Engineering Connections Aligned with the STEM Rubric Principles

K – 12 Correlation

NC STEM Education Schools and Programs

North Carolina Department of Public Instruction

The "E" in STEM, the engineering component, is connected to Science, Technology, Mathematics, and courses within the existing Standard Course of Study. Engineering Connections are developed and aligned with the STEM Implementation Rubric Principles. The Key Engineering Elements in the Engineering Connections align characteristics to Grades K-5, Grades 6-8, and Grades 9-12. These Connections enrich courses in the Arts, Career and Technical Education, English Language, Healthful Living, Music, Social Studies, and World Languages as well as Out-of-School programs.

HOW TO USE THIS RUBRIC:

1. The Rubric outlines quality indicators of the four Engineering Key Elements aligned to the three STEM Principles. The Engineering Key Elements help focus and clarify the scope of review for each STEM Principle.

   STEM Principles:

   - Integrated Science, Technology, Engineering, and Mathematics (STEM) Curriculum Aligned with State, National, and Industry Standards
   - On-going community and industry engagement
   - Connections to postsecondary education

   Engineering Key Elements:

   - Engineering Habits of Mind
   - Engineering Design Process
   - Systems Thinking
   - Problem Solving

2. The Implementation Continuum across the page represents varying depths of implementation, or quality.

"Model"	Highest level of achievement representing a model
"Prepared"	Quality program meeting expectations
"Developing"	Needs improvement but program has a good start
"Early"	Beginning STEM program

Public Schools of North Carolina
State Board of Education | Department of Public Instruction

Summary

Engineering Connections Aligned with the STEM Attribute Principles

Elementary School _____ **Middle School** _____ **High School** _____

STEM Principles	Early →	Developing →	Prepared ●	Model ●
Integrated Science, Technology, Engineering and Mathematics (STEM) curriculum aligned with state, national, and industry standards				
1) Engineering Habits of Mind				
2) Design Process				
3) Systems Thinking				
4) Problem Solving				
On-going community and industry engagement				
5) Engineering Habits of Mind				
6) Design Process				
7) Systems Thinking				
8) Problem Solving				
Connections to postsecondary education				
9) Engineering Habits of Mind				
10) Design Process				
11) Systems Thinking				
12) Problem Solving				

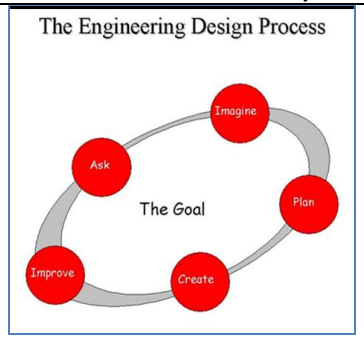
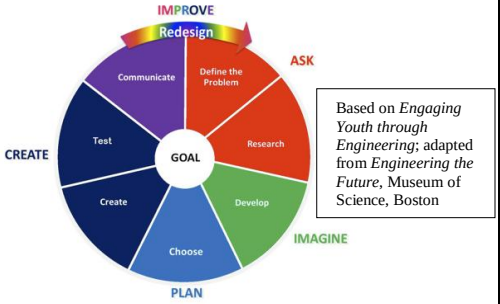
K-12 Correlation: Engineering Connections Aligned with the STEM Rubric Principles

Integrated STEM Curriculum, Aligned with State, National, and Industry Standards (Principle)					
(1) Engineering Habits of Mind (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** →	**Developing** →	**Prepared** ●	**Model** ●
Elementary School	1.1 Professional Development	Teacher professional development identifies Engineering Habits of Mind.	Teacher professional development illustrates engineering habits of mind at least once a year.	Teacher professional development applies the engineering habits of mind at least once per semester.	Teachers use engineering habits of mind in professional development. Every workshop illustrates how to use the habits of mind in an integrated classroom.
	1.2 Collaboration (teamwork)	Teamwork in the classroom takes place weekly, team roles are not defined, and teams have 2 members.	Team's exhibit evidence of defined roles at least twice weekly and teams have 2-3 members.	Students exemplify cooperative teamwork daily and teams have 3-4 members.	Student teams of 3-4 members design complete solutions to age appropriate difficult and unfamiliar problems.
	1.3 Optimism	Classroom practice includes a mechanism to encourage students to address frustrations productively.	Teachers identify student frustrations as a driver for learning.	Students apply persistence by managing frustrations in solving familiar problems.	Students apply persistence in solving unfamiliar problems most of the time.
	1.4 Communication	Evidence-based communication (oral and/or written) is exemplified in a single subject area less than weekly.	Written and oral communication between students and student/teacher uses evidence-based argumentation in multiple subject areas at least weekly.	Student written and oral communications exemplify appropriate use of content knowledge in multiple subject areas weekly.	Students apply content knowledge from multiple subject areas to support argumentation daily.
	1.5 Creativity	Teachers recognize that problems may have multiple correct solutions.	Teachers encourage students to compare multiple solution pathways for problems twice weekly.	Students explain multiple solutions to problems daily.	Students implement multiple solutions to problems daily.
	1.6 Attention to ethical consideration	Teachers identify that ethical considerations are a part of decision making.	Teachers encourage discussion of ethical considerations among students at least monthly.	Students explain ethical considerations associated with global problems under consideration weekly.	Classroom operations and student work clearly use consideration of ethical tradeoffs.
	1.7 System Thinking	See Systems Thinking Key Element for implementation			

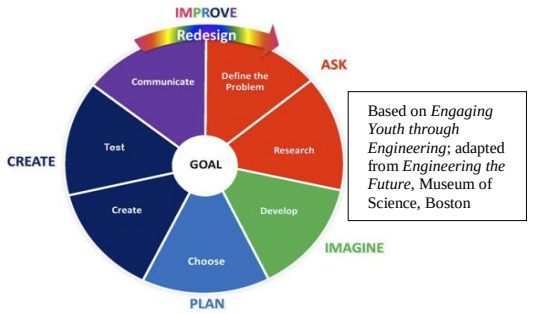
Integrated STEM Curriculum, Aligned with State, National, and Industry Standards (Principle)						
(1) Engineering Habits of Mind (Engineering Key Element)						
Key Engineering Element Descriptions		**Early** →	**Developing** →	**Prepared** ●	**Model** ●	
Middle School	1.1 Professional Development	Teacher professional development identifies Engineering Habits of Mind.	Teacher professional development illustrates engineering habits of mind at least once a year.	Teacher professional development applies the engineering habits of mind at least once per semester.	Teacher use engineering habits of mind in professional development. Every workshop illustrates how to use the habits of mind in an integrated classroom.	
	1.2 Collaboration (teamwork)	Teamwork in the classroom takes place weekly, team roles are not clearly defined, and teams have 2 members.	Team's exhibit evidence of *defined roles* at least twice weekly and teams have 2-3 members.	Students exemplify cooperative teamwork daily and teams have 3-4 members.	Student teams of 3-4 members design complete solutions to age appropriate difficult and unfamiliar problems.	
	1.3 Optimism	Classroom practice includes a mechanism to encourage students to address frustrations productively.	Teachers identify student frustrations as a driver for learning.	Students apply persistence by managing frustrations with problem solving with encouragement from the teacher.	Students apply persistence in solving unfamiliar problems most of the time without teacher intervention.	
	1.4 Communication	Evidence-based communication (oral and/or written) is exemplified in a single subject area less than weekly.	Written and oral communication between students and student/teacher uses evidence-based argumentation in multiple subject areas at least weekly.	Student written and oral communications exemplify appropriate use of content knowledge in multiple subject areas weekly.	Students apply content knowledge from multiple subject areas to support argumentation daily.	
	1.5 Creativity	Teachers and students recognize that problems may have multiple correct solutions.	Teachers encourage students to use multiple solution pathways for problems twice weekly.	Students explain multiple solutions to problems daily.	Students implement multiple solutions to global problems.	
	1.6 Attention to ethical consideration	Teachers identify that ethical considerations are a part of decision making.	Teachers encourage discussion of ethical considerations among students at least monthly.	Students explain ethical considerations associated with global problems under consideration weekly.	Classroom operations and student work clearly analyze consideration of ethical tradeoffs.	
	1.7 System Thinking	See Systems Thinking Key Element for implementation				

Integrated STEM Curriculum, Aligned with State, National, and Industry Standards (Principle)					
(1) Engineering Habits of Mind (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** ➡	**Developing** ➡	**Prepared** ●	**Model** ●
High School	1.1 Professional Development	Teacher professional development identifies Engineering Habits of Mind.	Teacher professional development illustrates engineering habits of mind at least once a year.	Teacher professional development applies the engineering habits of mind at least once per semester.	Teacher use engineering habits of mind in professional development. Every workshop illustrates how to use the habits of mind in an integrated classroom.
	1.2 Collaboration (teamwork)	Teamwork in the classroom takes place weekly, team roles are not defined, and teams have 2 members.	Team's exhibit evidence of defined roles at least twice weekly and teams have 2-3 members.	Students exemplify cooperative teamwork daily and teams have 3-4 members.	Student teams of 3-4 members design complete solutions to age appropriate difficult and unfamiliar problems.
	1.3 Optimism	Classroom practice includes a mechanism to encourage students to address frustrations productively.	Teachers identify student frustrations as a driver for learning.	Students apply persistence by managing frustrations with unfamiliar problems.	Students analyze frustrations in solving unfamiliar and difficult problems to persist to completion without teacher intervention.
	1.4 Communication	Evidence-based communication (oral and/or written) is exemplified in a single subject area less than weekly.	Written and oral communication between students and student/teacher uses evidence-based argumentation in multiple subject areas at least weekly.	Student written and oral communications exemplify appropriate use of content knowledge in multiple subject areas weekly.	Students apply content knowledge from multiple subject areas to support argumentation daily.
	1.5 Creativity	Teachers and students recognize that problems may have multiple correct solutions.	Teachers encourage students to use multiple solution pathways for problems twice weekly.	Students explain multiple solutions to problems daily.	Students implement multiple solutions to global problems.
	1.6 Attention to ethical consideration	Teachers identify that ethical considerations are a part of decision making.	Teachers encourage discussion of ethical considerations among students at least monthly.	Students explain ethical considerations associated with global problems under consideration weekly.	Classroom operations and student work clearly generate consideration of ethical tradeoffs.
	1.7 System Thinking	See Systems Thinking Key Element for implementation			

Integrated STEM Curriculum, Aligned with State, National, and Industry Standards (Principle)					
(2) Engineering Design Process (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** →	**Developing** →	**Prepared** ●	**Model** ●
Elementary School	2.1	Teacher professional development focuses on project-based learning at least one day per year.	Teacher professional development focuses on project-based learning to meet multiple objectives at least two days per year.	Teacher professional development focuses on using the Engineering Design Process in multiple ways, not just in project based learning, at least two days per year.	Teachers organize opportunities to use the Engineering Design Process in classroom practice at least four days per year; this may include personalized learning.
	2.2	Teachers exemplify the Engineering Design Process as an authentic problem solving process monthly.	Teachers apply the Engineering Design Process in real-world authentic problems monthly.	Teachers analyze students' use of the Engineering Design Process in real-world, authentic problem solving monthly.	Teachers evaluate students' use of the Engineering Design Process in real-world, authentic problem solving weekly
	2.3	Students recognize the Engineering Design Process in the classroom.	Students exemplify the Engineering Design Process in oral and/or written communication monthly.	Students implement the Engineering Design Process in oral and/or written communication in weekly.	Students apply the Engineering Design Process in interdisciplinary problem solving weekly.
	2.4	Students identify models in engineering design projects four times per year.	Students summarize models in engineering design projects four times per year.	Students explain models in engineering design projects monthly.	Students use models in multiple subject areas two times per month.
	2.5	Teachers identify alternative viewpoints in engineering design Projects monthly.	Teachers exemplify alternative viewpoints in engineering design projects weekly.	Students explain alternative viewpoints in engineering design projects monthly.	Students use alternative viewpoints in engineering design projects weekly.

Engineering Design Process Elementary School	Engineering Design Process Elementary School	Engineering Design Process Middle and High School	Design Process Graphic
Ask	 Grades K-5, based on *Engineering is Elementary* from Museum of Science, Boston	**Define the problem**, include criteria and constraints	 Based on *Engaging Youth through Engineering*; adapted from *Engineering the Future*, Museum of Science, Boston
Imagine		**Research**	
Plan		**Develop** ideas	
Create		**Choose** and approach	
Improve as needed at any step		**Create** Model or Prototype	
		Test	
		Communicate	
		Redesign as needed at any step	

Integrated STEM Curriculum, Aligned with State, National, and Industry Standards (Principle)					
(2) Engineering Design Process (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** →	**Developing** →	**Prepared** ●	**Model** ●
Middle School	2.1	Teacher professional development focuses on project-based learning at least one day per year.	Teacher professional development focuses on project-based learning to meet multiple objectives at least two days per year.	Teacher professional development focuses on using the Engineering Design Process in multiple ways, not just in project based learning, at least two days per year.	Teachers organize opportunities to use the Engineering Design Process in classroom practice at least four days per year; this may include personalized learning.
	2.2	Teachers exemplify the Engineering Design Process as an authentic problem solving process monthly.	Teachers apply the Engineering Design Process in real-world, authentic problems monthly.	Teachers analyze students' use of the Engineering Design Process in real-world, authentic problem solving monthly.	Teachers evaluate students' use of the in Engineering Design Process real-world, authentic problem solving weekly.
	2.3	Students recall the Engineering Design Process twice per month.	Students explain the Engineering Design Process and evidence of its implementation is seen monthly in student work.	Students apply the steps of the Engineering Design Process in problem solving weekly.	Students analyze the design of a product using the reverse engineering approach at least two times per year..
	2.4	Students identify models or prototypes in design projects four times per year.	Students exemplify models or prototypes in design projects four times per year.	Students use models or prototypes in design projects monthly.	Students differentiate between types of models or prototypes in multiple subject areas two times per month.
	2.5	Students identify global and ethical issues within an existing design.	Students exemplify global and ethical viewpoints in proposing a design.	Students apply global and ethical viewpoints as a part of the Engineering Design Process.	Students differentiate between proposed designs using global and ethical viewpoints

Engineering Design Process Elementary School	Engineering Design Process Middle and High School	Design Process Graphic
Ask	**Define the problem**, including criteria and constraints	
	Research	
Imagine	**Develop** ideas	
Plan	**Choose** an approach	
Create	**Create** Model or Prototype	
	Test	
	Communicate	
Improve as needed at any step	**Redesign** as needed at any step	

Based on *Engaging Youth through Engineering*; adapted from *Engineering the Future*, Museum of Science, Boston

Integrated STEM Curriculum, Aligned with State, National, and Industry Standards (Principle)					
(2) Engineering Design Process (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** ➡	**Developing** ➡	**Prepared** ●	**Model** ●
High School	2.1	Teacher professional development focuses on project-based learning at least one day per year.	Teacher professional development focuses on project-based learning to meet multiple objectives at least two days per year.	Teacher professional development focuses on using the Engineering Design Process in multiple ways, not just in project based learning, at least two days per year.	Teachers organize opportunities to use the Engineering Design Process in classroom practice at least four days per year; this may include personalized learning.
	2.2	Teachers exemplify the Engineering Design Process as an authentic problem solving process monthly.	Teachers apply the Engineering Design Process in real-world, authentic problems monthly.	Teachers analyze students' use of the Engineering Design Process in real-world, authentic problem solving monthly.	Teachers evaluate students' use of the Engineering Design Process in real-world, authentic problem solving weekly
	2.3	Students recall the Engineering Design Process twice per month.	Students explain the Engineering Design Process and evidence of its implementation is seen monthly in student work.	Students apply the steps of the Engineering Design Process in problem solving weekly.	Students analyze the design of a product using the reverse engineering approach at least two times per year.
	2.4	Students identify models or prototypes in engineering design projects four times per year.	Students exemplify models or prototypes in engineering design projects four times per year.	Students use models or prototypes in engineering design projects monthly.	Students differentiate between types of models or prototypes in multiple subject areas two times per month.
	2.5	Students identify global and ethical issues within an existing design.	Students exemplify global and ethical viewpoints in engineering design weekly.	Students apply global and ethical viewpoints in engineering design monthly.	Students analyze global and ethical viewpoints in engineering design weekly.

Engineering Design Process Elementary School	**Engineering Design Process Middle and High School**
Ask	**Define the problem**, including criteria and constraints
	Research
Imagine	**Develop** ideas
Plan	**Choose** an approach
Create	**Create** Model or Prototype
	Test
	Communicate
Improve as needed at any step	**Redesign** as needed at any step

Design Process Graphic

Based on *Engaging Youth through Engineering*; adapted from *Engineering the Future*, Museum of Science, Boston

Integrated STEM Curriculum, Aligned with State, National, and Industry Standards (Principle)					
(3) Systems Thinking (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** ➡	**Developing** ➡	**Prepared** ●	**Model** ●
Elementary School	3.1	Students recognize a system is either natural or human-made weekly.	Students identify the characteristics of natural and human-made systems monthly.	Students compare systems in multiple content areas monthly.	For a given natural or human-made system, students explain how parts relate to each other, and how parts, or combination of parts, contribute to the function of the system as a whole four times per year.
Middle School	3.1	Students classify a system as either natural or human-made according to its characteristics weekly.	Students recognize how natural and human-made systems are often embedded in larger systems monthly.	Students explain systems in multiple content areas monthly.	For a given natural or human-made system, students analyze how the individual parts function, how parts relate to each other, and how parts, or combinations of parts, contribute to the function of the system as a whole four times per year.
High School	3.1	Students classify a system as either natural or human-made according to its characteristics weekly.	Students explain how natural and human-made systems are often embedded in larger systems monthly.	Students apply a systems thinking approach across multiple content areas to solve problems monthly.	Students analyze the relationships among systems that are embedded within larger technological, social, natural, environmental, etc. systems four times per year.

Systems Thinking is a fundamental way of viewing problems in Engineering. It is an approach to problem solving that leads one to understand that problems consist of smaller parts which are interrelated and have impact on each other.

Characteristics of a system:

- A system is composed of parts that must be related
- A system has boundaries
- A system can be nested inside another system
- A system can overlap with another system
- A system can change with time
- A system receives inputs and sends outputs
- A system is designed to transform inputs into outputs

Integrated STEM Curriculum, Aligned with State, National, and Industry Standards (Principle)					
(4) Problem Solving (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** ➡	**Developing** ➡	**Prepared** ●	**Model** ●
Elementary School	4.1	Students identify a single solution approach to well-defined problems with no extraneous information provided monthly.	Students exemplify a single solution approach to problems with extraneous information provided weekly.	Students explain multiple-solution approaches to problems with extraneous information provided monthly.	Students apply multiple- solution approaches to problems to eliminate extraneous information monthly.
	4.2	Teachers illustrate multiple-solution approaches to problem solving.	Teachers explain problem-solving techniques leading to multiple solution pathways.	Teachers use problem solving techniques, including assumptions, to solve problems.	Teachers organize problems that require assumptions to solve.
	4.3	Teachers identify local problems and their relationship to the community.	Teachers explain how local problems impact the community.	Students understand how the community can solve local problems.	Students explain multiple- solution approaches to community problems.
Middle School	4.1	Students illustrate a single solution approach to well-defined problems with extraneous information provided monthly.	Students exemplify multiple-solution approaches to problems with extraneous information provided weekly.	Students recognize that assumptions are required to solve given problems monthly.	Students analyze problem information to determine when assumptions are necessary and to eliminate extraneous information four times per year.
	4.2	Teachers recognize the need to prepare problem solutions in advance.	Teachers explain a single approach to solving problems using student input.	Teachers outline to students their own problem solving approach to a given problem.	Teachers use different approaches to solve student generated problems that require assumptions
	4.3	Students identify local problems and their relationship to global issues.	Students explain how local problems are related to global issues.	Students apply interdisciplinary knowledge to understand global issues.	Students analyze problems to identify interdisciplinary solutions to global issues.
High School	4.1	Students illustrate a single solution approach to well-defined problems with extraneous information provided monthly.	Students exemplify multiple-solution approaches to problems with extraneous information provided two times a month.	Students apply multiple-solution approaches, optimization techniques, and tradeoffs to problems four times per year.	Students analyze problem information to determine when assumptions are necessary and to eliminate extraneous information four times per year.
	4.2	Teachers exemplify multiple-solution approaches and optimization techniques to problem solving monthly.	Teachers apply multiple-solution approaches and optimization techniques to problem solving weekly.	Teachers organize problems to include assumptions, optimization techniques, and tradeoffs to arrive at solutions four times per year.	Teachers generate problems that require the elimination of extraneous information and the identification of assumptions to arrive at solutions two times per year.
	4.3	Students identify local problems and their relationship to global issues.	Students explain how local problems are related to global issues.	Students apply interdisciplinary knowledge and optimization techniques to understand global issues.	Students analyze problems to identify interdisciplinary solutions to global issues.

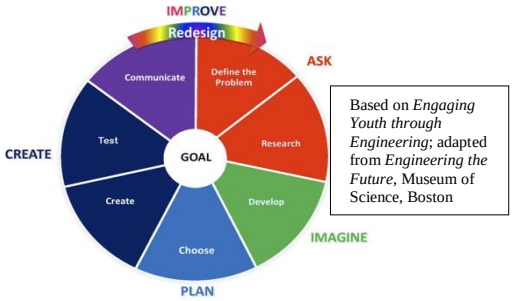
***Optimization** is identifying the best solution to a problem while balancing competitive or conflicting factors. (Grades K-8 Key Engineering Element Descriptions are developmental. Grades 9-12 are application)

****Tradeoffs** are deciding which criteria are most important to determine the best solution to a specific problem.

On-going Community and Industry Engagement (Principle)					
(5) Engineering Habits of Mind * (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** ➡	**Developing** ➡	**Prepared** ●	**Model** ●
Elementary School	5.1	Teachers identify opportunities to partner with the local industry and community at least once a year.	Teachers implement partnerships with local industry and community that provide interactions with students at least twice a year.	Teachers apply collaborative principles to form industry and community partnerships at least three times a year.	Teachers organize extension opportunities for themselves and their students both outside and in the classroom at least once for themselves and four times a year for students to develop the STEM pipeline the workforce and postsecondary education.
	5.2	Teachers identify funding opportunities from industry, foundations and non-profit organizations interested in STEM education.	Teachers review requests for proposals for funding opportunities from industry, foundations and non-profit organizations interested in STEM education.	Teachers and school system personnel organize a grant proposal for funding from STEM stakeholders such as industry, foundations and non-profit organizations to enhance engineering education in the classroom and school wide.	Teachers and school system personnel implement a grant from STEM stakeholders such as industry, foundations and non-profit organizations to enhance engineering education in the classroom and school-wide.
Middle School	5.1	Teachers identify opportunities to partner with the local industry and community at least once a year.	Teachers implement partnerships with local industry and community that provide interactions with students at least twice a year.	Teachers apply collaborative principles to form industry and community partnerships at least three times a year.	Teachers organize extension opportunities for themselves and their students both outside and in the classroom at least once for themselves and four times a year for students to develop the STEM pipeline the workforce and postsecondary education.
	5.2	Teachers identify funding opportunities from industry, foundations and non-profit organizations interested in STEM education.	Teachers review requests for proposals for funding opportunities from industry, foundations and non-profit organizations interested in STEM education.	Teachers and school system personnel organize a grant proposal for funding from STEM stakeholders such as industry, foundations and non-profit organizations to enhance engineering education in the classroom and school wide.	Teachers and school system personnel implement a grant from STEM stakeholders such as industry, foundations and non-profit organizations to enhance engineering education in the classroom and school-wide.
High School	5.1	Teachers identify opportunities to partner with the local industry and community at least once a year.	Teachers implement partnerships with local industry and community that provide interactions with students at least twice a year.	Teachers apply collaborative principles to form industry and community partnerships at least three times a year.	Teachers organize extension opportunities for themselves and their students both outside and in the classroom at least once for themselves and four times a year for students to develop the STEM pipeline the workforce and postsecondary education.
	5.2	Teachers identify funding opportunities from industry, foundations and non-profit organizations interested in STEM education.	Teachers review requests for proposals for funding opportunities from industry, foundations and non-profit organizations interested in STEM education.	Teachers and school system personnel organize a grant proposal for funding from STEM stakeholders such as industry, foundations and non-profit organizations to enhance engineering education in the classroom and school wide.	Teachers and school system personnel implement a grant from STEM stakeholders such as industry, foundations and non-profit organizations to enhance engineering education in the classroom and school-wide.

***Engineering Habits of Mind** includes Collaboration (Teamwork), Optimism, Communication, Creativity, Attention to Ethical Consideration, and Systems Thinking.

On-going Community and Industry Engagement (Principle)					
(6) Engineering Design Process (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** ➡	**Developing** ➡	**Prepared** ●	**Model** ●
Elementary School	6.1	Teachers select engineers from local industry and community to speak in classrooms once a year.	Teachers select engineers from local industry and community to discuss engineering design at least twice a year.	Teachers identify engineers from local industry, higher education institutions or community to demonstrate to students how they have used the design process at least once a year.	Teachers implement partnerships with engineers from industry, post-secondary and/or the community for mentoring interactions with the teachers and students.
Middle School	6.1	Teachers select engineers from local industry and community to speak in classrooms once a year.	Teachers select engineers from local industry and community to discuss engineering design at least twice a year.	Teachers identify engineers from local industry, higher education institutions or community to demonstrate to students how they have used the design process at least once a year.	Teachers implement partnerships with engineers from industry, post-secondary and/or the community for mentoring interactions with the teachers and students.
High School	6.1	Teachers select engineers from local industry and community to speak in classrooms once a year.	Teachers select engineers from local industry and community to discuss engineering design at least twice a year.	Teachers identify engineers from local industry, higher education institutions or community to demonstrate to students how they have used the design process at least once a year.	Teachers implement partnerships with engineers from industry, post-secondary and/or the community for mentoring interactions with the teachers and students.

Engineering Design Process Elementary School	Engineering Design Process Middle and High School	Design Process Graphic
Ask	**Define the problem**, including criteria and constraints	
	Research	
Imagine	**Develop** ideas	
Plan	**Choose** an approach	
Create	**Create** Model or Prototype	
	Test	
	Communicate	
Improve as needed at any step	**Redesign** as needed at any step	

Based on *Engaging Youth through Engineering*; adapted from *Engineering the Future*, Museum of Science, Boston

On-going Community and Industry Engagement (Principle)					
(7) Systems Thinking (Engineering Key Element)					
Key Engineering Element Descriptions		Early	Developing	Prepared	Model
Elementary School	7.1	Teachers and students recognize systems in the local economy once a year.	Teachers and students deconstruct a community system four times a year.	Teachers and students analyze the role(s) of businesses in a local system twice a year.	Teachers and students execute partnerships with local businesses and industry to infer how they fit into more than one system twice a year.
Middle School	7.1	Teachers and students recognize systems in the local economy once a year.	Teachers and students deconstruct a community system four times a year.	Teachers and students analyze the role(s) of businesses in a local system twice a year.	Teachers and students execute partnerships with local businesses and industry to infer how they fit into more than one system twice a year.
High School	7.1	Teachers and students recognize systems in the local economy once a year.	Teachers and students deconstruct a community system four times a year.	Teachers and students analyze the role(s) of businesses in a local system twice a year.	Teachers and students execute partnerships with local businesses and industry to infer how they fit into more than one system twice a year.

Systems Thinking is a fundamental way of viewing problems in Engineering. It is an approach to problem solving that leads one to understand that problems consist of smaller parts which are interrelated and have impact on each other.

Characteristics of a system:

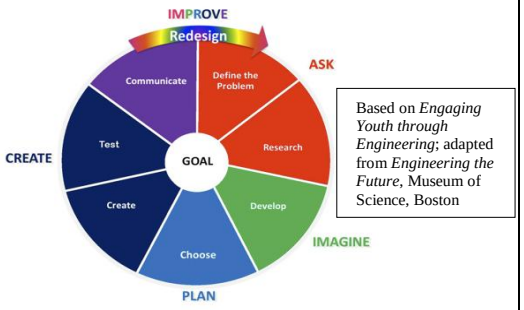
- A system is composed of parts that must be related
- A system has boundaries
- A system can be nested inside another system
- A system can overlap with another system
- A system can change with time
- A system receives inputs and sends outputs
- A system is designed to transform inputs into outputs

On-going Community and Industry Engagement (Principle)					
(8) Problem Solving (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** →	**Developing** →	**Prepared** ●	**Model** ●
Elementary School	8.1	Teachers and students identify problems in the local community that they help solve twice per year.	Teachers and students implement partnerships with community and/or industry to understand how they solve local problems twice per year.	Teachers and students implement partnerships with community and/or industry to evaluate multiple solutions to a particular problem twice a year.	Teachers and students implement a solution to address a local problem in the community annually. Students explain results to local industry, post-secondary or government representatives.
Middle School	8.1	Teachers and students identify problems in the local community that they help solve twice per year.	Teachers and students implement partnerships with community and/or industry to understand how they solve local problems twice per year.	Teachers and students implement partnerships with community and/or industry to evaluate multiple solutions to a particular problem twice a year.	Teachers and students implement a solution to address a local problem in the community annually. Students explain results to local industry, post-secondary or government representatives.
High School	8.1	Teachers and students identify problems in the local community that they help solve twice per year.	Teachers and students implement partnerships with community and/or industry to understand how they solve local problems twice per year.	Teachers and students implement partnerships with community and/or industry to evaluate multiple solutions to a particular problem twice a year.	Teachers and students implement a solution to address a local problem in the community annually. Students explain results to local industry, post-secondary or government representatives.

Connections with Postsecondary Education (Principle)					
(9) Engineering Habits of Mind * (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** →	**Developing** →	**Prepared** ●	**Model** ●
Elementary School	9.1	Teachers identify local postsecondary institutions that have outreach programs available for partnering.	Students and teachers coordinate with postsecondary outreach programs once a year	Teachers use materials and resources developed by postsecondary programs for schools that apply the engineering habits of mind.	Students and teachers identify careers in engineering at postsecondary institutions.
Middle School	9.1	Teachers identify local postsecondary institutions that have outreach programs available for partnering.	Students and teachers coordinate with postsecondary outreach programs once a year.	Teachers use materials and resources developed by postsecondary programs for schools that apply the engineering habits of mind.	Students and teachers recognize coursework that students need to matriculate to a postsecondary institution after high school.
High School	9.1	Teachers identify local postsecondary institutions that have outreach programs available for partnering.	Students and teachers coordinate with postsecondary outreach programs once a year.	Teachers use materials and resources developed by postsecondary programs for schools that apply the engineering habits of mind.	Teachers organize extension opportunities for themselves and their students both outside and in the classroom at least once for themselves and four times a year for students to develop the STEM pipeline for the workforce and postsecondary education.

***Engineering Habits of Mind** includes Collaboration (Teamwork), Optimism, Communication, Creativity, Attention to Ethical Consideration, and Systems Thinking.

Connections with Postsecondary Education (Principle)					
(10) Engineering Design Process (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** →	**Developing** →	**Prepared** ●	**Model** ●
Elementary School	10.1	Teachers identify engineers from postsecondary institutions to speak to students once per year.	Teachers use connections with engineers from postsecondary institutions to discuss engineering design twice per year.	Teachers identify research and/or an invention designed by engineers at a postsecondary institution to show students how the design process is used once per year.	Teachers identify postsecondary partners for students in the classroom to apply the design process to their own product once per year.
Middle School	10.1	Teachers identify engineers from postsecondary institutions to speak to students once per year.	Teachers use connections with engineers from postsecondary institutions to discuss engineering design twice per year.	Teachers identify research and/or an invention designed by engineers at a postsecondary institution to show students how the design process is used once per year.	Teachers identify postsecondary partners for students in the classroom to apply the design process to their own product once per year.
High School	10.1	Teachers identify engineers from postsecondary institutions to speak to students once per year.	Teachers use connections with engineers from postsecondary institutions to discuss engineering design twice per year.	Teachers identify research and/or an invention designed by engineers at a postsecondary institution to show students how the design process is used once per year.	Teachers identify postsecondary partners for students in the classroom to apply the design process to their own product once per year.

Engineering Design Process Elementary School	Engineering Design Process Middle and High School	Design Process Graphic
Ask	**Define the problem**, including criteria and constraints	
	Research	
Imagine	**Develop** ideas	
Plan	**Choose** an approach	
Create	**Create** Model or Prototype	
	Test	
	Communicate	
Improve as needed at any step	**Redesign** as needed at any step	

Based on *Engaging Youth through Engineering*; adapted from *Engineering the Future*, Museum of Science, Boston

Connections with Postsecondary Education (Principle)					
(11) Systems Thinking * (Engineering Key Element)					
Key Engineering Element Descriptions		Early →	Developing →	Prepared ●	Model ●
Elementary School	11.1	Teachers and students understand postsecondary institutions as a part of the educational system in which they participate.	Students identify postsecondary institutions as a possible route for their own educational development.	Students and teachers recognize a need for educational and career goals.	Students identify career goals.
Middle School	11.1	Teachers and students understand postsecondary institutions as a part of the educational system in which they participate.	Students identify postsecondary institutions as a possible route for their own educational development.	Students compare postsecondary institutions to meet their career goals.	Students select postsecondary institutions to visit.
High School	11.1	Teachers and students understand postsecondary institutions as part of an embedded educational system.	Students select postsecondary institutions to meet their academic and career goals.	Students use systems thinking to map their own educational pathway from high school to a postsecondary institution of their choice.	Students select a postsecondary institution to visit that was previously mapped to their own educational pathways.

***Systems Thinking** is a fundamental way of viewing problems in Engineering. It is an approach to problem solving that leads one to understand that problems consist of smaller parts which are interrelated and have impact on each other.

Characteristics of a system:

- A system is composed of parts that must be related
- A system has boundaries
- A system can be nested inside another system
- A system can overlap with another system
- A system can change with time
- A system receives inputs and sends outputs
- A system is designed to transform inputs into outputs

Connections with Postsecondary Education (Principle)					
(12) Problem Solving (Engineering Key Element)					
Key Engineering Element Descriptions		**Early** ➡	**Developing** ➡	**Prepared** ●	**Model** ●
Elementary School	12.1	Teachers illustrate problem-solving techniques to identify postsecondary institutions with whom to partner.	Teachers and students use problem-solving techniques to develop relationships with postsecondary engineering partner institutions.	Schools implement partnerships with postsecondary institutions to compare how students learn at different levels.	Students visit a postsecondary engineering or engineering technology program.
Middle School	12.1	Teachers illustrate problem-solving techniques to identify postsecondary institutions with whom to partner.	Teachers and students use problem-solving techniques to develop relationships with postsecondary engineering partner institutions.	Schools implement partnerships with postsecondary institutions to compare how students learn at different levels.	Students visit a postsecondary engineering or engineering technology program.
High School	12.1	Teachers illustrate problem-solving techniques to identify postsecondary institutions with whom to partner.	Teachers and students use problem-solving techniques to develop relationships with postsecondary engineering partner institutions.	Students coordinate with postsecondary students for mentoring on study skills and related learning tools.	Teachers and students organize a visit to a postsecondary engineering or engineering technology program research lab or seminar.

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