



# Culinology® Learning Objectives based upon CRC® and CCS® Principal Knowledge Topics



Mastering the body of knowledge to become a Certified Research Chef™ (CRC®) or a Certified Culinary Scientist™ (CCS®) means to understand Culinology® - the Intersection of Culinary Art and Food Science. Culinology® helps us to understand how and why things happen to food.

Understanding Culinology® encourages a stronger product development process focused on the appropriate commercialization of the culinary gold standard.

The culinary gold standard is the benchmark sample produced in a culinary kitchen with specific attributes based upon sound culinary principles providing the best example of a product prior to the limitations of commercialization.

## General Culinology® (CRC® 52%; CCS® 52%)

### A.1 Product Development (CRC® 32%; CCS® 32%)

#### A.1.a. Allergens

- i. Develop a core knowledge of allergens as listed by the Food and Drug Administration (FDA), specific to the Top 8.
- ii. Illustrate why a knowledge of allergens is critical when developing a food product or serving a meal.
- iii. Compare the different control measures taken within a food production facility and a restaurant kitchen and outline common alternative ingredients for food sensitivities.
- iv. Compare the distinction between a food allergy, a food intolerance, and a food sensitivity to a given food and trigger reactions.
- v. Understand the labeling requirements of an allergen in a food product according to the Food Allergen Labeling and Consumer Protection Act (FLACPA).

#### A.1.b Commercializing the Culinary Gold Standard

- i. Explain the implementation and benefit of the Stage-gate process.
- ii. Explain how consumer, market and culinary insights combine to identify opportunity areas for creation of new products.
- iii. Explain why it is important to understand the critical attributes of a gold standard that the commercialized product must have and which attributes can be compromised.
- iv. Explain the value of working within a cross functional team when creating and commercializing the gold standard.
- v. Describe how to use the gold standard to anchor a product and limit product drift.
- vi. Demonstrate how the role of each member of the product development team affects the commercialization of the product from a concept, to a manufacturable form, and finally a new product in the market.

#### A.1.c Food Safety and Sanitation

- i. Explain the origin, implementation and purpose of Hazard Analysis and Critical Control Points (HACCP), including its seven principles, how to recognize and define Critical Control Points and how HACCP flow relates to recipe development and implementation.
- ii. Recognize and implement safe lab and plant safety principles including the use of personal protection equipment (PPE), utilizing a safety data sheet (SDS), Hazard types (biological, chemical and physical) and suggest ways to design safety controls into daily work practices.
- iii. Identify the following safety equipment elements, how they work and why they are necessary in the kitchen: fire extinguishers, ventilation, first aid and (PPE).



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- iv. Explain and implement food safety principles in a lab or plant setting while recognizing the difference between clean and sanitary procedures, setting up walk in storage, safe cooling procedures, danger zone ranges, ways to reduce cross contamination and the basics of time/temperature principle for safe food.
- v. Explain how microbial growth and spoilage occurs in food, including the four major food borne microorganisms and the foods commonly associated with them.
- vi. Explain commercial sterility as it relates to pasteurization and be able to define process lethality (including D, F, Z and Fo values), listing target temperatures for lethality of Clostridium and explaining the importance of calculating these thermal death curves as it relates to consumer safety.

## A.1.d Government Food Regulations

- i. Discuss the history of food law in the United States, including the key milestones of implementation (Food and Drug Act, Food Additive Amendment, Food Drug and Cosmetic Act, publishing of CFR Title 21, Etc.) and the importance of standard of identity products.
- ii. Discuss the different levels of product labeling claims (organic, all- natural, non-GMO, etc.).
- iii. Compare and contrast US Government and local jurisdiction oversight organizations (i.e. USDA, FDA, FSIS) including the products they govern, their roles and organization structure.
- iv. Discuss the implementation of the NLEA (Nutrition Labeling and Education Act) label, how to interpret it, recommended daily values and requirements for health claims on packaging.

## A.1.e Ingredient Sourcing and Management

- i. Defend First-In, First-Out. (FIFO) and storage procedures for various types of kitchen/lab ingredients.
- ii. Examine the impact of seasonality and ingredient pricing on the product launch cycle.
- iii. Examine procurement methods to balance ingredient innovation, sustainability, and food cost with social, economic, climate, and, corporate social responsibility objectives.
- iv. Develop a parstock system to reduce inventory time and increase speed and service to the customer.
- v. Illustrate purchasing, storing, ripening, preparing, processing and preservation of ingredients, including the ripening stages and how storage conditions can affect the integrity of products.

## A.1.f Nutrition Trends

- i. Translate nutrition trends into the development of food products and menus.
- ii. Examine the different types of proteins and their consumer acceptance in food products.
- iii. Discuss consumer concerns as related to the nutritional content of various foods.
- iv. Describe the appropriate application of alternative ingredients, (i.e. sugar, fat, sodium, gluten) when developing food for specific nutritional requirements.

## A.1.g Product Development Process

- i. Explain the role of a Culinologist® and significance of Culinology® as it relates to the Product Development process.
- ii. Define the stages of product development and recognize the key aspects of each stage.
- iii. Define Project and Product Statements and explain why they are critical for successful product development.
- iv. Identify basic types of manufacturing equipment, explain their usage and identify what type of products they produce.



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- v. Explain the Post-Launch Evaluation (PLE) process, how to apply its learnings to future initiatives, and how it directs product optimization.

## A.1.h Sensory Evaluation

- i. Explain types of sensory tests and the instances when they should be used.
- ii. Explain and define sensory analysis and sensory evaluation.
- iii. Communicate the differences between the common sensory methods and describe how each can be used to guide product development (i.e. Discrimination, Descriptive, Affective, Fuzzy Front end).
- iv. Determine the appropriate size of panels to effectively deliver statistically significant results.
- v. Explain the factors that can influence sensory verdicts.

## A.1.i Weight & Measurement Conversions

- i. Explain the difference between weight versus volume and why it is important to use weight over volume when it comes to recipe development.
- ii. Describe the benefits of working in percentages when it comes to scalability.
- iii. Describe units of measure and measuring utensils, portioning equipment and have an understanding of converting between volume and weight, metric and imperial (U.S.), and Celsius and Fahrenheit.

## A.2 Macro and Micro Ingredients (CRC® 20%; CCS® 20%)

### A.2.a Carbohydrates

- i. Define the differences between simple and complex carbohydrates, dietary fiber and list examples and their nutritional benefits.
- ii. Identify important food sugars, the chemical reactions they participate in, and their functional properties.
- iii. Label a botanical illustration of a kernel of grain.
- iv. Identify and discuss common sources of carbohydrates (sugar, potatoes, grains, pasta, fruits, vegetables, etc.)

### A.2.b Commercial Flavorings and Colors

- i. Distinguish the factors affecting perception of taste, what can be added to enhance the perception of taste and the concept of top, mid and base notes.
- ii. Differentiate between how environmental factors, human factors and storage conditions affect flavors.
- iii. Explain the differences between emulsions, extracts, essential oils, reaction flavors, spray dried and encapsulation, and determine the appropriate use of each application.
- iv. Discuss the regulatory differences between categories of flavors (WONF, N&A, FTNF, type, natural, artificial).
- v. List the types of commercial colors available, specifically the differences between certified (i.e. lakes and dyes) and noncertified food colors (i.e. carotenoids) and the process of caramel color production.



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## A.2.c Dairy Products

- i. Compare and contrast butters and margarine, their composition and applications in cooking and baking.
- ii. Explain the production steps for milk, cheese, cultured dairy products and concentrated milk products, and illustrate their attributes and safe storage requirements.
- iii. Explain how the standards of identification for milk products relate to compositional differences.
- iv. Identify the category of cheese (i.e. fresh, unripened, soft, semi-soft, firm, hard, processed) and demonstrate the appropriate culinary application and storage requirement for shelf life and food safety.

## A.2.d Fats, Oils and Lipids

- i. Discuss rendering, sensory results of rancidity, melt, smoke, & flash points, and explain when fats, oils and lipids break down.
- ii. Differentiate types of fats, oils and lipids (functional and nutritional aspects) and apply the appropriate cooking method(s).
- iii. Explain the functionality of fats, oils and lipids in emulsions, and how temperature affects the viscosity and opacity of oils.
- iv. Discuss the functional properties of fats, oils and lipids (aeration, crystallization, heat transfer, and mouth feel).
- v. Explain hydrogenation of fats, oils and lipids and how this affects their physical properties.
- vi. Examine how classifications of fats, oils and lipids (i.e. saturated, monounsaturated, polyunsaturated, trans fat) and the various chemical profiles of fatty acids affects general health and nutrition.
- vii. Discuss the basic production and refining methods for fats, oils and lipids and understand the basic processing of fats, oils and lipids including winterization, fractionation, plasticizing, polymorphism, crystallization, and polymerization.

## A.2.e Functional Ingredients

- i. Discuss the functional properties of common food additives, including acidulants, alkalis, buffers, pH adjusting ingredients, etc. and how they affect food.
- ii. Describe related chemical and functional properties of water, salt and food acids.
- iii. Explain the types, functions, and benefits of food starches, extenders and gums in food systems.
- iv. Define and explain the purpose of various types of regulated food additives (curing agents, cure accelerators, yield enhancers, sweeteners, etc.).
- v. Discuss the functionality and classification of natural or artificial antioxidants and clearly explain the terms for oxidation, reduction, oxidizing agent and reducing agent.
- vi. Describe types of chemical and biological leavening and their functionality in baked products and batters.
- vii. Understand the functional characteristics of emulsions, foams, gels, protein hydrolysates, and lipids.

## A.2.f General Nutrition

- i. Define micro and macro (e.g. carbohydrates, lipids and protein) nutrients and illustrate the differences between each.
- ii. Calculate the energy value of food, accounting for the energy components of essential nutrients.



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- iii. Specify the function, source, and technique for nutrient retention of the various vitamins and minerals.
- iv. Define healthy nutrition and describe how to develop products that meet established nutrition requirements.
- v. Interpret the value of phytochemicals as they relate to disease prevention and the role of water in the healthy maintenance of the human body.
- vi. Demonstrate how to write and develop a food nutrition label.
- vii. Describe recommended dietary guidelines and serving sizes.
- viii. List six categories of essential nutrients.

## A.2.g Proteins

- i. Identify structure and muscle composition, relative collagen content of meat tenderness, and how they match to various animal sources.
- ii. Describe the benefits of marination in preparation of meats.
- iii. Describe various aging methods for meat.
- iv. Explain the Maillard reaction
- v. Describe how poultry age affects the choice of cooking method.
- vi. Describe common fabrication (primal, subprimal, commercial cuts) and preparation methods for meat, poultry, and seafood.
- vii. Compare and contrast various sources of alternate proteins, focusing on nutritional values, cooking techniques and a balanced diet plan.
- viii. Explain the chemical basis for red meat color.

## Food Science and Engineering (CRC® 37%; CCS® 11%)

### B.1 Food Science (CRC® 22%; CCS® 3%)

#### B.1.a Analytical, Organoleptic, and Microbiological Testing

- i. Identify the most common analytical equipment and basic fundamental testing procedures used for testing food products specific to water activity, pH, brix, and moisture.
- ii. Indicate signs of food spoilage and be able to identify visual signs of pathogenic spoilage.
- iii. Identify microbiology testing procedures for pathogenic and spoilage bacteria and understand the importance in regards to product quality and safety.
- iv. Recognize sampling, cultures, and microscopic methods (TPC, APC, Coliform indicator organisms).
- v. Describe the attributes that are evaluated in routine shelf life testing (organoleptic, microbiological, color, oxidative rancidity).

#### B.1.b Fermentation

- i. List the five types of fermentation, their growth conditions under which they ferment, the cycle each type of fermentation undergoes and which type is appropriate for a specific food product
- ii. Identify which type of fermentation is appropriate (i.e. lactobacillus, yeast-based, mold-based plus two more from the Culinology® book) based upon the product being produced.
- iii. Examine a fermented product to determine if it was manufactured under unsafe processing procedures and apply processing improvements to implement safe fermentation standards.
- iv. Discuss the testing procedures used to determine if a fermented food is safe to eat.



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## B.1.c Food Chemistry

- i. Explain the chemical structure, properties, and interactions of carbohydrates, lipids, and proteins as it relates to food structure, color, flavor, and texture.
- ii. Understand the major chemical and biological reactions that occur during food processing and storage of fresh and processed foods.
- iii. Distinguish the roles of enzymes in food production, processing, quality attributes, and shelf life.
- iv. Distinguish between enzymatic (polyphenol oxidase) and non-enzymatic (Maillard Browning) browning reactions within fruit, vegetables, meat, and baked goods and their influences on ripening, color, flavor, and texture.
- v. Explain the reaction conditions and processes that affect color, flavor, texture, nutrition, safety, stability of antioxidants, and additives in a food product.
- vi. Clearly understand the mechanism of lipid oxidation through lipid peroxidation and the three phases in which it occurs.
- vii. Explain the functional properties of starch gelatinization and retrogradation in starch based foods and food emulsions.

## B.1.d Food Microbiology

- i. Explain water activity and how moisture, free water, **absorbed water** and bound water are related to water activity and how water activity affects the growth of various classes of spoilage organisms.
- ii. Identify the parts of and explain their function within plant and animal cells, bacterial phage and viral organisms.
- iii. Explain the lock and key model of enzyme activity, the roles of enzymes in food processing and how to control enzymatic effects during food processing and storage
- iv. Explain the process of enzyme driven lipolysis, proteolysis, hydrolysis and enzymatic oxidation.

## B.1.e Product Shelf Life

- i. Describe negative effects of temperature, oxygen and light on food quality and shelf life over time and how to implement hurdle technology to mitigate product spoilage.
- ii. Interpret environmental factors (temperature, oxygen, light, enzymatic, microorganism, chemical) to determine the approximate shelf life of a product.
- iii. Understand the prime factors (physical, microbiological, chemical, and environmental) that can contribute to flavor loss, the creation of off flavors, oxidized flavor and food spoilage.

## B.2 Food Process Engineering (CRC® 15%; CCS® 8%)

### B.2.a Food Packaging Engineering -

- i. Discuss the factors of a food product that determines the selection criteria for modified atmosphere, vacuum and aseptic packaging.
- ii. Review the most critical material properties of plastics and understand how and why to apply to packaging selection.
- iii. Discuss the barrier property differences between metal cans, flexible pouches, glass and edible films.



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## B.2.b Industrial Thermal Processing

- i. Describe the following principles of heat transfer: conduction, convection, induction and radiation including the difference between wet bulb and dry bulb temperatures.
- ii. Explain the following effects of heat: coagulation, gelatinization, caramelization and browning.
- iii. Explain the retort process, defining D, Z, Z<sub>0</sub>, and the process of lethality calculations including come up and come down time, static and rotary retorts and Commercial Lethality
- iv. Recognize and identify different thermal processing equipment and determine what type of products would be produced using it.

## B.2.c Principles of Commercial Food Processing

- i. Explain the different processes and purpose of milk pasteurization.
- ii. Describe what an extruder is and the types of food products it produces.
- iii. Describe sun drying, drum drying, spray drying, and freeze-drying techniques.
- iv. Discuss how a product's attributes (ingredients, water activity, pH) and requirements (storage conditions, ingredient restrictions, cost) affect the selection of a processing/preservation technique.

## Culinary Arts (CRC® 11%; CCS® 37%)

### C.1 Principles of Culinary Arts (CRC® 3%; CCS® 22%)

#### C.1.a Kitchen Tools and Equipment

- i. Describe cooking technology: silicone bakeware, induction.
- ii. Differentiate between pots, pans, tools, small equipment, and commercial equipment used for cooking and food processing, the advantages or disadvantages of each and what should be considered in the selection process for each.
- iii. Identify the parts, shapes, functions, and sharpening techniques of a kitchen knife.

#### C.1.b Baking and Pastry Fundamentals

- i. Discuss the gluten content of flour, the type of flour (soft, hard) and the protein content, and the culinary applications.
- ii. Explain how the process of aging or bleaching flour affects baked goods.
- iii. Illustrate the differences between liquid and dry sweeteners and their uses and functions as they relate to baked goods.
- iv. Differentiate the levels of cooked sugar syrup stages and the applications for each level.
- v. Demonstrate your knowledge of the different fats and their functions in baking.
- vi. Differentiate between powdered and sheet gelatin and how each is used.
- vii. Explain the differences between chemical leavening (the composition, uses, and role of acids in baking powder and baking soda) and physical leavening (creaming, foaming, folding) and how they affect the leavening of baked goods.
- viii. Demonstrate your knowledge of what function each portion of the egg plays in baking.
- ix. Describe the various mixing methods and their applications (e.g. biscuit, muffin, creaming, foaming)
- x. Explain the steps in producing yeast doughs, including the use of Baker's percent, the proper choice of yeast, the function of fermentation, the role of salt, and the significance of temperature control.



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- xi. Differentiate between types of doughs in baking (e.g. lean and rich, laminated, flaky and mealy,) and explain the procedure for preparing.

## C.1.c Principles of Cooking

- i. Define and outline the similarities and differences between basic cooking techniques (dry, moist, and combination) and discuss why specific cooking techniques are chosen for various product applications.
- ii. Identify the chef stations, responsibilities, and differences of the classic and modern kitchen brigade.
- iii. Define the term "Mise en Place" and clearly explain its importance in a kitchen.
- iv. Demonstrate various knife cuts and determine appropriate cuts for specific ingredients.
- v. Apply appropriate prep/cooking/holding/presentation options when presented with a menu.

## C.1.d Product Presentation

- i. Illustrate the importance of highlighting food quality and preparation through proper plating techniques while also considering balance, dimension, color, texture and supporting elements.
- ii. Contrast how a product would be presented to a guest in a restaurant versus a Foodservice customer during a presentation.

## C.1.e Traditional Stocks, Sauces & Soups

- i. Identify the steps in making and the ingredient preparation of various types of stocks, (white, brown, fish, fumet, court bouillon, etc.) sauces (mother and leading sauces) and soups (clear, consommé, cream, puree, bisques, chowders and cold).
- ii. Explain the following key terms associated with stock making: sweat, deglaze, degrease, caramelize, remouillage, nage, and glaze.
- iii. Recognize how small/compound sauces are created, and explain the following contemporary sauces: purees, salsas, relish, beurre blanc, compound butters, coulis, vegetable juice sauces, flavored oils and pan sauces.
- iv. Recognize the following sauce and soup thickening agents, their purpose and benefits or disadvantages: roux, cornstarch, arrowroot, beurre manié, liaison, emulsification, tempering and slurry.
- v. Recognize the following sauce finishing techniques: reduction, straining and monté au beurre.

## C.2 Culinary Research and Development (CRC® 8%; CCS® 15%)

### C.2.a Culinary Gold Standard

- i. Describe what the culinary gold standard is and why the culinary gold standard is the benchmark of the product development process.
- ii. Explain why it is essential to use proper culinary techniques and principles when executing the culinary gold standard.
- iii. Describe the impact of culinary techniques and principles on the culinary gold standard.
- iv. Defend the value of, and the theory behind, the culinary gold standard and how it is used to produce commercial products.
- v. Describe best practices to evaluate a gold standard product and document specific attributes.





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## C.2.b Culinary Product Applications

- i. Illustrate how processing affects nutrient retention, paying special attention to intentional losses, losses due to leaching and thermal processes and techniques (freezing, drying, retorting, etc.) that can be employed to preserve nutrients.
- ii. Outline the different types of gelled fruit products, focusing on their standard of identity requirements (fruit source and sugar), the functionality of the thickening agent used and the processing conditions needed (% Solids, pH, Pectin Content).
- iii. Discuss reduced oxygen packaging (ROP) processing and packaging techniques, such as Sous Vide, High Pressure Processing and Cook/Chill, providing an outline of the process and its benefits, focusing on shelf life extension and the types of foods each works best with.
- iv. Outline the process of marination (of proteins) focusing on the ingredients commonly used, their function, marinade preparation, the concept of meat weight and the types of equipment used for marination in meat processing.

## C.2.c Recipe Development and Formula Ratios

- i. Explain how to calculate recipe yield and how to convert portion size.
- ii. Define common abbreviations and prefixes for measurements and common equivalents.
- iii. Understand how to calculate recipe cost, unit cost, food cost percent and selling price.
- iv. Define conversion factor, A.P. (as purchased), E.P. (edible portion), overhead costs and inventory.
- v. Recognize the difference between the definitions for "recipe" and "standardized recipe."
- vi. Determine the correct measurement format for use in a recipe.

## C.2.d Regional & World Cuisines

- i. Identify typical authentic flavors, ingredients, and cooking methods that are fundamental to various global cuisine, national cuisine, regional cuisine, and ethnic cuisine.