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Middle school-aged child enjoyment of food tastings predicts interest in nutrition education on osteoporosis prevention

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Abstract

BACKGROUND—*NEEDs for Bones (NFB)*, based on the Health Belief Model, is a 4-lesson osteoporosis-prevention curriculum for 11-14 year-olds. This study examined the relationship between enjoyment of food tastings and interest in *NFB*.

METHODS—*NFB* was administered by teachers as part of standard practice and evaluated after the 4th lesson using a 21-item survey. Significant clustering of students within classrooms required use of random-intercept multilevel ordinal regression models in SAS proc GLIMMIX, with students nested within classrooms. Analyses considered tasting experience, eating attitudes, sex, grade, and cohort.

RESULTS—Students ($N = 1619$; 50% girls) participated from 85 4th-8th grade classrooms (47% 6th grade; 31% 7th grade) in 16 Pennsylvania SNAP-Ed eligible schools over 2 academic years. For all foods tasted, students who did not enjoy the food tasting were less interested in the lesson than students who did enjoy the food tasting (all $p < .001$); refried beans (OR 0.30), soy milk (OR = 0.55), cranapple juice (OR = 0.51), sunflower kernels (OR = 0.48), and Swiss cheese (OR = 0.49).

CONCLUSIONS—Enjoyment of food tasting activities can predict interest in nutrition education on osteoporosis prevention, supporting resource allocation and inclusion of food tasting activities in school-age nutrition education.

Keywords

child and adolescent health; nutrition and diet; teaching techniques; curriculum

Osteoporosis is the most prevalent skeletal disease and is characterized by poor bone quality and inadequate bone mass.^{1,2} More than 18 million Americans are at risk for developing this disorder and 10 million individuals have the diagnosis.² Medical costs from the approximately 1.5 million osteoporosis-related bone fracture cases each year are estimated to be \$16 to \$22 billion.^{2,3} Osteoporosis morbidity is high; 70% do not attain their pre-fracture health.² Peak bone mass occurs between the ages of 10 to 20, making adequate calcium consumption crucial among children and adolescents.⁴ Prolonged inadequate intake increases bone fragility and risk for osteoporosis.⁵ However, most adolescents are not consuming 1300 mg of calcium -the recommended intake for individuals between the ages of 9 and 18.⁶⁻¹⁰ In fact, only one in four boys and less than one in ten girls between the ages of 9 to 13 achieves the recommended dietary intake for calcium.¹⁰

Clearly, education about the importance of calcium and how to increase intake by adolescents is warranted. Existing curricula are available from reputable organizations, such as the National Dairy Council and Durham's Innovative Nutrition Education program, but they were not designed to align with the Pennsylvania Department of Education Academic Standards (PDE).^{11,12} In addition, these curricula are not “teacher ready” in that they do not provide all necessary materials, supplies, and shelf-stable foods to taste, making additional effort required for teachers to use them. *NEEDs for Bones (NFB)* was designed to meet PDE common core standards and to be teacher-ready for those interested in providing osteoporosis prevention for 11-14 year-olds.¹³

Tenets of the Health Belief Model (HBM) undergird *NFB* (Table 1). HBM posits health behavior change as a function of perceived condition severity, perceived susceptibility to the problem, perceived benefits from the problem, and perceived barriers to addressing the problem.¹⁴ Each of the 4 lessons focus on a specific calcium topic and include a corresponding food tasting activity. Table 2 outlines lesson-specific key messages and foods tasted. Each kit includes a teacher's guide, handouts, shelf-stable and readily available foods for tasting, supplies, teacher documentation form, and student evaluations. Online *NFB* training for teachers is available at www.needscenter.org/resources1/needs-for-bones/.

According to the Health Education Curriculum Analysis Tool from the Centers for Disease Control and Prevention, maintaining interest and audience engagement is one of the most important characteristics of effective health education.¹⁵ Interest increases learning and recognition of the need to make sustained healthy changes.¹⁶ Thus, to capture students' interest and foster behavior change, food tastings are integrated with *NFB* activities.

Effectiveness of incorporating food tasting activities as part of nutrition education interventions has been investigated with equivocal outcomes. Tasting activities were part of a fruit and vegetable education intervention that targeted 3rd and 4th graders.¹⁷ Students were assigned to intervention only, intervention with tasting activities, and no intervention (control). Findings revealed a non-significant difference among groups with less plate waste

in the intervention with tasting activities.¹⁷ A quasi-experimental impact assessment of *Cooking with Kids* (CWK)¹⁸ divided 3rd to 5th graders into 3 groups: (1) CWK cooking and tasting curriculum (CWK-CT), (2) CWK tasting curriculum (CWK-T), and (3) control – no intervention. Results revealed significant improvement in vegetable preference in both the CWK-CT and CWK-T groups.¹⁹

How enjoyment of tasting activities relates to interest in nutrition education has not been examined. Studying this relationship is critical to understanding the cost effectiveness of school-based nutrition education because of the associated personnel, material, and time costs. Two main categories define interest: situational and personal. Situational interest (SI) is “the appealing effect of unique characteristics students recognize in a learning task during interaction with the task.”²⁰ SI is affected by the enjoyment experience of an activity (instant enjoyment), rather than personal preference for the activity that defines personal interest.^{21,22} Since interest increases learning, educational researchers have explored the concept of situational interest as a potential way to motivate students.¹⁶ To the authors’ knowledge, no studies of situational interest to examine activity experience and interest in nutrition education have been published. Determining the relationship between enjoyment of food tasting activities and interest in the lessons could possibly serve as an explanation of why some interventions are not as successful or effective as expected even with engaging activities, such as food tasting.

Factors other than enjoyment may influence student interest in nutrition education. These include experience tasting a food item, eating attitudes, sex, and grade. Attitudes toward food and eating are one domain of the Satter Eating Competence model;²⁴ a model shown to be associated with increased dietary quality, including calcium in adults.²⁵ Individuals with positive eating attitudes may be more interested in food and nutrition-related lessons because they already have a more positive attitude toward food and tend to have a higher healthy eating index.²⁵ Sex differences in eating habits and views on nutrition are well documented.²⁶ Grade, as a proxy for age, may play an important role in lesson interest because students are less interested and engaged in school lessons in general as they get older.²⁷

This study explored responses to *NFB* and specifically examined the relationship between enjoyment of food tasting activities and interest in *NFB* lessons delivered during the school day, considering tasting history of the food, eating attitudes, sex, and grade. The null hypothesis of no relationship is accompanied by an alternative hypothesis that enjoyment of a tasting experience is positively related to interest in the nutrition education.

METHODS

Participants and Program

NEEDs for Bones (NFB), based on the Health Belief Model (HBM), was designed to meet the Pennsylvania Department of Education Academic Standards (PDE) and to be teacher-ready for those interested in providing osteoporosis prevention for 11-14 year-olds.¹⁴ It focused on calcium for osteoporosis prevention education in this age group because vitamin D is not a concern nutrient in this population. Despite the crucial role that vitamin D plays in

calcium metabolism and studies showing the sub-optimal intake of this fat-soluble vitamin, the Institute of Medicine indicated that “data from these surveys show that average blood levels of vitamin D are above the 20 nanograms per milliliter that the IOM committee found to be the level that is needed for good bone health for practically all individuals. These seemingly inconsistent data suggest that sun exposure currently contributes meaningful amounts of vitamin D to North Americans and indicates that a majority of the population is meeting its needs for vitamin D.”²⁸ Each of the 4 lessons focused on a specific calcium topic and included a corresponding food tasting activity. Table 2 outlines lesson-specific key messages and foods tasted. Each kit includes a teacher's guide, handouts, shelf-stable and readily available foods for tasting, supplies, teacher documentation form, and student evaluations. Food items were selected based on a combination of factors, such as shelf-stability, availability, nutritional content, and novelty to the students. For instance, most students had not tried refried beans, a shelf-stable, readily available food that provides 33 milligrams (mg) of calcium per 100 gram (g) and could easily be served with corn chips. Moreover, it is a vehicle to add other calcium sources, such as cheese. Cranapple juice was selected as the calcium fortified juice because it is more readily available, especially in economical amounts. In addition to 3 mg of calcium per 100 g, the juice provides vitamin C (100%), potassium (12%) magnesium (2%) as well as small amounts of other vitamins and minerals. Online NFB training for teachers is available at www.needscenter.org/resources/needs-for-bones/.

Schools located in Pennsylvania and eligible to participate in SNAP-Ed, such as having 50% student participation in the Free and Reduced-Price Lunch program, were recruited using letters to teachers and administrators, announcements at meetings and on listservs, and word of mouth. A signed memorandum of understanding was required to specify roles and responsibilities of teachers and researchers.

Teachers from 16 schools, representing 85 classrooms were recruited through contacts with SNAP-Ed providers in Pennsylvania. In all, 22 teachers were included in cohorts 1 and 2 combined and only 2 teachers taught in both cohorts.

Instrumentation

A 21-item survey set was administered by the classroom teacher after the completion of all four lessons to assess interest in lessons (4 items), enjoyment of food tasting activities (5 items), and eating attitude (3 items), and to document tasting experience (5 items), new knowledge (1 item), age, sex, and grade level. All items were pre-tested with the target audience and determined to have face and content validity.

Scoring

Possible scores for items denoting interest in lessons or enjoyment of food tasting activities items ranged from 1 (not at all interested/didn't enjoy at all) through 5, (very interested/ really enjoyed).

Eating attitude items were pulled from the 5-item Eating Attitude scale of the Satter Eating Competence Model Inventory;^{29,30} the 2 items not used did not apply to this age group. Response options were Always, Often, Sometimes, Rarely, and Never, but we collapsed

rarely and never into one category due to small cell sizes. Rarely and never were coded 0, sometimes was coded 1, often was coded 2, and always was coded 3. Thus, the 3-item eating attitudes score could range from 0 (low) to 9 (high). The temporal stability of the ecSatter Inventory, eating attitude scale has been demonstrated and validated with a general population in previous studies.³⁰

Tasting experience for the 5 foods (refried beans, soy milk, cranapple juice, sunflower kernels, and Swiss cheese) was recorded as yes-first time or no-not first time. An open-ended question format was used for students to report what they had learned from *NFB*.

Procedure

The intervention was administered in 2 cohorts: September 2011-May 2012 (cohort 1) and October 2012-May 2013 (cohort 2). For both cohorts, most of the teachers completed all four lessons within a two-week period. Lesson delivery commenced throughout the academic year based on teacher preference and the starting months of the lesson were scattered across the different months among the two cohorts. The *NFB* kit was shipped or delivered directly to teachers. Researchers assured kit receipt and followed-up periodically to answer questions and enhance fidelity of the curriculum. Classroom teachers administered surveys to students at the end of lesson 4. Lessons were taught during the normal class period so all students within the participating classrooms received the *NFB* lessons but parents or students had an opt-out option if they did not want to include survey responses in the research study.

Data Analysis

Data were analyzed with SAS 9.3 (SAS Institute Inc.). Preliminary analyses included an examination of Cronbach's α for the eating attitudes scale, tests for multi-collinearity, and calculating the intra-class correlation coefficients (ICC) to determine the degree of nesting of students within classrooms and within teachers. Cohort 1 and 2 participant characteristics were compared using t-tests or chi-square tests. Cohort also was included in the final model because of the significant differences found in variables of interest between the 2 cohorts, controlling for any observed and unobserved differences between the cohorts that may impact the outcomes observed (Table 3). Significant clustering of students within classrooms required use of random-intercept multilevel ordinal logistic regression models with students (level 1, $N = 1619$) nested within classrooms (level 2, $N=85$) using SAS Proc GLIMMIX. Enjoyment in food tasting activity was the main independent variable of interest, and interest in lesson was our dependent variable for each of the 5 food items. Lesson interest is an ordered variable. Therefore multilevel ordinal logistic regression models were utilized, with 'really not interested' as the reference category. These models predict the odds of being in higher category of lesson interest relative to the reference group for each variable. Small cell sizes in some categories required collapsing enjoyment of food tasting activities (independent variable) into 3 categories (enjoy, neutral, not enjoy). The need for a 3-level ordinal regression model (students within classrooms within teachers) was also tested, but there was not enough variation in the dependent variables at the teacher level ($N = 22$) to enable the use of three level models. Based upon previous literature, first time tasting of food items, eating attitudes score, sex, grade level, and cohort were included as

potential covariates.²⁴⁻²⁸ Missing data were examined for randomness for any potential bias, in terms of whether they were from specific classrooms, teachers, or grade levels, and no specific patterns were found. Level of significance was considered at $p < .05$.

RESULTS

Participant characteristics are presented in Table 4. A total of 1650 4th to 8th graders from 85 classrooms in Pennsylvania SNAP-Ed eligible schools received *NFB*, but 31 opted out of the evaluation process. The 1619 students (cohort 1, $N = 506$ from 26 classrooms; cohort 2, $N = 1113$ from 59 classrooms) included 47% in 6th grade, 31% in 7th grade and 50% girls.

An average of 60% of the students enjoyed the food tastings, but there was wide variation in enjoyment by type of food (refried beans: 38%, soy milk: 39%, cranapple juice: 84%, sunflower kernels: 76%, and Swiss cheese: 61%). In terms of lesson interest, an average of 53% were either interested or really interested in the corresponding lessons (refried beans: 46%, soy milk: 45%, cranapple juice: 56%, sunflower kernels: 54%, and Swiss cheese: 63%). Mean eating attitude scale was 6.4 ± 2.1 (Cronbach's α was 0.61). The 5 commonly available foods appeared to be novel to these students. Two or more foods were tasted for the first time by 65% of the students and overall, a mean of 2.1 ± 1.4 food items were tasted for the first time during participation in *NFB*. Of the 5 featured foods, 65% of the students had not tasted soy milk, 53% of the students had not tasted refried beans, 38% had not tasted cranapple juice, 34% had not tasted Swiss cheese, and 20% had not tasted sunflower kernels. The sample size for each of the food items varied because of missing responses but was assessed for randomness and no specific patterns were found. One teacher substituted a food item for sunflower kernels as a precaution of food allergy, which explained the increased number of missing data in that model. However, results from the sunflower kernels models were consistent in terms of direction and significance when compared with those from the other food items.

Null models with no predictor variables were explored for each outcome to determine the amount of variation in each outcome that could be explained by classroom vs. student-level differences. The intra-class correlation coefficients (ICCs) were significant in each of the null models, representing a range of 6.8%-8.3% of the unexplained variation in the outcome occurring at the classroom level (Table 5). The bivariate analyses (model 2) demonstrated significant associations between food tasting enjoyment (independent variable) and lesson interest (dependent variable). Students exhibited greater interest in the lesson if they enjoyed the tasting experience. Consistent patterns were found across all five food items. Compared to those who enjoyed the tasting experience, students who did not enjoy the tasting experience had lower odds (0.30-0.55) of being interested in the lesson. Similarly, students who were neutral about the tasting experience had lower odds (0.40-0.59) of being interested in the lesson than those who enjoyed the tasting experience. On the other hand, students who were neutral about the tasting experience had higher odds (1.49-1.97) of being interested in the lesson compared to those who did not enjoy the tasting experience in 2 food items (refried beans and soy milk).

With the addition of covariates in each of the full models (model 3), the relationship between food tasting enjoyment and lesson interest remained consistent in terms of the direction and significance. Net of all other predictor variables, students who did not enjoy the tasting experience had lower odds (0.30-0.54) of being interested in the lesson than those who enjoyed the tasting experience. Similarly, compared to those who enjoyed the tasting experience, students who were neutral about the tasting experience had lower odds (0.41-0.62) of being interested in the lesson.

When controlling for tasting experience, eating attitudes, sex, grade, and cohort, each covariate demonstrated a unique relationship with lesson interest (dependent variable). Of all covariates, only tasting food items for the first time did not show any significant association with lesson interest. Students with a more positive eating attitude were more likely to be interested in the *NFB*; this pattern was significant for four of the food items (refried beans, cranapple juice, sunflower kernels, and Swiss cheese). Each unit increase in the eating attitudes scale was associated with 7%-9% (depending on the food item) increase in lesson interest. Girls were more interested than boys in *NFB* with a range of 26%-33% higher odds for 4 of the food items (refried beans, vanilla soymilk, sunflower kernels, and Swiss cheese). Students in higher grade levels exhibited lower interest in the lesson, but that association was significant for only one of the food items (cranapple juice). With every grade level increase, the odds of being interested in the cranapple lesson decreased by 16%. Compared to cohort 2, cohort 1 had lower odds (0.60-0.69) in lesson interest for 4 of the food items (refried beans, cranapple juice, sunflower kernels, and Swiss cheese).

DISCUSSION

This study provided important insights and contributions to the literature for school-based nutrition education. A cross-sectional study with 1619 middle school or nearly middle school age children who participated in a nutrition-focused osteoporosis prevention intervention demonstrated a positive relationship between enjoyment in food tasting activities and lesson interest. As noted by Chen et al, activities that are exploration focused and that generate instant enjoyment evoke situational interest, thereby increasing learning.^{17,21,31,32} Results revealed the crucial role of food tasting activities in school-based nutrition education.

Although not significant, students who tasted the food item for the first time seemed to be more interested in *NFB*. The fact that novelty evokes situational interest may serve as an explanation for the observed results.³² This sort of relationship has been previously found in the field of physical education; Carlson revealed that repetition of activities decreased student interest in physical education and “situational interest is often destroyed when students perceive that there is nothing new in the activity.”^{31,33} This phenomenon could perhaps migrate to the field of nutrition education where students view the foods that they have tried as “nothing new,” reducing their lesson interest. This relationship suggests that there may be benefits of including novel food items as part a tasting activity in school-based nutrition education, but more research is needed to better understand this relationship.

The association between the eating attitude index and lesson interest was consistent with the tested association that individuals with higher eating attitudes scores may have increased interest in the nutrition lessons due to a more positive attitude toward food.^{25,26} Addressing and improving eating competence among students may positively increase their interest and openness to nutrition education.

Consistent with educational psychology literature, girls were significantly more interested in *NFB* than boys. In general, girls are more interested and engaged, have higher standards, and outperform boys in school.³⁴⁻³⁶ Sex differences in learning style, body composition, health belief, weight concern, nutrition knowledge, parental influence on dietary habits, and food choices have also been well-documented.³⁷⁻⁴⁵ Results from this study, combined with educational response differences between girls and boys, support examining the efficacy of sex specific nutrition education curricula.⁴⁵ Individualized nutrition program that are sex-specific is noted as one of the essential characteristics of an effective health education curriculum by the Centers for Disease Control and Prevention and programs, such as the Dairy Council of California Personal Nutrition Planner and diabetes nutrition education, have shown favorable results.⁴⁶⁻⁴⁸ Perhaps, this is the new approach that school-based nutrition education would need to adopt to enhance outcomes.

The relationship between grade level and lesson interest presented an interesting phenomenon. Although the curriculum was designed for 11-14 year-olds (6th-8th grade), 4th and 5th graders were included in the study because some teachers taught various grade levels and were interested in teaching *NFB* lessons for all of their students. Thus, a potential for increased level of intervention difficulty for 4th and 5th graders could forewarn of a slight positive relationship between grade level and lesson interest, but results represented an opposite trend. Lesson interest decreased significantly as grade level increase in one of the food items (cranapple juice) and non-significant trends were demonstrated in the other four food items (refried beans, soy milk, sunflower kernels, and Swiss cheese). Dietary habits are formed during school age and maintained throughout adulthood.⁴⁹⁻⁵² Once established, eating habits are difficult to change.⁵³ Older students may have stronger established dietary habits resulting in less interest in the nutrition lesson and willingness to adopt new dietary behavior. The importance of early nutrition education was supported by the findings.

Lastly, students in cohort 2 were more interested in the lessons than cohort 1. Teachers' familiarity with the *NFB* process and material were ruled out as contributors to the findings because only two teachers continued to teach in cohort 2 after cohort 1. While shorter lesson length and longer preparation time are noted in cohort 2, the impact of both factors on student outcomes remains unclear, as noted in the literature.⁵⁴⁻⁵⁵ The fact that cohort 2 included 4th and 5th graders may serve as an explanation for the difference in interest level between the 2 cohorts. This observation is consistent with the main outcome, where students in lower grade levels were more interested in the lessons. However, observed and unobserved differences between cohort 1 and 2 were accounted for in the final models for each dependent variable through the introduction of a fixed effect for cohort. Even with controlling for the differences in the 2 cohorts, the relationship between enjoyment of food tastings and interest in nutrition education persisted.

Limitations

Although this cross-sectional study revealed a positive association between enjoyment of food tasting activities and interest levels in the nutrition lessons, the cross-sectional design precludes causal inference. Although current models *suggested* that enjoyment in the food tasting activities could predict interest levels in the nutrition lessons, the alternate direction also could be supported – ie, students' incoming interest in the nutrition lessons could predict or influence their assessments of food tasting enjoyment. Nevertheless, the consistent significant association identified an important relationship between the 2 variables.

Although the study only had 5 food items and students were not assessed for their personal preference on the food items, consistent patterns were found in each of the 5 different food items.

For all but refried beans and soymilk, the introduction of our covariates (tasting experience, eating attitudes, sex, grade, and cohort) was able to explain a large proportion of the classroom level variation in lesson interest, as indicated by the reduction in the intercept variances, thereby showing that the relationship between enjoyment and interest is complex and can be confounded by inflexible characteristics. However, nearly half or more of the variance was not explained by the covariates depending on the food item.

Conclusions

Causality between enjoyment in food tasting experience and lesson interest could not be determined in this cross-sectional study. However, significant relationship between these factors was identified and supports situational interest as playing a key role. Level of enjoyment in food tastings could possibly play an important role in influencing students' interest in *NFB*. Including food tasting activities and evaluating student enjoyment of the experience may be an essential component for planning nutrition education programs with sustained learner interest.

IMPLICATIONS FOR SCHOOL HEALTH

Findings from this study have practical implications for school health professionals, public health practitioners, dietitians, nutritionists, school health researchers, and health educators who are interested in school-based nutrition education. Results refuted the null hypothesis of a relationship between enjoyment of tasting experience and interest in *NFB* and supported the alternative hypothesis of a positive relationship for this nutrition-focused osteoporosis prevention intervention in school age children. The findings temper concerns about personnel, time, material costs, food safety, and allergy issues with food tastings. This study demonstrated that teaching *NFB*, which aligns with the PDE academic standards, is feasible as well as effective, serving as a model for future education and research about implementing health curricula into a classroom setting. Incorporating food tastings as part of the regular curriculum is suggested to increase students' interest in school-based nutrition education. Results suggest that selecting novel foods to taste and attention to student enjoyment can contribute the overall effectiveness of nutrition-related prevention programs.

Human Subjects Approval Statement

This study was reviewed and approved by The Pennsylvania State University Office for Research Protections.

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Table 1

Health Belief Model and Tenet Appearance in *NEEDs for Bones*

Health Belief Model Tenet	Tenet Appearance in <i>NEEDs for Bones</i>
Perceived Susceptibility • What do you think your chances are of getting a condition?	Osteoporosis risk factors are presented. Calcium needs of adolescents are identified. Students learn if their intake meets their needs.
Perceived Severity • What are your beliefs about the seriousness of a condition and its consequence?	Graphic images of normal and osteoporotic bone are displayed; consequences of osteoporosis are discussed.
Perceived Benefits • How effective is taking action to reduce risk or seriousness of the condition?	Students complete case studies that require taking action to reduce risk of osteoporosis
Perceived Barriers • Material or psychological costs associated with addressing the problem	Addresses difficulties finding good sources of calcium, especially in fast foods and convenience stores as well as being unsure of good sources of calcium. Problems participating in weight-bearing exercise are addressed.
Self-efficacy • Confidence in one's abilities to address the problem	Student taste foods that are good sources of calcium. They practice identifying calcium-rich foods found in convenience stores and fast food restaurants and learn to do easy weight-bearing exercise.

Table 2**Key Messages and Taste-testing Food Items by *NEEDs* for *Bones* Lessons**

Lessons	Food Items [*]	Key Messages
Enjoy Calcium-Rich Foods	Refried beans • 33 mg of calcium/100 g • 91 kcal/100 g	Encourage students to build on calcium-containing foods that they already like. Snacks and food varying in calcium content can provide calcium throughout the day. Weight-bearing physical activity is important for bone building.
Calcium Case Studies	Vanilla soy milk • 123 mg of calcium/100 g • 43 kcal/100 g	Case studies are designed to show students that (1) skipping breakfast makes it more difficult to get adequate calcium; (2) you can get enough calcium if you are a vegetarian; and (3) you can meet your calcium needs if you are lactose intolerant or don't drink cow's milk.
Where's "Cal?"	Sunflower kernels • 78 mg of calcium/100 g • 584 kcal/100 g Cranapple juice • 3 mg of calcium/100 g • 63 kcal/100 g	Using knowledge of skilled marketers, students can help empower other students to easily locate calcium-rich, great-tasting foods and beverages in convenience stores. One small change in a behavior once a week can translate into increased body strength
Fast "Cal"	Swiss cheese wedges • 791 mg of calcium/100 g • 380 kcal/100 g	A "good" source of calcium provides 10-19% DV for calcium, and an "excellent" source provides 20% DV of calcium according to the U.S. Food and Drug Administration. Many foods and beverages in fast-food restaurants can help students meet their daily calcium requirements.

^{*} Nutrient analysis is based on the United States Department of Agriculture (USDA) National Nutrient Database.²³

Table 3 Comparisons of Cohort 1 and Cohort 2 *NEEDs for Bones* Response and Tasting Experience

	Total	Cohort 1	Cohort 2	p-Value
Lesson interest ^{*†‡}				
Enjoy Calcium-Rich Foods	3.4 ± 1.1 N=1560	3.3 ± 1.1 N=503	3.5 ± 1.1 N=1057	<.001
Calcium Case Studies	3.3 ± 1.2 N=1547	3.2 ± 1.2 N=497	3.3 ± 1.2 N=1050	.060
Where's "Cal?"	3.6 ± 1.2 N=1537	3.3 ± 1.2 N=495	3.7 ± 1.2 N=1050	<.001
Fast "Cal"	3.8 ± 1.2 N=1531	3.5 ± 1.2 N=489	3.9 ± 1.2 N=1042	<.001
Tasting enjoyment level ^{*†§}				
Refried bean	2.8 ± 1.6 N=1492	2.9 ± 1.5 N=485	2.8 ± 1.7 N=1007	.558
Vanilla soymilk	2.9 ± 1.6 N=1489	2.5 ± 1.5 N=489	3.0 ± 1.7 N=1000	<.001
Sunflower kernels	4.2 ± 1.2 N=1269	4.0 ± 1.3 N=492	4.3 ± 1.2 N=777	<.001
Cranapple juice	4.4 ± 1.1 N=1525	4.2 ± 1.2 N=489	4.5 ± 1.1 N=1036	<.001
Swiss cheese wedges	3.6 ± 1.6 N=1497	3.3 ± 1.6 N=489	3.8 ± 1.5 N=1008	<.001
First time tasting food item ^{/#}				
Refried bean	860 (53.1) N=1619	273 (54.0) N=506	587 (52.7) N=1113	.651
Vanilla soymilk	1051 (65.0) N=1618	330 (65.2) N=506	721 (64.8) N=1112	.882
Sunflower kernels	278 (20.1) N=1380	83 (16.4) N=506	195 (22.3) N=874	.008
Cranapple juice	619 (38.2) N=1619	219 (43.3) N=506	400 (35.9) N=1113	.005
Swiss cheese wedges	545 (33.7) N=1619	169 (33.4) N=506	376 (33.8) N=1113	.880
Number of first time food ^{*†}	2.1 ± 1.4 N=1619	2.1 ± 1.4 N=506	2.1 ± 1.4 N=1113	.384
Eating attitude index ^{*†¶}	6.4 ± 2.1 N=1498	6.1 ± 2.1 N=486	6.5 ± 2.1 N=1012	.001

* Table entries represents mean ± SD. Numbers vary because of incomplete responses.

† p-values based on t-test of association, except for first time tasting food item that is based on chi-square test, between cohort 1 and cohort 2.

[‡] Lesson interest level scores range from 1 = not at all interested to 5 = very interested.

[§] Tasting enjoyment level scores range from 1 = did not enjoy at all to 5 = really enjoyed.

[/] Table entries represent frequency (%).

[¶] Eating attitude index scores range from 0 = low to 9 = high.

[#] p-values based on chi-square test of association between cohort 1 and cohort 2.

Table 4 Characteristics of Participants and *NEEDs for Bones* Delivery

	Total	Cohort 1	Cohort 2
* Grade	1547 (100.0)	501 (100.0)	1046 (100.0)
4 th Grade	132 (8.5)	0 (0.0)	132 (12.6)
5 th Grade	137 (8.9)	0 (0.0)	137 (13.1)
6 th Grade	729 (47)	148 (29.5)	581 (55.5)
7 th Grade	477 (30.8)	353 (70.5)	124 (11.9)
8 th Grade	72 (4.7)	0 (0.0)	72 (6.9)
* Sex	1551 (100.0)	500 (100.0)	1051 (100.0)
Female	779 (50.2)	251 (50.2)	528 (50.2)
Male	772 (49.8)	249 (49.8)	523 (49.8)
Classroom (number of classroom)*	85 (100.0)	26 (100.0)	59 (100.0)
4 th Grade	7 (8.2)	0 (0.0)	7 (11.9)
5 th Grade	6 (7.0)	0 (0.0)	6 (10.2)
6 th Grade	38 (44.7)	8 (30.8)	30 (50.8)
7 th Grade	29 (34.1)	18 (69.2)	11 (18.6)
8 th Grade	5 (5.9)	0 (0.0)	5 (8.5)
Classroom size (students/classroom) [†]	19.0 ± 4.9	19.5 ± 4.8	18.9 ± 5.0
Lesson length (min) [†]			
Enjoy Calcium-Rich Foods	45.9 ± 13.5	54.6 ± 19.4	42.1 ± 7.2
Calcium Case Studies	45.3 ± 15.5	55.0 ± 21.2	41.1 ± 9.6
Where's "Cal?"	44.9 ± 14.2	51.5 ± 20.9	42.0 ± 8.7
Fast "Cal"	44.0 ± 13.7	49.4 ± 20.0	41.7 ± 8.9
Teacher preparation time (min) [†]			
Enjoy Calcium-Rich Foods	22.7 ± 18.6	14.4 ± 11.9	26.2 ± 19.8
Calcium Case Studies	22.2 ± 18.6	16.0 ± 12.5	24.8 ± 20.1
Where's "Cal?"	21.5 ± 18.7	14.0 ± 11.0	24.7 ± 20.4
Fast "Cal"	20.8 ± 18.9	14.2 ± 10.9	23.6 ± 20.8

* Table entries represent frequency (%). Percentages may not equal 100% in response to rounding.
† Table entries represent mean $\pm$ SD.

Table 5

Two-level Ordinal Logistic Regression with *NEEDs for Bones* Lesson Interest, Enjoyment in Food Tasting Activities, and Covariates*

	Model 1: Null Model			Model 2: 2-Level Model with IV [†]			Model 3: 2-Level Model with IV and CV [†]			
	Estimate	SE		Estimate	SE	OR	Estimate	SE	OR	95% CI
Refried Beans (N=1371)										
1 Really interested (Intercept) [‡]	*** -1.412	0.088		*** -0.837	0.105		-0.770	0.503		
2 Interested (Intercept) [‡]	-0.146	0.078		*** 0.503	0.103		0.591	0.503		
3 Neutral (Intercept) [‡]	*** 1.498	0.089		*** 2.239	0.119		*** 2.347	0.507		
4 Not interested (Intercept) [‡]	*** 3.074	0.139		*** 3.853	0.162		*** 3.969	0.519		
Not enjoyed [‡]				*** -1.201	0.115	0.30	*** -1.213	0.116	0.30	0.24-0.37
Neutral [‡]				*** -0.524	0.157	0.59	*** -0.486	0.158	0.62	0.45-0.84
First time [§]							0.159	0.101	1.17	0.96-1.43
Eating attitude index							0.087	0.024	1.09	1.04-1.14
Female							0.284	0.100	1.33	1.09-1.62
Grade							-0.121	0.078	0.89	0.76-1.03
Cohort 1							-0.379*	0.157	0.69	0.50-0.94
Variance (SE): classroom (level 2)	** 0.240	(0.069)		** 0.229	(0.068)		** 0.172	(0.059)		
ICCs: classroom (level 2) [†]	0.068			0.065			0.050			
Vanilla Soymilk (N=1356)			Model 1: Null Model			Model 2: 2-Level Model with IV			Model 3: 2-Level Model with IV and CV	
	Estimate	SE		Estimate	SE	OR	Estimate	SE	OR	95% CI
1 Really interested (Intercept) [‡]	*** -1.573	0.095		*** -1.277	0.111		-1.113	0.572		
2 Interested (Intercept) [‡]	** -0.235	0.083		0.084	0.104		0.257	0.571		
3 Neutral (Intercept) [‡]	*** 1.031	0.088		*** 1.366	0.111		** 1.545	0.572		
4 Not interested (Intercept) [‡]	*** 2.498	0.118		*** 2.844	0.137		*** 3.028	0.578		
Not enjoyed [‡]				*** -0.603	0.110	0.55	*** -0.616	0.112	0.54	0.43-0.67

Vanilla Soymilk (N=1356)	Model 1: Null Model			Model 2: 2-Level Model with IV			Model 3: 2-Level Model with IV and CV		
	Estimate	SE		Estimate	SE	OR	Estimate	SE	OR
Neutral [‡]				-0.206	0.158	0.81	-0.201	0.159	0.82
First time [§]							0.077	0.109	1.08
Eating attitude index							0.034	0.024	1.04
Female							0.269 ^{**}	0.100	1.31
Grade							-0.090	0.089	0.91
Cohort 1							-0.042	0.179	0.96
Variance (SE): classroom (level 2)	0.299 ^{**}	(0.079)		0.294 ^{**}	(0.078)		0.296 ^{**}	(0.080)	
ICCs: classroom (level 2)	0.083			0.082			0.082		
Cranapple Juice (N=1385)	Model 1: Null Model			Model 2: 2-Level Model with IV			Model 3: 2-Level Model with IV and CV		
	Estimate	SE		Estimate	SE	OR	Estimate	SE	OR
1 Really interested (Intercept) [‡]	-0.993 ^{***}	0.085		-0.905 ^{***}	0.086		-0.230	0.499	
2 Interested (Intercept) [‡]	0.257 ^{**}	0.081		0.357 ^{***}	0.082		1.046 [*]	0.500	
3 Neutral (Intercept) [‡]	1.397 ^{***}	0.090		1.508 ^{***}	0.092		2.205 ^{***}	0.502	
4 Not interested (Intercept) [‡]	2.779 ^{***}	0.126		2.899 ^{***}	0.129		3.602 ^{***}	0.511	
Not enjoyed [‡]				-0.684 ^{***}	0.175	0.51	-0.670 ^{***}	0.175	0.51
Neutral [‡]				-0.538 ^{**}	0.189	0.58	-0.475 [*]	0.190	0.62
First time [§]							0.107	0.101	1.11
Eating attitude index							0.068 ^{**}	0.024	1.07
Female							0.150	0.099	1.16
Grade							-0.178 [*]	0.077	0.84
Cohort 1							-0.427 ^{**}	0.155	0.65
Variance (SE): classroom (level 2)	0.273 ^{**}	(0.075)		0.254 ^{**}	(0.072)		0.168 ^{**}	(0.058)	
ICCs: classroom (level 2)	0.077			0.072			0.049		

Sunflower Kernels (N=1134)		Model 1: Null Model		Model 2: 2-Level Model with IV		Model 3: 2-Level Model with IV and CV	
		Estimate	SE	Estimate	SE	Estimate	SE
1 Really interested (Intercept) [†]		*** -1.089	0.093	*** -0.912	0.097	-0.556	0.559
2 Interested (Intercept) [†]		* 0.177	0.087	*** 0.385	0.094	0.757	0.559
3 Neutral (Intercept) [†]		*** 1.329	0.096	*** 1.565	0.105	*** 1.947	0.562
4 Not interested (Intercept) [†]		*** 2.704	0.134	*** 2.971	0.143	*** 3.360	0.571
Not enjoyed [‡]				*** -0.732	0.170	*** -0.734	0.170
Neutral [‡]				*** -0.923	0.171	*** -0.896	0.171
First time [§]						0.158	0.137
Eating attitude index							1.17
Female						** 0.079	0.026
Grade						* 0.233	0.109
Cohort 1						-0.137	0.084
						-0.396*	0.164
Variance (SE): classroom (level 2)		** 0.259 (0.081)		** 0.267 (0.082)		** 0.191 (0.070)	
ICCs: classroom (level 2)		0.073		0.075		0.055	
Swiss Cheese (N=1364)		Model 1: Null Model		Model 2: 2-Level Model with IV		Model 3: 2-Level Model with IV and CV	
		Estimate	SE	Estimate	SE	Estimate	SE
1 Really interested (Intercept) [†]		*** -0.532	0.081	** -0.273	0.087	-0.224	0.483
2 Interested (Intercept) [†]		*** 0.547	0.081	*** 0.833	0.090	0.900	0.483
3 Neutral (Intercept) [†]		*** 1.613	0.093	*** 1.920	0.102	*** 2.001	0.486
4 Not interested (Intercept) [†]		*** 2.789	0.127	*** 3.106	0.135	*** 3.187	0.494
Not enjoyed [‡]				*** -0.715	0.116	*** -0.649	0.117
Neutral [‡]				*** -0.698	0.163	*** -0.631	0.163
First time [§]						0.078	0.106
Eating attitude index						*** 0.083	0.024

Swiss Cheese (N=1364)	Model 1: Null Model			Model 2: 2-Level Model with IV			Model 3: 2-Level Model with IV and CV		
	Estimate	SE		Estimate	SE	OR	Estimate	SE	OR
Female							0.243 [*]	0.101	1.28
Grade							-0.095	0.074	0.91
Cohort 1							-0.518 ^{***}	0.146	0.60
Variance (SE): classroom (level 2)	0.263 ^{**}	(0.077)		0.217 ^{**}	(0.069)		0.120 [*]	(0.053)	
ICCs: classroom (level 2)	0.074			0.062			0.035		
[*] p < .05									
^{**} p < .01									
^{***} p < .001.									
[†] Corresponding lesson interest with possible scores ranging from 1: not at all interested to 5: very interested (reference).									
[‡] Small cell sizes in some categories required collapse of enjoyment of food tasting activities into three categories: (1) not enjoy; really did not or did not enjoy; (2) neutral; neutral; and (3) enjoy; really enjoyed or enjoyed.									
[§] First time tasting corresponding food item.									
[/] IV=independent variable; CV= covariate; ICC=intra-class correlation coefficient.									