

Principles of Engineering

	Performance Objectives	Show-Me Content	Show-Me Goals	National Standards	Alignment
1.1	Definition of Engineering				
1.	Define key engineering terms.	CA1			B
2.	Identify engineering achievements through history.	CA6, SS2		7:9-12	A
1.2	Engineers as Problem Solvers				
1.	Demonstrate an understanding of engineering.			9:9-12	B
2.	Identify five historical engineering role models, including minorities and women.	SS2	1.9		B
3.	Identify problems for engineers to solve in the future.	SS6, SC8	3.1	10:6-8G 11:9-12M	A
4.	Describe attributes associated with being a successful engineer.	CA1, SS6	4.4, 4.8		C
1.3	The Engineering Team				
1.	Understand the importance of engineering teams.		4.6		C
2.	Understand the role of out-sourcing in the engineering process.	SS4			C
3.	Describe how gender-bias, racial-bias and other forms of stereotyping and discrimination can adversely affect communications within an engineering team.	CA7, SS6	2.3		C
4.	Understand how ethics influences the engineering process.		4.4	4:9-12J	C
5.	Understand how social, environmental and financial constraints influence the engineering process.	SS4, SS6		2:9-12W-AA	C
1.4	Careers in Engineering				
1.	Describe the difference between engineering disciplines and job functions.				D
2.	Describe the professional and legal responsibilities associated with being an engineer.	SS3	4.4		D
3.	Research the educational requirements to become an engineer.		4.8		D
4.	Conduct an interview with an engineer to become familiar with a field of engineering.	CA1, CA6	4.8		D
2.1	Communication and Documentation				
1.	Demonstrate documentation, record keeping and communication in engineering.	CA1, CA4, CA6	2.1	17:9-12Q	D
2.2	Sketching				
1.	Compose sketches using proper sketching techniques in the solution of design problems.	CA5	2.5	9:9-12I	E
2.	Select appropriate sketching styles for presentation of a design problem to a group.	FA1	2.1	9:9-12I	E

3.	Apply proper proportioning while producing annotated sketches.	FA2		9:9-12I	E
2.3	Technical Writing				
1.	Develop a written technical report of research conducted on a career field in engineering.	CA1, CA4	2.1		D, F
2.	Formulate an organized outline for a technical paper.	CA1, CA4	1.8		F
2.4	Data Representation and Presentation				
1.	Create tables, charts, and graphs to illustrate data.	CA4	1.8	12:9-12L	F
2.	Select appropriate types of tables, charts, or graphs to accurately communicate collected data for written work or presentations.	MA3	1.8	12:9-12L	F
2.5	Oral Presentations				
1.	Design and deliver a presentation utilizing appropriate support materials on research they have conducted.	CA6	1.8, 2.1	12:9-12L	F
2.	Create support materials to appropriately demonstrate concepts used in the presentation.	CA4	1.8	12:9-12L	F
3.1	Design Process				
1.	Understand the need for the design process in engineering.	CA3	3.4	8:9-12H	B
3.2	Design Process				
1.	Diagram and present the product development lifecycle of an invention.	CA6	1.8	12:9-12L	F
2.	Examine the history of an invention and its effects on society and the environment.	SC8	1.9	7:9-12I	A
3.	Examine the evolution of an invention and how the design process was applied to it.	CA3		7:9-12G	A
4.1	Engineering Systems				
1.	Describe the process engineers use to design solutions/new products.		3.4	8:9-12H	B
2.	Understand the functions of engineering systems.	SC1, SC2		13:9-12K, 13:9-12N	B
4.2	Mechanisms				
1.	Explain the functions of the essential components of a mechanical system.	CA1, SC1, SC2		2:6-8M	I
2.	Create a display of a mechanical system from a household item.	CA6	2.1, 3.1		I
3.	Explain the function of the six different types of simple machines.	SC2			I
4.	Calculate the mechanical advantage gained by the six different types of simple machines.	MA1			I
5.	Apply simple machines to create mechanical systems in the solution of a design problem.	SC1, SC2	3.1, 3.3	11:9-12Q	I
4.3	Thermodynamics				

1.	Conduct an energy analysis on a section of a home and calculate the heat loss through walls and windows.	MA1, MA2	1.10	5:9-12G	I
2.	Evaluate systems undergoing thermodynamic cycles for efficiency.	SC1	1.2	12:9-12N	I
3.	Describe the concept and function of a heat engine (incorporating the first and second laws of thermodynamics).	CA1, SC1		12:9-12L	I
4.4	Fluid Systems				
1.	Identify an appropriate fluid power source for different functions.	SC2	3.5	16:9-12N	I
2.	Create a flow diagram schematic for an actual fluid power circuit.		1.8, 2.1	12:9-12L	I
3.	Explain mathematically the work being done by a specific fluid power device.	MA4			H
4.	Safely setup and adjust a fluid power system.		4.7	12:9-12O	I
4.5	Electrical Systems				
1.	Create schematic drawings to facilitate experimental measurements of electrical circuits.	MA1	1.8	12:9-12L	I
2.	Apply Ohm's and Watt's laws in designing safe electrical circuits.	MA4, SC1		11:9-12P	H
3.	Estimate current consumption by a circuit and compare estimates to accurate measurements.	MA1			H
4.	Assess community electrical system needs.	MA1, MA4	1.2	13:9-12L	J
5.	Evaluate the impact supplying electrical generation has on communities.	SC8		13:9-12K	J
4.6	Control Systems				
1.	Design, diagram and implement a program to control a device.	M4	3.1	11:9-12Q	H
2.	Apply concepts of mechanical, electrical, and control systems in solving design problems.	SC1, SC2	3.1	11:9-12O	H
3.	Evaluate the operation of a sorting device and make appropriate changes in design, circuitry or programming.		3.7	11:9-12P	H
4.	Demonstrate and defend a solution to the design problem.	CA6	2.1	11:9-12R	F, J
5.1	Statics and Strength of Materials				
1.	Define key terms related to kinematics.	CA1			B
5.2	Statics				
1.	Mathematically analyze a simple truss to determine types and magnitude of forces supported in the truss.	MA2, SC2		11:9-12P	G, H
2.	Define, describe, and analyze the stresses and forces acting on an object.	SC2		11:9-12P	L
3.	Design, construct, and test a model bridge to support the greatest amount of weight per gram of bridge mass.		2.5	11:9-12O	M
4.	Prepare and present a mathematical analysis of a truss design as part of a 5 minute oral presentation about a bridge design.	CA6, MA3	1.8	11:9-12R	F

5.3	Strength of Materials				
1.	Explain how safety, cost effectiveness, and client and societal acceptance influence the design process.	H/PE6	3.8	9:9-12L	K
2.	Explain the difference between the area of a cross section of an object and the second moment of the area (Moment of Inertia) and predict the relative strength of one shape versus another.	MA2			G, L
3.	Apply a computer aided engineering package to analyze a structure.		1.8	11:9-12P	G
4.	Explain the effects that stress has on a material and how the material will react.	SC1, SC2			L
6.1	Materials and Strength of Materials				
1.	Define terms related to materials, machines, and processes.	CA1			B
6.2	Categories of Materials				
1.	Identify the five basic categories of solid engineering materials.	SC1		19:9-12M	N
2.	Compare and contrast the physical properties of organics, metals, polymers, ceramics, and composites.	SC1		19:9-12M	N
3.	Trace the production of raw material to finished product.			19:6-8H	O
4.	Identify practical applications of each material category to engineered products and processes.			19:9-12M	N
5.	Collect, analyze, and test samples of the four basic materials.	SC7	1.3	19:9-12M	K, N
6.	Document and present laboratory data related to studies of material classifications.	CA4	1.8, 2.1		N
6.3	Properties of Materials				
1.	Identify and document the properties of materials.	SC1		19:9-12M	N
2.	Design an experiment to identify an unknown material.	SC7	1.3, 3.5		N
3.	Formulate test data conclusions from analysis of recorded laboratory test data for presentations in the form of charts, graphs, written, verbal, and multi-media formats.	CA6	1.8		K
4.	Analyze forces acting on materials.	SC2			N
6.4	Manufacturing Process				
1.	Describe examples of the major categories of production processes.	CA1		19:6-8F	O
2.	Analyze a component of a product and describe the processes used in its creation.	CA1	1.6	19:6-8F	O
3.	Interpret a drawing and produce a part.		2.5	17:9-12Q	E
4.	Give an oral presentation on the production processes used to create products from a given category of materials and a demonstration about one of the processes.	CA1, CA6	2.1	19:6-8F	F
6.5	Quality Control				
1.	Explain the difference between mass and weight.	SC1			B

2.	Utilize a variety of precision measurement tools to measure appropriate dimensions, mass, and weight.	MA2			H
3.	Explain the need for quality control and describe what customers and companies refer to when the term “quality” is used.	CA1, SS4		2:9-12DD	O
4.	Calculate the mean, median, mode, and standard deviation for a set of data and apply that information to quality assurance.	MA3	1.6, 1.8		G, O
5.	Explain the difference between process and product control.	CA1			B, O
6.	Distinguish between the characteristics of quality in a final product and the control of quality in each step of a process.	CA1			O
7.	Describe how control charts are used in industry and predict whether a process is "in" or “out of control" using a control chart.	CA1		12:9-12L	O
6.6	Material Testing				
1.	Describe and safely conduct destructive and non-destructive material testing and use the data collected to compute and document mechanical properties.	CA1, SC1	1.3		N
2.	Analyze a product that breaks and explain how the material failed.	CA1, SC1	3.1		P
7.1	Engineering and Reliability				
1.	Define engineering terms related to reliability and redundancy.	CA1			B
7.2	Reliability				
1.	Diagram a system and identify the critical components.	FA1	1.8	2:9-12X	I
2.	Mathematically estimate the chance of failure of a system given information on certain components.	MA3		2:9-12Y	H
3.	List the causes of failure and be able to propose solutions.	CA1	3.1	12:9-12M	P
4.	Prepare and defend a position on an ethical engineering dilemma.	CA6	2.1, 4.4	4:9-12J	P
7.3	Case Study				
1.	Research the engineering, legal, social, and ethical issues related to a final design developed in a case study.	CA4	1.2, 3.8	4:9-12J	C, P
2.	Analyze an engineering failure and present an oral report which identifies causes, damage done, design failures, and other areas where the failure has impacted the environment or society.	SC8	1.8	5:9-12L, 12:9-12L	F, P
3.	Prepare a written report explaining their analysis of an engineering failure.	CA1, CA4	2.1	12:9-12L	P
8.1	Kinematics				
1.	Define engineering terms related to kinematics.	CA1			B
2.	Produce graphs depicting trajectory information data gathered in testing.	MA4	1.8	12:9-12L	Q
8.2	Linear Motion				
1.	Explain the difference between distance traveled and displacement.	MA4, SC2			Q

2.	Design and build a device for conducting experiments of acceleration, displacement, and velocity.	SC2	1.3	11:9-12Q	Q
8.3	Trajectory Motion				
1.	Explain how velocity and acceleration are calculated.	MA4			Q
2.	Calculate range and initial acceleration from data recorded from experiments.	MA4	1.8		Q
3.	Design and produce a three fold pamphlet to include an explanation of ballistic device drawings and a summarization of data recorded from experiments.	CA4	1.8, 2.5	12:9-12L	F
4.	Analyze test data and utilize the results to make decisions.		3.7	12:9-12N	Q