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Technology and Nutrition: A New Way for Children to Learn

Technology and Nutrition: Interactive Strategies for Children to Learn Nutrition

Nicole Bogden

Western Michigan University

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Abstract

This manuscript aims to describe nutritional requirements and needs for children and how technology is being used to improve nutritional knowledge among them. Several technologies and applications are explored, and recommendations are given for ways to improve. Four interactive nutrition games for children are examined: two computer games and two mobile applications. Through revision of performance, nutrition content, attraction, design and attention capabilities, *HealthyHeroes* was chosen to be the best game for children to learn and have fun with the subject of nutrition.

Introduction and Purpose

Nutrition is one of the many important aspects of life. Without adequate nutrition, the human body and brain do not thrive, but succumbs to illness and disease. As the world advances in inventing processed foods, children are not getting the proper amount and quality of nutrition they need for optimal health (Bell, Rogers, Dietz, Ogden, & Schuler, 2011). “The unhealthy condition that results from not eating enough food or not eating enough healthy food” is known as malnutrition (Merriam-Webster, 2015a). Out of 74.5 million children in the United States, 12.5 million children are affected by obesity (Bell, Rogers, Dietz, Ogden, & Schuler, 2011; ChildStats.gov, 2012). Obesity can lead to children developing disorders such as hypertension, high cholesterol, and diabetes. Undernourishment is also categorized as malnutrition, and there are 15.8 million children that do not get enough nutrients they need (Feeding America, 2015). It is significant for children to learn what nutrients are beneficial for their body, that way they can independently start eating good quality foods. Once children understand proper nutrition, the rate in obesity with children has a chance to decrease and hopefully diminish (Bell, Rogers, Dietz, Ogden, & Schuler, 2011).

Children use technology in different formats for school, communication, social media, and entertainment. With technology and interactive gaming, children can learn what kind of nutrition they need in order to attain excellent health. In the Grunwald study of technology use among children aged 3-18 years, 2,392 parents participated and provided information about technology ownership and children’s usage patterns. The portable computer had the highest ownership and daily use, followed by the smartphone, tablet, iPod Touch and e-reader (see Figure 1) (Grunwald Associates, Learning First Alliance & AT&T, 2013).

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Figure 1. Family Technology Ownership and Child Use, Pre-K-12

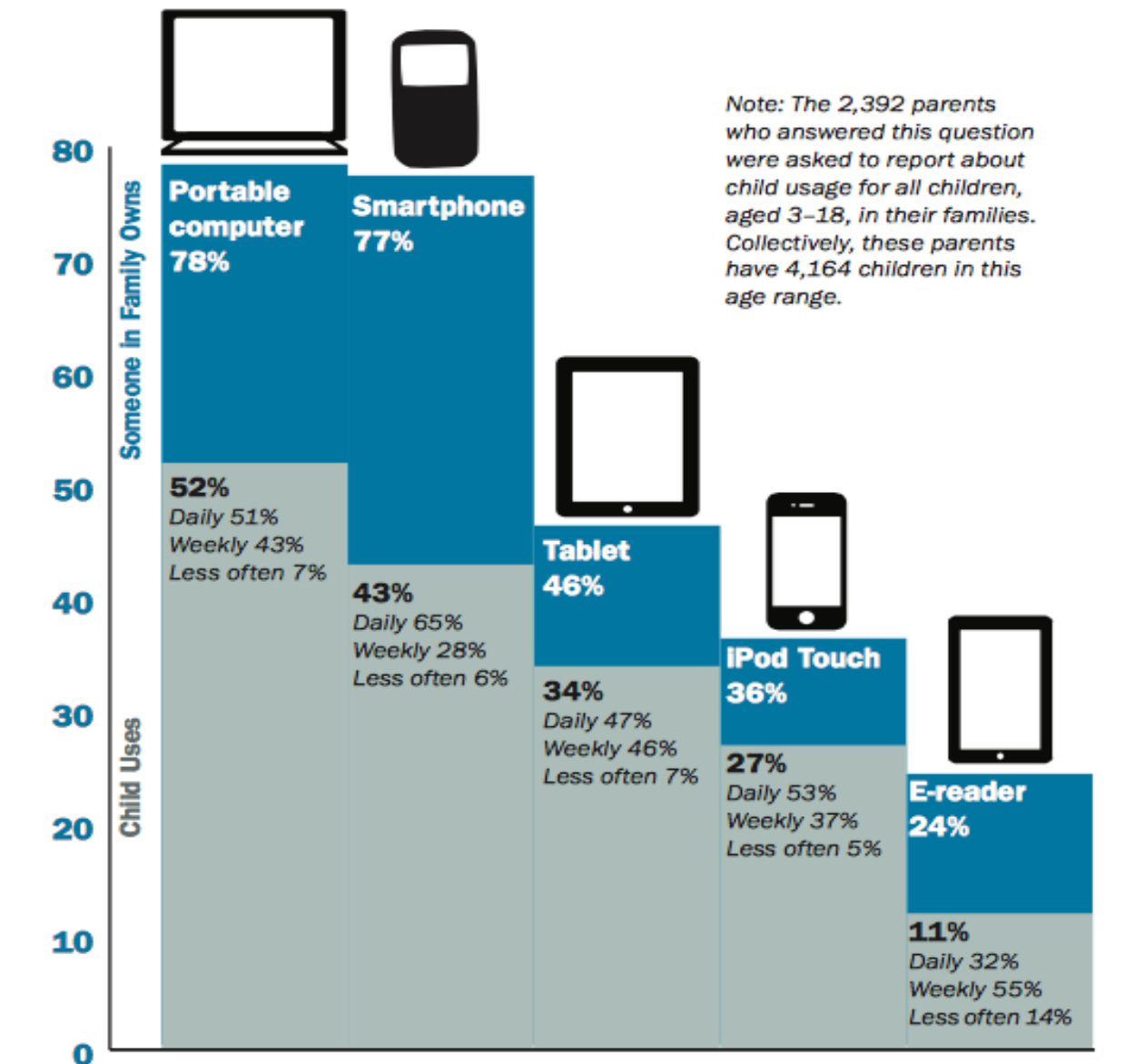


Figure 1. “Child Uses” appears in gray on the bottom while “Someone in Family Owns” is at the top in blue. The devices are listed from highest to lowest for family ownership and children. Percentages in black indicate the average use among all children, with further breakdowns according to daily, weekly and less than weekly usage. Adapted from “Living and Learning with Mobile Devices,” by Grunwald Associates, Learning First Alliance, & AT&T, 2013. Grunwald Associates LLC, p. 6.

Media consumption will only continue to expand, as additional technological tools are developed. This means that as more mobile devices and other technologies are available,

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children will desire to use these devices. More than 4 out of 5 children (82%) use mobile and/or portable devices (Grunwald Associates, Learning First Alliance & AT&T, 2013). Mobile phones and devices have applications that have interactive capabilities for children such as touching, reading, thinking, writing, speaking, and can catch children's attention easily. Touch screens, in contrast to keyboards, are a more natural way to use the fingers to interact with technology; so most children like to use the iPod Touch to download and play with applications and games (Hoover, 2013). Game designers have taken advantage of this and have created applications for children such as Angry Birds and Doodle Jump (Fisher, 2014).

Technology is ubiquitous in children's environments and creates a flexible approach for learning in classrooms, homes and many other environments. Since mobile devices are portable, informative and stimulating, children can interact with them in multiple ways to learn important information on subjects such as nutrition. Mobile devices can be stimulating by providing learning activities such as physical exercise games and participatory simulations (Druin, 2009). Learning through innovative technology is likely to have positive effects on social health (Lu, Kharrazi, Gharghabi, & Thompson, 2013). Teaching children nutrition through interactive gaming is a very effective way to provide children with the knowledge of what to eat, how much to eat, and most importantly, how to live a healthy life (Thai, Lowenstein, Ching, & Rejeski, 2009). The main purpose of this paper is to describe how nutritional education and mobile technologies can be combined to promote learning among children.

Background

Nutrition is defined as "the process of eating the right kind of food so people can grow properly and be healthy" (Merriam-Webster, 2015b). The purpose of taking in proper nutrition is to stay healthy and replenish nutrients used by the body for daily growth and functioning. The

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consumption of necessary nutrients to meet the body's needs contributes to optimal cognitive, physical, social and emotional growth (Gómez-Pinilla, 2008). Therefore, it is important that children get proper nutrition to succeed in their academic performances. If the essential nutrient intake is balanced in children, their health will be optimal and will provide a healthy foundation for their future health (Gómez-Pinilla, 2008).

Nutritional professionals have come to believe that nutritious foods consisting of whole grains, lean meats, and fruits and vegetables are accessible to all Americans, regardless of household income (Drewnowski & Eichelsdoerfer, 2010). However, important factors influence the ability to acquire balanced nutrition such as socioeconomic status and geographic location. Frequently when a parent's income declines high quality foods need to be eliminated or reduced from a child's diet (Drewnowski & Eichelsdoerfer, 2010). There are 14.7 million children that live in poverty and suffer from a low socioeconomic status (Feeding America, 2015).

Genetic predispositions also affect on how the body metabolizes nutrient intake and can lead to malnutrition because the body cannot absorb the essential nutrients (Saunders & Smith, 2010). For example, when a mother is pregnant and has poor nutrition, it will affect the child as it grows (Terre des hommes, 2011). If a mother does not eat properly during pregnancy, the fetus' body is exposed to nutritional deficiencies and may develop serious diseases.

Malnutrition has been an undertreated and under-recognized issue for a long period of time (Saunders & Smith, 2010). In the United Kingdom (UK), an unstated amount of hospitals reported that in the last 15 years patients have had a decline in their nutritional welfare. This decline in nutrition may happen when they are in the hospital for treatment of malnutrition or from an incident such as a bowel infarction (Saunders & Smith, 2010).

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The prevalence of malnutrition has increased in hospitals, because the clinicians treating these patients have not been fully aware that malnutrition with different disorders needs to be treated with specific nutritional requirements. As a result of inadequate treatment, the mortality rate for these patients is increasing (Saunders & Smith, 2010). This study found that the deficiencies occur in the micronutrients, especially for children. Globally many children consume inadequate amounts of micronutrients such as folic acid, iodine, iron, Vitamin A, and zinc. These deficiencies can be a leading cause of disease, debility, developmental delays and death (Project Healthy Children, 2012). It should be every clinician's responsibility to provide the appropriate nutrients for patients with complex nutritional needs (Saunders & Smith, 2010). Once this happens, nutritional health will improve (Saunders & Smith, 2010).

Patients in the UK who have been tested for malnutrition in the past took the Malnutrition Universal Screening Tool (MUST). The MUST screening tool incorporates the patient's body mass index (BMI), unintentional weight loss, and projected future weight loss to prevent the patient from developing a worse state of malnourishment (Saunders & Smith, 2010). The MUST screening tool also assesses parenteral nutrition (PN), which is a nutritional supplement administered intravenously for patients whose nutritional needs are not met by oral intake (Saunders & Smith, 2010). Clinicians rescreen patients who receive parenteral supplementation at seven-day intervals for nutritional wellness (Saunders & Smith, 2010).

Along with assessments, clinicians have taken certain initiatives to improve dietary care. One published initiative is the Nutrition Action Plan, which helps raise awareness, provides guidance, promotes screening and training, and clarifies standards to improve nutritional attention (Saunders & Smith, 2010). These initiatives cannot only identify and improve the nutrition status of children, but they can help clinicians inform health care systems around the

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world of the need for improvements in the treatment of malnutrition (Saunders & Smith, 2010). Once the awareness of malnutrition is spread, nutritional care could be on its way to being a major advancement in hospitals.

Society is so technologically advanced it is hard to imagine living without it years ago. In the past, only paper documentation was used in health care settings, but now hospitals are set up to be far from an only paper process. In the 1960's, the main influences that drove healthcare were Medicare and Medicaid (Grandia, 2015). The mainframe computer systems used by these organizations were expensive, shared and huge (Grandia, 2015). Another way to improve nutritional care in children is through the use of technology as discussed in the next section.

In the 1970's, computers became smaller and more efficient, but were only used in work environments and not available to the public yet (Grandia, 2015). In the 1980's, hospitals began using computers to facilitate coding of diagnosis-related groups (DRG) and to seek reimbursements from government agencies. Health care providers needed information from clinical and financial systems in order to be reimbursed, so the healthcare drivers were very useful (Grandia, 2015). In the 1990's, the pressure for healthcare competition kept rising, so access to computer systems and networks created the process of uniting hospitals, providers and managed care together. An Integrated Delivery Network (IDN) was created to group data and reporting together (Grandia, 2015). Finally, in the 2000's technology was available for healthcare workers dealing with clinical applications. This helped improve real-time clinical decision support (Grandia, 2015).

Today, children of modern society are being born into the "digital generation", where they are surrounded by technology such as televisions, computers, video games and mobile devices. Many toys appropriate for young infants contain different types of technology.

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Technology is used by parents to calm, distract and educate their children (Allday, 2013).

Explosive growth has occurred in the use of technology to help children develop critical thinking skills to solve daily life problems (Allday, 2013).

Technology is being used to help develop attention skills in children and to teach them how to focus and improve memory, learn language, broaden creativity and strengthen problem-solving abilities (Taylor, 2012). Popular technology games that focus on these areas are Captain's LogAhoy!, Play Attention, SmartDriver Plus, and S.M.A.R.T BrainGames (Hodges, 2015). There are especially beneficial for children with attention deficit disorder (Hodges, 2015). Mobile devices can also be motivating learning tools since the child has to discover information on their own and figure out different forms of "information flow" (Druin, 2009, p. 15).

Video games and other screen media are very popular. Research has shown that technologies such as video games can help children become more visual, focused, quicker in reactions and detail oriented (Taylor, 2012). Children with developed skills such as these can become independent learners (Druin, 2009, p. 15).

However, there are still some consequences to technology and gaming. One consequence of technology and the Internet is that users may become very skilled in finding resources and information, but less skilled in memorizing information (Taylor, 2012). Another consequence is that technology distracts children away from daily life activities. Therefore, it is important to monitor a child's usage on the mobile device and make sure the child interacts with the world around him/her (Druin, 2009, p. 14).

The future for children and technology is very optimistic because of the vast array of learning approaches facilitated by technology. Since technology is changing the way children think in beneficial ways, teachers and parents should create teaching lessons where technology is

added into teaching structures. Issues such as the learning of nutrition for children, could be made easier by creating teaching methods to adapt to the technology's capability. Once the two are joined, the teaching and retention of nutrition will be improved (Allday, 2013).

Literature Review

According to Benton (2010) and Raush (2013), nutrition has an effect on cognitive abilities of children. Benton studied children under 2 years of age, since the brain grows rapidly and is vulnerable to an inadequate diet (Benton, 2010). He studied these children in developing countries such as Southeast Asia and Africa. Raush studied 5,398 children ages 6-16 in the United States to find the relevance between dietary intake and academic performance (Raush, 2013). It was found by Raush that when given poor nutrition, a child's academic performance could be in jeopardy (2013). In school, children are expected to do well on their tests and receive a competitive grade point average (GPA). This is why parents and caregivers are encouraged to provide children key nutrients, since these nutrients could have an effect on a child's life for a long period of time (Raush, 2013).

Benton (2010) and Raush (2013) agree on the fact that nutrition plays a key role in behavior. If a child eats breakfast everyday in the morning before school, not only will his/her memory improve, so will their glucose tolerance, attention span and time management (Benton, 2010). Meals with glucose are very essential in the morning since the brain feeds off carbohydrates. Therefore, it is important to focus more on consuming nutrient rich foods and less on the poor nutrient foods, such as "fast food" (Raush, 2013).

A third agreement Benton (2010) and Raush (2013) have is the effects of junk food. "Junk Food", is defined by Raush as "unhealthy food", such as foods that are high in fat and cholesterol (Raush, 2013). Both authors believe that when a child is malnourished at a young

age, there is a negative effect on brain development. For example, in the United States, many Americans consume a diet high in fatty foods. It is beneficial to consume some fat, but the consumption of polyunsaturated fatty acids (PUFAs) does not enhance a child's performance in school (Raush, 2013). Brain development from protein, fat, carbohydrates, vitamins and minerals (Benton, 2010). Therefore, the consumption of these necessary nutrients is vital to developing a healthy brain.

The comparison of Gale, et al. (2009) and Gewa, et.al (2009), two different studies, shows agreement that cognitive function is improved by fortification of children's diets with micronutrients. Gale, et al. studied in Southampton, UK, 241 children four years of age but assessed their diet intake at 6-12 months of age. He measured the four year olds' intelligence, visual attention, visuomotor precision, science repetition, and verbal fluency with the Developmental Neuropsychological Assessment (NEPSY), and visual form-constancy with the Test of Visual Perceptual skills (Gale, Martyn, Marriott, Limond, Crozier, Inskip, Godfrey, Law, Cooper, Robinson & the Southampton Women's Survey Study Group, 2009). Using various assessment tools, Gewa, et.al (2009) found that children with adequate consumption of micronutrients had a higher IQ and improved memory performance. One study in Kenya evaluated the dietary iron (Fe), zinc (Zn) and B vitamins in the years 1998 through 2000, and focused on first graders from twelve selected schools (Gewa, Weiss, Bwibo, Whaley, Sigman, Murphy, Harrison, Neumann, 2009). The results showed that the presence of these nutrients (Fe, Zn and B) resulted in improvement in childrens' test scores (Gale et.al, 2009). One difference between this study and the Gale, et.al (2009) study is the fundamental age of the children. In the Gale, et.al (2009) study, the authors studied children of three different ages, while Gewa's study targeted an unknown number of first graders who were of various ages.

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Participants in both studies were assessed for two different food intakes and participated in recall interviews. Gale et.al., (2009) food assessment and dietary pattern analysis were more descriptive, having the first group of foods being vegetables, fruit, meat, fish, home-prepared foods, breast-milk, baby foods and milk formula. The second group consumed bread, snacks, biscuits, squash, breakfast cereals, potato chips, breast milk and baby rice. Gale, et.al (2009) selected these foods from home visit interviews, asking food frequency questionnaires and portion sizes. The authors used 6-month old infants for the first group and 12-month old infants for the second group. The two different age groups were selected to provide a cognitive function follow-up with the children as 4-year olds (Gale et.al, 2009). Their findings showed that the 6-month olds consumed more fruit, vegetables and home-prepared foods. The 12-month olds consumed the snacks, processed meat, squash and potato chips the most (Gale et.al, 2009). This study showed that when infants are exposed to 'adult food' patterns, they are less likely to eat as well and that can inhibit their cognitive improvements (Gale et.al, 2009). A second finding showed that when the 6-month olds consumed the fruit, vegetables and home-prepared foods, they had a higher IQ than the 12-month olds who ate snacks and processed meat (Gale et.al, 2009). A limitation to this study was that the women who participated with their children belonged to high class, educated families and breastfed their child (Gale et.al, 2009).

For Gewa, et al.'s (2009) food intake assessment, the children were given mixed dishes made at home and some snacks. Recall interviews, recording snack records at school and snack intake from each study child were assessed. The mothers made the mixed dishes to standard recipes rich in Fe, Zn and B vitamins (Gewa et.al, 2009).

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Overall, these two studies showed that natural and unprocessed foods are the best for children to consume, for they contain the highest and most beneficial nutrients for health, growth, development and school performance.

Some essential nutrients that belong on the meal plate are carbohydrates, proteins, and fats. Carbohydrates are mainly composed of sugars and starches (Institute of Medicine of the National Academies, 2005). They provide energy to cells in the body, especially the brain. The brain mostly thrives on carbohydrates, so this nutrient is essential for learning and memory development. The recommended carbohydrate intake for children is 130g a day (Institute of Medicine of the National Academies, 2005).

Proteins are an essential nutrient that the body needs. Proteins provide structure to the body and function as enzymes, carrier proteins and hormones (Institute of Medicine of the National Academies, 2005). Amino Acids are components of proteins. One protein consists of nine amino acids. The recommended amount of protein consumption is 0.8 grams per kilogram of body weight per day (Institute of Medicine of the National Academies, 2005). For children ages 3 to 5, 31 to 40 pounds (14 to 18 kg) is the normal average weight range. Children ages 5 to 10 have the normal weight of 40 to 70 pounds (18 to 32 kg) (Disabled World, 2014). For children ages 9 and older it is necessary to have 1.5 g of protein per kg weight per day (Delimaris, 2013). Meanwhile, ages 4 to 8 must have at least 19 grams per day, ages 1 to 3 must have 13 grams per day and infants must consume 9.1 to 11 grams daily (Coleman, n.d.)(b).

The main source of fuel the body relies on is fats. The most essential fatty acids are polyunsaturated fatty acids. N-3 Polyunsaturated fatty acids (Omega-3) take the role of being structural membrane lipids in nerve and eye tissue. They also help metabolize n-6 polyunsaturated fatty acids (Omega-6), which are also fundamental to the human body (Institute

of Medicine of the National Academies, 2005). These two polyunsaturated fatty acids together create a balance that provides the most energy bodies can absorb and maintain.

The body will store fats in order to have energy to meet demands placed on the body. Some fats that are synthesized by the body are saturated fatty acids, monounsaturated fatty acids and cholesterol. These fats are non-nutritious and have little known beneficial value for the body. Therefore, they are not required to be in the human diet (Institute of Medicine of the National Academies, 2005). The main cells that store fat are called adipocytes, which turn the stored fat to use as energy for the body (O'Keeffe, n.d.). Fats also create two times more potential energy than protein or carbohydrates, but mainly fuel low to moderate long activities since it produces energy at a slower rate (Eberle, Widmayer, & Breer, 2014). Fats and carbohydrates combined make the best energy. Children ages 4 to 8 need 33 to 78 grams of fat each day, and ages 9 to 13 need 39 to 101 grams of fat each day (Coleman, n.d.)(a). Below is what all three micronutrients together should look like on a meal plate (see Figure 2).



Figure 2. Note that there are 30 percent of proteins, 30 percent of fats and 40 percent of carbohydrates. Adapted from “Calories, Fat, Carbs & Protein Per Day” by *The Science of Eating*, 2014.

Other important micronutrients that the body requires are vitamins and minerals.

Vitamins are crucial micronutrients that have important functions in the human body. They are separated into two groups, water-soluble (B-complex and C) vitamins and fat-soluble (A, D, E, K) vitamins (Bellows & Moore, 2012b; Bellows & Moore, 2012a).

Vitamin A has an extensive role with bone growth, tooth development, reproduction, cell division, gene expression and the immune system (Bellows & More, 2012a). Wholesome food choices for vitamin A are dairy products, orange or dark green fruits and vegetables, fish and liver. Not only does vitamin A moisturize the body, but helps prevent cancer as well. Children

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are recommended to take 400 micrograms retinol activity equivalents of vitamin A every day (BabyCenter Medical Advisory Board, 2013e).

Vitamin D helps with the body's use of calcium and phosphorus to create strong bones and healthy teeth. Foods that have vitamin D are milk, fish oil, and dairy. The body synthesizes vitamin D from sunlight exposure as well. Children should get 400 IU of vitamin D each day (BabyCenter Medical Advisory Board, 2013g).

Vitamin E works as an antioxidant, lowering the risk of illness, disease and cancer (Bellows & Moore, 2012a). Vegetable oil, fruits, vegetables, grains, nuts, sunflower seeds and cereals are good sources of vitamin E. Children ages 1 to 3 need 6 milligrams of vitamin E and children ages 4 to 8 need 7 milligrams (BabyCenter Medical Advisory Board, 2013h).

Vitamin K helps with blood clotting, bone health and protein production for blood, bones and kidneys. Green or leafy-vegetables, vegetable oil and animal products have vitamin K in them (Bellows & Moore, 2012a). Children ages 1 to 3 should get 30 micrograms and 4 to 8 year olds should get 55 micrograms a day (Connolly, 2014).

There are eight B-complex vitamins: thiamin (vitamin B1), riboflavin (vitamin B2), niacin (vitamin B3), pyridoxine (vitamin B6), folic acid, vitamin B12, biotin and pantothenic acid (Bellows & Moore, 2012b). B-complex vitamins help energize the body, support a well-balanced appetite, good vision, healthy skin, and help maintain the nervous system and red blood cell formation. Cereal grains, meat, poultry, eggs, fish, milk, legumes and vegetables contain B-complex vitamins. Children should get 900 mcg of thiamin, 900 mcg of riboflavin, 12 mg of niacin, 1 mg vitamin B6, 300 mcg of folic acid, 1.8 mcg of vitamin B12, 20 mcg of biotin and 4 mg of pantothenic acid every day (Drake, 2011).

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Vitamin C is necessary for healing injuries, bone formation, strengthening blood vessel walls, immune system improvements, increased absorption of iron and acts as an antioxidant (Bellows & Moore, 2012b). Consuming citrus fruits daily can fulfill the body's need for vitamin C. Ages 1 to 3 need 15 milligrams daily and ages 4 to 8 need 25 mg of vitamin C daily (BabyCenter Medical Advisory Board, 2013f).

There are five types of minerals that the body needs: calcium, iron, magnesium, potassium and zinc. Calcium is necessary for strong bones and teeth, and the functioning of blood vessels, muscles, nerves and hormones (Radcliffe, 2014). Calcium is in dairy, vegetables, tofu, cereal and juice. Children ages 1 to 3 need 700 mg per day and children ages 4 to 8 need 1,000 mg a day (BabyCenter Medical Advisory Board, 2013a).

Iron is necessary for development of red blood cells and hemoglobin, which is a protein that oxygenates the tissues. Iron is found in meats, poultry, fish, beans and lentils (Radcliffe, 2014). Having an iron deficiency is called anemia. Anemia causes weakness and fatigue, so children with this deficiency can have difficulty performing in school. Children ages 1 to 3 need 7 milligrams and children ages 4 to 8 years need 10 mg daily (BabyCenter Medical Advisory Board, 2013b).

Magnesium helps control blood glucose levels, blood pressure, muscles, nerves, and protein construction (Radcliffe, 2014). The best foods to eat for a substantial amount of magnesium are legumes, nuts, seeds, whole grains, and green vegetables. The recommended amount for children ages 1 to 3 is 80 mg and for ages 4 to 8 it is 130 mg daily (BabyCenter Medical Advisory Board, 2013c).

Potassium is excellent for muscle contraction, heart functions, operating nerve signals, and turning carbohydrates into energy sources. Bananas, potatoes, plums, orange juice and

vegetables all are high in potassium (Radcliffe, 2014). The recommended amount for children ages 1 to 3 is 3,000 mg per day and 4 to 8 year olds should take 3,800 mg per day (BabyCenter Medical Advisory Board, 2015d).

The last necessary mineral is zinc. Zinc is important to the body because it helps regulate the body's metabolism. Zinc is also necessary for protein synthesis, immune system functions, wound healing, DNA synthesis, and fetal growth in women who are pregnant (Radcliffe, 2014). Oysters, red meat, poultry, nuts, beans, whole grains and dairy products contain excellent sources of zinc. Children ages 1 to 3 need 3 mg per day and ages 4 to 8 need 5 mg of zinc per day (BabyCenter Medical Advisory Board, 2015i). The diagram below displays how each mineral contributes to bone health, one of the many benefits of consuming minerals for the body (see Figure 3) (Immunotec, 2015).

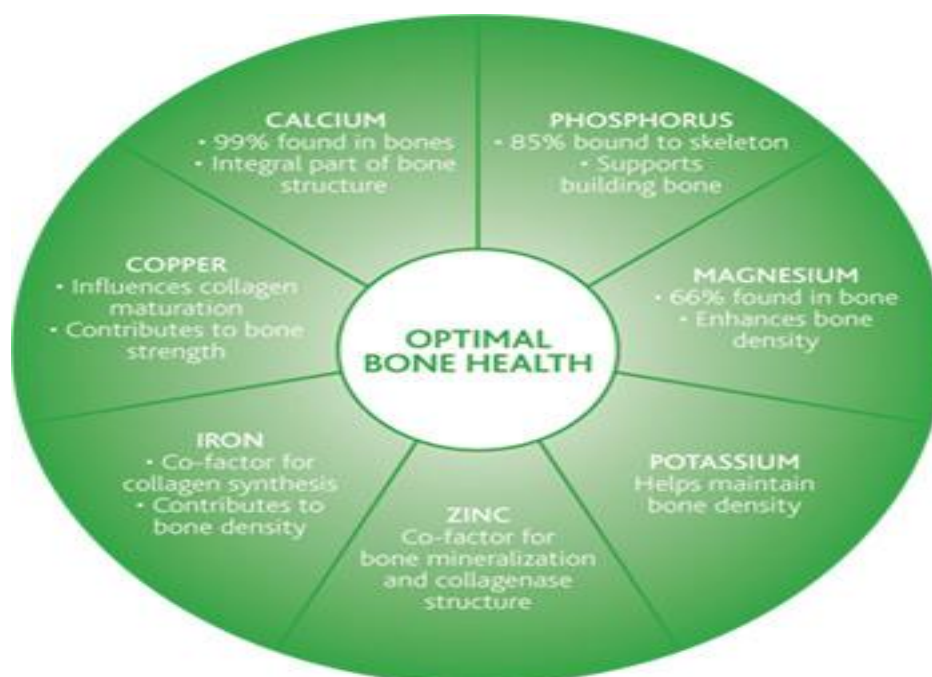


Figure 3. The diagram is represented to show how calcium, phosphorus, magnesium, potassium, zinc, iron and copper make up all parts of healthy bones. Each micronutrient takes a part in making the whole optimal picture. Adapted from *Immunotec*, 2015.

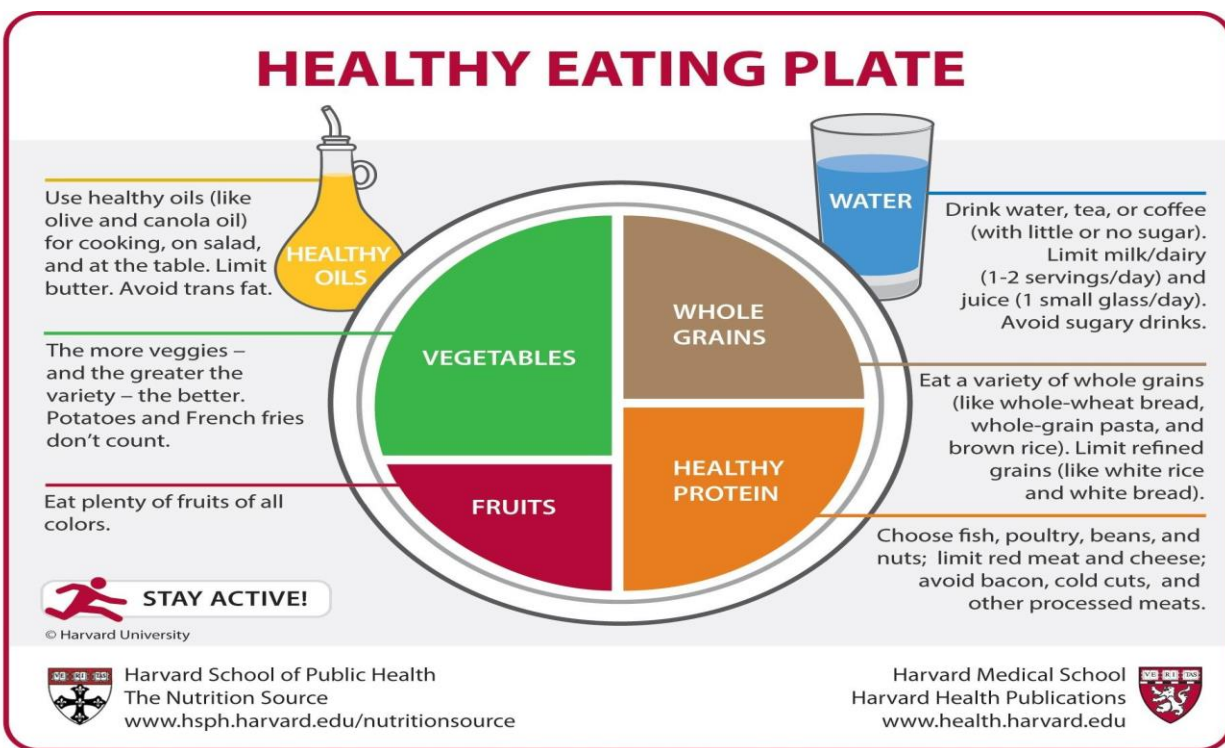
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In order for the human body to flourish nutritionally, eating foods that contain the essential nutrients are critical. Learning what sources of foods are optimal for nutrition and required quantities is the next important step when selecting what to buy and what to eat. Creating balanced nutrition starts with food portions on a plate. Below are the general recommendations of nutritious items to eat or drink.

Vegetables should represent the biggest portion of a meal and consist of a variety of foods. Following that are whole grains and proteins, which should be equal on a plate. Anything that is whole-wheat or whole-grain is sufficient to eat, but white grains should be limited (Harvard School of Public Health, 2015b). It is suggested that white grains be limited to only being used 3 times a week (Lipinski, 2003). Healthy protein consists of fish, poultry, pork, beef, beans, and nuts. It is advised to limit red meat and cheese and to not eat bacon, cold cuts, or processed meats (Harvard School of Public Health, 2015b). Fruits and healthy oils are also essential for children to consume. Last, it is important to drink water; researchers from Australia found that children ages 5 to 8 should drink five glasses of water. Children ages 9 to 12 years old should 7 glasses and ages 13 and up should have 8 to 10 glasses (Healthy Kids, 2015). It is advised to avoid sugary drinks as much as possible (Harvard School of Public Health, 2015a).

Below is what is called the Healthy Eating Plate, which shows what food groups, beverages and other types of dietary necessities need to always be on a food plate (see Figure 4) (Harvard School of Public Health, 2015b). Although the plate explains what foods to eat and

limit from each food group, it does not give specific portions.



*Figure 4. Note that there are vegetables, fruits, healthy oils, whole grains and healthy protein that make up a food plate. Water is also important to drink during meals. Adapted from “The Nutrition Source,” by Harvard T.H. Chan School of Public Health, 2015b, *Harvard T.H. Chan School of Public Health*.*

On choosemyplate.gov, there are daily food plans available for people of all ages. For example, a 6-8-year-old child who does 60 minutes of exercise a day was chosen to illustrate how many portions of each food group they should have (see Figure 5) (2015). This 8-year-old female that has an average height and weight has a food pattern of at least 1800 calories. It is recommended for them to get at least six ounces of grains a day, with at least three ounces of whole grains a day (ChooseMyPlate.gov, 2015). Two and a half cups of vegetables should be eaten every day, and vegetables types such as dark green, red and orange, beans and peas, starchy and other veggies should be eaten weekly with at least one to five and a half cups

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(ChooseMyPlate.gov, 2015). One and a half cups of fruit, two and a half cups of dairy and five ounces of protein should also be consumed per day. Since oils are important, an 8 year old should have only five teaspoons a day. Empty calories on the other hand, such as extra fats and sugars should be limited to 160 calories per day (ChooseMyPlate.gov, 2015). Sodium should also be reduced to 2300 mg a day (ChooseMyPlate.gov, 2015). A picture example is placed below (see Figure 5).

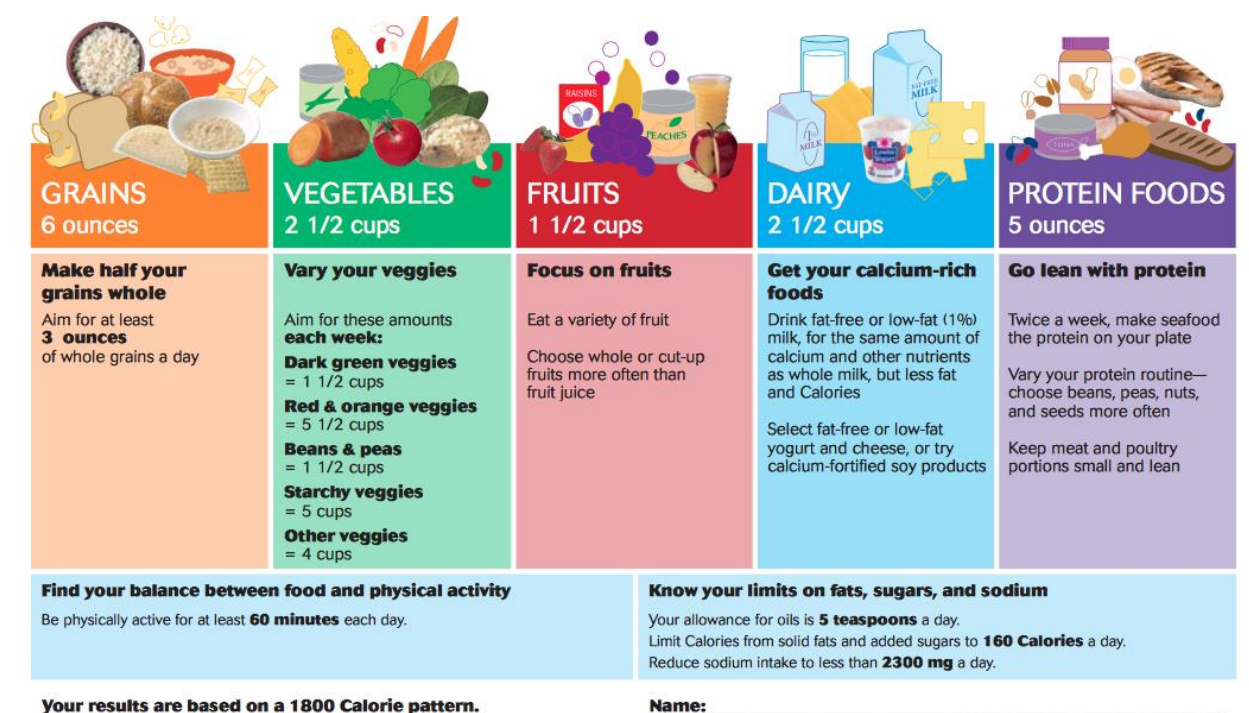


Figure 5. Grains, vegetables, fruits, dairy, and protein foods organize the daily food plans by information on portions. Information on what to limit and balance is also provided. Adapted from “Daily Food Plans” by ChooseMyPlate.gov, 2015, *United States Department of Agriculture*.

There are many methods to acquire proper nutrition. However, a huge problem in society is that children are seldom taught how to read nutrition labels (U.S Food and Drug Administration, 2014). Additionally, children can be encouraged from society, family and friends to eat food that is not healthy and portion controls are not monitored (U.S Food and Drug

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Administration, 2014). It is only as children mature, that an interest emerges on being or becoming healthy.

When teaching children how to read nutrition labels, the first thing they should be taught is how to read the serving size. The serving size explains how many servings there are and how big each serving is in relation to cups or pieces (U.S Food and Drug Administration, 2014). A major thing most consumers do not know is that all of the nutrition information is based on *one serving* (U.S Food and Drug Administration, 2014).

The next section regarding food labels is the total amount of calories, calories from fat, and the percent daily value. The daily values on food and drink products are based on a 2,000-calorie diet, so it is important to choose foods that have high nutrients instead of the ones that are low. Total fat, saturated fat, trans fat, cholesterol, and sodium are all nutrients that should be kept at a minimum, because they can lead to obesity and cause heart disease, cancer, and high blood pressure (U.S Food and Drug Administration, 2014). Ingredients are listed in order of amount. Therefore, it is important to buy or eat foods that have healthy ingredients listed first (U.S. Food and Drug Administration, 2015).

Children should know different methods on how to acquire nutrition. Some excellent methods are to broil, bake, grill, roast and steam foods instead of frying them. Fried foods have a lot of fat and calories and therefore should be avoided. Fast foods should also be limited, since they consist of deep-fried and fatty foods (U.S. Food and Drug Administration, 2015). Breakfast is the first step daily towards obtaining proper nutrients. Eating breakfast is the key source of energy necessary for learning, so consuming healthy foods in the morning will fuel cognitive abilities. It is very important to eat slowly, and when one has had enough, to stop eating. Parents should be active role models when it comes to eating healthy. Always choose wholesome foods

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and encourage children to try new healthy ones (Centers for Disease Control and Prevention, 2014).

All of these requirements can be achieved when a family eats at a table. When everyone is together, they can learn how and what to eat together. This is essential for parents, for they can watch how their child eats and can give him/her tips on how to eat better. Taking a child to the grocery store is also beneficial for teaching a child how to pick healthy nutritious foods. Learning about nutrition is a bonding experience for families, and a learning experience for children.

Technology

Ever since the start of the 21st century, technology has influenced how people learn and love. In technologically advanced societies, 8 to 18 year olds spend an average time of 7 hours and 38 minutes on electronic media everyday (The Henry J. Kaiser Family Foundation, 2010). This results in children spending more than 53 hours a week with technology (The Henry J. Kaiser Family Foundation, 2010). As a result, technology is influencing how children learn. Innovative technologies can help facilitate the learning about nutrition in very empowering ways (National Association for the Education of Young Children, 2012). Below are some technologies that can be used in educational settings or at home to improve the education of nutrition.

The iPod touch has become one of the most popular devices for children to use, especially in classrooms (Wylie, 2015). The iPod touch is tactile, has Wi-Fi Internet abilities, and has many applications that can download from the iTunes store application. Some parents might wonder what applications could be used in the classroom, since they think these devices are used mostly for play. However, Apple has created many interesting information applications, such as Google Earth, where a child can explore the world, Quick Graph, where he/she can practice

plotting equations, Dictionary.com, where he/she can search a dictionary and thesaurus much faster, Story Kit, for creating stories and the NASA app, where a child can learn about recent space missions (Wylie, 2015). To have this much information in the palm of a hand is a very quick and adaptive way of learning in classrooms.

IPads are the second most popular devices, since they are exactly like the portable iPod touch but larger and with more features (Wylie, 2015). Some applications that are considered to be beneficial for children are The Elements, which is an interactive periodic table, Alphabet Fun, which teaches handwriting, numbers and letter recognition, and Beautiful Planet HD, which lets one have a virtual tour of 160 different countries (Wylie, 2015). The best detail about the iPad is that it “provides the potential to empower and uplift students in their learning, maximizes effectiveness, is active, engaging, and customized” (Wylie, 2015, para. 13). Since the use of mobile technologies is increasing in many countries, having students learn with these devices would enable a 24-hour access to develop critical thinking, differentiation and problem solving at an early age (Goundar, 2011).

The third most well liked device is the E-book. E-books are portable, easy-to-update and cost-effective online books that can be read on netbooks, e-readers and laptops (Wylie, 2015). This device would be highly effective for teaching, since children can just carry around a lightweight device instead of a heavy textbook. In fact, a child can have access to over 40,000 books on an e-reader, giving him/her an interesting incentive to read (Goundar, 2011).

The fourth device, Proloquo2go, is a new mobile technology for people with special needs. Proloquo2go is a mobile device that helps children with autism, speaking disabilities and other disorders of the sort learn how to speak in a natural way (Wylie, 2015). The application has

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a library of symbols and text-to-speech adaptations that can help disabled children learn inside and outside the classroom (Wylie, 2015).

The last piece of technology, the smartphone, of various platforms (Android, iPhone, Windows) is used in many environments. Texting and calling are popular uses of this device, and some schools are using these tools for learning. A school in Ireland is teaching the Irish language to their students by sending them Irish-word text messages through the National Council for Curriculum and Assessment (NCCA) (Wylie, 2015). There are also texting websites like *Poll Everywhere* and *Text the Mob*, where students can respond to a question via text posted by a teacher (Wylie, 2015). This unique and entertaining method of learning creates different ways for children to complete assignments.

Mobile technology is just starting out in schools, but in many ways it will soon help children succeed in the classroom. Nielsen (2015) states that “when we ban, rather than embrace, real-world technologies, we leave students ill-equipped to know how to harness the power of technology for learning, unprepared to develop a respectable digital footprint, and without adequate knowledge to safely navigate the web” (Wylie, 2015, para. 17) Children need to learn how to use technology since the world will depend on them in the future to advance it.

Not all schools and homes can afford mobile technology to promote learning. Therefore, companies have stepped in to promote great education through technology (Goundar, 2011). For example, the BBC (British Broadcasting Corporation) World Service Trust and the BBC (British Broadcasting Corporation) Learning English began an initiative and provided mobile phones to citizens of Bangladesh, to promote learning of the English language. This act of service was called the Janala Project and was funded by the UK’s Department for International Development

(UKAID) (Goundar, 2011). The results were that the citizens of Bangladesh improved in their ability to speak and read the English language.

Although technology has a useful function in school and home environments, it should be used with healthy moderation (Brown, 2015). Five year olds should do no more than a half hour with mobile technology, and children ages 7-10 should do no more than one hour in context of sitting, eye health and exercise. Even though developing technical skills is important, children need to learn how to cultivate cognitive, social and language skills outside of the technical world (Brown, 2015). Their eyes can also benefit from a balance of technology use, for using mobile devices can cause eye problems if not monitored. However, if the child is using the mobile tool only for learning purposes, then the device can be used for a longer period of time (Brown, 2015). It is best for parents and schools to limit or prohibit non-interactive media that does not promote engagement with children. Non-interactive media consists of watching television shows and movies. Allowing children to do passive, non-interactive activities for a long duration can create bad habits and promote health issues in the future, such as obesity (National Association for the Education of Young Children (Naeyc), 2012).

Available Interactive Gaming

Wylie (2015) describes a study that was completed and funded by the Department of Education, stating that the PBS Kids application, Martha Speaks Dog Party, helped children ages three to seven improve on the subject of vocabulary by 31 percent (PR Newswire, 2015).

Another similar study by Luckin, et.al (2005) focused on children ages 5 to 7 that were using mobile devices to learn math in the classroom and at home. The mobile technologies used for this study were an Interactive Whiteboard and a tablet (Luckin, Boulay, Smith, Underwood, Fitzpatrick, Holmberg, Kerawalla, Tunley, Brewster, & Pearce, 2005). The availability of these

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resources helped teachers with lessons, created a place where parents and teachers can see the student's progress, and overall helped the child with doing their homework (Luckin, et al., 2005).

Learning about nutrition through interactive gaming can be enjoyable for children, along with helping them develop attention skills and nutritional choice selections (Learntobehealthy.org, 2015). Interactive gaming is easy to use, learn, and is affordable. One of the finest qualities about mobile technology is that it has game applications on most, if not all technological devices (Learntobehealthy.org, 2015). Children embrace technology; therefore it can be a useful medium to teach them how to take care of their bodies, giving rewarding results not only for themselves, but also for the world (Lu, Kharrazi & Thompson, 2013).

With the emergence of the Internet, there are online games available for a child to use on multiple devices (mobile and desktop). *MyPlate Match* is a game that teaches kids to learn about the five food groups, and how much from each group is necessary for healthy eating. The game targets children 4 to 8 years of age, but can be used by anyone. The *MyPlate Match Game* is an excellent way for children to start learning healthy eating habits and trying new foods in their balanced diet (Dairy Council of California, 2015). The game only takes about 5 to 10 minutes, and can be used in any environment where Wi-Fi or Internet is available.

When the game first starts, the first objective is to “learn to eat healthy by knowing how to eat from all five food groups” (Dairy Council of California, 2015). In order to do this, each food group shape needs to go to their proper spot on the plate by being dragged across the screen. Once all pieces are in their spots, the next thing to do is learn about each food group. This step is accomplished by moving the mouse over to each part of the plate (Dairy Council of California, 2015). *MyPlate* teaches children to recognize foods that do not fit into any food group, and that they are called “extras” (Dairy Council of California, 2015). The food group

shapes are excellent food serving representations. From playing this game, children have a visual example of how much food to put on their plate and which different foods are classified as fruits, grains, vegetables and meat (see Figure 6) (Dairy Council of California, 2015).

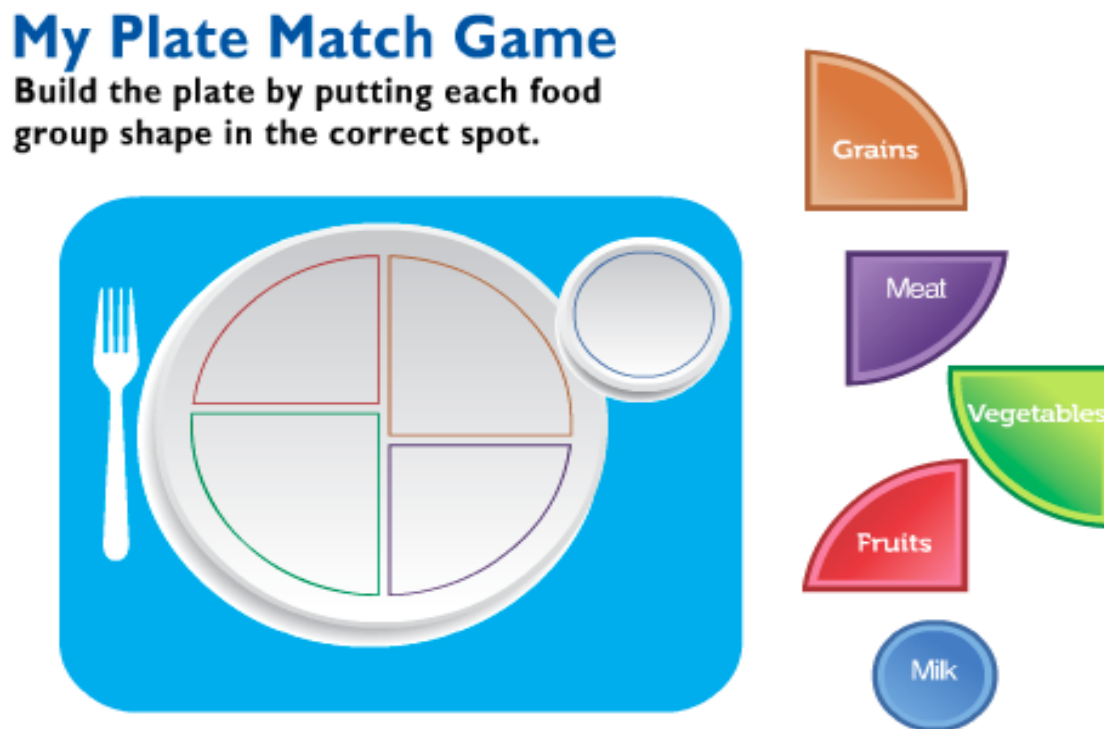


Figure 6. This is an example of how the game first starts. The player has to put all the food groups into portions on the plate. Adapted from “The MyPlate Match Game”, 2015, by *Dairy Council of California*.

The next part of the game is accomplished by dragging each food item or drink to the correct area. Once each food group is complete, it will show a checkmark and give recommended servings for each age group. (Dairy Council of California, 2015). The process of dragging each food item to the correct area can be confusing at first, since foods like yogurt or

cheese go in the “Milk” section (see Figure 7) (Dairy Council of California, 2015). A dairy section on the plate should be created instead.

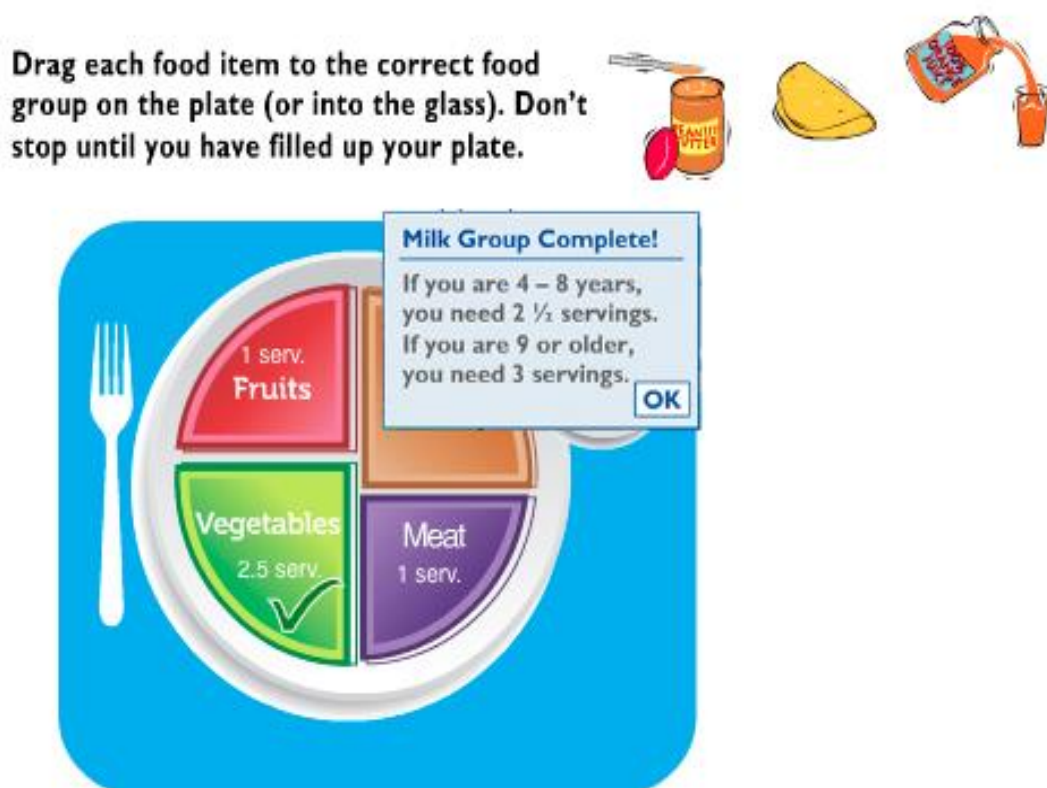


Figure 7. This figure shows the process of dragging each food item to the correct place on the plate. The only food group that shows the proper amount of servings when complete is the “Milk” section. Adapted from “The MyPlate Match Game”, 2015, by *Dairy Council of California*.

The following topic is about physical activity, since exercise for children is another component needed for healthy growth and development. The daily-recommended amount for each exercise is displayed by a clock (see Figure 8) (Dairy Council of California, 2015).

Get Plenty of Physical Activity!

Fill up the clock with the recommended daily amount of moderate to vigorous level physical activity needed each day.



Figure 8. This picture shows the analog clock and the activities a player can select to complete the 60 minutes. The clock does not express a clear expression of 60 minutes, but rather shows a time frame of 12 hours. Adapted from “The MyPlate Match Game”, 2015, by *Dairy Council of California*.

Some activities are not physical, which could draw questions about why it was even part of the selection. The goal for moderate to vigorous physical activities needed each day is 60 minutes, but the game makes the player select three different sports that have durations of 3 hours each. The game and its directions do not seem to match up very well, nonetheless, this computer interactive game is essential for children to learn what kind of food groups, how many servings of each food group, and how much physical activity they need to stay at their prime health level (Dairy Council of California, 2015).

The next interactive computer game for children to learn nutrition is called *Mission Nutrition* (Kids Health, 2015). The game is set up to feel like home, making decisions on what to eat with what is available. This game starts out great by giving a “How To Play” description, which helps the player know what he/she needs to do. There are three tasks in this game; the first task is to practice critical thinking to determine which kinds of foods have a lot of sugar, the second task is to find a snack that provides carbohydrates and protein to the body, and the third task is to test a child’s knowledge of fruit facts (see Figure 9) (Kids Health, 2015).



Figure 9. Note that this is what the game setting looks like. The player has to find specific items from the refrigerator, fruit bowl and cupboard to complete the game. Adapted from “Mission Nutrition”, 2015, by *Kids Health*.

A positive aspect of *Mission Nutrition* is that any food item can be clicked on for information about that certain item. The goal is to not just get the correct answers, but to learn

about the other foods in the house as well as their effects on the body. A negative aspect of the game is that it ends very quickly, and feels like it ends just when the player is starting to learn and get motivated (Kids Health, 2015). A second negative aspect is that having the player search for sugary soda might encourage learning that promotes poor nutrition (see Figure 10).

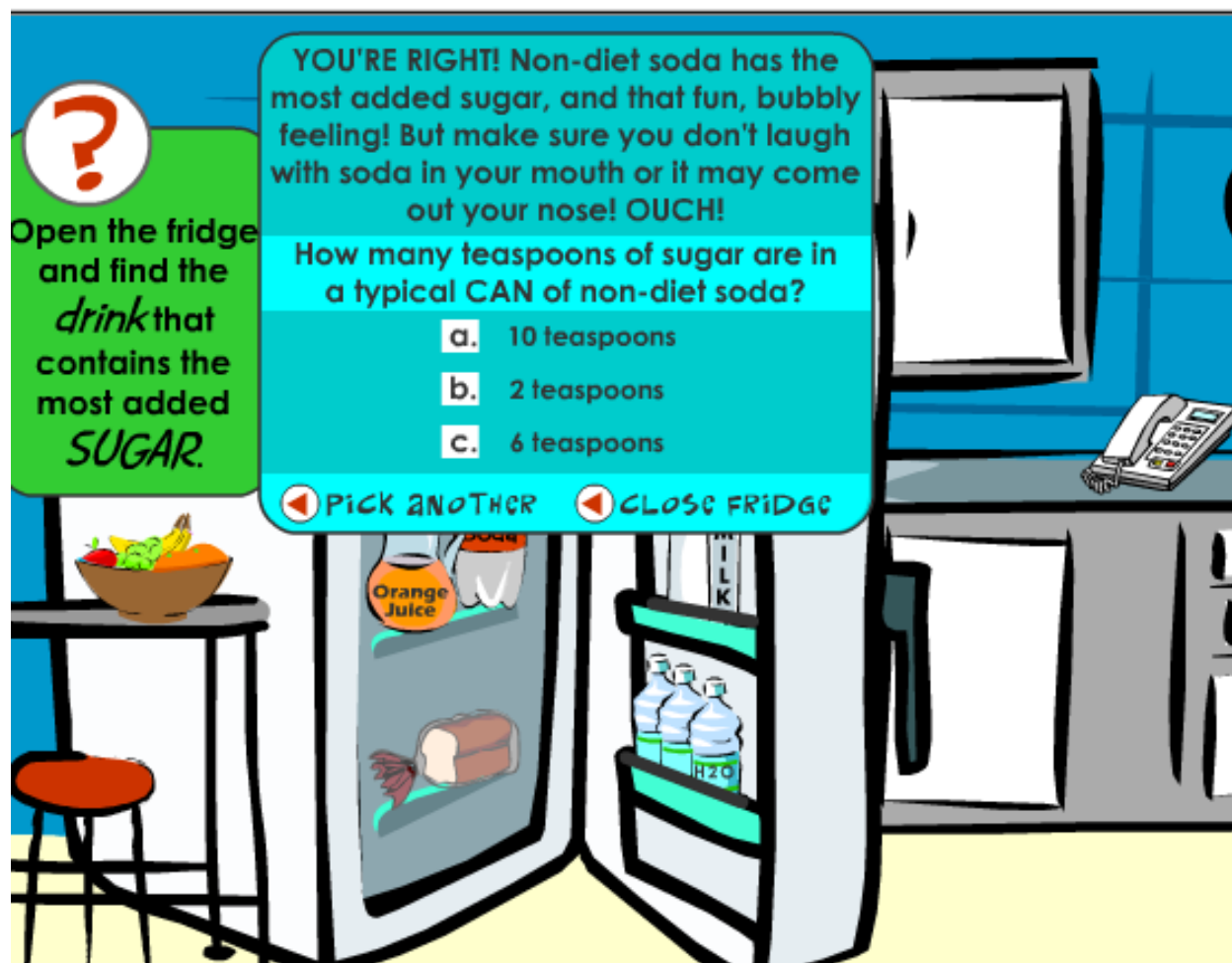


Figure 10. The quiz question is shown; displaying that the game reinforces poor nutrition. Adapted from "Mission Nutrition", 2015, by Kids Health.

Aside from computer games, there are applications on mobile devices that children interact with to learn about nutrition. *AwesomeEats* is an application supported by Whole Kids Foundation that starts each game with a chapter, depending on which chapter was last played.

Once the chapter has begun, the application starts off with a “Did You Know?” statement and Game Tips (Whole Kids Foundation, 2014).

The whole aspect of the game is to sort what foods are not good for the body and which ones are required for optimal health. A rating is given after each level and a player can advance if the game is played in a proper and competitive way (see Figure 11) (Whole Kids Foundation, 2014). A benefit that this game has is that it can be played on an iOS, Windows and Android phone (Whole Kids Foundation, 2014). Many applications can only be played on one system, so having all three available is desirable. It is unknown how many levels there are to play since they are all locked until each level is reached, but the game still gives a goal of getting the fruits and vegetables into the appropriate places, instead of just learning how these foods benefit the player.



Figure 11. This is what the rating looks like after each level is completed. The rating is out of three stars and shows how many food items were collected correctly. The total score is recorded at the bottom. Adapted from “AwesomeEats”, 2014, by *Whole Kids Foundation*.

A negative aspect of this game is that the food tips given after each level do not relate to the foods the player just performed with. However, the game is a great interactive game for a child if they love to sort, learn, and be under a timed challenge (see Figure 12) (Whole Kids Foundation, 2014). The application gives a total score for each round, and there are always achievements and leaderboards to look at. This is an application that makes learning nutrition a fun, yet active goal.



Figure 12. The picture displays the main goal of the game, to get all fruits, vegetables and nuts into the appropriate sections. Adapted from “AwesomeEats”, 2014, by Whole Kids Foundation.



Figure 13. This figure displays an Awesome Eats tip. Adapted from “Awesome Eats”, 2014, by Whole Kids Foundation.

HealthyHero is another application used for learning about nutrition, which is available on all mobile devices, such as iOS, Android phones, Nooks and Amazon devices (Yogome, 2013). *HealthyHero* has the main objective to teach children about healthy eating habits (Yogome, 2013). The game has a competitive factor, where the player can complete up to 36 levels against a hungry monster. In order to go to the next level, the player must feed the monster the correct and directed food items, or else he/she will lose points and not be able to move on. There are two different versions to play this game; there is *Healthy Heroes 1 – Nutrition for*

Kids, which is the paid version that costs \$2.99, and there is *HealthyHero*, which is the game that is being described (Yogome, 2013).

The meal objectives for each level are all nutrient-based, and the goal is to find the three food items that were given. Breakfast, lunch, dinner and snacks are all considered when these three food items are given out to find, and each level provides the total amount of calories for the three food items together (Yogome, 2013). The application gives reminders and hints throughout the game, by only saying the certain food item's name that needs to go to the monster.

HealthyHero is amusing, interactive, and an excellent way for children to learn how to make healthy food selections when there are other unhealthy foods available (see Figure 14) (Yogome, 2013).



Figure 14. This is the setting of the game. As boxes of food drop down, the player selects the healthy foods to feed the monster, such as granola and raisins. Adapted from “HealthyHero”, 2013, by Yogome.

Discussion

The fact that the *MyPlate* Match Game makes players arrange food items into the appropriate food groups shows that children are in the process of learning the right food groups and portions. Another positive fact about this game is that *MyPlate* briefly explains why the game is important to play, and how it facilitates learning and practicing nutritious foods for the body and mind.

The action of putting drink items on a food plate and putting food items where drinks go can be problematic, because it confuses where food and drinks actually go for meals. A child or any person for that matter, does not put yogurt or cheese in their “milk” drink. Therefore, not having authentic place options for players to place their food or drink in the game can confuse the child when actually selecting food or drinks for a meal in real life. However, it is beneficial for children to know that these items are under the fruit or dairy food groups.

Another problematic area is in the physical activities category. When selecting physical activities, the system shows both physical and non-physical options. When a non-physical activity is chosen, the system responds with, “This activity is fun, but it does not count toward your recommended amount of moderate to vigorous level physical activity minutes needed each day” (Dairy Council of California, 2015). Therefore, the focus of physical exercise can be unclear if the game includes both physical *and* non-physical activities. The fact that the clock moves three hours every time a physical activity is entered, gives the idea that a child needs 12 hours of exercise everyday when the recommended amount is 60 minutes. This is not ideal if a child is trying to learn visually how many hours a day he/she should exercise.

Mission Nutrition has many beneficial attributes such as providing clear directions, providing an at-home setting, pointing out which drinks have excess sugar, and which foods are

nutritious and provide vitamins. It is clear that in this game it is not only giving objectives for the player to find, but also giving out important information as well. *Mission Nutrition* makes a priority for the child to learn why he/she should limit/eliminate soda, or why the child should eat foods with protein and vitamin C. This game is relatable to a child's own life and can help a child know what to and what not to consume. However, because of how short the game is, it feels limited to what it is teaching the player. Having only three parts for a game will have a player wanting more or feeling disappointed very quickly. It is possible that a player could take the mission of finding soda the wrong way and want to drink it more instead of limiting it. How the game describes the soda, saying "that fun, bubbly feeling" and "make sure you don't laugh with soda in your mouth" can reinforce the child to think it is okay to drink a can of soda that has 10 teaspoons of sugar (Kids Health, 2015).

The application *AwesomeEats* is an excellent game for children who get bored easily and have a competitive edge. The availability of this game is perfect since it is able to perform well on all mobile devices. The fact that the application is more strategic than informative gives a less benefit on the player learning nutrition. This means that the game will improve their skills to group different fruits and vegetables, but it does not teach them why they are grouping them or why they are important. Furthermore, giving food tips that are not related to the food levels could be considered pointless for the player to be grouping the certain fruits and vegetables together. For example, after grouping black-eyed peas, mushrooms and tomatoes into their appropriate spots, the food tip ended up being about whole grains. It is assumed that the player would expect to be given a little fact at least about the foods they just interacted with. When it comes to strategic game levels, it may be problematic to have to guess at the number of levels in the game. Not knowing specifically how many levels there are can be problematic since children need

goals to feel a challenge and a certain state of flow in a game (Jesper, 2007). Not giving a clear goal can lead to a player feeling frustrated (Jesper, 2007).

In comparison to the other three interactive games on nutrition, *HealthyHero* is the best one in the opinion of Yang, et.al (2013). The game readily captures the player's attention by having fun level names such as "Gobble Guts", "Fajita", "Snuggle-Tooth", "Pickles", "Nightmare" and "Macaroni". Some of the names do not sound the healthiest, but the food names nonetheless attract the player. Under the level selections, there is a "For Parents" section on the left and a "HEALTHY friends" section on the right. In the "For Parents" section, the parents have to do a math problem in order to get into the game. This could be a great entrance question if the parent's child is below the third grade, but if the child is a 4th or 5th grader, it will be easy for them to get into the parents section. In this section, a parent can follow their child's progress in the game, request for more information about the program, download other games, and read some tips and general recommendations for their child's diet. This is an excellent addition and has not been on the other three interactive nutrition games.

The "HEALTHY friends" section is another game itself that the child can choose to play. Each level has a certain fruit or vegetable they have to spell and if spelled correctly, they get a fun, interesting fact about that food item. This is an excellent learning tool for children, since a child will be excited to learn about the food item they just got right from correctly spelling the word.

During the original *HealthyHero* game, the player knows how many levels there are, how many calories each meal level has for breakfast, lunch and dinner, and knows which foods are and are not critical for the monster to consume. This game encourages healthy eating selections around poor eating choices, and is a great skill to practice when searching for healthy foods. The

fact that there are two versions of this game gives beneficial options for children who want to play and learn more through use of their parent's money, or the option for children from low incomes to play free mobile application games on nutrition.

Recommendations

It is recommended for the *MyPlate* game that the directions stay the same, but the visual technique of the game should change. Yang, Hwang, and Yang in their study found that learning systems should develop personalized modules for adaptive learning systems; therefore the *MyPlate* should have a section for dairy on the plate (2013). They should also have different glasses next to "milk" to show that a child could have orange juice or water, instead of moving "orange juice" to the "fruits" section on the plate. It is important to make the *MyPlate* an exact representation of where food and drinks go, or else it will confuse the child even more (Yang, Hwang, & Yang, 2013). Another option could be to be clear with the directions when putting food or drinks in food groups, saying that the liquids such as "juice" count as fruit, and "cheese" and "yogurt" count as dairy. Or, label the milk glass as "dairy". However, it should be a requirement on the *MyPlate* that water can also be an option. Children need to learn how many of glasses of water a day they should have.

For the physical activity section, instead of having an analog clock to determine the amount of activities needed in order to complete 60 minutes, a digital clock would be a better visual. For example, every time a child selects a physical activity, the clock can automatically add the amount of time contributing to the 60-minute requirement. Since Hwang, Sung, Hung, Huang and Tsai found that focusing on the awareness and focus of the game is important, the non-physical activities such as a computer, Gameboy, and CDs should also be taken away (2012). The focus of the game is to improve nutrition and physical health, not to recognize non-

physical activities (Chuang & Chen, 2009). The non-physical activities do not seem to improve the selection of active choices; it seems just to be a distraction the player should not be selecting.

For the *Mission Nutrition* computer game, how everything is setup should be kept along with the information and directions, however, additions are required. Hwang, et.al (2012) indicated that learning styles are likely to influence how students learn and how they interact. Therefore, this game has the potential to be more adventurous for finding different food items and drinks, so having more objectives to find items like a salad, pineapple or even water would make the game a little more interesting, intelligent, and fun (Chuang & Chen, 2015). Most importantly, there should be no emphasis on sugar or any bad food items, for it can reinforce bad food selections. Having a quiz with more than one question would also be beneficial. This quiz could go after the end of the game to recap what the player just learned. In addition, *Mission Nutrition* could have levels added to it, having different challenges set up for how hard the level is. If all of these aspects were put into the game, not only would it make the computer game longer, but also more interactive and help give a long-term effect on the education of nutrition to the player (Yang, Hwang, & Yang, 2013).

Yang, et.al (2013) stated that knowing and having a difficult level can benefit learning, along with taking in personal characteristics and learning styles. Therefore, the recommendation for *AwesomeEats* is to have the amount of levels available to complete stated in the start of the game. That way the player knows where he/she is at all times, and how many levels are left to complete the game (Chuang & Chen, 2009). The second suggestion is to have more information on the fruits and vegetables that the player interacts with. There should be a food tip before and after each level on the different vegetables and fruits, that way the information stays with the player in a more efficient manner (Chuang & Chen, 2009).

HealthyHeroes is highly recommended since it takes in personal preferences and individual learning into account (Yang, et.al, 2013). It is a learning game not only for children, but also for involved parents (Yang, Hwang, & Yang, 2013). The competitive goals and nutrition information are great starts to these games, but they need more. The first recommendation is to include food meals for children who are vegetarian, vegan, lactose free, nut free or gluten free, and have kosher style diets. That way these children can learn how to eat well with having these certain regimes (Yang, Hwang, & Yang, 2013).

The second recommendation is that after each level or section is completed, the game should automatically go back to the levels section (Chuang & Chen, 2009). The application currently has the game go to the paid version where one can “download” it. However, if one does not have the funds to have the paid version, they should not feel pressured to do so each time they play the free version. Therefore, having the game only focus on what it provides as a free version will be beneficial to all children who use the game (Chuang & Chen, 2009).

Conclusion

Children ages 5 to 10 have received options inside and outside of the classroom to learn nutrition with technology. Malnutrition has become an important issue. Whether they are underweight, overweight or normal weight, some children are still malnourished and are lacking the main functional nutrients for the human body to develop physically and cognitively. Interactive gaming on nutrition that is accessible on the computer and a mobile device can increase the knowledge on the subject for the child, and enhance the decision-making skills about foods and drinks that are best for the human body. If a child has entertaining and interactive learning options on a device he or she uses every day, there is a higher incentive for that child to immerse him or herself with gaining the knowledge of different subjects, such as

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nutrition. It is recommended that a study should be conducted on how these four games are handled by children and how much they learn by the content that is provided. The world and its people are depending on technology more each and every day, so to have children start learning nutrition at an early age will create awareness for the importance of nutrients, servings of food groups, proper growth and development and the need for children to have a bright and healthy future.

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