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ABSTRACT

This document reports the results of a practicum to instruct the staff of one elementary school in the basic content of the metric system and to demonstrate some teaching strategies for instructing elementary students in metrics. A series of six after-school workshops were run on a weekly basis. Details are given concerning the planning, organization, selection of materials, and evaluation of the workshop sessions. A model is developed to aid other schools in planning inservice workshops on the metric system. Appendices include a copy of the metric system survey given to teachers, lists of metric teaching materials, the workshop agenda, pre- and posttests given to teachers, a copy of the evaluation questionnaire, and details of the model for an introductory methods workshop (including samples of learning activities and a list of metric reading materials). (DT)

"THINK METRIC"

AN INSERVICE PROGRAM FOR TEACHERS

by

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Submitted in partial fulfillment of the requirements for the degree of Doctor of Education, Nova University -

Atlanta Cluster
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Coordinator

Mini Practicum
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ABSTRACT

The purpose of the practicum was to instruct the staff of East Central Elementary School in the basic content of the metric system and to demonstrate some teaching strategies for instructing elementary students in metrics. A series of six workshops after school on a weekly basis was selected to accomplish the stated objectives. A model was developed which could be useful to other elementary schools that want to prepare their teachers to "think metric." Utilizing two outside resource consultants, along with the principal, the Workshop proved to be a success in terms of the established objectives. However, some needed changes are pointed out in the evaluation and model sections of the practicum.

"THINK METRIC"

AN INSERVICE PROGRAM FOR TEACHERS

Robert E. Dunbar[1]

INTRODUCTION

Every American is facing or soon will be facing the task of learning to "think metric." This change from the English system of measurements to the metric system of measurements appears inevitable. Despite America's advanced technological society, conversion will not be as easy to accomplish as some people have envisioned. The majority of the task of teaching the metric system to our American populace will belong to the educational community.[2] The elementary school is typically among the first organizations in the educational community to begin preparations for such a conversion. Therefore, the training of elementary

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[1]Principal, East Central Elementary School, 1502 Dean Avenue, Rome, Georgia 30161. 300 students.

[2]Philip G. Jones, "Metrics: Schools Will Be Teaching It and You'll Be Living It--Very, Very Soon," Education Digest, 39, No. 11, November, 1973, 23.

school teachers should be planned as an initial, high priority step in an effective metric conversion program.

As an elementary school principal, this participant saw an opportunity to begin the preparation of his school population for the metric conversion. It was recognized that teachers need to be prepared or retrained to teach the new measurement system in such a way as to "supplant rather than supplement" our traditional system of measurements.[3] The National Bureau of Standards recommended a 10-year school metrication calendar for all school districts in 1971. The first two years of this calendar were to be devoted to planning, training teachers, and curriculum research. In view of this national suggestion, the participant discussed with his faculty the need for staff instruction in the basics of metric content. Plans were made for a series of inservice workshops to instruct teachers in the terminology, content, and teaching strategies of the metric system. Pre- and post-testing revealed an increased knowledge of the metric system following

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[3]Louis C. Fillinger, Learning and Teaching Metric Measurement: A Handbook for Teachers in the Elementary and Junior High School, Danville, Illinois: Interstate Printers and Publishers, 1974, p. 5.

instruction, while teacher evaluation questionnaires demonstrated increased fulfillment of teachers' confidence in metrics instruction.

The National Education Association has stated that "The teaching of metrics tends to be about a system that 'could be used' and 'some people use'--instead of a system that 'we are going to use' and 'you must learn to use'."[4] This participant, after an extensive review of the literature and discussion with mathematics consultants, recognized the need for teacher training and attempted to improve teachers' knowledge of a system which "we are going to use." Priority must be given to educating all American school children in metrics; therefore, attention must be paid to the instruction of our educators.

STATEMENT OF THE PROBLEM

During the 1976-77 school year, a new organizational plan is being considered at East Central for the teaching of math. It is envisioned that all classroom teachers will be teaching math using a modified continuous

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[4]Jones, op. cit., p. 24.

progress approach. In this approach, each student in grades three through six will report to the classroom teacher working nearest his math level, no matter what grade the student is assigned. All teachers will be assigned various math levels, and math will be taught at the same time in these grades. In the past, one teacher has taught all the math in grades four through six in a departmentalized organizational pattern.

Not only is there to be a change in the math organizational structure, but a new mathematics textbook series will be instituted in grades four through six at the beginning of the year. The new series, Addison-Wesley's Investigating School Mathematics, already in use in grades one through three, will be implemented in the upper elementary grades. The new series places emphasis on the teaching of metrics, one reason why teachers must be trained in the area of metrics.

Having examined the status of metrics instruction at East Central Elementary School in a somewhat cursory fashion, the participant made the decision to purposefully discuss with East Central's staff members their feelings about the teaching of metrics and the extent

to which metrics instruction was being given in the school. As a result of teacher feedback obtained from individual conferences, evaluation, classroom observations, and metrics survey (see Appendix A), the following problem was identified:

> Teachers lack confidence in the teaching of metrics because of their own lack of knowledge in the area of the metrics system.

The most concrete expression of the need for a workshop to improve teachers' knowledge of the metrics system and strategies for teaching metrics was pointed out in a survey distributed among 18 staff members in February, 1976. The percentages expressed in the following paragraph were abstracted from this survey. It is the opinion of the principal that the need for a workshop is most dramatically documented in the results of this survey as found in Table 1.

Fifty per cent of the school's staff have not taken a course in the teaching of mathematics in the elementary school within the past five years. Seventy-five per cent of the school's instructional staff have not attended a mathematics workshop within the past five years. Of the

TABLE 1

Metric System Survey Results, East Central Elementary School

QUESTION	RESPONSES			
1. Number of years since last course in teaching of elementary math	1-3 yrs. 18%	4-6 yrs. 31%	7-10 yrs. 25%	
	10+ yrs. 13%	Never 13%		
2. Percentage of teachers attending math workshop within past 5 years	Yes 25%	No 75%		
Of those who answered Yes above, percentage of teachers who attended workshop dealing with metrics	Yes 0%	No 25%		
3. Percentage of teachers engaged in independent professional reading on the metric system	Yes 44%	No 56%		
4. Percentage of teachers engaged in different types of metrics instruction	Self-Contained 18%	On-going Topic 18%		
	Not Applicable 64%			
5. Percentage of teachers viewing metric system in conjunction with instruction in other subject areas	Yes 75%	No 12%	Not Applicable 12%	

6.	Percentage of teachers indicating feeling of confidence in teaching metrics	Yes 0%	No 93%	Not Applicable 7%
7.	Percentage of teachers feeling workshop in metric instruction would increase confidence in teaching metrics	Yes 81%	No 7%	Not Applicable 12%

25 per cent who have attended a math workshop, none of the teachers indicated that the content of the math workshops dealt significantly with metrics or the teaching of metrics. Fifty-six per cent of the teachers indicated that they had done no type of independent professional reading in the area of metrics. Only 36 per cent of the faculty stated that they were engaged in any form of metrics instruction in the classroom. Seventy-five per cent of the staff gave the opinion that metrics instruction could be integrated into other subject areas besides math and science. A very significant 93 per cent of the teachers stated that they lacked confidence in instructing students in the metrics system. Eighty-one per cent of the staff felt that a series of inservice programs would help to increase their own knowledge of metrics and in their confidence in teaching metrics.

Since a voluntary program for America's national conversion to metrics was mandated by the United States Congress and signed into law in December, 1975, the immediacy of the problem of obtaining help in learning the fundamentals of metrics and the instruction of metrics was further dramatized. Finally, the entire

practicum problem centered around the teachers' lack of knowledge of the weight and measurement system which they will be using in their own daily lives and will be expected to teach to their students effectively. It appears to be a truism that what teachers understand and feel comfortable in teaching will be reflected in the quality of their classroom instruction. Thus the practicum was conceived to fill this void existing in East Central Elementary School.

PURPOSE OF THE PRACTICUM

The purpose of the practicum was twofold:

1. to plan, develop, and institutionalize a metrics workshop to instruct teachers in the content of the metrics system and to provide some examples of appropriate teaching strategies.
2. to plan and develop a model for organizing introductory metrics workshops for teachers, to be shared with other schools and systems.

LIMITATIONS OF THE PRACTICUM

The Metrics Workshop carried out in this practicum did not purport to give to teachers an in-depth study of

metrics, but more to teach them the fundamentals of metrics along with some teaching strategies for conveying metrics to their students. As a staff, East Central's teachers seem committed to the teaching of metrics to their students, since now there will be adequate teaching materials and up-to-date texts which present metrics. No attempt, however, will be made to evaluate specifically the manner in which each teacher accomplishes the teaching of metrics to her students.

REVIEW OF THE LITERATURE

Historic Background of the Metric System

By the late Middle Ages, a complex assortment of measurement systems was in use throughout Europe. Arbitrary units such as the span, palm, and cubit were used as units of measurements. A rebirth of scientific interest in France between the sixteenth and seventeenth centuries laid the foundation for the metric system. A final impetus for the reform of the system of measurement came at the time of the French Revolution. Wide variations existed in measurements, and all reminders of this feudal system and of kings were to be discarded.

In 1790, the French Academy appointed several

committees to investigate weights and measures reform. Change to a new system was to be made with serious regard for the future. Three overall principles were considered in drawing up a new system of measurements:

1. The standard unit of length should be based on some unchanging, absolute standard found in the physical universe.
2. The basic units of length, volume, and weight should be directly related to each other.
3. The multiples and subdivisions of the standard units should be decimally related.[5]

The French Academy committees specified the units of length should be equal to one ten-millionth of an arc representing the distance between the North Pole and the equator. The standard unit of length was to be called the metre (meter), derived from the Greek metron, meaning "a measure." The idea of having the standard of length on some position of the earth, along with its decimalization, was first proposed in 1670 by Gabriel Mouton, the vicar of St. Paul's Church in Lyon. For this reason, historians have settled on Mouton as a

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[5]Arthur E. Hallerberg, "The Metric System: Past, Present --Future?" The Arithmetic Teacher, 20, No. 4, April, 1973, 315.

"founding father" of the metric system.[6]

France officially adopted the metric system in 1795. Its use was mandatory, but not strictly enforced, for the new system did not meet with immediate approval. Other European countries were invited to Paris in 1798 to learn of the system so that it might be adopted as an international standard. The educational impact of this effort was to be felt at a later time, as gradually most of the major European nations adopted the metric system. As of the beginning of the twentieth century, Britain and the United States were among the only leading industrial nations of the world not to have adopted the metric system.

Only recently have the nations of the British Commonwealth begun to convert. Britain began its metrication program in 1965, while the South African government decided to convert in 1966. Australia and New Zealand began their programs in 1970, with Canada as last to announce its decision to convert in 1971. Progress in conversion is slow as the countries attempt to attain

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[6]Gary G. Bitter, Jerald L. Mikesell, and Kathryn Maurdeff, Activities Handbook for Teaching the Metric System, Boston: Allyn and Bacon, 1976, p. 310.

their goals for conversion. With the ultimate conversion of the United States to the metric system, the French Academy's goal will be attained--the adoption of the metric system as an international standard.

America's Conversion to the Metric System

In the United States, the argument over whether the metric system should be adopted as the single official system of weights and measures is perhaps one of our longest continuing controversies. At the same time that France was studying the metric system, Thomas Jefferson, then Secretary of State, wrote a report for Congress on the need for modernization of weights and measures. Jefferson's plan involved units of measurement based on the decimal system and units directly related to each other. His recommendation was not accepted and the adoption of metrics was not considered again until the early 1800's.

In 1816, President Madison requested Secretary of State John Quincy Adams to prepare a new statement on weights and measures. Upon this request, Adams issued an exhaustive report in 1821 on the subject, listing the advantages and disadvantages of both the English and the

metric systems to the United States at that time. Adams recommended retention of the English system by the United States, which precluded further consideration of the metric system for another 40 years. Then in 1966, Congress passed an act making it lawful to use the metric system for transaction of any business in the United States. As of this time, use of the metric system was not mandatory, but it was anticipated that in a short period a further act would set the date for its exclusive adoption.

Follwing this legislation, until the early 1960's, there was little real progress toward metrication in the United States, as the metric issue became a full-fledged public controversy. In the late 1960's and early 1970's, bills to force the United States to convert were introduced to Congress, but passage was continually blocked. Then in 1968, the Metric Study Act became law, providing for a three year program to determine the impact of increasing the use of the metric system. The report recommended that the "United States change to the International Metric System deliberately and carefully" and that "Congress, after deciding on a plan for the nation, establish a target date 10 years ahead, by which time the United States will have become predominately, though

not exclusively, metric."[7]

Since 1971, there have been several attempts to enact federal legislation to establish a national metric conversion board. The Metric Conversion Act of 1972 passed the United States Senate, but failed to have action taken on it in the House and was, therefore, defeated. A bill establishing national policy in metric education did become law in 1974. The law stated that:

> It is the policy of the United States to encourage educational agencies and institutions to prepare students to use the metric system of measurements with ease and facility as a part of the regular education program.[8]

The Metric Conversion Act of 1975, signed into law on December 22, 1975, established a national policy of United States conversion and a United States Metric Board to coordinate and assist the voluntary, gradual increasing use of the metric system. Now under the direction of the United States Metric Board, the United

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[7]Claire R. Geier, Metric System of Weights and Measures: U. S. Conversion, Library of Congress, Congressional Research Service, February, 1976, p. 8.

[8]Albert B. Chalupsky and Jack J. Crawford, "Preparing the Educator to Go Metric," Phi Delta Kappan, 57, No. 4, December, 1975, 263.

States is officially committed in following the directives of the 1971 Metric Study--to convert to the metric system through a voluntary, coordinated national program.

Teacher Training in the Metric System

America's conversion to the metric system is inevitable with the passage of the Metric Conversion Act of 1975. Now the United States is no longer concerned with the question as to "when" conversion will occur. It is now a question of "where" and "how." The brunt of the task of converting to the metric system will belong to the educational community, for the schools are largely "where" conversion will be learned. The 1971 National Bureau of Standards study recommended a coordinated national program to set about deliberately and carefully changing to the metric system. Among these recommendations was one which has great impact on education: "That early priority be given to educating every American schoolchild and the public at large to think in metric terms."[9] The proper education of students is the most important factor for a successful conversion.

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[9]Fred J. Helgren, "Schools are Going Metric," The Arithmetic Teacher, 20, No. 4, April, 1973, 311.

Congress' metric message to the educational community, as implied in this study, was to start then to convert local educational programs. A 10 year school metrication calendar issued to all school districts identified the first two years to be involved in "planning, training teachers, and curriculum research."[10] Teachers will need to be prepared or retrained to teach the new measurement system. It is estimated that 8-15 hours of inservice training would suffice teachers for going metric.[11] A basic introduction to metrics is essential, for teachers must know and understand metrics themselves before they can teach it to children. They do not, however, have to learn everything about the system in order to begin teaching the basic fundamentals.

Elementary school teachers will require the most intensive training.[12] Early elementary teachers must be especially familiar with the metric system, for it is important not to confuse beginners with the two systems of measurement. Inservice training activities can be

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[10]Jones, op. cit., p. 24.

[11]U. S. Department of Commerce, U. S. Metric Study: Interim Report--Education, National Bureau of Standards, Special Publication 345-6, Washington, D. C.: U. S. Government Printing Office, 1971, p. 49.

[12]Ibid., p. 50.

carried out in a number of ways. Programs for inservice can be completed in pre-planning days, during teacher work days, weekend workshops, or through television instruction. Time available for these activities is small, however, and often, most instruction occurs in after-school sessions. Resource people for inservice training may include supervisors, college professors, or consultants. Despite the details of setting up teacher workshops in metric education, it is essential that the:

> . . . emphasis should lie in the strategies and tactics for teaching measurement in early and later elementary years, and in achieving at least the beginnings of an easy familiarity with the metric units.[13]

The strategies for teaching metrics are learned as the teachers experience metrics in the workshop situation. "Training should be similar to that which we hope teachers will use with their students, as teachers generally 'teach as they are taught'."[14] The essential component of teacher training workshops is that the material stimulate the participants and give them

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[13] Ibid., p. 53.

[14] Ibid., p. 116.

something to take home to teach to others. Teachers must "learn by doing" and experience the measuring activities themselves. Planning for teacher training should include projects and activities that call for estimation and measurement. In this way, teachers are at ease with measurement in the metric system, and their students will, in turn, find it simple.

Teachers have a large responsibility in instructing our nation's youth in the new measurement system. Only by experiencing the measurement system themselves can they attempt to instruct students. This experience can be attained through teacher-training activities. Teachers cannot afford to delay the duty of teaching children for tomorrow's metric world. "Teachers must assume the obligation to prepare themselves, their pupils, and subsequently, the public, to meet our country's commitment to go metric."[15]

Strategies for Teaching the Metric System

In metric conversion, the United States occupies a unique position in recent history. We are well behind

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[15]Lottie Viets, "Experiences for Metric Missionaries," The Arithmetic Teacher, 20, No. 4, April, 1973, 315.

other countries in the adoption of the metric measurement system. This tardiness provides at least one benefit, for it permits the United States to profit from the experiences of other nations in their experiments in changing measurement systems. America can benefit from the resulting educational problems encountered when such countries as Australia, Britain, New Zealand, and Canada converted.

Classroom practices and teaching strategies are proposed for the successful instruction of elementary students. Some of these are based upon the experiences of other nations' educators, while other strategies are espoused by educational agencies such as the National Education Association and the National Council of Teachers of Mathematics. At the top of the list of suggested teaching strategies is the idea that concepts of metrics should be taught through the use of metrics.[16] Students should be actively involved and learn to use the new measurement system in meaningful experiences. Students will learn best if they are not "taught" but are allowed to experience the new system. Teaching should stress a

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[16]Helgren, op. cit., p. 311.

"hands-on experience" approach in which students work individually or in small groups.

"Hands-on experiences" should focus on measurement, letting the students practice in estimating and then measuring.[17] Too often the study of measurement has consisted solely of written work. Lack of attention to activities encouraging thinking and estimating in a measurement system made study dry and dull for pupils. Therefore, to motivate students in learning a new measurement system, teachers must focus on measurement activities.

The metric system can seem so difficult if instruction deals with the full range of units such as the deciliter or the dekaliter. The general public only needs to know the following metric units: meter, kilometer, centimeter, milliliter, liter, gram, kilogram, and ton.[18] These units will suffice for 90 per cent of

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[17]Marilyn N. Suydam, "Metric Curriculum: Scope, Sequence, and Guidelines," in A Metric Handbook for Teachers, J. L. Higgins, ed., Reston, Virginia: National Council of Teachers of Mathematics, 1974, p. 81.

[18]John L. Feirer, "Now Is a Good Time to Get Started in Metrics," Industrial Education, 64, No. 6, September, 1975, 32.

the public's needs. Therefore, teach only what the student needs to know--do not overteach.[19]

American students and teachers are faced with the dilemna of living with two measurement systems. For the time being, students will be living in a non-metric world, while learning the metric system in school. Ideally, instruction would occur when metrics has been totally adopted, but we must begin now in instructing metrics. Thus, students must now be taught the metric system as another measuring system.

Students should be instructed in the metric system as the first measurement system. It is important that they learn to think in terms of the metric system itself. They must learn to estimate, measure, and think intuitively within the metric system. Then, as long as the United States exists under two measurement systems, students can be taught simple comparisons of equivalent measures in the customary system.[20] For example, a liter is slightly larger than a quart, a meter slightly

[19] Ibid.

[20] Bitter, op. cit., p. 14.

longer than a yard. This will be helpful, but in no case should one stress conversion exercises.[21] The student must learn to think in the metric system, and not depend on converting metric units to familiar English units. Dual labels only complicate and block new learning. As a teaching tactic, one must constantly keep this in mind, for conversion can seriously impede instruction.

For the teacher who is interested in a learning center approach to metrics instruction, games can be of great benefit.[22] Games can be operated independent of direct teacher control, allowing the teacher to do individual work with other children. Metric games provide teachers with specific activities for pupils who do not respond to more typical types of instruction. Games can be used with verbally unskilled students or students who are not challenged in the classroom and tend to become bored with the regular classroom routine. Metric games can be easily reproduced from various

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[21]Suydam, op. cit., p. 84.

[22]Cecil R. Trueblood and Michael Szabo, "Procedures for Designing Your Own Metric Games for Pupil Involvement," The Arithmetic Teacher, 21, No. 5, May, 1974, 404.

sources or designed by the individual teacher.

Teachers will continue to be challenged as they attempt to instruct students in the metric system while living in a non-metric society. Such instruction can be done, however, as evidenced from England's conversion experience. Britain is still struggling in its effort to go fully metric, yet one observer noted that any Englishman with difficulty simply needs to grab a near-by 10 year old child.[23] The children have no trouble understanding metrics with Britain's entire educational system now metric.

In conclusion, the following strategies can be kept in mind as the teacher instructs students in the use of the metric system:

1. Teach students to "think metric."
2. Focus instruction on estimation and measurement.
3. Stress "hands-on experiences."
4. Do not stress conversion; suggest only approximation between English and metric systems.
5. Teach only those metric units students need to know.

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[23]"Britain's Metric Woes: Lesson for U. S.," U. S. News and World Report, 80, No. 19, May 10, 1976, 48.

CONCEPTUALIZATION OF THE SOLUTION

It is less than reasonable to expect teachers to instruct students in an area as current and important as metrics without providing them with some formal instruction in metrics and accompanying teaching strategies. The participant felt that conducting a series of programs and workshops in the area of metrics would help to increase teachers' knowledge in this area.

As the metrics workshops were planned, there were three main objectives:

1. To upgrade (increase) teachers' basic knowledge of the content of the metric system.
2. To introduce some appropriate strategies for teaching metrics in the elementary school.
3. To increase the teachers' feelings of confidence in instructing students in the metric system.

East Central Elementary is the only school in the school system to have planned such inservice programs in metrics. Principals were informed of the workshops, and some principals did indicate an interest, but stated their teachers had been too involved in the Southern Association

self-study to undertake any additional workshops during the 1975-1976 school year. Some principals also indicated an interest in the results of our workshops. The Model for Developing an Introductory Metrics Workshop will be shared with the principals in hopes of encouraging workshops in other elementary schools.

EXECUTING THE PRACTICUM

Determining the Need

In planning inservice activities for the East Central Elementary School staff, the participant's previous experience has demonstrated to him the importance of the staff's support. Teachers may be compelled to participate in workshops such as East Central's Metrics Workshop, but often their enthusiasm, support, and interest are increased when they have played a role in deciding what types of workshops are needed and planned.

Through informal conversations, discussions, and evaluation sessions with the teachers, the principal learned from several teachers that they lacked confidence and felt uncomfortable in attempting to effectively teach metrics to their students. In the newly adopted

math textbook in grades one through three, Addison-Wesley's Investigating School Mathematics, metrics and metric terms are used, and many teachers were not familiar with these terms. Teachers had become aware of metrics since the new textbooks did pay considerable attention to metrics. Even more important is the fact that emphasis is placed on metrics in the new math texts for grades four, five, and six, which will be introduced during 1976-1977.

Principal Dunbar made the decision to survey the entire East Central staff concerning metrics with the purpose of determining the actual need for an inservice program in metrics. (See Appendix A.) As a result of this survey the decision was made to pursue plans for a metrics workshop for the purpose of instructing all teachers and staff members in metrics. (See Table 1 for survey results.)

The survey indicated that more than 50 per cent of the school's staff members had not participated in a mathematics education course or workshop within the past five years, nor had they done any professional reading on the subject of metrics. A highly significant 93 per

cent indicated that they did not feel confident in instructing elementary students in metrics, and more than 80 per cent felt that a series of inservice programs on the subject of metrics would help them to gain confidence in the teaching of metrics.

Seeking System Level Approval

Approval for the metrics inservice programs was received from the school system superintendent and curriculum director. Superintendent Jesse C. Laseter interrogated the participant completely on the need of such a workshop, the cost for consultants and materials, and the timing of such a workshop since the Southern Association of Colleges and Schools (SACS) Visiting Committee would be present during April, 1976. Mr. Laseter questioned the wisdom of beginning such a series of inservice programs since teachers had been required to take on such a heavy load during the year in preparation for the Visiting Committee. Mr. Laseter did approve the workshop, and he agreed that the school system would pay for the expenses of an outside consultant since the Rome City SChool System does not have a math or science consultant on its staff. Mr. Sam McCain, Curriculum Director, sanctioned the workshop

and had originally planned to participate himself, but systemwide accreditation and other priority tasks precluded his being present at the sessions.

Selection of Consultants

Immediately on receiving approval from the Superintendent to pay for the consultant, the search began for such a qualified individual. The first person to be considered was Dr. Frances Thompson, who is math consultant for the Northwest Georgia Cooperative Educational Services Agency (NW Georgia CESA), an agency funded through the Georgia Department of Education.

Dr. Thompson was contacted and asked to serve as the director and resource person for the Metrics Workshop. She agreed to accept this role and to try to plan her schedule so that she would be available to conduct her portions of the workshop on her own time. Since the Rome City School System does not participate in CESA, she would not be allowed to serve the Rome City Schools during her regularly scheduled duty day as consultant for the NW Georgia CESA.

Dr. Thompson received her BS degree from Abilene Christian College, her MA degree from the University of

Texas, and her Ed.D. in mathematics education from the University of Georgia. She has served as the math consultant for the NW Georgia CESA for approximately three years, and she enjoys an excellent reputation in mathematics education in northwest Georgia. She did a brief series of mathematics inservice programs for the East Central staff during 1974-1975, and the staff worked well with her at that time.

An additional resource person, Miss Betty Roe, was selected by the principal and Dr. Thompson to aid with the Metrics Workshop. Miss Roe, math teacher at West Rome High School, was recommended to lend assistance to the East Central Workshop. During the Spring Quarter, 1976, Miss Roe had planned a senior high level math quarter course in metrics at West Rome High School. Principal Charles Hudson was aware of her plans and recommended Miss Roe, a Berry College graduate.

Since Dr. Thompson was available for two inservice programs, she suggested that Miss Roe be asked to present a session. After discussing the possibilities with Miss Roe in early March, 1976, it was decided that Miss Roe would present a session on metric prefixes, the

linear aspects of metrics, and demonstrate some activities and worksheets which she had used and was planning to use in her senior high course.

Selection of Workshop Materials

An important part of this practicum was the selection and purchase of the necessary materials to be used in the Workshop and for subsequent use by East Central teachers as they plan and instruct their students. Dr. Thompson served as the resource person in recommending these materials which would be considered basic materials any elementary school should have in order to teach metrics. Dr. Thompson did not recommend the purchase of any teaching kits initially until all the basics had been purchased.

The principal had reviewed books and articles in planning for the Workshop, and he made the decision to order several of these. At least two salesmen gave the principal some free teaching materials, specifically, a set of metrication masters and a teacher's edition of a student metric text. Congressman Larry P. McDonald, on request from the principal, sent some pamphlets and other materials which he obtained from the U. S. Government

Printing Office and the Library of Congress.

The following lists contain those materials, either purchased or received free, that were used in the Workshop:

Instructional Supplies

2 Vertical Metric Tapes
1 Think Metric Personal Scale
2 Simple Scales
2 Metric Stacking Masses
2 Graduated Liter Pitchers
2 Wooden Centimeter Rulers
1 Trundle Wheel
1 Bar Mass Set
12 Maple Meter Rulers
1 Balance Scale
20 Individual Student Celsius Thermometers
1 Celsius Lab Thermometer

Charts

The Metric System. Dansville, New York: Instructor Publications, Inc., 1976.

Duplicating Masters

Nichols, Eugene D., et al., Metrication Masters, New York: Holt, Rinehart and Winston, 1974.

Pamphlets

Geier, Claire R., Metric System of Weights and Measures: United States Conversion, Washington, D. C.: U. S. Government Printing Office, 1976.

U. S. Department of Commerce, Brief History of Measurement Systems, Washington, D. C.: U. S. Government Printing Office, 1972.

Teacher Resource Books

Bitter, Gary G., et al., Activities Handbook for Teaching the Metric System, Boston: Allyn and Bacon, 1976.

Haugaard, James C., et al., Fun and Games with Metrics, Englewood Cliffs; Prentice-Hall, 1974.

_____, The Metric System (Student Book) Teacher's Edition, Menlo Park, California: Addison-Wesley Publishing Company, 1974.

Trueblood, Cecil R., Metric Measurements: Activities and Bulletin Boards, Dansville, New York: Instructor Publications, Inc., 1973.

U. S. Department of Commerce, U. S. Metric Study. Interim Report-Education, Washington, D. C.: U. S. Government Printing Office, 1971.

See Appendix D for a list of all metric materials available to teachers in the East Central Elementary School and Rome City Schools Materials Center.

Plans and Schedules for Workshop Programs

Principal Dunbar consulted other authorities in the metrics area as plans were being made for the Workshop sessions. Mrs. Clare Nesmith, math consultant for the Georgia Department of Education, offered her suggestions in a conversation. Mrs. Nesmith gave her hearty endorsement to Dr. Frances Thompson as being an outstanding resource person. Mrs. Nesmith told the participant that the Georgia Department of Education had not made any concrete plans to deal with metrics in the state curriculum guides beyond the references to metrics made in the 1971 editions of the math guides. According to Mrs. Nesmith, a Georgia Metrication Committee, which has

been appointed, will begin official meetings in January, 1977, to plan the institutionalization program for metrics in all of Georgia's schools. No target date has been set as to when metrics education will become a reality for all of Georgia's students.

Mrs. Joyce White, math supervisor for the Cobb County, Georgia, Public Schools, in a conversation with the participant, stated that she had conducted several one or two-hour workshops in Cobb County's elementary schools. These workshops, however, were done only on request by principals. Cobb County is a metro Atlanta county, with a school district population of more than 50,000. In her workshops, Mrs. White had apparently presented more conversion activities from English to metrics than had been suggested in the literature. Mrs. White did inform the participant that her system had been able to fund several metrics kits for their schools from federal monies. She recommended that the Rome School System purchase at least one complete metrics kit for its central Materials Center.

An interesting sidelight gained from Mrs. White indicated that some Cobb principals were receiving some

resistance to conversion to metrics from parents. A group of parents had complained that teaching metrics was nothing more than another educational bandwagon, and that its sole purpose was to take parents' minds away from the "new math" controversy.

As previously stated, because of Dr. Thompson's busy schedule and our school's limited financial resources, it was decided that the principal, along with Miss Betty Roe, would conduct several of the Workshop sessions. Dr. Thompson met Principal Dunbar for two hours on Wednesday, March 17, 1976, to discuss the precise plans for the Workshop programs and to finalize the dates for each session.

The following Workshop dates, programs, and leaders were planned:

Session	Date	Program	Leader
1	Wednesday 4/7/76 3:00 p.m.	Pre-test and Orientation Brief metric history U. S. Conversion to metrics Advantages and disadvantages of metrics	Ellis Dunbar
2	Wednesday 4/14/76	Eye Gate Filmstrip, Joseph Louis LaGrange AIMS 16mm film, A Metric America Discussion of films	Ellis Dunbar

Session	Date	Program	Leader
3	Wednesday 4/21/76 3:00 p.m.	Lecture: Uses of metric system, metric prefixes Handout: All You Will Need to Know About Metrics Appropriate Linear activities and worksheets	Miss Roe
4	Wednesday 5/5/76 3:00 p.m.	Lecture on mass, volume, and temperature Appropriate "hands on" activities and teaching strategies	Dr. Thompson
5	Wednesday 5/12/76 3:00 p.m.	Summary and remarks concerning previous week's activities "Hands on" activities and metric teaching strategies	Dr. Thompson
6	Wednesday 5/19/76 3 00 p.m.	Post-test, evaluation Discussion of Workshop Principal's statement of appreciation to faculty	Ellis Dunbar

A more detailed summary of each of the six workshop sessions is found in Appendix E.

Developing the Model

Based on a suggestion by Professor Melvin H. Tennis, Nova Practicums Reviewer, a model was developed which could aid other schools interested in planning a metrics

workshop. Developed almost entirely after the East Central Metrics Workshop had been completed, the model incorporates all of the features of the Workshop with some minor modifications (see Appendix J). The five main sections of the model are:

I. Organizational steps in setting up a metrics inservice program

II. List of basic metrics measurement materials

III. List of metrics consultants

IV. Samples of suggested teaching/learning activities

V. Selected metrics reading materials.

Since metrics education will become an important curriculum topic for more and more elementary teachers, this model can serve as a springboard for area schools to plan and develop their own inservice programs based on the model. An individual school or group of schools would necessarily have to tailor the model to meet their needs, but the list of basic materials needed in any elementary school and the list of activities, games, and professional readings should prove valuable to almost any elementary or junior high (middle) school teacher interested in teaching metrics. Some of the activities would have to be modified to meet the needs of primary

or junior high age students.

The activities and teaching ideas contained in the model are primarily those suggested by the Workshop consultants and used in the Workshop. There are other activities that could be easily substituted. Since more and more publishing and audio-visual companies are flooding the market with metrics teaching materials, there is an adequate variety from which to choose. It should be noted here that it is cheaper to purchase the basic metrics teaching materials listed in the model individually rather than buying a prepared teaching kit. The consultant and principal verified this information as plans were made for purchasing the needed teaching materials. Dr. Catherine M. Maney (a Nova graduate) did some excellent evaluations of metrics materials in her Maxi II practicum, An Effort to Produce a Recommended List of Elementary Metric Materials.

Model Changes from East Central Workshop

There were six inservice programs in the East Central Workshop; however, only four sessions are suggested in the model. If properly organized, sessions one and two could be combined, and the filmstrip on Joseph Louis

LaGrange could be eliminated. Also the post-test and evaluation portions of the Workshop could be incorporated into the final session instead of having a special session for these items. If teachers are expected to attend inservice programs such as these after the school day is completed on a weekly basis, four sessions seems more feasible than six.

Exporting the Model

The participant plans to present an abstract of the model at the Annual Administrative Workshop for the Rome City Schools during early August, 1976. The suggestion will be made then that consideration be given by the school system to the possibility of training elementary and junior high school principals as a group and encouraging them to work with their staffs. The participant also plans to present the model at the September or October meeting of the Seventh District Elementary Principals, an organization which he serves as president. A copy of the model will be made available to principals who are interested.

EVALUATION

Evaluation of the Workshop Schedule

The East Central Metrics Workshop was composed of six afternoon sessions, which lasted a total of approximately seven and one-half hours. As recommended in the model, the numbers of sessions and hours should be reduced by combining sessions one and two into one session, and five and six into one session. The filmstrip, Joseph Louis LaGrange, should be substituted with another historical filmstrip or completely eliminated. It did not serve its intended purpose of presenting a brief metric history.

It is suggested that, if possible, workshop sessions begin at the start of the school year, and be held during pre-planning days. If this could be accomplished, a four to six hour workshop on one day could prove satisfactory. The only drawback to this plan is that workshop participants would not have sufficient time to study the content of the workshop to determine if there were misunderstandings and large gaps in their metrics knowledge.

If it is necessary to plan after school workshop sessions, give teachers the schedule as far ahead as possible. Using the regularly scheduled staff meeting day, and in a couple of instances trying to include faculty meeting agenda items and the workshop agenda, proved to be less than satisfactory. Teachers are willing to stay other days if they are given ample warning.

Evaluation of the Content Mastery

In order to determine the degree of mastery of metric system content, pre- and post-tests were administered to the Workshop participants. The same mastery test was used for both pre- and post-testing (see Appendix F). The mastery test was derived largely from a sample metric mastery test in Activities Handbook for Teaching the Metric System.[24] The sample test was not used in its entirety, for several questions in the sample tested information not given in the sessions of the East Central Metrics Workshop. Only those questions which would measure information as presented to the participants were included on the mastery test.

[24]Bitter, op. cit., p. 337.

The pre- and post-tests were designed to include questions to measure: history of the metric system, linear measure, volume measure, weight measure, temperature measure, and knowledge of prefixes. No instruction was given on conversion from English to Metrics; therefore, no questions on conversion were included in the pre- and post-tests.

The pre-test was administered to 18 participants during the first session of the Workshop. The number of participants fluctuated in each session, as student teachers joined or left the group and as teachers were absent. Fifteen individuals were present for all six sessions and were administered the post-test. A comparison of the pre- and post-testing was made on the 15 participants who were present for the entire Workshop (see Table 2).

Table 2 presents a comparison of pre- and post-tests for the 15 participants. Staff members were assured of their anonymity in the publication of this report, thus names were omitted. Seven participants made a perfect score (100%) on their post-tests. The lowest score on the post-test was 76 per cent of the answers

TABLE 2

Comparison of Pre- and Post-Testing

East Central Elementary School

Teachers	Percentage of Answers Correct		Percentage of Increase
	Pre-Test	Post-Test	
A	72%	95%	23%
B	19%	100%	81%
C	14%	100%	86%
D	4%	76%	72%
E	47%	90%	43%
F	57%	90%	33%
G	85%	95%	10%
H	28%	95%	67%
I	14%	100%	86%
J	47%	81%	34%
K	47%	85%	38%
L	24%	100%	76%
M	28%	100%	72%
N	62%	100%	38%
O	43%	100%	57%

correct; yet, this individual teacher had improved her score from a pre-test score of four per cent of the answers correct. The average percentage of increase between the pre- and post-tests results was 54.4 per cent with the highest percentage of increase being 86 and the lowest percentage of increase being 10 per cent. These post-test results showed a generally high level of performance on content mastery on the part of the Workshop participants.

Evaluation Questionnaire

A summative evaluation questionnaire was administered during the final Workshop session to all teachers and student teachers who had participated in the Workshop (see Appendix G). The questionnaire was drawn up by Principal Dunbar to try to determine whether or not the Workshop had met its primary objectives as far as the teachers were concerned.

To encourage freedom of expression, teachers were asked not to put their names on their questionnaires. Results of the questionnaire are presented in Table 3.

All questionnaire respondents indicated that they were encouraged to read more professionally in the area

TABLE 3

Metrics Workshop Evaluation

QUESTIONS	TOTAL NUMBER RESPONSES	RESPONSES YES	NO
1. Will the information and ideas you received from the Metrics Workshop help you in your plans to teach metrics next year?	15	87%	
2. Will you be encouraged to read more professionally in the area of metrics as a result of the Metrics Workshop?	15	100%	
3. Do you feel more confident about teaching metrics as a result of the Metrics Workshop?	15	80%	14%
4. Were the presentations related to the Metrics Workshop effective? (film, filmstrip, lecture, hands-on activities, and demonstrations)	15	100%	
5. Would you be willing to attend a more in-depth Metrics Workshop at Berry College or elsewhere as a result of your introduction to metrics at our school?	15	60%	27%

6. What aspect of the Metrics Workshop was MOST valuable?

experiments in estimation
demonstrations of games and activities
Dr. Thompson's lessons

7. What aspect of the Metrics Workshop was LEAST valuable?

filmstrip, lecture

8. What suggestions can you make for improving a Metrics Workshop such as this one? (in the event another school wanted to organize a workshop?

workshop should be carried out at beginning of year
different meeting time than on same day as faculty meeting
need for suggested reading material on subject
need for home exercises to be checked together

of metrics (question 2), and all respondents felt that the presentation sessions were effective (question 4). Eighty-seven per cent (13 per cent did not respond to the question) felt that the information and ideas presented in the Workshop would help them in their instruction in metrics next year (question 1). Apparently those 13 per cent who did not respond felt that metrics information was not applicable to them. Eighty per cent felt more confident in the teaching of metrics and 60 per cent of the staff would be willing to pursue additional in-depth metrics workshops.

The most valuable parts of the workshop were listed in the evaluation questionnaire:

1. Dr. Thompson's presentations and activities.
2. Demonstrations of relevant metrics games and activities.
3. Experiments in estimating in metrics.

The filmstrip was mentioned most often as being the least valuable portion of the Workshop.

Examples of comments made to improve the Workshop included the following:

1. Workshop should be conducted at the beginning

of the year.

2. Workshop should be held on a different day from the regularly scheduled staff meeting day.
3. Length of time of the Workshop should be extended.
4. Need for additional reading material on metrics was expressed.
5. Need for homework type exercises which could be checked and discussed the following week was expressed.

Evaluation of the Consultants

Dr. Frances Thompson and Miss Betty Roe proved to be excellent resource persons and consultants. Dr. Thompson was more than generous with both her time and knowledge in planning and instituting the Workshop, and she went beyond the call of duty, even in the providing of materials for which she received no compensation. She worked extremely well in providing the leadership for East Central teachers in this Workshop. Two teachers responded in the questionnaire that the most valuable aspects of the Workshop were Dr. Thompson's lectures and demonstrations.

Miss Roe, who led only one session, presented her

material well and was very enthusiastic in her presentation. She was most empathetic with the teachers since she hereself was drawing up a one quarter course in metrics for high school students. The unfortunate aspect of her session was that teachers did not have time to complete and check their worksheets on linear measurement.

It should be noted that a formal evaluation of the consultants by the teachers was not made; nevertheless, it was obvious to the principal that their presentations exceeded all of his expectations.

Evaluation of Audio-visuals

Two audio-visuals, a 16mm film and a color sound filmstrip with cassette, were provided for use by Dr. Thompson. The 16mm film, produced by AIMS, A Metric America, is an outstanding film which could be used to introduce to almost any group the reasons why America needs to convert to metrics. The film also provides a good background of basic metric information. Teachers expressed pleasure in viewing this film, and they discussed with the consultant how they could obtain the film for use in their own classes. This film is recommended for any group studying the metric system, above the primary level.

The color sound filmstrip with cassette, Joseph Louis LaGrange, gave some historical background of the metric founders; however, no one was very enthusiastic about the filmstrip. Some teachers remarked in their evaluations that this filmstrip was the least valuable part of the entire Metrics Workshop. It is the participant's opinion that the filmstrip probably should have been omitted entirely.

There are several excellent sound filmstrips available. Dr. Catherine M. Maney, a Nova Ed.D. graduate (Boston Cluster), evaluated a wide variety of audio-visuals in her Maxi II practicum report.[25] She listed as excellent the following sound filmstrips with cassettes:

Title	Producer (Publisher)	Grade(s)
Let's Go Metric	Cambridge Book Co. (NY Times)	K-6
Meter, Liter, and Gram Fun	C. W. Clark, Inc.	1-5
Think Metric	Educational Products, Inc.	4-8
Metric Delights	Math-Master	1-3
Stories to Help You Think Metric	Math-Master	4-6
The Adventures of Mr. Windbag in Metricland	Educational Products, Inc.	1-3

[25]Catherine M. Maney, An Effort to Produce a Recommended List of Elementary Metric Materials, Unpublished Practicum Report, Nova University, 1975.

This information from Dr. Maney reached the participant too late for consideration in planning; however, plans at East Central include purchasing one or two sets of these sound filmstrips as money permits.

CONCLUSION

This Nova participant found the East Central Elementary School Metrics Workshop to be a significant and worthwhile endeavor to present the basic content of the metric system and some examples of teaching strategies to the school's staff. At a time when the importance for all Americans, both adults and children, to learn the metric system cannot be overestimated, East Central's staff should be better able to serve its student body.

The Workshop resulted in the purchase of needed metrics materials, the instruction of teachers in metrics, and could possibly result in encouraging other system schools to begin to "THINK METRIC." While the needs of other schools and school districts might be somewhat different from East Central's, the Metrics Workshop Model could serve as a guideline for other schools in the preparation of their staffs. Failure of schools

to prepare teachers to give adequate metrics instruction is a great disservice to America's students as well as her teachers.

GET ON THE BANDWAGON, AMERICA!!!!! THINK METRIC!!!

APPENDIX A

EAST CENTRAL ELEMENTARY SCHOOL

METRIC SYSTEM SURVEY

1. How long has it been since you had a course in the teaching of elementary mathematics?

   _____ 1-3 years
   _____ 4-6 years
   _____ 7-10 years
   _____ More than 10 years

2. Have you attended any mathematics workshops within the past five years?

   _____ Yes _____ No

   If yes, did the content of the workshop deal at all with the teaching of metrics?

   _____ Yes _____ No

   Comments _____

3. Have you done any recent independent professional reading on the metric system or the teaching of the metric system?

   _____ Yes _____ No

   Comments _____

4. Do you teach the metric system as a self-contained unit of study or do you teach the metric system as an on-going topic throughout the year?

   _____ Self-contained unit _____ On-going topic _____ N/A

   Comments _____

5. Do you think that the metric system could be taught in conjunction with other subject areas besides math and science?

   _____ Yes _____ No _____ N/A

   Comments _____

6. Do you feel confident that your knowledge of the metric system is adequate to instruct students in the application and use of the metric system?

   _____ Yes _____ No _____ N/A

   Comments _____

7. Do you feel that a series of inservice programs on the content and teaching strategies of the metric systemwould make you feel more confident in your ability to teach the metric system?

   _____ Yes _____ No _____ N/A

   Comments _____

LARRY P. McDONALD
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COMMITTEE:
ARMED SERVICES

SUBCOMMITTEES:
RESEARCH AND DEVELOPMENT
SEAPOWER AND
STRATEGIC AND CRITICAL
MATERIALS

APPENDIX B

Congress of the United States
House of Representatives
Washington, D.C. 20515

March 10, 1976

R. Ellis Dunbar, Principal
East Central Elementary School
Rome, Georgia 30161

Dear Mr. Dunbar:

Thank you for your letter requesting information on the metric system. I was able to obtain information from the Library of Congress which I hope you will find useful.

Thank you again for writing and your kind offer to visit your new school is appreciated.

Sincerely,

Larry P. McDonald

LPM/mm
Enclosure

APPENDIX C

THE LIBRARY OF CONGRESS

Congressional Research Service

WASHINGTON, D.C. 20540

METRIC SYSTEM

Enclosed are several publications relating to the metric system and to the controversy over the adoption of the system by the United States. The question of metric conversion has been before the Congress numerous times and is a subject of widespread interest among scientists, businessmen, educators, and the general public. The enclosed materials review the history of the system and past efforts at metrication; they also provide tables, graphs and charts which illustrate the use of metric units and give conversion factors.

Additional information may be found in the sources cited in some of the enclosed publications, and also in current periodicals. The "Readers' Guide to Periodical Literature," available in local libraries, is a good source for identifying recent articles under the heading, "Metric System."

Congressional Reference
Division

APPENDIX D

LIST OF METRIC TEACHING MATERIALS AVAILABLE IN EAST CENTRAL ELEMENTARY SCHOOL AND ROME CITY SCHOOLS MATERIALS CENTER

East Central Elementary School

Charts

The Metric System, Dansville, New York: Instructor Publications, Inc., 1976.

Duplicating Masters

Nichols, Eugene D., et. al., Metrication Masters, New York: Holt, Rinehart, and Winston, 1974.

Instructional Supplies

Quantity	Item
2	Vertical Metric Tapes
1	Think Metric Personal Scale
2	Simple Scales
2	Metric Stacking Masses
2	Graduated Liter Pitchers
2	Wooden Centimeter Rulers
1	Trundle Wheel
1	Bar Mass Set
1	Maple Meter Rulers (Box of 12)
1	Balance Scale
2	Individual Student Celsius Thermometers (2 boxes of 10 each)
1	Celsius Lab Thermometer

Pamphlets

Geier, Claire R., Metric System of Weights and Measures: United States Conversion, Washington, D. C.: U. S. Government Printing Office, 1976.

U. S. Department of Commerce, Brief History of Measurement Systems, Washington, D. C.: U. S. Government Printing Office, 1972.

Student Books

Behrens, June, True Book of Metric Measurement, Children's Press, 1975.

Branley, Franklyn M., Measure With Metric, Crowell, 1974.

----------, Think Metric, Crowell, 1972.

Teacher Resource Books

Bitter, Gary G., et. al., Activities Handbook for Teaching the Metric System, Boston: Allyn and Bacon, 1976.

Haugaard, James C., et. al., Fun and Games with Metrics, Englewood Cliffs: Prentice-Hall, 1974.

----------, The Metric System (Student Book) Teacher's Edition, Menlo Park, California: Addison Wesley Publishing Company, 1974.

Trueblood, Cecil R., Metric Measurements: Activities and Bulletin Boards, Dansville, New York: Instructor Publications, Inc., 1973.

U. S. Department of Commerce, U. S. Metric Study. Interim Report - Education, Washington, D. C.: U. S. Government Printing Office, 1971.

Rome City Schools Materials Center

Filmstrips and Teaching Information

Clearvue, Inc., English or Metric? That is the Question. 4 sound filmstrips with cassettes.

Encyclopedia Britannica Educational Corporation, Measuring, 5 filmstrips.

Singer/SVE, Beginning Metric Measurement, 5 filmstrips with charts and additional teaching materials.

APPENDIX E

Metrics Workshop
East Central Elementary School

Wednesday, April 7, 1976

Session I: Summary

Ellis Dunbar, Leader

A. Pre-test administered to staff members (see Appendix F).

B. Orientation to the Metrics Workshop.

1. Purposes of Workshop
2. Announcement of consultants: Dr. Frances Thompson and Miss Betty Roe
3. Dates and tentative content for each Workshop program
4. Making plans for metric curriculum for the 1976-1977 school year

C. A brief history of the metric system's development; America's conversion to metrics, "how" and "when?".

D. Advantages and disadvantages of America's conversion to metrics.

Metrics Workshop
East Central Elementary School

Wednesday, April 14, 1976

Session II: Summary

Ellis Dunbar, Leader

A. Eye Gate filmstrip entitled, Joseph Louis LaGrange. LaGrange, along with Gabriel Mouton, is credited with establishing the metric system. Filmstrip provided by Dr. Frances Thompson, metrics consultant.

B. 16mm film, A Metric America, produced by AIMS, explores the reasons for America's need to convert to the metric system. The film, also obtained from Dr. Thompson, is a well done, animated production which is recommended for showing to any group trying to understand the background and need for America's conversion to metrics. This film is a "must" for any metrics workshop.

C. Brief discussion of two films.

Metrics Workshop
East Central Elementary School

Wednesday, April 21, 1976

Session III: Summary

Miss Betty Roe, Leader

A. Lecture
   1. Uses of metric measurement in industry, the home, the school, and on the road
   2. Metric prefixes
   3. Discussion of handout entitled, All You Will Need to Know About Metrics
   4. Linear measurement

B. Completion of varied worksheets and activities provided by Miss Roe on linear measurement (see Appendix J, Section IV, for copies of these activities)
   1. "Estimation and Measure"
   2. "Linear Measurement"
   3. "Metric Measurements"
   4. Meter Airport"
   5. "Ruler Master and Metric Prefixes"
   6. "Millimeter Horse Race"

NOTE: Some worksheets were not completed during the session because of limited time. Teachers took these items home to complete.

Metrics Workshop
East Central Elementary School

Wednesday, May 5, 1976

Session IV: Summary

Dr. Frances Thompson, Leader

A. Lecture on mass (weight), volume (capacity), and temperature.

NOTE: Dr. Thompson theorizes that the best approach to teaching metrics is through the "hands-on" approach; therefore, her lecture remarks were brief. Most of the one and one-half hour session was devoted to activities aimed at permitting teachers to pursue measurement activities in groups.

B. "Hands-on" activities. This session was attended by approximately 20 teachers and student teachers. During the activity period, teachers were divided into five groups of four each. Each group spend approximately ten minutes working together to perform the activities described below (see Appendix J, Section IV, for copies of the activities):

1. Station 1--Discovering Three Important Temperatures; Using Celsius Thermometer
2. Station 2--Estimating and Finding Volume (Capacity)
3. Station 3--Volume Activity
4. Station 4--Guess the Mass (Weight)

Session IV (continued)

5. Station 5--A Dollar's Worth of Change (Mass)

C. Announcement made by Dr. Thompson and Principal Dunbar that National Metric Week would be May 10-14, 1976. Several teachers made bulletin boards and hall displays alluding to National Metric Week.

Metrics Workshop
East Central Elementary School

Wednesday, May 12, 1976

Session V: Summary

Dr. Frances Thompson, Leader

A. Introductory remarks

B. Summary and question/answer period related to previous week's activities

C. "Hands-on" activities composed of metrics games and teaching strategies. Again this week, the 20 member staff of teachers and student teachers was divided into five groups of four each. One activity was placed at each station, and teachers worked in groups. Listed below are the activities which are included in the Model, Section IV (Appendix J).

1. Station 1--"Linus' Lines"
2. Station 2--"Meters for Kilometers"
3. Station 3--"The Car Race"
4. Station 4--"Metric Concentration"
5. Station 5--"Spin-a-Meter"

D. Utilization of teaching games and strategies. There were two main purposes for these activities: (1) to

reinforce the sessions and (2) to present several teaching ideas and games that could be easily adapted to classroom use. Each teacher was given a copy of all the games and ideas for her own use.

E. Discussion of information contained in Allene Wakefield's "Some Information, Activities and Resources on the Metric System" (see Model, Section IV, Appendix J).

Metrics Workshop
East Central Elementary School

Wednesday, May 19, 1976

Session VI: Summary

Ellis Dunbar, Leader

A. Post-test. The same test was used for both the pre- and the post-test. It seemed important that teachers not feel any pressure or strain in taking a post-test such as this one. Teachers were told that their scores would remain confidential to allay any individual's fear of possible embarrassment.

B. Evaluation. A summative evaluation questionnaire composed by Principal Dunbar was administered to all teachers and student teachers who had been present for all Workshop sessions. Teachers were assured anonymity as they completed the questionnaire in order to get as true a picture as possible of their feelings about the Workshop.

C. Principal's statement of appreciation to faculty. Principal Dunbar delivered a statement of appreciation to all staff members in which he thanked them for their cooperation and enthusiasm displayed during the

Workshop. He informed staff members that letters of appreciation would be sent to Superintendent Laseter, Dr. Thompson, and Miss Roe.

APPENDIX F

THE METRIC SYSTEM

Pre- and Post-Test

Name _____

1. In what country did the Metric System originate? _____

2. The _____ is the standard metric measure for length.

3. The _____ is the standard metric measure for volume or capacity.

4. The _____ is the standard metric measure for weight or mass.

5. Temperature in the Metric System is measured by _____ degrees. (Fahrenheit, Celsius).

6. In the Metric System, each unit is _____ times the next smaller unit. (1, 10, 100, 1,000).

7. A meter is the same as _____ centimeters. (1, 10, 100, 1,000).

8. To measure the thickness of a dime, you would use _____ in the Metric System. (meters, centimeters, millimeters, kilometers).

9. A meter is nearest in length to a _____. (foot, yard, mile, inch).

10. A gram is the same as _____ milligrams. (1, 10, 100, 1,000).

11. A package of butter would be measured in _____ in the Metric System. (grams, liters, meters).

12. A liter is nearest in volume to a _____. (pint, quart, gallon).

13. Which of the following would be appropriate for measuring vanilla flavoring in a recipe? _____ (Milligrams, millimeters, milliliters).

14. The boiling point on the Celsius scale is _____. (10° C, 212° C, 100° C).

15. The normal body temperature on the Celsius scale is _____. (37° C, 50° C, 98° C).

16. Match the following Metric System prefixes with their meanings:

_____ milli	A. ten
_____ centi	B. one hundred
_____ deci	C. one hundredth
_____ deca	D. one thousandth
_____ hecto	E. one thousand
_____ kilo	F. one tenth

APPENDIX G

EAST CENTRAL ELEMENTARY SCHOOL
1502 Dean Avenue
Rome, Georgia 30161

METRICS WORKSHOP

EVALUATION

May 19, 1976

	YES	NO
1. Will the information and ideas you received from the Metrics Workshop help you in your plan to teach metrics next year?	____	____
2. Will you be encouraged to read more professionally in the area of metrics as a result of the Metrics Workshop?	____	____
3. Do you feel more confident about teaching metrics as a result of the Metrics Workshop?	____	____
4. Were the presentations related to the Metrics Workshop effective? (film, filmstrip, lecture, hands on activities, and demonstrations)	____	____
5. Would you be willing to attend a more in-depth Metrics Workshop at Berry College or elsewhere as a result of your introduction to metrics at our school?	____	____

6. What aspect of the Metrics Workshop was MOST valuable?

_____

7. What aspect of the Metrics Workshop was LEAST valuable?

_____

8. What suggestions can you make for improving a Metrics Workshop such as this one? (in the event another school wanted to organize a workshop).

_____

_____

APPENDIX H

EAST CENTRAL ELEMENTARY SCHOOL

A ROME CITY SCHOOL

TELEPHONE (404) 232-8310
ROME, GEORGIA 30161

JESSE C. LASETER, SUPERINTENDENT
ROY F. GOOLSBY, ASSISTANT SUPERINTENDENT

R. ELLIS DUNBAR
PRINCIPAL

June 6, 1976

Mr. Jesse C. Laseter, Superintendent
Rome City Schools
307 East Third Avenue
Rome, Georgia 30161

Dear Mr. Laseter:

I want to thank you for your financial support for the consultant's fees for East Central's Metrics Workshop, which was completed during the latter part of May. As a result of the Workshop, I prepared a model for a metrics workshop for distribution to other schools and school systems that might be interested. I also have in my possession a vast amount of metrics materials that might be of value to other schools that are planning to teach metrics in the near future.

My personal feelings and the evaluations of the staff members seem to indicate that the Workshop was a success. Thank you for your approval and financial assistance for this Workshop.

Sincerely,

R. Ellis Dunbar

R. Ellis Dunbar
Principal

APPENDIX I

EAST CENTRAL ELEMENTARY SCHOOL

A ROME CITY SCHOOL

TELEPHONE (404) 232-8310
ROME, GEORGIA 30161

JESSE C. LASETER, SUPERINTENDENT
ROY F. GOOLSBY, ASSISTANT SUPERINTENDENT

R. ELLIS DUNBAR
PRINCIPAL

June 6, 1976

Dr. Frances Thompson, Math Consultant
Northwest Georgia CESA
Fish Creek School
Rockmart, Georgia

Dear Frances:

Permit me to thank you for your help in the planning and instituting of our Metrics Workshop for the East Central faculty. It is my distinct impression from the evaluation reports and from comments during our summary session on May 19 that the Workshop was a success in almost every way.

I want to wish you my very best as you assume your new position in Waycross later this year. I will look forward to visiting you when we are in your area of the state.

Thanks again for everything. You did a magnificent job.

Sincerely,

R. Ellis Dunbar
Principal

APPENDIX J

A MODEL FOR PLANNING AN INTRODUCTORY METRICS WORKSHOP FOR ELEMENTARY TEACHERS

Developed by

Robert Ellis Dunbar, Principal
East Central Elementary School
1502 Dean Avenue
Rome, Georgia 30161

for

National Ed.D. Program
Nova University
3301 College Aver
Fort Lauderdale, Florida 33314

TABLE OF CONTENTS

MEA RE FOR MEASURE*

Althoug to some it may seem strange,
But not ing stays the same but change:
And so the pendulum now swings
About the way we measure things,
And now the inches, yards and feet
Give way to things with metric beat,
And ounces, pints, gallons and quarts
Are measurements of liter sorts,
And no more think in terms of milo,
Now kilometers are in style.
And when we think of melt or freeze,
'Tis not in Fahrenheit but C's.
Let's greet the news without ambivalence
And check this table for equivalents.

*"Meters, Liters, Grams Come to Canada," Rome News-Tribune, May 18, 1976, 5D.

A MODEL FOR PLANNING AN INTRODUCTORY METRICS WORKSHOP FOR ELEMENTARY TEACHERS

I. Organizational steps in setting up a metrics inservice program for elementary teachers.

A. Identify the need for a metrics workshop in the local school using faculty input. Need can be identified through faculty surveys, conferences between staff members and principal, and informal discussions. Without faculty support for such a workshop, the workshop would not be as productive or successful.

B. Secure school system approval from appropriate personnel. Inquire as to monies available to fund any workshops held in local schools.

C. Give consideration to amount of money available from school and/or school system to fund workshop. Money must be available to purchase basic metrics measurement materials and to provide for consultant fees.

D. Obtain qualified personnel to conduct workshop sessions. Faculty members of other local schools may be sufficiently informed in metrics to conduct portions of the workshop. Consultants who are more knowledgeable in suggestions for teaching strategies and activities should be called upon for their expertise.

E. Organize a planning session with consultant to outline workshop sessions.
   1. determine number of sessions
   2. determine content of each session
   3. determine who will lead each session
   4. determine dates and time most suitable
   5. determine evaluation methods to be used

F. Order necessary metrics measurement materials needed in order to carry out inservice activities. (See Section II. List of Basic Metric Measurement Materials.)

G. Establish workshop agendas. Determine what portion of each session will be devoted to brief lecture and what portion will be devoted to "hands-on" activities

in which teachers actually work with measuring objects. Sessions should last no more than one hour. Listed below are suggested agendas for four sessions.

1. Session 1--Introduction and orientation to metrics, including history of metric system, need for America's conversion to metric system. Introductory film on metrics, such as AIMS' A Metric America.

2. Session 2--Lecture and hands-on activities in linear and weight measures. In accordance with accepted teaching strategies in metrics, strong emphasis should be placed on hands-on activities. Teachers should "discover" relationships between metric multiples and sub-multiples. Number of different activities to be carried on simultaneously depends upon number of teachers involved in workshop. Suggestions for teaching/learning activities may be found in Section IV. Samples of Suggested Teaching/Learning Activities.

3. Session 3--Lecture and hands-on activities in volume and temperature measures, again with strong emphasis on games and hands-on activities.

4. Session 4--Summary of teaching strategies for instructing elementary students in metrics. Examples of games which can be used in the classroom to motivate students to learn metrics. All activities included in the Model Section IV can be used in introducing the metric system to elementary teachers. The same activities can be adapted according to the needs and grade levels of the students for use in the classroom in instructing students in introductory metrics. Optional--post-testing (see Section IV).

H. Evaluation of sessions. A key aspect in completion of workshops is permitting participants to evaluate the sessions for the purpose of making suggestions to workshop leaders and consultants. A faculty evaluation survey will indicate the strong and weak points of the workshop, while the post-test will indicate knowledge of content.

I. Determination by participants of need for additional workshops. Teachers may indicate need for certain types of activities or teaching suggestions.

J. Distribute Metrics Bibliography for sources of independent professional reading. (See Section V. List of Selected Metric Reading Materials.)

II. List of basic metrics measurement materials recommended in order to carry out inservice programs.

The following is a list of basic metric measurement materials which could be considered essential for institutionalizing a metrics workshop in linear, weight, volume, and temperature. A suggested company and price for ordering each are listed.

A. Creative Publications, P.O. Box 10328, Palo Alto, California 94303

Quantity	Item	Each	Total Price
2	Vertical Metric Tapes (Box of 10)	3.50	7.00
1	Think Metric Personal Scale	14.00	14.00
2	Simple Scales	9.00	18.00
2	Metric Plastic Stacking Masses	4.00	8.00
2	Graduated Liter Pitchers	4.50	9.00
2	Wooden Centimeter Rulers (Box of 12)	5.50	11.00
1	Trundle Wheel	10.00	10.00
1	Bar Mass Set	12.75	12.75
1	Maple Meter Rulers (Box of 12)	8.80	8.80
1	Balance Scale (w/masses)	27.50	27.50

B. ABC School Supply, 437 Armour Circle, N.E., Atlanta, Georgia 30324

Quantity	Item	Each	Total Price
2	Individual Student Celsius Thermometers (Box of 10)	6.00	12.00

C. Math Master, P.O. Box 1911, Big Spring, Texas 79720

Quantity	Item	Each	Total Price
1	Celsius Lab Thermometer	3.50	3.50

III. List of metrics consultants available to conduct metrics inservice workshops.

A. Dr. Frances Thompson
Northwest Georgia CESA
Fish Creek School
Rockmart, Georgia

B. Miss Betty Roe, Math Department
West Rome High School
Redmond Circle
Rome, Georgia 30161

C. Dr. Robert Catanzano, Math Department
Berry College
Mount Berry, Georgia 30149

D. Mrs. Clare Nesmith
Math Consultant
Georgia Department of Education
State Office Building
Atlanta, Georgia 30334

E. Miss Catherine Draper
Math Consultant
Georgia Department of Education
State Office Building
Atlanta, Georgia 30334

F. Mrs. Joyce White
Math Supervisor
Cobb County Public Schools
Waddell Street
Marietta, Georgia 30060

IV. Samples of suggested teaching/learning activities.

A. General Reference Materials

1. All You Will Need to Know About Metric
Some Information, Activities, and Resources on the Metric System, by Allene D. Wakefield
3. Ruler Master and Metric Prefixes
4. Metric Reference Chart

B. Measuring Activities

1. Weight Activities
2. Temperature Activities
3. Volume Activities
4. Think Metric (Linear)--Classroom Activity
5. Think Metric (Volume)--Classroom Activity
6. Think Metric (Weight)--Classroom Activity
7. Estimation and Measurement
8. Linear Measurement
9. Metric Measurements (Linear)
10. Millimeter Horse Race (Linear)
11. Meter Airport (Linear)
12. Happy Equivalents (Linear)

C. Metric Game Activities

1. Metric Concentration
2. Metric Wheel
3. Spin-a-Meter
4. Spin-a-100 cm Train
5. The Car Race! A Metric Game by Elisabeth Hallamore
6. Meters for Kilometers! A Metric Game with Cards by Elisabeth Hallamore
7. Linus' Lines. A Measuring Game in [illegible]m!
8. Metric Songs

D. Metric System Post-Test

All You Will Need to Know About Metric

(For Your Everyday Life)

10

Metric is based on Decimal system

The metric system is simple to learn. For use in your everyday life you will need to know only ten units. You will also need to get used to a few new temperatures. Of course, there are other units which most persons will not need to learn. There are even some metric units with which you are already familiar: those for time and electricity are the same as you use now.

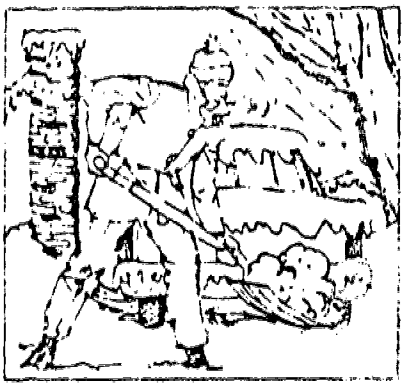
BASIC UNITS

METER: a little longer than a yard (about 1.1 yards)
LITER: a little larger than a quart (about 1.06 quarts)
GRAM: about the weight of a paper clip

(comparative sizes are shown)

1 METER

1 YARD



25 DEGREES FAHRENHEIT

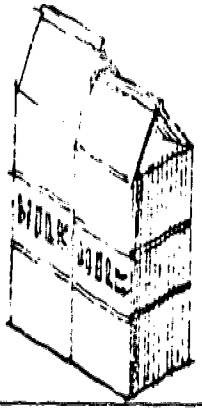
COMMON PREFIXES

(to be used with basic units)

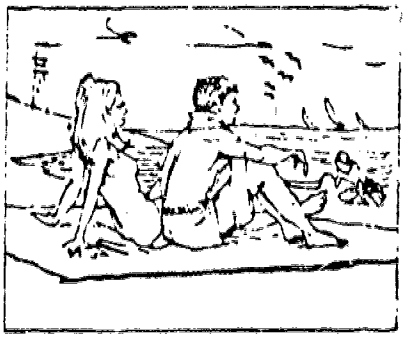
Milli: one-thousandth (0.001)
Centi: one-hundredth (0.01)
Kilo: one-thousand times (1000)

For example:
1000 millimeters = 1 meter
100 centimeters = 1 meter
1000 meters = 1 kilometer

1 LITER



1 QUART



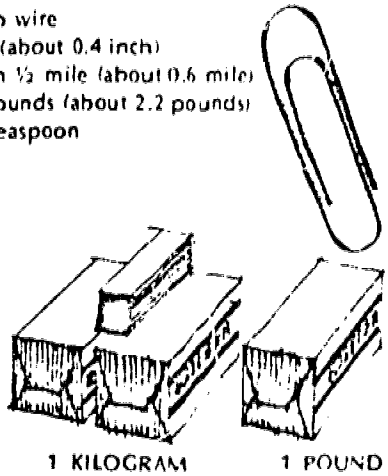
25 DEGREES CELSIUS

OTHER COMMONLY USED UNITS

Millimeter:	0.001 meter	diameter of paper clip wire
Centimeter:	0.01 meter	width of a paper clip (about 0.4 inch)
Kilometer:	1000 meters	somewhat further than ½ mile (about 0.6 mile)
Kilogram:	1000 grams	a little more than 2 pounds (about 2.2 pounds)
Milliliter:	0.001 liter	five of them make a teaspoon

OTHER USEFUL UNITS

Hectare: about 2½ acres
Tonne: about one ton

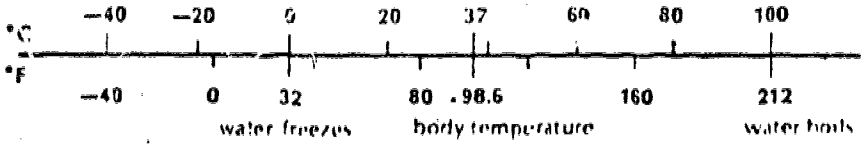


1 KILOGRAM

1 POUND

TEMPERATURE

degrees Celsius are used



For more information, write to: Metric Information Office, National Bureau of Standards
Washington, D.C. 20234

SOME INFORMATION, ACTIVITIES AND RESOURCES ON THE METRIC SYSTEM

BY: ALLENE D. WAKEFIELD

I. General Information.

A. Some basic principles of measurement:

1. Measurement is a comparison.
2. Measurements are approximate.
3. The measuring unit must be of the same nature as the object being measured (e.g., we do not weigh the distance from here to Atlanta.)
4. When we wish to make more precise measurements, we subdivide the unit. Sometimes the subdivisions are given names, and become units. (e.g., ¼ gallon is a quart). This is especially true in the metric system. (1/100 liter = 1 centiliter)

B. The metric system.

1. Basic units.

   a. Length : meter (m)
   b. Weight : gram (g)
   c. Volume : liter (L)

2. Greek prefixes indicate multiples; Latin prefixes denote subdivisions. These are basic:

   a. deci - 1/10 .1 (d)
   b. centi - 1/100 .01 (c)
   c. milli -1/1000 .001 (m)
   d. deka - 10 (dk)
   e. hecto - 100 (h)
   f. kilo - 1000 (k)

For your information, some others are:

g. mega - 1,000,000 (M)
h. giga - 1,000,000,000 (G)
i. tera - 1,000,000,000,000 (T)

And.

j. micro - 1/1,000,000 (m)
k. nano - 1/1,000,000,000 (n)
l. pico - 1/1,000,000,000,000 (p)

C. Do not stress conversion from the English System to the metric system. Rather, help the children estimate in each system. They should realize that a meter is close to a yard; their little finger is <u>about</u> one cm wide, etc.

D. Depending on the child's grade level and ability, exercises like the following could be given:

1 _____ = 1000 meters.
1 hectometer = _____ meters.
1 _____ = 10 meters.
1/10 meter = 1 _____.
1 _____ = .01 liter.
100 grams = 1 _____.

345 cm = meters + ____dm + ____cm
847.92 m = ____ hm + ____ dkm + ____ m
+____dm + ____ cm
2.006 liters = ____liters + ____ ml

E. Cuisenaire rods are based on the metric system. If children are familiar with the rods, the rods are useful for the introducing of the metric system. The white rod is one centimeter in length and one cubic centimeter in volume. The orange rod is ten centimeters or one decimeter in length.

II. Some Activities.

A. <u>Principle</u>.

Activities can be used to develop and/or reinforce lesson.

B. <u>Activities</u>:

1. Let students work singly or in pairs to fill out the personal data sheet.

PERSONAL DATA SHEET

Name_____Date_____

1. Age: _____ years _____ months
2. Height: _____ft. ____in. or _____cm
3. Weight: _____lbs. or _____kg _____g
4. Waist: _____in. or _____cm
5. Chest: _____in. or _____cm
6. Span: _____in. or _____cm
7. Reach: _____in. or _____cm
8. Pace: _____
9. Length of shoe: _____in. or _____cm

2. Graph collections of various items of personal data from above.

Examples:

a. Make a graph showing each student's height in cm.
b. Let students work in pairs to cut string to represent various personal measurements. String can be taped on chalkboard or glued to posterboard to form a number of different bar graphs. Strings can be measured in centimeters.
c. Let each child cut a strip of paper as long as his stride. Use these strips to measure the classroom. Make a graph of paper strips. Record length of classroom in strides beneath each stride.
d. Have a group of students measure out a distance of 50(?) meters. Time students as they run it. Record results on a graph or chart.

3. Create a metric center. Collect objects commonly measured in metric units (16mm film, foreign road maps, cultured pearls, military shell casings, snow skis, etc.) Collect objects with English and metric label measurements. (1 box soda crackers 198 grams, 1 bottle vinegar 355 cc, etc.)

4. Measure various objects in the room in metric units. Record.

5. Use adding machine tape to make a 2-meter strip to measure their heights. Mark it off in centimeters.

6. Use 2 paper plates, a coat hanger and string to make a balance. Weigh various objects: pencil, key, etc. *1 paperclip weighs approx. 1 gram. Use groups of paperclips to balance other objects.

7. Use pictures from Sears (or other) catalogs to make job cards.

Examples:

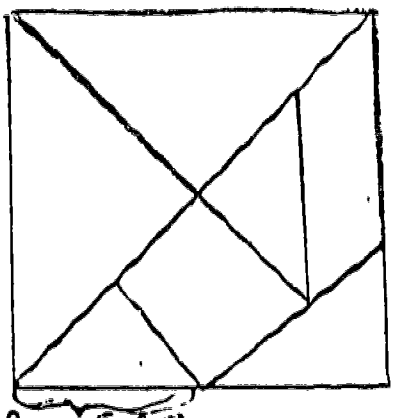
a. Picture of toy train set.
Activity: Use string to measure the track. Then measure your string in centimeters. (and/or decimeters and centimeters)
b. Pictures of people - different sizes
Activity: measure the people in centimeters, compare their sizes.
c. Let children cut out pictures of various objects as they desire. Then let them measure the pictures. Arrange them on construction paper according to size. Write their heights.

d. Teacher gives a list of 5 definite measurements. Children search catalogs for pictures of objects that are as tall as the given measure.

8. Girls enjoy Barbie dolls.

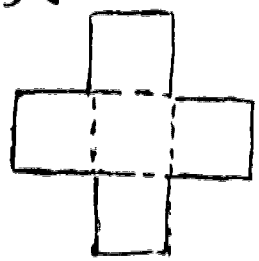
a. Measure Barbie in centimeters: height, weight, waist, feet, wrist, etc.
b. Measure her shoes, comb, etc.
c. Make a skirt (etc.) for Barbie. (Teacher, please give skirt measurements in centimeters. They can make a maxi and/or mini. Younger children do not have to put in a hem. Older girls (6th grade up) should be given hem measurements in centimeters.)

9. Make a Chinese Tangram Puzzle. Make each side 0.1 meter. (or 1 decimeter or 10 centimeters which are all the same, of course.)



Cut out your drawing.

a. Rearrange pieces to make a square.
b. Make a figure like the telephone.
c. What else can you make? (See tangram puzzle, books, cards, etc.)



Use paper that is marked off in one centimeter squares. Draw and cut out this design. Fold it on the dotted lines and use a little tape to help you make a box.

The box is <u>one cubic centimeter</u> in size.

a. Make a similar pattern for a box that is two centimeters on each side.

   (1) How many one centimeter cubes will it hold?
   (2) What happens to the volume when the length of a side doubles?
   (3) See if you can predict how many "one cm cubes" can fit into a box that is 3 cm on each side. Make a 3 cm cube. See if you were right.

b. Make a 10 cm cube.

   (1) How many 1 cm cubes will fit into it?
   (2) This is 1 liter. Make cubes to show 1 centiliter. 1 deciliter, 1 dekaliter, etc. Put them on a poster, or get a branch of a tree and from it hang these metric units. Give it a name: Liter tree, Merry Metric Tree, or one of your own.

11. Provide materials for [illegible] a real one or a miniature model. Give all measurements in the metric system.

12. Make use of string to show a dekameter, (and perhaps a hectometer and a kilometer.) Have children measure and mark off each meter with a felt tip pen. They can use the string to measure and mark off the school corridor, the perimeter of the school yard, etc. They will get some feel for the various measures.

    a. Perhaps children could put signs in the corridor marking off each dekameter.
    b. A 100 meter walk (dash) could be set up.
    c. Children could compute the number of times they must walk around the perimeter of the school yard to cover a kilometer.

13. Sponsor a "Metric Day" or "Metric Week" at your school. Require any measuring activities to be done in metric units. Examples: Temperature in Celcius degrees; recess relay races in metric lengths; post signs telling distances to "Miss Smith's Room" in metric units; use kilometers per hour to give speed limits on school property (walking (?) or driving)

14. Make a 1 cm cube (see activity 10). If it were filled with water, the weight of the water would be one gram. Make a chart showing a dekagram, hectogram, etc.

15. The volume of the white cuisenaire rod is one cubic centimeter. Cubic centimeters in various rods. One orange rod is 10 cc. What is the volume of 10 orange rods? Have them put 10 orange rods side by side, and have them cover the rods with white rods - Count how many. If you stacked 10 layers of 10 orange rods, how many cubic centimeters would you have? You have 1,000. This is one liter.

III. Some Resources.

Addison Wesley Publishing Company, Inc., James McNeeley, Representative, 9 Dunwoody Park, Suite 120, Atlanta, Georgia, 30341, (404) 394-7820).

A. Paper centimeter strips, color coded as Cuisenaire Rods.
B. Success with Mathematics: duplicator masters for instructional aids - vol. 1. Contains masters for 1 cm square graph paper, centimeter and millimeter rulers and other non-metric activities.

Metric Association, 2004 Ash Street, Waukegan, Illinois, 60085.

From this non-profit organization you can obtain for $3.00: one 20 cm plastic ruler; two 1.5 m plastic measuring tapes; two copies of the booklet, Metric Units of Measure; one workbook for students and teachers Metric Supplement to Science and Mathematics; one GO METRIC bumper sticker; one copy of the last newsletter; membership in the Metric Association which includes a subscription to the newsletter.

General Information about metrication: Superintendent of Documents, US Government Printing Office, Washington, D. C., 20402.

Metric Information Office, US Department of Commerce, National Bureau of Standards, Washington, D. C., 20234.

Midwest Publications Company, Inc., Box 129, Troy, Michigan, 48084.

A. I'm OK. You're OK. Let's Go Metric, $3.25, Dr. Donald A. Buckeye. This book is a set of activities to introduce the metric system. The activities are divided into four reading levels: no read, low read, medium read, high read. The activities can be torn out and laminated; materials needed are close to zero budget.

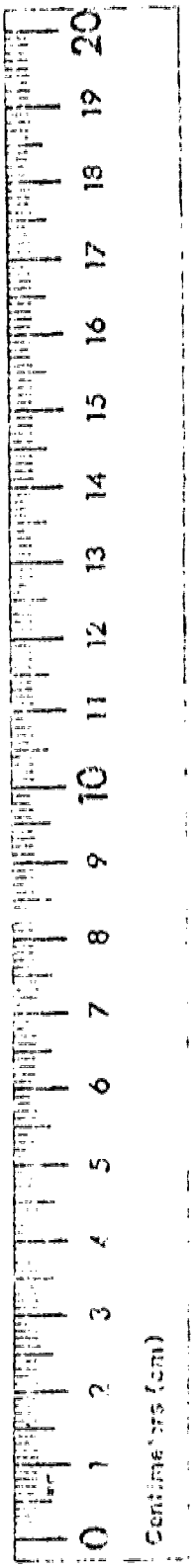
The Cooper Group: Crescent, Lufkin, Weller, P. O. Box 728, Apex, North Carolina, 27502.

A. The Amazing Story of Measurement. In comic book format and put out by manufacturers of precision instruments, this little booklet gives a concise and easy to understand history of measurement. Small quantities of the book can be obtained free of charge. They usually take a long time to arrive, so order long before you need them. They can be a basis of a learning center.

Man the Measurer, Roy A. Gallant, 1972, Doubleday and Company. Contains a history of measurement. Suitable as a library book for upper grade students.

IV A

RULER MASTER AND METRIC PREFIXES



Metric System Prefixes:

milli = 0.001
centi = 0.01
deci = 0.1
deka = 10
hecto = 100
kilo = 1000

Metric Units of Length:

1000 millimeters = 1 meter
100 centimeters = 1 meter
10 decimeters = 1 meter
10 meters = 1 dekameter
100 meters = 1 hectometer
1000 meters = 1 kilometer

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PRIOR TO BEING SHIPPED TO EDRS DUE
TO COPYRIGHT RESTRICTIONS

MASS (WEIGHT) ACTIVITIES

ACTIVITY #1 - Guess the Mass

Objective: The teacher/student should be able to accurately guess the mass of several predetermined objects and then check himself.

Problem: Estimate and then determine the mass of the following objects:
- nickel
- piece of chalk
- ring
- liter of water
- paper clip
- pound of meat

Materials: balance scale (two, if possible)
items listed above
other items of interest to the participants

Directions: Estimate, then determine the mass (in grams) of the aforementioned items.

ACTIVITY #2 - A Dollar's Worth of Change

Objective: The teacher/student should be able to find the mass of objects accurately and to calculate using metric measures.

Problem: Find the mass of a dollar's worth of pennies, nickels, dimes, and quarters, and determine which combination will have the greatest and least mass.

Materials: balance scale
100 pennies
20 nickels
10 dimes
4 quarters

Directions: Find the mass of 100 pennies, the mass of 20 nickels, the mass of 10 dimes, and the mass of 4 quarters. Which combination of coins adding up to $1.00 has the greatest mass, the least mass?

WEIGHT ACTIVITIES

Objective: The purpose of these activities is to provide many different experiences weighing both liquid and solids. The teacher/student will acquire skill in measuring correctly various liquid and dry substances within 1 milliliter and 5 grams of accuracy.

ACTIVITY #1

Materials:
ice
flour
sand
balance scale
water
various measurement containers
various mixing containers
plaster of paris

Directions: Using metric measuring materials and instruments, answer the following:

1. A liter of ice cubes weighs _____.
2. Allow the liter of ice cubes to melt. What is the volume of water remaining? _____ How much does the remaining water weigh? _____
3. A liter of unsifted flour weighs?_____
4. How much does a liter of sifted flour weigh?_____
5. How much does a liter of unmixed plaster of paris weigh?_____
6. Mix the plaster with a liter of water. The volume now is _____.
7. Allow the mixture to dry for 24 hours. How much does it weigh now? _____
8. Weigh a liter of sand. _____
9. Mix the sand with a liter of water. It now weighs_____.
10. The volume is _____.

WEIGHT ACTIVITIES (CONTINUED)

ACTIVITY #2

Materials: can of fruit
tangerine (or substitute)
scale
measurement container

Directions: Using metric equipment, answer the following questions:

1. Weigh the content of a can of fruit._____
2. Separate the fruit from the juice. The volume of the juice is _____.
3. How much does just the fruit weigh?_____
4. Add the fruit and juice together. What is the volume now? _____
5. Weigh a tangerine. _____
6. Weigh just the skin. _____
7. How much does the fruit weigh? _____
8. How much do the pits weigh? _____

TEMPERATURE ACTIVITIES

Objective: The purpose of these activities is to provide experiences in determining Celsius temperature. The teacher/student should be able to discover three important temperature readings using the Celsius thermometer.

Problem: Using the Celsius thermometer and other provided materials, determine the boiling point of water, the freezing point of water, and the current room temperature.

ACTIVITY #1

Materials: metal backed Celsius laboratory thermometer
small electric coffee pot
water

Directions: Using metric measuring instrument, determine the Celsius temperature at which water boils.

ACTIVITY #2

Materials: metal backed Celsius laboratory thermometer
container of crushed ice

Directions: Using metric measuring instrument, determine the Celsius temperature at which water freezes.

NOTE: It is virtually impossible to get Celsius thermometer to record a freezing point of 0 unless it stays in the container of ice for an extended period, which in this case was not desirable.

ACTIVITY #3

Materials: Celsius laboratory thermometer

Directions: Using metric measuring instrument, determine the current room temperature.

VOLUME ACTIVITIES

ACTIVITY #1 - Estimating and Finding Volume (Capacity)

Objective: The teacher/student should be able to estimate and then find the exact volume of several containers.

Problem: Find the capacity in liters and milliliters of each of the following containers:
- mustard jar
- instant coffee jar
- 32 oz. Coke bottle
- 1 liter Coke bottle
- 8 oz. household glass

Materials:
- 2 liter pitchers
- large jug
- mustard jar
- instant coffee jar
- 32 oz. Coke bottle
- 1 liter Coke bottle
- 8 oz. household glass

Directions: Estimate and then find the exact capacity in liters and milliliters of the aforementioned containers.

Extension Activity: Ask teacher/student to estimate the capacity of an automobile's gas tank, in liters.

ACTIVITY #2

Objective: The teacher/student should be able to think in liters and milliliters after participating in this activity.

Problem: Given three containers of water, one containing 800 milliliters, one containing 500 milliliters, and one containing 300 milliliters, pour water back and forth in these containers until one container has 400 milliliters in it.

Materials: 3 containers of water properly marked in milliliters

Directions: Using the provided containers of 800, 500, and 300 milliliters of water, prepare one container from these three that will contain exactly 400 milliliters. There can be no estimating.

THINK METRIC

Classroom Activity

Part A: Use your balance scales to do these problems.

1. The weight (mass) of two gem clips is _____.

2. A nickel weighs _____.

3. Weigh your pencil. _____

4. Weigh several other items and list below:

Item	Weight (Mass)
_____	_____
_____	_____
_____	_____
_____	_____

Part B: Work the following problems.

1. Jane bought 2 kilograms of candy. Bob bought 1500 grams of the same candy. Who had more candy? _____

2. Sally weighs 50 kilograms and is 165 centimeters tall. Is she fat, thin, or about the right size? _____

Part C: Choose the best unit of weight (gram or kilogram) for measuring each of these.

1. A bar of candy (10¢ bar) _____

2. A silver dollar _____

3. Your weight _____

4. A large book _____

5. A thumb tack _____

THINK METRIC (Linear)

Classroom Activity

Part A: Use your metric ruler to do these problems.

1. The length of your pencil _____ cm
2. The width of your desk ____ cm
3. The height of your desk ____ cm
4. The length of your foot ____ cm
5. Width of this page ____ cm
6. Length of this page ____ cm
7. Width of your thumb ____ cm
8. Width of a coin ____ cm

Part B: Solve the following problems:

1. David is 120 centimeters tall, Karen's height is 110 centimeters, and Eric's height is 105 centimeters. The total of their heights is _____ centimeters or _____ meters.

2. The tallest known Oregon redwood tree is approximately 108 meters tall. If the average growth of a redwood tree is about 2 meters per year, about how old is this tree? _____ years

Part C: Choose the best metric unit or length (meter, centimeter, millimeter, or kilometer) for measuring each of the following items.

1. Length of a sheet of paper _____
2. Circumference of earth _____
3. Depth of the ocean _____
4. Length of fabric _____
5. Height of a tree _____
6. Length of a shoelace _____

THINK METRIC (Volume)

Classroom Activity

Part A: Use your liter flask to do these problems.

1. Which contains more, a quart of water or a liter? _____

2. About how many milliliters in a cup? _____ (Use an 8 oz cup)
   (Then try it again for any size of paper cup.)
3. Take the cubic decimeter box and fill it with water. Pour carefully into the liter flask. What do you observe? How many milliliters did it hold? _____

   _____

4. How many cubic centimeters in a cubic decimeter? _____

5. What do you now know about a milliliter and a cubic centimeter?

   _____

6. Weigh the liter flask of water. Pour the water out and weigh the flask. How much does the water weigh? _____

Part B: Now try to work the following.

1. Could you drink 250 ml of water without pausing for breath? Try it!
   (Use a paper cup.)

2. Could you serve a paper cup (8 oz.) of coke to each of six friends if you had 1 liter of coke? _____ Would there be some left? _____
   About how many milliliters? _____

ESTIMATION AND MEASUREMENT

I. First estimate, then measure each of the following to the nearest centimeter.

		Estimate	Measurement
1.	the length of your desk top	_____	_____
2.	the width of your desk top	_____	_____
3.	the length of the sole of your shoe	_____	_____
4.	the distance from your wrist to your elbow	_____	_____
5.	the longest distance you can make between your thumb and little finger of one hand	_____	_____
6.	the thickness of your desk top	_____	_____
7.	the width of this paper	_____	_____
8.	the length of your pencil or pen	_____	_____
9.	the length of your left thumbnail	_____	_____
10.	the length of your desk pencilholder	_____	_____

II. First estimate, then measure each of the following to the nearest meter.

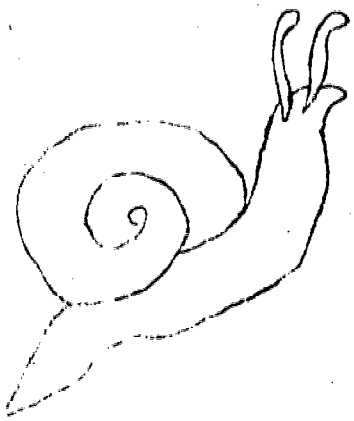
1.	the length of the room	_____	_____
2.	the width of the room	_____	_____
3.	the height of the door	_____	_____
4.	the length of the chalk board	_____	_____

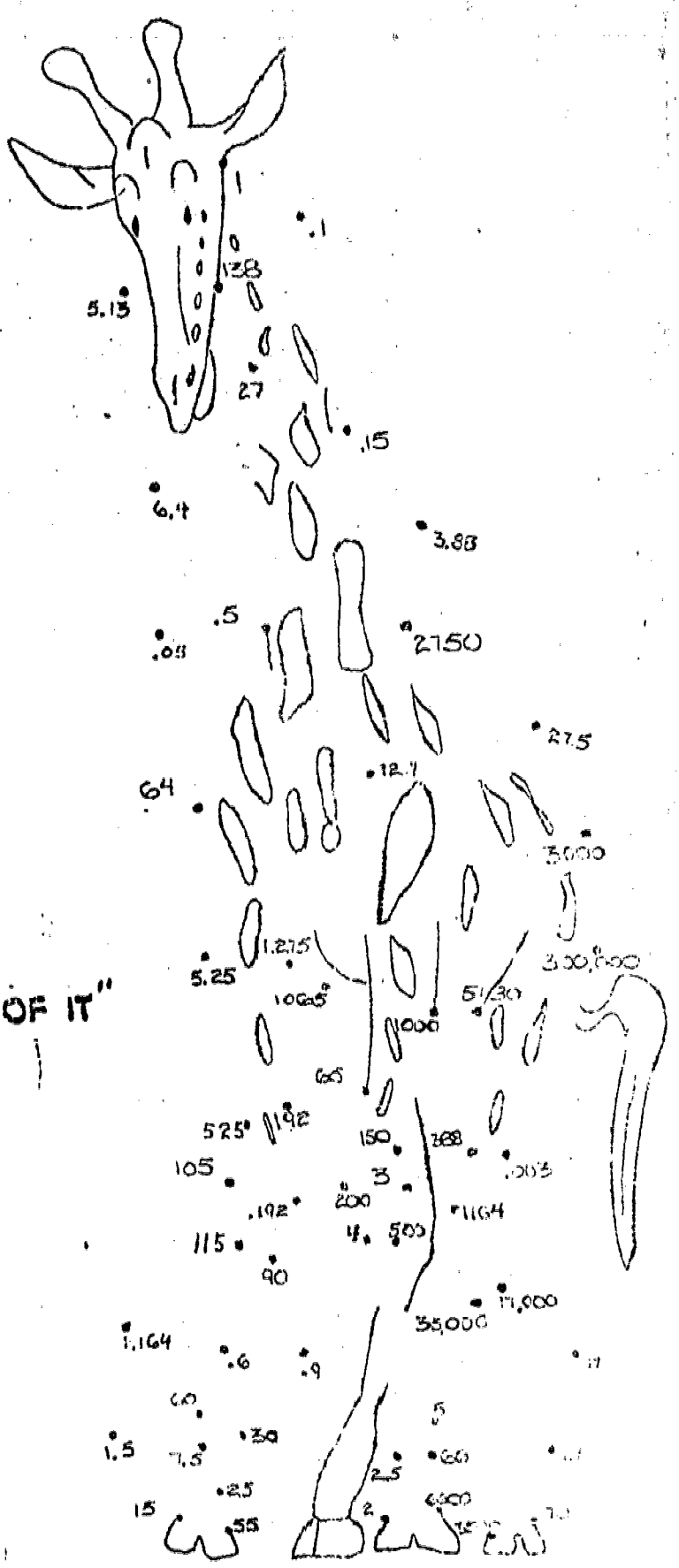
Connect the answers in order.

1. 10 mm = _____cm
2. 15 cm = _____m
3. 275 m = _____dm
4. 3 [illegible] = _____m
5. 3 [illegible] = _____cm
6. 5 [illegible] = _____m
7. .1? km = _____cm
8. .1? cm = _____m
9. 35 [illegible] = _____cm
10. 35 [illegible] = _____mm

Continued on next page

"THE LONG AND SHORT OF IT"





11. [illegible] 409.7 km, [illegible] 3 successive days. What was the total distance travelled? _____km

12. On the trip in problem 11, what was the average distance travelled per day? _____km

13. The largest fish ever caught on a rod measured about 513 cm long. How many millimeters is that? _____mm

14. There are 3000 meters in 3 km. How many meters in 1 km? _____m

15. The smallest shark found in the Philippines measures only 15 cm. How many millimeters is that? _____mm

16. The height of a ceiling is 300 cm. How many meters is that? _____m

17. A rectangular table is 90 cm wide by 160 cm long. What is its perimeter? _____cm

18. In problem 17, what is the perimeter in meters? _____m

19. How many meters of fencing are needed for a rectangular play area 11 m wide by 22 m long? _____m

20. In problem 19, what is the amount needed in centimeters? _____cm

In problems 21-43, choose the best estimate.

21. The average height of a basketball player
(A) 3 cm (B) 2 m (C) 1 dm

22. The height of a ceiling in a home is
(A) 2.5 m (B) 3.5 cm (C) 4.5 dm

23. The length of a ladybug is
(A) 4 mm (B) 2 m (C) 3 km

24. The length of a mattress is
(A) 100 cm (B) 150 m (C) 200 cm

25. The waist measurement of a stewardess is
(A) 65 cm (B) 66 mm (C) 67 m

26. The length of the George Washington Bridge is
(A) 2000 mm (B) 1065 m (C) 1500 km

27. The length of the Golden Gate Bridge is
(A) 1.275 km (B) 1275 mm (C) 127.5 km

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METRIC GAME ACTIVITIES

METRIC CONCENTRATION (2-4 players)

Necessary materials: 24 cardboard cards

Label each card with one part of a pair of metric terms, such as two cards would be labelled "kilometer" and two cards labelled "decimeter." There will be 12 matched sets of metric terms.

Directions: Shuffle cards and place them face down on the table. Players turn up two cards at a time. If cards match, player keeps cards and takes another turn. If cards do not match, it is the next player's turn. Play continues until all cards have been matched. Player with most cards wins.

Alternatives: Cards could be labelled with 12 sets of metric equivalents, such as 10 cm and 1 dm. Cards could be labelled with 12 sets of matched metric prefix and decimal equivalent, such as deci and .1.

METRIC WHEEL (individual activity)

Necessary materials: circular piece of cardboard
10 wooden clothespins

Make up 10 pairs of equivalent metric measurements, such as 100 cm and 1 m. Label the circular wheel with 10 metric measurements. Label each clothespin with one of the matching measurements. Turn wheel over and record answers on the back.

Directions: Children match equivalent metric measurements by clipping clothespins on wheel in appropriate place. Check answers on back of card.

Alternatives: Match abbreviations with metric terms, such as km for kilometer. Match metric prefix with decimal equivalent, such as centi and .01.

SPIN - A - METER (2 players)

Necessary materials: stick 1 meter long
strips of colored paper 1-10 cm long
(or cuisenaire rods)
spinner with all ten colors represented
on it

Directions: Player spins to see who goes first. The player who spins the longest color goes first. Players take turn spinning and selecting strips of appropriate colors. Strips are placed in a train along the side of the meter stick. The first player to make the 1 m stick length wins.

SPIN - A - 100 CM TRAIN (2 players)

Necessary materials: meter stick
cuisenaire rods
centimeter rulers
spinner

Label the spinner from 1 cm to 10 cm.

Directions: Players spin to determine the length of cuisenaire rods they will select. Using the centimeter rulers, they measure to find a rod length to match the centimeter they spinned. Players place rods on each side of the meter stick. First player to reach 100 cm in winner.

THE CAR RACE!

A Metric Game by Elisabeth Hallamore
(in The Metric Book, Barron's Educational Series, Inc., 1974)

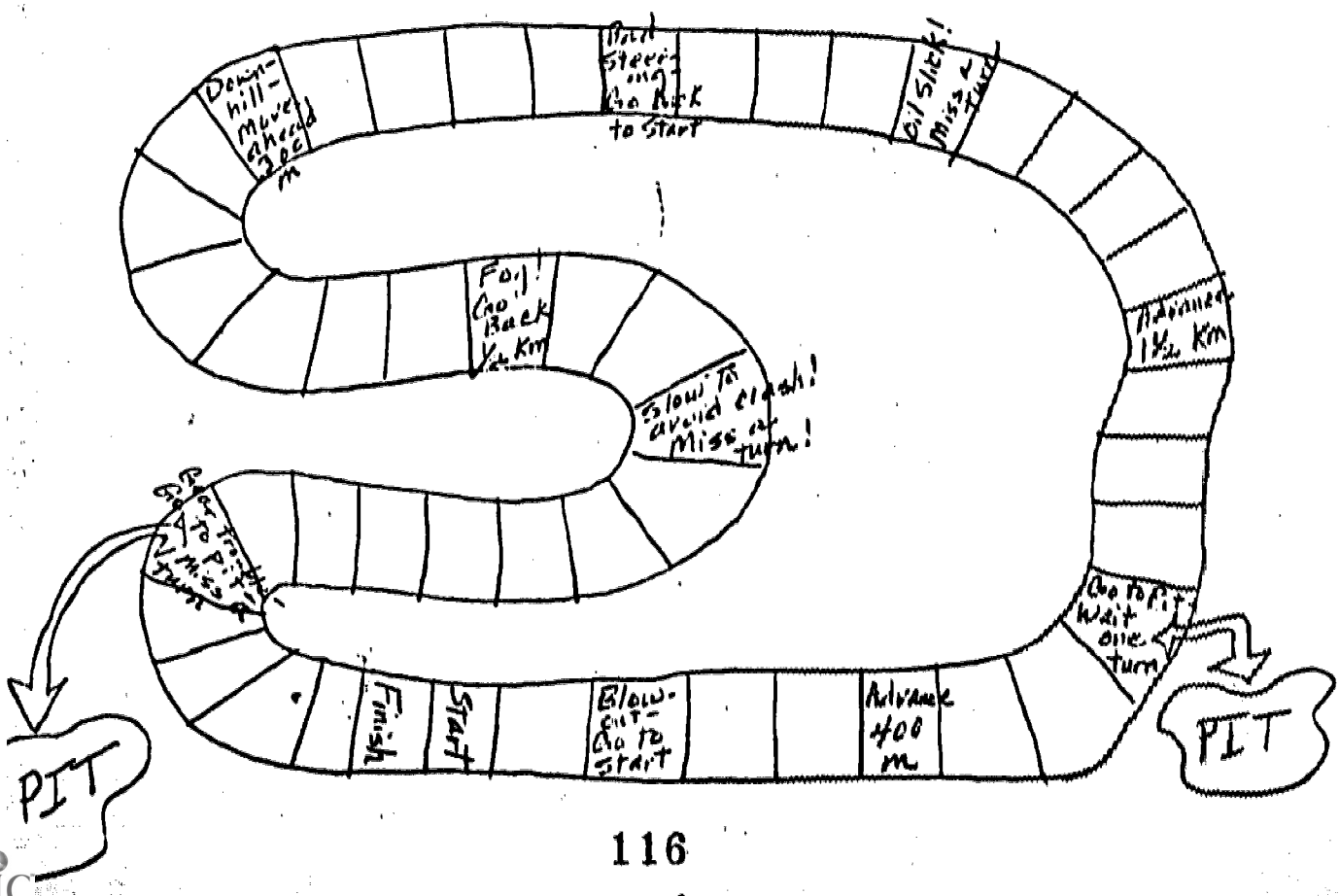
Number of Players: 2 to 4

Note: Each space on the track represents a 100 meter length.

How to Play:

1. Use 2 regular dice. Place a marker (like chess pieces) on the starting line for each player or driver.
2. Roll one of the dice to decide who starts first. The highest number goes first, then next highest goes next, and so on.
3. The first driver rolls the dice, counts the spots on top and moves that number of spaces.
4. The next driver continues in the same way, and so on.
5. If a player rolls a double, he moves that number of spaces and takes another turn. (For every double rolled, even if he does it several times in a row, he gets another turn.)
6. Follow all the other directions on the race track.
7. The winner is the first one to cross the finish line after two laps have been completed.

Design for the Gameboard: (Sample)



METERS FOR KILOMETERS!

A Metric Game with Cards

(from The Metric Book by Elisabeth Hallamore, Barron's Educational Series, Inc., 1974)

Number of Players: 3 to 5

(For an alternate game, use grams and kilograms instead of meters and kilometers.) (The alternate terms are shown in parentheses below in the rules.)

Needed:

1. A deck of 52 cards cut from light weight cardboard. Print 500 meters (grams) on 7 cards, 1000 meters (grams) on 2 cards, and make 10 each of 50 meters (grams), 100 meters (grams), 200 meters (grams) and 400 meters (grams).
2. Print "Exchange for 1 km"(kg) on the remaining 3 cards.
3. 16 additional cards of a different color. Label each "1 kilometer" (kg).
4. 2 small trays (you can make these by cutting the bottoms off milk cartons).

Rules:

1. Place the 16 cards labelled 1 km (kg) in one of the trays. Keep the other tray for exchange cards.

2. The dealer shuffles the deck of 52 cards and deals 5 cards one at a time to each player.

3. Any player with an "Exchange for 1 km" (kg) card puts it in the exchange tray. The dealer gives him in return a "1 km" (kg) card and the player places this card face up in front of him.

4. The dealer places the cards left over from the deal face down in a pile in the center of the table. He turns the top card face up and places it beside the pile (discard pile).

5. The player to left of the dealer begins the play. He may choose to pick up either the top card on the pile or the face up card. His aim is to make some or all of his cards total 1000 m (g). If the player has 1000 m (g) worth of cards in his hand, he shows them to the other players for checking. He then places them in the exchange tray and picks up a 1 km (kg) card. The player places this card face up in front of him, then discards one card from his hand.

6. The player to the left then has his turn.

7. Play continues until one of the players has exchanged all his cards for 1 km(kg) cards and the last card has been discarded from his hand. Then the game is over.

8. The players with cards left in their hands must deduct the number of meters (grams) they have from their kilometer (kilogram) cards. The player with the most kilometers (kilograms) in front of him is the winner(that is, the one with the greatest remaining number of points).

LINUS' LINES
A Measuring Game in Metric Fun!

For 2 to 4 players Needed: Centimeter rulers, pencils

Rules:

1. Each player needs a game sheet and a metric ruler marked in centimeters with millimeter divisions. A set of cards should be designed to suit the level of the pupils who are to use the cards.
2. To begin playing each player draws a card at random and the player whose card states the greatest length is named to be the first player.
3. Shuffle the deck. Start playing and rotate clockwise.
4. A play consists of drawing a card and constructing a segment equal in length to the length indicated on the card drawn. The first line segment must start from the end of Linus' pointing finger, going in any direction. Successive segments constructed on each turn must start at the end point of the last segment constructed, going in any direction. The player keeps the card unless it is a "Linus Card". (For small decks of less than 20 cards, return all cards to bottom of deck after each draw.)
***5. The object of the game is to end a segment within circle 1, then continuing the segments, go to circle 2, to circle 3, and to circle 4. The first player to end in circle 4 wins the game.
6. A segment may not pass completely through any circle during the game, but segments may intersect. If a player feels that he cannot draw his segment anywhere without going through a circle or going too far out of the way, he may pass without drawing a segment.
7. When a "Linus Card" is drawn the player must follow the directions, and then return the "Linus Card" to the deck.

Suggested Decks of Cards to Make and Use:

Deck A: Include only lengths expressed in centimeters, and include some "Linus Cards" with instructions such as "Go to the next circle", "Start over", "Do what the last player did and take another turn", "Go to circle #2", "Estimate the distance to the next circle, and if your estimate is correct to the nearest centimeter, go to the next circle", etc.

Deck B: Include only lengths expressed in millimeters, and include "Linus Cards" as described above.

Deck C: Include some cards with lengths expressed as centimeters and some in millimeters. Include some Linus Cards.

Deck D: Include some cards with lengths expressed in centimeters, millimeters, and decimeters. Include some Linus Cards.

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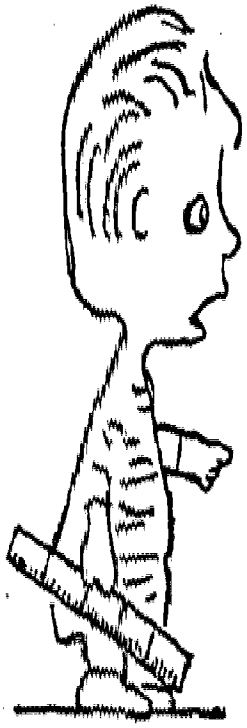

LINUS' LINES

4

1

113

3

2

METRIC SONGS

"The Centimeter Worm"
(to tune "Inchworm")

Hundred Centimeters make a meter,
Hundred Centimeters make a meter,
That's all you have on your metric-like mind,
Hundred Centimeters make a meter,
Hundred Centimeters make a meter,
Why can't you understand?
Refrain:
Centimeter worm - centimeter worm,
Measuring the metric lines,
You and your measurements,
You'll probably go far!
Seems to me you'd stop and see,
How beautiful they are.

"Join the Metric System"
(to Pepsi-Cola tune)

Join the metric system - Use a meter, not a foot.
Do the metric system - A little change is all it took.
All across the nation - It's the metric generation.
Here today and here to stay for measuring.

THE METRIC SYSTEM

A POST TEST

Name _____

1. In what country did the Metric System originate? _____

2. The _____ is the standard metric measure for [illegible].

3. The _____ is the standard metric measure for [illegible] or capacity.

4. The _____ is the standard metric measure for weight or mass.

5. Temperature in the Metric System is measured by _____ degrees. (Fahrenheit, Celsius).

6. In the Metric System, each unit is _____ times the next smaller unit. (1, 10, 100, 1,000).

7. A meter is the same as _____ centimeters. (1, 10, 100 [illegible]).

8. To measure the thickness of a dime, you would use _____ the Metric System. (meters, centimeters, millimeters, [illegible])

9. A meter is nearest in length to a _____. (foot, [illegible] mile [illegible]).

10. A gram is the same as _____ milligrams. (1, 10, 100, 1,000).

11. A package of butter would be measured in _____ in the Metric System. (grams, liters, meters).

12. A liter is nearest in volume to a _____. (pint, quart, gallon).

13. Which of the following would be appropriate for measuring vanilla flavoring in a recipe? _____ (Milligrams, millimeters, milliliters).

14. The boiling point on the Celsius scale is _____. (10° C, 212° C, 100° C).

15. The normal body temperature on the Celsius scale is _____. (37° C, 0° C, 98° C).

16. Match the following Metric System prefixes with their meanings:

_____milli	A. ten
_____centi	B. one hundred
_____deci	C. one hundredth
_____deca	D. one thousandth
_____hecto	E. one thousand
_____kilo	F. one tenth

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