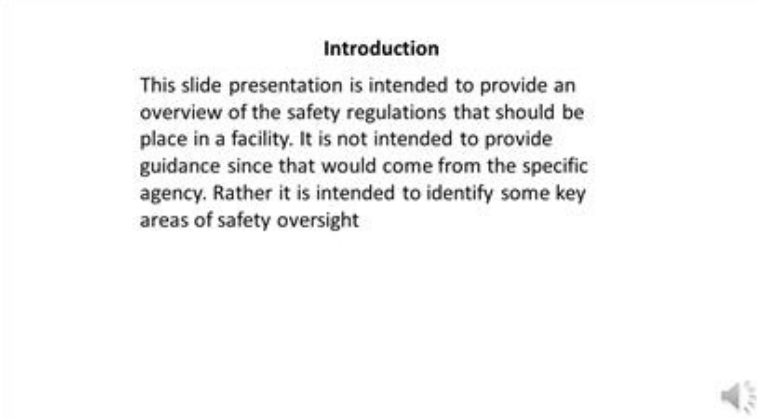
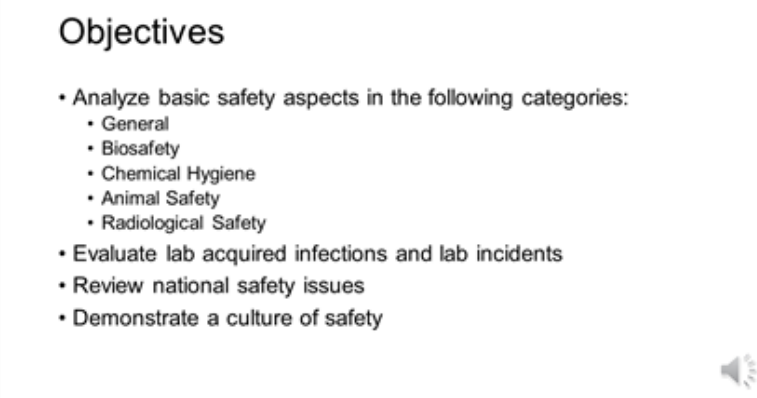
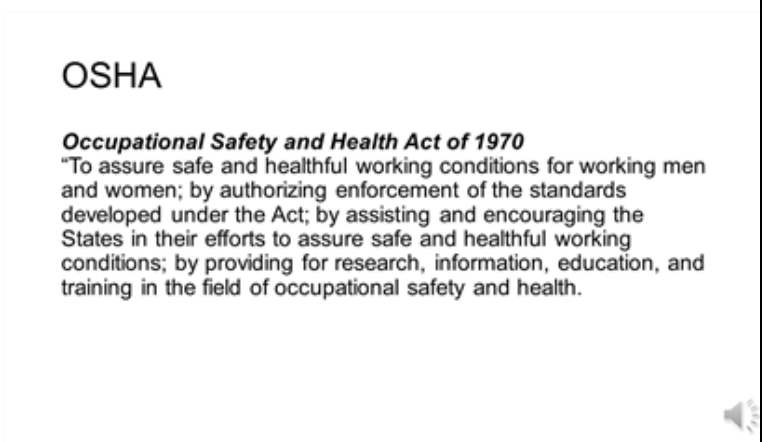
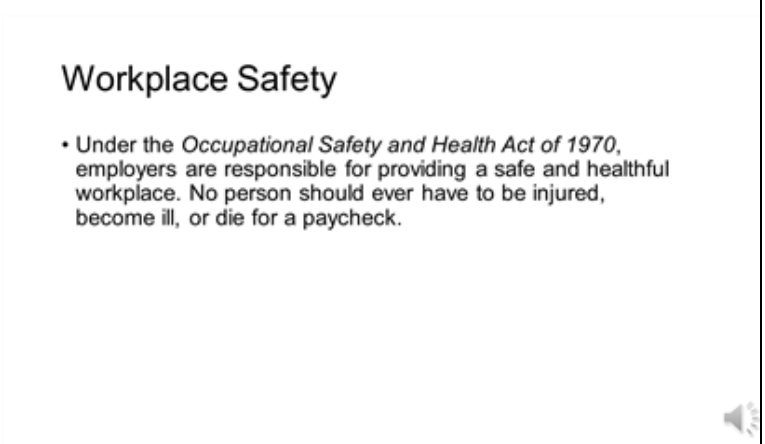
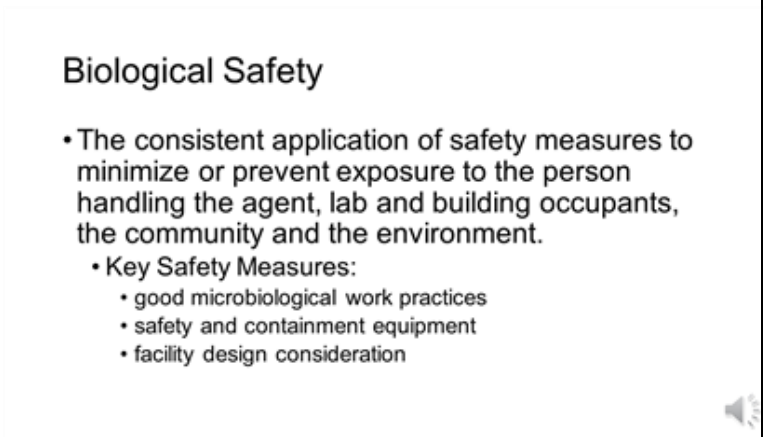
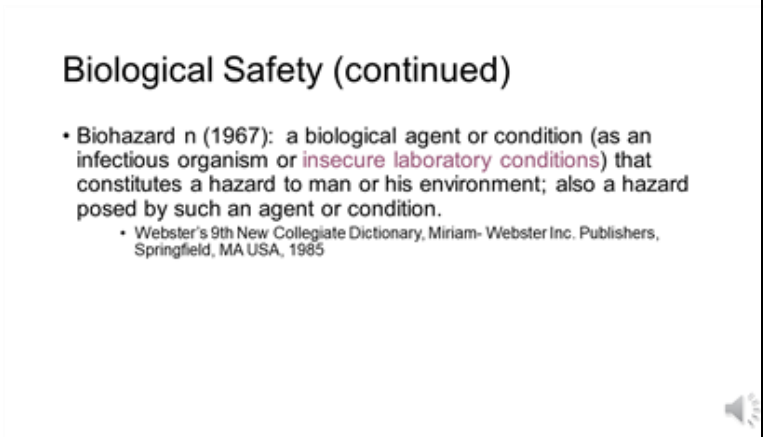
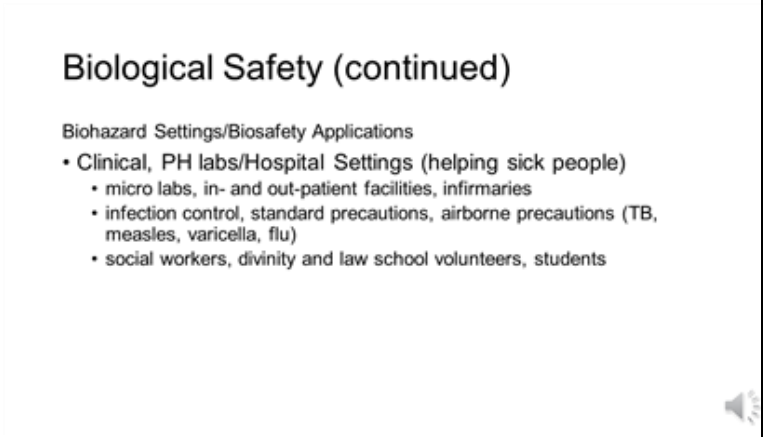
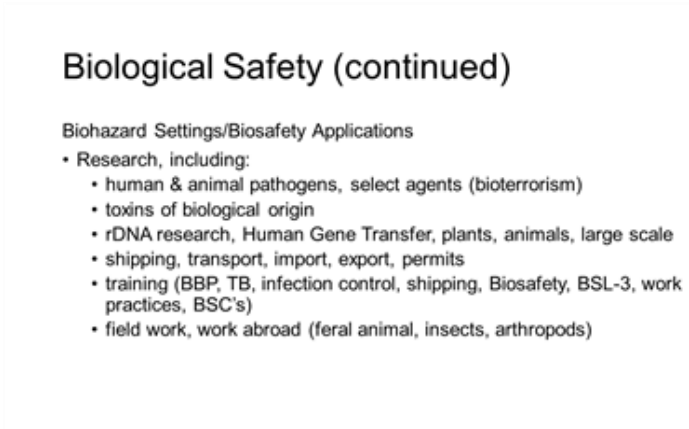
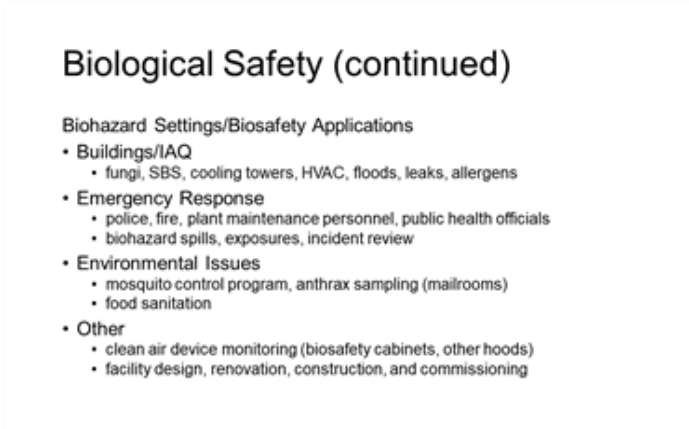
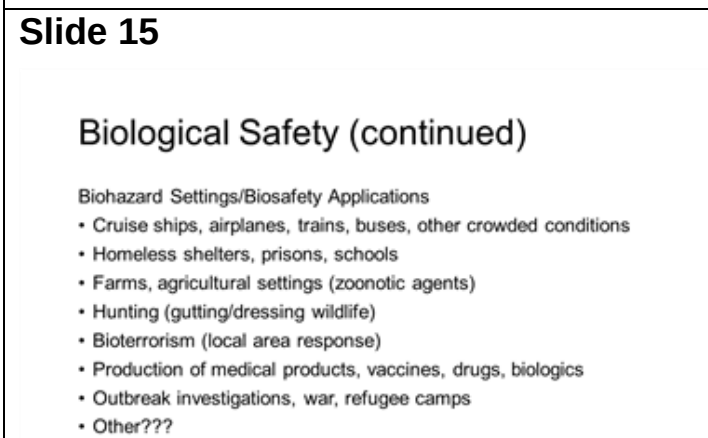
Transcript Handout
Slides: 53
Duration: 00:30:02

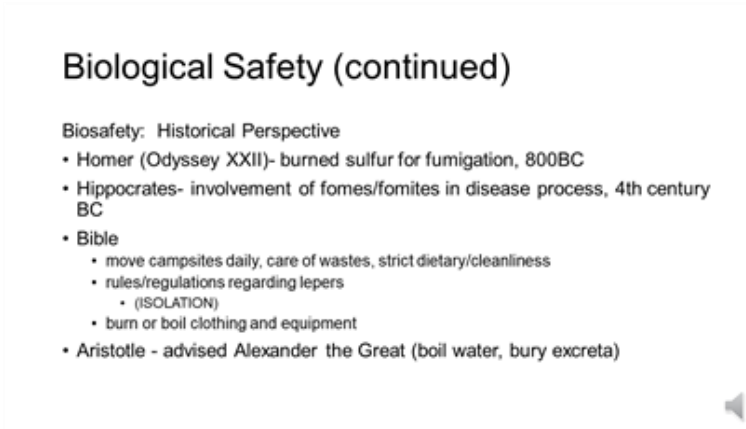
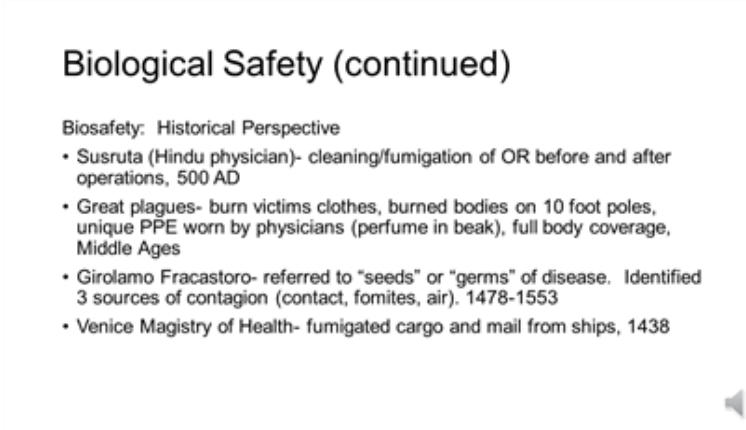
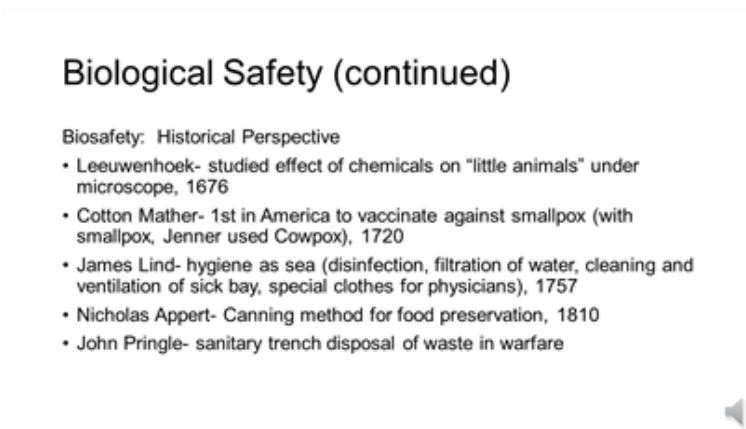
Slide 1 	Welcome to our first lecture of the Lab Safety and Security course. This lecture was prepared by Dr. Andrew Cannons the Laboratory Director of the Bureau of Public Health Laboratories – Tampa. Audio is provided by Dr. Roberts by request.
Slide 2 	This slide presentation is intended to provide an overview of the safety regulations that should be place in a facility. It is not intended to provide guidance since that would come from the specific agency. Rather it is intended to identify some key areas of safety oversight and set the stage for the rest of the course.
Slide 3 	In this presentation we will discuss laboratory safety in a general fashion. We will discuss safety in general, Biosafety, Chemical Hygiene, Animal Safety and Radiological Safety. In addition we will briefly discuss Lab Acquired Infections and Lab Incidents and Review National Safety Issues. Finally we will briefly talk about developing a Culture of Safety. This lecture is designed to set the stage for this course on Safety aspects in the laboratory

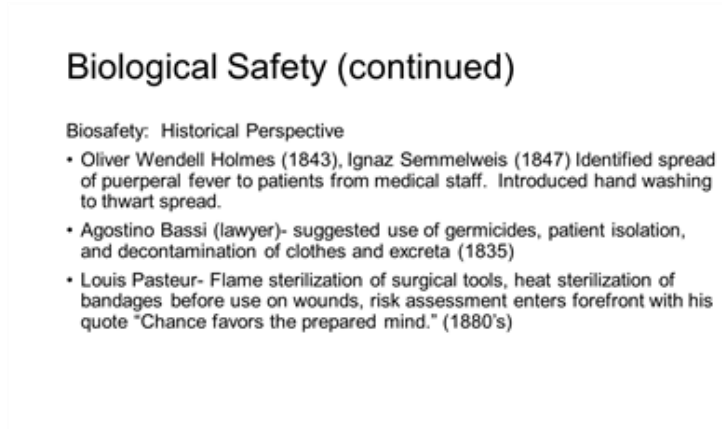
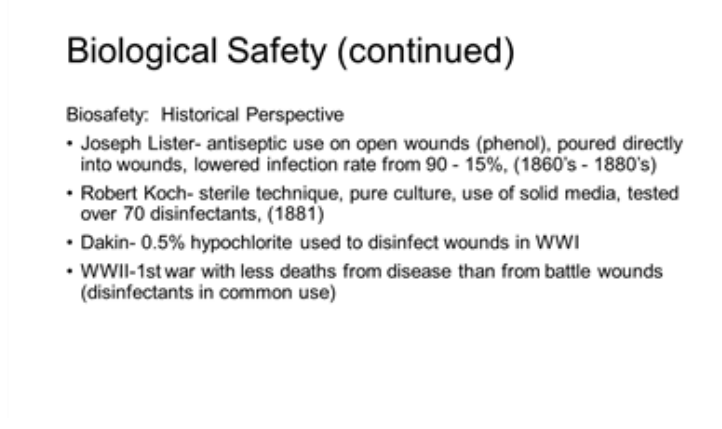
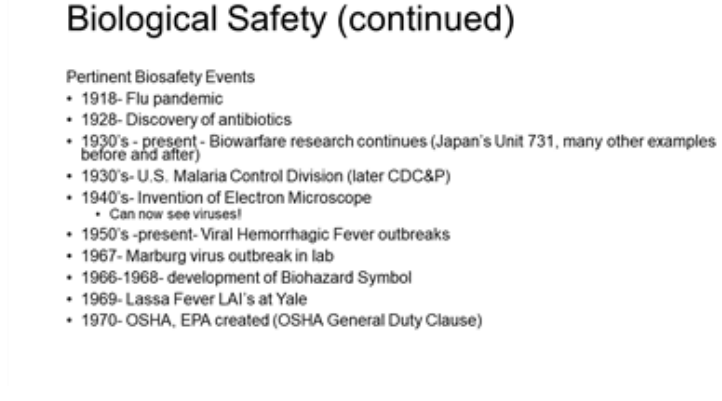
Slide 4 	Let's first discuss why the laboratory needs to be safe. Basically a laboratory can be an unsafe environment whether we are dealing with biological agents, chemicals, radiologicals or animals and minimizing hazards as much as possible is very important, The OSHA act of 1970 really was the first regulation put into place to address safety in the workplace: Occupational Safety and Health Act of 1970 "To assure safe and healthful working conditions for working men and women; by authorizing enforcement of the standards developed under the Act; by assisting and encouraging the States in their efforts to assure safe and healthful working conditions; by providing for research, information, education, and training in the field of occupational safety and health https://www.osha.gov/Publications/osha2254.pdf
Slide 5 	So for workplace safety, under the OSHA act employers are responsible for providing a safe and healthful workplace. No person should ever have to be injured, become ill, or die for a paycheck.
Slide 6 	Let's look at some reasons why a laboratory might not be the safest place, even though OSHA expects the workplace to be a safe environment. What are reasons why safety can fail: Profit before safety -Safety is viewed as a cost not an investment Fear- Problems not discussed to avoid reprisal Ineffective leadership- Prevents recognition of risks and opportunities leading to wrong decisions being made Non-compliance- staff not following rules and procedures

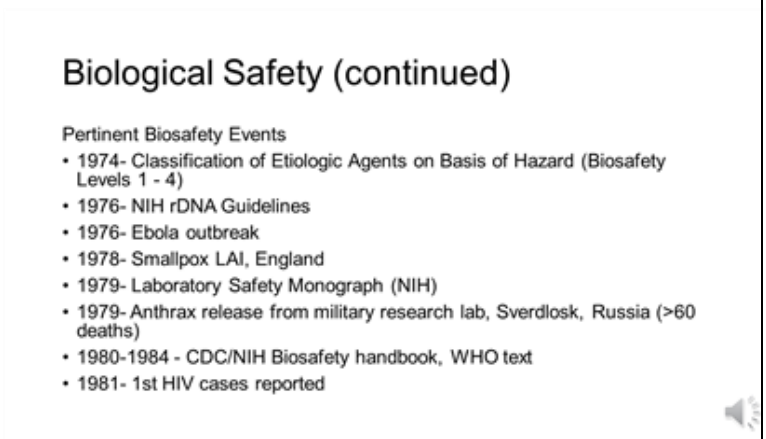
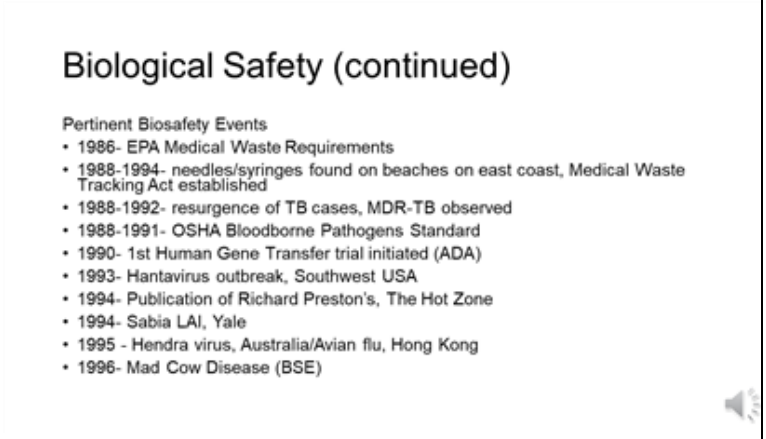
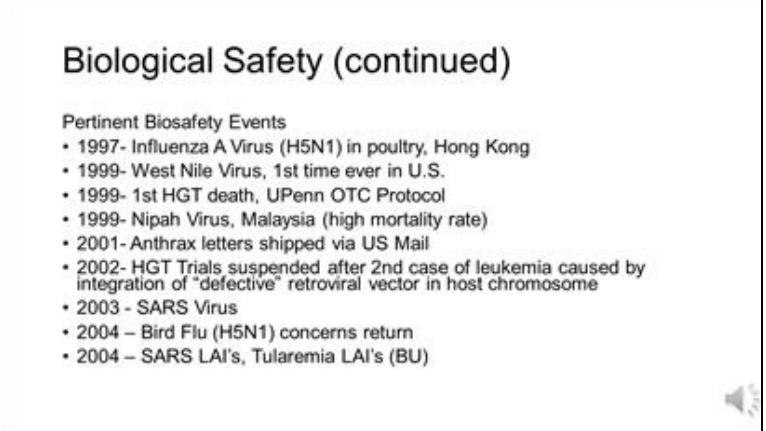
Slide 7 	And some more reasons Miscommunication -Critical safety information not relayed to the decision makers Competency failures- Inadequate training Ignoring lessons learned- Critical information not shared or enforced Erosion of funds- Cost saving models, combining safety with other positions
Slide 8 	So what if you build a strong safety culture in your facility? A Strong Safety Culture equals Incident Reduction And a Safety Culture is the result of: Management and employee assumptions and beliefs Attitudes Policies and procedures Priorities, responsibilities and accountability Production and pressures Actions or lack of actions to correct unsafe behavior Employee training and motivation Employee involvement and “buy in”
Slide 9 	And A Strong Safety Culture will mean Few at risk behaviors Low incident rates Low turn over Low absenteeism High productivity

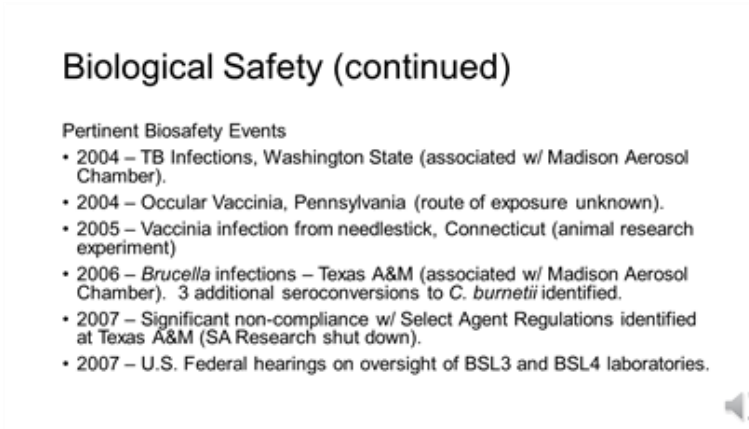
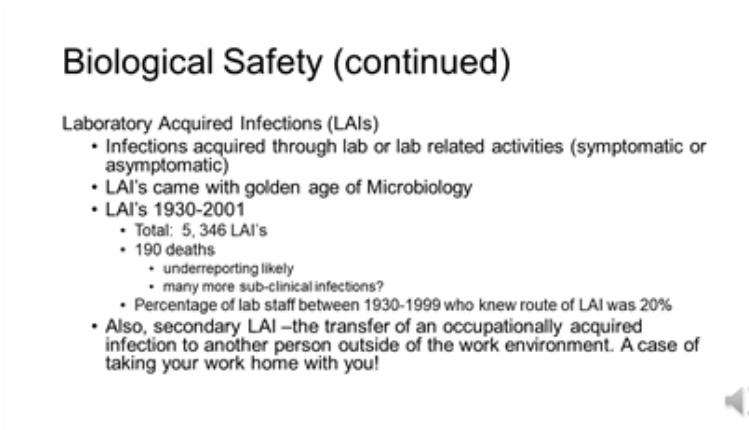
Slide 10 	What is biological safety? We can define it as the consistent application of safety measures to minimize or prevent exposure to the person handling the agent, lab and building occupants, the community and the environment. The Key Safety Measures: good microbiological work practices, use of safety and containment equipment and facility design consideration
Slide 11 	A Biohazard can be defined as a biological agent or condition (as an infectious organism or insecure laboratory conditions) that constitutes a hazard to man or his environment; also a hazard posed by such an agent or condition. This is the Webster's 9th New Collegiate Dictionary, Miriam- Webster Inc. Publishers, Springfield, MA USA, 1985
Slide 12 	What are the Biohazard Settings/Biosafety Applications First we have the Clinical, public health labs/Hospital Settings (helping sick people) microbiology labs, in- and out-patient facilities, infirmaries infection control, standard precautions, airborne precautions (TB, measles, varicella, flu) social workers, divinity and law school volunteers, students

Slide 13 	What are the Biohazard Settings/Biosafety Applications Next we have Research, including: human & animal pathogens, select agents (bioterrorism) toxins of biological origin rDNA research, Human Gene Transfer, plants, animals, large scale shipping, transport, import, export, permits training (BBP, TB, infection control, shipping, Biosafety, BSL-3, work practices, BSC's) field work, work abroad (feral animal, insects, arthropods)
Slide 14 	What as the Biohazard Settings/Biosafety Applications We also have to consider Buildings/IAQ Fungi, SBS, cooling towers, HVAC, floods, leaks, allergens Emergency Response -police, fire, plant maintenance personnel, public health officials, biohazard spills, exposures, incident review Environmental Issues - mosquito control program, anthrax sampling (mailrooms), food sanitation Other, including clean air device monitoring (biosafety cabinets, other hoods), facility design, renovation, construction, and commissioning
Slide 15 	Finally Biohazard Settings/Biosafety Applications can be found in Cruise ships, airplanes, trains, buses, other crowded conditions Homeless shelters, prisons, schools Farms, agricultural settings (zoonotic agents) Hunting (gutting/dressing wildlife) Bioterrorism (local area response) Production of medical products, vaccines, drugs, biologics Outbreak investigations, war, refugee camps Are there any others you can think of?

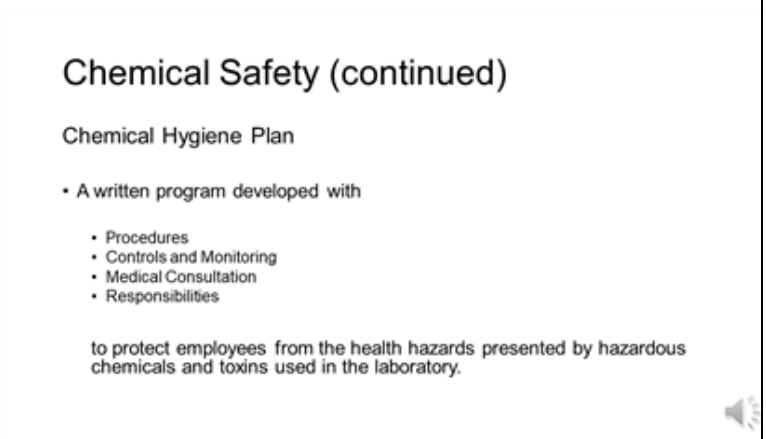
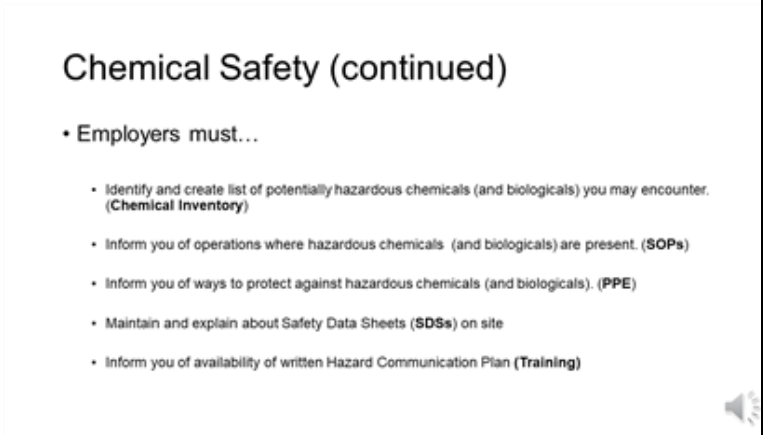
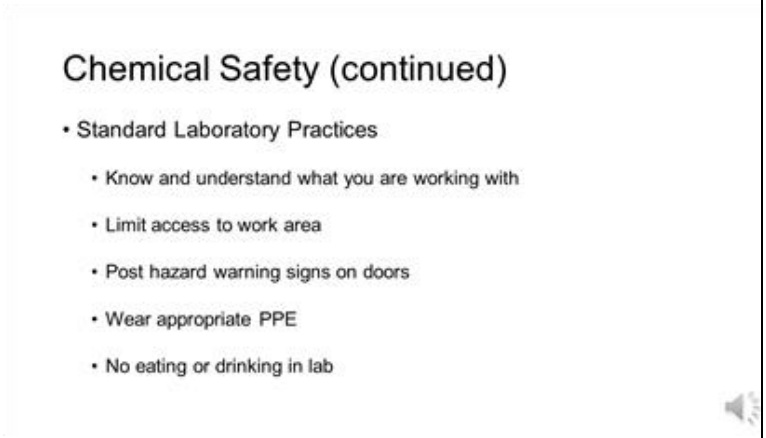
Slide 16 	What about the historical aspects of biological safety? We can go way back and find some examples of biosafety being put into practice: Homer (Odyssey XXII)- burned sulfur for fumigation, 800BC Hippocrates- involvement of fomes/fomites in disease process, 4th century BC Bible –describes moving campsites daily, care of wastes, strict dietary/cleanliness, rules/regulations regarding lepers, (ISOLATION) burn or boil clothing and equipment Aristotle - advised Alexander the Great to boil water and bury excreta
Slide 17 	What about the historical aspects of biological safety - some examples of biosafety being put into practice (continued): Susruta (Hindu physician)- cleaning/fumigation of OR before and after operations, 500 AD Great plagues- burn victims clothes, burned bodies on 10 foot poles, unique PPE worn by physicians (perfume in beak), full body coverage, Middle Ages Girolamo Fracastoro- referred to "seeds" or "germs" of disease. Identified 3 sources of contagion (contact, fomites, air). 1478-1553 Venice Magistry of Health- fumigated cargo and mail from ships, 1438
Slide 18 	What about the historical aspects of biological safety - some examples of biosafety being put into practice (continued): Leeuwenhoek- studied effect of chemicals on "little animals" under microscope, 1676 Cotton Mather- 1st in America to vaccinate against smallpox (with smallpox, Jenner used Cowpox), 1720 James Lind- hygiene as sea (disinfection, filtration of water, cleaning and ventilation of sick bay, special clothes for physicians), 1757 Nicholas Appert- Canning method for food preservation, 1810 John Pringle- sanitary trench disposal of waste in warfare

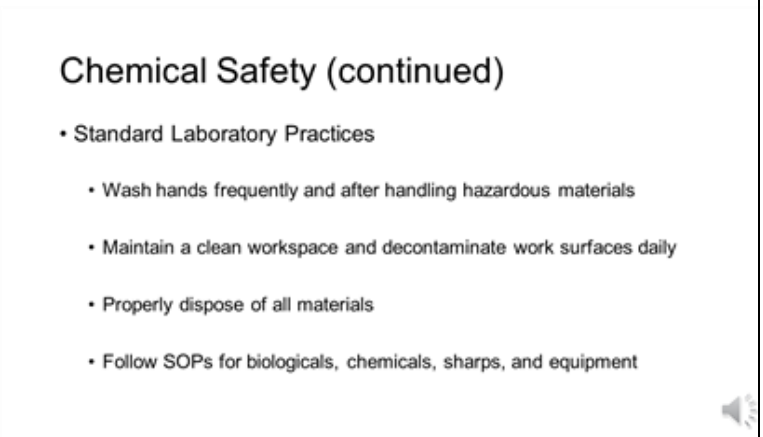
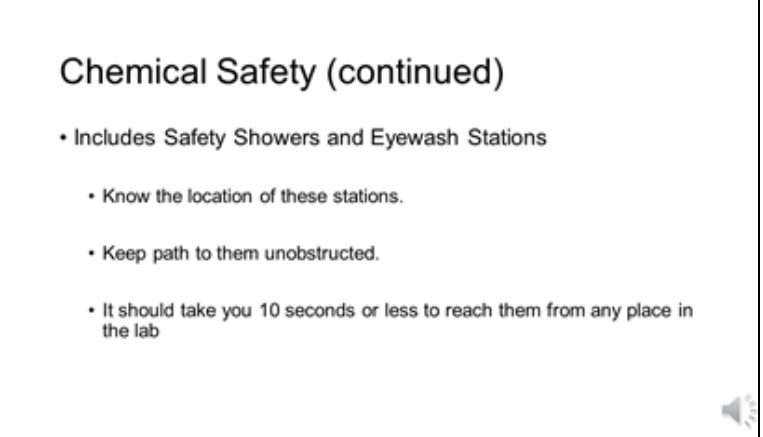
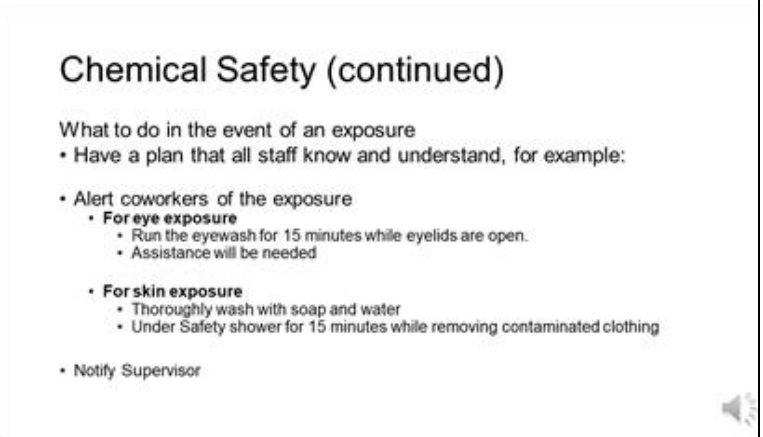
Slide 19 	What about the historical aspects of biological safety - some examples of biosafety being put into practice (continued): Oliver Wendell Holmes (1843), Ignaz Semmelweis (1847) Identified spread of puerperal fever to patients from medical staff. Introduced hand washing to thwart spread. Agostino Bassi (lawyer)- suggested use of germicides, patient isolation, and decontamination of clothes and excreta (1835) Louis Pasteur- Flame sterilization of surgical tools, heat sterilization of bandages before use on wounds, risk assessment enters forefront with his quote "Chance favors the prepared mind." (1880's)
Slide 20 	What about the historical aspects of biological safety - some examples of biosafety being put into practice (continued): Joseph Lister- antiseptic use on open wounds (phenol), poured directly into wounds, lowered infection rate from 90 - 15%, (1860's - 1880's) Robert Koch- sterile technique, pure culture, use of solid media, tested over 70 disinfectants, (1881) Dakin- 0.5% hypochlorite used to disinfect wounds in WWI WWII-1st war with less deaths from disease than from battle wounds (disinfectants in common use)
Slide 21 	Over the next few slides, let's also look at some pertinent biosafety events throughout history –these typically can be key to operations in the laboratory 1918- Flu pandemic 1928- Discovery of antibiotics 1930's - present - Biowarfare research continues (Japan's Unit 731, many other examples before and after) 1930's- U.S. Malaria Control Division (later CDC&P) 1940's- Invention of Electron Microscope Can now see viruses! 1950's -present- Viral Hemorrhagic Fever outbreaks 1967- Marburg virus outbreak in lab 1966-1968- development of Biohazard Symbol 1969- Lassa Fever LAI's at Yale 1970- OSHA, EPA created (OSHA General Duty Clause)

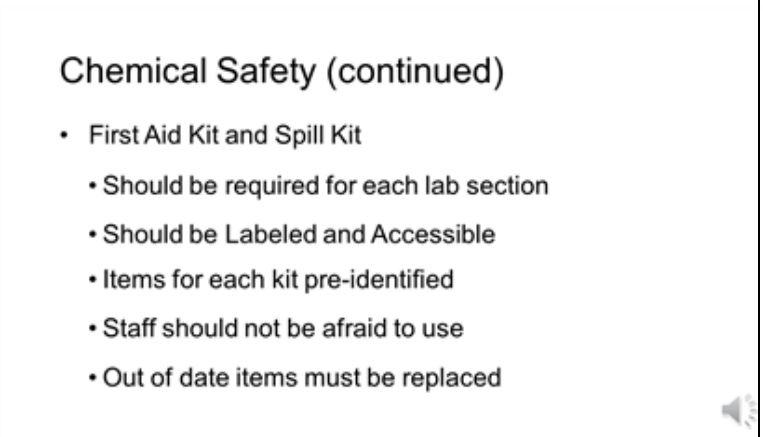
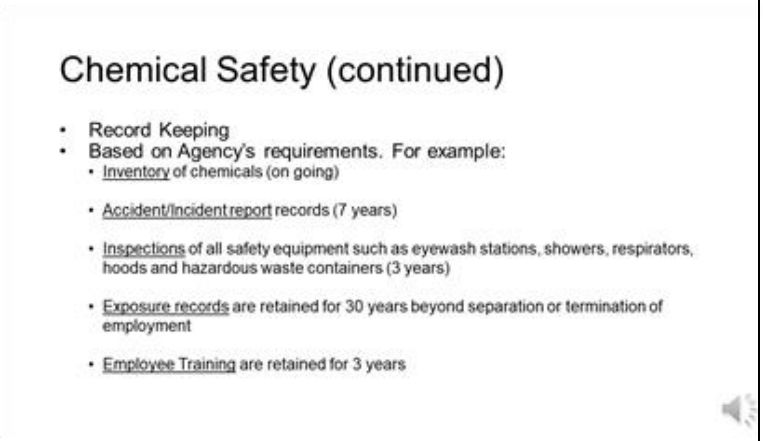
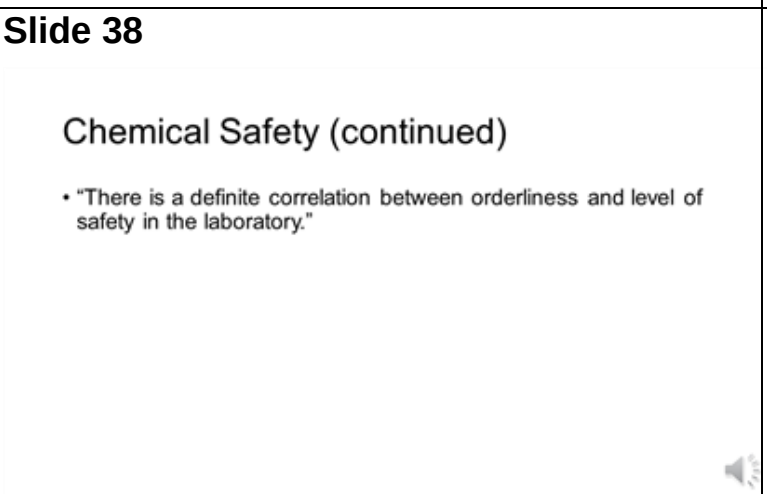
Slide 22 	Let's continue to look at some pertinent biosafety events throughout history 1974- Classification of Etiologic Agents on Basis of Hazard (Biosafety Levels 1 - 4) 1976- NIH rDNA Guidelines 1976- Ebola outbreak 1978- Smallpox LAI, England 1979- Laboratory Safety Monograph (NIH) 1979- Anthrax release from military research lab, Sverdlosk, Russia (>60 deaths) 1980-1984 - CDC/NIH Biosafety handbook, WHO text 1981- 1st HIV cases reported
Slide 23 	Let's continue to look at some pertinent biosafety events throughout history 1986- EPA Medical Waste Requirements 1988-1994- needles/syringes found on beaches on east coast, Medical Waste Tracking Act established 1988-1992- resurgence of TB cases, MDR-TB observed 1988-1991- OSHA Bloodborne Pathogens Standard 1990- 1st Human Gene Transfer trial initiated (ADA) 1993- Hantavirus outbreak, Southwest USA 1994- Publication of Richard Preston's, The Hot Zone 1994- Sabia LAI, Yale 1995 - Hendra virus, Australia/Avian flu, Hong Kong 1996- Mad Cow Disease (BSE)
Slide 24 	Let's continue to look at some pertinent biosafety events throughout history 1997- Influenza A Virus (H5N1) in poultry, Hong Kong 1999- West Nile Virus, 1st time ever in U.S. 1999- 1st HGT death, UPenn OTC Protocol 1999- Nipah Virus, Malaysia (high mortality rate) 2001- Anthrax letters shipped via US Mail 2002- HGT Trials suspended after 2nd case of leukemia caused by integration of "defective" retroviral vector in host chromosome 2003 - SARS Virus 2004 – Bird Flu (H5N1) concerns return 2004 – SARS LAI's, Tularemia LAI's (BU)

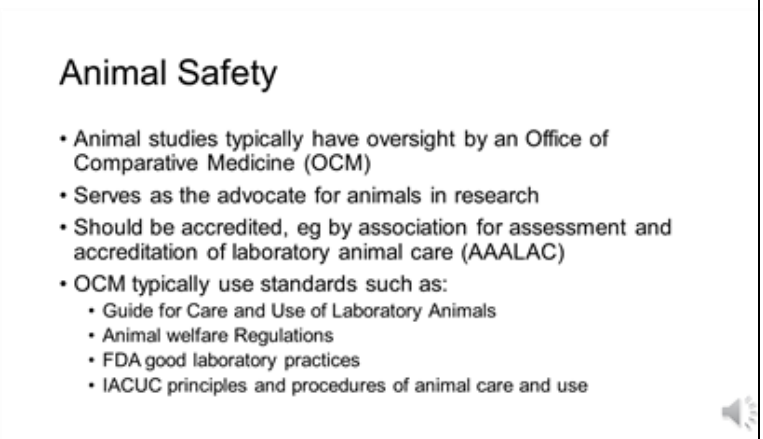
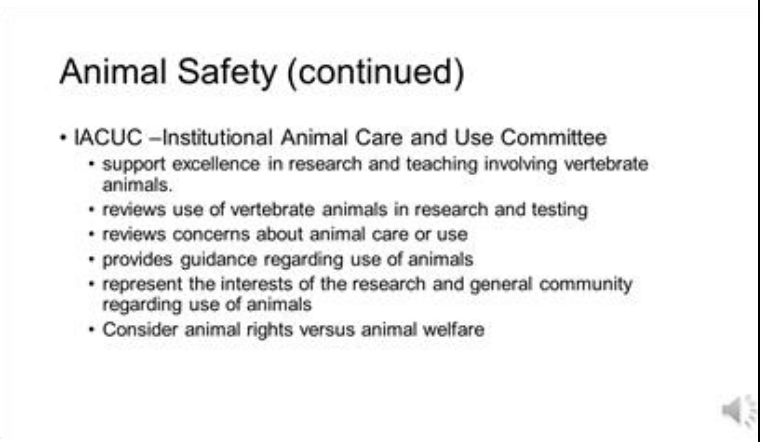
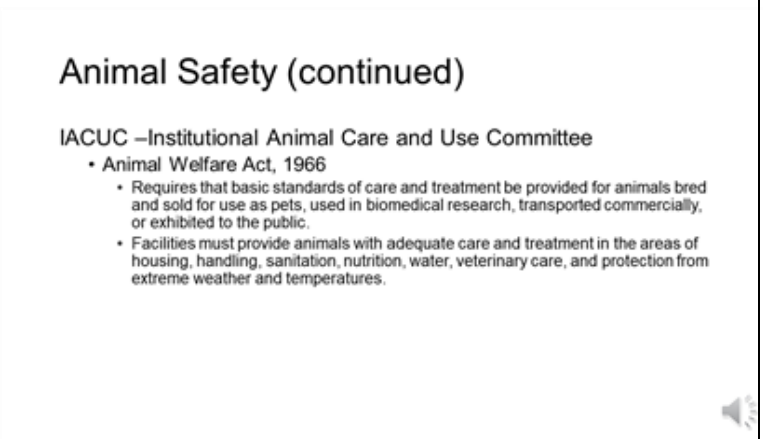
Slide 25 	Let's continue to look at some pertinent biosafety events throughout history 2004 – TB Infections, Washington State (associated w/ Madison Aerosol Chamber). 2004 – Occular Vaccinia, Pennsylvania (route of exposure unknown). 2005 – Vaccinia infection from needlestick, Connecticut (animal research experiment) 2006 – Brucella infections – Texas A&M (associated w/ Madison Aerosol Chamber). 3 additional seroconversions to C. burnetii identified. 2007 – Significant non-compliance w/ Select Agent Regulations identified at Texas A&M (SA Research shut down). 2007 – U.S. Federal hearings on oversight of BSL3 and BSL4 laboratories And there are more recent ones too
Slide 26 	And important aspect of biological safety is the consideration of Laboratory Acquired Infections (LAIs) These are Infections acquired through lab or lab related activities (symptomatic or asymptomatic) They came with the golden age of Microbiology Between 1930-2001, there were a Total of 5, 346 LAI's documented, 190 deaths from LAIs Likely LAIs were, and still are underreported and likely many more sub-clinical infections occuring The percentage of lab staff between 1930-1999 who knew route of LAI was 20% Also important. secondary LAI –the transfer of an occupationally acquired infection to another person outside of the work environment. A case of taking your work home with you!

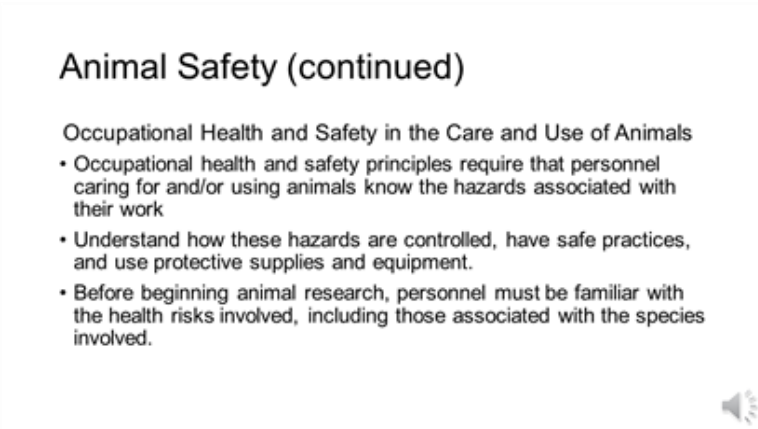
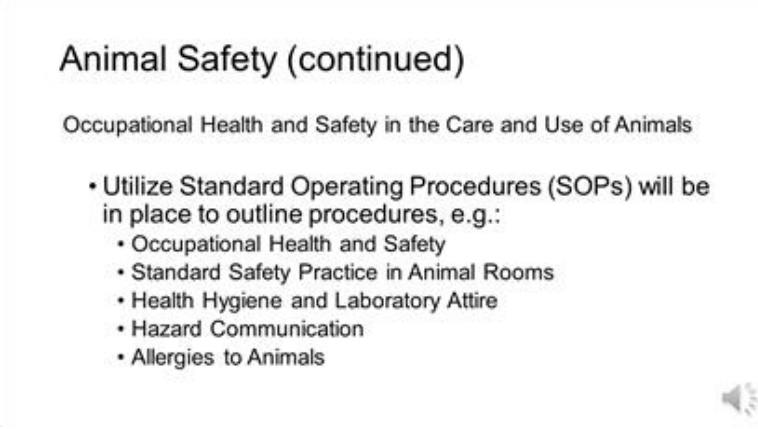
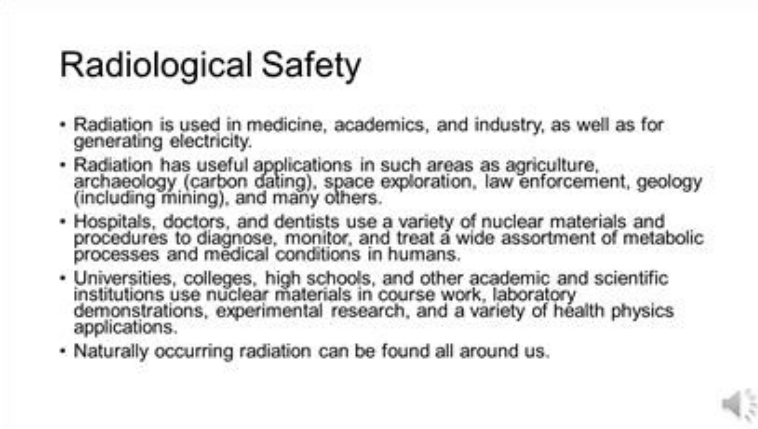
Slide 27 The Fear of HIV Led to Changes in Biosafety • Universal precautions to prevent contact with blood and body fluids • Bloodborne Pathogens Standard- 1992 • Other exposures have continued • **Fatal Laboratory-Acquired Infection with an Attenuated *Yersinia pestis* Strain** --- Chicago, Illinois, 2009. • **Laboratory-Acquired Vaccinia Virus Infection** --- Virginia, 2008 • **Laboratory-Acquired Brucellosis** --- Indiana and Minnesota, 2006 • **Laboratory-Acquired West Nile Virus Infections** --- United States, 2002 • **Laboratory-Acquired Meningococcal Disease** --- United States, 2000	HIV in the 1980s led to changes in biosafety Brought about Universal precautions to prevent contact with blood and body fluids The Bloodborne Pathogens Standard was introduced in 1992 Since then we do know exposures that have continued –so LAIs is not fixed Fatal Laboratory-Acquired Infection with an Attenuated Yersinia pestis Strain --- Chicago, Illinois, 2009. Laboratory-Acquired Vaccinia Virus Infection --- Virginia, 2008 Laboratory-Acquired Brucellosis --- Indiana and Minnesota, 2006 Laboratory-Acquired West Nile Virus Infections --- United States, 2002 Laboratory-Acquired Meningococcal Disease --- United States, 2000
Slide 28 Where do we need to be for all labs?  	This figure demonstrate a road, the biosafety road map, with 7 stops detailing where we need to be for all labs. The steps are as follows: Stop 1 – Biosafety risk assessment Stop 2 – Selection of safety practices to prevent portal of entry Stop 3 – Select and incorporate biosafety competencies Stop 4 – Safety orientation and training Stop 5 – Audits, monitoring, safety committee Stop 6 – Occupational health program Stop 7 – Creating a culture of safety
Slide 29 Chemical Safety • Hazard Communication and the Right to Know • Enacted in 1984 after the Bhopal Incident. • Standard created to ensure safety when working with chemicals. • Hazard Communication = Right to Know • **Since 2012 it is the Right to Understand** You have a **RIGHT TO UNDERSTAND** about the hazardous chemicals you use on the job and how to work safely with them.	Let's move on to Chemical Safety Chemical safety includes Hazard Communication and the Right to Know This was Enacted in 1984 after the Bhopal Incident. The chemical hygiene Standard was created to ensure safety when working with chemicals. Hazard Communication = Right to Know Since 2012 it is the Right to Understand Basically You have a RIGHT TO UNDERSTAND about the hazardous chemicals you use on the job and how to work safely with them.

Slide 30 	As part of the program a laboratory is required to have a Chemical Hygiene Plan This is a written program developed with Procedures Controls and Monitoring Medical Consultation Responsibilities This is aimed to protect employees from the health hazards presented by hazardous chemicals and toxins used in the laboratory.
Slide 31 	As part of the program Employers must… Identify and create list of potentially hazardous chemicals (and biologicals) you may encounter. (Chemical Inventory) Inform staff of operations where hazardous chemicals (and biologicals) are present. (SOPs) Inform staff of ways to protect against hazardous chemicals (and biologicals). (PPE) Maintain and explain to staff about Safety Data Sheets (SDSs) on site Inform staff of the availability of written Hazard Communication Plan (Training)
Slide 32 	The Standard Laboratory Practices for chemical hygiene/safety are Know and understand what you are working with Limit access to work area Post hazard warning signs on doors Wear appropriate PPE No eating or drinking in lab

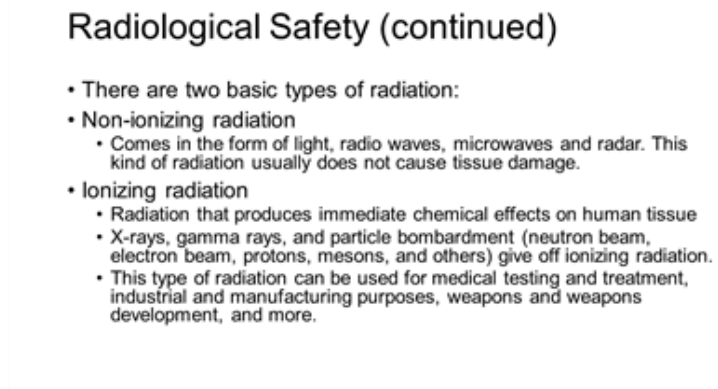
Slide 33 	The Standard Laboratory Practices for chemical hygiene/safety are Staff must Wash hands frequently and after handling hazardous materials Staff must Maintain a clean workspace and decontaminate work surfaces daily Staff must Properly dispose of all materials Staff must Follow SOPs for biologicals, chemicals, sharps, and equipment
Slide 34 	Chemical safety includes the equipment used in case of an exposure, that includes the Safety Showers and Eyewash Stations Staff must Know the location of these stations. Staff must Keep the path to them unobstructed. It should take staff 10 seconds or less to reach them from any place in the lab
Slide 35 	Staff need to know what to do in the event of an exposure There must be a plan that all staff know and understand, for example: Alert coworkers of the exposure For eye exposure Run the eyewash for 15 minutes while eyelids are open. Assistance will be needed For skin exposure Thoroughly wash with soap and water Under Safety shower for 15 minutes while removing contaminated clothing Notify Supervisor

Slide 36 	In addition labs need to consider First Aid Kit and Spill Kit Should be required for each lab section Should be Labeled and Accessible Items for each kit pre-identified Staff should not be afraid to use Out of date items must be replaced
Slide 37 	Chemical safety also requires Record Keeping and how often these are done and how long these are kept for is Based on Agency's requirements. For example: Inventory of chemicals (on going) Accident/Incident report records (7 years) Inspections of all safety equipment such as eyewash stations, showers, respirators, hoods and hazardous waste containers (3 years) Exposure records are retained for 30 years beyond separation or termination of employment Employee Training are retained for 3 years
Slide 38 	"There is a definite correlation between orderliness and level of safety in the laboratory."

Slide 39 	Let's now move on to Animal Safety Animal studies typically have oversight by an Office of Comparative Medicine (OCM). The OCM serves as the advocate for animals in research.0 The OCM should be accredited, eg by association for assessment and accreditation of laboratory animal care (AAALAC) The OCM typically use standards such as: Guide for Care and Use of Laboratory Animals Animal welfare Regulations FDA good laboratory practices IACUC principles and procedures of animal care and use
Slide 40 	The IACUC –Institutional Animal Care and Use Committee They support excellence in research and teaching involving vertebrate animals. They review use of vertebrate animals in research and testing They review concerns about animal care or use They provide guidance regarding use of animals They represent the interests of the research and general community regarding use of animals They consider animal rights versus animal welfare
Slide 41 	The IACUC –Institutional Animal Care and Use Committee Animals in research are protected by the Animal Welfare Act, 1966 Requires that basic standards of care and treatment be provided for animals bred and sold for use as pets, used in biomedical research, transported commercially, or exhibited to the public. Facilities must provide animals with adequate care and treatment in the areas of housing, handling, sanitation, nutrition, water, veterinary care, and protection from extreme weather and temperatures.

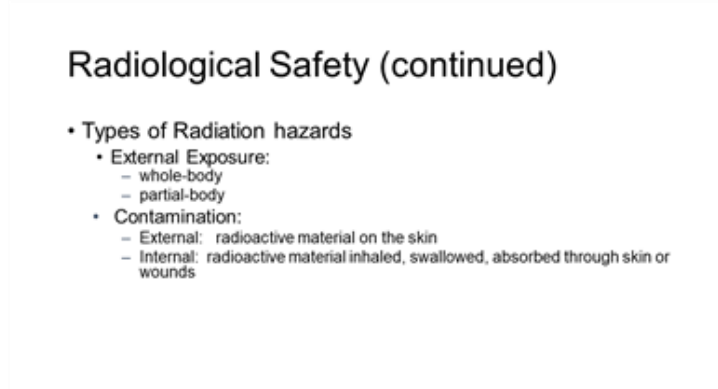
Slide 42 	Occupational Health and Safety in the Care and Use of Animals -this is there to protect the staff working with the animals Occupational health and safety principles require that personnel caring for and/or using animals know the hazards associated with their work Staff should understand how these hazards are controlled, have safe practices, and use protective supplies and equipment. Before beginning animal research, personnel must be familiar with the health risks involved, including those associated with the species involved.
Slide 43 	Occupational Health and Safety in the Care and Use of Animals -this is there to protect the staff working with the animals Staff are required to Utilize Standard Operating Procedures (SOPs) that are be in place to outline procedures, e.g.: Occupational Health and Safety Standard Safety Practice in Animal Rooms Health Hygiene and Laboratory Attire Hazard Communication Allergies to Animals
Slide 44 	Let's now move on to Radiological Safety Radiation is used in medicine, academics, and industry, as well as for generating electricity. Radiation has useful applications in such areas as agriculture, archaeology (carbon dating), space exploration, law enforcement, geology (including mining), and many others. Hospitals, doctors, and dentists use a variety of nuclear materials and procedures to diagnose, monitor, and treat a wide assortment of metabolic processes and medical conditions in humans. Universities, colleges, high schools, and other academic and scientific institutions use nuclear materials in course work, laboratory demonstrations, experimental research, and a variety of health physics applications. Naturally occurring radiation can be found all around us.

Slide 45



There are two basic types of radiation:
Non-ionizing radiation – this Comes in the form of light, radio waves, microwaves and radar. This kind of radiation usually does not cause tissue damage.
Ionizing radiation –this is Radiation that produces immediate chemical effects on human tissue. Includes X-rays, gamma rays, and particle bombardment (neutron beam, electron beam, protons, mesons, and others) give off ionizing radiation. This type of radiation can be used for medical testing and treatment, industrial and manufacturing purposes, weapons and weapons development, and more.

Slide 46



The Types of Radiation hazards are
External Exposure:
whole-body
partial-body
And Contamination:
External: radioactive material on the skin
Internal: radioactive material inhaled, swallowed, absorbed through skin or wounds

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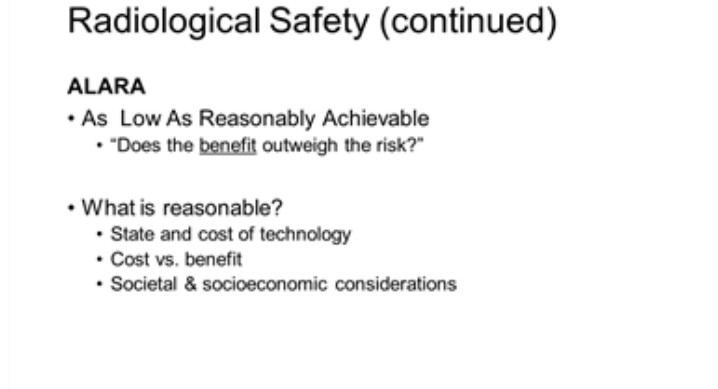
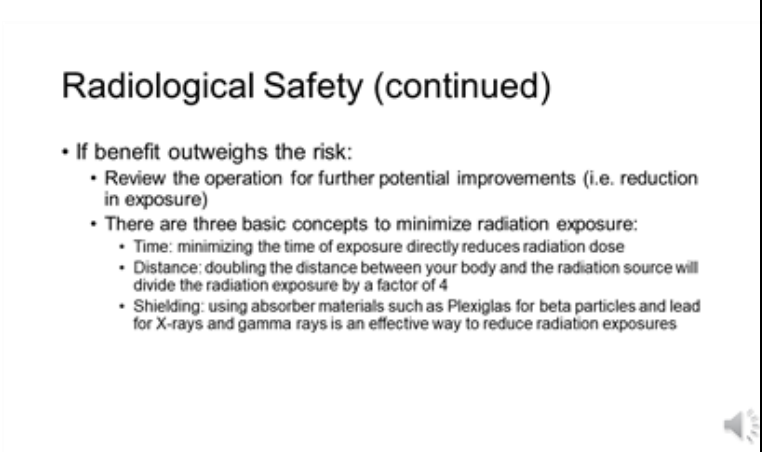
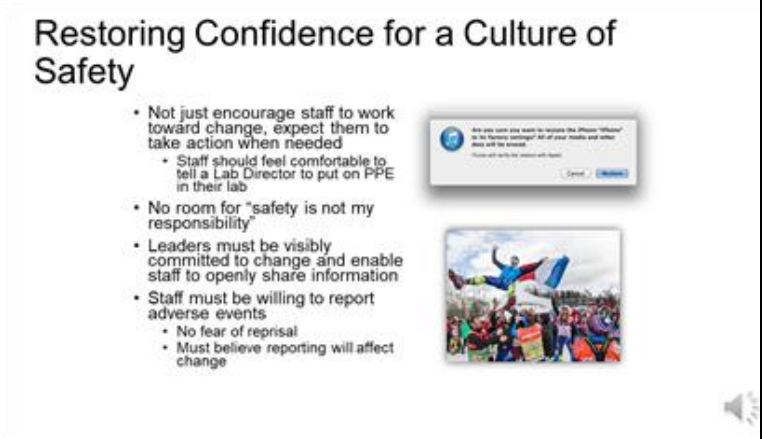
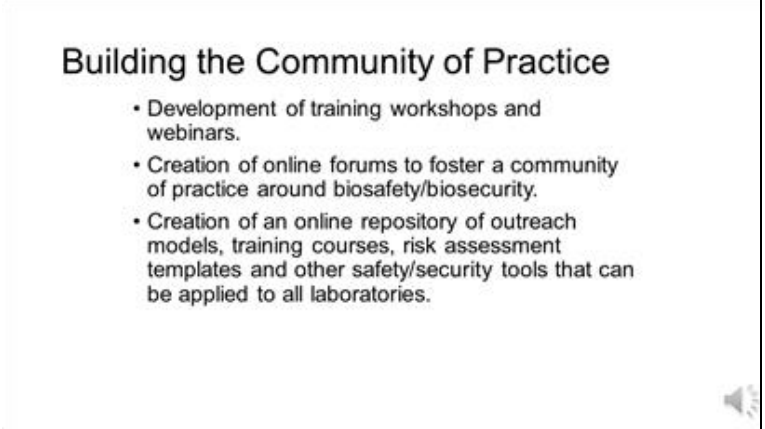
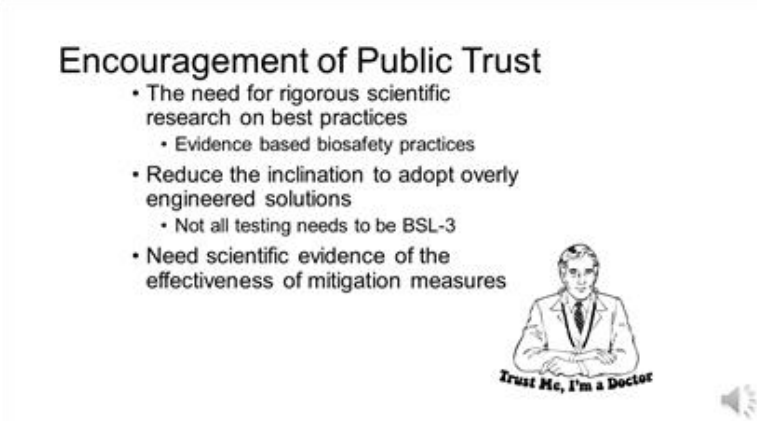
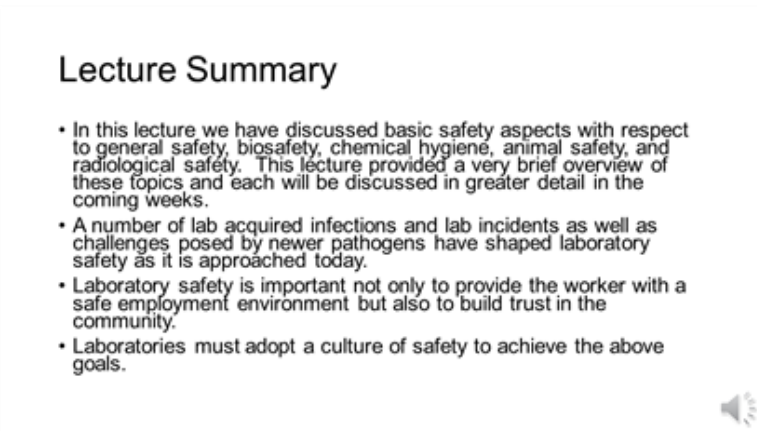


An important consideration with radiation safety is the term ALARA
ALARA stands for As Low As Reasonably Achievable. Basically this means "Does the benefit outweigh the risk?"
And What is reasonable to consider ?
State and cost of technology
Cost vs. benefit
Societal & socioeconomic considerations

Slide 48 	If the benefit does outweigh the risk, then the staff and employer should Review the operation for further potential improvements (i.e. reduction in exposure) Consider that there are three basic concepts to minimize radiation exposure: Time: minimizing the time of exposure directly reduces radiation dose Distance: doubling the distance between your body and the radiation source will divide the radiation exposure by a factor of 4 Shielding: using absorber materials such as Plexiglas for beta particles and lead for X-rays and gamma rays is an effective way to reduce radiation exposures
Slide 49 	Restoring Confidence for a Culture of Safety Finally let's consider a culture of safety for ALL hazards This can include Not just encourage staff to work toward change, expect them to take action when needed Staff should feel comfortable to tell a Lab Director to put on PPE in their lab No room for "safety is not my responsibility" Leaders must be visibly committed to change and enable staff to openly share information Staff must be willing to report adverse events No fear of reprisal Must believe reporting will affect change
Slide 50 	Safety in the facility is about building a community of practice That is Development of training workshops and webinars. The Creation of online forums to foster a community of practice around biosafety/biosecurity. The Creation of an online repository of outreach models, training courses, risk assessment templates and other safety/security tools that can be applied to all laboratories.

Slide 51 	Safety in the facility is about building public trust The need for rigorous scientific research on best practices. This includes Evidence based biosafety practices The need to Reduce the inclination to adopt overly engineered solutions. For example Not all testing needs to be BSL-3 The Need for scientific evidence of the effectiveness of mitigation measures
Slide 52 	What is the future for laboratory safety? Labs will have active viable safety programs Over time, quality indicators can be measured, for example: Risk assessments completed Risk assessments revised and reasons for revision Reduction in exposures Competencies in place
Slide 53 	In this lecture we have discussed basic safety aspects with respect to general safety, biosafety, chemical hygiene, animal safety, and radiological safety. This lecture provided a very brief overview of these topics and each will be discussed in greater detail in the coming weeks. A number of lab acquired infections and lab incidents as well as challenges posed by newer pathogens have shaped laboratory safety as it is approached today. Laboratory safety is important not only to provide the worker with a safe employment environment but also to build trust in the community. Laboratories must adopt a culture of safety to achieve the above goals.