FLORIDA STATE UNIVERSITY

THE MATHEMATICS TEACHER USES SPORTS

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Professor Directing Paper

Representative, Graduate Council

Dean of the Graduate School
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INTRODUCTION

The effectiveness of a secondary mathematics program is highly dependent upon the resourcefulness of the individual teacher. The fact that many mathematics teachers have failed to make mathematics a living thing for boys and girls is no secret. Such failure is expressed in the following quotation from *Mathematics in General Education* by the Commission on Secondary School Curriculum.

"Changes in mathematics instruction have not kept pace with the changing interests and concerns of the student body or with emerging conceptions of the proper aims and purposes of secondary education. The teacher has been made increasingly aware of the inappropriateness of traditional courses by the indifference of many students to the subject, or their outspoken dislike for it. He has also been disturbed by criticism of the mathematics curriculum voiced by specialists in education, many of whom are known to understand mathematics and to prize it for what it has meant to them."

THE PROBLEM IS

What can be done to bring secondary mathematics courses in tempo with the present day needs and interests of the student? The purpose of this paper is to suggest a partial answer to this question.

It is doubtless true that most boys and girls in the secondary school are far more interested in sports than in mathematics. Johnny

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sits in the classroom day-dreaming of Joe DiMaggio and his great powers in baseball. Jim can't wait for the last bell to ring to free him for football practice. Mary anxiously anticipates her doubles tennis match after school. It is not a profound statement to say that interest in sports is common to all American youth.

Why not draw upon this common interest and bring sports into the mathematics classroom -- or even take the mathematics classroom out to the field of sports? Such a question may seem unreasonable to those who have not given much thought to the possibility of approaching certain phases of mathematics through student interests in sports. Actually, such an approach is not at all unreasonable. The sports world offers practical examples of numerous mathematical relationships. The sports world is many student's world so let us study the possibilities that may be arranged.

The specific purpose from this point on is to set forth several examples of situations in the mathematics classroom (whether it be within the four walls of the school building or not on the ball diamond) wherein sports play an integral part. It is hoped that the reader will sense the thrilling possibilities of living mathematics instruction through student interests in athletics.

No attempt will be made to enumerate completely the mathematical ideas that are utilized by people of the sporting world. Not only would such a listing be impractical, it is unnecessary for the purposes of this paper. Attention will be concentrated on a few examples which are particularly interesting and adaptable to a unit or special activity in the mathematics curriculum.
A few general examples may serve to clarify the problem further and point up some of the possibilities for solving it.

GENERAL EXAMPLES

Two days before our local track team is to play host to three neighboring schools in quadrangular meet, teachers are notified that classes will be dismissed for the afternoon. "But what about my study plan?", (or "That will be a good afternoon for me to go shopping.") would be the immediate reaction of many teachers. However, the alert teacher would not react this way. He would visit the coach. Together, they would plan to make the track meet contribute to the mathematics teacher's program; to making fractions, measurements, and the like mean more to the boys and girls. For example, they might plan the scoring of the meet. They might arrange with the official scorer for a central scoring station where some students would take charge of totalling the scores. Then certain students could be assigned to score particular events. Think of the intriguing problem Joe and Johnny might have at the high-jump computing a three-way tie for first place; the thrill that Bill and Mary would get when they bring their results to the totalling station after they see their classmate Tommy tie for first place in a hurdle event. While these students help with the scoring other students make interesting measurements, keep time records — yes, the possibilities are numerous. The next day when Joe tells his dad, as they read about the meet in the local paper, "Our class in arithmetic did that," he indeed feels himself a part of his school. But what happens to the scorecard? Certain students are assigned to make the
scorecard into an attractive bulletin board display; the teacher finds this a wonderful reference many times during the discussion of fractions.

"Peter just isn't learning graphing, he's too interested in football." The teacher can visit the coach again. With his aid a study of Peter's problem is made and a plan is developed to help him. Peter can correlate his interests in football with his study of mathematics by keeping a weight chart.

<table>
<thead>
<tr>
<th>WEIGHT</th>
<th>MON</th>
<th>TUES</th>
<th>WED</th>
<th>THURS</th>
<th>FRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>169</td>
<td></td>
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<tr>
<td>168</td>
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<tr>
<td>164</td>
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</tr>
</tbody>
</table>

Fig. 1
Peter and the teacher set up a graph like Figure 1. Peter is to work out his chart for a week and then present it to the class.

On Monday Peter brings in a graph like Figure 2.

--- WEIGHT BEFORE PRACTICE

--- WEIGHT AFTER PRACTICE
Peter has done a problem of his own and is proud of his project. As he presents his graph to the class there is an air of understanding and importance in his voice. He points out the small variation in his weight on Thursday. That day he had a light workout. But look what happened on Friday, the night of the game.

Boys and girls tend to look upon professional athletes as immortals. References to professional teams or players are good motivation. Have you as a teacher thought of a baseball training camp as a center of mathematical computation and measurement? Consider for a moment the integrated mathematics program of the Brooklyn Dodgers in their training camp at Vero Beach, Florida, and follow a player through a portion of his training procedure.

Upon arrival in camp, Player A fills out a questionnaire. Then he takes special tests depending on what position he wants to play. For example, suppose Player A wants to catch. He must take a series of intelligence tests to determine his baseball I.Q. and to differentiate between his ability to think baseball and his powers as a student of the game. He must take perception tests, batting tests, speed tests, throwing tests, and the like. Experts study the results to determine Player A's ability. They conclude that he should become a third baseman. However when Player A fails to develop a good whip throw from third to first the experts try him at first base. There Player A comes through. In fact the Brooklyn Dodgers' regular first baseman this season is Player A.

\(^2\)Time Magazine: Volume LIII, No. 12, March 21, 1949; page 83.
All great coaches use testing in their programs. Reference should be made to Everett Dean, great Stanford coach, for the fine work he has done in developing testing procedure in basketball.©

Aren't you astounded that a baseball manager actually computes mathematically a play such as Boudreau's pick-off play?© Or that the same man has calculated the distance to move from his regular shortstop position to be in proper position to handle the variation that batted balls follow when hit against curve ball pitching. Isn't it just a bit amazing that the same man has calculated the adjustment to make toward the batter with a runner on first base thereby eliminating the two seconds lost in completing the throw on to second to first.

Yes, these are surprising things to the humble onlooker of a baseball game but the real astounding part is that these relationships are to be found in all sports and they are all present in the high school teacher's back yard and on the mind of every student.

The teacher may develop many interesting and practical problems to captivate interests students have toward professional people in the world of sports. He might arrange interesting problems in percentage, for example: a student might keep a day-by-day record of his or her favorite baseball player's batting average; many interesting problems like this can be developed in other fields. The teacher must be aware of these possibilities and have established a study plan flexible enough for the student to take advantage of the opportunities these fields offer.

©Everett Dean; Progressive Basketball; Stanford University Press, copyright 1942 & 1946; pages 43 through 60.
©Roscoe McDowell; Pic Quarterly Baseball Magazine; Spring 1949 Issue; pages 38 & 39.
A most valuable mathematical project can be evolved from the study of the measurement of an official baseball field. Have you ever examined the many geometric problems, the problems using the Pythagorean theorem, and the many valuable measurement problems that a baseball
field can produce? Examine for yourself these problems in Figure 3.
(For ten cents a teacher can obtain a copy of the Official Baseball
Rules for the current year by writing the National Baseball Congress
of America, Wichita, Kansas. This copy will carry a diagram of the
official baseball field.)

SPECIFIC EXAMPLES

THE JUNIOR HIGH MATHEMATICS TEACHER CAN USE SPORTS

In the treatment of subject matter material the Junior High Mathe-
matics teacher must place adequate emphasis on the social and informa-
tional phases of mathematics as well as the computational. Mastery of
concepts in mathematics will in turn help the student to acquire know-
ledge for understanding the fundamental skills. "Teaching designed to
give understanding as well as skills will stress the reasonableness of
the answer. If we can develop power of judgment and skill in estimating
the result, the coming generation will not be as dependent as the present
one on paper and pencils for calculation. 5

Practical experience is valuable to this age student. The teacher
must be careful to not use abstract statements to an excess. The symbol-
ism used by the Junior High mathematics teacher should be carefully ex-
plained. The instructor should use practical application to illustrate
the symbolism and in turn adequately use this symbolism and examples to
explain new symbolism.

50. 1946; page 23.
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50. 1946; page 23.
The teacher should require participation of all students in the study of these experiments. Through this participating in experiments the teacher can observe the students' ability to handle the problem in the practical sense. Also, the teacher should develop written exercises to see that the problem is clear to all.

The field of sports can lend many valuable examples to the Junior High mathematics teacher. From this group the following are but a few.

1. Metric Measure

A study could be made of the relationship in metric measure used by European and Latin American countries with respect to the American use of yards in calculating distances for running events in track.

In the famous Olympic games the races are calculated in meters. For example, when America's crack 440 yard relay team won the 400 meter relay at the Olympics, how many yards did they run? The student may calculate his result by several methods after he knows that 1 meter is equal to approximately 1.1 yards, or that 1 yard equals approximately .9144 meters. The student might set-up a ratio $\frac{M}{y} = \frac{.9144}{1}$ or an equation $M = .9144y$, or he might use 1.1 yards equal 1 meter in like manner.

The teacher can use this calculation for drill on decimals, and use of approximate numbers should be emphasized. A chart could be made, similar to the following, to illustrate the equation: $M = .9144y$. 

<table>
<thead>
<tr>
<th>DISTANCE IN YARDS</th>
<th>DISTANCE IN METERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>.9144</td>
</tr>
<tr>
<td>50</td>
<td>91.44</td>
</tr>
<tr>
<td>100</td>
<td></td>
</tr>
<tr>
<td>150</td>
<td></td>
</tr>
<tr>
<td>200</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The teacher should be alert to show the percentage relationship in 100 meters = .9144 yards or $\frac{91.44}{100}$ is 91.4% approximately.

2. **Finding the Average**

Among the most interesting problems in computing average at the Junior High level is the computing of average scores or average weight. For example: Johnny, a member of the Junior High basketball team has made the following individual scores for five games; 16, 14, 13, 20 and 23. What is Johnny's average score? If Johnny had made the same score each time then five times this score would be his total score. But it can be seen that a different score was made each time. What is the total score?

\[
\begin{array}{c}
16 \\
14 \\
13 \\
20 \\
23 \\
\hline
86
\end{array}
\]

adding the five scores together the total is found to be 86. What score multiplied by 5 will equal 86?
From this question the equation 5 times a certain score equals eighty-six, or \(5x = 86\); where \(x\) the certain score, is derived. Then dividing 86 by 5 the result is found to be \(5\) \(\frac{86}{5}\) (17.2). The teacher can then emphasize the accuracy of this quantity and express the importance of correct calculation in addition etc., in calculating the average score.

A similar problem might be set up by students to calculate the average weight of the football team, the number of serves in a tennis game, the number of putts in a golf match, and many others all developed somewhat like the illustrative example.

3. Use of Graphing

The teacher should be alert to relate other material to interesting problems like Example 2, Finding the Average.

The bar graph could be an adequate asset in this particular example. From the data given in Example 2 a bar graph like the following figure could be made:

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8H. Graffis, Golf Lessons, Chicago; The National Golf Foundation, 1948.
Ease of reading the bar graph should be shown. The importance of the graph in keeping valuable statistical data for later reference should be stressed by the instructor. Such graphs should be shown by the instructor.

4. Use of Old Gymnasium Equipment

Much of the equipment discarded by the athletic department could be made into excellent and live examples by the mathematics teacher. A basketball, tennis ball etc., are select examples that could be used to illustrate the sphere. An old battered football may be the perfect illustration of an ellipsoid of revolution.
Many others may be found by the alert teacher, the discus, the shot-put for weight examples and the like.

Boys and girls are sometimes perplexed by formulas. Aid can be given these students through practical examples where the student can participate in an actual experiment. The formula circumference is equal to pi times the diameter is an example. The basketball can be used to clarify this formula. By measuring the circumference and dividing the result by 3.14 (pie) the student can determine the diameter. The ball can then be cut in half and the diameter measured. The instructor could present quotations from the Rules book on basketball stating the measurements that are used for official purposes. Officials rules can be obtained through the athletic department.9

Students might develop an interesting correspondence by measuring the diameter of the basketball goal and comparing this result with that of the ball.

Other such examples could be made with like equipment from other sports areas.

5. **Percentage Problems in Sports**

Calculating percentages to express the performances of well known players is interesting and informative to the student.

A typical example might be calculation of pitching percentages. Boys and girls could make up a problem similar to the following by keeping data on their favorite star.

---

<table>
<thead>
<tr>
<th>PLAYER</th>
<th>CLUB</th>
<th>THROWS</th>
<th>GAMES</th>
<th>WON</th>
<th>LOST</th>
<th>P.C.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunger</td>
<td>St. Louis Cardinals</td>
<td>R</td>
<td>40</td>
<td>16</td>
<td>5</td>
<td>.762</td>
</tr>
<tr>
<td>Feller</td>
<td>Cleveland Indians</td>
<td>R</td>
<td>42</td>
<td>20</td>
<td>11</td>
<td>.645</td>
</tr>
<tr>
<td>NEWHOUSER</td>
<td>Detroit Tigers</td>
<td>L</td>
<td>40</td>
<td>17</td>
<td>17</td>
<td>.500</td>
</tr>
</tbody>
</table>

What player participated in the most games? What player won the greatest number of games? Why does Hunger have the best percentage yet he won the fewest games?

The P.C. in the charts means percentage (in baseball, though not in arithmetic) and is a ratio of the number of games won and lost. These words applied to a formula would become: P.C. = \( \frac{W}{W + L} \); where P.C. is percentage, W number of games won and L number games lost. From the chart a specific calculation could be made. For example calculate the P.C. for Hunger:

The formula is: P.C. = \( \frac{W}{W + L} \). To find the

\[
P.C. = \frac{16}{16 + 5} = \frac{16}{21} = \frac{16}{21} \times 21
\]

In the discussion of examples typical to the Junior High mathematics teacher an attempt has been made to show how the practical situation can stimulate the boy or girl to think. That these ordinary

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problems and illustrations have meaning, and that a definite satisfaction can come from doing that which makes the drill meaningful to this age student.

Other reference problems that could be handled in a manner similar to the preceding examples.

1. Conversion of all track events from yards to meters.
2. Ratio problems from dashes and distance races.
3. Percentage problems of all types derived from - Major League Baseball, facts, figures and official rules.
4. Computing averages from scores in any event introducing statistical methods on an elementary level.
5. Graphing examples are quite common in any of the reference material. The examples are well presented for use by the instructor.

For aid in setting-up these units the teacher should study the bibliography and acquire material to aid in constructing the unit.

The Algebra Teacher Can Use Sports

Perhaps the chief reason why some teachers experience only a slight measure of success in teaching boys and girls algebra is not to be found in the inherent difficulty of the subject but rather in the vagueness of teaching aims. "Algebra is usually taught as though it were a practical technique devoid of logical basis and of rational interconnections."¹¹

¹¹Commission on Secondary School Curriculum; Mathematics in General Education; D. Appleton-Century; New York and London; 1938; page 189.
"In a great number of high schools algebra is an elective."\(^{12}\) In particular, the elective status of the higher courses implies a somewhat different personnel in such classes. These students are likely to be inherently more interested and capable than the junior-high-school students. "It is also quite probable that they are studying algebra because of its subsequent usefulness in academic or professional fields."\(^{13}\) In view of these facts, the technical aspects of algebra may legitimately come to occupy a relatively more important place among the instructional aims. "This, of course, does not imply any lessening of the emphasis upon understanding, but it does imply a progressively increasing insistence upon the mastery of the algebraic tools."\(^{14}\)

To help boys and girls facilitate mastery of the logical concepts of algebra the teacher can use examples from ordinary experiences to make the concepts live. The field of sports can lend many excellent examples that are usable and practical to the boy or girl studying algebra.

1. (a) The Distance Formula

\[ S = \frac{1}{2} gt^2 \]

may be a useful and understandable equation once the student has used it to make calculations based upon ordinary experiences.

\(^{12}\)Dr. W. T. Edwards & Others; State Department of Education; Bulletin No. 50; 1946; page 31

\(^{13}\)Commission on Secondary School Curriculum; Mathematics in General Education; D. Appleton-Century; New York and London; 1938; page 189.

To give a specific example: Students might use the distance formula to estimate the height they can throw a ball in the air. Several different types of balls might be used, the basketball, the baseball and the like. A stop watch should be used to obtain the time the object stays in the air. Students should take turns keeping the time. For example: Johnny can keep the baseball in the air 5 seconds as timed by Mary. Johnny and Mary then substitute this information in the equation to find the height. Assuming the laws of gravitation Mary and Johnny know the ball reached the maximum height in 2.5 seconds. Using the formula, \( S = \frac{1}{2} gt^2 \) (where \( g \) is 32.2 feet per second), \( t \) is the time (2.5 seconds) and \( s \) is the height, Mary and Johnny have: \( S = \left(\frac{1}{2}\right) 32.2 \ (2.5)^2 \ S = 100.625' \) or by rounding off \( S = 101 \) feet. Mary then tried the throw while Johnny keeps the time. Mary can keep the ball in the air for 3 seconds. The height of Mary’s throw is then calculated as follows: \( S = \left(\frac{1}{2}\right) 32.2 \ (1.5)^2 \ S = 36.225 \) feet, or by rounding off 36 feet. The teacher should take advantage of this opportunity to express the importance of accurate use of decimals, fraction etc.; also, the rounding off of numbers and approximation in measurement.

1. (b) Time-rate-distance formula

From the general example of the track meet project the algebra teacher can derive many interesting problems to satisfy the formula, (distance equals rate times time) \( D = rt \). If Bill can run the hundred yard dash in eleven seconds what is his rate of speed. Using the formula \( D = rt \), \( 100 = r(11) \), \( r = \frac{100}{11} \), or \( r = 9.09 \) yards per
second or \( r = 9.01 \) yards per second. If Bill could run at this same rate of speed for 125 yards, how many seconds would it take him to cover this distance? Referring to the formula again, \( 125 = 9.01t \)
\[ t = \frac{125}{9.01} = 13.83 \text{ seconds}. \]

After computing the number of yards covered in a number of seconds, problems in converting this relationship to miles per hour could be developed. For example: The introduction of a table similar to the one used in the metric measure section could be made.

2. **Pythagorean Theorem**

To the student the hypotenuse is equal to the sum of the squares of the other two sides, might be just so many words that can be represented by \( c^2 = a^2 + b^2 \). But when can the student use such an equation. From the general example page 8 there are many examples where the student might use this formula. How could the student find the distance from third base to first base using this equation? The distance from first to second is 90 feet and the same from second to third with a 90° angle at second base, therefore, the distance from third base is the hypotenuse.

\[
\begin{align*}
\text{Distance} & = c^2 = (90)^2 + (90)^2 \\
& = 8100 + 8100 \\
& = 16200 \\
& = 127.2789
\end{align*}
\]

![Fig. 5]
3. Directed Numbers

The teacher may search many times for select examples for solving various problems in directed numbers to eliminate the formation suggested by the rules. The loss and gain of yardage in football would be a live and understanding example to many boys and girls.

An interpretation from this relationship might be as follows: A gain of 7 yards and 3 yards on successive plays total 10 yards or \( 7 + 3 = 10 \), losses of 7 yards and 3 yards on successive plays would be a total loss of 10 yards or \( (-7) + (-3) = -10 \), a gain of 7 yards and a loss of 3 yards would be a result of 4 yards or \( +7 + (-3) = +4 \) and the like.

Through the appropriate use of unique experiences outside of the classroom the teacher can contribute to growth of the algebra student. Algebra may become a highly prized means for the boy or girl to interpret his environment.

GEOMETRY USES SPORTS

"The recognition of familiar elements in new context, which contributes to the satisfaction of the successful student in mathematical courses, also influence his appreciation of geometric form as seen in the world around him."

"Creativeness may also be encouraged in discovering and formulating problems, in devising methods of attack, in recognizing relationships

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among data, in discovering methods of proof, and in presenting conclusions in expositional or other forms. But if mathematics is to be a field of creative activity, the approach to problems must involve a type of investigational experience which is an adventure into the unknown — it must provide constant opportunity for discovery.  

"Children of secondary school age, whether in the seventh grade or in the twelfth, find problems easier to understand when they conceive something tangible."  

In geometry, models made by the students, even though crude, are valuable. Blackboard drawings can have meaning when they are examples of geometric figures familiar to the boys and girls.

1. Using The Baseball Diamond

Using the dimensions given in the diagram of a baseball field a teacher can derive many illustrative examples like the following:

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17 Dr. W. T. Edwards & Others; State Department of Education; Bulletin No. 50; 1946; page 56.
The baseball diamond can be effectively used in discussing diagonals, perpendiculars and the like. The application of the diagram to studying squares, parallelograms, rectangles, etc., can be intriguing to the student. "Rules Book."

2. The Use of Old Gymnasiuim Equipment

Much of the equipment used in the sports world is of value to classroom discussion of geometric figures and design. Study of the proof and use of geometric theorems can be aided by specific examples either produced by the student or furnished by the instructor.

3. Athletic Fields

For scale drawing problems that might be used in geometry the teacher would be wise to consider the many examples offered by the tennis court, the football field, the basketball court and many others. The use of parallel lines, right angles, semi-circles, circles and the like are to be found in abundance. The drawing to scale of football fields could acquaint the student with the construction of perpendiculars, parallel lines etc. The teacher could receive such exact measurements from the coach. For a diagram of the high school football field the teacher should contact the coach for diagram material that he will have available.

19Everett S. Dean, Progressive Basketball; Stanford University; Stanford University Press; 1942 & 1945.
4. Loci Studied in Connection With Sports

Many interesting applications of loci problems are to be found in sports. The teacher should be alert to acquire photographs of typical problems. The follow through of the golfer in his drive, the serve in tennis, the trajectory of the arrow in archery, etc., are often photographed and made into colorful ads and the like. These informative photographs make excellent bulletin board displays.

BUSINESS ARITHMETIC IN SPORTS

"Business arithmetic" is primarily a terminal course designed for the upper senior high grades. Usually it is for those students who plan further work in business training or business itself. Customarily students taking this arithmetic have completed ninth grade mathematics.

The teacher of business arithmetic should be aware of problems related to his field of study that can be found in the sports world. When the football team is outfitted with new uniforms, or when they take a trip many business problems arise that will be of interest to boys and girls. Similar problems will arise in the sports field as one seasonal game replaces another.

The mathematics teacher should be alert to problems of immediate interest to students, especially those related to the school situation. Here is an actual example:

20Reference to Magazines and Books in: WHERE TO FIND REFERENCE MATERIAL.
Funds were needed to aid the athletic department to outfit the basketball team; however, the money available had to be used to re-finish the gymnasium floor. The letter club planned to do something about the problem. A part of their plan was to publish financial results of one basketball game.

Results of ticket sales of Friday night's game -

**Income**

- 225 tickets @ 50¢
  - $112.50
- From athletic fund for student tickets
  - 20.00
- 200 student tickets @ 10¢
- **Total** $132.50

**Balance**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paid out</td>
<td></td>
</tr>
<tr>
<td>Officials salary</td>
<td>$40.00</td>
</tr>
<tr>
<td>Visiting team</td>
<td>60.00</td>
</tr>
<tr>
<td>Electricity</td>
<td>5.73</td>
</tr>
<tr>
<td>Water</td>
<td>3.92</td>
</tr>
<tr>
<td>Heat</td>
<td>15.00</td>
</tr>
<tr>
<td>Janitor</td>
<td>5.00</td>
</tr>
<tr>
<td><strong>Balance</strong></td>
<td><strong>$134.65</strong></td>
</tr>
</tbody>
</table>

**Loss of** $2.15

3. **Statistical Work**

Reference should be made to example in Junior High School section.

The students themselves should be given ample opportunity to make suggestions of material important to them, especially those examples avail-
able in the school or community. For examples of a professional nature
notice should be given the daily sports page and official athletic
material. See Bibliography and section on Where to Find Reference
Material.

Through these examples the student can receive training from
ordinary experiences within the school. The teacher can express
through the examples the need for accuracy, approximate numbers,
significant figures, and the like. Some of the problems previously
mentioned in connection with the Junior High mathematics could be
used for review of fundamental operations with fractions, decimals,
percentages and the simpler ideas of statistical methods.
CONCLUSIONS

It may be concluded from these examples that the mathematics teachers may uphold their responsibilities in keeping with the philosophy of the school by integrating the study of a particular subject matter with other teachers and subject fields in the school system. The mathematics teacher may be interested in the analyzing and solving of a problem where the art instructor may have his interests directed to the appreciation of color tastes in painting. Nevertheless their ultimate aims in keeping with the philosophy of the school toward common results for the individual in and out of the school are the same.

"Hence the first approach to any subject in the school, if thought is to be aroused and not merely words acquired, should be as un-scholastic as possible. To realize what an experience, or empirical situation, means, we have to call to mind the sort of situation that presents itself outside of school; the sort of occupations that interest and engage activity in ordinary life. And careful inspection of methods which are permanently successful in formal education, whether in arithmetic or learning to read, or studying geography, or learning physics or a foreign language, will reveal that they depend for their efficiency upon the fact that they go back to the type of the situation which causes reflection out of school in ordinary life. They give the pupils something to do, not something to learn; and the doing is of such a nature as to demand thinking, or the intentional noting of connections; learning naturally results."22

22 John Dewey; Democracy and Education; McMillan Company; 1916; page 181.
The symbolism and methods of mathematics often seem impractical to the average individual. He does not realize that these are actually basic to solving problems of living. This difficulty should not be underestimated. The mathematics teacher is responsible for equipping the student with the language he needs to solve the problems that will arise as he lives out his life. There is an increasing field of important thought which can be expressed only in the language of mathematics. Automobile advertisers make wide use of the term "compression ratio" in the copy they insert in such popular magazines as Life and Time. Speculations on the origin of life rely upon statistics. High frequency communication has introduced such large numbers that a knowledge of exponents is essential for grasping even an elementary understanding of what is taking place in that field. Quantum physics has started a chain of reasoning which portends that an understanding of the language of mathematics will prove indispensable for such ultimate consideration as the very nature of life itself. The time will come when every school boy will want to know Einstein's famous equation for the relation of matter and energy. All indications are that the language of mathematics will become increasingly important as a tool for understanding every day life. But the teacher cannot succeed in creating such a tool without relating this language to the immediate interests of the boys and girls.

The teacher of mathematics can make certain indispensable and distinctive contributions to the attainment of the broad purposes of general education. He can also make certain contributions that are
similar in nature to those made by teachers in other fields.

Any field of study deserves a place in the curriculum (only) insofar as it has a unique role to play in meeting the educational needs of students. Although teachers in all departments of the school share the major purposes of education and can unite in discussing their common objectives and common difficulties, the teacher who by taste and training is especially well equipped along some one line may be expected to have his own particular contribution to make.

"But in investigating the role of a particular field of study it is necessary to examine the tracery of its interconnections with other fields. In the past this necessity has escaped the attention of many, largely because of their continuing faith in pure discipline. As a result, the resources peculiar to each field have seldom been properly focused upon attaining common aims, and students have neither recognized the mutually reinforcing roles of the concepts, methods, and techniques of the various areas of human knowledge nor have they profited from this reinforcement in meeting their needs.

The teacher of each subject, preoccupied with imparting his own particular knowledges and skills, has failed to devise classroom methods with this larger aim in view. The development of desirable characteristics of personality has been largely left to chance through lack both of insight on the part of teachers in the different fields and of cooperative planning and action on the part of the student and teacher and the staff as a whole."23

23Commission on Secondary School Curriculum; Mathematics In General Education; D. Appleton-Century Company; 1933; page 43.
It may be recognized that the school is responsible for making available experiences that will enable the student to make selections of his own. "Helping the individual in becoming progressively more able to guide himself"24 and to solve his problems wisely is helping him to meet his needs. Many times the teacher can promote problem-solving by arranging projects, field trips, etc. For example, the correlation of Peter's problem of graphing with his football was a start in the evolving plan to aid him with problem solving.

Pedagogically, the field of mathematics has many and broad relationships in sports. The average teacher cannot hope to have an understanding of all sports but a good cross section of sports typical to his society is indeed advantageous for classroom use. Relationships to sports is valuable to the instructor first, because of their place in the life of the student; secondly, the teacher has excellent facilities at hand, in the use of the playground, gymnasium, etc., and thirdly, due to the reference given to sports in reading materials of importance to the age group, etc.

The teacher may feel free to learn with the students and should develop in the classroom a reciprocal concern for individual and group, dignity of individual and a free play of intelligence; relationships to other fields are of definite importance to this development.

The ideas that underlie this paper have been stated before. Here they are stated in a new context, examined specifically through

24Lefever & Others; Principles and Techniques of Guidance; The Ronald Press Company, New York; copyright 1941; page 37.
examples from the field of sports. These examples should lead to many others in the field of sports, and indeed in practically every situation in the student's experience. The daily life of mechanics minded and sports-loving American youth presents a plethora of interesting, and hence motivating, possibilities for creating new learning situations for mathematics. As teachers go about their daily routine, they should observe and seize every opportunity for presenting new relationships between mathematics and other fields of study, making particular use of any specialized knowledge they may have, as the writer has attempted to do in the field of sports.
WHERE TO FIND REFERENCE MATERIAL

The high school coach should be a valuable asset to the mathematics teacher in finding material from the field of sports. He will be able to suggest where to write for additional information that is not carried by the school library or his personal library.

All fields of sports have not been covered in this article, however such sports as swimming, hunting and photography can produce vivid examples for integrated study. If your community suggests a type of sport other than those covered in this article the teacher should feel free to contact the athletic department at his state university.

The following is a list of magazines some of which should be carried by your school library. By scanning these magazines you may receive examples that can be developed like the examples in the SPECIFIC EXAMPLES section.

5. Spalding Sports Show. Magazines of this type are published by sporting goods companies as advertising material. These magazines many times furnish excellent examples and illustrations. These magazines can be received by writing sporting goods companies addresses of these companies can be received from the coach. For a copy of the Spalding Sports Show contact A. G. Spalding & Bros. Inc., 161 6th Avenue, New York 13, New York.
BIBLIOGRAPHY


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