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NEED-TO-KNOW CRITERIA

Water Laboratory Analyst

A Need-to-Know Guide when preparing for the:

ABC Water Laboratory Analyst Certification Exam

WPI WATER PROFESSIONALS INTERNATIONAL
The Associated Boards of Certification

Superior Water Starts Here™

Before You Dive In…

What is the *Need-to-Know Criteria?*

This **ABC Water Laboratory Analyst** Need-to-Know Criteria was developed to assist analysts in understanding the content that will be covered in the ABC Water Laboratory Analyst exam. A methodical and comprehensive international investigation was conducted to determine the most significant job tasks performed by water laboratory analysts. The content covered on the exam represents the job tasks identified through this research as essential analyst competencies, and is not limited to the practices of your system/facility. The following pages organize these job tasks into Core Competency Job Areas, and identify how much of the test is devoted to each area.

Is this *Need-to-Know Criteria* relevant to MY exam?

WPI offers a variety of standardized and customized exam services. This document is reflective only of the ABC Water Laboratory Analyst exam; older editions of the standardized exam and various customized exams are also administered by various certification programs. Please contact your certifying authority to determine whether they have implemented this exam for your program.

Exam Preparation Resources

Visit **gowpi.org** to access the formula/conversion table administered with this exam, a list of approved references, information on purchasing study guides available from partner organizations, and more.

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ABC Water Laboratory Analyst

Introduction

As part of the development of its certification exams, Water Professionals International (WPI) conducted a job analysis of water laboratory analysts during 2001 and 2002. The purpose of the job analysis was to identify the essential job tasks performed by water laboratory analysts and the capabilities required to competently perform these job tasks. The results of this job analysis provided WPI with the foundation for the development of new water laboratory analyst certification exams.

The **ABC Water Laboratory Analyst** *Need-to-Know Criteria* was developed from the results of WPI's water laboratory analyst job analysis. The information in this document reflects the essential job tasks performed by analysts and their requisite capabilities. This document is intended to be used by certification programs and trainers to help prepare analysts for certification.

How the Job Analysis Was Conducted

Subject Matter Expert Committee

A Subject Matter Expert (SME) Committee provided technical assistance in the development of the job analysis. This committee developed the list of the important job tasks performed by water laboratory analysts. The committee verified the technical accuracy, clarity, and comprehensiveness of the job tasks. The SMEs then identified the capabilities (i.e., knowledge, skills, and abilities) required to perform the identified job tasks. Identification of capabilities was done on a task-by-task basis, so that a link was established between each task statement and requisite capability.

Task Inventory

A task survey was developed from the data collected by the committee. The survey included 8-point rating scales for frequency of performance and seriousness of inadequate or incorrect performance. These two rating scales were used because they provide useful information (i.e., how critical each task is and how frequently each task is performed) pertaining to certification.

The task inventory also included a background information section where demographic data such as gender, age, ethnic origin, educational level attained, work experience, and certification level were collected. Space was provided at the end of the survey for analysts to list any important tasks performed on their job which were not included on the survey, and to make general comments.

The task inventory was sent to 299 water laboratory analysts throughout the United States. 153 out of the 299 inventories mailed were returned for a response rate of 51%. Class levels were created based on lab tests run as follows:

Class I: Non-supervisors running the following lab tests: pH, Chlorine residual, Temperature, TS/Dissolved solids, Hardness, Alkalinity, Turbidity, and Fluoride.

Class II: Non-supervisors running the following lab tests: all Class I tests plus Nitrogen, Phosphorus, Coliform, Heterotrophic plate count, Chloride, and Sulfate.

Class III: Non-supervisors running the following lab tests: all Class I and II tests plus Metals, Inorganics, Organics, and Microbiology of algae and water organisms.

Class IV: Supervisors running any of the tests listed above in Class I through III.

Results

The mean, standard deviation, and the percentage of respondents performing each task statement at each class level were computed. The mean was used to determine the importance of items and the standard deviation was used to identify items with a wide variation in responses. The percentage of respondents performing each task statement was used to identify tasks and capabilities commonly performed by analysts throughout the United States and Canada.

A criticality value of 2 (mean seriousness rating) + mean frequency rating was calculated for each item on the inventory. This formula gives extra weight to the seriousness rating in determining critical items and was appropriate because it emphasized the purpose of certification—to provide competent analysts.

CORE COMPETENCY JOB AREAS

The SME committee reviewed the results of the analyst survey to identify the most important and commonly performed job tasks and capabilities for water laboratory analysts. The essential tasks and capabilities that were identified through this process are called the core competencies.

The following pages list the core competencies for water laboratory analysts. The core competencies are clustered into the following job duties:


Collect and Preserve Samples


Prepare Samples for Analysis


Analyze Samples and Interpret Results


Operate and Maintain Equipment and Instruments


Handle Chemicals and Wastes


Quality Assurance/Quality Control


Manage Laboratory


Laboratory Safety

Water Laboratory Analyst Certification *Need-to-Know Criteria*

ABC Water Laboratory Analyst Certification Exam

The ABC water laboratory analyst certification exams evaluate an analyst's knowledge of tasks related to the operation of water laboratories. Each exam is based on the core competencies listed in this Need-to-Know Criteria. To successfully pass a WPI exam, an analyst must demonstrate knowledge of the core competencies in this document.

Four levels of certification exams are offered by WPI, with Class I being the lowest level and Class IV the highest level. Each exam consists of 100 multiple-choice questions. Each exam's specifications are based on a weighting of the job analysis results so that they reflect the criticality of tasks performed on the job. The specifications list the percentage of questions on the exam that fall under each job duty. For example, the ABC Class I Water Laboratory Analyst exam consists of 17 questions relating to the job duty "Collect and Preserve Samples" and its associated tasks and capabilities. The list of core competencies for each job area is on the following pages.

EXAM SPECIFICATIONS

CORE COMPETENCY JOB AREA	CLASS I	CLASS II	CLASS III	CLASS IV
COLLECT AND PRESERVE SAMPLES	17%	12%	5%	5%
PREPARE SAMPLES FOR ANALYSIS	12%	19%	14%	5%
ANALYZE SAMPLES AND INTERPRET RESULTS	24%	19%	21%	7%
OPERATE AND MAINTAIN EQUIPMENT/INSTRUMENTS	14%	11%	14%	7%
HANDLE CHEMICALS AND WASTES	5%	8%	8%	5%
QUALITY ASSURANCE/QUALITY CONTROL	9%	9%	15%	18%
MANAGE LABORATORY	5%	8%	9%	34%
LABORATORY SAFETY	9%	9%	9%	14%
GENERAL SCIENCE	5%	5%	5%	5%

Collect and Preserve Samples

	Class I	Class II	Class III	Class IV
Alkalinity	X	X	X	X
Ammonia	X	X	X	X
Chloride	X	X	X	X
Disinfectant residual	X	X	X	X
Coliform	X	X	X	X
Conductivity	X	X	X	X
Cyanide			X	X
Fluoride	X	X	X	X
Hardness	X	X	X	X
Heterotrophic plate count	X	X	X	X
Jar test	X	X	X	X
Metals			X	X
Microbiology of algae and water organisms		X	X	X
Multiple tube for MPN	X	X	X	X
Nitrate/Nitrite	X	X	X	X
Organics		X	X	X
pH	X	X	X	X
Phosphorus	X	X	X	X
Polychlorinated biphenyls (PCBs)		X	X	X
Solids	X	X	X	X
Sulfate	X	X	X	X
Temperature	X	X	X	X
Turbidity	X	X	X	X

REQUIRED CAPABILITIES:

Ability to determine appropriate sample location

Be familiar with chain of custody procedures

Be familiar with holding times, preservatives, and storage conditions

Be familiar with permit requirements

Be familiar with Personal Protective Equipment

Be familiar with safety procedures for sample collection and preservation

Be familiar with sample identification and labeling procedures

Be familiar with the sterilization process

Knowledge of biology and chemistry

Knowledge of contamination sources

Knowledge of duplicates and splits

Knowledge of sample types

Knowledge of sampler setup

Knowledge of sampling techniques and equipment

Prepare Samples for Analysis

	Class I	Class II	Class III	Class IV
Digestion		x	x	x
Dilution	x	x	x	x
Distillation		x	x	x
Extraction			x	x
Filtration	x	x	x	x
Laboratory pure water	x	x	x	x
Matrix modifiers			x	x
Media preparation	x	x	x	x
Mixing	x	x	x	x
pH adjustment	x	x	x	x
Reagent addition and preparation	x	x	x	x
Sample concentration	x	x	x	x
Temperature adjustment	x	x	x	x

REQUIRED CAPABILITIES:

Ability to identify common laboratory apparatus and glassware

Ability to maintain and operate equipment/instruments

Ability to perform calculations

Ability to prepare reagents

Ability to store and handle chemicals

Ability to weigh/measure accurately

Be familiar with dilution techniques

Be familiar with documentation requirements

Be familiar with laboratory pure water standards

Be familiar with Safety Data Sheets (SDSs)

Be familiar with Personal Protective Equipment

Be familiar with quality control/quality assurance practices

Be familiar with safety procedures

Knowledge of apparatus preparation

Knowledge of contamination sources

Knowledge of holding times

Knowledge of interferences

Knowledge of method limitations

Knowledge of reagent purity

Knowledge of sample preparation techniques

Knowledge of laboratory pure water classification (types I, II, III)

Analyze Samples and Interpret Results

	Class I	Class II	Class III	Class IV
Alkalinity	X	X	X	X
Ammonia		X	X	X
Chloride	X		X	X
Disinfectant residual	X	X	X	X
Coliform	X	X	X	X
Conductivity	X	X	X	X
Cyanide			X	X
Fluoride	X	X	X	X
Hardness	X	X	X	X
Heterotrophic plate count	X	X	X	X
Jar tests	X	X	X	X
Metals			X	X
Microbiology of algae and water organisms		X	X	X
Multiple tube for MPN		X	X	X
Nitrate/Nitrite	X	X	X	X
Organics			X	X
pH	X	X	X	X
Phosphorus		X	X	X
Polychlorinated biphenyls (PCBs)				X
Solids	X	X	X	X
Sulfate		X	X	X
Temperature	X	X	X	X
Turbidity	X	X	X	X
Tasks performed	**Class I**	**Class II**	**Class III**	**Class IV**
Calibrate and check instruments	X	X	X	X
Flow and loading calculations	X	X	X	X
Optimize equipment and instruments	X	X	X	X
Perform titrations	X	X	X	X
Prepare standards	X	X	X	X
Prepare standard curve	X	X	X	X
Reduce data and perform calculations	X	X	X	X
Record results	X	X	X	X
Review data	X	X	X	X
Interpret results	X	X	X	X

REQUIRED CAPABILITIES:

Ability to calibrate instruments

Ability to determine appropriate sample volume

Ability to evaluate and interpret data

Ability to follow written procedures

Ability to recognize abnormal analytical results and determine appropriate corrective action

Ability to select proper test method

Ability to summarize results of analysis

Ability to use aseptic techniques

Be familiar with common acid and alkali solutions

Be familiar with normal characteristics of water

Be familiar with quality control/quality assurance practices

Be familiar with reporting requirements

Knowledge of additive volumes

Knowledge of analytical procedures

Knowledge of basic math and statistics

Knowledge of biology and chemistry

Knowledge of interferences

Knowledge of method limitations

Operate and Maintain Equipment/Instruments

Operate equipment:	Class I	Class II	Class III	Class IV
Amperometric titrator	X	X	X	X
Apparatus and glassware	X	X	X	X
Atomic absorption spectrophotometer (flame and furnace)			X	X
Autoanalyzer (mercury, cyanide)			X	X
Autoclave	X	X	X	X
Balances	X	X	X	X
Cold vapor atomic absorption spectrophotometer			X	X
Computer	X	X	X	X
Continuous flow analyzer	X	X	X	X
Desiccators	X	X	X	X
Digestion apparatus		X	X	X
Distillation apparatus	X	X	X	X
Gas chromatograph (GC) and GC/MS			X	X
ICP/ and ICP/MS			X	X
Incubator	X	X	X	X
Ion specific electrodes (ammonia)	X	X	X	X
Microscope	X	X	X	X
Oven and muffle furnace	X	X	X	X
pH and conductivity meters	X	X	X	X
Turbidimeter	X	X	X	X
UV/Vis spectrophotometer/color	X	X	X	X
Water purification equipment	X	X	X	X
Maintain equipment and instruments:	**Class I**	**Class II**	**Class III**	**Class IV**
Calibrate equipment/instruments	X	X	X	X
Clean equipment/instruments	X	X	X	X
Retain maintenance contracts		X	X	X
Store equipment/instruments	X	X	X	X
Troubleshoot equipment/instruments	X	X	X	X
Retain maintenance logs	X	X	X	X

REQUIRED CAPABILITIES:

Ability to determine appropriate corrective action

Ability to follow written procedures

Ability to identify common laboratory apparatus and glassware

Ability to interpret manuals

Be familiar with EPA approved procedures

Be familiar with labware cleaning procedures

Be familiar with proper installation procedures

Be familiar with recordkeeping requirements

Knowledge of basic math

Knowledge of biology and chemistry

Knowledge of computers

Knowledge of electronic equipment

Knowledge of instrumental techniques

Handle Chemicals and Wastes

Dispose of laboratory wastes:	Class I	Class II	Class III	Class IV
Biohazard	x	x	x	x
Expired and excess reagents	x	x	x	x
Glassware	x	x	x	x
Waste minimization and pollution prevention	x	x	x	x
Store and handle containers:	**Class I**	**Class II**	**Class III**	**Class IV**
Label containers	x	x	x	x
Maintain inventory	x	x	x	x
Maintain security	x	x	x	x
Maintain current Safety Data Sheets (SDSs)	x	x	x	x
Segregate chemicals	x	x	x	x

REQUIRED CAPABILITIES:

Ability to store and handle chemicals safely

Be familiar with labeling requirements

Be familiar with Safety Data Sheets (SDSs)

Be familiar with Personal Protective Equipment

Be familiar with regulations

Be familiar with waste storage requirements

Knowledge of chemical compatibility, storage limitations and expiration dates

Knowledge of chemical hygiene plan

Knowledge of chemical spill cleanup procedures and hazard management plan

Knowledge of holding times

Knowledge of pollution prevention methods

Knowledge of safety procedures

Knowledge of pathogens

Quality Assurance/Quality Control

	Class I	Class II	Class III	Class IV
Conduct internal audits				X
Develop, maintain, and interpret control charts	X	X	X	X
Establish method detection/reporting limits		X	X	X
Establish quality assurance plans		X	X	X
Maintain method detection/reporting limits	X	X	X	X
Maintain training records				X
Perform corrective actions	X	X	X	X
Conduct proficiency tests	X	X	X	X
Validate data	X	X	X	X

REQUIRED CAPABILITIES:

Ability to determine appropriate corrective action

Be familiar with approved analytical methods

Be familiar with permit and recordkeeping requirements

Be familiar with regulations

Knowledge of auditing procedures

Knowledge of basic statistics

Knowledge of chemistry

Knowledge of computer spreadsheets and databases

Manage Laboratory

	Class I	Class II	Class III	Class IV
Administer security, safety, and compliance program	X	X	X	X
Develop and maintain standard operating procedures		X	X	X
Ensure staff is trained		X	X	X
Maintain analyst certification	X	X	X	X
Maintain laboratory certification				X
Maintain records	X	X	X	X
Maintain regulatory compliance/ethics	X	X	X	X
Order supplies		X	X	X
Organize and plan work activities	X	X	X	X
Promote public relations				X
Respond to complaints				X
Supervise operation of laboratory				X
Write reports (e.g., federal, state, internal)	X	X	X	X
Establish recordkeeping system:	**Class I**	**Class II**	**Class III**	**Class IV**
Analytical				X
Documentation				X
Maintenance				X
Personnel				X
Record information:	**Class I**	**Class II**	**Class III**	**Class IV**
Analytical	X	X	X	X
Documentation	X	X	X	X
Financial				X
Maintenance	X	X	X	X
Personnel				X

REQUIRED CAPABILITIES:

Ability to accurately transcribe data

Ability to determine what information needs to be recorded

Ability to evaluate laboratory performance

Ability to evaluate and interpret data

Ability to generate plans

Ability to summarize results of analysis

Be familiar with documentation requirements

Be familiar with permit requirements

Be familiar with regulations

Be familiar with reporting requirements

Knowledge of approved analytical methods

Knowledge of basic math

Knowledge of computer spreadsheets and databases

Knowledge of customer service principles

Knowledge of principles of communication

Knowledge of principles of management

Knowledge of principles of project management

Knowledge of principles of public relations

Knowledge of recordkeeping policies

Knowledge of water treatment processes

Laboratory Safety

Establish safety programs for:	Class I	Class II	Class III	Class IV
Burns		x	x	x
Chemicals	x	x	x	x
Compressed gases				x
Confined space				x
Electrical shock				x
Fire				x
General safety and health	x	x	x	x
Housekeeping	x	x	x	x
Infectious materials		x	x	x
Personal hygiene	x	x	x	x
Personal Protective Equipment	x	x	x	x
Showers and eyewash stations	x	x	x	x
Spill response and cleanup		x	x	x
Toxic fumes				x
Perform safety procedures for:	**Class I**	**Class II**	**Class III**	**Class IV**
Burns	x	x	x	x
Chemicals	x	x	x	x
Compressed gases	x	x	x	x
Confined space	x	x	x	x
Electrical shock	x	x	x	x
Fire	x	x	x	x
General safety and health	x	x	x	x
Housekeeping	x	x	x	x
Infectious materials	x	x	x	x
Personal hygiene	x	x	x	x
Personal Protective Equipment	x	x	x	x
Showers and eyewash stations	x	x	x	x
Spill response and cleanup	x	x	x	x
Toxic fumes	x	x	x	x

REQUIRED CAPABILITIES:

Ability to communicate verbally and in writing

Ability to operate equipment

Ability to recognize unsafe work conditions

Ability to select safety equipment

Be familiar with Safety Data Sheets (SDSs)

Be familiar with Personal Protective Equipment

Be familiar with regulations

Knowledge of chemical hygiene plan

Knowledge of compressed gas cylinder handling hazards

Knowledge of confined space characteristics

Knowledge of fume hood operation

Knowledge of safety procedures and emergency plan

References

The following are approved as reference sources for the ABC Water Laboratory Analyst examinations. Analysts should use the latest edition of these reference sources to prepare for the exam.

California State University, Sacramento (CSUS) Foundation, Office of Water Programs

- *Water Treatment Plant Operation, Volume I and Volume II*
- *Utility Management*
- *Manage for Success*

To order, contact: Office of Water Programs
California State University, Sacramento
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Sacramento, CA 95819-6025
Website: www.owp.csus.edu
Phone: (916) 278-6142
Fax: (916) 278-5959
E-mail: wateroffice@csus.edu

Maria Csuros and Csaba Csuros

- *Environmental Sampling and Analysis for Metals*
- *Environmental Sampling and Analysis for Technicians*
- *Environmental Sampling and Analysis Lab Manual*
- *Microbiological Examination of Water and Wastewater*

Available at: www.routledge.com

United States Environmental Protection Agency

- *Handbook for Analytical Quality Control in Water and Wastewater Laboratories*
- *Methods for Chemical Analysis of Water and Wastes*

Available at: www.epa.gov

Water Environment Federation

- *Standard Methods for the Examination of Water and Wastewater*
- *Water and Wastewater Laboratory Techniques*

To order, contact: Water Environment Federation
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Alexandria, VA 22314-1994
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References

- Code of Federal Regulations, Title 29 (Labor), Part 1910, Occupational Safety and Health Standards
  Available at: www.osha.gov; click on Standards
- Code of Federal Regulations, Title 40 (Protection of Environment), Chapter I, Parts 136, 261, 433, 501, and 503
  Available at: www.govinfo.gov/app/collection/cfr

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