PASSAIC COUNTY TECHNICAL INSTITUTE

WAYNE, NJ

PLTW | Engineering

PROJECT LEAD THE WAY 1 CURRICULUM

Revised November 2014 - 2015

Project Lead the Way 1 Curriculum – Overview

I. COURSE DESCRIPTION

Introduction to Engineering Design (IED) is a high school level course that is appropriate for students who are interested in design and engineering. The major focus of the IED course is to expose students to design process, research and analysis, teamwork, communication methods, global and human impacts, engineering standards, and technical documentation. IED gives students the opportunity to develop skills and understanding of course concepts through activity-, project-, and problem-based learning. Used in combination with a teaming approach, IED challenges students to continually hone their interpersonal skills, creative abilities and understanding of the design process. It also allows students to develop strategies to enable and direct their own learning, which is the ultimate goal of education.

The course assumes no previous knowledge, but students should be concurrently enrolled in college preparatory mathematics and science. Students will employ engineering and scientific concepts in the solution of engineering design problems. In addition, students use a 3D solid modeling design software package to help them design solutions to solve proposed problems. Students will develop problem-solving skills and apply their knowledge of research and design to create solutions to various challenges that increase in difficulty throughout the course. Students will also learn how to document their work, and communicate their solutions to their peers and members of the professional community.

Introduction to Engineering Design is one of three foundation courses in the Project Lead The Way high school pre-engineering program. Students dig deep into the engineering design process, applying math, science, and engineering standards to hands-on projects. They work both individually and in teams to design solutions to a variety of problems using 3D modeling software, and use an engineering notebook to document their work.

Curriculum Design

The PLTW Learning Management System (LMS)

This Learning Management System course instance is intended to be a complete teaching curriculum, not just a guide or an outline. The curriculum is composed of units and lessons. Each lesson contains Activities, Projects, and Problems (APBs). The teacher resource materials for lesson planning and documentation are located in each lesson module on locked pages.

PCTI CTE Curriculum Unit Planner

I. Course Description:	Project Lead the Way- Introduction to Engineering Design	Grade(s)	9
Unit Plan Title:	1. Design Process		

II. Course Objectives/Outline

Common Core Literacy Technical Subjects –
Reading:
RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

NJ Core Technology Education -8.2.12.B.1, 8.2.12.C.6, 8.2.12.C.5, 8.2.12.C.3, 8.2.5.D.1, 8.2.12.D.3, 8.2.12.D.1

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5)

Essential Questions

- **EQ1** -- When solving an engineering problem, how can we be reasonably sure that we have created the BEST solution possible? What is the evidence?
- **EQ2** – What is the most effective way to generate potential solutions to a problem? How many alternate solutions are necessary to ensure a good final solution?
- **EQ3** – What engineering accomplishment of the 20th century has had the greatest impact on society? Justify your answer.
- **EQ4** – What will be the biggest impact that engineering will have on society and your life in the 21st century? Justify your answer.
- **EQ5** – Engineering tends to be a male-dominated profession. Why is that?

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson
Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each profession.
4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques
10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VII. Suggested Time Frame: 4 weeks

III. Method of Student evaluation

40%tests 30%projects 20%quizzes 10% class participation and quizzes

PCTI CTE Curriculum Unit Planner

I. Course Description:	Project Lead the Way - Introduction to Engineering Design	Grade(s)	9
Unit Plan Title:	2. Technical Sketching and Drawing		

II. Course Objectives/Outline

Common Core State Standards for Mathematical Practice
Geometric-G.MG.1

Common Core Literacy Technical Subjects –
Reading:
RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

NJ Core Technology Education -8.2.12.B.1, 8.2.12.C.6, 8.2.12.C.5, 8.2.12.C.3, 8.2.5.D.1, 8.2.12.D.3, 8.2.12.D.1

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5)

Essential Questions

- **EQ1 –** How is technical drawing similar to and different from artistic drawing?
- **EQ2 –** What can cause a technical drawing to be misinterpreted or to be inadequate when conveying the intent of a design to someone unfamiliar with the original problem or solution?
- **EQ3 –** In what ways can technical drawings help or hinder the communication of problem solution in a global community.
- **EQ4 –** Strong spatial-visualization skills have been linked to success in engineering. Why are spatial-visualization skills so important to engineering success?

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson
Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each profession.
4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques
10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VII. SUGGESTED Time Frame: 2 weeks
III. Method of Student evaluation
40%tests 30%projects 20%quizzes 10% class participation and quizzes

PCTI CTE Curriculum Unit Planner

I. Course Description:	**Project Lead the Way - Introduction to Engineering Design**	**Grade(s)**	**9**
Unit Plan Title:	**3. Measurement and Statistics**		

II. Course Objectives/Outline

Common Core State Standards for Mathematical Practice
Geometry- G.MG.1, G.GMD.3,
Number and Quantity - N.Q .1, N.Q .2, N.Q .3,
Algebra- A.CED.3, S.ID.4

Common Core Literacy Technical Subjects –
Reading:
RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

NJ Core Technology Education -8.2.12.B.1, 8.2.12.C.6, 8.2.12.C.5, 8.2.12.C.3, 8.2.5.D.1, 8.2.12.D.3, 8.2.12.D.1

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5)

Essential Questions

- **EQ1 –** Can statistics be interpreted to justify conflicting viewpoints? Can this affect how we use statistics to inform, justify and validate a problem solution?
- **EQ2 --** Why is error unavoidable when making a measurement?
- **EQ3 –** When recording measurement data, why is the use of significant figures important?
- **EQ4 –** What strategy would you use to teach another student how to use units and quantitative reasoning to solve a problem involving quantities? (For example, a problem like A3.2 number 4 or number 5.)
- **EQ5 –** What would happen if engineers did not follow accepted dimensioning standards and guidelines but, instead, used their own individual dimensioning methods?
- **EQ6 –** When measuring the length of a part, would an inaccurate (but precise) measuring instrument be more or less likely to indicate the actual measurement than an imprecise (but accurate) measuring instrument? Justify your answer.

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson
Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each profession.

4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques
10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VII. Suggested Time Frame: 3 weeks

III. Method of Student evaluation

40%tests 30%projects 20%quizzes 10% class participation and quizzes

PCTI CTE Curriculum Unit Planner

I. Course Description:	**Project Lead the Way - Introduction to Engineering Design**	**Grade(s)**	**9**
Unit Plan Title:	**4. Modeling Skills**		

II. Course Objectives/Outline

Common Core Literacy Technical Subjects –
Reading:

RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

Common Core State Standards for Mathematical Practice
Geometry- G.MG.1,
Number and Quantity- N.Q .1,N.Q .2,
Algebra- A.CED.2,A.REI.3,A.CED.4,S.ID.6.a,S.ID.6.c,S.ID.7,
Functions- F.IF.2,F.IF.5,F.IF.6,F.BF.1.a

NJ Core Technology Education -8.2.12.B.1, 8.2.12.C.6, 8.2.12.C.5, 8.2.12.C.3, 8.2.5.D.1, 8.2.12.D.3, 8.2.12.D.1

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5)

- **EQ1 –** How should one decide what information and/or artifacts to include in a portfolio? Should a portfolio always include documentation on the complete design process?
- **EQ2 –** Did you use every possible type of model during the design and construction of your puzzle cube? Describe each model that you used?
- **EQ3 –** How reliable is a mathematical model?

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson

Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each profession.
4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques
10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VII. Suggested Time Frame: 4 weeks

III. Method of Student evaluation

40%tests 30%projects 20%quizzes 10% class participation and quizzes

I. Course Description:	Project Lead the Way - Introduction to Engineering Design	Grade(s)	9
Unit Plan Title:	5. Geometry of Design		

II. Course Objectives/Outline

Common Core Literacy Technical Subjects –
Reading:
RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

Common Core State Standards for Mathematical Practice
Geometry G.MG.1,G.MG.2,G.MG.3,
Algebra- A.CED.4,A.CED.1,A.REI.4.b

NJ Core Technology Education -8.2.12.B.1, 8.2.12.C.6, 8.2.12.C.5, 8.2.12.C.3, 8.2.5.D.1, 8.2.12.D.3, 8.2.12.D.1

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5

Essential Questions

- **EQ1 –** What advantage(s) do Computer Aided Design (CAD) and Drafting provide over traditional paper and pencil design? What advantages does paper and pencil design provide over CAD?
- **EQ2 –** Which high school math topic/course, Algebra or Geometry, is more closely related to engineering? Justify your answer.
- **EQ3 –** How does the material chosen for a product impact the design of the product?

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson
Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each profession.
4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques
10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VII. Suggested Time Frame: 4 weeks

III. Method of Student evaluation

40%tests 30%projects 20%quizzes 10% class participation and quizzes

PCTI CTE Curriculum Unit Planner

I. Course Description:	Project Lead the Way - Introduction to Engineering Design	Grade(s)	9
Unit Plan Title:	6. Reverse Engineering		

II. Course Objectives/Outline

Common Core Literacy Technical Subjects –
Reading:
RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

NJ Core Technology Education -8.2.12.B.1, 8.2.12.C.6, 8.2.12.C.5, 8.2.12.C.3, 8.2.5.D.1, 8.2.12.D.3, 8.2.12.D.1

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5)

Essential Questions

- **EQ1 –** Why are many consumer product designs not commercially successful?
- **EQ2 –** When, if ever, is it acceptable for a company to reverse engineer and reproduce a successful consumer product designed by another person/company?

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson
Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each profession.
4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques
10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VII. Suggested Time Frame: 3 weeks

III. Method of Student evaluation
40%tests 30%projects 20%quizzes 10% class participation and quizzes

PCTI CTE Curriculum Unit Planner

I. Course Description:	Project Lead the Way - Introduction to Engineering Design	Grade(s)	9
Unit Plan Title:	7. Documentation		

II. Course Objectives/Outline

Common Core Literacy Technical Subjects –
Reading:
RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

Common Core State Standards for Mathematical Practice
Geometry-G.MG.1,G.MG.3,G.GMD.4,
Number and Quantity- N.Q .3

NJ Core Technology Education -8.2.12.B.1, 8.2.12.C.6, 8.2.12.C.5, 8.2.12.C.3, 8.2.5.D.1, 8.2.12.D.3, 8.2.12.D.1

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5)

Essential Questions

- **EQ1 --** What are the consequences to the final solution if the design problem is poorly communicated?
- **EQ2 –** How does one know that a given design solution is the best possible solution?
- **EQ3 –** Engineering is described as the application of math, science and technology to solve problems. Does this description imply that

designing an enhancement to an Automoblox vehicle is the work of an engineer? Justify your answer.

- **EQ4 –** What quality makes a set of drawings sufficient to adequately represent the design intent?
- **EQ5 –** Is it always necessary to indicate a tolerance for every dimension on a technical drawing? Justify your answer.
- **EQ6 --** Stephen Covey includes Begin with the End in Mind as one of the seven habits listed in his book The 7 Habits of Highly Effective People. How can this habit make an engineer more effective?
- **EQ7-** In your opinion which step of the design process is most important to successfully innovate or invent a new product? Justify your answer.

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson
Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each profession.
4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques
10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VII. Suggested Time Frame: 5 weeks

III. Method of Student evaluation

40%tests 30%projects 20%quizzes 10% class participation and quizzes

PCTI CTE Curriculum Unit Planner

I. Course Description:	**Project Lead the Way - Introduction to Engineering Design**	**Grade(s)**	**9**
Unit Plan Title:	**8. Advanced Computer Modeling**		

II. Course Objectives/Outline

Common Core Literacy Technical Subjects –
Reading:
RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

Common Core State Standards for Mathematical Practice
Algebra A.CED.1,A.REI.3,

NJ Core Technology Education -8.2.12.B.1, 8.2.12.C.6, 8.2.12.C.5, 8.2.12.C.3, 8.2.5.D.1, 8.2.12.D.3, 8.2.12.D.1

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5)

Essential Questions

- **EQ1 –** Are working drawings always necessary in order to communicate the design of a consumer product? Justify your answer.
- **EQ2 –** Animated assemblies are not typically included as part of the technical documentation of a design. How can 3D animated assembly models of an object or a proposed design be used in the design process? Beyond the design process?

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson
Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each profession.
4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques

10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VII. Suggested Time Frame: 3 weeks

III. Method of Student evaluation

40%tests 30%projects 20%quizzes 10% class participation and quizzes

PCTI CTE Curriculum Unit Planner

I. Course Description:	**Project Lead the Way - Introduction to Engineering Design**	**Grade(s)**	**9**
Unit Plan Title:	**9. Design Team**		

II. Course Objectives/Outline

Common Core Literacy Technical Subjects –
Reading:
RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

Common Core State Standards for Mathematical Practice
Geometry G.MG.1,G.MG.2,G.MG.3

NJ Core Technology Education -8.2.12.B.1, 8.2.12.C.6, 8.2.12.C.5, 8.2.12.C.3, 8.2.5.D.1, 8.2.12.D.3, 8.2.12.D.1

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5)

Essential Questions

- **EQ1 --** Is it ever advantageous to create a design or solve a problem individually as opposed to using a team approach? Explain.
- **EQ2 –** What strategy would you use to form a design team in order to obtain the best solution possible?
- **EQ3 –** What does it mean to be "ethical" in your work? Do engineers need to be taught to be "ethical"?
- **EQ 4 –** It has been said that, "Having a vision without action is a daydream; Taking action without a vision is a nightmare!" How does this apply to engineering design?

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson
Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each profession.

4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques
10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VII. Suggested Time Frame: 6 weeks

III. Method of Student evaluation

40%tests 30%projects 20%quizzes 10% class participation and quizzes

PCTI CTE Curriculum Unit Planner

I. Course Description:	**Project Lead the Way - Introduction to Engineering Design**	**Grade(s)**	**9**
Unit Plan Title:	**10. Design Challenges**		

II. Course Objectives/Outline

Common Core Literacy Technical Subjects –

Reading:
RST.9-10.1, RST.9-10.2, RST.9-10.3, RST.9-10.4, RST.9-10.5, RST.9-10.6, RST.9-10.7, RST.9-10.8, RST.9-10.9, RST.9-10.10

Writing:
WHST.9-10.1, WHST.9-10.2, WHST.9-10.3, WHST.9-10.4, WHST.9-10.5, WHST.9-10.6, WHST.9-10.7, WHST.9-10.8, WHST.9-10.9, WHST.9-10.10

Common Core State Standards for Mathematical Practice
Geometry -G.MG.1,G.MG.3

Career & Technical Education (CTE) Content Area-
9.3.ST.1, 9.3.ST.2, 9.3.ST.3, 9.3.ST.4, 9.3.ST.5, 9.3.ST.6,9.3.ST-ET.1, 9.3.ST-ET.2, 9.3.ST-ET.3, 9.3.ST-ET.4, 9.3.ST-ET.5,9.3.ST-SM-1, 9.3.ST-SM-2, 9.3.ST-SM-3

Essential Questions (3-5)

Essential Questions

- **EQ1 –** Engineering has been referred to as the "stealth" profession. Do you think this is an appropriate label? Explain.
- **EQ2 –** If you had to describe one strategy that would most help an engineer be a good and effective designer, what would it be?

IV. List of Textbooks, Instructional Material

Project Lead the Way, "Introduction to Engineering Design" online curriculum

Informational Texts (3-5) *[career-related readings; journal articles, books, etc]*

Engineering Drawings and Design Fourth Edition Madsen Turpin
Engineering Design An Introduction Karsnitz, Obrien, Hutchinson
Engineering Your Future A Brief Students Guide to Engineering

Expected Proficiencies

1. Students will have an understanding of the history of design.
2. Students will have an understanding of engineering professional organizations
3. Students will research and discover the possible career opportunities in engineering and the education required to achieve each

profession.

4. Students will be able to understand the design process, the value of teams.
5. Students will investigate the principles of design and the elements of design.
6. Students will develop their own portfolio to display their work
7. Students will plan and compose a written technical report.
8. Students will design and deliver presentation utilizing appropriate visual aids
9. Students will develop proper hand drawing techniques
10. Students will create various pictorial sketches by hand
11. Students will add annotations to sketches and be able to understand annotations from a given drawing.

Writing Assessments (1-3)

Each activity in the unit has a writing component including; research papers, conclusion questions and short paragraph answers.

Resources *(software, videos, career exploration-related activities)*

Microsoft, Inc. (2008). Clip art. Retrieved from http://office.microsoft.com/en-us/clipart/default.aspx
National Aeronautics and Space Administration (NASA). (n.d.). NASA image exchange. Retrieved from http://nix.nasa.gov/
National Aeronautics and Space Administration (NASA). (1960). Wernher von braun. [Web Photo]. Retrieved from http://en.wikipedia.org/wiki/File:Wernher_von_Braun_crop.jpg
National Council of Teachers of English (NCTE) and International Reading Association (IRA) (1996). Standards for the English language arts. Newark, DE: IRA; Urbana, IL: NCTE.
National Research Council (NRC). (1996). National science education standards. Washington, D. C.: National Academy Press.

VI. Suggested Time Frame: 2 weeks

III. Method of Student evaluation

40%tests 30%projects 20%quizzes 10% class participation and quizzes

I. Methods of Student Evaluations

The following assessment methods may be used in a variety of combinations by teachers and students in order to gather information on student understanding and instruction. This information should be used in the preparation and designing of future lessons or related activities. Teachers and students should consider the various assessment methods as a means to improve instruction and learning.

- Computerized assessment
- Concept mapping

- Demonstrations/Presentations
- Engineering Notebook
- Informal observations/discussions/conferences
- Student self-reflection/assessment …
- Performance assessment Paper and pencil tests
- Performance tasks
- Portfolios
- Project/Product
- Individual and group work
- Research Papers
- Technical Reports
- Tests and/or Quizzes

Mastering of the core proficiencies of Project Lead The Way 3 shall be evaluated in accordance with the general grading policies as listed in the student handbook:

- PLTW Projects/Tests 40%
- PLTW Activities/Engineering Notebook 20%
- Quizzes 20%
- Homework/Class Notebook 10%
- Class Participation 10%

I. List of Textbooks, Instructional Materials and Software

- Project Lead The Way® Curriculum: Principles of Engineering™ © 2014 Charitable Venture Foundation, Indianapolis

- Principles of Engineering (Handley, Marshall, Coon) © 2012 Delmar, Cengage Learning, Clifton Park, NY, (Includes workbook and solutions manual)

- Technical Drawing textbook, 13th Ed.,(Giesecke/Mitchell/Spencer, et al.) © 2009 Pearson Education, Upper Saddle River, NJ
- Autodesk® Inventor® Professional 2014, 64-Bit Edition © 2013 Autodesk, Inc.
- Engineering Drawings and Design, Fourth Edition Madsen Turpin
- Engineering Design An Introduction, Karsnitz, Obrien, Hutchinson
- Engineering Your Future A Brief Students Guide to Engineering
- Microsoft® Office Professional Plus 2010, © 2010 Microsoft Corporation
- Adobe® Reader® XI, © 1984-2012 Adobe Systems Inc.

II. Instructional Strategies

The main goal of this course is to recruit students into a career in one of the many fields of engineering by using hands-on activities for motivation. The curriculum content engages students is APPB learning: Activities, Projects, and Problem-Based. Projects allow the students to demonstrate understanding of the subject content, engage in meaningful activities, become independent learners, make connections from prior knowledge, use

real life technologies and resources, obtain ownership of their learning, and exhibit growth in social skills, self-management skills, and ability to learn on one's own.

Instruction will be given using class notes, prepared worksheets, and activities from the Principles of Engineering Curriculum 2014. Hands on experience in problem solving (in teams and individually) is used along with computer aided drawing, technical writing, creating spreadsheets and PowerPoint presentations. Research requiring the internet is included.

Scope and Sequence Chart – Unit 1				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Identify the steps in an engineering design process and describe the activities involved in each step of the process.	ID			
Explain the concept of proportion and how it relates to freehand sketching.	ID			
Identify and describe a variety of brainstorming techniques and rules for brainstorming..	ID			
Differentiate between invention and innovation.	ID			
Identify and differentiate between the work of an engineer and the work of a scientist.	ID			
Identify and differentiate between mechanical, electrical, civil, and chemical engineering fields.	ID			
Explain the contributions of engineers from different engineering fields in the design and development of a	ID			
Generate and document multiple ideas or solution paths to a problem through brainstorming	IDR			
Describe the design process used in the solution of a particular problem and reflect on all steps of the design process.	I			
Utilize an engineering notebook to clearly and accurately document the design process according to accepted standards and protocols to prove the origin and chronology of a design.	I			
Create sketches or diagrams as representations of objects, ideas, events, or systems	I			

Scope and Sequence Chart – Unit 2				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Identify line types (including construction lines, object lines, hidden lines, and center lines) used on a technical drawing per ANSI Line Conventions and Lettering Y14.2M-2008 and explain the purpose of each line.	ID			
Identify and define technical drawing representations including isometric, orthographic projection, oblique, and perspective views.	ID			
Identify the proper use of each technical drawing representation including isometric, orthographic projection, oblique, and perspective views.	ID			
Apply tonal shading to enhance the appearance of a pictorial sketch and create a more realistic appearance of a sketched object.	I			
Hand sketch isometric views of a simple object or part at a given scale using the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections.	ID			
Hand sketch 1-point and 2-point perspective pictorial views of a simple object or part given the object, a detailed verbal description of the object, a pictorial view of the object, and/or a set of orthographic projections.	I			
Select flat patterns (nets) that fold into geometric solid forms.	I			
Hand sketch orthographic projections at a given scale and in the correct orientation to fully detail an object or part using the actual object, a detailed verbal description of the object, or a pictorial and isometric view of the object.	I			
Determine the minimum number and types of views necessary to fully detail a part.	ID			
Choose and justify the choice for the best orthographic projection of an object to use as a front view on technical drawings.	I			

Scope and Sequence Chart – Unit 3				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Identify general rules for dimensioning on technical drawings used in standard engineering practice.	ID			
Distinguish between sample statistics and population statistics and know appropriate applications of each.	ID			
Distinguish between precision and accuracy of measurement.	ID			
Measure linear distances (including length, inside diameter, and hole depth) with accuracy using a scale, ruler, or dial caliper and report the measurement using an appropriate level of precision.	ID			
Use units to guide the solution to multi-step problems through dimensional analysis and choose and interpret units consistently in formulas.	ID			
Convert quantities between units in the SI and the US Customary measurement systems	IDR			
Convert between different units within the same measurement system including the SI and US Customary measurement systems.	IDR			
Dimension orthographic projections of simple objects or parts according to a set of dimensioning standards and accepted practices.	ID			
Identify and correct errors and omissions in the dimensions applied in a technical drawing based on accepted practice and a set of dimensioning rules	ID			
Calculate statistics related to central tendency including mean, median, and mode	IDR			
Represent data with plots on the real number line (e.g., dot plots, histograms, and box plots).	IDR			
Use statistics to quantify information, support design decisions, and justify problem solutions.	ID			
Use a spreadsheet program to store and manipulate raw data.	ID			
Use a spreadsheet program to perform calculations using formulas.	I			
Use a spreadsheet program to create and display a histogram to represent a set of data.	ID			

Scope and Sequence Chart – Unit 4				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Explain the term "function" and identify the set of inputs for the function as the domain and the set of outputs from the function as the range.	ID			
Be familiar with the terminology related to and the use of a 3D solid modeling program in the creation of solid models and technical drawings.	ID			
Differentiate between additive and subtractive 3d solid modeling methods. Compare the efficiency of the modeling method of an object using different combinations of additive and subtractive methods.	ID			
Develop and/or use graphical, computer, physical and mathematical models as appropriate to represent or solve problems.	ID			
Fabricate a simple object from technical drawings that may include an isometric view and orthographic projections.	ID			
Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints.	ID			
Generate CAD multi-view technical drawings, including orthographic projections and pictorial views, as necessary, showing appropriate scale, appropriate view selection, and correct view orientation to fully describe a simple part according to standard engineering practice	ID			
Construct a testable prototype of a problem solution	ID			
Analyze the performance of a design during testing and judge the solution as viable or non-viable with respect to meeting the design requirements	ID			
Utilize project portfolios to present and justify design projects	ID			
Use a spreadsheet program to graph bi-variate data and determine an appropriate mathematical model using regression analysis. Construct a scatter plot to display bi-variate data, investigate patterns of association, and represent the association with a mathematical model (linear equation) when appropriate.	ID			
Solve equations for unknown quantities by determining appropriate substitutions for variables and manipulating the equations.	ID			
Use function notation to evaluate a function for inputs in its domain and interpret statements that use function notation in terms of a context. Interpret a function to solve problems in the context of the data	ID			

Scope and Sequence Chart – Unit 5				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Identify types of polygons including a square, rectangle, pentagon, hexagon, and octagon	IDR			
Differentiate between inscribed and circumscribed shapes.	IDR			
Identify and differentiate geometric constructions and constraints (such as horizontal lines, vertical lines, parallel lines, perpendicular lines, colinear points, tangent lines, tangent circles, and concentric circles) and the results when applied to sketch features within a 3D solid modeling environment.	ID			
Distinguish between the meanings of the terms weight and mass	IDR			
Define the term “physical property” and identify the properties of length, volume, mass, weight, density, and surface area as physical properties.	ID			
Solve real world and mathematical problems involving area and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, right prisms, cylinders, and spheres.	ID			
Create three-dimensional solid models of parts within CAD from sketches or dimensioned drawings using appropriate geometric and dimensional constraints and model features.	ID			
Measure mass with accuracy using a scale and report the measurement using an appropriate level of precision. Measure volume with accuracy and report the measurement with an appropriate level of precision.	ID			
Calculate a physical property indirectly using available data or perform appropriate measurements to gather the necessary data (e.g., determine area or volume using linear measurements or determine density using mass and volume measurements).	ID			
Solve volume problems using volume formulas for rectangular solids, cylinders, pyramids, cones, and spheres	IDR			
Use physical properties to solve design problems (e.g., design an object or structure to satisfy physical constraints or minimize cost)..	ID			

Assign a specific material (included in the software library) to a part and use the capabilities of the CAD software to determine the mass, volume, and surface area of an object for which a 3D solid model has been created.	ID			
Assign a density value to a new material (not included in the software library) and apply the material to a 3D solid model within CAD software in order to determine the physical properties of the object.	ID			

Scope and Sequence Chart – Unit 6				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Identify and describe the visual principles and elements of design apparent in a natural or man-made object.	ID			
Describe the process of reverse engineering.	ID			
Explain the various reasons to perform reverse engineering including discovery, documentation, investigation, and product improvement.	ID			
Explain how the visual elements and principles of design affect the aesthetics and commercial success of a product.	ID			
Perform a functional analysis of a product in order to determine the purpose, inputs and outputs, and the operation of a product or system.	I			
Perform a structural analysis of a product in order to determine the materials used and the form of component parts as well as the configuration and interaction of component parts when assembled (if applicable).	I			
Select and utilize technology (software and hardware) to create high impact visual aids.	ID			

Scope and Sequence Chart – Unit 7				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Identify and differentiate between size dimensions and location dimensions. Identify and correctly apply chain dimensioning or datum dimensioning methods to a technical drawing. Identify dimensioning standards commonly used in technical drawing.	ID			
Identify the shapes of two-dimensional cross sections of three dimensional objects.	ID			
Identify, define and explain the proper use of a section view in technical drawing.	ID			
Read and interpret a hole note to identify the size and type of hole including through, clearance, blind, counter bore, and countersink holes.	ID			
Identify and differentiate among limit dimensions, a unilateral tolerance, and a bilateral tolerance. Differentiate between clearance and interference fit.	ID			
Explain each assembly constraint (including mate, flush, insert, and tangent), its role in an assembly model, and the degrees of freedom that it removes from the movement between parts.	ID			
Hand sketch a scaled full or half section view in the correct orientation to fully detail an object or part given the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections.	ID			
Generate section views using CAD according to standard engineering practice. Dimension a section view of a simple object or part according to a set of dimensioning standards and accepted practices.	ID			
Annotate (including specific and general notes) working drawings according to accepted engineering practice. Include dimensioning according to a set of dimensioning rules, proper hole and thread notes, proper tolerance annotation, and the inclusion of other notes necessary to fully describe a part according to standard engineering practice.	ID			
Create specific notes on a technical drawing to convey important information about a specific feature of a detailed object, and create general notes to convey details that pertain to information presented on the entire drawing (such as units, scale, patent details, etc.).	ID			
Model and annotate (with a hole note) through, clearance, blind, counter bore, and countersink holes. Compare the effect of chain dimensioning and datum dimensioning on the tolerance of a particular	ID			

specified dimension. Determine the specified dimension, tolerance, upper limit, and lower limit for any given dimension and related tolerance (or any distance that is dependent on given dimensions) shown on a technical drawing.				
Identify the type of fit given a drawing, a description, or a physical example of two mating parts. Determine the allowance between two mating parts of an assembly based on dimensions given on a technical drawing.	ID			
Create assemblies of parts in CAD and use appropriate assembly constraints to create an assembly that allows correct realistic movement among parts. Manipulate the assembly model to demonstrate the movement. Create a CAD assembly drawing. Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD.	ID			
Analyze information gathered during reverse engineering to identify shortcoming of the design and/or opportunities for improvement or innovation.	ID			
Define and justify a design problem and express the concerns, needs, and desires of the primary stakeholders.	ID			
Present and justify design specifications, and clearly explain the criteria and constraints associated with a successful design solution.	ID			
Write a design brief to communicate the problem, problem constraints, and solution criteria. Support design ideas using a variety of convincing evidence.	ID			
Jointly develop a decision matrix based on accepted outcome criteria and constraints.	ID			
Create a set of working drawings to detail a design project.	ID			

Scope and Sequence Chart – Unit 8				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Identify, define, and explain the proper use of an auxiliary view in technical drawing.	ID			
Use advanced modeling features to create three-dimensional solid models of complex parts and assemblies within CAD and with little guidance given the actual part using appropriate geometric and dimensional constraints.	ID			
Formulate equations and inequalities to represent relationships between quantities.	ID			

Using a CAD application, create relationships among part features and dimensions using parametric formulas.	ID			
Create an exploded assembly view of a multip-part product. Identify each component of the assembly with identification numbers and create a parts list to detail each component using CAD.	ID			
Perform a peer review of technical drawings and offer constructive feedback based on standard engineering practices.	ID			
Hand sketch an auxiliary view in the correct orientation to fully detail an object or part given the actual object, a detailed verbal description of the object, a pictorial view of the object, or a set of orthographic projections.	ID			
Generate an auxiliary view using CAD according to standard engineering practice.	ID			

Scope and Sequence Chart – Unit 9				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Identify and describe the steps of a typical product lifecycle (including raw material extraction, processing, manufacture, use and maintenance, and disposal).	IDR			
Identify and explain how the basic theories of ethics relate to engineering.	ID			
Identify team member skill sets needed to produce an effective team.	IDR			
Define the term group norms and discuss the importance of norms in creating an effective team environment.	IDR			
Identify the advantages and disadvantages of virtual design teams compared to traditional design teams.	IDR			
Assess the development of an engineered product and the impact of the product on society and the environment. Utilize research tools and resources (such as the Internet; media centers; market research; professional journals; printed, electronic, and multimedia resources; etc.) to validate design decisions and justify a problem solution.	IDR			
Summarize key ideas in information sources including scientific and engineering texts, tables, diagrams, and graphs.	IDR			
Deliver organized oral presentations of work tailored to the audience. Demonstrate positive team behaviors and contribute to a positive team dynamic. Identify appropriate technology to support	IDR			

remote collaboration among virtual design team members (such as asynchronous communications, audio and video conferencing, instant messaging, synchronous file editing, and file transfer).				

Scope and Sequence Chart – Unit 10				
SKILL TO BE LEARNED **Key: I – Introduced, D – Developed, R– Reinforced**	**SUGGESTED GRADE LEVELS**			
	9	**10**	**11**	**12**
Identify the steps in an engineering design process and describe the activities involved in each step of the process.	IDR			
Develop and document an effective solution to a problem that meets specific design requirements	IDR			
Document and describe the design process used in the solution of a problem and reflect on all steps of the design process.	IDR