1969

Diet, growth and related factors of school children before and after nutrition education

Mary Jeanette Fulkerson Baker
Iowa State University

 69-20,623

BAKER, Mary Jeanette Fulkerson, 1942-
DIET, GROWTH AND RELATED FACTORS OF SCHOOL CHILDREN BEFORE AND AFTER NUTRITION EDUCATION.

Iowa State University, Ph.D., 1969
Health Sciences, nutrition

University Microfilms, Inc., Ann Arbor, Michigan

DIET, GROWTH AND RELATED FACTORS OF SCHOOL CHILDREN BEFORE AND AFTER NUTRITION EDUCATION

by

Mary Jeanette Fulkerson Baker

A Dissertation Submitted to the
Graduate Faculty in Partial Fulfillment of
The Requirements for the Degree of
DOCTOR OF PHILOSOPHY

Major Subject: Nutrition

Approved:

Signature was redacted for privacy.

In Charge of Major Work

Signature was redacted for privacy.

Head of Major Department

Signature was redacted for privacy.

Dean of Graduate College

Iowa State University
Ames, Iowa

1969

TABLE OF CONTENTS

	Page
INTRODUCTION	1
REVIEW OF LITERATURE	5
Relationships among Diet, Growth and Other Selected Factors	5
Nutrition Education	13
Survey of School Children, Monroe County, Iowa	24
PROCEDURE	27
Selection of Subjects	27
Schedule	29
Collection of Data	31
Dietary recalls and records	31
Pertinent literature	31
Procedure followed in present study	32
Body measurements	34
Growth histories and dates of birth	34
Heights and weights	35
Skinfold thicknesses	36
Arm and leg girths	37
Vegetable preference ratings	38
Preliminary study	38
Procedure followed in present study	39
Physical fitness scores	40
Agility	41
Strength	42
Endurance	42
Speed	42
Handgrip dynamometer readings	43

Page

Hours of sleep 43

Parents' heights, weights, ages and education 44

Scholastic achievement scores 44

Hemoglobin concentrations 44

Illnesses and menarchial ages 45

Development of Nutrition Education Program 46

Bases for planning the program 46

Objectives and generalizations 47

Test of nutrition-related cognitive abilities 48

Learning experiences 49

Administration of the Test of Nutrition-Related Cognitive Abilities 51

Instruction of Experimental Groups 51

Analyses of Data 53

RESULTS AND DISCUSSION 55

Relationships among Diet, Growth and Other Selected Factors 55

Factors related to diet 55

Relationships among body measurements 61

Factors related to body status 66

Factors related to growth 73

Factors related to performance 85

Relationships between diet and growth of individuals 90

	Page
Influence of Nutrition Education and Grade Level on Diet, Growth and Selected Factors	95
Changes in scores on test of nutrition-related cognitive abilities	97
Changes in responses to specific test items	105
Changes in nutritive and caloric value of diet	135
Changes in vegetable preference ratings	150
Changes in body measurements	155
Changes in scores of physical fitness and handgrip strength	160
Additional comments	165
SUMMARY AND RECOMMENDATIONS	167
LITERATURE CITED	173
ACKNOWLEDGEMENTS	179
APPENDIX A	181
APPENDIX B	185
APPENDIX C	189
APPENDIX D	196
APPENDIX E	199
APPENDIX F	227

INTRODUCTION

Obesity is one of the major public health problems in the United States among both children and adults. In an effort to discover the causes of obesity and possible preventatives several studies have contrasted obese adolescent subjects with non-obese teen-agers (3, 4, 10, 14, 17, 21, 29, 45). Pickenpaugh (35) reported that parents of 16 out of 27 heavy Iowa girls had noted the onset of overweight in their daughters by age 10, suggesting the problem of overweight should be studied earlier than adolescence. The need for such a study was confirmed by the 1964-1965 survey of children, kindergarten through eighth grade, in Monroe County Iowa (22) in which the subjects were generally heavier, but not taller than Iowa children of corresponding ages measured in the early 1940's (20). The trend toward increased weight-for-age was even greater than that observed in a state-wide sample of Iowa children in the early 1950's (41). Inspection of longitudinal records of heavy seventh- and eight-graders in Monroe County (23) showed that more of these children had moved into the heavy weight-for-age category between the ages of eight to eleven than within any other age range.

Heaviness for age or height can only suggest overfatness. Measures of body composition are needed to determine what tissue compartments contribute the excessive weight. In addition, parents' body measurements and observations of health habits of school-age children during the period of rapid body change are needed to understand the observed trend in weight gain.

The Monroe County survey (22) indicated three areas in which the dietary practices of many of the children could be improved.

1. Many children omitted or ate skimpy breakfasts.
2. Most children consumed snacks which were high in caloric value, but low in protein, vitamins and minerals.
3. Often subjects rejected vegetables offered at school and at home.

Casual comments of subjects indicated many of them exercised freedom in selection of breakfasts and snacks. For these children to assume responsibility for their own health, including nutrition, they needed to understand basic concepts of growth and to have the ability and desire to apply basic principles of health to their own life patterns.

Rosenstock stated that some of the failure of people to behave according to recommendation is due to lack of good information rather than lack of motivation (38). When questioned, many children in Monroe County reported that television advertisements were their source of nutrition-related information while others could give no source of information. Thus, the need for a nutrition education program was indicated.

To implement and test a program of nutrition education and simultaneously study growth of the intermediate-grade child a study was designed with the following objectives:

1. to determine the relationships among diet, growth and selected factors of fourth- and fifth-grade pupils of Monroe County, Iowa.

2. to determine the influence of a specially prepared program of nutrition education and grade level on diet, growth and related factors of these pupils.

The present study was conducted in Monroe County, Iowa because the author had already established rapport there and administrators of the school system had indicated interest in a nutrition education project. This county, located in the eastern part of south-central Iowa, is in the center the Ten County Rural Area Development program sponsored by the United States Department of Agriculture. Formerly the site of a large coal-mining industry, the county is in the midst of an economic transition to tourist and agricultural businesses.

All pupils who, during the 1966-67 school year, were in the third and fourth grades of the public schools were invited to serve as subjects. Approximately 200 of the 279 children participated. Data were collected from spring, 1967 through spring, 1968. Diets were interpreted in terms of energy and nutritive values. Growth was measured by changes in height, weight, skinfold thicknesses, arm and leg girth and upper arm muscle-bone diameter. Factors studied in addition to diet and growth were knowledge of nutrition, vegetable preference, scholastic achievement, hours of sleep, hemoglobin concentration of blood, physical fitness, handgrip strength, illnesses, menarche and parents' heights, weights and education. Socio-economic level was not included as a factor because the earlier survey (22) had indicated that this factor tended to be homogeneous.

Data were collected both before and after the nutrition education program was carried out in the fall, 1967 and the following winter. Analysis of variance was used to determine influence of nutrition education on variables subject to change. Correlations were used to determine relationships among the various factors.

REVIEW OF LITERATURE

The Review of Literature is divided into three parts. The first section includes findings of the relationships among diet, body status or growth, and the following factors among children: age, sex, knowledge of nutrition, intelligence, food preference, physical fitness, sleep, physiological maturity, heights and weights of parents and education of parents. The second portion of the review concerns studies of the influence of nutrition education on knowledge of nutrition, diet and growth. Because the present study is a direct outgrowth of survey findings of Miriam Kaled, a review of her thesis comprises the third part.

Relationships among Diet, Growth and Other Selected Factors

Hinton (16) identified factors related to eating behavior and dietary adequacy of girls 12-14 years of age. Seven-day food intake records were scored using a point system for servings from 14 food groups. Among 140 girls she found that dietary adequacy scores were significantly correlated ($p \leq 0.01$) with ratings of food enjoyment ($r = 0.21$) and with scores of a nutrition knowledge test ($r = 0.32$). There was no significant relationship between an index of physical activity estimated from seven-day activity records and quality of diet, although girls who were more active appeared to consume more milk and milk equivalents and more ascorbic acid-rich foods than less active girls. The author indicated that the records may not have been precise enough to make accurate estimates of activity.[1]

When girls were grouped according to seven categories of weight for age, heaviness for age was negatively correlated with dietary adequacy scores (r = -0.22). This may be explained by the fact that weight for age was related to concern about overweight (r = 0.51) and to missing meals (r = 0.14). According to bone age:chronological age ratios and menarchial status the girls who were heavy for their ages tended to mature earlier than the other girls. Heavy girls also tended to be less active than girls of medium or light weight; however, the relationship was not significant.

Influence of grade and sex on food acceptance by 320 Iowa children, grades three through ten, were investigated by Irving (18). Using a ratio of foods accepted to foods tasted she found that boys accepted green and yellow vegetables, ascorbic acid-rich foods, eggs, and milk and milk products more than did girls. Younger girls accepted green and yellow vegetables more than older girls.

Eppright _et al_. (13) compared food intakes and body measurements of children consuming liberal amounts of nutrients with children consuming limited amounts of nutrients. Of a

---

[1]Hinton, Maxine Armstrong. Food and Nutrition Department, Iowa State University, Ames, Iowa. Conference regarding measurements of activity. Personal communication. 1968.

random sample of Iowa children, 6-18 years of age, 141 of the 586 boys and 84 of the 602 girls consumed diets in which intakes of all nutrients exceeded 100 percent of the 1953 Recommended Dietary Allowances. On the other hand, 172 boys and 247 girls had diets in which the intake of one or more nutrients was below two-thirds recommended amounts. Mean body measurements at each age of Group I (those consuming the liberal diets) were compared with those of Group III (those consuming the limited diets). Similar differences between the two groups were seen among both boys and girls at most ages. Average weights among Group I exceeded those of Groups III by almost 2 kg. Mean heights of Group I were approximately 2 cm greater than those of Group III. Average leg girths of Group I exceeded those of Group III by about 1 cm.

A study of food intake and activity reported by Huenemann *et al.* (17) included approximately 120 teen-agers 16-17 years old. A subsample of a larger study, these subjects were chosen to represent lean, average, and obese adolescents. Seven-day activity and food records indicated that boys spent significantly more time ($p \leq 0.05$) in moderate and strenuous activities than did girls. Boys of average build spent more time in strenuous activities than did somewhat lean or obese boys. Boys with diets of highest caloric value (2,500-4,000 kcal per day) were more active and taller than the other boys in the study. Between the ninth and twelfth grades they gained more lean and total body weight than did other boys.

Girls consuming diets of highest energy value (2,500-3,000 kcal per day) had lower activity scores than did other girls. Lowest caloric intakes among girls were associated with largest increases in lean and total body weights and highest activity scores. The 10 girls consuming diets of lowest caloric value (1,000-1,500 kcal) were the shortest throughout the study. Therefore, they may have had the lowest basal energy requirements. Otherwise, these finding appear to be contrary to accepted concepts of energy balance.

Because obesity is one of the major health problems in the United States, much recent work with children has concentrated on the relationship of obesity to various factors, including diet, activity, maturation and parents' body sizes. Garn and Haskell (14) measured fat and skin shadows on chest X-ray plates of 259 children 1.5-17.5 years old in the Fels Longitudinal Program. Children from 1.5 to 12.5 years of age, who were one standard deviation above average in width of subcutaneous fat, were about 0.35 standard deviation above the average in height or advanced in height by approximately one-half year.

Of the approximately 1,200 boys and girls, 6-18 years of age, in the state-wide Iowa sample Eppright et al. (10) classified as very heavy or obese the subjects who were in channel A_3 or above on the Wetzel Grid. Approximately 11% of the boys and 17% of the girls were thus classified. Under 12 years of age, 12% of the girls were very heavy or obese; overweight increased with age among the girls after age 12.

Dietary practices of heavy and obese subjects were compared with those of children in the M channel of the Wetzel Grid. Average daily caloric values of the diets were as follows:

		No.	kcal
boys, under 12,	heavy	31	2417
	medium	84	2347
boys, 12 or older,	heavy	34	3047
	medium	65	3157
girls, under 12,	heavy	39	2082
	medium	60	2176
girls, 12 or older,	heavy	62	2373
	medium	44	2604

Except for boys under 12 years old, caloric values of the diets were less for heavy children than for children of medium physiques. However, only among girls over 12 years of age was the difference significant ($p \leq 0.05$).

Within a group of 65 boys Stefanik et al. (45) classified as obese those subjects who had combined scapular, triceps and abdominal skinfold thicknesses which were 40 mm or more. Dietary histories were obtained. For the obese group mean consumption of food provided 454 kcal less during the school year and 1,227 kcal less at camp than for the non-obese group.

When boys were asked to recall their activities for 24 hours little difference was revealed between the obese and non-obese subjects in type of activity pursued or in time spent in each type during the school year or at camp. When recording observed activity of the boys camp counselors rated the obese subjects somewhat more sedentary or less active than the non-obese boys. The authors concluded that the obese boys may have been overestimating their activity on the recall questionnaires.

Johnson et al. (21) observed 28 obese girls matched by age, height and school grade with 28 non-obese girls. Caloric intake of the obese group was significantly lower than that of the girls of normal size. Interviews concerning amount of time spent in various daily and weekly activities showed that obese girls were sedentary 90 percent of the time while non-obese girls were sedentary 85 percent of the time.

Growth of girls to 8-13 years of age was studied by Pickenpaugh (35). Twenty-seven girls in the A_4 and A_3 channels of the Wetzel Grid were paired by heights and chronological ages with 27 girls in the A_2, A_1, M and B_1 channels. All of these girls had remained in their respective channels for at least one year. The subjects were among 183 girls concurrently participating in an investigation of dairy, fruit and vegetable supplements provided at school.

Mean increases in weight over a three year period were relatively the same for both heavy and medium girls. Total gains of girls who were under 11 years of age at the beginning of the study were slightly greater for the stocky girls than were those of the girls of medium build. There was a trend for more parents of stocky girls to be overweight than parents of medium girls; however, the difference was not significant.

Three 24-hour activity records for each subject showed no differences between heavy and medium-weight girls, either in number of hours spent in four categories of activity or in a calculated "activity index". However the records may not have been detailed enough to detect small differences in activity. Results of the Kraus-Weber test for muscular fitness favored the stocky girls. The difference between the two groups was small and occurred primarily in the exercise requiring the subjects to bend down and touch the floor with their fingertips while keeping their legs straight. Serum alkaline phosphatase levels were higher for the girls of medium weight than for the heavy girls, indicating the girls of medium weight were undergoing more rapid bone growth than their pair-mates. Therefore, medium girls may have been more awkward in the muscular fitness test than were heavy girls.

Bullen et al. (3) compared 115 subjects at a camp for obese girls with 27 non-obese control subjects. A positive relationship between obesity in parents and obesity in girls was noted. Obese girls thought they did not have sufficient information about the foods best for them. In response to direct questions regarding activity obese girls listed as many strenuous activities as did non-obese and reported the same amount of time spent in them.

In a later publication Bullen et al. (4) reported photographing actual behavior of 109 obese girls and 72 control subjects 13-17 years of age. Motion pictures of the girls swimming and playing volleyball and tennis were analyzed by industrial time and motion techniques. According to films of swimming only an average of nine percent of the obese girls were actually swimming at one time compared with 55 percent of the control subjects. During tennis and volleyball games obese girls were more often observed standing still or sitting down to rest than were girls of the control group ($p \leq 0.01$).

An intensive study of 10 heavy girls 10-16 years of age paired with 10 girls of medium weight was made by Munsen (29). In all pairs, girls of medium weight reported higher caloric intakes than did the heavy girls. Dietary scores were assigned according to the percentage of the Recommended Dietary Allowances consumed of each nutrient estimated. In eight of the ten pairs the heavy girls had dietary scores which were inferior to those of their pairmates. When percentage of the total daily caloric intake obtained after four o'clock in the afternoon was calculated, heavy girls were found to obtain a larger proportion of their caloric intake late in the day than did their pairmates (64% versus 56%). In seven pairs the medium girls had higher activity scores based on activity records of one Saturday. Body motions were rated according to a predetermined scale for 15 minutes during study hall. Higher restlessness scores were observed for the medium-weight girls than for their heavy partners.

Nutrition Education

Many programs of nutrition education have been reported. Only a sample of those which included children and for which measurements were made both before and after teaching are reviewed here.

In 1927 Eichelberger (9) reported a study in which weight gain was a goal of nutrition education. Underweight of children in nine Moberly, Missouri schools was compared before and after nutrition was taught. Classifications of weight for the 1,773 children were based on the Baldwin-Wood tables but the distributions of age and sex were not presented.

In some schools a nutritionist taught in each classroom one-half hour per week for six months of one year. In others apparently a nutritionist taught once a week for three to six months each of three years. The number of schools participating in each type of program was not made clear in the report. Classroom teachers integrated nutrition education with other studies. Mothers of underweight children were visited at home by a nutritionist.

The author stated that although the statistics she presented may not have been completely accurate, they were believed to be fairly representative of the actual situation. No basis for her statement was given. The proportion of children 15% or more underweight dropped from 8% before nutrition education to 3% afterwards. The percentage of children 10% to 15% underweight dropped from 14 to 6.

In three schools representing three different family income levels weight gains tended to reflect income level. Neither criteria nor actual figures for income levels were given. In the school rated "excellent" (N = 280) the proportion of children 7% or more underweight dropped from 28% to 9%. In contrast the percentages of children rated 7% or more underweight dropped from 26 to 14 in the "fairly good" school (N = 250) and from 24 to 15 in the "poor" school (N = 300). Since the ages of the children and times of measurement were not given interpretation of these findings is tenuous.

A school having one year of nutrition education (N = 121) was compared with a school having three years (N = 237). In the first school the proportion of children 7% or more underweight dropped from 50% to 26%. In the school having three years of nutrition education the proportion of underweight children dropped from 34% to 9%. The author concluded that the three year program was superior in reducing underweight. However, decreases in the percentage of children who were underweight (24 and 25) were similar for the two schools.

Twenty-four children divided into two groups and paired according to I.Q., sex and age were studied by Neel (32). Six children 7-9 years old in the experimental group received nutrition instruction for 12 weeks while their pairmates learned to bake cookies. While six experimental subjects 10-11 years old studied nutrition, their pairmates received no special instruction. Food records showed increased intakes of whole wheat bread and certain vegetables for all children. The author concluded that exchange of information probably occurred between experimental and control subjects.

Nutrition education and school lunch programs were initiated in the rural elementary schools of Dakota County, Minnesota (1). Each teacher with the help of a home economist was responsible for planning and executing a nutrition program in her school. A preliminary survey yielded seven-day dietary records for 555 children. The Hatcher checklist of foods was used to evaluate the diets. Points were given for servings of "desirable" foods and subtracted for servings of "undesirable" foods and beverages such as coffee. Ratings of "good", "fair" and "poor" were then assigned to the diets.

One year after the program began dietary records were again obtained from children of six schools (N = 159). Thirty percent of the children, who were surveyed initially had "good" diets; while 53% of the children who were rechecked had good diets. The percentage of children having "poor" diets decreased from 32 to 12. The author concluded significant progress had been made. However, the conclusion rests on the assumption that the 159 children who were rechecked were representative of the original 555 subjects. No statement or evidence supporting such an assumption was presented.

At the request of the school superintendent a nutrition education program was initiated in Ascension Parish, Louisiana in 1944. Whitehead (54) reported that she consulted with elementary and secondary school teachers regarding the teaching of nutrition. The teachers did the actual selecting and teaching of nutrition-related subject matter. A school lunch supervisor was appointed and lunch menus were improved. Occasionally teachers and pupils helped plan the lunches. The project continued after the investigator left the area in 1948. During the school year 1950-51 a re-appraisal of diets and teaching was made.

Data collected annually over the seven-year period indicated significant ($p \leq 0.01$) improvement in dietary intakes. Seven-day dietary records were scored by teachers using a point system for protective foods. Ratings of "good", "fair" or "poor" were then assigned to the diets. Between 1944-45 and 1950-51 the proportion of children, grades 2-11 in the white public schools, reporting "good" diets increased from 1.6% to 31.0%. The percentage of children reporting "poor" diets decreased from 38.9 to 4.7. Much of the improvement appeared to be due to better school lunches.

Consumption of foods classified into 10 groups was compared with standards based on the Recommended Dietary Allowances. Consumption of milk increased from 40 to 60, eggs from

50 to 90 and citrus fruits from 35 to 69% standard.

During the study the number of subjects increased from 1,529 to 2,158. The report implied but did not state specifically that the population studied in 1950 was representative of that investigated in 1944. Food rationing and the war-time economy were not discussed in the report. However, economic conditions may have improved in the post-war years influencing changes in diet.

Diets of the Ascension Parish children were generally superior to those of children in St. Martin Parish in 1947-48 and 1950-51. However, data were not available to compare dietary practices of the two parishes in 1944.

A study involving sixth- and seventh-grade pupils receiving nutrition education for two years and one year respectively, was reported by Whitehead (53). At each grade level there were three experimental classes which received nutrition instruction and three classes which were pooled to form one composite control group. Criteria for evaluating seven-day food records were the numbers of servings from 10 food groups which together would provide the Recommended Dietary Allowances. For each food group the total number of servings consumed by the class as a whole was divided by the total number of recommended servings for the class and multiplied by 100 to obtain a percentage. Only records of pupils who submitted data for all sampling periods were used.

Percentage intake of each food group was reported separately for each of the experimental classes. The present writer averaged the percentages of the three experimental classes at each grade level. These averages were biased by the number of pupils in each class (not reported), if the groups were of unequal size. Nevertheless, the statistics needed to be condensed for concise reviewing.

Initially the seventh-grade experimental classes had higher intakes of foods from seven groups than did the control classes. After one year of nutrition education intakes of the experimental groups increased for all food groups except non-citrus fruit. Greatest differences in changes between experimental and control classes were as follows:

	Experimental			Control		
Food group	before	after	change	before	after	change
Eggs	76[#]	93	17	80	65	-15
Citrus fruit	89	103	14	89	71	-18
Butter or fortified margarine	45	83	38	36	37	1

One year after the completion of nutrition education the intakes of the various food groups among the experimental classes had decreased. Differences between the research and control classes were then similar to initial differences.

[#]Amounts consumed are expressed as percentage of amounts recommended. Numbers in first two columns are averages of means for three classes.

Among sixth-graders greater increases were seen among the experimental classes than among the control classes for intakes of foods of all groups except non-citrus fruit. At the end of two years experimental subjects exceeded control subjects particularly in the intakes of citrus fruit (121 versus 79)[#], whole grain cereals (135 versus 93)[#] and butter or fortified margarine (128 versus 50)[#]. The greater intakes of whole grain cereals and butter or margarine of the experimental classes versus the control classes may not have indicated superior quality of diet, especially if overweight was a problem. When compared with their control classes, the two-year experimental classes increased intakes from the ten food groups more than did classes receiving nutrition education for only one year.

In Puerto Rico, Roberts (37) coordinated the research and community action program of the Doña Elena Project. The physical status and home conditions of rural families of two barrios were surveyed. A program including three school meals per day and nutrition education of children was initiated in the barrio of Doña Elena. Instruction in nutrition and agriculture was offered to the adults of the community. Along with the nutrition program efforts to provide stoves, latrines,

---

[#]Amount consumed expressed as percentage of amount recommended. First number is average of three percentages reported.

water containers, roads and electricity were made.

At the beginning of the project twenty-nine Doña Elena children were matched by sex, height and weight with 29 children of a neighboring barrio. During the first year of the program growth of the Doña Elena children exceeded that of their pairmates by an average of 0.6 inches in height and 2.0 pounds in weight per child. Much of the improvement in growth appeared to be due to the school feedings because growth tended to decline when school was not in session or when attendance was low.

Taylor (48, pp. 448-454) directed an eight-year nutrition education program in a New York City elementary school located in a low-income area. Approximately 75% of the school's teachers participated in the program. Parents were often invited to share in demonstration meetings. In evaluating six years of Taylor's Program, Sostman (48, pp. 448-454) found that 36% of the children in the classrooms in which nutrition was a regular part of the program had fully adequate breakfasts compared with 11% of the children in the other classrooms. Number of children preparing their own breakfasts increased by 17% after they had prepared breakfasts in the classroom. School lunch participation increased from 25% to 42% of the pupils. Because Sostman's original report of the Taylor project was not available details of the study and of environmental conditions were not reviewed. Thus, the conclusion that nutrition education effected the changes in diet must be taken with reserve.

Grant (15) reported that self-selected lunches of 50 fifth-grade children of a private laboratory school were photographed before, during and after a nine-week nutrition unit. The photographic equipment was changed several times during the experiment to lead the children to believe the pictures were being taken merely to develop a technique of food recording.

During the teaching of the unit the percentage of lunches including a vegetable other than potatoes increased from 15 to 39 while the percentage including a fruit increased from 30 to 35. How often the lunches were photographed was not made clear; therefore, the probable representativeness of these statistics remains in question.

Photographs of two days' lunches obtained five weeks after the completion of the unit revealed a continued increase in selection of fruits and vegetables. Of the 39 children observed the first day 49% chose vegetables and 37% chose fruits. The second day the children were given menus before lunch and asked to think about what the nutrition teacher had said as they planned their lunches. Of the 45 children participating that day 87% and 51% chose vegetables and fruits, respectively.

Sixteen children were 20% or more overweight according to the Baldwin-Wood tables. Eight children were between 10 and 19% overweight. The lunches of half of these two groups of overweight children were reported. Among these twelve children all but one decreased the caloric value of their lunches during the period in which they received nutrition education. The average decrease was 63 kcal per lunch.

A nutrition unit for use with fourth-graders was developed by Stanley (44). The nine-week unit was taught on alternate days by two regular teachers in two Davenport, Iowa schools. From a list of suggestions each teacher selected the experiences to include in her own program. Pupils of a third school served as control subjects. Two fourth-grade classes from each of the three schools were included in the study.

Three-day dietary records were kept by the children within one week prior to and one week following the classes of the nutrition unit. Dietary scores were obtained by assigning points for various types of protective foods consumed. The optimum dietary score was 100. Objective tests of nutrition knowledge were administered before and after the unit was taught.

Significant gains ($p \leq 0.05$) were made in dietary scores of boys in experimental School B whose average score increased from 66.1 to 77.4. Changes in dietary scores of the girls of that school were insignificant. However, average test scores for both boys and girls of School B increased significantly ($p \leq 0.01$). Changes in dietary scores and test scores of pupils in experimental School A and the control school were negligible.

Initial average dietary score of the boys of School B ($\overline{X}$ = 66.1) was lower than that of boys in School A ($\overline{X}$ = 76.9) and the control school ($\overline{X}$ = 74.2); thus the boys of School B had more room for improvement than did the other boys. Among additional explanations for the differences between changes of pupils in School A versus School B was the widespread illness among the children of School A when the second three-day dietary records were kept. Furthermore, the teacher at School B appeared to be more interested in the project than did the teacher at School A.

Kunkel and Hall (26) evaluated three-day dietary records before and after one semester of classes in foods for high school boys and girls. Diets were rated using the Tinsley method modified for the 1953 Recommended Dietary Allowances. (For a brief description of the method and the original citation see reference 26). Forty-four percent of the 86 adolescents enrolled in the five foods classes improved their dietary ratings compared with 11% of 38 pupils in a control group. In two classes pupils rated their own food records as part of their class work. Improvement of dietary rating was slightly greater among the pupils who evaluated their diets (49%) than among pupils who did not (42%) suggesting self-evaluation was beneficial in changing food habits.

A combined nutrition education and physical fitness program for 13-14 year old boys was reported by Christakis *et al.*

(6). All of the boys were at least 15% overweight for height, age and sex according to the Baldwin-Wood tables. Subjects were from ten freshman classes stratified according to scholastic ability of the pupils. The experimental group included 49 boys from 6 randomly selected classes. The control group consisted of 33 boys from the other three classes. Strata of the experimental group matched those of the control group. Boys in the experimental groups voluntarily attended after-school nutrition classes twice a week. During their regular physical education classes they were taught special exercises they could perform at home. A basketball team was organized for them.

During the eighteen months of the project there was an 11% decrease in overweight among the experimental group compared with 2% decrease among the control subjects. Greater, though not significant, decreases in skinfold thicknesses were seen among the experimental group.

Survey of School Children, Monroe County, Iowa

In a survey of 245 children, kindergarten through eighth grade, in Monroe County, Iowa, Kaled (22) obtained a 24-hour dietary recall and a 48-hour food intake record for each subject. The intakes of vitamin A, ascorbic acid, calcium and iron tended to be low. Among children 9-11 years old 47% of the boys and 56% of the girls had vitamin A intakes which were less than two-thirds of the National Research Council's 1964

Recommended Dietary Allowances for them. Calculated ascorbic acid intakes for this group were below two-thirds of the RDA for 67% and 79% of boys and girls, respectively. Iron intake below two-thirds of the RDA was noted for 63% of the girls and 27% of the boys. Protein and riboflavin intakes were generally higher than the recommended allowances.

Most children consumed snacks and the snacks were often self-selected. For breakfast, the usual pattern was milk with bread, toast or cereal.

While energy value of the diet was below the RDA for the majority of the children there was a trend for preadolescent children to be heavier, but not taller than a statewide sample of Iowa children observed in the 1950's. A steep increase in skinfold thicknesses was observed among boys from eight to twelve years of age.

Children's intakes of protein, fat, carbohydrate, calcium, thiamine, riboflavin, and ascorbic acid were found to be positively related to the formal education of the mother. No relationship between nutrient intake and socio-economic group was observed. Because only five socio-economic groups were represented and 67% of the sample was from the second category (2,500-5,000 dollars per family per year) the likelihood of finding a relationship was small.

Children were asked to rate each of 77 items on a food checklist as "like it very much", "would eat it once a week", "would not eat it", "dislike it" or "have not tried it". Girls, particularly of the nine to eleven-year-old group, tended to dislike more foods than did boys. Number of foods liked was related to intakes of fat, iron, vitamin A, thiamine and riboflavin. Boys had greater intakes of all nutrients except vitamin A and ascorbic acid than girls.

A majority of children reported having had some instruction in nutrition at school, while other sources of information included television advertisements and occasional radio and television programs.

PROCEDURE

Selection of Subjects

All third- and fourth-grade children of the six public elementary schools in Monroe County, Iowa were given the opportunity to participate in this study. Four of the six schools had cooperated in the 1964-65 survey (22). At that time, rapport between the writer and school personnel had been established; in addition, school administrators had indicated willingness to cooperate with nutrition education research in their district.

Plans for the study were made as Iowa State University professors and the author consulted with school administrators during the fall of 1966. Originally the researchers had hoped to include physical education as a variable in the study, but no qualified teacher, who could travel to each school, was available.

In March, 1967 the experimenters talked with school principals concerning the project. They then visited each third- and fourth-grade classroom to explain the collection of data to the teacher and children. On the same day copies of letters of explanation were mailed to parents of the children (Appendix A). Personal notes of appreciation and interest were included in the letters to parents of children who had cooperated in the earlier study. Parents were asked to grant permission for their children to be in the present study by signing and returning enclosed, self-addressed post cards (Appendix A).

In March copies of follow-up letters (Appendix A) and second post cards were sent home with children whose parents had not responded to the first letter.

The parents of 201 out of 279 children responded affirmatively. Thirty-one of the children participating had been subjects in the 1964-65 survey at which time they had been first- and second-graders. Before September, 1967 seven children moved out of the county and one transfered to the special education class; the remaining 193 subjects were distributed in schools and in classes as shown in Table 1.

Table 1. Distribution of subjects (Fall, 1967)

School code no.	Boys	Girls
Fourth grade		
I	10	8
III	6	6
VII	5	8
V	11	6
VI	5	12
VIII	12	7
	49	47
Fifth grade		
I	11	3
III$_1$	10	8
III$_2$	9	9
V	11	8
VI	4	9
VIII	4	11
	49	48

Schedule

Collection of data and the treatment were accomplished according to the following schedule.

April 4 - May 11, 1967	Collection of data: dietary recalls, body measurements, hemoglobin concentrations, hours of sleep
September 1 - 15, 1967	Collection of data: dietary recalls and records, body measurements, vegetable preference ratings, hours of sleep, physical fitness tests, handgrip dynamometer readings, parent's heights, weights and ages
October 12 and 13, 1967	Collection of data: test of nutrition-related cognitive abilities in Schools III, VI and VII (first administration)
October 16 - November 3, 1967	Treatment: nutrition classes in fourth grades of Schools III, VI and VII
October 30 - November 3, 1967	Collection of data: test of nutrition-related cognitive abilities in Schools I, V and VIII. (first administration)
November 6 and 7, 1967	Collection of data: test of nutrition-related cognitive abilities in Schools III, VI and VII (second administration)

November 6 - 24, 1967	Treatment: nutrition classes in fifth grades of Schools I, V and VIII
November 27, 1967	Collection of data: test of nutrition-related cognitive abilities in Schools I, V and VIII (second administration)
January 22 - February 5, 1968	Treatment: breakfast bulletin board in experimental classrooms
February 5 and 6, 1968	Treatment: rat-feeding demonstration in experimental classrooms
February 27 - March 1, 1968	Collection of data: dietary recalls and records
April 2 - May 7, 1968	Collection of data: dietary recalls, body measurements, vegetable preference ratings, hours of sleep, test of nutrition-related cognitive abilities (third administration) illnesses, menarchial age
May 8 - 10, 1968	Collection of data: physical fitness tests, handgrip dynamometer readings, hours of sleep

Throughout the year parents' education and scholastic achievement scores of the children were obtained from school records when convenient.

Collection of Data

Dietary recalls and records

Pertinent literature   Consideration of the objectives is necessary in selecting methods for collecting dietary data. In this project a basis for comparing the dietary intakes of pupils before and after nutrition education with intakes of control subjects was needed. The intakes of vitamin A and vitamin C, which tend to be quite variable, were of special interest. A method was needed which would sample for a group the intake of these nutrients.

Chalmers et al. (5) in a study of dietary data of subjects of various age groups concluded that consecutive days can be considered independent of each other. Eppright et al. (11) found that for 345 Iowa children 9-11 years old dietary records for Tuesday, Wednesday, and Thursday tended to be the most representative of the week. Average daily intakes of 12 nutrients on these three days were consistently about one percent higher than for the remaining four days of the week. For the three days relative sampling errors for the two most variable nutrients, vitamin A and vitamin C, were 8.3% and 4.0%, respectively. Records of less than three days gave sampling variation for these nutrients outside the 10% tolerance limits.

Weighing, the most accurate method of determining food consumption if done correctly, is impractical when dietary intakes of a large number of children are being sampled. Iowa workers (12) concluded that for untrained subjects household estimates of quantity were as accurate as weighed measures. Furthermore, due to inconvenience weighed food intake may not be typical (49).

Food intake histories, while designed to give a long-range estimate of food intake, have been found, especially with children, to overestimate food consumption as much as 25% to 60% for group averages (55). Dietary recalls and records have been found to give nutrient intake estimates which agree well with each other (56). No significant differences in evaluation by food groups between records kept by 9-11-year-old children and their mothers were found in Iowa (12). The validity of using unweighed records is suggested by a 0.5 correlation, significant at the one percent level, between estimated ascorbic acid intake and serum ascorbic acid of 63 children (12).

Procedure used in present study This study incorporated two 24-hour dietary recalls and one 24-hour record for each subject obtained on school days before and after the treatment period. For the dietary recall the subject was asked to name and describe the foods he had eaten during the previous 24-hour period beginning with the most recent meal and working backwards in time. Standard measuring equipment, tableware, and food models were used to estimate amounts eaten. The child's ability to estimate quantity was checked against his estimate of school lunch portions. Children who were thought to have difficulty were asked to make estimates using a variety of equipment for a given food. Where and with whom meals were eaten were recorded. At the end of the interview the subject was asked if he had chewed any gum or taken any pills or syrups during the 24-hour period. This procedure provided information concerning use of nutrient supplements without the interviewer's suggesting their use. Examples of dietary interview questions and data are included in Appendix B.

During the 1964-65 survey the author noted that recalls were easiest to obtain and apparently less likely to have omissions if taken in the afternoon rather than in the morning. This practice was followed in the present study when possible. To facilitate collection of data many of the recalls were initiated in the morning, but completed in the afternoon so the children did not have to recall food consumed prior to afternoon snacks the day before. Whether recalls were initiated in the morning and completed in the afternoon or carried out entirely in the afternoon, paired classes or portions thereof were treated the same.

When a food record was to be kept by a subject, he was given a form with space for meals and snacks to be recorded. The child was asked to, "Write down everything you eat from now until this time tomorrow". Each subject was shown his own completed recall as an example and he was requested to read the instructions (Appendix B) attached to his record sheet before leaving the interview area. One or two days later the record was collected by an interviewer who briefly checked it for omissions or inaccuracies with the child. If a child failed to bring back his record, he was interviewed to obtain a second 24-hour recall.

Energy value and intake of eight nutrients according to the dietaries were calculated by digital computer. Master cards from the Agricultural Research Service (1964) (50) were used as the reference for energy and nutrient values of commonly served portions of food. Additional master cards were added using values from U.S.D.A. Handbook No. 8 (51), Church and Church (7) and food producers' pamphlets.

Body measurements

Growth histories and dates of birth Heights and weights of the subjects prior to the time of the study were copied from school nurses' records onto Jackson-Kelly charts (20). Information of any outstanding medical abnormalities was also recorded. Date of birth for each subject was obtained from his school record and was later checked by asking him his birthday and age.

Heights and weights Height and weight measurements were taken early in the day. The children were requested to go to the rest room prior to being measured. The girls were measured in their stocking feet and slips. The boys were asked to remove their shirts and shoes and to take heavy items out of their pockets.

A Borg bathroom scale, which had been calibrated every six months by the author, was placed on a level part of the floor. Each subject stepped onto the scale several times until three readings reproducible within one-half pound had been obtained. Only the readings after which the scale returned to "zero" were recorded. The readings were recorded to the nearest half-pound.

Because weight measurements tend to be quite highly skewed (46) they were transformed to logarithms before being used in analyses which assume Gaussian distribution.

Stature was measured with a pair of meter sticks taped to a flat surface parallel to the floor. Following the recommendations of the Committee on Nutritional Anthropometry (24) the experimenter ascertained that the subject was standing erect with the heels and scapulae in contact with the wall and chin parallel to the floor. A right angle headpiece was used to determine the highest point on the child's head. Readings were recorded to the nearest tenth of a centimeter.

Skinfold thicknesses   Parizkova (34) reported that for 241 children combined subscapular and triceps skinfolds bore the highest correlations with body density (r = -.8783 for boys, r = -.8046 for girls) of all possible pairs of measurements from 10 sites.

Skinfold thicknesses were measured by a standard procedure (24) used by the author in the 1964-65 survey (22) Measurements were made on the right side of the body on the triceps and under the scapula using a Harpenden skinfold caliper calibrated to exert a constant pressure of 10 gm/mm^2.

The subscapular skinfold was lifted on the midpoint of a diagonal line from the tip of the scapula to the midline of the back and was perpendicular to the diagonal line. The caliper was applied on the fold 1 cm to the right and above the fingers holding the fold.

The triceps skinfold was lifted on the midline of the back of the arm at the midpoint between the tip of the acromial process and the olecranon. The midpoint was determined with a steel tape and marked with a wax pencil while the elbow was flexed at a 90 degree angle. The skinfold was lifted with the arm hanging relaxed. The caliper was applied on the fold at a point 1 cm distal the midpoint being held by the fingers.

At least three readings were made at each site. For skinfold thicknesses which did not stabilize readily, the reading was taken on the quick count of five after the pressure of the caliper had been applied. All readings were recorded to the nearest 0.01 cm.

For analyses requiring a Gaussian distribution measurements were converted using the formula, Z = 100 log (readings in 0.1 mm - 18) where 18 in tenths of millimeters is the average thickness of two layers of skin (8).

Arm and leg girths   A steel tape was used to measure the circumferences of the right arm and leg. The arm girth was measured, with the arm hanging relaxed, at the same point at which the skinfold thickness was determined. Care was taken to make the measurements with the tape parallel to the floor. At least three readings were taken.

For the leg girth measurements the subject stood with his weight on the left foot while his right foot rested on a tray 10-1/2 inches from the floor. The tray was adjusted so that the lower leg was perpendicular to the floor. The widest part of the calf was determined by making measurements on a series of levels on the lower leg. The largest reproducible readings for the arm and leg girths were considered representative of their respective sites. Muscle bone diameters (39) were estimated by the equation in which, MBD = (arm girth/π - triceps skinfold thickness).

Vegetable preference ratings

Preliminary study In using paper-and-pencil evaluations of food preferences the question arises whether there is a measurable difference in response of the subject to his own mental image of a food object compared with his response if he knew the characteristics of the food object the investigator has in mind. A preliminary study of this problem was undertaken with girls in Ames, Iowa using a seven-point hedonic scale. The scale consisted of a series of cartoon faces expressing a continuum of affect varying from much pleasure to much displeasure (Appendix C).

Using a checklist of foods rated by Monroe County children during the 1964-65 survey (Appendix C) six vegetables (potato chips, corn, tomatoes, green beans, cooked carrots, and candied sweet potatoes) were chosen to fall on a continuum from generally well liked to generally much disliked. One group of 15 fourth-grade girls evaluated in random order the vegetables while seeing and tasting them and again four weeks later without the food present. A second group of 14 fourth-, fifth-, and sixth-grade girls evaluated the vegetables first without the foods present and again two weeks later as they tasted the foods. Details of the testing are included in Appendix C. Slight variations of preparation were done with the foods and no description of preparation, except "candied" sweet potatoes were made on the rating scales in an effort to elicit any significant differences in evaluation with and without food present.

Partially hierarchal three-way factorial analysis of variance indicated that the seven-point scale differentiated significantly ($p \leq .01$) among individual subjects. Further, the mean ratings of each of the vegetables were widely and evenly spread over the continuum. No significant differences between treatments could be found indicating the hypothesis, "No significant differences exist between scoring with and without vegetables present", could not be rejected.

Procedure followed in present study For this study the more convenient no-food-present method was chosen. The seven-point scales were changed to pictures of boys (Appendix C) since the instrument was to be used with mixed groups. Nine vegetables were chosen for evaluation; French fried potatoes, baked potatoes, cabbage slaw, cooked carrots, raw carrots, tomato juice, candied sweet potatoes, baked yellow squash, and canned green beans. French fried potatoes, a well-liked food (22), was chosen to serve as a reference point with which to compare the other vegetables. Baked potatoes, raw cabbage, and tomato juice were of interest because they contribute a medium amount of ascorbic acid at moderately low cost. Carrots, sweet potatoes, and yellow squash were included to compare ratings of these vegetables with vitamin A values of the children's diets. Green beans were selected to serve as a somewhat neutral food.

The rating scales were distributed in the classrooms in the afternoons. The children were instructed to make an X across the face of the person that showed how much they liked the vegetable named. The experimenter gave a verbal discription of the degree of liking or disliking represented by each picture. The pluses and minuses underneath the scales were also pointed out. The children were told that if they had not tasted the vegetables, to mark and X by "never tasted" rather than on any of the faces.

In a few cases the children marked only extreme responses or marked more than one face per vegetable. These children were called into the interview room individually or in small groups. The instrument was explained more slowly and the children were asked to mark new copies of the scales.

For analysis a value of 8, 6, 5, 4, 3, 2 or 0 was recorded for each response to a previously tasted vegetable. One score for each child was calculated by dividing the sum of these values by nine, the total number of vegetables. A second score was obtained by dividing the sum by the number of items tasted, that is, 9 minus the number of items not tasted.

<u>Physical fitness scores</u>

Two seniors majoring in physical education at Iowa State University administered the New York State Physical Fitness Screening Test (33). They were supervised by a specialist in elementary physical education. The four components of the test were; agility, strength, endurance, and speed they were measured by sidesteps, situps, squat thrusts and a dash, respectively.

Because only two of the six schools had gymnasiums, tests for five of the schools were conducted out of doors on ground as grassy and level as could be found. At one school the steep terrain made it necessary to conduct the tests in the gymnasium. Approximately one hour was required for the testing of each class. Classes were retested in the spring at the same time of day as in the preceding fall. In the spring non-subjects as well as subjects were tested. The children were equipped with scorecards (Appendix D) and pencils and wore slacks and tennis shoes when available.

Each pupil had a pupil partner who counted and recorded the raw score for each section of the first three components of the test. Before each of the first three sections of the test the administrators demonstrated the correct procedures along with some incorrect movements ascertaining that the children understood clearly which movements would receive points. Each pair of partners was given opportunity to practice the task a few times before the scoring began.

Agility The pupil started with his feet straddling the center line parallel to each of two lines four feet to either side of the center line. At the signal "Ready-Go" the pupil sidestepped to the right and then to the left so each foot crossed its respective outside line. He continued sidestepping to the right and left until the 10-second time limit was called. His partner, who stood facing him, recorded as the raw score the number of times he had crossed a line, including the center line, without stepping on it.

Strength The pupil started from the long lying position on his back. At the command "Ready-Go" he sat up, fingers interlocked behind head, and touched an elbow to the opposite knee while his partner held down his ankles about one foot apart. Return to the starting position completed the task. The number of correct situps accomplished in one minute constituted the raw score.

The order of the New York Test was altered by conducting the endurance task prior to the dash.

Endurance Starting from the erect standing position the pupil squatted with hands on ground and thrust legs backward keeping the arms and body straight. A return to the squat position and then to erect standing position completed the squat thrust. The raw score was the number of correct squat thrusts completed in 30 seconds.

Speed Pupils ran individually one and one-half times around two Indian clubs placed 45 feet apart. The time to the nearest half second required to run the distance was recorded as the raw score. If a child slipped or stepped on one of the markers, he was allowed to rest then repeat the task.

For analyses involving the separate components of the test raw scores were used. Achievement levels (numbers from one to ten corresponding to percentile ranks for performance by grade and sex) were presented in the test manual (33). Achievement levels for each component of the test were added together to obtain each pupil's total fitness score.

Handgrip dynamometer readings

The use of the Smedley improved handgrip dynamometer was demonstrated to the subjects in class groups. Distance between the stirrups was set at the maximum of six centimeters (52). One reading each was taken for the right and left hand. With the arm of the test hand raised straight above the head the subject received the instrument, dial and palm of hand facing medially. The subject was told to squeeze as hard as possible as he lowered his arm in an arc. The instrument was read audibly to the nearest half kilogram and recorded. Announcing the readings in the presence of a peer group has been found to help motivate maximal effort (52). If the face of the instrument or elbow touched the body during a trial, the child was allowed a second trial after several minutes rest.

Hours of sleep

Each child was asked what time he had gone to bed the night before and what time he had gotten up in the morning.

Then he was asked what were his usual hours. Reported times were recorded to the nearest quarter hour. The number of hours in bed was computed later.

Parents' heights, weights, ages and education

A letter with form (Appendix D) requesting the heights, weights, and ages of the parents was sent home with each child. A space was provided for writing illnesses or injuries which might have affected height or weight. The last grade completed by each parent was copied from school records.

Scholastic achievement scores

Reading and composite raw scores and percentile ranks for the Iowa Every Pupil Test of Basic Skills were copied from school records. The tests had been administered in January, 1967 and January, 1968.

Hemoglobin concentrations

The night before the trip to Monroe County, 4.0 ml deionized water was pipetted into each of two screw-top vials per subject. Saran Wrap was placed under the lid to prevent possible contamination and/or evaporation. The vials were then refrigerated.

All blood samples were collected in the morning between 9:00 and 12:00. The subject swung his left arm to increase circulation in that limb. A finger of the left hand was swabbed with alcohol and punctured with an individual sterile lancet while the subject was being distracted. Duplicate samples were collected in clean, dry 10-microliter pipettes and quantitatively delivered into the vials. The vials were returned to an ice chest. If there was not enough blood to obtain a sample, no attempt was made to repuncture the finger or squeeze the finger in order to obtain a sample.

Within 48 hours after collection of the blood samples, 0.010 ml concentrated ammonium hydroxide was added to each vial. The samples were mixed thoroughly and read immediately in the Beckman Model DU Spectrophotometer at 540 mμ. Duplicate samples which did not agree within one gram percent of each other were not used in calculations. Oxyhemoglobin concentration was calculated according to the following formula:

$$\text{Grams percent hemoglobin} = \frac{\text{Total Volume X Reading}}{\text{9.18 X Volume of blood sample}}$$

$$= \frac{4.020 \text{ X Reading}}{9.18 \text{ X } 0.010}$$

$$= 43.79 \text{ X Reading}$$

<u>Illnesses and menarchial ages</u>

During the last interview in spring, 1968 the children were asked how many days of school they had missed during the the year. Usually they were able to remember the exact number of days and volunteered the reasons for their absences, not always due to illnesses. Illnesses and frequent colds were also recorded. Date of onset of menses according to verbal report of the girls was recorded; menarchial age was computed later.

Development of Nutrition Education Program

Bases for planning the program

Planning for the nutrition education program was based on the following considerations:

1. Results of the 1964-65 survey of Monroe County children's diet and growth.
2. Other nutrition research findings pertinent to this age group.
3. Nutrition-related needs and resources of the children casually observed by the author.
4. Responses of the children to open-ended items concerning nutrition and health.
5. Nutrition-related concepts included in elementary science and health textbooks and curriculum materials.
6. Developmental tasks and interests of school-age children.
7. Principles of education.
8. Expectations and resources of the cooperating school system.
9. Author's philosophy of education.
10. Time and materials available for the program.
11. Possible evaluation techniques.

Objectives and generalizations

Objectives were written in terms of pupil behaviors. Broad objectives were delineated as follows:

> After a child has completed this unit, he should be more likely to consume a balanced diet because he should be better able to:
>
> I. Formulate a concept of health involving optimum well-being.
>
> II. Comprehend the dependence of health on food.
>
> III. Improve his own food habits if his intake of some nutrients is low or excessive.
>
> IV. Recognize that diet interacts with many factors to affect health.

Behaviors needed to obtain broad objectives were incorporated into sub-objectives. Sub-objectives were arranged in hierarchies according to complexity under their respective broad objectives (Appendix E). A level of competence and/or internalization from Bloom's Taxomony of Educational Objectives (2, 25) was identified for each behavior to test whether or not objectives were arranged within true hierarchies.

Generalizations and facts were selected to correspond to the stated objectives. Here "generalization" refers to a statement of truth concerning the relationship of two or more concepts which is applicable in a number of situations. Generalizations and supporting facts were arranged in hierarchies (Appendix E) to show concept development and were written alongside their respective objectives. To assure that the generalizations could potentially be verbalized by the pupils, the generalizations were written in a style fourth-grade children could use.

The objectives and generalizations were judged for accuracy of content and logical development of concepts by three professors of nutrition and a specialist in youth health programs reviewed them to assess appropriateness for pupils of intermediate grades. Their suggestions were incorporated into the statements which are presented in Appendix E.

Test of nutrition-related cognitive abilities

Two multiple-choice items were proposed for most of the stated objectives. Many of the distracters for the items were selected from responses to open-ended items administered early in 1967 to approximately 70 fourth- and fifth-grade pupils in Monroe County. A specialist in home economics education evaluation scrutinized the proposed items for appropriateness for the stated objectives and generalizations and for difficulty. Items were modified according to her suggestions and presented to graduate students of food and nutrition. Items for which the graduate students did not give the anticipated responses were either modified or deleted.

Thirty-nine questions for which there were 105 correct responses were then administered to 47 fourth- and fifth-grade children of the parochial school in Monroe County. This school was not included in the experimental design but had agreed to cooperate in preliminary use of the test and teaching unit. Incorrect responses which were selected by fewer than four pupils were deleted. Some of the items were combined or deleted to shorten the test. The final test consisted of 67 items in two parts. The first part contained 14 items with only one correct response each. The second part contained questions for which one or more than one response were correct. Each response was considered a separate true-false item.

The 67-item test (Appendix E) was administered in the parochial school following special nutrition classes taught in both the fourth and fifth grades. Items 15 and 9 which were misinterpreted and item 12 which was answered correctly but on the basis of misinformation were therefore not scored leaving 64 items.

The score was the number of correct responses. Item and score analyses based on test results in the experimental schools were used to evaluate the instrument's ability to discriminate among pupils.

Learning experiences

Thirteen daily lessons and two follow-up experiences were planned using the objectives and generalizations to guide selection of the experiences. The lessons were planned for 30-minute periods. The majority of the experiences involved active manipulation of materials which the pupils could perform or observe. The author limited the selection of experiences to those requiring materials easily obtainable by an elementary school teacher. For reasons of safety no experiences requiring heating of materials within the classroom were included. During the unit the children made growth charts, observed cells under the microscope, simulated cell division using clay models, fingered milk ash, bent a decalcified bone and blew into lime water to detect the presence of carbon dioxide. In addition, they watched milk clot with both trypsin and rennin, blotted food with writing paper to determine the presence of fat, dropped iodine on food to determine presence of starch and compared physical properties of food. They evaluated their diets, kept a record of activities and tasted squash, many for the first time. A partial list of the experiences is presented in Appendix E.

In the fall, 1967 the lessons were taught on a trial basis in the fourth- and fifth-grade classrooms of the parochial school. A few of the experiences were used in the experimental schools.

Follow-up experiences included a breakfast bulletin board in January, 1968 and an animal feeding demonstration early in February. The bulletin board was entitled "Good breakfasts come in many foods" and was planned to emphasize the variety of foods which could be included in nutritious breakfasts. It showed three non-traditional breakfasts based on sandwiches plus one bacon-and-egg breakfast. At the university weanling rats were fed meat, potatoes and bread for three weeks. To emphasize the potential importance of snacks half of them were given chocolate bars in addition to the basal diet. The other half received milk and raw carrots. The children evaluated the rats' diets before comparing sizes and appearances of the animals.

Administration of the Test of Nutrition-Related Cognitive Abilities

The multiple-choice test of nutrition-related cognitive abilities was administered to all children in each fourth- and fifth-grade classroom of the six public schools. The test was given within one week before and again within one week after the teaching of the thirteen-lesson unit. The test was administered for the third time in the spring of 1968. Both classes of a given school were tested on the same day.

The author read aloud the instructions on the front page of each section before the pupils were allowed to begin working on that section. The two sections were administered separately. Most of the pupils completed the test within one-half hour.

Instruction of Experimental Groups

The fourth- and the fifth-grade class in each of the six public schools was considered a block in the statistical design. Because the fifth-grade pupils from Schools III and

VII were mixed and housed together in School III, the class with the larger representation from School VII was considered the fifth grade for that block.

The experimental nutrition classes could not be conducted in the fifth-grade classrooms of Schools III and VII due to scheduling difficulties. Three out of the four remaining schools were randomly selected for experimental nutrition education in the fifth-grade. In the schools in which the fifth-graders received the special instruction, the fourth-grade classes served as controls; in the remaining three schools the fourth-grade classes received the instruction and the fifth-grade classes served as controls. See Table 2 for a summary of the assignment of treatments by classroom.

Table 2. Assignment of treatments among classes

	Nutrition education	Control
Fourth grade	III[a], VI, VII	I, V, VIII
Fifth grade	I, V, VIII	III, VI, VII

[a]Original code numbers for schools have been retained for the benefit of those who may wish to refer to original data. Schools II, the junior high school, and IV, the parochial school, participated in the 1964-1965 survey but not in the present investigation.

The author taught the experimental unit in the fourth-grade classrooms October 16 through November 3 and in the fifth-grade classrooms November 6 through November 22, 1967. Care was taken to treat each group similarly, to record unusual circumstances and responses soon after the class was over and to avoid during teaching the use of examples included in the multiple-choice test. On days eight and ten of the unit magnetic tape recordings of each class period were made. They were made to use in case there would be particular problems in interpreting the data of one group. This difficulty did not arise and the recordings did not yield information which was not already noted in a diary.

The following January the breakfast bulletin board previously described was displayed in the experimental classrooms for one week. Not wishing to impose the care of rats on the classroom teachers, the author fed the animals as described above at the university. In February the animals were transported to each experimental classroom. The animals were examined by the children after they had reviewed the nutrient contributions of the diets consumed by the rats.

Analyses of Data

Correlations and regression analyses were used to study the relationships among diet, growth and other selected variables. Analysis of variance for a factorial design with schools as blocks was used to determine significance of changes following nutrition education.

RESULTS AND DISCUSSION

Relationships among Diet, Growth and Other Selected Factors

Correlation coefficients were calculated to study relationships among variables. Unless otherwise stated, the correlations were based on data collected early in the fall, 1967 before nutrition education was initiated. Some of the correlation matrices were calculated eliminating subjects with missing data for certain variables; thus, the number of observations and therefore the level of significance for the correlations varied.

Factors related to diet

Analysis by correlation assumes bivariate normal distribution and equal variance of one variable at each level of the other variable (42, pp. 177-179). The distributions of energy value of the diet and nutrient intakes were skewed toward the high numbers. Because the dietary data did not fit the assumptions, statistical significance of the relationships was not tested. Nevertheless, the correlation coefficients were considered to be descriptive.

Nutrient intake was related to sex ($r \doteq -0.20$ to -0.25, Table 3) except vitamin A value and ascorbic acid. For these two nutrients boys tended to have greater intakes than girls (Table 4). Because food energy value of the boys' diets also

Table 3. Intercorrelations among age, sex, nutrition-related cognitive abilities, vegetable preference and diet (Spring and fall, 1967, N = 192)

Variables	1	2	3	4	5	6	7
1 Age (mo)							
2 Sex (boy = 1) (girl = 2)	-0.04						
3 Nutrition test score	0.20	0.01					
4 Vegetable preference total score	0.04	0.08	-0.04				
5 Vegetable preference subscore	-0.01	-0.01	-0.05	0.85			
6 Energy value (kcal)	0.03	-0.26	0.06	0.06	0.10		
7 Protein (gm)	0.04	-0.23	0.04	0.15	0.18	0.80	
8 Calcium (mg)	0.00	-0.20	0.08	0.05	0.07	0.66	0.79
9 Iron (mg)	0.08	-0.22	0.01	0.16	0.17	0.82	0.80
10 Vitamin A value (10 IU)	0.01	-0.09	0.11	0.23	0.27	0.27	0.30
11 Thiamine (mg)	0.07	-0.25	-0.02	0.12	0.16	0.79	0.75
12 Riboflavin (mg)	0.04	-0.21	0.07	0.04	0.07	0.77	0.82
13 Niacin (mg)	0.10	-0.20	-0.02	0.18	0.20	0.62	0.71
14 Ascorbic acid (mg)	0.06	-0.06	0.08	0.17	0.16	0.35	0.27
Mean	120.4	1.49	30.0	45.6	16.5	2319	85
Standard deviation	7.4		4.1	11.4	6.9	538	21

r = 0.14 significant at the 0.05 level

r = 0.19 significant at the 0.01 level

Table 3 (Continued)

Variables	8	9	10	11	12	13	14
1 Age (mo)							
2 Sex (boy = 1) (girl = 2)							
3 Nutrition test score							
4 Vegetable preference total score							
5 Vegetable preference subscore							
6 Energy value (kcal)							
7 Protein (gm)							
8 Calcium (mg)							
9 Iron (mg)	0.46						
10 Vitamin A value (10 IU)	0.28	0.35					
11 Thiamine (mg)	0.68	0.75	0.32				
12 Riboflavin (mg)	0.88	0.64	0.48	0.77			
13 Niacin (mg)	0.27	0.77	0.30	0.58	0.50		
14 Ascorbic acid (mg)	0.20	0.34	0.33	0.34	0.27	0.31	
Mean	1221	11.9	495	1.21	2.37	13.9	66
Standard deviation	419	3.1	347	0.33	0.71	3.8	37

r = 0.14 significant at the 0.05 level

r = 0.19 significant at the 0.01 level

Table 4. Means and standard deviations of daily food energy and nutrient values of diet by grade and sex (Spring and fall, 1967)

	Fourth-grade boys N=48	Fifth-grade boys N=49	Fourth-grade girls N=47	Fifth-grade girls N=48
Energy value (kcal)	2514 ±587	2405 ±489	2094 ±462	2257 ±508
Protein (gm)	90 ±22	89 ±18	77 ±18	83 ±23
Calcium (mg)	1272 ±374	1339 ±406	1099 ±466	1171 ±379
Iron (mg)	12.7 ±3.4	12.4 ±2.6	10.9 ±2.8	11.6 ±3.1
Vitamin A value (IU)	4980 ±3190	5560 ±3300	4580 ±3780	4670 ±3450
Thiamine (mg)	1.29 ±0.32	1.29 ±0.31	1.09 ±0.31	1.16 ±0.34
Riboflavin (mg)	2.50 ±0.66	2.54 ±0.62	2.14 ±0.80	2.30 ±0.67
Niacin (mg)	14.9 ±4.3	14.5 ±3.0	13.0 ±3.1	13.5 ±4.0
Ascorbic acid (mg)	68 ±40	68 ±33	60 ±35	67 ±39

tended to be higher than that of the girls, the greater nutrient intakes among boys appeared to be due to greater total food consumption rather than to superior quality of diet. Eppright (13) reported that between six and 12 years of age Iowa boys tended to consume about 10 percent more than girls. For the present study average daily caloric intake of boys was 11 percent greater than that of girls.

Dietary values were not related to age within the age range of this study, that is, from 8 years, 8 months to 11 years, 11 months.

There was a positive relationship between total score on vegetable preference rating scales and intakes of protein, iron, niacin and ascorbic acid and vitamin A value of the diet. When the subscore of four carotene-rich vegetables (raw carrots, cooked carrots, candied sweet potatoes and baked yellow squash) was correlated with vitamin A value of the diet, the coefficient was 0.27, which was the highest relationship observed between vegetable preference and nutrients. The partial correlation coefficient between vitamin A value and subscore, holding energy value of the diet constant, was 0.25 suggesting the relationship was due to quality of diet rather than quantity consumed. However, protein, iron, niacin and ascorbic acid were equally correlated to total score and subscore of yellow vegetables.

Kaled (22) had observed that Monroe County children tended to like best the foods eaten most often. This suggested that (1) children learn to like foods served often, or (2) that children accept the foods they like. The positive correlations with protein, iron, niacin and ascorbic acid are not unreasonable if the vegetable ratings used in this study were somewhat indicative of food acceptance in general.

No relationship between vegetable ratings and sex were observed. In contrast, greater acceptance of green and yellow vegetable by boys than girls was observed by Irving (18). Kaled (22) found that on a 77-item checklist (Appendix C) boys rated foods higher than girls. The differences between the sexes were greatest among the 9-11-year-old subjects. In Kaled's survey only four categories of affect were used for the 77 foods of different classes, whereas in the present study a seven-point hedonic scale was used with nine vegetables. Thus, a difference in procedure may have produced the difference in findings of the two studies.

A positive relationship between score on a test of nutrition knowledge and score of dietary quality of adolescent girls was reported by Hinton (16). In the present study a slight relationship was observed between vitamin A value of the diet and score on the nutrition test ($r = 0.11$) before nutrition education. Because variation in the test scores was small (s.d. = 4.1) a high relationship would not have been likely.

Kaled (22) observed positive relationships ranging from 0.10 to 0.19 between a child's intake of various nutrients and highest grade completed by his mother. These relationships were not observed in the present study (Table 5). A smaller number of observations in the present study (N = 159) than in Kaled's survey (N = 245) and a smaller standard deviation for mother's education (s.d. = 1.8 in Kaled's study, s.d. = 1.5 in present study) may account for not confirming Kaled's findings. The correlation between vitamin A value of the diet and father's education (r = 0.15) may be a chance relationship. No relationship between child's nutrient intake and education of the father had been observed by Kaled.

Caloric value of the diet was related by values greater than 0.60 to intakes of all nutrients estimated (Table 3) except ascorbic acid (r = 0.35) and vitamin A value of the diet (r = 0.27). The highest correlation between nutrients was between calcium and riboflavin (r = 0.88), suggesting a common source, namely milk and milk products. Similar nutrient interrelationships were observed by Kaled (22).

Relationships among body measurements

Because their distributions tended to be skewed toward the high values, individual measurements of weight and skinfold thicknesses were transformed to logarithms. Correlation coefficients for arm girth, leg girth, muscle-bone diameter and ratio of weight to height had been calculated before the

Table 5. Intercorrelations between education of parents and diet of child (Spring and fall, 1967, N = 159)

Variables	1	2	Mean	S.D.
Father's education (yr)			11.1	2.3
Mother's education (yr)	0.38		11.6	1.5
Energy value (kcal)	0.04	-0.06	2299	533
Protein (gm)	0.07	-0.04	84	21
Calcium (mg)	0.08	0.00	1206	416
Iron (mg)	0.06	-0.03	11.8	3.0
Vitamin A value (10 IU)	0.15	-0.09	510	368
Thiamine (mg)	0.02	-0.08	1.18	0.32
Riboflavin (mg)	0.06	-0.06	2.35	0.70
Niacin (mg)	-0.01	-0.13	13.8	3.6
Ascorbic acid (mg)	0.07	0.05	67	38

r = 0.15 significant at the 0.05 level

r = 0.20 significant at the 0.01 level

distributions of these variables were found to be skewed to the right. Therefore, except for height, statistical significance of coefficients of untransformed data were not determined.

Both height and logarithm of weight were positively correlated with each other and with all other body measurements (Table 6). Because an extremely high relationship ($r = 0.97$) existed between the logarithm of weight and the ratio of weight to height, the weight to height ratio does not appear to be a uniquely valuable index of body status for the age group studied.

Leg girth, an often used measure of muscle mass, correlated highly ($r = 0.84$) with muscle-bone diameter of the upper arm. The relationship between leg girth and combined grip strength of both hands measured separately was 0.56. Because that relationship was comparable to the correlation between muscle-bone diameter of the upper arm and handgrip strength ($r = 0.51$), leg girth in this population seems to be as good an indicator of musculature as is muscle-bone diameter of the upper arm.

Because muscle-bone diameter is calculated from arm girth, the correlation between these two variables ($r = 0.91$) should not be considered evidence of the validity of using arm girth alone as an indicator of musculature. However, the relationship between arm girth and handgrip strength ($r = 0.47$) lends support to the use of arm girth in comparing musculature.

Table 6a. Intercorrelations among body measurements and handgrip (Fall, 1967, N = 192)

Variables	1	2	3	4	5	6	7	8	9	10
1 Height (cm)										
2 Log weight	0.75									
3 Weight/height (lb/in)	0.59	0.97								
4 Log triceps skinfold thickness	0.32	0.66	0.68							
5 Log subscapular skinfold thickness	0.33	0.72	0.77	0.80						
6 Log total skinfold thickness	0.34	0.72	0.76	0.98	0.89					
7 Arm girth (cm)	0.50	0.92	0.96	0.76	0.82	0.82				
8 Leg girth (cm)	0.61	0.94	0.94	0.68	0.73	0.73	0.91			
9 Muscle-bone diameter (cm)	0.49	0.85	0.89	0.51	0.67	0.59	0.91	0.84		
10 Handgrip strength (kg)	0.59	0.60	0.53	0.21	0.26	0.24	0.47	0.56	0.51	
Mean	138.4	1.8616	1.36	196.00	160.06	212.30	21.5	28.9	5.7	34.7
Standard deviation	6.4	0.0890	0.26	16.92	20.96	17.48	3.0	2.8	0.7	7.7

$r = 0.14$ significant at 0.05 level

$r = 0.19$ significant at 0.01 level

Table 6b. Means and standard deviations[a] for weight and skinfold thicknesses (Fall, 1967, N = 192)

Weight

Mean $\text{antilog } 1.8616^b = 72.7$ (lb)

S.D. $72.7 \pm \text{antilog } (1.8616^b \pm 0.0890^c) = + 16.5$ (lb)

$- 13.5$ (lb)

Triceps skinfold thickness

Mean $0.1 \{18 + \text{antilog } [0.01(196.00^b)]\} = 10.9$ (mm)

S.D. $10.9 \pm 0.1 \{18 + \text{antilog } [0.01(196.00^b \pm 16.92^c)]\} =$

$+ 4.4$ (mm)

$- 2.9$ (mm)

Subscapular skinfold thickness

Mean $0.1 \{18 + \text{antilog } [0.01 (160.06^b)]\} = 5.8$ (mm)

S.D. $5.8 \pm 0.1 \{18 + \text{antilog } [0.01 (160.06^b \pm 20.96^c)]\} =$

$+ 2.5$ (mm)

$- 1.5$ (mm)

Total skinfold thickness

Mean $0.1 \{36 + \text{antilog } [0.01 (212.30^b)]\} = 16.9$ (mm)

S.D. $16.9 \pm 0.1 \{36 + \text{antilog } [0.01(212.30^b \pm 17.48)]\} =$

$+ 6.6$ (mm)

$- 4.4$ (mm)

---

[a]From logarithmically transformed data.

[b]Logarithmic mean.

[c]Logarithmic standard deviation.

Logarithm of total skinfold thickness (triceps and subscapula) was related to leg girth (r = 0.73) and muscle-bone diameter (r = 0.59). Because of these correlations and that between logarithm of total skinfold thickness and handgrip strength, (r = 0.24), fatness appeared to be associated with muscularity among these children.

Factors related to body status

As would be expected among growing children, measurements of body size tended to increase with age, particularly height (r = 0.44) and logarithm of weight (r = 0.25). Relationships between age and logarithm of total skinfold thickness (r = 0.06) and between age and muscle-bone diameter (r = 0.10) were very low reflecting the wide individual variation within the age range studied (104 - 143 mo).

Boys tended to be slightly taller (r = -0.08) and heavier (r = -0.13) than girls in the fall, 1967, while girls tended to have greater triceps (r = 0.16) and subscapular (r = 0.16) skinfold thicknesses than did boys. Tanner and Whitehouse (47) have observed that skinfold thicknesses were thicker in girls than in boys as early as two years of age. Measuring breadth of fat at six sites with X-ray pictures Reynolds (36) found that girls in all age groups, 6 to 18 years of age, were fatter than boys of corresponding ages.

Boys were more muscular than the girls; the correlation coefficient between sex and muscle-bone diameter was -0.16 and between sex and handgrip strength was -0.43. Boys also tended to have higher concentrations of hemoglobin in the blood ($r = -0.18$, $\bar{X} = 12.35$ versus 12.16 gm/100 ml) than girls. Sidwell (41) reported that values of hemoglobin concentration were higher for Iowa boys than for girls beginning at eight years of age. For mean values of measurements of body status by sex and grade see Table 7.

Height and logarithm of weight were positively related to intakes of most nutrients and caloric value of the diets (Table 8). Correlations between dietary energy value and height ($r = 0.24$) and logarithm of weight ($r = 0.15$) suggested that large children tended to consume more food than small children. No relationship was observed between logarithm of total skinfold thickness and caloric value of the diet ($r = -0.07$).

That overweight and obesity are related to caloric intake late in the day (night-eating syndrome) has been suggested. Munsen (29) studied eating patterns of 10 heavy adolescent girls and 10 girls of medium weight who were of similar ages, heights and stages of maturation. On the average the heavy group obtained 64% of their total daily caloric intake after four o'clock in the afternoon, while their pairmates obtained an average of 56% late in the day. For both groups caloric value of food consumed after four o'clock was over 50 % of the

Table 7. Means and standard deviations of age and body measurements by grade and sex (Fall, 1967)

	Fourth-grade boys N=48	Fifth-grade boys N=49	Fourth-grade girls N=47	Fifth-grade girls N=48
Age (mo)	115.1	126.2	114.4	125.7
	±6.0	±4.5	±3.4	±4.9
Height (cm)	136.5	141.2	134.9	140.9
	±5.3	±5.6	±6.8	±5.3
Weight (lb)[a]	70.9	78.3	66.2	75.5
	+13.4	+16.9	+15.4	+16.6
	-11.2	-13.9	-12.5	-13.6
Weight/height (lb/in)	1.34	1.43	1.27	1.39
	±0.22	±0.26	±0.25	±0.27
Triceps skinfold thickness (mm)[a]	10.0	10.7	11.0	12.0
	+4.1	+4.9	+3.9	+3.8
	-2.8	-3.1	-2.7	-2.7
Subscapular skinfold thickness (mm)[a]	5.2	5.8	6.0	6.2
	+2.0	+2.6	+3.2	+2.4
	-1.2	-1.6	-1.6	-1.5
Total skinfold thickness (mm)[a]	15.3	16.8	17.2	18.5
	+5.8	+7.1	+6.3	+6.3
	-3.9	-4.6	-4.3	-4.4
Arm girth (cm)	21.2	22.1	20.7	21.9
	±2.7	±3.0	±2.9	±3.1
Leg girth (cm)	28.8	29.9	27.7	29.4
	±2.4	±3.1	±2.5	±2.7
Muscle-bone diameter (cm)	5.7	5.9	5.4	5.7
	±0.7	±0.6	±0.7	±0.7

[a]From logarithmically transformed data, therefore standard deviations are greater above their respective means than below.

Table 8. Intercorrelations among body status[a] and diet (Spring and fall, 1967, N=192)

Variables	1	2	3	4	5	6	7	8	9
1 Age (mo)									
2 Sex (boy = 1) (girl = 2)	-0.04								
3 Height (cm)	0.44	-0.08							
4 Log weight	0.25	-0.13	0.75						
5 Log of triceps skinfold thickness[b]	0.05	0.16	0.32	0.66					
6 Log of subscapular skinfold thickness[b]	0.07	0.16	0.33	0.72	0.80				
7 Log of total skinfold thickness[b]	0.06	0.17	0.34	0.72	0.98	0.89			
8 Muscle-bone diameter (cm)	0.10	-0.16	0.49	0.85	0.51	0.67	0.59		
9 Handgrip strength (kg)	0.30	-0.43	0.59	0.60	0.21	0.26	0.24	0.51	
10 Energy value (kcal)	0.03	-0.26	0.24	0.15	-0.08	-0.07	-0.07	0.11	0.16
11 Protein (gm)	0.04	-0.23	0.24	0.21	0.03	0.01	0.04	0.21	0.21
12 Calcium (mg)	0.00	-0.20	0.25	0.23	0.09	0.09	0.11	0.24	0.18
13 Iron (mg)	0.08	-0.22	0.16	0.10	-0.10	-0.11	-0.09	0.06	0.12
14 Vitamin A value (10 IU)	0.01	-0.09	0.06	0.02	-0.09	-0.06	-0.07	0.03	0.06
15 Thiamine (mg)	0.07	-0.25	0.11	0.04	-0.14	-0.12	-0.13	0.05	0.13
16 Riboflavin (mg)	0.04	-0.21	0.21	0.17	0.01	0.01	0.02	0.18	0.16
17 Niacin (mg)	0.10	-0.20	0.09	0.05	-0.11	-0.14	-0.11	0.05	0.15
18 Ascorbic acid (mg)	0.06	-0.06	0.18	0.16	-0.03	0.03	0.00	0.13	0.17
Mean	120.4	1.49	138.4	1.8616	196.0	160.1	212.3	5.7	34.7
Standard deviation	7.4	.50	6.4	0.8896	16.9	21.0	17.5	0.7	7.7

r = 0.14 significant at 0.05 level
r = 0.19 significant at 0.01 level

[a]As of September, 1967.

[b]See page 37.

total daily value which is contrary to recommendations for more or less even distribution of caloric value throughout the day.

In the present study the percentage of daily caloric value obtained after school was dismissed in the afternoon ($\overline{X}$ = 47) correlated negatively with logarithm of weight (r = -0.18) and logarithm of total skinfold thickness (r = -0.20). In Munsen's study the difference between the two groups of girls was rather small (8%). Furthermore, the difference probably reflects the tendency for heavy adolescent girls to omit breakfast or lunch or to eat only small amounts of food at these meals in an attempt to lose weight. However, when Sondgeroth compared 29 heavy girls with 89 non-heavy high school girls, she found no significant difference between them in percent of energy value obtained after three o'clock in the afternoon. About half of her subjects lived in a boarding school with meal service whereas Munsen's subjects all lived at home. In the present study the author did not notice restriction of food intake at breakfast or lunch for the purpose of losing weight from interview data among the heavy elementary school children. Only five of 95 girls and 12 of 97 boys were classified as obese according to the criteria (triceps skinfold measurements) suggested by Seltzer and Mayer (40). Possibly heavy fourth- and fifth-grade children were admonished by parents to restrict food intake in the evenings and/or light-weight children were encouraged to eat large quantities at home giving rise to the negative relationship observed in the current study.

Correlation coefficients for 159 subjects for whom there were complete data for height, weight and education of both parents were calculated (Table 9). There was a higher correlation between the height of the child and that of the father ($r = 0.41$) than that of the mother ($r = 0.26$). Both relationships were significant at the 0.01 level. The relationships between the logarithm of the child's weight with the father's height ($r = 0.23$) and with the mother's height ($r = 0.21$) were also significant ($p \leq 0.01$). Although correlations involving logarithm of child's weight, leg girth and muscle-bone diameter appeared to be greater with father's weight than with mother's weight, the differences in correlations were not significant. Except for child's height with parents' weight and logarithm of child's subscapular skinfold thickness with parents' heights, correlation coefficients were greater when sum of the parents' measurements rather than either parent's measurement was the correlate. Because the heights and weights of parents were obtained by questionnaire, precision and accuracy of the data depended on accuracy of instruments used by the parents, time of day measurements were made, clothing worn, precision of the readings and ability and/or willingness of parents to record true values. How much of the correlations were due to

Table 9. Intercorrelations among body measurements of parents and child (Fall, 1967, N = 159)

Variables	1	2	3	4	5	6
1 Father's height (in)						
2 Mother's height (in)	0.14					
3 Sum of parents' heights (in)	0.80	0.71				
4 Father's weight (lb)	0.53	0.09	0.43			
5 Mother's weight (lb)	0.06	0.30	0.22	0.21		
6 Sum of parents' weights (lb)	0.39	0.24	0.42	0.80	0.76	
7 Height (cm)	0.41	0.26	0.45	0.22	0.06	0.18
8 Log weight	0.23	0.21	0.29	0.24	0.14	0.25
9 Log triceps skinfold thickness	0.16	0.15	0.20	0.16	0.22	0.24
10 Log subscapular skinfold thickness	0.04	0.12	0.10	0.14	0.13	0.17
11 Log total skinfold thickness	0.12	0.14	0.17	0.17	0.17	0.22
12 Arm girth	0.12	0.16	0.18	0.20	0.14	0.22
13 Leg girth	0.11	0.17	0.18	0.16	0.12	0.18
14 Muscle-bone diameter	0.10	0.13	0.15	0.18	0.09	0.18
Mean	69.6	64.7	134.3	179.3	143.5	322.9
Standard deviation	2.7	2.3	3.8	27.1	25.1	40.7

r = 0.15 significant at 0.05 level

r = 0.20 significant at 0.01 level

heredity and how much were due to common environment were impossible to determine. In addition, the author knew that at least seven of the children had been adopted, although no distinction was made between natural and adopted parents in the analysis.

There were small positive relationships between hemoglobin concentration of blood and dietary values of only three nutrients in the diets of Monroe County children (iron, r = 0.12; vitamin A value, r = 0.10 and ascorbic acid, r = 0.18). Because blood samples were obtained only in the spring, 1967 and before dietary data were gathered the observed relationships between nutritive value and hemoglobin concentration are valid only if the food intake was representative of previous dietary practices. Measuring hemoglobin concentration after collection of dietary data might have yielded different relationships.

Small positive relationships were observed between hemoglobin concentration and all measures of body size (Table 10) including logarithm of total skinfold thickness (r = 0.12). Much of the correlation can be explained by the age and sex dependence of these variables.

Factors related to growth

Changes in body size were calculated by subtracting values obtained in the spring, 1967 from values obtained the following spring. The measurements within each school were made a year apart, plus or minus one week. Average daily nutrient intake

Table 10. Intercorrelations among diet, body measurements and hemoglobin concentration of blood (Spring and fall, 1967, N = 148)

Variables	1	2	3	4	5	6	7	8
1 Age (mo)								
2 Sex (boy = 1) (girl = 2)	0.01							
3 Height (cm)	0.43	-0.08						
4 Log weight	0.25	-0.16	0.76					
5 Log total skinfold[a] thickness	0.13	0.11	0.39	0.75				
6 Leg girth (cm)	0.19	-0.19	0.63	0.94	0.75			
7 Muscle-bone diameter (cm)	0.11	-0.16	0.52	0.89	0.65	0.87		
8 Energy value (kcal)	0.02	-0.25	0.25	0.16	-0.05	0.18	0.14	
9 Protein (gm)	0.03	-0.21	0.26	0.23	0.07	0.25	0.23	0.80
10 Calcium (mg)	-0.02	-0.20	0.26	0.25	0.16	0.25	0.26	0.67
11 Iron (mg)	0.10	-0.20	0.18	0.12	-0.06	0.14	0.10	0.83
12 Vitamin A value (10 IU)	0.01	-0.12	0.07	0.06	0.00	0.02	0.09	0.25
13 Thiamine (mg)	0.08	-0.26	0.15	0.05	-0.11	0.07	0.06	0.81
14 Riboflavin (mg)	0.03	-0.21	0.25	0.21	0.08	0.21	0.22	0.78
15 Niacin (mg)	0.09	-0.17	0.14	0.08	-0.10	0.09	0.08	0.64
16 Ascorbic acid (mg)	0.03	-0.04	0.20	0.18	0.05	0.19	0.15	0.38
17 Hemoglobin concentration (gm/100 ml)	0.01	-0.18	0.09	0.17	0.12	0.15	0.14	0.05
Mean	120.4	1.51	138.5	1.8659	213.2	29.1	5.7	2354
Standard deviation	7.3		6.5	0.0918	17.8	2.9	0.7	566

r = 0.16 significant at the 0.05 level
r = 0.21 significant at the 0.01 level

[a]See page 37.

Table 10 (Continued)

Variables	9	10	11	12	13	14	15	16	17
1 Age (mo)									
2 Sex (boy = 1) (girl = 2)									
3 Height (cm)									
4 Log weight									
5 Log total skinfold[a] thickness									
6 Leg girth (cm)									
7 Muscle-bone diameter (cm)									
8 Energy value (kcal)									
9 Protein (gm)									
10 Calcium (mg)	0.80								
11 Iron (mg)	0.81	0.50							
12 Vitamin A value (10 IU)	0.28	0.24	0.35						
13 Thiamine (mg)	0.76	0.70	0.76	0.31					
14 Riboflavin (mg)	0.82	0.88	0.67	0.44	0.78				
15 Niacin (mg)	0.72	0.28	0.81	0.34	0.59	0.50			
16 Ascorbic acid (mg)	0.27	0.20	0.36	0.37	0.31	0.26	0.31		
17 Hemoglobin concentration (gm/100 ml)	0.07	-0.01	0.12	0.10	0.07	0.02	0.07	0.18	
Mean	86	1240	12.1	502	1.24	2.42	14.1	68	12.3
Standard deviation	22	440	3.2	343	0.35	0.74	3.8	39	0.7

r = 0.16 significant at the 0.05 level
r = 0.21 significant at the 0.01 level

and energy value of food intake sampled six days throughout the year were used as dietary correlates.

For boys and girls combined there were no relationships between age and changes in body measurements (Table 11) except for weight ($r = 0.15$). Studying boys separately (Table 12) one observes a relationship between age and change in muscle-bone diameter ($r = 0.14$). Among boys age tended to be negatively correlated with change of triceps skinfold thickness ($r = -0.13$) in contrast to findings of Tanner and Whitehouse (47) who have reported that triceps skinfold thickness increased steadily for boys from 8 to 12 years of age. Among girls (Table 13) age did correlate positively with change in triceps skinfold thickness ($r = 0.14$).

For all subjects combined girls tended to have greater increments in heights than did boys ($r = 0.28$, $\bar{X} = 5.7$ cm versus $\bar{X} = 5.0$ cm). Change in weight was related to sex ($r = 0.47$) with the girls having a greater average increase ($\bar{X} = 10.4$ lb for girls versus $\bar{X} = 8.9$ lb for boys). Similar differences in rate of growth can be seen in cross-sectional data (Table 7). Difference in average height between fourth- and fifth-grade girls as of fall, 1967 was 6.0 cm while that of the boys was 4.7 cm. Difference in average weight between the two grades was 9.3 lb for girls and 7.4 lb for the boys. These statistics probably reflect the fact that some of the girls were undergoing the pre-pubertal growth spurt. Two of

Table 11. Intercorrelations among diet and changes in body size (Spring 1967 to spring, 1968, N = 183)

Variables	1	2	3	4	5	6	7	8	9
1 Age (mo)(spring, 1968)									
2 Sex (boy = 1) (girl = 2)	-0.05								
3 Δ height (cm)	0.10	0.28							
4 Δ weight (lb)	0.15	0.17	0.44						
5 Δ triceps skinfold thickness (mm)	0.00	0.02	-0.02	0.29					
6 Δ subscapular skinfold thickness (mm)	-0.03	0.16	0.13	0.50	0.54				
7 Δ total skinfold thickness (mm)	-0.02	0.08	0.04	0.42	0.93	0.80			
8 Δ leg girth (cm)	-0.06	0.01	0.28	0.60	0.25	0.39	0.34		
9 Δ muscle-bone diameter (cm)	0.03	-0.01	0.23	0.51	-0.36	0.06	-0.22	0.50	
10 Energy value (kcal)	0.15	-0.25	0.06	0.02	-0.03	0.03	-0.01	0.01	0.02
11 Protein (gm)	0.15	-0.29	-0.04	0.05	0.05	0.02	0.04	0.01	0.01
12 Calcium (mg)	0.10	-0.15	-0.04	0.07	0.00	0.02	0.01	-0.06	0.02
13 Iron (mg)	0.16	-0.32	-0.05	-0.02	0.02	-0.01	0.01	0.02	-0.01
14 Vitamin A value (10 IU)	-0.05	-0.05	-0.12	0.09	0.06	0.10	0.09	0.00	0.01
15 Thiamine (mg)	0.15	-0.30	-0.08	-0.08	-0.07	-0.04	-0.07	-0.02	-0.04
16 Riboflavin (mg)	0.11	-0.19	-0.08	0.06	0.04	0.04	0.05	-0.03	0.03
17 Niacin (mg)	0.09	-0.29	-0.02	-0.01	0.08	-0.01	0.06	0.06	0.00
18 Ascorbic acid (mg)	-0.03	0.07	0.26	0.12	-0.01	-0.02	-0.01	0.03	0.00
19 % kcal/basal	0.07	-0.01	-0.04	-0.20	-0.08	-0.03	-0.07	-0.03	-0.04
Mean	128.0	1.48	5.3	9.6	0.7	0.5	1.2	1.2	0.3
Standard deviation	7.3		1.2	4.7	2.0	1.2	2.7	0.9	0.3

r = 0.14 significant at 0.05 level

r = 0.19 significant at 0.01 level

Table 11 (Continued)

Variables	10	11	12	13	14	15	16	17	18	19
1 Age (mo)(spring, 1968)										
2 Sex (boy = 1) (girl = 2)										
3 Δ height (cm)										
4 Δ weight (lb)										
5 Δ triceps skinfold thickness (mm)										
6 Δ subscapular skinfold thickness (mm)										
7 Δ total skinfold thickness (mm)										
8 Δ leg girth (cm)										
9 Δ muscle-bone diameter (cm)										
10 Energy value (kcal)										
11 Protein (gm)	0.82									
12 Calcium (mg)	0.69	0.79								
13 Iron (mg)	0.81	0.83	0.48							
14 Vitamin A value (10 IU)	0.22	0.31	0.27	0.34						
15 Thiamine (mg)	0.79	0.76	0.65	0.77	0.29					
16 Riboflavin (mg)	0.74	0.85	0.91	0.63	0.48	0.74				
17 Niacin (mg)	0.66	0.73	0.30	0.81	0.32	0.63	0.51			
18 Ascorbic acid (mg)	0.39	0.28	0.23	0.29	0.27	0.38	0.28	0.33		
19 % kcal/basal	0.81	0.55	0.47	0.61	0.12	0.63	0.54	0.48	0.33	
Mean	2293	84	1208	11.7	482	1.18	2.32	13.8	65	92
Standard deviation	468	18	361	2.6	257	0.29	0.60	3.5	30	39

r = 0.14 significant at 0.05 level

r = 0.19 significant at 0.01 level

Table 12. Intercorrelations among diet and changes in body size among boys (Spring, 1967 to spring, 1968, N = 96)

Variables	1	2	3	4	5	6	7	8	9
1 Age (mo)									
2 Δ height (cm)	-0.07								
3 Δ weight (lb)	0.14	0.33							
4 Δ triceps skinfold thickness (mm)	-0.13	-0.04	0.46						
5 Δ subscapular skinfold thickness (mm)	0.00	0.13	0.56	0.56					
6 Δ total skinfold thickness (mm)	-0.09	0.03	0.56	0.94	0.81				
7 Δ leg girth (cm)	-0.11	0.27	0.48	0.30	0.48	0.41			
8 Δ muscle-bone diameter (cm)	0.14	0.31	0.33	-0.20	0.11	-0.10	0.49		
9 Energy value (kcal)	0.04	0.09	0.02	-0.07	0.09	-0.01	-0.08	-0.06	
10 Protein (gm)	0.10	0.08	0.13	0.05	0.08	0.07	0.00	0.01	0.79
11 Calcium (mg)	0.07	0.00	0.02	0.05	0.01	0.04	-0.17	-0.14	0.60
12 Iron (mg)	0.10	0.09	0.06	-0.03	0.09	0.01	0.02	0.01	0.79
13 Vitamin A (10 IU)	-0.04	-0.01	0.16	0.28	0.23	0.30	0.04	-0.16	0.25
14 Thiamine (mg)	0.09	0.03	-0.06	-0.11	0.00	-0.07	-0.04	-0.09	0.79
15 Riboflavin (mg)	0.05	-0.01	0.02	0.08	0.05	0.08	-0.12	-0.10	0.73
16 Niacin (mg)	0.00	0.12	0.10	0.04	0.10	0.07	0.11	0.10	0.68
17 Ascorbic acid (mg)	-0.15	0.20	-0.04	-0.03	0.00	-0.02	0.02	-0.05	0.44
18 % kcal/basal	-0.08	-0.04	-0.23	-0.15	0.03	-0.10	-0.05	-0.07	0.90
Mean	128.3	5.0	8.9	0.7	0.4	1.0	1.2	0.3	2406
Standard deviation	7.6	0.9	4.2	1.9	1.1	2.6	1.0	0.3	441

r = 0.20 significant at 0.05 level

r = 0.26 significant at 0.01 level

Table 12 (Continued)

Variables	10	11	12	13	14	15	16	17	18
1 Age (mo)									
2 Δ height (cm)									
3 Δ weight (lb)									
4 Δ triceps skinfold thickness (mm)									
5 Δ subscapular skinfold thickness (mm)									
6 Δ total skinfold thickness (mm)									
7 Δ leg girth (cm)									
8 Δ muscle-bone diameter (cm)									
9 Energy value (kcal)									
10 Protein (gm)									
11 Calcium (mg)	0.74								
12 Iron (mg)	0.79	0.37							
13 Vitamin A (10 IU)	0.30	0.24	0.30						
14 Thiamine (mg)	0.69	0.58	0.71	0.21					
15 Riboflavin (mg)	0.82	0.90	0.53	0.41	0.68				
16 Niacin (mg)	0.75	0.25	0.79	0.32	0.58	0.47			
17 Ascorbic acid (mg)	0.23	0.23	0.29	0.37	0.45	0.31	0.28		
18 % kcal/basal	0.66	0.49	0.69	0.18	0.75	0.62	0.57	0.43	
Mean	89	1260	12.5	495	1.27	2.43	14.8	63	93
Standard deviation	17	352	2.5	216	0.30	0.57	3.6	28	36

r = 0.20 significant at 0.05 level

r - 0.26 significant at 0.01 level

Table 13. Intercorrelations among diet and changes in body size among girls (Spring, 1967 to spring, 1968, N = 87)

Variables	1	2	3	4	5	6	7	8	9
1 Age (mo)									
2 Δ height (cm)	0.28								
3 Δ weight (lb)	0.18	0.46							
4 Δ triceps skinfold thickness (mm)	0.14	-0.01	0.15						
5 Δ subscapular skinfold thickness (mm)	-0.05	0.07	0.43	0.52					
6 Δ total skinfold thickness (mm)	0.08	0.02	0.29	0.93	0.80				
7 Δ leg girth (cm)	0.01	0.31	0.75	0.19	0.30	0.26			
8 Δ muscle-bone diameter (cm)	-0.05	0.20	0.63	-0.47	0.04	-0.32	0.54		
9 Energy value (kcal)	0.26	0.18	0.11	0.02	0.05	0.03	0.11	0.07	
10 Protein (gm)	0.18	0.01	0.09	0.06	0.06	0.07	0.04	0.00	0.81
11 Calcium (mg)	0.13	-0.01	0.16	-0.04	0.08	0.01	0.08	0.13	0.72
12 Iron (mg)	0.21	-0.01	0.00	0.09	0.01	0.06	0.03	-0.04	0.81
13 Vitamin A (10 IU)	-0.06	-0.17	0.06	-0.10	0.03	-0.06	-0.04	0.11	0.19
14 Thiamine (mg)	0.21	-0.02	-0.01	-0.01	0.00	-0.01	0.01	0.00	0.78
15 Riboflavin (mg)	0.16	-0.05	0.15	0.02	0.10	0.06	0.08	0.12	0.74
16 Niacin (mg)	0.20	0.02	-0.02	0.16	-0.03	0.10	0.01	-0.09	0.58
17 Ascorbic acid (mg)	0.09	0.29	0.22	0.01	-0.05	-0.02	0.04	0.03	0.40
18 % kcal/basal	0.22	-0.03	-0.17	-0.02	-0.08	-0.05	-0.02	-0.02	0.78
Mean	127.6	5.7	10.4	0.7	0.7	1.5	1.2	0.3	2168
Standard deviation	7.1	1.3	5.0	2.0	1.2	2.8	0.9	0.4	467

r = 0.21 significant at 0.05 level

r = 0.27 significant at 0.01 level

Table 13 (Continued)

Variables	10	11	12	13	14	15	16	17	18
1 Age									
2 Δ height (cm)									
3 Δ weight (lb)									
4 Δ triceps skinfold thickness (mm)									
5 Δ subscapular skinfold thickness (mm)									
6 Δ total skinfold thickness (mm)									
7 Δ leg girth (cm)									
8 Δ muscle-bone diameter (cm)									
9 Energy value (kcal)									
10 Protein (gm)									
11 Calcium (mg)	0.84								
12 Iron (mg)	0.84	0.58							
13 Vitamin A (10 IU)	0.32	0.29	0.38						
14 Thiamine (mg)	0.80	0.72	0.79	0.38					
15 Riboflavin (mg)	0.86	0.91	0.70	0.54	0.81				
16 Niacin (mg)	0.68	0.30	0.81	0.33	0.60	0.51			
17 Ascorbic acid (mg)	0.38	0.25	0.36	0.20	0.41	0.29	0.48		
18 % kcal/basal	0.50	0.45	0.60	0.08	0.58	0.48	0.42	0.26	
Mean	78	1152	10.9	468	1.09	2.20	12.8	67	92
Standard deviation	18	364	2.4	296	0.26	0.63	3.0	32	42

r = 0.21 significant at 0.05 level

r = 0.27 significant at 0.01 level

the 87 girls measured in the spring, 1968 reported that menarche had occurred during the year. None had menstruated prior to the study.

Girls tended to have greater increases in subscapular skinfold thickness than boys ($r = 0.16$, $\overline{X} = 0.7$ mm versus $\overline{X} = 0.4$ mm). This finding agrees with Tanner and Whitehouse (47) who observed a greater slope in the growth of subscapular skinfold thickness among girls than boys. On the other hand, within the ages 8 to 12 years no relationship between sex and growth of the triceps skinfold thickness was observed in the British survey (47) or in the current study. Both change of leg girth and growth of muscle-bone diameter were also unrelated to sex.

Increment in height was associated with changes in weight ($r = 0.44$, Table 11), leg girth ($r = 0.28$) and muscle-bone diameter ($r = 0.23$). Among boys increment in height tended to be positively related also to change in skinfold thickness at the subscapular site ($r = 0.13$) but not at the triceps.

Change in weight was slightly more highly related to change in total skinfold thickness ($r = 0.56$) than to change in leg girth ($r = 0.48$) for boys. In contrast girls showed a significantly ($p \leq 0.01$) greater correlation between change in weight and change in leg girth ($r = 0.75$) than change in total skinfold thickness ($r = 0.29$).

The measurement of the subscapular skinfold thickness was independent of the measurement of muscle-bone diameter as was measurement of total skinfold thickness of leg girth measurement. Because muscle-bone diameter was calculated from the triceps skinfold thickness, correlations of muscle-bone diameter with triceps skinfold thickness and with total skinfold thickness were not considered to be meaningful. Change in subscapular skinfold thickness was not related to change in muscle-bone diameter for the children as a group. However, among the boys alone, increase in subscapular skinfold thickness tended to be related to increase in muscle-bone diameter ($r = 0.11$) while change in total skinfold thickness was related to change in leg girth among both boys ($r = 0.41$) and girls ($r = 0.26$).

Nutrient intakes were not related to increment in height except in the case of ascorbic acid ($r = 0.26$). For the group as a whole there was a small correlation between ascorbic acid intake and change in weight ($r = 0.12$). The relationships between intake of certain nutrients and changes in body measurements were small and inconsistent and, therefore, probably were the result of chance.

Weight and fatness have been found to be negatively related to energy value of the diet in many studies (10, 16, 17, 21, 45). However, among the fourth- and fifth-grade children in the present study, changes in weight, skinfold thickness, leg girth and muscle-bone diameter were not related to energy value of the diet. Apparently activity and/or utilization of calorigenic nutrients were more important in determining change in body mass than was food intake.

Basal caloric requirement of each subject was estimated from height and weight using the Wetzel Grid. The percent of food energy over basal was calculated by the formula

$$\% \text{ kcal/basal} = \frac{\text{average daily kcal - basal kcal x 100}}{\text{basal kcal}}.$$

Surprisingly, the values so obtained correlated negatively with change in weight ($r = -0.20$) and did not correlate with any other change in body measurement. Among the girls percent caloric intake above basal was positively related to age ($r = 0.22$). The method used may have overestimated basal energy requirement of obese subjects because it did not take into account differences in metabolic rate between lean and adipose tissue.

Factors related to performance

Diet and growth are important due to their influence on both physical and mental performance. A few relationships involving measurements of performance have been investigated in the current study. The data included and the method of analysis do not warrant conclusions about cause and effect, but rather suggest possible influences. Measurements of performance included the following:

scholastic achievement	- average of 1967 and 1968 scores of Iowa Every Pupil Test of Basic Skills
general strength	- handgrip dynamometer readings
physical fitness	- scores of The New York State Physical Fitness Screening Test
agility	- number of lines crossed in 10 seconds of sidestepping
strength	- number of situps completed in 60 seconds
endurance	- number of squat thrusts accomplished in 30 seconds
speed	- time required to run 45 yards

The low positive correlation between the two tests of strength, that is, handgrip and number of situps, (r = 0.13 Table 14) suggests that at least one of the tests was not valid or reliable, or that the two tests measured different components of strength. Logarithm of total skinfold thickness related positively to strength of handgrip (r = 0.24), but negatively to number of situps accomplished (r = -0.21). These correlations confirm the casual observation that fatness tended to hinder spacially a child's ability to perform the situps. On the other hand, body fat did not appear to impede a child's use of the dynamometer.

The sum of the grip strengths of both hands was positively related to agility (r = 0.24), height (r = 0.59) and logarithm of weight (r = 0.60). The significant relationship between handgrip strength and age (r = 0.30) suggest the previously mentioned relationships may have been a result of physical growth and maturation. Nutrient intake was positively correlated with handgrip strength as was caloric value of the diet (r = 0.16).

Table 14. Intercorrelations among performance, age, sex, body measurements and diet (Spring and fall, 1967, N = 192)

Variables	1	2	3	4	5	6	7
1 Handgrip (kg)							
2 Agility (sidesteps)	0.24						
3 Strength (situps)	0.13	0.33					
4 Endurance (squat thrusts)	0.03	0.12	0.26				
5 Speed (seconds)	-0.25	-0.30	-0.24	-0.08			
6 Total fitness score	0.10	0.61	0.71	0.59	-0.48		
7 ITBS (scholastic achievement)	0.07	0.24	0.00	-0.08	-0.21	0.06	
8 Age	0.30	0.07	0.08	-0.04	-0.20	-0.06	0.17
9 Sex (boy = 1) (girl = 2)	-0.43	-0.09	-0.11	-0.05	0.31	0.02	0.09
10 Height	0.59	0.18	0.03	-0.09	-0.08	-0.03	0.20
11 Log weight	0.60	0.06	-0.11	-0.15	0.13	-0.22	0.08
12 Log total skinfold thickness	0.24	-0.08	-0.21	-0.17	0.39	-0.30	0.01
13 Leg girth	0.56	-0.01	-0.11	-0.17	0.17	-0.25	0.04
14 Muscle-bone diameter	0.51	0.00	-0.13	-0.12	0.14	-0.21	0.00
15 Energy value	0.16	0.04	0.09	-0.07	-0.18	0.02	-0.01
16 Protein	0.21	0.05	0.11	-0.08	-0.11	0.01	-0.07
17 Calcium	0.18	0.06	0.05	-0.08	-0.06	-0.03	0.04
18 Iron	0.12	0.04	0.16	-0.07	-0.17	0.06	-0.07
19 Vitamin A value	0.06	0.04	0.15	-0.04	-0.12	0.08	0.03
20 Thiamine	0.13	0.03	0.12	-0.05	-0.17	0.03	-0.11
21 Riboflavin	0.16	0.04	0.09	-0.06	-0.11	0.00	-0.04
22 Niacin	0.15	0.03	0.15	-0.06	-0.18	0.05	-0.19
23 Ascorbic acid	0.17	0.09	0.16	-0.09	-0.14	0.11	0.05
Mean	34.7	12.3	20.7	13.0	12.0	19.3	43.3
Standard deviation	7.7	2.1	6.4	4.2	0.9	4.5	12.2

r = 0.14 significant at 0.05 level

r = 0.18 significant at 0.01 level

Scores for four of the six pairs of components of the physical fitness test were significantly related. Strength was positively related with agility (r = 0.33) and endurance (r = 0.26). Time required to run 45 yards, which is inversely proportional to speed, was negatively correlated with agility (r = -0.30) and strength (r = -0.24). Neither agility nor speed was related with endurance. Time required for the dash was significantly related to age (r = -0.20) but not to height (r = -0.08).

A positive partial correlation was observed between score for agility and scholastic achievement scores with age held constant (r = 0.23) but the correlation was negative (r = -0.18) between scholastic achievement score and time required to run 45 yards, age held constant. There were essentially no relationships between scores of other components of physical fitness and achievement test score. The negative correlation between achievement test score and niacin intake was probably a chance relationship. No other correlations with the nutrient intakes occurred.

The number of situps completed in one minute was related with dietary values for iron (r = 0.16), vitamin A (r = 0.15), niacin (r = 0.15) and ascorbic acid (r = 0.16). Time required to run 45 yards was correlated negatively with intakes of iron (r = -0.17), thiamine (r = -0.17), niacin (r = -0.18) and ascorbic acid (r = -0.14). One might suggest the dependency of strength and speed on age and sex would give rise to the observed correlations. When age and sex were held constant, relationships between scores of physical fitness and intakes of the B vitamins did decrease markedly, but the correlations between strength or speed and dietary values of iron, vitamin A and ascorbic acid changed very little. Because the relationships between measures of physical fitness and nutritive value of the diet were low and inconsistent, the practical significance of these relationships is questionable.

Score of endurance was negatively related to logarithm of weight (r = -0.15), logarithm of total skinfold thickness (r = -0.17), leg girth (r = -0.17) and muscle-bone diameter (r = -0.12). Thus, larger, fatter individuals tended to have less endurance than smaller, leaner children.

A positive correlation between time required to run 45 yards and logarithm of total skinfold thickness (r = 0.39) indicated that children who tended to be fat were slower than children who tended to be slender. Also related to time required for the dash were leg girth (r = 0.17) and muscle-bone diameter (r = 0.14). When logarithm of total skinfold thickness was held constant, the partial correlation coefficients for leg girth and muscle-bone diameter with speed score were -0.19 and -0.13, respectively. Thus, the more muscular children tended to be faster than the other children providing they were not fatter. Time required to complete the dash was negatively correlated with energy value of the diet (r = -0.18) and with nutrient intake. These relationships are probably dependent on size and sex of the child.

Raw scores for each component of the physical fitness test were translated into achievement levels within sex and grade (see page 43). The four achievement levels of each subject were added together to obtain his total fitness score. Total fitness score correlated negatively with logarithm of weight ($r = -0.22$), logarithm of total skinfold thickness ($r = -0.30$), leg girth ($r = -0.25$) and muscle-bone diameter ($r = -0.21$). When logarithm of total skinfold thickness was held constant partial correlations of total fitness score to leg girth ($r = -0.06$) and muscle-bone diameter ($r = -0.04$) diminished. Therefore, fatness apparently accounted for negative correlations originally observed.

Relationships between diet and growth of individuals

While population trends are valuable in studying relationships between diet and growth, important individual differences may be obscured. The author has chosen several subjects for whom individual information was particularly interesting.

The body measurements of a fifth-grade boy are given in Table 15. The first spring he informed the interviewer that he was on a calorie-restricted diet for the purpose of losing weight. He could not remember the caloric allowance his doctor had prescribed. No change in activity was reported. By fall, 1967 his weight and skinfold thicknesses had decreased

Table 15. Body measurements of subject 08-2-23-1

	Spring, 1967	Fall, 1967	Spring, 1968
Height	144.4 cm	145.8 cm	148.5 cm
Weight	105.3 lb	97.5 lb	111.2 lb
Triceps skinfold thickness	20.9 mm	12.5 mm	17.7 mm
Subscapular skinfold thickness	18.4 mm	10.3 mm	13.4 mm
Arm girth	28.6 cm	25.2 cm	29.3 cm
Leg girth	37.8 cm	33.8 cm	35.1 cm
Muscle-bone diameter	7.0 cm	6.8 cm	7.6 cm

considerably. In the spring of 1968 he volunteered the information that he had quit the reducing diet but needed to resume it. Measurements at that time indicated that his body fat had increased markedly, although he was still less fat than he had been a year earlier.

The energy value of his food intake for a single day in the spring, 1967 was estimated to be 1697 kilocalories. The average caloric value of food intake two days in the following fall and two days in the winter was calculated to be 1814 kilocalories. Except for vitamin A value and ascorbic acid intake, which normally vary widely from day to day, intakes of protein, vitamins and minerals were fairly constant over the six days sampled and were at least two-thirds of the 1968 RDA. The subject reported that he lowered caloric intake by restricting consumption of rich desserts and sweet snacks and by substituting non-nutritive sweetener for sugar added at the table. Assuming energy expenditure was held constant, a reduction equivalent to about 200 kcal per day over a four-month period could account for a weight loss of 7 or 8 lbs. Such a reduction could be accomplished by the dietary restrictions reported. Likewise, an increase of about 200 kcal over 8 or 9 months could account for a weight gain of 14 or 15 lb.

One fifth-grade girl reported particularly large food intake and exhibited large increments in fat and muscle tissue. As shown by the following values (Table 16) from data obtained in the fall, 1967 the subject was relatively small for her age.

Table 16. Body measurements of subject 05-2-27-2 and means for fifth-grade girls (Fall, 1967)

Variables	Subject	Average of fifth-grade girls (N=48)
Age	122.8 mo	125.7 mo
Height	130.0 cm	140.9 cm
Weight	61.6 lb	75.7 lb[a]
Triceps skinfold thickness	10.2 mm	12.0 mm[a]
Subscapular skinfold thickness	6.1 mm	6.2 mm[a]
Arm girth	20.4 cm	21.9 cm
Leg girth	27.9 cm	29.4 cm
Muscle-bone diameter	5.5 cm	5.7 cm

[a]Obtained from logarithmically transformed data.

Estimated caloric value of food intake reported by this subject was 3786 kilocalories per day over a period of one year from April, 1967 until April, 1968. Average daily caloric value of the diet for all girls over this period of time was 2168 kilocalories per day. Changes in body measurements from spring, 1967 to spring, 1968 are given below.

Table 17. Changes in body measurements of subject 05-2-27-2 and average changes for all girls (Spring, 1967 to spring, 1968)

Variables	Subject	Average of all girls (N=87)
Height	4.5 cm	5.7 cm
Weight	12.3 lb	10.4 lb
Triceps skinfold thickness	2.7 mm	0.7 mm
Subscapular skinfold thickness	2.1 mm	0.7 mm
Arm girth	4.8 cm	1.1 cm
Leg girth	2.9 cm	1.2 cm
Muscle-bone diameter	0.8 cm	0.3 cm

Since her increment in height was less than the average, it does not appear that this subject was merely catching up in size with the others. Her secondary sexual characteristics were not developed enough to suggest she was ready for puberty. The dietary caloric value for this subject (3786 kcal per day), which is approximately 1600 kcal greater than the average value may have overestimated her usual intake. Her physical fitness scores, which were below average, suggested that she was not particularly active and likely to expend exceptionally large amounts of energy. That her food intake probably was larger than that of most girls is apparent in the larger increments in skinfolds and muscle mass, however. If her large dietary intakes were to continue, she would be likely to become obese.

Fraternal twin girls living together reported markedly different numbers of food items eaten and amounts of food consumed. The twin reporting the larger intake (2640 kilocalories per day) gained 15.5 pounds during the year. Her sister reported a smaller food intake (1648 kilocalories per day) and gained 9.2 pounds during the year. The twin who gained the greater amount of weight also had an increase of 3 mm in total skinfold thicknesses whereas her sister had none. At the end of the present study, the heavier twin exhibited more advanced development of secondary sex characteristics than did her sister. She also obtained better scores for all components of the physical fitness test, the greatest difference occurring in number of situps (22 versus 15).

Assuming the twins had similar genetic potentials for growth, the influence of diet on growth would be clearly seen in the above example. Except for size and maturation, the girls looked very much alike suggesting they had inherited many identical characteristics. However, one cannot assume that growth potentials are alike for fraternal twins. Whether differences in eating habits and growth between these two girls were the result of inherent or environmental conditions cannot be known for sure.

Influence of Nutrition Education and Grade Level on Diet, Growth and Selected Factors

All of the approximately 280 fourth- and fifth-grade pupils of the six public elementary schools of Monroe County, Iowa participated in an experiment of nutrition education. Of these pupils about 200 were subjects for whom all data included in this study could be collected. For the remaining pupils only scores on the test of nutrition-related cognitive abilities and the Iowa Every Pupil Test of Basic Skills were obtained.

The nutrition education program consisted of thirteen daily lessons taught by the author in the fall, 1967 plus a bulletin board and rat feeding demonstration which were provided the following winter. In half of the schools the program was conducted in fourth-grade classes; in the other half the program was administered to fifth-grade classes. In each school the fourth- or fifth-grade class not receiving special instruction served as a control group. This produced a partially balanced incomplete block design where schools served as blocks (Table 18).

Table 18. Design of factorial experiment

	Factor A: Treatment	
Factor B: grade	Nutrition education	Control
Fourth	III[a], VI, VII	I, V, VIII
Fifth	I, V, VIII	III, VI, VII

[a]Original code numbers for schools have been retained for the benefit of those who may wish to refer to original data. Schools II, the junior high school and IV, the parochial school participated in the 1964-1965 survey but not in the present investigation.

Before the teaching began, data for each school were collected in the spring and early fall of 1967. The nutrition test was administered in each school before and after the completion of the experimental unit in the fall and again in spring, 1968. Other data as described earlier were obtained in April and early May of 1968. Within each school data of a given type were collected in both the experimental and the control classes on the same day.

Classroom means rather than individual data were used in the analyses of variance. For each variable the values of a given child were included in the classroom mean only if both pre- and post-treatment measurements were available. A list of the number of pupils averaged for classroom means for each

each variable is given in Appendix F.

Schools III, VI and VII, which had nutrition education in the fourth grade, were considered to be Group I. Group II consisted of Schools I, V and VIII in which nutrition was taught in the fifth grades. Analyses of variance were based on the model given in Table 19.

Group, treatment and time of measurement are fixed effects; school is random. The model assumes there is no school-by-grade interaction. A sample analysis of variance is presented in Table 20. The test for grade-by-treatment interaction using the model is conservative, therefore the null hypothesis, "There is no effect of interaction between treatment and grade", is less likely to be rejected when false than if a completely balanced design had been used.

Changes in scores on test of nutrition-related cognitive abilities

The test of nutrition-related cognitive abilities (Appendix E) was administered within one week before nutrition teaching began and re-administered within one week after the thirteen lessons were completed. It was given for the third time in the spring of 1968. Neither pupils nor teachers were allowed to see the tests except during actual administration. Individual scores for the second test were given to each teacher of an experimental group to use in assigning quarterly grades. Otherwise, test results were not released. When

Table 19. Statistical model for analyses of variance

$$X_{jkl/i} = \bar{X} + L_i + S_{j/i} + T_k + LT_{ik} + ST_{jk/i} + P_l + LP_{il} + SP_{jl/i} + TP_{kl} + LTP_{ikl} + STP_{jkl/i}$$

where:

$X_{jkl/i}$	∿	the mean of the classroom of school j in group i having treatment k measured at time l
$\bar{X}$	∿	the mean of all classroom means
L_i	∿	the effect of group i (interaction of grade and treatment)
$S_{j/i}$	∿	the effect of school j within group i
T_k	∿	the effect of treatment k
LT_{ik}	∿	the effect of interaction between group i and treatment k
$ST_{jk/i}$	∿	the effect of interaction between school j and treatment k within group i
P_l	∿	the effect of time of measurement l
LP_{il}	∿	the effect of interaction between group i and time of measurement l
$SP_{jl/i}$	∿	the effect of interaction between school j and time of measurement l within group i
TP_{kl}	∿	the effect of interaction between treatment k and time of measurement l
LTP_{ikl}	∿	the effect of interaction among group i, treatment k and time of measurement l
$STP_{jkl/i}$	∿	the effect of interaction among school j, treatment k and time of measurement l within group i

Table 20. Sample analysis of variance. (Scores on test of nutrition-related cognitive abilities at first and second administrations)

Source[a]	d.f.	S.S.	M.S.	E.M.S.	F.
L	1	25,764	25,764	$\sigma_e^2 + pt\sigma_s^2 + ptsK_l^2$	4.214
S/L	4	73,373	6,114	$\sigma_e^2 + pt\sigma_s^2$	
T	1	120,050	120,050	$\sigma_e^2 + p\sigma_{st}^2 + plsK_t^2$	15.445*
TL	1	30,258	30,258	$\sigma_e^2 + p\sigma_{st}^2 + psK_{tl}^2$	3.893
ST/L	4	93,274	7,773	$\sigma_e^2 + p\sigma_{st}^2$	
P	1	264,264	264,264	$\sigma_e^2 + t\sigma_{sp}^2 + tslK_p^2$	32.010**
PL	1	6,160	6,160	$\sigma_e^2 + t\sigma_{sp}^2 + tsK_{pl}^2$	<1
SP/L	4	99,068	8,256	$\sigma_e^2 + t\sigma_{sp}^2$	
TP	1	175,232	175,232	$\sigma_e^2 + slK_{tp}^2$	72.114**
TPL	1	10,952	10,952	$\sigma_e^2 + sK_{tpl}^2$	4.507
STP/L	4	29,159	2,430	σ_e^2	

[a]See preceding table for explanation of sources of variation.

*$p \leq 0.05$.

**$p \leq 0.01$.

teaching, the investigator did not use examples included in the test and made no attempt to emphasize topics which pupils had answered incorrectly on the initial test.

Responses of all pupils in the experimental groups were pooled to analyze the test for the first, second and third administrations. Mean scores on the first administration (N = 130) was 29.8 $\pm$ 4.1; the median score was 30. The coefficient of reliability estimated by the Kuder-Richardson "formula 20" (19) was 0.28. These statistics reflected the inability of the test to discriminate reliably among individuals. Low reliability coefficients and small standard deviations are not uncommon for populations in which knowledge of the tested material is uniformly low.

On the second administration (N = 131) the mean had risen to 36.4 $\pm$ 6.0 (median = 36). The increase in standard deviation from 4.1 to 6.0 reflected increased dispersion of scores. The coefficient of reliability rose to 0.65. Many consider that coefficients over 0.60 indicate ability of a test to discriminate among groups.[1]

The mean for the third administration (N = 131) was 34.2 $\pm$ 5.2 (median = 34) while the coefficient of reliability was 0.54.

---

[1]Chadderdon, Hester. Home Economics Education Department, Iowa State University, Ames, Iowa. Conference concerning test analysis. Personal communication. 1968.

Progress toward cognitive objectives as a result of thirteen daily lessons should have been most apparent in the differences between scores of the first and second administrations. Indeed, significantly greater improvements in scores were observed among the experimental groups than among the control groups ($p \leq 0.01$). See Table 21.

Table 21. Mean[a] scores of nutrition test, administrations 1 and 2

	Administration 1	Administration 2	Change
Experimental	29.7	36.3	6.6
Control	30.2	30.9	0.7

[a]Means are averages of 6 classroom means.

Between the second and third administrations of the test, subjects in experimental groups had time to forget what they had learned and control subjects had time to study part of the subject matter included on the test. For instance, some control groups studied cells and digestion in the interim. In the winter a bulletin board and an animal feeding demonstration were provided for the experimental classes to reinforce their learnings (see page 50).

The mean scores for administration 3 demonstrated the expected decreases among the experimental groups and increases among control groups when compared with those obtained for administration 2. However, the experimental group maintained its improvement over the control group when compared with administration 1 (See Table 22).

Table 22. Mean[a] scores of nutrition test, administrations 1 and 3

	Administration 1	Administration 3	Change
Experimental	29.1	33.3	4.2
Control	30.6	32.9	2.3

[a]Means are averages of 6 classroom means. Note: Means for administration 1 vary slightly from those given in Table 21 because, if a child was absent during administrations 2 or 3, his score for administration 1 would be omitted from the calculation of the respective mean.

When the variance was partitioned into the 11 sources shown in the model (Table 19), the treatment-by-time of measurement term which indicated influence of treatment, only approached significance at the 0.05 level with one and four degrees of freedom.

Disregarding time of measurement fifth-graders had scores that were significantly ($p \leq 0.01$) higher than those of the fourth-grade pupils (X = 32.6 versus X = 30.3). This finding reflects the fact that material usually covered in fourth and fifth grades was included on the test, thus giving the older groups an advantage. Furthermore, the fifth-graders probably had more experience in reading and responding to tests.

There is a possibility that a test of cognitive abilities may, in fact, be a test of general scholastic ability or intelligence rather than the intended cognitive abilities. Score on the nutrition test for the first administration was related to composite score on the Iowa Every Pupil Test of Basic Skills (r = 0.54). Furthermore, among the experimental subjects change in nutrition test score from administration 1 to administration 2 was related to the scholastic achievement score (r = 0.24).

Seventy-five of the 252 children, or 30%, had reading scores below the twenty-fifth percentile on the Iowa test. Since performance in the test depended on reading ability as well as nutrition-related cognitive abilities, the experimenter pronounced words when asked to do so; however, the poorest readers seldom requested help. According to the Iowa reading test scores poor readers appeared to be fairly evenly dispersed among the classrooms; therefore, their nutrition test scores were not eliminated.

Changes in mean scores of the Iowa Every Pupil Test of Basic Skills (ITBS) were not significantly associated with treatment. Finding that ITBS scores had increased more for the experimental groups than for the control classes would have suggested that the increases in nutrition test scores might have been due to increased general scholastic ability rather than to nutrition classes.

In summary, both initial score and change of score on the nutrition test between administrations 1 and 2 were related to ITBS score for individuals. However, on a group basis changes in ITBS scores did not explain differences in changes in nutrition test scores between the experimental and control groups.

Although it was not measured, enthusiasm for learning may have been an important outcome of the experimental nutrition program. Doubtless part of pupils' enthusiasm was due to having a visiting teacher. Beyond that, facial expressions, questions and comments of the children indicated intense interest in the subject matter. During a discussion of cell growth and function one class asked the experimenter a number of questions about the cause of death. Pupils of another class whispered cheers for foods being tested with iodine to detect the presence of starch. Two classes stayed after school to disassemble an anatomical model and then challenged the author to re-assemble it. A number of pupils brought food labels from home for classmates to inspect. Perhaps these children will be likely to participate eagerly in further study of nutrition.

Changes in responses to specific test items

Responses to individual nutrition test items were analyzed to provide indications of pupils' attainment of specific cognitive objectives. However, the following cautions should be made concerning interpretation of such data:

(1) Individual test items provide evidence of goal achievement only if the items test the ability set forth in the objective. A specialist in home economics evaluation and the author selected items they considered to have construct validity; theoretically the items would measure what they were supposed to measure. No other test of validity was applied to the items.

(2) The items evidenced achievement of objectives only to the extent that they are representative of the desired behaviors. Due to the need for a test which most of the pupils could complete in 30 minutes, only one or a few items related to an objective could be included. The probability of misjudging attainment of any particular cognitive objective was high due to the limited sampling of behavior related to that goal.

To analyze the individual items, responses of all pupils in experimental classrooms were pooled; classroom means were ignored and no adjustments were made for missing data. The numbers of children from experimental classrooms tested were 130 the first time and 131 the second and third times.

The discussion is organized according to the order of the objectives rather than the order of the items in the test. To save space, "After a child has completed this unit, he should be better able to", has been omitted from the following statements of objectives, leaving only the pupil behaviors. See Appendix E for a complete statement of objectives. Questions preceded by arabic numerals have only one correct response each. Questions preceded by a capital letter may have more than one correct response, therefore, each response for such questions was considered a separate true-false item. Crosses indicate responses intended to be correct. The numbers under responses are the numbers of children who made correct choices on the first, second and third administrations, respectively.

Objective: I. Formulate a concept of health involving optimum well-being.

Items: A. What does the meaning of the word health include?

X 16. being at one's best in body

103 109 111

X 17. being at one's best in mind

60 72 73

X 18. getting along well with others

36 89 59

As would be expected, a majority of the children initially thought health was a state of physical well-being; therefore, there was little subsequent improvement in numbers of correct responses for item 16. Chalk drawings were used to encourage discussion of characteristics of physical health, mental alertness and social well-being. The comments and inflections of a number of children indicated they were surprised that health included social aspects. Responses to item 18 suggested social health was a new concept to many and that it was later forgotten by some although there was much material concerning social relationships in the health textbooks used by these children.

Item 15, "not being sick", intended to be a correct choice, was eliminated because some children feeling the phrase was too limited failed to mark it. Item 19, "never getting tired", intended to be an incorrect phrase was also eliminated because some children asked if it meant "at night" or "things like falling asleep in class".

The 103 to 111 correct responses to item 16, "being at one's best in body", were about the maximum which could be expected. On the Iowa Every Pupil Test of Basic Skills 35 children in the experimental group had average reading scores below the twenty-fifth percentile. Many of these pupils probably were unable to read the test and responded disregarding content of the responses.

Objectives: IIA. Relate health and growth of the body to that of the cells.

IIA1. Formulate an elementary, workable definition of a cell in its relationship to the body.

IIA2. Describe in elementary terms cell division and growth.

Item: 7. Here are some definitions of cells written by fourth-graders. Which is correct?

____1. Cells are little holes in the body that let out sweat.

__X_2. Cells are the smallest living parts of plants and animals.

10 57 49

____3. Cells are tiny tubes that run throughout the body.

____4. Cells are tiny blocks that make up the skin.

____5. Cells are the molecules of which everything is made.

Initially confusion about cells was widespread and included the class which told the author that they knew "all about cells". Many of the children thought they were blood vessels; 65 pupils selected response 3 at the beginning. Although there was an increase of 47 children marking the correct response, a majority never did select the correct definition.

Response 5 was selected by 24, 29 and 37 pupils during the year. The investigator did not talk about molecules except when asked in one class which were larger, cells or molecules. Probably more effort to distinguish among cells, molecules and atoms should be made in the middle grades since children have heard all these terms and all are too small to be seen with the unaided eye.

Item: 9. Which of these sentences about cells is true?

___1. Most cells are shaped like long tubes.

___2. Most cells in the body are square.

___3. Most cells in the human body live 60 to 90 years.

_X_4. The dividing and growing of the cells are what makes the body grow.

42	51	60

___5. A tissue is made of many different kinds of cells.

Regarding item 9 the number of children selecting the fifth response increased from 23 to 44 between the first and second administrations. Perhaps in reading this response some children put the emphasis on "many" rather than on "different kinds". Otherwise making clay models of tissues and the accompanying discussion did not appear sufficient for many children to develop the generalization, "A tissue is made of cells of the same kind grouped together to do their work".

Items: F. Which of these sentences is (or are) true?

___38. New cells are formed from little seeds in the body.

93	107	111

X 39. New cells are formed when parent cells divide into halves.

54	91	98

___40. New cells are formed when nutrients from food bump together in an empty space in the body.

80	83	94

___41. New cells are formed when little bumps break off old cells.

69	82	71

X 42. After a new cell is formed, it grows.

106	104	102

Each child was given a portion of homemade clay with which to simulate cell division and growth. Following the lead of the investigator the children were to divide their clay into fourths. The first fourth was to represent a cell; the rest stood for food and water. The first cell was divided in half to form "two cells". Then "food and water" were used to make the two "new cells" as large as the "parent cell". Each "new cell" was to be divided giving rise to four "new cells". The remaining food and water were to be used to make the "cells grow". Apparently for a few the simulation was too abstract for them to visualize the process of cell division and growth. A series of drawings or a simple film about cell division and growth preceding the simulation might have made the process more clear.

Items: B. Which of the following do cells need to live and grow?

X 20.	protein		
	93	100	95
X 21.	carbohydrate		
	49	80	71
X 22.	fat		
	27	39	28
X 23.	vitamins		
	117	98	113
X 24.	minerals		
	114	103	107

While the number of correct responses to items 21 and 22 increased between the first and second administrations, the importance of carbohydrate and fat was not recognized as often as was the need for protein, vitamins and minerals. Probably at least two factors contributed to the lesser number of correct responses for items 21 and 22 compared with items 20, 23 and 24. (1) Statements of the children often sounded like quotations from advertisements on television. Advertisements often implied that fat and carbohydrate were unnecessary or harmful while protein, vitamins and minerals were beneficial. The television claims were repeated more often and over a longer period of time than were the classroom experiences involving fat and carbohydrate. (2) Although carbohydrate and fat, along with protein, were given priority in the classroom study of energy, they were not given emphasis in the experiences involving improvement of diet because they were usually supplied in sufficient quantities. Furthermore, during the study of energy balance the need for some people to reduce intake of fat and carbohydrate became obvious. Perhaps some children interpreted needing decreased amounts of these nutrients as not needing any.

<u>Objective</u>: IIB1. <u>Outline</u> the process of digestion.

Items: 3. Where does digestion begin?

___1. stomach

___2. small intestine

_X_3. mouth

33 85 80

___4. esophagus

Initially 58 children thought digestion began in the stomach. This may have been related to their concept of indigestion. "What is digestion?", was asked in three classrooms the year before (see page 48). At that time a number of children indicated they thought digestion was pain in the stomach. Esophagus was the word the author pronounced the most; few children knew what it was at the beginning of the year.

C. What happens to food after it enters the small intestine?

___25. Saliva is poured onto the food.

110	109	101

_X_ 26. The food is broken by digestive juices.

61	51	66

___27. The food goes to the stomach.

54	92	89

___28. The food goes to the kidneys to have waste removed.

59	84	64

_x_ 29. Tiny particles of food pass out of the small intestine into the blood.

71	104	84

Responses to this series of items indicated that the children were more knowledgable about the sequence of the digestive processes beyond the stomach after the unit had been taught.

The order of the processes had been explained to them using an anatomical model and the diagrams in their health books. Decreases in the number of correct responses between the second and third administrations of the test illustrated the transitoriness of simple recall learning which was not reinforced later in the year.

Objective: IIB2. Recall some of the functions of nutrients in the body.

Item: D. Which nutrients can be used to provide energy?

X 30. proteins			
	87	103	92
__ 31. vitamins			
	20	31	14
X 32. carbohydrates			
	53	70	53
__ 33. minerals			
	24	42	42
X 34. fats			
	34	51	39

The misconceptions the investigator sensed most frequently were those regarding nutrient function and the relative nutrient composition of food, particularly bread. In these areas comments often sounded like phrases from food advertisements. The small number of correct responses for vitamins and minerals reflect the often quoted phrase "vitamins and minerals for energy". Perhaps a distinction between the nutrients which supply energy and those which help release energy is too difficult of the child in the middle grade. However, pupils' comments indicated they did understand that energy could be released from protein, carbohydrate and fat.

Item: 6. What is one of the jobs of vitamins in the body?

___1. Vitamins provide building blocks for the cells to use in making new materials.

___2. Vitamins can be broken to provide energy.

___3. Vitamins make up the main part of the heart.

_X_4. Vitamins help enzymes in the making of new materials.

39 17 22

Abstract paper shapes were used to illustrate the facilitative role of vitamins and minerals in enzymatic reactions. Pupils seemed to have difficulty grasping the concept. Probably the concept should be introduced to more advanced grades.

Item: 5. Which minerals make teeth and bones hard?

___1. calcium and iron

_X_2. calcium and phosphorus

20 63 66

___3. iron and phosphorus

The children examined a decalcified chicken bone, which they were told had most of the calcium and phosphorus removed. They seemed surprised that a bone could be made soft and that there was a protein matrix. Some of the children tried to decalcify bones at home.

<u>Objective</u>: IIB3. <u>Recognize</u> selected components in food.

Nutrient function and food composition were integrated in the unit. Functions of the nutrients and then foods which were good sources of the nutrients were presented. Pictures of good sources of the nutrients under discussion were pinned onto a bulletin board. The board was cleared and the pictures were repinned every day or two as the children recalled nutrient functions and sources. Although nothing had been said about the Basic Four Food Groups the pictures corresponding to each of the groups were always pinned in the same quadrant of the board. After all nutrients had been reviewed, yarn was placed in a design to divide the four groups and the Basic Four Food Group Plan was introduced. Names of groups and numbers of recommended servings from each group were added to the board.

Item: 10. Which of these foods is a good source of vitamin A?

___1. cabbage

___2. baked beans

_X_3. pumpkin

3 42 23

___4. apple

___5. corn

On the first and third administration "apple" was marked the most often (53 and 49 times, respectively). The children were told that color is a clue to vitamin A value of fruits and vegetables. Perhaps if the item had included, "consider the colors for the following", more children might have selected the correct response. Children found learning the carotene-rich fruits and vegetables difficult because of exceptions, such as oranges, to the color "clue".

Item: 11. Which of these foods is a fair source of vitamin C?

_X_1. baked potato

21 38 19

___2. canned peaches

___3. apple

___4. milk

This item depends entirely on ability to recall or recognize names of foods containing significant amounts of vitamin C. Strictly speaking the children could not <u>recognize</u> the nutrient. No clues for determining its presence were given since no sensory characteristics are available for distinguishing vitamin C in food. Consequently, there was little or no retention of the information. Initially the largest number of choices (f = 72) was for milk. On the second and third administrations of the test the response most often selected was canned peaches (f = 45 and 42, respectively).

Items: G. Which of the following foods is or are good sources of protein?

_X_ 43.	cheese			
		75	101	81
____ 44.	carrots			
		26	40	25
____ 45.	potatoes			
		32	53	58
_X_ 46.	dried beef			
		42	64	55
____ 47.	bread			
		27	51	56

Knowledge of the relative nutrient content of the four food groups was needed to respond correctly to these items. Each time the test was given over half the children selected carrots, potatoes and bread as good sources of protein. Perhaps good protein sources would have been easier for the pupils to learn if foods had been experimentally burned. Children could then have distinguished food of high protein content by smell. Because at least one classroom building had been declared unsafe, no experiences requiring heating in the schoolrooms were used.

Objective: IIB3a. Relate caloric value of foods to certain characteristics of taste and feel.

Item: 13. Think about how each of the following foods tastes and feels. If you had equal amounts of each of these foods, which would be lowest in energy value (calories)?

____1. cooked corn

____2. canned peaches

_X_3. carrot sticks

45 39 39

____4. applesauce

Many children appeared to do well on an assignment in which they selected foods from their own dietaries which were high or low in energy value and listed the "clues" to their selection. However, responses to item 13 showed no improvement. The number of children selecting applesauce rose from 25 on the first testing to 37 on the second. Perhaps the examples of apples as food low in energy value was responsible for the change. Sweetness was one of the "clues" used in class. Some of the children may not have perceived applesauce as being sweet since it is less sweet than most dessert foods.

Item: 14. (If you had equal amounts of each of these foods)[1] which would be lowest in energy value (calories)?

---

[1]This phrase should have been omitted from the test.

____1. a slice of bread with butter

__X_2. a large Graham cracker

42	35	51

____3. one piece of white cake without frosting

____4. a frosted doughnut

There was a decrease in the number of children who chose the first response (f = 41, 29 and 26). Perhaps the decline was influenced by the fact that butter was used various times during the fall and in the winter follow-up to illustrate properties of fat. Why the number of children who selected responses 3 and 4 increased at the second administration remains a mystery. Perhaps the word "large" in response 2 suggested a larger quantity than was intended.

Objectives: IIIB. Judge his own diet using the Basic Four Food Groups Guide.

IIIB1. Recall the number of servings from each food group and sub-group recommended for fourth- and fifth-grade children.

IIIB2. Place foods in their respective groups and sub-groups.

Items: This is what Lynn had to eat one day.

Breakfast	Lunch
Toast Butter Milk	Cheese Sandwich Apple Chocolate Cupcake Milk

Snack	Supper
Grape Pop	Pork Chop Mashed Potatoes Noodles Bread Butter Peach Ice Cream

I. Which of these foods are included in the Fruit and Vegetable Group of the Basic Four?

_X_ 50. apple

118	121	123

____ 51. grape pop

99	103	97

_X_ 52. mashed potatoes

91	78	79

____ 53. noodles

82	103	103

____ 54. peach ice cream

73	49	61

If Lynn ate one servings of each food listed, how many servings did she eat from the Fruit and Vegetable Group? _____

J. How many servings each day from the Fruit and Vegetable Group are recommended? (Select only one answer.)

(55) ____ 1. two or more

____ 2. three or more

_X_ 3. four or more

19	67	25

____ 4. five or more

K. According to the Basic Four Food Groups Guide, how many more servings would she need from the Fruit and Vegetable Group? (Select only one answer.)

(56) ____1. She would not need any more servings.

____2. She would need at least one more serving.

_X_3. She would need at least two more servings.

19 33 36

____4. She would need at least three more servings.

Several children told the author that grape pop was made of grape juice. Such misconceptions regarding soft drinks need to be corrected if children are to evaluate their diets realistically.

Item 55 showed one of the greatest gains of any of the items between test 1 and 2, as did item 61 which follows below. However, a minority correctly answered the question the third time. Due to insufficient reinforcement after the conclusion of the unit the number of recommended servings was forgotten by most.

Items: This is what Dick had to eat one day.

Breakfast	Lunch
Grape Juice	Tuna Fish Sandwich
Cornflakes Milk	Carrot Sticks
Toast Butter	Apple
Cocoa	White Cupcake
	Milk

Snack	Supper
Orange	Meat Loaf Mashed Potatoes Green Beans Bread Butter Canned Peaches Milk

L. Which of these foods are included in the *Meat Group* of the *Basic Four?*

__X__ 57. tuna fish

100	116	105

__X__ 58. meat loaf

115	126	128

____ 59. milk

99	121	122

____ 60. cocoa

115	126	126

If Dick ate one serving of each food listed, how many servings did he have from the Meat Group? _____

M. How many servings each day from the Meat Group are recommended? (Select only one answer.)

(61) ____ 1. one or more

__X__ 2. two or more

48	69	50

____ 3. three or more

____ 4. four or more

N. According to the Basic Four Food Groups Guide, how many more servings from the Meat Group should he have eaten? (Select only one answer.)

(62) _X_1. He would not need anymore servings.

35 46 31

____2. He would need at least <u>one</u> more serving.

____3. He would need at least <u>two</u> more servings.

35 46 31

____4. He would need at least <u>three</u> more servings.

Some classes had difficulty carrying out the work in which they were to evaluate their own diets. The degree of difficulty completing the assignment seemed to be inversely related to the amount of discipline in the room. One class which had particular difficulty listening to instructions did not complete the experience. Since the task tended to be accomplished more accurately by fifth-graders than by fourth-graders, perhaps the experience would have been more effective if carried out later in the school year when the children were more mature and settled.

Objective: IIIC1. Realize that food serves social and psychological functions.

Item: 2. Bill and Mike were making a display labeled "Things Food Can Do". Which of these could they include?

____1. provide nutrients

____2. help express love

____3. remind people of home

__X_4. all of these

15	23	11

Discussion of various functions of food was crowded into the last day of the unit, consequently very few children chose the correct response.

Objective: IIIC2. Recognize some factors which may affect food acceptance.

Items: E. Which of these sentences is (or are) true?

__X_35. You can help others learn to like foods by helping make mealtimes happy.

80	88	86

____36. You can help a person learn to like a new food by telling him he won't grow well if he doesn't eat it.

65	78	72

__X_37. A person often learns to like the same food his family likes.

93	97	92

Due to lack of time only a portion of one period was devoted to this objective. However, a majority of children responded correctly to items 35 and 37 on all three testings indicating that the answers were intuitively obvious or that they already had become acquainted with factors influencing eating habits.

Objective: IIID. Select snacks which contribute to overall nutrition.

The following items were designed to measure attainment of the cognitive portion of this objective. The nutritive value of snacks consumed before and after nutrition education was estimated to see if subjects had changed their selection of snacks.

Items: O. After school Paul wants to eat a snack that will help him get the nutrients he needs. This is what he had had so far today from the Fruit and Vegetable Group of the Basic Four.

½ cup applesauce
1 banana

He will probably have some potatoes and carrots for supper. Which of the foods listed below would help him get all of the recommended number of servings within the Fruit and Vegetable Group?

__X__ 63. orange

103	113	102

____ 64. 2 slices of pineapple

46	37	52

____ 65. peanut butter and lettuce sandwich

77	83	88

____ 66. raisin cookies

90	100	100

____ 67. peach

43	41	44

This series of items was intended to be the most difficult. While a majority of pupils responded correctly to items 63, 65 and 66, few responded correctly to the whole series. A list of possible reasons for choices should have been added to determine if children perceived a need for a vitamin C-rich food.

Objective: IIIE1. Recognize that a nutritious breakfast can consist of a variety of inexpensive and easy-to-prepare foods.

H. This is what Jan and Jill each had for breakfast.

Jan

½ Cup Tomato Juice
1 Slice Ham
2 Pancakes Butter Syrup
1 Cup Milk

Jill

½ Cup Tomato Juice
Peanut Butter Sandwich
(2 Slices Bread)
1 Cup Milk

____48. Jan's breakfast is more nutritious than Jill's.

36 62 40

__X_49. Both breakfasts contain foods from each of the Basic Four Food Groups.

51 73 44

Some of the children who responded to the open-ended items were asked to write menus for nutritious breakfasts. All menus contained bacon and eggs or pancakes. During the unit the children discussed breakfasts they could prepare themselves including those based on sandwiches. In the winter a bulletin board entitled "Good Breakfasts Come in Many Foods" was left in each experimental classroom for one week. The displays showed stylized pictures of the foods listed in each of four breakfast menus. One of the menus was traditional; and others were based on sandwiches. Because the number of correct responses to item 48 in the spring dropped markedly, the bulletin board had not been effective in reinforcing the concept that non-traditional breakfasts can be as nutritious as traditional ones.

A nutritionist well-trained in food composition might question the validity of the item on the grounds that the breakfasts are not entirely equal in nutrient content. However, a child would not be able to detect the minor differences and should not be confused on that point.

Objective: IV. Recognize that diet interacts with many factors to affect health.

Item: 4. Bill usually felt tired. He had a hard time keeping up with the other boys. What caused Bill to feel tired?

___1. He probably didn't get enough of the foods which provide energy.

___2. He probably didn't get enough sleep.

___3. He probably didn't get enough exercise.

_X_4. There are many things which may have influenced how he felt.

31 46 45

About 60 children selected response 2 each time the test was administered. Apparently they perceived lack of sleep as the most probable cause of tiredness.

Objective: IVA. Realize that there exists a range of acceptable sizes and growth rates.

Item: 1. Tom is the shortest boy in his class. What should Tom do about his height?

__X__ 1. realize that some boys grow more slowly than others

62 69 73

____2. eat more foods like eggs and vegetables

____3. drink more milk

____4. get more exercise

The number of children selecting responses 2 and 3 dropped from 53 to 40 between tests 1 and 2. Thus, there was apparently no implication in the teaching of any magical power of food to influence growth. Certainly none was intended.

Item: 8. Jim was watching the sixth grade go through the lunch line. He noticed that many of the girls were taller than most of the boys. Which of the following statements is correct?

__X__ 1. In most sixth grade classes many of the girls are taller than the boys.

36 67 82

____2. The boys were probably born shorter than the girls.

____3. The girls probably eat better food than the boys.

____4. The girls probably have taller parents than the boys.

____5. The girls probably get more exercise than the boys.

The children seemed to enjoy making transparent growth charts for projection. For most it was their first attempt to graph material and they were proud of their work which was, except in one or two cases, accurate. A graph of the average growth of Monroe County girls was superimposed on a graph for the boys. Many of the children expressed surprise when they saw the accelerated growth of the girls around the age of 12. To reinforce this discovery the children were asked to observe the sixth- and seventh-graders in their school. A page discussing the sex differences in growth rate was included in the fifth-grade health book. Reading this may have caused the increase in correct responses between tests 2 and 3. Perhaps some of the children may have noticed the trend in themselves toward the end of the year.

Objective: IVB. Recognize the relationships between energy intake and expenditure.

Item: 12. George is eating food with energy value of about 2,500 Calories each day. Usually he uses up about 2,000 Calories of energy each day. What is probably happening to George?

____1. He is losing weight.

__X__2. He is gaining weight.

____3. If he has good posture, his weight isn't changing.

____4. If he is doing special exercises, his weight isn't changing.

This item was not scored because it proved to be invalid. In the parochial school the author discovered that as children's understanding of energy balance increased, the number of correct responses decreased. From casual comments she learned that the children initially associated the word "calories" with gaining weight. Several of them thought that 2500 Calories was a tremendous amount of energy value for any one. Thus, as children learned more about energy balance they realized there was more to consider than they had previously thought and became confused on item 12. If the situation in the item had described negative energy balance, the item probably would have been useful in testing the concept of energy balance.

According to the number of correct responses the following experiences appeared to help children attain the stated objectives.

Experiences	Concepts or ideas
cartoon and discussion of social health	definition of health
observation of cells through microscope	definition of cells
simulation of cell division and growth using clay	cell growth
simulation of digestion in mouth and study of anatomical model	process of digestion
decalcified bone (and perhaps milk ash)	role of calcium and phosphorous in bone
Basic Four Food Group bulletin board and discussion of protein sources	sources of protein

Experiences (Continued)

graphs of average growth of Monroe County boys and girls	difference between average growth of boys and girls

Most of these experiences required manipulation of materials by the subjects.

The experiences which seemed least effective (according to test responses on the test) were those requiring children to classify their own food intake according to relative caloric value and evaluation of diets. A majority of the children correctly classified their food intake according to relative energy value as a class assignment. Therefore, the items 13 and 14 regarding relative caloric value may have been too difficult. Nevertheless more practice with the exercise would probably have been beneficial. Also if the children had actually handled foods high and low in energy value, rather than just thinking about them, the lesson might have made greater impact. Due partly to lack of time many children did not correctly complete the evaluation of their diets using the Basic Four Food Groups. Therefore, it was not surprising that most children did not correctly evaluate the diets on the test. For the most part they correctly classified the foods, but they failed to add up the servings consumed and subtract them from the number of servings recommended.

The breakfast bulletin board did not appear to reinforce the idea that non-traditional breakfasts can be just as nutritious as traditional ones. However, it is possible that items

48 and 49 did not measure recognition of that fact since they also included the Basic Four Food Groups which is another major concept.

The animal demonstration was planned to review nutrient function and source as well as the Basic Four Food Groups. It may have helped children remember how to group foods, but it apparently failed to reinforce the number of recommended servings from each group. Since no rationale for the numbers of recommended servings was given, these numbers were obviously hard to remember. Doubtless the animal demonstration would have been more beneficial if the children had cared for the rats themselves. A major purpose of the animal demonstration was to emphasize the potential importance of snacks. The attainment of this objective was not measured.

The most difficult items of the test tended to be those involving food composition and relative caloric values of foods. At least some of the misconceptions regarding food composition seemed to reflect advertising claims of food producers. Probably more practice in classifying foods according to major nutritive contributions is needed in order for children to have a functional knowledge of food composition. Public knowledge of food composition and relative caloric values of foods appears to be important in light of the increasing need for and interest in restricting food consumption among the general population. To develop a functional knowledge of relative nutritive and caloric values, children probably need practice in identifying nutrient sources for several years. Otherwise, what facts are learned will be quickly forgotten.

Items requiring evaluation of food intake using the Basic Four Food Groups also tended to be difficult for the children. The ability to evaluate one's diet in order to make rational changes appears to be important enough to be practiced with increasing accuracy at various grade levels. Although children made correct choices more often on items regarding definition of health, cells, growth and digestion than for questions regarding nutrient and caloric values of foods and evaluation of diet, the latter subjects appeared to be appropriate for introduction in the middle grades because children were enthusiastic about studying them.

An item analysis for the control group was not done for responses on the first administration. Responses of the experimental and control groups were assumed to be comparable before nutrition education because average scores for the experimental ($\overline{X}$ = 29.1) and control ($\overline{X}$ = 30.6) groups were similar.

The responses of the control groups on the third administration of the test were compared with those of the experimental groups on the first administration. Nine items for which the control subjects had at least 20 correct responses[1]

---

[1]Twenty responses represented about 15% of the children.

more than did the experimental groups are mentioned below. These items suggest areas of learning for the control groups which were similar to those included in the experimental unit. Complete statements of the items can be found in Appendix E.

Items 3, 25, 26 and 27 dealt with digestion which was usually introduced in the fifth grade. The health teacher of two of the control groups showed the investigator pictures of the alimentary canal drawn by fifth-graders.

Item 39 dealt with division and growth of cells; subject matter on cells was included in the fourth- and fifth-grade health books. The role of calcium and phosphorus (item 5) was included in the fifth-grade text book. Making mealtime pleasant (item 35) was included in both the fourth- and fifth-grade books. Increases in correct responses to items 59 and 66 reflect an introduction of the Basic Four Food Groups included in the books of both grades. In addition, improvements in responses of the control groups probably reflected to some extent an increase over the period of seven months in the ability of pupils to read the items.

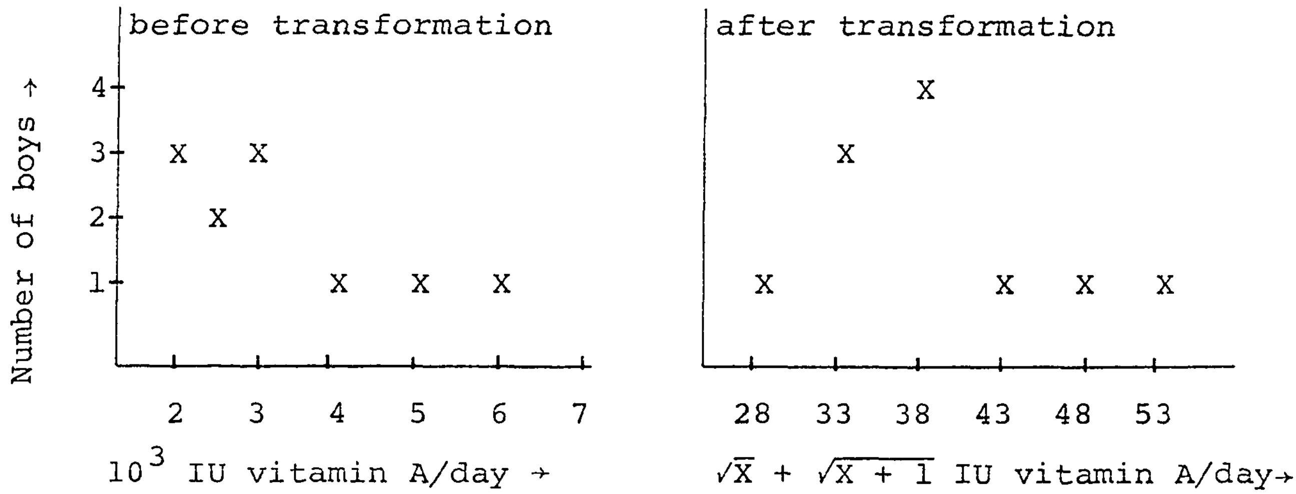
Changes in nutritive and caloric values of diets

Average daily intake of protein, calcium, iron, thiamine, riboflavin, niacin and ascorbic acid and caloric and vitamin A values of the diets were calculated. For each subject one day in the spring, 1967 and two consecutive days the following fall were sampled before treatment. Following treatment, two consecutive days late in the winter and one day in the spring, 1968 were sampled. Classroom means for boys and girls were calculated separately.

There were only four boys in one classroom and only five in another. In a third classroom there were only three girls. In these three classrooms a large intake of one nutrient by one subject would have caused the mean to be higher than that likely to be representative. The distributions of all nutrient intakes and the caloric value of the diets were skewed toward the high values. Such skewedness would tend to exaggerate the significance of the F tests (42, p. 325). Therefore, a square root transformation ($X' = \sqrt{X} + \sqrt{X + 1}$) was applied to all individual daily averages. Figure 1 shows the influence of the transformation on distributions in one class. Individual data thus transformed were used to calculate classroom means used in analyses of variance.

Because subjects had implied that generally they had more freedom in choosing foods for snacks than for meals, snacks were analyzed separately as well as with total daily averages. Average daily nutritive and caloric values of snacks of individuals were transformed using the square root formula shown above.

No significant effect on dietary intake values for average daily total intake or snacks due to treatment was observed for either boys or girls. Averages by treatment within sex are



$\overline{X}$ = 4320 IU vitamin A/day $\overline{X}$ = 4190 IU vitamin A/day

N = 11 N = 11

Figure 1. Distributions of average daily vitamin A value (School I, grade 5, boys, spring and fall, 1967)

presented in Tables 23 and 24. Inspection of the tables indicated there was little consistent change associated with treatment.

During the 1967-68 school year orange juice was donated to the schools by the government. The teacher who had shown the most interest in the experimental unit initiated daily orange juice breaks in her room. The increased consumption of orange juice among her pupils was reflected in the increase in ascorbic acid intake from snacks among fourth-grade experimental groups (from 8 to 13 mg among boys, from 5 to 16 mg among girls). Whether the investigator influenced the teacher to

Table 23. Mean[a] daily energy and nutrient values of diets by treatment (Spring, 1967 to spring, 1968)

	N	Energy value (kcal)	Protein (gm)	Calcium (mg)	Iron (mg)
Boys					
Experimental	42				
Before		2479	90	1300	12.6
After		2361	83	1107	11.9
Change		-118	-7	-193	-0.7
Control	55				
Before		2413	88	1256	12.4
After		2282	87	1171	12.0
Change		-131	-1	-85	-0.4
Girls					
Experimental	48				
Before		2056	76	1050	10.4
After		2074	76	1076	10.6
Change		18	0	26	0.2
Control	44				
Before		2194	80	1155	11.5
After		2223	80	1207	10.8
Change		29	0	52	-0.7

[a]Means are averages of 6 classroom means. Classroom means were obtained from square root transformations of individual data.

Table 23 (Continued)

	Vitamin A value (IU)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)
Boys					
Experimental					
Before	4530	1.32	2.55	14.5	73
After	4200	1.21	2.21	13.7	57
Change	-330	-0.11	-0.34	-0.8	-16
Control					
Before	5190	1.24	2.44	14.9	58
After	4130	1.18	2.26	14.5	53
Change	-1060	-0.06	-0.18	-0.4	-5
Girls					
Experimental					
Before	4160	1.04	2.03	12.5	58
After	4060	1.02	2.07	12.7	66
Change	-100	-0.02	0.04	0.2	8
Control					
Before	4490	1.17	2.32	12.9	56
After	4490	1.12	2.26	12.5	59
Change	0	-0.05	-0.06	-0.4	3

Table 24. Mean[a] daily energy and nutrient values of snacks by treatment (Spring, 1967 to spring, 1968)

	N	Energy value (kcal)	Protein (gm)	Calcium (mg)	Iron (mg)
Boys					
Experimental	42				
Before		447	12	300	0.9
After		392	8	168	0.8
Change		-55	-4	-132	-0.1
Control	55				
Before		366	10	244	0.8
After		336	8	187	0.7
Change		-30	-2	-57	-0.1
Girls					
Experimental	48				
Before		374	10	250	0.8
After		372	10	239	0.9
Change		-2	0	-11	0.1
Control	44				
Before		365	9	222	0.9
After		388	9	237	0.9
Change		23	0	15	0.0

[a]Means are averages of 6 classroom means. Classroom means were obtained from square root transformations of individual data.

Table 24 (Continued)

	Vitamin A value (IU)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Ascorbic acid (mg)
Boys					
Experimental					
Before	600	0.14	0.45	0.8	7
After	440	0.11	0.26	0.8	7
Change	-160	-0.03	-0.19	0.0	0
Control					
Before	540	0.11	0.37	0.7	4
After	360	0.10	0.28	0.7	4
Change	-180	-0.01	-0.09	0.0	0
Girls					
Experimental					
Before	530	0.11	0.38	0.6	4
After	520	0.13	0.38	0.8	13
Change	-10	0.02	0.00	0.2	9
Control					
Before	460	0.12	0.35	0.8	5
After	500	0.12	0.35	0.7	7
Change	40	0.00	0.00	-0.1	2

begin the orange juice snacks or not is open to question. Needs for more vitamin A and ascorbic acid had been emphasized when the children were evaluating their diets as part of their learning experiences.

In one school orange juice was served as a snack to both the experimental and control groups; however, consumption was not encouraged. Occasionally orange juice was served with the school lunch in some schools. The donated orange juice was consumed in at least one school only by the employees who said they did not know what else to do with it. For the county as a whole government-donated orange juice did not increase average ascorbic acid consumption during the experiment. Experimental groups (boys and girls combined) averaged 4 mg less ascorbic acid at the end and control groups 1 mg less than at the beginning of the study.

The ultimate objective of nutrition education is the improvement of dietary habits of the pupils. Significant improvement of nutritive value of the diets was not observed in the present study which employed a short-term nutrition education program. Ideally a graded program similar to that suggested by Martin (28) should be studied. Such a program in the primary grades would guide development of favorable attitudes toward food. Functions of the major nutrient classes and their sources would be introduced in the middle grades. Nutrient functions and sources would be studied in greater detail in the intermediate grades. At all grade levels nutrition education would be directed toward formation of good eating habits. A long-term, multi-grade project was outside the resources of the investigators. Because school time for any given subject is at a premium, the investigators were interested in determining if any influence could be detected with a small program.

School lunches were not altered as part of the program. In contrast much of the improvement of diet reported by Roberts (37) and Whitehead (54) could be attributed to the school lunch.

The nutrition education program in the present study was primarily a rational one in which children studied the function of nutrients, composition of food, and the interactions of nutrition with other health practices. The pupils in the experimental groups evaluated a sample of their own dietaries using the Basic Four Daily Food Guide. Aside from that and discussions of how diets might be improved through better breakfasts, better snacks and greater acceptance of a variety of foods there was no campaign to get children to change food habits.

In Grant's study (15) the children at one point were asked to consider what they had learned about nutrition before planning lunch menus. Selection of fruits and vegetables subsequently increased markedly. In the present study the investigators made no reference to the nutrition education program at any time during collection of data. Whether the children perceived the educational program to be part of an experiment is not known. The children never suggested to the author that the teaching might have been experimental. In talking with teachers the investigators de-emphasized the experimental nature of the teaching in order to reduce the possibility of obtaining biased responses after teaching. The author was referred to as a "visiting teacher". Because pupils had observed the author collecting data "to see what boys and girls eat and how they grow" for three years prior to teaching the experimental unit, they may not have realized the teaching and collecting of data were for a common purpose.

Dietary data obtained just prior to teaching and compared with the 1968 revision of the Recommended Dietary Allowances (31) indicated there was not as much need for dietary improvement as had been suggested by the earlier Monroe County study in which dietary calcium, iron, vitamin A value and ascorbic acid had been judged to be low (22). The nutrition education program had been planned using the 1964 Recommended Dietary Allowances (30) and dietary intakes of fourth- and fifth-grade children surveyed in 1964-65 (22).

When dietary intakes of children in the present study were judged against the 1968 Recommended Dietary Allowances (31), average intakes of most nutrients except iron among the girls appear to approach recommendations of the Food and Nutrition Board of the National Research Council (Table 25).

Table 25. Mean[a] daily nutrient intake of boys and girls and recommended dietary allowances[b] (Spring 1967 to spring 1968)

	Boys' daily average N=96	RDA	Girls' daily average N=87	RDA
Energy value (kcal)	2384	2350	2137	2225
Protein (gm)	87	42	78	45
Calcium (mg)	1208	1100	1122	1100
Iron (mg)	12.2	10	10.8	14
Vitamin A value (IU)	4512	4000	4300	4000
Thiamine (mg)	1.24	1.2	1.09	1.1
Riboflavin (mg)	2.36	1.2	2.17	1.2
Niacin (mg)	14.4	16	12.6	15
Ascorbic acid (mg)	60	40	60	40

[a]Averages of 12 classroom means which were obtained from transformed data of individuals.

[b]Allowances for ages 8 to 10 and 10 to 12 were averaged.

Niacin intake appeared low because it was calculated omitting niacin equivalents available from tryptophan while Recommended Dietary Allowances include the tryptophan contribution to niacin equivalents. With the high protein intake of the population under study, mean niacin equivalents probably exceeded the recommended amounts.

Means for evaluating nutrient intake of a population have been criticized (12) because a few high intakes may cover up a large number of sub-optimal intakes. The transformation applied to individual data reduced this bias, but did not entirely eliminate it.

In comparison with the children surveyed in 1964-65, those studied in 1967-68, particularly the girls, appeared to have greater actual intakes of all nutrients. Means in Table 26, obtained from untransformed data, were somewhat higher than the averages of transformed data presented in Table 25. The percentage increases in estimated consumption in 1967-68 over that in 1964-65 also was computed. While caloric value of the diets increased by 6% and 14%, vitamin A value of girls' diets increased by 31% and ascorbic acid intakes among both boys and girls increased by 46% and 49%, respectively, suggesting an improvement in quality of diet as well as an increase in quantity.

The percentages of children whose dietary intakes were below two-thirds of the Recommended Dietary Allowances in 1964-65 were compared with those in 1967-68. Table 27 shows a marked decrease in percentage of diets meeting less than two-thirds of the 1964 RDA for calcium, iron, vitamin A and ascorbic acid. When the 1968 Recommended Dietary Allowances were applied to the 1967-68 diets, the percentages dropped even lower.

Table 26. Increases in dietary values[a]

	Boys 1964-1965 N=51	1967-1968 N=96[b]	% increase	Girls 1964-1965 N=43	1967-1968 N=87[b]	% increase
Energy value (kcal)	2260	2406	6.5	1909	2168	13.6
Protein (gm)	87	89	2.3	70	78	11.4
Calcium (mg)	1163	1260	8.3	980	1152	17.6
Iron (mg)	12.3	12.5	1.6	9.4	10.9	16.0
Vitamin A value (IU)	4770	4950	3.8	3570	4680	31.1
Thiamine (mg)	1.1	1.3	18.2	0.9	1.1	22.2
Riboflavin (mg)	2.2	2.4	9.1	1.8	2.2	22.2
Niacin (mg)	13.0	14.8	13.8	10.6	12.8	20.8
Ascorbic acid (mg)	43	63	46.5	45	67	48.9

[a]Means were obtained from non-transformed data.

[b]Only data for children who had both 1967 and 1968 data were included.

Table 27. Percentages of boys and girls with dietary intakes below 67% Recommended Dietary Allowances

	1964-1965 1964 RDA	Spring and fall 1967 1964 RDA	Winter and spring 1968 1964 RDA	1967-1968 1968 RDA
Boys	N=51	N=97[a]	N=97[a]	N=96
Calcium (mg)	15.7	4.1	12.4	7.3
Iron (mg)	27.4	19.6	22.7	0.0
Vitamin A value (IU)	47.0	20.6	27.8	4.2
Ascorbic acid (mg)	66.6	36.1	47.4	3.1
Girls	N=43	N=95[a]	N=95[a]	N=87
Calcium (mg)	23.3	10.5	18.3	10.3
Iron (mg)	62.8	41.1	37.6	26.4
Vitamin A value (IU)	55.8	32.6	33.3	13.8
Ascorbic acid (mg)	79.0	51.6	43.0	6.9

[a]All available dietary data were used regardless of whether each child had complete data for all variables in both 1967 and 1968. Therefore, the numbers of subjects included in this table vary slightly from those presented in the preceding table.

The children (N = 192) studied in 1967-68 may have represented a different population from the earlier, smaller sample (N = 94). Schools VII and VIII had not been included in the survey and children from School VIII reported the consumption of generally good diets. In addition, School IV, the parochial school, had been part of the survey, but was not in the present study.

One-third of the dietary data for the present study was collected in the early fall of 1967. Fresh fruits and vegetables which are good sources of carotene and/or fair sources of ascorbic acid were consumed frequently. Collection of dietary information for the earlier study was begun at the end of October after these foods were no longer readily available. Thus, seasonal variation in diet may have accounted for some of the differences in nutrient value between the two studies.

Change in methodology may have caused some of the differences in estimates of nutrient intake. When mothers reported food intakes in tablespoons or cups, calculations were based on standard measuring tablespoons or cups, largely without question in 1964-65. In the present investigation children used food models to show the investigators how much they had eaten. When the quantity indicated by the child differed from the amount recorded in tablespoons or cups the investigators changed the record. What a mother reported as a tablespoon often turned out to be one-fourth cup. On the other hand, amounts reported as "a cup" were sometimes changed by the researchers to one-half or three-fourths cup.

Finally, diets of the nine to eleven-year-old children may have actually improved in the interim. Milk consumption at school may have increased. Certainly the consumption of orange juice at school increased.

In summary, the estimated intakes of calcium, iron, vitamin A and ascorbic acid increased from 1964-65 to 1967-68. In addition, the Recommended Dietary Allowances decreased between 1964 and 1968 except for iron for girls over 10 years old. In view of the magnitude of these changes the author would neither expect nor recommend radical increases in nutrient intake to result from nutrition education.

Changes in vegetable preference ratings

Since eating behavior is dependent on desire for food, a program of nutrition education should include consideration of affective learning as well as cognitive learning. One component of the desire for food is the aesthetic pleasure associated with eating. Subjects were asked to rate their liking for vegetables on a seven-point hedonic scale (Appendix C). Vegetables were selected for study because prior data from Monroe County (22) had indicated they were the most disliked class of food. If eaten in larger amounts a variety of vegetables could have improved the diets of the children of that area.

Vegetable preference scores for individuals included an "uncorrected" score (total points for the nine vegetables divided by nine) and a "corrected" score (total points divided by only the number of vegetables tasted. "Uncorrected" and "corrected" subscores were calculated by dividing the total points for the four carotene-rich vegetables by four and by the number tasted, respectively.

Because other workers (18, 22) had found sex to be related to food preference, the sexes were separated for the analyses of variance. This was done before the correlations revealed no relationship existed between sex and vegetable preference.

Between fall, 1967 and spring, 1968 mean vegetable preference scores, both "corrected" and "uncorrected", declined significantly ($p \leq 0.01$) among the girls (Table 28). Decreases in scores among boys and declines in subscores among both boys and girls were not significant. Inspection of the data indicated that, in general, ratings for all vegetables except raw carrots declined.

Because the scales were relative rather than absolute, decreases in scores did not necessarily indicate declines in vegetable preference. In some of the schools one assistant to the investigator tended to talk down to the subjects during the second administration of the rating scales. The children may have been offended by her manner causing them to respond negatively.

Table 28. Mean[a] vegetable preference scores by treatment (Fall, 1967 and spring, 1968)

	N	Total score (uncorrected)	Total score (corrected)	Subscore (uncorrected)	Subscore (corrected)
Boys					
Experimental	42				
Before		4.7	5.2	3.8	4.5
After		4.5	4.9	3.5	4.0
Change		-0.2	-0.3	-0.3	-0.5
Control	56				
Before		5.1	5.6	4.4	5.3
After		4.7	5.2	3.9	4.7
Change		-0.4	-0.4	-0.5	-0.6
Girls					
Experimental	48				
Before		5.1	5.8	4.1	5.3
After		4.9	5.2	4.0	4.3
Change		-0.2	-0.6	-0.1	-1.0
Control	41				
Before		5.1	5.7	4.0	5.0
After		4.6	5.2	3.8	4.7
Change		-0.5	-0.5	-0.2	-0.3

[a]Means are averages of 6 classroom means.

At the end of the 13-lesson unit pupils in the experimental groups were encouraged to taste mashed yellow squash. One sample was seasoned with salt and butter. A second sample was flavored with brown sugar and cinnamon in addition to salt and butter. Children's comments tended to favor the sweetened vegetable.

For the analysis of squash alone, boys' and girls' scores were combined. The numbers of children in the experimental and control groups who had tasted squash were comparable before treatment. Because a number of the children in the experimental groups tasted squash for the first time as part of the treatment, the number of children rating squash in these groups increased; however, the number of children rating squash in the control groups changed little.

"Uncorrected" scores for squash tended to increase slightly among experimental groups (d = 0.2) and decrease slightly among control groups (d = -0.2). The increase in "uncorrected" scores among the experimental groups was due to the increase in number of children responding to the vegetable.

Mean "corrected" scores for the experimental groups tended to decrease more than those of the control groups. Individual scores for squash tended to be low, both before and after treatment. Because the divisors (number of children who had tasted squash) for the "corrected" scores for the experimental groups increased more than those of the control groups the decline was greater for the experimental groups than for the control groups. The greater decrease in ratings of the experimental groups (d = -1.6) compared with the control groups (d = -0.4) approached significance at the 0.05 level.

Whether the increase in "uncorrected" scores or the decrease of the "corrected" scores of the experimental groups is of greater importance is difficult to determine. The relationship between vitamin A value of the diet and the "uncorrected" subscore for individuals (r = 0.27) was slightly higher than the relationship between vitamin A value and the "corrected" subscore (r = 0.22). The slight differences between correlation coefficients suggested that the "uncorrected" score might be more predictive of actual food consumption than the "corrected" score.

Only about four children in each classroom indicated they had tasted squash before as well as after treatment. Average scores for these few children dropped 1.0 points among the experimental groups and 0.0 among the control groups. The greatest declines were seen among the pupils in the following situation.

The regular teacher of one of the experimental classrooms confounded the study of vegetable preferences. In front of the pupils, she made negative comments to the author about squash immediately after the pupils had tasted the vegetable in the classroom and again one week and three months later. Average "corrected" score for squash in that classroom fell from 5.0 to 1.1, a drop of 3.9 points. The average drop in the other classrooms was 1.5 points.

No significant change related to treatment was observed for the scores of the nine vegetables together. However, among the boys, disregarding time of measurement, "corrected" subscores were significantly higher ($p \leq 0.01$) for the experimental groups ($\bar{X} = 5.3$) than for the control groups ($\bar{X} = 4.4$). Since there was no treatment-by-time of measurement interaction changes in boys' subscores were not due to treatment. Among the girls, "corrected" subscores decreased ($d = -1.0$) significantly more ($p \leq 0.05$) among the experimental groups than did those of the control groups ($d = -0.3$). At the end of the year more of the subjects in the experimental groups than in the control groups had tasted squash. Therefore, the denominators of the experimental groups' scores had increased more than had those of the control groups. One must infer from these findings that "tasting" a new vegetable did not lead to its acceptance.

Changes in body measurements

Some nutrition education programs have been designed to lead to weight gain (9, 37). On the other hand, the combined nutrition education and physical education program of Christakis *et al*. (6) was planned to help obese subjects reduce weight, particularly weight due to fat. Although the investigators of the present study had hoped to include physical education as an independent variable, no physical education teacher was found, so that variable was deleted. Nevertheless, the concept of energy balance was retained in the nutrition lessons.

Among both boys and girls (Table 29) both height and logarithm of weight increased significantly ($p \leq 0.01$) between fall, 1967 and spring, 1968. There were no significant changes in height or logarithm of weight attributable to treatment or grade-by-treatment interaction (Table 30).

Among girls the average increase in logarithm of the combined triceps and subscapular skinfold thickness was significant ($p \leq 0.05$) with time while the average increase among boys was not. Among girls increases in logarithm of total skinfold thickness appeared to vary significantly with treatment ($p \leq 0.05$) with girls in the experimental classes having the greater increase (1.8 mm versus 0.7 mm). Since girls in the two groups had similar caloric intakes, both before and after treatment, nutrition education probably did not really influence the changes in skinfold thickness. Although the difference was not significant, total physical fitness scores of the control groups tended to excel those of the experimental groups at both times of measurement. Therefore, activity may have been greater among girls of control classes than among girls of experimental classes accounting for the smaller skinfold increases among the control groups. Since activity, *per se*, was not measured, the above suggestion could not be tested.

Table 29. Changes in body measurements by sex (Fall, 1967 to spring, 1968)

	Boys			Girls		
	Before	After	Change	Before	After	Change
Height (cm)	138.5	141.9	3.3**	137.7	141.3	3.7**
Weight[a] (lb)	73.9	79.7	5.8**	70.7	77.5	6.8**
Triceps skinfold thickness[a] (mm)	10.1	10.6	0.5	11.5	12.2	0.7
Subscapular skinfold thickness[a] (mm)	5.5	5.6	0.1	6.1	6.6	0.5
Total skinfold thickness[a] (mm)	15.7	16.3	0.6	17.8	19.0	1.2*
Arm girth[a] (cm)	21.4	22.2	0.8**	21.2	21.6	0.4
Leg girth[a] (cm)	29.1	30.1	1.0**	28.4	29.5	1.1**
Muscle-bone diameter[a] (cm)	5.8	5.9	0.1**	5.6	5.6	0.0**

[a]Values obtained from means of logarithmically transformed data.

*$p \leq 0.05$.

**$p \leq 0.01$.

Table 30. Mean[a] body measurements by treatment (Fall, 1967 and spring, 1968)

	N[b]	Height (cm)	Weight[c] (lb)	Weight/height[c] (lb/in)	Triceps & skinfold thickness (mm)
Boys					
Experimental	42				
Before		139.1	75.6	1.38	10.2
After		142.6	81.7	1.46	10.8
Change		3.5	6.1	0.08	0.6
Control	56				
Before		137.9	72.3	1.33	10.0
After		141.1	77.8	1.40	10.4
Change		3.2	5.5	0.07	0.4
Girls					
Experimental	48				
Before		138.1	71.3	1.31	11.6
After		141.7	78.4	1.41	12.7
Change		3.6	7.1	0.10	1.1
Control	44				
Before		137.3	70.1	1.30	11.4
After		141.0	76.6	1.38	11.8
Change		3.7	6.5	0.08	0.4

[a]Means are averages of 6 classroom means.

[b]Approximate number of subjects. For exact number for each variable see Appendix F.

[c]Obtained from logarithmically transformed data.

Table 30 (Continued)

	Subscapular[c] skinfold thickness (mm)	Total[c] skinfold thickness (mm)	Arm[c] girth (cm)	Leg[c] girth (cm)	Muscle-bone[c] diameter (cm)
Boys					
Experimental					
Before	5.7	15.9	21.7	29.4	5.8
After	5.7	16.6	22.5	30.6	6.0
Change	0.0	0.7	0.8	1.2	0.2
Control					
Before	5.3	15.5	21.1	28.7	5.7
After	5.4	16.0	21.9	29.5	5.8
Change	0.1	0.5	0.8	0.8	0.1
Girls					
Experimental					
Before	6.1	17.9	21.4	28.5	5.6
After	6.8	19.7	21.9	29.6	5.6
Change	0.7	1.8	0.5	1.1	0.0
Control					
Before	6.1	17.7	20.9	28.3	5.5
After	6.4	18.4	21.4	29.3	5.6
Change	0.3	0.7	0.5	1.0	0.1

Perhaps girls in the experimental classes were undergoing pre-pubertal changes more than those of the control groups. Even though the two girls who experienced menarche were in experimental classes, there was insufficient evidence to conclude that girls in the experimental group tended to be more mature than those in the control group. Neither treatment nor treatment-by-grade interaction appeared to affect changes in logarithms of skinfold thicknesses among boys.

Logarithms of arm girth, leg girth and muscle-bone diameter of the upper arm each increased significantly ($p \leq 0.01$) for both boys and girls during the school year, but neither treatment nor treatment-by-grade interaction affected these changes.

Changes in scores of physical fitness and handgrip strength

The New York State Physical Fitness Screening Test was administered in the fall, 1967 and again in the spring, 1968. The four components (agility, strength, endurance and speed) were measured by sidesteps, situps, squat thrusts and a dash, respectively. (Details of the test and its scoring are on pages 41-43.

Changes in activity as well as maturation would influence the test scores obtained at different times. Disregarding treatment the only significant changes in physical fitness score ($p \leq 0.05$) was observed in the agility test for girls; the mean increased from 12.3 to 13.7 sidesteps per 10 seconds. However, significant ($p \leq 0.05$) increases in grip strength of both boys (d = 5.0 kg) and girls d = 4.8 kg) were observed.

Among girls the effect due to treatment-by-grade interaction was significant for changes in scores of strength ($p \leq 0.05$, Table 31). Average changes in scores were positive for fifth-graders (d = 2.9 situps) while negative for fourth-graders (d = -0.5 situps) and greater for control classes (d = 2.1 situps) than for experimental classes (d = 0.2 situps). However, the differences in changes of scores between treatments disregarding grades were not significant. Differences between changes of fifth-graders and fourth-graders may have been due to physiological changes, particularly since some of the older girls were approaching puberty. In addition, fifth-graders in three of the six schools participated in physical education classes twice a week. That changes in scores tended to be less for experimental classes than for control groups was probably not actually a result of treatment since there was nothing in the unit that likely would have influenced such a change. Perhaps the difference reflects the fact that two of the three fifth grade classes which had physical education were control groups. Subjects in the fifth-grade experimental group which did have physical education classes may have been fatigued during the spring testing as they had completed another physical fitness test about two hours earlier.

Neither treatment nor treatment-by-grade affected changes in physical fitness scores among boys or handgrip strength

Table 31. Mean[a] physical fitness scores and handgrip dynamometer readings (Fall, 1967 and spring, 1968)

	N	Agility (sidesteps)	Strength (situps)	Endurance (squat thrusts)	Speed (seconds)	Total fitness	Total handgrip strength (kg)
Boys							
Experimental	41						
Before		12.4	20.4	12.9	11.7	19.0	39.0
After		13.7	24.7	13.2	11.6	21.2	44.0
Change		1.3	4.3	0.3	-0.1	2.2	5.0
Control	52						
Before		12.5	21.7	12.5	11.6	19.0	36.5
After		13.1	24.3	12.3	11.7	20.2	41.6
Change		0.6	2.6	-0.2	0.1	1.2	5.1
Girls							
Experimental	45						
Before		11.5	21.3	12.7	12.5	18.9	31.5
After		13.5	21.5	12.1	12.1	21.0	37.0
Change		2.0	0.2	-0.6	-0.4	2.1	5.5
Control	40						
Before		13.1	19.9	12.9	12.0	20.6	30.9
After		13.9	22.0	13.2	11.9	22.1	35.1
Change		0.8	2.1	0.3	-0.1	1.5	4.2

[a]Means are averages of 6 classroom means.

among either boys or girls (Table 31).

In the fifth grade of School VIII a physical fitness program following the plan of the President's Council on Physical Fitness was instituted during the 1967-68 school year. No other school had the program. However, when fourth- and fifth-grades of Group II (Schools I, V and VIII) were combined for an analysis of variance, physical fitness scores did not differ significantly due to school or school-by-time of measurement interaction.

Table 32 shows that, in general, scores of children in School VIII did not improve as much as those of subjects in the other two schools. In some cases average scores deteriorated. A number of factors may have been responsible for the limited improvement in scores from School VIII. For this particular analysis the fourth-grade class was averaged with the fifth-grade class of each of the three schools although fourth-graders in School VIII did not participate in the physical fitness program. In addition the subjects representing the fifth-grade boys of School VIII tended to be stocky and to perform poorly on the tests. At the time of the second administration of the New York test some of the subjects had completed the tests recommended by the President's Council only an hour or two earlier; thus, they may have been fatigued. Except for speed, the New York test may have measured components of physical fitness which differed from those included in the program of the President's Council.

Table 32. Physical fitness scores for Schools I, V and VIII. (Fall, 1967 and spring, 1968)

		I	V	VIII
			Boys	
Agility (sidesteps)	Before	13.1	12.2	11.9
	After	14.0	14.4	12.1
	Change	0.9	2.2	0.2
Strength (situps)	Before	21.8	18.6	23.8
	After	26.0	28.0	21.3
	Change	4.2	9.4	-2.5
Endurance (squat thrusts)	Before	13.3	12.3	14.8
	After	13.2	12.9	13.5
	Change	-0.1	0.6	-1.3
Speed (seconds)	Before	12.2	11.8	11.7
	After	11.8	11.5	12.1
	Change	-0.4	-0.3	0.4
			Girls	
Agility (sidesteps)	Before	12.5	12.0	12.6
	After	13.9	13.8	12.9
	Change	1.4	1.8	0.3
Strength (situps)	Before	21.8	17.8	22.3
	After	24.3	21.8	21.7
	Change	2.5	4.0	-0.6
Endurance (squat thrusts)	Before	11.6	13.4	12.6
	After	12.5	13.4	12.8
	Change	0.9	0.0	0.2
Speed (seconds)	Before	13.0	12.2	11.7
	After	12.5	11.7	12.0
	Change	-0.5	-0.5	0.3

Additional comments

A number of limitations in addition to those already mentioned, should be recognized concerning the educational portion of this study. The author taught the experimental unit and provided the follow-up experiences. This created an artificial situation. The children were excited by the mere fact of having a different teacher. While she had built rapport with most of the pupils during collection of data and had been appraised of the backgrounds of a number of subjects, the investigator lacked the understanding of family situations and study habits which the regular teachers possessed. Further, due to her specialized training, the investigator was more able to deal with some of the technical questions raised by the children than most regular teachers would have been.

Because this investigator had planned the experiment and the educational unit, she was ego-involved as a teacher, hoping to produce positive results. The author tried to be intellectually honest and avoid biasing results. Frankly the author believes she may have over-compensated for ego involvement by not encouraging the children enough. Ordinarily an interested teacher would probably have urged the children to change their eating habits and drilled them on weak points in their learning.

Nevertheless, the investigator believed that the advantages of having one research-oriented person teach the experimental unit outweighed the disadvantages just mentioned. By having only one teacher, the variables of teacher personality and subject matter competence were virtually eliminated. Furthermore, the investigator appreciated the need for controlling the research situation and noting any departures from plans.

SUMMARY AND RECOMMENDATIONS

Approximately 200 children participated in a study with the following objectives:

1. To determine the relationships among diet, growth and selected factors of fourth- and fifth-grade children of Monroe County, Iowa.

2. To determine the influence of a specially prepared program of nutrition education on diet, growth and related factors of these pupils.

Body measurements, one-day dietary recalls, hours of sleep and hemoglobin concentrations of blood were obtained in the spring, 1967 when the children were in the third and fourth grades. Early the following fall body measurements, hours of sleep, one-day dietary recalls and one-day dietary records were obtained. Tests of physical fitness, handgrip strength and nutrition-related cognitive abilities were administered along wtih a vegetable preference rating scale. Education of parents and achievement test scores were copied from school records. Heights, weights and ages of parents were obtained by questionnaire. Data thus collected was used in correlations of the various factors.

During the fall, 1967 a three-week experimental unit was taught in three of the fourth- and three of the fifth-grade classrooms. The unit was planned to help pupils develop concepts and generalizations concerning health, cells, growth, digestion, nutrient function and food composition. Pupils evaluated their own diets using the Basic Four Food Groups, discussed breakfasts and snacks and tasted squash, many for the first time. Pupils of the other six classrooms served as controls, receiving no special nutrition teaching. Within a week after the unit was completed the test of nutrition-related cognitive abilities was re-administered in both experimental and control classrooms. During the winter a bulletin board illustrating nutritious, non-traditional breakfasts and a rat feeding demonstration were taken to the experimental groups. The animals had been fed a basal meat, potatoes and bread diet. The potential importance of snacks was illustrated by giving half the animals chocolate bars and the other half milk and raw carrots. The children reviewed the nutrient contributions of the rats' diets and then compared the sizes and appearances of the animals.

A one-day food recall and a one-day record in the winter and a one-day recall in the spring, 1968 furnished post-treatment dietary data. Body measurements were made in the spring, 1968 and the physical fitness test, handgrip strength test, test of nutrition-related cognitive abilities and vegetable preference rating scales were re-administered.

Significance of influence of nutrition education was judged by analyses of variance of factors measured both before and after treatment. Relationships of average nutrient intake over the six days sampled with change in body measurements from spring, 1967 to spring, 1968 were determined by correlation.

Vegetable preference scores were positively related to the intake of most nutrients, and particularly to vitamin A value of the diet. No relationship was observed between score on the test of nutrition-related cognitive abilities and intake of nutrients. Height and weight were related to nutrient intakes and caloric values of the diets; that is, taller and heavier children ate more food than smaller children. There was no relationship between diet and skinfold thickness suggesting obese children were neither eating more nor restricting food intake in comparison to other children.

Parents' heights and weights tended to be related to all measures of child's body size, that is height, weight, skinfold thickness, arm and leg girths and muscle-bone diameter. Large children, including those with large skinfold thicknesses tended to excel in handgrip strength. Performance in situps, squat thrusts and running tended to be impaired among children with large skinfold thicknesses.

A number of children had large increments of weight, skinfold thickness, leg girth and muscle-bone diameter over the period of one year. Some individuals exhibited large weight and fat increases while consuming diets of greater-than-average caloric value, but the sample as a whole showed no relationship between dietary intake and growth of muscle or fat. Among boys in this age group increase in weight was more highly related to increase in indices of body fat than those of muscle; among the girls the opposite was true.

Scores on a test of nutrition-related cognitive abilities increased significantly more for experimental classes than for control classes when measurement was made within a week after completion of special nutrition classes. Between the second and third administrations (approximately five months) scores of the experimental groups declined while scores of control groups improved. However, scores of the experimental groups were still superior to those of the control groups, although not significantly so.

Ratings of vegetable preference declined for both experimental and control groups during the school year. Among girls scores of foods divided by the number of foods tasted declined significantly more among experimental groups than among control groups. Of the foods rated, scores for squash among boys and girls declined significantly more among experimental groups than among control groups. During the unit children tasted squash, many for the first time. Thus the denominator (number of foods tasted) increased more among experimental groups than among control groups. In general, ratings for squash were low, therefore, the average value was not high enough to compensate for the increased denominators.

No significant changes in diet due to treatment were observed. This finding was not surprising due to the short-term nature of the program. In addition, about 90% of the boys and 75% of the girls appeared to have adequate diets before the treatment. Although changes in skinfold thicknesses among girls differed significantly with treatment and improvement in girls' scores of strength varied significantly with treatment-by-grade interaction, these changes could not be attributed logically to treatment.

In view of the enthusiasm for studying the subject, the freedom of food selection and the ability to develop nutrition-related generalizations observed among the children of this study, nutrition appears to be appropriate subject matter for pupils in intermediate grades. The interest the children showed in growth on the cellular level leads the author to recommend inclusion of basic concepts and generalizations of growth and nutrient function. The study of food composition is recommended based on the widespread misconceptions concerning sources of nutrients and the keen interest the pupils expressed in discovering various components of food. The problem of obesity suggests energy balance needs to be taught in the middle grades. However, for children to have a functional knowledge of relative nutrient and energy values of foods, they need much more practice in testing and classifying foods. Such experiences should be included at several grade levels with increasing complexity and accuracy of information the goal.

To change food habits a graded program of nutrition education beginning with nursery school or kindergarten is probably needed. Emphasis in early years should be on affective learning, learning to like foods. During the middle grades basic concepts concerning nutrient functions and sources should be introduced. Upper-grade nutrition education should include more complex generalizations concerning nutrient function and source. Application of principles of nutrition in evaluating diets should continue from middle to upper grades with increasing accuracy.

To better understand development of overweight and obesity during the middle school years intensive investigations which include time and motion analyses of activity are needed. In addition, growth of 9-11-year-old children should be studied for more than a year in order to observe many children becoming overweight and/or obese. Perhaps such studies would provide implications for co-ordinated efforts of nutrition education and physical education of the middle-grade child.

LITERATURE CITED

1. Benson, M. C. A study of methods of changing food habits of rural children in Dakota County, Minnesota. United States Office of Education Series No. 5. 1944.

2. Bloom, Benjamin S., ed. Taxonomy of educational objectives. Handbook I: Cognitive Domain. New York, New York, David McKay Company, Inc. 1956.

3. Bullen, Beverly A., Monello, Lenore F., Cohen, Haskel and Mayer, Jean. Attitudes toward physical activity food and family in obese and non-obese girls. American Journal of Clinical Nutrition 12: 1-11. 1963.

4. Bullen, Beverly A., Reed, Robert B. and Mayer, Jean. Physical activity of obese and non-obese adolescent girls appraised by motion picture sampling. American Journal of Clinical Nutrition 14: 211-223. 1964.

5. Chalmers, Faith W., Clayton, Mary W., Gates, Lorraine O., Tucker, Ruth E., Wertz, Anne W., Young, Charlotte M. and Foster, Walter D. The dietary record - how many and which days? American Dietetic Association Journal 28: 711-717. 1952.

6. Christakis, G., Sajecki, S., Hillman, R. W., Miller, E., Blumenthal, S. and Archer, M. Effect of a combined nutrition education and physical fitness program on the weight status of obese high school boys. Federation Proceedings 25: 15-19. 1966.

7. Church, Charles Frederick and Church, Helen Nichols. Food values of portions commonly used. 10th ed. Philadelphia, Pennsylvania, J. B. Lippincott Company. 1966.

8. Edwards, D. A. W., Hammond, W. H., Healy, M. J. R., Tanner, J. M. and Whitehouse, R. H. Design and accuracy of calipers for measuring subcutaneous tissue thickness. British Journal of Nutrition 9: 133-143. 1955.

9. Eichelberger, Marietta. A study of the value of nutrition instruction in a school system. Journal of Home Economics 19: 320-322. 1927.

10. Eppright, Ercel S., Coons, Irma and Jebe, Emil. Very heavy and obese school children in Iowa. Journal of Home Economics 48: 168-172. 1956.

11. Eppright, Ercel S., Jebe, Emil, Sidwell, Virginia D., Marlatt, Abby L., Northam, Jack I., Biscoff, Georgine A., Clark, Ruth Maxine, McGrath, Blynn C., Loose, Bessie L., Cellucci, Helen W., Patton, Mary Brown, Gluyas, Shirley Boschardt, Tyrrell, Dorothy, Basnett, Dorthea T., Glenn, Grace, Adrian, Florence, Bowser, Mary and Anderson, Bernice. Nutrition of 9-, 10- and 11-year-old public school children in Iowa, Kansas and Ohio. I. Dietary findings. Iowa Agricultural Experiment Station Bulletin 434: 613-631. 1955.

12. Eppright, Ercel S., Patton, Mary Brown, Marlatt, Abby L. and Hathaway, Milicent L. Dietary study methods. V. Some problems in collecting dietary information about groups of children. American Dietetic Association Journal 28: 43-48. 1952.

13. Eppright, Ercel, Roderuck, Charlotte, Sidwell, Virginia D. and Swanson Pearl P. Relationship of estimated nutrient intakes of Iowa school children to physical and biochemical measurements. Journal of Nutrition 54: 557-570. 1954.

14. Garn, Stanley M. and Haskell, Joan A. Fat thickness and developmental status in childhood and adolescence. American Journal of Diseases of Children 99: 746-751. 1960.

15. Grant, Faye Woodard. Effect on eating habits of nutrition education in the fifth grade. Determination by photography. American Dietetic Association Journal 26: 413-416. 1950.

16. Hinton, Maxine Armstrong. Factors related to the eating behavior and dietary adequacy of girls 12-14 years of age. Unpublished Ph.D. thesis. Ames, Iowa, Library, Iowa State University. 1962.

17. Huenemann, Ruth L., Shapiro, Leona R., Hampton, Mary C. and Mitchell, Barbara W. Teen-agers' activities and attitudes toward activity. American Dietetic Association Journal 51: 433-440. 1967.

18. Irving, Evelyn Marie. Factors related to acceptance of foods by pupils in certain Iowa schools. Unpublished M.S. thesis. Ames, Iowa, Library, Iowa State University. 1951.

19. Iowa State University. Student Counseling Service. Test Scoring and Analysis Service. Report 68-01. 1968.

20. Jackson, R. L. and Kelly, H. G. Growth charts for use in pediatric practice. Journal of Pediatrics 27: 215-229. 1945.

21. Johnson, Mary Louise, Burke, Bertha S. and Mayer, Jean. Relative importance of inactivity and overeating in the energy balance of obese high school girls. American Journal of Clinical Nutrition 4: 37-44. 1956.

22. Kaled, Miriam Ann. Nutritional status of children, kindergarten through eighth grade, Monroe County, Iowa. Unpublished M.S. thesis. Ames, Iowa, Library, Iowa State University. 1965.

23. Kaled, Miriam Ann. Correlation matrix and growth charts. Unpublished data. Ames, Iowa, Department of Food and Nutrition, Iowa State University of Science and Technology. 1965.

24. Keys, Ancel, ed. Recommendations concerning body measurements for the characterization of nutritional status. Human Biology 28: 111-123. 1956.

25. Krathwohl, David R., Bloom, Benjamin S. and Masia, Bertram B. Taxonomy of educational objectives. Handbook II. Affective domain. New York, New York, David McKay Company, Inc. 1964.

26. Kunkel, Naomi and Hall, Olive. Influence of nutrition teaching on adolescents' eating habits. American Dietetic Association Journal 34: 1220-1222. 1958.

27. Lollis, Emily Shirley. Some of the factors influencing the dietary habits of adolescent girls. Unpublished M.H.Ec. thesis. Norman, Oklahoma, Library, University of Oklahoma. 1960.

28. Martin, Ethel Austin. Nutrition education in action. New York, New York, Holt, Rinehart and Winston, Inc. 1963.

29. Munsen, Katherine Jacobson. Diet, measurements and physical activity of ten heavy girls and ten girls of medium weight. Unpublished M.S. thesis. Ames, Iowa, Library, Iowa State University. 1965.

30. National Research Council. Recommended dietary allowances. 6th ed. National Academy of Sciences--National Research Council Publication 1146. 1964.

31. National Research Council. Recommended dietary allowances. 7th ed. National Academy of Sciences--National Research Council Publication 1694. 1968.

32. Neel, Ruth S. Nutrition education for the very young. Journal of Home Economics 38: 265-268. 1946.

33. The New York State physical fitness screening test for boys and girls - grades 4-12. Manual for teachers (preliminary edition). Mimeographed. Albany, New York. The State Education Department. ca. 1961.

34. Parizkova, Jana. Total body fat and skinfold thickness in children. Metabolism 10: 794-807. 1961.

35. Pickenpaugh, Melba Eloise. Nutriture of school girls of very heavy and of medium physiques. Unpublished M.S. thesis. Ames, Iowa, Library, Iowa State University. 1957.

36. Reynolds, Earle E. The distribution of subcutaneous fat in childhood and adolescence. Research in Child Development, Inc. Society Monographs 15, No. 2. 1950.

37. Roberts, Lydia J. The Dona Elena Project. Rio Piedras, Puerto Rico, University of Puerto Rico. 1963.

38. Rosenstock, Irwin M. What research in motivation suggests for public health. American Journal of Public Health 50: 295-302. 1960.

39. Seltzer, Carl C. and Mayer, Jean. Body build and obesity-who are the obese? American Medical Association Journal 189: 677-684.

40. Seltzer, Carl C. and Mayer, Jean. A simple criterion of obesity. Postgraduate Medicine 38: A-101-106. Aug. 1965.

41. Sidwell, Virginia DeCecco. Body measurements and blood constituents in relation to nutrient intake of Iowa children. Unpublished Ph.D. thesis. Ames, Iowa, Library, Iowa State University. 1954.

42. Snedecor, G. W. and Cochran, W. G. Statistical methods. 6th ed. Ames, Iowa, Iowa State University Press. 1967.

43. Sondgeroth, Sister Mary Luke. Dietary practices and body fatness of ninth and twelvth grade girls in relation to their concepts of nutrition. Unpublished M.S. thesis. Ames, Iowa, Library, Iowa State University. 1968.

44. Stanley, Lucille Anstey. Effect of teaching nutrition to fourth grade pupils in Davenport, Iowa. Unpublished M.S. thesis. Ames, Iowa, Library, Iowa State University. 1956.

45. Stefanik, Patricia A., Heald, Felix P., Jr. and Mayer, Jean. Caloric intake in relation to output of non-obese and obese adolescent boys. American Journal of Clinical Nutrition 7: 55-62. 1959.

46. Tanner, J. M. The assessment of growth and development in children. Archives of Disease in Childhood 27: 10-33. 1952.

47. Tanner, J. M. and Whitehouse, R. H. Standards for sub-cutaneous fat in British children: percentiles for thicknesses of skinfolds over triceps and below scapula. British Medical Journal 5276: 446-450. 1962.

48. Taylor, Clara Mae and Orrea, Florence Pye. Foundations of nutrition. New York, New York, The Macmillan Company. 1966.

49. Trulson, Martha F. and McCann, Mary B. Comparison of dietary survey methods. American Dietetic Association Journal 35: 672-676. 1959.

50. United States Agricultural Research Service. Calculating the nutritive value of diets. Agricultural Research Service Publication 62-10-1. 1964.

51. Watt, Bernice K. and Merrill, Annabel L. Composition of foods. United States Department of Agriculture Handbook 8. 1963.

52. Whipple, Guy Montrose. Manual of mental and physical tests. Part 1. Baltimore, Maryland, Warnick and York, Inc. 1914.

53. Whitehead, Floy Eugenia. How nutrition education can affect adolescents' food choices. American Dietetic Association Journal 37: 348-356. 1960.

54. Whitehead, Floy Eugina. Studies in nutrition education. American Dietetic Association Journal 28: 622-627. 1952.

55. Young, Charlotte M., Chalmers, Faith W., Church, Helen N., Clayton, Mary M., Tucker, Ruth E., Wertz, Anne W. and Foster, Walter D. A comparison of dietary study methods. I. Dietary history vs. seven-day record. American Dietetic Association Journal 28: 124-128. 1952.

56. Young, Charlotte M., Hagan, Gladys C., Tucker, Ruth E. and Foster, Walter D. A comparison of dietary study methods. II. Dietary history vs. seven-day record vs. 24-hour recall. American Dietetic Association Journal 28: 218-221. 1952.

ACKNOWLEDGEMENTS

Grateful appreciation is expressed to Dr. Charlotte Roderuck, Dr. Maxine Hinton and Dr. Ercel Eppright for their patient guidance of this study; to Dr. Hester Chadderdon for her assistance in developing the objectives, generalizations and nutrition test; to Dr. Leroy Wolins for his many hours of statistical counseling; to Miss Helen Bishop for reviewing the unit; to Dr. Wilma Brewer and Dr. Pilar Garcia for their assistance in obtaining resources; to Dr. Waldean Robicnaux and Miss Carolyn Rasmus for directing the physical fitness portion of the study; to Mrs. Elizabeth Yetley for her tireless efforts in collecting and coding the data; to Mrs. Sharon Bleeker, Mrs. Carol Merrit, Mrs. Barbara Stoeker, Miss Patty Rustwick, Miss Jan Dunn, Dr. Evelyn Mar, Miss Alberta Paysen, Miss Emily Updegraf and Mrs. Cynthia Campbell for their help in collecting data, to Miss Linda Payton for her patient coding of data; and to Allan Baker for his encouragement and help throughout the study.

The author gratefully acknowledges the people of Monroe County who assisted with this study; Mr. William Dabb, Mr. Robert Snell, Sister St. Anne and the elementary school principals for their assistance in administering the study; to the third-, fourth- and fifth-grade teachers for cooperating in all phases of the field work; to the nurses for assisting with blood sampling and health records; to the children and their parents for contributing enthusiasm and data for the study; and to the many other friends for making the investigators feel at home in Monroe County.

APPENDIX A

IOWA STATE UNIVERSITY
OF SCIENCE AND TECHNOLOGY
Ames, Iowa 50010

COLLEGE OF HOME ECONOMICS
OFFICE OF THE DEAN

March 1, 1967

Dear Parents:

Food and exercise influence how children grow and develop. In 1964-1966, members of the Home Economics Research staff at Iowa State University, Ames, made a survey of the diets consumed and growth of Monroe County children. In addition to giving us some valuable information concerning children's nutrition, the study raised some questions about the relationship of physical activity to diet and growth. We want to obtain answers for these questions and need your cooperation for success of our proposed study.

Third and fourth grade children have been chosen for a study which will include the factor of physical activity as well as those related to diet and growth. Your child____________________ has the opportunity to participate in this study.

As before, the study will be conducted in the schools with the cooperation of school officials. We have contacted the school officials and the pupils to explain in part the purpose of the study and the procedures to be included. The pupils participating will be measured this spring and several times next year. Some of them will be asked to keep two day records of what they eat, will be tested for their physical fitness, and will be requested to give a few drops of fingertip blood for analysis. All information obtained from individual children will be kept confidential.

We hope that you will want to help us in this much needed research. The more children who participate, the more reliable the findings will be. Will you please indicate your willingness to have your child included in the study by signing the enclosed card.

Thank you for your cooperation.

Sincerely yours,
Charlotte E. Roderuck

Charlotte E. Roderuck, Ph.D.,
Professor of Food and Nutrition

Maxine Hinton, Ph.D., Associate
Professor of Food and Nutrition

(Miss) Mary Jean Fulkerson,
Research Assistant

(Mrs.) Elizabeth Yetley,
Research Assistant

I am willing to cooperate in the children's nutrition study. Please include my child ______________________.

Parent(s) or guardian's signature:

____

Please mail this stamped, self-addressed card at your earliest convenience.

Form used for permission card

Iowa State University
of Science and Technology
Ames, Iowa 50010

College of Home Economics

March 28, 1967

Dear Parents:

At the beginning of this month, we mailed a letter to you describing the nutrition study for which we had selected your child ________________. To date, we have not received your card stating whether or not you are willing to have __________ included in the study. We realize that the letter may not have reached you or that the card has been missent; so, we are sending another card home with your child for your reply.

If you have questions or wish for further information, will you kindly indicate this on the card. We shall be most happy to contact you if you have further questions.

Finally, if you are unwilling to have your child participate in this study, will you please state this on the card. In any case, please return the card to us at your earliest convenience.

Sincerely yours,

Charlotte E. Roderuck

Charlotte E. Roderuck, Ph.D.
Professor of Food and Nutrition

Maxine Hinton, Ph.D. Associate
Professor of Food and Nutrition

(Miss) Mary Jean Fulkerson,
Research Assistant

(Mrs.) Elizabeth Yetley,
Research Assistant

APPENDIX B

Typical Questions Used in Obtaining Dietary Recalls

Did you have anything for breakfast?

Was your bowl more like this one or that one (pointing)?

How far up in the bowl did the cornflakes go <u>before</u> you added milk?

Did the "orange juice" taste like a real orange? More sour or more sweet?

Would the amount of peas you ate be as much as one of these (pointing to piles of dried beans)?

Can you show me with your fingers how big the meat in your hamburger was?

Name:________________________ Code No.________________________
Date:________________________

Food Record or Recall

Time	Food Eaten and Description	Amount	Where	With Whom
Lunch	Milk Soup, chicken noodle Lunchmeat sandwiches	8 oz. 1 cup 2 slices bread 2 slices meat	Home	Sibling
A.M. Snack	None			
Break.	Milk Donuts, Cake, no frosting	8 oz. 5	Home	Sibling
Eve. Snack	Apple, raw Donuts, same as above Milk	1 med. 3 8 oz.	Home	Alone
Supper	Fried chicken "Tator Tots" Milk	1 drumstick 6 16 oz.	Home	Family
After-noon Snack	Mountain Dew pop	10 oz.	Downtown	Friends
	no pills (initials of interviewer)			

How to Keep Your Food Record

Write down everything you eat, chew or drink except water.

Include any pills you may take.

Write down the name of each food and describe it as well as you can.

Tell how the meat is cooked.

Example: Roast Beef

Tell whether fruits and juices are fresh, frozen, canned or dried.

Example: Frozen Orange Juice

List butter, sugar, salad dressing, cream or milk if added.

Example: Corn Flakes with
sugar
whole milk

If the food is a mixture such as a stew or a casserole, ask your mother to help you write down the recipe.

Example: Tuna Noodle Casserole
1/4 lb. uncooked noodles
1-7 oz. can tuna fish
1 can cream of mushroom soup
1/2 cup crushed potato chips

Write down the amount of food you actually ate.

If you have them, use "standard" measuring cups for such foods as vegetables, puddings, juices and milk.

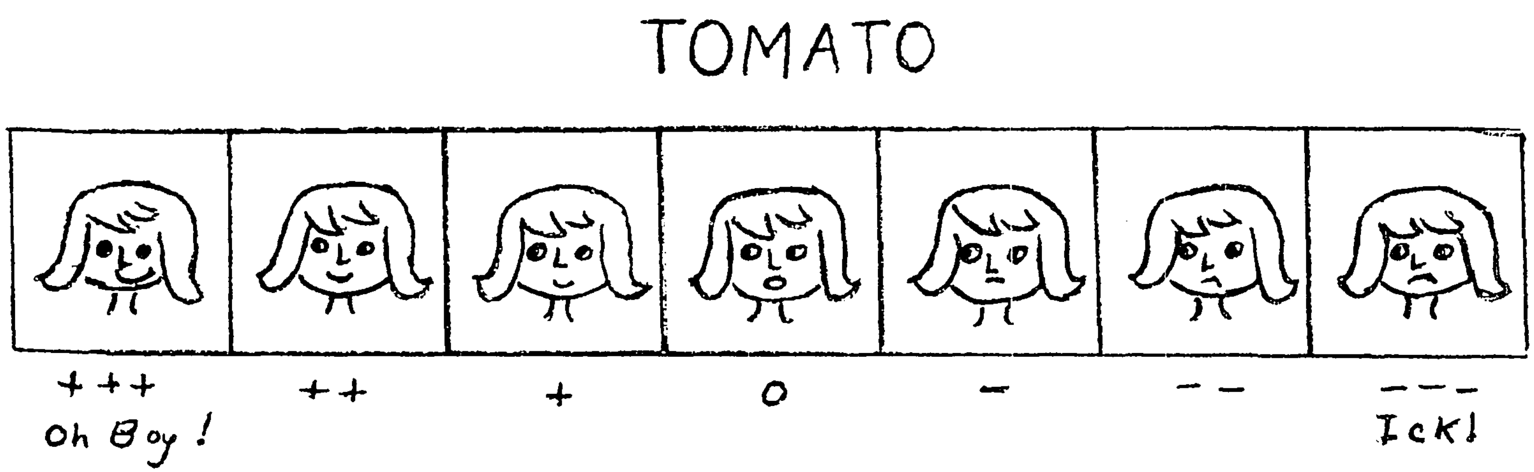
Use measuring spoons for sugar and jelly.

Hold a ruler near sliced meat and cheese to measure them.

Look on the wrapper for the weight of foods such as candy bars.

For the school lunch write down how many servings you eat of vegetables, meat, salad or dessert.

APPENDIX C



Sample vegetable preference rating scale for preliminary study

V FOOD CHECKLIST

Instructions: Place an (x) in the appropriate column that describes your attitude toward the listed foods.

Food	Like It Very Much	Would Eat It Once a Week	Would Not Eat It	Dislike It	Have Not Tried It
Baked Beans					
Broccoli					
Brussels Sprouts					
Cabbage Slaw					
Cooked Cabbage					
Cauliflower					
Carrot Sticks					
Cooked Carrots					
Corn on the Cob					
Canned Corn					
Head Lettuce					
Fresh Peas					
Canned Peas					
Eggplant					
Sauerkraut					
Potato Chips					
French Fried Potatoes					
Baked Potatoes					
Mashed Potatoes					
Sweet Potatoes					
Baked Yellow Squash					
Summer Squash					
Fresh Tomatoes					
Stewed Tomatoes					
Tomato Juice					
Turnips					
Apples					
Avocado					
Bananas					
Oranges					
Orange Juice					
Peaches					
Canned Peaches					
Fresh Strawberries					
Cornbread					
White Bread					
Crackers					
Oatmeal					
Cornflakes					
Spaghetti					
Baked Custard					
Ice Cream					
Puddings					
Pie					
Cake					
Cookies					
Candy Bars					
Milk					
Reconstituted Dried Milk					
Buttermilk					
Cottage Cheese					
Yellow Cheese					
Butter					
Scrambled Eggs					
Fried Eggs					
Hard Boiled Eggs					
Soft Boiled Eggs					
Poached Eggs					
Peanut Butter					
Hamburger					
Beef Steak					
Beef Roast					
Lamb Chops					
Lamb Roast					
Pork Chops					
Pork Roast					
Fried Fresh Fish					
Oyster Stew					
Canned Salmon					
Liver					
Liver Sausage					
Fried Chicken					
Roast Chicken					
Roast Turkey					
Margarine					
Vegetable Soup					
Chili					

Procedure followed in Preliminary Study

Before the two testing periods in which the foods were served the subjects were given the following instructions:

Do not talk during the test.
Drink some water before tasting a different vegetable.
Taste the vegetable before marking the sheet.

The vegetables were set out in sight of all in clean glass casserole dishes on a turquoise cloth. Each girl was supplied with a small paper plate, paper cup of water, plastic fork and paper napkin. The investigators served the vegetables to each girl in the order designated by the rating sheets which had previously been randomly arranged. The subjects were supplied clean plates after three of the six vegetables had been served.

Methods of serving the vegetables

Potato chips - Fresh potato chips were served from a dish at room temperature.

Corn - Green Giant boiling bag frozen corn was boiled and kept hot till serving.

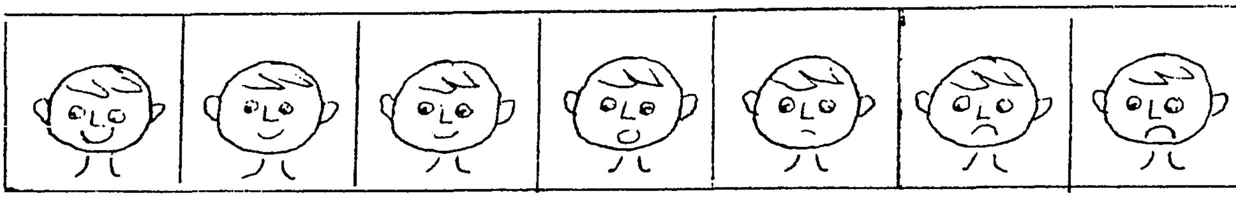
Tomatoes - Fresh red tomatoes were sectioned into six or eight pieces and very lightly salted and sugared. They were served cold on a bed of endive.

Green beans - Green Giant boiling bag frozen beans were boiled and served hot and tender-crisp.

Cooked carrots - Fresh carrots were cut into four-inch strips and cooked to the tender-crisp stage. They were served hot with butter and fresh flaked parsley.

Candied sweet potatoes - Whole sweet potatoes were cooked until tender in steam, then sliced crosswise and peeled. The slices were placed in a casserole and covered with a brown sugar sauce. They were served hot.

French fried potatoes

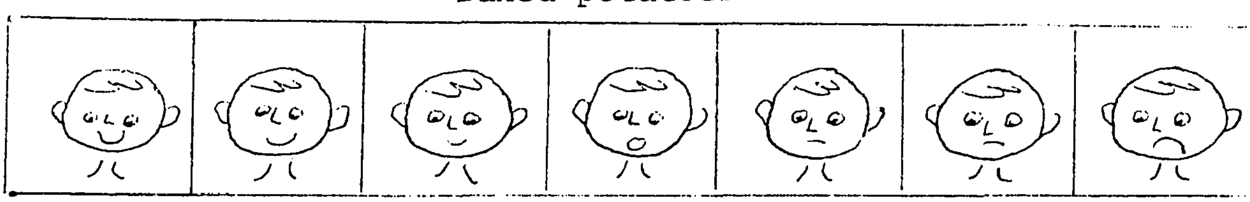


+++ ++ + 0 - -- ---

Oh boy! Ick!

Never tasted ____

Baked potatoes



+++ ++ + 0 - -- ---

Oh boy! Ick!

Never tasted ____

Cabbage slaw

+++ ++ + 0 - -- ---

Oh boy! Ick!

Never tasted ____

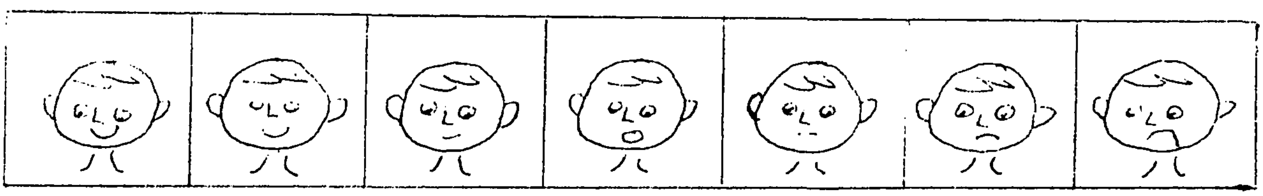
Cooked carrots

+++ ++ + 0 - -- ---

Oh boy! Ick!

Never tasted ____

Raw carrots

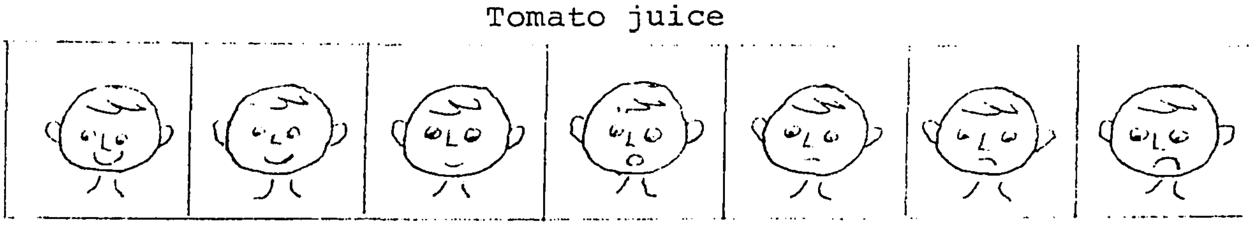


+++ ++ + 0 - -- ---

Oh boy! Ick!

Never tasted ____

Tomato juice

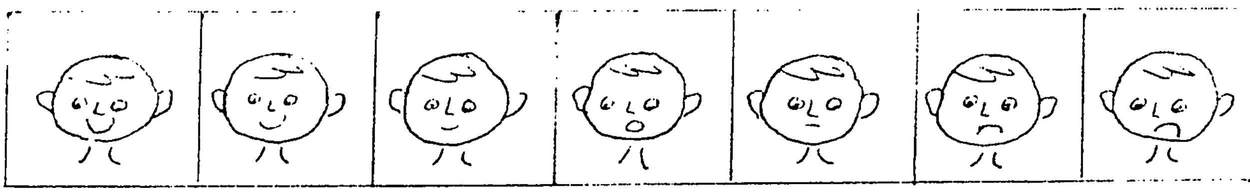


+++ ++ + 0 - -- ---

Oh boy! Ick!

Never tasted ____

Candied sweet potatoes

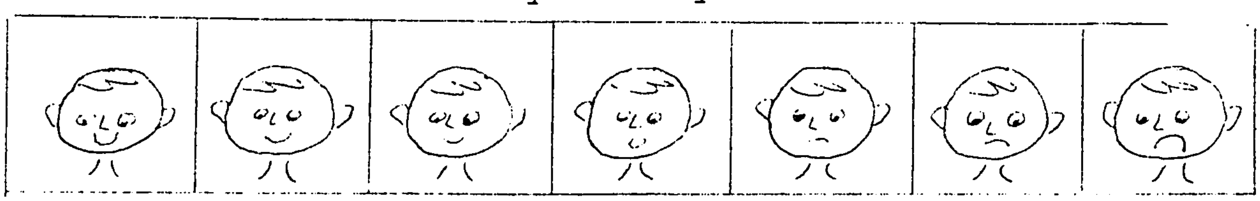


+++ ++ + o - -- ---

Oh boy! Ick!

Never tasted ____

Baked yellow squash

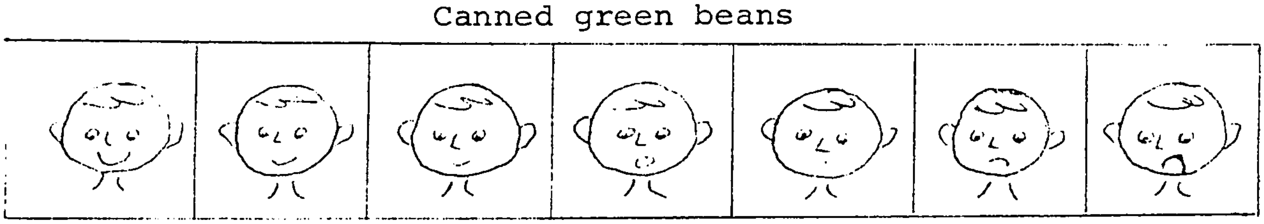


+++ ++ + o - -- ---

Oh boy! Ick!

Never tasted ____

Canned green beans



+++ ++ + o - -- ---

Oh boy! Ick!

Never tasted ____

APPENDIX D

(Name and Code No.) ______________

	Raw Score	Achievement Level	% rank	Date	Time
Agility					
Strength					
Speed					
Endurance					
Total Fitness					

Form used for physical fitness score card

Iowa State University
Ames, Iowa 50010

Dear Parents:

In interpreting children's growth patterns it is helpful to know the heights and weights of their parents. We would appreciate your help in filling out the blank below. Please seal it in the envelope attached to your child's food record so that he may return it.

This information will be kept confidential as is all of the individual information obtained in this research project.

Thank you for your cooperation.

Sincerely,

Mary Jean Fulkerson

Mary Jean Fulkerson
Graduate Research Assistant

- -

Code no. ______________

Date ______________

	Age	Height	Weight	Serious injury or illness that might affect height or weight
Father:	___	__ft.__in.	___lb.	______________________________
Mother:	___	__ft.__in.	___lb.	______________________________

APPENDIX E

Objectives

After a child has completed this unit, he should be more likely to consume a balanced[1] diet because he should be better able to: (application and acceptance of a value)[2]

I. Formulate a concept of health involving optimum well-being. (comprehension-translation)

This could be demonstrated by his ability to:

IA. Define health in his own words in terms of optimum well-being. (comprehension-translation)

IB. Identify characteristics of health. (knowledge)

II. Comprehend the dependence of health on food. (comprehension-extrapolation)

This will involve his being able to:

IIA. Relate health and growth of the body to that of the cells. (comprehension-extrapolation)
To do this a child must be able to:

IIA1. Formulate an elementary, workable definition of a cell in its relationship to the body. (comprehension-translation)

IIA2. Describe in elementary terms cells division and growth. (comprehension-translation)

IIA3. Recognize selected components in food. (knowledge)

Note: In the classroom experiences for objectives IIA3 and IIB2 are to be integrated.

IIA3a. Relate caloric value of foods to certain characteristics of taste and feel. (comprehension-interpretation)

---

[1]The diets were judged by sex within the classroom using the Recommended Dietary Allowances of the National Research Council.

[2]Words in parentheses are levels of competency and/or internalization from Bloom's taxonomy of educational objectives (2, 25).

IIB. Recognize the basic dependence of the body cells on food. (comprehension-extrapolation)

IIB1. Outline the process of digestion, absorption and transport of nutrients to the cells. (knowledge)

IIB2. Recall some of the functions of nutrients in the body. (knowledge)

III. Improve his own food habits if his intake of some nutrients is low. (application and willingness to respond)

A typical child in this county could improve his diet if he would:

IIIA. Recognize that food is the major source of nutrients. (knowledge)

IIIB. Judge his own diet using the Basic Four Food Groups Guide. (application)

To do this he must be able to:

IIIB1. Recall the number of servings from each group and sub-group recommended for fourth- and fifth-grade children. (knowledge)

IIIB2. Place foods in their respective groups and sub-groups. (knowledge)

IIIC. Accept a wide variety of foods from all four food groups. (willingness to respond)

This may be facilitated if the child can:

IIIC1. Realize that food serves social and psychological functions. (knowledge)

IIIC2. Recognize some factors which may affect food acceptance. (knowledge)

IIIC3. Realize that food preferences can change. (knowledge)

IIIC4. Be willing to taste new or disliked foods. (willingness to receive)

IIID. Select snacks which contribute to overall nutrition. (application and willingness to respond)

IIIE. Eat a nutritious breakfast before school. (application and willingness to respond)

A child will be more likely to do this if he can:

Recognize that a nutritious breakfast can consist of a variety of inexpensive and easy-to-prepare foods. (knowledge)

IV. Recognize that diet interacts with many factors to affect health. (knowledge)

Within Objective IV a child in this county should be able to:

IVA. Realize that there exists a range of acceptable sizes and growth rates.

IVB. Recognize the relationships between energy intake and expenditure. (knowledge)

Generalizations[1] and Facts

I. You are healthy when you are at your best in body, mind and relations with others.

Health includes having good posture, bright eyes, sound teeth, shining hair and clear skin.

Health includes keeping well and having strength and endurance suitable for a boy or girl of your age and size.

Health includes having an alert mind.

Health includes getting along well with others.

[1]Generalizations are numbered and lettered to correspond to objectives.

II. Cells need food to live and grow.

IIA. The health of the body depends upon the condition of most of the cells making up the body.

IIA1. Cells are the smallest living parts into which plants and animals can be divided.

Cells are very tiny.

An animal cell is filled with cytoplasm and has a nucleus (except a red cell in the blood). The outside covering is called the cell membrane.

There are many kinds of cells.

Many cells of the same kind are grouped together to form a tissue. A tissue is made of similar cells grouped together to do their work.

IIA2. Cells form new cells by dividing in two. The new cells then grow to be as big as the parent cells.

New cells keep replacing some of the old cells in the bodies of both children and adults.

When the body grows, new cells of certain kinds are being made much faster than the old cells are dying. Nerve and muscle cells grow larger, but they do not divide after a person is born.

IIA3. Foods look, taste and feel different because they have different amounts of water, fiber, protein, sugar, starch and fat and they have different coloring and flavoring substance.

Breads and cereals are made from grains that contain a lot of starch.

Meat, fish and poultry are made of animal cells so they contain a lot of protein. Water and fat make them juicy.

Milk is a source of calcium, phosphorus and protein in lots of water. Food made from milk also contains calcium, phosphorus and protein.

Most fresh vegetables contain a lot of water which makes them crisp. Fiber helps them hold their firm shape.

The yellow coloring matter in most deep yellow fruits and vegetables and in most dark green leafy vegetables can be broken down to form vitamin A. Therefore, most of these foods are good sources of vitamin A.

Because many vitamins and iron are stored in the liver of animals, liver is a good source of these nutrients.

Fat in food helps make it smooth, oily, greasy or crisp.

Sugar in food helps make it sweet or sweet and gooey.

IIA3a. The taste and feel of fat, sugar, fiber and water in food help a person tell whether a food is high or low in energy value.

Calories in food are a measure of how much energy the body can get from chemically breaking proteins, fats and carbohydrates.

An ounce of fat contains more than twice the energy value as an ounce of protein or carbohydrate.

A food is lower in energy value than others of its group if it
- is watery
- has more fiber
- is crisp from water.

IIB. Cells use substances from food to produce new cell material and to produce the energy needed to do the cells' work.

IIB1. Digestion is the process of breaking up food in the body so it is small enough to pass out of the digestive tract into the blood which carries it to the cells.

The digestive tract is like a long twisted tube that extends from the mouth to the rectum. In order for food to be used by the cells, it must pass through the cells which form the walls of this tube.

Food is digested in the body by grinding, chemical breaking and detergent action.

In the mouth food is cut and ground by the teeth into smaller pieces. It is mixed with saliva which begins to break the food by chemical reactions.

The food goes down the esophagus into the stomach where it is churned and mixed with digestive juices that chemically break the food some more.

In the small intestine food is broken by digestive juices into particles small enough to go through the cells of the intestine walls into the blood.

Undigested food enters the large intestine where water is taken from it. The undigested material is mixed with bacteria from the large intestine and leaves the body during a bowel movement.

IIB2. Food has materials called nutrients for building and repairing the body and for producing energy in the body.

Proteins from food provide the building blocks for the cells.

Animal cells are made mostly of water, protein and fat. They also have carbohydrates, minerals and vitamins.

Proteins from food are taken apart by the body and put back together to form the kinds of proteins needed by the body.

Enzymes are special proteins made by the cells to help make new materials or produce energy.

Vitamins and minerals help enzymes do their work.

Vitamins are found in very small amounts in food and in the body.

Only small amounts of vitamins are needed by the body.

Calcium and phosphorus are deposited in bones and teeth to make them hard.

If the body does not have as much of the different nutrients at one time as it needs, it can't make all the new material it needs.

When proteins, fats and carbohydrates are changed to carbon dioxide and water by the body, they release energy for the body.

Proteins, carbohydrates and fats can be broken down to release energy.

Sugars and starches are carbohydrates.

Much of a plant cell is made of starch. The starch is used to store energy for the plant.

Animals can store energy as body fat.

As proteins, fats and carbohydrates are taken apart to provide energy, they are combined with the oxygen we breathe and changed to carbon dioxide and water.

Nutrients which are not needed immediately for building and repair or for energy are stored in the liver or fat until they are needed.

Iron and some of the vitamins are stored in the liver.

Proteins and carbohydrates can be broken down and made into fat to be stored in the fat tissue of the body.

A food is higher in energy value than others of its group if it
- is greasy or oily
- is crisp from fat
- is thick or smooth
- is sweet or gooey.

III. A person is more likely to get all the nutrients he needs if he eats many different kinds of foods.

IIIA. A person can usually get enough of the nutrients he needs from food.

IIIB. The Basic Four Food Groups can be used as a guide to check a diet and to select foods for a diet.

The following amounts of food from each food group are recommended for fourth- and fifth-grade children:

Two servings each day from the meat group. The meat group includes meat, fish, poultry, cheese, eggs, dried peas and beans and nuts.

Three cups of milk each day. Cheese, ice cream and foods made with milk may be used for part of the milk.

Four servings each day from the fruit and vegetable group including one serving each day of a food rich in vitamin C and one serving every two days of a fruit or vegetable rich in vitamin A value.

Foods rich in vitamin C include citrus, fruits, cantaloup, raw strawberries, broccoli and green pepper.

Two servings of foods which are fair sources of vitamin C may be eaten in place of one serving of a good source. Raw cabbage, potatoes cooked in their skins, spinach, tomatoes and tomato juice are fair sources of vitamin C.

Four servings each day from the whole-grain and enriched bread and cereal group.

IIIC. Many things influence the choices people make about food.

IIIC1. Food has many meanings to people.

Food is used to express love and friendship.

Special foods are used to celebrate special days.

Certain foods remind a person of his home and family.

IIIC2. Food likes and dislikes depend on many things besides the look, taste and feel of the food itself.

A person has a tendency to like the foods he is used to eating.

A person has a tendency to like the same foods his friends and family like.

A person has a tendency to like better foods which are eaten when people are happy.

IIIC3. Food likes and dislikes can and do change.

A person's food likes and dislikes change as he grows older.

Often a person can learn to like a new or disliked food by eating small servings of the food with favorite foods.

IIID. Snacks may be selected from the Basic Four Food Groups.

Many raw fruits and vegetables make tasty snacks.

Milk or fruit drinks can be made for snacks or party refreshments.

Interesting sandwiches or crackers can be served for snacks or party foods.

Many cereals can be munched for snacks.

IIIE. Any food found in the Basic Four Food Groups may be eaten for breakfast.

Many cereals are inexpensive and easy to serve.

Many different kinds of sandwiches can be made for breakfast including egg, bologna, cheese or peanut butter. Some people make breakfast sandwiches from toast.

Non-fat dry milk is inexpensive and can be used to make drinks for breakfast.

There are many kinds of fresh, canned, frozen and dried fruits; vegetables and juices that are easy to serve for breakfast.

IV. Many things work together to affect health.

Some of the things that work together to affect health are food, exercise, rest, cleanliness, immunization from disease, safety, heredity and emotions.

IVA. Each person grows in his own way.

Each person grows to have his own special adult size and appearance.

Each child has his own speed of growth.

Many girls between the ages of 9 or 10 and 13 suddenly gain a lot of weight before they grow much taller.

Between the fifth and eighth grades many girls grow faster for a time than the boys.

IVB. A balance between kind and amount of food eaten and exercise is needed for control of weight.

Energy for the body must come from food or from body tissues.

When a person uses the same amount of energy as the food he eats can provide, there is no change in the amount of energy stored in his body.

A person can lower the amount of fat in his body by using more energy than the food he eats can provide.

A person can raise the amount of fat in his body by using less energy than the food he eats can provide.

Objectives with Corresponding Experiences

I. Formulate a concept of health involving optimum well-being.

Imagine a healthy boy or girl. Discuss how he would look, feel and act. Contrast characteristics of health and lack of health portrayed by specially drawn cartoon pictures of physical health, mental alertness and getting along well with others.

II. Comprehend the dependence of health on food.

Judge diets of rats; then compare growth, size and appearance of the animals.

Six weanling rats from one litter were numbered in order of weight at three weeks of age. All animals were fed each day 1 tablespoon of a 2:3 mixture of fine enriched bread crumbs and potato flakes plus 1/2 teaspoon raw hamburger. In addition, odd numbered rats consumed *ad libitum* "whole" dried milk (1/2 lb fortified margarine mixed with 1 lb non-fat dried milk). Even numbered rats consumed squares of chocolate bars *ad libitum*. The animals were compared three weeks after weaning (at six weeks of age).

IIA1. Formulate an elementary, workable definition of a cell in its relationship to the body.

Observe red blood and epithelial cells under the microscope. Look at drawings and listen to tape concerning number, variety and basic structure of cells in body.

Vote on type of "tissue" for class to make. Make four cells of the selected type and add to the model of a tissue.

IIA2. Describe in elementary terms cell division and growth.

Simulate cell division and growth using home-made clay.

IIA3. Recognize selected components in food.

Suggest sources of protein which are foods from animals. Compare fresh and dried beans. Select pictures of good animal and vegetable sources of protein, that is, foods included in the Meat Group of the Basic Four Food Groups plus milk and cheese. Arrange foods of Meat Group in first quadrant of bulletin board.

Feel milk ash (residue after organic matter has been burned from powdered milk). Thicken milk with rennin. Squeeze curd and compare product with cheese.

Rub scraped carrot and note yellow color that comes off. Name fruits and vegetables which have a deep yellow color. List vegetables which are leafy and dark green. Arrange pictures of foods high in vitamin A value.

Blot foods in absorbant writing paper to determine foods with a high proportion of fat. (These foods will leave a grease stain after the paper is dry).

IIA3a. Relate caloric value of foods to certain characteristics of taste and feel.

From a menu select foods which are high, low and in between in energy value. Tell which "clues" apply to these foods. (See below).

Compare lettuce with corn and orange with corn. Write down "clues" for foods low in energy value (characteristics of first food in each of the above pairs.

IIB. Recognize the basic dependence of the body cells on food.

Tell what happens when a boy eats the following lunch

Hamburger on bun
Raw carrots
Milk

Discuss how the food gets from the mouth to the cells. Name the main nutrients in each food. Tell what these nutrients do.

IIB1. Outline the process of digestion, absorption, and transport of nutrients to the cells.

Observe simulation of food passing through a cell membrane. Granulated sugar is sprinkled in the center of a paper towel draped over a cup. Water is poured on the sugar. Someone tastes the liquid in the cup to ascertain if sugar passed through the towel.

Compare cutting, tearing and mashing of food with teeth as these processes are simulated on a cooked potato using knife and fork.

Try to mix corn oil with water by agitation. Simulate action of bile using liquid detergent.

Observe (at intervals for several hours) action of pepsin on milk. (Teacher adds 2 teaspoons dry pepsin dissolved in 2 tablespoons water with 1 tablespoon 0.1 M HCl to 1 cup milk.

Using diagram in book trace path of digestion. Examine three-dimensional models of digestive organs.

Study diagram of circulatory system and diagram of arteries, veins and capillaries. Feel pulse. With each pulse imagine food and water being pushed out of capillaries into fluid around cells.

IIB2. Recall some of the functions of nutrients in the body.

Observe illustration of protein function in providing building materials for the body. Abstract shapes of varying sizes and colors are hooked together to represent the building blocks in one protein of a hamburger. The pieces are detached from one another representing the process of chemical digestion. The pieces are rearranged to form a new "protein needed by the body".

Squeeze meat to find water and fat (leaves grease mark on absorbant writing paper).

Bend decalcified bone (chicken tibia which has been soaked in vinegar for one week).

Test foods for the presence of starch. (Iodine dropped on moistened starch will turn dark purple).

Blow through a straw into lime water to detect presence of carbon dioxide. (Water becomes cloudy.)

Compare milk shake with milk, cake with bread, bacon with roast chicken, salad dressing with milk. Write down "clues" for foods high in energy value (characteristics of first food in each of the above pairs).

IIIB. Judge his own diet using the Basic Four Food Groups Guide.

Watch filmstrip (The Power of Food by the National Livestock and Meat Board).

Judge one-day food intake using Basic Four Food Groups Guide.

Place pictures of foods in their respective groups. Discuss why some foods are not included. Label each group and sub-group and add number of recommended servings.

IIIB2. Place foods in their respective groups and sub-groups.

Study diagram of cereal grain. Feel and look at unprocessed wheat. Look for the word enriched on wrappers of bread and other cereal products. Arrange pictures of whole-grain and enriched bread and cereal products on fourth quadrant of bulletin board.

IIIC1. Realize that food serves social and psychological functions.

Discuss cartoons representing roles of food in body building, holiday celebrations and expressing friendships.

IIIC2. Recognize some factors which may affect food acceptance.

Contrast and consider reasons for differences in food preferences among people of different countries.

IIIC3. Realize that food preferences can change.

Suggest ways to help others learn to like new foods.

Taste mashed squash seasoned with butter and salt. Taste some to which brown sugar and cinnamon have been added.

IIID. Select snacks which contribute to overall nutrition.

Judge diets of rats; then compare growth, size and appearance of the animals (See II above.)

Suggest nutritious snacks.

IIIE. Eat a nutritious breakfast before school.

Suggest breakfasts which could be easily prepared.

Observe bulletin board entitled "Good breakfasts come in many foods". Printed menus of one traditional and three non-traditional breakfasts are illustrated by stylized pictures of the foods.

IV. Recognize that diet interacts with many factors to affect health.

Observe bulletin board entitled "Many things affect health" (Familiar cartoon character illustrates food, rest, exercise, cleanliness and love. Caption at bottom asks, "What other things can you name?")

IVA. <u>Realize</u> that there exists a range of acceptable sizes and growth rates.

Divide into committees and make transparent growth charts for use with an overhead projector. Compare superimposed graphs of individuals. Compare average growth of boys versus girls.

IVB. <u>Recognize</u> the relationships between energy intake and expenditure.

Observe marble analogy. A large, strong balloon containing marbles represents a person made of protein, fat and carbohydrate. Additional marbles which go into the balloon represent protein, fat and carbohydrate in food. Marbles which are removed from the balloon represent carbon dioxide and water after energy expenditure. As long as the same number of marbles come out of the balloon as go in, the balloon stays the same size. Observe and discuss what happens to the balloon when more marbles are put in (eaten) than are taken out (used for energy). Observe what happens when more marbles are removed (used for energy) than are put in (eaten).

Keep record of activity and sleep. Discuss which activities require much energy and which require little. Talk about the reasons for exercising.

Name ______________________________

Code No. __________________________

Date ______________________________

This is a test about food and health. The test will be in two parts.

Part 1

After each question there are several choices for the answer. Mark an X in the blank to the left of the one right answer.

Here is an example.

Des Moines is the capitol of what state?

____1. Illinois

____2. Indiana

_X_3. Iowa

____4. Missouri

Try to answer each question, but do not spend a lot of time on any one question.

There is only one right answer for each question in Part 1.

1. Tom is the shortest boy in his class. What should Tom do about his height?

____1. realize that some boys grow more slowly than others

____2. eat more foods like eggs and vegetables

____3. drink more milk

____4. get more exercise

2. Bill and Mike were making a display labeled "Things Food Can Do." Which of these could they include?

____1. provide nutrients

____2. help express love

____3. remind people of home

____4. all of these

3. Where does digestion begin?

____1. stomach

____2. small intestine

____3. mouth

____4. esophagus

4. Bill usually felt tired. He had a hard time keeping up with the other boys. What caused Bill to feel tired?

____1. He probably didn't eat enough of the foods which provide energy.

____2. He probably didn't get enough sleep.

____3. He probably didn't get enough exercise.

____4. There are many things which may have influenced how he felt.

5. Which minerals make teeth and bones hard?

____1. calcium and iron

____2. calcium and phosphorus

____3. iron and phosphorus

6. What is one of the jobs of vitamins in the body?

____1. Vitamins provide building blocks for the cells to use in making new materials.

____2. Vitamins can be broken to provide energy.

____3. Vitamins make up the main part of the heart.

____4. Vitamins help enzymes in the making of new materials.

7. Here are some definitions of cells written by fourth graders. Which one is correct?

____1. Cells are little holes in the body that let out sweat.

____2. Cells are the smallest living parts of plants and animals.

____3. Cells are tiny tubes that run throughout the body.

____4. Cells are tiny blocks that make up the skin.

____5. Cells are the molecules of which everything is made.

8. Jim was watching the sixth grade go through the lunch line. He noticed that many of the girls were taller than most of the boys. Which of the following statements is correct?

____1. In most sixth grade classes many of the girls are taller than the boys.

____2. The boys were probably born shorter than the girls.

____3. The girls probably eat better food than the boys.

____4. The girls probably have taller parents than the boys.

____5. The girls probably get more exercise than the boys.

9. Which of these sentences about cells is true?

____1. Most cells are shaped like long tubes.

____2. Most cells in the body are square.

____3. Most cells in the human body live 60 to 90 years.

____4. The dividing and growing of the cell are what makes the body grow.

____5. A tissue is made of many different kinds of cells.

10. Which of these foods is a good source of vitamin A?

____1. cabbage

____2. baked beans

____3. pumpkin

____4. apple

____5. corn

11. Which of these foods is a fair source of vitamin C?

____1. baked potato

____2. canned peaches

____3. apple

____4. milk

12. George is eating food with energy value of about 2,500 calories each day. Usually he uses up about 2,000 calories of energy each day. What is probably happening to George?

____1. He is losing weight.

____2. He is gaining weight.

____3. If he has good posture, his weight isn't changing.

____4. If he is doing special exercises, his weight isn't changing.

13. Think about how each of the following foods tastes and feels. If you had equal amounts of each of these foods, which would be lowest in energy value (calories)?

____1. cooked corn

____2. canned peaches

____3. carrot sticks

____4. applesauce

14. If you had equal amounts of each of these foods, which would be lowest in energy value (calories)?

____1. a slice of bread with butter

____2. a large Graham cracker

____3. one piece of white cake without frosting

____4. a frosted doughnut

Name ______________________

Code No. ______________________

Date ______________________

Part 2

In Part 2 there may be more than one right answer for each question. Mark an X in the blank to the left of each right answer.

Here is an example.

Which of these are animals?

_X_ 1. elephant

___ 2. corn

_X_ 3. horse

_X_ 4. sheep

___ 5. beans

Try to answer each question, but do not spend a lot of time on any one question.

<u>There may be only one or more than one right answer to each question in Part 2.</u>

A. What does the meaning of the word health include?

____15. not being sick

____16. being at one's best in body

____17. being at one's best in mind

____18. getting along well with others

____19. never getting tired

B. Which of the following do cells need to live and grow?

____20. protein

____21. carbohydrate

____22. fat

____23. vitamins

____24. minerals

C. What happens to food after it enters the small intestine?

____25. Saliva is poured onto the food.

____26. The food is broken by digestive juices.

____27. The food goes to the stomach.

____28. The food goes to the kidneys to have waste removed.

____29. Tiny particles of food pass out of the small intestine into the blood.

D. Which nutrients can be used to provide energy?

____30. proteins

____31. vitamins

____32. carbohydrates

____33. minerals

____34. fats

E. Which of these sentences is true?

____35. You can help others learn to like foods by helping make mealtimes happy.

____36. You can help a person learn to like a new food by telling him he won't grow well if he doesn't eat it.

____37. A person often learns to like the same foods his family likes.

F. Which of these sentences is true?

____38. New cells are formed from little seeds in the body.

____39. New cells are formed when parent cells divide into halves.

____40. New cells are formed when nutrients from food bump together in an empty space in the body.

____41. New cells are formed when little bumps break off old cells.

____42. After a new cell is formed, it grows.

G. Which of the following foods is or are good sources of protein?

____43. cheese

____44. carrots

____45. potatoes

____46. dried beef

____47. bread

H. This is what Jan and Jill each had for breakfast.

Jan	Jill
½ Cup Tomato Juice	½ Cup Tomato Juice
1 Slice Ham	Peanut Butter Sandwich
2 Pancakes Butter Sirup	(2 Slices Bread)
1 Cup Milk	1 Cup Milk

Which sentence is correct?

____48. Jan's breakfast is more nutritious than Jill's.

____49. Both breakfasts contain foods from each of the Basic Four Food Groups.

This is what Lynn had to eat one day.

Breakfast	Lunch	Snack	Supper
Toast Butter Milk	Cheese Sandwich Apple Chocolate Cupcake Milk	Grape Pop	Pork Chop Mashed Potatoes Noodles Bread Butter Peach Ice Cream

I. Which of these foods are included in the Fruit and Vegetable Group of the Basic Four?

____50. apple

____51. grape pop

____52. mashed potatoes

____53. noodles

____54. peach ice cream

If Lynn ate one serving of each food listed, how many servings did she have from the Fruit and vegetable Group?

____

J. How many servings each day from the Fruit and Vegetable Group are recommended? (Select only one answer.)

(55) ____1. two or more

____2. three or more

____3. four or more

____4. five or more

K. According to the Basic Four Food Groups Guide, how many more servings would she need from the Fruit and Vegetable Group? (Select only one answer.)

(56) ____1. She would not need any more servings.

____2. She would need at least one more serving.

____3. She would need at least two more servings.

____4. She would need at least three more servings.

This is what Dick had to eat one day.

Breakfast	Lunch	Snack	Supper
Grape Juice Cornflakes Milk Toast Butter Cocoa	Tuna fish Sandwich Carrot Sticks Apple White Cupcake Milk	Orange	Meat Loaf Mashed Potatoes Green Beans Bread Butter Canned Peaches Milk

L. Which of these foods are included in the Meat Group of the Basic Four?

____57. tuna fish

____58. meat loaf

____59. milk

____60. cocoa

If Dick ate one serving of each food listed, how many servings did he have from the Meat Group?

____

M. How many servings each day from the Meat Group are recommended? (Select only one answer.)

(61) ____1. one or more

____2. two or more

____3. three or more

____4. four or more

N. According to the Basic Four Food Groups Guide, how many more servings from the Meat Group should he have eaten? (Select only one answer.)

(62) ____1. He would not need anymore servings.

____2. He would need at least one more serving.

____3. He would need at least two more servings.

____4. He would need at least three more servings.

O. After school Paul wants to eat a snack that will help him get the nutrients he needs. This is what he has had so far today from the Fruit and Vegetable Group of the Basic Four.

$\frac{1}{2}$ cup applesauce
1 banana

He will probably have some potatoes and carrots for supper. Which of the foods listed below would help him get all of the recommended number of servings within the Fruit and Vegetable Group?

____63. orange

____64. 2 slices of pineapple

____65. peanut butter and lettuce sandwich

____66. raisin cookies

____67. peach

APPENDIX F

Number of subjects included in each classroom mean

	Experimental						Control					
	4th			5th			4th			5th		
Nutrition test 1 and 2	21	19	17	20	25	26	21	22	31	24	17	25
Nutrition test 1 and 3	20	19	17	22	23	26	20	21	30	25	15	23
Scholastic achievement	21	17	14	19	24	20	20	20	30	23	16	19
Vegetable preference rating (boys)	6	5	5	11	11	4	10	11	12	9	4	10
Vegetable preference rating (girls)	6	12	8	3	8	11	6	6	6	9	7	7
Squash rating	12	17	13	14	19	15	15	17	18	17	11	17
Nutrients (boys)	6	5	5	11	11	4	10	11	11	9	4	8
Nutrients (girls)	6	12	8	3	8	11	7	6	7	9	8	7
Height (boys)	6	5	5	11	11	4	10	11	12	9	4	10
Weight (boys)	6	5	5	11	11	4	10	11	12	9	4	10
Weight/height (boys)	6	5	5	11	11	4	10	11	12	9	4	10
Triceps skinfold thickness (boys)	6	5	5	11	11	4	10	11	12	9	4	9
Subscapular skinfold thickness (boys)	6	5	5	11	11	4	10	11	12	9	4	10
Total skinfold thickness (boys)	6	5	5	11	11	4	10	11	12	9	4	9
Arm girth (boys)	6	4	5	11	11	4	10	11	12	9	4	10
Leg girth (boys)	6	5	5	11	10	4	10	10	10	9	4	10
Muscle-bone diameter (boys)	6	4	5	11	11	4	10	11	12	9	4	9
Height (girls)	6	12	8	3	8	11	8	6	6	9	8	7
Weight (girls)	6	12	8	3	8	11	8	6	6	9	8	7

Number of subjects included in each classroom mean (continued)

	Experimental						Control					
	4th			5th			4th			5th		
Weight/height (girls)	6	12	8	3	8	11	8	6	6	9	8	7
Triceps skinfold thickness (girls)	6	12	8	3	8	11	8	5	6	9	8	7
Subscapular skinfold thickness (girls)	6	12	8	3	8	11	8	6	6	9	8	7
Total skinfold thickness (girls)	6	12	8	3	8	11	8	5	6	9	8	7
Arm girth (girls)	6	12	8	3	8	11	8	5	6	9	8	7
Leg girth (girls)	6	12	8	3	8	11	8	5	6	9	8	7
Muscle-bone diameter	6	12	8	3	8	11	8	5	6	9	8	7
Handgrip strength (boys)	6	5	5	10	11	4	9	11	12	9	4	9
Handgrip strength (girls)	4	12	8	3	8	10	7	6	6	9	6	7
Physical fitness (boys)	6	5	5	10	11	4	9	11	10	9	4	9
Physical fitness (girls)	4	12	8	3	8	10	7	6	5	9	6	7

Mean[a] daily energy and nutrient values of diets of boys (Spring, 1967 to spring, 1968)

	Before	After	Change
Energy value (kcal)			
4th E[b]	2602	2242	-360
5th C[c]	2401	2185	-216
5th E	2360	2483	123
4th C	2426	2382	- 44
Experimental	2479	2361	-118
Control	2413	2282	-131
Protein (gm)			
4th E	89	73	- 16
5th C	88	79	- 9
5th E	91	93	2
4th C	88	94	6
Experimental	90	83	- 7
Control	88	87	- 1
Calcium (mg)			
4th E	1182	922	-260
5th C	1235	1081	-154
5th E	1425	1309	-116
4th C	1278	1265	- 13
Experimental	1300	1107	-193
Control	1256	1171	- 85
Iron (mg)			
4th E	13.2	10.9	-2.3
5th C	12.6	10.8	-1.8
5th E	11.9	12.9	1.0
4th C	12.1	13.2	1.1
Experimental	12.6	11.9	-0.7
Control	12.4	12.0	-0.4

[a]Means are averages of classroom means. Classroom means were obtained from square root transformations of individual data.

[b]E=experimental.

[c]C=control.

Mean daily energy and nutrient values of diets of boys (Spring, 1967 to spring, 1968) (Continued)

	Before	After	Change
Vitamin A value (IU)			
4th E	4970	4060	- 910
5th C	5980	3720	-2260
5th E	4110	4340	230
4th C	4460	4560	100
Experimental	4530	4200	- 330
Control	5190	4130	-1060
Thiamine (mg)			
4th E	1.34	1.16	-0.18
5th C	1.24	1.09	-0.15
5th E	1.31	1.25	-0.06
4th C	1.25	1.28	0.03
Experimental	1.32	1.21	-0.11
Control	1.24	1.18	-0.06
Riboflavin (mg)			
4th E	2.44	1.89	-0.55
5th C	2.41	2.09	-0.32
5th E	2.66	2.55	-0.11
4th C	2.46	2.44	-0.02
Experimental	2.55	2.21	-0.34
Control	2.44	2.26	-0.18
Niacin (mg)			
4th E	15.1	13.0	- 2.1
5th C	15.5	12.8	- 2.7
5th E	13.8	14.5	0.7
4th C	14.4	16.4	2.0
Experimental	14.5	13.7	- 0.8
Control	14.9	14.5	- 0.4
Ascorbic acid (mg)			
4th E	80	73	- 7
5th C	60	47	- 13
5th C	67	44	- 13
4th C	56	59	3
Experimental	73	57	- 16
Control	58	53	- 5

Mean[a] daily energy and nutrient values of snacks of boys (Spring, 1967 and spring, 1968)

	Before	After	Change
Energy value (kcal)			
4th E	493	394	- 99
5th C	405	359	- 46
5th E	404	391	- 13
4th C	329	314	- 15
Experimental	447	392	- 55
Control	366	336	- 30
Protein (gm)			
4th E	12	7	- 5
5th C	10	8	- 2
5th E	13	9	- 4
4th C	9	8	- 1
Experimental	12	8	- 4
Control	10	8	- 2
Calcium (mg)			
4th E	281	135	-146
5th C	242	178	-064
5th E	318	204	-114
4th C	247	197	-050
Experimental	300	168	-132
Control	244	187	-057
Iron (mg)			
4th E	1.0	0.9	-0.1
5th C	0.9	0.8	-0.1
5th E	0.8	0.8	0.0
4th C	0.7	0.6	-0.1
Experimental	0.9	0.8	-0.1
Control	0.8	0.7	-0.1
Vitamin A(IU)			
4th E	670	440	-230
5th C	570	320	-250
5th E	530	450	- 80
4th C	510	410	-100
Experimental	600	440	-160
Control	540	360	-180

Mean daily energy and nutrient values of snacks of boys (Spring, 1967 and spring, 1968) (Continued)

	Before	After	Change
Thiamine (mg)			
4th E	0.14	0.11	-0.03
5th C	0.11	0.10	-0.01
5th E	0.14	0.11	-0.03
4th C	0.11	0.09	-0.02
Experimental	0.14	0.11	-0.03
Control	0.11	0.10	-0.01
Riboflavin (mg)			
4th E	0.43	0.21	-0.22
5th C	0.37	0.27	-0.10
5th E	0.48	0.31	-0.17
4th C	0.38	0.30	-0.08
Experimental	0.45	0.26	-0.19
Control	0.37	0.28	-0.09
Niacin (mg)			
4th E	.9	1.0	0.1
5th C	.8	.7	-0.1
5th E	.8	.7	-0.1
4th C	.5	.6	0.1
Experimental	.8	.8	0.0
Control	.7	.7	0.0
Ascorbic acid (mg)			
4th E	8	13	5
5th C	4	5	1
5th E	7	3	-4
4th C	4	3	-1
Experimental	7	7	0
Control	4	4	0

Mean[a] daily energy and nutrient values of diets of girls (Spring, 1967 to spring, 1968)

	Before	After	Change
Energy value (kcal)			
4th E	2080	1882	-198
5th C	2336	2278	- 58
5th E	2033	2275	242
4th C	2058	2169	111
Experimental	2056	2074	18
Control	2194	2223	29
Protein (gm)			
4th E	77	64	-13
5th C	84	76	- 8
5th E	76	88	12
4th C	76	84	8
Experimental	76	76	0
Control	80	80	0
Calcium (mg)			
4th E	1004	890	-114
5th C	1157	1172	15
5th E	1097	1261	164
4th C	1153	1243	90
Experimental	1050	1076	26
Control	1155	1207	52
Iron (mg)			
4th E	10.6	9.7	-0.9
5th C	12.1	10.4	-1.7
5th E	10.2	11.5	1.3
4th C	10.8	11.2	0.4
Experimental	10.4	10.6	0.2
Control	11.5	10.8	-0.7

[a]Means are averages of classroom means. Classroom means were obtained from square root transformations of individual data.

Mean daily energy and nutrient values of diets of girls (Spring, 1967 to spring, 1968) (Continued)

	Before	After	Change
Vitamin A (IU)			
4th E	4410	4480	70
5th C	4890	3940	-950
5th E	3920	3650	-270
4th C	4110	5080	970
Experimental	4160	4060	-100
Control	4490	4490	0
Thiamine (mg)			
4th E	1.06	.98	-0.08
5th C	1.25	1.10	-0.15
5th E	1.02	1.06	0.04
4th C	1.09	1.15	0.06
Experimental	1.04	1.02	-0.02
Control	1.17	1.12	-0.05
Riboflavin (mg)			
4th E	2.02	1.79	-0.23
5th C	2.43	2.12	-0.31
5th E	2.04	2.36	0.32
4th C	2.22	2.41	0.19
Experimental	2.03	2.07	0.04
Control	2.32	2.26	-0.06
Niacin (mg)			
4th E	13.1	11.1	-2.0
5th C	13.9	11.6	-2.3
5th E	11.9	14.4	2.5
4th C	11.9	13.5	1.6
Experimental	12.5	12.7	0.2
Control	12.9	12.5	-0.4
Ascorbic acid (mg)			
4th E	54	69	15
5th C	58	60	2
5th E	62	63	1
4th C	54	58	4
Experimental	58	66	8
Control	56	59	3

Mean[a] daily energy and nutrient values of snacks of girls (Spring, 1967 to Spring, 1968)

	Before	After	Change
Energy value (kcal)			
4th E	411	321	- 90
5th C	421	435	14
5th E	338	427	89
4th C	312	344	32
Experimental	374	372	- 2
Control	365	388	23
Protein (gm)			
4th E	10	8	- 2
5th C	11	10	- 1
5th E	10	12	2
4th C	8	9	1
Experimental	10	10	0
Control	9	9	0
Calcium (mg)			
4th E	249	167	- 82
5th C	250	258	8
5th E	251	325	74
4th C	195	216	21
Experimental	250	239	- 11
Control	222	237	15
Iron (mg)			
4th E	0.9	0.9	0.0
5th C	1.2	1.0	-0.2
5th E	0.7	0.9	0.2
4th C	0.7	0.8	0.1
Experimental	0.8	0.9	0.1
Control	0.9	0.9	0.0

[a]Means are averages of classroom means. Classroom means were obtained from square root transformations of individual data.

Mean daily energy and nutrient values of snacks of girls (Spring, 1967 to spring, 1968) (Continued)

	Before	After	Change
Vitamin A (IU)			
4th E	550	370	-180
5th C	670	500	-170
5th E	520	700	180
4th C	290	500	210
Experimental	530	520	- 10
Control	460	500	40
Thiamine (mg)			
4th E	0.12	0.12	0.00
5th C	0.15	0.12	-0.03
5th E	0.10	0.14	0.04
4th C	0.09	0.12	0.03
Experimental	0.11	0.13	0.02
Control	0.12	0.12	0.00
Riboflavin (gm)			
4th E	0.39	0.26	-0.13
5th C	0.40	0.37	-0.03
5th E	0.38	0.51	0.13
4th C	0.30	0.33	0.03
Experimental	0.38	0.38	0.00
Control	0.35	0.35	0.00
Niacin (gm)			
4th E	0.7	0.8	0.1
5th C	1.2	0.7	-0.5
5th E	0.6	0.8	0.2
4th C	0.5	0.7	0.2
Experimental	0.6	0.8	0.2
Control	0.8	0.7	-0.1
Ascorbic acid (gm)			
4th E	5	16	11
5th C	8	5	-3
5th E	4	11	7
4th C	3	9	6
Experimental	4	13	9
Control	5	7	2

Mean[a] vegetable preference scores of boys (Fall, 1967 and spring, 1968)

	Before	After	Change
Vegetable preference (uncorrected)			
4th E	4.4	4.4	0.0
5th C	5.2	4.8	-0.4
5th E	5.0	4.6	-0.4
4th C	5.0	4.7	-0.3
Experimental	4.7	4.5	-0.2
Control	5.1	4.7	-0.4
Vegetable preference (corrected)			
4th E	5.1	5.0	-0.1
5th C	5.7	5.4	-0.3
5th E	5.3	4.8	-0.5
4th C	5.5	5.0	-0.5
Experimental	5.2	4.9	-0.3
Control	5.6	5.2	-0.4
Vegetable preference subscore (uncorrected)			
4th E	3.7	3.5	-0.2
5th C	4.4	3.9	-0.5
5th E	3.9	3.6	-0.3
4th C	4.3	3.9	-0.4
Experimental	3.8	3.5	-0.3
Control	4.4	3.9	-0.5
Vegetable preference subscore (corrected)			
4th E	4.7	4.2	-0.5
5th C	5.3	4.9	-0.4
5th E	4.4	3.8	-0.6
4th C	5.2	4.5	-0.7
Experimental	4.5	4.0	-0.5
Control	5.3	4.7	-0.6

[a]Means are averages of classroom means.

Mean[a] vegetable preference scores of girls (Fall, 1967 and spring, 1968)

	Before	After	Change
Vegetable preference (uncorrected)			
4th E	5.4	5.4	0.0
5th C	5.2	4.8	-0.4
5th E	4.9	4.4	-0.5
4th C	5.0	4.4	-0.6
Experimental	5.1	4.9	-0.2
Control	5.1	4.6	-0.5
Vegetable preference (corrected)			
4th E	6.1	5.8	-0.3
5th C	5.9	5.5	-0.4
5th E	5.5	4.6	-0.9
4th C	5.4	4.9	-0.5
Experimental	5.8	5.2	-0.6
Control	5.7	5.2	-0.5
Vegetable preference subscore (uncorrected)			
4th E	4.5	4.6	0.1
5th C	4.2	4.0	-0.2
5th E	3.8	3.3	-0.5
4th C	3.9	3.5	-0.4
Experimental	4.1	4.0	-0.1
Control	4.0	3.8	-0.2
Vegetable preference subscore (corrected)			
4th E	5.7	5.0	-0.7
5th C	5.3	5.2	-0.1
5th E	4.9	3.6	-1.3
4th C	4.6	4.2	-0.4
Experimental	5.3	4.3	-1.0
Control	5.0	4.7	-0.3

[a]Means are averages of classroom means.

Mean[a] scores for squash of boys and girls (Fall, 1967 and spring, 1968)

	Before	After	Change
Squash (uncorrected)			
4th E	2.1	2.1	0.0
5th C	2.2	2.3	0.1
5th E	1.7	2.2	0.5
4th C	2.8	2.4	-0.4
Experimental	1.9	2.1	0.2
Control	2.5	2.3	-0.2
Squash (corrected)			
4th E	4.7	2.7	-2.0
5th C	4.3	4.1	-0.2
5th E	3.8	2.5	-1.3
4th C	4.5	3.9	-0.6
Experimental	4.3	2.6	-1.7
Control	4.4	4.0	-0.4

[a]Means are averages of classroom means.

Mean[a] body measurements of boys (Fall, 1967 and spring, 1968)

	Before	After	Change
Height (cm)			
4th E	135.2	138.6	3.4
5th C	138.8	142.1	3.3
5th E	143.1	146.6	3.5
4th C	137.0	140.2	3.2
Experimental	139.1	142.6	3.5
Control	137.9	141.1	3.2
Weight[b] (lb)			
4th E	66.5	71.5	5.0
5th C	71.7	77.1	5.4
5th E	85.8	93.4	7.6
4th C	72.9	78.5	5.6
Experimental	75.6	81.7	6.1
Control	72.3	77.8	5.5
Weight/height[b] (lb/in)			
4th E	1.25	1.31	0.06
5th C	1.31	1.38	0.07
5th E	1.52	1.62	0.10
4th C	1.35	1.42	0.07
Experimental	1.38	1.46	0.08
Control	1.33	1.40	0.07
Triceps skinfold thickness[b] (mm)			
4th E	8.3	8.8	0.5
5th C	9.4	9.4	0.0
5th E	12.5	13.4	0.9
4th C	10.8	11.6	0.8
Experimental	10.2	10.8	0.6
Control	10.0	10.4	0.4

[a]Means are averages of classroom means.

[b]Classroom means were obtained from logarithms of individual data.

Mean body measurements of boys (Fall, 1967 and spring, 1968) (Continued)

	Before	After	Change
Subscapular skinfold thickness[b] (mm)			
4th E	4.7	4.7	0.0
5th C	5.1	5.2	0.1
5th E	6.9	7.2	0.3
4th C	5.5	5.6	0.1
Experimental	5.7	5.7	0.0
Control	5.3	5.4	0.1
Total skinfold thickness[b] (mm)			
4th E	13.1	13.5	0.4
5th C	14.7	14.7	0.0
5th E	19.5	20.8	1.3
4th C	16.3	17.3	1.0
Experimental	15.9	16.6	0.7
Control	15.5	16.0	0.5
Arm girth[b] (cm)			
4th E	20.1	20.7	0.6
5th C	20.8	21.4	0.6
5th E	23.4	24.5	1.1
4th C	21.5	22.4	0.9
Experimental	21.7	22.5	0.8
Control	21.1	21.9	0.8
Leg girth[b] (cm)			
4th E	27.7	28.9	1.2
5th C	28.4	29.4	1.0
5th E	31.1	32.4	1.3
4th C	29.1	29.7	0.6
Experimental	29.4	30.6	1.2
Control	28.7	29.5	0.8
Muscle-bone diameter[b] (cm)			
4th E	5.5	5.6	0.1
5th C	5.6	5.8	0.2
5th E	6.1	6.4	0.3
4th C	5.8	5.8	0.0
Experimental	5.8	6.0	0.2
Control	5.7	5.8	0.1

Mean[a] body measurements of girls (Fall, 1967 and spring, 1968)

	Before	After	Change
Height (cm)			
4th E	135.2	138.2	3.0
5th C	140.5	144.2	3.7
5th E	141.1	145.2	4.1
4th C	134.2	137.8	3.6
Experimental	138.1	141.7	3.6
Control	137.3	141.0	3.7
Weight[b] (lb)			
4th E	65.3	71.6	6.3
5th C	73.4	79.7	6.3
5th E	77.9	86.0	8.1
4th C	67.0	73.4	6.4
Experimental	71.3	78.4	7.1
Control	70.1	76.6	6.5
Weight/height[b] (lb/in)			
4th E	1.23	1.32	0.09
5th C	1.33	1.41	0.08
5th E	1.40	1.51	0.11
4th C	1.27	1.36	0.09
Experimental	1.31	1.41	0.10
Control	1.30	1.38	0.08
Triceps skinfold thickness[b] (mm)			
4th E	10.9	11.4	0.5
5th C	11.6	11.6	0.0
5th E	12.4	14.2	1.8
4th C	11.2	12.0	0.8
Experimental	11.6	12.7	1.1
Control	11.4	11.8	0.4

[a]Means are averages of classroom means.

[b]Classroom means were obtained from logarithms of individual data.

Mean body measurements of girls (Fall, 1967 and spring, 1968) (Continued)

	Before	After	Change
Subscapular skinfold thickness[b] (mm)			
4th E	6.0	6.5	0.5
5th C	6.1	6.2	0.1
5th E	6.2	7.1	0.9
4th C	6.2	6.6	0.4
Experimental	6.1	6.8	0.7
Control	6.1	6.4	0.3
Total skinfold thickness[b] (mm)			
4th E	17.0	18.0	1.0
5th C	17.8	17.9	0.1
5th E	18.9	21.5	2.6
4th C	17.7	18.9	1.2
Experimental	17.9	19.7	1.8
Control	17.7	18.4	0.7
Arm girth[b] (cm)			
4th E	20.4	20.8	0.4
5th C	21.1	21.4	0.3
5th E	22.4	23.0	0.6
4th C	20.8	21.4	0.6
Experimental	21.4	21.9	0.5
Control	20.9	21.4	0.5
Leg girth[b] (cm)			
4th E	27.3	28.2	0.9
5th C	28.7	29.6	0.9
5th E	29.9	31.1	1.2
4th C	28.0	29.1	1.1
Experimental	28.5	29.6	1.1
Control	28.3	29.3	1.0
Muscle-bone diameter[b] (cm)			
4th E	5.4	5.4	0.0
5th C	5.5	5.6	0.1
5th E	5.9	5.9	0.0
4th C	5.5	5.6	0.1
Experimental	5.6	5.6	0.0
Control	5.5	5.6	0.1

Mean[a] physical fitness scores and handgrip dynamometer readings of boys (Fall, 1967 and spring, 1968)

	Before	After	Change
Agility (sidesteps)			
4th E	12.4	14.0	1.6
5th C	12.6	12.5	-0.1
5th E	12.3	13.4	1.1
4th C	12.5	13.6	1.1
Experimental	12.4	13.7	1.3
Control	12.5	13.1	0.6
Strength (situps)			
4th E	20.9	22.6	1.7
5th C	20.6	25.2	4.6
5th E	20.0	26.7	6.7
4th C	22.8	23.4	0.6
Experimental	20.4	24.7	4.3
Control	21.7	24.3	2.6
Speed (seconds)			
4th E	11.5	11.4	-0.1
5th C	11.3	11.6	0.3
5th E	11.8	11.8	0.0
4th C	12.0	11.8	-0.2
Experimental	11.7	11.6	-0.1
Control	11.6	11.7	0.1
Endurance (squat thrusts)			
4th E	12.8	13.3	0.5
5th C	11.0	11.3	0.3
5th E	13.0	13.2	0.2
4th C	14.0	13.2	-0.8
Experimental	12.9	13.2	0.3
Control	12.5	12.3	-0.2

[a]Means are averages of classroom means.

Mean physical fitness scores and handgrip dynamometer readings of boys (Fall, 1967 and spring, 1968) (Continued)

	Before	After	Change
Total fitness			
4th E	20.3	22.7	2.4
5th C	17.5	18.6	1.1
5th E	17.6	19.6	2.0
4th C	20.4	21.9	1.5
Experimental	19.0	21.2	2.2
Control	19.0	20.2	1.2
Total handgrip strength (kg)			
4th E	34.3	40.3	6.0
5th C	36.1	42.2	6.1
5th E	43.7	47.6	3.9
4th C	36.9	40.9	4.0
Experimental	39.0	44.0	5.0
Control	36.5	41.6	5.1

Mean[a] physical fitness scores and handgrip dynamometer readings of girls (Fall, 1967 and spring, 1968)

	Before	After	Change
Agility (sidesteps)			
4th E	11.2	13.1	1.9
5th C	13.2	14.6	1.4
5th E	11.8	13.9	2.1
4th C	12.9	13.2	0.3
Experimental	11.5	13.5	2.0
Control	13.1	13.9	0.8
Strength (situps)			
4th E	21.3	19.0	-2.3
5th C	19.8	22.9	3.1
5th E	21.3	24.0	2.7
4th C	19.9	21.2	1.3
Experimental	21.3	21.5	0.2
Control	19.9	22.0	2.1
Speed (seconds)			
4th E	12.6	12.2	-0.4
5th C	11.7	11.8	0.1
5th E	12.4	12.0	-0.4
4th C	12.2	12.1	-0.1
Experimental	12.5	12.1	-0.4
Control	12.0	11.9	-0.1
Endurance (squat thrusts)			
4th E	13.2	12.0	-1.2
5th C	12.9	12.8	-0.1
5th E	12.1	12.2	0.1
4th C	12.9	13.6	0.7
Experimental	12.7	12.1	-0.6
Control	12.9	13.2	0.3

[a]Means are averages of classroom means.

Mean physical fitness scores and handgrip dynamometer readings of girls (Fall, 1967 and spring, 1968) (Continued)

	Before	After	Change
Total fitness			
4th E	19.4	20.5	1.1
5th C	20.2	22.2	2.0
5th E	18.4	21.4	3.0
4th C	20.9	22.0	1.1
Experimental	18.9	21.0	2.1
Control	20.6	22.1	1.5
Total handgrip strength (kg)			
4th E	29.7	34.1	4.4
5th C	33.2	37.8	4.6
5th E	33.3	39.9	6.6
4th C	28.6	32.3	3.7
Experimental	31.5	37.0	5.5
Control	30.9	35.1	4.2