

FOOD SAFETY FOR CONSUMERS, PRESENTED  
BY PROGRAMMED INSTRUCTION

by

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## CHAPTER I

### INTRODUCTION

Consumer interest in all matters has increased tremendously during the past decade. Inevitably, the safety of the food supply has become a subject of important concern to people everywhere, according to Benarde and Jerome (1972).

Simon and Kuehl (1973) found that many consumers did not recognize their own contribution to the safety of the food supply. Horner (1972) stated that many consumers overlooked their responsibility for hygienic food preparation and sanitary practices in the home.

According to Mrak (1970), there has been a very serious need for food safety education for the consumer. Woodburn (1967) stressed that the most important fact to teach consumers about food safety was that foodborne illness could be prevented.

The importance of the increase in foodborne illness as a serious public health problem in the United States can not be doubted. White (1972) estimated that everyone in the United States had some form of bacteria-produced intestinal disturbance at least once every 5 years. He further stated the prevalence of the hazards from food contamination by bacteria and other organisms are not known because not all cases are reported by the victims or physicians. Foster (1968) stated that the estimates ranged from several thousand to a few million cases per year.

Consumers must be able to recognize the hazards of foodborne illness and must be able to know how to prevent these hazards. Benarde and Jerome (1972) stated the greatest difficulty to overcome was the lack of knowledge and information available to consumers.

An approach to teaching food and nutrition principles to adults has involved the use of a technique called programmed instruction (Carter, 1963; Kiang, 1970).

This study was undertaken to determine if programmed instruction could be an effective tool for teaching basic food safety principles to consumers.



## CHAPTER II

### REVIEW OF LITERATURE

#### PROGRAMMED INSTRUCTION

##### History

The inception of the idea of auto-instructional devices was attributed to Dr. S. L. Pressey (1960). In the mid 1920's, Pressey designed a simple mechanical device for test administration and testing as well as teaching. The student using the device was presented with multiple-choice questions and was provided with immediate feedback concerning the correctness of his response. However, after experimenting and publishing his results, Pressey found little enthusiasm among his colleagues (Deterline, 1962).

Later work was done with auto-instructional devices by B. F. Skinner (1954). His programming technique was based on the experimental analysis of behavior and its direct application to learning. Skinner's theory emphasized that learning was most effective when there was immediate and positive reinforcement of the desired response or behavior demonstrated by an individual. Like Pressey, Skinner used a teaching machine to present his programmed material to the student. Skinner (1958) described his teaching machine and stated that lack of enthusiasm for Pressey's machine was due to cultural inertia and the insufficient understanding of the principles of learning.

A major difference between Pressey's and Skinner's machines was that Skinner recommended that students compose their own response rather than choose it from multiple-choice questions (Deterline, 1962). The similarity between Pressey's and Skinner's teaching machines was that the student was told immediately by the machine whether his response was correct or incorrect.

According to Chidester (1967), Skinner's classic presentation provided the foundation for recent educational applications of programmed instruction.

### Types

In current applications of programmed instruction, Moore and Klachko (1967) stated that the two most widely used forms of programmed instruction were the (1) Skinner-type extrinsic or linear constructed response program and (2) the Crowder-type intrinsic or branching, multiple-choice question program.

### Linear

Skinner (1958) described his linear approach to programmed instruction which involved the presentation of the material in the program in small steps or frames. The mastery of the subject was developed as the student proceeded through the program. Frames were usually only one or two sentences in length. The student constructed the response for each frame by filling in the blank spaces in the frame. The route through the material in the program was established by the programmer. Deterline (1962) defined this form

of programmed instruction as extrinsic programming.

Skinner (1958) required the occurrence of immediate and positive reinforcement after the student constructed his response. To assure reinforcement, each step or frame included cues or prompts which were gradually faded out as the concept in the program was built up.

Errors occurred very infrequently in linear programming and an error by the student was considered a fault of the programmer (Skinner, 1958). All wrong responses were to be eliminated so it would be unnecessary to unlearn incorrect responses later.

Deterline (1962) reported the main purpose of linear or Skinner-type programming was breadth of understanding of a concept and not rote memorization.

Linear programming allowed self-pacing, according to Deterline (1962). Eventually, even the slowest student learned the material presented in the program in some finite period of time.

### Branching

N. A. Crowder (1960) originated the multiple-choice, branching-type of programmed instruction in which the student was presented with a large amount of information, followed by multiple-choice questions, in sequence of frames. Each frame ranged from a quarter to almost a full page in length.

Crowder (1963) stated the material presented in the branching-type program was controlled by the student. The student was required to recognize the correct answers in the frame rather than produce it himself as in the Skinner-type linear program.

The student's route through the program was determined by his own response. Crowder (1963) and Deterline (1962) defined this form as intrinsic programming. The student who chose one alternative in the multiple-choice question was directed to different material than a student choosing another alternative. Deterline (1962) reported that the alternative routes were called branches and it was through these branches that the student determined which frames he received later.

Reinforcement took place if the correct response was chosen by the student (Crowder, 1963). If the incorrect response was chosen, corrective feedback was provided by the branching technique to explain to the student the basis for his errors.

Self pacing was also a feature of the Crowder-type branching program. The response by the student determined the number of steps or frames he would use. According to Crowder (1963), the more capable student proceeded at a faster rate.

The Skinner-type linear and the Crowder-type branching methods of programmed instruction produced learning (Deterline, 1962). According to Crowder (1963), the objective of both schools of programming was to provide material for individual study.

However, the linear or Skinner-type program was the preferred method to use when teaching apodictic subject matter with only one correct understanding or application, according to Chidester (1967). Crowder-type or branching programs were effective when teaching contingent subject matter of a variety of understandings and applications.

Scriven (1969) further pointed out that the success of the slower learner in the linear program was slightly greater than the success of the slower learner using the branching program.

### Features

Auto-instructional devices ranged from simple non-mechanical devices such as punchboards to textbooks to more complex mechanical devices and machines involving computers (Lumsdaine, 1960).

Regardless of the method of presentation or the type of programming technique (Skinner or Crowder), all programmed instruction had some common characteristics.

Chidester (1967) listed these similarities: (1) all programmed instruction was presented in either small or large steps; (2) participation and an overt or covert response were required at each step; and (3) feedback occurred after the response.

Silverman (1960) included self-pacing as a characteristic feature of programmed instruction. However, Taber et al., (1965) stated that programmed instruction could provide a pacing feature so students learned at a faster rate. An individual who worked rapidly under the pressure of an external deadline often produced a product equal to or better than what he would have done if he had worked more slowly.

Moore and Klachko (1967) reported that one of the initial steps in writing programs was to determine the terminal objectives

or behaviors of the subjects. Klaus (1961) stated that the objectives representing the criterion behaviors could be expressed in terms of a comprehensive test which covered the entire course. Taber et al., (1965) agreed that the completed test could be used as a document which described the terminal objectives. Chidester (1967) pointed out that it was possible to construct bad or even effective programs without stating terminal objectives or behaviors even though most sound programs usually did include these objectives. After defining terminal objectives, an outline describing every principle that the student was to be exposed to was to be prepared (Deterline, 1962).

Klaus (1961) outlined the next steps as writing the program frames, followed by trial testing, revision, and final testing until the program was ready for field tryout. This tested efficiency was a characteristic feature of programmed instruction, according to Scriven (1969). An extremely high response rate of 90 per cent or higher on the frames was a characteristic feature desired of programmed instruction so that guaranteed comprehensibility as determined by the students themselves was obtained.

Techniques for writing programs have developed rapidly. Klaus (1961) maintained that the rules for successful writing of a program in a specified area were frequently modified because of the nature of the subject matter involved.

### Advantages and Disadvantages

Programmed instruction has been used in a variety of learning situations. Moore and Klachko (1967) stated that research indicated the only prerequisite for most programmed instruction was that the student had to be able to read and see.

In a study by Carter et al., (1964), programmed instruction for food service employees was equally effective in teaching old and young, those with little education and those well-educated. No significant relation between pretest and post-test change scores and the variables of intelligence, reading skill, and age, determined through a questionnaire, was found in this study. Studies by McDonald and Kaufman (1963) with programmed instruction on dietary management for diabetic patients further supported these results.

Scriven (1969) stated there was some evidence that reading skills improved through the use of programmed texts possibly because of the enforced care of reading. Carter et al., (1964) pointed out that reading skill was the most important factor in the speed with which a program was completed and in the number of mistakes in the program. Well-educated adults who could follow instructions and who were used to reading could adapt to any form of program, according to Moore and Klachko (1967).

The development of programmed instruction was costly and time-consuming. Scriven (1969) pointed out that it was impractical to make minor modifications in programs because all revisions required extensive retesting.

Moore and Klachko (1967) found that many difficulties arose in the field testing of a program for diabetic patients because of the time factor. A pretest, post-test, and Gates Reading Level Survey, requiring 1 hour each to complete, were not received favorably by the patients or the hospital administrators. This time did not include the time required for the actual programmed material. The authors recommended that programs should be kept short. One hour was the suggested time with 30 minutes the preferred time for the completion of the programmed material.

#### RESEARCH ON PROGRAMMED INSTRUCTION

##### Nutrition and Dietetics

Successful application of the various techniques of programmed instruction has been demonstrated in the area of nutrition and dietetics. Kiang (1970) developed a 139 frame, linear program on protein metabolism for students in a 5 year baccalaureate nursing program. The students who received programmed instruction achieved significantly higher scores than a group of comparable students who had assigned readings which covered the same material. The majority of students who studied the programmed instruction unit expressed favorable comments.

In a basic college course in nutrition, Studdiford and Guthrie (1972) found that learning and retention were higher for college students using programmed instruction plus the



conventional lecture than for students exposed to just the conventional lecture.

Weber (1965) developed and evaluated 8 units of programmed instruction designed to teach basic nutrition to junior high school students. Increased knowledge about nutrition was obtained by the students using the programmed instruction.

McDonald and Kaufman (1963) conducted a study to determine the feasibility of using programmed instruction for teaching 106 diabetic patients. A branching-type, multiple-choice program was developed for use in a teaching machine. Results indicated the teaching machine was effective. Change scores on the pretest and post-test showed that 77 per cent of the 106 patients gained some new knowledge from the programmed instruction.

Increased knowledge was obtained for diabetic patients using a teaching machine in a study by Young et al., (1969). Patients using the teaching machine learned significantly more than baseline patients who did not use the teaching machine.

Tani and Hankin (1971) used an audiovisual programmed instruction to supplement the individual interview with the dietitian for diabetic patients. Increased knowledge was obtained by the experimental subjects. Professional time from the dietitian was reduced by 50 per cent among the experimental subjects.

Freeman and Bulechek (1968) used a book type of programmed instruction to teach dietary principles to renal dialysis patients. A 28-question, multiple-choice exam was developed to test acquisition

of knowledge from the program. Patients who used the programmed instruction showed a significant gain in the number of correct responses on the exam.

Pye et al., (1970) developed a program of learning to help cardiovascular patients understand and follow the fat-controlled diet. Learning was increased significantly by the programmed instruction.

Brady (1970) developed an auto-instructional program for dietitians on the essential nutrient folacin. All test subjects showed substantial improvement in performance on the post-test after exposure to the program.

#### Food Service Sanitation

Carter (1963) developed a programmed instruction on sanitation for nonprofessional foodservice employees below the supervisory level employed at the University of Missouri Medical Center. The employees were divided into two groups of 34 each. One group served as the control group and received no instruction. The other group was the experimental group and received the programmed instruction. A 145 frame, multiple-choice, branching-type program for use in a teaching machine was chosen for the study. An objective test with 50 multiple-choice and 50 true-false questions on personal hygiene was used as the pretest and post-test. A gain in scores was obtained by 94 per cent of the experimental group. The mean score for the post-test was 9.86 points higher than the pretest mean score. The pretest, biographical questionnaire,

Gates Reading Level Survey, post-test, and program itself averaged 3 hours and 40 minutes for the experimental group.

Roach (1968) used the same sanitation program developed by Carter to study the effect of instructing 60 food service workers from the Veterans Administration Hospital in Vancouver, Washington. Knowledge about sanitation was increased when subjects finished the programmed instruction and this new learning was carried over into the work situation.

#### FOOD SAFETY CONTROVERSIES

Through an extensive review of literature for preparation of the program on food safety principles and practices, current controversial subjects were noted. Explanation of these controversies was warranted in this study.

##### Molds

Foods contaminated with molds once considered as safe for consumption have been re-evaluated for safety because of recent studies on mycotoxins.

Mycotoxins are the toxic products produced by various molds. Joffe (1964) described one well-documented episode of a disease caused by a mycotoxin that occurred in Russia in 1942 during wartime conditions. Cereal grain, left to overwinter in the field, was harvested the following spring and consumed in foodstuffs by man. The disease was characterized by the destructive action on the blood-forming elements of bone marrow and was termed alimentary aleukia.

Worldwide interest was again focused on mycotoxins in 1960 with the death of 100,000 young turkey poults in Southern England (Wogan, 1966). The disease, termed the "turkey X disease" produced sudden death of unknown causes in the young turkey poults. The cause of their mysterious death was eventually traced to the Brazilian peanut meal the turkeys were consuming. Sargeant et al., (1961) stated the peanut meal was found to contain the toxin of the mold genus, Aspergillus flavus. These toxins were termed aflatoxins (Wogan, 1966).

Frazier (1967) listed the aflatoxins as B<sub>1</sub>, B<sub>2</sub>, G<sub>1</sub>, and G<sub>2</sub> produced by Aspergillus flavus, Aspergillus parasiticus, and Penicillium puberulum. These aflatoxins grew on peanuts, wheat, various cereals, and in culture media.

Further research indicated that aflatoxins were harmful and even carcinogenic in some animals, according to Wogan (1966). Lancaster et al., (1961) stated that a purified diet containing 20 per cent of the toxic Brazilian groundnut meal reduced food intake and growth of rats. Of 11 rats fed such a diet for approximately 6 months, 9 developed malignant liver tumors and 2 rats had metastases to the lungs. The authors concluded the diet was carcinogenic.

Ashley et al., (1964) studied the effect of wheat aflatoxins fed to rainbow trout for periods of 6 to 9 months. Trout fed crude aflatoxin at 0.08 ppm of their diet had classical multinodular hepatoma in 60 per cent of the livers autopsied. The authors

concluded that aflatoxins were carcinogenic to the rainbow trout.

According to Wogan (1964), guinea pigs, monkeys, and ducklings were other animals affected by aflatoxins. Day old ducklings were the most susceptible species with regard to critical fatality caused by aflatoxins.

Aflatoxins, especially aflatoxin B<sub>1</sub>, are an acute poison (Wogan, 1966). No reports of human poisoning were reported and there was no evidence that aflatoxins could cause liver cancer in man.

In light of the possible harm of aflatoxins, Wodicka (1973) advised consumers to avoid consumption of all moldy food except mold-ripened cheeses where mold had obviously been introduced. Frazier (1967) listed blue, Roquefort, Camembert, Brie, and Gammelost as some of the mold-ripened cheeses.

Wodicka further stated that it was not enough to remove or trim parts of the food where the mold was obvious. The visible mold was only the spore-bearing part of the organism and most of the mold was embedded in food tissues and could not be seen.

Moore (1966) recommended to consumers that moldy foods be thrown away in their entirety until more specific information on the topic was available.

The current revision of the consumer bulletin "Keeping Food Safe To Eat" (1974) did not include any statements about the possible harmful effects of molds, according to Davis (1974).

### Clostridium Perfringens Foodborne Illness

The specific cause of the foodborne illness from Clostridium perfringens bacteria is not known and therefore, the illness is termed either Clostridium perfringens food poisoning or Clostridium perfringens foodborne illness.

Zottola (1971) termed the illness caused by Clostridium perfringens as a food poisoning. Extensive growth of Clostridium perfringens bacteria in food and consumption of live organisms were necessary for illness; however, eating food containing a small number of Clostridium perfringens bacteria did not cause illness. This suggested growth did not occur in the intestinal tract or if it did, illness did not occur. The author did point out that a free toxin had not been found by researchers.

Frazier (1967) also termed the disease as Clostridium perfringens food poisoning. Food poisonings were referred to as illnesses caused by poison present in the food when it was eaten.

Bryan (1969) stated that the absence of secondary spread, fever, and immunity suggested the illness was a food poisoning, but he pointed out that suspensions of dead organisms or culture filtrates failed to produce illness in human volunteers. On this basis, he termed the illness Clostridium perfringens foodborne illness.

### Danger Zones

Danger zones, the temperatures where both infectious bacteria and toxin-producing microorganisms grow rapidly, have been a

controversial subject on food safety.

For food service establishments, Longree and Blaker (1971) stated that food should not be kept in the danger zone of 45°F to 140°F for more than 4 hours.

Zottola (1967) defined the temperatures for the danger zone from 60°F to 120°F.

Consumer bulletins differed in the range of temperatures for the danger zone. Horner (1972) stated 45°F to 115°F was the danger zone consumers should recognize.

In "Keeping Food Safe To Eat" (1971), the authors stated that food should not be kept in the danger zone of 60°F to 120°F for more than 3 to 4 hours. The revision of the bulletin, currently in process, defined the temperatures of the danger zone as 60°F to 125°F for no more than 2 to 3 hours. These changes were made on the basis of advice from the Subcommittee No. 1, Committee on Food Safety, according to Davis (1974). Frazier (1967) reported that the maximum temperature for growth of Clostridium perfringens bacteria was 122°F so the increase in the temperature of the danger zone was probably justified.

## CHAPTER III

### MATERIALS AND METHODS

#### FORMULATION OF GENERAL OBJECTIVES

The purpose of this study was to determine the effectiveness of teaching principles of food safety by programmed instruction for consumers.

A self-instructional program was developed to teach concepts that would enrich the consumer's understanding of food safety and which would allow the consumer to develop a repertoire which was applicable in a variety of situations.

The difference in the initial behavior before using the programmed material and in the terminal behavior after using the programmed material was assessed in relation to the terminal objectives of the programmed material.

#### FORMULATION OF SPECIFIC OBJECTIVES

The terminal objectives of the programmed material were expressed in terms of a criterion test which covered pertinent principles of food safety, as determined through an extensive review of literature. The primary sources examined for development of the program and criterion test are shown in Appendix C beginning on page 75.

An effort was made to limit the time required to complete the programmed material and the accompanying criterion test.



Versatility was a desired feature of the programmed instruction so the material was presented in textbook form.

The subjects were expected to participate actively and receive immediate feedback so a linear programming technique was employed.

The mean error rate of responses on the final draft of the programmed text was limited to 10 per cent.

#### CRITERIA FOR SUBJECT SELECTION

The program was limited to subjects who could see, read, and write the English language. The reading level required of subjects was at the ninth to tenth grade reading level or higher.

No prior instruction on food safety was required. The subjects were expected to be voluntary participants.

#### PREPARATION OF CRITERION TEST QUESTIONS

The criterion test was based on the terminal behaviors expected at the completion of the programmed text.

An objective-type subject matter test containing 25 true-false questions was constructed to test the learner's initial behavior before using the programmed text. The pretest is shown in Appendix A beginning on page 43.

A post-test, to test the learner's terminal behavior after using the programmed text, was composed of the same questions as the pretest, but the order of questions was randomly selected.

The criterion test was submitted for accuracy and clarity to a faculty advisor and necessary revisions were made.

The test was administered initially to 3 volunteers. The time required to complete the criterion test ranged from 10 to 15 minutes.

#### PREPARATION OF PROGRAMMED TEXT

A linear technique was employed in writing the programmed material. The programmed material was presented in a textbook form.

The course, entitled "Food Safety: Programmed Learning for Consumers", consisted of 100 frames divided into 3 units: (1) Microorganisms and Foodborne Illness, (2) Bacterial Foodborne Illness, and (3) Prevention of Foodborne Illness. The program is presented in Appendix B beginning on page 47.

Preparation of the programmed text was done in several steps. An outline covering each of the 3 units was constructed. From the outline, a preparation of draft frames was completed; reviewed; and rewritten. The frames were shown to 3 trial subjects; revised; and rewritten. The trial procedure was repeated and further revisions were made.

The program was submitted for technical accuracy and clarity to a faculty advisor and necessary revisions were made. The final form was duplicated on white paper and placed in a brown folder. These booklets were the form of programmed instruction employed in field testing.

From the trial procedure, an estimation of the minimum time required to complete the program was determined to be at least 30 minutes.

#### APPLICATION OF READABILITY FORMULA

The readability formula of Dale and Chall (1948) was applied to the criterion test and to every odd-numbered frame for each of the 3 units in the programmed text to compute the reading level of the material.

The criterion test and the programmed text were written at a level averaging around the ninth to tenth grade reading level.

#### EXPERIMENTAL DESIGN

##### Selection of Population to be Studied

Two groups of consumers were selected for the study. One group, designated Group I, consisted of 29 women from the Arlington County Homemakers Clubs, Arlington, Virginia. Club presidents, county officers, and committee chairmen were members of the group. Of the 29 subjects, 20 completed the study.

The second group, designated Group II, consisted of 18 female technicians from the Virginia Polytechnic Institute and State University, Arlington County Extension. Of the 18 subjects, 17 completed the study.

Both groups were comparable in age. All participants had completed high school. Educational levels for both groups are shown in Table 1.

Table 1. Educational Level of Subjects in Groups I and II.

Group	High School Graduate	Beyond High School
I	13	7
II	13	4

### Environmental Conditions

The physical environment for both groups was standardized. Chairs were provided for each of the participants and only a few in each group had access to tables. Lighting in the rooms was adequate.

The experiment was scheduled as a special segment to a regularly scheduled meeting for both groups. In Group I, the experiment was a special segment of the monthly business meeting on May 7, 1974. In Group II, the experiment was the first part of a regularly scheduled training session on June 11, 1974.

Due to the limitation of available time, the Arlington County Extension leader restricted the experimenter to approximately 1 hour for completion of the entire study for each of the groups.

Prior to participation in the study, the purpose of the study and the value of their cooperation was explained to both groups of subjects. Each subject was randomly assigned a number for identification purposes in the study.

### Administration of Pretest

The administration of the pretest was standardized for both groups. Directions were read aloud. A time allotment of 10 to 15 minutes was given to both groups.

The pretest was collected after completion by all participants.

### Administration of Programmed Text

Directions for the programmed text were read aloud for both groups. A time allotment of 30 to 40 minutes was given for all participants.

The same program was administered to both groups except for one minor change. The last sentence in frame #6 of the program administered to Group II was changed from "Molds are another type of \_\_\_\_\_" to "Molds are microorganisms and are another type of \_\_\_\_\_". A high error rate on the frame warranted this change.

Participants in both groups were asked to close the booklet after completion or after the time allotment had expired.

### Administration of Post-test

The administration of the post-test was standardized for both groups. A time allotment of 10 to 15 minutes was given to both groups.

## ANALYSIS OF DATA

The mean differences of pretest and post-test scores were analyzed by the student's t test (Downie and Heath, 1970).

In this study, the probability level of 0.001 per cent was considered significant.

## CHAPTER IV

### RESULTS AND DISCUSSION

The purpose of this study was to determine the effectiveness of teaching basic principles of food safety by programmed instruction for consumers.

#### CRITERION TEST

The mean scores and percentage scores of the pretest and the post-test administered with the programmed text are shown in Table 2. The positive change in score between the pretest and the post-test for both Groups I and II was significant at the 0.001 level. Both Group I and II had a highly significant positive change in score. However, the difference between pretest and post-test change in score was slightly lower in Group II.

Percentage correct response rate on the pretest and post-test for Group I and Group II are shown in Table 3 and Fig. 1.

Pretest and post-test raw scores and change in scores for Group I and Group II are shown in Table 4 and 5, respectively. Of all the subjects, 3 subjects in Group I and 2 subjects in Group II had a change in score in the negative direction. Moore and Klachko (1967) stated that occasionally students answered fewer questions correctly on the post-test after completion of the programmed material.

All subjects completed the criterion test in the time allotted.

Table 2. Mean Scores and Percentages Scores of Pretest and Post-test Administered with Programmed Text.

Group	Number of Subjects	Pretest		Post-test		Difference Between Pretest and Post-test Change in Score
		Mean	Percentage Score	Mean	Percentage Score	
I	20	17.8 $\pm$ 2.52	71.2	20.6 $\pm$ 2.61	82.6	+ 11.4% *
II	17	15.1 $\pm$ 3.52	60.5	17.1 $\pm$ 4.46	68.2	+ 7.7% *
Total	37		66.3		76.0	+ 9.7% *

\*Significant at 0.001 level



Table 3. Percentage Correct Response Rate on Pretest and Post-test for Group I and Group II.

Percentage Correct Response Rate	Group I		Group II	
	Pretest	Post-test	Pretest	Post-test
36			2	1
40				1
44			1	
48	1			1
52	1		1	1
56	1		4	
60			3	1
64	1	2		3
68	4	1	2	2
72	3	1		2
76	4	4	2	
80	3		1	1
84	1	3		1
88	1	4	1	
92		3		1
96				1
100		2		1

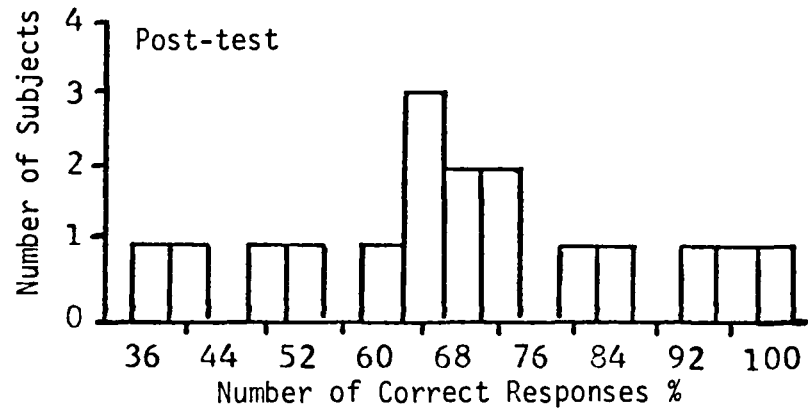
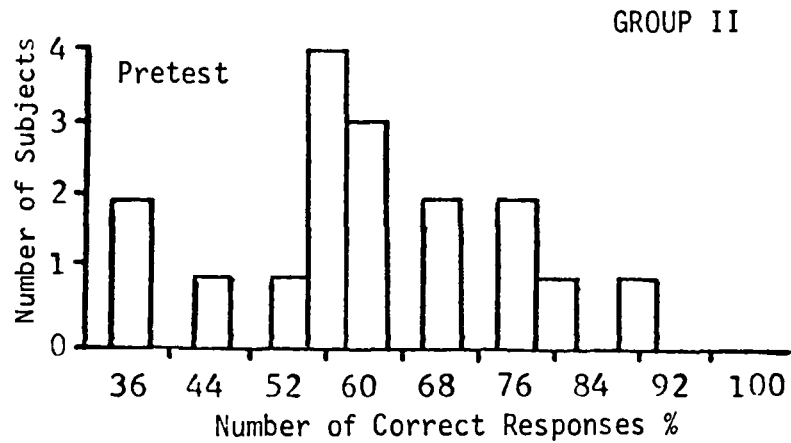
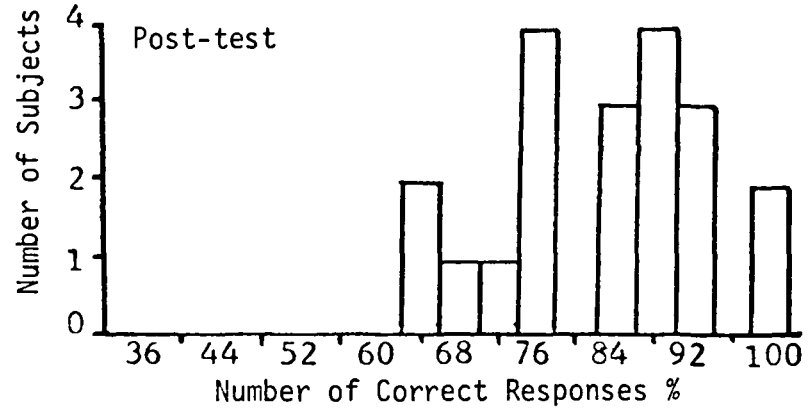
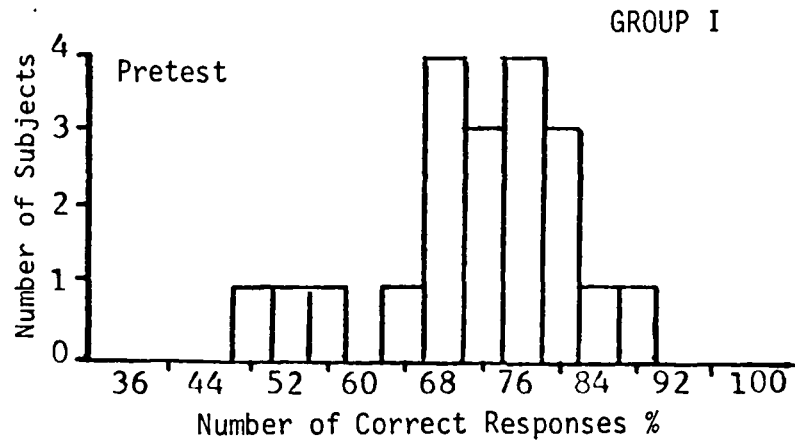


Fig. 1. Percentage Correct Response Rate on Pretest and Post-test for Group I and Group II.

Table 4. Pretest and Post-test Raw Scores and Change in Scores of Group I.

Subject Number	Pretest Score $x_1$	Post-test Score $y_1$	Difference $D_1$
1	16	25	+ 9
2	17	22	+ 5
3	18	22	+ 4
4	20	19	- 1
5	20	22	+ 2
6	12	16	+ 4
7	17	23	+ 6
8	19	19	0
9	13	18	+ 5
10	19	25	+ 6
11	22	23	+ 1
12	14	16	+ 2
13	17	21	+ 4
14	18	19	+ 1
15	19	17	- 2
16	17	21	+ 4
17	18	21	+ 3
18	19	22	+ 3
19	20	19	- 1
20	21	23	+ 2

Table 5. Pretest and Post-test Raw Scores and Change in Scores of Group II.

Subject Number	Pretest Score $x_2$	Post-test Score $y_2$	Difference $D_2$
1	9	9	0
2	14	16	+ 2
3	20	24	+ 4
4	22	23	+ 1
5	19	25	+ 6
6	14	13	- 1
7	17	18	+ 1
8	15	15	0
9	13	16	+ 3
10	15	17	+ 2
11	9	12	+ 3
12	19	20	+ 1
13	15	16	+ 1
14	17	21	+ 4
15	11	10	- 1
16	14	17	+ 3
17	14	18	+ 4

### PROGRAMMED TEXT

The percentage error rate and the mean error rate calculated from the number of subjects who constructed all responses in the programmed text are shown in Table 6.

Group II had a lower error rate on the program than Group I. However, both Group I and Group II fell within the required 10 per cent error rate.

Some subjects in both groups were unable to complete the programmed text in the 30 to 40 minute time limit. Of these subjects, 4 in Group I and 6 in Group II did not complete all of the responses. Subjects were not included in the tally of total number of errors in the program if they skipped one or several frames in the middle of the text or if they did not complete all of the text.

### CONCLUSIONS

The basic principles of food safety can be taught effectively to consumers by programmed instruction. Current and controversial topics in the food safety field can be presented easily and clearly in programmed instruction. Consumers can be kept informed of these new trends in food safety through the programmed instruction method of learning.

Self pacing through the programmed text was a definite feature observed in this study. Although most subjects proceeded rapidly through the program in the 30 to 40 minute time limit, others worked much slower and some did not have time to complete

Table 6. Percentage Error Rate and Mean Error Rate Calculated from Number of Subjects Who Constructed All Responses in the Programmed Text.

Group	Percentage Error Rate																			Mean Error Rate (per cent)	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		19
I n=16 <sup>1</sup>	2	1	2	1		1		1	1	1	2			1	1				1	1	7.6
II n=11 <sup>2</sup>	2	3	1	1	1	1	1		1												2.8
Total n=27 <sup>3</sup>	4	4	3	2	1	2	1	1	2	1	2			1	1				1	1	
Mean Error Rate for Subjects from Group I and Group II																					5.6

<sup>1</sup> Number completed out of 20

<sup>2</sup> Number completed out of 17

<sup>3</sup> Number completed out of 37

the program in the allotted time. Several subjects commented that they were rushed and would have preferred to proceed more slowly in order to grasp the material better.

Even though not all subjects completed the entire programmed text, the significantly higher scores on the post-test indicated that some new learning had occurred as a result of being exposed to the programmed text.

Generally, comments expressed to the author about the programmed instruction were favorable. Many subjects requested copies of the programmed text and the criterion test for their own use at home. Others expressed that they wanted to see the results of the study to see the overall improvement on the criterion test after exposure to the program.

#### RECOMMENDATIONS

Since self pacing through the programmed text was found to be a necessary feature in this study, future use of the program should allow ample time for completion of the entire program. One hour was estimated to be the maximum time it would require any subject in either of the experimental groups to complete the entire program. The criterion test was easily completed in the 10 to 15 minute time limit. Both the program and the criterion test, administered as a pretest and post-test, would probably take no longer than 1 hour and 30 minutes for all subjects to finish completely. Some groups may proceed at a faster rate. The 1 hour and 30 minutes would appear to be the maximum time required to complete the study. Others

using the program should not attempt to shorten the program by eliminating frames. The same significant results obtained in this study would not be likely to occur with use of a shortened version of the program.

Some informal observations noted by the author led to other recommendations. The ideal testing environment would have allowed tables for all subjects. Many subjects had a difficult time keeping the program folder in their laps while writing and turning pages. The few subjects using the tables proceeded at a faster rate than the subjects without tables.

Subjects should be informed prior to the day of the study of the details involved in the programmed instruction testing situation. Many subjects were not prepared for the testing situation; they were prepared for the regularly scheduled meeting or training session. A few subjects in Group I had a negative attitude toward the study and these feelings were expressed to the author. These subjects felt the study was taking up too much of the time needed for the scheduled meeting. Possibly, these negative attitudes could have been avoided if the subjects had been informed prior to the scheduled meeting day as to what the study would entail.

Future users of this program should take these recommendations into consideration.

This study did not test whether there was a behavioral change in terms of food safety practices in the home. Further studies



are needed to determine if consumers practice the principles taught in this study.

## CHAPTER V

### SUMMARY

The purpose of this study was to determine the effectiveness of teaching basic food safety principles by programmed instruction for consumers.

A linear programming technique was employed and the programmed material was presented in textbook form.

The difference between the initial behavior and terminal behavior of subjects using the programmed material was assessed in relation to the terminal objectives of the programmed material.

The terminal objectives of the programmed material were expressed in a criterion test used as a pretest and as a post-test.

The criterion test and the programmed text were administered to two groups of consumers, Group I and Group II. Change scores between the pretest and post-test were tested for level of significance for each group.

The positive change in score between the pretest and post-test for both Group I and Group II was significant at the 0.001 level. The significantly higher scores on the post-test indicated that new learning occurred as a result of exposure to the programmed material.

The mean error rate calculated from the number of subjects who constructed all responses on the final draft of the

programmed text was within the specified 10 per cent level.

The time required to complete the program was kept short so that the maximum time required was estimated to be 1 hour.

The results obtained indicated that food safety could be taught effectively to consumers through programmed instruction.

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APPENDICES



APPENDIX A

## FOOD SAFETY QUIZ

INSTRUCTIONS

Some statements about food safety are given on the following page. Please show whether or not you think each statement is true or false. If you don't understand a statement, ask your instructor about it. If you are completely unsure of the answer, circle both "T" and "F".

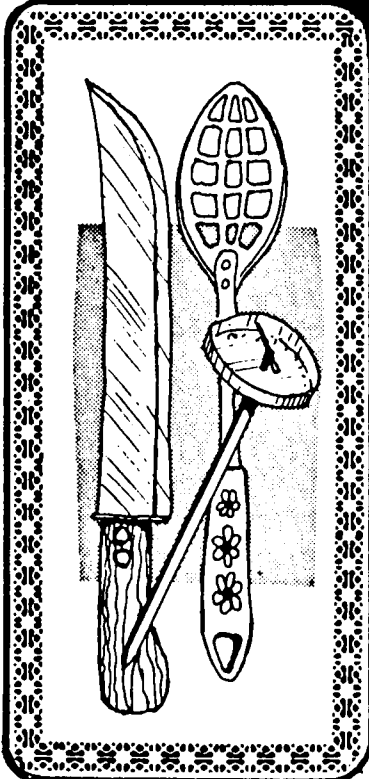
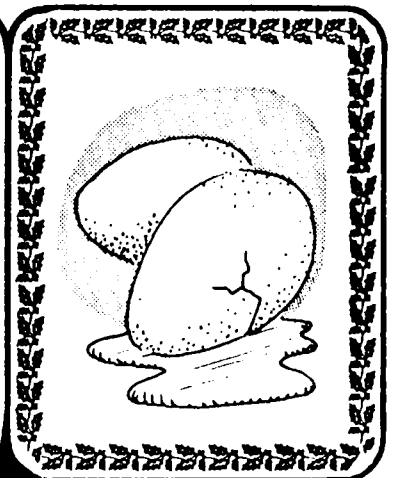
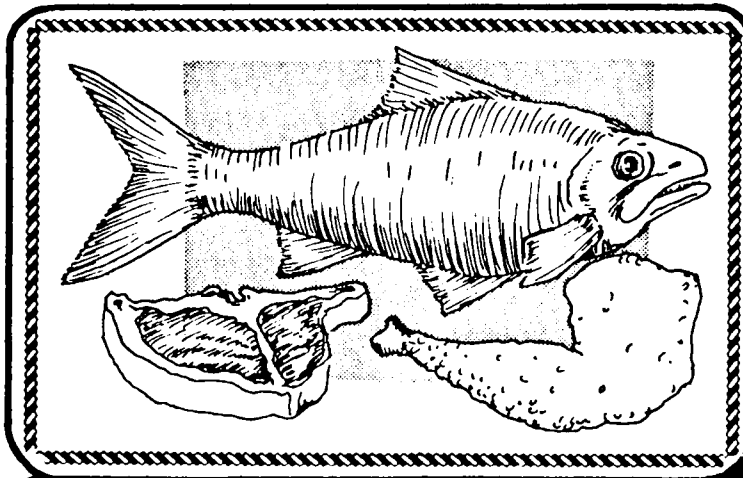
1. Food poisoning is caused by eating food containing poison from bacteria growing in the food ..... T F
2. Food infection is caused by eating food containing harmful bacteria ..... T F
3. Bacteria live almost everywhere and most bacteria are harmless ..... T F
4. Thorough cooking will destroy all disease-producing bacteria and the poisons produced by bacteria ..... T F
5. Only sick persons carry disease-producing bacteria ..... T F
6. Personal hygiene helps to prevent the spread of foodborne illness through food ..... T F
7. Outbreaks of foodborne illness are usually caused by bacteria that live naturally in the human body ..... T F
8. Bacteria need food, warmth, moisture, and time to grow and multiply ..... T F
9. All bacteria, like humans, need air in order to live .... T F
10. Although refrigeration will not kill bacteria, freezing will kill the bacteria ..... T F
11. Fruits and vegetables should be washed before eating because their skins may have been in contact with insect sprays, fertilizers, or polluted irrigation water ..... T F
12. All frozen food can be thawed at room temperature ..... T F
13. Hot food must be cooled at room temperature before it is refrigerated or the food will spoil..... T F
14. Food that causes foodborne illness usually has a characteristic odor, taste, or color ..... T F
15. Poultry and fish can be thawed in cold water before cooking ..... T F
16. Most moldy foods are safe to eat if the moldy part is cut off and discarded ..... T F
17. Frozen foods that have thawed should not be frozen again even though they still may have ice crystals..... T F

18. Cream pies, cream puffs, chocolate eclairs, and creme-filled bakery products should not be refrigerated because they will get soggy ..... T F
19. Meat and poultry can be partially cooked one day and cooked completely the next day if refrigerated between cooking periods ..... T F
20. All vegetables and fruits can be processed safely for home-canning in a boiling water bath ..... T F
21. Large turkeys should not be stuffed because the center of the stuffing may not reach the temperature needed to kill salmonellae organisms ..... T F
22. Cracked eggs should not be eaten raw; however, they are safe to eat when soft-fried ..... T F
23. A safe practice is to stuff poultry the day before it is to be cooked ..... T F
24. All home-canned vegetables can be safely eaten without further cooking ..... T F
25. Cooked food should never be prepared on the same cutting board or platter used for preparing raw food unless these surfaces have been thoroughly washed in soap and hot water ..... T F

APPENDIX B  
PROGRAMMED TEXT

# FOOD SAFETY

## PROGRAMMED LEARNING FOR CONSUMERS



INSTRUCTIONS: This is a programmed text on food safety. Work through it carefully. Try to learn as much as you can.

True statements will be made on some of the basic principles of food safety. A question will be asked after each statement. Fill in the blanks to the best of your knowledge.

The correct answer will be below the line of asterisks after each statement. Be sure to cover the answer while reading the statement and recording your answer. Use the piece of cardboard attached to cover the answers as you go along.

EXAMPLE:

---

This is a programmed text on food \_\_\_\_\_.

\*\*\*\*\*

Answer: SAFETY

---

Everyone wants to be sure the food the family eats is safe. Foods purchased in the store are expected to be safe and wholesome. To keep food safe, the consumer must know and practice the basic principles of food safety designed to prevent foodborne illness.

UNIT 1 MICROORGANISMS AND FOODBORNE ILLNESS

1. Food must contain disease-producing germs to cause foodborne illness. These germs are called microorganisms. Tiny living cells that can be seen only through a microscope are called \_\_\_\_\_.

\*\*\*\*\*

MICROORGANISMS

2. Microorganisms live in the air we breathe; in the water we drink; in the food we eat; and on the objects we touch. Microorganisms also live inside our bodies, especially inside our bloodstream and intestinal tract. So, as you see, microorganisms seem to live \_\_\_\_\_.

\*\*\*\*\*

EVERYWHERE

3. Fortunately, most microorganisms are not harmful. Some are even helpful and serve necessary and useful purposes. However, other microorganisms can spoil food and even cause disease. These are \_\_\_\_\_ microorganisms.

\*\*\*\*\*

HARMFUL

4. We will discuss two types of microorganisms: bacteria and fungi. Yeasts and molds are two types of fungi. Bacteria, yeasts, and molds are all \_\_\_\_\_.

\*\*\*\*\*

MICROORGANISMS



5. Yeast is a type of fungi. Man uses yeast for making bread and other food products. However, yeast can also cause spoilage of food. For example, yeast can cause fruit juice to bubble and spoil. Yeast is both \_\_\_\_\_ and \_\_\_\_\_ in food.

\*\*\*\*\*

### HELPFUL, HARMFUL

6. Some molds are used in food to develop desirable flavors, as in cheeses. Other molds grow on food and decay it. Until recently, we thought these decaying molds were not harmful. But, in fact, recent studies have shown that these molds may be harmful to us. We do not really know at this time if molds are harmful. Molds are microorganisms and another type of \_\_\_\_\_.

\*\*\*\*\*

### FUNGI

7. The most plentiful microorganisms in our world and in our bodies are one-celled microorganisms called bacteria. One bacterium reproduces by splitting into two bacteria, two small copies of the original one. Single-celled microorganisms that live and reproduce by themselves are called \_\_\_\_\_.

\*\*\*\*\*

### BACTERIA

8. Bacteria need food, warmth, moisture, and time to reproduce. Most bacteria need air to grow but some grow in the absence of air. Others can get along with or without \_\_\_\_\_.

\*\*\*\*\*

### AIR

9. Very hot temperatures will kill most bacteria. Cold temperatures slow down or stop bacterial growth. However, cold temperatures will not kill bacteria. Bacteria grow best when the temperature is \_\_\_\_\_.

\*\*\*\*\*

### WARM

10. Under the right conditions, the number of bacteria will double about every 20 minutes. For example, each of 4 bacteria could split and there would be a total of \_\_\_\_\_ bacteria.

\*\*\*\*\*

8

11. In three hours, 4 bacteria could reproduce to several thousand bacteria. Besides time, bacteria always need \_\_\_\_\_, \_\_\_\_\_, and \_\_\_\_\_ to reproduce.

\*\*\*\*\*

FOOD, WARMTH, MOISTURE

12. Some types of bacteria have the ability to form special structures called spores. Bacterial spores are able to stay alive under conditions that would kill bacteria not in the spore form. Not all bacteria can form \_\_\_\_\_.

\*\*\*\*\*

SPORES

13. Spores can stay alive at hot temperatures that would kill bacteria not in the spore form. Bacteria stay alive for hours, days, or even years as \_\_\_\_\_.

\*\*\*\*\*

SPORES

14. Bacterial spores are found everywhere. When spores land in a place where they receive food, warmth, and moisture, spores can develop to \_\_\_\_\_ and start to reproduce again.

\*\*\*\*\*

BACTERIA

15. Bacteria need food, warmth, moisture, and time to reproduce. Food, especially warm, moist food is an ideal place for \_\_\_\_\_ to grow into large numbers.

\*\*\*\*\*

BACTERIA

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16. Most bacteria in food are harmless. Some are even helpful. We use bacteria to make foods such as sauerkraut and vinegar. Although most bacteria are harmless and some are helpful, there are other bacteria that are \_\_\_\_\_.

\*\*\*\*\*

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#### HARMFUL

---

17. Harmful bacteria in food may cause foodborne illness. Most foodborne illnesses can be classified as either food infections or food poisonings. Two types of foodborne illness are food \_\_\_\_\_ and food \_\_\_\_\_.

\*\*\*\*\*

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#### INFECTIONS, POISONINGS

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18. Small numbers of harmful bacteria in food will not cause illness. If bacteria have enough time and if they have food, warmth, and moisture, the number of harmful bacteria will \_\_\_\_\_.

\*\*\*\*\*

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#### INCREASE

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19. Large numbers of harmful bacteria in food we eat can cause an "infection". When we eat food containing a great amount of harmful bacteria, it may result in a disease called food \_\_\_\_\_.

\*\*\*\*\*

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#### INFECTION

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20. Some bacteria are able to produce a little bit of "poison" as they grow in food. When the number of bacteria increases, more "poison" is produced. The bacteria themselves are not harmful but the \_\_\_\_\_ is harmful.

\*\*\*\*\*

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#### POISON

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21. When we eat food containing large amounts of "poison" produced by bacterial growth, this can result in a disease called food \_\_\_\_\_.

\*\*\*\*\*

POISONING

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YOU HAVE COMPLETED UNIT 1. TURN THE PAGE AND BEGIN UNIT 2.

UNIT 2 BACTERIAL FOODBORNE ILLNESS

1. Harmful bacteria or harmful poisons produced by bacteria may grow in food and cause foodborne illness. There are many types of bacteria and each acts differently in food. We will discuss four types of bacteria that can cause foodborne illness. You will need to use CHART A on the following page to fill in some of the blanks in this unit.

2. Look at CHART A. Bacteria that cause food infection are called salmonellae bacteria. A disease caused by eating food contaminated with large numbers of salmonellae bacteria is called \_\_\_\_\_.

\*\*\*\*\*

SALMONELLOSIS

3. When a person eats food containing large numbers of salmonellae bacteria, the salmonellae grow rapidly inside his intestinal tract and may make him very sick. Some people remain infected with salmonellae even after the symptoms of the disease disappear. Salmonellosis is a food \_\_\_\_\_.

\*\*\*\*\*

INFECTION

4. Live salmonellae are also present in the body wastes of persons who remain infected. When an infected person doesn't wash his hands after visiting the toilet and handles food, he may contaminate the food with \_\_\_\_\_.

\*\*\*\*\*

SALMONELLAE

5. Another person eating the food might then become infected with salmonellae bacteria. It is easy to see why this disease is called a food \_\_\_\_\_.

\*\*\*\*\*

INFECTION

## CHART 'A'

**BACTERIAL FOODBORNE ILLNESS**

NAME OF ILLNESS:	WHAT CAUSES IT:
SALMONELLOSIS (FOOD INFECTION)	SALMONELLAE BACTERIA
PERFRINGENS FOODBORNE ILLNESS	<u>CLOSTRIDIUM</u> <u>PERFRINGENS</u> BACTERIA
STAPHYLOCOCCUS FOOD POISONING	<u>STAPHYLOCOCCUS</u> <u>AUREUS</u> BACTERIA
BOTULISM (FOOD POISONING)	<u>CLOSTRIDIUM</u> <u>BOTULINUM</u> BACTERIA

---

6. Household pets, insects, flies, and cockroaches can also spread salmonellae bacteria. For this reason, they should be kept out of areas where there is \_\_\_\_\_.

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FOOD

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7. Poultry, red meat, and fish are often contaminated with salmonellae when they are being prepared for the market. Dirty eggs or cracked eggs may also be contaminated with salmonellae. Infected poultry may contaminate the outside of eggs with their body wastes. If the eggs are cracked, \_\_\_\_\_ may get inside the eggs.

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SALMONELLAE

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8. Food contaminated with large numbers of salmonellae bacteria does not have a bad odor, nor is the appearance or flavor changed. It is very difficult to tell by looking, tasting, or smelling when food is contaminated with \_\_\_\_\_.

\*\*\*\*\*

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SALMONELLAE

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9. Fortunately, salmonellae can be destroyed by high temperatures during cooking. Cold temperatures will prevent salmonellae from reproducing. Salmonellae bacteria grow best when the temperature is \_\_\_\_\_.

\*\*\*\*\*

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WARM

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10. In summary, salmonellae are found mainly in the intestinal tracts and body wastes of infected persons and animals and in foods such as poultry, red meat, fish, and eggs. Fortunately, salmonellae can be destroyed by high \_\_\_\_\_ during cooking.

\*\*\*\*\*

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TEMPERATURES

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11. Look at CHART A. When a person eats food containing large numbers of Clostridium perfringens bacteria, he may become ill with a disease called \_\_\_\_\_.

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PERFRINGENS FOODBORNE ILLNESS

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12. Clostridium perfringens are bacteria that are able to form spores. These spores are found mostly in soil, dust, and in most raw foods. The spores themselves are not harmful. Under the right conditions, the spores can develop to \_\_\_\_\_.

\*\*\*\*\*

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BACTERIA

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13. High temperatures during cooking usually kill Clostridium perfringens bacteria. However, high temperatures do not always destroy Clostridium perfringens \_\_\_\_\_.

\*\*\*\*\*

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SPORES

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14. Perfringens foodborne illness usually occurs when a person eats foods that were cooked and allowed to cool slowly. High protein foods such as meat, poultry, and gravy that were cooked and allowed to cool slowly may cause \_\_\_\_\_.

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PERFRINGENS FOODBORNE ILLNESS

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15. As the hot food slowly gets warm, the spores develop to bacteria. If left for a very long time, \_\_\_\_\_ bacteria can grow into large numbers.

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CLOSTRIDIUM PERFRINGENS

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16. Food contaminated with large numbers of Clostridium perfringens bacteria does not have a bad odor, nor is the appearance or flavor changed. It is difficult to know by smelling, tasting, or looking if food is contaminated with \_\_\_\_\_.

\*\*\*\*\*

CLOSTRIDIUM PERFRINGENS BACTERIA

17. Look at CHART A again. Staphylococcus aureus bacteria are bacteria that are able to produce a poison. A disease caused by eating food containing poison produced by Staphylococcus aureus is \_\_\_\_\_.

\*\*\*\*\*

STAPHYLOCOCCUS FOOD POISONING

18. A short name for Staphylococcus aureus bacteria is staph bacteria. Staph bacteria themselves are harmless but their poison is harmful and can cause sickness. Staph bacteria are easily destroyed by high temperatures. However, high temperatures do not easily destroy staph \_\_\_\_\_.

\*\*\*\*\*

POISON

19. Most people always have staph bacteria on their hands, skin, hair, in the nose and throat discharges, and in pus from infected cuts and boils. Staph bacteria get into food through \_\_\_\_\_ who handle food.

\*\*\*\*\*

PEOPLE

20. Cream pies, cream puffs, deviled eggs, turkey salad, and ham salad are some foods often involved with staph food poisoning. Any food requiring a great deal of hand labor in preparation is a possible source of \_\_\_\_\_.

\*\*\*\*\*

STAPH FOOD POISONING

21. Foods requiring a great deal of hand labor are often left at warm room temperatures for long times. Staph bacteria grow best at warm temperatures and have plenty of time to produce large quantities of \_\_\_\_\_.

\*\*\*\*\*

POISON

22. Foods contaminated with staph poison do not have a bad odor nor is their appearance or flavor changed. It is very difficult to tell by \_\_\_\_\_, \_\_\_\_\_, or \_\_\_\_\_ if food is contaminated with staph bacteria or poison.

\*\*\*\*\*

LOOKING, TASTING, SMELLING

23. Look at CHART A once more. Clostridium botulinum bacteria are also bacteria that can produce a poison. This poison is more harmful than the poison of staph bacteria. A disease caused by eating food containing the poison of Clostridium botulinum bacteria is \_\_\_\_\_.

\*\*\*\*\*

BOTULISM

24. Clostridium botulinum bacteria are bacteria that can form spores that are not easily destroyed by high temperatures. These spores live almost everywhere and are harmless. When Clostridium botulinum spores receive food, warmth, and moisture, they can develop to \_\_\_\_\_.

\*\*\*\*\*

BACTERIA

25. Clostridium botulinum bacteria grow best without air. These bacteria grow best in sealed containers of food, such as home-canned food, where there is no air. As Clostridium botulinum bacteria grow in these foods, they produce a very deadly poison that can cause a disease called \_\_\_\_\_.

\*\*\*\*\*

BOTULISM

26. As mentioned before, Clostridium botulinum spores are not easily destroyed by high temperatures. Most cases of botulism involve home-canned foods that were not processed at a high enough temperature for a long enough time to kill the heat-resistant \_\_\_\_\_.

\*\*\*\*\*

SPORES

27. Fortunately, the poison produced by Clostridium botulinum can be destroyed by high temperatures. If the poison is not destroyed and the food is eaten, a disease called \_\_\_\_\_ may occur.

\*\*\*\*\*

BOTULISM

28. Look at CHART B on the following page to answer questions 28-30. The foodborne illness that lasts the shortest amount of time and is the least serious is \_\_\_\_\_.

\*\*\*\*\*

PERFRINGENS FOODBORNE ILLNESS

29. The most serious disease is \_\_\_\_\_.

\*\*\*\*\*

BOTULISM

30. A disease that in severe infections may cause high fever and even death is \_\_\_\_\_.

\*\*\*\*\*

SALMONELLOSIS

CHART 'B'

TYPE OF FOODBORNE ILLNESS	SYMPTOMS	USUAL TIME FOR SYMPTOMS TO APPEAR	HOW LONG DISEASE MAY LAST
SALMONELLOSIS	SEVERE HEADACHES, VOMITING, DIARRHEA, ABDOMINAL CRAMPS, & FEVER. SEVERE INFECTIONS MAY CAUSE DEATH.	12 to 36 HOURS	2 to 7 DAYS
PERFRINGENS FOODBORNE ILLNESS	NAUSEA WITHOUT VOMITING, DIARRHEA, SERIOUS INFLAMMATION OF STOMACH & INTESTINES. MILD.	8 to 20 HOURS	24 HOURS
STAPHYLOCOCCUS FOOD POISONING	VOMITING, DIARRHEA, ABDOMINAL CRAMPS. MILD.	3 to 8 HOURS	1 to 2 DAYS
BOTULISM	DOUBLE VISION, INABILITY TO SWALLOW, SPEECH DIFFICULTY, PROGRESSIVE RESPIRATORY PARALYSIS. DEATH RATE HIGH.	12 to 36 HOURS or LONGER	3 to 6 DAYS

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31. Foodborne illness doesn't always occur when contaminated food is eaten. It really depends on the health of the person eating the food, the amount of harmful bacteria or poison in the food, and the amount of food a person eats. Infants, elderly persons, and sick persons are more likely to get foodborne illness. Only a few cases end with death and these usually involve the persons mentioned above. Botulism is an exception because the majority of cases are fatal.

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TURN THE PAGE AND BEGIN THE FINAL UNIT OF THIS BOOKLET.

### UNIT 3 PREVENTION OF FOODBORNE ILLNESS

1. In UNIT 1 and UNIT 2, you learned about microorganisms and in particular, about bacteria. We discussed four types of bacterial foodborne illness. In this final unit, you will learn how to prevent foodborne illness.

2. All harmful bacteria need food, warmth, moisture, and time to grow in food or to produce their poison. There are specific foods that harmful bacteria seem to prefer that we call "potentially hazardous" foods. "Potentially hazardous" foods are foods most often involved with outbreaks of \_\_\_\_\_.

\*\*\*\*\*

#### FOODBORNE ILLNESS

3. "Potentially hazardous" foods include items that are high in protein. Meat, poultry, fish, milk, eggs, and products made with these items are \_\_\_\_\_ foods.

\*\*\*\*\*

#### POTENTIALLY HAZARDOUS

4. Harmful bacteria do not grow very well in sour foods. Sour foods are often called acid foods. Bacteria grow best in foods that are low-\_\_\_\_\_ foods.

\*\*\*\*\*

#### ACID

5. Fruits, tomatoes, pickled vegetables, vinegar, and lemon juice are examples of acid foods. Meats and most vegetables are examples of low-\_\_\_\_\_ foods.

\*\*\*\*\*

#### ACID

6. Bacteria also grow best in moist foods. High protein foods, low-acid foods, and moist foods are \_\_\_\_\_ foods.

\*\*\*\*\*

#### POTENTIALLY HAZARDOUS

7. The point is to try to keep as many harmful bacteria as possible out of food especially "potentially hazardous" foods. The best way is to practice personal hygiene. Personal hygiene will help control outbreaks of \_\_\_\_\_.

\*\*\*\*\*

FOODBORNE ILLNESS

8. Personal hygiene is extremely important in controlling outbreaks of staph food poisoning. Many \_\_\_\_\_ bacteria are on hands, skin, and hair.

\*\*\*\*\*

STAPH

9. When preparing food, you should always wash your hands well with soap and hot water. Hair should be pinned back to prevent it from falling into the food. It is important to wash your hands after smoking, blowing your nose, coughing, or sneezing because the nose and throat contain many \_\_\_\_\_ bacteria.

\*\*\*\*\*

STAPH

10. Also, avoid using the same spoon for tasting more than once. A utensil should be used whenever possible instead of your hands. Do not handle foods if you have cuts or sores because staph bacteria might be transferred to the food. If conditions are right, staph bacteria will grow and produce \_\_\_\_\_ as they grow.

\*\*\*\*\*

POISON

11. Personal hygiene is also important in the control of salmonellae bacteria. When you handle raw poultry, raw meat, or raw fish, your hands may be contaminated with \_\_\_\_\_.

\*\*\*\*\*

SALMONELLAE

12. You must wash your hands well after handling raw foods because you can also transfer salmonellae to other foods. It is a good practice to wash your hands after each visit to the toilet before handling cooked or raw \_\_\_\_\_.

\*\*\*\*\*

FOODS

13. Clostridium perfringens and Clostridium botulinum spores are very widespread. They can be controlled somewhat through proper personal \_\_\_\_\_.

\*\*\*\*\*

HYGIENE

14. Even if we take precautions, harmful bacteria might still get into moist food. Besides food and moisture, bacteria need time and warm temperatures to reproduce into large numbers or to produce large quantities of poison. The best way to control the growth of bacteria and the production of poison by some bacteria is to control \_\_\_\_\_ and \_\_\_\_\_.

\*\*\*\*\*

TIME, TEMPERATURE

15. Look at the thermometer on the next page in CHART C. Bacteria can grow in food between 40°F and 140°F. However, bacteria grow best between 60°F and 125°F, which is called the \_\_\_\_\_ zone.

\*\*\*\*\*

DANGER

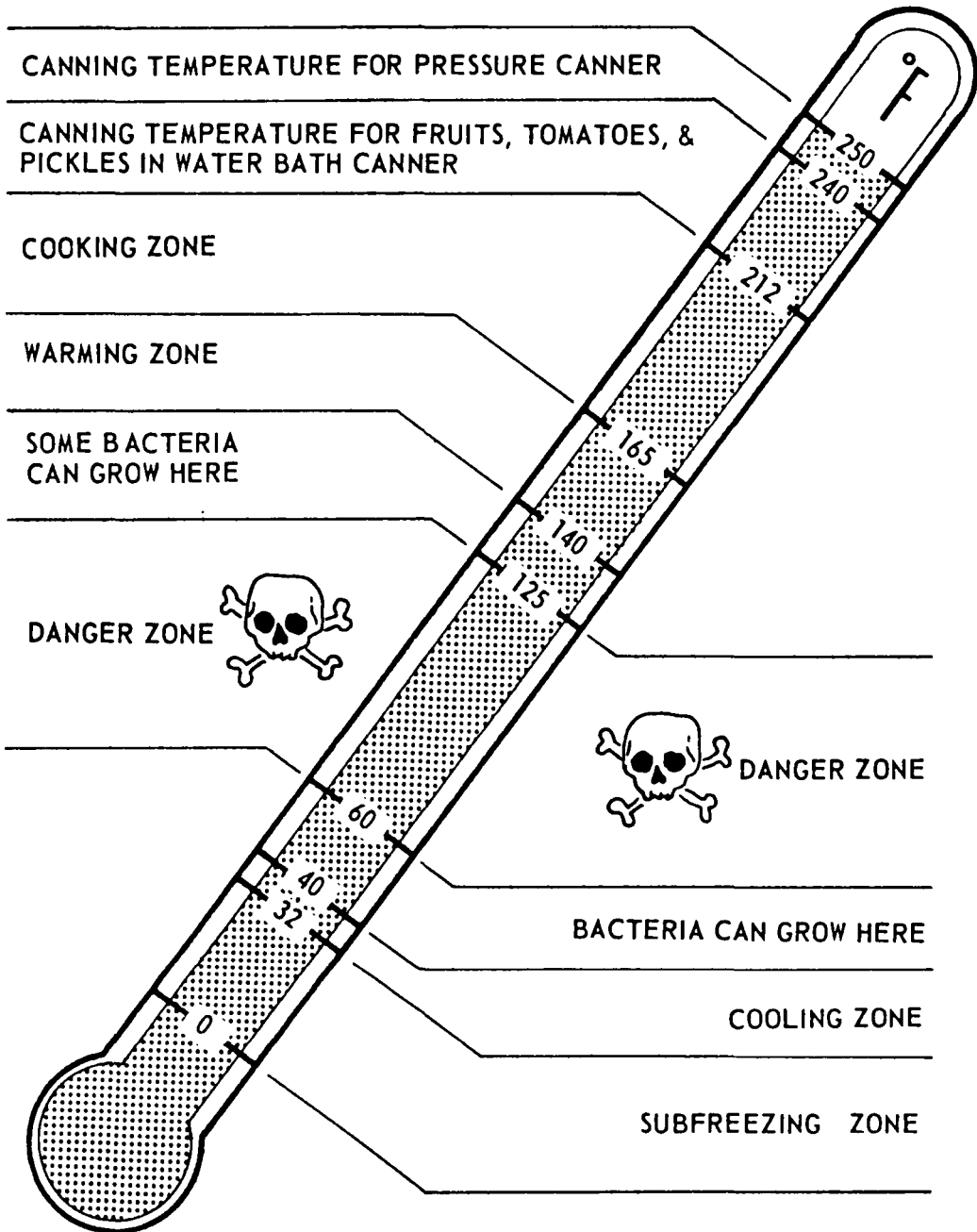
16. Cold foods should be kept cold because this slows down or stops bacterial growth and the production of poison. Cold foods should be kept at approximately \_\_\_\_\_°F.

\*\*\*\*\*



CHART 'C'

# THERMOMETER FOR CONTROL OF BACTERIA



17. Hot foods not to be eaten right away should not be allowed to cool to room temperature before refrigerating. These foods will not turn "sour" if they are refrigerated right away. Hot leftover food should be \_\_\_\_\_ as quickly as possible.

\*\*\*\*\*

REFRIGERATED

18. Hot foods should be cooled in small batches. The more surface exposed to the cold air of the refrigerator, the faster the food will \_\_\_\_\_.

\*\*\*\*\*

COOL

19. Cream puffs, cream pies, custards, and meringues should not be left at room temperature because they might be contaminated with salmonellae or staph bacteria. These foods should be refrigerated immediately because staph and salmonellae grow well at \_\_\_\_\_ temperatures.

\*\*\*\*\*

WARM

20. Foods that are not going to be eaten in 1-3 days should be frozen. You can safely refreeze foods that have thawed if they still contain ice crystals or if they have been in the refrigerator no longer than 1 or 2 days. Freezing slows down or stops the growth of all harmful \_\_\_\_\_.

\*\*\*\*\*

BACTERIA

21. Look at CHART C. Bacteria do not grow well at temperatures over 140°F. Hot cooked foods should be kept at \_\_\_\_\_ °F or higher.

\*\*\*\*\*

22. All bacteria are destroyed at 165°F. Salmonellae are bacteria that can be destroyed at \_\_\_\_\_°F.

\*\*\*\*\*

165

23. Clostridium perfringens spores are not easily destroyed and can remain in hot cooked food. As the hot food cools down below 140°F, the spores can develop to bacteria. The bacteria may start to reproduce into large numbers. Hot food should be kept at \_\_\_\_\_°F or above to prevent the growth of Clostridium perfringens bacteria.

\*\*\*\*\*

140

24. Although staph bacteria are killed during cooking, people might contaminate food with staph bacteria after the food has been cooked. To insure staph bacteria will not grow and produce poison, keep hot foods at \_\_\_\_\_°F or above.

\*\*\*\*\*

140

25. Look at CHART C. When home-canning food, you must use high temperatures to destroy Clostridium botulinum spores. These spores can be destroyed at temperatures between 212-250°F. The temperature used depends on whether the food is acid or low-acid. All bacteria prefer \_\_\_\_\_ - \_\_\_\_\_ foods.

\*\*\*\*\*

LOW ACID

26. Fruits, tomatoes, and pickles are acid foods. These foods can be safely processed for canning in a boiling water bath at 212°F. Clostridium botulinum bacteria do not grow well in \_\_\_\_\_.

\*\*\*\*\*

ACID FOODS

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27. Home-canned vegetables, meat, and poultry are low-acid foods. These should be processed only in a pressure canner at temperatures between 240-250°F. High temperatures are necessary to kill the \_\_\_\_\_.

\*\*\*\*\*

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SPORES

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28. If Clostridium botulinum spores are not killed, the spores will develop to bacteria during storage and start to produce their deadly poison. However, this poison can be destroyed by \_\_\_\_\_.

\*\*\*\*\*

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HEAT

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29. To be safe, all home-canned vegetables, meat, and poultry should be boiled for 10-20 minutes to destroy any \_\_\_\_\_ that may have been produced.

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POISON

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30. Do not use or taste any canned food that shows any sign of spoilage such as bulging can ends, leakage, off-odor, spurting liquid or mold. However, home-canned food may not have any of these signs. So, it is best to do as suggested above and boil home-canned vegetables, meat, and poultry for \_\_\_\_\_ to \_\_\_\_\_ minutes.

\*\*\*\*\*

---

10, 20

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31. You have learned how to control bacterial growth by controlling temperature. Time must also be controlled. Bacteria reproduce every 20 minutes under the right conditions. All bacteria need time to \_\_\_\_\_.

\*\*\*\*\*

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REPRODUCE

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32. Look at CHART C again. Food should not be left in the DANGER ZONE for more than 2-3 hours. This time includes the time during preparation, service, and storage. Bacteria grow best between \_\_\_\_\_°F and \_\_\_\_\_°F.

\*\*\*\*\*

60-125

33. Food should be thawed in the refrigerator. If necessary, frozen food can be thawed in a watertight wrapper under cold water. Do not thaw at room temperature because the outside of the food may be in the DANGER ZONE while the center is still frozen. Some \_\_\_\_\_ may start to produce poison which will not be destroyed by cooking.

\*\*\*\*\*

BACTERIA

34. Proper personal hygiene, control of temperature, and control of time are necessary to control the growth of bacteria and the production of poison by some bacteria. Special precautions are necessary in the preparation of some foods to prevent outbreaks of \_\_\_\_\_.

\*\*\*\*\*

FOODBORNE ILLNESS

35. Use only clean eggs with sound shells in any recipe in which eggs are not thoroughly cooked, such as soft-cooked eggs, scrambled eggs, poached eggs, ice cream, creme fillings, and meringues. Cracked or soiled eggs may contain salmonellae and should be used only in foods that are thoroughly cooked. Temperatures of 165°F will kill \_\_\_\_\_.

\*\*\*\*\*

SALMONELLAE

36. Large turkeys should not be stuffed. If the cavity of the turkey contains salmonellae, the dressing can also become contaminated. Although salmonellae are destroyed by cooking, the thick meat of the large turkey will insulate the dressing and prevent it from reaching \_\_\_\_\_°F, the temperature necessary to destroy salmonellae.

\*\*\*\*\*

37. Smaller turkeys can be stuffed. The center of the thigh and the dressing should reach 165°F. Use a \_\_\_\_\_ to check both.

\*\*\*\*\*

THERMOMETER

38. Turkey is sometimes stuffed before freezing or stuffed with warm dressing the day before it is to be cooked. If both are contaminated with salmonellae, the salmonellae will have plenty of \_\_\_\_\_ to reproduce into large numbers.

\*\*\*\*\*

TIME

39. The same turkey and dressing could also be contaminated with staph bacteria through handling. There would be plenty of time for staph to produce large quantities of \_\_\_\_\_.

\*\*\*\*\*

POISON

40. Always stuff turkey and other foods just before cooking. Also, do not stuff and freeze poultry. Poultry is considered a "potentially \_\_\_\_\_" food and should be treated with caution.

\*\*\*\*\*

HAZARDOUS

41. All home-canned vegetables, except corn, green beans, peas, and spinach, should be brought to a rolling boil, covered, and boiled for 10 minutes. Spinach, corn, green beans, and peas and all home-canned meat and poultry need to boil 20 minutes. This will assure destruction of any \_\_\_\_\_ that may have been produced by Clostridium botulinum bacteria.

\*\*\*\*\*

POISON

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42. Leftover gravy should be boiled for several minutes before serving and leftover meats should be heated thoroughly. Never partially cook any meat one day and complete cooking the next day. Thorough cooking is necessary to destroy harmful \_\_\_\_\_.

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BACTERIA

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43. Fruits and vegetables may be contaminated with polluted irrigation water, fertilizers, or insect sprays. All fruits and vegetables should be \_\_\_\_\_ carefully before use.

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WASHED

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44. Molds, other microorganisms, were mentioned in UNIT 1. Until we find out further information, avoid eating all parts of moldy food except mold-ripened cheeses where the mold has been introduced deliberately. \_\_\_\_\_ may be harmful.

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MOLDS

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45. Cooked food should never be prepared on the same surface used for preparing raw food unless the surface has been thoroughly cleaned. Avoid using the same utensils, platters, or cutting boards because of possible \_\_\_\_\_ with harmful bacteria.

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CONTAMINATION

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46. Blenders, can openers, meat grinders, and cutting boards should be washed thoroughly with soap and hot water after each use. The addition of chlorine laundry bleach in the proportion recommended on the package will assure destruction of \_\_\_\_\_.

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BACTERIA

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47. When washing dishes, use sponges or dishcloths that are washed or sterilized regularly. Dishes and pots should be rinsed in water at 170°F to kill bacteria. Make sure the water is hot enough by checking often with a \_\_\_\_\_.

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THERMOMETER

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48. Proper extermination and prompt disposal of garbage will keep flies, cockroaches, and other insects under control. Salmonellae are often spread by \_\_\_\_\_.

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INSECTS

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In UNITS 1 and 2, you learned about microorganisms, especially bacteria and about bacterial foodborne illness. In UNIT 3, we discussed ways to control bacteria and prevent foodborne illness. Hopefully, you can now use this information and keep food safe to eat.



APPENDIX C

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FOOD SAFETY FOR CONSUMERS PRESENTED BY PROGRAMMED INSTRUCTION

by

Susan Stewart Howard

(ABSTRACT)

This study investigated the effectiveness of teaching basic food safety principles by programmed instruction for consumers. A linear-type programmed text was developed and evaluated.

The difference between initial behavior and terminal behavior of subjects using the programmed text was assessed in relation to the terminal objectives of the programmed material. The terminal objectives of the programmed material were expressed in a criterion test used as a pretest and post-test.

The criterion test and programmed text were administered to 2 groups of consumers consisting of 20 subjects and 17 subjects, respectively. A positive change in scores between the pretest and post-test was significant at the 0.001 level for both groups.

The error rate of the programmed text was within the specified 10 per cent level. The maximum time required to complete the programmed text was estimated to be 1 hour.

The results obtained indicated that food safety could be taught effectively to consumers through programmed instruction.