



Building and Sustaining Hygienic Design for Food Processing

-Perspectives for the new generation of food scientists-



3-A SSI Annual Meeting – Milwaukee, May 16th-19th, 2016

Alejandro Echeverry, Ph.D.

Assistant Professor / Food Safety

Department of Animal and Food Sciences

Texas Tech University

Outline of Presentation



1. Introduction
2. Everyone needs to help
3. Current programs/syllabus in food science
4. Future professionals
5. Suggestions

1. Introduction



Hygienic Design.....

What's the importance?

1. Listeria Outbreak
2. 2 deaths
3. >350 Products; 42 brands
4. 250 people layoff

Recalls Pasco frozen food plant on ice

Recall Press Release

CRF Frozen Foods Expands Voluntary Recall to Include All Frozen Vegetable and Fruit Products Due To Possible Health Risk

Updated Items:

- Formatting changes have been made to O Organics, Pantry Essentials, Safeway Kitchens, and Signature Kitchens product codes.
- No products have been added.

PASCO, Wash., May 4, 2016 /PR Newswire/ — As a precaution, CRF Frozen Foods of Pasco, Washington is expanding its voluntary recall of frozen organic and traditional fruits and vegetables. We are performing this voluntary recall in cooperation with the Food and Drug Administration (FDA) and the Centers for Disease Control and Prevention (CDC) because these products have the potential to be contaminated with *Listeria monocytogenes*. The organism can cause serious and sometimes fatal infections in young children, frail or elderly people, and others with weakened immune systems. Although healthy individuals may suffer only short-term symptoms such as high fever, severe headache, stiffness, nausea, abdominal pain, and diarrhea, *Listeria* infection can cause miscarriages and stillbirths among pregnant women.

The two-page FDA inspection report includes boilerplate citations of applicable sections of the federal Food, Drug, and Cosmetic Act on its second page. The

2. Everyone needs to help!



1. Who is going to help us?

- HACCP TEAM, of course!!!!!!!!!!!!!!

- *Food Technologists*
- *Food Scientist*
- *Ind. Microbiologists/Food Microbiologist*
- *Meat Scientists*
- *Dairy Scientists*
- *R&D*
- *Nutritionists*
- *Food /Agricultural Engineers*

What they need to know:

1. Metallurgy / Materials
2. Process engineering
3. Safety Engineering
4. Production Engineering
5. Maintenance
6. Mechanical Engineering
7. Thermal processes
8. Rheology
9. Fluid Mechanics
10. Quality Assurance

3. Schools with Food Engineering/related Programs (Undergraduate)



College/University
Auburn University
Brigham Young University
Clemson University
Iowa State University
Kansas State University
Louisiana State University
Ohio State University
Michigan State University
University of Minnesota-Twin Cities
University of Wisconsin-Madison

Different Areas of Emphasis:

- Biosystems Engineering | Forest engineering
- Manufacturing
- Packaging Science
- Agricultural Engineering
- Bioproducts and Biosystems
- Dairy/Meat/Grains/Poultry/Vegetables

3. Example – Auburn University





Biosystems Engineering

Samuel Ginn College of Engineering

Samuel Ginn College of Engineering

Up to Research and Outreach

Food and Biological Engineering

Food and Biological Engineering

College of Engineering / Academic Programs / Biosystems Engineering / Research and Outreach / Food and Biological Engineering

Biological engineering involves applying biosystems engineering principles to the solution of problems involving biological organisms and their environments. Biological engineering combines knowledge of process design with biological principles to develop the processing methods to produce new products from bioresources. Biological engineering develops microbiological processes to produce foods, biochemicals, enzymes, and pharmaceuticals. Biological engineering develops basic processes that occur at the genetic or cellular level and then deploys these processes at industrial scales.

Food engineering involves applying engineering principles to basic food science problems and scaling up these processes in a safe, cost-effective manner for efficient manufacture and distribution. This focus area will include work in bio-sensors, food safety, and bio-based products development. New initiatives in this focus area will lead the Ginn College of Engineering and the College of Agriculture into high visibility research and outreach that can make significant impacts on the Alabama economy.



Faculty working in this area include:

- Dr. Oladiran Fasina, P.Eng.
- Dr. Yifen Wang

Current projects in this area include:

- Rheological properties of food and biological materials
- Postharvest handling and storage of bioenergy crops
- Densification of bioenergy crops
- Compaction behavior, pelleting and utilization of solid animal manure
- Demonstration of pellet furnace and use of biofuel pellets as energy efficient fuel source.

Last Updated: May 05, 2016



Facebook Twitter YouTube Instagram

College of Engineering / Academic Programs / Biosystems Engineering / Academic Programs / Courses / BSEN & ECEN Courses

BSEN & ECEN Courses

For Biosystems Engineering course descriptions go to the Auburn University Bulletin.

- ENGR 1110 Introduction to Biosystems Engineering *Dr. David Blersch*
- BSEN 2210 Engineering Methods for Biosystems *Dr. Tim McDonald*
- BSEN 2240 Biological and Bioenvironmental Heat and Mass Transfer *Dr. Sushil Adhikari*
- BSEN 3210 Mechanical Power for Biosystems *Dr. Tim McDonald*
- BSEN 3230 Natural Resources Conservation Engineering
- BSEN 3240 Process Engineering in Biosystems *Dr. Yifen Wang*
- BSEN 3260 Engineering for Precision Agriculture and Forestry *Dr. Tim McDonald*
- BSEN 3310 Hydraulic Transport in Biological Systems *Dr. Oladiran Fasina*
- BSEN 3500 Natural Resource Systems Conservation
- BSEN 3510 Agricultural Power and Machinery Fundamentals
- BSEN 3530 Agricultural Production and Processing Facility Technology
- BSEN 3560 Turf Systems Irrigation Design *Dr. Mark Dougherty*
- BSEN 3610 Instrumentation and Controls for Biological Systems *Dr. Tim McDonald*
- BSEN 4210 Irrigation System Design for Biosystems *Dr. Mark Dougherty*
- BSEN 4250 Hydraulic Control Systems Design *Dr. Tim McDonald*
- BSEN 4300 Professional Practice in Biosystems Engineering
- BSEN 4310 Engineering Design for Biosystems *Dr. Mark Dougherty*
- BSEN 4960 Special Problems in Biosystems Engineering
- BSEN 4967 Honors Special Problems
- BSEN 4970 Special Topics in Biosystems Engineering *Dr. Sushil Adhikari*
- BSEN 4980 Undergraduate Research
- BSEN 4997 Honors Reading and Special Topics
- BSEN 5220 Geospatial Technologies for Biosystems *Dr. Jasmeet Lamba*
- BSEN 5230 Waste Management and Utilization Engineering for Biosystems *Dr. Yi Wang*
- BSEN 5250 Deterministic Modeling for Biosystems *Dr. Bill Batchlor*
- BSEN 5260 Renewable Energy in Biosystems Process Operations *Dr. Oladiran Fasina*
- BSEN 5510 Ecological Engineering *Dr. David Blersch*
- BSEN 5520 Watershed Modeling *Dr. Jasmeet Lamba*
- BSEN 5540 Biomass and Biofuels Engineering *Dr. Sushil Adhikari*
- BSEN 5550 Principles of Food Engineering Technology *Dr. Oladiran Fasina*
- BSEN 5560 Site Design for Biosystems *Dr. Mark Dougherty*
- BSEN 6220 Geospatial Technologies in Biosystems *Dr. Jasmeet Lamba*
- BSEN 6230 Waste Management and Utilization Engineering for Biosystems *Dr. Yi Wang*
- BSEN 6250 Deterministic Modeling for Biosystems *Dr. Bill Batchlor*
- BSEN 6260 Renewable Energy in Biosystems Process Operations *Dr. Oladiran Fasina*
- BSEN 6510 Ecological Engineering *Dr. David Blersch*
- BSEN 6520 Watershed Modeling *Dr. Puneet Srivastava*
- BSEN 6550 Principles of Food Engineering Technology *Dr. Oladiran Fasina*
- BSEN 7020/7026 Site-Specific Technologies for Agriculture and Forestry Systems
- BSEN 7050 Soil Dynamics of Tillage and Traction
- BSEN 7110/7116 Fundamentals of Instrumentation for Biological Systems *Dr. Tim McDonald*
- BSEN 7120 Stochastic Modeling for Biosystems
- BSEN 7220 Renewable Energy Systems Design, Analysis and Applications *Dr. Oladiran Fasina*
- BSEN 7240 Bulk Solids Storage, Handling and Transportation *Dr. Oladiran Fasina*
- BSEN 7260 Advanced Unit Operations in Biosystems Engineering *Dr. Oladiran Fasina*
- BSEN 7280 Food Thermal Processing *Dr. Yifen Wang*
- BSEN 7310 Non-point Source Pollution
- BSEN 7320 Non-point Source Pollution Modeling
- BSEN 7330 Soil-Plant-Environmental System Design *Dr. Mark Dougherty*
- BSEN 7350 Engineering Analysis of Lakes and Reservoirs *Dr. Mark Dougherty*
- BSEN 7900 Special Problems in Biosystems Engineering
- BSEN 7950 Seminar

- BSEN 3240 Process Engineering
- BSEN 3530 Agricultural Production and Processing Facility Technology
- BSEN 5550 Principles of Food Engineering
- BSEN 7280 Food Thermal Processing

3. Example – Clemson University



Food Science / Packaging Sciences



2015-2016 Undergraduate Announcements

FDSC 4030* Food Chemistry and Analysis 2 (1) Principles of analytical procedures and techniques used to quantitatively and qualitatively determine chemical composition of foods, and elucidate the physio-chemical properties of food materials. Laboratories provide experience in critical thinking, performing food analysis, and analyzing data. *Preq:* BCHM 3050 and BIOL 4340 and FDSC 2140; and Food Science major or minor. *Coreq:* FDSC 4031.

FDSC 4031* Food Chemistry and Analysis Laboratory 0 (3) Non-credit laboratory to accompany FDSC 4030. *Coreq:* FDSC 4030.

FDSC 4040* Food Preservation and Processing 3 (3) Principles of food preservation applied to flow processes, ingredient functions, and importance of composition and physical characteristics of foods related to their processing; product recalls and product development concepts. *Preq:* Food Science major or minor or Packaging Science major or minor; and BCHM 3050; and either FDSC 2140 or FDSC 3010; and one of PHYS 1220 or PHYS 2000 or PHYS 2070.

FDSC 4060* Food Preservation and Processing Laboratory I 1 (3) Laboratory exercises on preservation methods, equipment utilized, and processes followed in food manufacture. *Preq:* FDSC 4040.

FDSC 4070* Quantity Food Production 2 (1) Principles of the production of food in quantity for use in food service systems. Emphasizes functions of components of foods and of ingredients in food, and focuses on the quality of the final product, on safe production of food, and on proper use of equipment. *Preq:* Food Science major or minor, or Packaging Science major or minor. *Coreq:* FDSC 4071.

FDSC 4071* Quantity Food Production Laboratory 0 (3) Non-credit laboratory to accompany FDSC 4070. *Coreq:* FDSC 4070.

FDSC 4080* Food Process Engineering 4 (3) Study of basic engineering principles and their application in food processing operations. Emphasizes the relation between engineering principles and fundamentals of food processing. *Preq:* Food Science major or minor; and CH 1020 and FDSC 2140; and one of MATH 1020 or MATH 1060; and one of PHYS 1220 or PHYS 2000 or PHYS 2070. *Coreq:* FDSC 4081.

FDSC 4081* Food Process Engineering Laboratory 0 (3) Non-credit laboratory to accompany FDSC 4080. *Coreq:* FDSC 4080.

FDSC (PKSC) 4090* Total Quality Management for the Food and Packaging Industries 3 (3) Introduction to the principles of modern quality management emphasizing quality standards and issues and the practices necessary for food processing and packaging companies to survive in a customer-driven marketplace. May also be offered as PKSC 4090.

FDSC 4101* Food Product Development Laboratory 0 (3) Non-credit laboratory to accompany FDSC 4100. *Coreq:* FDSC 4100.

FDSC 4170 Seminar 1 (1) Literature research and oral presentation of a current food science topic. *Preq:* Food Science major.

FDSC 4180 Seminar 1 (1) Literature research and oral presentation of a current food science topic.

FDSC 4200 Special Topics in Food Science 1-3 (1-3) Special topics in food science not covered in other courses. May be repeated for a maximum of 12 credits, but only if different topics are covered. Includes Honors sections. *Preq:* Consent of instructor.

FDSC 4210 Special Problems in Food Science 1-4 (1-4) Independent research investigation in food science areas not conducted in other courses. May be repeated for a maximum of 12 credits. Includes Honors sections. *Preq:* Consent of instructor.

FDSC 4300* Dairy Processing and Sanitation 3 (2) Processing, manufacture and distribution of fluid, frozen, cultured and other dairy products. Emphasizes sanitation in a commercial food processing plant environment, chemical and microbiological aspects, processing procedures, equipment operation, ingredient applications, formulation and functional properties. *Preq:* BIOL 1040 and BIOL 1060 and CH 1020. *Coreq:* FDSC 4301.

FDSC 4301* Dairy Processing and Sanitation Laboratory 0 (3) Non-credit laboratory to accompany FDSC 4300. *Coreq:* FDSC 4300.

FDSC 4500 Creative Inquiry—Food Science 1-6 (1-6) Individual or small team research experience in close collaboration with a faculty member. Expands undergraduate learning by application of the scientific method. Research is selected by the student with approval of faculty. May be repeated for a maximum of ten credits.

FDSC 4910 Practicum 1-4 (1-4) Supervised experiential opportunities in the food industry. May be repeated for a maximum of 12 credits. *Preq:* Food Science major and Junior standing and consent of department chair.

FJ
Pr
Sp
ris
As
Ta

FE
I
f
c
t
f
FE

- FDSC 4080 Food Process Engineering
- FDSC 4300 Dairy Processing and Sanitation

Alejandro Echeverry, Ph.D



3. Example – Iowa State University



Agricultural and Biosystems Engineering – F.E. Option

IOWA STATE UNIVERSITY
College of Engineering
College of Agriculture and Life Sciences

Agricultural and Biosystems Engineering



- EM 324 Mechanics of Materials
- ABE 415 Ag & Biosystems Eng. design

Undergraduate Curriculum in Biological Systems Engineering Food Engineering Option 2016-2017 Catalog Total Credits 128					
First Year (32 cr.)					
Semester 1 (16 cr.)			Semester 2 (16 cr.)		
R	Engr 101	Orientation (FS)	1	ABE 110	Experiencing BSE (S)
3	ABE 170	Graphics and Design (FS)	3	ABE 160	Engineering Problems (FS)
4	Math 165	Calculus I (FSSS)	4	Math 166	Calculus II (FSSS)
4	Chem 167	General Chemistry (FS)	5	Phys 221	Classical Physics I (FSSS)
1	Chem 167L	General Chemistry Lab (FS)	3	Engl 250	Writ/Oral/Vis/Elec Composition (FSSS)
3	Engl 150	Crit. Think. and Comm.(FSSS)			
1	Lib 160	Information Literacy (FSSS)			
Second Year (34 cr.)					
Semester 3 (17 cr.)			Semester 4 (17 cr.)		
3	ABE 216	Fund. Ag. and Biol. Engineering (F)	2	ABE 218	Project Mgmt/Design Ag & Bio Engr (S)
3	EM 274	Statics of Engineering (FSSS)	1	ABE 201	Preparing for the Workplace (FS)
3	Stat 305	Engineering Statistics (FSSS)	3	EM 324	Mechanics of Materials (FSSS)
5	Phys 222	Classical Physics II (FSSS)	4	Math 267	Differential Equations (FSSS)
3	Biol 212	Principles of Biology II (FSSS)	3	Chem 231	Organic Chemistry (FSSS)
			1	Chem 231L	Organic Chemistry Lab (FSSS)
			3	ME 231	Thermodynamics (FSSS)
Third Year (31 cr.)					
Semester 5 (15 cr.)			Semester 6 (16 cr.)		
3	ABE 316	Applications and Systems Modeling (FS)	3	ABE 380	Principles of BSE (S)
4	ABE 363	Electric Power and Electronics (FS)	3	→	Mass/Transport Sequence I
3	ABE 451	Food Engineering (F)	3	Micro 302	Biology of Microorganisms (FSSS)
1	EM 327	Mechanics of Materials Lab (FSSS)	1	Micro 302L	Microbiology lab (FSSS)
3	FSHN 311	Food Chemistry (F)	3	→	SS&H Elective (FSSS)
1	FSHN 311L	Food Chemistry Lab (F)	3	→	SS&H Elective (FSSS)
Fourth Year (31 cr.)					
Semester 7 (14 cr.)			Semester 8 (17 cr.)		
2	ABE 415	Ag & Biosystems Engr. Design I (FS)	2	ABE 416	Ag & Biosystems Engr. Design II (FS)
3	ABE 404	Instrumentation for Ag and Bio Engr (F)	3	ABE 469	Grain Processing and Handling (S)
3	ABE 480	Engineering Analysis of Bio Systems (F)	3	→	Heat/Mass Transport Sequence II
3	FSHN 420	Food Microbiology (F)	3	→	Communication Elective (FSSS)
3	FSHN 471	Food Processing (F)	3	→	International Perspective Elective (FSSS)
			3	→	U. S. Diversity Elective (FSSS)
*Please check the current catalog and Schedule of Classes for most recent offerings					

3. Example – Kansas State University



Food Science Program

KANSAS STATE
UNIVERSITY

K-State home » Food Science Institute » Why Food Science? » Food Science Undergraduate Program

Food Science Institute

Home

Students & Programs

Future Students

Undergraduate Program

Learning Outcomes

Curriculum Options

Graduate Program

Online Education

Academic Resource Center

Courses

Loans and Scholarships

Job Opportunities

Food Science Club

Student-to-Student Recruiting Leaders

Awards & Recognition

Other Information

Fountain Reading Room

News & Events

People

Facilities

Participating Colleges & Departments

Food Science Undergraduate Program

Food Science is a field that brings the science of food to life. Students learn the fundamental properties of food raw materials important to designing and processing safe, wholesome, and attractive food products.

K-State's undergraduate food science and industry program is certified by the Institute of Food Technologists (IFT) and indicates the national recognition of the program. The IFT is a nonprofit scientific society with 28,000 members who work in food science and related professions in industry, academia, and government.

Students may choose between the science or business options. The science option curriculum interfaces well with Pre-Veterinary Medicine and Pre-Medicine requirements.

Job Opportunities are strong and in the past 25 years, K-State has never had enough graduates to fill available jobs. Starting salaries have ranged from \$38,000 to \$52,000.

Food Science Core Courses (30–32 credit hours)

Must have a 2.0 GPA average.

- [FDSCI 101 – Foundations in Food Science & Industry](#) Credits: (1)
- [GENAG 200 – Topics in Agriculture](#) Credits: (0–3) [College Careers](#) Credits: (0)
- [FDSCI 302 – Introduction to Food Science](#) Credits: (3)
- [FDSCI 305 – Fundamentals of Food Processing](#) Credits: (3)
- [FDSCI 500 – Food Science Seminar](#) Credits: (1)
- [FDSCI 501 – Food Chemistry](#) Credits: (3)
- [FDSCI 600 – Food Microbiology](#) Credits: (2)
- [FDSCI 601 – Food Microbiology Lab](#) Credits: (2)
- [FDSCI 690 – Principles of HACCP and HARPC](#) Credits: (3)
- [FDSCI 727 – Chemical Methods of Food Analysis](#) Credits: (2)
- [FDSCI 728 – Physical Methods of Food Analysis](#) Credits: (2)
- [GRSC 540 – Engineering Applications to Grain/Food Products](#) Credits: (3)
- [GRSC 541 – Engineering Applications to Grain/Food Products Laboratory](#) Credits: (1)

Select one

- [ASI 318 – Fundamentals of Nutrition](#) Credits: (3)
- [FNDH 132 – Basic Nutrition](#) Credits: (3)

Select one


- [FDSCI 695 – Quality Assurance of Food Products](#) Credits: (3)
- [FDSCI 740 – Research and Development of Food Products](#) Credits: (4)

- **FDSCI 305**
Fundamentals of Food Processing
- **GRSC 540/541**
Engineering applications for grain/food products

3. Example –University of Minnesota



Bioproducts and Biosystems Engineering



UNIVERSITY OF MINNESOTA
Driven to Discover™

Department of Bioproducts and Biosystems Engineering

Home

Undergraduate ▾

Graduate ▾

Research ▾

Extension & Outreach ▾

Alumni & Friends ▾

Partners ▾

Food Engineering


Addressing the growing need for safe and healthy foods and healthy lives


Food engineers design and develop processes and products that address the world's growing demand for safe and healthy foods and healthy lives. From developing new and innovative bioprocessing solutions to food processing, machinery, packaging, ingredients, instrumentation, and control, food engineers create important cost-effective systems and solutions.

Food engineering students can tailor their education to their personal interests and career objectives. Graduates will be prepared for careers in the food processing and related agricultural products industry. Graduates will also be prepared for continuing their education at the graduate level in engineering, science, medicine, law, and business.

Degree

Students in this program will graduate from the College of Science and Engineering with a [Bachelor of Bioproducts and Biosystems Engineering \(BBE\)](#) with an emphasis (or major sub-plan) in Food Engineering (which will appear on the official transcript). Students can [apply for admission](#) to BBE through either the College of Science and Engineering or through the College of Food, Agricultural and Natural Resource Sciences (listed as "Pre-BBE").





COLLEGE OF
Science & Engineering
UNIVERSITY OF MINNESOTA

CSE Academic Advising
College of Science and Engineering
105 Lind Hall • 207 Church Street SE
Minneapolis, MN 55455
612-624-2890 • CSEAdvising@umn.edu
cse.umn.edu

Rev. Date:
6/2015

BBE - Food Engineering

Freshman Year

Fall Semester

BBE 1001 BP Orientation 1

Chem 1061/65 Chem Princ I (placement into course, or 1015) 4

Math 1371 Calculus I (placement into course, or pre-req) 4

Phys 1301W Intro Physics I (& Math 1371) 4

CSE 1001: 1st Yr Experience 1

Lib Ed or Writ 1301/1401 3/4

Spring Semester

Chem 1062/66 Chem Princ II (1061/1065) 4

Math 1372 Calculus II (1371) 4

Phys 1302W Intro Physics II (1301, & Math 1372) 4

Lib Ed or Writ 1301/1401 3/4

Sophomore Year

Fall Semester

Biol 1009 General Biology 4

Math 2374 or 2263 Multi Calc (1372) 4

BBE 2001 Mech. & Struct. Des. (Math 1372, Phys 1301) 4

BBE 2002 Intro to Eng Design (Math 1371, Chem 1061/65, Writ 1301) 3

Spring Semester

Math 2373 or 2243 Lin Al/Dif Eq. I (1372) 4

BBE 3033 Material & Energy Balance in Biol Systems (Math 1372, Phys 1302, Chem 1062/66) 3

Chem 2301 Organic Chem I (1062/66) 3

BBE 3043 Biol/Enviro Thermo (Biol 1009, Chem 1061/65, Phys 1302, Math 1372) 3

Liberal Education course 3/4

Junior Year

Fall Semester

BBE 3013 Engr Prin Cell Proc (Biol 1009, Math 1372, BioC 2011 or Chem 2301) 3

BBE 3012 Transport Biol I (BBE 2001, 3033, Math 2373, 2374, Physics 1302) 4

Stat 3021 Intro to Prob/Stat (Math 1372) 3

Liberal Education course 3/4

BioC 3021 Biochemistry 3

Spring Semester

BBE 4013 Transport in Biol Sys (UD, BBE 3013, 3043, 3012) 3

BBE 4402 BP Engineering Lab I (UD, Chem 2301) 1

BBE 4713 Biol Process Engr (BBE 4013 or & 4013) 3

VBS 2032 General Microbiology with Lab 5

BBE 4303 Intro Bio-based MatSci (UD, BBE 2001) 3

Senior Year

Fall Semester

BBE 4023W Proc. Cont. & Instr. (UD) 3

Technical Elective I 3/4

Technical Elective II 3/4

Emphasis course I 3/4

Emphasis course II 3/4

Spring Semester

BBE 4502W Capstone Design (BBE 2002) 4

BBE 4723 Food Proc. Eng. (BBE 4013 or & 4013) 3

Technical Elective III 3/4

Emphasis course III 3/4

Liberal Education course 3/4

About This Plan

Department Contact Information

- BBE Mechanical and Structural Design
- Electives cover other topics:
- IE 5513 Engineering Safety
- FSCN 4332 Food Processing Operations

Alejandro Echeverry, Ph.D



3. Example –University of Nebraska-Lincoln



Food Science Program & Biological Systems Engineering



Semester 1 - Fall	Semester 2 - Spring	Semester 3 - Fall	Semester 4 - Spring
<div>BSEN 100 Introduction to Biological Engineering and Agricultural Engineering1 cr</div> <div>CHEM 113 Fundamental Chemistry I4 cr</div> <div>ENGR 10 Freshman Engineering Seminar0 cr</div> <div>MATH 106 Calculus I5 cr</div> <div>ACE 5, 6, 7, 8, or 93 cr</div> <div>ACE 5, 6, 7, 8, or 93 cr</div> <div>Total Credits16</div>	<div>BSEN 112 Computer-Aided Problem-Solving2 cr</div> <div>CHEM 114 Fundamental Chemistry II3 cr</div> <div>MATH 107 Calculus II4 cr</div> <div>PHYS 211 General Physics I4 cr</div> <div>Organizational Skills Elective (see adviser for list)3 cr</div> <div>Total Credits16</div>	<div>BSEN 225 Engineering Properties of Biological Materials3 cr</div> <div>CHEM 251 & CHEM 253; or CHEM 255 & CHEM 257; or CHEM 261 & CHEM 2634 cr</div> <div>ENGR 20 Sophomore Engineering Seminar0 cr</div> <div>JGEN 200 Technical Communication I3 cr</div> <div>MATH 208 Calculus III4 cr</div> <div>MECH 223 Engineering Statics3 cr</div> <div>Total Credits17</div>	<div>BSEN 130 Computer-Aided Design2 cr</div> <div>BSEN 244 Thermodynamics of Living Systems3 cr</div> <div>LIFE 120 Fundamentals of Biology I3 cr</div> <div>LIFE 120L Fundamentals of Biology I Laboratory1 cr</div> <div>MATH 221/821 Differential Equations3 cr</div> <div>MECH 373 Engineering Dynamics3 cr</div> <div>Computer Programming Elective (BSEN 212A, BSEN 212B, or BSEN 212E)1 cr</div> <div>Total Credits16</div>
Year 3		Year 4	
Semester 5 - Fall	Semester 6 - Spring	Semester 7 - Fall	Semester 8 - Spring
<div>LIFE 121 Fundamentals of Biology II3 cr</div> <div>LIFE 121L Fundamentals of Biology II Laboratory1 cr</div> <div>CIVE 310 or CHME 332 or MECH 3103 cr</div> <div>ELEC 211 Elements of Electrical Engineering I3 cr</div> <div>MECH 321 or MATH 3803 cr</div> <div>BSEN Emphasis Elective3 cr</div> <div>Total Credits16</div>	<div>BIOC 321 or BIOC 4313 cr</div> <div>BSEN 344 Biological and Environmental Transport Processes3 cr</div> <div>ACE 5, 6, 7, 8, or 93 cr</div> <div>BSEN Emphasis Elective3 cr</div> <div>Engineering or Science Emphasis Elective3 cr</div> <div>Oral Communication Elective (ALEC 102, COMM 209, COMM 210 COMM 283, COMM 286, ENGR 100, GERM 303, JAPN 202, JGEN 300, RUSS 304, or SPAN 303)3 cr</div> <div>Total Credits16</div>	<div>BSEN 2063 cr</div> <div>BSEN 460/860 Instrumentation and Controls3 cr</div> <div>BSEN 4701 cr</div> <div>Design I in Agricultural and Biological Systems Engineering1 cr</div> <div>ACE 5, 6, 7, 8, or 93 cr</div> <div>BSEN Emphasis Elective3 cr</div> <div>Engineering or Science Emphasis Elective3 cr</div> <div>Total Credits16</div>	<div>BSEN 480 Design II in Agricultural and Biological Systems Engineering3 cr</div> <div>ENGR 400 Professional Ethics and Social Responsibilities1 cr</div> <div>ACE 5, 6, 7, 8, or 93 cr</div> <div>Biological Sciences Elective5 cr</div> <div>BSEN Emphasis Elective3 cr</div> <div>Engineering Emphasis Elective3 cr</div> <div>Total Credits18</div>

- Mech 373 Engineering Dynamics
- BSNE Instrumentation and Control
- BSEN 470 Design in Agricultural and Biological Systems Engineering

3. Example –Brigham Young University (Utah)



Manufacturing Engineering Technology



BS in Manufacturing Engineering Technology (75–78 hours*)

Show All Course Desc
Hide All Course Desc

Program Requirements | [View MAP](#) | [View Program Outcomes](#)

1. Students must have a minimum of 124 total hours to graduate with this major.

2. Complete the following manufacturing core courses:

MFG 130 : Modern Manufacturing. (3:2:2)
MFG 220 : Material Removal. (3:2:3)
MFG 230 : Computer-Aided Manufacturing. (3:2:3)
MFG 291 : Manufacturing Leadership. (1:1:1)
MFG 331 : Metals Processes. (4:3:3)
MFG 340 : Quality Systems in Manufacturing. (3:2:3)
MFG 355 : Plastics Materials and Processing. (3:2:3)
MFG 431 : Tool Design. (3:2:3)
MFG 434 : Introduction to Manufacturing Automation. (3:2:2)
MFG 480 : Process Planning and Systems Design. (3:3:0)
MFG 491 : Professional Seminar. (1:1:0)

3. Complete 3 hours of the following:

MFG 399R : International Internship. (1-3:0:0)

4. Complete the following supporting courses:

CE EN 103 : Engineering Mechanics--Statics. (3:3:0)
CE EN 203 : Engineering Mechanics--Mechanics of Materials. (3:3:0)
CHEM 105 : General College Chemistry. (4:5:0)
ENGL 316 : Technical Communication. (3:3:0)
ENG T 231 : Foundations of Global Leadership. (3:3:0)
IT 318 : Electronics, Computers, and Manufacturing. (3:2:3)
ME EN 172 : Engineering Graphics--Principles and Applications. (3:2:2)
ME EN 250 : Science of Engineering Materials. (3:3:0)
STAT 201 : Statistics for Engineers and Scientists. (3:3:0)
TECH 312 : Exploration in Innovation Design Techniques. (1:1:0)

5. Complete the following:

MATH 112 : Calculus 1. (4:5:0)

6. Complete one of the following options:

Either

PHSCS 105 : General Physics 1. (3:3:0)
PHSCS 107 : General Physics Lab 1. (1:0:3)

Or

PHSCS 121 : Introduction to Newtonian Mechanics. (3:3:1)

7. Complete the following:

MFG 479 : Innovation and Entrepreneurship. (3:3:0)
ME EN 475 : Integrated Product and Process Design 1. (3:2:3)
ME EN 476 : Integrated Product and Process Design 2. (3:2:3)

- MFG 331: Metals Processes
- MFG 355: Plastic Materials and Processing
- MFG 431: Tool Design
- CE EN 203: Engineering Mechanics – Mechanic of Materials
- ME EN 250: Science of Engineering Materials



3. Current Programs – TTU's Food Science (Undergraduate)

B.S. in Food Science



- FDSC 3305 Principles of Food Engineering

TTU Home » Official Publications Home »

Food Science (FDSC)

2000 Sophomore Level 3000 Junior Level 4000 Senior Level
5000 Graduate Level 6000 Graduate Level

[Click here for an explanation of how to read course offerings.](#)
[Click here for A-Z course descriptions list.](#)

2000 LEVEL COURSES

2300. [AGRI 1329] **Principles of Food Technology** (3:3:0). Basic information necessary to understand technological aspects of modern industrial food supply systems. A fundamental background in food classification, modern processing, and quality control. Fulfills Core Technology and Applied Science requirement. F, S, SS.

2302. **Elementary Analysis of Foods** (3:2:3). Basic laboratory practice in food product testing. Should have had a course in chemistry or other lab science. Fulfills Core Technology and Applied Science requirement. S.

3000 LEVEL COURSES

3100. **Food Science Seminar** (1:1:0). Information to prepare students to function in a competitive work environment or professional/graduate school. F, S.

3301. **Food Microbiology** (3:2:3). Prerequisite: MBIO 3400 or permission of instructor. Microorganisms important in food spoilage and in food preservation. Study of methods for preservation of food with respect to control of microbiological growth and activity. S, even years. (Writing Intensive)

3302. **Advanced Food Analysis** (3:2:3). Prerequisite: CHEM 3305, 3105, FDSC 2302, or permission of instructor. Study of laboratory techniques fundamental to establishing the nutritional value and overall acceptance of foods. Investigation of food constituents and methods used in their analysis. F, even years. (Writing Intensive)

3303. **Food Sanitation** (3:3:0). Principles of sanitation in food processing and food service applications. Chemical, physical, and microbiological basis of sanitation. Equipment and food product care. Fulfills Core Technology and Applied Science requirement. F, S, and SSII.

3304. **Fruit and Vegetable Processing** (3:2:3). Practice in preserving fruits and vegetables. Suitable for nonmajors. F.

3305. **Principles of Food Engineering** (3:2:3). Prerequisite: MATH 1320 and 1321 or higher-level math. Course provides students exposure in using food engineering principles for improving the commonly used unit operations in the food processing industry.

3309. **Food Safety** (3:3:0). Food safety and sanitation in food manufacturing and/or processing. Topics include FDA and USDA regulations, HACCP principles, and good manufacturing practices. F.

4000 LEVEL COURSES

4001. **Food Science Problems** (V1-6). Taught on an individual basis. May be repeated for credit with permission. F, S, SS.

4303. **Food Chemistry** (3:2:3). Prerequisite: CHEM 3305, 3105 or permission of instructor. Chemical and physicochemical properties of food constituents. A comprehensive study of food components, their modification, and technology applications in food. (Writing Intensive) F, odd years.

4304. **Field Studies in Food Processing and Handling** (3:1:4). Visits to food processing and handling facilities and discussions of operations. F.

4306. **Dairy Products Manufacturing** (3:2:3). Physical and chemical characteristics of milk and milk products. Principles involved in processing dairy foods. S.

4307. **Poultry Processing and Products** (3:2:3). Poultry meat and egg processing including functional properties, meat quality and value-added products. S.

[Back to Top](#)

4. Future Professionals....what can we do for them?



- Include and reinforce the need for Hygienic design in as many courses as you can
- Topics might need to be food product-specific
 - Adapt available reference materials
 - Create new classes!

New Class: Hygienic Design of Food Processing Plants



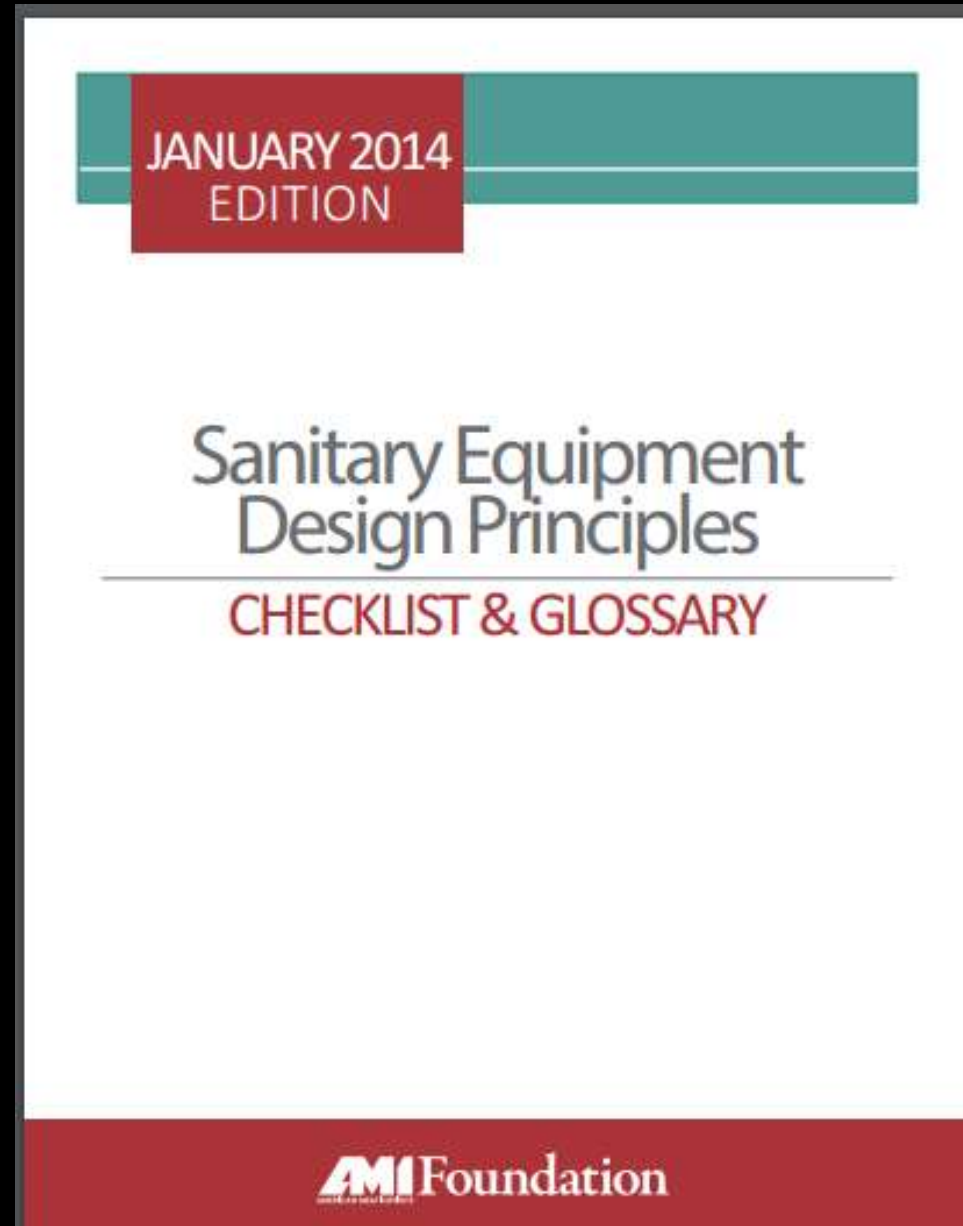
- Equipment and Process Needs
- Regulations
- Prevention of Deliberate contamination
- Minimum Hygienic Design Requirements
- Factory Layout Impact
- Segregation

Specific Areas:

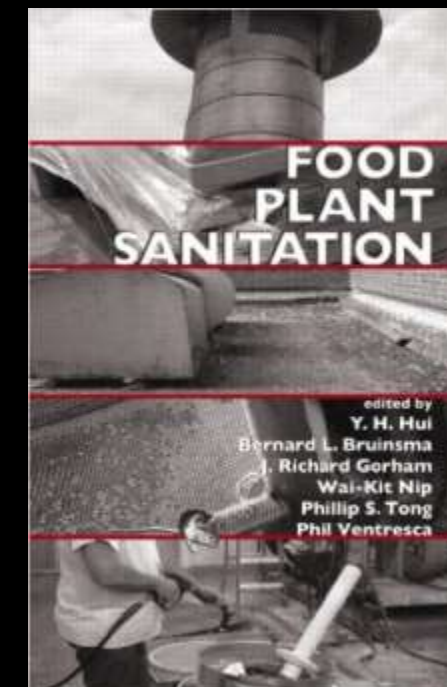
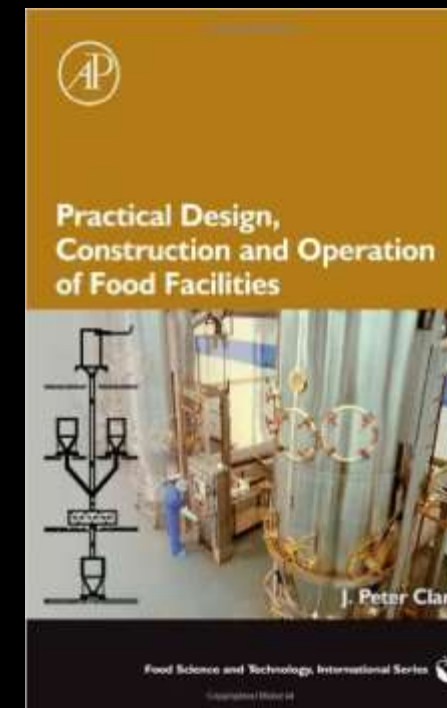
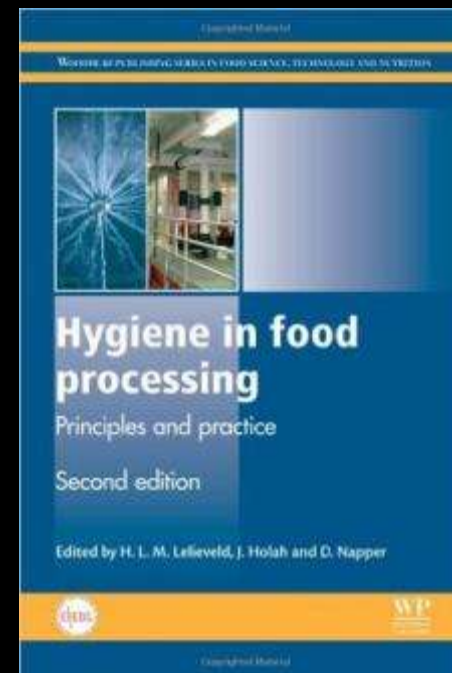
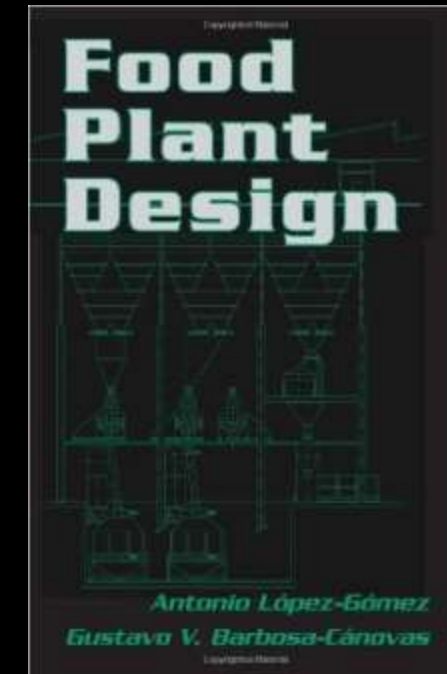
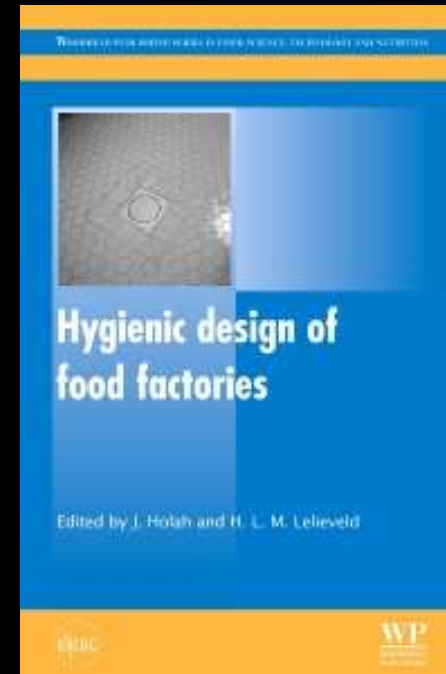
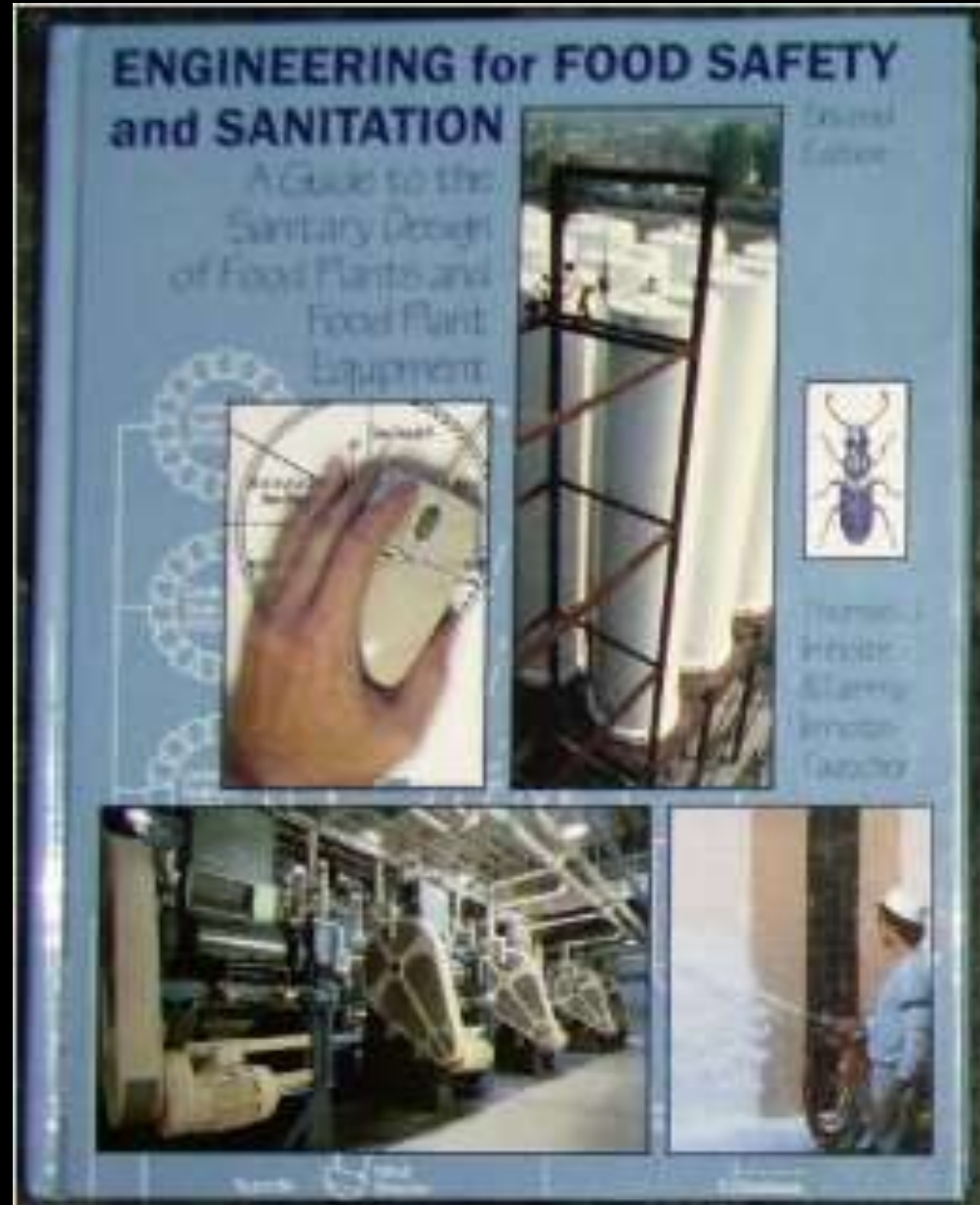
- Airflow
- Wall Finishes
- Ceilings
- Floors
- Drains
- Electricity supply
- Piping
- Lightning
- Exhaust & Dust Control
- Entries and Exits
- Steam Production
- Storage Areas



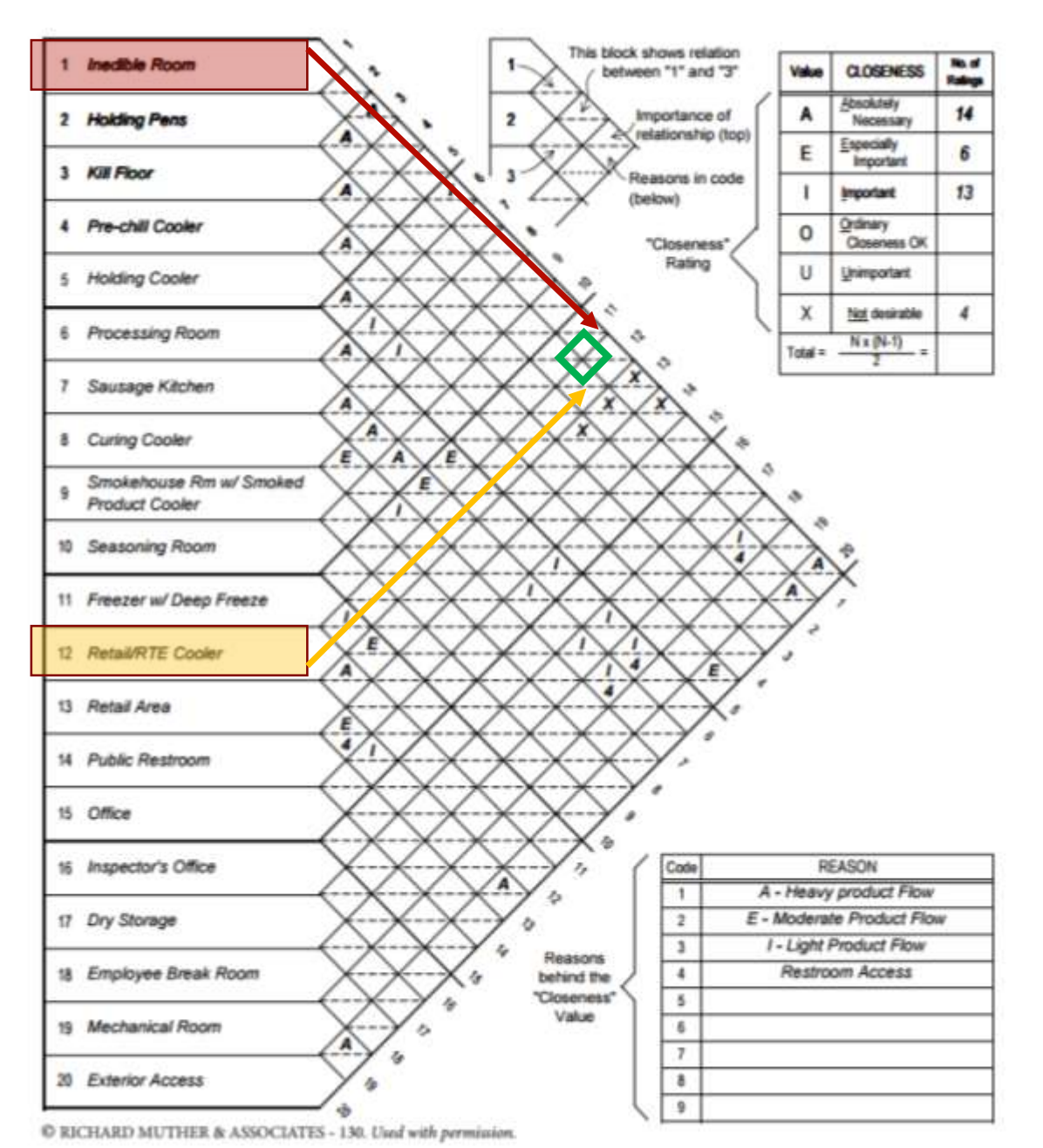
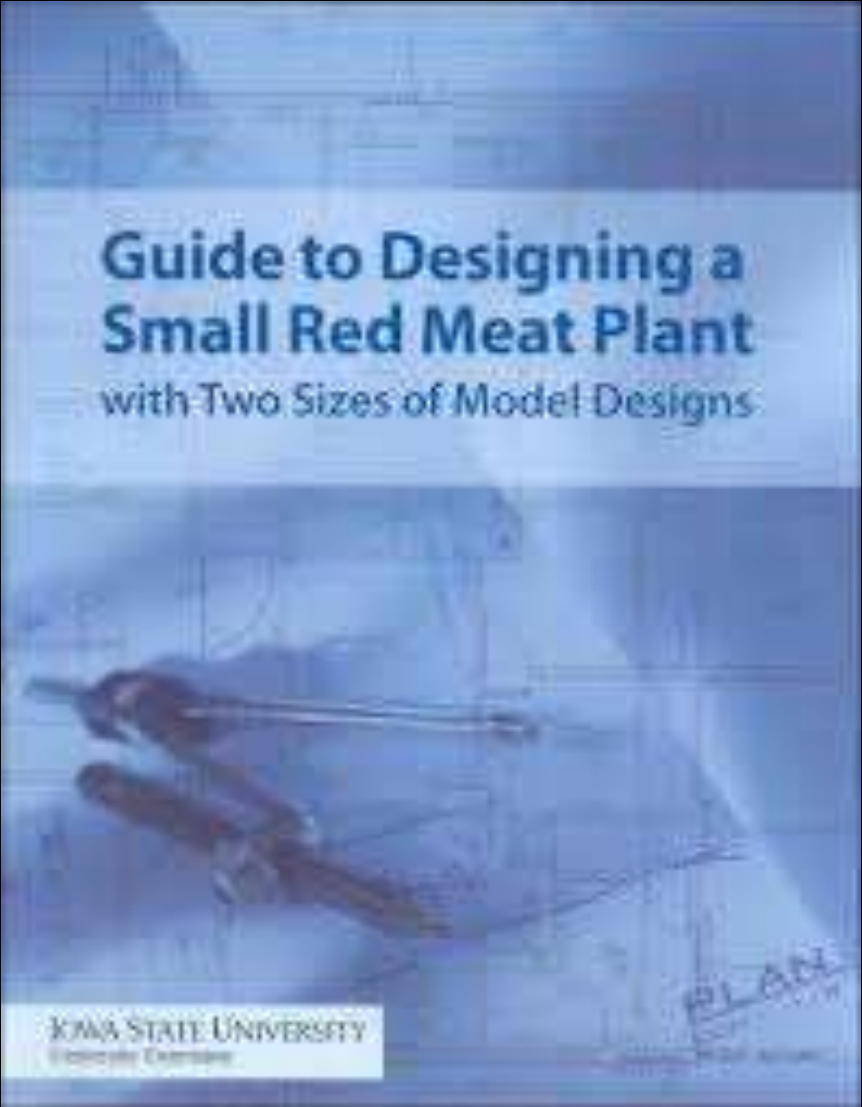
4. Use of Reference Materials in Class



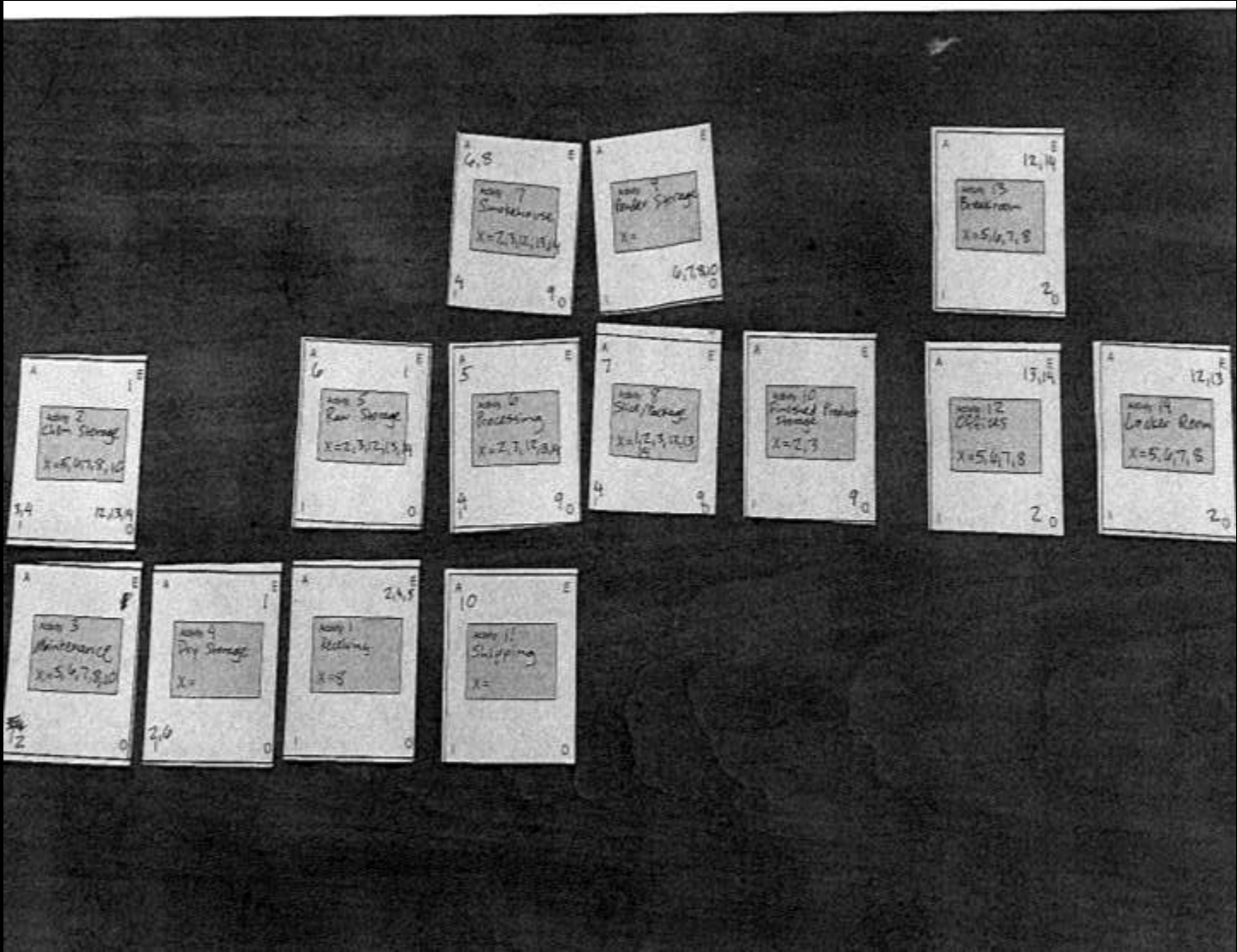
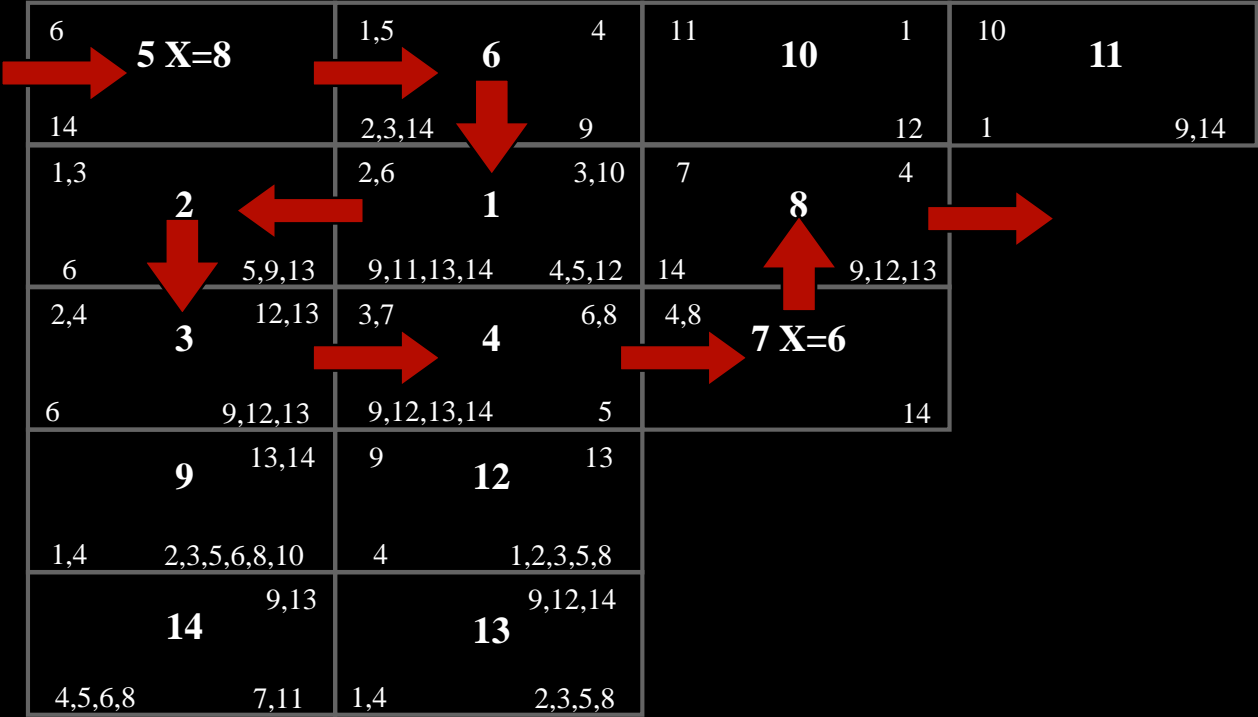
4. Use of Reference Materials in Class



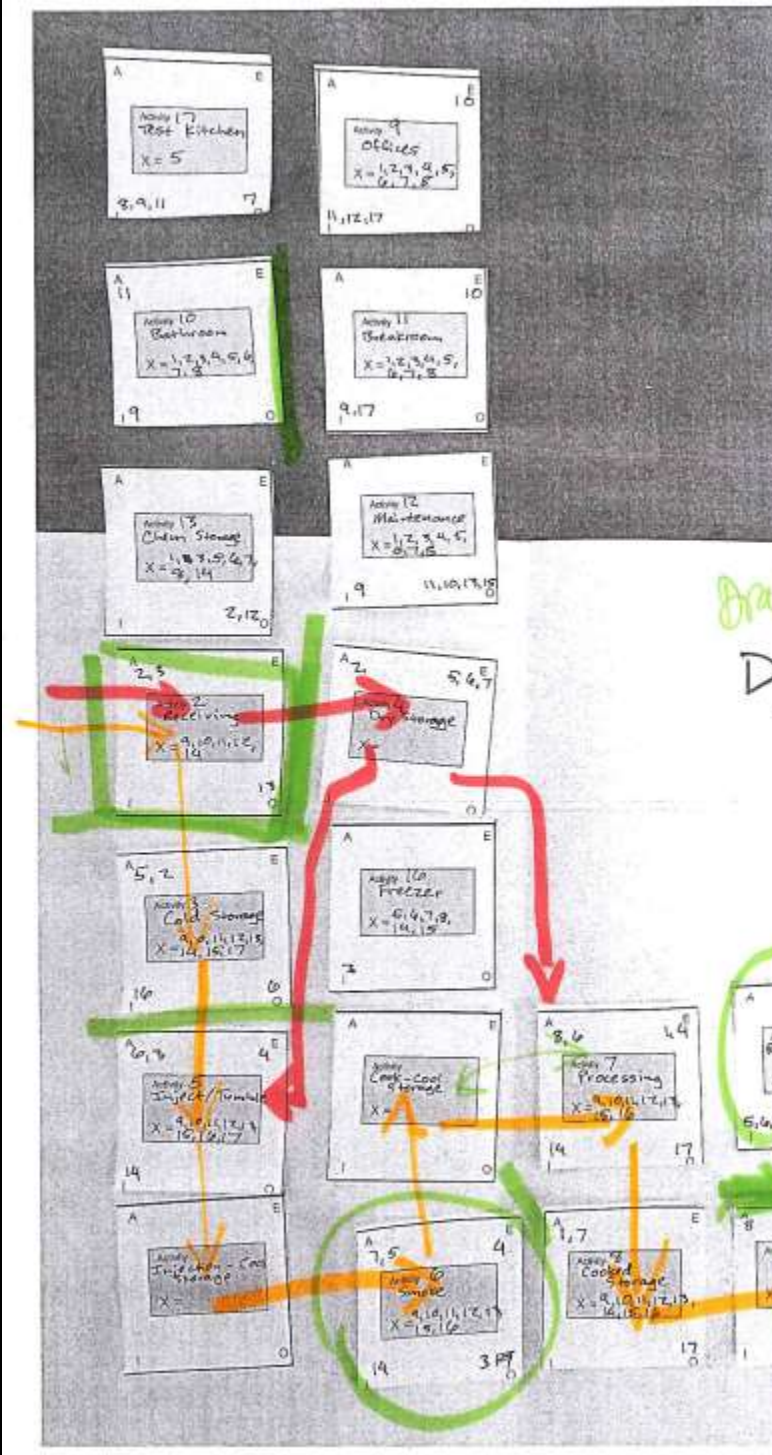
4. Use of Reference Materials in Class – Adapt guides to other food products



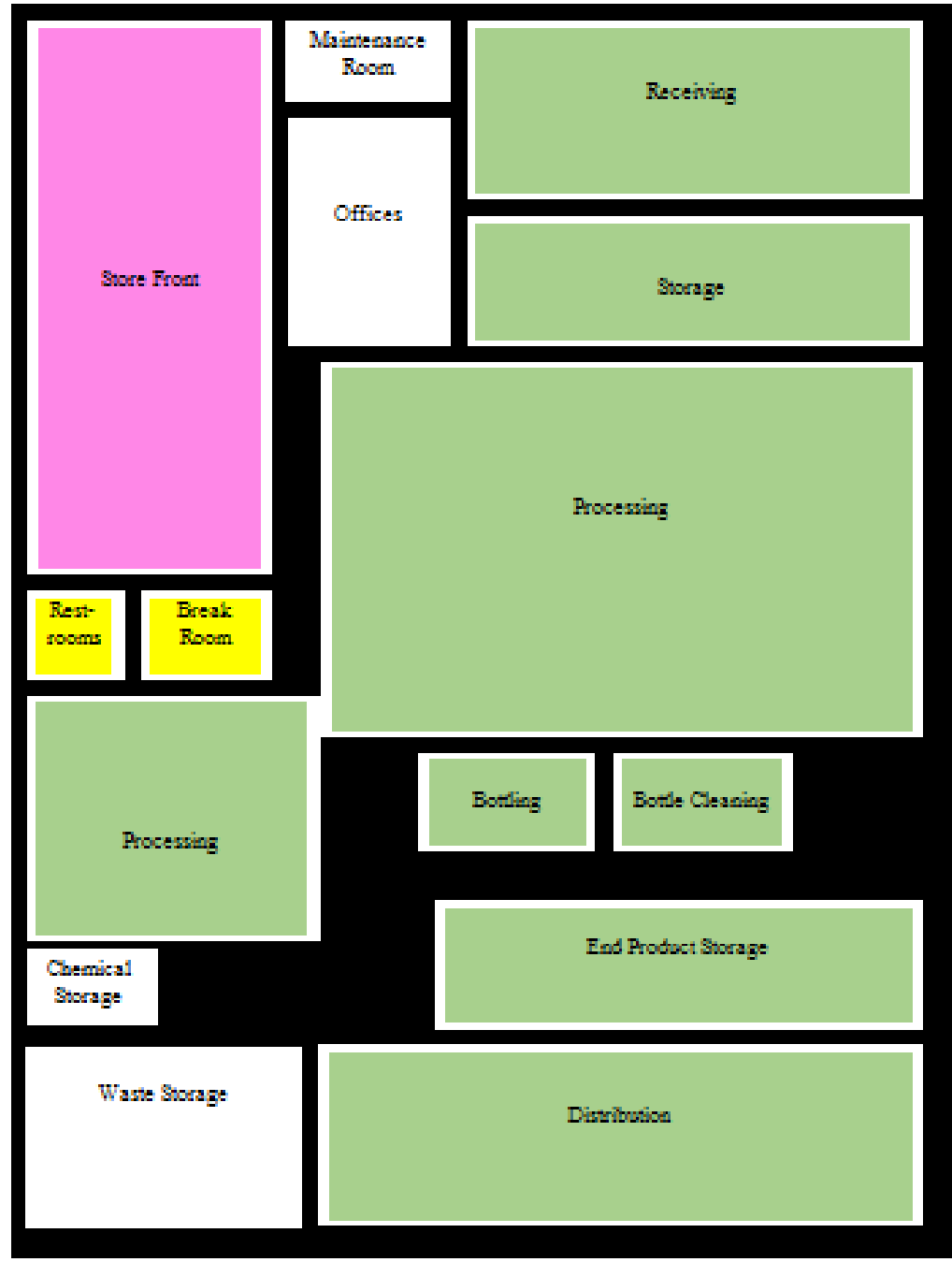
Flow Analysis – Dimensionless Block Diagram



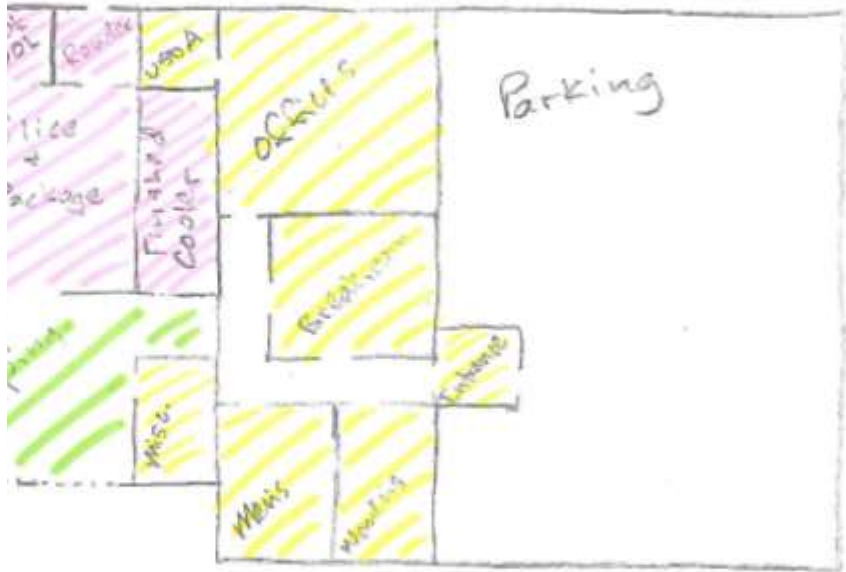
Flow Analysis – Dimensionless Block Diagram



7.6 Segregation – Allergen Areas



e Profiles



What NOT to do with students.....



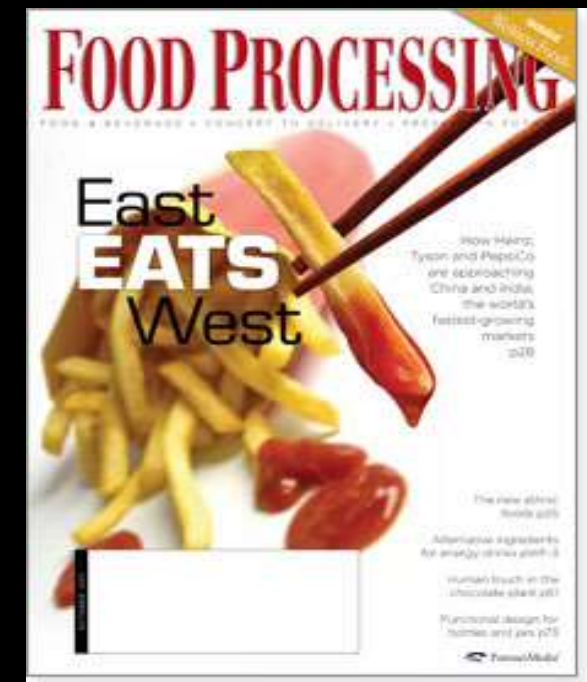
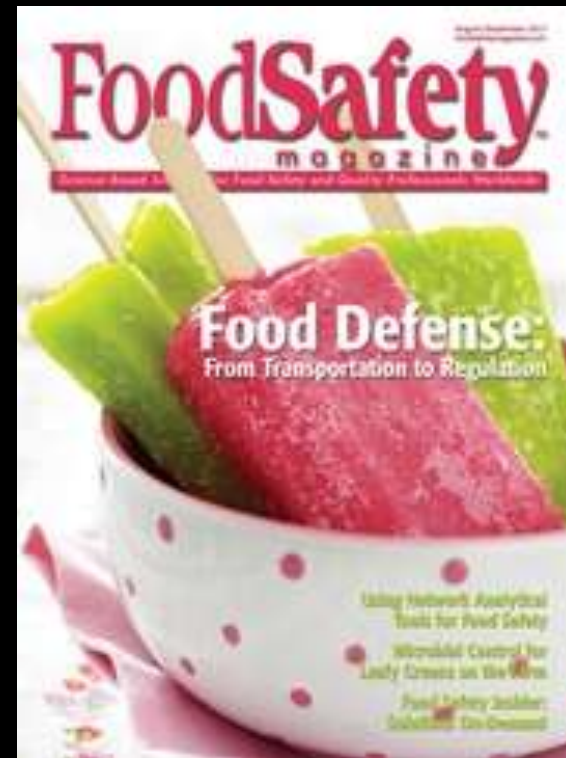
Requirement for plant “X”:

- “ *“18-8 stainless Steel shall be AISI 300 series or better...”*
- It’s a designation given by the American Iron and Steel Institute to *stainless steel....*”
- “The AISI 300 series stainless steels are all variations on the *original 18-8 alloy...*”
- You know, 18% chromium, 8% nickel....

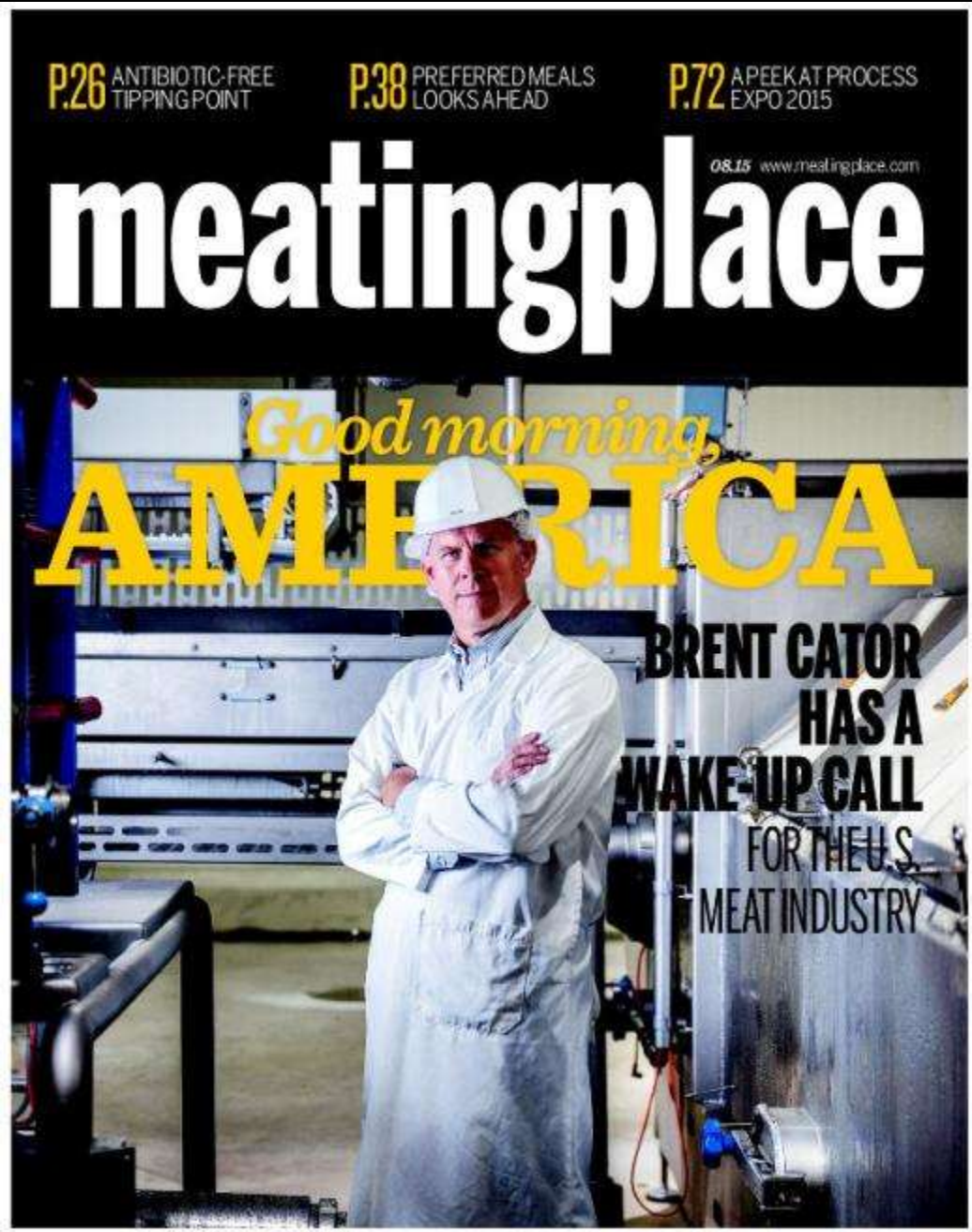
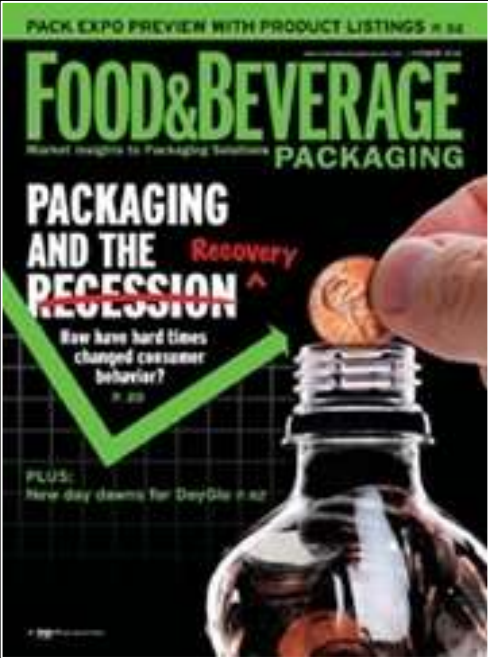
5. Suggestions

Academia:

1. Encourage students subscription to trade magazines



5. Suggestions



5. Suggestions

Academia:

2. Encourage students to become members of professional organizations and to participate and volunteer in their groups and committees



Dairy Quality & Safety Professional Development Group

Mission Statement: To promote the production and processing of safe, high quality dairy products and to develop program topics and symposia for presentation at the IAFP Annual Meetings.

Sanitary Equipment and Facility Design Professional Development Group

Mission Statement: To serve as a forum for the advancement of hygienic design and construction of food processing equipment and facilities.

Food Hygiene & Sanitation Professional Development Group

Mission Statement: To provide information on the developments in hygiene and sanitation in the food industry



5. Suggestions



Academia:

2. Encourage students to become members of professional organizations and to participate and volunteer in their groups and committees



Dairy Foods

Concerned with quality control, compositional standards, product and process development, equipment and plant design, sanitation, sensory evaluation, biotechnology of dairy cultures, and development and implementation of marketing strategies.

5. Suggestions



Industry & Trade Organizations:

1. Increase access to students
2. Internship Experience
3. RFP / RFA
 - White Papers / Guides
 - Evaluation / validation of Materials (biofilm formation, cleanability)
 - Sponsor Hygienic Design Series in trade magazines / case studies
4. Support Programs / Endowed Positions

5. Suggestions



Industry & Trade Organizations:

2. Provide scholarships for educational events
3. Follow up & request feedback / experience / current projects



<http://www.stopfoodborneillness.org/>



Alejandro Echeverry, Ph.D





TEXAS TECH UNIVERSITY™



Alejandro Echeverry, Ph.D.

Assistant Professor / Food Safety & Food Engineering

Department of Animal and Food Sciences

Texas Tech University

E-mail: alejandroecheverry@ttu.edu