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How color affects food choices

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by

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Abstract

How Color Affects Food

by

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Color has a very strong influence in the hospitality industry. How much thought has been given to food choices because of color, and how influential is that on customers' satisfaction of a food product? Staff that prepares food must understand how color and taste work together through presentation and eye appeal to create the WOW factor since customers eat with their eyes first.

People associate different foods with different colors. When this perception changes it often has a detrimental effect on the customer's perception of how that food should taste. Scientific information was gathered on the history of food, the sensory perception of taste, and environmental color design. The information was synthesized to develop a course on how color affects food choices of hospitality foodservice customers. The course will allow students to experience lectures, hands-on taste testing and classroom experimentation. The goal is to help hospitality industry employees develop a better insight into the world of taste.

The importance of understanding the effect color has on food choices is paramount to hospitality industry employees. The application of the new found knowledge will allow students to develop a keener sense of why color affects food choices made by hospitality foodservice customers.

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Part One

Introduction

The first to feast is the eyes. This old axiom has a very significant meaning to a chef. Chefs are always conscious of how food looks before it is served as well as how it looks during the preparation stages.

Color has a very strong influence in the hospitality industry. Color choices in decor and environmental planning are commonplace in building designs today. How color influences customer satisfaction has also been studied. But how much thought is given to food choices because of color, and how influential is that on customers' satisfaction of a food product? A literature review will be performed to assess what research has been conducted on the influence of color in food choices.

Purpose

The purpose of this paper is to develop a tool for the hospitality industry in the form of a lesson plan that may be taught to show how color affects the decisions customers make with food choices. The lesson plan may be used in hospitality schools as well as in the hospitality industry for employee training in the area of culinary operations. Comprehensive training of front and back of the house personnel is essential to a successful operation. Having the tools to understand how color affects the decisions customers make with food choices should prove quite beneficial. Staff that prepares food must understand how color and taste work together through presentation and eye appeal to create the wow factor since customers eat with their eyes first.

Justification

The major goal of the hospitality services provider is to satisfy customers while being profitable. On the hotel side of the industry, decor, front desk operations, clean rooms and customer service are essential for customer satisfaction (Bitner, 1992, p. 57). All these areas may be strictly monitored and controlled for peak efficiency. On the food and beverage side of the equation, choices and customer satisfaction may be harder to define and control. Food by its nature is perishable, unstable, and highly affected by market conditions, growing conditions and weather. Very little information is available in the form a lesson plan focusing on a customer's perception of color in their food choices in the hospitality industry. Any tools that can be created to aid in increasing customer satisfaction for food are important and useful.

One area that has not been studied to its fullest potential is color and how it pertains to food choices and satisfaction. A lesson plan that teaches how taste works in stimulating the palate and how the brain works in conjunction to how color affects that choice should help to increase the knowledge of hospitality staff. The application of such knowledge will help increase customer satisfaction and ultimately profit.

The justification for this paper is to offer the hospitality industry options to improve customer service through added knowledge of how color affects food choices. The food segment of the hospitality industry is a major revenue contributor to the bottom line of healthy hospitality businesses. This paper will help support hospitality service providers with keys to understanding just how important color can be.

Constraints

The nature of the lesson plan must be very basic with clear and distinct goals based on how taste works and how color influences individuals' concept of taste. Research on this subject is limited adding to the constraints of the subject.

The perceptions that are created in each person's mind as to their understanding about color are a major constraint. People's perception of color can be affected by many outside influences. A person's cultural background, environmental surroundings, family perceptions, and personal learning experiences will leave a lasting memory on the brain, which will direct the thinking.

Glossary

American Culinary Federation (ACF): the authority on cooking in America since 1929, ACF is the premier professional chefs' organization in North America with more than 22,000 members in more than 230 chapters (The American Culinary Federation [ACF], 2008).

Research Chefs Association (RCA): Formed in 1996 by a group of food professionals with a common interest in the challenges facing the profession. RCA has become the premier source of culinary and technical information for the food industry (Resource Chefs Association [RCA], 2008, p. 1)

Sensory perception: the conscious recognition and interpretation of sensory stimuli that serve as a basis for understanding, learning, and knowing or for motivating a particular action or reaction (Mosby's Medical Dictionary, 2009).

WOW factor: culinary term used by chefs to describe the initial eye appeal of a food item that makes the food more desirable to eat; impressing the eye and the palate (L. Perrot, personal communication, September, 1998).

Part Two

Literature Review

Introduction

To understand how people use color to make food choices, one must begin with the history of food. Dating back to early man, color in nature motivated man's first ability to choose safe foods. The natural color in foods is an inherent teaching method of training the brain to recognize acceptable and safe food. The adage that 'the first to feast it is the eyes' has much more meaning than people first realize. Before one can study color in all its facets, the mechanism of taste must be understood to include how it relates to color. Color affects our taste, our mood, and our inner comfort level. The act of eating is caused by the stimulation of hunger. This paper will examine how the primitive instinct of eating evolved into the world of hospitality and dining. The visual impact of eating began with food itself.

History of Food

Prehistory

Archaeological research shows that as early man evolved over millions of years, the brain's volume increased. With that development man had better vision and memory. With these changes in place, man became a hunter-gatherer rather than a nocturnal animal rooting for food in the ground to eat in the safety of the darkness of night. Man could walk erect and scan his environment for food. The mind would store information on how food tastes and looks (Toussaint-Samat, 1992, p. 1). Man could now choose what he wanted to eat. The visual importance of memory would play a key role in decision making.

Paleontologists have a good idea of what early man ate and lived on from research gathered after examining dental wear patterns on the teeth of prehistoric man. Vegetables were the first foods followed by high protein diets due to the energy needed to survive (Toussaint-Samat, 1992). Fresh animal meat was bright red and usually safe to eat. Meat that started to rot would turn brown and smell and would be less desirable. Nature uses color to protect humans. When man first learned to control fire he also learned to cook his food, finding it easier to eat and improving the flavor (Toussaint-Samat). When meat was cooked too long and it became blackened, the results would be a charcoal-bitter taste. Paul Rozin, PhD, explains how humans, as omnivores, have an innate sense to distinguish safe foods from potentially toxic foods. He reasons that the cues are preferences at birth for sweet tastes (safe foods) and aversions to bitter tastes (unsafe foods), (Rozin, 2005). These are yet other examples of how certain colors had particular flavors that could denote good and bad tastes.

Modern Era

In today's world of the culinary arts and the hospitality industry, color plays a major role in satisfying customers. Chefs do not create foods from recipes; they create food from life experience and ideas gathered over many years of training and experience. This accumulated knowledge culminates in a combination of taste and color to satisfy the customer (Kunz & Kaminsky, 2001). Chefs attempt to create what is called 'the WOW factor'. A recent industry trend report indicates that consumers are more demanding and are developing more discriminating tastes and food requirements (Packaged Facts, 2006). Furthermore, it has been noted that food color and palatability have a binding tie to one another (Garber, Hyatt, & Starr, 2001), This brings one back to the old adage 'the first to feast is the eyes' (US Food and Drug Administration [FDA], 1993).

Environmental Influences

Dining Room and color

The hospitality industry's hotels and restaurants use the same wow factor to their advantage. Industry professionals create elaborate lobbies and façades matching beautiful colors with surroundings not only to entice current customers but to influence potential guests as to how wonderful their visit may be (National Restaurant Association [NRA], 2000, ¶ 3). Color plays an essential role in decision-making when it pertains to food and hospitality choices. Before individuals allow food to pass their lips, they must feel confident that the food they are about to eat is safe and pleasing to the palate. The dining room will be a comfortable environment without distractions, and the work environment will aide in efficient production. Much of this is possible through the proper use of color.

Dining room and work areas are greatly affected by color. The choice of colors can affect consumers' perceptions and choices of foods. Singh reports that the proper use of color, and its importance in influencing the choices people make, is determined by the fact that most people make up their minds within the first 90 seconds of their encounter with people or products (Singh, 2006). Up to 90 percent of the decision-making perception was based on color alone. These decisions will also influence feelings of a positive or negative nature. Scientifically, color is light that is carried by wavelengths and absorbed by the retina of the eye. This in turn generates a signal that is sent to the brain. Light can change one's concept or perception of color because it is a combination of seven spectral colors as discovered by Sir Isaac Newton (Programa de Investigación Color / Color Research Program, n.d., ¶ 1).

Lighting and ambience

The two major forms of lighting used in the hospitality industry are incandescent and florescent. Fluorescent lighting represents 67 percent of lighting use around the world. It will intensify blues and greens but the colors orange, yellow, and red will appear dull (Singh, 2006, ¶ 1). Restaurant studies have shown that red colors stimulate appetite, and this is a main reason red is used by fast food operations. The color yellow is also used by fast food operations in an attempt to generate sales. However, formal restaurants try to create a different atmosphere or ambience by using the color blue or soft hues resulting in longer stays which increases the meal check. This is accomplished by selling more wine, desserts, and coffee in a soothing atmosphere (Singh, ¶ 9).

Research conducted by Stroebele and De Castro (2004) studied environmental surroundings called ambience that act as a stimulus on food choices. The perception of food can be influenced by a variety of stimuli such as temperature, smell, distractions, wait time and the color of food (Stroebele & De Castro, 2004). Identical foods were prepared according to texture and color and served in the school cafeteria and the school restaurant. The foods that were served in the restaurant setting were rated higher in sensory appeal. The study further concluded that the intake amount of foods can also be attributed to these factors further justifying the claim that color can affect our food choices (Stroebele & De Castro). Mahoney and Hall (2007) found that "little research has been conducted into the factors that influence food purchasing behavior" although "food sales represent a significant proportion of hospitality industry income" (O'Mahony & Hall, 2007).

Anatomy of Taste

The American Heritage Dictionary offers two definitions of taste. The first definition is that taste is the body's sensory ability to distinguish sweet, sour, salty, and bitter when substances come in contact with the tongue. The second definition is that taste is a combination of taste, smell and touch which the mouth can sense (Utermohlen, 2006). New taste studies have shown that there are at least six sensory tastes, adding the tastes of fat and Umami. Umami means 'delicious' in Japanese and it is the word often used to describe the savory taste of food when it is heightened. The anatomy of taste uses the tongue, nose, brain and the visual concepts that have taught what the brain should expect. Taste is actually the last sensory perception that takes place (Utermohlen). Many scientific studies have concluded that sensory stimulants that affect the human body are touch, taste, smell, sound, and sight. Additional studies indicate that body position sense (proprioception) and movement sensation (vestibular input) can also contribute to sensory stimulation (Net Industries, 2009).

Food is first visualized and then placed into the mouth where it is chewed. During mastication the saliva that is activated in the mouth mixes with the macerated food and gives off a vapor to the nose. During this process individual molecules of taste are carried in bundled nerves, where the synapses, or cell-to-cell communicators, send the information to the neural transmitters in the form of serotonin. The serotonin then fires additional synapses, which shoot the message to the brain where it is stored (Utermohlen, 2006).

The sense of taste is also influenced by external sensory perceptions such as sight, sound, touch, and smell. Most individuals are familiar with how things taste and feel. There are also internal influences associated with taste such as hunger, thirst, balance and pain. Hunger affects taste because it is the sensation to fill ourselves and feel satisfied. Thirst is also part of hunger

because it needs to be satisfied. Balance is when one is not necessarily hungry or thirsty but preparing to dine. Pain may have a significant effect on taste because medication will often times desensitize the taste buds. When in pain and taking medications, the result inhibits the synapses from firing and therefore, the message to the brain is blocked. Age has also been found to act as a desensitizer to taste. In "The Effect of Age on Taste", David Koepnick (n.d.) cites studies that have shown that individuals begin to lose taste receptors at the age of 30. This continues until almost 50 percent of taste is lost by the time men reach the age of 60 and women reach the age of 65 (Koepnick). The human body, at that age, does not produce as many neurotransmitters such as serotonin that cause the synapses to fire. In turn the needed cell-to-cell communication is diminished.

Smoking, drinking, and a stuffy nose have also been known to influence the ability to taste. The ability to taste and smell work together creating the food signal that is sent to the brain. The loss of taste and smell that occurs in the elderly can result in poor appetite and inappropriate food choices. The use of food enhancements and preparing the food to be more visually appetizing will help to increase salivary flow in the mouth reducing the need for salt along with complaints associated with chemosensory issues (Schiffman & Graham, 2000).

Taste is more than just the science of how our sensory system works. Taste is a combination of how food looks, smells, and sounds. With the smell of fresh brewed coffee comes the anticipation of a steeping hot cup of brown coffee and the flavor associated with it. When placing a piece of carrot in the mouth to chew there is an expected crunch and flavor. "Taste is a product of our genes and our environment," says Leslie J. Stein, PhD (Hatfield, 1998, p. 1) who conducts research at the Monell Chemical Senses Center in Philadelphia. Recent research has demonstrated that our genes help to determine how our brain assimilates taste and

flavor. Stein also states that, “infants and young children need to learn what foods are safe to eat” (Hatfield, p. 1). The brain works as a giant computer storing the memories of all flavors and tastes from our childhood. When a child complains of not liking broccoli, it may have been because the first time broccoli was tasted it was not properly prepared and had a bitter taste. Bitter is nature's way of protecting us from unsafe food. The brain must be retrained to overcome the memory of bitter broccoli. In an attempt to retrain the brain, preparing the dish for that same child, the broccoli must not be overcooked and it should be served with a cheese sauce. This will create a new visual image and taste sensation that the brain can store to overcome the bitter memory (Hatfield). Additional studies by Stein indicate that the mothers of unborn children may transfer flavor preferences in the amino acids that are fed to the baby during pregnancy.

Genes cannot be changed; however, training can overcome likes and dislikes in flavor and taste of food. The four basic tastes were identified over two thousand years ago by the Greek philosopher Democritus. In the 1890’s, the French Chef, Augustus Escoffier, suggested that there was a fifth taste that he felt was responsible for the successful flavors of his soups. In 1908, the Japanese chemist Kikunae Ikeda discovered that the amino acid glutamate was the enhancing flavor in a variety of seaweeds soups. Because of this discovery, a fifth taste, Umami, was named in honor of him. It is the Japanese word for delicious (Keim, December 22, 2008).

Anatomy of Color

Color has been used for centuries to enhance food palatability and acceptance. The masking of the color of wine began four hundred years B.C. when the early Egyptians and Romans colored wines with herbs and spices to make it more appealing (TourEgypt.net, 2000, ¶ 21). Synthetic colors have been used and developed throughout the commercial food industry

during the late 1800s to help decorate as well as disguise low-quality food. During this period of time, color additives and other additive compounds were toxic (Downham & Collins, 1999). There was no legislation to control this particular part of the food industry. In the early 1900s color additives were used throughout the United States and Europe. Many were made from petroleum products that were toxic. The coloring techniques of the past that used animal, mineral and plant resources were discontinued due to synthetic chemical colorings that were easier to blend and did not impart unwanted flavor. Governments throughout Europe began regulating the use of additives to include color (Downham & Collins). The United States finally reduced the number of coloring products from 700 to nine (Food and Drug Administration [FDA], 2009). The following are the certified color additives for use in food: Food, Drug & Cosmetic (FD&C) Blue No. 1, FD&C Blue No. 2, FD&C Green No. 3, FD&C Red No. 40, FD&C Red No. 3, FD&C Yellow No. 5, FD&C Yellow No. 6, Orange B and Citrus Red No. 2. There are an additional 22 colors that are exempt from certification with the FDA. These include pigments from natural sources such as saffron, caramel color, fruit juice and beet powder to name just a few (Food and Drug Administration [FDA], 2009).

Marketing food trends by major manufacturers and producers is greatly influenced by color. Downham and Collins (1999) state that color affects almost everything one does in life. From purchasing items for one's home, one's clothing, or one's food, decisions are made without realizing that color and surroundings influence those very decisions. They further hypothesize that all individuals are very sensitive to the color of food. Appetites can be influenced and stimulated by color as well as the reverse effect; color may discourage eating certain foods and diminish the desire for the food (Downham & Collins, 1999).

Colors will suggest the flavors that are anticipated when eating or drinking. A bright colored orange drink will imply the flavor of orange. Accordingly, a bright red colored drink may hint at strawberry or cherry flavor. Washed out colors of orange or red drinks may indicate a lesser quality of drink and not appear as appealing. Over the last 20 to 30 years many sociological, economic and technical issues have influenced the food industry. Foods are being processed to create visually appealing food that tastes good that can be used by single-parent families, working mothers and the elderly (Downham & Collins, 1999). This illustrates just how important color is to food choices. Dependable statistics on the size of the color market are unavailable. A 2000 estimate revealed that the $940m industry could be categorized as synthetic colors $400m, natural colors $250m, nature identical colors $189m and caramel color $100m. Food manufacturers increased use of color additives to improve the visual presence of processed foods has prompted the FDA to require all manufacturers to list all color additives on ingredient labels (Food and Drug Administration [FDA], 2009). Published figures from one major manufacturer indicate that natural colorings and flavors could reach $5.3b by 2012 (the-infoshop.com, 2009). These statistics further substantiate that color is extremely important in the food industry.

Cultural Color Concepts

It is important to understand the cultural meaning of color when discussing how color affects our choices. Table 1 highlights the meaning given to colors across cultures.

Table 1

Colors and Cultures

Color	Tradition/Country	Meaning

Red	China	Good luck, celebration, reaching upward, fire
	India	Purity
	South Africa	Mourning
	Russia	Communism
	Western cultures	Excitement, love, stop
	Cherokee Indians	Triumph, success
Yellow	China	Nourishing
	India	Merchants
	Western cultures	Hope, hazard, coward
Green	China	Exorcism
	India	Islam
	Ireland	Represents the entire country
	Western cultures	Spring, St. Patrick's Day, Christmas
Blue	Iran	Spirituality, heaven
	Cherokee Indians	Trouble, defeat
	Western cultures	Depression, corporations
Purple	Western cultures	Royalty
	Thailand	Mourning (worn by widows)
White	Japan	Death
	Eastern cultures	Funerals
	Western cultures	Angels, peace (white dove), brides, good guys
Black	China	Worn by young boys
	Western cultures	Funerals, death, bad guys

Note: From "Color Symbolism Chart by Culture; Understand the Meanings of Color in Various Cultures Around the World" by Jennifer Kyrnin, 2009. *About.com*, 1-2.

Hotels and restaurants must be aware of color meanings in different cultures when they are setting up buffets for special parties. A western wedding would not consider using black as the prevailing color due to the symbolism in this country although in recent years the generational attitude toward black has changed to one of chic sophistication.

Color and Taste Combined

The importance of color on taste perception is essential when customers decide whether or not to eat food that is prepared for them. This is why plate presentation is a key focus of top chef's nation wide (Jahnke, March 19, 2007, ¶. 1). People associate different foods with different colors. When this perception changes it often has a detrimental effect on the customer's perception of how that food should taste (Williams, 2007, p. 7). Common color and food associations are noted in the Table 2.

Table 2

Common Color and Food

Color	Food
Purple, blue	Eggplant, blackberry, purple cabbage, plum
Green	Avocado, cucumber, spinach, kale, broccoli, snow pea, zucchini, artichoke
White, tan	Cauliflower, mushrooms, parsnip, potato, ginger, onions, jicama
Yellow, orange	Papaya, pineapple, apricot, pumpkin, peach, carrot, sweet potato, orange, corn
Red	Cranberry, beet, watermelon, tomato, pomegranate, radish, strawberry

Note: From "Eating by Color for Maximum Health" by C. Williams, 2007, p. 7.

Synthetic Food Colors (Rung International, n.d.)

Synthetic food colors (see Figure 1) are man-made and used to enhance the naturally occuring color of the food without adding flavor (United States Department of Health and Human Services, 2004, ¶ 15).

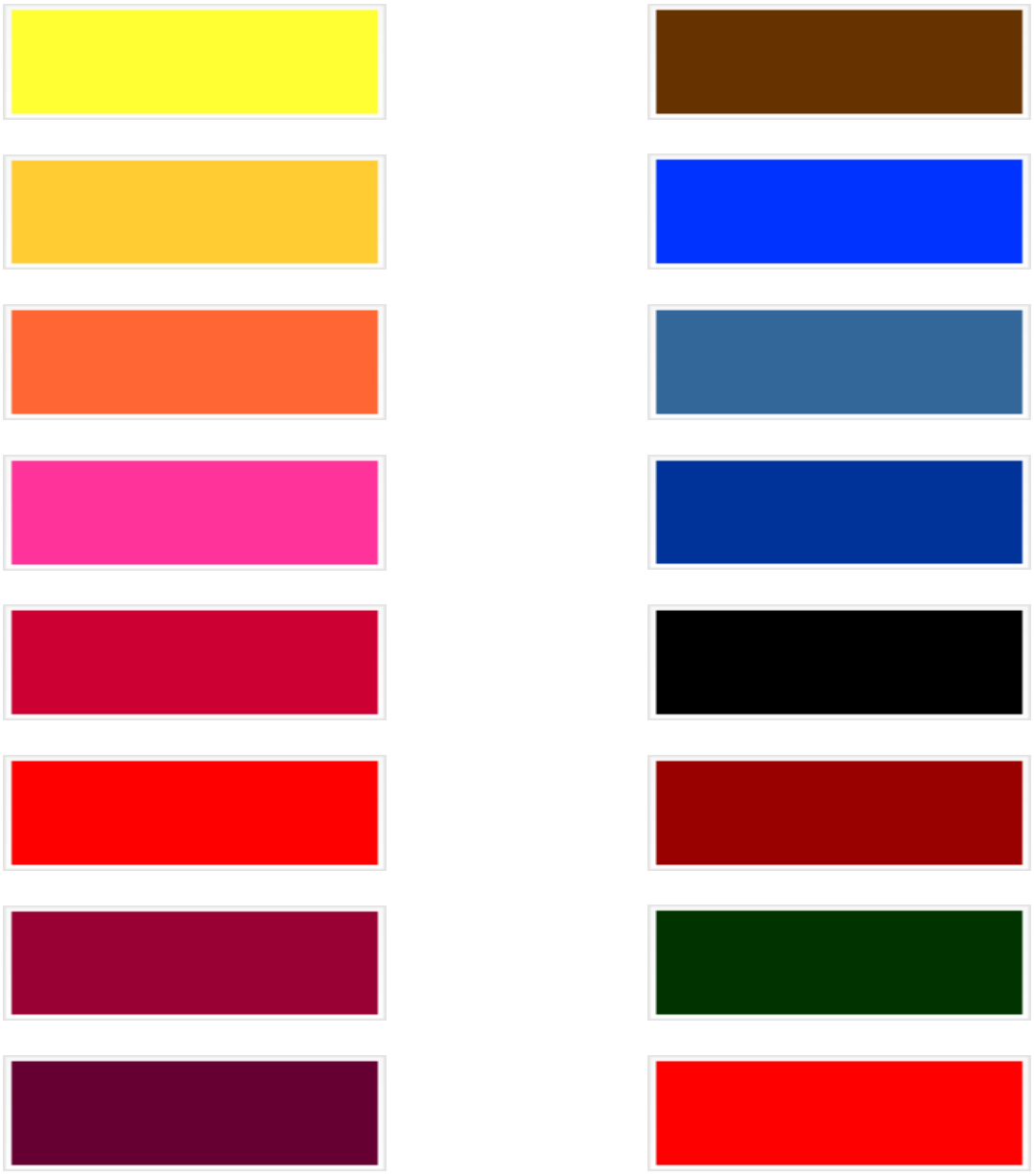


Figure 1. Synthetic food colors.

Natural Food Colors (Rung International, n.d.)

Natural food colors are those derived from the natural pigments noted in Figure 2 below (United States Department of Health and Human Services, 2004, p. 16).

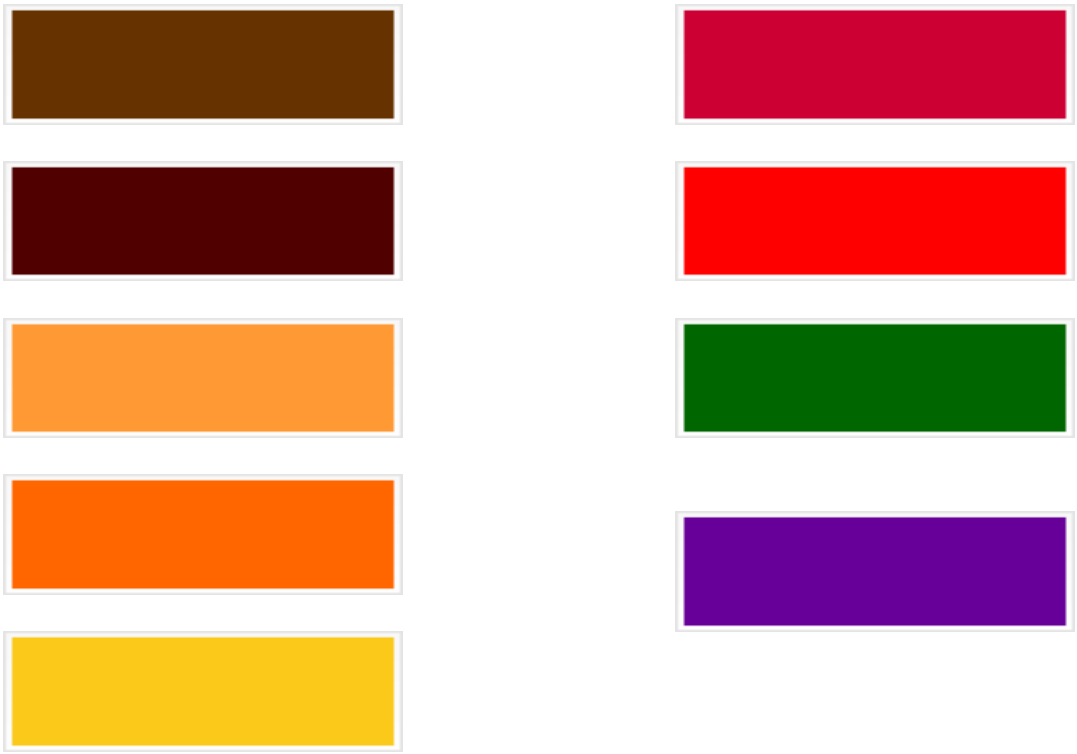


Figure 2. Natural food colors.

Food producers rely on taste association to help sell their food products. A great deal of experimentation has taken place to find the perfect color hue to enhance the food product that is being marketed. Many studies have proven that color does make a difference in food taste perception. In recent years there has been a 25% increase in the use of natural colors (Rung International, n.d.).

Special colored lighting was placed in a room where participants were to be tested. Each participant was given a plate of steak and French fries to eat. The food appeared to be a normal color; however, when it was revealed that the actual color of the steak was blue and the French fries green, some of the members of the test group became ill. This test reaction may be attributed to preconceived taste education and instinctual reaction (Jahnke, ¶ 5).

Blumenthal states that the colors blue and purple are found infrequently in foods therefore humans have a weak appetite response to these colors (Color Matters; J. L. Morton, 2008, ¶ 4). People are taught from an early age that blue and purple are associated with the idea but that food may not be safe to eat and that the taste would obviously be disagreeable. Many times, food color is used to convince taste buds that there is an increase in flavor or difference in taste perception where none really exists. The March edition of the *Journal of Consumer Research* published an article entitled, "Tastes Perception: More than Meets the Tongue". Hoegg and Alba focused on taste perception and color. Incremental changes in color and sweetness of orange juice revealed that participants found a greater difference in taste perception of juice with different colors than of juice with varying degrees of sweetness (Hoegg & Alba, 2007, p. 492). This affirms that color has a great influence on taste perception.

There have also been attempts by food manufacturers to create products with different colors to increase marketing sales. The Heinz Ketchup Company developed ketchups in an array of rainbow colors beginning with green, then purple, pink, orange and finally blue. Their target market was children. After a few years the products were discontinued because of lack of interests from young people (Jahnke, March 19, 2007, ¶ 8). Another example of product development influenced by color was the marketing decision to produce Crystal Pepsi in 1992. The cola product was a colorless, caffeine-free soft drink. The product never became successful and this was attributed to the fact that people associate different colors with different tastes. Many people trying the new Pepsi product said it tasted like lemon lime soda. None of these flavors were part of the ingredients (Jahnke, ¶ 9). Because of the training the brain receives throughout a lifetime in regard to the perception of taste and color associations, it is difficult for the brain to conceive change of taste on preconceived notions. Too many people eating green ketchup perceived that it did not taste like regular red ketchup even though the formula was identical.

Another example of taste and color perceptions is the sensory evaluation of wine, which is based on psychological concepts and the senses of taste, smell, sight and touch (Nemanic). The first step to tasting wine involves picking up the glass by the stem, tilting it away from the body and placing the glass over a white surface to observe the color of the wine. The observation should include the depth of the wine's color. Brown tones in wine will sometimes indicate age. The viscosity of a wine can be checked by swirling the wine in the glass. When judging wines they are placed next to each other for hints on how the wine will taste. A stronger and deeper color indicates that the wine will taste richer and more full-bodied (Smith, 2003).

Ross, Bohlscheid, and Weller conducted research in the visual masking techniques of two wines by trained assessors. Their study was based on the technique called color masking. Masking uses color variants to disguise the wine in order to minimize sensory perceptions of the evaluator panelists (Ross, Bohlscheid, & Weller, 2008). The masking techniques used (1) blue wineglass/white illumination, (2) clear glass/red illumination, and (3) clear glass/white illumination. There were 10 panelists in the study. The trained panelists were affected by the masking technique of red illumination being served in clear glasses. Each member of the trained panel indicated that they would perceive a spicier more intense flavor, while wine served in blue glasses were considered to be more astringent. The consumer panel indicated that the clear glass illuminated red resulted in a perception that the wine would be more astringent, and the blue glass resulted in the expectation the wine would taste more flavorful and appealing (Ross et al.). Masking techniques influenced the perceptions of both trained and untrained panelists. The overall conclusion of the study was that the visual sensory perception of the product may be influence by masking techniques.

A 2006 study by university scientists in Spain found flavor intensity improved when mandarin juice was added to orange juice to enhance the color. Regular juice consumers tested preferred orange juice that was colored with up to 10% mandarin juice. The results revealed consumers' perception that the richer colored orange juice had a bolder taste profile. Orange juice in the US can by mixed with up to 10% mandarin juice to improve its color (Perez-Lopez, Beltran, Serrano-Megias, Lopez, & Carbonell-Barrachina, 2005).

In 1996 Costa Magoulas, coordinator of culinary operations, conducted a simple study (Magoulas, 1996) pertaining to how color affected people's tastes. Ten staff members of a cafeteria kitchen operation were selected to take part in the taste tests. The following

information was gathered from each individual: age, gender, ethnic background, and the region of the country in which they were raised. Each member of the test group was brought into a room and asked to taste a plain gelatin, then describe sensory flavor. Next, four puddings colored blue, green, red and yellow were placed in front of each member. Tasters were asked to pick the pudding they preferred.

The plain gelatin was flavored lemon but appeared plain. Four tasters identified the gelatin as having no flavor, two members of the tasting panel identified the flavor as lemon, two tasters identified the flavor as a vegetable taste, and two members could not identify the flavor although it tasted sweet.

The results of the pudding tasting was that five members of the panel chose red, three chose yellow, two chose green and no tasters chose blue. It is important to note that all of the puddings were flavored with vanilla although all tasters who chose the red color indicated that it had a berry flavor, the two yellow and two green puddings chosen by panel members stated the puddings tasted like cake icing, which was similar to the vanilla. One taster choosing yellow indicated a lemon flavor.

Overall conclusions of the gelatin test indicated people have a need to be able to see and connect color with taste to get a better understanding of the sensory perception. The conclusions of the pudding test indicated that blue is not a very popular color in food.

Conclusion

The importance of sensory perception of color and how it relates to food choices is validated through a variety of studies conducted by researches at universities and in the science community world wide. The purpose of this literary review was to collect scientific information

pertaining to the early history of food dating back to early man and how color affected the foods that were eaten. Scientific information was gathered on the sensory perception of taste, and the science of taste was examined and documented. Information proved that taste is the body's sensory ability to distinguish sweet, sour, salty, and bitter. A new taste called Umami is also documented. Taste is actually the last step in sensory perceptions. Food is first visualized and then place into the mouth. Studies indicated that taste is influenced by external perceptions such as sight, sound, touch and smell as well as internal perceptions such as hunger, thirst, balance and pain. Scientific studies were used to conclude that color has been used for centuries to enhance food acceptance. This practice dates back to the ancient Egypt, Greece, and Rome.

Synthetic color and natural color additives are being used by manufacturers to enhance the marketability of food products. The servicescape of a hotel or restaurant also has a direct effect on the way people perceive tastes because of the ambience created with color and the type of lighting used. Many examples of food products are noted indicating how the sensory perception of color has affected those choices to customers.

This information will be used to develop a lesson plan describing the science of taste, the science of color as a sensory perception, and how to use color to enhance the dining experience. The lesson plan will include a PowerPoint presentation, written material and gradable test that will allow the student to gain a better understanding of how color affects food choices of customers.

Part Three

Introduction

A course based on how color affects food choices will be experienced by students through lecture, hands-on taste testing and classroom experimentation (Appendix A). Assessments will measure the overall level of comprehension by the end of the course. The lesson plan begins with a lecture (Appendix B) on the history of food, developed from literature reviews and an unpublished work by Costa Magoulas (Magoulas). Next there will be a lecture (Appendix C) with a slide presentation focusing on the science of taste and how taste works (Appendix D). A hands-on taste testing will follow that will allow students the opportunity to synthesize the science of taste. The tasting will consist of a variety of salts and sugars (Appendix E). Afterwards, a lecture on color and its influence on daily living as well as its influence across cultures will be presented as cited in Appendix F using the presentation cited in Appendix G.

The combination of materials presented from the history of food to the science of taste will aid students in developing an understanding on how color influences food choices of the hospitality foodservice customer.

Results

The goal of this course is to help hospitality industry employees develop a better insight into the world of taste to understand how people use color when looking at and choosing food. Questions that students will be able to answer afterwards include (1) why does color have such an influence on food choices, (2) do taste and color work together to achieve a satisfied palate for customers, and (3) can food colors have a negative effect on food choices?

Two assessments (Appendix H and I) will be given during the course to measure the students' knowledge of the subject matter presented that will make up half the students' grades. Assessment answer guides are supplied for the convenience of the instructor (Appendix J and K). Class participation will constitute the other half of the students' grades for the course.

Conclusions

The importance of understanding the effect color has on food choices is paramount to hospitality industry employees. Those responsible for accepting, preparing, designing, displaying, and serving food items will be able to offer insight to the hospitality team as to the scientific and cultural aspects of making foods appealing to a broad range of customers in a variety of venues. By correctly assessing daily encounters, the hospitality employee may contribute to the positive outcome for both customer satisfaction and company revenues.

Appendixes A through K provide the necessary documentation for presenting this course for maximum effectiveness.

Recommendations

The course is designed to be presented to students from secondary school culinary programs through college level hospitality programs. The application of the new-found knowledge will allow students to develop a keener sense of why color affects food choices made by hospitality foodservice customers.

Appendix A

Syllabus: HOW COLOR EFFECTS FOOD CHOICES

COURSE DESCRIPTION: An introduction to the science of taste and how it is affected by color.

COURSE OBJECTIVE: To develop an understanding of the science of taste and how color relates to customer satisfaction.

TEXT: How Color affects Food Choices (2009). Unpublished Professional Paper for University of Nevada-Las Vegas. Magoulas, C: author. Web site for off campus students: www.pureandnobleprofession.com.

SUGGESTED WEB SOURCES:

- American Culinary Federation at www.acfchefs.com
- Food and Drug Administration at http://www.fda.gov/Food/default.htm
- American Marketing Association at http://www.marketingpower.com/AboutAMA/Pages/AMA%20Publications/AMAPublications.aspx
- Restaurant Hospitality at http://restaurant-hospitality.com/

LEARNING OUTCOMES:

- To define the history of food and its influence on America culture
- To examine and classify the different scientific elements of taste
- To differentiate the many aspects of colors and how colors influence our choices in life
- To apply the understanding of color to customer food choices
- To distinguish the variety of attributes of sugars and salts
- To take part in a color taste test

GRADING:

Grades will be based on 200 points.

Protocol: 90-100 A 80-90 B 70-79 C 60-69 D 59-less F

Class Assessment 1-History of Food	50 points
Class Assessment 2-Science of taste	50 points
Class Participation 1-Savor the Flavor	50 points
Class Participation 2-Color Taste Test	50 points
	200 points

NOTES:

- Students are expected to maintain a professional manner and dress in accordance with hospitality industry standards while in the classroom and kitchen.
- Academic integrity is everyone's responsibility. It is expected that students will abide by the Code of Conduct set forth by the institution.
- Each student will complete a teaching evaluation at the end of the course for quality assessment of coursework presented by the faculty member or seminar leader.
- Instructor Contact information: Costa Magoulas, CEC, CCE, CCA, AAC; cell 386.316.4228 or chefmagoulas@yahoo.com.

Appendix B

Lecture Notes Outline-The Fuel that Fired History

A. Cave men

   a. Raw food-fire-cooked food

   b. Man lived longer

   c. Fire influenced history from that point forward

B. Food is power

   a. Basic to cultures and societies

      i. Diet of urban worker inadequate-crowded with immigrants

      ii. Slaughter of bison detrimental to American Indian way of life

      iii. Sourdough bread from California-basic to western wilderness pioneers

      iv. Germans brought one-pot cooking, Italian's brought tomatoes

      v. Chinese and Italian immigrants opened first American restaurants

      vi. Roman catholic's brought meat-less Friday's

   b. Fortunes of government-feast and famine

      i. 1919 Volstead Act-constitutional amendment outlawing commercial manufacturing and sale of alcoholic beverages

      ii. Bars turned into sandwich and lunch counters

      iii. Great Depression increased consumption of dried beans; meat consumption declined 30%

      iv. War time increased consumption of perishables so staples could be shipped to troops overseas

      v. 1940's School Lunch Program

C. U. S. History 1865 to present

a. 19th century trends revolutionized the American diet
    i. People moving westward
    ii. Laborers needed cheap food
    iii. New middle class needed food
    iv. Exporting margarine and butterine to Britain
b. Immigration brought foods from around the world-Europe and China
c. Industrial revolution
    i. Railroads afforded mass transit of food across nation
    ii. Value in bulk transportation of goods
    iii. Supply of cheap American grain to other parts of the world
d. Industrial technology
    i. Cast iron stoves vs. open fire pits
    ii. Canning vs. fresh fruits and vegetables
    iii. Icebox-invented in Maryland
    iv. Refrigeration-meats, produce, milk, eggs
    v. Sanitation in meatpacking houses was deplorable
    vi. First pure food and drug law mandated inspection of goods sold interstate-President Theodore Roosevelt
    vii. Sugar sales surged
    viii. Coffee processing introduced Maxwell House coffee-from Nashville hotel
    ix. Grocery chains stores
e. Maslow's Hierarchy of Needs

f. World War I-unfit Europeans and Americans eating poor diets

g. Manufacturing of foods-canned, branded, stable prices

D. Impact of science on food

a. Food sold to rich was adulterated-dangerous ingredients

b. Food preservation-excluding air-end of 18th century

c. Louis Pasteur-pasteurization saved lives

d. Vitamins discovered in 20th century

e. Finer quality glass and optical science-vast improvements in microscopes

f. Advancements in biology and chemistry-founded science of bacteriology

Appendix C

Savor the Flavor Lecture Outline

- How we taste-today's discussion
  - Anatomy of taste
    - The tongue
    - The nose
    - The brain
    - Ready, set, taste
- The five senses
- The world of taste
  - The tongue
  - Anatomy of the tongue
- Ready, set, taste
  - Sweet-an agreeable taste, smell, sound
  - Salty-a tang or piquant taste
  - Sour-having a sharp acid taste tart
  - Bitter-having a sharp disagreeable taste-as quinine
  - Umami-the fullest of senses that encompasses sight, smell, touch, hearing and taste employing emotion and intellect
- The nose and tongue working together taste and smell
  - Share the same airway
  - Chewing food causes vaporization
  - Smell receptors – 5 million

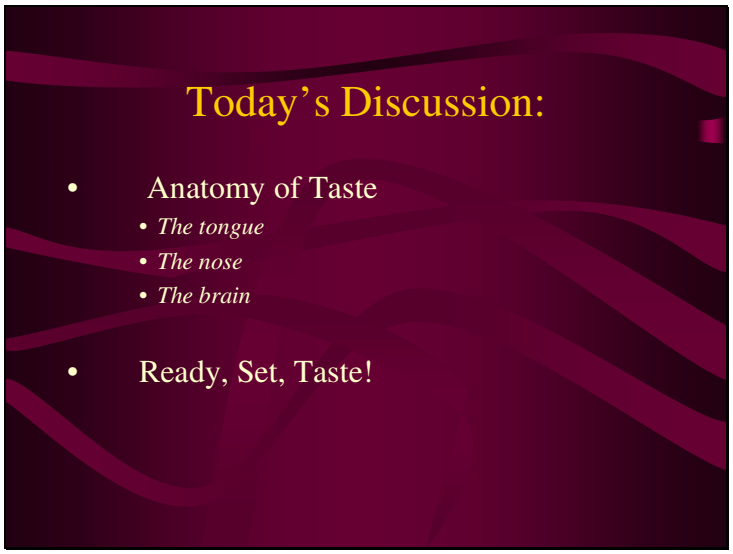
- Fist line of defense against poisoning
    - Bitter and rancid foods vaporize well
- One molecule can

- Blind taste test
    - Five volunteers-blindfolds please
    - Sweet – honey powdered-fructose
    - Salt – seasoning salt – celery salt
    - Bitter – tonic water – liquid smoke
    - Sour – balsamic vinegar – tomato paste
    - Your nose knows-rose water and wasabi
- Now it's time to enter the word of taste
- Taste is a celebration of the sense and seasons
- It is state of mind…a state of fulfillment

Appendix D

Slide 1

Slide 2


Today's Discussion:
Anatomy of Taste
The tongue
The nose
The brain
Ready, Set, Taste!

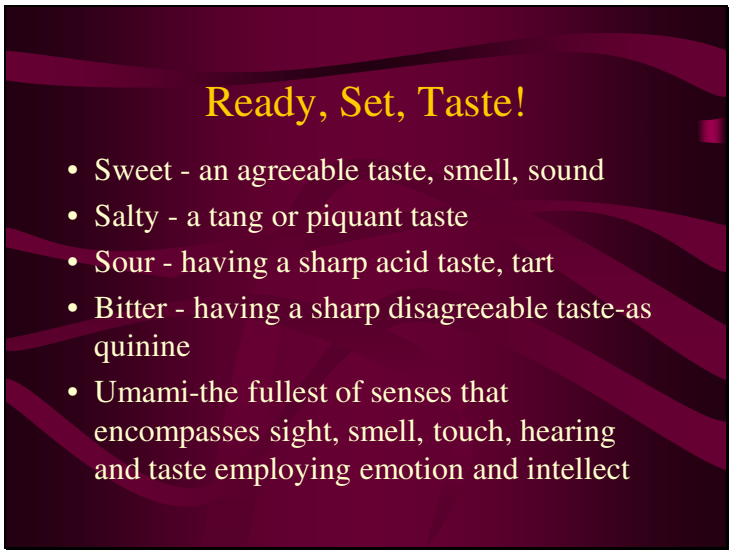
Slide 3


The Five Senses
•Internal
•hunger
•thirst
•balance
•pain
•External
•sight
•sound
•touch
•smell
•taste

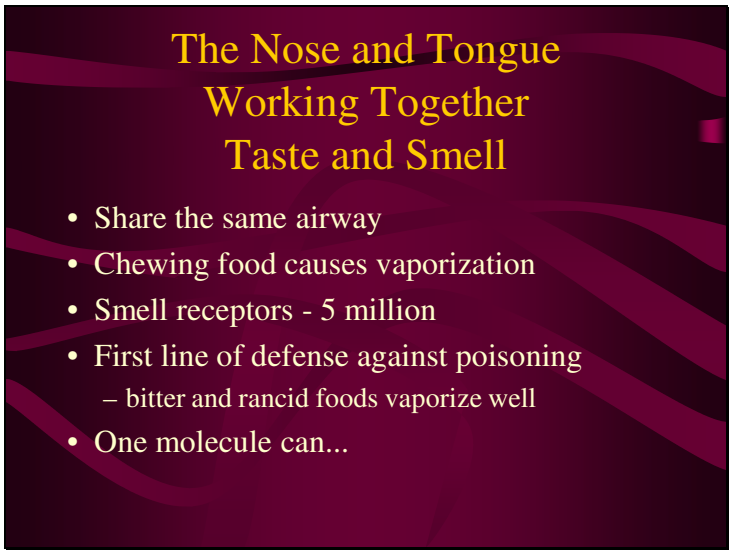
Slide 4


The World of Taste
The Tongue
Anatomy of the tongue
Sour
Umami
Salty
Bitter
Sweet

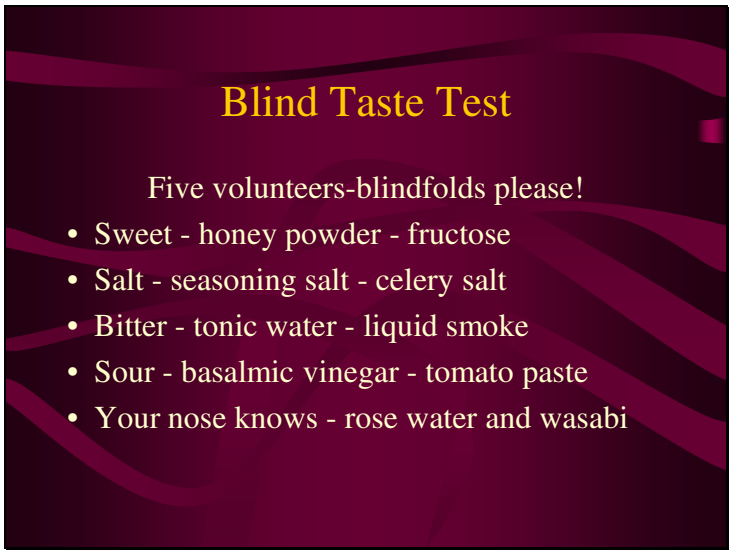
Slide 5


Ready, Set, Taste!
• Sweet - an agreeable taste, smell, sound
• Salty - a tang or piquant taste
• Sour - having a sharp acid taste, tart
• Bitter - having a sharp disagreeable taste-as quinine
• Umami-the fullest of senses that encompasses sight, smell, touch, hearing and taste employing emotion and intellect

Slide 6


The Nose and Tongue
Working Together
Taste and Smell
• Share the same airway
• Chewing food causes vaporization
• Smell receptors - 5 million
• First line of defense against poisoning
– bitter and rancid foods vaporize well
• One molecule can...

Slide 7


Blind Taste Test
Five volunteers-blindfolds please!
• Sweet - honey powder - fructose
• Salt - seasoning salt - celery salt
• Bitter - tonic water - liquid smoke
• Sour - basalmic vinegar - tomato paste
• Your nose knows - rose water and wasabi

Slide 8

Slide 9


Taste is a celebration of the
senses and seasons.
It is a state of mind…
a state of fulfillment.

Appendix E

Savor the Flavor Tasting Seminar for Class Participation

STUDENT EXPECTATIONS

- Students will develop an understanding of how salts and sugars differ in taste
- Students will have the opportunity to discuss their perception of differences in tastes of salts and sugars
- Students will learn to understand the differences in the five taste perceptions
- Students will add to their knowledge base and experiences that will benefit their advancement in the hospitality industry

TASTING MATERIAL

Table salt
Kosher salt
Sea salt
No salt substitute
Seasoned salt (Mrs. Dash)
Table sugar
Fructose
Brown sugar
Turbinado sugar
Corn syrup
Honey
Sugar-free substitute
Tasting spoons
4 ounce plastic cups
Bottled water
Paper bags
Two large trays
Lemons
Toothpicks

PROCEDURE

1. Place each salt and sugar tasting sample into individual 4 oz cups; label 1, 2, 3, etc.
2. Separate the salts and sugars into the two trays.
3. Place a quantity of small tasting spoons onto each tray**.**
4. Place a few paper bags onto each tray for used spoons.
5. Place cut wedges of lemon into two 4 oz cups.
6. Place a quantity of toothpicks on each tray for lemon tasting.
7. Supply each taster with a bottle of water for cleansing the palate during the tasting session.

8. Lecturer will walk students through tasting each sample using the information from the Table 1.
9. Class will participate in discussions as each sample is tasted.

Table 1

SALTS	SUGARS
• Table salt—Sodium chloride, 25 million tons a year, most common. Steam cleaned from salt mines. All salt come the sea. Much of the world's production comes from salt mines which are dried sea beds. • Kosher salt—many small cubes stuck together making it ideal for curing. Kosher salt usually has no additives. It received its name because it is used by the Jewish religion to make meat kosher. The Koran prohibits consumption of any blood. Jewish food law requires that kosher meat must be slaughtered and prepared in a certain manner and a common way to remove final traces of blood from meat is to soak and salt it. Kosher meat has a distinct flavor. • Sea salt—sun and wind evaporation is used leaving a fine light crystal high in minerals. • No salt products—Potassium chloride. • Season salt—a combination of herbs and spices that enhances the flavors of foods without the use of salt.	• Table sugar—made from sugar cane or sugar beets highly refined. Powdered sugar is granulated sugar that has been crushed with a small amount of cornstarch added. US consumption is 157 pounds per year per person. In the 1600's sugar consumption was 7 pounds per year per person. • Fructose — made from fruit, it is the sweetest sugar. Also found in honey. One only needs to use 1/3 of regular sugar. • Brown sugar—made from white sugar combined with molasses. • Turbinado sugar—100% pure sugar cane with natural molasses. • Corn syrup—high fructose is produced by processing corn starch to yield glucose to the exact same sweetness and taste. It is actually cheaper than sugar. It is the largest percentage of sweetener used in processed food. • Honey/ natural sucrose—very healthy, 300 different varieties. Sterile, it was used as an antiseptic during World War II. • Sugar free substitute—170 pounds per year per person is used. 20 pounds p/p aspartame or saccharine.

Note: From "Magoulas, C."

Appendix F

The First to Feast is the Eyes Lecture Outline

- In the hospitality industry color plays a major role in customer satisfaction
- Before we allow food to pass our lips, it must be pleasing to the eye
- Color effects our taste, our mood and our inner comfort level
- The WOW factor
- Chefs attempt to create food that sends a signal to the brain that will stimulate taste
- The International Journal of Food Science and Technology states that color effects almost everything one does in life
- Hotels use the same WOW factor using elaborate facades and lobbies matching beautiful colors to entice customers
- Color has been used for centuries to enhance food acceptance
- The early Romans and Egyptians colored wine with herbs and spices to make it more appealing
- Synthetic colors have been used by the commercial food industry since the late 1800s
- Appetites can be influenced and stimulated by color
- Color may also discourage eating certain foods and diminish the desire for eating
- People associate different foods with different colors
- When this perception changes it has a detrimental effect on customer perception of how food should taste
- How would you react to : blue beef steak or French fries, green pumpkin or beets, red cauliflower or onions, white strawberries or avocado, green cooked eggs or fish

- Many times food color is used to convince taste buds that there is an increase in flavor or difference in taste perception when none exists
- A study of orange juice was conducted
- Orange juice was made with 10% mandarin orange juice giving it a bolder richer color
- Orange juice was made with a higher content of sugar with no mandarin juice added
- Test groups picked the juice with mandarin orange, stating that it was sweeter and had a bolder taste
- The Pepsi Company in 1992 introduced Crystal Pepsi; a clear color tasting beverage.
- After a few years the product was discontinued
- Many complained that it had a lemon lime taste on preconceived notions
- Cola should be brown; ketchup should be red
- Studies indicate that most people make their choices within 90 second of their encounters with people or products
- When choices were made, 60-90% of the decision making process was based on color alone
- Fast food restaurants studied have shown that red colors and yellow colors stimulate appetites
- Formal restaurants try to create a different atmosphere by using the color blue and soft hues resulting in a longer customer stay which increases meal check average
- Identical foods were served in a school cafeteria and then in the school restaurant
- The food served in the restaurant setting was rated higher in sensory appeal
- Color must be considered in decor, lighting, plate and food presentation
- The natural color of food is what we have been trained to accept

- The first to feast really is the eyes!

Appendix G

Slide 1

_____

_____

_____

_____

_____

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_____

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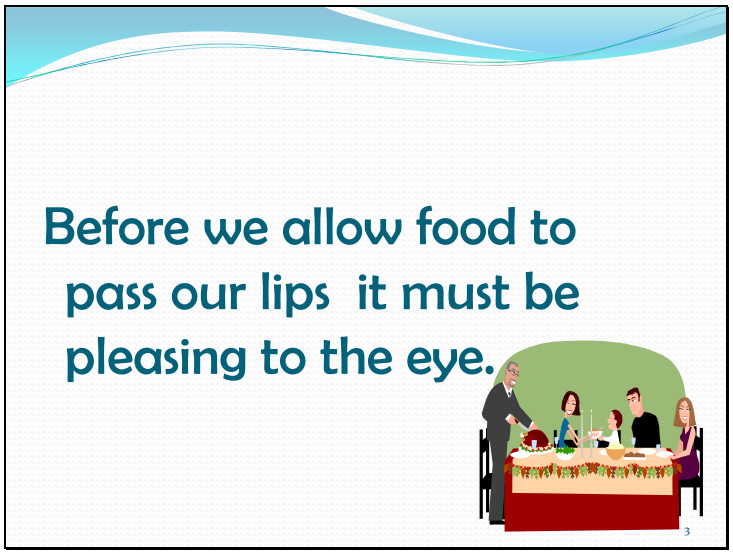
Slide 2


Color and Food
In the hospitality industry color plays a major role in customer satisfaction.
happy
day!
2

Slide 3

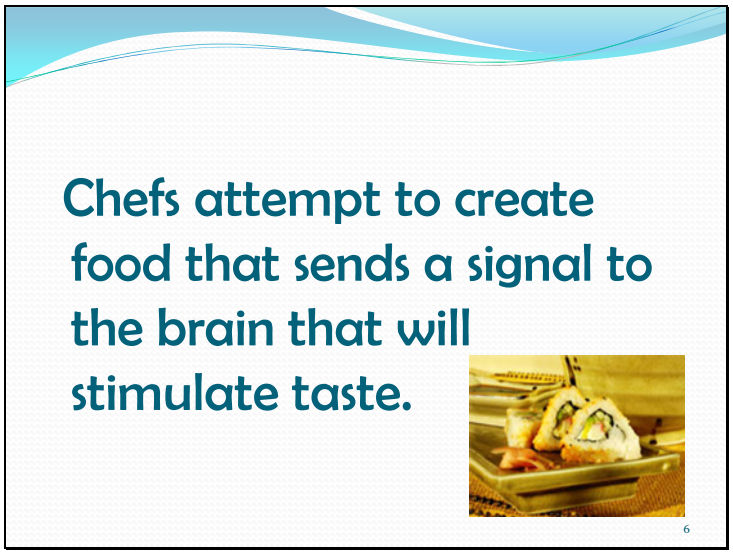

Before we allow food to pass our lips it must be pleasing to the eye.
3

Slide 4


Color effects out taste, our mood and our inner comfort level.
4

Slide 5

Slide 6


Chefs attempt to create food that sends a signal to the brain that will stimulate taste.
6

Slide 7


The International Journal of Food Science and Technology states that color effects almost everything one does in life.
7

Slide 8


Hotels use the same WOW factor using elaborate facades and lobbies matching beautiful colors to entice customers.
8

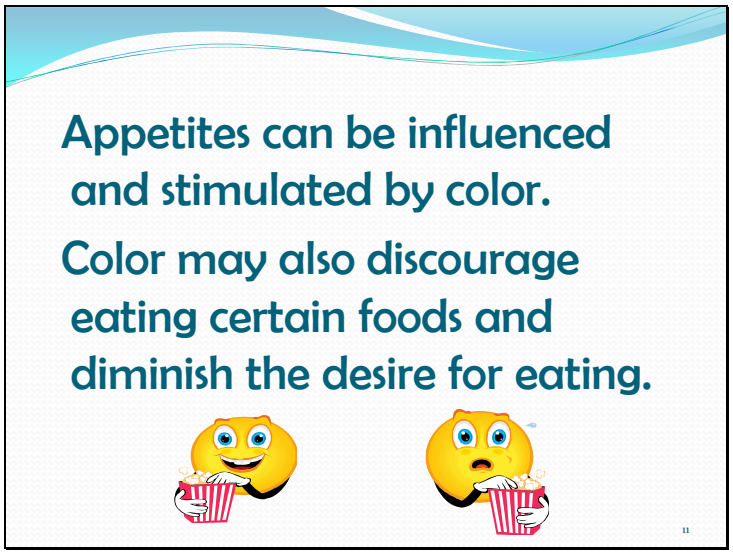
Slide 9


Color has been used for centuries to enhance food acceptance.
The early Romans and Egyptians colored wine with herbs and spices to make it more appealing.
9

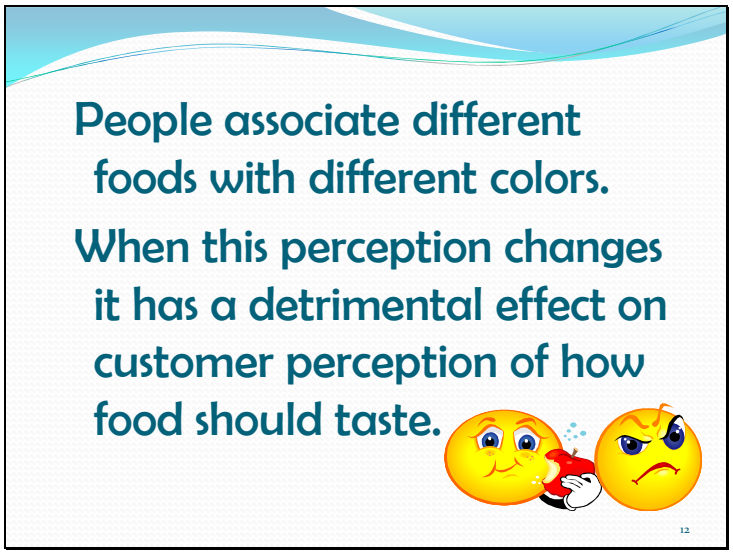
Slide 10


Synthetic colors have been used by the commercial food industry since the late 1800s.
10

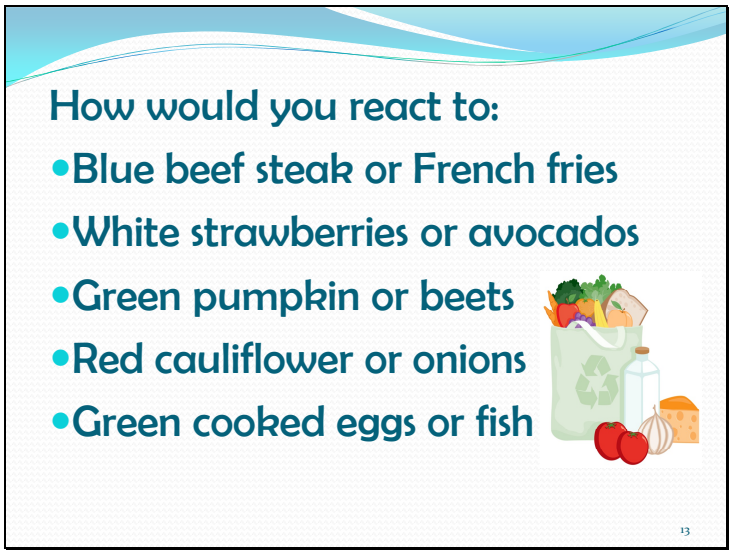
Slide 11


Appetites can be influenced and stimulated by color.
Color may also discourage eating certain foods and diminish the desire for eating.
11

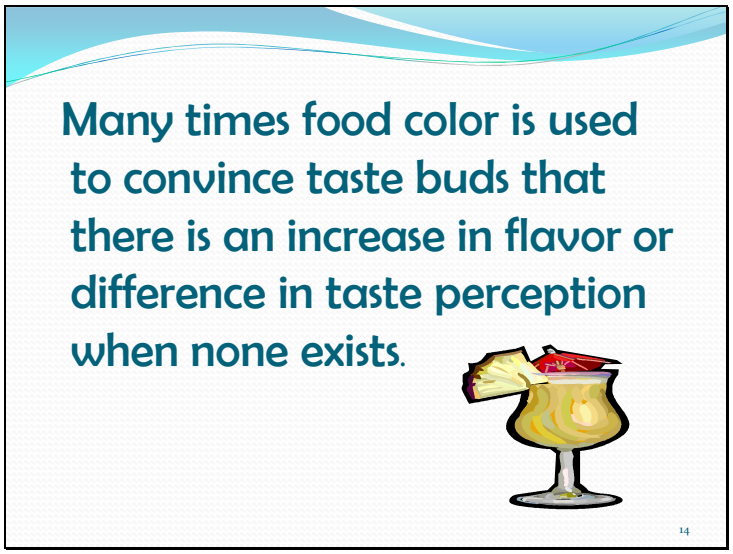
Slide 12


People associate different foods with different colors.
When this perception changes it has a detrimental effect on customer perception of how food should taste.
12

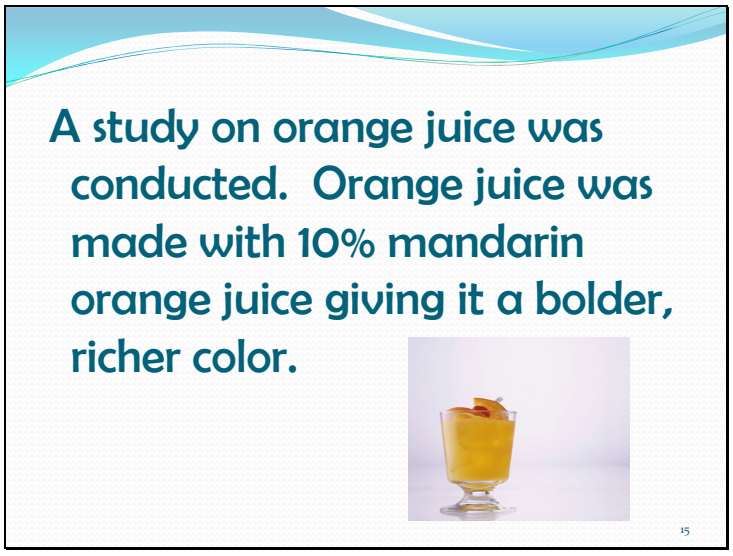
Slide 13


How would you react to:
•Blue beef steak or French fries
•White strawberries or avocados
•Green pumpkin or beets
•Red cauliflower or onions
•Green cooked eggs or fish
13

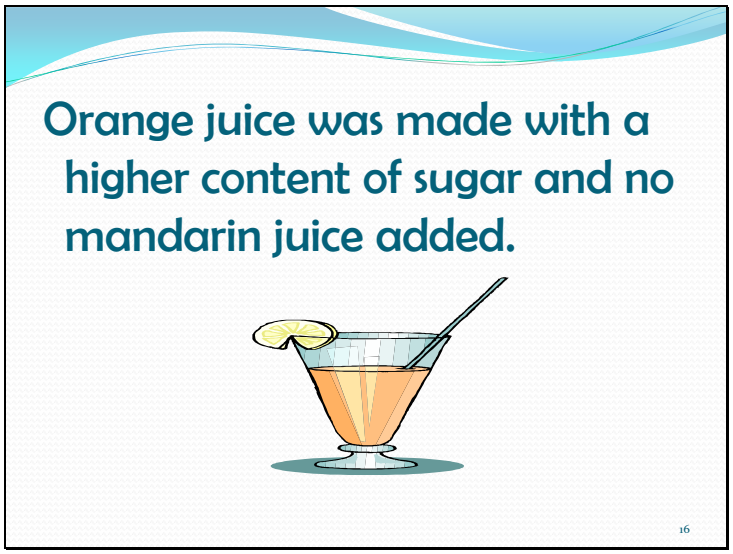
Slide 14


Many times food color is used to convince taste buds that there is an increase in flavor or difference in taste perception when none exists.
14

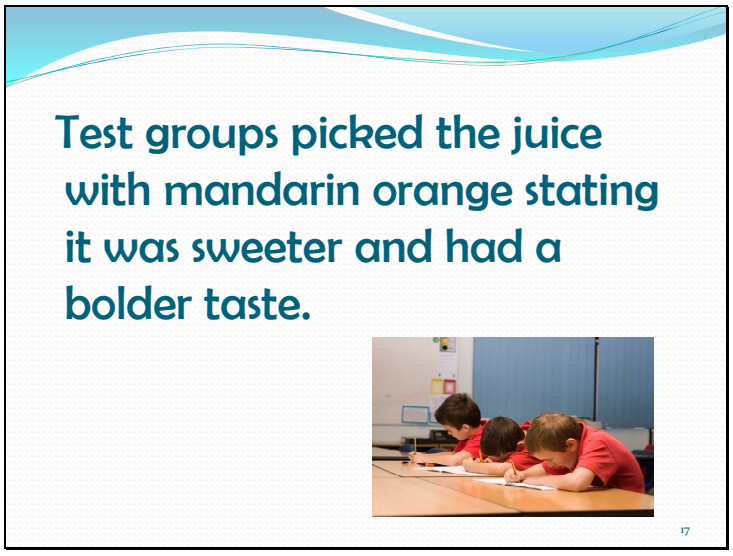
Slide 15


A study on orange juice was conducted. Orange juice was made with 10% mandarin orange juice giving it a bolder, richer color.
15

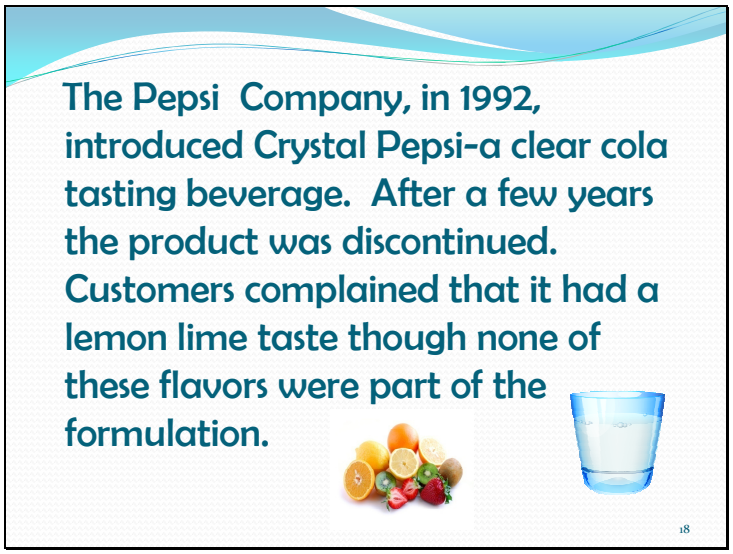
Slide 16


Orange juice was made with a higher content of sugar and no mandarin juice added.
16

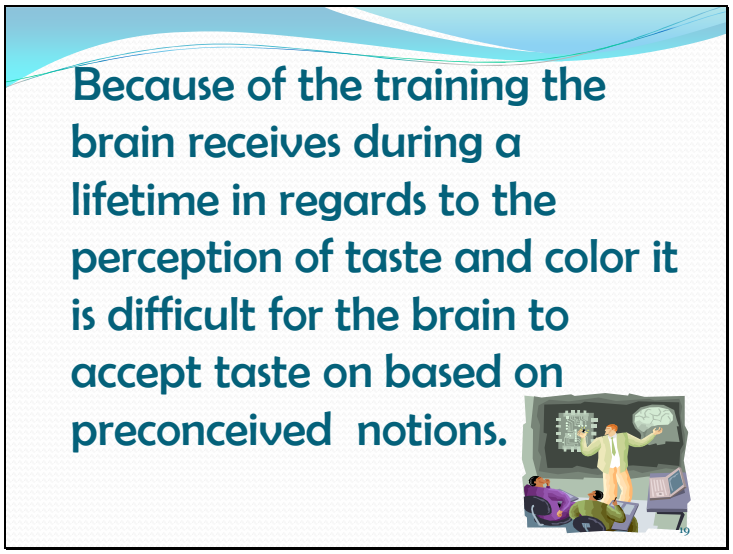
Slide 17


Test groups picked the juice with mandarin orange stating it was sweeter and had a bolder taste.
17

Slide 18


The Pepsi Company, in 1992, introduced Crystal Pepsi-a clear cola tasting beverage. After a few years the product was discontinued. Customers complained that it had a lemon lime taste though none of these flavors were part of the formulation.
18

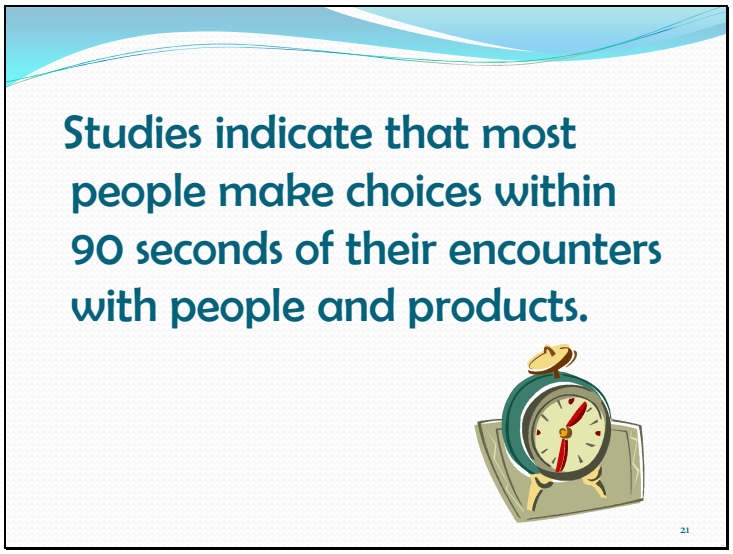
Slide 19


Because of the training the brain receives during a lifetime in regards to the perception of taste and color it is difficult for the brain to accept taste on based on preconceived notions.
19

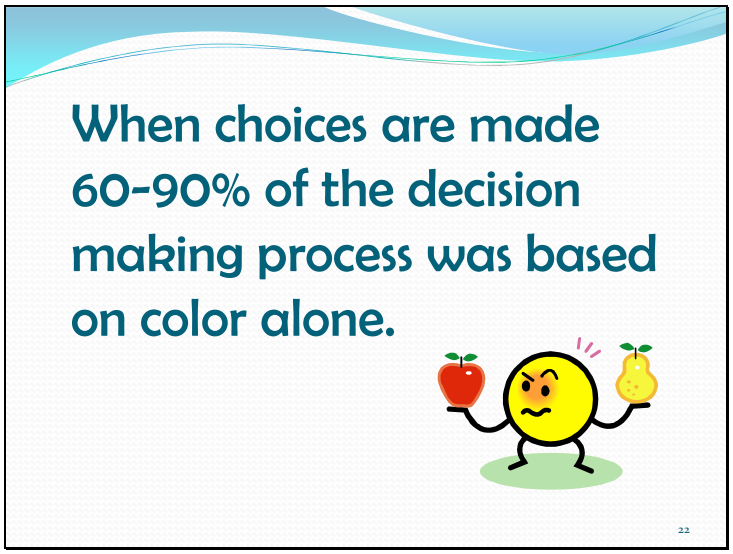
Slide 20


So...our brain says...
✓Cola should be brown
✓Ketchup should be red
20

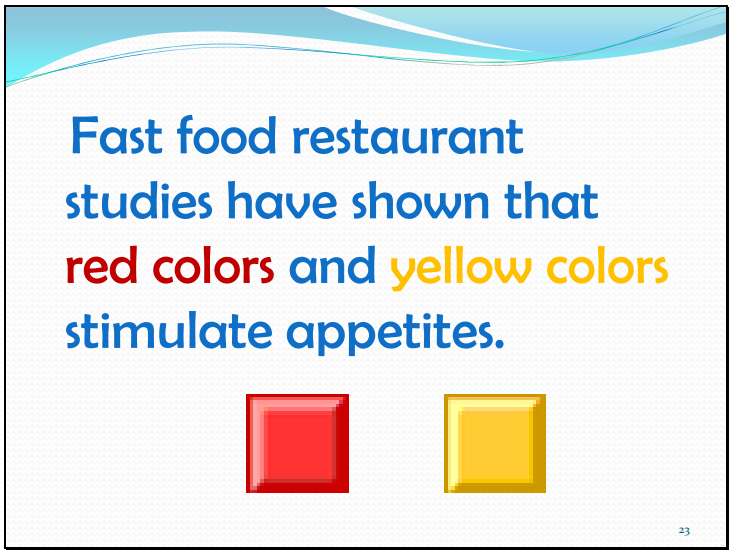
Slide 21


Studies indicate that most people make choices within 90 seconds of their encounters with people and products.
21

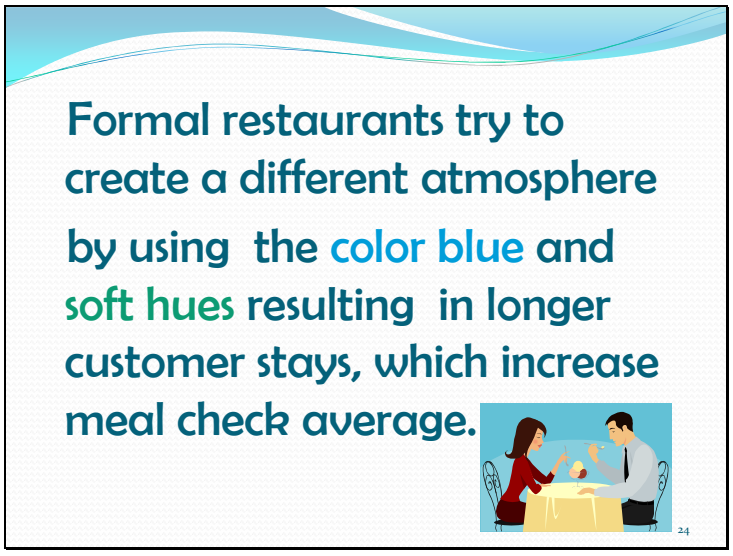
Slide 22


When choices are made 60-90% of the decision making process was based on color alone.
22

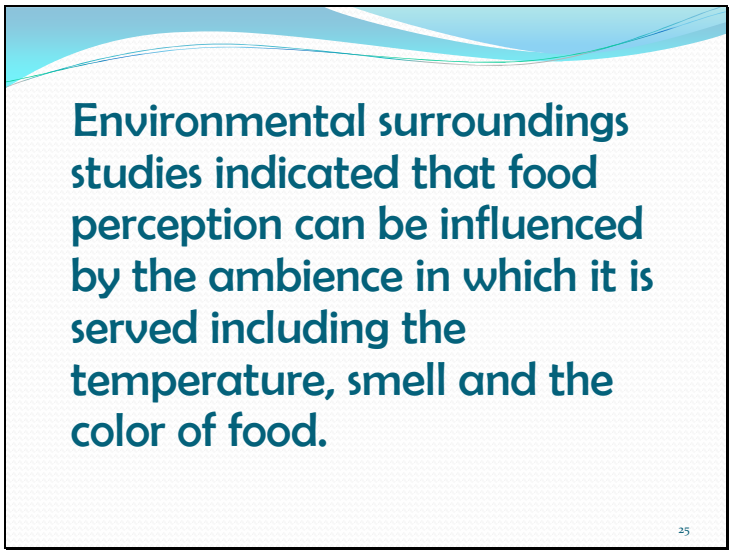
Slide 23


Fast food restaurant studies have shown that red colors and yellow colors stimulate appetites.
23

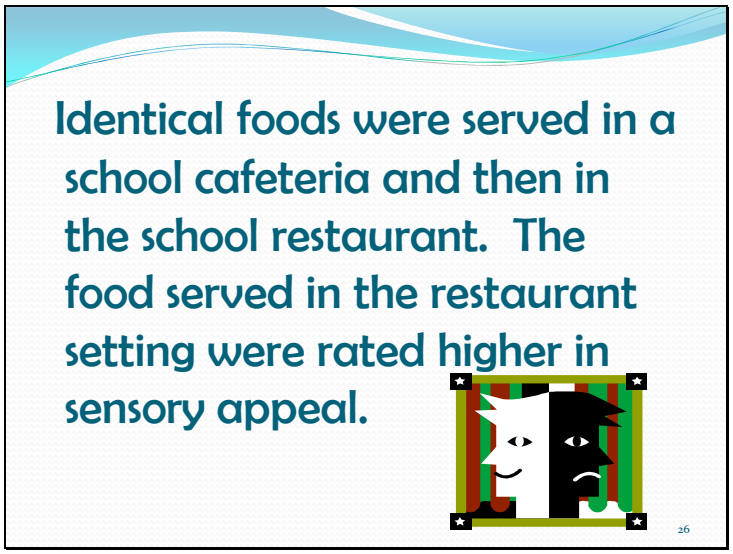
Slide 24


Formal restaurants try to create a different atmosphere by using the color blue and soft hues resulting in longer customer stays, which increase meal check average.
24

Slide 25


Environmental surroundings studies indicated that food perception can be influenced by the ambience in which it is served including the temperature, smell and the color of food.
25

Slide 26


Identical foods were served in a school cafeteria and then in the school restaurant. The food served in the restaurant setting were rated higher in sensory appeal.
26

Slide 27


Color must be considered in decor, lighting, china, food presentation and in the natural color of food that we have been trained to accept.
27

Slide 28

Slide 29

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Slide 30

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Appendix H

ASSESSMENT 1 - FOOD HISTORY

1. Few things are as basic to society and culture as
   a. power
   b. land
   c. government
   d. food

2. All history is affected by the needs of people. One of the best known models for explaining individual needs is
   a. the Declaration of Independence
   b. Maslow's Hierarchy of Needs
   c. the principals set forth in Grecian democracy
   d. the development of labor unions

3. The key fundamental contribution to the science of food diet and history was not to come until the _____ century.
   a. 20th
   b. 19th
   c. 18th
   d. 17th

4. Research in biology and chemistry was sparked by the development of the finer quality glass that was used in the
   a. development of better china for dining
   b. development of better glass containers to hold beverages and food
   c. development of better windows to insulate homes
   d. development of more accurate lenses for microscopes

5. _____ was/were the first to influence the quality and quantity of food that fueled the Industrial Revolution.
   a. Shipping
   b. Horses
   c. Mass transit
   d. Railroads

6. Americans who had migrated from rural regions where hunting, fishing, and gathering of fresh fruit and vegetables was common were crowded together into cities. Consequently

the diet of urban workers became inadequate in many areas especially in_____ and _____, which was nearly nonexistent in city life.

a. beef and pork
b. chicken and fish
c. fruits and vegetables
d. cheese and dairy products

7. The advent of steamships near the end of the 19th century brought large waves of non-English speaking people into the United States. Italian immigrants brought with them_____

a. pasta
b. pizza
c. fresh tomatoes
d. cheese making

8. The Industrial Revolution also ushered in new technology to the kitchen. The_____ made the biggest impact for women working in the kitchen.

a. ice box
b. stove
c. canned food
d. recipe books

9. _____ probably did more to change the flavor and the direction of history than any other invention by bringing with it better health as well as enjoyment to the table.

a. fresh fruits and vegetables
b. fresh meat
c. white flour bread
d. refrigeration

10. The future has accelerated demand for_____ and _____ above all other things pertaining to society.

a. fast foods and microwave food
b. ethnic and exotic foods
c. speed and convenience
d. government and technology

Appendix I

Assessment 2 - Savor the Flavor

1. The anatomy of taste consists of the _____ , _____, and _____ working together to create the sensory perception of taste.

2. The external elements of taste are _____ , _____, _____ ,_____, and _____.

3. The internal elements of taste are _____, _____. _____and _____.

4. Two of the five external senses that work together are_____ and_____.

5. Sweet, salty, sour, and bitter constitute the four basic tastes. The fifth taste is called_____.

Appendix J

ASSESSMENT 1 ANSWER GUIDE - FOOD HISTORY

1. Few things are as basic to society and culture as
   a. power
   b. land
   c. government
   d. food

2. All history is affected by the needs of people. One of the best known models for explaining individual needs is
   a. the Declaration of Independence
   b. Maslow's Hierarchy of Needs
   c. the principals set forth in Grecian democracy
   d. the development of labor unions

3. The key fundamental contribution to the science of food diet and history was not to come until the _____ century.
   a. 20th
   b. 19th
   c. 18th
   d. 17th

4. Research in biology and chemistry was sparked by the development of the finer quality glass that was used in the
   a. development of better china for dining
   b. development of better glass containers to hold beverages and food
   c. development of better windows to insulate homes
   d. development of more accurate lenses for microscopes

5. _____ was/were the first to influence the quality and quantity of food that fueled the Industrial Revolution.
   a. Shipping
   b. Horses
   c. Mass transit
   d. Railroads

6. Americans who had migrated from rural regions where hunting, fishing, and gathering of fresh fruit and vegetables was common were crowded together into cities. Consequently

the diet of urban workers became inadequate in many areas especially in_____ and _____, which was nearly nonexistent in city life.

a. beef and pork
b. chicken and fish
c. fruits and vegetables
d. cheese and dairy products

7. The advent of steamships near the end of the 19th century brought large waves of non-English speaking people into the United States. Italian immigrants brought with them_____

a. pasta
b. pizza
c. fresh tomatoes
d. cheese making

8. The Industrial Revolution also ushered in new technology to the kitchen. The_____ made the biggest impact for women working in the kitchen.

a. ice box
b. stove
c. canned food
d. recipe books

9. _____ probably did more to change the flavor and the direction of history than any other invention by bringing with it better health as well as enjoyment to the table.

a. fresh fruits and vegetables
b. fresh meat
c. white flour bread
d. refrigeration

10. The future has accelerated demand for_____ and _____ above all other things pertaining to society.

a. fast foods and microwave food
b. ethnic and exotic foods
c. speed and convenience
d. government and technology

Appendix K

Assessment 2 Answer Guide - Savor the Flavor

1. The anatomy of taste consists of the **tongue, nose** and **brain** working together to create the sensory perception of taste.

2. The external elements of taste are **sight, sound, smell, touch** and **taste**.

3. The internal elements of taste are **hunger, thirst, balance,** and **pain.**

4. Two of the five external senses that work together are **taste** and **smell.**

Sweet, salty, sour, and bitter constitute the four basic tastes. The fifth taste is called **Umami.**

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