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THE DEVELOPMENT AND COMPARATIVE EVALUATION OF A SELF-INSTRUCTIONAL  
MODULE FOR QUANTITY FOOD STORAGE

by

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THE MEMORY  
OF  
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## INTRODUCTION

Every foodservice establishment needs adequate, efficiently arranged, and well managed storage space for profitable operation. Lukowski et al. (1) indicated that storage is important in the overall operation of the foodservice facility because it is the link between receiving and preparation. Storage performs a holding function, between the time supplies of food are received and the time they are used in the preparation of meals, when quality can be retained or lost (1). The Food Storage Guide for Schools and Institutions (2) reported that good storage facilities help keep foods safe, wholesome, and appetizing, thus helping to ensure the service of nutritious, sanitary, and palatable meals.

Storage is also vital in the foodservice establishment for another major reason. It is the operational phase where management can exert effective control without appreciably adding to cost in terms of time and personnel (1). Good storage can reduce the costs of operation (1, 3). Lukowski and coworkers (1) pointed out that opportunities for increasing profits are greater when there is effective control of shrinkage, pilferage, and the unnecessary handling of food.

Current societal changes have resulted in more meals being consumed away from home (4). These societal changes which have increased patronage of foodservice operations coupled with the importance of storage in the operation establish the need for the development of educational tools that facilitate learning by those persons who will be responsible for managing and/or planning a foodservice operation.

In these days of exploding knowledge, it has become evident that traditional methods of teaching are too inefficient and ineffective to keep pace with current educational demands (5). Advances in communication media have made possible many new types of learning experiences. By incorporating new audiovisual products, educators may be relieved of some of the routine and time consuming tasks in teaching so that they may give direct and individualized help to the students. Also, learning experiences can be developed with enough adaptability to allow each student to adjust learning according to his/her background, interest, and abilities.

Dale (6) supported the use of audiovisual materials when he stated that it is no longer suitable to consider audiovisual materials as an appendage to curriculum, but rather integral and working parts of a carefully formulated program of planned educational experiences. Lumsdaine (7) carried the point further when he indicated that auto-instructional methods may represent the most important innovation in education since the advent of the textbook.

Various types of communication media have been utilized with success in the teaching of botany, agronomy, veterinary anatomy, biology, and chemistry (5, 8-12). Quantity food storage is a basic component in a management oriented course involving principles of quantity food production and purchasing for dietetic and restaurant management students. A search of the literature did not reveal any studies concerned with the development of audiovisual instructional materials for these concepts for the college student.

## Objectives of the Study

The purpose of this research was to integrate basic information about quantity food storage into a self-instructional module for the students in the junior level, management oriented Fundamentals of Quantity Food Production course at Kansas State University. It is also intended that the module serve as a review for students in advanced level management courses such as Foodservice Systems and Foodservice Equipment and Layout. In addition, it may be used as a remedial unit for students who have a deficiency in this area. The objectives of this study were:

1. to develop a slide/tape self-instructional module on quantity food storage incorporating factors that facilitate learning.
2. to evaluate the effectiveness of the module by comparing cognitive test scores of students in Fundamentals of Quantity Food Production who used the module with scores of those who did not have the module available to them.

## Definition of Terms

The following are the definition of terms used in this study:

Quantity Food Storage--the dry, refrigerated, or frozen storage of semiperishable and perishable foods which are purchased in quantity lots for use in commercial and institutional foodservice operations.

Dry Food Storage--the storage of semiperishable foods such as canned goods and bulk dry staples that do not require refrigeration.

Refrigerated Storage--the storage of perishable foods such as fresh meat, milk, eggs and produce in artificially cooled, insulated units that can maintain temperatures between 32°F and 45°F.

Frozen Food Storage--the storage of previously frozen perishable products such as fruits, vegetables, and meat in artificially cooled, insulated units that can maintain temperatures at 0°F or lower.

Audiovisual--experiences, equipment, and materials used for communication in instruction; training and education functions are implied (13).

Auto-Instruction--self-guided learning; used interchangeably with programmed instruction, programmed learning, automated teaching, and self-instruction materials (13).

Auto-tutorial--self-instructional approach with emphasis on student learning rather than on the mechanisms of teaching (5).

Instructional Media--devices which present a complete body of information, and are largely self-supporting rather than supplementary in the teaching process (13). Examples include programmed texts, slide/tapes programs, videotapes, films, and multimedia packages.

Module--a series of slide/tape presentations that form a unit of study.

Programmed Instruction--a sequence of carefully constructed experiences leading the student to mastery of a subject with minimal errors to achieve educational objectives.

Self-Instruction--a type of self-paced programmed instruction using slide/tape presentations.

Slide--a 2" x 2" mounted transparency designed to be used with a slide projector.

Slide Projector--projection instrument designed to accept 2" x 2" mounted transparencies.

## REVIEW OF LITERATURE

### Learning

Learning is considered to have taken place whenever the individual's behavior is modified (14, 15). Gagné (16) further points out that "learning is a change in human disposition or capability, which persists over a period of time, and which is not simply ascribable to processes of growth."

Bigge (17) reports that the two most prominent families of contemporary learning theories are the behavioristic or connectionist group and the Gestalt-field, organismic, or cognitive group. The behavioristic group interprets man's behavior as connections or associations between stimuli and response. The Gestalt-field family assumes that the cognitive processes of insight, intelligence and organizational ability are basic characteristics of human behavior. Within the Gestalt-field frame of reference, behavior is a function of a total situation; a person interacting within a field of psychological forces which include purposes and goals, interpretation of relevant physical objects and events, and memories and anticipation (17). This family is more concerned with how one learns rather than what they learn (14).

Based on the theory of association, Gagné (16) believes that there are basic forms of learning that include: signal learning, stimulus-response learning, and chaining. Beyond the basic forms of learning, he approaches the subject of kinds of learning from the standpoint of "learned capabilities." The five varieties of capability are viewed as: intellectual skill, verbal information, cognitive strategies, motor

skills, and attitudes. In each individual situation there are conditions within the learning situation which must exist for learning to take place (16).

Principles of learning are grouped by Bigge (17) in three categories: motivation for learning, making learning more efficient, and retention. From a motivation for learning standpoint, he indicated that the role of personal involvement, intrinsic versus extrinsic motivation, success, demotivation caused by "pat" answers, tests as motivation sources, and self-imposed goals versus teacher-imposed goals will all influence learning. In making learning more efficient, Bigge pointed out that improving the efficiency of learning necessitates establishing conditions which maximize change of understanding or behavior in a given time frame. To further improve efficiency, it is recognized that active participation of learners in the learning process is advantageous over passive reception. Participation is promoted through some specific principles which involve readiness for learning, practice, and part versus whole learning. Where retention is concerned, Bigge suggested that factors such as meaning, purpose in remembering and forgetting, overlearning, spaced review versus cramming, and intervening events would influence learning (17).

To develop an effective unit of study one must be cognizant of the factors that affect and/or facilitate learning. Differences of opinion exist regarding factors that are detrimental to and those that facilitate learning. When preparing to teach, Brown and Thorton (18) recommend incorporating conditions essential to learning in addition to analyzing college philosophy and purposes, one's discipline and personal philosophy, and the learners. The conditions they viewed essential to learning include learner's knowledge of course goals; varied and appropriate

learning experiences; clear communication; realistic, fair assignments; learner's knowledge of course structure and organization; student participation in course planning; clear assignments and standards of performance; and the opportunity for the learner to verbalize, generalize, and evaluate. When analyzing learners they suggested investigating reasons for enrolling, motivation, intellectual ability, reactions to instructor personality and to learning experiences, and the student's need for security and independence (18).

According to Cobun (19), sensory involvement assists learning with hearing providing about eleven per cent and visual experiences accounting for eighty-three per cent of learning. Kinder (20) indicated that retention of what is learned is related to the senses. He reported the following approximations, developed about 1950, by P.J. Phillips at the University of Texas:

Holding time as nearly constant as possible, people remember:

- 10 per cent of what they read.
- 20 per cent of what they hear.
- 30 per cent of what they see.
- 50 per cent of what they hear and see.
- 70 per cent of what they say.
- 90 per cent of what they say as they do a thing.

Barriers to effective communications were applied to the learning situation by Kinder (20). Included were poor physical reception, inaccurate reading of feedback, dissimilar background experiences, jargon, verbalism, differing concepts of space and time, and the generation gap since the older and the younger people live in two different worlds.

Kemp (14) believed that finding solutions for problems involved in education requires new ways of approaching and organizing for learning. He suggested a shift from teaching by the teacher to learning by the

student, a move from static to dynamic instructional programs, a shift from viewing the student as part of the group to recognizing him or her as an individual by supplying alternatives for an individualized learning approach, the use of audiovisual materials in new formats for individualized learning rather than for group instruction, and the use of a systematic procedure for instructional planning.

According to Kemp (14), the development of individualized learning using instructional media demonstrates an application of the stimulus-response theory in which learning is broken down into small steps that require an appropriate response followed by immediate knowledge of results. This concept is implicit in the programmed instruction utilized by James G. Holland and B.F. Skinner (21).

Postlewait et al. (5) described the development of an effective educational program utilizing an auto-tutorial approach to learning. Factors to be included were repetition, concentration, association, small unit steps, appropriate communication vehicle, multiple approaches, and use of integrated experiences.

#### Patterns for Teaching and Learning

Most learning takes place within three broad methods: instructor presentation, individualized or independent study, and interaction between teacher and student or among students (14). As changes have taken place in instructional programs, students are spending a greater proportion of their time in individualized learning rather than in attending classroom presentations (14). Consequently, audiovisual materials and other resources provide many of the necessary learning experiences.

The traditional instructor presentation method is typified by one-way communication from the teacher to the student as in the traditional lecture with information presented at the instructor's rate (14). In addition, the students are physically passive even though they are listening and taking notes (14, 22, 23). Since the current trend is to reduce the amount of time spent in traditional presentation by the instructor in preference for independent study of the material by the learner, the purposes served by this method are changing. To complement, or even replace the usual teacher presentation, audiovisual materials may be utilized to serve one or more of the instructional needs relative to a subject. Also, learner participation during the presentation can be increased by providing activities such as completing exercise sheets or working with the actual materials being presented (14).

Individualized learning may take many forms and is given numerous names including independent study, self-instruction, and learner- or self-guided instruction (5, 14). Its principal attribute is that the student assumes responsibility for his/her own learning which allows him/her to proceed with activities and materials at his/her own level and pace. With entry level concepts, all students generally use the same material with only their individual rate of study being different. With more advanced concepts, alternatives for accomplishing the objectives are provided along with a correlated variety of materials, thus the choice of learning experience is made by the student (14). Elements that contribute to individualized learning approaches include a clear statement of learning objectives and required levels of performance, pretesting to allow bypassing, alternate procedures, participation activities, immediate feedback on

performance, and the opportunity for the learner to check his understanding with the objectives (5, 14).

According to Kemp (14), topics and supporting materials in individualized instruction are usually developed on a single concept level rather than as broad, general subjects. Media selected for such concepts must be suitable for independent study and should be carefully integrated with other activities (5, 14).

The third pattern for teaching and learning, student-teacher or student-student interaction, provides opportunities for personalized exchange. With students spending more time working on their own under individualized learning conditions, it is necessary to provide opportunities for direct contact both with the instructor and other students (14, 20). Such experiences are possible with the teacher-student interaction pattern. During small group discussions, some of the resources utilized in the presentation or individualized learning approaches should be available for reference (14). Illustrative concepts, case studies, and other materials to stimulate discussion can be utilized. Kemp (14) pointed out a need for effectively designed media materials for use in group activities.

#### Contribution of Audiovisual Materials to Learning

As audiovisuals have moved from the periphery to an integral element in the instruction process, there have been recognized contributions to the learning process. Anyone planning, producing, or utilizing audiovisual materials should recognize their contribution to the learning process and utilize them for the benefits which they offer (24). The Commission on Instructional Technology (24), Smith and Nagel (25), and Kinder (20) have

reported some of the contributions of audiovisual materials to the learning process. Included are provision of worthwhile experiences for students that teachers are unable to furnish, better use of instructional time, and individualization for learner's preference and pace. Additionally, audiovisual materials can make learning immediate, make access to learning equal for learners, and give instruction a scientific base through systematic planning. Audiovisuals can also provide variety in learning, offer concrete experiences, arouse interest, motivate, increase retention, develop continuity of thought, and facilitate attitude and behavior change. Kinder (20) emphasized that it must be remembered that these values are obtained "only when the materials are well designed and when they are used appropriately to achieve specific learner objectives."

Some deterrents to learning associated with audiovisual materials have been pointed out by educators. Although problems have been identified by audiovisual research workers, a summary by Carpenter (26) draws together the major problems which include limitations of audiovisual materials for communicating abstract meanings; difficulty of teaching general principles by means of specific and concrete models, objects and pictures; difficulty of matching the variety of instructional materials with the variability of individuals; and the difficulty of personalizing instruction when motion pictures and television are utilized.

### Designing for Instruction

When planning for traditional methods of teaching, decisions are frequently made in an intuitive fashion and may be based on ambiguous purposes according to Kemp (14). Usually subject content has been the basis for planning with little attention to other details. It is now

acknowledged that the instructional process is complex and that many factors must be given attention if results are to be successful (14).

As indicated by Kemp (14), when an instructor wishes to teach something, several activities are necessary if he is to succeed. He must decide upon the goals he intends to reach; select procedures, content, and methods relevant to those goals, cause the student to interact with appropriate subject matter in accordance with the principles of learning; and evaluate the learners' performance according to the goals originally selected.

Kemp (27, 14) utilized the term "instructional development" as the broad process of designing an instructional program using an objective, systematic approach. Objectives, strategies, and evaluation form the framework of instructional development procedures. Along with these three elements are other supporting factors including equipment, technical expertise and subject matter resources. When all of these components are integrated, an instructional design plan can be developed (14).

Many systematic approaches to instructional planning have been proposed such as those suggested by Brown and coworkers (28), Kemp (27, 14), Erickson and Curl (29), and Ryan (30, 31). Although they vary in their degree of complexity, all include the same basic elements and can be diagrammed as in Figure 1.

It is stressed repeatedly in the literature that objectives are an important aspect in all areas of educational planning. The desire to establish uniformity in objectives was demonstrated, beginning in 1948, by the formation of a system which classified the goals of the educational process (32). The result was the development of a taxonomy which categorized the cognitive, affective and psychomotor domains (32). Bloom

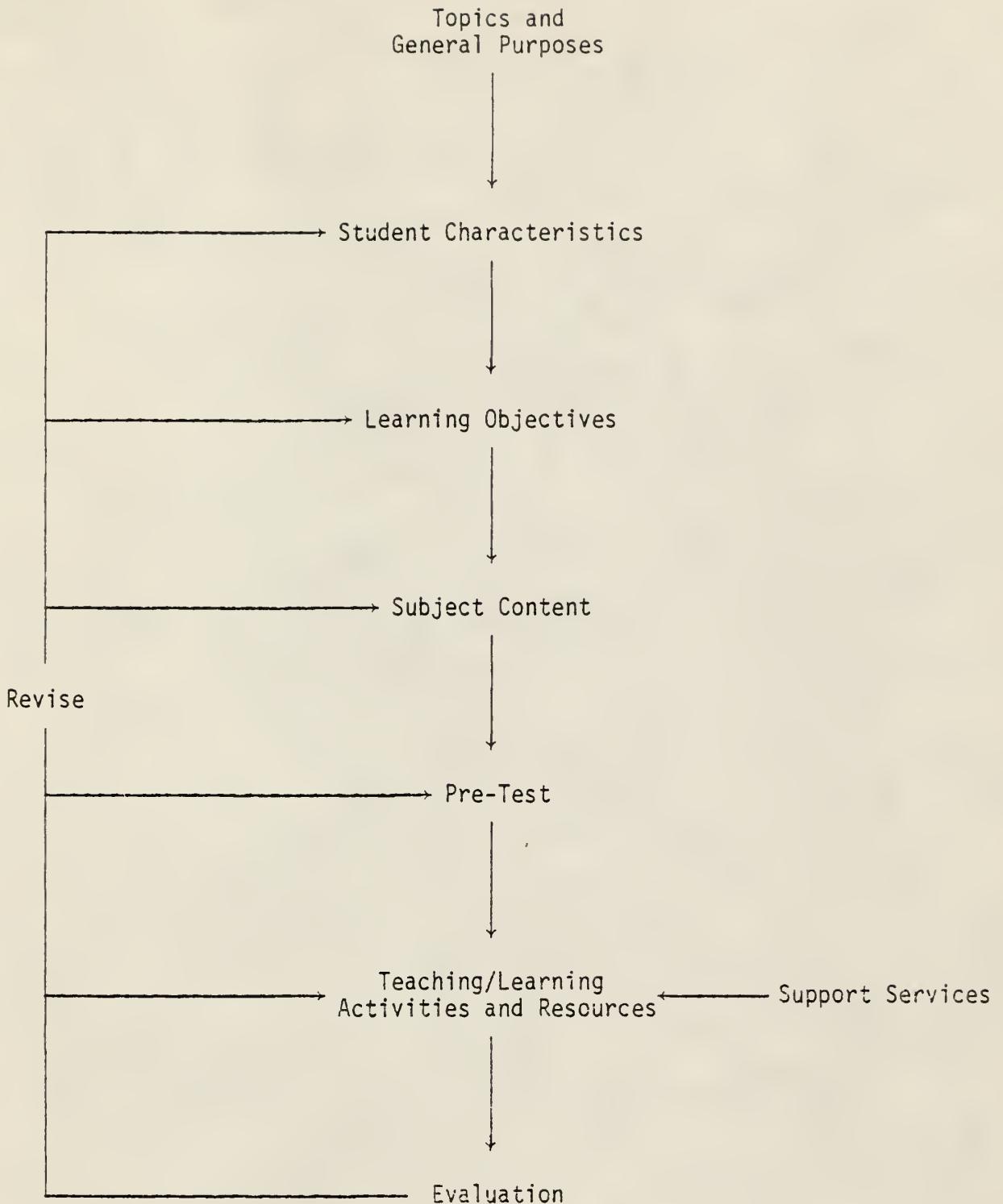


Fig. 1. Flow chart showing systems approach to design of instructional planning (27)

et al. (32) identified six levels of intellectual activity included in the cognitive domain as knowledge, comprehension, application, analysis, synthesis, and evaluation.

Mager (33) describes an objective as "an intent communicated by a statement describing a proposed change in a learner--a statement of what the learner is to be like when he has successfully completed a learning experience." Plowman (34) views objectives as "intentions, expectancies, or aims that lead us to behave or perform in certain ways." He goes on to say that they are "useful pedagogical tools because they make it possible to be more precise, logical, and effective in planning and evaluating learning experiences" (34). Mager (33) summed up the importance of objectives when he said, "an instructor will function in a fog of his own making until he knows just what he wants his students to be able to do at the end of the instruction."

#### Media in the Instructional Design Plan

Media to be utilized within the instructional design plan must be determined by the instructional objectives, subject matter, and the instructional method. Criteria for selection of media are described by Kemp (14) as "which media, in what form, and at what time, will most effectively and efficiently provide the most relevant experience for learners."

The systems concept makes the idea of media as instructional "aids" obsolete (29, 14), or as Luhan (35) asserted, media can no longer be considered just the "transmission belt." Kemp (14) stressed that "media are not supplementary to, or in support of instruction, but are the instructional input itself."

Kemp (14) pointed out that objectives require different kinds of learning thus necessitating that instructional resources must be matched to the required objective. Therefore, each concept to be taught will require an individual consideration of resources. In some cases the choice is by the purpose which the media serves, i.e. motion through motion pictures. In other cases, available equipment, convenience, cost, availability of technical expertise along with other factors will be determiners of media choice.

### Perception and Communication Principles

Relevant principles must be applied to insure satisfactory results when planning and producing audiovisual materials. Principles which are essential to the development of instructional materials include perception and communication.

Perception. According to Kemp (14), perception is the process through which an individual becomes aware of the world around him. In physiological terms, Tortora and Anagnostakos (36) stated, "perception refers to the conscious registration of a sensory stimulus." The senses are utilized to apprehend objects and events. Of these senses, the eyes, ears and the nerve endings in the skin are the primary means of maintaining contact with our environment.

For a sensation to occur, the following chain of events must be fulfilled (30):

A stimulus, or change in the environment, capable of initiating a response by the nervous system must be present.

A receptor or sense organ must pick up the stimulus and convert it to a nerve impulse. A sense receptor or sense organ may be viewed as specialized nervous tissue that is extremely sensitive to . . . external conditions.

The impulse must be conducted along a nervous pathway from the receptor or sense organ to the brain.

A region of the brain must translate the impulse into a sensation.

Two aspects of major importance about perception relate to the designing of instructional materials. First, a perceptual event includes many sensory messages which do not occur independently, but instead are related and combined into intricate patterns. Second, a person reacts to only a small part of all that is occurring around him at any given time. Therefore, it is necessary to design materials that will attract the attention and retain the interest of the learner. It is known that perception is individual and unique. As Kemp (14) pointed out, an individual perceives an event in terms of his past experiences, present motivation, and present circumstances.

Much research has been conducted on perception. In one extensive review of the literature, Fleming (37) presented a summary of his findings. Major points with relevance to planning and producing effective instructional materials are:

#### IMPORTANCE OF PERCEPTION

In general, the better an object or person, event, or relationship is perceived the better it can be remembered.

It is important in instruction to avoid misperception. If a student misperceives the intent or content of a paragraph or film sequence, he may also misunderstand it or may learn something false or irrelevant.

Where it is desirable, instruction to replace the real world with some substitute or surrogate such as a photograph or drawing, it is important to know something about how to represent that reality adequately for perceptual purposes.

#### BASIC PERCEPTUAL PRINCIPLES

Man's perception is relative rather than absolute, all other things being equal.

Man is a very selective perceiver. He attends to only a few of the sights, sounds and smells available to him in his environment at any one time.

Man's perceptions are organized. He does not perceive chaotic arrays of different brightnesses, colors, temperatures, and noises, except perhaps at a discotheque. Rather, he perceives relationships, groupings, objects, events, words, and people.

Man perceives what he expects or is "set" to perceive. This influences both what he selects and how he organizes and interprets it.

The perceptions of one individual or group may vary markedly from that of another in the same situation.

Fleming (37) elaborated on these points when he discussed attention and preattention; perceptual elements and processing; perception of objects, pictures, and words; and perceptual capacity. Discussion of perceptual distinguishing, grouping and organizing; perception of size, depth, space, time and motion; and perception and cognition constituted the remainder of his findings (37).

Additional pertinent findings reported by Toch and MacLean (38) include:

There is no purposive behavior without perception.

Behavior is an outcome of past perceptions and a starting point for future perceptions.

The perceiver and his world do not exist independently.

Meanings are given to things by the perceiver in terms of all the prior experiences he has accumulated.

Perceptual experiences are personal and individual.

A percept is a link between the past, which gives it meaning, and the future, which it helps to interpret.

Those things that have been tied in most closely and most often with past personal experiences predominate perceptually over the unusual or the unfamiliar.

Since two persons cannot be in the same place at the same time, they must see at least slightly different environments.

Though no two persons can have exactly the same meanings for things observed, common experiences tend to produce shared meanings which make communication possible.

Communication. According to Tortora and Anagnostakos (36), perception leads to communication. Regardless of the simplicity or complexity, all communication follows a sequence of events that may be diagrammed as shown in Figure 2 which is a model presented by Shannon and Warren (39).

In communications the goal is understanding (40). To have effective communication the receiver must be active. When active, he reacts thereby bringing forth a response termed feedback (see Figure 2). Feedback enables the sender to correct errors in the transmitted message, improve the encoding and transmission, or assist the recipient in decoding the message.

Another element which must be considered in communications is noise. Noise enters the communications model as shown in Figure 2. Noise is considered to be any disturbance that interferes with or distorts the transmission of the message. This factor can have a serious impact on the success or failure of communication. To varying degrees, noise distorts information transmission, therefore it must be recognized as an obstacle to be overcome.

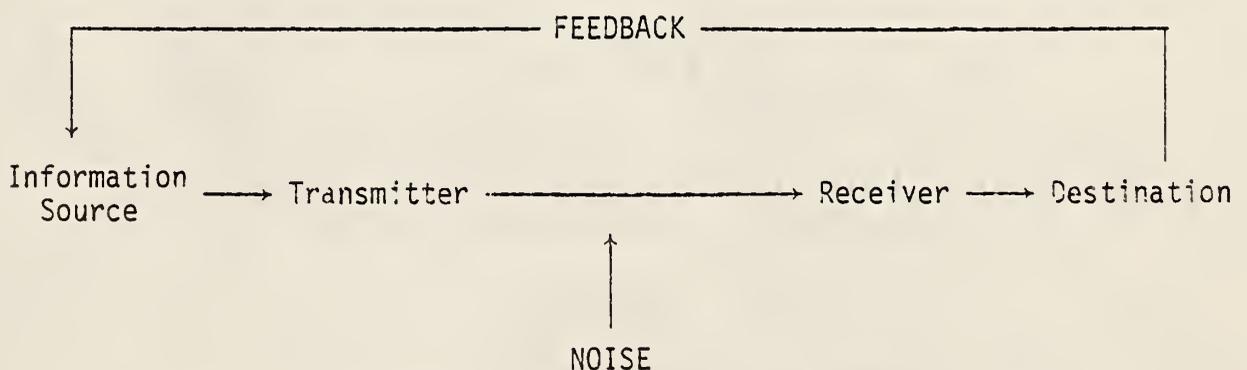


Fig. 2. Communications model

Redundancy is frequently utilized to overcome the effect of noise. However, Kast and Rosenzweig (40) point out that even though redundancy can be helpful research has not identified a correlation between the amount of communication and the degree of understanding.

#### Research on Audiovisual Instruction Materials

A search of the literature reveals a vast amount of research involving audiovisual materials. Most of the studies concern utilization practices and evaluation of the instructional value of specific materials compared to traditional teaching methods. However, in some experiments, a particular aspect of an audiovisual presentation was varied to determine the effect upon learning. Kemp (14) presented a summary of the findings of some of these experiments (41-50). Information relevant to this research as cited by Kemp is summarized in the following discussion. From a survey spanning thirty years, Hoban and Van Ormer (41) identified factors that were believed to be important when developing audiovisual instructional material. Selected factors include use of a rate of development slow enough for the learner to grasp material and succinct but thorough treatment of subject matter. They also suggested the use of an introduction, summary, and repetition within a presentation. Caution was recommended on the use of commentary, personal pronouns, and nomenclature. It was noted that color and music do not appear to increase learning. Pretesting instructional materials and employing learner participation was advocated (41).

May and Lumsdaine (42) summarized an eight year series of experimental studies concerning problems in production and utilization of teaching films. Among other findings, they reported that 1) a crude

presentation such as pencil sketches of visuals may be at least equal in effectiveness to a polished film, 2) narrated film is preferred over live dialogue except where the use of live dialogue can have marked superiority for meeting particular objectives, and 3) liberal use of titles, questions, and other printed words can improve teaching effectiveness.

To improve quality and effectiveness of audiovisual materials, May (43-45) suggested the use of motivators which are devices, effects or procedures that cause the learner to pay close attention, to look or listen for relevant and crucial clues, to have a "set" or put forth effort to learn, and to respond or practice. Positive motivators include the use of color to gain and hold attention, dramatic presentations, humor and comic effects, and inserted printed questions; reinforcers are techniques to increase the probability that the learner will remember and can reproduce what was presented. May reiterated that there are no clear guidelines of ways to increase retention, but there is evidence that pleasing, interesting, and satisfying stimuli are positive reinforcers. Cue identifiers, devices or effects that help the learner identify and recognize relevant cues, include color, arrows and pointers, animation, "implosion" techniques (having assembled parts fall into place without being handled by the demonstrator), subjective camera angles, and directed narration. Simplifiers, procedures for making presentations more effective, include improving readability of narration, eliminating irrelevant pictorial materials, repeating illustrations or adding additional illustrations (43-45). May questioned whether or not improved learning resulted from procedures such as musical backgrounds, introductory and review sections, and optical effects.

Travers summarized findings from audiovisual research from 1950 until 1967, which verified and contrasted with results presented above. He reported that even though color adds to the attractiveness of a training device it does not necessarily mean that learning is improved except when the learning involves an actual color discrimination. Although some verbalization is necessary, verbal simplification increases effectiveness. No optimum amount of verbalization has been identified. Slow speeds for transmitting verbal information are favored, but they can be too slow. May (43-45) said that for relatively simple material, listening comprehension is likely to be most effective at speeds of around 160 words per minute. When narration is accompanied by video, the optimum rate of the narration appears to be slower. Overt response, practiced by the learner during a film, results in increased learning, and furnishing knowledge of results as part of the participation process has positive effects upon learning (46).

Research on single versus multiple channel sensory involvement was conducted by Hartman (47) and Gropper (48). Hartman (47), in 1961, concluded that the meaning of a visual message is often ambiguous and subject to personal interpretation, and the use of words to direct attention is essential. The audio channel is more capable of obtaining attention if it is used as an interjection on the pictorial channel rather than being continuously parallel with the pictorial (47). In 1966, Gropper (48) reported that while concepts and principles can be acquired solely on the basis of visual presentation, to rely only on visual lessons is inefficient. Words serve an important cueing role and should be incorporated, for this secondary purpose, into a visual presentation. These conclusions were contradicted by Travers (46) who investigated the use of single versus

multiple sensory involvement. He concluded that the simultaneous use of two senses, visual and auditory, are likely to be of value only when the rate of input of information is very slow. The silent film with the alternation of picture and print would appear to find theoretical support as a teaching device.

More recent research reported by Allen (49) in 1974 supported previous findings. He reported that increased learning resulted from student participation, visual cueing directed learner's attention, repetition aided learning, and sequencing materials from subordinate to complex concepts enhanced learning.

A generalization made by Levie and Dickie (50) that influences the design of audiovisual materials was that learning is facilitated by increasing the number of relevant cues and reducing the number of irrelevant ones in terms of the concept to be learned. When a presentation involving a media form can be reduced in complexity so that only the factors that directly contribute to accomplishing the task (e.g. realism, color, motion, or picture detail) are included, learning will be more predictable and replicable (50).

#### Home Economics Research Utilizing Self-Instruction Procedures

A search of the literature revealed only one research project that investigated the use of self-instructional techniques for quantity food storage. This experiment involved foodservice employees at the University of Wisconsin in 1973 (51). After utilizing programmed instruction, Runyon found that comparison of pretest-posttest scores of sixty-six foodservice workers showed that there was a statistically significant

increase in the worker's understanding of food storage techniques attributable to the programmed instructional unit.

An investigation related to the subject matter was conducted by Cartwright (52) who developed and evaluated an employee training manual with directives for receiving, storing, and issuing food and supplies. Eighty-six full time and student workers were divided into two groups with one group having access to the manual and the other not having use of the manual. Comparison of prior knowledge of receiving, storing, and issuing of food and supplies between the two groups revealed no statistically significant differences. Comparison of pre- and posttest scores of the group using the manual showed a highly significant difference in employee knowledge. However, no statistically significant improvement in on-the-job performance could be attributed to having the use of the manual.

As reported, self-instructional techniques have been utilized successfully for teaching a variety of subject matter to participants from widely differing backgrounds. A limited number of studies have been reported in the home economics field that investigated the use of self-instructional techniques for food and foodservice related content. The following research has been selected to illustrate the diversity of media approaches, the age and background of the subjects, the variety of subject matter covered, and the various factors that have been analyzed.

In 1963 Sullivan (53) investigated the use of instructional television for teaching the laboratory portion of a college foods course. The results of the study indicated that laboratory class time might be reduced by one half without a significant reduction in student achievement, and that the majority of students viewing instructional television thought it was beneficial to learning and understanding of the course

content. No significant difference in achievement between students utilizing the instructional television and those who did not view it was found, but evaluations indicated that confidence in procedure and method were aided by the use of this medium.

Based on responses from sixty-seven Oklahoma vocational home economics teachers, Gould (54) developed guidelines for four types of audiovisual materials: 35 mm slides, overhead transparencies, programmed instruction, and 8 mm motion pictures. Based on these guidelines, sample audiovisual materials were developed, utilized, and evaluated resulting in an indication that the guidelines brought the teachers up to date on developments in audiovisual instruction and inspired them to try new methods and materials. Gould's investigation at Oklahoma State University in 1968 was the beginning of a number of research projects on audiovisual methods and materials in home economics.

Kanjanasthiti (55) developed and evaluated programmed material which was designed to teach basic nutrition at the college level. After translation into Thai, she found that the mean retest score was significantly greater than the mean pretest score which led to the conclusion that the programmed instruction technique was effective and that translation of the program from English to Thai was feasible.

Programmed instruction modules for college foods courses were developed and evaluated by Murphey (56). She found that it was feasible for the instructor to develop programmed modules, and that low error rates and high gain scores indicated that students learned well from them.

Almquist (57) designed and prepared a learning activities package on concepts of planning kitchen arrangements and storage to meet family needs and interests. Evaluation of the package showed that this type of

self-paced approach to learning was appropriate for high school students, college students, and adult homemakers. In addition, the data showed that utilizing a variety of learning activities and media tended to motivate and hold student interest throughout the sequence of lessons in the package.

The purpose of a research project completed by Bickelhaupt (58) was to determine whether or not student attitudes toward Brazilian culture could be changed by a foods unit using selected audiovisual materials. It was determined that while all groups had a mean positive change in attitude, the largest positive change occurred with the group that had used the most audiovisual materials.

Harsh (59) compared retention of learning from programmed instruction and lecture-demonstration methods for learning concepts of food measurement in 120 seventh grade students. His study showed that neither method of instruction was superior in terms of gain scores or amount of materials retained.

While studying the feasibility of utilizing self-instruction techniques in an entry level nutrition and food science course at Syracuse University, Short (60) found that students exposed to the self-instruction method which included use of film loops, film strips, slides, displays and computer assisted instruction integrated with taped lectures performed at least as well on cognitive examinations as students taught by conventional means.

Smith (61) compared the effectiveness in teaching the operation of audiovisual equipment by the auto-tutorial method versus the demonstration-laboratory method. Findings supported the hypothesis that students who learn the operation of audiovisual equipment by the auto-tutorial

method will perform as well as students who are taught by the demonstration-laboratory method.

Utilizing the systems approach, Roach (62) developed a system for the design of self-instructional materials at the collegiate level for a module on quantity food purchasing. When the students exposed to the self-instructional strategy were compared with those exposed to the traditional lecture on a cognitive posttest, the average achievement of students using the self-instructional method was not different from the average achievement of those students taught by the lecture method. Confidence ratings for performing tasks associated with food purchasing did not differ significantly between the two groups, nor did enthusiasm ratings. However, those students utilizing the self-instruction unit reacted more favorably to the unit of study than the lecture students. Significant differences were found on overall and individual ratings of the self-instructional method.

Two slide tape programs on egg quality and cookery were created by Downes (64) for use in a beginning foods class. Her formulated hypothesis: "An audiovisual presentation added to conventional classroom methods will produce an educationally important gain over the gain produced by conventional classroom method alone." Improvements in learning for the students having the use of the slide tape programs was found to be statistically significant as measured by the t-formula for dependent means. Downes (63) concluded that there was an educationally important gain, a gain greater than one-third of a standard deviation.

When comparing the traditional lecture and self-study approaches for teaching elementary nutrition to college students, Dick (64) found that frequency distributions of the students' final score showed that although

not significantly different on any one test, the students utilizing the self-study approach tended to have higher grades.

Wilkinson (65) attempted to determine if learning packages could be an effective means for teaching high school and vocational students how to operate quantity foodservice equipment. Her conclusions were that learning packages require more time than traditional methods to teach a task, but were able to accomplish the objectives; packages require the use of a great deal of paper; and much time is required of the teacher to prepare packages.

Achievement, retention of subject matter, study time, and attitudes of students utilizing six self-instruction (SI) slide tape modules were compared by Brown (66) with those factors for students exposed to traditional lecture (TLec) for a meats unit in an advanced food science course for two semesters. Differences between the fall semester SI and TLec groups were not significant for achievement, retention of subject matter, study time, or general reaction to the course. The fall SI students scored both attitudes toward the meats unit and increased positive attitude toward the field significantly higher than the TLec group. During the spring semester, the two groups differed in achievement with one SI group scoring significantly higher than TLec or the other SI group. The TLec group thought the course was worth the effort required more than did the SI students.

Kingure (67) evaluated learning by comparing the conventional methods of instruction with a multi-media approach to teaching a beginning foods laboratory course. The findings indicated that there was no significant difference in pretest and posttest scores between the two approaches. The major differences were found in student satisfaction, stimulation of

interest in the subject matter, and attitudes toward the course which led to the conclusion that the multi-media approach was acceptable and effective.

Prichard (68) investigated the use of audiovisual materials as a possible solution to the problem of limited dietitians' time for teaching modified diets to patients. Patient posttest results showed a substantial gain in knowledge from the slide tape presentation. Sharpe (69) found a significant increase in knowledge after completion of programmed instruction which led to the conclusion that programmed instruction is an effective educational tool for teaching of diabetic patients. However, she cautioned that programmed instruction should not be used as the only means of instruction for diabetic patients.

In 1977 Bates (70) developed and evaluated a self-instructional unit on interviewing for dietetic students. The self-instructional group who used video tapes was compared with a group instructed using the traditional lecture. Analysis of the various tests administered to the two groups indicated that the two instructional methods were equally effective.

Dameron (71) developed and evaluated a self-instructional module for orienting students in the utilization of the Critical Incident Performance Evaluation Instrument. She used a form of programmed instruction for the module. The effectiveness of the module was ascertained by comparing the pretest, posttest, and retest scores of a group using the module versus the group of students taught by the traditional lecture-discussion method. Dameron (71) concluded that analysis of the data indicated that the self-instructional module was as effective as the lecture-discussion method for teaching critical incident technique concepts.

As can be seen from the investigations cited, self-instruction techniques, regardless of media form and age or background of subjects, are at least equal to or more effective than traditional teaching methods. Although they are time intensive from a preparation standpoint and involve a significant initial investment, after development of self-instructional materials, the instructor may be relieved of some of the routine and time consuming tasks in teaching so that more direct and individualized help may be given to students. In addition, they are effective as motivators; interest increasers; and provide, to varying extents, for individual differences.

## METHODOLOGY

### Subjects

Subjects were students enrolled in Fundamentals of Quantity Food Production (660-440) during the 1978-79 academic year at Kansas State University, Manhattan, Kansas. This undergraduate, management oriented course is required for students in dietetics, restaurant and institutional management. It may be taken by students in some options in the Department of Foods and Nutrition, and occasionally by students in business administration curricula.

Thirty-five students who were enrolled in Fundamentals of Quantity Food Production during the fall 1978 semester were designated as the control group. The group consisted of four sophomores, twenty-two juniors, six seniors, and three graduate students from the Departments of Dietetics, Restaurant and Institutional Management and Foods and Nutrition; and the College of Business Administration. The control group was composed of thirty-three females and two males. The experimental group, those students enrolled in the spring 1979 semester, consisted of seventeen students. Classification of the experimental group was one freshman, two sophomores, ten juniors, three seniors, and one graduate student from the Departments of Dietetics, Restaurant and Institutional Management and Foods and Nutrition and included fifteen females and two males. In the combined groups student age ranged from eighteen to fifty years with 99 per cent between the ages of eighteen and thirty-three. Specific background data of the students in both groups can be found in Table 1.

Table 1: Specific background data of students in control and experimental groups

	group	
	control (N=35)	experimental (N=17)
sex		
male	2	2
female	33	15
classification		
freshman	0	1
sophomore	4	2
junior	22	10
senior	6	3
graduate	3	1
major		
dietetics and institutional management	25	9
institutional management	3	1
restaurant management	1	3
foods and nutrition	4	3
foods and nutrition science	1	1
general business administration	1	0

### Content of the Module

Quantity food storage, a basic concept in quantity food production, integrates information about storage safety and sanitation, facility and equipment requirements, and recommendations for temperature and humidity. No single source was available that contained all of the desired information. A module of instruction was developed on quantity food storage. This unit of study was composed of three slide/tape programs on dry food storage, refrigerated storage, and frozen food storage. Content of the

module was obtained from the course textbook, Food Service in Institutions by West et al. (72), Using Storage in Foodservice Institutions by Ludowski et al. (1), Food Storage Guide for Schools and Institutions (2), Principles of Food Science by Borgstrom (73), Food Science by Charley (74), and numerous other books and publications (75-84).

### Development of the Module

Utilizing the systems approach, an outline of tasks to be accomplished for each unit was developed into a flow chart shown in Figure 3. Objectives for the module were stated in behavioral terms (Appendix A). When the objectives were written, construction of cognitive evaluation items was begun with items being adjusted as the module was developed.

Instructional materials were planned and produced. Media selected were 2" x 2" slides and audio cassette tapes with accompanying ten question quizzes. This slide/tape combination permitted flexibility for development and revision of materials. Scripts to be placed on the audio tapes were written and visuals to illustrate effectively that content for the accompanying slides were selected or created by the researcher. The result was programs on dry food storage, refrigerated food storage, and frozen food storage. The dry food storage program consisted of sixty-eight color slides with an accompanying nineteen minute tape. The presentation on refrigerated food storage had a fifteen minute tape coupled with sixty-three color slides. The frozen food storage tape was nine minutes in length and was accompanied by twenty-eight color slides to illustrate the content. Those principles which are thought to facilitate learning and those factors which are considered to enhance perception were employed.

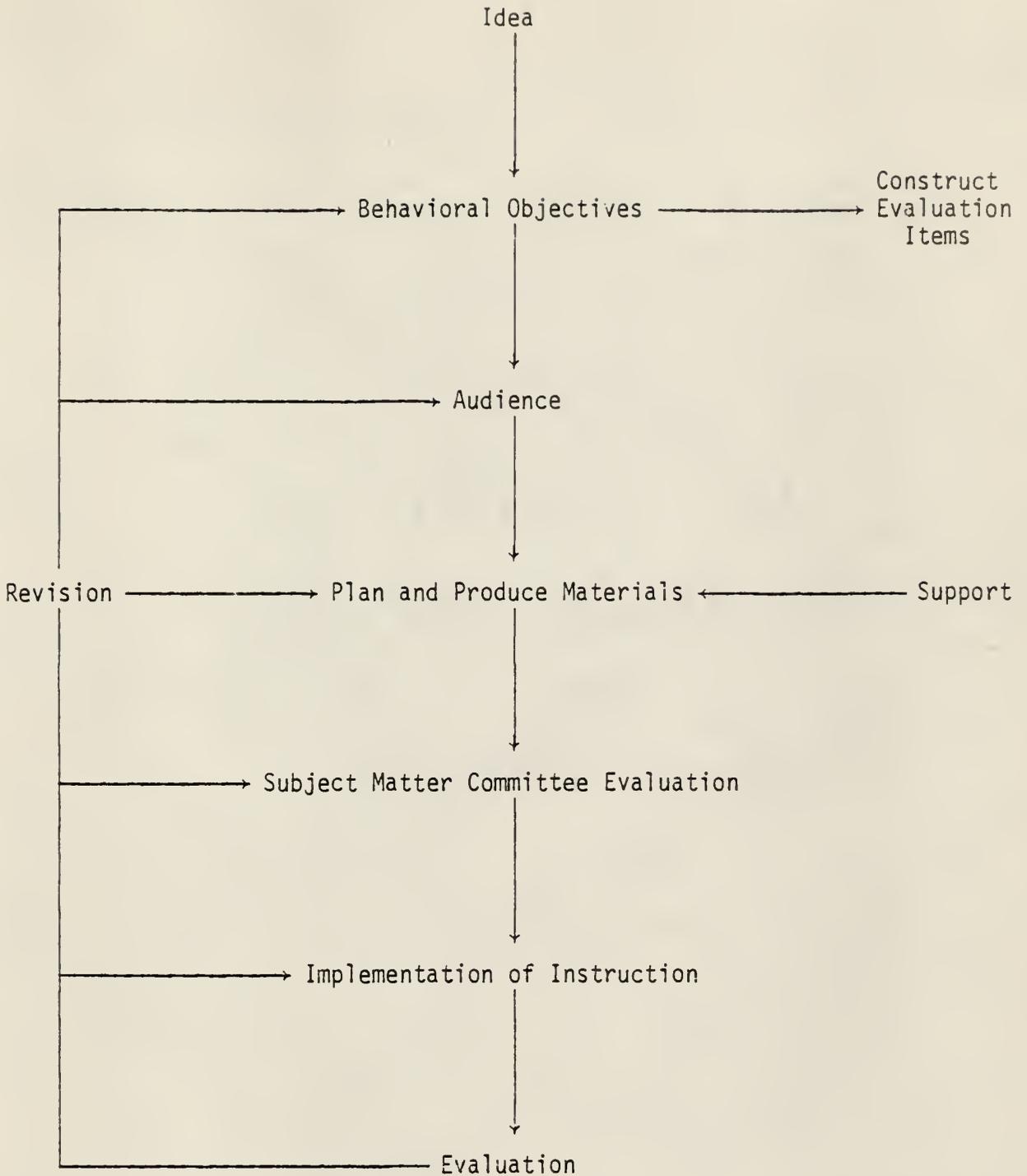


Fig. 3. Flow chart for design of instructional module

Two media specialists evaluated the technical and design aspects of the presentations. Pictures of selected slides are located in Appendix B.

A folder accompanying each of the three slide/tape presentations included an instruction guide, an outline of content with space for note-taking, a script with a brief slide description, and two equivalent ten question quizzes (Appendix C).

#### Evaluation of the Module

For the purpose of measuring the effectiveness of the module on learning quantity food storage concepts, cognitive test questions were developed by the researcher. Utilizing guidelines outlined by Coulter (85), thirty multiple-choice items were developed, each with a single correct response. Most were four-response items. Where possible, correct answers and distractors were ordered by random number selection to eliminate patterning of correct responses. The number of items and the specific items to be included on the examination, from those developed, were selected by the course instructor. Questions were distributed randomly among questions on other quantity foods subject matter developed by the course instructor and administered as the final examination in the Fundamentals of Quantity Food Production class. A copy of the twenty-one test items that were utilized in this experiment is included in Appendix D. Scoring and item analyses were done at the Computer Center, Kansas State University.

Evaluation of each of the slide/tape presentations in the module was completed before use in the experiment by a subject matter committee which included the researcher's major professor who had conducted similar research (62), the course instructor, and the instructor of Foodservice Equipment and Layout (660-635), a course which requires Fundamentals of

Quantity Food Production as a prerequisite. Revision of content assured accuracy of information and terminology from both an audio and visual standpoint.

Additional changes, after the experiment, were prompted by comments on cards the students were asked to complete after viewing each slide/tape presentation. Copy of a comment card is included in Appendix E.

### Design for the Experiment

The experiment was conducted during the last three weeks of the semester during fall and spring semesters 1978-79. Quantity food storage concepts were included during the teaching of units of study on sanitation, quality control, and purchasing. A copy of the course objectives is included in Appendix F.

Approximately three weeks prior to final week of the fall semester 1978, the entire class (control group) was given the quantity food storage objectives based on content from textbook or instructor's lectures (Appendix G). Students were informed that these objectives covered subject matter concerned with quantity food storage over which they would be evaluated on their course final along with other course content. Instructions and discussion of materials were conducted by the course instructor and students had no contact with the researcher. Evaluation of the quantity food storage information was accomplished by randomly incorporating the cognitive test items over quantity food storage into a 100 question multiple-choice final examination given during final week. Students were allowed to see their examinations after grading, but all examinations were retained by the course instructor.

At the corresponding time during the spring 1979 semester, the entire class (experimental group) was given the same objectives (Appendix G) utilized during the fall semester 1978. The objectives were attached to a cover sheet that explained the required assignment of the three slide/tape presentations, Media Center hours, and the dates the slide/tapes would be available for use (Appendix H). It was recommended that they use the material at their convenience, but to plan their time wisely for the time allotted. Each student was asked to complete a comment card to verify completion of the program. The instructor was supplied with a copy of the script and the answers to the quizzes included in the folder accompanying each slide/tape program. In addition to studying the slide/tape programs, the experimental group attended class and had access to the textbook as did the control group. It was pointed out that the quantity food storage subject matter would be included on their course final along with other course material. As before, instructions and discussion of materials were managed by the course instructor and there was no student-researcher contact.

#### Sites of the Study

Lectures for both groups were held in a conventional classroom in Justin Hall. The experimental group, who had the use of the self-instruction module, utilized, in addition to the lecture room, the Instructional Media Center, a classroom converted for self-study purposes. The room is equipped with study carrels, each wired to accommodate audio-visual equipment. The carrels have high sides which permit students to operate the equipment without disturbing each other and earphones are utilized to eliminate noise. Each carrel is equipped with a built-in

cassette tape recorder and a slide projector with a reflection system that projects the visual image on a screen located in the front panel of each carrel. A student monitor is present in the Center to check out materials, to keep equipment and materials in order, and to assist with the operation of the equipment. A floor plan of the Center and a list of equipment used in this study are found in Appendix I.

### Statistical Analysis

A one-way analysis of variance (86) was utilized to compare the means of the control and experimental groups on three measures: quantity food storage test score, final examination score, and final course grade. To analyze quantity food storage further, analysis of covariance (86) was used to control for effects of the final examination and final course grade.

Questions 24 and 39 were eliminated from statistical analysis due to conflicting information within the course textbook. Although related to quantity food storage concepts, question 20, which was developed by the course instructor, was not included in the statistical analysis since a specific objective for that concept had not been developed.

Responses on individual test items related to quantity food storage were compiled. Percentage differences were calculated to compare responses of the control and experimental groups.

For purposes of analysis, maximum scores on the quantity food storage test and final examination were 18 and 100, respectively. Course grade was based on 100 per cent.

## RESULTS AND DISCUSSION

A one-way analysis of variance was used to compare the means of the control and experimental groups on three measures: quantity food storage test score, final examination score, and final course grade. The results for comparison of these measures are found in Table 2. As indicated, no significant difference in final examination score nor final course grade between the two groups was found. When the groups were compared on the quantity food storage test, the experimental group tended to score higher ( $P = 0.07$ ).

Table 2: Comparison of course grade and scores on quantity food storage test and final examination for control and experimental groups

	maximum score	mean score by group		F value <sup>1</sup>	p <sup>2</sup>
		control (N=35)	experimental (N=17)		
		mean std. error	mean std. error		
quantity food storage test	18	14.77 ±0.37	15.94 ±0.52	3.36	0.07
final examination	100	76.86 ±1.04	77.00 ±1.49	0.01	0.94
course grade	100%	88.92 ±0.80	89.64 ±1.15	0.26	0.61

<sup>1</sup>F value, one-way analysis of variance.

<sup>2</sup>P, probability level.

To examine the test results in more detail and to determine if some variation could be accounted for by the difference of final examination and final course grade, analysis of covariance was used to control for effects of final examination scores and final course grades. The initial analysis indicated that course grade was not a significant covariate.

Data were reanalyzed using only the final examination score as a covariate (Table 3). When the quantity food storage test scores were adjusted for effects of the final examination, the difference between the control and experimental groups was significant ( $P = 0.03$ ). The mean score of the experimental group was significantly higher than that of the control (15.92 compared to 14.78). In addition, the final examination score was a significant covariate ( $P = 0.001$ ).

Table 3: Analysis of covariance for quantity food storage test scores of control and experimental groups with final examination score as covariate

source	df	F value	prob. level
period (control or experimental)	1	4.82	.03
final	1	26.57	.001
group	N	mean <sup>1</sup>	std. error
control	35	14.78	.30
experimental	17	15.92	.43

<sup>1</sup>Mean score, quantity food storage test score. Maximum score = 18.

Data in Table 4 indicate that there was a higher percentage of correct responses by the experimental group on thirteen of the eighteen questions analyzed. Percentage difference between the two groups for those five items on which the control group had a higher percentage of correct scores was only 3.3 per cent or less.

Three questions (13, 76, and 98) had the highest rate of incorrect responses by both groups. Since question 13 was seeking shelving measurement information and various types of measurements pertaining to shelving are presented in the literature, there may have been confusion with the other measurement data associated with shelving.

Question 76 was concerned with the types of losses prevented by proper storage. Terminology may have been the problem on this question. To answer question 76, the student was asked to select which of the following was not prevented by proper storage; pilferage, fumigation, deterioration, infestation, or both fumigation and infestation.

In question 98, the distractor could be easily confused with the most correct response. The correct response was "for all fruits (except bananas) and vegetables." Many students, however, selected the response, "for all fruits and vegetables."

Table 4: Correct responses to quantity food storage test items for control and experimental groups

item no. <sup>1</sup>	item topic	group				% difference between groups
		control (N=35)		experimental (N=17)		
		correct <sup>2</sup>		correct <sup>2</sup>		
		no.	%	no.	%	
2	refrigerated storage cleaning schedule	30	85.7	14	82.4	- 3.3
5	storeroom walls	31	88.6	16	94.1	+ 5.5
10	flow pattern of food through operation	30	85.7	14	82.4	- 3.3
13	shelf distance from walls and floor	25	71.4	12	70.6	- 0.8
18	thermometer placement in refrigerated storage	17	48.6	15	88.2	+39.6
19	rationale for painting windows opaque	32	91.4	15	88.2	- 3.2
28	reasons for adequate lighting	35	100.0	17	100.0	0.0
33	storeroom floors	34	97.1	17	100.0	+ 2.9
34	rationale for storing meat and eggs away from other foods	27	77.1	16	94.1	+17.0
38	storage of open bulk products	34	97.1	17	100.0	+ 2.9
46	danger zone temperature range	29	82.9	15	88.2	+ 5.3
56	rationale for air circulation	31	88.6	17	100.0	+11.4
61	frequency of checking thermometers	29	82.9	15	88.2	+ 5.3
67	arrangement of food items on shelves	34	97.1	17	100.0	+ 2.9
76	losses prevented by proper storage	24	68.6	12	70.6	+ 2.08
82	means of facilitating air circulation	30	85.7	14	82.4	- 3.3
87	temperature range for frozen food storage	27	77.1	16	94.1	+17.0
98	temperature range for fruits (except bananas) and vegetables	18	51.4	12	70.6	+19.6

<sup>1</sup>Refers to item number in final examination.

<sup>2</sup>Correct = number and percentage of group with correct item response.

## SUMMARY AND CONCLUSIONS

### Summary

The purpose of this research was to develop a self-instructional module for teaching concepts related to quantity food storage. The rationale for the development of this module was to integrate the concepts related to quantity food storage and to relieve the course instructor for more direct student-teacher contact. In addition, it was intended that the module serve as a review unit for advanced level courses. The module was composed of three slide/tape presentations on dry food storage, refrigerated food storage, and frozen food storage.

The module was evaluated during two semesters by a total of fifty-two dietetic, restaurant and institutional management, foods and nutrition, and business administration students in the junior level, management oriented course, Fundamentals of Quantity Food Production, at Kansas State University. For research purposes the fall 1978 class, who did not have the use of the module, was designated the control group and the spring 1979 class, who used the module, was considered to be the experimental group. The efficacy of the module was tested by comparing the means of quantity food storage test scores, final examination scores and course grades of the group using the module with the group who did not use the module.

A one-way analysis of variance was utilized to compare the means of these measures of the control and experimental groups. Analysis of covariance was used to control for effects of final examination score and course grade. Data were reanalyzed using only final examination score as

a covariate. In addition, responses on individual quantity food storage test items were compiled and the percentage differences between the two groups were calculated.

### Conclusions and Recommendations

The analysis of data revealed that the self-instructional unit facilitated learning through integration of concepts which were taught under various headings such as sanitation and quality control. Based on this finding, the self-instructional module could be utilized to draw together both those concepts presented in lecture or text and those from outside sources, and allow the student to master or review these concepts at the student's own pace and convenience.

Since objectives are considered to be an integral part of the teaching-learning process, it would be interesting to determine the effect of availability versus unavailability of objectives both in conjunction with the use of the module and without its use. One suggestion, if one were repeating this experiment, would be to have a semester when neither objectives nor module were available followed by semesters with the same criteria as this research.

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## APPENDIXES

APPENDIX A  
Behavioral Objectives

## DRY STORAGE OBJECTIVES

Upon completion of this program, the student should be able to:

- list the four overall functions of storage in the foodservice operation.
- describe by means of an outline or diagram the flow of food from receiving to preparation.
- define the term, semiperishable foods.
- list three types of loss which are prevented or controlled by the proper storage of food after it is received.
- describe the following:
  - a. storeroom walls
    - 1. permeability to moisture.
    - 2. ability to be cleaned.
  - b. storeroom floors
    - 1. resistance to slippage.
    - 2. ability to be cleaned.
- describe the lock system on the storeroom door, and indicate rationale for limiting access to storeroom.
- indicate the two accessories that windows, if they are present in the dry storage area, should include, and the reason for painting the windows opaque.
- list three reasons for having adequate lighting in the dry storage area, and identify the recommended number of foot-candles of lighting in the storeroom.
- identify the relative humidity range considered satisfactory for most products, indicate the maximum humidity for best storage conditions, and list two results of humidity that is too high in the dry storage area.
- identify two types of ventilation which can be used to obtain circulation of air in dry storage, indicate three reasons that circulation of air is necessary around bags, cartons and cans of food, and list three items the storeroom should be free of to further aid in ventilation, temperature and humidity control.
- indicate the number of inches of minimum clearance that racks, dollies, and shelves should be away from walls and above floors to permit free flow of air, and describe the way cases of food should be arranged on racks, dollies and skids to permit free flow of air.
- indicate the number of times per day thermometer readings should be taken in the dry storage area, and describe the two styles of stacking quantity lots of bagged foods such as flour, rice and beans.

- identify the type of containers in which broken lots of items such as sugar and flour should be stored, and indicate the piece of equipment which is needed for each container.
- describe how the storeroom should be arranged to facilitate taking inventory and ease of locating items, and how old and new stock of the same item should be arranged on a shelf, rack, skid or dollie.
- list the two types of material from which storeroom shelving can be made.
- indicate the reason that some foodstuffs must be stored away from other foods, and list three items which should not be stored in the same area as food.
- indicate the two evidences of spoilage which all food should be checked for frequently.
- indicate the frequency of sweeping and mopping the storeroom floors, and list four other things in the storeroom which should be cleaned and washed regularly.
- identify the reason for controlling rodents and insects, and recognize the availability of services from outside the organization for controlling rodents and insects.

## REFRIGERATED STORAGE OBJECTIVES

Upon completion of this program, the student should be able to:

- list the two types of refrigerated storage space needed in a foodservice operation, and define a refrigerated storage space.
- indicate an advantage of having a walk-in refrigerator door sill which is flush with the outside floor.
- identify the type of shelving which is preferable in refrigerated storage, and indicate the material from which refrigerator shelving should be made.
- indicate the frequency of checking temperature in refrigerated storage, and indicate the section of the refrigerator where a thermometer should be placed.
- list three types of thermometers which can be used in refrigerated storage, and indicate the advantage of a single-pen thermometer.
- indicate the effect of low temperatures on the growth of bacteria, yeasts and molds.
- list the specific recommended temperature ranges for the following:
  - a. fruits (except bananas), vegetables and most other perishable produce.
  - b. dairy products and eggs.
  - c. meat and fowl.
  - d. fish and shellfish.
  - e. "danger zone"--temperature range which favors bacterial growth in perishable food products.
- indicate the importance of controlling humidity in refrigerated storage of meats and fresh fruits and vegetables.
- identify the suggested number of days that meat may be left unfrozen.
- identify the reason meat and eggs should be stored away from other food, and describe the way egg crates should be stacked to allow circulation of air.
- indicate the frequency of cleaning and the procedure for handling spillage in refrigerated storage.

## FROZEN STORAGE OBJECTIVES

When the student has completed this program, he/she should be able to:

- indicate two advantages of frozen food storage.
- contrast freezing food versus frozen food storage.
- indicate how often thermometers should be read, and identify the reason that thermometer readings should be taken.
- identify three types of thermometers which can be used in frozen storage, and indicate the temperature range for frozen foods.
- identify whether or not frozen foods should be stored in their original containers, and the step which must be taken to protect foods which cannot be stored in their original containers.
- describe the frequency of cleaning and the recommended steps in cleaning frozen food storage units.

APPENDIX B

Selected Slides for Self-Instruction Module

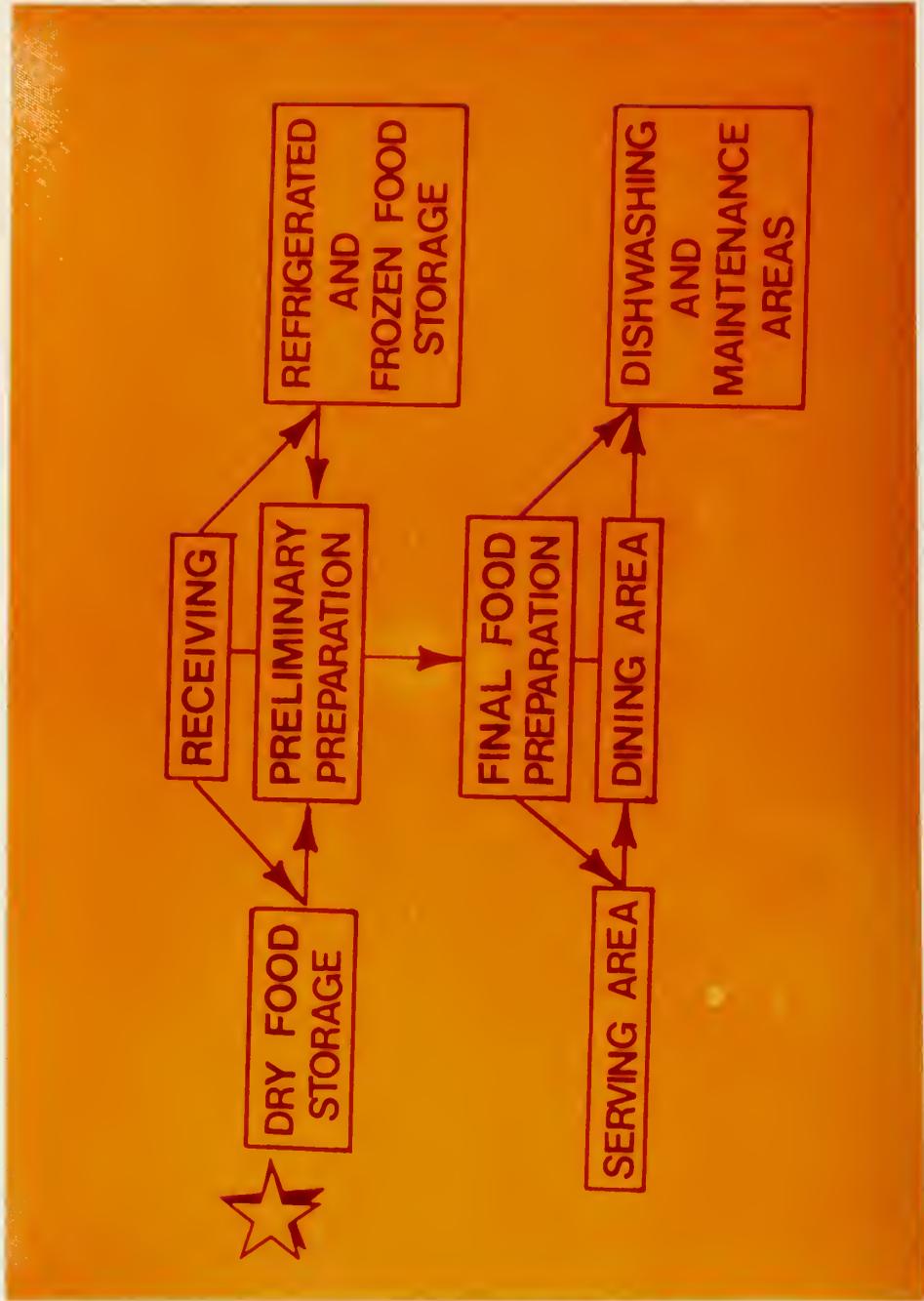
## Dry Food Storage Program

### Slide Number 3

**Narration:** Storage is important in the overall operation of the food-service business because it is the link between receiving and preparation.

Efficient arrangement of the receiving and food storage areas in relation to other areas is of major importance in an economical operation.

This diagram illustrates the interrelationship of various areas, suggesting the flow of food from receiving and food storage to preparation and serving areas.

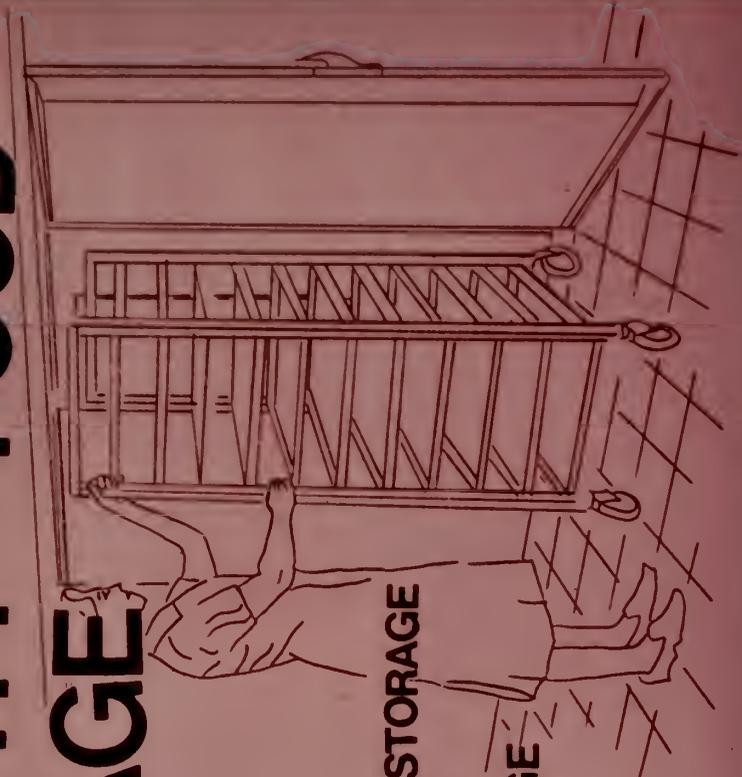


## Refrigerated Food Storage Program

### Slide Number 1

Narration: Two types of refrigerated storage space are needed in a foodservice operation.

# QUANTITY FOOD STORAGE



• DRY STORAGE

\*• REFRIGERATED STORAGE

• FROZEN STORAGE

## Refrigerated Food Storage Program

### Slide Number 19

Narration: Portable tray racks are also desirable, if the refrigerator floor is flush with the outside floor, since they may be loaded with food at the preparation area and wheeled into the refrigerator until serving time.



Refrigerated Food Storage Program

Slide Number 33

Narration: Specific temperature ranges for the major classes of food are:

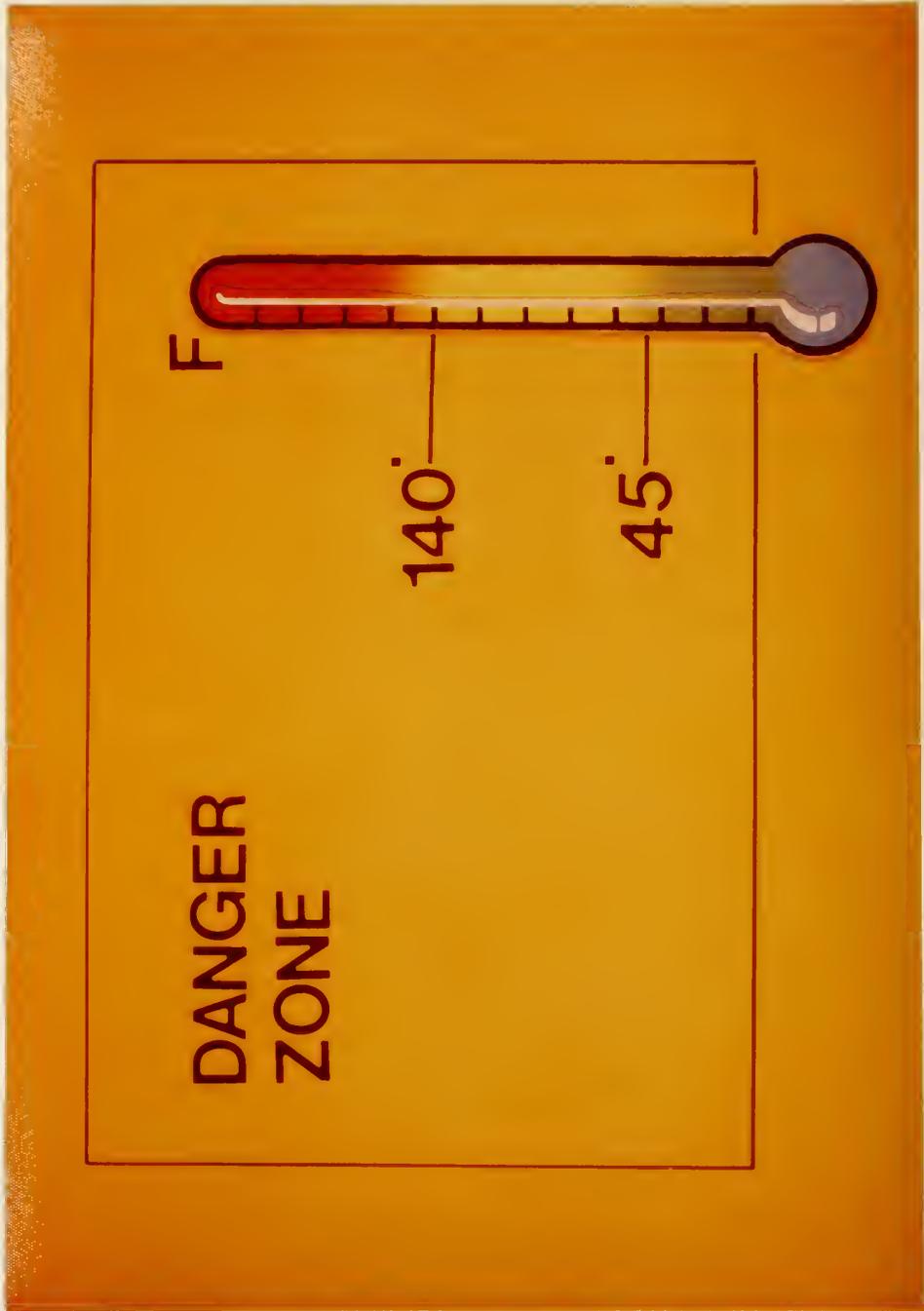
- a. Fruits (except bananas), vegetables and most other perishable products, 34° to 45°F.



Refrigerated Food Storage Program

Slide Number 37

Narration: It should be remembered that the temperature range known as the danger zone which favors bacterial growth is 45° to 140°F.



## Frozen Food Storage Program

### Slide Number 3

Narration: Frozen food storage should be adequate for maintaining temperatures of 0°F or lower.

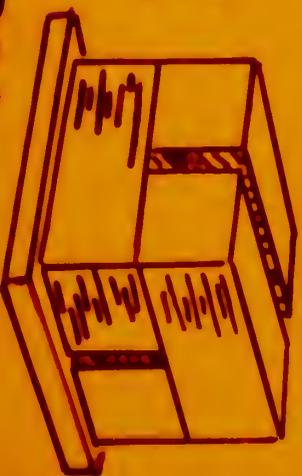


Frozen Food Storage Program

Slide Number 23

Narration: Methods of storage promoting good circulation of air should be utilized.

**METHODS  
WHICH  
FACILITATE  
AIR  
CIRCULATION**



APPENDIX C

Instruction Guide, Outline, Script and Quizzes for  
Dry Food Storage, Refrigerated Food Storage  
and Frozen Food Storage

## INSTRUCTION GUIDE

You are about to view one of a series of three slide/tape presentations on Quantity Food Storage.

This slide/tape program is designed to give the student an overview of Dry Food Storage.

To complete this program, the student should:

1. Read the outline which accompanies this program.
2. Read the behavioral objectives.
3. Place the carousel on the slide projector and insert the tape into the tape recorder. If help is needed, please contact the person in charge of the Media Center.

The slide projector should be advanced each time a tone is heard on the tape.

4. Upon completion of this program, close your notes and take one or more of the quizzes which are included in the folder. If you miss two or more questions on any given quiz, the program should be viewed again.
5. When all of the above criteria have been completed, please fill out the card with your name in the file box on the Media Center desk.
6. Go on to the next slide/tape presentation in this series.

## DRY STORAGE

## OUTLINE

- I. Introduction
- II. Interrelationship of various areas
- III. Functions of dry storage
- IV. Basic physical facility criteria
  - A. Floors
  - B. Exterior walls and subfloors
  - C. Walls and ceilings
  - D. Bases
  - E. Doors
  - F. Windows
  - G. Lighting
- V. Humidity
- VI. Ventilation
- VII. Thermometers and temperatures

VIII. Basic equipment

- A. Shelving
- B. Portable equipment
- C. Bulk storage equipment
- D. Scales

IX. Storage practices

X. Sanitation

XI. Summary

## DRY STORAGE

## SCRIPT

SLIDE DESCRIPTION	NARRATION
1. Quantity food storage	1. Every food service establishment needs adequate, efficiently arranged and well managed storage for profitable operation.
2. Functions of quantity food storage	2. In the food service operation, storage should: <ol style="list-style-type: none"> <li>a. Provide space to hold food until used;</li> <li>b. Keep quality loss in food at a minimum;</li> <li>c. Provide convenience for employees who handle and use food; and</li> <li>d. Function as a major control point.</li> </ol>
3. Flow diagram	3. Storage is important in the overall operation of the food service business because it is the link between receiving and preparation.
Receiving	
Dry Food Storage	Refrigerated and Frozen Food Storage
Preliminary Preparation	
Final Food Preparation	Efficient arrangement of the receiving and food storage areas in relation to other areas is of major importance in an economical operation.
Serving Area	Dishwashing and Maintenance Areas
Dining Area	
4. Dry storage	4. The dry food storage area which will be discussed in this program should be conveniently located to the receiving area and adjacent to the food preparation center.

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| 5. Semiperishables   | 5. The dry food storage area provides orderly storage for food not requiring refrigeration or freezing.   |
|  | These foods are known as semi-perishables.  |
| 6. Roof with elements, fire, insects, rodents, spoilage organisms, theft | 6. The dry food storage area should also provide protection of foods from the elements, fire, insects, rodents, spoilage organisms and safeguard them from theft.                       |
| 7. Little man slipping on the floor                                      | 7. The floors in the dry storage areas should be slip resistant and easily cleaned.   |
| 8. Exterior walls and subfloors  | 8. The exterior walls and subfloors should be tightly constructed, rodent and insect proof, and insulated to protect foods from the elements.   |
| 9. Little man washing wall   | 9. Walls and ceilings should be of light colors, smooth, impervious to moisture, and easy to wash and repair.   |
| 10. Coved bases  | 10. Coved bases should be provided at the floor line.   |
| 11. Double doors   | 11. A heavy duty door of sufficient width for passage of pallets is needed.   |
| 12. Double doors with inside push bar                                    | 12. The door should lock from the outside, but <u>always</u> open from the inside without a key.  |
|  | To aid in control, the number of doors allowing access to the storeroom should be limited.  |
| 13. Window with screen, sash, painted opaque                             | 13. No windows are necessary, unless required by law.   |
|  | If windows are provided, they should be equipped with a security sash and screens, painted opaque to protect food from direct sunlight, and placed to avoid interference with shelving. |

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| 14. Light bulb   | 14. Good visibility in the storage area makes it easier for employees to locate and put away food.<br><br>Good lighting contributes to better housekeeping by employees.   |
| 15. Light bulb with 15-foot candles  | 15. When the light is fairly uniform, about 15-foot candles, throughout the storeroom, it is easier to see areas that require cleaning, check inventories and condition of food.<br><br>Experience shows that employees will keep working areas neater and cleaner under these conditions.   |
| 16. Humidity, 50 to 60 per cent  | 16. Humidity is an important factor in storeroom conditions that is often overlooked or not given sufficient attention.<br><br>A relative humidity of 50 to 60 per cent is considered satisfactory for most products.<br><br>It should not go over 70 per cent for best storage conditions.  |
| 17. Rusting cans<br>Caking of dry and dehydrated products<br>Growth of bacteria and mold<br>Infestation of insects | 17. Humidity that is too high can result in rusting cans, caking of dry and dehydrated products, growth of bacteria and mold, and infestation of insects in the storeroom.   |
| 18. Ventilation with arrows  | 18. Good ventilation in the dry food storage area is essential to the proper storage of any type of food.<br><br>By assisting in controlling the temperature and humidity, ventilation retards growth of various types of bacteria and molds, preventing mustiness and rusting of metal containers and minimizes caking of ground or powdered foods. |

19. Natural ventilation
19. Natural ventilation is obtained by proper construction of the storeroom to permit entrance of fresh cool air through louvers at the floor level and the escape of warm air through louvers at the ceiling or roof level.
20. Mechanical ventilation
20. When natural ventilation is not possible, mechanical or forced-air ventilation with intake and/or exhaust fans, keep fresh air circulating.
- In hot, humid climates, where the recommended temperatures cannot be maintained by natural or mechanical ventilation and humidities are consistently over 80 per cent, it may be necessary to install artificial refrigeration to keep temperatures from going above 70°F.
21. Little man standing under open pipes
21. To further aid in ventilation, temperature and humidity control, the storeroom should be free of uninsulated steam and water pipes, water heaters, refrigeration condensing units, or other heat producing devices.
22. Thermometer
22. Whenever foods are stored, a reliable thermometer is essential to make sure that proper temperatures are maintained in order to prevent spoilage and deterioration.
23. Little man with twice daily
23. Thermometer readings should be taken and recorded at least twice daily, and more frequently if there is difficulty in maintaining the desired temperature.
- Corrective measures should be taken to raise or lower the temperature.
24. Picture of thermometer
24. Wall thermometers such as the one shown here are suitable for dry food storage areas.

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| 25. Little man coming through the door to check the thermometer  | 25. The thermometer should be mounted in the vicinity of the door, where there is less danger of breakage, and at eye level for easy reading.  |
| 26. Red cross out with thermometer next to light and on door   | 26. It should <u>not</u> be mounted on the door, near a light bulb or other heat source or in a recessed pocket.   |
| 27. 40° to 70°F  | 27. Temperatures of 40° to 70°F are recommended for the dry food storage area.   |
| 28. <u>Picture</u> of wood shelves   | 28. Storeroom shelving may be of wood or metal.  |
| 29. Slide of metal shelves   | 29.  |
| 30. Advantages and disadvantages   | 30. Each material has advantages and disadvantages so the needs of the operation must be considered.   |
| 31. Metal and wood on combination background   | 31. A combination of wood and metal shelving may be used to gain some advantages that each offer.  |
| 32. Circulation diagram  | 32. Whenever possible, shelving should be constructed in a manner such as that seen here to allow for good circulation.  |
| 33. Shelves<br>Strong enough to support the weight of canned goods and other items being stored<br>Well braced against tipping | 33. The shelves should be strong enough to support the weight of the canned goods and other items being stored.<br><br>The shelving should be well braced against tipping.               |
| 34. Drawing of shelves and skid 2 inches from wall and 10 inches off the floor   | 34. Two inches minimum clearance from the walls should be allowed for cleaning and air circulation.<br><br>Clearance between the bottom shelf and the floor will vary according to need. |

However, regardless of need, the bottom shelf should be at least 6 to 10 inches from the floor to allow for proper cleaning and air flow.

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| 35. Boxes on skids                         | 35. Many storerooms have little or no shelving, with goods held in cases on skids and pallets as shown here.  |
| 36. Variety of portable equipment          | 36. Portable equipment such as that seen here is needed for efficient handling and storing of foods.<br><br>The kinds and volumes of food to be handled determines the type of equipment.   |
| 37. Metal container with tight fitting lid | 37. Metal containers with tight fitting covers should be used for storing <u>broken</u> lots of such items as flour, cornmeal, sugar, dried beans, and rice.<br><br>The number needed will depend on the number and types of foods to be stored and delivery practices. |
| 38. <u>Picture</u> of scoop                | 38. Scoops are needed for each storage container in use.<br><br>They should be made of corrosion resistant material.  |
| 39. Large scale                            | 39. Scales should be available for weighing large and small items.  |
| 40. Small scale                            | 40.   |
| 41. Canned goods                           | 41. The importance of storing food properly cannot be over-emphasized.<br><br>Contrary to common belief, canned goods do not last forever.  |
| 42. 6 months or less                       | 42. The usual recommendation is to store canned goods for no more than six months.  |

43. Cost
43. Improper storage may cause spoilage which is not only wasteful but increases food cost.
44. Food borne illness
44. Of even greater importance is the health hazard involved.
45. Little man with a tummy ache
45. Food that is even slightly contaminated because of improper care may cause illness.
46. Efficient methods of storage
46. In storing foods, it is important not only to consider the use of proper storage methods, but also to consider efficient methods of storage which will save space and make for ease in handling the foods.
47. Lock-style, Chimney-style
47. Quantity lots of bagged foods such as flour, rice, and beans may be stacked on dollies, skids or pallets utilizing either the Chimney-style or Lock-style stacking method shown here.
- Either method permits the necessary circulation of air.
48. Stainless steel container with a label
48. To review, broken lots of these bagged foods should be stored in metal containers equipped with tight fitting covers.
- The cans should be clearly labeled with date, price and product.
49. Alternating patterns
49. Quantity lots of cased and boxed foods stacked in alternating patterns on dollies, skids or pallets as shown here make a stable load for storing and handling.
50. Visible labels
50. The labels should be exposed for ease of identification.

51. Skid with water around the bottom
  52. Man pulling skid
  53. Goods on shelves
  54. Systematic arrangement
  55. Dated and priced
  56. First-in, first-out
  57. Away from walls
  58. Keeps food from absorbing moisture
  59. Cans giving off odor
  60. Picture of chemicals
  61. Little man with a mop and bucket
51. The elevation of bulk supplies makes for easy cleaning and prevents water damage or accumulated soil, and discourages the breeding of vermin.
  52. In addition, the pallets may be loaded directly from the delivery truck, thus eliminating the unnecessary work of rehandling the supplies.
  53. If desired, smaller lots of canned foods may be stored on shelves in or out of the cases.
  54. Foods should be arranged in the storage area according to type to facilitate locating and taking of inventories.
  55. New stock should be dated and priced to provide a record so that old stock may be used first.
  56. The oldest stocks should be placed out front to assure the use of foods on a "first-in, first-out" basis.
  57. As a reminder, all foods should be stored away from walls and off the floor.
  58. This keeps them from absorbing moisture that will cause cans to rust, package seams to burst, and food to mold or rot.
  59. Foods that absorb odors must be stored away from foodstuffs that give off odors.
  60. Items such as paint, soap, wax, mops and other chemicals should be stored in a separate storeroom away from food.
  61. Good housekeeping practices need to be followed daily to insure cleanliness and orderliness in all food storage areas.

Sanitation and cleanliness are a must in food handling and storage.

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| 62. To keep dry food storage areas in good condition | 62. To keep dry food storage areas in good condition, foods must be inspected regularly, and cleaning schedules established and followed.   |
| 63. Bulging and leaking cans                         | 63. All food should be checked frequently for evidence of spoilage such as bulging or leaking cans.   |
|  | Where spoilage has occurred, the food should be removed immediately and the area cleaned thoroughly to prevent contamination of other food. |
| 64. Little man saying, "Swept daily, mopped weekly"  | 64. The storeroom floors need to be swept daily and mopped at least once a week.  |
| 65. Cleaned and washed regularly                     | 65. Skids, dollies and pallets on which foods are stored should be moved as needed to permit thorough cleaning of the floors.               |
|  | The walls, shelves, skids, dollies, and pallets should be cleaned and washed regularly.   |
| 66. Insects  | 66. Insect and rodent infestation may occur even under ideal storeroom conditions.  |
| 67. Rodents  | 67. Since they are carriers and transmitters of communicable diseases, constant vigilance must be maintained for any sign of infestation.   |
| 68. Little man saying, "Hey, Extermination Man"      | 68. The most effective ways of eliminating and controlling both rodent and insects are by extermination and fumigation.                     |

However, the services of such a company should not be relied on completely.

69. Summary

69. In summary -----

Dry storage should:

- a. Provide space to hold food until used;
- b. Keep quality loss in food at a minimum. This can be accomplished by:
  1. Maintaining temperatures between 40° and 70°F.
  2. Proper ventilation.
  3. Having storage equipment off the floors and away from walls.
  4. Storing broken lots of bagged foods in covered containers.
  5. Storing canned goods 6 months or less.
  6. Using a first-in, first-out system.
  7. Controlling insects and rodents.
  8. Establishing and following regular cleaning schedules.
- c. Provide convenience for employees by:
  1. Providing adequate lighting.
  2. Systematic arrangement of food.
  3. Having portable equipment available.
- d. Function as a major control point by:
  1. Limiting access to the storage area.

70. The end

70.

## DRY STORAGE QUIZ I

CLOSE ALL NOTES AND BOOKS AND COMPLETE THE FOLLOWING QUIZ ON A SEPARATE SHEET OF PAPER. PLEASE DO NOT WRITE ON THE QUIZ. READ ALL QUESTIONS CAREFULLY AND ANSWER ACCORDING TO THE INSTRUCTIONS GIVEN. UPON COMPLETION, CHECK YOUR ANSWERS WITH YOUR NOTES OR THE SCRIPT. IF YOU HAVE MISSED TWO OR MORE, THEN YOU SHOULD VIEW THE SLIDE/TAPE PRESENTATION AGAIN.

SELECT THE CORRECT ANSWER

1. Which of the following may be used to facilitate circulation of air in the dry storage area?
  - A. Wall vents.
  - B. Grates in the floor.
  - C. Leave the door open.
  - D. Fans.
  - E. Both A and D.
  
2. Which of the following is NOT a type of loss that is prevented or controlled by the proper storage of food?
  - A. Pilferage.
  - B. Deterioration.
  - C. Infestation.
  - D. Fumigation.
  - E. Both B and D.
  
3. 40° to 70°F is the temperature range recommended for:
  - A. Dry storage areas.
  - B. Fruit and vegetable storage areas.
  - C. Receiving area.
  - D. Trash and garbage disposal area.
  - E. Prepreparation area.
  
4. To facilitate inventory taking and ease of locating food items, foods should be:
  - A. Stored in an orderly and systematic arrangement.
  - B. Grouped so that similar items are together.
  - C. Grouped so that all containers of the same size are together.
  - D. Both A and B.
  - E. Both A and C.
  
5. Circulation of air is necessary around bags and cartons of food in the dry storage area to:
  - A. Eliminate odors.
  - B. Remove moisture.
  - C. Increase moisture.
  - D. Both A and C.
  - E. Both A and B.

## FILL IN THE BLANK

6. Foods which do not require refrigeration or freezing are known as \_\_\_\_\_.
7. The storeroom door should lock from the outside but always open from the inside without a \_\_\_\_\_.
8. When storeroom lighting is fairly uniform, about \_\_\_\_\_, it is easier to see areas that require cleaning, check inventories and condition of food.
9. To aid in \_\_\_\_\_, the number of doors allowing access to the storeroom should be limited.
10. Since canned goods do not last forever, the usual recommendation is to store them for \_\_\_\_\_ or less.

## DRY STORAGE QUIZ II

CLOSE ALL NOTES AND BOOKS AND COMPLETE THE FOLLOWING QUIZ ON A SEPARATE SHEET OF PAPER. PLEASE DO NOT WRITE ON THE QUIZ. READ ALL QUESTIONS CAREFULLY AND ANSWER ACCORDING TO THE INSTRUCTIONS GIVEN. UPON COMPLETION, CHECK YOUR ANSWERS WITH YOUR NOTES OR THE SCRIPT. IF YOU HAVE MISSED TWO OR MORE, THEN YOU SHOULD VIEW THE SLIDE/TAPE PRESENTATION AGAIN.

SELECT THE CORRECT ANSWER

1. After bags of items such as flour and sugar have been opened but not completely used, the remainder should be stored in:
  - A. A metal container without a lid.
  - B. A metal container with a tight fitting lid.
  - C. The original container, using a tie.
  - D. Any available container.
  
2. Storeroom floors should be:
  - A. Easy to clean and slip resistant.
  - B. Clean resistant and slip resistant.
  - C. Permeable to moisture and easy to clean.
  - D. Impermeable to moisture and susceptible to slippage.
  
3. Adequate lighting in the dry storage area is necessary for:
  - A. All of the following.
  - B. Cleaning.
  - C. Checking inventories.
  - D. Checking conditions of foods.
  
4. If windows are present in the storeroom, they should be painted opaque to:
  - A. Keep foods from mildewing.
  - B. Protect foods from direct sunlight.
  - C. Prevent growth of mold.
  - D. All of the above.
  
5. To permit free flow of air, shelves should be at least \_\_\_\_\_ off the floor and \_\_\_\_\_ away from the wall.
  - A. 10 inches; 2 inches.
  - B. 12 inches; 6 inches.
  - C. 2 inches; 10 inches.
  - D. 36 inches; 4 inches.

LIST THE APPROPRIATE ANSWERS IN THE BLANKS PROVIDED

6. List three of the four functions of storage.
- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
7. List three things which the dry food storage area should protect food from.
- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
8. List three results of humidity which is too high in the dry food storage area.
- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
9. List three items which the storeroom should be free of to aid in ventilation, temperature and humidity control.
- A. \_\_\_\_\_
- B. \_\_\_\_\_
- C. \_\_\_\_\_
10. Name the two stacking methods recommended for quantity lots of bagged foods.
- A. \_\_\_\_\_
- B. \_\_\_\_\_

## INSTRUCTION GUIDE

You are about to view one of a series of three slide/tape presentations on Quantity Food Storage.

This slide/tape program is designed to give the student an overview of Refrigerated Storage.

To complete this program, the student should:

1. Read the outline which accompanies this program.
2. Read the behavioral objectives.
3. Place the carousel on the slide projector and insert the tape into the tape recorder. If help is needed, please contact the person in charge of the Media Center.

The slide projector should be advanced each time a tone is heard on the tape.

4. Upon completion of this program, close your notes and take one or more of the quizzes which are included in the folder. If you miss two or more questions on any given quiz, the program should be viewed again.
5. When all of the above criteria have been completed, please fill out the card with your name in the file box on the Media Center desk.
6. Go on to the next slide/tape presentation in this series.

## REFRIGERATED STORAGE

## OUTLINE

- I. Introduction
- II. Definition of refrigerated storage
- III. Interrelationship of various areas
- IV. Basic criteria
  - A. Interiors and exteriors
  - B. Optional features
  - C. Door latches
- V. Basic equipment
  - A. Shelving
  - B. Portable tray racks
- VI. Thermometers and temperatures
- VII. Humidity
- VIII. Storage practices
- IX. Sanitation
- X. Summary

## REFRIGERATED STORAGE

## SCRIPT

SLIDE DESCRIPTION	NARRATION
1. Quantity food storage	1. Two types of refrigerated storage space are needed in a food service operation.
2. Refrigerated/Frozen	2. These two types are: <ol style="list-style-type: none"> <li>a. Refrigerated storage which is maintained at a temperature of 32° to about 45°F, and</li> <li>b. Frozen food storage which is maintained at 0°F or below.</li> </ol>
3. Refrigerated storage	3. Refrigerated storage will be discussed in this program. <p>A refrigerated storage space can be any artificially cooled, properly insulated area where the desired temperature and humidity can be maintained by use of refrigeration units.</p>
4. Flow diagram	4. The refrigerated food storage space should be convenient to the receiving area and adjacent to the food preparation center. <p>Usually, the walk-in type of refrigerated storage boxes are located in the storage area, and the reach-in type boxes are nearer to the food preparation center.</p>
5. Reach-in Away from walls Level Away from sources of heat	5. Reach-in refrigerators with built-in motors and compressors operate best when placed away from walls so that air can circulate freely around and above them. <p>They should be level, and away from sources of heat such as sunny windows, radiators, hot pipes and ranges.</p>

- |  |  |
|--|--|
| 6. Picture of compressor/motor   | 6. If motor and compressor units are not built into the refrigeration equipment, the separate units should be placed where they can have a good flow of air around them. |
|  | These units should <u>not</u> be placed in a room where food is stored because they give off heat.   |
| 7. Aluminum<br>Stainless steel<br>Porcelain enamel                                     | 7. Interiors and exteriors may be aluminum, stainless steel, or porcelain enamel.  |
| 8. Door-operated electric lights<br>Adjustable plated wire shelves<br>Slides for trays | 8. Interiors fitted with door-operated electric lights, adjustable plated wire shelves, and slides for trays are recommended.  |
| 9. Picture of portable tray rack   | 9. Some other features include locking hardware, doors on both sides for pass through, and portable tray racks.  |
| 10. Walk-in<br>Sectional commercial<br>Built-in  | 10. Walk-in refrigerators may be the sectional commercial type or built-in as part of the building.  |
| 11. Picture of a bank of walk-ins  | 11. In large food service operations several separate compartments with varying temperatures and humidities may be used.   |
| 12. Picture of portable rack going through a walk-in door                              | 12. The floor of walk-in refrigerators, if flush with the outside floor, permits easy access for mobile equipment such as portable shelves, tray racks and dollies.      |
| 13. Built-in keyed lock picture  | 13. For safety and security, door latches should have a built-in keyed lock and interior safety release that can be opened from the inside.                              |
| 14. Safety release picture   | 14.  |
| 15. Half height doors picture  | 15. Half-height reach-in doors are also available, if used, they should open into the kitchen area.  |

16. Metal shelves picture
  17. Picture of stationary shelves
  18. Portable shelf picture
  19. Picture of food on tray rack
  20. Overload
  21. Thermometer
  22. Little man with twice daily
  23. Picture of low temperature thermometer
  24. Warmest area
16. Shelves in refrigerated storage should be constructed of metal.
  17. Storage shelves for use in walk-in refrigerators may be either stationary or portable.
  18. Mobile shelving such as that seen here with casters is preferable for ease in moving for cleaning.
  19. Portable tray racks are also desirable, if the refrigerator floor is flush with the outside floor, since they may be loaded with food at the preparation area and wheeled into the refrigerator until serving time.
  20. However, since portable tray racks can present air circulation problems, care must be taken not to overload the unit.
  21. Reliable thermometers are essential inside refrigerated facilities to make sure that proper temperatures are maintained.
  22. Thermometer readings should be taken twice daily since the quality of fresh food is adversely affected by exposure to temperatures above or below those recommended.
  23. Low temperature thermometers are suitable for use in reach-in refrigerators.  
  
Low temperature thermometers of the type shown here are designed to hook on wire baskets, shelves or partitions, or to be placed on any flat surface.
  24. Areas in the refrigerator will vary in temperature.

After the warmest area of the refrigerator is determined, the thermometer should be placed there and the thermostat adjusted to obtain the recommended storage temperature.

25. Picture of a remote reading thermometer

25. Remote reading thermometers of the type shown here are designed for use in walk-in refrigerators.

The capillary tube permits placing the thermometer scale outside the refrigerated facility so that the temperature can be checked without opening the door.

26. Picture of a single-pen recording thermometer

26. Single-pen recording thermometers of the type shown here are designed to record continuously the temperatures of walk-in refrigerators.

27. Provides a weekly record

27. The chart rotates once in seven days, providing a weekly record.

This type of instrument eliminates guesswork as to how high or for how long temperatures may have risen.

28. Picture of large quantity of food

28. The single-pen recording thermometers are especially important in food service operations where large quantities of food are purchased.

29. Low temperatures  
Slow growth of:  
Bacteria  
Yeasts  
Molds

29. Since low temperatures slow down the growth of bacteria, yeasts and molds, the maximum acceptable temperature range for storage of all perishable foods is about 45°F.

30. 45°F or lower

30. 45°F or lower is desirable since the internal temperature of most products is usually higher than the refrigerated temperature surrounding them.

- |   |   |
|---|---|
| 31. Require different temperatures and humidities | 31. Different kinds of perishable products require different storage temperatures and humidities if they are to retain optimum quality.                       |
| 32. Picture of a bank of refrigerators            | 32. As a result, it is desirable to have separate refrigerated units with the appropriate temperature and humidity for each class of food.                    |
| 33. 34° to 45°F                                   | 33. Specific temperature ranges for the major classes of food are:<br>a. Fruits (except bananas), vegetables and most other perishable products, 34° to 45°F. |
| 34. 38° to 46°F                                   | 34. b. Dairy products and eggs, 38° to 46°F.  |
| 35. 33° to 38°F                                   | 35. c. Meat and fowl, 33° to 38°F.  |
| 36. 23° to 30°F                                   | 36. d. Fish and shellfish, 23° to 30°F.   |
| 37. Danger zone                                   | 37. It should be remembered that the temperature range known as the danger zone which favors bacterial growth is 45° to 140°F.                                |
| 38. Humidity<br>Shrinkage<br>Spoilage             | 38. The humidity of the air in refrigerated storage has an effect on shrinkage and spoilage.  |
| 39. 75 to 85 per cent                             | 39. In meat storages, the humidity should be kept between 75 and 85 per cent.   |
| 40. Too low<br>Shrinkage<br>Loss of flavor        | 40. If humidity is too low, there will be shrinkage and loss of flavor.   |
| 41. Too high<br>Increase bacteria growth          | 41. If there is too much moisture, meats may spoil sooner due to increased bacterial growth.  |
| 42. 85 to 90 per cent                             | 42. For most fruits and vegetables, a relative humidity of 85 to 90 per cent gives the best results.  |

- |   |   |
|---|---|
| 43. Refrigerate immediately, meat   | 43. Fresh meats such as ground meat and liver, poultry, and fish must be refrigerated immediately.  |
| 44. No longer than recommended for each type of meat  | 44. Since these are highly perishable foods that lose quality quickly, they should be held close to 32°F for no longer than is recommended for each type of meat. |
| 45. Absorb odors, meat  | 45. Meat should be stored away from other foods.  |
| 46. Picture of meat and vegetables together   | 46. Foreign flavors in meat can be traced to such things as fresh fruits and vegetables stored in the same refrigerator.  |
| 47. Refrigerate immediately, dairy products and eggs  | 47. Milk, cheese, butter, and eggs must also be refrigerated immediately.<br><br>Prompt and continuous refrigeration is as essential for these products as meats. |
| 48. Wrapped tightly, cheese   | 48. Cheese should be tightly wrapped to prevent drying out.   |
| 49. Wrapped<br>To prevent absorption of odors<br>To protect against light and air               | 49. Butter also needs to be wrapped to prevent absorption of odors and to protect it against exposure to light and air, which hasten rancidity.                   |
| 50. Absorb odors, eggs  | 50. Eggs also absorb odors; therefore foods that give off strong odors should not be stored near eggs.  |
| 51. Picture of cross stacked egg crates   | 51. Egg crates should be cross stacked to allow circulation of air.   |
| 52. Cold<br>Covered   | 52. Milk should be kept cold and covered.   |
| 53. Refrigeration<br>Preserves fresh flavor<br>Covering<br>Prevents absorbing odors and flavors | 53. The proper refrigeration preserves the fresh flavor and the covering prevents the milk from absorbing odors and flavors from other foods.                     |

- |   |  |
|---|--|
| 54. Refrigerate immediately, fruits and vegetables  | 54. Fresh fruits and vegetables require immediate refrigeration.   |
| 55. Color<br>Flavor<br>Texture<br>Nutritive value   | 55. This helps preserve their color, flavor, texture and nutritive value.  |
| 56. Paper wrappings   | 56. Paper wrappings should be left on to help keep them clean and to prevent spoilage and loss of moisture.  |
| 57. Methods which facilitate air circulation  | 57. These products should be stored in a manner which will allow cold air to circulate around them.  |
| 58. Auxiliary refrigerator  | 58. All refrigeration equipment needs to be checked frequently to see that it is kept in good condition.<br><br>An auxiliary refrigeration unit should be available and ready for use in an emergency.   |
| 59. Once a week   | 59. Reach-in and walk-in refrigerators require thorough cleaning at least once a week.   |
| 60. Clean up spillage immediately   | 60. Any spillage should be cleaned up immediately.   |
| 61. Suggestions for cleaning<br>Remove food and portable equipment<br>Wash and rinse shelves, meathooks, skids, etc.<br>Wash and rinse interiors<br>Inspect food and put in a clean container | 61. Some suggestions for cleaning include:<br>a. Remove food supplies and portable equipment to do a thorough job of cleaning.<br>b. Wash shelves, meathooks, skids, and any other equipment with hot water containing a good detergent. Rinse well with hot water.<br>c. Wash the interior with warm water and baking soda. Walk-in refrigerator walls and floors may need to be scrubbed with a hot detergent solution, and rinsed thoroughly. |

- d. Foods should be carefully inspected for quality and put in clean containers before replacing in the refrigerator.

62. In summary -----

Refrigerated storage should  
 Provide space to hold fresh perishable food until used  
 Keep quality loss in food at a minimum  
 Provide convenience for employees  
 Function as a control point

62. In summary -----

- Refrigerated storage should:
- a. Provide space to hold fresh perishable food until used.
  - b. Keep quality loss in food at a minimum. This can be accomplished by:
    - 1. Refrigerating perishables immediately.
    - 2. Maintaining proper temperatures and humidities for each class of food.
    - 3. Checking temperatures twice daily.
    - 4. Keeping foods that absorb odors away from foods that give off odors.
    - 5. Keeping foods properly covered.
    - 6. Cleaning refrigerated units weekly or immediately if spillage occurs.
  - c. Provide convenience for employees by:
    - 1. Having portable equipment available.
  - d. Function as a control point by:
    - 1. Limiting access to the refrigerated units through the use of proper locking hardware.

63. The end

63.

## REFRIGERATED STORAGE QUIZ I

CLOSE ALL NOTES AND BOOKS AND COMPLETE THE FOLLOWING QUIZ ON A SEPARATE SHEET OF PAPER. PLEASE DO NOT WRITE ON THE QUIZ. READ ALL QUESTIONS CAREFULLY AND ANSWER ACCORDING TO THE INSTRUCTIONS GIVEN. UPON COMPLETION, CHECK YOUR ANSWERS WITH YOUR NOTES OR THE SCRIPT. IF YOU HAVE MISSED TWO OR MORE, THEN YOU SHOULD VIEW THE SLIDE/TAPE PRESENTATION AGAIN.

SELECT THE CORRECT ANSWER

1. If motor and compressor units are not built into the refrigeration equipment, they should be:
  - A. Away from walls.
  - B. Away from sources of heat.
  - C. Away from food since they give off heat.
  - D. Away from the building.
  
2. For proper flow of food, refrigerated storage should be:
  - A. Convenient to the receiving area.
  - B. Convenient to the storeroom.
  - C. Adjacent to the food preparation center.
  - D. Both A and B.
  - E. Both A and C.
  
3. Refrigerated storage should have locking hardware to:
  - A. Keep doors from accidentally opening.
  - B. Prevent pilferage.
  - C. To limit access.
  - D. Both B and C.
  - E. Both A and B.
  
4. If you were going to buy shelving for refrigerated storage, which of the following would NOT be desirable?
  - A. Shelves constructed of metal.
  - B. Shelves which are mobile.
  - C. Shelves constructed of wood.
  - D. Shelves which are constructed to allow for circulation of air.
  - E. None of the above.
  
5. Refrigerated storage should be cleaned:
  - A. Once a month.
  - B. Once a week.
  - C. Biweekly.
  - D. Semiannually.
  - E. None of the above.

IN THE BLANK PROVIDED, PLACE THE LETTER OF THE ANSWER FROM COLUMN B WHICH BEST DESCRIBES THE QUESTION IN COLUMN A.

- |  |  |
|--|--|
| _____ 1. Eggs.                                   | A. Absorb odors.   |
| _____ 2. Fruits (except bananas) and vegetables. | B. Fruits and vegetables.  |
| _____ 3. Danger zone.                            | C. Maximum acceptable temperature range for all perishable food. |
| _____ 4. 75 to 85 per cent humidity.             | D. Meat.   |
| _____ 5. 45°F or lower.                          | E. 33° to 38°F.  |
|  | F. 34° to 45°F.  |
|  | G. 45° to 140°F.   |

## REFRIGERATED STORAGE QUIZ II

CLOSE ALL NOTES AND BOOKS AND COMPLETE THE FOLLOWING QUIZ ON A SEPARATE SHEET OF PAPER. PLEASE DO NOT WRITE ON THE QUIZ. READ ALL QUESTIONS CAREFULLY AND ANSWER ACCORDING TO THE INSTRUCTIONS GIVEN. UPON COMPLETION, CHECK YOUR ANSWERS WITH YOUR NOTES OR THE SCRIPT. IF YOU HAVE MISSED TWO OR MORE, THEN YOU SHOULD VIEW THE SLIDE/TAPE PRESENTATION AGAIN.

SELECT THE CORRECT ANSWER

1. An advantage of mobile shelving in refrigerated storage is:
  - A. Lower cost.
  - B. Better air circulation.
  - C. Ease of movement for cleaning.
  - D. All of the above.
2. Which of the following foods easily absorb odors?
  - A. Eggs.
  - B. Rump roast and chicken.
  - C. Oranges and grapes.
  - D. Both A and B.
  - E. Both B and C.
3. Meat, poultry and fish are highly perishable, therefore they:
  - A. Should be refrigerated for no longer than recommended for each type of meat.
  - B. Are adversely affected by the danger zone temperatures.
  - C. Should be held between 33° and 38°F.
  - D. All of the above.
  - E. Both A and B.
4. All of the following EXCEPT ONE are true about eggs, select it.
  - A. Eggs absorb odors.
  - B. Eggs are easily broken.
  - C. Eggs should be stored between 33° and 38°F.
  - D. Egg crates should be cross stacked to promote circulation of air.
  - E. Must be refrigerated immediately.
5. Humidity which is too high in meat storage will promote:
  - A. Excess hydration.
  - B. Decreased bacterial growth.
  - C. Increased bacterial growth.
  - D. Shrinkage.
  - E. None of the above.

## FILL IN THE BLANK

6. If humidity is too low in meat storage there will be \_\_\_\_\_  
and \_\_\_\_\_.
7. Fish and shellfish should be stored at a temperature range of  
\_\_\_\_\_ to \_\_\_\_\_ F.
8. Since temperatures above or below those recommended for fresh food  
has an adverse effect, thermometer readings should be taken  
\_\_\_\_\_.
9. Foreign flavors in meat can be traced to such things as \_\_\_\_\_  
and \_\_\_\_\_ in the same refrigerator.
10. Paper wrappings should be left on fruits and vegetables to prevent  
\_\_\_\_\_ and \_\_\_\_\_.

## INSTRUCTION GUIDE

You are about to view one of a series of three slide/tape presentations on Quantity Food Storage.

This slide/tape program is designed to give the student an overview of Frozen Food Storage.

To complete this program, the student should:

1. Read the outline which accompanies this program.
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3. Place the carousel on the slide projector and insert the tape into the tape recorder. If help is needed, please contact the person in charge of the Media Center.

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## FROZEN STORAGE

## OUTLINE

- I. Introduction
- II. Interrelationship of various areas
- III. Types of frozen storage units
- IV. Basic equipment
- V. Thermometers and temperatures
- VI. Storage practices
- VII. Sanitation
- VIII. Summary

## FROZEN STORAGE

## SCRIPT

SLIDE DESCRIPTION	NARRATION
1. Quantity food storage	<p>1. Need for frozen food storage has increased as more frozen foods are used in food service establishments.</p> <p>Thus, adequate storage for frozen food makes it possible to eliminate many steps in food handling and preparation.</p>
2. Frozen food storage	<p>2. Freezing food requires lowering the internal temperature significantly within a short period of time in specialized low temperature units such as blast freezers.</p> <p>Therefore, frozen food storage which is discussed in this program is designed primarily for the storage of previously frozen food, not freezing of unfrozen food.</p>
3. 0°F or lower	<p>3. Frozen food storage should be adequate for maintaining temperatures of 0°F or lower.</p>
4. Flow diagram	<p>4. The frozen food storage should be convenient to the receiving area and adjacent to the food preparation center.</p>
5. Walk-in/Reach-in	<p>5. There are two basic types of frozen food storage, walk-in and reach-in.</p>
6. Away from walls Level Away from heat sources	<p>6. Frozen food cabinets with built-in motors and compressors operate best when placed away from walls so that air can circulate freely around and above them.</p>

Frozen food cabinets should be level, and away from sunny windows, radiators, hot pipes and ranges.

- |  |   |
|--|---|
| 7. Auxiliary unit                                  | 7. As is the case for all forms of refrigeration, an auxiliary frozen food storage unit should be available and ready to use to maintain proper temperatures in an emergency. |
| 8. Picture of metal shelves                        | 8. Shelves in frozen food storage units should be constructed of metal.   |
| 9. Picture of portable shelves                     | 9. Walk-in frozen food storage units may have portable or stationary shelves.   |
| 10. Picture of stationary shelves                  | 10.   |
| 11. Picture of removable and/or adjustable shelves | 11. The reach-in type should have removable or adjustable shelves.  |
| 12. Picture of keyed lock                          | 12. To insure control, doors should have a built-in keyed lock.   |
| 13. Picture of interior safety release             | 13. For safety, walk-ins should have an interior safety release that can be opened from the inside.   |
| 14. Thermometer                                    | 14. Reliable thermometers are essential in frozen food storage facilities to make sure that proper temperatures are maintained.   |
| 15. Little man with twice daily                    | 15. Thermometer readings should be taken twice daily since the quality of frozen food is adversely affected by exposure to temperatures above those recommended.              |
| 16. Picture of low temperature thermometer         | 16. Low temperature thermometers are suitable for use in frozen food cabinets.  |

Low temperature thermometers of the type shown here may be hooked on wire baskets, shelves or partitions or placed on any flat surface.

17. Warmest area

17. Areas in the frozen food cabinet will vary in temperature.

After the warmest area is found, the thermometer should be placed there and the thermostat adjusted to obtain the recommended temperature.

18. Picture of remote reading thermometer

18. The remote reading thermometer shown here is designed for use in walk-in frozen food cabinets.

The capillary tube permits placing the thermometer scale outside the frozen food storage unit so that the temperature can be checked without opening the door.

19. Picture of single-pen recording thermometer

19. The single-pen recording thermometer shown here is designed to continuously record the temperature of walk-in frozen storage units.

This type of instrument eliminates the guesswork of how high or for how long temperatures may have risen.

20. Picture of large quantity of frozen food

20. The importance of the single-pen recording thermometer is of great significance in storage of mass quantities of frozen food.

21. 0° to -20°F

21. The recommended temperature range for frozen foods is 0° to -20°F.

Temperatures above 0°F, even for brief periods, will cause loss in quality.

22. Proper containers
22. Frozen food should be stored in proper containers.
- This will reduce the possibility of freezer burn and drying out of the foods.
- If space does not permit storing these foods in the original containers or if the container has been damaged, food should be wrapped in moisture-vapor-proof material before placing in frozen food storage.
23. Methods which facilitate circulation of air
23. Methods of storage promoting good circulation of air should be utilized.
24. Cleaned as needed
24. Frozen food storage units should be cleaned as needed, following the manufacturer's instructions.
- Units requiring defrosting should be cleaned according to the manufacturer's directions.
25. When cleaning is necessary  
 Disconnect the unit  
 Remove all food  
 Defrost (if necessary)  
 Wash and rinse interior and exterior  
 Connect the frozen food cabinet and let it run to reduce temperature
25. When a complete job of cleaning is necessary, the following is recommended:
- a. Disconnect the unit.
  - b. Remove all food.
  - c. Defrost, if necessary.
  - d. Wash and rinse the interior and exterior.
  - e. Connect the frozen food cabinet and let it run to reduce temperature before replacing food.
26. First-in/first-out
26. When returning the food to frozen food storage, it is a good idea to take an inventory and to place the older packages so that they will be used first.

27. In summary -----

Frozen food storage should  
 Provide space to hold  
 frozen food until used  
 Keep quality loss in  
 frozen food at a minimum  
 Provide convenience for  
 employees  
 Function as a control  
 point

28. The end

27. In summary -----

Frozen food storage should:

- a. Provide space to hold frozen food until used.
- b. Keep quality loss in frozen food at a minimum. This can be accomplished by:
  1. Maintaining temperatures of 0°F or lower.
  2. Checking temperatures at least twice daily.
  3. Storing food properly.
  4. Using storage methods which promote good air circulation.
  5. Cleaning as needed.
- c. Provide convenience for employees.
- d. Function as a control point by:
  1. Thorough use of proper locking hardware.

28.

## FROZEN FOOD STORAGE QUIZ I

CLOSE ALL NOTES AND BOOKS AND COMPLETE THE FOLLOWING QUIZ ON A SEPARATE SHEET OF PAPER. PLEASE DO NOT WRITE ON THE QUIZ. READ ALL QUESTIONS CAREFULLY AND ANSWER ACCORDING TO THE INSTRUCTIONS GIVEN. UPON COMPLETION, CHECK YOUR ANSWERS WITH YOUR NOTES OR THE SCRIPT. IF YOU HAVE MISSED TWO OR MORE, THEN YOU SHOULD VIEW THE SLIDE/TAPE PRESENTATION AGAIN.

SELECT THE CORRECT ANSWER

1. If you were asked to buy a thermometer for a frozen food storage facility where large quantities of frozen food are stored, which of the following would you choose to get a continuous reading?
  - A. Low temperature thermometer.
  - B. Remote reading thermometer.
  - C. Minimum/maximum thermometer.
  - D. Single-pen recording thermometer.
  
2. Frozen food storage units should be adequate for maintaining temperatures of:
  - A. 32°F or lower.
  - B. 32°C or lower.
  - C. 0°F or lower.
  - D. 0°C or lower.
  
3. An advantage of a remote reading thermometer in frozen food storage is that it:
  - A. Provides a twenty-four hours a day, seven days a week record.
  - B. Can be attached on any shelf or partition.
  - C. Can be read without opening the door.
  - D. None of the above.

THE FOLLOWING ARE TRUE/FALSE QUESTIONS--PLACE TRUE OR FALSE IN THE BLANK PROVIDED

- \_\_\_\_\_ 4. The two basic types of frozen food storage are walk-in and reach-in.
  
- \_\_\_\_\_ 5. Frozen food cabinets are designed for freezing unfrozen food.
  
- \_\_\_\_\_ 6. An auxiliary frozen food storage unit should be available and ready to use to maintain proper temperatures in an emergency.
  
- \_\_\_\_\_ 7. Thermometer readings in frozen food cabinets should be taken daily.
  
- \_\_\_\_\_ 8. Frozen food cabinets which require defrosting should be cleaned according to the manufacturer's instructions.

## TRUE/FALSE CONTINUED

- \_\_\_\_\_ 9. If the original container on frozen food is damaged, the food will need to be wrapped in moisture-vapor-proof material.
- \_\_\_\_\_ 10. When returning food to frozen food storage after cleaning, it is a good idea to put the older packages out front so they will be used first.

## FROZEN FOOD STORAGE QUIZ II

CLOSE ALL NOTES AND BOOKS AND COMPLETE THE FOLLOWING QUIZ ON A SEPARATE SHEET OF PAPER. PLEASE DO NOT WRITE ON THE QUIZ. READ ALL QUESTIONS CAREFULLY AND ANSWER ACCORDING TO THE INSTRUCTIONS GIVEN. UPON COMPLETION, CHECK YOUR ANSWERS WITH YOUR NOTES OR THE SCRIPT. IF YOU HAVE MISSED TWO OR MORE, THEN YOU SHOULD VIEW THE SLIDE/TAPE PRESENTATION AGAIN.

SELECT THE CORRECT ANSWER

1. In reach-in frozen food storage units, the shelving should be:
  - A. Adjustable.
  - B. Constructed of metal.
  - C. Constructed of wood.
  - D. Both A and B.
  
2. Since areas in the frozen food cabinet vary in temperature, the thermometer should be:
  - A. Placed in the center of the box.
  - B. Placed near the door.
  - C. Placed in the warmest area of the box.
  - D. Placed in the lightest area of the box.
  
3. For safety, walk-in frozen food storage units should have:
  - A. Stainless steel walls.
  - B. Wide doors.
  - C. An interior safety release.
  - D. A built-in keyed lock.
  
4. Frozen food storage units should be cleaned:
  - A. Once a week.
  - B. As needed.
  - C. Monthly.
  - D. When it can be worked into the schedule.

IN THE BLANK PROVIDED, PLACE THE LETTER OF THE ANSWER FROM COLUMN B WHICH BEST DESCRIBES THE QUESTION IN COLUMN A

- |  |                                      |
|--|--------------------------------------|
| _____ 1. Recommended temperature range for frozen food storage.                            | A. Built-in keyed lock.              |
| _____ 2. Eliminates the guesswork of how high or for how long temperatures may have risen. | B. Interior safety release.          |
| _____ 3. Should have removable or adjustable shelves.                                      | C. Low temperature thermometer.      |
| _____ 4. To insure control in frozen food storage.   | D. Reach-in frozen food cabinet.     |
| _____ 5. For safety of employees.  | E. Single-pen recording thermometer. |
| _____ 6. Can be placed on any partition or shelf.  | F. Walk-in frozen food unit.         |
|  | G. 0° to -20°F.                      |
|  | H. 32° to 0°F.                       |

APPENDIX D

Test Items Utilized to Evaluate Quantity Food  
Storage Concepts

## QUANTITY FOOD STORAGE TEST ITEMS

2. To maintain proper sanitation, refrigerated storage facilities should be thoroughly cleaned:
- biweekly
  - semimonthly
  - monthly
  - weekly
5. Storeroom walls should be:
- slip resistant and easy to clean
  - impervious to moisture and easy to clean
  - pervious to moisture and easy to clean
  - none of the above
10. Food should flow through the foodservice operation in one of the following patterns, which is:
- Receiving → Serving → Dining
  - Receiving → Storage → Preparation
  - Storage → Preparation → Dining
  - Storage → Receiving → Prepreparation
13. To permit free flow of air, shelves should be at least \_\_\_\_\_ off of the floor and \_\_\_\_\_ inches away from the wall.
- 36 inches; 4 inches
  - 2 inches; 10 inches
  - 12 inches; 6 inches
  - 10 inches, 2 inches
18. To maintain a proper temperature in refrigerated storage, the thermometer should be:
- placed in the coldest section of the box
  - placed near the front of the box
  - hung from the top of the box
  - placed in the warmest section of the box
19. If windows are present in the storeroom, they should be painted opaque to:
- prevent growth of mold
  - protect foods from direct sunlight
  - keep foods from mildewing
  - all of the above

20. Holding food at zero degrees Fahrenheit or less:
- destroys all bacteria
  - retards bacterial growth
  - destroys all cocci and spores
  - has no effect on bacterial growth if the food has been contaminated
24. Since quality is lost very rapidly, fresh meat should be left in an unfrozen state for not more than:
- 3 to 4 days
  - 1 to 2 days
  - 2 to 3 days
  - 1 week
28. Adequate lighting in the dry storage area is necessary for:
- all of the following
  - checking inventories
  - checking conditions of foods
  - cleaning
33. Storeroom floors should be:
- easy to clean and slip resistant
  - permeable to moisture and easy to clean
  - clean resistant and slip resistant
  - impermeable to moisture and susceptible to slippage
34. Both meat and eggs should be stored away from other foods since they both:
- emit strong odors
  - are damaged easily
  - absorb odors
  - need lower temperatures than other foods
38. After bags of items such as flour and sugar have been opened but not completely used, the remainder should be stored in:
- any available container
  - a metal container without a lid
  - a metal container with a tight fitting lid
  - the original container using a tie for closing
39. The temperature range which is recommended for refrigerated storage of dairy products is:
- 38 degrees to 46 degrees Centigrade
  - 38 degrees to 46 degrees Fahrenheit
  - 33 degrees to 38 degrees Centigrade
  - 33 degrees to 38 degrees Fahrenheit

46. The danger zone favoring bacterial growth is the temperature range from:
- 40-140 degrees Farenheit
  - 45-145 degrees Farenheit
  - 40-145 degrees Farenheit
  - 45-140 degrees Farenheit
56. Circulation of air is necessary around bags and cartons of food in the dry storage area to:
- remove moisture
  - eliminate odors
  - increase moisture
  - both a and b
  - both b and c
61. Temperatures above the ideal range in the refrigerated storage area are detrimental to foods; therefore, the thermometer should be:
- checked on alternating days
  - checked as often as possible
  - checked to make sure it is working
  - checked twice weekly
  - checked twice daily
67. To facilitate inventory taking and ease of locating food items, foods should be:
- grouped so that similar items are together
  - grouped so that all containers of the same size are together
  - stored in an orderly and systematic arrangement
  - both a and b
  - both a and c
76. Which of the following is not a type of loss that is prevented or controlled by the proper storage of food?
- pilferage
  - fumigation
  - deterioration
  - infestation
  - both b and d
82. Which of the following may be used to facilitate circulation of air in the dry storage area:
- wall vents
  - leaving the door open
  - grates in the floor
  - fans
  - both a and d

87. Frozen food storage should be maintained at:
- a. 0° to -20°F
  - b. 32° to 0°F
  - c. 0° to -20°C
  - d. 32° to -20°F
98. A temperature range of 34° to 45°F is recommended:
- a. for all fruits and vegetables
  - b. as the maximum acceptable range for all perishable foods
  - c. for all fruits (except bananas) and vegetables
  - d. for dairy products and eggs

APPENDIX E  
Comment Card

NAME \_\_\_\_\_ CLASSIFICATION \_\_\_\_\_

DRY FOOD STORAGE - DATE COMPLETED \_\_\_\_\_  
COMMENTS:

REFRIGERATED STORAGE - DATE COMPLETED \_\_\_\_\_  
COMMENTS:

FROZEN FOOD STORAGE - DATE COMPLETED \_\_\_\_\_  
COMMENTS:

APPENDIX F  
Course Objectives

KANSAS STATE UNIVERSITY, COLLEGE OF HOME ECONOMICS  
Dietetics, Restaurant and Institutional Management Department

Quantity Foods Course Objectives

Upon completion of this course, you should be able to:

1. Identify the 3 basic managerial skills described by Katz and know their application in foodservice.
2. Identify basic concepts of the systems approach and component parts in a foodservice system.
3. Recognize work areas of the institutional kitchen and (explain) how they relate to each other.
4. Recognize the need for safety and safety programs in the institutional kitchen and demonstrate the application of safety practices.
5. Recognize the importance of sanitation and sanitation programs in the institutional kitchen and demonstrate the application of correct sanitation practices.
6. a) Apply the principles of motion economy and work methods improvement to quantity food production.  
b) Apply the problem solving technique in selected situations.
7. a) Understand the methods of cookery and know the respective equipment involved in each method.  
b) Demonstrate understanding of operation and cleaning of large equipment and know the functions of each piece of equipment.
8. a) Apply food science principles to the production of quality food in quantity.  
b) Identify sources of information concerning the various aspects of "quantity foods."
9. Apply the fundamental of menu planning.
10. Demonstrate the ability to adjust and standardize recipes for quality food produced in quantity.
11. a) Comprehend the meaning of quality food and be able to evaluate food produced in quantity.  
b) Understand basic purchasing criteria in relationship to quality food.
12. Apply principles of portion control and selected principles of portion costing.

13. Identify factors in influencing food acceptability, recognize the role of food acceptability in the foodservice system, and assess food acceptability in given situations.
14. Understand the concept of merchandising as it relates to the processing and service subsystems.
15. Understand the concepts underlying distribution and service of food in quantity.
16. Realize the importance of inter and intra communications within foodservice systems.

APPENDIX G

Quantity Food Storage Objectives

## QUANTITY FOOD PRODUCTION

## QUANTITY FOOD STORAGE OBJECTIVES

The following are specific objectives covering Quantity Food Storage subject matter in the Quantity Food Production course. It should be noted that these objectives cover only the subject matter concerned with Quantity Food Storage and NOT all of the subject matter over which you will be tested on your final.

QUANTITY FOOD STORAGE OBJECTIVES

When the student finishes Principles of Quantity Food Production, he/she should be able to:

DRY STORAGE

- describe by means of an outline the flow of food from receiving to preparation.
- list the three types of loss which are prevented or controlled by the proper storage of food after it is received.
- describe the following:
  - a. storeroom walls
    - 1. permeability to moisture.
    - 2. ability to be cleaned.
  - b. storeroom floors
    - 1. resistance to slippage.
    - 2. ability to be cleaned.
- indicate the two accessories that windows, if they are present in the dry storage area, should include, and the reason for painting the windows opaque.
- list the three reasons for having adequate lighting in the dry storage area.
- identify two types of ventilation which can be used for circulation of air in the dry storage area.
- list three reasons that the circulation of air is necessary around bags and cartons of food in the dry storage area.

- indicate the number of inches of minimum clearance that racks, dollies, and shelves should be away from walls and above floors to permit free flow of air.
- identify the type of containers in which broken lots of items such as sugar and flour should be stored.
- describe the way cases of food should be arranged on racks, dollies and skids to permit free flow of air.
- describe how the storeroom should be arranged to facilitate taking inventory and ease of locating items, and how old and new stock of the same item should be arranged on a shelf, rack, skid or dolly.
- identify the reason for controlling rodents and insects, and recognize the availability of services from outside the organization for controlling rodents and insects.

#### REFRIGERATED STORAGE

- indicate the frequency of checking temperatures in refrigerated storage.
- indicate where the thermometer should be placed in a refrigerator so that proper temperature can be maintained.
- list the specific recommended temperature ranges for the following:
  - a. fruits (except bananas), vegetables and most other perishable products.
  - b. dairy products and eggs.
  - c. meat and fowl.
  - d. fish and shellfish.
  - e. "danger zone"--temperature range which favors bacterial growth in perishable food products.
- indicate the importance of controlling humidity in refrigerated storage of meats and fresh fruits and vegetables.
- identify the suggested number of days that meat may be left unfrozen.
- identify the reason meat and eggs should be stored away from other food.
- indicate the frequency of cleaning and the procedure for handling spillage in refrigerated storage.

#### FROZEN STORAGE

- identify the temperature range for frozen food storage.

APPENDIX H

Cover Sheet Describing Assignment of Module, Media  
Center Hours and Dates of Availability

## QUANTITY FOOD PRODUCTION

During your last unit of study you will cover a variety of material, some of which will be pertinent to quantity food storage. To aid in integrating this material, a series of three slide/tape programs has been developed for your use. This series consists of the following programs: Dry Food Storage, Refrigerated Food Storage, and Frozen Food Storage.

Viewing of this series of programs is required. The three slide/tape presentations will be available to you in the self-instructional laboratory (Media Center), Ju 150, from April 23, 1979 through May 11, 1979. Hours for the self-instructional laboratory (Media Center), Ju 150, during this period will be:

Monday - Friday 8:30 a.m. to 4:30 p.m.

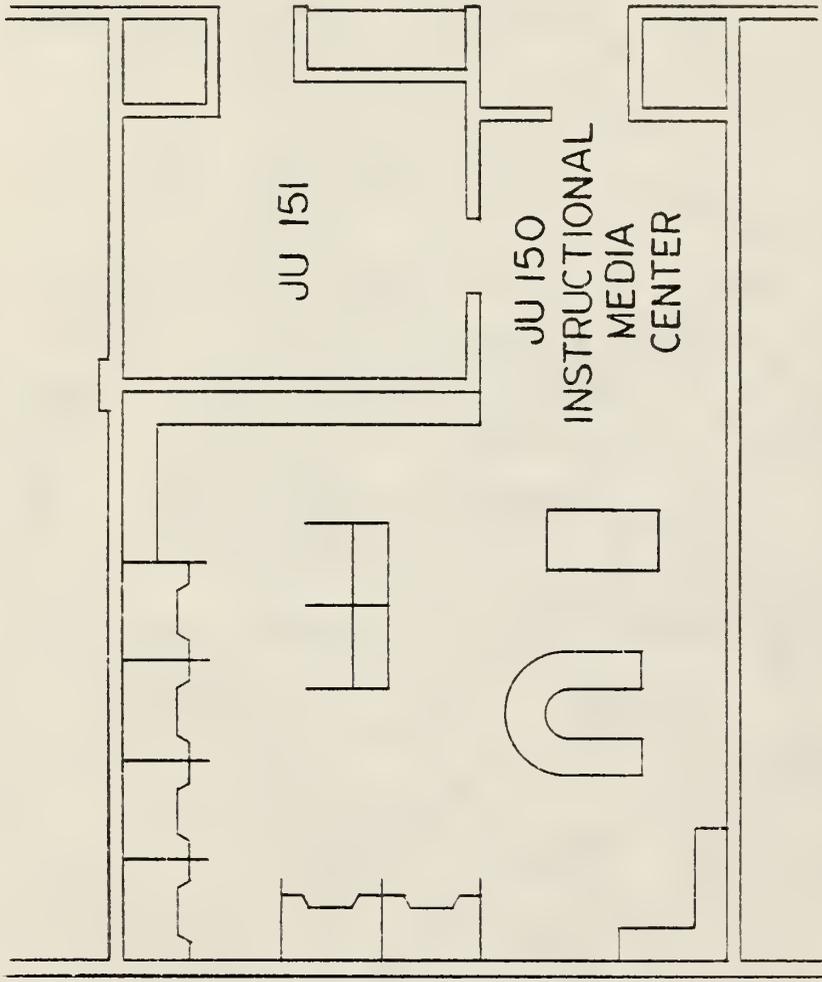
Use the laboratory at your convenience, but plan your time carefully so that all three slide/tape programs can be viewed during the time allotted.

Procedures for use of the material are included in the folder accompanying each program and should be read before you study the program for the greatest benefit. The objectives for this series of programs have been attached to this sheet.

APPENDIX I

Floor Plan of Instructional Media Center and List of  
Equipment Utilized in Study

INSTRUCTIONAL MEDIA CENTER  
DEPARTMENT OF INSTITUTIONAL MANAGEMENT



SCALE:  $\frac{1}{8}'' = 1'-0''$   
DWG BY: D.R.B.

## LIST OF EQUIPMENT UTILIZED IN STUDY

1. Wollensak 3M Cassette Guardian--2515 AV  
2505 AV
2. Kodak Ektagraphic Slide Projector Model B-2

THE DEVELOPMENT AND COMPARATIVE EVALUATION OF A SELF-INSTRUCTIONAL  
MODULE FOR QUANTITY FOOD STORAGE

by

MARGARET ANN RITCHEY BOCK

B.S., Kansas State University, 1968

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AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

Department of Dietetics, Restaurant,  
and Institutional Management

KANSAS STATE UNIVERSITY  
Manhattan, Kansas

1979

test items were compiled and the percentage differences between the two groups were calculated.

When using a one-way analysis of variance, no significant difference in final examination score nor final course grade between the two groups was found. When the groups were compared on the quantity food storage test, the experimental group tended to score higher ( $P = 0.07$ ). Initial analysis of covariance used to control effects of final examination scores and final course grades indicated that course grade was not a significant covariate. Reanalysis of data using only final examination score as a covariate revealed that the difference between the control and experimental groups on quantity food storage was significant ( $P = 0.03$ ). In addition, the final examination score was a significant covariate ( $P = 0.001$ ).

The analysis of data revealed that the self-instructional unit facilitated learning through integration of concepts which were taught under various headings such as sanitation and quality control. Based on this finding, the self-instructional module could be utilized to draw together both those concepts presented in lecture or text and those from outside sources, and allow the student to master or review these concepts at the student's own pace and convenience.

## ABSTRACT

The purpose of this research was to develop a self-instructional module for teaching concepts related to quantity food storage. The rationale for the development of this module was to integrate the concepts related to quantity food storage and to relieve the course instructor for more direct student-teacher contact. In addition, it was intended that the module serve as a review unit for advanced level courses. The module was composed of three slide/tape presentations on dry food storage, refrigerated food storage, and frozen food storage.

The module was evaluated during two semesters by a total of fifty-two dietetic, restaurant and institutional management, foods and nutrition, and business administration students in the junior level, management oriented course, Fundamentals of Quantity Food Production, at Kansas State University. For research purposes the fall 1978 class, who did not have the use of the module, was designated the control group and the spring 1979 class, who used the module, was considered to be the experimental group. The efficacy of the module was tested by comparing the means of quantity food storage test scores, final examination scores and course grades of the group using the module with the group who did not use the module.

A one-way analysis of variance was utilized to compare the means of these measures of the control and experimental groups. Analysis of covariance was used to control for effects of final examination score and course grade. Data were reanalyzed using only final examination score as a covariate. In addition, responses on individual quantity food storage

