



5
Modules

Certificate Program

WATER TREATMENT TECHNOLOGY

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STUDY AT YOUR PACE
ON YOUR SCHEDULE

Certificate in Water Treatment Technology

Earn your certificate in Water Treatment Technology through American Water College in partnership with California State University, Fresno. This is a one-year online certificate program. Students complete the program by watching online lectures, reading assigned texts, and submitting assignments online.



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Demonstrate Your
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AMERICAN WATER COLLEGE

(661) 874-1655

AmericanWaterCollege.org

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Water Treatment Technology

The Water Treatment Technology Certificate Program includes five modules. All modules are self-paced, online courses. Students will receive a certificate upon completing each module as well as an overall certificate after completing all five modules. The topics of the five modules are outlined below.

Water Sources

(2.1 CEUs)

- Water Supply Hydrology
- Groundwater Sources
- Surface Water Sources
- Emergency and Alternative Water Sources
- Use and Conservation of Water
- Water Quality
- Water Source Protection

Introduction to Water Treatment

(4.3 CEUs)

- Water Treatment Processes
- Treatment of Water at the Source
- Preliminary Treatment
- Water Coagulation and Flocculation
- Sedimentation Basins and Clarifiers
- Filtration
- Disinfection
- Fluoridation

Advanced Water Treatment

(4.3 CEUs)

- Control of Corrosion and Scaling
- Iron and Manganese Control
- Lime Softening
- Ion Exchange
- Adsorption
- Aeration
- Membrane Processes
- Water Treatment Plan Residuals
- Treatment Plant Instrumentation and Control

Water Treatment Math

(3.6 CEUs)

- Powers and Scientific Notation
- Dimensional Analysis
- Rounding and Estimating
- Solving for the Unknown Value
- Ratios and Proportions
- Averages
- Percentages
- Linear Measurements
- Area Measurements
- Volume Measurements

Applied Chemistry

(2.9 CEUs)

- Operator Chemistry Made Easy
- The Structure of Matter
- The Classification of Matter
- Valence, Chemical Formulas, and Chemical Equations
- Solutions
- Acids, Bases, and Salts
- Chemistry of Treatment Processes
- Chemical Dosage Problems

Water Sources

Course Overview

This course is designed to introduce students to the sources of water and the various threats to our water supply. Course material consists of reading assignments, video lectures, and lesson quizzes.

Course completion requires that the student successfully complete each component of each individual lesson. Students are not permitted to “challenge” the course quizzes to receive credit. Review questions and written assignments must be submitted either online or uploaded in a Word document for the professor’s review. Lesson quizzes have a minimum passing score of 70%.

Upon successful completion of the course requirements, students will receive a certificate of completion for the Water Sources course, which is applicable toward a Certificate in Water Treatment Technology from American Water College.

Water Sources(2.1 CEUs)

- Water Supply Hydrology
- Groundwater Sources
- Surface Water Sources
- Emergency and Alternative Water Sources
- Use and Conservation of Water
- Water Quality
- Water Source Protection

Required Texts

Textbook: Water Treatment Operator Training Handbook

Edition: Third Edition

Author: Nicholas Pizzi and William C. Lauer

ISBN: 978-1-58321-861-7

Educational Objectives

- To provide students with an overview of water use and conservation
- To provide students with a foundational knowledge of water sources
- To acquaint students with various source water threats
- To provide students with an overview of source water protection
- To provide students with an overview of water quality, water quality regulations and the public health concerns regarding water quality

Water Sources

Evaluation

Students will be graded on their performance on each lesson quiz, and their course participation. Unless each unit is completed, the student will not be permitted to advance to the next lesson, and the student will not be awarded credit for completion until all assignments, quizzes and lectures are completed. Please contact our office with any questions.

Support

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Water Sources

Lesson 1 – Water Supply Hydrology

Summary of This Lesson

Hydrology is the branch of science concerned with the properties of the earth's water, especially water movement in relation to land. This lesson explores the 12 processes in the hydrologic cycle, from evaporation and transpiration to snowmelt and subsurface flow.

In the context of water treatment, the study of hydrology is primarily concerned with factors that interrupt or affect the water supply and quality of water to be treated. This lesson explores a few of those adverse factors and their impact. Additionally, this lesson will introduce students to water volume and flow measurement terminology.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain and identify the different processes in the hydrologic cycle
- Identify and explain groundwater sources and groundwater movement
- Identify and explain surface water sources and the impact of the hydrologic cycle on surface water sources
- Identify and explain water volume and flow measurements

Assignments for This Lesson

- o Read Chapter 1, "Water Supply Hydrology," in [Water Sources](#)
- o Watch the video lecture for Lesson 1
- o Write a 1-page paper describing the hydrologic cycle. Include the major processes and what happens during each process. Upload to professor for review.
- o Complete the quiz for Lesson 1

Water Sources

Lesson 2 – Groundwater Sources

Summary of This Lesson

Wells are the most common and efficient means of tapping a groundwater source. This lesson takes an in-depth look at the different types of wells, well drilling, well maintenance, well development and aquifer recharge. Additionally, students are introduced to the contamination factors associated with wells, and means of preventing groundwater contamination.

Finally, this lesson introduces springs and infiltration galleries as means of tapping a groundwater source.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify the different types of water wells
- Correctly identify and explain well terminology
- Identify the different types of wells
- Explain well construction procedures and methods
- Explain different methods of well development
- Identify and explain sanitary considerations in well construction and use
- Evaluate aquifer performance
- Explain well operation, maintenance and abandonment
- Define and explain springs and infiltration galleries

Assignments for This Lesson

- o Read Chapter 2, “Groundwater Sources, in [Water Sources](#)
- o Watch the video lecture for Lesson 2
- o Write a 1-2 page paper describing the sequence of events required to drill and finish a new well. Include in your paper all of the major components of a well and their function. Upload to professor for review.
- o Complete the quiz for Lesson 2

Water Sources

Lesson 3 – Surface Water Sources

Summary of This Lesson

Surface water can be largely defined as water that is not under the ground; for the purposes of this lesson, surface water will describe water that is open to the atmosphere and subject to surface runoff. As a part of the hydrologic cycle, surface water makes up a significant source of treatable drinking water.

This lesson will explore the different sources, types and factors that influence surface water supply, as well as some methods of protecting surface water sources.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify surface water sources
- Explain surface runoff, and identify factors that influence surface runoff
- Explain surface source considerations
- Identify different methods of water storage
- Identify and explain intake structures and their purposes
- Identify and explain surface-supply operating problems and contamination concerns

Assignments for This Lesson

- o Read Chapter 3, “Surface Water Sources,” in [Water Sources](#)
- o Watch the video lecture for Lesson 3
- o Write a few paragraphs describing the types of intake structures. Include in your paper why there are different types of intake structures and the purpose they serve. Students are not required to submit this assignment.
- o Complete the quiz for Lesson 3

Water Sources

Lesson 4 – Emergency and Alternative Water Sources

Summary of This Lesson

When the public water supply is interrupted or contaminated, there is more at stake than just the inconvenience for the customers. There are potential health risks inherent in an interrupted supply, from microbiological to chemical contamination to the more obvious sanitary concerns.

Each utility should develop an emergency response plan in the event of anything from a water main break to direct contamination. We will also look at alternative sources of water utilities can and should tap if or when an emergency arises.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify causes of source disruption
- Identify causes of source contamination
- List and evaluate long and short-term solutions for disruption or contamination
- Identify and list alternative water sources
- List emergency water supply options
- Evaluate and explain water reuse options

Assignments for This Lesson

- o Read Chapter 4, “Emergency and Alternative Water Sources,” in *Water Sources*
- o Watch the video lecture for Lesson 4
- o Write a short paper describing the possible sources of source water contamination. Upload to professor for review.
- o Complete the quiz for Lesson 4

Water Sources

Lesson 5 – Use and Conservation of Water

Summary of This Lesson

Water is our most valuable, most plentiful and most vital resource. The availability of safe drinking water is often taken for granted, until there is a shortage or an emergency situation as we discussed in the previous lesson. It is important for both utilities and customers to be aware of their water usage, and to be educated on various ways to conserve water.

This lesson will take an in-depth look at the different categories of water use, conservation issues and methods, and water rights issues that may affect a municipality's water use or conservation.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- List the three categories of water use
- Explain water use in each category
- Explain water conservation methods
- Explain water conservation benefits
- Explain water conservation problems
- Identify and explain water rights issues

Assignments for This Lesson

- o Read Chapter 5, "Use and Conservation of Water," in *Water Sources*
- o Watch the video lecture for Lesson 5
- o Write a short paper describing steps a water utility can take to encourage the efficient use of water. Upload to professor for review.
- o Complete the quiz for Lesson 5

Water Sources

Lesson 6 – Water Quality

Summary of This Lesson

The public water supply must not only be reliable and continuous, the water must conform to state and federal standards for water quality. It is important for the public to have complete confidence in the quality of the water their utility supplies to their tap.

This lesson looks at the four different characteristics of water quality, the public health concerns and importance of water quality, and the major public drinking water regulations.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- List and explain the four categories of water quality characteristics
- Identify and explain the factors that influence source water quality
- Explain the public health significance of water quality
- List the major public water supply regulations

Assignments for This Lesson

- o Read Chapter 6, “Water Quality,” in Water Sources
- o Watch the video lecture for Lesson 6
- o Write a short paper describing the four broad categories of water quality characteristics and how they differ from each other. Give examples from each category. Upload to professor for review.
- o Complete the quiz for Lesson 6

Water Sources

Lesson 7 – Water Source Protection

Summary of This Lesson

There are myriad ways to protect a public drinking water supply, starting with protection at the source. There are natural threats and human threats; both groundwater and surface water sources are vulnerable to contamination.

This lesson will cover the different types of pollution, their effect, and different means of protecting groundwater and surface water sources from future pollution.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the fundamental principles of source water protection
- Explain methods and evaluation of surface water protection
- Explain methods and evaluation of groundwater protection

Assignments for This Lesson

- o Read Chapter 7, “Water Source Protection,” in *Water Sources*
- o Watch the video lecture for Lesson 7
- o Write a short paper discussing how the recreational use of lakes that are sources of drinking water can be accomplished. Upload to professor for review.
- o Complete the quiz for Lesson 7

Introduction to Water Treatment

Course Overview

This course is designed to provide a foundational look at Water Treatment processes and methods. Course material consists of reading assignments, video lectures, review questions, study problems and lesson quizzes.

Course completion requires that the student successfully complete each component of each individual lesson. Review questions and written assignments must be submitted either online or uploaded in a Word document for the professor's review. Lesson quizzes have a minimum passing score of 70%.

Upon successful completion of the course requirements, students will receive a certificate of completion for 4.3 CEUs (43 contact hours) for the Introduction to Water Treatment course, which is applicable toward a Certificate in Water Treatment Technology from American Water College.

Required Texts

Textbook: Water Treatment Operator Training Handbook

Edition: Third Edition

Author: Nicholas Pizzi and William C. Lauer

ISBN: 978-1-58321-861-7

Educational Objectives

- To provide students with an overview of water treatment processes
- To provide students with a foundational knowledge of treatment processes at different stages of water treatment
- To acquaint students with the different components of a water treatment plant and their function

Introduction to Water Treatment

Evaluation

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Introduction to Water Treatment

Lesson 1 – Water Treatment Processes

Summary of This Lesson

Most water sources, whether groundwater or surface water, contain contaminants of some kind. The water treatment process is designed to remove those contaminants, providing safe and palatable drinking water. This lesson will look at reasons for treatment, selecting methods of treatment, and water source considerations.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain why the public water supply must generally be treated
- Identify and explain the advantages and disadvantages of groundwater as a source for the public drinking water
- Identify and explain the advantages and disadvantages of surface water as a source for the public drinking water
- Identify the factors influencing the type of treatment that must be used by a public water system
- Identify potential problems in treatment byproduct disposal
- Identify the different types of point-of-use treatment units and explain their use

Assignments for This Lesson

- No reading assignment
- Watch the video lecture for Lesson 1
- Answer Review Questions
- Complete the quiz for Lesson 1

Introduction to Water Treatment

Lesson 2 – Treatment of Water at the Source

Summary of This Lesson

While most water treatment occurs at a treatment plant, there are some situations where it is economically prudent, or practical, or even necessary, to treat water before it enters the treatment plant. This lesson will look at different reasons for treating water at the source, various source water threats, and different methods of source treatment.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify the problems that can be caused by algae growth in a water source
- Identify the problems that can be caused by aquatic plants in a reservoir
- Explain the methods of controlling the growth of algae
- Explain why stratification occurs in reservoirs, and how it can be prevented

Assignments for This Lesson

- No reading assignment
- Watch the video lecture for Lesson 2
- Answer Review Questions
- Complete the quiz for lesson 2

Introduction to Water Treatment

Lesson 3 – Preliminary Treatment

Summary of This Lesson

Preliminary treatment, or Pretreatment, is used when the water source contains large debris (rocks, logs, branches, aquatic plants, leaves, etc.) or sand, gravel, and gritty substances. Failing to remove debris and grit may cause equipment damage or failure, clog pumps, and complicate the normal treatment process. Preliminary treatment is also used to remove massive amounts of sediment before entering the treatment plant, to alleviate the burden on the treatment plant's settling or sedimentation basins. Preliminary treatment can also reduce the amount of chemicals used in the treatment process. This lesson will focus primarily on screening, presedimentation and microstraining as methods for preliminary treatment.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify and explain the function and types of screens used on raw-water intakes
- Explain why presedimentation of surface water is often necessary
- Explain how presedimentation sand-and-grit removal devices work
- Explain what microstrainers are used for and how they separate

Assignments for This Lesson

- Chapter 4 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 3
- Answer Review Questions
- Complete the quiz for Lesson 3

Introduction to Water Treatment

Lesson 4 – Water Coagulation and Flocculation

Summary of This Lesson

Coagulation and Flocculation are the first two steps in conventional water treatment designed to remove turbidity and nonsettlable solids from water. Nonsettlable solids can be biological organisms, viruses, protozoans, color-causing particles and inorganic solids; not only are the visible nonsettlable solids aesthetically unacceptable, but the bacteria and organic matter can cause serious illness if not removed from the water.

This lesson will examine coagulation, the process of adding and rapid-mixing chemical coagulant agents into raw water, and flocculation, the process of slow-mixing chemicals into water to assist in particle buildup. After coagulation and flocculation, the floc is settled out in sedimentation basins, and then filtered to remove any remaining suspended matter, which we'll cover in the following two lessons.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain why coagulation and flocculation are necessary in treating most surface water
- Explain the purpose of coagulation and flocculation in the treatment process
- Explain how coagulants work, and the difference between coagulants and coagulant aids
- Identify the different types of equipment used to feed coagulant chemicals
- Explain the basic design principles of rapid-mix facilities
- Understand the regulations that have an impact on the design or operation of the coagulation and flocculation process
- Identify and explain the advantages or disadvantages of various chemicals for coagulation and flocculation, and how they should be selected
- Explain how to properly monitor the coagulation and flocculation process for optimal results
- List and explain safety precautions related to handling chemicals
- Explain how and why proper records of the coagulation and flocculation process should be kept

Introduction to Water Treatment

Assignments for This Lesson

- Chapter 5 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 4
- Answer Review Questions
- Complete the quiz for Lesson 4

Introduction to Water Treatment

Lesson 5 – Sedimentation Basins and Clarifiers

Summary of This Lesson

In the conventional water treatment process, sedimentation (also known as “clarification”) is between flocculation and filtration. Water flows slowly through the sedimentation basin or clarifier, allowing sand, grit, pollutants, floc, and other solids to settle out of the water, thus lessening the load on the filters. This lesson will cover types of sedimentation basins, the principles of settling and optimal settling conditions, and collecting sludge for removal.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify the different types of sedimentation basins
- Identify and explain the different zones and parts of sedimentation basins
- Explain the principles of tube and plate settlers
- Explain the methods of sludge removal
- Identify typical problems encountered in operating sedimentation basins
- List the methods for disposing of sedimentation basin sludge

Assignments for This Lesson

- Chapter 6 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 5
- Answer Review Questions
- Complete the quiz for Lesson 5

Introduction to Water Treatment

Lesson 6 – Filtration

Summary of This Lesson

After coagulation, flocculation, and sedimentation (or clarification), the water is filtered. Filtration is most important in surface water treatment, as groundwater is naturally filtered in most cases. Surface water runoff and contamination pose the more serious threat, which filtration is designed to combat.

This lesson will cover filtration methods and principles, filter media and filtration monitoring for optimal performance and government regulatory compliance.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify the types of commonly used filtration facilities
- Explain the principle of gravity filter operation
- Explain the differences between pressure filters and gravity filters
- Identify the types of media used in filters
- Identify the types of underdrain systems used in filters
- Identify the types of commonly used filter controls
- Explain the purpose of backwashing filters and how backwashing is performed
- Identify the methods of monitoring filter operation
- Identify the principle regulations governing filtration operations
- Identify common filter operating problems
- List the types of records that must be kept on filter operation

Assignments for This Lesson

- Read Chapter 7 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 6
- Answer Review Questions
- Complete the quiz for Lesson 6

Introduction to Water Treatment

Lesson 7 – Disinfection

Summary of This Lesson

Disinfection is the addition of chemicals to destroy or inactivate disease-causing organisms in water. Viruses, bacteria, fungi, or protozoa can cause symptoms ranging from mild illness to death. Disinfection is not sterilization, but disinfection does remove or inactivate organisms to acceptable levels.

This lesson examines the diseases and organisms that disinfection targets, the methods of disinfection (primarily chlorine or chlorine gas), regulations of disinfection by-products (DBPs), monitoring the disinfection process, and safety procedures for disinfection.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify the most commonly occurring waterborne diseases in the US
- Explain the methods of disinfecting drinking water
- Explain chlorination principles
- Identify the common points of disinfection application
- Identify the equipment for handling and feeding chlorine gas
- Identify the equipment and facilities used for hypo chlorination
- Identify the equipment used for other disinfection methods
- List state and federal regulations requiring the application of disinfectants to drinking water
- List state and federal regulations of disinfection by-products
- Explain the correct procedures for handling and connecting chlorine cylinders and containers
- Identify chlorine operation problems
- Explain chlorine control tests
- Identify and explain safety equipment and procedures for working with chlorine

Assignments for This Lesson

- Read Chapter 8 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 7
- Answer Review Questions
- Complete the quiz for Lesson

Introduction to Water Treatment

Lesson 8 – Fluoridation

Summary of This Lesson

Fluoride can often be found in most drinking water sources, either as a naturally-occurring ion, or after being added at a treatment plant to provide this essential element for bone and tooth development. Fluoridation is the process of deliberately adding fluoride to the public water supply.

This lesson covers the process and reasons for fluoridation, the regulations affecting fluoridation, monitoring, tests, and safety precautions.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- List the reasons for obtaining an optimum concentration of fluoride in drinking water
- Identify the long-term effects of excessive levels of fluoride in drinking water
- Identify the chemicals commonly used in fluoridating water
- Identify the equipment used for feeding fluoride to drinking water
- Identify the regulations requiring fluoridation of drinking water
- Explain how fluoride feed equipment is operated
- Identify and explain the operational control tests used when feeding fluoride
- Identify and explain safety precautions to observe in handling fluoride chemicals

Assignments for This Lesson

- Read Chapter 10 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 8
- Answer Review Questions
- Complete the quiz for Lesson 8

Advanced Water Treatment

Course Overview

This course is designed to provide an advanced overview of Water Treatment processes and methods. Course material consists of reading assignments, video lectures, review questions, study problems and lesson quizzes.

Course completion requires that the student successfully complete each component of each individual lesson. Review questions and written assignments must be submitted either online or uploaded in a Word document for the professor's review. Lesson quizzes have a minimum passing score of 70%.

Upon successful completion of the course requirements, students will receive a certificate of completion for 4.3 CEUs (43 contact hours) for the Advanced Water Treatment course, which is applicable toward a Certificate in Water Treatment Technology from American Water College.

Advanced Water Treatment (4.3 CEUs)

- Control of Corrosion and Scaling
- Iron and Manganese Control
- Lime Softening
- Ion Exchange
- Adsorption
- Aeration
- Membrane Processes
- Water Treatment Plant Residuals
- Treatment Plant Instrumentation and Control

Required Texts

Textbook: Water Treatment Operator Training Handbook

Edition: Third Edition

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Educational Objectives

- To provide students with an overview of water treatment processes
- To provide students with an advanced understanding of treatment processes at different stages of water treatment
- To acquaint students with the different components of a water treatment plant and their function



Advanced Water Treatment

Evaluation

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Advanced Water Treatment

Lesson 1 – Control of Corrosion and Scaling

Summary of This Lesson

Some water systems find it necessary to take steps to control corrosion and scaling, not only to comply with federal or state regulations, but to extend the life of plumbing equipment, improve water quality and protect the public health. If the source water for a treatment plant causes corrosion or deposits scale on the system pipes and plumbing fixtures, there is a potential for lead or copper and other trace metals entering the public water supply.

This lesson will provide an overview of the reasons and methods of stabilizing water, controlling corrosion and scaling, and the chemicals involved in corrosion control.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the reasons for stabilizing water
- Explain the basic chemistry of corrosion and scale formation
- List state and federal regulations requiring corrosion control
- Identify and explain the methods for controlling corrosion
- Identify and explain the chemicals and equipment used for corrosion control
- Identify factors to be considered in selecting an appropriate stabilization process
- Explain the operation of a stabilization process
- Identify the common problems encountered in operating stabilization processes

Assignments for This Lesson

- Read Chapter 10 - Specialized Treatment Processes pages 161 –162 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 1
- Answer Review Questions
- Complete the quiz for Lesson 1

Advanced Water Treatment

Lesson 2 – Iron and Manganese Control

Summary of This Lesson

Excessive iron or manganese can pose aesthetic, health, or operational problems in a public water system. It is important not only to understand how iron and manganese can enter the water supply, but also to be familiar with the risks and treatment processes that remove iron and manganese from drinking water.

This lesson will provide an overview of the problems caused by excessive iron and manganese, the methods of removing iron and manganese, and the monitoring and regulations that govern iron and manganese control

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify the problems caused by excessive iron and manganese in water
- Explain the methods used for iron and manganese removal
- Identify and explain the equipment and facilities used for iron and manganese control
- List the regulations that apply to iron and manganese in drinking water
- Explain the monitoring and operation of iron and manganese removal processes

Assignments for This Lesson

- Read Chapter 10 - Specialized Treatment Processes pages 150 –152 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 2
- Answer Review Questions
- Complete the quiz for Lesson 2

Advanced Water Treatment

Lesson 3 – Lime Softening

Summary of This Lesson

The two most commonly used water softening processes used in water treatment are lime softening, or the lime-soda ash process, and ion exchange. Ion exchange will be addressed in the next lesson, while this lesson focuses on the occurrence, chemistry, and effects of hard water and how lime softening addresses water hardness.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify the characteristics and effects of hard and soft water
- List the minerals causing water hardness
- Identify the various types of water hardness
- Identify and explain the equipment used for lime-soda ash softening
- Identify regulations that may affect the softening process
- Explain how softening chemicals are stored and fed
- Explain how softening facilities are operated
- Identify and explain tests used for operational control of the softening process
- Identify and explain special safety precautions for handling softening chemicals

Assignments for This Lesson

- Read Chapter 9 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 3
- Answer Review Questions
- Complete the quiz for Lesson 3

Advanced Water Treatment

Lesson 4 – Ion Exchange

Summary of This Lesson

Ion exchange is the most common method for treatment plants to remove unwanted ions, some of which cause water hardness.

This lesson will detail the ion exchange process and the developments made in this process. Additionally, we will look at the advantages and disadvantages of this process as a means of water treatment and softening.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify the chemicals that can be removed from water using ion exchange processes
- Identify and explain the advantages and disadvantages of ion exchange processes
- Explain the chemistry of ion exchange softening
- Identify and explain the facilities and equipment used for ion exchange softening
- Identify the problems encountered in disposing of wastes from the ion exchange process

Assignments for This Lesson

- Read Chapter 10 – Specialized Treatment Processes pages 162 –164 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 4
- Answer Review Questions
- Complete the quiz for Lesson 4

Advanced Water Treatment

Lesson 5 – Adsorption

Summary of This Lesson

Adsorption is the adhesion of atoms, ions, or molecules from a gas, liquid, or dissolved solid on the surface of a solid. In water treatment, adsorption is used primarily to remove organic substances in water that can cause problems from taste and odor complaints to serious health problems.

This lesson will provide an overview of the organic compounds that are objectionable and why, the regulations affecting adsorption and organic removal, the safety concerns when using carbon, and the operation and testing of adsorption processes.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the occurrence of organic chemicals of concern in groundwater and surface water
- Identify and explain the methods for removing organic chemicals of concern
- Explain the principles of adsorption
- Explain the methods of using powdered and granular activated carbon
- List federal and state regulations that may require the use of adsorption treatment
- Explain the operation and testing of adsorption processes
- Identify and explain special safety precautions that should be observed when using carbon

Assignments for This Lesson

- Read Chapter 10 – Chapter 10 – Specialized Treatment Processes page 148-150 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 5
- Answer Review Questions 1
- Complete the quiz for Lesson 5

Advanced Water Treatment

Lesson 6 – Aeration

Summary of This Lesson

Natural aeration occurs when streams or rivers tumble over rocks and the water flow becomes turbulent. The turbulence brings air and water into contact, and the air dissolves into the water.

In water treatment, aeration is used to remove volatile organics from water, reduce the concentration of taste and odor-causing chemicals, to remove carbon dioxide and remove radon gas. When aeration is used, it's usually the first part of the treatment process.

This lesson will look at the use and efficiency of aeration, and the problems associated with aeration as part of the treatment process.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain how aeration removes or modifies constituents in water
- Identify the troublesome constituents in water that are commonly removed by aeration
- Identify the types of aerators commonly used by public water systems
- Identify common problems associated with the operation of aeration equipment

Assignments for This Lesson

- Read Chapter 10 – Specialized Treatment Processes page 147 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 6
- Answer Review Questions
- Complete the quiz for Lesson 6

Advanced Water Treatment

Lesson 7 – Membrane Processes

Summary of This Lesson

Chemical dosing to remove contaminants can result in higher levels of DBPs in the water supply, which can cause problems of their own. Membrane processes are an alternative to utilizing disinfection solely in the treatment process.

This lesson introduces membrane processes, and the advantages and disadvantages of using membrane as part of the treatment process.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Identify and explain the types of membrane processes
- Identify and explain the principles of microfiltration and nanofiltration/reverse osmosis
- Identify the types of equipment used
- Explain the operation of a membrane system

Assignments for This Lesson

- Read Chapter 11 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 7
- Answer Review Questions
- Complete the quiz for Lesson 7

Advanced Water Treatment

Lesson 8 – Water Treatment Plant Residuals

Summary of This Lesson

It is important for water treatment plant residuals, such as sludge, to be handled and disposed of properly in order to ensure that operations continue smoothly, and that the treatment plant stays in compliance with the state and federal regulations for water quality. It is crucial to develop a residuals-handling program and maintain adherence to the residuals-handling protocol.

This lesson discusses the purpose of residual dewatering and disposal and the means to accomplish both, and how the residual-handling applies as part of the overall water treatment process.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the importance of residuals handling, dewatering, and disposal to the overall operation of a water treatment plant
- Explain how and why residuals are dewatered
- Explain methods of calculating sludge quantities
- Explain how sludges are removed from water treatment basins
- Explain how solids separation processes are applied to water treatment plant sludges

Assignments for This Lesson

- Read Chapter 6 – Sedimentation pages 79-85 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 8
- Answer Review Questions
- Complete the quiz for Lesson 8

Advanced Water Treatment

Lesson 9 – Treatment Plant Instrumentation and Control

Summary of This Lesson

It is important to be familiar with the different instrumentation and controls that are a part of a water treatment plant. These instruments and controls not only monitor flow, control processes with greater precision and improve the safety of the workplace, but they also track data and monitor the condition of equipment, which reduces the workload on operators.

This lesson explores the different types of instruments and their purpose in the water treatment process.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the purpose and principal methods used for measuring flow
- Identify and explain the methods of measuring pressure and level
- Explain the principles of equipment automation
- Identify and explain the potential of computers for providing records and operational control in water treatment systems

Assignments for This Lesson

- Read Chapter 13 in *Water Treatment Operator Training Handbook*
- Watch the video lecture for Lesson 9
- Answer Review Questions
- Complete the quiz for Lesson 9

Water Treatment Math

Course Overview

This course is designed to acquaint students with the math, formulas and calculations used in water treatment, storage, and distribution. Course material consists of reading assignments, video lectures, review questions, study problems and lesson quizzes.

Course completion requires that the student successfully complete each component of each individual lesson. Review questions and written assignments must be submitted either online or uploaded in a Word document for the professor's review. Lesson quizzes have a minimum passing score of 70%.

Upon successful completion of the course requirements, students will receive a certificate of completion for 3.6 CEUs (36 contact hours) for the Water Treatment Math course, which is applicable toward a Certificate in Water Treatment Technology from American Water College.

Water Treatment Math (3.6 CEUs)

- Powers and Scientific Notation
- Dimensional Analysis
- Rounding and Estimating
- Solving for the Unknown Value
- Ratios and Proportions
- Averages
- Percentages
- Linear Measurements
- Area Measurements
- Volume Measurements

Required Texts

Textbook: *Basic Science Concepts and Applications*, Principles and Practices of Water Supply Operations series

Edition: Fourth Edition

Author: Nicholas G. Pizzi

ISBN: 1-58321- 778-9

Water Treatment Math

Educational Objectives

- To provide a foundational understanding of powers and scientific notation
- To demonstrate dimensional analysis
- To provide students with an understanding of rounding, estimating, and solving for an unknown value
- To demonstrate ratios, proportions, averages, and percentages
- To provide students with an understand of linear measurements
- To provide a foundational understanding of area and volume measurement calculations
- To demonstrate conversions
- To demonstrate graphs and tables and their uses in water treatment
- To provide students with a foundational understanding of calculating per capita water use, domestic water use, and industrial water use
- To demonstrate calculating average daily flow, surface overflow and weir overflow rates
- To provide a foundational understanding of filter loading and filter backwash rates
- To demonstrate mudball calculation
- To demonstrate detention time calculations
- To demonstrate well problem calculations

Evaluation

Students will be graded on their performance on each lesson quiz, and their course participation. Unless each unit is completed, the student will not be permitted to advance to the next lesson, and the student will not be awarded credit for completion until all assignments, quizzes and lectures are completed. Please contact our office with any questions.

Support

Students can contact our student support staff with any course-related, content-related, or technology-related inquiries. Our office hours are Monday-Thursday, 9-5 CT, and Friday 9-12 CT.

Contact Info:

Phone Number: (661) 874-1655

Email Inquiries: Info@americanwatercollege.org

Additionally, students are encouraged to contact their professor directly with any questions or comments.

Water Treatment Math

Lesson 1 – Powers and Scientific Notation

Summary of This Lesson

In this lesson we will be covering two common methods of expressing numbers: powers and scientific notation.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to convert numbers and units from exponential form to whole numbers or expanded form
- How to change numbers and units from the expanded form into the exponential form
- How to take numbers out of positive and negative scientific notation
- How to put numbers in scientific notation

Assignments for This Lesson

- Read Mathematics Chapter 1, "Powers and Scientific Notation," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 1
- Complete the quiz for Lesson 1

Water Treatment Math

Lesson 2 – Dimensional Analysis

Summary of This Lesson

Dimensional Analysis is a tool to determine whether you have setup a problem correctly. Dimensional analysis does not use any numbers, it only uses the units to check the math problem.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to express a horizontal fraction as a vertical fraction
- How to divide a fraction
- How to divide out or cancel terms in the numerator and denominator of a fraction

Assignments for This Lesson

- Read Mathematics Chapter 2, "Dimensional Analysis," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 2
- Complete the quiz for Lesson 2

Water Treatment Math

Lesson 3 – Rounding and Estimating

Summary of This Lesson

Estimating will help you have a ballpark idea of what your end answer should be. It gets you close to the final answer quickly. To estimate you will also be rounding. Rounding is done by replacing the final digits of a number with zeros.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to round a complex number to a place value in the decimal system
- How to estimate the approximate value of a calculation

Assignments for This Lesson

- Read Mathematics Chapter 3, "Rounding and Estimating," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 3
- Complete the quiz for Lesson 3

Water Treatment Math

Lesson 4 – Solving for the Unknown Value

Summary of This Lesson

Often, you will be given a formula and all but one piece of information. Using the formula, you can solve for that last bit of information. At times though, you will have to change the formula using addition, subtraction, multiplication, and division.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to solve for the unknown value in formulas using multiplication and division
- How to solve for the unknown value in formulas using addition and subtraction

Assignments for This Lesson

- Read Mathematics Chapter 4, "Solving for the Unknown Value," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 4
- Complete the quiz for Lesson 4

Water Treatment Math

Lesson 5 – Ratios and Proportions

Summary of This Lesson

Ratios are a common expression of how two numbers relate to each other. When ratios are proportionate, it means the numbers have been scaled up equally. We will cover what ratios and proportions are as well as how to calculate and use them.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How ratios and proportions are used
- The applications of ratios and proportions in water system calculations
- How to perform ratio and proportion calculations

Assignments for This Lesson

- Read Mathematics Chapter 5, "Ratios and Proportions," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 5
- Complete the quiz for Lesson 5

Water Treatment Math

Lesson 6 – Averages

Summary of This Lesson

An average is simply taking a larger amount of data and finding one number to represent it. We will cover, how to calculate averages and what their used for.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to calculate averages of groups of numbers
- Common applications of averaging in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 6, "Averages," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 6
- Complete the quiz for Lesson 6

Water Treatment Math

Lesson 7 – Percent

Summary of This Lesson

Percent is an expression per 100. Percentages are the way you can take any number, whether higher or lower than 100, and express it as a part of the whole. They can be converted to decimal numbers and fractions. Most percentages are used in formulas as decimals instead of percentages.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to perform percent calculations
- Common uses of percent calculations in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 7, "Powers and Scientific Notation," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 7
- Complete the quiz for Lesson 7

Water Treatment Math

Lesson 8 – Linear Measurements

Summary of This Lesson

Linear measurements are a measure of distance. It is expressed as a straight line even if it comes from curved or angular objects. For example, a circumference is a linear measurement around a circle. When you write the circumference, you write it as a line in feet or yards or meters.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of performing linear measurements of angular and circular objects
- Common applications of linear measurements in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 8, "Linear Measurements," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 8
- Complete the quiz for Lesson 8

Water Treatment Math

Lesson 9 – Area Measurements

Summary of This Lesson

Area measurements are measures of object surfaces. Commonly you will see square feet and square inches, but there are many other area measures you can use; such as, square yards, square meters, square centimeters and so on. Acre is also a unit of area. In this lesson though, we will be focusing on the three most commonly used area calculations of square, circle, and triangle.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to calculate area measurements of rectangles, triangles, and circles
- Common applications of area measurements in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 9, "Area Measurements," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 9
- Complete the quiz for Lesson 9

Water Treatment Math

Lesson 10 – Volume Measurements

Summary of This Lesson

In lesson 8 we covered linear measurement. In lesson 9 we covered area measurements. Now we will add a 3rd dimension to cover volume measurements. Volume is the amount of space an object occupies. It will always be expressed as a cube, even for volumes with square or jagged edges.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to calculate volume measurements of shapes such as boxes, cylinders, cones, and shapes
- Common applications of volume measurements in water systems

Assignments for This Lesson

- Read Mathematics Chapter 10, "Volume Measurements," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 10
- Complete the quiz for Lesson 10

Water Treatment Math

Lesson 11 – Conversions

Summary of This Lesson

Converting between units is the process of starting with one unit and ending up with another unit. All formulas are boiled down to converting between a unit (or group of units) and ending with another unit. To convert units, you will find equivalents and either multiply them or divide by them. In this lesson we will show you how to make sure you have the right units and how to know when to multiply or divide.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- What a unit is
- What an equivalent is
- How are units and equivalents used to solve math problems
- Methods for converting units
- Common unit conversions required in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 11, "Conversions," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 11
- Complete the quiz for Lesson 11

Water Treatment Math

Lesson 12 – Graphs and Tables

Summary of This Lesson

Graphs and tables are simply a visual expression of data. In this lesson we will only cover the creation of simple graphs and tables and the method interpreting and using them.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to read and interpret graphs and tables
- The purpose of various graphs and tables used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 12, "Graphs and Tables," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 12
- Complete the quiz for Lesson 12

Water Treatment Math

Lesson 13 – Per Capita Water Use

Summary of This Lesson

Per capita water use is the measure of water use per person served. One way to express per capita use is gallons per capita per day (gpcd). We will cover calculating and using per capita water use in this lesson.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- How to calculate per capita water use
- The importance and uses of per capita water use data in water system operations.

Assignments for This Lesson

- Read Mathematics Chapter 13, "Per Capita Water Use," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 13
- Complete the quiz for Lesson 13

Water Treatment Math

Lesson 14 – Domestic Water Use Based on Household Fixtures

Summary of This Lesson

Domestic water use generally makes up the largest portion of water use from a system. Common household fixture flow rates can be used to estimate the domestic water use.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of estimating domestic water use based on household fixtures
- How household fixture unit information is used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 14, "Domestic Water Use Based on Household Fixtures," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 14
- Complete the quiz for Lesson 14

Water Treatment Math

Lesson 15 – Water Use per Unit of Industrial Product Produced

Summary of This Lesson

Industrial production is generally measured by the product produced. Examples given in your textbook are 20,000 gallons per ton of green beans in a cannery and 43,000 gallons used per ton of paper. This information is used to calculate the expected water requirements by an industrial plant.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating water use per unit of industrial product produced
- How data on water use per unit of industrial product produced are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 15, "Water Use per Unit of Industrial Product Produced," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 15
- Complete the quiz for Lesson 15

Water Treatment Math

Lesson 16 – Average Daily Flow

Summary of This Lesson

Average daily flow is just the total flow of water divided by the total number of days. This is an average, not a projection or estimate. Your actual daily flow will be different. The average daily flow is the number used to represent the daily flow required by the community.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating average daily flow for a water system
- How average daily flow data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 16, "Average Daily Flow," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 16
- Complete the quiz for Lesson 16

Water Treatment Math

Lesson 17 – Surface Overflow Rate

Summary of This Lesson

Surface overflow rate is important in producing the best quality effluent. If the surface overflow rate is too high, there will be increased turbulence that results in suspended particles carrying over and not settling out. Surface overflow rate is calculated using the *surface area* not the weir length.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating surface overflow rate
- How surface overflow rate data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 17, "Surface Overflow Rate," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 17
- Complete the quiz for Lesson 17

Water Treatment Math

Lesson 18 – Weir Overflow Rate

Summary of This Lesson

Weir overflow rate is the measure of water flowing over the weir. The weir is the length the water has to flow out of a tank (whether round or straight).

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating weir overflow rate
- How weir overflow rate data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 18, "Weir Overflow Rate," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 18
- Complete the quiz for Lesson 18

Water Treatment Math

Lesson 19 – Filter Loading Rate

Summary of This Lesson

Filter loading rate is measured – in theory – much like surface overflow rate. You are calculating the flow based on the area. Only in this case, we are looking for the filter capacity and determining when a filter needs to be backwashed. Filter loading rate is calculated by the minute and not the day like surface overflow rate.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating filter loading rate
- How filter loading rate data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 19, "Filter Loading Rate," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 19
- Complete the quiz for Lesson 19

Water Treatment Math

Lesson 20 – Filter Backwash Rate

Summary of This Lesson

It's important to know the backwash rate used in a filter because an excessive backwash rate will cause operational problems as will a backwash that's too slow. It is measured in gpm/ft² or inches of water rise/minute. Typical backwash rates vary from 15 gpm/ft² to 22 gpm/ft².

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating filter backwash rate
- How filter backwash rate data are used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 20, "Filter Backwash Rate," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 20
- Complete the quiz for Lesson 20

Water Treatment Math

Lesson 21 – Mudball Calculation

Summary of This Lesson

Monitoring and calculating mudball formation is important particularly with sand filters. Mudballs can cause operational problems and filter malfunctions. Mudballs are calculated as a percent in the sample taken.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculating percent volume of mudballs in a filter
- How mudball calculation information is used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 21, "Mudball Calculation," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 21
- Complete the quiz for Lesson 21

Water Treatment Math

Lesson 22 – Detention Time

Summary of This Lesson

Detention time is the theoretical time a particle of water is in a tank or chamber. It is used for flash mixing, coagulation-flocculation, and sedimentation. It can be expressed as seconds, minutes, hours, or days. Most often seconds, minutes, and hours are used.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of determining detention time in a basin
- How detention time is used in water system operations

Assignments for This Lesson

- Read Mathematics Chapter 22, "Detention Time," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 22
- Complete the quiz for Lesson 22

Water Treatment Math

Lesson 23 – Well Problems

Summary of This Lesson

Well yield, drawdown, and specific capacity are the three primary well calculations. This information is used to select the appropriate equipment and make operational changes.

Lesson Objectives

Upon completion of this lesson, students will gain an understanding of:

- Methods of calculation well yield, drawdown, and specific capacity
- How well calculations are used in water well operation and maintenance

Assignments for This Lesson

- Read Mathematics Chapter 23, "Well Problems," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 23
- Complete the quiz for Lesson 23

Applied Chemistry

Course Overview

This course is designed to acquaint students with the chemistry principles involved in water treatment, storage and distribution, and the math that applies to chemistry principles. Course material consists of reading assignments, video lectures, review questions, study problems and lesson quizzes.

Course completion requires that the student successfully complete each component of each individual lesson. Review questions and written assignments must be submitted either online or uploaded in a Word document for the professor's review. Lesson quizzes have a minimum passing score of 70%.

Upon successful completion of the course requirements, students will receive a certificate of completion for the Applied Chemistry course, which is applicable toward a Certificate in Water Treatment Technology from American Water College.

Applied Chemistry (2.9 CEUs)

- Operator Chemistry Made Easy
- The Structure of Matter
- The Classification of Matter
- Valence, Chemical Formulas, and Chemical Equations
- Solutions
- Acids, Bases, and Salts
- Chemistry of Treatment Processes
- Chemical Dosage Problems

Required Texts

Textbook: *Basic Science Concepts and Applications*, Principles and Practices of Water Supply Operations series

Edition: Fourth Edition

Author: Nicholas G. Pizzi

ISBN: 1-58321-778-9

Educational Objectives

- To provide students with an overview of the structure of matter
- To provide students with an overview of the classification of matter
- To acquaint students with chemical formulas and equations
- To provide students with an overview of solutions, calculating solutions and dilution calculations
- To acquaint students with acids, bases and salts
- To provide students with an overview of the chemistry of water treatment processes
- To acquaint students with chemical dosage problems and calculations

Applied Chemistry

Evaluation

Students will be graded on their performance on each lesson quiz, and their course participation. Unless each unit is completed, the student will not be permitted to advance to the next lesson, and the student will not be awarded credit for completion until all assignments, quizzes and lectures are completed. Please contact our office with any questions.

Support

Students can contact our student support staff with any course-related, content-related, or technology-related inquiries. Our office hours are Monday-Thursday, 9-5 CT, and Friday 9-12 CT.

Contact Info:

Phone Number: (661) 874-1655

Email Inquiries: Info@americanwatercollege.org

Additionally, students are encouraged to contact their professor directly with any questions or comments.

Applied Chemistry

Lesson 1 – The Structure of Matter

Summary of This Lesson

This lesson takes a detailed look at the basic structure of matter, how elements are represented in the periodic table, and why knowledge of the structure of elements is important in water system operations.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the basic structure of matter
- Explain how elements are represented in the periodic table
- Explain why knowledge of the structure of elements is important in water system operations

Assignments for This Lesson

- Read Chemistry 1, "The Structure of Matter," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 1
- Answer Review Questions
- Complete the quiz for Lesson 1

Applied Chemistry

Lesson 2– The Classification of Matter

Summary of This Lesson

Anything that has mass and occupies space is considered to be “matter”. Matter exists in three forms: solids, liquids, and gases.

This lesson takes a detailed look at how matter is classified into pure elements, compounds, and mixtures, its definition and examples of each classification, and why this is important in water system operations.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain how matter is classified into pure elements, compounds, and mixtures
- Explain the definition and examples of each classification
- Explain why this is important in water system operations

Assignments for This Lesson

- Read Chemistry 2, "The Classification of Matter," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 2
- Answer Review Questions
- Complete the quiz for Lesson 2

Applied Chemistry

Lesson 3 – Valence, Chemical Formulas and Chemical Equation

Summary of This Lesson

The electrons that are in the outer shell of an atom are called the valence electrons. These outer shell electrons are either shared between atoms or transferred from one to another during a chemical reaction.

This lesson takes a detailed look at the principles of valence, chemical formulas, chemical equations, the definitions of chemical terms, and why this is important in water system operations.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the principles of valence, chemical formulas, and chemical equations
- Explain the definition of chemical terms
- Explain why this is important in water system operations

Assignments for This Lesson

- Read Chemistry 3, "Valence, Chemical Formulas, and Chemical Equations," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 3
- Answer Review Questions
- Complete the quiz for Lesson 3

Applied Chemistry

Lesson 4 – Solutions

Summary of This Lesson

There are two components that make up a solution: solvent and solute.

This lesson takes a detailed look at the principles of creating chemical solutions, how to calculate quantities of chemicals to use in making chemical solutions, and why chemical solutions are important in water system operations.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the principles of creating chemical solutions
- Explain how to calculate quantities of chemicals to use in making chemical solutions
- Explain why chemical solutions are important in water system operations

Assignments for This Lesson

- Read Chemistry 4, "Solutions," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 4
- Answer Review Questions
- Complete the quiz for Lesson 4

Applied Chemistry

Lesson 5 – Acids, Bases and Salts

Summary of This Lesson

This lesson takes a detailed look at the meaning and significance of salts, pH, and alkalinity, and why these compounds and measurements are important in water system operations.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the meaning and significance of salts, pH, and alkalinity
- Explain why these compounds and measurements are important in water system operations

Assignments for This Lesson

- Read Chemistry 5, "Acids, Bases and Salts," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 5
- Answer Review Questions
- Complete the quiz for Lesson 5

Applied Chemistry

Lesson 6 – Chemistry of Treatment Processes

Summary of This Lesson

This lesson covers the taste and odor removal processes, coagulation processes, iron and manganese removal processes, lime-soda ash softening processes, recarbonation processes, ion exchange softening processes, scale and corrosion control processes, and chlorination processes.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the taste and odor removal processes
- Explain the coagulation processes
- Explain the iron and manganese removal processes
- Explain the lime-soda ash softening processes
- Explain the recarbonation processes
- Explain the ion exchange softening processes
- Explain the scale and corrosion control processes
- Explain the chlorination processes

Assignments for This Lesson

- Read Chemistry 6, "Chemistry of Treatment Processes," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 6
- Answer Review Questions
- Complete the quiz for Lesson 6

Applied Chemistry

Lesson 7 – Chemical Dosage Problems

Summary of This Lesson

This lesson covers mg/L to lb/day conversions, mg/L to percent conversions, feed rate conversions, chlorine dosage, demand, and residual calculations, percent strength calculations, lime-soda ash softening calculations, and fluoridation calculations.

Lesson Objectives

Upon completion of this lesson, students will be able to:

- Explain the mg/L to lb/day conversions
- Explain the mg/L to percent conversions
- Explain the feed rate conversions
- Explain the chlorine dosage, demand, and residual calculations
- Explain the percent strength calculations
- Explain the lime-soda ash softening calculations
- Explain the fluoridation calculations

Assignments for This Lesson

- Read Chemistry 7, "Chemical Dosage Problems," in *Basic Science Concepts and Applications*
- Watch the video lecture for Lesson 7
- Answer Review Questions
- Complete the quiz for Lesson 7

Enrollment & Payment Options

Students have the option to enroll in one course at a time or in the complete Water Treatment Technology Certificate Program. By enrolling in the complete program, students will receive a discounted enrollment fee.

Option 1 – Individual Course Enrollment

Water Sources	\$179.99
Introduction to Water Treatment	\$399.99
Advanced Water Treatment	\$399.99
Water Treatment Math	\$349.99
<u>Applied Chemistry</u>	<u>\$299.99</u>
Total Program Cost	\$1,629.95

Option 2 – Complete Program Enrollment \$1,495.00

Enroll online at:

<https://americanwatercollege.org/water-treatment-certificate/>

Contact us for more information:

Phone – (661) 874-1655

Email – info@americanwatercollege.org