

Sample Integrated Lesson Plan:

Sensory perception and the role of the Maillard reaction in the flavor development of chocolate

Course Title:	Culinary Arts 1
Core Alignment:	Biology/Chemistry
Duration/Time Frame:	60 minutes
CTE Standards:	04.0 Demonstrate science knowledge and skills 13.0 Describe the principles of basic food science 15.0 List essential nutrients and their function 19.0 Apply principles of food science in cooking and baking techniques
CTE/Science Benchmarks:	<u>CTE:</u> 13.01 Explain how taste and aroma combine to give foods flavor 13.03 Compare and analyze reason for evaluating food products subjectively and objectively 17.01 Explain the role of the five senses in eating food 17.02 Describe how the five basic tastes can affect the appeal of food 17.03 Explain how color, texture and temperature effect visual appeal of food 28.01 Identify the physical and chemical changes in foods that result from the application of heat or cold <u>Science:</u> SC.912.P.8.2 Differentiate between physical and chemical properties and changes of matter SC.912.N.1.6 Describe how scientific inferences are drawn from scientific observations and provide examples from the content being studied SC.912.N.2.2 Identify which questions can be answered through science and which questions are outside the boundaries of science investigation. SC.912.P.12.12 Explain how various factors, such as concentration, temperature, and the presence of a

catalyst affect the rate of chemical reaction

CCSS ELA Literacy Standards:	<p>LACC.1112.RST.1.3 Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks. Analyze the experimental results based on information in the text.</p> <p>LACC.1112.WHST.3 .7 Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.</p>
CCSS Mathematical Practices:	<p>MACC.K12.MP.5.1: Use appropriate tools strategically.</p> <p>MACC.K12.MP.6.1: Attend to precision.</p>
Lesson Objectives:	<p>Students will: Examine how the Maillard reaction is responsible for the flavor, aromas and color changes of many foods we eat, including chocolate.</p> <p>Determine what happens when amino acids react with sugars at elevated temperatures.</p> <p>Identify specifics of the five tastes, the senses, and the three ways flavors of food can be changed.</p>
Materials:	<p>Handouts, articles, tasting sheets, chocolate samples, water, paper plates, napkins, chocolate nibs, cocoa beans, grinder, mortar and pestle, warmer, chocolate books, team numbered place cards.</p>

Key terms/Vocabulary:	<p><u>CTE:</u> Flavor, sweet, sour, proteins, salty, umami, aromas, roasting, vertical tasting, cocoa mass, cocoa, bitter, salty, cocoa butter, conching, molecular gastronomy, flavorist, nutty, pungent, fruity, grassy.</p> <p><u>Core:</u> Sensory perception, analysis, amino acids, non-enzymatic, chemical reaction, reducing sugars, flavor compounds, glucose, polysaccharides, molecules, opaque, translucent, Maillard reaction, molecules, microbes, Chemoreceptors, gustatory receptors cells, gustatory hairs, taste pores, synapse, neurons, cerebral cortex,</p>
Integrated Technology:	PowerPoint presentation
Anticipatory Set/ Intro Essential Question:	How is the chemical process known as the Maillard Reaction key to creating the flavors and aromas we recognize as chocolate? What are the five principle tastes perceived by the tongue? Why does the combination of taste and aroma create flavor.
Exploratory Investigation:	Students will participate in a vertical tasting with six samples of chocolate, engaging all the senses. They will determine the aroma, taste, mouth feel, melting process, and color. The teacher will demonstrate with the help of students, the process of roasting the cocoa beans, and conching the nibs that will become the chocolate we love to eat.
Practice/ Problem Solving Application:	<p>Illustrated worksheet and word bank exploring the five senses perceived on the tongue.</p> <p>Vocabulary worksheet, matching definitions with key terms associated with the Maillard reaction.</p> <p>Crossword puzzle of terms</p>
Check for Understanding/ Justification:	Short Smart clicker assessment - Five questions

Closure/Summary:	Finish the lesson by explaining that the most important chemical reactions that occur during cooking are those that occur between proteins and sugars. These have become known as the Maillard reaction, and provide the tastes, smells, and colors that are much desired and lend their characteristics to a variety of foods. The reactions are complex and the details are by no means understood today. Despite many chemist devoting their lives to study the reactions. Small group discussion; How and why do you think this complexity offers the Chef a range of interesting possibilities?
Reflections/Research:	Although the Maillard reaction is responsible for some of cooked foods more delightful flavors, the reaction also has a dark side. It can produce cancer-causing acrylamide and furans in food, particularly highly processed or burnt meats. Medical researchers have discovered that the Maillard reaction takes place spontaneously in human tissue and its products have been linked to a variety of diseases including diabetes and cataracts. Provide article.
Lab activity	Research chocolate around the world. Have small groups of students collect recipes, specialties, and research cultural influences that can be collected and assembled into a group binder.
Inquiry lab	How does temperature affect the taste, and aroma of chocolate?
Literacy activity	Write a one paragraph summary of article provided on chocolate.
Extension of lesson	Determine the nutritional value and the benefits of eating chocolate.
Modifications/ Accommodations:	<p><u>ESE:</u> Additional time to complete tasks, one-on-one instructional assistance.</p> <p><u>Gifted:</u> Additional assistance by groups or fellow student.</p> <p><u>ESOL:</u> Provide dictionaries, use of translators. Opportunity to complete lesson in ESOL office</p>