7-2011

Intervention to Increase Knowledge and Consumption of Folate-rich Foods Based on the Health Belief Model

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INTERVENTION TO INCREASE KNOWLEDGE AND CONSUMPTION OF FOLATE-RICH FOODS BASED ON THE HEALTH BELIEF MODEL

By

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A THESIS

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Master of Science

Major: Nutrition and Health Sciences

Under the Supervision of Professor Julie Albrecht

Lincoln, Nebraska

July 2011

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University of Nebraska, 2011

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Folate is important in the prevention of birth defects and in the maintenance of general health. Even after mandatory fortification, many people are still not consuming the RDA of 400 mcg/day. Consuming a diet rich in naturally high-folate foods, as opposed to supplementation, may offer additional health benefits and promote an overall healthy diet.

The purpose of this pilot study was to test the hypothesis that a learner-centered educational intervention based on the Health Belief Model (HBM) will successfully increase knowledge and consumption of folate-rich foods, while increasing positive beliefs about folate and health. A two group parallel control trial was conducted at two schools in Nebraska. Pre- and post- study questionnaires included a folate-based food frequency questionnaire, a HBM questionnaire, and a folate knowledge test. Participants in the intervention group also completed a post-study evaluation. The intervention consisted of three 30-minute lessons followed by participant creation of podcasts. One podcast was viewed each week for eight weeks following the lessons. Data were entered into SPSS. T-tests measured simple effects within the intervention and control groups, and ANOVA measured within-subject effects between the groups.

Folate consumption decreased in both the intervention and control groups, with a greater decrease occurring in the control group. These differences were not significant ($p > 0.05$). Significant increases ($p= 0.000$) in folate knowledge occurred in the intervention group. This difference remained significant ($p= 0.001$) when compared to the control group. Average HBM rankings significantly decreased ($p < 0.05$) toward "strongly agree" (likert scale of 1-6) in the intervention group ($p < 0.05$) for all constructs except cues to action. However, when compared to the control group these differences were only significant for self efficacy and perceived susceptibility. Creating and viewing podcasts may be helpful for the retention of knowledge over time, but did not appear to be an effective cue to action.

Acknowledgements

I would like to thank my thesis committee, Dr. Julie A. Albrecht, for all of her support, guidance and encouragement; Dr. Kaye Stanek Krogstrand, and Dr. Timothy Carr for all of their guidance throughout this process. Thank you to Houston Lester from the NEAR Center for the hours spent helping to analyze the statistics. I would also like to thank the teachers and students who devoted hours of their classroom time to this project. Thank you for your time and cooperation!

Table of Contents

List of Tables and Appendices

Tables

Appendices

Chapter 1: Literature Review

Folate and General Health

Folate is a water-soluble vitamin that is involved in the transfer of one-carbon units required for amino acid metabolism, and other important reactions. Folate is a term used to describe naturally occurring folate which is found in foods, while folic acid is the term used to describe the synthesized form of folate that is added to fortified foods and supplements (Bailey LB et al., 2001).

Adequate folate intake is important to maintain good health and help prevent diseases. Folate aids in the synthesis of deoxyribonucleic acid (DNA), provides methyl groups for the conversion of homocysteine to methionine (this also requires vitamin B12), and is required for the production of red and white blood cells (Mahan K and Escott-Stump S, 2004); however, a folate deficiency may lead to impaired DNA synthesis, reduced cell division and megaloblastic anemia. Symptoms of deficiency may include weakness, depression, neuropathy, skin lesions and poor growth. Folate deficiency may also lead to homocysteinemia, which is associated with occlusive vascular disease (Mahan K and Escott-Stump S, 2004).

High folate diets and blood folate levels have been associated with a decreased risk of certain cancers, particularly colorectal cancer. Animal studies have shown that dosage and timing of folate supplementation are important factors; high dosage supplementation after neoplasms develop may actually promote carcinogenesis, while moderate supplementation in normal yet folate deficient cells may help prevent carcinogenesis (Kim YI, 2003). There has been some debate as to whether the decreased risk of colorectal cancer is due mostly to high folate diets or more attributable to higher

fiber intake. Researchers have reported that while folate from food may protect against colorectal cancer, additional folate from supplements offered no added protection (Bingham S, 2006).

Folate Status and Birth Defects

Because of its role in normal cell division, folate is very important during pregnancy for the rapidly dividing embryonic cells. Consuming sufficient folate before and during early pregnancy can help prevent neural tube defects (NTDs) such as spina bifida and anencephaly (Wolff T et al., 2009). Currently, the Center for Disease Control and Prevention (CDC) recommends that all women of childbearing age consume 400 mcg per day to significantly reduce the occurrence and reoccurrence of NTDs. If this guideline were followed, an estimated 50% to 70% of NTDs could be prevented (Center for Disease Control and Prevention, 2011).

An estimated 3000 pregnancies in the United States are affected by NTDs each year (Center for Disease Control and Prevention, 2010). Babies with anencephaly are often still born or die soon after birth; whereas, with spina bifida, babies usually survive with varying degrees of disability (Bailey LB, 2010). In any case, NTDs cause emotional, social, and financial distress to families with a baby born with an NTD. According to the CDC, the annual cost of medical and surgical care for people with spina bifida exceeds $200 million, while the estimated lifetime cost of care directly associated with spina bifida for one child is $560,000 (Center for Disease Control and Prevention, 2010).

Mosley BS and colleagues (2009) evaluated the relationship between maternal folate intake and NTDs in births after mandatory fortification and found that supplemental folic acid did not reduce the risk of having a baby affected by a NTD, nor

did intake of dietary folate. Since NTD rates have declined since fortification, the authors offer the following explanation for their findings: that fortification reduced the number of folic acid-sensitive NTDs (Mosely BS et al., 2009).

According to Baker PN et al. (2009) adolescents are more likely than adults to experience negative pregnancy outcomes, and are more likely to consume diets high in energy, and low in micronutrients. In this study of pregnant adolescents, blood folate status results were compared with their food frequency questionnaires during their 3rd trimester. Babies who were small for gestational age (SGA) were associated with mothers who had lower folate status (Baker PN et al., 2009).

The CDC analyzed the results from a 2003-2007 national survey and found that of women aged 18-24, 60% were aware of folic acid, 6% knew when folic acid should be taken, and 30% reported use of supplements containing folic acid. This age group (18-24) scored the lowest percentages of all women between ages 18-45. The CDC states since approximately one third of all births in the US are born to 18-24 year old women; folic acid consumption should be promoted and targeted to this age group (Center for Disease Control and Prevention, 2008).

Additionally, fifty percent of all pregnancies are unplanned (Center for Disease Control and Prevention, 2010), and many women do not know they are pregnant until they miss a period (after they are about one month pregnant), when folate is most important. Since the neural tube closes around day 28, it may be too late to prevent NTDs by folic acid supplementation after pregnancy is discovered. Helping women develop long-term healthy eating habits, including folate-rich foods, will increase folate status before pregnancy and help decrease the risk of NTDs.

Folate Status and Fortification

Low folate consumption in women of childbearing age has been a problem in the past and continues to be a problem today although to a lesser degree. In a 2005 study by Dietrich M and colleagues, dietary folate intakes, serum and red blood cell folate status were assessed pre and post mandatory fortification by comparing NHANES III results (from 1988-1994) to the NHANES 1999-2000 results. NHANES III reported a mean intake in males and females of all ages to be 275 +/- 3.2 mcg/d. NHANES 1999-2000 reported the total mean intake to be 351 +/- 9.1 mcg/d; a total increase of 76 mcg/d (28%) after mandatory fortification. Among women ages 20-39, mean folate increased from 217 +/- 5.2 mcg/d to 294 +/- 12.6 mcg/d; a total increase of 77 mcg/d (36%) (Dietrich M et al., 2005).

In 2010, Tinker and colleagues analyzed the NHANES 2003-2006 data to determine folic acid intakes among women aged 15-44. For women of this age group, only 24% consumed the recommended amount of folic acid from all sources including fortified foods and supplements. Furthermore, the median intake was only 221 mcg for women ages 15-24, with 15.5% consuming the recommended amounts of folate. Among women who regularly eat fortified cereal, 45% consumed the recommended amount of folic acid; similarly, 72% of women who take folic acid supplements consumed the recommended daily amount (Tinker et al., 2010).

Breakfast foods tend to be high in folate and folic acid. Fortified breakfast cereals and bread, orange juice and other fruits that are commonly consumed at breakfast are all examples of folate-rich breakfast items. A study by Rampersaud GC et al. (2005) found that over time, breakfast consumption has declined among children and adolescents in the

United States. On the day of their survey, 30% of all 15-18 year olds skipped breakfast, and 59% of high school students reported skipping breakfast more than three times during the previous week. People who eat breakfast are more likely to meet the dietary recommendations, and tend to have an overall higher quality diet than those who skip breakfast (Rampersaud GC et al., 2005).

In the study by Dietrich M et al. (2005), post-fortification increases in serum (57%) and red blood cell (136%) folate concentrations were much higher than the increase in reported dietary folate intake (28%), and is most likely due to unreliable information on food labels because most products contain more folic acid than federally required which results in underestimation of dietary folate intake (Dietrich M et al., 2005). Quinlivan EP and Gregory JF (2003) reported the effects of mandatory food fortification and found that the increase in folic acid intake from fortified foods ranged from 215-240 mcg/day. This is much higher than the predicted increase of 70-130 mcg/day.

Although mandatory fortification resulted in a 19% reduction in NTD incidence, the study by Quinlivan and Gregory (2003) cites evidence that folic acid intakes >200 mcg taken at one time may overload they body's capacity to metabolize folic acid to 5-methyltetrahydrofolate, leaving unmetabolized folic acid in the plasma which cannot be retained or used by cells. High folic acid intake has the potential to mask a cobalamin (vitamin B12) deficiency. Also, the ability of increased folate intake to decrease homocysteine levels plateaus after supplementation of >200mcg/day. The same researchers cited that people taking supplements containing B vitamins (cobalamin, B6, riboflavin) were able to decrease their homocysteine levels further than those only

supplementing folic acid (Quinlivan EP and Gregory JF, 2003). It can be inferred from these findings that while mandatory fortification successfully increased plasma folate levels, focusing on higher intakes of natural folate sources such as citrus fruits, vegetables and beans, which are naturally good sources of other nutrients as well, would be helpful in promoting overall good health in addition to NTD prevention.

Folate from dietary sources is predominately polyglutamates. Because polyglutamates must be hydrolyzed to monoglutamates to be transported in the intestine, monoglutamates are more bioavailable than polyglutamates (Blom H, 2009). Ashfield-Watt and colleagues (2003) compared blood folate levels of subjects who consumed folate rich foods versus subjects who consumed folic acid fortified foods. The results showed that while folate intake increased more easily in those who ate fortified foods than in those who ate folate-rich foods, the rise in plasma folate levels were similar between people in both groups (Ashfield-Watt PA et al., 2003). This indicates that increasing intakes of naturally occurring folate-rich foods do increase plasma folate levels, and an intervention to increase these foods (as opposed to supplementation) may be warranted.

To reinforce the importance of natural folate intake, a 2002 study tested whether dietary counseling to eat more folate-rich foods could lower total homocysteine (tHcy) levels in free living individuals (Venn BJ et al., 2002). After 4 weeks the intervention group increased their average consumption of folate-rich foods from 263 mcg/d to 618 mcg/d, and increased serum folate by 37%. Total homocysteine was lowered from 12.0 to 11.3 mmol/L, and a final decrease at the 17 week follow up was even lower at 9.7 mmol/L. The researchers conclude that natural folate intake improved folate status,

decreased tHcy levels, and may be more beneficial than food fortification due to improved dietary habits leading to increased intakes of important nutrients and decreased intakes of saturated fat.

Types of Interventions and Their Efficacy

Various interventions have been conducted in an attempt to increase folate consumption in women. The majority of these interventions aim to increase folate status with supplementation, rather than naturally folate-rich foods. A systematic review of studies aimed at increasing awareness, knowledge and consumption of folic acid before and during pregnancy found that on average, awareness increased from 60% to 72%, knowledge from 21% to 45%, and consumption from 14% to 23% (Chivu et al., 2008), indicating that interventions are effective. The researchers concluded that since consumption only rose from 14% to 23%, further research is needed to design more effective interventions to increase folic acid consumption. The following paragraphs will examine the methods of various interventions to increase folate and folic acid.

Watkins ML et al. (2004) provided free folic acid supplements at family planning clinics. An increase in knowledge occurred in their study, but there was no increase in reported consumption of supplements or increase in serum folate levels. The study did find that more knowledge of folic acid correlated to increased consumption.

A few studies measured the results after a medical professional had delivered a quick intervention. Lawrence JM et al. (2003) conducted a study with 18-39 year old women in which their primary care physicians delivered the message that folic acid reduces the risk of NTDs. Multivitamins, which included folic acid, were mailed to the participants. The researchers found that only a small number of women used the

multivitamins and discontinued use shortly thereafter. Robbins JM et al. (2005) involved gynecologists delivering the intervention during women's routine visits. The patients were randomly assigned to an intervention group which received brief folic acid counseling, a reminder phone call and 30 trial folic acid tablets, or a control group which received counseling regarding another health topic along with a folic acid pamphlet. The intervention group increased folic acid consumption by 68% and the control group by only 20%.

In another study (Hickling S et al., 2007), subjects were given brief individual dietary feedback and educational information in a general practice setting. At the eight week follow up, the intervention group had significantly higher intakes of folate than the control group. Similarly, in a study conducted by Schwarz EB et al. (2008), participants went through a 15 minute computerized folate education session and were given 200 free folate tablets. The intervention increased knowledge and use of folate supplements at 6 months or longer after the intervention. These studies demonstrate that brief education counseling and personalized feedback may be effective ways to increase folate consumption.

Cena ER and colleagues (2008) delivered learner-centered nutrition education to low-income women and evaluated the effects on folate intake and other food-related behaviors. Participants completed three questionnaires: one for demographics, the Block Dietary Folate Equivalents Screener, and a food behavior checklist. Subjects in the intervention group participated in one learner-centered lesson (2 ½ hours) which involved group discussions, activities, worksheets, visual aids, cooking demonstrations and explanations from the instructor. The control group received a non-nutrition-related

lesson. The researcher reported that those who received the nutrition lesson had greater increases in folate intake and improvements in food-related behaviors than those in the control group (Cena ER et al., 2008). This study, unlike the others that focused on supplementation, focused on increasing consumption of high folate foods.

A study by Garden-Robinson and Beauchamp (2011) assessed changes in folic acid awareness, knowledge and behavior among women of childbearing age which followed a statewide education intervention that used mass media and printed media as its method of disseminating information. They conducted pre- and post- intervention surveys and results showed an increase in folic acid knowledge and supplement intake. They also reported a reduction in perceived barriers to taking a folic acid supplement. The most commonly reported perceived barriers in their study to taking a folic acid supplement included forgetting to take it, and not knowing why they need to take it.

These studies demonstrate that interventions can have a positive effect on the awareness, knowledge and consumption of folic acid- particularly those which involve educational interventions. While many studies have used interventions to increase consumption by supplementation, there seems to be a lack of interventions aimed at increasing consumption of foods naturally high in folate. Folic acid supplementation is an effective way of increasing intake and decreasing the risk of NTDs, however with half of all pregnancies being unplanned, it is likely that most women will not begin supplementing until after the neural tube has closed and NTDs may have already occurred. Additionally, improved dietary habits are likely to result in further health benefits, and some evidence suggests excessive folic acid supplementation could increase risks for certain cancers (Dary, 2009). Research is needed to develop interventions that

effectively increase the consumption of foods such as vegetables, fruits and beans that are naturally high in folate.

The Health Belief Model

Behavior theories are models that help us understand human behavior. These theories are important to use when developing group programs and interventions because they give us a guideline to follow, which results in a successful program or intervention. The Health Belief Model (HBM) was one of the first theories of health behavior, and is one of the most well known.

The Health Belief Model is based on value-expectancy, meaning behaviors can be predicted by a person's expected outcomes of that behavior and how much value they place on that outcome. There are six constructs to the HBM: 1) Perceived susceptibility, 2) Perceived severity, 3) Perceived benefits, 4) Perceived barriers, 5) Self-efficacy, and 6) Cues to action. The way a person relates themselves to each of these areas is predictive of how likely they are to engage or not engage in a certain behavior (Strecher VJ and Rosenstock IM, 1997). While the first four constructs have been developed and researched over the years, the self-efficacy and cues to action constructs have rarely been tested (Carpenter CJ, 2010).

A recent meta-analysis evaluated 18 studies to determine whether health behaviors over time could be predicted by the original four HBM constructs (perceived susceptibility, severity, benefits and barriers), and evaluated which constructs were the most predictive of health behaviors (Carpenter CJ, 2010). Perceived susceptibility was found to be the weakest predictor of behavior, followed by perceived severity; while perceived benefits and barriers were the strongest predictors of behavior. The study

recommended that HBMs which measure direct effects of each construct be discontinued. Instead, focus should be on the possible moderators of variables that may influence each construct (i.e. prevention vs. treatment behaviors, and drug regimens vs. other behaviors).

Other meta-analyses have reached different conclusions. In 1984, Janz NZ and Becker MH's findings supported use of the HBM, and recommended use of its constructs in health education. Specifically, their study found perceived barriers, benefits and susceptibility to be good predictors of behavior, with perceived barriers being the strongest. Perceived severity was the least predictive of health behavior (Janz NZ and Becker MH, 1984). Another meta-analysis (Harrison JA et al., 1992) found a weak relationship between HBM constructs and behavior, and indicated a need to show how the constructs work together.

Few studies have been conducted on the applicability of the Health Belief Model specifically for use in a folate intervention. A study by Kloeblen AS and Batish SS (1999) used the HBM to confirm its applicability in determining folate intention among low-income pregnant women. They developed a 56 question interview to assess each area of the HBM and found that perceived benefits was the most predictive of intention to follow a high folate diet (folate intention). Folate intention was also positively correlated with self-efficacy, HBM total score, perceived susceptibility, severity and benefits. Tailoring an educational intervention to the HBM constructs may be an effective way to promote permanent consumption of high folate foods (Kloeben AS and Batish SS, 1999). Contrary to these findings, Quillin JM and colleagues (2000) assessed beliefs about folic acid in college women using the HBM and the Fetal Health Locus of Control Scale (FHLCS) before and after an educational intervention. They found awareness of folic

acid was not associated with multivitamin consumption, while beliefs were not associated with awareness or use of folic acid; not supporting the use of the HBM or FHLCS in educational interventions to increase the consumption of multivitamins in college women (Quillin JM et al., 2000).

Summary and Statement of Problem

Folate is important in the prevention of birth defects and in the maintenance of general health. Since mandatory fortification of enriched grain products in 1998, blood folate statuses have improved and the number of neural tube defects has decreased (Quinlivan EP and Gregory JF, 2003). Still, many people are not consuming the recommended amounts of folate, especially from naturally occurring folate-rich sources (Tinker et al., 2010). While supplemental folic acid is more bioavailable than natural folate from food, foods that are naturally high in folate have been proven to improve blood folate status (Blom H, 2009) and may help prevent additional diseases, provide additional nutrients, and help promote healthy dietary habits (Venn BJ et al., 2002).

Since younger women (ages 18-24) have the least awareness, knowledge and consumption of folic acid, an intervention that targets this age group may be warranted (Center for Disease Control and Prevention, 2008). Evidence indicates that the best methods for interventions involve learner-centered education (Cena ER et al., 2008). Forming an intervention around the health belief model may be effective, especially when focusing on barriers and benefits (Janz NZ and Becker MH, 1984). The cue to action component of the HBM has been minimally reported in previous research studies, and may prove to be important (Carpenter CJ, 2010). Developing an educational

intervention that encompasses these theories may be an effective way to increase consumption of folate-rich foods among young people.

Our educational intervention was tailored to high school students under age 18 and addressed each construct of the Health Belief Model. Special focus was given to the cue to action construct, with participant podcast creation and subsequent viewing to address this construct. The study objectives were to increase participants' knowledge of folate, increase consumption of folate-rich foods, and increase positive beliefs about folate health based on the Health Belief Model.

Chapter 2: Methods and Materials

Experimental Design

The study design was a two group parallel, controlled trial lasting a total of fifteen weeks with a twelve week intervention period. The objective of the study was to test the hypothesis that a learner-centered educational intervention based on the health belief model will successfully increase knowledge and consumption of folate-rich foods, while increasing positive beliefs about folate and health. Prior to initiation of the study, approval was granted by the Institutional Review Board of the University of Nebraska. Participants in the study were males and females under the age of 18 who were enrolled in a high school food and nutrition course in two school systems. At each school, the teacher of a food and nutrition course was contacted and asked to incorporate the study into their curriculum for the semester. Upon teacher approval, approval was granted by the corresponding school district and school superintendant.

All participants were required to sign an informed assent form (Appendix A), and have their parent or guardian sign a parental consent form (Appendix B) to participate. Before assent and consent forms were distributed, a description of the study (Appendix C) was read aloud to participants. They were informed that participation was completely voluntary, although certain activities would be required by the teacher for grading purposes. If students did not wish to participate, they were instructed to indicate this on their consent forms. Students who would be 18 years of age at any point during the study were asked to indicate this on the consent forms. Any data that may have been collected by students who did not wish to participate, did not give assent or parental consent, or

would be 18 at any point during the study was not analyzed or included in the results of the study.

At each school, two sections of the same food and nutrition class participated. One section served as the intervention group and participated in a folate education intervention, while the other section served as the control and received no intervention. One week before the intervention began, participants in both the intervention and control groups were asked to fill out a set of three questionnaires.

The first questionnaire was a food frequency questionnaire (FFQ) designed to measure their consumption of common folate-rich foods (Appendix D). Our preferred FFQ would have been the Block Dietary Folate Equivalents (DFE) Screener (NutritionQuest, 2009), however, since we did not have free access to this we designed our own based on current literature (Yen J et al., 2003; USDA, 2010). We did use a format very similar to the Block Screener. It listed foods and serving sizes, followed by boxes asking participants to estimate how many servings they typically consumed per day, week, month or year. A study titled "Folate intake assessment: Validation of a new approach" (Yen J et al., 2003) validated a folate-specific focused recall to estimate folate intake. Their recall tools for participants included a dietary intake summary checklist and a folate-specific food descriptor list, which listed many foods that are "excellent" or "good" sources of folate, and grouped them by food category: fruits and vegetables, beans and nuts, folic acid fortified cereal and bars, and folic acid fortified products. On the FFQ we created, we listed many of the foods listed in their food descriptor list and categorized them accordingly. Some of the food sources listed in the study by Yen and

colleagues were omitted as they are not commonly consumed in the Midwest, such as okra, papaya and parsnips.

Folate content of foods listed on the FFQ from the USDA Nutrient Database was recorded in a chart based on serving size (Appendix E). This chart was used to calculate the estimated folate intake of participants. Folate content of many foods varies depending on whether the food is raw, cooked, canned or frozen. The average folate content of the cooked, raw, canned and frozen forms of several foods were calculated and used in our nutrient database. Listing one food, rather than several forms of the same food, was intended to make accurate recalls easier for participants.

A modified version of a folic acid quiz (Appendix F) from the Center for Disease Control and Prevention (found at http://www.cdc.gov/ncbddd/folicacid/quiz.html)was used to assess participants' folate knowledge (Center for Disease Control and Prevention, 2010). To my knowledge this quiz has never been validated as an assessment tool, but the questions covered the main points about folate and health.

The third questionnaire (Appendix G) distributed was a Health Belief Model (HBM) questionnaire, designed to assess participants' beliefs about folate. The questionnaire we developed was a modified version of the HBM questionnaire used in a study by Kloeblen and Batish (1999), which was found to be predictive of intention to permanently follow a high folate diet in low-income pregnant women. To make the questionnaire more practical for use in a high school classroom with limited time, the questionnaire was shortened from its original 56 statements to 18 statements; omitting redundant statements. Statements from all constructs of the HBM were included.

After completion of the twelve week intervention period, post-study questionnaires were filled out by all participants in both the intervention and the control groups. The same three questionnaires from the pre-study were used for the post-study, plus an additional post-study evaluation for the intervention group (Appendix H). While the control group did not participate in the intervention, the results of the study, as well as the lesson plans (Appendix I) were provided to the teachers upon completion of the study.

The Intervention

During the first four weeks of the study, the intervention group participated in a series of three thirty minute folate lessons (Appendix I), one each week, that were based on the six constructs of the Health Belief Model: perceived susceptibility, severity, benefits, barriers, self-efficacy and cues to action. Lessons were designed to be learner-centered, involving a high level of participation from subjects. All lessons were designed and delivered by the primary investigator of this study.

Lesson one addressed perceived susceptibility and severity. The topic of folate was introduced, sources of folate and the food guide pyramid were reviewed, and the importance of folate in the body for disease and birth defect prevention was discussed. Pictures were shown to depict the severity of neural tube defects. Participants then filled out a 24 hour dietary recall, and compared their intakes to the recommendations on the food guide pyramid (Appendix J). At the end of class several folate-rich foods were sampled, including: orange slices, cherry tomatoes, baby carrots, fortified flat bread slices and hummus. Tomatoes and carrots contain folate but are not particularly excellent sources; these were mainly used to dip into the hummus.

Lesson two addressed self efficacy. Participants created their own burritos with folate-rich ingredients: black beans, fortified rice, pico de gallo, guacamole, romaine lettuce and flour tortillas. Recipes for foods sampled were handed out, and participants were encouraged to try them at home. Folate-rich burrito ingredients were reviewed, and other nutrients in these foods were identified. Food nutrition labels were then distributed as examples as we reviewed how to read a food label. Participants were instructed to find folate on the label, and acknowledge that it might not always be listed.

Lesson three addressed perceived benefits and barriers. A story was read to the class about a girl named Jane who wanted to start eating more folate-rich foods to increase her energy levels and prevent disease. Participants listed benefits and barriers to her making this decision. For all barriers listed, participants brainstormed ways to overcome these barriers. The class was given a sample of Jane's usual daily diet. Participants identified areas in her diet that could be improved by adding more fruits and vegetables. The objective of this lesson was to encourage eating breakfast as an easy way to include more folate in their diets. For the remainder of class, Folate Jeopardy was played as a way to review important concepts learned during the three lessons.

During the fourth week, participants in the intervention groups were instructed to create a short podcast (30-90 seconds) that incorporated the concepts learned in class. They worked in groups of one, two or three so that each class developed a total of eight podcasts. A "cheat sheet" was handed out to participants, summarizing the main learning objectives and suggested ideas of what to include in their podcasts. Participants were encouraged to be as creative as they could be, and were allowed to use voice recordings and pictures, or a short digital recording of themselves. Software for podcast

development included Microsoft's Movie Maker, Power Point, and Apple's Garage Band. Completed podcasts were viewed in class, one each week, as the cues to action component of the HBM.

Table 1 includes a timeline of when each component of the study occurred, and which HBM construct was addressed in each lesson.

Table 1. Study Timeline

Week	Activity	HBM Construct(s) Addressed
1	Study introduced. Assent and consent forms distributed.	
2	Pre-study questionnaires	
3	Lesson 1 (Intervention begins)	Perceived susceptibility, severity
4	Lesson 2	Self-efficacy
5	Lesson 3	Perceived benefits, barriers
6	Podcast development	Cues to action (CTA)
7	View podcast in class	CTA
8	View podcast in class	CTA
9	View podcast in class	CTA
10	View podcast in class	CTA
11	View podcast in class	CTA
12	View podcast in class	CTA
13	View podcast in class	CTA
14	View podcast in class (Intervention ends)	CTA
15	Post-study questionnaires	

Analytical Procedures

Estimated folate intake of each participant was calculated by analyzing their FFQs, and adding the folate content of each reported food consumed. Folate content of each food on the FFQ was obtained through the USDA Nutrient Database (USDA, 2010) based on portion size. FFQs of the intervention group were compared to those of the control group, allowing us to measure the effectiveness of the intervention at increasing intake of folate-rich foods. Estimated folate intakes were compared using the following categories: folate from fruits and vegetables (FV); folate from beans and nuts (BN); folate from fortified foods (Fort); combined folate from fruits, vegetables, beans and nuts (FVB); combined folate from natural and fortified foods (TFD); folate from multivitamins (MV); combined folate from all food sources and supplements (FMVD).

HBM constructs were measured using a six point Likert scale (strongly agree=1, strongly disagree=6) (Appendix G). Statements on the HBM questionnaire were grouped and analyzed by construct, and the average increase or decrease in numeric response was calculated. Only one statement addressed perceived benefits. Five statements addressed perceived barriers, but when the likert scale is flipped, they essentially address perceived benefits. Two statements addressed self efficacy, three questions addressed cues to action, and three questions addressed perceived severity. Four statements addressed perceived severity, but only females were asked to respond to these. Decreases in HBM rank indicate a decrease on the likert scale towards 1 (strongly agree), while an increase in HBM rank indicates an increase on the likert scale towards 6 (strongly disagree).

Knowledge of folate was measured by comparing the percentage of questions answered correctly on the pre test to the percentage of questions answered correctly on

the post test. The difference in pre- and post- test scores was obtained. Higher percentages indicate increased levels of folate knowledge.

Post-study evaluations were administered to participants of the intervention group. These were meant to evaluate participant opinions regarding how helpful they perceived the study to be. Responses to 11 statements were measured on a 6-point likert scale (1= strongly agree, 6= strongly disagree). In the analysis, responses of 1-3 (agree somewhat- strongly agree) and 4-6 (disagree somewhat – strongly disagree) were grouped. Percentages of participants who agreed or disagreed with each statement were obtained. No further statistical analysis was performed for this evaluation.

Statistical Analysis

Data were entered into SPSS and a repeated measures analysis of variance was performed. Descriptive statistics, mean differences, p-values, within-subject effects, and simple effects were obtained and analyzed for FFQ's, HBM questionnaires, and folate knowledge tests. Results were considered significant at the alpha= 0.05 level ($p< 0.05$), and were considered to be trending toward significance at the alpha= 0.10 level ($p< 0.10$).

Sphericity assumes homogeneity among the variances of the differences between the repeated measures factors. In an analysis of variance, it is possible to violate sphericity when variables are measured more than twice. If sphericity is incorrectly assumed, it can result in an invalid F-value; a large F- value will result in a lower p-value (UCLA, 1997). Because our study has only 2 variables (pre- and post-tests), sphericity violation is highly unlikely and sphericity is assumed.

The simple effects test measures whether or not there were significant changes between the pre- and post-tests of the intervention group and the control group, independently of one another.

The within-subject effects test measures whether or not there are significant differences between the pre- and post-tests, and whether these differences depend on a number of variables. The first variable measures whether there are differences between all of the pre-tests and post-tests for both the intervention and control groups combined. The second variable was "condition," which measures whether differences between the pre- and post-tests depend on which group participants were a part of: intervention or control. This was the most important measurement for our study. The third variable was "school." This measures whether differences between the pre- and post-test scores depended on which school the participants were in, but does not depend on condition. The fourth variable was the "three-way interaction." The three-way interaction measures the differences between the pre- and post-tests, and determines whether the differences depend on which school participants came from, and whether the effect of the school depends on the condition (intervention or control group).

Mean differences and p-values were obtained within the intervention and control groups. For the FFQs, these values were found for each of the seven folate categories. For the HBM questionnaires, these values were found for each of the HBM constructs. For the folate knowledge tests, these values were found for the percentage of questions answered correctly in the pre- versus post-tests.

Chapter 3: Results

Participants

After eliminating participants who did not provide signed parental consent and student assent forms, and students who would be 18 years old at any point during the study, a total of 44 subjects participated in our study. A total of 25 participants were in the intervention group (School A: 7 males, 5 females; School B: 2 males, 11 females), and 19 participants were in the control group (School A: 3 males, 4 females; School B: 9 males, 3 females).

Folate Food Frequency

Food frequency questionnaires (FFQs) from 38 participants were analyzed; 23 from intervention group, 15 from control group. Reasons for exclusion of FFQ data include not completing both the pre- and post-FFQs, and illegible handwriting. T-tests for simple effects results are listed in Table 2; ANOVA results for within-subject effects are listed in Table 3.

Folate consumption for pre- and post-tests was divided into seven categories: Fruits and vegetables (FV), beans and nuts (BN), fortified foods (Fort), multivitamin (MV), fruits, vegetables, beans and nuts combined (FVB), total folate from natural and fortified food sources (TFD), and total folate from all food and multivitamins (FMVD). No significant differences were found in any of the seven categories within the intervention or control groups, independently of one another.

Total folate intake for the intervention and control groups exceeded the RDA of 400 mcg/day for both pre- and post-study folate FFQ's intakes. Results show that both the intervention and control groups decreased their fruit and vegetable (FV) consumption

from pre-test to post-test. There was a very small decrease in folate consumption (3.51 mcg/day) in the intervention group and a very small decrease in folate consumption (17.09 mcg/day) in the control group (Table 2). The within-subject effects test found no significant differences between pre- and post-FFQs (Table 3). Any differences between FV pre- and post-FFQs did not depend on condition (whether intervention or control group), or the three-way interaction ($p > 0.05$). There was, however, a significant difference ($p = 0.028$) in the pre- and post- FV folate intakes between schools. Folate consumption between the intervention and control groups at school A increased an average of 13.5 mcg/day, while average folate consumption decreased by 34.13 mcg/day at school B.

Folate intake from beans and nuts (BN) decreased an average of 30.40 mcg/day in the intervention group, and decreased by an average of 40.36 mcg/day in the control group (Table 2). No significant difference was found in the within-subject effects test for the BN category between the pre- and post- FFQ intakes overall ($p>.05$). Differences between BN pre and post FFQs did not depend on condition, school or three-way interaction (Table 3).

Consumption of folate from fortified foods (Fort) decreased by an average of 53.35 mcg/day in the intervention group, and by 66.33 mcg/day in the control group (Table 2). There were no significant differences found in the within-subject effects test. Differences between Fort pre- and post-tests did not depend on condition, school or three-way interaction (Table 3).

Folate intake from multivitamins (MV) increased an average of 32.47 mcg/day in the intervention group, and decreased an average of 30.79 mcg/day in the control group

(Table 2). Differences between the pre- and post- FFQ intakes on the within-subject effects test were not significant ($p>.05$) (Table 3). Differences between MV pre- and post- FFQs did not depend on condition, school or three-way interaction ($p= 0.05$), although at the alpha= 0.10 level, the difference appears to be affected by condition (intervention versus control) ($p= 0.09$).

Folate intake from fruits, vegetables and beans combined (FVB) decreased by an average of 33.63 mcg/day in the intervention group, and by an average of 55.64 mcg/day in the control group (Table 2). No significant differences were seen between pre- and post- FFQ intakes in the within-subject effects test for the FVB group ($p > 0.05$). Differences between FVB pre and post FFQs did not depend on condition, school or three-way interaction ($p > 0.05$) (Table 3).

Total folate from natural and fortified food sources (TFD) decreased by an average of 86.76 mcg/day in the intervention group, and by an average of 123.78 mcg/day in the control group (Table 2). The TFD group showed no significant differences between pre- and post- FFQ intakes in the within-subject effects test ($p>0.05$). Differences between TFD pre- and post- FFQs did not depend on condition, school or three-way interaction ($p > 0.05$) (Table 3).

Results show that both the intervention and control groups decreased their total intake of folate from all sources (FMVD). Participants in the intervention decreased their consumption by an average of 54.29 mcg/day, while the control group decreased consumption by 154.47 mcg/day (Table 2). There were no significant differences in the FMVD category between the pre- and post- FFQ intakes in the within-subject effects test

(p= 0.237) (Table 3). Differences between FMVD pre- and post- FFQs did not depend on condition (p= 0.567), school (p= 0.979) or three-way interaction (p= 0.267).

Partial eta squared values were calculated for all folate categories. The following are eta squared guidelines for effect size: 0.01=small, 0.06=medium, 0.14=large. With the exception of the categories already shown to have significant differences, all partial eta squared scores for condition appear to be small. This means that even if we increased sample sizes, it would be unlikely that any significant differences would occur in any folate category based on condition.

Folate Knowledge

Pre- and post-knowledge test results for folate knowledge are provided in Table 4 (T-test for simple effects) and Table 5 (ANOVA within-subject effects). A total of 40 knowledge tests were analyzed; 25 from the intervention group and 15 from the control group. Participant data was excluded if there was not both a pre- and post- knowledge test. Percentage of questions answered correctly on the pre-test was compared to the percentage of questions answered correctly on the post-test.

An average increase of 21.2% was found for the intervention group from the pre-test to the post-test, while the control group decreased their percentage of correct answers by an average of 3%. A significant difference level (p= 0.013) between the pre- and post-knowledge test scores was found, and this difference depended on condition (whether in intervention or control group) (p= 0.001), and also on the school (p= 0.022). The three-way interaction was not significant (p > 0.05).

Table 2. (Simple Effects)
Pre- and Post-Study Folate Consumption (mcg/day) for Participants based on Food Frequency Questionnaires for Folate Containing Foods

	Intervention Group								Control Group							
		Pre- Study		Post- Study		Change				Pre- Study		Post- Study		Change		
	n	**Mean**	Std. Dev.	**Mean**	Std. Dev.	**Mean Diff**	Std. Error	**p**	n	**Mean**	Std. Dev.	**Mean**	Std. Dev.	**Mean Diff**	Std. Error	**p**
FV	23	**97.14**	63.91	**93.89**	62.73	**-3.51**	12.60	**.782**	15	**129.65**	112.68	**98.66**	87.89	**-17.09**	16.34	**.309**
BN	23	**86.91**	82.60	**56.26**	50.19	**-30.40**	45.05	**.504**	15	**192.48**	339.98	**122.77**	147.89	**-40.36**	59.11	**.499**
Fort	23	**330.18**	252.52	**272.87**	206.25	**-53.35**	64.59	**.415**	15	**360.51**	351.71	**295.25**	193.28	**-66.33**	88.76	**.439**
MV	23	**57.13**	137.83	**89.43**	167.78	**32.47**	21.99	**.149**	15	**87.60**	164.29	**65.61**	139.34	**-30.79**	28.86	**.294**
FVB	23	**184.05**	133.82	**150.42**	86.54	**-33.63**	51.42	**.518**	15	**319.73**	384.56	**221.43**	220.73	**-55.64**	67.47	**.415**
TFD	23	**514.02**	338.62	**423.28**	256.70	**-86.76**	103.60	**.408**	15	**682.64**	714.30	**516.68**	347.31	**-123.78**	135.94	**.369**
FMVD	23	**571.15**	443.48	**512.71**	369.40	**-54.29**	105.13	**.609**	15	**770.24**	684.73	**582.29**	329.04	**-154.47**	137.95	**.270**

*Significant at alpha=.10 level, **Significant at alpha=.05 level
FV = Fruits and Vegetables
BN = Beans and Nuts
Fort = Fortified Foods
MV = Multivitamins
FVB = Fruits, Vegetables, Beans and Nuts Total
TFD = Total Folate From Unfortified Foods
FMVD = Total Folate From All Sources

Table 3. (Within-subject Effects)
Anova Results for FFQ's

Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
FV	Sphericity Assumed	1789.462	1	1789.462	.982	.329	.028
FV *condition	Sphericity Assumed	776.698	1	776.698	.426	.518	.012
FV * school	Sphericity Assumed	9574.301	1	9574.301	5.253	.028**	.134
FV *condition * school	Sphericity Assumed	5405.800	1	5405.800	2.966	.094*	.080
Error(FV)	Sphericity Assumed	61973.658	34	1822.755			
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
bn	Sphericity Assumed	21113.156	1	21113.156	.907	.348	.026
bn * condition	Sphericity Assumed	417.875	1	417.875	.018	.894	.001
bn * school	Sphericity Assumed	28545.535	1	28545.535	1.226	.276	.035
bn * condition * school	Sphericity Assumed	37134.976	1	37134.976	1.594	.215	.045
Error(bn)	Sphericity Assumed	791852.311	34	23289.774			
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
fort	Sphericity Assumed	60401.158	1	60401.158	1.261	.269	.036
fort*condition	Sphericity Assumed	710.939	1	710.939	.015	.904	.000
fort * school	Sphericity Assumed	37714.637	1	37714.637	.788	.381	.023
fort*condition * school	Sphericity Assumed	32737.960	1	32737.960	.684	.414	.020
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
mv	Sphericity Assumed	11.952	1	11.952	.002	.963	.000

mv *condition	Sphericity Assumed	16878.576	1	16878.576	3.040	.090*	.082
mv * school	Sphericity Assumed	3871.856	1	3871.856	.697	.410	.020
mv *condition * school	Sphericity Assumed	2138.752	1	2138.752	.385	.539	.011
Error(mv)	Sphericity Assumed	188777.029	34	5552.266			
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
fvb	Sphericity Assumed	33603.168	1	33603.168	1.107	.300	.032
fvb *condition	Sphericity Assumed	2042.303	1	2042.303	.067	.797	.002
fvb * school	Sphericity Assumed	68941.295	1	68941.295	2.272	.141	.063
fvb *condition * school	Sphericity Assumed	69238.996	1	69238.996	2.281	.140	.063
Error(fvb)	Sphericity Assumed	1031850.424	34	30348.542			
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
TFD	Sphericity Assumed	186926.695	1	186926.695	1.517	.226	.043
TFD*condition	Sphericity Assumed	5778.621	1	5778.621	.047	.830	.001
TFD * school	Sphericity Assumed	5135.674	1	5135.674	.042	.839	.001
TFD * condition * school	Sphericity Assumed	200813.156	1	200813.156	1.630	.210	.046
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
FMVD	Sphericity Assumed	183949.208	1	183949.208	1.450	.237	.041
FMVD*condition	Sphericity Assumed	42409.149	1	42409.149	.334	.567	.010
FMVD * school	Sphericity Assumed	89.102	1	89.102	.001	.979	.000
FMVD*condition * school	Sphericity Assumed	161503.645	1	161503.645	1.273	.267	.036
Error(FMVD)	Sphericity Assumed	4313382.325	34	126864.186			

Table 4. (Simple Effects)
Pre- and Post- Study Knowledge Scores

	Intervention Group								Control Group							
		Pre- Study		Post- Study		Change				Pre- Study		Post- Study		Change		
	n	**Mean**	Std. Dev.	**Mean**	Std. Dev.	**Mean Diff**	Std. Error	**p**	n	**Mean**	Std. Dev.	**Mean**	Std. Dev.	**Mean Diff**	Std. Error	**p**
School A	12	**.592**	.117	**.692**	.117	**.100**			7	**.543**	.127	**.457**	.341	**-.086**		
School B	13	**.438**	.233	**.762**	.185	**.324**			12	**.450**	.188	**.475**	.242	**.025**		
Mean Total	25	**.512**	.199	**.728**	.157	**.212**	.045	**.000 ****	19	**.484**	.171	**.468**	.273	**-.03**	.054	**.574**

*Significant at alpha=.10 level, **Significant at alpha=.05 level

Table 5. (Within-subject Effects)
ANOVA Results for Knowledge Tests

Source		Type III Sum of Squares	df	Mean Square	F	Sig. (p)	Partial Eta Squared
correct	Sphericity Assumed	.170	1	.170	6.682	.013	.143
Correct*Condition	Sphericity Assumed	.303	1	.303	11.910	.001	.229
correct*school	Sphericity Assumed	.144	1	.144	5.669	.022	.124
correct* condition* school	Sphericity Assumed	.016	1	.016	.642	.428	.016
Error(correct)	Sphericity Assumed	1.017	40	.025			

Table 6. (Simple Effects)
Pre- and Post- Study Health Belief Model Results

	Intervention Group								Control Group							
		Pre- Study		Post- Study		Change				Pre- Study		Post- Study		Change		
HBM Construct	n	**Mean**	Std. Dev.	**Mean**	Std. Dev.	**Mean Diff**	Std. Error	**p**	n	**Mean**	Std. Dev.	**Mean**	Std. Dev.	**Mean Diff**	Std. Error	**p**
Benefits	25	**1.92**	.909	**1.56**	.583	**-.353**	.163	**.037 ****	15	**1.87**	.640	**1.93**	.884	**.050**	.223	**.824**
Barriers	25	**3.94**	.778	**4.52**	.683	**.574**	.153	**.001 ****	15	**3.88**	.570	**4.00**	.701	**.170**	.210	**.423**
Self Efficacy	25	**2.14**	.848	**1.74**	.765	**-.396**	.149	**.012 ****	15	**2.07**	.884	**2.27**	1.02	**.300**	.204	**.150**
Cues to Action	25	**3.03**	.952	**3.27**	1.13	**.254**	.157	**.114**	15	**2.84**	.846	**3.16**	1.05	**.500**	.215	**.025 ****
Severity	23	**2.39**	.763	**1.93**	.952	**-.472**	.202	**.026 ****	13	**2.44**	.644	**2.35**	1.01	**.005**	.291	**.987**
Susceptibility	13	**2.38**	.747	**1.57**	.458	**-.833**	.222	**.003 ****	3	**2.17**	.382	**3.17**	.144	**1.00**	.453	**.047 ****

*Significant at alpha=.10 level, **Significant at alpha=.05 level

Table 7. (Within-subject Effects) ANOVA Results for HBM Questionnaires							
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
Benefits (Ben)	Sphericity Assumed	.398	1	.398	1.204	.280	.032
Ben*condition	Sphericity Assumed	.704	1	.704	2.131	.153	.056
Ben * school	Sphericity Assumed	.080	1	.080	.243	.625	.007
Ben*condition * school	Sphericity Assumed	.242	1	.242	.732	.398	.020
Error(one)	Sphericity Assumed	11.899	36	.331			
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
Barriers (Bar)	Sphericity Assumed	2.408	1	2.408	8.213	.007**	.186
Bar*condition	Sphericity Assumed	.711	1	.711	2.424	.128	.063
Bar * school	Sphericity Assumed	.036	1	.036	.123	.728	.003
Bar*condition * school	Sphericity Assumed	.664	1	.664	2.266	.141	.059
Error(two)	Sphericity Assumed	10.554	36	.293			
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
Self Efficacy (SE)	Sphericity Assumed	.040	1	.040	.144	.706	.004
SE*condition	Sphericity Assumed	2.104	1	2.104	7.601	.009**	.174
SE * school	Sphericity Assumed	.710	1	.710	2.564	.118	.066
SE*condition * school	Sphericity Assumed	.167	1	.167	.602	.443	.016
Error(seven)	Sphericity Assumed	9.965	36	.277			
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
Cues to Action (CTA)	Sphericity Assumed	2.472	1	2.472	8.057	.007**	.183
CTA*condition	Sphericity Assumed	.262	1	.262	.855	.361	.023
CTA * school	Sphericity Assumed	3.706	1	3.706	12.078	.001**	.251
CTA*condition * school	Sphericity Assumed	.191	1	.191	.624	.435	.017

Error(nine)	Sphericity Assumed	11.046	36	.307			
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
Severity (Sev)	Sphericity Assumed	.817	1	.817	1.746	.196	.052
Sev * condition	Sphericity Assumed	.849	1	.849	1.816	.187	.054
Sev * school	Sphericity Assumed	1.374	1	1.374	2.937	.096*	.084
Sev * condition * school	Sphericity Assumed	.050	1	.050	.107	.746	.003
Error(twelve)	Sphericity Assumed	14.971	32	.468			
Source		**Type III Sum of Squares**	**df**	**Mean Square**	**F**	**Sig. (p)**	**Partial Eta Squared**
Susceptibility (Sus)	Sphericity Assumed	.030	1	.030	.109	.747	.009
Sus * condition	Sphericity Assumed	3.612	1	3.612	13.209	.003**	.524
Sus * school	Sphericity Assumed	.002	1	.002	.007	.936	.001
Sus * condition * school	Sphericity Assumed	.002	1	.002	.007	.936	.001
Error(fift)	Sphericity Assumed	3.281	12	.273			

Health Belief Model

Health Belief Model (HBM) questionnaires from 40 participants were analyzed; 25 from the intervention group, and 15 from the control group. Participant data was excluded if there was not both a pre- and post-HBM questionnaire. Statements on the HBM questionnaire addressed the six main constructs of the HBM: perceived susceptibility, severity, benefits, barriers, self efficacy and cues to action.

Summarized, simple-effects results for each construct are given in Table 6. Analysis of variance within-subject effects are listed in Table 7. Results for each statement on the HBM questionnaire are listed below according to HBM construct (Tables 8 - 13). When interpreting the results of this survey, please note that a decrease in HBM rank indicates a decrease on the likert scale towards 1 (strongly agree), while an increase in HBM rank indicates an increase on the likert scale towards 6 (strongly disagree).

Perceived Benefits

Table 8. Results of the HBM Construct: Perceived Benefits for Study Participants (Scale: 1= strongly agree, 2= agree, 3= somewhat agree, 4= somewhat disagree, 5= disagree, 6= strongly disagree)

	Average Responses per Question					
HBM Construct: Perceived Benefits	**Intervention** n=25			**Control** n=15		
HBM Statement	**Pre**	**Post**	**Diff**	**Pre**	**Post**	**Diff**
Improving my diet to include more foods that are high in folate could make me feel better and be a healthier person overall.	1.92	1.56	-0.353	1.87	1.93	0.05

Ranks for the perceived benefits question decreased by an average of 0.353 in the intervention group, and increased by 0.050 in the control group, indicating a greater change in the intervention group towards more strongly agreeing with statements regarding perceived benefits (Table 6). The difference in the intervention ranks was

significant (p=0.037), while the control scores were not significant (p > 0.05). Results of the analysis of variance within-subject effects test (Table 7) do not indicate any significant differences in overall ranks, or any significant differences depending on condition, school or three-way interaction (p > 0.05).

Perceived Barriers

Table 9. Results of the HBM Construct: Perceived Barriers for Study Participants
(Scale: 1= strongly agree, 2= agree, 3= somewhat agree, 4= somewhat disagree, 5= disagree, 6= strongly disagree)

	Average Responses per Question					
HBM Construct: Perceived Barriers	**Intervention** n=25			**Control** n=15		
HBM Statement	**Pre**	**Post**	**Diff**	**Pre**	**Post**	**Diff**
Eating a diet high in folate would be expensive.	3.56	3.65	0.09	3.6	3.5	-0.1
I don't know enough about what foods are high in folate.	1.95	4.27	2.31	1.75	2.55	0.8
I don't like most foods that are high in folate (vegetables, citrus fruit: oranges, grapefruit, strawberries, beans, cereal).	4.83	5.10	0.28	4.85	4.85	0
It would be too hard to change my diet to include more foods that are high in folate.	4.65	4.45	-0.20	4.65	4.35	-0.3
My friends and family would not like the changes in my diet if I tried to eat foods that are high in folate.	4.70	5.10	0.40	4.6	5.05	0.45

Ranks to the perceived barriers questions increased by an average of 0.574 in the intervention group, and increased by only 0.170 in the control group (Table 6). Since the scale was flipped for this set of questions, participants in the intervention group were more likely to disagree with statements regarding perceived barriers. The differences between the intervention group ranks was significant (p= 0.001), while differences among control ranks were not significant (p= 0.423). Results of the analysis of variance

for within-subject effects (Table 7) indicate a significant overall difference between pre- and post- HBM test ranks at the alpha= 0.05 level (p= 0.007). However, the difference in pre- and post- HBM ranks did not depend on condition, school or three-way interaction (p > 0.05).

Self Efficacy

Table 10. Results of the HBM Construct: Self Efficacy for Study Participants
(Scale: 1= strongly agree, 2= agree, 3= somewhat agree, 4= somewhat disagree, 5= disagree, 6= strongly disagree)

	Average Responses per Question					
HBM Construct: Self Efficacy	**Intervention** n=25			**Control** n=15		
I am confident that I could eat a diet high in folate if I tried.	2.13	1.69	0.44	2.05	2.5	-0.45
I feel that I would be able to follow a diet high in folate if I wanted to.	2.08	1.78	0.30	2.05	2.2	-0.15

Self efficacy ranks decreased an average of 0.396 points in the intervention group, and increased by 0.300 in the control group (Table 6), indicating that participants were more likely to agree with statements regarding positive beliefs about self efficacy after receiving the intervention. Significant differences occurred in the intervention group (p= 0.012) but not in the control group (p= 0.150). However, results from the analysis of variance within-subject effects (Table 7) were not significant for overall pre- and post- HBM ranks (p > 0.05). Differences in pre- and post- HBM ranks did not depend on condition, school or three-way interaction (p > 0.05). There was a trend toward significance at the alpha= 0.10 level for differences depending on condition (p= 0.09).

Cues to Action

Table 11. Results of the HBM Construct: Cues to Action for Study Participants (Scale: 1= strongly agree, 2= agree, 3= somewhat agree, 4= somewhat disagree, 5= disagree, 6= strongly disagree)						
	Average Responses per Question					
HBM Construct: Cues to Action	**Intervention** n=25			**Control** n=15		
HBM Statement	**Pre**	**Post**	**Diff**	**Pre**	**Post**	**Diff**
An occasional reminder (like a text message) would help me remember to eat more foods that are high in folate.	3.07	3.07	0	2.6	3.1	-0.5
Reading pamphlets or seeing posters about folate would help me remember to eat more foods that are high in folate.	3.06	3.33	-0.27	3.3	3.3	0
If a friend or someone I know told me about folate that would help me be sure I get plenty of folate in my diet.	2.88	3.20	-0.33	2.7	3.60	-0.78

The cues to action ranks increased an average of 0.254 in the intervention group, and increased an average of 0.500 in the control group (Table 6). Both groups were less likely to agree with statements stating that a reminder would help them increase their folate intake in the post HBM questionnaire, and the control group was less likely to agree than was the intervention group. Rank increases in the intervention group were not significant ($p= 0.114$), but they were significant in the control group ($p = 0.025$). Results from the analysis of variance within-subject effects (Table 7) was significant for the overall pre- and post- HBM ranks ($p= 0.007$), but this did not depend on condition ($p > 0.05$). Interestingly, the difference depended on school ($p= 0.001$), with school B showing a greater increase in ranks (less likely to believe cues to action would be helpful)

than in school A. There was no significant difference in the three-way interaction ($p > 0.05$).

Perceived Severity

Table 12. Results of the HBM Construct: Perceived Severity for Study Participants
(Scale: 1= strongly agree, 2= agree, 3= somewhat agree, 4= somewhat disagree, 5= disagree, 6= strongly disagree)

	Average Responses per Question					
HBM Construct: Perceived Severity	**Intervention** n=23			**Control** n=13		
Having a birth defect is a very serious condition.	1.83	1.38	0.45	1.6	1.677	-0.04
Having a baby with a birth defect would be very expensive.	1.87	1.57	0.30	1.65	2.10	-0.44
Having a baby with a birth defect would negatively affect my social life, my family and my ability to go to school or work.	3.5	2.83	0.67	3.85	3.61	0.47

Ranks for perceived severity decreased an average of 0.472 in the intervention group, and increased an average of 0.005 in the control group (Table 6). In the post HBM test, the intervention group was more likely to agree with statements stating the risks of not consuming adequate folate are severe. Differences in the intervention group were significant ($p= 0.026$), while differences in the control group were not significant ($p= 0.987$).Results from the analysis of variance for within-subject effects (Table 7) indicate no significant differences in pre- and post- HBM ranks overall, or based on condition, school or three-way interaction ($p > 0.05$). At the alpha= 0.10 level, there is a trend toward significant difference based on school ($p= 0.096$), with a greater decrease in their HBM ranks (higher perceived severity).

Perceived Susceptibility

Table 13. Results of the HBM Construct: Perceived Susceptibility for Study Participants (Scale: 1= strongly agree, 2= agree, 3= somewhat agree, 4= somewhat disagree, 5= disagree, 6= strongly disagree)

	Average Responses per Question					
HBM Construct: Perceived Susceptibility	**Intervention** n=13			**Control** n=3		
HBM Statement	**Pre**	**Post**	**Diff**	**Pre**	**Post**	**Diff**
Eating more foods high in folate and folic acid, even if I'm not pregnant, could prevent or reduce my risk of having a baby with a birth defect.	2.07	1.06	0.99	1.75	3	-1
If I do not eat a diet high in folate and folic acid prior to pregnancy and very early in pregnancy, I could have a baby with a birth defect.	2.8	1.83	1.06	2.75	3.5	-0.75
If I were to become pregnant, my unborn baby could be sick without my even knowing it.	2.7	1.90	0.82	2	3.75	-1.75
It is possible to become pregnant and not know it right away.	2.17	1.47	0.47	2	2.5	-0.5

Ranks for perceived susceptibility decreased an average of 0.833 in the intervention group, and increased an average of 1.0 in the control group (Table 6), which means that females in the intervention group agreed with more statements of perceived susceptibility in the post test. The decrease in ranks in the intervention group ($p= 0.003$) were significant, and the increase in the control group ranks ($p=0.047$) also were significant. Results of the analysis of variance within-subject effects (Table 7) indicate a significant difference in the pre- and post- HBM ranks depending on condition ($p= 0.003$), but no significant difference in overall ranks, school or in the three-way interaction ($p > 0.05$). Because the perceived susceptibility section was answered by females only, there were significantly fewer subjects (intervention, n=13; control, n=3).

HBM Summary

Positive changes in beliefs were observed in the intervention group for all HBM constructs except for cues to action, while no significant differences occurred in the control group ranks (Table 6). All rank changes between pre- and post- HBM tests in the intervention group were significant at the alpha= 0.05 level; however when compared to the control group, only changes in self efficacy and perceived susceptibility appear to be significantly different. While there was no significant difference for perceived barriers between the intervention and the control group, the partial eta squared value of 0.063 indicates a moderate effect size. This means if we had a larger sample size we may have seen a significant difference in perceived barriers between conditions.

Post Evaluations

Results of the post evaluation surveys that were administered to participants of the intervention group (n=24) after the study was completed are listed in Table 14.

Table 14. Post- Study Evaluations from Participants in the Intervention Group
Scale: 1= strongly agree, 2= agree, 3= slightly agree, 4= slightly disagree, 5= disagree, 6= strongly disagree

Question	% Who Agree- Strongly Agree	% Who Disagree- Strongly Disagree
1.) I feel like I have learned at least one new concept about folate and health.	**100%** n=24	**0%** n=0
2.) The information I learned is important.	**100%** n=24	**0%** n=0
3.) I have made at least one change to my diet since learning about folate. (For example, a change could be eating more fruits, vegetables, or eating breakfast more often).	**75%** n=18	**25%** n=6
4.) The lessons were a worthwhile experience.	**95.8%** n=23	**4.2%** n=1
5.) I eat more fruit now than I did before.	**70.8%** n=17	**29.2%** n=7
6.) I eat more vegetables now than I did before.	**56.5%** n=14	**43.5%** n=10
7.) I try to include more high-folate foods in my diet now.	**66.7%** n=16	**33.3%** n=8
8.) I have discovered high-folate food(s) that I enjoy eating.	**79.2%** n=19	**20.8%** n=5
9.) *Creating* a podcast helped reinforce concepts learned in class.	**62.5%** n=15	**37.5%** n=9
10.) *Watching* the podcasts in class helped me retain the information longer.	**54.2%** n=13	**45.8%** n=11
11.) I tried one or more of the foods at home that were sampled in class.	**41.7%** n=10	**58.3%** n=14

Chapter 4: Discussion

According to the food frequency questionnaire (FFQ) results, folate consumption after the intervention decreased in both the intervention and the control groups, with the exception of an increase in folate from multivitamins in the intervention group. These differences were not significant ($p > 0.05$), with the exception of fruits and vegetable (FV) consumption. FV consumption showed a significant difference in the pre- vs. post-FFQs when comparing the two schools ($p= 0.028$). While both the intervention and control groups decreased folate consumption in the post FFQ, the mean folate difference in the control group between pre- and post- folate consumption was lower in all seven folate categories. While folate consumption decreased in both the intervention and control groups, total folate intake was not below the RDA of 400 mcg/day.

The decrease in folate intake is surprising because of the time of year the study took place. It would be expected that since this study took place from January through April, that an increase in FV would occur due to more fruits and vegetables being in season. One possible explanation for this decrease is that the intervention group may have become more familiar with serving sizes, and more aware of portions they were actually consuming as a result of the intervention. It is very likely that both groups overestimated servings consumed on the FFQ's, and since the intervention group became more aware of their actual folate intake and serving sizes, their consumption appeared to decrease on the post- FFQ.

The significant difference between the two schools could possibly be attributed to a couple factors. First, lessons were planned to take 30 minutes. The teacher in school B preferred to devote the entire 50 minute class period to each lesson, while school A

received the 30 minute lessons as planned. These extra 20 minutes may have impacted post-test results for FFQ, HMB and knowledge tests. Second, the location of the school may have had an impact. School A was in an urban location, while school B was in a more rural location. Different lifestyle factors may play a role in the attitudes of the students and dietary habits.

Folate intake from multivitamins (MV) increased with a trend toward significance between the pre- and post- FFQs, depending on condition ($p= 0.09$). This is an interesting finding as the study promoted consumption of foods that are high in folate; not folate from multivitamins. It is possible that MV intake increased as a result of the intervention, even though this was not our intent. It would be easy for students to over or under estimate their use of multivitamins. If participants went through phases throughout the year where they remember to take their multivitamin for a few weeks, and then forget for a few weeks, this could affect the MV FFQ results depending on what phase they were going through when they filled out the FFQ.

The mean total folate intake from all sources (FMVD) in the pre FFQ was 571.15 (143% RDA) and 770.24 (193% RDA) mcg/day in the intervention and control groups, respectively. FMVD in the Post FFQ was 512.71 (128% RDA) and 582.29 (146% RDA) mcg/day in the intervention and control groups, respectively. FMVD in both the pre- and post-FFQs was greater than the RDA of 400mcg/day. This is higher than the mean intake of folate from all sources of 351 +/- 9.1 mcg/day reported in NHANES 1999-2000 (Dietrich M et al., 2005) for both men and women. This more likely indicates an overestimation of folate intake from high folate foods, rather than actual higher folate intakes than the national average.

A high proportion of folate came from fortified foods. Pre- and post- FFQ intakes of fortified foods for the intervention group were 330.18 (82.5% RDA, 57.8% actual intake) and 272.87 (68.2% RDA, 53.2% actual intake) mcg/day, and in the control group were 360.51 (90.1% RDA, 46.8% actual intake) and 295.25 (73.8% RDA, 50.7% actual intake) mcg/day, respectively. The proportion of folate from fruits, vegetables, beans and nuts (FVB) was much smaller. Pre- and post- FFQ intakes of FVB for the intervention group were 184.05 (46% RDA, 32.2% actual intake) and 150.42 (37.6% RDA, 29.3% actual intake) mcg/day, and in the control group were 319.73 (80% RDA, 41.5% actual intake) and 221.43 (55.3% RDA, 38% actual intake) mcg/day, respectively. FVB intake results from our FFQ are comparable to (but overall lower than) NHANES III (1988-1994) results (Dietrich M et al., 2005) before mandatory fortification. NHANES III reported mean intakes for males and females of 275 +/- 3.2 mcg/day. While folate from all sources appears to be more than adequate in our sample population, consumption of naturally occurring folate from food sources was low. As was concluded by Venn BJ et al., 2002, a diet high in natural folate may be more beneficial than fortification due to improved dietary habits leading to increased intakes of other important nutrients associated with these foods and decreased intakes of foods containing saturated fat. Cena and colleagues (2008) conducted a similar study on low-income women of childbearing age (18-45) using the Block Dietary Folate Equivalent Screener (Nutrition Quest, 2010). They found significant increases in naturally occurring food folate ($p= 0.009$) and a trend toward significance in synthetic folic acid from fortified foods ($p= 0.088$) in the intervention. The differences in results between Cena's study and our study

could be attributed to the use of different FFQs. Differences may also be due to participant, age, gender, culture and income level.

Based on the Health Belief Model (HBM) questionnaires, beliefs about folate and health (measured on a 6-point likert scale) decreased slightly in all constructs except cues to action (slight increase) in the intervention group, and increased slightly in all constructs except perceived barriers (slight increase) in the control group. Significant differences ($p < 0.05$) were found between the pre- and post- HBM questionnaires depending on condition for self efficacy ($p= 0.009$) and perceived susceptibility ($p= 0.003$). Therefore, it can be concluded that the intervention increased self-efficacy and perceived susceptibility in the intervention group.

To partially address the perceived susceptibility construct, 24-hour dietary recalls were conducted in the intervention group. The purpose of the 24-hour recall was to compare participants' actual intakes of folate-rich foods (fruits and vegetables) to the recommendations of the Food Guide Pyramid (http://www.choosemyplate.gov). An older (1992) image of the pyramid was used (Appendix J) to make personal comparisons easier for the participants, but the 2010 pyramid was also discussed. The 2011 My Plate (http://www.choosemyplate.gov) (USDA, 2011) became available during the study, but was not published in time to discuss during the lessons. Making these comparisons served as an eye-opener to those who were not consuming recommended amounts of fruits, vegetables, beans, nuts and grains, and was designed to increase perceived susceptibility. However, since only the women answered perceived susceptibility questions (all of which were related to pregnancy), the effects of the 24-hour recall were not analyzed in the data from male participants. We cannot be certain that the changes in perceived

susceptibility were the result of the 24-hour recalls or simply due to increased knowledge of birth defect risks. Additionally, data from individual 24-hour recalls were not collected or analyzed. This data may have been useful to our study in addition to FFQs, but recalls were used for participant awareness only.

The significant difference ($p = 0.001$) for the cues to action construct was dependent on school, but not on condition (whether participants were in the intervention or control group). Differences between schools may be attributed to different attitudes between rural versus urban schools. It is also possible that participants of the control group in one school may have been exposed to the podcasts of the intervention group, or had encountered media that changed their attitudes towards the cues to action construct. Since there was no significant difference between the intervention and control groups in this construct, it can be concluded that viewing a podcast each week was not as effective as hypothesized for a cue to action. However, other factors may be attributable to this lack of change. Since the primary investigator was not present for the weekly viewings, it is not possible to know if the podcasts were played on a weekly basis.

Additionally, there were some technical difficulties in school B the day we discussed benefits and barriers and much of the lesson was rushed. This may have resulted in less change for the HBM scores for benefits and barriers constructs at school B.

A Cronbach's Alpha was performed on our HBM questionnaire for each construct that had 2 or more statements. This was to determine reliability of whether our statements measured what we intended them to measure. Cronbach's Alpha results for pre and post responses (respectively) are as follows: Barriers: 0.625, 0.595; self efficacy: 0.977, 0.864;

cues to action: 0.557, 0.688; perceived severity: 0.130, 0.639; perceived susceptibility: 0.530, 0.857. A Cronbach's Alpha of 0.70 is considered acceptable by most standards (UCLA, 1997). Our results indicate we may not be accurately measuring beliefs in each construct.

The knowledge scores indicate a significant increase in folate knowledge in the intervention group between pre- and post- knowledge tests. Since the post knowledge tests were administered nine weeks after the last lesson (eight weeks after podcast development), knowledge was retained over the nine week period. Retention of knowledge may be attributable in part to viewing student podcasts in class each week during the eight week period.

Post-study evaluations of the intervention group indicated overall positive responses from participants. To highlight a few of the responses, 75% of participants claim to have made at least one dietary change since learning about folate; 79.2% claim to have discovered at least one high-folate food they enjoy eating because of the lessons; 62.5% agree that creating podcasts was a helpful way to reinforce concepts learned in class; 54.2% agree that watching the podcasts in class helped them retain the information longer, and 41.7% claim to have tried at home one of the recipes sampled in class. Creating podcasts took about two hour-long class periods, instead of the one hour initially planned. Podcasting is an interactive way to help students learn and retain information over time, as indicated by positive post-study evaluations and significant increases in knowledge that were retained over eight weeks.

Chapter 5: Limitations

A major limitation to this study was the small sample size. With a sample size of 44 and a 95% confidence interval, our margin of error is 14.76%. To reduce the margin of error to 5% we would need to increase our sample size to 377 (Raosoft, 2004). Also, our sample schools were chosen based on convenience, rather than randomly selecting schools in Nebraska. Because of our small sample size and non-randomized selection of sample schools, we consider this to be a pilot study.

The Health Belief Model questionnaire had been validated to predict intent to follow a high folate diet among pregnant women (Kloeblen and Batish, 1999); however we used a modified, shorter version in a non-pregnant population of both males and females. Cronbach's Alpha results were sub-optimal, and indicate that our HBM questionnaire may not be accurately measuring beliefs in each construct.

The knowledge assessment was a modified form of a quiz found on the CDC's website (Center for Disease Control and Prevention, 2010). This questionnaire has not been validated for use in a research setting, but it was straight forward as to whether or not participants learned the material after the intervention.

The food frequency questionnaire used was also not validated. It was a similar format to the Block DFE questionnaire (Nutrition Quest, 2010), and was based on previous research (Yen J et al., 2003) and the USDA Nutrient Database (USDA, 2010). Since the same questionnaire was used for both the pre- and post- FFQs, it likely measures the differences accurately regardless of whether folate intake was over or underestimated.

The last limitation is the uneven length of lessons between the schools. School B requested a full 50 minute lesson, while school A received the 30 minute lessons as planned. All lessons were presented by the primary investigator to ensure that all the information was covered in both classes. The extra 20 minutes of attention given to participants in school B may account for some differences in scores between schools. It may have been beneficial to provide an educational session for teachers prior to beginning the study to ensure equal lengths of time and equal levels of teacher involvement between schools. Additional differences between schools may be attributed to school location; school A was rural, and school B was urban. Different lifestyle factors may play a role in students' attitudes and dietary habits.

Chapter 6: Conclusions

The results of this study indicate that a folate intervention based on the Health Belief Model effectively increases knowledge about folate and health, but does not increase consumption of folate-rich foods. The intervention increased self efficacy and perceived susceptibility according to the Health Belief Model, but no significant effect on perceived benefits, barriers, severity or cues to action were found.

Podcasting is an interactive way to help students learn and retain information over time, as indicated by positive post-study evaluations and significant increases in knowledge that were retained over eight weeks. It may not be an effective cue to action. Podcasting is a time consuming process that may take several class periods to complete. For practical applications, teachers may choose to use podcasting with a broader range of topics (for example, each student creates a podcast for a different nutrient to share with the class).

This study was considered a pilot project. If a larger study was to be conducted, a larger sample size would be needed. This would include a randomized selection of more schools throughout Nebraska with an educational session for teachers prior to conducting the study. Additional consideration should be given to ensure equal lesson lengths between schools, adequate time for podcast development, and the use of validated instruments.

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IRB#:
Youth Assent Form- Intervention

Folate Intervention for High School Students

1. We would like to invite you to take part in this study. You are eligible to take part because you are a high school student **under** 18 years of age. If you are 18 or older you will still be allowed to participate in the study, but none of the data we obtain from you will be analyzed. If you are **18 or older**, please indicate this here: _____.
2. This project has been explained to you, and your parents have given their consent for your participation.
3. If you have any questions at any time, please ask.
4. In this study, we will be doing a number of nutrition related activities.
5. In this study, we will ask you to fill out the forms that are given to you about certain foods.
6. You are free to decide not to participate in this study. You can also withdraw at any time without harming your relationship with the researchers, the University of Nebraska-Lincoln, or _____School District.
7. You are free to decide what foods you want to taste or not taste, and which research activities you want to participate in if they are not class requirements.

I will be visiting your classroom 6 times over the next 4 months to talk to you about nutrition. The first and last times I visit, you will need to fill out a set of 3 questionnaires. Each of the 6 visits will require about 30 minutes.

During two of the lessons we will be sampling food. If you have any food allergies, we will need to know this in advance. In the case of a medical emergency, the school nurse will be available for treatment. **If you have any food allergies please list them here:**

Appendix A

If you do not wish to be included in the research but would still like to participate in the food tastings, please indicate this along with any food allergies or intolerances in the space provided above. You will not be allowed to consume any foods that you have listed.

Any information that you provide will be kept strictly confidential. The information obtained in this study may be published in scientific journals or presented at scientific meetings, but your individual identity will be kept strictly confidential. The results of this study will be shared with the _____ School District in aggregate form, and again your identity will be kept strictly confidential.

YOU ARE MAKING A DECISION WHETHER OR NOT TO PARTICIPATE IN THIS RESEARCH STUDY. SIGNING THIS FORM MEANS THAT YOU HAVE DECIDED TO PARTICIPATE AND HAVE READ ALL THAT IS ON THIS FORM. YOU AND YOUR PARENTS WILL BE GIVEN A COPY OF THIS ASSENT FORM TO KEEP.

_____ _____

SIGNATURE OF SUBJECT **DATE**

_____ _____

SIGNATURE OF INVESTIGATOR **DATE**

IDENTIFICATION OF INVESTIGATORS

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IRB #:
Youth Assent Form- Control

Folate Intervention for High School Students

1. We would like to invite you to take part in this study. You are eligible to take part because you are a high school student **under** 18 years of age. If you are 18 or older you will still be allowed to participate in the study, but none of the data we obtain from you will be analyzed. If you are **18 or older**, please indicate this here: _____.
2. This project has been explained to you, and your parents have given their consent for your participation.
3. If you have any questions at any time, please ask.
4. In this study, we will ask you to fill out the forms that are given to you about certain foods.
5. You are free to decide not to participate in this study. You can also withdraw at any time without harming your relationship with the researchers, the University of Nebraska-Lincoln, or ____ School District.
6. You are free to decide which research activities you want to participate in if they are not class requirements.

I will visit your classroom on two separate occasions to have you fill out questionnaires. These two occasions will be approximately 4 months apart, and should take about 30 minutes each time.

Any information that you provide will be kept strictly confidential. The information obtained in this study may be published in scientific journals or presented at scientific meetings, but your individual identity will be kept strictly confidential. The results of this study will be shared with the _____ School District in aggregate form, and again your identity will be kept strictly confidential.

YOU ARE MAKING A DECISION WHETHER OR NOT TO PARTICIPATE IN THIS RESEARCH STUDY. SIGNING THIS FORM MEANS THAT YOU HAVE DECIDED TO PARTICIPATE AND HAVE READ ALL THAT IS ON THIS FORM. YOU AND YOUR PARENTS WILL BE GIVEN A COPY OF THIS ASSENT FORM TO KEEP.

_____ _____

SIGNATURE OF SUBJECT **DATE**

Appendix A

SIGNATURE OF INVESTIGATOR _____ DATE _____

IDENTIFICATION OF INVESTIGATORS

PRIMARY INVESTIGATOR: Lindsay M. LaBrosse, Phone: (612) 275- 0531
SECONDARY INVESTIGATOR: Julie A. Albrecht, Ph.D. Office: (402) 472-8884

Appendix B

IRB# 20110111226
Date Approved: 01/20/2011
Valid Until: 01/19/2012

University of Nebraska Lincoln

College of Education and Human Sciences
Department of Nutrition and Health Sciences
110 Ruth Leverton Hall
PO Box 830806
Lincoln, NE 68583-0806
(402) 472-3716
FAX (402) 472-1587

IRB #:
Parental Informed Consent Form- Intervention

Folate Intervention for High School Students

You are invited to permit your child to participate in a research study about the consumption of high-folate foods (vegetables, fruits, beans, etc.). The following information is provided to help you make an informed decision whether or not to allow your child to participate. If you have any questions, please do not hesitate to ask.

Your child is eligible to participate because s/he attends high school and is a member of _____ classroom, and is under the age of 18. If your child is 18 or older they will still be allowed to participate, but none of the data collected from them will be used in the analysis. If your child is **18 or older**, please indicate this here: _____.The purpose of the study is to increase your child's knowledge about folate and folic acid, and to increase the consumption of high-folate foods (primarily fruits and vegetables) among youth.

The study will be conducted during six regularly scheduled class periods. The study sessions will occur once a week for 5 consecutive weeks, with the sixth session occurring approximately 4 months after the first session. Each session will last approximately 30 minutes. Any activities completed as part of this project may or may not be considered a part of the class for grading purposes. Activities will include reviewing the food guide pyramid, learning the benefits of eating naturally high-folate foods, folate games, creating a podcast for a class website, and tasting different high-folate foods. Since folate and folic acid play a major role in the prevention of birth defects, some attention will be focused here. Please be aware that by discussing the prevention of birth defects, we are in no way implying sexual activity of students. The goal of this discussion is to increase awareness of folate's role in good health.

During the first and last class period, students will be asked to fill out questionnaires regarding their knowledge and consumption of high-folate foods. This is necessary in order to test the effectiveness of the program.

As a result of this research study, your child will be learning more about healthy eating and will help us as researchers determine whether these particular interventions successfully increase student's knowledge and intake of high-folate foods.

These activities will be included as part of the curriculum in _____ classroom. If you decide you do not want your student to participate in the study, any information that may be obtained from them will be excluded from the data analysis.

Appendix B

If your child has any special food preferences or allergies we would need of a medical emergency, the school nurse will be available for treatment. **allergies or other related concerns, please list them here:**

If you do not wish for your child to be included in the research but would still like them to participate in the food tastings, please indicate this along with any food allergies or intolerances in the space provided above. Your child will not be allowed to consume any foods that you have listed.

Any information obtained during this study which could identify your child will be kept strictly confidential. Files will be kept in a secured room on University of Nebraska property. The information obtained in the study may be published in scientific journals or presented at scientific meetings, but your child's identity will be kept strictly confidential. The results of this study will be shared with the _____, School District in aggregate form, and again your child's identity will be kept strictly confidential.

Your child's rights as a research subject have been explained to you. You may ask questions about the study and have those questions answered before agreeing to participate or anytime during the study. If you have any additional questions concerning your child's rights that cannot be answered by the investigator, you may contact the University of Nebraska Institutional Review Board (IRB), telephone (402) 472-6965.

You are free to decide not to have your child participate in this study or to withdraw your child at any time without adversely affecting their or your relationship with the investigator at the University of Nebraska, or with _____School District. Your decisions will not result in any loss of benefits to which your child is otherwise entitled.

DOCUMENTATION OF INFORMED CONSENT

YOU ARE VOLUNTARILY MAKING A DECISION WHETHER OR NOT TO ALLOW YOUR CHILD TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE CERTIFIES THAT YOU HAVE DECIDED TO ALLOW YOUR CHILD TO PARTICIPATE HAVING READ AND UNDERSTOOD THE INFORMATION PRESENTED. YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP.

_____ _____

SIGNATURE OF PARENT OR GUARDIAN **DATE**

IN MY JUDGEMENT THE PARENT/LEGAL GUARDIAN IS VOLUNTARILY AND KNOWINGLY GIVING INFORMED CONSENT AND POSSESSES THE LEGAL CAPACITY TO GIVE INFORMED CONSENT TO PARTICIPATE IN THIS RESEARCH STUDY.

_____ _____

SIGNATURE OF INVESTIGATOR **DATE**

IDENTIFICATION OF INVESTIGATORS
PRIMARY INVESTIGATOR
Lindsay M. LaBrosse, Phone: (612) 275-0531

SECONDARY INVESTIGATOR
Julie A. Albrecht, Ph.D. Office: (402) 472-8884

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IRB #:
Parental Informed Consent Form- Control

Folate Intervention for High School Students

You are invited to permit your child to participate in a research study about the consumption of folate-rich foods (primarily fruits and vegetables). The following information is provided to help you make an informed decision whether or not to allow your child to participate. If you have any questions, please do not hesitate to ask.

Your child is eligible to participate because s/he attends high school and is a member of _____classroom, and is under the age of 18. If your child is 18 or older they will still be allowed to participate, but none of the data obtained from them will be used in the analysis. If your child is **18 or older**, please indicate this here: _____. The purpose of the study is to measure knowledge and consumption of folate and folic acid-rich foods (primarily fruits and vegetables) in youth.

_____may or may not choose to use this activity as part of regular classroom curricula. If you decide you do not want your child to participate in the study, we are not allowed to use any data collected from your child for our research. If the classroom teacher decides not to require this activity, your child will be allowed to work on other school related activities as decided by the classroom teacher during these two 30 minute periods.

As a participant in this study, your child will be asked to fill out three separate questionnaires on two separate occasions (about 4 months apart). The three questionnaires will take a total of approximately 30 minutes to complete on each occasion. Each questionnaire asks questions about folate knowledge or food choices. The data collected from your student will be used for comparison with other students their age and will help us, as researchers, determine whether particular interventions successfully increase student's knowledge and consumption of folate-rich foods.

Any information obtained during this study which could identify your child will be kept strictly confidential. Files will be kept in a secured room on University of Nebraska property. The information obtained in the study may be published in scientific journals or presented at scientific meetings, but

Appendix B

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your child's identity will be kept strictly confidential. The results of this study will be shared with the _____ School District in aggregate form, and again your child's identity will be kept strictly confidential.

Your child's rights as a research subject have been explained to you. You may ask questions about the study and have those questions answered before agreeing to participate or anytime during the study. If you have any additional questions concerning your child's rights that cannot be answered by the investigator, you may contact the University of Nebraska Institutional Review Board (IRB), telephone (402) 472-6965.

You are free to decide not to have your child participate in this study or to withdraw your child at any time without adversely affecting their or your relationship with the investigator at the University of Nebraska, or with _____ School District. Your decisions will not result in any loss of benefits to which your child is otherwise entitled.

DOCUMENTATION OF INFORMED CONSENT

YOU ARE VOLUNTARILY MAKING A DECISION WHETHER OR NOT TO ALLOW YOUR CHILD TO PARTICIPATE IN THIS RESEARCH STUDY. YOUR SIGNATURE CERTIFIES THAT YOU HAVE DECIDED TO ALLOW YOUR CHILD TO PARTICIPATE HAVING READ AND UNDERSTOOD THE INFORMATION PRESENTED. YOU WILL BE GIVEN A COPY OF THIS CONSENT FORM TO KEEP.

_____ _____

SIGNATURE OF PARENT OR GUARDIAN **DATE**

IN MY JUDGEMENT THE PARENT/LEGAL GUARDIAN IS VOLUNTARILY AND KNOWINGLY GIVING INFORMED CONSENT AND POSSESSES THE LEGAL CAPACITY TO GIVE INFORMED CONSENT TO PARTICIPATE IN THIS RESEARCH STUDY.

_____ _____

SIGNATURE OF INVESTIGATOR **DATE**

IDENTIFICATION OF INVESTIGATORS
PRIMARY INVESTIGATOR
Lindsay M. LaBrosse, Phone: (612) 275-0531

SECONDARY INVESTIGATOR
Julie A. Albrecht, Ph.D. Office: (402) 402-472-8884

Appendix C

Recruitment Script for Control Subjects

Good morning everyone. My name is Lindsay LaBrosse, I am a graduate student at the University of Nebraska-Lincoln. For my Master's Thesis I am conducting a study to see if a certain series of lessons will successfully increase the awareness, knowledge and consumption of foods that are high in a certain nutrient. Because you are all high school students under age 18, you are eligible to participate in this study. Your teacher has agreed to let me incorporate these lessons into your regularly scheduled class time.

Participation in this study is completely voluntary, however, your teacher may request that you participate in certain activities that are relevant to this course's material and will be used for grading purposes. If you choose not to participate in the study, any information that may be obtained from you will not be used in the data analysis. For non-required activities, your teacher will provide an alternative activity such as study hall.

If you choose to participate in this study, you will be asked to complete a set of three questionnaires on two separate occasions. The first occasion will be next week, and the second occasion will be approximately four months from then. The questionnaires will take about 30 minutes to complete on each occasion.

I am passing out 2 consent forms. One is a parental consent form, which you will need to bring home and have your parent or guardian sign. The other is an assent form, which you will need to sign after your parent signs their consent form. Please bring these signed forms back to your teacher as soon as possible before next week. Again, your participation in this study is optional. If you do not wish to participate, you and your parent(s) do not need to sign the forms. Just bring them back to class and write "I do not wish to participate" at the top.

Does anyone have any questions at this time?

Appendix C

Recruitment Script for Intervention Subjects

Good morning everyone. My name is Lindsay LaBrosse, I am a graduate student at the University of Nebraska-Lincoln. For my Master's Thesis I am conducting a study to see if a certain series of lessons will successfully increase the awareness, knowledge and consumption of foods that are high in a certain nutrient. Because you are all high school students under age 18, you are eligible to participate in this study. Your teacher has agreed to let me incorporate these lessons into your regularly scheduled class time.

Participation in this study is completely voluntary, however, your teacher may request that you participate in certain activities that are relevant to this course's material and will be used for grading purposes. If you choose not to participate in the study, any information that may be obtained from you will not be used in the data analysis. For non-required activities, your teacher will provide an alternative activity such as study hall.

If you choose to participate in the study, you will participate in four 30 minute lessons- which will occur during your regularly scheduled classes. There will be one lesson each week for four weeks. In these lessons you will learn about folate, food choices, will get to sample foods, and will work in groups to create short podcasts. The podcasts will be 30-90 seconds each and will be uploaded to a private UNL website, and one will be played for your class each week.

The week immediately before the lessons begin, and one day about 4 months from the first lesson, you will be asked to complete a set of questionnaires. These will also take about 30 minutes to complete each time, and will again be filled out during your regularly scheduled class period.

I am passing out 2 consent forms. One is a parental consent form, which you will need to bring home and have your parent or guardian sign. The other is an assent form, which you will need to sign after your parent signs their consent form. Please bring these signed forms back to your teacher as soon as possible before next week. Again, your participation in this study is optional. If you do not wish to participate, you and your parent(s) do not need to sign the forms. Just bring them back to class and write "I do not wish to participate" at the top.

Does anyone have any questions at this time?

Appendix D

Name _____

Food Frequency
Of Folate-rich Foods

Directions: Please list the approximate number of times you eat the foods listed. For example, if you eat 1 cup of spinach 2 times per month, list 2 in the "times per month" column. Or if you drink 1 cup of orange juice 2 times per day, list 2 in the "times per day" column.

Food Item	Medium Serving	Times per Day	Times per Week	Times per Month	Times per Year	Never Eat It
Category: Fruits and Vegetables						
Spinach (cooked)	½ cup					
Spinach (raw)	1 cup					
Asparagus	½ cup or 4 spears					
Avocado (includes guacamole)	1 medium					
Beets	½ cup					
Broccoli cooked	½ cup					
Broccoli raw	1 cup					
Brussel Sprouts	½ cup					
Green Peas	½ cup					
Lettuce	1 cup					
Corn	½ cup					
Cauliflower (raw)	1 cup					
Tomato Juice	8 fl oz					

Orange Juice	8 fl oz					
Strawberries	8 medium					
Grapes	1 cup					
Cantaloupe	¼ medium					
Banana	1 medium					
Category: Beans and Nuts						
Beans, cooked (Black, navy, pinto, kidney, chick peas)	½ cup					
Lima Beans	½ cup					
Refried beans or bean dip	½ cup					
Baked Beans (like pork n' beans)	½ cup					
Peanuts	2 oz					
Sunflower Seeds	2 oz					
Mixed Nuts (Any of the following: Almonds, cashews, walnuts, hazelnuts)	2 oz					
String Beans	½ cup					
Category: Folic Acid Fortified Products						
Cold breakfast cereal	¾ cup					
Hot breakfast cereal	¾ cup					
Cereal bars	1 bar					
Pasta (Macaroni, spaghetti,	½ cup					

etc.)						
Rice	1 cup					
Bagel	1 medium					
Bread, Roll, ½ English muffin	1 each					
Flour tortilla	1 each					
Crackers	15 crackers					
Waffles	1 each					
	Yes	**No**				
Do you take a multivitamin?						
If yes, how often do you take it? (circle one)	Every day	4-6 times per week	1-3 times per week	Less than once per week	Less than once per month	

Appendix E

USDA Nutrient Database folate content of foods per serving size for assessing FFQs					
Food Item	**Serving size**	**Folate- food (mcg)**	**Folic Acid (mcg)**	**DFE (mcg)**	**Total Folate**
Spinach (raw)	1 cup	58	0	58	58
Spinach (cooked)	½ cup	25	0	25	25
Asparagus (cooked, boiled, drained)	4 spears	89	0	89	89
Avocado	1 each	163	0	163	163
Beets canned	½ cup canned	24	0	24	24
Beets raw	½ cup raw	74	0	74	74
Beets, cooked boiled drained	½ cup	68	0	68	68
Beets- AVG	½ cup	55.3	0	55.3	55.3
Broccoli, raw	1 cup	57	0	57	57
Broccoli, cooked	½ cup	52	0	52	52
Brussel sprouts, cooked	½ cup	47	0	47	47
Peas, canned	½ cup	37	0	37	37
Peas (frozen, prepared)	½ cup	47	0	47	47
Peas- AVG	**½ cup**	**42**		**42**	**42**
Lettuce, Romaine	1 cup	64	0	64	64
Lettuce, iceberg	1 cup	17	0	17	17
Lettuce- AVG	**1 cup**	**40.5**		**40.5**	**40.5**
Corn	½ cup (75 g)	17	0	17	17
Cauliflower, raw	1 cup	61	0	61	61
Tomato juice, canned	6 fl oz	36	0	36	36
Orange Juice (chilled)	8 fl oz	47	0	47	47
Strawberries	8 medium	23	0	23	23
Grapes	1 cup	3	0	3	3
Cantaloupe	¼ medium	29	0	29	29
Banana	1 medium	24	0	24	24
Lima Beans (large, mature seed, canned)	½ cup	60	0	60	60
Baked Beans	½ cup	15	0	15	15
Refried beans	½ cup	66	0	66	66
Black beans (cooked, boiled)	½ cup	128	0	128	128

Navy beans (cooked, boiled)	½ cup	127	0	127	127
Navy beans, canned	½ cup	81	0	81	81
Kidney beans (cooked, boiled)	½ cup	115	0	115	115
Kidney beans (canned)	½ cup	46	0	46	46
Chickpeas (cooked, boiled)	½ cup	141	0	141	141
Chickpeas (canned)	½ cup	80	0	80	80
Pinto beans (cooked, boiled)	½ cup	147	0	147	147
Pinto beans (canned)	½ cup	72	0	72	72
Avg dry beans (black, navy, kidney, chickpea, pinto)	**½ cup**	**132**	**0**	**132**	**132**
Avg canned beans (navy, kidney, chickpea, pinto)	**½ cup**	**70**	**0**	**70**	**70**
Peanuts, raw	2 oz	136	0	136	136
Almonds	2 oz	28	0	28	28
Cashews	2 oz	14	0	14	14
Walnuts	2 oz	56	0	56	56
Hazelnuts	2 oz	64	0	64	64
Avg mixed nuts (almonds, cashews, walnuts, hazelnuts)	**2 oz**	**38**	**0**	**38**	**38**
Sunflower Seeds	2 oz	134		134	134
Green beans, canned	½ cup	24	0	24	24
Green beans, frozen, microwaved	½ cup	7	0	7	7
Green Beans-AVG	**½ cup**	**15.5**		**15.5**	**15.5**
Cold breakfast cereal (cheerios)	1 cup	5	268	460	273
Cereal Bar (Nutrigrain)	1 bar	125		125	125

Pasta- Enriched	½ cup	5	46	83.5	51
Rice- white	1 cup	4	104	180	108
Bagel	1 med., enriched	30	122	237	152
Bread, dinner roll, ½ English muffin- AVG	**1 each**	**9.75**	**13.25**	**31.75**	**22.75**
Bread- white	1 slice	6	22	43	28
Bread- wheat	1 slice	14		14	14
English Muffin	½	11	11	28	21
Dinner Roll	1	8	20	42	28
Flour tortilla	1 med.	4	28	50	31
Crackers (standard snack type)	1 serving	3	16	30	19
Waffles (plain, frozen)	1 each	4	20	38	24
Multivitamin (Centrum, Regular)	1 tablet		400		400

Appendix F

Name _____

How Much Do You Know About Folate and Folic Acid?

1.) Folate is a
- a.) B vitamin
- b.) form of vitamin C
- c.) substitute for vitamin E
- d.) mineral

2.) Folate and folic acid reduce the risk for:
- a.) Spina bifida
- b.) Anencephaly
- c.) Neural tube defects
- d.) All of the above

3.) Women and men ages 15 and older should consume:
- a.) 400 micrograms (mcg) of folic acid everyday
- b.) 200 micrograms (mcg) of folic acid everyday
- c.) 400 milligrams (mg) of folic acid everyday
- d.) 0.4 micrograms (mcg) of folic acid everyday

4.) All of the following are good sources of folate or folic acid EXCEPT:
- a.) a bowl of cereal with 100% of the DV (daily value) of folic acid
- b.) oranges, cooked beans, spinach
- c.) a large glass of milk
- d.) take a multivitamin that includes folic acid

5.) Spina bifida and anencephaly:
- a.) Are neural tube defects
- b.) Are among the most preventable birth defects
- c.) Result in varying degrees of damage to the spinal cord and nervous system
- d.) All of the above

6.) About how many pregnancies are affected by spina bifida and anencephaly each year in the U.S.?
- a.) 100
- b.) 500
- c.) 2,000
- d.) 3,000

7.) In order to help prevent neural tube defects, folic acid must be taken:

a.) After a women discovers she is pregnant
b.) After a woman has her first prenatal visit
c.) Before and during the first few months of pregnancy
d.) During the third trimester

8.) **While the easiest way to get the right amount of folic acid everyday is to take a supplement, it is still very important to eat a healthy diet full of folate-rich foods in order to:**

a.) Prevent health problems such as heart disease
b.) Prevent birth defects
c.) Help your body create red blood cells
d.) All of the above

9.) A woman should be taking folic acid and eating high-folate foods if she:

a.) Is planning a pregnancy
b.) Is capable of becoming pregnant, even if she is not planning a pregnancy
c.) Thinks she might become pregnant sometime in the future
d.) All of the above

10.)It is very important for both men *and* women to eat high-folate foods everyday to promote overall good health

a.) True
b.) False

Appendix G

Name _____

Health Belief Model Questionnaire

Your answers to this questionnaire will remain anonymous. Please answer the following questions honestly, by circling the number that corresponds with your answer.

1= Strongly agree
2= Agree
3=Agree somewhat
4=disagree somewhat
5= disagree
6= strongly disagree

Question	Strongly Agree	Agree	Agree Some-what	Disagree Some-what	Disagree	Strongly Disagree
1.) Improving my diet to include more foods that are high in folate (vegetables, citrus fruit, beans, cereal) could make me feel better and be a healthier person overall.	1	2	3	4	5	6
2.) Eating a diet high in folate would be expensive.	1	2	3	4	5	6
3.) I don't know enough about what foods are high in folate.	1	2	3	4	5	6
4.) I don't like most foods that are high in folate (vegetables, citrus fruit: oranges, grapefruit, strawberries, beans, cereal).	1	2	3	4	5	6
5.) It would be too hard to change my diet to include more foods that are high in folate.	1	2	3	4	5	6
6.) My friends and family would not like the changes in my diet if I tried to eat foods that are high in folate.	1	2	3	4	5	6
7.) I am confident that I could eat a diet high in folate if I tried.	1	2	3	4	5	6
8.) I feel that I would be able to follow a diet high in folate if I wanted to.	1	2	3	4	5	6
9.) An occasional reminder (like a text	1	2	3	4	5	6

message) would help me remember to eat more foods that are high in folate.						
10.) Reading pamphlets or seeing posters about folate would help me remember to eat more foods that are high in folate.	1	2	3	4	5	6
11.) If a friend or someone I know told me about folate, that would help me be sure I get plenty of folate in my diet.	1	2	3	4	5	6
12.) Having a birth defect is a very serious condition.	1	2	3	4	5	6
13.) Having a baby with a birth defect would be very expensive.	1	2	3	4	5	6
14.) Having a baby with a birth defect would negatively affect my social life, my family and my ability to go to school or work.	1	2	3	4	5	6

Males: you may stop here. **Females:** please answer the next four questions that pertain to pregnancy.

Please note that these questions do NOT imply sexual activity- they are meant to assess awareness. Your answers will remain anonymous.

Question	**Strongly Agree**	**Agree**	**Agree Somewhat**	**Disagree Somewhat**	**Disagree**	**Strongly Disagree**
15.) Eating more foods high in folate and folic acid, even if I'm not pregnant, could prevent or reduce my risk of having a baby with a birth defect.	1	2	3	4	5	6
16.) If I do not eat a diet high in folate and folic acid prior to pregnancy and very early in pregnancy, I could have a baby with a birth defect.	1	2	3	4	5	6
17.) If I were to become pregnant, my unborn baby could be sick without my even knowing it.	1	2	3	4	5	6
18.) It is possible to become pregnant and not know it right away.	1	2	3	4	5	6

Appendix H

Name _____

Program Evaluation

Please answer the following questions as honestly as possible according to the scale below. These questions are meant to help us evaluate the folate lessons that were provided to you.

1= Strongly agree
2= Agree
3=Agree somewhat
4=disagree somewhat
5= disagree
6= strongly disagree

Question- **Thinking back to the folate lessons you participated in…**	**Strongly Agree**	**Agree**	**Agree Some-what**	**Disagree Some-what**	**Disagree**	**Strongly Disagree**
1.) I feel like I have learned at least one new concept about folate and health.	1	2	3	4	5	6
2.) The information I learned is important.	1	2	3	4	5	6
3.) I have made at least one change to my diet since learning about folate. (For example, a change could be eating more fruits, vegetables, or eating breakfast more often).	1	2	3	4	5	6
4.) The lessons were a worthwhile experience.	1	2	3	4	5	6
5.) I eat more fruit now than I did before.	1	2	3	4	5	6
6.) I eat more vegetables now than I did before.	1	2	3	4	5	6
7.) I try to include more high-folate foods in my diet now.	1	2	3	4	5	6
8.) I have discovered high-folate food(s) that I enjoy eating.	1	2	3	4	5	6

9.) *Creating* a podcast helped reinforce concepts learned in class.	1	2	3	4	5	6
10.) *Watching* the podcasts in class helped me retain the information longer.	1	2	3	4	5	6
11.) I tried one or more of the foods at home that were sampled in class.	1	2	3	4	5	6

Appendix I

Lesson 1: Intro to Folate (perceived susceptibility and severity)

Objectives:

1. Students will be able to name 5 foods that are naturally high in folate, and recall that many grain products are fortified with folic acid.
2. Students will be able to list 3 functions of folate in the body.
3. Students will be able to list 2 health risks of not consuming enough folate or folic acid.
4. Students will reflect on their own 24 hour diet recall and think of at least 2 times in the day where they could add a high folate food.

Time	What Do I Say?	What Do I Do?	Supplies Needed
	How many of you have heard of folate? Folic acid? Folate is a B vitamin found in "foliage"… Folic acid is synthesized and added to certain foods.		
5 min	When you think of "foliage" what foods come to mind? Let's try to think of as many of these high folate "foliage" foods as we can.	Have students call out foods that are high in folate, and write them on the board. Use power point to show pictures of less popular foods.	Power point slides with pictures of high folate foods. White board, marker.
5 min	How many of you have heard of the food pyramid? Look at our list of high folate foods. Where do most of these fall on the food pyramid? Most fall in the larger areas (formerly the bottom of the pyramid). If we eat a balanced diet and follow the food pyramid, we're more likely to get enough folate to support our body's functions.	On power point slide, show picture of the food pyramid. Draw the pyramid on the board. Shade in the vegetable, fruit and grain areas. Explain that abiding by the food pyramid will help us get enough folate in our diets naturally.	Power point slide with the food pyramid. White board, marker.
10 min	Now we know what folate is and where it's found, but does anyone know why it's so important to our bodies? List functions of folate in the body. Show risks of not getting enough folate. Most pregnancies are unplanned. The neural tube develops in the first couple weeks of pregnancy so it's very important to make sure you're getting enough folate before you become pregnant to avoid having a baby with a NTD.	Ask students why they think folate is important. Then use power point to list actual folate functions. After functions, show risks of not getting enough: NTD's, heart disease.	Power point presentation about folate functions. Show pictures of NTD's.
10 min	I want everyone to think about what	Hand out diet recall	Diet recall sheets w/

	you ate yesterday from the time you woke up to the time you went to bed. Write down everything on the paper provided, no matter how small. Even a piece of gum or candy counts. Now compare your food history to the food pyramid. Place a tally for each food you ate in the corresponding food group of your pyramid. Where do most of your tallies fall? What foods did you eat that were high in folate? I want everyone to think of at least 2 times in their day where they could add a high folate food. (share these ideas as a class). Eating breakfast is one way to ensure that you're eating folate. A bowl of cereal and a glass of OJ is a high folate breakfast.	sheets. Have class share their ideas aloud, write on board.	blank food pyramid White board, marker
5 min	While you fill out your recall sheets, I will be passing out some samples of high folate foods. I encourage you to at least try each of the foods on your plate.	While students are writing their 24 hr recalls, pass out plates of high folate snacks: Hummus, pita bread, carrots (for dipping), cherry tomatoes, and an orange slice.	Mini paper plates, enough food for everyone. Cooler with ice, kept at or below 40°F.

Lesson 2: Food Demonstration Day (self efficacy)

Objectives:

1. Students will be able to identify all 4 high folate ingredients in the burrito.
2. Students will identify 4 other nutrients found in "foliage", and list at least 1 health benefit of each nutrient listed.
3. Students will be able to explain what % daily value means on a food label.
4. Students will be able to locate folate on a food label, and understand that not all foods are required to list all nutrients.

Time	What Do I Say?	What Do I Do?	Supplies Needed
20 min	Last week we talked about folate and why it's so important. What were some of the reasons why our bodies need folate? (quick 1 min review). This week we'll actually be tasting some of the high folate foods we talked about. How many of you like burritos? I encourage you to at least try every item on the burrito bar. Did you like the burritos? Were you surprised that burritos are high in folate? What are some other meal ideas that are high in folate? • Most Mexican foods • Salads: add beans, etc • 3 bean salad	Set up burrito bar. Allow students to go through the line and make a burrito (Do this first so ingredients stay at proper temp). Have students list which ingredients are high in folate, and which are not. Write the answers on the white board. Brain storm high folate meal ideas on the white board. Hand out recipes for high folate meals.	Burrito ingredients: Flour tortillas, beans, rice, guacamole, spinach, cheese, salsa Hot and Cold coolers to hold foods at temp. White board, marker Printed recipes
5 min	Did you know that foods that are high in folate tend to be high in other nutrients too? What are some other nutrients that are found in: oranges, beans, spinach, whole grains? Vitamin C,A,E Fiber What do these nutrients do for our bodies?	Ask students to name nutrients. Show power point slides of nutrients and how they benefit our bodies	Power point slides
10 min	Now we're going to practice identifying nutrients on nutrition labels, so we can know which foods are better choices. This may be review for many of you, but consider it a good refresher. A good way to check if a food is a nutritious choice or not is to compare the calories and fat to the amount of	Pass out example food labels, have students look at them. Post the same label on power point slide.	Food label hand outs. Power point slide.

	other nutrients. I want everyone to look at their labels and find: calories, fat, carbohydrate, sugar, protein. The grams listed may not mean much alone, which is why the %DV is listed on the left. Who knows what %DV means? Based on a 2000 kcal/d diet, that is the % of that nutrient that is being met by eating one serving of the food. Serving sizes. Servings per pkg. Most vitamins and minerals are listed on the bottom. Not all foods are required to have nutrition labels- natural foods like produce. So it's good to know that fruits and veggies are high in vitamins and minerals, and low in fat, sodium		

Lesson 3: Barriers and Benefits

Objectives:

1. Students will comprehend that in order for most people to make changes, the benefits to change need to outweigh the barriers.
2. Students will identify at least 2 benefits and at least 2 barriers to eating more high-folate foods every day.

Time	What Do I Say?	What Do I Do?	Supplies Needed
10 min	Most people need time to decide if they really want to make a change. In our case, the change is eating more foods that are high in folate. While deciding if the time is right to make a change, it helps to weigh out the benefits vs. barriers of making the change. I.e. a list of pros and cons. (Read a story example about someone who wants to stop drinking pop and go to swim practice more in order to be a faster swimmer) Go over benefits and barriers with the class. In order to be healthier, we want to eat more high-folate foods such as vegetables, fruits, beans, nuts and cereal. I want everyone to make a list of their own benefits and barriers to eating high folate foods. Explain that making a change takes time. Taking small, gradual steps is more likely to lead to success. Try adding just one or two high folate foods to your diet each day.	Read story. Write benefits and barriers on white board. Ask everyone to write down their benefits and barriers. Share with class. Write on board. Try to make it so there are more benefits than barriers.	White board, marker. Story.
10-15 min (as long as time permits)	Now we're going to play a game. Folate Jeopardy! (This is a good review of everything we've talked about, and serves as a reminder to eat more folate)	Using either the white board or a power point, make a jeopardy board. Go around the room and have students pick and answer questions. Prizes optional: Give away cereal bars (non-perishable, high folic acid).	Prepared jeopardy board and questions.
5 min	Introduce next week's lesson: Podcasts. Next week we will be working on computers to make podcasts. Has	Divide class into 8 groups. Their assignment for next week will to come up with an outline for their	

	anyone heard of or had experience making podcasts? We will work on these in groups (divide class to include 12 groups, one for each remaining week) In your podcast, I want you to include benefits to eating folate and folic acid, and what some of the sources are. These will serve as reminders over the next 8 weeks. Try to "sell" your point of eating more folate by making it like a commercial. Include pictures of high folate foods. Please make sure pictures are appropriate for class. These should be 30-90 seconds each. I want everyone to think about this over the next week, so when we work on these we can get them finished quickly and posted online.	podcast.	

Lesson 4: Podcasts (Cues to Action)

Objectives:

1. Students will create podcasts to be used as cues to action (reminders) to eat more high-folate foods.

Time	What Do I Say?	What Do I Do?	Supplies Needed
30-45 min	Today we will be working on computers to make podcasts. Has anyone heard of or had experience making podcasts? We will work on these in groups (divide class to include 11 groups, one for each remaining week) In your podcast, I'd like you to include benefits to eating folate and folic acid, and what some of the sources are. These will serve as reminders over the next81 weeks. Try to "sell" your point of eating more folate by making it like a commercial. Include pictures of high folate foods. Please make sure pictures are appropriate for class. These should be about 1 minute each.	Divide class into 8 groups. Lead class to computer lab. Walk students through the steps of creating a podcast	Computer lab with microphones Website for podcasts
		Have students save podcasts to a flash drive. Upload to secure UNL website or save to teacher's hard drive.	

Appendix J

Name: _____

24 Hour Food Record

Think about what you ate yesterday, from the time you woke up to the time you went to bed. Record EVERYthing you ate, no matter how small you think it may be. Then for each food recorded, put a tally mark on your food pyramid. For example, if you had 2 waffles, syrup and a banana for breakfast you would put 2 tallies in the grain group, one in the sweets, and one in the fruit group.

Time of Day	Food	Amount Eaten
Early morning/Breakfast		
Mid-morning		
Lunch Time		
Afternoon (any time between lunch and dinner)		
Dinner		
Evening/night time snacks		

Food Pyramid

Please place a tally for each food on your food record into the corresponding food group section.