OF TABULATION MAY 1, 1953  
TABULATED BY W. F. TINKLE

## TABULATION SHEET

TOPIC GRIP STRENGTH RESIDUALS

	A				B				C				D				E				F			
	$\Sigma X$	N	Mx	$\Sigma X^2$	$\Sigma X$	N	Mx	$\Sigma X^2$	$\Sigma X$	N	Mx	$\Sigma X^2$	$\Sigma X$	N	Mx	$\Sigma X^2$	$\Sigma X$	N	Mx	$\Sigma X^2$	$\Sigma X$	N	Mx	$\Sigma X^2$
1 100F	-101	18	-5.01	6077	-182	19	-9.57	15610	-126	10	-12.6	9502												
2 100F					-44	24	-2.04	34200	-333	17	-19.5	10809	-59	1	-59	3481								
3 101A	150	13	11.53	11704	-203	12	-16.91	17105	36	2	12.0	1530												
4 102A	47	7	6.71	5192	67	7	9.57	3895	15	11	1.36	11037	-1	7	1.42	9985	-55	3	-18.33	1433				
5 102A	134	9	14.88	6875	-15	3	-5.00	3275	-39	6	-6.50	2727	-62	4	-22.01	2692	19	1	19.00	361				
6																								
7 102B	57	6	9.50	2909	159	8	19.87	11817	199	15	13.26	12109	46	2	-23.0	1186								
8 102B	-17	3	-5.66	1570	-93	5	-8.60	1615	-27	5	-5.40	3435	10	3	3.33	98								
9 102C	-27	5	-5.40	2387	5	6	8.33	3219	14	2	7.0	1606	-14	1	-24.0	576	-20	3	-6.67	2858				
10 102C	201	7	28.71	7773	18	4	-4.50	4277	-48	5	9.60	3150	-140	4	-35.0	7042								
11 102K	26	4	6.51	2602	147	20	7.35	3575	15	12	1.25	9059	20	1	20.0	400								
12 102K					-94	19	-4.94	12460	-91	13	-7.0	9951	-48	5	-9.60	3675	16	1	16	256				
13 103A	92	7	13.14	5396	90	13	6.92	16020	-75	7	-10.71	6761												
14 103A	39	3	13.0	11345	-112	4	-8.00	12136	-12	9	-1.33	3212												
15 103B	144	8	14.25	16192	-80	9	-10.00	7194	-43	7	-6.14	2059	-24	1	-24.0	576								
16 103B	17	4	4.25	4793	34	6	5.66	4989	-104	12	-8.66	16584	-36	3	-12.0	3548	1	1	1					
17 103E	-50	1	-50	2500	-33	11	-3.00	10594	13	4	3.25	1527												
18 200C	73	6	2.16	1385	-137	7	-14.62	7639	117	8	14.62	6198	-7	2	-3.50	569								
19 200E	28	4	7.00	3522	128	16	-8.00	14416	6	14	4.28	12636												
20																								
21 200I	68	5	13.00	6314	-85	13	-6.53	21253	-133	8	-16.62	5670												
22 200K	89	3	29.66	6261	-75	10	-7.50	8167	-36	12	-3.00	7712												
23 202E	-24	2	-12.00	416	87	6	14.51	3083	-17	11	-1.54	8888	-89	4	-22.25	2609								
24 202I	26	17	1.52	12676	153	11	13.90	10459	-72	2	-36.0	2870												
25 202I	-9	12	-1.75	3721	-169	9	-18.77	13053	67	3	22.33	3371												
26																								
27 TOTALS	873	144	6.06	120007	-435	252	-1.72	239246	-674	195	-345	155305	-504	38	13.26	31427	-41	9	-8.55	4909				
28																								
29																								
30																								
31																								
32																								
33																								
34																								
35																								

APPENDIX C  
MEAN GRIP STRENGTH BY COURSE

Course	Mean Grip (lb.)	N
Badminton	268.2	34
Boxing	266.6	51
Beginning Swimming	261.9	27
D. Tumbling	260.0	47
Foil Fencing	258.8	16
Ice Skating	258.6	54
Wrestling	258.2	50
Bowling	256.9	25
Tap Dancing	256.8	22
Tumbling	256.1	57
Handball	255.9	26
Individual Athletics	253.8	75
Apparatus Stunts	253.3	37
Group Games	250.0	90
Tennis	249.5	23



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