Microbiological Testing

Definition: An overview of microbiological test methods and related programmatic requirements used by regulatory human and animal food laboratories.

Level 2 Competency: Generate microbiological results.

Level 3 Competencies:

- Report results. - Communication
- Describe how microbiological analysis supports the organization's mission. - Leadership
- Explain programmatic requirements for testing. - Programmatic
- Perform microbiological testing according to protocols. - Technical

Laboratory Processing

BRAINSTORM

- Gram stain
- Perform method QC Matrices
- Isolation, culture, screening, characterization, confirmation techniques
- Sterility
- Aseptic techniques
- Organisms
- Select agents
- Streaking
- Sub culturing
- Sample disinfection
- Dilution
- Emerging technologies
- Plate selection
- Batch controls
- Morphology
- Phenotypical characteristics
- Enrichments
- Incubation
- Sample homogenization
- Cultural isolation
- Biochemical analysis
- Plating
- Media enrichments (pre, post, selective, and secondary)
- Microscopy
- Utilize controls
- Different microbes
- Control charting
- Productivity controls
- Process controls
- Matrix inhibition

Definition: Applied measures used in analytical testing.

Level 4 Competency: Discuss the process for microbiological analysis.

1. **Level 5 Competency:** Demonstrate usage of laboratory equipment.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can identify the different pieces of laboratory equipment associated with microbiological analysis. 2. The laboratory analyst can explain the type of testing performed with the laboratory equipment used for microbiological analysis. 3. The laboratory analyst can describe the maintenance and frequency for the types of laboratory equipment used for microbiological analysis. 4. The laboratory analyst can recognize when equipment is not working correctly.	1. The laboratory analyst can assist with selection of laboratory equipment for new test methods. 2. The laboratory analyst can troubleshoot equipment that requires additional review.
2. **Level 5 Competency:** Recognize emerging technologies.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe current technologies available for microbiological analysis. 2. The laboratory analyst listens to presentations about emerging technologies. 3. The laboratory analyst can contrast current and emerging technologies.	1. The laboratory analyst can perform constant scans of literature, webinars, posters, etc. about emerging technologies. 2. The laboratory analyst can inform leadership and coworkers about the potential for an emerging technology to be incorporated into the microbiology laboratory. 3. The laboratory analyst can assist with incorporating emerging technologies into the microbiology laboratory.
3. **Level 5 Competency:** Demonstrate isolation of bacteria.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe the reasons for use of selective or non-selective media within the methods being performed in the laboratory. 2. The laboratory analyst can describe the results to be obtained when using selective and non-selective media for the methods being performed in the laboratory. 3. The laboratory analyst can identify presumptive or suspicious colonies. 4. The laboratory analyst can employ microbiological techniques within the methods being performed in the laboratory.	1. The laboratory analyst can show others how to perform microbiological techniques for training of other staff members. 2. The laboratory analyst can troubleshoot the isolation of bacteria, including the media used within the methods being performed in the laboratory.

a. Aseptic techniques b. Streaking plates c. Single colony isolation	
4. **Level 5 Competency:** Describe enrichment methods.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe enrichment methods being performed in the laboratory. 2. The laboratory analyst can contrast the types of enrichment methods used in the microbiology laboratory.	1. The laboratory analyst can troubleshoot the use of enrichment methods being performed in the laboratory. 2. The laboratory analyst can understand additives or supplements. 3. The laboratory analyst can understand environmental conditions (temperature, aerobic, anaerobic, facultative) during enrichment.
5. **Level 5 Competency:** Describe how the laboratory maintains analyte integrity.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe aseptic techniques in collection and testing. 2. The laboratory analyst can employ aseptic techniques in laboratory analysis. 3. The laboratory analyst can explain the importance of the following on analyte integrity (purity): a. Collection techniques b. Sample containers c. Sample packaging d. Sample transportation e. Sample storage	1. The laboratory analyst can troubleshoot contamination issues. 2. The laboratory analyst can recognize potential loss of analyte integrity. (purity)
6. **Level 5 Competency:** Explain the relevance of sample heterogeneity.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe the importance of sample heterogeneity in laboratory sampling in microbiology: a. Contribution to error in sampling b. Compositional heterogeneity c. Distributional heterogeneity d. Ways to improve heterogeneity	1. The laboratory analyst suggests opportunities for improvement to minimize errors associated with heterogeneity.

7. **Level 5 Competency:** Describe steps to ensure results are defensible.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe the role of QA/QC in the laboratory analysis. 2. The laboratory analyst can explain the importance of obtaining a representative sample. 3. The laboratory analyst works within chain of custody requirements. 4. The laboratory analyst can explain the importance of documentation.	1. The laboratory analyst suggests improvements to laboratory intake, sampling, and testing process to ensure results are defensible.

Equipment and Supplies		
BRAINSTORM		
• Supply order • Instrumentation • Pipettes • Biosafety cabinet • ID systems • Kits	• Chemical inventories • PPE • Biohazard waste • Lot numbers and expiration dates • Chromogenic agar • Culture plates and broth	• SDS • Equipment receipt and maintenance • Calibration • Preventive maintenance • Verification of supplies • Quality critical supplies

Definition: The system that ensures resource availability.

Level 4 Competency: Describe the system that ensures resource availability.

1. **Level 5 Competency:** Summarize laboratory supply quality control (QC)

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe the quality control needed for laboratory supplies: a. Disposables (e.g., pipette tips, test tubes, containers) b. Measuring supplies (e.g., pipettes, beakers, graduated cylinders, flasks) c. Reagents, chemicals, media 2. The laboratory analyst can discuss the importance of supply quality control on test results. 3. The laboratory analyst understands the role of Certificates of Quality (Analysis) for laboratory media and reagents. 4. The laboratory analyst ensures required supply quality control is performed per schedule.	1. The laboratory analyst can assist with the troubleshooting of quality control problems.

2. **Level 5 Competency:** Summarize laboratory equipment QC.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe the quality control needed for their laboratory's equipment.	1. The laboratory analyst can assist with the troubleshooting of quality control problems.

2. The laboratory analyst can discuss the importance of equipment quality control on test results. 3. The laboratory analyst ensures required equipment quality control is performed per schedule.	

Proficiency		
BRAINSTORM • Experienced scientist • Demonstrate proficiency • Audits • CLIA (Clinical lab improvement amendments)	• ISO 17025 • Competency testing • Ethics •	• Authorization to perform • GLP • Quality manual • QC and safety manuals

Definition: Process of ensuring quality results.

Level 4 Competency: Describe the importance of competency verification.

1. **Level 5 Competency:** Describe the importance of being proficient in microbiological testing.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can explain the difference between competency and proficiency. 2. The laboratory analyst can describe elements of a competency testing program. 3. The laboratory analyst can give examples of common sources of error.	1. The laboratory analyst can assist others with improved proficiency through mentoring. 2. The laboratory analyst can assist management with the conducting of assessments, spot checks, and proficiency tests. 3. The laboratory analyst can give examples of elements of testing that are subject to sources of error that experienced scientists may spot versus an entry level.

2. **Level 5 Competency:** Recognize compliance with standards.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can list standards that are incorporated into the laboratory's testing policies and procedures. 2. The laboratory analyst can describe elements of the standards that impact testing accuracy. 3. The laboratory analyst can explain the relationship between the standards and testing accuracy.	1. The laboratory analyst participates in SOP reviews and audits to assure compliance with relevant standards. 2. The laboratory analyst assists in training more junior staff in how standards are addressed in the SOPs.

3. **Level 5 Competency:** Recognize compliance with quality management system (QMS)	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe how different QMS elements address laboratory testing proficiency and accuracy. 2. The laboratory analyst can describe the relationship of QMS and laboratory safety. 3. The laboratory analyst can explain how the QMS addresses failed tests 4. The laboratory analyst can explain how the QMS addresses non-compliances.	1. The laboratory analyst assists leadership with making improvements in policies and procedures. 2. The laboratory analyst monitors self and other staff for compliance with QMS. 3. The laboratory analyst mentors more junior staff on the relevance of compliance to laboratory proficiency.

Samples

BRAINSTORM

- Sample portion
- Sample quality
- Sample receiving
- Specimen rejection
- Chain of custody
- Repeat samples
- Sufficient sample
- Outbreak samples
- Sample traceability

Definition: Representative materials collected for microbiological analysis.

Level 4 Competency: Describe how sample integrity will be maintained.

1. **Level 5 Competency:** Discuss requirements for sample processing.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
1. The laboratory analyst can list the steps when processing samples. 2. The laboratory analyst can recognize when samples are sufficient (volume) for testing. 3. The laboratory analyst can explain the special care (additional precautions) for handling outbreak samples. 4. The laboratory analyst can take required sample portion for testing.	1. The laboratory analyst can assist with troubleshooting. 2. The laboratory analyst can justify the need for repeat samples.

2. **Level 5 Competency:** Explain why samples are rejected.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
1. The laboratory analyst can identify factors that adversely impact analyte integrity. 2. The laboratory analyst can identify factors that adversely impact evidentiary integrity. 3. The laboratory analyst can recognize sample identification requirements (labeling).	1. The laboratory analyst can demonstrate good practices on packing to avoid rejecting samples.

Methods		
BRAINSTORM • Method selection • Serology/Agglutination • Confirmatory methods • Rapid methods	• Screening methods • Testing methods • Serotyping	• Molecular methods • Rule out testing • WGS

Definition: The analytical instructions used in microbiological testing.

Level 4 Competency: Recognize fit for purpose methods.

1. **Level 5 Competency:** Describe the types of screening methods.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can define a screening method.	1. The laboratory analyst can provide suggestions to improve a screening method.

2. **Level 5 Competency:** Describe the types of confirmatory methods.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can define a confirmatory method.	1. The laboratory analyst can provide suggestions to improve a confirmatory method.

3. **Level 5 Competency:** Locate reference documents.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can explain a reference document for methods, such as: a. BAM b. MLG c. AOAC 2. The laboratory analyst can explain where to find reference documents for methods, such as: a. Online	1. The laboratory analyst participates in creating a reference document.

b. Hard copies c. Membership required	
4. **Level 5 Competency:** Locate guidance documents.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can explain a guidance document for methods, such as: a. FDA b. USDA c. AOAC d. Lab network guidance e. APHL f. PFP 2. The laboratory analyst can explain where to find guidance documents, such as: a. Online b. Hard copies c. Membership required	1. The laboratory analyst participates in creating a guidance document.

Environmental Conditions

Definition: Environmental factors that can influence testing in human and animal food safety microbiology laboratories.

Level 2 Competency: Relate environmental factors that affect laboratory testing.

Level 3 Competencies:

- Explain the importance of environmental factors that can affect laboratory testing. - Communication
- Discuss leadership roles in quality laboratory testing. - Leadership
- Identify requirements to mitigate environmental contamination within laboratory. - Programmatic
- Identify environmental conditions that can lead to contamination of laboratory samples. - Technical

Contaminants			
BRAINSTORM • Physical • Pests	• Aerosols	• Directionality of workflow	• Airborne

Definition: Potential sources of contamination in a properly functioning microbiological laboratory.

Level 4 Competency: Describe potential sources of contamination in a microbiological laboratory.

2. **Level 5 Competency:** Explain how directionality of workflow limits contamination in the lab.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
5. The laboratory analyst can describe the steps of workflow. 6. The laboratory analyst can describe the critical control points in the workflow.	1. The laboratory analyst can troubleshoot the workflow process. 2. The laboratory analyst can train others on workflow process. 3. The laboratory analyst can suggest improvements to the workflow process.

3. **Level 5 Competency:** List steps to minimize/prevent aerosolization.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**

4. The laboratory analyst can give 3 examples of when aerosols are sources of contamination. a. Opening doors b. Opening test tubes c. Opening culture plates d. Sneezing/breathing e. Powders f. Pipette tips g. Spills h. Air currents 5. The laboratory analyst can describe techniques to minimize/prevent aerosolization. 6. The laboratory analyst can describe the importance of minimizing/preventing aerosolization.	1. The laboratory analyst can identify 5 examples of when aerosols are sources of contamination: a. Opening doors b. Opening test tubes c. Opening culture plates d. Sneezing/breathing e. Powders f. Pipette tips g. Spills h. Air currents
4. **Level 5 Competency:** List steps to minimize/prevent physical contamination.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can give 3 examples of potential sources of physical contamination: a. Pests b. Aerosols c. Dust particulates d. Fomites e. PPE f. Yeast/mold g. Delivery service h. Leaking ceilings i. Leaking packages 2. The laboratory analyst can describe techniques to minimize/prevent physical contamination. 3. The laboratory analyst can describe the importance of minimizing/preventing physical contamination.	1. The laboratory analyst can give 5 examples of potential sources of physical contamination: a. Pests b. Aerosols c. Dust particulates d. Fomites e. PPE f. Yeast/mold g. Delivery service h. Leaking ceilings i. Leaking packages
8. **Level 5 Competency:** Differentiate between routes of contamination.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**

1. The laboratory analyst can describe internal routes of contamination. 2. The laboratory analyst can list 3 examples of routes of internal contamination: a. Physical b. Pests c. Aerosols	4. The laboratory analyst can discuss both internal and external routes of contamination.

Facility

BRAINSTORM

- Temperature
- Humidity
- Lighting
- Electrical
- Records
- Static electricity
- DI water
- Water sources
- IPM
- Biosafety levels
- Restricted access to testing areas
- Controlled environments
- Specialized spaces
- Waste streams
- Decontamination
- Positive/negative pressure labs

Definition: Requirements and controls used to maintain environmental conditions in a properly functioning microbiological laboratory.

Level 4 Competency: Describe controls to maintain environmental conditions.

2. **Level 5 Competency:** Describe facility controls for BSL1 laboratories.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
5. The laboratory analyst can identify at least 3 specific facility controls: a. HVAC system b. Temperature monitoring system c. Humidity d. Air balance e. Specialized spaces f. Waste stream g. PPE	1. The laboratory analyst can explain the purpose of specific facility controls: a. HVAC system b. Temperature monitoring system c. Humidity d. Air balance e. Specialized spaces f. Waste stream

h. Decontamination i. BSL1 safety practices	g. PPE h. Decontamination i. BSL1 safety practices
3. **Level 5 Competency:** Describe facility controls for BSL2 laboratories.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
4. The laboratory analyst can identify at least 3 specific facility controls. 5. The laboratory analyst can explain the purpose of a biosafety cabinet. 6. The laboratory analyst can explain the purpose of an autoclave. 7. The laboratory analyst can recognize when decontamination is required.	1. The laboratory analyst can explain how to operate a biosafety cabinet. 2. The laboratory analyst can correlate decontamination with different BSL2 agents. 3. The laboratory analyst can explain the purpose of specific facility controls: a. HVAC system b. Temperature monitoring system c. Humidity d. Air balance e. Negative/positive pressure f. Restricted access g. Waste stream h. PPE i. Autoclaves j. BSL2 safety practices
3. **Level 5 Competency:** Identify specialized spaces in the laboratory.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can name 3 specialized spaces: a. Sample receipt room b. Media prep room c. Autoclave room	1. The laboratory analyst can explain the purpose of unidirectional workflow. 2. The laboratory analyst can explain the purpose of the specialized spaces.

d. Clean room e. Controlled access room 2. The laboratory analyst can identify unidirectional workflow.	
4. **Level 5 Competency:** Describe waste streams in the laboratory.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can identify the different types of waste streams. 2. The laboratory analyst can describe how to properly dispose of waste: a. Used PPEs b. Contaminated consumables c. Contaminated sharps d. Broken glass e. Trash f. Biowaste i. Processed samples ii. Cultures	1. The laboratory analyst can explain why there are different waste streams. 2. The laboratory analyst can suggest improvements to waste stream management.

Environmental Monitoring		
BRAINSTORM		
• Sterility plates • Swabbing • Aerobic plate count (APC)	• Controls • Media • Reagent • Drop plates • Biological sterility	• DNA contamination • Internal vs external contamination • DI water monitoring • Yeast and mold • Microbic density(amount of bacterial present)
Definition: Processes to evaluate the control of contamination.		

Level 4 Competency: Describe processes to evaluate the control of contamination.

3. **Level 5 Competency:** Recognize methods of environmental monitoring.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
1. The laboratory analyst can list 3 methods of environmental monitoring: a. Sterility plates b. Drop plates c. Swabbing d. Aerobic plate count (APC) e. Yeast and mold f. DI water	4. The laboratory analyst has an understanding the results of environmental monitoring. 5. The laboratory analyst can correlate results with actions needed.

4. **Level 5 Competency:** Recognize the importance of controls for identifying contamination during testing.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
4. The laboratory analyst can recognize the significance of using controls.	3. The laboratory analyst can assist with troubleshooting issues.

4. **Level 5 Competency:** Recognize the importance of sterility to limit sources of contamination.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
1. The laboratory analyst can recognize the importance of employing aseptic techniques (EP5).	1. The laboratory analyst can assist with troubleshooting issues.

Equipment

BRAINSTORM

- Decontamination
- Autoclave
- Sterilization
- Cleaning protocols
- Biosafety cabinets
- HEPA filter
- Use of bio indicator

Definition: Tools required to control environmental contamination.

Level 4 Competency: Describe tools required to control environmental contamination.

1. **Level 5 Competency:** List types of decontamination methods**.**

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
5. The laboratory analyst can list 3 types of decontamination methods: a. Steam b. Heat/Pressure c. Gas d. Vapor e. UV f. Chemical g. Dry Heat	1. The laboratory analyst has knowledge of the application of each decontamination method: a. Steam b. Heat/Pressure c. Gas d. Vapor e. UV f. Chemical g. Dry Heat

2. **Level 5 Competency:** Recognize sterilization tools.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
1. The laboratory analyst can list 3 types of sterilization tools: a. Autoclave b. Heat block c. Flame or incinerator d. UV light e. Filters f. Chemicals i. Bleach ii. Alcohol g. Gases (oxidizers)	1. The laboratory analyst can correlate sterilization tools with application: a. Autoclave b. Heat block c. Flame or incinerator d. UV light e. Filters f. Chemicals i. Bleach ii. Alcohol g. Gases (oxidizers)

3. **Level 5 Competency:** List equipment that can be used to control contamination.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can list 3 pieces of equipment that can be used to control contamination: a. Centrifuge cups and rotors b. Biohazard bags/bins c. Biohazard carriers d. Biosafety cabinets e. HEPA filters f. Sterilization tools	1. The laboratory analyst can explain how to use the equipment. 2. The laboratory analyst can explain how the equipment controls contamination.

Aseptic Techniques

Definition: Precautionary measures while carrying out microbiological work to prevent the contamination of cultures, sterile media, environments, etc., and/or infection of persons by extraneous microorganisms.

Level 2 Competency: Assure microbiological testing using aseptic techniques.

Level 3 Competencies:

- Discuss the requirements of aseptic techniques. - Communication
- Recognize the importance of aseptic techniques. - Leadership
- Apply laboratory SOPs. - Programmatic
- Perform aseptic techniques. - Technical

Sources of Contamination

BRAINSTORM

- Cross contamination
- Aerosolization
- Droplets
- Impact on results
- Verification
- Certificate of sterility
- Risk assessment
- Investigator controls
- Safety
- Biosafety levels
- Biohazards
- Lab acquired infection
- Air quality
- Risk of the types of specimen (liquid vs solid vs lyophilized vs DNA)
- Hot positive control when and how
- Instrument maintenance
- Quality control
- Env controls
- Pathogen decontamination requirement
- Sterilization vs pre-sterilization
- Env assessment
- Sterility practices
- Best practices
- Practice
- Lab safety manual
- When in doubt change gloves, pipette tips, etc.
- Pathogen risk
- Pure culture contamination
- Media QC
- Use of certified products
- Quality manual
- Hazard symbols
- Training (why?)
- Know when to enlist the aid of others
- Adhere to rules
- Provide feedback
- Hazard communication
- SOP

Definition: Elements that may compromise testing, sample integrity, and other laboratory activities.

Level 4 Competency: Describe sources of contamination.

3. **Level 5 Competency:** Recognize contamination risks.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can list three sources of contamination: a. Aerosols b. Droplets c. Air quality d. Cross-contamination between samples e. Pure culture contamination f. Use of improperly sterilized testing items	1. The laboratory analyst can explain how to mitigate the risks. 2. The laboratory analyst can give specific examples of each of the source.

4. **Level 5 Competency:** Identify errors of pipetting techniques.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
5. The laboratory analyst can give three examples of operator errors: a. Overaspirating b. Tip can fall off c. Overwinding pipette d. Using more than +/- 10% of volume e. Improper storage f. Pipetting at an angle g. Not examining tip prior to dispensing h. Touching pipette tip to an unintended surface	4. The laboratory analyst can explain the impact of operator errors 5. The laboratory analyst can troubleshoot errors.

5. **Level 5 Competency:** Recognize contamination of a culture.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can recognize by colony morphology. 2. The laboratory analyst can perform controls to detect contamination.	3. The laboratory analyst can troubleshoot contaminations.

Aseptic Sample Processing		
BRAINSTORM		
• Flame loops • Alcohol wiping • Disposable loops • Bunsen burners • Autoclave sterilization • Techniques to sterilize utensils • Labeling • Vortexing • Streaking • Cell culture • Lids/invert plates • Disinfect equipment	• Decontamination of exterior sample • Airflow • Specific techniques (open/close test tubes, donning sterile gloves) • Pipette tip changes • Pipetting low to high dilution • Gravity phase vs liquid phase • Sterilization pouches • Aerosol barrier tip • Pipettor handling • Biosafety cabinets • PPE • Lab coats	• Laminar flow hood • Bench set-up • Zoning • Avoiding excessive air for media • Contact time • Cleaning for DNA/RNA • Airflow • Pre and post disinfection • Cleaning spills • Sharps disposal
Definition: Ensuring that samples are processed following aseptic techniques. **Level 4 Competency:** Describe aseptic sample processing.		
3. **Level 5 Competency:** Identify sources of processing error.		
Based on Level 5 competency – Not an all-inclusive list		
BEHAVIORAL ANCHORS Average		**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can list potential operator errors: a. Pipetting techniques b. Not using PPE correctly c. Improper labeling d. Not following SOPs		1. The laboratory analyst can troubleshoot the errors.
4. **Level 5 Competency:** Recognize practices to avoid cross contamination.		
Based on Level 5 competency – Not an all-inclusive list		

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
1. The laboratory analyst can list potential practice errors: a. Aerosols production b. Inadequate disinfection c. Bench set-up d. Zoning	2. The laboratory analyst can troubleshoot the practice errors.
4. **Level 5 Competency:** Demonstrate aseptic inoculating techniques.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
3. The laboratory analyst can demonstrate the following techniques: a. Avoiding droplets b. Controls are not contaminated c. Handling consumables properly	1. The laboratory analyst can help train on techniques.
5. **Level 5 Competency:** Demonstrate use of PPE.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can choose appropriate PPE. 2. The laboratory analyst can don and doff appropriately. 3. The laboratory analyst can wash hands.	1. The laboratory analyst can train others on use of PPE.
6. **Level 5 Competency:** Describe sterilization processes.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
3. The laboratory analyst can Identify 3 types of sterilization processes: a. Use of Autoclave b. Use of Heat block c. Use of UV light d. Use of Filters e. Use of Chemicals (bleach, alcohol, gases)	1. The laboratory analyst can correlate sterilization tools with application. 2. The laboratory analyst has an understanding of the sterilization process.
7. **Level 5 Competency:** Describe disinfection processes.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can recognize the importance of expiration dates (manufacturers and working solutions) for disinfection. 2. The laboratory analyst can recognize the importance of contact time.	1. The laboratory analyst can correlate the disinfection process with the disinfectant.

3. The laboratory analyst can recognize the importance of concentration. 4. The laboratory analyst can follow SOPs.	
8. **Level 5 Competency:** Describe tools for prevention of contamination during testing.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can list 3 pieces of equipment that can be used to control contamination during testing: a. Biosafety cabinets b. Sterilization tools c. HEPA filters d. Biohazard carriers e. Biohazard bags/bins f. Centrifuge cups and rotors g. PPE	1. The laboratory analyst can explain how to use the equipment. 2. The laboratory analyst can explain how it controls contamination.
9. **Level 5 Competency:** Explain how to handle a biohazardous spill.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst has knowledge of SOPs. 2. The laboratory analyst can follow the SOPs. 3. The laboratory analyst is aware of where the spill kits are located ahead of time.	1. The laboratory analyst can correlate the type of spill with potential impact. 2. The laboratory analyst can identify the anatomy of a spill. (i.e. aerosols)
10. **Level 5 Competency:** Recognize how to prevent a contamination event.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst performs work based on biosafety protocols. 2. The laboratory analyst can identify symptoms of laboratory acquired infection, as applicable. 3. The laboratory analyst can identify the routes of contamination. 4. The laboratory analyst disposes of waste properly. 5. The laboratory analyst can access the biosafety manual.	1. The laboratory analyst can train others on best practices for preventing contamination events. 2. The laboratory analyst recognizes that symptoms may be indicative of contamination.

Aseptic Sample Handling		
BRAINSTORM		
• Disinfectant vs antiseptic • Handwashing • Personal hygiene • Decontamination procedures • Sterile handling (no touch technique)	• Spill containment • Clean/dirty work areas • Cleaning techniques • Biohazard trash • Pipette blowout vs touch off	• Heat killing • Hot positive control when and how • Hygiene • Sterile vs non-sterile supplies, reagents and media
Definition: Ensuring that samples are handled following aseptic techniques. **Level 4 Competency:** Describe aseptic sample handling.		
5. **Level 5 Competency:** List types of lab supplies used for aseptic techniques.		
Based on Level 5 competency – Not an all-inclusive list		
BEHAVIORAL ANCHORS Average		**BEHAVIORAL ANCHORS Outstanding**
4. The laboratory analyst lists three types of laboratory supplies: a. Gloves b. Disinfectants c. Flames d. Autoclaves e. Disposable consumables i. Pipette ii. Pipette tips & filters iii. Loops		1. The laboratory analyst lists more than three types of laboratory supplies: a. Gloves b. Disinfectants c. Flames d. Autoclaves e. Disposable consumables i. Pipette ii. Pipette tips & filters iii. Loops
6. **Level 5 Competency:** Describe preparation techniques for sample handling.		
Based on Level 5 competency – Not an all-inclusive list		

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
5. The laboratory analyst can plan their work from clean to dirty. 6. The laboratory analyst can identify which supplies they need. a. Clean bags b. A place for hazardous waste disposal 7. The laboratory analyst knows how to open sterile packaging. 8. The laboratory analyst recognizes that their sample prep area must be clean. a. Wiping down bench top	4. The laboratory analyst can train others preparation techniques for sample handling.
5. **Level 5 Competency:** Recognize the importance of clean to dirty workflow.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
2. The laboratory analyst can give reasons why clean to dirty workflow is important: a. Contamination prevention b. Helps with organization c. Helps with troubleshooting	1. The laboratory analyst can assist with troubleshooting contamination issues.
6. **Level 5 Competency:** Describe how to handle biohazard waste.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
5. The laboratory analyst recognizes the biohazard waste process. 6. The laboratory analyst recognizes that biohazard waste has a unique disposal stream.	4. The laboratory analyst can suggest improvements to the biohazard waste process if necessary.
7. **Level 5 Competency:** Describe decontamination processes.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst name three decontamination processes: a. Chemical b. Autoclave (steam & pressure) c. Heat d. UV light	1. The laboratory analyst understands how the decontamination process works. 2. The laboratory analyst can distinguish which decontamination method is most effective.
8. **Level 5 Competency:** Explain how to maintain sterility in a non-sterile work environment.	
Based on Level 5 competency – Not an all-inclusive list	

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
1. The laboratory analyst can follow strict protocols. a. Avoid touching 2. The laboratory analyst understands the sources of potential contamination. 3. The laboratory analyst recognizes the importance of following strict protocols. 4. The laboratory analyst uses the proper supplies correctly.	1. The laboratory analyst can suggest improvements.

Basic Foodborne Pathogens

Definition: Broad knowledge of human and animal food borne pathogens and the food safety system.

Level 2 Competency: Discuss the impact of foodborne pathogens in the IFSS.

Level 3 Competencies:

- Discuss how analytical results are communicated within your organization - Communication
- Describe the impact of analytical results on food safety - Leadership
- Discuss the regulatory framework that supports the prevention of foodborne illness - Programmatic
- Describe the impact of human and animal foodborne pathogens - Technical

Regulatory

BRAINSTORM

- Preventive controls for human food
- Regulatory authority
- Outbreak investigations
- Action levels
- Impact of findings
- Adulteration
- Surveillance sampling
- Outbreak surveillance
- Reportable food registry
- Recall plan
- Embargo
- Recalls
- FSMA
- Labs role in evidence collection
- Traceback
- PC for animal food
- Food safety
- HACCP
- Select agents
- Surveillance and investigations
- Regulatory actions
- Regulatory authority vs implied authority

Definition: The laboratory's role within the legal framework that ensures the safety of the food supply.

Level 4 Competency: Describe the laboratory's role in the food safety regulatory framework.

4. **Level 5 Competency:** Recognize regulatory authorities.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can explain how regulatory agencies impact food safety. 2. The laboratory analyst can recognize that laboratories are part of a regulatory system. 3. The laboratory analyst can recognize that laboratories need to perform in a certain way because they are part of a regulatory system.	1. The laboratory analyst can explain the role of the laboratory in the regulatory system. 2. The laboratory analyst has an awareness of the requirements of a specific regulatory program.
5. **Level 5 Competency:** Recognize action levels for certain organisms.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. Recognize the impact of the testing. 2. Recognize there are action levels. 3. Recognize when they would need to communicate an action level.	1. The laboratory analyst understands how action levels are set. 2. The laboratory analyst understands the background of action levels.
6. **Level 5 Competency:** Discuss the impact of erroneous laboratory results.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst understands the implications of false positive results: a. Food removed from commerce b. Loss of credibility c. Cause panic 2. The laboratory analyst understands the implications of false negative results: a. Contaminated food left in commerce b. Illness c. Loss of credibility d. Damage to food industry	1. The laboratory analyst can give an example of the impact of erroneous lab results.

Data Sharing		
BRAINSTORM • Lab networks • LIMS (lab info management system) • Data sharing • Analytical worksheet packages	• PULSENET • GenomeTrakr • elexnet • FERN • FoodNet	• Vet-LIRN • ICLN • NAHLN • PFP

Definition: The collaboration between public health partners in sharing laboratory findings.

Level 4 Competency: Summarize the importance of data sharing.

4. **Level 5 Competency:** Recognize food laboratory networks.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
2. The laboratory analyst can recognize the networks exist. 3. The laboratory analyst can recognize their laboratory may be a part of a network.	2. The laboratory analyst can recognize the benefits of being part of a network.

3. **Level 5 Competency:** Explain the importance of accurate raw data in an analytical worksheet.

Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
4. The laboratory analyst can recognize that laboratory results impact public health. 5. The laboratory analyst can recognize that laboratory results may be used in legal actions. 6. The laboratory analyst can recognize that analytical worksheets may be used as evidence in legal actions.	1. The laboratory analyst can explain the importance of accurate lab results. 2. The laboratory analyst can explain the importance of proper documentation of records.

Analytical

BRAINSTORM

- Selective media
- Pathogen detection methods
- Screening methods
- False results
- Serology
- Whole genome sequencing
- Sample identification
- Sub typing isolates
- Antigen ID
- Matrix inhibitions
- Aseptic techniques
- Biosafety
- Rapid methods
- CIDT (culture independent diagnostic testing)
- Detection technologies
- Positive and neg controls
- Pathogen isolation
- Meta genomics
- Microbiological sampling
- Food compendiums
- Bad bug book
- Testing methods
- BAM
- MLG
- CDC's MMWR
- Confirmation methods
- AOAC OMA
- Method validation

Definition: Methods used to detect pathogens.

Level 4 Competency: Discuss validated methods used in detecting pathogens.

7. **Level 5 Competency:** Recognize the purpose of rapid detection technologies.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
5. The laboratory analyst understands the advantages of rapid detection technologies: a. Speed b. Less technical skill may be needed c. Run more analytes at the same time 6. The laboratory analyst understands the disadvantages of rapid detection technologies: a. May detect nonviable (not culturable) organisms b. May not be the complete protocol (confirmatory tests may be required) c. May involve costly instrumentation d. Consumables costly e. Maintenance	6. The laboratory analyst can assist with recommending emerging technologies.

8. **Level 5 Competency:** List the methods used for pathogen detection.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
9. The laboratory analyst can name methods used for pathogen detection: a. Selective media b. Biochemical tests c. ELISA d. Microscopy e. Molecular	1. The laboratory analyst can describe methods used for pathogen detection: a. Selective media b. Biochemical tests c. ELISA d. Microscopy e. Molecular
9. **Level 5 Competency:** Describe challenges in analytical testing.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
7. The laboratory analyst can give examples of challenges: a. Sampling b. Having a method and/or equipment in place for requested testing c. Resolution of testing (limits of detection)	5. The laboratory analyst can explain how to address challenges in analytical testing.
10. **Level 5 Competency:** Discuss the difference between screening and confirmatory methods.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
2. The laboratory analyst recognizes that a screening test may result in certain false positive rate. 3. The laboratory analyst recognizes that a confirmatory test is currently required to confirm viability. 4. The laboratory analyst recognizes that a screening test may not yield a viable culture for further testing (molecular subtyping, whole genome sequencing).	3. The laboratory analyst understands the limitations of screening and confirmatory methods.
11. **Level 5 Competency:** Discuss subtyping methods for outbreak detection.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
5. The laboratory analyst can recognize subtyping methods: a. Serology b. Molecular (Whole genome sequencing)	2. The laboratory analyst understands how the results are used in outbreak detection.

12. **Level 5 Competency:** Define how competitor organisms affect analysis.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst knows that competitor organisms can affect the growth of pathogens. 2. The laboratory analyst understands **that** selective media is used. 3. The laboratory analyst understands **that** specific growth conditions limit competitor organisms and encourage the growth of pathogens. (atmosphere, temperature, etc.)	1. The laboratory analyst can teach others about competitor organisms. 2. The laboratory analyst understands why selective media is used. 3. The laboratory analyst understands why specific growth conditions limit competitor organisms and encourage the growth of pathogens. (nutrients, atmosphere, temperature, etc.)

Pathogen Characteristics

BRAINSTORM

- Pathogenicity
- Packaging impacts
- Infective dose
- Most common pathogens
- Toxins
- Competitor organisms
- Gram positive
- Gram negative
- Enteric pathogens
- Viral vs bacterial pathogens
- Parasites
- Indicator organisms
- Vectors
- History of organisms
- Zoonotic
- Emerging pathogens
- Waterborne illness
- Antibiotic resistance
- CDC's top 5 bacteria:
- Noro, salmonella, C. Perfringens, Campy, Staph Aureus.
- Pathogens leading to hospitalization: C. Bot, listeria, E. Coli, Vibrio

Definition: The traits of microorganisms that may cause foodborne illness.

Level 4 Competency: Discuss foodborne pathogens.

4. **Level 5 Competency:** Describe foodborne pathogens.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
1. The laboratory analyst can identify pathogens associated with food. 2. The laboratory analyst can associate pathogens with various foods.	1. The laboratory analyst is aware of emerging pathogens. 2. The laboratory analyst can give examples of where common pathogens are found: a. Peanut butter – Salmonella b. Chicken salad – Listeria

5. **Level 5 Competency:** Describe the mode of infection for foodborne pathogens.

Based on Level 5 competency – Not an all-inclusive list

BEHAVIORAL ANCHORS Average	BEHAVIORAL ANCHORS Outstanding
2. The laboratory analyst can describe the route of infection: a. Fecal/oral route	1. The laboratory analyst can describe other routes of infection for pathogens.

6. **Level 5 Competency:** Recognize the importance of emerging foodborne pathogens.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst recognizes the potential for emerging foodborne pathogens: a. New organisms b. Organisms found in different types of foods c. New technologies	1. The laboratory analyst can explain how emerging pathogens can occur.

Food Pathogen Relationship		
BRAINSTORM • Route of infection • Infectious carrier • Food borne illness • Illness symptoms	• Env factors • Epidemiology • At risk population • Outbreak detection	• Infective dose • Food globalization • Modes of transmission • Low moisture food • pH
Definition: The link between foods and disease-causing organisms. **Level 4 Competency:** Describe the relationship between pathogens and food.		
2. **Level 5 Competency:** Explain how foods become contaminated.		
Based on Level 5 competency – Not an all-inclusive list		
BEHAVIORAL ANCHORS Average		**BEHAVIORAL ANCHORS Outstanding**
6. The laboratory analyst can describe how foods can become contaminated: a. Water b. Animal input c. Vectors d. Processing and post processing issues		3. The laboratory analyst can describe processes in place to prevent contamination of food.
3. **Level 5 Competency:** Describe food characteristics that affect bacterial growth.		
Based on Level 5 competency – Not an all-inclusive list		
BEHAVIORAL ANCHORS Average		**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can describe food characteristics that affect bacterial growth: a. Water activity b. pH c. Processing procedures (canning, heat treating, fermentation)		1. The laboratory analyst can describe how the characteristics affect bacterial growth.

4. **Level 5 Competency:** Recognize how epidemiology is used to detect outbreaks.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
4. The laboratory analyst understands the relationship between epidemiology and the laboratory.	1. The laboratory analyst understands that the relationship between epidemiology and the laboratory must be flexible. (things constantly change in response to ongoing investigation)
5. **Level 5 Competency:** Describe the symptoms caused by foodborne pathogens.	
Based on Level 5 competency – Not an all-inclusive list	
BEHAVIORAL ANCHORS Average	**BEHAVIORAL ANCHORS Outstanding**
1. The laboratory analyst can relate symptoms to the pathogen.	1. The laboratory analyst can describe at risk populations related to foodborne pathogens: a. Daycare b. Prisons c. Cruise ships d. Immunocompromised i. Elderly ii. Pregnant