This course supports the assessments for QNT2. The course covers 4 competencies and represents 3 competency units.

**Introduction**

**Overview**
Chemistry is the study of the properties and interactions of matter. The study of chemistry allows you to better understand how chemical transformations of matter occur and prepare to teach students general chemistry in your own classroom.

**Competencies**
This course provides guidance to help you demonstrate the following 4 competencies:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.
- **Competency 204.3.2: Chemical Reactions**
  The graduate has a broad understanding of chemical reactions.
- **Competency 204.3.3: Stoichiometry**
  The graduate has a broad understanding of stoichiometry.
- **Competency 204.3.4: Solutions, Rates, and Energy Changes**
  The graduate has a broad understanding of solutions, rates of reaction, and energy changes.

**Teaching Dispositions Statement**
Please review the [Statement of Teaching Dispositions](#).

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**Preparation for Success**

The information in this section is provided to detail the resources available for you to use as you complete this course.

**Learning Resources**

The learning resources listed in this section are required to complete the activities in this course. For many resources, WGU has provided automatic access through the course. However, you may need to manually enroll in or independently acquire other resources. Read the full
instructions provided to ensure that you have access to all of your resources in a timely manner.

**Manually Enrolled Resources**

Take a moment to enroll in the learning resources listed in this section. To enroll, navigate to the “Learning Resources” tab, click the “Sections” button, and then click the “Enroll Now” button for each resource. Once your mentor approves your enrollment in the resource, you will receive an e-mail with further access instructions. Contact your mentor if you have questions.

**Chemistry - Section 1 of OWL**

This resource access to the following items:

- Thinkwell videos
- MAS (Mastery) questions

After enrolling, you will receive an e-mail describing how to log in. After logging in, choose "Assignment List" from the left-hand column. Complete the activities in the "Introduction to OWL" folder to be sure your computer is compatible with this resource. The following 4.5 minute recording will help you navigate around OWL:

- [OWL Take 3](#)

**Chemistry Labs by LateNiteLabs**

LateNiteLabs is a simulation program that encourages learning by allowing you to model and experiment with virtual chemicals. After enrolling, you will receive an e-mail describing how to log in.

**Other Learning Resources**

You will use the following learning resources for this course.

**Science Methods LabPaq**

This self-contained laboratory kit includes a lab manual and the science equipment, supplies, and chemicals necessary to complete college laboratory experiments at home. The experiments reinforce science content and teach laboratory techniques.

This resource is ordered by submitting the [LabPaq Liability Release Form](#). Follow the directions at the top of the form to receive this resource. Fax, mail, or, preferably, attach this form to an e-mail to learning@wgu.edu. They will process your lab order, and your materials will ship within five to seven business days.

Please check your package as soon as it arrives. If there are any missing or damaged items, you will need to notify the Learning Resources Department right away. Two weeks after shipment, Hands-On Labs will be unable to make exchanges or supply replacements for items.
Additional Preparations

Webinars

The course mentor is creating new webinars to help with your understanding of the material. If you find a concept challenging as you work through this course, please check the Additional Webinars spreadsheet to see if there is a webinar to help you further understand the concept.

History and Philosophy of Science

It is important to have an understanding of the history and nature of science. As a science teacher, it is also important that you pass this understanding to your students. There are a number of misconceptions that still dominate science classrooms today. For example, many people still believe there is only one scientific method that describes how science is conducted, or that there is little or no difference between a scientific theory and a hypothesis.

The Nature of Science

Science is more than a body of knowledge that describes the way the world behaves. Science is also a way of thinking and investigating. It is inseparable from society and technology.

This topic addresses the following competency:

- Competency 204.3.1: Chemical Structure
  The graduate has a broad understanding of chemical structure and stability.

NSTA's Position on the Nature of Science

The National Science Teachers Association (NSTA) is an organization that holds conferences, publishes literature, and works with teachers from kindergarten through college in an attempt to improve science education. If you are not already a member, you are encouraged to become one.

Review the following web page:

- "The Nature of Science"

In your science notebook, answer the following question:

- What is NSTA's position on the nature of science?

NSES Standard on the History and Nature of Science

The National Science Education Standards (NSES) were produced by the National Research Council. NSTA supports these standards and has been engaged in an effort to implement the standards across the country.

Review the following web page:

- "History and Nature of Science"
In your science notebook, answer the following questions:

- How is science a human endeavor?
- How does science distinguish itself from other bodies of knowledge?

**Understanding the Nature of Science**

Read the following sections in *Chemistry*:

- section 1.1 (“Chemistry: An Overview”)
- section 1.2 (“The Scientific Method”)

In your science notebook, answer the following questions:

- What are two of the fundamental concepts of chemistry?
- Why are there many different versions of the scientific method?
- What is a scientific model?

**Scientific Inquiry**

Review the following web page:

- "Scientific Inquiry"

In your science notebook, answer the following question:

- What is NSTA's position on scientific inquiry?

**Scientific Inquiry Lab**

In the lab manual of LabPaq, read the following pages:

- pages 1–11 about using LabPaq
- pages 12–16 about presenting lab information
- pages 17–29 about equipment and lab techniques

Complete the following experiment in the Science Methods LabPaq:

- experiment 1 ("The Scientific Method")

After completing the lab, send your lab report to the course mentor to verify your findings.

**Measurement**

You will learn about the uncertainty of measurements, including accuracy and precision, and you will learn about the use of significant figures as a means for communicating the uncertainty of the numbers you use.

This topic addresses the following competency:
• **Competency 204.3.1: Chemical Structure**
  
  The graduate has a broad understanding of chemical structure and stability.

**Scientific Notation**

Review the following web page:

  • "Exponents: Scientific Notation"

Complete all MAS questions in the following section of the OWL Chemistry resource:

  • section 1.3d ("Scientific Notation Using a Calculator")

Make sure you are comfortable entering numbers in scientific notation into your calculator and performing operations with them. Typically, if you multiply numbers that are too large on your calculator, it will show the results in scientific notation. It will probably look something like this: 6.4E17.

If you have a TI-83 or TI-84 calculator, you can also press the "Mode" button and specifically select scientific notation.

**Uncertainty, Precision, and Accuracy**

Review the following section in *Chemistry*:

  • section 1.4 ("Uncertainty in Measurement")

In your science notebook, answer the following question:

  • How would you decide if something is "accurate" or "inaccurate"?

**Rounding and Significant Digits**

Complete all MAS questions in the following section of the OWL Chemistry resource:

  • section 1.5 ("Significant Figures and Calculations")

**SI System of Units**

Review the following web page:

  • "Metric Units and Converting Between Them"

Complete all MAS questions in the following section of the OWL Chemistry resource:

  • section 1.6b ("Unit Conversions: Metric")

Review the NSTA website for the official position of the NSTA on the use of the metric system.

**Dimensional Analysis**
Review the following web page:

- "Cancelling/Converting Units"

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 1.6c ("Unit Conversions: Metric/English")

To appreciate the importance of units, read the following story in Chemistry:

- "Chemical Connections: Critical Units!" (p. 8)

**Measurement Lab**

Complete the following experiment in the Science Methods LabPaq:

- experiment 2 ("Measurement: Length, Mass, Volume, Density, and Time")

After completing the lab, send your lab report to the course mentor to verify your findings.

*Note: Experiment 3 describes how to calculate percent error.*

**Experimental Error Lab**

Complete the following experiment in the Science Methods LabPaq:

- experiment 3 ("Experimental Errors and Uncertainty")

After completing the lab, send your lab report to the course mentor to verify your findings.

**Atoms and Molecules**

Chemistry is the branch of science that describes atoms and the interactions between atoms that make up matter.

You will review the foundations necessary for studying chemical reactions.

**Classification of Matter**

You will better understand how matter is classified and how are atoms, elements, compounds, and mixtures are related.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.

**Section 1.9 in Chemistry**

Complete all MAS questions in the following section of the OWL Chemistry resource:
Atomic Structure
The view of the atom has changed over time. You will trace the historical evolution of the atomic model.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.

History of the Atomic Model

The following individuals helped advance understanding of the atomic model:

- Democritus
- Dalton
- Rutherford
- Thomson
- Millikan
- Bohr (you will learn more in section 7.4)
- de Broglie (you will learn more in chapter 7)

Read the following sections in the *Chemistry* text:

- section 2.1 ("The Early History of Chemistry")
- section 2.2 ("Fundamental Chemical Laws")
- section 2.3 ("Dalton's Atomic Theory")
- section 2.4 ("Early Experiments to Characterize the Atom")
- section 2.5 ("The Modern View of Atomic Structure: An Introduction")
- section 2.6 ("Molecules and Ions")
- section 2.7 ("An Introduction to the Periodic Table")

Review the following web page:

- ["The Models of the Atom"](http://example.com/models)

Watch the following Thinkwell videos:

- "Early Discoveries and the Atom: Democritus, Dalton, Thomson"
- "Understanding Electrons: Millikan"
- "Understanding the Nucleus: Rutherford"
- "Modern Atomic Structure"

Atomic Particles

Complete all MAS questions in the following sections of the OWL Chemistry resource:
• section 2.4d ("Dalton and the Atomic Theory")
• section 2.5b ("Atomic Composition")

**Naming Compounds**

You will understand how chemical compounds are named. You need to become familiar with all of the common nomenclature in order to progress in chemistry. This is similar to memorizing the alphabet before you try to read.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**
  
  The graduate has a broad understanding of chemical structure and stability.

**Nomenclature**

Read the following section in *Chemistry*:

• section 2.8 ("Naming Simple Compounds")

Watch the following Thinkwell videos:

- "Describing Chemical Formulas"
- "Naming Chemical Compounds"
- "Organic Nomenclature"

Complete all MAS questions in the following section of the OWL Chemistry resource:

• section 2.8 ("Naming Simple Compounds")

Many students find that making flash cards helps with learning the rules. For example, you could make flash cards of the terms mentioned in Table 2.3 and Table 2.4 on page 58, as well as Table 2.5 on page 62. It may help to make sticky notes with the different ions and put them around your house.

If you have any memory tricks, post them to the message board so that other students can benefit.

**Stoichiometry**

Stoichiometry is the study of the quantities of substances that take part in a chemical reaction. During chemical reactions, the amount of each substance and the total electrical charge is always conserved. You will learn how to use fundamental laws of chemistry to balance chemical equations. As you complete this section, consider the following questions:

- How do you balance chemical equations?
- How do you calculate the molar mass from atomic mass?
- How can you calculate a compound's empirical formula from percent composition?
- What are the different stoichiometry relationships that you can calculate?
Stoichiometry
This section covers stoichiometry. You will learn how to convert between moles, molecules, grams, and elements.

This topic addresses the following competency:

- **Competency 204.3.3: Stoichiometry**
  The graduate has a broad understanding of stoichiometry.

Chemical Equations

Read the following chapter in *Chemistry*:

- chapter 3 ("Stoichiometry")

In your notebook, write down the definitions to empirical formula and molecular formula, as described in section 3.7. Give examples of each.

Watch the following Thinkwell videos:

- "An Introduction to Chemical Reactions and Equations"
- "CIA Demonstration: Magnesium and Dry Ice"
- "Balancing Chemical Equations"

To cement your understanding, view the following recorded calls after you have read the material:

- "Stoichiometry I"
- "Stoichiometry II"

Complete all MAS questions in the following section of the OWL Chemistry resource:

- chapter 3 ("Stoichiometry")

Chemical Reactions

Chemical reactions are the application of chemistry. In order to fully understand these reactions, it is important to understand some of the underlying concepts that drive chemical reactions. As you complete this section, consider the following questions:

- What are redox reactions, and how are they balanced?
- What are common examples of redox reactions?

Introduction to Solutions

This section will help you understand solutions. A solution is a homogenous mixture of two or more substances.

This topic addresses the following competency:
• **Competency 204.3.2: Chemical Reactions**

Read Sections 4.1- 4.4 in Chemistry

Read the following sections in *Chemistry*:

- section 4.1 ("Water, the Common Solvent")
- section 4.2 ("The Nature of Aqueous Solutions: Strong and Weak Electrolytes")
- section 4.3 ("The Composition of Solutions")
- section 4.4 ("Types of Chemical Reactions")

Watch the following Thinkwell videos:

- "Properties of Solutions"
- "CIA Demonstration: The Electric Pickle"
- "Concentrations of Solutions"

In your science notebook, answer the following questions:

- What makes water a good solvent?
- What makes a substance a strong electrolyte?
- How is the strength of a solution determined?

**Types of Reactions**

This section will help you understand the various types of reactions, including precipitation, acid-base, and oxidation-reduction reactions.

This topic addresses the following competency:

- **Competency 204.3.2: Chemical Reactions**

**Acid-Base Reactions**

Read the following section in *Chemistry*:

- section 4.8 ("Acid-Base Reactions")

Watch the following Thinkwell videos:

- "Acid-Base Reactions"
- "Acid-Base Titrations"
- "Solving Titration Problems"

Complete all required MAS questions in the following section of the OWL Chemistry resource:

- section 4.8
Oxidation-Reduction Reactions

Read the following sections in Chemistry:

- section 4.9 ("Oxidation-Reduction Reactions")
- section 4.10 ("Balancing Oxidation-Reduction Equations")

Watch the following Thinkwell videos:

- "Oxidation-Reduction Reactions"
- "Oxidation Numbers"
- "Balancing Redox Reactions by the Oxidation Number Method"
- "Balancing Redox Reactions Using the Half-Reaction Method"
- "Corrosion and the Prevention of Corrosion"

Review the following web page:

- "The Six Types of Chemical Reaction"

Complete all MAS questions in the following sections of the OWL Chemistry resource:

- section 4.9 ("Oxidation-Reduction Reactions")
- section 4.10 ("Balancing Oxidation-Reduction Equations")

It may be helpful to remember the following mnemonic:

- LEO the lion says GER ("Loose Electrons Oxidize" and "Gain Electrons Reduce")

Practice Identifying Reactions

Write down the types of reactions using the information from the following web page:

- "The Six Types of Chemical Reaction"

Practice identifying them. Make a card with the six reaction types. Work the practice problems at the bottom of the screen.

Titration Performance Task

Complete the following task in TaskStream:

- Chemistry Lab: Titration of Strong/Weak Acids

For this task, you will be using the Late Nite Labs software. Acquaint yourself with this software. Read the background description for the lab in Late Nite Labs and follow the procedures exactly. You will be writing up your report separately to submit in TaskStream.

Even though you are working in a virtual lab, you still need to follow lab safety. Review the list of "Potential Laboratory Hazards" within the Science Methods LabPaq manual (around page 26) before starting the lab.
Note: Drag the flask to the burette (not the burette to the flask).

Thinkwell has a demonstration with the calculations worked out for you for an example problem:

- "CIA Demonstration: Barium Hydroxide-Sulfuric Acid Titration"
- Click on "Lab Preparation With Sound"

You are asked to compare the Ka values, not calculate them. You are welcome to look up the Ka of acetic acid and HCl.

For details about this performance assessment, see the "Assessment Preparation" box in this course.

**Complete the Titration Summative Performance Assessment**

Go to [TaskStream](#) and complete the Titration of Strong/Weak Acids task. Before submitting, check that you have covered all the requirements in the rubric. If you need help, contact the course mentor.

For this task, you will be using the [Late Nite Labs](#) software. Acquaint yourself with this software. Read the background description for the lab in Late Nite Labs and follow the procedures exactly. You will be writing up your report separately to submit in TaskStream.

Even though you are working in a virtual lab, you still need to follow lab safety. Review the list of "Potential Laboratory Hazards" within the Science Methods LabPaq manual (around page 26) before starting the lab.

Note: Drag the flask to the burette (not the burette to the flask).

Thinkwell has a demonstration with the calculations worked out for you for an example problem:

- "CIA Demonstration: Barium Hydroxide-Sulfuric Acid Titration"
- Click on "Lab Preparation With Sound".

You are asked to compare the Ka values, not calculate them. You are welcome to look up the Ka of acetic acid and HCl.

**Chemical Energy**

Thermochemistry is the branch of chemistry that studies the amount of heat energy gained or lost during a chemical reaction. An interesting and important relationship is present between energy, work, and heat. But be careful, this relationship and an understanding of the definition of heat are often misunderstood. It is usually best to think of heat as energy transferred because of a difference in temperature.

**Thermochemistry**

This section will help you understand thermochemistry.
This topic addresses the following competencies:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.

- **Competency 204.3.2: Chemical Reactions**
  The graduate has a broad understanding of chemical reactions.

**The Nature of Energy**

Read the following section in *Chemistry*:

- section 6.1 ("The Nature of Energy")

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 6.1 ("The Nature of Energy")
  Work the practice problems.

In your science notebook, define the following terms:

- endothermic reaction
- exothermic reaction

**Enthalpy and Calorimetry**

Read the following section in the *Chemistry* text:

- section 6.2 ("Enthalpy and Calorimetry")

Watch the following Thinkwell videos:

- "Heats of Reaction: Enthalpy"
- "CIA Demonstration: Thermite Reaction"

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 6.2 ("Enthalpy and Calorimetry")

View the following recorded call:

- "Practice Problems"

**Hess's Law**

Read the following section in *Chemistry*:

- section 6.3 ("Hess's Law")

Complete all MAS questions in the following section of the OWL Chemistry resource:
Experiment 9: Caloric Content of Food

Complete the following experiment in the Science Methods LabPaq:

- experiment 9 ("Caloric Content of Food")

Be sure to review the Laboratory Techniques, Basic Safety, and Potential Laboratory Hazards described at the beginning of the Science Methods LabPaq manual.

Periodicity

The periodic table may be the greatest tool ever used by chemists. It was originally used to describe patterns observed in properties of elements before it eventually became apparent that it can also be used to predict patterns in elements.

Periodic Trends

This section will help you understand the periodic table. While you are certainly not expected to memorize the periodic table, you should be able to read it fluently, and you should know the most common atoms without having to constantly refer to it.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**
  
The graduate has a broad understanding of chemical structure and stability.

Contributors to Our Understanding of the Atom

Review the following sections in *Chemistry*:

- section 7.1 ("Electromagnetic Radiation")
- section 7.2 ("The Nature of Matter")
- section 7.3 ("The Atomic Spectrum of Hydrogen")
- section 7.4 ("The Bohr Model")
- section 7.5 ("The Quantum Mechanical Model of the Atom")

Review the contributions by the following individuals:

- Democritus
- Dalton
- Rutherford
- Thomson
- Millikan
- Bohr
- de Broglie

Filling Orbitals

Read the following section in *Chemistry*:
Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 7.11d ("Electron Configurations: Filling Orbitals")

**Periodic Trends in Atomic Properties**

Read the following section in *Chemistry*:

- section 7.12 ("Periodic Trends in Atomic Particles")

Watch the following Thinkwell videos:

- "Periods and Atomic Size"
- "Ionization Energy"
- "Electron Affinity"
- "An Introduction to Electronegativity"

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 7.12 ("Periodic Trends in Atomic Particles")

**Ionic and Covalent Bonding**

A chemical bond is the energy that holds atoms together.

**Chemical Bonding**

This section will help you understand chemical bonding. As you review the activities, think about how ionic and covalent bonds compare.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.

**How Electronegativity Affects Bonding**

Read the following sections in *Chemistry*:

- section 8.1 ("Types of Chemical Bonds")
- section 8.2 ("Electronegativity")
- section 8.3 ("Bond Polarity and Dipole Moments")

Complete all MAS questions in the following sections of the OWL Chemistry resource:

- section 8.2 ("Electronegativity")
- section 8.3 ("Bond Polarity and Dipole Moments")

**How Ionization Energy Affects Bonding**
Read the following sections in the *Chemistry* text:

- section 8.4 ("Ions: Electron Configurations and Sizes")
- section 8.5 ("Energy Effects in Binary Ionic Compounds")
- section 8.6 ("Partial Ionic Character of Covalent Bonds")

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 8.4 ("Ions: Electron Configurations and Sizes")

**Valence Electrons and Chemical Bonding**

Watch the following Thinkwell videos:

- "Valence Electrons and Chemical Bonding"
- "Ionic Bonds"
- "CIA Demonstration: Conductivity Apparatus-Ionic versus Covalent Bonds"

Covalent bonding is determined by atomic size, ionization energy, and electronegativity.

In your science notebook, list each term. Next to each term, write why the characteristic would make two atoms share an electron instead of trading the electron.

**Molecular Structure**

This section will help you understand the Lewis structure and VSEPR model. Practice first with individual atoms and then combine the individual atoms into molecules.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.

**Lewis Dot Structures**

Read the following sections in *Chemistry*:

- section 8.10 ("Lewis Structures")
- section 8.11 ("Exceptions to the Octet Rule")
- section 8.12 ("Resonance")

Watch the following Thinkwell videos:

- "Lewis Dot Structures for Covalent Bonds"
- "Predicting Lewis Dot Structures"

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 8.10e ("Lewis Structures: Interpret")
Molecular Geometry and the VSEPR Theory

Read the following section in the *Chemistry* text:

- section 8.13 ("Molecular Structure: The VSEPR Model")

Watch the following Thinkwell videos:

- "Valence-Shell Electron-Pair Repulsion Theory"
- "Molecular Shapes for Steric Numbers 2-4"
- "Molecular Shapes for Steric Numbers 5 & 6"
- "Predicting Molecular Characteristics Using VSEPR Theory"

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 8.13e ("Molecular Geometry from Lewis Structure: 2, 3, or 4 Pairs")

**Solids, Liquids, and Gases**

This section covers both intramolecular bonding and intermolecular forces.

**Gases**

This section will help you understand gases.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**

  The graduate has a broad understanding of chemical structure and stability.

**The Ideal Gas Law**

Read the following sections in *Chemistry*:

- section 5.1 ("Pressure")
- section 5.2 ("The Gas Laws of Boyle, Charles and Avogadro")
- section 5.3 ("The Ideal Gas Law")

Watch the following Thinkwell video:

- "The Ideal Gas Law"

Complete all MAS questions in the following sections of the OWL Chemistry resource:

- section 5.3d ("Ideal Gas Law: Calculate P, V, and T")
- section 5.3e ("Combined Gas Law: Calculate P2, V2, and T2")

**Self Study**

In your science notebook, write the PV = nRT equation, and then write what each variable
stands for.

- How does changing one variable affect the other variables?
- How can you relate the following two systems together?
  - \( \frac{PV}{T} = \frac{PV}{T} \)

**Experiment 5: Properties of Gases**

Complete the following experiment in the Science Methods LabPaq:

- experiment 5 ("Properties of Gases")

Be sure to review the Laboratory Techniques, Basic Safety, and Potential Laboratory Hazards described at the beginning of the Science Methods LabPaq manual.

**Liquids and Solids**

This section will help you understand liquids and solids.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.

**Properties of Liquids**

Read the following sections in *Chemistry*:

- section 10.1 ("Intermolecular Forces")
- section 10.2 ("The Liquid State")

Watch the following Thinkwell video:

- "Properties of Liquids"

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 10.1i ("Intermolecular Forces: Effects")

**Experiment 4: Separation of a Mixture of Solids**

Complete the following experiment in the Science Methods LabPaq:

- experiment 4 ("Separation of a Mixture of Solids")

**Properties of Ionic Solids**

Read the following section in *Chemistry*:

- section 10.7 ("Ionic Solids")
Review the following table within this section:

- Table 10.7 ("Types and Properties of Solids")

Watch the following Thinkwell video:

- "CIA Demonstration: The Conductivity of Molten Salts"

In your science notebook, list the properties of an ionic crystal. Include the general melting temperature, electricity conduction, hardness, and brittleness.

**Changes of State**

As temperature and pressure change, so does the phase of a substance. Diagrams can be made to show these phase changes.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.

**Phase Changes**

Read the following section in *Chemistry*:

- section 10.8 ("Vapor Pressure and Changes of State")

Complete all MAS questions in the following sections of the OWL Chemistry resource:

- section 10.8a ("Phase Changes and Energy Flow: Particulate")
- section 10.8d ("Intermolecular Forces and Vapor Pressure")
- section 10.8q ("Heating Curves: Interpret")

**Phase Diagrams**

Read the following section in *Chemistry*:

- section 10.9 ("Phase Diagrams")

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 10.9c ("Phase Diagrams: Interpret")

**Particle Organization**

In your science notebook, make a chart like the one below and fill in what you already know. Fill in the rest with information from the *Chemistry* text.

<table>
<thead>
<tr>
<th>Particle Organization</th>
<th>Density</th>
<th>Compressibility</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


Solutions

This section covers solutes, solvents, and concentrated solutions.

**Solutions**

This section will help you understand solutions. A solution is a homogenous mixture of two or more substances.

This topic addresses the following competency:

- **Competency 204.3.4: Solutions, Rates, and Energy Changes**
  The graduate has a broad understanding of solutions, rates of reaction, and energy changes.

**Types of Solutions**

Watch the following Thinkwell video:

- "Types of Solutions"

In your science notebook, provide examples of solutions, naming the solute and the solvent. Be sure to include examples from all states of matter.

Complete all MAS questions in the following section of the OWL Chemistry resource:

- section 11.2a ("Solution Terminology")

You are responsible for knowing the solution terminology summarized here.

**Solutions Practice Problems**

Practice calculating a solution's concentration. This can be done several ways. Section 11.1 in the *Chemistry* text works through many methods.

Complete all MAS questions in the following sections of the OWL Chemistry resource:

- section 11.1a ("Mass Percent")
- section 11.1f ("Molarity: Mass Percent and Density")

Parts per million (ppm) is another way to show concentration of a solution. Parts per million can refer to a ratio of masses. For example, if a solution is 1ppm then there is one gram of solute per 1000 kilogram of solution.
Solution Composition Chart

Watch the following Thinkwell videos:

- "Molarity and the Mole Fraction"
- "Molality"

In your science notebook, complete the following chart:

<table>
<thead>
<tr>
<th>Units</th>
<th>How You Find It</th>
</tr>
</thead>
<tbody>
<tr>
<td>Percent</td>
<td></td>
</tr>
<tr>
<td>Molarity</td>
<td></td>
</tr>
<tr>
<td>Parts Per Million</td>
<td></td>
</tr>
</tbody>
</table>

Factors That Affect Solubility

Watch the following Thinkwell videos:

- "Energy and the Solution Process"
- "Temperature Change and Solubility"
- "Pressure Change and Solubility"

Read the following section in the *Chemistry* text:

- section 11.3 ("Factors Affecting Solubility")

In your science notebook, list the factors that affect solubility and describe why they do so.

Complete all MAS questions in the following sections of the OWL Chemistry resource:

- section 11.2b ("Solution Formation")
- section 11.2f ("Intermolecular Forces and Solubility")

Solutions Performance Assessment

Complete the following task in TaskStream:

- Chemistry Lab: Solutions

For details about this performance assessment, see the "Assessment Preparation" box.

Chemical Kinetics and Equilibrium

Chemical kinetics is the study of the factors that determine the rate of reaction. Chemical reactions are the application of chemistry. In order to fully understand these reactions, it is important to understand some of the underlying concepts that drive chemical reactions, such as chemical kinetics and chemical equilibrium.
Reaction Rate

This section will help you understand reaction rates. There are many factors that determine the rate of a reaction.

This topic addresses the following competency:

- Competency 204.3.4: Solutions, Rates, and Energy Changes
  The graduate has a broad understanding of solutions, rates of reaction, and energy changes.

Definition

Read the following section in Chemistry:

- section 12.1 ("Reaction Rates")

Watch the following Thinkwell videos:

- "An Introduction to Reaction Rates"
- "Rate Laws: How the Reaction Rate Depends on Concentration"

In your science notebook, answer the following questions:

- What is a reaction rate?
- From reviewing Figure 12.1, how does the concentration of reactant affect the reaction rate?

Factors That Affect Reaction Rates

Read the following sections in Chemistry:

- section 12.6 ("A Model for Chemical Kinetics")
- section 12.7 ("Catalysis")

Watch the following Thinkwell videos:

- "The Collision Model"
- "The Arrhenius Equation"
- "Catalysts and Types of Catalysts"

In your science notebook, answer the following questions:

- How does temperature affect the reaction rate?
- What two requirements must be satisfied for reactants to collide successfully, causing products to form?
- Can you explain Figure 12.13?
  Smaller reactant particles provide a greater surface area. This increases the chances for
particle collisions, so the reaction rate increases.

**Equilibrium Shift**

Read the following section in *Chemistry*:

- section 13.7 ("Le Châtelier's Principle")

In your science notebook, explain how the following affect equilibrium:

- change in concentration
- change in pressure
- change in temperature

**Examples of Reactions**

Watch the following Thinkwell videos:

- "CIA Demonstration: Elephant Snot"
- "CIA Demonstration: The Cobalt(II)-Catalyzed Reaction of Potassium Sodium Tartrate"
- "CIA Demonstration: The Copper-Catalyzed Decomposition of Acetone"

The Elephant Snot reaction was fast. In your science notebook, list examples of reactions that are fast and some that are slow. Think about reactions that occur around where you live and in the kitchen. Share examples in the message board of fast and slow reactions.

If the penny in the last video was cut into smaller pieces, there would be more surface area of copper. How would this effect the rate of the reaction?

**Reaction Rate Chart**

In your science notebook, complete the chart to explain the following questions:

- What does each factor do to the reaction rate?
- Why does each factor change the reaction rate?

<table>
<thead>
<tr>
<th>What It Does</th>
<th>What Does It</th>
</tr>
</thead>
<tbody>
<tr>
<td>Temperature</td>
<td></td>
</tr>
<tr>
<td>Reactant Concentration</td>
<td></td>
</tr>
<tr>
<td>Orientation of Particle</td>
<td></td>
</tr>
<tr>
<td>Particle Size</td>
<td></td>
</tr>
<tr>
<td>Catalyst</td>
<td></td>
</tr>
</tbody>
</table>
Think about the opposites of each factor. What happens when the particle size gets bigger? What if the size gets smaller?

**Electrochemistry**

As the name implies, electrochemistry is the study of the interchange of chemical and electrical energy.

**Electrochemistry**

Complete the activities within this section to gain an understanding of electrochemistry.

This topic addresses the following competency:

- **Competency 204.3.2: Chemical Reactions**
  The graduate has a broad understanding of chemical reactions.

**Review**

In previous activities you learned

- what makes water a good solvent,
- what makes a substance a strong electrolyte, and
- how the strength of a solution is determined.

In your science notebook, answer the following question:

- Which conducts electricity better: salt water or distilled water? Why?

**Electrochemical Cells**

Read the following sections in *Chemistry*:

- section 18.1 ("Balancing Oxidation-Reduction Equations")
- section 18.2 ("Galvanic Cells")

Watch the following Thinkwell videos:

- "Reviewing Oxidation-Reduction Reactions"
- "Electrochemical Cells"
- "Batteries"
- "CIA Demonstration: The Fruit-Powered Clock"
- "Electrolytic Cells"
- "Corrosion and the Prevention of Corrosion"

Complete all required MAS questions in the following sections of the OWL Chemistry resource:

- section 18.1
- section 18.2

**Oxidation States of Manganese Performance Assessment**
Complete the following task in TaskStream:

- Chemistry Lab: Oxidation States of Manganese

For details about this performance assessment, see the "Assessment Preparation" box in this course.

**Atomic Changes**

The term nuclear often makes people feel uncomfortable. The term really is not as scary as many people think. In fact, nuclear chemistry is really just the study of the nucleus of atoms.

**Nuclear Chemistry**

This section will help you understand nuclear chemistry. What do you think when you hear about radioactive decay? What do you think is happening to the atom?

This topic addresses the following competencies:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.
- **Competency 204.3.2: Chemical Reactions**
  The graduate has a broad understanding of chemical reactions.

**Balancing Nuclear Reactions**

Read the following section in Chemistry:

- section 19.1 ("Nuclear Stability and Radioactive Decay")

Watch the following Thinkwell video:

- "The Nature of Radioactivity"

Complete all required MAS questions in the following section of the OWL Chemistry resource:

- section 19.1

**Nuclear Changes**

Read the following section in Chemistry:

- section 19.3 ("Nuclear Transformations")

Watch the following Thinkwell video:

- "Stability of Atomic Nuclei"

Complete all MAS questions in the following sections of the OWL Chemistry resource:


- section 19.3a ("Decay vs. Bombardment Reactions")
- section 19.3b ("Nuclear Bombardment and Fission")
- section 19.3c ("Nuclear Bombardment and Fusion")

**Fusion and Fission**

Read the following section in *Chemistry*:

- section 19.6 ("Nuclear Fission and Nuclear Fusion")

Watch the following Thinkwell videos:

- "Nuclear Fission"
- "Nuclear Fusion"

Remember the difference between fusion and fission. Think about what the word fuse means to you. In your science notebook, draw a picture of something fusing. Fusion is as simple as putting two atoms together. Fission is splitting. Draw a picture of what it means to create a fissure.

**Experiment 13: Radioactive Decay**

Complete the following experiment in the Science Methods LabPaq:

- experiment 13 ("Radioactive Decay")

**Organic Molecules**

Organic chemistry is the study of the compounds of carbon. Much of organic chemistry is understanding how these organic compounds can be organized and grouped into functional groups, as well as understanding the physical properties and typical reactions of these groups.

**Organic Chemistry**

Most organic molecules are fundamentally hydrocarbons, but they have additional atoms or groups of atoms called functional groups. There are common functional groups that exhibit characteristics. In this section, you will learn about their characteristics.

This topic addresses the following competency:

- **Competency 204.3.1: Chemical Structure**
  The graduate has a broad understanding of chemical structure and stability.

**Functional Groups**

Read the following section in *Chemistry*:

- section 22.4 ("Hydrocarbon Derivatives")

While reading, write down common uses of each type of functional group.
There are five types of functional groups you need to know:

- alcohols
- aldehydes
- ketones
- organic acids
- esters

Make five flash cards and write the name of a functional group on the front of each card. On the back, write any information you learn about these groups.

Watch the following Thinkwell videos:

- "Alcohols, Ethers, and Amines"
- "Carbonyl-Containing Functional Groups"

Complete all required MAS questions in the following section of the OWL Chemistry resource:

- section 22.4

**Final Steps**

Congratulations on completing the activities in this course! This course has prepared you to complete the assessment associated with this course. If you have not already been directed to complete the assessment, schedule and complete your assessment now.

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