

Laboratory Staffing

(ISO/IEC 17025: Section 5.2)

Learning Objectives

At the end of this section, you should be able to:

- IDENTIFY and DESCRIBE training course availability, and training requirements for OWM Laboratory Recognition and ENSURE that laboratory documentation is complete and up to date;
- REVIEW and CREATE sample on the job training (OJT) outlines as a part of orienting a new employee;
- SHARE best practices in OJT; and
- CONTRIBUTE insights for a working group outline related to metrologist hiring, probation, promotion, retention, and succession planning.

"Knowing what's right doesn't mean much unless you do what's right." — Theodore Roosevelt

Where are we going?

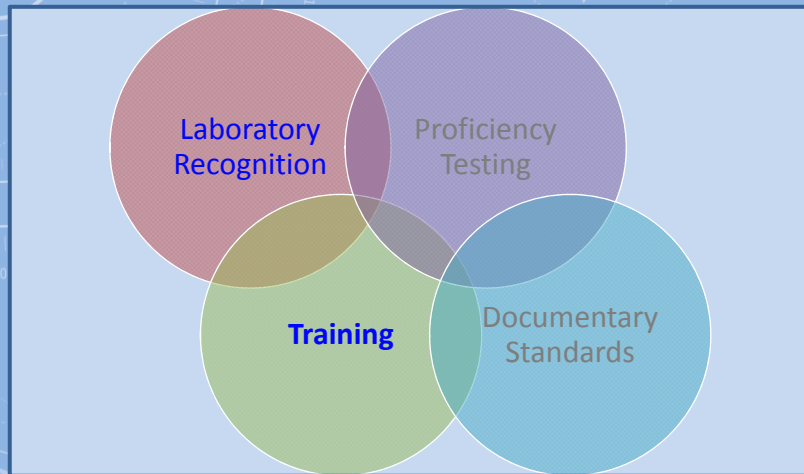
- OWM Training Requirements (for State W&M Laboratories)
 - Courses available to everyone....
- Laboratory Auditing Program (LAP) Problems
 - Fundamentals of Metrology
 - PT and Internal Audits
 - Advanced Mass Seminar Pre-work and Follow Up Measurements
 - Internal Audit + Measurements to support valid Uncertainties + PT
- Transferring learning to others
 - ADDIE Model
 - Learning Objectives
 - 4-step OJT process with practice
 - Documenting OJT



NIST Office of Weights and Measures Laboratory Metrology Program

Training Requirements for State W&M Labs
Training Availability and Insights for Other Labs

Laboratory Metrology Program Four Key Areas



Laboratory Metrology Program Areas

	Recognition	Training	Proficiency Testing	Documentary Standards
Reference(s)	HB 143, HB 150+ ISO/IEC 17025	NISTIRs 5672, 6969, 7383, (HB 145) ANSI/IACET	NISTIRs 7082, 7214 ISO/IEC 17043	NIST HB 105-1 through 105-8 ASTM USP
Processes	Annual Submissions and Reviews On site assessments	Applications (OWM Contact System) Pre-requisites Training Evaluation Training Needs Assessments	Planning Conducting Evaluating Reporting	ANSI* OWM published process
Measuring Results	Maps NVLAP Scoring Model Workload Survey	Course Evaluations LAP Problems (PTs and Technical Assessments) Follow up: Application and Impact	Passing Percentage by Parameter and Year	Level of adoption Time to update

Training Activities

- Updated Calibration Procedures and Training Aids
 - Length Session in 2014 at C-RMAP
 - Added Excel Tools, including Control Charts into each course and as Job Aids
- ANSI/IACET Accreditation (2013)
 - Quality Manual and Procedures
 - Course Evaluation Methods to Measure Impact
- Metrology Training Redesign
 - ADDIE and Adult Learning
 - Alignment of Learning Objectives, Activities, and Assessments



Area 2: Laboratory Training

Weeks	1	2	3	4	5	6
Old Course Structure						
NOTE! Old courses no longer available!!!		Basic Mass		Intm. Mass and Volume	Adv. Mass	
		Basic Metrology for States (Mass, Volume, Length)				
New Course Structure						
Math Pre-Test	Fundamentals of Metrology (2011)					with LAP Problems
	with LAP Problems	Mass (Basic and Intm.) (2012)		Webinar: SOP 18 Part I and II	Adv. Mass (2015)	
		Webinar: SOP 8 Part I and II		Volume (Basic and Intm.) (2013)		

Webinars

- **Webinars Scheduled Throughout the Year**
- Will be scheduled as requests are made....

Lab Metrology Webinar List	17025 Section (Basis of Need)
Document Control and Record Keeping	4.3. 4.13
Contract Review	4.4.
Supplier Evaluation	4.6.
Internal Auditing Best Practices	4.14. (and 4.10, 4.11, 4.12)
Conducting an Effective Management Review	4.15.
Calibration Method Validation	5.4.
Basic Uncertainty Concepts	5.4.6.
Documenting Traceability and Calibration Intervals	5.6.
Traceability Assessment for W&M	5.6.
Measurement Assurance Basics	5.9.
Measurement Assurance with PMAP	5.9
Advanced Measurement Assurance	5.9, SOP 30, 9, 17, 20
Proficiency Testing & Root Cause Analysis	5.9.
Calibration Report Evaluation	5.10.
PT Analysis	Mentoring or Data Review
Annual Submission Process *	Multi
Software Verification & Validation	Multi
Laboratory Admin Workshop	Multi
Customer Service	4.7, 4.8
Basic Mass, SOP 8, Webinar (SOP 8)	Technical (SOP 8, 29)
Basic Volume, SOP 18, Webinar (SOP 18)	Technical (SOP 18, 29)
Uncertainty Budget Tables for SOP 4	Technical (SOP 4, 29)
Uncertainty Budget Tables for SOP 8	Technical (SOP 8, 29)
Uncertainty Budget Tables for SOP 19	Technical (SOP 19, 29)
Uncertainty Budget Tables for SOP 14	Technical (SOP 14, 29)

Updated Training Requirements

- Handbook 143, Table 2 updated 2011, 2013, 2015
 - Circulated and Posted
- 2007 version still valid for current staff if they completed all requirements
- Anyone out of the lab (out of calibration function) needs refresher training!
- Considering: Laboratory Administration Seminar as a part of the Core Requirements (submit input)

Recognition Level	Training Required	For Whom	How Often
All Measurement Personnel	Regional Measurement Assurance Program (PMAP) Training	At least one staff member	Annually
Legal Metrology* Mass, Echelon III Volume, Echelon II	1. Fundamentals of Metrology (1 week course) 2. Introduction and Orientation to Mass and Volume Procedures* 3. Fundamentals of Metrology, Laboratory Auditing Program (LAP) problems 4. Successful completion of proficiency testing	Usually all staff, at least one staff member	Once Initially Refresher portions covered during Regional Measurement Assurance Program (PMAP) training
Mass Calibration Echelon III and II	1. All of the above, plus: 2. Mass Seminar (2 week course) 3. Successful completion of proficiency testing for each area on the laboratory Scope	Usually all staff, at least one staff member	Once Initially Refresher recommended every 10 years
Advanced Mass Calibration, Echelon I	1. All of the above, plus: 2. Advanced Mass Seminar (1 week course) 3. Advanced Laboratory Auditing Program (LAP) problems 4. Successful completion of proficiency testing using weighing design 5. Optional: Advanced Hands-On Mass Seminar (if available)	At least one staff member	Once Initially Refresher recommended every 10 years
Volume Calibration, Echelon I and II	1. Legal Metrology Requirements and Mass Calibration Requirements noted above 2. Volume Calibration Course (1 week) 3. Successful completion of proficiency testing for each area on the laboratory scope using gravimetric calibrations	Usually all staff, at least one staff member	Once Initially Refresher recommended every 10 years
All measurement personnel in addition to mass and volume	1. Documented evidence of training 2. Successful completion of proficiency testing in each area of the laboratory Scope	At least one, as needed	At least once; Refresher as needed

Activity

- Review Quality Manual and Administrative Procedures for “Training Requirements” for your laboratory.

Action Items

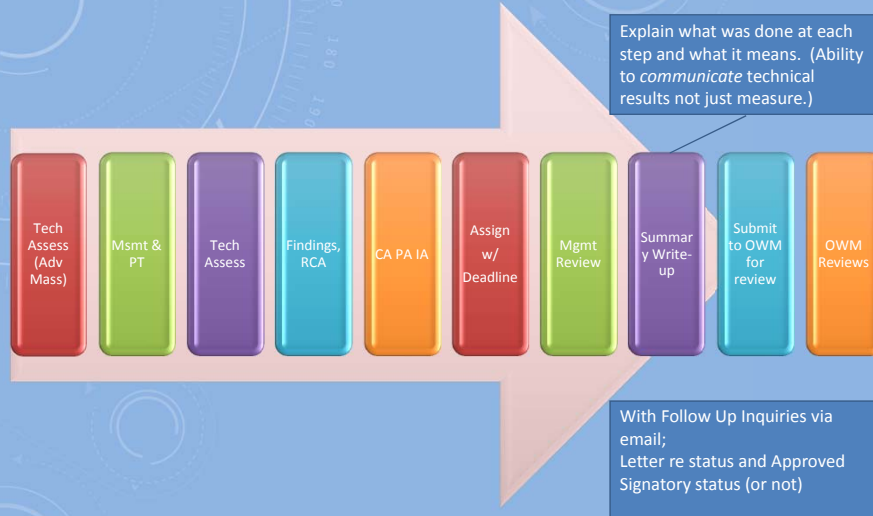
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- 2.
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- 6.
- 7.
- 8.
- 9.
- 10.



Laboratory Auditing Program (LAP) Problems

“Specialized Technical Auditing”
Fundamentals of Metrology
Advanced Mass Pre-work and LAP Problems

LAP Problems.....integrate into lab operations!



In vain have you acquired knowledge if you have not imparted it to others.

Deuteronomy Rabbah, (c.900, commentary on the Book of Deuteronomy)

In today's environment, hoarding knowledge ultimately erodes your power. If you know something very important, the way to get power is by actually sharing it.

*Joseph L. Badaracco, *1948, professor of Business ethics at Harvard Business School*

Effective On the Job Training Desire + Knowledge +Tools

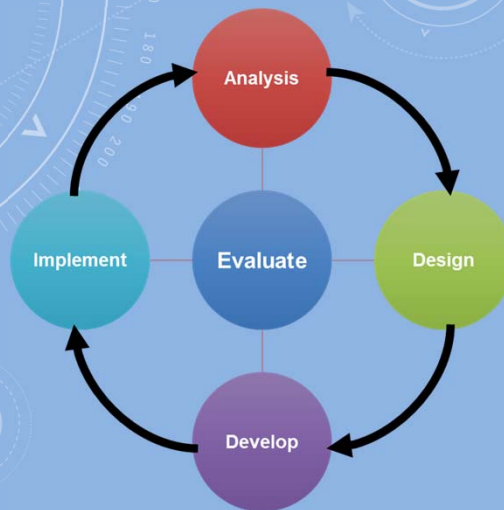
Share your knowledge. It's a way to achieve immortality.

Dalai Lama (1357-1419, high lama of Tibetan Buddhism)

Often, we are too slow to recognize how much and in what ways we can assist each other through sharing expertise and knowledge.

*Owen Arthur, *1949, Barbadian politician*

ADDIE Training Model



Analysis

- Needs Assessment & Perspectives
 - Metrologist
 - Lab Management
- Who is the audience?
- What is the overall expected outcome of the session (big picture)?
- Sources of Input
 - Prior courses
 - Evaluation forms
 - Surveys
 - Annual submissions
 - Inquiries
 - PT/ILC data
 - Instructor workshops
 - Standards
 - Requests

Design

- Write Learning Objectives – Bloom’s Taxonomy
- Evaluate and Select “Best” Delivery (Teaching Methods) and Techniques (Activities)
 - Lecture
 - Hands-on/Laboratory
 - Computer based (CD, DVD, Internet)
 - Casts: podcast, webcast, video cast, VHS
 - Style:
 - 4-step Model (we will cover)
 - Read, Demo, Do, Evaluate, Share
 - Collaborative (Team)
 - Investigative (Assign Problem)
 - Self Study
 - Mentoring, Guided
- Evaluate – what is “best” approach to meet objectives? (Assessment)

Learning Objectives

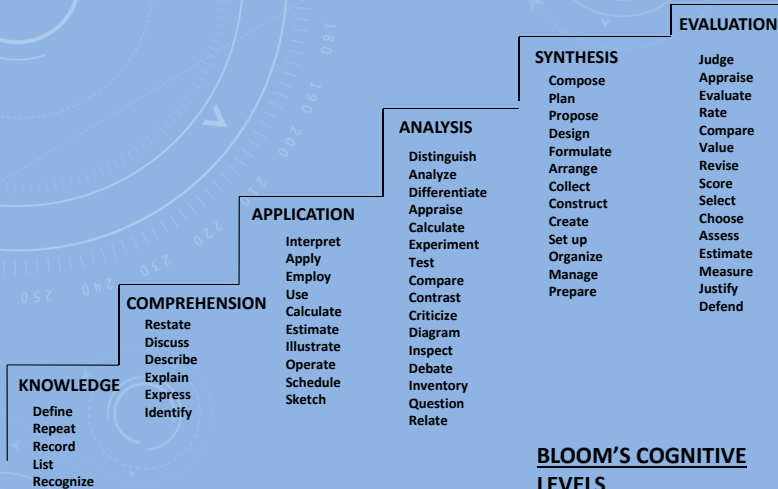
Definition: *A statement in specific and measurable terms that describes what the learner will know or be able to do as a result of engaging in a learning activity.*

1. Must be learner centered
2. Select a _____ for performing the task (action).
Determine if the *verb* you have chosen best describes the type of behavior that the learners need to display after training (see [Bloom's Taxonomy](#)).
3. Under what conditions (resources) must the task be performed?
4. Determine to what standards (quality) the task must be performed.

• **Example:**

- Using the presented procedure, you will accurately list at least three characteristics that are required in the uncertainty analysis and reporting process.

Learning Objectives: Related to performance, observable



VERBS.....

Avoid generic “Know” and “Understand”

- **Know**
 - describe, identify, recall, arrange, define, duplicate, label, list, memorize, name, order, recognize, reproduce state.
- **Comprehend**
 - comprehend, give example, classify, describe, discuss, explain, express, identify, indicate, locate, recognize, report, restate, review, select, translate,
- **Apply**
 - apply, change, construct, compute, choose, demonstrate, dramatize, employ, illustrate, interpret, operate, practice, schedule, sketch, solve, use, write.
- **Analyze**
 - analyze, break down, relate, appraise, calculate, categorize, compare, contrast, criticize, differentiate, discriminate, distinguish, examine, experiment, question, make inferences, find evidence, test.
- **Synthesize**
 - summarize, arrange, combine, categorize, assemble, collect, compose, construct, create, design, develop, formulate, manage, organize, plan, prepare, propose, set up, write.
- **Evaluate**
 - appraise, interpret, argue, assess, attach, compare, defend, estimate, judge, predict, rate, core, select, support, value, evaluate, prove, deduct.

Notes

D

Develop

- Develop Materials
 - Instructor materials, outline, notes (e.g., outline and SOP)
 - Student handouts (SOP and work instructions)
 - Case studies and resources (e.g., demonstration and calibration)
 - Additional learning tools and aids (videos, CD ROM)
- Evaluate content – will it achieve objectives?
- Convert technical content – difficult? Easy?

I

Implement

- Course logistics – based on location
- Contracts
- Facility
- Equipment & standards – maintenance, updating, shipping
- Printing/duplicating materials – shipping if needed
- Present the training – instructor development (key KSAs)
 - Know the technical content (metrology)
 - Know and apply learning/teaching body of knowledge
 - Be able to develop objectives, select strategies
 - Be able to present and interact effectively
 - Teach to achieve the objectives
- Evaluate: which of these does NOT contribute to learning?

Evaluate

- Evaluate all steps in the ADDIE processes
- Evaluate learning at all stages
- Conduct Course Evaluation: Kirkpatrick & Phillips Models
 - Satisfaction
 - smile sheets
 - Learning
 - pre-test, post-test, self assessment
 - Application
 - Intention to apply, calibration report development in class, 45-day follow up, LAP problems, graded projects
 - Impact
 - applied on the job – measurement quality meets needs; improved PTs/ILCs
 - Return on Investment
 - costs, values, research

Writing Learning Objectives

Elements:

1. Learner centered
2. Verb (action)
3. Conditions (resources)
4. Standards (quality)



Activity – What will you or your staff know or do after this class?

- Class:
 - Internal Auditing Best Practices, Webinar
- Stated objectives:

During this webinar, using your notes and ISO/IEC 17025 or NIST HB 143, you will:

 - IDENTIFY internal auditing criteria (Section 4.14) in ISO/IEC 17025:2005 & NIST HB 143:2007;
 - IDENTIFY the steps of an audit cycle;
 - DESCRIBE the difference between a “desk audit,” “functional audit,” “technical audit,” and “management system audit”;
 - IDENTIFY template checklists and other tools that can be used to successfully document the audit process; and
 - APPLY best practices to CONDUCT an effective internal management system audit within your laboratory.

Notes

Activity – What do you want (your employee) to know or do?



- Example VERBS:
 - Read (the SOP)
 - Pour (water)
 - Demonstrate (for another staff or manager)
 - Evaluate (against tolerance)
 - Read (a meniscus)
 - Measure (temperature)
 - Measure (weight)
 - Calculate (volume)
 - Calculate (density)
 - Evaluate (ID)
 - Test (coefficient of cubical expansion)
 - Identify (material)
 - Assess design (vs specifications)

Notes

Activity – What do you want (your employee) to know or do?

At the end of this session, you will be able to:

Reminder:

1. Learner centered
2. Verb (action)
3. Conditions (resources)
4. Standards (quality)



Notes

Planning: Keep Alignment and Performance Expectations in Mind!

Objectives	Activities	Assessment

OJT Worksheets (and resource job aids)

- Skill Assessment – **think** through the task
- 4-Step Process for OJT
- OJT Planning and Documentation – document the plan, document the observations
- More information: NCSLI Recommended Practice 17

Ensuring Objective Evidence!

Documenting: Laboratory Training Plan Log

LAB TRAINING LOG								
Staff Member:	JONES							
Position:	Metrologist							
Hire Date:	2005-Jun-25							
Training Topic	Training Date		Training Provider	Hours	Successful Completion	Training Supervisor		
	From	To				Initial	Date	
Metrology Lab Introduction Training	-	2005-Nov-15	SMITH	2	y	SMITH	2005-Nov-15	
Introduction to NIST Handbook 145 & NISTIR 6969	-	2005-Nov-15	SMITH	2	y	SMITH	2005-Nov-15	
SOP 18	-	2005-Nov-15	SMITH	2	y	SMITH	2005-Nov-15	
SOP 4	2006-Jan-03	2006-Jan-05	SMITH	5	y	SMITH	2006-Jan-06	
SOP 5 basic	-	2006-Feb-28	SMITH	1.5	y	SMITH	2006-Feb-28	
Basic Mass, Length, Volume Seminar	2006-Mar-27	2006-Apr-07	NIST	80	y	SMITH / certificate	2006-Apr-10	
Basic LAP Problems		2007-Jan-01	SELF STUDY		y	SMITH / NIST	2007-Jan-01	
Intermediate Seminar	2006-Dec-11	2006-Dec-15	NIST	40	y	SMITH / certificate	2006-Dec-20	
Intermediate LAP Problems		2007-Feb-26	SELF STUDY	120	y	SMITH / NIST	2007-Mar-10	
PLAN								
Advanced Mass Seminar	2014	2014	NIST	40	TBD			
Advanced LAP Problems	2015	2015	SELF STUDY		TBD			

Activity – Sharing Best Practices

Notes

Laboratory Staffing Working Group

Recommendations for Laboratory Metrology Personnel Requirements

Lifecycle Activities

- Outreach: K to 12, University
- Job Descriptions: OPM and SOC
- Hiring: posting and sharing
- Interviews (assessments)
- Training
- Retention (Compensation, Benefits, Culture)
- Retirement

Biggest Challenges???



Notes

REVIEW: Learning Objectives

- NOW, you should be able to:
- IDENTIFY and DESCRIBE training course availability, and training requirements for OWM Laboratory Recognition and ENSURE that laboratory documentation is complete and up to date;
- REVIEW and CREATE sample on the job training (OJT) outlines as a part of orienting a new employee;
- SHARE (**IDENTIFY**) best practices in OJT; and
- CONTRIBUTED insights for a working group outline related to metrologist hiring, probation, promotion, retention, and succession planning.

Reflection: Concepts and Applications

- Make a note about a key **concept** or idea you have learned that you can share with someone after this class.
- Identify one gap or weakness in your laboratory or identify one tool you can use to make improvements. Write it down on your **application** notes.

