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2014 - 2015 Research and Development – Curriculum Map

Month	September	October	November	December	January
2014 Common Core Curriculum Standards	8.1.12.A.3-4, 8.2.12.E.1, 8.2.12.F.1-3	8.1A1-2, 8.1.12.C.1, 8.2.12.A.1, 8.2.12.F.1-3	8.1.A.1, 8.1.A.3-4, 8.1.B.1, 8.1.C.1, 8.1.D.1-4, 8.1.E.2, 8.1.F.2, 8.2.A.1, 8.2.B.1-3, 8.2.C.1-3, 8.2.D.1, 8.2.E.1, 8.2.F.1-3, 8.2.G.1	8.1A1-2, 8.1.12.C.1, 8.2.12.A.1, 8.2B1-3, 8.2.12.C.1-2, 8.2.12.F.1-3	8.1.8.A.1-5, 8.1.8.B.1, 8.1.8.C.1, 8.1.8.D.1-2, 8.2.8.B.1-3, 8.2.8.D.1, 8.1.8.E.1, 8.1.8.F.1-2, 8.1.8.G.1-2
Essential Questions	When are expository and technical writing styles applicable to an engineering notebook?	Why is creation of a problem statement important in preparation to design and develop solutions to a problem?	How does engineering transform an idea into a new product?	How does a drawing come to life?	How can the fabrication process improve the efficiency of a product?
Content	*Introduction to Research and Development*	*Problem Identification*	*The Design Process*	*The Manufacturing Process*	*Safety and Project Fabrication*
Skills And Topics	• evaluate informed decision making as a valuable tool in the problem-solving process • demonstrate the ability to use technical and expository writing as an essential communication skill • use technical writing to communicate the pertinent aspects of a problem and a potential solution addressing a particular audience	• research and identify the problem to be studied • use brainstorming techniques to generate problem statements to the identified problem • write a concise statement specific to the problem • determine the level of accuracy required to validate results • draw analogies between professional roles and real-world research problems	• explore the design processes that guide professionals from different career areas • provide examples of the design process used by engineers (e.g., identify the problem, conduct research, develop a design brief, brainstorm ideas, model, optimize, present, qualify, manufacture, and communicate results) • compare and contrast the engineering design	• Understand the role of research and development in the production of new or improved products, processes, and materials. • Understand that product development processing involves developmental stages (e.g., raw material input, processing, producing outputs). • Understand the advanced systematic processes involved in the custom fabrication and mass	• demonstrate safe work habits • read and follow written safety procedures • safely operate tools and equipment • identify a safe work plan for each process • demonstrate safe working methods and procedures • develop a plan for safety in the work environment • demonstrate the safe use of all tools and equipment

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	• identify the aspects of the design process used by engineers: o define the problem o brainstorm solutions o research technical limitations o identify requirements o explore possible solutions to a problem o select an approach to problem solution o develop a design proposal o make a model or prototype o test the performance of the prototype o refine the specifications of the prototype o apply the specifications to make a final prototype		• process and the scientific method • research the types of problems engineers seek to resolve • generate engineering drawings, including isometric, orthographic sections, and detailed views leading to complete engineering drawings • Understand that engineering design is a sequential process involving modeling and • optimization to find the best solution within given constraints. • Use a variety of verbal and graphic techniques to present conclusions. • understand how to develop work schedules and plans, which include optimal use of materials, processes, time, and expertise. • understand how	production of products • Demonstrate world class manufacturing concepts (e.g., just-in-time, point-of-use-delivery, pull-through production, one-piece manufacturing, and cellular manufacturing). • Understand the development and management of production systems for manufacturing products. • Use computer software to aid in the manufacturing of products (e.g., computer aided manufacturing (CAM), computer numerical control (CNC), rapid prototype (RP)). • Perform a patent search using all gathered information. • correspond with engineers and designers as to changes needed.	• pass a general safety test with a minimum score of 90% • identify the seven steps of the problem-solving model. o define the problem. o set goals o develop alternatives o select the best solution o implement the solution o evaluate the results and make changes o if the product is acceptable end the process. If not, go back to #4 and repeat process from there • demonstrate that engineering design is an iterative process involving modeling and optimization to find the best solution within given constraints

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	o communicate the results • use an engineer's notebook to chronologically document all aspects of the design project		societal interests, economics, ergonomics, and environmental considerations influence a solution. • understand the importance of safety, cost, ease of use, and availability when • selecting tools. • use optimization techniques, such as linear programming, to determine optimum solutions to problems. • develop the process of creating a scale model of an object or structure (e.g., a model automobile, building, bridge). • use technical drawings (e.g., blueprints, schematics, mechanical drawings) to construct an object or structure.	• Summarize project design and develop formal report. • Identify characteristics of various forms of written instruction or documentation used in the engineering design industry. (e.g., Engineering Change Orders, process flow instructions, delivery schedules, and documentation of manufacturing process). • Understand how robots and computers are used in the manufacturing processes. • Understand basic technological systems used in the manufacturing industry. • Understand the importance of meeting product and processing specifications. • Understand how	• use a variety of verbal and graphic techniques to present conclusions • develop work schedules and plans, which include optimal use of materials, processes, time, and expertise • demonstrate how societal interests, economics, ergonomics, and environmental considerations influence a solution • explain the importance of safety, cost, ease of use, and availability when selecting tools • use optimization techniques, such as linear programming, to determine optimum solutions to problems • develop the process of creating a scale model of an object or structure (e.g., a model automobile,

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				materials are separated, combined, formed, and finished through a variety of methods.	building, bridge) • use technical drawings (e.g., blueprints, schematics, mechanical drawings) to construct an object or structure
Performance Assessments	• Assessments • Engineer's notebook • Expository essay: the decision-making steps necessary to solve a problem	• Assessments • Problem statement	• Collections of designs sketches and models • Design briefs • Student participation • Assessments	• construct a prototype to match design process • Decision matrix • Student participation • Assessments	• Tool and equipment familiarization • Tool location assessment • Student Participation • Assessments

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2014 Common Core Curriculum Standards	8.1.12.A1-4, 8.2.12.A1, 8.2.12.B1-3, 8.2.12.C1-3, 8.2.12.E.1, 8.2.12.F.1-3			8.2.12.A.1, 8.2.12.B1-3, 8.2.12.C1-3, 8.2.12.E.1, 8.2.12.F.1-3	8.2.12.B1-3, 8.2.12.C3, 8.2.12.E.1, 8.2.12.F.1-3
Essential Questions	How does the design phase transition into fabrication of a product?			How is an engineer's testing procedure different from a scientist's use of the scientific method?	How do engineers present their design solutions and prototypes to potential users?
Content	*Fabrication Process*			*Testing Process*	*Presentation*
Skills And Topics	• recognize tool machine safety to prevent accidents during construction of prototypes • review the use of the Computer and Network Systems (CNS) machine and program the machine • write step-by-step instructions to program the robotic arm for prototype assembly • compare and contrast the applications of appropriate materials to best serve as the prototype	• layout and planning • material selection • utilize equipment for forming, cutting, shaping, drilling and milling • correctly fasten material and components • functionally assemble final products • Describe how manufacturing has evolved • List the major components of a manufacturing system • Identify manufacturing inputs	• place the history of the development of CIM and CNC machines into a timeline perspective • understand the basic codes, operation, and motion programming of CNC machines • use the basic codes to cut a design as a prototype on the CNC machine(s) • Translate CNC code from Computer Aided Design (CAD) drawings using the CNC machine • use basic engineering	• identify prototype testing as a controlled procedure • determine specific criteria to assess the success or failure of a test of the prototype • write a detailed description of the testing procedure to ensure validity of design solution tests • evaluate test results to determine accuracy and repeatability of the testing procedure • use the results of	• identify the advantages and disadvantages of web-based exchanges of information over bound, printed material • use Microsoft Office applications to develop presentation of design solution • create a PowerPoint presentation using visual aids, sketches, scale models, and project information in a professional manner • produce a technical

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	• perform a cost analysis of available materials and equipment to produce the prototype • detail a scale working model of the prototype	• Describe manufacturing processes • Identify manufacturing outputs	dimensioning for manufacturing prototype projects • construct multi-sheet • engineering drawings with detail and section views	prototype testing to refine the design and improve the design solution • Correctly manipulate final product to perform to design intent. • determine design failures or successes. • determine build failures or successes. • determine a course of action to proceed or re-visit design and build solutions • identify trends and how they affect changes within a system • describe how changes in design technology have impacted business and industry, identify current trends, and recommend how a technical system might be improved	report providing thorough communication of all aspects of the design solution • select and use various media formats and techniques to effectively communicate the design solution process for a target audience • develop rough draft for final presentation. • research materials for presentation. • use correct terminology; clarify the problem or issues to be presented. • identify, organize, and define ideas from various sources to logically support a position and use these ideas in debate. • incorporate final designs, models, simulations, and other test results to demonstrate an optimal solution.

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Performance Assessments	• Project Fabrication Program code for CNC • Spreadsheet of attribute comparison of materials used for the prototype • Spreadsheet cost analysis • Prototype scale model	• Journal • Engineering Notebook • Cost Estimation	• Student participation • Assessments • Chart of points • Design briefs • Written evaluations • 3D Inventor drawings, engineering dimensions, and evaluations	• Written evaluations • Written description of the prototype-testing procedure • Report of test results • Prototype refinement plan	• Final Exam Portfolio • PowerPoint presentation • Technical Report

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Integration of Technology	*Autodesk AutoCAD and Inventor* software, Internet, Web Quests, wireless laptop computers, computer laboratory, portable language, laboratory, classroom computers, SMART Boards, multimedia presentations, simulations, video streaming, podcasting
Writing	Open-ended responses, conclusions and analysis of exploratory activities
Formative Assessments	Warm-up activities, exploratory activities, class discussions, student participation, quizzes, design briefs, sketches, Inventor research, benchmark assessments
Summative Assessments	Quizzes, tests, authentic assessments, projects, final examination, benchmark assessments
Interdisciplinary Connections	*ELA: RST.9-10.1-10, RST.11-12.1-10, WHST.9-10.1-2, 4-10, WHST.11-12.1-2, 4-10, SL.9-10.1-6, SL.11-12.1-6, L.9-10.1-6, L.11-12.1-6, SL.1-6, L.1-6, RST.1-10, WHST.1-2, WHST.4-10 *Mathematics: N-Q.1-3, N-VM.1-5, F-IF.1-2, F-IF.4-7, F-BF.1.a-c, F-LE.1-5, A-SSE.1, A-CED.1-4, A-REI.1-3, A-REI.10-11 Science: 5.1.12.A.1-3, 5.1.12.B.1-4, 5.1.12.C.1-3, 5.1.12.D.1-2, 5.2.12.A.1-4, 5.2.12.B.1, 5.2.12.C.1-2, 5.2.12.D.4-5 Arts: The Arts are exemplified through the implementation of the elements of design applied while developing industrial solutions via sketches, drawings and prototypes. Technology: 8.1.12.A.1-4, 8.1.12.C.1 World Language: 7.1.AL.B.5 21st Century Life/Careers: 9.1.12.A.1-4, 9.1.12.B.1-3, 9.1.12.C.4-5, 9.1.12.E.4-5, 9.1.12.F.1-2, 9.1.12.F.5-6, 9.3.12.C.1-6
21st Century Themes	Global Awareness, Civic Literacy, Financial, Economic, Business, and Entrepreneurial Literacy
21st Century Skills	Creativity and Innovation, Media Literacy, Critical Thinking and Problem Solving, Life and Career Skills, Information and Communication Technologies Literacy, Communication and Collaboration, Information Literacy
Resources	*National Educational Technology Standards for Students: Connecting Curriculum and Technology. (2000).* Eugene, OR: International Society for Technology in Education, *Technical Drawing, 13th Edition*, *Giesecke and Mitchell, Jig and Fixture Design, 4th Edition,* Edward Hoffman, *Machinery's Handbook, 26th Edition,* Erik Oberg and Franklin D. Jones
Careers	Applicable career options are discussed as they arise throughout the Engineering Design program. Career options include, but are not limited to, the following career clusters: Architecture and Construction Career Cluster; Arts, A/V Technology, and Communications Career Cluster; Business, Management, and Administration Career Cluster; Education and Training Career Cluster; Government and Public Administration Career Cluster; Information Technology Career Cluster; Law, Public Safety, Correction, and Security Career Cluster; Manufacturing Career Cluster; Marketing Career Cluster; Science, Technology, Engineering and Mathematics Career Cluster; Transportation, Distribution, and Logistics Career Cluster.

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2013 Common Core Content Standards:

RST: Reading in Science and Technical Subjects

WHST: Writing in History, Science, and Technical Subjects

SL: Speaking and Listening

L: Language

CCCS for Mathematics

N:	Real Number System	**N-VM**	Vector and	**G-CO**	Congruence
A:	Algebra	**A-SSE**	See Structure in Expressions	**G-SRT**	Similarity, Right Triangles and Trigonometry
F:	Functions	**A-REI**	Reasoning with Equations and Inequalities	**G-C**	Circles
G:	Geometry	**F-IF**	Interpreting Functions	**G-GPE**	Expressing Geometric Properties w/Equations
S:	Statistics and Probability	**F-BF**	Building Functions	**S-ID**	Making Inferences and Justifying Conclusions
MD:	Measurements and Data	**F-LE**	Linear, Quadratic and Exponential Models	**S-CP**	Conditional Probability & the Rules of Probability
N-Q	Quantities	**F-TF**	Trigonometric Functions	**S-MD**	Using Probability to Make Decisions