

COURSE SYLLABUS

FST220 FOOD MICROBIOLOGY

Credit	: 2(2-0) (2 hours lectures and discussions per week for 14 weeks; no laboratory work)
Academic Year	: 2014/2015
Semester	: 4
Pre-requisite	: BIO212 Basic Microbiology
Number of students	: 130, divided into 2 parallel classes (65 students per class)
Delivery Method	: Lecture, class discussion, and independent study (literature search, independent reading, group discussion, group assignment) and oral presentation.
Course Coordinator	: Winiati Puji Rahayu
Contact	: 62-251-8626725; 08161336158)
Language	: Indonesia
Lecturers	: Parallel Class 1: 1. Winiati Pudji Rahayu (wini_a@hotmail.com) 2. C.C. Nurwitri (nurwitri_ccn@yahoo.com) 3. Suliantari (suli_tari@yahoo.com) Parallel Class 2: 1. Budiatman Satiawihardja (budisat08@yahoo.com) 2. Harsi D. Kusumaningrum. (h_kusumaningrum@ipb.ac.id) 3. Siti Nurjanah (siti_nrjh@yahoo.com)
Day and Time	: Monday, 07.00-08.40 am
Classrooms	: RK PAU1 (PC1); RK PAU2 (PC2)

I. Course Description

This course covers the characteristic of microbial growth, intrinsic and extrinsic factors and their relationship to microbial growth; the principles of food fermentation and the role of beneficial microbes; the role of microorganisms and food spoilage; pathogenic microorganisms, infection and intoxication, mycotoxin, viruses and parasites; the principles to control microbial growth; as well as qualitative and quantitative microbiological analysis.

Food microbiology is a sub-discipline of food science that discusses the microorganisms which inhabit, create or contaminate food. Food microbiology unites the disciplines of microbiology and food technology, facilitating advances in providing safer food for the world. Food microbiology covers basic and applied aspects of microorganisms of importance to food safety and food spoilage

as well as benefit to food supply. Better understanding of the microorganisms that cause disease and spoilage in foods will lead to better ways of controlling them.

Food can be contaminated by pathogenic and spoilage microorganisms. Bacteria such as Salmonella, Campylobacter, certain strains of Escherichia coli, and other enteropathogenic bacteria, can persist, and some will multiply in foods. If not killed before the food is eaten, these microorganisms can cause serious illness. Illness due to microorganisms is also caused by toxins left behind in foods as a consequence of microbial growth. Fungi, such as those in the genus Fusarium and Aspergillus, grow well on grains and other crops. As they grow, they produce toxic substances called mycotoxins. The toxins cause a variety of damaging effects on the nervous, digestive, immune and vascular systems. Some are also highly carcinogenic, including one of the most potent cancer causing chemicals known aflatoxin.

The control of microbiological pathogen and spoilage requires an understanding of a number of factors including the knowledge of possible hazards, their likely occurrence in different products, their physiological properties and the availability and effectiveness of different preventative measures. Finding ways to slow or even prevent microbial spoilage will provide one set of solutions to this problem.

Furthermore, beneficial microorganisms cultivated in foods can provide added value far beyond delay or prevention of spoilage. Many of these microorganisms can produce food fermentation product that has functional properties, such as the release of compounds antagonistic to pathogens or stimulation of the host immune system. Better understanding of the nature of such functional effects and finding ways to strengthen it will allow scientists to capitalize further on the beneficial effects of the microorganisms.

II. Learning Outcomes

Upon successful completion of this course students will have learned important pathogens and spoilage microorganisms in foods and the conditions under which they will grow, conditions under which the important pathogens are commonly inactivated, killed or made harmless in food, principles involving food preservation via fermentation processes, the role and significance of microbial inactivation, adaptation and environmental factors (i.e., A_w , pH, temperature) on growth and response of microorganisms in various environments, and conditions, including sanitation practices, under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods.

This course is also designed to improve student's success skills, especially in oral and written communication, defining a problem, identifying potential causes and possible solutions and making thoughtful recommendations, applying critical thinking skills to new situations, commitment to the highest standards of professional integrity and ethical values, working and/or interacting with individuals from diverse cultures, working effectively with others, dealing with individual and/or group conflict, independently researching scientific and non-scientific information, and facilitating group projects. In relation to learning outcomes recommended in IFT Education Standards, after completing this course students are expected to:

LO Code	Learning Outcomes	Coverage	
		Detail	Some extent
II.A.1	be able to identify the important pathogens and spoilage microorganisms in foods and the conditions under which they will grow	X	
II.A.2	be able to identify the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods	X	
II.B.1	understand the principles involving food preservation via fermentation processes		X
II.C.1	understand the role and significance of microbial inactivation, adaptation and environmental factors (i.e., Aw, pH, temperature) on growth and response of microorganisms in various environments	X	
II.D.1	be able to identify the conditions, including sanitation practices, under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods	X	
III.B.1	know the spoilage and deterioration mechanisms in foods and methods to control deterioration and spoilage		X
III.B.2	understand the principles that make a food product safe for consumption		X
III.D.1	understand the principles and current practices of processing techniques and the effects of processing parameters on product quality		X
III.F.1	understand the basic principles and practices of cleaning and sanitation in food processing operations		X
IV.A.1	be able to apply and incorporate the principles of food science in practical, real-world situations and problems		X
IV.D.1	be able to apply the principles of food science to control and assure the quality of food products		X
IV.F.1	be aware of current topics of importance to the food industry		X
VI.A.1	demonstrate the use of oral and written communication skills	X	
VI.B.1	define a problem, identify potential causes and possible solutions, and make thoughtful recommendations	X	
VI.B.2	define a problem, identify potential causes and possible solutions, and make thoughtful recommendations	X	
VI.C.1	commit to the highest standards of professional integrity and ethical values	X	
VI.C.2	work and/or interact with individuals from diverse cultures	X	
VI.E.1	work effectively with others	X	
VI.E.3	deal with individual and/or group conflict		X
VI.F.1	independently research scientific and non-scientific information	X	
VI.G.2	facilitate group projects	X	

III. Course Learning Outcomes

Upon successful completion of this course the student will be able to:

1. describe food safety problems and solution in Indonesia and in global perspectives (C2, comprehension).
2. identify and classify types of microorganisms in food processing and compare their characteristics and behaviour (C4, analysis).
3. determine food classification based on their perishability and level risk to public health considering their acidity and water activity (C3, application).
4. describe microbial growth kinetic and measurement (C2, comprehension).
5. summarize intrinsic and extrinsic factors affecting the growth of microbes in foods (C2, comprehension).
6. use a computer modeling to estimate the microbial growth (C3, application).
7. describe principles of food fermentation (C2, comprehension).
8. identify microorganisms in food fermentation product and describe their roles (C2, comprehension).
9. correlate food spoilage during preparation, processing and storage to potential spoilage microorganisms (C4, analysis).
10. differentiate the roles of bacteria, mycotoxin, viruses and parasites to foodborne diseases, and compare pathogens that cause infection and intoxication (C4, analysis).
11. determine and use the the principles of sanitation, heat treatment, irradiation, modified atmosphere, antimicrobial preservative and combination of method (hurdle concept) to control microbial growth (C3, application).
12. determine and use the principles of sampling and sample preparation in microbiological analysis (C3, application)
13. evaluate the microbiological quality of foods by qualitative and quantitative microbiological analyses (C5, evaluation).
14. apply the principles of food microbiology to evaluate food related cases in daily application (C5, evaluation).

IV. Textbooks and Teaching Material Support

A. Textbooks

1. Bamforph,C.W. 2005. Food, Fermentation and Microorganisms. Blackwell Pubs.
2. Buchanan,R.L. and Whiting,R.C. 1994. Pathogen Modelling Program Version 4.0. Microbial Safety Research Unit. USDA ARS Eastern Regional Research Centre.
3. Harrigan,W.P. 1988. Laboratory Methods in Food Microorganism. 3rd. Ed. Academic Press. San Diego.
4. Jay,J.M. 2000. Modern Food Microbiology. CRC Press. London.
5. Lund,B.M., Parker,T.C. and Gould,G.W. 2000. The Microbiological Safety and Quality of Food. Vol 1 & 2.
6. Marianne,D., Miliotis dan Jefrey,W.B. 2003. International Handbook of foodborne pathogens. Marcell & Decker Inc.
7. Marriot,N.G. and Gravani,R.B. 2006. Principles of Food Sanitation. 5th Edition. Springer Publ.

8. Ray, B. 2001. Fundamental Food Microbiology. CRC Press. London.
9. Lelieveld, H.L.M., Mostert, M.A., Holah, J. and White, W. 2003. Hygiene in food processing. CRC Press, New York.

B. Teaching Material Support

Various course materials (modules, handouts and audio visual) are accessible online in Learning Management System (LMS) at <http://lms.ipb.ac.id>). Students must use their own ID and password to upload the course materials. Contact IT administrator (Mr. Dodi) at Computer Laboratory for registration.

(a) Modules (14 topics). Available in the form of pdf file (MS word). Each module contains short theory and step-by-step problem solving exercises.

(b) Handouts (14 topics). Available in the form of pdf file (Power Point). Most handouts are written in English. The power point contains graphic illustrations, photographs, tables, images, and animations.

(c) Audio visuals. Some audio visuals are accessible in LMS. Students can listen lecturer's explanation of certain topics.

VI. Course Outline

Week	Topics	Sub-topics	Lecturers
1	Introduction : Food Microbiology in Indonesia and global perspectives	<ul style="list-style-type: none"> Microorganism in food processing Food safety problems and solution in Indonesia 	WPR, BSA
2,3,4	Microbial Growth	<ul style="list-style-type: none"> Microbial growth kinetic and measurement Intrinsic and extrinsic factors affecting growth and live of microbes Computer modelling of microbial growth 	CCN, SUL, BSA
Student Presentation, Group 1-2 (Week 3)			
5	Principles of Food Fermentation	<ul style="list-style-type: none"> Basic of food fermentation process Food fermentation products and beneficial microbes 	CCN, BSA
Student Presentation, Group 3-4 (Week 5)			
6,7	Microbial Spoilage of Foods	<ul style="list-style-type: none"> Microbial spoilage of meat, eggs, milk, seafood and their products Microbial spoilage of vegetables, fruits, cereal and their products 	CCN, BSA, SNU
Student Presentation, Group 7-8 (Week 9)			

Week	Topics	Sub-topics	Lecturers
10,11,12	Principles of Food Preservation by Controlling Microbial Growth	<ul style="list-style-type: none"> Microbial control by applying sanitation methods and temperature control Microbial control by drying, 	WPR, SNU, HDK

		irradiation and modified atmosphere <ul style="list-style-type: none"> • Microbial control by using antimicrobial preservatives and acid; applying non thermal processing and combination of methods (hurdle concept) 	
Student Presentation, Group 9-10 (Week 12)			
13,14	Principles of Food Microbiological Analysis	<ul style="list-style-type: none"> • Sampling and preparation of microbiological analysis • Qualitative and quantitative microbiological analysis 	CCN, HDK
Student Presentation, Group 11-12 (Week 14)			

Note: WPR (Winiati Pudji Rahayu), CCN (C.C. Nurwitri), SUL (Suliantari); BSA (Budiantman Satiawihardja), HDK (Harsi D. Kusumaningrum), SNU (Siti Nurjanah)

VI. Potential Course Overlap

Some topics in this course will be discussed in more detail in other courses, such as principles of food fermentation in Food Fermentation Technology course (FST 321), and foodborne pathogen in Food Safety and Sanitation course (FST322). Principles of food microbiological analyses will be practiced in Food Microbiology Laboratory course (FST 320).

VII. Lecture Rules

1. All cellular phones must be switched off during class periods. No exceptions.
2. Students arriving later than 5 minutes after the beginning of class are not allowed to attend the lecture.
3. There is a minimum requirement of class attendance. According to the university rules, only students with a minimum of 80% class attendance are eligible to take a final written examination, except under extenuating circumstances.

VIII. Assessment Tools

A. Quizzes

Quizzes consist of two types: online and offline quizzes

1. Online quizzes are available for each topic in the form of multiple choice questions uploaded in LMS (www.seafast.ipb.ac.id/moodle). Students must complete weekly online quizzes. Students will receive automatic feedback and scores of their weekly quizzes.
2. Offline quizzes are available for each topic in the form of essays questions. Ten questions are available for each quiz. Students will receive the score after a week.

B. Written Examinations

1. You will have two written examinations: Mid and final examinations. Check your exam schedule on the announcement board. The mid and final examinations will cover course materials

delivered in week 1-7 and 8-12, respectively. Remember that they are closed book examinations.

2. There will be some models of written examination with different cognitive levels (50 multiple choice questions and 2-3 essays).
3. The score for each question will be presented in paper sheets. Total scores: 100.
4. Remember that dishonesty or cheating during examination will result in the cancellation of your course. Obtaining or receiving illegal assistance from other student's work/lecture notes/textbook/other information sources and accessing unauthorized information about an examination before hand are categorized as cheatings. Disciplinary action will be imposed if a student is found to have seriously violated any of the rules contained in the Code of Conduct: warning, reduction of grades, suspension or expulsion.
5. Your scores will be posted on the announcement board soon after exam papers are graded. You may verify your scores to the lecturers.
6. The following examples of questions will help you to familiarize with written examinations:

Example 1 (C1, Knowledge)

Water in food used by microbes for their growth is called:

- (A) free water
- (B) bond water
- (C) all types of water
- (D) (A) and (b) are correct
- (E) All above answers are correct

Example 2 (C4, Analysis)

Microbes stop growing exponentially and enter the stationary phase when:

- (A) Nutrition in the growth medium has run out
- (B) They are growth-inhibitor metabolite
- (C) They reach the highest number
- (D) (A) and (B) are correct
- (E) All above answers are correct

Example 3 (C3, application)

Calculate the time of these bacteria assuming that the generation time is 40 min, the initial number is 10², and the final number after incubation is 10⁶:

- (A) 2 minutes
- (B) 4 minutes
- (C) 6 minutes
- (D) 8 minutes
- (E) No correct answer

Example 4 (C6, evaluate)

A sterilized canned food has a pH of 5.0 and *A_w* of 0.87. According to your opinion, what is the level risk of this food and what is the classification of this food?

C. Group Assignment: Paper and Oral Presentation

Students in group must complete 7 serial group assignments in the form of short papers and oral presentations conducted during the course period. The following are description of the group assignment. Lecturer will divide students into 12 groups (4-5 students per group) by considering students' diversity.

Week	Student Activities	Assign-
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1	<i>Selecting a food to be evaluated:</i> Each group must discuss and select a food to be evaluated in term of microbiological point of view.	1
2-3	<i>Identification intrinsic factors in food that may cause food spoilage:</i> Each group must (1) estimate the chemical components in food selected and identify which components may stimulate the growth of microbes; (2) estimate the water content and water activity of the selected food; (3) estimate the source the microbial contamination that may occur in food, and (4) estimate types of microbes that potentially grow in this food	2
4-5	<i>Identifying microbial advantages in food processing:</i> Each group must (1) identify some fermentation products that can be produced from their chosen food; (2) describe fermentation process being applied; (3) identify the microbes involved in the fermentation process; and (4) evaluate the possible biochemical changes that may occur during the fermentation process	3
6-7	<i>Identifying potential food spoilage:</i> Each group must (1) identify spoilage microbes that potentially decompose their chosen food; (2) estimate the indication of food spoilage considering the characteristics of spoilage microorganisms.	4
8-9	<i>Identifying potential health risk caused by microbial contamination:</i> Each group must (1) identify pathogenic microbes potentially contaminate their chosen food; and (2) predict health risk caused by the pathogenic microbes	5
10-12	<i>Controlling microbial growth:</i> Each group must (1) determine potential methods to control the microbial growth in their chosen food; (2) judge the safety of the controlling method; and (3) estimate the shelf life of food after application the selected methods	6
13-14	<i>Selecting suitable microbiological analysis:</i> Each group must (1) select suitable technique for microbial identification and measurement on their chosen food; (2) select a suitable method for sample preparation, analysis, calculation and reporting	7

Grading Criteria of Student Presentation and Paper Writing

- Each group will present orally once during the course. Each group presentation is for 10 minutes, including discussion session. Presentation is conducted at the end of a topic. Look at the schedule of student presentation in the table of course outline.
- Your group presentation will be graded according to the following criteria (maximum score: 100): (1) clarity and accuracy of information delivered during oral presentation (40%); (2) ability to answer the questions during discussion session (40%); and (3) presentation technique (20%).
- The following rubric is used as a guideline to grade your oral presentation:

Criteria	Excellent	Strong Case (80)	Developing (70)	Limited (60)
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	(90-100)			
Clarity and accuracy of information delivered during oral presentation (40%)	Information of the case is delivered clearly, and clear and correct conclusion/ recommendation	Comprehension information of the case and conclusion are inadequate	Some information is not accurate	Information of the case is not clear, a lot of missing or inaccurate information
Ability to answer the questions during discussion session (40%)	Clear and correct explanation with strong argument and references	Clear and correct explanation but not supported by strong argument or reference	Clear explanation, some information is missing, incorrect or irrelevant, fail to answer with strong argument or no reference	Unclear explanation, fail to answer the questions, comment is not taken seriously
Presentation technique (20%)	Power point presentation is very clear, systematic, free of word error, excellent appearance	Power point presentation is clear enough, and good appearance	Power point presentation is just enough, not systematic	Power point presentation is not clear, not well preparation

- Each group have to write 2-4 pages of review paper regarding the above assignment. Your paper must contain the information to answer every question in each assignment.
- The paper is graded based on the following criteria (maximum score for each criteria: 100): (1) Description of the case (50%), (2) Conclusion (20%), (3) Cited references (20%); (4) Writing format (grammar, punctuation, sentence structure, spelling, etc.) (10%). Comment of the paper will be returned as a feedback.
- Grade 50 will be given to late submission and zero grade will be given to any plagiarism. Plagiarism includes any work copied in whole or in part from another individual's work.
- The following rubric is used as a guideline to grade your paper.

Criteria	Excellent (90-100)	Strong Case (80)	Developing (70)	Limited (60-69)
Description of the case (50%)	Very Clear description of the case supported with an adequate cited references	Clear description of the case supported by adequate cited references	Description of the case is not clear although cited references are adequate	Case description is no clear, without support of adequate references
Conclusion (20%)	Statement draws an excellent conclusion	Statement draws a well conclusion from the case	Statement draws a good conclusion from the case	No conclusion or the statement does not reflect the paper content
Cited references (20%)	Use recent and various	Use adequate references	Use inadequate references	No references cited in the paper

	references			
Writing format (grammar, punctuation, sentence structure, spelling, etc.) (10%)	Sentences vary in length, are well formed and word choice is consistently precise; the writing is free of error	Sentences vary in length, are well formed and word choice is generally good; but the sporadic word error is found	Sentences vary in length, are well formed, but frequent word error is found	Many sentences constructed wrongly, and many word error is found

D. Student Participation and Attendance in Class

Student participation in this class, especially in accessing web pages, will be scored automatically by LMS. The scoring is based on the student's frequency to log in the LMS. Student can log in for reading teaching materials, complete online quizzes, access of assignment or chatting in the discussion forum with lecturers or other students.

IX. Final Grade Classification

The grading criteria are based on quizzes, written examination, written assignment, oral presentation, and class participation. The grading criteria, their score scale, and percentage to total grade are as presented in the following table.

No	Criteria	% grade	Score scale
1.	Online and class quizzes (average of 14 quizzes)	10	0-100
2.	Middle written examination	25	0-100
3.	Final written examination	25	0-100
4.	Group assignment: 7 assignments		
	Short Paper (Group)	15	60-100
	Oral presentation (Group)	15	60-100
5.	Student participation and attendance in class (accessing LMS	10	0-100
	Maximum Score		100

Grade classification: A \geq 80; AB: 75-79; B: 70-74; BC: 65-69; C: 55-64; D: 45-54; E < 45

**Assessment Tools to Measure the Achievement of Learning Outcomes
in Food Microbiology Course (FST220)**

Code : FST 220

Course : Food Microbiology

Credit : 2(2-0)

Code	Learning Outcomes	Topics Covered in this Course	Assessment Tools
II.A.1.	be able to identify the important pathogens and spoilage microorganisms in foods and the conditions under which they will grow (covered in detail)	<ul style="list-style-type: none"> Foodborne bacterial pathogen: Infection and intoxication. Factors affecting growth of pathogens in foods: nutrients in food, pH, aw, RH, temperature and time. Mycotoxin, viruses and parasites. 	Written examinations, group assignment (short paper and oral presentation)
II.A.2.	be able to identify the conditions under which the important pathogens are commonly inactivated, killed or made harmless in foods (covered in detail)	<ul style="list-style-type: none"> Microbial control by applying sanitation methods and temperature control Microbial control by drying, irradiation and modified atmosphere Microbial control by using antimicrobial preservatives and acid; applying non thermal processing and combination of methods 	Written examinations, group assignment (short paper and oral presentation)
II.B.1	understand the principles involving food preservation via fermentation processes (covered to some extent)	<ul style="list-style-type: none"> Basic of food fermentation process: chemical, biochemical and sensory changes during fermentation. Microbial metabolism. Food fermentation product and its beneficial microbes: product fermentation based on plant (vegetable, legume and nut) and animal (fish and meat) 	Written examinations, group assignment (short paper and oral presentation)
III.C.1.	understand the role and significance of microbial inactivation, adaptation	<ul style="list-style-type: none"> Microbial growth kinetic and measurement Factor intrinsic and 	Written examinations, group assignment (short paper and oral presentation)

	and environmental factors (i.e., Aw, pH, temperature) on growth and response of microorganisms in various environments (covered in detail)	extrinsic affecting growth and live of microbes ☐ Computer modelling of microbial growth	presentation)
II.D.1.	be able to identify the conditions, including sanitation practices, under which the important pathogens and spoilage microorganisms are commonly inactivated, killed or made harmless in foods (covered in detail)	Microbial control by applying sanitation methods and temperature control	Written examinations, group assignment (short paper and oral presentation)
III.B.1.	know the spoilage and deterioration mechanisms in foods and methods to control deterioration and spoilage (covered to some extent)	<ul style="list-style-type: none"> • Microbial spoilage of vegetables, fruits, cereal and their products • Microbial spoilage of meat, eggs, milk, seafood and their products 	Written examinations, group assignment (short paper and oral presentation)
III.B.2	understand the principles that make a food product safe for consumption (covered to some extent)	<ul style="list-style-type: none"> • Important microorganism in food safety. • Microorganisms and foodborne diseases. • Microorganism that caused food spoilage and their ability to spoil a given food, when prepared, processed and stored under given conditions 	Written examinations, group assignment (short paper and oral presentation)
III.D.1	understand the principles and current practices of processing techniques and the effects of processing parameters on product quality (covered to some extent)	<ul style="list-style-type: none"> • Microbial control by using antimicrobial preservatives and acid • Applying non thermal processing and combination of methods (hurdle concept) 	Written examinations, group assignment (short paper and oral presentation)
III.F.1.	understand the basic principles and practices of cleaning and sanitation in food processing operations (covered to some extent)	<ul style="list-style-type: none"> • Microbial control by applying sanitation methods and temperature control • Microorganisms in food processing 	Written examinations, group assignment (short paper and oral presentation)
IV.A.1.	be able to apply and incorporate the principles of food science in practical, real world situations and	<ul style="list-style-type: none"> • Microorganism in food processing • Food safety problems and solution in 	Written examinations, group assignment (short paper and oral presentation)

	problems (covered to some extent)	Indonesia	
IV.D.1.	be able to apply the principles of food science to control and assure the quality of food products (covered to some extent)	<ul style="list-style-type: none"> • Microbial control by using antimicrobial preservatives and acid • Applying non thermal processing and combination of methods 	Written examinations, group assignment (short paper and oral presentation)
IV.F.1.	be aware of current topics of importance to the food industry (covered to some extent)	Food safety problems and solution in Indonesia	Written examinations, group assignment (short paper and oral presentation)
VI.A.1.	demonstrate the use of oral and written communication skills (covered in detail)	Group assignment	Group assignment (short paper and oral presentation)
VI.B.1.	define a problem, identify potential causes and possible solutions, and make thoughtful recommendations (covered in detail)		
VI.B.2.	apply critical thinking skills to new situations (covered in detail)		
VI.C.1.	commit to the highest standards of professional integrity and ethical values (covered in detail)		
VI.C.2.	work and/or interact with individuals from diverse cultures (covered in detail)		
VI.E.1.	work effectively with others (covered in detail)		
VI.E.3.	deal with individual and/or group conflict (covered to some extent)		
VI.F.1.	independently research scientific and non-scientific information (covered in detail)		
VI.G.2.	facilitate group projects (covered in detail)		

