

Materials Science: Chemistry

Description: Materials Science: Chemistry explores the basic concepts of Chemistry and extends these ideas to real world applications. Materials Science consists of 5 main groupings; Crystals, Metals, Polymers, Glass/Ceramics, and Composites. These categories are explored through the application of chemistry, leading to many exciting, high quality experiments and investigations.

Why take Materials Science? Materials Science courses are a proven stepping-stone to engineering and technical disciplines. Students who choose Materials Science Engineering in college have jobs waiting for them when they graduate (100% of OSU MSE graduates were placed in jobs, averaging a **starting** salary of \$60,000!).

Course of Study

Topic/Time Frame	Ohio Science Academic Content Standards Grades 11-12	Ohio Technology Academic Content Standards Grades 9-12	Concepts Addressed	Activity (A) Demonstration (D) Lab (L) Video (V)
Unit 1: Introduction To Materials Science 3 Weeks	Standard - PS ➤ Benchmark - A ▫ Indicator – 12.1, 12.2 Standard - SI ➤ Benchmark - A ▫ Indicator – 11.5, 12.1, 12.2, 12.3, 12.4, 12.5	Standard 7-DW ➤ Benchmark - C ▫ Indicator - 9.4, 12.1 Standard 7-DW ➤ Benchmark - D ▫ Indicator - 9.2, 9.3, 9.4	<ul style="list-style-type: none"> ○ Science Safety ○ Scientific Method ○ History Of Materials ○ Classification Of Matter ○ Classification Of Materials 	<ul style="list-style-type: none"> ○ Paper Clip Destruction (A) ○ Happy Sad Balls (D) ○ Classification Of Matter (L) ○ Classification Of Materials (L) ○ Engineering Disasters (V) ○ White Powders Lab (L)

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	<p>Standard - SW</p> <ul style="list-style-type: none"> ➤ Benchmark - A ▫ Indicator – 12.2 			
<p>Unit 2:</p> <p>Measurements/Calculations & Basic Math Skills</p> <p>3 Weeks</p>	<p>Standard - PS</p> <ul style="list-style-type: none"> ➤ Benchmark - A ▫ Indicator – 12.1, 12.2 <p>Standard - SI</p> <ul style="list-style-type: none"> ➤ Benchmark - A ▫ Indicator – 12.1, 12.3 		<ul style="list-style-type: none"> ○ Measurement/Math Skills ○ Significant Digits ○ Scientific Notation ○ Accuracy/Precision ○ Dimensional Analysis ○ Area ○ Volume ○ Density ○ Percent Composition 	<ul style="list-style-type: none"> ○ Powers Of Ten (V) ○ Bubble Gum Article (A) ○ Bubble Gum Percent Composition (L) ○ Polymer Blocks (L) ○ Density Of Materials (L) ○ Small – Scale Balance Lab (L) ○ Coke Vs. Diet Coke (D) ○ Density Of Pennies (L) ○ Shrinking Plastic (L)
<p>Unit 3</p> <p>Properties Of Materials</p> <p>4 Weeks</p>	<p>Standard - PS</p> <ul style="list-style-type: none"> ➤ Benchmark - A ▫ Indicator – 12.1, 12.2 ➤ Benchmark - E ▫ Indicator – 12.15 <p>Standard - SI</p> <ul style="list-style-type: none"> ➤ Benchmark - A ▫ Indicator – 12.1, 12.2, 12.3, 12.4, 12.5 	<p>Standard 2-TS</p> <ul style="list-style-type: none"> ➤ Benchmark - C ▫ Indicator - 9.1, 9.2 <p>Standard 2-TS</p> <ul style="list-style-type: none"> ➤ Benchmark - E ▫ Indicator - 9.3, 12.2 <p>Standard 6-D</p> <ul style="list-style-type: none"> ➤ Benchmark - A ▫ Indicator - 9.9 ➤ Benchmark - C ▫ Indicator - 9.1 	<ul style="list-style-type: none"> ○ Measurement Of Chemical And Physical Properties ○ Chemical Properties ○ Thermal Properties ○ Mechanical Properties ○ States Of Matter ○ Phase Diagram ○ Separation Of Mixtures ○ Energy ○ Endothermic/Exothermic Reactions ○ Brittleness 	<ul style="list-style-type: none"> ○ Rolling Pennies (L) ○ Drawing Wire (L) ○ Making An Alloy (L) ○ Specific Heat Lab (L) ○ Rubber Bands And Heat (L) ○ Endothermic/Exothermic Reactions (L) ○ Paper Chromatography (L) ○ Properties Of Materials (V) ○ Thermal Conductivity

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	<p>Standard - ST</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.3, 12.5 	<p>Standard 7-DW</p> <ul style="list-style-type: none"> ➤ Benchmark - D <ul style="list-style-type: none"> ▫ Indicator - 9.2. 9.3, 9.4 	<ul style="list-style-type: none"> ○ Malleability ○ Ductility ○ Conductivity 	<p>Of Metals (D)</p> <ul style="list-style-type: none"> ○ Just A Phase (L)
<p>Unit 5</p> <p>Structure Of Materials</p> <p>4 Weeks</p>	<p>Standard - PS</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1 ➤ Benchmark – C <ul style="list-style-type: none"> ▫ Indicator 12.13 <p>Standard - SI</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.2, 12.3, 12.4, 12.5 	<p>Standard 7-DW</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 12.1 ➤ Benchmark - D <ul style="list-style-type: none"> ▫ Indicator - 9.2. 9.3, 9.4 <p>Standard 1-NT</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 9.1, 12.2 <p>Standard 2-TS</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 9.1, 9.2, 10.2 	<ul style="list-style-type: none"> ○ Atomic Theory ○ Structure Of The Atom ○ Structure Of Materials As They Relate To Macroscopic Properties ○ Crystal Structures ○ Amorphous ○ Ions ○ Octet Rule ○ Isotopes ○ Periodicity ○ Annealing ○ Tempering ○ Work-Hardening 	<ul style="list-style-type: none"> ○ Flame Test (L) ○ Isotopic Abundance (L) ○ Gas Tubes Line Spectrum (L) ○ Energy Of Photons From Flinn (D) ○ Ice Crystal Model (D) ○ Polystyrene Foam Ball Crystal Models (L) ○ Copper Wire (L) ○ Metal Explorations (L) ○ Nitinol Wire Temperature Of Transition (L) ○ Graphing Periodicity (A) ○ Samurai Sword Article (A)
<p>Unit 6</p> <p>Chemical Bonding & Formulas</p>	<p>Standard - PS</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.2 	<p>Standard 2-TS</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 9.1 <p>Standard 6-D</p>	<ul style="list-style-type: none"> ○ Types Of Bonds ○ Valence Electrons ○ Lewis Structures ○ Bonding & Properties As They Relate To 	<ul style="list-style-type: none"> ○ Growing Crystals (L) ○ Bobby Pin (L) ○ Grain Boundaries (Bending Tin Bar) (D) ○ Molecular Models (L)

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4 Weeks	<p>Standard - SI</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.2, 12.3, 12.4, 12.5 	<ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 9.1 <p>Standard 7-DW</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 12.1 	<p>Material Uses</p> <ul style="list-style-type: none"> ○ Lattice Forms ○ FCC/BCC Crystal Structures ○ Grain Boundaries ○ Writing & Naming Compounds ○ Polarity ○ Hydrogen Bonding ○ Water As Solvent 	<ul style="list-style-type: none"> ○ Molecular Origami (A) ○ Ions Lab (L)
<p>Unit 7</p> <p>Earth Materials</p> <p>4 Weeks</p>	<p>Standard - PS</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1 <p>Standard - SI</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.3, 12.4, 12.5 <p>Standard - ST</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.3 		<ul style="list-style-type: none"> ○ Minerals ○ Structure Of Earth ○ Types Of Rocks, Minerals, & Ores ○ Rock Tests ○ Nomenclature ○ Radioactive Decay ○ Radiation Protection ○ Fission Vs Fusion ○ Geologic Time 	<ul style="list-style-type: none"> ○ Earth Structure (A) ○ Rock Types (A) ○ Natural Resources (A) ○ Ionic Compound Naming (A) ○ Copper From Malachite (L) ○ Properties Of Minerals (L) ○ Aluminum Lab (L) ○ Radiation Shielding (L) ○ Earth's Magnetic Relative Dating (A) ○ Pennium-123 (L) ○ China Syndrome (V)
<p>Unit 8</p> <p>Metals & Reactions</p>	<p>Standard - PS</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.2 	<p>Standard 1- NT</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 9.1, 12.2 	<ul style="list-style-type: none"> ○ History, Structure, & Properties Of Metals ○ Metallic Bonding ○ Metal Failure 	<ul style="list-style-type: none"> ○ Metal Explorations (L) ○ Activity Series (L) ○ Tin/Bismuth Phase

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<p>5 Weeks</p>	<p>Standard - SI</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.3, 12.4, 12.5 <p>Standard - ST</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.3 	<p>Standard 2-TS</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 9.1, 9.2, 10.2 ➤ Standard 2-TS Benchmark - E <ul style="list-style-type: none"> ▫ Indicator - 9.3, 12.2 	<ul style="list-style-type: none"> ○ Activity Series ○ Writing And Balancing ○ Oxidation/Reduction Reactions ○ Acid/Base Reactions ○ Ph ○ Corrosion ○ Conductivity ○ Magnetic Properties ○ Metallurgy ○ Slip Planes ○ Extraction, Manufacturing Methods ○ Interstitial & Replacement Alloys 	<p>Diagram (L)</p> <ul style="list-style-type: none"> ○ Floating Penny (L) ○ Gold Penny (L) ○ Corrosion Of Nails (L) ○ Electroplating (L) ○ Tin Soldiers (L) ○ Lost Wax Casting (L)
<p>Unit 9</p> <p>Ceramics & Glasses</p> <p>3 Weeks</p>	<p>Standard - PS</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.2 <p>Standard - SI</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.2, 12.3, 12.4 <p>Standard - ST</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 	<p>Standard 7-DW</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 12.1 <p>Standard 2-TS</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 9.1, 9.2, 10.2 <p>Standard 2-TS</p> <ul style="list-style-type: none"> ➤ Benchmark - E <ul style="list-style-type: none"> ▫ Indicator - 12.2 	<ul style="list-style-type: none"> ○ History, Properties, & Structure Of Ceramics ○ Covalent Network ○ Crystalline Structure Vs. Amorphous Structure ○ Ionic Bonding ○ Insulators ○ Thermal Expansion ○ Heat Capacity ○ Quarries 	<ul style="list-style-type: none"> ○ Changing Clay (L) ○ Glass Fusion (L) ○ Glass Bending (L) ○ Borax Beads (L) ○ Density Of Glass (L) ○ Raku (L) ○ Samples Of Broken Glass (D) ○ Automatic Sunglasses (Article) ○ Non-Safety Glass (Article) ○ Smart Windows

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	12.2, ▫ 12.3			(Article)
Unit 10 Polymers & Carbon Chemistry 4 Weeks	Standard - PS ➤ Benchmark - A ▫ Indicator – 12.1, 12.2 ➤ Benchmark - E ▫ Indicator – 11.2, 12.15 Standard - SI ➤ Benchmark - A ▫ Indicator – 12.1, 12.3	Standard 1-NT ➤ Benchmark - C ▫ Indicator - 9.1, 12.2 Standard 2-TS ➤ Benchmark - C ▫ Indicator - 9.1, 9.2, 10.2 Standard 2-TS ➤ Benchmark - E ▫ Indicator - 9.3, 12.2 Standard 6-D ➤ Benchmark - A Indicator - 9.9	○ History, Structure, & Properties of Polymers ○ Polymer Nomenclature ○ Functional groups ○ Carbon bonding ○ Cross-linking ○ Catalysis ○ Natural & synthetic Polymers ○ Recycling ○ Fossil fuels ○ US Oil & Gas reserves ○ Flexibility & Rigidity ○ Glass Transition	○ Casein Glue ○ Milk Jug (D) ○ Rigid Foam (L) ○ Flexible Foam (L) ○ Polymer Detective (L) ○ Characterization of recyclable Polymers (IO) ○ Polymethylacrlate (D) ○ Slime, Gluep, Gak (L) ○ Playing with Polymers (L) ○ Nylon (D)
Unit 11 Composites 3 Weeks	Standard - PS ➤ Benchmark - A ▫ Indicator – 12.1, 12.2 ➤ Benchmark - E ▫ Indicator – 11.2, 12.15	Standard 1-NT ➤ Benchmark - C ▫ Indicator - 9.1, 12.2 Standard 2-TS ➤ Benchmark - C ▫ Indicator - 9.1, 9.2, 10.2	○ Investigations of underlying structures of matter ○ Properties of composites ○ Improvement of properties through the combination of	○ Polystyrene & Paper Laminate (L) ○ Epoxy & fiber (L) ○ Concrete Testing Concrete Strength (L) ○ Young’s Modulus of Beams (L)

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	<p>Standard - SI</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.2, 12.3, 12.5 <p>Standard - ST</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator – 12.1, 12.2 	<ul style="list-style-type: none"> ➤ Benchmark - E <ul style="list-style-type: none"> ▫ Indicator – 9.2, 9.3, 12.2 <p>Standard 6-D</p> <ul style="list-style-type: none"> ➤ Benchmark - C <ul style="list-style-type: none"> ▫ Indicator - 9.1, 12.1 <p>Standard 6-D</p> <ul style="list-style-type: none"> ➤ Benchmark - A <ul style="list-style-type: none"> ▫ Indicator - 9.3, 9.4, 12.1 <p>Standard 7-DW</p> <ul style="list-style-type: none"> ➤ Benchmark - D <ul style="list-style-type: none"> ▫ Indicator - 9.4, 11.5, 12.1, 12.2 	<p>materials</p> <ul style="list-style-type: none"> ○ Modern uses of composites ○ Laminates ○ Particle reinforced ○ Fiber reinforced 	
<p>Unit 12</p> <p>Materials Science of Chocolate</p> <p>1 Week</p>	<p>Standard - SI</p> <p>Benchmark – A</p> <p>Indicator – 11.3, 12.1, 12.3, 12.4</p> <p>Standard - SW</p> <p>Benchmark – A</p> <p>Indicator – 12.2</p>		<ul style="list-style-type: none"> ○ Tempering ○ Processing 	<ul style="list-style-type: none"> ○ The Materials Science of Chocolate (Article) ○ The Great Chocolate Experiment (L)

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