Drinking Water & Wastewater
Operator Certification Training
Instructor Guide

Module 29:
General Chemistry

A Note to the Instructor

Dear Instructor:

The primary purpose of this course *General Chemistry* is to provide an overview of the fundamentals of chemistry, including the concept of matter and its structure, the laws of chemistry, chemical reactions, stoichiometry and solutions. Treatment plant operators require this knowledge so that they may effectively perform their job duties. This module has been designed to be completed in approximately 4 hours, but the actual course length will depend upon the content and/or delivery modifications and results of course dry runs performed by the Pa. DEP-approved sponsor. The number of contact hours of credit assigned to this course is based upon the contact hours approved under the Pa. DEP course approval process. To help you prepare a personal lesson plan, timeframes have been included in the instructor guide at the Unit level and at the Roman numeral level of the topical outline. You may adjust these timeframes as necessary to match course content and delivery modifications made by the sponsor. Please make sure that all teaching points are covered and that the course is delivered as approved by Pa. DEP.

Web site URLs and other references are subject to change, and it is the training sponsor's responsibility to keep such references up to date.

Delivery methods to be used for this course include:
- Lecture
- Exercises
- Questioning

To present this module, you will need the following materials:
- One workbook per participant
- Extra pencils
- Flip Chart
- Markers
- Laptop (loaded with PowerPoint) and an LCD projector **or** overheads of presentation and an overhead projector
- Screen

Icons to become familiar with include:

Participant Workbook	Instructor Guide
Exercise/Activity	Same icons for Participant Workbook apply to the Instructor Guide.
Case Study	**Ans:** Answer to exercise, case study, discussion, question, etc.
Discussion Question	PowerPoint Slide
Calculation(s)	Overhead
Review Exercise	Flip Chart
Key Definition(s)	Suggested "Script"
Key Point(s)	

Instructor text that is meant to be general instructions for the instructor are designated by being written in script font and enclosed in brackets. For example:

[*Ask participants if they have any questions on how to read the table. Answer any questions participants may have about how to read the table.*]

If your module includes the use of a PowerPoint presentation, below are some helpful controls that you may use within the Slide Show.
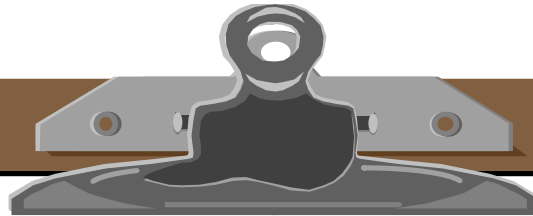
PowerPoint Slide Show Controls

You can use the following shortcuts while running your slide show in full-screen mode.

To	Press
Advance to the next slide	N, ENTER, or the SPACEBAR (or click the mouse)
Return to the previous slide	P or BACKSPACE
Go to slide <number>	<number>+ENTER
Display a black screen, or return to the slide show from a black screen	B
Display a white screen, or return to the slide show from a white screen	W
Stop or restart an automatic slide show	S
End a slide show	ESC
Return to the first slide	Both mouse buttons for 2 seconds
Change the pointer to a pen	CTRL+P
Change the pen to a pointer	CTRL+A
Hide the pointer and button temporarily	CTRL+H
Hide the pointer and button always	CTRL+L
Display the shortcut menu	SHIFT+F10 (or right-click)
Erase on-screen annotations	E
Go to next hidden slide	H
Set new timings while rehearsing	T
Use original timings while rehearsing	O
Use mouse-click to advance while rehearsing	M

INSTRUCTOR GUIDE

INTRODUCTION OF MODULE: <u>5 minutes</u>

Display Slide 1—Module 29: General Chemistry.

[Welcome participants to "Module 29 – General Chemistry." Indicate the primary purpose of this course is to provide an overview of the fundamentals of chemistry, including the concept of matter and its structure, the laws of chemistry, chemical reactions, stoichiometry and solutions.]

[*Introduce yourself.*]

[*Provide a brief overview of the module.*]

This module contains 5 units. On page i, you will see the topical outline for **Unit 1 – Fundamentals of Chemistry**, **Unit 2 – Formulas, Equations and Reactions**, **Unit 3 – Solutions**, **Unit 4 – Acids and Bases** and **Unit 5 - Safety.**

[Continue to briefly review outline.]

UNIT 1: 55 minutes

Display Slide 2 —Unit 1: Fundamentals of Chemistry.

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

- List the parts of an atom.

- Given the number of protons in an element, indicate its atomic number.

- Given the atomic number of an element, indicate the number of protons in the element.

- Define atomic weight and perform atomic weight calculations.

- Explain the purpose of the periodic table and identify its parts.

Display Slide 3—Unit 2: Fundamentals of Chemistry.

The remaining objectives for Unit 1 are:

- List three states of matter and explain the difference among them.

- List and define four physical properties of matter.

- Explain the difference between elements, compounds and mixtures.

- List the primary differences between a physical and a chemical change of matter

MATTER: <u>30 minutes</u>

The Structure of Matter

We will begin this unit by discussing the concept of matter and its structure.

Matter

[*Review the definition of matter in the workbook.*]

[Review the information about elements in the workbook.]

Atoms

[*Review the definition of atom in the workbook.*]

Atomic Number

[Review the information in the workbook on atomic number, protons, neutrons and electrons.]

The next page shows a diagram of an atom.

Atomic Structure

[Review the information in the workbook.]

Display Slide 4 Diagram of an Atom.

This slide is a diagram of an atom. As you can see, the nucleus in the center of the atom is composed of protons, which show a positive charge, and neutrons, which show no charge. Surrounding the nucleus on the outside are the electrons, which show a negative charge.

Atomic Weight

So far we have learned about the structure of an atom and we have learned about the atomic number. Our next discussion will focus on the concept of atomic weight.

[Review the definition of atomic weight listed in the workbook.]

[Review the information in the workbook.

The Periodic Table of Elements

We have completed our discussion of the atom and are now going to talk about the Periodic Table of Elements.

[Review the information in the workbook.]

Display Slide 5—Reading the Periodic Table.

This slide shows some of the information that can be located on the Periodic Table. As you can see, the atomic number of the element is located at the top. The atomic symbol for the element, which in this example is Calcium, is located in the middle. Below the symbol is the atomic weight of the element. This is just an example of one element on the table.

[*Read the definition of a Periodic Table.*]

A full copy of the Periodic Table is included in the appendix of your workbook. Now it's time for you to use the Periodic Table to answer some questions.

[*Review the information in the workbook.*]

☑ **Periodic Table Exercise**

1. What is the atomic number of an element that contains 11 protons?

Ans: Sodium

2. The element Carbon has the atomic number of 6. How many protons does Carbon contain?

Ans: 6

3. Indicate the atomic weight of an element that contains 7 protons and 7 neutrons.

Ans: 14

CLASSIFICATION OF MATTER: <u>10 minutes</u>

Classification of Matter

Compound

[*Review the definition of compound in the workbook.*]

[*Review the information in the workbook, go over the water molecule.*]

[*Ask participants the following questions to generate discussion. If available write responses on a whiteboard or flip chart]*

What are some common compounds used in water and wastewater treatment?
Ans: Alum, sodium hydroxide, lime…

What are some common elements used in water and wastewater treatment?
Ans: oxygen, ozone, chlorine

Mixture

The final classification of matter is the mixture.

[*Review the definition of mixture in the workbook.*]

One simple example of a mixture is a pile composed of sawdust and iron filings. While these two ingredients might be mixed together to form the mixture, they both retain their distinct properties. There is no reaction between the two ingredients. By using a magnet, you can easily separate the iron filings from the sawdust.

[Review the information in the workbook.]

[*Review the definition of heterogenous mixture in the workbook.*]

[*Review the definition of homogeneous mixture in the workbook.*]

[*Review Figure 1.4 Classification of Matter*]

Matter exits in three different states.

[Review the information in the workbook.]

PHYSICAL PROPERTIES OF MATTER: 15 MINUTES

Mass

In this section, we will talk about the physical properties of matter, which include: mass, weight, density and specific gravity. The first physical property of matter that we are going to review is mass.

[*Review the definition of mass in the workbook.*]

[Review the information in the workbook.]

Weight

The next physical property is weight.

[*Review the definition of weight in the workbook.*]

[Review the information in the workbook.]

Density

The third physical property is density.

[*Review the definition of density in the workbook.*]

[Review the information in the workbook.]

Density of Water

Since we are talking about density, it is necessary for us to take a few minutes to talk specifically about the density of water.

[Review the information in the workbook.]

Specific Gravity

So far we have discussed the physical properties of mass, weight and density. The last physical property we will review is specific gravity.

[*Review the definition of specific gravity in the workbook.*]

[Review the information in the workbook.]

Calculating Specific Gravity

Let's take a look at how specific gravity is calculated.

[Review the information in the workbook.]

[Example]

[Review the example in the workbook.]

Calculating the Weight of a Gallon of Chemical

At times, it may be necessary for you to calculate the weight of a gallon of chemical. To perform this calculation, you will need to know the specific gravity of the chemical. Let's take a look at how you would do this type of calculation.

[Review the information in the workbook.]

Now let's look at two examples.

Example 1

[Review Example 1 in the workbook.]

Example 2

[Review Example 2 in the workbook.]

Changes of Matter

So far, we have talked about the states of matter, the physical properties of matter and the classification of matter. Now we will discuss some of the changes that take place with matter.

[Review the information in the workbook.]

Now that you understand the difference between a physical and a chemical change in matter, spend the next five minutes completing the exercise in your workbook and then we will review the answers.

✔ Physical and Chemical Changes

[Review the following statements and mark whether the change is physical or chemical.]

	PHYSICAL	CHEMICAL
1. Drinking water from ocean water by means of evaporation and condensation	✔	
2. Sodium from sodium chloride		✔
3. Pulverizing rock salt	✔	
4. Burning wood		✔
5. Dissolving sugar into water	✔	
6. Rusting of Iron		✔
7. The evaporation of alcohol	✔	

[*Have participants work through the review exercise. Ask for volunteers for answers.*]

Review Exercise

1.   Define the term matter and list the three states of matter.

Ans: Matter occupies space and has mass. The air that surrounds us, the pencil that we write with and the water that we drink are all examples of matter. The three states of matter are solid, liquid and gas.

2.   Differentiate between mass, weight, density and specific gravity.

Ans: Mass is the amount of matter present in a given object.

Weight is the mass of an object being acted upon by gravity.

Density is the mass of a substance per unit of volume of the substance.

Specific gravity is the density of a substance compared to the weight of the same volume of water.

3.   Explain the difference between a physical and a chemical change in matter.

Ans: A physical change in matter is a change in the form of matter but not in its chemical identity. A chemical change in matter is a change in which one or more kinds of matter transform into a new kind of matter.

4.   List and define three classes of matter.

Ans: Element – a substance that cannot be decomposed into simpler substances by any chemical reaction.

Compound – a substance that is composed of two or more elements that are chemically combined in fixed proportions.

Mixture – a material that can be separated by physical means into two or more substances.

We have now reached the end of Unit 1. In this unit, we have discussed some of the fundamentals of chemistry. Are there any questions about the material before we move on to Unit 2?

Display Slide 6—Unit 2: Formulas, Equations and Reactions.

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

- Determine the molecular weight of a chemical formula.

- Define mole and calculate the number of moles in a compound

- Explain the relationship between chemical equations and chemical reactions.

- List and describe four common reactions used in water or wastewater treatment.

MOLECULAR WEIGHT AND MOLES: <u>35 minutes</u>

In the first unit, we discussed some fundamentals of chemistry and during that discussion we defined matter as the substance of which a physical object is composed. In this unit we are going to learn about how that matter reacts to each other.

Molecular Weight

In our discussion about the Periodic Table, we talked about the elements and how they are arranged and compounds-how (and a little bit about why) elements combine with each other. Now let's talk about chemical formulas and what purpose they serve.

[Review the introductory information on chemical formulas in the workbook.]

[*Read the definition of molecular weight.*]

To understand chemical reactions, create solutions or determine chemical feed quantities, we must first know how to calculate molecular weight.

[*Review information on molecular weights.*]

[Remind participants that there is a Periodic Table located in the Appendix of the workbook. This is where they will find the atomic weights of the various elements.]

Let's look at some examples of calculating molecular weight.

[*Review Example 1.]*

[*Review Example 2.]*

Now it is your turn to do some molecular weight calculations. Take five minutes to do the exercise on page 2-3 of your workbook.

☑ Exercise

1.   What is the molecular weight of H_2SO_4 (sulfuric acid)?

Ans: 2 H atoms = 1.0080 + 1.0080 = 2.016
1 S atom = 32.064
4 O atoms = 15.9994 + 15.9994 + 15.9994 + 15.9994 = 63.9976
By adding the three molecular weights together, we get a total molecular weight of 98.0776 for H_2SO_4.

2.   What is the molecular weight of 2 molecules of CH_4 (methane)?

Ans: 1 C atom = 12.0112
4 H atoms = 1.0080 + 1.0080 + 1.0080 + 1.0080 = 4.032
By adding the two molecular weights together (12.0012 + 4.032), we get a total molecular weight of 16.0432 for CH_4, which is the weight of one molecule of CH_4. Since we are asked to calculate the molecular weight of two molecules of CH4, we need to add 16.0432 + 16.0432, which gives us a total molecular weight for the two molecules of 32.0864.

THE MOLE CONCEPT: <u>25 minutes</u>

Definition

Now that you are familiar with molecular weights and how to calculate them, we will turn our attention to the mole.

[*Review the definition of mole weight in the workbook.*]

[Review the information in the workbook.]

Calculations

Let's do some calculations involving moles.

[Review the information in the workbook.]

Note that we often use the abbreviation "mol" to represent the term "mole."

Calculations Using Moles

1. Calculate the number of moles in 80 grams of NaOH (sodium hydroxide, or caustic soda).

Ans: Step 1: To calculate the molecular weight of NaOH, reference the periodic table to determine the following atomic weights:
1 Na atom = 22.9898
1 O atom = 15.9994
1 H atom = 1.00797
By adding the three molecular weights, we get a total molecular weight of 39.99717 for NaOH.

Step 2: To calculate the number of moles, divide the molecular weight by the total number of grams.
Moles = $\frac{39.99717}{80 \text{ grams}}$
Moles = 0.50 moles

2. Calculate the number of moles in 40 grams of H_2O_2 (hydrogen peroxide).

Ans: Step 1: To calculate the molecular weight of H_2O_2, reference the periodic table to determine the following atomic weights:
2 H atoms = 1.0080 + 1.0080 = 2.0160
2 O atoms = 15.9994 + 15.9994 = 31.9988
By adding the two molecular weights, we get a total molecular weight of 34.0040 for H_2O_2.

Step 2: To calculate the number of moles, divide the molecular weight by the total number of grams.
Moles = $\frac{34.0040}{40 \text{ grams}}$
Moles = 0.85 moles

3. Calculate the number of moles in 79 grams of $KMnO_4$ (potassium permanganate).

Ans: Step 1: To calculate the molecular weight of $KMnO_4$, reference the periodic table to determine the following atomic weights:
1 K atom = 39.0983
1 Mn atom = 54.9381
4 O atoms = 15.9994 + 15.9994 + 15.9994 + 15.9994 = 63.9976
By adding the three molecular weights, we get at total molecular weigh of 158.0340 for$KMnO_4$.

Step 2: To calculate the number of moles, divide the molecular weight, by the total number of grams.
Moles = $\frac{158.0340}{79 \text{ grams}}$
Moles = 2.0 moles

4.   Calculate the number of grams in 0.5 mol of HCl (hydrochloric acid).

Ans: Step 1: To calculate the molecular weight of HCl, reference the periodic table to determine the following atomic weights:
1 H atom = 1.0080
1 Cl atom = 35.4527
By adding the three molecular weights, we get at total molecular weigh of 36.4607 for HCl.

Step 2: To calculate the number of grams, multiply the molecular weight by the total number of moles per molecule.
Grams = (36.4607) (0.5 mol)
Grams = 18.23

5.   Calculate the number of grams in 1 mol of $Fe_2(SO_4)_3$ (ferric sulfate).

Ans: Step 1: To calculate the molecular weight of $Fe_2(SO_4)_3$, reference the periodic table to determine the following atomic weights:
2 Fe atoms = 55.847+ 55.847 = 111.694
3 x 1 S atoms = 32.066 + 32.066 + 32.066 = 96.198
3 x 4 O atoms = 12 x 15.9994 = 191.992
By adding the three molecular weights, we get at total molecular weigh of 399.884 for $Fe_2(SO_4)_3$.

Step 2: To calculate the number of grams, multiply the molecular weight by the total number of moles per molecule.
Grams = (399.884) x (1 mol)
Grams = 399.88

CHEMICAL EQUATIONS AND REACTIONS: <u>20 minutes</u>

Now that we have learned some of the fundamentals of chemistry, the structure of matter and molecular weight calculations, and the mole concept, we will turn our attention to the topic of chemical reactions. Let's begin by talking about what purpose chemical reactions serve. After that, we will take a look at a few examples of chemical reactions.

Chemical Equations and Reactions

[Review the information in the workbook.]

[Ask participants the following question to generate discussion. If available write responses on a whiteboard or flip chart]

What are some examples of chemical reactions in your treatment system?

Ans: Disinfection Reactions (Chlorine Reactions), Softening, Coagulation, Precipitation, Nutrient Removal, Iron Removal, Corrosion Control.

<div align="center">Examples</div>

In this section, you will see a list of a few common chemical reactions. In the first reaction, we see that hydrogen and oxygen react to form water.

<div align="center">Uses of Chemical Equations at Treatment Plants</div>

As a treatment plant operator, there are several ways in which you will use chemical equations. Let's review some of those uses.

[*Review the information in the workbook.*]

<div align="center">Disinfection</div>

Disinfection is yet another example of chemical reactions that occur in aqueous solutions.

[*Review the definition of disinfection in the workbook.*]

[Review the information in the workbook.]

Chlorine Reactions in Water

Let's take a look at the chlorine reactions that occur in water.

[*Review the information in the workbook.*]

<div align="center">Coagulation</div>

[*Review the definition of coagulation in the workbook.*]

[Review the information in the workbook.]

Coagulation Using Aluminum Sulfate (Alum)

Since alum is a common coagulation chemical, we will show a reaction using this chemical.

[Review the information in the workbook.]

Coagulation Using Ferric Chloride

Since ferric chloride is a common coagulation chemical, we will focus our discussion on coagulation using this chemical.

[Review the information in the workbook.]

Chemical Precipitation

Chemical precipitation is another example of a type of chemical reaction that occurs in aqueous solution.

[*Review the definition of chemical precipiation in the workbook.*]

[Review the information in the workbook.]

[*Review the definition of cation in the workbook.*]

Iron Removal

[Review the information in the workbook]

Iron Oxidation by Potassium Permanganate

A common example of a chemical used for precipitation is potassium permanganate. Let's take a look at how iron is removed using this chemical.

[Review the information in the workbook.]

UNIT 3: <u>55 minutes</u>

Display Slide 7—Unit 3: Solutions.

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

- Describe the characteristics of a solution.

- List the three means of describing the concentration of a solution and differentiate among them.

Display Slide 8—Unit 3: Solutions.

The remaining learning objectives for this module are:

- Distinguish between creating solutions from standard solutions and creating solutions from chemicals.

- Correctly perform percent by weight and percent by volume calculations, dilution calculations and calculations to determine the concentration of solutions.

CONCENTRATION OF SOLUTIONS: <u>10 minutes</u>

In this unit, we are going to discuss solutions: the characteristics of solutions, how to describe the concentration of a solution, ways to create solutions and how to perform calculations in regards to solutions. Let's begin by reviewing a few definitions that are important for you to understand when talking about solutions.

Description

[*Review the definitions listed in the workbook.*]

Concentration of a Solution

Now that we know the definition of a solution, let's talk about expressing the concentration of a solution.

[Review the information in the workbook.]

By Weight Concentration

[Review the information in the workbook.]

Percent Composition

Percent composition is another means of expressing the concentration of a solution.

[Review the information in the workbook..]

Percent by Weight

[Review the information in the workbook.]

Example

[Review the example in the workbook.]

Percent by Volume

[Review the information in the workbook.]

Example

[Review the example in the workbook.]

Molarity

Another way to express the concentration of a solution is molarity.

[*Review the definition of molarity in the workbook.]*

[*Review the information in the workbook.*]

CREATING SOLUTIONS: 45 MINUTES

Creating Solutions

Now that we have completed our discussion of ways to express the concentration of a solution, we will turn our attention to creating solutions. One way to make a solution of known concentration is to dilute a "standard solution."

Solutions from Standard Solutions

[*Review the definition of standard solutions listed in the workbook.]*

[*Review the information in the workbook.*]

Calculating Unknown Solutions

Sometimes you will need to determine the concentration of an unknown solution.

[Review the information in the workbook.]

Diluting Standard Solutions

Now let's talk about the three methods for creating standard solutions.

[Review the information in the workbook.]

Let's take a look at some examples of how we would use this formula.

Example 1

[*Use flipchart to work through Example 1 in the workbook.*]

Example 2

[*Use flipchart to work through Example 2 in the workbook.*]

[Review the information in the workbook.]

Solutions from Chemicals

In this final section, we are going to take a look at how solutions are created from chemicals.

[Review the information in the workbook.]

Example 1

The first example shows us how to determine the molarity of a solution composed of deionized water and hydrochloric acid.

[*Use flipchart to work through Example 1 in the workbook.*]

Example 2

This next example requires you to perform some calculations to help you make a solution of potassium permanganate.

[*Use flipchart to work through Example 2 in the workbook.]*

Example 3

In this last example, we need to determine the volume of sodium chloride required. Let's take a look at how to do this.

[*Use flipchart to work through Example 3 in the workbook.*]

Now it's time for you to do some of these calculations on your own. Turn to page 3-7 in your workbook and do the exercises you see there. You will have 15 minutes to do these exercises and then we will review the answers.

✓ Exercise

1. Calculate the Molarity of 12g of NaOH dissolved in 250 milliliters of deionized water.

Ans: Step 1: Convert grams of NaOH to moles.
1 atom of Na = 22.9898
1 atom of O =   15.9994
1 atom of H =   <u>1.0080</u>
                            39.9972
Moles of NaOH = 12 grams/39.9972 = 0.30 moles

Step 2: Calculate the molarity of the solution
Molarity = 0.30 mol/0.250 L = 1.2 M
Remember that since the definition of Molarity is the number of moles per 1 liter, we need to convert milliliters to liters so that the end result is in mol/Liter, or, M.

2   Calculate the grams of $Na_2S_2O_3$ (Sodium Thiosulfate) necessary to create a 10 ml solution of 0.6 M solution.

Ans: Step 1: Convert moles of $Na_2S_2O_3$ to grams.
     2 atoms of Na = 2 x 22.9898 = 45.9796
     2 atoms of S = 2 x 32.066 =   64.132
     3 atoms of O = 3 x 15.9994 = <u>47.9982</u>
                       158.1098

     Step 2: Molarity = moles of solute/volume (L) of the solution

     Remember from earlier that Moles   =   <u>Wt of substance in grams</u>
                                 Molecular wt. in grams

     So Molarity = <u>Wt of substance in grams</u>
                 <u>Molecular wt. in grams</u>
                      L

         0.6 M = <u>X (wt. of substance g)</u>
                 <u>158.1099 g MW</u>
                      0.01 L

     Solving the equation for "x" we end up with the following formula:
      M x L x MW = x

     Step 3: Calculate the number of grams in the solution using the formula from Step 2.
     (0.6 M) (0.01 Liters) (158.1098 g/mol) = 0.95 g

3.   Calculate the Molarity of a solution of 81.1 grams of $MgCl_2$, Magnesium Chloride, in 1.0 Liter of deionized water.

Ans: Step 1: Convert moles of $MgCl_2$ to grams.
     1 atoms of Mg = 1 x 24.3050 = 24.3050
     2 atoms of Cl = 2 x 35.4527 = <u>70.9054</u>
                       95.2104
     Moles $MgCl_2$ = <u>81.1 grams</u>
                 95.2104 g/mol
     Moles $MgCl_2$ = 0.85 mol

     Step 2: Calculate the molarity of the solution.
     Molarity = 0.85 mol/1.0 L = 0.85 M

     We have completed Unit 3 Solutions. Are there any questions about any of the material we have covered in this module?

UNIT 4: <u>20 minutes</u>

Display Slide 9—Unit 4: Acids and Bases

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

- Define the terms acid and base.
- Explain the pH scale.
- Define alkalinity and state the importance.

ACIDS AND BASES: 5 MINUTES

Acids and Bases

[*Review information in the workbook.*]

[*Review the definition of acid listed in the workbook.*]

[*Review the definition of base listed in the workbook.*]

PH SCALE: 10 MINUTES

pH Scale

[*Review information in the workbook.*]

[*Review the definition of pH listed in the workbook.*]

[*Ask participants the following questions to generate discussion. If available write responses on a whiteboard or flip chart*]

What are some processes that are affected by pH?

Ans: Disinfection, Coagulation, Lime Stabilization….

Display Slide 10—pH scale

Look at the pH scale diagram in your workbook. Where do your treatment processes normally fall on the pH scale.

ALKALINITY: 5 MINUTES

Alkalinity

[*Review information in the workbook.*]

💬 This concludes Unit 4 Acids and Bases. Remember, pH is an important parameter in water and waste water treatment. Many processes function optimally at certain pH's. In addition, alkalinity, the ability of a water to resist change to pH is also important in water and wastewater treatment.

UNIT 4: <u>45 minutes</u>

Display Slide 11—Unit 5: Safety

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

- Locate important information on MSDS sheets.

- Identify proper storage procedures for chemicals.

- Identify personal protection equipment and discuss proper usage.

MSDS: 25 MINUTES

MSDS

[Review information in the workbook.]

[Go over the Requirements of MSDS.]

[*Review the sections of an MSDS*]

[*Continue to review the sections of the MSDS.*]

MSDS Exercise

💬 In order to become familiar with reading and finding information on MSDS sheets, let's do a short exercise. You will find an MSDS sheet for Sodium Hydroxide in the appendix. Remember, each company may have a slightly different style of MSDS sheet but the same information is always in the same sections. Take 5 – 10 minutes to answer the questions and we'll go through the sheet as a class.

Class Exercise:

1.   In Which section would you find information concerning the different hazards associated with handleling caustic soda?
- Section 3: Hazards Identification.

2.   What are the possible routes of entry?
- Eye Contact: May cause tissue injury and loss of vision
- Skin Contact: Corrosive to all tissue
- Inhalation: concentrated mist May damage respiratory tract
- Ingestion: Ingestion

3.   What information would you look for from the MSDSs, before repairing and metering pump or chemical feed system?

- Exposure Controls and Protective equipment
- Handling and Storage
- First Aid
- Fire Fighting Measures
- Physical and chemical properties

4.   Where would you find information about storing Sodium Hydroxide? What are the storage recommendations?
- Section 7 Handling and Storage
  Keep in a tightly closed container. Protect from physical damage. Store in a cool, dry, ventilated area away from sources of heat, moisture and incompatibilities. Always add the caustic to water while stirring; never the reverse. Containers of this material may be hazardous when empty since they retain product residues (dust, solids); observe all warnings and precautions listed for the product. Do not store with aluminum or magnesium. Do not mix with acids or organic materials.

CHEMICAL STORAGE: 10 MINUTES

<div align="center">Chemical Storage</div>

[*Review information on Chemical Storage in the workbook.]*

PPE: 10 MINUTES

<div align="center">Personal Protection Equipment</div>

[*Review information on personal protection equipment in the workbook.*]

We have now completed Module 29 Chemistry. Please feel free to ask any questions about any of the material we've gone over today.