



# Food Safety Scientist A Dynamic STEM Educational Adventure Bacteria: The Good, The Bad and The Ugly

Department of Dairy & Food Science College of Agriculture, Food & Environmental Sciences

## Acknowledgements:

#### Curriculum:

Food Safety Scientist: A Dynamic STEM Educational Adventure

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South Dakota State University (SDSU) and New Mexico State University (NMSU) produced this project as part of a Higher Education Challenge Grant "Innovative STEM instruction techniques to increase the number and diversity of students in food safety related majors". SDSU served as the lead institution for the overall project developing the content and curriculum with NMSU leading the digital creation of classroom media, animations and interactive educational technologies. North Dakota State University serves as the outside evaluator of the project. This project was supported by Agriculture and Food Research Initiative Competitive Grant no. 2011-38411-30625 from the USDA National Institute of Food and Agriculture. This project was supported in part by the USDA NIFA grant numbers 2008-38411-19055, NDSU serving as the lead institution with SDSU and NMSU as sub-awardees. Virtual Lab creative presentation © 2010 The NMSU Board of Regents

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## **Food Safety Scientist** A Dynamic STEM Educational Adventure

Real-life situations provide some of the greatest opportunities for students to learn how science impacts their life. Explore the common science and technological concepts in the development of a safe food supply within the classroom through the Food Safety Scientist Curriculum.

#### Engaging

The Food Safety Scientist Curriculum is intended to enhance the regular classroom curriculum. Educators are encouraged to pick and choose from the various educational tools to engage students in the STEM related field of food safety.

#### **Scientists Needed**

Food safety requires the need for scientists in the research laboratory, production practices, regulatory agencies, veterinarians, food product development and processing, meeting the demands of feeding the world, as well as preparing and serving food within the home. Educators in Science, Agriculture, and Family and Consumer Sciences utilize the components of the curriculum to help students explore STEM careers that keep food healthy and safe.

#### **Free Curriculum**

The curriculum is entirely free. Educators can access the website, download materials they want to use in their educational setting and change them to meet their needs. Components of the curriculum have been used in formal and informal educational settings as well as with various age levels. For example, the virtual labs of gram staining and using a microscope have been used with middle school students as well as introductory microbiology courses at colleges and universities across the United States.

#### **Curriculum Components**

The curriculum enhancement tool Food Safety Scientist includes the following components:

- 1. Unit Guide to assist teachers in identifying the goals, objectives and standards (Next Generation Science Standards, and Career and Technical Education Classes) for each unit and individual learning experiences.
- 2. Interactive Virtual Labs that include real-life situations that bring science, technology, engineering and math into the delivery of a safe food supply.
- 3. Hands-on laboratory experiences that compliment the virtual labs. Providing the opportunity for students to gain real-life experiences and a greater understanding of the applications of STEM for food safety scientists.
- 4. Exposure to careers related to the agricultural and food safety sciences.
- 5. Discussion Guides for teachers to empower students to explore the various scientific concepts that are utilized to develop a safe food system.

## **Contents of Unit**

#### Bacteria: The Good, The Bad and the Ugly

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Good Bad Ugly Teacher Resource Sheet
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Slides: Lab Protocol: Gram Staining Yogurt Sample or Milk (Raw or Past)
Slides: Using Microscope (Oil Immersion)

\*Three Virtual Labs are a critical component of this unit:

- 1. Growing Bactieria- Inspecting a Dairy Processing Plant
- 2. Gram Staining (testing yogurt)
- 3. Oil Immersion Microscope

#### **Overall Goal:**

Increase the number of students that consider food safety and related fields as a career path

Enrichment Activity	Time Allowed	Objectives Applied*	Standards*
Virtual Lab-Disposable Lab	10 minutes	1,2,3,4,5,6,7,8	FCS 8, FCS 9.2,FCS 9.2.1,
Equipment			FCS 9.5.7, FS 2.2,
			MS-LS1-1, MS-LS1-5
Comparing Raw & Pasteurized	45 minutes to	1,2,3,4,5,7,8	FCS 8, FCS 8.2.1, FCS 9,
Milk and Testing Surfaces	inoculate petrifilm		FCS 9.2, FCS 9.2.1,
	& conduct swabs		FCS 9.5, FCS 9.5.7, AN6.1,
	70		FS 2.2, MS-LS1-1,
	30 minutes for		MS-LS1-5
	observation and		
	record results		
Video: Connecting the Dots-The	5 minutes	1,2,3,6,/	FCS 9.5, FCS 9.5./,
Invention of 3M <sup>TM</sup> Petrifilm <sup>TM</sup>			AgP 1.3, FS 1.2, AS 1.1,
Plates.			MS-EIS1-2
Class Discussion	20 minutes	1,2,3,4,5,6,7,8	FCS 8, FCS 8.2.1,FCS 9, AgP
			1.2,AgP 1.3, AgP 2.1, AN 6.1,
			FS 2.2, MS-LS1-1, MS-LS1-5
Virtual Lab-Gram Staining	10 minutes	1,2,3,4,5,7,8	FCS 9.2, FCS 9.5,
			FCS 9.5.7, FS 2.2., MS-LS1-1,
			MS-LS1-2
Hands on: Gram Staining	40 minutes	2,5	FCS 9.2 FCS 9.5,
			FCS 9.5.7, FS 2.2,
			MS-LS1-1, MS-LS1-2
Virtual Lab: Oil Immersion	10 minutes	2,3,4,5,7	FCS 9.2, FCS 9.5,
Microscope			FCS 9.5.7, FS 2.2,
			MS-LS1-1, MS-LS1-2
Hands on: Using a Microscope	15 minutes	2,3,4,5,7,8	FCS 9.2,FCS 9.5,
			FCS 9.5.7, FS 2.2,
			MS-LS1-1, MS-LS1-2
Discussion Guide: Gram Staining	20 minutes	1,2,3,4,5,6,7,8	FCS 9.5, FCS 9.5.7,
and Using a Microscope-			MS-LS1-1, MS-LS1-2
Reflection & Discussion Questions			

\*See charts below to identify standards  $\vartheta$  objectives

#### **Performance Objectives of Students**

- 1. Express an understanding of the monitoring of the food supply for safety and quality.
- 2. Increase knowledge regarding food microbiology.
- 3. Students will make inferences and interpretations from knowledge gained regarding the science related to monitoring the safety of the food supply.
- 4. Students will examine the overall safety of the food supply from the farm to table.
- 5. Students will demonstrate laboratory science skills associated with growing bacteria, gram staining, and using a microscope.
- 6. Students will describe the various types of safe food handling practices and monitoring of the food supply.
- 7. Students will identify and give examples of various careers that support the safety of the food supply.
- 8. Students will evaluate their competency in food safety and related fields.

#### Standards:

#### Family and Consumer Sciences

Standard 8: Integrate knowledge, skills, and practices required for careers in food production and services 8.2.1: Determine pathogens found in food and their roles in causing illness

Standard 9: Integrate knowledge, skills, and practices required for careers in food science, dietetics, and nutrition

- 9.2: Apply risk management procedures for food safety, food testing, and sanitation.9.2.1: Determine factors that contribute to foodborne illness
- 9.5: Demonstrate use of current technology in food product development and marketing 9.5.7: Conducting testing for safety of food products, utilizing available technology.

#### Agriculture

ITA7.1 Illustrate how raw commodities become table-ready food products

- AgP 1.2 Discuss how food safety is addressed in the food processing industry
- AgP 1.3 Explain how regulatory agencies in the food industry work to protect consumers
- AgP 2.1 Translate regulatory procedures as they apply to food processing
- AgP 3.4 Process food safely
- AN6.1 Compare and contrast consumer concerns related to animal food products.
  - i.e.: Debate pasteurization of milk products
- FS 1.2 Identify industry organizations and their impact on the food industry
- FS 2.2 Apply safety and sanitation practices used in the food industry
- AS 1.1 Appraise the fundamentals of the agriculture industry and its impact in the world
- AS 6.1 Demonstrate how to best maintain animal health

#### Science (Next Generation Science Standards)

MS-LS1-1 – conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types

MS-LS1-2- develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function

MS-LS1-5 – Construct a scientific explanation based on evidence for how environmental and genetic factors influence the growth of organisms

MS-ETS1-2 – Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem

## **Good Bad Ugly Teacher Resource Sheet**

#### Materials Needed for "Comparing Raw vs Pasteurized Milk Lab"

#### (Per lab group or student)

- (4) 3M<sup>™</sup>Petrifilm<sup>™</sup>-Aerobic Count
- (4) 3M<sup>™</sup> Petrifilm<sup>™</sup>-E.Coli/coliform Count
- (2) Disposable Pipettes
- (1) 3M<sup>™</sup> Spreader
- 2 Tablespoons Raw Milk
- 2 Tablespoons Pasteurized Milk

#### Materials Needed for "Testing Surfaces for Microbial Contamination Lab" (Per lab group or student)

- (8) 3M<sup>™</sup> Quick Swabs
- (1) 1 cm Swabbing Template
- (4) 3M™Petrifilm™-Aerobic Count
- (4) 3M<sup>™</sup> Petrifilm<sup>™</sup>-E.Coli/coliform Count
- (1) Spreader

#### Materials Needed for Gram Staining and Microscope Lab

Microscope (preferably with oil immersion lens) Gram stain reagent set Crystal violet Gram's iodine Decolorize reagent (95% alcohol) Safranin

#### **Background Information**

Before conducting this lab, read the Good Bad Ugly discussion guide. The discussion guide provides background information and many links to websites for additional information.

- To learn about the dangers of raw milk, visit: <u>http://www.fda.gov/food/foodborneillnesscontaminants/</u> <u>buystoreservesafefood/ucm079516.htm#video</u>
- To familiarize yourself with foodborne pathogens and illnesses visit: <u>http://www.fda.gov/Food/</u> <u>FoodbornelllnessContaminants/default.htm</u>
- To learn about homemade yogurt ("Good" bacteria) visit: <u>http://www.uaf.edu/files/ces/publications-db/</u> <u>catalog/hec/FNH-00062.pdf</u>
- To review proper Gram Staining techniques, visit: <u>http://www.life.umd.edu/classroom/bsci424/</u> LabMaterialsMethods/GramStain.htm

#### **Other Notes**

#### "Testing Surfaces for Microbial Contamination"

Students should sanitize their swabbing template with 70% ethanol sanitizing solution between each sample. Students should use paper towels or cotton balls to apply the solution. Each group should need approximately 4 ounces of solution total.

Slide	Notes
Comparing Raw & Rasteurized Milk and Testing Surfaces for Microbial Contamination. Randson Model Route Lourice Lucitorite Lourice Lucitorite Lourice Lucitorite Lourice Lucitorite Lacottaria Lucitorite Lucitori	
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Procedure: Culturing the Extension Quick Swab Samples	
Petrfilm <sup>™</sup> and 4 E.ColiColitorm petrfilm <sup>™</sup> (if not already completed) with date, sample source, and initials • Label Control Slides for each petrfilm <sup>™</sup> . • Platf from quick seab pound cities each type of pound cities each type of pound cities each type of each petrfilm <sup>™</sup> .	
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STOP	
Incubate all samples for 48 hours	
before analyzing the results	
After 48 hours, remove the Petrifilm from the incubator     If the Petrifilm has a number of colonies that can be easily counted, count all the colonies directly Leave the top layer on the Petrifilm down	
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Extension     Extension     When the sample has too many colonies to count     directly, estimate the number of colonies by:         Pricing a square in the middle of the sample area and count the         colonies in this square area         The present the colonies of the sample area and count the         colonies of the sample area and count the         colonies of the sample area and count the         colonies of the sample area and count the         colonies of the sample area and count the         colonies of the sample area and count the         colonies of the sample area and count the         colonies of the sample area and count the         colonies of the sample area and         colonies of the sample area and         colonies of the sample area and         colonies of the sample area area	
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Interpreting Data	
Compare the number of colonies from different sample sources and interpreting the results of the experiment     Orth planer definition of the source of	
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### Lab Report – Comparing Raw Vs. Pasteurized Milk and Testing Surface Hygiene

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\_\_\_\_\_ Date: \_\_\_\_\_

#### Introduction:

What is the purpose of this lab?

What do you hypothesize the results will indicate?

#### **Results:**

#### Raw vs Pasteurized Milk

1. Aerobic Petrifilm Plate Count Raw Milk Results:

#1 = \_\_\_\_\_ Colonies/ml of milk

#2 = \_\_\_\_\_ Colonies/ml of milk

- Average: \_\_\_\_\_ Colonies/ml of milk
- 2. Aerobic Petrifilm Plate Count Pasteurized Milk Results:

#1 = \_\_\_\_\_ Colonies/ml of milk

#2 =\_\_\_\_\_ Colonies/ml of milk

Average: \_\_\_\_\_ Colonies/ml of milk

#### 3. E. coli / Coliform Petrifilm Plate Raw Milk Count Results:

#1 = \_\_\_\_\_ Colonies/ml of milk

#2 =\_\_\_\_\_ Colonies/ml of milk

- Average: \_\_\_\_\_ Colonies/ml of milk
- 4. E. coli / Coliform Petrifilm Plate Pasteurized Milk Count Results:

#1 = \_\_\_\_\_ Colonies/ml of milk

#2 =\_\_\_\_\_ Colonies/ml of milk

Average: \_\_\_\_\_ Colonies/ml of milk

5. Controls:

Aerobic = \_\_\_\_\_Colonies

E. coli/Coliforms = \_\_\_\_\_ Colonies

#### **Contact Surface Samples from Various Surfaces**

 Aerobic Petrifilm Plate count from Wet Swab Surface tested:\_\_\_\_\_\_\_\_Colonies/cm2 #1 = \_\_\_\_\_\_Colonies/cm2

Average:

2. Aerobic Petrifilm Plate count from Dry Swab Surface tested: \_\_\_\_\_

#1 =	_ Colonies/cm2
#2 =	Colonies/cm2
Average:	

3. E. coli/Coliform Petrifilm Plate count from Wet Swab

Surface tested:	
#1 =	Colonies/cm2
#2 =	Colonies/cm2

#2 =	C	olonies/
Average:		

4. E. coli/Coliform Petrifilm Plate count from Dry Swab Surface tested:\_\_\_\_\_

#1 =	Colonies/cm2
#2 =	Colonies/cm2
Average:	

5. Controls: Aerobic Petrifilm Plate:\_\_\_\_\_ Colonies/cm2 E. coli/Coliform Petrifilm Plate: \_\_\_\_\_ Colonies/cm2

#### **Discussion**:

- 1. Why is milk pasteurized?
- 2. Why are food contact surfaces tested?
- 3. Why test for aerobic and E. coli/Coliform bacteria?

#### Interpretation/Conclusion:

From the Results what statements can you make that are conclusive? Were the results as you expected?

## Lab Report – Comparing Raw Vs. Pasteurized Milk and Testing Surface Hygiene

Name: Teacher Version

\_\_\_\_\_ Date: \_\_\_\_\_

#### Introduction:

What is the purpose of this lab?

<u>Compare the level of microbial contamination of raw milk to pasteurized milk. The types of bacteria investigated are coliforms and aerobic bacteria. The testing of various surfaces will give an indication of the level of contamination surfaces. For example, this information can be used to compare surfaces before and after they were clean and/or sanitized.</u>

What do you hypothesize the results will indicate?

No coliforms will be present in the pasteurized milk. The level of contamination of aerobic bacteria will be much higher in the raw milk, compared to the pasteurized. Surfaces that have a lot of contact by people (i.e. computer key board) will have higher levels of contamination. Surfaces that have been cleaned and/or sanitized will have a lower level of contamination.

#### **Results:**

#### Raw vs Pasteurized Milk

1. Aerobic Petrifilm Plate Count Raw Milk Results:

#1 =	Сс	olor	nies	;/n	nl c	of n	nilk
	-						

#2 = \_\_\_\_\_ Colonies/ml of milk Average: \_\_\_\_\_ Colonies/ml of milk

Average: \_\_\_\_\_ Colonies/ml of milk

2. Aerobic Petrifilm Plate Count Pasteurized Milk Results:

#1 = \_\_\_\_\_ Colonies/ml of milk

#2 =\_\_\_\_\_ Colonies/ml of milk

Average: \_\_\_\_\_ Colonies/ml of milk

3. E. coli / Coliform Petrifilm Plate Raw Milk Count Results:

#1 = \_\_\_\_\_ Colonies/ml of milk

#2 =\_\_\_\_\_ Colonies/ml of milk

Average: \_\_\_\_\_ Colonies/ml of milk

4. E. coli / Coliform Petrifilm Plate Pasteurized Milk Count Results:

#1 = \_\_\_\_\_ Colonies/ml of milk

#2 =\_\_\_\_\_ Colonies/ml of milk

Average: \_\_\_\_\_ Colonies/ml of milk

5. Controls:

Aerobic = \_\_\_\_\_Colonies

E. coli/Coliforms = \_\_\_\_\_ Colonies

#### **Contact Surface Samples from Various Surfaces**

 Aerobic Petrifilm Plate count from Wet Swab Surface tested:\_\_\_\_\_\_\_\_\_Colonies/cm2 #1 = \_\_\_\_\_\_Colonies/cm2 #2 = \_\_\_\_\_Colonies/cm2 Average:

> Page 13 © 2020, South Dakota Board of Regents

2. Aerobic Petrifilm Plate count from Dry Swab

#1 =	Colonies/cm2
#2 =	Colonies/cm2
Average:	

3. E. coli/Coliform Petrifilm Plate count from Wet Swab

Surface tested:	
#1 =	Colonies/cm2
#2 =	Colonies/cm2

#2	 	
Average:		

4. E. coli/Coliform Petrifilm Plate count from Dry Swab

Sunace lesled.	
#1 =	Colonies/cm2
#2 =	Colonies/cm2
Average:	

5. Controls: Aerobic Petrifilm Plate: \_\_\_\_\_ Colonies/cm2 E. coli/Coliform Petrifilm Plate: \_\_\_\_\_ Colonies/cm2

#### **Discussion**:

- Why is milk pasteurized? <u>To destroy pathogens that are commonly associated with raw milk. Such as Listeria Monocytogenes</u>, Salmonella, <u>Campylobacter</u>, and E.coli.
- Why are food contact surfaces tested? <u>To identify if food contact surfaces have been adequately cleaned and sanitized to stop the spread of microorgansims</u> <u>(i.e. raw juices from poultry contaminating a cutting board that could be used for cooked or ready-to-eat food</u> <u>products.</u>)
- 3. Why test for aerobic and E. coli/Coliform bacteria? <u>These microorganisms are often associated with foodborne illness, and they can be an indication of fecal</u> <u>contamination</u>

#### Interpretation/Conclusion:

From the Results what statements can you make that are conclusive? Were the results as you expected?

## **Reflection and Discussion Questions**

#### Virtual Labs:

- Growing bacteria (inspecting a processing plant, aka disposable lab)
- Gram Staining (testing yogurt)

#### Introduction:

Good bacteria and bad bacteria – that is often a criteria that people will use to categorize bacteria. However, bacteria and other microorganisms found in food, such as fungi (yeast, and molds) are considered pathogenic (Bad), spoilage (Ugly) and in some instances beneficial (Good). Microorganisms can also be harmless ... just hangin' out.

Below are two guided discussions to serve as a review of the Virtual Lab: Growing Bacteria with disposable supplies and equipment. The purpose of this guide is to build upon some basic concepts and applications that are related to food microbiology and food safety.

- 1. Beneficial Microorganisms (related to food)
- 2. Pathogenic Foodborne Microorganisms

#### Beneficial microorganisms (related to food):

Guiding concept: Bacteria and are often suspected to be harmful to humans – particularly in our food. However, the human body needs bacteria that are beneficial such as those that improve our intestinal health. Some bacteria and fungi (yeasts and molds) are useful in processing and preserving foods. Learning how to use the microscope in testing bacteria in a yogurt sample is the first step to identify beneficial bacteria from their bad relatives.

#### Food Processing and Fermentation:

Yogurt is produced by fermenting milk with specific bacteria. Fermentation of food is commonly used to process food for making alcoholic beverages, leavening of bread and preserving foods.

- 1. What is food fermentation?
  - a. Fermentation used in the food and beverage industry to convert carbohydrates into alcohol, carbon dioxide and organic acids (i.e. lactic acid and acetic acid). The fermentation process often takes place in an anaerobic environment which means no oxygen is present.
- 2. In the Gram staining virtual lab yogurt was being analyzed to see if undesirable bacteria were present.
  - a. Yogurt is a fermented food. What food product is fermented to make yogurt? What are the microorganisms that are used in yogurt making? Can you make yogurt in your home?
    - Yogurt is made from milk it is best to use milk that has been pasteurized. Why is that important? destroy pathogenic organisms (mostly gram –) and at the same time some spoilage organisms are destroyed. The sugar in milk (lactose) is utilized by the bacteria to produce an acid. The acid that is produced lowers the pH of the milk causing proteins to form a gel resulting in the consistency of yogurt.
    - The two common bacteria used to make yogurt are *Lactobacillus bulgaricus* and *Streptococcus thermophilus*
    - Yogurt can be easily made in the home using basic kitchen utensils. There are several good recipes on the Internet that are easy to follow. Always use a pasteurized milk product to reduce the risk of foodborne illnesses commonly associated with the consumption of raw milk.
- 3. Fermenting milk to make yogurt is also a form of preserving milk to extend the shelf-life. Processing milk made into yogurt extends the shelf life for several weeks.

- 4. What other foods are preserved by using a fermentation process?
  - a. Fermented vegetables sauerkraut, Kimchi, certain pickles. These are often made by adding salt to change the environment to promote the growth of lactic acid producing bacteria. The bacteria utilize the carbohydrates (sugars) in the vegetables to produce lactic acid giving the product a sour taste.
  - b. Dry sausages such as salami sugars are added to ground meat that lactic acid producing bacteria feed on. This lowers the pH, therefore proteins will denature and coagulate. This also lowers its ability to hold water – creating a dried food product that has been preserved for longer storage time. The process takes many weeks (several months).
  - c. Beverages of wine, beer and cider.
    - Wine is made from yeast that utilize the sugars of the fruit juices to produce alcohol.
    - Beer is made from yeast that utilizes the starches from cereal grains to produce alcohol.
  - d. Cider is a made from the fermentation of apple juice by yeast to produce alcohol. This is often referred to as hard cider because of the alcohol content.
  - e. Leavened breads yeasts utilize the sugar from the starches of cereal grains to produce gas causing the bread to rise.

Probiotic Bacteria are beneficial to the human body by improving the balance of bacteria in the intestine.

- 1. How can bacteria in our intestine be beneficial to us?
  - a. Inhibiting pathogens and toxin producing bacteria from reproducing in our intestine
  - b. Several specific health effects from probiotic bacteria are being investigated and documented that address chronic diseases.
- 2. How do we get probiotics in our diet?

Some probiotics are added to food products to improve the products' health benefits for consumers, yogurt is the best example. The probiotics commonly added into yogurt include bacteria from the Lactobacillus Family (LAB).

#### Pathogenic Foodborne Microorganisms

Underlying Concept: The Centers for Disease Control estimates that each year roughly 1 in 6 Americans (48,000,000 people) get sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases. (1)

#### Leading Foodborne Illnesses (FBI):

- What is a foodborne pathogen?
   a. A disease causing microorganisms commonly transmitted or found in a food sources
- 2. What is a foodborne illness?

a. A FBI is an illness that develops from consuming a food that was contaminated with a disease causing agent.

- 3. What is a FBI outbreak? And, can you think of any foodborne illness outbreaks that have occurred?
  - a. A FBI outbreak is when two or more people get the same disease from eating the same contaminated food. For example, two people develop Salmonellosis from drinking the same source of contaminated unpasteurized milk. They must have the exact same strain of Salmonella. And the same strain must be in the food source as well.
  - b. Several examples of foodborne illness outbreaks in the United States (and in some cases internationally):
    - Shiga-toxin producing E. coli O104 in Germany 784 patients with hemolytic uremic syndrome (HUS)–a type of kidney failure, 23 deaths associated with HUS. Four confirmed cases in the United States. <u>http://www.cdc.gov/ecoli/2011/ecoliO104/index.html#introduction</u>
    - Investigation Announcement: Multistate Outbreak of Human Salmonella Typhimurium Infections Associated with Exposure to Clinical and Teaching Microbiology Laboratories - As of April 20, 2011, a total of 73 individuals infected with the outbreak strain of Salmonella Typhimurium have been reported from 35 states. <u>http://www.cdc.gov/salmonella/typhimurium-laboratory/042711/index.html</u>
    - Botulism associated with commercially canned chili sauce Texas and Indiana, July 2007. <u>http://www.cdc.gov/mmwr/preview/mmwrhtml/mm56d730a1.htm?s\_cid=mm56d730a1\_e</u>
    - Additional Foodborne Illness outbreaks can be reviewed at the Centers for Disease Control Outbreak Response team's website: <u>http://www.cdc.gov/outbreaknet/</u>
- 4. What is pasteurization and why is milk pasteurized?
  - a. Pasteurization destroys pathogenic microorganisms by heating the milk very quickly to destroy pathogenic microorganisms, then cooling it very fast.
  - b. Why is the milk heated and cooled so quickly?
    - The milk first needs to get to a temperature that is high enough to kill the pathogens that are commonly associated with raw (unpasteurized) milk.
    - This process occurs very quickly to keep the milk from getting a cooked flavor. Underlying Concept: The Centers for Disease Control estimates that each year roughly 1 in 6 Americans (48,000,000 people) get sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases. (1)
    - The cooling process also happens very fast, once again so it doesn't develop a cooked flavor, and to obtain refrigeration temperatures so bacteria that are still present in the milk do not grow.
- 5. Does pasteurization destroy all the microorganisms in the milk?
  - a. No it destroys mostly pathogenic organisms. If all the microorganisms were destroyed that would be sterilizing the milk.
  - b. Unlike sterilization, pasteurization is not intended to kill all pathogenic microorganisms in the food or liquid. Instead, pasteurization aims to reduce the number of viable pathogens so they are unlikely to cause disease (assuming the pasteurization product is refrigerated and consumed before its expiration date). Commercial-scale sterilization of food is not common because it adversely affects the taste and quality of the product.

- 6. Do you think very many people get sick from drinking unpasteurized milk, or eating products made from unpasteurized milk?
  - a. Not like the number of people that get the common cold. The FBIs that are often a result of unpasteurized milk are very serious, and people can get very ill. (Unlike the common cold).
  - b. From 1998 through 2008, 86 outbreaks due to consumption of raw milk or raw milk products were reported to Centers for Disease Control. These resulted in 1,676 illnesses, 191 hospitalizations, and 2 deaths. Because not all cases of foodborne illness are recognized and reported, the actual number of illnesses associated with raw milk likely is greater. (2)

To learn more about the risks of consuming unpasteurized milk, visit the Centers for Disease Control Website. <u>http://www.cdc.gov/foodsafety/rawmilk/raw-milk-index.html</u>. This website is very comprehensive and includes videos of families and individuals that become seriously ill from consuming unpasteurized milk.

(1) CDC. (2011). "2011 Estimates of Foodborne Illness inte h United States." Retrieved 6-17-11, 2011, from <u>http://www.cdc.gov/Features/dsfoodborneEstimates</u>.

(2) CDC. (2011). "Raw Milk Questions and Answers." Retreived 6-27-11, from <u>http://www.cdc.gov/foodsafety/</u> <u>rawmilk/raw-milk-questions-and-answers.html</u>

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Equipment         Cram stain reagent           • Inoculating loop         - Gram stain reagent           • Bunsen Burner         - Gram stain reagent           • Glass microscope         - Crystal violet           • Pipette (disposable)         - Gram stain reagent           • Clasp (close pin or torgs)         - Gram stain reagent           • Microscope (preferably with oil immersion lens)	
Gram Staining – View Bacteria • Gram staining process stains bacteria. The color can be observed under the microscope. • Bacteria that stain a pink or reddish color are called Gram-negative. • Bacteria that stain a purple color are called Gram-positive.	
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Procedure	
<ul> <li>Transfer a small amount (two loops) of sample from the test tube to previously prepared slide.</li> <li>Tilt the slide to spread the drop out slightly, about the size of a penny.</li> <li>This picture has two circles, we are only doing one.</li> </ul>	
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Procedure Extension	
<ul> <li>Stating</li> <li>Cover the sample with Crystal Vole, and allow it to set for 60 second.</li> <li>Rane with slowly numing tay water.</li> <li>Cover sample with Gram's toding uater.</li> <li>Cover sample with Geolotizing magnet 69% ettry it acched for 30 sec. Rines this tay water.</li> <li>Cover sample with Safarain – rest 80 sec. Rines with water.</li> </ul>	
Procedure	
<ul> <li>Dry the slide off by placing it between two sheets of highly absorbent biblious paper, and gertly press the paper down a few lines.</li> <li>It is ready for observing under the microscope.</li> </ul>	
Lean name and was addeded in 1 4 (20), bud Table Barry Physics	

Slide	Notes
Using a Microscope (bil Immersion) Meretarian et al. The formation of the	
Basic Parts of a Extension	Lets identify and list the function or purpose of each part of the microscope: (this is an animated slide)
<ul> <li>(i) U) U)</li></ul>	<ol> <li>Eyepiece - focus and magnify the object (usually 10X)</li> <li>Objectives - the lens that focuses on the object. Magnify - the lens in this picture is probably 40X</li> <li>Nosepiece - houses the objectives and is used to rotate the objectives and secure them in place for focusing.</li> <li>Stage - holds the specimen you are studying</li> <li>Stage Clip - secures the slide that you are studying</li> <li>Coarse focus - use this first to get the specimen (bacteria) you are studying in view.</li> <li>Fine Focus - use this after the coarse focus, or when going to a higher power to get a detailed image in focus.</li> <li>Arm - use to carry the microscope.</li> <li>Diaphragm - controls the amount of light that shines onto the specimen.</li> <li>Light source - shines a light on the image so the lens can then focus.</li> </ol>
Oil Immersion Objective       Exercise         This is a close up view of the 100X Oil Immersion Objective Lens       Immersion	
Check out the microscopes in your classroom. Look on the objectives, is there a 100X, and does the objectives, is there a 100X, and does will skip the step to add oil to the slide.	
Look on the objectives, is there a 100X, and does it have "oil" printed on it as well? If it doesn't, you will skip the step to add oil to the slide.	

Slide	Notes
<ul> <li>Looking at Bacteria on a Steerson</li> <li>Use a compound light microscope to study the bacteria on this slide.</li> <li>O get the best view - the more powerful oil immersion microscope is used.</li> </ul>	Gram Stained Slide Need a Microscope to see the individual bacteria from the specimen on this slide.
<image/> <section-header><section-header><list-item><list-item><list-item><list-item><section-header><list-item><list-item><list-item><list-item><list-item><list-item><section-header></section-header></list-item></list-item></list-item></list-item></list-item></list-item></section-header></list-item></list-item></list-item></list-item></section-header></section-header>	Rotate the nosepiece to the lowest magnification, 10x. Keep rotating the nosepiece until you hear the "click" sound, which means the lens is at the right position to use. Place the previous prepared slide on the stage of the microscope and secure it with the clips. Use the diaphragm to adjust the amount of light that goes through the slide.
<section-header><section-header><section-header><section-header><section-header><section-header><image/><image/><image/><image/></section-header></section-header></section-header></section-header></section-header></section-header>	<ul> <li>When doing this demonstrate with the microscope you have in the classroom. Some microscopes have a 4x and some may have a 10X</li> <li>With some microscope the nosepiece moves up and down – not the stage. Bring the objective lens (10x) as close to the slide as possible.</li> <li>1. Focus the image by adjusting two knobs (coarse and fine adjustments) of the microscope.</li> <li>2. Start with the coarse adjustment and rotate it to bring the stage as close to the lens as possible.</li> <li>3. Slowly rotate the coarse adjustment to bring the sample into focus.</li> <li>4. Once you see a vague image, very carefully rotate the fine adjustment knob to make the image as sharp as possible.</li> <li>5. You may need to move the slide so the image is located where it can be focused upon.</li> </ul>
<section-header><section-header><section-header><section-header><section-header><image/><image/><image/></section-header></section-header></section-header></section-header></section-header>	<ol> <li>In some instances you may have to slightly adjust the coarse focus.</li> <li>Usually not.</li> <li>Rotate the nosepiece to the 40x lens. (difficult to see in this photo</li> <li>Only use the fine adjustment to bring the image into focus.</li> <li>Once again, adjust (move) the slide to position the image if needed.</li> <li>For the next observation, you are going to use the oil immersion lens, which needs to be used with a small amount of immersion oil.</li> </ol>

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	Do not return back to a lower magnification lens after this step.
100 X Magnifiation	Image of bacteria from a sample. Notice the different shapes some are called cocci (round) Bacilli (rods) This is a magnification of 1000x (100x objective lense and a 10x Eyepiece lens)
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tion x magnification	
Determining Magnification       Excession         power of objective lens x power of eyepiece lens = total magnification       Excession         1 do objective lens x 10X eyepiece lens = 100X total magnification       Excession         What does that mean?       Excession	What does that mean? Answer: the image appears 100x larger that what it really is.

Slide	Notes
Cleaning Up	Ask: What does it mean to autoclave something?
<ol> <li>Remove the sample slide from the microscope and turn of the light source.</li> <li>Wipe off the excess oil on the microscope lens with a lens paper.</li> <li>Unplug the microscope and cover it with the protecting cover.</li> <li>Put the microscope back to the shelf and wipe down working table with sanitizing solution.</li> <li>Wash slide and give to teacher so they can autoclave.</li> </ol>	Placing it in a chamber with extremely high heat to sterilize it (destroy all bugs – viruses, bacteria, parasites). This is used in research labs and hospitals.