

Career & Technical Education (CTE) Standards Revision Project

Cluster: Manufacturing

Pathways: Production, Manufacturing Production Process, Logistics & Inventory Control, Maintenance/Installation & Repair

Manufacturing Cluster Overview

The Manufacturing cluster prepares students for careers in planning, managing and performing the processing of materials into intermediate or final products. Pathways related to professional and technical support for this cluster include: Production, Manufacturing Production Process Development, Maintenance/Installation & Repair, Logistics & Inventory and Control. (Source: www.careerclusters.org)

Ben Nesbitt, Program Director, Skilled Trades & Technical Sciences

Karen Ellis, Project Coordinator

Sherrie Schneider, Project Coordinator

Skilled Trades & Technical Sciences Content Team

Terry Angell
Warren Tech

Rod Atkins
Front Range Community College

Chuck Beck
Red Rocks Community College

Matt Brown
Warren Tech

Madonna Crane
Warren Tech

Gary Cryan
Front Range Community College

Mike Daly
Warren Tech

Vicki Flower
Warren Tech

Rick Glesner
Community College of Denver

Judi Maciel
Warren Tech

Robert Maez
Pueblo Community College

Chris Mathias
Warren Tech

Doug Mugge
Arapahoe Community College

Cathy Rock
Red Rocks Community College

Greg Shamburg
Pickens Technical College

Lorrie Toni
Colorado Community College System

Vic Vandamme
Warren Tech

Janet Wilson
Pikes Peak Community College

Kent Wright
Northeastern Junior College

Standards: Manufacturing 1

Career Cluster/Cluster Grouping:	Manufacturing
Pathway(s):	Manufacturing Production Process Development
Prepared Completer Competencies: <ul style="list-style-type: none"> MNC.10 Use the technical knowledge and skills required to pursue the targeted careers for all pathways in the career cluster, including knowledge of design, operation and maintenance of technological systems critical to the career cluster. 	
High School Expectations	
Concepts and skills students know include: <ul style="list-style-type: none"> MNC10.01 Describe and employ technical skills and knowledge required for careers in manufacturing in order to perform basic workplace activities common to manufacturing. 	
Evidence Outcomes - Students can:	21st Century Skills and Readiness Competencies
<p>a. Demonstrate the planning and layout processes (e.g., designing, print reading, measuring) used in manufacturing.</p> <p>MAT01.02.a, MAT04.01.a, MAT04.01.b, MAT04.01.c, MAT04.01.d, MAT04.01.e, MAT04.01.f, MAT04.02.a, MAT04.02.b, MAT04.02.c, MAT04.02.d, MAT04.02.e, MAT04.02.f, MAT04.03.a, MAT04.03.b, MAT04.03.c, MAT04.03.d</p> <p>RWC01.01.a, RWC01.01.b, RWC01.01.c, RWC01.01.d, RWC01.01.e, RWC01.01.f, RWC01.02.a, RWC01.02.b, RWC01.02.c, RWC01.02.d, RWC01.02.e, RWC01.02.f, RWC01.02.g, RWC01.03.a, RWC01.03.b, RWC01.03.c, RWC01.03.d, RWC01.05.a, RWC01.05.b, RWC01.05.c, RWC02.01.c, RWC02.02.a, RWC02.02.b, RWC02.02.c, RWC02.02.d, RWC02.05.a, RWC02.06.b, RWC02.06.c, RWC03.01.a, RWC03.01.b, RWC03.01c, RWC03.01.d, RWC03.02.g, RWC03.03.a, RWC03.03.b, RWC03.03.c, RWC03.03.d, RWC03.03.e, RWC03.03.f</p>	Academic Content Knowledge Alignment: <p>MAT01.02.a - Number Sense, Properties, and Operations:</p> <ul style="list-style-type: none"> Use of number theory arguments to justify relationships involving whole numbers <ul style="list-style-type: none"> Develop and justify conjectures about relationships involving whole numbers. <p>MAT03.01.a - Data Analysis, Statistics, and Probability:</p> <ul style="list-style-type: none"> Statistical methods take variability into account, supporting informed decision-making through quantitative studies designed to answer specific questions <ul style="list-style-type: none"> Formulate appropriate research questions that can be answered with statistical analysis. <p>MAT03.01.b - Data Analysis, Statistics, and Probability:</p> <ul style="list-style-type: none"> Statistical methods take variability into account, supporting informed decision-making through quantitative studies designed to answer specific questions <ul style="list-style-type: none"> Determine appropriate data collection methods to answer a research question.

PWR01.01.b, PWR01.01.c, PWR01.01.e, PWR01.02.b, PWR01.02.d, PWR02.02.b, PWR02.03.a, PWR02.03.b, PWR02.03.c, PWR02.04.b, PWR02.04.c, PWR02.04.d, PWR02.06.a, PWR02.06.b, PWR02.06.c, PWR02.06.d, PWR02.06.e, PWR02.06.f, PWR02.06.g, PWR02.07.c, PWR02.07.d, PWR02.07.e, PWR02.07.f, PWR02.07.g, PWR02.08.a, PWR02.08.b, PWR02.08.c, PWR02.09.a, PWR02.09.b, PWR02.09.c, PWR02.09.d

b. Summarize how materials can be processed using tools and machines.

MAT01.02.a, MAT04.01.a, MAT04.01.b, MAT04.01.c, MAT04.01.d, MAT04.01.e, MAT04.01.f, MAT04.02.a, MAT04.02.b, MAT04.02.c, MAT04.02.d, MAT04.02.e, MAT04.02.f, MAT04.03.a, MAT04.03.b, MAT04.03.c, MAT04.03.d

RWC01.01.a, RWC01.01.b, RWC01.01.c, RWC01.01.d, RWC01.01.e, RWC01.01.f, RWC01.02.a, RWC01.02.b, RWC01.02.c, RWC01.02.d, RWC01.02.e, RWC01.02.f, RWC01.02.g, RWC01.03.a, RWC01.03.b, RWC01.03.c, RWC01.03.d, RWC01.05.a, RWC01.05.b, RWC01.05.c, RWC02.01.c, RWC02.01.d, RWC02.02.a, RWC02.02.b, RWC02.02.c, RWC02.02.d, RWC02.05.a, RWC02.06.b, RWC02.06.c, RWC03.01.a, RWC03.01.b, RWC03.01.c, RWC03.01.d, RWC03.02.g, RWC03.03.a, RWC03.03.b, RWC03.03.c, RWC03.03.d, RWC03.03.e, RWC03.03.f

SCI01.01.a, SCI01.01.b, SCI01.01.c, SCI01.01.d, SCI01.01.e, SCI01.02.a, SCI01.02.b, SCI01.02.c, SCI01.02.d, SCI01.03.a, SCI01.03.b, SCI01.03.d, SCI01.05.a, SCI01.05.b, SCI01.05.c, SCI01.05.d, SCI01.06.a, SCI01.06.b, SCI01.06.c, SCI02.01.c

PWR01.01.b, PWR01.01.c, PWR01.01.e, PWR01.02.b, PWR01.02.d, PWR02.02.b, PWR02.03.a, PWR02.03.b, PWR02.03.c, PWR02.04.b, PWR02.04.c, PWR02.04.d, PWR02.06.a, PWR02.06.b, PWR02.06.c, PWR02.06.d, PWR02.06.e, PWR02.06.f, PWR02.06.g, PWR02.07.c, PWR02.07.d, PWR02.07.e, PWR02.07.f, PWR02.07.g, PWR02.08.a, PWR02.08.b, PWR02.08.c, PWR02.09.a, PWR02.09.b, PWR02.09.c, PWR02.09.d

MAT03.01.c - Data Analysis, Statistics, and Probability:

- Statistical methods take variability into account, supporting informed decision-making through quantitative studies designed to answer specific questions.
 - Explain how data might be analyzed to provide answers to a research question.

MAT03.02.a - Data Analysis, Statistics, and Probability:

- The design of an experiment or sample survey is of critical importance to analyzing the data and drawing conclusions.
 - Identify the characteristics of a well-designed and well-conducted survey.

MAT03.02.c - Data Analysis, Statistics, and Probability:

- The design of an experiment or sample survey is of critical importance to analyzing the data and drawing conclusions
 - Differentiate between the inferences that can be drawn in experiments versus observational studies.

MAT03.03.a - Data Analysis, Statistics, and Probability:

- Visual displays and summary statistics condense the information in data sets into usable knowledge
 - Identify and choose appropriate ways to summarize numerical or categorical data using tables, graphical displays, and numerical summary statistics (describing shape, center and spread) and accounting for outliers when appropriate.

MAT03.03.b - Data Analysis, Statistics, and Probability:

- Visual displays and summary statistics condense the information in data sets into usable knowledge
 - Define and explain how sampling distributions (developed through simulation) are used to describe the sample-to-sample variability of sample statistics.

MAT03.03.c - Data Analysis, Statistics, and Probability:

- Visual displays and summary statistics condense the information in data sets into usable knowledge.
 - Describe the relationship between two categorical variables using percents.

MAT04.01.a - Shape, Dimension, and Geometric Relationships:

- Attributes of two- and three-dimensional objects are measurable and can be quantified.
 - Calculate (or estimate when appropriate) the perimeter and area of a two-dimensional irregular shape.

<p>c. Describe various types of assembling processes (e.g., mechanical fastening, mechanical force, joining, fusion bonding, adhesive bonding) used in manufacturing.</p> <p>MAT01.02.a</p> <p>SCI03.05.a, SCI03.05.b, SCI03.06.b, SCI03.06.d</p> <p>PWR01.01.b, PWR01.01.c, PWR01.01.e, PWR01.02.b, PWR01.02.d, PWR02.02.b, PWR02.03.a, PWR02.03.b, PWR02.03.c, PWR02.04.b, PWR02.04.c, PWR02.04.d, PWR02.06.a, PWR02.06.b, PWR02.06.c, PWR02.06.d, PWR02.06.e, PWR02.06.f, PWR02.06.g, PWR02.07.c, PWR02.07.d, PWR02.07.e, PWR02.07.f, PWR02.07.g, PWR02.08.a, PWR02.08.b, PWR02.08.c, PWR02.09.a, PWR02.09.b, PWR02.09.c, PWR02.09.d</p> <p>d. Explain finishing processes (e.g., types of finishing materials, surface preparation, methods of application) used in manufacturing.</p> <p>MAT01.02.a,</p> <p>RWC04.06.c, RWC04.06.d, RWC04.06.e</p> <p>PWR01.01.b, PWR01.01.c, PWR01.01.e, PWR01.02.b, PWR01.02.d, PWR02.02.b, PWR02.03.a, PWR02.03.b, PWR02.03.c, PWR02.04.b, PWR02.04.c, PWR02.04.d, PWR02.06.a, PWR02.06.b, PWR02.06.c, PWR02.06.d, PWR02.06.e, PWR02.06.f, PWR02.06.g, PWR02.07.c, PWR02.07.d, PWR02.07.e, PWR02.07.f, PWR02.07.g, PWR02.08.a, PWR02.08.b, PWR02.08.c, PWR02.09.a, PWR02.09.b, PWR02.09.c, PWR02.09.d</p>	<p>MAT04.01.b - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Attributes of two- and three-dimensional objects are measurable and can be quantified. <ul style="list-style-type: none"> ○ Justify, interpret, and apply the use of formulas for the surface area, and volume of cones, pyramids, and spheres including real-world situations. <p>MAT04.01.c - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Attributes of two- and three-dimensional objects are measurable and can be quantified. <ul style="list-style-type: none"> ○ Solve for unknown quantities in relationships involving perimeter, area, surface area, and volume. <p>MAT04.01.d - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Attributes of two- and three-dimensional objects are measurable and can be quantified. <ul style="list-style-type: none"> ○ Apply the effect of dimensional change, utilizing appropriate units and scales in problem-solving situations involving perimeter, area, and volume. <p>MAT4.1.e - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Determination and utilization of the area of irregular shapes, and surface area and volume of cones and pyramids, cylinders and prisms, and spheres. <ul style="list-style-type: none"> ○ Analyze real-world situations involving perimeter and area of irregular shapes and volume of cones/pyramids, cylinders/prisms, and spheres. <p>MAT04.01.f - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Determination and utilization of the area of irregular shapes, and surface area and volume of cones and pyramids, cylinders and prisms, and spheres <ul style="list-style-type: none"> ○ Develop and justify conjectures about relationships among properties of shapes in two- and three-dimensions using construction tools, including technology. <p>MAT04.02.a - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Objects in the plane and their parts, attributes, and measurements can be analyzed deductively. <ul style="list-style-type: none"> ○ Classify polygons according to their similarities and differences. <p>MAT04.02.b - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Objects in the plane and their parts, attributes, and measurements can be analyzed deductively. <ul style="list-style-type: none"> ○ Solve for unknown attributes of geometric shapes based on their congruence, similarity, or symmetry.
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<p>e. Explain the processes of inspection and quality control used in manufacturing.</p> <p>MAT01.02.a, MAT03.01.a, MAT03.01.b, MAT03.01.c, MAT03.02.a, MAT03.02.c, MAT03.03.a, MAT03.03.b, MAT03.03.c</p> <p>RWC03.01.a, RWC03.01.b, RWC03.01c, RWC03.02.g, RWC03.03.a, RWC03.03.b, RWC03.03.c, RWC03.03.d, RWC03.03.e, RWC03.03.f, RWC03.04.a, RWC03.04.b, RWC03.04.c, RWC03.04.d, RWC04.06.c, RWC04.06.d, RWC04.06.e</p> <p>SCI03.05.a, SCI03.05.b, SCI03.06.b, SCI03.06.d</p> <p>PWR01.01.b, PWR01.01.c, PWR01.01.e, PWR01.02.b, PWR01.02.d, PWR02.02.b, PWR02.03.a, PWR02.03.b, PWR02.03.c, PWR02.04.b, PWR02.04.c, PWR02.04.d, PWR02.06.a, PWR02.06.b, PWR02.06.c, PWR02.06.d, PWR02.06.e, PWR02.06.f, PWR02.06.g, PWR02.07.c, PWR02.07.d, PWR02.07.e, PWR02.07.f, PWR02.07.g, PWR02.08.a, PWR02.08.b, PWR02.08.c, PWR02.09.a, PWR02.09.b, PWR02.09.c, PWR02.09.d</p>	<p>MAT04.02.c - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Objects in the plane and their parts, attributes, and measurements can be analyzed deductively. <ul style="list-style-type: none"> ○ Know and apply properties of angles including corresponding, exterior, interior, vertical, complementary, and supplementary angles to solve problems. Justify the results using two-column proofs, paragraph proofs, flow charts, or illustrations. <p>MAT04.02.d - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Objects in the plane and their parts, attributes, and measurements can be analyzed deductively <ul style="list-style-type: none"> ○ Develop conjectures and solve problems about geometric figures including definitions and properties (congruence, similarity, and symmetry). Justify these conjectures using two-column proofs, paragraph proofs, flow charts, or illustrations. <p>MAT04.02.e - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Relationships among two- and three-dimensional geometric figures, including congruence, similarity and symmetry. <ul style="list-style-type: none"> ○ Design a geometric structure with accurate and appropriate units of measure. <p>MAT04.02.f - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Relationships among two- and three-dimensional geometric figures, including congruence, similarity and symmetry. <ul style="list-style-type: none"> ○ Develop and justify conjectures about relationships among properties of shapes in two dimensions (polygons and circles) and three dimensions (cones and pyramids, cylinders and prisms, and spheres) using construction tools, including technology. <p>MAT04.03.a - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically. <ul style="list-style-type: none"> ○ Make conjectures involving two-dimensional objects represented with Cartesian coordinates. Justify these conjectures using two-column proofs, paragraph proofs, flow charts, and/or illustrations. <p>MAT04.03.b - Shape, Dimension, and Geometric Relationships:</p> <ul style="list-style-type: none"> • Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically. <ul style="list-style-type: none"> ○ Represent transformations (reflection, translation, rotation, and dilation) using Cartesian coordinates.
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MAT04.03.c - Shape, Dimension, and Geometric Relationships:

- Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically.
 - Develop arguments to establish what remains invariant and what changes after a transformation (reflection, translation, rotation, and dilations). Justify these conjectures using two-column proofs, paragraph proofs, flow charts, and/or illustrations.

MAT04.03.d - Shape, Dimension, and Geometric Relationships:

- Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically.
 - Using construction tools, including technology, make conjectures about relationships among properties of shapes in the plane including those formed through transformation. Justify these conjectures using two-column proofs, paragraph proofs, flow charts, and/or illustrations.

RWC01.01.a - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness.
 - Prepare and deliver a formal presentation for different purposes and audiences (such as expository, persuasive, entertaining, inspirational, or recognition).

RWC01.01.b - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness.
 - Identify a central idea or thesis, organize ideas, and develop a speech for an intended purpose and audience.

RWC01.01.c - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness.
 - Use examples, illustrations, graphics, quotations, analogies, facts, and statistics to focus and support the content of a presentation.

RWC01.01.d - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness.
 - Use grammar and vocabulary appropriate for the situation, audience, topic, and purpose.

RWC01.01.e - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness.
 - Choose specific words and word order for intended effect and meaning.

RWC01.01.f - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness.
 - Select appropriate technical or specialized language.

RWC01.02.a - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
 - Design an effective group effort to accomplish a goal.

RWC01.02.b - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
 - Implement an effective group effort that achieves a goal.

RWC01.02.c - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
 - Analyze differences in group perspectives to help bring the group to consensus or to solve a perceived problem.

RWC01.02.d - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
 - Participate in the preparations of the group activity or product, defining and assuming individual roles and responsibilities.

RWC01.02.e - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
 - Assume a leadership role in a group that is collaboratively working to accomplish a goal.

RWC01.02.f - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
 - Self-evaluate roles in the preparation and completion of the group goal.

RWC01.02.g - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
 - Critique and offer suggestions for improving presentations given by own group and other groups.

RWC01.03.a - Oral Expression and Listening:

- Verbal and nonverbal cues impact the intent of communication.
 - Give informal talks using an appropriate level of formality of verbal language and nonverbal interaction with audience.

RWC01.03.b - Oral Expression and Listening:

- Verbal and nonverbal cues impact the intent of communication.
 - Deliver formal oral presentations for intended purpose and audience, using effective verbal and nonverbal communication.

RWC01.03.c - Oral Expression and Listening:

- Verbal and nonverbal cues impact the intent of communication.
 - Deliver oral talks with clear enunciation, vocabulary, and appropriate organization; nonverbal gestures; and tone.

RWC01.03.d - Oral Expression and Listening:

- Verbal and nonverbal cues impact the intent of communication.
 - Analyze audience responses to evaluate how effectively the talk or presentation met the purpose.

RWC01.05.a - Oral Expression and Listening:

- Content that is gathered carefully and organized well successfully influences an audience.
 - Organize and deliver a presentation that influences a specific audience.

RWC01.05.b - Oral Expression and Listening:

- Content that is gathered carefully and organized well successfully influences an audience.
 - Reflect on the content and approach to a presentation.

RWC01.05.c - Oral Expression and Listening:

- Content that is gathered carefully and organized well successfully influences an audience.
 - Select organizational patterns and structures and choose precise vocabulary and rhetorical devices.

RWC02.01.c - Reading for All Purposes:

- Apply critical reading and metacognitive strategies to interpret, analyze and evaluate form, function and structure in a variety of complex literary texts.
 - Synthesize central ideas, supporting details, or themes.

RWC02.01.d - Reading for All Purposes

- Apply critical reading and metacognitive strategies to interpret, analyze and evaluate form, function and structure in a variety of complex literary texts.
 - Describe, compare, or make inferences about characters, ideas, or events within and among texts.

RWC02.02.a - Reading for All Purposes:

- Interpreting and evaluating complex informational texts require the understanding of rhetoric, critical reading, and analysis skills.
 - Use reading and note-taking strategies (outlining, mapping systems, skimming, scanning, key word search) to organize information and make connections within and across informational texts.

RWC02.02.b - Reading for All Purposes:

- Interpreting and evaluating complex informational texts require the understanding of rhetoric, critical reading, and analysis skills.
 - Use semantic cues, signal words, and transitions to identify text structures (such as critique, proposition/support, inductive/deductive) and to summarize central ideas and supporting details.

RWC02.02.c - Reading for All Purposes:

- Interpreting and evaluating complex informational texts require the understanding of rhetoric, critical reading, and analysis skills.
 - Obtain and use information from text and text features (index, bold or italicized text, subheadings, graphics) to answer questions, perform specific tasks, or identify and solve problems.

RWC02.02.d - Reading for All Purposes:

- Interpreting and evaluating complex informational texts require the understanding of rhetoric, critical reading, and analysis skills.
- Explain and interpret the visual components supporting the text (maps, complex tables and diagrams, and transitional devices, such as use of white space).

RWC02.05.a - Reading for All Purposes:

- Literary and historical influences determine the meaning of traditional and contemporary literary texts.
 - Generalize about universal themes, cultural or historical perspectives from multiple texts.

RWC02.06.b - Reading for All Purposes:

- Apply understanding of complex organizational text structures and features to reading comprehension.
 - Use the features of electronic information to communicate, gain information, or research a topic.

RWC02.06.c - Reading for All Purposes:

- The development of new ideas and concepts within informational and persuasive manuscripts.
 - Compare the development of an idea or concept in multiple texts supported by text-based evidence.

RWC03.01.a - Writing and Composition:

- Use a recursive writing process for planning, developing and revising text for a variety of academic, workplace, and literary purposes and audiences.
 - Establish and maintain a text structure appropriate to audience and purpose.

RWC03.01.b - Writing and Composition:

- Use a recursive writing process for planning, developing and revising text for a variety of academic, workplace, and literary purposes and audiences.
 - Organize ideas consistent with text structure (e.g., chronology, proposition-support, critique, inductive-deductive) in well-developed paragraphs.

RWC03.01.c - Writing and Composition:

- Use a recursive writing process for planning, developing and revising text for a variety of academic, workplace, and literary purposes and audiences.
 - Select and use formal, informal, literary, or technical language appropriate to audience and context.

RWC03.01.d - Writing and Composition:

- Use a recursive writing process for planning, developing and revising text for a variety of academic, workplace, and literary purposes and audiences.
 - Write with clear focus, depth, accurate and relevant detail.

RWC03.02.g - Writing and Composition:

- Ideas, evidence, structure, and style create persuasive, academic, and technical texts for particular audiences and specific purposes.
 - Draw a conclusion by synthesizing information.

RWC03.03.a - Writing and Composition:

- Standard English conventions effectively communicate to targeted audiences and purposes.
 - Follow the conventions of Standard English to write varied, strong, correct, complete sentences.

RWC03.03.b - Writing and Composition:

- Standard English conventions effectively communicate to targeted audiences and purposes.
 - Deliberately manipulate the conventions of Standard English for stylistic effect appropriate to the needs of a particular audience and purpose.

RWC03.03.c - Writing and Composition:

- Standard English conventions effectively communicate to targeted audiences and purposes.
 - Seek and use an appropriate style guide to govern conventions for a particular audience and purpose.

RWC03.03.d - Writing and Composition:

- Manipulate the elements and structures of informational text to create persuasive, academic, and technical writing.
 - Select language appropriate to context (e.g., technical, formal).

RWC03.03.e - Writing and Composition:

- Manipulate the elements and structures of informational text to create persuasive, academic, and technical writing.
 - Use transitional words or phrases appropriate to text structure to enhance ideas.

RWC03.03.f - Writing and Composition:

- Manipulate the elements and structures of informational text to create persuasive, academic, and technical writing.
 - Support judgments with substantial evidence and well-chosen elaboration.

RWC03.04.a - Writing and Composition:

- Stylistic and thematic elements of literary or narrative texts can be refined to engage or entertain an audience.
 - Organize events, details, ideas and reflections or observations strategically to influence the audience's emotions and understanding of the implicit or explicit theme.

RWC03.04.b - Writing and Composition:

- Stylistic and thematic elements of literary or narrative texts can be refined to engage or entertain an audience.
 - Write literary and narrative texts using a range of stylistic devices (poetic techniques, figurative language, symbolism, graphic or visual components) to support the presentation of implicit or explicit theme.

RWC03.04.c - Writing and Composition:

- Stylistic and thematic elements of literary or narrative texts can be refined to engage or entertain an audience.
 - Enhance the expression of voice, tone, and point of view in a text by strategically using precise diction (considering denotation, connotation, and audience associations); diverse syntax; varied sentence patterns; and punctuation for stylistic effect.

RWC03.04.d - Writing and Composition:

- Stylistic and thematic elements of literary or narrative texts can be refined to engage or entertain an audience.
 - Use a range of strategies to evaluate whether the writing is presented in a clear and engaging manner (such as reading the text from the perspective of the intended audience, seeking feedback from a reviewer).

RWC04.06.c - Research and Reasoning:

- Collect, analyze, and evaluate information obtained from multiple sources to answer a question, propose solutions, or share findings and conclusions.
 - Identify and evaluate potential sources of information for accuracy, reliability, validity, and timeliness.

RWC04.06.d - Research and Reasoning :

- Collect, analyze, and evaluate information obtained from multiple sources to answer a question, propose solutions, or share findings and conclusions.
 - Use a variety of strategies (such as search engines, online databases, interview) to collect and organize relevant and significant information.

RWC04.06.e - Research and Reasoning:

- Collect, analyze, and evaluate information obtained from multiple sources to answer a question, propose solutions, or share findings and conclusions.
 - Distinguish between types of evidence (such as expert testimony, analogies, anecdotes, statistics) and use a variety of types to support a particular research purpose.

SCI01.01.a - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.
 - Gather, analyze and interpret data and create graphs regarding position, velocity and acceleration of moving objects.

SCI01.01.b - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.
 - Develop, communicate and justify an evidence-based analysis of the forces acting on an object and the resultant acceleration produced by a net force.

SCI01.01.c - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.
 - Develop, communicate and justify an evidence-based scientific prediction regarding the effects of the action-reaction force pairs on the motion of two interacting objects.

SCI01.01.d - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.
 - Examine the effect of changing masses and distance when applying Newton's law of universal gravitation to a system of two bodies.

SCI01.01.e - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.
 - Identify the limitations of Newton's laws in extreme situations.

SCI01.02.a - Physical Science:

- Matter has definite structure that determines characteristic physical and chemical properties.
 - Develop, communicate, and justify an evidence-based scientific explanation supporting the current model of an atom.

SCI01.02.b - Physical Science:

- Matter has definite structure that determines characteristic physical and chemical properties.
 - Gather, analyze and interpret data on chemical and physical properties of elements such as density, melting point, boiling point, and conductivity.

SCI01.02.c - Physical Science:

- Matter has definite structure that determines characteristic physical and chemical properties.
 - Use characteristic physical and chemical properties to develop predictions and supporting claims about elements' positions on the periodic table.

SCI01.02.d - Physical Science:

- Matter has definite structure that determines characteristic physical and chemical properties.
 - Develop a model that differentiates atoms and molecules, elements and compounds, and pure substances and mixtures.

SCI01.03.a - Physical Science:

- Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.
 - Recognize, analyze, interpret, and balance chemical equations (synthesis, decomposition, combustion, and replacement) or nuclear equations (fusion and fission).

SCI01.03.b - Physical Science:

- Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.
 - Predict reactants and products for different types of chemical and nuclear reactions.

SCI01.03.d - Physical Science:

- Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.
 - Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate the conservation of mass and energy.

SCI01.05.a - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
 - Develop, communicate, and justify an evidence-based scientific explanation regarding the potential and kinetic nature of mechanical energy.

SCI01.05.b - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
 - Use appropriate measurements, equations and graphs to gather, analyze, and interpret data on the quantity of energy in a system or an object.

SCI01.05.c - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
 - Use direct and indirect evidence to develop predictions of the types of energy associated with objects.

SCI01.05.d - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
 - Identify different energy forms, and calculate their amounts by measuring their defining characteristics.

SCI01.06.a - Physical Science:

- When energy changes form, it is neither created nor destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases.
 - Use direct and indirect evidence to develop and support claims about the conservation of energy in a variety of systems, including transformations to heat.

SCI01.06.b - Physical Science:

- When energy changes form, it is neither created nor destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases.
 - Evaluate the energy conversion efficiency of a variety of energy transformations.

SCI01.06.c - Physical Science:

- When energy changes form, it is neither created nor destroyed; however, because some is necessarily lost as heat, the amount of energy available to do work decreases.
 - Describe energy transformations both quantitatively and qualitatively.

SCI02.01.c - Life Science:

- Matter tends to be cycled within an ecosystem, while energy is transformed and eventually exits an ecosystem.
 - Analyze and interpret data from experiments on ecosystems where matter such as fertilizer has been added or withdrawn such as through drought.

SCI03.05.a - Earth Science:

- There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.
 - Develop, communicate, and justify an evidence-based scientific explanation regarding the costs and benefits of exploration, development, and consumption of renewable and nonrenewable resources.

SCI03.05.b - Earth Science:

- There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.
 - Evaluate positive and negative impacts on the geosphere, atmosphere, hydrosphere, and biosphere in regards to resource use.

SCI03.06.b - Earth Science:

- The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes.
 - Analyze and interpret data, maps, and models concerning the direct and indirect evidence produced by physical and chemical changes that water, air, gravity, and biological activity create.

SCI03.06.d - Earth Science:

- The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes.
 - Use remote sensing and geographic information systems (GIS) data to interpret landforms and landform impact on human activity.

Learning & Behavioral Skills -- Post-Secondary & Workforce Readiness:

PWR01.01.b-Postsecondary & Workforce Readiness, Content Knowledge , Literacy
• Write clearly and coherently for a variety of purposes and audiences.

PWR01.01.c-Postsecondary & Workforce Readiness, Content Knowledge , Literacy
• Use logic and rhetoric to analyze and critique ideas.

PWR01.01.e-Postsecondary & Workforce Readiness, Content Knowledge , Literacy
• Employ standard English language properly and fluently in reading, writing, listening, and speaking.

PWR01.02.b-Postsecondary & Workforce Readiness, Content Knowledge , Mathematical Sciences
• Understand and apply algebraic and geometric concepts and techniques.

PWR01.02.d-Postsecondary & Workforce Readiness, Content Knowledge , Mathematical Sciences
• Apply knowledge of mathematics to problem solve, analyze issues, and make critical decisions that arise in everyday life.

PWR02.02.b-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Find and Use Information/Information Technology
• Understand the ethical uses of information.

PWR02.03.a-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Creativity and Innovation
• Demonstrate intellectual curiosity.

PWR02.03.b-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Creativity and Innovation
• Generate, evaluate, and implement new ideas and novel approaches

PWR02.03.c-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Creativity and Innovation
• Develop new connections where none previously existed

PWR02.04.b-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Global and Cultural Awareness
• Interact effectively with and respect the diversity of different individuals, groups, and cultures.

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PWR02.04.c-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Global and Cultural Awareness

- Recognize the interdependent nature of our world.

PWR02.04.d-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Global and Cultural Awareness

- Understand how communicating in another language can improve learning in other disciplines and expand professional, personal, and social opportunities.

PWR02.06.a-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Work Ethic

- Plan and prioritize goals.

PWR02.06.b-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Work Ethic

- Manage time effectively.

PWR02.06.c-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Work Ethic

- Take initiative, and follow.

PWR02.06.d-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Work Ethic

- Learn from instruction and criticism.

PWR02.06.e-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Work Ethic

- Take responsibility for completion of work .

PWR02.06.f-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Work Ethic

- Act with maturity, civility, and politeness.

PWR02.06.g-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Work Ethic

- Demonstrate flexibility and adaptability.

PWR02.07.c-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Personal Responsibility

- Behave honestly and ethically.

	<p>PWR02.07.d-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Personal Responsibility</p> <ul style="list-style-type: none"> • Take responsibility for actions. <p>PWR02.07.e-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Personal Responsibility</p> <ul style="list-style-type: none"> • Understand the relevance of learning to postsecondary and workforce readiness <p>PWR02.07.f-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Personal Responsibility</p> <ul style="list-style-type: none"> • Demonstrate awareness of and evaluate career options. <p>PWR02.07.g-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Personal Responsibility</p> <ul style="list-style-type: none"> • Attend to personal health and wellness. <p>PWR02.08.a-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Communication</p> <ul style="list-style-type: none"> • Read, write, listen and speak effectively. <p>PWR02.08.b-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Communication</p> <ul style="list-style-type: none"> • Construct clear, coherent, and persuasive arguments. <p>PWR02.08.c-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Communication</p> <ul style="list-style-type: none"> • Communicate and interact effectively with people who have different primary languages. <p>PWR02.09.a-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Collaboration</p> <ul style="list-style-type: none"> • Work effectively with others. <p>PWR02.09.b-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Collaboration</p> <ul style="list-style-type: none"> • Acknowledge authority and take direction.
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	<p>PWR02.09.c-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Collaboration</p> <ul style="list-style-type: none">• Cooperate for a common purpose. <p>PWR02.09.d-Postsecondary & Workforce Readiness, Learning and Behavior Skills, Collaboration</p> <ul style="list-style-type: none">• Use teamwork and leadership skills effectively.
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Attachment 1

The following Academic Standards apply across all Manufacturing Career Cluster Pathways unless otherwise noted:

Mathematics

Number Sense

MAT01.01.a - Number Sense, Properties, and Operations

- The complex number system includes real numbers and imaginary numbers
Show that between any two rational numbers there are an infinite number of rational numbers, and that between any two irrational numbers there are also an infinite number of irrational numbers.

MAT01.01.b - Number Sense, Properties, and Operations

- The complex number system includes real numbers and imaginary numbers.
Express the square root of a negative number using imaginary numbers.

MAT01.02.a - Number Sense, Properties, and Operations

- Use of number theory arguments to justify relationships involving whole numbers.
Develop and justify conjectures about relationships involving whole numbers.

MAT01.02.b - Number Sense, Properties, and Operations:

- Formulate, represent, and use algorithms with real numbers flexibly, accurately, and efficiently..
Use technology to perform operations (addition, subtraction, multiplication, and division) on numbers written in scientific notation.

MAT01.03.a - Number Sense, Properties, and Operations:

- Systematic counting techniques are used to describe and solve problems.
Use combinatorics (Fundamental Counting Principle, permutations and combinations) to solve problems in real-world contexts.

MAT01.02.b - Number Sense, Properties, and Operations:

- Formulate, represent, and use algorithms with real numbers flexibly, accurately, and efficiently..
Use technology to perform operations (addition, subtraction, multiplication, and division) on numbers written in scientific notation.

MAT01.02.b - Number Sense, Properties, and Operations:

- Formulate, represent, and use algorithms with real numbers flexibly, accurately, and efficiently..
Use technology to perform operations (addition, subtraction, multiplication, and division) on numbers written in scientific notation.

Equations

MAT02.01.e - Patterns, Functions, and Algebraic Structures:

- Functions model situations where one quantity determines another and can be represented algebraically, graphically, and using tables.
Categorize sequences as arithmetic, geometric, or neither and develop formulas for the general terms related to arithmetic and geometric sequences.

MAT02.03.a - Patterns, Functions, and Algebraic Structures:

- Application of transformations, including arithmetic combinations (addition, subtraction, and multiplication) and translations (vertical, horizontal, and dilations) to representations of elementary functions using tables, graphs, symbols, text, and geomet.
Sketch the graph of common elementary functions and translations of those functions.

MAT02.05.a - Patterns, Functions, and Algebraic Structures:

- Solutions to equations, inequalities and systems of equations are found using a variety of tools.
Find, using all tools including graphing technology, solutions to quadratic and cubic equations and inequalities by using appropriate algebraic methods such as factoring, completing the square, graphing or using the quadratic formula.

MAT02.06.a - Patterns, Functions, and Algebraic Structures:

- Quantitative relationships in the real world can be modeled and solved using functions.
Represent, solve, using all tools including graphing technology, and interpret problems in various contexts using linear, quadratic, and exponential functions.

MAT02.06.b - Patterns, Functions, and Algebraic Structures:

- Quantitative relationships in the real world can be modeled and solved using functions.
Represent, solve, using all tools including graphing technology, and interpret problems involving direct and inverse variations and a combination of direct and inverse variation.

Statistics

MAT03.01.a - Data Analysis, Statistics, and Probability:

- Statistical methods take variability into account, supporting informed decision-making through quantitative studies designed to answer specific questions.
Formulate appropriate research questions that can be answered with statistical analysis.

MAT03.01.b - Data Analysis, Statistics, and Probability:

- Statistical methods take variability into account, supporting informed decision-making through quantitative studies designed to answer specific questions.
Determine appropriate data collection methods to answer a research question

MAT03.01.c - Data Analysis, Statistics, and Probability:

- Statistical methods take variability into account, supporting informed decision-making through quantitative studies designed to answer specific questions.
Explain how data might be analyzed to provide answers to a research question.

MAT03.02.a - Data Analysis, Statistics, and Probability:

- The design of an experiment or sample survey is of critical importance to analyzing the data and drawing conclusions.
Identify the characteristics of a well-designed and well-conducted survey.

MAT03.02.c - Data Analysis, Statistics, and Probability:

- The design of an experiment or sample survey is of critical importance to analyzing the data and drawing conclusions.
Differentiate between the inferences that can be drawn in experiments versus observational studies.

MAT03.03.a - Data Analysis, Statistics, and Probability:

- Visual displays and summary statistics condense the information in data sets into usable knowledge. Identify and choose appropriate ways to summarize numerical or categorical data using tables, graphical displays, and numerical summary statistics (describing shape, center and spread) and accounting for outliers when appropriate.

MAT03.03.b - Data Analysis, Statistics, and Probability:

- Visual displays and summary statistics condense the information in data sets into usable knowledge. Define and explain how sampling distributions (developed through simulation) are used to describe the sample-to-sample variability of sample statistics.\

MAT03.04.a - Data Analysis, Statistics, and Probability:

- Randomness is the foundation for using statistics to draw conclusions when testing a claim or estimating plausible values for a population characteristic. Define and explain the meaning of significance (both practical and statistical).

MAT03.04.c - Data Analysis, Statistics, and Probability:

- Randomness is the foundation for using statistics to draw conclusions when testing a claim or estimating plausible values for a population characteristic. Determine the margin of error associated with an estimate of a population characteristic.

Geometry of Shapes

MAT04.01.a - Shape, Dimension, and Geometric Relationships:

- Attributes of two- and three-dimensional objects are measurable and can be quantified. Calculate (or estimate when appropriate) the perimeter and area of a two-dimensional irregular shape.

MAT04.01.b - Shape, Dimension, and Geometric Relationships:

- Attributes of two- and three-dimensional objects are measurable and can be quantified. Justify, interpret, and apply the use of formulas for the surface area, and volume of cones, pyramids, and spheres including real-world situations.

MAT04.01.c - Shape, Dimension, and Geometric Relationships:

- Attributes of two- and three-dimensional objects are measurable and can be quantified.
Solve for unknown quantities in relationships involving perimeter, area, surface area, and volume.

MAT04.01.d - Shape, Dimension, and Geometric Relationships:

- Attributes of two- and three-dimensional objects are measurable and can be quantified.
Apply the effect of dimensional change, utilizing appropriate units and scales in problem-solving situations involving perimeter, area, and volume.

MAT04.01.d - Shape, Dimension, and Geometric Relationships:

- Attributes of two- and three-dimensional objects are measurable and can be quantified.
Apply the effect of dimensional change, utilizing appropriate units and scales in problem-solving situations involving perimeter, area, and volume.

MAT04.01.f - Shape, Dimension, and Geometric Relationships:

- Determination and utilization of the area of irregular shapes, and surface area and volume of cones and pyramids, cylinders and prisms, and spheres..
Develop and justify conjectures about relationships among properties of shapes in two- and three-dimensions using construction tools, including technology.

MAT04.02.a - Shape, Dimension, and Geometric Relationships:

- Objects in the plane and their parts, attributes, and measurements can be analyzed deductively.
Classify polygons according to their similarities and differences.

MAT04.02.b - Shape, Dimension, and Geometric Relationships:

- Objects in the plane and their parts, attributes, and measurements can be analyzed deductively.
Solve for unknown attributes of geometric shapes based on their congruence, similarity, or symmetry.

MAT04.02.c - Shape, Dimension, and Geometric Relationships:

- Objects in the plane and their parts, attributes, and measurements can be analyzed deductively.
Know and apply properties of angles including corresponding, exterior, interior, vertical, complementary, and supplementary angles to solve problems. Justify the results using two-column proofs, paragraph proofs, flow charts, or illustrations.

MAT04.02.d - Shape, Dimension, and Geometric Relationships:

- Objects in the plane and their parts, attributes, and measurements can be analyzed deductively. Develop conjectures and solve problems about geometric figures including definitions and properties (congruence, similarity, and symmetry). Justify these conjectures using two-column proofs, paragraph proofs, flow charts, or illustrations.

MAT04.02.e - Shape, Dimension, and Geometric Relationships:

- Relationships among two- and three-dimensional geometric figures, including congruence, similarity and symmetry.. Design a geometric structure with accurate and appropriate units of measure.

MAT04.02.f - Shape, Dimension, and Geometric Relationships:

- Relationships among two- and three-dimensional geometric figures, including congruence, similarity and symmetry.. Develop and justify conjectures about relationships among properties of shapes in two dimensions (polygons and circles) and three dimensions (cones and pyramids, cylinders and prisms, and spheres) using construction tools, including technology.

MAT04.03.a - Shape, Dimension, and Geometric Relationships:

- Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically. Make conjectures involving two-dimensional objects represented with Cartesian coordinates. Justify these conjectures using two-column proofs, paragraph proofs, flow charts, and/or illustrations.

MAT04.03.b - Shape, Dimension, and Geometric Relationships:

- Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically. Represent transformations (reflection, translation, rotation, and dilation) using Cartesian coordinates.

MAT04.03.c - Shape, Dimension, and Geometric Relationships:

- Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically. Develop arguments to establish what remains invariant and what changes after a transformation (reflection, translation, rotation, and dilations). Justify these conjectures using two-column proofs, paragraph proofs, flow charts, and/or illustrations.

MAT04.03.d - Shape, Dimension, and Geometric Relationships:

- Objects in the plane can be transformed, and those transformations can be described and analyzed mathematically. Using construction tools, including technology, make conjectures about relationships among properties of shapes in the plane including those formed through transformation. Justify these conjectures using two-column proofs, paragraph proofs, flow charts, and/or illustrations.

MAT04.04.a - Shape, Dimension, and Geometric Relationships:

- Right triangles are central to geometry and its applications.
Apply right triangle trigonometry (sine, cosine, and tangent) to find indirect measures of lengths and angles

MAT04.04.a - Shape, Dimension, and Geometric Relationships:

- Right triangles are central to geometry and its applications.
Apply right triangle trigonometry (sine, cosine, and tangent) to find indirect measures of lengths and angles

MAT04.06.b - Shape, Dimension, and Geometric Relationships:

- Indirect measurement of quantities using techniques of algebra or geometry..
Apply the laws of sines and cosines to find indirect measures of lengths and angles.

Science

Physics

SCI01.01.a - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.

Gather, analyze and interpret data and create graphs regarding position, velocity and acceleration of moving objects.

SCI01.01.b - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.

Develop, communicate and justify an evidence-based analysis of the forces acting on an object and the resultant acceleration produced by a net force.

SCI01.01.c - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.

Develop, communicate and justify an evidence-based scientific prediction regarding the effects of the action-reaction force pairs on the motion of two interacting objects.

SCI01.01.d - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.

Examine the effect of changing masses and distance when applying Newton's law of universal gravitation to a system of two bodies.

SCI01.01.e - Physical Science:

- Newton's laws of motion and gravitation describe the relationships among forces acting on and between objects, their masses, and changes in their motion – but have limitations.

Identify the limitations of Newton's laws in extreme situations.

SCI01.02.a - Physical Science:

- Matter has definite structure that determines characteristic physical and chemical properties.
Develop, communicate, and justify an evidence-based scientific explanation supporting the current model of an atom.

SCI01.02.b - Physical Science:

- Matter has definite structure that determines characteristic physical and chemical properties.
Gather, analyze and interpret data on chemical and physical properties of elements such as density, melting point, boiling point, and conductivity.

SCI01.02.c - Physical Science:

- Matter has definite structure that determines characteristic physical and chemical properties.
Use characteristic physical and chemical properties to develop predictions and supporting claims about elements' positions on the periodic table.

SCI01.02.d - Physical Science:

- Matter has definite structure that determines characteristic physical and chemical properties.
Develop a model that differentiates atoms and molecules, elements and compounds, and pure substances and mixtures.

SCI01.02.e - Physical Science:

- Matter has definite structure which determines characteristic physical and chemical properties..
Make inferences based on indirect evidence used to draw conclusions about the structure of an atom and its subatomic particles.

SCI01.03.a - Physical Science:

- Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.
Recognize, analyze, interpret, and balance chemical equations (synthesis, decomposition, combustion, and replacement) or nuclear equations (fusion and fission).

SCI01.03.b - Physical Science:

- Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy.
Predict reactants and products for different types of chemical and nuclear reactions.

SCI01.03.d - Physical Science:

- Matter can change form through chemical or nuclear reactions abiding by the laws of conservation of mass and energy. Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate the conservation of mass and energy.

SCI01.05.a - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
Develop, communicate, and justify an evidence-based scientific explanation regarding the potential and kinetic nature of mechanical energy.

SCI01.05.b - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
Use appropriate measurements, equations and graphs to gather, analyze, and interpret data on the quantity of energy in a system or an object.

SCI01.05.c - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
Use direct and indirect evidence to develop predictions of the types of energy associated with objects.

SCI01.05.d - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
Identify different energy forms, and calculate their amounts by measuring their defining characteristics.

SCI01.05.a - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
Develop, communicate, and justify an evidence-based scientific explanation regarding the potential and kinetic nature of mechanical energy.

SCI01.05.b - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
Use appropriate measurements, equations and graphs to gather, analyze, and interpret data on the quantity of energy in a system or an object.

SCI01.05.c - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
Use direct and indirect evidence to develop predictions of the types of energy associated with objects.

SCI01.05.d - Physical Science:

- Energy exists in many forms such as mechanical, chemical, electrical, radiant, thermal, and nuclear, that can be quantified and experimentally determined.
Identify different energy forms, and calculate their amounts by measuring their defining characteristics.

Solar and Climate**SCI03.02.a - Earth Science:**

- As part of the solar system, Earth interacts with various extraterrestrial forces and energies such as gravity, solar phenomena, electromagnetic radiation, and impact events that influence the planet's geosphere, atmosphere, and biosphere in a variety of.
Develop, communicate, and justify an evidence-based scientific explanation addressing questions around the extraterrestrial forces and energies that influence Earth. (Renewable Energy Systems)

SCI03.04.a - Earth Science:

- Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere.
Develop, communicate, and justify an evidence-based scientific explanation that shows climate is a result of energy transfer among the atmosphere, hydrosphere, geosphere and biosphere. (Renewable Energy Systems)

SCI03.04.b - Earth Science:

- Climate is the result of energy transfer among interactions of the atmosphere, hydrosphere, geosphere, and biosphere. Analyze and interpret data on Earth's climate. (Renewable Energy Systems)

SCI03.05.a - Earth Science:

- There are costs, benefits, and consequences of exploration, development, and consumption of renewable and nonrenewable resources.
Develop, communicate, and justify an evidence-based scientific explanation regarding the costs and benefits of exploration, development, and consumption of renewable and nonrenewable resources.

SCI03.06.d - Earth Science:

- The interaction of Earth's surface with water, air, gravity, and biological activity causes physical and chemical changes. Use remote sensing and geographic information systems (GIS) data to interpret landforms and landform impact on human activity.

Reading, Writing, Communication

Leadership and Speaking

RWC01.01.a - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness. Prepare and deliver a formal presentation for different purposes and audiences (such as expository, persuasive, entertaining, inspirational, or recognition).

RWC01.01.b - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness. Identify a central idea or thesis, organize ideas, and develop a speech for an intended purpose and audience

RWC01.01.c - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness. Use examples, illustrations, graphics, quotations, analogies, facts, and statistics to focus and support the content of a presentation.

RWC01.01.d - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness. Use grammar and vocabulary appropriate for the situation, audience, topic, and purpose.

RWC01.01.e - Oral Expression and Listening:

- Effective speaking in formal and informal settings requires appropriate use of methods and audience awareness. Choose specific words and word order for intended effect and meaning.

RWC01.02.a - Oral Expression and Listening:

- Effective collaborative groups accomplish goals. Design an effective group effort to accomplish a goal.

RWC01.02.b - Oral Expression and Listening:

- Effective collaborative groups accomplish goals. Implement an effective group effort that achieves a goal.

RWC01.02.c - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
Analyze differences in group perspectives to help bring the group to consensus or to solve a perceived problem.

RWC01.02.d - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
Participate in the preparations of the group activity or product, defining and assuming individual roles and responsibilities.

RWC01.02.e - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
Assume a leadership role in a group that is collaboratively working to accomplish a goal.

RWC01.02.f - Oral Expression and Listening:

- Effective collaborative groups accomplish goals.
Self-evaluate roles in the preparation and completion of the group goal.

RWC01.03.a - Oral Expression and Listening:

- Verbal and nonverbal cues impact the intent of communication.
Give informal talks using an appropriate level of formality of verbal language and nonverbal interaction with audience.

RWC01.03.b - Oral Expression and Listening:

- Verbal and nonverbal cues impact the intent of communication.
Deliver formal oral presentations for intended purpose and audience, using effective verbal and nonverbal communication.

RWC01.03.c - Oral Expression and Listening:

- Verbal and nonverbal cues impact the intent of communication.
Deliver oral talks with clear enunciation, vocabulary, and appropriate organization; nonverbal gestures; and tone.

RWC01.03.d - Oral Expression and Listening:

- Verbal and nonverbal cues impact the intent of communication.
Analyze audience responses to evaluate how effectively the talk or presentation met the purpose.

RWC01.05.a - Oral Expression and Listening:

- Content that is gathered carefully and organized well successfully influences an audience.
Organize and deliver a presentation that influences a specific audience.

RWC01.05.b - Oral Expression and Listening:

- Content that is gathered carefully and organized well successfully influences an audience.
Reflect on the content and approach to a presentation.

RWC01.05.c - Oral Expression and Listening:

- Content that is gathered carefully and organized well successfully influences an audience.
Select organizational patterns and structures and choose precise vocabulary and rhetorical devices.

RWC01.05.d - Oral Expression and Language Study:

- Listen actively and contribute effectively in small and large groups to collaboratively accomplish a goal..
Assume a leadership role in a group collaboratively working to accomplish a goal.

RWC01.05.e - Oral Expression and Language Study:

- Listen actively and contribute effectively in small and large groups to collaboratively accomplish a goal..
Self – evaluate roles in the preparation and completion of the group goal.

Reading

RWC02.01.c - Reading for All purposes:

- Apply critical reading and metacognitive strategies to interpret, analyze and evaluate form, function and structure in a variety of complex literary texts..
Synthesize central ideas, supporting details, or themes.

RWC02.02.a - Reading for All Purposes:

- Interpreting and evaluating complex informational texts require the understanding of rhetoric, critical reading, and analysis skills.
Use reading and note-taking strategies (outlining, mapping systems, skimming, scanning, key word search) to organize information and make connections within and across informational texts.

RWC02.02.c - Reading for All Purposes:

- Interpreting and evaluating complex informational texts require the understanding of rhetoric, critical reading, and analysis skills.
Obtain and use information from text and text features (index, bold or italicized text, subheadings, graphics) to answer questions, perform specific tasks, or identify and solve problems.

RWC02.02.d - Reading for All Purposes:

- Interpreting and evaluating complex informational texts require the understanding of rhetoric, critical reading, and analysis skills.
Explain and interpret the visual components supporting the text (maps, complex tables and diagrams, and transitional devices, such as use of white space).

RWC02.05.a - Reading for All Purposes:

- Literary and historical influences determine the meaning of traditional and contemporary literary texts.
Generalize about universal themes, cultural or historical perspectives from multiple texts.

RWC02.06.b - Reading for All purposes:

- Apply understanding of complex organizational text structures and features to reading comprehension..
Use the features of electronic information to communicate, gain information, or research a topic.

RWC02.06.c - Reading for All Purposes:

- The development of new ideas and concepts within informational and persuasive manuscripts.
Compare the development of an idea or concept in multiple texts supported by text-based evidence.

Writing**RWC03.01.a - Writing and Composition:**

- Use a recursive writing process for planning, developing and revising text for a variety of academic, workplace, and literary purposes and audiences..
Establish and maintain a text structure appropriate to audience and purpose.

RWC03.01.b - Writing and Composition:

- Use a recursive writing process for planning, developing and revising text for a variety of academic, workplace, and literary purposes and audiences..
Organize ideas consistent with text structure (e.g., chronology, proposition-support, critique, inductive-deductive) in well-developed paragraphs..

RWC03.01.c - Writing and Composition:

- Use a recursive writing process for planning, developing and revising text for a variety of academic, workplace, and literary purposes and audiences..
Select and use formal, informal, literary, or technical language appropriate to audience and context..

RWC03.01.d - Writing and Composition:

- Use a recursive writing process for planning, developing and revising text for a variety of academic, workplace, and literary purposes and audiences..
Write with clear focus, depth, accurate and relevant detail.

RWC03.03.a - Writing and Composition:

- Standard English conventions effectively communicate to targeted audiences and purposes.
Follow the conventions of Standard English to write varied, strong, correct, complete sentences.

RWC03.03.b - Writing and Composition:

- Standard English conventions effectively communicate to targeted audiences and purposes.
Deliberately manipulate the conventions of Standard English for stylistic effect appropriate to the needs of a particular audience and purpose

RWC03.03.c - Writing and Composition:

- Standard English conventions effectively communicate to targeted audiences and purposes.
Seek and use an appropriate style guide to govern conventions for a particular audience and purpose.

RWC03.03.d - Writing and Composition:

- Manipulate the elements and structures of informational text to create persuasive, academic, and technical writing..
Select language appropriate to context (e.g., technical, formal).

RWC03.02.g - Writing and Composition:

- Ideas, evidence, structure, and style create persuasive, academic, and technical texts for particular audiences and specific purposes.
Draw a conclusion by synthesizing information.

RWC03.04.a - Writing and Composition:

- Stylistic and thematic elements of literary or narrative texts can be refined to engage or entertain an audience.
Organize events, details, ideas and reflections or observations strategically to influence the audience's emotions and understanding of the implicit or explicit theme.

RWC03.04.b - Writing and Composition:

- Stylistic and thematic elements of literary or narrative texts can be refined to engage or entertain an audience.
Write literary and narrative texts using a range of stylistic devices (poetic techniques, figurative language, symbolism, graphic or visual components) to support the presentation of implicit or explicit theme.

RWC03.04.c - Writing and Composition:

- Stylistic and thematic elements of literary or narrative texts can be refined to engage or entertain an audience.
Enhance the expression of voice, tone, and point of view in a text by strategically using precise diction (considering denotation, connotation, and audience associations); diverse syntax; varied sentence patterns; and punctuation for stylistic effect.

RWC03.04.d - Writing and Composition:

- Stylistic and thematic elements of literary or narrative texts can be refined to engage or entertain an audience.
Use a range of strategies to evaluate whether the writing is presented in a clear and engaging manner (such as reading the text from the perspective of the intended audience, seeking feedback from a reviewer).

Research and Reasoning**RWC4.1.d - Research and Reasoning:**

- Conduct self-designed research that gathers and analyzes information from a variety of sources to answer a question, propose solutions or share findings and conclusions..
Evaluate quality, accuracy, and completeness of information and the credibility of the sources.

RWC04.03.a - Research and Reasoning:

- Self-designed research provides insightful information, conclusions, and possible solutions.
Define and narrow a topic for research (thesis statement, hypothesis, research question) to address a specific purpose and audience.

RWC04.03.c - Research and Reasoning:

- Self-designed research provides insightful information, conclusions, and possible solutions.
Evaluate quality, accuracy, and completeness of information and the bias, credibility and reliability of the sources.

RWC04.03.d - Research and Reasoning:

- Self-designed research provides insightful information, conclusions, and possible solutions.
Use a variety of strategies (e.g. technical reading, direct observation, survey development) to collect relevant information to support the thesis/research question and explain why specific strategies were used instead of others.

RWC04.04.a - Research and Reasoning:

- Complex situations require critical thinking across multiple disciplines.
Analyze the logic of complex situations by questioning the purpose, question at issue, information, points of view, implications and consequences inferences, assumptions and concepts.

RWC04.04.b - Research and Reasoning:

- Complex situations require critical thinking across multiple disciplines.
Evaluate strengths and weaknesses of their logic and logic of others by using criteria including relevance, clarity, accuracy, fairness, significance, depth, breadth, logic and precision.

RWC04.04.c - Research and Reasoning:

- Complex situations require critical thinking across multiple disciplines.
Determine the extent to which they entered empathetically into competing points of view, exercised confidence in reason, recognized the limits of their knowledge on the topic (intellectual humility), explored alternative approaches to solving or addressing.