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Date June 15, 1977

IN-SERVICE METRIC EDUCATION FOR A SECONDARY OR POST-SECONDARY VOCATIONAL FOOD SERVICE PROGRAM

by

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ABSTRACT

The current status of U.S. metrication in industry, government, and education was examined through an extensive literature review including the historical perspective which led to passage of the Metric Conversion Act of 1975. Vocational education is the liaison between the formal educational setting for imparting knowledge and the various industries for whom it prepares students with specialized training for occupational success in the world of work. Food service is a subcategory of consumer and home economics related occupations which is one of the seven broad vocational instructional areas. Food service and preparation will undergo changes in terms of weight, volume, and temperature measurements that will require extensive changes in both materials and teaching techniques to facilitate the transition to the metric system of measurement.

The specific concerns of vocational metric education were examined to provide the foundation for designing a learning package of metric materials for the awareness stage of the 'think metric' process for secondary and post-secondary students in a vocational food service program. The 'think metric' strategy involves learning to think meaningfully in terms of metric measurement. When the 'think metric' approach is combined with 'hands-on' metric measurement learning activities which provide a reference framework of equivalent units in the customary system, vocational students are able to acquire measurement skills and SI knowledge necessary to perform occupational related tasks on the job.

The outgrowth of the investigation led to the development of a learning package of metric materials designed to follow the format outlined by the American Home Economics Association. The learning package contains two sections, one for the instructor and one for the student. Objectives, learning activities for the metric concepts of length, weight, volume, and temperature, and evaluation instruments are presented to introduce secondary and post-secondary students in a vocational food service program to the metric system of measurement. The learning package awaits testing for content validity before implementation.

Chapter 1

DESCRIPTION OF THE PROJECT

Introduction

Metrication is now visibly upon the American horizon with the passage of the Metric Conversion Act of 1975. Education is one of the primary sectors faced with the challenges of adopting the metric system as the accepted common system of measurement.

Plans and programs for metrication appear to be proceeding in a disjointed manner lacking both specific federal steering and state guidelines (Cross, 1975). National surveys of public attitudes toward the metric changeover have shown that the more knowledgeable a person is about it, the more receptive the person will be to conversion.

The industrial response to the worldwide metric measurement language necessitates metric training specific to each industry. Because each individual uses measurement units in a variety of ways, requirements for metric training will vary considerably.

Vocational education provides a unique bridge between general education and preparation for occupational success. According to the Metric Education, Interpretive Report No. 1 (1975), vocational education and home economics courses will require extensive changes in both materials and teaching techniques to facilitate metric transition. Consumer and home economics related occupations is one of the seven broad vocational service programs used to categorize vocational

instructional areas. Occupational preparation for employment in the food service industry is an important subcategory of consumer and home economics related occupations.

Vocational education emphasizes training for entry level employment at the secondary level. Post-secondary programs place emphasis on training for upgrading of worker skills or advanced technical training. Vocational programs are designed to present situations where manipulative skill training is combined with the related trade knowledge required to perform occupational related tasks on the job in response to the needs of industry. Vocational education instructional programs will require familiarizing the students with selected aspects of the SI system and developing measurement skills appropriate to the occupation for which they are being trained (Dieffenderfer, 1976). Changing to the metric system in occupational food service will involve changing recipes to metric units with quantities being measured in grams, kilograms, liters, and milliliters; utensil sizes will change to linear metric units with oven temperatures being measured in degrees Celsius.

The period of transition which involves dual dimensioning requires special consideration for the development of positive attitudes that will lead to acceptance and adoption of the metric system of measurement. The process of learning to 'think metric'

involves the more complicated procedure of relearning a system of measurement which is a much more difficult process for the established learner than for the neophyte.

Education is faced with the challenge of developing metric education programs particular to the needs of each instructional area. Vocational metric education must design metric education programs and materials to prepare students to meet the changing needs of industry. The review of literature indicates an absence of metric instructional materials specifically designed for vocational food service programs.

Statement of the Project

The problem of this project will be to examine current metric information from related disciplines and design a learning package of self-instructional metric materials to be used for in-service secondary and post-secondary vocational food service programs for the first awareness stage of the five stages in the learning to 'think metric' process outlined by Warning (1972).

Purpose of the Project

The author will examine existing metric information through an extensive literature review to determine specific considerations in designing a learning package for vocational food service metric education. At the time of this writing the investigator has not

discovered pertinent curriculum materials for metric education in vocational food service programs.

Nevada educators report in a 1976 study that they consider students inadequately prepared in the metric system (Trend & Lee, 1976). Because learning metrics is like learning a second language, metric education will require more effort, time, and patience for those persons who have previously learned customary units (Cooper, Magisos, Hauck, & Channell, 1975). According to Cooper et al. (1975) the metric system provides students in vocational education programs with the vehicle for learning basic measurement skills.

Vocational metric education emphasis is placed on teaching SI measurement through practical application relevant to training needs of the instructional area. Appropriate metric experiences are needed to guide the learner to discovery of measurement concepts while at the same time exciting the student's interest and enthusiasm. Students approaching adulthood need to know enough about the metric system to function effectively both on the job and as consumers.

Although metric conversion is progressing in the United States, Pokorney (1973) notes the near absence of quality metric training materials. Persons undertaking metric training programs have had to create their own materials which is both time-consuming and requires creative talent (Pokorney, 1973). Odom, Metric Coordinator of the

National Bureau of Standards, asserts that attention must be paid now to improving both the quantity and quality of metric education (The Current Status and Impact of Metric Education, 1974).

Although the Gallup Poll conducted in January 1977 with personal interviews of 1409 adults in 300 scientifically selected localities across the nation shows that 74% of Americans indicate an awareness of the metric system compared to 54% reported in 1973, only 29% were in favor of adopting the system while 39% opposed adopting with 6% undecided (Metric Reporter, 1977). Gallup concluded that part of the resistance stems from widespead ignorance of basic metric measures.

Warning (1972) notes the results of Iowa State University sociology researchers of the five stages people must advance through before adopting a new system with ease of habit and applies the five stages of learning to the 'think metric' process. While the awareness stage, information-gathering stage, application stage, trial stage, and adoption stage are concisely described, no specific suggestions are offered for implementing metric education.

The awareness stage is the introductory phase of metric education concerned with the development of positive attitudes necessary for acceptance and adoption of the metric system of measurement. Attention to this crucial preliminary stage of evolutionary metrication

is vital to both personal life and professional preparation for participation in the contemporary U.S. labor force. The American National Metric Council is sponsoring one-day metric awareness seminars in selected localities across the nation in 1977 offering an introduction to SI with 'hands-on' measurement activities designed to eliminate the fears and anxieties that many individuals, small businesses, and major corporations feel about metrication (Metric Reporter, 1977). If a person is not familiar with the metric system of measurement, introductory activities are essential.

The author is using this project in food service metric education as professional preparation. Being an effective change agent during U.S. transition requires a comprehensive understanding of the metric system of measurement.

General Questions to be Answered

An attempt will be made to answer the following questions:

1. What are the specific vocational food service needs to be considered in designing a learning package of self-instructional metric materials for the awareness stage of the 'think metric' process?

2. What are the objectives for the awareness stage of vocational food service metric education?

3. What types of materials and activities are appropriate for the awareness stage of metric education in a vocational food service program?

4. What resources are necessary for implementing metric education for the awareness stage in a vocational food service program?

General Procedure

The author will employ the format outlined by the American Home Economics Association for developing home economics learning packages in designing a learning package of self-instructional metric materials to be used for the awareness stage in a vocational food service program. The format for developing home economics learning packages provides a structure that includes both essential components for learner self-instruction and for the teacher to facilitate learner self-instruction (Home Economics Learning Packages: Format, 1970).

The learning package for the awareness stage will develop the basic concepts of metric measurement related to the needs of vocational food service. Instructional objectives of observable performance behaviors that the student will be expected to perform will be stated. A list of commercially available learning materials will be compiled to indicate the resources needed for the awareness stage of metric education in a vocational food service program. Sensory learning activities will be described to provide the student

learner with 'hands-on' metric experiences during the awareness stage. Evaluation activities of a pre-test and post-test will be developed for diagnosis of learning. Optional student-directed quests for further study related to the use of metrics in related food service situations will be suggested.

Limitations

1. Pertinent metric information was limited in scope and difficult to obtain during the transition to establishment and functioning of a central coordinating U.S. Metric Board.

2. The availability of current metric literature and resources was dependent upon diversified delivery systems which were sometimes unresponsive.

Delimitations

1. Because of the broad nature of the topic of metric education, it was necessary for the author to develop a learning package of self-instructional metric materials for only one stage, awareness, of the learning to 'think metric' process for a vocational food service program.

2. The project will remain a theoretical construct with untested content validity awaiting future implementation in appropriate circumstances.

Definitions of Terms

The awareness stage is the first stage in the learning to 'think metric' process where a person becomes aware of how her/his life will be affected by conversion to the metric system of measurement (Warning, 1972).

Customary or American system refers to the system of measurement unit (year, pound, second, degree Fahrenheit) most commonly used in the U.S., formerly referred to as the English system (Metric Education Program: Proposed Rules, 1975).

Dual dimensioning refers to the transitional period where the customary system of measurement will be accommodated while the metric system is being learned and accepted (Gaucher & Perry, 1974).

'Hands-on' experiences allow students to learn the metric system while actually doing metric-related activities (Metric Education.... 1975).

In-service education describes the time and sequence of planned instructional activities within a comprehensive educational program (Harris, Bessent, & McIntyre, 1969).

A learning package is a self-instructional unit developed for learning one basic concept in which the idea to be learned is broken into its several components for learner self-instruction and for the teacher to facilitate learner self-instruction (Ray, Shear, & Olmstead, 1970).

Metrication refers to the process of changing from the customary or American system to the metric system of measurement as defined by the International System of Units (Science Research Associates, 1976).

SI (International System of Units), popularly known as the modernized metric system, is the coherent system of units based upon and including the meter (length), kilogram (mass), second (time), kelvin (temperature), ampere (electric current), and candela (luminous intensity) as established in 1960 by the General Conference on Weights and Measures (Measuring Systems and Standards Organizations, 1970).

'Think metric' is a phrase describing the process of learning to think meaningfully in terms of metric measurement (Metric Education ..., 1975).

Summary

As the United States increasingly moves in an erratic manner toward adoption of the metric system as the common system of measurement, more attention is being focused on how education will meet the metric changeover challenge. Vocational areas including consumer and home economics related occupations are key subject areas for implementing pragmatic metrication.

The purpose of this project is to design a learning package of self-instructional metric materials to be utilized during the

awareness stage of the 'think metric' process as part of in-service metric education for secondary and post-secondary vocational food service programs. In the absence of specific information and materials, pertinent resources from other disciplines will be adapted in developing the learning package of self-instructional metric materials for the important introductory awareness stage of metric measurement in vocational food service. Based on the format developed by the American Home Economics Association for constructing a learning package of materials, activities will be devised for promoting metric awareness through 'hands-on' learning experiences that will encourage the development of positive attitudes--a necessary foundation for metric acceptance and adoption. Evaluation activities in the form of a pre-test and post-test will be developed to diagnose the learner's status in relation to the instructional objectives for the first awareness stage in the 'think metric' process.

This project of the metric awareness stage is intended to serve as a starting point for in-service metric education in secondary and post-secondary vocational food service programs. Hopefully it will serve as a foundation from which expansion could ensue in the development of learning packages of self-instructional metric materials for the remaining four stages (information-gathering, application, trial, and adoption) of the learning to 'think metric' process.

Chapter 2

REVIEW OF LITERATURE

This review of literature will present an overview of the United States involvement and preparations for transition from the customary or American system of measurement to the metric system of measurement.

Concerns about transition to the metric system spring from a lack of information. National metric surveys in 1971 and 1973 indicate that the more knowledgeable people are about it, the more receptive they are to conversion to the metric system of measurement.

Topics to be reviewed include a brief history of the United States involvement with the metric system, organizations and current U.S. policies concerned with metric transition, vocational implications of the changeover to the metric system, and metrication for occupational home economics food service education.

Metrics in the United States: A Brief History

In 1866 the United States passed three metric bills: the use of metric weights and measures was legalized; one bill specified English-system equivalents of metric weights and measures; and metric postal scales were distributed to all post offices exchanging mail with foreign countries (A Metric America: A Decision Whose Time has Come, 1971).

Although the United States joined with 16 other major nations of the world by endorsing the international metric system of weights and measures in the Treaty of the Meter in 1875, there was no immediate concerted effort to convert practically to the system it had officially approved (A Metric America..., 1971). The International Organization of Weights and Measures, founded in Paris in 1875 as a result of the Treaty of the Meter, is the recognized international authority on weights and measures and maintains master measuring standards in Sevres, France (Measuring Systems and Standards Organizations, 1970). The metric standards which were constructed as a result of the Treaty and distributed to participating nations have served as the fundamental weights and measures standards of the United States since 1893 (Brief History of Measurement Systems, 1976). The General Conference on Weights and Measures is the diplomatic organization composed of Treaty adherents which meets periodically to ratify improvements and standards in the metric system (Brief History of Measurement Systems, 1976).

As nations gradually adopted the metric system of official weight and measurement, standardization became a concern. The International Organization for Standardization (ISO) was created in 1947 to advance the development of standards and promote international cooperation in intellectual, scientific, technological, and economic

activities (Measuring Systems..., 1970). By eliminating the differences between national standards, ISO Recommendations promoted a freer international trade exchange.

In 1960 The Eleventh General Conference on Weights and Measures adopted an extensive revision and simplification of the metric system. The redefined metric units became known as the modernized metric system and were named Système International d' Unités (SI). SI, the universally accepted abbreviation, is founded on six base units: meter is the unit of length, kilogram is the unit of mass (weight), second is the unit of time, ampere is the unit of electric current, kelvin translated into degree Celsius is the unit of temperature, and candela is the unit of luminous intesity (A Metric America..., 1971). Speed and volume units are derived from the unit of length, thus relating the basic units of the system to each other.

The debate over the relative merits of the logic and simplicity of the metric system compared to the familiar customary system has been a long one. The metric controversy over whether the United States should adopt the metric system produced both serious and frivolous points by both proponents and opponents. The anti-metric organization, the American Institute of Weights and Measures, receiving strong political and financial support from influential industries, cited costs and conversion confusion in protests and

anti-metric publicity which defeated early pro-metric proposals prior to the 1930's (Borges, 1976).

Worldwide interest in science and the metric system was reawakened in 1957 when the Soviet Union launched its first Sputnik. Since the metric system is the measurement language of scientists, the U.S. government began to consider increasing its use (Borges, 1976).

Between 1965 and 1975 five English-speaking countries made significant plans for progress in adopting the metric system of measurement: Great Britain embarked upon a 10 year metrication program in 1965; South Africa began conversion activities in 1966 and has proceeded rapidly with its planned, forceful schedule; New Zealand established a Metric Advisory Board in 1969 with plans to complete conversion by the end of 1976; Australia launched its 10 year metrication program with the Metric Conversion Act passed in May 1970; and Canada established the Canadian Metric Commission in June 1971 with anticipated complete conversion by the end of 1980 (Metric Education, Interpretive Report No. 1, 1975).

Increased application of the metric system as a universal language affected the trade exchange of U.S. measurement-sensitive products. The primary impetus to U.S. metric conversion commitment resulted from the unfavorable international trade position of

remaining an isolated non-metric island in a predominately metric world (Science Research Associates, 1976).

Prior to 1968 when the Metric Study Act became law to investigate and make recommendation regarding the metric dilemma, there had been little real progress toward metric conversion in the United States.

Organizations and Current U.S. Policies Concerned with Metric Transition

The United States National Bureau of Standards is responsible for controlling measurement units and standards in the United States (Measuring Systems..., 1970). The National Bureau of Standards was established in 1901 as part of the U.S. Department of Commerce to provide technical assistance in the form of development, maintenance, and dissemination of fundamental standards of physical measurement to industry, government, and educational institutions through technical information and research associate programs (Measuring Systems..., 1970). In 1968 Congress passed a law authorizing the National Bureau of Standards to direct the Metric Study Group to study the advantages and disadvantages of increased use of the metric system. The Metric Study Group expended three years of intensive research examining representative views of business, labor, trade associations, consumers, educators, and professionals toward metric conversion. The findings and recommendations for U.S. metrication by the Metric Study Group are

summarized by DeSimone in A Metric America: A Decision Whose Time has Come (1971).

The U.S. Metric Study concluded: (a) increased use of the metric system is in the best interest of the United States; (b) this nation should change to the metric system revolving around a central coordinating body backed by the federal government through a coordinated national program; and (c) the transition period should be 10 years, at the end of which the nation would be predominately metric (A Metric America..., 1971).

DeSimone offered the following strong arguments in support of U.S. metric conversion:

1. The decimal base and logical relationship among metric units make calculations both easier and quicker.

2. Because the metric system is easier to learn, mathematics teachers would have more time to concentrate on areas other than fractions. Engineers, too, would probably make fewer errors.

3. By continuing to use a measurement system alien to over 80% of the world's population, we could place ourselves at a competitive disadvantage in world markets because we will have little voice in setting world standards. We would strengthen our economic and political role in the world if we join in a common measurement system (Borges, 1976, pp. 12-13).

The preference reported by the Metric Study Group for voluntary participation by all sectors through a carefully planned transition

program presented the need for metric preparations and timing. New metric bills were introduced in both houses of Congress beginning in mid-August 1972, but it was not until December 23, 1975 that President Ford signed Public Law 94-168, or The Metric Conversion Act of 1975.

The Metric Conversion Act of 1975 provided for the establishment of a 17 member United States Metric Board designed to carry out a broad program of planning, coordination, and public education for U.S. conversion to the metric system (U.S. Passes Metric Bill with Amendments; U.S. House of Representatives Approves Senate Bill, 1976). The Metric Conversion Act of 1975 neither included enforcement powers of any kind nor stipulated a conversion time period. The law is a weakened version of the U.S. Metric Study recommendations: legislators were forced to exclude a fixed conversion period by trading off with organized labor's insistence of a subsidy provision to cover individual worker's conversion expenses (Borges, 1976).

The Metric Conversion Act of 1975 allows the development of a rational plan for voluntary changeover which permits the metric system to affect the various sectors of the economy as they are ready for it (America Joins a Metric World, 1976). Specifically the bill authorizes and directs the Metric Board to:

1. consult with and take into account the interests, views, and conversion costs of U.S. commerce and industry
2. establish procedures for groups to recommend conversions
3. publicize proposed programs and hold hearings
4. encourage increased standardization activities
5. encourage retention, in new metric language, of internationally accepted U.S. standards and designs
6. consult and cooperate with foreign governments, intergovernmental organizations, and private international organizations
7. assist the public by providing information and educational programs
8. conduct research and surveys and make appropriate recommendations to the President and to Congress
9. report annually to the President and Congress on its activities (Borges, 1976, pp. 15-16).

The bill deviates from the recommendations of the Metric Study in that no conversion time limit is set, no definite commitment by the federal government is given, and no incentives are provided for conversion. As of April 1977, the status of the U.S. Metric Board as reported in the Metric Reporter published by the American National Metric Council is that President Carter's nominees to the 17 member board will not be announced for at least another three months (Metric Reporter, 1977).

In addition to leaving the United States at a distinct trading disadvantage, the customary or American system of measurement leaves the U.S. in a powerless position on international standard-making committees. SI is the official measurement language of both the International Electrotechnical Commission which sets standards for

electrical and electronic equipment and the International Organization for Standardization which is responsible for standards in all other fields (Measuring Systems..., 1970). To date relatively few standards have been adopted on an international basis; however, it is likely that most standards will be drafted by 1983 (Borges, 1976). One recommendation of the U.S. Metric Study was that the United States should make a firm policy about effective participation in international standards activity. The Metric Conversion Act of 1975 instructs the U.S. Metric Board to:

> Consult and cooperate with foreign governments, and international organizations, in collaboration with the Department of State, and, through appropriate member bodies, with private international organizations, which are or become concerned with encouragement and coordination of increased use of metric measurement units or engineering standards based on such units, or both. Such consultation shall include efforts, where appropriate, to gain international recognition for metric standards proposed by the United States, and, during the United States conversion, to encourage retention of equivalent customary units, usually by way of dual dimensions, in international standards or recommendations.

U.S. participation is important to our future self-interest since incompatible international standards can function as formidable non-tariff barriers to trade. According to a statement made by Senator Pell in 1973, the Department of Commerce estimated that U.S. metric conversion could bring close to a $2-billion annual improvement in our balance of payments position (Borges, 1976). As western

European members of the Common Market have become unified by working out differences in national standards, their plan beginning in 1978 to conduct all commercial transactions in SI units necessitates that the United States translate customary to metric measurements if it wishes to be competitive in trading with these countries (Borges, 1976). Dual dimensioning will be allowed only if it is determined not to be confusing; each Common Market nation will separately judge compliance of each product with this policy (America Joins a Metric World, 1976).

It is the responsibility of the National Bureau of Standards to interpret and clarify terminology for use in the United States. A point of frequent concern in the literature is the spelling of meter/metre and liter/litre. Officially both spellings for both words are currently considered acceptable. Although the Department of Commerce, including the National Bureau of Standards, is using the -er spelling exclusively, there is no policy which discourages any company or organization from adopting the -re spelling for its own use (Ogontz Metric News No. 4, 1976). The American National Metric Council, established in 1973 as the voluntary non-profit national coordinating body for metric conversion in the private sector, prefers 'meter' and 'liter' spellings. The Educational Materials Sector Committee of the American National Metric Council

recommends the spellings 'meter' and 'liter' for all publications with a copyright date of 1982 or later to be accepted and implemented by all writers, publishers, and users of elementary and secondary educational materials (Metric Guide of Educational Materials, 1977).

In clarifying the weight-mass confusion, the National Bureau of Standards has recommended redefining weight to mean mass. Thus, discontinuing the term weight to mean force (expressed as newtons in SI units) will allow mass and weight to be synonymous terms (referred to in kilograms in SI units) (Current Metric Activity, 1976).

Although the Consultative Committee on Units of the International Committee for Weights and Measures failed to adopt the recommended "L" for liter to avoid confusion of the international symbol of lower case "l" for liter with the numeral "1," the Secretary of Commerce exercised the authority specified in The Metric Conversion Act of 1975 in recommending the symbol "L" for liter in the United States (Ogontz Metric News No. 5, 1977; Metric Guide for Educational Materials, 1977). In the interest of consistency, the Educational Materials Sector Committee recommends using the symbol mL for milliliter (Guide for Educational Materials, 1977).

Assessing the potential cost of U.S. metrication is extremely difficult to evaluate in dollars and cents. Odom reports that the British experience verifies that estimates cannot be made because

currently incurred metrication costs are difficult to isolate, while benefits are largely intangible and continue indefinitely into the future (Odom, Effects of Metrication on the U.S. Economy, 1974). The Metric Study proposed 'letting metrication costs lie where they fall' to insure costs are minimized during transition. According to Odom there would be no real incentive to hold costs down with financial reimbursement (Odom, Effects of Metrication..., 1974).

Prior to passage of the Metric Conversion Act of 1975, a bill establishing national policy in metric education did become law in 1974. The Education Amendments of 1974 specified that increased use of the metric system of measurement in the United States is inevitable and that it would become the dominant system of weights and measures (Tardif, Hoffmann, Lorenzen, 1975). The law further states:

> It is the policy of the United States to encourage educational agencies and institutions to prepare students to use the metric system of measurement with ease and facility as a part of the regular education program (Tardif et al., 1975, p. 37).

The Interstate Consortium on Metric Education consisting of 28 participating state-level education representatives met twice in 1974 for the purpose of planning how the nation's educational institutions could best prepare Americans to understand and use metrics. The recommendations of the Interstate Consortium on Metric Education centered around development and evaluation of instructional

materials along with pedagogical treatment of metric education, implementation of changeover to metrics and promotion of public support, and pre-service and in-service training programs in measurement (Tardif et al., 1975).

Following the Interstate Consortium on Metric Education and prior to passage of the Metric Conversion Act of 1975, the Department of Health, Education, and Welfare established proposed rules with specific guidelines for funding state and multi-state cooperative metric education programs (Metric Education Program: Proposed Rules, 1975). In support of this policy the commissioner of education was authorized to spend $10 million for each fiscal year ending prior to July 1, 1978, for grants and contracts to encourage educational agencies to promote the use of the metric system. The appropriated funds support model and demonstration projects aimed at improving the quality and extent of metric education.

Although there is legal sanction for metric conversion, the U.S. is poorly prepared for transition (Metric Education, Interpretive Report No. 1, 1975). Willenbrock (1975) noted that the most rapid metric changeover is occurring in American industry and education, and urged a cooperative effort toward metric changeover.

Education is responding to the national metric undertaking. Schools throughout the nation are displaying an awareness of the

need to teach metrics as the primary system of measurement. Every state has begun some type of state level activity to introduce the metric system (Current Metric Activity, 1976). State and local weights and measures officials have begun planning for the effects of metric changeover on commercial weights and measures activities. The National Bureau of Standards has equipped each state with a set of metric standards and laboratory instruments that are NBS-certified for accuracy (America Joins a Metric World, 1976).

The U.S. can profit from tardiness by learning from five nation-wide experiments in changing measurement systems. Examination of Great Britain, South Africa, Australia, New Zealand, and Canada establishes unanimous disapproval for the practice of conversion from customary to metric units; such training is counterproductive and makes learning unnecessarily complicated (Metric Education..., 1975). Learning metrics is analogous to learning a second language: the metric system is most effectively learned when 'thinking metric' is combined with a 'hands-on' experience with the new system (Metric Education..., 1975).

Teachers are currently in the vanguard of a slow-moving metrication program. Although eventual U.S. changeover to the metric system of measurement is imminent, Dubisch (1976) describes the intervening period that poses problems. Dubisch (1976) urges

fostering a positive attitude toward change, applying the 'think metric' aspect, and confining instruction to those SI units most frequently used during transition.

It currently appears that educators have three alternatives in approaching metric conversion: (a) adopt teaching the metric system exclusively, (b) teach half metric system, half customary system, or some proportion thereof, or (c) stick with the customary system (Cross, 1975). Most schools and state education planning agencies favor the second alternative. Educators are caught in a conversion bind: while preparing students for the future by teaching them to think in metrics, they must still equip them to live in the present world which uses the customary system. This transitional period involves learning to live with dual-dimensioning where the customary system must be accommodated while the metric system is being learned and accepted. This transitional period presents a unique challenge to educators who must teach and aid those living with dual-dimensioning (Metric Education..., 1975).

Because measurement is a subtle concept which is often difficult to understand, Doherty (1976) asserts that students must learn to associate a number with a given quantity and be able to deal effectively with the numbers they obtain from the measurement process. British and Australian conversion experiences demonstrate that metric

training is most effectively accomplished when scheduled in short activity sessions which are distributed over several time periods with classroom tryouts of measuring tools and materials (Metric Education..., 1975).

Trent and Lee (1976), in a survey of the progress and concerns of Nevada educators in establishing the metric system as the primary measurement system, report that the data from teachers indicate that the majority of students are inadequately prepared in the metric system.

Chalupsky and Crawford (1975) warn of the inaccurate and inadequate products generated by the intense demand for metric instructional materials in the absence of evaluation efforts; they recommend evaluation of materials on a national basis broadly communicated to the schools as a useful guide for metric programs.

Dubisch (1976) suggests avoiding complex instructional materials which make the metric system seem more difficult by discussing the full range of units when only a select few are useful to the student.

Vocational Implications of Metrication

Education is a major pivotal activity in preparing the nation for increased use of the metric system. Since vocational education programs design their curricula to meet the needs of specific industries, it is the responsibility of vocational educators to focus on

skills for tomorrow's jobs based on industries' metrication plans. Pokorney (1973) describes the challenge facing training and development people as that of efficient retraining of the entire workforce in the use and understanding of a new measurement language. According to Pokorney (1973) extensive metric training programs will have to be developed and presented throughout the Seventies. Because each individual uses measurement units in a variety of ways, requirements for metric training will vary considerably throughout the labor force (Pokorney, 1973).

Vocational education provides a most opportune setting to perform a major role during metric transition. Since vocational education gets its subject matter from industry, it is necessary to keep abreast of changes made there. Lundy (1974) questions if significant efforts are being made to integrate the metric system into existing programs that are designed to teach about industry.

Dieffenderfer (1976) states that the two major concerns for metric education in vocational education programs are acquiring SI measurement skills needed to perform occupational related tasks and developing a knowledge of SI needed to think metric and make judgments, estimates, and comparisons of measurement values in work related problems. Students will be required to be familiar with only selected aspects of the SI system and will need to develop

measurement skills appropriate to the occupation for which they are being trained. According to Dieffenderfer (1976) it will be necessary for vocational educators and curriculum developers to maintain a perspective of general occupational needs in order to accurately assess the impact of metrication on the content of their subject area. Dieffenderfer (1976) emphasizes the need for vocational educators to teach SI metrics through a series of practical application exercises.

According to Cooper, Magisos, Hauck, and Channell (1975) the metric system provides vocational students with the instrument for learning basic measurement skills necessary for success in vocational skills. A vocational student equipped with entry level skills including metric measurement would have both a job acquisition and mobility advantage (Cooper et al., 1975).

Miller (1974) states that awareness and education on the part of the teacher are requisite activities in preparing for teaching metrics. Sixty-one percent of the occupational education teachers in secondary and post-secondary institutions surveyed in New York in 1974 believed that emphasis now needs to be placed on teaching the metric system in each particular discipline or instructional area (New York Educators and the Metric System, 1974). They mentioned the need for methods and application types of metric materials

specific to each instructional field. As a result of this study it was recommended that metric measurement teaching techniques specific to the occupational education areas be developed and packaged into a 'hands-on' in-service workshop experience.

Because the changes to metric will have varying degrees of impact, Odom recommends the rule of reason that change be made in a sensible way where it is advantageous to do so in order that problems will be minimized and money will not be spent for the sake of going metric alone (Current Status and Impact of Metric Conversion, 1974).

Harper (cited by Darling, 1974, p. 2) describes metric transition thusly:

> It is always disconcerting to have generally accepted terminology displaced, just as it is to have generally accepted information or beliefs proved false. Both make it necessary to relearn--a harder process than learning initially, because it involves not only acquiring new concepts but also discarding some that are well-worn and comfortable.

Darling (1974) reassuringly proposes that, although uncomfortable at first, the metric system provides an easier way to weigh and measure than the customary system does. Metric converters currently available can make comparisons of the customary units with metric units more easily understood by individuals embarking upon relearning exercises.

One unique concern noted in the vocational-technical arena was the loss of the intuitive 'feel' for correct dimensions during the metric changeover (A Metric America..., 1971; Chalupsky et al., 1975;

Cooper et al., 1975). This lack of 'sixth sense' for metric units can be relearned by providing students with opportunities for repeated practice in estimation; a personal referent must be chosen for comparison before contextual clues can be internalized (Cooper et al., 1975).

Appropriate metric content can be identified by looking at the performance tasks required (Cooper et al., 1975). By streamlining the metric system content for simplicity and practicality and presenting it prior to actual application, students can develop positive attitudes toward mathematics while improving both decimal notation and measurement skills (Cooper et al., 1975; Metric Education..., 1975).

Lindbeck (1974) states that the curriculum for any in-service metric training program should be based on content of metric needs. The first step is awareness of impending metric change by causing students to become aware of the issues (Going Metric in Teacher Education, 1974). Lindbeck stresses teaching students what they need to know and nothing more: emphasis is on the meter, liter, kilogram, and degree Celsius.

The United States can profit from experiences of other nations undergoing metric transition who caution against overtraining and presenting materials irrelevant to job requirements. It is recommended to teach workers only that information they will use on the job just prior to actual use (Metric Education..., 1975).

Metrics and Occupational Home Economics Food Service

Subject areas affected by metric transition extend beyond those of quantification. Vocational education and home economics courses require extensive changes in both materials and teaching techniques (Metric Education..., 1975).

According to Roberts (1965) vocational homemaking is an important area for making new ideas available and stimulating their usage: "The aim of vocational education is to educate present and prospective workers for proficiency in their chosen, socially useful occupations" (p. 7). A student of the metric system will be better able to cope not only with future industrial demands, but with other problems related to the future of mankind because the language of measurement is an important communication factor in the worldwide family of man.

Parker depicts home economists as key agents of change and the important opinion leaders who must adopt a strategy of ideas and procedures to facilitate implementation of the metric system (The Shift Toward Metric, 1973). Parker urges that home economists launch extensive and intensive metric education programs to insure that conversion will be as efficient and painless as possible (Think Metric, 1973).

Home economics education includes two types of programs. Consumer homemaking education is designed to help individuals and families

improve home environments and the quality of personal and family life. Occupational home economics education is designed to prepare individuals for gainful employment in occupations utilizing home economics skills and knowledge. Food service, childcare service, clothing service, and home and institutional services are examples of home economics occupational areas.

Kabakjian (1974), in summarizing the results of a survey by a coordinating committee under the auspices of the American National Metric Council investigating the progress colleges of education were making in preparing teachers to teach metric measures, reported that none of the 28 responding home economics departments had developed a course of study in metric measurement and only 30% had developed metric guidelines. Teacher education departments expressed the greatest interest in receiving packets of instructional aids and materials and in the establishment of guidelines for transition to the metric system (Kabakjian, 1974).

The "Illinois Teacher of Home Economics" provided the opportunity for home economics teachers to learn and teach metrics by offering a correspondence course for two college credits with a series of eight lessons in four 1974-1975 issues (Oppert, 1974-75). Oppert (May/June 1975) points to the need for additional research in the food preparation area before the change to metrics is completed.

Commercial companies have undertaken metric education with information directed toward consumerism. Both Sears, Roebuck and Company (1976) and J. C. Penney Company, Incorporated (1974) offer packets for home economics teachers with metric information and materials which could be adapted for vocational food service programs. A Metric Workbook for Teachers of Consumer and Homemaking Education (1976) contains metric materials including transparencies and suggestions for learning-by-doing activities which could be adapted for vocational food service programs; the ample listing of sources for metric supplies facilitates procurement of metric classroom equipment.

Because home economics is interdisciplinary in scope, it provides the subject matter for affecting metric conversion in several areas concurrently. Both consumer homemaking education and occupational home economics programs will be deeply involved as the waves of metrication break upon American economic sectors.

Gaucher and Perry (1974) present three projections for the home economist involved with conversion to the metric system of measurement:

1. The home economist will have the primary role in interpreting and teaching the new measuring system as it relates to food purchasing and preparation, home equipment and furnishings, and home sewing items.

2. The home economist will assume an important role in assuring her students, and their parents through them, that the changeover to the metric system will not make every household measuring device obsolete.

3. The home economist will be called upon to establish an 'accommodation' (dual dimensioning) until metrics become established as a way of life.

Batcher and Young (1974) point out that changing to metrics provides opportunities for improvements in more specific clothing size designations that reflect body measurements, establishment of equipment standards, reduction in excessive varieties and sizes of products, reduction in number as well as simplification of container sizes, easier dietary calculations and communication of nutritional information, and simplification of price comparisons.

Since metrication in the United States will be evolutionary, products will often go through a two-stage process of change. The 'soft' or mental change involves a change in language or terminology which translates customary to metric measurements. Industry will make the 'hard' or module change that involves changing the dimensions of an object, preferably to rounded metric units. This transitional period of dual dimensioning is a period of time where both measuring systems will be used simultaneously. The home economics laboratory provides an excellent forum for teaching metrics and comparisons of customary to metrics through 'doing' experiences (Gaucher and Perry, 1974). The home economics teacher is helping

the student deal with two worlds and is hopefully fostering consumer acceptance and usage of metrics in the home at the same time.

Warning (1972) outlines five stages people must advance through before a new product or system can be used with ease of habit. The first stage in learning to 'think metric' is the awareness stage, where a person becomes aware of the impending metric change. The information-gathering stage follows with the individual beginning to acquire information and measuring devices. In the third application stage the individual begins to apply his knowledge. During the fourth trial stage the person uses the metric system more and more frequently; if trial runs are successful and pleasant, the old system tends to be forgotten. By the time a person has reached the fifth adoption stage, he has begun to think in metric terms and becomes an enthusiast, being convinced of the superiority of the new system. Batcher and Young (1974) describe the fourth trial stage as the one where home economists can provide frequent opportunities for students to use metric units and measuring equipment.

Measurements used in food purchase and preparation affect many people and services. Batcher and Young (1974) state that the foods field is the area of home economics that will be most affected by change to the metric system since volume, temperature, and weight are involved.

Schlessinger and Kennedy (1967) describe the specific changes that metric measurements will have on food preparation.

> Temperature: A change from Fahrenheit to a Celsius temperature scale entails changing calibrations on oven controls and using a degree Celsius thermometer.
>
> Mass: Mass units are mainly used in commercial production and marketing of food; weight measures in institutional recipes could be readily converted to the metric system. However, scales and balances would have to either be replaced or recalibrated.
>
> Capacity: Volume measures are used extensively in home food preparation. The liter is 5.7% larger than the United States quart. Addition of the 500 milliliter metric pint and 250 milliliter metric cup is suggested.
>
> Length: Pan dimensions would be expressed in centimeters. Because of the 5.7% increase in volume with the use of the metric cup, larger pan volumes will be needed; it is suggested that pan volumes be about 5% larger than present ones.

Schlessinger and Kennedy (1967) note that the 15 milliliter tablespoon is not consistent for the 250 milliliter metric cup, because 250 does not give a whole number when divided by 15.

Neither fractions nor customary names of cup, tablespoon, and teaspoon should be used with metric units to avoid confusion and retain simplicity of the metric concept (Batcher and Young, 1974). Oppert (May/June 1975) suggests adopting the term 'metric measures'.

For employment in the foods service industry it is necessary for students to learn metric weight measurements used by commercial restaurants and institutional kitchens where liquids are weighed

and batters are scaled (weighed) into pans (Lindbeck, Metrics in Career Education, 1975). There are three types of scales used in institutional food service: a spring scale, a two-pan balance scale, and a triple-beam balance scale. Goodrich (1974) points to the potential problem for food processing areas where scales and batching equipment must be modified for kilogram or liter measurement: the sufficient number of scale mechanics may not be available for nation-wide scale conversion.

Students in career home economics foods courses need to learn degree Celsius in order to employ appropriate cooking temperatures in addition to metric weighing and familiarity with metric equipment sizes (Lindbeck, Metrics in Career Education, 1975). The British Columbia Home Economics Association (1975) states that for roasting meats, minutes per pound can be converted to minutes per kilogram by doubling the suggested cooking time and adding 10%. Students will need to know centimeters for 8 centimeter hamburger patties or forming 2.5 centimeter cookie dough balls.

Walker's (1974) study on using metrics in food preparation was concerned with establishing volumetric standards for home food preparation measurement equipment, converting oven and range temperatures from Fahrenheit to degree Celsius, and 'metrivising' standard recipes based on proposed volumetric standards. Walker (1974) concluded that volume measurement procedure, although less accurate

than mass (weight) measurement, should be maintained by the American homemaker who is unlikely to invest in a gram scale or adopt the unfamiliar European ingredient weighing concept.

In converting recipes to metric measurement it is important to maintain the proper ratio of ingredients. Basing metric recipes on the 250 milliliter metric cup, the relationship to a customary 237 milliliter cup results in 1.0548 conversion factor; all recipe ingredients could be multiplied by this conversion factor to obtain metric measurement in proper proportions (Walker, 1974).

Summary

Although the metric system has been legal in the United States since 1866, it has only been within the last decade that plans for implementation have begun. Studies indicate that Americans working cooperatively with a centralized coordinating body, the U.S. Metric Board established in 1975, can one voluntarily expect to experience planned transition to the metric system of measurement within the next 10 years.

Although the majority of Americans are not well-versed in the metric system, informed persons tend to favor the SI for its inherent simplicity based on the decimal system. The competitive disadvantage of the customary measurement system in the world market metric system provides the primary stimulus for U.S. conversion. It is necessary

for the U.S. to participate in international standard-setting activities to avoid a trade disadvantage with the rest of the metric world.

Education and industry are major sectors concerned with the pending metric changeover. A coordinated program that provides flexibility and encourages various segments of society to deal voluntarily with particular problems as they arise is preferred.

Vocational educators face a challenge in developing quality metric education programs designed to meet the metrication needs of industry. The period of dual dimensioning during transition presents a unique situation for dealing with measurement situations. Metric transition provides the opportunity for examining other practices of vocational areas that need revision such as upgrading course technical content, updating job training requirements, and re-evaluating skill training activities provided to students in order to improve efficiency and quality of training programs. Vocational educators will need to provide appropriate levels of metric education now while preparing to develop complete metrication programs as they become required by job demands.

Home economics education involves two types of programs, consumer homemaking education and occupational home economics education, which are directly involved in the U.S. metrication process.

The area of food preparation and food service will be most affected by metric changeover. To date clear guidelines and materials to direct the course of metric transition in occupational food service programs are sketchy in nature and minimal in availability.

Chapter 3

PROCEDURE

The Current Setting for U.S. Metrication

Government

While the federal government lacked specific metric direction before passage of the Metric Conversion Act of 1975, several federal agencies had begun metrication efforts. Even with the establishment of the U.S. Metric Board, the National Bureau of Standards will retain responsibility for maintaining the national measurement system, coordinating metrication with state weights and measures officials, and assisting with national metric changeover through interaction with consumer, business, and scientific groups (America Joins a Metric World, 1976). The National Bureau of Standards has begun a metric training program for a core group of weights and measures regulatory officials who will then be responsible for training 3,000 U.S. regulatory officials (Borges, 1976).

The Department of Defense issued a policy statement in June 1975 that it would consider using the International Metric System when feasible, practical, and efficient, particularly in design of new material (Borges, 1976). The Treasury Department has specified metric-sized bottles for distilled alcoholic beverages which have also been approved for the wine industry (America Joins a Metric World, 1976). The National Aeronautics and Space Administration

has been using metric units extensively for several years and the Maritime Administration has developed a conversion program that will affect all facets of merchant shipping by 1980 (Borges, 1976).

The Environmental Protection Agency has been setting pollution standards in metric units and the Department of Agriculture has begun issuing crop yield data in both metric and customary units (Borges, 1976). The Patent and Trademark Office has issued a metric requirement for patent applications and the Department of Interior has plans for metricating by 1980 (Borges, 1976).

Other federal agencies having initiated some metric activity from committee formation to using metric publications and signs include the Federal Highway Administration, Federal Housing Administration, Department of Health, Education, and Welfare, National Weather Service, Forest Service, National Park Service, and Federal Communications Commission (America Joins a Metric World, 1976). Upon passage of the Metric Conversion Act of 1975, the Secretary of Commerce requested all federal departments and agencies to appoint metric coordinators for a federal metric liaison program (Borges, 1976).

Prior to passage of the Metric Conversion Act of 1975 state governments were more active with metric conversion than the federal government. Every state has begun some type of state level activity to introduce the metric system of measurement; 32 states have some

type of formal action by state legislatures and/or state school boards (Current Metric Activity, 1976).

Industry

The industrial community is responding to metric conversion necessitated by doing business abroad with metric trading partners. In addition to opening up new markets, the benefits of standardization under the metric system will be realized in reduced inventories of various sized products and parts (America Joins a Metric World, 1976).

The National Association of Manufacturers, the U.S. Chamber of Commerce, and the National Grange have adopted pro-metric resolutions (Borges, 1976). The GM produced 1976 Chevette is claimed to be the first U.S. built metric car (A Metric Workbook for Teachers of Consumer and Homemaking Education, 1976). Pepsi Cola is test marketing metric-sized bottles in Los Angeles and selling liter bottles in the Atlanta area (Current Metric Activity, 1976).

Thirty-seven major corporations have announced policies to convert their operations (America Joins a Metric World, 1976). Caterpillar Tractor, Chrysler, Ford Motor Company, General Motors, Honeywell, IBM, International Harvester, Minnesota Mining and Manufacturing, Seven-Up, Travelers Insurance, and Xerox are among the first metric-minded corporations. Production is being accompanied by the normal phasing out of non-metric parts.

Sears, Roebuck and Company, Montgomery Ward, and J. C. Penney are notable leaders in the national retailing world who have joined the metric bandwagon with much emphasis on consumer metric education.

Large corporations will have significantly more impact on the small business conversion process than will governmental measures: the total sales of companies undergoing metric changeover exceed $130 billion; General Motors conversion alone will affect 40,000 suppliers (Borges, 1976).

Manufacturing processing and packaging facilities will primarily be affected by metric conversion in the food industry (Borges, 1976). Goodrich (1974) notes three area of the food industry concerned with metrication: converting metric process facilities, changing sizes of packaged products, and converting weight scales in wholesale and retail sectors. Conversion to the metric system provides opportunities for clearing up the packaging maze and educating the consumer through exposure to metric-labeled foodstuffs. Although the food industry has little to gain economically by resizing grocery products to metric modules due to relatively little export significance, it can provide an important educational bridge in the total national program. If conversion is to be meaningful, the consumer must be exposed to essentially a total metric environment.

Industry is attempting to promote understanding and sound use of the metric system by training personnel to a metric oriented environment. Pokorney (1973) asserts that metric training at all levels in all departments should be given early attention along with consideration of additional manpower necessary for training programs. Programs should be organized to familiarize all personnel with metric units in general and to provide individual workers with more detailed instruction within the scope of their own job responsibilities (Pokorney, 1973).

The American National Metric Council is primarily responsible for coordinating industrial activities for metrication in the private sector. The "Metric Reporter," which is the biweekly official publication of the American National Metric Council, presents updated metric news of the industrial community as well as information concerning governmental metric activities.

Education

Because individuals ultimately make the metric conversion with acceptance and adoption of the metric system, education as the process for imparting metric knowledge is a vital concern during transition. Educating the public about the metric system has been given high priority in implementing the changeover. Persons will experience some inconvenience as they adapt to the new metric units by adjusting

to new equipment at their jobs and by learning new ways of measuring with the metric system.

The National Education Association and National Council of Teachers of Mathematics have long favored conversion to the metric system of measurement (Science Research Associates, 1976). The National Education Association states that learning the metric system will be increased if students learn in a variety of subjects such as home economics, English, industrial arts, agriculture, music, business education, distributive education, and vocational-technical classes (Recommendations for Teaching Metric, 1976). Chalupsky and Crawford (1975) in describing the professional educator's role in metric planning note that the extent of support for metrication varies widely among the educational specialities: science and math educators are in the forefront followed by support from industrial arts and vocational educators; social studies and language groups tend to remain aloof or are ignored during initial metric planning. Metric conversion provides educators with the opportunity for professional leadership which extends beyond classroom subject matter in areas of adult education, public awareness, and consumer education (Chalupsky and Crawford, 1975).

DeVault, co-author of Science Research Associates math textbooks, stresses that teachers should adopt an informal approach to

teaching metric measurement regardless of the age level of students: "It is important that we avoid a formalized approach to instruction of metric measures. . . . Measurement is part of our real-world experience and should be treated as informally as we treat other real-world experiences" (Science Research Associates, 1976, p. 32).

The National Council of Teachers of Mathematics has established the following general guidelines for teaching metric measurement.

1. Choose an appropriate unit of measure and use it to measure a variety of objects . . . . Repeated experiences with the basic unit should lead to estimation of lengths with no more than about 10% error . . . . The unit chosen should be appropriate to the size of the object measured.

2. Use multiples of the basic unit as the need arises for a larger unit, and subdivisions of the basic unit where smaller units are needed. By referring larger and smaller units back to the basic unit estimation of larger and smaller units is easier . . . . Limitation of the number of larger and smaller units taught makes the learning goals more realistic and manageable. The goal of thorough learning of a few larger or smaller units is much preferred to mere acquaintance with many different units.

3. Limit expectations of mastery of conversions within a measuring system to commonly used units adjacent in size.

4. Use the approximate nature of the measuring process in the physical world as a theme.

5. Use the actual units as often as possible; avoid scaled down versions . . . . Actual involvement is essential . . . . The flavor of 'hands-on'

> experience is much more important than anything else (Metric: Not If, But How, 1974, pp. 366-67).

The New York State Education Department proposes the following guidelines for metric education:

1. Compare, don't convert. It is logical to make comparisons between the old and new. . . , but the process of converting arithmatically will not lead to facility with metrics. Compare, or estimate, distances, sizes, etc., while concentrating on substituting metric for customary.

2. All people will need to know the basics of metrics but not everyone will need to know all about metrics . . . . It is not necessary to memorize all metric symbols, prefixes, base units, or derived units.

3. The format for writing measurements is to give the size, mass, etc., in correct metric terms followed by customary units in brackets, if it is necessary . . . . It is not necessary to carry out measurement further than whole numbers (Metric--Now, 1975, p. 30).

Response to General Question Number 1:
Considerations for Vocational Food Service Metric Education

Learning the metric system by the 'think metric' process involves complex interaction among the psychomotor, cognitive, and affective domains. The development of positive feelings rather than fear about the new system of measurement is necessary along with knowledge and skills (Oppert, 1975). Students need to first be aware of the importance of learning the metric system before being encouraged to learn metric units (Oppert, 1975). Science Research Associates (1976) stresses the need for being aware of the issues

of impending metric change and adopting an informal approach to instruction of metric measurement.

During the years of transition from the customary to the metric system, the rate of changeover will vary in different societal sectors. Some competence with both systems will be needed during the transitional period. Having two separate systems of measurement permits students to learn to 'think metric' by exposing them to a totally metric environment for a brief period of time (Measurement with Metric, 1974). While general comparisons between systems are helpful, there is a consensus in the literature to avoid mental conversions.

The premise that concrete experiences with 'hands-on' activities is the best way to teach measurement relies heavily upon the learning theories of Piaget (Measurement with Metric, 1974). If generalizations are to grow from concrete examples, Doherty (1976) recommends providing a metric environment with measuring tasks which allows the learner to physically explore objects around him.

Dubisch (1976) emphasizes providing actual measurement situations with opportunities for estimation and verification as a means of providing a comfortable acquaintance with the metric system and overcoming negative attitudes towards metrics prevalent in the U.S. Complex metric instruction should be avoided to prevent confusion

and frustration. Initial metric instruction should be confined to common usage of the important measurement units such as meter, centimeter, kilometer, liter, milliliter, gram, kilogram, and degree Celsius (Darling, 1974; Dubisch, 1976; Measurement with Metric, 1974; Metric Education..., 1975; Science Research Associates, 1976).

Successful 'hands-on' experiences provided through short activity sessions over several time periods with classroom tryouts of measuring tools and materials conveys the simplicity of the metric system necessary for acceptance with actual contact in the new system (Metric Education..., 1975). Because it is essential to relearn the intuitive feel for correct measurement dimensions lost during the changeover, it is necessary to provide repeated practice in estimation with verification of estimations by making actual comparisons of concrete objects (Metric Education..., 1975). Each learner must select a personal metric measure referent for comparison before contexual clues can be internalized (Cooper et al., 1975). Although there is no need to know precise differences, a framework of equivalent measures in the customary system provides learners with a useful tool for meaningful comparisons during the transition period (Bitter, Mikesell, & Maurdeff, 1976). Cooper et al. (1975) state that measurement performance tasks determine the metric content for vocational education with emphasis on needed job information.

The literature review indicates a preference for the workshop approach for in-service educational training in the metric system of measurement (Cooper et al., 1975; Metric Education, 1975; Kabakjian, 1974; Metric--Now, 1974; Pokorney, 1973; Trent & Lee, 1976). Warning (1972) suggests that learning the metric system within groups is likely to be more successful than self-teaching. In-service education provides the systematic process for presenting meaningful sequential metric information through structured activities which lead to exploration, discovery, and investigation of metric measurements (Bitter et al., 1976). The continuous learning approach permits the teacher to discover and build upon the learner's knowledge by selecting activities appropriate to the learner's level of readiness and need for metric measurement information (Measurement with Metric, 1974).

Designing a learning package of self-instructional metric materials for the awareness stage of the learning to 'think metric' process provides the preliminary information for the continuous learning approach which is appropriate for in-service metric education in a vocational food service program. Although the learning package of self-instructional metric materials will be designed for use by one person, it will frequently be advantageous for students to work together on some of the activities. The contents of the

learning package could be adapted to provide learning-by-doing sessions for group participation to facilitate the workshop approach for in-service metric education training. Learning packages for the other four stages (information-gathering, application, trial, and adoption) of Warning's (1972) learning to 'think metric' process will remain to be developed for a complete metric workshop for a vocational food service program.

Response to General Question Number 2:
Objectives for the Awareness Stage of
Vocational Food Service Metric Education

The literature indicates that there are fundamental goals in learning the metric system of measurement:

1. Students will become aware of how their lives will be affected by changeover to the metric system of measurement.

2. Students will learn metric units and useful prefixes.

3. Students will practice using the metric system through activities.

4. Students will learn to 'think metric' through 'hands-on' experiences rather than practice conversions.

Students in vocational food service programs will focus on specific goals of metric education related to occupational training:

1. The student will become aware of and develop SI measurement skills needed to perform occupational tasks of the food service industry.

2. The student will develop a knowledge of SI metric needed to 'think metric' and begin to make judgments, estimates, and comparisons of measurement values in work related food service situations.

Objectives for introduction to metric measurements in the awareness stage of the learning to 'think metric' process are derived from evidence that the more knowledgeable a person is about the metric system, the more receptive the person is to metric changeover. The development of positive attitudes which encourage acceptance of the metric system of measurement can best be fostered by simple, successful 'hands-on' sequential metric measurement activities.

Instructional objectives for the awareness stage of the learning to 'think metric' process will include behavioral content from the cognitive, affective, and psychomotor domains. In the cognitive domain metric knowledge through recall and recognition of basic terminology and symbols will provide objective content selected to promote thinking and understanding abilities. In the affective domain attitudinal objectives concerning learner awareness of the importance of becoming familiar with metric units will be selected to foster the development of positive attitudes toward metrication. Objectives in the psychomotor domain will promote learner improvement in manipulative skills by using metric measuring equipment common to occupational food service.

Response to General Question Number 3: Materials and Activities for the Awareness Stage of Vocational Food Service Metric Education

The primary goals of metric education during the awareness stage of the 'think metric' process focus on the development of positive attitudes for acceptance of metric measurement combined with acquiring a knowledge of common metric terminology and building a personal framework of equivalent measures in the customary system for comparisons. The challenge during the awareness stage appears to be motivating the student's curiosity to investigate the simplicity and advantages of metric measurement through exploration and discovery activities. Oppert (1975) suggests that the student must first be made aware of the importance of learning the metric system of measurement before being immersed in a totally metric environment for a brief period of time to alleviate fears of the unfamiliar new system.

Learning activities through 'hands-on' metric measurement experiences are depicted consistently in the literature as the most appropriate means of promoting maximum student imvolvement with the metric system. "Hands-on' measurement activities provide practice with the metric system necessary to develop understanding. Estimating and then verifying by direct measurement with metrically scaled instruments are recommended techniques (Measurement with Metric, 1974).

A well-organized, interesting sequence of appropriate 'hands-on' activities within the student's ability promote understanding in learning to 'think metric' (Bitter et al., 1976; Measurement with Metric, 1974). Provisions for a variety of structured educational exploratory and discovery experiences combined with reassurance from the instructor encourage and stimulate learning as a reward and reinforcement of achievement (Bitter et al., 1976; Oppert, 1975).

In fostering metric measurement acceptance it is important to begin with basic concepts at a level easy to comprehend (Oppert, 1975). Information presented should stress significant concepts of the metric system relevant to the student's needs (Cooper et al., 1975). Introduction of one metric measurement concept at a time minimizes confusion and frustration and increases the likelihood of idea acceptance (Metric: Not If, But How, 1974; Oppert, 1975).

Dieffenderfer (1976) points to the importance for acquiring specific SI measurement knowledge and skills needed to perform specific occupational related tasks. While specific occupational SI measurement knowledge is necessary in vocational training, the interrelationship of units and the logic of the complete metric system should be presented for purposes of continuity and understanding (Measurement with Metric, 1974). Bitter et al. (1976) suggest presenting detailed metric charts to depict the logic of the metric system, to show the origin of prefixes, to illustrate

the accepted written symbols, and to emphasize the commonly used units.

Response to General Question Number 4:
Resources Necessary for Implementing Metric Education During the Awareness Stage

The author reviewed the literature extensively to determine the current commercially available metric resources appropriate for use in the awareness stage of metric education in a vocational food service program. The Center for Vocational Education at Ohio State University has prepared Metric Education: An Annotated Bibliography for Vocational, Technical, and Adult Education (1974), which is a very useful resource that makes vital information accessible for assistance in meeting the metric education needs in vocational, technical, and adult education. The author was unable to obtain metric instructional kits reportedly being prepared for in-service vocational areas by the Center for Metric Education at Western Michigan University in Kalamazoo, Michigan.

The title Metric Workbook for Food Service and Lodging (Crawford and McDowell, 1976) suggests the presence of a solution to the problem of the project. However, the author discovered the title misleading upon investigation, for the instructional contents focused upon the essentials of mathematical computation in the absence of 'hands-on' metric measurement activities.

'Hands-on' metric measurement activities for the awareness stage of the 'think metric' process in a vocational food service setting requires the costly investment in metric measuring equipment. Students should have metric rulers, metersticks, a balance scale with weights, a spring scale with gram gradations, bath scales, large and small liquid and dry measures, an all-purpose Celsius thermometer, and Celsius cooking thermometers (oven, refrigerator-freezer, meat, and candy) available for metric learning activities in the classroom. In the interest of economy in the educational system, Dubisch (1976) recommends starting a metrication program by having students make their own measuring devices whenever possible.

Summary

The current setting for U.S. metrication involves varying degrees of metric changeover in governmental agencies and industrial corporations. Public acceptance by individual members of society is essential for adoption of the new system of measurement. Education has a paramount role in promoting acceptance during transition and is faced with the primary challenge of making the need for relearning a measurement system a palatable learning experience during the confusing period of dual dimensioning.

The basic issue of metric education concerns overcoming the negative attitudes that are encountered as normal resistance to change. Special attention must be given to the development of

positive attitudes through easily understood, successful metric measuring experiences.

In vocational education there is the additional expressed concern for the experienced loss of the intuitive feel for correct measurement dimensions during transition. Although there is no need to know the precise differences between the two systems, a frame of reference of equivalent measures in customary units is necessary for comparisons during the dual dimensioning phase. Persons trained in both measurement systems will have a job advantage as food service industries adopt evolutionary metric changeover.

Materials for implementing the awareness stage of metric education in a vocational food service program need to concentrate on 'hands-on' measurement activities with emphasis on acquisition of SI measurement skills and knowledge needed to perform occupational related tasks. Estimation with measurement verification is recommended as a primary strategy for the 'think metric' process. Metric measuring equipment specific to the performance tasks of food service is essential for executing 'hands-on' measurement activities.

Chapter 4

THE LEARNING PACKAGE

This learning package was designed by the author in response to the general questions posed by the problem of metric education for the awareness stage of the 'think metric' process in a vocational food service program. This self-instructional unit was developed to introduce a novice at the secondary or post-secondary level to the metric system of measurement during the transition period. Objectives from the affective, cognitive, and psychomotor taxonomic domains were constructed to include the encompassing behaviors sought through the accomplishment of the learning experiences in this package. Multidimensional learning materials were utilized to stimulate and encourage experimentation with the metric system of measurement. Diversified learning activities are suggested to familiarize students with metric terminology and to provide the foundation for building a personal frame of reference for comparisons between the two systems. The learning package contains three instruments for evaluation: the Pre-Test serves to diagnose the learner's status in relation to the objectives; self-evaluation through questions and discussion within the learning activities is provided to help the learner assess her/his own progress; and the Post-Test is designed to measure the extent to which the learner has achieved the instructional objectives.

HOME ECONOMICS LEARNING PACKAGE

Teacher Section

TITLE: MEETING METRIC MEASURES

SUBJECT: Metric System
Introductory Awareness Stage of the 'Think Metric' Process

PERFORMANCE LEVEL: Maturity Level: Secondary, Post-Secondary Vocational Food Service Programs

Complexity Level: Beginning
Taxonomic Levels:
- Cognitive (knowledge)
- Affective (attitudes)
- Psychomotor (manipulative skills)

PURPOSE: This package is designed to introduce the student to the metric system of measurement and to alert the student to changes in terminology and tools that metrication will bring to both personal life and future employment in the food service industry.

PRODUCED: June 1977

by

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Generalizations to be Learned

The more knowledgeable a person is about the metric system, the more receptive the person is to U.S. metric changeover. Metrication involves significant changes in measurement thinking related to food preparation and service in terms of weight, volume, and temperature. The amounts being measured do not change, but the terminology and tools used to describe the amounts is new which presents the need for learning the metric system of measurement.

Component Ideas

1. Awareness of the impact of impending metric changeover in both personal life and occupational preparation provides the background information necessary for the development of positive attitudes which encourage acceptance and involvement with the metric system of measurement.

2. A knowledge of base units and symbols of length, weight, volume, and temperature and commonly used prefixes will provide students with the metric measurement language particular to food service occupations.

3. 'Hands-on' metric measurement activities will promote the development of manipulative skills appropriate to metric measurement tasks of food service occupations.

Instructional Objectives

1. Given the advantages and background for U.S. metrication, the student will be able to discuss in writing three reasons that she/he feels are important for learning and using the metric system of measurement.

2. Given written descriptions of metric terminology, the student will correctly identify in writing without aid the base units, prefixes, and symbols of metric units commonly used in occupational food service situations.

3. Given metric measuring tools and tasks, the student will estimate first and secondly measure for verification metric lengths, weights, volumes, and temperatures common to occupational food service situations and record the findings in writing on worksheets.

Instructional Approach

Each individual will explore and discover the metric system of measurement through 'hands-on' learning activities which will lead to the achievement of the desired behavioral outcomes.

Identification of the Learners

This learning package for the awareness stage of the 'think metric' process is designed for students in secondary and post-secondary vocational food service programs. Introductory metric materials with elementary metric facts are presented for novices to the metric system. This package is designed for use by one person, although it may be advantageous for students to work in pairs on some of the activities.

The activities of each lesson should be completed in the suggested numerical sequence to allow for the building of metric concepts provided by the experiences. Adequate time for completion of each activity is necessary to allow for the achievement of the purpose of each activity. The amount of metric measuring equipment needed depends on the size of the class enrollment.

Special Instructions

Equipment Needed
---Overhead transparency projector
---Tape recorder
---Bulletin Boards

Materials Needed
---Book
A Metric Workbook for Teachers of Consumer and Homemaking Education. Orange County Department of Education. Santa Ana, CA, 1976. Includes brief history of the metric system and transparency presentation on length, weight, volume, and temperature with narration used as a learning activity in Lesson I. Send $1.50 check or money order to: Orange County Dept. of Ed., P.O. Box 11846, Santa Ana, CA 92711.

---Pamphlet
"Living with Metric," Educational Systems Group, Union Carbide Corporation. New York, 1975. Explains America's new system of

measurement using the 'think metric' approach. 10-49 copies available at $ .60 each from Union Carbide Educational Aids Department, P.O. Box 363, Tuxedo, NY 10987.

---Metric Kits

Metric Teaching Aids: Sample Kit. Union Carbide Research Center. New York, 1975. This $9.00 kit includes two wall charts (Metric System and Metric Measure), three conversion calculators, a metric tape measure, and a 500 mL metric liquid measuring cup. Order from Union Carbide Educational Aids Dept., P.O. Box 363, Tuxedo, NY 10987.

National Bureau of Standards Metric Kit, U.S. Dept. of Commerce. The NBS Metric Kit comes with a metric conversion card, metric ruler, chart of The Modernized Metric System, and two pamphlets entitled "The Metric Changeover" and "What About Metric?" Order the $2.00 NBS Metric Kit (No. C13.10:410) from Superintendent of Document, Government Printing Office, Washington, D.C. 20402

---Metric Equipment (in addition to items supplied in kits)

Amount of equipment needed depends on class side; no more than 406 students should be working at learning centers at one time.

Metric large dry measures, set 3 cups (50 mL, 125 mL, 250 mL), $ .60 plastic set
Metric small dry measures, set 5 spoons (1 mL, 2 mL, 5 mL, 14 mL, 25 mL), $ .40 plastic set
Celsius cooking thermometers, oven ($1.50); refrigerator-freezer ($1.50); meat ($3.00); candy ($3.00)
Spring Chatillon counter scale with scoop, 25 kg cap. x 100 g gradations ($50.00)
Price list for schools available upon request from The Metric Shop, Box 392, 720 Cayuga Street, Lewiston, NY 14092

Metric bath scales (about $15) and meter sticks (10/$5) available from Cal Western Supply Co., 126 East Graham Place, Burbank, CA 91502

Student thermometers (range -10°C to 110°C) priced at 10/$4 and
Single beam balance scale with 50 g, 20 g, 10 g, 10 g, 5 g, 2 g, 2 g, 1 g mass pieces (about $18.50) available from Library Filmstrip Center, 3033 Aloma, Wichita, KA 67211

---Other Materials
Cash register tapes
Quart milk containers
Half-gallon milk cartons
Assortment color felt markers
Flour, sugar, salt, popcorn, dried beans, cooking oil, dry milk, dry cereal flakes, instant potato flakes, honey, solid shortening, 1 pound margarine (cubes)
Ingredients for Peanut Butter Cookie Recipes and Vanilla Cake recipe

Media Needed
---Transparencies (to be made by instructor from presentation illustrated in A Metric Workbook for Teachers of Consumer Homemaking Education)

---Tape cassette (to be made by instructor from narration for transparency presentation supplied in A Metric Workbook . . .)

---Bulletin board display of Languages of Measurement illustrating the similar common units of both metric and customary systems (see Reference Materials supplied in this section)

---Posters (to be prepared by instructor using Reference Materials information supplied in this section)
Meter Scale and Linear Metric Units
Gram Scale and Mass (Weight) Metric Units
Liter Scale and Volume Metric Units
Celsius and Fahrenheit Oven Temperature Comparisons
Celsius Scale Thermometer (Bacterial Growth Range)

---Activity worksheets for linear, weight, volume, and temperature measurement (to be developed by instructor to fit particular learning activity for each lesson.)

Facilities Needed and Special Equipment
---Tables for learning activities
---Customary dry and liquid measuring equipment
---Sink, stovetop, oven, refrigerator with freezer compartment
---Popcorn popper, mixer, mixing bowls
---Baking utensils, cake, pie, bread pans, and baking sheets

Special Requirements

Reference Materials

LANGUAGES OF MEASUREMENT
Some Common Units

LENGTH	MASS	VOLUME	TEMPERATURE	ELECTRIC CURRENT	TIME
METRIC SYSTEM					
millimeter	milligram	milliliter	Celsius	ampere	second
centimeter	*gram	*liter			
*meter	kilogram				
kilometer	tonne				
CUSTOMARY SYSTEM					
inch	ounce	fluid ounce	Fahrenheit	ampere	second
foot	pound	teaspoon			
yard	ton	tablespoon			
fathom	grain	gill			
furlong	dram	cup			
cubit		pint			
rod		quart			
mile		gallon			
		barrel			
		peck			
		bushel			

*Base units of International System of Units (SI)

METER SCALE AND LINEAR METRIC UNITS

Units	Prefix	Symbol
*kilometer	kilo	km = 1000 (10^3) meters
hectometer	hecto	hm = 100 (10^2) meters
dekameter	deka	dam = 10 (10^1) meters
*METER	BASE UNIT	m = 1 (10^0) meter
decimeter	deci	dm = 0,1 (10^{-1}) meters
*centimeter	centi	cm = 0,01 (10^{-2}) meters
*millimeter	milli	mm = 0,001 (10^{-3}) meters

*Commonly used units

GRAM SCALE AND MASS (WEIGHT)METRIC UNITS

Units	Prefix	Symbol
*tonne		t = 1000 kilograms
*kilogram	kilo	kg = 1000 (10^3) grams
hectogram	hecto	hg = 100 (10^2) grams
dekagram	deka	dag = 10 (10^1) grams
*GRAM	BASE UNIT	g = 0.1 (10^{-1}) grams
centigram	centi	cg = 0.01 (10^{-2}) grams
*milligram	milli	mg = 0.001 (10^{-3}) grams

*Commonly used units

LITER SCALE AND VOLUME METRIC UNITS

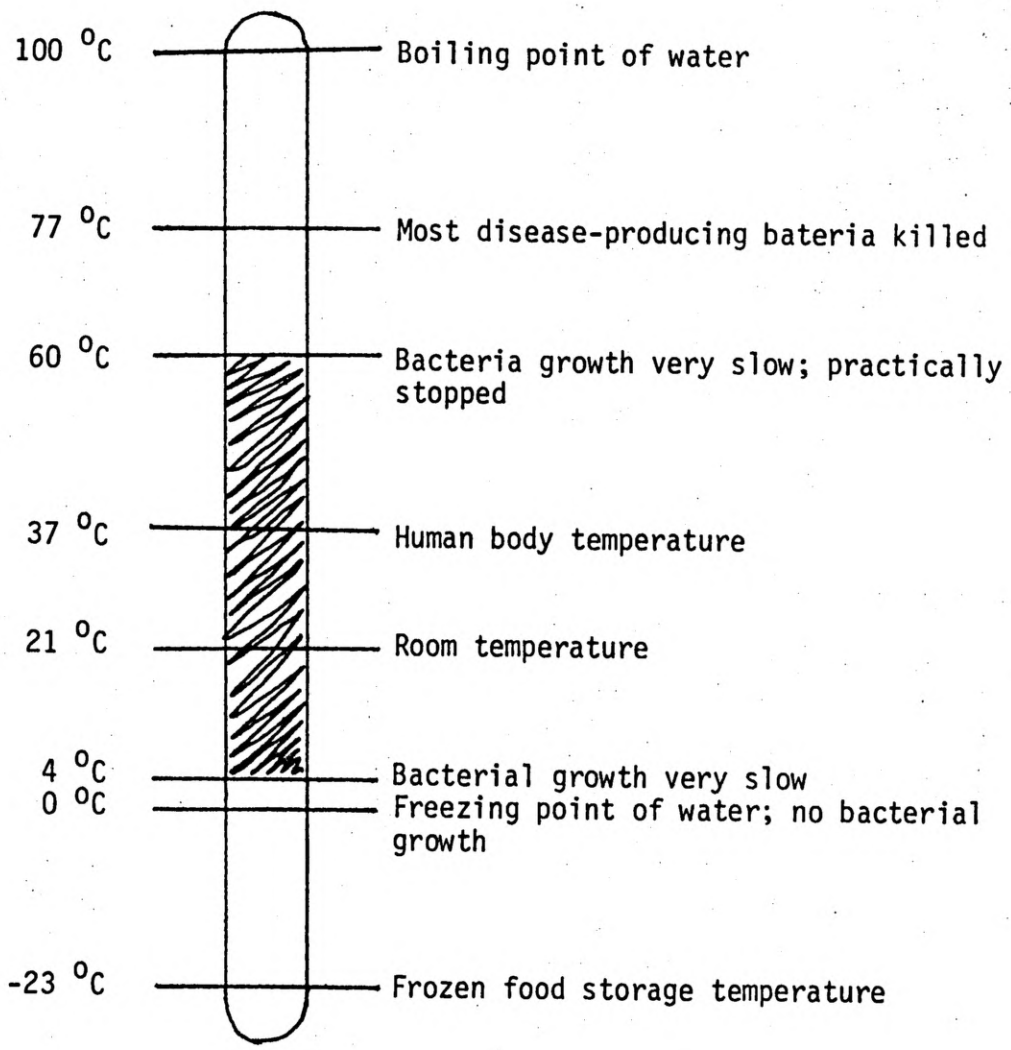
Units	Prefix	Symbol
kiloliter	kilo	kL** = 1000 (10^3) liters
hectoliter	hecto	hL = 100 (10^2) liters
dekaliter	deka	daL = 10 (10^1) liters
*LITER	BASE UNIT	L = 1 (10^0) liter
deciliter	deci	dL = 0.1 (10^{-1}) liters
centiliter	centi	cL = 0.01 (10^{-2}) liters
*milliliter	milli	mL = 0.001 (10^{-3}) liters

*Commonly used units
**The U.S. Dept. of Commerce has recommended the capitol letter L for the symbol for liter in the U.S.

Note: 1 liter = 1000 cubic centimeters (cm^3)
1 milliliter = 1 cubic centimeters (cm^3)

ROUNDED COMPARISONS OF OVEN TEMPERATURES

Fahrenheit		Celsius
300	-	150
325	-	170
350	-	180
375	-	190
400	-	200
425	-	220



Shaded area represents range (4 °C to 60 °C) of "DANGER ZONE" for bacterial growth

Adapted from Metric Workbook for Foodservice/Lodging by H. W. Crawford and M. C. McDowell. Cahners Books International, Inc., Boston, 1976.

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Evaluation Instructions

This learning package includes three instruments for evaluation. The Pre-Test in the student's section determines the student's status in relation to the learnings suggested in this package. The instructor with the student must decide on the level of success appropriate for the student to bypass this package.

Self-evaluation through questioning within the learning activities is designed to help the learner assess her/his own progress. Several activities throughout the package call for oral discussion between the instructor and learner upon the student's completion of the activities. This discussion provides a means of joint instructor-student evaluation of the learner's progress in the particular area.

Upon completion of the entire learning package, the student will take the Post-Test which the instructor will hold until requested. The instructor also keeps the scoring keys to the Pre-Test and Post-Test.

Pre-Test Key

Part I:	1.	d	8.	d	14.	m	20. ^{o}C
	2.	c	9.	a	15.	cm	
	3.	a	10.	b	16.	liter	
	4.	b	11.	a	17.	mL	
	5.	a	12.	c	18.	g	
	6.	b	Part II:		19.	kilogram	
	7.	c	13.	International system of Units			

Part III: 21-23 Discussion Questions
Any three of the following may be counted correct.

Adopting the metric system strengthens U.S. international trading position.
The metric system is the universal language of measurement.
Like our monetary system, the simplicity of the decimal based metric system facilitates easier computation.
The consistent interrelationships among metric units promote easier understanding and comprehension of measurement concepts than the nonrelated customary measurement units.
The units of metric measurement are a logical system with larger units formed by using a multiple of 10 of the preceding unit.
The U.S. is changing to the metric system as its common measurement system; industries are rapidly expanding their use of metric measurement.

Post-Test Key

Part I:	1.	a	13.	a	25.	b	
	2.	c	14.	c	Part II:		
	3.	b	15.	b	26.	cm	
	4.	c	16.	c	27.	m	
	5.	d	17.	b	28.	km	
	6.	b	18.	b	29.	^{o}C	
	7.	c	19.	d	30.	L	
	8.	c	20.	c	31.	g	
	9.	b	21.	d	32.	kg	
	10.	b	22.	b	33.	cm^3	
	11.	a	23.	c	34.	mL	
	12.	d	24.	a			

Part III: 35-37 Discussion Questions
Any three of the following may be counted correct.

Adopting the metric system strengthens U.S. international trading position.
The metric system is the universal language of measurement.
Like our monetary system, the simplicity of the decimal based metric system facilitates easier computation.
The consistent interrelationships among metric units promote easier understanding and comprehension of measurement concepts than the nonrelated customary measurement units.
The units of metric measurement are a logical system with larger units formed by using a multiple of 10 of the preceding unit.
The U.S. is changing to the metric system as its common measurement system; industries are rapidly expanding their use of metric measurement.

Part IV: 38-40
Any of the three following may be counted correct.

Quantities will be measured in grams, kilograms, liters, and milliliters.
Recipes will be changed to metric units.
Serving sizes will be expressed in centimeters or gram scoops.
Broiling, frying, and oven temperatures will use degrees Celsius.
Utensil sizes will change.

Post-Test

The activities of this learning package have challenged you to become aware of the importance of beginning to 'think metric' in personal life and in occupational food service situations. Now that you have accomplished the objectives, you are ready to see just how much success you have had with this challenge.

Directions:

1. Read the statements and questions carefully for each part.
2. Mark your answers on a separate, blank sheet of paper.
3. When you have completed the test, take it to your instructor so you may review it together to see if you have successfully accomplished the goals.

Part I: Write the letter indicating the correct answer for each question or statement next to the number on your answer sheet.

1. In place of inches what metric term will be used to measure similar distances?

   a. centimeter
   b. liter
   c. meter
   d. milliliter

2. The length of a new pencil would be approximately

   a. 8 millimeters
   b. 8 meters
   c. 18 centimeters
   d. 18 kilograms

3. The correct symbol for meter is

   a. M
   b. m
   c. m.
   d. Mm

4. A meter is

   a. slightly shorter than a yard
   b. the same length as a yard
   c. slightly longer than a yard
   d. approximately twice the length of a yard

5. Which of the following lines appears to be equal to two centimeters?

   a. _____
   b. _____
   c. _____
   d. _____

6. The meter is a measure of

   a. weight
   b. length
   c. volume
   d. time

7. A meter equals 100

   a. mm
   b. km
   c. cm
   d. mg

8. A pound of sugar has the approximate weight of

   a. 1 kilogram
   b. 50 grams
   c. 400 grams
   d. 250 grams

9. One kilogram is the equivalent of

   a. five pounds
   b. 2.2 pounds
   c. 1 pound
   d. 18 ounces

10. A woman who weighs 110 pounds would have a metric weight of approximately

    a. 25 kg
    b. 50 kg
    c. 100 kg
    d. 250 kg

11. One gram is approximately

    a. 1/30 ounce
    b. 1/30 pound
    c. 1/30 kilogram
    d. 1/100 kilogram

12. The metric unit of weight to replace pounds is

    a. kilometer
    b. centimeter
    c. gram
    d. kilogram

13. The symbol for gram is

    a. g
    b. g.
    c. gm
    d. G

14. Instead of ounces we will use the metric units of

    a. kilograms
    b. milligrams
    c. grams
    d. centimeters

15. Volume is

    a. measured in centimeters
    b. a measure of capacity
    c. two dimensional
    d. for dry measurement only

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16. One liter is

    a. equal to a quart
    b. less than a quart
    c. greater than a quart
    d. equal to a gallon

17. The symbol for liter is

    a. l
    b. L
    c. l.
    d. always written out

18. One liter contains

    a. 2000 mL
    b. 100 mL
    c. 500 mL
    d. 25 mL

19. The customary tablespoon is approximately equal to

    a. 250 mL
    b. 100 mL
    c. 50 mL
    d. 15 mL

20. The customary teaspoon is approximately equal to

    a. 50 mL
    b. 15 mL
    c. 5 mL
    d. 0.5 mL

21. Which of the following will be used for ordinary temperature measurement in the metric system?

    a. Kelvin
    b. Fahrenheit
    c. Centigrade
    d. Celsius

22. The melting point of ice on the metric thermometer is

    a. 32^{o} F
    b. $0\ ^{o}C$
    c. $250\ ^{o}K$
    d. $62\ ^{o}C$

23. Normal body temperature on the metric thermometer is

    a. 98.6^{o} F
    b. $373\ ^{o}K$
    c. $37\ ^{o}C$
    d. $62\ ^{o}C$

24. A comfortable room temperature on the metric scale is

    a. $23\ ^{o}C$
    b. $32\ ^{o}C$
    c. $373\ ^{o}K$
    d. 80^{o} F

25. A 400^{o} F setting on the oven dial is approximately equivalent to

    a. $150\ ^{o}C$
    b. $200\ ^{o}C$
    c. $220\ ^{o}C$
    d. $300\ ^{o}C$

Part II: Match the metric symbol to the correct metric unit by writing the symbol next to the number on your answer sheet.

26.	____ centimeter	kg
27.	____ meter	mL
28.	____ kilometer	g
29.	____ degree Celsius	km
30.	____ liter	m^{3}
31.	____ gram	cm^{3}
32.	____ kilogram	L
33.	____ cubic centimeter	cm
34.	____ milliliter	^{o}C

Part III: 35-37 Discussion questions. Having been exposed to the advantages and reasons for adopting the International System of Units as our common measurement language, discuss in writing three reasons you consider important in learning to use the metric system of measurement.

Part IV: 38-40 Name three areas of food service and preparation that will change with adoption of the metric system of measurement.

HOME ECONOMICS LEARNING PACKAGE

Student Section

MEETING METRIC MEASURES

On December 23, 1975 President Ford signed the Metric Conversion Act of 1975 which provides for the establishment of a 17 member U.S. Metric Board to plan and coordinate a broad program of public education for U.S. voluntary conversion to the metric system of measurement within the next 10 years. As a result of the unfavorable world trade position by remaining a non-metric island, U.S. industry is responding by changing to the metric system of measurement.

Conversion between the two systems is unnecessary. The more we know about the logical simplicity of the metric system which has the same decimal base as our monetary system, the more comfortable we will be working with the new system.

The amounts of items being measured metrically will not change in occupational food service, but the terminology used to describe the amounts will be new. Metric measurement involves using new tools for the same measuring tasks.

This learning package is designed to introduce you to metric measurement and familiarize you with the new terminology and goals which will affect both your personal life and future employment in the food service industry.

Learning Objectives

Upon completion of this learning package you should be able to accomplish successfully the following objectives:

1. Given the advantages and background for U.S. metrication, you will be able to discuss in writing three reasons that you feel are important for learning and using the metric system of measurement.

2. Given written descriptions of metric terminology, you will correctly identify in writing without aid the base units of length, weight, volume, and temperature commonly used in occupational food service situations.

3. Given metric measuring tasks and tools, you will be able to estimate first and secondly measure for verification metric lengths, weights, volumes, and temperatures common to occupational food service and record the findings in writing on worksheets.

Pre-Test

To determine your present knowledge about the metric system of measurement, take the following Pre-Test. After completing the Pre-Test, ask your instructor for the answers. If you already have sufficient knowledge to accomplish the stated objectives, you will not be required to continue with this particular learning package.

Directions

1. Read the directions for each part carefully.
2. Write your answers on a separate sheet of paper.
3. When you have completed the test, get the key from your instructor and check your work, marking only the incorrect items. Subtract the number of incorrect items from 23, and place the number of correct answers at the top of your answer sheet.
4. Take your scored test to your instructor to jointly decide the areas of future investigation that would enhance your knowledge and understanding of the metric system of measurement.

Part I: Write the letter indicating the correct answer for each statement or question next to the number on your answer sheet.

1. The basic unit of linear measurement in the metric system is

   a. gram
   b. cubit
   c. furlong
   d. meter

2. To measure the dimensions of a baking pan you would use _____ in the metric system.

   a. meters
   b. milliliters
   c. centimeters
   d. kilograms

3. A meter is nearest in length to

   a. a yard
   b. a foot
   c. a mile
   d. an inch

4. A centimeter is a little less than

   a. a foot
   b. 0.5 inch
   c. a football field
   d. 0.5 mile

5. A package of butter is measured in _____ in the metric system.

   a. kilograms or grams
   b. liters or milliliters
   c. meters or centimeters
   d. degrees Celsius

6. A kilogram is approximately equal to

   a. 0.5 pound
   b. 2 pounds
   c. 100 pounds
   d. 1000 pounds

7. The basic unit of volume measure in the metric system is

   a. imperial gallon
   b. gram
   c. liter
   d. centimeter

8. Which of the following is appropriate for measuring vanilla flavoring in a 5 dozen metric cookie recipe?

   a. centimeter
   b. liter
   c. kilogram
   d. milliliter

9. A liter is lightly more than

   a. a quart
   b. a pint
   c. an imperial gallon
   d. a bushel

10. A metric thermometer measures degrees in

   a. centigrade
   b. Celsius
   c. Fahrenheit
   d. all of the above

11. If it was 30^{o} C you might

    a. be sun bathing
    b. have a fever
    c. be shoveling snow
    d. be at the North Pole

12. If a recipe specifies baking cookies at 190^{o} Celsius, the approximate Fahrenheit temperature would be

    a. 225^{o}
    b. 300^{o}
    c. 375^{o}
    d. 500^{o}

Part II: Complete the following items by supplying the correct response for the blank by writing the answer beside the number on your answer sheet.

13. What does SI stand for?_____

14. The symbol _____ is used to indicate meter.

15. The symbol for centimeter is written as _____.

16. The symbol L is used to indicate _____.

17. The symbol _____ is used to indicate milliliter.

18. The symbol for gram is written as _____.

19. The symbol kg is used to indicate _____.

20. Temperature in degrees Celsius is written _____.

Part III: Discussion questions. Discuss in writing three reasons
21-23 you feel are important for learning and using the metric system of measurement.

Lesson I: What is the metric system of measurement?

The metric system is the highly organized system of measurement based on the decimal system in which units of length, area, volume, and weight are related. The more knowledgeable we are about the metric system, the more comfortable we will feel using metric terminology and measurement.

Component Idea

Awareness of the impact of impending metric changeover in personal life and occupational preparation provides the background information for the development of positive attitudes which encourage acceptance of and involvement with the metric system of measurement.

Objective

Given the advantages and background for U.S. metrication, you will be able to discuss in writing three reasons you feel are important for learning and using the metric system of measurement.

Instructions

Complete Activities 1, 2, 4, 5, 7, and 9; you may select any or all other activities you feel necessary to achieve the objective. When you feel that you have accomplished the lesson objective, go on to Lesson II.

Learning Activities

1. View transparency presentation with narration "Learning the Metric System of Measurement."

2. Read the pamphlet "Living with Metric: An Explanation of America's New System of Measurement."

3. Create a bulletin board of articles about metrics discovered in the news and display labeling information in metric units noted on household products.

4. Investigate three wall charts (The Modernized Metric System, Metric System, and Metric Measure) and note base units, symbols, and systematic organization of prefixes.

5. Examine the metric measuring equipment and identify which tools are appropriate for what metric units of measurement.

6. Examine the metric conversion calculators and conversion card available from your instructor and practice finding the metric units for known customary quantities.

7. Discuss with the instructor and fellow students the advantages and disadvantages of changing to the metric system of measurement.

8. Read additional metric information contained in the pamphlets entitled "The Metric Changeover" and/or "What About Metric?"

9. Observe the bulletin board display of Languages of Measurement with common units of the metric and customary systems. Note that there are fewer common units to learn in the metric system.

Lesson II: Linear Measurement

Measurement is the practical application of comparing and describing items in our environment against a standard unit. A standard is a precisely defined unit used for consistency of measurement by members of the worldwide community. Multiples and subdivisions of the standard unit are used to determine measurement of larger and smaller quantities. All base units for mass, area, and volume are based on the metric units of length.

Component Ideas

The meter is the base unit for length in the metric system. A meter is a little longer than a yard. There are 100 centimeters in a meter. Your small fingernail is about 1 centimeter in width. The symbol for meter is m and the symbol for centimeter is cm (periods are not used after the symbol except when symbols are at the end of a sentence.) Symbols for metric units are the same in singular and plural. Meters will replace yards, centimeters will replace inches, and mileage distances will be referred to in kilometers.

Objectives

You will learn the terms meter and centimeter, the amounts they refer to, and their symbols. You will make a 2 meter measuring tape and mark centimeter increments before measuring and recording familiar items at the learning centers. You will be able to judge whether meter or centimeter is appropriate for a given linear measurement situation and begin to estimate lengths in metric units before verifying with your 2 meter tape, a metric ruler, or meterstick.

Instructions

Complete Activities 1, 2, 3, 5, 6, 7, and 8; you may wish to do 4 to achieve the objectives.

Linear Learning Activities

1. Using a meterstick as a standard, make a 2 meter measuring device with cash register tape, marking the meter (m) notations in one color with a felt marker and the centimeter (cm) increments in another color. How many centimeters in a meter? Compare a meter to a yardstick; which is longer?

2. Using your metric tape, determine your height in both meters and centimeters with the help of a classmate and record your findings on the linear measurement worksheet. Estimate the height of the tallest and shortest class members in both meters and centimeters; verify with actual measurement and note both sets of figures on your worksheet.

3. Estimate first and then measure in the appropriate metric unit your metric body measurements for each of the following: hand span, reach of both arms outstretched, width of little finger, neck circumference, length from elbow to end of longest finger, and length of nose to end of outstretched hand. Record your estimates and actual measurements on your worksheet.

4. Using your 2 meter measuring tape, find all the things in the room that are about 1 meter long. Which items are just a little longer than 1 meter? Which items are a little shorter than 1 meter?

5. Estimate first and then measure to verify in centimeters before recording on your worksheet the following items: width of a slice of bread, length of a new pencil, length of a paper clip, and the thickness of a cookbook. Using the Union Carbide 20 cm ruler with millimeter markings, note that the wire thickness of the paper clip is about 1 millimeter. Although millimeter measurements are not commonly used, observe that 10 millimeters (mm) = 1 centimeter (cm).

6. Estimate and then verify by measurement the dimensions of a cookie sheet, bread, cake, and pie baking pans. Label the pans in metric units.

7. Using a 12 inch/foot ruler, measure a strip of paper that is 12 inches long. Using a metric ruler, measure another strip of paper that is 30.5 centimeters long. Do you think it is easier to divide the strip of paper into five equal parts by using your inch/foot ruler or by using your metric ruler to help you? Using the inch/foot ruler, divide the 12-inch strip of paper into five equal parts. Using your metric ruler, divide the 30.5-cm strip into five equal parts. Which method was easier?

8. Investigate the Meter Scale and linear Metric Units poster available from your instructor. Note the relationship between all the units of length. The prefix centi means 1/100 of the base unit; the prefix milli means 1/1000 of the base unit. What are the commonly used metric units of linear measurement? What metric unit of length compares to miles in the customary system?

Lesson III: Weight Measurement

In SI mass in measured in grams or kilograms. In commercial and everyday use, the word weight nearly always means mass. Using the word weight to mean mass and the word weigh to mean "determine the mass of" is acceptable in everyday life and general education.

Component Ideas

The gram is the base unit of mass (weight) in the metric system. A gram is small--approximately the weight of a paper clip or thumbtack; 30 grams is the approximate equivalent of an ounce. The kilogram (1000 grams) is approximately equal to 2.2 pounds. The kilogram (kg) will replace pounds on items with a weight of more than two pounds. Grams (g) will replace ounces and be used for items with weights less than two pounds.

Objectives

You will learn the terms gram and kilogram, the amounts they refer to, and their symbols. You will use metric scales to measure weights in grams and kilograms. You will gain practice in estimating and verifying weight measurement in gram and kilogram units.

Instructions

Complete Activities 1, 2, 3, 4, 5, 6, and 8, and any others you may wish to do to help you achieve the objectives.

Weight Learning Activities

1. Use the metric bath scales and weigh yourself. Learn your weight in kilograms and use it as a reference point. Is the number of kilograms of your weight larger or smaller than the number of customary pounds?

2. Use a balance scale and practice weighing the accompanying mass pieces until you become competent using the balance scale accurately. Place a cake pan on one side before placing a total of 50 gram (g) mass pieces on each side. What does the added weight on one side do the result? How would you correct this problem for ingredient weighing?

3. Being certain you know how to adjust the scale for the weight of the holding container, use the spring scale and practice weighing the following ingredients: 50 g sugar, 100 g flour, 500 g solid shortening. Measure and note the gram weights of the following items on your weight measurement worksheet: 1 teaspoon baking powder, 2 teaspoons baking soda, 1 tablespoon salt, 1 pound of sugar, and 2 cups of peanut butter.

4. Using the spring scale, estimate first, and then measure to verify before recording, both figures on your weight worksheet the gram weights of the following items: a thumbtack, penny, nickle, new pencil, apple, banana, orange, slice of bread, loaf of bread, and a 5 pound bag of potatoes. Which items are more appropriately expressed in kilogram units? (Note 100 grams = 1 kilogram)

5. Using either scale, weigh the following ingredients and mix together with hands in a bowl to make a clay dough: 480 g flour, 435 g salt, and 195 g water. Weigh out 1 kilogram (kg) of dough and shape into a ball. Hold the ball in either hand and get the feel of the weight of a 1 kg unit.

6. Estimate first and measure to verify, using the spring scale before recording both figures on your weight worksheet, the kilogram weights of the following: 1 pound margarine, 46-oz can tomato juice, 5 pounds instant potato flakes, 10 pounds sugar, and 12 pounds oranges.

7. Suppose you were to make hamburger patties from 162 kilograms of hamburger. How many 90 gram hamburger patties would you be making? Hint: 100 g = 1 kg; total grams divided by 90 equals the number of patties.

8. Investigate the Gram Scale and Mass (Weight) Metric Units poster available from your instructor. Note that the prefix kilo means 1000 times the base unit. A milligram (mg) is 1/1000 gram and is used in dietary analysis of nutrients. What are the commonly used metric units for weight in food service?

9. Find the metric weight of 1 pound of popcorn; then pop the corn and find its metric weight. Eat the popcorn and discuss whether popping changes the weight of corn. What accounts for the difference? What would happen to the metric weight of dried beans soaked overnight?

Lesson IV: Volume Measurement

Volume is a three-dimensional compound unit of length and weight derived from the base units of meter and gram:

1 liter (L) = 1 cubic decimeter (dm^3) = 1 kilogram (kg) water

1 milliliter (mL) = 1 cubic centimeter (cm^3) = 1 gram (g) water

There is a consistent relationship between units of length, weight, and volume.

Component Ideas

The liter is the base metric unit for measuring capacity or volume. A liter is slightly larger than a quart. Milliliter is the only other common metric unit of volume. 1 milliliter (mL) is 1/1000 of a liter, or 1 liter (L) = 1000 milliliter (mL). Liters will replace quarts, half-gallons, and gallons. Milliliters will replace teaspoons, tablespoons, cups, and pints.

Objectives

You will learn the terms liter and milliliter, the amounts they refer to, and their symbols (L and mL). You will use volume metric measuring equipment to measure capacity in liters and milliliters. You will gain practice in estimating and verifying volume measurement in liter and milliliter units.

Instructions

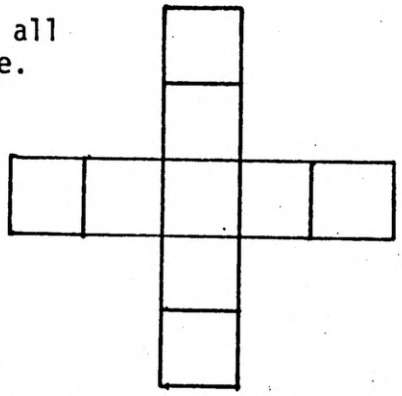
Complete Activities 1, 2, 3, 4, 5, 6, and 8; you may wish to do 7.

Volume Learning Activities

1. Using your metric tape, mark with a different color felt pen that 10 centimeters (cm) = 1 decimeter (dm). Obtain an empty half-gallon milk carton and measure up 1 decimeter from the bottom using your metric measuring tape and cut all around the carton. You now have a cubic decimeter (dm^3) which is commonly called a liter (L).

2. Fill an empty quart milk carton with water to the full line and pour the water into your liter container. What is the result?

3. Using typing paper and a pencil, trace all solid lines and cut out the cross shape. Fold all solid lines and form a cube, gluing overlapping edges together. Using a metric ruler, verify that each side of the cube is 1 cm. 1 cubic centimeter (cm^3) = 1 milliliter (mL). Your 1 cm^3 shape has the volume of 1 mL. Recipe ingredients may be expressed in either mL or cm^3 for volume units.



4. Investigate the metric volume kitchen measuring equipment. The metric cup holds 250 milliliters (mL). Note that there are five small dry metric measuring spoons (1 mL, 2 mL, 5 mL, 15 mL, and 25 mL). The customary teaspoon is approximately equal to 5 milliliters (mL); the customary tablespoon is approximately equal to 15 milliliters (mL). Using salt, verify the comparison using the metric spoons to fill the customary spoons.

5. Fill the 250 mL liquid measuring cup with water and pour the contents into a customary cup over a sink. Fill the metric 250 mL dry measuring cup with flour by the dipping methods; now fill the customary dry cup measure with flour from the metric measuring cup over the flour canister. What are the results? Using metric measuring equipment results in volumes slightly larger than using customary measures: either recipes or pan sizes will need to be changed slightly to accommodate the increased volume resulting from the use of metric volume measuring equipment.

6. Using the liter liquid measuring cup, estimate first, and measure to verify before recording on your volume worksheet, the capacities of the following items which have been filled with water: juice glass, coffee cup, tall water glass, coke bottle, half-liter wine bottle, mixing bowl, and casserole.

7. Create a metric volume bulletin board display by collecting packaging labels which record contents in liters or milliliters.

8. Investigate the Liter Scale and Volume Metric Units poster available from your instructor. What are the most commonly used metric volume units in food service? Because of the interrelationship between metric units, the liter is a derived base unit for volume which equals 1000 cm^3; the milliliter equals 1 cm^3.

Lesson V: Temperature Measurement

The Celsius scale has been chosen as the SI metric thermometer for measuring temperature. Temperature is expressed in degrees Celsius (^oC). The Celsius scale starts with easily recognized points in nature: 0 ^oC is the freezing point of water and 100 ^oC is the point at which water boils. Prefixes have no logical place in temperature measurement.

Component Ideas

The easiest way to learn the Celsius temperature scale is through experience. By identifying convenient points on the Celsius scale with familiar physical states, reference points can be associated with environmental happenings. One degree on the Celsius scale makes a lot of difference. Temperatures in ^oC will be considerably different than the familiar Fahrenheit system.

Objectives

You will learn to express temperature in degrees Celsius by using the appropriate symbol ^oC. You will become familiar with appropriate points on a metric thermometer. You will gain experience in using a metric thermometer and will begin making estimations and verifications of environmental temperatures. You will become familiar with Celsius temperatures important in food preparation and food service.

Instructions

1. With a Celsius thermometer (range -10 ^oC to 110 ^oC) determine the Celsius temperatures and note in ^oC on your temperature worksheet the following: boiling water, bowl of ice water, a comfortable room temperature, and normal body temperature.

2. Boil 500 mL water and slowly add 125 mL of salt; being careful to keep the thermometer off the bottom of the pan, note and record the temperature in ^{o}C when the water again begins to boil. Boil another 500 mL of water and slowly add 125 mL of sugar; note and record the temperature in ^{o}C when the sugar water begins to boil. What factors influence the boiling point of water? Discuss with your instructor the need for recognizing certain stages of cooking, such as soft ball or hard crack as in candy making, along with temperature observation, as important guidelines in food preparation.

3. Examine the four types of Celsius thermometers used in food service and preparation and correctly identify the specific purpose of each.

4. Using your Celsius thermometer, compare various portions of your body with the normal body temperature of about 37 ^{o}C. First estimate and then verify with the Celsius thermometer before recording on your temperature worksheet: inside your fist, under your knee, and your breath. How close are your measurements to 37 ^{o}C? Why are they not exactly 37 ^{o}C?

5. Estimate first and then measure in ^{o}C to verify before recording on your worksheet: How close to boiling is hot tap water? How close to freezing is cold tap water? How warm is it in your room? How close are your estimates?

6. Make a Celsius reference thermometer on your worksheet indicating in ^{o}C the following points: water freezes, water boils, room temperature, and normal body temperature. Why does an oral medical thermometer not register higher than 50 ^{o}C?

7. When baking in the oven, the Celsius thermometer will read approximately one-half the Fahrenheit scale. Note the poster with rounded comparisons of oven temperatures available from your instructor. Record the following common cooking temperatures on your worksheet: baking, 175 ^{o}C; frying, 190 ^{o}C; broiling 250 ^{o}C. Do you know the temperature for boiling eggs?

8. Investigate the Celsius Scale Thermometer poster which illustrates the range of bacterial growth. What are the extremes in ^{o}C for the danger zone of bacterial growth? Record and label the danger zone range for bacterial growth on your worksheet. Why are we concerned about the ^{o}C temperature range for bacterial growth in food service? What would you do if you observed a 12 ^{o}C reading on a refrigerator thermometer?

Lesson VI: Culmination of Meeting Metric Measures

Familiarity with the metric system provides the foundation for accepting and using it in measurement situations. An integration of knowledge, attitudes, and manipulative skills leads to successful experiences using the new metric system of measurement.

Component Ideas

Although the homemaker will use liters and milliliters for volume measurements, institutional food service will primarily use grams and kilograms in weighing ingredients and scaling batters. Being able to use both weight and volume methods of metric measurement in metric recipes in addition to knowing how to bake in Celsius temperatures enables you to greet U.S. metrication with a feeling of confidence that you can deal effectively with the new system both in personal life and in future employment in the food service industry.

Objective

You will apply a combination of metric knowledge gained from previous lessons to gain practice using SI in a variety of measurement situations.

Instructions

Complete Activities 1, 2 or 3, and 4; you may do 5 if you like.

Learning Activities

1. Weigh 100 grams of each of the following commodities: flour, sugar, dry milk, cooking oil, dry flaked cereal, mashed potatoes, and honey. Measure each 100 g commodity in a 500 mL measuring cup and record the volume on your worksheet. Answer the following questions on your worksheet:

   Which method of measurement feels most comfortable?
   Which method of measurement is most accurate?
   Which foods are easiest to measure in grams?
   Which foods are easiest to measure in milliliters?

2. Prepare the following recipe for Peanut Butter Cookies using the metric system by weight of non-liquid ingredients. Be sure to use a Celsius oven thermometer to check the temperature before baking.

   PEANUT BUTTER COOKIES

   224 grams margarine
   260 grams peanut butter
   200 grams sugar
   212 grams firmly packed light brown sugar
     2 large eggs, beaten
     5 milliliters vanilla
   312 grams all-purpose flour
     3 grams baking powder
     4 grams baking soda
     6 grams salt

   1. Weigh and stir together margarine, peanut butter, granulated sugar, and brown sugar until well blended.
   2. Beat in eggs and vanilla.
   3. Stir together flour, baking powder, baking soda, and salt.
   4. Add to peanut butter mixture, stirring until well blended.
   5. Shape into 2.5 centimeter balls. If necessary, chill dough until it can be handled easily.
   6. Place balls about 5 centimeters apart on a greased baking sheet.
   7. Flatten with tines of floured fork, making a cross-wise pattern.
   8. Bake in 180 ^{o}C oven 12 to 15 minutes or until lightly browned. Yield: about 75 (5 centimeter) cookies.

3. Prepare the following recipe for Peanut Butter Cookies using the metric system by volume measurement of the majority of ingredients. Be sure to use a Celsius oven thermometer to check the temperature before baking.

PEANUT BUTTER COOKIES

240 milliliters margarine
240 milliliters peanut butter
240 milliliters sugar
240 milliliters firmly packed light brown sugar
2 large eggs, beaten
5 milliliters vanilla
600 milliliters unsifted spooned all-purpose flour
5 milliliters baking powder
5 milliliters baking soda
5 milliliters salt

1. Measure and stir together margarine, peanut butter, granulated sugar, and brown sugar until creamy and well blended.
2. Beat in eggs and vanilla.
3. Stir together flour, baking powder, baking soda, and salt.
4. Add to peanut butter mixture, stirring until well blended.
5. Shape into 2.5 centimeter balls. If necessary, chill dough until it can be handled easily.
6. Place balls about 5 centimeters apart on greased baking sheet.
7. Flatten with tines of floured fork, making a cross-wise pattern.
8. Bake in 180 ^{o}C oven 12 to 15 minutes or until lightly browned. Yield: about 75 (5 centimeter) cookies.

4. Prepare the following recipe for Vanilla Cake:

VANILLA CAKE

95 grams shortening
250 grams sugar
96 grams eggs, beaten
250 grams all-purpose flour
12 grams baking powder
6 grams salt
183 milliliters milk
5 milliliters vanilla

1. Cream shortening and sugar together.
2. Add eggs and mix thoroughly.
3. Sift dry ingredients together.
4. Add half of the flour and half of the milk-vanilla to the creamed mixture and blend thoroughly.
5. Add the remaining ingredients and mix well.
6. Pour batter into two 20 centimeter greased and floured layer cake pans.
7. Bake at 190 ^{o}C for 25-30 minutes, or until cake surface springs back when touched lightly.
8. Cool cake for 10 minutes before removing from pans.

5. Spend one day living metrically, recording everyday activities using metric measurement when possible. Note the many events that can be measured using SI.

Post-Test

When you have accomplished the objectives in all lessons, ask your teacher for the Post-Test.

Quest

If you are interested in further study of metric measurement, you may wish to do some of the activities listed below. Please see your instructor before you undertake a project of your choice.

1. Conduct a survey of managers in food establishments in the community to determine the status of metric usage, feelings about conversion, and evidence of metrication on institutional food packaging labels.

2. Develop a metric resource center of recent articles, books, and pamphlets to service as metric reference materials for the classroom.

3. Set up a display of metric and customary measuring devices to illustrate the relationships and differences between the two systems.

4. Investigate and report to the class the commercial availability of metric measuring equipment in the community.

Summary

This learning package of metric information for secondary and post-secondary students in a vocational food service program was developed for the awareness stage of the 'think metric' process. Learning activities were designed to introduce the student to the universal SI measurement language and to create an awareness of the impact U.S. metrication will have in both personal life and future employment in the food service industry. Because all base units for mass, area, and volume are based on metric units of length, the concept of linear measurement preceded the sequential development of mass and volume concepts. Learning activities were specifically developed for mass, volume, and temperature for the areas of food preparation and service directly affected by metric changeover. Learning activities were designed to emphasize the common metric units of length, weight, volume, and temperature particular to food service situations. Culmination learning activities were designed to integrate the knowledge and skills of previous lessons.

The learning package contains two separate sections, one for the instructor and one for the student. The format outlined by the American Home Economics Association was followed in developing the learning package (Home Economics Learning Packages: Format, 1970).

Chapter 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

Economic survival in the world marketplace provided the primary stimulus for commitment to a planned U.S. metrication program with the passage of the Metric Conversion Act of 1975. The U.S. Metric Board, yet to become a reality at the time of this writing, was established to direct a broad program of planning, coordination, and public education for U.S. evolutionary conversion to the metric system of measurement within a 10 year period. Living and functioning in a metric America will cause some discomfort at first, but studies have shown that metrically informed persons tend to favor adoption of SI measurement for its logical simplicity based on the ease of use of the decimal system. Industry and education are pivitol sectors directly concerned with the enormous challenge of retooling individual societal members in a new language of measurement. Because learning the metric system involves the difficult process of relearning, special attention must be paid to the period of dual dimensioning when two separate measurement systems will be accommodated simultaneously during transition. Although comparisons between the customary and metric system are helpful, conversion is to be avoided since it hinders the 'think metric' process which involves learning to visualize relative sizes in metric units.

People become conversant with metric units and measures by cognizant understanding of their uses and relationships through practical experiences involving both physical and mental interaction.

Vocational education is the liaison between the formal educational setting for imparting knowledge and the various industries for whom it prepares students with specialized training for occupational success in the world of work. Vocational education curricula whose content is predetermined by the industrial clientele it serves must include instructional programs which are designed to accommodate transition to a new system of measurement. In response to industries' metrication plans, vocational students will need to acquire metric measurement skills needed to perform occupational related tasks and develop the ability to 'think metric' for making judgments, estimates, and comparisons of measurement values in work related situations. In the absence of specific materials for metric education in a vocational food service program, this project was undertaken to develop a learning package of self-instructional metric materials for secondary and post-secondary students for the awareness stage of the 'think metric' process.

The procedure followed in designing the learning package was based on responses to the general questions posed by the problem. These provided the information necessary for developing metric

materials for the awareness stage of the 'think metric' process in a vocational food service program. Particular attention was given to the development of positive attitudes where the student's need for being aware of impending metric changeover was necessary before experiencing successful, relevant 'hands-on' metric measurement activities. Metric learning activities had to be designed to resurrect the intuitive feel for correct measurement dimensions lost during the transition period by providing personal referents for comparison to promote the internalization of contextual clues.

The format for developing learning packages outlined by the American Home Economics Association was followed in designing metric materials for the awareness stage of the 'think metric' process for a vocational food service program. The title "Meeting Metric Measures" identified the major idea for the learning package during the awareness stage. Background information concerning the nature of the International System of Units was provided in the first lesson to introduce the metric system. Additional lessons were designed to present a single measurement concept in sequence (linear, mass, volume, and temperature) with learning activities reflecting food service situations. Culmination learning activities were designed to integrate knowledge and skills previously learned in the sixth and final lesson. Objectives from the affective, cognitive, and

psychomotor taxonomic domains were selected to convey the expected performance of the desired behavioral outcomes. Multidimensional learning materials were presented throughout the diversified learning activities to promote the achievement of the objectives. Pre-evaluation, self-evaluation, and post-evaluation tools were developed to assess the learner's status in relation to the concept. Based on the aforementioned components, the final compilation of metric materials resulted in a learning package with two distinct instructor and student sections for the awareness stage of the 'think metric' process for secondary and post-secondary students in a vocational food service program.

Conclusions

Based on the experience of the author, accepting the challenge of designing metric materials for a specific instructional area as a solitary individual is an enormous undertaking in the absence of definite guidelines to steer the course of the endeavor. Legal commitment to a U.S. metrication program through planned change has not resulted in the prompt establishment of an active U.S. Metric Board charged with the responsibility for implementing metric transition. This interim between passage of the Metric Conversion Act of 1975 and active direction and coordination by the U.S. Metric Board is an awkward period lacking the executive leadership necessary for developing comprehensive metric training programs.

The National Bureau of Standards continues to function as the primary governmental agency responsible for dissemination of public metric information. The American National Metric Council is primarily responsible for coordinating metric activities in the private industrial sector.

Since it is U.S. policy to 'let metrication costs lie where they fall,' industry is converting to metric measurement at an uneven pace as equipment replacement dictates the phasing out of non-metric parts. Vocational education must prepare students bilingually in the language of measurement. It is necessary to prepare them for the future while still equipping them with skills necessary for working in the present world which utilizes customary units.

Particular attention must be given to providing 'hands-on' learning activities which foster the development of positive attitudes imperative for acceptance and adoption of the new metric system of measurement. Relearning a measurement system involves learning objectives from the affective, cognitive, and psychomotor taxonomic domains.

Equipping the vocational food service laboratory with metric measuring equipment to facilitate metric education in the classroom is an essential, costly investment at the onset of transition.

Recommendations

Due to the scope of metric education in a vocational food service program, more people need to be involved in planning metric materials for a specific instructional area. Direct contact and input from the food service industry would enhance the opportunity for integrating metric needs with educational curriculum designs.

Because of the expense involved during dual dimensioning an interdisciplinary approach to metric education, with shared information and equipment among subject areas, is desirable when feasible.

The learning package designed for the awareness stage of the 'think metric' process awaits testing for content validity before being implemented in a secondary or post-secondary vocational food service program. This learning package is one of the few, if any, comprehensive learning packages which should be implemented for the first stage of metric transition in a vocational food service program.

Consideration should be given to the development of additional learning packages for the remaining four stages of the 'think metric' process to establish a continuum of materials for a complete plan of metric education in a vocational food service program. The remaining four stages of the 'think metric' process are information-gathering stage, application stage, trial stage, and adoption stage.

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