NUTRITION AND FOOD SCIENCE TEACHING AND LEARNING SYLLABUS Upper Secondary Express Course Normal (Academic) Course

Implementation starting with 2021 Secondary Three Cohort



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Ministry of Education SINGAPORE

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SECTION 1: INTRODUCTION

Value of Nutrition and Food Science Education Nutrition and Food Science in the 21st Century Framework and Big Ideas of Nutrition and Food Science Curriculum

INTRODUCTION

The design of the Nutrition and Food Science (NFS) syllabus takes into account the changing social and economic landscape in Singapore, new lifestyles and technological advancements that lead to the introduction of new ideas and food products. With lifestyle changes, self-management through knowledge of basic nutrition and attitude towards physical activities have direct impact on one's health. Technological advancements in food science address national concerns with food security. Therefore, knowledge and skills in NFS are important as they prepare our students to thrive in a future driven by globalisation and technological advances.

The NFS curriculum is aligned with the Desired Outcomes of Education (DOE) and remains relevant in today's context. It aims to nurture concerned citizens who take an active role in bettering the lives of those around them through their knowledge in nutrition and health, food literacy and food science. With increased life expectancy, good health through selection and consumption of nutritious food is crucial. Through sound meal-planning or food selection for themselves and their family members, students act as advocates to those around them to combat Singapore's increasing prevalence of diet-related health problems (such as obesity, coronary heart diseases and hypertension)¹.

Food security is of concern for Singapore as the nation imports more than 90% of its food². Food literacy and food science are key to the development and acquisition of appropriate food commodities that will provide sustainable, safe and healthier food products for the nation. Through application of food science knowledge in experimentation with recipes to improve the sensory and nutritional qualities of food products, students are able to become active contributors by developing innovative food products that are nutritious, sustainable and yet affordable (e.g., plant-based protein food such as tofu nuggets).

Food literacy will allow students to be confident individuals who are able to make discerning judgement and think critically in a society where there is an increase in demand for convenience food due to busy lifestyles. For example, selecting convenience foods that are healthier such as canned tuna in water with a reduced sodium content as compared to canned curry tuna that is high in fats and salt. Students will also take responsibility for their own learning through assignment of self-directed authentic tasks, for example, to conduct their own investigation on the ways to reduce the amount of food waste generated in the school canteen to promote food sustainability.

¹ <u>https://www.moh.gov.sg/content/moh_web/home/statistics/Health_Facts_Singapore.html</u>

² <u>https://www.todayonline.com/singapore/big-read-far-peoples-minds-food-security-looming-issue</u>

Value of Nutrition and Food Science

The study of NFS is important as it builds a strong foundation in understanding the link between nutrition and good health, whereby students will be cognisant of making informed food choices. Students will also be able to apply food science principles in the area of food preparation and cooking in creating healthier food products. At the same time, food sustainability issues in Singapore will be introduced in the syllabus to create awareness of the nation's concern on food security.

- 1. <u>Develops Food Literacy and Promotes Health.</u> NFS aims to equip students with essential knowledge and skills on food literacy, developing them to be discerning individuals in selecting food commodities that are suitable for preparing healthier yet palatable dishes. With these knowledge and skills, they will be able to plan balanced meals for themselves and their families that may reduce the risk of potential diet-related health problems.
- 2. <u>Promotes Consumer Education</u>. In a fast-paced society with a variety of easily available food choices, it is important for Singaporeans to be discerning in their food choices and be aware of food safety issues that plague consumers globally. Hence, this curriculum aims to prepare students to be discerning consumers who can make informed decisions in an increasingly sophisticated consumer landscape (e.g., to select food from reliable sources).
- **3.** <u>Develops Capability in Food Sustainability.</u> Food science plays an important role in Science, Technology, Engineering and Math (STEM) field dealing with issues such as food sustainability and food security. These are key areas of concern that Singapore faces while we seek to stay resilient in terms of making sure that there is a sustainable supply of food in Singapore. Through the NFS curriculum, students will gain knowledge on food security in Singapore, choose food from sustainable sources and do their part in reducing food wastage.
- 4. <u>Promotes Food Innovation through Food Science</u>. Early introduction to food science education in the NFS curriculum could interest students to explore the possibilities of joining the growing food industry³. The Food Manufacturing Transformation Map aims to have an average productivity growth of 4.5% and to create 2000 jobs by 2020, with Singapore as a leading food and nutrition hub in Asia by 2025⁴. With food science and technology gaining importance in the manufacturing sector, food companies in Singapore are investing in research and development to develop innovative food products to capture new markets in a sustainable manner.

³ In the food manufacturing sector in 2013, there were 844 food-related establishments, and these accounted for 0.7% of Singapore's Gross Domestic Contribution with a value-add of \$2,828 million. Source: Economic Development Board & SPRING Singapore (2013)

⁴ <u>https://www.enterprisesg.gov.sg/industries/type/food-manufacturing/industry-profile</u>

Nutrition and Food Science in the 21st Century

The NFS curriculum offers opportunities for students to develop 21st Century Competencies (21CC) as illustrated by the following examples:

- a) **Civic, Global and Cross-cultural Literacy.** Students will learn how to plan meals that meet the needs of different groups of people around them, for instance, understanding dietary restrictions of different cultures, religions or managing meals for people with allergies.
- b) **Communication, Collaboration and Information Skills.** Students will have opportunities to work in groups and collaborate in assignments that hone these skills. For example, advocating sustainability when making food choices through designing a brochure where students will hone their communication, collaboration and information gathering skills through the process.
- c) **Critical, Adaptive and Inventive Thinking.** Students will have the opportunities for experiential learning in the form of the sensory evaluation process during practical lessons. These practical lessons develop students to reflect and think critically about the strengths and weaknesses of the dishes they have prepared, so as to identify areas for improvements. For example, when the spaghetti in a pasta dish is too chewy for the elderly, the student may brainstorm solutions to improve the outcome of the dish to suit the elderly.

Framework and Big Ideas in NFS Curriculum

The design of the NFS syllabus is guided by the NFS Education Framework. This framework is conceptualised around three student outcomes: **Health Ambassador**, **Discerning Consumer** and **Food Innovator**, which stem from the value-proposition of the subject.

The middle ring shows the three main attitudes: **Appreciate**, **Advocate** and **Apply**, which the curriculum should be anchored upon. The main strands of the subject, Nutrition & Health, Food Literacy & Consumer Literacy and Food Science were included in the framework to guide the overarching content.



Figure 1. NFS Education Framework

The table below provides an elaboration of the student outcomes:

Table 1. Elaboration of NFS Student Outcomes

Health Ambassador	Advocate nutrition and health for self, family and the community.
Discerning Consumer	Appreciate how a variety of food is used in food management and take into consideration the issue of food security, which includes food safety and sustainable food consumption.
Food Innovator	Apply scientific principles during food preparation and cooking

The focus of each strand is elaborated below:

- a) **Nutrition and Health.** Topics provide the foundation for students to understand the importance of good nutrition and its relationship to various diet-related health problems. This helps them select and prepare nutritious food for consumption to support proper growth and good health.
- *b)* **Food Literacy.** Topics provide fundamental concepts for developing a discerning person capable of planning a balanced meal and making responsible decisions in sustainable food selection for self and others. The introduction to 'Sustainable Food Consumption' is a first step to educate students on how they can play an active role in practising sustainability during meal planning and food preparation. *(NB: Consumer Literacy only applies to lower secondary Food & Consumer Education)*
- c) **Food Science.** Students can use their knowledge in culinary food science covered in this strand to innovate food products that are nutritious, appealing and sustainable. It equips students with knowledge to apply food science concepts learnt in food preparation and cooking, such as understanding the functions of sugar (tenderising agent in baked products) to determine the minimum amount of sugar to make a tender savoury cupcake that contains lesser sugar and yet appealing to a diabetic adult.

As NFS students understand the concepts learnt in the curriculum, they will have the opportunities to apply scientific principles during food preparation and cooking. They also learn to appreciate the importance of using a variety of food commodities in food management and the issues of food security, including food safety and sustainable food consumption. In this way, they will also be able to advocate nutrition and health for self, family and the community, thereby achieving the student outcomes of a health ambassador, a discerning consumer and a food innovator.

The big ideas of the subject can be found in **Table 2** as follows:

Table 2. NFS Big Ideas

Nutrition & Health

- Right amounts of nutrients are essential for proper growth and development.
- Excessive or deficiency in nutrient intake can lead to diet-related health problems.

Food Literacy & Consumer Literacy

- A balanced diet is achieved through proper meal planning.
- Appropriate food choices contribute to sustainable food consumption.
- Good money management habits help to build savings and meet needs and wants.⁵
- A discerning consumer makes informed decisions for self, family and the community.

Food Science

- Food will deteriorate in quality if not handled or stored properly.
- Sensory qualities of food are altered during preparation and cooking.
- Application of food science principles can culminate in unlimited combination of food possibilities that can meet human nutritional needs.

⁵ Only applicable to lower secondary Food & Consumer Education

SECTION 2: CONTENT

Syllabus Aims Content Structure Syllabus Outline Curriculum Time

Syllabus Aims

The NFS syllabus provide students with a broad understanding of concepts in nutrition and health, food literacy and principles of food science. Students will be exposed to authentic real- world contexts through hands-on practical and coursework. Through these learning experiences, the syllabus aims to develop students to:

- lead a healthier lifestyle proactively through proper diet and nutrition;
- advocate sustainable food consumption by planning and making appropriate food choices; and
- apply principles of culinary science creatively in food preparation and cooking.

Content Structure

The NFS syllabus content comprises three strands, Nutrition and Health, Food Literacy and Food Science. An overview of the organisation of the syllabus content is presented in table 3.

Strands	Topics	Description
Nutrition and	Nutrients	This strand is about the importance of
Health		macronutrients, micronutrients, water and
	Diet and Health	dietary fibre in the diet and their relationship to
		health. As such, students can become
		advocates for proper nutrition and health.
Food Literacy	Food Management	This strand focuses on the factors to consider
		when planning meals for various groups of
	Smart Consumer	people. It also covers content knowledge on
		sustainable food consumption. This strand
		develops students to be discerning consumers
		who make appropriate food choices.
Food Science	The Science in Food	This strand covers topics such as the reasons
	Preparation	for cooking food, and the science behind food
		preparation and cooking. Having basic
	Reactions in Food During	knowledge in food science can foster students
	Preparation and Cooking	to be inquisitive in innovating food products.
	Sensory Evaluation of	
	Food	

Table 3. Content Structure NFS Syllabus (O and N(A) Levels)

Syllabus Outline

торіс	LEARNING Candidates w	OUTCOMES will be able to:			
TOPIC	O- Level	N(A) - Level			
NUTRITION AND HEALTH					
A. Nutrients, Water and	1. Proteins	1. Proteins			
Dietary Fibre	 (a) State the chemical elements which make up a protein molecule (b) State the digestion products of proteins (i.e., amino acids) (c) List the food sources of proteins (d) Explain the functions of proteins in the body (e) Define: (i) essential amino acids and give examples (ii) non-essential amino acids and give examples (iii) high biological value proteins and give food examples (iv) low biological value proteins and give food examples (v) complementary proteins 	 (a) State the chemical elements which make up a protein molecule (b) List the food sources of proteins (c) Explain the functions of proteins in the body (d) Define: (i) essential amino acids and give examples (ii) non-essential amino acids and give examples (iii) high biological value proteins and give food examples (iv) low biological value proteins and give food examples (v) complementary proteins and give food examples 			
	and give food examples				
	2. Carbohydrates	2. Carbohydrates			
	 (a) State the chemical elements which make up a carbohydrate molecule 	 (a) State the chemical elements which make up a carbohydrate molecule 			
	(b) State the digestion products of carbohydrates (i.e., glucose, fructose and galactose)	(b) List the food sources of carbohydrates			
	(c) List the food sources of carbohydrates	 (c) Explain the functions of carbohydrates in the body (d) Define 			
	(d) Explain the functions of carbohydrates in the body	(i) simple carbohydrates as monosaccharides and			
	 (e) Define: (i) simple carbohydrates as monosaccharides and disaccharides and give food examples (ii) complex carbohydrates as polysaccharides (i.e., starch, cellulose and pectin) and give food examples 	disaccharides and give food examples (ii) complex carbohydrates as polysaccharides (i.e., starch, cellulose and pectin) and give food examples			

торіс			LEARNING	OUTCOMES vill be able to:				
TOPIC			O- Level		N(A) - Level			
	3.	Fats		3.	Fats			
		(a)	State the chemical elements which make up a fat molecule		(a)	State the chemical elements which make up a fat molecule		
		(b)	State the digestion products of fats (i.e., fatty acids and glycerol)		(b) (c)	List the food sources of fats Explain the functions of fats in the		
		(c)	List the food sources of fats		. ,	body		
		(d)	Explain the functions of fats in the body		(d)	Define: (i) saturated fats and give		
		(e)	 befine: (i) saturated fats and give food examples (ii) monounsaturated fats and give food examples (iii) polyunsaturated fats and give food examples (iv) trans fats and give food examples 			 food examples (ii) monounsaturated fats and give food examples (iii) polyunsaturated fats and give food examples (iv) trans fats and give food examples 		
	4.	Vita	mins	4.	Vita	mins		
		(a)	Classify vitamins into fat-soluble vitamins (A, D, E and K) and water-soluble vitamins (B ₁ , B ₂ , B ₃ , B ₁₂ and C)		(a)	Classify vitamins into fat-soluble vitamins (A, D, E and K) and water- soluble vitamins (B ₁ , B ₂ , B ₃ , B ₁₂ and C)		
		(b)	List the food sources of the following vitamins: A, B ₁ , B ₂ , B ₃ , B ₁₂ , C, D, E and K		(b)	List the food sources of the following vitamins: A, B ₁ , B ₂ , B ₃ , B ₁₂ , C, D, E and K		
		(c)	Explain the functions of vitamins A, B ₁ , B ₂ , B ₃ , B ₁₂ , C, D, E and K in the body		(c)	State the functions of vitamins A, B_1 , B_2 , B_3 , B_{12} , C, D, E and K in the body		
	5.	Min	erals	5.	Min	erals		
		(a)	List the food sources of the following minerals: calcium, phosphorous, iron, sodium chloride and potassium		(a)	List the food sources of the following minerals: calcium, phosphorous, iron, sodium chloride and potassium		
		(b)	Explain the functions of calcium, phosphorus, iron, sodium chloride and potassium in the body		(b)	State the functions of calcium, phosphorus, iron, sodium chloride and potassium in the body		

	торіс	LEARNING OUTCOMES					
	TOPIC			O- Level	N(A) - Level		N(A) - Level
		6.	Wat	er	6.	Wate	r
			(a)	 (a) Explain the factors that affect water intake: state of health, diet, level of activity and onvironment 		(a) 	Explain the factors that affect water intake: state of health, diet, level of activity and environment
			(b)	List the food sources of water in		(b) I 1	List the food sources of water in the diet
			(c)	the diet Explain the functions of water in the body		(c) 5 I	State the functions of water in the body
		7.	Diet	ary Fibre	7.	Dieta	ry Fibre
			(a)	List the food sources of dietary fibre		(a) I	List the food sources of dietary fibre
			(b)	Explain the functions of dietary fibre in the body		(b) 5 i	State the functions of dietary fibre in the body
в.	Diet and Health	8.	Diet	and Health Problems	8.	Diet a	and Health Problems
В.	Diet and Health Problems	8.	Diet (a) (b)	and Health Problems Define the term malnutrition (shortage / excess intake of particular nutrients) Explain the common health problems associated with an excessive or insufficient intake of nutrients, water and dietary fibre in Singapore: (i) obesity (ii) hypertension (iii) type 2 diabetes (iv) coronary heart disease (v) dehydration (vi) heat stroke (vii) constipation (viii) osteoporosis (ix) anaemia	8.	Diet a	And Health Problems Define the term malnutrition (shortage / excess intake of particular nutrients) Explain the common health problems associated with an excessive or insufficient intake of nutrients, water and dietary fibre in Singapore: (i) obesity (ii) hypertension (iii) type 2 diabetes (iV) coronary heart disease (V) dehydration (vi) heat stroke (vii) constipation (viii) osteoporosis (ix) anaemia

ΤΟΡΙΟ	LEARNING OUTCOMES Candidates will be able to:				
Torre	O- Level	N(A) - Level			
FOOD LITERACY					
A. Food Management	9. Diet & Meal Planning	9. Diet & Meal Planning			
	(a) Explain the term balanced diet	(a) Explain the term balanced diet			
	(b) Explain the concept of energy balance	(b) Explain the concept of energy balance			
	 (c) Explain the factors to consider when planning meals: (i) nutritional needs: school children, teenagers, adults and elderly (ii) physiological: age, gender, metabolic rate, level of physical activity, health status (iii) psychological: individual preferences (including vegetarians: lacto vegetarian, ovo vegetarian, lacto-ovo vegetarian and vegan) (iv) social: occasions, ethnic customs and traditions, religions, parental / peer / media influence, vegetarianism (v) economic: value for money, demand and supply (in relation to cost, quality, quantity and nutritional value) 	 (c) Explain the factors to consider when planning meals: (i) nutritional needs: school children, teenagers, adults and elderly (ii) physiological: age, gender, metabolic rate, level of physical activity, health status (iii) psychological: individual preferences (including vegetarians: lacto vegetarian, ovo vegetarian, lacto-ovo vegetarian and vegan) (iv) social: occasions, ethnic customs and traditions, religions, parental / peer / media influence, vegetarianism (v) economic: value for money, demand and supply (in relation to cost, quality, quantity and nutritional value) 			
	 Meal Analysis (a) Evaluate and modify recipes / meals using the food guide recommended by HPB and Recommended Dietary Allowances to meet different dietary / nutritional needs 	 10. Meal Analysis (a) Evaluate and modify recipes / meals using the food guide recommended by HPB and Recommended Dietary Allowances to meet different dietary / nutritional needs 			
B Smart Consumer	11. Sustainable Food Consumption	-			
	(a) Define the term sustainable food consumption				
	(b) Identify current food consumption practices and their impact on the environment				
	 (c) State sustainable food consumption guidelines: (i) selecting food from sustainable sources (ii) aiming to be waste-free 				
	 (d) Apply sustainable food consumption guidelines in the preparation and cooking of food 				

TODIC	LEARNING OUTCOMES						
TOPIC		O- Level				eable	N(A) - Level
	12. C	Conv	enien	nce Food	11.	Conv	venience Food
	(1	a)	List th conve and r canne chille	he different types of enience food (ready-to-cook ready-to-eat: bottled / ed food, dried food, frozen / ed food)		(a)	List the different types of convenience food (ready-to-cook and ready-to-eat: bottled / canned food, dried food, frozen / chilled food)
	(b)	Expla disad food	in the advantages and Ivantages of convenience		(b)	Explain the advantages and disadvantages of convenience food
	(1	c)	Expla follov	in the functions of the wing additives:		(c)	State the types of information found on food and nutrition labels
		() () ()	(i) (ii) (iii) (iv)	salt sugar and sweeteners (aspartame, saccharin, stevia) sodium nitrite monosodium glutamate		(d)	Interpret and apply information found on food and nutrition labels
	((d) S e a	State exces: additi	the health concerns of sive consumption of these ves:			
		() () ()	(i) (ii) (iii) (iv)	salt sugar and sweeteners (aspartame, saccharin, stevia) sodium nitrite monosodium glutamate			
	((e) I f I	nterp found abels	pret and apply information I on food and nutrition			
	((f) E r	Evalua nutrit	ate the benefits of food and ion labels to the consumer			

LEARNING TOPIC Candidates v						COMES e able to:
	Torne			O- Level		N(A) - Level
FC	OD SCIENCE					
А.	The Science of Food	13.	Foo	d Safety	12.	Food Safety
	Preparation and Cooking		(a) (b)	State causes of food spoilage: microbial, chemical and physical spoilage Explain how to avoid and reduce the risk of food spoilage and food contamination when preparing, cooking and storing food (including hygienic practices)		 (a) State how to avoid and reduce the risk of food spoilage and food contamination when preparing, cooking and storing food (including hygienic practices)
		14.	Prep	paration and Cooking of Food	13.	Preparation and Cooking of Food
			(a)	Explain the reasons for cooking food		 (a) Explain the reasons for cooking food
			(b)	Explain the choice (in terms of nutrients, uses and effects of preparation and cooking) of:		(b) Explain the choice (in terms of nutrients, uses and effects of preparation and cooking) of:
				 (i) meat (ii) poultry (iii) seafood (iv) eggs (v) dairy products (vi) cereals (vii) fruit (viii) vegetables (ix) pulses and legumes 		 (i) meat (ii) poultry (iii) seafood (iv) eggs (v) dairy products (vi) cereals (vii) fruit (viii) vegetables (ix) pulses and legumes
в.	Reactions in Food	15.	Met	hods of Cooking	14.	Methods of Cooking
	during Preparation and Cooking		(a) (b) (c)	Explain how heat is transferred (conduction, convection and radiation) in the different methods of cooking (grilling, baking, dry-frying, stir-frying / sautéing, shallow-frying, deep- frying, boiling, simmering, steaming, microwave cooking) State the advantages and disadvantages of each method of cooking Use a variety of cooking methods in the preparation of meals		 (a) Explain how heat is transferred (conduction, convection and radiation) in the different methods of cooking (grilling, baking, dry-frying, stir-frying / sautéing, shallow-frying, deep- frying, boiling, simmering, steaming, microwave cooking) (b) State the advantages and disadvantages of each method of cooking

	LEARNING OUTCOMES					
TOPIC	Candidates v	will be able to:				
	O- Level	N(A) - Level				
	16. Reactions in Food during Preparation and Cooking	15. Reactions in Food during Preparation and Cooking				
	 (a) Explain the following terms that occur in the preparation and cooking of food: (i) carbohydrates: gelatinisation, caramelisation, dextrinisation (ii) fats: shortening, emulsion, melting point, smoke point (iii) proteins: denaturation, foaming, coagulation, gluten development, Maillard browning (iv) fruit / vegetables: enzymatic browning (b) Explain the functions of the key ingredients (flour, sugar, raising agent, fat, egg, liquid) and justify the procedures in the preparation and cooking of the following products: cakes, biscuits, pastries, batters, sauces (including local dishes) 	 (a) Explain the following terms that occur in the preparation and cooking of food: (i) carbohydrates: gelatinisation, caramelisation, dextrinisation (ii) fats: shortening, emulsion, melting point, smoke point (iii) proteins: denaturation, foaming, coagulation, gluten development, Maillard browning (iv) fruit / vegetables: enzymatic browning (b) Demonstrate the skills required and justify the procedures in the preparation and cooking of the following products (including local dishes): (i) cakes, biscuits (creaming, rubbing-in, whisking) (ii) shortcrust pastry (iii) batters (thin and thick) (iv) sauces (roux and blended) 				
C. Evaluation of food	17. Sensory Evaluation	16. Sensory Evaluation				
	 (a) State the reasons for conducting sensory evaluation of food products from recipes and food investigations 	 (a) State the reasons for conducting sensory evaluation of food products from recipes and food investigations 				
	 (b) Evaluate the sensory properties (texture, flavour, appearance, aroma) of food products 	 (b) Evaluate the sensory properties (texture, flavour, appearance, aroma) of food products 				

Curriculum Time

The NFS syllabus spans across a two-year period with a total of 46 and 43 curriculum weeks⁶ for O and N(A) levels respectively. It is recommended that schools allocate a minimum of five periods (about 35-40 minutes per period) of NFS lessons per week. To make learning meaningful, the lesson content could consist of three consecutive periods of practical and two periods of theory per week. In addition, content could also be taught through the coursework task in Secondary Three.

Table 4. Curriculum Time

Level	No. of weeks	Duration
Secondary 3 & 4 – O level	46	A minimum of 5 periods
Secondary 3 & 4 – N(A) Level	43	(175 – 200 minutes)

⁶ This is after deducting time needed for school events, examinations and WAs, but includes time for white space.

SECTION 3:

PEDAGOGY

The Singapore Curriculum Philosophy Pedagogical Considerations Teaching Processes Framework for 21st Century Competencies and Student Outcomes Useful Teaching Strategies

The Singapore Curriculum Philosophy

The Singapore Curriculum Philosophy (SCP) guides teachers to think about the teaching and learning of the curriculum, while placing our students' interest at heart.

The beliefs of SCP are:

- (i) We believe in holistic education.
- (ii) We believe that every child wants to learn and can learn. We focus on students' learning needs when designing learning experiences.
- (iii) We believe that learning flourishes:
 - in caring and safe environments,
 - when students construct knowledge actively,
 - through the development of thinking skills and dispositions, and
 - when assessment is used to address students' learning gaps.

NFS teachers should use these beliefs when designing and implementing lesson ideas to enhance the learning experiences of students. This can help students find more meaning and make connections in the knowledge and skills gained through the curriculum.

Pedagogical Considerations

Learner-centered approaches that involve students in doing and evaluating their work support the applied learning nature in the NFS syllabus. Inquiry-Based Learning (IBL), Collaborative Learning (CoL), and Experiential Learning (ExL) are examples of strategies that are learner-centered. These strategies allow students to think deeply and foster learning, thus helping students construct and retain knowledge better.

Adapting IBL in the teaching and learning of NFS requires students to evaluate their findings from food science experiments to determine appropriate types and quantity of ingredients, optimum temperature or preparation time to produce the best outcome for the food products. CoL in a NFS classroom encourages students to work together to make connections of the knowledge acquired across the different topics to solve a real-life problem. In ExL, students can collaborate with one another and have active conversation during practical lessons to discuss ways to modify recipes to make dishes healthier; improve quality of the dishes; and promote sustainability.

Students will be motivated when they are engaged in their learning through meaningful authentic tasks as such tasks will allow students to construct their own knowledge and develop thinking skills. These take place when students generate explanation, elaborate and/or reflect on the outcomes of their work with their teachers as facilitators.

Teaching Processes

The Singapore Teaching Practice (STP)⁷ is a model that shows explicitly how effective teaching and learning can be achieved in our Singapore classrooms. One of the components of the STP, the Pedagogical Practices, comprises four Teaching Processes that outline what teachers ought to reflect on and put into practice before, during and after their interactions with students in all learning contexts.



Figure 2. Pedagogical Practices

As we value every student as an individual with diverse learning needs, experiences, beliefs, knowledge and skills, there is a need to customise and adapt the enactment of the Teaching Areas and Teaching Actions. Each Teaching Area includes a set of important considerations or Teaching Actions that help enact it.

⁷ For more information on STP, refer to the STP website (<u>https://opal.moe.edu.sg/STP</u>).

<u>Table 6</u> provides an example of a Teaching Area of the STP and specific examples that could be used in the NFS classrooms.

Teaching Area	Teaching Action	Lesson Example
	Teaching Action 1: Using Stories and Images The use of stories and images can help students make connection to theory and	A case study on hygiene lapses by food operators can be shared with students. Teachers can open the discussion to the class or get students to work together to answer questions related to food safety and discuss the importance of keeping food safe (ethical issue).
Arousing interest	real-life context. This could trigger students to explore the content and deepen their understanding of the topic(s). Real-life examples and real- world problems could be presented to students to allow them to discuss, identify problems and provide possible solutions.	 To further engage students, teachers could get students to: share with the class ways in which food safety can be practiced using a jingle create a video advertisement on how to reduce risks of food safety **Articles from the following sources could be considered: The Straits Times Ministry of Health National Environment Agency Singapore Food Agency

 Table 6. An example of NFS lessons using STP Teaching Areas and Actions

Framework for 21st Century Competencies and Student Outcomes

The NFS syllabus is designed to prepare students for the 21st Century. The development of 21st Century Competencies (21CC) is inherent in the content, learning process and assessment tasks of the syllabus. NFS provides an important platform in preparing students to live in a world marked by changing lifestyles, globalisation and consumer patterns. The Framework for 21CC and Student Outcomes is shown in Figure 3 below.



Figure 3. Framework for 21st Century Competencies and Student Outcomes

<u>Table 7</u> shows how the NFS syllabus correspond to the corresponding 21CC developmental milestone for upper secondary⁸

Table 7. Knowledge, Skills and Attitudes in NFS and the Corresponding Developmental Milestone

Examples Knowledge, Skills and Attitudes in NFS		Corresponding 21CC Developmental Milestone		
Civ	Civic, Global and Cross-cultural Literacy			
•	Consider social factors when planning meals for different ethnic and/or religious groups.	1.4 The student can convey and critically evaluate knowledge to co-construct new understandings and complex ideas persuasively and with impact, while considering the specific purpose and context of communication.		
	Work well and show respect with other socio-cultural groups during lessons and collaborative learning.	6.4 The student can contribute to information and perspectives shared in constructive and ethical ways, and manage their online reputation and relationships responsibly.		
Critical, Adaptive and Inventive Thinking				

 Understand the relationship between nutrition/diet and health and makes connections and ideas to solve issues Makes decisions, with supporting justifications, to incorporate food sustainability 	 1.4 The student can use evidence and adopt different viewpoints to explain their reasoning and decisions, having considered the implications of the relationship among different viewpoints. 5.4 The student can generate ideas that are unique or modified substantially from existing ones and explore different pathways that lead to solutions.
 Understand the scientific principles underlying food preparation, processing and safety Explore, adapt and modify ideas and/or recipes to meet the task requirement Manages complexities and ambiguities by adjusting one's perspective and strategies Assesses different contexts and situations in order to make connections and draw new insights 	 2.4 The student can plan, organise and evaluate their thinking strategies to monitor their learning. They suspend judgement, reassess conclusions and consider alternatives to refine their thoughts, attitudes, behaviour and actions. 4.4. The student can draw on different perspectives and strategies to adjust their approach when required, adapting learnt knowledge and skills in new and unexpected contexts to solve complex and unexpected problems. 3.4 The student can draw on the similarities and differences between different contexts or situations to extract new insights to inform their perspective or approach.
Communication, Collaboration and Inform	nation Skills
 Effectively communicates information and co-constructs meaning 	1.4 The student can convey and critically evaluate knowledge to co-construct new understandings and complex ideas persuasively and with impact, while considering the specific purpose and context of communication.
 Employs effective strategies to locate digital and non-digital information and resources, and exercises discernment by evaluating the accuracy, credibility, and relevance of information 	5.4 The student can refine search results, organise information systematically and manage information sensitively, and evaluate the accuracy, credibility and relevance of information.

Useful Teaching Strategies

To enhance active learning, two teaching strategies are introduced. They are Differentiated Instruction and Socratic Questioning. Lesson examples based on some of these strategies are also provided.

Differentiated Instructions (DI)

DI is an approach to planning and delivering a lesson for the entire class while meeting the needs of

every individual. As students come from diverse backgrounds and possess varied skills, strengths, and learning styles, teachers cannot possibly reach every learner by using only one method of instruction. By using DI, teachers can identify the best way to teach each student. Teachers can differentiate instruction through <u>content</u>, <u>process</u>, <u>product</u> and <u>environment</u> according to students' interest, readiness and learning profile.



Figure 4. Ways to Differentiate Instruction (Tomlinson & Imbeau, 2010)

Students tend to learn better if tasks:

- are a close match for their skills and understanding of a topic (readiness);
- ignite curiosity or passion in them (interest); and
- encourage them to work in a preferred manner (learning profile).

Ideas and materials that build on students' interest and choice should be incorporated in the curriculum to engage students in learning.



Differentiation in Content

Content can be described as the knowledge, skills and attitudes we want students to learn. It refers to our standards and written curriculum, or simply what we teach or what we want students to learn.

Differentiating content requires students to be pre-tested so that the teacher can identify students who do not require instruction. Students who demonstrate understanding of the concept can skip the instructionstep and proceed to apply the concepts to the task of solving a problem.

The revised Bloom's Taxonomy provides a comprehensive set of classifications for learner cognitive processes. Each level builds on the foundation that precedes it. It helps teachers to determine the level of learning that could be included in an instructional unit and the differentiation of content to cater to students' abilities.

Level	Definition	Questions
Remembering	Recall Regurgitation of facts	Tell, List, State, Define
Understanding	Repeat in own words	Give an example, Explain
Applying	Apply to a new situation	Build, Demonstrate, Make, Develop
Analysing	Study parts	Compare, Analyse, Categorise, Contrast
Evaluating	Give opinion backed by facts	Evaluate, Judge, Critique, Discuss
Creating	Form new concept from learned material	Design, Create, Construct, Develop

Differentiation in Process

Differentiating the processes means varying learning activities or strategies to provide appropriate methods for students to explore the concepts. It is important to give students alternate paths to manipulate the ideas embedded within the concept.

To differentiate processes, it is important to consider students' academic strengths, learning preferences and emotional states. This will help to determine how students make sense of or master content differently, so that teachers can decide on the appropriate instructional strategy to adopt. One way to differentiate the process of learning to help students make sense of the content is to scaffold students' learning with different levels of support, challenge and complexity based on their academic strengths and emotional states, such as their readiness and confidence level. Organising students according to their learning preferences to maximise active participation and learning in the lesson, either individually, in pairs or in groups, is another strategy. By designing learning tasks that require students to collaborate with one another, teachers can tap on students' strengths, and by supporting them to understand information and ideas and to apply skills, teachers differentiate the learning process based on learners' profiles.



The figure below provides a visual representation of the five dimensions of a learner's profile that teachers must understand and address to enhance the effectiveness of teaching and learning. **Figure 8.** Five Dimensions of a Learner's Profile



(Adapted from Powell & Kusuma-Powell, 2011)

Differentiation in Product



Product refers to assessments or demonstrations of what students have learned after an extended period of learning.

Students demonstrate the knowledge, skills, attitudes and values (KSAV) that they acquired at the end of a unit or over a period of time through meaningful assignments that require them to rehearse, apply and extend their learning. To differentiate the product, teachers will need to consider all five dimensions of their learners' profiles so as to provide students with variety, choice and challenge when demonstrating their learning. One way to do so is to provide students with different choices to represent their learning. For example, instead of writing an essay, students can be given the choice to express their learning by creating a skit, producing a graphic organiser or presenting an oral report. Another way could be to consider providing students with varied working arrangements to complete the assignment; for instance, they may work either individually or as a group for different assignments. Table 11 shows some relevant examples for consideration.

Differentiation in Environment

The positive climate of a classroom and its configuration impact students' learning tremendously. When teachers understand all the five dimensions of learners' profiles, they can design learning environment that would enable students to feel affirmed, as well as to develop a sense of affiliation and purpose that contribute to their learning.

For example, teachers can establish classroom routines that allow the academically stronger students to help their peers when they are busy with other students and unavailable to offer help immediately. If some students prefer to work alone in a quiet space while others learn better through peer discussion, the teacher can also manage the learning space by providing areas in the classroom for students to work quietly without distractions, as well as provide collaborative spaces that facilitate discussions.



Socratic Questioning

Questioning is an action of asking questions. Effective questioning is essential to good teaching and learning and is particularly useful in teaching the NFS coursework as it helps to ensure that key issues are discussed. Good questioning helps to develop the way students think and learn.

Socratic questioning technique is named after Socrates (470-399 B.C.), a Greek philosopher. The technique is based on the practice of a disciplined and rigorously thoughtful dialogue. The teacher elicits an engaged dialogue with the student during the discussion which enables the student to examine ideas in depth and breadth and construct meaning from them.

Socratic questioning helps students to think critically by focusing on the process of thinking surrounding a central issue. Carefully structured questioning also helps examine students' own thinking processes. Thoughtful, disciplined questioning in the classroom supports student-centred learning, develops problem-solving skills and helps students construct and retain knowledge.

Teachers can use the Socratic questioning technique to facilitate the development of NFS coursework, especially for the management and processing of information. Through questioning, students are enabled to interpret, analyse and communicate ideas. This method serves to promote active, student-centred learning, while the teacher maintains the role of a facilitator.

Using Socratic Questioning in the Classroom⁹

Role of the Teacher

- Respects students' viewpoints, probes their understanding and shows genuine interest in their thinking
- Poses questions that are meaningful to aid students in learning
- Creates and sustains an intellectually stimulating classroom environment

Role of the Student

Before an exercise in thoughtful questioning, it is advisable that the teacher tells students that they are expected to do the following:

- Participate when called upon
- Answer questions as clearly and succinctly as possible

Conditions for Effective Socratic Questioning

• A Safe Environment

A safe environment is crucial as it lessens students' anxiety and fear of making mistakes. It would enable students to be confident to respond to questions and to form their own questions to explore and learn new things. Teachers would need to develop the confidence in their students to ask questions and clarify understanding in the classroom.

• Wait Time

Every student is a unique individual and the time taken to process the thoughts would differ. Understanding students' profile would help teachers decide on the wait time needed to seek answers for their questions. Giving sufficient time also means that students' answers are well considered.

⁹ <u>http://serc.carleton.edu/introgeo/socratic/index.html</u>

Responding to Partial/Wrong Responses

Teachers could prompt and probe students to be more accurate and specific in answering. Teachers could understand what students are thinking by asking them to rationalise their responses.

Teachers could also acknowledge the parts of the answer that are correct. If students still do not answer correctly, teachers should continue to prompt students.

SECTION 4: ASSESSMENT

Types of Assessment National Examination Assessment is an important feature of the teaching and learning process. It is integral to the learning process and helps students become self-directed learners as it creates awareness of their progress. It helps teachers to determine whether learning has taken place by providing information on students' progress. Assessment also gives teachers feedback on the effectiveness of their own teaching. However, there is a need to match the type of assessment to the specific purpose for which it is intended.

Types of Assessment

Formative Assessment

Formative Assessment (FA) is carried out during the instructional process to provide feedback to adjust ongoing teaching and learning to improve students' achievement of intended instructional outcomes. It may involve informal methods such as observation and oral questioning, or the formative use of more formal measures such as quizzes or performance assessment.

Assessment for Learning (AfL) is an assessment that supports teaching and learning with the specific use of learner-centred approaches and strategies. Teachers may identify gaps in students' learning and provide quality feedback for students on how to improve their work. AfL is used to redirect learning in ways that help learners master learning goals and is primarily used for ensuring that the intended learning outcomes are achieved by students.

Summative Assessment

The purpose of summative assessment (SA) is to provide information on students' mastery of content, knowledge and skills, and assigning grades or certifying students' proficiency. In Secondary Three, there should be no more than one weighted assessment (WA) per term, in addition to end-of-year examination (EYE). The WA could include tasks such as written test, online assignment, case study, brochure or oral presentation.

In NFS, WAs and/or examinations could be aimed to assess students' understanding and application of the concepts learnt rather than on recall of knowledge. Other than written form of assessment, schools could also consider alternative modes of assessment such as practical skills and coursework process skills.

National Examination¹⁰

The assessment objectives are classified into three main areas:



¹⁰ Refer to SEAB for examination syllabus.

Table 9. Assessment Objectives and Their Descriptors

AOA: (O and N(A) Levels)	 Knowledge with understanding Candidates should be able to demonstrate knowledge and understanding of facts, concepts, and terminology in relation to: (i) nutrition and health (ii) food literacy (iii) food science
AOB: (O and N(A) Levels)	 Handling information and solving problems Candidates should be able to: (i) locate, select, interpret information (ii) analyse information (iii) present reasoned explanations (iv) solve problems
AOC:	 Application of skills, knowledge and understanding in a variety of contexts Candidates should be able to extend the learnt knowledge towards planning a food investigation, preparing, cooking and presenting dishes in a variety of contexts involving the following processes: O Level: gather information on the roles/functions of the ingredients gather information on meal planning guidelines for a target group of people justify the appropriateness of the selected dishes with reference from the prior research present recipes of the final three dishes with justifications analyse and use the research findings to plan a food investigation observe and record sensory evaluations present clear photographic evidence observe and measure results accurately record results using graphs, tables, charts, sensory analysis, labelled diagrams analyse results linked to research findings and food science principles demonstrate good organisational and time management skills in planning for investigation and/or task apply food preparation techniques and use different cooking methods in preparing dishes/meals for different situations demonstrate proficient use of equipment and good management of resources in food preparation

Reference Material

Book Title	Author	Publisher
Food Styling	Delores Custer	John Wiley & Sons, Inc., Hoboken, New Jersey
Cooking Ingredients: A Practical Guide to Choosing and using World Foods	Christine Ingram	Anness Publishing Ltd
Waste Free Kitchen handbook	Dana Gunders	Library of Congress Cataloging- in-Publication
Knife Skills: How to Carve/Chop/Slice/Fillet	Marcus Wareing, Shaun Hill, Charlie Trotter, Lyn Hall	Dorling Kindersley Limited
The Science of Food: An exploration of what we eat and how we cook	Marty Jopson	Michael O'Mara Books Limited
Culinary Reactions: The Everyday Chemistry of Cooking	Simon Quellen Field	Chicago Review Press – Incoporated
How Food Works	-	Dorling Kindersley Limited
The Science of Cooking	Dr. Stuart Farrimond	Dorling Kindersley Limited
The Food Lab	J. kenji Lopez - ALT	W.W.Norton & Company Limited